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QGIS User Guide

Publicación 2.18

QGIS Project

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Contents

CHAPTER 1

Preámbulo

This document is the original user guide of the described software QGIS. The software and hardware described in this document are in most cases registered trademarks and are therefore subject to legal requirements. QGIS is subject to the GNU General Public License. Find more information on the QGIS homepage, http://www.qgis.org.

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This document has been typeset with reStructuredText. It is available as reST source code via github and online as HTML and PDF via http://www.qgis.org/en/docs/. Translated versions of this document can be downloaded in several formats via the documentation area of the QGIS project as well. For more information about contributing to this document and about translating it, please visit http://qgis.org/en/site/getinvolved/index.html.

Enlaces en este documento

Este documento contiene enlaces internos y externos. Pulsando un enlace interno navega dentro del documento, mientras que pulsando un enlace externo abre una dirección de Internet. En formato PDF, los enlaces internos y externos son mostrados en azul y son manejados por el navegador del sistema. En formato HTML, el navegador muestra y maneja ambos de manera idéntica.

Autores y Editores de las Guías de Usuario, Instalación y Programación:

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Internet: http://www.qgis.org

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CHAPTER 2

Prólogo

¡Bienvenido al maravilloso mundo de los Sistemas de Información Geográfica (SIG)!

QGIS es un Sistema de Información Geográfica de código abierto. El proyecto nació en mayo de 2002 y se estableció como un proyecto en SourceForge en junio del mismo año. Hemos trabajado duro para hacer que el software SIG (tradicionalmente software propietario caro) esté al alcance de cualquiera con acceso básico a un ordenador personal. QGIS actualmente funciona en la mayoría de plataformas Unix, Windows y Mac. QGIS se desarrolla usando el kit de herramientas Qt (https://www.qt.io) y C++. Esto significa que es ligero y tiene una interfaz gráfica de usuario (GUI) agradable y fácil de usar.

QGIS pretende ser un SIG amigable, proporcionando funciones y características comunes. El objetivo inicial del proyecto era proporcionar un visor de datos SIG. QGIS ha alcanzado un punto en su evolución en el que está siendo usado por muchos para sus necesidades diarias de visualización de datos SIG. QGIS admite diversos formatos de datos ráster y vectoriales, con el nuevo formato de ayuda fácilmente agregado usando la arquitectura del complemento.

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Truco: Documentación al día

The latest version of this document can always be found in the documentation area of the QGIS website at http://www.qgis.org/en/docs/.

CHAPTER 3

Convenciones

Esta sección describe los estilos homogéneos que se utilizarán a lo largo de este manual.

3.1 Convenciones de la Interfaz Gráfica o GUI

Las convenciones de estilo del GUI están destinadas a imitar la apariencia de la interfaz gráfica de usuario. En general, un estilo reflejará la apariencia simplificada, por lo que un usuario puede escanear visualmente el GUI para encontrar algo que se parece a lo mostrado en el manual.

- Menú Opciones: *Capa* → *Añadir capa ráster* o *Preferencias* → *Barra de Herramientas* → *Digitalizacion*
- Herramienta:  Añadir capa ráster
- Button : **[Save as Default]**
- Título del Cuadro de Diálogo: *Propiedades de capa*
- Pestaña: *General*
- Selección:  *Renderizar*
- Botón de selección:  *Postgis SRID*  *EPSG ID*
- Seleccionar un número: 
- Seleccionar una cadena: 
- Browse for a file: 
- Seleccionar un color: 
- Barra de desplazamiento: 
- Texto de entrada: 

El sombreado muestra un componente de la interfaz que el usuario puede pulsar.

3.2 Convenciones de Texto o Teclado

Entes manual también inclue estilos relacionados a textos, comandos de teclado y codificacion para indicar diferentes entidades, como las clases o métodos. Estos estilos no corresponden a la apariencia real de cualquier texto o codificacion dentro de QGIS.

- Hyperlinks: http://qgis.org
- Combinaciones de Teclas: Pulsar `Ctrl+B`, significa mantener pulsada la tecla Ctrl y pulsar la letra B.

- Nombre de un Archivo: `lakes.shp`
- Nombre de una Clase: **NewLayer**
- Método: *classFactory*
- Servidor: *myhost.de*
- Texto para el Usuario: `qgis --help`

Las líneas de código se muestran con una fuente de ancho fijo:

```
PROJCS["NAD_1927_Albers",
  GEOGCS["GCS_North_American_1927",
```

3.3 Instrucciones específicas de cada plataforma

GUI sequences and small amounts of text may be formatted inline: Click *File* → *QGIS* → *Quit to close QGIS*. This indicates that on Linux, Unix and Windows platforms, you should click the File menu first, then Quit, while on macOS platforms, you should click the QGIS menu first, then Quit.

Las cantidades mayores de texto se pueden formatear como listas:

- Hacer esto
- Hacer aquello
- Or do that

o como párrafos:

Hacer esto y esto y esto. Entonces hacer esto y esto y esto, y esto y esto y esto, y esto y esto y esto.

Do that. Then do that and that and that, and that and that and that, and that and that and that, and that and that.

Las capturas de pantalls que aparecen a lo largo de la guía de usuario han sido creadas en diferentes plataformas; éstas se indicarán por el icono específico para cada una al final del pie de imagen.

CHAPTER 4

Características

QGIS offers many common GIS functionalities provided by core features and plugins. A short summary of six general categories of features and plugins is presented below, followed by first insights into the integrated Python console.

4.1 Ver datos

You can view and overlay vector and raster data in different formats and projections without conversion to an internal or common format. Supported formats include:

- Spatially-enabled tables and views using PostGIS, SpatiaLite and MS SQL Spatial, Oracle Spatial, vector formats supported by the installed OGR library, including ESRI shapefiles, MapInfo, SDTS, GML and many more. See section *Trabajar con catos vectoriales*.
- Ráster y formatos de imagenes admitidos por la biblioteda GDAL (Geospatial Data Abstraction Library) instalada, por ejemplo GeoTIFF, ERDAS IMG, ArcInfo ASCII GRID, JPEG, PNG y muchos más. Vea la sección *Trabajar con catos raster*.
- Ráster GRASS y datos vectoriales de base de datos GRASS (location/mapset). Vea sección *Integracion GRASS SIG*.
- Datos espaciales en línea servidos como servicios web OGC incluyendo WMS, WMTS, WCS, WFS, y WFS-T. Vea la sección *Trabajar con datos OGC*.

4.2 Explorar datos y componer mapas

Se puede componer mapas y explorar datos espaciales interactivamente con una GUI amigable. Las muy útiles herramientas disponibles en la GUI incluyen:

- Navegador QGIS
- Reproyección al vuelo
- Gestor de Base de Datos
- Map composer
- Panel de vista general
- Marcadores espaciales
- Herramientas de anotaciones
- Identificar/seleccionar objetos espaciales
- Editar/ver/buscar atributos
- Data-defined feature labelling

- Vectores definidos por datos y herramientas para simbologia raster.
- Composición del atlas y mapa con capas de cuadricula.
- North arrow scale bar and copyright label for maps
- Apoyo para guardar y restaurar proyectos

4.3 Crear, editar, gestionar y exportar datos

Puede crear, editar, administrar y exportar capas vectoriales y ráster en varios formatos. QGIS ofrece lo siguiente:

- Herramientas de digitalización para formatos reconocidos OGR y capas vectoriales GRASS
- Ability to create and edit shapefiles and GRASS vector layers
- Complemento de georeferenciador para geocodificar imágenes
- GPS tools to import and export GPX format, and convert other GPS formats to GPX or down/upload directly to a GPS unit (On Linux, usb: has been added to list of GPS devices.)
- Apoyo para visualizar y editar datos de OpenStreetMap
- Ability to create spatial database tables from shapefiles with DB Manager plugin
- Mejor manejo de tablas de bases de datos espaciales
- Herramientas para la gestión de tablas de atributos vectoriales
- Opción para guardar capturas de pantalla como imágenes georeferenciadas
- Herramienta para exportar DXF con capacidades aumentadas de explorar estilos y plugins que realizan funciones parecidas a CAD.

4.4 Analizar datos

You can perform spatial data analysis on spatial databases and other OGR- supported formats. QGIS currently offers vector analysis, sampling, geoprocessing, geometry and database management tools. You can also use the integrated GRASS tools, which include the complete GRASS functionality of more than 400 modules. (See section *Integracion GRASS SIG*.) Or, you can work with the Processing Plugin, which provides a powerful geospatial analysis framework to call native and third-party algorithms from QGIS, such as GDAL, SAGA, GRASS and more. (See section *Introducción*.)

4.5 Publicar mapas en Internet

QGIS se puede utilizar como un cliente WMS, WMTS, WMS-C o WFS y WFS-T, y como servidor WMS, WCS o WFS (vea la sección *Trabajar con datos OGC*.) Además, se pueden publicar sus datos en Internet utilizando un servidor web con UMN MapServer o GeoServer instalado.

4.6 Extender funcionalidades QGIS a través de complementos

QGIS se puede adaptar a sus necesidades especiales con la arquitectura de complemento extensible y bibliotecas que se pueden utilizar para crear complementos. Se puede incluso crear nuevas aplicaciones con C++ o Python.

4.6.1 Complementos del Núcleo

Los complementos del núcleo incluyen:

1. Coordinate Capture (Capture mouse coordinates in different CRSs)
2. DB Manager (Exchange, edit and view layers and tables from/to databases; execute SQL queries)
3. Dxf2Shp Converter (Convert DXF files to shapefiles)
4. eVIS (Visualize events)
5. GDALTools (Integrate GDAL Tools into QGIS)
6. Georeferencer GDAL (Add projection information to rasters using GDAL)
7. GPS Tools (Load and import GPS data)
8. GRASS (Integrate GRASS GIS)
9. Heatmap (Generate raster heatmaps from point data)
10. Interpolation Plugin (Interpolate based on vertices of a vector layer)
11. Metasearch Catalogue Client
12. Offline Editing (Allow offline editing and synchronizing with databases)
13. Oracle Spatial GeoRaster
14. Processing (formerly SEXTANTE)
15. Raster Terrain Analysis (Analyze raster-based terrain)
16. Road Graph Plugin (Analyze a shortest-path network)
17. Spatial Query Plugin
18. Topology Checker (Find topological errors in vector layers)
19. Zonal Statistics Plugin (Calculate count, sum, and mean of a raster for each polygon of a vector layer)

4.6.2 Complementos externos de Python

QGIS ofrece un número creciente de complementos Python externos que son proporcionados por la comunidad. Estos se encuentran en el repositorio oficial de complementos y se pueden instalar fácilmente usando el instalador del complemento Python. Vea la sección *El diálogo de complementos*.

4.7 Consola de Python

For scripting, it is possible to take advantage of an integrated Python console, which can be opened from menu: *Plugins → Python Console*. The console opens as a non-modal utility window. For interaction with the QGIS environment, there is the `qgis.utils.iface` variable, which is an instance of `QgsInterface`. This interface allows access to the map canvas, menus, toolbars and other parts of the QGIS application. You can create a script, then drag and drop it into the QGIS window and it will be executed automatically.

For further information about working with the Python console and programming QGIS plugins and applications, please refer to *PyQGIS-Developer-Cookbook*.

4.8 Problemas Conocidos

4.8.1 Limitación en el número de archivos abiertos

Si va a abrir un proyecto grande de QGIS y está seguro de que todas las capas son válidas, pero algunas capas se marcan como malas, es probable que se enfrentará a este problema. Linux (y otros sistemas operativos, así mismo) tiene un límite de archivos abiertos por proceso. Los límites de recursos son por proceso y heredados. El `ulimit`, que es una cáscara integrada, cambia los límites solamente para el proceso actual; el nuevo límite será heredado por los procesos hijos.

Puede consultar toda la información actual de ulimit escribiendo:

```
$ ulimit -aS
```

Puede ver el número permitido de ficheros abiertos por proceso con el siguiente comando en una consola:

```
$ ulimit -Sn
```

Para cambiar los límites de una **sesión existente**, debería poder usar algo como:

```
$ ulimit -Sn #number_of_allowed_open_files
$ ulimit -Sn
$ qgis
```

Para solucionarlo para siempre

En la mayoría de los sistemas Linux, los límites de recursos se establecen al iniciar sesión por el módulo `pam_limits` de acuerdo con los ajustes contenidos en:file:*/etc/security/limits.conf* o `/etc/security/limits.d/*.conf`. Debe ser capaz de editar esos archivos si tiene privilegios de root (también a través de sudo), pero tendrá que volver a iniciar sesión para que los cambios surtan efecto.

Más información:

http://www.cyberciti.biz/faq/linux-increase-the-maximum-number-of-open-files/ http://linuxaria.com/article/open-files-in-linux?lang=en

CHAPTER 5

Novedades de QGIS 2.18

Esta versión contiene nuevas características y se extiende la interfaz de programación con respecto a versiones anteriores. Le recomendamos que utilice esta versión sobre las versiones anteriores.

This release includes hundreds of bug fixes and many new features and enhancements over QGIS 2.14 that will be described in this manual. You may also review the visual changelogs at http://qgis.org/en/site/forusers/visualchangelogs.html.

CHAPTER 6

Comenzar

This chapter gives a quick overview of installing QGIS, some sample data from the QGIS web page, and running a first and simple session visualizing raster and vector layers.

6.1 Installation

Installation of QGIS is very simple. Standard installer packages are available for MS Windows and macOS. For many flavors of GNU/Linux, binary packages (rpm and deb) or software repositories are provided to add to your installation manager. Get the latest information on binary packages at the QGIS website at http://download.qgis.org.

6.1.1 Installation from source

If you need to build QGIS from source, please refer to the installation instructions. They are distributed with the QGIS source code in a file called `INSTALL`. You can also find them online at http://htmlpreview.github.io/?https://raw.github.com/qgis/QGIS/master/doc/INSTALL.html. If you want to build a particular release, you should replace `master` by the release branch (commonly in the `release-X_Y` form) in the above-mentioned link because instructions may differ.

6.1.2 Installation on external media

QGIS allows you to define a `--configpath` option that overrides the default path for user configuration (e.g., `~/.qgis2` under Linux) and forces **QSettings** to use this directory, too. This allows you to, for instance, carry a QGIS installation on a flash drive together with all plugins and settings. See section *System Settings* for additional information.

6.1.3 Sample Data

The user guide contains examples based on the QGIS sample dataset.

The Windows installer has an option to download the QGIS sample dataset. If checked, the data will be downloaded to your `My Documents` folder and placed in a folder called `GIS Database`. You may use Windows Explorer to move this folder to any convenient location. If you did not select the checkbox to install the sample dataset during the initial QGIS installation, you may do one of the following:

- Usar datos SIG que ya tenga
- Download sample data from http://qgis.org/downloads/data/qgis_sample_data.zip
- Desinstalar QGIS y volver a instalarlo con la opción de descarga de datos marcada (sólo recomendado si las soluciones anteriores no funcionaron).

For GNU/Linux and macOS, there are not yet dataset installation packages available as rpm, deb or dmg. To use the sample dataset, download the file `qgis_sample_data` as a ZIP archive from http://qgis.org/downloads/data/ and unzip the archive on your system.

The Alaska dataset includes all GIS data that are used for examples and screenshots in the user guide; it also includes a small GRASS database. The projection for the QGIS sample dataset is Alaska Albers Equal Area with units feet. The EPSG code is 2964.

```
PROJCS["Albers Equal Area",
GEOGCS["NAD27",
DATUM["North_American_Datum_1927",
SPHEROID["Clarke 1866",6378206.4,294.978698213898,
AUTHORITY["EPSG","7008"]],
TOWGS84[-3,142,183,0,0,0,0],
AUTHORITY["EPSG","6267"]],
PRIMEM["Greenwich",0,
AUTHORITY["EPSG","8901"]],
UNIT["degree",0.0174532925199433,
AUTHORITY["EPSG","9108"]],
AUTHORITY["EPSG","4267"]],
PROJECTION["Albers_Conic_Equal_Area"],
PARAMETER["standard_parallel_1",55],
PARAMETER["standard_parallel_2",65],
PARAMETER["latitude_of_center",50],
PARAMETER["longitude_of_center",-154],
PARAMETER["false_easting",0],
PARAMETER["false_northing",0],
UNIT["us_survey_feet",0.3048006096012192]]
```

If you intend to use QGIS as a graphical front end for GRASS, you can find a selection of sample locations (e.g., Spearfish or South Dakota) at the official GRASS GIS website, http://grass.osgeo.org/download/sample-data/.

6.2 Launching QGIS

6.2.1 Starting and Stopping QGIS

Starting QGIS is done as you usually do for any other application on your platform. It means that you can launch QGIS by:

- typing `qgis` at a command prompt, assuming that QGIS is added to your PATH or you're in its installation folder
- using the Applications menu if using a precompiled binary, the Start menu or the Dock
- doble clic el ícono en su carpeta de Aplicaciones o atajo de escritorio
- double clicking an existing QGIS project (`.qgs`) file. Note that this will also open the project

To stop QGIS, click:

- the menu option *Project* → *Exit QGIS* or use the shortcut `Ctrl+Q`
- *QGIS* → *Quit QGIS*, or use the shortcut `Cmd+Q`
- or use the red cross at the right top corner of the main interface of the application.

6.2.2 Command Line Options

In previous section you learned how to start QGIS. You will see that QGIS also provides further command line options.

QGIS supports a number of options when started from the command line. To get a list of the options, enter `qgis --help` on the command line. The usage statement for QGIS is:

```
qgis --help
```

Returns:

```
QGIS - 2.16.1-Nødebo 'Nødebo' (8545b3b)
QGIS is a user friendly Open Source Geographic Information System.
Usage: /usr/bin/qgis.bin [OPTION] [FILE]
OPTION:
  [--snapshot filename]       emit snapshot of loaded datasets to given file
  [--width width]     width of snapshot to emit
  [--height height]   height of snapshot to emit
  [--lang language]   use language for interface text
  [--project projectfile]     load the given QGIS project
  [--extent xmin,ymin,xmax,ymax]      set initial map extent
  [--nologo]  hide splash screen
  [--noversioncheck]  don't check for new version of QGIS at startup
  [--noplugins]       don't restore plugins on startup
  [--nocustomization] don't apply GUI customization
  [--customizationfile]       use the given ini file as GUI customization
  [--optionspath path]        use the given QSettings path
  [--configpath path] use the given path for all user configuration
  [--authdbdirectory path] use the given directory for authentication database
  [--code path]       run the given python file on load
  [--defaultui]       start by resetting user ui settings to default
  [--dxf-export filename.dxf] emit dxf output of loaded datasets to given file
  [--dxf-extent xmin,ymin,xmax,ymax]  set extent to export to dxf
  [--dxf-symbology-mode none|symbollayer|feature]     symbology mode for dxf output
  [--dxf-scale-denom scale]   scale for dxf output
  [--dxf-encoding encoding]   encoding to use for dxf output
  [--dxf-preset visiblity-preset]     layer visibility preset to use for dxf output
  [--help]            this text
  [--]                treat all following arguments as FILEs

FILE:
  Files specified on the command line can include rasters,
  vectors, and QGIS project files (.qgs):
   1. Rasters - supported formats include GeoTiff, DEM
      and others supported by GDAL
   2. Vectors - supported formats include ESRI Shapefiles
      and others supported by OGR and PostgreSQL layers using
      the PostGIS extension
```

Truco: Example Using command line arguments

You can start QGIS by specifying one or more data files on the command line. For example, assuming you are in the `qgis_sample_data` directory, you could start QGIS with a vector layer and a raster file set to load on startup using the following command: `qgis ./raster/landcover.img ./gml/lakes.gml`

Command line option `--snapshot`

This option allows you to create a snapshot in PNG format from the current view. This comes in handy when you have a lot of projects and want to generate snapshots from your data.

Currently, it generates a PNG file with 800x600 pixels. This can be adjusted using the `--width` and `--height` command line arguments. A filename can be added after `--snapshot`.

Command line option `--lang`

Based on your locale, QGIS selects the correct localization. If you would like to change your language, you can specify a language code. For example, `qgis --lang it` starts QGIS in Italian localization.

Command line option `--project`

Starting QGIS with an existing project file is also possible. Just add the command line option `--project` followed by your project name and QGIS will open with all layers in the given file loaded.

Command line option `--extent`

To start with a specific map extent use this option. You need to add the bounding box of your extent in the following order separated by a comma:

```
--extent xmin,ymin,xmax,ymax
```

Command line option `--nologo`

This command line argument hides the splash screen when you start QGIS.

command line option `--noversioncheck`

Don't check for new version of QGIS at startup.

Command line option `--noplugins`

If you have trouble at start-up with plugins, you can avoid loading them at start-up with this option. They will still be available from the Plugins Manager afterwards. **Command line option** `--customizationfile`

Using this command line argument, you can define a GUI customization file, that will be used at startup.

Command line option `--nocustomization`

Using this command line argument, existing GUI customization will not be applied at startup.

Command line option `--optionspath`

You can have multiple configurations and decide which one to use when starting QGIS with this option. See *Opciones* to confirm where the operating system saves the settings files. Presently, there is no way to specify a file to write settings to; therefore, you can create a copy of the original settings file and rename it. The option specifies path to directory with settings. For example, to use `/path/to/config/QGIS/QGIS2.ini` settings file, use option:

```
--optionspath /path/to/config/
```

Command line option `--configpath`

This option is similar to the one above, but furthermore overrides the default path for user configuration (`~/.qgis2`) and forces **QSettings** to use this directory, too. This allows users to, for instance, carry a QGIS installation on a flash drive together with all plugins and settings.

Command line option `--authdbdirectory`

Again, this option is similar to the one above but define the path to the directory where the authentication database will be stored.

Command line option `--code`

This option can be used to run a given python file directly after QGIS has started.

For example, when you have a python file named `load_alaska.py` with following content:

```
from qgis.utils import iface
raster_file = "/home/gisadmin/Documents/qgis_sample_data/raster/landcover.img"
layer_name = "Alaska"
iface.addRasterLayer(raster_file, layer_name)
```

Assuming you are in the directory where the file `load_alaska.py` is located, you can start QGIS, load the raster file `landcover.img` and give the layer the name 'Alaska' using the following command: `qgis --code load_alaska.py`

Command line options `--dxf-*`

These options can be used to export QGIS project into a DXF file. Several options are available:

- *–dxf-export*: the DXF filename into which to export the layers;

- *–dxf-extent*: the extent of the final DXF file;
- *–dxf-symbology-mode*: several values can be used here: none (no symbology), symbollayer (Symbol layer symbology), feature (feature symbology);
- *–dxf-scale-deno*: the scale denominator of the symbology;
- *–dxf-encoding*: the file encoding;
- *–dxf-preset*: choose a visibility preset. These presets are defined in the layer tree, see *Panel de capas*.

6.3 Sample Session: Load raster and vector layers

Now that you have QGIS installed and a sample dataset available, we would like to demonstrate a short and simple QGIS sample session. We will visualize a raster and a vector layer. We will use:

- the `landcover` raster layer i.e., `qgis_sample_data/raster/landcover.img`
- and the `lakes` vector layer i.e., `qgis_sample_data/gml/lakes.gml`.

1. Start QGIS as seen in *Starting and Stopping QGIS*
2. Click on the  Add Raster Layer icon.
3. Browse to the folder `qgis_sample_data/raster/`, select the ERDAS IMG file `landcover.img` and click **[Open]**.
4. If the file is not listed, check if the *Files of type*  combo box at the bottom of the dialog is set on the right type, in this case **Erdas Imagine Images (*.img *.IMG)**.
5. Now click on the  Add Vector Layer icon.
6.  *File* should be selected as *Source Type* in the new *Add vector layer* dialog. Now click **[Browse]** to select the vector layer.
7. Browse to the folder `qgis_sample_data/gml/`, select **Geography Markup Language [GML] [OGR] (*.gml *.GML)** from the *Filter*  combo box, then select the GML file `lakes.gml` and click **[Open]**. In the *Add vector layer* dialog, click **[OK]**. The *Coordinate Reference System Selector* dialog opens with *NAD27 / Alaska Alberts* selected, click **[OK]**.
8. Zoom in a bit to your favourite area with some lakes.
9. Haga doble clic en la capa `lakes` en el panel Capas para abrir el diálogo *Propiedades*.
10. Click on the *Style* tab and select a blue as fill color.
11. Click on the *Labels* tab and select *Show labels for this layer* in the drop-down menu to enable labeling. Then from the *Label with* list, choose the `NAMES` field as the field containing labels.
12. To improve readability of labels, you can add a white buffer around them by clicking *Buffer* in the list on the left, checking  *Draw text buffer* and choosing 3 as buffer size.
13. Click **[Apply]**. Check if the result looks good, and finally click **[OK]**.

You can see how easy it is to visualize raster and vector layers in QGIS. Let's move on to the sections that follow to learn more about the available functionality, features and settings, and how to use them.

6.4 Projects

The state of your QGIS session is considered a project. QGIS works on one project at a time. Settings are considered as being either per-project or as a default for new projects (see section *Opciones*). QGIS can save the state of your workspace into a project file using the menu options *Project* →  *Save* or *Project* →  *Save*

As.... If the loaded project file on disk was meanwhile changed, by default, QGIS will ask you if you want to overwrite the changes into the project file. This behavior is set by checking *Prompt to save project and data source changes when required* under *Settings* → *Options* → *General* menu .

Load saved projects into a QGIS session using *Project* → *Open...*, *Project* → *New from template* or *Project* → *Open Recent* →.

At startup, a list of screenshot with the name and path of each of the most recent projects (up to ten) is shown instead of a white and empty map canvas. This is a handy and quicker way to remember what a project was about and double-click a row opens the selected project. If you're willing to create a new project, just add new layers and the list disappears.

If you wish to clear your session and start fresh, choose *Project* → *New*. Either of these menu options will prompt you to save the existing project if changes have been made since it was opened or last saved.

The kinds of information saved in a project file include:

- Las capas añadidas
- Que capas pueden ser consultadas
- Propiedades de la capa, incluyendo simbolización y estilos
- Proyección de la vista del mapa
- Última extensión vista
- Print Composers
- Print Composer elements with settings
- Print Composer atlas settings
- Configuración de digitalización
- Tabla de relaciones
- Proyectos Macros
- Proyecto de estilos predeterminados
- Configuración de complementos
- Configuración de servidor QGIS desde la pestaña de ajustes de OWS en propiedades del proyecto
- Consultas almacenadas en el Administrador de BBDD

The project file is saved in XML format, so it is possible to edit the file outside QGIS if you know what you are doing. The file format has been updated several times compared with earlier QGIS versions. Project files from older QGIS versions may not work properly any more. To be made aware of this, in the *General* tab under *Settings* → *Options* you should tick *Warn when opening a project file saved with an older version of QGIS*.

Whenever you save a project in QGIS a backup of the project file is made with the extension `.qgs~`.

6.5 Output

There are several ways to generate output from your QGIS session. We have discussed one already in section *Projects*, saving as a project file. Here is a sampling of other ways to produce output files:

- Menu option *Project* → *Save as Image...* opens a file dialog where you select the name, path and type of image (PNG, JPG and many other formats). A world file with extension `PNGW` or `JPGW` saved in the same folder georeferences the image.
- Menu option *Project* → *DXF Export...* opens a dialog where you can define the 'Symbology mode', the 'Symbology scale' and vector layers you want to export to DXF. Through the 'Symbology mode' symbols from the original QGIS Symbology can be exported with high fidelity.

- Menu option *Project* →  *New Print Composer*... opens a dialog where you can layout and print the current map canvas (see section *Print Composer*).

CHAPTER 7

IGU QGIS

When QGIS starts, you are presented with the GUI as shown in the figure (the numbers 1 through 5 in yellow circles are discussed below).

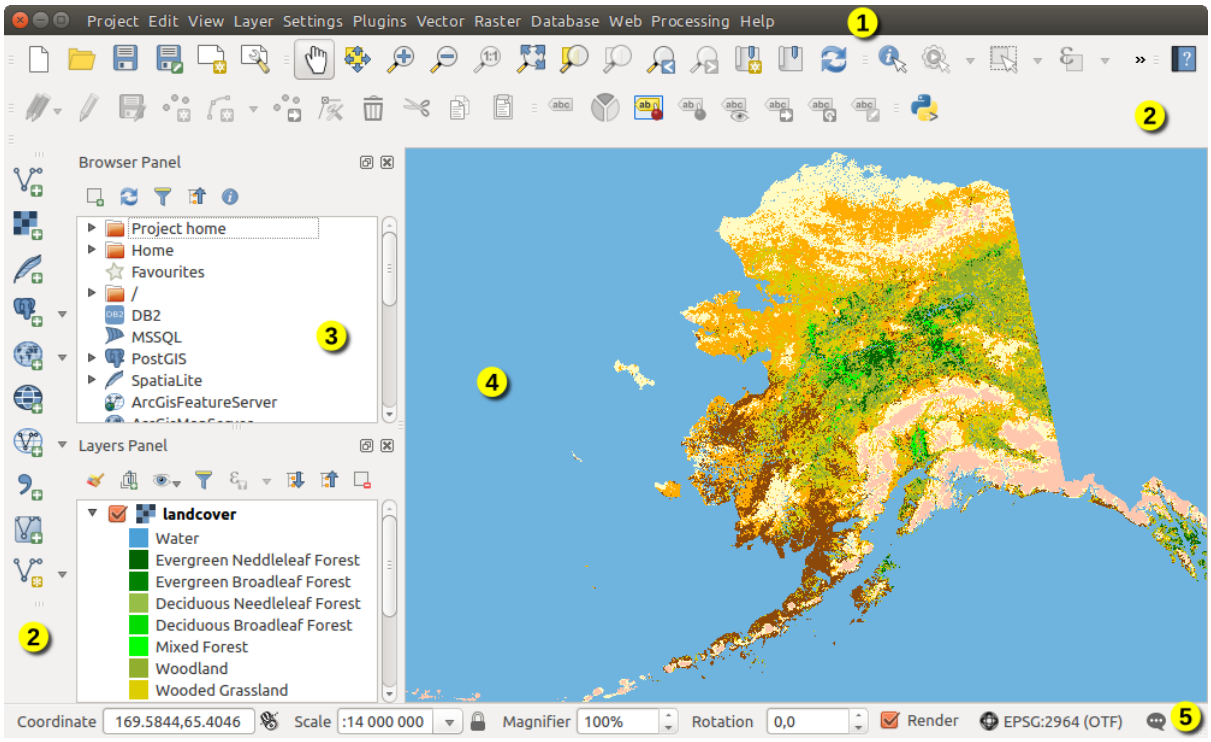


Figure 7.1: Interfaz Gráfica de Usuario de QGIS con datos de muestra de Alaska

Nota: Las decoraciones de las ventanas (barra de título, etc.) pueden ser distintas dependiendo de su sistema operativo y su gestor de ventanas.

La Interfaz Gráfica de Usuario de QGIS está dividida en cinco componentes:

1. Barra de Menú
2. Barras de herramientas
3. Paneles
4. Vista del mapa
5. Barra de Estado

These five components of the QGIS interface are described in more detail in the following sections. Two more sections present keyboard shortcuts and context help.

7.1 Barra de Menú

The menu bar provides access to various QGIS features using a standard hierarchical menu. The top-level menus and a summary of some of the menu options are listed below, together with the associated icons as they appear on the toolbar, and keyboard shortcuts. The shortcuts presented in this section are the defaults; however, keyboard shortcuts can also be configured manually using the *Configure shortcuts* dialog, opened from *Settings* → *Configure Shortcuts...*.

Although most menu options have a corresponding tool and vice-versa, the menus are not organized exactly like the toolbars. The toolbar containing the tool is listed after each menu option as a checkbox entry. Some menu options only appear if the corresponding plugin is loaded. For more information about tools and toolbars, see section *Barras de herramientas*.

Nota: QGIS is a cross-platform application meaning that though it provides you with the same tools, they may be placed in different menus according to the operating system specification. The lists below show the most common location and precise when there is a variation.

7.1.1 Proyecto

Menú Opción	Atajos	Referencia	Barra de herramietas
 *Nuevo*	`Ctrl+N`	see *Projects*	*Proyecto*
 *Open*	`Ctrl+O`	see *Projects*	*Proyecto*
Nuevo a partir de plantilla →		see *Projects*	
Abrir recientes →		see *Projects*	
 *Guardar*	`Ctrl+S`	see *Projects*	*Proyecto*
 *Guardar como...*	`Ctrl+Shift+S`	see *Projects*	*Proyecto*
 *Save as Image...*		see *Output*	
DXF Export...		see *Output*	
DWG/DXF Import...			
 *Project Properties...*	`Ctrl+Shift+P`	see *Projects*	
 *New Print Composer*	`Ctrl+P`	see *Print Composer*	*Proyecto*
 *Composer manager...*		see *Print Composer*	*Proyecto*
Print Composers →		see *Print Composer*	
 *Salir de QGIS*	`Ctrl+Q`		

Under  macOS, the *Exit QGIS* command corresponds to *QGIS* → *Quit QGIS* (`Cmd+Q`).

7.1.2 Editar

Menú Opción	Atajos	Referencia	Barra de herramietas
Deshacer	Ctrl+Z	see *Digitalización avanzada*	*Digitalización Avanzada*
Rehacer	Ctrl+Shift+Z	see *Digitalización avanzada*	*Digitalización Avanzada*
Cortar objetos espaciales	Ctrl+X	see *Digitalizando una capa existente*	*Digitalización*
Copiar objetos espaciales	Ctrl+C	see *Digitalizando una capa existente*	*Digitalización*
Pegar objetos espaciales	Ctrl+V	see *Digitalizando una capa existente*	*Digitalización*
Paste features as →		see *Trabajar con la tabla de atributos*	
Add Feature	Ctrl+.	see *Digitalizando una capa existente*	*Digitalización*
Añadir cadena circular		see *Digitalizando una capa existente*	*Digitalización*
Añadir cadena circular por radio		see *Digitalizando una capa existente*	*Digitalización*
Mover objeto(s) espacial(es)		see *Digitalizando una capa existente*	*Digitalización*
Borrar lo seleccionado		see *Digitalizando una capa existente*	*Digitalización*
Modificar atributos de los objetos seleccionados		see *Editar valores de atributo*	*Digitalización*
Rotar objeto(s) espacial(es)		see *Digitalización avanzada*	*Digitalización Avanzada*
Simplificar objeto espacial		see *Digitalización avanzada*	*Digitalización Avanzada*
Añadir anillo		see *Digitalización avanzada*	*Digitalización Avanzada*
Añadir parte		see *Digitalización avanzada*	*Digitalización Avanzada*
Rellenar anillo		see *Digitalización avanzada*	*Digitalización Avanzada*
Borrar anillo		see *Digitalización avanzada*	*Digitalización Avanzada*
Borrar parte		see *Digitalización avanzada*	*Digitalización Avanzada*
Remodelar objetos espaciales		see *Digitalización avanzada*	*Digitalización Avanzada*
Desplazar curva		see *Digitalización avanzada*	*Digitalización Avanzada*
Dividir objetos espaciales		see *Digitalización avanzada*	*Digitalización Avanzada*
Dividir partes		see *Digitalización avanzada*	*Digitalización Avanzada*

After activating  Toggle editing mode for a layer, you will enable the `Add Feature` icon in the *Edit* menu depending on the layer type (point, line or polygon).

7.1.3 Edit (extra)

Menú Opción	Atajos	Referencia	Barra de herramietas
 *Add Feature*		see *Digitalizando una capa existente*	*Digitalización*
 *Add Feature*		see *Digitalizando una capa existente*	*Digitalización*
 *Add Feature*		see *Digitalizando una capa existente*	*Digitalización*

7.1.4 Ver

Menú Opción	Atajos	Referencia	Barra de herramietas
Pan Map		see *Zum y paneo*	*Navegación de mapas*
Pan Map to Selection			*Navegación de mapas*
Acercar zum	`Ctrl+Alt++`	see *Zum y paneo*	*Navegación de mapas*
Alejar zum	`Ctrl+Alt+-`	see *Zum y paneo*	*Navegación de mapas*
Seleccionar →		see *Selecting features*	*Atributos*
Identify Features	`Ctrl+Shift+I`	see *Identify Features*	*Atributos*
Medir →		see *Mediciones*	*Atributos*
Statistical Summary		see *Panel de resumen estadístico*	*Atributos*
Zum General	`Ctrl+Shift+F`		*Navegación de mapas*
Zum a la capa			*Navegación de mapas*
Zum a la selección	`Ctrl+J`		*Navegación de mapas*
Zum anterior			*Navegación de mapas*
Zum siguiente			*Navegación de mapas*
Zoom To Native Resolution			*Navegación de mapas*
Ilustraciones →		see *Elementos decorativos*	
Modo Vista previa →			
Map Tips		see *Propiedades a mostrar*	*Atributos*
Nuevo marcador...	`Ctrl+B`	see *Marcadores espaciales*	*Atributos*
Mostrar marcadores	`Ctrl+Shift+B`	see *Marcadores espaciales*	*Atributos*
Actualizar	`F5`		*Navegación de mapas*
Paneles →		see *Paneles y Barras de Herramientas*	
Barras de herramientas→		see *Paneles y Barras de Herramientas*	
Alternar el modo de pantalla completa	`F11`		

Under Linux KDE, *Panels* →, *Toolbars* → and *Toggle Full Screen Mode* are rather placed in *Settings* menu. *Preview mode* → is not available under macOS.

7.1.5 Capa

Menú Opción	Atajos	Referencia	Barra de herramietas
Crear capa →		see *Creating new vector layers*	*Manage Layers*
Añadir capa →		see *Exploring Data Formats and Fields*	*Manage Layers*
Empotrar capas y grupos...		see *Anidar proyectos*	
Añadir desde archivo de definición de capa...			
Copy style		see *Save and Share Layer Properties*	
Paste style		see *Save and Share Layer Properties*	
Abrir tabla de atributos	F6	see *Trabajar con la tabla de atributos*	*Atributos*
Conmutar edición		see *Digitalizando una capa existente*	*Digitalización*
Guardar cambios de la capa		see *Digitalizando una capa existente*	*Digitalización*
Ediciones actuales →		see *Digitalizando una capa existente*	*Digitalización*
Save As...		see *Creating new layers from an existing layer*	
Save As Layer Definition File...			
Eliminar capa/grupo	Ctrl+D		
Duplicar capa(s)			
Establecer visibilidad de escala de capa(s)			
Establecer SRC de la capa(s)	Ctrl+Shift+C		
Establecer SRC del proyecto a partir de capa			
Propiedades...		see *El Dialogo de las Propiedades del Vector*	
Filter...	Ctrl+F	see *Constructor de Consulta*	
Etiquetado		see *Propiedades de etiquetas*	
Add to Overview	Ctrl+Shift+O		*Manage Layers*
Add All To Overview			
Remove All From Overview			
Mostrar todas las capas	Ctrl+Shift+U		*Manage Layers*
Ocultar todas las capas	Ctrl+Shift+H		*Manage Layers*
Show selected Layers			
Hide selected Layers			

7.1.6 Configuración

Menú Opción	Atajos	Referencia	Barra de herramietas
Custom CRS...		see *Sistema de referencia de coordenadas personalizada*	
Style Manager...		see *El Administrador de estilos*	
Configure shortcuts...		see *Atajos de teclado*	
Customization...		see *Personalización*	
Options...		see *Opciones*	
Snapping Options...		see *Configurar la tolerancia del autoensamblado y radio de búsqueda*	

Under Linux KDE, you'll find more tools in *Settings* menu such as *Project Properties*, *Panels* →, *Toolbars* → and *Toggle Full Screen Mode*.

7.1.7 Complementos

Menú Opción	Atajos	Referencia	Barra de herramietas
Administrar e Instalar complementos ...		see *El diálogo de complementos*	
Python Console	`Ctrl+Alt+P`		

Cuando inicie QGIS por primera vez no se cargan todos los complementos principales.

7.1.8 Vectorial

Menú Opción	Atajos	Referencia	Barra de herramietas
OpenStreetMap →		see *Importing OpenStreetMap Vectors*	
Analysis Tools →		see *Menu Vectorial*	
Research Tools →		see *Menu Vectorial*	
Geoprocessing Tools →		see *Menu Vectorial*	
Geometry Tools →		see *Menu Vectorial*	
Data Management Tools →		see *Menu Vectorial*	

When starting QGIS for the first time not all core plugins are loaded. Many of the above-mentioned sub-menus require the core plugin Processing to be activated.

7.1.9 Ráster

Menú Opción	Atajos	Referencia	Barra de herramietas
Raster calculator...		see *Calculadora Ráster*	
Align Raster...		see *Raster Alignment*	
Analysis →		see *Complemento Herramientas de GDAL*	
Projection →		see *Complemento Herramientas de GDAL*	
Conversion →		see *Complemento Herramientas de GDAL*	
Miscellaneous →		see *Complemento Herramientas de GDAL*	
Extraction →		see *Complemento Herramientas de GDAL*	

When starting QGIS for the first time not all core plugins are loaded. Many of the above-mentioned sub-menus require the core plugin Processing to be activated.

7.1.10 Base de datos

Menú Opción	Atajos	Referencia	Barra de herramietas
Database →		see *Complemento administrador de BBDD*	*Base de datos*

Cuando inicie QGIS por primera vez no se cargan todos los complementos principales.

7.1.11 Web

Menú Opción	Atajos	Referencia	Barra de herramietas
Metasearch		see *Cliente de Catálogo de metasearch*	*Web*

Cuando inicie QGIS por primera vez no se cargan todos los complementos principales.

7.1.12 Procesado

Menú Opción	Atajos	Referencia	Barra de herramietas
Toolbox		see *The toolbox*	
Graphical Modeler...		see *Modelador gráfico*	
History and log...		see *El administrador del historial*	
Options...		see *Configuring the processing framework*	
Results viewer...		see *Configurar aplicaciones externas*	
Commander	`Ctrl+Alt+M`	see *La línea de órdenes de QGIS*	

Cuando inicie QGIS por primera vez no se cargan todos los complementos principales.

7.1.13 Ayuda

Menú Opción	Atajos	Referencia	Barra de herramietas
Help Contents	F1		*Ayuda*
What's This?	Shift+F1		*Ayuda*
API Documentation			
Reportar un problema			
Need commercial support?			
QGIS Home Page	Ctrl+H		
Check QGIS Version			
About			
Patrocinadores de QGIS			

7.1.14 QGIS

This menu is only available under macOS and contains some OS related commands.

Menú Opción	Atajos	Referencia
Preferencias		
Acerca de QGIS		
Hide QGIS		
Mostrar todo		
Hide Others		
Quit QGIS	Cmd+Q	

Preferences and *About QGIS* are the same commands as *Settings* → *Options* and *Help* → *About*. *Quit QGIS* corresponds to *Project* → *Exit QGIS* under the other platforms.

7.2 Paneles y Barras de Herramientas

From the *View* menu (or *Settings*), you can switch on and off QGIS widgets (*Panels* →) or toolbars (*Toolbars* →). You can (de)activate any of them by right-clicking the menu bar or a toolbar and choose the item you want. Each panel or toolbar can be moved and placed wherever you feel comfortable within QGIS interface. The list can also be extended with the activation of *Core or external plugins*.

7.2.1 Barras de herramientas

The toolbar provides access to most of the same functions as the menus, plus additional tools for interacting with the map. Each toolbar item has pop-up help available. Hold your mouse over the item and a short description of the tool's purpose will be displayed.

Every toolbar can be moved around according to your needs. Additionally, they can be switched off using the right mouse button context menu, or by holding the mouse over the toolbars.

Truco: Restauración de barras de herramientas

If you have accidentally hidden a toolbar, you can get it back by choosing menu option *View* → *Toolbars* → (or *Settings* → *Toolbars* →). If for some reason a toolbar (or any other widget) totally disappears from the interface, you'll find tips to get it back at *restoring initial GUI*.

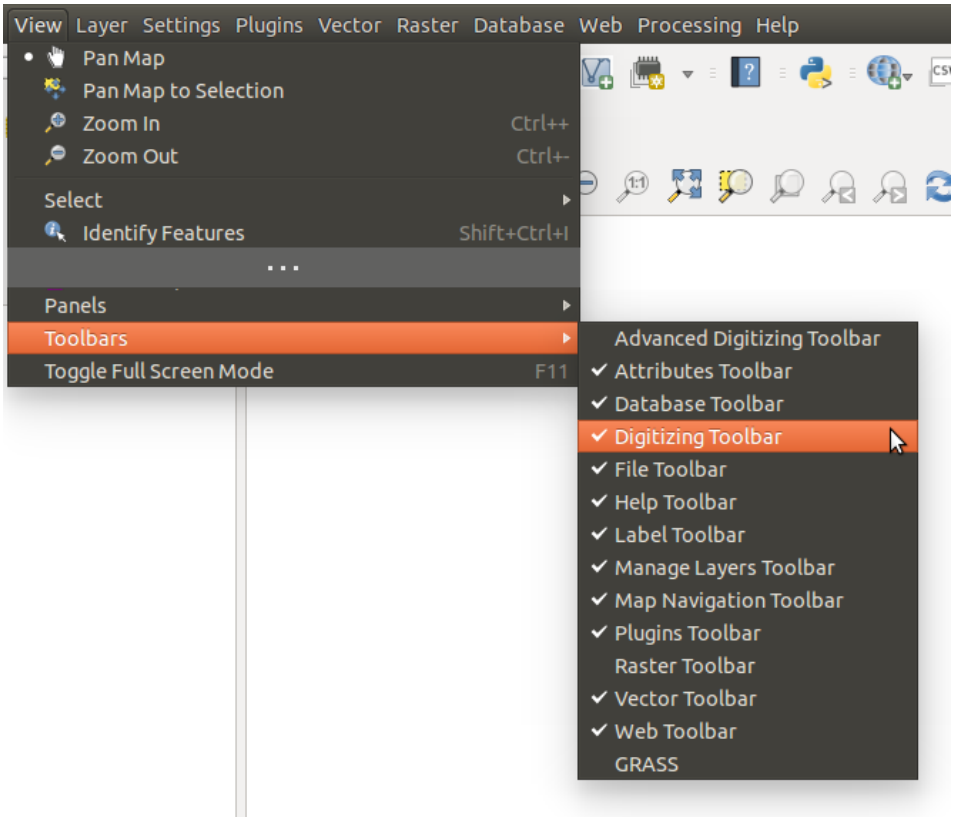


Figure 7.2: The Toolbars menu

7.2.2 Paneles

Besides toolbars, QGIS provides by default many panels to work with. Panels are special widgets that you can interact with (selecting options, checking boxes, filling values...) in order to perform a more complex task.

Below are listed default panels provided by QGIS:

- the *Panel de capas*
- the *Browser Panel*
- the *Advanced Digitizing Panel*
- the *Spatial Bookmarks Panel*
- the *GPS Information Panel*
- the *Tile Scale Panel*
- the *Identify Panel*
- the *User Input Panel*
- the *Layer Order Panel*
- el *Layer Styling Panel*
- el *Panel de resumen estadístico*
- the *QGIS Overview Panel*
- the *Panel de mensajes de registro*
- the *Panel de deshacer/rehacer*
- the *Processing Toolbox*

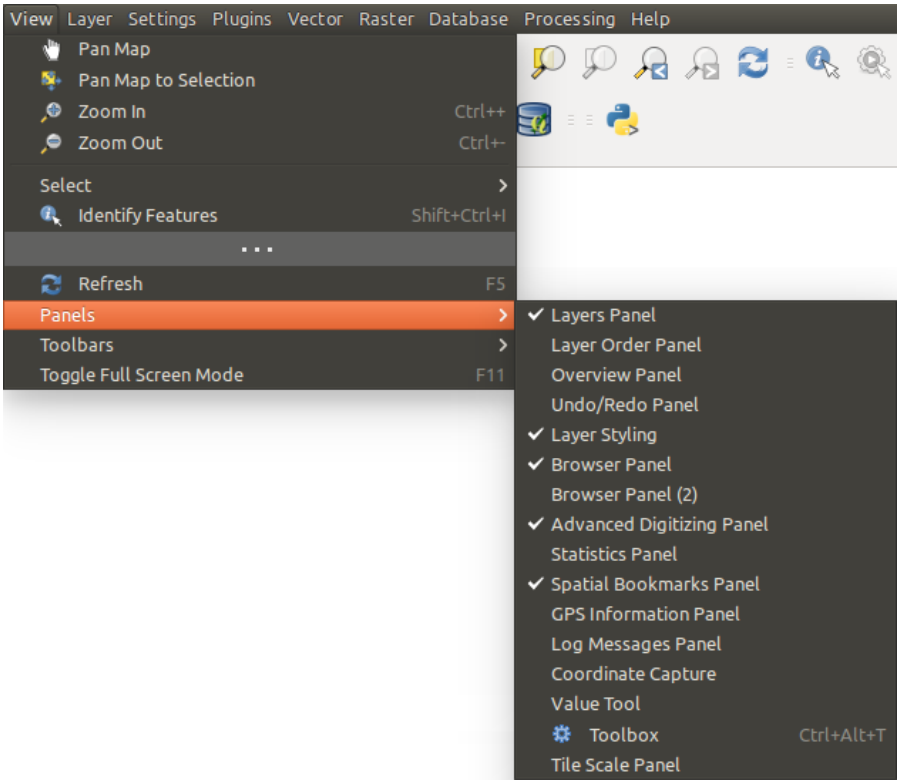


Figure 7.3: El menú de paneles

7.3 Vista del mapa

Also called **Map canvas**, this is the "business end" of QGIS — maps are displayed in this area. The map displayed in this window will depend on the vector and raster layers you have chosen to load.

When you add a layer (see e.g. *Opening Data*), QGIS automatically looks for its Coordinate Reference System (CRS) and zooms to its extent if you work in a blank QGIS project. The layer's CRS is then applied to the project. If there are already layers in the project, and in the case the new layer has the same CRS as the project, its features falling in the current map canvas extent will be visualized. If the new layer is in a different CRS from the project's, you must *Enable on-the-fly CRS transformation* from the *Project* → *Project Properties* → *CRS* (see *Define On The Fly (OTF) CRS Transformation*). The added layer should now be visible if data are available in the current view extent.

The map view can be panned, shifting the focus of the map display to another region, and it can be zoomed in and out. Various other operations can be performed on the map as described in the *Barras de herramientas* description. The map view and the legend are tightly bound to each other — the maps in view reflect changes you make in the legend area.

Truco: Zum al mapa con la rueda del ratón

Puede utilizar la rueda del ratón para acercar y alejar zum en el mapa. Coloque el cursor del ratón dentro del mapa y gire la rueda hacia adelante (hacia la derecha) para acercar y hacia atrás (hacia usted) para alejarlo. El zum se centra en la posición del cursor del ratón. Puede personalizar el comportamiento del zum de la rueda del ratón usando la pestaña *Herramientas del mapa* bajo el menú *Configuración*→ *Opciones*

Truco: Desplazar el mapa con las teclas de dirección y barra de espaciadora

You can use the arrow keys to pan the map. Place the mouse cursor inside the map area and click on the right arrow key to pan east, left arrow key to pan west, up arrow key to pan north and down arrow key to pan south. You can also pan the map using the space bar or the click on mouse wheel: just move the mouse while holding down space bar or click on mouse wheel.

7.4 Barra de Estado

The status bar provides you with general information about the map view, and actions processed or available and offers you tools to manage the map view.

On the left side of the status bar, you can get a summary of actions you've done (such as selecting features in a layer, removing layer) or a long description of the tool you are hovering over (not available for all tools). On startup, the bar status also informs you about availability of new or upgradeable plugins (if checked in *Plugin Manager settings*).

In case of lengthy operations, such as gathering of statistics in raster layers or rendering several layers in map view, a progress bar is displayed in the status bar to show the current progress of the action.

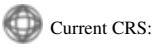
The  *Coordinate* option shows the current position of the mouse, following it while moving across the map view. You can set the unit (and precision) to use in the project properties, General tab. Click on the small button at the left of the textbox to toggle between the Coordinate option and the  *Extents* option that displays in map units, the coordinates of the current lower leftmost and upper rightmost points of the map view, as you pan and zoom in and out.

Next to the coordinate display you will find the *Scale* display. It shows the scale of the map view. If you zoom in or out, QGIS shows you the current scale. There is a scale selector, which allows you to choose among *predefined and custom scales* to assign to the map view.

On the right side of the scale display you can define a current magnification level for your map view. This allows to zoom in to a map without altering the map scale, making it easier to accurately tweak the positions of labels and symbols. The magnification level is expressed as a percentage. If the *Magnifier* has a level of 100%, then the current map is not magnified. Additionally, a default magnification value can be defined within *Settings* → *Options* → *Rendering* → *Rendering behaviour*, which is very useful for high resolution screen to avoid too small symbols.

To the right of the magnifier tool you can define a current clockwise rotation for your map view in degrees.

On the right side of the status bar, there is a small checkbox which can be used to temporarily prevent layers being rendered to the map view (see section *Renderizado*).

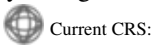
To the right of the render functions, you find the 

icon with the EPSG code of the current project CRS. Clicking on this lets you *Enable 'on the fly' CRS transformation* properties for the current project and apply another CRS to the map view.

Finally, the 

button opens the *Log Messages Panel* which informs you on underlying process (QGIS startup, plugins loading, processing tools...)

Truco: Calcular la escala correcta de su lienzo de mapa

When you start QGIS, the default CRS is `WGS 84 (epsg 4326)` and units are degrees. This means that QGIS will interpret any coordinate in your layer as specified in degrees. To get correct scale values, you can either manually change this setting, e.g. to meters, in the *General* tab under *Project* → *Project Properties*, or you can use the 

icon seen above. In the latter case, the units are set to what the project projection specifies (e.g., `+units=us-ft`).

Note that CRS choice on startup can be set in *Settings* → *Options* → *CRS*.

CHAPTER 8

Herramientas generales

8.1 Ayuda de contexto

When you need help on a specific topic, you can access context help via the **[Help]** button available in most dialogs — please note that third-party plugins can point to dedicated web pages.

8.2 Paneles

QGIS provides by default many panels to work with. Some of these panels are described below while others may be found in different parts of the document. A complete list of default panels provided by QGIS is available at *Paneles*.

8.2.1 Panel de capas

The *layers Panel* lists all the layers in the project and helps you manage their visibility. A layer can be selected and dragged up or down in the legend to change the Z-ordering. Z-ordering means that layers listed nearer the top of the legend are drawn over layers listed lower down in the legend.

Nota: The Z-ordering behavior can be overridden by the *Layer Order* panel.

At the top of the Layers panel, a toolbar allows you to:

-  Open the layer styling dock: toggle the layer styling panel on and off.
-  Añadir nuevo grupo
-  Manage Visibility: control visibility of layers and preset layers combination.
-  Filter Legend by Map Content: only the layers that are set visible and whose features intersect the current map canvas have their style rendered in the layers panel. Otherwise, a generic NULL symbol is applied to the layer. Based on the layer symbology, this is a convenient way to identify which kind of features from which layers cover your area of interest.
-  Filter Legend by Expression: helps you apply an expression to remove from the selected layer tree styles that have no feature satisfying the condition. This can be used for example to highlight features that are within a given area/feature of another layer. From the drop-down list, you can edit and clear the expression set.
-  Expand All or  Collapse All layers and groups in the layers panel.
- and  Remove Layer/Group currently selected.

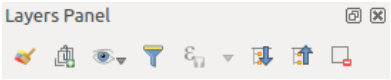


Figure 8.1: Barra de herramientas de capa en panel de capas

Nota: Tools to manage the layers panel are also available to layout the map and legend items of the print composer

Preset the layers visibility

The button allows you to add **Presets** views in the legend. Presets are a way to save and easily restore a combination of layers with their current style. To add a preset view, just set visible the layers you want, with their desired symbology, and click on button. Choose *Add Preset...* from the drop-down menu and give a name to the preset. The added preset is listed at the bottom of the drop-down menu and is recalled by clicking on it.

The *Replace Preset* → option helps you overwrite a preset content with the current map view while the *Remove Current Preset* button deletes the active preset.

All the added presets are also present in the map composer in order to allow you to create a map layout based on your specific views (see *Propiedades principales*).

Overview of the context menu of the Layers panel

At the bottom of the toolbar, the main component of the Layers panel is the frame listing vector or raster layers added to the project and, those layers can be organized in groups. Depending on the item selected in the panel, a right-click shows a dedicated set of options presented below.

Opción	Capa vectorial	Capa Ráster	Grupo
Zoom to Layer/Group	✓	✓	✓
Show in Overview	✓	✓	
Zoom to Native Resolution (100%)		✓	
Stretch Using Current Extent		✓	
Remove	✓	✓	✓
Duplicate	✓	✓	
Set Layer Scale Visibility	✓	✓	
Zoom to Visible Scale	✓	✓	
Set Layer/Group CRS	✓	✓	✓
Set Project CRS from Layer	✓	✓	
Estilos →	✓	✓	
Copy Style	✓	✓	
Paste Style	✓	✓	✓
Open Attribute Table	✓		
Toggle Editing	✓		
Ediciones actuales →	✓ (in Edit mode)		
Save As...	✓	✓	
Save As Layer Definition File...	✓	✓	✓
Filter...	✓		
Show Feature Count	✓		
Properties	✓	✓	
Move to Top-level	✓	✓	
Rename	✓	✓	✓
Group Selected	✓	✓	
Set Group WMS Data			✓
Mutually Exclusive Group			✓
Add Group			✓

Tabla: Menú contextual de los elementos del panel de Capas

For GRASS vector layers, Toggle editing is not available. See section *Digitalizar y editar una capa vectorial GRASS* for information on editing GRASS vector layers.

Interact with Groups and layers

Layers in the legend window can be organized into groups. There are two ways to do this:

1. Press the icon to add a new group. Type in a name for the group and press `Enter`. Now click on an existing layer and drag it onto the group.
2. Select some layers, right click in the legend window and choose *Group Selected*. The selected layers will automatically be placed in a new group.

To bring a layer out of a group, you can drag it out, or right click on it and choose *Move to top-level*; the layer is placed at the same level than the group it was inside. Groups can also be nested inside other groups.

The checkbox for a group will show or hide all the layers in the group with one click.

Enabling the **Mutually Exclusive Group** option you can make a group have only one layer visible at the same time. Whenever a layer within the group is set visible the others will be toggled not visible.

It is possible to select more than one layer or group at the same time by holding down the `Ctrl` key while selecting the layers with the left mouse button. You can then move all selected layers to a new group at the same time.

You may also delete more than one layer or group at once by selecting several items with the `Ctrl` key and pressing `Ctrl+D` afterwards. This way, all selected layers or groups will be removed from the layers list.

Editing vector layer style

From the Layers panel, you have shortcuts to easily and quickly edit the layer rendering. Right-click on a vector layer and select *Styles* → in the list in order to:

- see the currently applied *styles* to the layer. In case you defined many styles for the layer, you can switch from one to another and have your layer rendering automatically updated in the map canvas.
- copy the current style, and when applicable, paste a copied style from another layer
- rename the current style, add a new one (which is actually a copy of the current one) or delete the current style (when multiple styles available).

Nota: The previous options are also available for raster layer.

Whether the features in the vector layer have all the same unique symbol or they are classified (in that case, the layer is displayed in a tree structure with each class as sub-item), the following options are available at layer level or class level:

- a *Edit Symbol...* button to open the *El Selector de Símbolo* dialog and update any property (symbol, size, color...) of the layer or feature symbol. Double-clicking on a feature does also open the *Symbol Selector* dialog.
- a *Selector de color* widget with a **Color Wheel** from which you can click a color and have it automatically update the symbol fill color. For convenience, **Recent colors** are available at the bottom of the color wheel.
- a  *Show All Items* and  *Hide All Items* to toggle on or off the visibility of all the classes of features. This avoids (un)checking items one by one.

Truco: Quickly share a layer style

From the context menu, copy the style of a layer and paste it to a group or a selection of layers: the style is applied to all the layers that are of the same type (vector vs raster) as the original layer and, in case of vector, have the same geometry type (point, line or polygon).

8.2.2 Working with the Legend independent layer order

There is a panel that allows you to define an independent drawing order for the layers panel. You can activate it in the menu *Settings* → *Panels* → *Layer Order Panel*. This feature allows you to, for instance, order your layers in order of importance, but still display them in the correct order (see figure_layer_order; you can notice that the `airports` features are displayed over the `alaska` polygon despite their layers placement in the Layers panel). Unchecking the  *Control rendering order* box underneath the list of layers will cause a revert to default behavior.

8.2.3 Layer Styling Panel

This panel is somehow a shortcut to some of the features of the layer properties dialog. It indeed offers you a quick and handy way to define the rendering and the behavior of a layer, and to visualize its effects without opening the layer properties dialog.

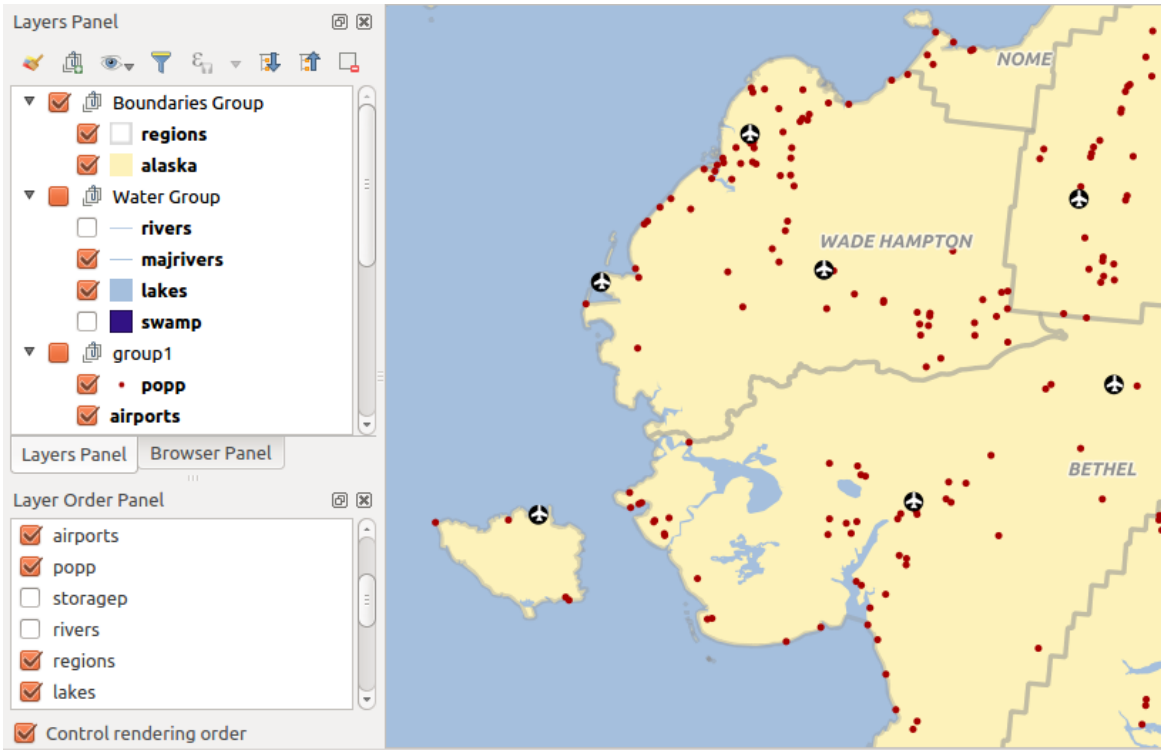


Figure 8.2: Define a legend independent layer order

Besides avoiding you dealing with the modal and blocking dialog of the layer properties, it also avoids you cluttering the screen with features dialogs given that it embeds most of them (color selector, effects properties, rule edit, label substitution...): e.g., clicking color buttons inside the layer style panel causes the color selector dialog to be opened inside the layer style panel itself rather than as a separate dialog.

From a drop-down list of current layers in the layer panel, select an item and:

- set its symbology, transparency, and histogram in case of raster layer. These options are the same available in *Dialogo de Propiedades Raster*
- set its symbology, and labels. These options are the same available in *El Dialogo de las Propiedades del Vector*
- manage the associated style(s) as described in *Managing Custom Styles*
- follow the whole history of changes you applied to the layer style in the current project; you can therefore cancel or restore to any state by selecting it in the list and hit **[Apply]** button.

Another powerful feature of this panel is the *Live update* checkbox. Tick it and your changes are automatically rendered in the map canvas as you go on. You no longer need to hit the **[Apply]** button.

Truco: Add custom tabs to the Layer Styling panel

Using *PyQGIS*, you can set new tabs to manage layer properties in the Layer Styling Panel. See https://nathanw.net/2016/06/29/qgis-style-dock-part-2-plugin-panels/ for an example.

8.2.4 Panel de resumen estadístico

This panel can show some statistics on a specific vector layers. The panel allows users to choose:

- the vector layer;
- the column or the expression;
- filter statistics to selected features;

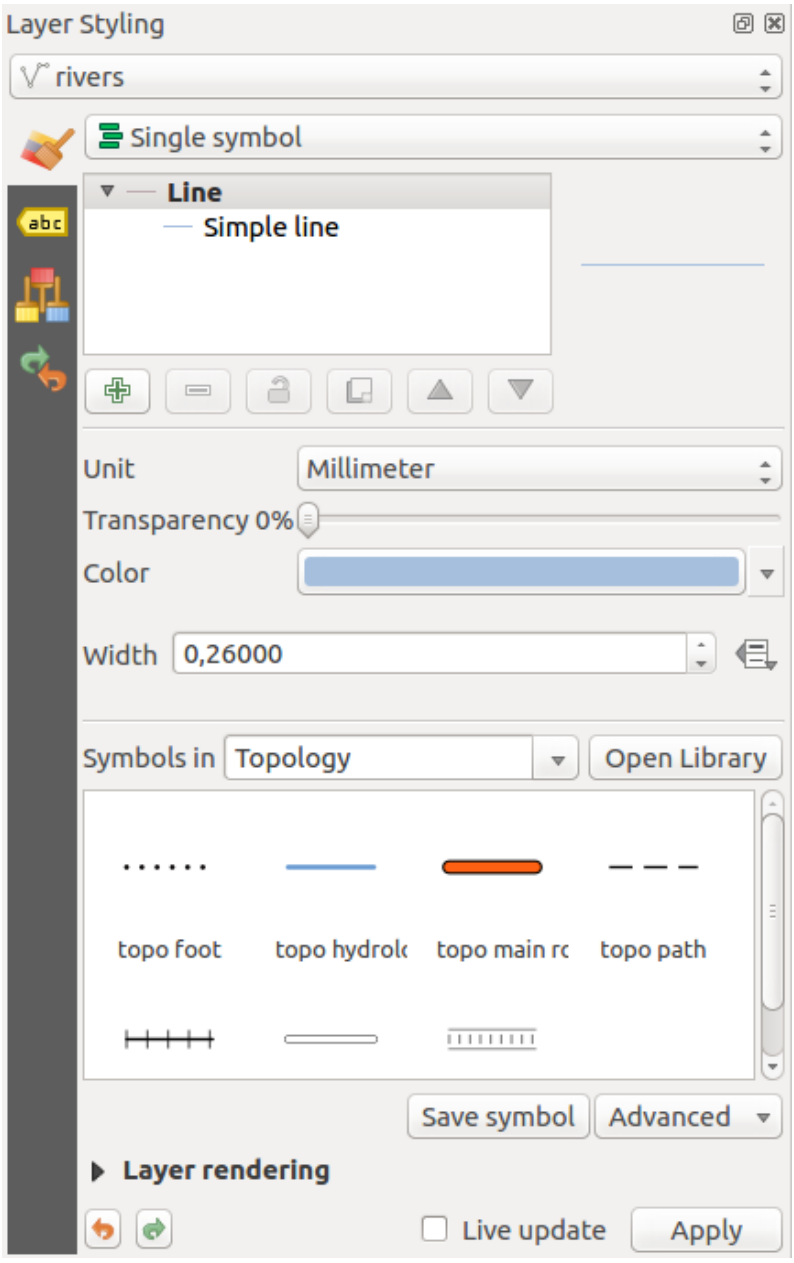


Figure 8.3: Defining a layer symbology from the layer styling panel

- refresh the informations;
- the statistics information to display with the bottom right button.

Statistic information available are (depending on the field's type):

Estadísticas	Cadena	Entero	Coma flotante	Fecha
Número	✓	✓	✓	✓
Contar valores distintos	✓			✓
Contar valores faltantes	✓			✓
Suma		✓	✓	
Media		✓	✓	✓
Desviación estándar		✓	✓	
Desviación estándar en ejemplo		✓	✓	
Valor mínimo	✓	✓	✓	✓
Valor máximo	✓	✓	✓	✓
Rango		✓	✓	✓
Minoría		✓	✓	
Mayoría		✓	✓	
Variedad		✓	✓	
Primer cuartil		✓	✓	
Tercer cuartil		✓	✓	
Rango intercuartil		✓	✓	
Longitud mínima	✓			
Longitud máxima	✓			

Tabla: Estadística disponible para cada tipo de campo

8.2.5 QGIS Overview Panel

In QGIS, you can use an overview panel that provides a full extent view of layers added to it. Within the view is a rectangle showing the current map extent. This allows you to quickly determine which area of the map you are currently viewing. Note that labels are not rendered to the map overview even if the layers in the map overview have been set up for labelling. If you click and drag the red rectangle in the overview that shows your current extent, the main map view will update accordingly.

8.2.6 Panel de mensajes de registro

When loading or processing some operations, you can track and follow messages that appear in different tabs using the  Log Messages Panel. It can be activated using the most right icon in the bottom status bar.

8.2.7 Panel de deshacer/rehacer

For each layer being edited, this panel shows the list of actions done, allowing to quickly undo a set of actions by simply selecting the action listed above. More details at *Undo and Redo edits*.

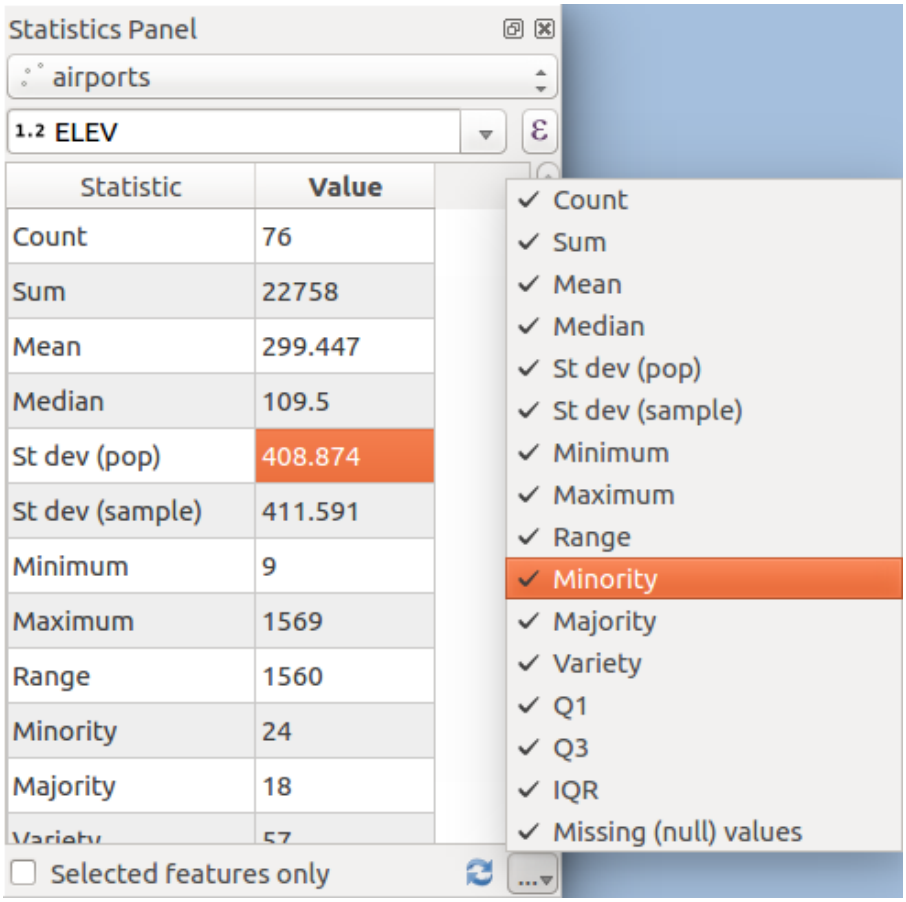


Figure 8.4: Mostrar estadística en un campo

8.3 Renderizado

By default, QGIS renders all visible layers whenever the map canvas is refreshed. The events that trigger a refresh of the map canvas include:

- Adding a layer
- Panning or zooming
- Resizing the QGIS window
- Changing the visibility of a layer or layers

QGIS le permite controlar el proceso de representación de varias maneras.

8.3.1 Renderizado dependiente de la escala

Scale-dependent rendering allows you to specify the minimum and maximum scales at which a layer (raster or vector) will be visible. To set scale-dependent rendering, open the *Properties* dialog by double-clicking on the layer in the legend. On the *General* tab, tick the *Scale dependent visibility* checkbox and enter the *Minimum (exclusive)* and *Maximum (inclusive)* scale values.

You can also activate the scale dependent visibility on a layer from the Layers panel. Right-click on the layer and in the context menu, select *Set Layer Scale Visibility*.

The Set to current canvas scale button helps you use the current map canvas scale as boundary of the range visibility.

Nota: When a layer is not rendered in the map canvas due to the map scale out of its visibility scale range, the layer is greyed in the Layers panel and a new option *Zoom to Visible Scale* appears in the layer context menu. Select it and the map is zoomed to the layer's nearest visibility scale.

8.3.2 Controlar el renderizado del mapa

Map rendering can be controlled in various ways, as described below.

Suspender el renderizado

To suspend rendering, click the *Render* checkbox in the lower right corner of the status bar. When the *Render* checkbox is not checked, QGIS does not redraw the canvas in response to any of the events described in section *Renderizado*. Examples of when you might want to suspend rendering include:

- Adding many layers and symbolizing them prior to drawing
- Adding one or more large layers and setting scale dependency before drawing
- Adding one or more large layers and zooming to a specific view before drawing
- Any combination of the above

Marcar la casilla *Renderizar* habilita el renderizado y origina un refresco inmediato del lienzo del mapa.

Configurar la opción de añadir una capa

You can set an option to always load new layers without drawing them. This means the layer will be added to the map, but its visibility checkbox in the legend will be unchecked by default. To set this option, choose menu option *Settings* → *Options* and click on the *Rendering* tab. Uncheck the *By default new layers added to the map should be displayed* checkbox. Any layer subsequently added to the map will be off (invisible) by default.

Detener el renderizado

To stop the map drawing, press the `ESC` key. This will halt the refresh of the map canvas and leave the map partially drawn. It may take a bit of time between pressing `ESC` and the time the map drawing is halted.

Nota: Actualmente no es posible detener la representación — esto se desactivó en el paso a Qt4 debido a problemas y cuelgues de la Interfaz de Usuario (IU).

Influir en la calidad del renderizado

QGIS has an option to influence the rendering quality of the map. Choose menu option *Settings* → *Options*, click on the *Rendering* tab and select or deselect *Make lines appear less jagged at the expense of some drawing performance*.

Acelerar renderizado

Hay algunos ajustes que le permiten mejorar la velocidad de presentación. Abrir el diálogo de las opciones de QGIS usando *Configuración*→ *Opciones*, ir a la pestaña guilabel:*Representación* y seleccionar o deseleccionar las siguientes casillas de verificación:

- *Use render caching where possible to speed up redraws*
- *Render layers in parallel using many CPU cores* and then set the *Max cores to use*.
- The map renders in the background onto a separate image and each *Map Update interval*, the content from this (off-screen) image will be taken to update the visible screen representation. However, if rendering finishes faster than this duration, it will be shown instantaneously.
- With *Enable Feature simplification by default for newly added layers*, you simplify features' geometry (less nodes) and as a result, they quickly display. Be aware that you can also face rendering inconsistencies.

8.4 Save and Share Layer Properties

8.4.1 Managing Custom Styles

When a vector layer is added to map canvas, QGIS uses by default a random symbol/color to render its features. You can however set a default symbol in *Project* → *Project Properties* → *Default styles* that will be applied to each newly added layer according to its geometry type.

But, most of the time, you'd prefer to have a custom and more complex style that can be applied automatically or manually (with less efforts) to the layers. You can achieve this goal using the *Style* combobox at the bottom of the Layer Properties dialog. This combobox provides you with functions to create, load and manage styles.

A style stores any information set in the layer properties dialog to render or interact with the features (including symbology, labeling, action, diagram... settings) for vector layer, or the pixels (band or color rendering, transparency, pyramids, histogram ...) for raster.

By default, the style applied to a loaded layer is named `default`. Once you have got the ideal and appropriate rendering for your layer, you can save it by clicking the *Style* combobox and choose:

- **Rename Current**: The active style gets renamed and updated with the current options
- **Add**: A new style is created using the current options. By default, it will be saved in the QGIS project file. See below to save the style in another file or a database
- **Remove**: delete unwanted style, in case you have more than one style defined for the layer.

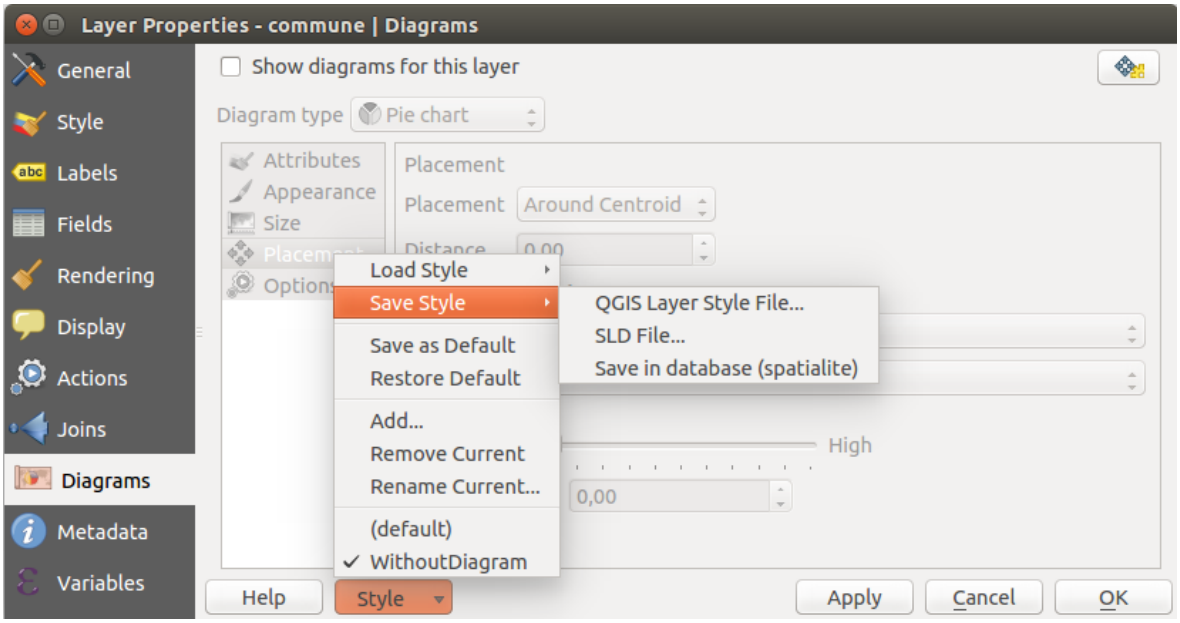


Figure 8.5: Vector layer style combobox options

At the bottom of the Style drop-down list, you see the styles set for the layer and the active one is checked.

Note that each time you validate the layer properties dialog, the active style is updated with the changes you've done.

You can create as many styles as you wish for a layer but only one can be active at a time. Combined to layer visibility preset, this offers a quick and powerful way to manage complex projects with few layers (no need to duplicate any layer in the map legend).

Truco: Manage styles from layer context menu

Right-click on the layer in *Layers Panel* to add, rename or remove layer style.

8.4.2 Storing Style in a File or a Database

While created styles from the *Style* combobox are by default saved inside the project and can be copied and pasted from layer to layer in the project, it's also possible to save them outside the project so that they can be loaded in another project.

Save in plain text file

Clicking the  *Style* → *Save Style*, you can save the style as a:

- QGIS layer style file (`.qml`)
- or SLD file (`.sld`), only available for vector layers.

Used on file based format layers (`.shp`, `.tab`...), *Save as Default* generates a `.qml` file along the layer (with the same name). SLDs can be exported from any type of renderer – single symbol, categorized, graduated or rule-based – but when importing an SLD, either a single symbol or rule-based renderer is created. That means that categorized or graduated styles are converted to rule-based. If you want to preserve those renderers, you have to stick to the QML format. On the other hand, it can be very handy sometimes to have this easy way of converting styles to rule-based.

Save in database

Vector layer style can also be stored in a database if the layer datasource is a database provider. Supported formats are PostGIS, GeoPackage, SpatiaLite, MSSQL and Oracle. The layer style is saved inside a table (named `layer_styles`) of the database. Click on *Save Style* → *Save in database* item then fill in the dialog to define a style name, add a description, a `.ui` file if applicable and check if the style should be the default style.

You can save several styles for a single table in the database. However each table can have only one default style. Default style can be saved in the layer database or in the QGIS local database, a SQLite database in the `~/.qgis2/` directory (where QGIS stores its local settings).

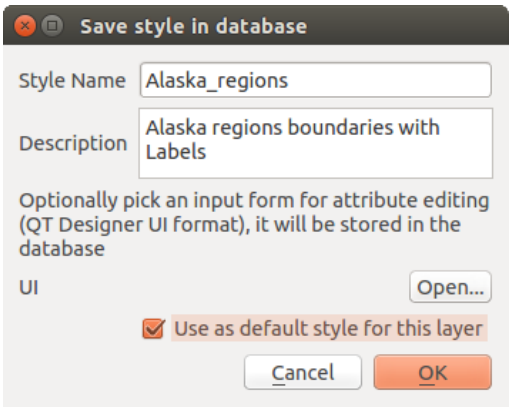


Figure 8.6: Save Style in database Dialog

Truco: Sharing style files between databases

You can only save your style in a database if the layer comes from such a database. You can't mix databases (layer in Oracle and style in MSSQL for instance). Use instead a plain text file if you want the style to be shared among databases.

Nota: You may encounter issues to restore the `layer_styles` table from a PostgreSQL database backup. Follow *QGIS layer_style table and database backup* to fix that.

Cargar estilos

When loading a layer in QGIS, if a default style already exists for this layer, QGIS loads the layer with this style. Also *Style* → *Restore Default* looks for and loads that file when pressed, replacing current style of the layer.

The *Style* → *Load Style* helps you apply any saved style to a layer. While plain text file style (`.sld` or `.qml`) can be applied to any layer whatever its format is, loading styles stored in database is only possible if the layer is from the same database or the style is stored in the QGIS local database.

The *Load Style from Database* dialog displays a list of related styles to the layer found in the database and all the other styles saved in it, with name and description.

Truco: Quickly share a layer style within the project

You can also share layer style within a project without importing a file or database style: right-click on the layer in the *Layers Panel* and, from the *Styles* combobox , copy the style of a layer and paste it to a group or a selection of layers: the style is applied to all the layers that are of the same type (vector vs raster) as the original layer and, in case of vector, have the same geometry type (point, line or polygon).

8.5 Selector de color

The *select color* dialog will appear whenever you push the  icon to choose a color. The features of this dialog depends on the state of the *Use native color chooser dialogs* parameter checkbox in *Settings* → *Options* → *General* menu. When checked, the color dialog used is the one of the OS being used. Otherwise, QGIS custom color chooser is used.

Truco: Dynamically change the color with the live-updating option

Check the *Use live-updating color chooser dialogs* option in the *Settings* → *Options* → *General* menu to have the color applied to your items as soon as you pick it in the color chooser dialog.

The custom color chooser dialog has four different tabs which allow you to select colors by  color ramp,  color wheel,  color swatches or  color picker (not available under ).

Whatever method you use, the selected color is always described through color sliders for `HSV` (Hue, Saturation, Value) and `RGB` (Red, Green, Blue) values. The color is also identifiable as a *HTML notation*. Finally, there is an *opacity* slider to set transparency level.

Modifying a color is as simple as clicking in the color wheel or ramp or in any of the color parameters sliders. You can adjust such parameters with the spinbox beside or, handy, scrolling the mouse wheel over the corresponding slider. You can also typeset the color html notation.

The dialog also provides a visual comparison between the *current* (applied to widget) and the *new* (being selected) colors. Thanks to drag-and-drop, any of these colors can be saved in a slot for an easy access.

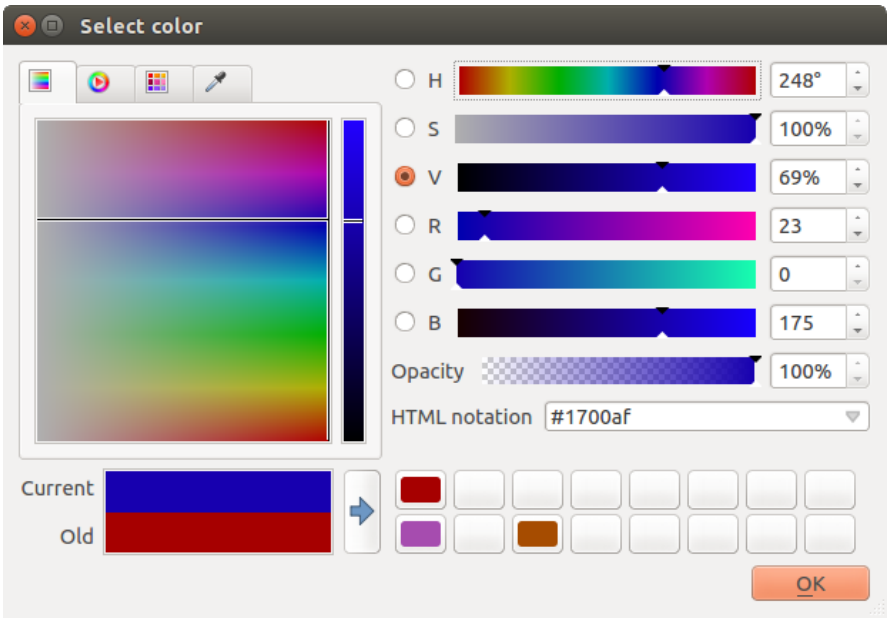


Figure 8.7: Color selector ramp tab

With  color ramp or  color wheel tab, you can browse to all possible color combinations and apply it to the item. In the  color swatches tab, you can choose from a preselected list of color palettes:

- *Recent colors*,
- *Standard colors*, a user-defined list of colors set under *Settings* → *Options* → *Colors* menu
- or *Project colors*, a user-defined list of colors set under *Project* → *Project Properties* → *Default Styles*.

The latest palettes can be modified thanks to the and buttons at the bottom of the frame. The ... button nearby the palette combobox also offers several options to:

- copy, paste, import or export colors
- create, import or remove color palettes. Check the *Show in Color Buttons* option to add the custom palette to the color selector widget (see figure_color_selector).

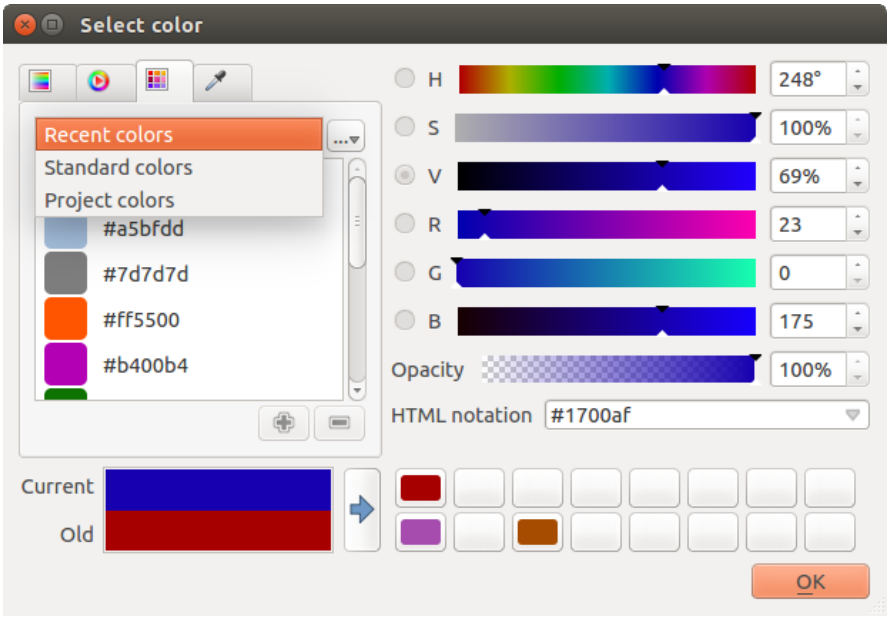


Figure 8.8: Color selector switcher tab

Another option is to use the color picker which allows you to sample a color from under your mouse pointer at any part of QGIS or even from another application by pressing the space bar. Please note that the color picker is OS dependent and is currently not supported by macOS.

Truco: Quick color modification

Click the drop-down arrow at the right of the color box button to display a widget for a quick color selection, either in the color wheel or from existing color palettes. You can also use it to *copy* or *paste* a color.

8.6 Modos de Mezcla

QGIS offers different options for special rendering effects with these tools that you may previously only know from graphics programs. Blending modes can be applied on layers, on features but also on print composer items:

- **Normal**: This is the standard blend mode, which uses the alpha channel of the top pixel to blend with the pixel beneath it. The colors aren't mixed.
- Iluminado: Este selecciona el máximo de cada componente del primer y segundo plano de píxeles. Tenga en cuenta que los resultados tienden a ser irregulares y rigurosos.
- **Screen**: Light pixels from the source are painted over the destination, while dark pixels are not. This mode is most useful for mixing the texture of one item with another item (e.g., you can use a hillshade to texture another layer).
- **Dodge**: Dodge will brighten and saturate underlying pixels based on the lightness of the top pixel. So, brighter top pixels cause the saturation and brightness of the underlying pixels to increase. This works best if the top pixels aren't too bright; otherwise the effect is too extreme.

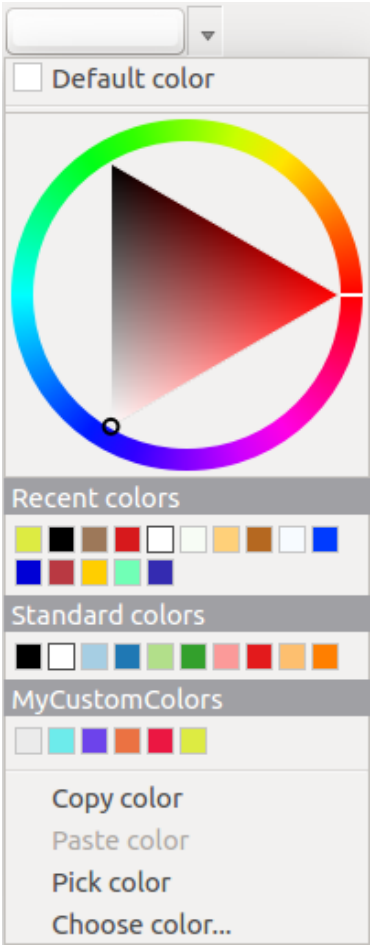


Figure 8.9: Menú seleccionador rápido de color

- **Addition**: This blend mode simply adds pixel values of one item with the other. In case of values above one (in the case of RGB), white is displayed. This mode is suitable for highlighting features.
- **Darken**: This creates a resultant pixel that retains the smallest components of the foreground and background pixels. Like lighten, the results tend to be jagged and harsh.
- **Multiply**: Here, the numbers for each pixel of the top item are multiplied with the corresponding pixels for the bottom item. The results are darker pictures.
- **Burn**: Darker colors in the top item cause the underlying items to darken. Burn can be used to tweak and colorise underlying layers.
- **Overlay**: This mode combines the multiply and screen blending modes. In the resulting picture, light parts become lighter and dark parts become darker.
- **Soft light**: This is very similar to overlay, but instead of using multiply/screen it uses color burn/dodge. This is supposed to emulate shining a soft light onto an image.
- **Hard light**: Hard light is also very similar to the overlay mode. It's supposed to emulate projecting a very intense light onto an image.
- **Difference**: Difference subtracts the top pixel from the bottom pixel, or the other way around, to always get a positive value. Blending with black produces no change, as the difference with all colors is zero.
- **Subtract**: This blend mode simply subtracts pixel values of one item from the other. In case of negative values, black is displayed.

8.7 Zum y paneo

QGIS provides tools to zoom and pan to your area of interest.

Apart from using the  pan and  zoom-in /  zoom-out icons on the toolbar with the mouse, navigating can also be done with the mouse wheel, spacebar and the arrow keys. A *Zoom factor* can be set under the *Settings* → *Options* → *Map tools* menu to define the scale behavior while zooming.

8.7.1 With the mouse wheel

You can press the mouse wheel to pan inside of the main window (on macOS, you may need to hold `cmd` key). You can roll the mouse wheel to zoom in and out on the map; the mouse cursor position will be the center of the zoomed area of interest. Holding down `Ctrl` while rolling the mouse wheel results in a finer zoom.

8.7.2 With the arrow keys

Panning the map is possible with the arrow keys. Place the mouse cursor inside the map area, and click on the right arrow key to pan east, left arrow key to pan west, up arrow key to pan north, and down arrow key to pan south.

You can also use the space bar to temporarily cause mouse movements to pan the map. The `PgUp` and `PgDown` keys on your keyboard will cause the map display to zoom in or out following the zoom factor set. Pressing `Ctrl` + or `Ctrl` − also performs an immediate zoom in/out on the map canvas.

When certain map tools are active (Identify, Measure...), you can perform a zoom by holding down `Shift` and dragging a rectangle on the map to zoom to that area. This is enabled for the map tools which are not selection tools (since they use `Shift` for adding to selection) nor edit tools.

8.8 Mediciones

8.8.1 Información general

QGIS provides four means of measuring geometries:

- the interactive measurement tools ,
- measuring in the Field Calculator,
- derived measures in the *Identify Features* tool,
- and a vector analysis tool: *Vector* → *Geometry Tools* → *Export/Add Geometry Columns*

Measuring works within projected coordinate systems (e.g., UTM) and unprojected data. The first three measuring tools behave equally to global project settings:

- If *"on the fly" CRS transformation* (see *Define On The Fly (OTF) CRS Transformation*) is enabled, the default measurement metric is - different from most other GIS - ellipsoidal, using the ellipsoid defined in *File* → *Project properties* → *General*. This is true both when geographic and projected coordinate systems are defined for the project.
- If you want to calculate the projected / planimetric area or distance using cartesian maths, the measurement ellipsoid has to be set to "None / Planimetric" (*File* → *Project properties* → *CRS*). However, with a geographic (= unprojected) CRS defined for the data and project, area and distance measurement will be ellipsoidal.
- If *"on the fly" CRS transformation* is disabled, the measurement metric is planimetric when the project coordinate system is projected and ellipsoidal when the project coordinate system is unprojected / geographic.

However, neither the identify tool nor the field calculator will transform your data to the project CRS before measuring. If you want to achieve this, you have to use the vector analysis tool: *Vector* → *Geometry Tools* → *Export/Add Geometry Columns*. Here, measurement is by default planimetric except if you choose the ellipsoidal measure.

8.8.2 Measure length, areas and angles interactive

Click the icon in the Attribute toolbar to begin measurements. The downward arrow near the icon helps you switch to the convenient tool to measure length, area or angle. The default unit used in the dialog is the one set in *Project* → *Project Properties* → *General* menu.

Nota: Configuring the measure tool

While measuring length or area, clicking the *Configuration* button at the bottom of the widget helps you define in menu *Settings* → *Options* → *Map Tools* the rubberband color, the precision of the measurements and the unit behavior. You can also choose your preferred measurement or angle units but keep in mind that those values are superseded in the current project by options made in *Project* → *Project Properties* → *General* menu.

All measuring modules use the snapping settings from the digitizing module (see section *Configurar la tolerancia del autoensamblado y radio de búsqueda*). So, if you want to measure exactly along a line feature, or around a polygon feature, first set its layer snapping tolerance. Now, when using the measuring tools, each mouse click (within the tolerance setting) will snap to that layer.

By default, Measure Line: QGIS measures real distances between given points according to a defined ellipsoid. The tool then allows you to click points on the map. Each segment length, as well as the total, shows up in the measure window. To stop measuring, click your right mouse button.

Note that you can use the drop-down list near the total to interactively change the measurement units while measuring. This unit is kept for the widget until a new or another project is opened.

The *Info* section in the dialog explains how calculations are made according to CRS settings available.

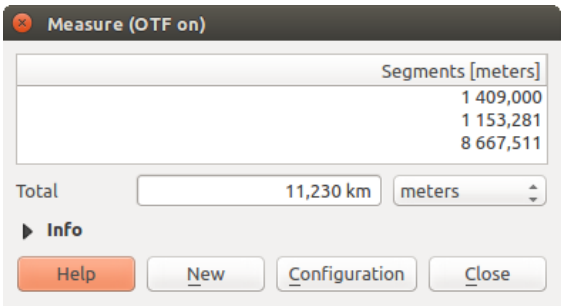


Figure 8.10: Medir Distancia

Measure Area: Areas can also be measured. In the measure window, the accumulated area size appears. Right-click to stop drawing. The Info section is also available as well as the ability to switch between different area units.

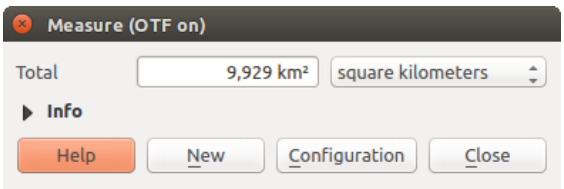


Figure 8.11: Medir Área

Measure Angle: You can also measure angles. The cursor becomes cross-shaped. Click to draw the first segment of the angle you wish to measure, then move the cursor to draw the desired angle. The measure is displayed in a pop-up dialog.

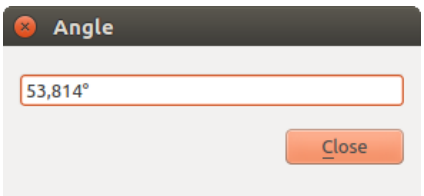


Figure 8.12: Medir Ángulo

8.9 Selecting features

QGIS provides several tools to select features in the map canvas. Selection tools are available in *View* → *Select* menu or in the *Attributes toolbar*.

Nota: Selection tools work with the currently active layer.

8.9.1 Selecting manually in the map canvas

To select one or several features with the mouse, you can use one of the following tools:

- Select Features by area or single click

-  Select Features by Polygon
-  Select Features by Freehand
-  Select Features by Radius

---

Nota: Except the  Select Features by Polygon tool, these manual selection tools allow you to select feature(s) in the map canvas with a single click.

While using the  *Select Feature(s)* tool, holding `Shift` or `Ctrl` toggles whether feature is selected (ie either adds to the current selection or remove from it).

For the other tools, different behaviors can be performed holding:

- `Shift`: add features to the current selection
- `Ctrl`: substract features from the current selection
- `Ctrl + Shift`: intersect with current selection, ie only keep overlapping features from the current selection
- `Alt`: select features that are totally within the selection shape. Combined to `Shift` or `Ctrl` keys, you can add or substract features to/from the current selection.

8.9.2 Selección automática

The other selection tools, also available from the *Attribute table*, perform a selection based on feature's attribute or its selection state (note that attribute table and map canvas show the same information, so if you select one feature in attribute table, it will be selected in map canvas also):

-  Select By Expression... allows user to select features using expression dialog.
-  Select Features By Value... or press `F3`
-  Deselect Features from All Layers or press `Ctrl+Shift+A` to deselect all selected features in all layers.
-  Select All Features or press `Ctrl+A` to select all features in the current layer.
-  Invert Feature Selection to invert the selection in the current layer.

For example, if you want to find regions that are boroughs from `regions.shp` of the QGIS sample data, you can use the  Select features using an Expression icon. Then, you open the *Fields and Values* menu and choose the field that you want to query. Double-click the field 'TYPE_2' and also click **[Load all unique values]** in the right panel. From the list, choose and double-click 'Borough'. In the *Expression* field, then you'd write the following query:

```
"TYPE_2"  =  'Borough'
```

From the expression builder dialog, you can also use the *Function list* → *Recent (Selection)* to make a selection that you used before. The dialog remembers the last 20 used expressions. See *Expresiones* chapter for more information and some example.

Truco: Save your selection into a new file

Users can save selected features into a **New Temporary Scratch Layer** or a **New Vector Layer** using *Edit* → *Copy Features* and *Edit* → *Paste Features as* in the wanted format.

8.9.3 Seleccionar objetos por valor

This selection tool opens the layer's feature form allowing the user to choose, for each field, which value to look for, if the search should be case sensitive, and the operation that should be used.

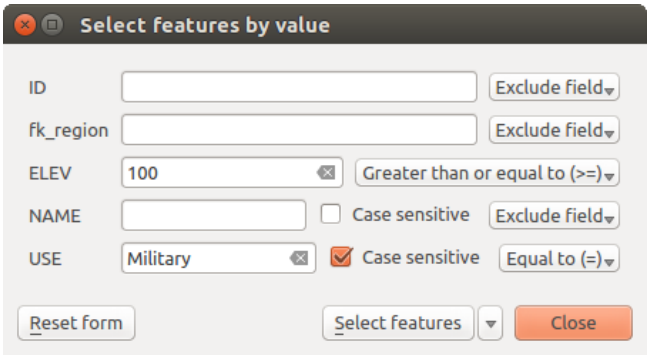


Figure 8.13: Filter/Select features using form dialog

Alongside each field, there is a drop-down list with the operation options to control the search behaviour. The common options are:

- *Exclude Field* - The field will not be used for searching
- *Igual a (=)*
- *Not equal to*
- *Falta (nulo)*
- *No Falta (no nulo)*

For numeric and datetime fields, the additional options are:

- *Mayor que (>)*
- *Menor que (<)*
- *Greater than or equal to (>=)*
- *Less than or equal to (<=)*
- *Entre (inclusivo)*
- *Is not between (inclusive)*

For text fields, the additional options are:

- *Contiene*
- *No contiene*

For the text options above, it is also possible to use the  *Case sensitive* option.

After setting all search options, you can use the *Select features* button to select the matching features. The drop-down options are:

- *Seleccionar objetos espaciales*
- *Añadir a una selección actual*
- *Filtrar la selección actual*
- *Eliminar de la selección actual*

You can also clean all search options using the *Reset form* button.

8.10 Configuración de anulación definida por datos

Beside many options in the vector layer properties dialog or settings in the print composer, you can find a  Data defined override icon. Thanks to *expressions* based on layer attributes or item settings, prebuild or custom functions and *variables*, this tool allows you to set dynamic value for the concerned parameter. When enabled, the value returned by this widget is applied to the parameter regardless its normal value (checkbox, textbox, slider...).

Clicking the  Data defined override icon shows following entries:

- *Description...* that indicates if the option is enabled, which input is expected, the valid input type and the current definition. Hovering over the widget also pops up these information;
- *Field type*: an entry to select from the layer's fields that match the valid input type;
- an entry to list the *Variable* available;
- *Edit...* button to create or edit the expression to use;
- *Paste* and *Copy* buttons;
- botón de *Limpiar* para eliminar la configuración.

Parameters that can be used with data-defined tools are:

- Style and symbols parameters
- Labels parameters
- Composer parameters

Truco: Use right-click to (de)activate the data overriding

You can enable or disable a configured  data-defined override button by simply clicking the widget with the mouse right button.

Nota: When the data-defined override option is setup correctly the icon is yellow  or  ; if it is broken, the icon is red  or  .

8.11 Identify Features

The Identify tool allows you to interact with the map canvas and get information on features in a pop-up window. To identify features, use:

- *View* → *Identify Features* menu,
- or press `Ctrl + Shift + I` (or `Cmd + Shift + I`),
- or click the  Identify Features icon on the Attributes toolbar.

8.11.1 Using the Identify Features tool

QGIS offers two ways to identify features with the  Identify Features tool:

- **left click** will identify features according to the mode set in the *Identify Results* panel
- **right click** will fetch all the snapped features from all the visible layers. This will open a context menu, allowing the user to choose more precisely the features to identify.

Truco: Filter the layers to query with the Identify Features tool

Uncheck the *Identifiable* column in *Project* → (or *Settings* →), *Project Properties* → *Identify layers* menu in front of a layer to avoid it being queried when using the Identify Features in a mode other than **Current Layer**. This is a handy way to return features from only layers that are of interest for you.

If you click on feature(s), the *Identify Results* dialog will list information about the clicked feature(s). The default view is a tree view where the first item is the name of the layer and its children are its identified feature(s). Each feature is described by the name of a field along with its value. This field is the one set in *Layer Properties* → *Display*. Then follows all the other information about the feature.

8.11.2 Feature informations

The Identify Results dialog can be customized to display custom fields, but by default it will display three kinds of information:

- **Actions**: Actions can be added to the identify feature windows. The action is run by clicking on the action label. By default, only one action is added, namely `View feature form` for editing. You can define more actions in the layer's properties dialog (see *Propiedades de acciones*).
- **Derived**: This information is calculated or derived from other information. This includes:
  - general information about the feature and its geometry: feature id, length or perimeter and area in map units depending on its geometry, the count of spatial parts and the number of the clicked part in case of multi-geometry, the count of vertices in the feature and the number of the closest one to the point clicked
  - coordinates information: the X and Y (and Z/M if available) coordinate values of the clicked point, the feature closest vertex and its first and last vertices. In case you click on a curved line using the info tool, QGIS will also display the radius of that section in the panel result.
- **Data attributes**: This is the list of attribute fields and values for the feature that has been clicked.

Nota: Links in feature's attributes are clickable from the *Identify Results* panel and will open in your default web browser.

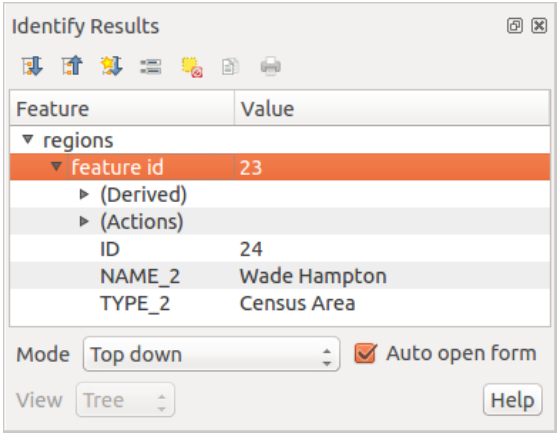


Figure 8.14: Dialogo de resultados de la identificación

8.11.3 The Identify Results dialog

At the top of the window, you have seven icons:

-  Expand tree
-  Collapse tree
-  Default behavior to define whether next identified features information should be collapsed or expanded
-  View the feature form
-  Clear Results
-  Copy selected feature to clipboard
-  Print selected HTML response

At the bottom of the window, you have the *Mode* and *View* comboboxes. With the *Mode* combobox you can define from which layers features should be identified:

- **Current layer** : only features from the selected layer are identified. The layer may not be visible in the canvas.
- **Top down, stop at first**: for only features from the upper visible layer.
- **Top down**: for all features from the visible layers. The results are shown in the panel.
- and **Layer selection**: opens a context menu where the user selects the layer to identify features from. Operates like a right-click. Only the chosen features will be shown in the result panel.

Nota: Identify tool configuration

You can configure the identify feature in *Project* → *Project Properties* in the *Identify layers* tab. The table allows user to select layer(s) that can be used by this tool to identify features (column *Identifiable*). You can also put this layer in read-only mode with the checkbox in the last column.

The *View* can be set as **Tree**, **Table** or **Graph**. 'Table' and 'Graph' views can only be set for raster layers.

The identify tool allows you to  *Auto open a form*. If checked, each time a single feature is identified QGIS will open a form showing its attributes. This is a handy way to quickly edit a feature's attributes.

Otras funciones se pueden encontrar en el menú contextual del elemento identificado. Por ejemplo, del menú contextual se puede:

- Ver el formulario del objeto espacial
- Zum a objeto espacial
- Copiar objeto espacial: Copiar toda la geometría y atributos del objeto espacial
- Toggle feature selection: Adds identified feature to selection
- Copiar el valor del atributo: copiar solo el valor del atributo sobre el cual se hizo clic
- Copiar atributos del objeto espacial: Copiar atributos del objeto espacial
- Limpiar resultados: quitar resultados de la ventana
- Limpiar resaltados: Deseleccionar los objetos espaciales en el mapa
- Resaltar todo
- Resaltar capa
- Activar capa: Elegir una capa para ser activada
- Propiedades de la capa: Abrir la ventana de propiedades de la capa.
- Expandir todo
- Colapsar todo

8.12 Herramientas de anotaciones

The Text Annotation tool in the attribute toolbar provides the possibility to place formatted text in a balloon on the QGIS map canvas. Use the *Text Annotation* tool and click into the map canvas.

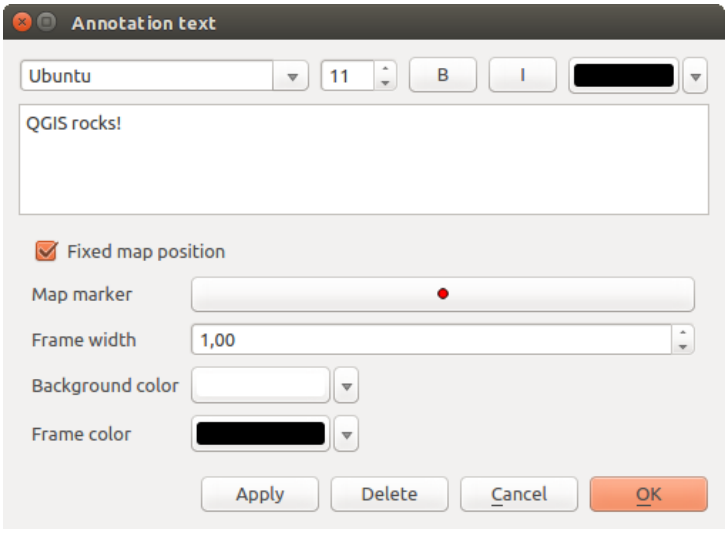


Figure 8.15: Diálogo de texto de anotación

Double clicking on the item opens a dialog with various options. There is the text editor to enter the formatted text and other item settings. For instance, there is the choice of having the item placed on a map position (displayed by a marker symbol) or to have the item on a screen position (not related to the map). The item can be moved by map position (by dragging the map marker) or by moving only the balloon. The icons are part of the GIS theme, and they are used by default in the other themes, too.

The Move Annotation tool allows you to move the annotation on the map canvas.

8.12.1 Html annotations

The Html Annotation tools in the attribute toolbar provides the possibility to place the content of an html file in a balloon on the QGIS map canvas. Using the *Html Annotation* tool, click into the map canvas and add the path to the html file into the dialog.

8.12.2 SVG annotations

The SVG Annotation tool in the attribute toolbar provides the possibility to place an SVG symbol in a balloon on the QGIS map canvas. Using the *SVG Annotation* tool, click into the map canvas and add the path to the SVG file into the dialog.

8.12.3 Form annotations

Additionally, you can also create your own annotation forms. The Form Annotation tool is useful to display attributes of a vector layer in a customized Qt Designer form (see figure_custom_annotation). This is similar to the designer forms for the *Identify features* tool, but displayed in an annotation item. Also see this video https://youtu.be/0pDBuSbQ02o?t=2m25s from Tim Sutton for more information.

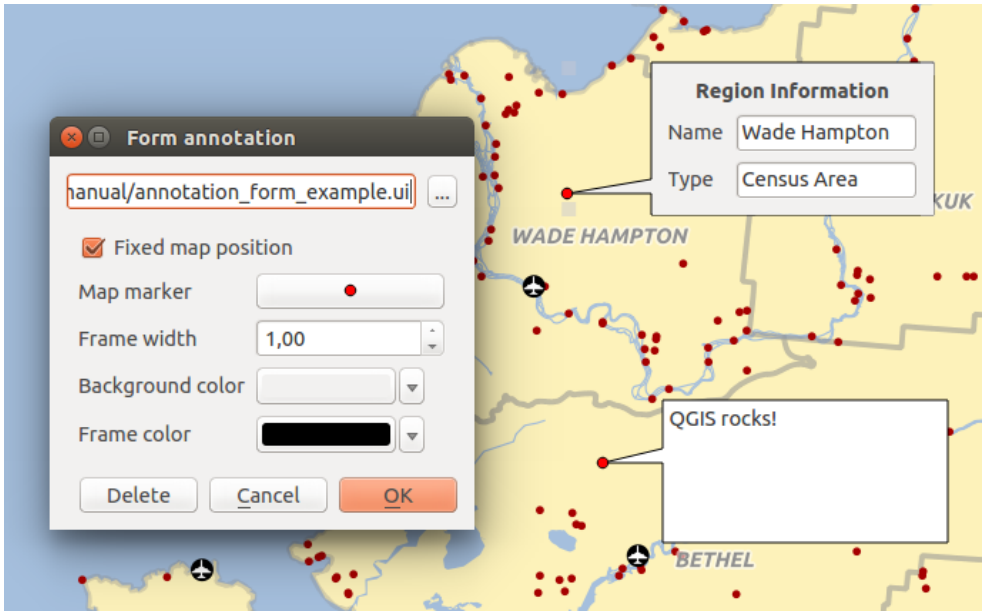


Figure 8.16: Customized qt designer annotation form

Nota: If you press `Ctrl+T` while an *Annotation* tool is active (move annotation, text annotation, form annotation), the visibility states of the items are inverted.

8.13 Marcadores espaciales

Spatial Bookmarks allow you to "bookmark" a geographic location and return to it later. By default, bookmarks are saved on the computer, meaning that they are available from any project in the same computer. If you wish to store the bookmark in the project file (`.qgs`) then you can do this by selecting the *In Project* checkbox.

8.13.1 Crear un marcador

Para crear un marcador:

1. Hacer zoom o desplazarse al área de interés.
2. Select the menu option *View* → *New Bookmark* or press `Ctrl-B`. The Spatial Bookmark panel opens with the newly created bookmark.
3. Introduzca un nombre descriptivo para el marcador (hasta 255 caracteres).
4. Check the *In Project* box if you wish to save the bookmark in the project file.
5. Press `Enter` to add the bookmark or click elsewhere.

Tenga en cuenta que puede tener múltiples marcadores con el mismo nombre.

8.13.2 Trabajar con marcadores

To use or manage bookmarks, select the menu option *View* → *Show Bookmarks*. The *Spatial Bookmarks* panel allows you to:

- Zoom to a Bookmark: select the desired bookmark and then click *Zoom To Bookmark*. You can also zoom to a bookmark by double-clicking on it.
- Delete a Bookmark: select the bookmark and click *Delete Bookmark*. Confirm your choice.

- Import or Export a bookmark: To share or transfer your bookmarks between computers you can use the *Import/Export Bookmarks* pull down menu in the *Spatial Bookmarks* dialog. All the bookmarks are transferred.

8.14 Anidar proyectos

Sometimes, you'd like to keep in different projects a bunch of layers with the same style. You can either create a *default style* for these layers or embed them from another project to save you tons of work.

Embed layers and groups from an existing project has some advantages over styling:

- all types of layers (vector or raster, local or online...) can be added
- fetching groups and layers, you can keep the same tree structure of the "background" layers in your different projects
- While the embedded layers are editable, you can't change their properties such as symbology, labels, forms, default values, actions... This ensures homogeneity throughout the projects
- modify the items in the original project and changes are propagated to all the other projects.

If you want to embed content from other project files into your project, select *Layer* → *Embed Layers and Groups* and:

1. Press ... to look for a project; you can see the content of the project (see figure_embed_dialog).
2. Press `Ctrl` (or `Cmd`) and click on the layers and groups you wish to retrieve.
3. Press **[OK]**. The selected layers and groups are embedded in the Layer panel and can be visualized in the map canvas now. Names of embedded items appear in italic to distinguish them from regular layers and groups.

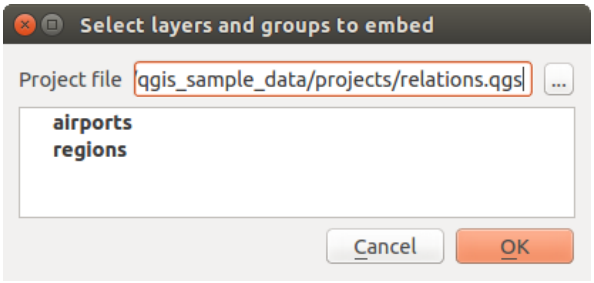


Figure 8.17: Seleccionar capas y grupos para empotrar

Like any other layer, an embedded layer can be removed from the project by right-click on the layer and choose Remove.

Truco: Change rendering of an embedded layer

It's not possible to change rendering of an embedded layer, unless you make the changes in the original project file. However, right-click on a layer and select *Duplicate* creates a layer which is fully-featured and not dependent to the original project. You can then safely remove the linked layer.

8.15 Elementos decorativos

The Decorations of QGIS include the Grid, the Copyright Label, the North Arrow and the Scale Bar. They are used to 'decorate' the map by adding cartographic elements.

8.15.1 Cuadrícula

 Cuadrícula permite agregar una rejilla de coordenadas y anotaciones a la vista del mapa.

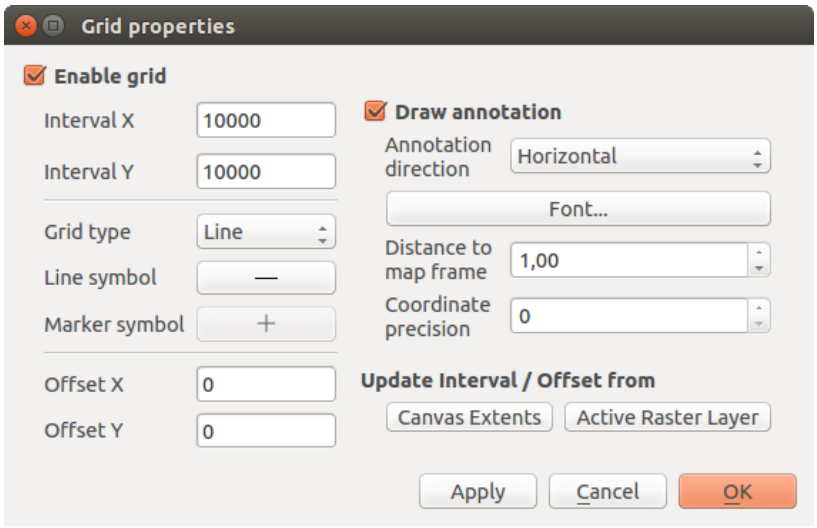


Figure 8.18: El Diálogo Cuadrícula

1. Select from menu *View* → *Decorations* → *Grid*. The dialog starts (see figure_decorations_grid).
2. Activate the  *Enable grid* checkbox and set grid definitions according to the layers loaded in the map canvas.
3. Activate the  *Draw annotations* checkbox and set annotation definitions according to the layers loaded in the map canvas.
4. Click **[Apply]** to verify that it looks as expected or **[OK]** if you're satisfied.

8.15.2 Etiqueta de derechos de autor

 Copyright label adds a copyright label using the text you prefer to the map.

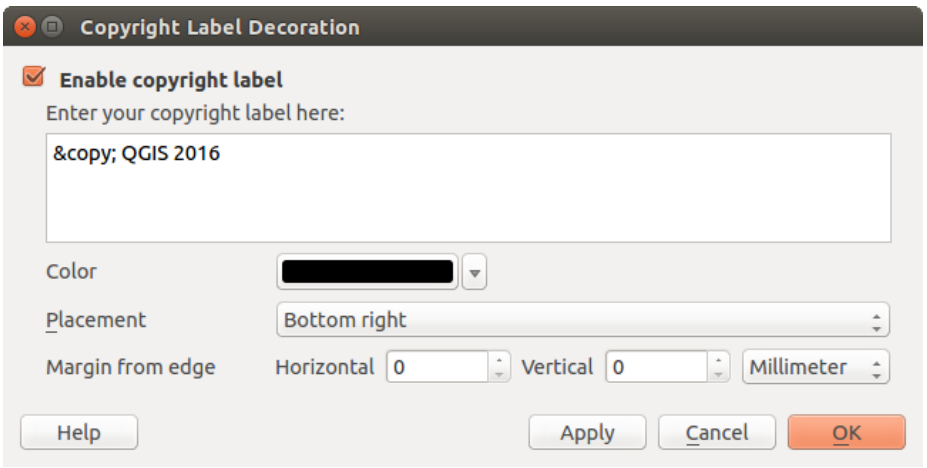


Figure 8.19: El Diálogo de Derechos de Autor

1. Select from menu *View* → *Decorations* → *Copyright Label*. The dialog starts (see figure_decorations_copyright).

2. Make sure the *Enable Copyright Label* checkbox is checked.
3. Enter the text you want to place on the map. You can use HTML as shown in the example.
4. Elegir la ubicación de la etiqueta en la lista desplegable *Ubicación*
5. You can refine the placement of the item by setting a Horizontal and/or Vertical *Marging from (Canvas) Edge*. These values can be a distance in **Millimeter** or **Pixels** or set as **Percentage** of the width or height of the map canvas.
6. You can change the color to apply.
7. Click **[Apply]** to verify that it looks as expected or **[OK]** if you're satisfied.

In the example above, which is the default, QGIS places a copyright symbol followed by the date in the lower right-hand corner of the map canvas.

8.15.3 Flecha del Norte

North Arrow places a simple north arrow on the map canvas. Currently, there is only one style available. You can adjust the angle of the arrow or let QGIS set the direction automatically. If you choose to let QGIS determine the direction, it makes its best guess as to how the arrow should be oriented. For placement of the arrow, you have four options, corresponding to the four corners of the map canvas. You can refine the placement of the arrow by setting a Horizontal and/or Vertical *Marging from (Canvas) Edge*. These values can be a distance in **Millimeter** or **Pixels** or set as **Percentage** of the width or height of the map canvas.

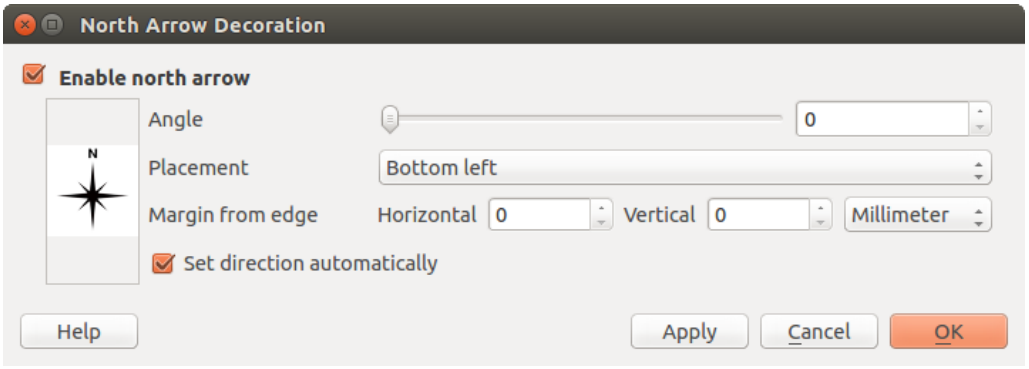


Figure 8.20: El Diálogo Flecha Norte

8.15.4 Barra de escala

Scale Bar adds a simple scale bar to the map canvas. You can control the style and placement, as well as the labelling of the bar.

QGIS only supports displaying the scale in the same units as your map frame. So if the units of your layers are in meters, you can't create a scale bar in feet. Likewise, if you are using decimal degrees, you can't create a scale bar to display distance in meters.

Para añadir una barra de escala:

1. Select from menu *View* → *Decorations* → *Scale Bar*. The dialog starts (see figure_decorations_scale).
2. Make sure the *Enable scale bar* checkbox is checked.
3. Choose the style from the *Scale bar style* combo box.
4. Select the color for the bar *Color of bar* or use the default black color.

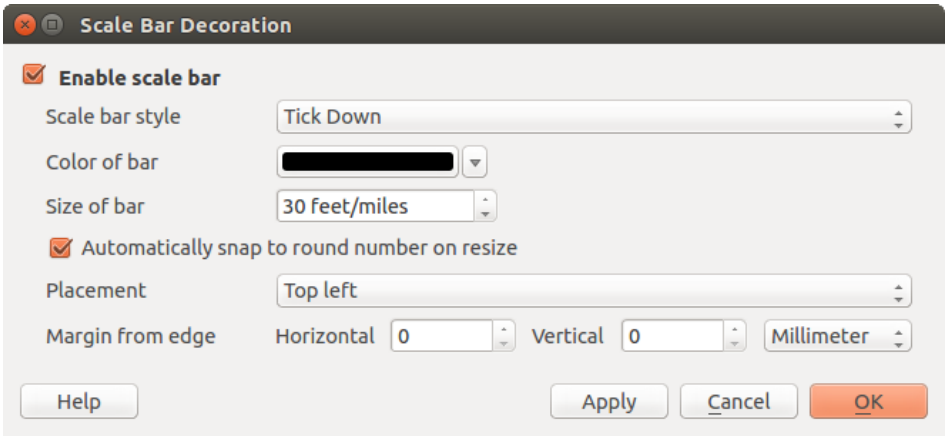


Figure 8.21: El Diálogo Barra de Escala

5. Set the *Size of bar* 1,00 .
6. Optionally, check *Automatically snap to round number on resize* to display values easy-to-read.
7. Choose the placement from the *Placement* combo box.
8. You can refine the placement of the item by setting a Horizontal and/or Vertical *Marging from (Canvas) Edge*. These values can be a distance in **Millimeter** or **Pixels** or set as **Percentage** of the width or height of the map canvas.
9. Click **[Apply]** to verify that it looks as expected or **[OK]** if you're satisfied.

Truco: Settings of Decorations

When you save a `.qgs` project, any changes you have made to Grid, North Arrow, Scale Bar and Copyright will be saved in the project and restored the next time you load the project.

8.16 Autenticación

QGIS has facility to store/retrieve authentication credentials in a secure manner. Users can securely save credentials into authentication configurations, which are stored in a portable database, can be applied to server or database connections, and safely referenced by their ID tokens in project or settings files. For more information see *Sistema de autenticación*.

A master password needs to be set up when initializing the authentication system and its portable database.

8.17 Variables

In QGIS, you can use variables to store useful recurrent values (e.g. the project's title, or the user's full name) that can be used in expressions. Variables can be defined at the application's global level, project level, layer level, composition level, and composer's item level. Just like CSS cascading rules, variables can be overwritten - e.g., a project level variable will overwrite any application's global level variables set with the same name. You can use these variables to build text strings or other custom expressions using the @ character before the variable name. For example in composer creating a label with this content:

```
This map was made using QGIS [% @qgis_version %]. The project file for this
map is: [% @project_path %]
```

Representará la etiqueta como ésta:

```
This map was made using QGIS 2.14. The project file for this map is:
/gis/qgis-user-conference-2015.qgs
```

Besides the *preset read-only variables*, you can define your own custom variables for any of the levels mentioned above. You can manage:

- **global variables** from the *Settings* → *Options* menu;
- **project's variables** from *Project properties* (see *Propiedades del proyecto*);
- **vector layer's variables** from the *Layer Properties* dialog (see *El Dialogo de las Propiedades del Vector*);
- **composition's variables** from the *Composition* panel in the Print composer (see *Composition Panel*);
- and **composer item's variables** from the *Item properties* panel in the Print composer (see *Composer Items Common Options*).

To differentiate from editable variables, read-only variable's names and values are emphasized in italic. On the other hand, higher level variables overwritten by lower level ones are strike through.

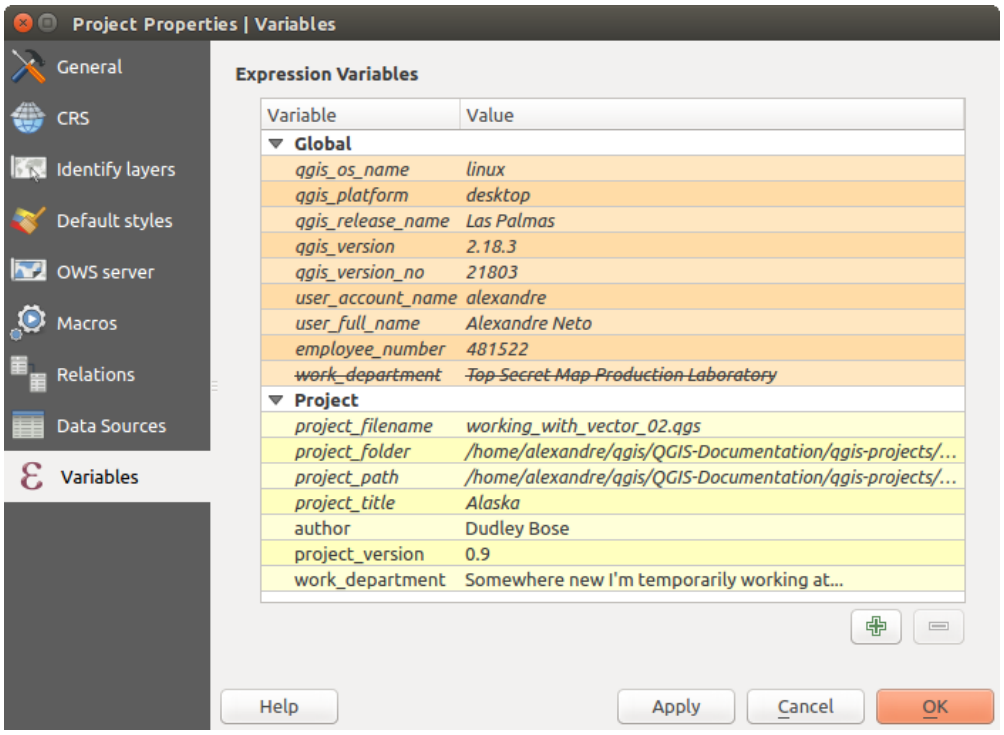


Figure 8.22: Variables editor at the project's level

Nota: You can read more about variables and find some examples in Nyall Dawson's Exploring variables in QGIS 2.12, part 1, part 2 and part 3 blog posts.

CHAPTER 9

Configuración QGIS

QGIS is highly configurable through the *Settings* menu. Choose between Options, Project Properties and Customization.

Nota: QGIS follows desktop guidelines for the location of options and project properties item. Consequently related to the OS you are using, location of some of items described below could be in the *Project* or the *Settings* menu.

9.1 Opciones

Some basic options for QGIS can be selected using the *Options* dialog. Select the menu option *Settings* → *Options*. You can modify the options according to your needs. Some of the changes may require a restart of QGIS before they will be effective.

The tabs where you can customize your options are described below.

9.1.1 Configuración general

Aplicación

- Select the *Style (QGIS restart required)* and choose between 'Oxygen', 'Windows', 'Motif', 'CDE', 'Plastique' and 'Cleanlooks'.
- Define the *Icon theme* . It can be 'default' or 'Night Mapping'.
- Define the *Icon size* .
- Define the *Font* and its *Size*. The font can be *Qt default* or a user-defined one.
- Change the *Timeout for timed messages or dialogs* .
- *Hide splash screen at startup*
- *Show tips at startup*
- *Check QGIS version at startup* to keep you informed if a newer version is released
- *QGIS-styled group boxes*
- *Use native color chooser dialogs* (see *Selector de color*)
- *Use live-updating color chooser dialogs* (see *Selector de color*)
- *Canvas rotation support (restart required)*

Los archivos de proyecto

- *Open project on launch* (choose between 'New', 'Most recent', 'Welcome Page', and 'Specific'). When choosing 'Specific' use the ... to define the project to use by default. The 'Welcome Page' displays a list of recent projects with screenshot.
- *Crear nuevo proyecto desde el proyecto predeterminado*. Tiene la posibilidad de presionar *Establecer el actual proyecto como predeterminado* o sobre *Restablecer el predeterminado*. Puede navegar a través de sus archivos y definir un directorio donde se encuentra las plantillas definidas por el usuario. Esto se añadirá a *Proyecto → Nueva plantilla de formulario*. Si activa primero *Crear nuevo proyecto desde proyecto predeterminado* y entonces guarde un proyecto en l la carpeta de las plantillas de proyecto.
- *Prompt to save project and data source changes when required*
- *Pedir confirmación cuando se va a eliminar una capa*
- *Warn when opening a project file saved with an older version of QGIS*
- *Enable macros* . This option was created to handle macros that are written to perform an action on project events. You can choose between 'Never', 'Ask', 'For this session only' and 'Always (not recommended)'.

9.1.2 System Settings

SVG paths

Add or Remove *Path(s) to search for Scalable Vector Graphic (SVG) symbols*. These SVG files are then available to symbolize features or decorate your map composition.

Rutas de complemento

Add or Remove *Path(s) to search for additional C++ plugin libraries*

QSettings

It helps you *Reset user interface to default settings (restart required)* if you made any *customization*.

Entorno

Variables de entorno del sistema ahora se puede ver, y muchos lo configuran en el grupo **Entorno** (ver figure_environment_variables). Esto es útil para las plataformas, como Mac, donde una aplicación GUI no heredan necesariamente entorno del casco del usuario. También es útil para configurar y visualizar las variables de entorno para los conjuntos de herramientas externas controladas por la caja de herramientas de procesamiento (por ejemplo, SAGA, GRASS), y para activar la salida de depuración para secciones específicas del código fuente.

- *Use custom variables (restart required - include separators)*. You can **[Add]** and **[Remove]** variables. Already-defined environment variables are displayed in *Current environment variables*, and it's possible to filter them by activating *Show only QGIS-specific variables*.

9.1.3 Data Sources Settings

Atributos de entidades espaciales y tabla

- *Open attribute table in a dock window*
- *Copy features as* 'Plain text, no geometry', 'Plain text, WKT geometry', or 'GeoJSON' when pasting features in other applications.
- *Attribute table behavior* : set filter on the attribute table at the opening. There are three possibilities: 'Show all features', 'Show selected features' and 'Show features visible on map'.

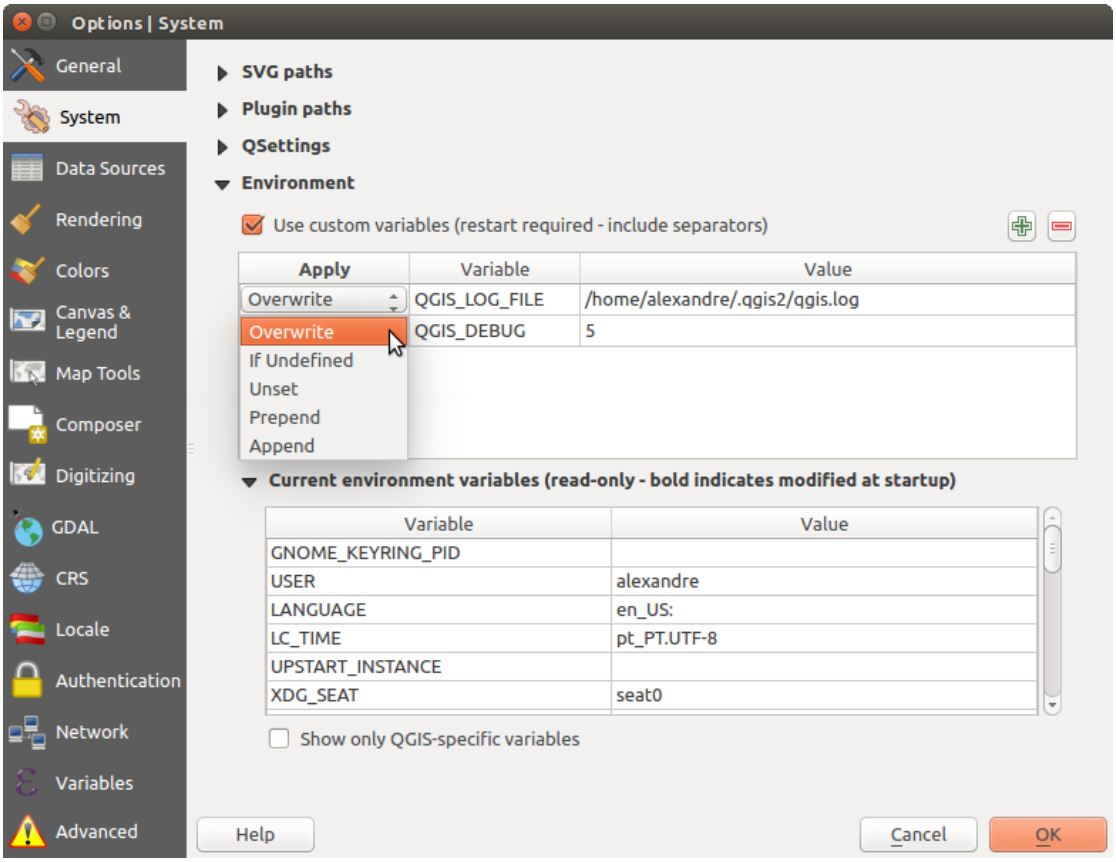


Figure 9.1: Variables del ambiente del sistema en QGIS

- *Default view*: define the view mode of the attribute table at every opening. It can be 'Remember last view', 'Table view' or 'Form view'.
- *Attribute table row cache* 1,00. This row cache makes it possible to save the last loaded N attribute rows so that working with the attribute table will be quicker. The cache will be deleted when closing the attribute table.
- *Representación de valores NULOS*. Aquí, puede definir un valor para los datos de campos que tienen un valor NULO.

Truco: Improve opening of big data attribute table

When working with layers with big amount of records, opening the attribute table may be slow as the dialog request all the rows in the layer. Setting the *Attribute table behavior* to **Show features visible on map** will make QGIS request only the features in the current map canvas when opening the table, allowing a quick data loading.

Note that data in this attribute table instance will be always tied to the canvas extent it was opened with, meaning that selecting **Show All Features** within such a table will not display new features. You can however update the set of displayed features by changing the canvas extent and selecting **Show Features Visible On Map** option in the attribute table.

Manejo de fuente de datos

- *Scan for valid items in the browser dock* ... . You can choose between 'Check extension' and 'Check file contents'.
- *Scan for contents of compressed files (.zip) in browser dock* ... . 'No', 'Basic scan' and 'Full scan' are possible.
- *Solicitar subcapas raster al abrir*. Algunas subcapas raster soportadas — se les llama subdataset en GDAL. Un ejemplo son los archivos netCDF — si hay muchos variables netCDF, GDAL ve cada variable como un

subconjunto de datos. La opción le permite controlar cómo lidiar con subcapas cuando se abre un archivo con subcapas. Dispone de las siguientes opciones:

- 'Siempre': Siempre preguntar (Si hay subcapas existentes)
- 'Si es necesario': Preguntar si la capa no tiene bandas, pero tiene subcapas
- 'Nunca': Nunca preguntar, no se cargará nada
- 'Cargar todo': Nunca preguntar, pero cargar todas las subcapas

- ☑ *Ignore shapefile encoding declaration*. If a shapefile has encoding information, this will be ignored by QGIS.
- ☑ *Añadir capas PostGIS con doble clic y seleccionar en modo extendido*
- ☑ *Añadir capas de Oracle con doble clic y seleccionar en modo extendido*
- ☑ *Ejecutar expresiones en el lado del servidor si es posible*

Hidden Browser Path

This widget lists all the folder you chose to hide from the Browser panel. Removing a folder from the list will make it available in the Browser panel.

9.1.4 Rendering Settings

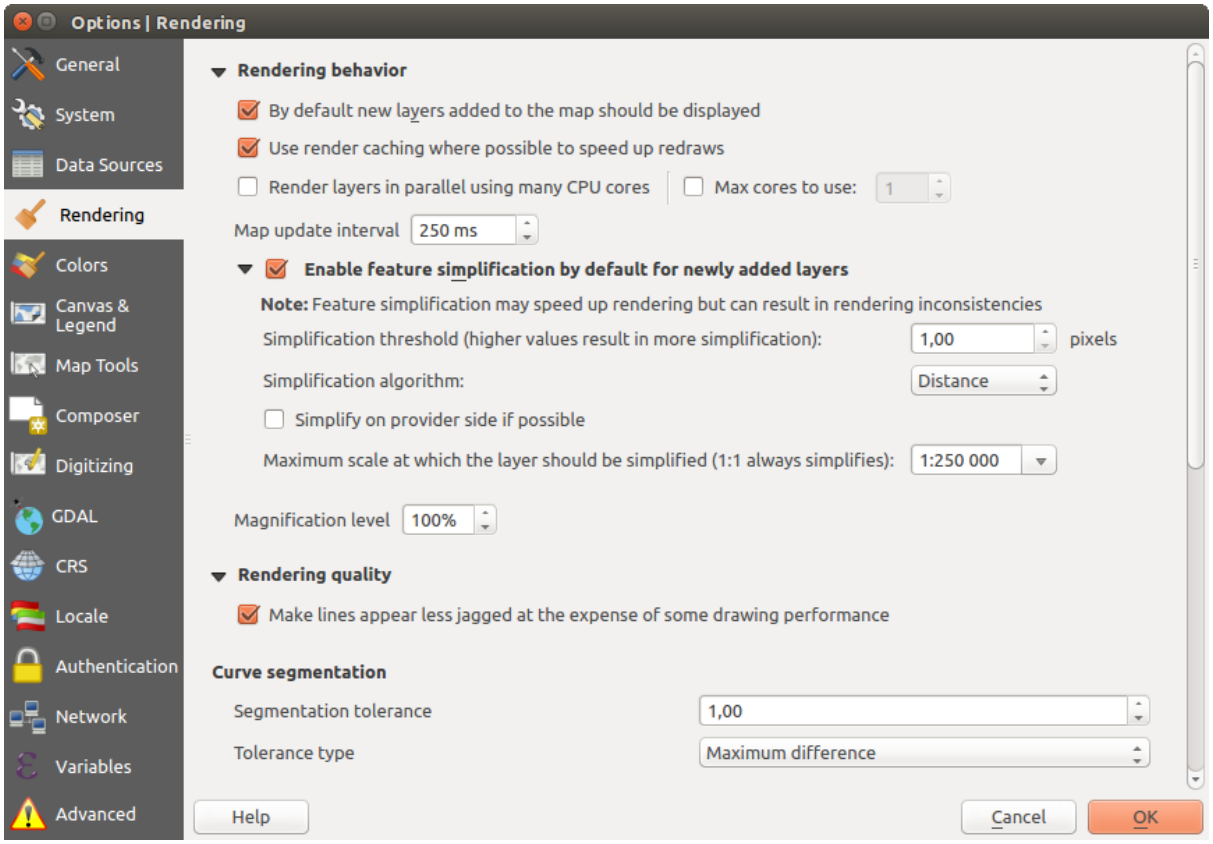


Figure 9.2: Rendering tab of Project Properties dialog

Comportamiento de presentación

- ☑ *By default new layers added to the map should be displayed*
- ☑ *Utilizar el cacheo de presentación en lo posible a la velocidad de regeneración*

- *Representación de capas en paralelo utilizando muchos núcleos CPU*
- *Máximo de núcleos a utilizar*
- *Intervalo de actualización del mapa (por defecto 250 ms)*
- *Habilitar simplificación de objetos espaciales por defecto a las nuevas capas añadidas*
- *Simplificación del umbral*
- *Simplification algorithm*: This option performs a local "on-the-fly" simplification on feature's and speeds up geometry rendering. It doesn't change the geometry fetched from the data providers. This is important when you have expressions that use the feature geometry (e.g. calculation of area) - it ensures that these calculations are done on the original geometry, not on the simplified one. For this purpose, QGIS provides three algorithms: 'Distance' (default), 'SnapToGrid' and 'Visvalingam'.
- *Simplify on provider side if possible*: the geometries are simplified by the provider (PostGIS, Oracle...) and unlike the local-side simplification, geometry-based calculations may be affected
- *Escala máxima a la que la capa se debe simplificar*
- *Magnification level* (see the *magnifier*)

Nota: Besides the global setting, feature simplification can be set for any specific layer from its *Layer properties* → *Rendering* menu.

Calidad de representación

- *Hacer que las líneas se muestren menos quebradas a expensas del rendimiento de la representación*

Curve segmentation

- *Segmentation tolerance*: this setting controls the way circular arcs are rendered. **The smaller** maximum angle (between the two consecutive vertices and the curve center, in degrees) or maximum difference (distance between the segment of the two vertices and the curve line, in map units), the **more straight line** segments will be used during rendering.
- *Tolerance type*: it can be 'Maximum angle' or 'Maximum distance'

Rásters

- Con *Selección de la banda RGB*, puede definir el numero para la banda Roja, Verde y Azul.

Mejora de contraste

- *Single band gray* . A single band gray can have 'No stretch', 'Stretch to MinMax', 'Stretch and Clip to MinMax' and also 'Clip to MinMax'.
- *Multi band color (byte/band)* . Options are 'No stretch', 'Stretch to MinMax', 'Stretch and Clip to MinMax' and 'Clip to MinMax'.
- *Multi band color (>byte/band)* . Options are 'No stretch', 'Stretch to MinMax', 'Stretch and Clip to MinMax' and 'Clip to MinMax'.
- *Limits (minimum/maximum)* . Options are 'Cumulative pixel count cut', 'Minimum/Maximum', 'Mean +/- standard deviation'.
- *Límite para corte del conteo acumulativo de píxeles*
- *Multiplicador de la desviación estándar*

Depuración

- *Map canvas refresh*

9.1.5 Colors Settings

This menu allows you to add some custom color that you can find in each color dialog window of the renderers. You will see a set of predefined colors in the tab: you can delete or edit all of them. Moreover you can add the color you want and perform some copy and paste operations. Finally you can export the color set as a `gpl` file or import them.

9.1.6 Canvas and Legend Settings

Default map appearance (overridden by project properties)

- Define a *Selection color* and a *Background color*.

Layer legend

- *Double click action in legend*  . You can either 'Open layer properties', 'Open attribute table' or 'Open layer styling dock' with the double click.
- The following *Legend item styles* are possible:
  -  *Capitalise layer names*
  -  *Bold layer names*
  -  *Bold group names*
  -  *Display classification attribute names*
  -  *Create raster icons (may be slow)*
  - you can also set the *WMS getLegendGraphic Resolution*

9.1.7 Map tools Settings

This tab offers some options regarding the behavior of the *Identify tool*.

- *Search radius for identifying and displaying map tips* is a tolerance distance within which the identify tool will depict results as long as you click within this tolerance.
- *Highlight color* allows you to choose with which color should features being identified be highlighted.
- *Buffer* determines a buffer distance to be rendered from the outline of the identify highlight.
- *Minimum width* determines how thick should the outline of a highlighted object be.

Herramienta de medición

- Definir *Color de la banda de medida* para herramienta de medida
- Definir *Lugares decimales*
-  *Keep base unit* to not automatically convert large numbers (e.g., meters to kilometers)
- *Preferred distance units*  ('Meters', 'Kilometers', 'Feet', 'Yards', 'Miles', 'Nautical Miles', 'Degrees' or 'Map Units')
- *Preferred area units*  ('Square meters', 'Square kilometers', 'Square feet', 'Square yards', 'Square miles', 'Hectares', 'Acres', 'Square nautical miles', 'Square degrees" or 'Map Units')
- *Preferred angle units*  ('Degrees', 'Radians', 'Gon/gradians', 'Minutes of arc', 'Seconds of arc' or 'Turns/revolutions')

Mover y zum

- Define a *Zoom factor* for zoom tools or wheel mouse

Escalas predefinidas

Here, you find a list of predefined scales. With the  and  buttons you can add or remove your personal scales. You can also import or export scales from/to a `.XML` file. Note that you still have the possibility to remove your changes and reset to the predefined list.

9.1.8 Composer Settings

Predeterminados de la composición

You can define the *Default font* used within the *print composer*.

Apariencia de la cuadrícula

- Definir el *Estilo de cuadrícula*  ('Sólido, 'Puntos', 'Cruces')
- Definir el *Color de la cuadrícula*

Valores predeterminados de la cuadrícula y guía

- Define the *Grid spacing* 
- Define the *Grid offset*  for x and y
- Define the *Snap tolerance* 

Composer Paths

- Define *Path(s) to search for extra print templates*: a list of folders with custom composer templates to use while creating new one.

9.1.9 Configuración de digitalización

This tab helps you configure general settings when *editing vector layer* (attributes and geometry).

Creación de entidades espaciales

-  *Suppress attribute form pop-up after feature creation*
-  *Reuse last entered attribute values*
- *Validar geometrías*. Editar lineas y polígonos complejos con muchos nodos puede resultar a una representación muy lenta. Esto se debe a los procesos de validación por defecto en QGIS puede tomar mucho tiempo. Para acelerar la representación, es posible seleccionar la validación de geometría GEOS (a partir de GEOS 3.3) o a pagarlo. La validación de geometría GEOS es mucho más rápido, pero la desventaja es que sólo el primer problema de geometría será reportado.

Banda de medición

- Define Rubberband *Line width*, *Line color* and *Fill color*
- *Don't update rubberband during node editing*

Autoensamblado

-  *Open snapping options in a dock window (QGIS restart required)*
- Define *Default snap mode*  ('To vertex', 'To segment', 'To vertex and segment', 'Off')
- Definir *Tolerancia de autoensamblado predeterminado* en unidades de mapa o píxeles
- Definir el *Radio de búsqueda para edición de vértices* en unidades de mapa o píxeles

Marcar vértices

-  *Mostrar marcadores sólo para los objetos espaciales seleccionados*

- Definir vértice *Estilo de marcador*  ('Cruz' (predeterminado), 'Círculo semitransparente' o 'Nada')
- Definir vértice *Tamaño de marcador*

Herramienta de desplazamiento de curva

The next 3 options refer to the  Offset Curve tool in *Digitalización avanzada*. Through the various settings, it is possible to influence the shape of the line offset. These options are possible starting from GEOS 3.3.

- *Join style*: 'Round', 'Mitre' or 'Bevel'
- *Segmentos del cuadrante*
- *Límite Miter*

9.1.10 Configuración de GDAL

GDAL es una biblioteca de intercambio de datos para archivos ráster. Es esta pestaña, puede *Editar opciones de creación* y *Editar opciones de pirámides* de los formatos ráster. Tu puedes definir que controlador GDAL se va a utilizar para un formato ráster, como en algunos casos más de un controlador está disponible.

9.1.11 Configuraciones SRC

Default CRS for new projects

-  *Don't enable 'on the fly' reprojection*
-  *Automatically enable 'on the fly' reprojection if layers have different CRS*
-  *Enable 'on the fly' reprojection by default*
- Select a CRS and *Always start new projects with this CRS*

SRC para nuevas capas

Esta área permite definir la acción a realizar cuando una nueva capa es creada, o cuando una capa sin SRC es cargada.

-  *Prompt for CRS*
-  *Use project CRS*
-  *Use default CRS*

Por defecto transformación de datum

-  *Ask for datum transformation when no default is defined*
- With the 'on-the-fly' CRS transformation enabled and the above option checked, adding layers of different CRS opens the *Select datum transformations* dialog. This offers you to select the most appropriate transformation settings. Validating this dialog with the 'Remember selection' option checked populates the table under *CRS → Default datum transformations* with information about 'Source CRS' and 'Destination CRS' as well as 'Source datum transform' and 'Destination datum transform'. From now, QGIS automatically uses the selected datum transformation for further transformation between these two CRSs until you  remove it from the list.

  You can use the  button to add a datum transformation if you know its parameters (source and destination ellipsoids and the numbers from the transformation table). You then need to manually enter each setting.

Nota: For more information on how QGIS handles layers projection, please read the dedicated section at *Trabajar con Proyecciones*.

9.1.12 Locale Settings

- *Override system locale* and *Locale to use instead*
- Information about active system locale

9.1.13 Authentication Settings

In the *Authentication* tab you can set authentication configurations and manage PKI certificates. See *Sistema de autenticación* for more details.

9.1.14 Network Tab

General

- Definir *Dirección de búsqueda de WMS*, por omisión es `http://geopole.org/wms/search?search=\%1\&type=`
- Definir *Expiró el tiempo para solicitudes de red* - por omisión 60000
- Define *Default expiration period for WMS Capabilities (hours)* - default is 24
- Definir *Periodo de expiración predeterminada para teselas WMS-C/WMTS (en horas)* - por omisión 24
- Define *Max retry in case of tile or feature request errors*
- Definir *Agente- Usuario*

Configuración de caché

Define the *Directory* and a *Size* for the cache.

- *Use proxy for web access* and define 'Host', 'Port', 'User', and 'Password'.
- Set the *Proxy type* according to your needs.
  - *Default Proxy*: Proxy is determined based on the application proxy set using
  - *Socks5Proxy*: Proxy genérico para cualquier tipo de conexión. Soporta TCP, UDP, unión a un puerto (conexiones entrantes) y autenticación.
  - *HttpProxy*: Implementado con el comando "CONNECT", sólo admite conexiones TCP salientes; admite la autenticación.
  - *HttpCachingProxy*: Implementando el uso de comandos HTTP normales, es útil sólo en el contexto de peticiones HTTP.
  - *FtpCachingProxy*: Implementar el uso de un proxy FTP, es útil sólo en el contexto de las peticiones FTP.

Excluir algunas URLs se puede agregar a la caja de texto debajo los valores del proxy (ver Figure_Network_Tab).

If you need more detailed information about the different proxy settings, please refer to the manual of the underlying QT library documentation at http://doc.qt.io/qt-4.8/qnetworkproxy.html#ProxyType-enum

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Truco: Utilizar proxies

Using proxies can sometimes be tricky. It is useful to proceed by 'trial and error' with the above proxy types, to check if they succeed in your case.

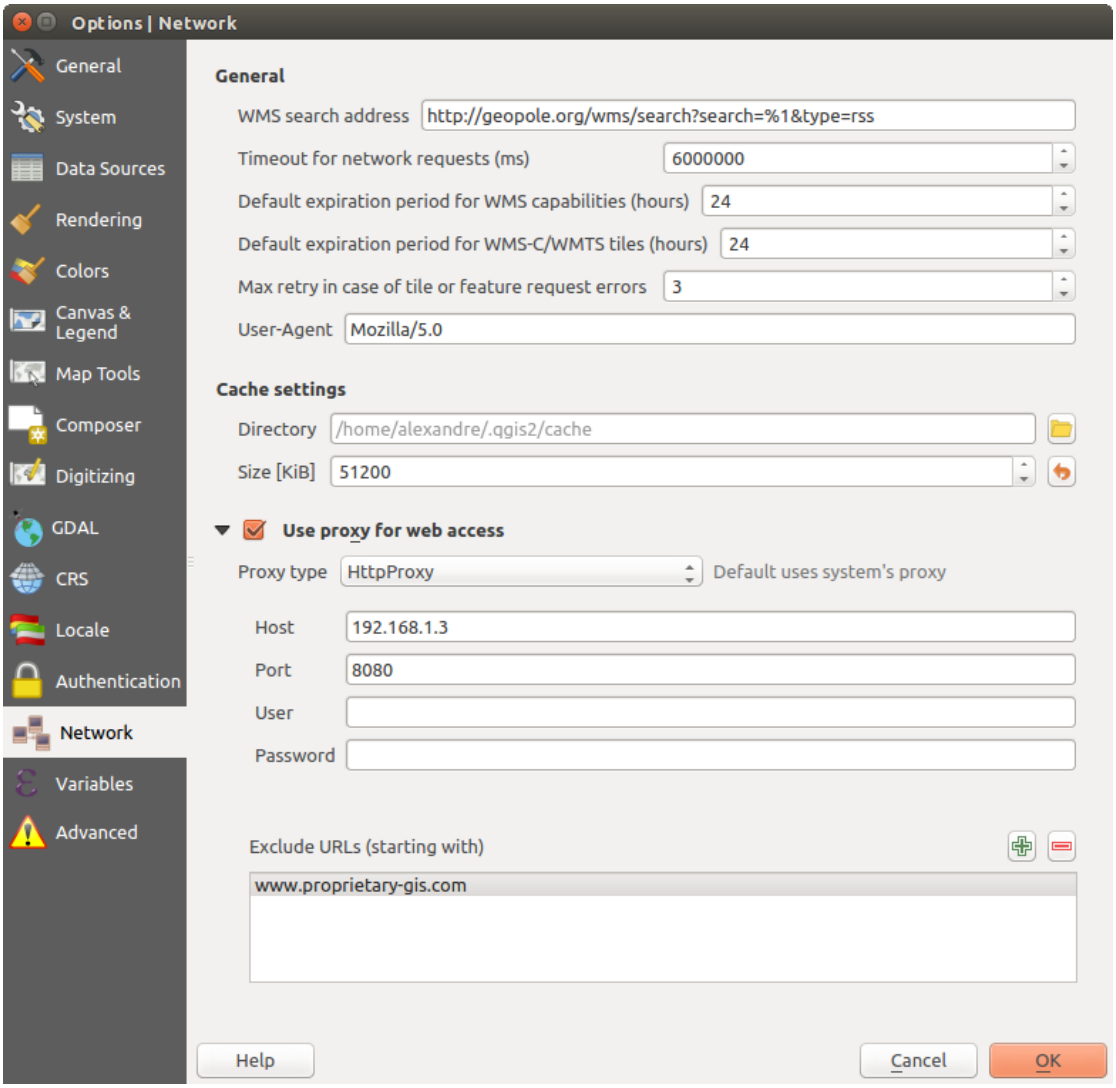


Figure 9.3: Configurar proxy en QGIS

9.1.15 Variables Settings

The *Variables* tab lists all the variables available at the global-level.

It also allows the user to manage global-level variables. Click the  button to add a new custom global-level variable. Likewise, select a custom global-level variable from the list and click the  button to remove it.

More information about variables in the *Variables* section.

9.1.16 Configuración avanzada

Depending on your OS, all the settings related to QGIS (UI, tools, data providers, default values, plugins options...) are saved:

-  in a text file: `$HOME/.config/QGIS/QGIS2.conf`
-  in the properties list file: `$HOME/Library/Preferences/org.qgis.qgis.plist`
-  in the registry under: `HKEY\CURRENT_USER\Software\QGIS\qgis`

The *Advanced* tab offers you in a single place, regardless your OS, means to manage these settings through the *Advanced Settings Editor*. After you promise to be careful, the widget is populated with a tree of all QGIS settings, which you can directly edit.

Advertencia: Avoid using the Advanced tab settings blindly
Be careful while modifying items in this dialog given that changes are automatically applied. Doing changes without knowledge can break your QGIS installation in various ways.

9.2 Propiedades del proyecto

In the properties window for the project under *Project* → *Project Properties* (or  *Settings* → *Project Properties*), you can set project-specific options.

The project-specific options overwrite their equivalent in the options described above.

- In the *General* tab, the **general settings** let you:
  - dé un texto al título del proyecto aparte de la ruta del archivo del proyecto
  - escoge el color a usar para objetos espaciales cuando son seleccionados
  - escoger el color de fondo: el color a usar para la tela de fondo del mapa
  - set whether the path to layers in the project should be saved as absolute (full) or as relative to the project file location. You may prefer relative path when both layers and project files can be moved or shared or if the project is accessed from computers on different platforms.
  - choose to avoid artifacts when project is rendered as map tiles. Note that checking this option can lead to performance degradation.

  Calculating areas and distances is a common need in GIS. However, these values are really tied to the underlying projection settings. The **Measurements** frame lets you control these parameters. You can indeed choose:
  - the ellipsoid to use: it can be an existing one, a custom one (you'll need to set values of the semi-major and semi-minor axis) or None/Planimetric.
  - the *units for distance measurements* for length and perimeter and the *units for area measurements*. These settings, which default to the units set in QGIS options but then overrides it for the current project, are used in:

* Attribute table field update bar
* Cálculos de calculadora de campo
* Identify tool derived length, perimeter and area values
* Default unit shown in measure dialog

The **Coordinate display** allows you to choose and customize the format of units to use to display the mouse coordinate in the status bar and the derived coordinates shown via the identify tool.

Finally, you can define a **project scale** list, which overrides the global predefined scales.

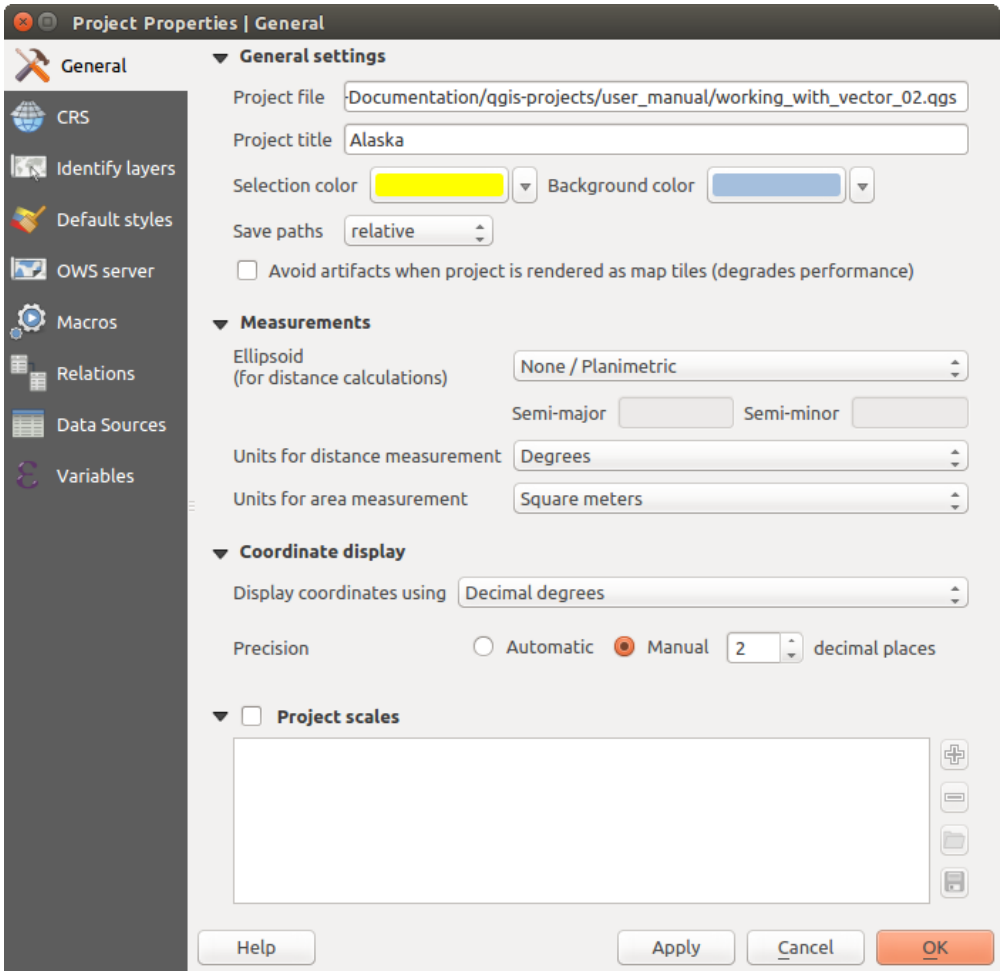


Figure 9.4: General tab of Project Properties dialog

- The *CRS* tab enables you to choose the Coordinate Reference System for this project, and to enable on-the-fly re-projection of raster and vector layers when displaying layers from a different CRS. For more information on projection's handling in QGIS, please read *Trabajar con Proyecciones* section.
- With the *Identify layers* tab, you set (or disable) which layers will respond to the *identify tool*. By default, layers are set queryable.

  You can also set whether a layer should appear as `read-only`, meaning that it can not be edited by the user, regardless of the data provider's capabilities. Although this is a weak protection, it remains a quick and handy configuration to avoid end-users modifying data when working with file-based layers.
- The *Default Styles* tab lets you control how new layers will be drawn when they do not have an existing `.qml` style defined. You can also set the default transparency level for new layers and whether symbols should have random colors assigned to them. There is also an additional section where you can define specific colors for the running project. You can find the added colors in the drop down menu of the color dialog window present in each renderer.

- The tab *OWS Server* allows you to configure your project in order to publish it online. Here you can define information about the QGIS Server WMS and WFS capabilities, extent and CRS restrictions. More information available in section *Prepare a project to serve* and subsequent.
- The *Macros* tab is used to edit Python macros for projects. Currently, only three macros are available: `openProject()`, `saveProject()` and `closeProject()`.

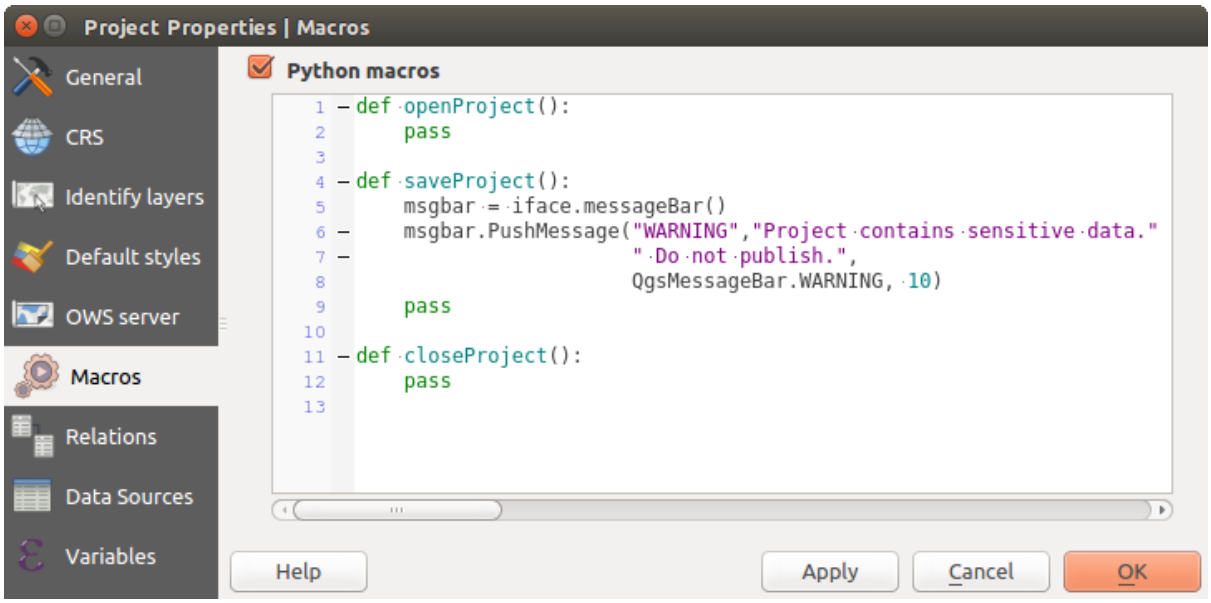


Figure 9.5: Definición macro en QGIS

- El panel:guilabel:*Relaciones* es utilizado para definir relaciones 1:n. Las relaciones están definidas en el diálogo de propiedades del proyecto. Una vez que existen las relaciones de una capa, un nuevo elemento de la interfaz de usuario en la vista del formulario (por ejemplo al identificar un elemento espacial y abrir el formulario) mostrará una lista de las entidades relacionadas. Este proporciona un poderosa forma para expresar, por ejemplo la inspección de la longitud de una tubería o el segmento de carretera. Se puede encontrar más información acerca de relaciones 1:n y soporte en la sección *Creating one or many to many relations*.
- In the *Data Sources* tab, you can:
  - *Evaluate default values on provider side*: When adding new features in a PostGreSQL table, fields with default value constraint are evaluated and populated at the form opening, and not at the commit moment. This means that instead of an expression like `nextval('serial')`, the field in the *Add Feature* form will display expected value (e.g., `25`).
  - *Automatically create transaction groups where possible*: When this mode is turned on, all (postgres) layers from the same database are synchronised in their edit state, i.e. when one layer is put into edit state, all are, when one layer is committed or one layer is rolled back, so are the others. Also, instead of buffering edit changes locally, they are directly sent to a transaction in the database which gets committed when the user clicks save layer. Note that you can (de)activate this option only if no layer is being edited in the project.
- The *Variables* tab lists all the variables available at the project's level (which includes all global variables). Besides, it also allows the user to manage project-level variables. Click the button to add a new custom project-level variable. Likewise, select a custom project-level variable from the list and click the button to remove it. More information on variables usage in the General Tools *Variables* section.

9.3 Personalización

The customization dialog lets you (de)activate almost every element in the QGIS user interface. This can be very useful if you want to provide your end-users with a 'light' version of QGIS, containing only the icons, menus or panels they need.

Nota: Antes de aplicar los cambios, debe reiniciar QGIS.

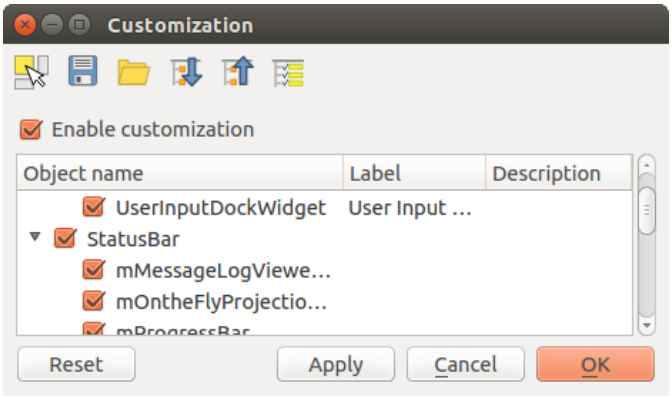


Figure 9.6: El diálogo de Personalización

Ticking the *Enable customization* checkbox is the first step on the way to QGIS customization. This enables the toolbar and the widget panel from which you can uncheck and thus disable some GUI items.

The configurable item can be:

- a **Menu** or some of its sub-menus from the *Barra de Menú*
- a whole **Panel** (see *Paneles y Barras de Herramientas*)
- the **Status bar** described in *Barra de Estado* or some of its items
- a **Toolbar**: the whole bar or some of its icons
- or any **widget** from any dialog in QGIS: label, button, combobox...

With Switch to catching widgets in main application, you can click on an item in QGIS interface that you want to be hidden and QGIS automatically unchecks the corresponding entry in the Customization dialog.

Once you setup your configuration, click **[Apply]** or **[Ok]** to validate your changes. This configuration becomes the one used by default by QGIS at the next startup.

The modifications can also be saved in a `.ini` file using Save To File button. This is a handy way to share a common QGIS interface among multiple users. Just click on Load from File from the destination computer in order to import the `.ini` file. You can also run *command line tools* and save various setups for different use cases as well.

Truco: Easily restore predefined QGIS

The initial QGIS GUI configuration can be restored by one of the methods below:

- unchecking *Enable customization* option in the Customization dialog or click the Check All button
- pressing the **[Reset]** button in the **QSettings** frame under *Settings* → *Options* menu, *System* tab
- launching QGIS at a command prompt with the following command line `qgis --nocustomization`
- setting to `false` the value of *UI* → *Customization* → *Enabled* variable under *Settings* → *Options* menu, *Advanced* tab (see the *warning*).

In most cases, you need to restart QGIS in order to have the change applied.

9.4 Atajos de teclado

QGIS provides default keyboard shortcuts for many features. You can find them in section *Barra de Menú*. Additionally, the menu option *Settings* → *Configure Shortcuts...* allows you to change the default keyboard shortcuts and add new keyboard shortcuts to QGIS features.

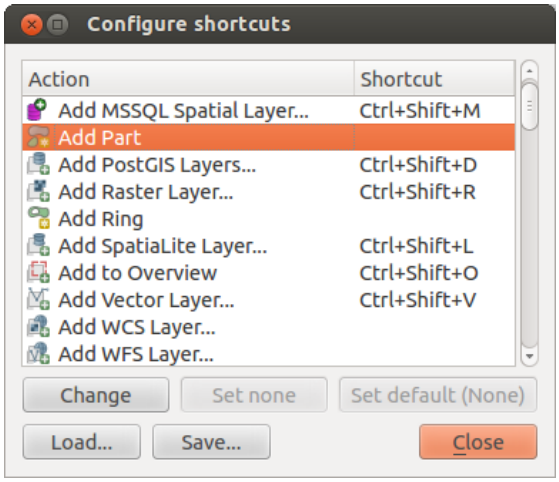


Figure 9.7: Define shortcut options

Configuration is very simple. Just select a feature from the list and click on :

- **[Change]** and press the new combination you want to assign as new shortcut
- **[Set none]** to clear any assigned shortcut
- or **[Set default]** to backup the shortcut to its original and default value.

Proceed as above for any other tools you wish to customize. Once you have finished your configuration, simply **[Close]** the dialog to have your changes applied. You can also **[Save]** the changes as an `.XML` file and **[Load]** them into another QGIS installation.

CHAPTER 10

Trabajar con Proyecciones

QGIS allows users to define a global and project-wide CRS (coordinate reference system) for layers without a pre-defined CRS. It also allows the user to define custom coordinate reference systems and supports on-the-fly (OTF) projection of vector and raster layers. All of these features allow the user to display layers with different CRSs and have them overlay properly.

10.1 Vista general de la ayuda de proyección

QGIS tiene ayuda para aproximadamente 2 700 SRC conocidos. Las definiciones para cada SRC esta almacenada en una base de datos SQLite que esta instalada con QGIS. Normalmente, no se necesita manipular la base de datos directamente. De hecho, si lo hace podría provocar que la ayuda de la proyección falle. Los SRC personalizados estan almacenados en una base de datos de usuario. Consulte la sección *Sistema de referencia de coordenadas personalizada* para obtener información sobre la gestión de su sistema de referencia de coordenadas personalizada.

Los SRC disponibles en QGIS se basan en los definidos por el European Petroleum Search Group (EPSG) y el Instituto Geográfico Nacional de Francia (IGNF) y se abstraen en gran parte de las tablas de referencia espaciales utilizados en GDAL. Los identificadores EPSG están presentes en la base de datos y se pueden utilizar para especificar un SRC en QGIS.

In order to use OTF projection, either your data must contain information about its coordinate reference system or you will need to define a global, layer or project-wide CRS. For PostGIS layers, QGIS uses the spatial reference identifier that was specified when the layer was created. For data supported by OGR, QGIS relies on the presence of a recognized means of specifying the CRS. In the case of shapefiles, this means a file containing the well-known text (WKT) specification of the CRS. This projection file has the same base name as the shapefile and a `.prj` extension. For example, a shapefile named `alaska.shp` would have a corresponding projection file named `alaska.prj`.

Whenever you select a new CRS, the layer units will automatically be changed in the *General* tab of the *Project Properties* dialog under the *Project* (or *Settings*) menu.

10.2 Especificar proyección global

QGIS starts each new project using the global default projection. The global default CRS is EPSG:4326 - WGS 84 (`proj=longlat +ellps=WGS84 +datum=WGS84 +no_defs`), and it comes predefined in QGIS. This default can be changed via the Select CRS button in the first section, which is used to define the default coordinate reference system for new projects, as shown in figure_projection_options. This choice will be saved for use in subsequent QGIS sessions.

When you use layers that do not have a CRS, you need to define how QGIS responds to these layers. This can be done globally or project-wide in the *CRS* tab under *Settings* → *Options*.

The options shown in figure_projection_options are:

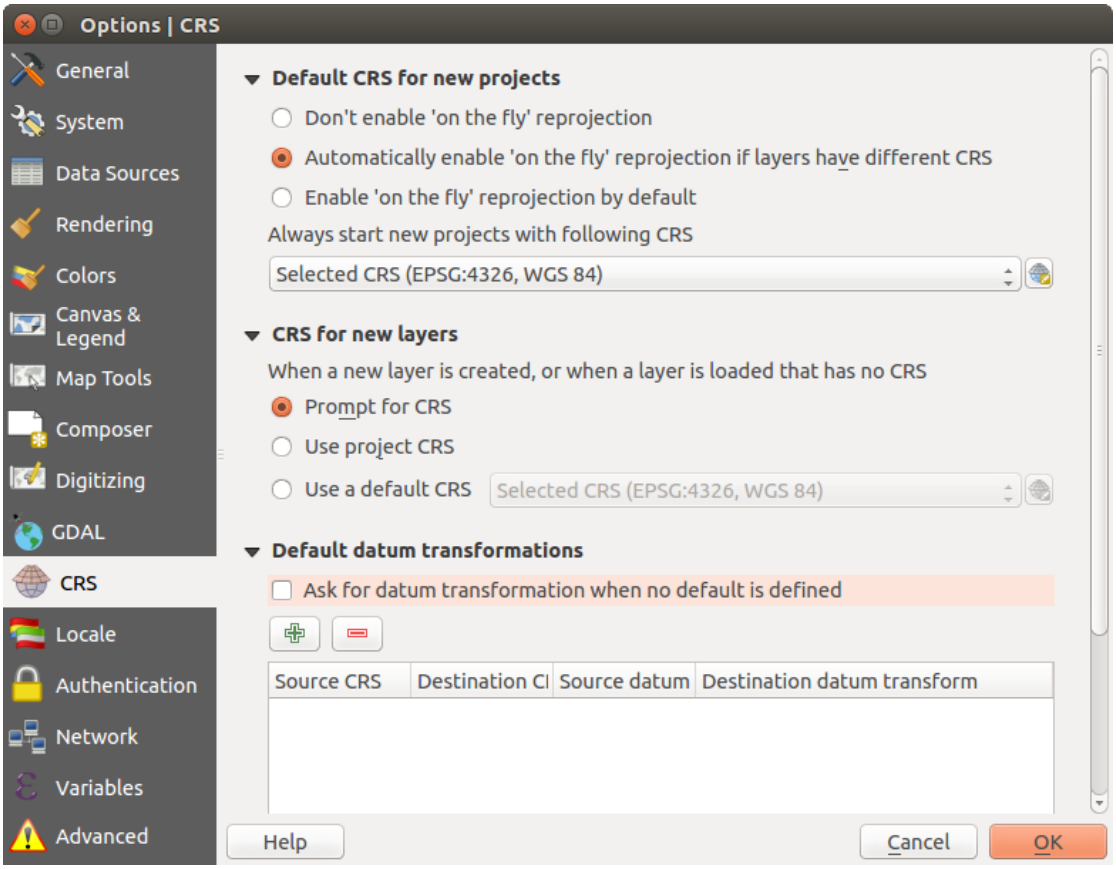


Figure 10.1: CRS tab in the QGIS Options Dialog

- *Prompt for CRS*
- *Use project CRS*
- *Usar SRC por omisión mostrado abajo*

If you want to define the coordinate reference system for a certain layer without CRS information, you can also do that in the *General* tab of the raster and vector properties dialog (see *General Properties* for rasters and *General Properties* for vectors). If your layer already has a CRS defined, it will be displayed as shown in *General tab in vector layers properties dialog*.

Truco: CRS in the Layers Panel

Right-clicking on a layer in the Layers Panel (section *Panel de capas*) provides two CRS shortcuts. *Set layer CRS* takes you directly to the Coordinate Reference System Selector dialog (see figure_projection_project). *Set project CRS from Layer* redefines the project CRS using the layer's CRS.

10.3 Define On The Fly (OTF) CRS Transformation

QGIS supports on the fly CRS transformation for both raster and vector data. However, OTF is not activated by default. When OTF is off, each layer is drawn using the coordinates as read from the data source. When OTF is on, each layer's coordinates are transformed to the CRS of the project.

There are three ways to enable On The Fly CRS Transformation:

- Select *Project Properties* → *CRS* from the *Project* (or *Settings*) menu. You can then activate the *Enable on the fly CRS transformation (OTF)* checkbox in the *CRS* tab and select the CRS to use

(see *Coordinate Reference System Selector*)

- Click on the CRS status icon in the lower right-hand corner of the status bar, leading you to the previous dialog.
- Turn OTF on by default in the *CRS* tab of the *Settings* → *Options* dialog by selecting *Enable 'on the fly' reprojection by default* or *Automatically enable 'on the fly' reprojection if layers have different CRS*.

If you have already loaded a layer and you want to enable OTF reprojection, the best practice is to open the *CRS* tab of the *Project Properties* dialog, activate the *Enable 'on the fly' CRS transformation* checkbox, and select a CRS. The CRS status icon will no longer be greyed out, and all layers will be OTF projected to the CRS shown next to the icon.

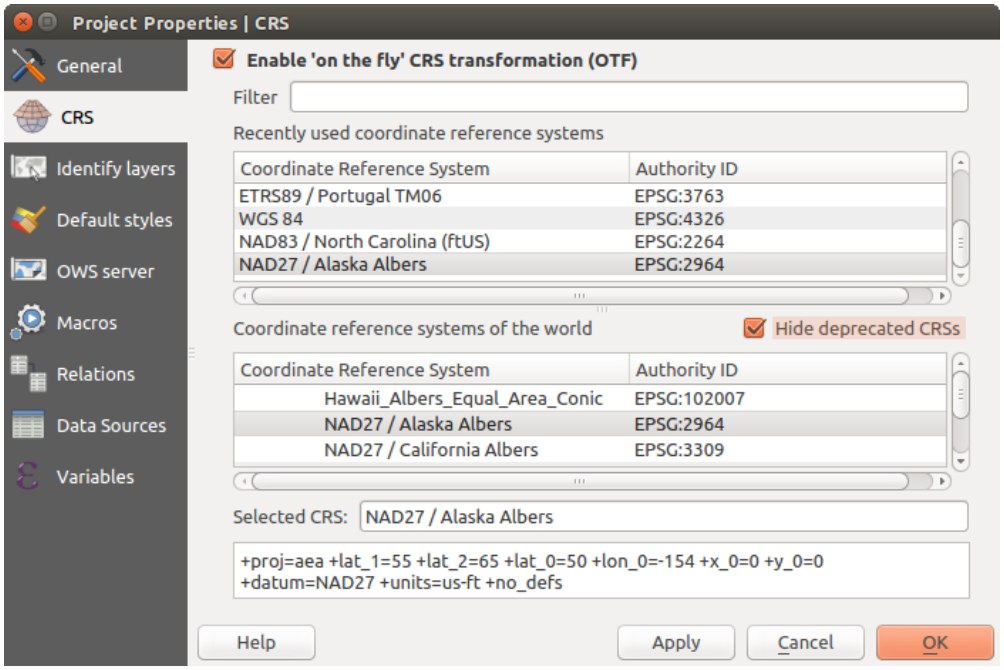


Figure 10.2: Diálogo de Propiedades del proyecto

10.4 Coordinate Reference System Selector

This dialog helps you assign a Coordinate Reference System to a project or a layer, provided a set of projection databases. Items in the dialog are:

- **Filter**: If you know the EPSG code, the identifier, or the name for a coordinate reference system, you can use the search feature to find it. Enter the EPSG code, the identifier or the name.
- **Recently used coordinate reference systems**: If you have certain CRSs that you frequently use in your everyday GIS work, these will be displayed in this list. Click on one of these items to select the associated CRS.
- **Coordinate reference systems of the world**: This is a list of all CRSs supported by QGIS, including Geographic, Projected and Custom coordinate reference systems. To define a CRS, select it from the list by expanding the appropriate node and selecting the CRS. The active CRS is preselected.
- **PROJ.4 text**: This is the CRS string used by the PROJ.4 projection engine. This text is read-only and provided for informational purposes.

Truco: Looking for a layer CRS? Use the CRS selector.

Sometimes, you receive a layer and you don't know its projection. Assuming that you have another layer with a valid crs that should overlaps with it, enable the OTF reprojection and, in the *General* tab of the Layer properties dialog, use the Coordinate Reference System selector to assign a projection. Your layer position is then moved accordingly. You may have to do some trial and error in order to find the right position, hence its original CRS.

Nota: When operating across layers, for example, computing intersections between two layers, it is important that both layers have the same CRS. To change the projection of an existing layer, it is **insufficient** to simply change the CRS in that layer's properties. Instead you must save the layer as a new layer, and choose the desired CRS for the new layer.

10.5 Sistema de referencia de coordenadas personalizada

Si QGIS no provee el sistema de referencia por coordenadas que necesita, puede definir un CRS predeterminado. Para definir un CRS, elegir *Custom CRS...* del menú *Ajustes*. CRSs personalizados se almacenan en su base de datos de usuario lqgl. A más del CRS personalizado, esta base de datos también contiene sus separadores espaciales y otros datos personalizados.

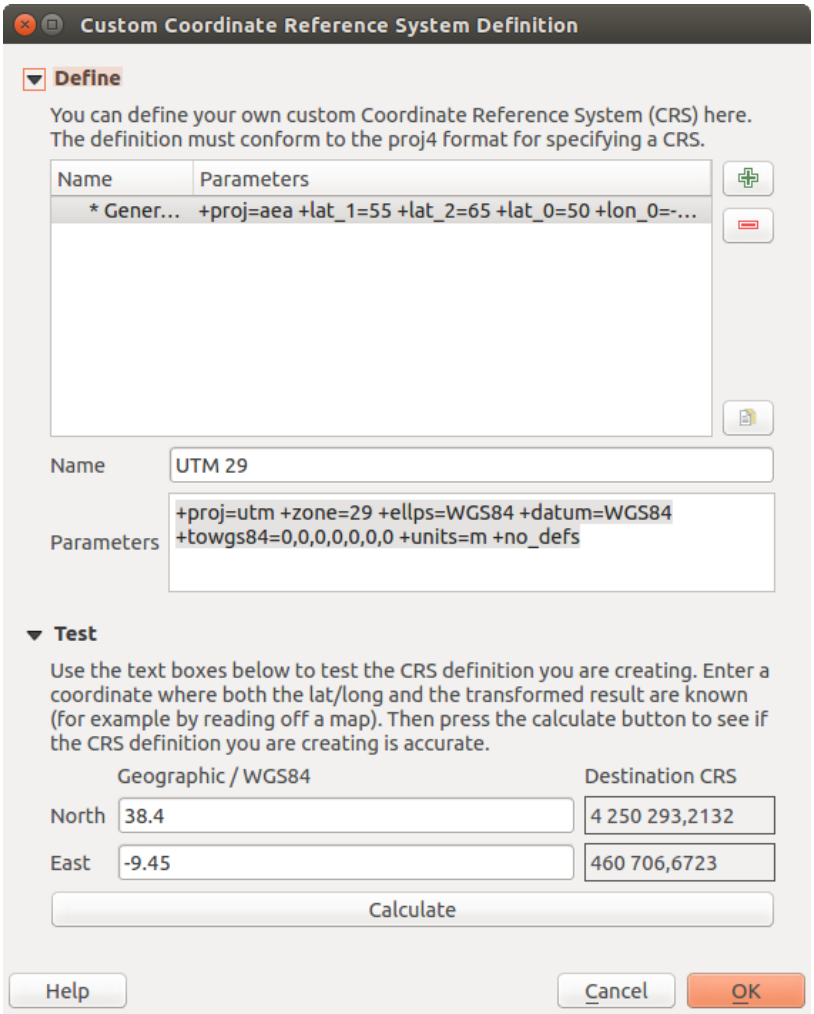


Figure 10.3: Diálogo SRC Personalizado

Definir un CRS personalizado en QGIS requiere un buen entendimiento de la librería de proyección PROJ.4. Para comenzar, referir a "Procedimientos de Proyección Cartográfica para el Entorno UNIX - Un Manual de Usuario"

por Gerald I Evenden, Reporte de Encuesta Geológica de Archivo Abierto U.S. 90-284, 1990 (disponible en ftp://ftp.remotesensing.org/proj/OF90-284.pdf).

This manual describes the use of the `proj.4` and related command line utilities. The cartographic parameters used with `proj.4` are described in the user manual and are the same as those used by QGIS.

El diálogo *Definición del Sistema de Referencia de Coordenadas personalizada* sólo necesita dos parámetros para definir un usuario de SRC:

1. Un nombre descriptivo
2. Los parámetros cartográficos en el formato PROJ.4

To create a new CRS, click the  Add new CRS button and enter a descriptive name and the CRS parameters.

Note que **:guilaber:'Parámetros'** debe empezar con un bloque "+proj=", para repersentar el nuevo sistema de referencia por coordenadas.

You can test your CRS parameters to see if they give sane results. To do this, enter known WGS 84 latitude and longitude values in *North* and *East* fields, respectively. Click on **[Calculate]**, and compare the results with the known values in your coordinate reference system.

10.6 Transformaciones de datos perdeterminadas

OTF depends on being able to transform data into a 'default CRS', and QGIS uses WGS84. For some CRS there are a number of transforms available. QGIS allows you to define the transformation used otherwise QGIS uses a default transformation.

In the *CRS* tab under *Settings* →  *Options* you can:

- set QGIS to ask you when it needs define a transformation using  *Ask for datum transformation when no default is defined*
- edit a list of user defaults for transformations.

QGIS asks which transformation to use by opening a dialogue box displaying PROJ.4 text describing the source and destination transforms. Further information may be found by hovering over a transform. User defaults can be saved by selecting  *Remember selection*.

CHAPTER 11

Administrar el origen de datos

11.1 Opening Data

As part of an Open Source Software ecosystem, QGIS is built upon different libraries that, combined with its own providers, offer capabilities to read and often write a lot of formats:

- Vector data formats include ESRI formats (shapefiles, geodatabases...), MapInfo and MicroStation file formats, AutoCAD DWG/DXF, GeoPackage, GeoJSON, GRASS, GPX, KML, Comma Separated Values, and many more... Read the complete list of OGR vector supported formats;
- Raster data formats include ArcInfo Binary Grid, ArcInfo ASCII Grid, JPEG, GeoTIFF, ERDAS IMAGINE, MBTiles, R or Idrisi rasters, ASCII Gridded XYZ, GDAL Virtual, SRTM, Sentinel Data, and many more... Read the complete list of raster supported formats;
- Database formats include PostgreSQL/PostGIS, SQLite/SpatiaLite, Oracle, DB2 or MSSQL Spatial, MySQL...;
- Support of web data services (WM(T)S, WFS, WCS, CSW, ArcGIS Servers...) is also handled by QGIS providers (see *QGIS como Cliente de Datos OGC*);
- You can also read supported files from archived folders and use QGIS native formats such as virtual and memory layers.

As of the date of this document, more than 80 vector and 140 raster formats are supported by the GDAL/OGR and QGIS native providers.

Nota: Not all of the listed formats may work in QGIS for various reasons. For example, some require external proprietary libraries, or the GDAL/OGR installation of your OS may not have been built to support the format you want to use. To have a list of available formats, run the command line `ogrinfo --formats` (for vector) or check *settings* → *Options* → *GDAL* menu (for raster) in QGIS.

11.1.1 The Browser Panel

QGIS Browser is one of the main panels of QGIS that lets you quickly and easily add your data to projects. It helps you navigate in your filesystem and manage geodata, regardless the type of layer (raster, vector, table), or the datasource format (plain or compressed files, database, web services).

To add a layer into a project:

1. right-click on QGIS toolbar and check *Browser Panel* to activate it or select it from the menu *View* → *Panels* (or *Settings* → *Panels*);
2. a browser tree with your filesystem, databases and web services is displayed;
3. find the layer in the list;

4. right-click on its name and select **Add selected layer(s)**. Your layer is now added to the *Layers Panel* and can be viewed in the *map canvas*.

Nota: You can also add a layer or open a QGIS project directly from the Browser panel by double-clicking its name or by drag-and-drop into the map canvas.

Once a file is loaded, you can zoom around it using the map navigation tools. To change the style of a layer, open the *Layer Properties* dialog by double clicking on the layer name or by right-clicking on the name in the legend and choosing *Properties* from the context menu. See section *Style Properties* for more information on setting symbology of vector layers.

At the top of the Browser panel, you find some icons that help you to:

-  Add Selected Layers: you can also add data into the map canvas by selecting **Add selected layer(s)** from the layer's context menu;
-  Refresh the browser tree;
-  Filter Browser to search for specific data. Enter a search word or wildcard and the browser will filter the tree to only show paths to matching DB tables, filenames or folders – other data or folders won't be displayed. See the Browser Panel(2) example on the figure_browser_panels. The comparison can be case-sensitive or not. It can also be set to:
  - **normal**: return any item containing the search text;
  - using **wildcard(s)**: fine tune the search using ? and/or * characters to specify the position of the search text;
  - empleando una **expresión regular**.
-  Collapse All the whole tree;
-  Enable/disable properties widget: when toggled on, a new widget is added at the bottom of the panel showing, if applicable, metadatas of the selected item.

Right-click an item in the browser tree helps you to:

- in case of file or table, display its metadata or open it in your project. Tables can even be renamed, deleted or truncated;
- in case of folder, bookmark it into your favourites, hide it from the browser tree. Hidden folders can be managed from the *Settings* → *Options* → *Data Sources* tab;
- create connection to databases or web servers;
- refresh, rename or delete schema.

You can also import files into databases or copy tables from one schema/database to another one with a simple drag-and-drop. There is a second browser panel available to avoid long scrolling while dragging. Just select the file and drag-and-drop from one panel to the other.

Truco: Add layers to QGIS by simple drag-and-drop from your OS file browser

You can also add file(s) to the project by drag-and-dropping them from your operating system file browser to the *Layers Panel* or the map canvas.

11.1.2 El gestor de Base de Datos

The *DB Manager* Plugin is another one of the main and native tools to integrate and manage spatial database formats supported by QGIS (PostGIS, SpatiaLite, GeoPackage, Oracle Spatial, MSSQL, DB2, Virtual layers) in one user interface. It can be activated from the *Plugins* → *Manage and Install Plugins...* menu.

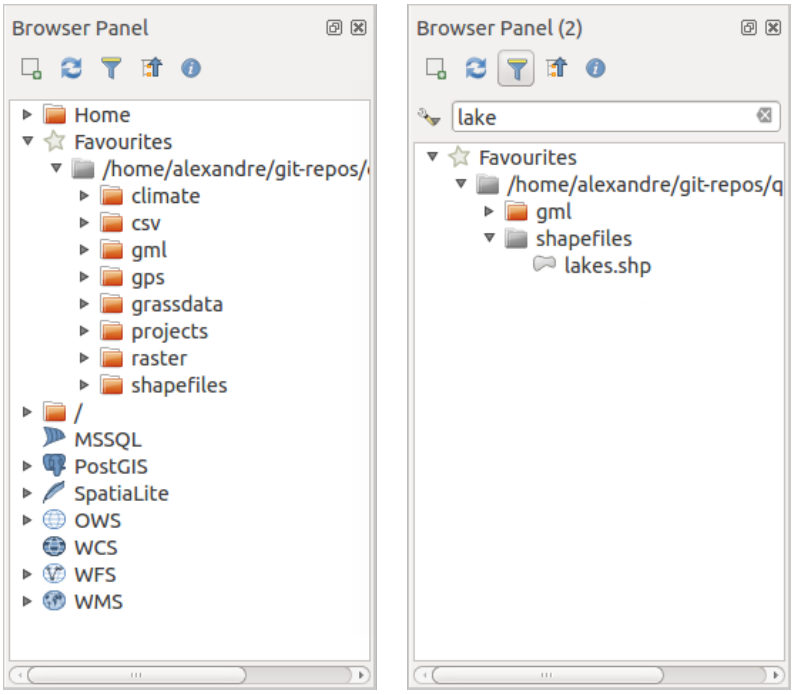


Figure 11.1: QGIS Browser panels side-by-side

The DB Manager Plugin provides several features:

- connect to databases and display its structure and contents;
- preview tables of databases;
- add layers to map canvas, either by double-click or drag-and-drop;
- add layers to a database from the QGIS Browser or from another database;
- create and add output of SQL queries to the map canvas;
- create *virtual layers*.

More information on DB Manager capabilities are exposed in *Complemento administrador de BBDD*.

11.1.3 Provider-based loading tools

Beside Browser Panel and DB Manager, the main tools provided by QGIS to add layers regardless the format, you'll also find tools that are specific to data providers.

Nota: Some *external plugins* also propose tools to open specific format files in QGIS.

Cargando una capa desde archivo

To load a layer from a file, you can:

- for vector data (like Shapefile, Mapinfo or dxf layer), click on Add Vector Layer toolbar button, select the *Layer* → *Add Layer* → *Add Vector Layer* menu option or press `Ctrl+Shift+V`. This will bring up a new window (see figure_vector_add) from which you can check *File* and click on **[Browse]**. You can also specify the encoding for the file if desired.

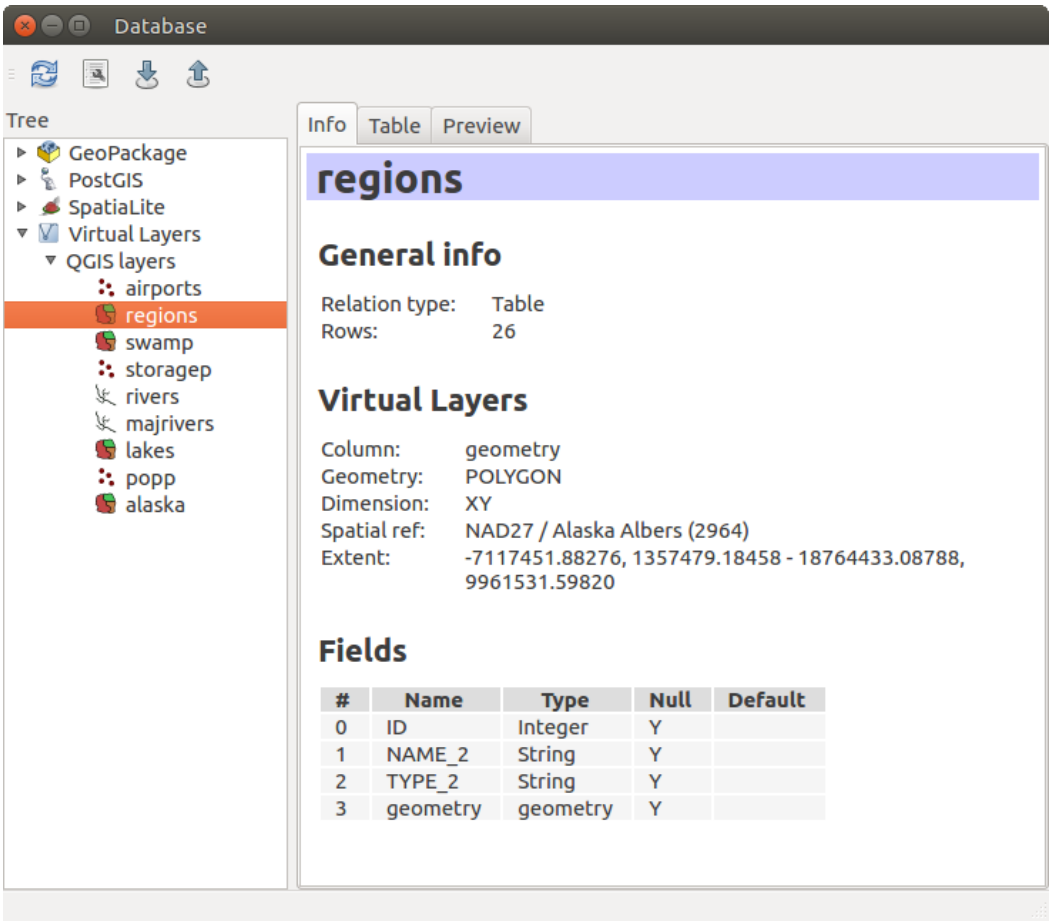


Figure 11.2: Diálogo del complemento administrador de BBDD

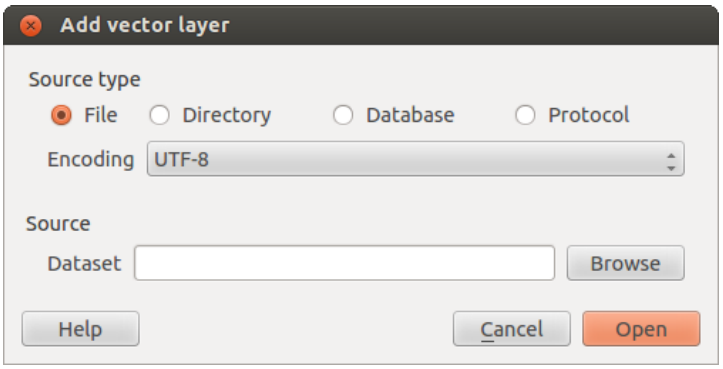


Figure 11.3: Diálogo de Añadir capa vectorial

- for raster layers, click on the Add Raster Layer icon, select the *Layer* → *Add Layer* → *Add Raster Layer* menu option or type `Ctrl+Shift+R`.

That will bring up a standard open file dialog (see figure_vector_open), which allows you to navigate the file system and load a shapefile, a geotiff or other supported data source. The selection box *Filter* allows you to preselect some supported file formats. Only the formats that have been well tested appear in the list. Other untested formats can be loaded by selecting `All files (*.*)`.

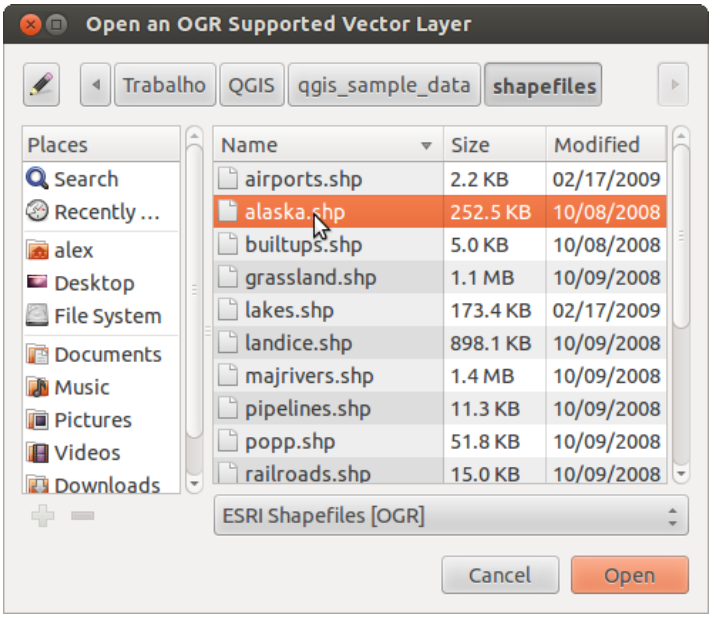


Figure 11.4: Abre un Diálogo de Capa Vectorial Soportada por OGR

Selecting a file from the list and clicking **[Open]** loads it into QGIS. More than one layer can be loaded at the same time by holding down the `Ctrl` or `Shift` key and clicking on multiple items in the dialog. Figure_vector_loaded shows QGIS after loading the `alaska.shp` file.

Nota: Because some formats like MapInfo (e.g., `.tab`) or Autocad (`.dxf`) allow mixing different types of geometry in a single file, loading such format in QGIS opens a dialog to select geometries to use in order to have one geometry per layer.

Using the Add Vector Layer tool:

- You can also load specific formats like `ArcInfo Binary Coverage`, `UK. National Transfer Format`, as well as the raw TIGER format of the `US Census Bureau` or `OpenfileGDB`. To do that, you'd need to select *Directory* as *Source type*. In this case a directory can be selected in the dialog after pressing **[Browse]**.
- With the *Database* source type you can select an existing database connection or create one to the selected database type. Available database types are `ODBC`, `OGDI Vectors`, `Esri Personal Geodatabase`, `MySQL` as well as `PostgreSQL` or `MSSQL`.

  Pressing the **[New]** button opens the *Create a New OGR Database Connection* dialog whose parameters are among the ones you can find in *Crear una conexión almacenada*. Pressing **[Open]** you can select from the available tables for example of the PostGIS enabled database.
- The last source type, *Protocol*, enables to open data from the web using for example `GeoJSON` or `CouchDB` format. After selecting the type you have to fill URI of the source.

Truco: Load layers and projects from mounted external drives on macOS

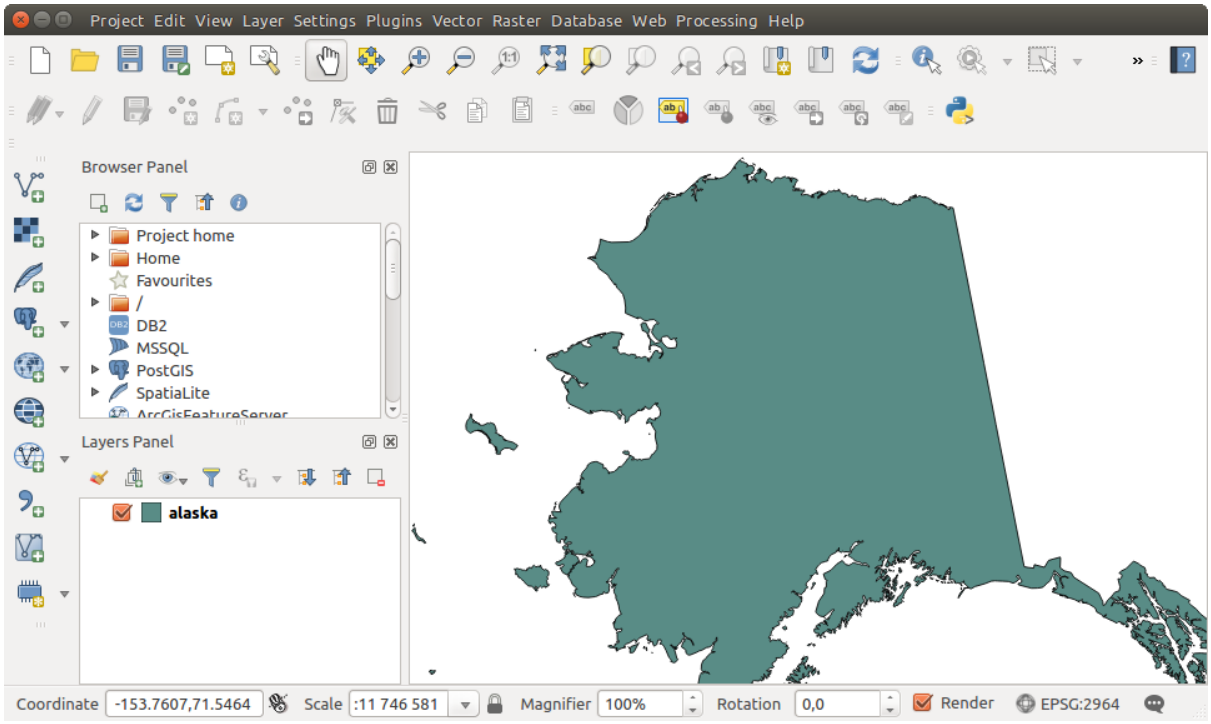


Figure 11.5: QGIS con archivo shape de Alaska cargado

On macOS, portable drives that are mounted beside the primary hard drive do not show up as expected under *File → Open Project*. We are working on a more macOS-native open/save dialog to fix this. As a workaround, you can type `/Volumes` in the *File name* box and press `Enter`. Then you can navigate to external drives and network mounts.

Importing a delimited text file

Delimited text file (e.g. `.csv`, `.txt`) can be loaded in QGIS using the tools described above. However, loaded this way, it'll show up like a simple table data. Sometimes, delimited text files can contain geometric data you'd want to visualize; this is what the *Add Delimited Text Layer* is designed for.

Click the toolbar icon Add Delimited Text Layer in the *Manage layers* toolbar to open the *Create a Layer from a Delimited Text File* dialog, as shown in figure_delimited_text.

First, select the file to import (e.g., `qgis_sample_data/csv/elevp.csv`) by clicking on the **[Browse]** button. Once the file is selected, QGIS attempts to parse the file with the most recently used delimiter. To enable QGIS to properly parse the file, it is important to select the correct delimiter. You can specify a delimiter by activating:

- *CSV (comma separated values)*;
- *Custom delimiters*, choosing among some predefined delimiters like `comma`, `space`, `tab`, `semicolon`...;
- or *Regular expression delimiter* and entering text into the *Expression* field. For example, to change the delimiter to tab, use `\t` (this is a regular expression for the tab character).

Once the file is parsed, set *Geometry definition* to *Point coordinates* and choose the `X` and `Y` fields from the dropdown lists. If the coordinates are defined as degrees/minutes/seconds, activate the *DMS coordinates* checkbox.

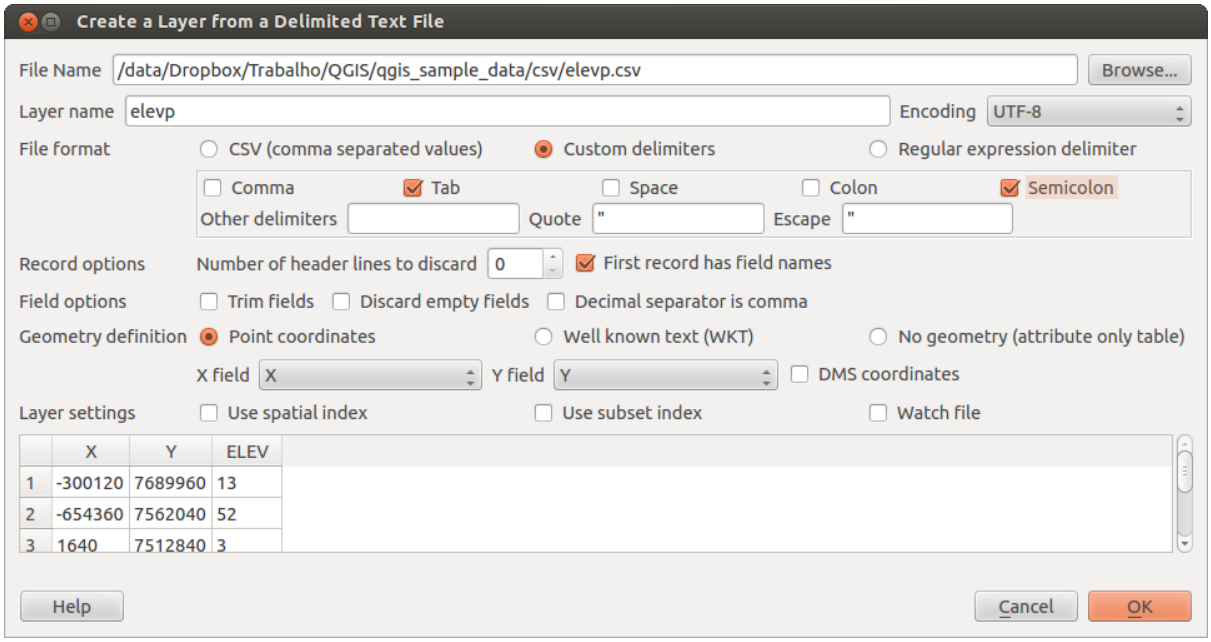


Figure 11.6: Delimited Text Dialog

Finally, enter a layer name (e.g., `elevp`), as shown in figure_delimited_text. To add the layer to the map, click **[OK]**. The delimited text file now behaves as any other map layer in QGIS.

There is also a helper option that allows you to trim leading and trailing spaces from fields — *Trim fields*. Also, it is possible to *Discard empty fields*. If necessary, you can force a comma to be the decimal separator by activating *Decimal separator is comma*.

If spatial information is represented by WKT, activate the *Well Known Text* option and select the field with the WKT definition for point, line or polygon objects. If the file contains non-spatial data, activate *No geometry (attribute only table)* and it will be loaded as an ordinal table.

Additionally, you can enable:

- *Use spatial index* to improve the performance of displaying and spatially selecting features;
- *Use subset index*;
- *Watch file* to watch for changes to the file by other applications while QGIS is running.

Importing a DXF or DWG file

`DXF` and `DWG` files can be added to QGIS by simple drag-and-drop from the common Browser Panel. You'll be prompted to select the sublayers you'd like to add to the project. Layers are added with random style properties.

Nota: DXF files containing several geometry types (point, line and/or polygon), the name of the layer will be made from *<filename.dxf> entities <geometry type>*.

To keep the dxf/dwg structure and its symbology in QGIS, you may want to use the dedicated *Project → DWG/DXF Import...* tool. Indeed, the *DWG/DXF Import* dialog allows you to import into GeoPackage database any element of the drawing file.

In the dialog, you have to:

- Input a location for a GeoPackage file, that will be created to store the DWG/DXF content to;
- Specify which coordinate system the data in the DWG data is in;

- Then use the **[Import]** button to select the DWG/DXF file to use (one per geopackage). The GeoPackage database will be automatically populated with the drawing file content. Depending on the size of the *CAD file, this could take some time;
- The *Expand block references* will transform the existing blocks into normal elements;
- the *Use curves* promotes the output layers geometry type to a `curved` one.

After the `.dwg` or `.dxf` data is imported into the GeoPackage database the frame in the lower half of the dialog is populated with the list of layers from the imported file. There you can select which layers to add to the QGIS project:

- At the top, set a *Group name* to group the drawing files in the project;
- Check layers to show: Each selected layer is added to an ad hoc group which contains vector layers for the point, line, label and area features of the drawing layer. The style of each layer is setup so that it resembles the look it originally had in *CAD;
- Check whether layer should be visible at opening;
- Alternatively using the *Merge layers* option places all layers in a single group;
- Press **[OK]** to open the layers in QGIS.

Importing OpenStreetMap Vectors

In recent years, the OpenStreetMap project has gained popularity because in many countries no free geodata such as digital road maps are available. The objective of the OSM project is to create a free editable map of the world from GPS data, aerial photography or local knowledge. To support this objective, QGIS provides support for OSM data.

Using the *Browser Panel*, you can load a `.osm` file to the map canvas, in which case you'll get a dialog to select sublayers based on the geometry type. The loaded layers will contain all the data of that geometry type in the file and keep the `osm` file data structure.

To avoid working with a such complex data structure, and be able to select only features you need based on their tags, QGIS provides a core and fully integrated OpenStreetMap import tool:

- To connect to the OSM server and download data, open the menu *Vector* → *OpenStreetMap* → *Download data...*. You can skip this step if you already obtained an `.osm` XML file using JOSM, Overpass API or any other source;
- The menu *Vector* → *OpenStreetMap* → *Import Topology from XML...* will convert your `.osm` file into a SpatiaLite database and create a corresponding database connection;
- The menu *Vector* → *OpenStreetMap* → *Export Topology to SpatiaLite...* then allows you to open the database connection, select the type of data you want (points, lines, or polygons) and choose tags to import. This creates a SpatiaLite geometry layer that you can add to your project by clicking on the Add SpatiaLite Layer toolbar button or by selecting the *Add SpatiaLite Layer...* option from the *Layer* menu (see section *SpatiaLite Layers*).

GPS

Loading GPS data in QGIS can be done using the core plugin: `GPS Tools`. Instructions are described in Section *Plugin de GPS*.

GRASS

Working with GRASS vector data is described in Section *Integracion GRASS SIG*.

SpatiaLite Layers

 The first time you load data from a SpatiaLite database, begin by:

- clicking on the  Add SpatiaLite Layer toolbar button;
- selecting the  *Add SpatiaLite Layer...* option from the *Layer* → *Add Layer* menu;
- or by typing `Ctrl+Shift+L`.

This will bring up a window that will allow you either to connect to a SpatiaLite database already known to QGIS, which you can choose from the drop-down menu, or to define a new connection to a new database. To define a new connection, click on **[New]** and use the file browser to point to your SpatiaLite database, which is a file with a `.sqlite` extension.

QGIS also supports editable views in SpatiaLite.

Database related tools

Crear una conexión almacenada

In order to read and write tables from the many database formats QGIS supports you'll need to create a connection to that database. While *QGIS Browser Panel* is the simplest and recommanded way to connect and use databases within, QGIS provides specific tools you can use to connect to each of them and load their tables:

-  *Add PostGIS Layer...* or by typing `Ctrl+Shift+D`
-  *Add MSSQL Spatial Layer* or by typing `Ctrl+Shift+M`
-  *Add Oracle Spatial Layer...* or typing `Ctrl+Shift+O`
-  *Add DB2 Spatial Layer...* or typing `Ctrl+Shift+2`

These tools are accessible either from the *Manage Layers Toolbar* or the *Layer* → *Add Layer* → menu. Connecting to SpatiaLite database is described at *SpatiaLite Layers*.

Truco: Create connection to database from the QGIS Browser Panel

Select the corresponding database format in the Browser tree, right-click and choose connect will provide you with the database connection dialog.

Most of the connection dialogs follow a common basis that will be described below using the PostGreSQL database tool as example.

The first time you use a PostGIS data source, you must create a connection to a database that contains the data. Begin by clicking the appropriate button as exposed above, opening an *Add PostGIS Table(s)* dialog (see figure_add_postgis_tables). To access the connection manager, click on the **[New]** button to display the *Create a New PostGIS Connection* dialog.

The parameters required for a PostGIS connection are exposed below. For the other database types, see their differences at *Particular Connection requirements*.

- **Name**: A name for this connection. It can be the same as *Database*.
- **Service**: Service parameter to be used alternatively to hostname/port (and potentially database). This can be defined in `pg_service.conf`. Check the *PostgreSQL Service connection file* section for more details.
- **Host**: Name of the database host. This must be a resolvable host name such as would be used to open a TCP/IP connection or ping the host. If the database is on the same computer as QGIS, simply enter *localhost* here.
- **Port**: Port number the PostgreSQL database server listens on. The default port for PostGIS is `5432`.

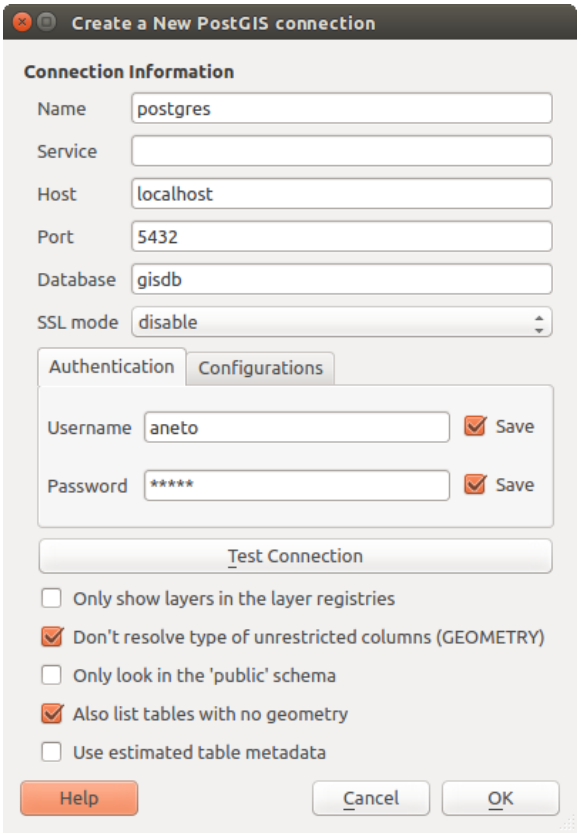


Figure 11.7: Create a New PostGIS Connection Dialog

- **Database**: Name of the database.
- **SSL mode**: How the SSL connection will be negotiated with the server. Note that massive speed-ups in PostGIS layer rendering can be achieved by disabling SSL in the connection editor. The following options are available:
  - *Disable*: Only try an unencrypted SSL connection;
  - *Allow*: Try a non-SSL connection. If that fails, try an SSL connection;
  - *Prefer* (the default): Try an SSL connection. If that fails, try a non-SSL connection;
  - *Require*: Only try an SSL connection.
- **Username**: User name used to log in to the database.
- **Password**: Password used with *Username* to connect to the database.

  You can save any or both of the `username` and `password` parameters, in which case they will be used by default each time you need to connect to this database. If not saved, you'll be prompted to fill the missing credentials to connect to the database in next QGIS sessions; meanwhile the connection parameters you entered are stored in a temporary internal cache and returned whenever a username/password for the same database is requested, until you close the current QGIS process.

  Advertencia: Configuración de usuario QGIS User y seguridad
  In the *Authentication* tab, saving **username** and **password** will keep unprotected credentials in the connection configuration. Those **credentials will be visible** if, for instance, you shared the project file with someone. Therefore, it's advisable to save your credentials in a *Authentication configuration* instead (*Configurations* tab - See *Sistema de autenticación* for more details) or in a service connection file (see *PostgreSQL Service connection file* for example).

Optionally, depending on the type of database, you can activate the following checkboxes:

- *Only show layers in the layer registries*
- *Don't resolve type of unrestricted columns (GEOMETRY)*
- *Only look in the 'public' schema*
- *Also list tables with no geometry*
- *Use estimated table metadata*

Truco: Use estimated table metadata to speed up operations

When initializing layers, various queries may be needed to establish the characteristics of the geometries stored in the database table. When the *Use estimated table metadata* option is checked, these queries examine only a sample of the rows and use the table statistics, rather than the entire table. This can drastically speed up operations on large datasets, but may result in incorrect characterization of layers (eg. the feature count of filtered layers will not be accurately determined) and may even cause strange behaviour in case columns that are supposed to be unique actually are not.

Once all parameters and options are set, you can test the connection by clicking on the **[Test connection]** button or apply it hitting **[OK]**. From the *Add PostGIS Table(s)*, click now on **[Connect]** and the dialog is filled with tables from the selected database (as shown in figure_add_postgis_tables).

Particular Connection requirements

Because of database type particularities, provided options are all the same for all the databases. Below are exposed these connection specificities.

PostgreSQL Service connection file The service connection file allows PostgreSQL connection parameters to be associated with a single service name. That service name can then be specified by a client and the associated settings will be used.

It's called `.pg_service.conf` under *nix systems (GNU/Linux, macOS etc.) and `pg_service.conf` on Windows.

The service file looks like:

```
[water_service]
host=192.168.0.45
port=5433
dbname=gisdb
user=paul
password=paulspass

[wastewater_service]
host=dbserver.com
dbname=water
user=waterpass
```

Nota: There are two services in the above example: `water_service` and `wastewater_service`. You can use these to connect from QGIS, pgAdmin etc. by specifying only the name of the service you want to connect to (without the enclosing brackets). If you want to use the service with `psql` you need to do something like `export PGSERVICE=water_service` before doing your psql commands.

Nota: You can find all the parameters here

Nota: If you don't want to save the passwords in the service file you can use the .pg_pass option.

On *nix operating systems (GNU/Linux, macOS etc.) you can save the `.pg_service.conf` file in the user's home directory and the PostgreSQL clients will automatically be aware of it. For example, if the logged user is `web`, `.pg_service.conf` should be saved in the `/home/web/` directory in order to directly work (without specifying any other environment variables).

You can specify the location of the service file by creating a `PGSERVICEFILE` environment variable (e.g. run the `export PGSERVICEFILE=/home/web/.pg_service.conf` command under your *nix OS to temporarily set the `PGSERVICEFILE` variable)

You can also make the service file available system-wide (all users) either by placing the `.pg_service.conf` file at `pg_config --sysconfdir` or by adding the `PGSYSCONFDIR` environment variable to specify the directory containing the service file. If service definitions with the same name exist in the user and the system file, the user file takes precedence.

Advertencia: There are some caveats under Windows:

- The service file should be saved as `pg_service.conf` and not as `.pg_service.conf`.
- The service file should be saved in Unix format in order to work. One way to do it is to open it with Notepad++ and *Edit → EOL Conversion → UNIX Format → File save*.
- You can add environmental variables in various ways; a tested one, known to work reliably, is *Control Panel → System and Security → System → Advanced system settings → Environment Variables* adding `PGSERVICEFILE` and the path of the type `C:\Users\John\pg_service.conf`
- After adding an environment variable you may also need to restart the computer.

Connecting to Oracle Spatial The spatial features in Oracle Spatial aid users in managing geographic and location data in a native type within an Oracle database. In addition to some of the options in *Crear una conexión almacenada*, the connection dialog proposes:

- **Database**: SID or SERVICE_NAME of the Oracle instance;
- **Port**: Port number the Oracle database server listens on. The default port is `1521`;
- **Workspace**: Workspace to switch to.

Optionally, you can activate following checkboxes:

- ☑ *Only look in metadata table*: restricts the displayed tables to those that are in the `all_sdo_geom_metadata` view. This can speed up the initial display of spatial tables;
- ☑ *Only look for user's tables*: when searching for spatial tables, restrict the search to tables that are owned by the user;
- ☑ *Also list tables with no geometry*: indicates that tables without geometry should also be listed by default;
- ☑ *Use estimated table statistics for the layer metadata*: when the layer is set up, various metadata are required for the Oracle table. This includes information such as the table row count, geometry type and spatial extents of the data in the geometry column. If the table contains a large number of rows, determining this metadata can be time-consuming. By activating this option, the following fast table metadata operations are done: Row count is determined from `all_tables.num_rows`. Table extents are always determined with the SDO_TUNE.EXTENTS_OF function, even if a layer filter is applied. Table geometry is determined from the first 100 non-null geometry rows in the table;
- ☑ *Only existing geometry types*: only list the existing geometry types and don't offer to add others;
- ☑ *Include additional geometry attributes*.

Truco: Capas Oracle Spatial

Normally, an Oracle Spatial layer is defined by an entry in the **USER_SDO_METADATA** table.

Connecting to DB2 Spatial In addition to some of the options described in *Crear una conexión almacenada*, the connection to a DB2 database (see *DB2 Spatial Layers* for more information) can be specified using either a Service/DSN name defined to ODBC or using the driver, host and port information.

An ODBC **Service/DSN** connection requires the service name defined to ODBC.

A driver/host/port connection requires:

- **Driver**: Name of the DB2 driver. Typically this would be IBM DB2 ODBC DRIVER.
- **DB2 Host**: Name of the database host. This must be a resolvable host name such as would be used to open a TCP/IP connection or ping the host. If the database is on the same computer as QGIS, simply enter *localhost* here.
- **DB2 Port**: Port number the DB2 database server listens on. The default DB2 LUW port is `50000`. The default DB2 z/OS port is `446`.

Truco: DB2 Spatial Layers

A DB2 Spatial layer is defined by a row in the **DB2GSE.ST_GEOMETRY_COLUMNS** view.

Nota: In order to work effectively with DB2 spatial tables in QGIS, it is important that tables have an INTEGER or BIGINT column defined as PRIMARY KEY and if new features are going to be added, this column should also have the GENERATED characteristic.

It is also helpful for the spatial column to be registered with a specific spatial reference identifier (most often `4326` for WGS84 coordinates). A spatial column can be registered by calling the `ST_Register_Spatial_Column` stored procedure.

Connecting to MSSQL Spatial In addition to some of the options in *Crear una conexión almacenada*, creating a new MSSQL connection dialog proposes you to fill a **Provider/DSN** name. You can also display available databases.

Loading a Database Layer

Once you have one or more connections defined to a database (see section *Crear una conexión almacenada*), you can load layers from it. Of course, this requires having available data. See e.g. section *Importing Data into PostgreSQL* for a discussion on importing data into a PostGIS database.

To load a layer from a database, you can perform the following steps:

1. Open the "Add <database> table(s)" dialog (see *Crear una conexión almacenada*),
2. Choose the connection from the drop-down list and click **[Connect]**.
3. Select or unselect *Also list tables with no geometry*.
4. Optionally, use some *Search Options* to reduce the list of tables to those matching your search. You can also set this option before you hit the **[Connect]** button, speeding this way the database fetching.
5. Find the layer(s) you wish to add in the list of available layers.
6. Select it by clicking on it. You can select multiple layers by holding down the `Shift` key while clicking.
7. If applicable, use the **[Set Filter]** button (or double-click the layer) to start the *Query builder* dialog (See section *Constructor de Consulta*) and define which features to load from the selected layer. The filter expression appears in the `sql` column. This restriction can be removed or edited in the *Layer Properties* → *General* → *Provider Feature Filter* frame.
8. The checkbox in the `Select at id` column that is activated by default gets the features ids without the attributes and speed in most cases the data loading.
9. Click on the **[Add]** button to add the layer to the map.

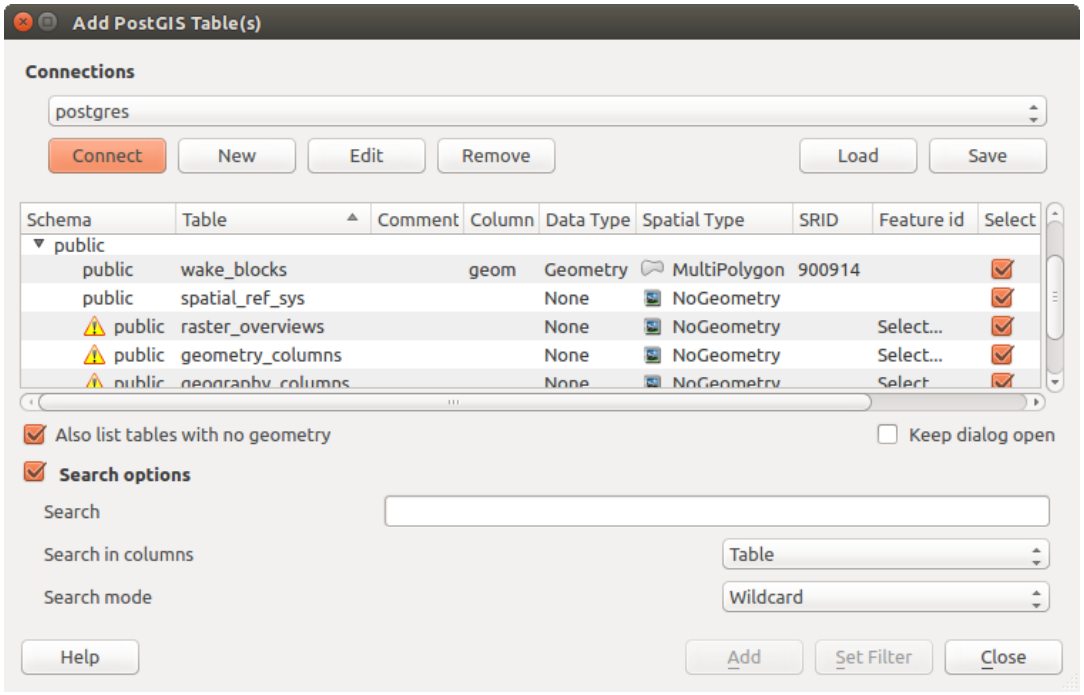


Figure 11.8: Add PostGIS Table(s) Dialog

Truco: Load database table(s) from the Browser Panel

Like simple files, connected database are also listed in the *Browser Panel*. Hence, you can load tables from databases using the Browser:

1. Find the layer to use with the  Filter Browser tool at the top the browser panel (see *The Browser Panel* for the search options);
2. select and drag-and-drop it in the map canvas.

11.1.4 Formato personalizados QGIS

QGIS proposes two custom formats you can load in the application using their own loading tool:

- Temporary Scratch Layer: a memory layer that is bound to the project it's opened with (see *Crear una nueva capa temporal* for more information)
- Virtual Layers: a layer resulting from a query on other layer(s) (see *Creating virtual layers* for more information)

11.1.5 Conectar con el servicios web

With QGIS you can have access to different types of OGC web services (WM(T)S, WFS(-T), CSW ...). Thanks to QGIS Server, you can also publish these services. Description of these capabilities and how-to are provided in chapter *Trabajar con datos OGC*.

11.2 Creando capaa

Layers can be created in many ways, including:

- empty layers from scratch;
- layers from existing layers;
- layers from the clipboard;
- layers as a result of an SQL-like query based on one or many layers: the *virtual layer*.

QGIS also provides tools to import/export different formats.

11.2.1 Creating new vector layers

QGIS allows you to create new Shapefile layers, new SpatiaLite layers, new GPX layers and new Temporary Scratch layers. Creation of a new GRASS layer is supported within the GRASS plugin. (Please refer to section *Crear una nueva capa vectorial GRASS* for more information on creating GRASS vector layers.)

Crear una nueva capa de archivo shape

To create a new Shapefile layer, choose *Create Layer* → *New Shapefile Layer...* from the *Layer* menu. The *New Shapefile Layer* dialog will be displayed as shown in figure_create_shapefile. Choose the type of layer (point, line or polygon) and the CRS (coordinate reference system).

Note that QGIS does not yet support creation of 2.5D features (i.e., features with X,Y,Z coordinates).

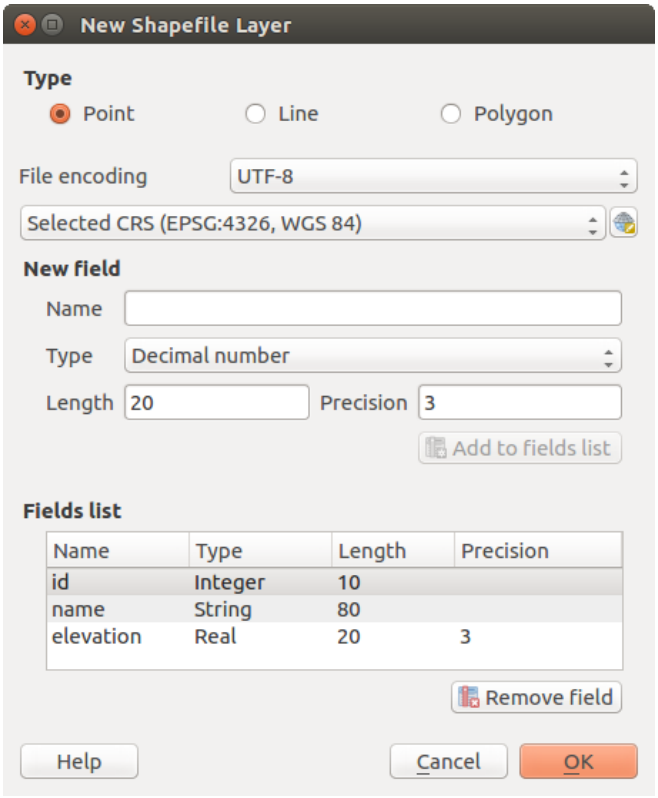


Figure 11.9: Creating a new Shapefile layer dialog

To complete the creation of the new Shapefile layer, add the desired attributes by specifying a name and type for each attribute and clicking on the **[Add to fields list]** button. A first 'id' column is added by default but can be removed, if not wanted. Only *Decimal number*, *Whole number*, *Text data* and *Date* attributes are supported. Additionally, depending on the attribute type, you can also define the length and precision of the new attribute column. Once you are happy with the attributes, click **[OK]** and provide a name for the Shapefile. QGIS will automatically add the `.shp` extension to the name you specify. Once the Shapefile has

been created, it will be added to the map as a new layer, and you can edit it in the same way as described in section *Digitalizando una capa existente*.

Crear una nueva capa SpatiaLite

To create a new SpatiaLite layer for editing, choose *New* → *New SpatiaLite Layer...* from the *Layer* menu. The *New SpatiaLite Layer* dialog will be displayed as shown in Figure_create_spatialite.

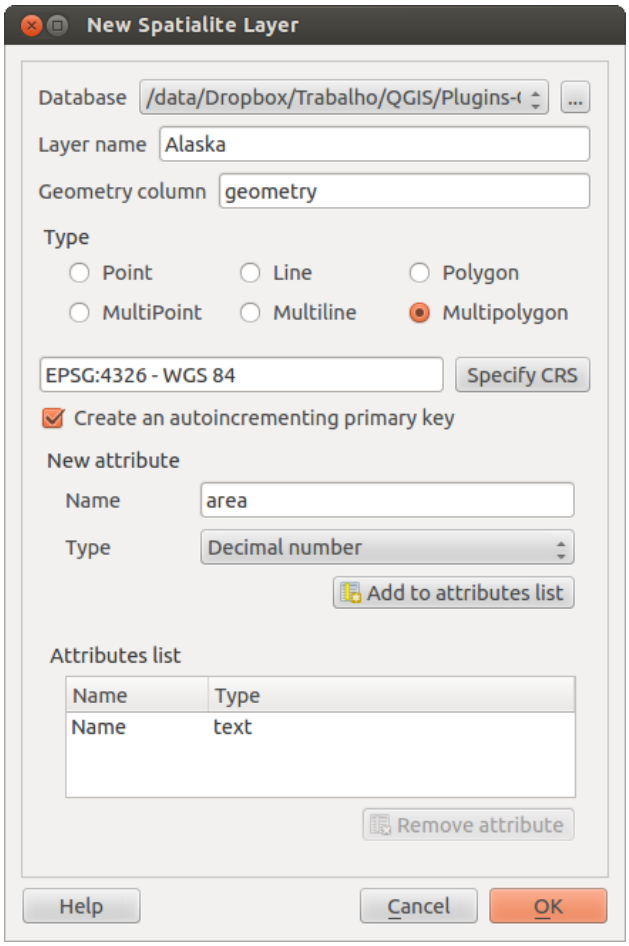


Figure 11.10: Creating a New SpatiaLite layer dialog

The first step is to select an existing SpatiaLite database or to create a new SpatiaLite database. This can be done with the browse button ... to the right of the database field. Then, add a name for the new layer, define the layer type, and specify the coordinate reference system with **[Specify CRS]**. If desired, you can select *Create an autoincrementing primary key*.

To define an attribute table for the new SpatiaLite layer, add the names of the attribute columns you want to create with the corresponding column type, and click on the **[Add to attribute list]** button. Once you are happy with the attributes, click **[OK]**. QGIS will automatically add the new layer to the legend, and you can edit it in the same way as described in section *Digitalizando una capa existente*.

Further management of SpatiaLite layers can be done with the DB Manager. See *Complemento administrador de BBDD*.

Creating a new GeoPackage layer

To create a new GeoPackage layer go to *Layer* → *New* → *New GeoPackage Layer...*. The *New GeoPackage Layer* dialog will be displayed as shown in figure_create_geopackage.

The first step is to select an existing GeoPackage or create a new one. This can be done by pressing the ellipses **[...]** button at the right of the Database field. Then, give a name for the new layer, define the layer type and specify the coordinate reference system with **[Specify CRS]**.

To define an attribute table for the new GeoPackage layer, add the names of the attribute columns you want to create with the corresponding column type, and click on the **[Add to fields list]** button. Once you are happy with the attributes, click **[OK]**. QGIS will automatically add the new layer to the legend, and you can edit it in the same way as described in section *Digitalizando una capa existente*.

Crear una nueva capa GPX

To create a new GPX file, you need to load the GPS plugin first. *Plugins* → *Plugin Manager...* opens the Plugin Manager Dialog. Activate the *GPS Tools* checkbox.

When this plugin is loaded, choose *New* → *Create new GPX Layer...* from the *Layer* menu. In the *Save new GPX file as* dialog, choose where to save the new file and press **[Save]**. Three new layers are added to the *Layers Panel*: `waypoints`, `routes` and `tracks` with predefined structure.

Crear una nueva capa temporal

Temporary Scratch Layers are in-memory layers, meaning that they are not saved on disk and will be discarded when QGIS is closed. They can be handy to store features you temporarily need or as intermediate layers during geoprocessing operations.

Empty, editable temporary scratch layers can be defined using *Layer* → *Create Layer* → *New Temporary Scratch Layer*. Here you can create *Multipoint*, *Multiline* and *Multipolygon* Layers beneath *Point*, *Line* and *Polygon* layers.

You can also create Temporary Scratch Layers from the clipboard. See *Creating new layers from the clipboard*.

11.2.2 Creating new layers from an existing layer

Both raster and vector layers can be saved in a different format and/or reprojected to a different coordinate reference system (CRS) using the *Save As...* function in the layer context menu (by right-clicking in the layer in the layer tree) or in the *Layer* → *Save As...* menu.

Common parameters

The *Save As* dialog shows several parameters to change the behavior when saving the layer. Common parameters for raster and vector are:

- *Format*
- *File name*
- *CRS* can be changed to reproject the data
- *Add saved file to map* to add the new layer to the canvas
- *Extent* (possible values are **layer**, **Map view** or **user-defined** extent)

However, some parameters are specific to raster and vector formats:

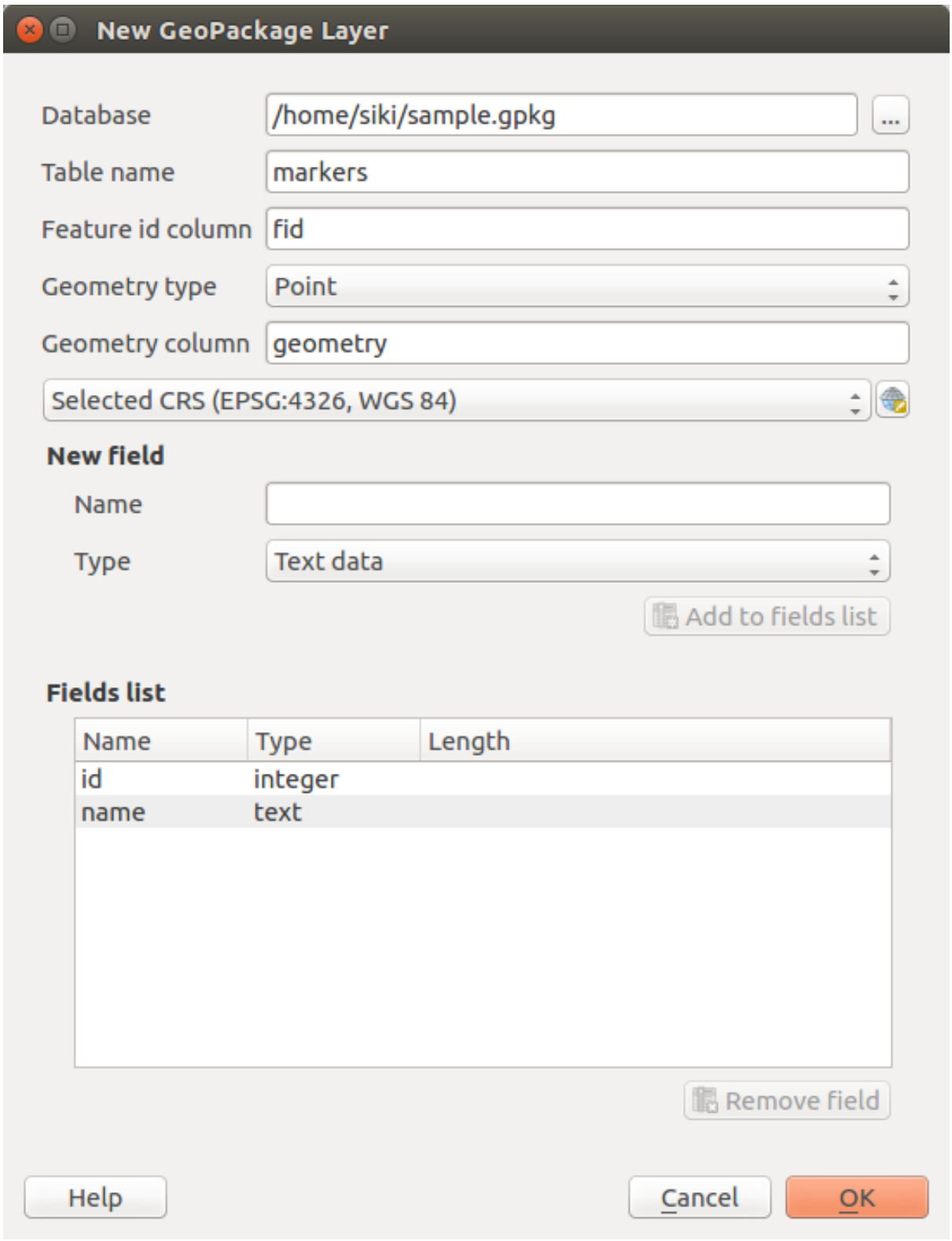


Figure 11.11: Creating a New GeoPackage layer dialog

Raster specific parameters

- *Output mode* (it can be **raw data** or **rendered image**)
- *Resolution*
- *Create Options*: advanced options (file compression, block sizes, colorimetry...) to fine tune the output file. See the gdal-ogr driver documentation.
- *Pyramids* creation
- *VRT Tiles*
- *No data values*

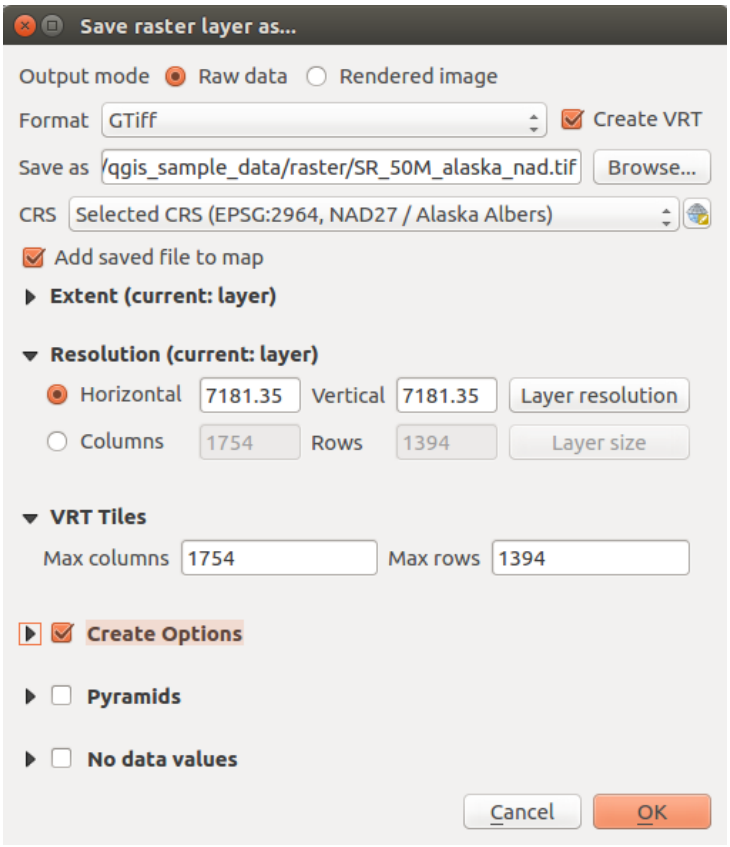


Figure 11.12: Saving as a new raster layer

Vector specific parameters

Depending on the format of export, some of these options are available or not:

- *Encoding*
- *Save only selected features*
- *Select fields to export and their export options*. In case you set your fields behavior with some *Edit widgets*, e.g. `value map`, you can keep the displayed values in the layer by checking *Replace all selected raw fields values by displayed values*.
- *Symbology export*: can be used mainly for DXF export and for all file formats who manage OGR feature styles (see note below) as DXF, KML, tab file formats:
  - **No symbology**: default style of the application that reads the data
  - **Feature symbology**: save style with OGR Feature Styles (see note below)

  - **Symbol Layer symbology**: save with OGR Feature Styles (see note below) but export the same geometry multiple times if there are multiple symbology symbol layers used
  - A **Scale** value can be applied to the latest options.

Nota: *OGR Feature Styles* are a way to store style directly in the data as a hidden attribute. Only some formats can handle this kind of information. KML, DXF and TAB file formats are such formats. For advanced users, you can read the OGR Feature Styles specification document.

- *Geometry*: you can configure the geometry capabilities of the output layer
  - *geometry type*: keep the original geometry of the features when set to **Automatic**, otherwise removes or overrides it with any type. You can add an empty geometry column to an attribute table, remove the geometry column of a spatial layer.
  - *Force multi-type*: force creation of multi-geometry features in the layer
  - *Include z-dimension* to geometries.

Truco: Overriding layer geometry type makes it possible to do things like save a geometryless table (e.g. `.csv` file) into a shapefile WITH any type of geometry (point, line, polygon), so that geometries can then be manually added to rows with the  Add Part tool .

- *Datasources Options*, *Layer Options* or *Custom Options* which allow you to configure some advanced parameters. See the gdal-ogr driver documentation.

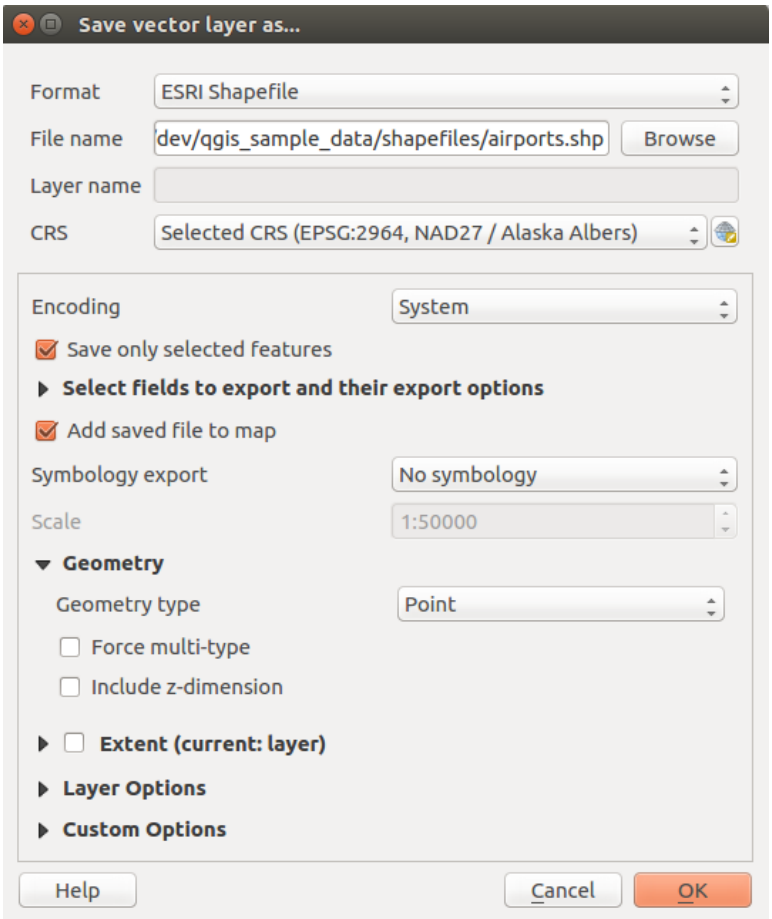


Figure 11.13: Saving as a new vector layer

When saving a vector layer into an existing file, depending on the capabilities of the output format (Geopackage, SpatiaLite, FileGDB...), the user can decide whether to:

- overwrite the whole file
- overwrite only the target layer (the layer name is configurable)
- append features to the existing target layer
- append features, add new fields if there are any.

For formats like ESRI Shapefile, MapInfo .tab, feature append is also available.

11.2.3 Creating new DXF files

Besides the *Save As...* dialog which provides options to export a single layer to another format, including `*.DXF`, QGIS provides another tool to export multiple layers as a single DXF layers. It's accessible in the *Project → DXF Export...* menu.

The *DXF Export* dialog allows the user to:

- indicate the destination layer file;
- choose the symbology mode and scale (see the OGR Feature Styles note);
- select the encoding and CRS;
- check the loaded layers to include in the DXF files or pick them from an existing *visibility preset*.

  For each layer, you can choose a field whose values are used to split features in generated destination layers in the DXF output. You can also choose to  *Use the layer title as name if set* and keep features grouped.
- choose to only *Export features intersecting the current map extent*.

11.2.4 Creating new layers from the clipboard

Features that are on the clipboard can be pasted into a new layer. To do this, Select some features, copy them to the clipboard, and then paste them into a new layer using *Edit → Paste Features as →* and choosing:

- *New Vector Layer...*: you need to select the layer CRS, poping up the *Save vector layer as...* dialog from which you can select any supported data format (see *Creating new layers from an existing layer* for parameters);
- or *Temporary Scratch Layer...*: you need to select the layer CRS and give a name.

A new layer, filled with selected features and their attributes is created and added to map canvas if asked.

Nota: Creating layers from clipboard applies to features selected and copied within QGIS and also to features from another source defined using well-known text (WKT).

11.2.5 Creating virtual layers

Virtual layers are a special kind of vector layer. They allow you to define a layer as the result of an SQL query involving any number of other vector layers that QGIS is able to open. Virtual layers do not carry data by themselves and can be seen as views to other layers.

To create a virtual layer, open the virtual layer creation dialog by clicking on *Add Virtual Layer* in the *Layer* menu or from the corresponding toolbar.

The dialog allows you to specify a *Layer name* and an SQL *Query*. The query can use the name (or id) of loaded vector layers as tables, as well as their field names as columns.

For example, if you have a layer called `airports`, you can create a new virtual layer called `public_airports` with an SQL query like:

```
SELECT *
FROM airports
WHERE USE = "Civilian/Public"
```

The SQL query will be executed, regardless of the underlying provider of the `airports` layer, even if this provider does not directly support SQL queries.

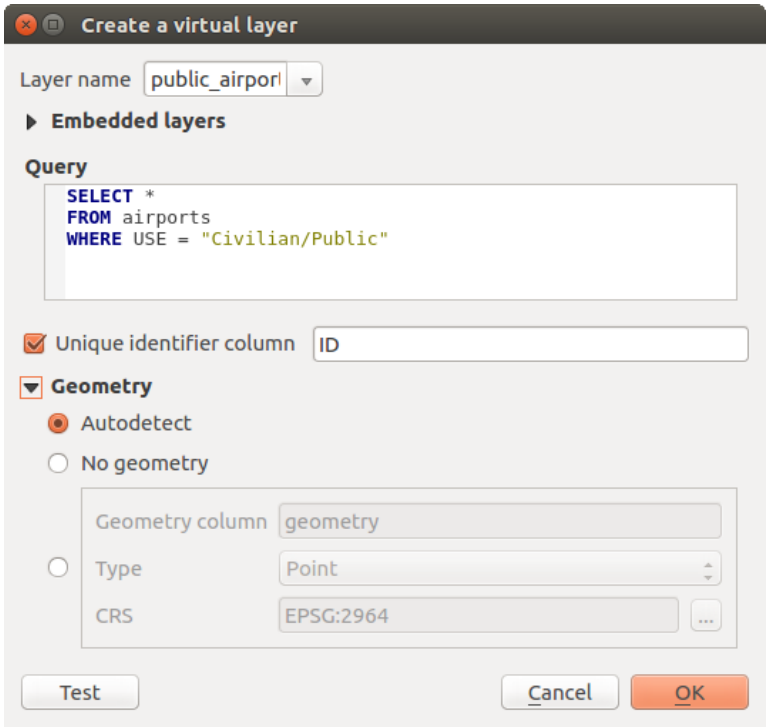


Figure 11.14: Create virtual layers dialog

Joins and complex queries can also be created, for example, to join airports and country information:

```
SELECT airports.*, country.population
FROM airports
JOIN country
ON airports.country = country.name
```

Nota: It's also possible to create virtual layers using the SQL window of *Complemento administrador de BBDD*.

Embedding layers for use in queries

Besides the vector layers available in the map canvas, the user can add layers to the *Embedded layers* list, which he can use in queries without the need to have them showing in the map canvas or Layers panel.

To embed a layer, click *Add* and provide the *Local name*, *Provider*, *Encoding* and the path to the *Source*.

The *Import* button allows adding layers loaded in the map canvas into the Embedded layers list. This allows to later remove those layers from the Layers panel without breaking any existent query.

Supported query language

The underlying engine uses SQLite and SpatiaLite to operate.

It means you can use all of the SQL your local installation of SQLite understands.

Functions from SQLite and spatial functions from SpatiaLite can also be used in a virtual layer query. For instance, creating a point layer out of an attribute-only layer can be done with a query similar to:

```
SELECT id, MakePoint(x, y, 4326) as geometry
FROM coordinates
```

Functions of QGIS expressions can also be used in a virtual layer query.

To refer the geometry column of a layer, use the name `geometry`.

Contrary to a pure SQL query, all the fields of a virtual layer query must be named. Don't forget to use the `as` keyword to name your columns if they are the result of a computation or function call.

Problemas de Rendimiento

With default parameters set, the virtual layer engine will try its best to detect the type of the different columns of the query, including the type of the geometry column if one is present.

This is done by introspecting the query when possible or by fetching the first row of the query (LIMIT 1) at last resort. Fetching the first row of the result just to create the layer may be undesirable for performance reasons.

The creation dialog allows to specify different parameters:

- *Unique identifier column*: this option allows specifying which field of the query represents unique integer values that QGIS can use as row identifiers. By default, an autoincrementing integer value is used. Defining a unique identifier column allows to speed up the selection of rows by id.
- *No geometry*: this option forces the virtual layer to ignore any geometry field. The resulting layer is an attribute-only layer.
- Geometry *Column*: this option allows to specify the name of the column that is to be used as the geometry of the layer.
- Geometry *Type*: this option allows to specify the type of the geometry of the virtual layer.
- Geometry *CRS*: this option allows to specify the coordinate reference system of the virtual layer.

Special comments

The virtual layer engine tries to determine the type of each column of the query. If it fails, the first row of the query is fetched to determine column types.

The type of a particular column can be specified directly in the query by using some special comments.

The syntax is the following: `/*:type*/`. It has to be placed just after the name of a column. `type` can be either `int` for integers, `real` for floating point numbers or `text`.

For instance:

```
SELECT id+1 as nid /*:int*/
FROM table
```

The type and coordinate reference system of the geometry column can also be set thanks to special comments with the following syntax `/*:gtype:srid*/` where `gtype` is the geometry type (`point`, `linestring`, `polygon`, `multipoint`, `multilinestring` or `multipolygon`) and `srid` an integer representing the EPSG code of a coordinate reference system.

Use of indexes

When requesting a layer through a virtual layer, indexes of this source layer will be used in the following ways:

- if an = predicate is used on the primary key column of the layer, the underlying data provider will be asked for a particular id (FilterFid)

- for any other predicates (>, <=, !=, etc.) or on a column without a primary key, a request built from an expression will be used to request the underlying vector data provider. It means indexes may be used on database providers if they exist.

A specific syntax exists to handle spatial predicates in requests and triggers the use of a spatial index: a hidden column named `_search_frame_` exists for each virtual layer. This column can be compared for equality to a bounding box. Example:

```
SELECT *
FROM vtab
WHERE _search_frame_=BuildMbr(-2.10,49.38,-1.3,49.99,4326)
```

Spatial binary predicates like `ST_Intersects` are significantly sped up when used in conjunction with this spatial index syntax.

11.3 Exploring Data Formats and Fields

11.3.1 Datos Raster

Raster data in GIS are matrices of discrete cells that represent features on, above or below the earth's surface. Each cell in the raster grid has the same size, and cells are usually rectangular (in QGIS they will always be rectangular). Typical raster datasets include remote sensing data, such as aerial photography, or satellite imagery and modelled data, such as an elevation matrix.

Unlike vector data, raster data typically do not have an associated database record for each cell. They are geocoded by pixel resolution and the x/y coordinate of a corner pixel of the raster layer. This allows QGIS to position the data correctly in the map canvas.

QGIS makes use of georeference information inside the raster layer (e.g., GeoTiff) or in an appropriate world file to properly display the data.

11.3.2 Datos Vectoriales

Many of the features available in QGIS work the same, regardless the vector data source. However, because of the differences in formats specifications (ESRI shapefiles, MapInfo and MicroStation file formats, AutoCAD DXF, PostGIS, SpatiaLite, DB2, Oracle Spatial and MSSQL Spatial databases, and many more), QGIS may handle differently some of their properties. This section describes how to work with these specificities.

Nota: QGIS supports (multi)point, (multi)line, (multi)polygon, CircularString, CompoundCurve, CurvePolygon, MultiCurve, MultiSurface feature types, all with Z and/or M values.

You should note also that some drivers don't support some of these feature types like CircularString, CompoundCurve, CurvePolygon, MultiCurve, MultiSurface feature type. QGIS will convert them to (multi)polygon feature.

ESRI Shapefiles

The ESRI shapefile is still one of the most used vector file format in QGIS. However, this file format has some limitation that some other file format have not (like Geopackage, spatialite). Support is provided by the OGR Simple Feature Library.

A shapefile actually consists of several files. The following three are required:

1. `.shp` file containing the feature geometries
2. `.dbf` file containing the attributes in dBase format
3. archivo del índice `.shx`

Shapefiles also can include a file with a `.prj` suffix, which contains the projection information. While it is very useful to have a projection file, it is not mandatory. A shapefile dataset can contain additional files. For further details, see the ESRI technical specification at http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf.

Improving Performance for Shapefiles

To improve the performance of drawing a shapefile, you can create a spatial index. A spatial index will improve the speed of both zooming and panning. Spatial indexes used by QGIS have a `.qix` extension.

Use these steps to create the index:

- Load a shapefile (see *The Browser Panel*);
- Open the *Layer Properties* dialog by double-clicking on the shapefile name in the legend or by right-clicking and choosing *Properties* from the context menu.
- In the *General* tab, click the **[Create Spatial Index]** button.

Problem loading a shape .prj file

If you load a shapefile with a `.prj` file and QGIS is not able to read the coordinate reference system from that file, you will need to define the proper projection manually within the *General* tab of the *Layer Properties* dialog of the layer by clicking the **[Specify...]** button. This is due to the fact that `.prj` files often do not provide the complete projection parameters as used in QGIS and listed in the *CRS* dialog.

For the same reason, if you create a new shapefile with QGIS, two different projection files are created: a `.prj` file with limited projection parameters, compatible with ESRI software, and a `.qpj` file, providing the complete parameters of the used CRS. Whenever QGIS finds a `.qpj` file, it will be used instead of the `.prj`.

Delimited Text Files

Tabular data is a very common and widely used format because of its simplicity and readability – data can be viewed and edited even in a plain text editor. A delimited text file is an attribute table with each column separated by a defined character and each row separated by a line break. The first row usually contains the column names. A common type of delimited text file is a CSV (Comma Separated Values), with each column separated by a comma.

Such data files can also contain positional information in two main forms:

- As point coordinates in separate columns
- As well-known text (WKT) representation of geometry

QGIS allows you to load a delimited text file as a layer or ordinal table. But first check that the file meets the following requirements:

1. The file must have a delimited header row of field names. This must be the first line in the text file.
2. The header row must contain field(s) with geometry definition. These field(s) can have any name.
3. The X and Y coordinates (if geometry is defined by coordinates) must be specified as numbers. The coordinate system is not important.
4. If you have any data that is not a string (text) and the file is a CSV file, you must have a CSVT file (see section *CSVT Files*).

As an example of a valid text file, we import the elevation point data file `elevp.csv` that comes with the QGIS sample dataset (see section *Sample Data*):

```
X;Y;ELEV
-300120;7689960;13
-654360;7562040;52
1640;7512840;3
[...]
```

Algunos elementos a tener en cuenta sobre el archivo de texto:

1. The example text file uses `;` (semicolon) as delimiter. Any character can be used to delimit the fields.

2. The first row is the header row. It contains the fields `X`, `Y` and `ELEV`.
3. No quotes (") are used to delimit text fields.
4. The X coordinates are contained in the `X` field.
5. The Y coordinates are contained in the `Y` field.

CSVT Files

When loading CSV files, the OGR driver assumes all fields are strings (i.e. text) unless it is told otherwise. You can create a CSVT file to tell OGR (and QGIS) what data type the different columns are:

Tipo	Nombre	Ejemplo
Número entero	Entero	4
Número decimal	Real	3.456
Fecha	Date (YYYY-MM-DD)	2016-07-28
Tiempo	Time (HH:MM:SS+nn)	18:33:12+00
Fecha y hora	DateTime (YYYY-MM-DD HH:MM:SS+nn)	2016-07-28 18:33:12+00

The CSVT file is a **ONE line** plain text file with the data types in quotes and separated by commas, e.g.:

```
"Integer","Real","String"
```

You can even specify width and precision of each column, e.g.:

```
"Integer(6)","Real(5.5)","String(22)"
```

This file is saved in the same folder as the `.csv` file, with the same name, but `.csvt` as the extension.

You can find more information at GDAL CSV Driver.

Others valuable informations for advanced users

Features with curved geometries (CircularString, CurvePolygon and CompoundCurve) are supported. Here are three examples of such geometry types as a delimited text with WKT geometries:

```
Label;WKT_geom
CircularString;CIRCULARSTRING(268 415,227 505,227 406)
CurvePolygon;CURVEPOLYGON(CIRCULARSTRING(1 3, 3 5, 4 7, 7 3, 1 3))
CompoundCurve;COMPOUNDCURVE((5 3, 5 13), CIRCULARSTRING(5 13, 7 15,
  9 13), (9 13, 9 3), CIRCULARSTRING(9 3, 7 1, 5 3))
```

Delimited Text supports also Z and M coordinates in geometries:

```
LINESTRINGM(10.0 20.0 30.0, 11.0 21.0 31.0)
```

PostGIS Layers

PostGIS layers are stored in a PostgreSQL database. The advantages of PostGIS are its spatial indexing, filtering and querying capabilities it provides. Using PostGIS, vector functions such as select and identify work more accurately than they do with OGR layers in QGIS.

Truco: PostGIS Layers

Normally, a PostGIS layer is defined by an entry in the geometry_columns table. QGIS can load layers that do not have an entry in the geometry_columns table. This includes both tables and views. Defining a spatial view provides a powerful means to visualize your data. Refer to your PostgreSQL manual for information on creating views.

This section contains some details on how QGIS accesses PostgreSQL layers. Most of the time, QGIS should simply provide you with a list of database tables that can be loaded, and it will load them on request. However, if you have trouble loading a PostgreSQL table into QGIS, the information below may help you understand any QGIS messages and give you direction on changing the PostgreSQL table or view definition to allow QGIS to load it.

Clave primaria

QGIS requires that PostgreSQL layers contain a column that can be used as a unique key for the layer. For tables, this usually means that the table needs a primary key, or a column with a unique constraint on it. In QGIS, this column needs to be of type int4 (an integer of size 4 bytes). Alternatively, the ctid column can be used as primary key. If a table lacks these items, the oid column will be used instead. Performance will be improved if the column is indexed (note that primary keys are automatically indexed in PostgreSQL).

QGIS offers a checkbox **Select at id** that is activated by default. This option gets the ids without the attributes which is faster in most cases.

View

If the PostgreSQL layer is a view, the same requirement exists, but views do not always have primary keys or columns with unique constraints on them. You have to define a primary key field (has to be integer) in the QGIS dialog before you can load the view. If a suitable column does not exist in the view, QGIS will not load the layer. If this occurs, the solution is to alter the view so that it does include a suitable column (a type of integer and either a primary key or with a unique constraint, preferably indexed).

As for table, a checkbox **Select at id** is activated by default (see above for the meaning of the checkbox). It can make sense to disable this option when you use expensive views.

QGIS layer_style table and database backup

If you want to make a backup of your PostGIS database using the `pg_dump` and `pg_restore` commands, and the default layer styles as saved by QGIS fail to restore afterwards, you need to set the XML option to `DOCUMENT` and the restore will work.

```
SET XML OPTION DOCUMENT;
```

Filter database side

QGIS allows to filter features already on server side. Check the *Settings* → *Options* → *Data Sources* →  *Execute expressions on postgres server-side if possible* checkbox to do so. Only supported expressions will be sent to the database. Expressions using unsupported operators or functions will gracefully fallback to local evaluation.

Support of PostgreSQL data types

Most of common data types are supported by the PostgreSQL provider: integer, float, varchar, geometry and timestamp.

Array data types are not supported.

Importing Data into PostgreSQL

Data can be imported into PostgreSQL/PostGIS using several tools, including the DB Manager plugin and the command line tools shp2pgsql and ogr2ogr.

Administrador de BBDD

QGIS comes with a core plugin named  DB Manager. It can be used to load shapefiles and other data formats, and it includes support for schemas. See section *Complemento administrador de BBDD* for more information.

shp2pgsql

PostGIS includes an utility called **shp2pgsql** that can be used to import shapefiles into a PostGIS-enabled database. For example, to import a shapefile named `lakes.shp` into a PostgreSQL database named `gis_data`, use the following command:

```
shp2pgsql -s 2964 lakes.shp lakes_new | psql gis_data
```

This creates a new layer named `lakes_new` in the `gis_data` database. The new layer will have a spatial reference identifier (SRID) of 2964. See section *Trabajar con Proyecciones* for more information on spatial reference systems and projections.

Truco: Exporting datasets from PostGIS

Like the import tool **shp2pgsql**, there is also a tool to export PostGIS datasets as shapefiles: **pgsql2shp**. This is shipped within your PostGIS distribution.

---

ogr2ogr

Además de **shp2pgsql** y **Administrador de BBDD**, hay otra herramienta para alimentar de datos geográficos a PostGIS: **ogr2ogr**. Esto es parte de su instalación GDAL.

To import a shapefile into PostGIS, do the following:

```
ogr2ogr -f "PostgreSQL" PG:"dbname=postgis host=myhost.de user=postgres
password=topsecret" alaska.shp
```

This will import the shapefile `alaska.shp` into the PostGIS database *postgis* using the user *postgres* with the password *topsecret* on host server *myhost.de*.

Note that OGR must be built with PostgreSQL to support PostGIS. You can verify this by typing (in )

```
ogrinfo --formats | grep -i post
```

If you prefer to use PostgreSQL's **COPY** command instead of the default **INSERT INTO** method, you can export the following environment variable (at least available on  and ):

```
export PG_USE_COPY=YES
```

ogr2ogr does not create spatial indexes like **shp2pgsl** does. You need to create them manually, using the normal SQL command **CREATE INDEX** afterwards as an extra step (as described in the next section *Mejorar el rendimiento*).

Mejorar el rendimiento

Retrieving features from a PostgreSQL database can be time-consuming, especially over a network. You can improve the drawing performance of PostgreSQL layers by ensuring that a PostGIS spatial index exists on each layer in the database. PostGIS supports creation of a GiST (Generalized Search Tree) index to speed up spatial searches of the data (GiST index information is taken from the PostGIS documentation available at http://postgis.net).

Truco: You can use the DBManager to create an index to your layer. You should first select the layer and click on *Table* → *Edit table*, go to *Indexes* tab and click on **[Add spatial index]**.

The syntax for creating a GiST index is:

```
CREATE INDEX [indexname] ON [tablename]
  USING GIST ( [geometryfield] GIST_GEOMETRY_OPS );
```

Tenga en cuenta que para tablas grandes, crear el índice puede tomar un largo tiempo. Una vez que el índice es creado, se debe realizar un `VACUUM ANALYZE`. Vea la documentación de PostGIS (POSTGIS-PROJECT *Referencias bibliográficas y web*) para mayor información.

The following is an example of creating a GiST index:

```
gsherman@madison:~/current$ psql gis_data
Welcome to psql 8.3.0, the PostgreSQL interactive terminal.

Type:  \copyright for distribution terms
       \h for help with SQL commands
       \? for help with psql commands
       \g or terminate with semicolon to execute query
       \q to quit

gis_data=# CREATE INDEX sidx_alaska_lakes ON alaska_lakes
gis_data-# USING GIST (the_geom GIST_GEOMETRY_OPS);
CREATE INDEX
gis_data=# VACUUM ANALYZE alaska_lakes;
VACUUM
gis_data=# \q
gsherman@madison:~/current$
```

Vector layers crossing 180° longitude

Many GIS packages don't wrap vector maps with a geographic reference system (lat/lon) crossing the 180 degrees longitude line (http://postgis.refractions.net/documentation/manual-2.0/ST_Shift_Longitude.html). As result, if we open such a map in QGIS, we will see two far, distinct locations, that should appear near each other. In Figure_vector_crossing, the tiny point on the far left of the map canvas (Chatham Islands) should be within the grid, to the right of the New Zealand main islands.

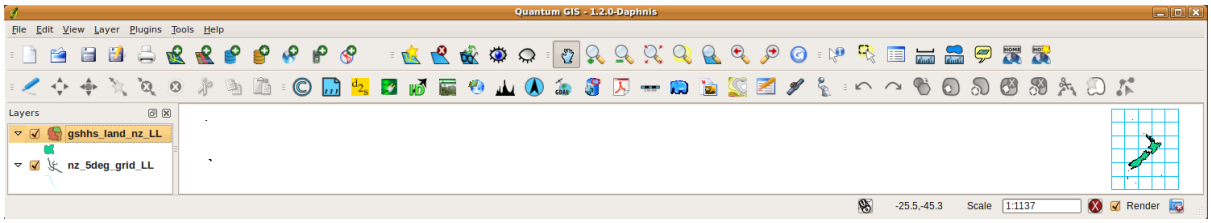


Figure 11.15: Map in lat/lon crossing the 180° longitude line

A work-around is to transform the longitude values using PostGIS and the **ST_Shift_Longitude** function. This function reads every point/vertex in every component of every feature in a geometry, and if the longitude coordinate is < 0°, it adds 360° to it. The result is a 0° - 360° version of the data to be plotted in a 180°-centric map.

Uso

- Import data into PostGIS (*Importing Data into PostgreSQL*) using, for example, the DB Manager plugin.
- Use the PostGIS command line interface to issue the following command (in this example, "TABLE" is the actual name of your PostGIS table): `gis_data=# update TABLE set the_geom=ST_Shift_Longitude(the_geom);`

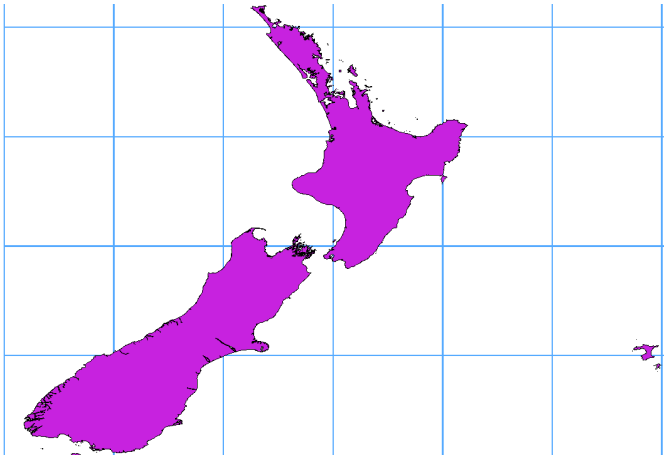


Figure 11.16: Crossing 180° longitude applying the **ST_Shift_Longitude** function

- If everything went well, you should receive a confirmation about the number of features that were updated. Then you'll be able to load the map and see the difference (Figure_vector_crossing_map).

SpatiaLite Layers

If you want to save a vector layer to SpatiaLite format, you can do this by right clicking the layer in the legend. Then, click on *Save as...*, define the name of the output file, and select 'SpatiaLite' as format and the CRS. Also, you can select 'SQLite' as format and then add `SPATIALITE=YES` in the OGR data source creation option field. This tells OGR to create a SpatiaLite database. See also http://www.gdal.org/ogr/drv_sqlite.html.

QGIS also supports editable views in SpatiaLite.

If you want to create a new SpatiaLite layer, please refer to section *Crear una nueva capa SpatiaLite*.

Truco: SpatiaLite data management Plugins

For SpatiaLite data management, you can also use several Python plugins: QSpatiaLite, SpatiaLite Manager or *DB Manager* (core plugin, recommended). If necessary, they can be downloaded and installed with the Plugin Installer.

DB2 Spatial Layers

IBM DB2 for Linux, Unix and Windows (DB2 LUW), IBM DB2 for z/OS (mainframe) and IBM DashDB products allow users to store and analyse spatial data in relational table columns. The DB2 provider for QGIS supports the full range of visualization, analysis and manipulation of spatial data in these databases.

User documentation on these capabilities can be found at the DB2 z/OS KnowledgeCenter, DB2 LUW KnowledgeCenter and DB2 DashDB KnowledgeCenter.

For more information about working with the DB2 spatial capabilities, check out the DB2 Spatial Tutorial on IBM DeveloperWorks.

The DB2 provider currently only supports the Windows environment through the Windows ODBC driver.

The client running QGIS needs to have one of the following installed:

- DB2 LUW
- IBM Data Server Driver Package
- IBM Data Server Client

If you are accessing a DB2 LUW database on the same machine or using DB2 LUW as a client, the DB2 executables and supporting files need to be included in the Windows path. This can be done by creating a batch file like the following with the name **db2.bat** and including it in the directory **%OSGEO4W_ROOT%/etc/ini**.

```
@echo off
REM Point the following to where DB2 is installed
SET db2path=C:\Program Files (x86)\sqllib
REM This should usually be ok - modify if necessary
SET gskpath=C:\Program Files (x86)\ibm\gsk8
SET Path=%db2path%\BIN;%db2path%\FUNCTION;%gskpath%\lib64;%gskpath%\lib;%path%
```

CHAPTER 12

Trabajar con catos vectoriales

12.1 La librería Símbolo

12.1.1 El Administrador de estilos

The Style Manager is the place where users can manage and create generic symbols to be used in several QGIS projects. You can open it with the *Settings* → *Style Manager* or from the **Style** tab in the vector layer's *Properties*. It allows users to:

- create, edit and remove symbols
- organize symbols in custom groups
- export and import symbols.

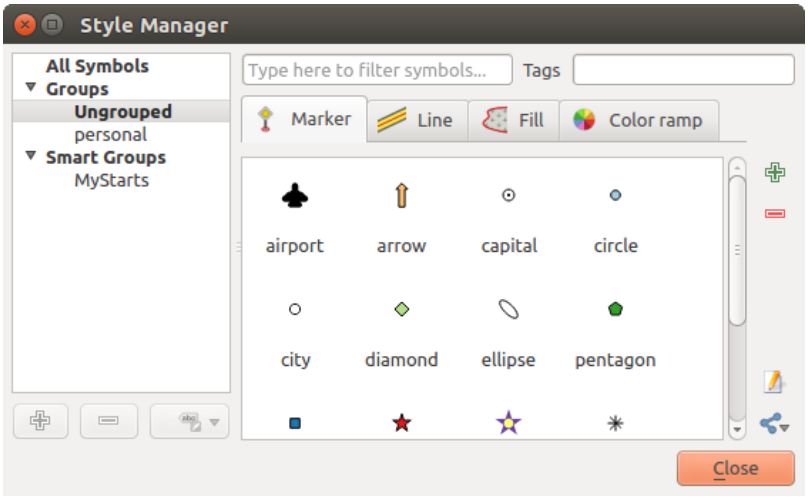


Figure 12.1: El Administrador de estilos

Groups and smart groups

You can organize symbols into different categories. These categories, listed in the panel at the left, can be static (called **Group**) or dynamic (named **Smart Group**). A group is smart when its symbols are dynamically fetched according to conditions set. See figure_smart_group:

To create a group, right click on an existing group or on the main **Groups** directory in the left of the dialog. You can also select a group and click the Add Group button. The new group will be a sub-group of the selected one.

Create **Smart Group** is similar to creating group, but instead select **Smart Groups**. The dialog box allows user to choose the expression to select symbols in order to appear in the smart group (contains some tags, member of

a group, have a string in its name, etc.). Any symbol that satisfies the entered condition(s) is automatically added to the smart group.

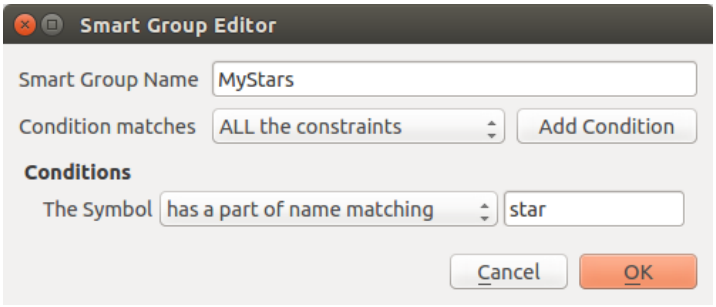


Figure 12.2: Creating a Smart Group

To remove a group or a smart group, right click on the group and select *Remove Group* or select it and push Remove Group button.

Unlike the smart groups that automatically fetch their belonged symbols, simple groups are filled by the user. To add a symbol into a group, you can either right click on a symbol, choose *Apply Group* and then the group name.

There is a second way to add several symbols into a group: just select the group, click and choose *Group Symbols*. All symbols display a checkbox that allows you to add the symbol into the selected groups. When selection is finished, you can click the same button, and choose *Finish Grouping*.

All the symbols that are not placed under a custom group belong to a default group named **Ungrouped**.

Add, Edit, Remove Symbol

Selecting a group returns in the right panel, if applicable, the list of symbols of the group (including its subgroups). These symbols are organized in four different tabs:

- **Marker** for point symbols
- **Line** for linear symbols
- **Fill** for surface symbols
- and *Rampa de color*.

To delete a symbol you no longer need, just select it and click Remove item (also available through right-click). The symbol will be deleted from the local symbols database.

The symbol list can be modified by adding new symbols with Add item button or modifying existing ones with Edit item. See *El Selector de Símbolo* for further information.

Share symbols

The Share item tool, at the right bottom of the Style Library dialog, offers options to easily share symbols with others: users can indeed export their symbols and import symbols to their library.

Exporting symbols

You can export the selected symbols to PNG, SVG or XML file formats. Exporting to PNG or SVG (both not available for color ramp symbols) creates a file for each selected symbol, and the SVG folder can be added to SVG Paths in *Settings* → *Options* to e.g. share these symbols on a network. The XML format generates a single file containing all the selected symbols. This file can then be imported in another user's style library.

Importing symbols

You can extend your symbols library by importing new symbols. Just select *Import* from the drop-down list at the right bottom of the dialog. In the new dialog, you'll need to :

- indicate the source of the symbols (it can be a `.xml` file on the disk or an url),
- give the name of the group under which the symbols will be put
- select the symbols you want to add to your library
- and press **Import**.

Note that import and export options are also available through right-click.

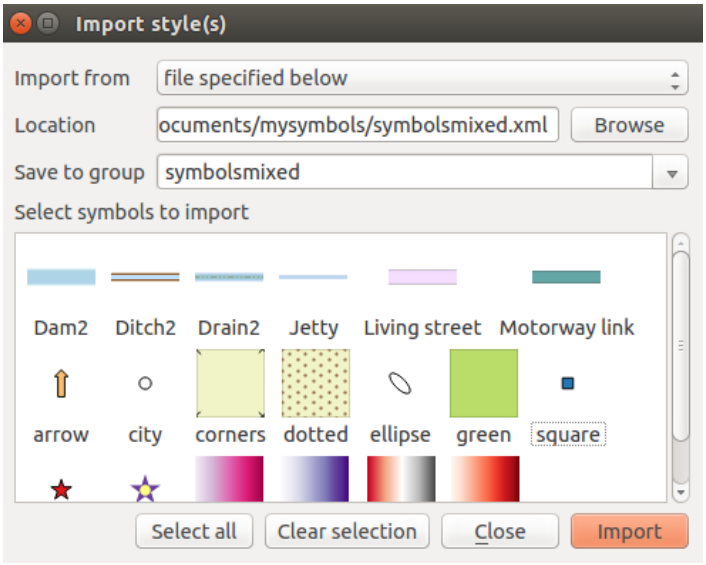


Figure 12.3: Importing symbols

Rampa de color

The Color ramp tab in the Style Manager presents different types of color ramps you can use to style layers.

To create a custom color ramp, activate the Color ramp tab and click the Add item button. The button reveals a drop-down list to choose the ramp type:

- *Gradient*: given a start and end colors, generate a color ramp which can be **continuous** or **discrete**. With double-clicking the ramp preview, you can add as many intermediate color stops as you want.
- *Random*: creates a random set of colors based on range of values for hue, saturation, value and opacity and a number of colors (classes)
- *ColorBrewer*: a set of predefined discrete color gradients you can custom the number of colors in the ramp
- or *cpt-city*: an access to a whole catalog of color gradients to locally *save as gradient color*.

Truco: Easily custom the color stops of the gradient color ramp

Double-clicking the ramp preview or drag-and-drop a color from the color spot onto the ramp preview adds a new color stop. Each color stop can be tweaked using the *Selector de color* widgets or by plotting each of its parameters. You can also reposition it using the mouse, the arrow keys (combine with `Shift` key for a larger move) or the *Relative position* spinbox. Pressing *Delete stop* as well as `DEL` key removes the selected color stop.

You can use the *Invert* option while classifying the data with a color ramp. See figure_color_custom_ramp for an example of a custom color ramp and figure_color_cpt_city for the cpt-city Colors dialog.

The cpt-city option opens a new dialog with hundreds of themes included 'out of the box'.

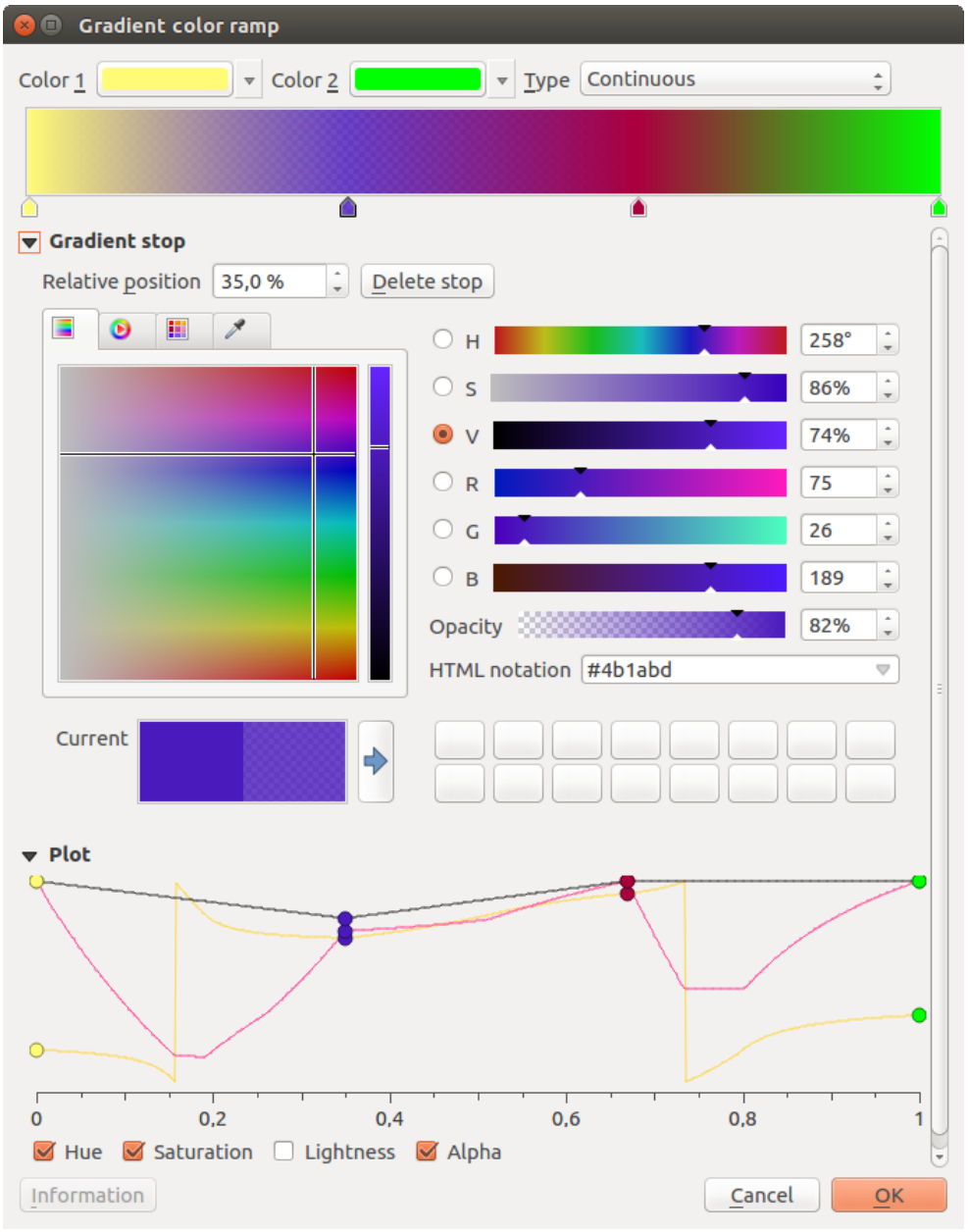


Figure 12.4: Ejemplo de rampa de color gradiente personalizado con pasos múltiples

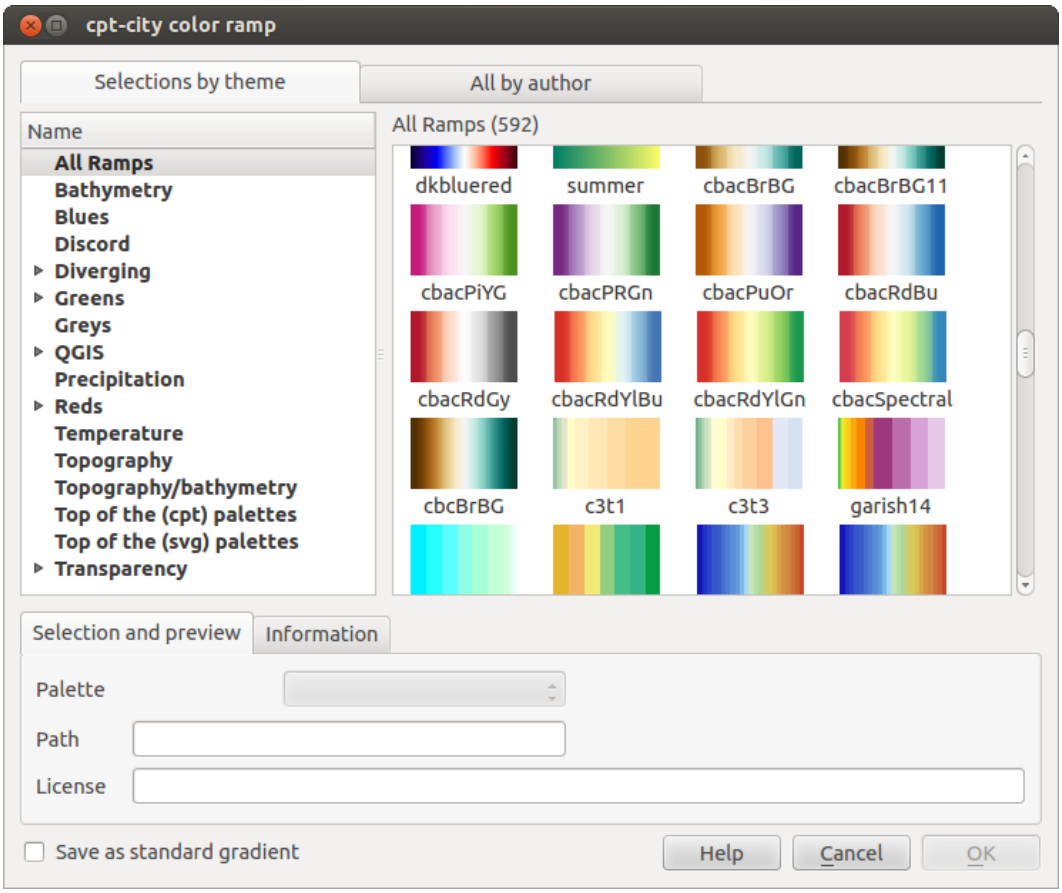


Figure 12.5: cpt-city dialog with hundreds of color ramps

12.1.2 El Selector de Símbolo

The Symbol selector is the main dialog to design a symbol. You can create or edit Marker, Line or Fill Symbols.

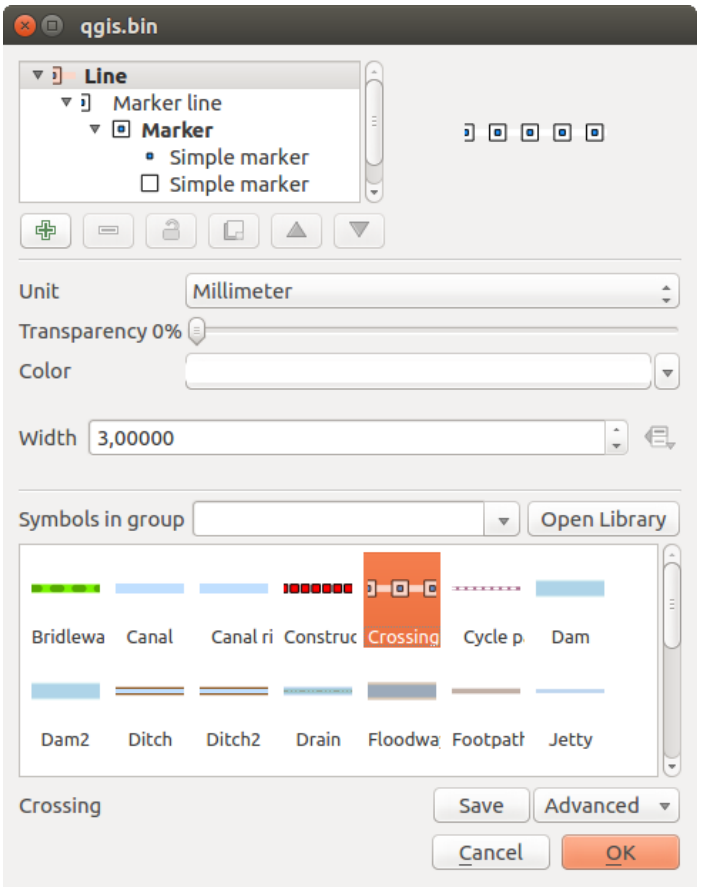


Figure 12.6: Designing a Marker symbol

Two main components structure the symbol selector dialog:

- the symbol tree, showing symbol layers that are combined afterwards to shape a new global symbol
- and settings to configure the selected symbol layer in the tree.

The symbol layer tree

A symbol can consist of several *Symbol layers*. The symbol tree shows the overlay of these symbol layers that are combined afterwards to shape a new global symbol. Besides, a dynamic symbol representation is updated as soon as symbol properties change.

A set of tools is available to manage the symbol tree items and according to the level selected, you'll get enabled different tools at the bottom of the dialog to:

- add new symbol layer: you can stack as many symbols as you want
- remove the selected symbol layer
- lock colors of symbol layer: a locked color stays unchanged when user changes the color at the global (or upper) symbol level
- duplicate a (group of) symbol layer(s)

- move up or down the symbol layer

Configuring a symbol

In QGIS, configuring a symbol is done in two steps: the symbol and then the symbol layer.

The symbol

At the top level of the tree, it depends on the layer geometry and can be of **Marker**, **Line** or **Fill** type. Each symbol can embed one or more symbols (including, of any other type) or symbol layers.

You can setup some parameters that apply to the global symbol:

- *Unit*: it can be **Millimeter**, **Pixels** or **Map unit**
- *Transparencia*
- *Color*: when this parameter is changed by the user, its value is echoed to all unlocked sub-symbols color
- *Size* and *Rotation* for marker symbols
- *Width* for line symbols

Nota: The *Data-defined override* button beside the last layer-related parameters is inactive when setting the symbol from the Style manager dialog. When the symbol is connected to a map layer, this button offers access to the *size assistant* dialog which helps to create proportional or multivariate analysis rendering.

The symbols used at this level are items you can pick from the *symbols library*. A list of available symbols of the same type from your symbol library is shown and can be filtered by selecting a group in the drop-down list just above. Click the *Save* button to add the designed symbol to your symbol library.

With the *Advanced*  option, you can:

- set the **symbol levels**: defining the way symbol layers are connected to each other in the map canvas (see *Symbols levels* for more information)
- and for line and fill symbols, **clip features to canvas extent**.

Truco: Note that once you have set the size in the lower levels of the *Symbol layers* dialog, the size of the whole symbol can be changed with the *Size* (for marker symbols) or the *Width* (for line symbols) menu in the first level again. The size of the lower levels changes accordingly, while the size ratio is maintained.

The symbol layer

At a lower level of the tree, you can customize the symbol layers. The available symbol layer types depend on the upper symbol type. You can apply on the symbol layer  *paint effects* to enhance its rendering.

Because describing all the options of all the symbol layer types would not be possible, only particular and significative ones are mentioned below.

Common parameters Some common options and widgets are available to build a symbol layer, regardless it's of marker, line or fill sub-type:

- the *color selector* widget to ease color manipulation
- *Units*: it can be **Millimeter**, **Pixels** or **Map unit**
- the  data-defined override widget near almost all options, extending capabilities of customizing each symbol (see *Configuración de anulación definida por datos* for more information)

Nota: While the description below assumes that the symbol layer type is bound to the feature geometry, keep in mind that you can embed symbol layers in each others. In that case, the lower level symbol layer parameter (placement, offset...) might be bound to the upper-level symbol, and not to the feature geometry itself.

Símbolos de marcador Appropriate for point geometry features, marker symbols have several *Symbol layer types*:

- **Simple marker** (default);
- **Ellipse marker**: a simple marker symbol layer, with customizable width and height;
- **Filled marker**: similar to the simple marker symbol layer, except that it uses a *fill sub symbol* to render the marker. This allows use of all the existing QGIS fill (and outline) styles for rendering markers, e.g. gradient or shapeburst fills;
- **Font marker**: use installed fonts as marker symbols;
- **Geometry generator** (see *The Geometry Generator*);
- **Vector Field marker** (see *The Vector Field Marker*);
- **SVG marker**: provides you with images from your SVG paths (set in *Settings* → *Options* → *System* menu) to render as marker symbol. Each SVG file colors and outline can be adapted.

  Nota: Requirements for a customizable SVG marker symbol

  To have the possibility to change the colors of a *SVG marker*, you have to add the placeholders `param(fill)` for fill color, `param(outline)` for outline color and `param(outline-width)` for stroke width. These placeholders can optionally be followed by a default value, e.g.:

```
<svg width="100%" height="100%">
<rect fill="param(fill) #ff0000" stroke="param(outline) #00ff00" stroke-width="param(stroke-w
</rect>
</svg>
```

For each marker symbol layer type, you can set some of the following properties:

- *Color* for the fill and/or stroke, using all the capabilities of the *Selector de color* widget;
- *Tamaño*
- *Outline style*
- *Outline width*
- *Estilo de unión*
- *Rotation*
- *Offset X,Y*: You can shift the symbol in the x- or y- direction;
- *Anchor point*.

In most of the marker symbols dialog, you also have a frame with previews of predefined symbols you can choose from.

Símbolos línea Appropriate for line geometry features, line symbols have following symbol layer types:

- **Simple line** (default): available settings are:
  - *Color*
  - *Pen width*
  - *Pen style*

  - *Estilo de unión*
  - *Estilo de mayusculas*
  - *Desplazamiento*
  -  *Use custom dash pattern*: overrides the *Pen style* setting with a custom dash.

- **Arrow**: draws lines as curved (or not) arrows with a single or a double head with configurable width, length and thickness. To create a curved arrow the line feature must have at least three vertices. It also uses a *fill symbol* such as gradients or shapeburst to render the arrow body. Combined with the geometry generator, this type of layer symbol helps you representing flow maps;
- **Geometry generator** (see *The Geometry Generator*);
- **Marker line**: displays a marker symbol along the line. It can be at a regular distance or based on its geometry: first, last or each vertex, on central point or on every curve point. You can set an offset along the line for the marker symbol, or offset the line itself. The *Rotate marker* option allows you to set whether the marker symbol should follow the line orientation or not.

Fill Symbols Appropriate for polygon geometry features, fill symbols have also several symbol layer types:

- **Simple fill** (default): the following settings are available:
  - *Fill* color
  - *Outline* color
  - *Estilo de relleno*
  - *Outline style*
  - *Outline width*
  - *Estilo de unión*
  - *Offset X,Y*
- **Centroid fill**: places a marker symbol at the centroid of the visible feature. The position of the marker may however not be the real centroid of the feature because calculation takes into account the polygon(s) clipped to area visible in map canvas for rendering and ignores holes. Use *The Geometry Generator* if you want the exact centroid.

  The marker can be placed on every part of a multi-part feature or only on its biggest part, and forced to be inside the polygon;
- **Geometry generator** (see geometry_generator_symbol);
- **Gradient fill**: uses a radial, linear or conical gradient, based on either simple two color gradients or a predefined *gradient color ramp* to fill polygon layers. Gradient can be rotated and applied on a single feature basis or across the whole map extent. Also start and end points can be set via coordinates or using the centroid (of feature or map);
- **Line pattern fill**: fills the polygon with a hatching pattern of line symbol layer. You can set the spacing between lines and an offset from the feature boundary;
- **Point pattern fill**: fills the polygon with a hatching pattern of marker symbol layer. You can set the spacing between lines and an offset from the feature boundary;
- **Raster image fill**: you can fill polygons with a tiled raster image. Options include (data defined) file name, opacity, image size (in pixels, mm or map units), coordinate mode (feature or view) and rotation;
- **SVG fill**: fills the polygon using *SVG markers*;
- **Shapeburst fill**: this option buffered a gradient fill, where a gradient is drawn from the boundary of a polygon towards the polygon's centre. Configurable parameters include distance from the boundary to shade, use of color ramps or simple two color gradients, optional blurring of the fill and offsets;
- **Outline: Arrow**: uses a line *arrow symbol* layer to represent the polygon boundary;

- **Outline: Marker line**: uses a marker line symbol layer to represent the polygon boundary;
- **Outline: simple line**: uses a simple line symbol layer to represent the polygon boundary. The *Draw line only inside polygon* option helps polygon borders inside the polygon and can be useful to clearly represent adjacent polygon boundaries.

Nota: When geometry type is polygon, you can choose to disable the automatic clipping of lines/polygons to the canvas extent. In some cases this clipping results in unfavourable symbology (e.g. centroid fills where the centroid must always be the actual feature's centroid).

The Geometry Generator Available with all types of symbols, the *geometry generator* symbol layer allows to use *expression syntax* to generate a geometry on the fly during the rendering process. The resulting geometry does not have to match with the original geometry type and you can add several differently modified symbol layers on top of each other.

Algún ejemplo:

```
-- render the centroid of a feature
centroid( $geometry )

-- visually overlap features within a 100 map units distance from a point
-- feature, i.e generate a 100m buffer around the point
buffer( $geometry, 100 )

-- Given polygon layer1( id1, layer2_id, ...) and layer2( id2, fieldn...)
-- render layer1 with a line joining centroids of both where layer2_id = id2
make_line( centroid( $geometry ),
           centroid( geometry( get_feature( 'layer2', 'id2', attribute(
               $currentfeature, 'layer2_id') ) )
         )
```

The Vector Field Marker The vector field marker is used to display vector field data such as earth deformation, tidal flows, and the like. It displays the vectors as lines (preferably arrows) that are scaled and oriented according to selected attributes of data points. It can only be used to render point data; line and polygon layers are not drawn by this symbology.

The vector field is defined by attributes in the data, which can represent the field either by:

- **cartesian** components (`x` and `y` components of the field)
- or **polar** coordinates: in this case, attributes define `Length` and `Angle`. The angle may be measured either clockwise from north, or Counterclockwise from east, and may be either in degrees or radians.
- or as **height only** data, which displays a vertical arrow scaled using an attribute of the data. This is appropriate for displaying the vertical component of deformation, for example.

The magnitude of field can be scaled up or down to an appropriate size for viewing the field.

12.2 El Dialogo de las Propiedades del Vector

El cuadro de diálogo *Propiedades de la capa* para una capa vectorial proporciona una configuración general para administrar la apariencia de los elementos de la capa en el mapa (simbología, etiquetas, diagramas), interacción con el mouse (acciones, textos de aviso del mapa, diseño de formularios). También proporciona información de la capa.

To access the *Layer Properties* dialog, double-click on a layer in the legend or right-click on the layer and select *Properties* from the pop-up menu.

Nota: Depending on the *external plugins* you have installed, new tabs may be added to the layer properties dialog. Those are not presented below.

Truco: Live update rendering

The *Layer Styling Panel* provides you with some of the common features of the Layer properties dialog and is a good modeless widget that you can use to speed up the configuration of the layer styles and automatically view your changes in the map canvas.

Nota: Because properties (symbology, label, actions, default values, forms...) of embedded layers (see *Anidar proyectos*) are pulled from the original project file and to avoid changes that may break this behavior, the layer properties dialog is made unavailable for these layers.

12.2.1 General Properties

 Use this tab to make general settings for the vector layer. There are several options available:

Layer Info

- Set the *Layer name* to display in the *Layers Panel*
- Display the *Layer source* of the vector layer
- Define the *Data source encoding* to define provider-specific options and to be able to read the file

Sistema de coordenadas de referencia

- Displays the layer's Coordinate Reference System (CRS) as a PROJ.4 string. You can change the layer's CRS, selecting a recently used one in the drop-down list or clicking on  Select CRS button (see *Coordinate Reference System Selector*). Use this process only if the CRS applied to the layer is a wrong one or if none was applied. If you wish to reproject your data into another CRS, rather use layer reprojection algorithms from Processing or *Save it into another layer*.
- Create a *Spatial Index* (only for OGR-supported formats)
- *Update Extents* information for a layer

Visibilidad dependiente de escala

You can set the *Maximum (inclusive)* and *Minimum (exclusive)* scale, defining a range of scale in which features will be visible. Out of this range, they are hidden. The  Set to current canvas scale button helps you use the current map canvas scale as boundary of the range visibility. See *Renderizado dependiente de la escala* for more information.

Constructor de Consulta

Under the **Provider Feature Filter** frame, the Query Builder allows you to define a subset of the features in the layer using a SQL-like WHERE clause and to display the result in the main window. As long as the query is active, only the features corresponding to its result are available in the project. The query result can be saved as a new vector layer.

The **Query Builder** is accessible through the eponym term at the bottom of the *General* tab in the Layer Properties. Under *Feature subset*, click on the **[Query Builder]** button to open the *Query builder*. For example, if you have a `regions` layer with a `TYPE_2` field, you could select only regions that are `borough` in the *Provider specific filter expression* box of the Query Builder. Figure_vector_querybuilder shows an example of the Query Builder

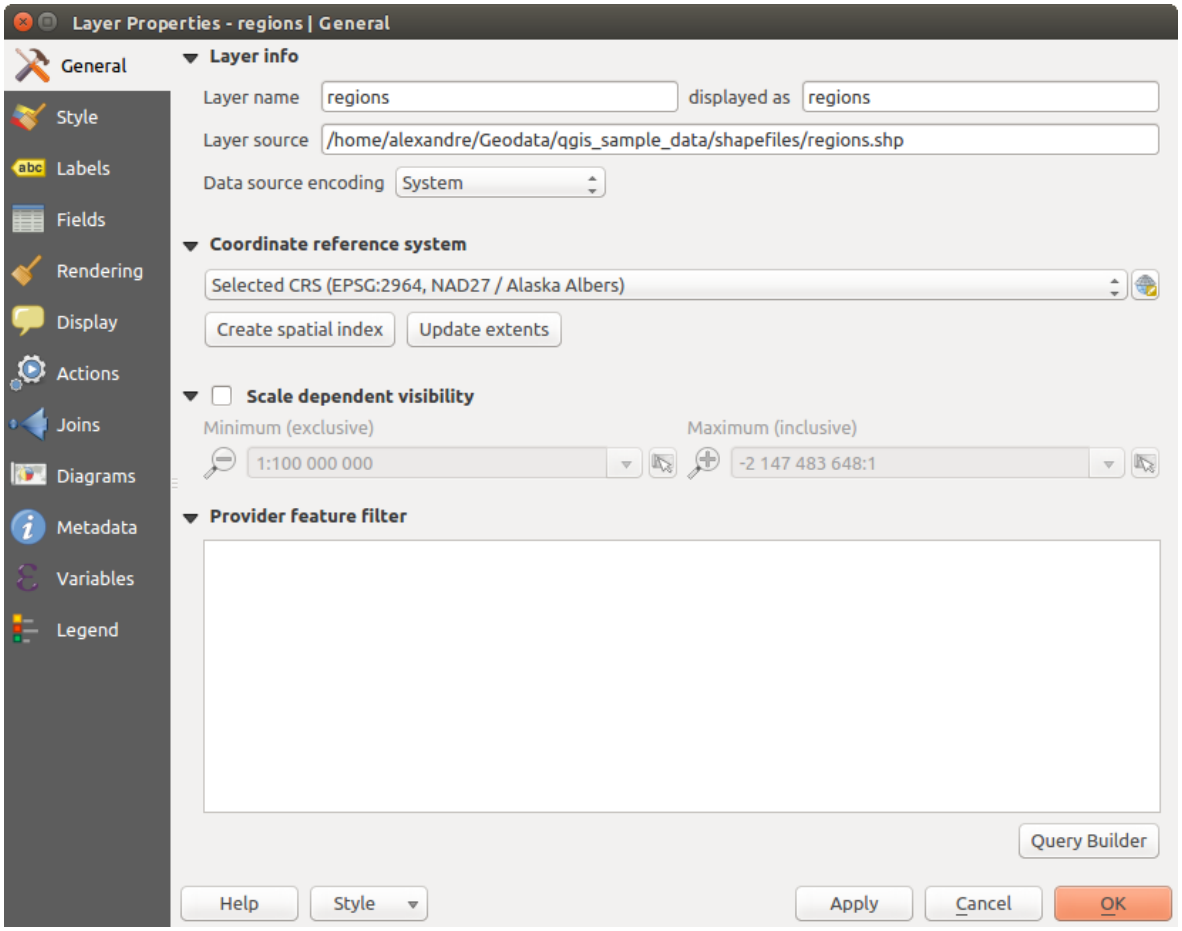


Figure 12.7: General tab in vector layers properties dialog

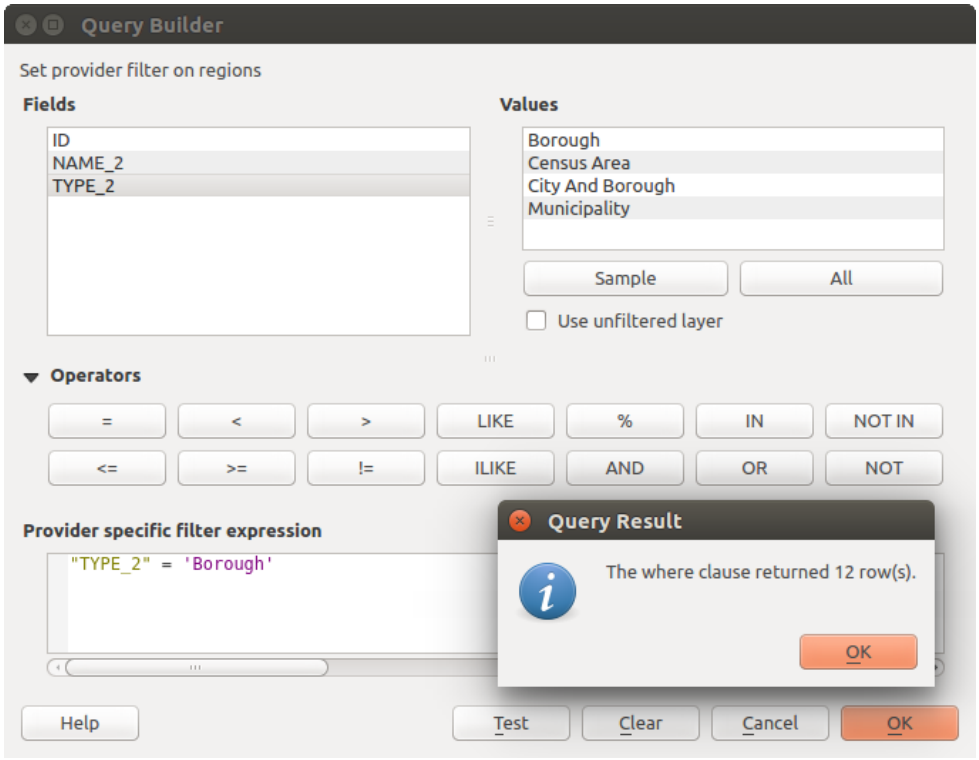


Figure 12.8: Constructor de Consulta

populated with the `regions.shp` layer from the QGIS sample data. The Fields, Values and Operators sections help you to construct the SQL-like query.

The **Fields list** contains all attribute columns of the attribute table to be searched. To add an attribute column to the SQL WHERE clause field, double click its name in the Fields list. Generally, you can use the various fields, values and operators to construct the query, or you can just type it into the SQL box.

The **Values list** lists the values of an attribute table. To list all possible values of an attribute, select the attribute in the Fields list and click the **[all]** button. To list the first 25 unique values of an attribute column, select the attribute column in the Fields list and click the **[Sample]** button. To add a value to the SQL WHERE clause field, double click its name in the Values list.

The **Operators section** contains all usable operators. To add an operator to the SQL WHERE clause field, click the appropriate button. Relational operators (= , > , ...), string comparison operator (`LIKE`), and logical operators (`AND`, `OR`, ...) are available.

The **[Test]** button shows a message box with the number of features satisfying the current query, which is useful in the process of query construction. The **[Clear]** button clears the text in the SQL WHERE clause text field. The **[OK]** button closes the window and selects the features satisfying the query. The **[Cancel]** button closes the window without changing the current selection.

QGIS treats the resulting subset acts as if it were the entire layer. For example if you applied the filter above for 'Borough', you can not display, query, save or edit Anchorage, because that is a 'Municipality' and therefore not part of the subset.

The only exception is that unless your layer is part of a database, using a subset will prevent you from editing the layer.

12.2.2 Style Properties

 The Style tab provides you with a comprehensive tool for rendering and symbolizing your vector data. You can use tools that are common to all vector data, as well as special symbolizing tools that were designed for the different kinds of vector data. However all types share the following dialog structure: in the upper part, you have a widget that helps you prepare the classification and the symbol to use for features and at the bottom the *Reproducción de capas* widget.

Truco: Exportar simbología vector

You have the option to export vector symbology from QGIS into Google *.kml, *.dxf and MapInfo *.tab files. Just open the right mouse menu of the layer and click on *Save As...* to specify the name of the output file and its format. In the dialog, use the *Symbology export* menu to save the symbology either as *Feature symbology* → or as *Symbol layer symbology* →. If you have used symbol layers, it is recommended to use the second setting.

Representación de elementos

The renderer is responsible for drawing a feature together with the correct symbol. Regardless layer geometry type, there are four common types of renderers: single symbol, categorized, graduated and rule-based. For point layers, there are a point displacement and a heatmap renderers available while polygon layers can also be rendered with the inverted polygons and 2.5 D renderers.

There is no continuous color renderer, because it is in fact only a special case of the graduated renderer. The categorized and graduated renderers can be created by specifying a symbol and a color ramp - they will set the colors for symbols appropriately. For each data type (points, lines and polygons), vector symbol layer types are available. Depending on the chosen renderer, the dialog provides different additional sections.

Nota: If you change the renderer type when setting the style of a vector layer the settings you made for the symbol will be maintained. Be aware that this procedure only works for one change. If you repeat changing the renderer type the settings for the symbol will get lost.

Representador de Símbolo Único

The *Single Symbol* renderer is used to render all features of the layer using a single user-defined symbol. See *El Selector de Símbolo* for further information about symbol representation.

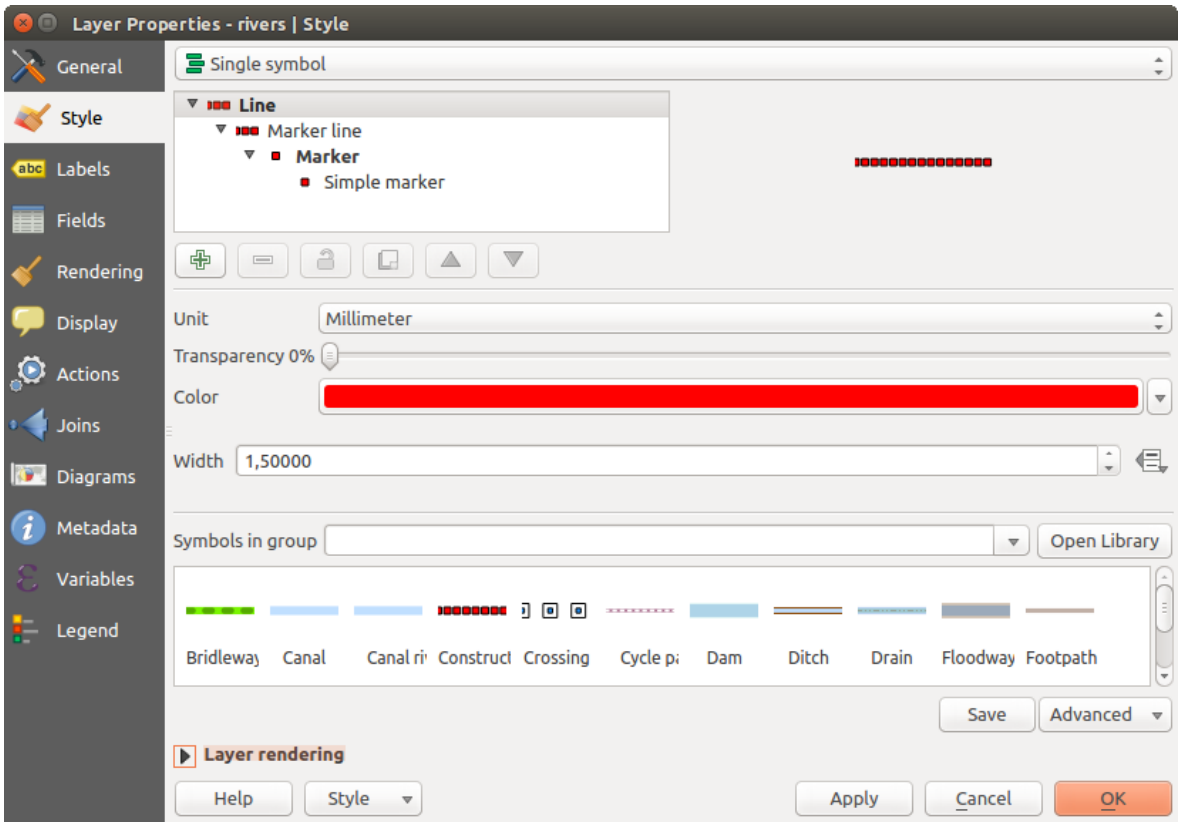


Figure 12.9: Propiedades de línea con símbolo único

Truco: Edit symbol directly from layer panel

If in your **Layers Panel** you have layers with categories defined through categorized, graduated or rule-based style mode, you can quickly change the fill color of the symbol of the categories by right-clicking on a category and choose the color you prefer from a color wheel menu. Right-clicking on a category will also give you access to the options **Hide all items**, **Show all items** and **Edit symbol**.

Sin representación de símbolos

The *No Symbols* renderer is a special use case of the Single Symbol renderer as it applies the same rendering to all features. Using this renderer, no symbol will be drawn for features, but labeling, diagrams and other non-symbol parts will still be shown.

Selections can still be made on the layer in the canvas and selected features will be rendered with a default symbol. Features being edited will also be shown.

This is intended as a handy shortcut for layers which you only want to show labels or diagrams for, and avoids the need to render symbols with totally transparent fill/border to achieve this.

Representador Categorizado

The  *Categorized* renderer is used to render the features of a layer, using a user-defined symbol whose aspect reflects the discrete values of a field or an expression. The Categorized menu allows you to

- select an existing field (using the Column listbox) or
- type or build an *expression* using the  Set column expression. The expression used to classify features can be of any type; it can for example:
  - be a comparison, e.g. `myfield >= 100`, `$id = @atlas_featureid`, `myfield % 2 = 0`, `within( $geometry, @atlas_geometry )`. In this case, QGIS returns values `1` (**True**) and `0` (**False**).
  - combine different fields, e.g. `concat( field1, ' ', field2 )` particularly useful when you want to process classification on two or more fields simultaneously.
  - be a calculation on fields, e.g. `myfield % 2`, `year( myfield ) field_1 + field_2`.
  - be used to transform linear values in discrete classes, e.g.:

    ```
    CASE WHEN x > 1000 THEN 'Big' ELSE 'Small' END
    ```

  - combine several discrete values in one single category, e.g.:

    ```
    CASE
    WHEN building IN ('residence', 'mobile home') THEN 'residential'
    WHEN building IN ('commercial', 'industrial') THEN 'Commercial and Industrial'
    END
    ```

Nota: While you can use any kind of expression to categorize features, for some complex expressions it might be simpler to use *rule-based rendering*.

- the symbol (using the *El Selector de Símbolo* dialog) which will be used as base symbol for each class;
- the range of colors (using the Color ramp listbox) from which color applied to the symbol is selected.

Then click on **[Classify]** button to create classes from the distinct value of the attribute column. Each class can be disabled unchecking the checkbox at the left of the class name.

To change symbol, value and/or label of the class, just double click on the item you want to change.

Right-click shows a contextual menu to **Copy/Paste**, **Change color**, **Change transparency**, **Change output unit**, **Change symbol width**.

The example in figure_categorized_symbology shows the category rendering dialog used for the rivers layer of the QGIS sample dataset.

Truco: Elegir y cambiar símbolos múltiples

The Symbology allows you to select multiple symbols and right click to change color, transparency, size, or width of selected entries.

Truco: Hacer coincidir las categorías con el nombre de símbolo

In the [Advanced] menu, under the classes, you can choose one of the two first actions to match symbol name to a category name in your classification. *Matched to saved symbols* match category name with a symbol name from your *Style Manager*. *Match to symbols from file* match category name to a symbol name from an external file.

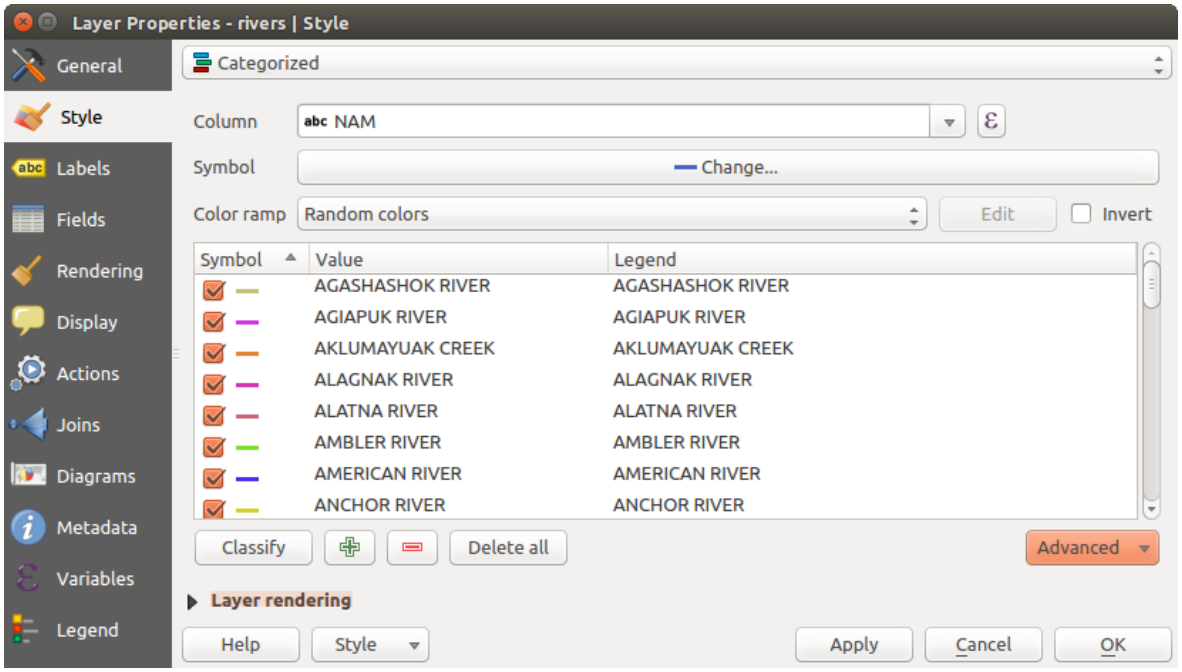


Figure 12.10: Opciones de simbolización categorizadas

Representador Graduado

The *Graduated* renderer is used to render all the features from a layer, using an user-defined symbol whose color or size reflects the assignment of a selected feature's attribute to a class.

Like the Categorized Renderer, the Graduated Renderer allows you to define rotation and size scale from specified columns.

Also, analogous to the Categorized Renderer, it allows you to select:

- The attribute (using the Column listbox or the Set column expression function)
- The symbol (using the Symbol selector dialog)
- El formato de leyenda y la precisión
- The method to use to change the symbol: color or size
- The colors (using the color Ramp list) if the color method is selected
- The size (using the size domain and its unit)

Then you can use the Histogram tab which shows an interactive histogram of the values from the assigned field or expression. Class breaks can be moved or added using the histogram widget.

Nota: You can use Statistical Summary panel to get more information on your vector layer. See *Panel de resumen estadístico*.

Back to the Classes tab, you can specify the number of classes and also the mode for classifying features within the classes (using the Mode list). The available modes are:

- Equal Interval: each class has the same size (e.g. values from 0 to 16 and 4 classes, each class has a size of 4);
- Quantile: each class will have the same number of element inside (the idea of a boxplot);
- Natural Breaks (Jenks): the variance within each class is minimal while the variance between classes is maximal;

- Standard Deviation: classes are built depending on the standard deviation of the values;
- Pretty Breaks: Computes a sequence of about n+1 equally spaced nice values which cover the range of the values in x. The values are chosen so that they are 1, 2 or 5 times a power of 10. (based on pretty from the R statistical environment http://astrostatistics.psu.edu/datasets/R/html/base/html/pretty.html)

The listbox in the center part of the *Style* tab lists the classes together with their ranges, labels and symbols that will be rendered.

Click on **Classify** button to create classes using the chosen mode. Each classes can be disabled unchecking the checkbox at the left of the class name.

To change symbol, value and/or label of the class, just double click on the item you want to change.

Right-click shows a contextual menu to **Copy/Paste**, **Change color**, **Change transparency**, **Change output unit**, **Change symbol width**.

The example in figure_graduated_symbology shows the graduated rendering dialog for the rivers layer of the QGIS sample dataset.

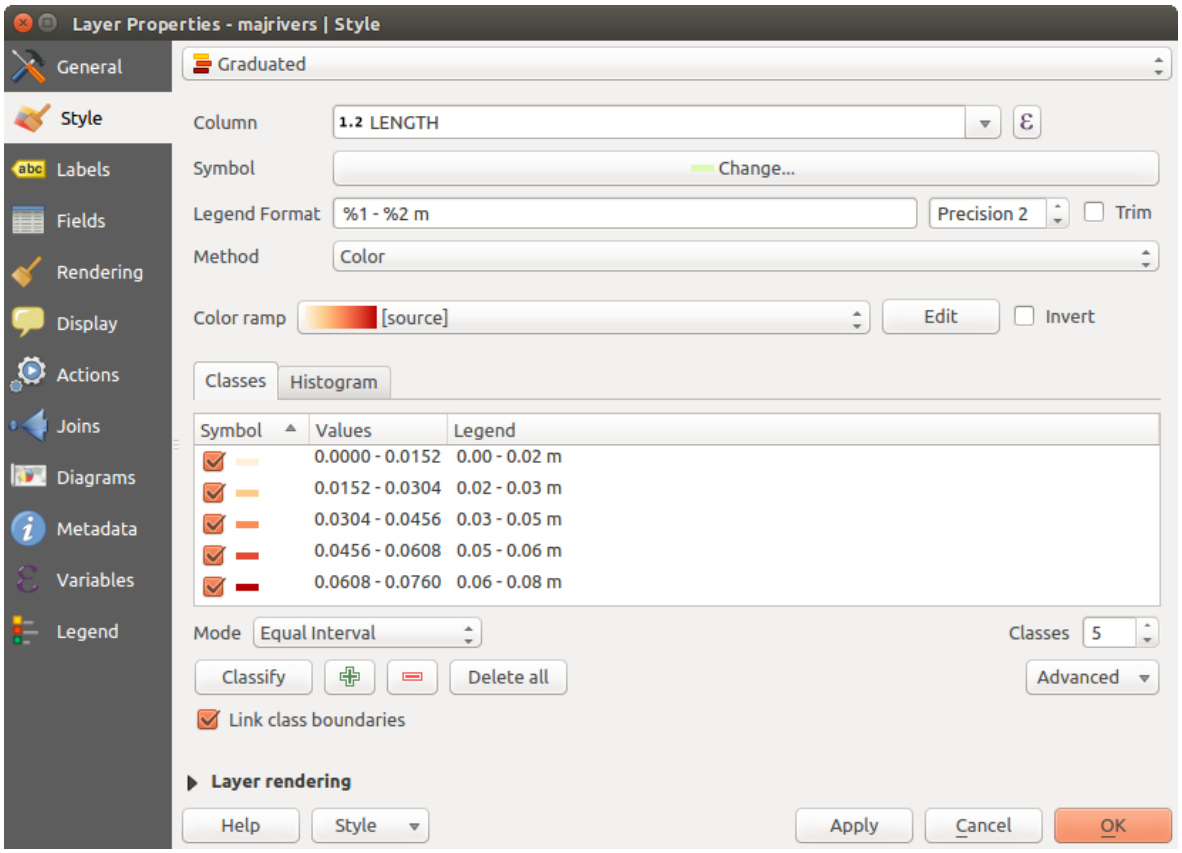


Figure 12.11: Graduated Symbolizing options

Truco: Thematic maps using an expression

Categorized and graduated thematic maps can be created using the result of an expression. In the properties dialog for vector layers, the attribute chooser is extended with a Set column expression function. So you don't need to write the classification attribute to a new column in your attribute table if you want the classification attribute to be a composite of multiple fields, or a formula of some sort.

Proportional Symbol and Multivariate Analysis

Proportional Symbol and Multivariate Analysis are not rendering types available from the Style rendering drop-down list. However with the **Size Assistant** options applied over any of the previous rendering options, QGIS allows you to display your point and line data with such representation. **Crear símbolo proporcional**

Proportional rendering is done by first applying to the layer the *Representador de Símbolo Único*. Once you set the symbol, at the upper level of the symbol tree, the *Data-defined override* button available beside *Size* or *Width* options (for point or line layers respectively) provides tool to create proportional symbology for the layer. An assistant is moreover accessible through the menu to help you define size expression.

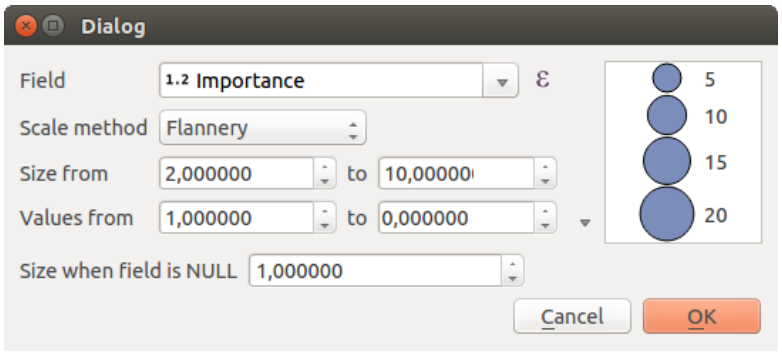


Figure 12.12: Varying size assistant

The assistant lets you define:

- The attribute to represent, using the Field listbox or the Set column expression function (see *Expresiones*)
- the scale method of representation which can be 'Flannery', 'Surface' or 'Radius'
- The minimum and maximum size of the symbol
- The range of values to represent: The down pointing arrow helps you fill automatically these fields with the minimum (or zero) and maximum values returned by the chosen attribute or the expression applied to your data.
- An unique size to represent NULL values.

To the right side of the dialog, you can preview the features representation within a live-update widget. This representation is added to the layer tree in the layer legend and is also used to shape the layer representation in the print composer legend item.

The values presented in the varying size assistant above will set the size 'Data-defined override' with:

```
coalesce(scale_exp(Importance, 1, 20, 2, 10, 0.57), 1)
```

Crear análisis multivariable

A multivariate analysis rendering helps you evaluate the relationship between two or more variables e.g., one can be represented by a color ramp while the other is represented by a size.

The simplest way to create multivariate analysis in QGIS is to first apply a categorized or graduated rendering on a layer, using the same type of symbol for all the classes. Then, clicking on the symbol **[Change]** button above the classification frame, you get the *El Selector de Símbolo* dialog from which, as seen above, you can activate and set the *size assistant* option either on size (for point layer) or width (for line layer).

Like the proportional symbol, the size-related symbol is added to the layer tree, at the top of the categorized or graduated classes symbols. And both representation are also available in the print composer legend item.

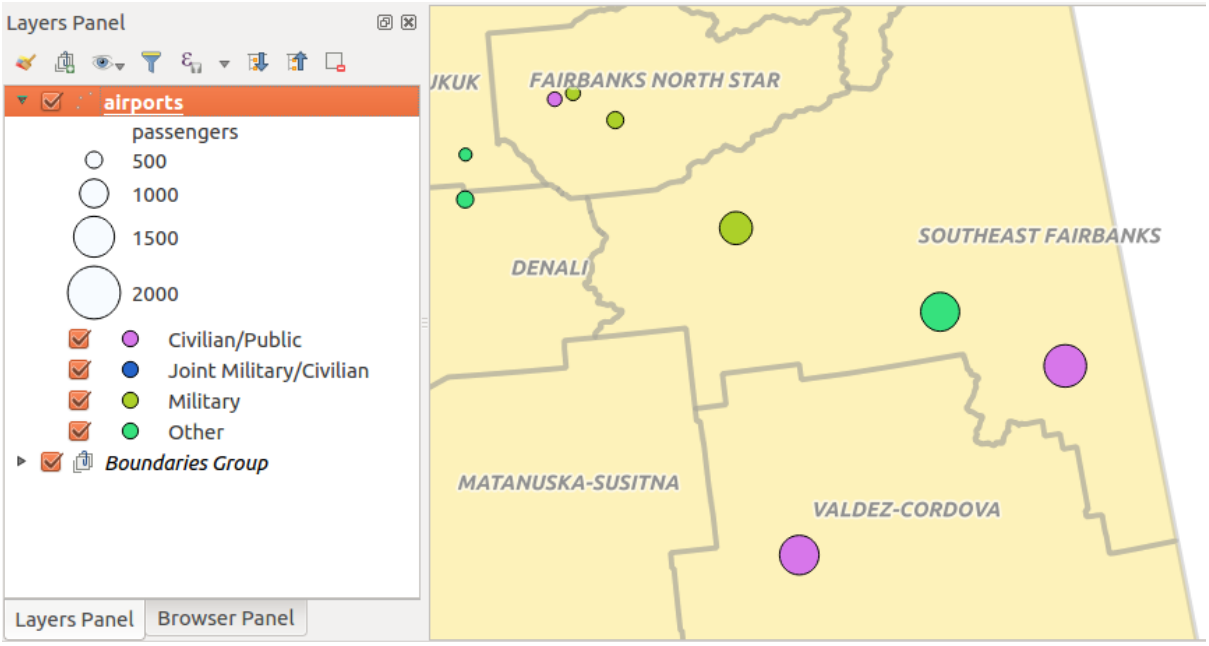


Figure 12.13: Multivariate example

Rule-based Renderer

The *Rule-based* renderer is used to render all the features from a layer, using rule-based symbols whose aspect reflects the assignment of a selected feature's attribute to a class. The rules are based on SQL statements. The dialog allows rule grouping by filter or scale, and you can decide if you want to enable symbol levels or use only the first-matched rule.

To create a rule, activate an existing row by double-clicking on it, or click on '+' and click on the new rule. In the *Rule properties* dialog, you can define a label for the rule. Press the ... button to open the expression string builder. In the **Function List**, click on *Fields and Values* to view all attributes of the attribute table to be searched. To add an attribute to the field calculator **Expression** field, double click on its name in the *Fields and Values* list. Generally, you can use the various fields, values and functions to construct the calculation expression, or you can just type it into the box (see *Expresiones*). You can create a new rule by copying and pasting an existing rule with the right mouse button. You can also use the 'ELSE' rule that will be run if none of the other rules on that level matches. Since QGIS 2.8 the rules appear in a tree hierarchy in the map legend. Just double-click the rules in the map legend and the Style tab of the layer properties appears showing the rule that is the background for the symbol in the tree.

The example in figure_rule_based_symbology shows the rule-based rendering dialog for the rivers layer of the QGIS sample dataset.

Point displacement Renderer

The *Point Displacement* renderer works to visualize all features of a point layer, even if they have the same location. To do this, the symbols of the points are placed on a displacement circle around one center symbol or on several concentric circles.

Nota: You can still render features with other renderer like Single symbol, Graduated, Categorized or Rule-Based renderer using the *Renderer* drop-down list then the *Renderer Settings...* button.

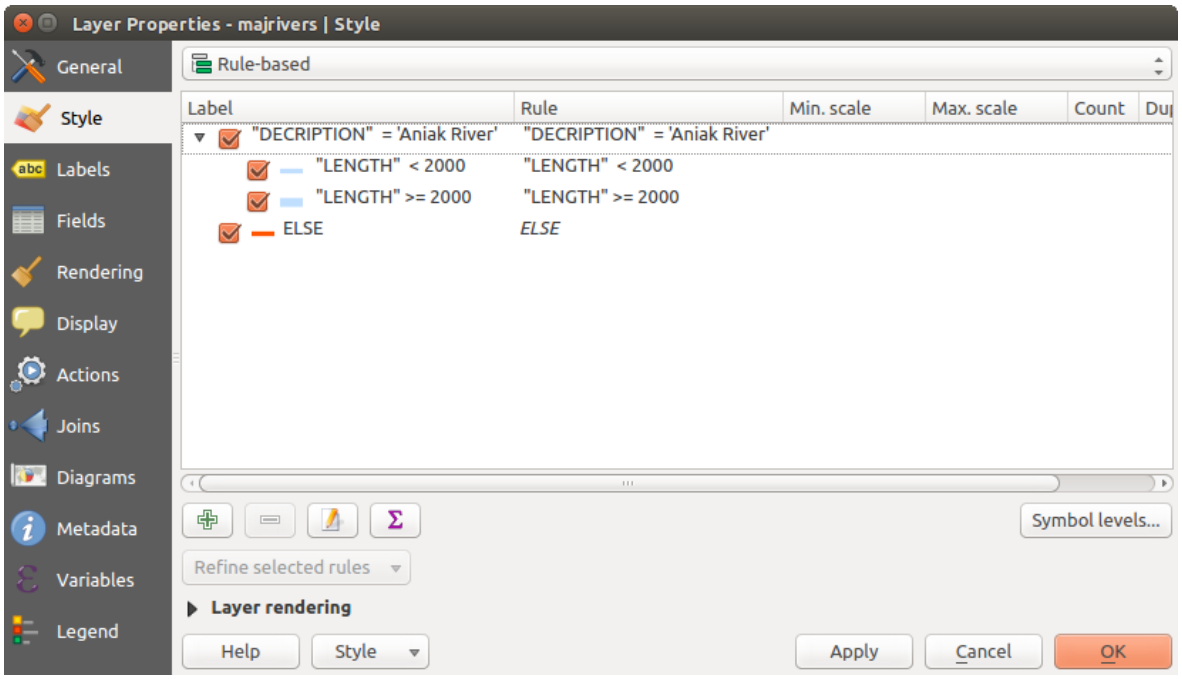


Figure 12.14: Opciones de simbología basada en reglas

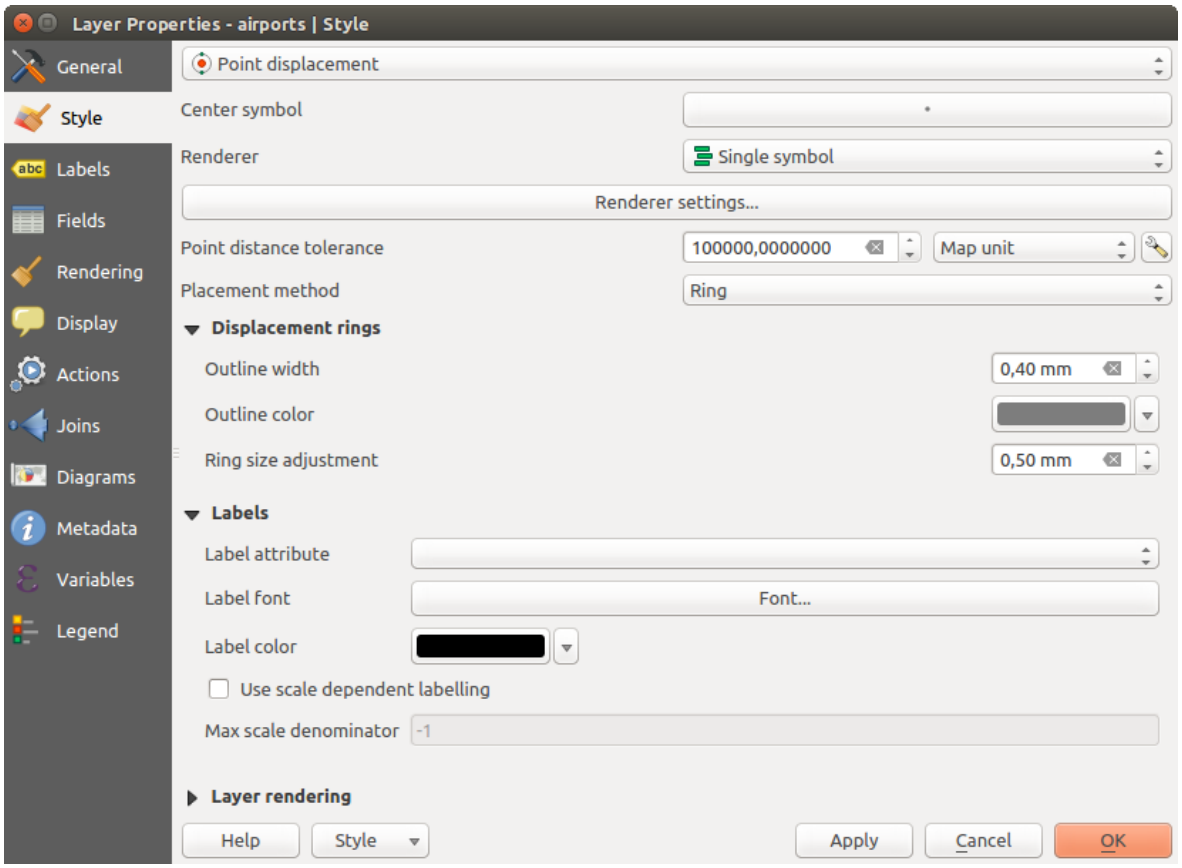


Figure 12.15: Cuadro de diálogo de desplazamiento de punto

Inverted Polygon Renderer

The *Inverted Polygon* renderer allows user to define a symbol to fill in outside of the layer's polygons. As above you can select subrenderers, namely Single symbol, Graduated, Categorized, Rule-Based or 2.5D renderer.

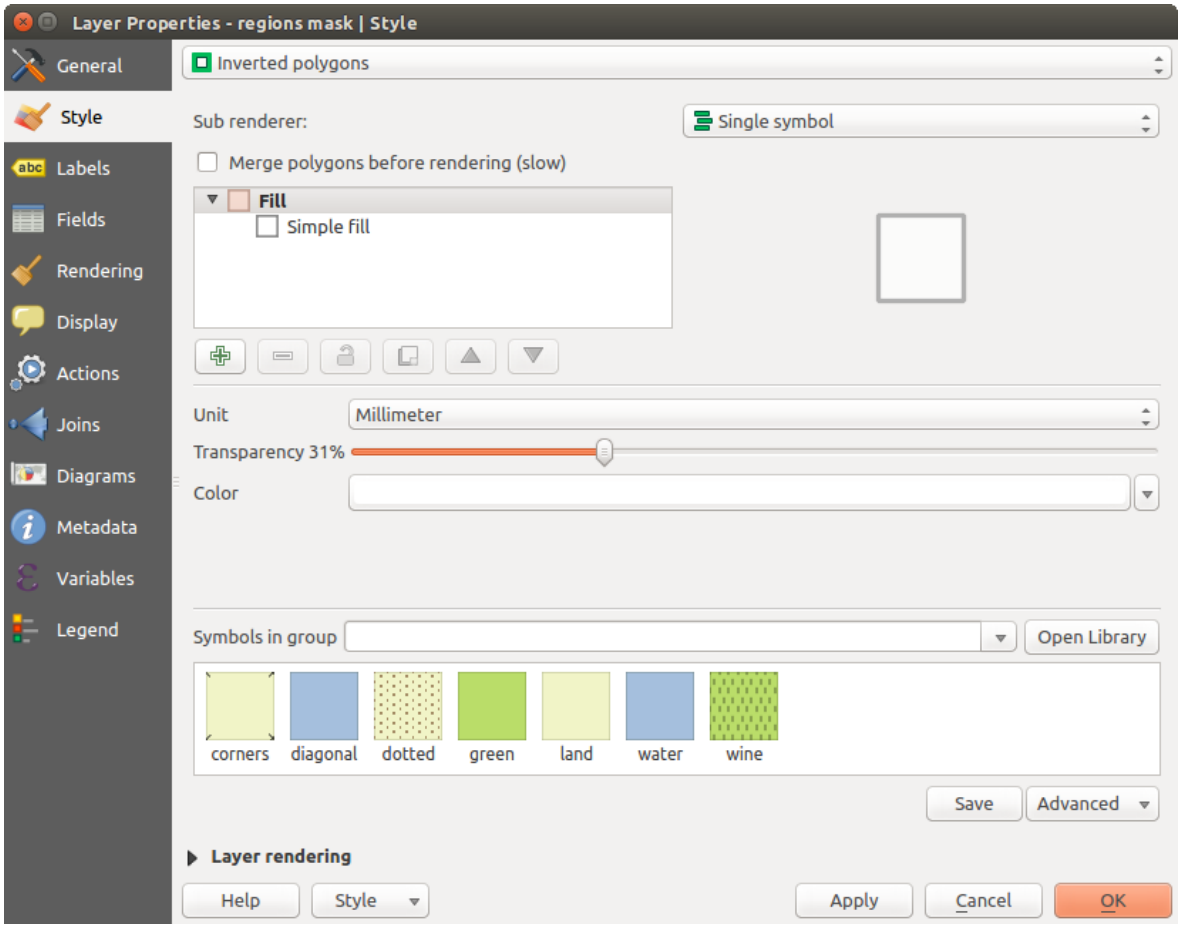


Figure 12.16: Inverted Polygon dialog

Heatmap Renderer

With the *Heatmap* renderer you can create live dynamic heatmaps for (multi)point layers. You can specify the heatmap radius in pixels, mm or map units, choose and edit a color ramp for the heatmap style and use a slider for selecting a trade-off between render speed and quality. You can also define a maximum value limit and give a weight to points using a field or an expression. When adding or removing a feature the heatmap renderer updates the heatmap style automatically.

2.5D Renderer

Using the *2.5D* renderer it's possible to create a 2.5D effect on your layer's features. You start by choosing a *Height* value (in map units). For that you can use a fixed value, one of your layer's fields, or an expression. You also need to choose an *Angle* (in degrees) to recreate the viewer position (0° means west, growing in counter clock wise). Use advanced configuration options to set the *Roof Color* and *Wall Color*. If you would like to simulate

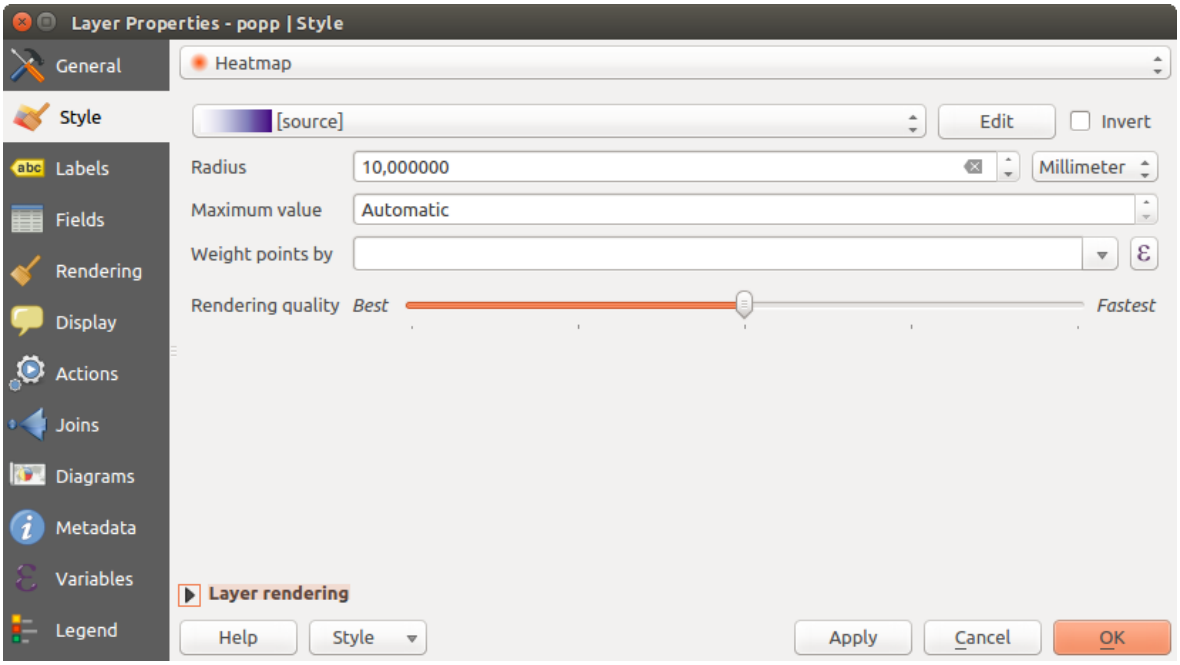


Figure 12.17: Diálogo Mapa de calor

solar radiation on the features walls, make sure to check the *Shade walls based on aspect* option. You can also simulate a shadow by setting a *Color* and *Size* (in map units).

Truco: Using 2.5D effect with other renderers

Once you have finished setting the basic style on the 2.5D renderer, you can convert this to another renderer (single, categorized, graduated). The 2.5D effects will be kept and all other renderer specific options will be available for you to fine tune them (this way you can have for example categorized symbols with a nice 2.5D representation or add some extra styling to your 2.5D symbols). To make sure that the shadow and the "building" itself do not interfere with other nearby features, you may need to enable Symbols Levels (*Advanced* → *Symbol levels...*). The 2.5D height and angle values are saved in the layer's variables, so you can edit it afterwards in the variables tab of the layer's properties dialog.

Reproducción de capas

From the Style tab, you can also set some options that invariably act on all features of the layer:

- *Layer transparency* : You can make the underlying layer in the map canvas visible with this tool. Use the slider to adapt the visibility of your vector layer to your needs. You can also make a precise definition of the percentage of visibility in the the menu beside the slider.
- *Layer blending mode* and *Feature blending mode*: You can achieve special rendering effects with these tools that you may previously only know from graphics programs. The pixels of your overlaying and underlaying layers are mixed through the settings described in *Modos de Mezcla*.
- Apply *paint effects* on all the layer features with the *Draw Effects* button.
- *Control feature rendering order* allows you, using features attributes, to define the z-order in which they shall be rendered. Activate the checkbox and click on the button beside. You then get the *Define Order* dialog in which you:
  - choose a field or build an expression to apply to the layer features
  - set in which order the fetched features should be sorted, i.e. if you choose **Ascending** order, the features with lower value are rendered under those with upper value.

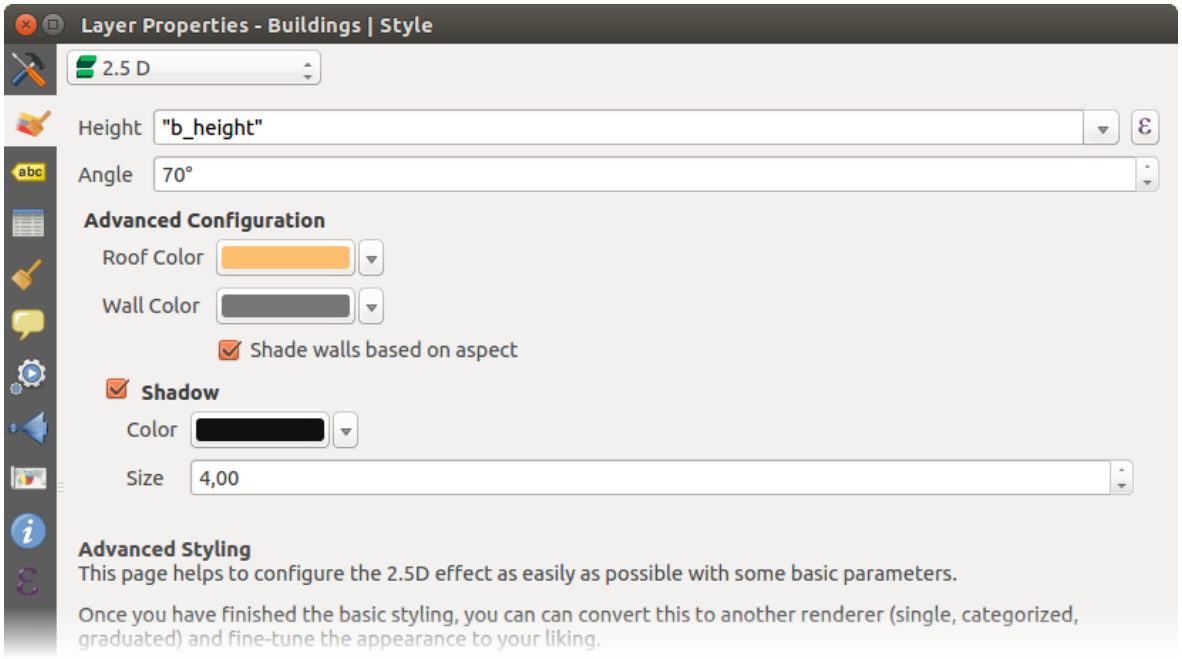


Figure 12.18: Diálogo 2.5D

– define when features returning NULL value should be rendered: **first** or **last**.

You can add several rules of ordering. The first rule is applied to all the features in the layer, z-ordering them according to the value returned. Then, for each group of features with the same value (including those with NULL value) and thus same z-level, the next rule is applied to sort its items among them. And so on...

Figure 12.19: Layer rendering options

Otras Configuraciones

Symbols levels

For renderers that allow stacked symbol layers (only heatmap doesn't) there is an option to control the rendering order of each symbol's levels.

For most of the renderers, you can access the Symbols levels option by clicking the **[Advanced]** button below the saved symbols list and choosing *Symbol levels*. For the *Rule-based Renderer* the option is directly available through **[Symbols levels]** button, while for *Point displacement Renderer* renderer the same button is inside the *Rendering settings* dialog.

To activate symbols levels, select the *Enable symbol levels*. Each row will show up a small sample of the combined symbol, its label and the individual symbols layer divided into columns with a number next to it. The numbers represent the rendering order level in which the symbol layer will be drawn. Lower values levels are drawn first, staying at the bottom, while higher values are drawn last, on top of the others.

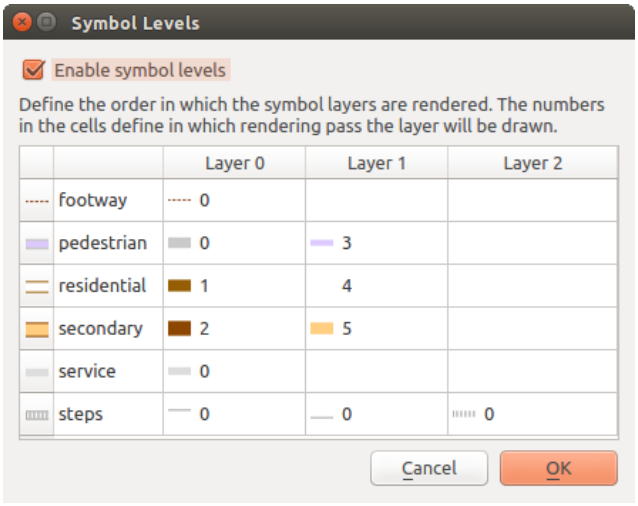


Figure 12.20: Symbol levels dialog

Nota: If symbols levels are deactivated, the complete symbols will be drawn according to their respective features order. Overlapping symbols will simply obfuscate to other below. Besides, similar symbols won't "merge" with each other.

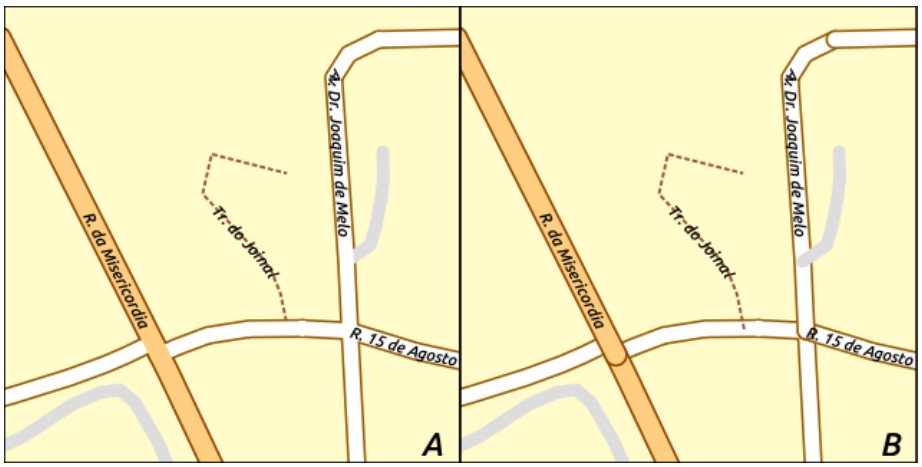


Figure 12.21: Symbol levels activated (A) and deactivated (B) difference

Efectos de dibujo

In order to improve layer rendering and avoid (or at least reduce) the resort to other software for final rendering of maps, QGIS provides another powerful functionality: the *Draw Effects* options, which adds paint effects for customizing the visualization of vector layers.

The option is available in the *Layer Properties –> Style* dialog, under the *Layer rendering* group (applying to the whole layer) or in *symbol layer properties* (applying to corresponding features). You can combine both usage.

Paint effects can be activated by checking the *Draw effects* option and clicking the Customize effects button, that will open the *Effect Properties* Dialog (see figure_effects_source). The following effect types, with custom options are available:

- **Source:** Draws the feature's original style according to the configuration of the layer's properties. The transparency of its style can be adjusted.

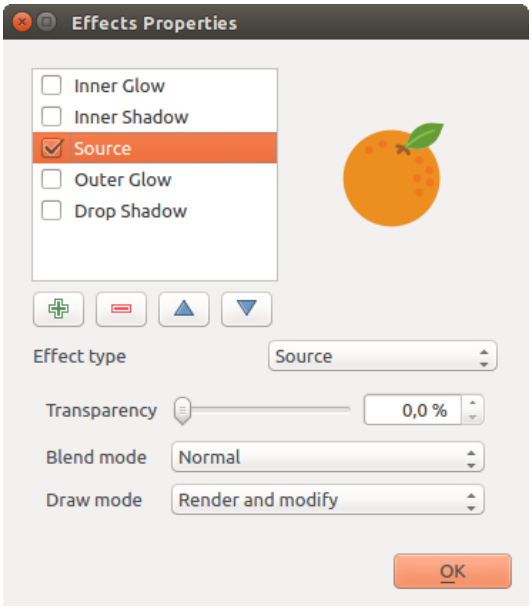


Figure 12.22: Efectos de dibujo: cuadro de diálogo Fuente

- **Blur:** Adds a blur effect on the vector layer. The options that someone can change are the *Blur type* (*Stack* or *Gaussian blur*), the strength and transparency of the blur effect.
- **Colorize:** This effect can be used to make a version of the style using one single hue. The base will always be a grayscale version of the symbol and you can use the *Grayscale* to select how to create it (options are: 'lightness', 'luminosity' and 'average'). If *Colorise* is selected, it will be possible to mix another color and choose how strong it should be. You can also control the *Brightness*, *contrast* and *saturation* levels of the resulting symbol.
- **Drop Shadow:** Using this effect adds a shadow on the feature, which looks like adding an extra dimension. This effect can be customized by changing the *offset* degrees and radius, determining where the shadow shifts towards to and the proximity to the source object. *Drop Shadow* also has the option to change the blur radius, the transparency and the color of the effect.
- **Inner Shadow:** This effect is similar to the *Drop Shadow* effect, but it adds the shadow effect on the inside of the edges of the feature. The available options for customization are the same as the *Drop Shadow* effect.
- **Inner Glow:** Adds a glow effect inside the feature. This effect can be customized by adjusting the *spread* (width) of the glow, or the *Blur radius*. The latter specifies the proximity from the edge of the feature where you want any blurring to happen. Additionally, there are options to customize the color of the glow, with a single color or a color ramp.
- **Outer Glow:** This effect is similar to the *Inner Glow* effect, but it adds the glow effect on the outside of the edges of the feature. The available options for customization are the same as the *Inner Glow* effect.
- **Transform:** Adds the possibility of transforming the shape of the symbol. The first options available for customization are the *Reflect horizontal* and *Reflect vertical*, which actually create a reflection on the horizontal and/or vertical axes. The 4 other options are:
  - *Shear*: slants the feature along the x and/or y axis
  - *Scale*: enlarges or minimizes the feature along the x and/or y axis by the given percentage
  - *Rotation*: turns the feature around its center point
  - and *Translate* changes the position of the item based on a distance given on the x and/or the y axis.

There are some common options available for all draw effect types. *Transparency* and *Blend mode* options work similar to the ones described in *Reproducción de capas* and can be used in all draw effects except for the transform

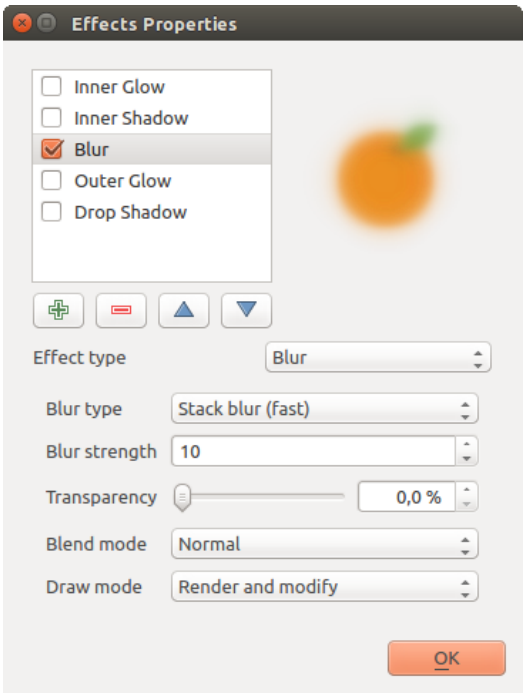


Figure 12.23: Efectos de dibujo: cuadro de diálogo Difuminar

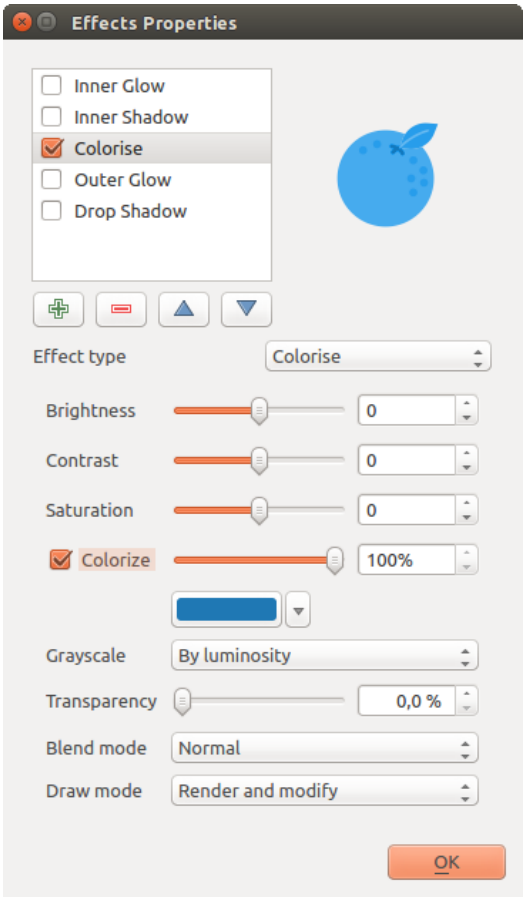


Figure 12.24: Efectos de dibujo: cuadro de diálogo Dar Color

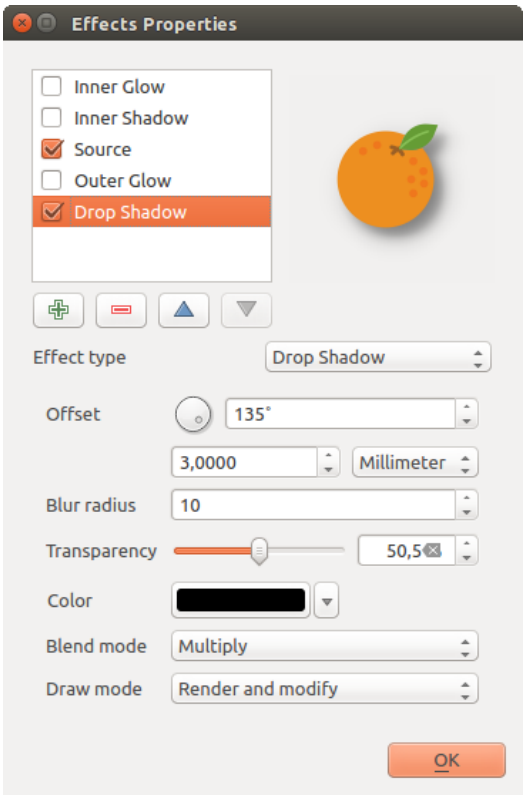


Figure 12.25: Efectos de dibujo: cuadro de diálogo Sombra exterior

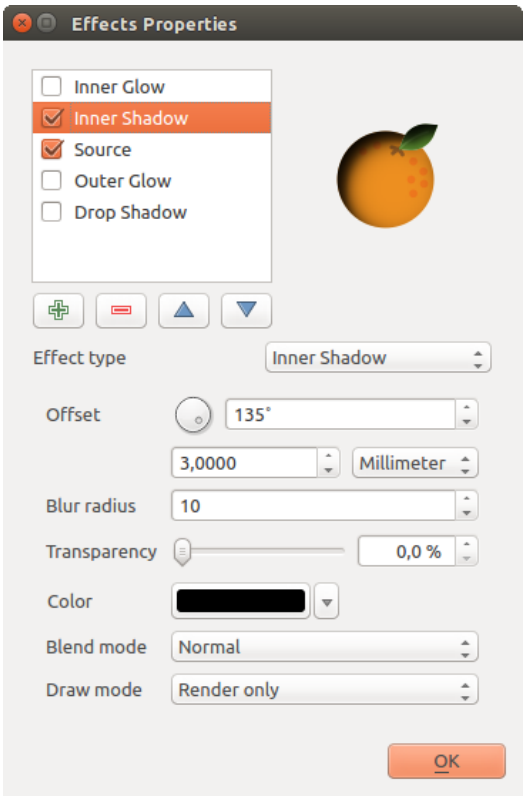


Figure 12.26: Efectos de dibujo: cuadro de diálogo Sombra interior

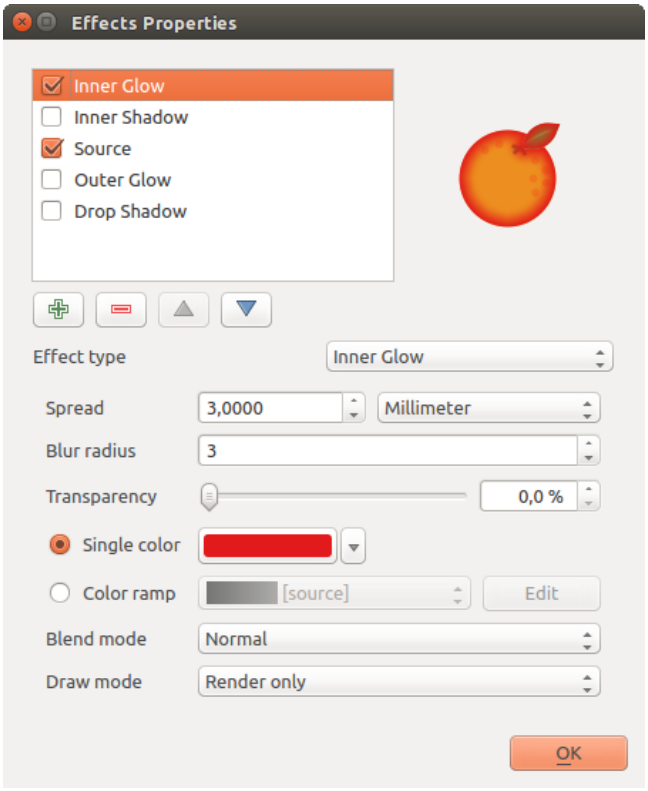


Figure 12.27: Efectos de dibujo: cuadro de diálogo Brillo interior

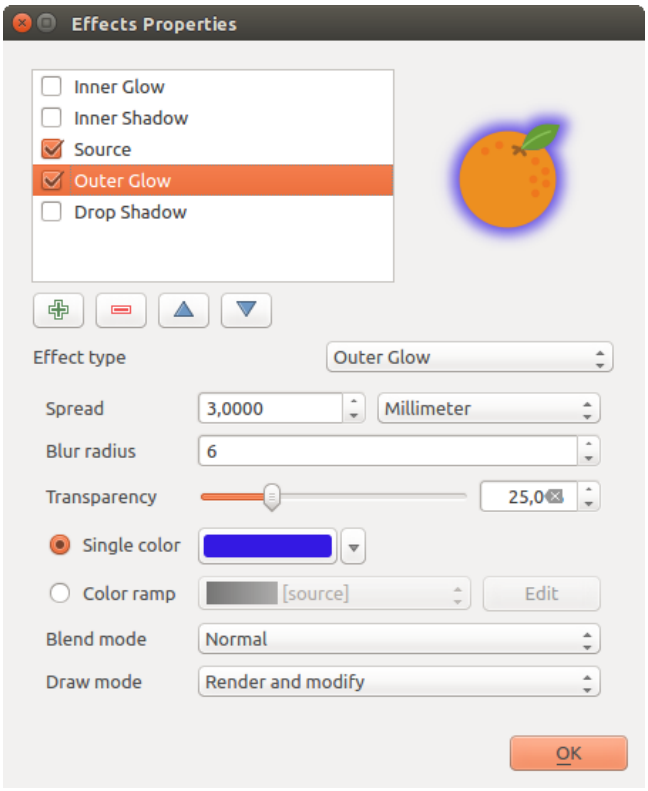


Figure 12.28: Efectos de dibujo: cuadro de diálogo Brillo exterior

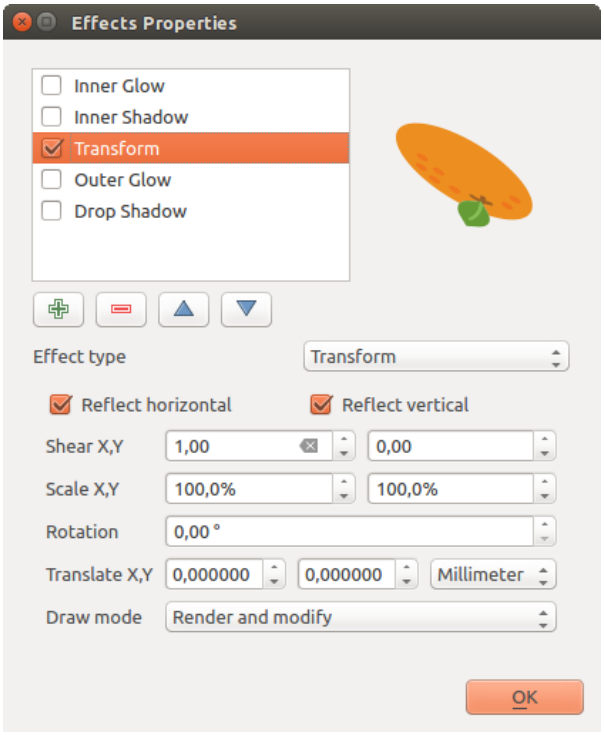


Figure 12.29: Efectos de dibujo: cuadro de diálogo Transformar

one.

One or more draw effects can used at the same time. You activate/deactivate an effect using its checkbox in the effects list. You can change the selected effect type by using the *Effect type* option. You can reorder the effects using Move up and Move down buttons, and also add/remove effects using the Add effect and Remove effect buttons.

There is also a *Draw mode* option available for every draw effect, and you can choose whether to render and/or to modify the symbol. Effects render from top to bottom.'Render only' mode means that the effect will be visible while the 'Modify only' mode means that the effect will not be visible but the changes that it applies will be passed to the next effect (the one immediately below). The 'Render and Modify' mode will make the effect visible and pass any changes to the next effect. If the effect is in the top of the effects list or if the immediately above effect is not in modify mode, then it will use the original source symbol from the layers properties (similar to source).

12.2.3 Propiedades de etiquetas

The *Labels* properties provides you with all the needed and appropriate capabilities to configure smart labeling on vector layers. This dialog can also be accessed from the *Layer Styling* panel, or using the Layer Labeling Options icon of the **Labels toolbar**.

Configurar una etiqueta

The first step is to choose the labeling method from the drop-down list. There are four options available:

- **No labels**
- **Show labels for this layer**
- *Rule-based labeling*

- and **Blocking**: allows to set a layer as just an obstacle for other layer's labels without rendering any labels of its own.

The next steps assume you select the **Show labels for this layer** option, enabling following tabs that help you configure the labeling:

- *Texto*
- *Formateo*
- *Buffer*
- *Fondo*
- *Sombra*
- *Ubicación*
- *Representación*

It also enables the **Label with** drop-down list, from which you can select an attribute column to use. Click ε if you want to define labels based on expressions - See *Definir etiquetas basadas en expresiones*.

The following steps describe simple labeling without using the *Data defined override* functions, which are situated next to the drop-down menus - see *Using data-defined override for labeling* for a use case.

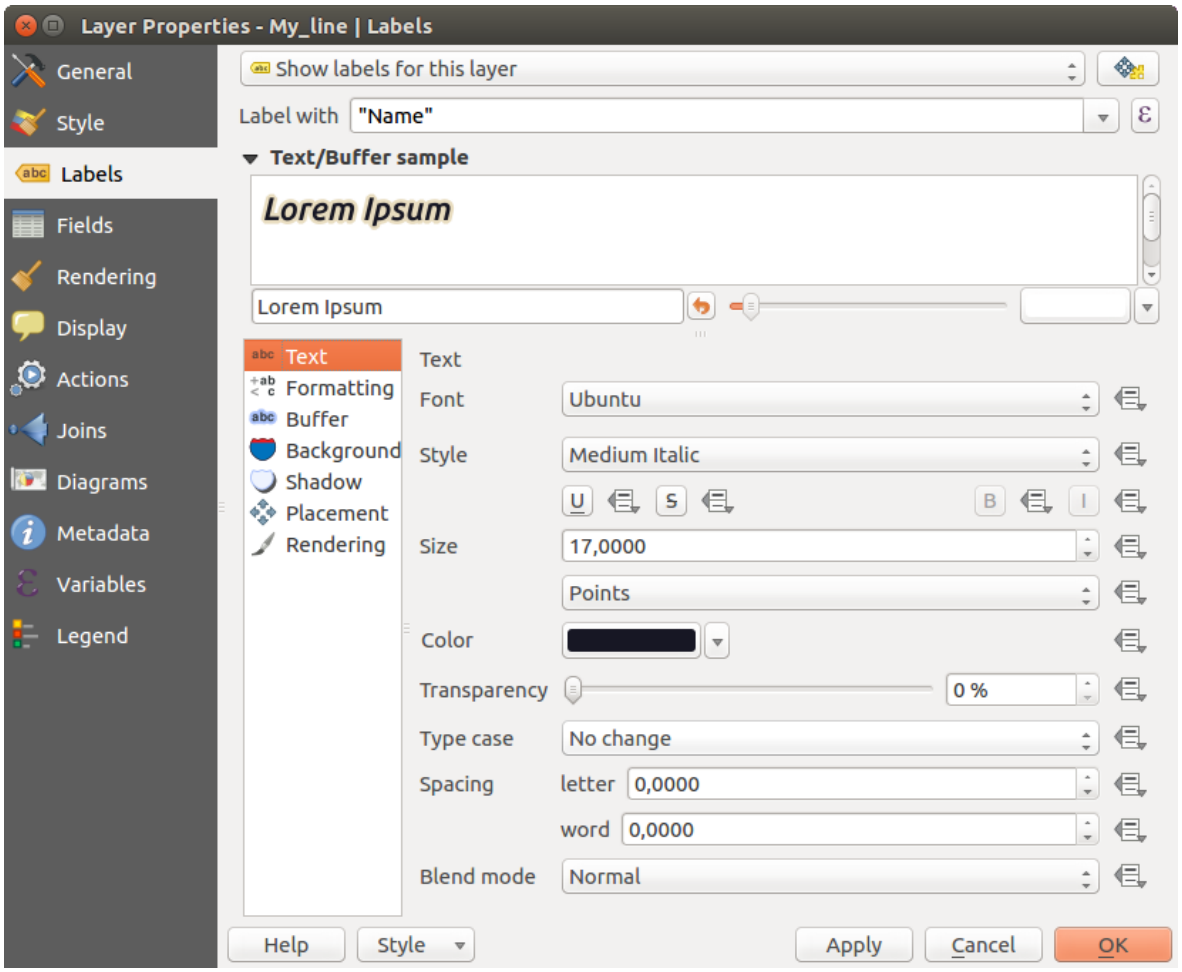


Figure 12.30: Configuración del etiquetado de capa - Pestaña de Texto

Pestaña de Texto

In the *Text* tab, you can define the *Font*, *Style*, and *Size* of your labels' text (see Figure_labels). There are options available to set the labels' *Color* and *Transparency*. Use the *Type case* option to change the capitalization style of the text. You have the possibility to render the text as 'All uppercase', 'All lowercase' or 'Capitalize first letter'. In *Spacing*, you can change the space between words and between individual letters. Finally, use the *Blend mode* option to determine how your labels will mix with the map features below them (see more about it in *Modos de Mezcla*).

The *Apply label text substitutes* option gives you ability to specify a list of texts to substitute to texts in feature labels (e.g., abbreviating street types). Replacement texts are thus used to display labels in the map canvas. Users can also export and import lists of substitutes to make reuse and sharing easier.

Pestaña de formato

In the *Formatting* tab, you can define a character for a line break in the labels with the *Wrap on character* option. You can also format the *Line Height* and the *alignment*. For the latter, typical values are available (left, right, and center), plus *Follow label placement* for point layers. When set to this mode, text alignment for labels will be dependent on the final placement of the label relative to the point. E.g., if the label is placed to the left of the point, then the label will be right aligned, while if it is placed to the right, it will be left aligned.

For line vector layers you can include *Line directions symbols* to help determine the lines directions. They work particularly well when used with the *curved* or *Parallel* placement options from the *Placement* tab. There are options to set the symbols position, and to *reverse direction*.

Use the *Formatted numbers* option to format numeric labels. You can set the number of *Decimal places*. By default, 3 decimal places will be used. Use the *Show plus sign* if you want to show the plus sign in positive numbers.

Pestaña de buffer

To create a buffer around the labels, activate the *Draw text buffer* checkbox in the *Buffer* tab. You can set the buffer's *Size*, *color*, and *Transparency*. The buffer expands from the label's outline , so, if the *color buffer's fill* checkbox is activated, the buffer interior is filled. This may be relevant when using partially transparent labels or with non-normal blending modes, which will allow seeing behind the label's text. Deactivating *color buffer's fill* checkbox (while using totally transparent labels) will allow you to create outlined text labels.

Pestaña de Fondo

In the *Background* tab, you can define with *Size X* and *Size Y* the shape of your background. Use *Size type* to insert an additional 'Buffer' into your background. The buffer size is set by default here. The background then consists of the buffer plus the background in *Size X* and *Size Y*. You can set a *Rotation* where you can choose between 'Sync with label', 'Offset of label' and 'Fixed'. Using 'Offset of label' and 'Fixed', you can rotate the background. Define an *Offset X,Y* with X and Y values, and the background will be shifted. When applying *Radius X,Y*, the background gets rounded corners. Again, it is possible to mix the background with the underlying layers in the map canvas using the *Blend mode* (see *Modos de Mezcla*).

Pestaña de Sombra

Use the *Shadow* tab for a user-defined *Drop shadow*. The drawing of the background is very variable. Choose between 'Lowest label component', 'Text', 'Buffer' and 'Background'. The *Offset* angle depends on the orientation of the label. If you choose the *Use global shadow* checkbox, then the zero point of the angle is always oriented to the north and doesn't depend on the orientation of the label. You can influence the appearance of the

shadow with the *Blur radius*. The higher the number, the softer the shadows. The appearance of the drop shadow can also be altered by choosing a blend mode.

Pestaña de Colocación

Choose the *Placement* tab for configuring label placement and labeling priority. Note that the placement options differ according to the type of vector layer, namely point, line or polygon.

Ubicación para capas punto With the *Cartographic* placement mode, point labels are generated with a better visual relationship with the point feature, following ideal cartographic placement rules. Labels can be placed at a set *Distance* either from the point feature itself or from the bounds of the symbol used to represent the feature. The latter option is especially useful when the symbol size isn't fixed, e.g. if it's set by a data defined size or when using different symbols in a categorized renderer.

By default, placements are prioritised in the following order:

1. arriba derecha
2. arriba izquierda
3. abajo derecha
4. abajo izquierda
5. al medio derecha
6. al medio izquierda
7. arriba, ligeramente derecha
8. abajo, ligeramente izquierda

Placement priority can, however, be customized or set for an individual feature using a data defined list of prioritised positions. This also allows only certain placements to be used, so e.g. for coastal features you can prevent labels being placed over the land.

The *Around point* setting places the label in an equal radius (set in *Distance*) circle around the feature. The placement of the label can even be constrained using the *Quadrant* option.

With the *Offset from point*, labels are placed at a fixed offset from the point feature. You can select the *Quadrant* in which to place your label. You are also able to set the *Offset X,Y* distances between the points and their labels and can alter the angle of the label placement with the *Rotation* setting. Thus, placement in a selected quadrant with a defined rotation is possible.

Ubicación para capas línea Label options for line layers include *Parallel*, *Curved* or *Horizontal*. For the *Parallel* and *Curved* options, you can set the position to *Above line*, *On line* and *Below line*. It's possible to select several options at once. In that case, QGIS will look for the optimal label position. For Parallel and curved placement options, you can also use the line orientation for the position of the label. Additionally, you can define a *Maximum angle between curved characters* when selecting the *Curved* option (see Figure_labels_placement_line).

For all three placement options, in *Repeat*, you can set up a minimum distance for repeating labels. The distance can be in `mm` or in `map units`.

Ubicación para capas polígono You can choose one of the following options for placing labels in polygons (see figure_labels_placement_polygon):

- *Desplazamiento desde el centroide*,
- *Horizontal (lento)*,
- *Al rededor del centroide*,

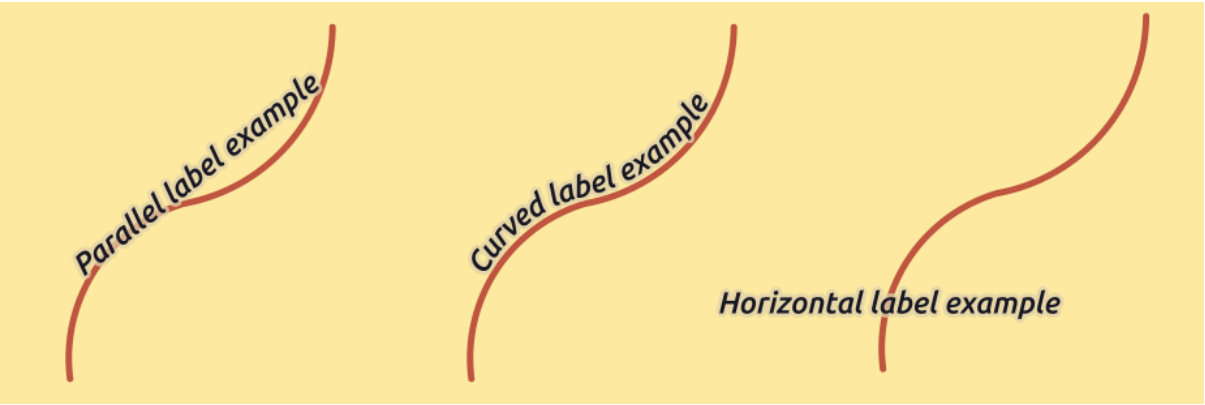


Figure 12.31: Label placement examples in lines

- *Libre (lento)*,
- *Usando perímetro*,
- and *Usando perímetro (curved)*.

In the *Offset from centroid* settings you can specify if the centroid is of the *visible polygon* or *whole polygon*. That means that either the centroid is used for the polygon you can see on the map or the centroid is determined for the whole polygon, no matter if you can see the whole feature on the map. You can place your label within a specific quadrant, and define offset and rotation.

The *Around centroid* setting places the label at a specified distance around the centroid. Again, you can define *visible polygon* or *whole polygon* for the centroid.

With the *Horizontal (slow)* or *Free (slow)* options, QGIS places at the best position either a horizontal or a rotated label inside the polygon.

With the *Using perimeter* option, the label will be drawn next to the polygon boundary. The label will behave like the parallel option for lines. You can define a position and a distance for the label. For the position, *Above line*, *On line*, *Below line* and *Line orientation dependent position* are possible. You can specify the distance between the label and the polygon outline, as well as the repeat interval for the label.

The *Using perimeter (curved)* option helps you draw the label along the polygon boundary, using a curved labeling. In addition to the parameters available with *Using perimeter* setting, you can set the *Maximum angle between curved characters polygon*, either inside or outside.

In the *priority* section you can define the priority with which labels are rendered for all three vector layer types (point, line, polygon). This placement option interacts with the labels from other vector layers in the map canvas. If there are labels from different layers in the same location, the label with the higher priority will be displayed and the others will be left out.

Pestaña de Renderizado

In the *Rendering* tab, you can tune when the labels can be rendered and their interaction with other labels and features.

Under *Label options*, you find the *scale-based* and the *Pixel size-based* visibility settings.

The *Label z-index* determines the order in which labels are rendered, as well in relation with other feature labels in the layer (using data-defined override expression), as with labels from other layers. Labels with a higher z-index are rendered on top of labels (from any layer) with lower z-index.

Additionally, the logic has been tweaked so that if 2 labels have matching z-indexes, then:

- if they are from the same layer, the smaller label will be drawn above the larger label

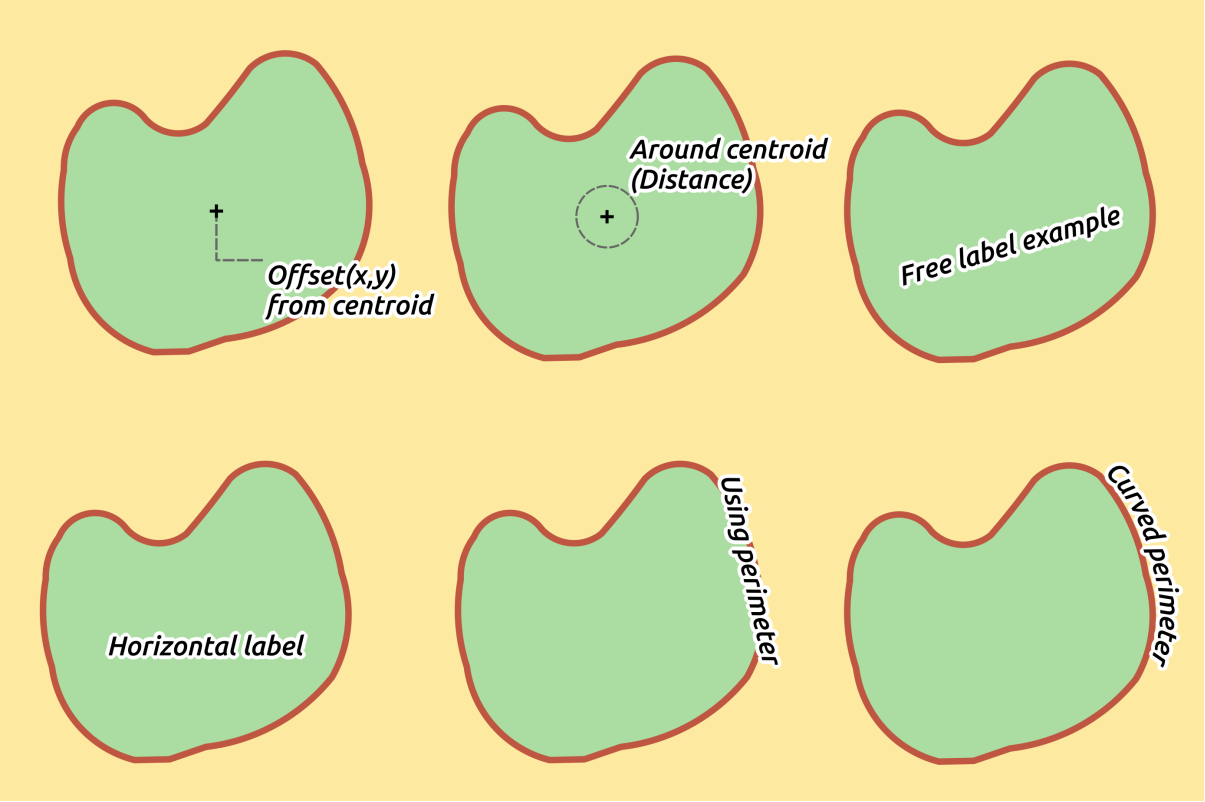


Figure 12.32: Ejemplos de colocación de etiqueta en polígonos

- if they are from different layers, the labels will be drawn in the same order as their layers themselves (ie respecting the order set in the map legend).

Note that this setting doesn't make labels to be drawn below the features from other layers, it just controls the order in which labels are drawn on top of all the layer's features.

While rendering labels and in order to display readable labels, QGIS automatically evaluates the position of the labels and can hide some of them in case of collision. You can however choose to *Show all labels for this layer (including colliding labels)* in order to manually fix their placement.

With data-defined expressions in *Show label* and *Always Show* you can fine tune which labels should be rendered.

Under *Feature options*, you can choose to *label every part of a multi-part feature* and *limit the number of features to be labeled*. Both line and polygon layers offer the option to set a minimum size for the features to be labeled, using *Suppress labeling of features smaller than*. For polygon features, you can also filter the labels to show according to whether they completely fit within the feature or not. For line features, you can choose to *Merge connected lines to avoid duplicate labels*, rendering a quite airy map in conjunction with the *Distance* or *Repeat* options in Placement tab.

From the *Obstacles* frame, you can manage the covering relation between labels and features. Activate the *Discourage labels from covering features* option to decide whether features of the layer should act as obstacles for any label (including labels from other features in the same layer). An obstacle is a feature QGIS tries as far as possible to not place labels over. Instead of the whole layer, you can define a subset of features to use as obstacles, using the data-defined override control next to the option.

The priority control slider for obstacles allows you to make labels prefer to overlap features from certain layers rather than others. A **Low weight** obstacle priority means that features of the layer are less considered as obstacles and thus more likely to be covered by labels. This priority can also be data-defined, so that within the same layer, certain features are more likely to be covered than others.

For polygon layers, you can choose the type of obstacle features could be by minimising the labels placement:

- **over the feature's interior**: avoids placing labels over the interior of the polygon (prefers placing labels totally outside or just slightly inside the polygon)
- or **over the feature's boundary**: avoids placing labels over boundary of the polygon (prefers placing labels outside or completely inside the polygon). E.g., it can be useful for regional boundary layers, where the features cover an entire area. In this case, it's impossible to avoid placing labels within these features, and it looks much better to avoid placing them over the boundaries between features.

Etiquetado basado en reglas

With rule-based labeling multiple label configurations can be defined and applied selectively on the base of expression filters and scale range, as in *Rule-based rendering*.

To create a rule, select the **Rule-based labeling** option in the main drop-down list from the *Labels* tab and click the button at the bottom of the dialog. Then fill the new dialog with a description and an expression to filter features. You can also set a *scale range* in which the label rule should be applied. The other options available in this dialog are the *common settings* seen beforehand.

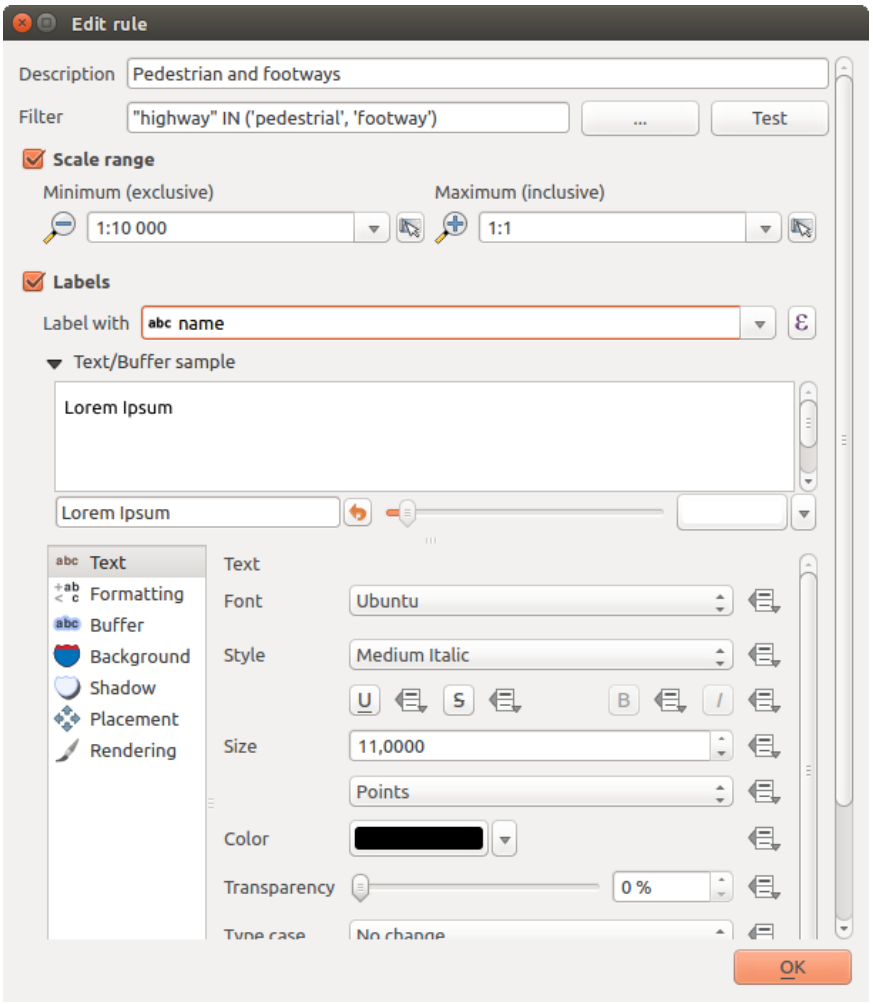


Figure 12.33: Configuración de reglas

A summary of existing rules is shown in the main dialog (see figure_labels_rule_based). You can add multiple rules, reorder or imbricate them with a drag-and-drop. You can as well remove them with the button or edit them with button or a double-click.

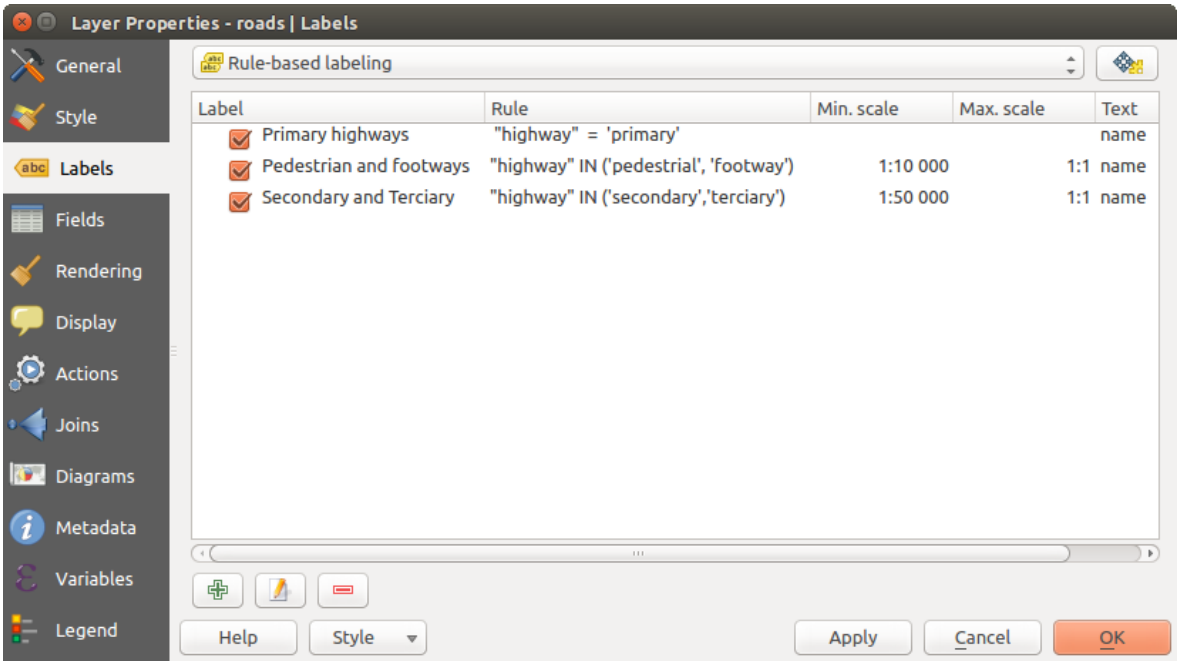


Figure 12.34: Panel de etiquetado basado en reglas

Definir etiquetas basadas en expresiones

Whether you choose simple or rule-based labeling type, QGIS allows using expressions to label features. Click the ε icon near the *Label with* drop-down list in the *Labels* tab of the properties dialog. In figure_labels_expression, you see a sample expression to label the alaska regions with name and area size, based on the field 'NAME_2', some descriptive text, and the function `$area` in combination with `format_number()` to make it look nicer.

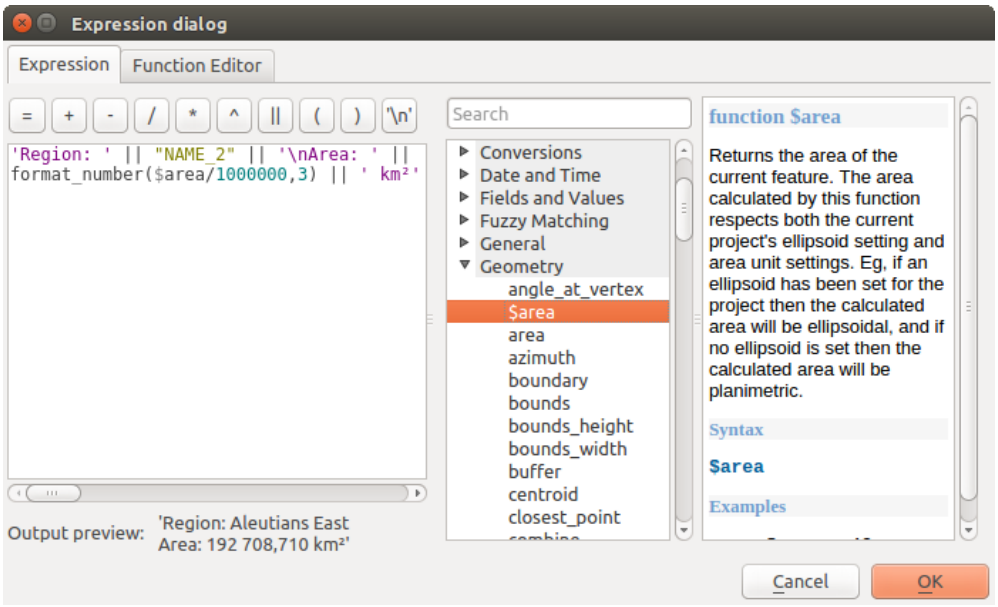


Figure 12.35: Usar expresiones para etiquetado

Expression based labeling is easy to work with. All you have to take care of is that:

- You need to combine all elements (strings, fields, and functions) with a string concatenation function such as `concat`, `+` or `||`. Be aware that in some situations (when null or numeric value are involved) not all of

these tools will fit your need.

- Strings are written in 'single quotes'.
- Fields are written in "double quotes" or without any quote.

Let's have a look at some examples:

1. Label based on two fields 'name' and 'place' with a comma as separator:

   ```
   "name" || ', ' || "place"
   ```

   Devuelve:

   ```
   John Smith, Paris
   ```

2. Label based on two fields 'name' and 'place' with other texts:

   ```
   'My name is ' + "name" + 'and I live in ' + "place"
   'My name is ' || "name" || 'and I live in ' || "place"
   concat('My name is ', name, ' and I live in ', "place")
   ```

   Devuelve:

   ```
   My name is John Smith and I live in Paris
   ```

3. Label based on two fields 'name' and 'place' with other texts combining different concatenation functions:

   ```
   concat('My name is ', name, ' and I live in ' || place)
   ```

   Devuelve:

   ```
   My name is John Smith and I live in Paris
   ```

   Or, if the field 'place' is NULL, returns:

   ```
   My name is John Smith
   ```

4. Multi-line label based on two fields 'name' and 'place' with a descriptive text:

   ```
   concat('My name is ', "name", '\n' , 'I live in ' , "place")
   ```

   Devuelve:

   ```
   My name is John Smith
   I live in Paris
   ```

5. Label based on a field and the $area function to show the place's name and its rounded area size in a converted unit:

   ```
   'The area of ' || "place" || ' has a size of '
   || round($area/10000) || ' ha'
   ```

   Devuelve:

   ```
   The area of Paris has a size of 10500 ha
   ```

6. Create a CASE ELSE condition. If the population value in field *population* is <= 50000 it is a town, otherwise it is a city:

   ```
   concat('This place is a ',
   CASE WHEN "population <= 50000" THEN 'town' ELSE 'city' END)
   ```

   Devuelve:

   ```
   This place is a town
   ```

As you can see in the expression builder, you have hundreds of functions available to create simple and very complex expressions to label your data in QGIS. See *Expresiones* chapter for more information and examples on expressions.

Using data-defined override for labeling

With the Data defined override functions, the settings for the labeling are overridden by entries in the attribute table. It can be used to set values for most of the labeling options described above. See the widget's description and manipulation in *Configuración de anulación definida por datos* section.

La Barra de Herramientas Etiqueta

The *Label Toolbar* provides some tools to manipulate *label* or *diagram* properties, but only if the corresponding data-defined option is indicated (otherwise, buttons are disabled). Layer might also need to be in edit mode.

Figure 12.36: La barra de herramientas Etiqueta

While for readability, `label` has been used below to describe the Label toolbar, note that when mentioned in their name, the tools work almost the same way with diagrams:

- Pin/Unpin Labels And Diagrams that has data-defined position. By clicking or draging an area, you pin label(s). If you click or drag an area holding `Shift`, label(s) are unpinned. Finally, you can also click or drag an area holding `Ctrl` to toggle the pin status of label(s).
- Highlight Pinned Labels And Diagrams. If the vector layer of the label is editable, then the highlighting is green, otherwise it's blue.
- Move Label And Diagram that has data-defined position. You just have to drag the label to the desired place.
- Show/Hide Labels And Diagrams that has data-defined visbility. If you click or drag an area holding `Shift`, then label(s) are hidden. When a label is hidden, you just have to click or drag an area around the feature's point to restore its visibility.
- Rotate Label. Click the label and move around and you get the text rotated.
- Change Label. It opens a dialog to change the clicked label properties; it can be the label itself, its coordinates, angle, font, size... as long as this property has been mapped to a field.

Advertencia: Label tools overwrite current field values
Using the *Label toolbar* to customize the labeling actually writes the new value of the property in the mapped field. Hence, be careful to not inadvertently replace data you may need later!

Customize the labels from the map canvas

Combined with the *Label Toolbar*, the data defined override setting helps you manipulate labels in the map canvas (move, edit, rotate). We now describe an example using the data-defined override function for the Move label function (see figure_labels_data_defined).

1. Import `lakes.shp` from the QGIS sample dataset.

2. Double-click the layer to open the Layer Properties. Click on *Labels* and *Placement*. Select *Offset from centroid*.

3. Look for the *Data defined* entries. Click the icon to define the field type for the *Coordinate*. Choose `xlabel` for X and `ylabel` for Y. The icons are now highlighted in yellow.

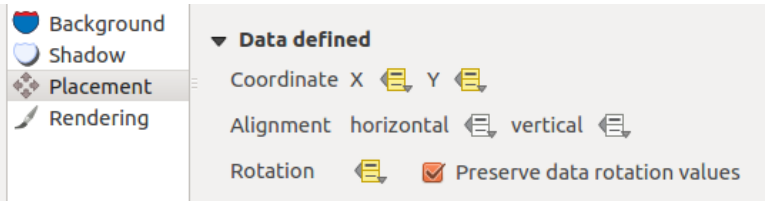


Figure 12.37: Labeling of vector polygon layers with data-defined override

4. Acercamiento a un lago

5. Set editable the layer using the Toggle Editing button.

6. Go to the Label toolbar and click the icon. Now you can shift the label manually to another position (see figure_labels_move). The new position of the label is saved in the `xlabel` and `ylabel` columns of the attribute table.

7. Using *The Geometry Generator* with the expression below, you can also add a linestring symbol layer to connect each lake to its moved label:

```
make_line( centroid( $geometry ), make_point( "xlabel", "ylabel" ) )
```

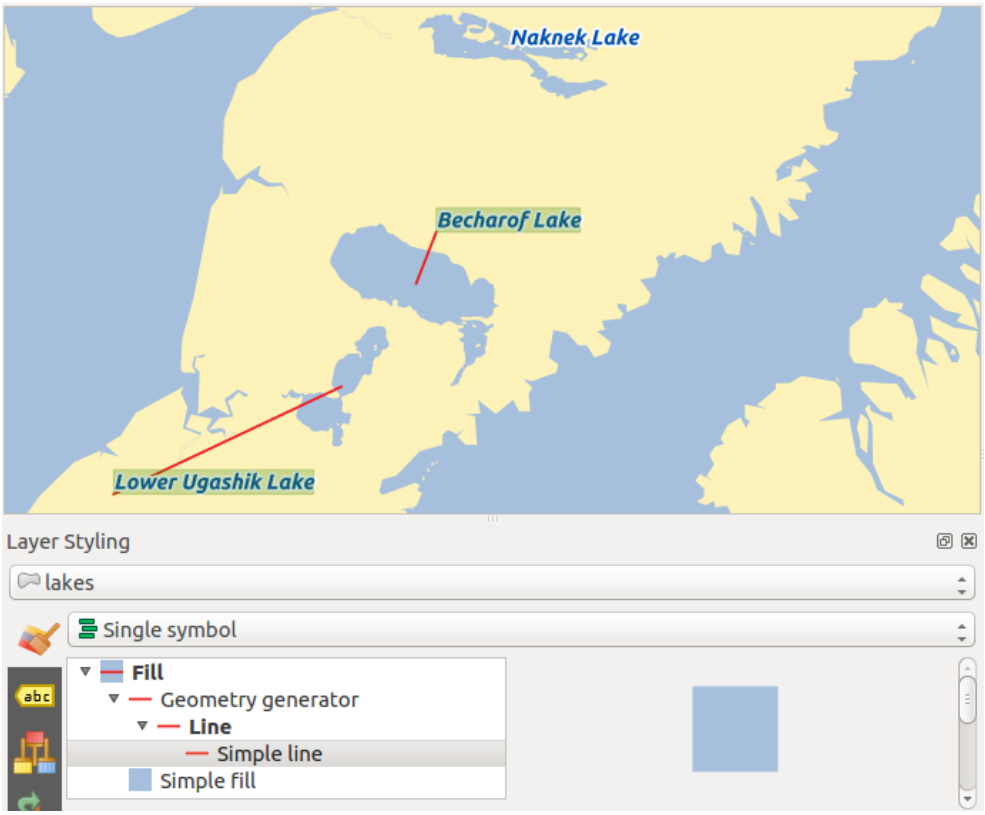


Figure 12.38: Mover etiquetas

12.2.4 Fields Properties

 The *Fields* tab helps you organize the fields of the selected dataset and the way you can interact with the feature's attributes. The buttons  New field and  Delete field can be used when the dataset is in  Editing mode.

You can rename fields by double-clicking in the fields name (note that you should switch to editing mode to edit the field name). This is only supported for data providers like PostgreSQL, Oracle, Memory layer and some OGR layer depending the OGR data format and version.

You can define some alias to display human readable fields in the feature form or the attribute table. In this case, you don't need to switch to editing mode. Alias are saved in project file.

Comments can be added by clicking in the comment field of the column but if you are using a PostgreSQL layer, comment of the column could be the one in the PostgreSQL table if set. Comments are saved in the QGIS project file as for the alias.

The dialog also lists read-only characteristics of the field such as its `type`, `type name`, `length` and `precision`. When serving the layer as `WMS` or `WFS`, you can also check here which fields could be retrieved.

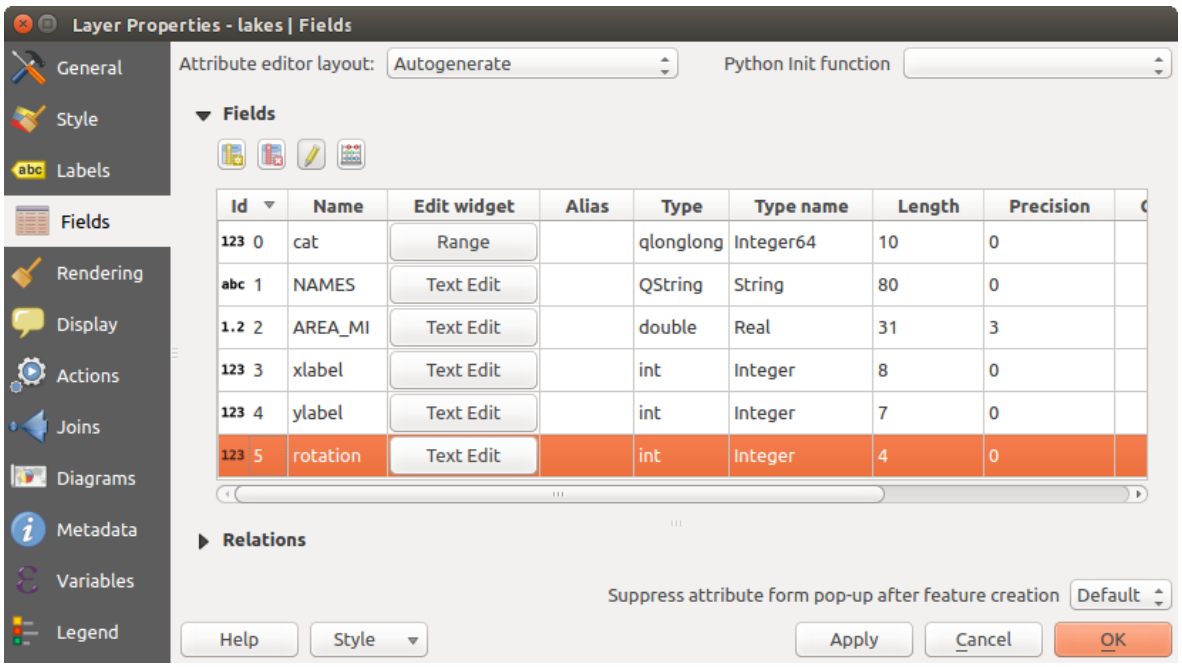


Figure 12.39: Field properties tab

Configurar el comportamiento del campo

Within the *Fields* tab, you also find an **Edit widget** column. This column can be used to define values or a range of values that are allowed to be added to the specific attribute table column. It also helps to set the type of widget used to fill or display values of the field, in the attribute table or the feature form. If you click on the **[Edit widget]** button, a dialog opens, where you can define different widgets.

Configuración común

Regardless the type of widget applied to the field, there are some common properties you can set to control whether and how a field can be edited:

- **Editable**: uncheck this to set the field read-only (not manually modifiable) when the layer is in edit mode. Note that checking this setting doesn't override any edit limitation from the provider.

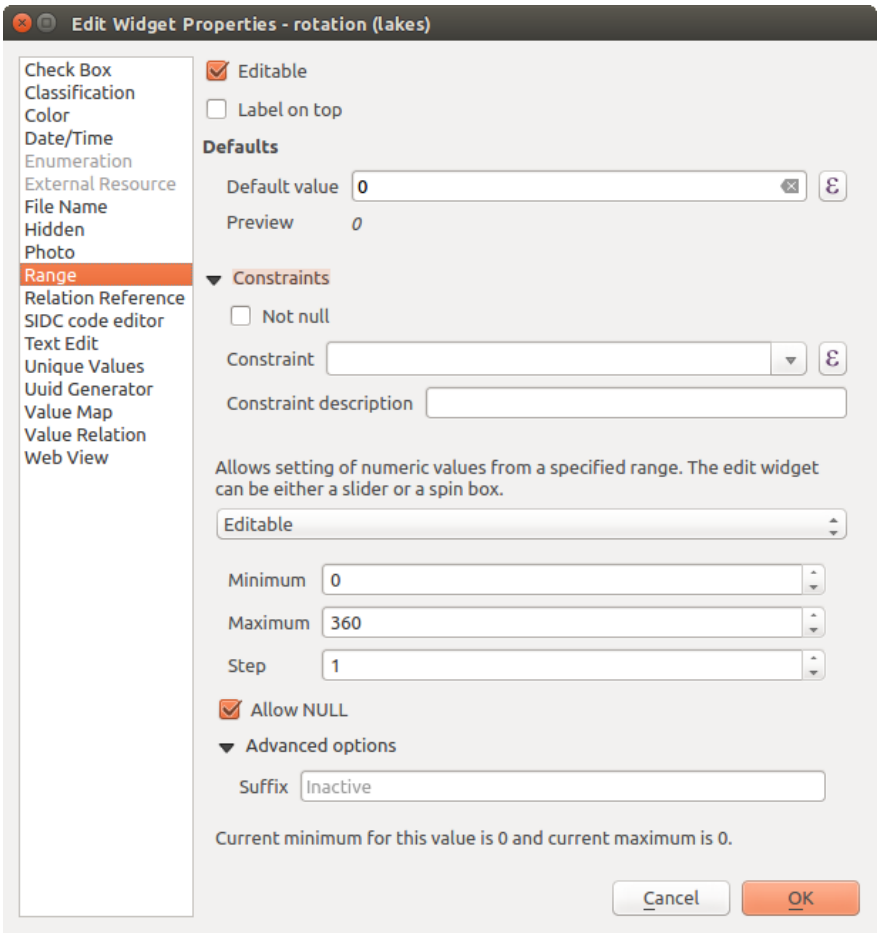


Figure 12.40: Dialog to select an edit widget for an attribute column

- **Label on top**: places the field name above or beside the widget in the feature form
- **Default value**: for new features, automatically populates by default the field with a predefined value or an *expression-based one*. For example, you can:
  - use `$x`, `$length`, `$area` to populate a field with the feature's x coordinate, length, area or any geometric information at its creation;
  - incremente a field by 1 for each new feature using `maximum("field")+1`;
  - save the feature creation datetime using `now()`;
  - use *variables* in expressions, making it easier to e.g. insert the operator name (`@user_full_name`), the project file path (`@project_path`), ...

  A preview of the resulting default value is displayed at the bottom of the widget.

Nota: The `Default value` option is not aware of the values in any other field of the feature being created so it won't be possible to use an expression combining any of those values i.e using an expression like `concat(field1, field2)` may not work.

- **Constraints**: you can constrain the value to insert in the field. This constraint can be:
  - *Not null*: force the user to provide a value
  - based on a custom expression: e.g. `regexp_match(col0,'A-Za-z')` to ensure that the value of the field *col0* has only alphabetical letter.

    A short description of the constraint can be added and will be displayed at the top of the form as a warning message when the value supplied does not match the constraint.

Modo de edición

The available widgets are:

- **Checkbox**: Displays a checkbox, and you can define what attribute is added to the column when the checkbox is activated or not.
- **Classification**: Displays a combo box with the values used for classification, if you have chosen 'unique value' as legend type in the *Style* tab of the properties dialog.
- **Color**: Displays a color button allowing user to choose a color from the color dialog window.
- **Date/Time**: Displays a line field which can open a calendar widget to enter a date, a time or both. Column type must be text. You can select a custom format, pop-up a calendar, etc.
- **Enumeration**: Opens a combo box with values that can be used within the columns type. This is currently only supported by the PostgreSQL provider.
- **External Resource**: Uses a "Open file" dialog to store file path in a relative or absolute mode. It can also be used to display a hyperlink (to document path), a picture or a web page.
- **File Name**: Simplifies the selection by adding a file chooser dialog.
- **Hidden**: A hidden attribute column is invisible. The user is not able to see its contents.
- **Photo**: Field contains a filename for a picture. The width and height of the field can be defined.
- **Range**: Allows you to set numeric values from a specific range. The edit widget can be either a slider or a spin box.
- **Relation Reference**: This widget lets you embed the feature form of the referenced layer on the feature form of the actual layer. See *Creating one or many to many relations*.
- **Text Edit** (default): This opens a text edit field that allows simple text or multiple lines to be used. If you choose multiple lines you can also choose html content.

- **Unique Values**: You can select one of the values already used in the attribute table. If 'Editable' is activated, a line edit is shown with autocompletion support, otherwise a combo box is used.
- **UUID Generator**: Generates a read-only UUID (Universally Unique Identifiers) field, if empty.
- **Value Map**: A combo box with predefined items. The value is stored in the attribute, the description is shown in the combo box. You can define values manually or load them from a layer or a CSV file.
- **Value Relation**: Offers values from a related table in a combobox. You can select layer, key column and value column. Several options are available to change the standard behaviours: allow null value, order by value, allow multiple selections and use of autocompleter. The forms will display either a drop-down list or a line edit field when completer checkbox is enabled.
- **Web View**: Field contains a URL. The width and height of the field is variable.

Truco: Relative Path in widgets

If the path which is selected with the file browser is located in the same directory as the `.qgs` project file or below, paths are converted to relative paths. This increases portability of a `.qgs` project with multimedia information attached. This is enabled only for File Name, Photo and Web View at this moment.

Customize a form for your data

By default, when you click on a feature with the  Identify Features tool or switch the attribute table to the *form view* mode, QGIS displays a form with tabulated textboxes (one per field). This rendering is the result of the default `Autogenerate` value of the *Layer properties* → *Fields* → *Attribute editor layout* setting. Thanks to the *widget setting*, you can improve this dialog.

You can furthermore define built-in forms (see figure_fields_form), e.g. when you have objects with many attributes, you can create an editor with several tabs and named groups to present the attribute fields.

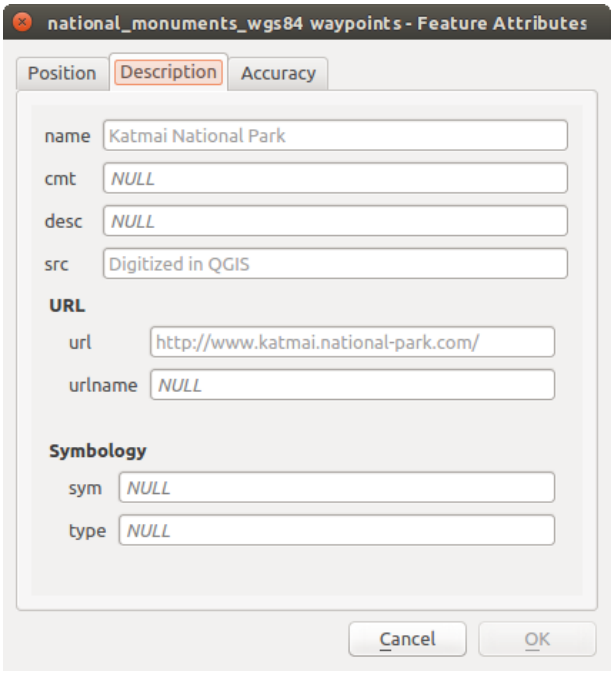


Figure 12.41: Resulting built-in form with tabs and named groups

El diseñador de arrastrar y soltar

Choose `Drag and drop designer` from the *Attribute editor layout* combobox to layout the features form within QGIS. Then, drag and drop rows from the *Fields* frame to the *Label* panel to have fields added to your custom form.

You can also use categories (tab or group frames) to better structure the form. The first step is to use the icon to create a tab in which fields and groups will be displayed (see figure_fields_layout). You can create as many categories as you want. The next step will be to assign to each category the relevant fields, using the icon. You'd need to select the targeted category beforehand. You can use the same fields many times.

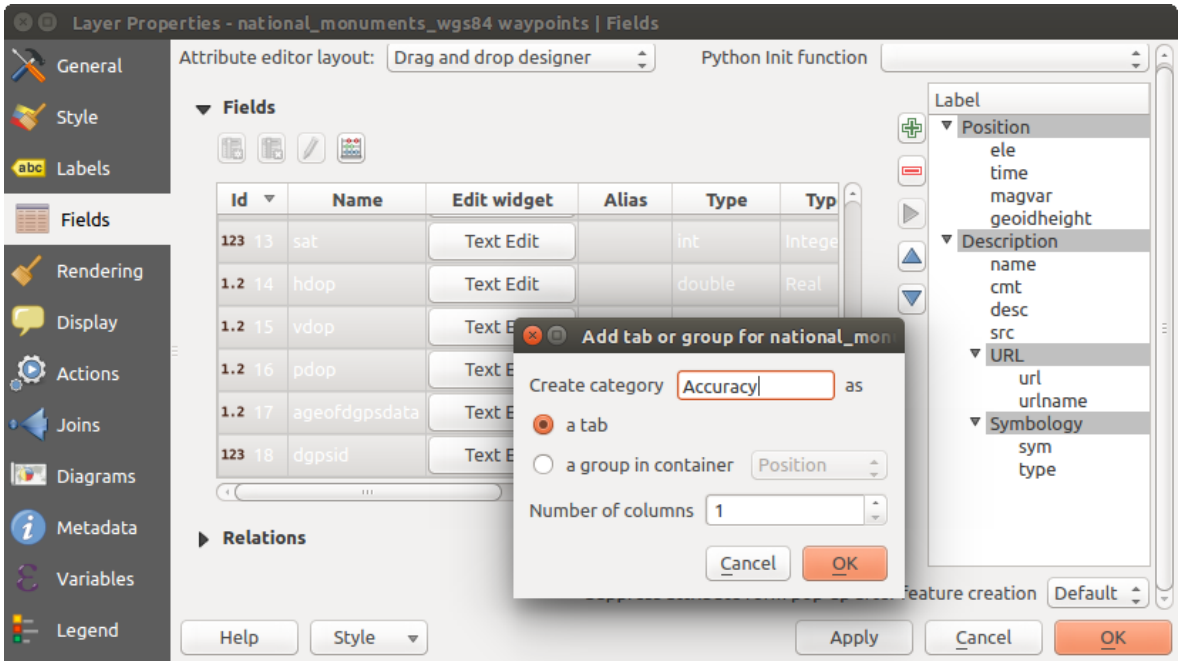


Figure 12.42: El cuadro de diálogo para crear categorías con el **Diseño del editor de atributos**

You can configure tabs or groups with a double-click. QGIS opens a form in which you can:

- choose to hide or show the item label
- rename the category
- set over how many columns the fields under the category should be distributed
- enter an expression to control the category visibility. The expression will be re-evaluated everytime values in the form change and the tab or groupbox shown/hidden accordingly.
- show the category as a group box (only available for tabs)

With a double-click on a field label, you can also specify whether the label of its widget should be visible or not in the form.

In case the layer is involved in `one to many relations` (see *Creating one or many to many relations*), referencing layers are listed in the *Relations* frame and their form can be embedded in the current layer form by drag-and-drop. Like the other items, double-click the relation label to configure some options:

- choose to hide or show the item label
- show the link button
- show the unlink button

Provide an ui-file

The `Provide ui-file` option allows you to use complex dialogs made with Qt-Designer. Using a UI-file allows a great deal of freedom in creating a dialog. Note that, in order to link the graphical objects (textbox, combobox...) to the layer's fields, you need to give them the same name.

Use the *Edit UI* to define the path to the file to use.

You'll find some example in the *Creating a new form* lesson of the *QGIS-training-manual-index-reference*. For more advanced information, see http://nathanw.net/2011/09/05/qgis-tips-custom-feature-forms-with-python-logic/.

Enhance your form with custom functions

QGIS forms can have a Python function that is called when the dialog is opened. Use this function to add extra logic to your dialogs. The form code can be specified in three different ways:

- `load from the environment`: use a function, for example in `startup.py` or from an installed plugin)
- `load from an external file`: a file chooser will appear in that case to allow you to select a Python file from your filesystem
- `provide code in this dialog`: a Python editor will appear where you can directly type the function to use.

In all cases you must enter the name of the function that will be called (`open` in the example below).

An example is (in module MyForms.py):

```
def open(dialog,layer,feature):
    geom = feature.geometry()
    control = dialog.findChild(QWidged,"My line edit")
```

Reference in Python Init Function like so: `open`

12.2.5 Propiedades de unión


The *Joins* tab allows you to join a loaded attribute table to a loaded vector layer. After clicking  , the *Add vector join* dialog appears. As key columns, you have to define a join layer you want to connect with the target vector layer. Then, you have to specify the join field that is common to both the join layer and the target layer. Now you can also specify a subset of fields from the joined layer based on the checkbox  *Choose which fields are joined*. As a result of the join, all information from the join layer and the target layer are displayed in the attribute table of the target layer as joined information. If you specified a subset of fields only these fields are displayed in the attribute table of the target layer.

QGIS currently has support for joining non-spatial table formats supported by OGR (e.g., CSV, DBF and Excel), delimited text and the PostgreSQL provider (see figure_joins).

Additionally, the add vector join dialog allows you to:

-  *Cache join layer in virtual memory*
-  *Crear índice de atributo en el campo de combinación*
-  *Choose which fields are joined*
- Create a  *Custom field name prefix*

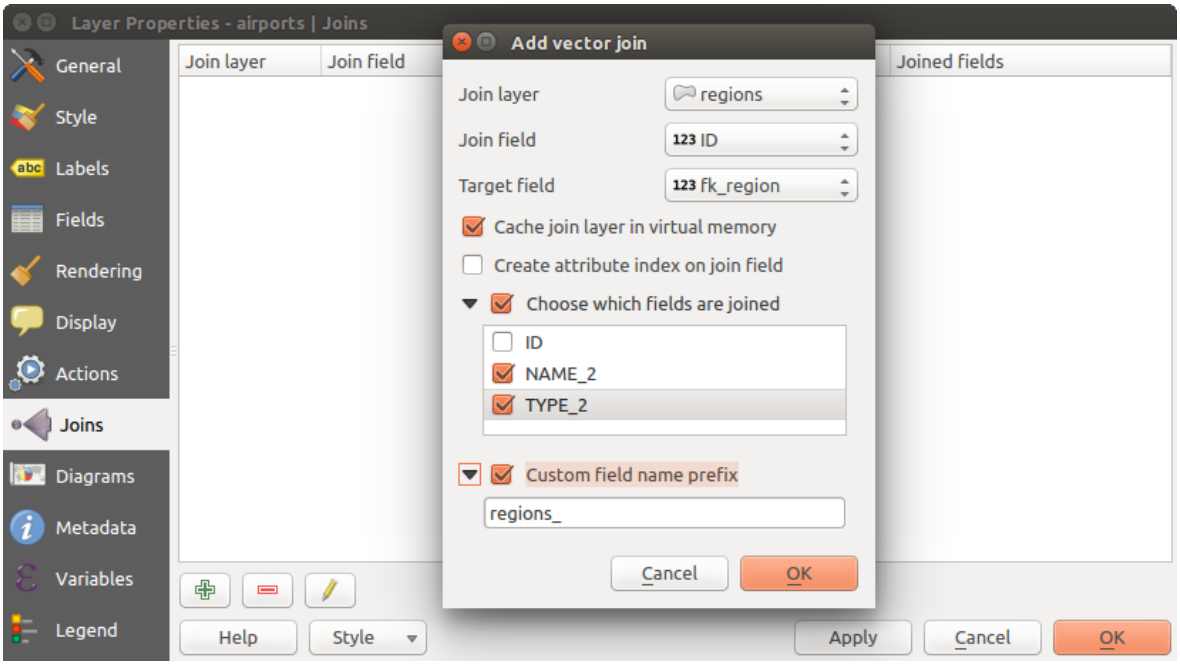


Figure 12.43: Join an attribute table to an existing vector layer

12.2.6 Propiedades de diagrama


The *Diagrams* tab allows you to add a graphic overlay to a vector layer (see figure_diagrams_attributes).

The current core implementation of diagrams provides support for:

- **pie charts**, a circular statistical graphic divided into slices to illustrate numerical proportion. The arc length of each slice is proportional to the quantity it represents,
- **text diagrams**, a horizontaly divided circle showing statistics values inside
- and **histograms**.

Truco: Switch quickly between types of diagrams

Given that the settings are almost common to the different types of diagram, when designing your diagram, you can easily change the diagram type and check which one is more appropriate to your data without any loss.

For each type of diagram, the properties are divided into several tabs:

- *Atributos*
- *Appearance*
- *Tamaño*
- *Colocación*
- *Opciones*
- *Leyenda*

Atributos

Attributes defines which variables to display in the diagram. Use  add item button to select the desired fields into the 'Assigned Attributes' panel. Generated attributes with *Expresiones* can also be used.

You can move up and down any row with click and drag, sorting how attributes are displayed. You can also change the label in the 'Legend' column or the attribute color by double-clicking the item.

This label is the default text displayed in the legend of the print composer or of the layer tree.

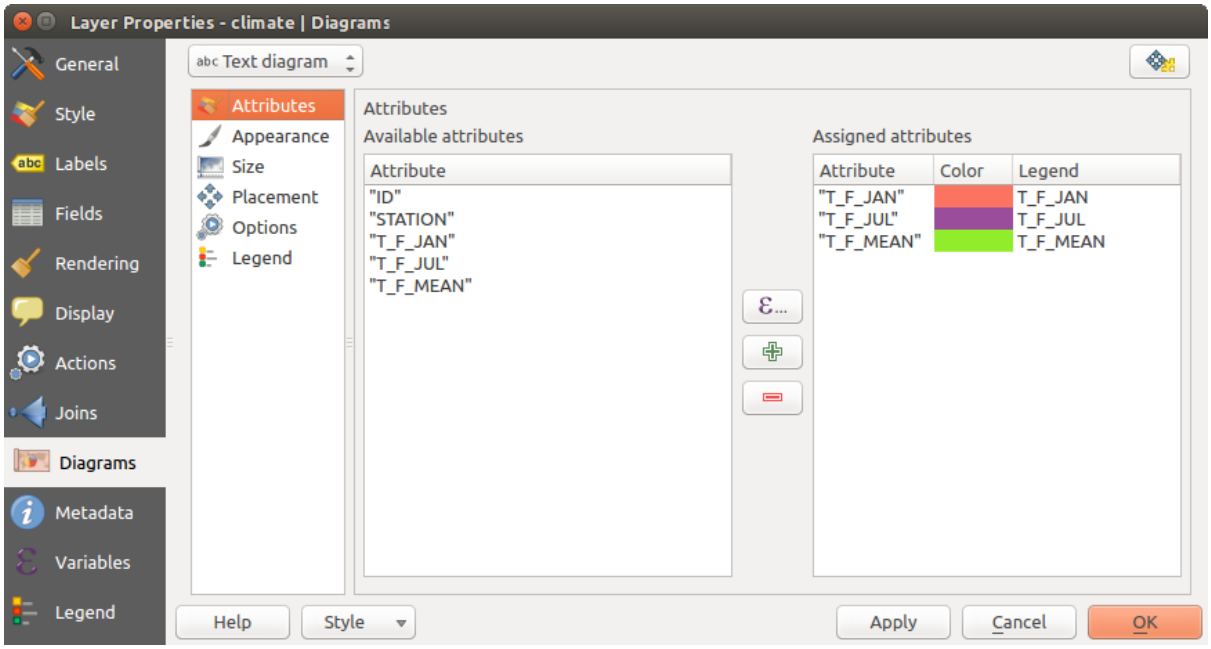


Figure 12.44: Propiedades de diagrama - pestaña de Atributos

Appearance

Appearance defines how the diagram looks like. It provides general settings that do not interfere with the statistic values such as:

- the graphic transparency, its outline width and color
- the width of the bar in case of histogram
- the circle background color in case of text diagram, and the font used for texts
- the orientation of the left line of the first slice represented in pie chart. Note that slices are displayed clockwise.

In this tab, you can also manage the diagram visibility:

- by removing diagrams that overlap others or *Show all diagrams* even if they overlap each other
- by selecting a field with *Data defined visibility* to precisely tune which diagrams should be rendered
- by setting the *scale visibility*

Tamaño

Size is the main tab to set how the selected statistics are represented. The diagram size units can be 'Map Units' or 'Millimeters'. You can use :

- *Fixed size*, an unique size to represent the graphic of all the features, except when displaying histogram
- or *Scaled size*, based on an expression using layer attributes.

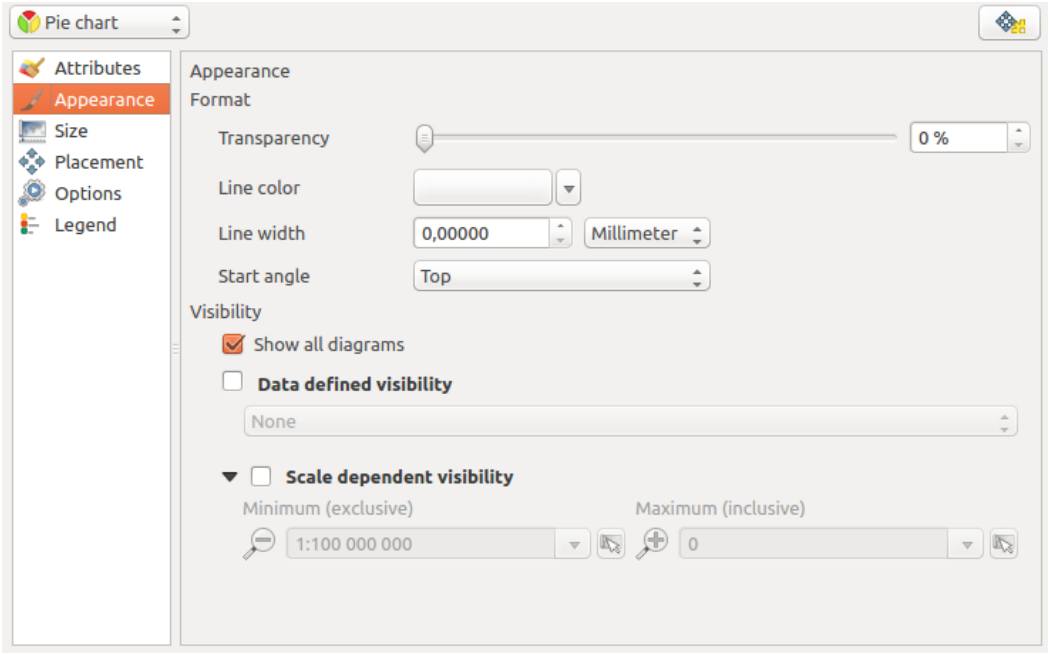


Figure 12.45: Diagram properties - Appearance tab

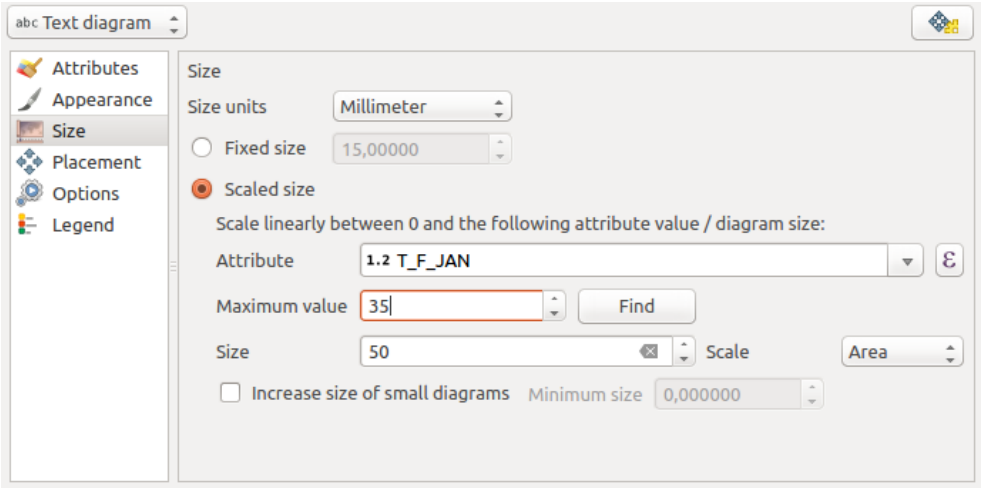


Figure 12.46: Propiedades de diagrama - pestaña de tamaño

Ubicación

Placement helps to define diagram position. According to the layer geometry type, it offers different options for the placement:

- 'Over the point' or 'Around the point' for point geometry. The latter variable requires a radius to follow.
- 'Over the line' or 'Around the line' for line geometry. Like point feature, the last variable requires a distance to respect and user can specify the diagram placement relative to the feature ('above', 'on' and/or 'below' the line) It's possible to select several options at once. In that case, QGIS will look for the optimal position of the diagram. Remember that here you can also use the line orientation for the position of the diagram.
- 'Over the centroid', 'Around the centroid' (with a distance set), 'Perimeter' and anywhere 'Inside polygon' are the options for polygon features.

The diagram can also be placed using feature data by filling the `X` and `Y` fields with an attribute of the feature.

The placement of the diagrams can interact with the labeling, so you can detect and solve position conflicts between diagrams and labels by setting the **Priority** slider or the **z-index** value.

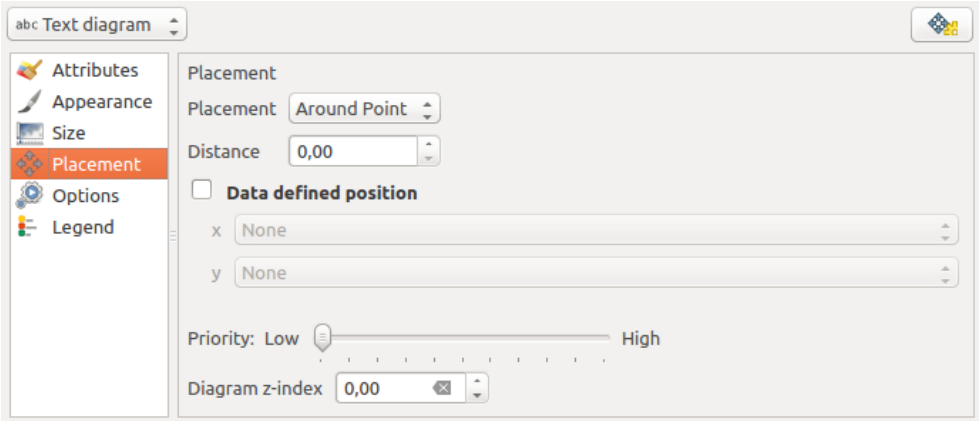


Figure 12.47: Vector properties dialog with diagram properties, Placement tab

Opciones

The *Options* tab has settings only in case of histogram. You can choose whether the bar orientation should be 'Up', 'Down', 'Right' and 'Left'.

Leyenda

From the *Legend* tab, you can choose to display items of the diagram in the *Panel de capas*, besides the layer symbology. It can be:

- the represented attributes: color and legend text set in *Attributes* tab
- and if applicable, the diagram size, whose symbol you can customize.

When set, the diagram legend items are also available in the print composer legend, besides the layer symbology.

Estudio de Caso

We will demonstrate an example and overlay on the Alaska boundary layer a text diagram showing temperature data from a climate vector layer. Both vector layers are part of the QGIS sample dataset (see section *Sample Data*).

1. Primero haga clic sobre el icono Añadir capa vectorial, navegue a la carpeta del conjunto de datos de ejemplo de QGIS y cargue las dos capas vectoriales `alaska.shp` y `climate.shp`.

2. pulsar doble en la capa “climate” en la leyenda del mapa para abrir el diálogo de la :guilabel: “Propiedades de la capa”
3. Click on the *Diagrams* tab and from the *Diagram type*  combo box, select ‘Text diagram’.
4. In the *Appearance* tab, we choose a light blue as background color, and in the *Size* tab, we set a fixed size to 18 mm.
5. In the *Position* tab, placement could be set to ‘Around Point’.
6. In the diagram, we want to display the values of the three columns `T_F_JAN`, `T_F_JUL` and `T_F_MEAN`. So, in the *Attributes* tab first select `T_F_JAN` and click the  button, then repeat with `T_F_JUL` and finally `T_F_MEAN`.
7. Now click **[Apply]** to display the diagram in the QGIS main window.
8. You can adapt the chart size in the *Size* tab. Activate the  *Scaled size* and set the size of the diagrams on the basis of the *maximum value* of an attribute and the *Size* option. If the diagrams appear too small on the screen, you can activate the  *Increase size of small diagrams* checkbox and define the minimum size of the diagrams.
9. Change the attribute colors by double clicking on the color values in the *Assigned attributes* field. Figure_diagrams_mapped gives an idea of the result.
10. Finally, click **[Ok]**.

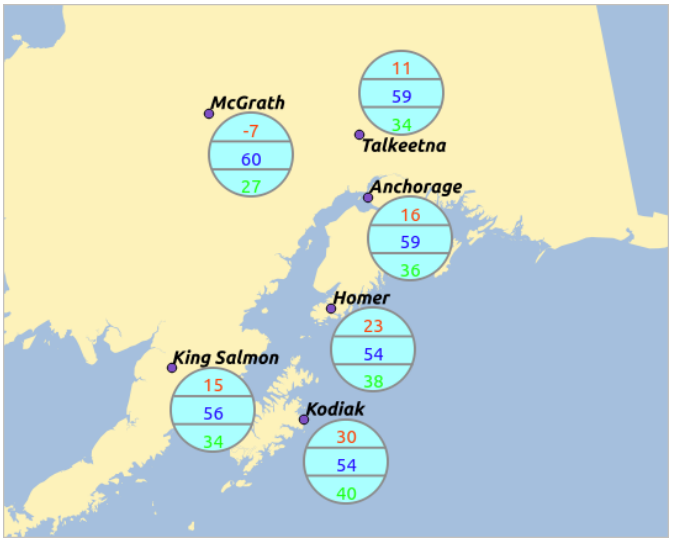


Figure 12.48: Gráfico de temperatura sobrepuesto en un mapa

Remember that in the *Position* tab, a  *Data defined position* of the diagrams is possible. Here, you can use attributes to define the position of the diagram. You can also set a scale-dependent visibility in the *Appearance* tab.

The size and the attributes can also be an expression. Use the  button to add an expression. See *Expresiones* chapter for more information and example.

Utilice suplantación definida por datos

As mentioned above, you can use some custom data-defined to tune the diagrams rendering:

- position in *Placement* tab by filling `X` and `Y` fields
- visibility in *Appearance* tab by filling the `Visibility` field

Vea *Using data-defined override for labeling* para más información.

12.2.7 Propiedades de acciones

QGIS provides the ability to perform an action based on the attributes of a feature. This can be used to perform any number of actions, for example, running a program with arguments built from the attributes of a feature or passing parameters to a web reporting tool.

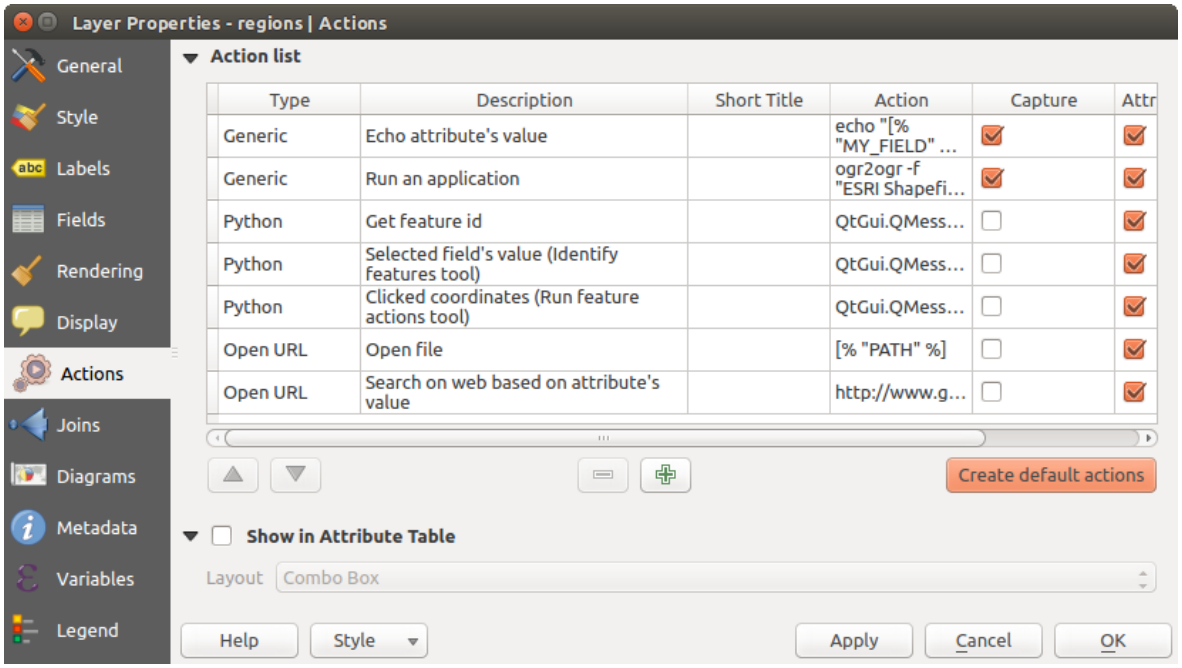


Figure 12.49: Overview action dialog with some sample actions

Actions are useful when you frequently want to run an external application or view a web page based on one or more values in your vector layer. They are divided into six types and can be used like this:

- Las acciones genéricas, Mac, Windows inician un proceso externo.
- Las acciones Python ejecutan una expresión Python.
- Las acciones genéricas y Python son visibles en todos lados.
- Mac, Windows and Unix actions are visible only on the respective platform (i.e., you can define three 'Edit' actions to open an editor and the users can only see and execute the one 'Edit' action for their platform to run the editor).

There are several examples included in the dialog. You can load them by clicking on **[Create default actions]**. To edit any of the examples, double-click its row. One example is performing a search based on an attribute value. This concept is used in the following discussion.

Definir Acciones

To define an attribute action, open the vector *Layer Properties* dialog and click on the *Actions* tab. In the *Actions* tab, click the Add a new action to open the *Edit Action* dialog.

Select the action *Type* and provide a descriptive name for the action. The action itself must contain the name of the application that will be executed when the action is invoked. You can add one or more attribute field values as arguments to the application. When the action is invoked, any set of characters that start with a `%` followed by the name of a field will be replaced by the value of that field. The special characters `%%` will be replaced by the value of the field that was selected from the identify results or attribute table (see using_actions below). Double quote marks can be used to group text into a single argument to the program, script or command. Double quotes will be ignored if preceded by a backslash.

If you have field names that are substrings of other field names (e.g., `col1` and `col10`), you should indicate that by surrounding the field name (and the % character) with square brackets (e.g., `[%col10]`). This will prevent the `%col10` field name from being mistaken for the `%col1` field name with a `0` on the end. The brackets will be removed by QGIS when it substitutes in the value of the field. If you want the substituted field to be surrounded by square brackets, use a second set like this: `[[%col10]]`.

Using the *Identify Features* tool, you can open the *Identify Results* dialog. It includes a *(Derived)* item that contains information relevant to the layer type. The values in this item can be accessed in a similar way to the other fields by proceeding the derived field name with `(Derived).`. For example, a point layer has an `X` and `Y` field, and the values of these fields can be used in the action with `%(Derived).X` and `%(Derived).Y`. The derived attributes are only available from the *Identify Results* dialog box, not the *Attribute Table* dialog box.

Two example actions are shown below:

- `konqueror http://www.google.com/search?q=%nam`
- `konqueror http://www.google.com/search?q=%%`

In the first example, the web browser konqueror is invoked and passed a URL to open. The URL performs a Google search on the value of the `nam` field from our vector layer. Note that the application or script called by the action must be in the path, or you must provide the full path. To be certain, we could rewrite the first example as: `/opt/kde3/bin/konqueror http://www.google.com/search?q=%nam`. This will ensure that the konqueror application will be executed when the action is invoked.

The second example uses the %% notation, which does not rely on a particular field for its value. When the action is invoked, the %% will be replaced by the value of the selected field in the identify results or attribute table.

Empleando Acciones

Actions can be invoked from either the *Identify Results* dialog, an *Attribute Table* dialog or from *Run Feature Action* (recall that these dialogs can be opened by clicking  Identify Features or  Open Attribute Table or  Run Feature Action). To invoke an action, right click on the feature and choose the action from the pop-up menu (they should have been enabled to be displayed in the attribute table). Actions are listed in the popup menu by the name you assigned when defining the action. Click on the action you wish to invoke.

Si se está invocando una acción que utilice la notación "‘‘" , haga clic derecho en el valor del campo en el cuadro de diálogo *Resultados de la Identificación* o en *Tabla de atributos* que desee pasar de la aplicación o script

Here is another example that pulls data out of a vector layer and inserts it into a file using bash and the `echo` command (so it will only work on  or perhaps ). The layer in question has fields for a species name `taxon_name`, latitude `lat` and longitude `long`. We would like to be able to make a spatial selection of localities and export these field values to a text file for the selected record (shown in yellow in the QGIS map area). Here is the action to achieve this:

```
bash -c "echo \"%taxon_name %lat %long\" >> /tmp/species_localities.txt"
```

Después de seleccionar algunas localidades y ejecutar la acción en cada una, al abrir el archivo de salida mostrará algo como esto:

```
Acacia mearnsii -34.0800000000 150.0800000000
Acacia mearnsii -34.9000000000 150.1200000000
Acacia mearnsii -35.2200000000 149.9300000000
Acacia mearnsii -32.2700000000 150.4100000000
```

As an exercise, we can create an action that does a Google search on the `lakes` layer. First, we need to determine the URL required to perform a search on a keyword. This is easily done by just going to Google and doing a simple search, then grabbing the URL from the address bar in your browser. From this little effort, we see that the format is http://google.com/search?q=qgis, where `QGIS` is the search term. Armed with this information, we can proceed:

1. Asegúrese de que la capa de `lakes` esté cargada.

2. Open the *Layer Properties* dialog by double-clicking on the layer in the legend, or right-click and choose *Properties* from the pop-up menu.
3. Haga clic en la pestaña *Acciones*
4. click  Add a new action.
5. Ingrese un nombre para la acción , por ejemplo `Búsqueda de Google`.
6. Para la acción, se necesita proporcionar el nombre del programa externo a ejecutar. En este caso, podemos utilizar Firefox. Si el programa no está en su ruta, se necesita proporcionar la ruta completa.
7. Following the name of the external application, add the URL used for doing a Google search, up to but not including the search term: `http://google.com/search?q=`
8. The text in the *Action* field should now look like this: `firefox http://google.com/search?q=`
9. Click on the drop-down box containing the field names for the `lakes` layer. It's located just to the left of the **[Insert]** button.
10. From the drop-down box, select 'NAMES' and click **[Insert]**.
11. Su texto de acción ahora se ve así:

    ```
    firefox http://google.com/search?q=%NAMES
    ```

12. To finalize and add the action, click the **[OK]** button.

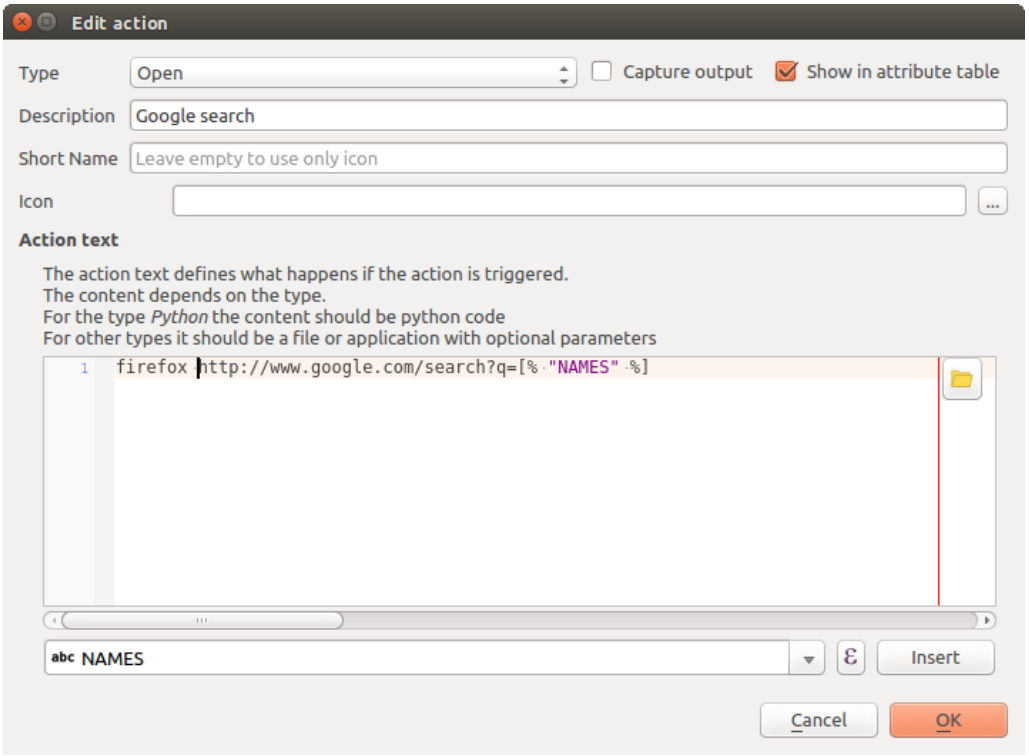


Figure 12.50: Edit action dialog configured with the example

This completes the action, and it is ready to use. The final text of the action should look like this:

```
firefox http://google.com/search?q=%NAMES
```

Ahora podemos utilizar la acción. Cierre el cuadro de diálogo *Propiedades de la capa* y acérquese a un área de interés. Asegure que la capa capa `lakes` este activa e identifique un lago. En la caja de resultados, ahora verá que su acción es visible.

When we click on the action, it brings up Firefox and navigates to the URL http://www.google.com/search?q=Tustumena. It is also possible to add further attribute fields to the ac-

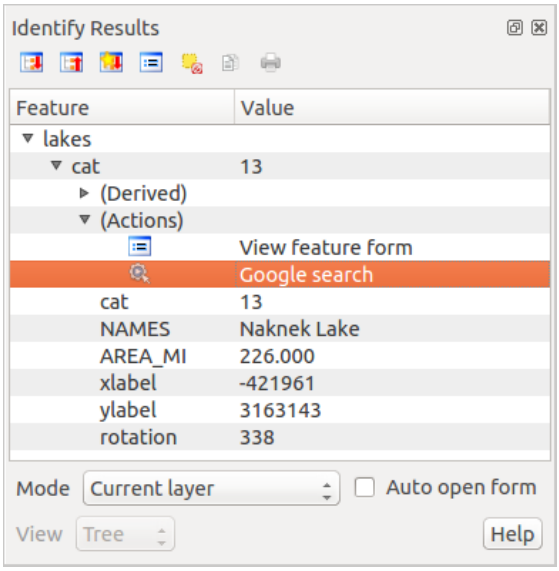


Figure 12.51: Seleccionar objetos espaciales y elegir una acción

tion. Therefore, you can add a + to the end of the action text, select another field and click on **[Insert Field]**. In this example, there is just no other field available that would make sense to search for.

You can define multiple actions for a layer, and each will show up in the *Identify Results* dialog.

You can also invoke actions from the attribute table by selecting a row and right-clicking, then choosing the action from the pop-up menu.

There are all kinds of uses for actions. For example, if you have a point layer containing locations of images or photos along with a file name, you could create an action to launch a viewer to display the image. You could also use actions to launch web-based reports for an attribute field or combination of fields, specifying them in the same way we did in our Google search example.

We can also make more complex examples, for instance, using **Python** actions.

Usually, when we create an action to open a file with an external application, we can use absolute paths, or eventually relative paths. In the second case, the path is relative to the location of the external program executable file. But what about if we need to use relative paths, relative to the selected layer (a file-based one, like a shapefile or SpatiaLite)? The following code will do the trick:

```
command = "firefox"
imagerelpath = "images_test/test_image.jpg"
layer = qgis.utils.iface.activeLayer()
import os.path
layerpath = layer.source() if layer.providerType() == 'ogr'
  else (qgis.core.QgsDataSourceURI(layer.source()).database()
    if layer.providerType() == 'spatialite' else None)
path = os.path.dirname(str(layerpath))
image = os.path.join(path,imagerelpath)
import subprocess
subprocess.Popen( [command, image ] )
```

We just have to remember that the action is one of type *Python* and the *command* and *imagerelpath* variables must be changed to fit our needs.

But what about if the relative path needs to be relative to the (saved) project file? The code of the Python action would be:

```
command = "firefox"
imagerelpath = "images/test_image.jpg"
projectpath = qgis.core.QgsProject.instance().fileName()
import os.path
```

```
path = os.path.dirname(str(projectpath)) if projectpath != '' else None
image = os.path.join(path, imagerelpath)
import subprocess
subprocess.Popen( [command, image ] )
```

Another Python action example is the one that allows us to add new layers to the project. For instance, the following examples will add to the project respectively a vector and a raster. The names of the files to be added to the project and the names to be given to the layers are data driven (*filename* and *layername* are column names of the table of attributes of the vector where the action was created):

```
qgis.utils.iface.addVectorLayer('/yourpath/[% "filename" %].shp',
  '[% "layername" %]', 'ogr')
```

Para añadir un ráster (una imagen TIF en este ejemplo), se vuelve:

```
qgis.utils.iface.addRasterLayer('/yourpath/[% "filename" %].tif',
  '[% "layername" %]')
```

12.2.8 Propiedades a mostrar

This tab is specifically created for map tips: display a message in the map canvas when hovering over a feature of the active layer. This message can either be the value of a *Field* or a more complex and full *HTML* text mixing fields, *expressions* and html tags (multiline, fonts, images, hyperlink ...).

To activate Map Tips, select the menu option *View* → *Map Tips* or click on the Map Tips icon. Map tip is a cross-session feature meaning that once activated, it stays on and apply to any set layer in any project, even in future QGIS sessions until it's toggled off.

Figures Display Code and Mapped show an example of HTML code and how it behaves in map canvas.

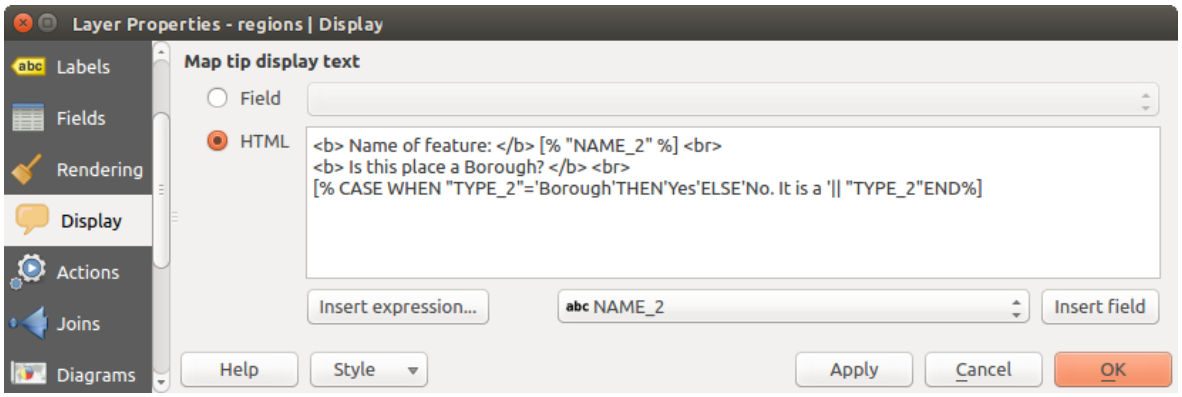


Figure 12.52: Código HTML para textos de aviso del mapa

12.2.9 Propiedades de representación

QGIS offers support for on-the-fly feature generalisation. This can improve rendering times when drawing many complex features at small scales. This feature can be enabled or disabled in the layer settings using the *Simplify geometry* option. There is also a global setting that enables generalisation by default for newly added layers (see *global simplification* for more information).

Nota: Feature generalisation may introduce artefacts into your rendered output in some cases. These may include slivers between polygons and inaccurate rendering when using offset-based symbol layers.

Figure 12.53: Textos de aviso del mapa con código HTML

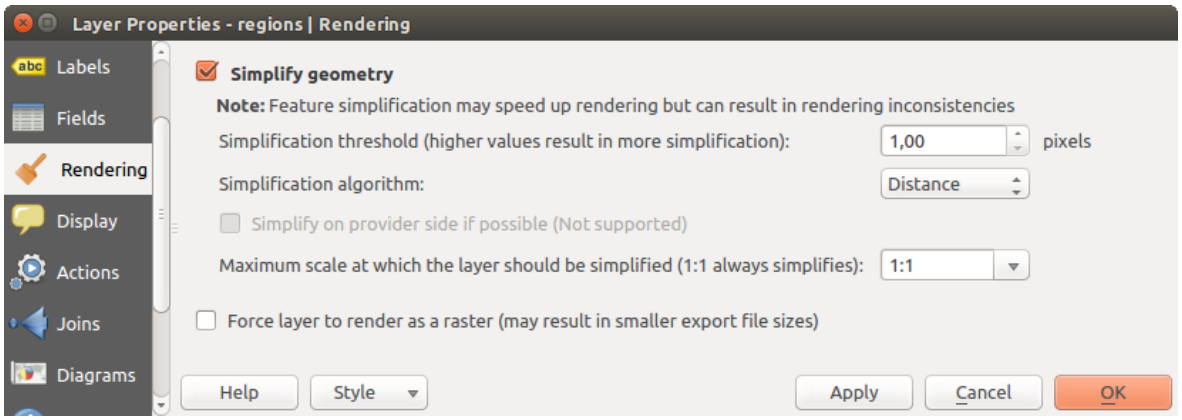


Figure 12.54: cuadro de diálogo de Simplificación de Geometría de capa

While rendering extremely detailed layers (e.g. polygon layers with a huge number of nodes), this can cause composer exports in PDF/SVG format to be huge as all nodes are included in the exported file. This can also make the resultant file very slow to work with/open in other programs.

Checking *Force layer to render as raster* forces these layers to be rasterised so that the exported files won't have to include all the nodes contained in these layers and the rendering is therefore sped up.

You can also do this by forcing the composer to export as a raster, but that is an all-or-nothing solution, given that the rasterisation is applied to all layers.

12.2.10 Propiedades de metadatos

The *Metadata* tab consists of *Description*, *Attribution*, *MetadataURL*, *LegendUrl* and *Properties* sections.

In the *Properties* section, you get general information about the layer, including specifics about the type and location, number of features, feature type, and editing capabilities. The *Extents* table provides you with information on the layer extent and the *Layer Spatial Reference System*, which is information about the CRS of the layer. This can provide a quick way to get useful information about the layer.

Additionally, you can add or edit a title and abstract for the layer in the *Description* section. It's also possible to define a *Keyword list* here. These keyword lists can be used in a metadata catalog. If you want to use a title from an XML metadata file, you have to fill in a link in the *DataUrl* field.

Use *Attribution* to get attribute data from an XML metadata catalog.

In *MetadataUrl*, you can define the general path to the XML metadata catalog. This information will be saved in the QGIS project file for subsequent sessions and will be used for QGIS server.

In the *LegendUrl* section, you can provide the url of a legend image in the url field. You can use the Format drop-down option to apply the appropriate format of the image. Currently png, jpg and jpeg image formats are supported.

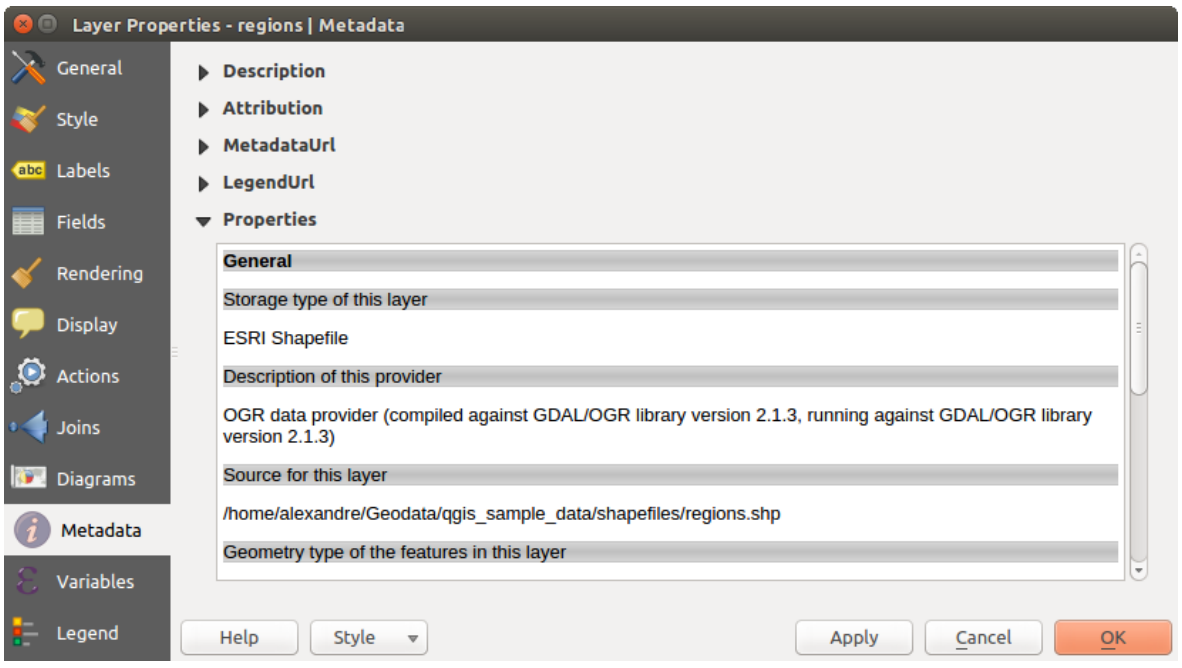


Figure 12.55: Metadata tab in vector layers properties dialog

Truco: Switch quickly between different layer representations

Using the *Styles* → *Add* combobox at the bottom of the *Layer Properties* dialog, you can save as many combinations of layer properties settings (symbology, labeling, diagram, fields form, actions...) as you want. Then,

simply switch between styles from the context menu of the layer in *Layers Panel* to automatically get different representations of your data.

12.2.11 Propiedades de variables

The *Variables* tab lists all the variables available at the layer's level (which includes all global and project's variables).

It also allows the user to manage layer-level variables. Click the button to add a new custom layer-level variable. Likewise, select a custom layer-level variable from the list and click the button to remove it.

Más información sobre el uso de variables en la sección de herramientas Generales *Variables*

12.2.12 Propiedades de la leyenda

The *Legend* tab provides you with a list of widgets you can embed within the layer tree in the Layers panel. The idea is to have a way to quickly access some actions that are often used with the layer (setup transparency, filtering, selection, style or other stuff...).

By default, QGIS provides transparency widget but this can be extended by plugins registering their own widgets and assign custom actions to layers they manage.

12.3 Expresiones

Based on layer data and prebuilt or user defined functions, **Expressions** offer a powerful way to manipulate attribute value, geometry and variables in order to dynamically change the geometry style, the content or position of the label, the value for diagram, the height of a composer item, select some features, create virtual field ...

12.3.1 The Expression string builder

Main dialog to build expressions, the *Expression string builder* is available from many parts in QGIS and, can particularly be accessed when:

- clicking the button;
- *selecting features* with the Select By Expression... tool;
- *editing attributes* with e.g. the Field calculator tool;
- manipulating symbology, label or composer item parameters with the Data defined override tool (see *Configuración de anulación definida por datos*);
- building a *geometry generator* symbol layer;
- doing some *geoprocessing*.

The Expression builder dialog offers access to the:

- *Expression tab* which, thanks to a list of predefined functions, helps to write and check the expression to use;
- *Function Editor tab* which helps to extend the list of functions by creating custom ones.

Some use cases of expressions:

- From Field Calculator, calculate a "pop_density" field using existing "total_pop" and "area_km2" fields:

```
"total_pop" / "area_km2"
```

- Update the field "density_level" with categories according to the "pop_density" values:

```
CASE WHEN "pop_density" < 50 THEN 'Low population density'
     WHEN "pop_density" >= 50 and "pop_density" < 150 THEN 'Medium population density'
     WHEN "pop_density" >= 150 THEN 'High population density'
END
```

- Apply a categorized style to all the features according to whether their average house price is smaller or higher than 10000€ per square metre:

```
"price_m2" > 10000
```

- Using the "Select By Expression..." tool, select all the features representing areas of "High population density" and whose average house price is higher than 10000€ per square metre:

```
"density_level" = 'High population density' and "price_m2" > 10000
```

  Likewise, the previous expression could also be used to define which features should be labeled or shown in the map.

Using expressions offers you a lot of possibilities.

Truco: Use named parameters to improve the expression reading

Some functions require many parameters to be set. The expression engine supports the use of named parameters. This means that instead of writing the cryptic expression `clamp( 1, 2, 9)`, you can use `clamp( min:=1, value:=2, max:=9)`. This also allows arguments to be switched, e.g. `clamp( value:=2, max:=9, min:=1)`. Using named parameters helps clarify what the arguments for an expression function refer to, which is helpful when you are trying to interpret an expression at a later date!

12.3.2 Lista de funciones

The *Expression* tab provides the main interface to write expressions using functions, layer's fields and values. It contains widgets to:

- type expressions using functions and/or fields. At the bottom of the dialog, is displayed the result of the expression evaluated on the first feature of the layer.
- select the appropriate function among a list, organized in groups. A search box is available to filter the list and quickly find a particular function or field. Double-clicking on the item's name adds it to the expression being written.
- display help for each function selected. When a field is selected, this widget shows a sample of its values. Double-clicking a value adds it to the expression.

Operadores

This group contains operators (e.g., +, -, *). Note that for most of the mathematical functions below, if one of the inputs is NULL then the result is NULL.

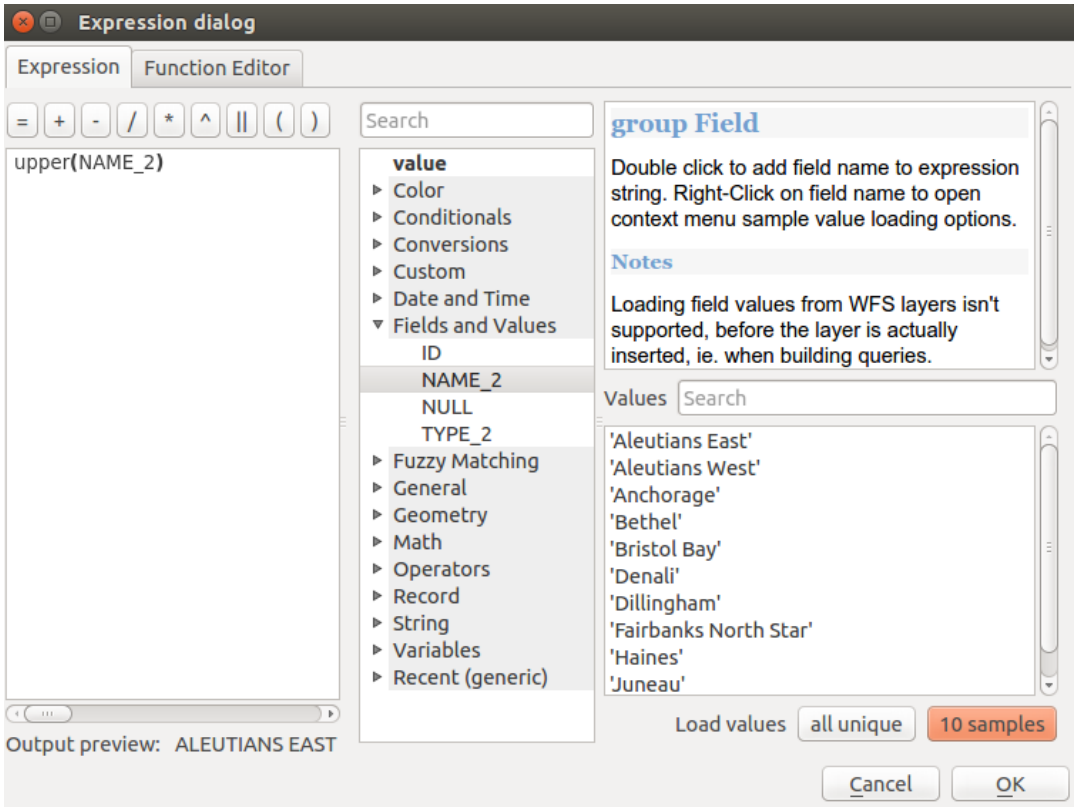


Figure 12.56: The Expression tab

Función	Descripción
a + b	Addition of two values (a plus b)
a - b	Subtraction of two values (a minus b).
a * b	Multiplication of two values (a multiplied by b)
a / b	División de dos valores (a dividido entre b)
a % b	Remainder of division of a by b (eg, 7 % 2 = 1, or 2 fits into 7 three times with remainder 1)
a ^ b	Power of two values (for example, 2^2=4 or 2^3=8)
a < b	Compares two values and evaluates to 1 if the left value is less than the right value (a is smaller than b)
a <= b	Compares two values and evaluates to 1 if the left value isless than or equal to the right value
a <> b	Compara dos valores y evalúa a 1 si no son iguales
a = b	Compara dos valores y evalúa a 1 si son iguales.
a != b	a and b are not equal
a > b	Compara dos valores y evalúa como 1 si el valor izquierdo es mayor que el valor derecho (a es mayor que b)
a >= b	Compara dos valores y evalúa a 1 si el valor de la izquierda es mayor que o igual que el valor de la derecha
a ~ b	a matches the regular expression b
||	Joins two values together into a string. If one of the values is NULL the result will be NULL
‘\n’	Inserta una nueva línea en una cadena
LIKE	Devuelve 1 si el primer parámetro coincide con el patrón provisto
ILIKE	Returns 1 if the first parameter matches case-insensitive the supplied pattern (ILIKE can be used instead of LIKE to make the match case-insensitive)
a IS b	Tests whether two values are identical. Returns 1 if a is the same as b
a OR b	Returns 1 when condition a or condition b is true
a AND b	Returns 1 when conditions a and b are true
NOT	Niega una condición
column name	Value of the field column name, take care to not be confused with simple quote, see below
“column name”	
‘cadena’	a string value, take care to not be confused with double quote, see above
NULL	valor nulo
a IS NULL	a no tiene valor
a IS NOT NULL	a tiene valor

Nota: About fields concatenation

You can concatenate strings using either || or +. The latter also means sum up expression. So if you have an integer (field or numeric value) this can be error prone. In this case, you should use ||. If you concatenate two string values, you can use both.

Algún ejemplo:

- Une una cadena de texto y un valor de un nombre de columna:

```
'My feature''s id is: ' || "gid"
'My feature''s id is: ' + "gid" => triggers an error as gid is an integer
"country_name" + '(' + "country_code" + ')'
"country_name" || '(' || "country_code" || ')'
```

- Test if the "description" attribute field starts with the 'Hello' string in the value (note the position of the % character):

```
"description" LIKE 'Hello%'
```

Conditionals

Este grupo contiene funciones para menejar comprobaciones condicionales en expresiones.

Función	Descripción
CASE WHEN ... THEN ... END	Evalúa una expresión y devuelve un resultado si es verdadera. Puede probar múltiples condiciones
CASE WHEN ... THEN ... ELSE ... END	Evalúa una expresión y devuelva un resultado diferente sea verdadero o falso. Puede probar múltiples condiciones
coalesce	Devuelve el primer valor no-NULO de la lista de expresión
si	Prueba una condición y devuelve un resultado diferente dependiendo de la comprobación condicional
regexp_match	Returns true if any part of a string matches the supplied regular expression

Algún ejemplo:

- Send back a value if the first condition is true, else another value:

```
CASE WHEN "software" LIKE '%QGIS%' THEN 'QGIS' ELSE 'Other' END
```

Funciones Matemáticas

Este grupo contiene funciones matemáticas,por ejemplo raíz cuadrada, seno y coseno

Función	Descripción
abs	Devuelve el valor absoluto de un número
arcos	Devuelve la inversa del coseno de un valor en radianes
arcsen	Devuelve la inversa del seno de un valor en radianes
atan	Returns the inverse tangent of a value in radians
atan2(y,x)	Returns the inverse tangent of y/x by using the signs of the two arguments to determine the quadrant of the result
azimuth(a,b)	Returns the north-based azimuth as the angle in radians measured clockwise from the vertical on point a to point b
ceil	Rounds a number upwards
clamp	Restricts an input value to a specified range
cos	Devuelve el coseno de un valor en radianes
grados	Convierte de radianes a grados
exp	Devuelve la exponencial de un valor
floor	Rounds a number downwards
ln	Returns the natural logarithm of the passed expression
log	Returns the value of the logarithm of the passed value and base
log10	Returns the value of the base 10 logarithm of the passed expression
máx	Returns the largest value in a set of values
mín	Returns the smallest value in a set of values
pi	Returns the value of pi for calculations
radianes	Convierte de grados a radianes
rand	Returns the random integer within the range specified by the minimum and maximum argument (inclusive)
randf	Returns the random float within the range specified by the minimum and maximum argument (inclusive)
round	Rounds to number of decimal places
scale_exp	Transforma un valor dado de un dominio de entrada a un rango de salida usando una curva exponencial
scale_linear	Transforma un valor dado de un dominio de entrada a un rango de salida usando interpolación lineal
sen	Returns the sine of an angle
raíz cuadrada	Returns the square root of a value
tan	Devuelve la tangente de un ángulo

Aggregates Functions

This group contains functions which aggregate values over layers and fields.

Función	Descripción
agregar	Returns an aggregate value calculated using features from another layer
concatenar	Returns the all aggregated strings from a field or expression joined by a delimiter
Número	Returns the count of matching features
count_distinct	Returns the count of distinct values
count_missing	Returns the count of missing (null) values
iqr	Returns the calculated inter quartile range from a field or expression
mayoría	Returns the aggregate majority of values (most commonly occurring value) from a field or expression
max_length	Returns the maximum length of strings from a field or expression
máximo	Returns the aggregate maximum value from a field or expression
media	Returns the aggregate mean value from a field or expression
mediana	Returns the aggregate median value from a field or expression
min_length	Returns the minimum length of strings from a field or expression
mínimo	Returns the aggregate minimum value from a field or expression
minoría	Returns the aggregate minority of values (least commonly occurring value) from a field or expression
q1	Returns the calculated first quartile from a field or expression
q3	Devuelve el tercer cuartil calculado a partir de un campo o expresión
intervalo	Returns the aggregate range of values (maximum - minimum) from a field or expression
relation_aggregate	Returns an aggregate value calculated using all matching child features from a layer relation
stdev	Returns the aggregate standard deviation value from a field or expression
sum	Returns the aggregate summed value from a field or expression

Ejemplos:

- Return the maximum of the "passengers" field from features in the layer grouped by "station_class" field:

```
maximum("passengers", group_by:="station_class")
```

- Calculate the total number of passengers for the stations inside the current atlas feature:

```
aggregate('rail_stations','sum',"passengers",
  intersects(@atlas_geometry, $geometry))
```

- Return the mean of the "field_from_related_table" field for all matching child features using the 'my_relation' relation from the layer:

```
aggregate_relation('my_relation', 'mean', "field_from_related_table")
```

o:

```
aggregate_relation(relation:='my_relation', calculation := 'mean',
  expression := "field_from_related_table")
```

Funciones de Color

This group contains functions for manipulating colors.

Función	Descripción
color_cmyk	Devuelve una representación en forma de cadena de un color en base a sus componentes cian, magenta, amarillo y negro
color_cmyka	Returns a string representation of a color based on its cyan, magenta, yellow, black and alpha (transparency) components
color_hsl	Returns a string representation of a color based on its hue, saturation, and lightness attributes
color_hsla	Devuelve una representación en forma de cadena de un color en base a sus atributos de matiz, saturación, luminosidad y canal alfa (transparencia).
color_hsv	Returns a string representation of a color based on its hue, saturation, and value attributes
color_hsva	Devuelve una representación en forma de cadena de un color en base a sus atributos de matiz, saturación, valor y canal alfa (transparencia)
color_part	Devuelve un componente específico de la cadena de un color, por ejemplo el componente rojo o el alfa
color_rgb	Returns a string representation of a color based on its red, green, and blue components
color_rgba	Returns a string representation of a color based on its red, green, blue, and alpha (transparency) components
más oscuro	Devuelve una cadena de color más oscura (o más clara)
más claro	Devuelve una cadena de color más clara (o más oscura)
project_color	Devuelve un color del esquema de color del proyecto
ramp_color	Devuelve una cadena que representa un color de una rampa de color
set_color_part	Sets a specific color component for a color string, eg the red component or alpha component

Funciones de conversión

This group contains functions to convert one data type to another (e.g., string to integer, integer to string).

Función	Descripción
to_date	Convierte una cadena de texto en un objeto fecha
to_datetime	Converts a string into a datetime object
to_int	Convierte una cadena de texto a número entero
to_interval	Converts a string to an interval type (can be used to take days, hours, months, etc. of a date)
to_real	Convierte una cadena de texto en número real
to_string	Convierte un número en cadena.
to_time	Converts a string into a time object

Funciones personalizadas

This group contains functions created by the user. See *Editor de Funciones* for more details.

Funciones de Fecha y Hora

Este grupo contiene funciones para manipular datos de fecha y hora.

Función	Descripción
edad	Returns as an interval the difference between two dates or datetimes
día	Extracts the day from a date or datetime, or the number of days from an interval
day_of_week	Returns a number corresponding to the day of the week for a specified date or datetime
hora	Extracts the hour from a datetime or time, or the number of hours from an interval
minuto	Extracts the minute from a datetime or time, or the number of minutes from an interval
mes	Extracts the month part from a date or datetime, or the number of months from an interval
now	Returns current date and time
segundo	Extracts the second from a datetime or time, or the number of seconds from an interval
semana	Extrae el número de la semana de una fecha o el número de semanas de un intervalo.
year	Extracts the year part from a date or datetime, or the number of years from an interval

This group also shares several functions with the *Funciones de conversión* (to_date, to_time, to_datetime, to_interval) and *Funciones de cadena* (format_date) groups.

Algún ejemplo:

- Get today's month and year in the "month_number/year" format:

```
format_date(now(),'MM/yyyy')
-- Returns '03/2017'
```

Besides these functions, subtracting dates, datetimes or times using the − (minus) operator will return an interval.

Adding or subtracting an interval to dates, datetimes or times, using the + (plus) and − (minus) operators, will return a datetime.

- Get the number of days until QGIS 3.0 release:

```
to_date('2017-09-29') - to_date(now())
-- Returns <interval: 203 days>
```

- The same with time:

```
to_datetime('2017-09-29 12:00:00') - to_datetime(now())
-- Returns <interval: 202.49 days>
```

- Get the datetime of 100 days from now:

```
now() + to_interval('100 days')
-- Returns <datetime: 2017-06-18 01:00:00>
```

Nota: Storing date and datetime and intervals on fields

The ability to store *date*, *time* and *datetime* values directly on fields may depend on the data source's provider (e.g., shapefiles accept *date* format, but not *datetime* or *time* format). The following are some suggestions to overcame this limitation.

date, *Datetime* and *time* can be stored in text type fields after using the `to_format()` function.

Intervals can be stored in integer or decimal type fields after using one of the date extraction functions (e.g., `day()` to get the interval expressed in days)

Campos y Valores

Contains a list of fields from the layer.

Generally, you can use the various fields, values and functions to construct the calculation expression, or you can just type it into the box.

To display the values of a field, you just click on the appropriate field and choose between *Load top 10 unique values* and *Load all unique values*. On the right side, the **Field Values** list opens with the unique values. At the top of the list, a search box helps filtering the values. To add a value to the expression you are writing, double click its name in the list.

Sample values can also be accessed via right-click. Select the field name from the list, then right-click to access a context menu with options to load sample values from the selected field.

Fields name should be double-quoted in the expression. Values or string should be simple-quoted.

Funciones Concordancia aproximada

This group contains functions for fuzzy comparisons between values.

Función	Descripción
hamming_distance	Returns the number of characters at corresponding positions within the input strings where the characters are different
levensheim	Returns the minimum number of character edits (insertions, deletions or substitutions) required to change one string to another. Measure the similarity between two strings
longest_common_substring	Returns the longest common substring between two strings
soundex	Returns the Soundex representation of a string

Funciones Generales

Este grupo contiene funciones generales variadas.

Función	Descripción
eval	Evaluates an expression which is passed in a string. Useful to expand dynamic parameters passed as context variables or fields
layer_property	Returns a property of a layer or a value of its metadata. It can be layer name, crs, geometry type, feature count...
var	Returns the value stored within a specified variable. See variable functions below

Funciones de Geometría

This group contains functions that operate on geometry objects (e.g., length, area).

Función	Descripción
$area	Returns the area size of the current feature
$geometry	Returns the geometry of the current feature (can be used for processing with other functions)
$length	Returns the length of the current line feature
$perimeter	Returns the perimeter of the current polygon feature
$x	Returns the x coordinate of the current feature
$x_at(n)	Returns the x coordinate of the nth node of the current feature's geometry
$y	Returns the y coordinate of the current feature
$y_at(n)	Returns the y coordinate of the nth node of the current feature's geometry
angle_at_vertex	Returns the bisector angle (average angle) to the geometry for a specified vertex on a linestring geometry
area	Devuelve el perímetro de un objeto de geometría poligonal. Los cálculos están en el Sistema de Referen
azimut	Returns the north-based azimuth as the angle in radians measured clockwise from the vertical on point_a
contorno	Returns the closure of the combinatorial boundary of the geometry (ie the topological boundary of the ge
límites	Returns a geometry which represents the bounding box of an input geometry. Calculations are in the Spa
bounds_height	Returns the height of the bounding box of a geometry. Calculations are in the Spatial Reference System
bounds_width	Devuelve la anchura del recuadro delimitador de una geometría. Los cálculos están en el Sistema de Ref
buffer	Returns a geometry that represents all points whose distance from this geometry is less than or equal to c
centroid	Returns the geometric center of a geometry
closest_point	Returns the point on a geometry that is closest to a second geometry
combinar	Devuelve la combinación de dos geometrías
contains(a,b)	Returns 1 (true) if and only if no points of b lie in the exterior of a, and at least one point of the interior o
convex_hull	Returns the convex hull of a geometry (this represents the minimum convex geometry that encloses all g
cruza	Returns 1 (true) if the supplied geometries have some, but not all, interior points in common
difference(a,b)	Returns a geometry that represents that part of geometry a that does not intersect with geometry b
inconexo	Returns 1 (true) if the geometries do not share any space together
distance	Returns the minimum distance (based on Spatial Reference System) between two geometries in projecte
distance_to_vertex	Returns the distance along the geometry to a specified vertex
end_point	Returns the last node from a geometry
exterior_ring	Returns a line string representing the exterior ring of a polygon geometry, or null if the geometry is not a
extrude(geom,x,y)	Returns an extruded version of the input (Multi-) Curve or (Multi-)Linestring geometry with an extensio
geom_from_gml	Returns a geometry created from a GML representation of geometry
geom_from_wkt	Returns a geometry created from a well-known text (WKT) representation
geom_to_wkt	Returns the well-known text (WKT) representation of the geometry without SRID metadata

Table 12.1 – proviene de la página

Función	Descripción
geometry	Devuelve la geometría de un objeto
geometry_n	Returns the nth geometry from a geometry collection, or null if the input geometry is not a collection
interior_ring_n	Returns the geometry of the nth interior ring from a polygon geometry, or null if the geometry is not a po
intersección	Returns a geometry that represents the shared portion of two geometries
intersecta	Tests whether a geometry intersects another. Returns 1 (true) if the geometries spatially intersect (share a
intersects_bbox	Tests whether a geometry's bounding box overlaps another geometry's bounding box. Returns 1 (true) if
is_closed	Returns true if a line string is closed (start and end points are coincident), false if a line string is not close
longitud	Returns length of a line geometry feature (or length of a string)
line_interpolate_angle	Returns the angle parallel to the geometry at a specified distance along a linestring geometry. Angles are
line_interpolate_point	Returns the point interpolated by a specified distance along a linestring geometry.
line_locate_point	Returns the distance along a linestring corresponding to the closest position the linestring comes to a spe
line_merge	Returns a (Multi-)LineString geometry, where any connected LineStrings from the input geometry have
m	Returns the m value of a point geometry
make_line	Crea una geometría de línea a partir de una serie de geometrías de puntos
make_point(x,y,z,m)	Returns a point geometry from x and y (and optional z or m) values
make_point_m(x,y,m)	Returns a point geometry from x and y coordinates and m values
make_polygon	Crea una geometría de polígono a partir de un anillo exterior y series opcionales de geometrías interiores
nodes_to_points	Returns a multipoint geometry consisting of every node in the input geometry
num_geometries	Devuelve el número de geometrías en una colección de geometrías o nulo si la geometría de entrada no e
num_interior_rings	Devuelve el número de anillos interiores de un polígono o una colección de geometrías o nulo si la geom
num_points	Devuelve el número de vértices de una geometría.
num_rings	Devuelve el número de anillos (incluidos los anillos exteriores) de un polígono o una colección de geom
order_parts	Ordena las partes de una MultiGeometría por los criterios dados
solapa	Comprueba si una geometría solapa con otra. Devuelve 1(verdadero) si las geometrías comparten espaci
perímetro	Devuelve el perímetro de un objeto de geometría poligonal. Los cálculos están en el Sistema de Referen
point_n	Returns a specific node from a geometry
point_on_surface	Returns a point guaranteed to lie on the surface of a geometry
proyecto	Returns a point projected from a start point using a distance and bearing (azimuth) in radians
relate	Prueba o devuelve la representación del Modelo de Intersección 9 Extendido Dimensional (DE-9IM) de
invertir	Reverses the direction of a line string by reversing the order of its vertices
segments_to_lines	Returns a multi line geometry consisting of a line for every segment in the input geometry
shortest_line	Returns the shortest line joining two geometries. The resultant line will start at geometry 1 and end at ge
start_point	Returns the first node from a geometry
sym_difference	Returns a geometry that represents the portions of two geometries that do not intersect
toca	Tests whether a geometry touches another. Returns 1 (true) if the geometries have at least one point in co
Transformar	Returns the geometry transformed from the source CRS to the destination CRS
Convertir	Returns a translated version of a geometry. Calculations are in the Spatial Reference System of this geon
unión	Devuelve una geometría que representa el conjunto unión de los puntos de las geometrías.
entre(a,b)	Tests whether a geometry is within another. Returns 1 (true) if geometry a is completely inside geometry
x	Returns the x coordinate of a point geometry, or the x coordinate of the centroid for a non-point geometr
x_min	Returns the minimum x coordinate of a geometry. Calculations are in the Spatial Reference System of th
x_max	Returns the maximum x coordinate of a geometry. Calculations are in the Spatial Reference System of th
y	Returns the y coordinate of a point geometry, or the y coordinate of the centroid for a non-point geometr
y_min	Returns the minimum y coordinate of a geometry. Calculations are in the Spatial Reference System of th
y_max	Returns the maximum y coordinate of a geometry. Calculations are in the Spatial Reference System of th
z	Returns the z coordinate of a point geometry

Algún ejemplo:

- You can manipulate the current geometry with the variable $geometry to create a buffer or get the point on surface:

```
buffer( $geometry, 10 )
point_on_surface( $geometry )
```

- Return the x coordinate of the current feature's centroid:

```
x( $geometry )
```

- Send back a value according to feature's area:

```
CASE WHEN $area > 10 000 THEN 'Larger' ELSE 'Smaller' END
```

Record Functions

Este grupo contiene funciones que operan sobre identificadores de registros.

Función	Descripción
$current-feature	Devuelve el objeto espacial que está siendo evaluado. Se puede usar con la función 'attribute' para evaluar los valores de atributo del objeto actual.
$id	Devuelve el ID del objeto de la fila actual
$map	Returns the id of the current map item if the map is being drawn in a composition, or "canvas" if the map is being drawn within the main QGIS window
$rownum	Returns the number of the current row
$scale	Returns the current scale of the map canvas
atributo	Devuelve el valor del atributo especificado de un objeto
get_feature	Devuelve el primer objeto de una capa que coincide con un valor de atributo dado
uuid	Generates a Universally Unique Identifier (UUID) for each row. Each UUID is 38 characters long.

Algún ejemplo:

- Return the first feature in layer "LayerA" whose field "id" has the same value as the field "name" of the current feature (a kind of jointure):

```
get_feature( 'layerA', 'id', attribute( $currentfeature, 'name') )
```

- Calculate the area of the joined feature from the previous example:

```
area( geometry( get_feature( 'layerA', 'id', attribute( $currentfeature, 'name') ) ) )
```

Funciones de cadena

Este grupo contiene funciones que operan sobre cadenas, por ejemplo reemplazar, convertir a mayúsculas.

Función	Descripción
char	Devuelve el carácter asociado con un código unicode
concat	Concatenates several strings to one
format	Da formato a una cadena usando los argumentos proporcionados.
format_date	Formats a date type or string into a custom string format
format_number	Devuelve un número formateado con el separador local de miles (también trunca el número al número de decimales indicado)
left(string, n)	Returns a substring that contains the n leftmost characters of the string
longitud	Returns length of a string (or length of a line geometry feature)
lower	Convierte una cadena a letras minúsculas.
lpad	Returns a string with supplied width padded using the fill character
regexp_replace	Devuelve una cadena en la que se ha remplazado la expresión regular proporcionada
regexp_substr	Devuelve la parte de una cadena que coincide con una expresión regular proporcionada
remplazar	Returns a string with the supplied string replaced
right(cadena, n)	Devuelve una subcadena que contiene los n caracteres más a la derecha de la cadena.
rpad	Returns a string with supplied width padded using the fill character
strpos	Returns the index of a regular expression in a string
substr	Devuelve una parte de una cadena.
Título	Convierte todas las palabras de una cadena a formato de título (todas las palabras en minúscula con la primera letra en mayúscula)
trim	Elimina todos los espacios en blanco (espacios, tabuladores, etc.) de comienzo y final de una cadena.
upper	Convierte una cadena a letras mayúsculas.
wordwrap	Devuelve una cadena ajustada un número de caracteres máximo/mínimo

Funciones recientes

This group contains recently used functions. Any expression used in the Expression dialog is added to the list, sorted from the more recent to the less one. This helps to quickly retrieve any previous expression.

Variables Functions

This group contains dynamic variables related to the application, the project file and other settings. It means that some functions may not be available according to the context:

- from the  Select by expression dialog
- desde  Calculadora de campos dialog
- desde el diálogo de propiedades de la capa
- from the print composer

To use these functions in an expression, they should be preceded by @ character (e.g, @row_number). Are concerned:

Función	Descripción
atlas_feature	Devuelve el objeto del atlas actual (como objeto espacial)
atlas_featureid	Devuelve el ID de objeto del atlas actual.
atlas_featurenumber	Returns the number of pages in composition
atlas_filename	Devuelve el nombre de archivo del atlas actual.
atlas_geometry	Devuelve la geometría de objeto del atlas actual

Continúa en l

Table 12.2 – proviene de la página anterior

Función	Descripción
atlas_pagename	Devuelve el nombre de la página del atlas actual
atlas_totalfeatures	Devuelve el número total de objetos en el atlas.
grid_axis	Devuelve el eje de la anotación de la cuadrícula actual (ej.: 'x' para longitud, 'y' para latitud).
grid_number	Devuelve el valor de anotación de la cuadrícula actual.
item_id	Returns the composer item user ID (not necessarily unique)
item_uuid	Returns the composer item unique ID
layer_id	Devuelve el ID de la capa actual
layer_name	Devuelve el nombre de la capa actual
layout_dpi	Devulve la resolución de la composición (DPI).
layout_numpages	Returns the number of pages in the composition
layout_pageheight	Returns the composition height in mm
layout_pagewidth	Returns the composition width in mm
map_extent_center	Returns the point feature at the center of the map
map_extent_height	Devuelve la altura actual del mapa
map_extent_width	Devuelve el ancho actual del mapa
map_id	Returns the ID of current map destination. This will be 'canvas' for canvas renders, and the item ID for co
map_rotation	Devuelve la rotación actual del mapa
map_scale	Devuelve la escala actual del mapa
project_filename	Returns the filename of current project
project_folder	Returns the folder for current project
project_path	Returns the full path (including file name) of current project
project_title	Devuelve el Título del proyecto actual.
qgis_os_name	Devuelve el nombre del sistema operativo, ej. 'Windows', 'Linux' o 'OSX'.
qgis_platform	Devuelve la plataforma de QGIS, ej. 'Escritorio' o 'Servidor'.
qgis_release_name	Devuelve el nombre de la versión actual de QGIS
qgis_version	Devuelve la versión actual de QGIS como cadena
qgis_version_no	Devuelve la versión actual de QGIS como número
symbol_angle	Devuelve el ángulo del símbolo usado para representar el objeto (solo válido para símbolos de marcador).
symbol_color	Returns the color of the symbol used to render the feature
user_account_name	Devuelve el nombre de la cuenta del sistema operativo del usuario actual.
user_full_name	Devuelve el nombre de usuario del sistema operativo del usuario actual.
row_number	Guarda el número de la fila actual.
Valor	Devuelve el valor actual

12.3.3 Editor de Funciones

With the Function Editor, you are able to define your own Python custom functions in a comfortable way.

The function editor will create new Python files in `.qgis2\python\expressions` folder and will auto load all functions defined when starting QGIS. Be aware that new functions are only saved in the `expressions` folder and not in the project file. If you have a project that uses one of your custom functions you will need to also share the `.py` file in the expressions folder.

Here's a short example on how to create your own functions:

```
@qgsfunction(args="auto", group='Custom')
def myfunc(value1, value2, feature, parent):
    pass
```

The short example creates a function `myfunc` that will give you a function with two values. When using the `args='auto'` function argument the number of function arguments required will be calculated by the number of arguments the function has been defined with in Python (minus 2 - `feature`, and `parent`).

This function then can be used with the following expression:

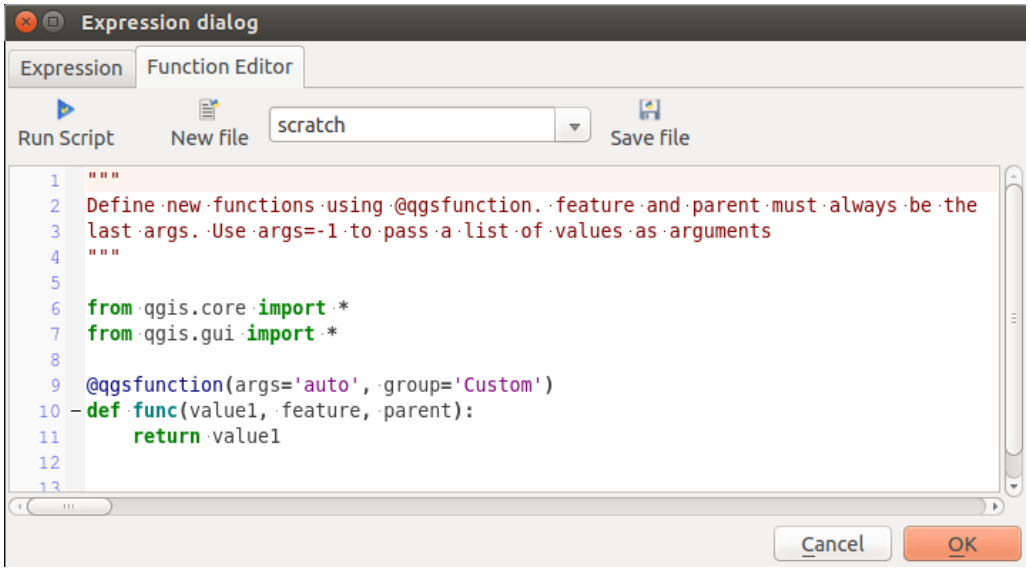


Figure 12.57: La pestaña Editor de funciones

```
myfunc('test1', 'test2')
```

Your function will be implemented in the *Custom* functions group of the *Expression* tab after using the *Run Script* button.

Se puede encontrar más información sobre cómo crear código Python en:ref:*PyQGIS-Developer-Cookbook*.

The function editor is not only limited to working with the field calculator, it can be found whenever you work with expressions.

‘ ‘

12.4 Trabajar con la tabla de atributos

The attribute table displays information on features of a selected layer. Each row in the table represents a feature (with or without geometry), and each column contains a particular piece of information about the feature. Features in the table can be searched, selected, moved or even edited.

12.4.1 Foreword: Spatial and non-spatial tables

QGIS allows you to load spatial and non-spatial layers. This currently includes tables supported by OGR and delimited text, as well as the PostgreSQL, MSSQL, SpatiaLite, DB2 and Oracle provider. All loaded layers are listed in the *Layers Panel*. Whether a layer is spatially enabled or not determines whether you can interact with it on the map.

Non-spatial tables can be browsed and edited using the attribute table view. Furthermore, they can be used for field lookups. For example, you can use columns of a non-spatial table to define attribute values, or a range of values that are allowed, to be added to a specific vector layer during digitizing. Have a closer look at the edit widget in section *Fields Properties* to find out more.

12.4.2 Introducing the attribute table interface

To open the attribute table for a vector layer, activate the layer by clicking on it in the *Panel de capas*. Then, from the main *Layer* menu, choose  *Open Attribute Table*. It is also possible to right-click on the layer and choose

Open Attribute Table from the drop-down menu, or to click on the *Open Attribute Table* button in the Attributes toolbar.

This will open a new window that displays the feature attributes for the layer (figure_attributes_table). According to the setting in *Settings* → *Options* → *Data sources* menu, the attribute table will open in a docked window or a regular window. The total number of features in the layer and the number of currently selected/filtered features are shown in the attribute table title, as well as if the layer is spatially limited.

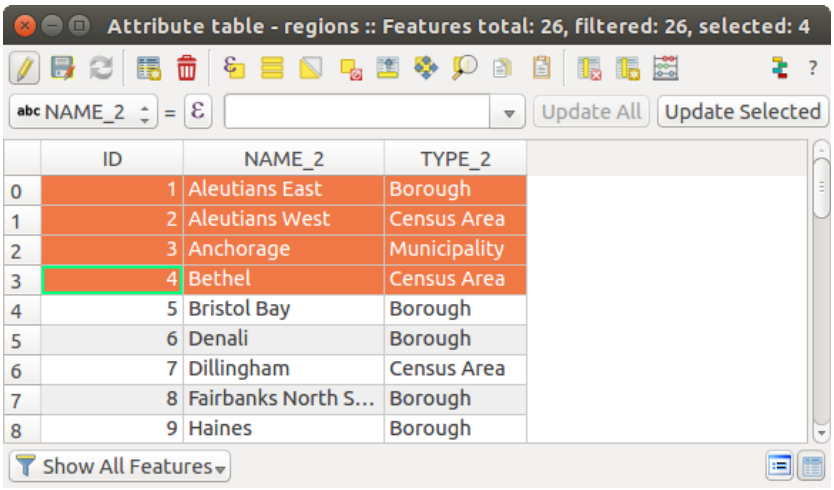


Figure 12.58: Tabla de atributos de la capa regiones

Los botones de la parte superior de la ventana de la tabla de atributos proporcionan la siguiente funcionalidad:

Icono	Etiqueta	Propósito	Atajo de teclado predeterminado
	Conmutar el modo de edición	Habilitar funciones de edición	`Ctrl+E`
	Conmutar el modo multiedición	Actualizar múltiples campos de muchos objetos	
	Guardar ediciones	Guardar las modificaciones actuales	`Ctrl+S`
	Recargar la tabla		
	Añadir objeto espacial	Añadir nuevo objeto sin geometría	
	Borrar objetos seleccionados	Eliminar los objetos seleccionados de la capa	
	Seleccionar objetos usando una expresión		
	Seleccionar todo	Seleccionar todos los objetos de la capa	`Ctrl+A`
	Invertir selección	Invertir la selección actual de la capa	`Ctrl+R`
	Deseleccionar todo	Deseleccionar todos los objetos de la capa actual	`Ctrl+Shift+A`
	Filter/Select features using form		`Ctrl+F`
	Mover la selección arriba del todo	Move selected rows to the top of the table	
	Desplazar el mapa a las filas seleccionadas		`Ctrl+P`
	Zoom map to the selected rows		`Ctrl+J`
	Copy selected rows to clipboard		`Ctrl+C`
	Paste features from clipboard	Insert new features from copied ones	`Ctrl+V`
	New field	Add a new field to the data source	`Ctrl+W`
	Borrar campo	Remove a field from the data source	`Ctrl+L`
	Open field calculator	Update field for many features in a row	`Ctrl+I`
	Conditional formatting	Enable table formatting	

Table Attribute 1: Available Tools

Nota: Depending on the format of the data and the OGR library built with your QGIS version, some tools may not be available.

Below these buttons is the Quick Field Calculation bar (enabled only in *edit mode*), which allows to quickly apply calculations to all or part of the features in the layer. This bar uses the same *expressions* as the  Field Calculator (see *Editar valores de atributo*).

Truco: Skip WKT geometry

If you want to use attribute data in external programs (such as Excel), use the  Copy selected rows to clipboard button. You can copy the information without vector geometries if you deactivate the  *Copy geometry in WKT*

representation from attribute table option in *Settings* → *Options* → *Data Sources* menu.

Table view vs Form view

QGIS provides two view modes to easily manipulate data in the attribute table:

- the Table view, displaying values of multiple features in a tabular mode, each row representing a feature and each column a field;
- and the Form view which shows identifiers of features in a first panel and displays only the attributes of the clicked identifier in the second one. Form view uses the layer fields configuration (see *Fields Properties*).

You can switch from one mode to the other by clicking the convenient icon at the bottom right of the dialog.

You can also specify the *Default view* mode at the opening of the attribute table in *Settings* → *Options* → *Data Sources* menu. It can be 'Remember last view', 'Table view' or 'Form view'.

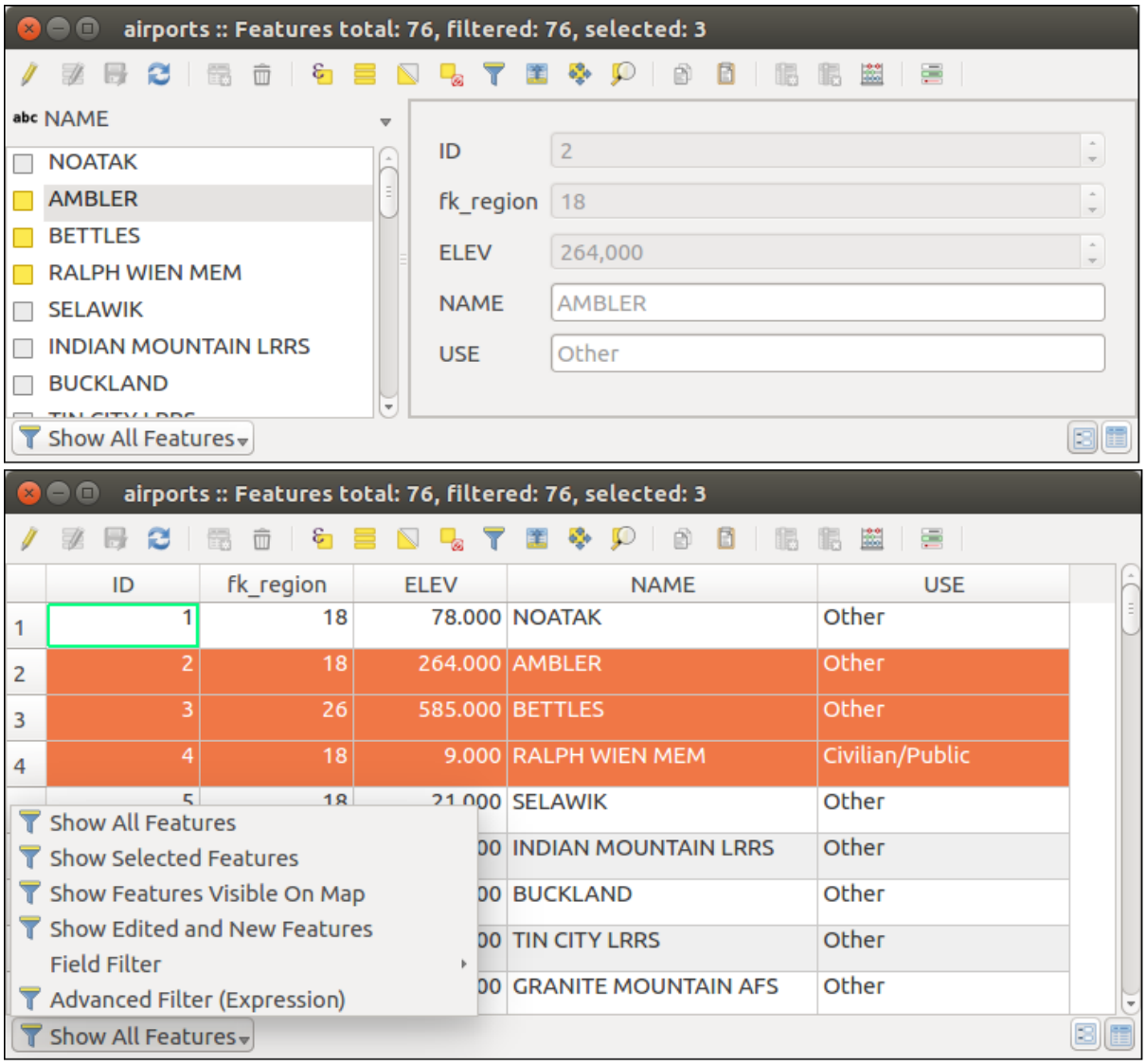


Figure 12.59: Attribute table in form view (top) vs table view (bottom)

Configuring the columns

Right-click in a column header when in table view to have access to tools that help you configure what can be displayed in the attribute table and how.

Hiding and organizing columns and enabling actions

By right-clicking in a column header, you can choose to hide it from the attribute table. To change several columns behavior at once, unhide a column or change the order of the columns, choose *Organize columns ...*. In the new dialog, you can:

- check/uncheck columns you want to show or hide
- drag-and-drop items to reorder the columns in the attribute table. Note that this change is for the table rendering and does not alter the fields order in the layer datasource
- enable a new virtual *Actions* column that displays in each row a drop-down box or button list of actions for each row, see *Propiedades de acciones* for more information about actions.

Resizing columns widths

Columns width can be set through a right-click on the column header and select either:

- *Set width...* to enter the desired value. By default, the current value is displayed in the widget
- *Autosize* to resize at the best fit the column.

It can also be changed by dragging the boundary on the right of the column heading. The new size of the column is maintained for the layer, and restored at the next opening of the attribute table.

Sorting columns

The table can be sorted by any column, by clicking on the column header. A small arrow indicates the sort order (downward pointing means descending values from the top row down, upward pointing means ascending values from the top row down). You can also choose to sort the rows with the *sort* option of the column header context menu and write an expression, e.g. to sort the row using multiple columns you can write `concat(col0, col1)`.

In form view, features identifier can be sorted using the  *Sort by preview expression* option.

Truco: Sorting based on columns of different types

Trying to sort an attribute table based on columns of string and numeric types may lead to unexpected result because of the `concat("USE", "ID")` expression returning string values (ie, `'Borough105' < 'Borough6'`). You can workaround this by using eg `concat("USE", lpad("ID", 3, 0))` which returns `'Borough105' > 'Borough006'`.

Formatting of table cells using conditions

Conditional formatting settings can be used to highlight in the attribute table features you may want to put a particular focus on, using custom conditions on feature's:

- geometry (e.g., identifying multi-parts features, small area ones or in a defined map extent...);
- or field value (e.g., comparing values to a threshold, identifying empty cells...)

You can enable the conditional formatting panel clicking on  at the top right of the attributes window in table view (not available in form view).

The new panel allows user to add new rules to format rendering of *Field* or *Full row*. Adding new rule opens a form to define:

- el nombre de la regla;
- a condition using any of the *expression builder* functions;
- the formatting: it can be choosen from a list of predefined formats or created based on properties like:
  - background and text colors;
  - use of icon;
  - bold, italic, underline, or strikeout;
  - tipo de letra.

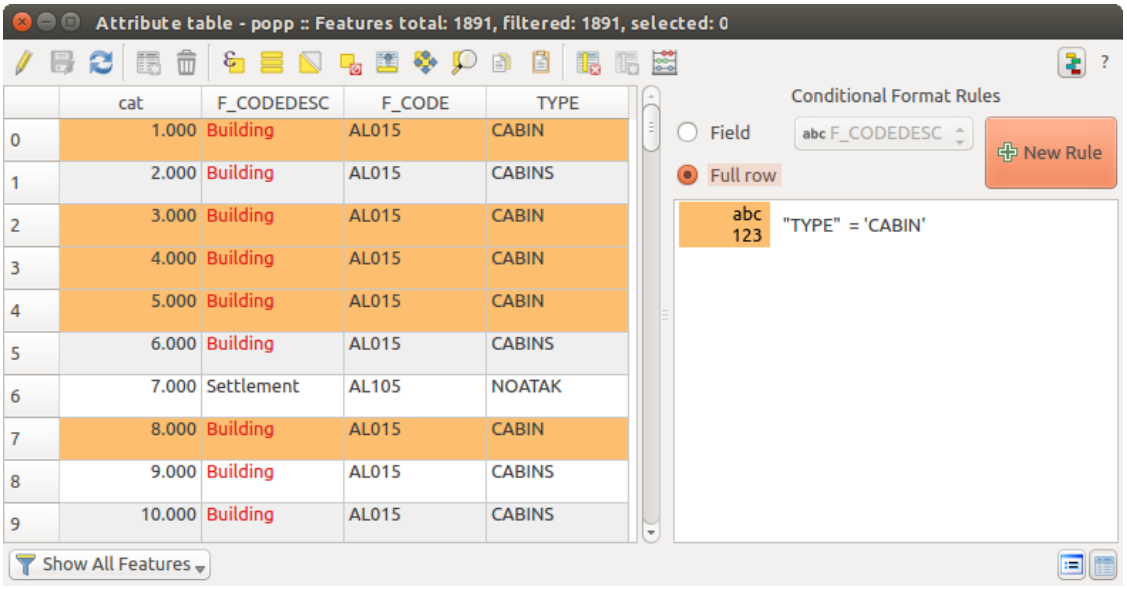


Figure 12.60: Formateo Condicional de una tabla de atributos

12.4.3 Interacting with features in an attribute table

Selecting features

In table view, each row in the attribute table displays the attributes of a unique feature in the layer. Selecting a row selects the feature and likewise, selecting a feature in the map canvas (in case of geometry enabled layer) selects the row in the attribute table. If the set of features selected in the map canvas (or attribute table) is changed, then the selection is also updated in the attribute table (or map canvas) accordingly.

Los registros se pueden seleccionar haciendo clic en el número de registros del lado izquierdo del registro. **Múltiples registros** se pueden marcar al mantener la tecla `Ctrl`. Una **selección continua** se puede hacer al mantener la tecla `Shift` y haciendo clic en varios encabezados de registros del lado izquierdo del registro. Todos los registros entre la posición actual del cursos y el registro donde se hace clic son seleccionados. Mover la posición del cursos en la tabla de atributos, al hacer clic en una celda de la tabla, no cambia el registro seleccionado. Cambiar la selección en el lienzo principal no mueve la posición del cursos en la tabla de atributos.

In form view of the attribute table, features are by default identified in the left panel by the value of their displayed field (see *Propiedades a mostrar*). This identifier can be replaced using the drop-down list at the top of the panel, either by selecting an existing field or using a custom expression. You can also choose to sort the list of features from the drop-down menu.

Click a value in the left panel to display the feature's attributes in the right one. To select a feature, you need to click inside the square symbol at the left of the identifier. By default, the symbol turns into yellow. Like in the table view, you can perform multiple feature selection using the keyboard combinations previously exposed.

Beyond selecting features with the mouse, you can perform automatic selection based on feature's attribute using tools available in the attribute table toolbar, such as (see section *Selección automática* and following one for more information and use case):

-  *Select By Expression...*
-  *Select Features By Value...*
-  *Deselect Features from All Layers*
-  *Select All Features*
-  *Invert Feature Selection.*

It is also possible to select features using the *Filtering and selecting features using forms*.

Filtering features

Once you have selected features in the attribute table, you may want to display only these records in the table. This can be easily done using the *Show Selected Features* item from the drop-down list at the bottom left of the attribute table dialog. This list offers the following filters:

- *Show All Features*
- *Show Selected Features*
- *Show Features visible on map*
- *Show Edited and New Features*
- *Field Filter* - allows the user to filter based on value of a field: choose a column from a list, type a value and press `Enter` to filter. Then, only the matching features are shown in the attribute table.
- *Advanced filter (Expression)* - Opens the expression builder dialog. Within it, you can create complex expressions to match table rows. For example, you can filter the table using more that one field. See *Expresiones* for more information.

It is also possible to filter features using the *Filtering and selecting features using forms*.

Nota: Filtering records out of the attribute table does not filter features out of the layer; they are simply momentaneously hidden from the table and can be accessed from the map canvas or by removing the filter. For filters that do hide features from the layer, use the *Query Builder*.

Truco: Update datasource filtering with `Show Features Visible on Map`

When for performance reasons, features shown in attribute table are spatially limited to the canvas extent at its opening (see *Data Source Options* for a how-to), selecting *Show Features Visible on Map* on a new canvas extent updates the spatial restriction.

Filtering and selecting features using forms

Clicking the  Filter/Select features using form or pressing `Ctrl+F` the attribute table dialog will switch to form view and all widgets are replaced with their search variant.

From this point onwards, this tool functionality is similar to the one described in the *Seleccionar objetos por valor*, where you can find descriptions of all operators and selecting modes.

Moreover, in the attribute table case, there is also a *Filter features* button that allows filtering features instead of selecting them (by creating an Advanced Filter (Expression) for the user).

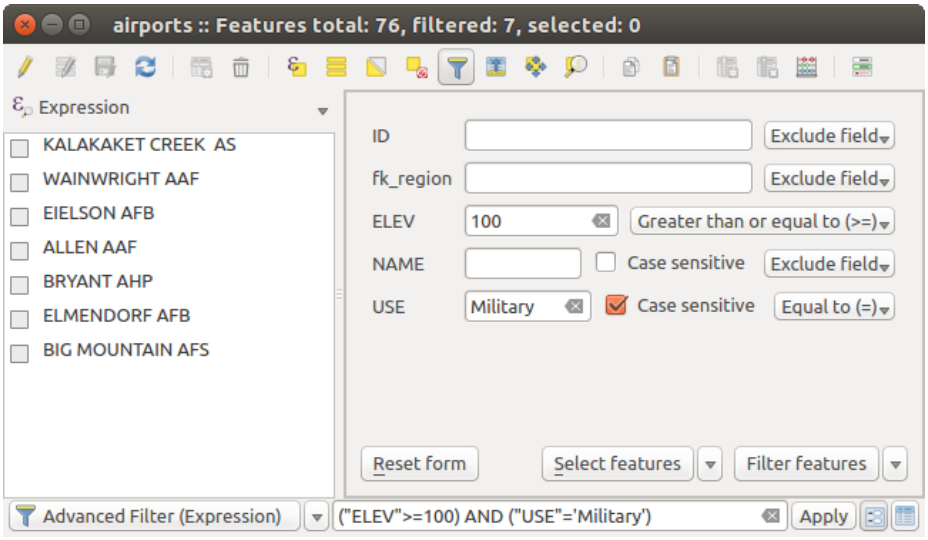


Figure 12.61: Attribute table filtered by the filter form

If there are already filtered features, you can refine the filter using the drop-down list next to the *Filter features* button. The options are:

- *Filter within ("AND")*
- *Extend filter ("OR")*

To clear the filter, either select *Show all features* option mentioned in *Filtering features*, or click the clear the expression and click **[Apply]**.

12.4.4 Using action on features

Users have several possibilities to manipulate feature with the contextual menu like:

- Select all (`Ctrl+A`) the features
- Copy the content of a cell in the clipboard with *Copy cell content*.
- *Zoom to feature* without having to select it beforehand
- Open form. It toggles attribute table into form view with a focus on the clicked feature

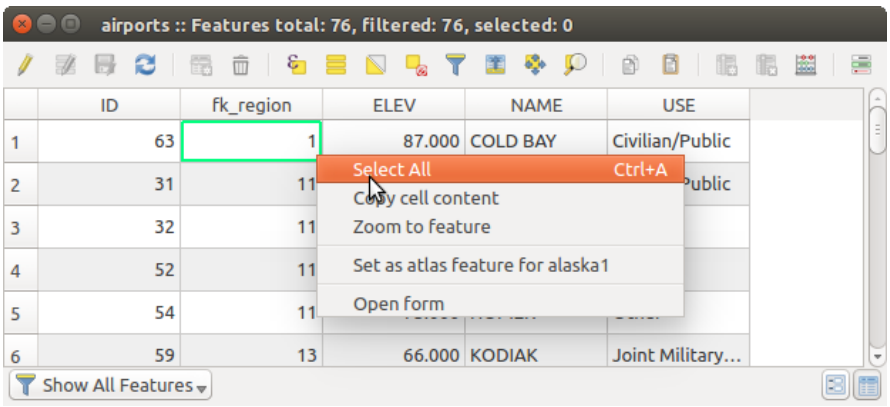


Figure 12.62: Copy cell content button

If you want to use attribute data in external programs (such as Excel, LibreOffice, QGIS or a custom web application), select one or more row(s) and use the Copy selected rows to clipboard button or press `Ctrl+C`. In *Settings* → *Options* → *Data Sources* menu you can define the format to paste to with *Copy features as* dropdown list:

- Plain text, no geometry,
- Plain text, WKT geometry,
- GeoJSON

You can also display a list of actions in this contextual menu. This is enabled in the *Layer properties* → *Actions* tab. See *Propiedades de acciones* for more information on actions.

Saving selected features as new layer

The selected features can be saved as any OGR-supported vector format and also transformed into another coordinate reference system (CRS). In the contextual menu of the layer, from the *Layers Panel*, click on *Save as* to define the name of the output file, its format and CRS (see section *Creating new layers from an existing layer*). To save the selection ensure that the *Save only selected features* is selected. It is also possible to specify OGR creation options within the dialog.

12.4.5 Editar valores de atributo

Editing attribute values can be done by:

- typing the new value directly in the cell, whether the attribute table is in table or form view. Changes are hence done cell by cell, feature by feature;
- using the *field calculator*: update in a row a field that may already exist or to be created but for multiple features; it can be used to create virtual fields.
- using the quick field *calculation bar*: same as above but for only existing field
- or using the *multi edit* mode: update in a row multiple fields for multiple features.

Using the Field Calculator

The Field Calculator button in the attribute table allows you to perform calculations on the basis of existing attribute values or defined functions, for instance, to calculate length or area of geometry features. The results can be written to a new attribute field, a virtual field, or they can be used to update values in an existing field.

The field calculator is available on any layer that supports edit. When you click on the field calculator icon the dialog opens (see figure_field_calculator). If the layer is not in edit mode, a warning is displayed and using the field calculator will cause the layer to be put in edit mode before the calculation is made.

Based on the *Expression Builder* dialog, the field calculator dialog offers a complete interface to define an expression and apply it to an existing or a newly created field. To use the field calculator dialog, you first must select whether you want to only update selected features, create a new attribute field where the results of the calculation will be added or update an existing field.

If you choose to add a new field, you need to enter a field name, a field type (integer, real, date or string) and if needed, the total field length and the field precision. For example, if you choose a field length of 10 and a field precision of 3, it means you have 6 digits before the dot, then the dot and another 3 digits for the precision.

A short example illustrates how field calculator works when using the *Expression* tab. We want to calculate the length in km of the `railroads` layer from the QGIS sample dataset:

1. Load the shapefile `railroads.shp` in QGIS and press Open Attribute Table.
2. Click on Toggle editing mode and open the Field Calculator dialog.
3. Select the *Create a new field* checkbox to save the calculations into a new field.
4. Add `length` as Output field name and `real` as Output field type, and define Output field length to be 10 and Precision, 3.

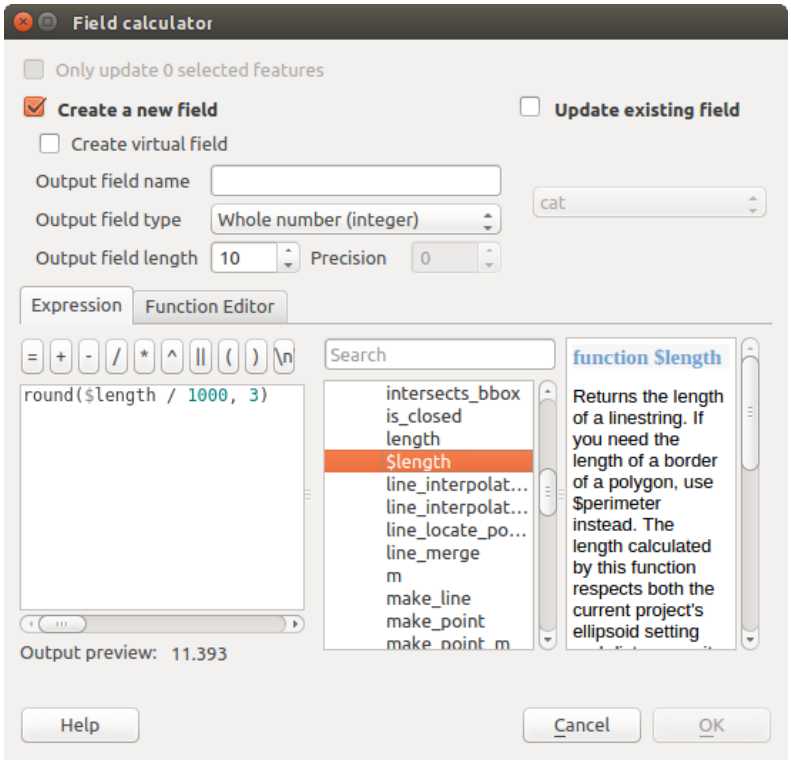


Figure 12.63: Calculadora de Campos

5. Now double click on function `$length` in the *Geometry* group to add it into the Field calculator expression box.
6. Complete the expression by typing `/ 1000` in the Field calculator expression box and click **[Ok]**.
7. Ahora puede encontrar un nuevo campo `longitud` en la tabla de atributos.

Creating a Virtual Field

A virtual field is a field based on an expression calculated on the fly, meaning that its value is automatically updated as soon as the underlying parameter changes. The expression is set once; you no longer need to recalculate the field each time underlying values change. For example, you may want to use a virtual field if you need area to be evaluated as you digitize features or to automatically calculate a duration between dates that may change (e.g., using `now()` function).

Nota: Uso de Campos Virtuales

- Virtual fields are not permanent in the layer attributes, meaning that they're only saved and available in the project file they've been created.
- Un campo puede definirse como virtual sólo al momento de su creación y la expresión usado no puede cambiarse luego: necesitará borrar y recrear el campo.

Using the Quick Field Calculation Bar

While Field calculator is always available, the quick field calculation bar on top of the attribute table is only visible if the layer is in edit mode. Thanks to the expression engine, it offers a quicker access to edit an already existing field.

In quick field calculation bar, you simply need to:

- select the existing field name in the drop-down list

- fill the textbox with an expression you directly write or build using the ε expression button
- and click on **[Update All]**, **[Update Selected]** or **[Update Filtered]** button according to your need.

Editing multiple fields

Unlike the previous tools, multi edit mode allows multiple attributes of different features to be edited simultaneously. When the layer is toggled to edit, multi edit capabilities are accessible:

- using the Toggle multi edit mode button from the toolbar inside the attribute table dialog,
- or selecting *Edit* → *Modify attributes of selected features* menu.

In order to edit multiple fields in a row:

1. select the features you want to edit;
2. from the attribute table toolbar, click the button. This will toggle the dialog to its form view. Feature selection could also be made at this step;
3. at the right side of the attribute table, fields (and values) of selected features are shown. New widgets appear next to each field allowing for display of the current multi edit state:
   - the field contains different values for selected features. It's shown empty and each feature will keep its original value. You can reset the value of the field from the drop-down list of the widget.
   - all selected features have the same value for this field and the value displayed in the form will be kept.
   - the field has been edited and the entered value will be applied to all the selected features. A message appears at the top of the dialog, inviting you to either apply or reset your modification.

   Clicking any of these widgets allows you to either set the current value for the field or reset to original value, meaning that you can roll back changes on a field-by-field basis.
4. make the changes to the fields you want and click on **Apply changes** in the upper message text or any other feature in the left panel.

Changes will apply to **all selected features**. If no feature is selected, the whole table is updated with your changes.

Modifications are made as a single edit command. So pressing Undo will rollback the attribute changes for all selected features at once.

Nota: Unlike the tool from the attribute table, hitting the *Edit* → *Modify Attributes of Selected Features* option provides you with a modal dialog to fill attributes changes. Hence, features selection is required before execution.

Nota: Multi edit mode is only available for auto generated and drag and drop forms (see *Customize a form for your data*); it is not supported by custom ui forms.

12.4.6 Creating one or many to many relations

Relations are a technique often used in databases. The concept is that features (rows) of different layers (tables) can belong to each other.

Introducing 1-N relations

As an example you have a layer with all regions of alaska (polygon) which provides some attributes about its name and region type and a unique id (which acts as primary key).

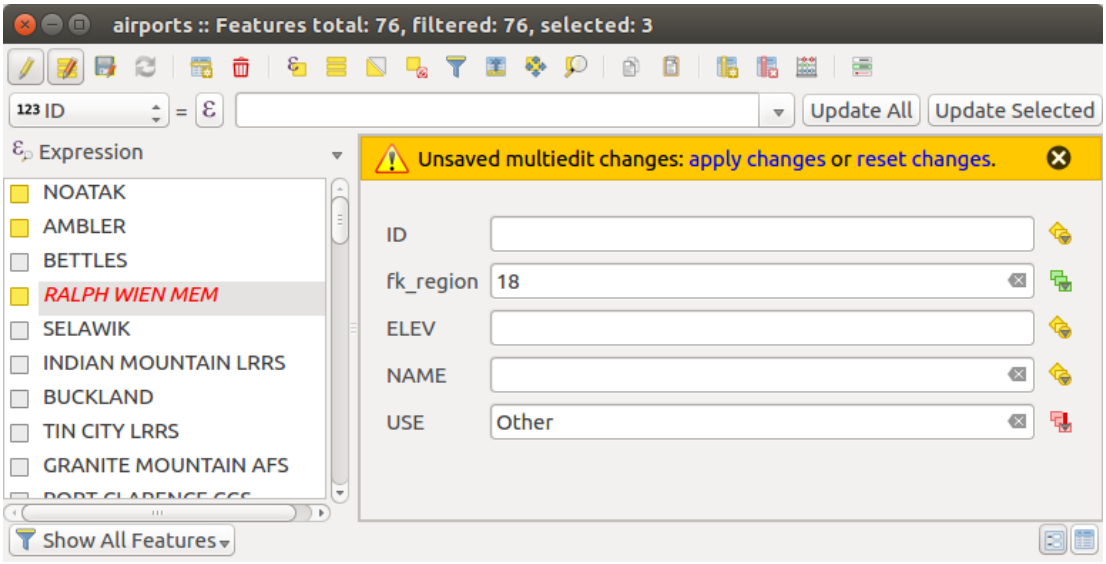


Figure 12.64: Editing fields of multiple features

Then you get another point layer or table with information about airports that are located in the regions and you also want to keep track of these. If you want to add them to the regions layer, you need to create a one to many relation using foreign keys, because there are several airports in most regions.

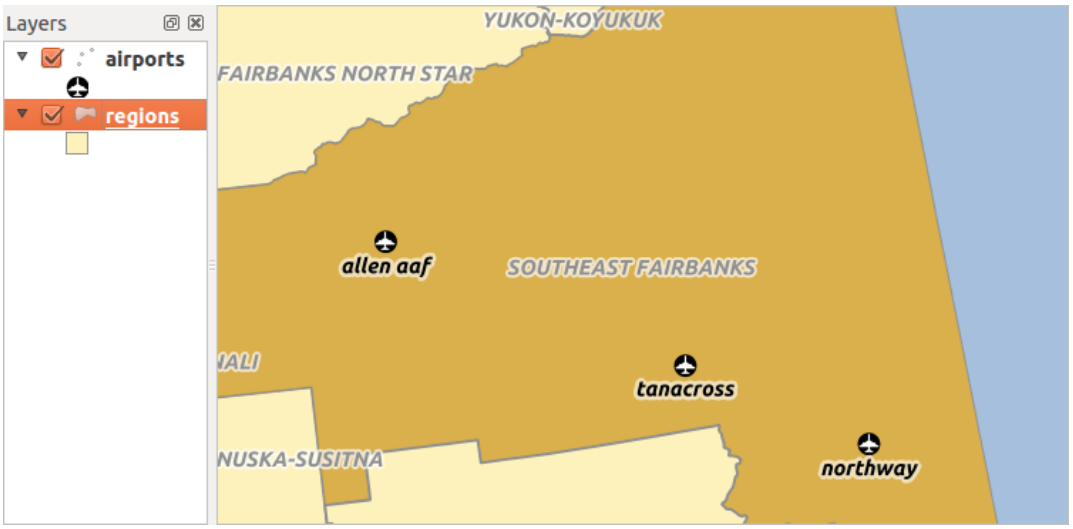


Figure 12.65: Región de Alaska con aeropuertos

Layers in 1-N relations

QGIS makes no difference between a table and a vector layer. Basically, a vector layer is a table with a geometry. So you can add your table as a vector layer. To demonstrate the 1-n relation, you can load the `regions` shapefile and the `airports` shapefile which has a foreign key field (`fk_region`) to the layer regions. This means, that each airport belongs to exactly one region while each region can have any number of airports (a typical one to many relation).

Foreign keys in 1-N relations

In addition to the already existing attributes in the airports attribute table, you'll need another field `fk_region` which acts as a foreign key (if you have a database, you will probably want to define a constraint on it).

This field fk_region will always contain an id of a region. It can be seen like a pointer to the region it belongs to. And you can design a custom edit form for editing and QGIS takes care of the setup. It works with different providers (so you can also use it with shape and csv files) and all you have to do is to tell QGIS the relations between your tables.

Defining 1-N relations (Relation Manager)

The first thing we are going to do is to let QGIS know about the relations between the layers. This is done in *Project → Project Properties...*. Open the *Relations* tab and click on **[Add Relation]**.

- **name** is going to be used as a title. It should be a human readable string, describing, what the relation is used for. We will just call say **Airports** in this case.
- **referencing layer** also considered as child layer, is the one with the foreign key field on it. In our case, this is the `airports` layer
- **referencing field** will say, which field points to the other layer so this is `fk_region` in this case
- **referenced layer** also considered as parent layer, is the one with the primary key, pointed to, so here it is the `regions` layer
- **referenced field** is the primary key of the referenced layer so it is `ID`
- **id** will be used for internal purposes and has to be unique. You may need it to build *custom forms*. If you leave it empty, one will be generated for you but you can assign one yourself to get one that is easier to handle.

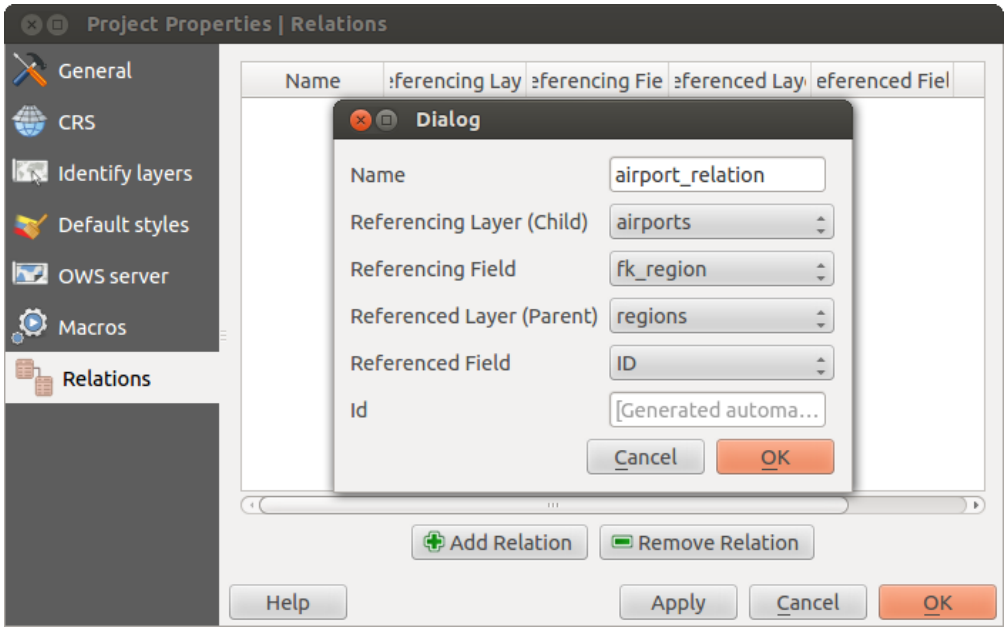


Figure 12.66: Administrador de relaciones

Forms for 1-N relations

Ahora que QGIS conoce la relación, se utilizará para mejorar el formulario generado. Como no hemos cambiado el método de formulario predeterminado (autogenerado) simplemente se añadirá un nuevo control a nuestro formulario. Así que vamos a seleccionar la capa Regiones en la leyenda y a utilizar la herramienta de identificación.

Dependiendo de la configuración, el formulario se puede abrir directamente o se tendrá que abrir desde el diálogo de identificación, dentro de las acciones.

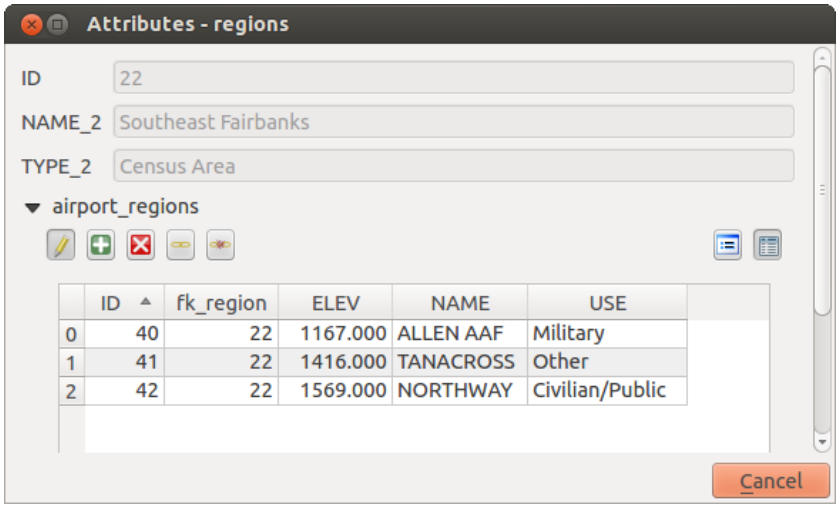


Figure 12.67: Identification dialog regions with relation to airports

As you can see, the airports assigned to this particular region are all shown in a table. And there are also some buttons available. Let's review them shortly

- The button is for toggling the edit mode. Be aware that it toggles the edit mode of the airport layer, although we are in the feature form of a feature from the region layer. But the table is representing features of the airport layer.
- The button will add a new feature to the airport layer. And it will assign the new airport to the current region by default.
- The button will delete the selected airport permanently.
- El símbolo abrirá un nuevo diálogo en el que se puede seleccionar cualquier aeropuerto existente que luego serán asignados a la región actual. Esto puede ser útil si ha creado el aeropuerto en la región equivocada por accidente.
- The symbol will unlink the selected airport from the current region, leaving them unassigned (the foreign key is set to NULL) effectively.
- The two buttons to the right switch between table view and form view where the later let's you view all the airports in their respective form.

If you work on the airport table, a new widget type is available which lets you embed the feature form of the referenced region on the feature form of the airports. It can be used when you open the layer properties of the airports table, switch to the *Fields* menu and change the widget type of the foreign key field 'fk_region' to Relation Reference.

If you look at the feature dialog now, you will see, that the form of the region is embedded inside the airports form and will even have a combobox, which allows you to assign the current airport to another region.

Introducing many-to-many (N-M) relations

N-M relations are many-to-many relation between two tables. For instance, the `airports` and `airlines` layers: an airport receives several airline companies and an airline company flies to several airports.

In such case, we need a pivot table to list all airlines for all airports. In QGIS, you should setup two *one-to-many relations* as explained above:

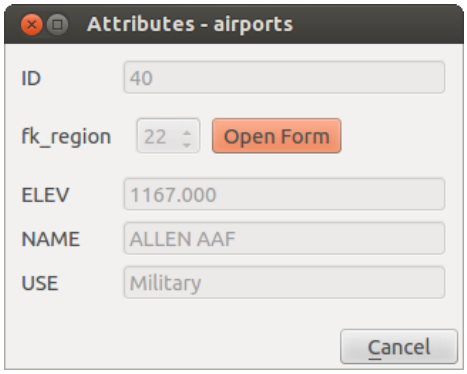


Figure 12.68: Identification dialog airport with relation to regions

- a relation between `airlines` table and the pivot table;
- and a second one between `airports` table and the pivot table.

When we add a new child (i.e. a company to an airport), QGIS will add a new row in the pivot table and in the `airlines` table. If we link a company to an airport, QGIS will only add a row in the pivot table.

In case you want to remove a link, an airline or an airport, QGIS won't remove the row in the pivot table. The database administrator should add a *ON DELETE CASCADE* instruction in the foreign key constraint:

```
ALTER TABLE location.airlines
ADD CONSTRAINT location_airlines_airports_id_fkey
   FOREIGN KEY (id)
      REFERENCES location.airports(id)
         ON DELETE CASCADE;
```

Nota: Combining N-M relation with automatic transaction group

You should enable the transaction mode in *Project Properties* → *Data Sources* → when working on such context. QGIS should be able to add or update row(s) in all tables (airlines, airports and the pivot tables).

Finally, adding such relations in a form is done in the same way that for a one-to-many relation. The *Relations* panel in the *Fields* properties of the vector layer will let the user add the relation in the form. It will appear as a **Many to many relation**.

12.5 Editar

QGIS supports various capabilities for editing OGR, SpatiaLite, PostGIS, MSSQL Spatial and Oracle Spatial vector layers and tables.

Nota: El procedimiento para edición de capas GRASS es diferente - vea la sección *Digitalizar y editar una capa vectorial GRASS* para más detalles.

Truco: Las ediciones simultáneas

This version of QGIS does not track if somebody else is editing the same feature at the same time as you are. The last person to save its edits wins.

12.5.1 Configurar la tolerancia del autoensamblado y radio de búsqueda

For an optimal and accurate edit of the vector layer geometries, we need to set an appropriate value of snapping tolerance and search radius for features vertices.

Tolerancia de autoensamblado

Snapping tolerance is the distance QGIS uses to `search` for the closest vertex and/or segment you are trying to connect to when you set a new vertex or move an existing vertex. If you aren't within the snapping tolerance, QGIS will leave the vertex where you release the mouse button, instead of snapping it to an existing vertex and/or segment. The snapping tolerance setting affects all tools that work with tolerance.

1. A general, project-wide snapping tolerance can be defined by choosing *Settings* → 🔧 *Options...*, *Digitizing* tab. You can select between 'To vertex', 'To segment' or 'To vertex and segment' as default snap mode. You can also define a default snapping tolerance and a search radius for vertex edits. The tolerance can be set either in map units or in pixels. The advantage of choosing pixels is that the snapping tolerance doesn't have to be changed after zoom operations. In our small digitizing project (working with the Alaska dataset), we define the snapping units in feet. Your results may vary, but something on the order of 300 ft at a scale of 1:10000 should be a reasonable setting.
2. A layer-based snapping tolerance that overrides the global snapping options can be defined by choosing *Settings* → *Snapping options*. It enables and adjusts snapping mode and tolerance on a layer basis (see figure_edit_snapping). This dialog offers three different modes to select the layer(s) to snap to:
   - *Current layer*: only the active layer is used, a convenient way to ensure topology within the layer being edited
   - *All layers*: a quick and simple setting for all visible layers in the project so that the pointer snaps to all vertices and/or segments. In most cases it is sufficient to use this snapping mode.
   - *Advanced*: if you need to edit a layer and snap its vertices to another layer, ensure the target layer is checked and increase the snapping tolerance to a greater value. Furthermore, snapping will never occur to a layer that is not checked in the snapping options dialog, regardless of the global snapping tolerance. So be sure to mark the checkbox for those layers that you need to snap to.

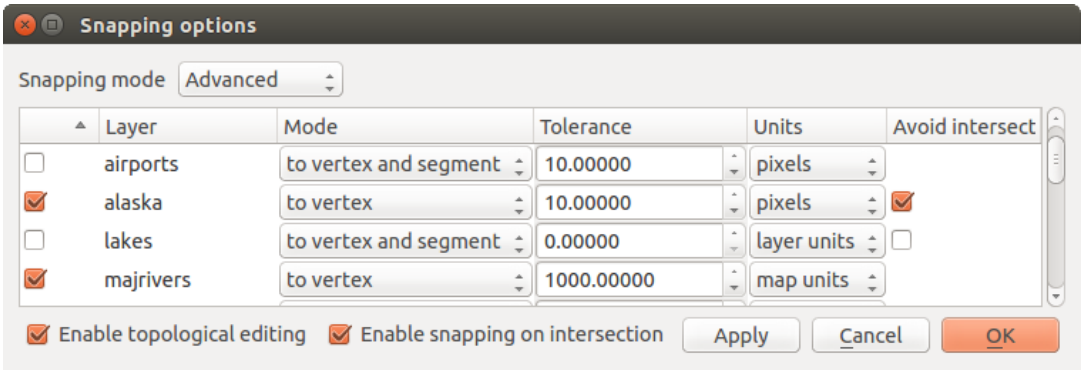


Figure 12.69: Editar opciones de autoensamblado en base a una capa (modo Avanzado)

Truco: Control the list of layers to snap

The *Snapping Options* dialog is by default populated with parameters (mode, tolerance, units) set in the global *Digitizing* tab. To avoid layers being checked by default in the **Advanced** mode and hence set snappable, define the *Default Snap mode* to `Off`.

Snapping tolerance can be set in `pixels` or `map units` (the units of the map view). While in the **Advanced** layer selection mode, it is possible to use a snapping tolerance that refers to `layer units`, the units of the reprojected layer when 'on-the-fly' CRS transformation is on.

Radio de búsqueda

Search radius is the distance QGIS uses to `search` for the closest vertex you are trying to select when you click on the map. If you aren't within the search radius, QGIS won't find and select any vertex for editing. The search

radius for vertex edits can be defined under *Settings* → *Options* → *Digitizing* tab. This is the same place where you define the general, project-wide snapping tolerance.

Snap tolerance and search radius are set in `map units` or `pixels`, so you may find you need to experiment to get them set right. If you specify too big of a tolerance, QGIS may snap to the wrong vertex, especially if you are dealing with a large number of vertices in close proximity. Set search radius too small, and it won't find anything to move.

12.5.2 Edición topológica

Besides layer-based snapping options, you can also define topological functionalities in the *Snapping options...* dialog in the *Settings* (or *File*) menu. Here, you can define *Enable topological editing*, and/or for polygon layers, activate the *Avoid Intersections* option.

Habilitar edición topológica

The option *Enable topological editing* is for editing and maintaining common boundaries in features mosaics. QGIS 'detects' shared boundary by the features, so you only have to move a common vertex/segment once, and QGIS will take care of updating the neighboring features.

Evitar intersecciones de nuevos polígonos

A second topological option called *Avoid intersections* prevents you to draw new features that overlap an existing one. It is for quicker digitizing of adjacent polygons. If you already have one polygon, it is possible with this option to digitize the second one such that both intersect, and QGIS then cuts the second polygon to the boundary of the existing one. The advantage is that you don't have to digitize all vertices of the common boundary.

Nota: If the new geometry is totally covered by existing ones, it gets cleared and the new feature will have no geometry when allowed by the provider, otherwise saving modifications will make QGIS pop-up an error message.

Advertencia: Use cautiously the *Avoid Intersections* option
Because the option cuts or clears geometry of any overlaping feature from any polygon layer, do not forget to uncheck this option once you no longer need it otherwise, you can get unexpected geometries.

Habilitar autoensamblado en intersecciones

Otra opción es utilizar *Habilitar autoensamblado en intersección*. Le permitirá que se ajuste a una intersección de las capas de fondo, incluso si no hay ningún vértice en la intersección.

Comprobador de Geometría

A core plugin can help the user to find the geometry invalidity. You can find more information on this plugin at *Complemento Comprobador de geometría*.

12.5.3 Digitalizando una capa existente

By default, QGIS loads layers read-only. This is a safeguard to avoid accidentally editing a layer if there is a slip of the mouse. However, you can choose to edit any layer as long as the data provider supports it (see *Exploring Data Formats and Fields*), and the underlying data source is writable (i.e., its files are not read-only).

Truco: Restrict edit permission on layers within a project

From the *Project* → *Project properties* → *Identify* tab, You can choose to set any layer read-only regardless the provider permission. This can be a handy way, in a multi-users environment to avoid unauthorized users to mistakenly edit layers (e.g., shapefile), hence potentially corrupt data. Note that this setting only applies inside the current project.

In general, tools for editing vector layers are divided into a digitizing and an advanced digitizing toolbar, described in section *Digitalización avanzada*. You can select and unselect both under *View* → *Toolbars* →. Using the basic digitizing tools, you can perform the following functions:

Icono	Propósito	Icono	Propósito
	Ediciones actuales		Conmutar edición
	Adicionar Característica: Capturar Punto		Añadir objeto espacial: Capturar línea
	Add Feature: Capture Polygon		Move Feature
	Add Circular String		Add Circular String By Radius
	Node Tool		Borrar lo seleccionado
	Cortar objetos espaciales		Copiar objetos espaciales
	Pegar objetos espaciales		Guardar cambios de la capa

Edición de tabla: Barra de herramientas de edición básica de capa vectorial

Note that while using any of the digitizing tools, you can still *zoom or pan* in the map canvas without losing the focus on the tool.

All editing sessions start by choosing the  Toggle editing option found in the context menu of a given layer, from the attribute table dialog, the digitizing toolbar or the *Edit* menu.

Once the layer is in edit mode, additional tool buttons on the editing toolbar will become available and markers will appear at the vertices of all features unless *Show markers only for selected features* option under *Settings* → *Options...* → *Digitizing* menu is checked.

Truco: Guardar regularmente

Remember to  Save Layer Edits regularly. This will also check that your data source can accept all the changes.

Añadir objetos espaciales

You can use the  Add Feature,  Add Feature or  Add Feature icons on the toolbar to add new feature (point, line and polygon) into the current layer.

The next buttons  Add circular string or  Add circular string by radius allow users to add line or polygon features with a circular geometry.

To create features with these tools, you first digitize the geometry then enter its attributes. To digitize the geometry, left-click on the map area to create the first point of your new feature.

For linear or curved geometries, keep on left-clicking for each additional point you wish to capture or use *automatic tracing* capability to accelerate the digitization. You can switch back and forth between linear *Add feature* tool and curved *Add circular string...* tools to create compound curved geometry. Pressing `Delete` or `Backspace` key reverts the last node you add. When you have finished adding points, right-click anywhere on the map area to confirm you have finished entering the geometry of that feature.

Nota: Curved geometries are stored as such only in compatible data provider

Although QGIS allows to digitize curved geometries within any editable data format, you need to be using a data provider (e.g. PostGIS, GML or WFS) that supports curves to have features stored as curved, otherwise QGIS segmentizes the circular arcs. The memory layer provider also supports curves.

Truco: Customize the digitizing rubber band

While capturing polygon, the by-default red rubber band can hide underlying features or places you'd like to capture a point. This can be fixed by setting a lower opacity (or alpha channel) to the rubber band's *Fill Color* in *Settings* → *Options* → *Digitizing* menu. You can also avoid the use of the rubber band by checking *Don't update rubber band during node editing*.

The attribute window will appear, allowing you to enter the information for the new feature. Figure_edit_values shows setting attributes for a fictitious new river in Alaska. However, in the *Digitizing* menu under the *Settings* → *Options* menu, you can also activate:

- *Suppress attributes pop-up windows after each created feature* to avoid the form opening
- or *Reuse last entered attribute values* to have fields automatically filled at the opening of the form and just have to type changing values.

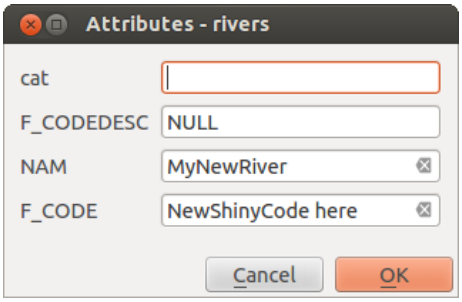


Figure 12.70: Enter Attribute Values Dialog after digitizing a new vector feature

With the Move Feature(s) icon on the toolbar, you can move existing features.

Node Tool

For shapefile-based or MapInfo layers as well as SpatiaLite, PostgreSQL/PostGIS, MSSQL Spatial, and Oracle Spatial tables, the Node Tool provides manipulation capabilities of feature vertices similar to CAD programs. It is possible to simply select multiple vertices at once and to move, add or delete them altogether. The node tool also works with 'on the fly' projection turned on and supports the topological editing feature. This tool is, unlike other tools in QGIS, persistent, so when some operation is done, selection stays active for this feature and tool.

It is important to set the property *Settings* → *Options* → *Digitizing* → *Search Radius:* 1,00 to a number greater than zero. Otherwise, QGIS will not be able to tell which vertex is being edited and will display a warning.

Truco: Marcadores vértices

La actual versión de QGIS reconoce tres tipos de marcadores de vértices: 'Círculo semitransparente', 'Cruz' y 'Nada'. Para cambiar el estilo del marcador, seleccione *Opciones* del menú *Configuración*, haga clic en la pestaña *Digitalización* y seleccione la entrada apropiada.

Operaciones básicas

Start by activating the  Node Tool and selecting a feature by clicking on it. Red boxes will appear at each vertex of this feature.

- **Selecting vertices**: You can select vertices by clicking on them one at a time, by clicking on an edge to select the vertices at both ends, or by clicking and dragging a rectangle around some vertices. When a vertex is selected, its color changes to blue. To add more vertices to the current selection, hold down the `Ctrl` key while clicking. Hold down `Ctrl` when clicking to toggle the selection state of vertices (vertices that are currently unselected will be selected as usual, but also vertices that are already selected will become unselected).
- **Adding vertices**: To add a vertex, simply double click near an edge and a new vertex will appear on the edge near to the cursor. Note that the vertex will appear on the edge, not at the cursor position; therefore, it should be moved if necessary.
- **Deleting vertices**: Select the vertices and click the `Delete` key. Deleting all the vertices of a feature generates, if compatible with the datasource, a geometryless feature. Note that this doesn't delete the complete feature, just the geometry part; To delete a complete feature use the  Delete Selected tool.
- **Moving vertices**: Select all the vertices you want to move, click on a selected vertex or edge and drag in the direction you wish to move. All the selected vertices will move together. If snapping is enabled, the whole selection can jump to the nearest vertex or line.

Each change made with the node tool is stored as a separate entry in the *Undo* dialog. Remember that all operations support topological editing when this is turned on. On-the-fly projection is also supported, and the node tool provides tooltips to identify a vertex by hovering the pointer over it.

Truco: Move features with precision

The  *Move Feature* tool doesn't currently allow to snap features while moving. Using the  Node Tool, select ALL the vertices of the feature, click a vertex, drag and snap it to a target vertex: the whole feature is moved and snapped to the other feature.

The Vertex Editor

With activating the *Node Tool* on a feature, QGIS opens the *Vertex Editor* panel listing all the vertices of the feature with their x, y (z, m if applicable) coordinates and r (for the radius, in case of circular geometry). Simply select a row in the table does select the corresponding vertex in the map canvas, and vice versa. Simply change a coordinate in the table and your vertex position is updated. You can also select multiple rows and delete them altogether.

Cortar, copiar, y pegar objetos espaciales

Selected features can be cut, copied and pasted between layers in the same QGIS project, as long as destination layers are set to  Toggle editing beforehand.

Truco: Transform polygon into line and vice-versa using copy/paste

Copy a line feature and paste it in a polygon layer: QGIS pastes in the target layer a polygon whose boundary corresponds to the closed geometry of the line feature. This is a quick way to generate different geometries of the same data.

Features can also be pasted to external applications as text. That is, the features are represented in CSV format, with the geometry data appearing in the OGC Well-Known Text (WKT) format. WKT and GeoJSON features from outside QGIS can also be pasted to a layer within QGIS.

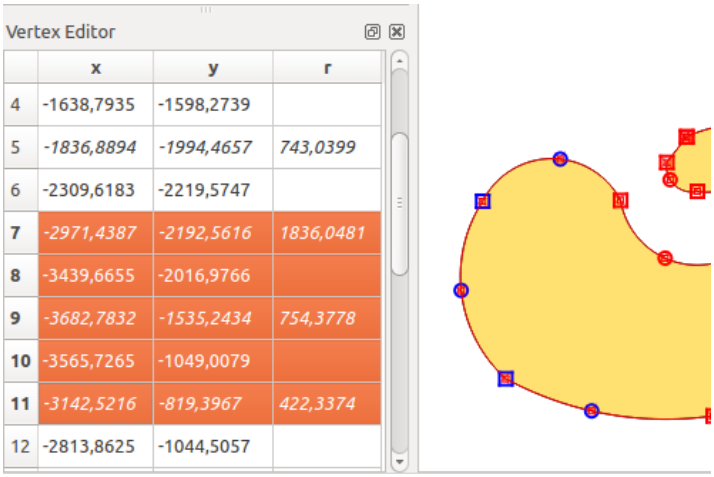


Figure 12.71: Vertex editor panel showing selected nodes

When would the copy and paste function come in handy? Well, it turns out that you can edit more than one layer at a time and copy/paste features between layers. Why would we want to do this? Say we need to do some work on a new layer but only need one or two lakes, not the 5,000 on our `big_lakes` layer. We can create a new layer and use copy/paste to plop the needed lakes into it.

Como un ejemplo, copiaremos algunos lagos a una nueva capa:

1. Cargar la capa desde donde desee copiar (capa fuente)
2. Cargar o crear la capa a la que desee copiar (capa destino)
3. Comenzar a editar la capa destino
4. Hacer la capa de fuente activa haciendo clic sobre ella en la leyenda
5. Use the Select Features by area or single click tool to select the feature(s) on the source layer
6. Click on the Copy Features tool
7. Hacer la capa de destino activa haciendo clic en la leyenda.
8. Click on the Paste Features tool
9. Detener edición y guardar los cambios

¿Qué pasa si la capa de origen y destino tienen diferentes esquemas (los nombres de campo y tipo no son los mismos)? QGIS poblará los que coinciden e ignorará el resto. Si no son importantes los atributos que se copian a la capa de destino, no importa la forma de diseñar los campos y tipos de datos. Si desea asegurarse de que todo - el objeto espacial y sus atributos - se copia, asegúrese de que los esquemas coincidan.

Nota: Congruencia del pegado de objetos espaciales

Si su capa de origen y destino utilizan la misma proyección, entonces el pegado de objetos espaciales tendrá la geometría idéntica a la capa origen. Sin embargo, si el destino tiene una proyección diferente, entonces QGIS no puede garantizar que la geometría sea idéntica. Esto es simplemente porque hay pequeños errores de redondeo involucrados en la conversión entre las proyecciones.

Truco: Copiar atributos de texto en otro

If you have created a new column in your attribute table with type 'string' and want to paste values from another attribute column that has a greater length the length of the column size will be extended to the same amount. This is because the GDAL Shapefile driver starting with GDAL/OGR 1.10 knows to auto-extend string and integer fields to dynamically accommodate for the length of the data to be inserted.

Borrar objetos espaciales seleccionados

If we want to delete an entire feature (attribute and geometry), we can do that by first selecting the geometry using the regular  Select Features by area or single click tool. Selection can also be done from the attribute table. Once you have the selection set, press `Delete` or `Backspace` key or use the  Delete Selected tool to delete the features. Multiple selected features can be deleted at once.

La herramienta  Cortar objetos espaciales en la barra de herramientas de digitalización también se puede utilizar para borrar objetos espaciales. Este efectivamente borra el objeto espacial pero también lo coloca en un "portapapeles espacial". Por lo tanto, cortamos el objeto espacial para borrar. Entonces podríamos utilizar la herramienta  Pegar objetos espaciales para colocarlo de nuevo, nos da una capacidad de deshacer de un nivel. Cortar, copiar y pegar funcionan sobre los objetos espaciales seleccionados, lo que significa que podemos operar más de una a la vez.

Guardar capas editadas

When a layer is in editing mode, any changes remain in the memory of QGIS. Therefore, they are not committed/saved immediately to the data source or disk. If you want to save edits to the current layer but want to continue editing without leaving the editing mode, you can click the  Save Layer Edits button. When you turn editing mode off with  Toggle editing (or quit QGIS for that matter), you are also asked if you want to save your changes or discard them.

Si los cambios no se pueden guardar (por ejemplo, disco lleno, o los atributos tienen valores que están fuera de rango), el estado de memoria de QGIS es preservado. Esto le permite ajustar sus ediciones e intentar de nuevo.

Truco: Integridad de datos

Siempre es buena idea respaldar sus datos fuente antes de iniciar la edición. Mientras los autores de QGIS han hecho todo el esfuerzo para preservar la integridad de sus datos, nosotros no ofrecemos garantía en este sentido.

Saving multiple layers at once

Este objeto espacial permite la digitalización de múltiples capas. Elegir  *Guardar las capas seleccionadas* para guardar todos los cambios que se hicieron en múltiples capas. Se tiene la oportunidad para  *Revertir las capas seleccionadas*, así que la digitalización puede ser retirada de todas las capas seleccionadas. Si se desea detener la edición de las capas seleccionadas,  *Cancelar para la capa(s) seleccionada(s)* es una forma fácil.

Las mismas funciones están disponibles para editar todas las capas del proyecto.

Truco: Use transaction group to edit, save or rollback multiple layers changes at once

When working with layers from the same PostGreSQL database, activate the *Automatically create transaction groups where possible* option in *Project* → *Project Properties* → *Data Sources* to sync their behavior (enter or exit the edit mode, save or rollback changes at the same time).

12.5.4 Digitalización avanzada

Icono	Propósito	Icono	Propósito
	Habilitar herramientas de digitalización avanzada		Habilitar Trazado
	Deshacer		Rehacer
	Rotar objeto(s) espacial(es)		Simplificar objeto espacial
	Añadir anillo		Añadir parte
	Rellenar anillo		
	Borrar anillo		Borrar parte
	Desplazar curva		Remodelar objetos espaciales
	Dividir partes		Dividir objetos espaciales
	Combinar atributos de objetos espaciales seleccionados		Combinar objetos espaciales seleccionados
	Rotar símbolos de puntos		Símbolos de punto de desplazamiento

Edición avanzada de tabla: la barra de herramientas de edición avanzada de capa vectorial

Deshacer y rehacer

The Undo and Redo tools allows you to undo or redo vector editing operations. There is also a dockable widget, which shows all operations in the undo/redo history (see Figure_edit_undo). This widget is not displayed by default; it can be displayed by right-clicking on the toolbar and activating the *Undo/Redo Panel* checkbox. The Undo/Redo capability is however active, even if the widget is not displayed.

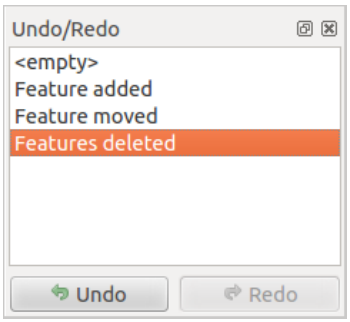


Figure 12.72: Rehacer y deshacer pasos digitalizados

When Undo is hit or `Ctrl+Z` (or `Cmd+Z`) pressed, the state of all features and attributes are reverted to the state before the reverted operation happened. Changes other than normal vector editing operations (for example, changes done by a plugin) may or may not be reverted, depending on how the changes were performed.

Utilizar el widget de historial de deshacer/rehacer, sólo haga clic para seleccionar la operación en la lista del histórico. Todos los objetos espaciales se revertirán al estado que tenían después de la operación de seleccionada.

Rotar objeto(s) espacial(es)

Use Rotate Feature(s) to rotate one or multiple features in the map canvas. Press the Rotate Feature(s) icon and then click on the feature to rotate. Either click on the map to place the rotated feature or enter an angle in the user input widget. If you want to rotate several features, they shall be selected first.

If you enable the map tool with feature(s) selected, its (their) centroid appears and will be the rotation anchor point. If you want to move the anchor point, hold the `Ctrl` button and click on the map to place it.

Si se mantiene `Shift` antes de hacer clic en el mapa, la rotación se hará en pasos de 45 grados, que pueden ser modificados después en el widget de entrada del usuario.

To abort feature rotation, you need to click on  Rotate Feature(s) icon.

Simplificar objeto espacial

The  Simplify Feature tool allows you to reduce the number of vertices of a feature, as long as the geometry remains valid. With the tool you can also simplify many features at once or multi-part features.

First, click on the feature or drag a rectangle over the features. A dialog where you can define a tolerance in `map units`, `layer units` or `pixels` pops up and a colored and simplified copy of the feature(s), using the given tolerance, appears over them. QGIS calculates the amount of vertices that can be deleted while maintaining the geometry. The higher the tolerance is the more vertices can be deleted. When the expected geometry fits your needs just click the **[OK]** button. The tolerance you used will be saved when leaving a project or when leaving an edit session. So you can go back to the same tolerance the next time when simplifying a feature.

To abort feature simplification, you need to click on  Simplify Feature icon.

Nota: Unlike the feature simplification option in *Settings* → *Options* → *Rendering* menu which simplifies the geometry just for rendering, the  Simplify Feature tool permanently modifies feature's geometry in data source.

Añadir parte

You can  Add Part to a selected feature generating a multipoint, multiline or multipolygon feature. The new part must be digitized outside the existing one which should be selected beforehand.

The  Add Part can also be used to add a geometry to a geometryless feature. First, select the feature in the attribute table and digitize the new geometry with the  Add Part tool.

Borrar parte

The  Delete Part tool allows you to delete parts from multifeatures (e.g., to delete polygons from a multi-polygon feature). This tool works with all multi-part geometries: point, line and polygon. Furthermore, it can be used to totally remove the geometric component of a feature. To delete a part, simply click within the target part.

Añadir anillo

You can create ring polygons using the  Add Ring icon in the toolbar. This means that inside an existing area, it is possible to digitize further polygons that will occur as a 'hole', so only the area between the boundaries of the outer and inner polygons remains as a ring polygon.

Rellenar anillo

You can use the Fill Ring function to add a ring to a polygon and add a new feature to the layer at the same time. Using this tool, you simply have to digitize a polygon within an existing one. Thus you need not first use the Add Ring icon and then the Add feature function anymore.

Borrar anillo

The Delete Ring tool allows you to delete rings within an existing polygon, by clicking inside the hole. This tool only works with polygon and multi-polygon features. It doesn't change anything when it is used on the outer ring of the polygon.

Remodelar objetos espaciales

You can reshape line and polygon features using the Reshape Features tool on the toolbar. For lines, it replaces the line part from the first to the last intersection with the original line.

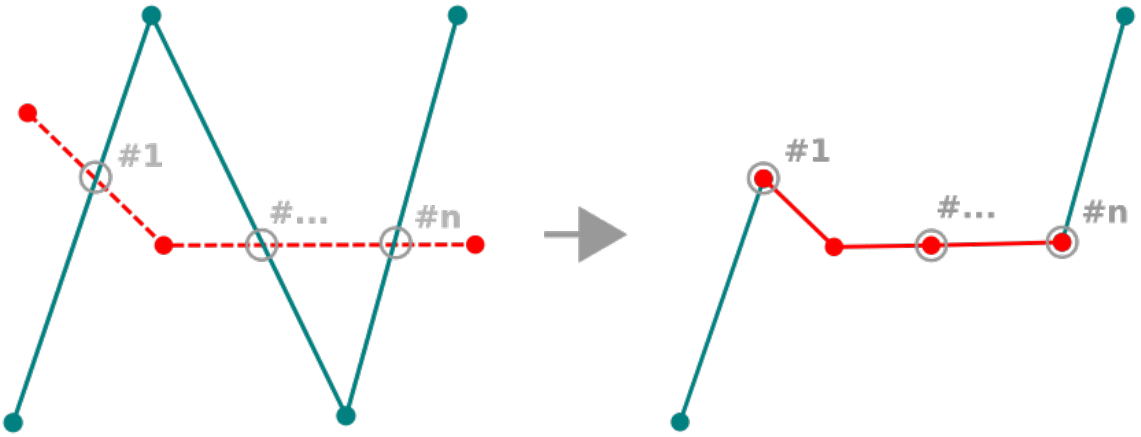


Figure 12.73: Remodelar linea

Truco: Extend linestring geometries with reshape tool

Use the Reshape Features tool to extend existing linestring geometries: snap to the first or last vertex of the line and draw a new one. Validate and the feature's geometry becomes the combination of the two lines.

For polygons, it will reshape the polygon's boundary. For it to work, the reshape tool's line must cross the polygon's boundary at least twice. To draw the line, click on the map canvas to add vertexes. To finish it, just right-click. Like with the lines, only the segment between the first and the last intersections is considered. The reshape line's segments that are inside the polygon will result in cropping it, where the ones outside the polygon will extend it.

With polygons, reshaping can sometimes lead to unintended results. It is mainly useful to replace smaller parts of a polygon, not for major overhauls, and the reshape line is not allowed to cross several polygon rings, as this would generate an invalid polygon.

Nota: La herramienta de remodelar podría alterar la posición inicial de un anillo de polígono o una linea cerrada.

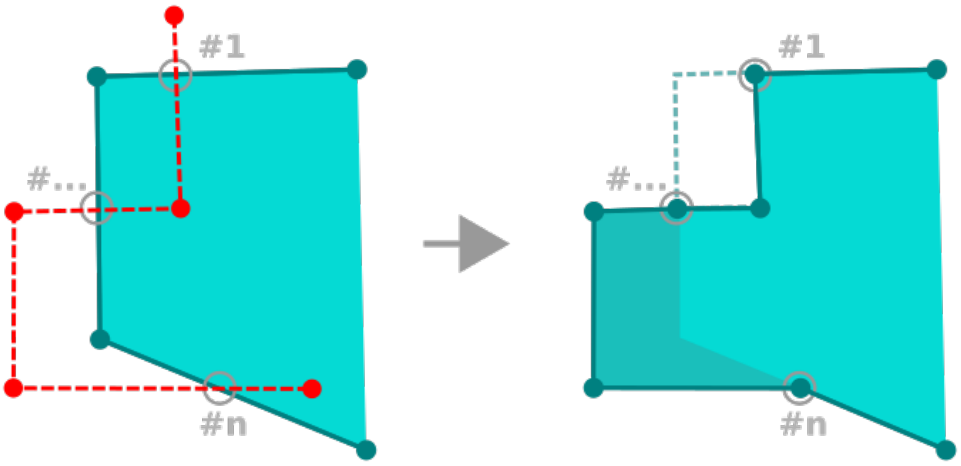


Figure 12.74: Remodelar polígono

Por lo tanto, el punto que está representado 'dos veces' no será más el mismo. Esto puede no ser un problema para la mayoría de las aplicaciones, pero es algo a considerar.

Desplazar curva

The Offset Curve tool creates parallel shifts of line layers. The tool can be applied to the edited layer (the geometries are modified) or also to background layers (in which case it creates copies of the lines / rings and adds them to the edited layer). It is thus ideally suited for the creation of distance line layers. The *User Input* dialog pops-up, showing the displacement distance.

Crear un desplazamiento de una capa de línea, primero se debe entrar en el modo de edición y activar la herramienta Desplazar curva. A continuación, haga clic en un objeto espacial para desplazarlo. Mueva el ratón y haga clic donde desee o introducir la distancia deseada en el widget de entrada del usuario. Los cambios pueden ser guardados con la herramienta Guardar edición de capa.

QGIS options dialog (Digitizing tab then **Curve offset tools** section) allows you to configure some parameters like **Join style**, **Quadrant segments**, **Miter limit**.

Dividir objetos espaciales

You can split features using the Split Features icon on the toolbar. Just draw a line across the feature you want to split.

Dividir partes

En QGIS ahora es posible dividir las partes de un objeto espacial múlti-parte, de modo que se incrementa el número de partes. Sólo se tiene que dibujar una línea en la parte que se desea dividir utilizando el icono Dividir partes

Truco: Split a polyline feature in one-click

A single click on a **snapped vertex** of a line feature with the Split Features or Split Parts tool is enough to have it split into new features or parts.

Combinar objetos espaciales seleccionados

The Merge Selected Features tool allows you to create a new feature by merging existing ones: their geometries are merged to generate a new one. If features don't have common boundaries, a multipolygon/multipolyline/multipoint feature is created.

First, select several features. Then press the Merge Selected Features button. In the new dialog, you can select at the top of the dialog which value to apply to each field of the new feature. That value can be:

- picked from the attributes of the initial features,
- an aggregation of the initial features attributes (Minimum, Maximum, Median, Sum, Count Concatenation... depending on the type of the field. see *Panel de resumen estadístico* for the full list of functions),
- skipped, meaning that the field will be empty,
- or manually entered, at the bottom of the rows.

Combinar atributos de objetos espaciales

The Merge Attributes of Selected Features tool allows you to apply same attributes to features without merging their boundaries. The dialog is the same as the `Merge Selected Features` tool's except that unlike that tool, selected objects are kept with their geometry while some of their attributes are made identical.

Rotar símbolos de puntos

The Rotate Point Symbols allows you to change the rotation of point symbols in the map canvas. First of all, you must apply to the symbol a *data-defined* rotation: in the *Layer Properties* → *Style* dialog, click the *Data-defined override* widget near the *Rotation* option of the highest level (preferably) of the symbol layers and choose a field in the *Field Type* combobox. Values of this field are hence used to rotate each feature's symbol accordingly.

Nota: As a global option, setting the rotation field at the first level of the symbol applies it to all the underlying levels while setting it at a lower level will rotate only this symbol layer (unless you have a single symbol layer).

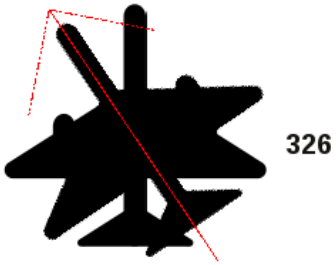


Figure 12.75: Rotar símbolos de puntos

To change the rotation of a symbol, click on a point feature in the map canvas with the Rotate Point Symbols and move the mouse around, holding the left button pressed. A red arrow with the rotation value will be visualized (see Figure_rotate_point). When you release the left mouse button again, the symbol is defined with this new rotation and the rotation field is updated in the layer's attribute table.

Truco: Si se mantiene presionada la tecla `Ctrl`, la rotación se realiza en pasos de 15 grados.

Símbolos de punto de desplazamiento

The  Offset Point Symbols allows you to interactively change the rendered position of point symbols in the map canvas. This tool behaves like the  Rotate Point Symbols tool except that it requires you to connect a field to the data-defined *Offset (X,Y)* property of the symbol, field which will then be populated with the offset coordinates while moving the symbol in the map canvas.

Nota: The  Offset Point Symbols tool doesn't move the point feature itself; you should use the  Node Tool or  Move Feature tool for this purpose.

Advertencia: Ensure to assign the same field to all symbol layers
If at least two layers of the symbol have different fields assigned to their data-defined property (e.g. rotation), the corresponding tool will consider that no field is assigned to the symbol property and won't perform the action.

Rastreo Automático

Usually, when using capturing map tools (add feature, add part, add ring, reshape and split), you need to click each vertex of the feature.

Using the automatic tracing mode you can speed up the digitization process. Enable the  Tracing tool by pushing the icon or pressing `t` key and *snap to* a vertex or segment of a feature you want to trace along. Move the mouse over another vertex or segment you'd like to snap and instead of an usual straight line, the digitizing rubber band represents a path from the last point you snapped to the current position. QGIS actually uses the underlying features topology to build the shortest path between the two points. Click and QGIS places the intermediate vertices following the path. You no longer need to manually place all the vertices during digitization.

Tracing requires snapping to be activated in traceable layers to build the path. You should also snap to an existing vertex or segment while digitizing and ensure that the two nodes are topologically connectable following existing features, otherwise QGIS is unable to connect them and thus traces a single straight line.

Nota: Adjust map scale or snapping settings for an optimal tracing

If there are too many features in map display, tracing is disabled to avoid potentially long tracing structure preparation and large memory overhead. After zooming in or disabling some layers the tracing is enabled again.

Truco: Quickly enable or disable automatic tracing by pressing `t` key

By pressing `t` key, tracing can be enabled/disabled anytime even while digitizing one feature, so it is possible to digitize some parts of the feature with tracing enabled and other parts with tracing disabled. Tools behave as usual when tracing is disabled.

12.5.5 El panel de Digitalización Avanzada

When capturing, reshaping, splitting new or existing geometries you also have the possibility to use the Advanced Digitizing panel. You can digitize lines exactly parallel or perpendicular to a particular angle or lock lines to specific angles. Furthermore, you can enter coordinates directly so that you can make a precise definition of your new geometry.

Nota: Las herramientas no están habilitadas si la vista del mapa esta en coordenadas geográficas.

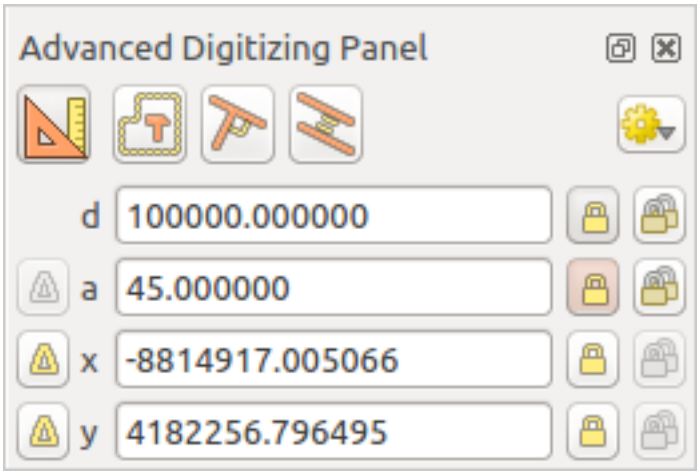


Figure 12.76: El panel de Digitalización Avanzada

The Advanced Digitizing panel can be open either with a right-click on the toolbar and choose Advanced Digitizing panel or in *View* → *Panels* → *Advanced Digitizing Panel*. Once the panel is visible, click the 

button to activate the Advanced Digitizing tool.

Conceptos

The aim of the Advanced Digitizing tool is to lock coordinates, lengths, and angles when moving the mouse during the digitalizing in the map canvas.

You can also create constraints with relative or absolute reference. Relative reference means that the next vertex constraints' values will be relative to the previous vertex or segment.

Opciones de autoensamblado

Click the  button to set the Advanced Digitizing Tool snapping settings. You can make the tool snap to common angles. The options are:

- *Do not snap to common angles*
- *Ajustar a ángulos 30º*
- *Ajustar a ángulos 45º*
- *Snap to 90º angles*

You can also control the snapping to features. The options are:

- *Do not snap to vertices or segments*
- *Snap according to project configuration*
- *Snap to all layers*

Atajos de teclado

To speed up the use of Advanced Digitizing Panel, there are a couple of keyboard shorcuts available:

Key	Simple	Ctrl + or Alt +	Shift +
d	Establecer distancia	Bloquear distancia	
a	Establecer ángulo	Bloquear ángulo	Toggle relative angle to last segment
x	Set x coordinate	Lock x coordinate	Toggle relative x to last vertex
y	Set y coordinate	Lock y coordinate	Toggle relative y to last vertex
c	Toggle construction mode		
p	Toggle perpendicular and parallel modes		

Absolute reference digitizing

When drawing a new geometry from scratch, it is very useful to have the possibility to start digitizing vertexes at given coordinates.

For example, to add a new feature to a polygonal layer, click the button. You can choose the X and Y coordinates where you want to start editing the feature, then:

- Click the *x* text box (or use the x keyboard shortcuts).
- Type the X coordinate value you want and press Enter or click the button to their right to lock the mouse to the X axis on the map canvas.
- Click the *y* text box (or use the y keyboard shortcuts).
- Type the Y coordinate value you want and press Enter or click the button to their right to lock the mouse to the Y axis on the map canvas.

Two blue dotted lines and a green cross identify the exact coordinates you entered. Start digitizing by clicking on the map canvas; the mouse position is locked at the green cross.

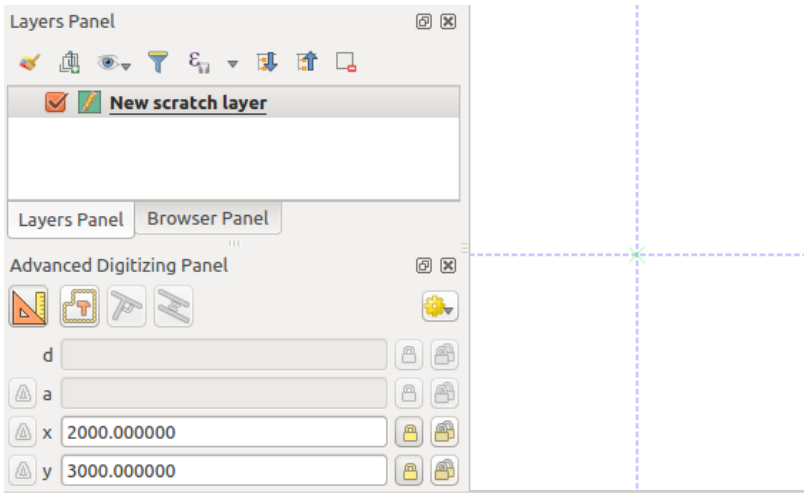


Figure 12.77: Start drawing at given coordinates

You can continue digitizing by free hand, adding a new pair of coordinates, or you can type the segment's **length** (distance) and **angle**.

If you want to draw a segment of a given length, click the *d (distance)* text box (keyboard shortcut d), type the distance value (in map units) and press Enter or click the button on the right to lock the mouse in the map canvas to the length of the segment. In the map canvas, the clicked point is surrounded by a circle whose radius is the value entered in the distance text box.

Finally, you can also choose the angle of the segment. As described before , click the *a (angle)* text box (keyboard shortcut a), type the angle value (in degrees), and press Enter or click the buttons on the right to lock it. In this way the segment will follow the desired angle:

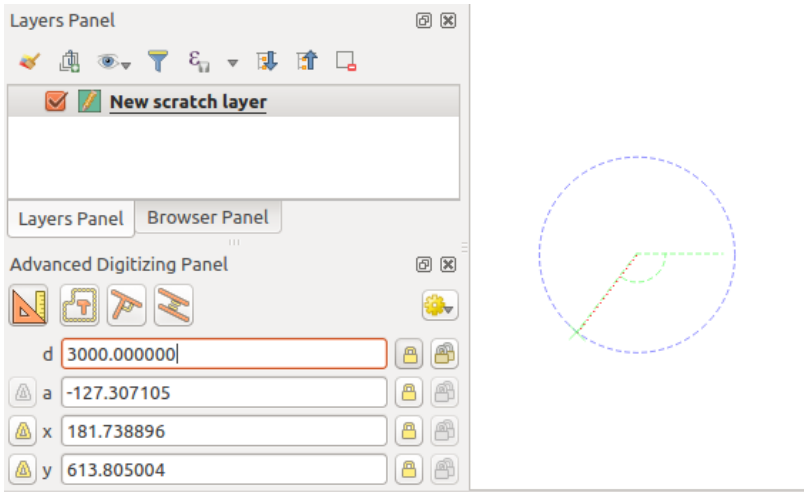


Figure 12.78: Fixed length segment

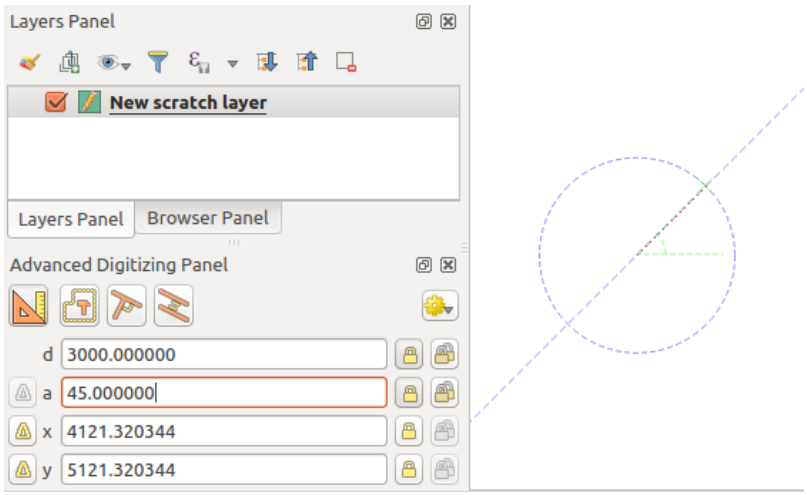


Figure 12.79: Fixed angle segment

Relative reference digitizing

Instead of using absolute values of angles or coordinates, you can also use values relative to the last digitized vertex or segment.

For angles, you can click the button on the left of the *a* text box (or press `Shift + a`) to toggle relative angles to the previous segment. With that option on, angles are measured between the last segment and the mouse pointer.

For coordinates, click the buttons to the left of the *x* or *y* text boxes (or press `Shift + x` or `Shift + y`) to toggle relative coordinates to the previous vertex. With these options on, coordinates measurement will consider the last vertex to be the x and y axes origin.

Continuous lock

Both in absolute or relative reference digitizing, angle, distance, x and y constraints can be locked continuously by clicking the *Continuous lock* buttons. Using continuous lock allows you to digitize several points or vertexes using the same constraints.

Parallel and perpendiculars line

All the tools described above can be combined with the Perpendicular and Parallel tools. These two tools allow drawing segments perfectly perpendicular or parallel to another segment.

To draw a *perpendicular* segment, during the editing click the Perpendicular icon (keyboard shortcut `p`) to activate it. Before drawing the perpendicular line, click on the segment of an existing feature that you want to be perpendicular to (the line of the existing feature will be colored in light orange); you should see a blue dotted line where your feature will be snapped:

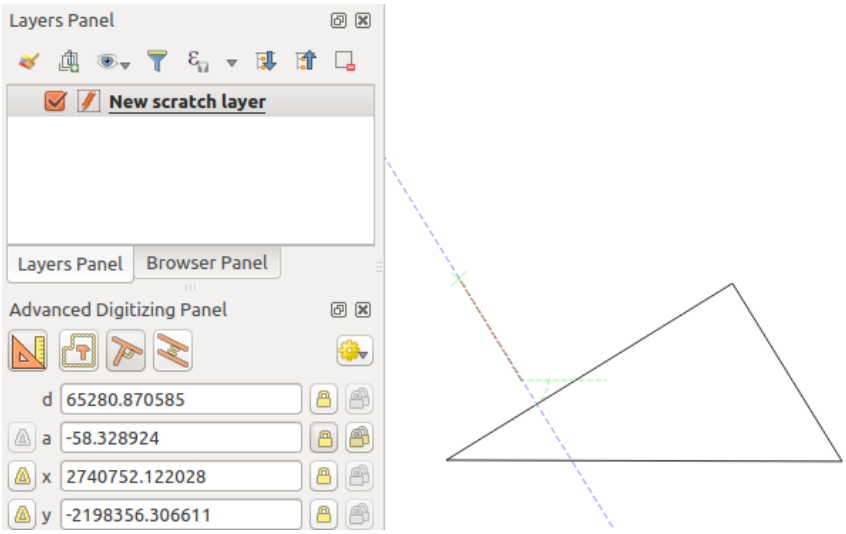


Figure 12.80: Perpendicular digitizing

To draw a *parallel* feature, the steps are the same: click on the Parallel icon (keyboard shortcut `p` twice), click on the segment you want to use as reference and start drawing your feature:

These two tools just find the right angle of the perpendicular and parallel angle and lock this parameter during your editing.

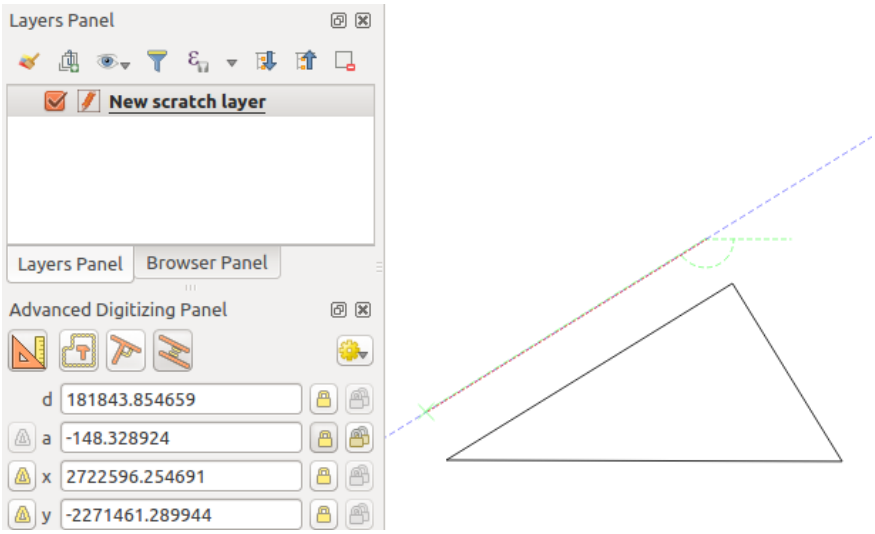


Figure 12.81: Parallel digitizing

Modo de construcción

You can enable and disable *construction* mode by clicking on the Construction icon or with the `c` keyboard shortcut. While in construction mode, clicking the map canvas won't add new vertexes, but will capture the clicks' positions so that you can use them as reference points to then lock distance, angle or x and y relative values.

As an example, the construction mode can be used to draw some point at an exact distance from an existing point.

With an existing point in the map canvas and the snapping mode correctly activated, you can easily draw other points at given distances and angles from it. In addition to the button, you have to activate also the *construction* mode by clicking the Construction icon or with the `c` keyboard shortcut.

Click next to the point from which you want to calculate the distance and click on the *d* box (`d` shortcut) type the desired distance and press `Enter` to lock the mouse position in the map canvas:

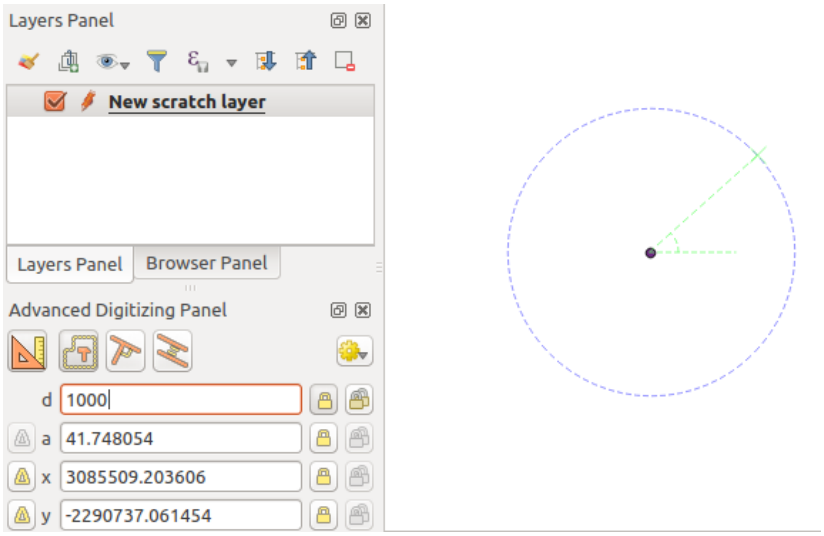


Figure 12.82: Distance from point

Before adding the new point, press `c` to exit the construction mode. Now, you can click on the map canvas, and the point will be placed at the distance entered.

You can also use the angle constraint to, for example, create another point at the same distance of the original one, but at a particular angle from the newly added point. Click the  Construction icon or with the `c` keyboard shortcut to enter construction mode. Click the recently added point, and then the other one to set a direction segment. Then, click on the *d* text box (`d` shortcut) type the desired distance and press `Enter`. Click the *a* text box (`a` shortcut) type the angle you want and press `Enter`. The mouse position will be locked both in distance and angle.

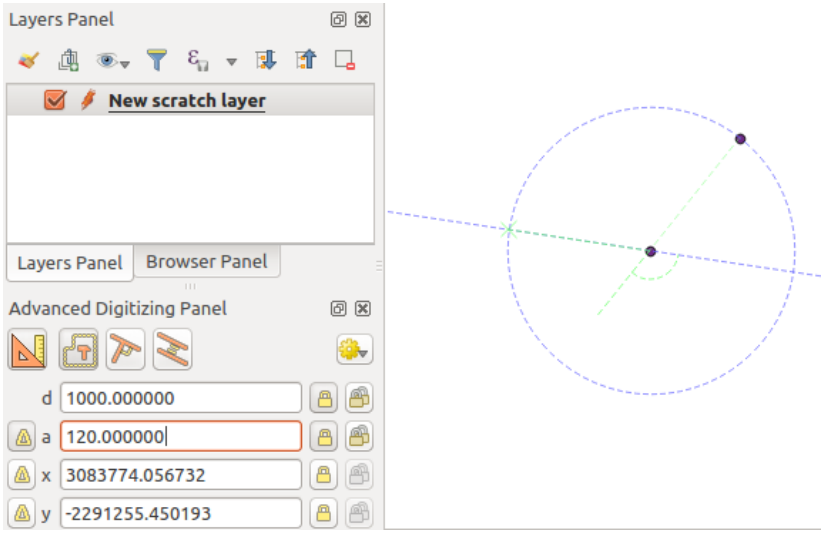


Figure 12.83: Distance and angle from points

Before adding the new point, press `c` to exit the construction mode. Now, you can click on the map canvas, and the point will be placed at the distance and angle entered. Repeating the process, several points can be added.

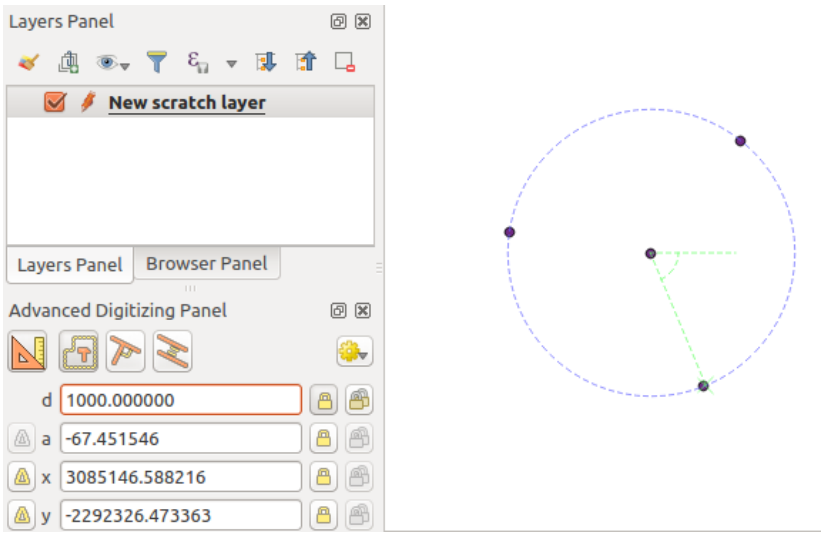


Figure 12.84: Points at given distance and angle

CHAPTER 13

Trabajar con catos raster

13.1 Dialogo de Propiedades Raster

To view and set the properties for a raster layer, double click on the layer name in the map legend, or right click on the layer name and choose *Properties* from the context menu. This will open the *Raster Layer Properties* dialog (see figure_raster_properties).

There are several tabs in the dialog:

- *General*
- *Style*
- *Transparency*
- *Pyramids*
- *Histogram*
- *Metadata*
- *Legend*

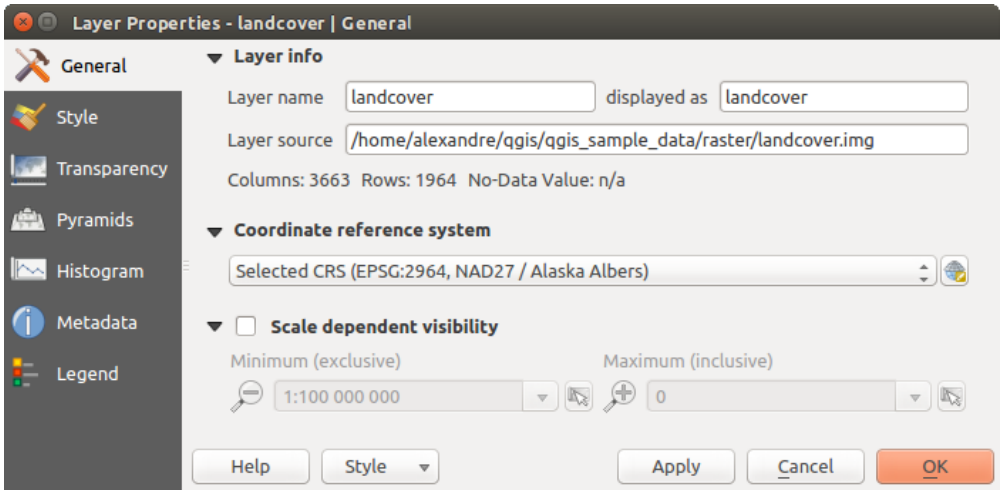


Figure 13.1: Raster Layers Properties Dialog

Truco: Live update rendering

The *Layer Styling Panel* provides you with some of the common features of the Layer properties dialog and is a good modeless widget that you can use to speed up the configuration of the layer styles and automatically view your changes in the map canvas.

Nota: Because properties (symbology, label, actions, default values, forms...) of embedded layers (see *Anidar proyectos*) are pulled from the original project file and to avoid changes that may break this behavior, the layer properties dialog is made unavailable for these layers.

13.1.1 General Properties

Layer Info

The *General* tab displays basic information about the selected raster, including the layer source path, the display name in the legend (which can be modified), and the number of columns, rows and no-data values of the raster.

Coordinate Reference System

Displays the layer's Coordinate Reference System (CRS) as a PROJ.4 string. You can change the layer's CRS, selecting a recently used one in the drop-down list or clicking on Select CRS button (see *Coordinate Reference System Selector*). Use this process only if the CRS applied to the layer is a wrong one or if none was applied. If you wish to reproject your data into another CRS, rather use layer reprojection algorithms from Processing or *Save it into another layer*.

13.1.2 Scale dependent visibility

You can set the *Maximum (inclusive)* and *Minimum (exclusive)* scale, defining a range of scale in which the layer will be visible. Out of this range, it's hidden. The Set to current canvas scale button helps you use the current map canvas scale as boundary of the range visibility. See *Renderizado dependiente de la escala* for more information.

13.1.3 Style Properties

Band rendering

QGIS offers four different *Render types*. The renderer chosen is dependent on the data type.

1. Multiband color - if the file comes as a multiband with several bands (e.g., used with a satellite image with several bands)
2. Paletted - if a single band file comes with an indexed palette (e.g., used with a digital topographic map)
3. Singleband gray - (one band of) the image will be rendered as gray; QGIS will choose this renderer if the file has neither multibands nor an indexed palette nor a continuous palette (e.g., used with a shaded relief map)
4. Singleband pseudocolor - this renderer is possible for files with a continuous palette, or color map (e.g., used with an elevation map)

Multiband color

With the multiband color renderer, three selected bands from the image will be rendered, each band representing the red, green or blue component that will be used to create a color image. You can choose several *Contrast enhancement* methods: 'No enhancement', 'Stretch to MinMax', 'Stretch and clip to MinMax' and 'Clip to min max'.

This selection offers you a wide range of options to modify the appearance of your raster layer. First of all, you have to get the data range from your image. This can be done by choosing the *Extent* and pressing **[Load]**. QGIS can *Estimate (faster)* the *Min* and *Max* values of the bands or use the *Actual (slower) Accuracy*.

Now you can scale the colors with the help of the *Load min/max values* section. A lot of images have a few very low and high data. These outliers can be eliminated using the *Cumulative count cut* setting. The standard data

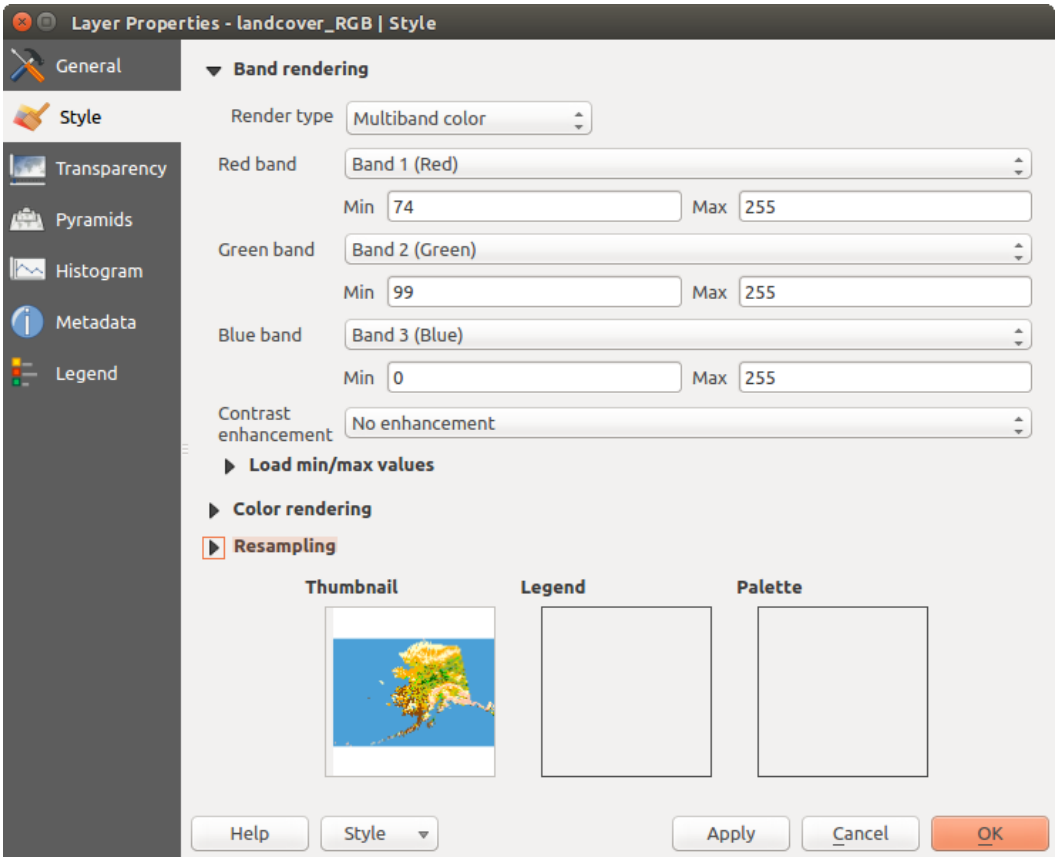


Figure 13.2: Raster Style - Multiband color rendering

range is set from 2% to 98% of the data values and can be adapted manually. With this setting, the gray character of the image can disappear. With the scaling option *Min/max*, QGIS creates a color table with all of the data included in the original image (e.g., QGIS creates a color table with 256 values, given the fact that you have 8 bit bands). You can also calculate your color table using the *Mean +/- standard deviation x* 1,00. Then, only the values within the standard deviation or within multiple standard deviations are considered for the color table. This is useful when you have one or two cells with abnormally high values in a raster grid that are having a negative impact on the rendering of the raster.

All calculations can also be made for the *Current* extent.

Truco: Viewing a Single Band of a Multiband Raster

If you want to view a single band of a multiband image (for example, Red), you might think you would set the Green and Blue bands to "Not Set". But this is not the correct way. To display the Red band, set the image type to 'Singleband gray', then select Red as the band to use for Gray.

Paletted

This is the standard render option for singleband files that already include a color table, where each pixel value is assigned to a certain color. In that case, the palette is rendered automatically. If you want to change colors assigned to certain values, just double-click on the color and the *Select color* dialog appears. Also, in QGIS it's possible to assign a label to the color values. The label appears in the legend of the raster layer then.

Contrast enhancement

Nota: When adding GRASS rasters, the option *Contrast enhancement* will always be set automatically to *stretch to min max*, regardless of if this is set to another value in the QGIS general options.

Singleband gray

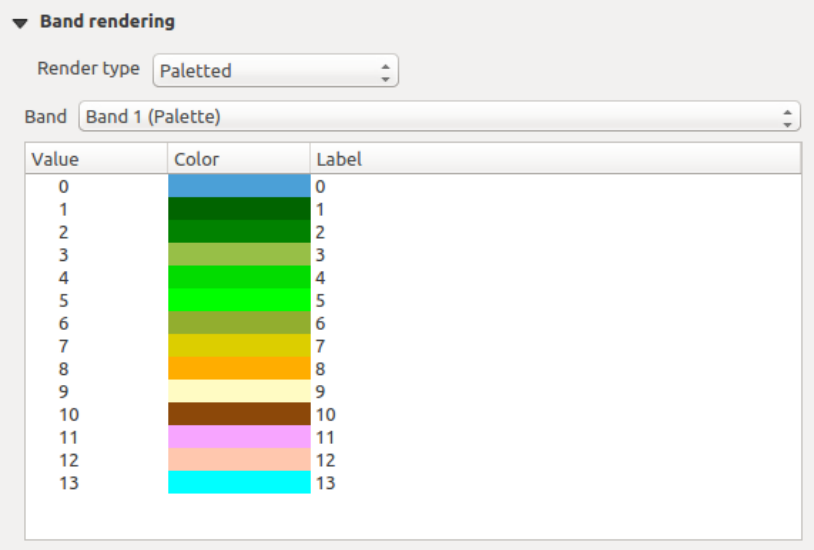


Figure 13.3: Raster Style - Paletted Rendering

This renderer allows you to render a single band layer with a *Color gradient*: 'Black to white' or 'White to black'. You can define a *Min* and a *Max* value by choosing the *Extent* first and then pressing **[Load]**. QGIS can *Estimate (faster)* the *Min* and *Max* values of the bands or use the *Actual (slower) Accuracy*.

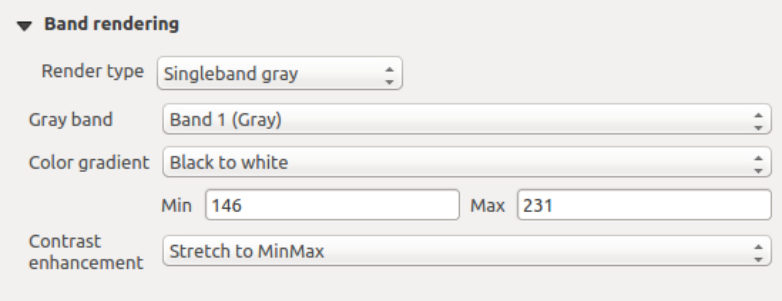


Figure 13.4: Raster Style - Singleband gray rendering

With the *Load min/max values* section, scaling of the color table is possible. Outliers can be eliminated using the *Cumulative count cut* setting. The standard data range is set from 2% to 98% of the data values and can be adapted manually. With this setting, the gray character of the image can disappear. Further settings can be made with *Min/max* and *Mean +/- standard deviation x* 1,00. While the first one creates a color table with all of the data included in the original image, the second creates a color table that only considers values within the standard deviation or within multiple standard deviations. This is useful when you have one or two cells with abnormally high values in a raster grid that are having a negative impact on the rendering of the raster.

Singleband pseudocolor

This is a render option for single-band files, including a continuous palette. You can also create individual color maps for the single bands here.

Three types of color interpolation are available:

1. Discrete
2. Lineal
3. Exact

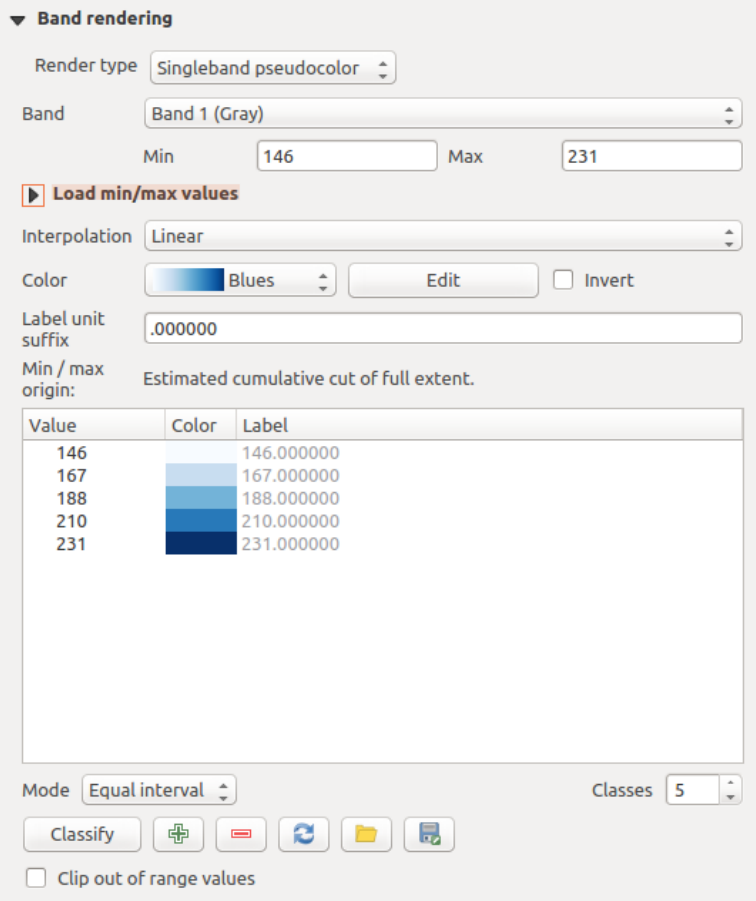


Figure 13.5: Raster Style - Singleband pseudocolor rendering

In the left block, the button Add values manually adds a value to the individual color table. The button Remove selected row deletes a value from the individual color table, and the Sort colormap items button sorts the color table according to the pixel values in the value column. Double clicking on the value column lets you insert a specific value. Double clicking on the color column opens the dialog *Change color*, where you can select a color to apply on that value. Further, you can also add labels for each color, but this value won't be displayed when you use the identify feature tool. You can also click on the button Load color map from band, which tries to load the table from the band (if it has any). And you can use the buttons Load color map from file or Export color map to file to load an existing color table or to save the defined color table for other sessions.

In the right block, *Generate new color map* allows you to create newly categorized color maps. For the *Classification mode* 'Equal interval', you only need to select the *number of classes* 1,00 and press the button *Classify*. You can invert the colors of the color map by clicking the *Invert* checkbox. In the case of the *Mode* 'Continuous', QGIS creates classes automatically depending on the *Min* and *Max*. Defining *Min/Max* values can be done with the help of the *Load min/max values* section. A lot of images have a few very low and high data. These outliers can be eliminated using the *Cumulative count cut* setting. The standard data range is set from 2% to 98% of the data values and can be adapted manually. With this setting, the gray character of the image can disappear. With the scaling option *Min/max*, QGIS creates a color table with all of the data included in the original image (e.g., QGIS creates a color table with 256 values, given the fact that you have 8 bit bands). You can also calculate your color table using the *Mean +/- standard deviation x* 1,00. Then, only the values within the standard deviation or within multiple standard deviations are considered for the color table.

Color de renderizado

For every *Band rendering*, a *Color rendering* is possible.

You can also achieve special rendering effects for your raster file(s) using one of the blending modes (see *Modos de Mezcla*).

Further settings can be made in modifying the *Brightness*, the *Saturation* and the *Contrast*. You can also use a *Grayscale* option, where you can choose between 'By lightness', 'By luminosity' and 'By average'. For one hue in the color table, you can modify the 'Strength'.

Remuestreo

The *Resampling* option makes its appearance when you zoom in and out of an image. Resampling modes can optimize the appearance of the map. They calculate a new gray value matrix through a geometric transformation.

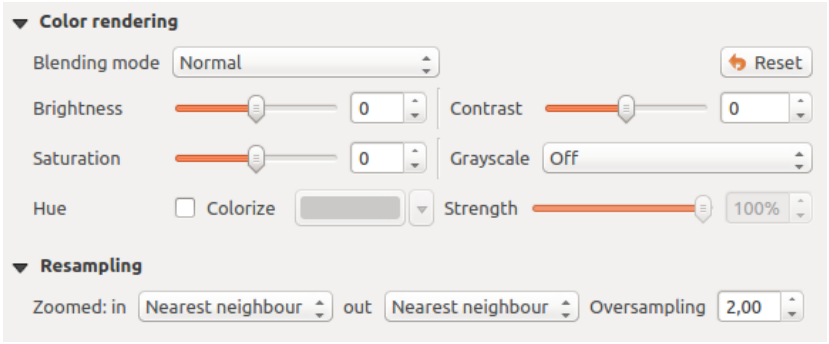
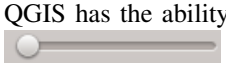


Figure 13.6: Raster Style - Color rendering and Resampling settings

When applying the 'Nearest neighbour' method, the map can have a pixelated structure when zooming in. This appearance can be improved by using the 'Bilinear' or 'Cubic' method, which cause sharp features to be blurred. The effect is a smoother image. This method can be applied, for instance, to digital topographic raster maps.

At the bottom of the *Style* tab, you can see a thumbnail of the layer, its legend symbol, and the palette.

13.1.4 Transparency Properties

QGIS has the ability to display each raster layer at a different transparency level. Use the transparency slider  to indicate to what extent the underlying layers (if any) should be visible though the current raster layer. This is very useful if you like to overlay more than one raster layer (e.g., a shaded relief map overlayed by a classified raster map). This will make the look of the map more three dimensional.

Additionally, you can enter a raster value that should be treated as *NODATA* in the *Additional no data value* option.

An even more flexible way to customize the transparency can be done in the *Custom transparency options* section. The transparency of every pixel can be set here.

As an example, we want to set the water of our example raster file `landcover.tif` to a transparency of 20%. The following steps are necessary:

1. Load the raster file `landcover.tif`.
2. Open the *Properties* dialog by double-clicking on the raster name in the legend, or by right-clicking and choosing *Properties* from the pop-up menu.
3. Select the *Transparency* tab.
4. From the *Transparency band* drop-down menu, choose 'None'.
5. Click the  Add values manually button. A new row will appear in the pixel list.
6. Enter the raster value in the 'From' and 'To' column (we use 0 here), and adjust the transparency to 20%.
7. Press the **[Apply]** button and have a look at the map.

You can repeat steps 5 and 6 to adjust more values with custom transparency.

As you can see, it is quite easy to set custom transparency, but it can be quite a lot of work. Therefore, you can use the button  Export to file to save your transparency list to a file. The button  Import from file loads your transparency settings and applies them to the current raster layer.

13.1.5 Pyramids Properties

Large resolution raster layers can slow navigation in QGIS. By creating lower resolution copies of the data (pyramids), performance can be considerably improved, as QGIS selects the most suitable resolution to use depending on the level of zoom.

You must have write access in the directory where the original data is stored to build pyramids.

From the *Resolutions* list, select resolutions for which you want to create pyramid by clicking on them.

If you choose **Internal (if possible)** from the *Overview format* drop-down menu, QGIS tries to build pyramids internally.

Nota: Please note that building pyramids may alter the original data file, and once created they cannot be removed. If you wish to preserve a 'non-pyramided' version of your raster, make a backup copy prior to building pyramids.

If you choose **External** and **External (Erdas Imagine)** the pyramids will be created in a file next to the original raster with the same name and a `.ovr` extension.

Several *Resampling methods* can be used to calculate the pyramids:

- Vecino más próximo
- Promedio
- Gauss
- Cúbico

- Modo
- Ninguno

Finally, click **[Build pyramids]** to start the process.

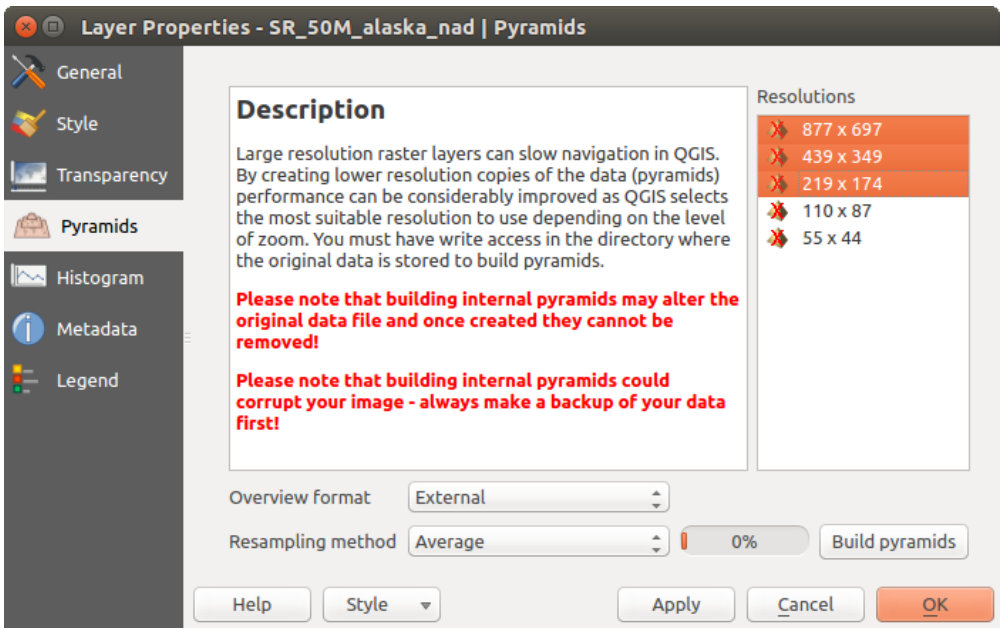


Figure 13.7: Raster Pyramids

13.1.6 Histogram Properties

The *Histogram* tab allows you to view the distribution of the bands or colors in your raster. The histogram is generated automatically when you open the *Histogram* tab. All existing bands will be displayed together. You can save the histogram as an image with the button. With the *Visibility* option in the *Prefs/Actions* menu, you can display histograms of the individual bands. You will need to select the option *Show selected band*. The *Min/max options* allow you to 'Always show min/max markers', to 'Zoom to min/max' and to 'Update style to min/max'. With the *Actions* option, you can 'Reset' and 'Recompute histogram' after you have chosen the *Min/max options*.

13.1.7 Metadata Properties

The *Metadata* tab displays a wealth of information about the raster layer, including statistics about each band in the current raster layer. From this tab, entries may be made for the *Description*, *Attribution*, *MetadataUrl* and *Properties*. In *Properties*, statistics are gathered on a 'need to know' basis, so it may well be that a given layer's statistics have not yet been collected.

13.1.8 Propiedades de la leyenda

The *Legend* tab provides you with a list of widgets you can embed within the layer tree in the Layers panel. The idea is to have a way to quickly access some actions that are often used with the layer (setup transparency, filtering, selection, style or other stuff...).

By default, QGIS provides transparency widget but this can be extended by plugins registering their own widgets and assign custom actions to layers they manage.

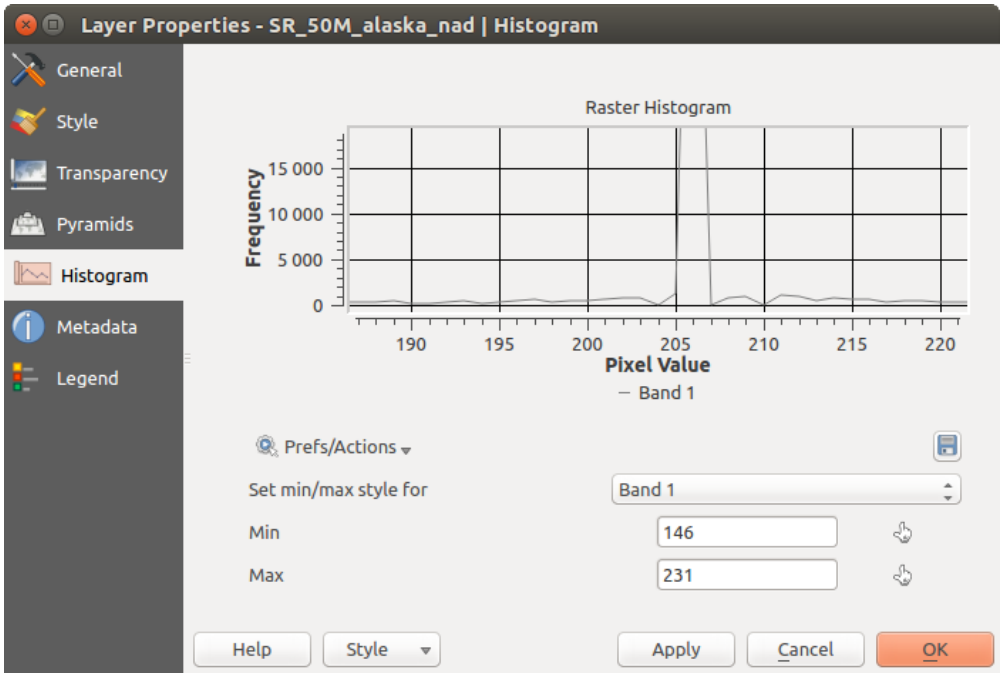


Figure 13.8: Histograma de Ráster

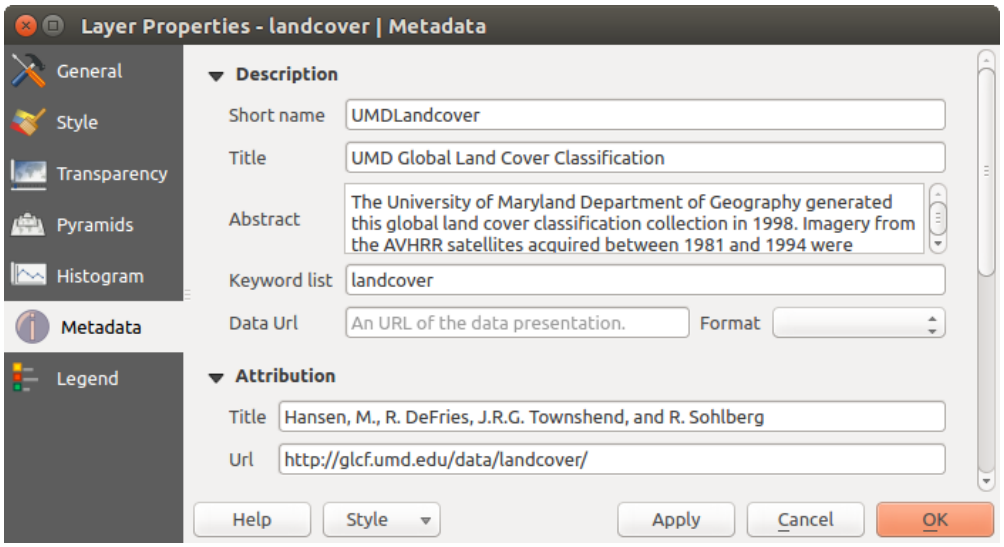


Figure 13.9: Raster Metadata

13.2 Análisis raster

13.2.1 Calculadora Ráster

La *Calculadora Ráster* en el menú *Ráster* permite realizar cálculos sobre la base de valores de píxeles de un ráster existente (vea figure_raster). Los resultados están escritos en una nueva capa ráster con un formato GDAL-reconocido.

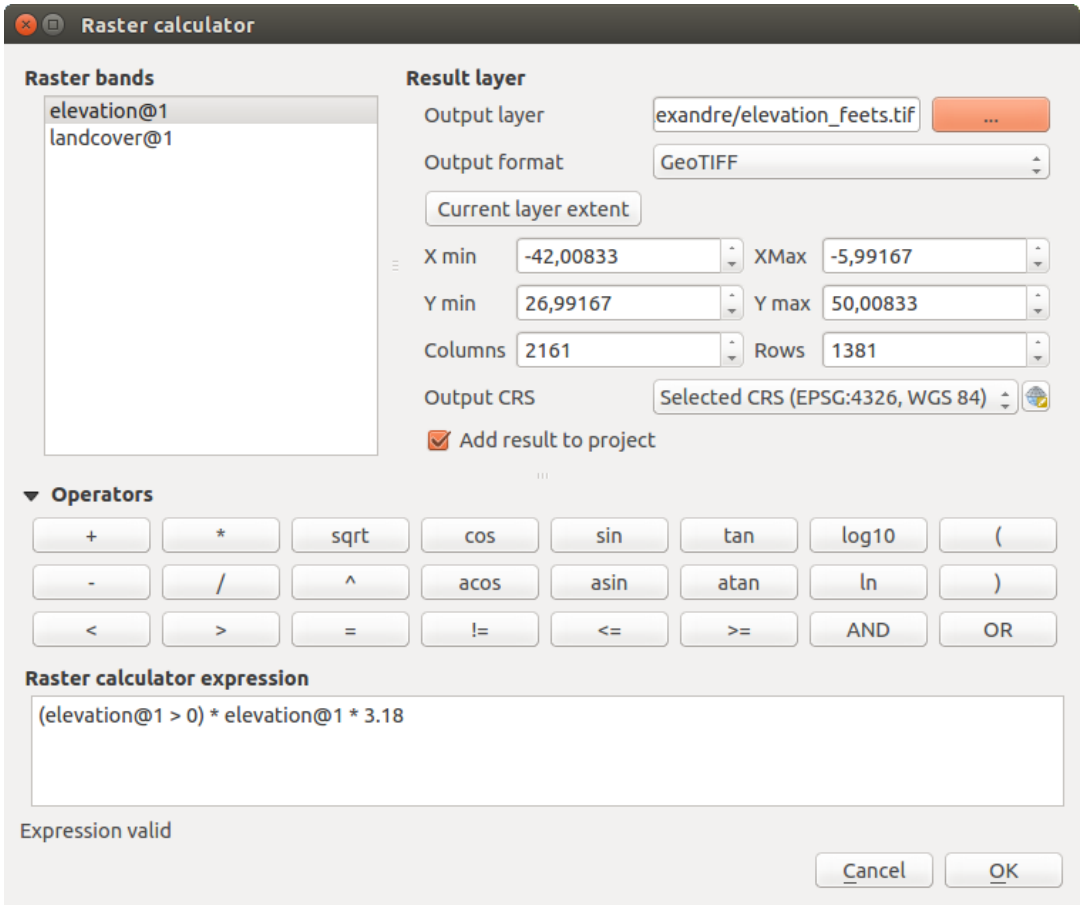


Figure 13.10: Calculadora Ráster

The **Raster bands** list contains all loaded raster layers that can be used. To add a raster to the raster calculator expression field, double click its name in the Fields list. You can then use the operators to construct calculation expressions, or you can just type them into the box.

In the **Result layer** section, you will need to define an output layer. You can then define the extent of the calculation area based on an input raster layer, or based on X,Y coordinates and on columns and rows, to set the resolution of the output layer. If the input layer has a different resolution, the values will be resampled with the nearest neighbor algorithm.

The **Operators** section contains all available operators. To add an operator to the raster calculator expression box, click the appropriate button. Mathematical calculations (+, −, ⋆, ...) and trigonometric functions (`sin`, `cos`, `tan`, ...) are available. Conditional expressions (=, !=, <, >=, ...) return either 0 for false or 1 for true, and therefore can be used with other operators and functions. Stay tuned for more operators to come!

With the *Add result to project* checkbox, the result layer will automatically be added to the legend area and can be visualized.

Ejemplos

Convert elevation values from meters to feet

Creating an elevation raster in feet from a raster in meters, you need to use the conversion factor for meters to feet: 3.28. The expression is:

```
"elevation@1" * 3.28
```

Using a mask

If you want to mask out parts of a raster – say, for instance, because you are only interested in elevations above 0 meters – you can use the following expression to create a mask and apply the result to a raster in one step.

```
("elevation@1" >= 0) * "elevation@1"
```

In other words, for every cell greater than or equal to 0 the conditional expression evaluates to 1, which keeps the original value by multiplying it by 1. Otherwise the conditional expression evaluates to 0, which sets the raster value to 0. This creates the mask on the fly.

Si desea clasificar un ráster –digamos, por ejemplo en dos clases de elevación, puede utilizar la siguiente expresión para crear un ráster con dos valores 1 y 2 en un solo paso.

```
("elevation@1" < 50) * 1 + ("elevation@1" >= 50) * 2
```

In other words, for every cell less than 50 set its value to 1. For every cell greater than or equal 50 set its value to 2.

13.2.2 Raster Alignment

This tool is able to take several rasters as input and to align them perfectly, that means:

- reproyectar al mismo SRC,
- remuestrea al mismo tamaño de celda y desplazamiento en la cuadrícula (grid),
- clip to a region of interest,
- reescale valores cuando sea necesario.

All rasters will be saved in another files.

First, open the tools from *Raster* → *Align Raster...* and click on the  Add new raster button to choose one existing raster in QGIS. Select an output file to save the raster after the alignment, the resampling method and if the tools need to *Rescale values according to the cell size*. The resampling method can be (see figure_raster_align_edit):

- **Vecino más próximo**
- Bilineal (núcleo 2x2)
- **Cubic (4x4 kernel)**: Cubic Convolution Approximation
- **Cubic B-Spline (4x4 kernel)**: Cubic B-Spline Approximation
- **Lanczos (6x6 kernel)**: Lanczos windowed sinc interpolation
- **Average**: computes the average of all non-NODATA contributing pixels
- **Mode**: selects the value which appears most often of all the sampled points
- **Maximum**, **Minimum**, **Mediane**, **First Quartile (Q1)** or **Third Quartile (Q3)** of all non-NODATA contributing pixels

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Nota: Methods like maximum, minimum, mediane, first and third quartiles are available only if QGIS is built with GDAL >= 2.0.

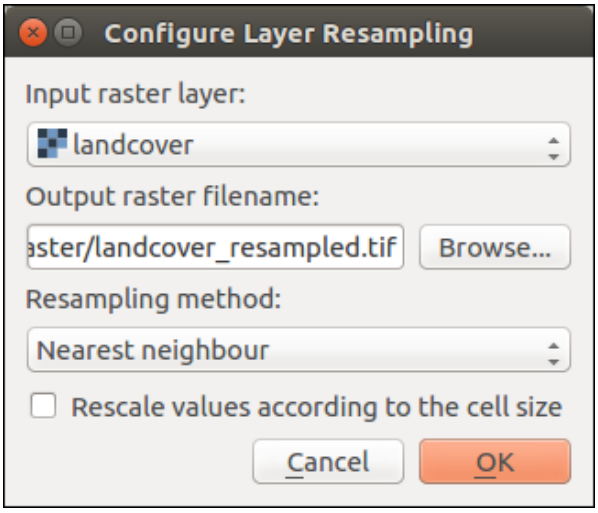

Figure 13.11: Select Raster Resampling Options

In the main *Align raster* dialog, you can still Edit file settings or Remove an existing file from the list of raster layers. You can also choose one or more other options (see figure_raster_align):

- Select the *Reference Layer*,
- Transform into a new *CRS*,
- Setup a different *Cell size*,
- Setup a different *Grid Offset*,
- *Clip to Extent*: it can be user-defined or based on a layer or the map view
- *Output Size*,
- *Add aligned raster to the map canvas*.

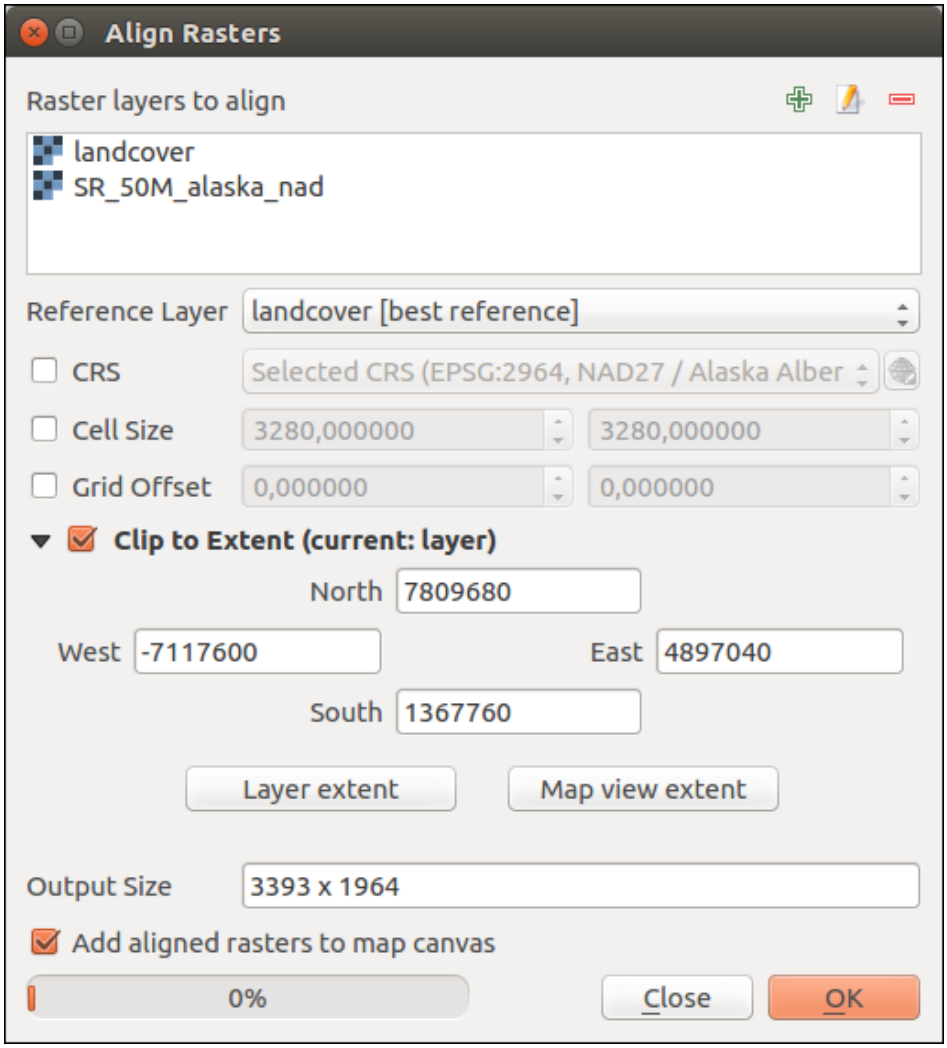

Figure 13.12: Raster Alignment

CHAPTER 14

Print Composer

With the Print Composer you can create nice maps and atlasses that can be printed or saved as PDF-file, an image or an SVG-file. This is a powerful way to share geographical information produced with QGIS that can be included in reports or published.

14.1 Overview of the Print Composer

The Print Composer provides growing layout and printing capabilities. It allows you to add elements such as the QGIS map canvas, text labels, images, legends, scale bars, basic shapes, arrows, attribute tables and HTML frames. You can size, group, align, position and rotate each element and adjust their properties to create your layout. The layout can be printed or exported to image formats, PostScript, PDF or to SVG (export to SVG is not working properly with some recent Qt4 versions; you should try and check individually on your system). You can save the layout as a template and load it again in another session. Finally, generating several maps based on a template can be done through the atlas generator.

14.1.1 Ejemplo de sesión

Before you start to work with the Print Composer, you need to load some raster or vector layers in the QGIS map canvas and adapt their properties to suit your own convenience. After everything is rendered and symbolized to your liking, click the  New Print Composer icon in the toolbar or choose *File* → *New Print Composer*. You will be prompted to choose a title for the new Composer.

To demonstrate how to create a map please follow the next instructions.

1. On the left side, select the  Add new map toolbar button and draw a rectangle on the canvas holding down the left mouse button. Inside the drawn rectangle the QGIS map view to the canvas.
2. Select the  Add new scalebar toolbar button and click with the left mouse button on the Print Composer canvas. A scalebar will be added to the canvas.
3. Select the  Add new legend toolbar button and draw a rectangle on the canvas holding down the left mouse button. Inside the drawn rectangle the legend will be drawn.
4. Select the  Select/Move item icon to select the map on the canvas and move it a bit.
5. While the map item is still selected you can also change the size of the map item. Click while holding down the left mouse button, in a white little rectangle in one of the corners of the map item and drag it to a new location to change its size.
6. Click the *Item Properties* panel on the left down side and find the setting for the orientation. Change the value of the setting *Map orientation* to '15.00° '. You should see the orientation of the map item change.
7. Now, you can print or export your print composition to image formats, PDF or to SVG with the export tools in Composer menu.

8. Finally, you can save your print composition within the project file with the Save Project button.

You can add multiple elements to the Composer. It is also possible to have more than one map view or legend or scale bar in the Print Composer canvas, on one or several pages. Each element has its own properties and, in the case of the map, its own extent. If you want to remove any elements from the Composer canvas you can do that with the `Delete` or the `Backspace` key.

14.1.2 The Composer Manager

The Composer Manager is the main window to manage print composers in the project. It helps you add new print composer, duplicate an existing one, rename or delete it. To open the composer manager dialog, click on the Composer Manager button in the toolbar or choose *Composer* → *Composer Manager*. It can also be reached from the main window of QGIS with *Project* → *Composer Manager*.

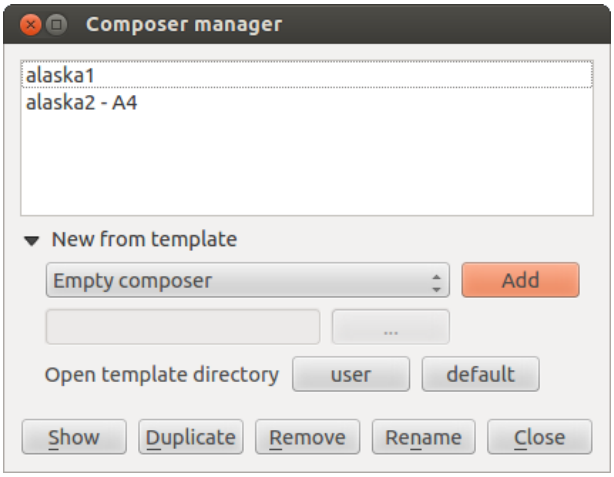

Figure 14.1: The Print Composer Manager

The composer manager lists in its upper part all the available print composers in the project. The bottom part shows tools that help to:

- show the selected composer(s): you can open multiple print composers in one-click
- duplicate the selected composer (available only if one print composer is selected): it creates a new composer using the selected composer as template. You'll be prompted to choose a new title for the new composer
- rename the composer (also available only if one print composer is selected): You'll be prompted to choose a new title for the composer. Note that you can also rename the composer by double-clicking on its title in the upper part
- remove the composer: the selected print composer(s) will be deleted from the project.

With the Composer Manager, it's also possible to create new print composers as an empty composer or from a saved template. By default, QGIS will look for templates in user directory (`~/.qgis2/composer_templates`) or application's one (`ApplicationFolder/composer_templates`). QGIS will retrieve all the available templates and propose them in the combobox. The selected template will be used to create a new composer when clicking *Add* button. You can also save composer templates in another folder. Choosing *specific* in the template list offers the ability to select such template and use it to create a new print composer.

14.1.3 Menus, tools and panels of the print composer

Opening the Print Composer provides you with a blank canvas that represents the paper surface when using the print option. Initially you find buttons on the left beside the canvas to add map composer items: the current QGIS

map canvas, text labels, images, legends, scale bars, basic shapes, arrows, attribute tables and HTML frames. In this toolbar you also find toolbar buttons to navigate, zoom in on an area and pan the view on the composer and toolbar buttons to select a map composer item and to move the contents of the map item.

Figure_composer_overview shows the initial view of the Print Composer before any elements are added.

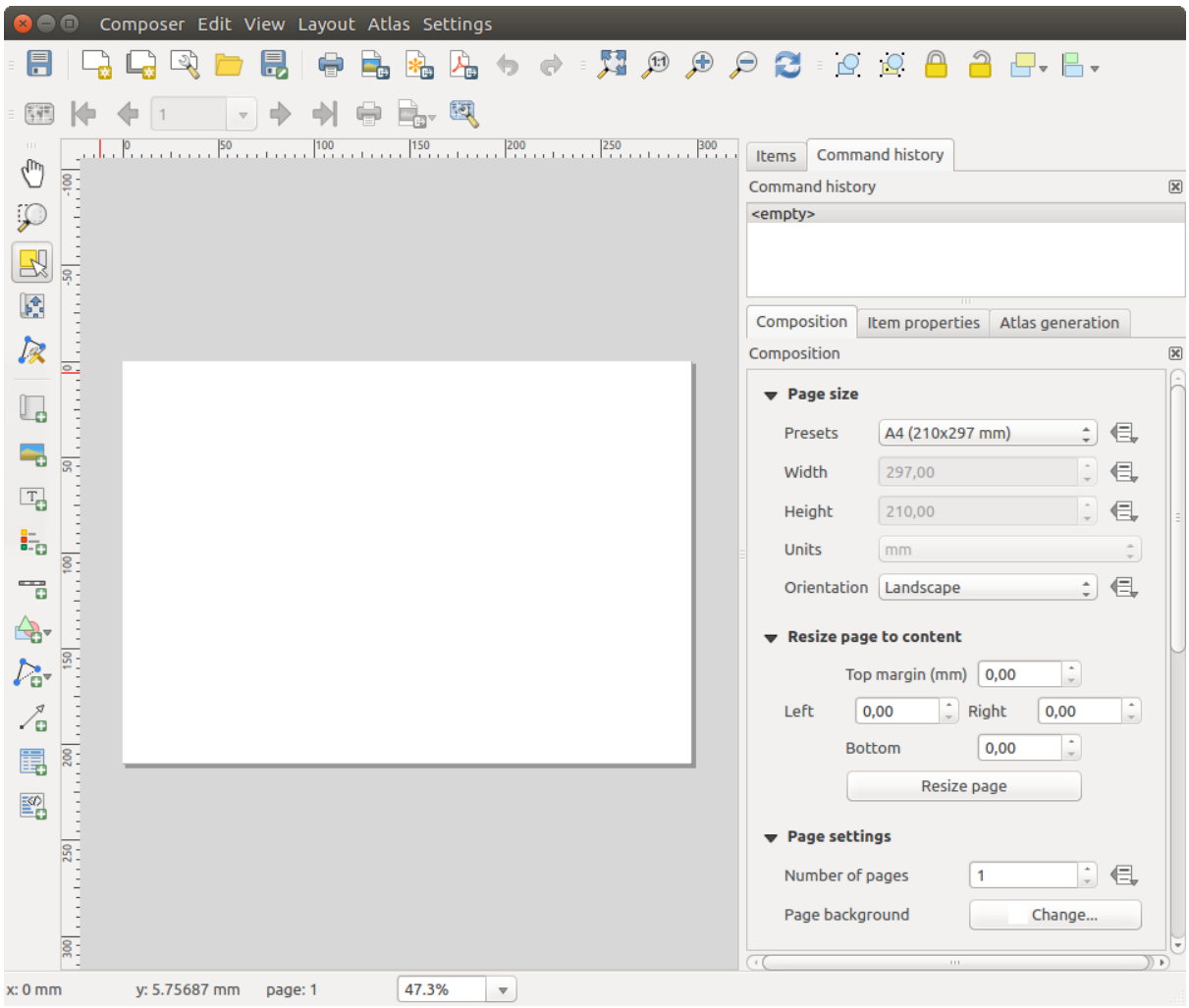

Figure 14.2: Print Composer

On the right beside the canvas you find two set of panels. The upper one holds the panels *Items* and *Command History* and the lower holds the panels *Composition*, *Item properties* and *Atlas generation*.

- The *Items* panel provides a list of all map composer items added to the canvas.
- The *Command history* panel displays a history of all changes applied to the Print Composer layout. With a mouse click, it is possible to undo and redo layout steps back and forth to a certain status.
- The *Composition* panel allows you to set paper size, orientation, the page background, number of pages and print quality for the output file in dpi. Furthermore, you can also activate the *Print as raster* checkbox. This means all items will be converted to raster before printing or saving as PostScript or PDF. In this panel, you can also customize settings for grid and smart guides.
- The *Item Properties* panel displays the properties for the selected item. Click the Select/Move item icon to select an item (e.g., legend, scale bar or label) on the canvas. Then click the *Item Properties* panel and customize the settings for the selected item (see *Composer Items* for detailed information on each item settings).

- The *Atlas generation* panel allows you to enable the generation of an atlas for the current Composer and gives access to its parameters (see *Generar un Atlas* for detailed information on atlas generation usage).

In the bottom part of the Print Composer window, you can find a status bar with mouse position, current page number, a combo box to set the zoom level, the number of selected items if applicable and, in the case of atlas generation, the number of features.

In the upper part of the Print composer window, you can find menus and other toolbars. All Print Composer tools are available in menus and as icons in a toolbar. See a list of tools in table_composer_tools.

The toolbars and the panels can be switched off and on using the right mouse button over any toolbar or through *View* → *Toolbars* or *View* → *Panels*.

Tools

Icon	Purpose	Icon	Purpose
	Save Project		New Composer
	Duplicate Composer		Composer Manager
	Load from template		Save as template
	Print or export as PostScript		Export to an image format
	Export print composition to SVG		Export as PDF
	Revert last change		Restore last change
	Zoom to full extent		Zoom to 100%
	Zoom in		Zoom out
	Refresh View		
	Pan		Zoom to specific region
	Select/Move item in print composition		Move content within an item
	Add new map from QGIS map canvas		Add image to print composition
	Add label to print composition		Add new legend to print composition
	Add scale bar to print composition		Add basic shape to print composition
	Add arrow to print composition		Add attribute table to print composition
	Add an HTML frame		Add nodes shape to print composition
	Edit a nodes shape		
	Group items of print composition		Ungroup items of print composition
	Lock Selected Items		Unlock All items
	Raise selected items		Lower selected items
	Move selected items to top		Move selected items to bottom
	Align selected items left		Align selected items right
	Align selected items center		Align selected items center vertical
	Align selected items top		Align selected items bottom
	Preview Atlas		First Feature
	Previous Feature		Next Feature
	Last feature		Print Atlas
	Export Atlas as Image		Atlas Settings

Table Composer 1: Print Composer Tools

Composer Menu

With the *Composer* → *Save Project* action, you can save the project file directly from the print composer window. The *Composer* menu also provides actions to:

- Create a new and blank print composer with  New Composer...
-  Duplicate Composer... : Create a new print composer by duplicating the current one

- Open the  Composer Manager...
- *Print Composers...* : Open an existing print composer

Once the layout is designed, with  Save as template and  Add items from template icons, you can save the current state of a Print Composer session as a `.qpt` template and load its item again in another session.

In the *Composer* menu, there are also powerful ways to share geographical information produced with QGIS that can be included in reports or published. These tools are  Export as Image...,  Export as PDF...,  Export as SVG... and  Print....

Menú Configuración

From *Settings* → *Composer Options* you can set some options that will be used as default on any composer during your work.

- *Compositions defaults* let you specify the default font to use.
- With *Grid appearance*, you can set the grid style and its color. There are three types of grid: **Dots**, **Solid** lines and **Crosses**.
- *Grid and guide defaults* defines spacing, offset and tolerance of the grid.

Edit Menu

Copy/Cut and Paste Items

The print composer includes actions to use the common Copy/Cut/Paste functionality for the items in the layout. As usual first you need to select the items using one of the options seen above; at this point the actions can be found in the *Edit* menu. When using the Paste action, the elements will be pasted according to the current mouse position. Using the *Edit* → *Paste in Place* action or pressing `Ctrl+Shift+V` will paste the items into the current page, at the same position they were in their initial page. It ensures to copy/paste items at the same place, from page to page.

Nota: HTML items can not be copied in this way. As a workaround, use the **[Add Frame]** button in the *Item Properties* panel.

View Menu

Navigation Tools

To navigate in the canvas layout, the Print Composer provides some general tools:

-  Zoom In
-  Zoom Out
-  Zoom Full
-  Zoom to 100%
-  Refresh view (if you find the view in an inconsistent state)
- *Show Grid* behind items.
- *Snap Grid* to snap items on the grid.

- *Show Guides* to help user to align items. These are red line that you can click in the rule (above or at the left side of the layout) and drag and drop to the desired location.
- *Snap Guides*: allows user to snap items to the guides,
- *Smart Guides*: uses other composer items as guides to dynamically snap to as user moves or reshapes an item.
- *Clear Guides* to remove all current guides.
- *Show Bounding box* around the items.
- *Show Rules* around the layout.
- *Show Pages* or set up pages to transparent. Often composer is used to create non-print layouts, e.g. for inclusion in presentations or other documents, and it's desirable to export the composition using a totally transparent background. It's sometimes referred to as "infinite canvas" in other editing packages.
- *Toggle Full Screen* makes the composer window to full screen.
- *Hide Panels* hides/shows the right panel
- *Panels* lists all panels available to hide/show them.
- *Toolbars* same as above for toolbars.

You can change the zoom level also using the mouse wheel or the combo box in the status bar. If you need to switch to pan mode while working in the Composer area, you can hold the `Spacebar` or the mouse wheel. With `Ctrl+Spacebar`, you can temporarily switch to Zoom In mode, and with `Ctrl+Shift+Spacebar`, to Zoom Out mode.

Hide and Show Panels

To maximise the space available to interact with a composition you can use *View* → *Hide panels* or press `F10`.

Nota: It's also possible to switch to a full screen mode to have more space to interact by pressing `F11` or using *View* → *Toggle full screen*.

Composition Panel

Page size and settings

In the *Composition* panel, you can define the global settings of the current composition.

You can choose one of the *Presets* formats for your paper sheet, or enter your custom *width*, *height* and *units*. You can also choose the page *Orientation* to use.

Composition can be divided into several pages. For instance, a first page can show a map canvas, and a second page can show the attribute table associated with a layer, while a third one shows an HTML frame linking to your organization website. Set the *Number of pages* to the desired value. you can also custom the *Page Background* with the color or the symbol you want.

The Page size options apply to all the pages in the composition. However, you can modify the values using the data defined override options (see *Data Defined Override Buttons*).

A custom page size can also be set, using the *Resize page* tool. This creates an unique page composition, resizes the page to fit the current contents of the composition (with optional margins).

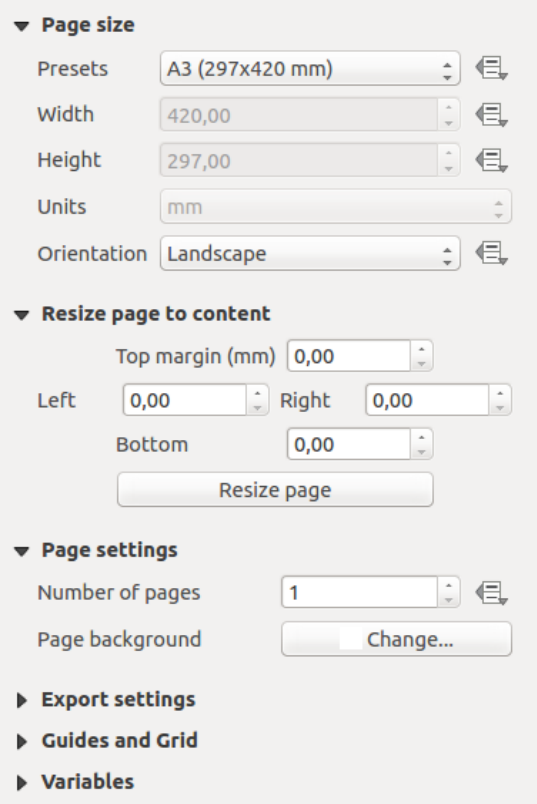

Figure 14.3: Composition settings in the Print Composer

Configuración de exportación

You can define a resolution to use for all exported maps in *Export resolution*. This setting can, however, be overridden each time you are exporting a map. When checked, *print as raster* means all elements will be rasterized before printing or saving as PostScript or PDF.

While exporting to an image file format, you can choose to generate a world file by checking *Save world file* and select a map item in *Reference map*. The world file is created beside the exported map, has the same name and contains information to georeference it easily.

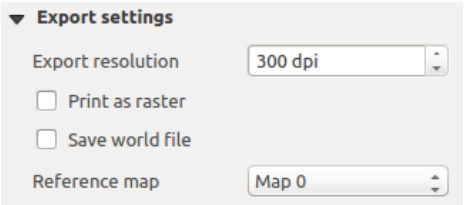

Figure 14.4: Export Settings in the Print Composer

Grid and guides

You can put some reference marks on your composition paper sheet to help you place some items. These marks can be:

- simple lines (called **Guides**) put at the position you want. To do that, ensure that *Show Rulers* and *Show Guides* in *View* menu are checked. Then, click and drag from within the ruler to the paper sheet. A vertical

or horizontal line is added to the paper and you can set its position following the coordinates displayed at the left bottom of the composer dialog.

- or regular **Grid**.

Whether grids or guides should be shown is set in *View* menu. There, you can also decide if they might be used to snap composer items. The *Grid and guides* section lets you customize grid settings like *Grid spacing*, *Grid offset* and *Snap tolerance* to your need. The tolerance is the maximum distance below which an item is snapped to a grid or a guide.

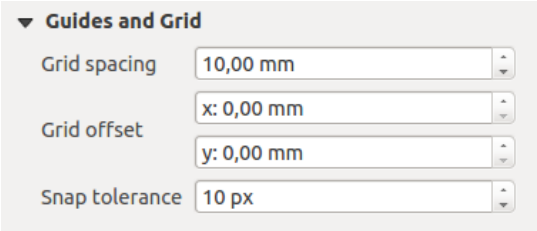

Figure 14.5: Snapping to grids in the Print Composer

In the *Options* → *Composer* menu in QGIS main canvas, you can also set the spacing, offset and snap tolerance of the grid as much as its style and color. These options are applied by default to any new print composer.

Variables

The *Variables* lists all the variables available at the composition's level (which includes all global and project's variables).

It also allows the user to manage composition-level variables. Click the button to add a new custom composition-level variable. Likewise, select a custom composition-level variable from the list and click the button to remove it.

More information on variables usage in the General Tools *Variables* section.

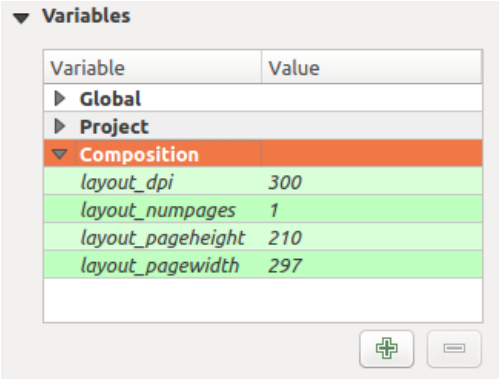

Figure 14.6: Variables editor in the Print Composer

Command History Panel: Revert and Restore actions

During the layout process, it is possible to revert and restore changes. This can be done with the revert and restore tools:

- Revert last change
- Restore last change

This can also be done by mouse click within the *Command history* panel (see figure_composer). The History panel lists the last actions done within the composer. Just select the point you want to revert to and once you do new action all the actions done after the selected one will be removed.

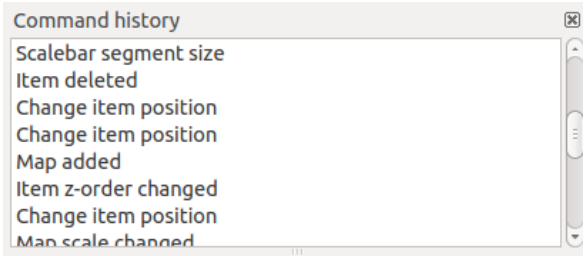

Figure 14.7: Command history in the Print Composer

Items Panel

The *Items* panel offers some options to manage selection and visibility of items. All the items added to the print composer canvas are shown in a list and selecting an item makes the corresponding row selected in the list as well as selecting a row does select the corresponding item in the print composer canvas. This is thus a handy way to select an item placed behind another one. Note that a selected row is shown as bold.

For any selected item, you can :

- set it visible or not,
- lock or unlock its position,
- order its Z position. You can move up and down each item in the list with a click and drag. The upper item in the list will be brought to the foreground in the print composer canvas. By default, a newly created item is placed in the foreground.
- change the name by double-clicking the text.

Once you have found the correct position for an item, you can lock it by ticking the box in column. Locked items are **not** selectable on the canvas. Locked items can be unlocked by selecting the item in the *Items* panel and unchecking the tickbox or you can use the icons on the toolbar.

14.2 Composer Items

14.2.1 Composer Items Common Options

Composer items have a set of common properties you will find at the bottom of the *Item Properties* panel: Position and size, Rotation, Frame, Background, Item ID, Variables and Rendering (See figure_composer_common).

- The *Position and size* dialog lets you define the size and position of the frame which contains the item. You can also choose which *Reference point* will be set at the **X** and **Y** coordinates previously defined.
- The *Rotation* sets the rotation of the element (in degrees).
- The *Frame* shows or hides the frame around the item. Click on the [Color] and [Thickness] buttons to adjust those properties.
- Use the *Background color* menu for setting a background color. Click on the [Color...] button to display a dialog where you can pick a color or choose from a custom setting. Transparency can be adjusted through atlering the alpha field settings.

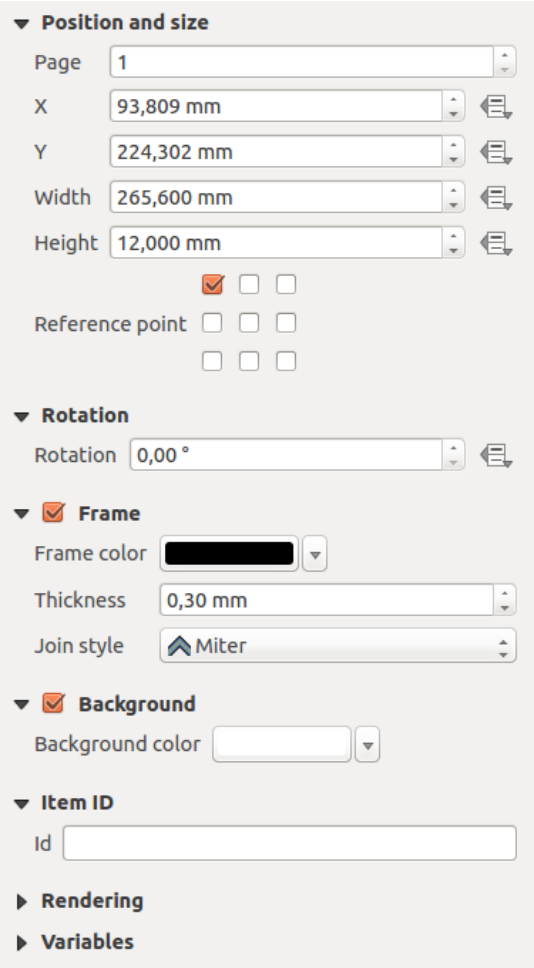

Figure 14.8: Common Item Properties Dialogs

- Use the *Item ID* to create a relationship to other Print Composer items. This is used with QGIS server and other potential web clients. You can set an ID on an item (for example, a map or a label), and then the web client can send data to set a property (e.g., label text) for that specific item. The GetProjectSettings command will list the items and IDs which are available in a layout.
- *Rendering* mode helps you set whether and how the item can be displayed.

Nota:

- If you checked *Use live-updating color chooser dialogs* in the QGIS general options, the color button will update as soon as you choose a new color from **Color Dialog** windows. If not, you need to close the **Color Dialog**.
- The Data defined override icon next to a field means that you can associate the field with data in the map item or use expressions. These are particularly helpful with atlas generation (See *Data Defined Override Buttons*).

Modo de representación

QGIS now allows advanced rendering for Composer items just like vector and raster layers.

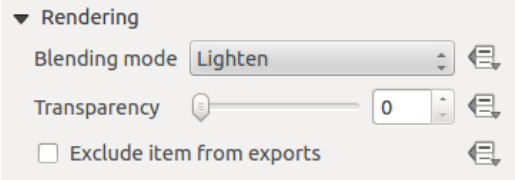

Figure 14.9: Modo de representación

- *Blending mode*: With this tool you can achieve effects which would otherwise only be achieved using graphic rendering software. The pixels of your overlaying and underlaying items can be mixed according to the mode set (see *Modos de Mezcla* for description of each effect).
- *Transparency*  : You can make the underlying item in the Composer visible with this tool. Use the slider to adapt the visibility of your item to your needs. You can also make a precise definition of the percentage of visibility in the menu beside the slider.
- *Exclude item from exports*: You can decide to make an item invisible in all exports. After activating this checkbox, the item will not be included in export to PDF, print etc..

Size and position

Each item inside the Composer can be moved and resized to create a perfect layout.For both operations the first step is to activate the Select/Move item tool and to click on the item; you can then move it using the mouse while holding the left button. If you need to constrain the movements to the horizontal or the vertical axis, just hold the `Shift` button on the keyboard while moving the mouse. If you need better precision, you can move a selected item using the `Arrow keys` on the keyboard; if the movement is too slow, you can speed up it by holding `Shift`.

A selected item will show squares on its boundaries; moving one of them with the mouse, will resize the item in the corresponding direction. While resizing, holding `Shift` will maintain the aspect ratio. Holding `Alt` will resize from the item center.

The correct position for an item can be obtained using the grid snapping or smart guides. Guides are set by clicking and dragging within the ruler area. To move a guide, click on the ruler, level with the guide and drag it to a new position. To delete a guide move it off the canvas. If you need to disable the snap on the fly, hold `Ctrl` while moving the mouse.

You can choose multiple items with the  Select/Move item button. Just hold the `Shift` button and click on all the items you need. You can then resize/move this group like a single item.

Once you have found the correct position for an item, you can lock it by using the items on the toolbar or ticking the box next to the item in the *Items* panel. Locked items are **not** selectable on the canvas.

Locked items can be unlocked by selecting the item in the *Items* panel and unchecking the tickbox or you can use the icons on the toolbar.

To unselect an item, just click on it holding the `Shift` button.

Inside the *Edit* menu, you can find actions to select all the items, to clear all selections or to invert the current selection.

Alineación

Raising or lowering the visual hierarchy for elements are inside the  Raise selected items pull-down menu. Choose an element on the Print Composer canvas and select the matching functionality to raise or lower the selected element compared to the other elements. This order is shown in the *Items* panel. You can also raise or lower objects in the *Items* panel by clicking and dragging an object's label in this list.

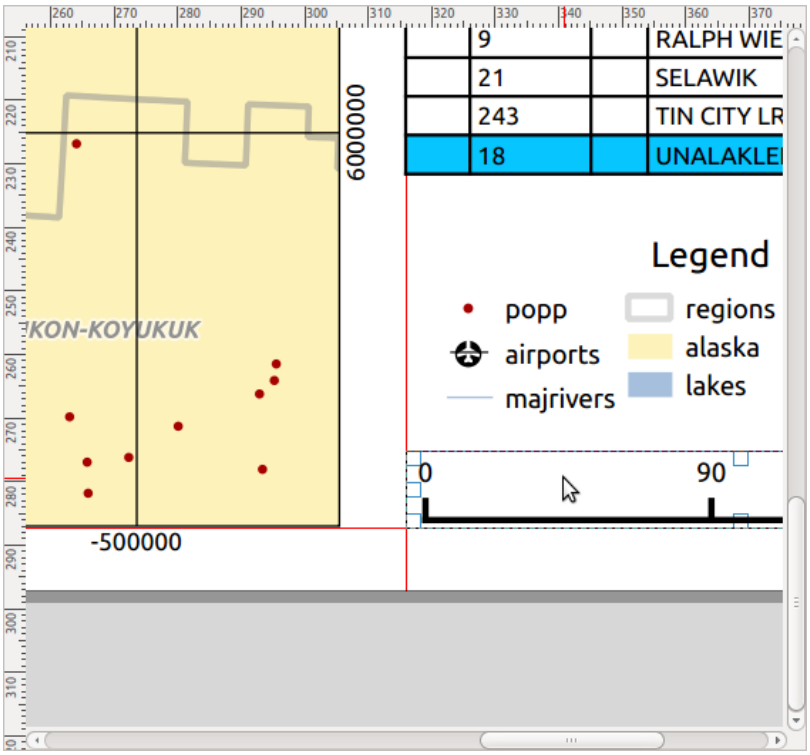

Figure 14.10: Alignment helper lines in the Print Composer

There are several alignment options available within the  Align selected items pull-down menu (see figure_composer_common_align). To use an alignment function, you first select the elements then click on the matching alignment icon. All selected elements will then be aligned to their common bounding box. When moving items on the Composer canvas, alignment helper lines appear when borders, centers or corners are aligned.

Variables

The *Variables* lists all the variables available at the composer item's level (which includes all global, project and composition's variables). Map items also include Map settings variables that provide easy access to values like the map's scale, extent, and so on.

In *Variables*, it's also possible to manage item-level variables. Click the button to add a new custom variable. Likewise, select any custom item-level variable from the list and click the button to remove it.

More information on variables usage in the General Tools *Variables* section.

14.2.2 El elemento del mapa

Click on the Add new map toolbar button in the Print Composer toolbar to add the QGIS map canvas. Now, drag a rectangle onto the Composer canvas with the left mouse button to add the map. To display the current map, you can choose between three different modes in the map *Item Properties* panel:

- **Rectangle** is the default setting. It only displays an empty box with a message 'Map will be printed here'.
- **Cache** renders the map in the current screen resolution. If you zoom the Composer window in or out, the map is not rendered again but the image will be scaled.
- **Render** means that if you zoom the Composer window in or out, the map will be rendered again, but for space reasons, only up to a maximum resolution.

Cache is the default preview mode for newly added Print Composer maps.

You can resize the map item by clicking on the Select/Move item button, selecting the element, and dragging one of the blue handles in the corner of the map. This button also helps to move the map to another place. Select the item and while holding the left mouse button, move to the new place and release the mouse button. After you have found the right place for an item, you can lock the item position within the Print Composer canvas. Select the map item and use the toolbar Lock Selected Items or the *Items* panel to Lock the item. A locked item can only be selected using the *Items* panel. Once selected you can use the *Items* panel to unlock individual items. The Unlock All Items icon will unlock all locked composer items. With the map selected, you can now adapt more properties in the map *Item Properties* panel.

To move layers within the map element, select the map element, click the Move item content icon and move the layers within the map item frame with the left mouse button.

Propiedades principales

The *Main properties* dialog of the map *Item Properties* panel provides the following functionalities (see figure_composer_map):

- The **Preview** drop-down menu allows you to select one of the preview modes 'Rectangle', 'Cache' and 'Render', as described above. If you change the view on the QGIS map canvas by changing vector or raster properties, you can update the Print Composer view by selecting the map element and clicking the **[Update preview]** button.
- The field *Scale* 1,00 manually sets the map item scale.
- The field *Map rotation* 1,00 allows you to rotate the map element content clockwise in degrees. The rotation of the map canvas can be imitated here.
- *Draw map canvas items* lets you show annotations that may be placed on the map canvas in the main QGIS window.

Layers

The *Layers* dialog of the map item panel provides the following functionality (see figure_composer_map_layers):

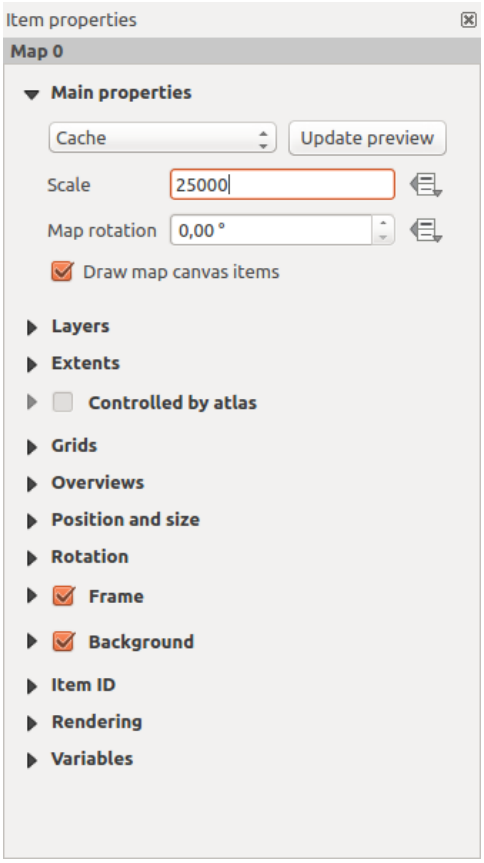

Figure 14.11: Map Item Properties Panel

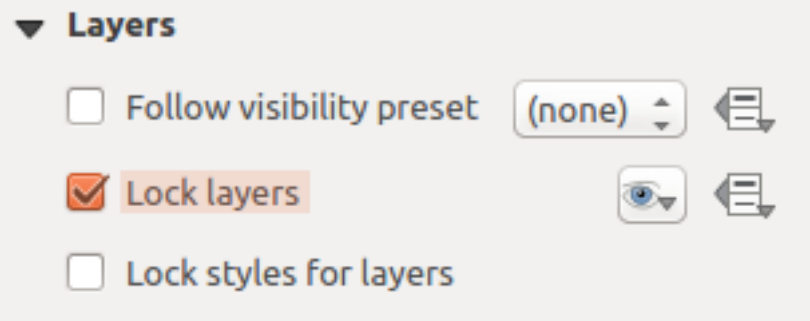

Figure 14.12: Map Layers Dialog

- If you want to keep the map item constantly updated with a visibility preset, use the *Follow visibility preset* and set the preset you want. Any changes applied to the preset in QGIS's main window (using the replace preset) will also show in the map item. In this case, the *Lock styles for layers* option will be disabled because *Follow visibility preset* also updates the style (symbology, label, diagram) of the visibility preset layers.
- To lock the layers shown on a map item to the current map canvas check *Lock layers*. After this option is enabled, any changes on the layers visibility in the QGIS's main window won't affect the Composer's map item. Nevertheless, style and labels of locked layers are still refreshed according to QGIS's main window. You can prevent this by using *Lock styles for layers*.

  Using the button, you can lock the map item's layers to one of the visibility presets you have prepared in QGIS (see *Panel de capas* to find out how to create visibility presets). Clicking the button will show the list of all the preset views. Select the preset you want to display. The map canvas will lock the preset layers automatically by enabling the *Lock layers*. You can release the preset by unchecking the *Lock layers* and press the button in the map composer's *Navigation* toolbar.

  Note that, unlike the *Follow visibility preset*, using the *Lock layers* option enabled and set to a preset, the map item layers won't be updated if the preset is changed (using the replace preset option) in QGIS's main window.

  Locked layers in the map can also be *data-defined*, using the icon beside the option. When used, this overrides the selection set in the drop-down list. You need to pass a list of layers separated by `|` character. The following example locks the map item to use only layers `layer 1` and `layer 2`:

  ```
  concat ('layer 1', '|', 'layer 2')
  ```

Extensión

The *Extents* dialog of the map item panel provides the following functionalities (see figure_composer_map_extents):

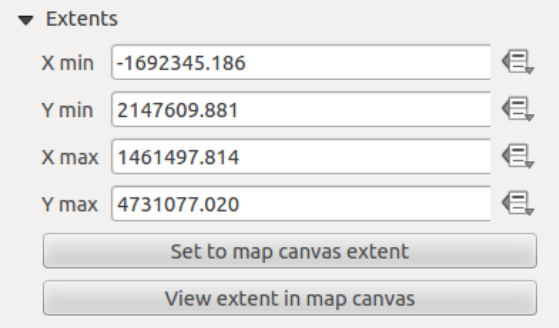

Figure 14.13: Map Extents Dialog

The **Map extents** area allows you to specify the map extent using `X` and `Y` min/max values and by clicking the **[Set to map canvas extent]** button. This button sets the map extent of the composer map item to the extent of the current map view in the main QGIS application. The button **[View extent in map canvas]** does exactly the opposite; it updates the extent of the map view in the QGIS application to the extent of the composer map item.

If you change the view on the QGIS map canvas by changing vector or raster properties, you can update the Print Composer view by selecting the map element in the Print Composer and clicking the **[Update preview]** button in the map *Item Properties* panel (see figure_composer_map).

Cuadrículas

The *Grids* dialog of the map *Item Properties* panel provides the possibility to add several grids to a map item.

- With the and buttons you can add or remove a selected grid.
- With the and buttons you can move a grid in the list and set the drawing priority.

When you double-click the added grid you can give it another name.

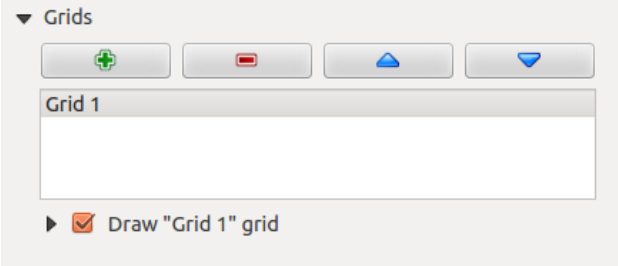

Figure 14.14: Diálogo de cuadrículas del mapa

After you have added a grid, you can activate the checkbox *Draw grid* to overlay a grid onto the map element. Expand this option to provide a lot of configuration options, see Figure_composer_map_grid_draw.

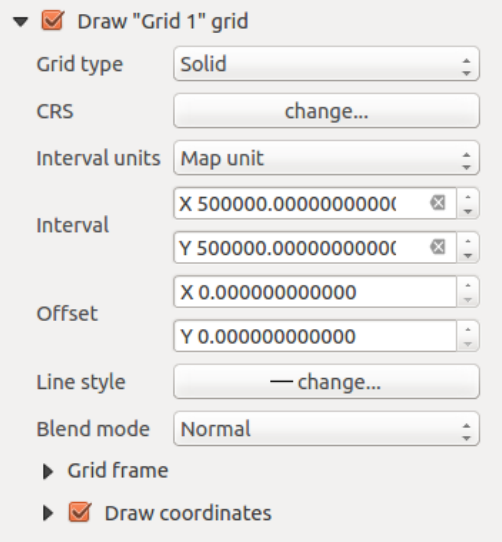

Figure 14.15: Draw Grid Dialog

As grid type, you can specify to use a 'Solid', 'Cross', 'Markers' or 'Frame and annotations only'. 'Frame and annotations only' is especially useful when working with rotated maps or reprojected grids. In the divisions section of the Grid Frame Dialog mentioned below you then have a corresponding setting. Symbology of the grid and its rendering mode can be chosen. See *Modo de representación*. Furthermore, you can define an interval in the X and Y directions, an X and Y offset, and the width used for the cross or line grid type.

- There are different options to style the frame that holds the map. Following options are available: No Frame, Zebra, Interior ticks, Exterior ticks, Interior and Exterior ticks and Lineborder.
- With 'Latitude/Y only' and 'Longitude/X only' setting in the divisions section you have the possibility to prevent a mix of latitude/y and longitude/x coordinates showing on a side when working with rotated maps or reprojected grids.
- Advanced rendering mode is also available for grids.
- The *Draw coordinates* checkbox allows you to add coordinates to the map frame. You can choose the annotation numeric format, the options range from decimal to degrees, minute and seconds, with or without suffix, aligned or not and a custom format using the expression dialog. You can choose which annotation

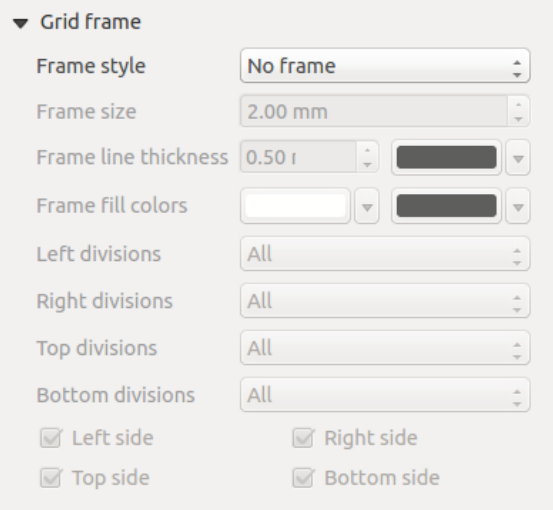

Figure 14.16: Diálogo de marco de cuadrícula

to show. The options are: show all, latitude only, longitude only, or disable(none). This is useful when the map is rotated. The annotation can be drawn inside or outside the map frame. The annotation direction can be defined as horizontal, vertical ascending or vertical descending. Finally, you can define the annotation font, the annotation font color, the annotation distance from the map frame and the precision of the drawn coordinates.

Vistas generales

The *Overviews* dialog of the map *Item Properties* panel provides the following functionalities:

You can choose to create an overview map, which shows the extents of the other map(s) that are available in the composer. First you need to create the map(s) you want to include in the overview map and the map you want to use as the overview map, just like a normal map.

Then expand *Overviews* option and press the green plus icon-button to add an overview. Initially this overview is named 'Overview 1' (see Figure_composer_map_overview). You can change the name when you double-click on the overview item in the list named 'Overview 1' and change it to another name.

- With the plus and minus button you can add or remove an overview.
- With the up and down button you can move an overview in the list and set the drawing priority.

When you select the overview item in the list you can customize it.

- The *Draw "<name_overview>" overview* needs to be activated to draw the extent of selected map frame.
- The *Map frame* combo list can be used to select the map item whose extents will be drawn on the present map item.
- The *Frame Style* allows you to change the style of the overview frame.
- The *Blending mode* allows you to set different transparency blend modes.
- La *Invertir vista general* crea una máscara al rededor de las extensiones cuando activa: las extensiones del mapa referenciado se muestran claramente, mientras que todo lo demás es mezclado con el color del marco.
- El *Centrar en vista general* pone la extensión del marco de la vista general al centro de la vista general del mapa. Sólo se puede activar un elemento de vista general para centrar, cuando ha añadido varias vistas generales.

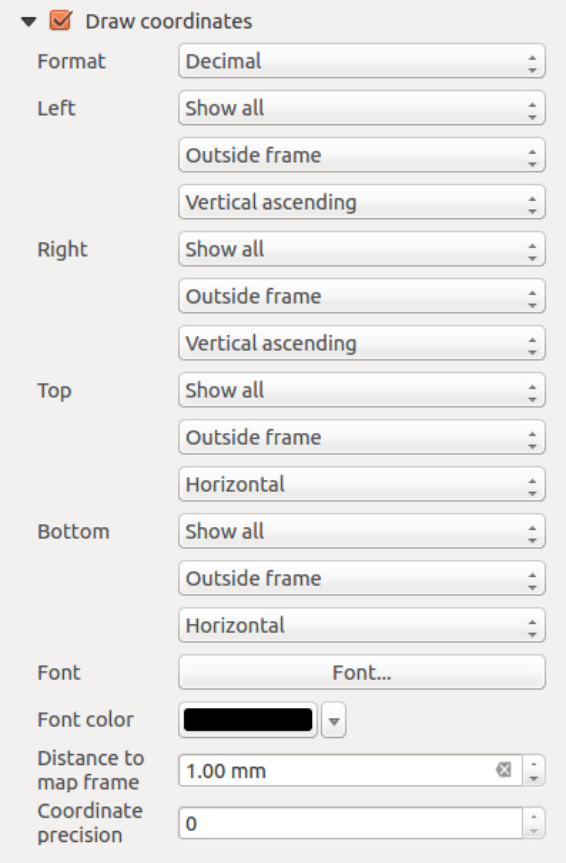

Figure 14.17: Diálogo Coordenadas para dibujo de rejilla

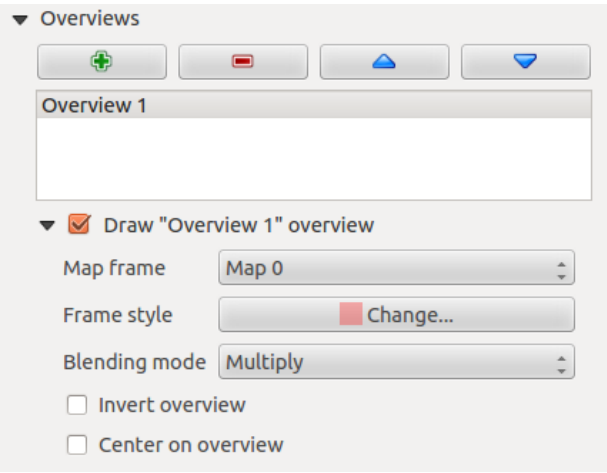

Figure 14.18: Map Overviews Dialog

14.2.3 El elemento etiqueta

To add a label, click the Add label icon, place the element with the left mouse button on the Print Composer canvas and position and customize its appearance in the label *Item Properties* panel.

The *Item Properties* panel of a label item provides the following functionality for the label item (see Figure_composer_label):

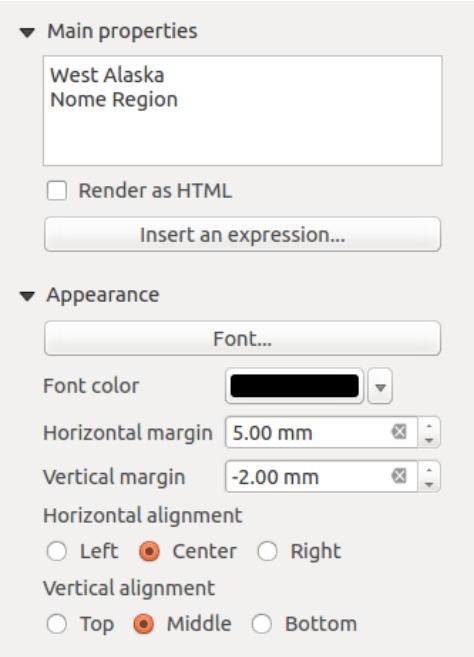

Figure 14.19: Label Item Properties Panel

Propiedades principales

- The main properties dialog is where the text (HTML or not) or the expression needed to fill the label is added to the Composer canvas.
- Las etiquetas pueden ser interpretadas como código HTML: check *Representar como HTML*. Ahora puede insertar una URL, una imagen seleccionable que enlaza a una página web o algo más complejo.
- You can also insert an expression. Click on **[Insert an expression]** to open a new dialog. Build an expression by clicking the functions available in the left side of the panel. Two special categories can be useful, particularly associated with the atlas functionality: **geometry** and **records** functions. At the bottom, a preview of the expression is shown.

Apariencia

- Define *Font* by clicking on the **[Font...]** button or a *Font color* selecting a color using the color selection tool.
- You can specify different horizontal and vertical margins in `mm`. This is the margin from the edge of the composer item. The label can be positioned outside the bounds of the label e.g. to align label items with other items. In this case you have to use negative values for the margin.
- Using the *Alignment* is another way to position your label. Note that when e.g. using the *Horizontal alignment* in *Center* Position the *Horizontal margin* feature is disabled.

14.2.4 El elemento leyenda

To add a map legend, click the Add new legend icon, place the element with the left mouse button on the Print Composer canvas and position and customize the appearance in the legend *Item Properties* panel.

The *Item properties* panel of a legend item provides the following functionalities (see figure_composer_legend):

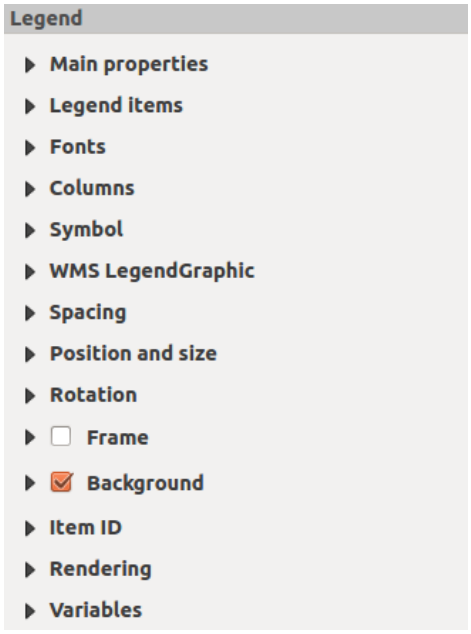

Figure 14.20: Legend Item Properties Panel

Propiedades principales

The *Main properties* dialog of the legend *Item Properties* panel provides the following functionalities (see figure_composer_legend_ppt):

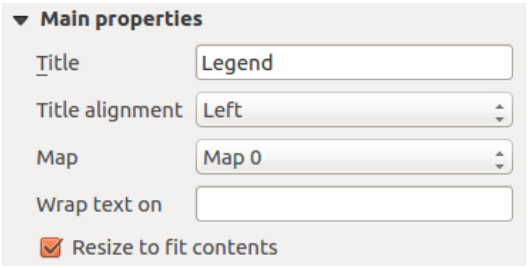

Figure 14.21: Legend Main properties Dialog

En propiedades principales se puede:

- change the title of the legend;
- set the title alignment to Left, Center or Right;
- choose which *Map* item the current legend will refer to in the select list;
- wrap the text of the legend title on a given character;
- use *Resize to fit contents* to control whether or not a legend should be automatically resized to fit its contents. If unchecked, then the legend will never resize and instead just stick to whatever size the user has set. Any content which doesn't fit the size is cropped out.

Elementos de la leyenda

The *Legend items* dialog of the legend *Item Properties* panel provides the following functionalities (see figure_composer_legend_items):

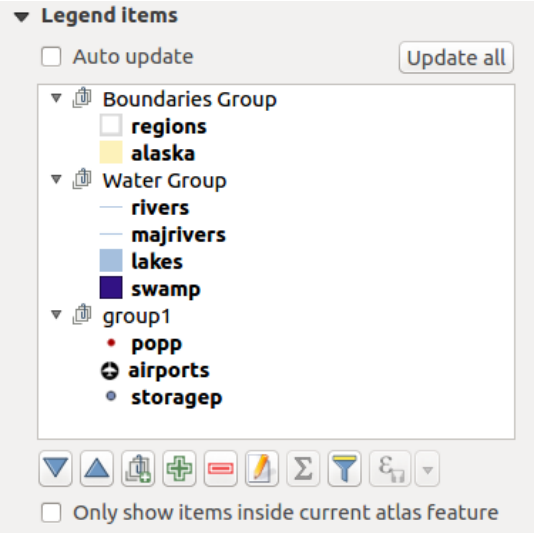

Figure 14.22: Legend Items Dialog

- La leyenda se actualizará automáticamente si *Auto actualizar* es activado. Cuando guilabel:*Auto actualizar* es desactivado este le dará más control sobre los elementos de la leyenda. Los iconos debajo de los elementos de la leyenda se activarán.
- La ventana de los elementos de la leyenda lista todos los elementos y le permite cambiar el orden, capas de grupos, eliminar y restaurar elementos en la lista, editar nombres de capas y añadir un filtro.
  - The item order can be changed using the and buttons or with 'drag-and-drop' functionality. The order can not be changed for WMS legend graphics.
  - Use the button to add a legend group.
  - Use the button to add layers and button to remove groups, layers or symbol classes.
  - The button is used to edit the layer, group name or title. First you need to select the legend item. Double-clicking the item also opens the text box to rename it.
  - The button adds a feature count for each class of vector layer.
  - With the Filter legend by map content button, only the legend items visible in the map will be listed in the legend. This tool remains available when *Auto-update* is active.
  - The Filter legend by expression helps you filter which of the legend items of a layer will be displayed, i.e. using a layer that has different legend items (e.g., from a rule-based or categorized symbology), you can specify a boolean expression to remove from the legend tree, styles that have no feature satisfying a condition. Note that the features are nevertheless kept and shown in the composer map item.

  While the default behavior of the legend item is to mimic the *Layers panel* tree, displaying the same groups, layers and classes of symbology, right-click any item offers you options to hide layer's name or raise it as a group or subgroup. In case you have made some changes to a layer, you can revert them by choosing *Reset to defaults* from the contextual menu.

  After changing the symbology in the QGIS main window, you can click on **[Update All]** to adapt the changes in the legend element of the Print Composer.

- While generating an atlas with polygon features, you can filter out legend items that lie outside the current atlas feature. To do that, check the *Only show items inside current atlas feature* option.

Fuentes, Columnas, Símbolo

The *Fonts*, *Columns* and *Symbol* dialogs of the legend *Item Properties* panel provide the following functionalities (see figure_composer_legend_fonts):

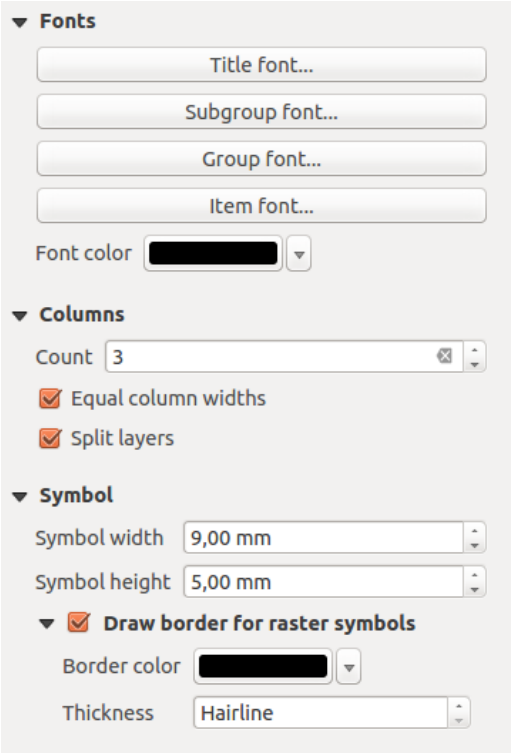

Figure 14.23: Legend Fonts, Columns and Symbol Dialogs

- You can change the font of the legend title, group, subgroup and item (layer) in the legend item. Click on a category button to open a **Select font** dialog.
- You provide the labels with a **Color** using the advanced color picker, however the selected color will be given to all font items in the legend..
- Legend items can be arranged over several columns. Set the number of columns in the *Count* 1,00 field.
  - *Anchura de columnas igual* controla cómo deberían ser ajustadas las columnas de la leyenda.
  - La opción *Dividir capas* permite a una capa categorizada o graduada de la leyenda repartirse en columnas.
- You can also change the width and height of the legend symbol, set a color and a thickness in case of raster layer symbol.

WMS LegendGraphic y espaciamiento

The *WMS LegendGraphic* and *Spacing* dialogs of the legend *Item Properties* panel provide the following functionalities (see figure_composer_legend_wms):

When you have added a WMS layer and you insert a legend composer item, a request will be sent to the WMS server to provide a WMS legend. This Legend will only be shown if the WMS server provides the GetLegendGraphic capability. The WMS legend content will be provided as a raster image.

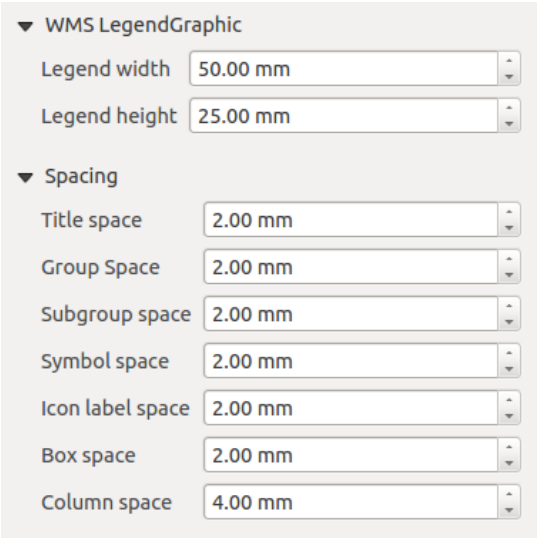

Figure 14.24: WMS LegendGraphic and Spacing Dialogs

GráficoDeLeyenda WMS se utiliza para poder ajustar el *Anchura de la leyenda* y la *Altura de la leyenda* de la imagen ráster de la leyenda WMS.

Spacing around title, group, subgroup, symbol, icon label, box space or column space can be customized through this dialog.

14.2.5 El elemento de barra de escala

To add a scale bar, click the Add new scalebar icon, place the element with the left mouse button on the Print Composer canvas and position and customize the appearance in the scale bar *Item Properties* panel.

The *Item properties* of a scale bar item tab provides the following functionalities (see figure_composer_scalebar):

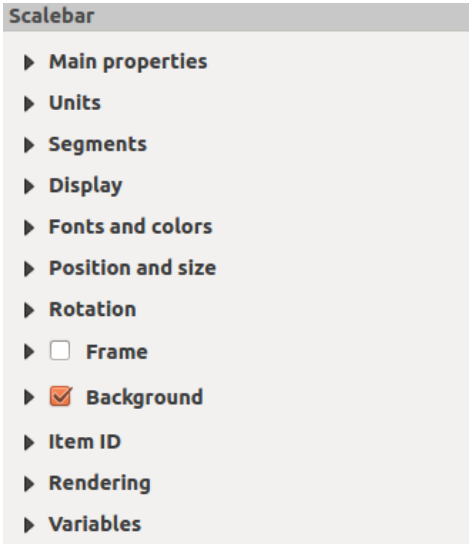

Figure 14.25: Scale Bar Item Properties Panel

Propiedades principales

The *Main properties* dialog of the scale bar *Item Properties* panel provides the following functionalities (see figure_composer_scalebar_ppt):

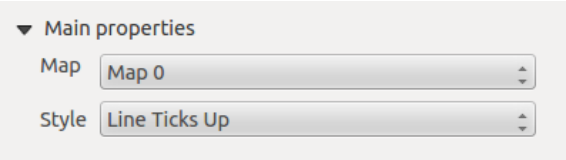

Figure 14.26: Scale Bar Main properties Dialog

- First, choose the map the scale bar will be attached to.
- Then, choose the style of the scale bar. Six styles are available:
  - **Single box** and **Double box** styles, which contain one or two lines of boxes alternating colors.
  - **Middle**, **Up** or **Down** line ticks.
  - **Numérico**, donde se imprime la relación de escala (por ejemplo, 1:50000).

Unidades y Segmentos

The *Units* and *Segments* dialogs of the scale bar *Item Properties* panel provide the following functionalities (see figure_composer_scalebar_units):

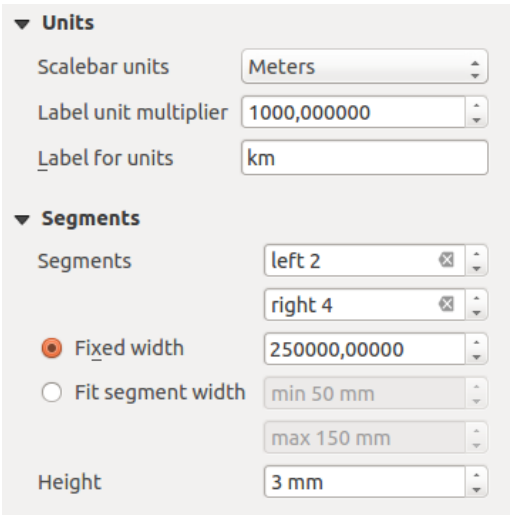

Figure 14.27: Scale Bar Units and Segments Dialogs

In these two dialogs, you can set how the scale bar will be represented.

- Select the units you want to use with *Scalebar units*. There are four possible choices: **Map Units**, the default one and **Meters**, **Feet** or **Nautical Miles** which may force unit conversions.
- The *Label unit multiplier* specifies how many scalebar units per labeled unit. Eg, if your scalebar units are set to "meters", a multiplier of 1000 will result in the scale bar labels in "kilometers".
- The *Label for units* field defines the text used to describe the units of the scale bar, eg "m" or "km". This should be matched to reflect the multiplier above.
- You can define how many *Segments* will be drawn on the left and on the right side of the scale bar.

- You can set how long each segment will be (*fixed width*), or limit the scale bar size in mm with *Fit segment width* option. In the latter case, each time the map scale changes, the scale bar is resized (and its label updated) to fit the range set.
- *Height* is used to define the height of the bar.

Mostrar

The *Display* dialog of the scale bar *Item Properties* panel provides the following functionalities (see figure_composer_scalebar_display):

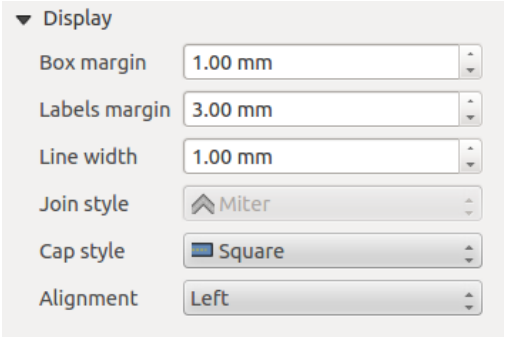

Figure 14.28: Scale Bar Display

Se puede definir como la barra de escala se mostrará en un marco.

- *Margen de caja* : espacio entre texto y bordes del marco
- *Labels margin* : space between text and scale bar drawing
- *Line width* : line width of the scale bar drawing
- *Join style* : Corners at the end of scalebar in style Bevel, Rounded or Square (only available for Scale bar style Single Box & Double Box)
- *Cap style* : End of all lines in style Square, Round or Flat (only available for Scale bar style Line Ticks Up, Down and Middle)
- *Alignment* : Puts text on the left, middle or right side of the frame (works only for Scale bar style Numeric)

Fuentes y colores

The *Fonts and colors* dialog of the scale bar *Item Properties* panel provides the following functionalities (see figure_composer_scalebar_fonts):

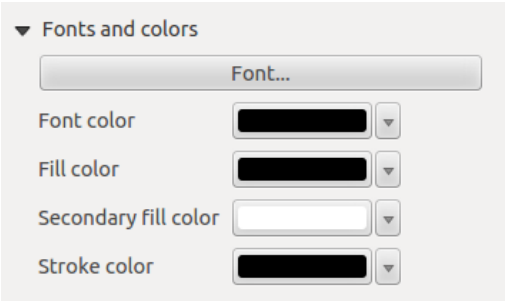

Figure 14.29: Scale Bar Fonts and colors Dialogs

You can define the fonts and colors used for the scale bar.

- Use the **[Font]** button to set the font of scale bar label
- *Color de letras*: establecer color de letras
- *Fill color*: set the first fill color
- *Color de relleno secundario*: establece el segundo color de relleno
- *Stroke color*: set the color of the lines of the Scale Bar

Fill colors are only used for scale box styles Single Box and Double Box. To select a color you can use the list option using the dropdown arrow to open a simple color selection option or the more advanced color selection option, that is started when you click in the colored box in the dialog.

14.2.6 El elemento de Tabla de Atributos

It is possible to add parts of a vector attribute table to the Print Composer canvas: Click the  Add attribute table icon, click and drag with the left mouse button on the Print Composer canvas to place and size the item. You can better position and customize its appearance in the *Item Properties* panel.

The *Item properties* panel of an attribute table provides the following functionalities (see figure_composer_table):

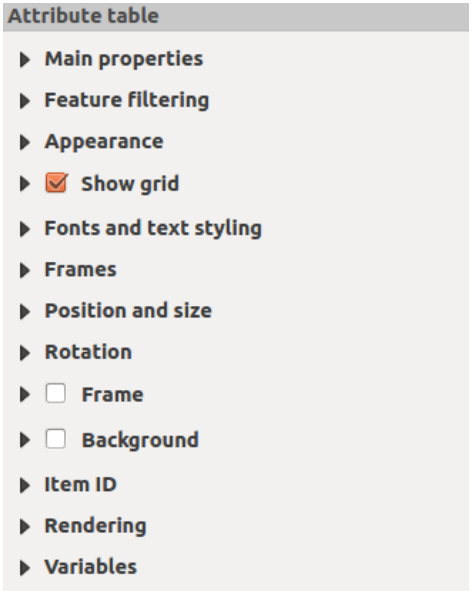

Figure 14.30: Attribute table Item Properties Panel

Propiedades principales

The *Main properties* dialog of the attribute table provides the following functionalities (see figure_composer_table_ppt):

- For *Source* you can normally select only **Layer features**.
- With *Layer* you can choose from the vector layers loaded in the project.
- In case you activated the *Generate an atlas* option in the *Atlas generation* panel, there are two additional *Source* possible:
  - **Current atlas feature** (see figure_composer_table_atlas): you won't see any option to choose the layer, and the table item will only show a row with the attributes from the current feature of the atlas coverage layer.

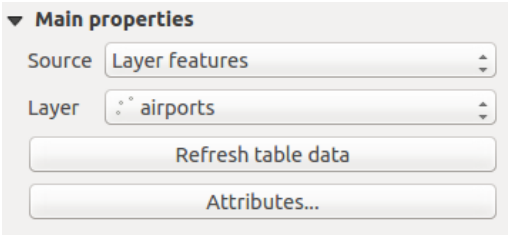

Figure 14.31: Attribute table Main properties Dialog

– and **Relation children** (see figure_composer_table_relation): an option with the relation names will show up. This feature can only be used if you have defined a relation using your atlas coverage layer as parent, and the table will show the children rows of the atlas coverage layer's current feature (for further information about the atlas generation, see *Generar un Atlas*).

- The button **[Refresh table data]** can be used to refresh the table when the actual contents of the table has changed.

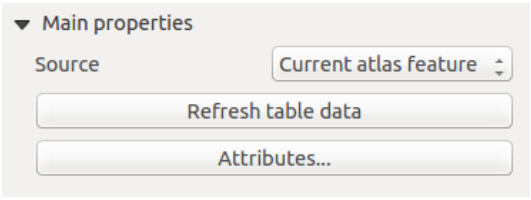

Figure 14.32: Attribute table Main properties for 'Current atlas feature'

Figure 14.33: Attribute table Main properties for 'Relation children'

- The button **[Attributes...]** starts the *Select attributes* menu, see figure_composer_table_select, that can be used to change the visible contents of the table. After making changes use the **[OK]** button to apply changes to the table. The upper part of the window shows the list of the attributes to display and the lower part helps to set the way the data is sorted.

  En la sección *Columnas* se puede:

  – Remove an attribute, just select an attribute row by clicking anywhere in the row and press the minus button to remove the selected attribute.

  – Add a new attribute use the plus button. At the end a new empty row appears and you can select empty cell of the column *Attribute*. You can select a field attribute from the list or you can select to build a new attribute using a regular expression (ε button). Of course you can modify every already existing attribute by means of a regular expression.

  – Use the up and down arrows to change the order of the attributes in the table.

  – Select a cell in the Headings column and, to change the heading, just type in a new name.

  – set a precise Alignment (mixing vertical and horizontal alignment options) for each column.

  – Select a cell in the Width column and change it from Automatic to a width in mm, just type a number. When you want to change it back to Automatic, use the cross.

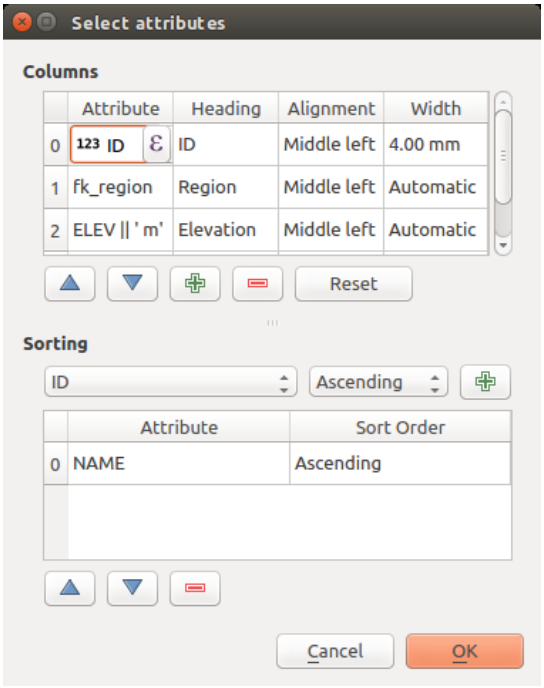

Figure 14.34: Attribute table Select attributes Dialog

– The **[Reset]** button can always be used to restore it to the original attribute settings.

En la sección *Ordenar* se puede:

– Add an attribute to sort the table with. Select an attribute and set the sorting order to 'Ascending' or 'Descending' and press the plus button. A new line is added to the sort order list.

– select a row in the list and use the up and down button to change the sort priority on attribute level. Selecting a cell in the Sort Order column helps you change the sorting order of the attribute field.

– use the minus button to remove an attribute from the sort order list.

Filtrado de objetos espaciales

The *Feature filtering* dialog of the attribute table provides the following functionalities (see figure_composer_table_filter):

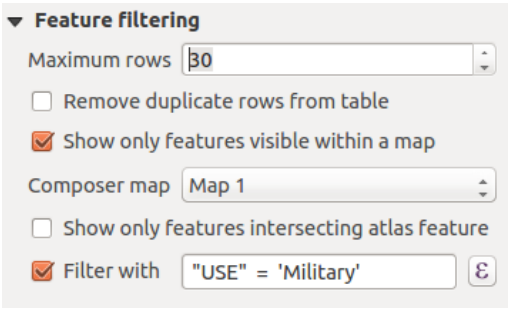

Figure 14.35: Attribute table Feature filtering Dialog

Puede:

- Define the *Maximum rows* to be displayed.
- Activar *Eliminar filas duplicadas de la tabla* para mostrar sólo registros únicos.

- Activate *Show only visible features within a map* and select the corresponding *Composer map* to display the attributes of features only visible on selected map.
- Activate *Show only features intersecting Atlas feature* is only available when *Generate an atlas* is activated. When activated it will show a table with only the features which intersect the current atlas feature.
- Activar *Filtrar con* y proporciona un filtro al escribir en la línea de entrada o insertar una expresión regular utilizando el botón de expresión dado. Unos pocos ejemplos de declaraciones de filtrado que puede utilizar cuando se han cargado la capa de aeropuertos a partir del conjunto de datos de la muestra:
  - `ELEV > 500`
  - `NAME = 'ANIAK'`
  - `NAME NOT LIKE 'AN%'`
  - `regexp_match( attribute( $currentfeature, 'USE' ) , '[i]')`

  La ultima expresión regular incluirá sólo los aeropuertos que tienen una letra 'i' en el campo de atributos 'USE'.

Apariencia

The *Appearance* dialog of the attribute table provides the following functionalities (see figure_composer_table_appearance):

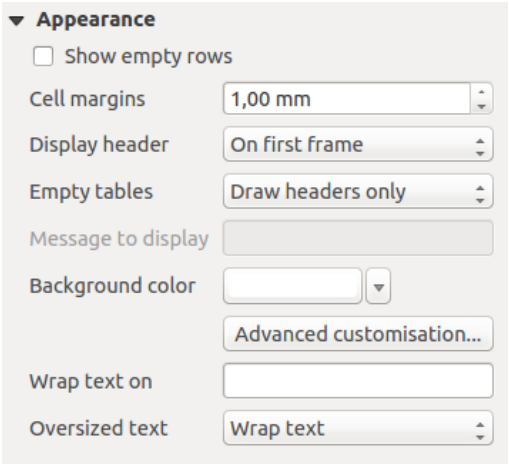

Figure 14.36: Attribute table appearance Dialog

- Click *Show empty rows* to fill the attribute table with empty cells. This option can also be used to provide additional empty cells when you have a result to show!
- With *Cell margins* you can define the margin around text in each cell of the table.
- With *Display header* you can select from a list one of 'On first frame', 'On all frames' default option, or 'No header'.
- The option *Empty table* controls what will be displayed when the result selection is empty.
  - **Dibujar cabeceras solamente**, sólo dibuja la cabecera excepto si se tiene elegido 'Sin encabezado' por *Mostrar encabezado*.
  - **Ocultar tabla entera**, sólo dibujará el fondo de la tabla. Se puede activar *No dibujar el fondo si el marco esta vacío* en *Marcos* para ocultar la tabla completamente.

  - **Mostrar mensaje establecido** dibujará el encabezado y añadirá un espaciado a la celda a todas las columnas y mostrará un mensaje como 'Sin resultados' que puede ser proveído en la opción *Mensaje a mostrar*

- La opción *Mensaje a mostrar* sólo se activa cuando se ha seleccionado **Mostrar mensaje establecido** para *Tabla Vacía*. El mensaje proporcionado se mostrará en la tabla en la primer fila, cuando el resultado es una tabla vacía.
- With *Background color* you can set the background color of the table. The *Advanced customization* option helps you define different background colors for each cell (see figure_composer_table_background)

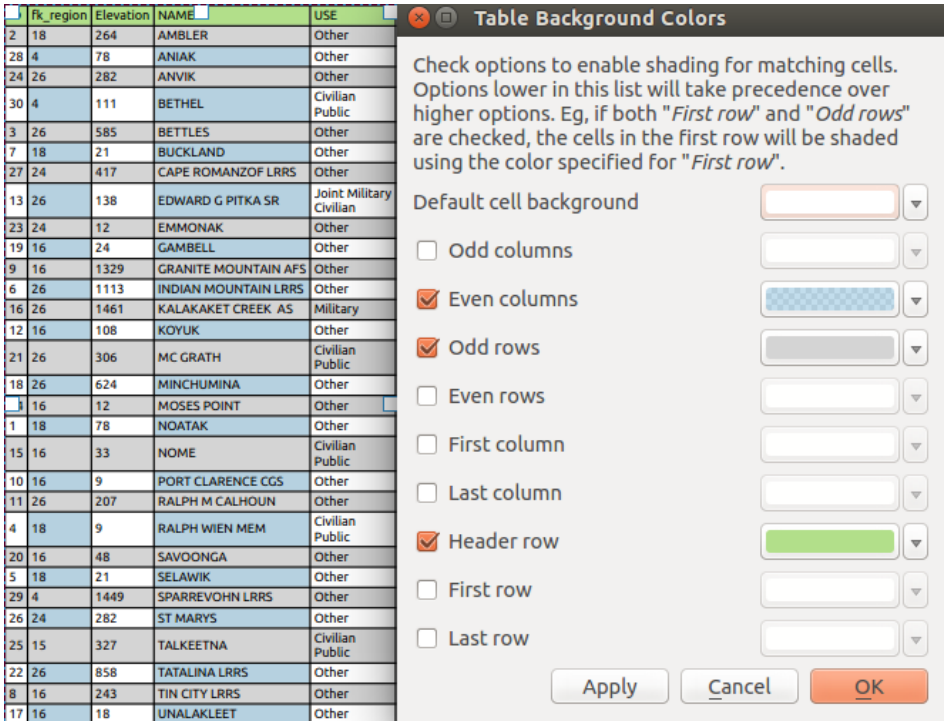

Figure 14.37: Attribute table Advanced Background Dialog

- With the *Wrap text on* option, you can define a character on which the cell content will be wraped each time it is met
- With *Oversized text* you define the behaviour when the width set for a column is smaller than its content's length. It can be **Wrap text** or **Truncate text**.

Mostrar cuadrícula

The *Show grid* dialog of the attribute table provides the following functionalities (see figure_composer_table_grid):

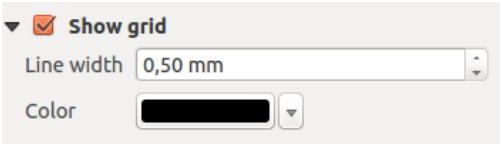

Figure 14.38: Attribute table Show grid Dialog

- Activate *Show grid* when you want to display the grid, the outlines of the table cells.
- Con *Ancho de línea* se puede establecer el espesor de las líneas utilizadas en la cuadrícula.
- The *Color* of the grid can be set using the color selection dialog.

Fuentes de letras y estilo de texto

The *Fonts and text styling* dialog of the attribute table provides the following functionalities (see figure_composer_table_fonts):

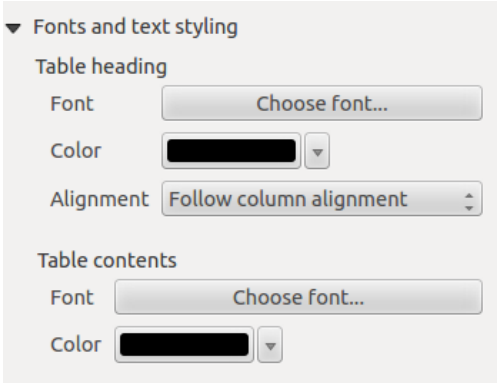

Figure 14.39: Attribute table Fonts and text styling Dialog

- You can define *Font* and *Color* for *Table heading* and *Table contents*.
- For *Table heading* you can additionally set the *Alignment* to *Follow column alignment* or override this setting by choosing *Left*, *Center* or *Right*. The column alignment is set using the *Select Attributes* dialog (see Figure_composer_table_select).

Marcos

The *Frames* dialog of the attribute table provides the following functionalities (see figure_composer_table_frames):

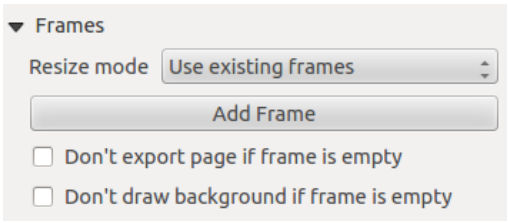

Figure 14.40: Attribute table Frames Dialog

- With *Resize mode* you can select how to render the attribute table contents:
  - *Use existing frames* displays the result in the first frame and added frames only.
  - *Extend to next page* will create as many frames (and corresponding pages) as necessary to display the full selection of attribute table. Each frame can be moved around on the layout. If you resize a frame, the resulting table will be divided up between the other frames. The last frame will be trimmed to fit the table.
  - *Repeat until finished* will also create as many frames as the *Extend to next page* option, except all frames will have the same size.
- Use the **[Add Frame]** button to add another frame with the same size as selected frame. The result of the table that will not fit in the first frame will continue in the next frame when you use the Resize mode *Use existing frames*.
- Activate *Don't export page if frame is empty* prevents the page to be exported when the table frame has no contents. This means all other composer items, maps, scalebars, legends etc. will not be visible in the result.

- Activar *No dibujar fondo si el marco está vacío* impide que el fondo que se puede extraer cuando el marco de la tabla no tiene contenido.

14.2.7 The Image Item

To add an image, click the Add image icon and drag a rectangle onto the Composer canvas with the left mouse button. You can then position and customize its appearance in the image *Item Properties* panel.

The image *Item Properties* tab provides the following functionalities (see figure_composer_image):

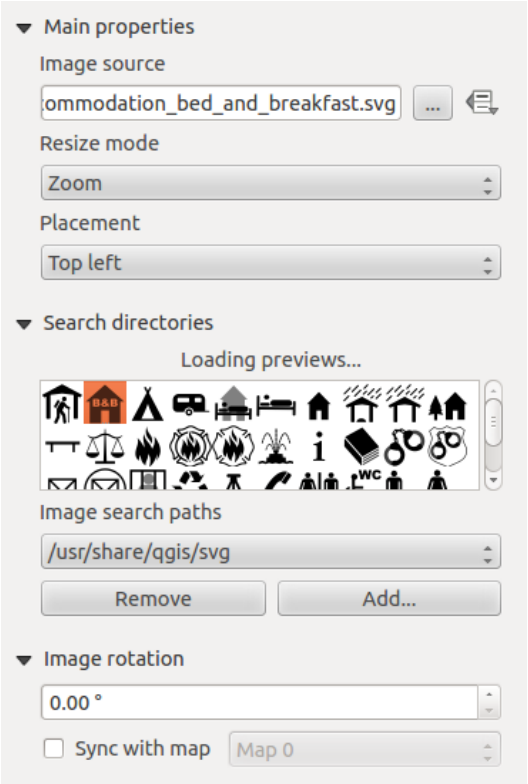

Figure 14.41: Image Item Properties panel

You first have to select the image you want to display. There are several ways to set the *image source* in the **Main properties** area.

1. Use the browse button ... of *image source* to select a file on your computer using the browse dialog. The browser will start in the SVG-libraries provided with QGIS. Besides `SVG`, you can also select other image formats like `.png` or `.jpg`.
2. You can enter the source directly in the *image source* text field. You can even provide a remote URL-address to an image.
3. From the **Search directories** area you can also select an image from *loading previews ...* to set the image source.
4. Use the data defined button to set the image source from a record or using a regular expression.

With the *Resize mode* option, you can set how the image is displayed when the frame is changed, or choose to resize the frame of the image item so it matches the original size of the image.

You can select one of the following modes:

- Zoom: Enlarges the image to the frame while maintaining aspect ratio of picture.

- Stretch: Stretches image to fit inside the frame, ignores aspect ratio.
- Clip: Use this mode for raster images only, it sets the size of the image to original image size without scaling and the frame is used to clip the image, so only the part of the image inside the frame is visible.
- Zoom and resize frame: Enlarges image to fit frame, then resizes frame to fit resultant image.
- Resize frame to image size: Sets size of frame to match original size of image without scaling.

Selected resize mode can disable the item options 'Placement' and 'Image rotation'. The *Image rotation* is active for the resize mode 'Zoom' and 'Clip'.

With *Placement* you can select the position of the image inside its frame. The **Search directories** area allows you to add and remove directories with images in SVG format to the picture database. A preview of the pictures found in the selected directories is shown in a pane and can be used to select and set the image source. It is possible to change SVG fill/outline color and outline width when using parameterized SVG files such as those included with QGIS. If you add a SVG file you should add the following tags in order to add support for transparency:

- *fill-opacity="param(fill-opacity)"*
- *stroke-opacity="param(outline-opacity)"*

You can read this blog post to see an example.

Images can be rotated with the *Image rotation* field. Activating the *Sync with map* checkbox synchronizes the rotation of the image (i.e., a rotated north arrow) with the rotation applied to the selected map item.

It is also possible to select a north arrow directly. If you first select a north arrow image from **Search directories** and then use the browse button ... of the field *Image source*, you can now select one of the north arrow from the list as displayed in figure_composer_image_north.

Nota: Muchas de las flechas del norte no tienen una 'N' añadida, esto se hace a propósito para los idiomas que no utilizan una 'N' para Norte, para que pueda utilizar otra letra.

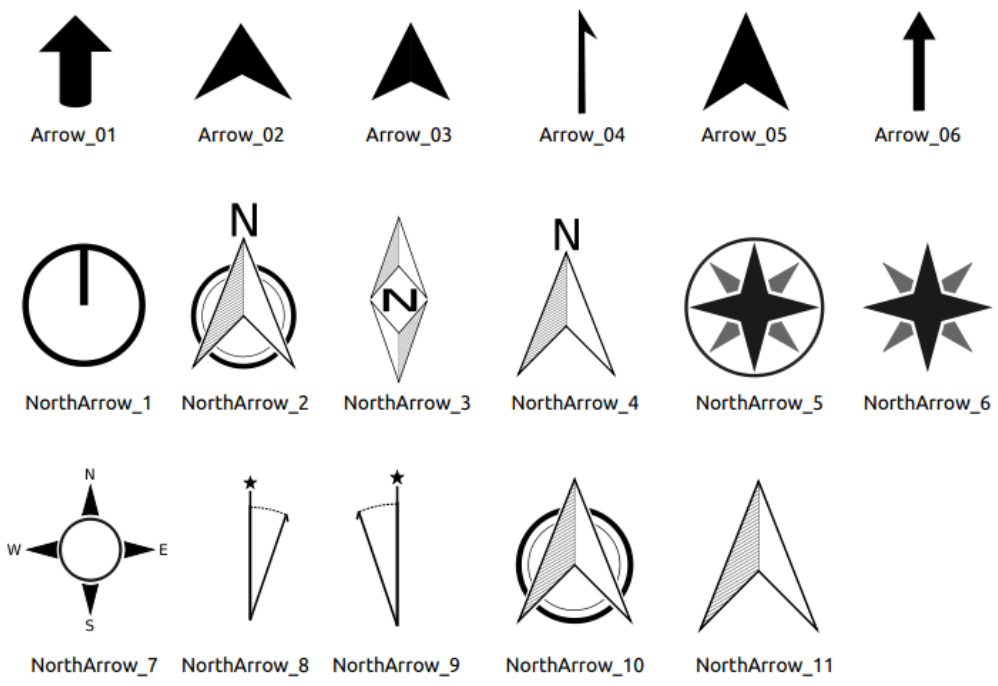

Figure 14.42: Las flechas de norte disponibles para la selección en la biblioteca SVG proporcionada.

14.2.8 El elemento del marco HTML

It is possible to add a frame that displays the contents of a website or even create and style your own HTML page and display it!

Click the  Add HTML frame icon, place the element by dragging a rectangle holding down the left mouse button on the Print Composer canvas and position and customize the appearance in the *Item Properties* panel (see figure_composer_html).

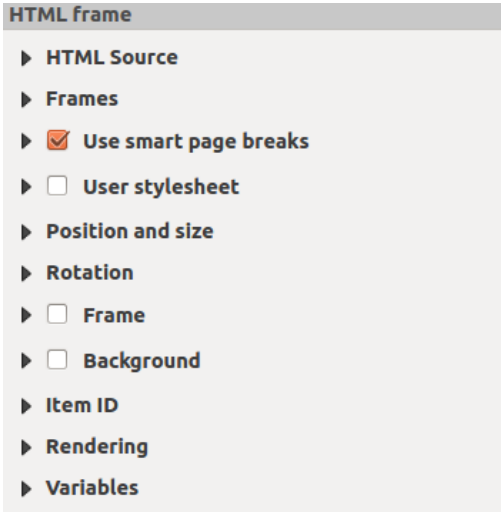

Figure 14.43: HTML Frame, the Item Properties Panel

Fuente HTML

As an HTML source, you can either set a URL and activate the URL radiobutton or enter the HTML source directly in the textbox provided and activate the Source radiobutton.

The *HTML Source* dialog of the HTML frame *Item Properties* panel provides the following functionalities (see figure_composer_html_ppt):

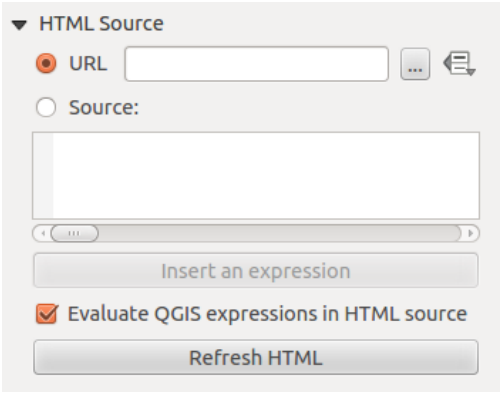

Figure 14.44: HTML frame, the HTML Source properties

- In *URL* you can enter the URL of a webpage you copied from your Internet browser or select an HTML file using the browse button  . There is also the option to use the Data defined override button, to provide an URL from the contents of an attribute field of a table or using a regular expression.
- En *Fuente* se puede ingresar el texto en la caja de texto con algunas pestañas HTML o proporciona una pagina completa de HTML.

- The **[insert an expression]** button can be used to insert an expression like `[%Year($now)%]` in the Source textbox to display the current year. This button is only activated when radiobutton *Source* is selected. After inserting the expression click somewhere in the textbox before refreshing the HTML frame, otherwise you will lose the expression.
- Activar la expresión *Evaluar las expresiones QGIS en código HTML* para ver el resultado de la expresión que ha incluido, de lo contrario, verá la expresión en su lugar.
- Use the **[Refresh HTML]** button to refresh the HTML frame(s) to see the result of changes.

Marcos

The *Frames* dialog of the HTML frame *Item Properties* panel provides the following functionalities (see figure_composer_html_frames):

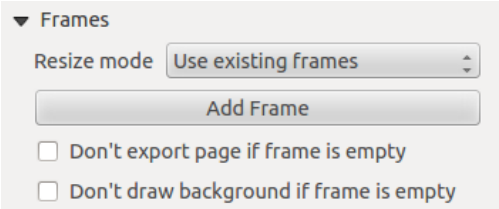

Figure 14.45: HTML frame, the Frames properties

- Con *Modo cambio de tamaño* se puede seleccionar cómo renderizar el contenido HTML:
  - *Use existing frames* displays the result in the first frame and added frames only.
  - *Extend to next page* will create as many frames (and corresponding pages) as necessary to render the height of the web page. Each frame can be moved around on the layout. If you resize a frame, the webpage will be divided up between the other frames. The last frame will be trimmed to fit the web page.
  - *Repeat on every page* will repeat the upper left of the web page on every page in frames of the same size.
  - *Repeat until finished* will also create as many frames as the *Extend to next page* option, except all frames will have the same size.
- Use the **[Add Frame]** button to add another frame with the same size as selected frame. If the HTML page that will not fit in the first frame it will continue in the next frame when you use *Resize mode* or *Use existing frames*.
- Activate *Don't export page if frame is empty* prevents the map layout from being exported when the frame has no HTML contents. This means all other composer items, maps, scalebars, legends etc. will not be visible in the result.
- Activar *No saque el fondo si el marco es empty* impide que el marco HTML está elaborando si la trama está vacía.

Usar saltos de página inteligentes y hoja de estilos de usuario

The *Use smart page breaks* dialog and *Use style sheet* dialog of the HTML frame *Item Properties* panel provides the following functionalities (see figure_composer_html_breaks):

- Activar *Usar saltos de página inteligentes* para impedir para evitar que el contenido del marco html de romper a mitad de camino una línea de texto por lo que continúa agradable y sencillo en el cuadro siguiente.

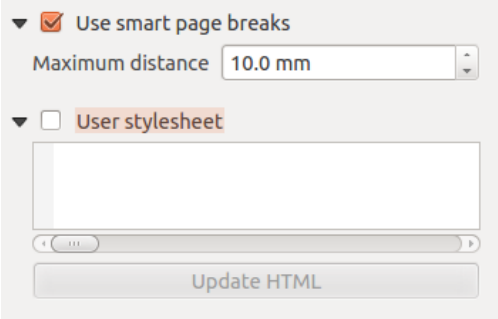

Figure 14.46: HTML frame, Use smart page breaks and User stylesheet properties

- Establecer la *Máxima distancia* permite en el cálculo de dónde colocar los saltos de página en el html. Esta distancia es la cantidad máxima de espacio vacío permitido en la parte inferior de un marco después de calcular la ubicación óptima de descanso. Ajustar un valor más grande resultará en una mejor elección de la ubicación de salto de página, pero más espacio perdido en la parte inferior de los marcos. Esto sólo se utiliza cuando *Usar saltos de página inteligentes* está activado.
- Activate *User stylesheet* to apply HTML styles that often is provided in cascading style sheets. An example of style code is provide below to set the color of `<h1>` header tag to green and set the font and fontsize of text included in paragraph tags `<p>`.

```
h1 {color: #00ff00;
}
p {font-family: "Times New Roman", Times, serif;
   font-size: 20px;
}
```

- Use the **[Update HTML]** button to see the result of the stylesheet settings.

14.2.9 Elementos de Forma

El elemento flecha

To add an arrow, click the Add Arrow icon, place the element holding down the left mouse button and drag a line to draw the arrow on the Print Composer canvas and position and customize the appearance in the scale bar *Item Properties* panel.

When you also hold down the `Shift` key while placing the arrow, it is placed in an angle of exactly 45° .

The arrow item can be used to add a line or a simple arrow that can be used, for example, to show the relation between other print composer items. To create a north arrow, the image item should be considered first. QGIS has a set of North arrows in SVG format. Furthermore you can connect an image item with a map so it can rotate automatically with the map (see *The Image Item*).

Item Properties

The *Arrow* item properties panel allows you to configure an arrow item.

The **[Line style...]** button can be used to set the line style using the line style symbol editor.

In *Arrows markers* you can select one of three radio buttons.

- *Default*: To draw a regular arrow, gives you options to style the arrow head
- *None*: To draw a line without arrow head
- *SVG Marker*: To draw a line with an SVG *Start marker* and/or *End marker*

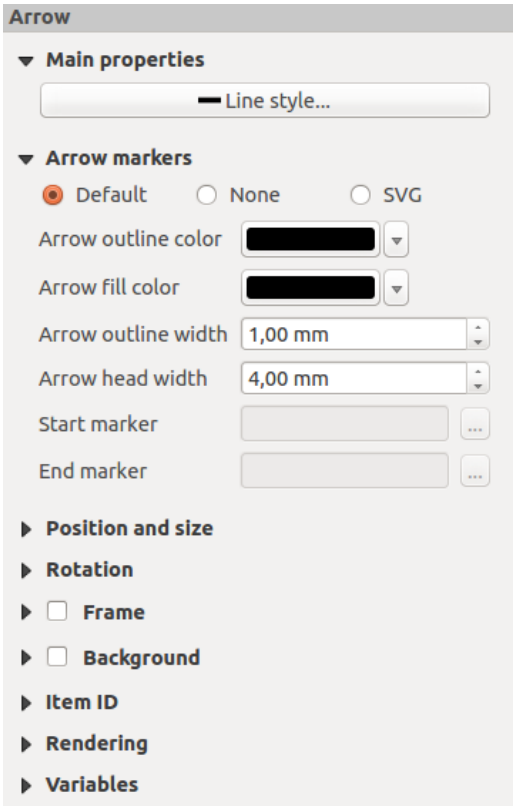

Figure 14.47: Arrow Item Properties Panel

For *Default* Arrow marker you can use following options to style the arrow head.

- *Arrow outline color*: Set the outline color of the arrow head
- *Arrow fill color*: Set the fill color of the arrow head
- *Arrow outline width*: Set the outline width of the arrow head
- *Arrow head width*: Set the size of the arrow head

For *SVG Marker* you can use following options.

- *Start marker*: Choose an SVG image to draw at the beginning of the line
- *End marker*: Choose an SVG image to draw at the end of the line
- *Arrow head width*: Set the size of Start and/or End marker

SVG images are automatically rotated with the line. Outline and fill colors of QGIS predefined SVG images can be changed using the corresponding options. Custom SVG may require some tags following this *instruction*.

The Basic Shape Items

To add a basic shape (ellipse, rectangle, triangle), click the  Add basic shape icon, place the element holding down the left mouse. Customize the appearance in the *Item Properties* panel.

When you also hold down the `Shift` key while placing the basic shape you can create a perfect square, circle or triangle.

The *Shape* item properties panel allows you to select if you want to draw an ellipse, rectangle or triangle inside the given frame.

You can set the style of the shape using the advanced symbol style dialog with which you can define its outline and fill color, fill pattern, use markers...

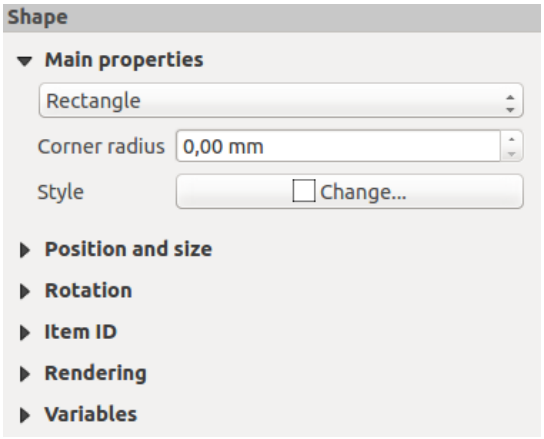

Figure 14.48: Shape Item Properties Panel

For the rectangle shape, you can set the value of the corner radius to round of the corners.

Nota: Unlike other items, you can not style the frame or the background color of the frame.

The Node-Based Shape Items

While arrow and basic shape items offer you simple and predefined geometric item to use, a node-based shape (polygon or polyline) helps you create a custom and more advanced geometric item. You can add as many lines or sides as you want to the item and independently and directly interact with each of its vertices.

To add a node-based shape, click the Add nodes item icon. Then perform left clicks to add nodes to your current shape. When you're done, a simple right click terminates the shape. Customize the appearance in the *Item Properties* panel.

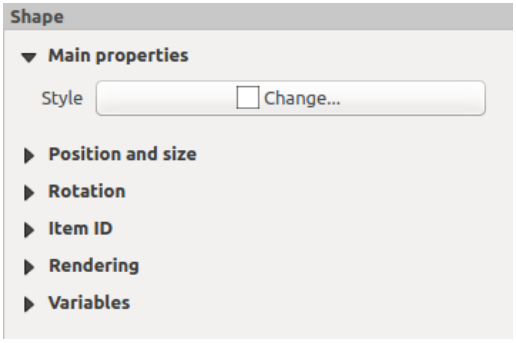

Figure 14.49: Nodes Shape Item Properties Panel

You can set the style of the shape using the advanced symbol style dialog available thanks to the **[Change...]** button in *Main properties*.

A specific tool is provided to edit node-based shapes through Edit Nodes Item. Within this mode, you can select a node by clicking on it (a marker is displayed on the selected node). A selected node can be moved either by dragging it or by using the arrow keys. Moreover, in this mode, you are able to add nodes to an existing shape. You just have to do a left click near a segment and if you are not too far from the shape, a node is added. Finally, you can remove the currently selected node by hitting the `DEL` key.

14.3 Crear salida

Figure_composer_output shows the Print Composer with an example print layout, including each type of map item described in the previous section.

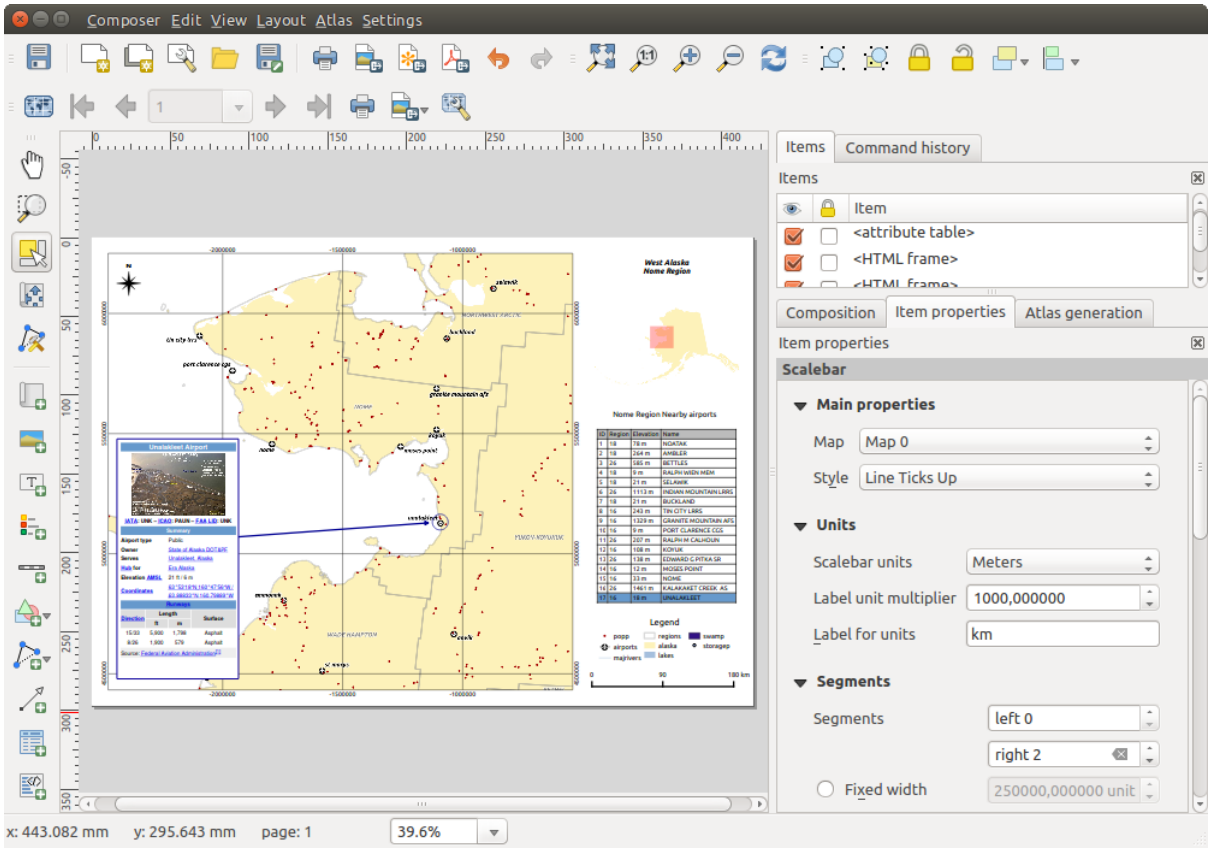

Figure 14.50: Print Composer with map view, legend, image, scale bar, coordinates, text and HTML frame added

Before printing a layout you have the possibility to view your composition without bounding boxes. This can be enabled by deactivating *View* → *Show bounding boxes* or pressing the shortcut `Ctrl+Shift+B`.

The Print Composer allows you to create several output formats, and it is possible to define the resolution (print quality) and paper size:

- The Print icon allows you to print the layout to a connected printer or a PostScript file, depending on installed printer drivers.
- The Export as image icon exports the Composer canvas in several image formats, such as PNG, BPM, TIF, JPG,...
- The Export as SVG icon saves the Print Composer canvas as an SVG (Scalable Vector Graphic).
- The Export as PDF icon saves the defined Print Composer canvas directly as a PDF.

14.3.1 Export as Image

Clicking the Export as image icon will ask you to enter the filename to use to export composition: in the case of multi-page composition, each page will be exported to a file with the given name appended with the page number.

You can then override the print resolution and the exported image dimensions (set in Composition panel).

By checking *Crop to content* option, the image output by the composer includes the minimal area enclosing all the items (map, legend, scale bar, shapes, label, image...) of each page of the composition:

- If the composition includes a single page, then the output is resized to include EVERYTHING on the composition. The page can then be reduced or extended to all items depending on their position (on, above, below, left or right of the page).
- In case of a multi-page composition, each page will be resized to include items in its area (left and right sides for all pages, plus top for the first page and bottom for the last page). Each resized page is exported to a separate file.

The *Crop to content* dialog also allows to add some margins around the cropped bounds.

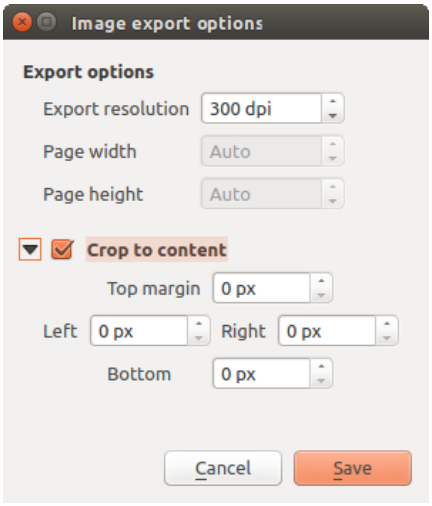

Figure 14.51: Image Export Options, output is resized to items extent

If you need to export your layout as a **georeferenced image** (e.g., to share with other projects), you need to enable this feature under the *Composition Panel*.

If the output format is a TIFF format, all you need to do is making sure to select the correct map item to use in *Reference map*, and the output will always be a GeoTIFF. For other image formats, you also need to check the *Save world file* option. With this option, the 'Export as image' action will create a world file along with the exported image.

Nota: Exporting large rasters can sometimes fail, even if there seems to be enough memory. This is a problem with the underlying Qt management of rasters.

14.3.2 Exportar como SVG

With Export as SVG, you also need to fill the filename (used as a basename for all files in case of multi-page composition) and then can apply *Crop to content option*.

The SVG export options dialog also allows to:

- *export map layers as svg groups*:
- render map labels as outlines

Nota: Actualmente, la salida SVG es muy básica. Este no es un problema en QGIS, pero un problema con la biblioteca Qt subyacente. Esperamos que esto se solucione en futuras versiones.

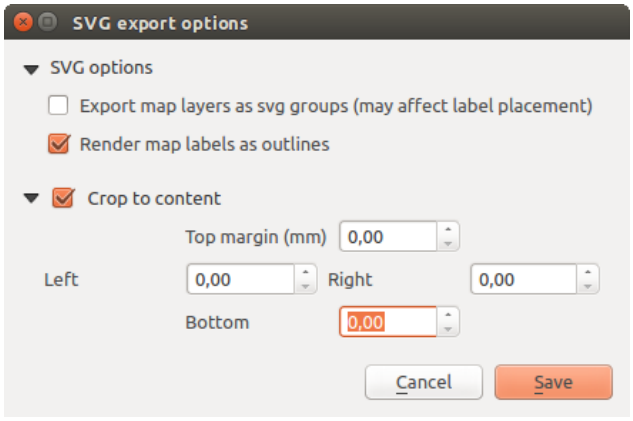

Figure 14.52: Opciones de Exportación de SVG

14.3.3 Exportar como PDF

The Export as PDF exports all the composition into a single PDF file.

If you applied to your composition or any shown layer an advanced effect such as blend modes, transparency or symbol effects, these cannot be printed as vectors, and the effects may be lost. Checking *Print as a raster* in the *Composition Panel* helps to keep the effects but rasterize the composition. Note that the *Force layer to render as raster* in the Rendering tab of Layer Properties dialog is a layer-level alternative that avoids global composition rasterization.

If you need to export your layout as a **georeferenced PDF**, in the *Composition Panel*, make sure to select the correct map item to use in *Reference map*.

14.3.4 Generar un Atlas

The Print Composer includes generation functions that allow you to create map books in an automated way. The concept is to use a coverage layer, which contains geometries and fields. For each geometry in the coverage layer, a new output will be generated where the content of some canvas maps will be moved to highlight the current geometry. Fields associated with this geometry can be used within text labels.

Every page will be generated with each feature. To enable the generation of an atlas and access generation parameters, refer to the *Atlas generation* panel.This panel contains the following widgets (see figure_composer_atlas):

- *Generate an atlas*, which enables or disables the atlas generation.
- A *Coverage layer* combo box that allows you to choose the (vector) layer containing the features on which to iterate over.
- An optional *Hidden coverage layer* that, if checked, will hide the coverage layer (but not the other ones) during the generation.
- An optional *Page name* combo box to give a more explicit name to each feature page(s) when previewing atlas. You can select an attribute of the coverage layer or set an expression. If this option is empty, QGIS will use an internal ID, according to the filter and/or the sort order applied to the layer.
- An optional *Filter with* text area that allows you to specify an expression for filtering features from the coverage layer. If the expression is not empty, only features that evaluate to `True` will be selected. The button on the right allows you to display the expression builder.
- An optional *Sort by* that, if checked, allows you to sort features of the coverage layer. The associated combo box allows you to choose which column will be used as the sorting key. Sort order (either ascending or descending) is set by a two-state button that displays an up or a down arrow.

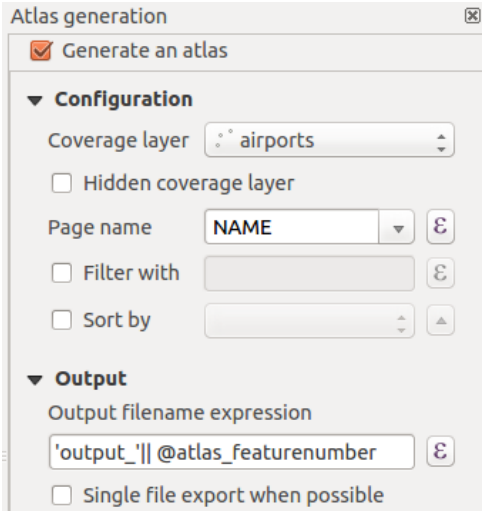

Figure 14.53: Atlas Generation Panel

You also have options to set the output of the atlas:

- An *Output filename expression* textbox that is used to generate a filename for each geometry if needed. It is based on expressions. This field is meaningful only for rendering to multiple files.
- A *Single file export when possible* that allows you to force the generation of a single file if this is possible with the chosen output format (PDF, for instance). If this field is checked, the value of the *Output filename expression* field is meaningless.

You can use multiple map items with the atlas generation; each map will be rendered according to the coverage features. To enable atlas generation for a specific map item, you need to check *Controlled by Atlas* under the item properties of the map item. Once checked, you can set:

- A *Margin around feature* that allows you to select the amount of space added around each geometry within the allocated map. Its value is meaningful only when using the auto-scaling mode.
- A *Predefined scale* (best fit). It will use the best fitting option from the list of predefined scales in your project properties settings (see *Project* → *Project Properties* → *General* → *Project Scales* to configure these predefined scales).
- A *Fixed scale* that allows you to toggle between auto-scale and fixed-scale mode. In fixed-scale mode, the map will only be translated for each geometry to be centered. In auto-scale mode, the map's extents are computed in such a way that each geometry will appear in its entirety.

Labels

In order to adapt labels to the feature the atlas plugin iterates over, you can include expressions. What you should take care of is to place expression part (including functions, fields or variables) between `[%` and `%]`. For example, for a city layer with fields CITY_NAME and ZIPCODE, you could insert this:

```
The area of [% upper(CITY_NAME) || ',' || ZIPCODE || ' is '
format_number($area/1000000,2) %] km2
```

or, another combination:

```
The area of [% upper(CITY_NAME)%],[%ZIPCODE%] is
[%format_number($area/1000000,2) %] km2
```

The information `[% upper(CITY_NAME) || ',' || ZIPCODE || ' is ' format_number($area/1000000,2) %]` is an expression used inside the label. Both expressions would result in the generated atlas as:

```
The area of PARIS,75001 is 1.94 km2
```

Data Defined Override Buttons

There are several places where you can use a Data Defined Override button to override the selected setting. These options are particularly useful with Atlas Generation.

For the following examples the *Regions* layer of the QGIS sample dataset is used and selected for Atlas Generation. We also assume the paper format *A4 (210X297)* is selected in the *Composition* panel for field *Presets*.

With a *Data Defined Override* button you can dynamically set the paper orientation. When the height (north-south) of the extents of a region is greater than its width (east-west), you rather want to use *portrait* instead of *landscape* orientation to optimize the use of paper.

In the *Composition* you can set the field *Orientation* and select *Landscape* or *Portrait*. We want to set the orientation dynamically using an expression depending on the region geometry. Press the button of field *Orientation*, select *Edit...* so the *Expression string builder* dialog opens. Enter the following expression:

```
CASE WHEN bounds_width($atlasgeometry) > bounds_height($atlasgeometry)
THEN 'Landscape' ELSE 'Portrait' END
```

Now the paper orients itself automatically. For each Region you need to reposition the location of the composer item as well. For the map item you can use the button of field *Width* to set it dynamically using following expression:

```
(CASE WHEN bounds_width($atlasgeometry) > bounds_height($atlasgeometry)
THEN 297 ELSE 210 END) - 20
```

Use the button of field *Height* to provide following expression:

```
(CASE WHEN bounds_width($atlasgeometry) > bounds_height($atlasgeometry)
THEN 210 ELSE 297 END) - 20
```

When you want to give a title above the map in the center of the page, insert a label item above the map. First use the item properties of the label item to set the horizontal alignment to *Center*. Next activate from *Reference point* the upper middle checkbox. You can provide the following expression for field *X* :

```
(CASE WHEN bounds_width($atlasgeometry) > bounds_height($atlasgeometry)
THEN 297 ELSE 210 END) / 2
```

For all other composer items you can set the position in a similar way so they are correctly positioned when the page is automatically rotated in portrait or landscape.

Information provided is derived from the excellent blog (in English and Portuguese) on the Data Defined Override options Multiple_format_map_series_using_QGIS_2.6 .

This is just one example of how you can use the Data Defined Override option.

Preview and generate

Figure 14.54: Barra de herramienta Vista Previa del Atlas

Once the atlas settings have been configured and composer items (map, table, image...) linked to it, you can create a preview of all the pages by clicking *Atlas* → *Preview Atlas* or Preview Atlas icon. You can then use the arrows in the same toolbar to navigate through all the features:

- First feature
- Previous feature
- Next feature
- Last feature

You can also use the combo box to directly select and preview a specific feature. The combo box shows atlas features name according to the expression set in the atlas *Page name* option.

As for simple compositions, an atlas can be generated in different ways (see *Crear salida* for more information). Instead of *Composer* menu, rather use tools from *Atlas* menu or Atlas toolbar.

This means that you can directly print your compositions with *Atlas* → *Print Atlas*. You can also create a PDF using *Atlas* → *Export Atlas as PDF...*: The user will be asked for a directory to save all the generated PDF files, except if the *Single file export when possible* has been selected. In that case, you'll be prompted to give a filename.

With *Atlas* → *Export Atlas as Images...* or *Atlas* → *Export Atlas as SVG...* tool, you're also prompted to select a folder. Each page of each atlas feature composition is exported to an image or SVG file.

Truco: Print a specific atlas feature

If you want to print or export the composition of only one feature of the atlas, simply start the preview, select the desired feature in the drop-down list and click on *Composer* → *Print* (or *export...* to any supported file format).

CHAPTER 15

Trabajar con datos OGC

15.1 QGIS como Cliente de Datos OGC

El Open Geospatial Consortium (OGC) es una organización internacional con miembros de más de 300 organizaciones comerciales, gubernamentales, sin fines de lucro y de investigación de todo el mundo. Sus miembros desarrollan e implementan estándares para contenido geoespacial y servicios, procesamiento de datos SIG y el intercambio.

Describing a basic data model for geographic features, an increasing number of specifications are developed by OGC to serve specific needs for interoperable location and geospatial technology, including GIS. Further information can be found at http://www.opengeospatial.org/.

Importar especificaciones OGC implementadas por QGIS:

- **WMS** — Web Map Service (*Cliente WMS/WMTS*)
- **WMTS** — Web Map Tile Service (*Cliente WMS/WMTS*)
- **WFS** — Web Feature Service (*Cliente WFS y WFS-T*)
- **WFS-T** — Web Feature Service - Transactional (*Cliente WFS y WFS-T*)
- **WCS** — Web Coverage Service (*WCT Cliente*)
- **WPS** — Web Processing Service
- **CSW** — Catalog Service for the Web
- **SFS** — Simple Features for SQL (*PostGIS Layers*)
- **GML** — Lenguaje de Marcado Generalizado

Los servicios de QGIS esta incrementando el uso para intercambiar datos geoespaciales entre diferentes implementaciones GIS y almacenes de datos. QGIS puede hacer frente a las especificaciones anteriores como un cliente, siendo **SFS** (a través del apoyo del proveedor PostgreSQL / PostGIS, vea la sección *PostGIS Layers*).

15.1.1 Cliente WMS/WMTS

Información general de la implementación WMS

Actualmente QGIS puede actual como un cliente WMS que entiende servidores WMS 1.1, 1.1.1 y 1.3. En particular, se ha probado contra los servidores de acceso público como DEMIS.

Un servidor WMS actúa sobre las peticiones por parte del cliente (por ejemplo, QGIS) para un mapa ráster con una extensión dada, el conjunto de capas, el estilo de simbolización y la transparencia. El servidor WMS después consulta sus fuentes de datos locales, rásteriza el mapa y lo envía de vuelta al cliente en formato ráster. Para QGIS, este formato sería típicamente JPEG o PNG.

WMS es genéricamente un servicio REST (Representational State Transfer) en lugar de un servicio Web en toda regla. Como tal, puede tomar las URLs generadas por QGIS y utilizarlos en el navegador web para recuperar las

mismas imágenes que QGIS utiliza internamente. Esto puede ser útil para la solución de problemas, ya que hay varias marcas de servidores WMS en el mercado y ellos tienen su propia interpretación de la estándar WMS.

Las capas WMS se pueden añadir sencillamente, siempre que conozca la URL para acceder al servidor WMS, si tiene una conexión útil a ese servidor, y el servidor entiende HTTP como mecanismo de transporte de datos.

Additionally, QGIS will cache your WMS responses (i.e. images) for 24h as long as the GetCapabilities request is not triggered. The GetCapabilities request is triggered everytime the **[Connect]** button in the **[Add layer(s) from WMS(T)S Server]** dialog is used to retrieve the WMS server capabilities. This is an automatic feature meant to optimize project loading time. If a project is saved with a WMS layer, the corresponding WMS tiles will be loaded from the cache the next time the project is opened as long as they are no older than 24H.

Información general de la implementación WMTS

QGIS también puede actuar como un cliente WMTS. WMTS es un estándar OGC para distribuir tiles de conjunto de datos geoespaciales. Este es una manera más rápida y más eficiente de distribuir datos que WMS porque con WMTS, el conjunto de tile es pregenerado y el cliente sólo solicita la transmisión de los tiles, no su producción. Una petición WMS implica típicamente ambos la generación y la transmisión de los datos. Un ejemplo bien conocido de un estándar no OGC para la visualización de datos geoespaciales de tiles es Google Maps.

Para mostrar los datos en una variedad de escalas cercanas a lo que el usuario podría querer, los conjuntos de teselas WMTS se producen en varios niveles de escala diferentes y están disponibles para el cliente SIG para pedirlos.

Este diagrama ejemplifica el concepto de conjunto de teselas:

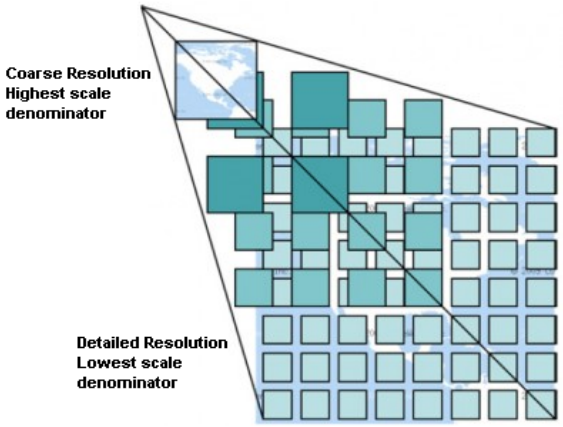

Figure 15.1: Concepto de conjunto de teselas WMTS

Los dos tipos de interfaz WMTS que QGIS reconoce son a través de Key-Value-Pairs (KVP) y RESTful. Estas dos interfaces son diferentes y es necesario especificarlos a QGIS diferente.

1. Con el fin de acceder a un servicio **WMTS KVP**, un usuario QGIS debe abrir la interfaz WMS/WMTS y añadir la siguiente cadena a la URL del servicio tile WMTS:

   ```
   "?SERVICE=WMTS&REQUEST=GetCapabilities"
   ```

   Un ejemplo de este tipo de dirección es

   ```
   http://opencache.statkart.no/gatekeeper/gk/gk.open_wmts?\
     service=WMTS&request=GetCapabilities
   ```

   Para probar la capa topo2 en este WMTS funciona muy bien. Añadir esta cadena indica que un servicio web WMTS se va a utilizar en lugar de un servicio WMS.

2. EL servicio **RESTful WMTS** toma una forma diferente, una URL sencilla. EL formato recomendado por OGC es:

`{WMTSBaseURL}/1.0.0/WMTSCapabilities.xml`

This format helps you to recognize that it is a RESTful address. A RESTful WMTS is accessed in QGIS by simply adding its address in the WMS setup in the URL field of the form. An example of this type of address for the case of an Austrian basemap is http://maps.wien.gv.at/basemap/1.0.0/WMTSCapabilities.xml.

Nota: You can still find some old services called WMS-C. These services are quite similar to WMTS (i.e., same purpose but working a little bit differently). You can manage them the same as you do WMTS services. Just add `?tiled=true` at the end of the url. See http://wiki.osgeo.org/wiki/Tile_Map_Service_Specification for more information about this specification.

Cuando se lee WMTS, a menudo se puede pensar en WMS-C también.

Seleccionar servidor WMS/WMTS

La primera ves que utiliza la característica WMS en QGIS, no hay servidores definidos.

Comience haciendo clic en el botón  Añadir capa WMS en la barra de herramientas, o seleccionando *Capa* → *Añadir capa WMS...*.

The dialog *Add Layer(s) from a Server* for adding layers from the WMS server appears. You can add some servers to play with by clicking the **[Add default servers]** button. This will add two WMS demo servers for you to use: the WMS servers of the DM Solutions Group and Lizardtech. To define a new WMS server in the *Layers* tab, select the **[New]** button. Then enter the parameters to connect to your desired WMS server, as listed in table_OGC_wms:

Nombre	Un nombre para esta conexión. Este nombre se utilizará en la lista desplegable de conexiones a servidor así que se puede distinguir de otros servidores WMS.
URL	La URL del servidor provee los datos. Este debe ser un nombre de host soluble – el mismo formato que usaría para abrir una conexión telnet o ping a un host.
Nombre de usuario	Nombre de usuario para acceder a un servidor asegurado de WMS. Este parámetro es opcional.
Contraseña	Contraseña para una autentificación básica al servidor WMS. Este parámetro es opcional
Ignorar URI GetMap	*Ignorar URI GetMap reportada en las capacidades*. Utilice un URI dado del campo URL anterior.
Ignorar la URI GetFeatureInfo	*Ignorar la URI GetFeatureInfo reportada en las capacidades*. Utilice un URI dado del campo URL anterior.

Tabla OGC 1: Parámetros de conexión WMS

Si necesita configurar un servidor proxy para poder recibir servicios WMS de internet, puede añadir su servidor proxy en las opciones. Elija *Configuración* → *Opciones* y haga clic en la pestaña *Red*. Ahí, puede añadir su configuración de proxy y habilitarlos al ajustar *Usar proxy para acceso web*. Compruebe que selecciono el tipo de proxy correcto del menú desplegable *Tipo de proxy* .

Una vez que la nueva conexión al servidor WMS ha sido creada, será preservado para futuras sesiones.

Truco: En las direcciones URL del servidor WMS

Asegúrese, al introducir la URL del servidor WMS, que tiene solo la base URL. Por ejemplo, no debe tener fragmentos como `request=GetCapabilities` o `version=1.0.0` en su URL.

Advertencia: Entering **username** and **password** in the *Authentication* tab will keep unprotected credentials in the connection configuration. Those **credentials will be visible** if, for instance, you shared the project file with someone. Therefore, it's advisable to save your credentials in a *Authentication configuration* instead (*configurations* tab). See *Sistema de autenticación* for more details.

Cargando capas WMS/WMTS

Once you have successfully filled in your parameters, you can use the **[Connect]** button to retrieve the capabilities of the selected server. This includes the image encoding, layers, layer styles and projections. Since this is a network operation, the speed of the response depends on the quality of your network connection to the WMS server. While downloading data from the WMS server, the download progress is visualized in the lower left of the WMS dialog.

Your screen should now look a bit like figure_OGC_add_wms, which shows the response provided by the European Soil Portal WMS server.

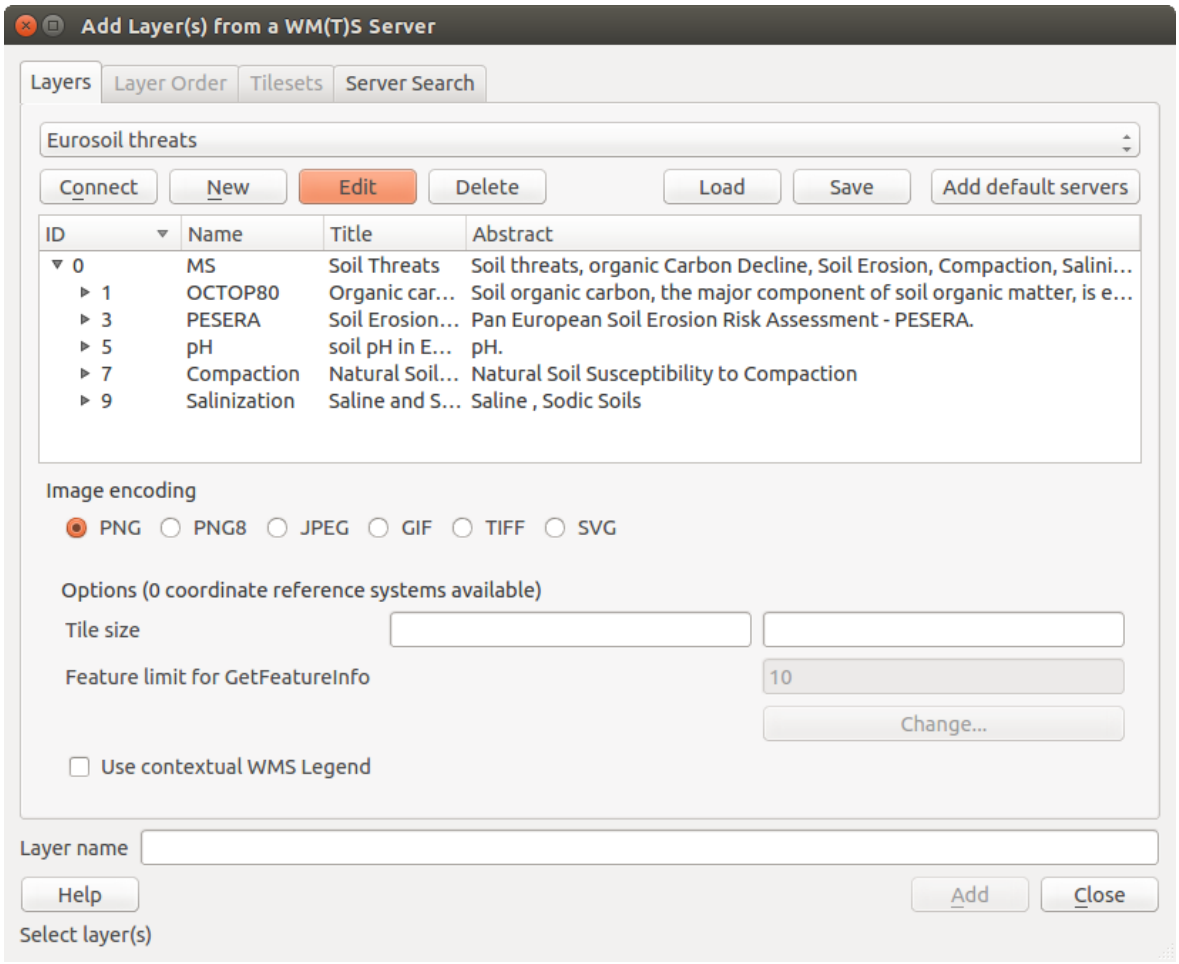

Figure 15.2: El diálogo para añadir un servidor WMS, muestra las capas disponibles

Codificación de la Imagen

La sección *Codificación de la imagen* lista los formatos que reconoce por ambos el cliente y el servidor. Elija uno dependiendo de sus requerimientos de precisión de imagen.

Truco: Codificación de la Imagen

Normalmente, encontrará que un servidor WMS le ofrece la opción de codificación de la imagen en JPEG o PNG. JPEG es un formato de compresión con pérdida, mientras que PNG reproduce fielmente los datos crudos raster.

Utilizar JPEG si se espera que los datos WMS sean de naturaleza fotográfica y/o no le importa cierta perdida de calidad de la imagen. Esta disyuntiva típicamente reduce en cinco veces la necesidad de transferencia de datos en comparación con PNG.

Utilice PNG si desea representaciones precisas de los datos originales y no le importa el incremento de los requisitos de transferencia de datos.

Opciones

La zona Opciones del diálogo provee un campo de texto donde se puede añadir un *Nombre de capa* para la capa WMS. Este nombre aparecerá en la leyenda después de cargar la capa.

Debajo del nombre de la capa, se puede definir *Tamaño de la tesela*, si desea establecer tamaños de tesela (por ejemplo, 256x256) para dividir la petición WMS en múltiples peticiones.

El *Límite del objeto espacial para GetFeatureInfo* define los objetos espaciales del servidor a consultar.

If you select a WMS from the list, a field with the default projection provided by the mapserver appears. If the **[Change...]** button is active, you can click on it and change the default projection of the WMS to another CRS provided by the WMS server.

Finalmente puede activar  *Utiliza leyenda-WMS contextual* si el servidor WMS admite este objeto. Entonces sólo la leyenda relevante para su actual extensión de vista de mapa se mostrará y así no incluirá los elementos de la leyenda por cosas que no puede ver en el mapa actual.

Orden de la capa

La pestaña *Orden de Capas* lista las capas seleccionadas disponibles de la conexión actual al servidor WMS. Puede notar que algunas capas son ampliables; esto significa que la capa se puede visualizar en una selección de estilos de imagen.

Se puede seleccionar varias capas a la vez, pero solo una imagen de estilo por capa. Cuando varias capas son seleccionadas, estas se combinarán en el servidor WMS y se transmitirán a QGIS una sola vez.

Truco: Ordenar capas WMS

Las capas WMS representadas por un servidor son sobrepuestas en el orden listado en la sección de Capas, desde la parte superior a la parte inferior de la lista. Si se desea cambiar el orden de la superposición, se puede usar la pestaña *Orden de capas*.

Transparencia

En esta versión de QGIS, la configuración *Transferencia global* de *Propiedades de la capa* esta codificado para estar siempre en donde este disponible.

Truco: Transparencia de capa WMS

La disponibilidad de imagen WMS transparente depende de la codificación de la imagen utilizada: PNG y GIF reconoce la transparencia, mientras JPEG deja sin reconocerlo.

Sistema de referencia de coordenadas

Un sistema de referencia de coordenadas (SRC) es la terminología para una proyección QGIS.

Cada capa WMS se puede representar en múltiples SRC's, dependiendo de la capacidad del servidor WMS.

To choose a CRS, select **[Change...]** and a dialog similar to *Diálogo SRC Personalizado* will appear. The main difference with the WMS version of the dialog is that only those CRSs supported by the WMS server will be shown.

Busqueda del servidor

Within QGIS, you can search for WMS servers. Figure_OGC_search shows the *Server Search* tab with the *Add Layer(s) from a Server* dialog.

As you can see, it is possible to enter a search string in the text field and hit the **[Search]** button. After a short while, the search result will be populated into the list below the text field. Browse the result list and inspect your search results within the table. To visualize the results, select a table entry, press the **[Add selected row to WMS list]** button and change back to the *Layers* tab. QGIS has automatically updated your server list, and the selected search result is already enabled in the list of saved WMS servers in the *Layers* tab. You only need to request the list

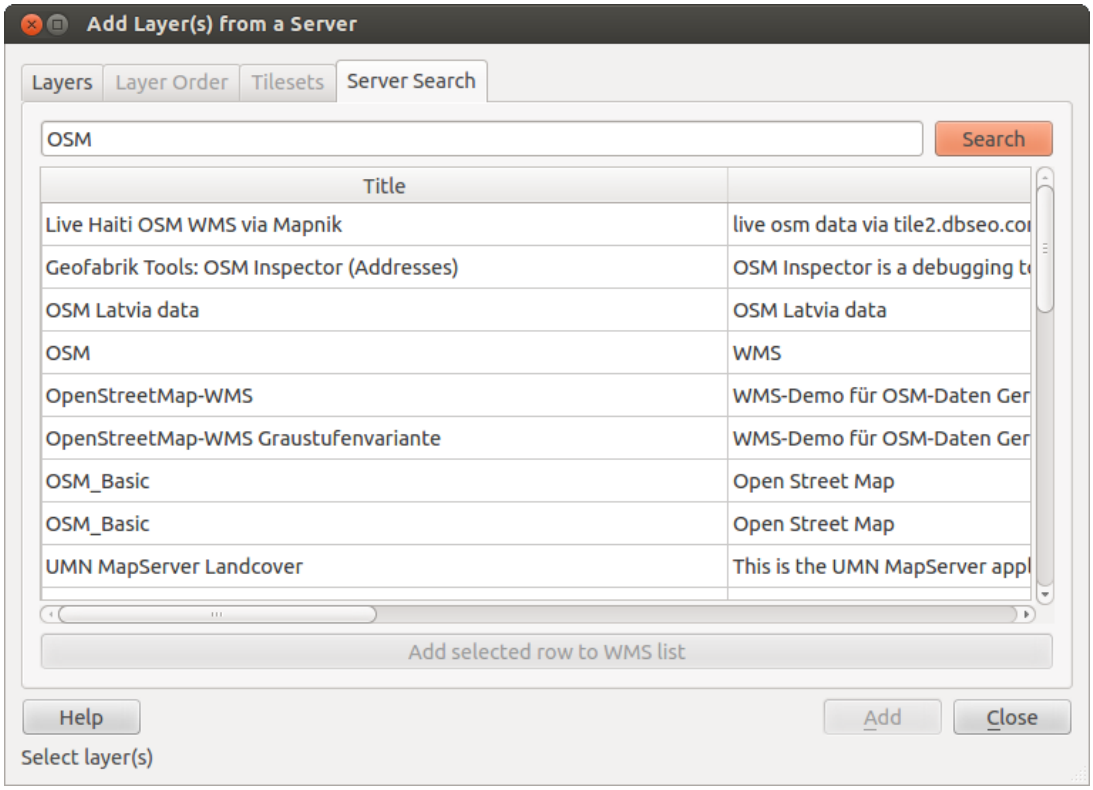

Figure 15.3: Diálogo de búsqueda de servidores WMS después de algunas palabras clave

of layers by clicking the **[Connect]** button. This option is quite handy when you want to search maps by specific keywords.

Básicamente, esta opción es una interfaz del API de http://geopole.org.

Conjunto de teselas

Al utilizar servicios WMTS (Cached WMS) como

```
http://opencache.statkart.no/gatekeeper/gk/gk.open_wmts?\
  service=WMTS&request=GetCapabilities
```

you are able to browse through the *Tilesets* tab given by the server. Additional information like tile size, formats and supported CRS are listed in this table. In combination with this feature, you can use the tile scale slider by selecting *View* → *Panels* (or *Settings* → *Panels*), then choosing *Tile Scale Panel*. This gives you the available scales from the tile server with a nice slider docked in.

Utilizar la herramienta de Identificar objetos espaciales

Una vez que haya añadido un servidor WMS, y si alguna capa de un servidor WMS es consultable, puede entonces utilizar la herramienta Identificar objetos espaciales para seleccionar un píxel del lienzo del mapa. Una consulta se hace al servidor WMS por cada selección realizada. El resultado de la consulta es regresada en texto plano. El formato de este texto es dependiente del servidor WMS particular utilizado. **Selección de Formato**

Si múltiples formatos de salida son reconocidos por el servidor, una lista desplegable con formatos admitidos se añade automáticamente al diálogo de resultados identificados y el formato seleccionada puede ser almacenado en el proyecto para la capa. **Usar formato GML**

La herramienta Identificar reconoce la respuesta del servidor WMS (GetFeatureInfo) en formato GML (se llama

Objeto espacial en la GUI de QGIS en este contexto). Si el formato "Objeto espacial" es admitido por el servidor y seleccionado, los resultados de la herramienta de identificador son objetos vectoriales, como de una capa vectorial regular. Cuando un objeto espacial es seleccionado en el árbol, este resalta en el mapa y se puede copiar a la papelera y pegar a otra capa vectorial. Vea el ejemplo de configuración de UMN Mapserver abajo que admite GetFeatureInfo en formato GML.

```
# in layer METADATA add which fields should be included and define geometry (example):

"gml_include_items"   "all"
"ows_geometries"      "mygeom"
"ows_mygeom_type"     "polygon"

# Then there are two possibilities/formats available, see a) and b):

# a) basic (output is generated by Mapserver and does not contain XSD)
# in WEB METADATA define formats (example):
"wms_getfeatureinfo_formatlist" "application/vnd.ogc.gml,text/html"

# b) using OGR (output is generated by OGR, it is send as multipart and contains XSD)
# in MAP define OUTPUTFORMAT (example):
OUTPUTFORMAT
    NAME "OGRGML"
    MIMETYPE "ogr/gml"
    DRIVER "OGR/GML"
    FORMATOPTION "FORM=multipart"
END

# in WEB METADATA define formats (example):
"wms_getfeatureinfo_formatlist" "OGRGML,text/html"
```

Ver propiedades

Una vez que haya añadido un servidor WMS, puede ver sus propiedades haciendo clic derecho sobre el mismo en la leyenda y la seleccionar *Propiedades*. **Pestaña de Metadatos**

La pestaña *Metadatos* muestra una gran cantidad de información acerca del servidor WMS, generalmente obtenida de la declaración de capacidades de ese servidor. Muchas definiciones pueden ser extraídas mediante la lectura del estándar WMS (vea OPEN-GEOSPATIAL-CONSORTIUM en *Referencias bibliográficas y web*), pero aquí hay algunas definiciones útiles:

- **Propiedades del servidor**
  - **Versión WMS** — La versión WMS implementada por el servidor.
  - **Formatos de Imagen** — La lista de MIME-types que el servidor puede responder con la elaboración del mapa. QGIS reconoce cualquier formato las bibliotecas Qt subyacentes con que fueron construidas, que es típicamente por lo menos `image/png` y `image/jpeg`.
  - **Formato de Identificación** — La lista de tipos MIME, el servidor puede responder, cuando utilice la herramienta de Identificación. Actualmente, QGIS reconoce el tipo `texto plano`.
- **Propiedades de la capa**
  - **Seleccionar** — Sea o no esta capa seleccionada cuando su servidor fue añadido a este proyecto.
  - **Visible** — Si la capa seleccionada es o no visible en la leyenda (aun no utilizada en esta versión de QGIS).
  - **Poder Identificar** — Sea o no esta capa regresará algunos resultados cuando la herramienta de identificar se utilice en él.
  - **Puede ser transparente** — Si esta capa puede ser representada o no con transparencia. Esta versión de QGIS siempre usará transparencia si este es `Si` y la codificación de la imagen admite la transparencia.
  - ** Puede Acercar zum ** — Si en esta capa se puede o no hacer zum en el servidor. Esta versión de QGIS asume que todas las capas WMS tienen este conjunto de `Si`. Capas deficientes pueden ser presentadas de manera extraña.

- **Conteo en Cascada** — Los servidores WMS pueden actuar como proxy para otros servidores WMS para obtener datos ráster de una capa. Esta entrada muestra el número de veces que se remitió la solicitud de esta capa para ver a los servidores WMS para obtener un resultado.
- **Ancho fijo, altura fija** — Si esta capa o no tiene fijas las dimensiones en píxeles de origen. Esta versión de QGIS asume que todas las capas WMS tienen este conjunto a nada. Capas deficientes pueden ser presentadas de forma extraña.
- **Recuadro delimitador WGS 84** — El recuadro delimitador de la capa, en coordenadas WGS 84. Algunos servidores WMS no establecen esto correctamente (por ejemplo, utilizan coordenadas UTM en su lugar). Si éste es el caso, entonces la vista inicial de la capa puede aparecer muy 'lejana' en QGIS. El webmaster de WMS debería ser informado de este error, que probablemente conocen como los elementos XML de WMS `LatLonBoundingBox`, `EX_GeographicBoundingBox` o el *BoundingBox'* de CRS:84.
- **Disponible en SRC** — Las proyecciones que esta capa puede representar por el servidor WMS. Éstos se enumeran en el formato nativo de WMS.
- **Disponible en estilo** — Los estilos de imagen que esta capa puede representar por el servidor WMS.

Show WMS legend graphic in table of contents and composer

The QGIS WMS data provider is able to display a legend graphic in the table of contents' layer list and in the map composer. The WMS legend will be shown only if the WMS server has GetLegendGraphic capability and the layer has getCapability url specified, so you additionally have to select a styling for the layer.

Si hay definida una legendGraphic, ésta se mostrará debajo de la capa. Es pequeña y hay que hacer clic sobre ella para abrirla en tamaño real (debido a una limitación de la arquitectura de QgsLegendInterface). Al hacer clic en la leyenda de la capa se abrirá un cuadro con la leyenda a la máxima resolución.

In the print composer, the legend will be integrated at it's original (downloaded) dimension. Resolution of the legend graphic can be set in the item properties under *Legend –> WMS LegendGraphic* to match your printing requirements

La leyenda mostrará información contextual basada en su escala actual. La leyenda WMS se muestra sólo si el servidor WMS tiene capacidad GetLegendGraphic y la capa tiene definida una url getCapability, para lo que se debe seleccionar un estilo.

Limitaciones del cliente WMS

No es posible la funcionalidad de cliente WMS que se ha incluido en esta versión de QGIS. Algunas de las excepciones más notables siguen.

Editar la configuración de la capa WMS

Una vez que haya completado el procedimiento de  Añadir capa WMS, no se podrá cambiar la configuración. Una solución alternativa es eliminar la capa por completo y empezar de nuevo.

**Autentificación necesaria en servidores WMS **

Actualmente, se admiten servicios WMS públicamente accesibles y garantizados. Los servidores WMS garantizados se puede acceder mediante autenticación pública. El usuario puede agregar las credenciales (opcional) cuando agregue un servidor WMS. Vea la sección :ref: *ogc-wms-servers* para más detalles.

Truco: Acceso garantizado a capas OGC

If you need to access secured layers with secured methods other than basic authentication, you can use InteProxy as a transparent proxy, which does support several authentication methods. More information can be found in the InteProxy manual at http://inteproxy.wald.intevation.org.

Truco: QGIS WMS Mapserver

Desde la versión 1.7.0, QGIS tiene su propia implementación de un servidor de mapas WMS 1.3.0. Lea más sobre esto en el capítulo *QGIS como Servidor de Datos OGC*.

15.1.2 WCT Cliente

 Un Web Coverage Service (WCS) proporciona acceso a los datos ráster en formas que son útiles para la representación del lado cliente, como datos de entrada en los modelos científicos, y para otros clientes. El WCS se puede comparar con la WFS y el WMS. Como WMS y WFS instancias de servicios, un WCS permite a los clientes elegir partes de las explotaciones de información de un servidor basado en restricciones espaciales y otros criterios de consulta.

QGIS tiene un proveedor WCS nativo y reconoce ambas versiones 1.0 y 1,1 (que son significativamente diferentes), pero actualmente se prefiere 1.0, porque 1.1 tiene muchos problemas (por ejemplo, cada servidor lo implementa de diferente forma con varias particularidades).

El proveedor de WCS nativo se encarga de todas las solicitudes de red y utiliza las configuraciones de red estándar de QGIS (especialmente de proxy). También es posible seleccionar el modo de caché ('siempre caché', 'preferentemente caché', 'preferentemente red', 'siempre red'). El proveedor también es compatible con la selección de tiempo de la posición, si el servidor ofrece el dominio temporal.

Advertencia: Entering **username** and **password** in the *Authentication* tab will keep unprotected credentials in the connection configuration. Those **credentials will be visible** if, for instance, you shared the project file with someone. Therefore, it's advisable to save your credentials in a *Authentication configuration* instead (*configurations* tab). See *Sistema de autenticación* for more details.

15.1.3 Cliente WFS y WFS-T

En QGIS, una capa WFS funciona prácticamente como cualquier otra capa vectorial. Puede identificar y seleccionar objetos espaciales, y ver la tabla de atributos. Desde QGIS 1.6, la edición WFS-T está también de reconocida.

En general, añadir una capa WFS es muy similar al procedimiento utilizado con WMS. La diferencia es que no hay servidores por defecto definidos, así que tenemos que añadir la nuestra.

Cargar una capa WFS

Como un ejemplo, utilizamos el servidor WFS de DM Solutions y mostramos una capa. La URL es http://www2.dmsolutions.ca/cgi-bin/mswfs_gmap

1. Haga clic en la herramienta  Añadir capa WFS en la barra de herramientas Capas. El diálogo *Añadir capa WFS de un servidor* aparecera.
2. Click on **[New]**.
3. Ingrese 'DS Solutions' como nombre.
4. Introducir la URL (véase más arriba).
5. Click **[OK]**.
6. Seleccione 'DM Solutions' de la lista desplegable *Conexiones de servidor*  .
7. Click **[Connect]**.
8. Espere a que la capa de capas este poblada.
9. Seleccione la capa *Parks* en la lista.
10. Click **[Apply]** to add the layer to the map.

Tenga en cuenta que cualquier configuración de proxy que pueda haber establecido en sus preferencias también son reconocidos.

In the WFS settings dialog, you can define the *maximal number of features* downloaded, set up the version, force to *Ignore axis orientation (WFS 1.1/WFS 2.0)* and force *Inverse axis orientation*.

Advertencia: Entering **username** and **password** in the *Authentication* tab will keep unprotected credentials in the connection configuration. Those **credentials will be visible** if, for instance, you shared the project file with someone. Therefore, it's advisable to save your credentials in a *Authentication configuration* instead (*configurations* tab). See *Sistema de autenticación* for more details.

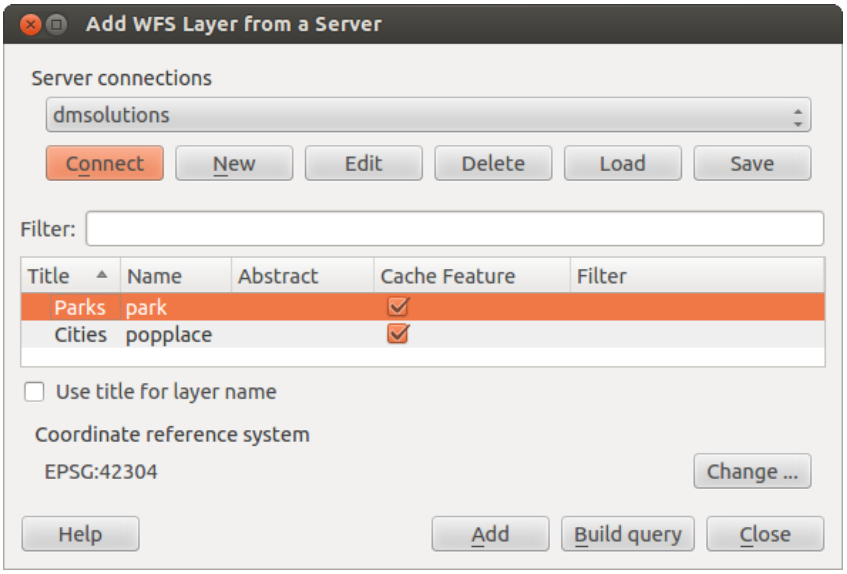

Figure 15.4: Añadir una capa WFS

Se dará cuenta el progreso de la descarga, se visualiza en la parte inferior izquierda de la ventana principal de QGIS. Una vez cargada la capa, se puede identificar y seleccionar una provincia o dos y ver la tabla de atributos.

Nota: About differences between WFS versions

WFS 1.0.0, 1.1.0 and 2.0 are supported. Background download and progressive rendering, on-disk caching of downloaded features and version autodetection are now supported.

Only WFS 2.0 service supports GetFeature paging.

Truco: Encontrar servidores WFS

Puede encontrar servidores WFS adicionales al utilizar Google o su buscador favorito. Hay un número de listas con URLs publicas, algunos son mantenidos y otros no.

15.2 QGIS como Servidor de Datos OGC

QGIS Server is an open source WMS 1.3, WFS 1.0.0 and WCS 1 1.1.1 implementation that, in addition, implements advanced cartographic features for thematic mapping. QGIS Server is a FastCGI/CGI (Common Gateway Interface) application written in C++ that works together with a web server (e.g., Apache, Lighttpd). It has Python plugin support allowing for fast and efficient development and deployment of new features. The original development of QGIS Server was funded by the EU projects Orchestra, Sany and the city of Uster in Switzerland.

El servidor QGIS utiliza QGIS como back-end para la lógica de los SIG y de mapa de representación. Además, la biblioteca Qt se utiliza para gráficos y para la plataforma independiente la programación en C++. En contraste

con otro software de WMS, el servidor de QGIS utiliza reglas cartográficos como un lenguaje de configuración, tanto para la configuración del servidor y de las reglas cartográficas definidas por el usuario.

As QGIS desktop and QGIS Server use the same visualization libraries, the maps that are published on the web look the same as in desktop GIS.

In the following sections, we will provide a sample configuration to set up a QGIS Server on Debian/Ubuntu Linux. For more detailed installation instructions on other platforms or distributions and more information on working with QGIS Server, we recommend reading the *QGIS Server Training Manual* or *server_plugins*.

15.2.1 Empezando

Installation

At this point, we will give a short and simple sample installation how-to for a minimal working configuration using Apache2 on Debian/Ubuntu. The first step is QGIS Server installation whose instructions are provided in QGIS installers page.

HTTP Server configuration

Apache

Install the Apache server in a separate virtual host listening on port `80`. Enable the rewrite module to pass HTTP BASIC auth headers:

```
$ sudo a2enmod rewrite
$ cat /etc/apache2/conf-available/qgis-server-port.conf
Listen 80
$ sudo a2enconf qgis-server-port
```

This is the virtual host configuration, stored in `/etc/apache2/sites-available/001-qgis-server.conf`:

```
<VirtualHost *:80>
 ServerAdmin webmaster@localhost
 DocumentRoot /var/www/html

 ErrorLog ${APACHE_LOG_DIR}/qgis-server-error.log
 CustomLog ${APACHE_LOG_DIR}/qgis-server-access.log combined

 # Longer timeout for WPS... default = 40
 FcgidIOTimeout 120
 FcgidInitialEnv LC_ALL "en_US.UTF-8"
 FcgidInitialEnv PYTHONIOENCODING UTF-8
 FcgidInitialEnv LANG "en_US.UTF-8"
 FcgidInitialEnv QGIS_DEBUG 1
 FcgidInitialEnv QGIS_SERVER_LOG_FILE /tmp/qgis-000.log
 FcgidInitialEnv QGIS_SERVER_LOG_LEVEL 0

 ScriptAlias /cgi-bin/ /usr/lib/cgi-bin/
 <Directory "/usr/lib/cgi-bin">
     AllowOverride All
     Options +ExecCGI -MultiViews +FollowSymLinks
     # for apache2 > 2.4
     Require all granted
     #Allow from all
 </Directory>
</VirtualHost>
```

Now enable the virtual host and restart Apache:

```
$ sudo a2ensite 001-qgis-server
$ sudo service apache2 restart
```

NGINX

You can use QGIS Server with nginx.

On Debian based systems:

```
apt-get install nginx fcgiwrap
```

Introduce the following in your nginx server block configuration:

```
1   location ~ ^/cgi-bin/.*\.fcgi$ {
2       gzip           off;
3       include fastcgi_params;
4       fastcgi_pass   unix:/var/run/fcgiwrap.socket;
5
6       fastcgi_param  SCRIPT_FILENAME /usr/lib/cgi-bin/qgis_mapserv.fcgi;
7       fastcgi_param  QGIS_SERVER_LOG_FILE /logs/qgisserver.log;
8       fastcgi_param  QGIS_SERVER_LOG_LEVEL 0;
9       fastcgi_param  QGIS_DEBUG 1;
10  }
```

As you can see from lines `6-9` you can add parameters in your location block in the form of `fastcgi_param param_name param_value`, e.g. `fastcgi_param DISPLAY ":99";`.

The `include fastcgi_params;` is important as it adds the parameters from `/etc/nginx/fastcgi_params`:

```
fastcgi_param  QUERY_STRING       $query_string;
fastcgi_param  REQUEST_METHOD     $request_method;
fastcgi_param  CONTENT_TYPE       $content_type;
fastcgi_param  CONTENT_LENGTH     $content_length;

fastcgi_param  SCRIPT_NAME        $fastcgi_script_name;
fastcgi_param  REQUEST_URI        $request_uri;
fastcgi_param  DOCUMENT_URI       $document_uri;
fastcgi_param  DOCUMENT_ROOT      $document_root;
fastcgi_param  SERVER_PROTOCOL    $server_protocol;
fastcgi_param  REQUEST_SCHEME     $scheme;
fastcgi_param  HTTPS              $https if_not_empty;

fastcgi_param  GATEWAY_INTERFACE  CGI/1.1;
fastcgi_param  SERVER_SOFTWARE    nginx/$nginx_version;

fastcgi_param  REMOTE_ADDR        $remote_addr;
fastcgi_param  REMOTE_PORT        $remote_port;
fastcgi_param  SERVER_ADDR        $server_addr;
fastcgi_param  SERVER_PORT        $server_port;
fastcgi_param  SERVER_NAME        $server_name;

# PHP only, required if PHP was built with --enable-force-cgi-redirect
fastcgi_param  REDIRECT_STATUS    200;
```

Prepare a project to serve

To provide a new QGIS Server WMS, WFS or WCS, we have to create a QGIS project file with some data. Here, we use the 'Alaska' shapefile from the QGIS sample dataset. Define the colors and styles of the layers in QGIS and the project CRS, if not already defined.

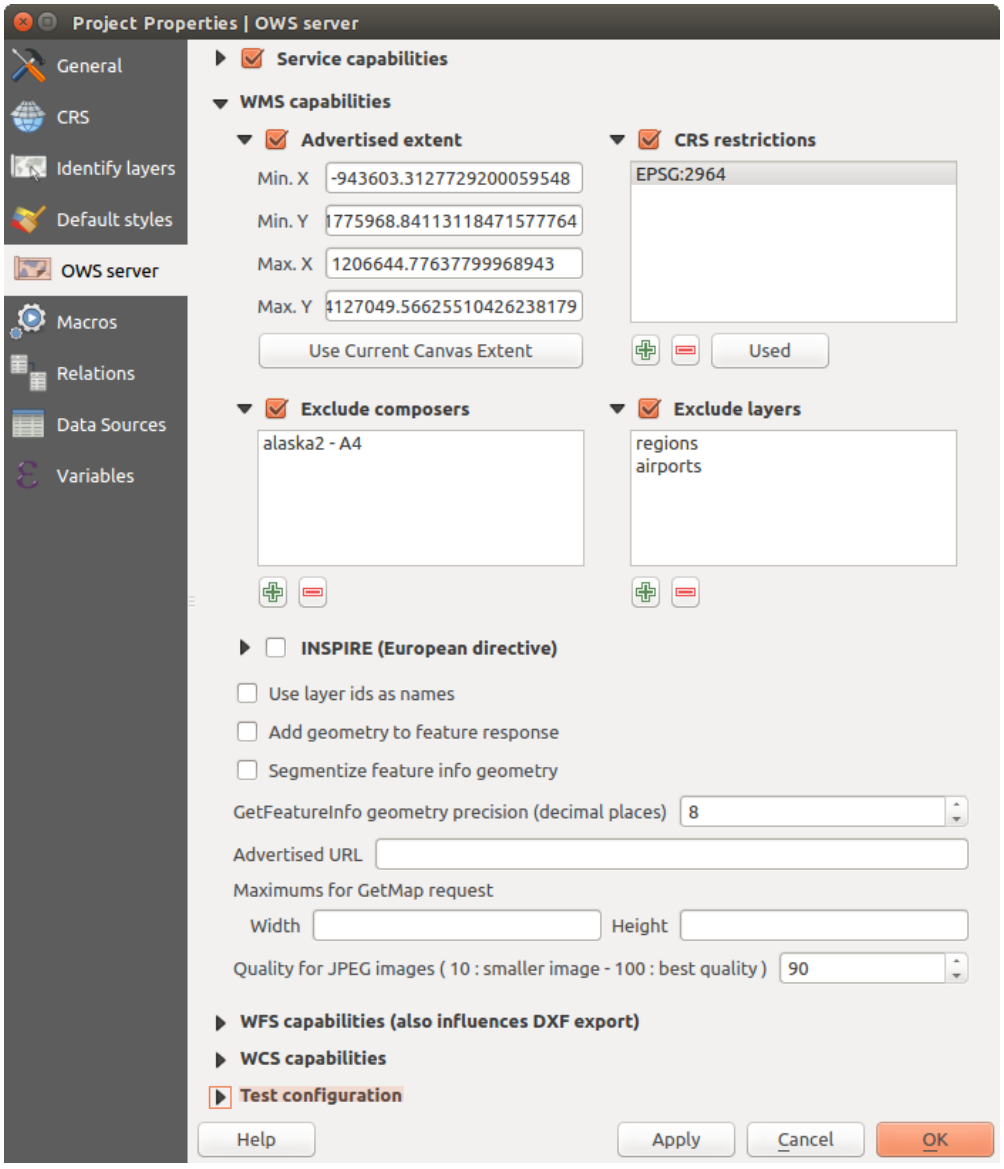

Figure 15.5: Definitions for a QGIS Server WMS/WFS/WCS project

Then, go to the *OWS Server* menu of the *Project → Project Properties* dialog and provide some information about the OWS in the fields under *Service Capabilities*. This will appear in the GetCapabilities response of the WMS, WFS or WCS. If you don't check *Service capabilities*, QGIS Server will use the information given in the `wms_metadata.xml` file located in the `cgi-bin` folder.

Advertencia: If you're using the QGIS project with styling based on SVG files using relative paths then you should know that the server considers the path relative to its `qgis_mapserv.fcgi` file (not to the `qgs` file). So, if you deploy a project on the server and the SVG files are not placed accordingly, the output images may not respect the Desktop styling. To ensure this doesn't happen, you can simply copy the SVG files relative to the `qgis_mapserv.fcgi`. You can also create a symbolic link in the directory where the fcgi file resides that points to the directory containing the SVG files (on Linux/Unix).

Capacidades WMS

In the *WMS capabilities* section, you can define the extent advertised in the WMS GetCapabilities response by entering the minimum and maximum X and Y values in the fields under *Advertised extent*. Clicking *Use Current Canvas Extent* sets these values to the extent currently displayed in the QGIS map canvas. By checking *CRS restrictions*, you can restrict in which coordinate reference systems (CRS) QGIS Server will offer to render maps. Use the button below to select those CRSs from the Coordinate Reference System Selector, or click *Used* to add the CRSs used in the QGIS project to the list.

If you have print composers defined in your project, they will be listed in the *GetProjectSettings* response, and they can be used by the GetPrint request to create prints, using one of the print composer layouts as a template. This is a QGIS-specific extension to the WMS 1.3.0 specification. If you want to exclude any print composer from being published by the WMS, check *Exclude composers* and click the button below. Then, select a print composer from the *Select print composer* dialog in order to add it to the excluded composers list.

If you want to exclude any layer or layer group from being published by the WMS, check *Exclude Layers* and click the button below. This opens the *Select restricted layers and groups* dialog, which allows you to choose the layers and groups that you don't want to be published. Use the `Shift` or `Ctrl` key if you want to select multiple entries.

You can receive requested GetFeatureInfo as plain text, XML and GML. Default is XML, text or GML format depends the output format chosen for the GetFeatureInfo request.

If you wish, you can check *Add geometry to feature response*. This will include in the GetFeatureInfo response the geometries of the features in a text format. If you want QGIS Server to advertise specific request URLs in the WMS GetCapabilities response, enter the corresponding URL in the *Advertised URL* field. Furthermore, you can restrict the maximum size of the maps returned by the GetMap request by entering the maximum width and height into the respective fields under *Maximums for GetMap request*.

If one of your layers uses the *Map Tip display* (i.e. to show text using expressions) this will be listed inside the GetFeatureInfo output. If the layer uses a Value Map for one of its attributes, this information will also be shown in the GetFeatureInfo output.

WFS capabilities

In the *WFS capabilities* area you can select the layers you want to publish as WFS, and specify if they will allow update, insert and delete operations. If you enter a URL in the *Advertised URL* field of the *WFS capabilities* section, QGIS Server will advertise this specific URL in the WFS GetCapabilities response.

WCS capabilities

In the *WCS capabilities* area, you can select the layers that you want to publish as WCS. If you enter a URL in the *Advertised URL* field of the *WCS capabilities* section, QGIS Server will advertise this specific URL in the WCS GetCapabilities response.

Ajuste fino de OWS

For vector layers, the *Fields* menu of the *Layer* → *Properties* dialog allows you to define for each attribute if it will be published or not. By default, all the attributes are published by your WMS and WFS. If you don't want a specific attribute to be published, uncheck the corresponding checkbox in the *WMS* or *WFS* column.

You can overlay watermarks over the maps produced by your WMS by adding text annotations or SVG annotations to the project file. See the *Herramientas de anotaciones* section for instructions on creating annotations. For annotations to be displayed as watermarks on the WMS output, the *Fixed map position* checkbox in the *Annotation text* dialog must be unchecked. This can be accessed by double clicking the annotation while one of the annotation tools is active. For SVG annotations, you will need either to set the project to save absolute paths (in the *General* menu of the *Project* → *Project Properties* dialog) or to manually modify the path to the SVG image so that it represents a valid relative path.

Serve the project

Now, save the session in a project file `alaska.qgs`. To provide the project as a WMS/WFS, create a new folder `/usr/lib/cgi-bin/project` with admin privileges and add the project file `alaska.qgs` and a copy of the `qgis_mapserv.fcgi` file - that's all.

Now test your project WMS, WFS and WCS. Add the WMS, WFS and WCS as described in *Cargando capas WMS/WMTS*, *Cliente WFS y WFS-T* and *WCT Cliente* to QGIS and load the data. The URL is:

```
http://localhost/cgi-bin/project/qgis_mapserv.fcgi
```

Cascading OGC layers

A QGIS project can of course contain layers coming from remote OGC servers (regardless of the underlying OGC server software used). This way QGIS will effectively **cascade** those layers through its OGC (QGIS Server based) services.

If the external OGC layers are coming from services that make use of the **HTTPS** protocol you must take care of some extra QGIS Server configuration. Example for the Apache web server:

```
$ mkdir /srv/qgis/.qgis2
$ chown www-data:www-data /srv/qgis/.qgis2
$ chmod 774 /srv/qgis/.qgis2
```

This ensures that the web server is able to write in some user defined folder. Then add the following line to the Apache virtual host file to ensure that Apache will use such folder:

```
FcgidInitialEnv HOME "/srv/qgis"
```

Restart Apache.

15.2.2 Servicios

QGIS Server supports some vendor parameters and requests that greatly enhance the possibilities of customising its behavior. The following paragraphs list the vendor parameters and the environment variables supported by the server.

Web Map Service (WMS)

GetMap

In the WMS GetMap request, QGIS Server accepts a couple of extra parameters in addition to the standard parameters according to the OGC WMS 1.3.0 specification:

- **DPI** parameter: The `DPI` parameter can be used to specify the requested output resolution.

  Ejemplo:

  ```
  http://localhost/cgi-bin/qgis_mapserv.fcgi?REQUEST=GetMap&DPI=300&...
  ```

- **IMAGE_QUALITY** parameter is only used for JPEG images. By default, the JPEG compression is `-1`. You can change the default per QGIS project in the *OWS Server → WMS capabilities* menu of the *Project → Project Properties* dialog. If you want to override it in a `GetMap` request you can do it using the `IMAGE_QUALITY` parameter:

  ```
  http://localhost/cgi-bin/qgis_mapserv.fcgi?\
   REQUEST=GetMap&FORMAT=image/jpeg&IMAGE_QUALITY=65&...
  ```

- **image/png; mode=** can be used to override the png format. You can choose between `image/png; mode=16bit`, `image/png; mode=8bit` and `image/png; mode=1bit`. This can shrink the output image size quite a bit. Example:

  ```
  http://localhost/cgi-bin/qgis_mapserv.fcgi?\
   REQUEST=GetMap&FORMAT=image/png; mode=8bit&...
  ```

- **OPACITIES** parameter: Opacity can be set on layer or group level. Allowed values range from 0 (fully transparent) to 255 (fully opaque).

  Ejemplo:

  ```
  http://localhost/cgi-bin/qgis_mapserv.fcgi?\
    REQUEST=GetMap&LAYERS=mylayer1,mylayer2&OPACITIES=125,200&...
  ```

- **FILTER** parameter: Subsets of layers can be selected with the `FILTER` parameter. Syntax is basically the same as for the QGIS subset string. However, there are some restrictions to avoid SQL injections into databases via QGIS server:

  Text strings need to be enclosed with quotes (single quotes for strings, double quotes for attributes) A space between each word / special character is mandatory. Allowed Keywords and special characters are 'AND','OR','IN','=','<','>=', '>','>=','!=*,'(',')'. Semicolons in string expressions are not allowed

  Ejemplo:

  ```
  http://myserver.com/cgi/qgis_mapserv.fcgi?REQUEST=GetMap&LAYERS=mylayer1,mylayer2&FILTER=myla
  ```

Nota: It is possible to make attribute searches via GetFeatureInfo and omit the X/Y parameter if a FILTER is there. QGIS server then returns info about the matching features and generates a combined bounding box in the xml output.

- **SELECTION** parameter: The `SELECTION` parameter can highlight features from one or more layers. Vector features can be selected by passing comma separated lists with feature ids in `GetMap` and `GetPrint`.

  Ejemplo:

  ```
  http://myserver.com/cgi/qgis_mapserv.fcgi?REQUEST=GetMap&LAYERS=mylayer1,mylayer2&SELECTION=m
  ```

  The following image presents the response from a GetMap request using the **SELECTION** option e.g. `http://myserver.com/...&SELECTION=countries:171,65`. As those features id's correspond in the source dataset to **France** and **Romania** they're highlighted in yellow.

Figure 15.6: Server response to a GetMap request with SELECTION parameter

It is possible to export layers in the DXF format using the GetMap Request. Only layers that have read access in the WFS service are exported in the DXF format. Here is a valid REQUEST and a documentation of the available parameters:

```
http://your.server.address/wms/liegenschaftsentwaesserung/abwasser_werkplan?SERVICE=WMS&VERSION=1
```

Parameters:

- FORMAT=application/dxf
- FILE_NAME=yoursuggested_file_name_for_download.dxf
- FORMAT_OPTIONS=see options below, key:value pairs separated by Semicolon

FORMAT_OPTIONS Parameters:

- **SCALE:scale** to be used for symbology rules, filters and styles (not an actual scaling of the data - data remains in the original scale).
- **MODE:NOSYMBOLOGY|FEATURESYMBOLOGY|SYMBOLLAYERSYMBOLOGY** corresponds to the three export options offered in the QGIS Desktop DXF export dialog.
- **LAYERSATTRIBUTES:yourcolumn_with_values_to_be_used_for_dxf_layernames** - if not specified, the original QGIS layer names are used.
- **USE_TITLE_AS_LAYERNAME** if enabled, the title of the layer will be used as layer name.

GetFeatureInfo

QGIS Server WMS GetFeatureInfo requests supports the following extra optional parameters to define the tolerance for point, line and polygon layers:

- **FI_POINT_TOLERANCE** parameter: Tolerance for point layers *GetFeatureInfo* request, in pixels.
- **FI_LINE_TOLERANCE** parameter: Tolerance for linestring layers *GetFeatureInfo* request, in pixels.
- **FI_POLYGON_TOLERANCE** parameter: Tolerance for polygon layers *GetFeatureInfo* request, in pixels.

GetPrint

QGIS server has the capability to create print composer output in pdf or pixel format. Print composer windows in the published project are used as templates. In the GetPrint request, the client has the possibility to specify parameters of the contained composer maps and labels.

Example:

The published project has two composer maps. In the *GetProjectSettings* response, they are listed as possible print templates:

```
<WMS_Capabilities>
...
<ComposerTemplates xsi:type="wms:_ExtendedCapabilities">
<ComposerTemplate width="297" height="210" name="Druckzusammenstellung 1">
<ComposerMap width="171" height="133" name="map0"/>
<ComposerMap width="49" height="46" name="map1"/></ComposerTemplate>
</ComposerTemplates>
...
</WMS_Capabilities>
```

The client has now the information to request a print output:

```
http://myserver.com/cgi/qgis_mapserv.fcgi?...&REQUEST=GetPrint&TEMPLATE=Druckzusammenstellung 1&ma
```

Parameters in the GetPrint request are:

- **<map_id>:EXTENT** gives the extent for a composer map as xmin,ymin,xmax,ymax.

- **<map_id>:ROTATION** map rotation in degrees
- **<map_id>:GRID_INTERVAL_X**, **<map_id>:GRID_INTERVAL_Y** Grid line density for a composer map in x- and y-direction
- **<map_id>:SCALE** Sets a mapscale to a composer map. This is useful to ensure scale based visibility of layers and labels even if client and server may have different algorithms to calculate the scale denominator
- **<map_id>:LAYERS**, **<map_id>:STYLES** possibility to give layer and styles list for composer map (useful in case of overview maps which should have only a subset of layers)

GetLegendGraphics

Several additional parameters are available to change the size of the legend elements:

- **BOXSPACE** space between legend frame and content (mm)
- **LAYERSPACE** versical space between layers (mm)
- **LAYERTITLESPACE** vertical space between layer title and items following (mm)
- **SYMBOLSPACE** vertical space between symbol and item following (mm)
- **ICONLABELSPACE** horizontal space between symbol and label text (mm)
- **SYMBOLWIDTH** width of the symbol preview (mm)
- **SYMBOLHEIGHT** height of the symbol preview (mm)

These parameters change the font properties for layer titles and item labels:

- **LAYERFONTFAMILY / ITEMFONTFAMILY** font family for layer title / item text
- **LAYERFONTBOLD / ITEMFONTBOLD** 'TRUE' to use a bold font
- **LAYERFONTSIZE / ITEMFONTSIZE** Font size in point
- **LAYERFONTITALIC / ITEMFONTITALIC** 'TRUE' to use italic font
- **LAYERFONTCOLOR / ITEMFONTCOLOR** Hex color code (e.g. #FF0000 for red)
- **LAYERTITLE / RULELABEL** (from QGIS 2.4) set them to 'FALSE' to get only the legend graphics without labels

Contest based legend. These parameters let the client request a legend showing only the symbols for the features falling into the requested area:

- **BBOX** the geographical area for which the legend should be built
- **CRS / SRS** the coordinate reference system adopted to define the BBOX coordinates
- **WIDTH / HEIGHT** if set these should match those defined for the GetMap request, to let QGIS Server scale symbols according to the map view image size.

Contest based legend features are based on the UMN MapServer implementation:

GetProjectSettings

This request type works similar to **GetCapabilities**, but it is more specific to QGIS Server and allows a client to read additional information which is not available in the GetCapabilities output:

- initial visibility of layers
- information about vector attributes and their edit types
- information about layer order and drawing order
- list of layers published in WFS

Web Feature Service (WFS)

GetFeature

In the WFS GetFeature request, QGIS Server accepts two extra parameters in addition to the standard parameters according to the OGC WFS 1.0.0 specification:

- **GeometryName** parameter: this parameter can be used to get the *extent* or the *centroid* as the geometry or no geometry if *none* if used (ie attribute only). Allowed values are *extent*, *centroid* or *none*.
- **StartIndex** parameter: STARTINDEX is standard in WFS 2.0, but it's an extension for WFS 1.0.0 which is the only version implemented in QGIS Server. STARTINDEX can be used to skip some features in the result set and in combination with MAXFEATURES will provide for the ability to use WFS GetFeature to page through results. Note that STARTINDEX=0 means start with

Extra parameters supported by all request types

- **FILE_NAME** parameter: if set, the server response will be sent to the client as a file attachment with the specified file name.
- **MAP** parameter: Similar to MapServer, the `MAP` parameter can be used to specify the path to the QGIS project file. You can specify an absolute path or a path relative to the location of the server executable (`qgis_mapserv.fcgi`). If not specified, QGIS Server searches for .qgs files in the directory where the server executable is located.

  Ejemplo:

  ```
  http://localhost/cgi-bin/qgis_mapserv.fcgi?\
    REQUEST=GetMap&MAP=/home/qgis/mymap.qgs&...
  ```

Nota:

You can define a **QGIS_PROJECT_FILE** as an environment variable to tell the server executable where to find the QGIS project file. This variable will be the location where QGIS will look for the project file. If not defined it will use the MAP parameter in the request and finally look at the server executable directory.

the first feature, skipping none.

REDLINING

This feature is available and can be used with `GetMap` and `GetPrint` requests.

The redlining feature can be used to pass geometries and labels in the request which are overlapped by the server over the standard returned image (map). This permits the user to put emphasis or maybe add some comments (labels) to some areas, locations etc. that are not in the standard map.

The request is in the format:

```
http://qgisplatform.demo/cgi-bin/qgis_mapserv.fcgi?map=/world.qgs&SERVICE=WMS&VERSION=1.3.0&
REQUEST=GetMap
...
&HIGHLIGHT_GEOM=POLYGON((590000 5647000, 590000 6110620, 2500000 6110620, 2500000 5647000, 590000
&HIGHLIGHT_SYMBOL=<StyledLayerDescriptor><UserStyle><Name>Highlight</Name><FeatureTypeStyle><Rule
&HIGHLIGHT_LABELSTRING=Write label here
&HIGHLIGHT_LABELSIZE=16
&HIGHLIGHT_LABELCOLOR=%23000000
&HIGHLIGHT_LABELBUFFERCOLOR=%23FFFFFF
&HIGHLIGHT_LABELBUFFERSIZE=1.5
```

Here is the image outputed by the above request in which a polygon and a label are drawn on top of the normal map:

Figure 15.7: Server response to a GetMap request with redlining parameters

You can see there are several parameters in this request:

- **HIGHLIGHT_GEOM**: You can add POINT, MULTILINESTRING, POLYGON etc. It supports multipart geometries. Here is an example: `HIGHLIGHT_GEOM=MULTILINESTRING((0 0, 0 1, 1 1))`. The coordinates should be in the CRS of the GetMap/GetPrint request.
- **HIGHLIGHT_SYMBOL**: This controls how the geometry is outlined and you can change the stroke width, color and opacity.
- **HIGHLIGHT_LABELSTRING**: You can pass your labeling text to this parameter.
- **HIGHLIGHT_LABELSIZE**: This parameter controls the size of the label.
- **HIGHLIGHT_LABELCOLOR**: This parameter controls the label color.
- **HIGHLIGHT_LABELBUFFERCOLOR**: This parameter controls the label buffer color.
- **HIGHLIGHT_LABELBUFFERSIZE**: This parameter controls the label buffer size.

15.2.3 Plugins

Instalación

La instalación de un complemento de ejemplo HelloWorld para probar los servidores. Se puede crear un directorio para mantener los complementos del servidor. Esto se especificará en la configuración del host virtual y transmitirlo al servidor a través de una variable de entorno.

```
$ sudo mkdir -p /opt/qgis-server/plugins
$ cd /opt/qgis-server/plugins
$ sudo wget https://github.com/elpaso/qgis-helloserver/archive/master.zip
# In case unzip was not installed before:
$ sudo apt-get install unzip
$ sudo unzip master.zip
$ sudo mv qgis-helloserver-master HelloServer
```

HTTP Server configuration

Apache

To be able to use server plugins, FastCGI needs to know where to look. So, we have to modify the Apache configuration file to indicate the **QGIS_PLUGINPATH** environment variable to FastCGI:

```
FcgidInitialEnv QGIS_SERVER_LOG_FILE /tmp/qgis-000.log
FcgidInitialEnv QGIS_SERVER_LOG_LEVEL 0
FcgidInitialEnv QGIS_PLUGINPATH "/opt/qgis-server/plugins"
```

Moreover, a basic HTTP authorization is necessary to play with the HelloWorld plugin previously introduced. So we have to update the Apache configuration file a last time:

```
# Needed for QGIS HelloServer plugin HTTP BASIC auth
<IfModule mod_fcgid.c>
    RewriteEngine on
    RewriteCond %{HTTP:Authorization} .
    RewriteRule .* - [E=HTTP_AUTHORIZATION:%{HTTP:Authorization}]
</IfModule>
```

A continuación, reinicie Apache:

```
$ sudo a2ensite 001-qgis-server
$ sudo service apache2 restart
```

Truco: If you work with a feature that has many nodes then modifying and adding a new feature will fail. In this case it is possible to insert the following code into the `001-qgis-server.conf` file:

```
<IfModule mod_fcgid.c>
FcgidMaxRequestLen 26214400
FcgidConnectTimeout 60
</IfModule>
```

How to use a plugin

Test the server with the HelloWorld plugin:

```
$ wget -q -O - "http://localhost/cgi-bin/qgis_mapserv.fcgi?SERVICE=HELLO"
HelloServer!
```

Se puede echar un vistazo al GetCapabilities predeterminado del servidor QGIS en : `http://localhost/cgi-bin/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.3.0&REQUEST=GetCapabili`

15.2.4 Canfiguración avanzada

Registro

To log requests sent to the server, set the following environment variables:

- **QGIS_SERVER_LOG_FILE**: Specify path and filename. Make sure that the server has proper permissions for writing to file. File should be created automatically, just send some requests to server. If it's not there, check permissions.
- **QGIS_SERVER_LOG_LEVEL**: Specify desired log level. Available values are:
  - 0 INFO (log all requests),
  - 1 WARNING,
  - 2 CRITICAL (log just critical errors, suitable for production purposes).

  Example:

```
SetEnv QGIS_SERVER_LOG_FILE /var/tmp/qgislog.txt
SetEnv QGIS_SERVER_LOG_LEVEL 0
```

Nota:

- When using Fcgid module use `FcgidInitialEnv` instead of `SetEnv`!
- Server logging is also enabled if executable is compiled in release mode.

Variables de entorno

You can configure some aspects of QGIS server by setting **environment variables**. For example, to set QGIS server on Apache to use /path/to/config/QGIS/QGIS2.ini settings file, add to Apache config:

```
SetEnv QGIS_OPTIONS_PATH "/path/to/config/"
```

or, if using fcgi:

```
FcgidInitialEnv QGIS_OPTIONS_PATH "/path/to/config/"
```

This is a list of the variables supported by QGIS server:

- **QGIS_OPTIONS_PATH**: Specifies the path to the directory with settings. It works the same way as QGIS application –optionspath option. It is looking for settings file in <QGIS_OPTIONS_PATH>/QGIS/QGIS2.ini.
- **QUERY_STRING**: The query string, normally passed by the web server. This variable can be useful while testing QGIS server binary from the command line.
- **QGIS_PROJECT_FILE**: the *.qgs* project file, normally passed as a parameter in the query string, you can also set it as an environment variable (for example by using *mod_rewrite* Apache module).
- **QGIS_SERVER_LOG_FILE**: Specify path and filename. Make sure that server has proper permissions for writing to file. File should be created automatically, just send some requests to server. If it's not there, check permissions.
- **QGIS_SERVER_LOG_LEVEL**: Specify desired log level. See *Registro*
- **MAX_CACHE_LAYERS**: Specify the maximum number of cached layers (default: 100).
- **DISPLAY**: This is used to pass (fake) X server display number (needed on Unix-like systems).
- **QGIS_PLUGINPATH**: Useful if you are using Python plugins for the server, this sets the folder that is searched for Python plugins.

- **DEFAULT_DATUM_TRANSFORM**: Define datum transformations between two projections, e.g. `EPSG:21781/EPSG:2056/100001/-1;EPSG:2056/EPSG:21781/-1/100001` sets the transformation between CH1903 LV03 (EPSG:21781) and CH1903 LV95 (EPSG:2056) and vice versa. You also need to place grid shift `.gsb` files in the directory where proj4 stores the grid shift files, e.g. in `/usr/share/proj`. You need to run `crssync` after you added new `.gsb` files and look up the ID in the `srs.db`. Look at attribute **coord_op_code** of table **tbl_datum_transform** in `srs.db` to find the correct entry.

Short name for layers, groups and project

A number of elements have both a `<Name>` and a `<Title>`. The **Name** is a text string used for machine-to-machine communication while the **Title** is for the benefit of humans.

For example, a dataset might have the descriptive Title "Maximum Atmospheric Temperature" and be requested using the abbreviated Name "ATMAX". User can already set title for layers, groups and project.

OWS name is based on the name used in layer tree. This name is more a label for humans than a name for machine-to-machine communication.

Servidor QGIS soporta:

- short name line edits to layers properties You can change this by right clicking on a layer, choose *Properties → Metadata tab → Description → Short name*.
- WMS data dialog to layer tree group (short name, title, abstract)

  By right clicking on a layer group and selecting the *Set Group WMS data* option you will get:

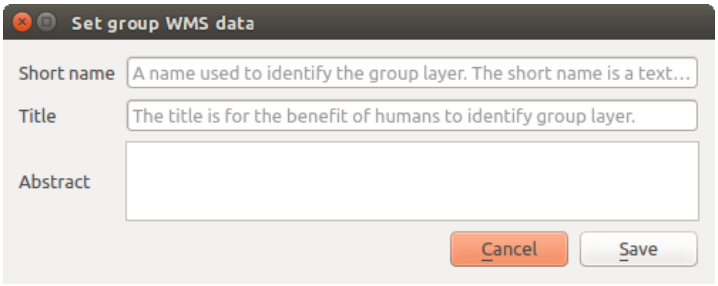

Figure 15.8: Set group WMS data dialog

- short name line edits to project properties - add a regexp validator `"^[A-Za-z][A-Za-z0-9\._-]*"` to short name line edit accessible through a static method
- add a regexp validator `"^[A-Za-z][A-Za-z0-9\._-]*"` to short name line edit accessible through a static method

  You can choose a short name for the project root by going to *Project properties → OWS Server → Service capabilities → Short name*.
- add a `TreeName` element in the `fullProjectSettings`

If a short name has been set for layers, groups or project it is used by QGIS Sever as the layer name.

Connection to service file

In order to make apache aware of the PostgreSQL service file (see the *PostgreSQL Service connection file* section) you need to make your `*.conf` file look like:

```
SetEnv PGSERVICEFILE /home/web/.pg_service.conf

<Directory "/home/web/apps2/bin/">
```

```
  AllowOverride None
.....
```

Add fonts to your linux server

Keep in mind that you may use QGIS projects that point to fonts that may not exist by default on other machines. This means that if you share the project, it may look different on other machines (if the fonts don't exist on the target machine).

In order to ensure this does not happen you just need to install the missing fonts on the target machine. Doing this on desktop systems is usually trivial (double clicking the fonts).

For linux, if you don't have a desktop environment installed (or you prefer the command line) you need to:

- On Debian based systems:

```
$ sudo su
$ mkdir -p /usr/local/share/fonts/truetype/myfonts && cd /usr/local/share/fonts/truetype/myfo

# copy the fonts from their location
$ cp /fonts_location/* .

$ chown root *
$ cd .. && fc-cache -f -v
```

- On Fedora based systems:

```
$ sudo su
$ mkdir /usr/share/fonts/myfonts && cd /usr/share/fonts/myfonts

# copy the fonts from their location
$ cp /fonts_location/* .

$ chown root *
$ cd .. && fc-cache -f -v
```

CHAPTER 16

Trabajar con datos GPS

16.1 Plugin de GPS

16.1.1 ¿Qué es GPS?

GPS, the Global Positioning System, is a satellite-based system that allows anyone with a GPS receiver to find their exact position anywhere in the world. GPS is used as an aid in navigation, for example in airplanes, in boats and by hikers. The GPS receiver uses the signals from the satellites to calculate its latitude, longitude and (sometimes) elevation. Most receivers also have the capability to store locations (known as **waypoints**), sequences of locations that make up a planned **route** and a tracklog or **track** of the receiver's movement over time. Waypoints, routes and tracks are the three basic feature types in GPS data. QGIS displays waypoints in point layers, while routes and tracks are displayed in linestring layers.

Nota: QGIS supports also GNSS receivers. But we keep using the term GPS in this documentation.

16.1.2 Cargando datos GPS desde archivo

There are dozens of different file formats for storing GPS data. The format that QGIS uses is called GPX (GPS eXchange format), which is a standard interchange format that can contain any number of waypoints, routes and tracks in the same file.

To load a GPX file, you first need to load the plugin. *Plugins* → *Plugin Manager...* opens the Plugin Manager Dialog. Activate the *GPS Tools* checkbox. When this plugin is loaded, a button with a small handheld GPS device will show up in the toolbar and in *Layer* → *Create Layer* → :

- Herramientas GPS
- *Create new GPX Layer*

For working with GPS data, we provide an example GPX file available in the QGIS sample dataset: `qgis_sample_data/gps/national_monuments.gpx`. See section *Sample Data* for more information about the sample data.

1. Select *Vector* → *GPS* → *GPS Tools* or click the GPS Tools icon in the toolbar and open the *Load GPX file* tab (see figure_GPS).
2. Browse to the folder `qgis_sample_data/gps/`, select the GPX file `national_monuments.gpx` and click **[Open]**.

Use the **[Browse...]** button to select the GPX file, then use the checkboxes to select the feature types you want to load from that GPX file. Each feature type will be loaded in a separate layer when you click **[OK]**. The file `national_monuments.gpx` only includes waypoints.

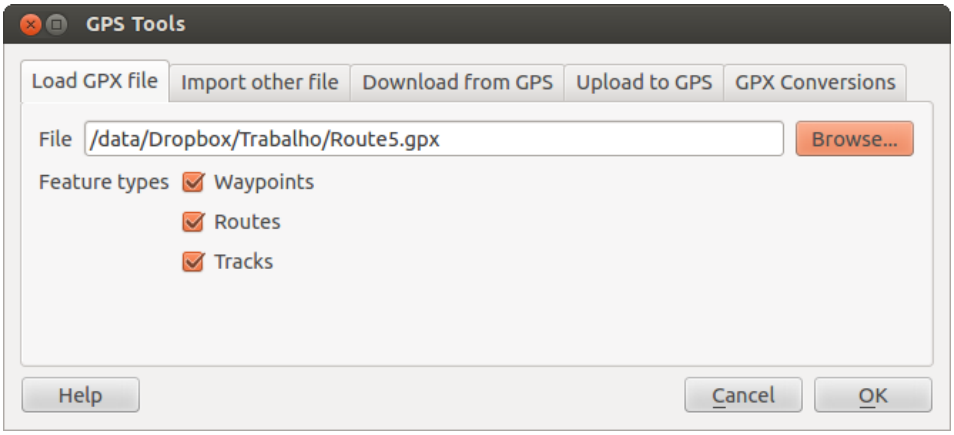

Figure 16.1: La ventana de diálogo *Herramientas GPS*

Nota: GPS units allow you to store data in different coordinate systems. When downloading a GPX file (from your GPS unit or a web site) and then loading it in QGIS, be sure that the data stored in the GPX file uses WGS 84 (latitude/longitude). QGIS expects this, and it is the official GPX specification. See http://www.topografix.com/GPX/1/1/.

16.1.3 GPSBabel

Since QGIS uses GPX files, you need a way to convert other GPS file formats to GPX. This can be done for many formats using the free program GPSBabel, which is available at http://www.gpsbabel.org. This program can also transfer GPS data between your computer and a GPS device. QGIS uses GPSBabel to do these things, so it is recommended that you install it. However, if you just want to load GPS data from GPX files you will not need it. Version 1.2.3 of GPSBabel is known to work with QGIS, but you should be able to use later versions without any problems.

16.1.4 Importando datos GPS

To import GPS data from a file that is not a GPX file, you use the tool *Import other file* in the GPS Tools dialog. Here, you select the file that you want to import (and the file type), which feature type you want to import from it, where you want to store the converted GPX file and what the name of the new layer should be. Note that not all GPS data formats will support all three feature types, so for many formats you will only be able to choose between one or two types.

16.1.5 Downloading GPS data from a device

QGIS can use GPSBabel to download data from a GPS device directly as new vector layers. For this we use the *Download from GPS* tab of the GPS Tools dialog (see Figure_GPS_download). Here, we select the type of GPS device, the port that it is connected to (or USB if your GPS supports this), the feature type that you want to download, the GPX file where the data should be stored, and the name of the new layer.

The device type you select in the GPS device menu determines how GPSBabel tries to communicate with your GPS device. If none of the available types work with your GPS device, you can create a new type (see section *Defining new device types*).

The port may be a file name or some other name that your operating system uses as a reference to the physical port in your computer that the GPS device is connected to. It may also be simply USB, for USB-enabled GPS units.

- On Linux, this is something like `/dev/ttyS0` or `/dev/ttyS1`.
- On Windows, it is `COM1` or `COM2`.

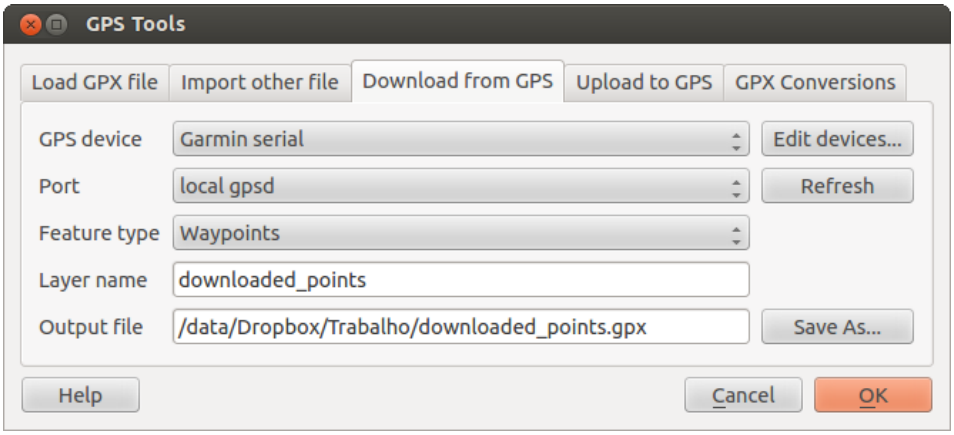

Figure 16.2: La herramienta de descarga

When you click **[OK]**, the data will be downloaded from the device and appear as a layer in QGIS.

16.1.6 Uploading GPS data to a device

You can also upload data directly from a vector layer in QGIS to a GPS device using the *Upload to GPS* tab of the GPS Tools dialog. To do this, you simply select the layer that you want to upload (which must be a GPX layer), your GPS device type, and the port (or USB) that it is connected to. Just as with the download tool, you can specify new device types if your device isn't in the list.

This tool is very useful in combination with the vector-editing capabilities of QGIS. It allows you to load a map, create waypoints and routes, and then upload them and use them on your GPS device.

16.1.7 Defining new device types

There are lots of different types of GPS devices. The QGIS developers can't test all of them, so if you have one that does not work with any of the device types listed in the *Download from GPS* and *Upload to GPS* tools, you can define your own device type for it. You do this by using the GPS device editor, which you start by clicking the **[Edit devices]** button in the download or the upload tab.

To define a new device, you simply click the **[New device]** button, enter a name, enter download and upload commands for your device, and click the **[Update device]** button. The name will be listed in the device menus in the upload and download windows – it can be any string. The download command is the command that is used to download data from the device to a GPX file. This will probably be a GPSBabel command, but you can use any other command line program that can create a GPX file. QGIS will replace the keywords `%type`, `%in`, and `%out` when it runs the command.

`%type` will be replaced by `-w` if you are downloading waypoints, `-r` if you are downloading routes and `-t` if you are downloading tracks. These are command-line options that tell GPSBabel which feature type to download.

`%in` will be replaced by the port name that you choose in the download window and `%out` will be replaced by the name you choose for the GPX file that the downloaded data should be stored in. So, if you create a device type with the download command `gpsbabel %type -i garmin -o gpx %in %out` (this is actually the download command for the predefined device type 'Garmin serial') and then use it to download waypoints from port `/dev/ttyS0` to the file `output.gpx`, QGIS will replace the keywords and run the command `gpsbabel -w -i garmin -o gpx /dev/ttyS0 output.gpx`.

The upload command is the command that is used to upload data to the device. The same keywords are used, but `%in` is now replaced by the name of the GPX file for the layer that is being uploaded, and `%out` is replaced by the port name.

You can learn more about GPSBabel and its available command line options at http://www.gpsbabel.org.

Once you have created a new device type, it will appear in the device lists for the download and upload tools.

16.1.8 Download of points/tracks from GPS units

As described in previous sections QGIS uses GPSBabel to download points/tracks directly in the project. QGIS comes out of the box with a pre-defined profile to download from Garmin devices. Unfortunately there is a bug #6318 that does not allow create other profiles, so downloading directly in QGIS using the GPS Tools is at the moment limited to Garmin USB units.

Garmin GPSMAP 60cs

MS Windows

Install the Garmin USB drivers from http://www8.garmin.com/support/download_details.jsp?id=591

Connect the unit. Open GPS Tools and use `type=garmin serial` and `port=usb:` Fill the fields *Layer name* and *Output file*. Sometimes it seems to have problems saving in a certain folder, using something like `c:\temp` usually works.

Ubuntu/Mint GNU/Linux

It is first needed an issue about the permissions of the device, as described at https://wiki.openstreetmap.org/wiki/USB_Garmin_on_GNU/Linux. You can try to create a file `/etc/udev/rules.d/51-garmin.rules` containing this rule

```
ATTRS{idVendor}=="091e", ATTRS{idProduct}=="0003", MODE="666"
```

After that is necessary to be sure that the `garmin_gps` kernel module is not loaded

```
rmmod garmin_gps
```

and then you can use the GPS Tools. Unfortunately there seems to be a bug #7182 and usually QGIS freezes several times before the operation work fine.

BTGP-38KM datalogger (only Bluetooth)

MS Windows

The already referred bug does not allow to download the data from within QGIS, so it is needed to use GPSBabel from the command line or using its interface. The working command is

```
gpsbabel -t -i skytraq,baud=9600,initbaud=9600 -f COM9 -o gpx -F C:/GPX/aaa.gpx
```

Ubuntu/Mint GNU/Linux

Use same command (or settings if you use GPSBabel GUI) as in Windows. On Linux it maybe somehow common to get a message like

```
skytraq: Too many read errors on serial port
```

it is just a matter to turn off and on the datalogger and try again.

BlueMax GPS-4044 datalogger (both BT and USB)

MS Windows

Nota: Se necesita instalar los controladores antes de usarlo en Windows 7. Vea el sitio del fabricante para la descarga apropiada.

Downloading with GPSBabel, both with USB and BT returns always an error like

```
gpsbabel -t -i mtk -f COM12 -o gpx -F C:/temp/test.gpx
mtk_logger: Can't create temporary file data.bin
Error running gpsbabel: Process exited unsuccessfully with code 1
```

Ubuntu/Mint GNU/Linux

Con USB

After having connected the cable use the `dmesg` command to understand what port is being used, for example `/dev/ttyACM3`. Then as usual use GPSBabel from the CLI or GUI

```
gpsbabel -t -i mtk -f /dev/ttyACM3 -o gpx -F /home/user/bluemax.gpx
```

Con Bluetooth

Use Blueman Device Manager to pair the device and make it available through a system port, then run GPSBabel

```
gpsbabel -t -i mtk -f /dev/rfcomm0 -o gpx -F /home/user/bluemax_bt.gpx
```

16.2 Seguimiento de GPS en Vivo

To activate live GPS tracking in QGIS, you need to select *Settings* → *Panels* *GPS information*. You will get a new docked window on the left side of the canvas.

There are four possible screens in this GPS tracking window:

- GPS position coordinates and an interface for manually entering vertices and features
- GPS signal strength of satellite connections
- GPS polar screen showing number and polar position of satellites
- GPS options screen (see figure_gps_options)

With a plugged-in GPS receiver (has to be supported by your operating system), a simple click on **[Connect]** connects the GPS to QGIS. A second click (now on **[Disconnect]**) disconnects the GPS receiver from your computer. For GNU/Linux, gpsd support is integrated to support connection to most GPS receivers. Therefore, you first have to configure gpsd properly to connect QGIS to it.

> **Advertencia:** If you want to record your position to the canvas, you have to create a new vector layer first and switch it to editable status to be able to record your track.

16.2.1 Posición y atributos adicionales

If the GPS is receiving signals from satellites, you will see your position in latitude, longitude and altitude together with additional attributes.

16.2.2 Fuerza de la señal GPS

Here, you can see the signal strength of the satellites you are receiving signals from.

16.2.3 GPS polar window

If you want to know where in the sky all the connected satellites are, you have to switch to the polar screen. You can also see the ID numbers of the satellites you are receiving signals from.

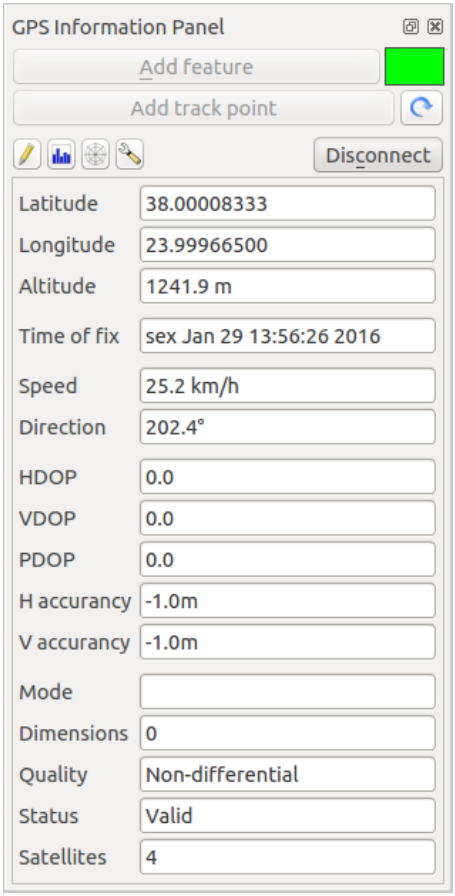

Figure 16.3: GPS tracking position and additional attributes

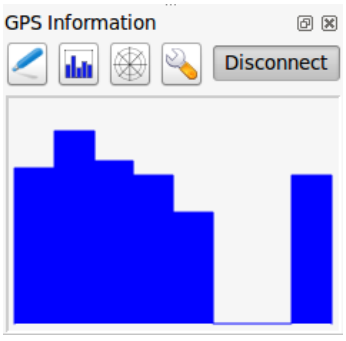

Figure 16.4: GPS tracking signal strength

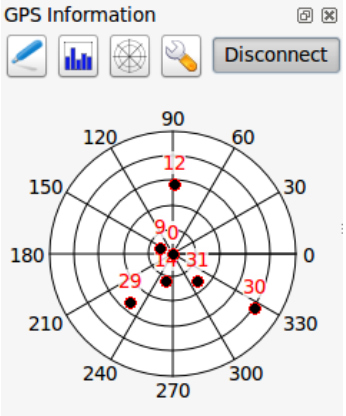

Figure 16.5: GPS tracking polar window

16.2.4 Opciones GPS

In case of connection problems, you can switch between:

- *Autodetect*
- *Internal*
- *Serial device*
- *gpsd* (selecting the Host, Port and Device your GPS is connected to)

A click on **[Connect]** again initiates the connection to the GPS receiver.

You can activate *Automatically save added features* when you are in editing mode. Or you can activate *Automatically add points* to the map canvas with a certain width and color.

Activating *Cursor*, you can use a slider to shrink and grow the position cursor on the canvas.

Activating *Map centering* allows you to decide in which way the canvas will be updated. This includes 'always', 'when leaving', if your recorded coordinates start to move out of the canvas, or 'never', to keep map extent.

Finally, you can activate *Log file* and define a path and a file where log messages about the GPS tracking are logged.

If you want to set a feature manually, you have to go back to Position and click on **[Add Point]** or **[Add track point]**.

16.2.5 Connect to a Bluetooth GPS for live tracking

With QGIS you can connect a Bluetooth GPS for field data collection. To perform this task you need a GPS Bluetooth device and a Bluetooth receiver on your computer.

At first you must let your GPS device be recognized and paired to the computer. Turn on the GPS, go to the Bluetooth icon on your notification area and search for a New Device.

On the right side of the Device selection mask make sure that all devices are selected so your GPS unit will probably appear among those available. In the next step a serial connection service should be available, select it and click on **[Configure]** button.

Remember the number of the COM port assigned to the GPS connection as resulting by the Bluetooth properties.

After the GPS has been recognized, make the pairing for the connection. Usually the authorization code is `0000`.

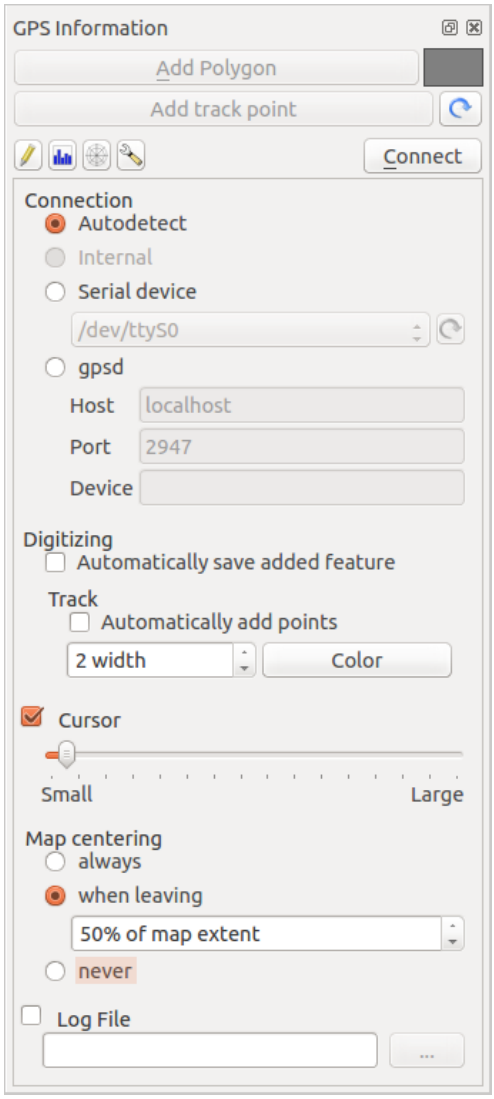

Figure 16.6: GPS tracking options window

Now open *GPS information* panel and switch to GPS options screen. Select the COM port assigned to the GPS connection and click the **[Connect]**. After a while a cursor indicating your position should appear.

If QGIS can't receive GPS data, then you should restart your GPS device, wait 5-10 seconds then try to connect again. Usually this solution work. If you receive again a connection error make sure you don't have another Bluetooth receiver near you, paired with the same GPS unit.

16.2.6 Utilizando GPSMAP 60cs

MS Windows

Easiest way to make it work is to use a middleware (freeware, not open) called GPSGate.

Launch the program, make it scan for GPS devices (works for both USB and BT ones) and then in QGIS just click **[Connect]** in the Live tracking panel using the *Autodetect* mode.

Ubuntu/Mint GNU/Linux

Para Windows la formas más fácil es usar un servidor en medio, en este caso GPSD, de manera

```
sudo apt-get install gpsd
```

Then load the `garmin_gps` kernel module

```
sudo modprobe garmin_gps
```

And then connect the unit. Then check with `dmesg` the actual device being used bu the unit, for example `/dev/ttyUSB0`. Now you can launch gpsd

```
gpsd /dev/ttyUSB0
```

Y finalmente conectar con la herramienta de rastreo en vivo QGIS.

16.2.7 Using BTGP-38KM datalogger (only Bluetooth)

Using GPSD (under Linux) or GPSGate (under Windows) is effortless.

16.2.8 Using BlueMax GPS-4044 datalogger (both BT and USB)

MS Windows

The live tracking works for both USB and BT modes, by using GPSGate or even without it, just use the *Autodetect* mode, or point the tool the right port.

Ubuntu/Mint GNU/Linux

Para USB

The live tracking works both with GPSD

```
gpsd /dev/ttyACM3
```

or without it, by connecting the QGIS live tracking tool directly to the device (for example `/dev/ttyACM3`).

Para Bluetooth

The live tracking works both with GPSD

```
gpsd /dev/rfcomm0
```

or without it, by connecting the QGIS live tracking tool directly to the device (for example `/dev/rfcomm0`).

CHAPTER 17

Sistema de autenticación

17.1 Authentication System Overview

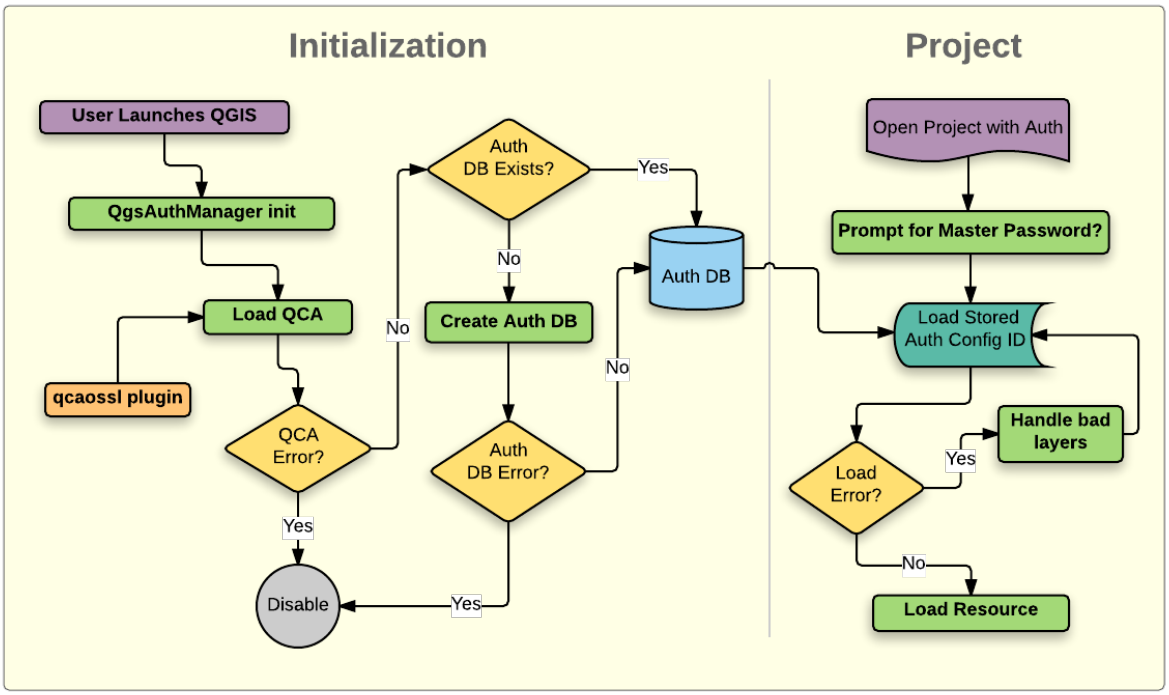

Figure 17.1: Anatomy of authentication system

17.1.1 Base de datos de autenticación

The new authentication system stores authentication configurations in an SQLite database file located, by default, at `<user home>/.qgis2/qgis-auth.db`.

This authentication database can be moved between QGIS installations without affecting other current QGIS user preferences, as it is completely separate from normal QGIS settings. A configuration ID (a random 7-character alphanumeric string) is generated when initially storing a configuration to the database. This represents the configuration, thereby allowing the ID to be stored in plain text application components, (such as project, plugin, or settings files) without disclosure of its associated credentials.

Nota: The parent directory of the *qgis-auth.db* can be set using the following environment variable, `QGIS_AUTH_DB_DIR_PATH`, or set on the command line during launch with the `--authdbdirectory` option.

17.1.2 Contraseña maestra

To store or access sensitive information within the database, a user must define a *master password*. A new master password is requested and verified when initially storing any encrypted data to the database. Only when sensitive information is accessed is the user prompted for the master password, which is then cached for the remainder of the session (until application is quit), unless the user manually chooses an action to clear its cached value. Some instances of using the authentication system do not require input of the master password, such as when selecting an existing authentication configuration, or applying a configuration to a server configuration (such as when adding a WMS layer).

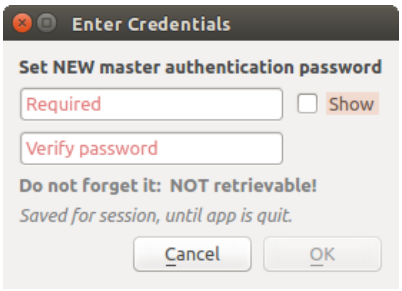

Figure 17.2: Input new master password

Nota: A path to a file containing the master password can be set using the following environment variable, `QGIS_AUTH_PASSWORD_FILE`.

Managing the master password

Once set, the master password can be reset; the current master password will be needed prior to resetting. During this process, there is an option to generate a complete backup of the current database.

Figure 17.3: Restablecer contraseña maestra

If the user forgets the master password, there is no way to retrieve or override it. There is also no means of retrieving encrypted information without knowing the master password.

If a user inputs their existing password incorrectly three times, the dialog will offer to erase the database.

17.1.3 Configuraciones de autenticación

You can manage authentication configurations from *Configurations* in the *Authentication* tab of the QGIS Options dialog (*Settings* → *Options*).

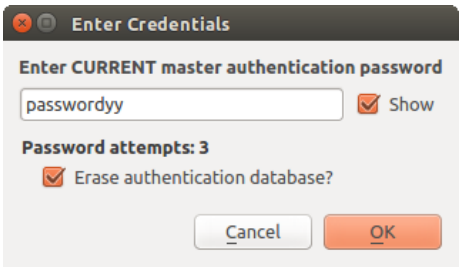

Figure 17.4: Password prompt after three invalid attempts

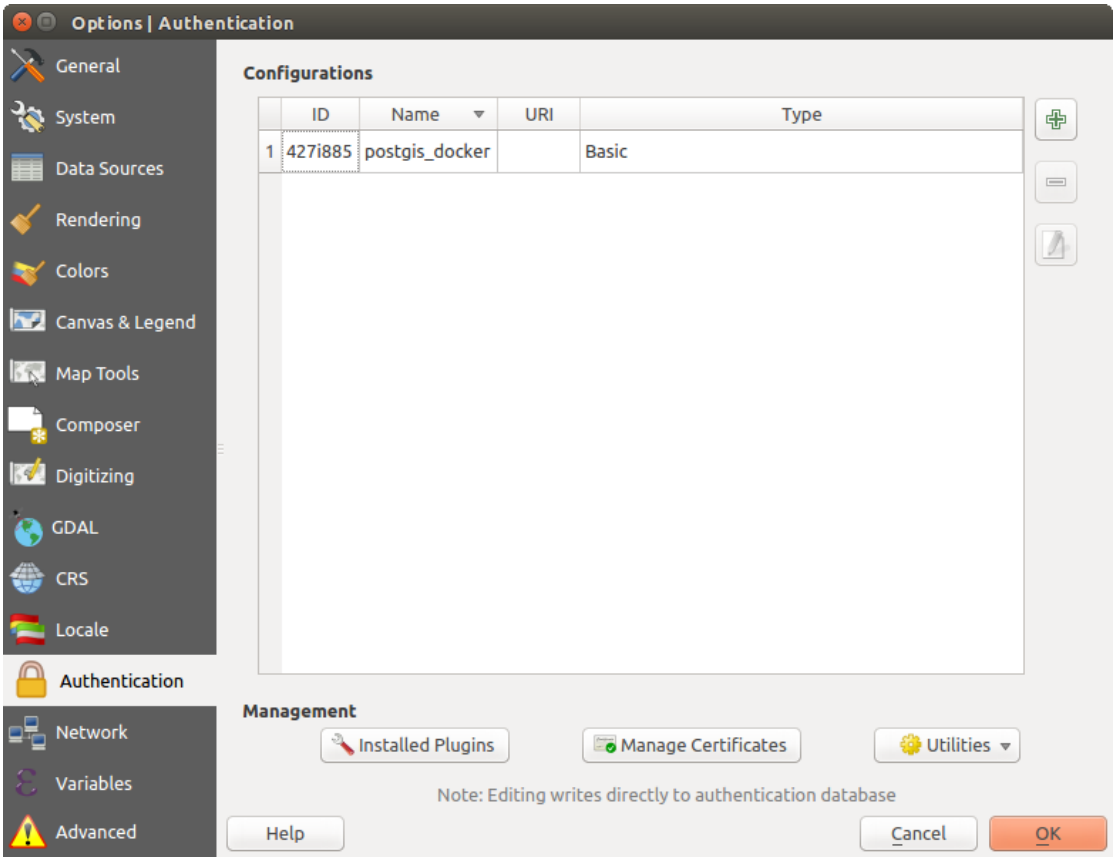

Figure 17.5: Configurations editor

Use the button to add a new configuration, the button to remove configurations, and the button to modify existing ones.

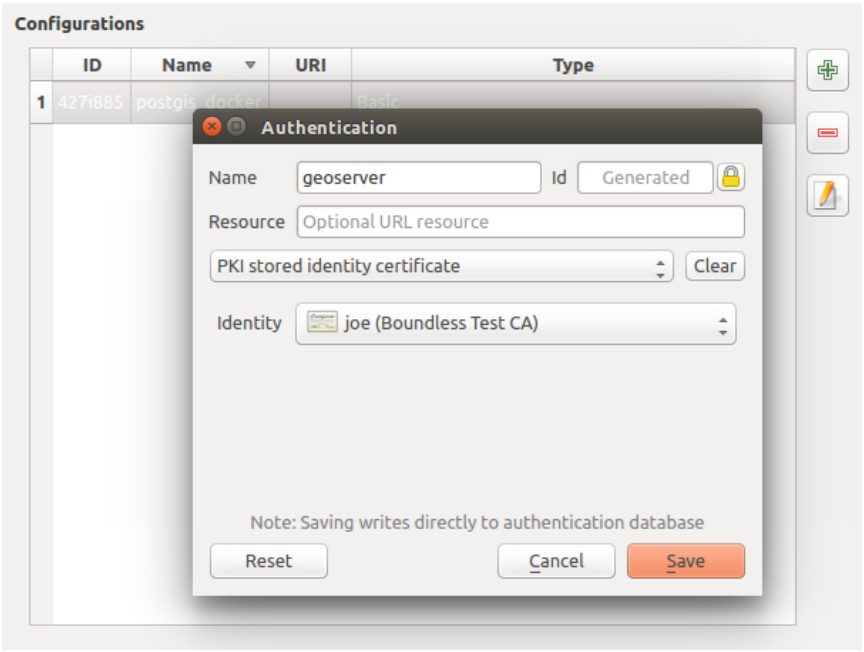

Figure 17.6: Adding config from within Configuration editor

The same type of operations for authentication configuration management (Add, Edit and Remove) can be done when configuring a given service connection, such as configuring an OWS service connection. For that, there are action buttons within the configuration selector for fully managing configurations found within the authentication database. In this case, there is no need to go to the *configurations* in *Authentication* tab of QGIS options unless you need to do more comprehensive configuration management.

When creating or editing an authentication configuration, the info required is a name, an authentication method and any other info that the authentication method requires (see more about the available authentication types in *Métodos de autenticación*).

17.1.4 Métodos de autenticación

Available authentications are provided by C++ plugins much in the same way data provider plugins are supported by QGIS. The method of authentication that can be selected is relative to the access needed for the resource/provider, e.g. HTTP(S) or database, and whether there is support in both QGIS code and a plugin. As such, some authentication method plugins may not be applicable everywhere an authentication configuration selector is shown. A list of available authentication method plugins and their compatible resource/providers can be accessed going to *Settings* → *Options* and, in the *Authentication* tab, click the **[Installed plugins]** button.

Plugins can be created for new authentication methods that do not require QGIS to be recompiled. Since the support for plugins is currently (since QGIS 2.12) C++-only, QGIS will need to be restarted for the new dropped-in plugin to become available to the user. Ensure your plugin is compiled against the same target version of QGIS if you intend to add it to an existing target install.

Nota: The Resource URL is currently an *unimplemented* feature that will eventually allow a particular configuration to be auto-chosen when connecting to resources at a given URL.

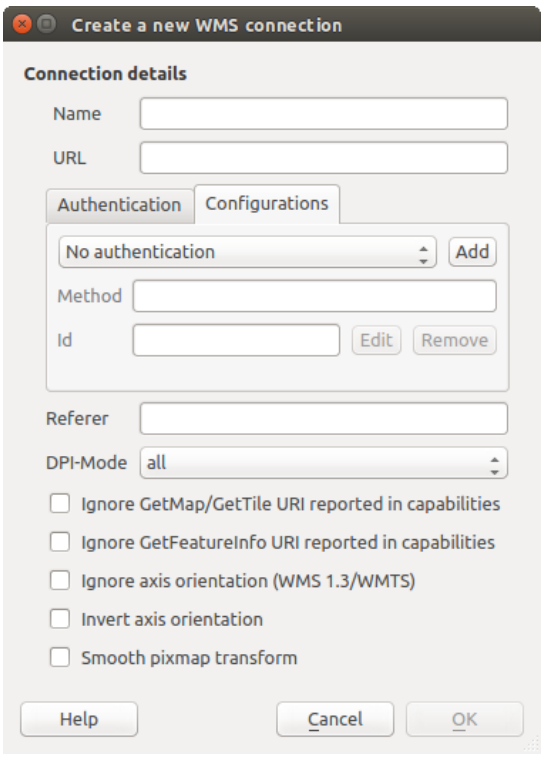

Figure 17.7: WMS connection dialog showing **[Add]**, **[Edit]**, and **[Remove]** authentication configuration buttons

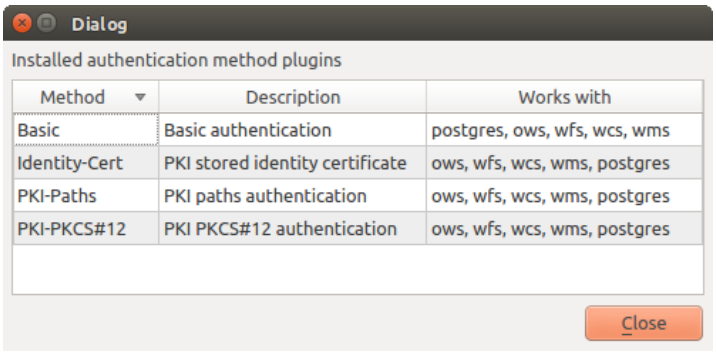

Figure 17.8: Available method plugins list

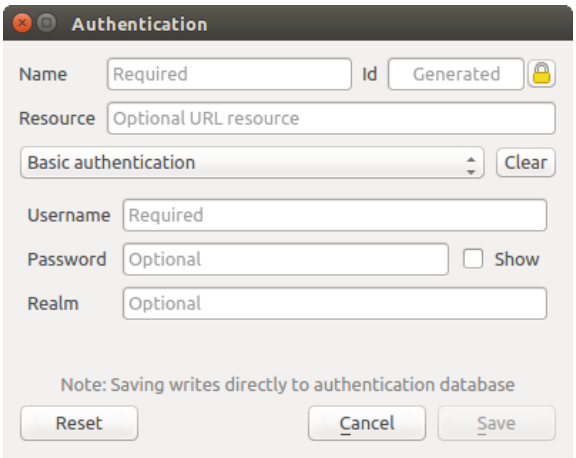

Figure 17.9: Basic HTTP authentication configs

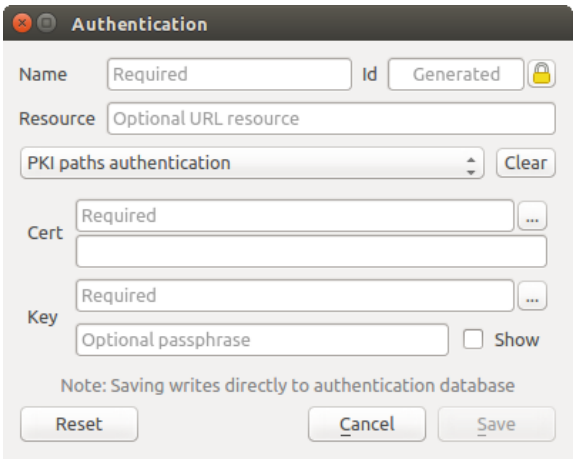

Figure 17.10: PKI paths authentication configs

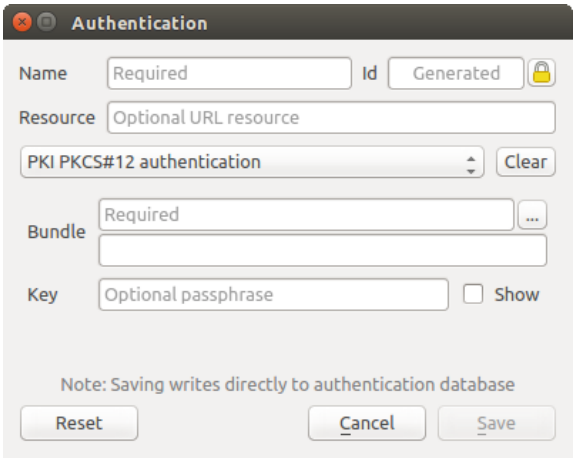

Figure 17.11: PKI PKCS#12 file paths authentication configs

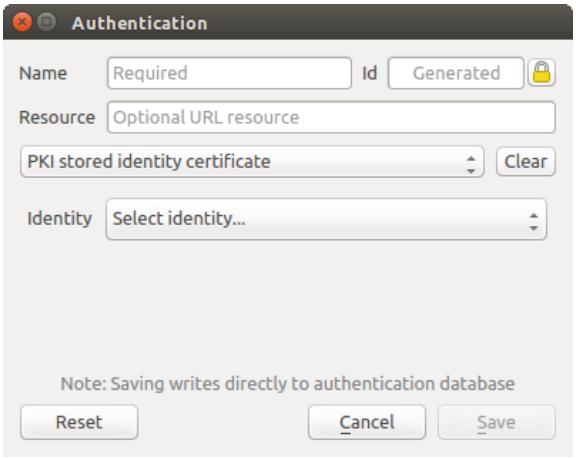

Figure 17.12: Stored Identity authentication configs

17.1.5 Master Password and Auth Config Utilities

Under the Options menu (*Settings* → *Options*) in the *Authentication* tab, there are several utility actions to manage the authentication database and configurations:

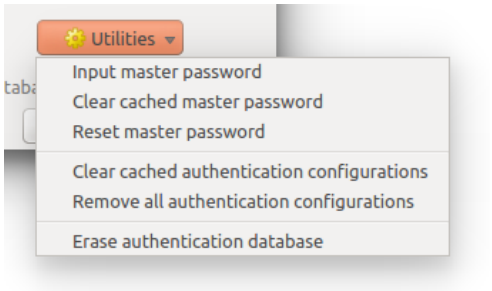

Figure 17.13: Menú utilidades

- **Input master password**:
  - Opens the master password input dialog, independent of performing any authentication database command. Clear cached master password
  - Unsets the master password if it has been set via input dialog. Reset master password
  - Opens a dialog to change the master password (the current password must be known) and optionally back up the current database.
- **Clear cached authentication configurations**: Clears the internal lookup cache for configurations used to speed up network connections. This does not clear QGIS's core network access manager's cache, which requires a relaunch of QGIS.
- **Reset master password**: Replaces the current master password for a new one. The current master password will be needed prior to resetting and a backup of database can be done.
- **Remove all authentication configurations**: Clears the database of all configuration records, without removing other stored records.
- **Erase authentication database**: Schedules a backup of the current database and complete rebuild of the database table structure. These actions are scheduled for a later time, so as to ensure other operations like project loading do not interrupt the operation or cause errors due to a temporarily missing database.

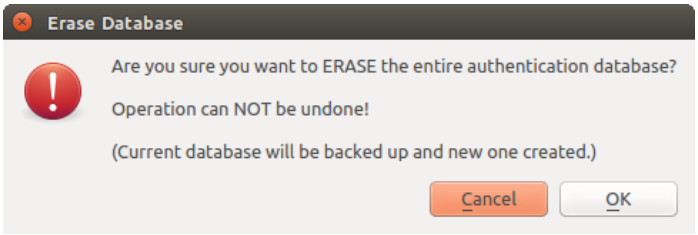

Figure 17.14: DB erase verification menu

17.1.6 Using authentication configurations

Typically, an authentication configuration is selected in a configuration dialog for a network services (such as WMS). However, the selector widget can be embedded anywhere authentication is needed or in non-core functionality, like in third-party PyQGIS or C++ plugins.

When using the selector, *No authentication* is displayed in the pop-up menu control when nothing is selected, when there are no configurations to choose from, or when a previously assigned configuration can no longer be

found in the database. The *Type* and *Id* fields are read-only and provide a description of the authentication method and the config's ID respectively.

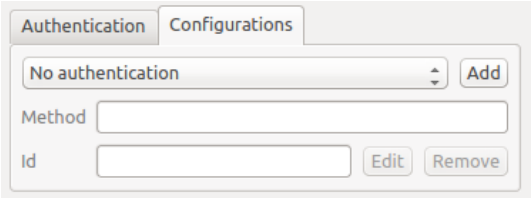

Figure 17.15: Authentication configuration selector with no authentication

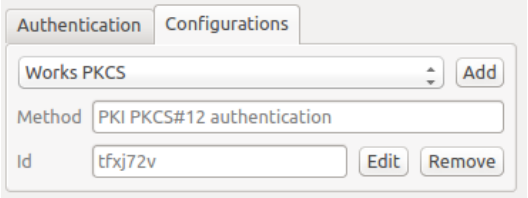

Figure 17.16: Authentication configuration selector with selected config

17.1.7 Python bindings

All classes and public functions have sip bindings, except `QgsAuthCrypto`, since management of the master password hashing and auth database encryption should be handled by the main app, and not via Python. See *Consideraciones de Seguridad* concerning Python access.

17.2 User Authentication Workflows

17.2.1 Autenticación HTTP(S)

One of the most common resource connections is via HTTP(S), e.g. web mapping servers, and authentication method plugins often work for these types of connections. Method plugins have access to the HTTP request object and can manipulate both the request as well as its headers. This allows for many forms of internet-based authentication. When connecting via HTTP(S) using the standard username/password authentication method will attempt HTTP BASIC authentication upon connection.

17.2.2 Base de datos de autenticación

Connections to database resources are generally stored as `key=value` pairs, which will expose usernames and (optionally) passwords, if *not* using an authentication configuration. When configuring with the new auth system, the `key=value` will be an abstracted representation of the credentials, e.g. `authfg=81t21b9`.

17.2.3 PKI authentication

When configuring PKI components within the authentication system, you have the option of importing components into the database or referencing component files stored on your filesystem. The latter may be useful if such components change frequently, or where the components will be replaced by a system administrator. In either instance you will need to store any passphrase needed to access private keys within the database.

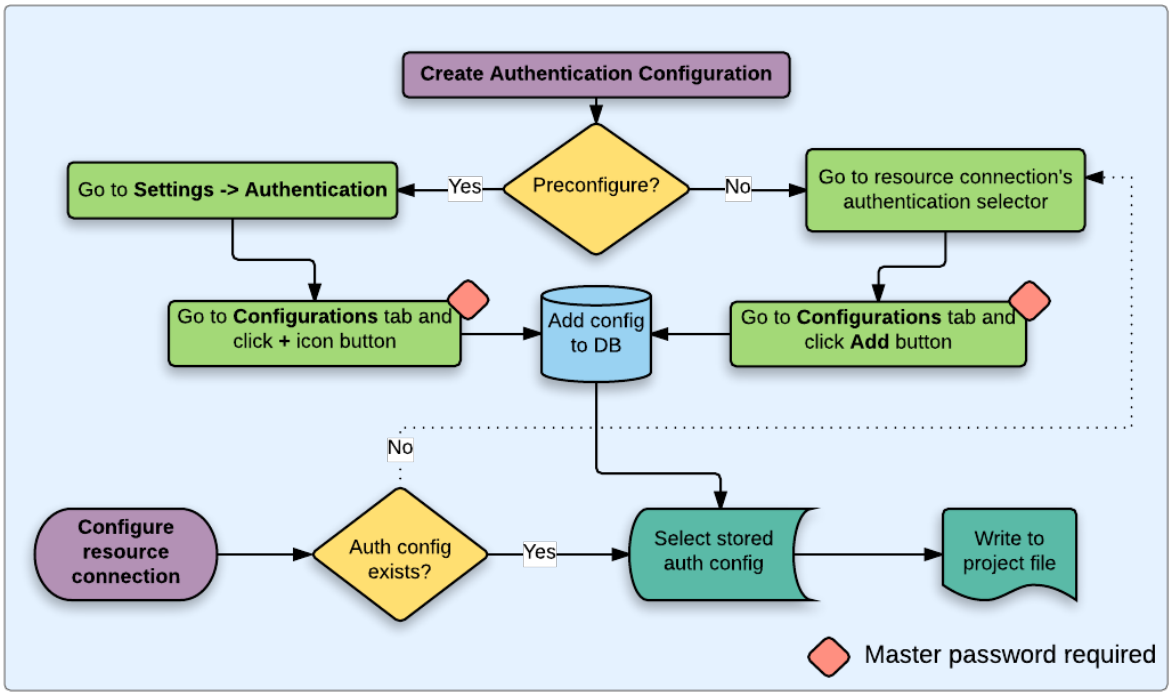

Figure 17.17: Generic user workflow

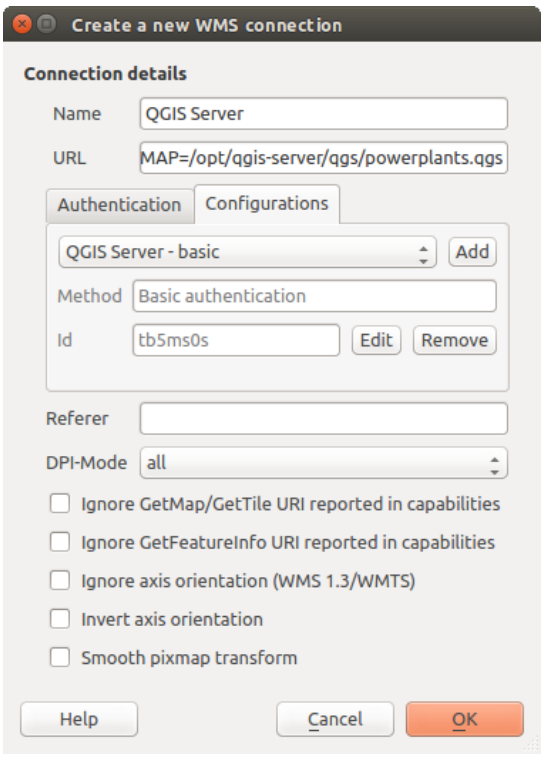

Figure 17.18: Configuring a WMS connection for HTTP BASIC

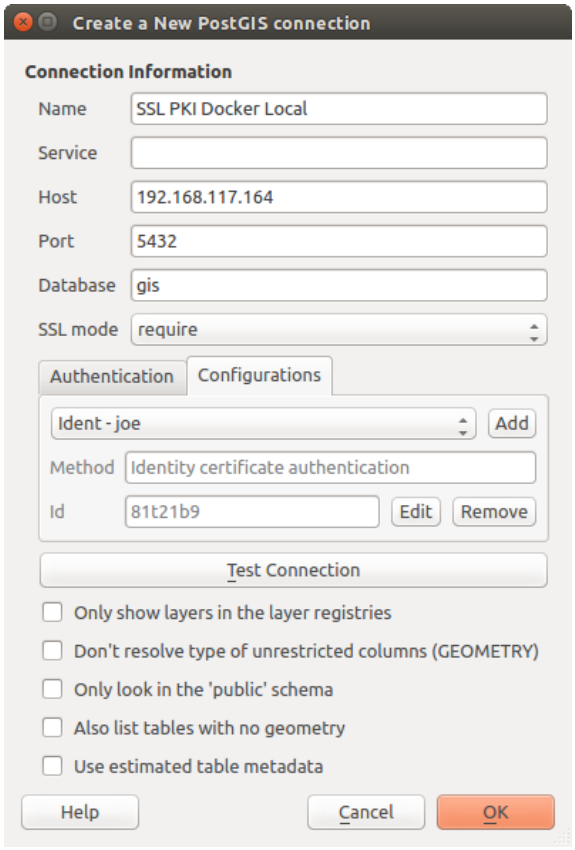

Figure 17.19: Configuring a Postgres SSL-with-PKI connection

All PKI components can be managed in separate editors within the **Certificate Manager**, which can be accessed in the *Authentication* tab in QGIS *Options* dialog (*Settings* → *Options*) by clicking the **[Manage certificates]** button.

In the *Certificate Manager*, there are editors for **Identities**, **Servers** and **Authorities**. Each of these are contained in their own tabs, and are described below in the order they are encountered in the workflow chart above. The tab order is relative to frequently accessed editors once you are accustomed to the workflow.

Nota: Because all authentication system edits write immediately to the authentication database, there is no need to click the *Options* dialog **[OK]** button for any changes to be saved. This is unlike other settings in the Options dialog.

Autoridades

You can manage available Certificate Authorities (CAs) from the **Authorities** tab in the **Certificate manager** from the **Authentication** tab of the QGIS **Options** dialog.

As referenced in the workflow chart above, the first step is to import or reference a file of CAs. This step is optional, and may be unnecessary if your PKI trust chain originates from root CAs already installed in your operating system (OS), such as a certificate from a commercial certificate vendor. If your authenticating root CA is not in the OS's trusted root CAs, it will need to be imported or have its file system path referenced. (Contact your system administrator if unsure.)

By default, the root CAs from your OS are available; however, their trust settings are not inherited. You should review the certificate trust policy settings, especially if your OS root CAs have had their policies adjusted. Any certificate that is expired will be set to untrusted and will not be used in secure server connections, unless you specifically override its trust policy. To see the QGIS-discoverable trust chain for any certificate, select it and click the Show information for certificate.

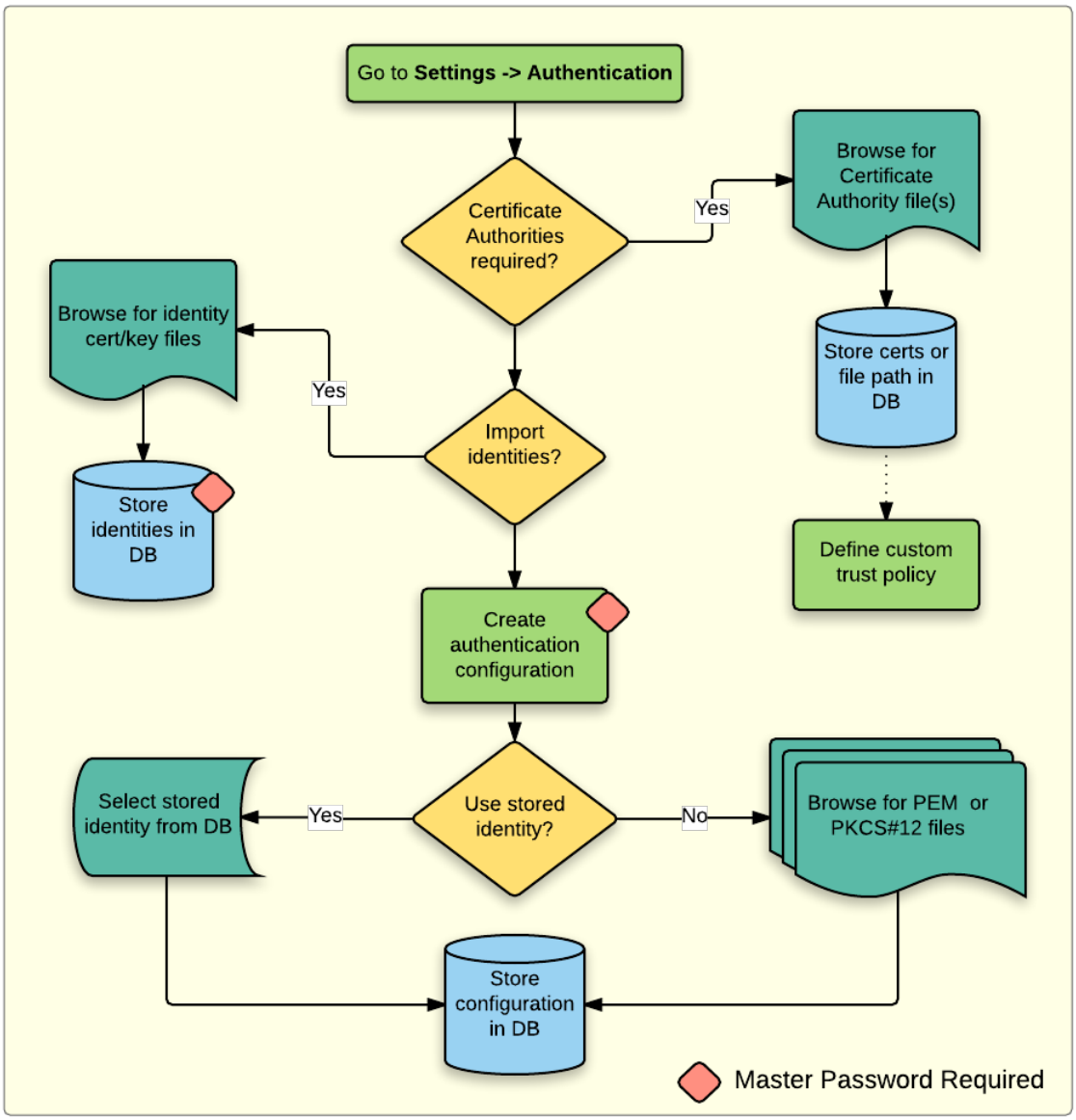

Figure 17.20: PKI configuration workflow

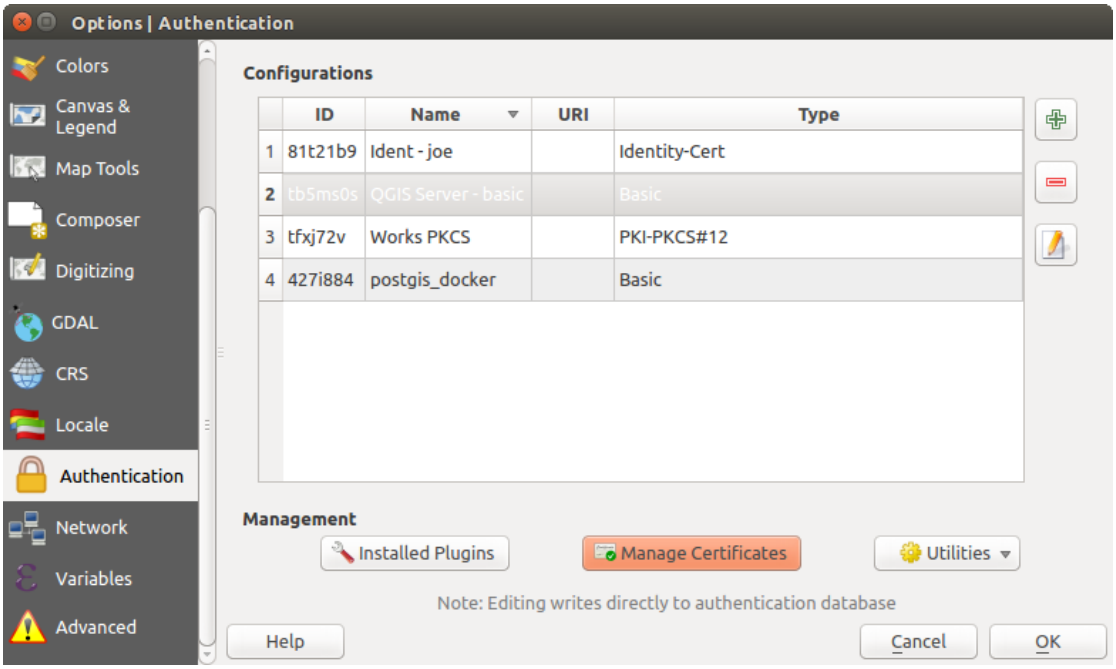

Figure 17.21: Opening the Certificate Manager

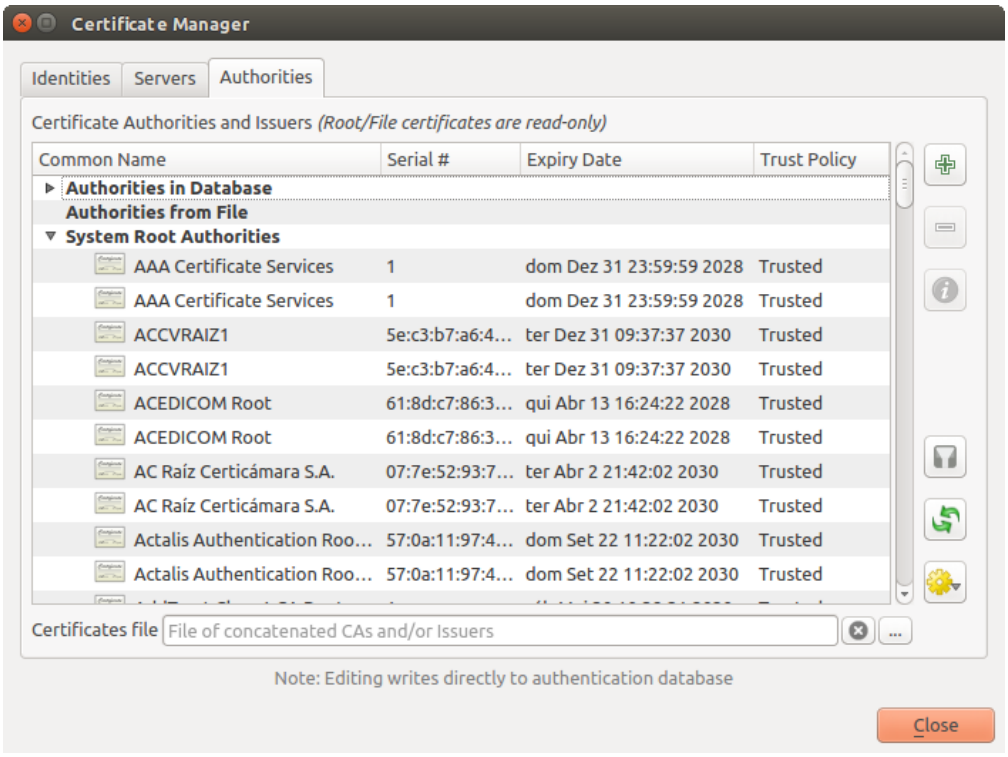

Figure 17.22: Editor de autoridades

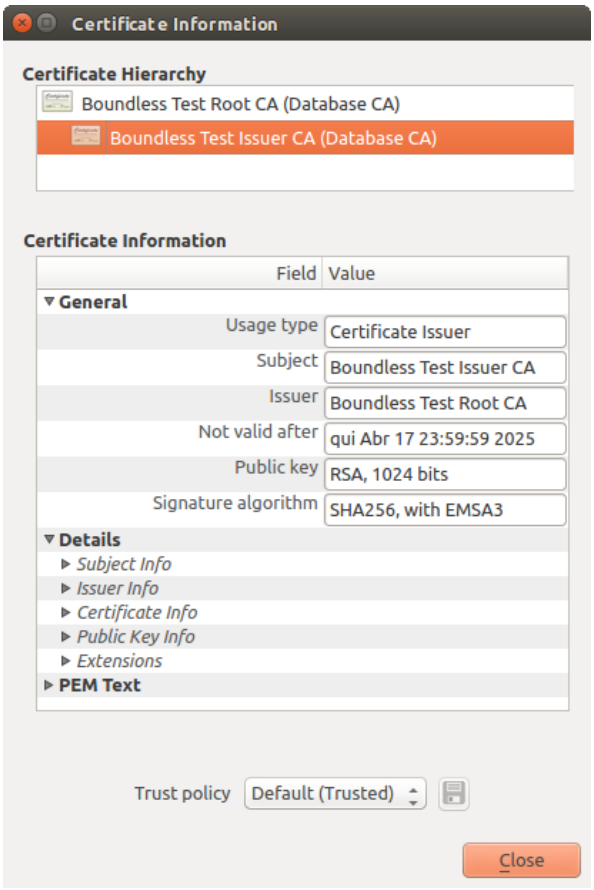

Figure 17.23: Dialogo de Información del certificado

You can edit the *trust policy* for any selected certificate within the chain. Any change in trust policy to a selected certificate will not be saved to the database unless the Save certificate trust policy change to database button is clicked *per* selected certification. Closing the dialog will **not** apply the policy changes.

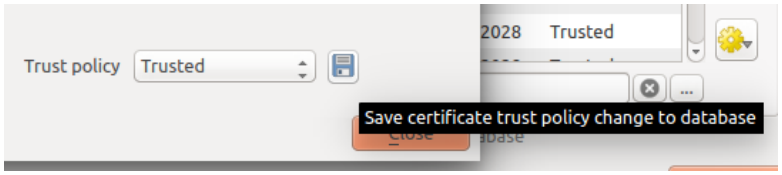

Figure 17.24: Saving the trust policy changes

You can review the filtered CAs, both intermediate and root certificates, that will be trusted for secure connections or change the default trust policy by clicking the **Options** button.

Advertencia: Changing the default trust policy may result in problems with secure connections.

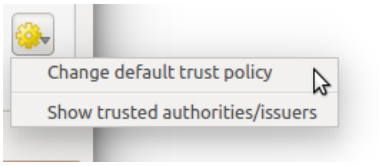

Figure 17.25: Authorities options menu

You can import CAs or save a file system path from a file that contains multiple CAs, or import individual CAs. The standard PEM format for files that contain multiple CA chain certifications has the root cert at the bottom of the file and all subsequently signed child certificates above, towards the beginning of the file.

The CA certificate import dialog will find all CA certificates within the file, regardless of order, and also offers the option to import certificates that are considered invalid (in case you want to override their trust policy). You can override the trust policy upon import, or do so later within the **Authorities** editor.

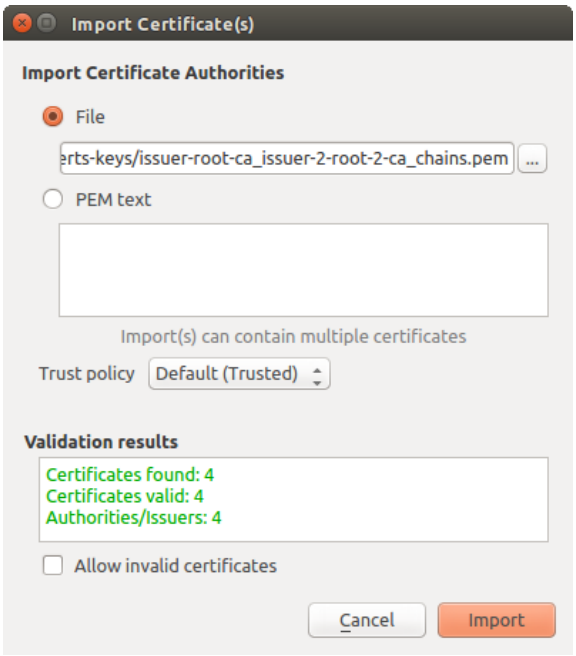

Figure 17.26: Import certificates dialog

Nota: If you are pasting certificate information into the *PEM text* field, note that encrypted certificates are not supported.

Identidades

You can manage available client identity bundles from the *Identities* tab in the *Certificate manager* from the **Authentication** tab of the QGIS **Options** dialog. An identity is what authenticates you against a PKI-enabled service and usually consists of a client certificate and private key, either as separate files or combined into a single "bundled" file. The bundle or private key is often passphrase-protected.

Once you have any Certificate Authorities (CAs) imported you can optionally import any identity bundles into the authentication database. If you do not wish to store the identities, you can reference their component file system paths within an individual authentication configuration.

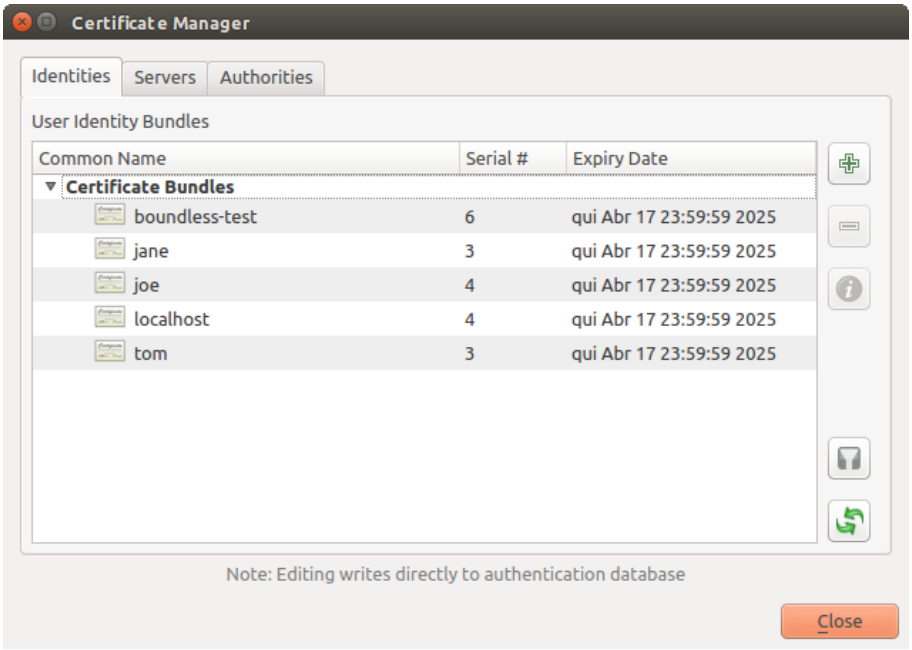

Figure 17.27: Identities editor

When importing an identity bundle, it can be passphrase-protected or unprotected, and can contain CA certificates forming a trust chain. Trust chain certifications will not be imported here; they can be added separately under the *Authorities* tab.

Upon import the bundle's certificate and private key will be stored in the database, with the key's storage encrypted using the QGIS master password. Subsequent usage of the stored bundle from the database will only require input of the master password.

Personal identity bundles consisting of PEM/DER (.pem/.der) and PKCS#12 (.p12/.pfx) components are supported. If a key or bundle is passphrase-protected, the password will be required to validate the component prior to import. Likewise, if the client certificate in the bundle is invalid (for example, its effective date has not yet started or has elapsed) the bundle can not be imported.

17.2.4 Handling bad layers

Occasionally, the authentication configuration ID that is saved with a project file is no longer valid, possibly because the current authentication database is different than when the project was last saved, or due to a credentials mismatch. In such cases the *Handle bad layers* dialog will be presented upon QGIS launch.

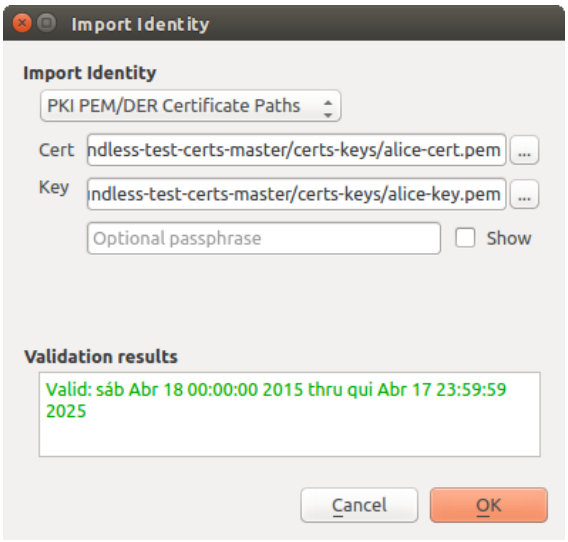

Figure 17.28: PEM/DER identity import

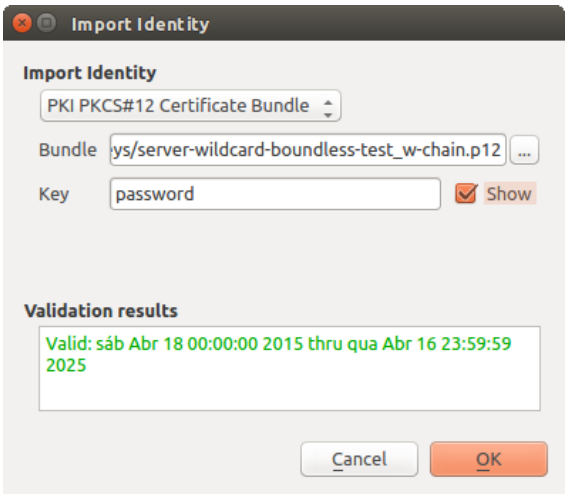

Figure 17.29: PKCS#12 identity import

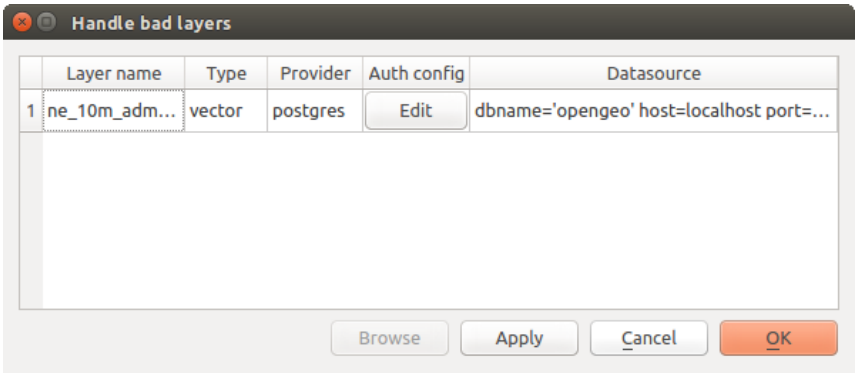

Figure 17.30: Handle bad layers with authentication

If a data source is found to have an authentication configuration ID associated with it, you will be able to edit it. Doing so will automatically edit the data source string, much in the same way as opening the project file in a text editor and editing the string.

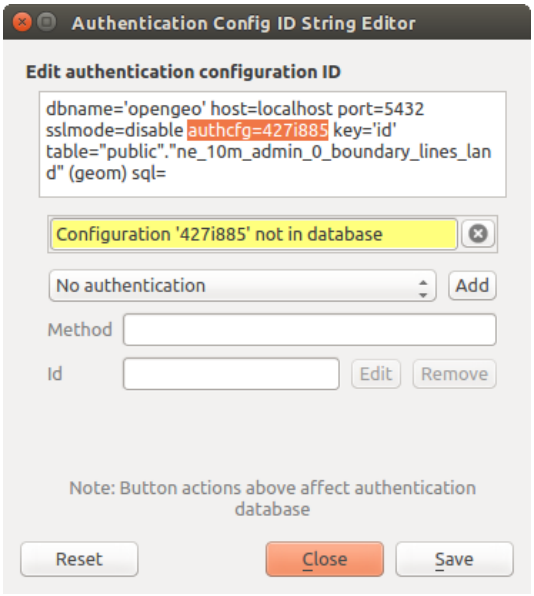

Figure 17.31: Editar ID de configuración de la autenticación

17.2.5 Changing authentication config ID

Occasionally, you will need to change the authenticationn configuration ID that is associated with accessing a resource. There are instances where this is useful:

- **Resource auth config ID is no longer valid**: This can occur when you have switched auth databases add need to *align* a new configuration to the ID already associated with a resource.
- **Shared project files**: If you intended to share projects between users, e.g. via a shared file server, you can *predefine* a 7-character (containing **a-z** and/or **0-9**) that is associated with the resource. Then, individual users change the ID of an authentication configuration that is specific to their credentials of the resource. When the project is opened, the ID is found in the authentication database, but the credentials are different per user.

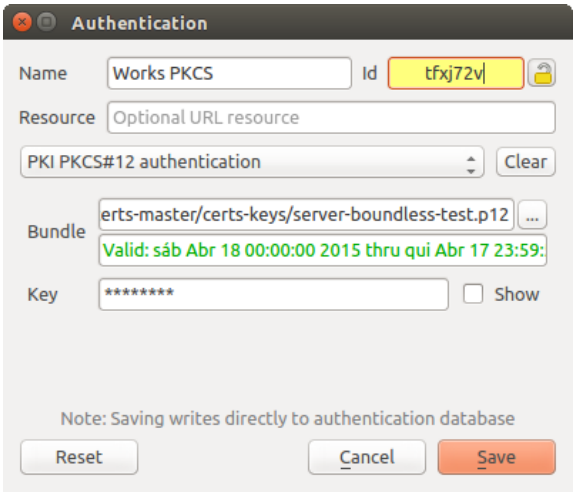

Figure 17.32: Changing a layer's authentication config ID (unlocked yellow text field)

Advertencia: Changing the auth config ID is considered an advanced operation and should only be done with full knowledge as to why it is necessary. This is why there is a lock button that needs clicked, to unlock the ID's text field prior to editing the ID.

17.2.6 Soporte de Servidor QGIS

When using a project file, with layers that have authentication configurations, as a basis for a map in QGIS Server, there are a couple of additional setup steps necessary for QGIS to load the resources:

- La base de datos de autenticación necesita estar disponible
- Authentication database's master password needs to be available

When instantiating the authentication system, Server will create or use `qgis-auth.db` in `~/.qgis2/` or the directory defined by the `QGIS_AUTH_DB_DIR_PATH` environment variable. It may be that the Server's user has no HOME directory, in which case, use the environment variable to define a directory that the Server's user has read/write permissions and is not located within the web-accessible directories.

To pass the master password to Server, write it to the first line of file at a path on the file system readable by the Server processes user and defined using the `QGIS_AUTH_PASSWORD_FILE` environment variable. Ensure to limit the file as only readable by the Server's process user and to not store the file within web-accessible directories.

Nota: `QGIS_AUTH_PASSWORD_FILE` variable will be removed from the Server environment immediately after accessing.

17.2.7 excepciones de servidor SSL

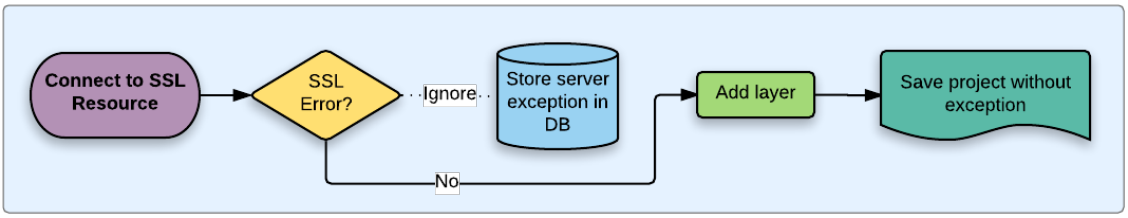

Figure 17.33: excepción de servidor SSL

You can manage SSL server configurations and exceptions from the **Servers** tab in the **Authentication** section of the QGIS **Options** dialog.

Sometimes, when connecting to an SSL server, there are errors with the SSL "handshake" or the server's certificate. You can ignore those errors or create an SSL server configuration as an exception. This is similar to how web browsers allow you to override SSL errors, but with more granular control.

Advertencia: You should not create an SSL server configuration unless you have complete knowledge of the entire SSL setup between the server and client. Instead, report the issue to the server administrator.

Nota: Some PKI setups use a completely different CA trust chain to validate client identities than the chain used to validate the SSL server certificate. In such circumstances, any configuration created for the connecting server will not necessarily fix an issue with the validation of your client identity, and only your client identity's issuer or server administrator can fix the issue.

You can pre-configure an SSL server configuration by clicking the button. Alternatively, you can add a configuration when an SSL error occurs during a connection and you are presented with an **SSL Error** dialog (where the error can be ignored temporarily or saved to the database and ignored):

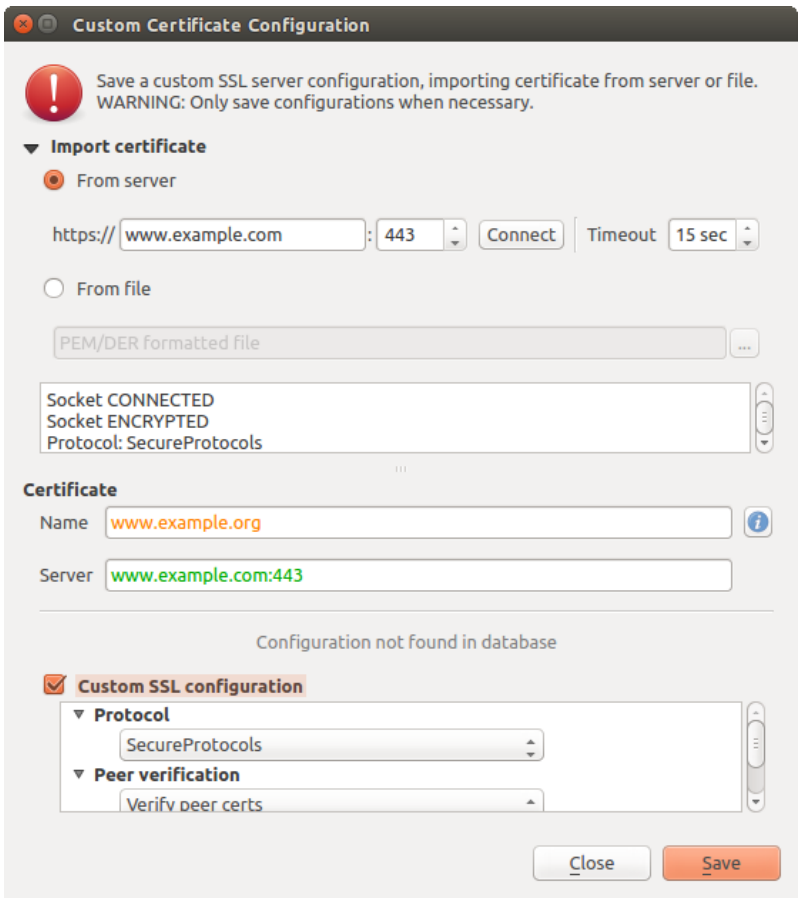

Figure 17.34: Adición manual de configuración

Once an SSL configuration is saved to the database, it can be edited or deleted.

If you want to pre-configure an SSL configuration and the import dialog is not working for your server's connection, you can manually trigger a connection via the **Python Console** by running the following code (replace `https://bugreports.qt-project.org` with the URL of your server):

```
from PyQt4.QtNetwork import *
req = QNetworkRequest(QUrl('https://bugreports.qt-project.org'))
reply = QgsNetworkAccessManager.instance().get(req)
```

This will open an SSL error dialog if any errors occur, where you can choose to save the configuration to the database.

17.3 Consideraciones de Seguridad

Once the master password is entered, the API is open to access authentication configs in the authentication database, similar to how Firefox works. However, in the initial implementation, no wall against PyQGIS access has been defined. This may lead to issues where a user downloads/installs a malicious PyQGIS plugin or standalone app that gains access to authentication credentials.

The quick solution for initial release of feature is to just not include most PyQGIS bindings for the authentication system.

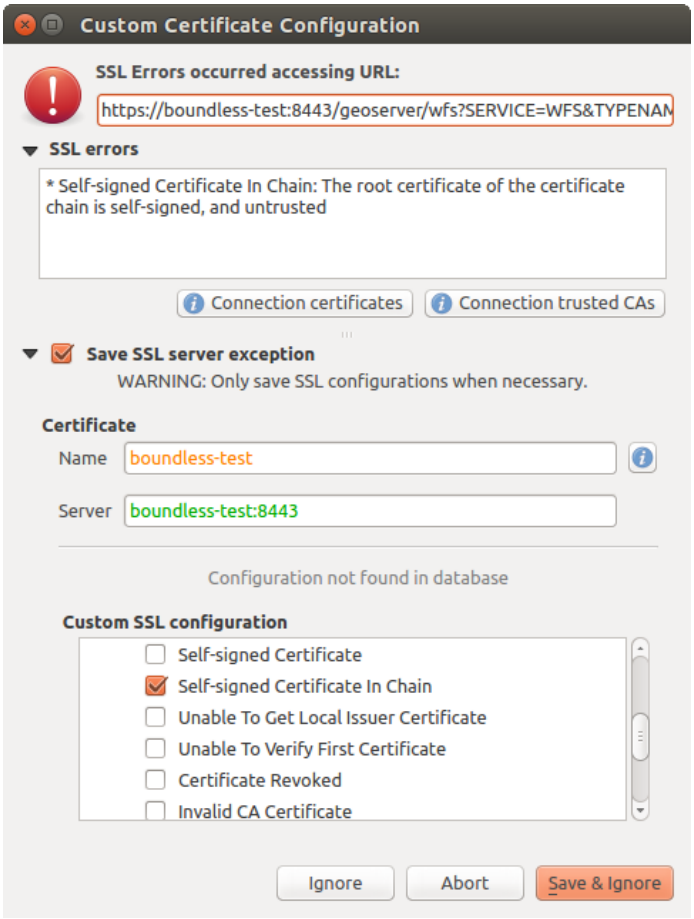

Figure 17.35: Adicionar configuración durante un error SSL

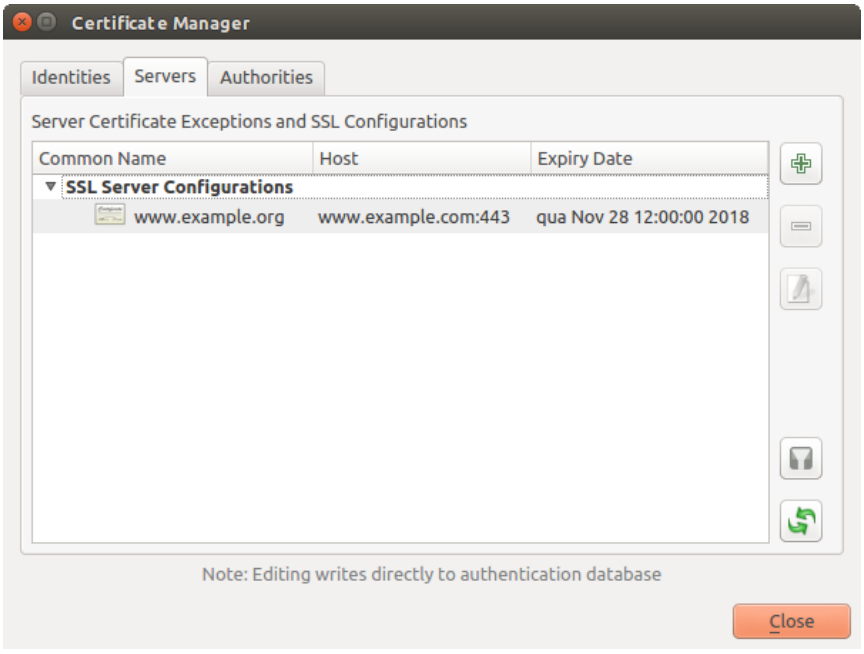

Figure 17.36: Configuración SSL existente

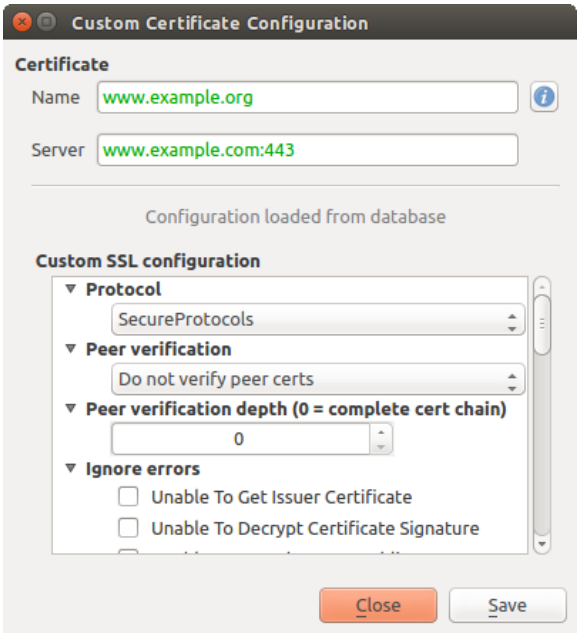

Figure 17.37: Editar una configuración SSL existente

Another simple, though not robust, fix is to add a combobox in *Settings* → *Options* → *Authentication* (defaults to "never"):

```
"Allow Python access to authentication system"
Choices: [ confirm once per session | always confirm | always allow | never]
```

Such an option's setting would need to be saved in a location non-accessible to Python, e.g. the authentication database, and encrypted with the master password.

- Another option may be to track which plugins the user has specifically
- allowed to access the authentication system, though it may be tricky to deduce which plugin is actually making the call.
- Sandboxing plugins, possibly in their own virtual environments, would reduce 'cross-plugin' hacking of authentication configs from another plugin that is authorized. This might mean limiting cross-plugin communication as well, but maybe only between third-party plugins.
- Another good solution is to issue code-signing certificates to vetted plugin authors. Then validate the plugin's certificate upon loading. If need be the user can also directly set an untrusted policy for the certificate associated with the plugin using existing certificate management dialogs.
- Alternatively, access to sensitive authentication system data from Python
- could never be allowed, and only the use of QGIS core widgets, or duplicating authentication system integrations, would allow the plugin to work with resources that have an authentication configuration, while keeping master password and authentication config loading in the realm of the main app.

The same security concerns apply to C++ plugins, though it will be harder to restrict access, since there is no function binding to simply be removed as with Python.

17.3.1 Limitaciones

The confusing licensing and exporting issues associated with OpenSSL apply. In order for Qt to work with SSL certificates, it needs access to the OpenSSL libraries. Depending upon how Qt was compiled, the default is to dynamically link to the OpenSSL libs at run-time (to avoid the export limitations).

QCA follows a similar tactic, whereby linking to QCA incurs no restrictions, because the qca-ossl (OpenSSL) plugin is loaded at run-time. The qca-ossl plugin is directly linked to the OpenSSL libs. Packagers would be the

ones needing to ensure any OpenSSL-linking restrictions are met, if they ship the plugin. Maybe. I don't really know. I'm not a lawyer.

The authentication system safely disables itself when `qca-ossl` is not found at run-time.

CHAPTER 18

Integracion GRASS SIG

GRASS integration provides access to GRASS GIS databases and functionalities (see GRASS-PROJECT in *Referencias bibliográficas y web*). The integration consists of two parts: provider and plugin. The provider allows to browse, manage and visualize GRASS raster and vector layers. The plugin can be used to create new GRASS locations and mapsets, change GRASS region, create and edit vector layers and analyze GRASS 2-D and 3-D data with more than 400 GRASS modules. In this section, we'll introduce the provider and plugin functionalities and give some examples of managing and working with GRASS data.

The provider supports GRASS version 6 and 7, the plugin supports GRASS 6 and 7 (starting from QGIS 2.12). QGIS distribution may contain provider/plugin for either GRASS 6 or GRASS 7 or for both versions at the same time (binaries have different file names). Only one version of the provider/plugin may be loaded on runtime however.

18.1 Conjuntos de datos demostración

As an example, we will use the QGIS Alaska dataset (see section *Sample Data*). It includes a small sample GRASS `LOCATION` with three vector layers and one raster elevation map. Create a new folder called `grassdata`, download the QGIS 'Alaska' dataset `qgis_sample_data.zip` from http://qgis.org/downloads/data/ and unzip the file into `grassdata`.

More sample GRASS `LOCATIONs` are available at the GRASS website at http://grass.osgeo.org/download/sample-data/.

18.2 Cargar capas ráster y vectorial de GRASS

If the provider is loaded in QGIS, the location item with GRASS  icon is added in the browser tree under each folder item which contains GRASS location. Go to the folder `grassdata` and expand location `alaska` and mapset `demo`.

You can load GRASS raster and vector layers like any other layer from the browser either by double click on layer item or by dragging and dropping to map canvas or legend.

Truco: Cargando datos GRASS

If you don't see GRASS location item, verify in *Help* → *About* → *Providers* if GRASS vector provider is loaded.

18.3 Importar datos dentro de una UBICACIÓN DE GRASS mediante arrastrar y soltar

This section gives an example of how to import raster and vector data into a GRASS mapset.

1. In QGIS browser navigate to the mapset you want to import data into.
2. In QGIS browser find a layer you want to import to GRASS, note that you can open another instance of the browser (*Browser Panel (2)*) if source data are too far from the mapset in the tree.
3. Drag a layer and drop it on the target mapset. The import may take some time for larger layers, you will see animated icon in front of new layer item until the import finishes.

When raster data are in different CRS, they can be reprojected using an *Approximate* (fast) or *Exact* (precise) transformation. If a link to the source raster is created (using `r.external`), the source data are in the same CRS and the format is known to GDAL, the source data CRS will be used. You can set these options in the *Browser* tab in *Opciones GRASS*.

If a source raster has more bands, a new GRASS map is created for each layer with **.<band number>** suffix and group of all maps with  icon is created. External rasters have a different icon  .

18.4 Managing GRASS data in QGIS Browser

- Copying maps: GRASS maps may be copied between mapsets within the same location using drag and drop.
- Deleting maps: Right click on a GRASS map and select *Delete* from context menu.
- Renaming maps: Right click on a GRASS map and select *Rename* from context menu.

18.5 Opciones GRASS

GRASS options may be set in *GRASS Options* dialog, which can be opened by right clicking on the location or mapset item in the browser and then choosing *GRASS Options*.

18.6 Iniciar el complemento GRASS

To use GRASS functionalities in QGIS, you must select and load the GRASS plugin using the Plugin Manager. To do this, go to the menu *Plugins* →  *Manage and Install Plugins...*, select  *GRASS* and click **[OK]**.

The following main features are provided with the GRASS menu (*Plugins* → *GRASS*) when you start the GRASS plugin:

-  Abrir directorio de mapas
-  Nuevo directorio de mapas
-  Cerrar directorio de mapas
-  Abrir herramientas de GRASS
-  Mostrar región actual de GRASS
-  GRASS Options

18.7 Abrir directorio de mapas

A GRASS mapset must be opened to get access to GRASS Tools in the plugin (the tools are disabled if no mapset is open). You can open a mapset from the browser: right click on mapset item and then choose *Open mapset* from context menu.

18.8 LOCALIZACIÓN y DIRECTORIO DE MAPA GRASS

GRASS data are stored in a directory referred to as GISDBASE. This directory, often called `grassdata`, must be created before you start working with the GRASS plugin in QGIS. Within this directory, the GRASS GIS data are organized by projects stored in subdirectories called `LOCATIONs`. Each `LOCATION` is defined by its coordinate system, map projection and geographical boundaries. Each `LOCATION` can have several `MAPSETs` (subdirectories of the `LOCATION`) that are used to subdivide the project into different topics or subregions, or as workspaces for individual team members (see Neteler & Mitasova 2008 in *Referencias bibliográficas y web*). In order to analyse vector and raster layers with GRASS modules, you generally have to import them into a GRASS `LOCATION`. (This is not strictly true – with the GRASS modules `r.external` and `v.external` you can create read-only links to external GDAL/OGR-supported datasets without importing them. This is not the usual way for beginners to work with GRASS, therefore this functionality will not be described here.)

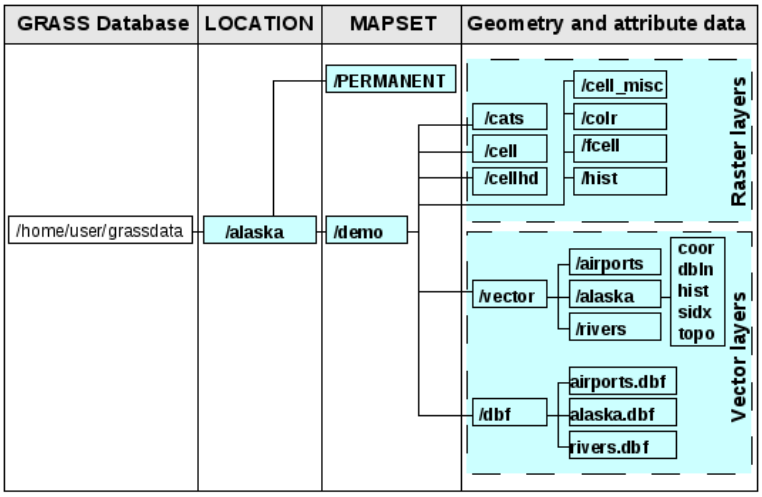

Figure 18.1: Datos GRASS en la LOCALIZACIÓN alaska

18.9 Importar datos dentro de una LOCALIZACIÓN DE GRASS

See section *Importar datos dentro de una UBICACIÓN DE GRASS mediante arrastrar y soltar* to find how data can be easily imported by dragging and dropping in the browser.

This section gives an example of how to import raster and vector data into the 'alaska' GRASS `LOCATION` provided by the QGIS 'Alaska' dataset in traditional way, using standard GRASS modules. Therefore, we use the landcover raster map `landcover.img` and the vector GML file `lakes.gml` from the QGIS 'Alaska' dataset (see *Sample Data*).

1. Inicie QGIS y asegúrese que el complemento GRASS está cargado.
2. En la barra de herramientas de GRASS, haga clic en el icono  Abrir directorio de mapas para que aparezca el asistente *DIRECTORIO DE MAPA*.
3. Select as GRASS database the folder `grassdata` in the QGIS Alaska dataset, as `LOCATION` 'alaska', as `MAPSET` 'demo' and click **[OK]**.

4. Ahora haga clic en el icono  Abrir herramientas de GRASS. El diálogo de la caja de herramientas de GRASS (vea la sección *La caja de herramientas GRASS*) aparece.
5. Para importar el mapa ráster `landcover.img`, haga clic en el modulo `r.in.gdal` en la pestaña *Árbol de módulos*. Este modulo GRASS le permite importar archivos ráster GDAL-admitidos en un `LOCALIZACIÓN` de GRASS. El diálogo del módulo para que `r.in.gdal` aparezca.
6. Browse to the folder `raster` in the QGIS 'Alaska' dataset and select the file `landcover.img`.
7. As raster output name, define `landcover_grass` and click **[Run]**. In the *Output* tab, you see the currently running GRASS command `r.in.gdal -o input=/path/to/landcover.img output=landcover_grass`.
8. When it says **Successfully finished**, click **[View output]**. The `landcover_grass` raster layer is now imported into GRASS and will be visualized in the QGIS canvas.
9. Para importar el archivo vector GML `lakes.gml`, haga clic en el modulo `v.in.ogr` en la pestaña *Árbol de módulos*. Este modulo GRASS le permite importar archivos vectoriales OGR-admitidos en una `LOCAZACIÓN` de GRASS. El diálogo del modulo para que `v.in.ogr` aparezca.
10. Browse to the folder `gml` in the QGIS 'Alaska' dataset and select the file `lakes.gml` as OGR file.
11. As vector output name, define `lakes_grass` and click **[Run]**. You don't have to care about the other options in this example. In the *Output* tab you see the currently running GRASS command `v.in.ogr -o dsn=/path/to/lakes.gml output=lakes\_grass`.
12. When it says **Succesfully finished**, click **[View output]**. The `lakes_grass` vector layer is now imported into GRASS and will be visualized in the QGIS canvas.

18.9.1 Crear una nueva LOCALIZACIÓN GRASS

As an example, here is the sample GRASS `LOCATION alaska`, which is projected in the Albers Equal Area projection using feet as units. This sample GRASS `LOCATION alaska` will be used for all examples and exercises in the following GRASS-related sections. It is useful to download and install the dataset on your computer (see *Sample Data*).

1. Inicie QGIS y asegúrese que el complemento GRASS está cargado.
2. Visualize the `alaska.shp` shapefile (see section *Cargando una capa desde archivo*) from the QGIS Alaska dataset (see *Sample Data*).
3. In the GRASS toolbar, click on the  New mapset icon to bring up the *MAPSET* wizard.
4. Select an existing GRASS database (GISDBASE) folder `grassdata`, or create one for the new `LOCATION` using a file manager on your computer. Then click **[Next]**.
5. We can use this wizard to create a new `MAPSET` within an existing `LOCATION` (see section *Añadir un nuevo DIRECTORIO DE MAPA*) or to create a new `LOCATION` altogether. Select  *Create new location* (see figure_grass_new_location).
6. Enter a name for the `LOCATION` – we used 'alaska' – and click **[Next]**.
7. Define the projection by clicking on the radio button  *Projection* to enable the projection list.
8. Estamos usando la proyección Albers Equal Area Alaska (pies). Puesto que nos ha tocado saber que está representado por el EPSG ID 2964, ingresamos en el cuadro de búsqueda. (Nota: Si desea repetir este proceso para otra `LOCALIZACIÓN` y proyección y no ha memorizado el EPSG ID, haga clic en el icono  SRC actual en la esquina inferior derecha de la barra de estado (vea sección *Trabajar con Proyecciones*)).
9. En *Filtrar*, inserte 2964 para seleccionar la proyección.
10. Click **[Next]**.

11. To define the default region, we have to enter the LOCATION bounds in the north, south, east, and west directions. Here, we simply click on the button **[Set current QGIS extent]**, to apply the extent of the loaded layer `alaska.shp` as the GRASS default region extent.
12. Click **[Next]**.
13. We also need to define a MAPSET within our new LOCATION (this is necessary when creating a new LOCATION). You can name it whatever you like - we used 'demo'. GRASS automatically creates a special MAPSET called PERMANENT, designed to store the core data for the project, its default spatial extent and coordinate system definitions (see Neteler & Mitasova 2008 in *Referencias bibliográficas y web*).
14. Check out the summary to make sure it's correct and click **[Finish]**.
15. La nueva LOCALIZACIÓN, 'alaska', y los dos DIRECTORIO DE MAPAS, 'demo' y 'PERMANENT', son creados. El conjunto de trabajo abierto actualmente es 'demo', como se ha definido.
16. Tenga en cuenta que algunas de las herramientas en la barra de herramientas de GRASS que estaban inhabilitadas ahora están habilitadas.

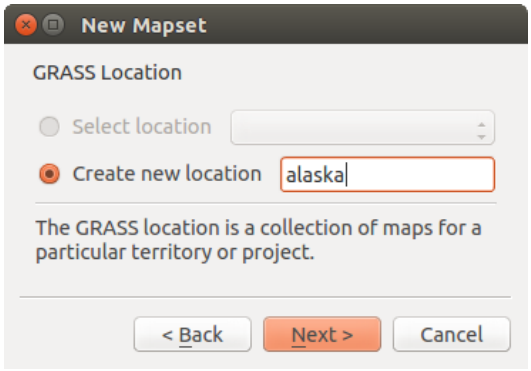

Figure 18.2: Cree una nueva LOCALIZACIÓN GRASS o un nuevo DIRECTORIO DE MAPA en QGIS

Si eso parecía como una gran cantidad de pasos, en realidad no es tan malo y una forma muy rápida de crear una LOCALIZACIÓN. La LOCALIZACIÓN 'alaska' ahora está listo para la importación de datos (vea la sección *Importar datos dentro de una LOCALIZACIÓN DE GRASS*). También puede utilizar los datos ya existentes vectoriales y ráster en el ejemplo LOCALIZACIÓN 'alaska' de GRASS, incluido en el conjunto de datos 'Alaska' de QGIS *Sample Data*, ya pasar a la sección *El modelo de datos vectoriales de GRASS*.

18.9.2 Añadir un nuevo DIRECTORIO DE MAPA

Un usuario sólo tiene acceso de escritura a un DIRECTORIO DE MAPA GRASS que él o ella crearon. Esto significa que además de acceder a su propio DIRECTORIO DE MAPA, se pueden leer mapas de otros usuarios' DIRECTORIO DE MAPAS (y ellos pueden leer los tuyos), pero sólo puede modificar o eliminar su propio DIRECTORIO DE MAPA.

Todos los DIRECTORIO DE MAPAS incluyen un archivo WIND que almacena los valores de las coordenadas de los límites actuales y la resolución ráster actualmente seleccionado (vea Neteler & Mitasova 2008 en *Referencias bibliográficas y web*, y la sección *La herramienta de región GRASS*).

1. Inicie QGIS y asegúrese que el complemento GRASS está cargado.
2. In the GRASS toolbar, click on the  New mapset icon to bring up the *MAPSET* wizard.
3. Seleccione la base de datos GRASS (GISDBASE) la carpeta `grassdata` con la LOCALIZACIÓN 'alaska', donde queremos añadir otro DIRECTORIO DE MAPA llamado 'test'.
4. Click **[Next]**.
5. We can use this wizard to create a new MAPSET within an existing LOCATION or to create a new LOCATION altogether. Click on the radio button  *Select location* (see figure_grass_new_location) and click **[Next]**.

6. Introduzca el nombre `text` para el nuevo `DIRECTORIO DE MAPA`. A continuación en el asistente, se ve una lista de un existente `DIRECTORIO DE MAPAS` y titulares correspondientes.
7. Click **[Next]**, check out the summary to make sure it's all correct and click **[Finish]**.

18.10 El modelo de datos vectoriales de GRASS

It is important to understand the GRASS vector data model prior to digitizing. In general, GRASS uses a topological vector model. This means that areas are not represented as closed polygons, but by one or more boundaries. A boundary between two adjacent areas is digitized only once, and it is shared by both areas. Boundaries must be connected and closed without gaps. An area is identified (and labelled) by the **centroid** of the area.

Además de los límites y centroides, un mapa vectorial también puede contener puntos y líneas. Todos estos elementos geométricos se pueden mezclar en una vector y serán representados en diferentes denominadas 'capas' dentro de un mapa vectorial GRASS. Por lo que en GRASS, una capa no es un mapa vectorial o ráster pero un nivel dentro de una capa vectorial. Esto es importante para distinguir cuidadosamente. (aunque es imposible mezclar elementos, es inusual e incluso en GRASS, sólo se utiliza en casos especiales como análisis de redes vectoriales. Usualmente, se debe preferir almacenar diferentes elementos geométricos en diferentes capas.)

Es posible almacenar varias 'capas' en un conjunto de datos vectoriales. Por ejemplo, campos, bosques y lagos se pueden almacenar en un vector. Un bosque y lago adyacente pueden compartir el mismo límite, pero tienen tablas de atributos separados. También es posible adjuntar atributos a límites. Un ejemplo podría ser el caso donde los límites entre un lago y un bosque es una carretera, por lo que puede tener una tabla de atributos diferente.

La 'capa' del objeto espacial es definido por la 'capa' dentro de GRASS. 'Capa' es el número que define si hay más de una capa dentro del conjunto de datos (por ejemplo, si la geometría es bosque o lago). Por ahora, sólo puede ser un número. En el futuro, GRASS también implementara nombres como campos en la interfaz de usuario.

Los atributos se pueden almacenar dentro de la `LOCALIZACIÓN` en GRASS como dBase o SQLite3 o en tablas de base de datos externa, por ejemplo, PostgreSQL, MySQL, Oracle, etc.

Los atributos en la tabla de base de datos están enlazadas a los elementos geométricos utilizando un valor 'categoría'.

'Categoría' (llave, ID) es un entero adjunto a la geometría primitiva, y se utiliza como el enlace a una columna llave en la tabla de base de datos.

Truco: Aprendizaje del modelo vectorial GRASS

The best way to learn the GRASS vector model and its capabilities is to download one of the many GRASS tutorials where the vector model is described more deeply. See http://grass.osgeo.org/documentation/manuals/ for more information, books and tutorials in several languages.

18.11 Crear una nueva capa vectorial GRASS

To create a new GRASS vector layer, select one of following items from mapset context menu in the browser:

- Nueva Capa de Puntos
- Nueva Capa de Líneas
- Nueva capa de polígonos

and enter a name in the dialog. A new vector map will be created and layer will be added to canvas and editing started. Selecting type of the layer does not restrict geometry types which can be digitized in the vector map. In GRASS, it is possible to organize all sorts of geometry types (point, line and polygon) in one vector map. The type is only used to add the layer to the canvas, because QGIS requires a layer to have a specific type.

It is also possible to add layers to existing vector maps selecting one of the items described above from context menu of existing vector map.

In GRASS, it is possible to organize all sorts of geometry types (point, line and area) in one layer, because GRASS uses a topological vector model, so you don't need to select the geometry type when creating a new GRASS vector. This is different from shapefile creation with QGIS, because shapefiles use the Simple Feature vector model (see section *Creating new vector layers*).

18.12 Digitalizar y editar una capa vectorial GRASS

GRASS vector layers can be digitized using the standard QGIS digitizing tools. There are however some particularities, which you should know about, due to

- GRASS topological model versus QGIS simple feature
- complejidad del modelo GRASS
  - multiple layers in single maps
  - multiple geometry types in single map
  - geometry sharing by multiple features from multiple layers

The particularities are discussed in the following sections.

Save, discard changes, undo, redo

> **Advertencia:** All the changes done during editing are immediately written to vector map and related attribute tables.

Changes are written after each operation, it is however, possible to do undo/redo or discard all changes when closing editing. If undo or discard changes is used, original state is rewritten in vector map and attribute tables.

There are two main reasons for this behaviour:

- It is the nature of GRASS vectors coming from conviction that user wants to do what he is doing and it is better to have data saved when the work is suddenly interrupted (for example, blackout)
- Necessity for effective editing of topological data is visualized information about topological correctness, such information can only be acquired from GRASS vector map if changes are written to the map.

Barra de herramientas

The 'Digitizing Toolbar' has some specific tools when a GRASS layer is edited:

Icono	Herramienta	Propósito
	Nuevo punto	Digitalizar un nuevo punto
	Nueva línea	Digitalizar nueva línea
	Nuevo límite	Digitalizar nuevo borde
	Nuevo centroide	Digitalizar nuevo centroide (etiqueta de área existente)
	Nuevo Contorno Cerrado	Digitalizar nuevo borde cerrado

Table GRASS Digitizing: GRASS Digitizing Tools

Truco: Digitalizando polígonos en GRASS

If you want to create a polygon in GRASS, you first digitize the boundary of the polygon. Then you add a centroid (label point) into the closed boundary. The reason for this is that a topological vector model links the attribute information of a polygon always to the centroid and not to the boundary.

Categoría

Category, often called cat, is sort of ID. The name comes from times when GRASS vectors had only singly attribute "category". Category is used as a link between geometry and attributes. A single geometry may have multiple categories and thus represent multiple features in different layers. Currently it is possible to assign only

one category per layer using QGIS editing tools. New features have automatically assigned new unique category, except boundaries. Boundaries usually only form areas and do not represent linear features, it is however possible to define attributes for a boundary later, for example in different layer.

New categories are always created only in currently being edited layer.

It is not possible to assign more categories to geometry using QGIS editing, such data are properly represented as multiple features, and individual features, even from different layers, may be deleted.

Atributos

Attributes of currently edited layer can only be modified. If the vector map contains more layers, features of other layers will have all attributes set to '<not editable (layer #)>' to warn you that such attribute is not editable. The reason is, that other layers may have and usually have different set of fields while QGIS only supports one fixed set of fields per layer.

If a geometry primitive does not have a category assigned, a new unique category is automatically assigned and new record in attribute table is created when an attribute of that geometry is changed.

Truco: If you want to do bulk update of attributes in table, for example using 'Field Calculator' (*Using the Field Calculator*), and there are features without category which you don't want to update (typically boundaries), you can filter them out by setting 'Advanced Filter' to `cat is not null`.

Editing style

The topological symbology is essential for effective editing of topological data. When editing starts, a specialized 'GRASS Edit' renderer is set on the layer automatically and original renderer is restored when editing is closed. The style may be customized in layer properties 'Style' tab. The style can also be stored in project file or in separate file as any other style. If you customize the style, do not change its name, because it is used to reset the style when editing is started again.

Truco: Do not save project file when the layer is edited, the layer would be stored with 'Edit Style' which has no meaning if layer is not edited.

The style is based on topological information which is temporarily added to attribute table as field 'topo_symbol'. The field is automatically removed when editing is closed.

Truco: Do not remove 'topo_symbol' field from attribute table, that would make features invisible because the renderer is based on that column.

Autoensamblado

To form an area, vertices of connected boundaries must have **exactly** the same coordinates. This can be achieved using snapping tool only if canvas and vector map have the same CRS. Otherwise, due conversion from map coordinates to canvas and back, the coordinate may become slightly different due to representation error and CRS transformations.

Truco: Use layer's CRS also for canvas when editing.

Limitaciones

Simultaneous editing of multiple layers within the same vector at the same time is not supported. This is mainly due to the impossibility of handling multiple undo stacks for a single data source.

On Linux and macOS only one GRASS layer can be edited at time. This is due to a bug in GRASS which does not allow to close database drivers in random order. This is being solved with GRASS developers.

Truco: Editar permisos de GRASS

Debe ser el propietario del `DIRECTORIO DE MAPA` de GRASS que desee editar. Es imposible editar capas de datos en un `DIRECTORIO DE MAPA` que no sea suyo, incluso si tiene permisos de escritura.

18.13 La herramienta de región GRASS

La definición de la región (ajuste una ventana de trabajo espacial) en GRASS es importante para trabajar con capas ráster. Análisis vectorial esta por defecto no limitado a cualquier definición de región definida. Pero todas los rásters recién creados tendrán la extensión espacial y resolución de la región GRASS definida actualmente, independientemente de su extensión y resolución original. La región GRASS actual es almacenada en el archivo `$LOCALIZACIÓN/$DIRECTORIO DE MAPA/WIND`, y define los límites norte, sur, este y oeste, número de columnas y filas, resolución espacial horizontal y vertical.

Es posible prender y apagar la visualización de la región GRASS en el lienzo de QGIS utilizando el botón  Mostrar región actual de GRASS.

The region can be modified in 'Region' tab in 'GRASS Tolls' dock widget. Type in the new region bounds and resolution, and click **[Apply]**. If you click on **[Select the extent by dragging on canvas]** you can select a new region interactively with your mouse on the QGIS canvas dragging a rectangle.

El modulo GRASS `g.region` proporciona muchos más parámetros para definir una extensión de región apropiada y resolución para su análisis ráster. Se puede utilizar estos parámetros con la caja de herramientas GRASS, descrito en la sección *La caja de herramientas GRASS*.

18.14 La caja de herramientas GRASS

La caja  Abrir herramientas GRASS proporciona funcionalidades de modulo GRASS para trabajar con datos dentro un `LOCALIZACIÓN` GRASS seleccionada y `DIRECTORIO DE MAPA`. Para utilizar la caja de herramientas GRASS necesita abrir una `LOCALIZACIÓN` y `DIRECTORIO DE MAPA` que tiene permisos de escritura para (normalmente se concede si ha creado el `DIRECTORIO DE MAPA`). Esto es necesario, porque las capas ráster y vector creadas durante análisis necesitan estar escritos a la `LOCALIZACIÓN` y `DIRECTORIO DE MAPA` actualmente

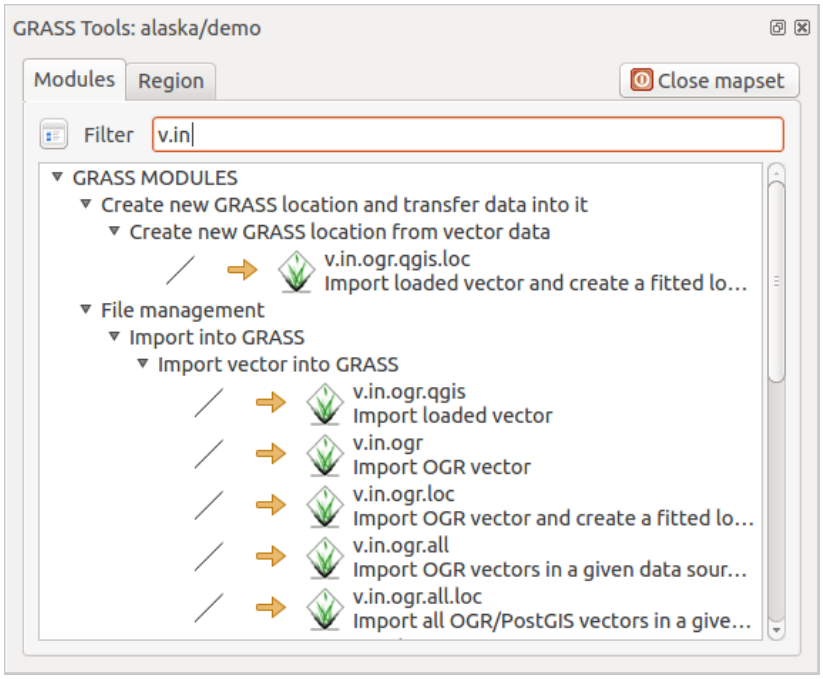

Figure 18.3: Caja de herramienta GRASS y módulo

18.14.1 Trabajando con módulos GRASS

La consola GRASS dentro de la caja de herramientas proporciona acceso a casi todo (más de 300) los módulos GRASS en una interfaz de línea de comando. Para ofrecer un entorno de trabajo más fácil de usar, cerca de 200 de los módulos de GRASS disponibles y funcionalidades también son proporcionados por diálogos gráficos dentro de la caja de herramientas del complemento GRASS.

A complete list of GRASS modules available in the graphical Toolbox in QGIS version 2.18 is available in the GRASS wiki at http://grass.osgeo.org/wiki/GRASS-QGIS_relevant_module_list.

También es posible personalizar el contenido de la caja de herramientas GRASS. Este procedimiento se describe en la sección *Personalizar la caja de herramientas GRASS*.

As shown in figure_grass_toolbox, you can look for the appropriate GRASS module using the thematically grouped *Modules Tree* or the searchable *Modules List* tab.

Al hacer clic en un icono de modulo gráfico, una nueva pestaña se añadirá al diálogo de Caja de herramientas, proporciona tres nuevas sub-pestañas *Opciones*, *Salida* y *Manual*.

Opciones

The *Options* tab provides a simplified module dialog where you can usually select a raster or vector layer visualized in the QGIS canvas and enter further module-specific parameters to run the module.

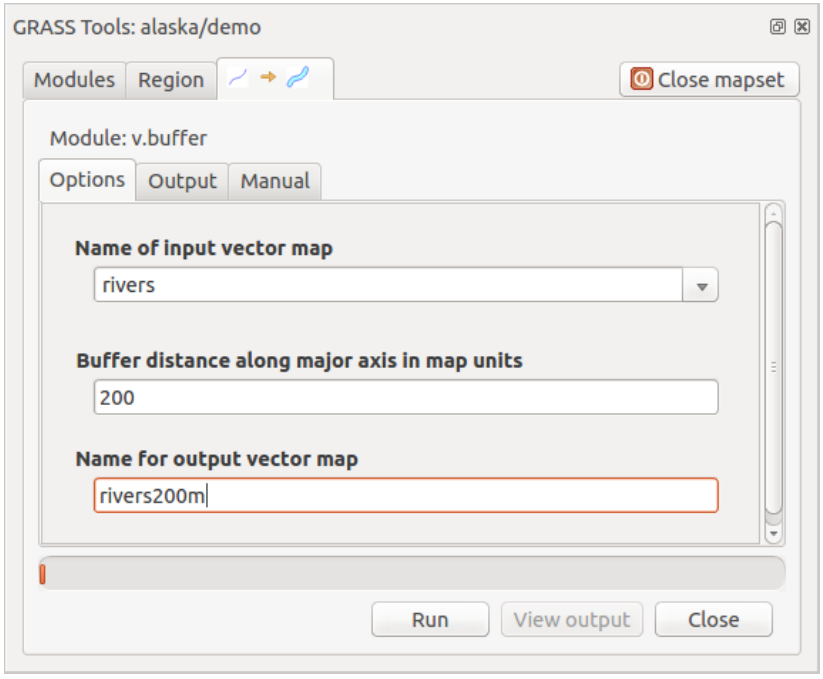

Figure 18.4: Opciones del módulo de la caja de herramientas GRASS

The provided module parameters are often not complete to keep the dialog simple. If you want to use further module parameters and flags, you need to start the GRASS shell and run the module in the command line.

Una nueva característica desde QGIS 1.8 es la implementación de un botón *Mostrar opciones avanzadas* abajo del diálogo del modulo simplificado en la pestaña *Opciones*. Por el momento, sólo se añade al modulo `v.in.ascii` como ejemplo de uso, pero probablemente es parte de más o todos los módulos en la caja de herramientas GRASS en futuras versiones de QGIS. Esto le permite usar las opciones del modulo de GRASS completo sin la necesidad de cambiar la consola de GRASS.

Salida

The *Output* tab provides information about the output status of the module. When you click the **[Run]** button, the module switches to the *Output* tab and you see information about the analysis process. If all works well, you will finally see a `Successfully finished` message.

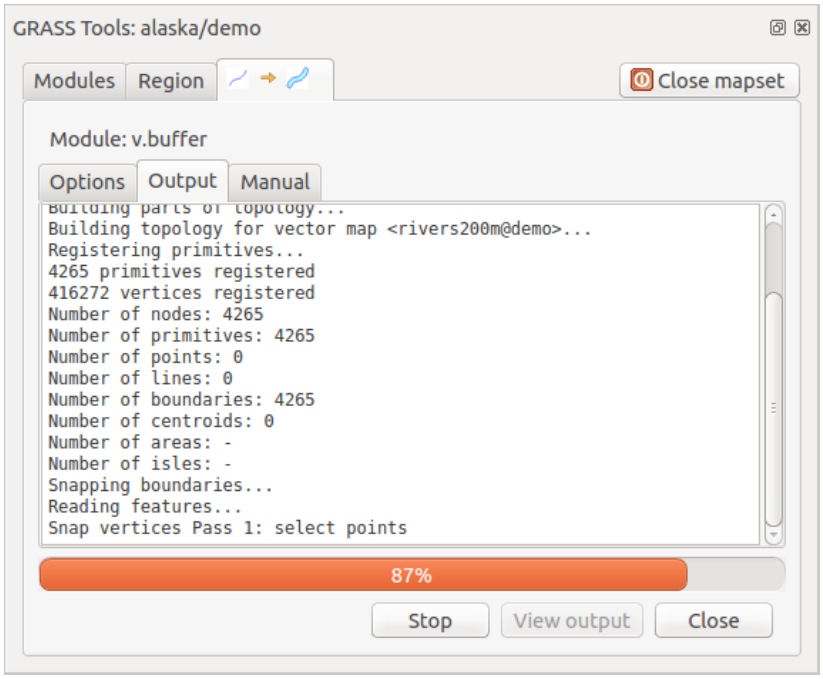

Figure 18.5: Salida del módulo de la caja de herramientas GRASS

Manual

La pestaña *Manual* muestra la página de ayuda HTML del modulo GRASS. Se puede utilizar para comprobar otros parámetros de los módulos y las banderas o para obtener un conocimiento más profundo acerca de la finalidad del módulo. Al final de cada página del manual del módulo, se ven otros enlaces al `Índice de ayuda principal`, al `Índice temático` y al `Índice completo`. Estos enlaces proporcionar información de ejemplo como el modulo `g.manual`.

Truco: Mostrar resultados inmediatamente

Si desea mostrar sus resultados de cálculo inmediatamente en su lienzo de mapa, se puede utilizar el botón 'Ver Salida' en la parte inferior de la pestaña de módulo.

18.14.2 Ejemplos del módulo GRASS

Los siguientes ejemplos demostrarán el poder de algunos módulos GRASS.

Crear curvas de nivel

El primer ejemplo crea un mapa de curvas de nivel vectoriales de un ráster de elevación (DEM). Aquí, se asume que se tiene `LOCALIZACIÓN` Alaska configurado como se explica en la sección *Importar datos dentro de una LOCALIZACIÓN DE GRASS*.

- First, open the location by clicking the Open mapset button and choosing the Alaska location.
- Ahora abra la caja de herramientas con el botón Abrir herramientas de GRASS.
- En la lista de categorías de herramientas, haga doble clic *Ráster* → *Administración de superficie*→ *Generar curvas de nivel vectoriales*.
- Now a single click on the tool **r.contour** will open the tool dialog as explained above (see *Trabajando con módulos GRASS*).
- In the *Name of input raster map* enter `gtopo30`.

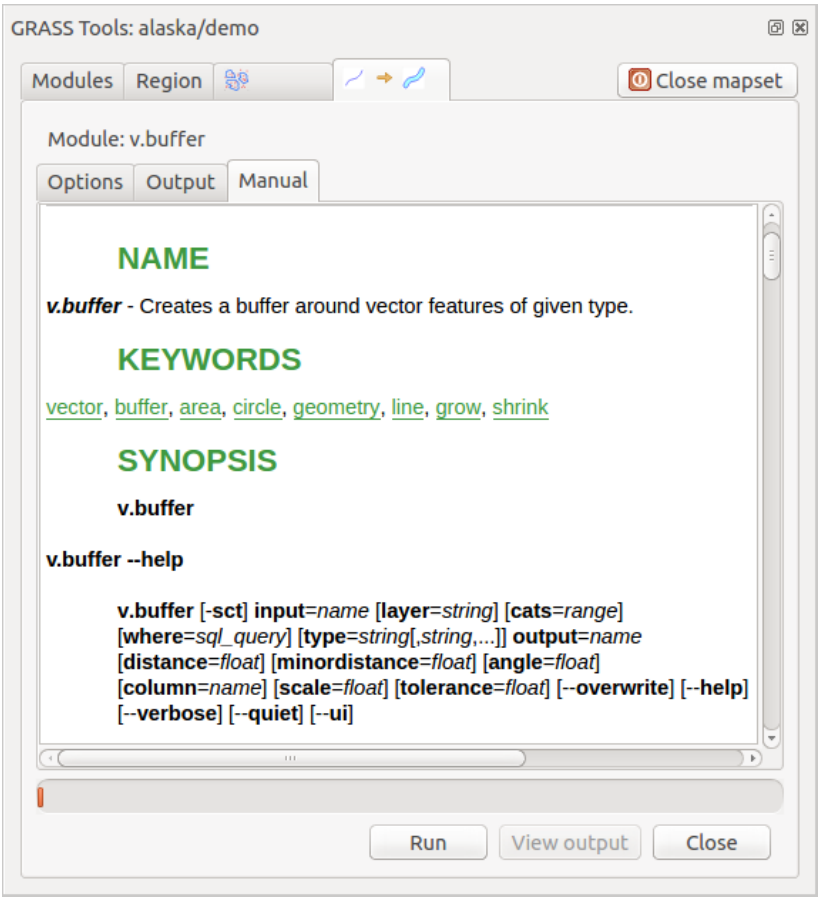

Figure 18.6: Módulo Manual de la caja de herramientas GRASS

- Type into the *Increment between Contour levels* 1,00 the value 100. (This will create contour lines at intervals of 100 meters.)
- Escriba en *Nombre de salida del mapa vectorial* el nombre `ctour_100`.
- Click **[Run]** to start the process. Wait for several moments until the message `Successfully finished` appears in the output window. Then click **[View Output]** and **[Close]**.

Dado que esta es una región grande, tomará un tiempo para mostrarla. Después de que termine la presentación, puede abrir la ventana de propiedades de la capa para cambiar el color de línea así el contorno aparece claramente sobre el ráster de elevación, como en *El Dialogo de las Propiedades del Vector*.

El siguiente acercamiento a una pequeña y montañosa área en el centro de Alaska. Al acercarse, se puede observar que las curvas de nivel tienen esquinas afiladas. GRASS ofrece la herramienta **v.generalize** para alterar ligeramente mapas vectoriales, manteniendo su forma general. La herramienta utiliza varios algoritmos diferentes con propósitos diferentes. Algunos de los algoritmos (es decir, Douglas Peucker y Vertex Reduction) simplificar la línea mediante la eliminación de algunos de los vértices. El vector resultante se carga más rápido. Este proceso es útil cuando se tiene un vector muy detallado, pero va a crear un mapa de escala muy pequeña, por lo que el detalle es innecesario.

Truco: La herramienta de simplificar

Note that QGIS has a *Vector* → *Geometry Tools* → *Simplify geometries* tool that works just like the GRASS **v.generalize** Douglas-Peuker algorithm.

Sin embargo, el proposito de este ejemplo es diferente. Las líneas de curvas de nivel creadas por `r.contour` tiene ángulos agudos que deben ser suavizados. Entre el algoritmo **v.generalize** hay Chaiken's, lo que hace precisamente eso (también astillas de Hermite). Tenga en cuenta que estos algoritmos se pueden **añadir** vértices adicionales al vector, haciendo que se cargue más lentamente

- Abra la caja de herramientas GRASS y haga doble clic en las categorías *Vectorial* → *Desarrollar mapa* → *Generalización*,
- Compruebe que el vector 'ctour_100' aparece como el *Nombre del vector de entrada*.
- From the list of algorithms, choose Chaiken's. Leave all other options at their default, and scroll down to the last row to enter in the field *Name for output vector map* 'ctour_100_smooth', and click **[Run]**.
- The process takes several moments. Once `Successfully finished` appears in the output windows, click **[View output]** and then **[Close]**.
- Se puede cambiar el color del vector para que se muestre claramente sobre el fondo del ráster y para contrastar con las curvas de nivel originales. Se dará cuenta de que las nuevas curvas de nivel tienen esquinas más suaves que el original durante su estancia fiel a la original de forma general.

Figure 18.7: Módulo GRASS v.generalize para suavizar un mapa vectorial

---

Truco: Otros usos de r.contour

El proceso descrito anteriormente se puede utilizar en otras situaciones equivalentes. Si tiene un mapa ráster de datos de precipitación, por ejemplo, entonces el mismo método se utilizará para crear un mapa vectorial de líneas isoyetas (lluvia constante).

Crear un efecto sombreado de relieve 3-D

Varios métodos se utilizan para mostrar capas de elevación y da un efecto #-D a mapas. El uso de líneas de curvas de nivel, como se mostro anteriormente, es un método popular regularmente elejido para producir mapas topológicos. El efecto de sombreado se crea de un ráster (elevación) DEM calculando primero la pendiente y el aspecto de cada celda, entonces simula la posición del sol en el cielo y da un valor de reflectancia a cada celda. De este modo se obtienen pendientes frente al sol iluminadas; las pendientes orientadas lejos del sol(en la sombra) se oscurecen.

- Comience este ejemplo cargando el ráster de elevación `gtopo30`. Inicie la caja de herramientas GRASS y bajo la categoría ráster, haga doble clic para abrir *Análisis espacial → Análisis del terreno*.
- A continuación haga clic en **r.shaded.relief** para abrir el módulo.
- Cambie el *ángulo del azimut* 1,00 270 a 315
- Enter `gtopo30_shade` for the new hillshade raster, and click **[Run]**.
- Cuando el proceso finalice, añada el ráster de mapa de sombras al mapa. Debe verlo desplegado en escala de grises.
- Para ver ambos sombreados y los colores de la *gtopo30'* juntos, mueva el mapa de sombreado abajo del mapa `gtopo30` en la tabla de contenido, a continuación abra la ventana *Propiedades* de `gtopo30`, cambie a la pestaña de *Transparencia* y establezca su nivel de transparencia a cerca de 25%.

Ahora debe tener la elevación `gtopo30` con su mapa de color y ajuste de transparencia mostrado **arriba** el mapa de sombras en escala de grises. Con el fin de ver los efectos visuales en el mapa de sombras, apague el mapa `gtopo30_shade`, a continuación, vuelva a encenderla.

Utilizar la consola de GRASS

The GRASS plugin in QGIS is designed for users who are new to GRASS and not familiar with all the modules and options. As such, some modules in the Toolbox do not show all the options available, and some modules do not appear at all. The GRASS shell (or console) gives the user access to those additional GRASS modules that do not appear in the Toolbox tree, and also to some additional options to the modules that are in the Toolbox with the simplest default parameters. This example demonstrates the use of an additional option in the **r.shaded.relief** module that was shown above.

El modulo **r.shaded.relief** puede tomar un parámetro `zmult`, que multiplica los valores de elevación relativas a las unidades de las coordenadas X-Y por lo que el efecto de sombreado es incluso más pronunciado.

- Load the `gtopo30` elevation raster as above, then start the GRASS Toolbox and click on the GRASS shell. In the shell window, type the command `r.shaded.relief map=gtopo30 shade=gtopo30_shade2 azimuth=315 zmult=3` and press **[Enter]**.
- After the process finishes, shift to the *Browse* tab and double-click on the new `gtopo30_shade2` raster to display it in QGIS.
- Como se explicó anteriormente, mueva ráster del relieve sombreado a bajo del ráster `gtopo30` en la tabla de contenido, entonces valide la transparecia de la capa coloreada `gtopo30`. Debe ver que el efecto 3-D destaca más fuertemente comparada con el primer mapa de relieve sombreado.

Estadísticas de ráster en un mapa vectorial

El siguiente ejemplo muestra como un módulo GRASS puede agregar datos ráster y añadir columnas de una estadística para cada polígono en un mapa vectorial.

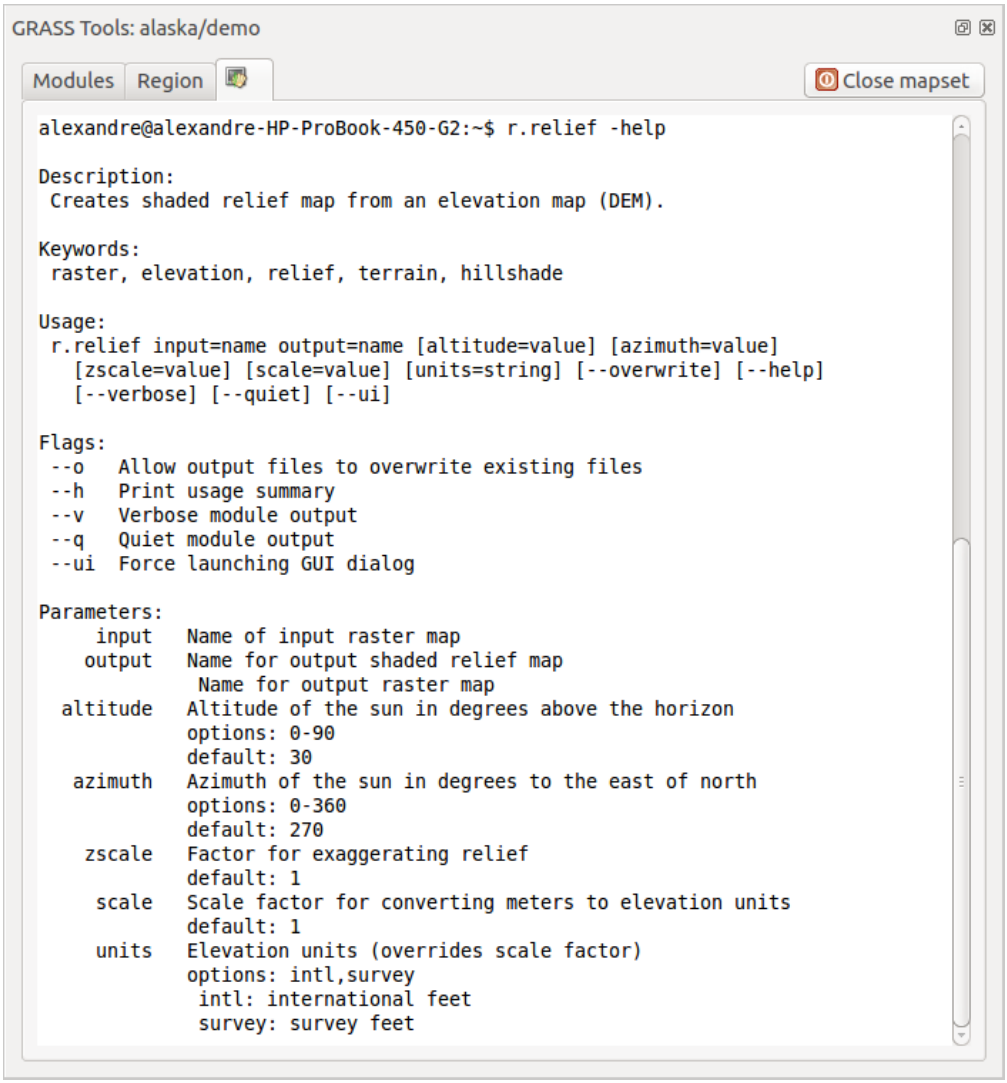

Figure 18.8: La consola de GRASS, módulo r.shaded.relief

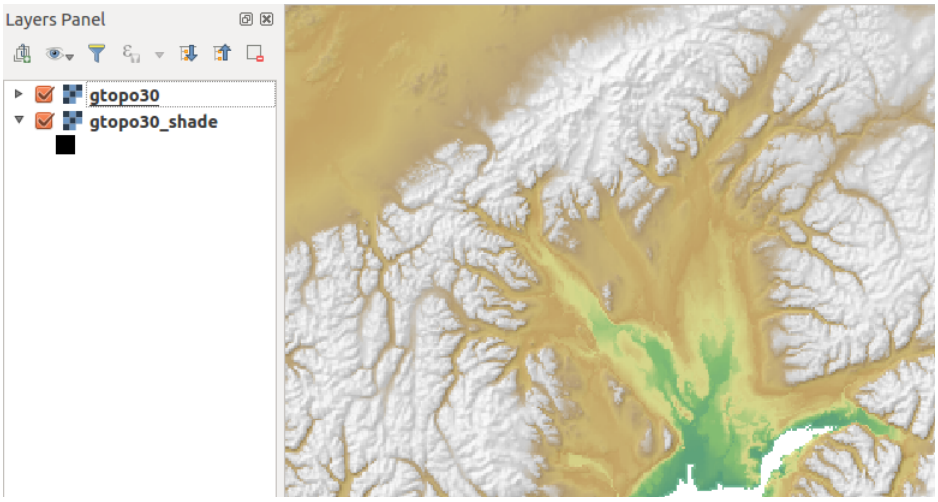

Figure 18.9: Mostrar relieve sombreado creado con el módulo de GRASS r.shaded.relief

- Again using the Alaska data, refer to *Importar datos dentro de una LOCALIZACIÓN DE GRASS* to import the trees shapefile from the `shapefiles` directory into GRASS.
- Ahora un paso intermedio es necesario: los centroides se deben añadir al mapa de árboles importado para que sea una zona de GRASS completa del vector (incluyendo ambos límites y centroides).
- De la caja de herramientas, elija *Vectorial* → *Desarrollar mapa* -> *Administrar objetos espaciales*, y abra el modulo **v.centroids**.
- Introduzca como el *Mapa vectorial de salida* 'forest_areas' y ejecute el módulo.
- Ahora cargue el vector `forest_areas` y muestre los tipos de bosque - caducifolio, árbol de hoja perenne, mixto - en diferentes colores: En la ventana *Propiedades* de la capa, la pestaña *Simbología*, elija de *Tipo de leyenda*  'Valor único' y establezca el *Campo de clasificación* a 'VEGDESC'. (Consulte la explicación de la pestaña de simbología en *Style Properties* de la sección vectorial.)
- A continuación vuelva a abrir la caja de herramientas de GRASS y abra *Vectorial* → *Actualizacion vectorial por otros mapas*.
- Haga clic en el modulo **v.rast.stats**. Ingrese `gtopo30` y `forest_areas`.
- Only one additional parameter is needed: Enter *column prefix* `elev`, and click **[Run]**. This is a computationally heavy operation, which will run for a long time (probably up to two hours).
- Finalmente, abra la tabla de atributos `forest_areas`, y verifique que varias de las nuevas columnas se han añadido, incluyendo `elev_min`, `elev_max`, `elev_mean`, etc., para cada polígono de bosque.

18.14.3 Personalizar la caja de herramientas GRASS

Casi todos los módulos de GRASS se pueden añadir a la caja de herramientas de GRASS. Una interfaz XML se proporciona para analizar los archivos XML muy sencillos que configuran la apariencia y los parámetros de los módulos dentro de la caja de herramientas.

Un ejemplo del archivo XML para generar el módulo `v.buffer` (v.buffer.qgm) luce como esto:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE qgisgrassmodule SYSTEM "http://mrcc.com/qgisgrassmodule.dtd">

<qgisgrassmodule label="Vector buffer" module="v.buffer">
        <option key="input" typeoption="type" layeroption="layer" />
        <option key="buffer"/>
        <option key="output" />
</qgisgrassmodule>
```

The parser reads this definition and creates a new tab inside the Toolbox when you select the module. A more detailed description for adding new modules, changing a module's group, etc., can be found on the QGIS wiki at http://hub.qgis.org/projects/quantum-gis/wiki/Adding_New_Tools_to_the_GRASS_Toolbox.

CHAPTER 19

Navegador independiente de QGIS

El Navegador QGIS (QGIS Browser) está disponible como una aplicación independiente y como un panel en QGIS de Escritorio (QGIS Desktop). Permite navegar fácilmente por el sistema de archivos y administrar los geodatos. Puede tener acceso a archivos vectoriales comunes (por ejemplo, archivos shape de ESRI o archivos MapInfo), bases de datos (PostGIS, Oracle, SpatiaLite o MS SQL Spatial) y conexiones OWS/WCS|WMS|WFS. También puede ver datos de GRASS (para obtener los datos en QGIS, ver *Integracion GRASS SIG*).

La descripción del panel del Navegador de QGIS está disponible en la sección *The Browser Panel* por lo que aquí solo se tratará la versión independiente del navegador.

Tal como el Panel de Navegación, el Navegador independiente ayuda a navegar por el sistema de archivos y gestionar los geodatos. También ayuda a previsualizarlos o crearlos y abrirlos en un proyecto QGIS mediante "arrastrar y soltar".

Iniciar el navegador de QGIS

- Inicie el navegador de QGIS utilizando el Menú Inicio o el acceso directo en el escritorio.
- El navegador de QGIS está disponible desde la carpeta Aplicaciones.

En figure_browser_standalone_metadata, se puede ver la funcionalidad mejorada del Navegador QGIS independiente. La pestaña *Param* proporciona los detalles de los conjuntos de datos basados en conexión como PostGIS o MSSQL Spatial. La pestaña *Metadata* contiene información general sobre el archivo (ver *Propiedades de metadatos*). Con la pestaña *Preview* se puede echar un vistazo a los archivos sin tener que importarlos al proyecto QGIS. También es posible previsualizar los atributos de los archivos en la pestaña *Attributes*.

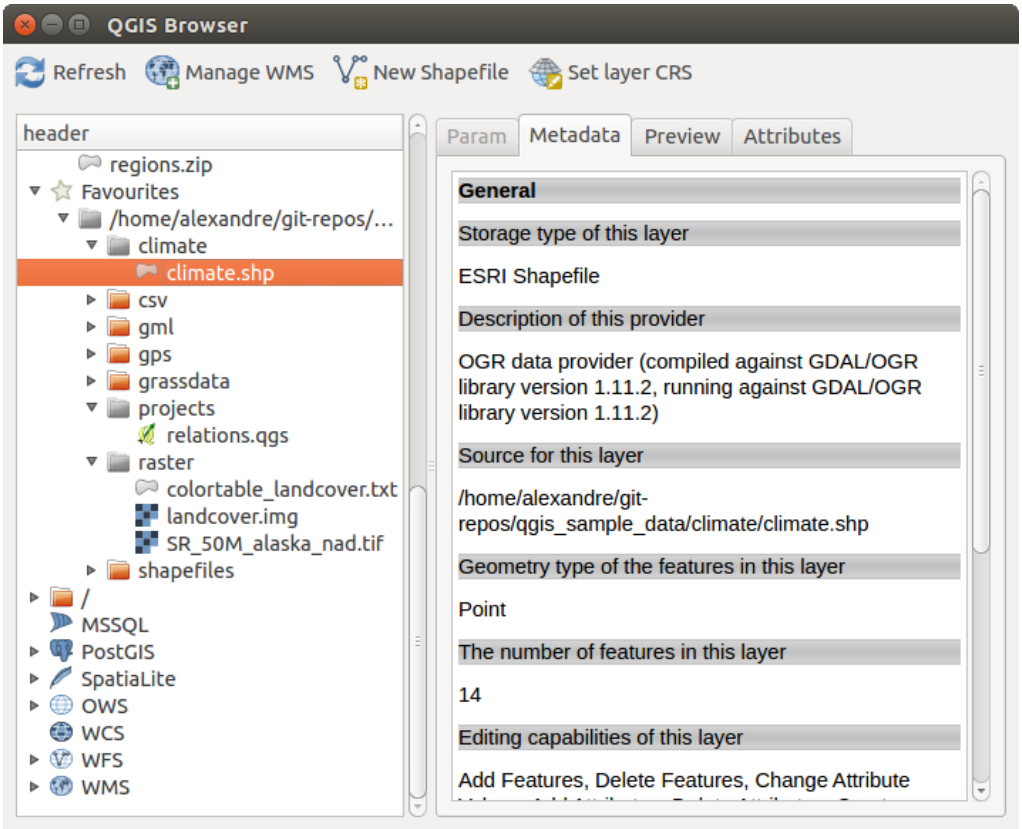

Figure 19.1: El Navegador QGIS [QGIS Browser] como aplicación independiente

CHAPTER 20

Entorno de trabajo de procesamiento de QGIS

20.1 Introducción

Este capítulo introduce al marco de procesamiento de QGIS, un entorno de geoprosesamiento que se puede utilizar para llamar algoritmos nativos o de terceros de QGIS, haciendo su tarea de análisis espacial más productivo y fácil de lograr.

En las siguientes secciones, revisaremos cómo usar los elementos gráficos de este sistema y sacar el máximo provecho de cada uno de ellos.

There are four basic elements in the framework GUI, which are used to run algorithms for different purposes. Choosing one tool or another will depend on the kind of analysis that is to be performed and the particular characteristics of each user and project. All of them (except for the batch processing interface, which is called from the toolbox or the algorithm execution dialog, as we will see) can be accessed from the *Processing* menu item. (You will see more than four entries. The remaining ones are not used to execute algorithms and will be explained later in this chapter).

- The *Toolbox*. The main element of the GUI, it is used to execute a single algorithm or run a batch process based on that algorithm.

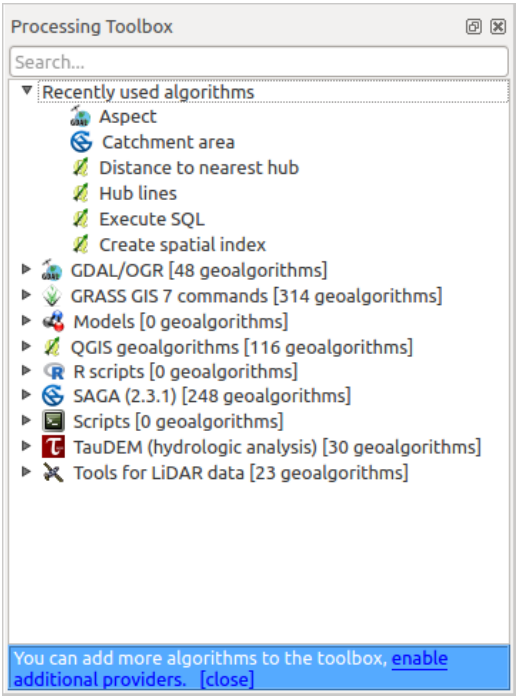

Figure 20.1: Caja de Herramientas de Procesamiento

- The *Graphical modeler*. Several algorithms can be combined graphically using the modeler to define a workflow, creating a single process that involves several subprocesses.

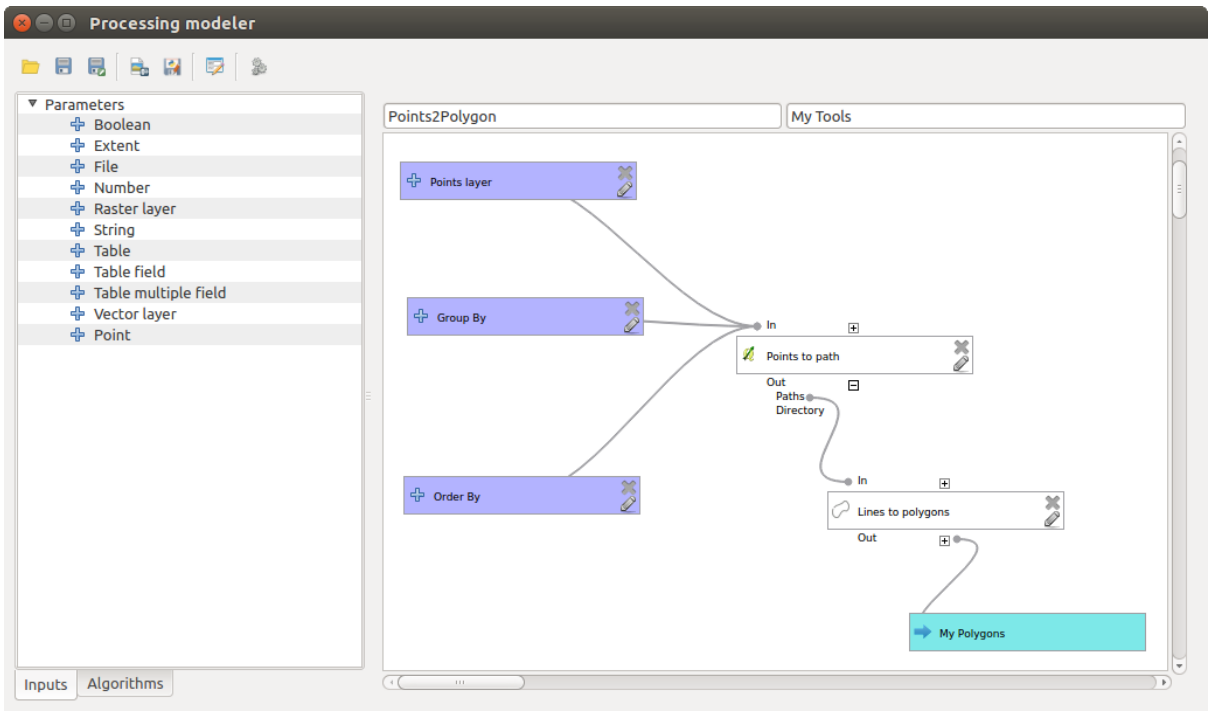

Figure 20.2: Procesamiento del modelador

- The *History manager*. All actions performed using any of the aforementioned elements are stored in a history file and can be later easily reproduced using the history manager.

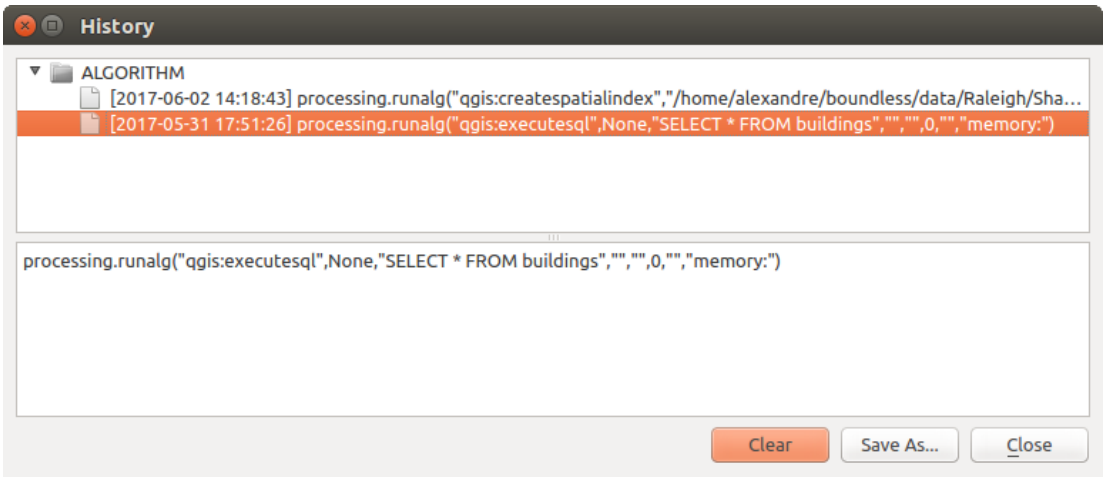

Figure 20.3: El historial del procesamiento

- The *Batch processing interface*. This interface allows you to execute batch processes and automate the execution of a single algorithm on multiple datasets.

En las siguientes secciones, revisaremos cada uno de los elementos a detalle.

Nota: *About Vector Menu*

Some processing algorithms can be accessed via the *Vector* menu which lists some tools from the processing framework but also from plugins.

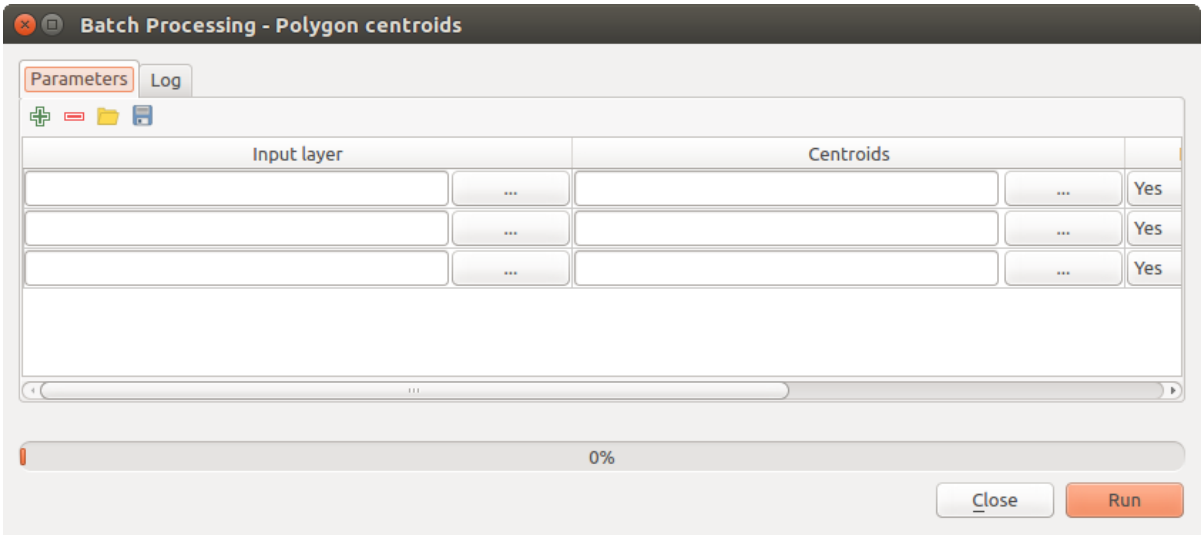

Figure 20.4: Interfaz de procesamiento por lote

20.2 Menu Vectorial

Vector menu provides a one-stop resource for many common vector-based GIS tasks. It provides a growing suite of spatial data management and analysis functions that are both fast and functional. These features are part of the processing framework. Note that some plugins can add other features so, in this chapter, only default features from processing framework will be listed.

Processing framework is automatically installed and, like any plugin, can be enabled and disabled using the Plugin Manager (see *El diálogo de complementos*). When enabled, the Processing plugin adds a *Vector* menu to QGIS, providing functions ranging from Analysis and Research Tools to Geometry and Geoprocessing Tools, as well as several useful Data Management Tools.

See *Entorno de trabajo de procesamiento de QGIS* for more information about the processing framework.

20.2.1 Herramientas de análisis

Icono	Herramienta	Propósito
	Matrix de distancia	Measure distances between two point layers, and output results as a) Square distance matrix, b) Linear distance matrix, or c) Summary of distances. Can limit distances to the k nearest features.
	Sum line length	Calculate the total sum of line lengths for each polygon of a polygon vector layer.
	Points in polygon	Count the number of points that occur in each polygon of an input polygon vector layer.
	List unique values	List all unique values in an input vector layer field.
	Estadísticas básicas para campos de texto	Compute basic statistics (mean, std dev, N, sum, CV) on an input text field.
	Basic statistics for numeric field	Compute basic statistics (mean, std dev, N, sum, CV) on an input numeric field
	Análisis del vecino más próximo	Compute nearest neighbor statistics to assess the level of clustering in a point vector layer.
	Mean coordinate(s)	Compute either the normal or weighted mean center of an entire vector layer, or multiple features based on a unique ID field.
	Intersecciones de líneas	Locate intersections between lines, and output results as a point shapefile. Useful for locating road or stream intersections, ignores line intersections with length > 0.

Table tools 1: Default tools in Analysis group

20.2.2 Herramientas de investigación

Icono	Herramienta	Propósito
	Selección aleatoria	Randomly select n number of features, or n percentage of features.
	Random selection within subsets	Randomly select features within subsets based on a unique ID field.
	Random points inside polygons	Generate pseudo-random points over a polygon layer (variable number of point or fixed number of point).
	Puntos aleatorios en la extensión	Generate pseudo-random points over a given extent.
	Random points in layer bounds	Generate pseudo-random points over bounds of a given input layer.
	Regular points	Generate a regular grid of points over a specified region and export them as a point shapefile.
	Cuadrícula vectorial	Generar una cuadrícula de línea o polígono en base aun espaciado de cuadrícula especificada.
	Seleccionar por localización	Seleccionar entidades en función de su ubicación con respecto a otra capa para formar una nueva selección, o sumar o restar de la selección actual.
	Polígono a partir de extensión de la capa	Create a single rectangular polygon layer from the extent of an input raster or vector layer.

Table Tools 2: Default tools in Research group

20.2.3 Herramientas de geoproceso

Icono	Herramienta	Propósito
	Convex hull(s)	Create minimum convex hull(s) for an input layer, or based on an ID field.
	Buffer with * fixed distance * distance field	Create buffer(s) around features * based on fixed distance * based on distance field
	Intersección	Overlay layers such that output contains areas where both layers intersect.
	Unión	Overlay layers such that output contains intersecting and non-intersecting areas.
	Symmetrical difference	Overlay layers such that output contains those areas of the input and difference layers that do not intersect.
	Cortar	Overlay layers such that output contains areas that intersect the clip layer.
	Deferencia	Overlay layers such that output contains areas not intersecting the clip layer.
	Disolver	Merge features based on input field. All features with identical input values are combined to form one single feature.
	Eliminate sliver polygons	Merges selected features with the neighboring polygon with the largest area or largest common boundary.

Table Tools 3: Default tools in Geoprocessing group

20.2.4 Geometry tools

Icono	Herramienta	Propósito
	Check geometry validity	Check polygons for intersections, closed holes, and fix node ordering. You can choose the engine used by the in the options dialog, digitizing tab Change the Validate geometries value. There is two engines: QGIS and GEOS which have pretty different behavior. Another tools exists which shows different result as well: Topology Checker plugin and 'must not have invalid geometries' rule.
	Export/Add geometry columns	Add vector layer geometry info to point (XCOORD, YCOORD), line (LENGTH), or polygon (AREA, PERIMETER) layer.
	Polygon centroids	Calculate the true centroids for each polygon in an input polygon layer.
	Triangulación de Delaunay	Calculate and output (as polygons) the Delaunay triangulation of an input point vector layer.
	Polígonos Voronoi	Calculate Voronoi polygons of an input point vector layer.
	Simplify geometry	Generalize lines or polygons with a modified Douglas-Peucker algorithm.
	Densificar geometrías	Densify lines or polygons by adding vertices.
	Multipartes a partes sencillas	Convert multipart features to multiple singlepart features. Creates simple polygons and lines.
	Singleparts to multipart	Merge multiple features to a single multipart feature based on a unique ID field.
	Polygons to lines	Convert polygons to lines, multipart polygons to multiple singlepart lines.
	Lines to polygons	Convert lines to polygons, multipart lines to multiple singlepart polygons.
	Extract nodes	Extract nodes from line and polygon layers and output them as points.

Table Tools 4: Default tools in Geometry group

Nota: The *Simplify geometry* tool can be used to remove duplicate nodes in line and polygon geometries. Just set the *Simplify tolerance* parameter to 0 and this will do the trick.

20.2.5 Herramientas de gestión de datos

Icono	Herramienta	Propósito
	Define current projection	Specify the CRS for shapefiles whose CRS has not been defined.
	Unir atributos por localización	Unir atributos adicionales a la capa de vectorial en función de su relación espacial. Los atributos de una capa vectorial se adjunta a la tabla de atributo de otra capa y se exporta como un archivo shape.
	Dividir capa vectorial	Split input layer into multiple separate layers based on input field.
	Merge shapefiles to one	Merge several shapefiles within a folder into a new shapefile based on the layer type (point, line, area).
	Crear índice espacial	Create a spatial index for OGR- supported formats.

Table Tools 5: Default tools in Data management group

20.3 The toolbox

The *Toolbox* is the main element of the processing GUI, and the one that you are more likely to use in your daily work. It shows the list of all available algorithms grouped in different blocks, and it is the access point to run them, whether as a single process or as a batch process involving several executions of the same algorithm on different sets of inputs.

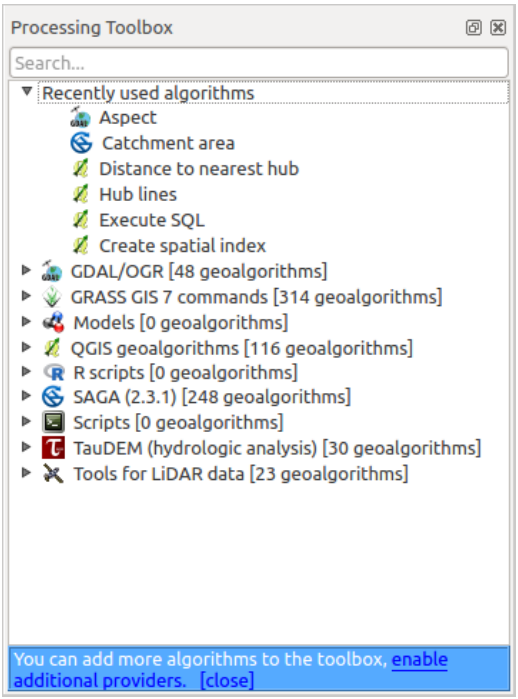

Figure 20.5: Caja de Herramientas de Procesamiento

The toolbox contains all the available algorithms, divided into so-called “Providers”.

Providers can be (de)activated in the settings dialog. A label in the bottom part of the toolbox will remind you of that whenever there are inactive providers. Use the link in the label to open the settings window and set up providers. We will discuss the settings dialog later in this manual.

By default, only providers that do not rely on third-party applications (that is, those that only require QGIS elements to be run) are active. Algorithms requiring external applications might need additional configuration. Configuring providers is explained in a later chapter in this manual.

In the upper part of the toolbox, you will find a text box. To reduce the number of algorithms shown in the toolbox and make it easier to find the one you need, you can enter any word or phrase on the text box. Notice that, as you type, the number of algorithms in the toolbox is reduced to just those that contain the text you have entered in their names.

If there are algorithms that match your search but belong to a provider that is not active, an additional label will be shown in the lower part of the toolbox.

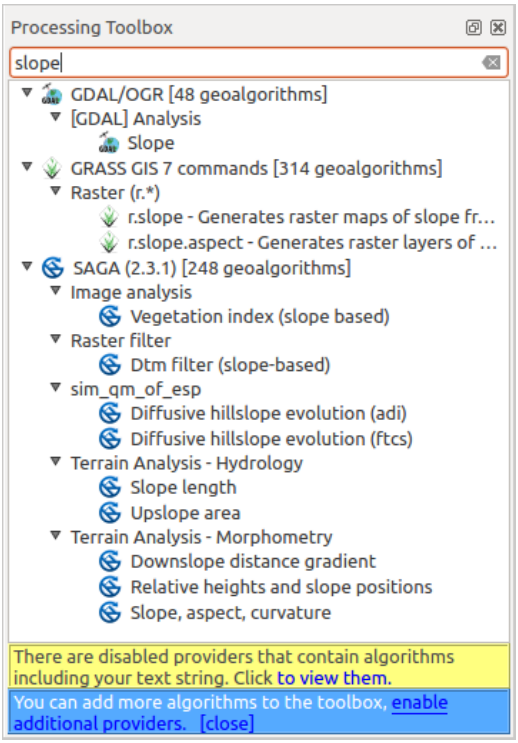

Figure 20.6: Processing Toolbox showing search results

If you click on the link in that label, the list of algorithms will also include those from inactive providers, which will be shown in light gray. A link to active each inactive provider is also shown.

To execute an algorithm, just double-click on its name in the toolbox.

20.3.1 El cuadro de diálogo de algoritmo

Once you double-click on the name of the algorithm that you want to execute, a dialog similar to that in the figure below is shown (in this case, the dialog corresponds to the 'Polygon centroids' algorithm).

This dialog is used to set the input values that the algorithm needs to be executed. It shows a list of input values and configuration parameters to be set. It of course has a different content, depending on the requirements of the algorithm to be executed, and is created automatically based on those requirements.

Aunque el número y el tipo de parámetro dependen de las características del algoritmo, la estructura es similar para todos ellos. Los parámetros encontrados en la tabla pueden ser de uno de los siguientes tipos.

- A **raster layer**, to select from a list of all such layers available (currently opened) in QGIS. The selector contains as well a button on its right-hand side, to let you select filenames that represent layers currently not loaded in QGIS.

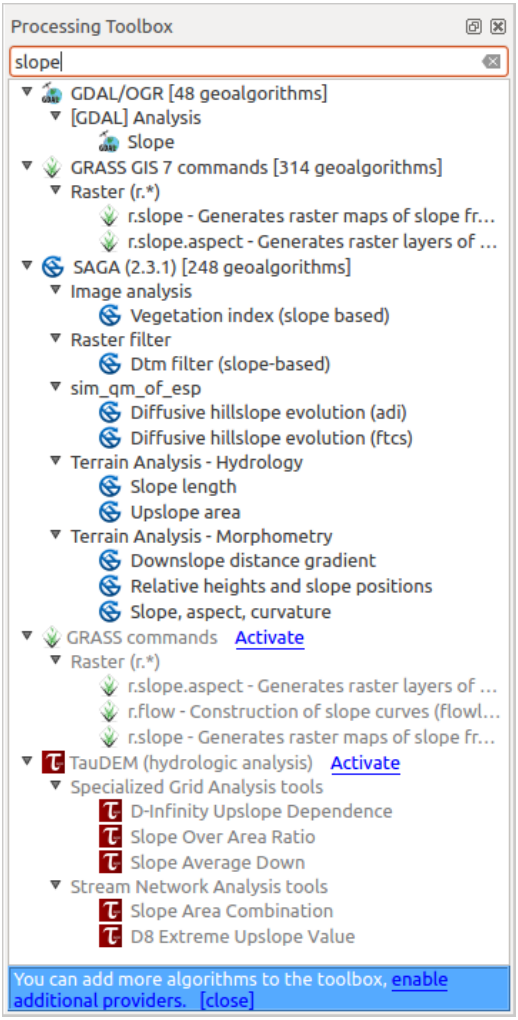

Figure 20.7: Processing Toolbox showing search results

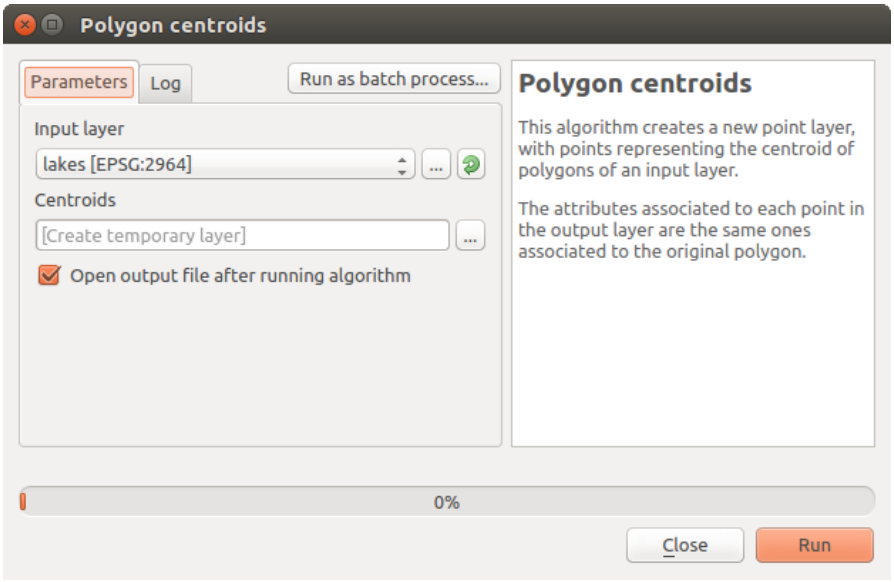

Figure 20.8: Diálogo de parámetros

- A **vector layer**, to select from a list of all vector layers available in QGIS. Layers not loaded in QGIS can be selected as well, as in the case of raster layers, but only if the algorithm does not require a table field selected from the attributes table of the layer. In that case, only opened layers can be selected, since they need to be open so as to retrieve the list of field names available.

  You will see an iterator button by each vector layer selector, as shown in the figure below.

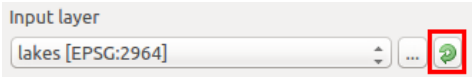

Figure 20.9: Vector iterator button

  Si el algoritmo contiene varios de ellos, será capaz de cambiar cada uno de ellos. Si el botón correspondiente a una entrada vectorial se cambia, el algoritmo será ejecutado iterativamente en cada uno de sus elementos, en lugar de sólo una vez para toda la capa, produciendo mayor cantidad de salidas como veces que se ejecuta el algoritmo. Esto permite la automatización del proceso cuando todas las características de una capa tienen que ser procesados por separado.

- A **table**, to select from a list of all available in QGIS. Non-spatial tables are loaded into QGIS like vector layers, and in fact they are treated as such by the program. Currently, the list of available tables that you will see when executing an algorithm that needs one of them is restricted to tables coming from files in dBase (`.dbf`) or Comma-Separated Values (`.csv`) formats.
- An **option**, to choose from a selection list of possible options.
- A **numerical value**, to be introduced in a spin box. You will find a button by its side. Clicking on it, you will open the expression builder that allows you to enter a mathematical expression, so you can use it as a handy calculator. Some useful variables related to data loaded into QGIS can be added to your expression, so you can select a value derived from any of these variables, such as the cell size of a layer or the northernmost coordinate of another one.

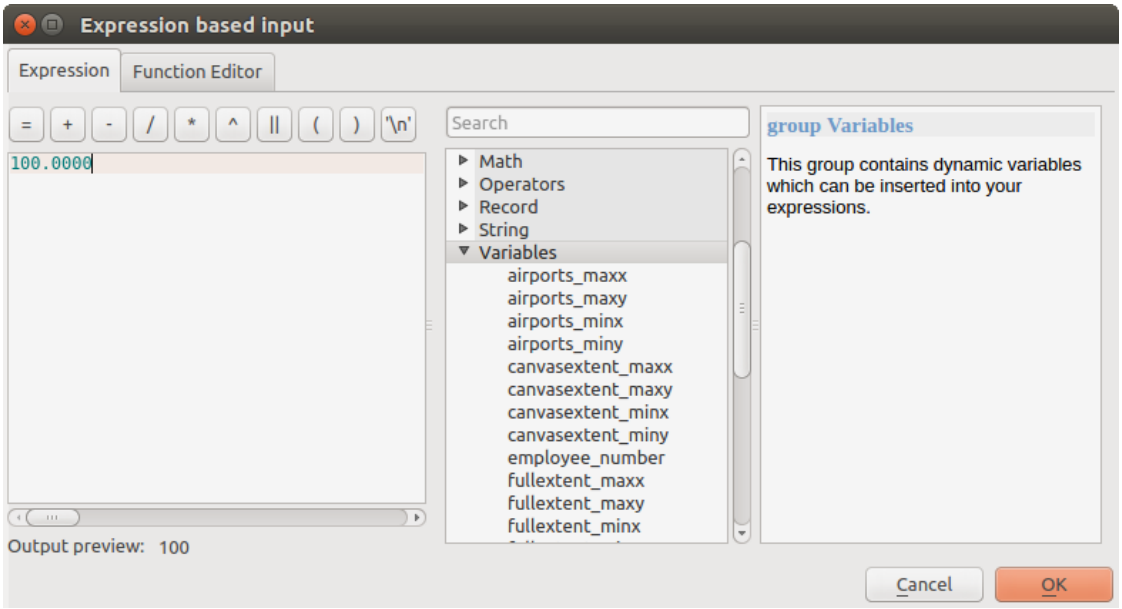

Figure 20.10: Entrada basada en expresión

- A **range**, with min and max values to be introduced in two text boxes.
- A **text string**, to be introduced in a text box.
- A **field**, to choose from the attributes table of a vector layer or a single table selected in another parameter.
- A **coordinate reference system**. You can type the EPSG code directly in the text box, or select it from the CRS selection dialog that appears when you click on the button on the right-hand side.

- An **extent**, to be entered by four numbers representing its `xmin`, `xmax`, `ymin`, `ymax` limits. Clicking on the button on the right-hand side of the value selector, a pop-up menu will appear, giving you three options:
  - to select the value from a layer or the current canvas extent,
  - to define it by dragging directly onto the map canvas, or
  - to use the minimum coverage from all input layers.

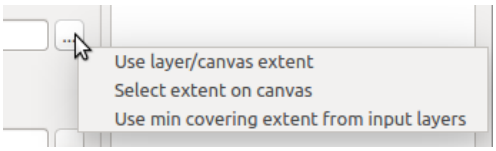

Figure 20.11: Selector de extensión

Si se selecciona la primera opción, se verá una ventana como la siguiente.

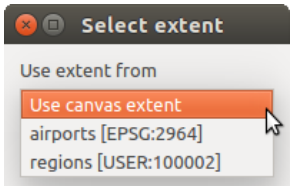

Figure 20.12: Lista de Extensión

Si se selecciona la segunda opción, la ventana de parámetros se ocultará, para que se pueda definir el rectángulo haciendo click y arrastrando dentro del lienzo. Una vez hecho esto, el cuadro de diálogo reaparecerá, con los valores correspondientes ya rellenos en en cuadro de texto.

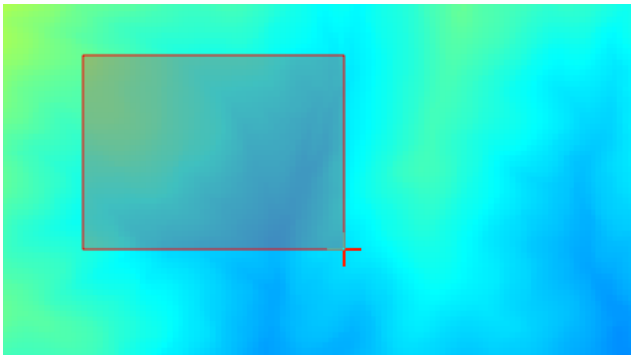

Figure 20.13: Arrastrar Extensión

- A **list of elements** (whether raster layers, vector layers or tables), to select from the list of such layers available in QGIS. To make the selection, click on the small button on the left side of the corresponding row to see a dialog like the following one.
- A **small table** to be edited by the user. These are used to define parameters like lookup tables or convolution kernels, among others.

  Click en el botón del lado derecho para ver la tabla y editar sus valores.

  Dependiendo del algoritmo, el número de filas que pueden ser modificadas o no al utilizar los botones del lado derecho de la ventana.

Along with the *Parameters* tab, you will find another tab named *Log*. Information provided by the algorithm during its execution is written in this tab, and allow you to track the execution and be aware and have more details about the algorithm as it runs. Notice that not all algorithms write information to this tab, and many of them might run silently without producing any output other than the final files.

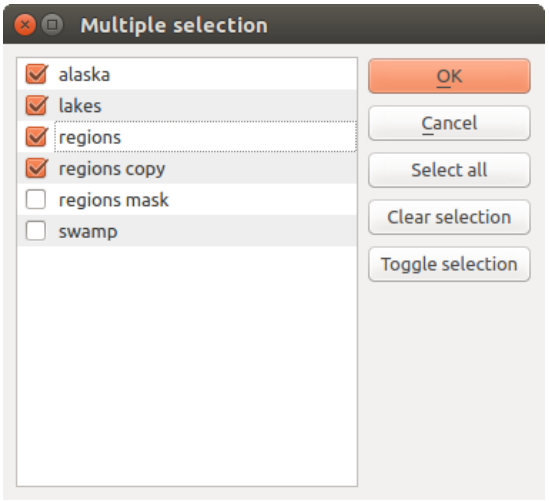

Figure 20.14: Selección Múltiple

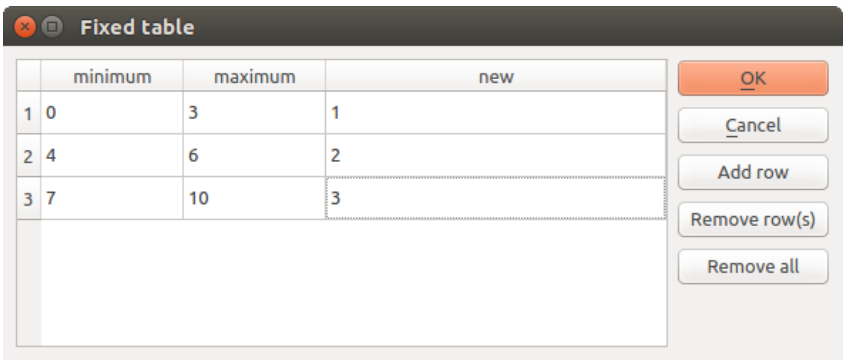

Figure 20.15: Tabla Fija

On the right hand side of the dialog you wil find a short description of the algorithm, which will help you understand its purpose and its basic ideas. If such a description is not available, the description panel will not be shown.

Some algorithms might have a more detailed help file, which might include description of every parameter it uses, or examples. In that case, you will find a *Help* tab in the parameters dialog.

Un comentario sobre proyecciones

Algorithms that are run from the processing framework — this is also true for most of the external applications whose algorithms are exposed through it — do not perform any reprojection on input layers and assume that all of them are already in a common coordinate system and ready to be analyzed. Whenever you use more than one layer as input to an algorithm, whether vector or raster, it is up to you to make sure that they are all in the same coordinate system.

Note that, due to QGIS's on-the-fly reprojecting capabilities, although two layers might seem to overlap and match, that might not be true if their original coordinates are used without reprojecting them onto a common coordinate system. That reprojection should be done manually, and then the resulting files should be used as input to the algorithm. Also, note that the reprojection process can be performed with the algorithms that are available in the processing framework itself.

By default, the parameters dialog will show a description of the CRS of each layer along with its name, making it easy to select layers that share the same CRS to be used as input layers. If you do not want to see this additional information, you can disable this functionality in the Processing settings dialog, unchecking the *Show CRS* option.

If you try to execute an algorithm using as input two or more layers with unmatching CRSs, a warning dialog will be shown.

Aún se puede ejecutar el algoritmo, pero en la mayoría de los casos se producirán resultados incorrectos, como capas vacias debido a que las capas de entrada no se solapan.

20.3.2 Resultados generados por algoritmos

Los tipos de resultados que se pueden generar cor un algoritmo son los siguientes:

- Una capa ráster.
- Una capa vectorial.
- Una tabla
- Un archivo HTML (usado para salidas de texto y salidas gráficas).

These are all saved to disk, and the parameters table will contain a text box corresponding to each one of these outputs, where you can type the output channel to use for saving it. An output channel contains the information needed to save the resulting object somewhere. In the most usual case, you will save it to a file, but in the case of vector layers, and when they are generated by native algorithms (algorithms not using external applications) you can also save to a PostGIS or Spatialite database, or a memory layer.

To select an output channel, just click on the button on the right side of the text box, and you will see a small context menu with the available options.

In the most usual case, you will select saving to a file. If you select that option, you will be prompted with a save file dialog, where you can select the desired file path. Supported file extensions are shown in the file format selector of the dialog, depending on the kind of output and the algorithm.

The format of the output is defined by the filename extension. The supported formats depend on what is supported by the algorithm itself. To select a format, just select the corresponding file extension (or add it, if you are directly typing the file path instead). If the extension of the file path you entered does not match any of the supported formats, a default extension will be appended to the file path, and the file format corresponding to that extension will be used to save the layer or table. Default extensions are `.dbf` for tables, `.tif` for raster layers and `.shp` for vector layers. These can be modified in the setting dialog, selecting any other of the formats supported by QGIS.

If you do not enter any filename in the output text box (or select the corresponding option in the context menu), the result will be saved as a temporary file in the corresponding default file format, and it will be deleted once you exit QGIS (take care with that, in case you save your project and it contains temporary layers).

You can set a default folder for output data objects. Go to the settings dialog (you can open it from the *Processing* menu), and in the *General* group, you will find a parameter named *Output folder*. This output folder is used as the default path in case you type just a filename with no path (i.e., `myfile.shp`) when executing an algorithm.

Al ejecutar un algoritmo que utiliza una capa vectorial en modo iterativo, la ruta del archivo introducido se utiliza como la ruta de la base para todos los archivos generados, los cuales se denominan utilizando el nombre base y añadiendo un número que representa el índice de la iteración. La extensión del archivo (y el formato) se utiliza para todos los archivos generados.

Apart from raster layers and tables, algorithms also generate graphics and text as HTML files. These results are shown at the end of the algorithm execution in a new dialog. This dialog will keep the results produced by any algorithm during the current session, and can be shown at any time by selecting *Processing* → *Results viewer* from the QGIS main menu.

Algunas aplicaciones externas pueden tener archivos (sin restricciones de extensión particulares) como de salida, pero no pertenece a ninguna de las categorías anteriores. Esos archivos de salida no serán procesadas por QGIS (abierto o incluido en el proyecto actual de QGIS), ya que la mayor parte del tiempo que corresponden a formatos de archivo o elementos no compatibles con QGIS. Esto es, por ejemplo, en el caso de archivos LAS utilizados para datos LiDAR. Los archivos se crean, pero no se ve nada nuevo en su sesión de trabajo en QGIS.

Para todos los otros tipos de salida, encontrará una casilla de verificación que se puede utilizar para decirle al algoritmo si se debe cargar el archivo una vez que se genera por el algoritmo o no. Por defecto, se abren todos los archivos.

Optional outputs are not supported. That is, all outputs are created. However, you can uncheck the corresponding checkbox if you are not interested in a given output, which essentially makes it behave like an optional output (in other words, the layer is created anyway, but if you leave the text box empty, it will be saved to a temporary file and deleted once you exit QGIS).

20.3.3 Configuring the processing framework

As has been mentioned, the configuration menu gives access to a new dialog where you can configure how algorithms work. Configuration parameters are structured in separate blocks that you can select on the left-hand side of the dialog.

Along with the aforementioned *Output folder* entry, the *General* block contains parameters for setting the default rendering style for output layers (that is, layers generated by using algorithms from any of the framework GUI components). Just create the style you want using QGIS, save it to a file, and then enter the path to that file in the settings so the algorithms can use it. Whenever a layer is loaded by Processing and added to the QGIS canvas, it will be rendered with that style.

Rendering styles can be configured individually for each algorithm and each one of its outputs. Just right-click on the name of the algorithm in the toolbox and select *Edit rendering styles for outputs*. You will see a dialog like the one shown next.

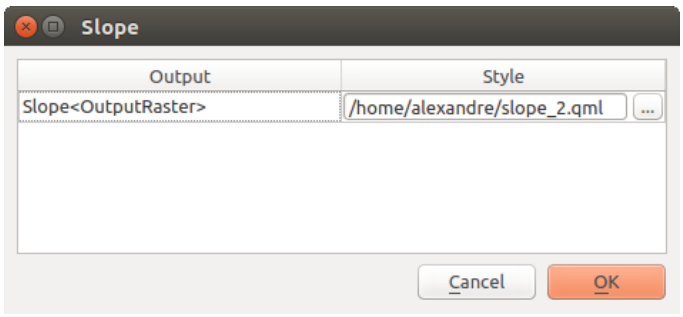

Figure 20.16: Rendering Styles

Select the style file (`.qml`) that you want for each output and press **[OK]**.

Other configuration parameters in the *General* group are listed below:

- *Use filename as layer name*. The name of each resulting layer created by an algorithm is defined by the algorithm itself. In some cases, a fixed name might be used, meaning that the same output name will be used, no matter which input layer is used. In other cases, the name might depend on the name of the input layer or some of the parameters used to run the algorithm. If this checkbox is checked, the name will be taken from the output filename instead. Notice that, if the output is saved to a temporary file, the filename of this temporary file is usually a long and meaningless one intended to avoid collision with other already existing filenames.
- *Keep dialog open after running algorithm*. Once an algorithm has finished execution and its output layers are loaded into the QGIS project, the algorithm dialog is closed. If you want to keep it open (to run the algorithm again with different parameters, or to better check the output that is written to the log tab), check this option
- *Use only selected features*. If this option is selected, whenever a vector layer is used as input for an algorithm, only its selected features will be used. If the layer has no selected features, all features will be used.
- *Pre-execution script file* and *Post-execution script file*. These parameters refer to scripts written using the processing scripting functionality, and are explained in the section covering scripting and the console.

Apart from the *General* block in the settings dialog, you will also find a block for algorithm providers. Each entry in this block contains an *Activate* item that you can use to make algorithms appear or not in the toolbox. Also, some algorithm providers have their own configuration items, which we will explain later when covering particular algorithm providers.

20.4 El administrador del historial

20.4.1 El historial del procesamiento

Cada vez que ejecutas un algoritmo, la información acerca del proceso es almacenado en el administrador de la historia. Junto con los parámetros usados, la fecha y hora de la ejecución también se guardan.

De esta manera, es fácil rastrear y controlar todo el trabajo que se ha desarrollado usando la caja de herramientas de procesado, y fácil reproducirlo.

El administrador del historial es un conjunto de entradas de registros agrupados de acuerdo a su fecha de ejecución, por lo que es más fácil encontrar información sobre un algoritmo ejecutado en cualquier momento en particular.

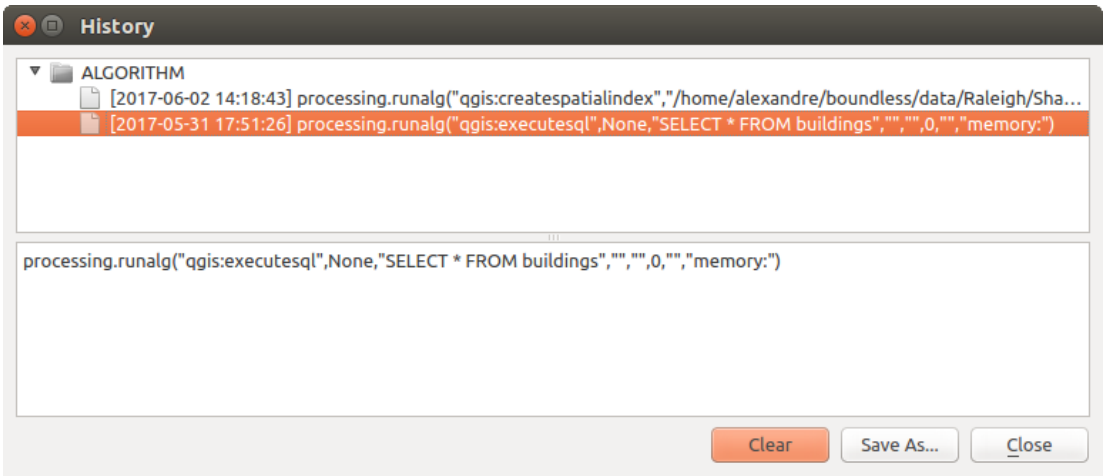

Figure 20.17: Historial

Información del proceso se mantiene como una expresión de línea de comandos, incluso si el algoritmo fue lanzado desde la caja de herramientas. Esto hace que sea también útil para aquellos que están aprendiendo cómo utilizar la interfaz de línea de comandos, ya que se pueden llamar un algoritmo usando la caja de herramientas y compruebe el administrados del historial para ver cómo ese mismo algoritmo podría ser llamado desde la línea de comandos.

Apart from browsing the entries in the registry, you can also re-execute processes by simply double-clicking on the corresponding entry.

20.4.2 El registro de procesamiento

The history dialog only contains the execution calls, but not the information produced by the algorithm when executed. That information is written to the QGIS log, in a *Processing* tab.

Third-party algorithms are usually executed by calling their command-line interfaces, which communicate with the user via the console. Although that console is not shown, a full dump of it is written to the log each time you run one of those algorithms. To avoid cluttering the log with that information, you can disable it for each provider, looking for the corresponding option in the provider entry of the settings dialog.

Algunos algoritmos, incluso si pueden producir un resultado con los datos de entrada dados , puede añadir comentarios o información adicional al registro, si detectan problemas potenciales con los datos, con el fin de advertirle. Asegúrese de revisar esos mensajes en el registro si se esta teniendo resultados inesperados.

20.5 Modelador gráfico

El "modelador gráfico" le permite crear modelos complejos usando una interfaz simple y fácil de usar. Cuando trabajas con SIG, la mayoría de los operaciones de análisis no están aislados, en cambio son parte de una cadena de operaciones. Usando un modelador gráfico, esa cadena de procesos se pueden envolver en un solo proceso, para que sea mas conveniente de ejecutarlo como un solo proceso más adelante en un conjunto diferente de las entradas. Sin importar cuantos pasos o diferentes algoritmos están involucrados, un modelo se ejecuta como un solo algoritmo, así ahorrando tiempo y esfuerzo, especialmente para modelos mas grande.

El modelador puede ser abierto desde el menu de procesamiento

El modelador tiene un cambas funcional donde la estructura del modelo y el flujo de trabajo que representa se puede ver. En la parte izquierda de la ventana, un panel con dos pestañas se pueden utilizar para agregar nuevos elementos al modelo.

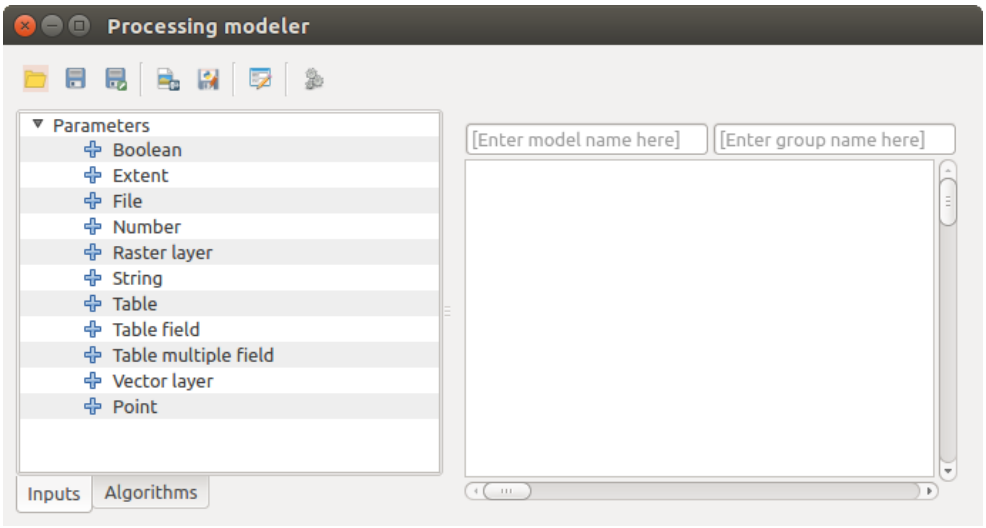

Figure 20.18: Modelador

Crear un modelo requiere dos pasos:

1. “Definición de entradas no necesarias”. Estas entradas se agregaran a la ventana de parámetros, asi el usuario puede poner sus valores cuando se ejecutan los modelos. El modelo en si es un algoritmo, asi la ventana de parámetros de genera automáticamente como pasa con todos los algoritmos disponibles en el marco de referencia del procesador.
2. “Definición de un flujo de trabajo”. Usando los datos entrantes de un modelo, el flujo de trabajo se define por algoritmos adicionales y seleccionando como se utilizan las entradas o salidas generados por otros almoritmos que ya estan en el modelo.

20.5.1 Definir entradas

El primer paso de crear un modelo es definir las entradas que se necesitan. Los siguientes elemenos se encuentran en la pestaña en el lado izquierdo de la ventana de modelos.

- Capa Raster
- Capa Vector
- Cadena
- Campo de la tabla
- Tabla
- Extensión
- NUmero
- Boolean
- Archivo

Haga doble clic en cualquiera de estos elementos, un diálogo se muestra para definir sus características. Depende de los parámetros en si. EL diálogo podría contener sólo un elemento básico (la descripción, que es la que el usuario verá al ejecutar el modelo) o más de ellos. Por ejemplo, al añadir un valor numérico, como se puede ver en la siguiente figura, parte de la descripción del parámetro, tiene que establecer un valor y un rango de valores validos.

Figure 20.19: Model Parameters Definition

Para cada entrada adicional, un nuevo elemento se agrega al canvas modelador.

También puede añadir entradas al arrastrar el tipo de entrada de la lista y soltarlo en la vista del modelador, en la posición donde dese ubicarla.

Figure 20.20: Model Parameters in canvas

20.5.2 Definicion del flujo de trabajo.

Una vez que se ha definido las entradas, es tiempo para definir los algoritmos que se les aplica. Los algoritmos se peuden encontrar en la pestaña *Algorithms* , agupados de una manera parecida a como estan en la caja de herramientas.

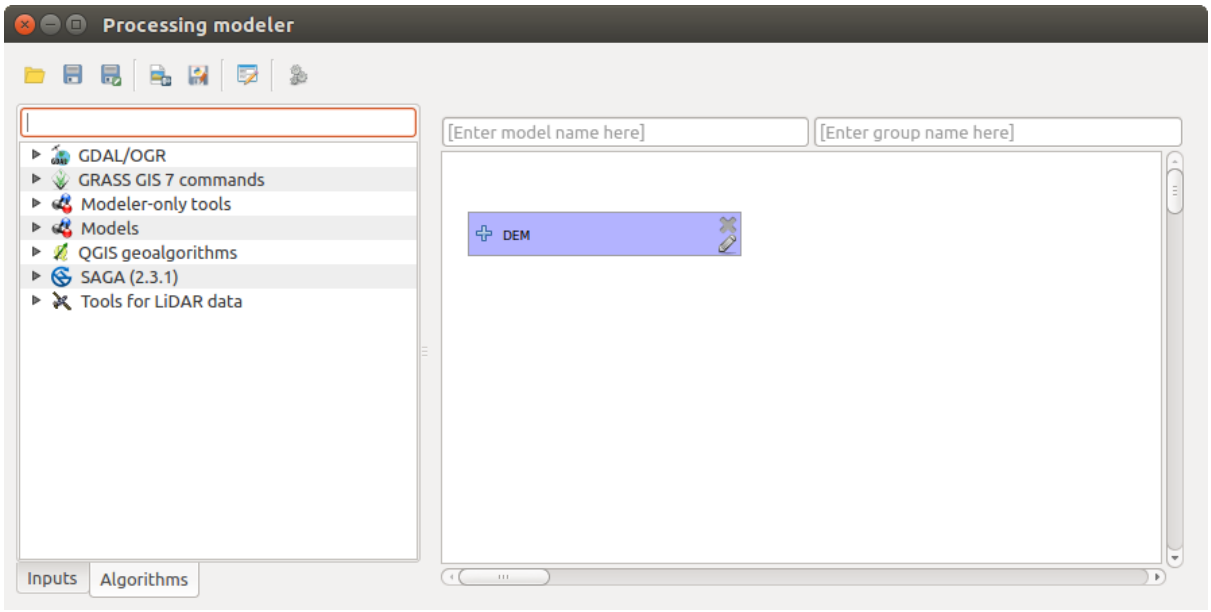

Figure 20.21: Model Inputs

Para añadir un algoritmo a un modelo, haga doble clic en su nombre o arrastre y suéltelo, al igual que se hace cuando añade entradas. Un diálogo de ejecución aparecerá, con un contenido similar a una encontrada en el panel de ejecución que se muestra cuando ejecutan el algoritmo de la caja de herramientas. La que se muestra a continuación corresponde al algoritmo 'Índice de convergencia' de SAGA.

Como se puede ver, existen algunas diferencias. En lugar de la caja de salida de archivo que se utiliza para establecer la ruta del archivo para capas y tablas de salida, una caja de texto simple se utiliza aquí. Si la capa generada por el algoritmo es sólo un resultado temporal que será utilizado como la entrada de otro algoritmo y no debe ser mantenida como resultado final, simplemente no modificar ese cuadro de texto. No escribir nada en él significa que el resultado es definitivo y el texto que se proporciona es la descripción de la salida, que será la salida que el usuario verá cuando se ejecute el modelo.

Seleccionar el valor de cada parámetro también es un poco diferente, ya que hay diferencias importantes entre contexto del modelador y de la caja de herramientas. Vamos a ver cómo introducir los valores para cada tipo de parámetro

- Las capas (ráster o vectorial) y tablas. Estos se seleccionan de una lista, pero en este caso, los posibles valores no son las capas o tablas actualmente cargadas en QGIS, sino la lista de modelos de entrada del tipo correspondiente, u otras capas o tablas generadas por algoritmos ya añadidos al modelo.
- Numerical values. Literal values can be introduced directly in the text box. But this text box is also a list that can be used to select any of the numerical value inputs of the model. In this case, the parameter will take the value introduced by the user when executing the model.

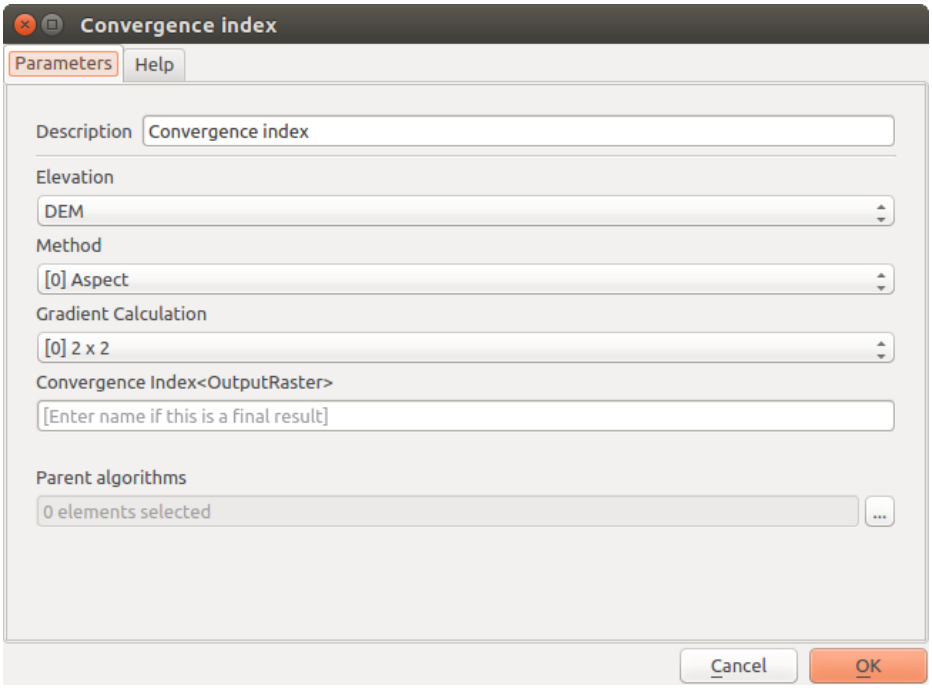

Figure 20.22: Model Algorithm parameters

- String. As in the case of numerical values, literal strings can be typed, or an input string can be selected.
- Campo de tabla. Los campos de la tabla padre o capa no se pueden conocer en tiempo de diseño, ya que dependen de la selección del usuario cada vez que el modelo es ejecutado. Para establecer el valor de este parámetro, escriba el nombre de un campo directamente en la caja de texto, o utilice la lista para seleccionar una entrada de campo de la tabla ya agregado al modelo. La validez del campo seleccionado será comprobada en tiempo de ejecución.

En todos los casos, se encontrará un parámetro adicional llamado *Algoritmos padres* que no esta disponible cuando llama al algoritmo de la caja de herramientas. Este parámetro permite definir el orden en que se ejecuten los algoritmos definiendo explícitamente un algoritmo como padre de la actual, lo que obligará al padre a ser ejecutado antes del actual.

Cuando se utiliza la salida de un algoritmo anterior como la entrada de su algoritmo, que establece de forma implícita el algoritmo anterior como padre del actual (y coloca la flecha correspondiente en la vista del modelador). Sin embargo, en algunos casos, un algoritmo puede depender de otro, incluso si no se utiliza ningún objeto de salida de la misma (por ejemplo, un algoritmo que ejecuta una sentencia de SQL en una base de datos PostGIS y otro que importa una capa en la misma base de datos) . En ese caso, basta con seleccionar el algoritmo anterior en el parámetro *Algoritmos padres* y los dos pasos se ejecutarán en el orden correcto.

Once all the parameters have been assigned valid values, click on **[OK]** and the algorithm will be added to the canvas. It will be linked to all the other elements in the canvas, whether algorithms or inputs, that provide objects that are used as inputs for that algorithm.

Los elementos se pueden arrastrar a una diferente posición dentro de la vista, para cambiar la forma de la estructura del modulo se muestra y hace más claro e intuitivo. Enlaces entre los elementos se actualizan automáticamente. Se puede acercar y alejar utilizando la rueda del ratón.

You can run your algorithm any time by clicking on the **[Run]** button. However, in order to use the algorithm from the toolbox, it has to be saved and the modeler dialog closed, to allow the toolbox to refresh its contents.

20.5.3 Guardar y cargar modelos.

Use the **[Save]** button to save the current model and the **[Open]** button to open any model previously saved. Models are saved with the `.model` extension. If the model has been previously saved from the modeler window,

you will not be prompted for a filename. Since there is already a file associated with that model, the same file will be used for any subsequent saves.

Antes de guardar un modelo, tienes que entrar el nombre y el grupo, utilizando las cajas de texto en la parte superior de la ventana.

Los modelos guardados en la carpeta `modelos` (la carpeta predeterminada cuando se le pide un nombre de archivo para guardar el modelo) aparecerá en la caja de herramientas en la rama correspondiente. Cuando se invoca la caja de herramientas, que busca en la carpeta `modelos` de archivos con la extensión `.model` y carga los modelos que contienen. Puesto que un modelo es en sí mismo un algoritmo, este se puede añadir a la caja de herramientas al igual que cualquier otro algoritmo.

La carpeta de los modelos se puede configurar desde el diálogo Procesos, bajo el grupo *Modelador*.

Se puede cargar modelos desde la carpeta `models` que no solo aparece en la caja de herramientas sino tambien en el arbol de argoritmos en la pestaña *Algorithms* de la ventana modeladora.

20.5.4 Editar un modelo.

Puedes editar un modelo que actualmente estar creando, redefiniendo el flujo de trabajo y la relacion entre los algoritmos y las entradas que definen el modelo en si.

Si haces click derecho en un algoritmo en el cambas representado en el modelo, puedes ver el menu de contexto parecido a lo siguiente:

Figure 20.23: Click derecho en el modelador

Seleccionando la opción *Remove* va a causar que el algoritmo seleccionado se elimine. Un algoritmo se puede eliminar solo si no hay otros algoritmas dependiendo de este. Eso es, si ninguna salida del algoritmo se utiliza en uno diferente de salida. Si intentar elimiar el algoritmo donde hay dependencia, un mensaje de advertencia como el que se ve abajo va a salir.

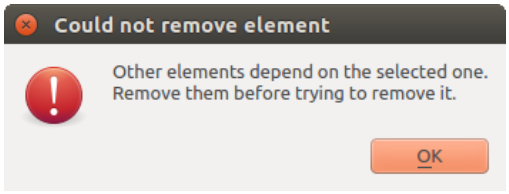

Figure 20.24: No se puede borrar el algoritmo

Seleccionando la opción *Editar* mostrara los parámetros de dialogo del algoritmo, para que puedas cambiar las entradas y los valores de los parámetros. No todos los elementos de entrada disponibles en le modelo van a aparecer en el caso de entradas disponibles. Las capas o valores generados en pasos mas avanzados en el flujo de trabajo por el modelo no van a estar disponibles si ellos causan una dependencia circular.

Select the new values and then click on the **[OK]** button as usual. The connections between the model elements will change accordingly in the modeler canvas.

Un modelo se puede ejecutar parcialmente, desactivando algunos de sus algoritmos. Para hacer eso, seleccione la opción *Desactivar* en el menú contextual que aparece cuando hace clic derecho en un elemento del algoritmo. El algoritmo seleccionado, y todos los que están en ella se mostrarán en gris y no se ejecutarán como parte del modelo.

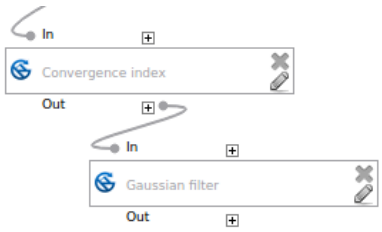

Figure 20.25: Modelo con algoritmos desactivados

Cuando haga clic en un algoritmo que no este activo, verá en su lugar una opción del menú *Activar* que puede utilizar para activarlo de nuevo.

20.5.5 Editando archivos de ayuda y meta informacion de modelos

You can document your models from the modeler itself. Just click on the **[Edit model help]** button and a dialog like the one shown next will appear.

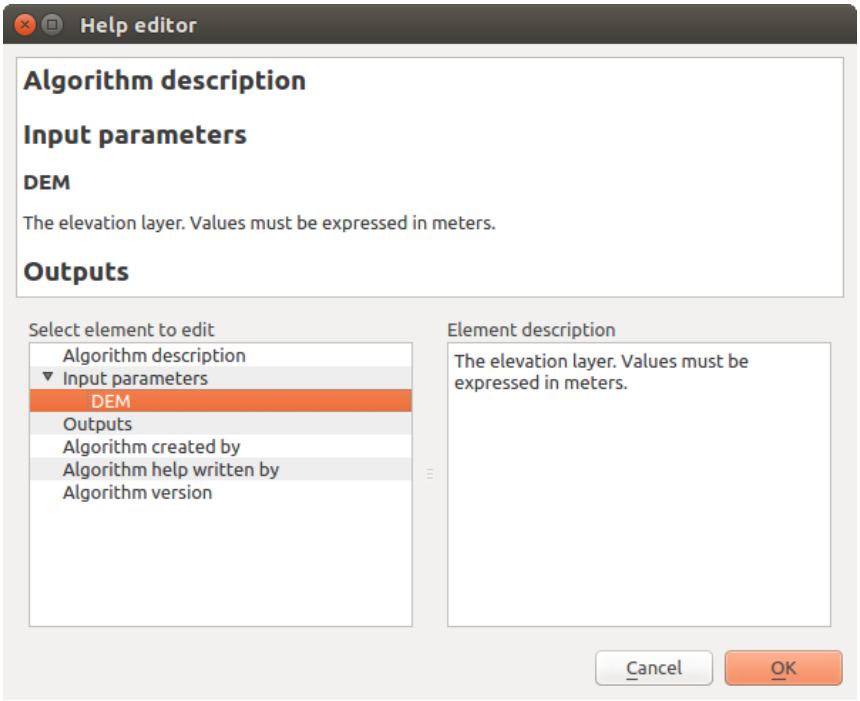

Figure 20.26: Edición de Ayuda

En el lado derecho, verá una página HTML simple, creado mediante la descripción de los parámetros de entrada y salidas del algoritmo, junto con algunos elementos adicionales como una descripción general del modelo o su autor. La primera vez que se abre el editor de ayuda, todas estas descripciones están vacíos, pero se pueden editar utilizando los elementos en la parte izquierda del cuadro de diálogo. Seleccione un elemento en la parte superior y luego escriba su descripción en el cuadro de texto de abajo.

Modelo de ayuda se guarda como parte de un modelo en si.

20.5.6 Exporting a model as a Python script

As we will see in a later chapter, Processing algorithms can be called from the QGIS Python console, and new Processing algorithms can be created as well using Python. A quick way of creating such a Python script is to create a model and then to export is as a Python file.

To do so, click on the *Export as Python script* button. Select the output file in the file chooser dialog, and Processing will write in it the Python commands that perform the same operations defined in the current model.

20.5.7 Acerca de algoritmos disponibles

Puede notar que algunos algoritmos que pueden ser ejecutados desde la caja de herramientas no aparecen en la lista de algoritmos disponibles cuando se está diseñando un modelo. Para ser incluidos en un modelo, un algoritmo debe tener una semántica correcta, de modo que sea adecuadamente enlazado a los otros en el flujo de trabajo. Si un algoritmo no tiene tal bien definida la semántica (por ejemplo, si el número de capas de salida no puede ser conocido de antemano), entonces no es posible utilizarlo dentro de un modelo, y por lo tanto, no aparece en el lista de algoritmos que se puede encontrar en el diálogo modelador.

Additionally, you will see some algorithms in the modeler that are not found in the toolbox. These algorithms are meant to be used exclusively as part of a model, and they are of no interest in a different context. The 'Calculator' algorithm is an example of that. It is just a simple arithmetic calculator that you can use to modify numerical values (entered by the user or generated by some other algorithm). This tool is really useful within a model, but outside of that context, it doesn't make too much sense.

20.6 La interfaz de procesamiento por lotes

20.6.1 Introducción

All algorithms (including models) can be executed as a batch process. That is, they can be executed using not just a single set of inputs, but several of them, executing the algorithm as many times as needed. This is useful when processing large amounts of data, since it is not necessary to launch the algorithm many times from the toolbox.

Para ejecutar un algoritmo como un proceso por lotes, haga clic en su nombre en la caja de herramientas y seleccionar la opción *Ejecutar como proceso por lotes* en el menú emergente que aparecerá.

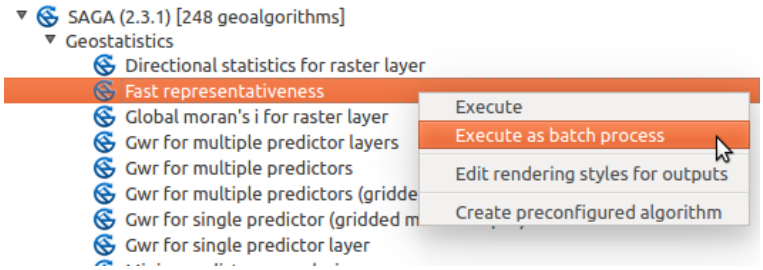

Figure 20.27: Batch Processing from right-click

Si tiene que ejecutar el diálogo del algoritmo abierto, también puede iniciar la interfaz de procesamiento por lotes desde allí, haga clic en el botón *Ejecutar como proceso por lotes...*.

20.6.2 La tabla de parámetros

La ejecución de un proceso por lotes es similar a la realización de una sola ejecución de un algoritmo. Los valores de los parámetros tienen que ser definidos, pero en este caso no sólo necesitan un valor único para cada parámetro, sino un conjunto de ellos en su lugar, una por cada vez que el algoritmo tiene que ser ejecutado. Los valores se introducen mediante una tabla como la que se muestra a continuación.

Cada línea de esta tabla representa una sola ejecución del algoritmo, y cada celda contiene el valor de uno de los parámetros. Es similar al diálogo de los parámetros que se ve cuando se ejecuta un algoritmo de la caja de herramientas, pero con una disposición diferente.

Por defecto, la tabla contiene sólo dos filas. Puede agregar o quitar filas utilizando los botones de la parte inferior de la ventana.

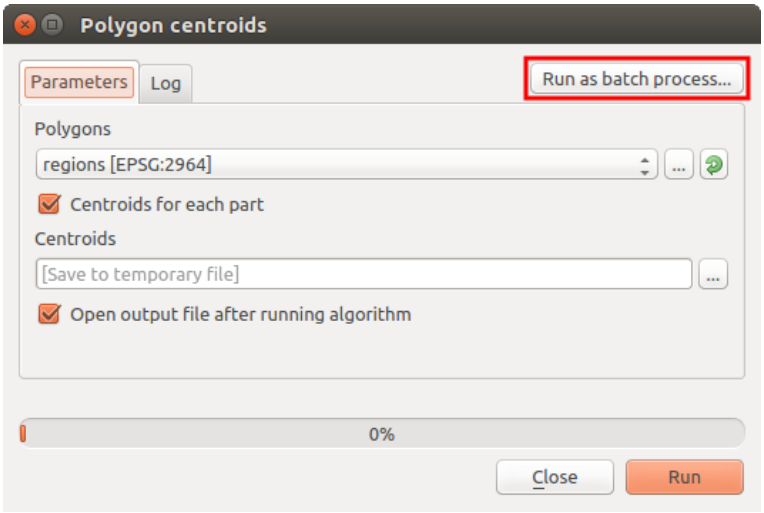

Figure 20.28: diálogo de procesamiento por lotes de algoritmo

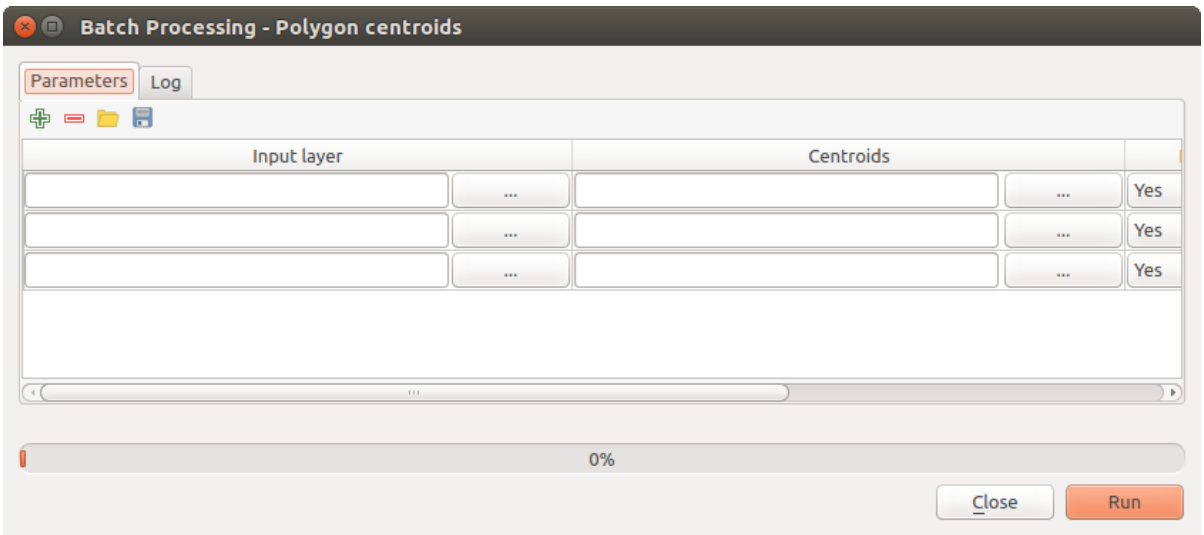

Figure 20.29: Procesamiento por Lotes

Una vez que el tamaño de la tabla se ha establecido, este tiene que ser llenado con los valores deseados.

20.6.3 Llenado de la tabla de parámetros

Para la mayoría de los parámetros, establecen el valor es trivial. Sólo tienes que escribir el valor o seleccionarlo de la lista de opciones disponibles, dependiendo del tipo de parámetro.

Filenames for input data objects are introduced directly typing or, more conveniently, clicking on the  button on the right hand of the cell, which will show a context menu with two option: one for selecting from the layers currently opened and another to select from the filesystem. This second option, when selected, shows a typical file chooser dialog. Multiple files can be selected at once. If the input parameter represents a single data object and several files are selected, each one of them will be put in a separate row, adding new ones if needed. If the parameter represents a multiple input, all the selected files will be added to a single cell, separated by semicolons (;).

Identificadores de capa se pueden introducir directamente en el cuadro de texto del parámetro. Puede introducir la ruta completa a un archivo o el nombre de una capa que está cargado actualmente en el proyecto de QGIS actual. El nombre de la capa se resolverá de forma automática a su ruta de origen. Tenga en cuenta que, si varias capas tienen el mismo nombre, esto podría causar resultados inesperados debido a la ambigüedad.

Los objetos de datos de salida siempre se guardan en un archivo y, a diferencia de cuando se ejecuta un algoritmo de la caja de herramientas, guardar en un archivo temporal o base de datos no está permitido. Puede escribir el nombre directamente o utilizar el diálogo de selector de archivos que aparece al hacer clic en el botón que lo acompaña.

Una ves que seleccione el archivo, un nuevo diálogo se mostrará para permitir la terminación automática de otras celdas en la misma columna (mismo parámetro).

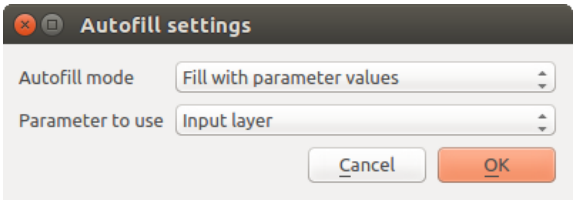

Figure 20.30: Guardar Procesamiento por lotes

Si se selecciona el valor por defecto ('No autocompletar'), se acaba de poner el nombre del archivo seleccionado en la celda seleccionada de la tabla de parámetros. Si se selecciona cualquiera de las otras opciones, todas las celdas debajo de la seleccionada será automáticamente llenado basado en un criterio definido. De esta manera, es mucho más fácil llenar la tabla, y el proceso por lotes se puede definir con menos esfuerzo.

El llenado automático puede hacerse por simple adición de los números correlativos a la ruta del archivo seleccionado, o al añadir el valor de otro campo en la misma fila. Esto es particularmente útil para nombrar a los objetos de datos de salida de acuerdo con los de entrada.

20.6.4 Ejecutar el proceso por lotes

To execute the batch process once you have introduced all the necessary values, just click on **[OK]**. Progress of the global batch task will be shown in the progress bar in the lower part of the dialog.

20.7 Utilizar algoritmos de procesamiento desde la consola

La consola permite a los usuarios avanzados incrementar su productividad y realizar operaciones complejas que no se pueden realizar utilizando cualquiera de los otros elementos de la GUI del marco de procesamiento. Modelos que involucran varios algoritmos se pueden definir mediante la interfaz de línea de comandos y operaciones

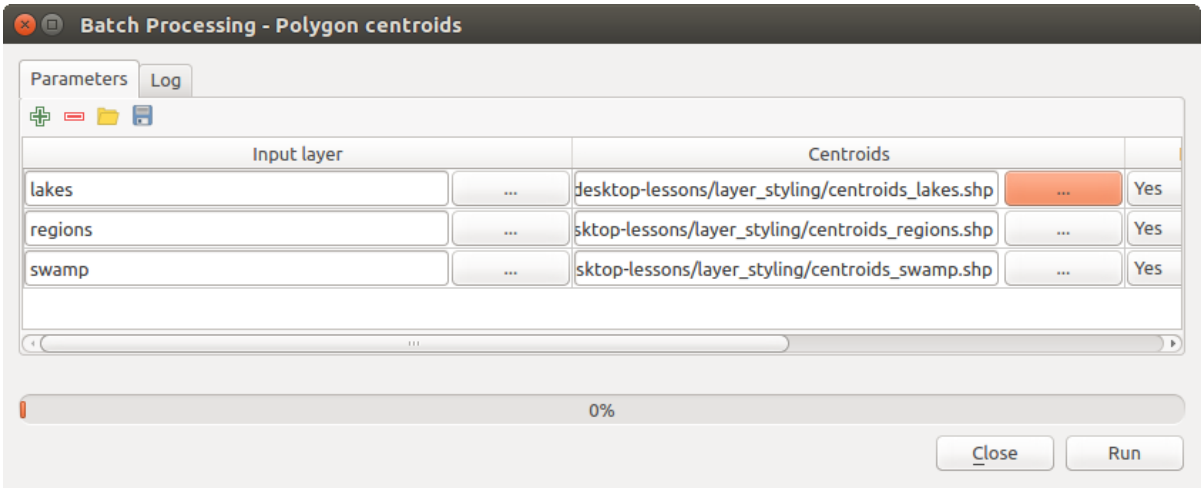

Figure 20.31: Ruta de archivo de procesamiento por lotes

adicionales tales como bucles y sentencias condicionales que se pueden añadir para crear flujos de trabajo más flexibles y potentes.

There is not a processing console in QGIS, but all processing commands are available instead from the QGIS built-in *Python console*. That means that you can incorporate those commands into your console work and connect processing algorithms to all the other features (including methods from the QGIS API) available from there.

El código se puede ejecutar desde la consola de Python, incluso si no especifica ningún método de procesamiento, se puede convertir en un nuevo algoritmo que más tarde puede llamar desde la caja de herramientas, el modelador gráfico o algún otro componente, tal como lo hace con cualquier otro algoritmo. De hecho, algunos de los algoritmos que se pueden encontrar en la caja de herramientas son sencillas secuencias de comandos.

En esta sección, veremos como utilizar algoritmos de procesado desde la consola de Python de QGIS, y también cómo escribir algoritmos utilizando Python.

20.7.1 Invocando algoritmos desde la consola de Python

Lo primero que tiene que hacer es importar las funciones de procesamiento con la siguiente línea:

```
>>> import processing
```

Now, there is basically just one (interesting) thing you can do with that from the console: execute an algorithm. That is done using the `runalg()` method, which takes the name of the algorithm to execute as its first parameter, and then a variable number of additional parameters depending on the requirements of the algorithm. So the first thing you need to know is the name of the algorithm to execute. That is not the name you see in the toolbox, but rather a unique command–line name. To find the right name for your algorithm, you can use the `algslist()` method. Type the following line in your console:

```
>>> processing.alglist()
```

You will see something like this.

```
Accumulated Cost (Anisotropic)-------->saga:accumulatedcost(anisotropic)
Accumulated Cost (Isotropic)---------->saga:accumulatedcost(isotropic)
Add Coordinates to points------------->saga:addcoordinatestopoints
Add Grid Values to Points------------->saga:addgridvaluestopoints
Add Grid Values to Shapes------------->saga:addgridvaluestoshapes
Add Polygon Attributes to Points------>saga:addpolygonattributestopoints
Aggregate----------------------------->saga:aggregate
Aggregate Point Observations---------->saga:aggregatepointobservations
Aggregation Index--------------------->saga:aggregationindex
Analytical Hierarchy Process---------->saga:analyticalhierarchyprocess
```

```
Analytical Hillshading---------------->saga:analyticalhillshading
Average With Mask 1------------------->saga:averagewithmask1
Average With Mask 2------------------->saga:averagewithmask2
Average With Thereshold 1------------->saga:averagewiththereshold1
Average With Thereshold 2------------->saga:averagewiththereshold2
Average With Thereshold 3------------->saga:averagewiththereshold3
B-Spline Approximation---------------->saga:b-splineapproximation
...
```

That's a list of all the available algorithms, alphabetically ordered, along with their corresponding command-line names.

You can use a string as a parameter for this method. Instead of returning the full list of algorithms, it will only display those that include that string. If, for instance, you are looking for an algorithm to calculate slope from a DEM, type `alglist("slope")` to get the following result:

```
DTM Filter (slope-based)-------------->saga:dtmfilter(slope-based)
Downslope Distance Gradient----------->saga:downslopedistancegradient
Relative Heights and Slope Positions-->saga:relativeheightsandslopepositions
Slope Length-------------------------->saga:slopelength
Slope, Aspect, Curvature-------------->saga:slopeaspectcurvature
Upslope Area-------------------------->saga:upslopearea
Vegetation Index[slope based]--------->saga:vegetationindex[slopebased]
```

This result might change depending on the algorithms you have available.

It is easier now to find the algorithm you are looking for and its command-line name, in this case `saga:slopeaspectcurvature`.

Once you know the command-line name of the algorithm, the next thing to do is to determine the right syntax to execute it. That means knowing which parameters are needed and the order in which they have to be passed when calling the `runalg()` method. There is a method to describe an algorithm in detail, which can be used to get a list of the parameters that an algorithm requires and the outputs that it will generate. To get this information, you can use the `alghelp(name_of_the_algorithm)` method. Use the command-line name of the algorithm, not the full descriptive name.

Calling the method with `saga:slopeaspectcurvature` as parameter, you get the following description:

```
>>> processing.alghelp("saga:slopeaspectcurvature")
ALGORITHM: Slope, Aspect, Curvature
   ELEVATION <ParameterRaster>
   METHOD <ParameterSelection>
   SLOPE <OutputRaster>
   ASPECT <OutputRaster>
   CURV <OutputRaster>
   HCURV <OutputRaster>
   VCURV <OutputRaster>
```

Now you have everything you need to run any algorithm. As we have already mentioned, there is only one single command to execute algorithms: `runalg()`. Its syntax is as follows:

```
>>> processing.runalg(name_of_the_algorithm, param1, param2, ..., paramN,
        Output1, Output2, ..., OutputN)
```

The list of parameters and outputs to add depends on the algorithm you want to run, and is exactly the list that the `alghelp()` method gives you, in the same order as shown.

Dependiendo del tipo de parámetro, los valores se introducen de manera diferente. La siguiente lista da una rápida revisión de cómo introducir los valores para cada tipo de parámetro de entrada.

- Raster Layer, Vector Layer or Table. Simply use a string with the name that identifies the data object to use (the name it has in the QGIS Table of Contents) or a filename (if the corresponding layer is not opened, it will be opened but not added to the map canvas). If you have an instance of a QGIS object representing the layer, you can also pass it as parameter. If the input is optional and you do not want to use any data object, use `None`.

- Selection. If an algorithm has a selection parameter, the value of that parameter should be entered using an integer value. To know the available options, you can use the `algoptions()` command, as shown in the following example:

```
>>> processing.algoptions("saga:slopeaspectcurvature")
METHOD(Method)
    0 - [0] Maximum Slope (Travis et al. 1975)
    1 - [1] Maximum Triangle Slope (Tarboton 1997)
    2 - [2] Least Squares Fitted Plane (Horn 1981, Costa-Cabral & Burgess 1996)
    3 - [3] Fit 2.Degree Polynom (Bauer, Rohdenburg, Bork 1985)
    4 - [4] Fit 2.Degree Polynom (Heerdegen & Beran 1982)
    5 - [5] Fit 2.Degree Polynom (Zevenbergen & Thorne 1987)
    6 - [6] Fit 3.Degree Polynom (Haralick 1983)
```

  In this case, the algorithm has one such parameter, with seven options. Notice that ordering is zero-based.

- La entrada múltiple. El valor es una cadena con descriptores de entrada separadas por punto y coma (`;`). Como en el caso de capas individuales o tablas, cada descriptor de entrada se puede el nombre del objeto de datos, o su ruta de archivo.
- El campo de la tabla de XXX. Utilice una cadena con el nombre del campo a usar. Este parámetro es sensible a mayúsculas y minúsculas.
- Tabla fija. Escribir la lista de todas las tablas de valores separadas por comas (`,`) y cerrar entre comillas (`"`). Los valores que empiezan en la fila superior y van de izquierda a derecha. También se puede utilizar un arreglo 2-D de valores que representen la tabla.
- SRC. Introduzca el número del código EPSG del SRC deseado.
- Extensión. Se debe utilizar una cadena con valores de `xmin`, `xmax`, `ymin` y `ymax` separados por comas (,).

Los parámetros boolean, archivo, cadena y numéricos no necesitan alguna explicación adicional.

Input parameters such as strings, booleans, or numerical values have default values. To use them, specify `None` in the corresponding parameter entry.

For output data objects, type the file path to be used to save it, just as it is done from the toolbox. If you want to save the result to a temporary file, use `None`. The extension of the file determines the file format. If you enter a file extension not supported by the algorithm, the default file format for that output type will be used, and its corresponding extension appended to the given file path.

Unlike when an algorithm is executed from the toolbox, outputs are not added to the map canvas if you execute that same algorithm from the Python console. If you want to add an output to the map canvas, you have to do it yourself after running the algorithm. To do so, you can use QGIS API commands, or, even easier, use one of the handy methods provided for such tasks.

The `runalg` method returns a dictionary with the output names (the ones shown in the algorithm description) as keys and the file paths of those outputs as values. You can load those layers by passing the corresponding file paths to the `load()` method.

20.7.2 Additional functions for handling data

Apart from the functions used to call algorithms, importing the `processing` package will also import some additional functions that make it easier to work with data, particularly vector data. They are just convenience functions that wrap some functionality from the QGIS API, usually with a less complex syntax. These functions should be used when developing new algorithms, as they make it easier to operate with input data.

Below is a list of some of these commands. More information can be found in the classes under the `processing/tools` package, and also in the example scripts provided with QGIS.

- `getObject(obj)`: Returns a QGIS object (a layer or table) from the passed object, which can be a filename or the name of the object in the QGIS Layers List

- `values(layer, fields)`: Returns the values in the attributes table of a vector layer, for the passed fields. Fields can be passed as field names or as zero-based field indices. Returns a dict of lists, with the passed field identifiers as keys. It considers the existing selection.
- `features(layer)`: Returns an iterator over the features of a vector layer, considering the existing selection.
- `uniqueValues(layer, field)`: Returns a list of unique values for a given attribute. Attributes can be passed as a field name or a zero-based field index. It considers the existing selection.

20.7.3 Crear scripts y ejecurarlos desde le Caja de Herramientas

You can create your own algorithms by writing the corresponding Python code and adding a few extra lines to supply additional information needed to define the semantics of the algorithm. You can find a *Create new script* menu under the *Tools* group in the *Script* algorithms block of the toolbox. Double-click on it to open the script editing dialog. That's where you should type your code. Saving the script from there in the `scripts` folder (the default folder when you open the save file dialog) with `.py` extension will automatically create the corresponding algorithm.

The name of the algorithm (the one you will see in the toolbox) is created from the filename, removing its extension and replacing low hyphens with blank spaces.

Let's have a look at the following code, which calculates the Topographic Wetness Index (TWI) directly from a DEM.

```
##dem=raster
##twi=output
ret_slope = processing.runalg("saga:slopeaspectcurvature", dem, 0, None,
                None, None, None, None)
ret_area = processing.runalg("saga:catchmentarea(mass-fluxmethod)", dem,
                0, False, False, False, False, None, None, None, None, None)
processing.runalg("saga:topographicwetnessindex(twi), ret_slope['SLOPE'],
                ret_area['AREA'], None, 1, 0, twi)
```

As you can see, the calculation involves three algorithms, all of them coming from SAGA. The last one calculates the TWI, but it needs a slope layer and a flow accumulation layer. We do not have these layers, but since we have the DEM, we can calculate them by calling the corresponding SAGA algorithms.

The part of the code where this processing takes place is not difficult to understand if you have read the previous sections in this chapter. The first lines, however, need some additional explanation. They provide the information that is needed to turn your code into an algorithm that can be run from any of the GUI components, like the toolbox or the graphical modeler.

These lines start with a double Python comment symbol (`##`) and have the following structure:

```
[parameter_name]=[parameter_type] [optional_values]
```

Here is a list of all the parameter types that are supported in processing scripts, their syntax and some examples.

- `raster`. A raster layer.
- `vector`. A vector layer.
- `table`. A table.
- `number`. A numerical value. A default value must be provided. For instance, `depth=number 2.4`.
- `string`. A text string. As in the case of numerical values, a default value must be added. For instance, `name=string Victor`.
- `boolean`. A boolean value. Add `True` or `False` after it to set the default value. For example, `verbose=boolean True`.
- `multiple raster`. A set of input raster layers.
- `multiple vector`. A set of input vector layers.

- `field`. A field in the attributes table of a vector layer. The name of the layer has to be added after the `field` tag. For instance, if you have declared a vector input with `mylayer=vector`, you could use `myfield=field mylayer` to add a field from that layer as parameter.
- `folder`. A folder.
- `file`. A filename.

The parameter name is the name that will be shown to the user when executing the algorithm, and also the variable name to use in the script code. The value entered by the user for that parameter will be assigned to a variable with that name.

When showing the name of the parameter to the user, the name will be edited to improve its appearance, replacing low hyphens with spaces. So, for instance, if you want the user to see a parameter named `A numerical value`, you can use the variable name `A_numerical_value`.

Layers and table values are strings containing the file path of the corresponding object. To turn them into a QGIS object, you can use the `processing.getObjectFromUri()` function. Multiple inputs also have a string value, which contains the file paths to all selected object, separated by semicolons (`;`).

Outputs are defined in a similar manner, using the following tags:

- `output raster`
- `output vector`
- `output table`
- `output html`
- `output file`
- `output number`
- `output string`

The value assigned to the output variables is always a string with a file path. It will correspond to a temporary file path in case the user has not entered any output filename.

When you declare an output, the algorithm will try to add it to QGIS once it is finished. That is why, although the `runalg()` method does not load the layers it produces, the final TWI layer will be loaded (using the case of our previous example), since it is saved to the file entered by the user, which is the value of the corresponding output.

Do not use the `load()` method in your script algorithms, just when working with the console line. If a layer is created as output of an algorithm, it should be declared as such. Otherwise, you will not be able to properly use the algorithm in the modeler, since its syntax (as defined by the tags explained above) will not match what the algorithm really creates.

Hidden outputs (numbers and strings) do not have a value. Instead, you have to assign a value to them. To do so, just set the value of a variable with the name you used to declare that output. For instance, if you have used this declaration,

```
##average=output number
```

the following line will set the value of the output to 5:

```
average = 5
```

In addition to the tags for parameters and outputs, you can also define the group under which the algorithm will be shown, using the `group` tag.

If your algorithm takes a long time to process, it is a good idea to inform the user. You have a global named `progress` available, with two possible methods: `setText(text)` and `setPercentage(percent)` to modify the progress text and the progress bar.

Several examples are provided. Please check them to see real examples of how to create algorithms using the processing framework classes. You can right-click on any script algorithm and select *Edit script* to edit its code or just to see it.

20.7.4 Documentación de las secuencias de comandos

As in the case of models, you can create additional documentation for your scripts, to explain what they do and how to use them. In the script editing dialog, you will find an **[Edit script help]** button. Click on it and it will take you to the help editing dialog. Check the section about the graphical modeler to know more about this dialog and how to use it.

Help files are saved in the same folder as the script itself, adding the `.help` extension to the filename. Notice that you can edit your script's help before saving the script for the first time. If you later close the script editing dialog without saving the script (i.e., you discard it), the help content you wrote will be lost. If your script was already saved and is associated to a filename, saving the help content is done automatically.

20.7.5 Pre y post-ejecución de la secuencia de comandos hooks

Scripts can also be used to set pre- and post-execution hooks that are run before and after an algorithm is run. This can be used to automate tasks that should be performed whenever an algorithm is executed.

La sintaxis es idéntica a la que se ha explicado anteriormente, pero una variable global adicional llamada `alg` está disponible, lo que representa el algoritmo que acaba de ser (o está a punto de ser) ejecutado.

In the *General* group of the processing configuration dialog, you will find two entries named *Pre-execution script file* and *Post-execution script file* where the filename of the scripts to be run in each case can be entered.

20.8 Writing new Processing algorithms as python scripts

You can create your own algorithms by writing the corresponding Python code and adding a few extra lines to supply additional information needed to define the semantics of the algorithm. You can find a *Create new script* menu under the *Tools* group in the *Script* algorithms block of the toolbox. Double-click on it to open the script edition dialog. That's where you should type your code. Saving the script from there in the `scripts` folder (the default one when you open the save file dialog), with `.py` extension, will automatically create the corresponding algorithm.

The name of the algorithm (the one you will see in the toolbox) is created from the filename, removing its extension and replacing underscores with blank spaces.

Let's have the following code, which calculates the Topographic Wetness Index (TWI) directly from a DEM

```
##dem=raster
##twi=output raster
ret_slope = processing.runalg("saga:slopeaspectcurvature", dem, 0, None,
                None, None, None, None)
ret_area = processing.runalg("saga:catchmentarea", dem,
                0, False, False, False, False, None, None, None, None, None)
processing.runalg("saga:topographicwetnessindextwi, ret_slope['SLOPE'],
                ret_area['AREA'], None, 1, 0, twi)
```

As you can see, it involves 3 algorithms, all of them coming from SAGA. The last one of them calculates the TWI, but it needs a slope layer and a flow accumulation layer. We do not have these, but since we have the DEM, we can calculate them by calling the corresponding SAGA algorithms.

The part of the code where this processing takes place is not difficult to understand if you have read the previous chapter. The first lines, however, need some additional explanation. They provide the information that is needed to turn your code into an algorithm that can be run from any of the GUI components, like the toolbox or the graphical modeler.

These lines start with a double Python comment symbol (`##`) and have the following structure

```
[parameter_name]=[parameter_type] [optional_values]
```

Here is a list of all the parameter types that are supported in processing scripts, their syntax and some examples.

- `raster`. A raster layer
- `vector`. A vector layer
- `table`. A table
- `number`. A numerical value. A default value must be provided. For instance, `depth=number 2.4`
- `string`. A text string. As in the case of numerical values, a default value must be added. For instance, `name=string Victor`
- `longstring`. Same as string, but a larger text box will be shown, so it is better suited for long strings, such as for a script expecting a small code snippet.
- `boolean`. A boolean value. Add `True` or `False` after it to set the default value. For example, `verbose=boolean True`.
- `multiple raster`. A set of input raster layers.
- `multiple vector`. A set of input vector layers.
- `field`. A field in the attributes table of a vector layer. The name of the layer has to be added after the `field` tag. For instance, if you have declared a vector input with `mylayer=vector`, you could use `myfield=field mylayer` to add a field from that layer as parameter.
- `extent`. A spatial extent defined by xmin, xmax, ymin, ymax
- `folder`. A folder
- `file`. A filename
- `crs`. A Coordinate Reference System
- `selection`. A dropdown menu that allows the user to select from a pre-populated list. For example `units=selection sq_km;sq_miles;sq_degrees`
- `name`. Name of the script. This will be displayed as the algorithm name in the processing toolbox. For example `My Algorithm Name=name`
- `group`. Folder name where the script will appear in the Processing Toolbox. For Example, adding `Utils=groups` will put the script within a `Utils` folder within Scripts.

The parameter name is the name that will be shown to the user when executing the algorithm, and also the variable name to use in the script code. The value entered by the user for that parameter will be assigned to a variable with that name.

When showing the name of the parameter to the user, the name will be edited to improve its appearance, replacing underscores with spaces. So, for instance, if you want the user to see a parameter named `A numerical value`, you can use the variable name `A_numerical_value`.

Layers and tables values are strings containing the filepath of the corresponding object. To turn them into a QGIS object, you can use the `processing.getObjectFromUri()` function. Multiple inputs also have a string value, which contains the filepaths to all selected objects, separated by semicolons (`;`).

Outputs are defined in a similar manner, using the following tags:

- `output raster`
- `output vector`
- `output table`
- `output html`
- `output file`
- `output number`
- `output string`
- `output extent`

The value assigned to the output variables is always a string with a filepath. It will correspond to a temporary filepath in case the user has not entered any output filename.

In addition to the tags for parameters and outputs, you can also define the group under which the algorithm will be shown, using the `group` tag.

The last tag that you can use in your script header is `##nomodeler`. Use that when you do not want your algorithm to be shown in the modeler window. This should be used for algorithms that do not have a clear syntax (for instance, if the number of layers to be created is not known in advance, at design time), which make them unsuitable for the graphical modeler

20.8.1 Manipulación de datos producidos por el algoritmo

When you declare an output representing a layer (raster, vector or table), the algorithm will try to add it to QGIS once it is finished. That is the reason why, although the `runalg()` method does not load the layers it produces, the final *TWI* layer will be loaded, since it is saved to the file entered by the user, which is the value of the corresponding output.

Do not use the `load()` method in your script algorithms, but just when working with the console line. If a layer is created as output of an algorithm, it should be declared as such. Otherwise, you will not be able to properly use the algorithm in the modeler, since its syntax (as defined by the tags explained above) will not match what the algorithm really creates.

Hidden outputs (numbers and strings) do not have a value. Instead, it is you who has to assign a value to them. To do so, just set the value of a variable with the name you used to declare that output. For instance, if you have used this declaration,

```
##average=output number
```

the following line will set the value of the output to 5:

```
average = 5
```

20.8.2 La comunicación con el usuario

If your algorithm takes a long time to process, it is a good idea to inform the user. You have a global named `progress` available, with two available methods: `setText(text)` and `setPercentage(percent)` to modify the progress text and the progress bar.

If you have to provide some information to the user, not related to the progress of the algorithm, you can use the `setInfo(text)` method, also from the `progress` object.

If your script has some problem, the correct way of propagating it is to raise an exception of type `GeoAlgorithmExecutionException()`. You can pass a message as argument to the constructor of the exception. Processing will take care of handling it and communicating with the user, depending on where the algorithm is being executed from (toolbox, modeler, Python console...)

20.8.3 Documentando sus scripts

As in the case of models, you can create additional documentation for your script, to explain what they do and how to use them. In the script editing dialog you will find a **[Edit script help]** button. Click on it and it will take you to the help editing dialog. Check the chapter about the graphical modeler to find out more about this dialog and how to use it.

Help files are saved in the same folder as the script itself, adding the `.help` extension to the filename. Note that you can edit your script's help before saving it for the first time. If you later close the script editing dialog without saving the script (i.e. you discard it), the help content you wrote will be lost. If your script was already saved and is associated with a filename, saving is done automatically.

20.8.4 Example scripts

Several examples are available in the on-line collection of scripts, which you can access by selecting the *Get script from on-line script collection* tool under the *Scripts/tools* entry in the toolbox.

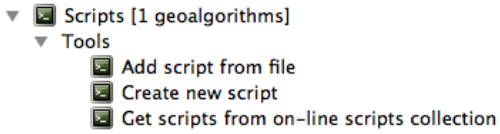

Figure 20.32: Processing Get Script

Please, check them to see real examples of how to create algorithms using the processing framework classes. You can right-click on any script algorithm and select *Edit script* to edit its code or just to see it.

20.8.5 Las mejores practivas al escribir scripts de algoritmos

Here's a quick summary of ideas to consider when creating your script algorithms and, especially, if you want to share with other QGIS users. Following these simple rules will ensure consistency across the different Processing elements such as the toolbox, the modeler or the batch processing interface.

- No cargar la capa resultante. Deje al Procesamiento manejar sus resultados y cargue sus capas si es necesario.
- Always declare the outputs your algorithm creates. Avoid things such as declaring one output and then using the destination filename set for that output to create a collection of them. That will break the correct semantics of the algorithm and make it impossible to use it safely in the modeler. If you have to write an algorithm like that, make sure you add the `##nomodeler` tag.
- Do not show message boxes or use any GUI element from the script. If you want to communicate with the user, use the `setInfo()` method or throw an `GeoAlgorithmExecutionException`
- As a rule of thumb, do not forget that your algorithm might be executed in a context other than the Processing toolbox.

20.8.6 Pre- and post-execution script hooks

Scripts can also be used to set pre- and post-execution hooks that are run before and after an algorithm is run. This can be used to automate tasks that should be performed whenever an algorithm is executed.

The syntax is identical to the syntax explained above, but an additional global variable named `alg` is available, representing the algorithm that has just been (or is about to be) executed.

In the *General* group of the processing config dialog you will find two entries named *Pre-execution script file* and *Post-execution script file* where the filename of the scripts to be run in each case can be entered.

20.9 Configurar aplicaciones externas

The processing framework can be extended using additional applications. Currently, SAGA, GRASS, OTB (Orfeo Toolbox) and R are supported, along with some other command-line applications that provide spatial data analysis functionalities. Algorithms relying on an external applications are managed by their own algorithm provider.

This section will show you how to configure the processing framework to include these additional applications, and it will explain some particular features of the algorithms based on them. Once you have correctly configured the system, you will be able to execute external algorithms from any component like the toolbox or the graphical modeler, just like you do with any other geoalgorithm.

By default, all algorithms that rely on an external application not shipped with QGIS are not enabled. You can enable them in the settings dialog. Make sure that the corresponding application is already installed in your system.

20.9.1 Aclaración para los usuarios de Windows

If you are not an advanced user and you are running QGIS on Windows, you might not be interested in reading the rest of this chapter. Make sure you install QGIS in your system using the standalone installer. That will automatically install SAGA, GRASS and OTB in your system and configure them so they can be run from QGIS. All the algorithms from these providers will be ready to be run without needing any further configuration. If installing through OSGeo4W application, make sure you select for installation SAGA, GRASS and OTB as well.

If you want to know more about how these providers work, or if you want to use some algorithms not included in the simplified toolbox (such as R scripts), keep on reading.

20.9.2 Aclaración respecto a los formatos de archivos

Cuando se utiliza un software externo, la apertura de un archivo en QGIS no significa que se puede abrir y procesar bien en ese otro software. En la mayoría de los casos, otro software puede leer lo que ha abierto en QGIS, pero en algunos casos, eso puede no ser cierto. Al utilizar las bases de datos o formatos de archivo poco comunes, ya sea para capas raster o vectoriales, podrían surgir problemas. Si eso sucede, trate de utilizar formatos de archivo conocidos que este seguro que ambos programas entiendan, y comprobar la salida de la consola (en el historico y el diálogo de registro) para saber más acerca de lo que va mal.

Utilizar capas raster de GRASS es, por ejemplo, uno de los casos en los que pueden existir problemas y no completarse el trabajo si se invoca un algoritmo externo que use dicha capa como entrada. Por este motivo, estas capas no aparecerán como disponibles para los algoritmos.

You should, however, find no problems at all with vector layers, since QGIS automatically converts from the original file format to one accepted by the external application before passing the layer to it. This adds extra processing time, which might be significant if the layer has a large size, so do not be surprised if it takes more time to process a layer from a DB connection than it does to process one of a similar size stored in a shapefile.

Providers not using external applications can process any layer that you can open in QGIS, since they open it for analysis through QGIS.

Regarding output formats, all formats supported by QGIS as output can be used, both for raster and vector layers. Some providers do not support certain formats, but all can export to common formats that can later be transformed by QGIS automatically. As in the case of input layers, if this conversion is needed, that might increase the processing time.

20.9.3 Nota referente a las seleccion de capas vectoriales

Las aplicaciones externas pueden también ser conscientes de las selecciones que existen en capas vectoriales dentro QGIS. Sin embargo, eso requiere reescribir todas las capas vectoriales de entrada, al igual que si originalmente estuvieran en un formato no compatible con la aplicación externa. Sólo cuando no existe ninguna selección o la opción *Utilizar sólo objetos espaciales seleccionados * no está activada en la configuración general de procesamiento, puede una capa ser directamente pasada a una aplicación externa.

En otros casos sólo es necesario exportar un conjunto de características seleccionadas, lo que hará que los tiempos de ejecución sean mayores.

20.9.4 SAGA

Los algoritmos de SAGA pueden ser ejecutados desde QGIS si se tiene SAGA instalado en su sistema y se puede configurar correctamente el entorno de procesamiento para que pueda encontrar ejecutables SAGA. En particular, se necesita la línea de comandos SAGA ejecutable para ejecutar algoritmos SAGA.

If you are running Windows, both the stand-alone installer and the OSGeo4W installer include SAGA along with QGIS, and the path is automatically configured, so there is no need to do anything else.

If you have installed SAGA yourself and your QGIS installer did not include it, the path to the SAGA executable must be configured. To do this, open the configuration dialog. In the *SAGA* block, you will find a setting named *SAGA Folder*. Enter the path to the folder where SAGA is installed. Close the configuration dialog, and now you are ready to run SAGA algorithms from QGIS.

If you are running Linux, SAGA binaries are not included with Processing, so you have to download and install the software yourself. Please check the SAGA website for more information.

En este caso, no hay necesidad de configurar la ruta al ejecutable de SAGA, y no se verán esas carpetas. En su lugar, debe asegurarse de que SAGA está correctamente instalado y se añade su carpeta a la variable de entorno PATH. Sólo tiene que abrir una consola y escribir `saga_cmd` para comprobar que el sistema puede encontrar donde se encuentran los archivos binarios de SAGA.

Sobre las limitaciones del sistema de cuadrícula de SAGA

Most SAGA algorithms that require several input raster layers require them to have the same grid system. That is, they must cover the same geographic area and have the same cell size, so their corresponding grids match. When calling SAGA algorithms from QGIS, you can use any layer, regardless of its cell size and extent. When multiple raster layers are used as input for a SAGA algorithm, QGIS resamples them to a common grid system and then passes them to SAGA (unless the SAGA algorithm can operate with layers from different grid systems).

La definición de este sistema de cuadrícula común es controlado por el usuario, y se encontrará varios parámetros en el grupo SAGA de la ventana de configuración para hacerlo. Hay dos formas de establecer el sistema de cuadrícula de destino.

- Establecerlo manualmente. se define la extensión estableciendo los valores de los siguientes parámetros:
  - *Resampling min X*
  - *Resampling max X*
  - *Resampling min Y*
  - *Resampling max Y*
  - *Resampling cellsize*

  Notice that QGIS will resample input layers to that extent, even if they do not overlap with it.
- Ajuste de forma automática a partir de capas de entrada. Para seleccionar esta opción, simplemente marque la opción *Utilizar el sistema de cuadrícula mínima para remuestreo*. Todos los demás ajustes se ignoran y la medida mínima que cubre todas las capas de entrada que se utilizarán. El tamaño de celda de la capa de destino es el máximo de todos los tamaños celulares de las capas de entrada.

Para los algoritmos que no utilizan múltiples capas raster, o para aquellos que no necesitan un único sistema de cuadrícula de entrada, no se realizará un remuestreo antes de invocar SAG y dichos parámetros no son utilizados.

Limitaciones para las capas multibanda

A diferencia de QGIS, SAGA no tiene soporte para capas multibanda. Si desea utilizar una capa multibanda (como un RGB o imagen multiespectral), primero hay que dividirlo en imágenes de un sola banda. Para ello, se puede utilizar el algoritmo 'imagen SAGA/Grid - Herramientas/Dividir' (que crea tres imágenes de una imagen RGB) o el algoritmo 'banda SAGA/Grid - Herramientas / Extracto' (para extraer una sola banda).

Limitaciones en el tamaño de celda

SAGA asume que las capas ráster tienen el mismo tamaño de celda en el eje X y Y. Si se está trabajando con una capa con diferentes valores para el tamaño de celda horizontal y vertical, es posible que obtenga resultados inesperados. En este caso, se añadirá una advertencia al registro de procesamiento, lo que indica que una capa de entrada podría no ser adecuada para ser procesada por SAGA.

Registro

Cuando QGIS llama a SAGA, lo hace utilizando su interfaz de linea de comandos, pasando así de un conjunto de comandos para realizar todas las operaciones necesarias. SAGA muestra su progreso al escribir información a la consola, que incluye el porcentaje de procesamiento ya realizado junto con el contenido adicional. Esta salida se filtra y utiliza para actualizar la barra de proceso mientras el algoritmo se ejecuta.

Both the commands sent by QGIS and the additional information printed by SAGA can be logged along with other processing log messages, and you might find them useful to track in detail what is going on when QGIS runs a SAGA algorithm. You will find two settings, namely *Log console output* and *Log execution commands*, to activate that logging mechanism.

La mayoría del resto de proveedores que utilizan una aplicación externa y la invocan a través de la línea de comandos tienen opciones similares, de forma que las podrá encontrar también en otros lugares de la lista de ajustes de procesamiento.

20.9.5 R. Creating R scripts

La integración R en QGIS es diferente al de SAGA y es que no hay un conjunto predefinido de algoritmos que pueda ejecutar (a excepción de algunos ejemplos). En su lugar, debe escribir sus scripts y llamar a los comandos R, al igual que lo haría desde R, y de una manera muy similar a lo que vimos en la sección dedicada a scripts de procesamiento. En esta sección se muestra la sintaxis para usar y llamar a los comandos de R QGIS y cómo usar en QGIS los objetos (capas, tablas) en ellos.

Lo primero que tienes que hacer, como vimos en el caso de SAGA, es decirle a QGIS donde se encuentran los archivos binarios R. Se puede hacer esto mediante la entrada :guilabel: *Carpeta de R* en el diálogo de configuración de procesamiento. Una vez establecido ese parámetro, se puede empezar a crear y ejecutar sus propios scripts de R.

Nota: for **Windows** user, usually the R executable file is in the `C:\Program Files\R\R-3.2` folder. Add just the folder and **NOT** the binary!

De nuevo, esto es diferente en Linux, dónde sólo hay que asegurarse de que el directorio de R está correctamente incluido en la variable de entorno PATH. Si R puede iniciarse simplemente escribiendo `R` en una consola, entonces la configuración es correcta.

To add a new algorithm that calls an R function (or a more complex R script that you have developed and you would like to have available from QGIS), you have to create a script file that tells the processing framework how to perform that operation and the corresponding R commands to do so.

Los archivos de script de R tienen la extensión `.rsx`, y crearlos es bastante sencillo si sólo tiene un conocimiento básico de la sintaxis y script de R. Deben ser almacenados en la carpeta de scripts de R. Se puede establecer esta carpeta en el grupo de ajustes *R* (disponible desde el diálogo de Configuración de procesamiento), al igual que se hace con la carpeta para scripts de procesamiento regular.

Vamos a echar un vistazo a un archivo de script muy simple, que llama al método R `spsample` para crear una cuadricula al azar dentro de los límites de los polígonos en una capa de polígono dada. Este método pertenece al paquete `maptools`. Dado que casi todos los algoritmos que pueden gustar incorporar a QGIS utilizará o generará datos espaciales, el conocimiento de paquetes espaciales como `maptools` y sobretodo `sp` es obligatoria.

```
##polyg=vector
##numpoints=number 10
##output=output vector
##sp=group
pts=spsample(polyg,numpoints,type="random")
output=SpatialPointsDataFrame(pts, as.data.frame(pts))
```

The first lines, which start with a double Python comment sign (`##`), tell QGIS the inputs of the algorithm described in the file and the outputs that it will generate. They work with exactly the same syntax as the Processing scripts that we have already seen, so they will not be described here again.

Please have a look at the *R Intro* and the *R Syntax* Training Manual Chapters to have more information on how to write your own R scripts-

Cuando se declara un parámetro de entrada, QGIS usa esa información con dos finalidades: crear la interfaz de usuario que solicita al usuario el valor de dicho parámetro y crear la variable correspondiente en R que se pueda usar después como entrada para los comandos en R.

In el ejemplo anterior, estamos declarando un tipo de entrada `vector` llamado `polyg`. Al ejecutar el algoritmo, QGIS abrirá en R la capa seleccionada por el usuario y almacenarlo en una variable llamada *polyg*'. Así el nombre de uno de los parámetros también es el nombre de la variable que se puede utilizar en R para acceder el valor de ese parámetro (así, se debe evitar utilizar palabras de R reservadas como nombres de parámetros).

Los elementos espaciales como las capas vectoriales y ráster se leen utilizando los comandos `readOGR()` y `brick()` (no tiene que preocuparse acerca de cómo agregar estos comandos a su archivo de descripción - QGIS lo hará), y se almacenan como objetos `Spatial*DataFrame`. Los campos de la tabla se almacenan como cadenas que contienen el nombre del campo seleccionado.

Las tablas se abren con el comando `read.csv()`. Sin una tabla introducida por el usuario no esta en formato CSV, será convertirá antes de importarlo en R.

Además, los ráster se pueden leer con el comando `readGDAL()` ' en lugar de ''`brick()` utilizando el `##usereadgdal`.

Si se es un usuario avanzado y no quiere QGIS para crear el objeto que representado la capa, puede utilizar la etiqueta `##passfilenames` para indicar que prefiere una cadena con el nombre de archivo en su lugar. En este caso, le corresponde abrir el archivo antes de realizar cualquier operación sobre los datos que contiene.

Con la información anterior, se puede comprender la primera línea de nuestro primer script de ejemplo (la primera línea que no comienza con un comentario de Python).

```
pts=spsample(polyg,numpoints,type="random")
```

La variable `polygon` ya contiene un objeto `SpatialPolygonsDataFrame`, por lo que se puede utilizar para llamar al método `spsample`, al igual que `numpoints`, que indica el número de puntos a añadir a la rejilla de ejemplo creada.

Como hemos declarado una salida de tipo vectorial llamada `salida`, tenemos que crear una variable llamada `salida` y almacenar un objeto `Spatial*DataFrame` en ella (en este caso, un `SpatialPointsDataFrame`). Se puede utilizar cualquier nombre para sus variables intermedias. Sólo asegúrese de que la variable almacena su resultado final y que tiene el mismo nombre que utilizó al declararla, y que contiene un valor adecuado.

In this case, the result obtained from the `spsample` method has to be converted explicitly into a `SpatialPointsDataFrame` object, since it is itself an object of class `ppp`, which is not a suitable class to be returned to QGIS.

If your algorithm generates raster layers, the way they are saved will depend on whether or not you have used the `##dontuserasterpackage` option. If you have used it, layers are saved using the `writeGDAL()` method. If not, the `writeRaster()` method from the `raster` package will be used.

Si ha utilizado la opción `#passfilenames`, las salidas se generan utilizando el paquete `raster` (mediante `writeRaster()`), incluso cuando no se utiliza para las entradas.

Si el algoritmo no genera ninguna capa, sino más bien en su lugar regresa un texto en la consola, tiene que indicar lo que desea que la consola mostrará una vez finalizada la ejecución. Para ello, basta con iniciar la línea de comandos que producen los resultados que desea imprimir con el signo > '('mayor'). La salida de todas las otras líneas no se mostrará. Por ejemplo, aquí está el archivo de descripción de un algoritmo que realiza una prueba normalmente en un determinado campo (columna) de los atributos de una capa vectorial:

```
##layer=vector
##field=field layer
##nortest=group
library(nortest)
>lillie.test(layer[[field]])
```

La salida de la última línea se imprime, pero la salida de la primera no (y tampoco están las salida de otras líneas de comando agregadas automáticamente por QGIS).

Si su algoritmo crea algún tipo de gráficos (utilizando el método `plot()`), añada la siguiente línea:

```
##showplots
```

Esto provocará que QGIS redireccione todas las salidas de gráficas R a un archivo temporal, que se abrirá una vez que terminé la ejecución de R.

Tanto los resultados gráficos como de consola, se mostrará en el gesto de resultados de procesamiento.

For more information, please check the script files provided with Processing. Most of them are rather simple and will greatly help you understand how to create your own scripts.

Nota: `rgdal` and `raster` libraries are loaded by default, so you do not have to add the corresponding `library()` commands (you just have to make sure that those two packages are installed in your R distribution). However, other additional libraries that you might need have to be explicitly loaded by typing, `library(ggplot2)`. If the package is not already installed on your machine, Processing will download and install it. In this way the package will be also available in R Standalone. **Be aware** that if the package has to be downloaded, the first time you run the script it might take a long time.

20.9.6 GRASS

Configuring GRASS is not much different from configuring SAGA. First, the path to the GRASS folder has to be defined, but only if you are running Windows. Additionally, a shell interpreter (usually `msys.exe`, which can be found in most GRASS for Windows distributions) has to be defined and its path set up as well.

By default, the processing framework tries to configure its GRASS connector to use the GRASS distribution that ships along with QGIS. This should work without problems in most systems, but if you experience problems, you might have to configure the GRASS connector manually. Also, if you want to use a different GRASS installation, you can change that setting and point to the folder where the other version is installed. GRASS 6.4 is needed for algorithms to work correctly.

Si se utiliza Linux, hay que asegurarse de que GRASS está correctamente instalado y que se puede ejecutar sin problemas desde una consola.

Los algoritmos de GRASS utilizan una región para cálculos. Esta región se puede definir manualmente utilizando valores similares a los encontrados en la configuración de SAGA, o automáticamente tomara la extensión mínima que cubre todas las capas de entrada utilizadas para ejecutar el algoritmo cada vez. Si el último enfoque es el comportamiento que prefiere, simplemente marque la opción *Utilizar la región de cobertura mínima* en los parámetros de configuración de GRASS.

20.9.7 GDAL

No additional configuration is needed to run GDAL algorithms. Since they are already incorporated into QGIS, the algorithms can infer their configuration from it.

20.9.8 Orfeo Toolbox

Orfeo Toolbox (OTB) algorithms can be run from QGIS if you have OTB installed in your system and you have configured QGIS properly, so it can find all necessary files (command-line tools and libraries).

As in the case of SAGA, OTB binaries are included in the stand-alone installer for Windows, but they are not included if you are running Linux, so you have to download and install the software yourself. Please check the OTB website for more information.

Once OTB is installed, start QGIS, open the processing configuration dialog and configure the OTB algorithm provider. In the *Orfeo Toolbox (image analysis)* block, you will find all settings related to OTB. First, ensure that algorithms are enabled.

Then, configure the path to the folder where OTB command-line tools and libraries are installed:

- Usually *OTB applications folder* points to `/usr/lib/otb/applications` and *OTB command line tools folder* is `/usr/bin`.
- If you use any of the installers that include OTB, such as OSGeo4W, there is no need for further configuration. Processing will detect the path automatically and will not show the corresponding configuration entries. Otherwise, fill the *OTB applications folder* and *OTB command line tools folder* parameters with the to the corresponding values for your installation.

20.9.9 TauDEM

TauDEM (Terrain Analysis Using Digital Elevation Models) is a tools for the extraction and analysis of hydrological information from Digital Elevation Models (DEM). TauDEM can be used from QGIS if you have it installed in your system and configured QGIS properly, so it can find all necessary files.

There are two versions of TauDEM tools: singlefile (TauDEM 5.0.6 or 5.1.2) and multifile (TauDEM 5.2.0). The difference between these versions in the supported inputs/outputs. Single files version accepts only single raster file and write single file as output. Multifile version accepts a directory with rasters and writes directory with rasters as output. Such directory should contain rasters that will be treated as a single DEM grid.

TauDEM Processing provider supports both single- and multifile versions of TauDEM and even allows to use them simultaneously.

Nota: While TauDEM Processing provider supports TauDEM 5.0.6, 5.1.2 and 5.2.0 we recommend to use 5.1.2 and/or 5.2.0 as this versions have some new tools available, like Gage Watershed and TWI.

Installing TauDEM under Windows

Please visit the TauDEM homepage and download desired version of the precompiled binaries for your platform (32-bit or 64-bit), usually this is "Command Line Executables". Also you need to download Microsoft HPC Pack 2012 MS-MPI. First install Microsoft HPC Pack 2012 MS-MPI by runing `mpi_x64.Msi` for 64-bit platforms and `mpi_x86.Msi` for 32-bit platforms.

Nota: If you want to use TauDEM 5.0.6

Installing TauDEM under Linux

Unfortunately there are no packages for most Linux distributions, so you should compile TauDEM by yourself. As TauDEM uses MPI it is necessary to install first any MPI implementation e.g MPICH or OpenMPI. Use your favorite package manager to install MPICH or OpenMPI.

Download TauDEM 5.2.0 source code package from GitHub repository and extract archive contents. Open terminal and cd into `src` directory inside extracted folder. Create build directory and cd into it

```
mkdir build
cd build
```

Configure your build (change install prefix if necessary) and compile

```
CXX=mpicxx cmake -DCMAKE_INSTALL_PREFIX=/usr/local ..
make
```

When compilation finished install TauDEM tools by running

```
sudo make install
```

Nota: Executable files will be installed into `bin` subdirectory inside prefix you specified at the con-

figure stage. For example if you specified prefix `/opt/taudem5.2` than binaries will be installed into `/opt/taudem5.2/bin`.

To use singlefile version — download source package here and perform above mentioned steps to compile and install it.

Old TauDEM 5.0.6 also available. But before compiling this version it is necessary to edit some source files.

Open the `linearpart.h` file, and after line

```
#include "mpi.h"
```

add a new line with

```
#include <stdint.h>
```

so you'll get

```
#include "mpi.h"
#include <stdint.h>
```

Save the changes and close the file. Now open `tiffIO.h`, find line `#include "stdint.h"` and replace quotes (`""`) with <>, so you'll get

```
#include <stdint.h>
```

Save the changes and close the file.

Now configure, compile and install TauDEM 5.0.6 using same commands as described above.

Configuring TauDEM provider

Once TauDEM is installed, start QGIS, open the Processing options dialog from *Processing* → *Options...* and configure the TauDEM algorithm provider. In the *Providers* group find *TauDEM (hydrologic analysis)* block, and expand it. Here you will see all settings related to TauDEM.

First, ensure that algorithms are enabled, and activate provider if necessary.

Next step is to configure MPI. The *MPICH/OpenMPI bin directory* setting used to define location of the `mpiexec` program. In most Linux distributions you can safely leave this empty, as `mpiexec` available in your `PATH`.

The *Number of MPI parallel processes to use* is a second setting related to MPI. It defines number of processes that will be used to execute TauDEM commands. If you don't know which value to use, it is better to leave this value unchanged.

Now we need to configure the path to the folder(s) where TauDEM command-line tools are installed. As we already mention TauDEM provider supports both single- and multifile TauDEM, so there are two settings for TauDEM folders:

- *TauDEM command line tools folder* used to set location of the singlefile tools
- *TauDEM multifile command line tools folder* used to set location of the multifile tools

If you have both TauDEM versions installed in different directories it is possible to specify both options.

The last step is to define which TauDEM version to use:

- with *Enable multifile TauDEM tools* option checked you will use multifile TauDEM tools from directory, specified in the *TauDEM multifile command line tools folder*. Multifile tools have same name as singlefile with "(multifile)" suffix added
- with *Enable single TauDEM tools* option checked you will use multifile TauDEM tools from directory, specified in the *TauDEM command line tools folder*.

It is possible to enable both tools simultaneously. In this case you will have two instances of each tool in toolbox and can use them in your analysis.

Nota: Be careful with developing Processing models using TauDEM!

As single- and multifile versions have different inputs, model created with singlefile algorithms will not work if only multifile algorithms are available. If you plan to share your model please specify which TauDEM version should be used or, better, provide two versions of your model: for single- and multifile TauDEM.

20.10 La línea de órdenes de QGIS

El procesado incluye una herramienta practica que le permite ejecutar algoritmos sin tener que utilizar la caja de herramientas, pero tan solo escribir el nombre del algoritmo que se desee ejecutar.

Esta herramienta es conocida como *Línea de órdenes GQIS*, y esto es solo una sencilla caja de texto con autocompletado donde se escribe el nombre del comando que se desee ejecutar.

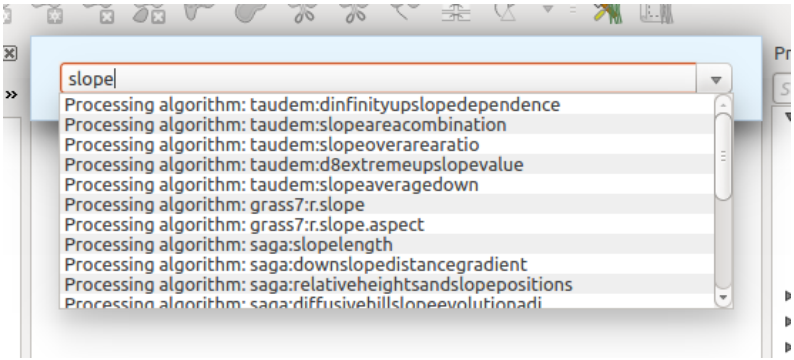

Figure 20.33: La línea de órdenes de QGIS

La línea de órdenes se inicia del menú *Procesamiento* o, mas practico, al presionar `Shift + Ctrl + M` (puede cambiar ese atajo de teclado en la configuración de QGIS si prefiere definir uno diferente). Para cerrarlo sólo presione `ESC`. Ademas de ejecutar algoritmos de procesado, la línea de órdenes da acceso a la mayoría de las funcionalidades en QGIS, lo que significa que le da una forma práctica y eficaz de ejecutar tareas QGIS y le permite controlar QGIS con un uso reducido de botones y menús.

Además, la línea de órdenes es configurable, así que puede agregar sus comandos personalizados y ellos tienen sólo unas pocas teclas de distancia, por lo que es una herramienta de gran alcance para ayudarle a ser más productivo en su trabajo diario con QGIS.

20.10.1 Comandos disponibles

Los comandos disponibles en la línea de órdenes caen en la siguiente categoría:

- Algoritmos de procesado. Estos se muestran como `Algoritmo de procesamiento: <nombre del algoritmo>`.
- Los elementos del menú. Estos se muestran como `Menu item: <Texto de entrada del menú>`. Todos los elementos de los menús disponibles desde la interfaz de QGIS están disponibles, incluso si se incluyen en un submenú.
- Funciones Python. Puede crear funciones cortas en Python que serán entonces incluidas en la lista de comandos disponibles. Ellos se muestran como `Function: <nombre de la función>`.

Para ejecutar cualquiera de los anteriores, inicie escribiendo y a continuación, seleccione el elemento de la lista de comandos disponibles que aparecen después de filtrar toda la lista de comandos con el texto que ha introducido.

En caso de llamar a una función de Python, puede seleccionar la entrada en la lista, que tiene el prefijo `Function:` (por ejemplo, `Function: removeall`), o simplemente escribir directamente el nombre de la función (``removeall` en el ejemplo anterior). No hay necesidad de añadir espacios después del nombre de la función.

20.10.2 Crear funciones personalizadas

Las funciones personalizadas se añaden al introducir el código correspondiente de Python en el archivo `commands.py` que se encuentra en el directorio `.qgis2/processing/commander` en su carpeta de usuario. Es solo un archivo Python simple donde puede añadir las funciones que necesite.

El archivo es creado con unas pocas funciones de ejemplo la primera vez que se abre la línea de órdenes. Si no ha lanzado la línea de órdenes, puede crear el archivo usted mismo. Para editar el archivo de comandos, utilice su editor de texto favorito. También puede utilizar un editor incorporado llamando al comando `edit` desde la línea de órdenes. Se abrirá el editor con el archivo de comandos, y se podrá editar directamente y luego guardar los cambios.

Por ejemplo, puede añadir la siguiente función, la cual borre todas las capa:

```
from qgis.gui import *

def removeall():
    mapreg = QgsMapLayerRegistry.instance()
    mapreg.removeAllMapLayers()
```

Una vez que se haya añadido la función, estará disponible en la línea de órdenes, y puede invocarlo escribiendo `removeall`. No hay necesidad de hacer algo más aparte de escribir la función en sí.

Las funciones pueden recibir parámetros. Añadir `*args` a la definición de su función para recibir argumentos. Cuando llame a la función desde la línea de órdenes, los parámetros tienen que ser pasados separados por espacios.

Aquí esta un ejemplo de una función que carga una capa y toma un parámetro con el nombre del archivo de la capa cargada.

```
import processing

def load(*args):
  processing.load(args[0])
```

If you want to load the layer in ;file:*/home/myuser/points.shp*, type in the Commander text box:

```
load /home/myuser/points.shp
```

CHAPTER 21

Complementos

21.1 Consola Python de QGIS

As you will see later in this chapter, QGIS has been designed with a plugin architecture. Plugins can be written in Python, a very famous language in the geospatial world.

QGIS brings a Python API (see *PyQGIS Developer Cookbook* for some code sample) to let the user interact with its objects (layers, feature or interface). QGIS also has a Python console.

The QGIS Python Console is an interactive shell for the python command executions. It also has a python file editor that allows you to edit and save your python scripts. Both console and editor are based on PyQScintilla2 package. To open the console go to *Plugins* → *Python Console* (`Ctrl+Alt+P`).

21.1.1 The Interactive Console

The interactive console is composed of a toolbar, an input area and an output one.

Barra de herramietas

The toolbar proposes the following tools:

-  *Clear console* to wipe the output area;
-  *Import class*: **Processing**, **PyQt4.QtCore** or **PyQt4.QtGui** class;
-  *Run command* available in the input area: same as pressing `Enter`;
-  *Show editor*: toggles *El Editor de código* visibility;
-  *Options...*;
-  *Help...*.

Consola

The console main features are:

- Code completion, highlighting syntax and calltips for the following APIs:
  - Python
  - PyQGIS
  - PyQt4

  - QScintilla2
  - osgeo-gdal-ogr
- `Ctrl+Alt+Space` to view the auto-completion list if enabled in the *Opciones*;
- Execute code snippets from the input area by typing and pressing `Enter` or *Run Command*;
- Execute code snippets from the output area using the *Enter selected* from the contextual menu or pressing `Ctrl+E`;
- Browse the command history from the input area using the `Up` and `Down` arrow keys and execute the command you want;
- `Ctrl+Shift+Space` to view the command history: double-clicking a row will execute the command. The *Command History* dialog can also be accessed from context menu of input area;
- Save and clear the command history. The history will be saved into the file `~/.qgis2/console_history.txt`;
- Open QGIS API documentation by typing `_api`;
- Open *PyQGIS Cookbook* by typing `_pyqgis`.

Truco: Reuse executed commands from the output panel

You can execute code snippets from the output panel by selecting some text and pressing `Ctrl+E`. No matter if selected text contains the interpreter prompt (`>>>`, `...`).

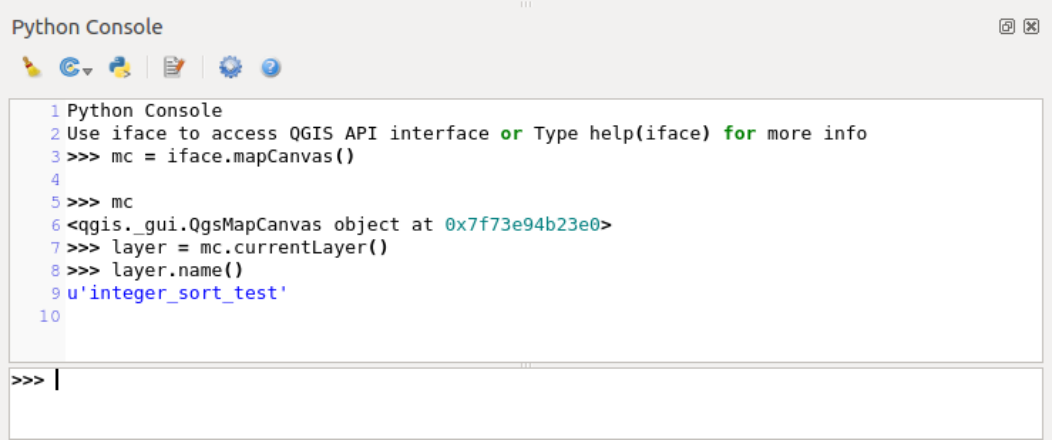

Figure 21.1: Consola de Python

21.1.2 El Editor de código

Use the Show editor button to enable the editor widget. It allows editing and saving Python files and offers advanced functionalities to manage your code (comment and uncomment code, check syntax, share the code via codepad.org and much more). Main features are:

- Code completion, highlighting syntax and calltips for the following APIs:
  - Python
  - PyQGIS
  - PyQt4
  - QScintilla2
  - osgeo-gdal-ogr

- `Ctrl+Space` to view the auto-completion list.
- Sharing code snippets via codepad.org.
- `Ctrl+4` Syntax check.
- Search bar (open it with the default Desktop Environement shorcut, usually `Ctrl+F`):
  - Use the default Desktop Environment shortcut to find next/previous (`Ctrl+G` and `Shift+Ctrl+G`);
  - Automatically find first match when typing in find box;
  - Set initial find string to selection when opening find;
  - Pressing `Esc` closes the find bar.
- Object inspector: a class and function browser;
- Go to an object definition with a mouse click (from Object inspector);
- Execute code snippets with the *Enter selected* command;
- Execute the whole script with the *Run script* command (this creates a byte-compiled file with the extension `.pyc`).

Nota: Running partially or totally a script from the *Code Editor* outputs the result in the Console output area.

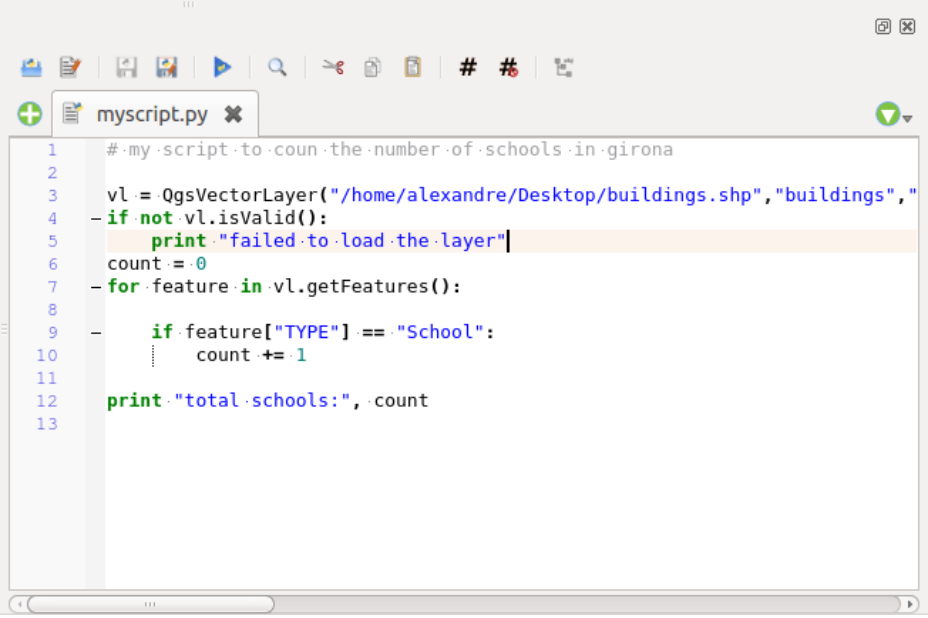

Figure 21.2: The Python Console editor

21.1.3 Opciones

Accessible either from the Console toolbar or the contextual menu of Console output panel or Code Editor, this adds further settings to manage and control the Python console behavior:

- **Autocompletion:** If checked the code completion is enabled. You can get autocompletion from current document, from installed APIs and both from APIs and current document.
- **Autocompletion threshold:** Sets the threshold to display the autocompletion list (in chars typed).
- **Automatic parentheses insertion:** If checked enables the autoclosing for bracket.
- **Auto-save script before running:** Allows you to save automatically the script to be executed in order to avoid to save it after any modification. This action will store a temporary file into the temporary system directory that will be automatically deleted after running.

- **Using preloaded APIs file:** You can choose whether use the preload APIs file or load some APIs files saved on your system.
- **Using prepared APIs file:** If checked the `*.pap` file will be used for code completion. To generate a prepared APIs file you have to load at least an `*.api` file and then compile it by clicking on **[Compile Apis...]** button.

Truco: Save the options

To save the state of console's widgets you have to close the Python Console from the close button. This allows you to save the geometry to be restored to the next start.

21.2 Complementos de QGIS

QGIS ha sido diseñado con una arquitectura de complementos. Esto permite que sea fácil añadir muchas características y funciones nuevas a la aplicación. Muchas de las características de QGIS están en realidad implementadas como complementos.

21.2.1 Complementos base y externos

QGIS plugins are implemented either as **Core Plugins** or **External Plugins**.

Core Plugins are maintained by the QGIS Development Team and are automatically part of every QGIS distribution. They are written in one of two languages: **C++** or **Python**.

Most of External Plugins are currently written in Python. They are stored either in the 'Official' QGIS Repository at http://plugins.qgis.org/plugins/ or in external repositories and are maintained by the individual authors. Detailed documentation about the usage, minimum QGIS version, home page, authors,and other important information are provided for the plugins in the Official repository. For other external repositories, documentation might be available with the external plugins themselves. External plugins documentation is not included in this manual.

To install or activate a plugin, go to *Plugins* → *Manage and install plugins...*.

Installed external python plugins are placed under `~/.qgis2/python/plugins` folder. Home directory (denoted by above ~) on Windows is usually something like `C:\Documents and Settings\(user)` (on Windows XP or earlier) or `C:\Users\(user)`. On some platforms (e.g., macOS), the `.qgis2` folder is hidden by default.

Paths to Custom C++ plugins libraries can also be added under *Settings* → *Options* → *System*.

Nota: According to the *plugin manager settings*, QGIS main interface can display a blue link in the status bar to inform you that there are updates for your installed plugins or new plugins available.

21.2.2 El diálogo de complementos

The menus in the Plugins dialog allow the user to install, uninstall and upgrade plugins in different ways. Each plugin has some metadata displayed in the right panel:

- information on whether the plugin is experimental
- descripción
- rating vote(s) (you can vote for your preferred plugin!)
- etiquetas
- some useful links to the home page, tracker and code repository
- autor(es)

- versión disponible

At the top of the dialog, a *Search* function helps you find any plugin using metadata information (author, name, description...). It is available in nearly every menu (except *Settings*).

The All tab

In the *All* tab, all the available plugins are listed, including both core and external plugins. Use **[Upgrade all]** to look for new versions of the plugins. Furthermore, you can use **[Install plugin]** if a plugin is listed but not installed, **[Uninstall plugin]** as well as **[Reinstall plugin]** if a plugin is installed. An installed plugin can be temporarily de/activated using the checkbox.

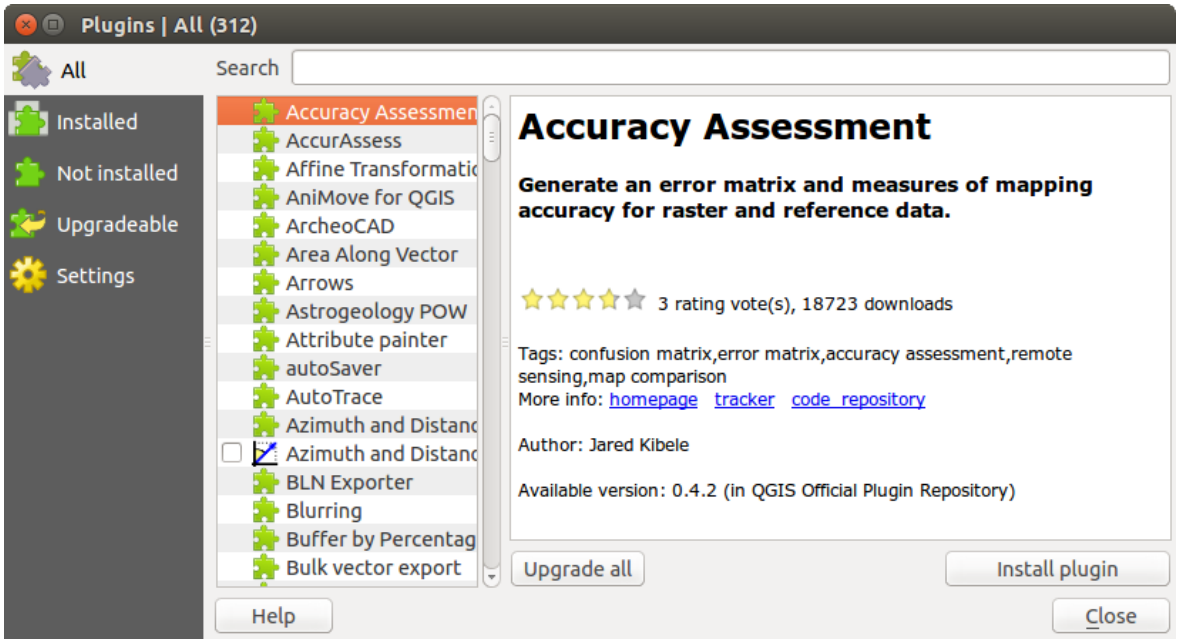

Figure 21.3: The *All* tab

The Installed tab

In *Installed* tab, you can find only the installed plugins. The external plugins can be uninstalled and reinstalled using the **[Uninstall plugin]** and **[Reinstall plugin]** buttons. You can **[Upgrade all]** here as well.

The Not installed tab

The *Not installed* tab lists all plugins available that are not installed. You can use the **[Install plugin]** button to implement a plugin into QGIS.

The Upgradeable and New tabs

The *Upgradeable* and *New* tabs are enabled when new plugins are added to the repository or a new version of an installed plugin is released. If you activated *Show also experimental plugins* in the *Settings* menu, those also appear in the list giving you opportunity to early test upcoming tools.

Installation can be done with the **[Install plugin]**, **[Upgrade plugin]** or **[Upgrade all]** buttons.

Figure 21.4: The *Installed* tab

Figure 21.5: The *Not installed* tab

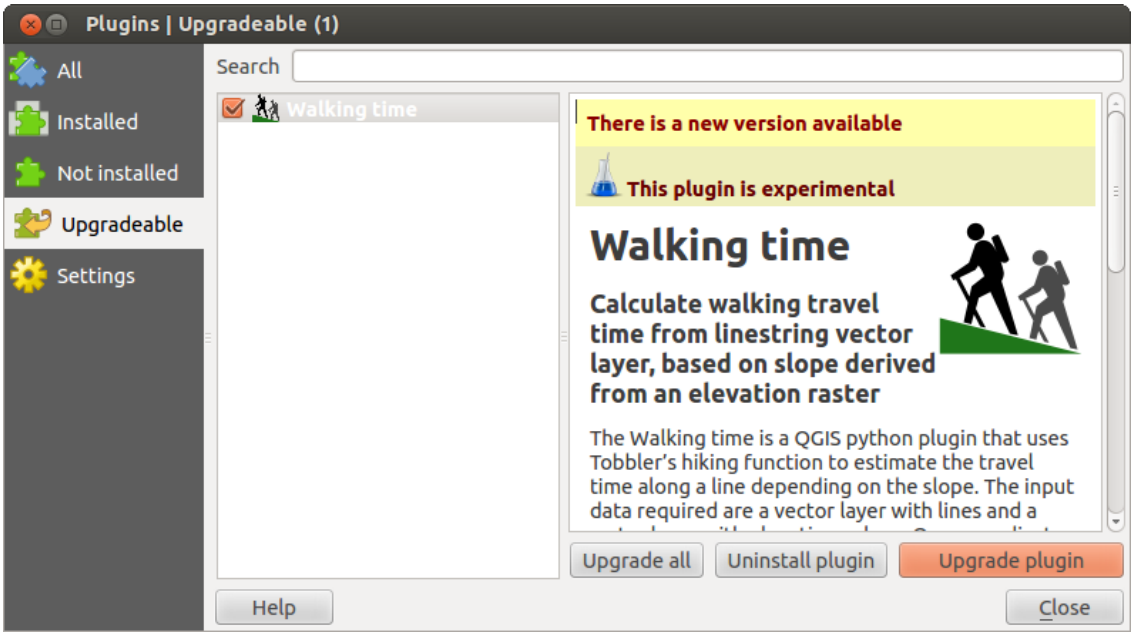

Figure 21.6: The *Upgradeable* tab

The Invalid tab

The *Invalid* tab lists all installed plugins that are currently broken for any reason (missing dependency, errors while loading, incompatible functions with QGIS version...). You can try the **[Reinstall plugin]** button to fix an invalidated plugin but most of the times the fix will be elsewhere (install some libraries, look for another compatible plugin or help to upgrade the broken one).

The Settings tab

In the *Settings* tab, you can use the following options:

- *Comprobar actualizaciones al inicio*. Siempre que un nuevo complemento o actualización de complemento esta disponible, QGIS informará 'cada vez que se inicia QGIS', 'una vez al día', 'cada 3 días', 'cada semana', 'cada 2 semanas' o 'cada mes'.
- *Mostrar también los complementos experimentales*. QGIS mostrará complementos en etapas tempranas de desarrollo, que son generalmente inadecuados para su uso en producción.
- *Show also deprecated plugins*. Because they use functions that are no longer available in QGIS, these plugins are set deprecated and generally unsuitable for production use. They appear among invalid plugins list.

To add external author repositories, click **[Add...]** in the *Plugin repositories* section. If you do not want one or more of the added repositories, they can be disabled via the **[Edit...]** button, or completely removed with the **[Delete]** button.

The default QGIS repository is an open repository and you don't need any authentication to access it. You can however deploy your own plugin repository and require an authentication (basic authentication, PKI). You can get more information on QGIS authentication support in *Autenticación* chapter.

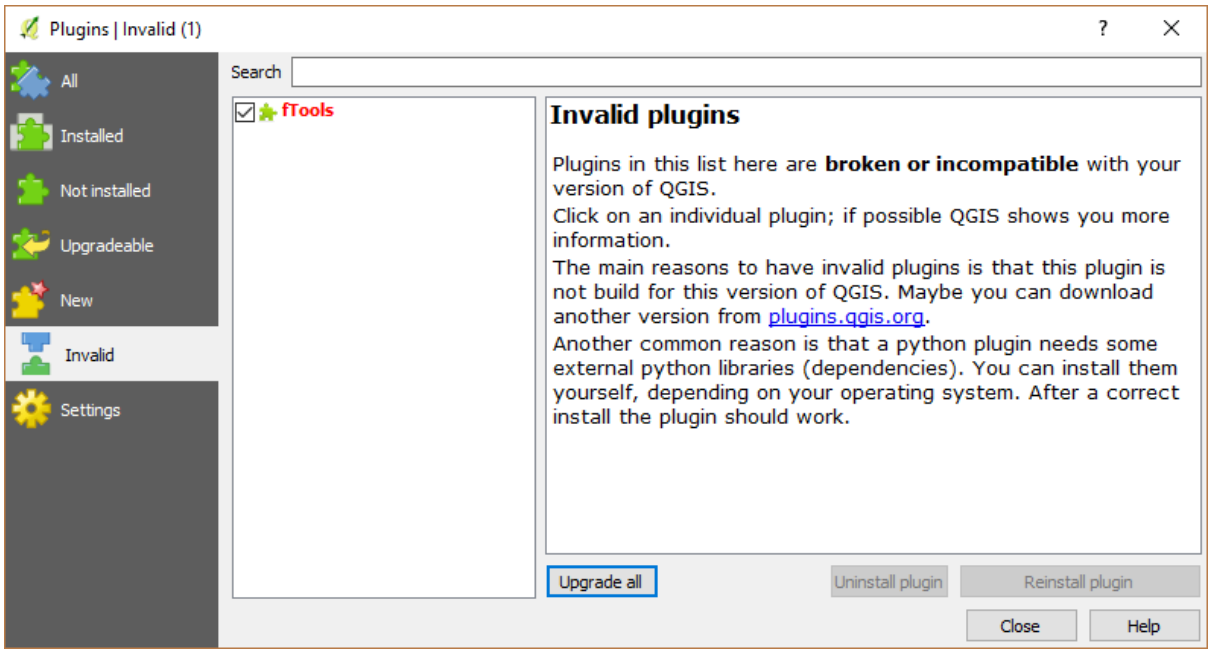

Figure 21.7: The *Invalid* tab

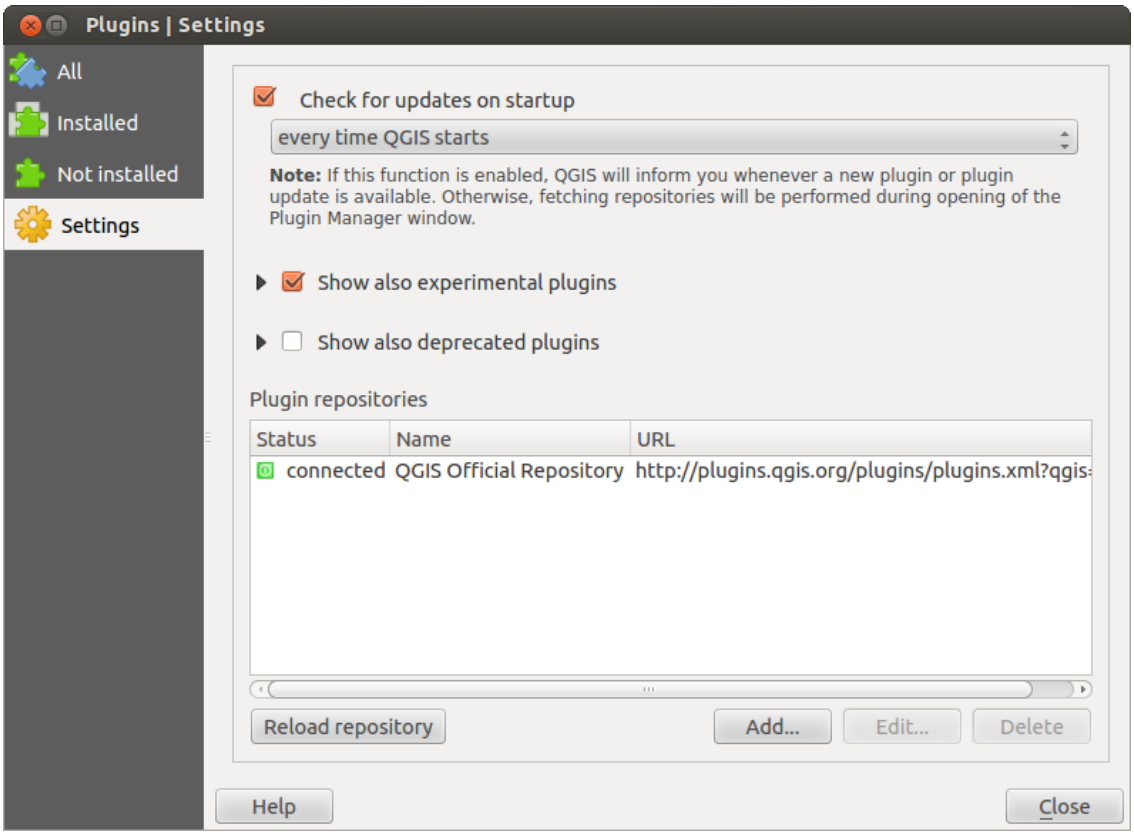

Figure 21.8: The *Settings* tab

21.3 Usar complementos básicos de QGIS

Icono	Complemento	Descripción	Manual de referencia
	Captura de coordenadas	Captura de coordenadas del ratón en diferentes SRC	*Complemento Captura de coordenadas*
	DB Manager	Administrar su base de datos dentro de QGIS	*Complemento administrador de BBDD*
	DXF2Shape Converter	Converts from DXF to SHP file format	*Complemento Conversor DxfaShp*
	eVis	Herramienta de visualización de eventos	*Complemento Visualización de Eventos*
	GDAL Tools	GDAL raster functionality	*Complemento Herramientas de GDAL*
	Comprobador de Geometría	Verificar y reparar errores en geometrías vectoriales	*Complemento Comprobador de geometría*
	Geometry Snapper	Snap geometries to a reference layer	*Complemento Ajuste de geometrías*
	Georreferenci-ador GDAL	Georeferenciación de rásteres con GDAL	*Complemento Georreferenciador*
	Herramientas de GPS	Herramientas para cargar e importar datos GPS	*Plugin de GPS*
	GRASS	Funcionalidad GRASS	*Integracion GRASS SIG*
	Heatmap	Create heatmap rasters from input vector points	*Complemento Mapa de calor*
	Interpolation plugin	Interpolation on base of vertices of a vector layer	*Complemento de interpolación*
	Metasearch Catalog Client	Interact with metadata catalog services (CSW)	*Cliente de Catálogo de metasearch*
	Edición fuera de línea	Edición fuera de línea y sincronización con la base de datos	*Complemento Edición fuera de linea*
	Oracle Spatial Georaster	Access Oracle Spatial GeoRasters	*Complemento GeoRaster espacial de Oracle*
	Administrar complementos	Administrar complementos núcleo y externos	*El diálogo de complementos*
Igeoproce-samientol	Procesamiento	Entorno de trabajo de procesado de datos espaciales	*Entorno de trabajo de procesamiento de QGIS*
	Raster Terrain Analysis	Compute geomorphological features from DEMs	*Complemento Análisis de Terreno*
	Road Graph plugin	Shortest path analysis	*Complemento Grafo de rutas*
	Spatial Query	Spatial queries on vectors	*Complemento Consulta espacial*
	Comprobador de Topología	Encontrar errores topológicos en capas vectoriales	*topología*
	Zonal Statistics	Calculate raster statistics for vector polygons	*Complemento de Estadísticas de zona*

21.4 Complemento Captura de coordenadas

El complemento de captura de coordenadas es fácil de usar y proporciona la capacidad de mostrar coordenadas en la vista del mapa para dos sistemas de referencia de coordenadas (SRC).

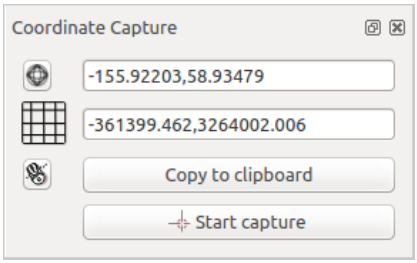

Figure 21.9: Complemento Captura de coordenadas

1. Start QGIS, select *Project Properties* from the *Settings* (KDE, Windows) or *File* (Gnome, macOS) menu and click on the *Projection* tab. As an alternative, you can also click on the CRS status icon in the lower right-hand corner of the status bar.
2. Pulse en la casilla de verificación *Activar transformación de SRC al vuelo* y seleccione un sistema de coordenadas proyectadas de su elección (vea también *Trabajar con Proyecciones*)
3. Activate the coordinate capture plugin in the Plugin Manager (see *El diálogo de complementos*) and ensure that the dialog is visible by going to *View* → *Panels* and ensuring that *Coordinate Capture* is enabled. The coordinate capture dialog appears as shown in Figure figure_coordinate_capture. Alternatively, you can also go to *Vector* → *Coordinate Capture* and see if *Coordinate Capture* is enabled.
4. Haga clic en el icono Pulse para seleccionar el SRC a usar para la visualización de coordenadas y elija un SRC diferente al que seleccionó anteriormente.
5. To start capturing coordinates, click on **[Start capture]**. You can now click anywhere on the map canvas and the plugin will show the coordinates for both of your selected CRS.
6. Para habilitar el seguimiento de coordenadas del ratón, pulse el icono Seguimiento del ratón.
7. También se pueden copiar las coordenadas seleccionadas al portapapeles.

21.5 Complemento administrador de BBDD

The DB Manager Plugin is officially part of the QGIS core and is intended to be the main tool to integrate and manage spatial database formats supported by QGIS (PostGIS, SpatiaLite, GeoPackage, Oracle Spatial, Virtual layers) in one user interface. The DB Manager Plugin provides several features. You can drag layers from the QGIS Browser into the DB Manager, and it will import your layer into your spatial database. You can drag and drop tables between spatial databases and they will get imported.

El menú *Base de datos* permite conectar a una base de datos existente, para iniciar la ventana de SQL y para finalizar el componente de Administrador de BBDD. Una vez que este conectado a la base de datos existente, los menús *Esquema* y *Tabla* aparecerá de forma adicional.

EL menú *Esquema* incluye herramientas para crear y eliminar (vaciar) esquemas y, si la topología esta disponible (e.j., PostGIS 2), iniciar un *TopoViewer*.

El menú *Tabla* permite crear y editar tablas y eliminar tablas y vistas. También es posible vaciar tablas y moverlas de un esquema a otro. Como función adicional, se puede realizar un VACUUM y luego un ANALYZE para cada tabla seleccionada. VACUUM simplemente recupera espacio y hace que este disponible para reusarlo. ANALYZE

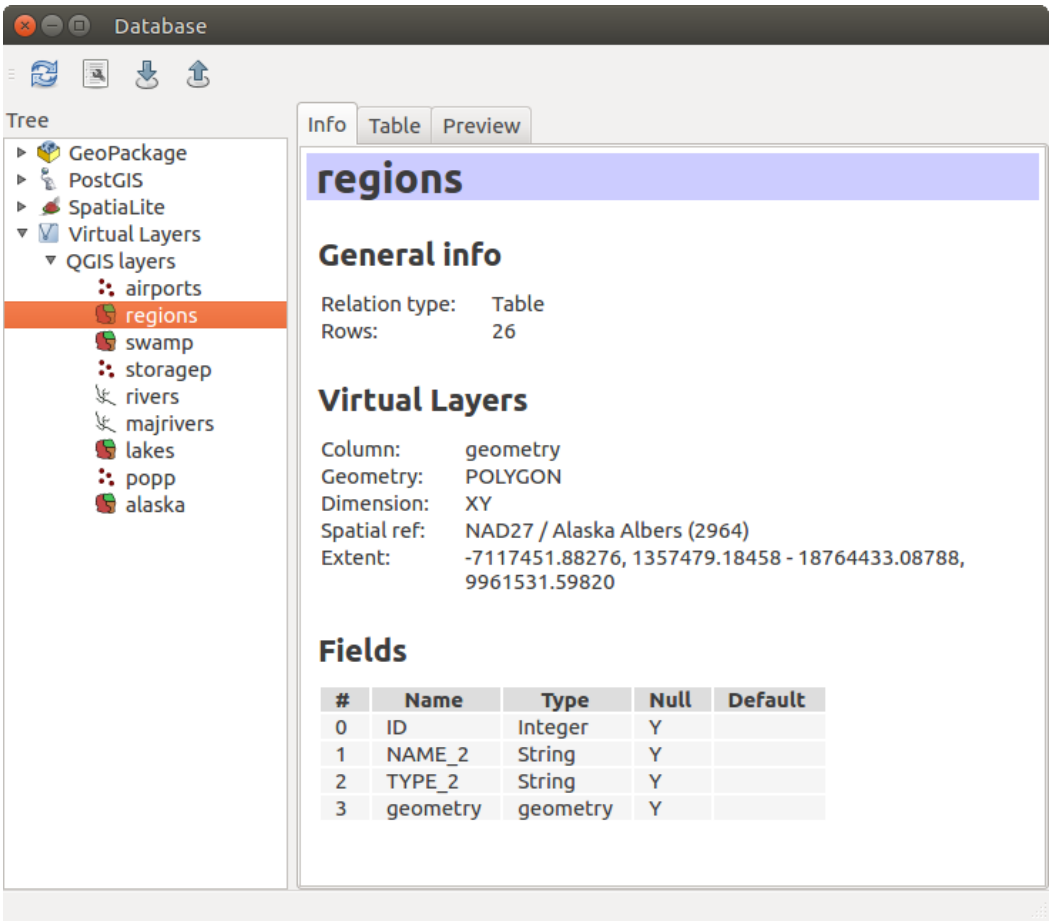

Figure 21.10: Diálogo del complemento administrador de BBDD

actualiza las estadisticas para determinar la forma más eficiente de ejecutar una consulta. Finalmente, se pueden importar capas/archivos, si estan cargados en QGIS o existen en el sistema de archivos. Y se puede exportar tablas de la base de datos a archivo vectorial con la función "Exportar archivo".

The *Tree* window lists all existing databases supported by QGIS. With a double-click, you can connect to the database. With the right mouse button, you can rename and delete existing schemas and tables. Tables can also be added to the QGIS canvas with the context menu.

Si se está conectado a una base de datos, la ventana **principal** del Administrador de BBDD ofrece tres pestañas. La pestaña *Info* proporciona información acerca de la tabla y su geometría, así como de los campos existentes, limitaciones e índices. También permite que ejecute Vacuum Analyze y crear índices espaciales en una tabla seleccionada, si no está ya hecho. La pestaña de *Tabla* muestra todos los atributos y la pestaña *Vista preliminar* representa las geometrías como vista previa.

21.5.1 Trabajar con la ventana SQL

You can also use the DB Manager to execute SQL queries against your spatial database and then view the spatial output for queries by adding the results to QGIS as a query layer. It is possible to highlight a portion of the SQL and only that portion will be executed when you press `F5` or click the *Execute (F5)* button.

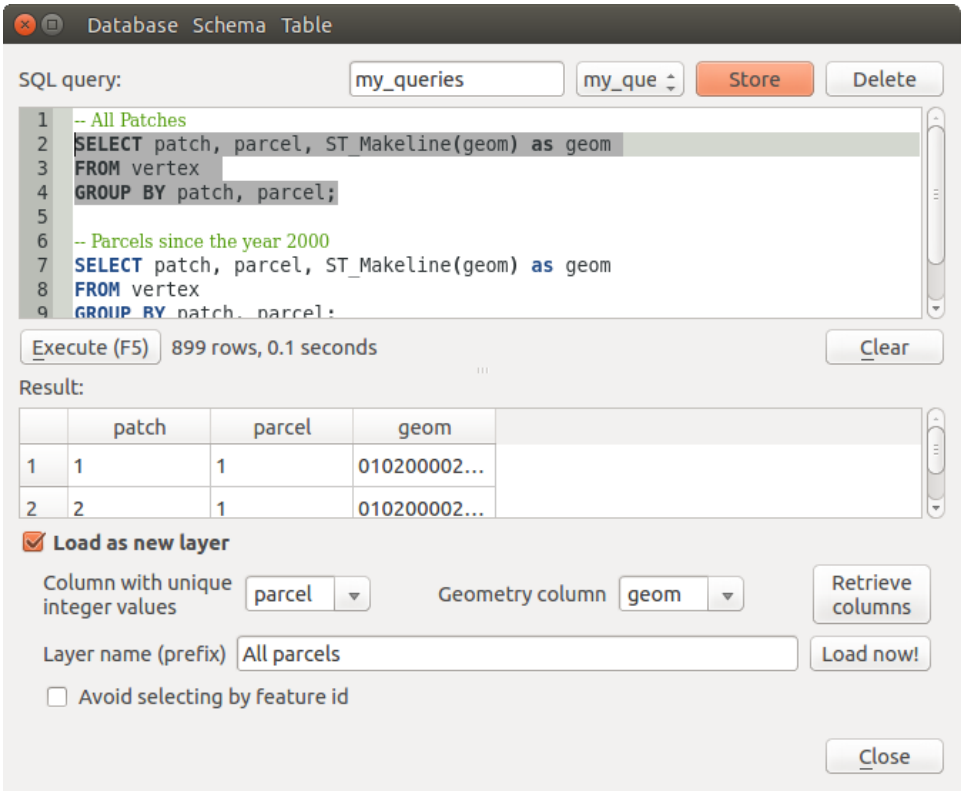

Figure 21.11: Executing SQL queries in the DB Manager SQL window

Nota: The SQL Window can also be used to create Virtual Layers. In that case, instead of selecting a database, select **QGIS Layers** under **Virtual Layers** before opening the SQL Window. See *Creating virtual layers* for instructions on the SQL syntax to use.

21.6 Complemento Conversor DxfaShp

El complemento Conversor DxfaShp se puede usar para convertir datos vectoriales del formato DXF a archivo shape. Requiere que se especifiquen los siguientes parámetros antes de ejecutarlo:

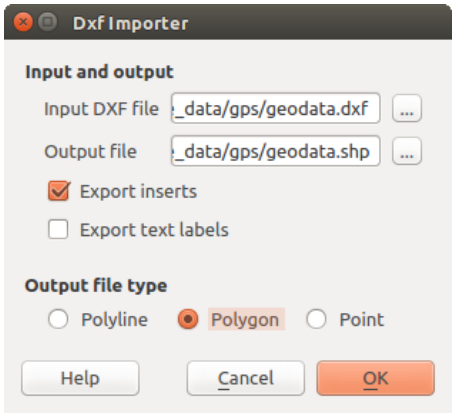

Figure 21.12: Complemento Conversor DxfaShp

- **Archivo DXF de entrada**: Introduzca la ruta al archivo DXF a convertir.
- **Archivo shp de salida**: Introduzca el nombre deseado para el archivo shape a crear.
- **Tipo de archivo de salida**: Especificar el tipo de geometría del archivo de salida. Actualmente los tipos soportados son polilíneas, polígonos y puntos.
- **Exportar etiquetas de texto**: Cuando esta casilla de verificación esta habilitada, se creará una capa de puntos adicional, y la tabla DBF asociada contendrá información sobre los campos "texto" que se encuentran en el archivo DXF y las cadenas de texto en sí.

21.6.1 Usar el complemento

1. Start QGIS, load the Dxf2Shape plugin in the Plugin Manager (see *El diálogo de complementos*) and click on the Dxf2Shape Converter icon, which appears in the QGIS toolbar menu. The Dxf2Shape plugin dialog appears, as shown in Figure_dxf2shape.
2. Introduzca el archivo DXF de entrada, un nombre para el archivo shape de salida y el tipo de archivo shape.
3. Habilitar la casilla de verificación *Exportar etiquetas de texto* si desea crear una capa extra de puntos con etiquetas.
4. Hacer clic en **[Aceptar]**

21.7 Complemento Visualización de Eventos

(This section is derived from Horning, N., K. Koy, P. Ersts. 2009. eVis (v1.1.0) User's Guide. American Museum of Natural History, Center for Biodiversity and Conservation. Available from http://biodiversityinformatics.amnh.org/, and released under the GNU FDL.)

El mecanismo de información sobre biodiversidad en el Museo Americano de Historia Natural(AMNH) Centro para la Biodiversidad y la Conservación (CBC) ha desarrollado la herramienta de visualización de eventos (eVis), otra herramienta de software para añadir al suite de monitoreo de conservación y herramienta de apoyo a las decisiones para guiar un área protegida y la planificación del paisaje. Este complemento permite a los usuarios enlazar fácilmente la geocodificación (es decir., se hacer referencia con latitud y longitud o coordenadas X y Y) de fotografías, y otros documentos de apoyo, a los datos vectoriales en QGIS.

eVis ahora esta instalado automáticamente y habilitado en nuevas versiones de QGIS, y como todos los demás complementos, se puede habilitar y deshabilitar utilizando el Administrador de Complementos (ver *El diálogo de complementos*).

El complemento de visualización de eventos se compone de tres módulos: la 'Herramienta para conexión a la base de datos', 'Herramienta de ID evento', y el 'Eventos del navegador'. Estos trabajan juntos para permitir la visualización de fotografías geocodificadas y otros documentos que están vinculados a objetos espaciales almacenados en archivo de vectores, base de datos o hojas de cálculo.

21.7.1 Explorador de Eventos

El módulo del explorador de eventos proporciona la funcionalidad para desplegar fotografías geocodificadas que están enlazadas con objetos espaciales vectoriales en la ventada de mapa de QGIS. Datos específicos por ejemplo, pueden ser desde un archivo vectorial que se pueden ingresar mediante QGIS o puede ser a partir del resultado de una consulta de base de datos. El objeto espacial vectorial debe tener información de atributos asociados con él para describir la ubicación y el nombre del archivo que contiene la fotografía y opcionalmente la dirección de la brújula de la cámara que se indico cuando fue adquirida la imagen . Su capa vectorial debe estar cargada en QGIS antes de ejercitar el explorador de eventos.

Iniciar el módulo de Explorador de eventos

To launch the Event Browser module, click on *Database* → *eVis* → *eVis Event Browser*. This will open the *Generic Event Browser* window.

La ventana *Explorador de eventos* tiene tres pestañas desplegadas en la parte superior de la ventana. La pestaña *Visualizar* se utiliza para ver las fotografías y los datos de sus atributos asociados. La pestaña *Opciones* proporciona un número de ajustes para controlar el funcionamiento del complemento eVis. Por último, la pestaña *Configuración de aplicaciones externas* se utiliza para mantener una tabla de extensiones de archivos y su aplicación asociada para permitir a eVis desplegar documentos que no sean imágenes.

Comprender la ventana Visualizar

Para ver la ventana *Visualizar*, haga clic en la pestaña *Visualizar* en la ventana *Explorador de Eventos*. La ventana *Visualizar* se utiliza para visualizar las fotografías geocodificadas y los atributos asociados a ellas.

1. **Ventana de Visualizar**: Una ventana donde la fotografía aparece.
2. **Botón de Acercar zoom**: Acercar zoom para ver más detalle. Si la imagen completa no puede ser visualizada en la ventana de visualizar, las barras de desplazamiento aparecerán en del lado izquierdo e inferior de la ventana para permitirle desplazarse por la imagen.
3. **Botón de Alejar zoom**: Alejar zoom para ver más área.
4. Botón **Zum general**: Despliega la fotografía completa.
5. **Ventana de información de atributos**: Toda la información de atributos del punto asociado con la foto que se está viendo se muestra aquí. Si el tipo de archivo al que hace referencia del registro mostrado no es una imagen sino un tipo de archivo definido en la pestaña *Configurar aplicaciones externas* cuando haga doble clic en el valor del campo que contiene la ruta al archivo se abrirá la aplicación para ver u oír el contenido del archivo. Si se reconoce la extensión del archivo los datos de los atributos se mostrarán en verde.
6. **Botones de Navegación**: Utiliza el botón anterior y siguiente para cargar el objeto anterior o siguiente cuando mas de un objeto espacial esta seleccionado.

Comprender la ventana de Opciones

1. **Ruta del archivo**: Una lista desplegable para especificar el campo de atributo que contiene la ruta del directorio o URL para las fotografías u otros documentos que se muestran. Si la ubicación es una ruta relativa, entonces la casilla de verificacion debe hacer clic. LA ruta base para una ruta relativa puede ser introducida en la caja de texto *Ruta Base* a continuación. La información sobre las diferentes opciones para especificar la ubicación del archivo se indica en la sección *Especificar la ubicación y nombre de la fotografía* a continuación.

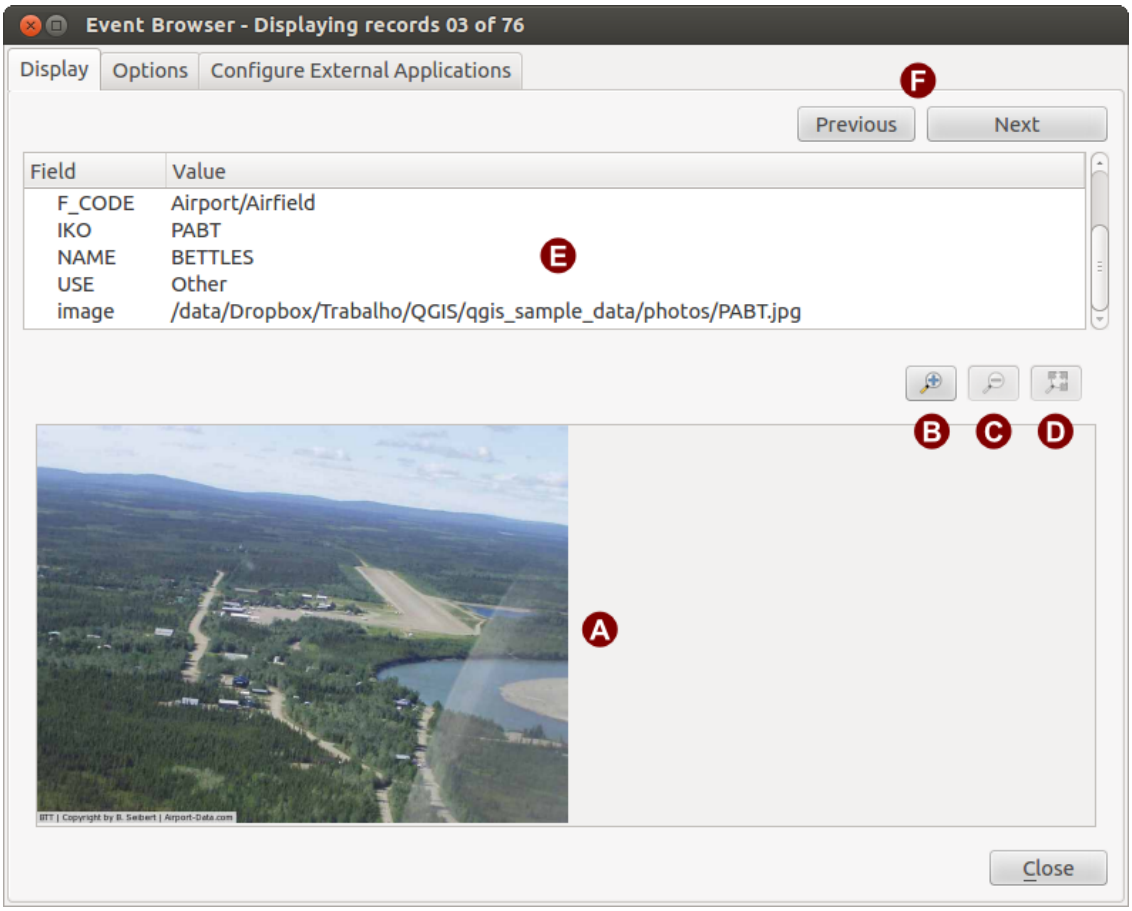

Figure 21.13: La ventana de *eVis* visualizar

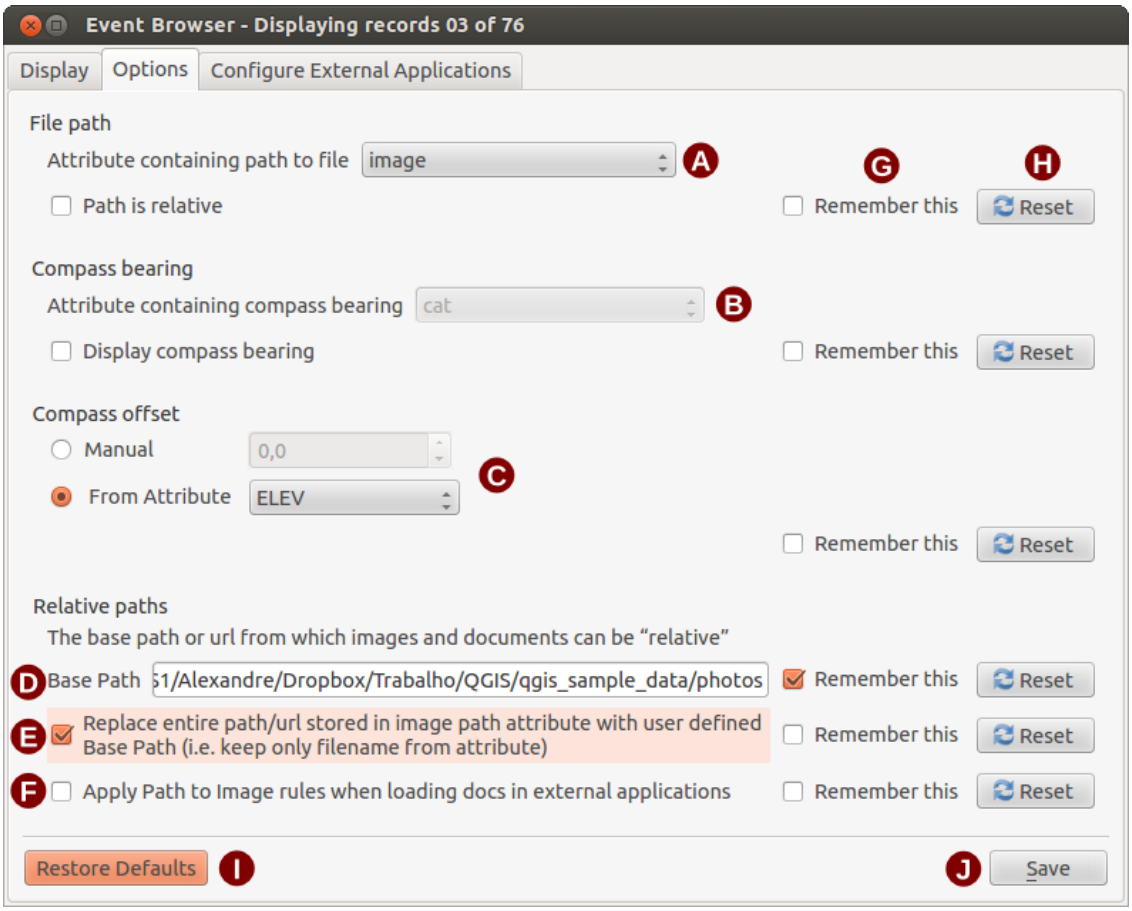

Figure 21.14: La ventana de *eVis* Opciones

2. **Rumbo de la brújula**: Una lista desplegable para especificar el campo de atributo que contiene el rumbo de la brújula asociado con las fotografías que se muestran. Si la información del rumbo de la brújula esta disponible, es necesario hacer clic en casilla de verificación a continuación el título del menú desplegable.
3. **Desplazamiento de la brújula**: El desplazamiento de la brújula se puede utilizar para compensar la declinación (para ajustar los rodamientos recolectados usando cojinetes magnéticos para el rumbo del norte verdadero). Haga clic en el botón de radio *Manual* para ingresar el desplazamiento en la caja de texto o haga clic en el botón de radio *De atributo* para seleccionar el campo del atributo que contiene los desplazamientos. Para ambas opciones, declinaciones del este deben introducirse utilizando valores positivos, y declinaciones al oeste deben utilizar valores negativos.
4. **Directory base path**: The base path onto which the relative path defined in Figure_eVis_options (A) will be appended.
5. **Sustituir la ruta**: Si esta casilla de verificación esta marcada, solo el nombre del archivo de A se anexará a la ruta base.
6. **Aplicar regla a todos los documentos**: Si se marco, las mismas reglas de ruta que están definidas para las fotografías se utilizarán para los documentos sin imagen, tales como películas, documentos de texto y archivos de sonido. Si no se marca, las reglas de ruta sólo se aplicarán a las fotografías, y los otros documentos ignorarán el parámetro de la ruta base.
7. **Remember settings**: If the checkbox is checked, the values for the associated parameters will be saved for the next session when the window is closed or when the **[Save]** button below is pressed.
8. **Restablecer**: Restablecer los valores en esta línea a la configuración predeterminada.
9. **Restore defaults**: This will reset all of the fields to their default settings. It has the same effect as clicking all of the **[Reset]** buttons.
10. **Guardar**: Esto guardará los ajustes sin cerrar el panel *Opciones*.

Comprender la ventana de Configurar aplicaciones externas

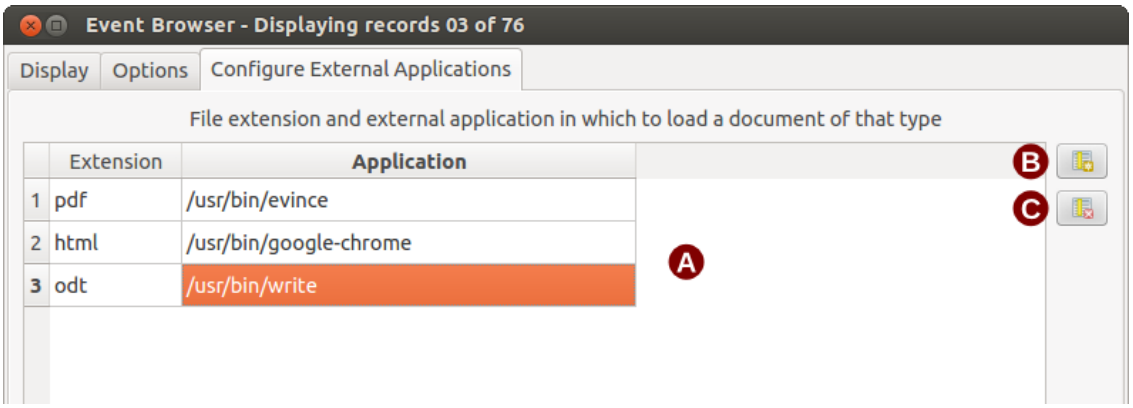

Figure 21.15: La ventana de *eVis* Aplicaciones externas

1. **Tabla de referencia de archivo**: Una tabla contiene los tipos de archivo que se pueden abrir utilizando eVis. Cada tipo de archivo necesita una extensión de archivo y la ruta de una aplicación que pueda abrir ese tipo de archivo. Esto proporciona la capacidad de abrir una amplia gama de archivos tales como películas, grabaciones sonoras y documentos de texto en lugar de solo imágenes.
2. **Añadir nuevo tipo de archivo**: Añadir un nuevo tipo de archivo con una única extensión y la ruta para la aplicación que puede abrirlo.
3. **Borrar la fila actual**: Borrar el tipo de archivo destacado en la tabla y definido por una extensión de archivo y una ruta a una aplicación asociada.

21.7.2 Especificar la ubicación y nombre de la fotografía

La ubicación y nombre de la fotografía se pueda almacenar utilizando una ruta relativa o absoluta, o una URL, si la fotografía esta disponible en el servidor web. Ejemplos de los diferentes enfoques están listados en la tabla evis_examples.

```
X        Y        FILE                                                BEARING
780596   1784017  C:\Workshop\eVis_Data\groundphotos\DSC_0168.JPG      275
780596   1784017  /groundphotos/DSC_0169.JPG                          80
780819   1784015  http://biodiversityinformatics.amnh.org/\
                  evis_testdata/DSC_0170.JPG                          10
780596   1784017  pdf:http://www.testsite.com/attachments.php?\
                  attachment_id-12                                    76
```

21.7.3 Especificar la ubicación y nombre de otros documentos soportados

Los documentos de apoyo tales como documentos de texto, videos, y clips de sonido también se pueden visualizar o reproducir por eVis. Para ello, es necesario añadir una entrada en el archivo de tabla de referencia que se puede acceder desde la ventana *Configurar Aplicaciones Externas ' en el :guilabel:'Generic Event Browser* que coincide con la extensión de archivo a una aplicación que se puede utilizar para abrir el archivo. También es necesario disponer de la ruta o URL para el archivo en la tabla de atributos de la capa vectorial. Una regla adicional que puede ser utilizada para las direcciones URL que no contienen una extensión de archivo para el documento que desea abrir es especificar la extensión del archivo antes de la URL. El formato es — `file extension:URL`. La URL es precedida por la extensión de archivo y dos puntos; esto es particularmente útil para el acceso a los mismos a partir de los wikis y otros sitios web que utilizan una base de datos para gestionar las páginas web (véase Table evis_examples).

21.7.4 Utilizar el Explorador de eventos

Cuando la ventana :guilabel: *Navegador de Eventos* se abre, una fotografía aparecerá en la pantalla si el documento se hace referencia en la tabla de atributos de archivo vectorial es una imagen y si la información de la ubicación del archivo en la ventana *Opciones* es correctamente establecida. Si se espera una fotografía y no aparece, será necesario ajustar los parámetros en la ventana :guilabel: *Opciones*.

Si un documento de apoyo (o una imagen que no tiene una extensión de archivo reconocido por eVis) se hace referencia en la tabla de atributos, el campo que contiene la ruta del archivo se resaltará en verde en la ventana de información de atributos si esa extensión de archivo se define en el archivo de la tabla de referencia se encuentra en la ventana *Configurar Aplicaciones Externas*. Para abrir el documento, haga doble clic en la línea verde resaltado en la ventana de información de atributos. Si un documento de apoyo se hace referencia en la ventana de información de atributos y la ruta del archivo no está resaltado en verde, entonces será necesario añadir una entrada para la extensión de nombre de archivo del archivo en la ventana *Configurar Aplicaciones Externas*. Si la ruta del archivo se resalta en verde, pero no se abre al hacer doble clic, será necesario ajustar los parámetros en la ventana :guilabel: *Opciones* por lo que el archivo puede ser localizado por eVis.

Si no se proporciona una brújula en la ventana :guilabel: *Opciones*, un asterisco rojo se mostrará en la parte superior de la característica de vector que se asocia con la fotografía que se muestra. Si se proporciona una brújula, a continuación, aparecerá una flecha apuntando en la dirección indicada por el valor en el campo de visualización de brújula en la ventana :guilabel: *Navegador de Eventos*. La flecha estará centrado sobre el punto que se asocia con la fotografía u otro documento.

To close the *Event Browser* window, click on the **[Close]** button from the *Display* window.

21.7.5 Herramienta ID evento

El módulo 'Evento ID' le permite mostrar una fotografía al hacer clic en un objeto espacial mostrado en la ventana de mapa de QGIS. El objeto espacial vectorial debe tener información de atributos asociada a él para describir la ubicación y nombre del archivo que contiene la fotografía y, opcionalmente, la dirección de la brújula de la

cámara que se estableció cuando fue adquirida la imagen. Esta capa debe cargarse en QGIS antes de ejecutar la herramienta 'Evento ID'

Iniciar el módulo ID evento

Para iniciar el módulo 'Evento ID', haga clic en el icono  Evento ID o haga clic en *Base de datos→ eVis → Herramienta de ID de evento eVis*. Esto hará que el cursor cambie a una flecha con una 'i' en la parte superior de la misma que significa que la herramienta de ID de evento está activa.

To view the photographs linked to vector features in the active vector layer displayed in the QGIS map window, move the Event ID cursor over the feature and then click the mouse. After clicking on the feature, the *Event Browser* window is opened and the photographs on or near the clicked locality are available for display in the browser. If more than one photograph is available, you can cycle through the different features using the **[Previous]** and **[Next]** buttons. The other controls are described in the *Explorador de Eventos* section of this guide.

21.7.6 Conexión a base de datos

El módulo 'Conexión a base de datos' proporciona herramientas para conectar a y consultar una base de datos u otros recursos ODBC, tales como una hoja de cálculo.

eVis puede conectar directamente a los siguientes tipos de base de datos: PostgreSQL, MySQL, y SQLite; también puede leer desde conexiones ODBC (por ejemplo, MS Access). Al leer desde una base de datos ODBC (por ejemplo una hoja de Excel), es necesario configurar su driver ODBC para el sistema operativo que esté utilizando

Iniciar el módulo de Conexión a base de datos

Para iniciar el módulo 'Conexión a base de datos', haga clic en el icono apropiado  Conexión a base de datos eVis o haga clic en *Base de datos → eVis → Conexión a base de datos eVis*. Esto abrirá la ventana *Conexión a base de datos*. La ventana tiene tres pestañas: *Consultas predefinidas*, *Conexión a base de datos*, y *Consulta SQL*. La ventana *Consola de salida* en la parte inferior de la ventana, muestra el estado de las acciones iniciadas por las diferentes secciones de este módulo.

Conectar a una base de datos

Haga clic en la pestaña *Conexión a la base de datos* para abrir la interfaz de conexión a base de datos. A continuación, utilice la lista desplegable *Tipo de base de datos*  para seleccionar el tipo de base de datos al que desea conectarse. Si una contraseña o nombre de usuario es necesario, esa información puede ser ingresada en las cajas de texto *Nombre de usuario* y *Contraseña*

Introduzca el host de base de datos en el cuadro de texto :guilabel: *Host de Base de Datos*. Esta opción no está disponible si ha seleccionado 'MS Access' como el tipo de base de datos. Si la base de datos reside en su equipo, usted debe seleccionar "localhost".

Introducir el nombre de la base de datos en la caja de texto *Nombre de la base de datos*. Si seleccionó 'ODBC' como el tipo de base de datos, es necesario introducir el nombre de la fuente de datos.

When all of the parameters are filled in, click on the **[Connect]** button. If the connection is successful, a message will be written in the *Output Console* window stating that the connection was established. If a connection was not established, you will need to check that the correct parameters were entered above.

1. **Tipo de base de datos**: Una lista desplegable para especificar el tipo de base de datos que se utilizará.
2. **Host de la base de datos**: El nombre del host de la base de datos.
3. **Puerto**: El numero de puerto si una un tipo de base de datos MySQL o PostgreSQL es seleccionado.
4. **Nombre de la base de datos**: EL nombre de la base de datos.
5. **Conectar**: Un botón para conectar a la base de datos utilizando los parámetros definidos anteriormente.

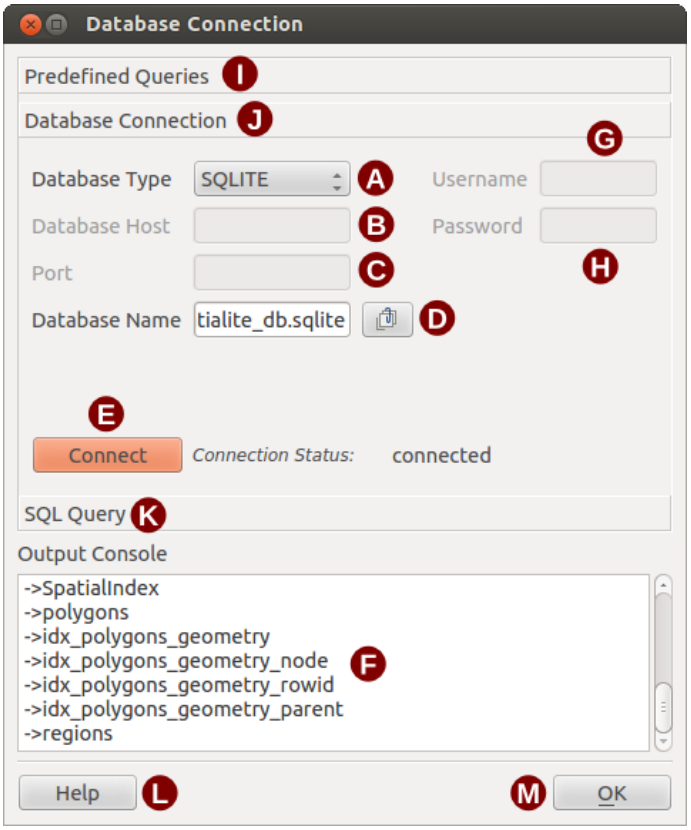

Figure 21.16: La ventana de conexión a base de datos *eVis*

6. **Salidas a la Consola**: La ventana de consola donde los mensajes relacionados a procesos son mostrados.
7. **Nombre del Usuario**: Nombre del usuario para utilizar cuando una base de datos este protegida con contraseña.
8. **Contraseña**: Para usar cuando la base de datos esta protegida con contraseña.
9. **Consultas predefinidas**: Pestaña para abrir la ventana "Consultas Predefinidas".
10. **Conexión a base de datos**: Pestaña para abrir la ventana "Conexión a base de datos".
11. **Consulta SQL**: Pestaña para abrir la ventana "Consulta SQL".
12. **Ayuda**: Muestra la ayuda en línea.
13. **Aceptar**: Cierra la ventana principal "Conexión a Base de datos"

Ejecutar consultas SQL

SQL queries are used to extract information from a database or ODBC resource. In eVis, the output from these queries is a vector layer added to the QGIS map window. Click on the *SQL Query* tab to display the SQL query interface. SQL commands can be entered in this text window. A helpful tutorial on SQL commands is available at http://www.w3schools.com/sql. For example, to extract all of the data from a worksheet in an Excel file, `select * from [sheet1$]` where `sheet1` is the name of the worksheet.

Click on the **[Run Query]** button to execute the command. If the query is successful, a *Database File Selection* window will be displayed. If the query is not successful, an error message will appear in the *Output Console* window.

En la ventana *Selección de archivo de base de datos*, introduzca el nombre de la capa que será creada de los resultados de la consulta en la caja de texto *Nombre de la nueva capa*

1. **Ventana de texto de consulta SQL**: Una pantalla para consultas tipo SQL.

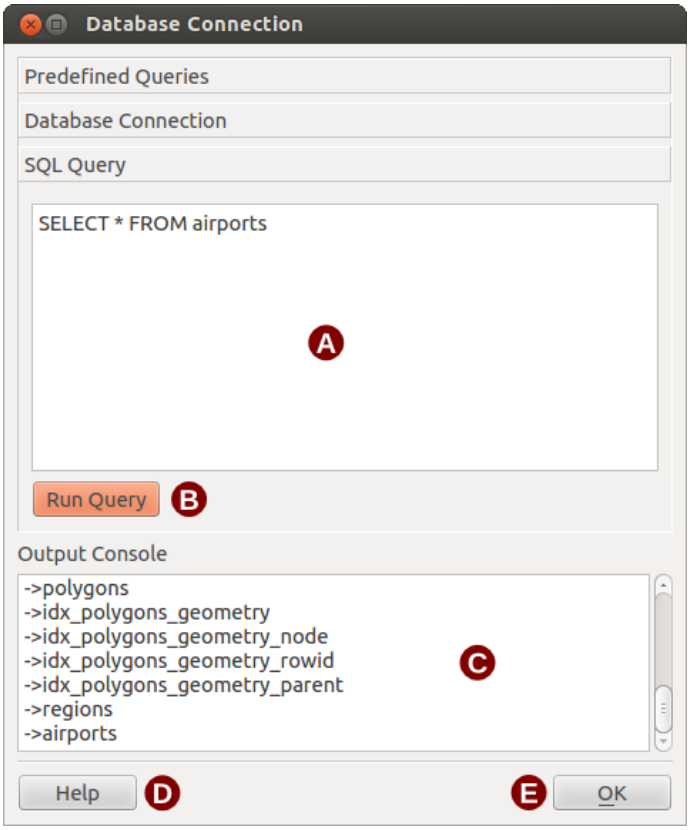

Figure 21.17: La pestaña Consulta SQL de eVis

2. **Ejecutar consulta**: El botón para ejecutar la consulta introducida en la *Consulta SQL*.
3. **Consola de salida**: La consola de salida donde se muestran los mensajes relacionados con el procesamiento.
4. **Ayuda**: Muestra la ayuda en línea.
5. **Aceptar**: Cierra la ventana principal *Conexión a base de datos*.

Use the *X Coordinate* and *Y Coordinate* combo boxes to select the fields from the database that stores the `X` (or longitude) and `Y` (or latitude) coordinates. Clicking on the **[OK]** button causes the vector layer created from the SQL query to be displayed in the QGIS map window.

Para guardar este archivo vectorial y usarlo en el futuro, se puede utilizar el comando de QGIS 'Guardar como...' que se accede haciendo clic derecho sobre el nombre de la capa en la leyenda del mapa de QGIS y después seleccione 'Guardar como...'

Truco: Crear una capa vectorial de una Hoja de cálculo de Microsoft Excel

Al crear una capa vectorial de una hoja de cálculo Microsoft Excel, es posible ver que los ceros no deseados ("0") hayan sido insertados en las filas de la tabla de atributos debajo de datos válidos. Esto puede ser causado por la supresión de los valores de estas celdas en Excel utilizando la tecla `Espacio`. Para corregir este problema, es necesario abrir el archivo de Excel (que necesita para cerrar QGIS si está conectado al archivo, que le permite editarlo) y luego usar *Edición* → *Borrar* para eliminar las filas en blanco del archivo. Para evitar este problema, puede simplemente eliminar varias filas en la hoja de Excel usando *Edición* → *Borrar* antes de guardar el archivo.

Ejecutar consultas predefinidas

Con las consultas predefinidas, se pueden seleccionar consultas escritas previamente almacenadas en un archivo de formato XML. Esto es particularmente útil, si no esta familiarizado con comandos SQL. Haga clic en la pestaña *Consultas predefinidas* para visualizar la interfaz de consultas predefinidas.

Para cargar un conjunto de consultas predefinidas, haga clic en el icono Abrir archivo. Este abrirá la ventana *Abrir archivo*, que se utiliza para localizar el archivo que contiene las consultas SQL. Cuando se cargan las consultas, sus títulos definidos en el archivo XML aparecerán en el menú desplegable situado justo debajo del icono Abrir archivo. La descripción completa de la consulta se mostrará en la ventana de texto en el menú desplegable.

Seleccione la consulta que desee ejecutar del menú desplegable y después haga clic en la pestaña *Consulta SQL* para ver las consultas que se han estado cargando en la ventana de consultas. Si es la primera vez puede ejecutar una consulta predefinida o esta cambiando a base de datos, necesita estar seguro para conectarse a la base de datos.

Click on the **[Run Query]** button in the *SQL Query* tab to execute the command. If the query is successful, a *Database File Selection* window will be displayed. If the query is not successful, an error message will appear in the *Output Console* window.

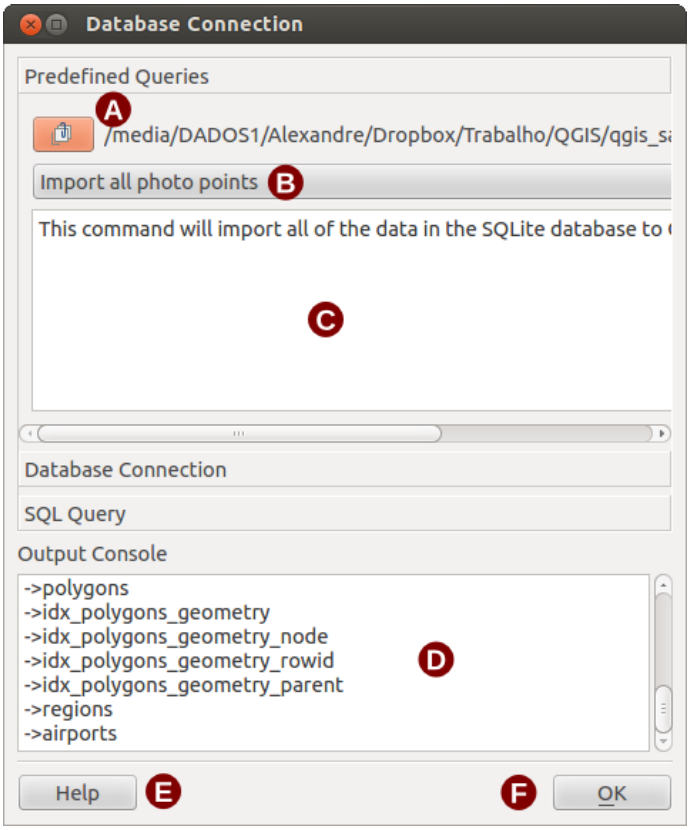

Figure 21.18: La pestaña de *eVis* Consultas predefinidas

1. **Abrir Archivo**: Iniciar el archivo "Abrir Archivo" navegar para buscar el archivo XML manteniendo las consultas predefinidas.
2. **Consultas predefinidas**: Una lista desplegable con todas las consultas definidas por el archivo XML de consultas predefinidas.
3. **Descripción de consulta**: Una descripción corta de la consulta. Esta descripción es del archivo XML de consultas predefinidas.
4. **Consola de salida**: La consola de salida donde se muestran los mensajes relacionados con el procesamiento.
5. **Ayuda**: Muestra la ayuda en línea.
6. **Aceptar**: Cierra la ventana principal "Conexión a Base de datos"

El formato XML para consultas predefinidas eVis

Las etiquetas XML leídas por eVis

Etiquetas	Descripción
Consulta	Definir el inicio y fin de una sentencia de consulta.
Descripción corta	Una descripción corta de la consulta que aparece en el menú desplegable de eVis.
Descripción	Una descripción más detallada de la consulta desplegada en la ventana de texto de consulta predefinida.
Tipo de base de datos	El tipo de la base de datos, definido en el menú desplegable de Tipo de base de datos en la pestaña de Conexión a base de datos.
Puerto	El puerto como se define en el cuadro de texto Puerto en la pestaña de Conexión a base de datos.
Nombre de la base de datos	El nombre de la base de datos como se define en el cuadro de texto en la pestaña de Conexión a base de datos.
Nombre de usuario	El nombre de usuario de la base de datos como se define en el cuadro de texto Nombre de usuario en la pestaña de Conexión a base de datos.
databasepassword	La contraseña de la base de datos como se define en el cuadro de texto Contraseña en la pestaña Conexión a base de datos.
Sentencia sql	El comando SQL
autoconectar	Una bandera (“verdadero” o “falso”) para especificar si las etiquetas anteriores deben utilizarse para conectarse automáticamente a la base de datos sin ejecutar la rutina de conexión de base de datos en la solapa Conexión de Base de Datos.

Se muestra un archivo XML de ejemplo completo con tres preguntas a continuación:

```
<?xml version="1.0"?>
<doc>
 <query>
   <shortdescription>Import all photograph points</shortdescription>
   <description>This command will import all of the data in the SQLite database to QGIS
      </description>
   <databasetype>SQLITE</databasetype>
   <databasehost />
   <databaseport />
   <databasename>C:\textbackslash Workshop/textbackslash
eVis\_Data\textbackslash PhotoPoints.db</databasename>
   <databaseusername />
   <databasepassword />
   <sqlstatement>SELECT Attributes.*, Points.x, Points.y FROM Attributes LEFT JOIN
      Points ON Points.rec_id=Attributes.point_ID</sqlstatement>
   <autoconnect>false</autoconnect>
 </query>
  <query>
   <shortdescription>Import photograph points "looking across Valley"</shortdescription>
   <description>This command will import only points that have photographs "looking across
      a valley" to QGIS</description>
   <databasetype>SQLITE</databasetype>
   <databasehost />
   <databaseport />
   <databasename>C:\Workshop\eVis_Data\PhotoPoints.db</databasename>
   <databaseusername />
   <databasepassword />
   <sqlstatement>SELECT Attributes.*, Points.x, Points.y FROM Attributes LEFT JOIN
      Points ON Points.rec_id=Attributes.point_ID where COMMENTS='Looking across
      valley'</sqlstatement>
   <autoconnect>false</autoconnect>
 </query>
 <query>
   <shortdescription>Import photograph points that mention "limestone"</shortdescription>
   <description>This command will import only points that have photographs that mention
      "limestone" to QGIS</description>
   <databasetype>SQLITE</databasetype>
   <databasehost />
   <databaseport />
```

```
   <databasename>C:\Workshop\eVis_Data\PhotoPoints.db</databasename>
   <databaseusername />
   <databasepassword />
   <sqlstatement>SELECT Attributes.*, Points.x, Points.y FROM Attributes LEFT JOIN
      Points ON Points.rec_id=Attributes.point_ID where COMMENTS like '%limestone%'
      </sqlstatement>
   <autoconnect>false</autoconnect>
 </query>
</doc>
```

21.8 Complemento Herramientas de GDAL

21.8.1 ¿Qué son las herramientas GDAL?

El complemento de herramientas GDAL ofrece una GUI para la colección de herramientas en Geospatial Data Abstraction Library, http://gdal.osgeo.org. Estas son las herramientas de gestión ráster para consultar, re-proyecto, urdimbre y combinar una amplia variedad de formatos ráster. También se incluyen herramientas para crear una capa (vector) del contorno, o un relieve sombreado de un ráster MDT, y para hacer una VRT (Virtual Raster Tile en formato XML) a partir de una colección de uno o más archivos ráster. Estas herramientas están disponibles cuando se instala el complemento y es activado.

La biblioteca GDAL

La librería GDAL consiste en un conjunto de programas de línea de comandos, cada uno con una larga lista de opciones. Los usuarios cómodos con la ejecución de comandos desde la terminal pueden preferir la línea de comandos, con acceso a todo el conjunto de opciones. El complemento de Herramientas GDAL ofrece una interfaz fácil de las herramientas, exponiendo las opciones más populares.

21.8.2 Lista de Herramientas GDAL

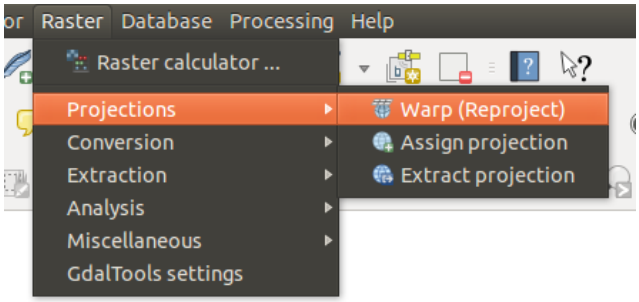

Figure 21.19: La lista del menú *Herramientas GDAL*

Projecciones

Warp (Reproject)	Esta utilidad es una imagen de mosaicos, reproyección y utilidad deformación. El programa puede reproyectar a cualquier proyección apoyada, y también se puede aplicar GCPs almacenados con la imagen si la imagen es "crudo" con información de control. Para obtener más información, se puede leer en el sitio web GDAL http://www.gdal.org/gdalwarp.html
Assign projection	Esta herramienta le permite asignar proyección a rásters que ya tengan una referencia geográfica, que le falte la información de la proyección. También con su ayuda, es posible alterar las definiciones de proyección existentes. Ambos archivos simples y el modo por lotes son compatibles. Para obtener más información, por favor visite la página de utilidad en el sitio GDAL http://www.gdal.org/gdalwarp.html.
Extract projection	Esta utilidad te ayuda a extraer información de la proyección de un archivo de entrada. Si desea extraer información de un directorio completo, puede usar el modo por lotes. Este crea ambos archivos `.prj` and `.wld`

Conversión

Rasterizar	Este programa fusiona geometrías vectoriales (puntos, líneas y polígonos) en la banda(s) ráster de una imagen raster. Los vectores se leen de formatos vectoriales reconocidos por OGR. Tenga en cuenta que los datos vectoriales debe estar en el mismo sistema de coordenadas como los datos ráster; en la reproyección al vuelo no se proporciona. Para obtener más información, consulte http://www.gdal.org/gdal_rasterize.html.
Polygonize	Esta utilidad crea polígonos vectoriales para todas las regiones conectadas de píxeles del ráster que comparte un valor de píxel en común. Cada polígono se crea con un atributo que indica el valor de píxel de dicho polígono. La utilidad crea el vector de salida de origen de datos si no existe ya, predeterminado a el formato de archivo shape de ESRI. Ver también http://www.gdal.org/gdal_polygonize.html.
Translate	Esta utilidad se puede utilizar para convertir los datos ráster entre diferentes formatos, lo que podría llevar a cabo algunas operaciones como subconjuntos, remuestreo, y reescalar píxeles en el proceso. Para obtener más información se puede leer en http://www.gdal.org/gdal_translate.html.
RGB a PCT	Esta utilidad calculará una tabla de pseudocolor óptima para una imagen RGB determinada, utilizando un algoritmo de corte medio de un histograma RGB downsampled. Luego se convierte la imagen en una imagen pseudocoloreada usando la tabla de colores. Esta conversión utiliza Floyd-Steinberg (difusión de errores) para maximizar la imagen de salida de calidad visual. La utilidad también se describe en http://www.gdal.org/rgb2pct.html.
PCT a RGB	Esta utilidad convertirá una banda pseudocolor en el archivo de entrada en un archivo RGB de salida del formato deseado. Para mayor información, vea http://www.gdal.org/pct2rgb.html.

Extracción

Contour	Este programa genera un archivo vectorial de curvas de nivel del modelo del terreno ráster (MDT). En http://www.gdal.org/gdal_contour.html, se puede encontrar más información.
Clipper	Esta utilidad le permite que acorte rásteres (extraer un subconjunto) utilizando una extensión seleccionada o en base a límites de la capa de máscara.. Más información se puede encontrar en http://www.gdal.org/gdal_translate.html.

Análisis

Filtrado	Esta utilidad elimina polígonos ráster más pequeños que un tamaño umbral previsto (en píxeles) y los reemplaza con el valor del píxel del polígono vecino más grande. El resultado se puede escribir de nuevo a la banda del ráster existente, o copiado en un nuevo archivo. Para mayor información, vea http://www.gdal.org/gdal_sieve.html.
Casi Negro	Esta utilidad escaneará una imagen y tratar de establecer todos los píxeles que son casi negros (o casi blancos) alrededor del borde para exactamente negro (o blanco). Esto se utiliza a menudo para "arreglar" comprimir pérdidas de fotos aéreas de modo que los píxeles de color se pueden tratar como transparentes cuando se hace el mosaico. También vea http://www.gdal.org/nearblack.html.
Rellenar sin datos	Esta utilidad rellena regiones de ráster seleccionadas (generalmente áreas sin datos) por interpolación de píxeles válidos alrededor de los bordes de las áreas. En http://www.gdal.org/gdal_fillnodata.html, se puede encontrar más información.
Proximidad	Esta utilidad genera un mapa ráster de proximidad que indica la distancia desde el centro de cada píxel al centro del píxel más cercano identificado como un píxel objetivo. Los pixeles objetivo son los del ráster fuente para la cual el valor de píxel del ráster está en el conjunto de valores de píxel objetivo. Para obtener más información, consulte http://www.gdal.org/gdal_proximity.html.
Cuadrícula (Interpolación)	Esta utilidad crea una cuadrícula regular (ráster) a partir de los datos dispersos leídos desde la fuente de datos OGR. Los datos de entrada serán interpolados para rellenar nodos de la cuadrícula con los valores, y puede elegir entre varios métodos de interpolación. La utilidad también se describe en el el sitio web GDAL, http://www.gdal.org/gdal_grid.html.
MDT(Modelos de Terreno)	Herramientas para analizar y visualizar DEMs. Esto puede crear un relieve sombreado, pendiente, orientación, color de relieve y un indice de irregularidad del terreno, un indice de posición topográfica y un mapa de irregularidad de algún ráster de elevación reconocido GDAL. Para mayor información , vea http://www.gdal.org/gdaldem.html.

Miscelánea

Construir ráster virtual (Catálogo)	Este programa crea un VRT (Conjunto de datos virtual) que es un mosaico de la lista de conjunto de datos GDAL de entrada. Vea también http://www.gdal.org/gdalbuildvrt.html.
Merge	Esta utilidad automáticamente hará el mosaico un conjunto de imágenes. Todas las imágenes deben estar en el mismo sistema de coordenadas y tener un número correspondiente de bandas, pero pueden ser superpuestas, y en diferentes resoluciones. En áreas de superposición, la última imagen se copiará en las anteriores. La utilidad también se describe en http://www.gdal.org/gdal_merge.html.
Información	Esta utilidad muestra diversa información acerca de un conjunto de datos ráster GDAL-implementado. En http://www.gdal.org/gdalinfo.html, puede encontrar más información.
Generar vistas generales	La utilidad gdaladdo se puede utilizar para construir o reconstruir las vistas generales para los formatos más compatibles con un de varios algoritmos de disminución de resolución. Para obtener más información, vea http://www.gdal.org/gdaladdo.html.
Tile Index	Esta utilidad crea un archivo shape con un registro para cada archivo de entrada ráster, un atributo contiene el nombre del archivo y una geometría de polígono delineando el ráster. Vea también http://www.gdal.org/gdaltindex.html.

Configuración de herramientas GDAL

Utilice este diálogo para integrar las variables GDAL.

21.9 Complemento Comprobador de geometría

Geometry Checker is a powerful core plugin to check and fix the geometry validity of a layer. The *Geometry Checker* dialog show differents grouped settings in the first tab (*Settings*):

- *Input vector layer*: to select the layer to check. A *Only selected features* checkbox can filter the geometry to the one selected.
- *Geometry validity*: give to the user the choice between *Self intersections*, *Duplicate nodes*, *Polygon with less than 3 nodes*.
- *Allowed geometry types*: to allow only some geometry types like point, multipoint, line, multiline, polygon and multipolygon.
- *Geometry properties* displays *Polygons and multipolygons may not contain any holes* and *Multipart objects must consist of more than one part*.
- *Geometry conditions*: user can add some condition to validate the geometries with a minimal segment length, a minimum angle between segment, a minimal polygon area and sliver polygons detection.
- *Topology checks*: checks for duplicates, for features within other features, overlaps smaller than a number, for gaps smaller than a number.
- *Tolerance*: you can define here the tolerance for the check.
- *Output vector layer* gives the choice to the user how get the result between modifiy the current layer and create a new layer.

After you are happy with the configuration, you can click on the **[Run]** button.

The results appear in the second tab and as an overview layer of the errors in the canvas (its name is *checker*). A table list the *geometry check result* with one error by row: the first row is an ID, the second the reason of the error, then the coordinates of the error, a value (depending on the type of the error) and finally the resolution column which indicates the resolution of the error. At the bottom of this table, you can export the error into a shapefile. At the left, you have the number of the errors and the fixed errors.

The *Geometry Checker Plugin* can find the following errors:

- Self intersections: a polygon with a self intersection,
- Duplicate nodes: two duplicates nodes in a segment
- Holes: hole in a polygon,
- Segment length: a segment length lower than a threshold,
- Minimum angle: two segments with an angle lower than a threshold,
- Minimum area: polygon area lower than a treshold,
- Silver polygon: this error come from very small polygon (with small area) with a large perimeter,
- Duplicates features,
- Feature within feature,
- Overlaps: polygon overlapping,
- Gaps: gaps between polygons

The following figure shows the different checks made by the plugin.

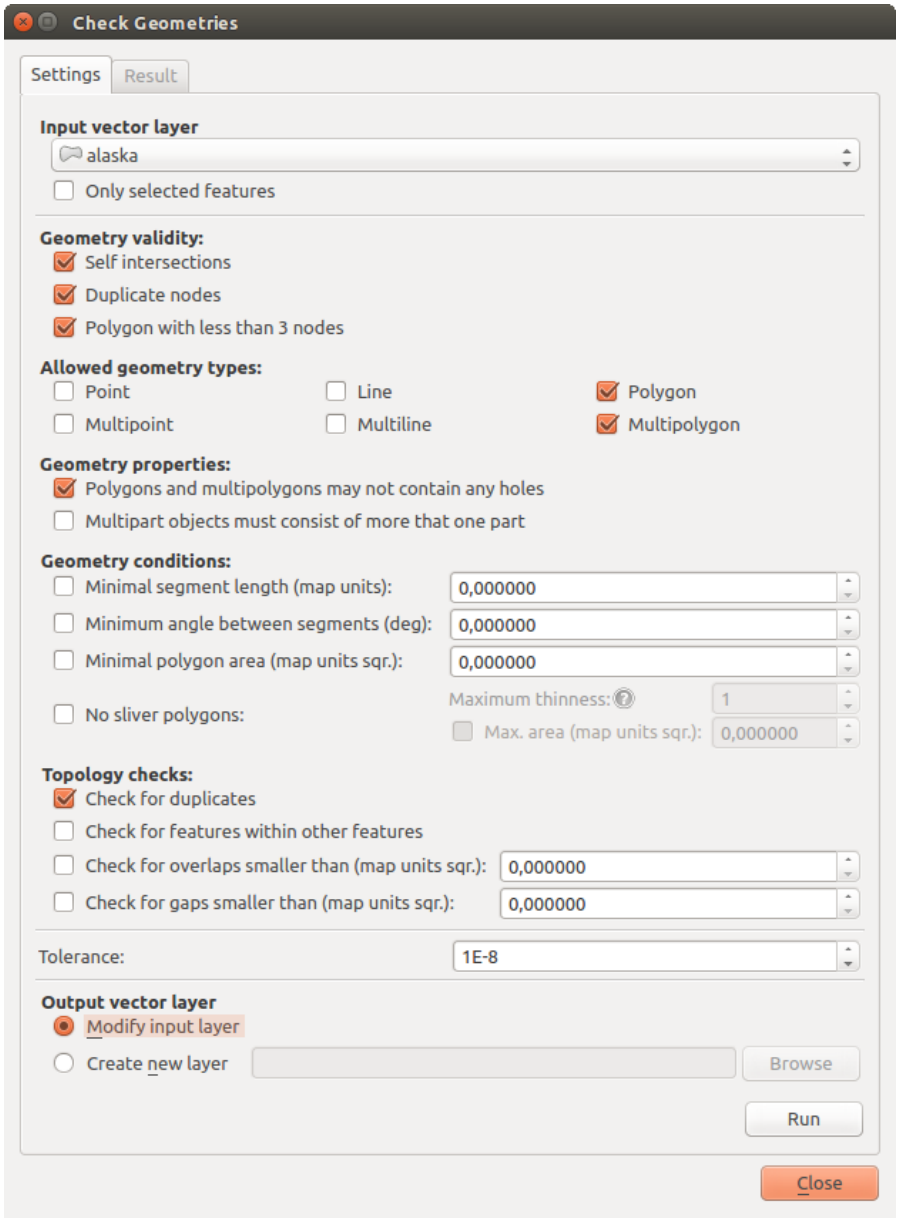

Figure 21.20: El complemento Comprobador de geometría

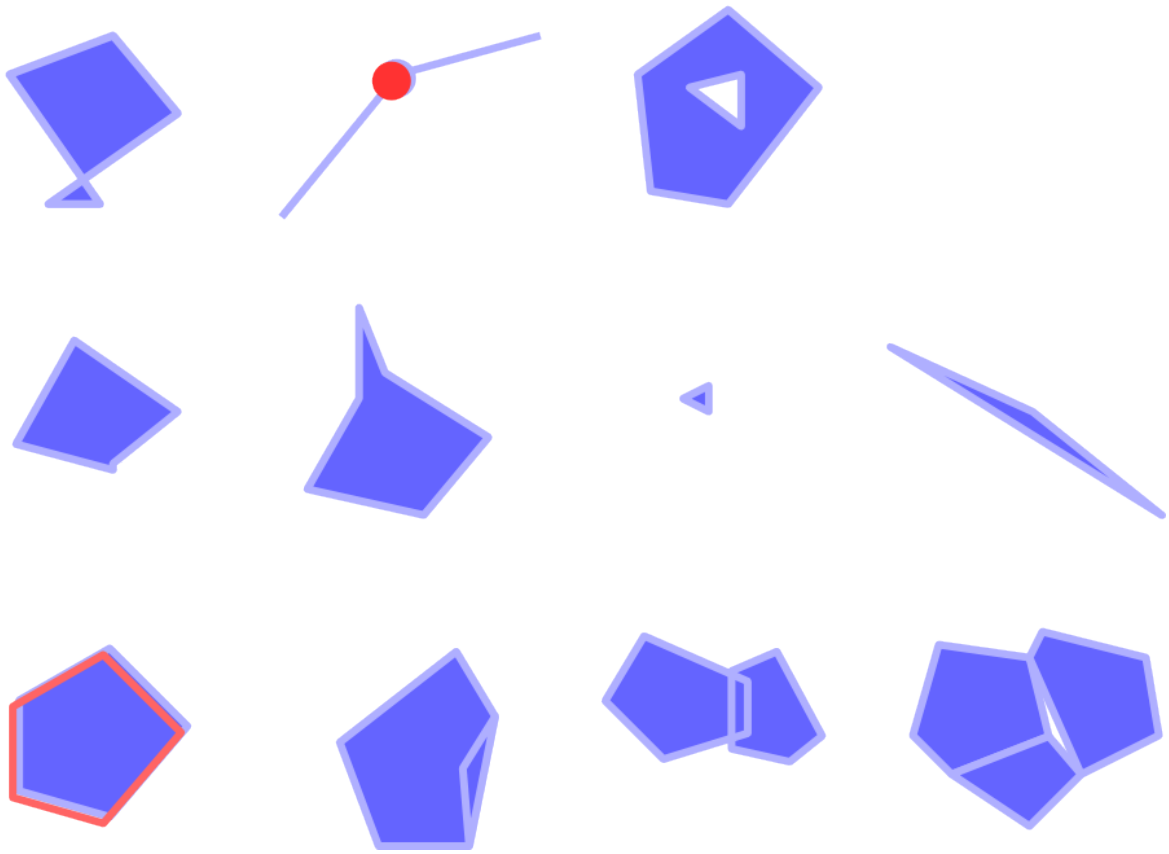

Figure 21.21: The Differents checks supported by the plugin

You can select a row to see the localisation of the error. You can change this behaviour by selecting another action between *error* (default), *Feature*, *Don't move*, and *Highlight contour of selected features*.

Below the zoom action when clicking on the table row, you can *Show the selected features in attribute table*, *Fix selected errors using default resolution* and *Fix selected errors, prompt for resolution method*. In the latter, you will see a window to choose the resolution's method among which:

- Merge with neighboring polygon with longest shared edge,
- Merge with neighboring polygon with largest area,
- Merge with neighboring polygon identical attribute value,if any, or leave as it
- Delete feature
- No action

Truco: Corregir multiples errores

You can fix multiple errors by selecting more than one row in the table with the *CTRL + click* action.

The default action could be changed with the last icon *Error resolution settings*. For some type of errors, you can change the default action between some specific action or *No action*.

Finally, you can choose which *attribute to use when merging features by attribute value*.

21.10 Complemento Ajuste de geometrías

La herramienta Ajuste de geometrías permite alinear de forma automática los bordes y vértices de una capa vectorial a los bordes y vértices de una segunda capa, utilizando una tolerancia definida por el usuario.

La interfaz de abajo muestra la configuración de este complemento. El usuario debe seleccionar la capa a modificar (ver *input vector layer) y la :guilabel:'reference layers* a la que ajustar. La *Maximum snapping distance (map units)* permite cambiar la tolerancia de ajuste.

Puede ajustar solo los objetos seleccionados marcando la *Only selected features*.

Output vector layer le permite elegir entre *Modifying input layer* o *Create a new layer*.

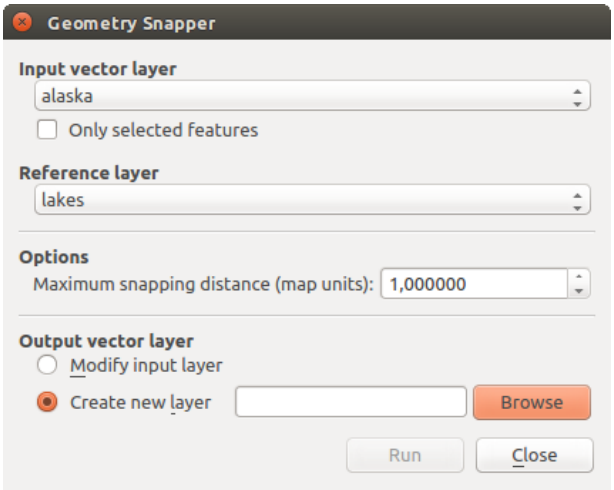

Figure 21.22: El complemento Ajuste de geometrías

21.11 Complemento Georreferenciador

The Georeferencer Plugin is a tool for generating world files for rasters. It allows you to reference rasters to geographic or projected coordinate systems by creating a new GeoTiff or by adding a world file to the existing image. The basic approach to georeferencing a raster is to locate points on the raster for which you can accurately determine coordinates.

Características

Icono	Propósito	Icono	Propósito
	Abrir ráster		Comenzar georreferenciado
	Generar script de GDAL		Cargar puntos PCT
	Guardar puntos PCT como		Configuración de la transformación
	Añadir punto		Borrar punto
	Mover punto PCT		Desplazar
	Acercar zum		Alejar zum
	Zum a la capa		Zum anterior
	Zum siguiente		Enlazar georreferenciador a QGIS
	Enlazar QGIS a georreferenciador		Estiramiento total del histograma
	Estiramiento local del histograma		

Table Georeferencer: Georeferencer Tools

21.11.1 Procedimiento habitual

Como coordenadas X e Y (GMS (gg mm ss.ss), GG (gg.gg) o coordenadas proyectadas (mmmm.mm)), que correspondan al punto seleccionado en la imagen, se pueden usar dos procedimientos alternativos:

- El propio ráster a veces proporciona cruces con coordenadas "escritas" sobre la imagen. En este caso se pueden introducir las coordenadas manualmente.
- Utilizar capas ya georreferenciadas. Estos pueden ser datos vectoriales o ráster que contengan los mismos objetos/entidades que la imagen que desea georreferenciar y con la proyección que desee para su imagen. En este caso puede introducir las coordenadas haciendo clic en el conjunto de datos de referencia cargado en el lienzo del mapa de QGIS.

El procedimiento habitual para georreferenciar una imagen consiste en seleccionar múltiples puntos en el ráster, especificando sus coordenadas, y elegir un tipo de transformación adecuado. Sobre la base de los parámetros y datos de entrada, el complemento calculará los parámetros del archivo de referencia. Cuantas más coordenadas suministre, mejor será el resultado.

The first step is to start QGIS, load the Georeferencer Plugin (see *El diálogo de complementos*) and click on *Raster* → *Georeferencer* , which appears in the QGIS menu bar. The Georeferencer Plugin dialog appears as shown in figure_georeferencer_dialog.

For this example, we are using a topo sheet of South Dakota from SDGS. It can later be visualized together with the data from the GRASS `spearfish60` location. You can download the topo sheet here: http://grass.osgeo.org/sampledata/spearfish_toposheet.tar.gz.

Introducir puntos de control sobre el terreno (PCT)

1. Para empezar a georreferenciar un ráster no referenciado, debemos cargarlo utilizando el botón  . El ráster aparecerá en la zona de trabajo principal del diálogo. Una vez que el ráster esté cargado, podemos empezar a introducir los puntos de referencia.

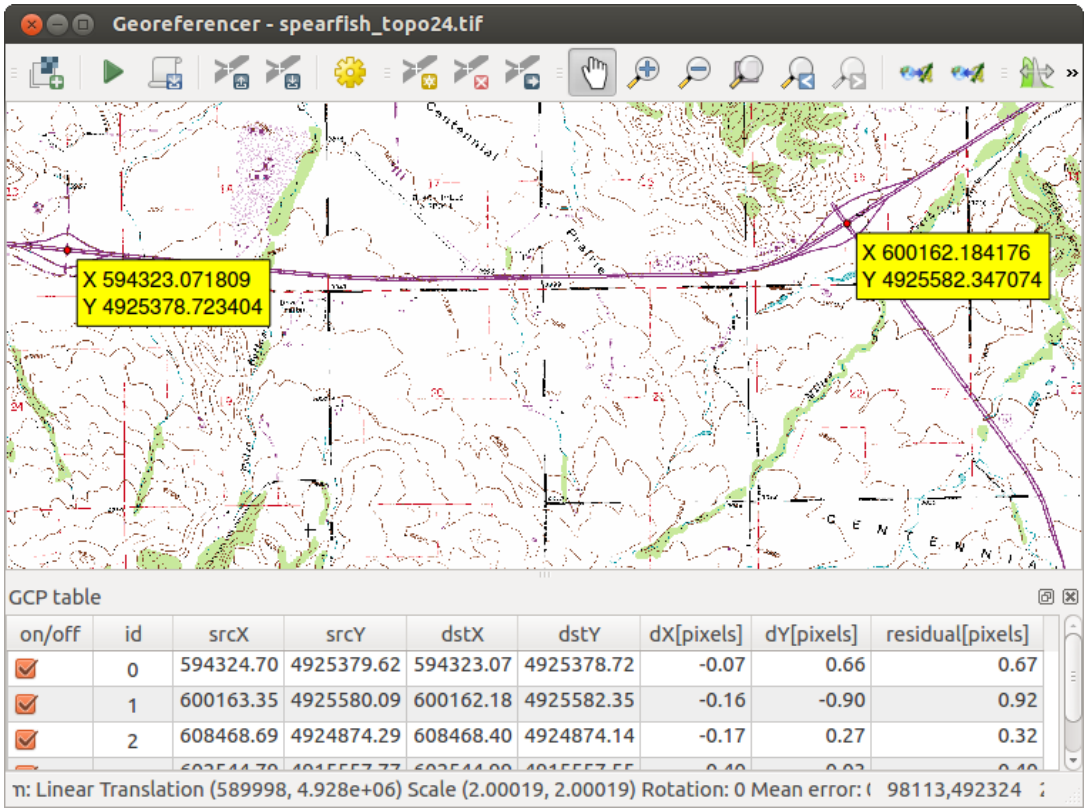

Figure 21.23: Diálogo del complemento Georreferenciador

2. Using the Add Point button, add points to the main working area and enter their coordinates (see Figure figure_georeferencer_add_points). For this procedure you have three options:
   - Hacer clic en un punto de la imagen ráster e introducir las coordenadas X e Y manualmente.
   - Haga clic en un punto de la imagen ráster y elija el botón Desde lienzo del mapa para añadir las coordenadas X e Y con la ayuda de un mapa ya georreferenciado cargado en el lienzo del mapa de QGIS.
   - Con el botón , puede mover los GCP en ambas ventanas, Si están en un lugar incorrecto.
3. Continuar introduciendo puntos. Debe tener por lo menos cuatro puntos y cuantas más coordenadas pueda proporcionar mejor será el resultado. Existen herramientas adicionales en el cuadro de diálogo del complemento para hacer zum o desplazar la zona de trabajo con el fin de localizar un conjunto relevante de puntos PCT.

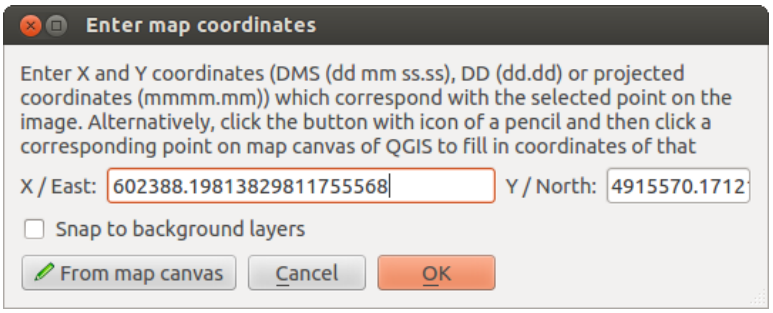

Figure 21.24: Add points to the raster image

Los puntos que se añaden al mapa se almacenarán en un archivo de texto separado (`[nombre del archivo].points`) generalmente junto con la imagen ráster. Esto nos permite reabrir el complemento Georeferenciador en una fecha posterior y añadir nuevos puntos o eliminar los ya existentes para optimizar el resultado.

El archivo de puntos contiene los valores de los puntos de la forma: `mapX, mapY, pixelX, pixelY`. Puede utilizar los botones Cargar puntos PCT y Guardar puntos PCT como para gestionar los archivos.

Definir la configuración de la transformación

Después de añadir los PCT a la imagen ráster, debe definir la configuración de la transformación para el proceso de georreferenciación.

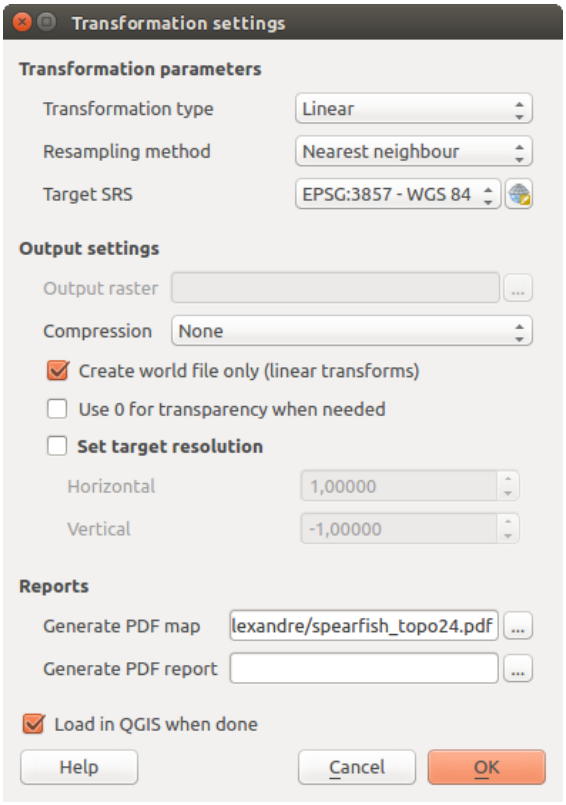

Figure 21.25: Defining the georeferencer transformation settings

Algoritmos de transformación disponibles

Dependiendo del número de puntos de control sobre el terreno que haya capturado, es posible que desee utilizar diferentes algoritmos de transformación. La elección del algoritmo de transformación también depende del tipo y la calidad de los datos de entrada y la cantidad de distorsión geométrica que está dispuesto a introducir en el resultado final.

Actualmente están disponibles los siguientes *Tipos de transformación*:

- El algoritmo **Lineal** se utiliza para crear un archivo de referencia y es diferente de los otros algoritmos, ya que realmente no trasforma el ráster. Este algoritmo probablemente no será suficiente si se trata de material escaneado.
- La trasformación **Helmert** realiza un escalado sencillo y trasformaciones de rotación.
- Los algoritmos **Polinomial** 1-3 son algunos de los algoritmos más utilizados introducidos para que coincidan los puntos de control sobre el terreno de origen y destino. El algoritmo polinomial más ampliamente utilizado es la transformación polinomial de segundo orden, que permite cierta curvatura. La transformación polinomial de primer orden (afín) preserva la colinealidad y permite escalado, traslación y rotación solamente.

- El algoritmo **Thin Plate Spline** (TPS) es un método de georreferenciación más moderno, que es capaz de introducir deformaciones locales en los datos. Este algoritmo es útil cuando se georreferencian originales de muy baja calidad.
- La trasformación **Proyectiva** es una rotación lineal y traducción de coordenadas.

Definir el método de remuestreo

El tipo de remuestreo que elija probablemente dependerá de los datos de entrada y el objetivo último del ejercicio. Si no se desea cambiar las estadísticas de la imagen, es posible que desee elegir "Vecino más próximo", mientras que un 'Remuestreo cúbico' probablemente proporcionará un resultado más suavizado.

Es posible elegir entre cinco diferentes métodos de remuestreo:

1. Vecino más próximo
2. Lineal
3. Cúbica
4. Spline cúbica
5. Lanczos

Definir la configuración de la trasformación

Hay varias opciones que deben definirse para el ráster de salida georreferenciado.

- La casilla de verificación checkboxl *Crear archivo de referencia* esta disponible solo si se decide utilizar la transformación lineal, porque esto quiere decir que la imagen ráster no será transformada realmente. En este caso, el campo *Ráster de salida* no se activa, porque solo se creará el nuevo archivo de referencia.
- Para todos los otros tipos de transformación hay que definir un *Ráster de salida*. Por omisión se creará un nuevo archivo ([nombre de archivo] _modificado) en la misma carpeta junto con la imagen ráster original.
- Como siguiente paso, tiene que definir el *SRE de destino* (Sistema de Referencia Espacial) para la imagen georeferenciada (vea *Trabajar con Proyecciones*).
- Si lo desea, puede **generar un mapa en pdf** y también **un informe en pdf**. El informe incluye información acerca de los parámetros de trasformación utilizados, una imagen de los residuos y una lista con todos los PCT y sus errores RMS.
- Además, puede activar la casilla de verificación *Establecer resolución de destino* y definir la resolución del píxel del archivo de salida. Por omisión la resolución horizontal y vertical es 1.
- Se puede activar la casilla *Usar 0 para transparencia cuando sea necesario*, si los píxeles con valor 0 deben visualizarse trasparentes. En nuestra hoja topográfica de ejemplo todas las áreas blancas serían transparentes.
- Finalmente, *Cargar en QGIS cuando esté hecho* cargar el ráster de salida automáticamente en la vista de mapa del QGIS cuando la transformación este hecha.

Mostrar y adaptar las propiedades del ráster

Clicking on the *Raster properties* option in the *Settings* menu opens the *Layer properties* dialog of the raster file that you want to georeference.

Configurar el georreferenciador

- Se puede definir si desea mostrar coordenadas GCP y/o IDs.
- Como unidades residuales se pueden elegir píxeles y unidades del mapa.
- Para el informe PDF puede definir un margen izquierdo y derecho y también puede establecer el tamaño del papel para el mapa PDF.
- Finalmente, puede activar *Mostrar la ventana del Georeferenciador adosada*.

Ejecutar la transformación

After all GCPs have been collected and all transformation settings are defined, just press the Start georeferencing button to create the new georeferenced raster.

21.12 Complemento Mapa de calor

El complemento *Mapa de calor* usa Estimación de Densidad de Kernel para crear un ráster de densidad (mapa de calor) de una capa de puntos de entrada. La densidad se calcula con base al número de puntos en una ubicación, de forma que un mayor número de puntos agrupados resulta en valores mayores. Los mapas de calor permiten una fácil identificación de los "puntos calientes" y la agrupación de los puntos.

21.12.1 Activar el complemento Mapa de calor

En primer lugar este complemento núcleo necesita ser activado utilizando el Administrador de Complementos (véase *El diálogo de complementos*). Después de activarlo, el icono de mapa de calor se puede encontrar en la barra de herramientas de Ráster, y bajo el menú *Ráster* → *Mapa de calor*.

Seleccione el menú *Ver* → *Barras de herramientas* → *Ráster* para mostrar la barra de herramientas Ráster, si no está visible.

21.12.2 Usar el complemento de Mapa de calor

Clicking the *Heatmap* tool button opens the Heatmap plugin dialog (see figure_heatmap_settings).

El diálogo tiene las siguientes opciones:

- **Capa de puntos de entrada**: Lista todas las capas vectoriales de puntos del proyecto actual y se usa para seleccionar la capa a analizar.
- **Ráster de salida**: Permite usar el botón ... para seleccionar la carpeta y el nombre de archivo del ráster de salida que genera el complemento Mapa de calor. La extensión del archivo no es necesaria.
- **Formato de salida**: Selecciona el formato de salida. Aunque se pueden elegir todos los formatos soportados por GDAL, en la mayoría de los casos GeoTIFF es el mejor formato a elegir.
- **Radio**: Se usa para especificar el radio de búsqueda del mapa de calor (o ancho de banda del kernel) en metros o unidades del mapa. El radio especifica la distancia alrededor de un punto a la que se notará la influencia del punto. Los valores más altos dan lugar a un mayor suavizado, mientras que los valores más pequeños pueden mostrar detalles y variación más finos en la densidad de puntos.

Cuando la casilla de verificación *Avanzado* está marcada, hay disponibles opciones adicionales:

- **Filas** y **Columnas**: Utilizado para cambiar las dimensiones del ráster de salida. Estos valores también están ligados a los valores de **Tamaño X de celda** y **Tamaño Y de celda**. Incrementar el número de filas y columnas disminuirá el tamaño de la celda e incrementará el tamaño del archivo de salida. Los valores en Filas y Columnas también están vinculados, por lo que duplicar el número de filas duplicará automáticamente el número de columnas y el tamaño de las celdas también se reducirá a la mitad. ¡El área geográfica del ráster de salida seguirá siendo el mismo!
- **Tamaño X de celda** y **Tamaño Y de celda**: Controlan el tamaño geográfico de cada píxel en el ráster de salida. Cambiar estos valores también cambiará el número de filas y columnas en el ráster de salida.
- **Forma del kernel**: La forma del kernel controla la proporción en la que la influencia de un punto disminuye a medida que aumenta la distancia desde el punto. Los diferentes kernels disminuyen en distintas proporciones, por lo que un kernel triweight da mayor peso a las entidades más próximas al punto de lo que hace el kernel Epanechnikov. En consecuencia, triweight da como resultado puntos calientes "más afilados" y Epanechnikov da puntos calientes "más suaves". Hay disponible una serie de funciones estándar del kernel en QGIS, que se describen e ilustran en Wikipedia.
- **Relación de decadencia**: Se puede utilizar con kernel Triangulares para un mayor control de cómo disminuye el calor de una entidad con la distancia a la misma.
  - Un valor de 0 (= mínimo) indica que el calor estará concentrado en el centro del radio dado y se extinguirá por completo en el borde.
  - Un valor de 0.5 indica que a los píxeles del borde del radio se les dará la mitad del calor que a los píxeles del centro del radio de búsqueda.
  - Un valor de 1 significa que el calor se distribuye uniformemente por todo el círculo del radio de búsqueda. (Esto es equivalente al kernel 'Uniforme'.)
  - Un valor mayor que 1 indica que el calor es mayor hacia el borde del radio de búsqueda que en el centro.

La capa de puntos de entrada también puede tener campos de atributos que pueden afectar la forma en que influyen en el mapa de calor:

- **Usar radio a partir de campo**: Establece el radio de búsqueda para cada entidad a partir de un campo de atributos de la capa de entrada.
- **Usar peso a partir de campo**: Permite ponderar las entidades de entrada por un campo de atributos. Esto se puede utilizar para aumentar la influencia que ciertas entidades tienen en el mapa de calor resultante.

Cuando se especifica un nombre para el archivo ráster de salida se puede utilizar el botón **[Aceptar]** para crear el mapa de calor.

21.12.3 Tutorial: crear un mapa de calor

For the following example, we will use the `airports` vector point layer from the QGIS sample dataset (see *Sample Data*). Another excellent QGIS tutorial on making heatmaps can be found at http://www.qgistutorials.com.

In Figure_Heatmap_data, the airports of Alaska are shown.

1. Select the *Heatmap* tool button to open the Heatmap dialog (see Figure_Heatmap_settings).
2. En el campo *Capa de puntos de entrada* , seleccione `airports` de la lista de capas de puntos cargadas en el proyecto actual.
3. Especifique un nombre para el archivo de salida haciendo clic en el botón próximo al campo *Ráster de salida*. Escriba el nombre del archivo `heatmap_airports` (no es necesaria la extensión de archivo).
4. Deje el *Formato de salida* como el formato predeterminado, `GeoTIFF`.
5. Cambie el *Radio* a `1000000` metros.
6. Click on **[OK]** to create and load the airports heatmap (see Figure_Heatmap_created).

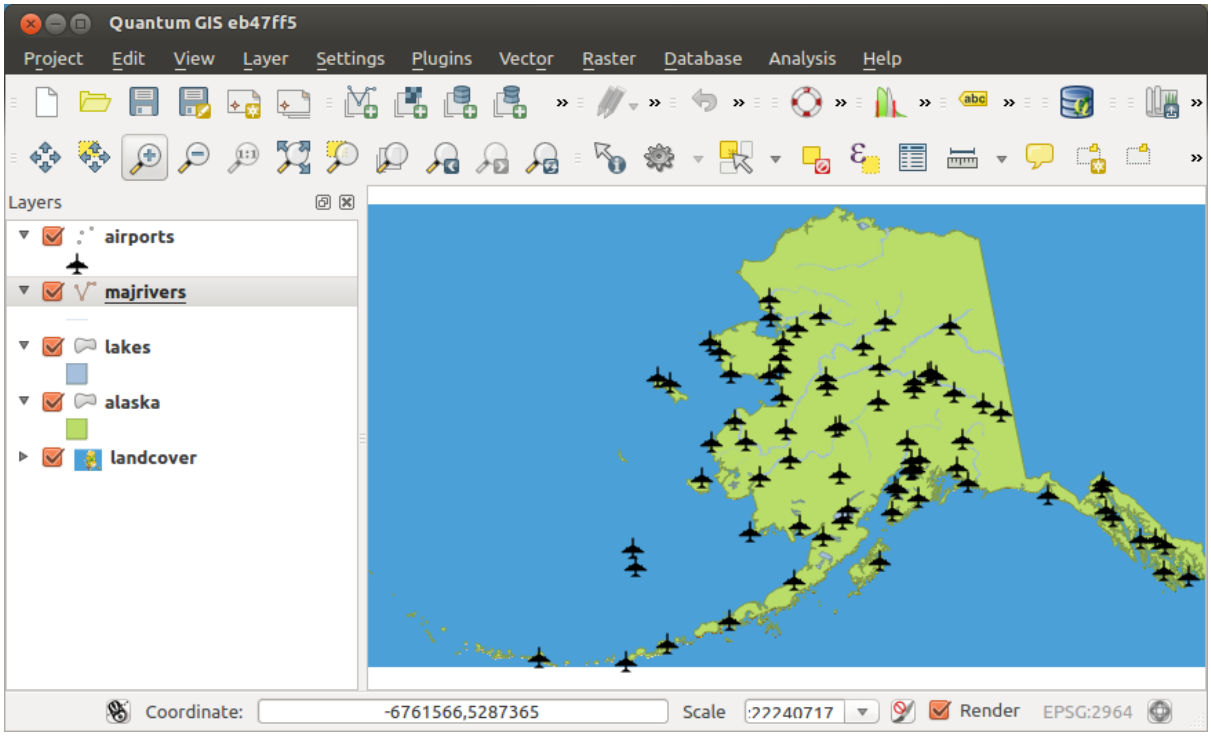

Figure 21.26: Aeropuertos de Alaska

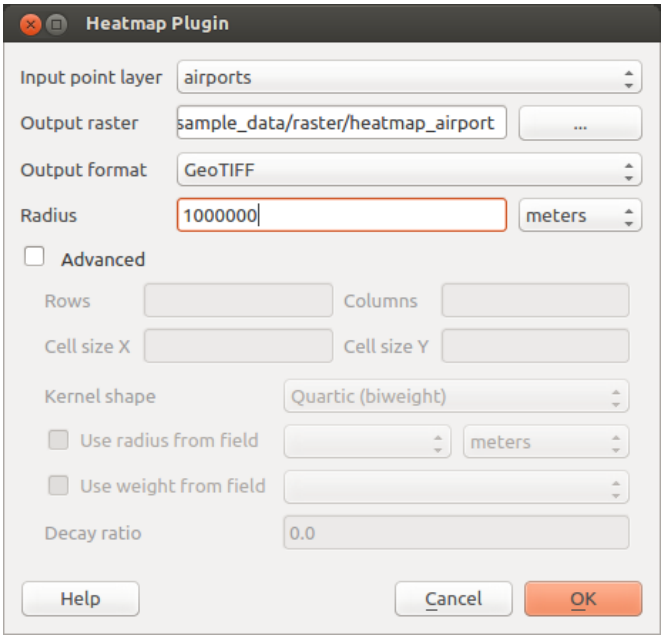

Figure 21.27: El diálogo del mapa de calor

QGIS generará el mapa de calor y añadirá el resultado a la ventana del mapa. Por omisión, el mapa de calor está sombreado en escala de grises, con las zonas más claras mostrando una mayor concentración de aeropuertos. Al mapa de calor se le puede aplicar ahora un estilo en QGIS para mejorar su apariencia.

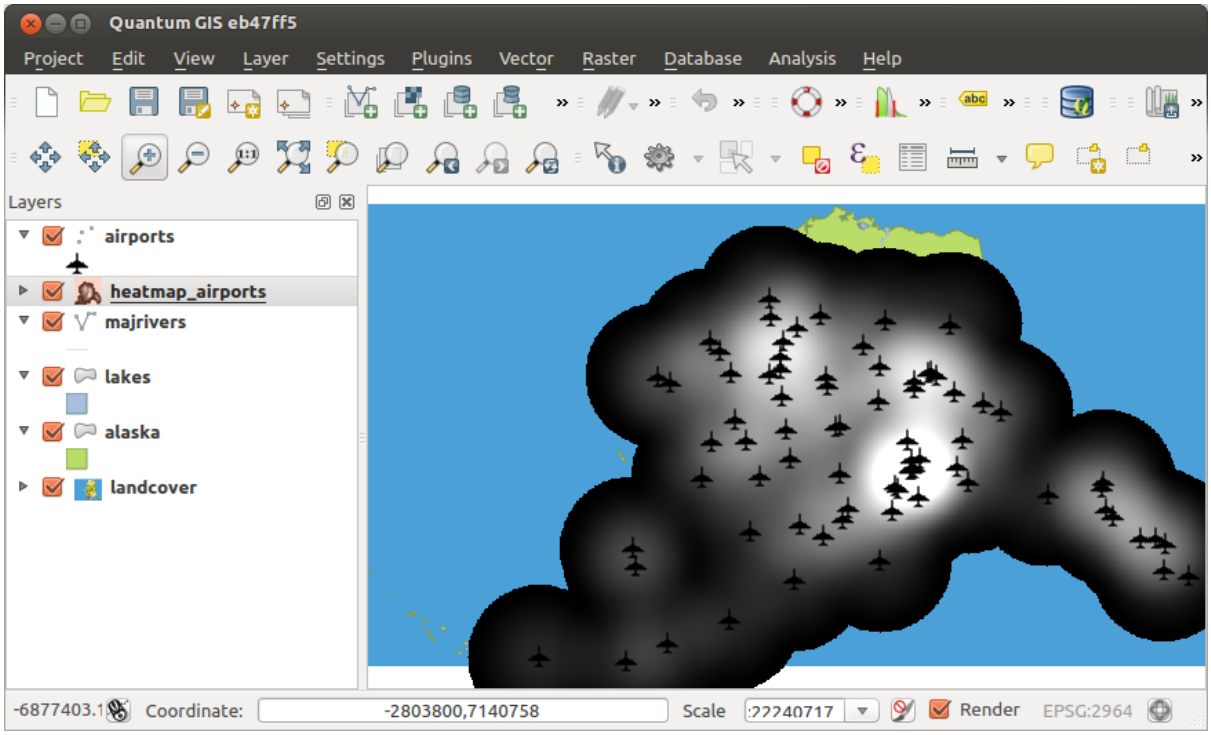

Figure 21.28: Después de cargar el mapa de calor se ve como una superficie gris

1. Abra el diálogo de propiedades de la capa `heatmap_airports` (seleccione la capa `heatmap_airports`, abra el menú contextual con el botón derecho del ratón y seleccione *Propiedades*).
2. Seleccione la pestaña *Estilo*.
3. Cambiar el *Tipo de representación* a 'Pseudocolor de una sola banda'.
4. Seleccionar una adecuada *Mapa de color map* , por ejemplo `YlOrRed`.
5. Haga clic en el botón **[Cargar]** para recabar los valores mínimo y máximo del ráster, después pulse el botón **[Clasificar]**.
6. Pulse **[Aceptar]** para actualizar la capa.

The final result is shown in Figure_Heatmap_styled.

21.13 Complemento de interpolación

The Interpolation plugin can be used to generate a TIN or IDW interpolation of a point vector layer. It is very simple to handle and provides an intuitive graphical user interface for creating interpolated raster layers (see Figure_interpolation). The plugin requires the following parameters to be specified before running:

- **Capas vectoriales** de entrada: Especificar las capas vectorial(es) de puntos de entrada a partir de una lista de capas de puntos cargadas. Si se especifican varias capas, entonces se usarán los datos de todas ellas para la interpolación. Nota: es posible insertar lineas o polígonos como restricción para la triangulación, especificando "puntos", "líneas de estructura" o "líneas de ruptura" en el cuadro combinado *Tipo* .
- **Atributo de interpolación**: Seleccionar la columna de atributos a usar para la interpolación o habilitar la casilla *Usar coordenada-Z* para usar los valores Z almacenados en la capa.

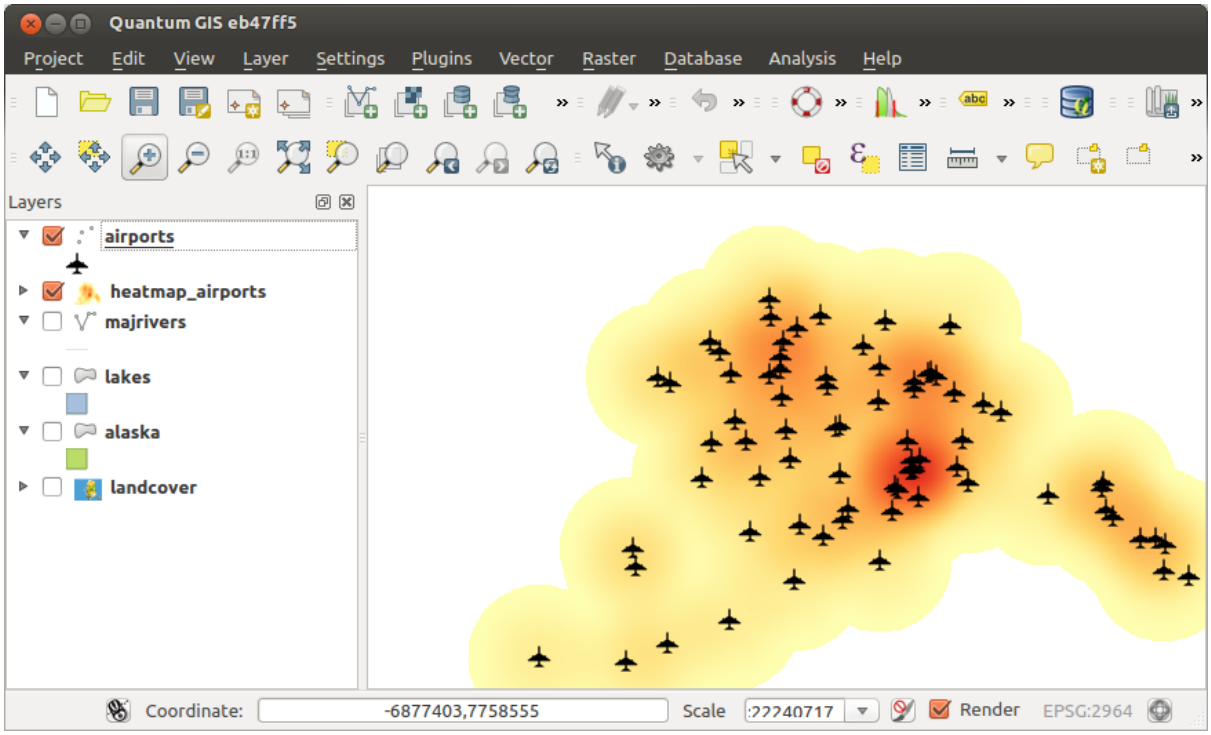

Figure 21.29: Estilo de mapa de calor de aeropuertos de Alaska

- **Método Interpolación**: Seleccionar el método de interpolación. Esto puede ser 'Red Irregular triangulada (TIN)' o 'Distancia Inversa Ponderada (IDW)'. Con el método TIN puede crear una superficie formada por triángulos de puntos vecinos más cercanos. Para ello, circunferencias circunscritas alrededor de puntos de muestra seleccionados se crean y sus intersecciones están conectados a una red de no superposición y tan compacto como sea posibles de triángulos. Las superficies resultantes no son lisas. Cuando se utiliza el método IDW los puntos de muestreo se ponderan durante la interpolación de tal manera que la influencia de un punto en relación con otros disminuye con la distancia desde el punto desconocido que desea crear. El método de interpolación IDW también tiene algunas desventajas: la calidad del resultado de la interpolación puede disminuir, si la distribución de puntos de datos de la muestra es desigual. Por otra parte, los valores máximos y mínimos en la superficie interpolada sólo pueden ocurrir en los puntos de datos de la muestra. Esto a menudo resulta en pequeños picos y pozos alrededor de los puntos de datos de la muestra.
- **Configurar método de interpolación**: Configurar el método de interpolación que ha elegido. Para el método TIN se puede elegir entre Lineal y Clough Toucher (cúbico). Se puede guardar también la triangulación en formato de archivo shape. Para la interpolación IDW se puede establecer el coeficiente de distancia.
- **Número de columnas/filas**: Especificar el número de filasy columnas para el archivo ráster de salida.
- **Archivo de salida**: Especifica un nombre para el fichero ráster de salida.
- *Añadir el resultado al proyecto* para cargar el resultado en la vista del mapa.

Tenga en cuenta que el uso de líneas como las limitaciones para la interpolación de la triangulación (método TIN). También se puede usar 'líneas de estructura' o 'líneas de rotura'. Al usar 'líneas de rotura' se producen roturas en la superficie mientras utiliza 'líneas de estructura' se producen roturas continuas. La triangulación es modificada por ambos métodos tales que no cruza una línea de borde de línea de rotura o estructura.

21.13.1 Usar el complemento

1. Comenzar QGIS y cargar una capa vectorial de puntos (ej. `elevp.csv`).
2. Load the Interpolation plugin in the Plugin Manager (see *El diálogo de complementos*) and click on the

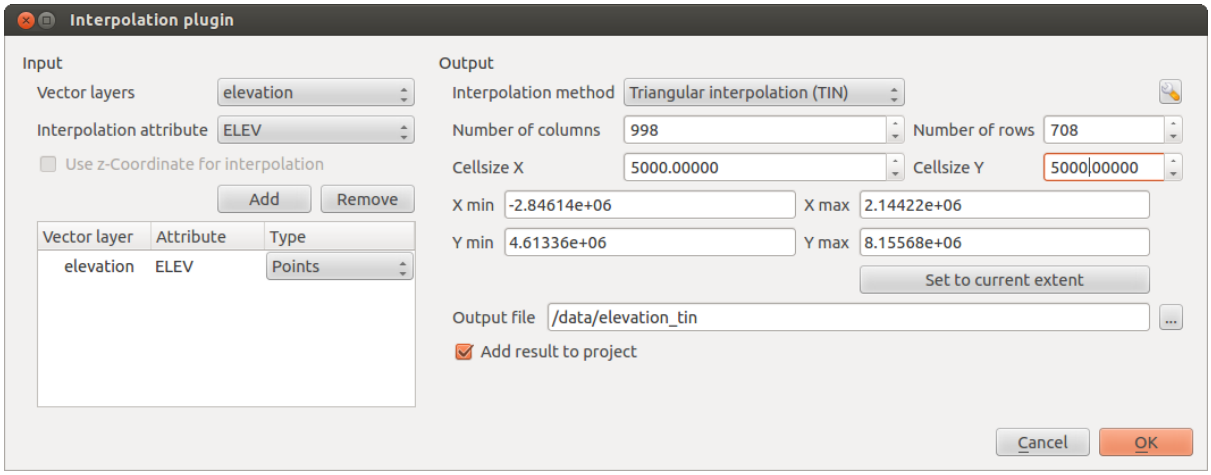

Figure 21.30: Complemento de interpolación

Raster → *Interpolation* → *Interpolation* menu, which appears in the QGIS menu bar. The Interpolation plugin dialog appears as shown in Figure_interpolation.

3. Seleccione una capa de entrada (ej. *elevp*) y una columna (ej. `ELEV`) para interpolación.
4. Seleccionar un método de interpolación(ej. 'Red Irregular Triangulada (Triangulated Irregular Network-TIN)') y especificar un tamaño de celda de 5000 así como el nombre del archivo ráster de salida (ej.:file:*elevation_tin*).
5. Pulse **[Aceptar]**.

21.14 Cliente de Catálogo de metasearch

21.14.1 Introducción

MetaSearch is a QGIS plugin to interact with metadata catalog services, supporting the OGC Catalog Service for the Web (CSW) standard.

MetaSearch provides an easy and intuitive approach and user-friendly interface to searching metadata catalogs within QGIS.

21.14.2 Instalación

Búsqueda Meta se incluye de forma predeterminada con QGIS 2.0 y superior. Se incluyen todas las dependencias dentro de MetaSearch.

Install MetaSearch from the QGIS plugin manager, or manually from http://plugins.qgis.org/plugins/MetaSearch.

21.14.3 Working with Metadata Catalogs in QGIS

CSW (Catalog Service for the Web)

CSW (Catalog Service for the Web) is an OGC (Open Geospatial Consortium) specification, that defines common interfaces to discover, browse and query metadata about data, services, and other potential resources.

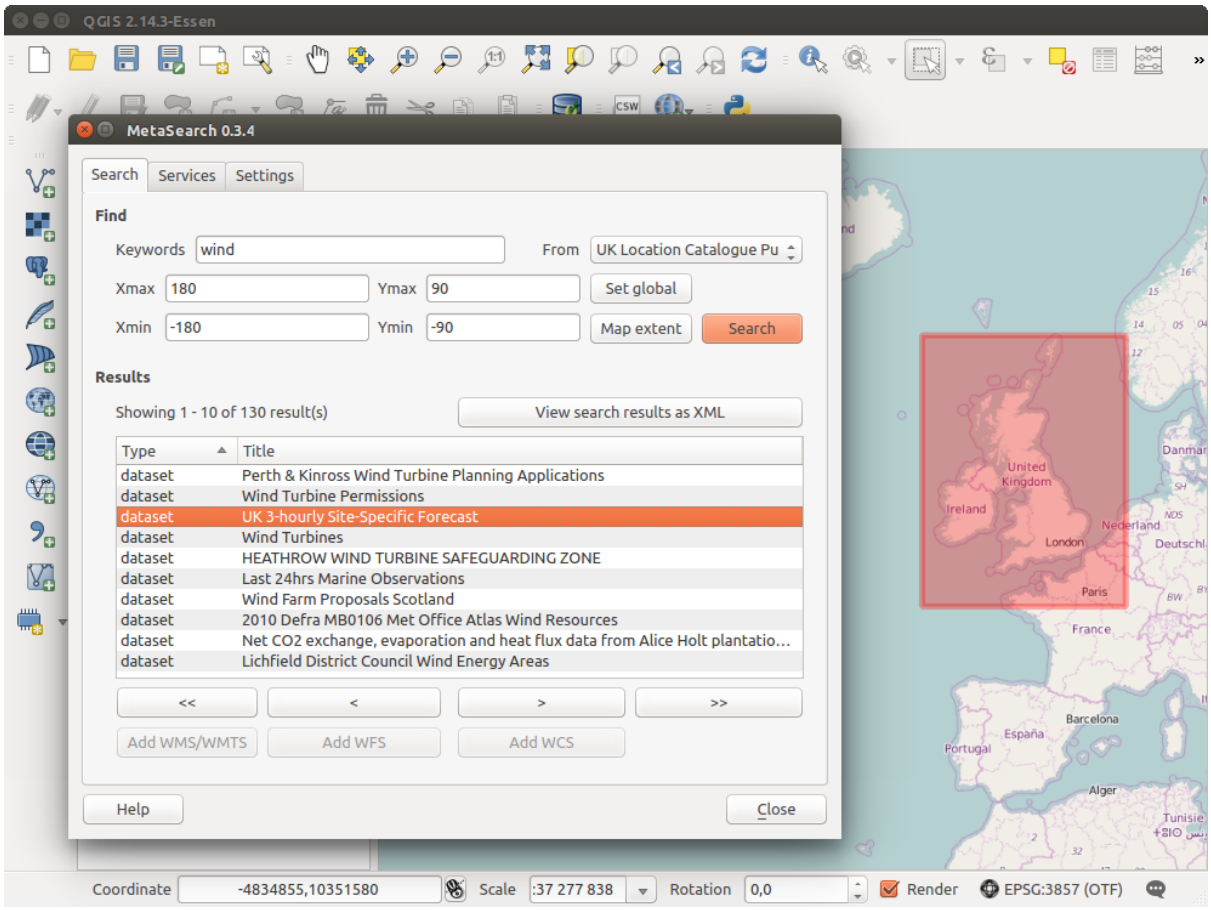

Figure 21.31: Search and results of Services in Metasearch

inicio

To start MetaSearch, click CSW icon or select *Web* → *MetaSearch* → *MetaSearch* via the QGIS main menu. The MetaSearch dialog will appear. The main GUI consists of three tabs: *Services*, *Search* and *Settings*.

Managing Catalog Services

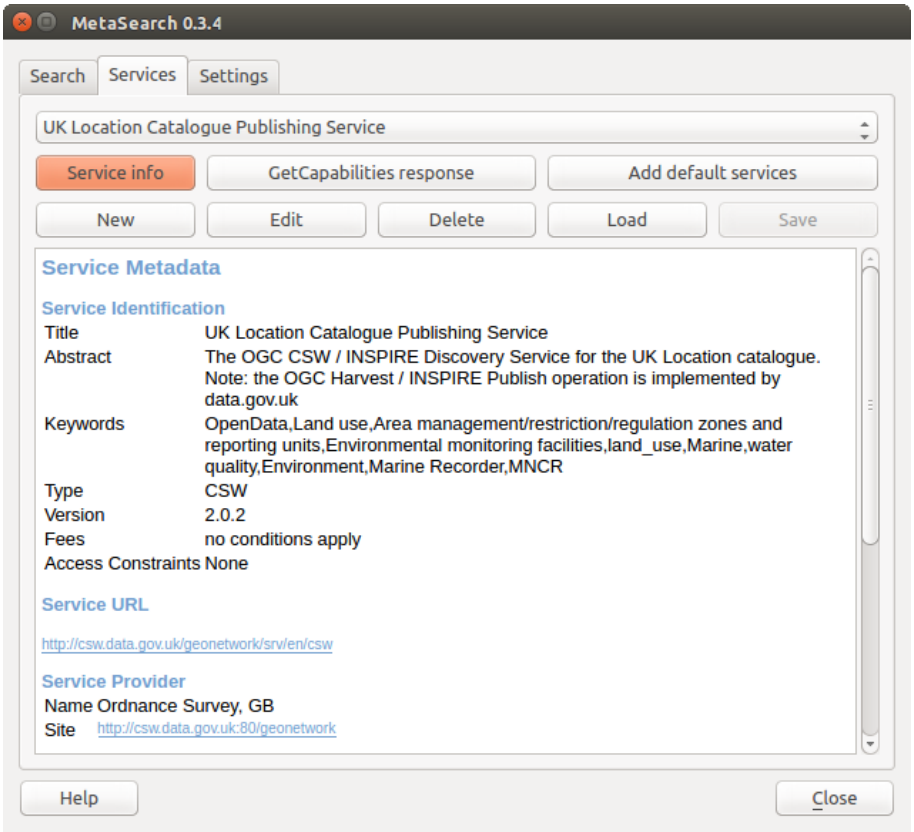

Figure 21.32: Managing Catalog Services

The *Services* tab allows the user to manage all available catalog services. MetaSearch provides a default list of Catalog Services, which can be added by pressing **[Add default services]** button.

To all listed Catalog Service entries, click the dropdown select box.

To add a Catalog Service entry, click the **[New]** button, and enter a *Name* for the service, as well as the *URL* (endpoint). Note that only the base URL is required (not a full GetCapabilities URL). Clicking **[OK]** will add the service to the list of entries.

To edit an existing Catalog Service entry, select the entry you would like to edit and click the **[Edit]** button, and modify the *Name* or *URL* values, then click **[OK]**.

To delete a Catalog Service entry, select the entry you would like to delete and click the **[Delete]** button. You will be asked to confirm deleting the entry.

MetaSearch allows for loading and saving connections to an XML file. This is useful when you need to share settings between applications. Below is an example of the XML file format.

```
<?xml version="1.0" encoding="UTF-8"?>
<qgsCSWConnections version="1.0">
    <csw name="Data.gov CSW" url="https://catalog.data.gov/csw-all"/>
    <csw name="Geonorge - National CSW service for Norway" url="http://www.geonorge.no/geonetwork
    <csw name="Geoportale Nazionale - Servizio di ricerca Italiano" url="http://www.pcn.minambient
```

```
    <csw name="LINZ Data Service" url="http://data.linz.govt.nz/feeds/csw"/>
    <csw name="Nationaal Georegister (Nederland)" url="http://www.nationaalgeoregister.nl/geonetw
    <csw name="RNDT - Repertorio Nazionale dei Dati Territoriali - Servizio di ricerca" url="http
    <csw name="UK Location Catalogue Publishing Service" url="http://csw.data.gov.uk/geonetwork/s
    <csw name="UNEP/GRID-Geneva Metadata Catalog" url="http://metadata.grid.unep.ch:8080/geonetwo
</qgsCSWConnections>
```

To load a list of entries, click the **[Load]** button. A new window will appear; click the **[Browse]** button and navigate to the XML file of entries you wish to load and click **[Open]**. The list of entries will be displayed. Select the entries you wish to add from the list and click **[Load]**.

Click the **[Service info]** button to displays information about the selected Catalog Service such as service identification, service provider and contact information. If you would like to view the raw XML response, click the **[GetCapabilities response]** button. A separate window will open displaying Capabilities XML.

Searching Catalog Services

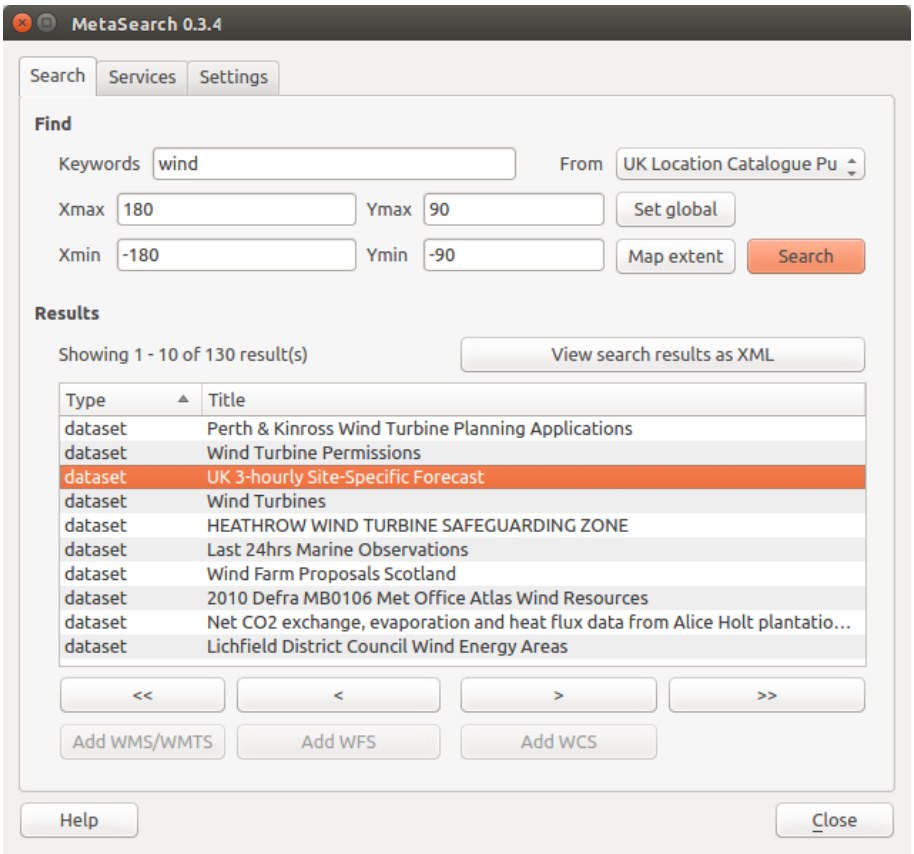

Figure 21.33: Searching catalog services

The *Search* tab allows the user to query Catalog Services for data and services, set various search parameters and view results.

The following search parameters are available:

- *Keywords*: free text search keywords;
- *From*: the Catalog Service to perform the query against;
- **Bounding box**: the spatial area of interest to filter on defined by *Xmax*, *Xmin*, *Ymax*, and *Ymin*. Click **[Set global]** to do a global search, click **[Map extent]** to do a search on the visible area only or manually enter custom values as desired.

Clicking the **[Search]** button will search the selected Metadata Catalog. Search results are displayed in a list and are sortable by clicking on the column title. You can navigate through search results with the directional buttons below the search results. Clicking the **[View search results as XML]** button opens a window with the service response in raw XML format.

Clicking a result will provides the following options:

- if the metadata record has an associated bounding box, a footprint of the bounding box will be displayed on the map;
- double-clicking the record displays the record metadata with any associated access links. Clicking the links opens the link in the user's web browser;
- if the record is an OGC web service (WMS/WMTS, WFS, WCS), the appropriate **[Add to WMS/WMTS|WFS|WCS]** buttons will be enabled for the user to add to QGIS. When clicking this button, MetaSearch will verify if this is a valid OWS. The OWS will then be added to the appropriate QGIS connection list, and the appropriate WMS/WMTS|WFS|WCS connection dialog will then appear.

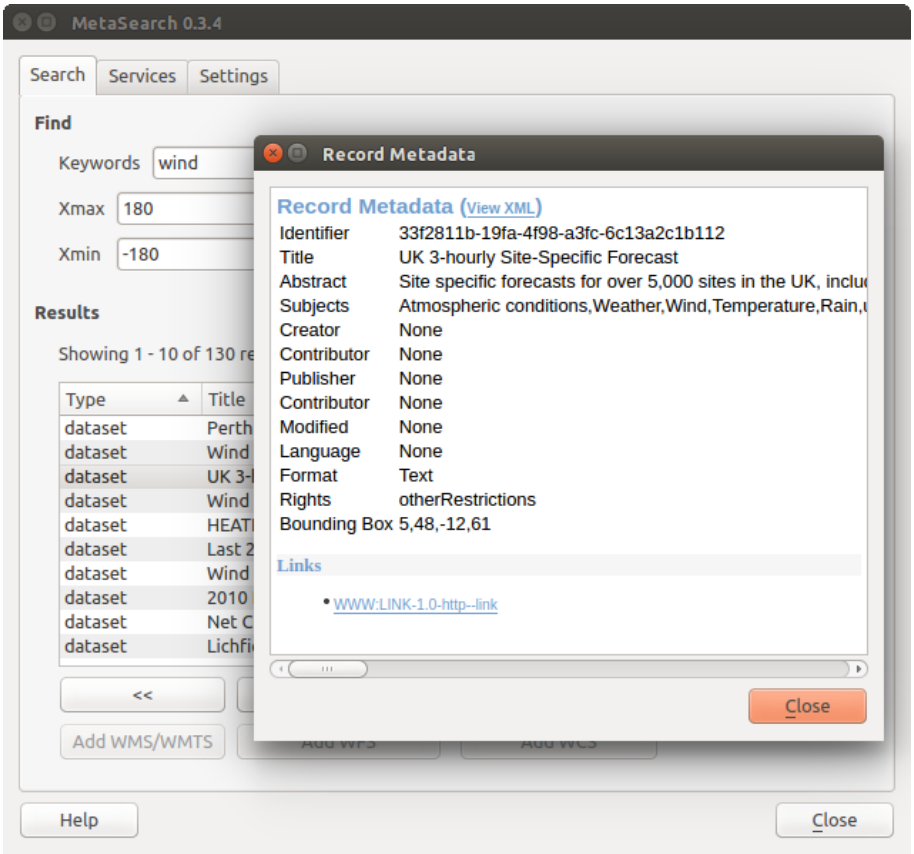

Figure 21.34: Metadata record display

Configuración

You can fine tune MetaSearch with the following *settings*:

- *Connection naming*: when adding an OWS connection (WMS/WMTS|WFS|WCS), the connection is stored with the various QGIS layer provider. Use this setting to set whether to use the name provided from MetaSearch, whether to overwrite or to use a temporary name;
- *Results paging*: when searching metadata catalogs, the number of results to show per page. Default value is 10;
- *Timeout*: when searching metadata catalogs, the number of seconds for blocking connection attempt. Default value is 10.

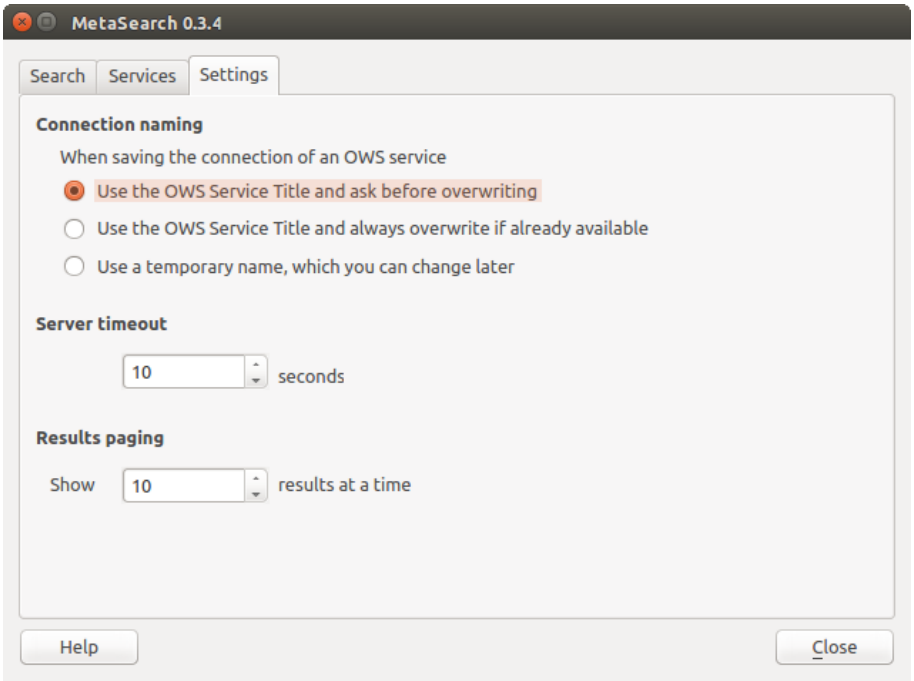

Figure 21.35: Metasearch setting

21.15 Complemento Edición fuera de linea

Para la recolección de datos, es una situación común para trabajar con un ordenador portátil o una línea de teléfono celular en el campo. A su regreso a la red, los cambios tienen que ser sincronizados con el origen de datos principal (ej., una base de datos PostGIS). Si varias personas están trabajando simultáneamente en los mismos conjuntos de datos, es difícil fusionar los cambios a mano, incluso si la gente no cambia los mismo elementos.

The Offline Editing Plugin automates the synchronisation by copying the content of a datasource (usually PostGIS or WFS-T) to a SpatiaLite database and storing the offline edits to dedicated tables. After being connected to the network again, it is possible to apply the offline edits to the master dataset.

21.15.1 Usar el complemento

- Open a project with some vector layers (e.g., from a PostGIS or WFS-T datasource).
- Go to *Database* → *Offline Editing* → *Convert to offline project* and select the layers to save. The content of the layers is saved to SpatiaLite tables.
- You can check *Only synchronize selected features if a selection is present* allowing the offline editing to only save and work on a subset. It can be invaluable in case of large layers.
- Editar las capas fuera de linea.
- Después de ser conectada de nuevo, actualizar los cambios usando *Base de datos*→ *Edición fuera de línea* → *Sincronizar*.

21.16 Complemento GeoRaster espacial de Oracle

En las bases de datos de Oracle, los datos raster se pueden almacenar como objetos SDO_GEORASTER disponibles con la extensión de Oracle Spatial. En QGIS, el complemento GeoRaster espacial de Oracle Spatial es ad-

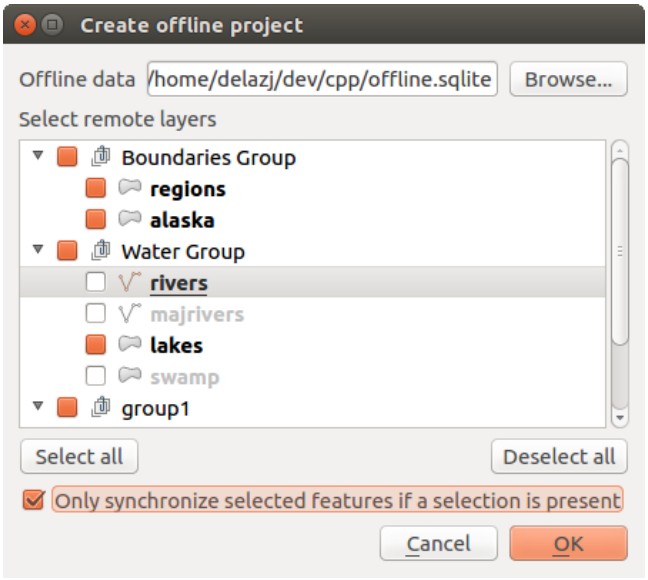

Figure 21.36: Crear un proyecto fuera de linea de capas PostGIS o WFS

mitido por GDAL y depende de que tenga instalado y funcionando en su equipo el producto de bases de datos de Oracle. Aunque Oracle es software propietario, proporciona de forma gratuita su software con fines de desarrollo y prueba. Aquí hay un ejemplo de cómo cargar imágenes raster a GeoRaster:

```
$ gdal_translate -of georaster input_file.tif geor:scott/tiger@orcl
```

Esto cargará el raster en la tabla predeterminada GDAL_IMPORT, como una columna llamada "RASTER"

21.16.1 Administrar conexiones

En primer lugar, se debe habilitar el complemento Oracle GeoRaster usando el Administrador de complementos (vea *El diálogo de complementos*). La primera vez que se cargue un GeoRaster en QGIS, debe crear una conexión a la base de datos de Oracle que contiene los datos. Para hacer esto, inicie haciendo clic en el botón de la barra de herramientas  Añadir capa de Oracle GeoRaster – esto abrirá la ventana del cuadro de diálogo *Seleccionar GeoRaster de Oracle Spatial*. Haga clic en **[Nuevo]** para abrir la ventana del cuadro de diálogo, y especifique los parámetros de conexión (vea Figure_oracle_raster_connection):

- **Nombre**: Introduzca un nombre para al conexión a la base de datos.
- **Instancia de la base de datos**: Introduzca el nombre de la base de datos a la que desea conectarse.
- **Nombre de usuario**: Especificar su nombre de usuario que usará para acceder a la base de datos.
- **Contraseña**: Proporcionar la contraseña asociada con su usuario que es requerida para el acceso a la base de datos.

Ahora, regrese a la ventana del cuadro de diálogo principal *Oracle Spatial GeoRaster* (vea Figure_oracle_raster_selection), utilice la lista desplegable para elegir una conexión, y utilice el botón **[Conectar]** para establecer la conexión. También se puede **[Editar]** al abrir el cuadro de diálogo anterior y realizar los cambios a la información de conexión, o use el botón **[Borrar]** para eliminarla de la lista desplegable.

21.16.2 Seleccionar un GeoRaster

Una vez que la conexión se ha establecido, la ventana de subconjuntos de datos mostrará los nombres de todas las tablas que contengan columnas GeoRaster en esa base de datos en el formato de un nombre del subconjunto de datos GDAL.

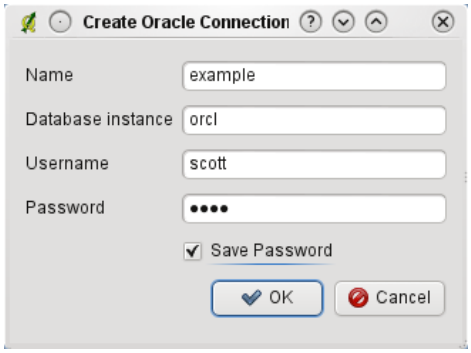

Figure 21.37: Crear dialogo de conexión de Oracle

Haga clic en uno de los subconjuntos de datos listados y después haga en **[Seleccionar]** para elegir el nombre de la tabla. Ahora se mostrará otra lista de subconjuntos de datos con los nombres de las columnas del GeoRaster en la tabla. Normalmente es una lista corta, ya que la mayoría de los usuarios no tendrán mas de una o dos columnas de GeoRaster en la misma tabla.

Clic sobre uno de los subconjuntos de datos en listados y después sobre **[Seleccionar]** para elegir una de las combinaciones tabla/columna. El dialogo mostrará ahora todos los registros que contengan objetos GeoRaster. Note que la lista de subconjunto de datos mostrará ahora las parejas de tablas de datos raster e Id de raster.

En cualquier momento, la entrada seleccionada se puede ser editar para ir directamente a un GeoRaster conocido o para regresar al inicio y seleccionar otro nombre de tabla.

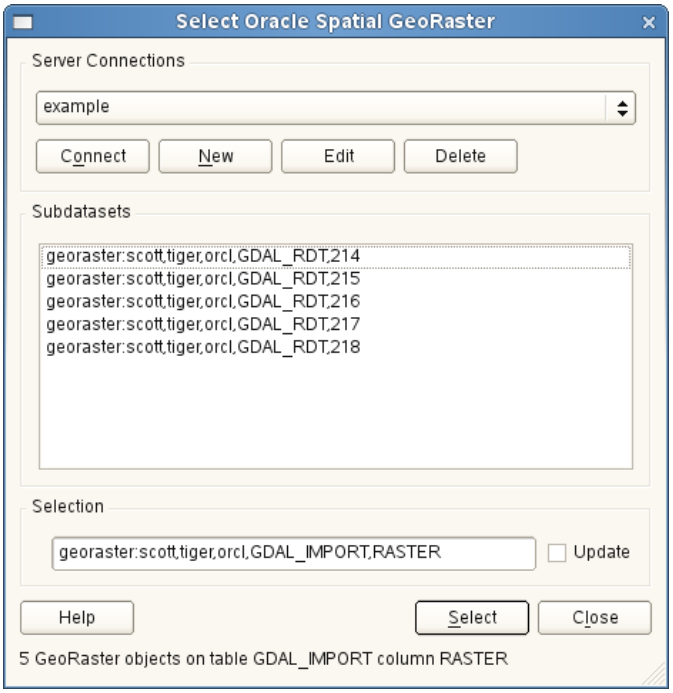

Figure 21.38: Diálogo de selección de GeoRaster de Oracle

La entrada de datos seleccionados también puede usarse para introducir una cláusula `WHERE` al final de la cadena de identificación (ej. `geor:scott/tiger@orcl,gdal_import,raster,geoid=`). Vea http://www.gdal.org/frmt_georaster.html para mayor información.

21.16.3 Mostrar GeoRaster

Finalmente, al seleccionar un GeoRaster de la lista de tablas de datos raster e Ids ráster, la imagen ráster se cargará en QGIS.

El dialogo *Seleccionar GeoRaster espacial de Oracle* puede cerrarse ahora y la siguiente ocasión en que se abra mantendrá la misma conexión y mostrará la misma lista previa de subconjuntos de datos, haciendo muy fácil abrir otra imagen del mismo contexto.

Nota: Los GeoRaster que contienen pirámides se mostrarán mucho más rápido, pero las pirámides se deben generar fuera de QGIS usando PL/SQL o gdaladdo.

Lo siguiente es un ejemplo usando `gdaladdo`:

```
$ gdaladdo georaster:scott/tiger@orcl,georaster\_table,georaster,georid=6 -r
nearest 2 4 6 8 16 32
```

Este es un ejemplo usando PL/SQL:

```
$ sqlplus scott/tiger
SQL> DECLARE
 gr sdo_georaster;
BEGIN
    SELECT image INTO gr FROM cities WHERE id = 1 FOR UPDATE;
    sdo_geor.generatePyramid(gr, 'rLevel=5, resampling=NN');
    UPDATE cities SET image = gr WHERE id = 1;
    COMMIT;
END;
```

21.17 Complemento Análisis de Terreno

 The Raster Terrain Analysis Plugin can be used to calculate the slope, aspect, hillshade, ruggedness index and relief for digital elevation models (DEM). It is very simple to handle and provides an intuitive graphical user interface for creating new raster layers (see Figure_raster_terrain).

Descripción del análisis:

- **Pendiente**: Calcula el ángulo de la pendiente de cada celda en grados (basado en primer orden estimación derivada).
- **Orientación**: Exposición (iniciar con 0 para la dirección norte, en grados antihorario).
- **Mapa de sombras**: Crea un mapa de sombra utilizando luz y sombra para proveer un aspecto más tridimencional para un mapa de relieve sombreado. El mapa de salida es una banda gris individual que refleja el valor gris de los píxeles.
- **Índice de irregularidad**: Una medición cuantitativa de la heterogeneidad del terreno tal como se describe por Riley et al. (1999). Se calcula para cada lugar con un resumen de los cambios en la elevación dentro de la cuadrícula de 3x3 píxeles.
- **Relieve**: Crea un mapa de relieve sombreado de los datos digitales de elevación. Implementado es un método para elegir los colores de elevación mediante el análisis de distribución de frecuencia. EL mapa de salida es una color multibanda con tres bandas que reflejan los valores RGB del relieve sombreado.

21.17.1 Usar el complemento

1. Inicie QGIS y cargue la capa ráster `gtopo30` de la ubicación de ejemplo de GRASS.
2. Cargar el complemento de Análisis de Terreno en el Administrador de Complementos (vea *El diálogo de complementos*).

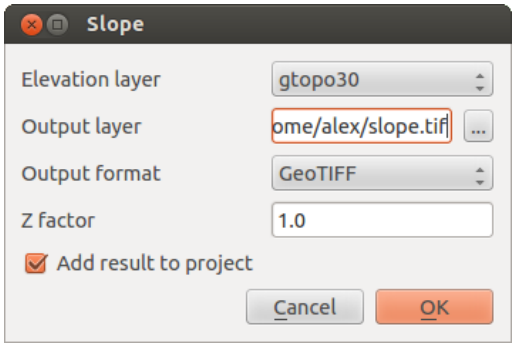

Figure 21.39: Complemento de Modelado de Terreno (Cálculo de la pendiente)

3. Select an analysis method from the menu (e.g., *Raster* → *Terrain Analysis* → *Slope*). The *Slope* dialog appears as shown in Figure_raster_terrain.
4. Especificar una ruta , y un tipo de archivo de salida
5. Haga clic en **[Aceptar]**.

21.18 Complemento Grafo de rutas

El Grafo de rutas es un complemento en C++ para QGIS que calcula la ruta más corta entre dos puntos en una capa de polilínea y traza esta ruta sobre la red de carreteras.

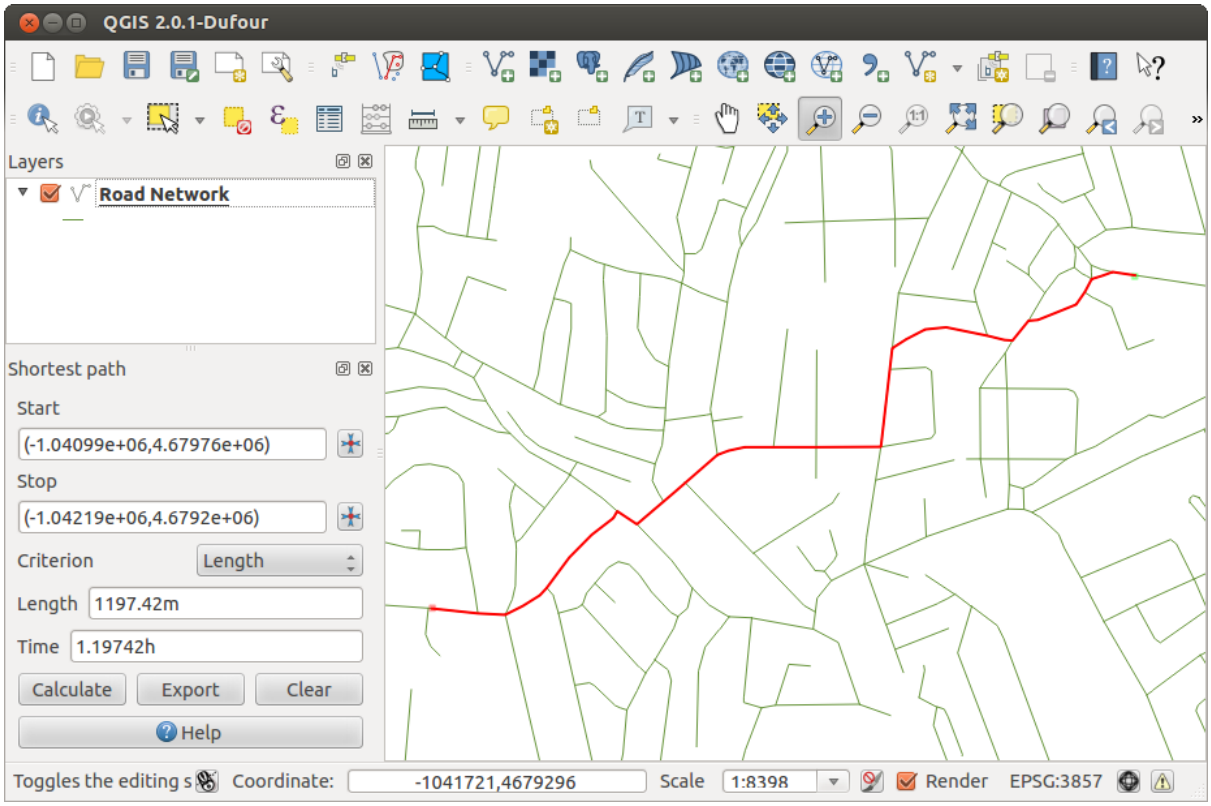

Figure 21.40: Complemento Grafo de rutas

Características principales:

- Calcula la ruta, así como la longitud y el tiempo de viaje.

- Optimiza la longitud o el tiempo de viaje.
- Exporta la ruta a una capa vectorial.
- Resalta la dirección de las carreteras (esto es lento y se utiliza principalmente para fines de depuración y para pruebas de configuración)

Como una capa de carreteras, se puede utilizar cualquier capa vectorial de polilínea en cualquier formato admitido por QGIS. Dos líneas con un punto en común se consideran conectadas. Tenga en cuenta que es necesario usar el SRC de la capa como SRC del proyecto mientras edita una capa de carreteras. Esto debido al hecho de recalcular las coordenadas entre diferentes SRC's introduce algunos errores que pueden resultar en discontinuidades, incluso cuando se utiliza el 'autoensamblado'.

En la tabla de atributos de la capa, se pueden usar los siguientes campos:

- Velocidad en una sección de la carretera (campo numérico).
- Dirección (cualquier tipo que se pueda convertir en texto). Las direcciones de avance y retroceso corresponden a una carretera de un solo sentido, ambas direcciones indican una carretera de doble sentidos.

Si algunos campos no tienen ningún valor o no existen, se usan los valores predeterminados. Puede cambiar lo predeterminado y algunas configuraciones del complemento en el diálogo de configuración del complemento.

21.18.1 Usar el componente

After plugin activation, you will see an additional panel on the left side of the main QGIS window. Now, enter some parameters into the *Road graph plugin settings* dialog in the *Vector* → *Road Graph* menu (see figure_road_graph_settings).

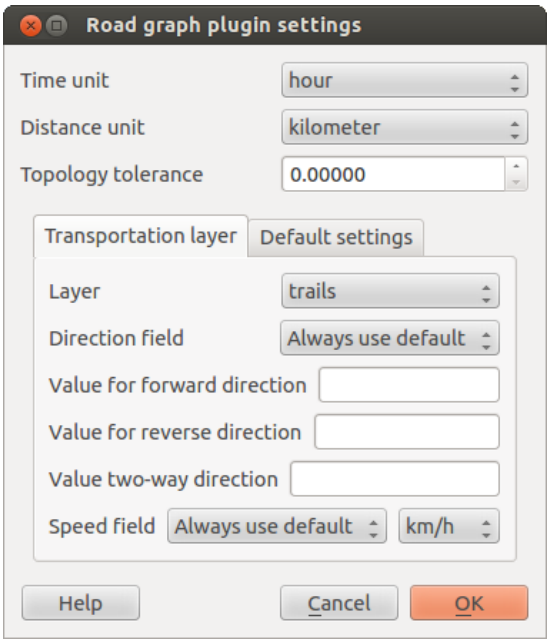

Figure 21.41: Configuración del complemento Grafo de rutas

Después de configurar *Unidad de tiempo*, *Unidad de distancia* y *Tolerancia de topología*, puede seleccionar la capa vectorial en la pestaña *Capa de transporte*. Aquí también puede seleccionar el *Campo de sentido* y el *Campo de velocidad*. En la pestaña *Configuración predeterminada*, puede establecer el *Sentido* para el calculo.

Finalmente, en el panel *Ruta más corta*, seleccione un punto de Inicio y un punto Final en la capa de red de carreteras y pulse **[Calcular]**.

21.19 Complemento Consulta espacial

El  Complemento Consulta espacial permite hacer una consulta espacial (ej., seleccionar objetos espaciales) en una capa de destino con referencia a otra capa. La funcionalidad con base en la librería de GEOS y depende de la capa de rasgos de origen seleccionado.

Operadores posibles son:

- Contiene
- Igual
- Solapa
- Cruzar
- Intersecta
- Está inconexo
- Toca
- Dentro

21.19.1 Usar el complemento

Como un ejemplo, queremos encontrar regiones en el conjunto de datos de Alaska que contenga aeropuertos. Los siguientes pasos son necesarios:

1. Inicie QGIS y cargue las capas vectoriales `regions.shp` y `airports.shp`.
2. Cargue el complemento de Consulta espacial en el Administrador de Complementos (vea *El diálogo de complementos*) y haga clic en el icono  Consulta espacial, que aparece en el menú de la barra de herramientas de QGIS. El diálogo de complemento aparece.
3. Seleccione la capa `regions` como la capa origen y `airports` como la capa de entidades de referencia.
4. Seleccione 'Contiene' como operador y haga clic en **[Aplicar]**.

Now you get a list of feature IDs from the query and you have several options, as shown in figure_spatial_query.

- Haga clic sobre  Crear capa con lista de elementos.
- Seleccione un ID de la lista y haga clic sobre  Crear capa con selección.
- Seleccione 'Eliminar de la selección actual' en el campo *Y utilizar el resultado para*  .
- Se puede  *Zum al elemento* o desplegar  *Registro de mensajes*.
- Además en *ID's de los objetos de resultado* con las opciones 'Origen inválido' y 'Referencia inválida' se puede tener una vista de los objetos espaciales con errores geométricos. Estos objetos no se utilizan para la consulta.

21.20 Complemento Comprobador de topología.

La topología describe las relaciones entre puntos, líneas y polígonos que representa los objetos espaciales de una región geográfica. Con el complemento de Comprobador de Topología, puede revisar sus archivos vectoriales y verificar la topología con varias reglas topológicas. Estas reglas comprueban con relaciones espaciales si su objeto espacial es 'Equal', 'Contain', 'Cover', 'CoveredBy', 'Cross', o son 'Disjoint', 'Intersect', 'Overlap', 'Touch' o 'Within' el uno al otro. Depende de sus preguntas individuales que reglas topológicas que se aplican a los datos vectoriales (por ejemplo, normalmente no aceptará overshoots en capas de líneas, pero si ellos representan callejones sin salida que no eliminará de su capa vectorial).

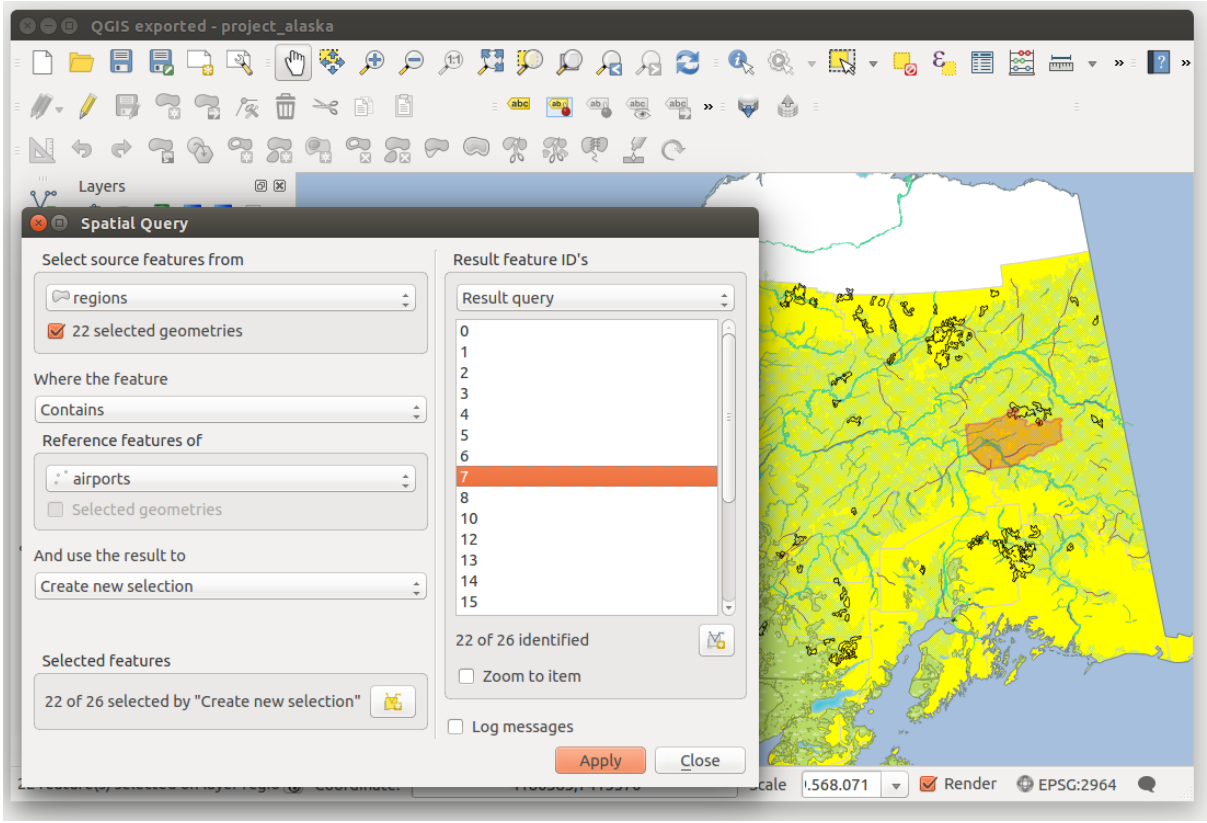

Figure 21.42: Análisis de consulta espacial - las regiones contienen aeropuertos

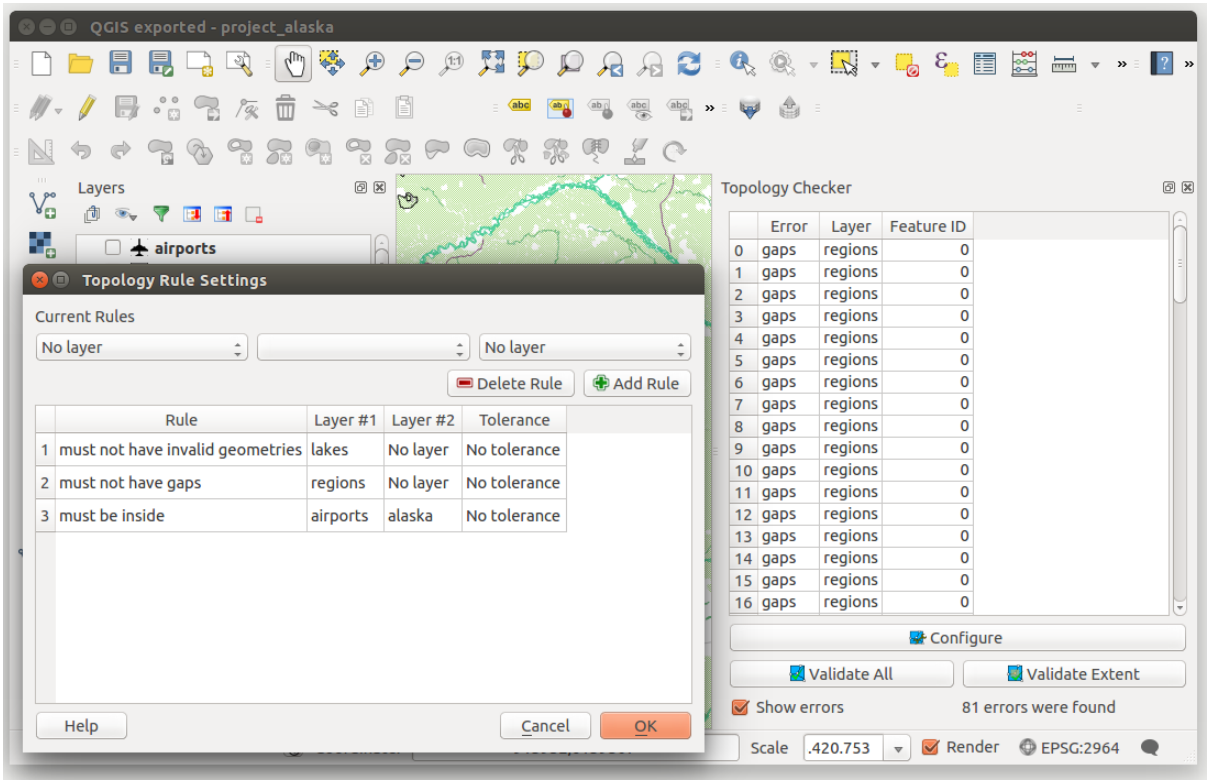

Figure 21.43: El complemento de Comprobador de Topología

QGIS tiene una característica de edición topológica integrada, que es ideal para la creación de nuevas funciones sin errores. Pero los errores de datos existentes y los errores inducidos son difíciles de encontrar. Este complemento le ayuda a encontrar cada error a través de una lista de reglas.

Es muy simple crear reglas topológicas con el complemento Comprobador de topología.

En **capa de puntos** las siguientes reglas están disponibles:

- **Must be covered by**: Aquí puede elegir una capa vectorial de su proyecto. Los puntos que no están cubiertos por la capa vectorial dada se produce en el campo 'Error'.
- **Must be covered by endpoints of**: Aquí puede elegir una capa de líneas de su proyecto.
- **Debe estar dentro de**: Aquí puede elegir una capa de polígono de su proyecto. Los puntos deben estar dentro de un polígono. Por otra parte, QGIS escribe un 'Error' del punto.
- **Must not have duplicates**: Siempre que un punto se representa dos o más veces, se producirá el campo 'Error'.
- **Must not have invalid geometries**: Comprobar si las geometrías son validas.
- **Must not have multi-part-geometries**: Todos los puntos multi-parte se escriben en el campo 'Error'.

En **Capas de líneas**, las siguientes reglas están disponibles:

- **End points must be covered by**: Aquí se puede seleccionar una capa de puntos de su proyecto.
- **Must not have dangles**: Este mostrará los overshoots en la capa de líneas.
- **Must not have duplicates**: Siempre que un objeto línea es representado una o dos veces, se producirá en el campo 'Error'.
- **Must not have invalid geometries**: Comprobar si las geometrías son validas.
- **Must not have multi-part geometries**: A veces, una geometría es en realidad una colección de simples (una sola pieza) geometrías. Una geometría de este tipo se denomina de geometría multiparte. Si contiene sólo un tipo de geometría simple, lo llamamos multi-punto, multi-línea o multi-polígono. Todas las líneas de multi-partes se escriben en el campo 'Error'.
- **No debe tener pseudos**: Un punto final de geometría de línea debe conectarse a los puntos finales de otras dos geometrías. Si el extremo está conectado al punto final de una sola otra geometría, el punto final se llama nodo pseudo.

En **capas de polígonos**, las siguientes reglas están disponibles:

- **Must contain**: La capa de polígonos debe contener al menos un punto de la geometría de la segunda capa.
- **Must not have duplicates**: Los polígonos de la misma capa no deben tener geometrías idénticas. Cada vez que una entidad de polígono se represente dos veces o más se producirá en el campo 'Error'.
- **Must not have gaps**: Los polígonos adyacentes no deben formar espacios entre ellos. Los límites administrativos podrían mencionarse como ejemplo (polígonos de los estados de Estados Unidos no tienen espacios entre ellos ...).
- **Must not have invalid geometries**: Comprobar si las geometrías con validas. Algunas de las reglas que definen si una geometría es valida son:
  - Anillos de polígonos deben cerrarse.
  - Los anillos que definen agujeros deben estar dentro de los anillos que definen los límites exteriores.
  - Los anillos no deben intersectarse (Ni pueden tocarse o cruzarse entre si)
  - Los anillos no puede tocar otros anillos, excepto en un punto.
- **Must not have multi-part geometries**: A veces, una geometría es en realidad una colección geometrías sencillas (parte sencilla). Una geometría de este tipo se denomina de geometría multi-parte. Si contiene sólo un tipo de geometría simple, lo llamamos multi-punto, multi-líneas o multi-polígono. Por ejemplo, un país que consta de múltiples islas se puede representar como un multi-polígono.
- **Must not overlap**: Los polígonos adyacentes no deben de compartir un área en común.

- **Must not overlap with**: Los polígonos adyacentes de una capa no deben compartir un área con los polígonos de otra.

21.21 Complemento de Estadísticas de zona

With the *Zonal statistics* plugin, you can analyze the results of a thematic classification. It allows you to calculate several values of the pixels of a raster layer with the help of a polygonal vector layer (see figure_zonal_statistics). Choosing a color band, the plugin generates output columns in the vector layer with an user-defined prefix and calculates for each polygon, statistics on pixels that are within. The available statistics are :

- **Count**: to count the number of pixels
- **Sum**: to sum the pixel values
- **Mean**: to get the mean of pixel values
- **Median**: to get the median of pixel values
- **StDev**: to get the standard deviation of pixel values
- **Min**: to get the minimum of pixel values
- **Max**: to get the maximum of pixel values
- **Range**: to get the range (max - min) of pixel values
- **Minority**: to get the less represented pixel value
- **Majority**: to get the most represented pixel value
- **Variety**: to count the number of distinct pixel values

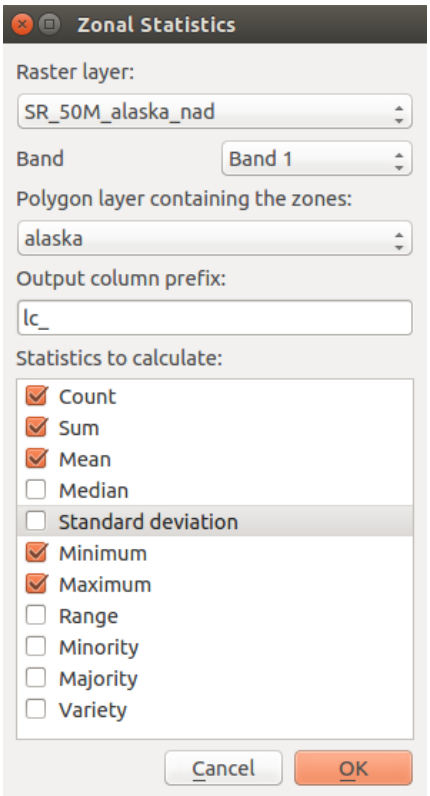

Figure 21.44: Diálogo de Estadísticas de zona

CHAPTER 22

Ayuda y apoyo

22.1 Listas de correos

QGIS está en desarrollo activo y como tal, no siempre funciona como se espera. La forma preferida de obtener ayuda es uniéndose a la lista de correo qgis-users. Sus preguntas llegarán a un público más amplio y las respuestas beneficiarán a otros.

22.1.1 Usuarios de QGIS

This mailing list is used for discussion of QGIS in general, as well as specific questions regarding its installation and use. You can subscribe to the qgis-users mailing list by visiting the following URL: http://lists.osgeo.org/mailman/listinfo/qgis-user

22.1.2 Desarrolladores QGIS

If you are a developer facing problems of a more technical nature, you may want to join the qgis-developer mailing list. This list is also a place where people can chime in and collect and discuss QGIS related UX (User Experience) / usability issues. It's here: http://lists.osgeo.org/mailman/listinfo/qgis-developer

22.1.3 QGIS Community Team

This list deals with topics like documentation, context help, user guide, web sites, blog, mailing lists, forums, and translation efforts. If you would like to work on the user guide as well, this list is a good starting point to ask your questions. You can subscribe to this list at: http://lists.osgeo.org/mailman/listinfo/qgis-community-team

22.1.4 QGIS Translations

This list deals with the translation efforts. If you like to work on the translation of the website, manuals or the graphical user interface (GUI), this list is a good starting point to ask your questions. You can subscribe to this list at: http://lists.osgeo.org/mailman/listinfo/qgis-tr

22.1.5 QGIS Project Steering Committee (PSC)

This list is used to discuss Steering Committee issues related to overall management and direction of QGIS. You can subscribe to this list at: http://lists.osgeo.org/mailman/listinfo/qgis-psc

22.1.6 QGIS User groups

In order to locally promote QGIS and contribute to its development, some QGIS communities are organized into QGIS User Groups. These groups are places to discuss local topics, organize regional or national user meetings, organize sponsoring of features... The list of current user groups is available at http://qgis.org/en/site/forusers/usergroups.html

You are welcome to subscribe to any of the lists. Please remember to contribute to the list by answering questions and sharing your experiences.

22.2 IRC

We also maintain a presence on IRC - visit us by joining the #qgis channel on irc.freenode.net. Please wait for a response to your question, as many folks on the channel are doing other things and it may take a while for them to notice your question. If you missed a discussion on IRC, not a problem! We log all discussion, so you can easily catch up. Just go to http://qgis.org/irclogs and read the IRC-logs.

Commercial support for QGIS is also available. Check the website http://qgis.org/en/commercial-support.html for more information.

22.3 Rastreador de Errores

While the qgis-users mailing list is useful for general 'How do I do XYZ in QGIS?'-type questions, you may wish to notify us about bugs in QGIS. You can submit bug reports using the QGIS bug tracker at http://hub.qgis.org/projects/quantum-gis/issues. When creating a new ticket for a bug, please provide an email address where we can contact you for additional information.

Por favor, tenga en cuenta que su error no siempre puede disfrutar de la prioridad que podría esperar (depende de su gravedad). Algunos errores pueden requerir de significativo esfuerzo por parte del desarrollador para remediar, y la mano de obra no siempre está disponible para esto.

Se pueden presentar las solicitudes de funciones utilizando el mismo sistema de ticket de errores. Asegúrate de seleccionar el tipo «Función».

If you have found a bug and fixed it yourself, you can submit either a Pull Request on the Github QGIS Project (prefered) or a patch also. The lovely redmine ticketsystem at http://hub.qgis.org/projects/quantum-gis/issues has this type as well. Check the `Patch supplied` checkbox and attach your patch before submitting your bug. One of the developers will review it and apply it to QGIS. Please don't be alarmed if your patch is not applied straight away – developers may be tied up with other commitments.

Tenga en cuenta que si proporciona una solicitud de extracción, su cambio sería más probable que se fusione en el código fuente!

22.4 Blog

The QGIS community also runs a weblog at http://planet.qgis.org/planet/, which has some interesting articles for users and developers as well provided by other blogs in the community. You are invited to contribute your own QGIS blog!

22.5 Plugins

The website http://plugins.qgis.org provides the official QGIS plugins web portal. Here, you find a list of all stable and experimental QGIS plugins available via the 'Official QGIS Plugin Repository'.

22.6 Wiki

Lastly, we maintain a WIKI web site at http://hub.qgis.org/projects/quantum-gis/wiki where you can find a variety of useful information relating to QGIS development, release plans, links to download sites, message-translation hints and more. Check it out, there are some goodies inside!

CHAPTER 23

Colaboradores

QGIS is an open source project developed by a team of dedicated volunteers and organisations. We strive to be a welcoming community for people of all race, creed, gender and walks of life. At any moment, you can get involved.

23.1 Autores

Below are listed people who dedicate their time and energy to write, review, and update the whole QGIS documentation.

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23.2 Traductores

QGIS is a multi-language application and as is, also publishes a documentation translated into several languages. Many other languages are being translated and would be released as soon as they reach a reasonable percentage of translation. If you wish to help improving a language or request a new one, please see http://qgis.org/en/site/getinvolved/index.html.

The current translations are made possible thanks to:

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CHAPTER 24

Apéndice

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CHAPTER 25

Referencias bibliográficas y web

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