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QGIS User Guide

Release 2.8

QGIS Project

July 30, 2016

Contents

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Preâmbulo

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Este documento contem ligações internas e externas. Ao clicar numa ligação interna este move dentro do documento, enquanto se clicar numa ligação externa abre um endereço de internet. No formato de PDF, as ligações internas e externas são exibidas a azul e são gerida pelo pesquisador do sistema. No formato HTML, o pesquisador exibe e gere ambas igualmente.

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Convenções

Esta secção descreve uma colecção de estilos uniformizados ao longo do manual.

2.1 Convenções GUI

Os estilos da convenção GUI destinam-se a copiar a aparência do GUI. Geralmente, o objectivo é usar a aparência, para que o utilizador possa visualizar e procurar o GUI e encontrar alguma coisa parecida no manual.

- Menu Opções: *Camada → Adicionar Camada Raster* ou *Configurações → Barra de Ferramentas → Digitalização*
- Tool: Add a Raster Layer
- Botão : **[Guardar como Padrão]**
- Título da Caixa de Diálogo: *Propriedades da Camada*
- Separador: *Geral*
- Caixa de Verificação: ☑ *Renderização*
- Radio Button: ◉ *Postgis SRID* ◯ *EPSG ID*
- Select a number: `1,00 ⬍`
- Select a string: `... ▼`
- Browse for a file: `...`
- Select a color: `Border ▬▬ ▾`
- Slider: ▭───────
- Input Text: `Display name` `lakes.shp`

Uma sombra indica um componente clicável no GUI.

2.2 Convenções de Texto ou Teclado

This manual also includes styles related to text, keyboard commands and coding to indicate different entities, such as classes or methods. These styles do not correspond to the actual appearance of any text or coding within QGIS.

- Hiperligação: http://qgis.org
- Combinações de Atalho: pressione `Ctrl+B`, significa pressionar e segura a tecla Ctrl e de seguida pressionae a tecla B.

- Nome do Ficheiro: `lakes.shp`

- Nome da Classe: **NewLayer**

- Método: *classFactory*

- Servidor:*meuservidor.pt*

- Texto do Utilizador: `qgis --help`

Linhas de código são indicados por uma fonte com largura fixa:

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

2.3 Instruções específicas da 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 Macintosh OS X platforms, you should click the QGIS menu first, then Quit.

Grandes quantidades de texto devem ser formatados como está na lista:

- 🐧 Faça isto

- ⊞ Faça aquilo

- ✖ Faça outra coisa

ou como parágrafos

🐧 ✖ Faça isto e isto e isto. De seguida faça isto e isto e isto e isto e isto e isto e isto e isto e isto e isto e isto e isto.

⊞ Faça aquilo. De seguida faça aquilo e aquilo e aquilo e aquilo e aquilo e aquilo e aquilo e aquilo e aquilo e aquilo e aquilo e aquilo e aquilo e aquilo.

As capturas de ecrã que aparecem ao longo do manual de utilizador foram criados para diferentes plaformas; a plataforma é indicada por um ícone específico da plataforma no fim da legenda da figura.

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Prefácio

Bem-vindo ao mundo maravilhoso dos Sistemas de Informação Geográfica (SIG)!

QGIS is an Open Source Geographic Information System. The project was born in May of 2002 and was established as a project on SourceForge in June of the same year. We've worked hard to make GIS software (which is traditionally expensive proprietary software) a viable prospect for anyone with basic access to a personal computer. QGIS currently runs on most Unix platforms, Windows, and OS X. QGIS is developed using the Qt toolkit (http://qt.digia.com) and C++. This means that QGIS feels snappy and has a pleasing, easy-to-use graphical user interface (GUI).

QGIS aims to be a user-friendly GIS, providing common functions and features. The initial goal of the project was to provide a GIS data viewer. QGIS has reached the point in its evolution where it is being used by many for their daily GIS data-viewing needs. QGIS supports a number of raster and vector data formats, with new format support easily added using the plugin architecture.

QGIS is released under the GNU General Public License (GPL). Developing QGIS under this license means that you can inspect and modify the source code, and guarantees that you, our happy user, will always have access to a GIS program that is free of cost and can be freely modified. You should have received a full copy of the license with your copy of QGIS, and you also can find it in Appendix *Licença Geral Pública GNU*.

Tip: Documentação Actualizada

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/.

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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 Visualização de dados

Pode ver ou sobrepor dados vectoriais e matriciais em diferentes formatos e projecções sem conversão para um formato interno ou comum. Os formatos suportados incluídos são:

- 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 *Trabalhando com Informação Vectorial*.

- Raster and imagery formats supported by the installed GDAL (Geospatial Data Abstraction Library) library, such as GeoTIFF, ERDAS IMG, ArcInfo ASCII GRID, JPEG, PNG and many more. See section *Trabalhando com Informação Matricial*.

- GRASS raster and vector data from GRASS databases (location/mapset). See section *Integração GRASS SIG*.

- Online spatial data served as OGC Web Services, including WMS, WMTS, WCS, WFS, and WFS-T. See section *Trabalhando com dados OGC*.

4.2 Exploração de dados e compositores de mapas

You can compose maps and interactively explore spatial data with a friendly GUI. The many helpful tools available in the GUI include:

- QGIS browser
- Reprojecção On-the-fly
- Gestor BD
- Compositor de Mapas
- Painel de Vista Global
- Marcadores espaciais
- Ferramentas de anotação
- Identificar/seleccionar elementos
- Editar/ver/procurar atributos
- Data-defined feature labeling

- Data-defined vector and raster symbology tools

- Atlas map composition with graticule layers

- North arrow scale bar and copyright label for maps

- Support for saving and restoring projects

4.3 Criar, editar, gerir e exportar dados

You can create, edit, manage and export vector and raster layers in several formats. QGIS offers the following:

- Digitizing tools for OGR-supported formats and GRASS vector layers

- Ability to create and edit shapefiles and GRASS vector layers

- Georeferencer plugin to geocode images

- 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.)

- Support for visualizing and editing OpenStreetMap data

- Ability to create spatial database tables from shapefiles with DB Manager plugin

- Tratamento melhorado de tabelas de bases de dados espaciais

- Tools for managing vector attribute tables

- Option to save screenshots as georeferenced images

- DXF-Export tool with enhanced capabilities to export styles and plugins to perform CAD-like functions

4.4 Analyse data

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 *Integração 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, fTools and more. (See section *Introdução*.)

4.5 Publicação de mapas na internet

QGIS can be used as a WMS, WMTS, WMS-C or WFS and WFS-T client, and as a WMS, WCS or WFS server. (See section *Trabalhando com dados OGC*.) Additionally, you can publish your data on the Internet using a webserver with UMN MapServer or GeoServer installed.

4.6 Extend QGIS functionality through plugins

QGIS can be adapted to your special needs with the extensible plugin architecture and libraries that can be used to create plugins. You can even create new applications with C++ or Python!

4.6.1 Módulos Core

Core plugins include:

1. Coordinate Capture (Capture mouse coordinates in different CRSs)

2. DB Manager (Exchange, edit and view layers and tables; execute SQL queries)

3. Dxf2Shp Converter (Convert DXF files to shapefiles)

4. eVIS (Visualize events)

5. fTools (Analyze and manage vector data)

6. GDALTools (Integrate GDAL Tools into QGIS)

7. Georeferencer GDAL (Add projection information to rasters using GDAL)

8. GPS Tools (Load and import GPS data)

9. GRASS (Integrate GRASS GIS)

10. Heatmap (Generate raster heatmaps from point data)

11. Interpolation Plugin (Interpolate based on vertices of a vector layer)

12. Metasearch Catalogue Client

13. Offline Editing (Allow offline editing and synchronizing with databases)

14. Oracle GeoRaster Espacial

15. Processamento (anteriomente designado de SEXTANTE)

16. Raster Terrain Analysis (Analyze raster-based terrain)

17. Road Graph Plugin (Analyze a shortest-path network)

18. Módulo de Consulta Espacial

19. SPIT (Import shapefiles to PostgreSQL/PostGIS)

20. Topology Checker (Find topological errors in vector layers)

21. Zonal Statistics Plugin (Calculate count, sum, and mean of a raster for each polygon of a vector layer)

4.6.2 Módulos Externos Python

QGIS offers a growing number of external Python plugins that are provided by the community. These plugins reside in the official Plugins Repository and can be easily installed using the Python Plugin Installer. See Section *The Plugins Dialog*.

4.7 Consola 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 Known Issues

4.8.1 Number of open files limitation

If you are opening a large QGIS project and you are sure that all layers are valid, but some layers are flagged as bad, you are probably faced with this issue. Linux (and other OSs, likewise) has a limit of opened files by process. Resource limits are per-process and inherited. The `ulimit` command, which is a shell built-in, changes the limits only for the current shell process; the new limit will be inherited by any child processes.

You can see all current ulimit info by typing

```
user@host:~$ ulimit -aS
```

You can see the current allowed number of opened files per proccess with the following command on a console

```
user@host:~$ ulimit -Sn
```

To change the limits for an **existing session**, you may be able to use something like

```
user@host:~$ ulimit -Sn #number_of_allowed_open_files
user@host:~$ ulimit -Sn
user@host:~$ qgis
```

To fix it forever

On most Linux systems, resource limits are set on login by the `pam_limits` module according to the settings contained in `/etc/security/limits.conf` or `/etc/security/limits.d/*.conf`. You should be able to edit those files if you have root privilege (also via sudo), but you will need to log in again before any changes take effect.

More info:

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

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What's new in QGIS 2.8

Este lançamento contém novas funcionalidades e estende a interface de programação em relação às versões anteriores. Nós recomendamos que use esta versão em vez de versões anteriores.

This release includes hundreds of bug fixes and many new features and enhancements that will be described in this manual. You may also review the visual changelog at http://qgis.org/en/site/forusers/visualchangelog28/index.html.

5.1 Application

- **Map rotation**: A map rotation can be set in degrees from the status bar
- **Bookmarks**: You can share and transfer your bookmarks
- **Expressions**:
    - when editing attributes in the attribute table or forms, you can now enter expressions directly into spin boxes
    - the expression widget is extended to include a function editor where you are able to create your own Python custom functions in a comfortable way
    - in any spinbox of the style menu you can enter expressions and evaluate them immediately
    - a get and transform geometry function was added for using expressions
    - a comment functionality was inserted if for example you want to work with data defined labeling
- **Joins**: You can specify a custom prefix for joins
- **Layer Legend**: Show rule-based renderer's legend as a tree
- **DB Manager**: Run only the selected part of a SQL query
- **Attribute Table**: support for calculations on selected rows through a 'Update Selected' button
- **Measure Tools**: change measurement units possible

5.2 Data Providers

- **DXF Export tool improvements**: Improved marker symbol export
- **WMS Layers**: Support for contextual WMS legend graphics
- **Temporary Scratch Layers**: It is possible to create empty editable memory layers

5.3 Digitizing

- **Advanced Digitizing**:
    - digitise lines exactly parallel or at right angles, lock lines to specific angles and so on with the advanced digitizing panel (CAD-like features)
    - simplify tool: specify with exact tolerance, simplify multiple features at once ...
- **Snapping Options**: new snapping mode 'Snap to all layers'

5.4 Map Composer

- **Composer GUI improvements**: hide bounding boxes, full screen mode for composer toggle display of panels
- **Grid improvements**: You now have finer control of frame and annotation display
- **Label item margins**: You can now control both horizontal and vertical margins for label items. You can now specify negative margins for label items.
- optionally store layer styles
- **Attribute Table Item**: options 'Current atlas feature' and 'Relation children' in Main properties

5.5 Plugins

- **Python Console**: You can now drag and drop python scripts into the QGIS window

5.6 QGIS Server

- Python plugin support

5.7 Symbology

- live heatmap renderer creates dynamic heatmaps from point layers
- raster image symbol fill type
- more data-defined symbology settings: the data-defined option was moved next to each data definable property
- support for multiple styles per map layer, optionally store layer styles

5.8 User Interface

- **Projection**: Improved/consistent projection selection. All dialogs now use a consistent projection selection widget, which allows for quickly selecting from recently used and standard project/QGIS projections

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Iniciando

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 Instalação

Installation of QGIS is very simple. Standard installer packages are available for MS Windows and Mac OS X. 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 Instalação à partir da fonte

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

6.1.2 Instalação no dispositivo de armazenamento externo

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 *Menu Sistema* for additional information.

6.2 Amostra de Dados

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:

- Use GIS data that you already have

- Download sample data from http://qgis.org/downloads/data/qgis_sample_data.zip

- Uninstall QGIS and reinstall with the data download option checked (only recommended if the above solutions are unsuccessful)

 X For GNU/Linux and Mac OS X, 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/.

6.3 Sample Session

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

6.3.1 Start QGIS

- ⬥ Start QGIS by typing "QGIS" at a command prompt, or if using a precompiled binary, by using the Applications menu.

- ⬥ Start QGIS using the Start menu or desktop shortcut, or double click on a QGIS project file.

- **X** Double click the icon in your Applications folder.

6.3.2 Load raster and vector layers from the sample dataset

1. Click on the ▦ Add Raster Layer icon.

2. Browse to the folder `qgis_sample_data/raster/`, select the ERDAS IMG file `landcover.img` and click **[Open]**.

3. 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)".

4. Now click on the ⬥ Add Vector Layer icon.

5. ⬤ *File* should be selected as *Source Type* in the new *Add vector layer* dialog. Now click **[Browse]** to select the vector layer.

6. 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]**.

7. Zoom in a bit to your favorite area with some lakes.

8. Faça duplo clique na camada `lakes` da legenda do mapa para abrir o diálogo *Propriedades*

9. Click on the *Style* tab and select a blue as fill color.

10. Click on the *Labels* tab and check the ☑ *Label this layer with* checkbox to enable labeling. Choose the "NAMES" field as the field containing labels.

11. 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.

12. 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 Starting and Stopping QGIS

In section *Sample Session* you already learned how to start QGIS. We will repeat this here, and you will see that QGIS also provides further command line options.

- 🐧 Assuming that QGIS is installed in the PATH, you can start QGIS by typing `qgis` at a command prompt or by double clicking on the QGIS application link (or shortcut) on the desktop or in the Applications menu.

- ⊞ Start QGIS using the Start menu or desktop shortcut, or double click on a QGIS project file.

- ✗ Double click the icon in your Applications folder. If you need to start QGIS in a shell, run `/path-to-installation-executable/Contents/MacOS/Qgis`.

To stop QGIS, click the menu option 🐧 ⊞ *File* ✗ *QGIS → Quit*, or use the shortcut `Ctrl+Q`.

6.5 Opções da Linha de Comandos

🐧 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
QGIS - 2.6.0-Brighton 'Brighton' (exported)
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
     [--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
     [--code path]   run the given python file on load
```

```
     [--defaultui]   start by resetting user ui settings to default
     [--help]                 this text

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
```

Tip: Exemplo do Uso dos argumentos da linha de comandos

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`

Opção da linha de comandos `--snapshot`

Esta opção permite que possa criar uma captura de ecrã no formato PNG da vista actual. Isto vem a calhar quando tem vários projectos e quer gerar capturas de ecrã dos seus dados.

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`.

Opção da linha de comandos `--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, `--lang=it` starts QGIS in italian localization.

Opção da linha de comandos `--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.

Opção da linha de comandos `--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`

Opção da linha de comandos `--nologo`

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

Opção da linha de comandos `--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.

Opção da linha de comandos `--nocustomization`

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

Opção da linha de comandos `--optionspath`

You can have multiple configurations and decide which one to use when starting QGIS with this option. See *Opções* 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/
```

Opção da linha de comandos `--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 `--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:

```python
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`

6.6 Projectos

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 *Opções*). QGIS can save the state of your workspace into a project file using the menu options *Project →* 💾 *Save* or *Project →* 💾 *Save As...*.

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

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.

O tipo de informação guardado num ficheiro de projecto inclui:

- Camadas adicionadas
- Which layers can be queried
- Layer properties, including symbolization and styles
- Projecção para a vista do mapa
- Última extensão visualizada
- Print Composers
- Print Composer elements with settings
- Print Composer atlas settings
- Digitizing settings
- Table Relations
- Project Macros
- Project default styles
- Plugins settings
- QGIS Server settings from the OWS settings tab in the Project properties
- Queries stored in the DB Manager

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 anymore. To be made aware of this, in the *General* tab under *Settings → Options* you can select:

- ☑ *Prompt to save project and data source changes when required*

- ☑ *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 ~.

6.7 Ficheiro de Saída

There are several ways to generate output from your QGIS session. We have discussed one already in section *Projectos*, 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 *Compositor de Impressão*).

.

QGIS GUI

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).
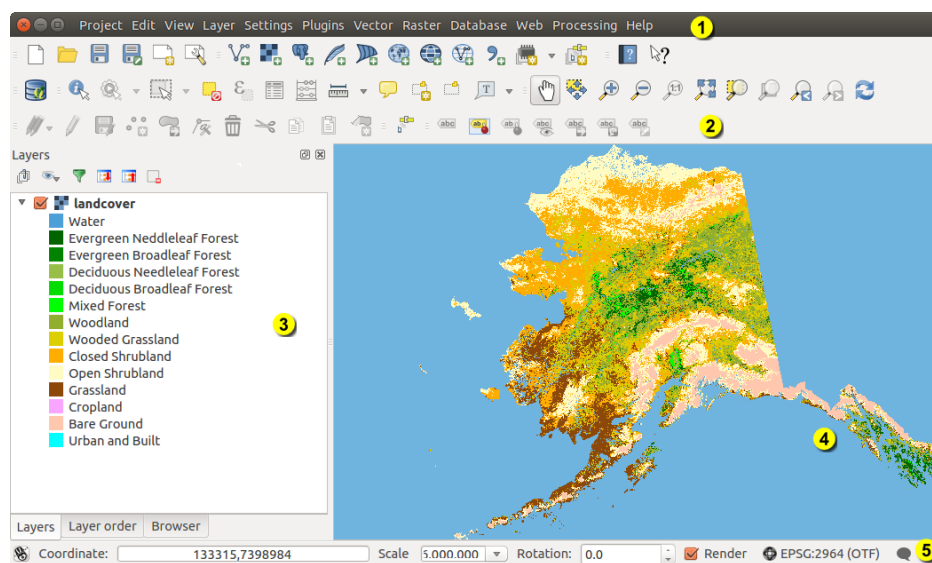

Figure 7.1: QGIS GUI with Alaska sample data

Note: As decorações na sua janela (Barra de Títulos, etc.) podem aparecer diferente maneira dependendo do seu sistema operativo e gestor de janelas.

The QGIS GUI is divided into five areas:

1. Barra de Menus

2. Tool Bar

3. Map Legend

4. Vista do 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 Menus

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...*.

Embora a maioria das opções do menu ter ferramentas correspondentes e vice-versa, os menos não estão organizados como as barras de ferramentas. A barra de ferramenta que contém a ferramenta é listada depois de cada opção de menu como uma entrada de caixa de verificação. Algumas opções de menu apenas aparecem se o módulo correspondente estiver carregado. Para mais informação sobre as ferramentas e barra de ferramentas, veja secção *Barra de Ferramentas*.

7.1.1 Projecto

Menu de Opções	Atalho	Referência	Barra de Ferramentas
New	Ctrl+N	veja *Projectos*	*Projecto*
Open	Ctrl+O	veja *Projectos*	*Projecto*
Novo a partir do modelo →		veja *Projectos*	*Projecto*
Open Recent →		veja *Projectos*	
Save	Ctrl+S	veja *Projectos*	*Projecto*
Save As...	Ctrl+Shift+S	veja *Projectos*	*Projecto*
Save as Image...		see *Ficheiro de Saída*	
DXF Export ...		see *Ficheiro de Saída*	
New Print Composer	Ctrl+P	veja *Compositor de Impressão*	*Projecto*
Composer manager ...		veja *Compositor de Impressão*	*Projecto*
Imprimir Compositores →		veja *Compositor de Impressão*	
Exit QGIS	Ctrl+Q		

7.1.2 Editar

Menu de Opções	Atalho	Referência	Barra de Ferramentas
Undo	`Ctrl+Z`	veja *Digitalização Avançada*	*Digitalização Avançada*
Redo	`Ctrl+Shift+Z`	veja *Digitalização Avançada*	*Digitalização Avançada*
Cut Features	`Ctrl+X`	veja *Digitalizar uma camada existente*	*Digitalização*
Copy Features	`Ctrl+C`	veja *Digitalizar uma camada existente*	*Digitalização*
Paste Features	`Ctrl+V`	veja *Digitalizar uma camada existente*	*Digitalização*
Colar elementos como →		Veja *Working with the Attribute Table*	
Add Feature	`Ctrl+.`	veja *Digitalizar uma camada existente*	*Digitalização*
Move Feature(s)		veja *Digitalizar uma camada existente*	*Digitalização*
Delete Selected		veja *Digitalizar uma camada existente*	*Digitalização*
Rotate Feature(s)		veja *Digitalização Avançada*	*Digitalização Avançada*
Simplify Feature		veja *Digitalização Avançada*	*Digitalização Avançada*
Add Ring		veja *Digitalização Avançada*	*Digitalização Avançada*
Add Part		veja *Digitalização Avançada*	*Digitalização Avançada*
Fill Ring		veja *Digitalização Avançada*	*Digitalização Avançada*
Delete Ring		veja *Digitalização Avançada*	*Digitalização Avançada*
Delete Part		veja *Digitalização Avançada*	*Digitalização Avançada*
Reshape Features		veja *Digitalização Avançada*	*Digitalização Avançada*
Offset Curve		veja *Digitalização Avançada*	*Digitalização Avançada*
Split Features		veja *Digitalização Avançada*	*Digitalização Avançada*
Split Parts		veja *Digitalização Avançada*	*Digitalização Avançada*
Merge Selected Features		veja *Digitalização Avançada*	*Digitalização Avançada*
Merge Attr. of Selected Features		veja *Digitalização Avançada*	*Digitalização Avançada*
Node Tool		veja *Digitalizar uma camada existente*	*Digitalização*

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

7.1.3 Editar (extra)

Menu de Opções	Atalho	Referência	Barra de Ferramentas
Add Feature		veja *Digitalizar uma camada existente*	*Digitalização*
Add Feature		veja *Digitalizar uma camada existente*	*Digitalização*
Add Feature		veja *Digitalizar uma camada existente*	*Digitalização*

7.1.4 Ver

Menu de Opções	Atalho	Referência	Barra de Ferramentas
Pan Map			*Navegação no Mapa*
Pan Map to Selection			*Navegação no Mapa*
Zoom In	`Ctrl++`		*Navegação no Mapa*
Zoom Out	`Ctrl+-`		*Navegação no Mapa*
Seleccionar →		veja *Selecionar e desselecionar elementos*	*Atributos*
Identify Features	`Ctrl+Shift+I`		*Atributos*
Medição →		veja *Medindo*	*Atributos*
Zoom Full	`Ctrl+Shift+F`		*Navegação no Mapa*
Zoom To Layer			*Navegação no Mapa*
Zoom To Selection	`Ctrl+J`		*Navegação no Mapa*
Zoom Last			*Navegação no Mapa*
Zoom Next			*Navegação no Mapa*
Zoom Actual Size			*Navegação no Mapa*
Decorações →		veja *Decorações*	
Preview mode →			
Map Tips			*Atributos*
New Bookmark	`Ctrl+B`	veja *Marcadores espaciais*	*Atributos*
Show Bookmarks	`Ctrl+Shift+B`	veja *Marcadores espaciais*	*Atributos*
Refresh	`F5`		*Navegação no Mapa*

7.1.5 Camada

Menu de Opções	Atalho	Referência	Barra de Ferramentas
Create Layer →		veja *Criando novas camadas Vectoriais*	Gerir Camadas
Add Layer →			Gerir Camadas
Embed Layers and Groups ...		veja *Nesting Projects*	
Add from Layer Definition File ...			
▤ Copy style		see *Estilos*	
▤ Paste style		see *Estilos*	
▤ Open Attribute Table		Veja *Working with the Attribute Table*	Atributos
✎ Toggle Editing		veja *Digitalizar uma camada existente*	Digitalização
▤ Save Layer Edits		veja *Digitalizar uma camada existente*	Digitalização
✎ Current Edits →		veja *Digitalizar uma camada existente*	Digitalização
Save as...			
Save as layer definition file...			
▤ Remove Layer/Group	Ctrl+D		
▤ Duplicate Layers (s)			
Set Scale Visibility of Layers			
Set CRS of Layer(s)	Ctrl+Shift+C		
Set project CRS from Layer			
Properties ...			
Query...			
▤ Labeling			
▤ Add to Overview	Ctrl+Shift+O		Gerir Camadas
▤ Add All To Overview			
▤ Remove All From Overview			
▤ Show All Layers	Ctrl+Shift+U		Gerir Camadas
▤ Hide All Layers	Ctrl+Shift+H		Gerir Camadas
▤ Show selected Layers			
▤ Hide selected Layers			

7.1.6 Configurações

Menu de Opções	Atalho	Referência	Barra de Ferramentas
Painéis →		veja *Panels and Toolbars*	
Barra de Ferramentas →		veja *Panels and Toolbars*	
Toggle Full Screen Mode	F 11		
Project Properties ...	Ctrl+Shift+P	veja *Projectos*	
Custom CRS ...		veja *Sistema de Coordenadas personalizado*	
Gestor de Estilo...		veja *Apresentação*	
Configure shortcuts ...			
Customization ...		veja *Personalização*	
Options ...		veja *Opções*	
Snapping Options ...			

7.1.7 Módulos

Menu de Opções	Atalho	Referência	Barra de Ferramentas
Manage and Install Plugins ...		veja *The Plugins Dialog*	
Python Console	Ctrl+Alt+P		

When starting QGIS for the first time not all core plugins are loaded.

7.1.8 Vector

Menu de Opções	Atalho	Referência	Barra de Ferramentas
Open Street Map →		veja *Loading OpenStreetMap Vectors*	
Ferramentas de Análise →		veja *Módulo fTools*	
Ferramentas de Investigação →		veja *Módulo fTools*	
Ferramentas de Geoprocessamento →		veja *Módulo fTools*	
Ferramentas de Geometria →		veja *Módulo fTools*	
Ferramenta de Gestão de Dados →		veja *Módulo fTools*	

When starting QGIS for the first time not all core plugins are loaded.

7.1.9 Matricial

Menu de Opções	Atalho	Referência	Barra de Ferramentas
Raster calculator ...		see *Calculadora Matricial*	

When starting QGIS for the first time not all core plugins are loaded.

7.1.10 Database

Menu de Opções	Atalho	Referência	Barra de Ferramentas
Database →		see *Módulo Gestor BD*	*Database*

When starting QGIS for the first time not all core plugins are loaded.

7.1.11 Web

Menu de Opções	Atalho	Referência	Barra de Ferramentas
Metasearch		see *MetaSearch Catalogue Client*	*Web*

When starting QGIS for the first time not all core plugins are loaded.

7.1.12 Processamento

Menu de Opções	Atalho	Referência	Barra de Ferramentas
Toolbox		veja *A caixa de ferramentas*	
Graphical Modeler ...		veja *O modelador gráfico*	
History and log ...		veja *Gestão do histórico*	
Options ...		veja *Configurando a infraestrutura do processamento*	
Results viewer ...		veja *Configurando as aplicações externas*	
Commander	`Ctrl+Alt+M`	veja *The QGIS Commander*	

When starting QGIS for the first time not all core plugins are loaded.

7.1.13 Ajuda

Menu de Opções	Atalho	Referência	Barra de Ferramentas
Help Contents	`F1`		*Ajuda*
What's This?	`Shift+F1`		*Ajuda*
API Documentation			
Need commercial support?			
QGIS Home Page	`Ctrl+H`		
Check QGIS Version			
About			
QGIS Sponsors			

Please note that for Linux 🐧, the menu bar items listed above are the default ones in the KDE window manager. In GNOME, the *Settings* menu has different content and its items have to be found here:

Custom CRS	*Edit*
Style Manager	*Edit*
Configure Shortcuts	*Edit*
Customization	*Edit*
Options	*Edit*
Snapping Options ...	*Edit*

7.2 Barra de Ferramentas

A barra de ferramentas fornece o acesso à maioria das mesmas funções que dos menus, mais as ferramentas adicionais para interagir com o mapa. Cada item da barra de ferramentas tem uma janela de ajuda disponível. Mantenha o seu rato em cima do item e uma descrição curta da finalidade da ferramenta irá ser exibida.

Every menu bar can be moved around according to your needs. Additionally, every menu bar can be switched off using your right mouse button context menu, holding the mouse over the toolbars (read also *Panels and Toolbars*).

Tip: Restaurar as Barras de Ferramentas

If you have accidentally hidden all your toolbars, you can get them back by choosing menu option *Settings →
Toolbars →*. If a toolbar disappears under Windows, which seems to be a problem in QGIS from time to time, you have to remove key \HKEY_CURRENT_USER\Software\QGIS\qgis\UI\state in the registry. When you restart QGIS, the key is written again with the default state, and all toolbars are visible again.

7.3 Map Legend

The map legend area lists all the layers in the project. The checkbox in each legend entry can be used to show or hide the layer. The Legend toolbar in the map legend are list allow you to **Add group**, **Manage Layer Visibility** of all layers or manage preset layers combination, **Filter Legend by Map Content**, **Expand All** or **Collapse All** and **Remove Layer or Group**. The button allows you to add **Presets** views in the legend. It means that you can choose to display some layer with specific categorization and add this view to the **Presets** list. To add a preset view just click on , choose *Add Preset...* from the drop down menu and give a name to the preset.

After that you will see a list with all the presets that you can recall pressing on the button.

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 *Propriedades principais*).

A camada pode ser seleccionada e arrastada para cima e para abaixo na legenda para alterar a ordenação-z. A Ordenação-Z significa que as camadas listadas perto do topo da legenda são desenhadas sobre as camadas listadas mais abaixo na legenda.

Note: This behaviour can be overridden by the 'Layer order' panel.

Layers in the legend window can be organised 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. Seleccione algumas camadas, e clique com o botão direito do rato na legenda da janela e escolha *Agrupar Seleccionados*. As camadas seleccionadas irão automaticamente incorporar o novo grupo.

Para trazer a camada para fora do grupo pode arrastar para fora, ou clicar no botão direito do rato em cima e escolha *Faça item de topo*. Os grupos podem ser também agrupados dentro de outros grupos.

A caixa de verificação para o grupo irá mostrar ou esconder todas as camadas do grupo com um clique.

The content of the right mouse button context menu depends on whether the selected legend item is a raster or a vector layer. For GRASS vector layers, ✏ ^Toggle editing is not available. See section *Digitalizando e editando as camadas vectoriais GRASS* for information on editing GRASS vector layers.

Right mouse button menu for raster layers

- *Zoom to Layer*
- *Show in overview*
- *Zoom to Best Scale (100%)*

- *Remove*

- *Duplicate*

- *Set Layer Scale Visibility*

- *Set Layer CRS*

- *Definir SRC do projecto a partir da Camada*

- *Styles →*

- *Save as ...*

- *Save As Layer Definition File ...*

- *Propriedades*

- *Renomear*

Additionally, according to layer position and selection

- *Move to Top-level*

- *Agrupar Seleccionados*

Right mouse button menu for vector layers

- *Zoom to Layer*

- *Show in overview*

- *Remove*

- *Duplicate*

- *Set Layer Scale Visibility*

- *Set Layer CRS*

- *Definir SRC do projecto a partir da Camada*

- *Styles →*

- *Open Attribute Table*

- *Toggle Editing* (not available for GRASS layers)

- *Save As ...*

- *Save As Layer Definition Style*

- *Filtrar*

- *Show Feature Count*

- *Propriedades*

- *Renomear*

Additionally, according to layer position and selection

- *Move to Top-level*

- *Agrupar Seleccionados*

Right mouse button menu for layer groups

- *Zoom to Group*

- *Remove*

- *Set Group CRS*

- *Renomear*

- *Add Group*

É possível seleccionar mais de uma camada ou grupo ao mesmo tempo segurando a tecla `Ctrl` enquanto selecciona as camadas com o botão esquerdo do rato. Pode mover todas as camadas seleccionadas para um novo grupo ao mesmo tempo.

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

7.3.1 Trabalhando com a Ordem da legenda de camada indepenente

There is a panel that allows you to define an independent drawing order for the map legend. You can activate it in the menu *Settings → Panels → Layer order*. 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). Checking the ☑ *Control rendering order* box underneath the list of layers will cause a revert to default behavior.
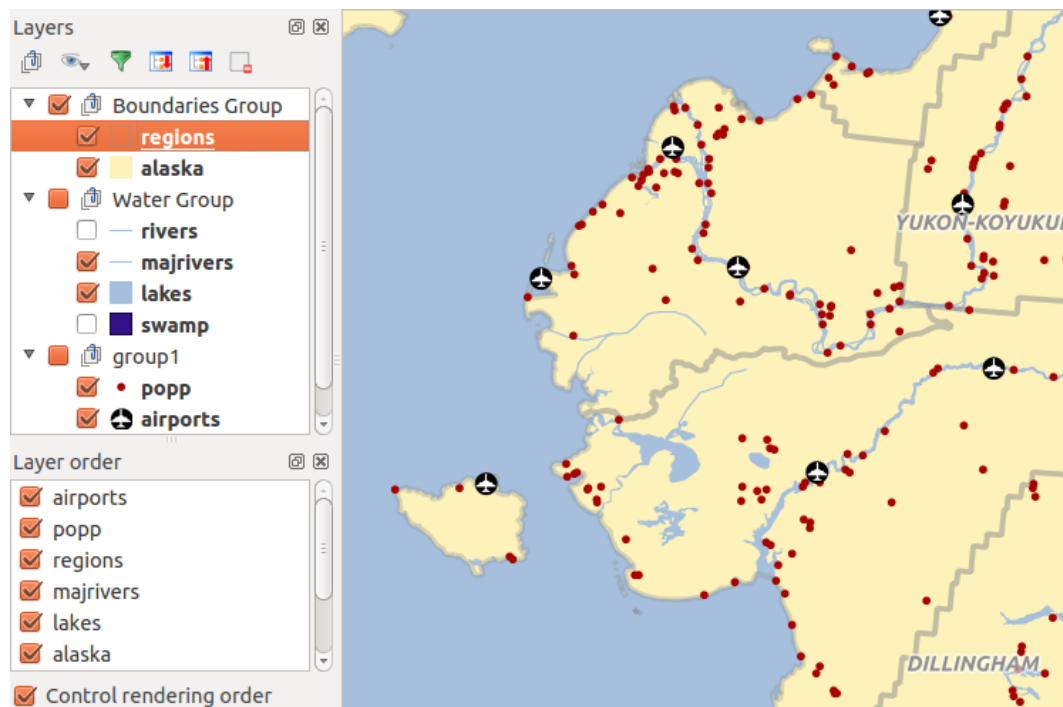
Figure 7.2: Define a legend independent layer order 🐧

7.4 Vista do Mapa

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 (see sections that follow for more information on how to load layers). 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 toolbar description above. The map view and the legend are tightly bound to each other — the maps in view reflect changes you make in the legend area.

Tip: Aumentado o Mapa com a roda do Rato

Pode usar a roda do rato para ampliar ou afastar o mapa. Posicione o cursos do rato dentro da área do mapa e rode a roda para a frente (longe de si) para ampliar e para trás (perto de si) para afastar. A posição do cursor do mapa é centrada onde a ampliação ocorre. Pode personalizar o comportamento de ampliação da roda do rato usando o separador *Ferramentas de mapa* no menu *Configurações → Opções* .

Tip: Movendo o Mapa com as Setas de Direcção e Barra de Espaço

Pode usar as teclas de direcção para mover o mapa. Coloque o cursor do mapa dentro da área do mapa e clique na tecla direita de direcção para mover para este, tecla esquerda de direcção para mover para oeste, tecla para cima para mover para norte e a tecla de direcção para baixo para mover para sul. Pode também mover o mapa usando a barra de espaço ou clicando na roda do rato: apenas mova o rato enquanto segura a barra de espaço ou clica a roda do rato.

7.5 Barra de Estado

The status bar shows you your current position in map coordinates (e.g., meters or decimal degrees) as the mouse pointer is moved across the map view. To the left of the coordinate display in the status bar is a small button that will toggle between showing coordinate position or the view extents 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 between predefined scales from 1:500 to 1:1000000.

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

A progress bar in the status bar shows the progress of rendering as each layer is drawn to the map view. In some cases, such as the gathering of statistics in raster layers, the progress bar will be used to show the status of lengthy operations.

If a new plugin or a plugin update is available, you will see a message at the far left of the status bar. 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 *Renderização* below). The icon ⊘ immediately stops the current map rendering process.

To the right of the render functions, you find the EPSG code of the current project CRS and a projector icon. Clicking on this opens the projection properties for the current project.

Tip: Calculando a Escala Correcta para o Seu Enquadramento do Mapa

When you start QGIS, the default units are degrees, and this means that QGIS will interpret any coordinate in your layer as specified in degrees. To get correct scale values, you can either change this setting to meters manually in the *General* tab under *Settings → Project Properties*, or you can select a project CRS clicking on the ⊕ Current CRS: icon in the lower right-hand corner of the status bar. In the last case, the units are set to what the project projection specifies (e.g., '+units=m').

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Ferramentas gerais

8.1 Atalhos do teclado

QGIS provides default keyboard shortcuts for many features. You can find them in section *Barra de Menus*. Additionally, the menu option *Settings → Configure Shortcuts..* allows you to change the default keyboard shortcuts and to add new keyboard shortcuts to QGIS features.
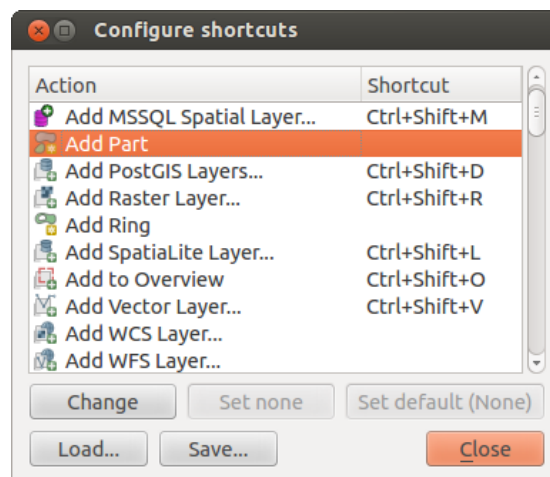
Figure 8.1: Define shortcut options 🐧 (Gnome)

Configuration is very simple. Just select a feature from the list and click on **[Change]**, **[Set none]** or **[Set default]**. Once you have finished your configuration, you can save it as an XML file and load it to another QGIS installation.

8.2 Ajuda 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.

8.3 Renderização

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

- Adicionando uma camada
- Movendo e ampliando

- Resizing the QGIS window

- Mudar a visibilidade da camada ou camadas

QGIS allows you to control the rendering process in a number of ways.

8.3.1 Renderização Dependente da Escala

Scale-dependent rendering allows you to specify the minimum and maximum scales at which a layer 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, click on the ☑ *Scale dependent visibility* checkbox to activate the feature, then set the minimum and maximum scale values.

You can determine the scale values by first zooming to the level you want to use and noting the scale value in the QGIS status bar.

8.3.2 Controlando a Renderização do Mapa

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

Suspendendo a Renderização

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 *Renderização*. 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

- Qualquer combinação acima

A activação da caixa de verificação ☑ *Renderização* permite a renderização e actualização imediata do enquadramento do mapa.

Setting Layer Add Option

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.

Terminando Renderização

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.

Note: It is currently not possible to stop rendering — this was disabled in the Qt4 port because of User Interface (UI) problems and crashes.

Updating the Map Display During Rendering

You can set an option to update the map display as features are drawn. By default, QGIS does not display any features for a layer until the entire layer has been rendered. To update the display as features are read from the datastore, choose menu option *Settings → Options* and click on the *Rendering* tab. Set the feature count to an appropriate value to update the display during rendering. Setting a value of 0 disables update during drawing (this is the default). Setting a value too low will result in poor performance, as the map canvas is continually updated during the reading of the features. A suggested value to start with is 500.

Influência da Qualidade de Renderização

To influence the rendering quality of the map, you have two options. Choose menu option *Settings → Options*, click on the *Rendering* tab and select or deselect following checkboxes:

- ☑ *Make lines appear less jagged at the expense of some drawing performance*

- ☑ *Fix problems with incorrectly filled polygons*

Acelerar a renderização

There are two settings that allow you to improve rendering speed. Open the QGIS options dialog using *Settings → Options*, go to the *Rendering* tab and select or deselect the following checkboxes:

- ☑ *Enable back buffer*. This provides better graphics performance at the cost of losing the possibility to cancel rendering and incrementally draw features. If it is unchecked, you can set the *Number of features to draw before updating the display*, otherwise this option is inactive.

- ☑ *Use render caching where possible to speed up redraws*

8.4 Medindo

Measuring works within projected coordinate systems (e.g., UTM) and unprojected data. If the loaded map is defined with a geographic coordinate system (latitude/longitude), the results from line or area measurements will be incorrect. To fix this, you need to set an appropriate map coordinate system (see section *Trabalhando com Projecções*). All measuring modules also use the snapping settings from the digitizing module. This is useful, if you want to measure along lines or areas in vector layers.

To select a measuring tool, click on 📏 and select the tool you want to use.

8.4.1 Measure length, areas and angles

📏 Measure Line: QGIS is able to measure real distances between given points according to a defined ellipsoid. To configure this, choose menu option *Settings → Options*, click on the *Map tools* tab and select the appropriate ellipsoid. There, you can also define a rubberband color and your preferred measurement units (meters or feet) and angle units (degrees, radians and gon). 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 interactively change the measurement units in the measurement dialog. It overrides the *Preferred measurement units* in the options. There is an info section in the dialog that shows which CRS settings are being used during measurement calculations.

📐 Measure Area: Areas can also be measured. In the measure window, the accumulated area size appears. In addition, the measuring tool will snap to the currently selected layer, provided that layer has its snapping tolerance set (see section *Configurando a Tolerância de Atracção e Raio de Pesquisa*). So, if you want to measure exactly
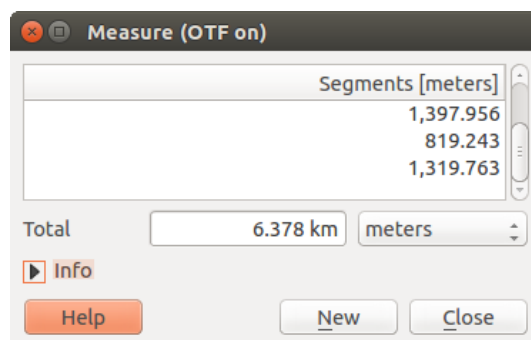
Figure 8.2: Measure Distance 🐧 (Gnome)

along a line feature, or around a polygon feature, first set its snapping tolerance, then select the layer. Now, when using the measuring tools, each mouse click (within the tolerance setting) will snap to that layer.
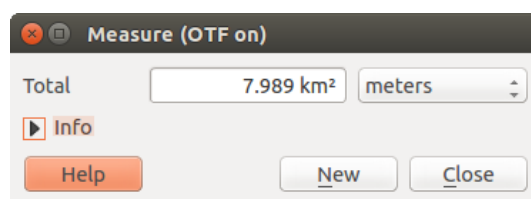
Figure 8.3: Measure Area 🐧 (Gnome)

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.
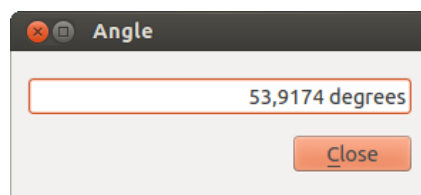
Figure 8.4: Measure Angle 🐧 (Gnome)

8.4.2 Selecionar e desselecionar elementos

The QGIS toolbar provides several tools to select features in the map canvas. To select one or several features, just click on and select your tool:

- Select Single Feature
- Select Features by Rectangle
- Select Features by Polygon
- Select Features by Freehand
- Select Features by Radius

To deselect all selected features click on Deselect features from all layers .

![Select feature using an expression icon] Select feature using an expression allow user to select feature using expression dialog. See *Expressions* chapter for some example.

Users can save features selection into a **New Memory Vector Layer** or a **New Vector Layer** using *Edit → Paste Feature as ...* and choose the mode you want.

8.5 Identificar elementos

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* or press `Ctrl + Shift + I`, or click on the ![icon] Identify features icon in the toolbar.

If you click on several features, the *Identify results* dialog will list information about all the selected features. The first item is the number of the layer in the list of results, followed by the layer name. Then, its first child will be the name of a field with its value. The first field is the one selected in *Properties → Display*. Finally, all information about the feature is displayed.

Esta janela pode ser personalizada para exibir campos personalizados, mas por defeito irá exibir três tipos de informação:

- Actions: Actions can be added to the identify feature windows. When clicking on the action label, action will be run. By default, only one action is added, to view feature form for editing.

- Derived: This information is calculated or derived from other information. You can find clicked coordinate, X and Y coordinates, area in map units and perimeter in map units for polygons, length in map units for lines and feature ids.

- Data attributes: This is the list of attribute fields from the data.
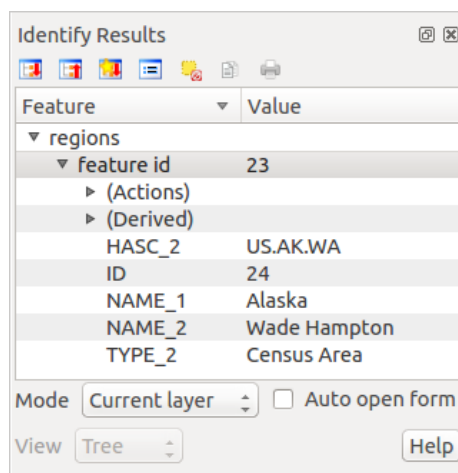
Figure 8.5: Identify feaures dialog ![penguin] (Gnome)

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

- ![icon] Expand tree

- ![icon] Collapse tree

- ![icon] Default behaviour

- ![icon] Copy attributes

- ![icon] Print selected HTML response

At the bottom of the window, you have the *Mode* and *View* comboboxes. With the *Mode* combobox you can define the identify mode: 'Current layer', 'Top down, stop at first', 'Top down' and 'Layer selection'. The *View* can be set as 'Tree', 'Table' and 'Graph'.

The identify tool allows you to auto open a form. In this mode you can change the feautures attributes.

Outras funções podem ser encontradas no menu de contexto do item identificado. Por exemplo, a partir do menu de contexto poderá:

- Ver o formulário do elemento

- Aproximar ao elemento

- Copiar elemento:Copiar todas as geometrias do elemento e atributos

- Toggle feature selection: adds identified feature to selection

- Copiar o valor do atributo: Copia apenas o valor do atributo que clicou

- Copy feature attributes: Copy only attributes

- Limpar resultado: remove os resultados na janela

- Clear highlights: Remove features highlighted on the map

- Destacar todos

- Destacar camada

- Activate layer: Choose a layer to be activated

- Propriedades da camada: Abre a janela das propriedades da camada

- Expandir todos

- Fechar todos

8.6 Decorações

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.

8.6.1 Grelha

Grid allows you to add a coordinate grid and coordinate annotations to the map canvas.

1. Seleccione a partir do menu *Ver → Decorações → Grelha*. A janela de diálogo inicia. (veja figure_decorations_1).

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.

5. Click **[OK]** to close the dialog.

8.6.2 Etiqueta de Direitos de autor

Copyright label adds a copyright label using the text you prefer to the map.
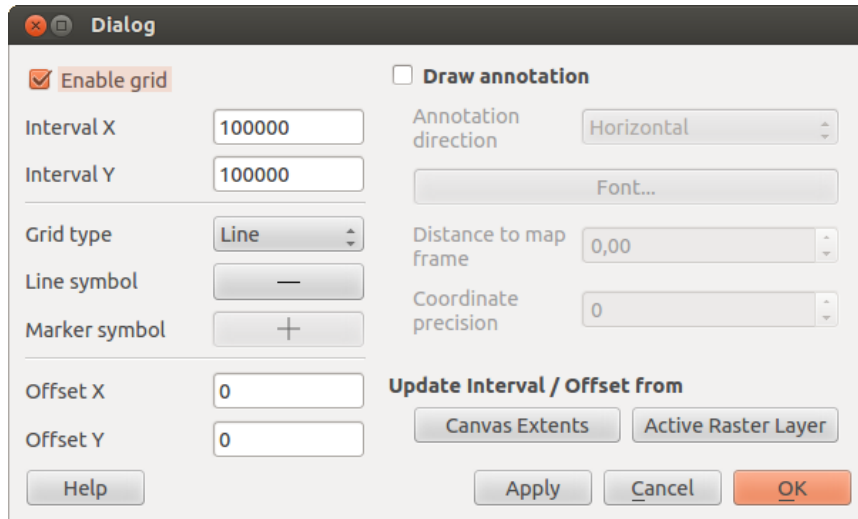
Figure 8.6: The Grid Dialog
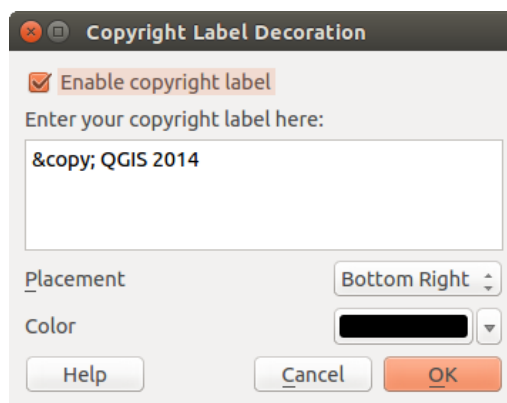
Figure 8.7: The Copyright Dialog

1. Seleccione a partir do menu *Ver* → *Decorações* → *Etiqueta Copyright*. O diálogo iniciará (veja figure_decorations_2).

2. Enter the text you want to place on the map. You can use HTML as shown in the example.

3. Choose the placement of the label from the *Placement* [...▼] combo box.

4. Make sure the ☑ *Enable Copyright Label* checkbox is checked.

5. Click **[OK]**.

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.

8.6.3 Seta do Norte

🧭 North Arrow places a simple north arrow on the map canvas. At present, 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.
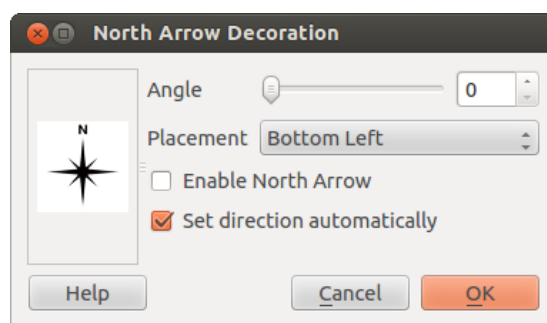
Figure 8.8: The North Arrow Dialog 🐧

8.6.4 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 labeling of the bar.
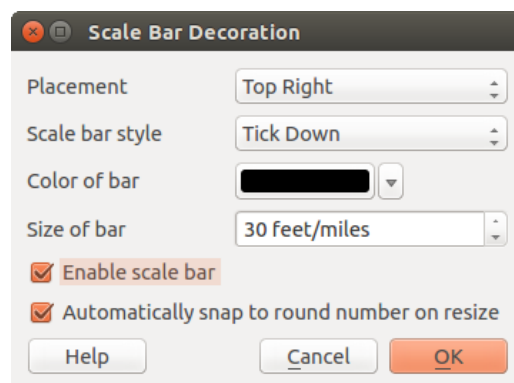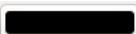
Figure 8.9: The Scale Bar Dialog 🐧

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 adicionar a barra de escala:

1. Select from menu *View → Decorations → Scale Bar*. The dialog starts (see figure_decorations_4).

2. Choose the placement from the *Placement* [...▼] combo box.

3. Choose the style from the *Scale bar style* [...▼] combo box.

4. Select the color for the bar *Color of bar* Border [■]▼ or use the default black color.

5. Set the size of the bar and its label *Size of bar* [1,00 ◇].

6. Make sure the ☑ *Enable scale bar* checkbox is checked.

7. Optionally, check ☑ *Automatically snap to round number on resize*.

8. Click **[OK]**.

Tip: Separador das Decorações

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.

8.7 Ferramentas de Anotação

The [T] 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.
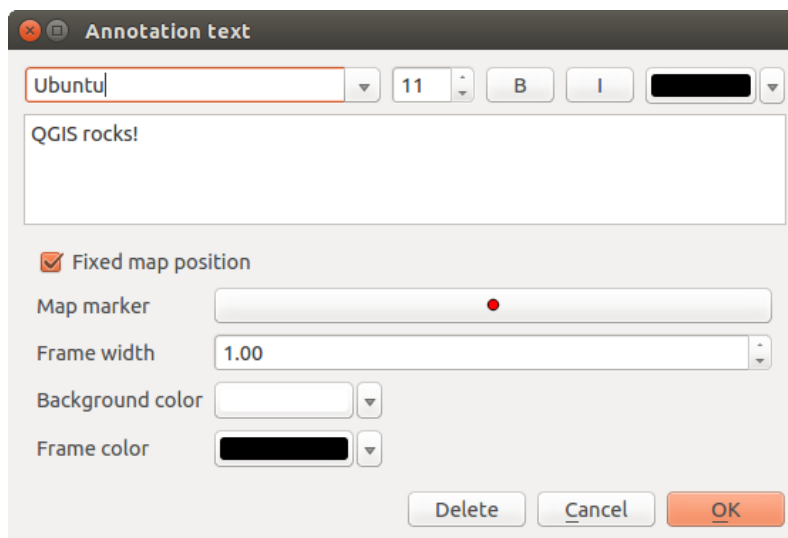
Figure 8.10: Annotation text dialog 🐧

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.

8.7.1 Anotações Html

The ![Html Annotation icon] 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.

8.7.2 Anotações SVG

The ![SVG Annotation icon] 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.

8.7.3 Formulários de anotações

Additionally, you can also create your own annotation forms. The ![Form Annotation icon] 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://www.youtube.com/watch?v=0pDBuSbQ02o from Tim Sutton for more information.
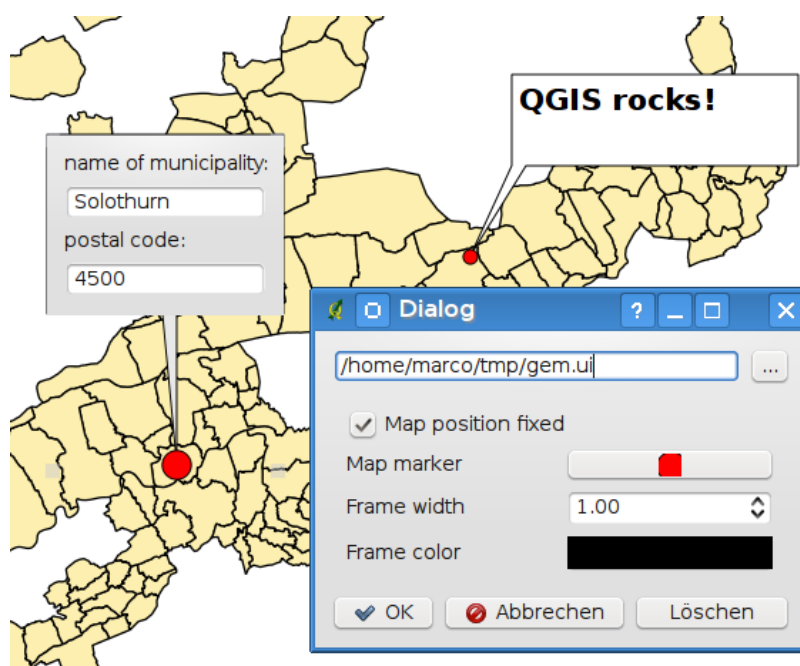
Figure 8.11: Customized qt designer annotation form

Note: Se clicar `Ctrl+T` enquanto a ferramenta *Anotação* é activada (move a anotação, anotação de texto, formulário da anotação), o estado de visibilidade desses itens são invertidos.

8.8 Marcadores espaciais

Spatial Bookmarks allow you to "bookmark" a geographic location and return to it later.

8.8.1 Criando um Marcador

Para criar um marcador:

1. Aproximar ou mover para uma área de interesse.

2. Select the menu option *View → New Bookmark* or press `Ctrl-B`.

3. Introduza um nome descritivo para o marcador (até 255 caracteres).

4. Press `Enter` to add the bookmark or **[Delete]** to remove the bookmark.

Repare que tem múltiplos marcadores com o mesmo nome.

8.8.2 Trabalhando com Marcadores

To use or manage bookmarks, select the menu option *View → Show Bookmarks*. The *Geospatial Bookmarks* dialog allows you to zoom to or delete a bookmark. You cannot edit the bookmark name or coordinates.

8.8.3 Zooming to a Bookmark

From the *Geospatial Bookmarks* dialog, select the desired bookmark by clicking on it, then click **[Zoom To]**. You can also zoom to a bookmark by double-clicking on it.

8.8.4 Deleting a Bookmark

To delete a bookmark from the *Geospatial Bookmarks* dialog, click on it, then click **[Delete]**. Confirm your choice by clicking **[Yes]**, or cancel the delete by clicking **[No]**.

8.8.5 Import or export a bookmark

To share or transfer your bookmarks between computers you can use the *Share* pull down menu in the *Geospatial Bookmarks* dialog.

8.9 Nesting Projects

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

8.9.1 Embebendo camadas

A seguinte janela permite que possa embeber camadas de outros projectos. Aqui está um pequeno exemplo:

1. Press ⬚ to look for another project from the Alaska dataset.

2. Select the project file `grassland`. You can see the content of the project (see figure_embed_dialog).

3. Press `Ctrl` and click on the layers `grassland` and `regions`. Press **[OK]**. The selected layers are embedded in the map legend and the map view now.

While the embedded layers are editable, you can't change their properties like style and labeling.
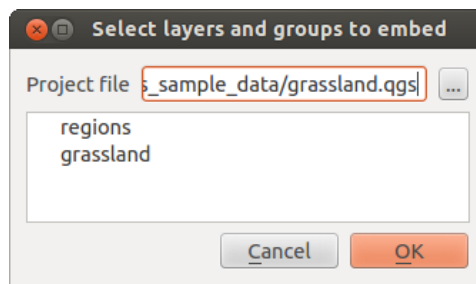
Figure 8.12: Select layers and groups to embed

8.9.2 Removendo camadas embebidas

Right-click on the embedded layer and choose Remove.

.

QGIS Configuration

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

Note: 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 above could be located in the *View* menu (Panels and Toolbars) or in *Project* for Options.

9.1 Panels and Toolbars

In the *Panels→* menu, you can switch on and off QGIS widgets. The *Toolbars→* menu provides the possibility to switch on and off icon groups in the QGIS toolbar (see figure_panels_toolbars).
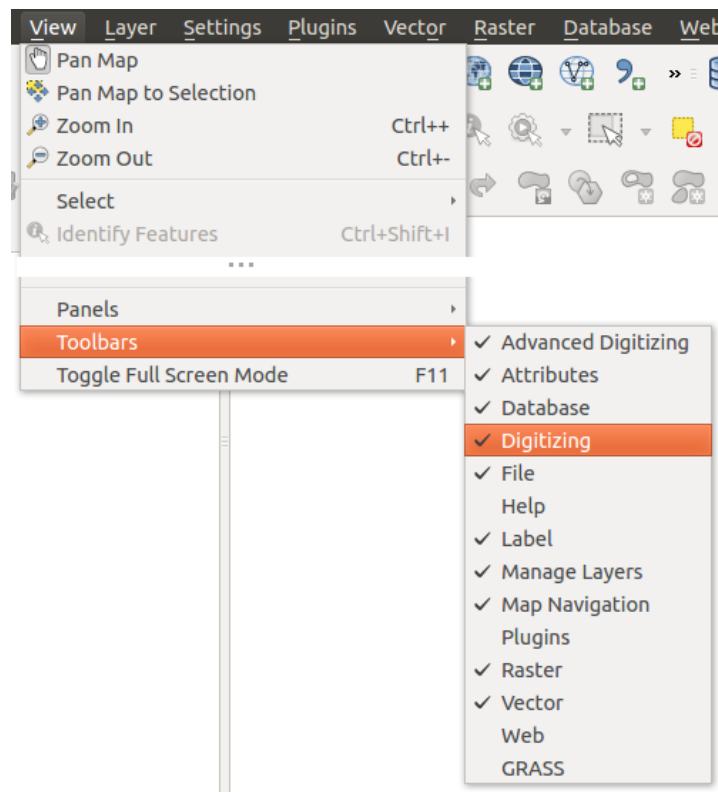
Figure 9.1: The Panels and Toolbars menu

Tip: Activating the QGIS Overview

In QGIS, you can use an overview panel that provides a full extent view of layers added to it. It can be selected under the menu 🐧 *Settings → Panels* or 🪟 *View → Panels*. 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 labeling. If you click and drag the red rectangle in the overview that shows your current extent, the main map view will update accordingly.

Tip: Show Log Messages

It's possible to track the QGIS messages. You can activate ☑ *Log Messages* in the menu 🐧 *Settings → Panels* or 🪟 *View → Panels* and follow the messages that appear in the different tabs during loading and operation.

9.2 Propriedades do Projecto

In the properties window for the project under 🐧 *Settings → Project Properties* (kde) or 🐧🪟 *Project → Project Properties* (Gnome), you can set project-specific options. These include:

- In the *General* menu, the project title, selection and background color, layer units, precision, and the option to save relative paths to layers can be defined. If the CRS transformation is on, you can choose an ellipsoid for distance calculations. You can define the canvas units (only used when CRS transformation is disabled) and the precision of decimal places to use. You can also define a project scale list, which overrides the global predefined scales.

- O menu *SRC* permite que escolha o Sistema de Coordenadas Referência para o projecto, e para activar a reprojecção on-the-fly das camadas matricias e vectoriais na exibição de camadas de diferentes SRC.

- With the third *Identify layers* menu, you set (or disable) which layers will respond to the identify tool (see the "Map tools" paragraph from the *Opções* section to enable identifying of multiple layers).

- The *Default Styles* menu 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 colours 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 define information about the QGIS Server WMS and WFS capabilities, extent and CRS restrictions.

- O menu *Macros* é para editar macros Python para os projectos. Actualmente, apenas estão disponíveis três macros: openProject(), saveProject() e closeProject().

- O menu *Relations* é usado para definir relações 1:n. As relações são definidas no diálogo das propriedades do projecto. Quando existirem relações para uma camada, um novo elemento de interface do utilizador na vista de formulário (p. ex. quando identificar um elemento e abrir o seu formulário) irá listar os elementos relacionados. Isto fornece uma maneira poderosa para expressar p. ex. o histórico de inspecção ao longo de um segmento de tubagem ou estrada. Poderá encontrar mais informação sobre suporte de relações 1:n na Secção *Creating one to many relations*.

9.3 Opções

🔧 Some basic options for QGIS can be selected using the *Options* dialog. Select the menu option *Settings →* 🔧 *Options*. The tabs where you can customize your options are described below.
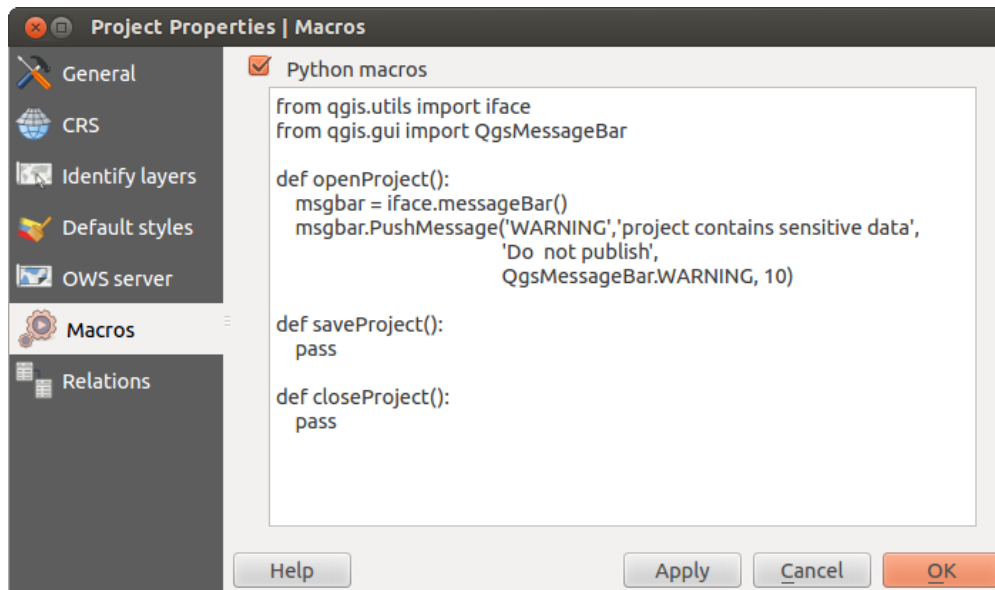
Figure 9.2: Macro settings in QGIS

9.3.1 Menu Geral

Aplicação

- Select the *Style (QGIS restart required)* [...▼] and choose between 'Oxygen','Windows','Motif','CDE', 'Plastique' and 'Cleanlooks' (🐧).

- Define the *Icon theme* [...▼] . Currently only 'default' is possible.

- Define the *Icon size* [...▼] .

- Define the *Font*. Choose between ⊙ *Qt default* and a user-defined font.

- Change the *Timeout for timed messages or dialogs* [...▼] .

- ☑ *Esconder o ecrã inicial no arranque*

- ☑ *Mostrar dicas ao iniciar*

- ☑ *Títulos da caixa de grupos a negrito*

- ☑ :guilabel:' Caixas de grupo em estilo QGIS'

- ☑ *Use native color chooser dialogs*

- ☑ *Use live-updating color chooser dialogs*

- ☑ *Custom side bar style*

- ☑ *Experimental canvas rotation support (restart required)*

Ficheiros de projecto

- *Open project on launch* [...▼] (choose between 'New', 'Most recent' and 'Specific'). When choosing 'Specific' use the [...] to define a project.

- ☑ *Create new project from default project*. Tem a possibilidade de carregar em *Set current project as default* ou em *Reset default*. Pode navegar através dos seus ficheiros e definir uma directoria onde encontrar os modelos de projecto definidos pelo utilizador. Isto será adicionado a *Project → New From Template*.

Primeiro active ☑ *Create new project from default project* e a seguir salve o projecto dentro da pasta de modelos de projecto.

- ☑ *Avisar para salvar projecto e alterações de fontes de dados quando necessário*

- ☑ *Prompt for confirmation when a layer is to be removed*

- ☑ *Avisar quando abrir um projecto guardado com uma versão antiga do |qg|*

- *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)'.

9.3.2 Menu Sistema

Ambiente

Variáveis de ambiente do sistema podem ser vistas agora, e muitas configuradas, no grupo **Environment** (ver figure_environment_variables). Isto é útil para plataformas, tais como Mac, onde um aplicativo GUI não herda necessariamente o ambiente do utilizador da linha de comandos. Também é útil para configuração e visualização de variáveis de ambiente para os conjuntos de ferramentas externas controlados pela caixa de ferramentas de Processamento (p. ex., SAGA, GRASS), e para activar a saída de depuração ("debugging") para secções específicas do código-fonte.

- ☑ *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*.
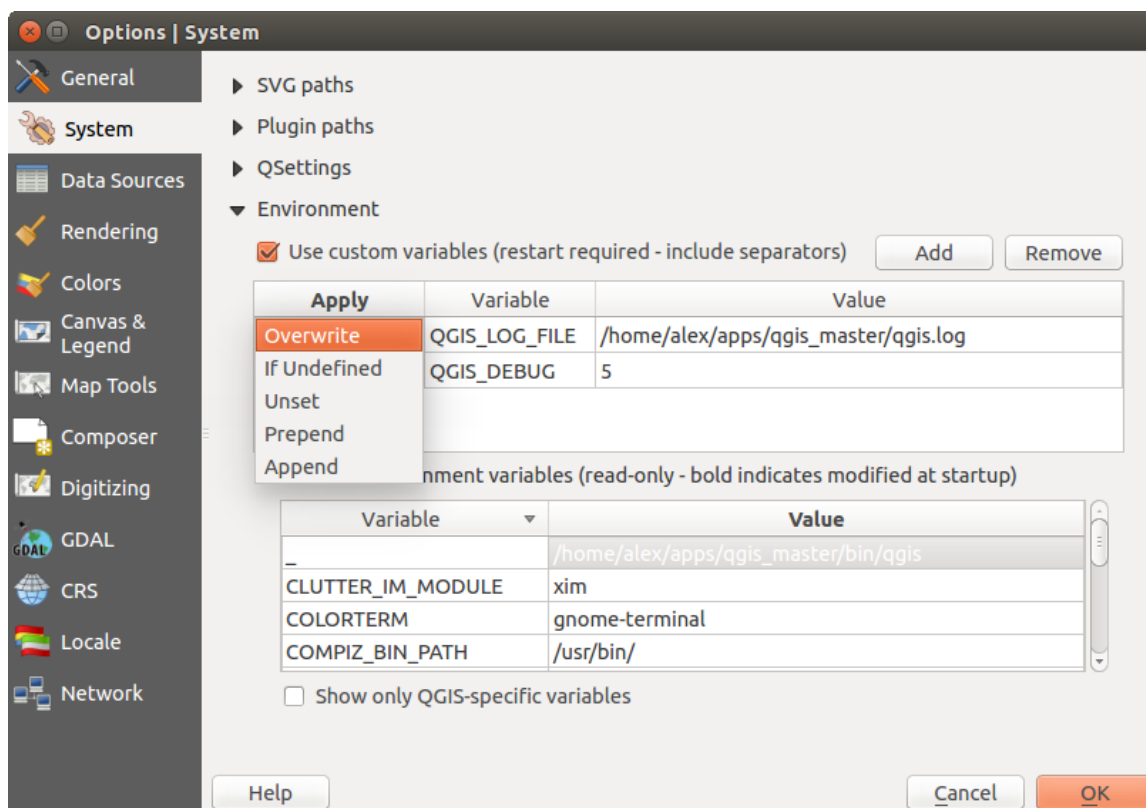
Figure 9.3: System environment variables in QGIS

Directórios dos módulos

[Adicionar] ou **[Remover]** *Caminho(s) para pesquisar bibliotecas de módulos C++ adicionais*

9.3.3 Menu Fonte de Dados

Atributos dos elementos e tabela

- ☑ *Abre a tabela de atributos na janela principal (Necessário reiniciar o QGIS)*

- ☑ *Copy geometry in WKT representation from attribute table.* When using 🗎 Copy selected rows to clipboard from the *Attribute table* dialog, this has the result that the coordinates of points or vertices are also copied to the clipboard.

- *Attribute table behaviour* [...▼] . There are three possibilities: 'Show all features', 'Show selected features' and 'Show features visible on map'.

- *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.

- *Representação para valores NULL.* Aqui, pode definir um valor para os campos de dados que contêm valores NULL.

Manipulação das fontes de dados

- *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.

- *Prompt for raster sublayers when opening.* Some rasters support sublayers — they are called subdatasets in GDAL. An example is netCDF files — if there are many netCDF variables, GDAL sees every variable as a subdataset. The option allows you to control how to deal with sublayers when a file with sublayers is opened. You have the following choices:

    - 'Sempre': Perguntar sempre (se existem subcamadas)

    - 'Se necessário': Perguntar se a camada não tem bandas, mas tem subcamadas

    - 'Nunca': Nunca pede, não irá carregar nada

    - 'Carregar tudo': Nunca pede, mas carrega todas as subcamadas

- ☑ *Ignore shapefile encoding declaration.* If a shapefile has encoding information, this will be ignored by QGIS.

- ☑ *Add PostGIS layers with double click and select in extended mode*

- ☑ *Adicione camadas Oracle com duplo clique e seleccione em modo alargado*

9.3.4 Menu de Renderização

Rendering behaviour

- ☑ *By default new layers added to the map should be displayed*

- ☑ *Use render caching where possible to speed up redraws*

- ☑ *Render layers in parallel using many CPU cores*

- ☑ *Max cores to use*

- *Map update interval (default to 250 ms)*

- ☑ *Enable feature simplication by default for newly added layers*

- *Simplification threshold*

- ☑ *Simplify on provider side if possible*

- *Maximum scale at which the layer should be simplified*

Qualidade de renderização

- ☑ *Fazer com que as linhas apareçam menos irregulares, em detrimento de algum desempenho do desenho*

Matriciais

- Com a *Selecção de banda RGB* pode definir o número para a banda Vermelha, Verde e Azul.

Contrast enhancement

- *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'.

- *Limites de contagem cumulativa de pixeis de corte*

- *Multiplicador do desvio-padrão*

Corrigindo Erros

- ☑ *Map canvas refresh*

9.3.5 Colors Menu

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.

9.3.6 Menu de Janela e Legenda

Aparência padrão do mapa (reescrita pelas propriedades do projecto)

- Define a *Cor da selecção* e a *Cor de fundo*.

Legenda da camada

- *Double click action in legend* ⬛▾ . You can either 'Open layer properties' or 'Open attribute table' with the double click.

- The following *Legend item styles* are possible:

    - ☑ *Maiusculizar os nomes das camadas*

    - ☑ *Tornar negrito os nomes das camadas*

    - ☑ *Tornar negrito os nomes dos grupos*

    - ☑ *Mostrar nomes de atributos de classificação*

    - ☑ *Criar ícones matriciais (pode ser lento)*

9.3.7 Menu Ferramentas de Mapa

This menu offers some options regarding the behaviour of the *Identify tool*.

- *Search radius for identifying and displaying map tips* is a tolerance factor expressed as a percentage of the map width. This means 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 are to be highlighted.

- *Buffer* expressed as a percentage of the map width, determines a buffer distance to be rendered from the outline of the identify highlight.

- *Minimum width* expressed as a percentage of the map width, determines how thick should the outline of a highlighted object be.

Ferramenta de medida

- Define *Cor do elástico* para as ferramentas de medida

- Define *Casas decimais*

- ☑ *Keep base unit*

- *Preferred measurements units* ⦿ ('Meters', 'Feet', 'Nautical Miles' or 'Degrees')'

- *Preferred angle units* ⦿ ('Degrees', 'Radians' or 'Gon')

Movendo e ampliando

- Define *Mouse wheel action* [...▼] ('Zoom', 'Zoom and recenter', 'Zoom to mouse cursor', 'Nothing')

- Define o *factor de aproximação/ afastamento* para a roda do rato

Escalas pré-definidas

Here, you find a list of predefined scales. With the **[+]** and **[-]** buttons you can add or remove your individual scales.

9.3.8 Composer Menu

Composition defaults

You can define the *Default font* here.

Aparência da Grelha

- Define the *Grid style* [...▼] ('Solid', 'Dots', 'Crosses')

- Define the *Grid color*

Grid and guide defaults

- Define the *Grid spacing* [1,00 ⇕]

- Define the *Grid offset* [1,00 ⇕] for x and y

- Define the *Snap tolerance* [1,00 ⇕]

9.3.9 Menu Digitalizar

Criação de elementos

- ☑ *Suprimir atributos de janelas pop-up depois de cada elemento criado*

- ☑ *Reutilizar últimos valores de atributos inseridos*

- *Validate geometries*. Editing complex lines and polygons with many nodes can result in very slow rendering. This is because the default validation procedures in QGIS can take a lot of time. To speed up rendering, it is possible to select GEOS geometry validation (starting from GEOS 3.3) or to switch it off. GEOS geometry validation is much faster, but the disadvantage is that only the first geometry problem will be reported.

Elástico

- Define a Borracha *Espessura da linha* e *Cor da linha*

Ajuste

- ☑ *Abrir opções de atracção na janela principal (necessário reiniciar o QGIS)*

- Define *Default snap mode* [...▼] ('To vertex', 'To segment', 'To vertex and segment', 'Off')

- Define *Tolerância de atracção pré-definida* em unidades de mapa ou pixeis

- Define o *Raio de pesquisa para editar vértices* em unidades de mapa ou pixeis

Marcadores de Vértices

- ☑ *Mostrar marcadores apenas para elementos seleccionados*

- Define vertex *Marker style* [...▼] ('Cross' (default), 'Semi transparent circle' or 'None')

- Definir o vértice *Tamanho do Marcador*

Ferramenta de curva de afastamento

The next 3 options refer to the 🥽 Offset Curve tool in *Digitalização Avançada*. 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*

- *Quadrant segments*

- *Miter limit*

9.3.10 Menu GDAL

GDAL is a data exchange library for raster files. In this tab, you can *Edit create options* and *Edit Pyramids Options* of the raster formats. Define which GDAL driver is to be used for a raster format, as in some cases more than one GDAL driver is available.

9.3.11 Menu SRC

SRC padrão para novos projectos

- ⚪ *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*

- Seleccione um SRC em *Iniciar sempre um novo projecto com este SRC*

SRC para novas camadas

This area allows you to define the action to take when a new layer is created, or when a layer without a CRS is loaded.

- ⦿ *Prompt for CRS*

- ⚪ *Use project CRS*

- ⚪ *Use default CRS*

Default datum transformations

- ☑ *Ask for datum transformation when no default is defined*

- If you have worked with the 'on-the-fly' CRS transformation you can see the result of the transformation in the window below. You can find information about 'Source CRS' and 'Destination CRS' as well as 'Source datum transform' and 'Destination datum transform'.

9.3.12 Locale Menu

- ☑ *Sobrepor idioma do sistema* e *Idioma a utilizar em alternativa*

- Informação sobre a região do sistema activo local

9.3.13 Network Menu

Geral

- Define *Pesquisa de endereço WMS*, padrão como `http://geopole.org/wms/search?search=\%1\&type=rss`

- Define *Tempo esgotado para pedidos de rede (ms)* - o padrão é 60000

- Define *Período de validade por defeito para tiles WMSC/WMTS (horas)* - por defeito é 24

- Define *Max retry in case of tile request errors*

- Define *User-Agent*

Configurações de cache

Define a *Pasta* e *Tamanho* para o cache.

- ☑ *Usar proxy para aceder à web* e define 'Máquina', 'Porta', 'Utilizador', e 'Palavra-chave'.

- Set the *Proxy type* [...▼] according to your needs.

  – *Default Proxy*: Proxy é determinado baseando-se na definição do proxy da aplicação em uso

  – *Socks5Proxy*: Proxy genérico para qualquer tipo de ligação. Suporta TCP, UDP, unindo a uma porta (ligações de entrada) e autenticação.

  – *HttpProxy*: Implementado usando o comando "LIGAR" , apenas suporta ligações TCP de saída; suporta autenticação.

  – *HttpCachingProxy*: Implementado usando comandos HTTP normais, é útil apenas no contexto de pedidos HTTP.

  – *FtpCachingProxy*: Implementado usando um proxy FTP, é útil no contexto de pedidos FTP.

Alguns URLs excluídos podem ser adicionados na caixa de texto debaixo das configurações de proxy (veja 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.trolltech.com/4.5/qnetworkproxy.html#ProxyType-enum.

Tip: Usando Proxies

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

You can modify the options according to your needs. Some of the changes may require a restart of QGIS before they will be effective.

- ⬤ Settings are saved in a text file: `$HOME/.config/QGIS/QGIS2.conf`
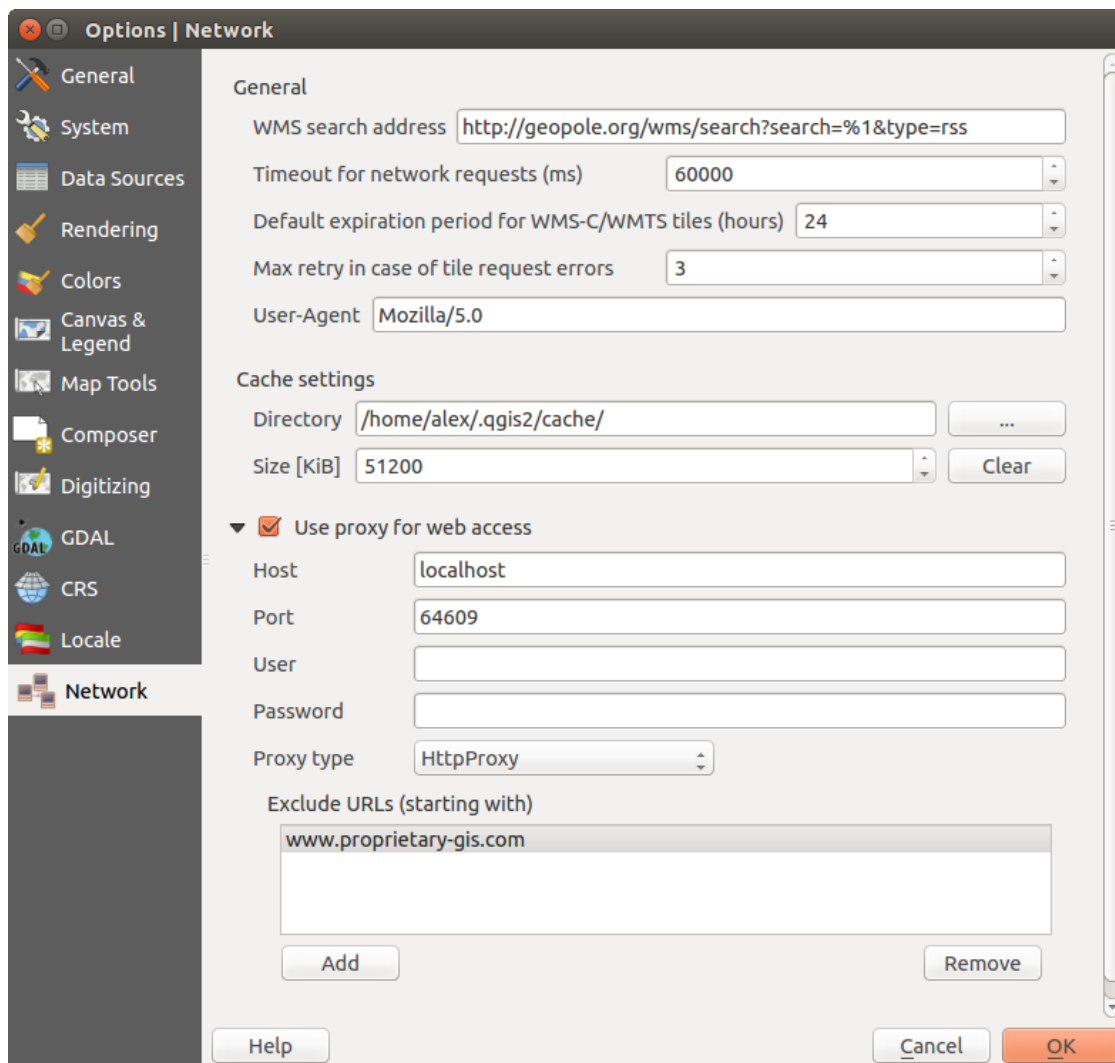
Figure 9.4: Proxy-settings in QGIS

- **X** pode encontrar as configurações em: `$HOME/Library/Preferences/org.qgis.qgis.plist`

- As configurações são armazenadas no registo em: `HKEY\CURRENT_USER\Software\QGIS\qgis`

9.4 Personalização

The customization tool lets you (de)activate almost every element in the QGIS user interface. This can be very useful if you have a lot of plugins installed that you never use and that are filling your screen.
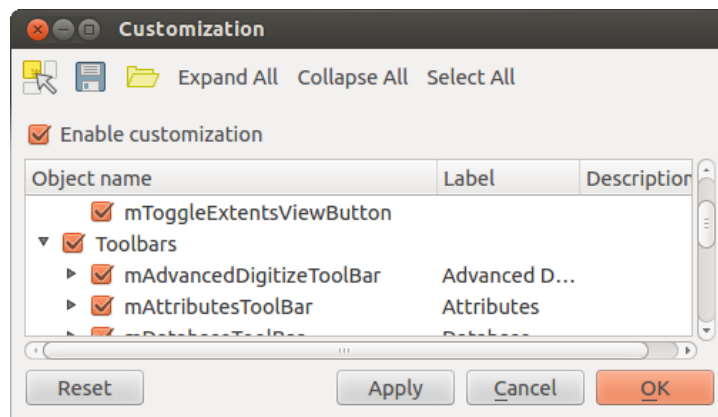
Figure 9.5: The Customization dialog

QGIS Customization is divided into five groups. In *Menus*, you can hide entries in the Menu bar. In *Panels*, you find the panel windows. Panel windows are applications that can be started and used as a floating, top-level window or embedded to the QGIS main window as a docked widget (see also *Panels and Toolbars*). In the *Status Bar*, features like the coordinate information can be deactivated. In *Toolbars*, you can (de)activate the toolbar icons of QGIS, and in *Widgets*, you can (de)activate dialogs as well as their buttons.

With Switch to catching widgets in main application, you can click on elements in QGIS that you want to be hidden and find the corresponding entry in Customization (see figure_customization). You can also save your various setups for different use cases as well. Before your changes are applied, you need to restart QGIS.

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Trabalhando com Projecções

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 Visão geral do Suporte a Projecções

QGIS has support for approximately 2,700 known CRSs. Definitions for each CRS are stored in a SQLite database that is installed with QGIS. Normally, you do not need to manipulate the database directly. In fact, doing so may cause projection support to fail. Custom CRSs are stored in a user database. See section *Sistema de Coordenadas personalizado* for information on managing your custom coordinate reference systems.

The CRSs available in QGIS are based on those defined by the European Petroleum Search Group (EPSG) and the Institut Geographique National de France (IGNF) and are largely abstracted from the spatial reference tables used in GDAL. EPSG identifiers are present in the database and can be used to specify a CRS in 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* (Gnome, OS X) or *Settings* (KDE, Windows) menu.

10.2 Especificação Geral da Projecção

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...]** button in the first section, which is used to define the default coordinate reference system for new projects, as shown in figure_projection_1. 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*.

As opções mostradas na figure_projections_1 são:

- ⦿ *Prompt for CRS*
- ⦾ *Use project CRS*
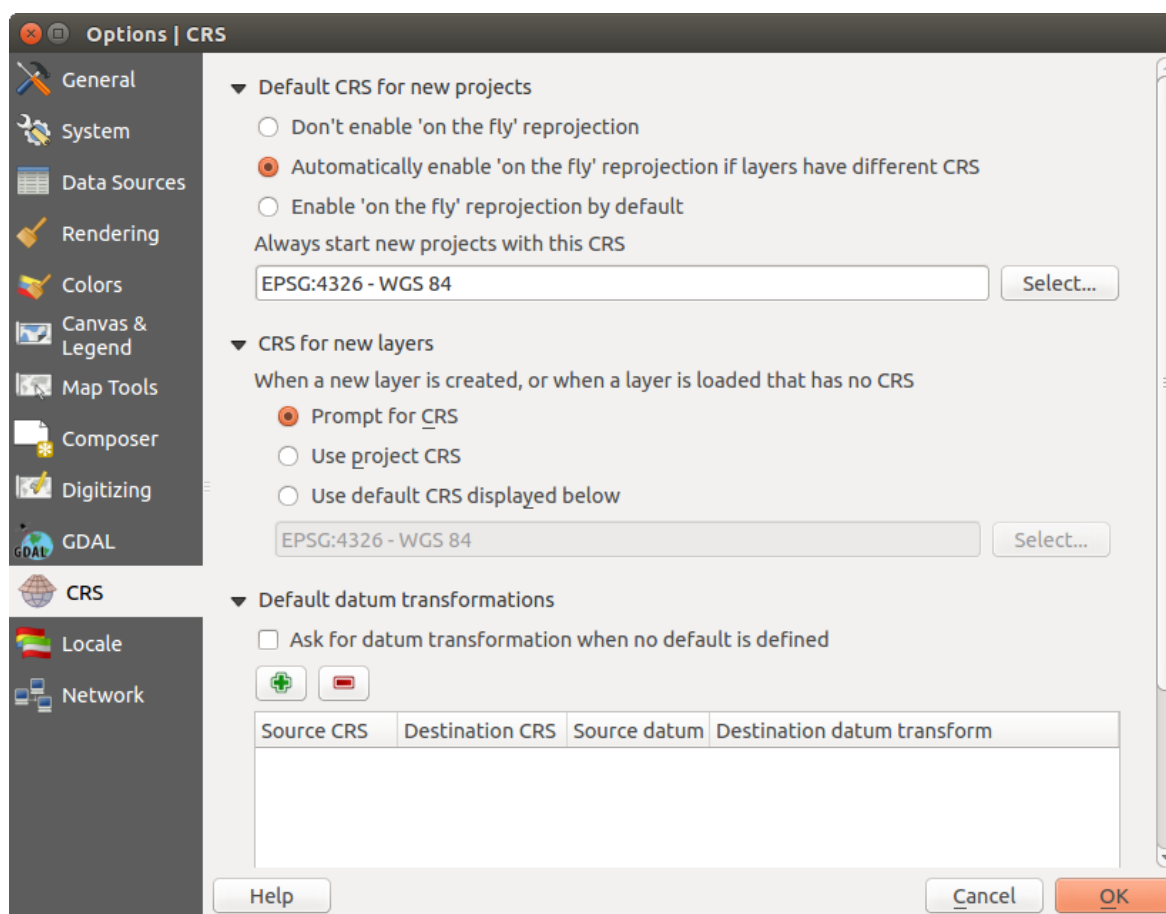
Figure 10.1: CRS tab in the QGIS Options Dialog

- ⬤ *Use default CRS displayed below*

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 *Menu Geral* for rasters and *Menu Geral* for vectors). If your layer already has a CRS defined, it will be displayed as shown in *Vector Layer Properties Dialog* .

Tip: SC na Legenda do Mapa

Clicando com o botão direito num tema na Legenda do Mapa (secção *Map Legend*) mostra dois atalhos SC. *Definir SC do tema* abre a janela de Selecção de Sistema de Coordenadas (ver figure_projection_2). *Definir SC do projecto a partir do Tema* redefine o SC do projecto usando o SC do tema.

10.3 Definir Reprojecção Dinâmica (RD)

QGIS supports OTF reprojection for both raster and vector data. However, OTF is not activated by default. To use OTF projection, you must activate the ☑ *Enable on the fly CRS transformation* checkbox in the *CRS* tab of the ✏ *Project Properties* dialog.

Há três formas de fazer isto:

1. Select 🔧 *Project Properties* from the *Project* (Gnome, OSX) or *Settings* (KDE, Windows) menu.

2. Clique no ícone ⊕ estado SC no canto inferior direito da barra de estado.

3. Active a projecção dinâmica por omissão no separador *SC* da janela *Opções* selecionando a ☑ *Activar reprojecção dinâmica por omissão* ou *Automaticamente activar a reprojecção dinâmica se temas têm diferentes SC*.

Se tem já carregado um tema e quer activar a projecção dinâmica, a melhor prática é abrir o separador *SC* na janela *Propriedades do Projecto*, selecionar um SC, e activar a caixa de selecção ☑ *Activar transformação dinâmica de SC*. O ícone ⊕ Estado SC deixará de estar desactivado (cinzento), e todos os temas serão dinamicamente reprojectados para o SC mostrado junto ao ícone.

O separador *SC* na janela *Propriedades do Projecto* contem cinco componentes importantes, como mostrado na Figure_projections_2 e descritos abaixo:

1. **Acivar transformção 'dinâmica´ de SC** — Esta caixa de selecção é usada para activar ou desactivar a projecção dinâmica. Quando desligada, cada tema é desenhado usando as coordenadas lidas dos seus dados, e os componentes descritos abaixo estão inactivos. Quando ligada, as coordenadas de cada tema são projectadas para o sistema de coordenadas definido para o mapa.

2. **Filtro** — Se conhece o código EPSG, o identificador, ou o nome para um sistema de coordenadas, pode usar a função de pesquisa para o encontrar. Introduza o código EPSG, o identificador ou o nome.

3. **Sistemas de coordenadas usados recentemente** — Se tem certos SCs que usa frequentemente no seu trabalho SIG diário, estes serão mostrados nesta lista. Clique num destes itens para selecionar o SC correspondente.

4. **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.

5. **Texto PROJ.4** — Este é um texto de SC usado pelo motor de projecções PROJ.4. Este texto é de apenas leitura e fornecido para fins de informação.

Tip: Janela de Propriedades do Projecto

Se abrir a janela *Propriedades do Projecto* a partir do menu **:menuselecion:'Projecto'**, deve clicar no separador *SC* para ver as definições de SC.
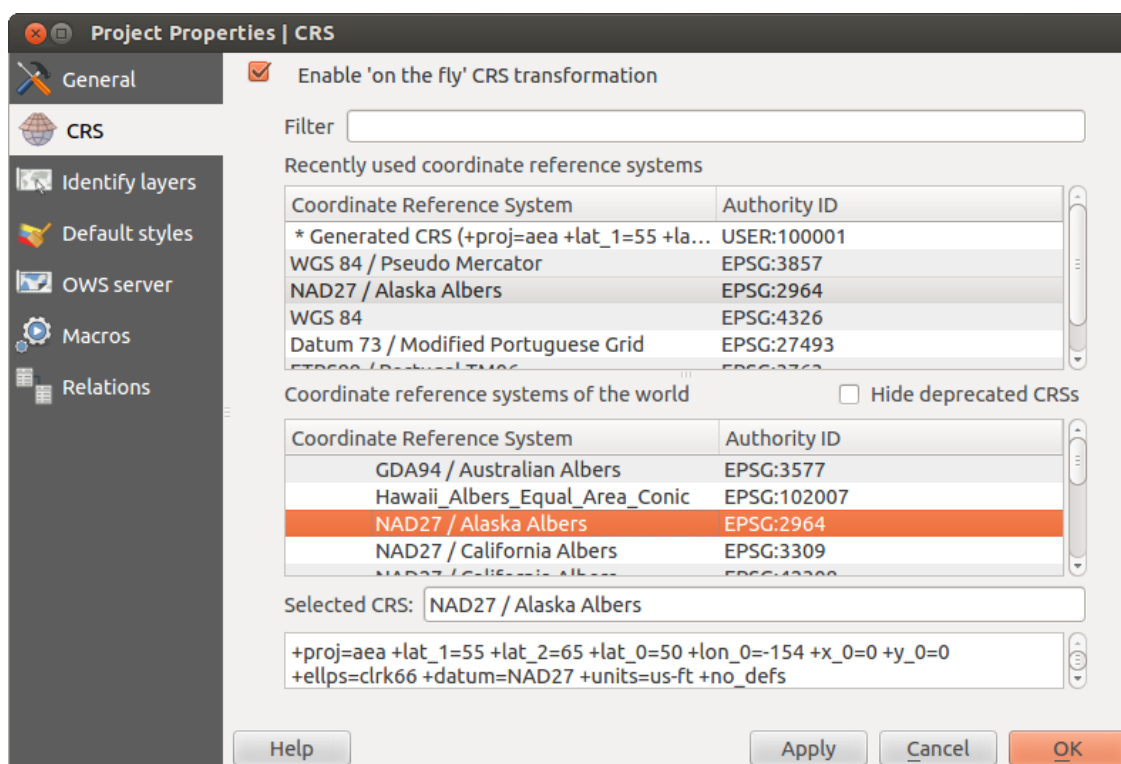
Figure 10.2: Project Properties Dialog 🐧

Abrindo a janela a partir do ícone ⊕ Estado SC abrirá automaticamente o separador *SC*.

10.4 Sistema de Coordenadas personalizado

If QGIS does not provide the coordinate reference system you need, you can define a custom CRS. To define a CRS, select 🌐 *Custom CRS...* from the *Settings* menu. Custom CRSs are stored in your QGIS user database. In addition to your custom CRSs, this database also contains your spatial bookmarks and other custom data.

Defining a custom CRS in QGIS requires a good understanding of the PROJ.4 projection library. To begin, refer to "Cartographic Projection Procedures for the UNIX Environment - A User's Manual" by Gerald I. Evenden, U.S. Geological Survey Open-File Report 90-284, 1990 (available at 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.

A janela *Definição de Sistema de Coordenadas personalizado* exige apenas dois parâmetros para definir um SC do utilizador:

1. Um nome descritivo

2. Os parâmetros cartográficos no 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 os *Parâmetros* devem começar com um bloco `+proj=`, para representar o novo sistema de coordenadas.

Pode testar os parâmetros do seu SC para ver se fornecem resultados aceitáveis. Para isto, introduza valores conhecidos de latitude e longitude WGS 84 nos campos *Norte* e *Este*, respectivamente. Clique em**[Calcular]**, e compare os resultados com os seus valores conhecidos no seu sistema de coordenadas.
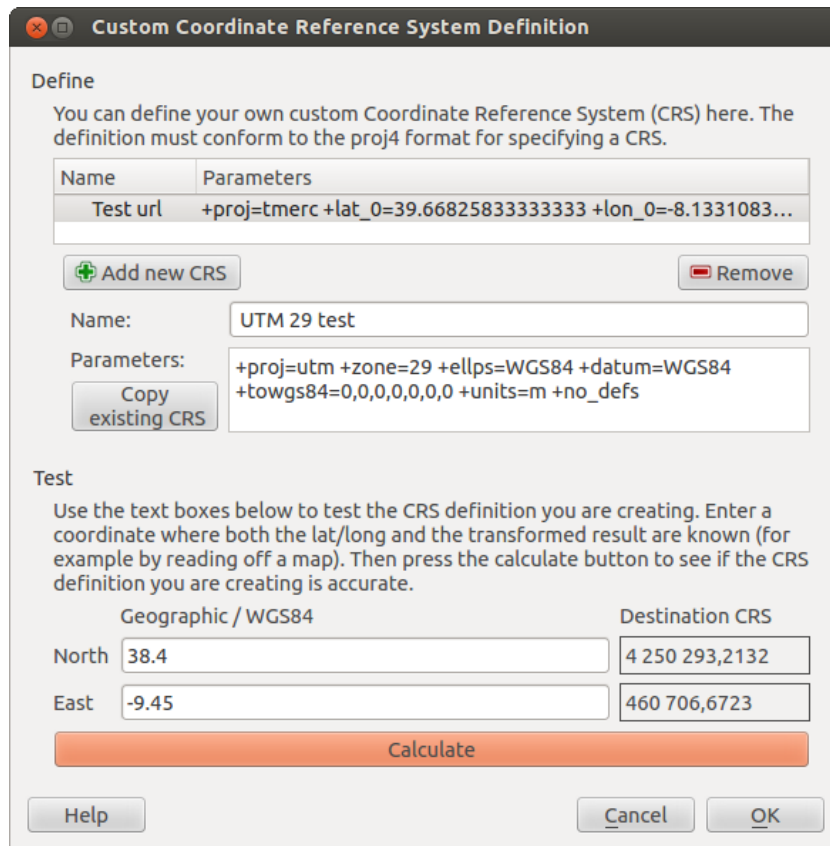
Figure 10.3: Custom CRS Dialog

10.5 Transformações de datum pré-definidas

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*
- editar uma lista do utilizador de transformações pré-definidas.

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*.

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QGIS Browser

The QGIS Browser is a panel in QGIS that lets you easily navigate in your filesystem and manage geodata. You can have access to common vector files (e.g., ESRI shapefiles or MapInfo files), databases (e.g., PostGIS, Oracle, SpatiaLite or MS SQL Spatial) and WMS/WFS connections. You can also view your GRASS data (to get the data into QGIS, see *Integração GRASS SIG*).
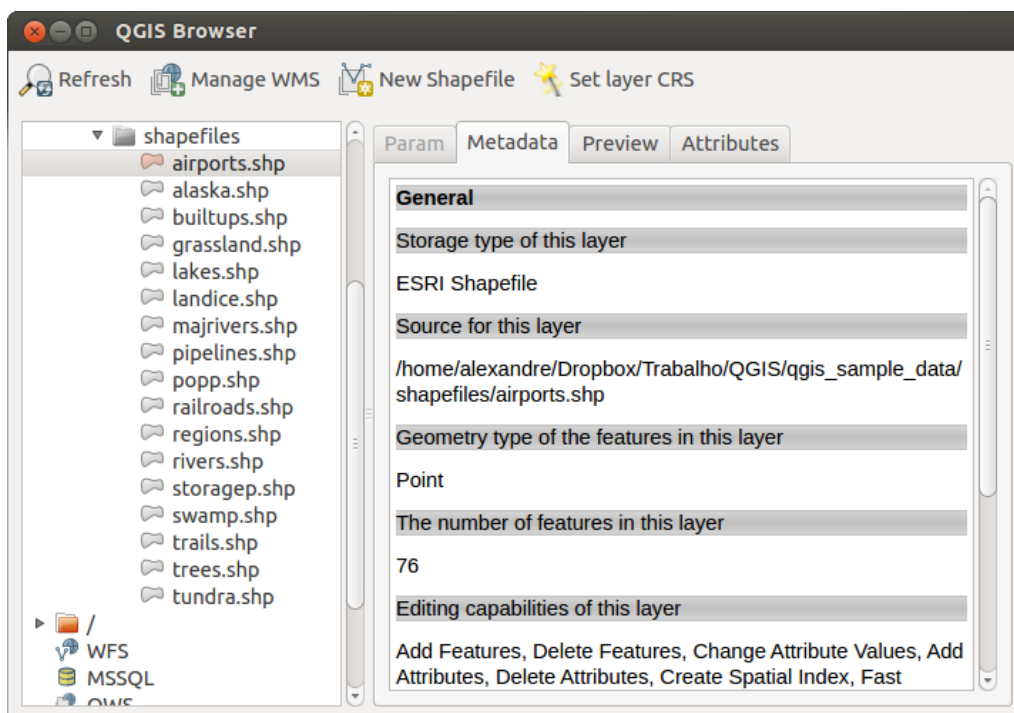
Figure 11.1: QGIS browser as a stand alone application

Use the QGIS Browser to preview your data. The drag-and-drop function makes it easy to get your data into the map view and the map legend.

1. Activate the QGIS Browser: Right-click on the toolbar and check ✅*Browser* or select it from *Settings →Panels*.

2. Drag the panel into the legend window and release it.

3. Click on the *Browser* tab.

4. Browse in your filesystem and choose the `shapefile` folder from `qgis_sample_data` directory.

5. Press the `Shift` key and select the `airports.shp` and `alaska.shp` files.

6. Press the left mouse button, then drag and drop the files into the map canvas.

7. Right-click on a layer and choose *Set project CRS from layer*. For more information see *Trabalhando com Projecções*.

8. Click on ^{Zoom Full} to make the layers visible.

There is a second browser available under *Settings → Panels*. This is handy when you need to move files or layers between locations.

1. Activate a second QGIS Browser: Right-click on the toolbar and check *Browser (2)*, or select it from *Settings → Panels*.

2. Drag the panel into the legend window.

3. Navigate to the *Browser (2)* tab and browse for a shapefile in your file system.

4. Select a file with the left mouse button. Now you can use the ^{Add Selected Layers} icon to add it into the current project.

QGIS automatically looks for the coordinate reference system (CRS) and zooms to the layer extent if you work in a blank QGIS project. If there are already files in your project, the file will just be added, and in the case that it has the same extent and CRS, it will be visualized. If the file has another CRS and layer extent, you must first right-click on the layer and choose *Set Project CRS from Layer*. Then choose *Zoom to Layer Extent*.

The ^{Filter files} function works on a directory level. Browse to the folder where you want to filter files and enter a search word or wildcard. The Browser will show only matching filenames – other data won't be displayed.

It's also possible to run the QGIS Browser as a stand-alone application.

Start the QGIS browser

- Escreva na linha de comandos "qbrowser" .

- Start the QGIS Browser using the Start menu or desktop shortcut.

- The QGIS Browser is available from your Applications folder.

In figure_browser_standalone_metadata, you can see the enhanced functionality of the stand-alone QGIS Browser. The *Param* tab provides the details of your connection-based datasets, like PostGIS or MSSQL Spatial. The *Metadata* tab contains general information about the file (see *Menu Metadados*). With the *Preview* tab, you can have a look at your files without importing them into your QGIS project. It's also possible to preview the attributes of your files in the *Attributes* tab.

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Trabalhando com Informação Vectorial

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12.1 Formatos de dados suportados

QGIS uses the OGR library to read and write vector data formats, including ESRI shapefiles, MapInfo and MicroStation file formats, AutoCAD DXF, PostGIS, SpatiaLite, Oracle Spatial and MSSQL Spatial databases, and many more. GRASS vector and PostgreSQL support is supplied by native QGIS data provider plugins. Vector data can also be loaded in read mode from zip and gzip archives into QGIS. As of the date of this document, 69 vector formats are supported by the OGR library (see OGR-SOFTWARE-SUITE in *Literatura e Referências Web*). The complete list is available at http://www.gdal.org/ogr/ogr_formats.html.

Note: Not all of the listed formats may work in QGIS for various reasons. For example, some require external commercial libraries, or the GDAL/OGR installation of your OS may not have been built to support the format you want to use. Only those formats that have been well tested will appear in the list of file types when loading a vector into QGIS. Other untested formats can be loaded by selecting `*.*`.

Trabalhar com os dados vectoriais GRASS está disponível na secção *Integração GRASS SIG*.

This section describes how to work with several common formats: ESRI shapefiles, PostGIS layers, SpatiaLite layers, OpenStreetMap vectors, and Comma Separated data (CSV). Many of the features available in QGIS work the same, regardless of the vector data source. This is by design, and it includes the identify, select, labeling and attributes functions.

12.1.1 ESRI Shapefiles

The standard vector file format used in QGIS is the ESRI shapefile. Support is provided by the OGR Simple Feature Library (http://www.gdal.org/ogr/).

Um shapefile na verdade consiste em vários arquivos. Os três seguintes são necessários:

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

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.

Loading a Shapefile

To load a shapefile, start QGIS and click on the Add Vector Layer toolbar button, or simply press `Ctrl+Shift+V`. This will bring up a new window (see figure_vector_1).
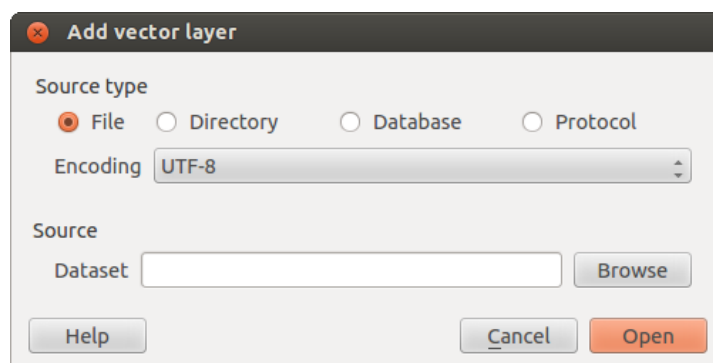
Figure 12.1: Add Vector Layer Dialog

From the available options check ◉ *File*. Click on **[Browse]**. That will bring up a standard open file dialog (see figure_vector_2), which allows you to navigate the file system and load a shapefile or other supported data source. The selection box *Filter* allows you to preselect some OGR-supported file formats.

You can also select the encoding for the shapefile if desired.
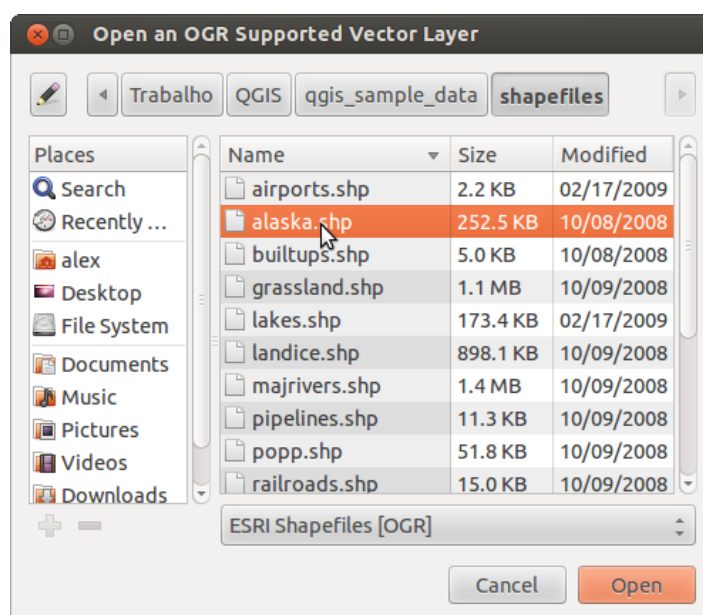
Figure 12.2: Open an OGR Supported Vector Layer Dialog

Selecting a shapefile from the list and clicking **[Open]** loads it into QGIS. Figure_vector_3 shows QGIS after loading the `alaska.shp` file.

Tip: Cores das Camadas

Quando adiciona uma camada no mapa, são atribuídas cores aleatórias. Quando adiciona mais que um tema ao mesmo tempo, são atribuídas cores diferentes a cada camada.

Once a shapefile 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

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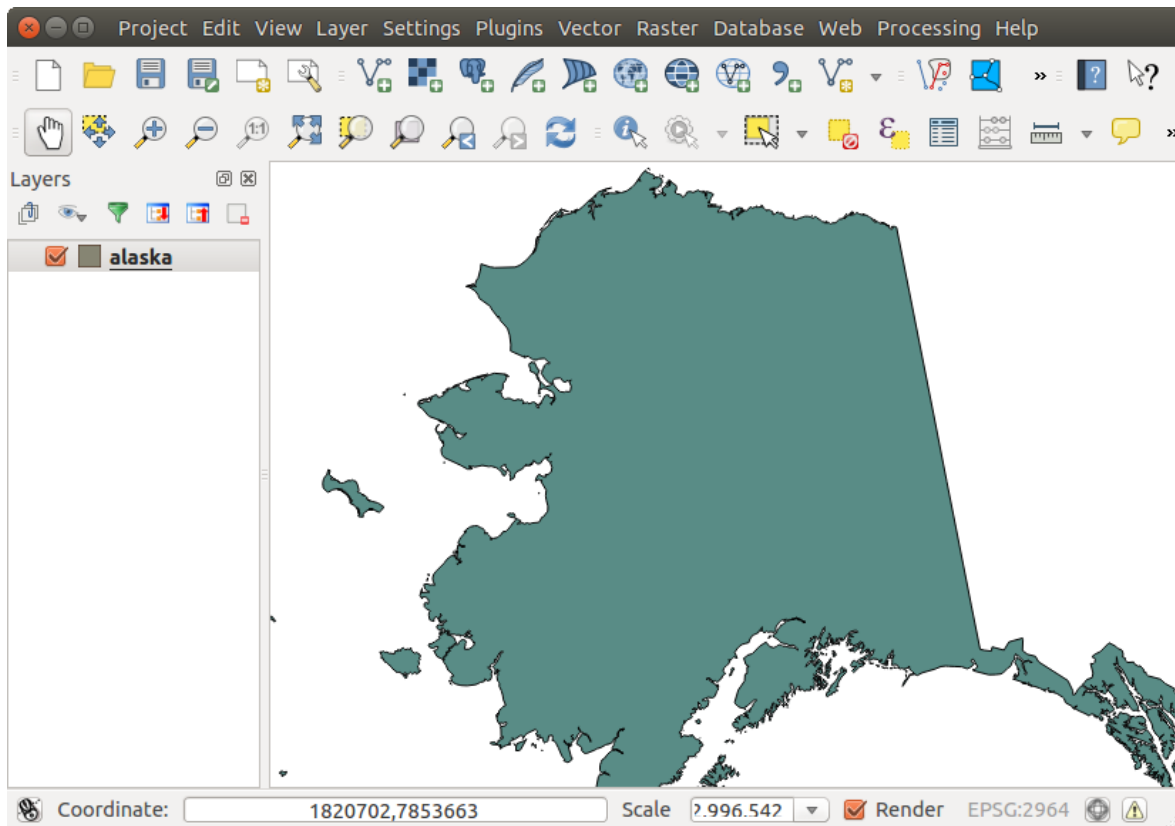
Figure 12.3: QGIS with Shapefile of Alaska loaded

the legend and choosing *Properties* from the context menu. See section *Estilos* for more information on setting symbology of vector layers.

Tip: Carrega camada e projecto de drives externas montadas em OS X

On OS X, 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 OSX-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.

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.

Utilize estes passos para criar um índice:

- Load a shapefile by clicking on the ![icon] Add Vector Layer toolbar button or pressing Ctrl+Shift+V.

- 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

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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`.

12.1.2 Loading a MapInfo Layer

To load a MapInfo layer, click on the Add Vector Layer toolbar button; or type `Ctrl+Shift+V`, change the file type filter *Files of type* : to 'Mapinfo File [OGR] (*.mif *.tab *.MIF *.TAB)' and select the MapInfo layer you want to load.

12.1.3 Loading an ArcInfo Binary Coverage

To load an ArcInfo Binary Coverage, click on the Add Vector Layer toolbar button or press `Ctrl+Shift+V` to open the *Add Vector Layer* dialog. Select *Directory* as *Source type*. Change the file type filter *Files of type* to 'Arc/Info Binary Coverage'. Navigate to the directory that contains the coverage file, and select it.

Similarly, you can load directory-based vector files in the UK National Transfer Format, as well as the raw TIGER Format of the US Census Bureau.

12.1.4 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.

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 *Amostra de Dados*):

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

Some items to note about the text file:

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.

Loading a delimited text file

Click the toolbar icon ![Add Delimited Text Layer] 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_1.
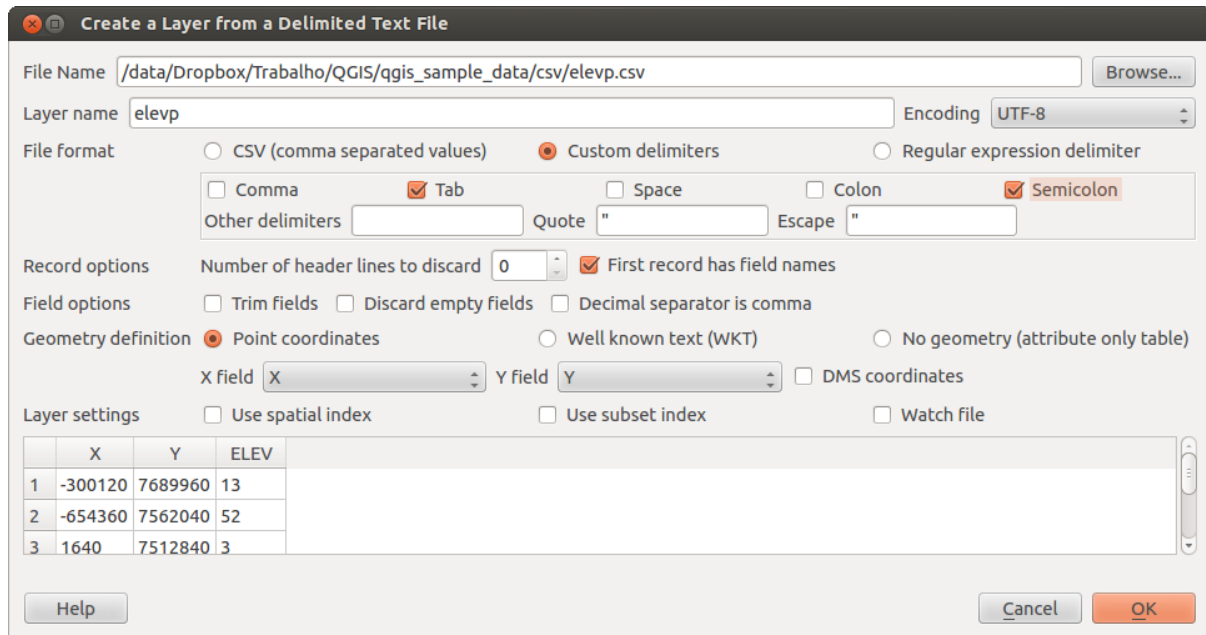
Figure 12.4: Delimited Text Dialog 🐧

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 ⦿ *Custom delimiters*, or by activating ⦿ *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.

Finally, enter a layer name (e.g., `elevp`), as shown in figure_delimited_text_1. 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.

Additionaly, 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.

12.1.5 OpenStreetMap data

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 suppport for OSM data.

Loading OpenStreetMap Vectors

QGIS integrates OpenStreetMap import as a core functionality.

- To connect to the OSM server and download data, open the menu *Vector → Openstreetmap → Load 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 an XML file* 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*).

12.1.6 Camadas POSTGIS

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

Criar uma Conexão Armazenada

The first time you use a PostGIS data source, you must create a connection to the PostgreSQL database that contains the data. Begin by clicking on the Add PostGIS Layer toolbar button, selecting the Add PostGIS Layer... option from the *Layer* menu, or typing `Ctrl+Shift+D`. You can also open the *Add Vector Layer* dialog and select Database. The *Add PostGIS Table(s)* dialog will be displayed. To access the connection manager, click on the **[New]** button to display the *Create a New PostGIS Connection* dialog. The parameters required for a connection are:

- **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`.

- **Host**: Name of the database host. This must be a resolvable host name such as would be used to open a telnet 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 is 5432.

- **Database**: Name of the database.

- **SSL mode**: How the SSL connection will be negotiated with the server. Note that massive speedups 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.

Optionally, you can activate the following checkboxes:

- ☑ *Save Username*

- ☑ *Save Password*

- ☑ *Only look in the geometry_columns table*

- ☑ *Don't resolve type of unrestricted columns (GEOMETRY)*

- ☑ *Only look in the 'public' schema*

- ☑ *Also list tables with no geometry*

- ☑ *Use estimated table metadata*

Once all parameters and options are set, you can test the connection by clicking on the **[Test Connect]** button.

Loading a PostGIS Layer

Once you have one or more connections defined, you can load layers from the PostgreSQL database. Of course, this requires having data in PostgreSQL. See section *Importing Data into PostgreSQL* for a discussion on importing data into the database.

To load a layer from PostGIS, perform the following steps:

- If the *Add PostGIS layers* dialog is not already open, selecting the *Add PostGIS Layer...* option from the *Layer* menu or typing `Ctrl+Shift+D` opens the dialog.

- Choose the connection from the drop-down list and click **[Connect]**.

- Select or unselect ☑ *Also list tables with no geometry*.

- Optionally, use some ☑ *Search Options* to define which features to load from the layer, or use the **[Build query]** button to start the *Query builder* dialog.

- Find the layer(s) you wish to add in the list of available layers.

- Select it by clicking on it. You can select multiple layers by holding down the `Shift` key while clicking. See section *Ferramenta de Consulta* for information on using the PostgreSQL Query Builder to further define the layer.

- Click on the **[Add]** button to add the layer to the map.

Tip: PostGIS Layers

Normally, a PostGIS layer is defined by an entry in the geometry_columns table. From version 0.9.0 on, 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.

Some details about PostgreSQL layers

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.

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).

If the PostgreSQL layer is a view, the same requirement exists, but views do not 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).

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. It can make sense to disable this option when you use expensive views.

Tip: Backup of PostGIS database with layers saved by QGIS

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

12.1.7 Importing Data into PostgreSQL

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

DB Manager

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 *Módulo Gestor BD* 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 *Trabalhando com Projecções* for more information on spatial reference systems and projections.

Tip: 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.

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ogr2ogr

Besides **shp2pgsql** and **DB Manager**, there is another tool for feeding geodata in PostGIS: **ogr2ogr**. This is part of your GDAL installation.

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 X):

```
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 *Improving Performance*).

Improving Performance

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.refractions.net).

The syntax for creating a GiST index is:

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

Note that for large tables, creating the index can take a long time. Once the index is created, you should perform a VACUUM ANALYZE. See the PostGIS documentation (POSTGIS-PROJECT *Literatura e Referências Web*) for more information.

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$
```

12.1.8 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_4, 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 12.5: 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.
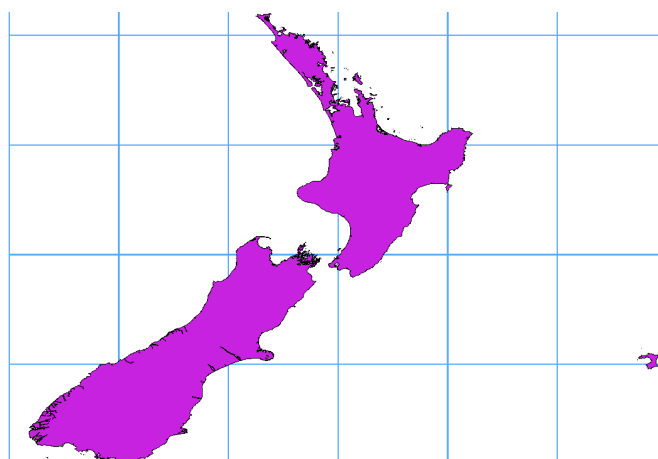
Figure 12.6: Crossing 180° longitude applying the **ST_Shift_Longitude** function

Usage

• 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);`

• 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_5).

12.1.9 SpatiaLite Layers

The first time you load data from a SpatiaLite database, begin by clicking on the Add SpatiaLite Layer toolbar button, or by selecting the Add SpatiaLite Layer... option from the *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.

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.

Creating a new SpatiaLite layer

If you want to create a new SpatiaLite layer, please refer to section *Criando uma nova camada SpatialLite*.

Tip: 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.

12.1.10 MSSQL Spatial Layers

QGIS also provides native MS SQL 2008 support. The first time you load MSSQL Spatial data, begin by clicking on the Add MSSQL Spatial Layer toolbar button or by selecting the Add MSSQL Spatial Layer... option from the *Layer* menu, or by typing `Ctrl+Shift+M`.

12.1.11 Oracle Spatial Layers

The spatial features in Oracle Spatial aid users in managing geographic and location data in a native type within an Oracle database. QGIS now has support for such layers.

Criar uma Conexão Armazenada

The first time you use an Oracle Spatial data source, you must create a connection to the database that contains the data. Begin by clicking on the Add Orcale Spatial Layer toolbar button, selecting the Add Orcale Spatial Layer... option from the *Layer* menu, or typing `Ctrl+Shift+O`. To access the connection manager, click on the **[New]** button to display the *Create a New Oracle Spatial Connection* dialog. The parameters required for a connection are:

- **Name**: A name for this connection. It can be the same as *Database*
- **Database**: SID or SERVICE_NAME of the Oracle instance.
- **Host**: Name of the database host. This must be a resolvable host name such as would be used to open a telnet connection or ping the host. If the database is on the same computer as QGIS, simply enter *'localhost'* here.
- **Port**: Port number the Oracle database server listens on. The default port is 1521.

- **Username**: Username used to login to the database.

- **Password**: Password used with *Username* to connect to the database.

Optionally, you can activate following checkboxes:

- ☑ *Save Username* Indicates whether to save the database username in the connection configuration.

- ☑ *Save Password* Indicates whether to save the database password in the connection settings.

- ☑ *Only look in meta data 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.

Once all parameters and options are set, you can test the connection by clicking on the **[Test Connect]** button.

Tip: QGIS User Settings and Security

Depending on your computing environment, storing passwords in your QGIS settings may be a security risk. Passwords are saved in clear text in the system configuration and in the project files! Your customized settings for QGIS are stored based on the operating system:

- 🐧 The settings are stored in your home directory in `~/.qgis2`.

- 🪟 The settings are stored in the registry.

Loading an Oracle Spatial Layer

🔵 Once you have one or more connections defined, you can load layers from the Oracle database. Of course, this requires having data in Oracle.

To load a layer from Oracle Spatial, perform the following steps:

- If the *Add Oracle Spatial layers* dialog is not already open, click on the 🔵 Add Oracle Spatial Layer toolbar button.

- Choose the connection from the drop-down list and click **[Connect]**.

- Select or unselect ☑ *Also list tables with no geometry*.

- Optionally, use some ☑ *Search Options* to define which features to load from the layer or use the **[Build query]** button to start the *Query builder* dialog.

- Find the layer(s) you wish to add in the list of available layers.

- Select it by clicking on it. You can select multiple layers by holding down the `Shift` key while clicking. See section *Ferramenta de Consulta* for information on using the Oracle Query Builder to further define the layer.

- Click on the **[Add]** button to add the layer to the map.

Tip: Oracle Spatial Layers

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

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12.2 The Symbol Library

12.2.1 Apresentação

The Symbol Library is the place where users can create generic symbols to be used in several QGIS projects. It allows users to export and import symbols, groups symbols and add, edit and remove symbols. You can open it with the *Settings → Style Library* or from the **Style** tab in the vector layer's *Properties*.

Share and import symbols

Users can export and import symbols in two main formats: qml (QGIS format) and SLD (OGC standard). Note that SLD format is not fully supported by QGIS.

 share item displays a drop down list to let the user import or export symbols.

Groups and smart groups

Groups are categories of Symbols and smart groups are dynamic groups.

To create a group, right-click on an existing group or on the main **Groups** directory in the left of the library. You can also select a group and click on the add item button.

To add a symbol into a group, you can either right click on a symbol then choose *Apply group* and then the group name added before. There is a second way to add several symbols into group: just select a group and click and choose **Group Symbols**. All symbols display a checkbox that allow you to add the symbol into the selected groups. When finished, you can click on the same button, and choose **Finish Grouping**.

Create **Smart Symbols** is similar to creating group, but instead select **Smart Groups**. The dialog box allow 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.)

Add, edit, remove symbol

With the *Style manager* from the **[Symbol]** menu you can manage your symbols. You can add item, edit item, remove item and share item. 'Marker' symbols, 'Line' symbols, 'Fill' patterns and 'colour ramps' can be used to create the symbols. The symbols are then assigned to 'All Symbols', 'Groups' or 'Smart groups'.

For each kind of symbols, you will find always the same dialog structure:

- at the top left side a symbol representation
- under the symbol representation the symbol tree show the symbol layers
- at the right you can setup some parameter (unit,transparency, color, size and rotation)
- under these parameters you find some symbol from the symbols library

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The symbol tree allow adding, removing or protect new simple symbol. You can move up or down the symbol layer.

More detailed settings can be made when clicking on the second level in the *Symbol layers* dialog. You can define *Symbol layers* that are combined afterwards. A symbol can consist of several *Symbol layers*. Settings will be shown later in this chapter.

Tip: 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* menu in the first level again. The size of the lower levels changes accordingly, while the size ratio is maintained.

12.2.2 Marker Symbols

Marker symbols have several symbol layer types:

- Ellipse marker
- Font marker
- Simple marker (default)
- SVG marker
- Vector Field marker

The following settings are possible:

- *Symbol layer type*: You have the option to use Ellipse markers, Font markers, Simple markers, SVG markers and Vector Field markers.
- *colors*
- *Size*
- *Outline style*
- *Outline width*
- *Angle*
- *Offset X,Y*: You can shift the symbol in the x- or y-direction.
- *Anchor point*
- *Data defined properties ...*

12.2.3 Line Symbols

Line marker symbols have only two symbol layer types:

- Marker line
- Simple line (default)

The default symbol layer type draws a simple line whereas the other display a marker point regularly on the line. You can choose different location vertex, interval or central point. Marker line can have offset along the line or offset line. Finally, *rotation* allows you to change the orientation of the symbol.

The following settings are possible:

- *colour*
- *Pen width*
- *Offset*
- *Pen style*

- *Join style*

- *Cap style*

- ☑ *Use custom dash pattern*

- *Dash pattern unit*

- *Data defined properties ...*

12.2.4 Polygon Symbols

Polygon marker symbols have also several symbol layer types:

- Centroid fill

- Gradient fill

- Line pattern fill

- Point pattern fill

- Raster image fill

- SVG fill

- Shapeburst fill

- Simple fill (default)

- Outline: Marker line (same as line marker)

- Outline: simple line (same as line marker)

The following settings are possible:

- *Colors* for the border and the fill.

- *Fill style*

- *Border style*

- *Border width*

- *Offset X,Y*

- *Data defined properties ...*

Using the color combo box, you can drag and drop color for one color button to another button, copy-paste color, pick color from somewhere, choose a color from the palette or from recent or standard color. The combo box allow you to fill in the feature with transparency. You can also just click on the button to open the palettte dialog. Note that you can import color from some external software like GIMP.

With the '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.

'Gradient Fill' *Symbol layer type* allows you to select between a ◉ *Two color* and ◯ *Color ramp* setting. You can use the ☑ *Feature centroid* as *Referencepoint*. All fills 'Gradient Fill' *Symbol layer type* is also available through the *Symbol* menu of the Categorized and Graduated Renderer and through the *Rule properties* menu of the Rule-based renderer. Other possibility is to choose a 'shapeburst fill' which is a buffered 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.

It is possible to only draw polygon borders inside the polygon. Using 'Outline: Simple line' select ☑ *Draw line only inside polygon*.

12.2.5 Color ramp

You can create a custom color ramp choosing *New color ramp...* from the *color ramp* drop-down menu. A dialog will prompt for the ramp type: Gradient, Random, colorBrewer, or cpt-city. The first three have options for number of steps and/or multiple stops in the color ramp. You can use the ☑ *Invert* option while classifying the data with a color ramp. See figure_symbology_3 for an example of custom color ramp and figure_symbology_3a for the cpt-city dialog.
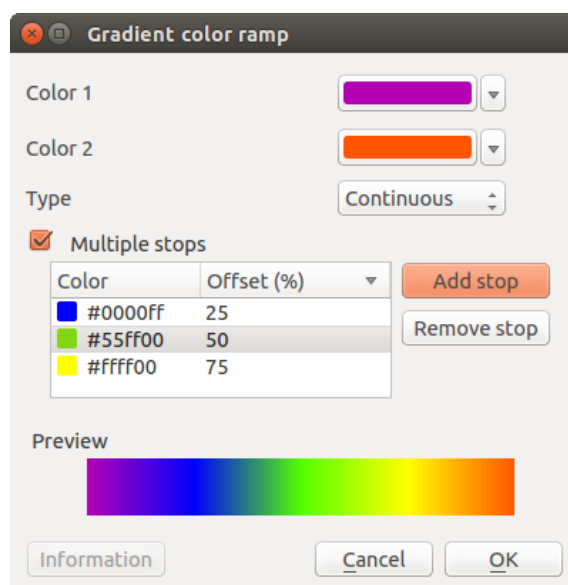
Figure 12.7: Example of custom gradient color ramp with multiple stops 🐧

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

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12.3 Janela das Propriedades da Camada Vectorial

The *Layer Properties* dialog for a vector layer provides information about the layer, symbology settings and labeling options. If your vector layer has been loaded from a PostgreSQL/PostGIS datastore, you can also alter the underlying SQL for the layer by invoking the *Query Builder* dialog on the *General* tab. 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.

12.3.1 Estilos

The Style menu provides you with a comprehensive tool for rendering and symbolizing your vector data. You can use *Layer rendering* → tools that are common to all vector data, as well as special symbolizing tools that were designed for the different kinds of vector data.

Renderers

The renderer is responsible for drawing a feature together with the correct symbol. There are four types of renderers: single symbol, categorized, graduated and rule-based. 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 point layers, there is a point displacement renderer available. For each data type (points, lines and polygons), vector symbol layer
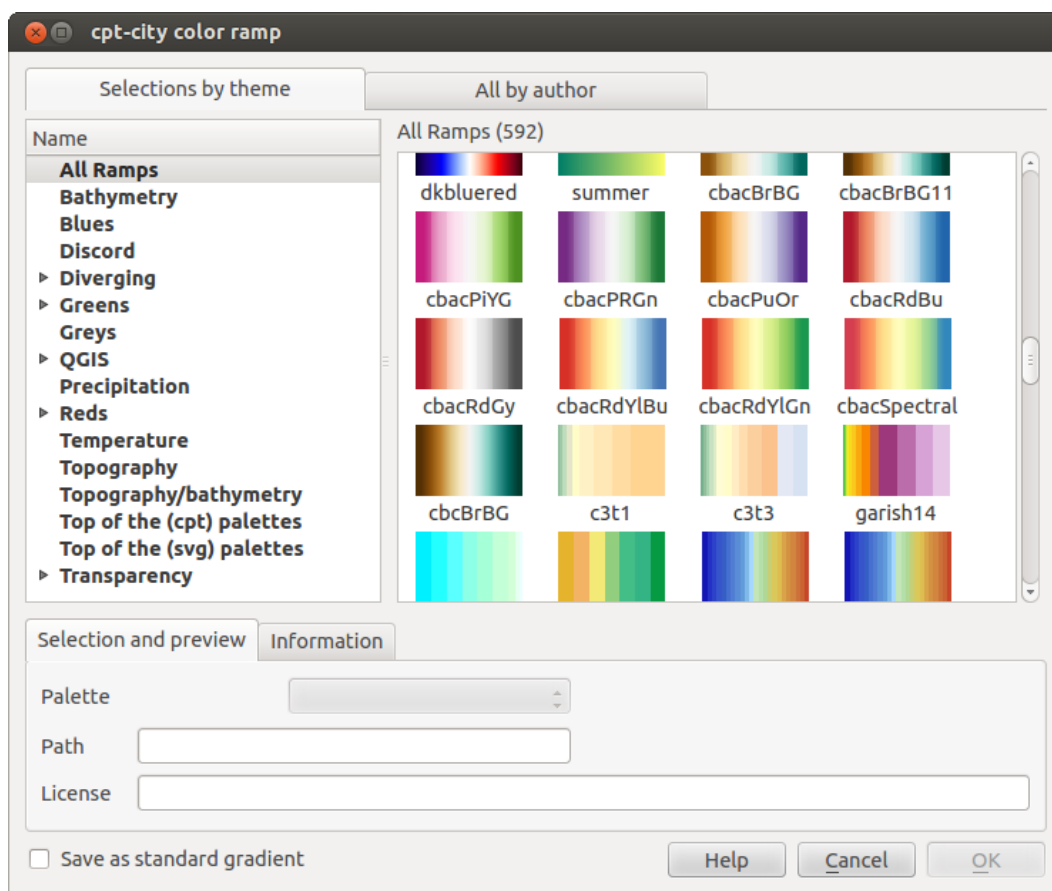
Figure 12.8: cpt-city dialog with hundreds of color ramps
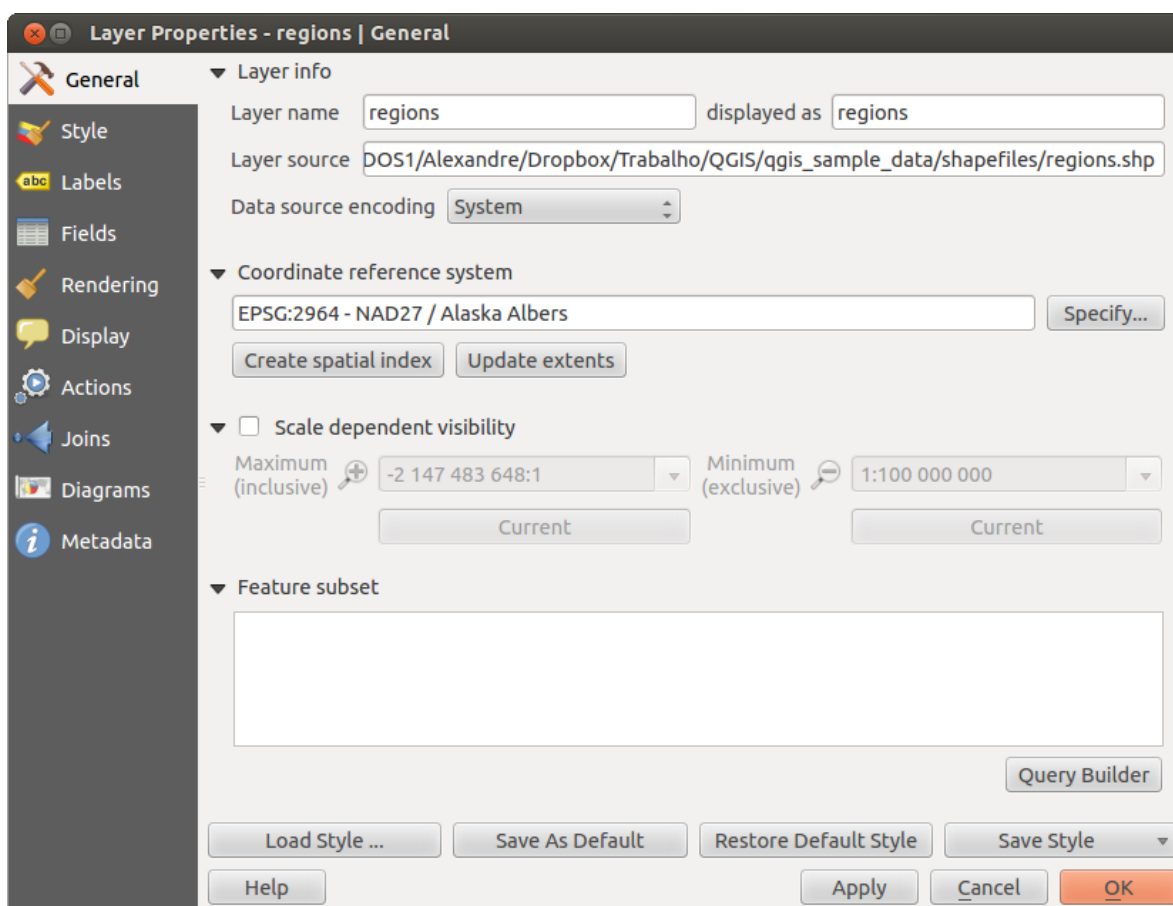
Figure 12.9: Vector Layer Properties Dialog

types are available. Depending on the chosen renderer, the *Style* menu provides different additional sections. On the bottom right of the symbology dialog, there is a **[Symbol]** button, which gives access to the Style Manager (see *Apresentação*). The Style Manager allows you to edit and remove existing symbols and add new ones.

After having made any needed changes, the symbol can be added to the list of current style symbols (using **[Symbol]** ⬚▼ *Save in symbol library*), and then it can easily be used in the future. Furthermore, you can use the **[Save Style]** ⬚▼ button to save the symbol as a QGIS layer style file (.qml) or SLD file (.sld). 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.

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.

If the datasource of the layer is a database (PostGIS or Spatialite for example), you can save your layer style inside a table of the database. Just click on *Save Style* comboxbox and choose **Save in database** item then fill in the dialog to define a style name, add a description, an ui file and if the style is a default style. When loading a layer from the database, if a style already exists for this layer, QGIS will load the layer and its style. You can add several style in the database. Only one will be the default style anyway.
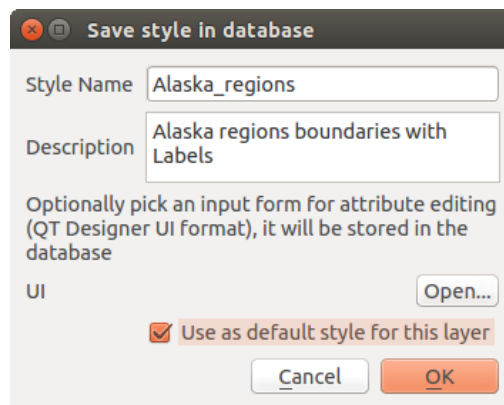
Figure 12.10: Save Style in database Dialog 🐧

Tip: Seleccionar e alterar múltiplos símbolos

A simbologia permite seleccionar múltiplos símbolos e com o clique do direito do rato alterar a cor, trnasparência, tamanho, ou largura das entradas seleccionadas.

Single Symbol Renderer

The Single Symbol Renderer is used to render all features of the layer using a single user-defined symbol. The properties, which can be adjusted in the *Style* menu, depend partially on the type of layer, but all types share the following dialog structure. In the top-left part of the menu, there is a preview of the current symbol to be rendered. On the right part of the menu, there is a list of symbols already defined for the current style, prepared to be used by selecting them from the list. The current symbol can be modified using the menu on the right side. If you click on the first level in the *Symbol layers* dialog on the left side, it's possible to define basic parameters like *Size*, *Transparency*, *color* and *Rotation*. Here, the layers are joined together.

In any spinbox in this dialog you can enter expressions. E.g. you can calculate simple math like multiplying the existing size of a point by 3 without resorting to a calculator.

If you click on the second level in the *Symbol layers* dialog a 'Data-defined override' for nearly all settings is possible. When using a data-defined color one may want to link the color to a field 'budged'. Here a comment functionality is inserted.
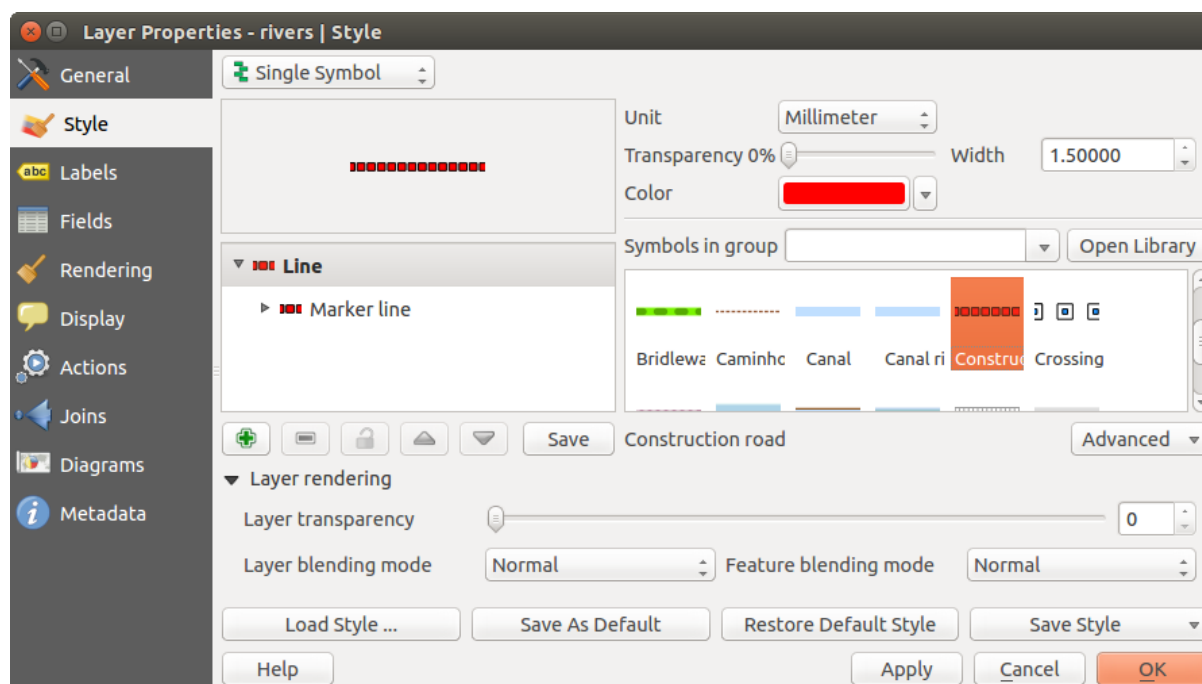
Figure 12.11: Single symbol line properties
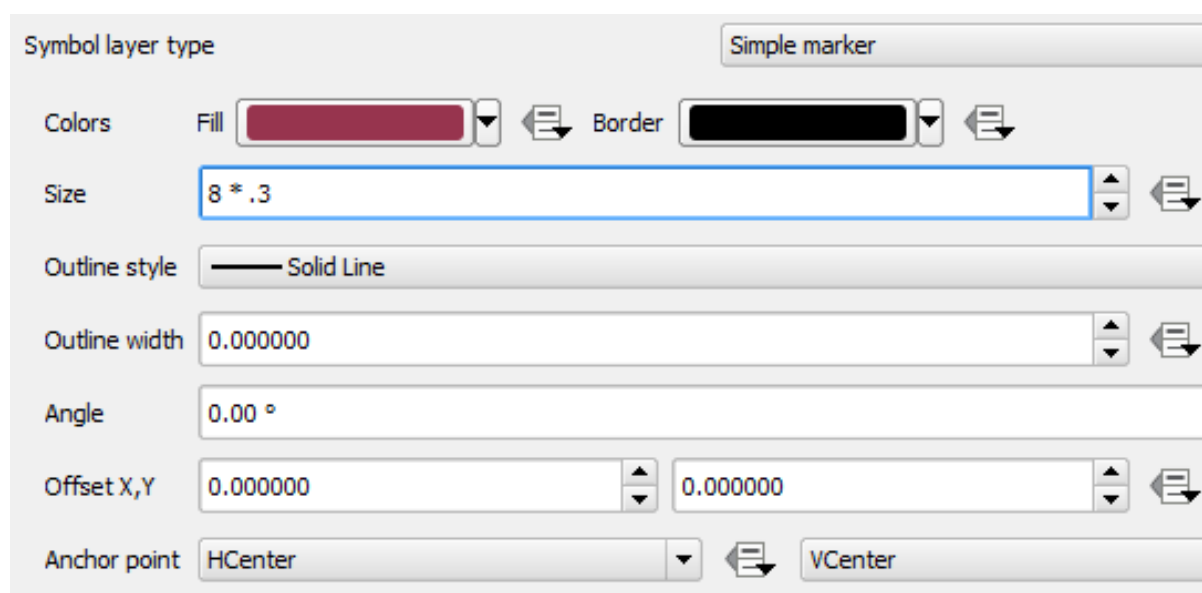
Figure 12.12: Expression in Size spinbox

```
/* This expression will return a color code depending on the field value.
 * Negative value: red
 * 0 value: yellow
 * Positive value: green
 */
CASE
  WHEN value < 0 THEN '#DC143C' -- Negative value: red
  WHEN value = 0 THEN '#CCCC00' -- Value 0: yellow
  ELSE '#228B22'                -- Positive value: green
END
```


static/user_manual/working_with_vector/symbol_data_defin
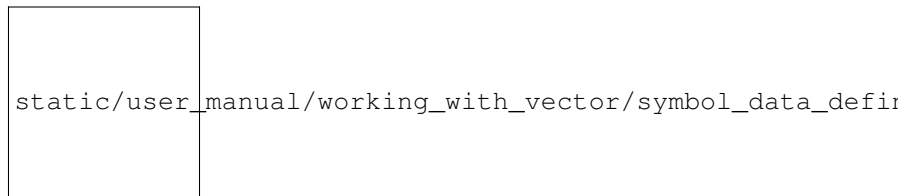
Figure 12.13: Data-defined symbol with Edit... menu

Categorized Renderer

The Categorized Renderer is used to render all features from a layer, using a single user-defined symbol whose color reflects the value of a selected feature's attribute. The *Style* menu allows you to select:

- The attribute (using the Column listbox or the ε... *Set column expression* function, see *Expressions*)

- The symbol (using the Symbol dialog)

- The colors (using the color Ramp listbox)

Then click on **Classify** button to create classes from the distinct value of the attribute column. Each classes can be disabled unchecking the checkbox at the left of the class name.

You can 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 **[Advanced]** button in the lower-right corner of the dialog allows you to set the fields containing rotation and size scale information. For convenience, the center of the menu lists the values of all currently selected attributes together, including the symbols that will be rendered.

The example in figure_symbology_6 shows the category rendering dialog used for the rivers layer of the QGIS sample dataset.

Graduated Renderer

The Graduated Renderer is used to render all the features from a layer, using a single user-defined symbol whose color 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, the *Style* tab allows you to select:

- The attribute (using the Column listbox or the ε... *Set column expression* function, see *Expressions* chapter)

- The symbol (using the Symbol Properties button)

- The colors (using the color Ramp list)

Additionally, 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);
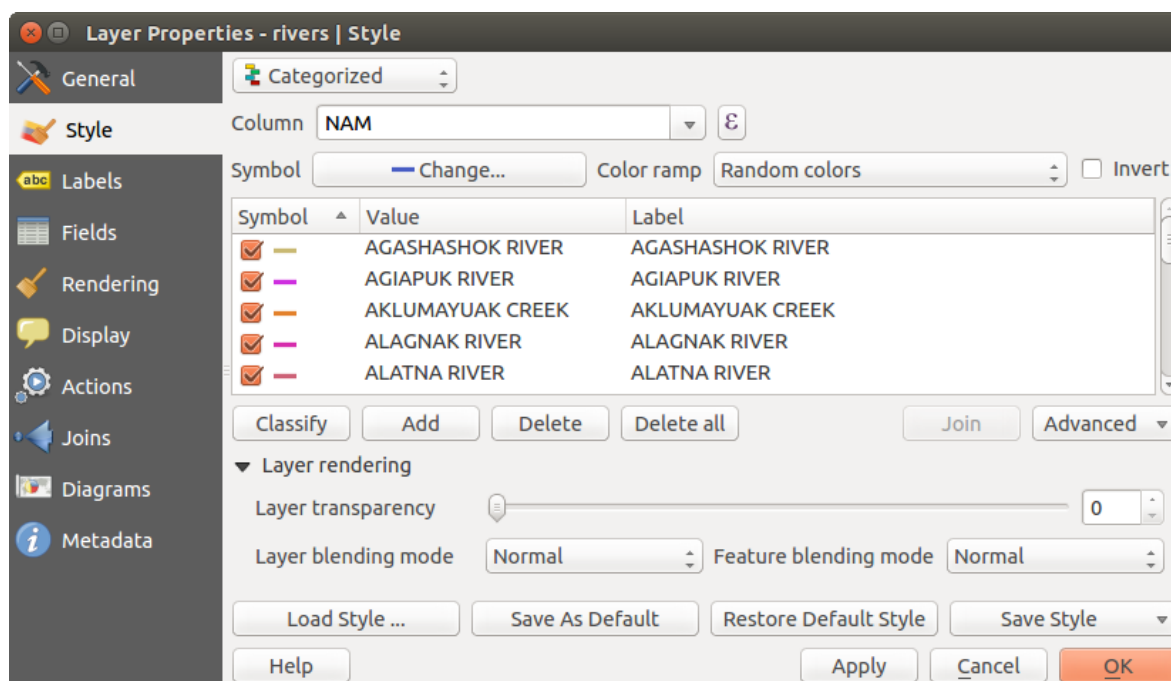
Figure 12.14: Categorized Symbolizing options
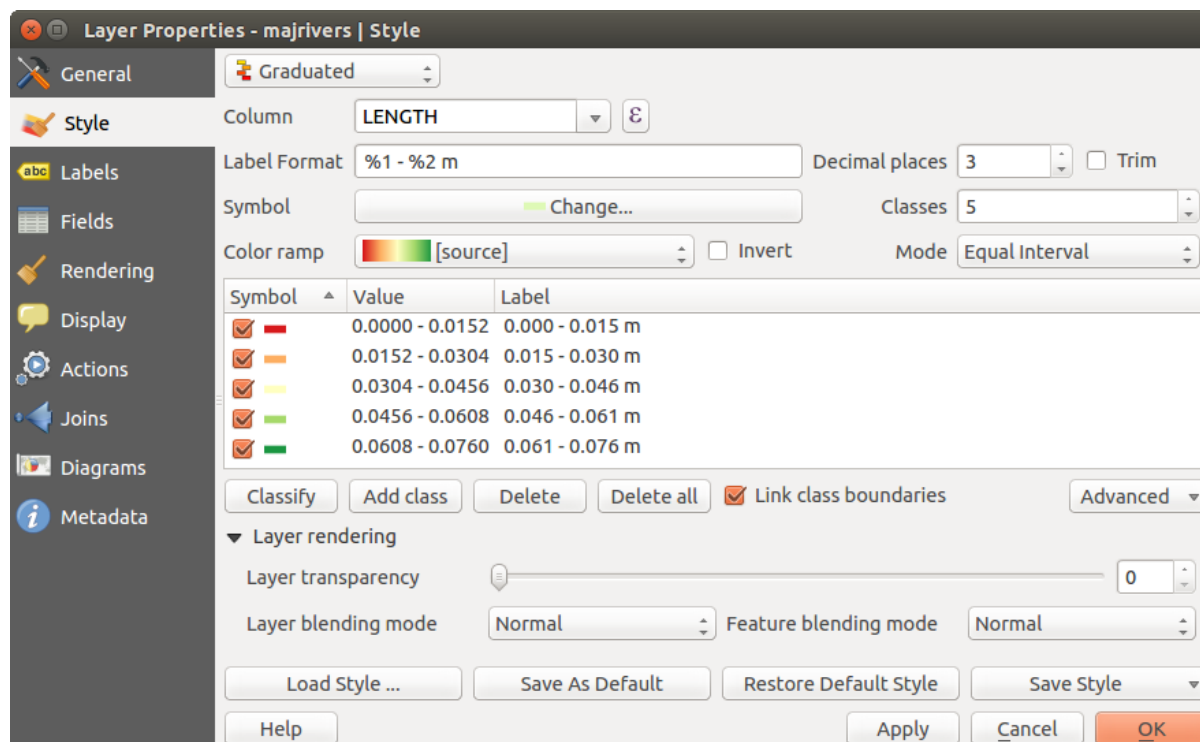
Figure 12.15: Graduated Symbolizing options

- 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: the same of natural breaks but the extremes number of each class are integers.

A caixa da lista no centro do menu *Estilo* lista as classes juntas com os seus intervalos, etiquetas e símbolos que serão renderizados.

Click on **Classify** button to create classes using the choosen mode. Each classes can be disabled unchecking the checkbox at the left of the class name.

You can change symbol, value and/or label of the clic, just double clicking 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_symbology_7 shows the graduated rendering dialog for the rivers layer of the QGIS sample dataset.

Tip: Mapas temáticos usando uma expressão

Categorized and graduated thematic maps can now be created using the result of an expression. In the properties dialog for vector layers, the attribute chooser has been augmented with a ℰ⋯ *Set column expression* function. So now you no longer 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.

Rule-based rendering

The Rule-based Renderer is used to render all the features from a layer, using rule based symbols whose color 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.

The example in figure_symbology_8 shows the rule-based rendering dialog for the rivers layer of the QGIS sample dataset.

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 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 *Expressions*). 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 match. Since QGIS 2.8 the rules appear in a tree hierarchy in the map legend. Just double-klick the rules in the map legend and the Style menu of the layer properties appears showing the rule that is the background for the symbol in the tree.

Point displacement

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 a center symbol.

Tip: Exportar simbologia do 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 selection 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.

Inverted Polygon
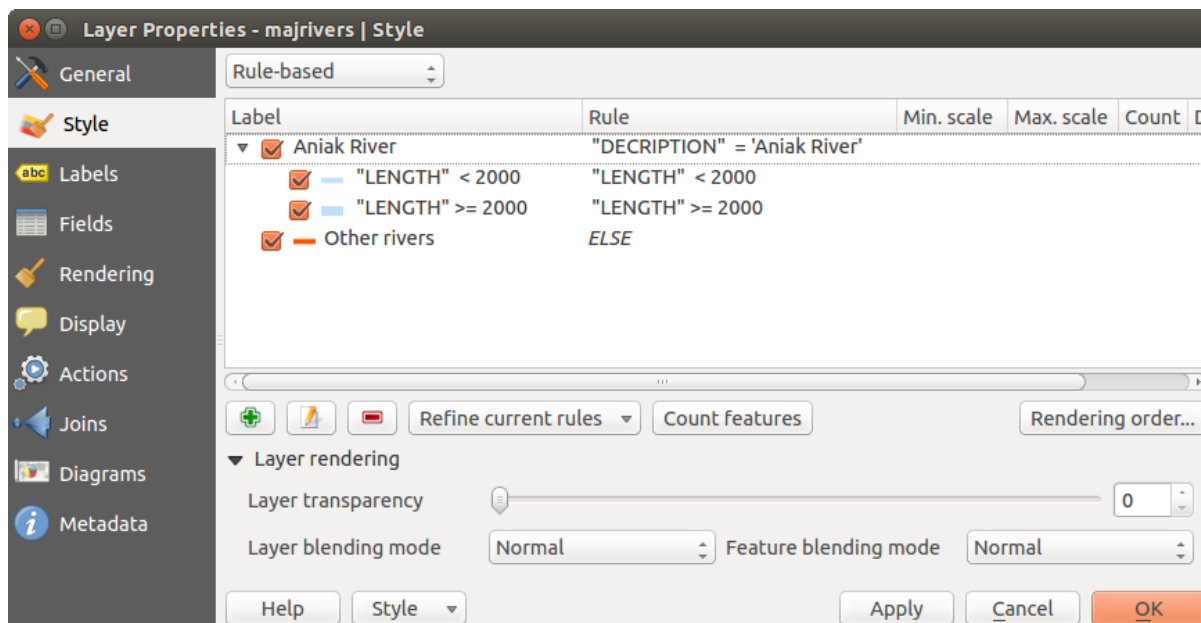
Figure 12.16: Rule-based Symbolizing options
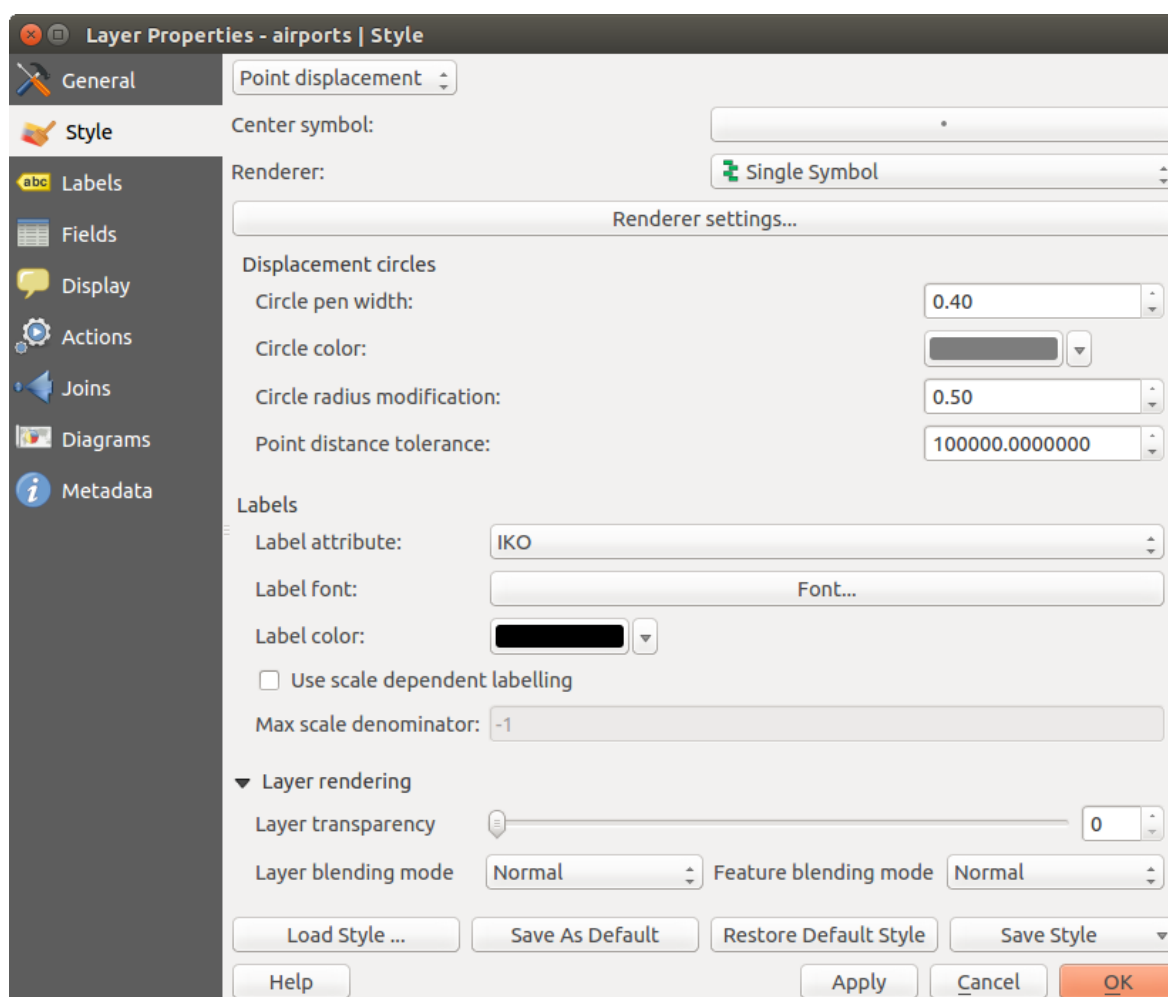
Figure 12.17: Point displacement dialog

Inverted polygon renderer allows user to define a symbol to fill in outside of the layer's polygons. As before you can select subrenderers. These subrenderers are the same as for the main renderers.
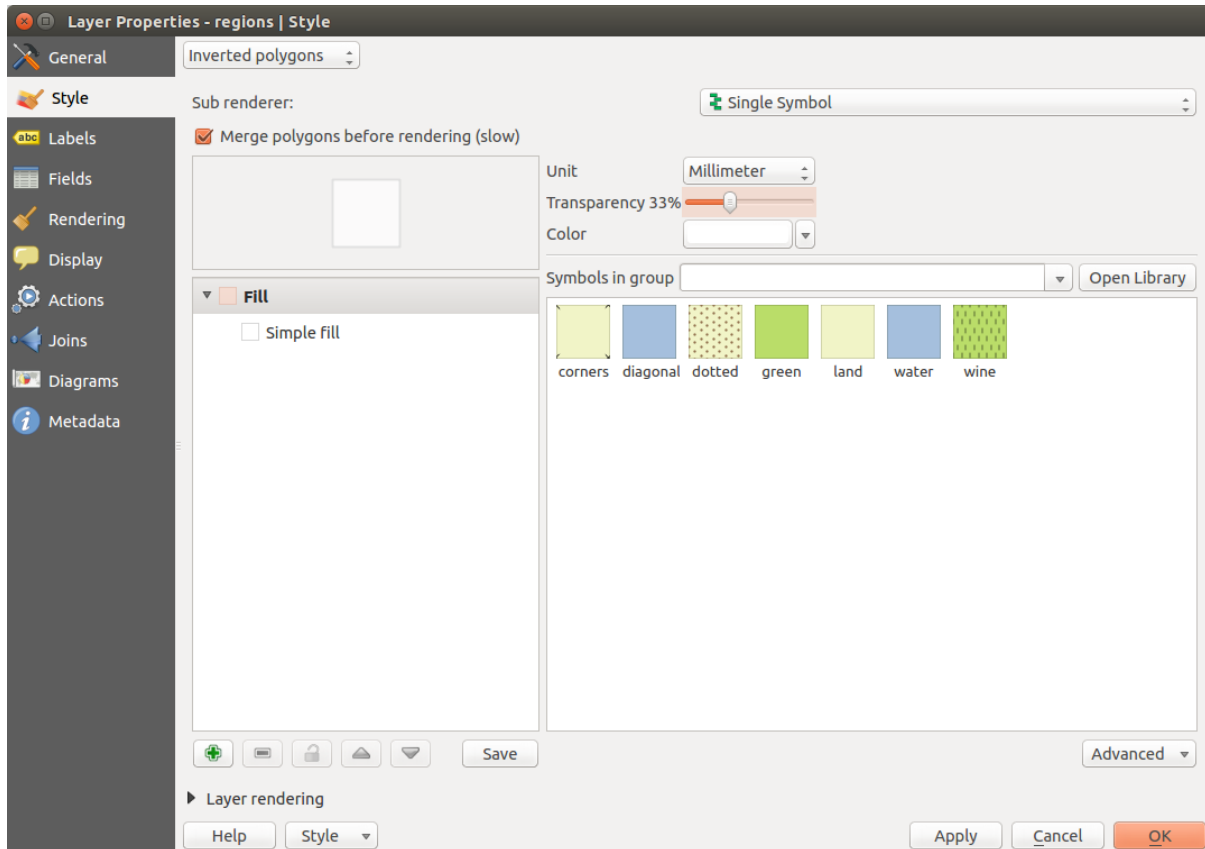
Figure 12.18: Inverted Polygon dialog

Tip: Switch quickly between styles

Once you created one of the above mentioned styles you can right-klick on the layer and choose *Styles → Add* to save your style. Now you can easily switch between styles you created using the *Styles →* menu again.

Heatmap

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 a color ramp for the heatmap style and use a slider for selecting a tradeoff between render speed and quality. When adding or removing a feature the heatmap renderer updates the heatmap style automatically.

Color Picker

Regardless the type of style to be used, the *select color* dialog will show when you click to choose a color - either border or fill color. This dialog has four different tabs which allow you to select colors by color ramp, color wheel, color swatches or color picker.

Whatever method you use, the selected color is always described through color sliders for HSV (Hue, Saturation, Value) and RGB (Red, Green, Blue) values. There is also an *opacity* slider to set transparency level. On the lower left part of the dialog you can see a comparison between the *current* and the *new* color you are presently selecting and on the lower right part you have the option to add the color you just tweaked into a color slot button.

With color ramp or with color wheel, you can browse to all possible color combinations. There are other

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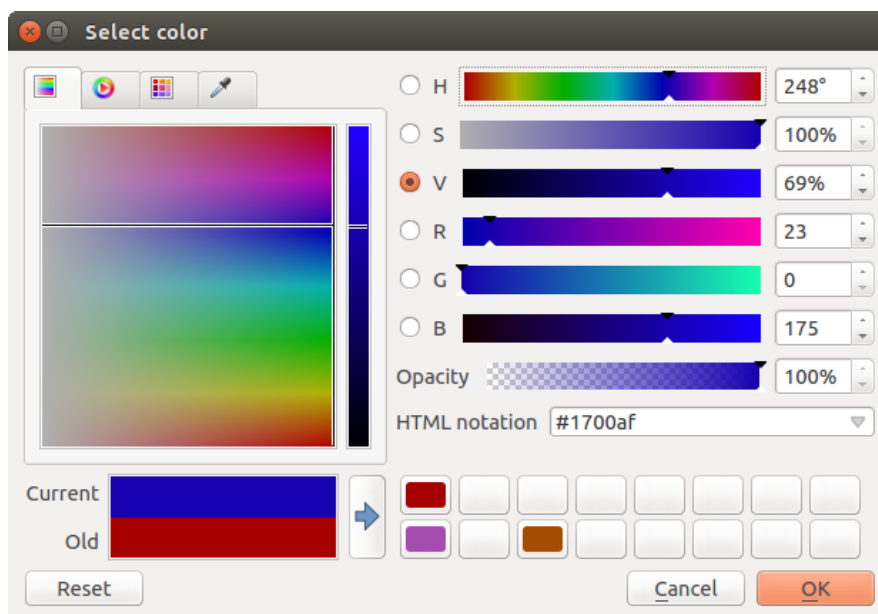
Figure 12.19: Color picker ramp tab

possibilities though. By using *color swatches* you can choose from a preselected list. This selected list is populated with one of three methods: *Recent colors*, *Standard colors* or *Project colors*
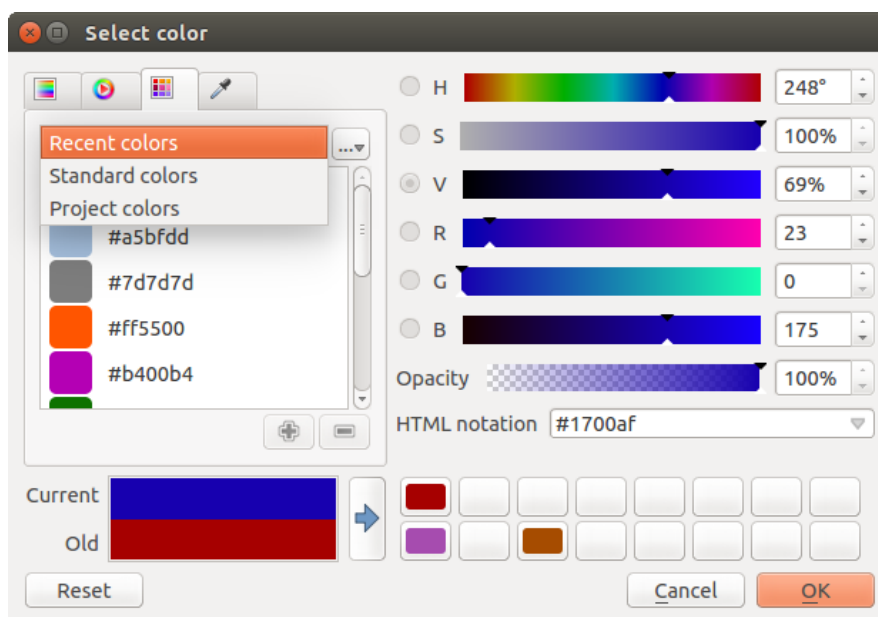
Figure 12.20: Color picker swatcher tab

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 OSX.

Tip: quick color picker + copy/paste colors

You can quickly choose from *Recent colors*, from *Standard colors* or simply *copy* or *paste* a color by clicking the drop-down arrow that follows a current color box.
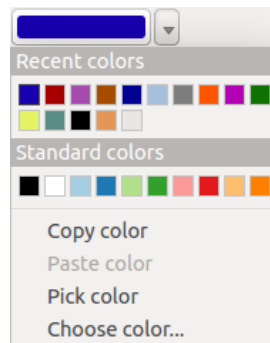
Figure 12.21: Quick color picker menu

Renderização da camada

- *Layer transparency* [slider] : 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 below.

    - 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.

    - Lighten: This selects the maximum of each component from the foreground and background pixels. Be aware that the results tend to be jagged and harsh.

    - 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 layer with another layer (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.

    - Addition: This blend mode simply adds pixel values of one layer 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 layer are multiplied with the corresponding pixels for the bottom layer. The results are darker pictures.

    - Burn: Darker colors in the top layer cause the underlying layers 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 layer from the other. In case of negative values, black is displayed.

12.3.2 Menu Etiquetas

The <abc> Labels core application provides smart labeling for vector point, line and polygon layers, and it only requires a few parameters. This new application also supports on-the-fly transformed layers. The core functions of the application have been redesigned. In QGIS, there are a number of other features that improve the labeling. The following menus have been created for labeling the vector layers:

- Texto
- Formatação
- Buffer
- Fundo
- Sombra
- Posicionamento
- Renderização

Let us see how the new menus can be used for various vector layers. **Labeling point layers**

Start QGIS and load a vector point layer. Activate the layer in the legend and click on the <abc> Layer Labeling Options icon in the QGIS toolbar menu.

The first step is to activate the ☑ *Label this layer with* checkbox and select an attribute column to use for labeling. Click ℰ… if you want to define labels based on expressions - See labeling_with_expressions.

The following steps describe a simple labeling without using the *Data defined override* functions, which are situated next to the drop-down menus.

You can define the text style in the *Text* menu (see Figure_labels_1). Use the *Type case* option to influence the text rendering. You have the possibility to render the text 'All uppercase', 'All lowercase' or 'Capitalize first letter'. Use the blend modes to create effects known from graphics programs (see blend_modes).

In the *Formatting* menu, you can define a character for a line break in the labels with the 'Wrap on character' function. Use the ☑ *Formatted numbers* option to format the numbers in an attribute table. Here, decimal places may be inserted. If you enable this option, three decimal places are initially set by default.

To create a buffer, just activate the ☑ *Draw text buffer* checkbox in the *Buffer* menu. The buffer color is variable. Here, you can also use blend modes (see blend_modes).

If the ☑ *color buffer's fill* checkbox is activated, it will interact with partially transparent text and give mixed color transparency results. Turning off the buffer fill fixes that issue (except where the interior aspect of the buffer's stroke intersects with the text's fill) and also allows you to make outlined text.

In the *Background* menu, 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 blend_modes).

Use the *Shadow* menu 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 (see blend_modes).

Choose the *Placement* menu for the label placement and the labeling priority. Using the ⦿ *Offset from point* setting, you now have the option to use *Quadrants* to place your label. Additionally, you can alter the angle of the label placement with the *Rotation* setting. Thus, a placement in a certain quadrant with a certain rotation is possible. In the *priority* section you can define with which priority the labels are rendered. It interacts with labels of the other vector layers in the map canvas. If there are labels from different layers in the same location then the label with the higher priority will be displayed and the other will be left out.

In the *Rendering* menu, you can define label and feature options. Under *Label options*, you find the scale-based visibility setting now. You can prevent QGIS from rendering only selected labels with the ☑ *Show all labels for this layer (including colliding labels)* checkbox. Under *Feature options*, you can define whether every part of a multipart feature is to be labeled. It's possible to define whether the number of features to be labeled is limited and to ☑ *Discourage labels from covering features*.
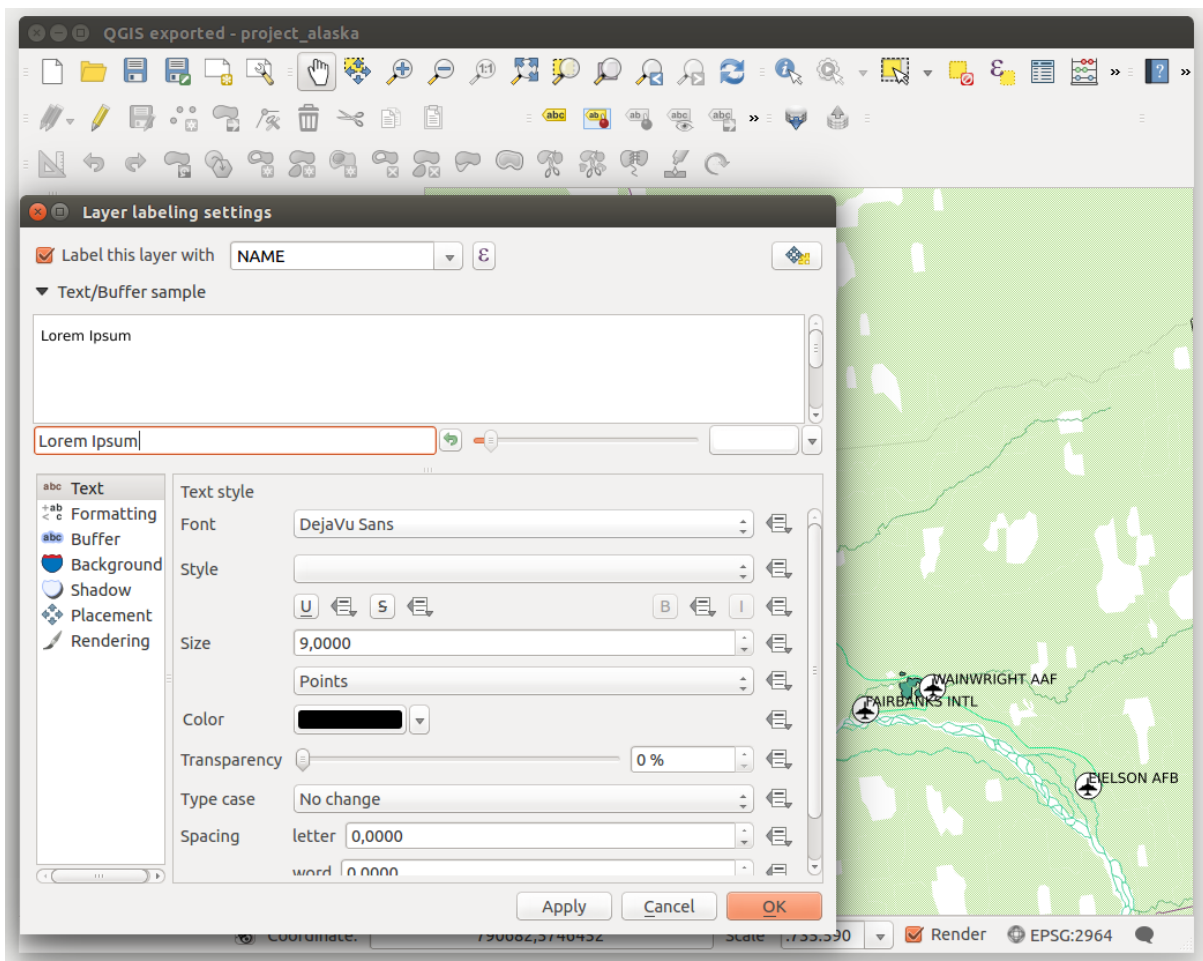
Figure 12.22: Smart labeling of vector point layers 🐧

Labeling line layers

The first step is to activate the ☑ *Label this layer* checkbox in the *Label settings* tab and select an attribute column to use for labeling. Click ℰ⋯ if you want to define labels based on expressions - See labeling_with_expressions.

After that, you can define the text style in the *Text* menu. Here, you can use the same settings as for point layers.

Also, in the *Formatting* menu, the same settings as for point layers are possible.

The *Buffer* menu has the same functions as described in section labeling_point_layers.

The *Background* menu has the same entries as described in section labeling_point_layers.

Also, the *Shadow* menu has the same entries as described in section labeling_point_layers.

In the *Placement* menu, you find special settings for line layers. The label can be placed ⦿ *Parallel*, ◯ *Curved* or ◯ *Horizontal*. With the ⦿ *Parallel* and ◯ *Curved* option, you can define the position ✅ *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 position of the label. Remember that here 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_2).

You can set up a minimum distance for repeating labels. Distance can be in mm or in map units.

Some Placement setup will display more options, for example, *Curved* and *Parallel* Placements will allow the user to set up the position of the label (above, below or on the line), *distance* from the line and for *Curved*, the user can also setup inside/outside max angle between curved label. As for point vector layers you have the possibility to define a *Priority* for the labels.

The *Rendering* menu has nearly the same entries as for point layers. In the *Feature options*, you can now *Suppress labeling of features smaller than*.
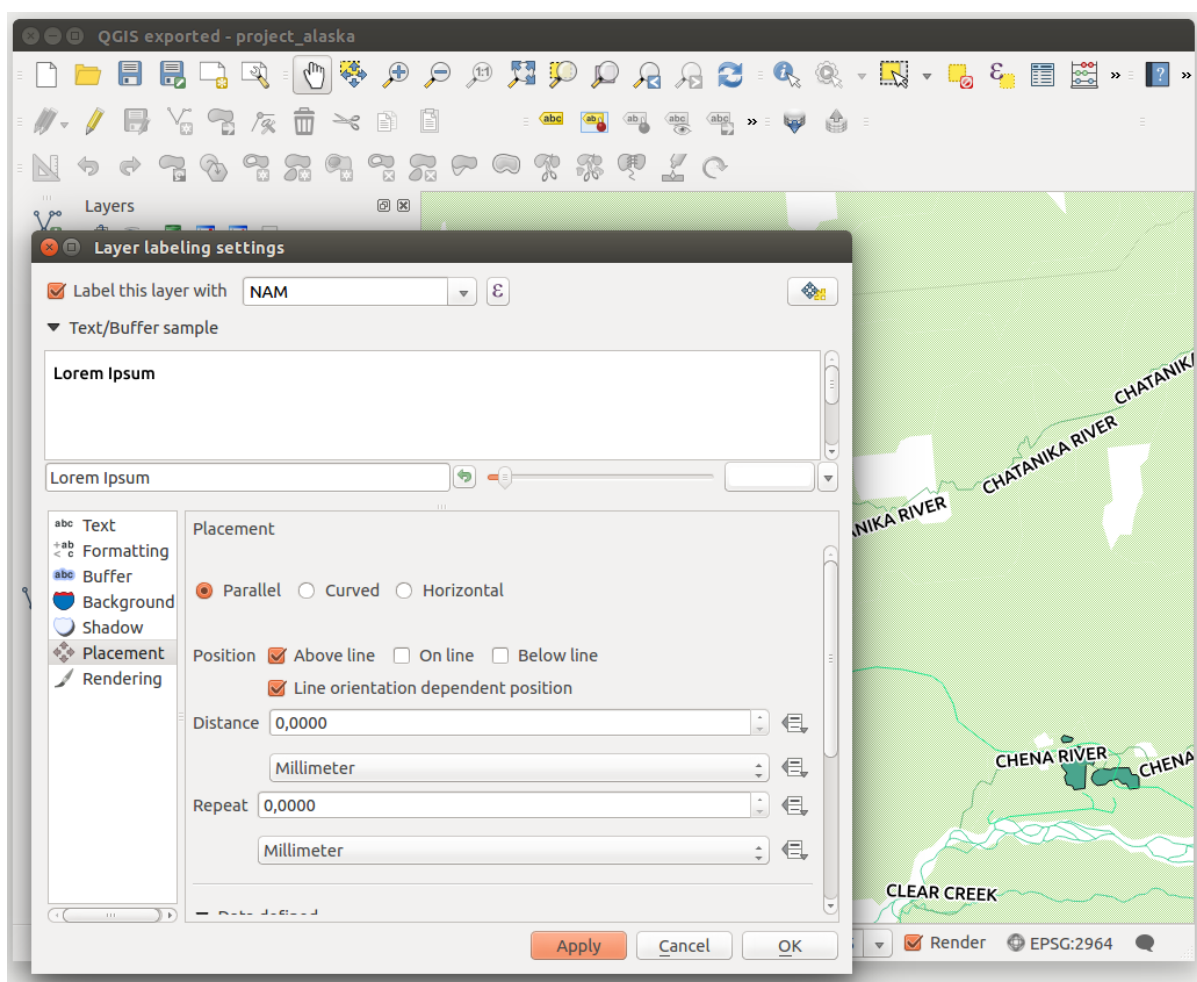
Figure 12.23: Smart labeling of vector line layers

Labeling polygon layers

The first step is to activate the ✅ *Label this layer* checkbox and select an attribute column to use for labeling. Click ε... if you want to define labels based on expressions - See labeling_with_expressions.

In the *Text* menu, define the text style. The entries are the same as for point and line layers.

The *Formatting* menu allows you to format multiple lines, also similar to the cases of point and line layers.

As with point and line layers, you can create a text buffer in the *Buffer* menu.

Use the *Background* menu to create a complex user-defined background for the polygon layer. You can use the menu also as with the point and line layers.

The entries in the *Shadow* menu are the same as for point and line layers.

In the *Placement* menu, you find special settings for polygon layers (see Figure_labels_3). ◉ *Offset from centroid*, ○ *Horizontal (slow)*, ○ *Around centroid*, ○ *Free* and ○ *Using perimeter* are possible.

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 with the quadrants here, and define offset and rotation. The ○ *Around centroid* setting makes it possible to place the label around the centroid with a certain distance. Again, you can define ◉ *visible polygon* or ○ *whole polygon* for the centroid. With the ○ *Using perimeter* settings, 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.

Related to the choice of Label Placement, several options will appear. As for Point Placement you can choose the distance for the polygon outline, repeat the label around the polygon perimeter.

As for point and line vector layers you have the possibility to define a *Priority* for the polygon vector layer.

The entries in the *Rendering* menu are the same as for line layers. You can also use *Suppress labeling of features smaller than* in the *Feature options*. **Define labels based on expressions**
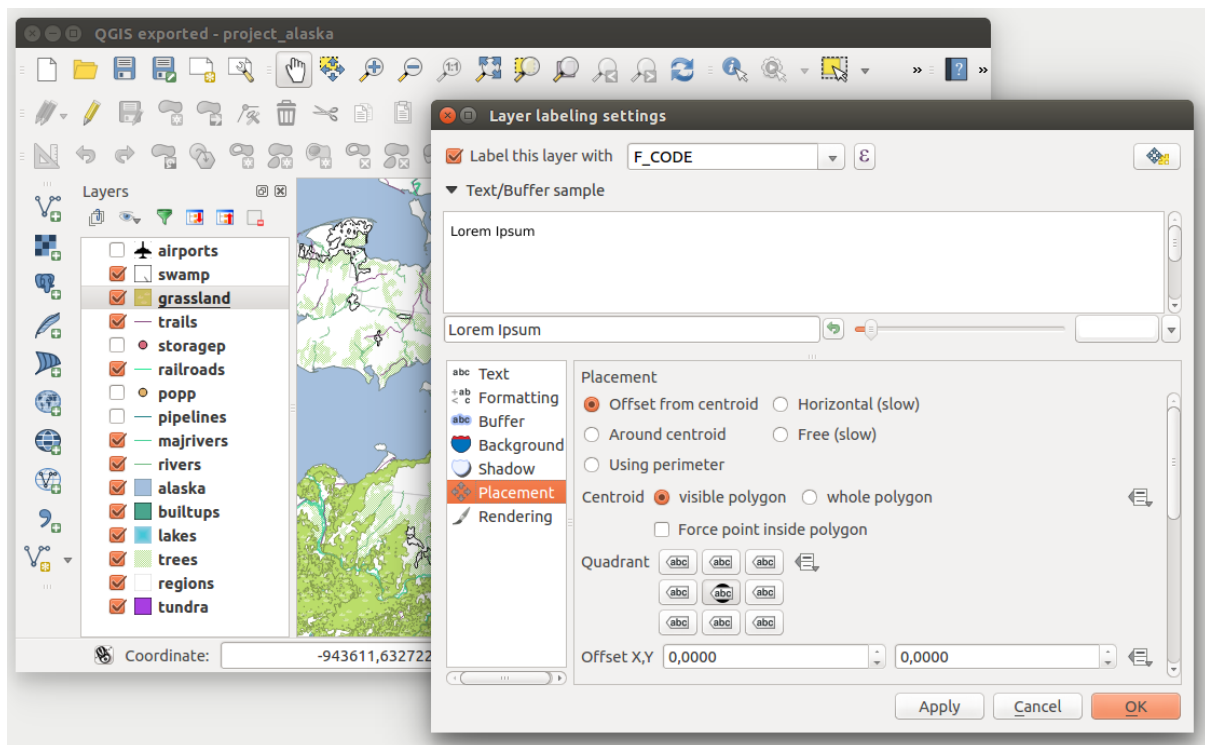
Figure 12.24: Smart labeling of vector polygon layers 🐧

QGIS allows to use expressions to label features. Just click the ℰ... icon in the [abc] Labels menu of the properties dialog. In figure_labels_4 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.
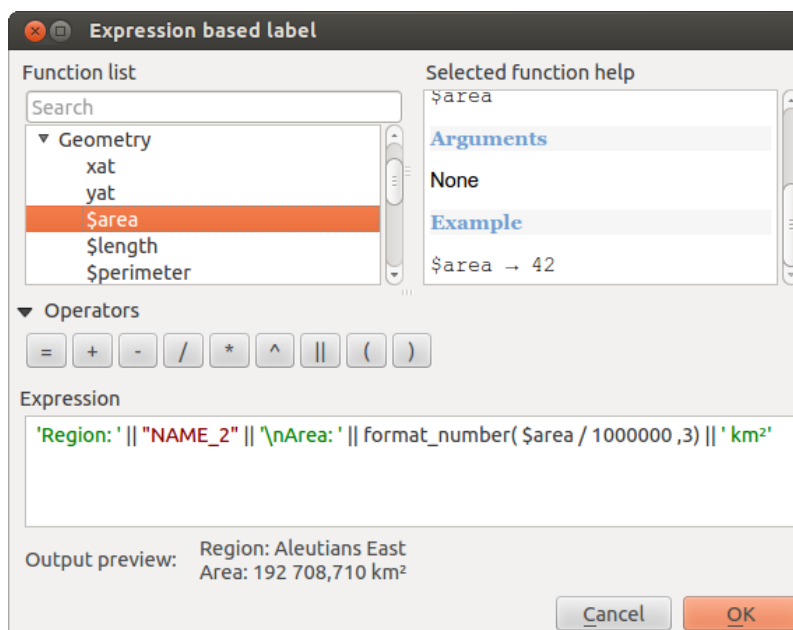
Figure 12.25: Using expressions for labeling

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 sign '||' and that fields a written in "double quotes" and strings in 'single quotes'. Let's have a look at some examples:

```
# label based on two fields 'name' and 'place' with a comma as separater
"name" || ', ' || "place"

-> John Smith, Paris

# label based on two fields 'name' and 'place' separated by comma
'My name is ' || "name" || 'and I live in ' || "place"

-> My name is John Smith and I live in Paris

# label based on two fields 'name' and 'place' with a descriptive text
# and a line break (\n)
'My name is ' || "name" || '\nI live in ' || "place"

-> My name is John Smith
   I live in Paris

# create a multi-line label based on a field and the $area function
# to show the place name and its area size based on unit meter.
'The area of ' || "place" || 'has a size of ' || $area || 'm²'

-> The area of Paris has a size of 105000000 m²

# create a CASE ELSE condition. If the population value in field
# population is <= 50000 it is a town, otherwise a city.
'This place is a ' || CASE WHEN "population <= 50000" THEN 'town' ELSE 'city' END

-> 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 *Expressions* 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. You can activate and deactivate the function with the right-mouse button. Hover over the symbol and you see the information about the data-defined override, including the current definition field. We now describe an example using the data-defined override function for the Move label function (see figure_labels_5).

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.

4. Ampliar ao lago.

5. Go to the Label toolbar and click the icon. Now you can shift the label manually to another position (see figure_labels_6). The new position of the label is saved in the 'xlabel' and 'ylabel' columns of the attribute table.
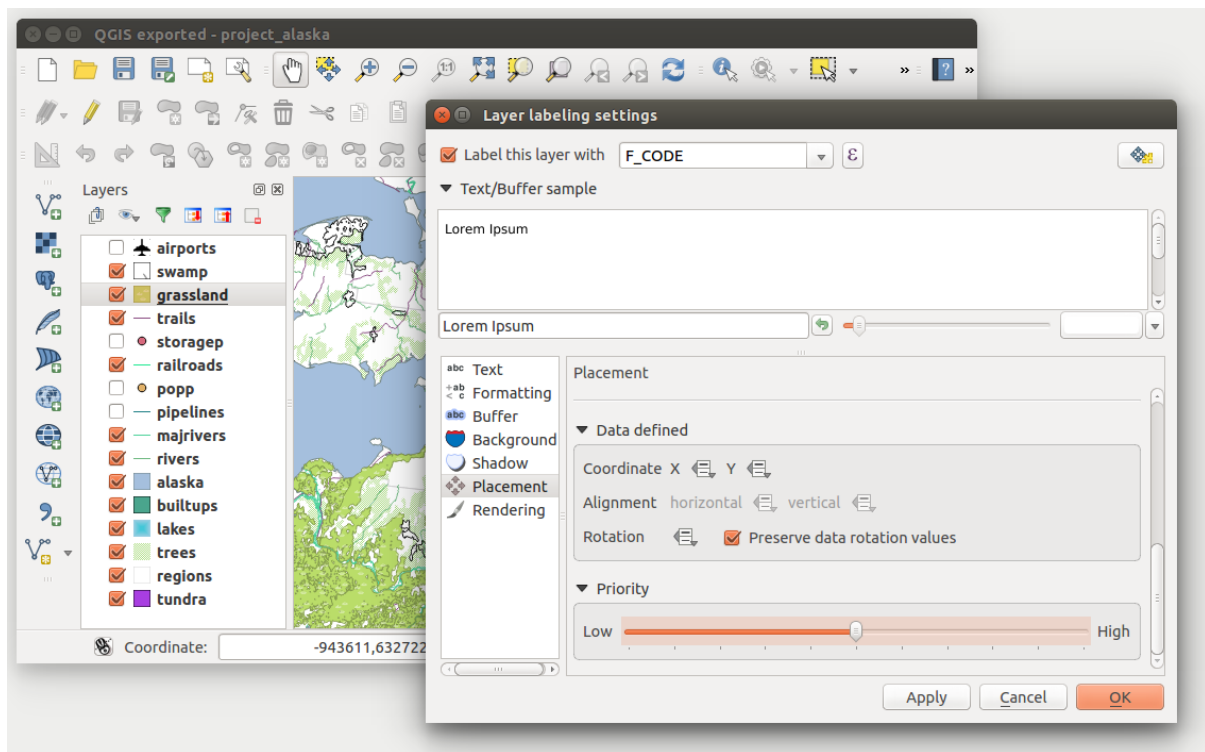
Figure 12.26: Labeling of vector polygon layers with data-defined override 🐧

12.3.3 Menu Campos

 Within the *Fields* menu, the field attributes of the selected dataset can be manipulated. The buttons
New Column and Delete Column can be used when the dataset is in Editing mode .

Editar Widget
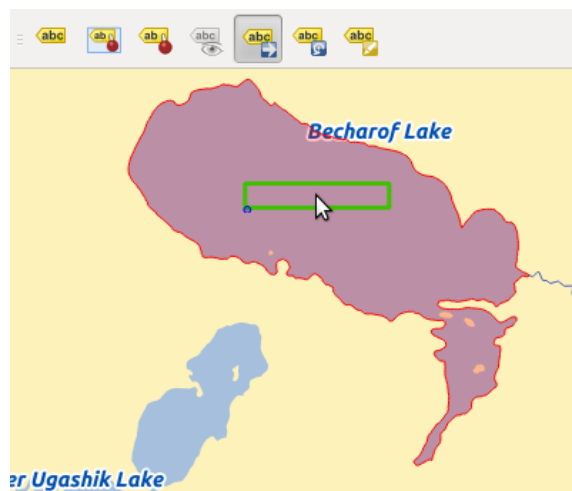
Figure 12.27: Move labels 🐧
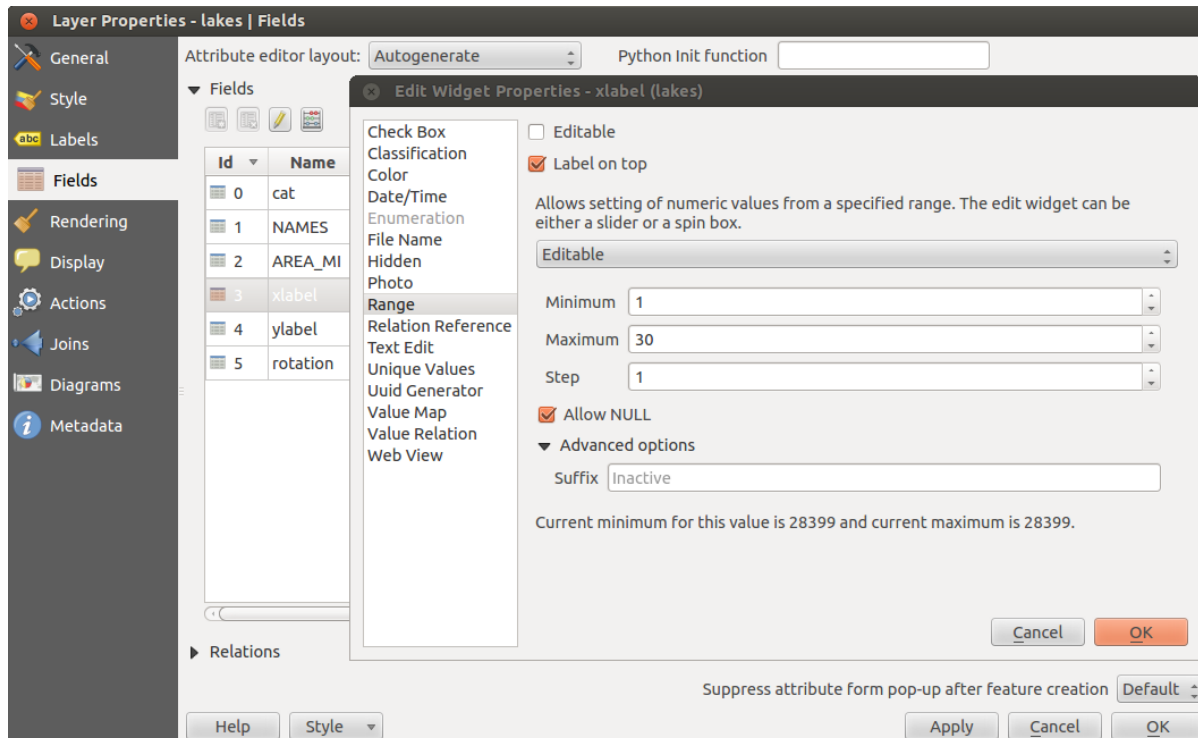
Figure 12.28: Dialog to select an edit widget for an attribute column 🐧

Within the *Fields* menu, 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. If you click on the **[edit widget]** button, a dialog opens, where you can define different widgets. These 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* menu 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.

- **Nome do ficheiro**: Simplifica a selecção ao adicionar um diálogo de escolha do ficheiro.

- **Hidden**: A hidden attribute column is invisible. The user is not able to see its contents.

- **Fotografia**: Campo que contem o nome do ficheiro da imagem. A largura e altura do campo podem se definidos.

- **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 widged lets you embed the feature form of the referenced layer on the feature form of the actual layer. See *Creating one 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.

- **Gerador UUID**: Gera um campo UUID de leitura (Identificador Único Universal), se estiver vazio.

- **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.

- **Webview**: Field contains a URL. The width and height of the field is variable.

Note: QGIS has an advanced 'hidden' option to define your own field widget using python and add it to this impressive list of widgets. It is tricky but it is very well explained in following excellent blog that explains how to create a real time validation widget that can be used like described widgets. See http://blog.vitu.ch/10142013-1847/write-your-own-qgis-form-elements

With the **Attribute editor layout**, you can now define built-in forms (see figure_fields_2). This is usefull for data entry jobs or to identify objects using the option auto open form when you have objects with many attributes. You can create an editor with several tabs and named groups to present the attribute fields.

Choose 'Drag and drop designer' and an attribute column. Use the ![icon] icon to create a category to insert a tab or a named group (see figure_fields_3). When creating a new category, QGIS will insert a new tab or named group for the category in the built-in form. The next step will be to assign the relevant fields to a selected category with the ![icon] icon. You can create more categories and use the same fields again.

Other options in the dialog are 'Autogenerate' and 'Provide ui-file'.

- 'Autogenerate' just creates editors for all fields and tabulates them.

- The 'Provide ui-file' option allows you to use complex dialogs made with the Qt-Designer. Using a UI-file allows a great deal of freedom in creating a dialog. For detailed information, see http://nathanw.net/2011/09/05/qgis-tips-custom-feature-forms-with-python-logic/.

QGIS dialogs can have a Python function that is called when the dialog is opened. Use this function to add extra logic to your dialogs. 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: MyForms.open

MyForms.py must live on PYTHONPATH, in .qgis2/python, or inside the project folder.
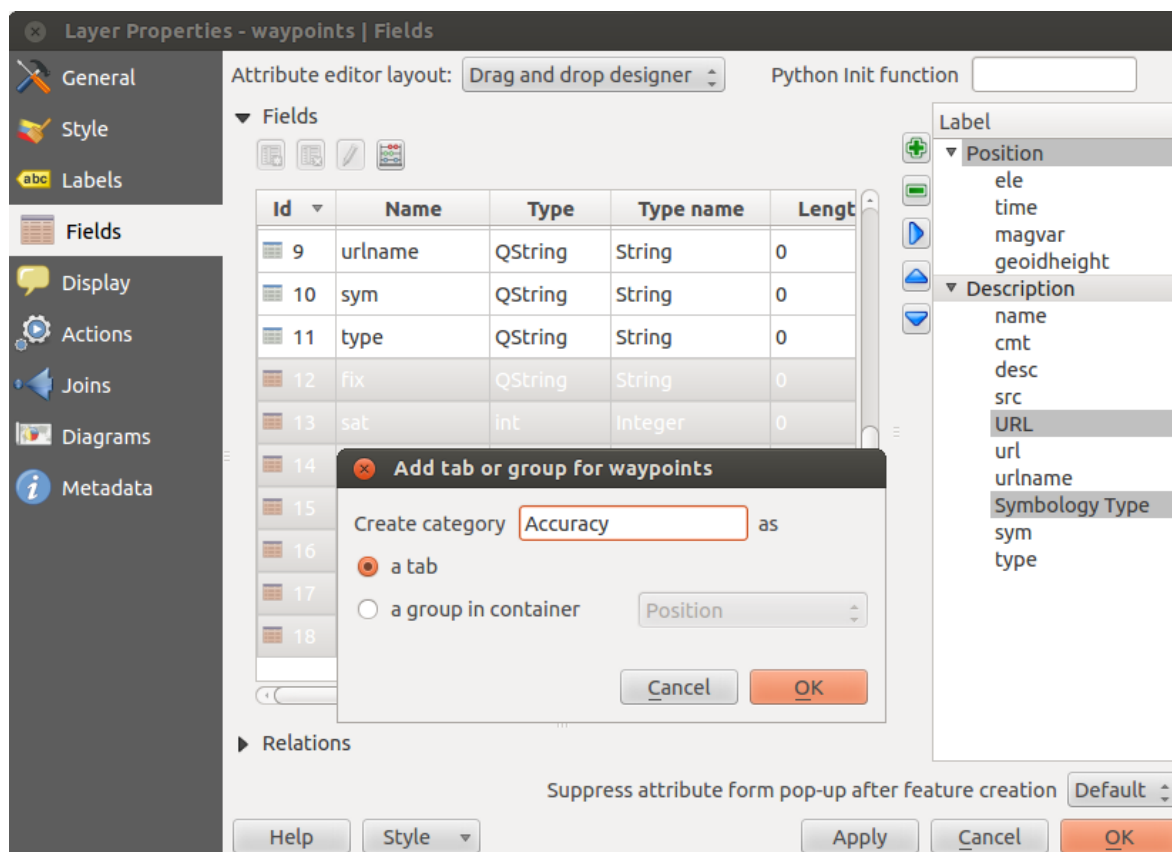
Figure 12.29: Janela de diálogo para criar categorias com o **Layout do editor de atributos**

12.3.4 Menu Geral

Use this menu to make general settings for the vector layer. There are several options available:

Informação da camada

- Muda o nome de exibição da camada em *exibir como*

- Define a *Fonte da camada* da camada vectorial

- Define the *Data source encoding* to define provider-specific options and to be able to read the file

Sistema de Referência de Coordenadas

- *Specify* the coordinate reference system. Here, you can view or change the projection of the specific vector layer.

Figure 12.30: Resulting built-in form with tabs and named groups

- Criar *Índice Espacial* (apenas para formatos OGR suportados)

- *Actualizar Extensões* da camada

- Veja ou altere a projecção de uma camada vectorial específica, clicando em guilabel:*Especificar ...*

Scale dependent visibility

- You can set the *Maximum (inclusive)* and *Minimum (exclusive)* scale. The scale can also be set by the **[Current]** buttons.

Feature subset

- With the **[Query Builder]** button, you can create a subset of the features in the layer that will be visualized (also refer to section *Ferramenta de Consulta*).

12.3.5 Menu Renderização

QGIS 2.2 introduces 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 new global setting that enables generalisation by default for newly added layers (see section *Opções*). **Note**: 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.

12.3.6 Menu Mostrar

This menu is specifically created for Map Tips. It includes a new feature: Map Tip display text in HTML. While you can still choose a *Field* to be displayed when hovering over a feature on the map, it is now possible to insert HTML code that creates a complex display when hovering over a feature. To activate Map Tips, select the menu option *View → MapTips*. Figure Display 1 shows an example of HTML code.
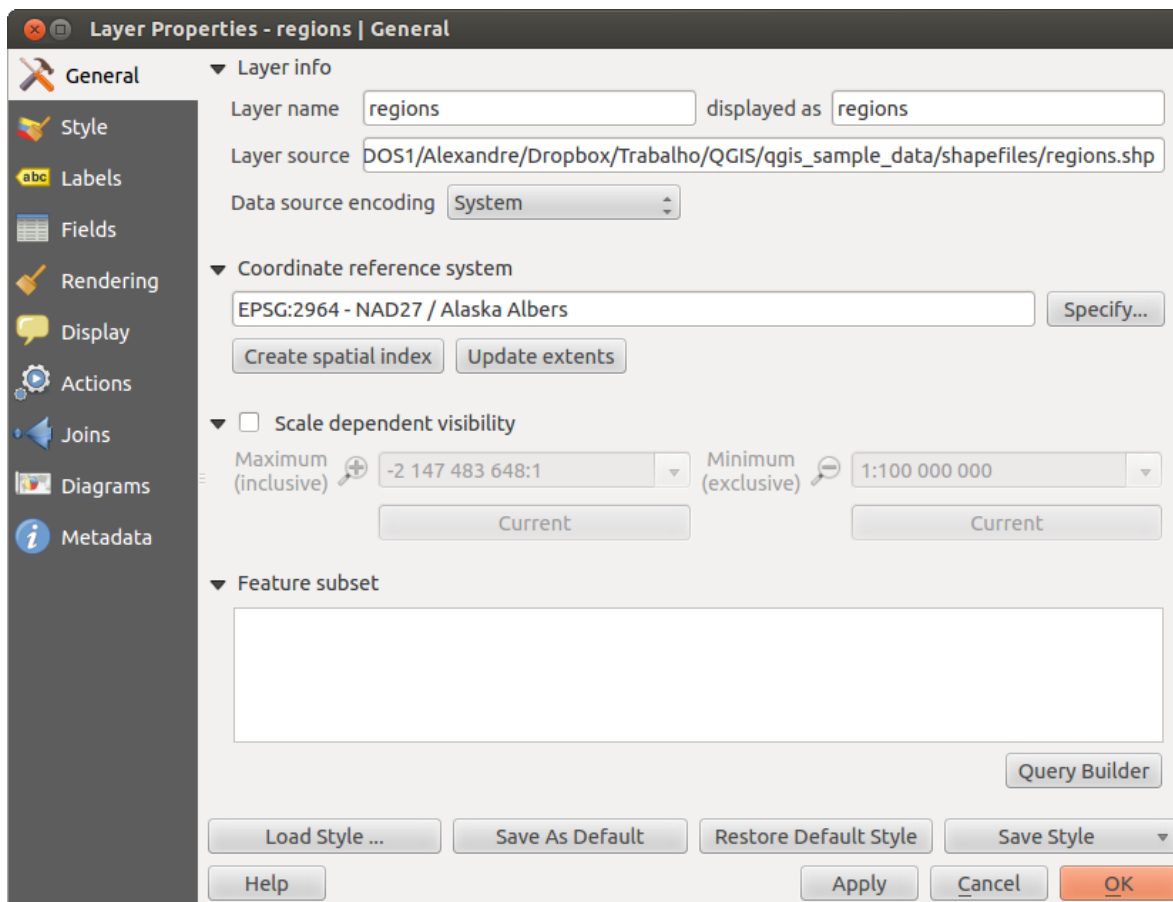
Figure 12.31: General menu in vector layers properties dialog
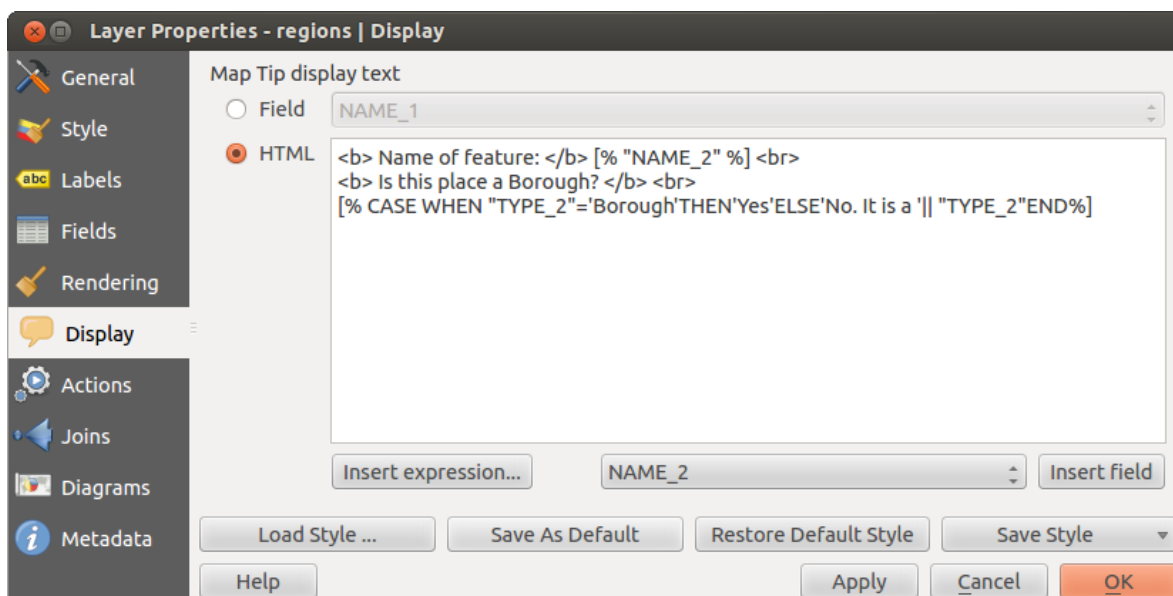
Figure 12.32: HTML code for map tip
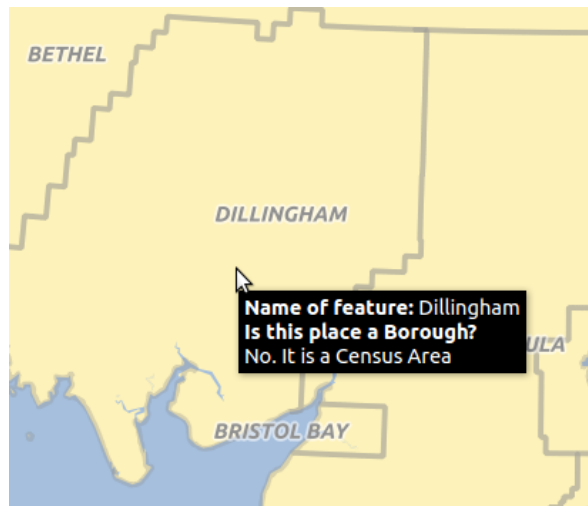
Figure 12.33: Map tip made with HTML code 🐧

12.3.7 Ações

 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.

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:

- Acções do tipo Genérico, Mac, Windows, e Unix começam um processo externo.

- Acções Python executam expressões Python.

- Generic and Python actions are visible everywhere.

- 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 **[Add default actions]**. One example is performing a search based on an attribute value. This concept is used in the following discussion.

Defining Actions

Attribute actions are defined from the vector *Layer Properties* dialog. To define an action, open the vector *Layer Properties* dialog and click on the *Actions* menu. Go to the *Action properties*. Select 'Generic' as 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 preceeding the derived field name with `(Derived).`. For example, a point layer has an `X` and `Y` field, and
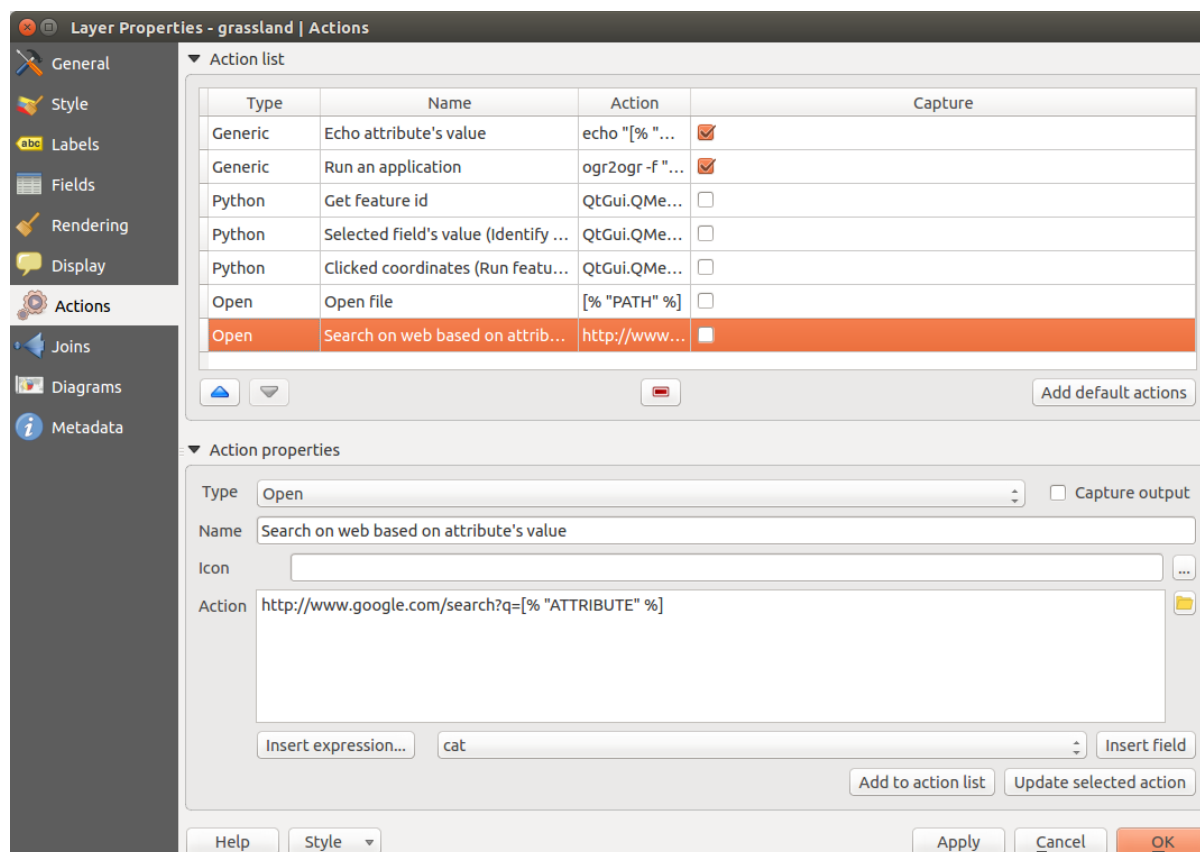
Figure 12.34: Overview action dialog with some sample actions

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.

Dois exemplo de acções são exibidos em baixo:

- `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.

Using Actions

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 record and choose the action from the pop-up menu. Actions are listed in the popup menu by the name you assigned when defining the action. Click on the action you wish to invoke.

If you are invoking an action that uses the `%%` notation, right-click on the field value in the *Identify Results* dialog or the *Attribute Table* dialog that you wish to pass to the application or 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"
```

Após seleccionar umas localidades e executado a acção para cada um, a abertuda do ficheiro irá mostrar algo como isto:

```
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. Garanta que a camada "lagos** está carregada.

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. Clique no menu *Acções*.

4. Introduza um nome para a acção, por exemplo `Google Search`.

5. For the action, we need to provide the name of the external program to run. In this case, we can use Firefox. If the program is not in your path, you need to provide the full path.

6. 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=`

7. The text in the *Action* field should now look like this: `firefox http://google.com/search?q=`

8. Click on the drop-down box containing the field names for the `lakes` layer. It's located just to the left of the **[Insert Field]** button.

9. From the drop-down box, select 'NAMES' and click **[Insert Field]**.

10. O seu texto da acção será algo como isto:

    `firefox http://google.com/search?q=%NAMES`

11. Para finalizar a acção, clique no botão **[Adicionar à lista de acções]**

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
```

We can now use the action. Close the *Layer Properties* dialog and zoom in to an area of interest. Make sure the `lakes` layer is active and identify a lake. In the result box you'll now see that our action is 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 action. 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.

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.

Podemos também efectuar exemplos mais complexo, por exemplo, usando acções **Python**.
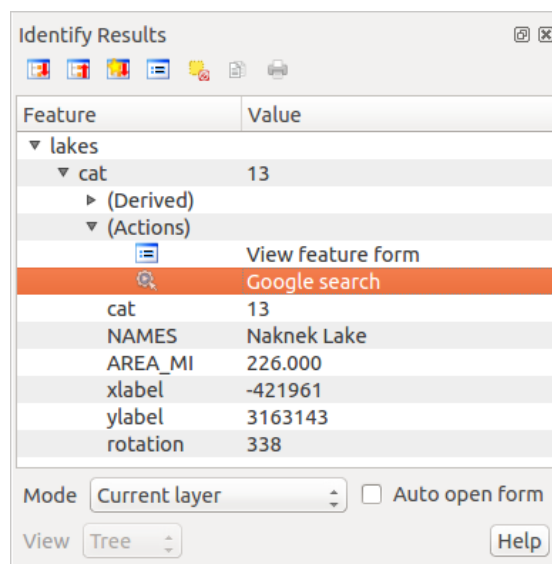
Figure 12.35: Select feature and choose action

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 adicionar um raster (uma imagem TIF neste exemplo), ficará:

```
qgis.utils.iface.addRasterLayer('/yourpath/[% "filename" %].tif','[% "layername" %]
')
```

12.3.8 Menu União

The *Joins* menu 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_1).
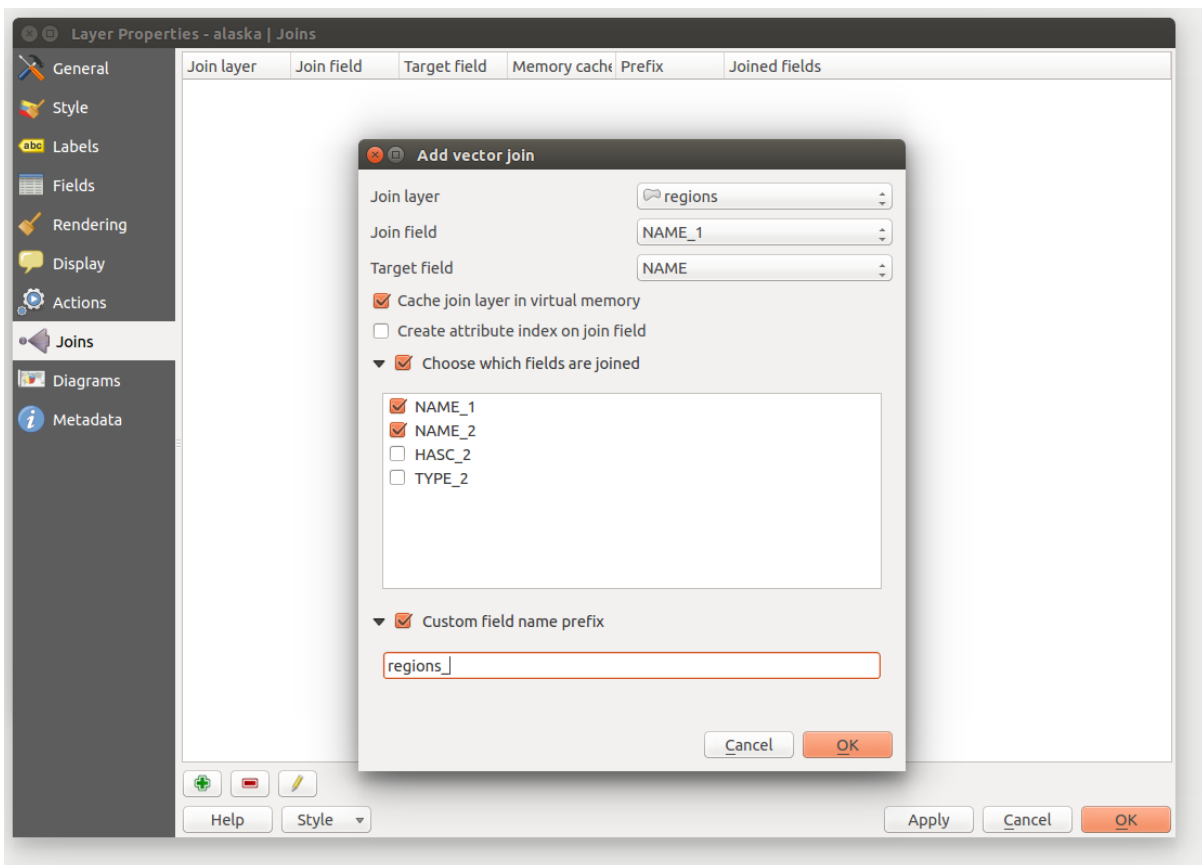
Figure 12.36: Join an attribute table to an existing vector layer ![penguin]

Additionally, the add vector join dialog allows you to:

- ![✓] *Cache join layer in virtual memory*

- ![✓] *Create attribute index on the join field*

- ![✓] *Choose which fields are joined*

- Create a ![✓] *Custom field name prefix*

12.3.9 Menu Diagramas

The *Diagrams* menu allows you to add a graphic overlay to a vector layer (see figure_diagrams_1).

The current core implementation of diagrams provides support for pie charts, text diagrams and histograms.

The menu is divided into four tabs: *Appearance*, *Size*, *Postion* and *Options*.

In the cases of the text diagram and pie chart, text values of different data columns are displayed one below the other with a circle or a box and dividers. In the *Size* tab, diagram size is based on a fixed size or on linear scaling according to a classification attribute. The placement of the diagrams, which is done in the *Position* tab, interacts with the new labeling, so position conflicts between diagrams and labels are detected and solved. In addition, chart positions can be fixed manually.
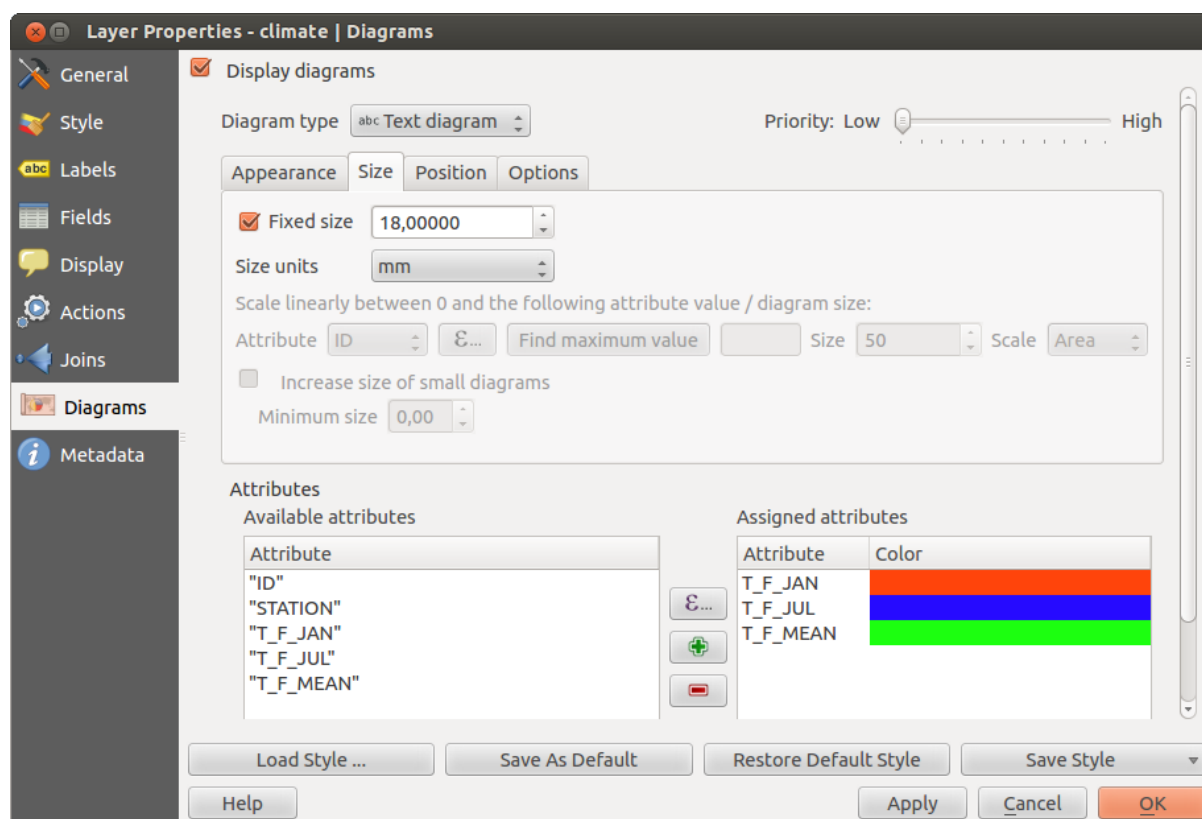
Figure 12.37: Vector properties dialog with diagram menu

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 *Amostra de Dados*).

1. First, click on the ⋎ Load Vector icon, browse to the QGIS sample dataset folder, and load the two vector shape layers `alaska.shp` and `climate.shp`.

2. Faça duplo clique na camada `climate` na legenda do mapa para abrir a janela das *Propriedades da Camada*

3. Click on the *Diagrams* menu, activate ☑*Display diagrams*, 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`. First select `T_F_JAN` as *Attributes* and click the ![+] button, then `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. Deactivate the ![✓] *Fixed size* and set the size of the diagrams on the basis of an attribute with the **[Find maximum value]** button and the *Size* menu. 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_2 gives an idea of the result.

10. Finalmente, clique **[Ok]**.
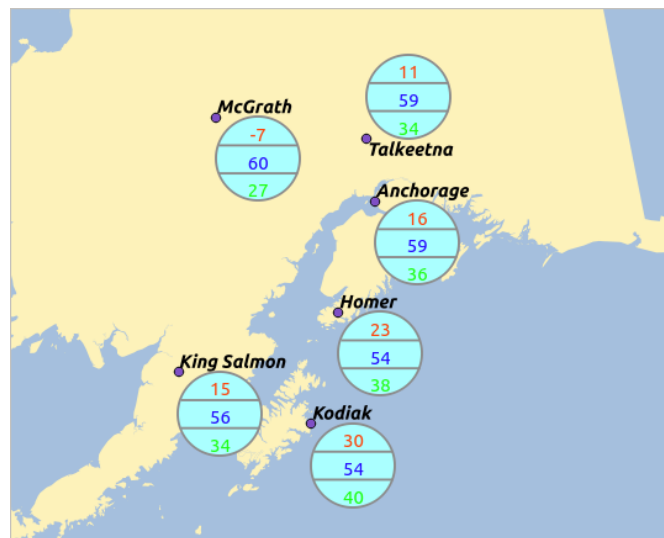
Figure 12.38: Diagram from temperature data overlayed on a map ![penguin]

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 ![ε] button to add an expression. See *Expressions* chapter for more information and example.

12.3.10 Menu Metadados

![info] The *Metadata* menu consists of *Description*, *Attribution*, *MetadataURL* 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 layer extent information and the *Layer Spatial Reference System*, which is information about the CRS of the layer. This is a quick way to get 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 catalogue. 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 catalogue. In *MetadataUrl*, you can define the general path to the XML metadata catalogue. This information will be saved in the QGIS project file for subsequent sessions and will be used for QGIS server.

.
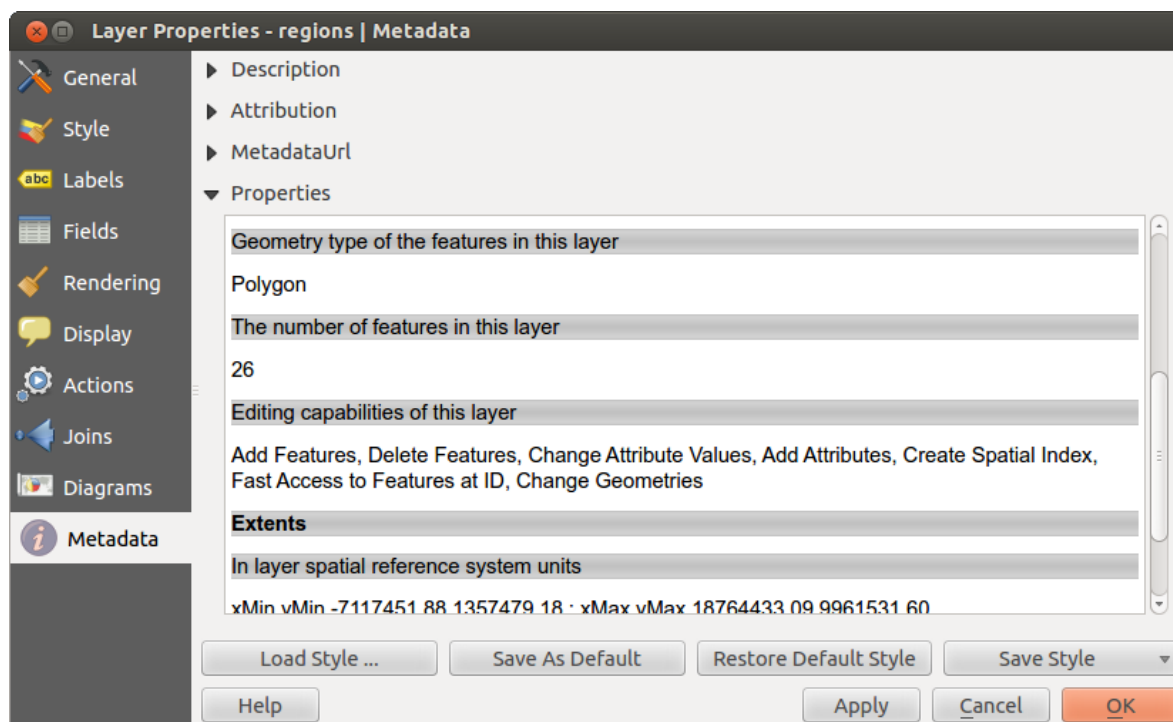
Figure 12.39: Metadata menu in vector layers properties dialog

12.4 Expressions

The **Expressions** feature are available through the field calculator or the add a new column button in the attribut table or the Field tab in the Layer properties ; through the graduaded, categorized and rule-based rendering in the Style tab of the Layer properties ; through the expression-based labeling ⬚ in the *abc* Labeling core application ; through the feature selection and through the diagram tab of the Layer properties as well as the *Main properties* of the label item and the *Atlas generation* tab in the Print Composer.

They are a powerful way to manipulate attribute value in order to dynamically change the final value in order to change the geometry style, the content of the label, the value for diagram, select some feature or create virtual column.

12.4.1 Functions List

The **Function List** contains functions as well as fields and values. View the help function in the **Selected Function Help**. In **Expression** you see the calculation expressions you create with the **Function List**. For the most commonly used operators, see **Operators**.

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 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. To display the values of a field, you just right click on the appropriate field. You can 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. To add a value to the Field calculator **Expression** box, double click its name in the **Field Values** list.

The *Operators*, *Math*, *Conversions*, *String*, *Geometry* and *Record* groups provide several functions. In *Operators*, you find mathematical operators. Look in *Math* for mathematical functions. The *Conversions* group contains functions that convert one data type to another. The *String* group provides functions for data strings. In the *Geometry* group, you find functions for geometry objects. With *Record* group functions, you can add a numeration to your data set. To add a function to the Field calculator **Expression** box, click on the > and then double click the

function.

Operators

This group contains operators (e.g., +, -, *).

```
a + b       a plus b
a - b       a minus b
a * b       a multiplied by b
a / b       a divided by b
a % b       a modulo b (for example, 7 % 2 = 1, or 2 fits into 7 three
            times with remainder 1)
a ^ b       a power b (for example, 2^2=4 or 2^3=8)
a = b       a and b are equal
a > b       a is larger than b
a < b       a is smaller than b
a <> b      a and b are not equal
a != b      a and b are not equal
a <= b      a is less than or equal to b
a >= b      a is larger than or equal to b
a ~ b       a matches the regular expression b
+ a         positive sign
- a         negative value of a
||          joins two values together into a string 'Hello' || ' world'
LIKE        returns 1 if the string matches the supplied pattern
ILIKE       returns 1 if the string matches case-insensitive the supplied
            pattern (ILIKE can be used instead of LIKE to make the match
            case-insensitive)
IS          returns 1 if a is the same as b
OR          returns 1 when condition a or b is true
AND         returns 1 when condition a and b are true
NOT         returns 1 if a is not the same as b
column name "column name"    value of the field column name, take
                             care to not be confused with simple
                             quote, see below
'string'                     a string value, take care to not be
                             confused with double quote, see above
NULL                         null value
a IS NULL                    a has no value
a IS NOT NULL                a has a value
a IN (value[,value])         a is below the values listed
a NOT IN (value[,value])     a is not below the values listed
```

Some examples:

- Joins a string and a value from a column name:

  ```
  'My feature's id is: ' || "gid"
  ```

- Test if the "description" attribute field starts with the 'Hello' string in the value (note the position of the % character):

  ```
  "description" LIKE 'Hello%'
  ```

Conditionals

This group contains functions to handle conditional checks in expressions.

```
CASE                         evaluates multiple expressions and returns a
                             result
CASE ELSE                    evaluates multiple expressions and returns a
                             result
```

```
coalesce                        returns the first non-NULL value from the
                                expression list
regexp_match                    returns true if any part of a string matches
                                the supplied regular expression
```

Some example:

- Send back a value if the first condition is true, else another value:

```
CASE WHEN "software" LIKE '%QGIS%' THEN 'QGIS' ELSE 'Other'
```

Mathematical Functions

This group contains math functions (e.g., square root, sin and cos).

```
sqrt(a)                         square root of a
abs                             returns the absolute value of a number
sin(a)                          sine of a
cos(a)                          cosine of a
tan(a)                          tangent of a
asin(a)                         arcsin of a
acos(a)                         arccos of a
atan(a)                         arctan of a
atan2(y,x)                      arctan of y/x using the signs of the two
                                arguments to determine the quadrant of the
                                result
exp                             exponential of a value
ln                              value of the natural logarithm of the passed
                                expression
log10                           value of the base 10 logarithm of the passed
                                expression
log                             value of the logarithm of the passed value
                                and base
round                           round to number of decimal places
rand                            random integer within the range specified by
                                the minimum
                                and maximum argument (inclusive)
randf                           random float within the range specified by
                                the minimum
                                and maximum argument (inclusive)
max                             largest value in a set of values
min                             smallest value in a set of values
clamp                           restricts an input value to a specified
                                range
scale_linear                    transforms a given value from an input
                                domain to an output
                                range using linear interpolation
scale_exp                       transforms a given value from an input
                                domain to an output
                                range using an exponential curve
floor                           rounds a number downwards
ceil                            rounds a number upwards
$pi                             pi as value for calculations
```

Conversions

This group contains functions to convert one data type to another (e.g., string to integer, integer to string).

```
toint                           converts a string to integer number
toreal                          converts a string to real number
tostring                        converts number to string
```

```
todatetime                    converts a string into Qt data time type
todate                        converts a string into Qt data type
totime                        converts a string into Qt time type
tointerval                    converts a string to an interval type (can be
                              used to take days, hours, months, etc. off a
                              date)
```

Date and Time Functions

This group contains functions for handling date and time data.

```
$now     current date and time
age      difference between two dates
year     extract the year part from a date, or the number of years from
         an interval
month    extract the month part from a date, or the number of months
         from an interval
week     extract the week number from a date, or the number of weeks
         from an interval
day      extract the day from a date, or the number of days from an
         interval
hour     extract the hour from a datetime or time, or the number
         of hours from an interval
minute   extract the minute from a datetime or time, or the number
         of minutes from an interval
second   extract the second from a datetime or time, or the number
         of minutes from an interval
```

Some example:

- Get the month and the year of today in the format "10/2014"

  ```
  month($now) || '/' || year($now)
  ```

String Functions

This group contains functions that operate on strings (e.g., that replace, convert to upper case).

```
lower                         convert string a to lower case
upper                         convert string a to upper case
title                         converts all words of a string to title
                              case (all words lower case with leading
                              capital letter)
trim                          removes all leading and trailing white
                              space (spaces, tabs, etc.) from a string
wordwrap                      returns a string wrapped to a maximum/
                              minimum number of characters
length                        length of string a
replace                       returns a string with the supplied string
                              replaced
regexp_replace(a,this,that)   returns a string with the supplied regular
                              expression replaced
regexp_substr                 returns the portion of a string which matches
                              a supplied regular expression
substr(*a*,from,len)          returns a part of a string
concat                        concatenates several strings to one
strpos                        returns the index of a regular expression
                              in a string
left                          returns a substring that contains the n
                              leftmost characters of the string
right                         returns a substring that contains the n
```

```
                              rightmost characters of the string
rpad                          returns a string with supplied width padded
                              using the fill character
lpad                          returns a string with supplied width padded
                              using the fill character
format                        formats a string using supplied arguments
format_number                 returns a number formatted with the locale
                              separator for thousands (also truncates the
                              number to the number of supplied places)
format_date                   formats a date type or string into a custom
                              string format
```

Color Functions

This group contains functions for manipulating colors.

```
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
ramp_color      returns a string representing a color from a color ramp
color_hsl       returns a string representation of a color based on its
                hue, saturation, and lightness attributes
color_hsla      returns a string representation of a color based on its
                hue, saturation, lightness and alpha (transparency)
                attributes
color_hsv       returns a string representation of a color based on its
                hue, saturation, and value attributes
color_hsva      returns a string representation of a color based on its
                hue, saturation, value and alpha (transparency) attributes
color_cmyk      returns a string representation of a color based on its
                cyan, magenta, yellow and black components
color_cmyka     returns a string representation of a color based on its
                cyan, magenta, yellow, black and alpha (transparency)
                components
```

Geometry Functions

This group contains functions that operate on geometry objects (e.g., length, area).

```
$geometry       returns the geometry of the current feature (can be used
                for processing with other functions)
$area           returns the area size of the current feature
$length         returns the length size of the current feature
$perimeter      returns the perimeter length of the current feature
$x              returns the x coordinate of the current feature
$y              returns the y coordinate of the current feature
xat             retrieves the nth x coordinate of the current feature.
                n given as a parameter of the function
yat             retrieves the nth y coordinate of the current feature.
                n given as a parameter of the function
xmin            returns the minimum x coordinate of a geometry.
                Calculations are in the Spatial Reference System of this
                Geometry
xmax            returns the maximum x coordinate of a geometry.
                Calculations are in the Spatial Reference System of this
                Geometry
ymin            returns the minimum y coordinate of a geometry.
                Calculations are in the Spatial Reference System of this
                Geometry
```

```
ymax            returns the maximum y coordinate of a geometry.
                Calculations are in the Spatial Reference System of this
                Geometry
geomFromWKT     returns a geometry created from a well-known text (WKT)
                representation
geomFromGML     returns a geometry from a GML representation of geometry
bbox
disjoint        returns 1 if the geometries do not share any space
                together
intersects      returns 1 if the geometries spatially intersect
                (share any portion of space) and 0 if they don't
touches         returns 1 if the geometries have at least one point in
                common, but their interiors do not intersect
crosses         returns 1 if the supplied geometries have some, but not
                all, interior points in common
contains        returns true if and only if no points of b lie in the
                exterior of a, and at least one point of the interior
                of b lies in the interior of a
overlaps        returns 1 if the geometries share space, are of the
                same dimension, but are not completely contained by
                each other
within          returns 1 if geometry a is completely inside geometry b
buffer          returns a geometry that represents all points whose
                distance from this geometry is less than or equal to
                distance
centroid        returns the geometric center of a geometry
bounds          returns a geometry which represents the bounding box of
                an input geometry. Calculations are in the Spatial
                Reference System of this Geometry.
bounds_width    returns the width of the bounding box of a geometry.
                Calculations are in the Spatial Reference System of
                this Geometry.
bounds_height   returns the height of the bounding box of a geometry.
                Calculations are in the Spatial Reference System of
                this Geometry.
convexHull      returns the convex hull of a geometry (this represents
                the minimum convex geometry that encloses all geometries
                within the set)
difference      returns a geometry that represents that part of geometry
                a that does not intersect with geometry b
distance        returns the minimum distance (based on spatial ref)
                between two geometries in projected units
intersection    returns a geometry that represents the shared portion
                of geometry a and geometry b
symDifference   returns a geometry that represents the portions of a and
                b that do not intersect
combine         returns the combination of geometry a and geometry b
union           returns a geometry that represents the point set union of
                the geometries
geomToWKT       returns the well-known text (WKT) representation of the
                geometry without SRID metadata
geometry        returns the feature's geometry
transform       returns the geometry transformed from the source CRS to
                the dest CRS
```

Record Functions

Este grupo contém funções que operam em indentificadores de registo.

```
$rownum              returns the number of the current row
$id                  returns the feature id of the current row
$currentfeature      returns the current feature being evaluated.
```

```
                           This can be used with the 'attribute' function
                           to evaluate attribute values from the current
                           feature.
$scale                     returns the current scale of the map canvas
$uuid                      generates a Universally Unique Identifier (UUID)
                           for each row. Each UUID is 38 characters long.
getFeature                 returns the first feature of a layer matching a
                           given attribute value.
attribute                  returns the value of a specified attribute from
                           a feature.
$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.
```

Fields and Values

Contains a list of fields from the layer. 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. Values or string should be simple-quoted.

.

12.5 Editando

QGIS supports various capabilities for editing OGR, SpatiaLite, PostGIS, MSSQL Spatial and Oracle Spatial vector layers and tables.

Note: The procedure for editing GRASS layers is different - see section *Digitalizando e editando as camadas vectoriais GRASS* for details.

Tip: Edições Simultâneas

This version of QGIS does not track if somebody else is editing a feature at the same time as you are. The last person to save their edits wins.

12.5.1 Configurando a Tolerância de Atracção e Raio de Pesquisa

Before we can edit vertices, we must set the snapping tolerance and search radius to a value that allows us an optimal editing of the vector layer geometries.

Tolerância de Atracção

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*. On Mac, go to *QGIS* → 🔧 *Preferences....* On Linux: *Edit* → 🔧 *Options*. In the *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 can be defined by choosing *Settings* → (or *File* →) *Snapping options...* to enable and adjust snapping mode and tolerance on a layer basis (see figure_edit_1).

Note that this layer-based snapping overrides the global snapping option set in the Digitizing tab. So, if you need to edit one layer and snap its vertices to another layer, then enable snapping only on the `snap to` layer, then decrease the global snapping tolerance to a smaller 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.
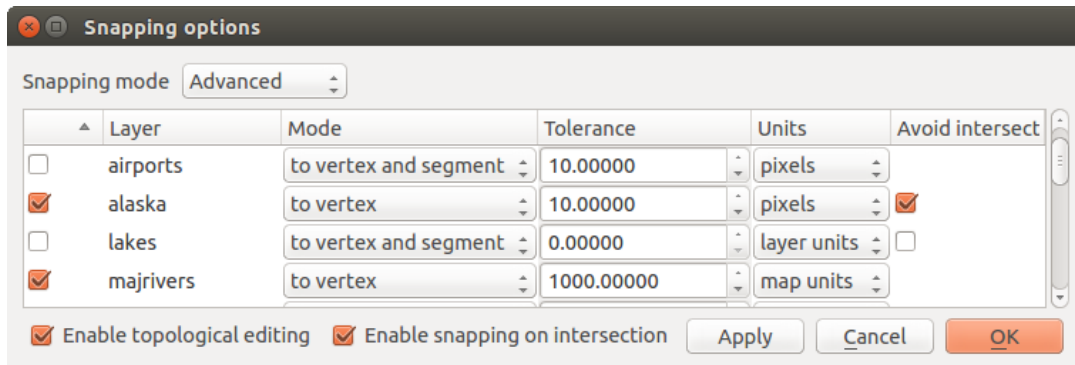
Figure 12.40: Edit snapping options on a layer basis (Advanced mode)

The *Snapping options* enables you to make a quick and simple general setting for all layers in the project so that the pointer snaps to all existing vertices and/or segments when using the 'All layers' snapping mode. In most cases it is sufficient to use this snapping mode.

It is important to consider that the per-layer tolerance in 'map units' was actually in layer units. So if working with a layer in WGS84 reprojected to UTM, setting tolerance to 1 map unit (i.e. 1 meter) wouldn't work correctly because the units would be actually degrees. So now the 'map units' has been relabeled to 'layer units' and the new entry 'map units' operates with units of the map view. While working with 'on-the-fly' CRS transformation it is now possible to use a snapping tolerance that refers to either the units of the reprojected layer (setting 'layer units') or the units of the map view (setting 'map units').

Raio de pesquisa

Search radius is the distance QGIS uses to `search` for the closest vertex you are trying to move when you click on the map. If you aren't within the search radius, QGIS won't find and select any vertex for editing, and it will pop up an annoying warning to that effect. 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.

The search radius for vertex edits in layer units can be defined in the *Digitizing* tab under *Settings* → 🔧 *Options*. This is the same place where you define the general, project- wide snapping tolerance.

12.5.2 Zooming and Panning

Before editing a layer, you should zoom in to your area of interest. This avoids waiting while all the vertex markers are rendered across the entire layer.

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.

Zooming and panning with the mouse wheel

While digitizing, you can press the mouse wheel to pan inside of the main window, and you can roll the mouse wheel to zoom in and out on the map. For zooming, place the mouse cursor inside the map area and roll it forward (away from you) to zoom in and backwards (towards you) to zoom out. The mouse cursor position will be the center of the zoomed area of interest. You can customize the behavior of the mouse wheel zoom using the *Map tools* tab under the *Settings* → 🔧 *Options* menu.

Panning with the arrow keys

Panning the map during digitizing 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 without interrupting your digitizing session.

12.5.3 Edição 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, you can activate the column ☑ *Avoid Int.*, which avoids intersection of new polygons.

Activar edição topológica

The option ☑ *Enable topological editing* is for editing and maintaining common boundaries in polygon mosaics. QGIS 'detects' a shared boundary in a polygon mosaic, so you only have to move the vertex once, and QGIS will take care of updating the other boundary.

Evitar intersecções de novos polígonos

The second topological option in the ☑ *Avoid Int.* column, called *Avoid intersections of new polygons*, avoids overlaps in polygon mosaics. 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 common boundary. The advantage is that you don't have to digitize all vertices of the common boundary.

Activar atracção nas intersecções

Another option is to use ☑ *Enable snapping on intersection*. It allows you to snap on an intersection of background layers, even if there's no vertex on the intersection.

12.5.4 Digitalizar uma camada 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, and the underlying data source is writable (i.e., its files are not read-only).

In general, tools for editing vector layers are divided into a digitizing and an advanced digitizing toolbar, described in section *Digitalização Avançada*. You can select and unselect both under

View → *Toolbars* →. Using the basic digitizing tools, you can perform the following functions:

Ícone	Finalidade	Ícone	Finalidade
	Edições actuais		Alternar edição
	Adding Features: Capture Point		Adding Features: Capture Line
	Adding Features: Capture Polygon		Mover Elemento
	Ferramenta de Nós		Apagar Seleccionados
	Cortar Elementos		Copiar Elementos
	Colar Elementos		Guardar edições da camada

Edição da Tabela: Edição básica da camada vectorial pela barra de ferramentas

All editing sessions start by choosing the Toggle editing option. This can be found in the context menu after right clicking on the legend entry for a given layer.

Alternatively, you can use the Toggle Editing Toggle editing button from the digitizing toolbar to start or stop the editing mode. Once the layer is in edit mode, markers will appear at the vertices, and additional tool buttons on the editing toolbar will become available.

Tip: Guardar Regularmente

Remember to Save Layer Edits regularly. This will also check that your data source can accept all the changes.

Adicionando Elementos

You can use the Add Feature, Add Feature or Add Feature icons on the toolbar to put the QGIS cursor into digitizing mode.

For each feature, 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 lines and polygons, keep on left-clicking for each additional point you wish to capture. When you have finished adding points, right-click anywhere on the map area to confirm you have finished entering the geometry of that feature.

The attribute window will appear, allowing you to enter the information for the new feature. Figure_edit_2 shows setting attributes for a fictitious new river in Alaska. In the *Digitizing* menu under the *Settings* → *Options* menu, you can also activate *Suppress attributes pop-up windows after each created feature* and *Reuse last entered attribute values*.
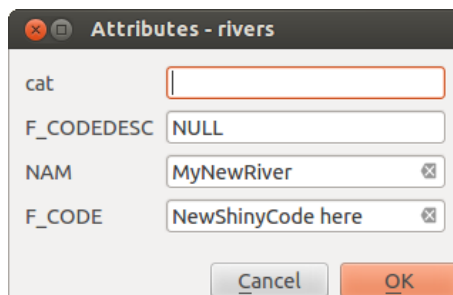
Figure 12.41: Enter Attribute Values Dialog after digitizing a new vector feature

With the Move Feature(s) icon on the toolbar, you can move existing features.

Tip: Attribute Value Types

For editing, the attribute types are validated during entry. Because of this, it is not possible to enter a number into a text column in the dialog *Enter Attribute Values* or vice versa. If you need to do so, you should edit the attributes in a second step within the *Attribute table* dialog.

Current Edits

This feature allows the digitization of multiple layers. Choose ![icon] *Save for Selected Layers* to save all changes you made in multiple layers. You also have the opportunity to ![icon] *Rollback for Selected Layers*, so that the digitization may be withdrawn for all selected layers. If you want to stop editing the selected layers, ![icon] *Cancel for Selected Layer(s)* is an easy way.

The same functions are available for editing all layers of the project.

Ferramenta de Nós

For shapefile-based layers as well as SpatialLite, PostgreSQL/PostGIS, MSSQL Spatial, and Oracle Spatial tables, the ![icon] 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 it 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. If the node tool is unable to find any features, a warning will be displayed.

It is important to set the property *Settings → ![icon] Options → Digitizing → Search Radius:* $\boxed{1,00 \;\updownarrow}$ to a number greater than zero (i.e., 10). Otherwise, QGIS will not be able to tell which vertex is being edited.

Tip: Marcadores de Vértice

The current version of QGIS supports three kinds of vertex markers: 'Semi-transparent circle', 'Cross' and 'None'. To change the marker style, choose ![icon] *Options* from the *Settings* menu, click on the *Digitizing* tab and select the appropriate entry.

Operações Básicas

Start by activating the ![icon] 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` or `Shift` 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**: After selecting vertices for deletion, click the `Delete` key. Note that you cannot use the ![icon] Node Tool to delete a complete feature; QGIS will ensure it retains the minimum number of vertices for the feature type you are working on. To delete a complete feature use the ![icon] 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.

Cortando, Copiando e Colando Elementos

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.

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.

However, in this version of QGIS, text features from outside QGIS cannot be pasted to a layer within QGIS. 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.

As an example, we will copy some lakes to a new layer:

1. Carregue a camada que quer copiar a partir (camada de origem)
2. Carregue ou crie a camada que quer copiar para (camada de destino)
3. Começar a editar a camada de destino
4. Active a camada de origem clicando nela na legenda
5. Use the 🔲 Select Single Feature tool to select the feature(s) on the source layer
6. Click on the 📄 Copy Features tool
7. Active a camada de destino clicando na legenda
8. Click on the 📋 Paste Features tool
9. Parar a edição e guardar as alterações

What happens if the source and target layers have different schemas (field names and types are not the same)? QGIS populates what matches and ignores the rest. If you don't care about the attributes being copied to the target layer, it doesn't matter how you design the fields and data types. If you want to make sure everything - the feature and its attributes - gets copied, make sure the schemas match.

Tip: Congruência dos Elementos Colados

If your source and destination layers use the same projection, then the pasted features will have geometry identical to the source layer. However, if the destination layer is a different projection, then QGIS cannot guarantee the geometry is identical. This is simply because there are small rounding-off errors involved when converting between projections.

Tip: Copy string attribute into another

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 accomodate for the length of the data to be inserted.

Apagando os Elementos Seleccionados

If we want to delete an entire polygon, we can do that by first selecting the polygon using the regular ![Select Single Feature] ^Select Single Feature^ tool. You can select multiple features for deletion. Once you have the selection set, use the ![Delete Selected] ^Delete Selected^ tool to delete the features.

The ![Cut Features] ^Cut Features^ tool on the digitizing toolbar can also be used to delete features. This effectively deletes the feature but also places it on a "spatial clipboard". So, we cut the feature to delete. We could then use the ![Paste Features] ^Paste Features^ tool to put it back, giving us a one-level undo capability. Cut, copy, and paste work on the currently selected features, meaning we can operate on more than one at a time.

Guardando as Camadas 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] ^Save Layer Edits^ button. When you turn editing mode off with ![Toggle editing] ^Toggle editing^ (or quit QGIS for that matter), you are also asked if you want to save your changes or discard them.

If the changes cannot be saved (e.g., disk full, or the attributes have values that are out of range), the QGIS in-memory state is preserved. This allows you to adjust your edits and try again.

Tip: Integridade dos dados

It is always a good idea to back up your data source before you start editing. While the authors of QGIS have made every effort to preserve the integrity of your data, we offer no warranty in this regard.

12.5.5 Digitalização Avançada

Ícone	Finalidade	Ícone	Finalidade
	Retroceder		Retomar
	Rodar Elemento(s)		Simplificar elemento
	Adicionar Anél		Adicionar Parte
	Fill Ring		Apagar Anél
	Apagar Parte		Refazer elementos
	Curva de Afastamento		Dividir Elementos
	Split Parts		Juntar Elementos Seleccionados
	Juntar Atributos dos Elementos Seleccionados		Rodar Símbolos de Pontos

Tabela de edição avançada: Barra de ferramentas de edição avançada de camadas vectoriais

Retroceder e Retomar

The ![Undo] ^Undo^ and ![Redo] ^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_3). This widget is not displayed by default; it can be displayed by right clicking on the toolbar and activating the Undo/Redo checkbox. Undo/Redo is however active, even if the widget is not displayed.
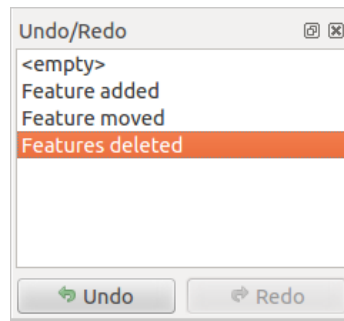
Figure 12.42: Redo and Undo digitizing steps

When Undo is hit, 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.

To use the undo/redo history widget, simply click to select an operation in the history list. All features will be reverted to the state they were in after the selected operation.

Rodar Elemento(s)

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.

If you hold `Shift` before clicking on the map, the rotation will be done in 45 degree steps, which can be modified afterwards in the user input widget.

Simplificar elemento

The Simplify Feature tool allows you to reduce the number of vertices of a feature, as long as the geometry doesn't change. With the tool you can also simplify multi-part features. First, drag a rectangle over the feature. The vertices will be highlighted in red while the color of the feature will change and a dialog where you can define a tolerance in map units or pixels will appear. QGIS calculates the amount of vertices that can be deleted while maintaining the geometry using the given tolerance. The higher the tolerance is the more vertices can be deleted. After gaining the statistics about the simplification just klick 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.

Adicionar Anél

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.

Adicionar Parte

You can add part polygons to a selected multipolygon. The new part polygon must be digitized outside the selected multi-polygon.

Fill Ring

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. Thus you need not first use the Add Ring icon and then the Add feature function anymore.

Apagar Anél

The Delete Ring tool allows you to delete ring polygons inside an existing area. This tool only works with polygon layers. It doesn't change anything when it is used on the outer ring of the polygon. This tool can be used on polygon and multi-polygon features. Before you select the vertices of a ring, adjust the vertex edit tolerance.

Apagar Parte

The Delete Part tool allows you to delete parts from multifeatures (e.g., to delete polygons from a multi-polygon feature). It won't delete the last part of the feature; this last part will stay untouched. This tool works with all multi-part geometries: point, line and polygon. Before you select the vertices of a part, adjust the vertex edit tolerance.

Refazer elementos

You can reshape line and polygon features using the Reshape Features icon on the toolbar. It replaces the line or polygon part from the first to the last intersection with the original line. With polygons, this 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.

Por exemplo, pode editar o limite de um polígono com esta ferramenta. Primeiro, clique na área interna do polígos junto do ponto onde pretende adicionar o novo vértice. Depois, atravesse o limite e adicione os vértices no exterior do polígono. Para finalizar, clique com o botão direito na área interna do polígono. A ferramente vai adicionar um nó automaticamente no ponto onde a linha atravessa o limite. Também é possível remover parte da área do polígono, começa-se a nova linha no exterior do polígono, adicionam-se vértices no interior e termina-se a linha no exterior do polígono com um clique no botão direito.

Note: The reshape tool may alter the starting position of a polygon ring or a closed line. So, the point that is represented 'twice' will not be the same any more. This may not be a problem for most applications, but it is something to consider.

Curvas de Afastamento

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 the edited layer). It is thus ideally suited for the creation of distance line layers. The displacement is shown at the bottom left of the taskbar.

To create a shift of a line layer, you must first go into editing mode and activate the Offset Curve tool. Then click on a feature to shift it. Move the mouse and click where wanted or enter the desired distance in the user input widget. Your changes may then be saved with the|mActionSaveEdits|:sup:*Save Layer Edits* tool.

QGIS options dialog (Digitizing tab then **Curve offset tools** section) allows you to configure some parameters like **Join style**, **Quadrant segments**, **Miter limit**.

Dividir Elementos

You can split features using the ![Split Features] Split Features icon on the toolbar. Just draw a line across the feature you want to split.

Split parts

In QGIS 2.0 it is now possible to split the parts of a multi part feature so that the number of parts is increased. Just draw a line across the part you want to split using the ![Split Parts] Split Parts icon.

Juntar elementos seleccionados

The ![Merge Selected Features] Merge Selected Features tool allows you to merge features. A new dialog will allow you to choose which value to choose between each selected features or select a function (Minimum, Maximum, Median, Sum, Skip Attribute) to use for each column. If features don't have a common boundaries, a multipolygon will be created.

Juntar os atributos dos elementos seleccionados

The ![Merge Attributes of Selected Features] Merge Attributes of Selected Features tool allows you to merge attributes of features with common boundaries and attributes without merging their boundaries. First, select several features at once. Then press the ![Merge Attributes of Selected Features] Merge Attributes of Selected Features button. Now QGIS asks you which attributes are to be applied to all selected objects. As a result, all selected objects have the same attribute entries.

Rodar Símbolos de Pontos

![Rotate Point Symbols] Rotate Point Symbols allows you to change the rotation of point symbols in the map canvas. You must first define a rotation column from the attribute table of the point layer in the *Advanced* menu of the *Style* menu of the *Layer Properties*. Also, you will need to go into the 'SVG marker' and choose *Data defined properties ...*. Activate ![checkbox] *Angle* and choose 'rotation' as field. Without these settings, the tool is inactive.
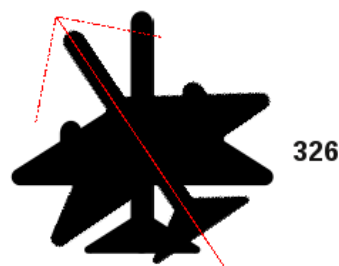
Figure 12.43: Rotate Point Symbols ![Linux icon]

To change the rotation, select a point feature in the map canvas and rotate it, holding the left mouse button pressed. A red arrow with the rotation value will be visualized (see Figure_edit_4). When you release the left mouse button again, the value will be updated in the attribute table.

Note: Se segurar a tecla `Ctrl` premido, a rotação irá ser feita em passos de 15 graus.

12.5.6 The Advanced Digitizing panel

When capturing new geometries or geometry parts you also have the possibility to use the Advanced Digitizing panel. You can digitize lines exactly parallel or at a specific angle or lock lines to specific angles. Furthermore you can enter coordinates directly so that you can make a precise definition for your new geomtry.

_figure_advanced_edit 1:
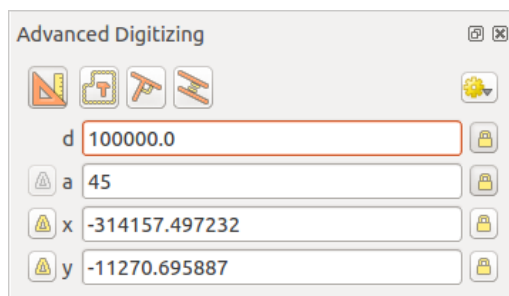
Figure 12.44: The Advanced Digitizing panel

The tools are not enabled if the map view is in geographic coordinates.

12.5.7 Criando novas camadas Vectoriais

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 *Criando uma nova camada vectorial GRASS* for more information on creating GRASS vector layers.

Criando uma nova camada Shapefile

To create a new shape layer for editing, choose *New →* *New Shapefile Layer...* from the *Layer* menu. The *New Vector Layer* dialog will be displayed as shown in Figure_edit_5. 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).

To complete the creation of the new shapefile layer, add the desired attributes by clicking on the **[Add to attributes list]** button and specifying a name and type for the attribute. A first 'id' column is added as default but can be removed, if not wanted. Only *Type: real* , *Type: integer* , *Type: string* and *Type:date* attributes are supported. Additionally and according to the attribute type, you can also define the width 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 a `.shp` extension to the name you specify. Once the layer has been created, it will be added to the map, and you can edit it in the same way as described in section *Digitalizar uma camada existente* above.

Criando uma nova camada SpatialLite

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_edit_6.

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*.
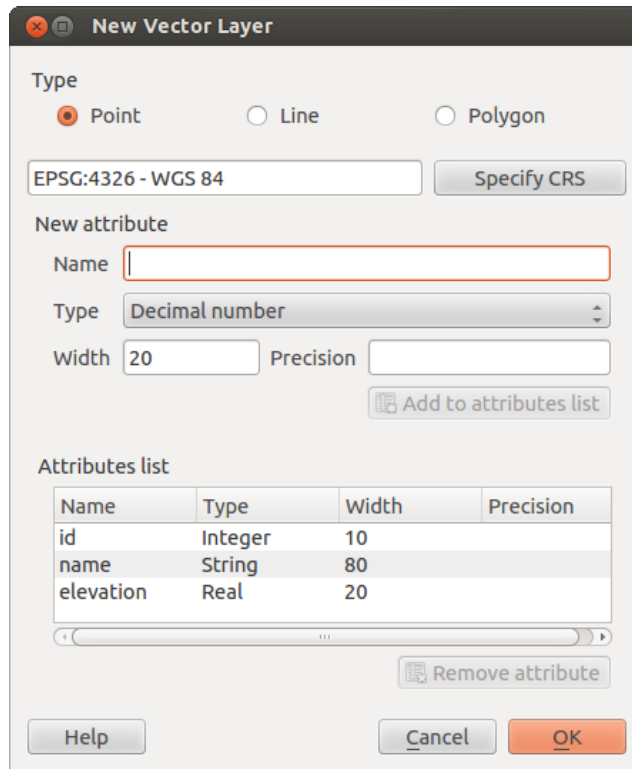
Figure 12.45: Creating a new Shapefile layer Dialog
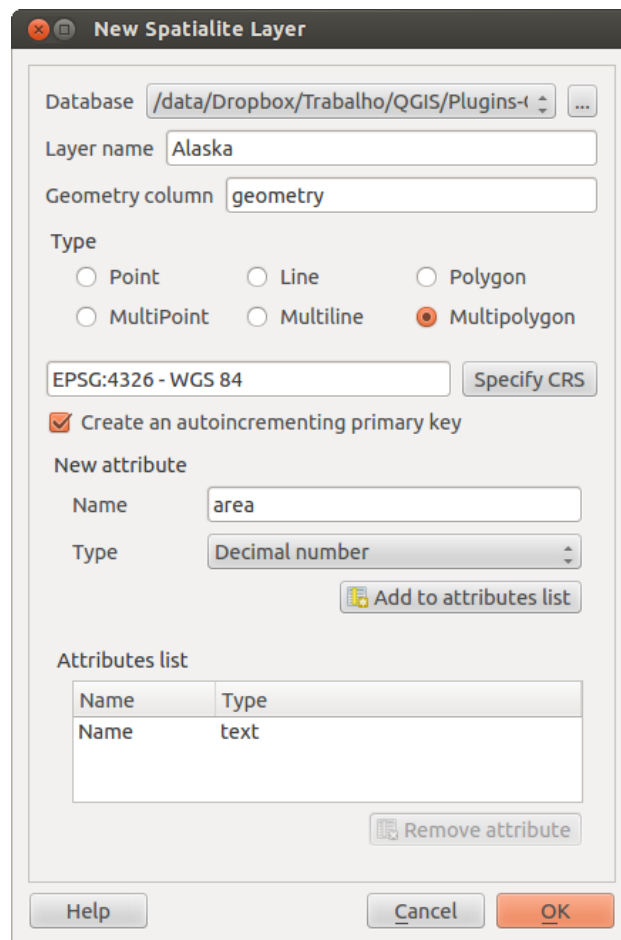
Figure 12.46: Creating a New SpatiaLite layer Dialog

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 *Digitalizar uma camada existente* above.

Further management of SpatiaLite layers can be done with the DB Manager. See *Módulo Gestor BD*.

Criando uma nova camada 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, you can choose where to save the new GPX layer.

Creating a new Temporary Scratch Layer
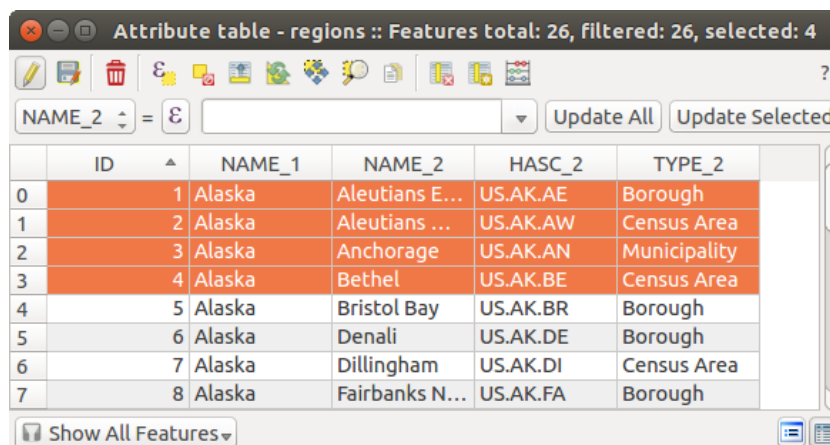
Empty, editable memory layers can be defined using *Layer → Create Layer → New Temporary Scratch Layer*. Here you can even create ◯ *Multipoint*, ◯ *Multiline* and ◯ *Multipolygon* Layers beneath ◉ *Point*, ◯ *Line* and ◯ *Polygon* Layers. Temporary Scratch Layers are not saved and will be discarded when QGIS is closed. See also paste_into_layer .

12.5.8 Working with the Attribute Table

The attribute table displays features of a selected layer. Each row in the table represents one map feature, and each column contains a particular piece of information about the feature. Features in the table can be searched, selected, moved or even edited.

To open the attribute table for a vector layer, make the layer active by clicking on it in the map legend area. 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, and 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_1). The number of features and the number of selected features are shown in the attribute table title.

Figure 12.47: Attribute Table for regions layer 🐧

Selecting features in an attribute table

Each selected row in the attribute table displays the attributes of a selected feature in the layer. If the set of features selected in the main window is changed, the selection is also updated in the attribute table. Likewise, if the set of rows selected in the attribute table is changed, the set of features selected in the main window will be updated.

Rows can be selected by clicking on the row number on the left side of the row. **Multiple rows** can be marked by holding the `Ctrl` key. A **continuous selection** can be made by holding the `Shift` key and clicking on several row headers on the left side of the rows. All rows between the current cursor position and the clicked row are selected. Moving the cursor position in the attribute table, by clicking a cell in the table, does not change the row selection. Changing the selection in the main canvas does not move the cursor position in the attribute table.

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).

For a **simple search by attributes** on only one column, choose the *Column filter →* from the menu in the bottom left corner. Select the field (column) on which the search should be performed from the drop-down menu, and hit the **[Apply]** button. Then, only the matching features are shown in the attribute table.

To make a selection, you have to use the ${}^\varepsilon$ Select features using an Expression icon on top of the attribute table. ${}^\varepsilon$ Select features using an Expression allows you to define a subset of a table using a *Function List* like in the Field Calculator (see *Calculadora de Campos*). The query result can then be saved as a new vector layer. For example, if you want to find regions that are boroughs from `regions.shp` of the QGIS sample data, you have to open the *Fields and Values* menu and choose the field that you want to query. Double-click the field 'TYPE_2' and also **[Load all unique values]** . From the list, choose and double-click 'Borough'. In the *Expression* field, the following query appears:

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

Here you can also use the *Function list → Recent (Selection)* to make a selection that you used before. The expression builder remembers the last 20 used expressions.

The matching rows will be selected, and the total number of matching rows will appear in the title bar of the attribute table, as well as in the status bar of the main window. For searches that display only selected features on the map, use the Query Builder described in section *Ferramenta de Consulta*.

To show selected records only, use *Show Selected Features* from the menu at the bottom left.

The field calculator bar allows you to make calculations on the selected rows only. For example, you can alter the number of the ID field of the file:*regions.shp* with the expression

```
ID+5
```

as shown in figure_attributes_1 .

The other buttons at the top of the attribute table window provide the following functionality:

- ✏️ Toggle editing mode to edit single values and to enable functionalities described below (also with `Ctrl+E`)

- 💾 Save Edits (also with `Ctrl+S`)

- 🟡 Unselect all (also with `Ctrl+U`)

- Move selected to top (also with `Ctrl+T`)

- Invert selection (also with `Ctrl+R`)

- Copy selected rows to clipboard (also with `Ctrl+C`)

- Zoom map to the selected rows (also with `Ctrl+J`)

- Pan map to the selected rows (also with `Ctrl+P`)

- Delete selected features (also with `Ctrl+D`)

- New Column for PostGIS layers and for OGR layers with GDAL version >= 1.6 (also with `Ctrl+W`)

- Delete Column for PostGIS layers and for OGR layers with GDAL version >= 1.9 (also with `Ctrl+L`)

- Open field calculator (also with `Ctrl+I`)

Below these buttons is the Field Calculator bar, which allows calculations to be quickly applied attributes visible in the table. This bar uses the same expressions as the Field Calculator (see *Calculadora de Campos*).

Tip: 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 *Settings* → *Options* → Data sources menu *Copy geometry in WKT representation from attribute table*.

Save 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). Just open the right mouse menu of the layer and click on *Save as* to define the name of the output file, its format and CRS (see section *Map Legend*). 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.

Paste into new layer

Features that are on the clipboard may be pasted into a new layer. To do this, first make a layer editable. 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* or *New memory layer*.

This applies to features selected and copied within QGIS and also to features from another source defined using well-known text (WKT).

Working with non spatial attribute tables

QGIS allows you also to load non-spatial tables. This currently includes tables supported by OGR and delimited text, as well as the PostgreSQL, MSSQL and Oracle provider. The tables can be used for field lookups or just generally browsed and edited using the table view. When you load the table, you will see it in the legend field. It can be opened with the Open Attribute Table tool and is then editable like any other layer attribute table.

As an example, you can use columns of the 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 *Menu Campos* to find out more.

12.5.9 Creating one 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.

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).

Foreign keys

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 region layer, you need to create a one to many relation using foreign keys, because there are several airports in most regions.

Figure 12.48: Alaska region with airports

In addition to the already existing attributes in the airports attribute table 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 the editing and QGIS takes care about 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.

Layers

QGIS makes no difference between a table and a vector layer. Basically, a vector layer is a table with a geometry. So can add your table as a vector layer. To demostrate you can load the 'region' shapefile (with geometries) and the 'airport' csv table (without geometries) and a foreign key (fk_region) to the layer region. 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).

Definition (Relation Manager)

The first thing we are going to do is to let QGIS know about the relations between the layer. This is done in *Settings → Project Properties*. Open the *Relations* menu and click on *Add*.

- **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** 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** 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 once this is supported. 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.
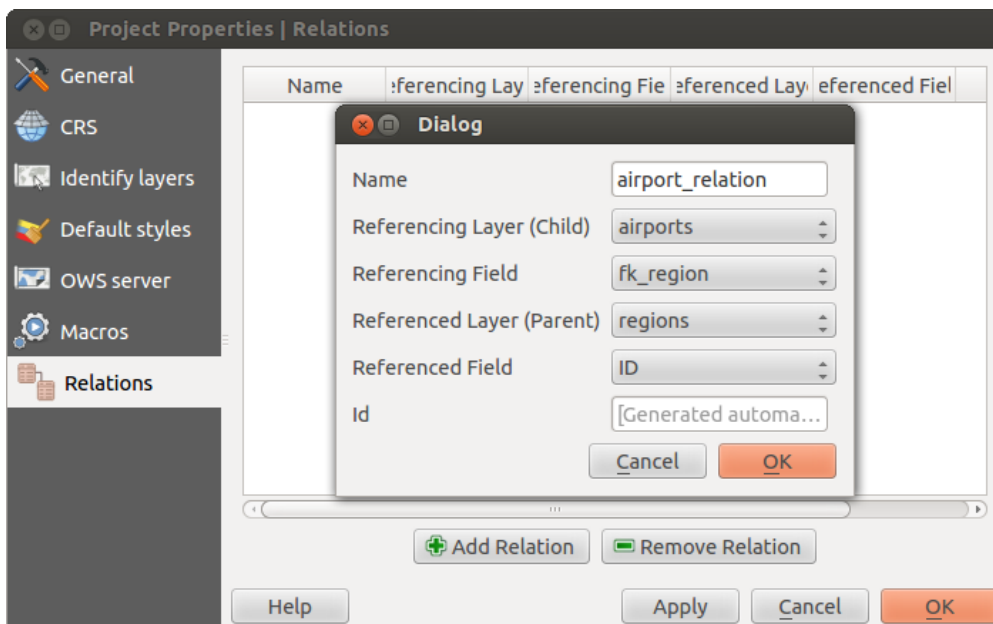
Figure 12.49: Relation Manager 🐧

Forms

Now that QGIS knows about the relation, it will be used to improve the forms it generates. As we did not change the default form method (autogenerated) it will just add a new widget in our form. So let's select the layer region in the legend and use the identify tool. Depending on your settings, the form might open directly or you will have to choose to open it in the identification dialog under actions.
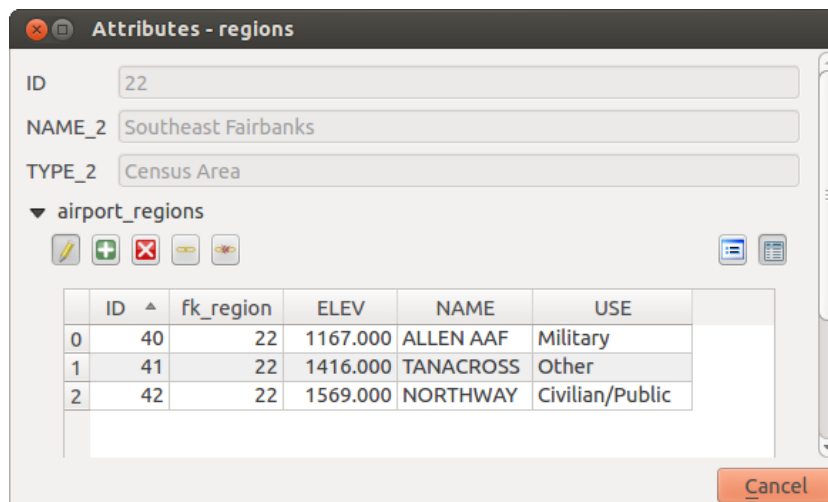
Figure 12.50: Identification dialog regions with relation to airports 🐧

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.

- The ⬯ symbol will open a new dialog where you can select any existing airport which will then be assigned to the current region. This may be handy if you created the airport on the wrong region by accident.

- 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.
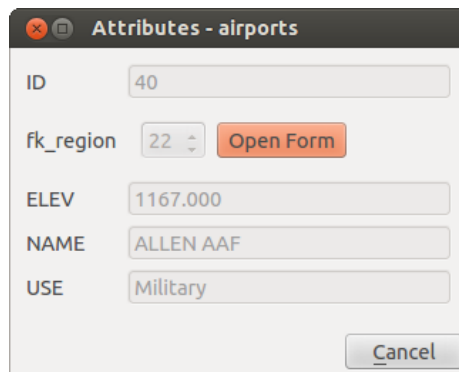
Figure 12.51: Identification dialog airport with relation to regions 🐧

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12.6 Ferramenta de Consulta

The Query Builder allows you to define a subset of a table using a SQL-like WHERE clause and to display the result in the main window. The query result can then be saved as a new vector layer.

12.6.1 Consulta

Open the **Query Builder** by opening the Layer Properties and going to the *General* menu. 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_attributes_2 shows an example of the Query Builder 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.
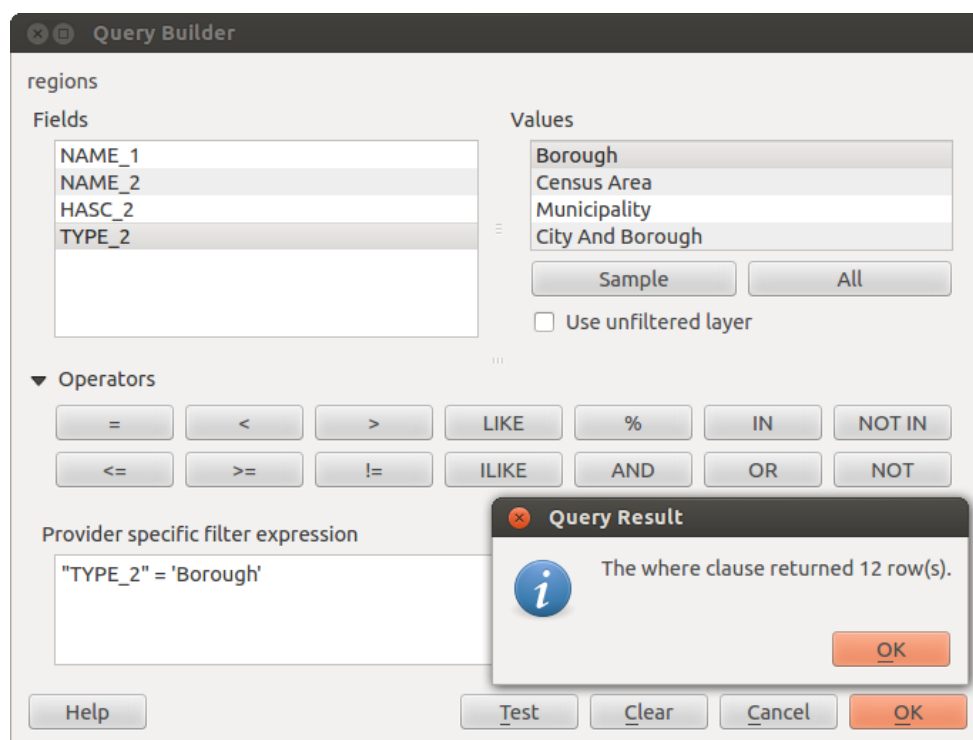
Figure 12.52: Ferramenta de Consulta

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 where 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.

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12.7 Calculadora de Campos

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.

Tip: Virtual Fields

- Virtual fields are not permanent and are not saved.

- To make a field virtual it must be done when the field is made.

The field calculator is now available on any layer that supports edit. When you click on the field calculator icon the dialog opens (see figure_attributes_3). 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.

The quick field calculation bar on top of the attribute table is only visible if the layer is editable.

In quick field calculation bar, you first select the existing field name then open the expression dialog to create your expression or write it directly in the field then click on **Update All** button.

12.7.1 Expression tab

In 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.
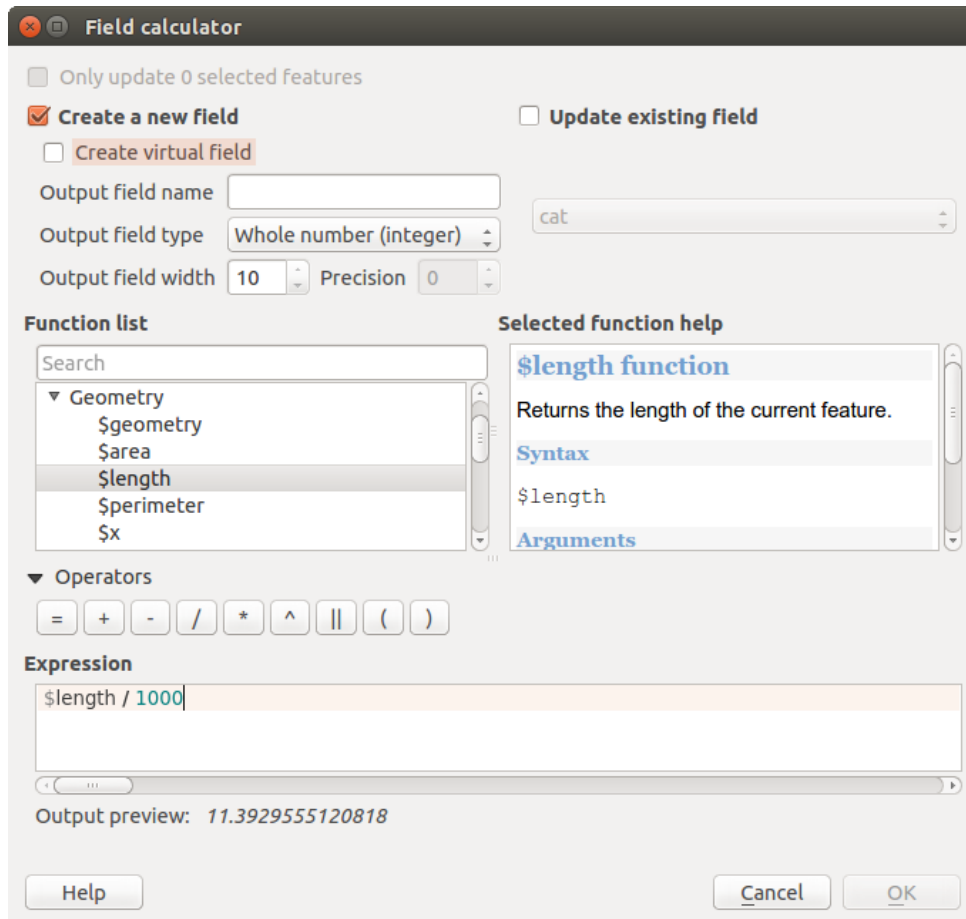
Figure 12.53: Calculadora de Campos

If you choose to add a new field, you need to enter a field name, a field type (integer, real or string), the total field width, and the field precision (see figure_attributes_3). For example, if you choose a field width 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 [icon] Open Attribute Table.

2. Clique no [icon] Alternar o modo de edição e abra a janela da [icon] Calculadora de Campos.

3. Select the [icon] *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 width to be 10 and Precision, 3.

5. Now double click on function `$length` in the *Geometry* group to add it into the Field calculator expression box.

6. Complete a expressão introduzindo "/ 1000" na caixa de expressões da Calculadora de campos e clique **[OK]**.

7. You can now find a new field `length` in the attribute table.

The available functions are listed in *Expressions* chapter.

12.7.2 Function Editor tab

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 `qgis2pythonexpressions` 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:

```python
@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:

```python
myfunc('test1', 'test2')
```

Your function will be implemented in the 'Custom' *Functions* of the *Expression* tab after using the *Run Script* button.

Further information about creating Python code can be found on http://www.qgis.org/html/en/docs/pyqgis_developer_cookbook/inde

The function editor is not only limited to working with the field calculator, it can be found whenever you work with expressions. See also *Expressions*.

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Trabalhando com Informação Matricial

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13.1 A trabalhar com Dados Matriciais

This section describes how to visualize and set raster layer properties. QGIS uses the GDAL library to read and write raster data formats, including ArcInfo Binary Grid, ArcInfo ASCII Grid, GeoTIFF, ERDAS IMAGINE, and many more. GRASS raster support is supplied by a native QGIS data provider plugin. The raster data can also be loaded in read mode from zip and gzip archives into QGIS.

As of the date of this document, more than 100 raster formats are supported by the GDAL library (see GDAL-SOFTWARE-SUITE in *Literatura e Referências Web*). A complete list is available at http://www.gdal.org/formats_list.html.

Note: Not all of the listed formats may work in QGIS for various reasons. For example, some require external commercial libraries, or the GDAL installation of your OS may not have been built to support the format you want to use. Only those formats that have been well tested will appear in the list of file types when loading a raster into QGIS. Other untested formats can be loaded by selecting the `[GDAL] All files (*)` filter.

A utilização de dados raster com GRASS está descrita na secção *Integração GRASS SIG*.

13.1.1 O que são dados 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 is 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.

13.1.2 Loading raster data in QGIS

Raster layers are loaded either by clicking on the ![icon] Add Raster Layer icon or by selecting the *Layer* → ![icon] *Add Raster Layer* menu option. 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 *Open a GDAL Supported Raster Data Source* dialog.

Once a raster layer is loaded in the map legend, you can click on the layer name with the right mouse button to select and activate layer-specific features or to open a dialog to set raster properties for the layer.

Opções do botão direito do rato para camadas raster

- *Aproximar à Extensão da Camada*
- *Ampliar à Melhor Escala (100%)*
- *Esticar Usando o Enquadramento Actual*
- *Adicionar ao Enquadramento*
- *Remover*
- *Duplicar*
- *Definir SRC da Camada*
- *Definir SRC do projecto a partir da Camada*
- *Guardar como ...*
- *Propriedades*
- *Renomear*
- *Copiar Estilo*
- *Adicionar Novo Grupo*
- *Expandir Tudo*
- *Ocultar Tudo*
- *Actualizar Ordem de Desenho*

.

13.2 Janela das Propriedades da Camada Raster

Para visualizar e definir as propriedades da camada raster, dê um duplo clique no nome da camada na legenda do mapa, ou clique com o botão direito no nome da camada e escolha:*Propriedades* a partir do menu de contexto. Irá abrir o diálogo *Propriedades da Camada Raster* (see figure_raster_1).

Existem vários menus na caixa de diálogo:

- *Geral*
- *Estilo*
- *Transparência*
- *Pirâmides*
- *Histograma*
- *Metadados*

13.2.1 Menu Geral

Informação da camada

O menu *General* apresenta informações básicas sobre a imagem selecionada, incluindo o caminho da origem da camada, o nome de exibição na legenda (que pode ser modificado), e o número de colunas, linhas e valores nulos do raster.
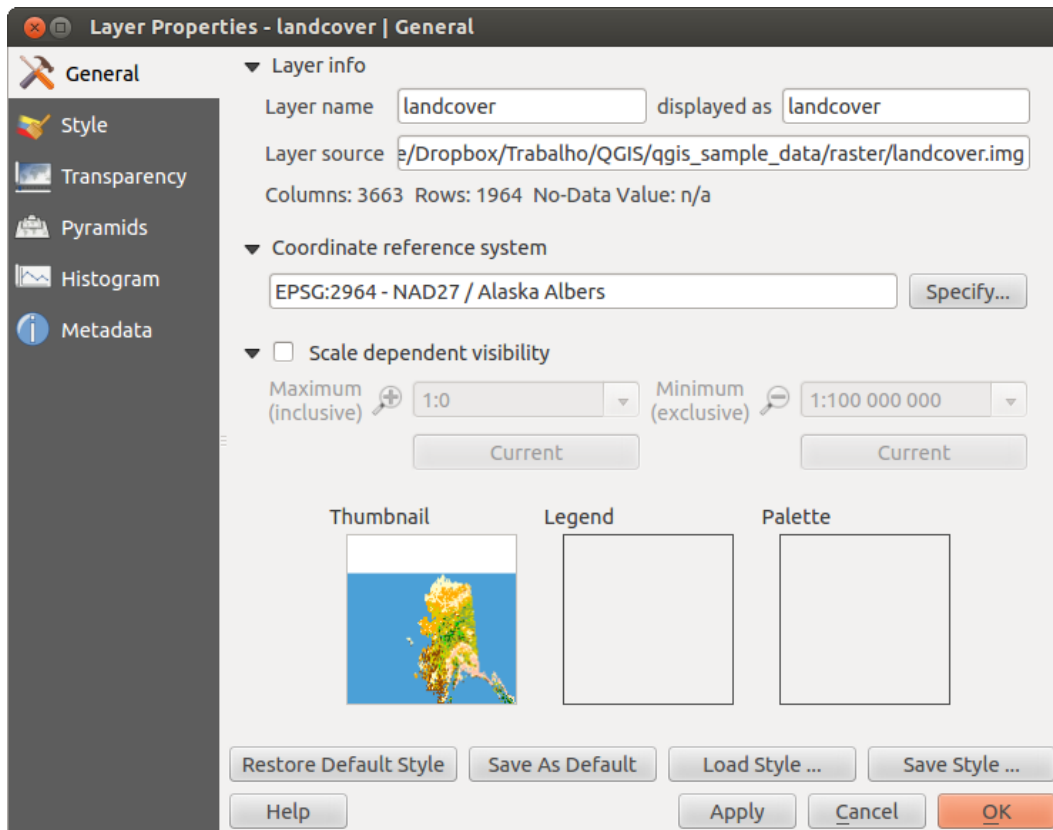
Figure 13.1: Raster Layers Properties Dialog

Sistema de Referência de Coordenadas

Aqui, pode encontrar a informação do sistema de referência de coordenadas (SRC) impressos numa sequência PROJ.4. Se essa configuração não estiver correta, ele pode ser modificada clicando no botão **[Specify]** .

Escala dependente da visibilidade

Além disso a visibilidade dependente da escala pode ser vista neste guia. Você terá que verificar a caixa de seleção e definir uma escala adequada, onde seus dados serão exibidos na tela do mapa.

Na parte inferior, pode ver uma miniatura da camada, a simbologia da legenda e a palete.

13.2.2 Estilos

Renderizar banda

QGIS offers four different *Render types*. The renderer chosen is dependent on the data type.

1. Multibanda cor - se o arquivo vem como multibanda, com várias bandas (e.g., usado para imagens de satelite com várias bandas)

2. Palete - se o ficheiro de banda simples vem com a palete indexada (e.g., usado em mapas topográficos digitais)

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 continous palette (e.g., used with a shaded relief map)

4. Banda Simples de Pseudocor - é possível a renderização de ficheiros com uma palete continua ou de cor (e.g., usada num mapa de altitude)

Cor multibanda

Com o renderizador da cor multibanda, as três bandas da imagem pode ser renderizada, pela banda que representa o componente vermelho, verde ou azul, que será usado para criar uma imagem colorida. Pode escolher vários: *Contrast enhancement* methods: 'No enhancement', 'Stretch to MinMax', 'Stretch and clip to MinMax' and 'Clip to min max'.
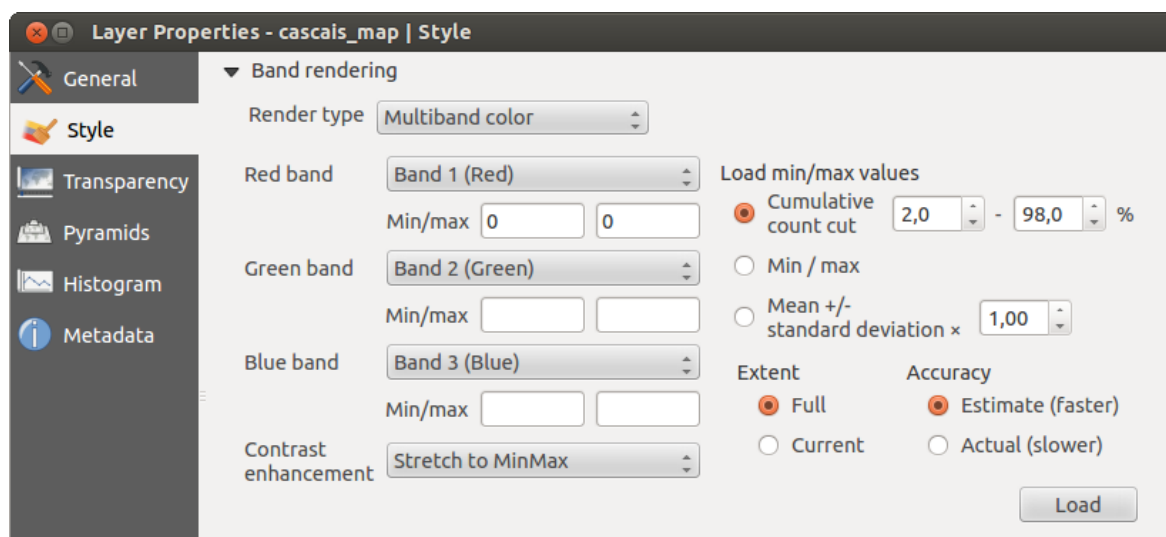
Figure 13.2: Raster Renderer - Multiband color

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 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.

Tip: Visualização de uma Banda Simples de um Raster Multibanda

Se quiser ver uma única banda de uma imagem multibanda (por exemplo, vermelho), pode pensar que iria definir o verde e faixas azuis para "Not Set". Mas esta não é a maneira correta. Para apresentar a banda vermelha, defina o tipo de imagem para 'Banda simples cinza', em seguida, selecione vermelha como a banda para usar a Cinza.

Paletizada

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 2.2. it's now possible to assign a label to the color values. The label appears in the legend of the raster layer then.

Melhorar contraste
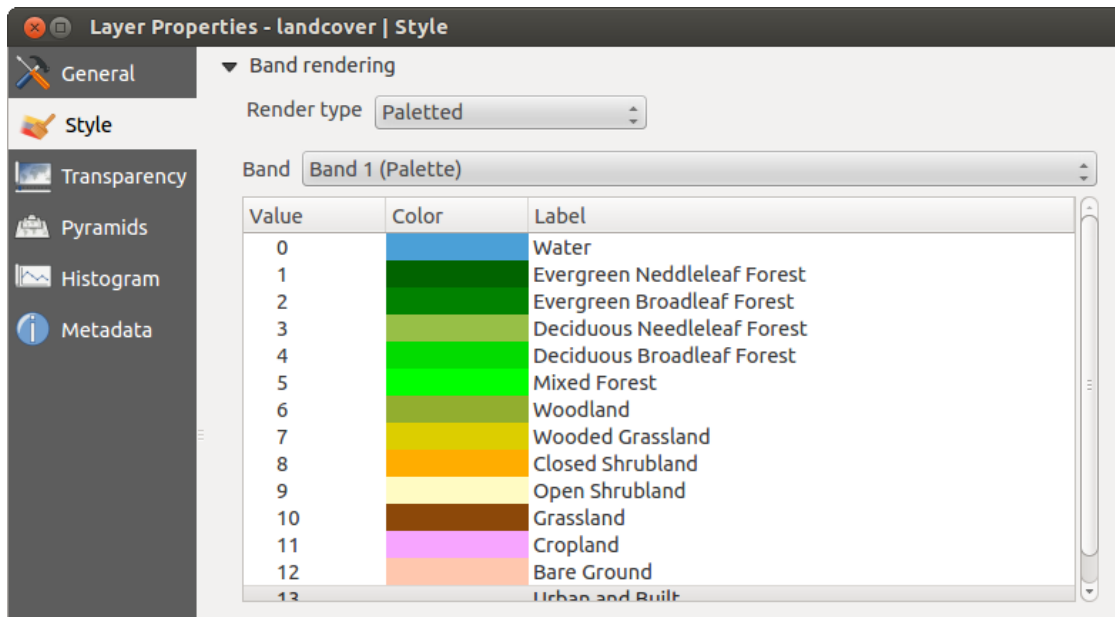
Figure 13.3: Raster Renderer - Paletted 🐧

Note: 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.

Banda cinza simples

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*.
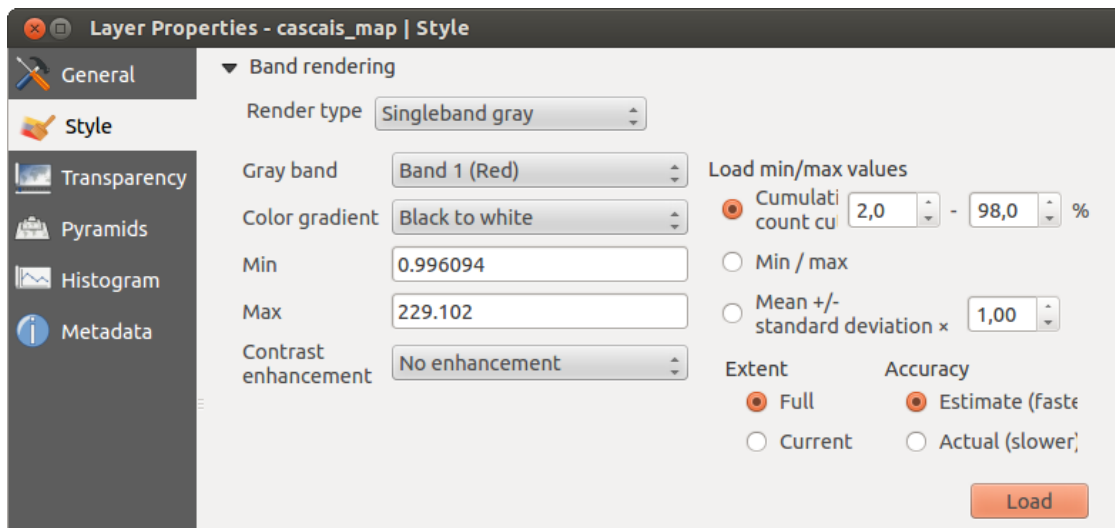
Figure 13.4: Raster Renderer - Singleband gray 🐧

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.

Banda de cor falsa simples

This is a render option for single-band files, including a continous palette. You can also create individual color maps for the single bands here. Três tipos de interpolação de cores estão disponíveis:
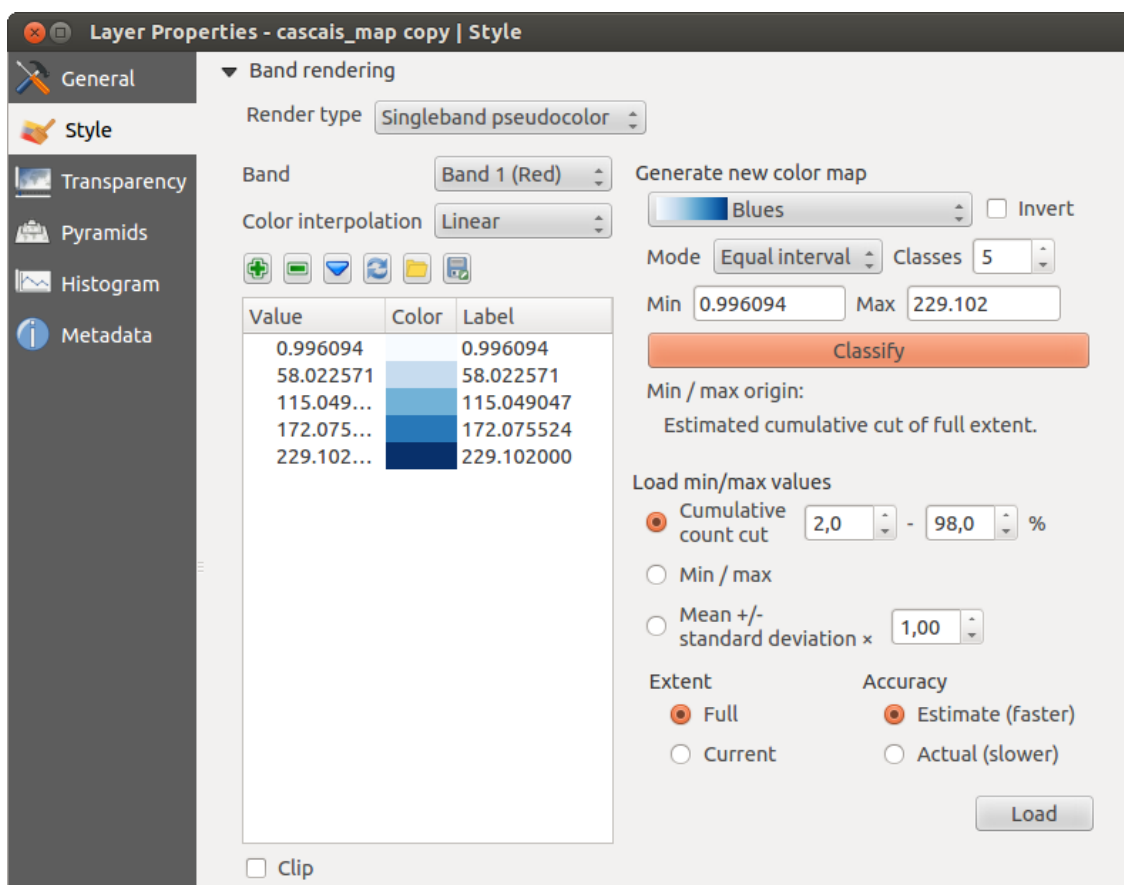
Figure 13.5: Raster Renderer - Singleband pseudocolor

1. Discreto
2. Linear
3. Exacto

In the left block, the button ![icon] Add values manually adds a value to the individual color table. The button ![icon] Remove selected row deletes a value from the individual color table, and the ![icon] 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 ![icon] Load color map from band, which tries to load the table from the band (if it has any). And you can use the buttons ![icon] Load color map from file or ![icon] 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* ![icon] 'Equal interval', you only need to select the *number of classes* ![icon] and press the button *Classify*. You can invert the colors of the color map by clicking the ![icon] *Invert* checkbox. In the case of the *Mode* ![icon] 'Continous', 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.

Renderização Cor

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 *Janela das Propriedades da Camada Vectorial*).

Further settings can be made in modifiying 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'.

Reamostragem

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.
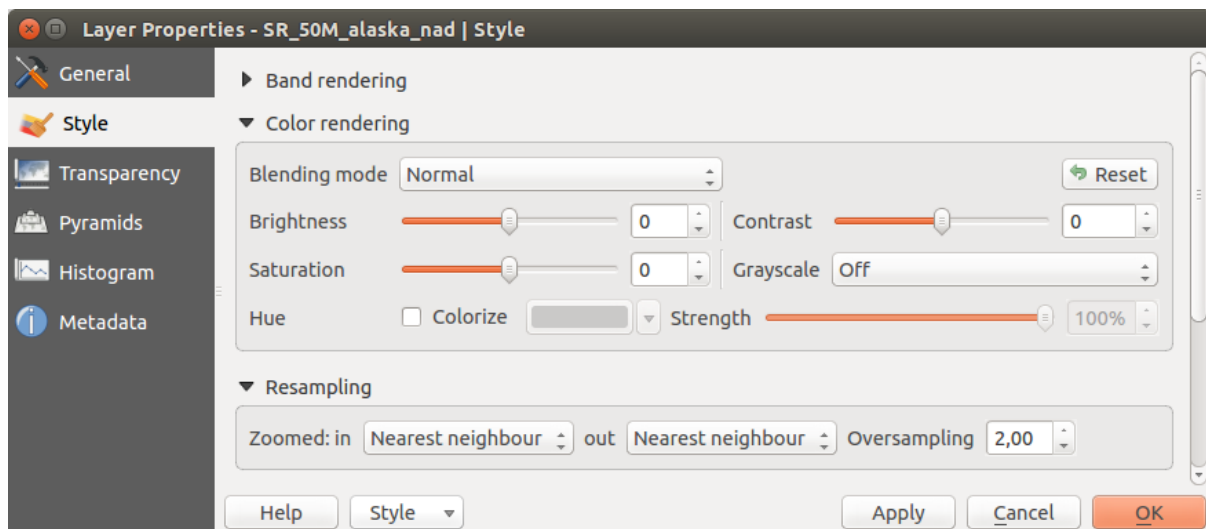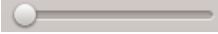
Figure 13.6: Raster Rendering - Resampling 🐧

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.

13.2.3 Menu Transparência

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* menu.

Uma forma ainda mais flexível para personalizar a transparência pode ser feito no: guilabel: *seção de opções de transparência personalizado*. A transparência de cada pixel pode ser definido aqui.

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 neccessary:

1. Carregar o ficheiro raster:ficheiro:*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. Seleccionar *Transparência* menu

4. No menu *Transparencia da banda*, escolha 'Nenhum'.

5. Click the ➕ Add values manually button. A new row will appear in the pixel list.

6. Entre o valor dos raster na coluna 'De' e 'Para' (usamos 0 aqui), e ajuste a transparência a 20%.

7. Pressione no botão **[Aplicar]** e olhe para o mapa

Pode repetir os passos 5 e 6 para ajustar mais valores com a transparência personalizada.

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.

13.2.4 Menu Pirâmides

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.

Deverá ter acesso à edição no directório onde os dados originais são armazenados para construir pirâmides.

Podem ser usados vários métodos de re-amostragem para calcular as pirâmides:

• Vizinho mais próximo

• Média

• Gauss

• Cúbico

• moda

• Nenhum

If you choose 'Internal (if possible)' from the *Overview format* menu, QGIS tries to build pyramids internally. You can also choose 'External' and 'External (Erdas Imagine)'.

Note que o cálculo de peirâmides pode modificar o arquivo original de dados, e uma vez criado, não pode ser apagado. Se desejar preservar uma versão 'sem pirâmides' do seu raster, faça uma cópia de segurança antes do cálculo das mesmas.

13.2.5 Menu Histograma

The *Histogram* menu allows you to view the distribution of the bands or colors in your raster. The histogram is generated automatically when you open the *Histogram* menu. 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*.
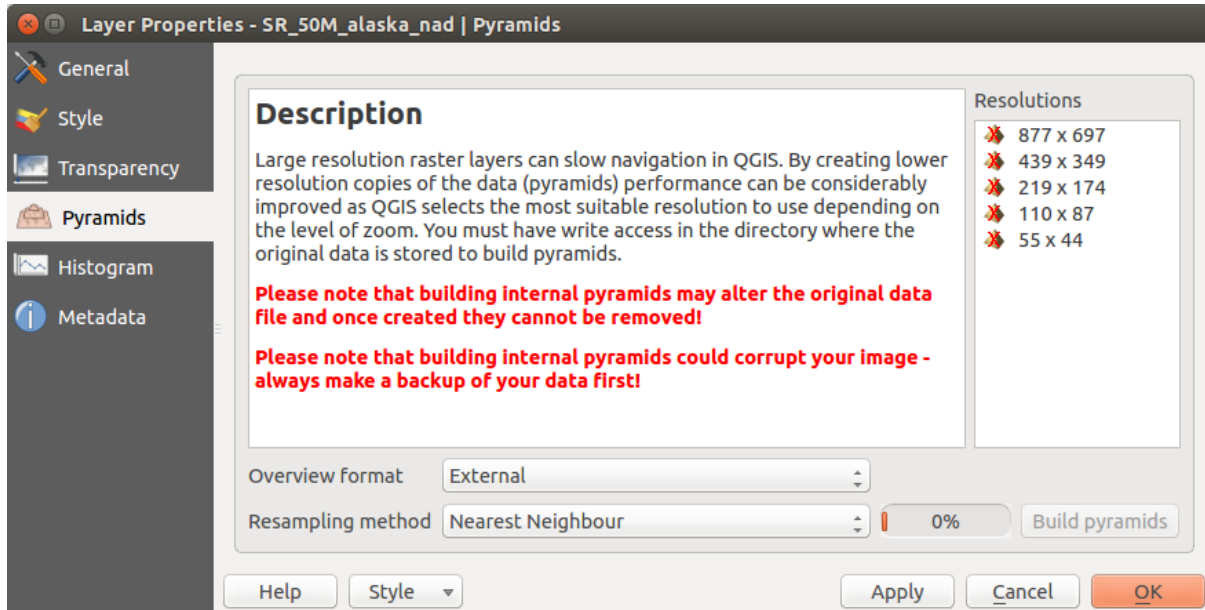
Figure 13.7: The Pyramids Menu
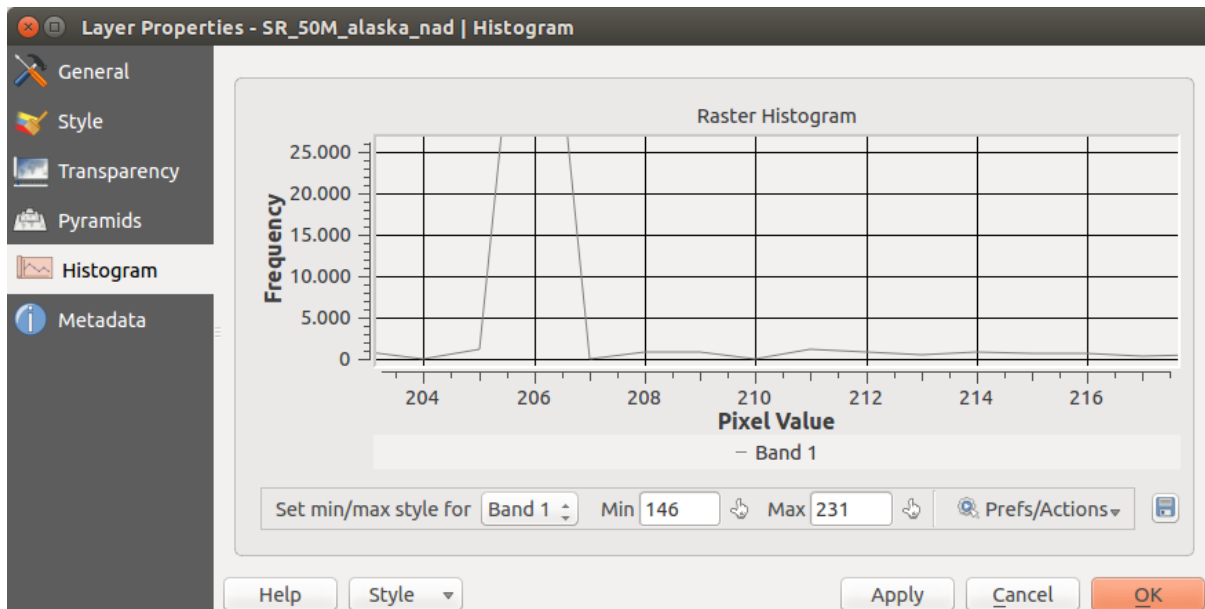
Figure 13.8: Raster Histogram

13.2.6 Menu Metadados

The *Metadata* menu displays a wealth of information about the raster layer, including statistics about each band in the current raster layer. From this menu, 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.
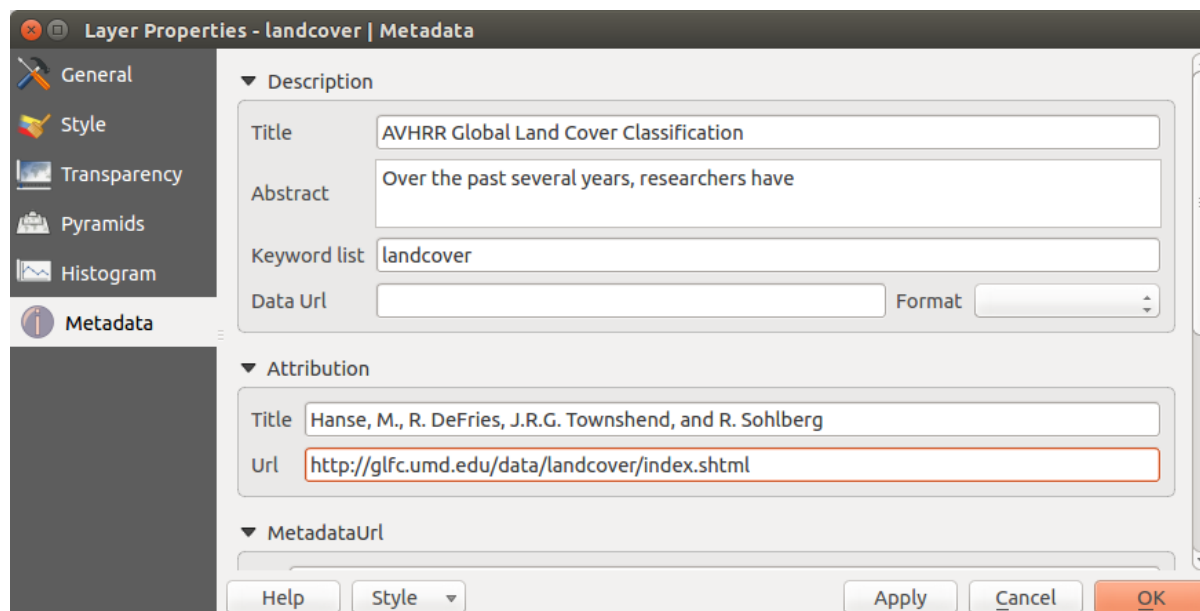
Figure 13.9: Raster Metadata 🐧

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13.3 Calculadora Matricial

The *Raster Calculator* in the *Raster* menu allows you to perform calculations on the basis of existing raster pixel values (see figure_raster_10). The results are written to a new raster layer with a GDAL-supported format.

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. 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.

13.3.1 Exemplos

Convert elevation values from meters to feet
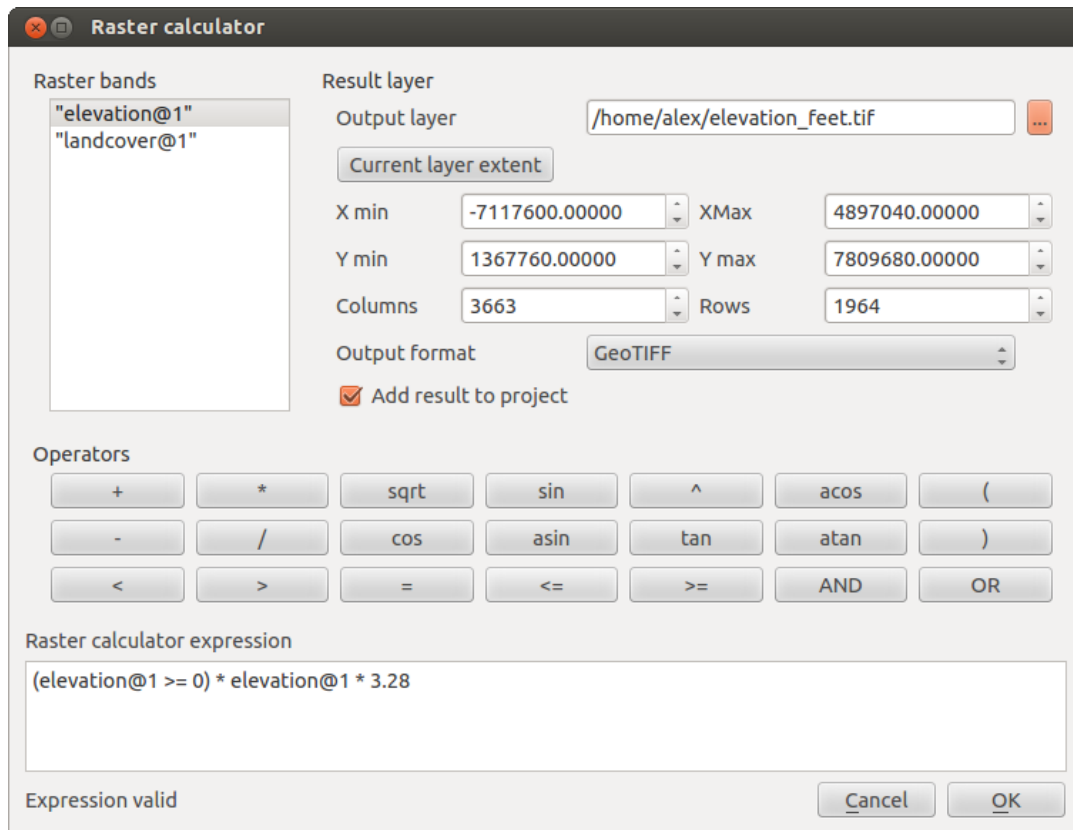
Figure 13.10: Calculador Matricial 🐧

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
```

Usando uma máscara

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, set its value to 1. Otherwise set it to 0. This creates the mask on the fly.

If you want to classify a raster – say, for instance into two elevation classes, you can use the following expression to create a raster with two values 1 and 2 in one step.

```
("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.

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Trabalhando com dados OGC

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14.1 QGIS as OGC Data Client

O Open Geospatial Consortium (OGC) é uma organização internacional com mais de 300 membros como entidades comerciais, sem fins lucrativos e de investigação distribuídos por todo mundo. Os membros desenvolvem e implementam standards para conteúdos e serviços geoespaciais, processamento e troca de dados SIG.

Descrevendo um modelo básico de dados para elementos geográficos e um número crescente de específicações estão desenvolvidos para servir necessidades específicas para localização interoperável e tecnologia geoespacial, incluindo o SIG. Mais informação é encontrada em http://www.opengeospatial.org/.

Important OGC specifications supported by QGIS are:

- **WMS** — Serviço de Mapas Web (*Cliente WMS/WMTS*)
- **WMTS** — Serviço de Mosaicos de Mapa Web (*Cliente WMS/WMTS*)
- **WFS** — Serviços de Elementos Web (*Cliente WFS e WFS-T*)
- **WFS-T** — Serviços de Elementos Web - Transacionais (*Cliente WFS e WFS-T*)
- **WCS** — Serviços de Cobertura Web (*Cliente WCS*)
- **SFS** — Elementos Simples para SQL (*Camadas POSTGIS*)
- **GML** — Linguagem de Marcadores Geográfico

OGC services are increasingly being used to exchange geospatial data between different GIS implementations and data stores. QGIS can deal with the above specifications as a client, being **SFS** (through support of the PostgreSQL / PostGIS data provider, see section *Camadas POSTGIS*).

14.1.1 Cliente WMS/WMTS

Visão Geral do Suporte WMS

QGIS currently can act as a WMS client that understands WMS 1.1, 1.1.1 and 1.3 servers. In particular, it has been tested against publicly accessible servers such as DEMIS.

A WMS server acts upon requests by the client (e.g., QGIS) for a raster map with a given extent, set of layers, symbolization style, and transparency. The WMS server then consults its local data sources, rasterizes the map, and sends it back to the client in a raster format. For QGIS, this format would typically be JPEG or PNG.

WMS is generically a REST (Representational State Transfer) service rather than a full-blown Web service. As such, you can actually take the URLs generated by QGIS and use them in a web browser to retrieve the same images that QGIS uses internally. This can be useful for troubleshooting, as there are several brands of WMS server on the market and they all have their own interpretation of the WMS standard.

As camadas WMS podem ser adicionadas facilmente, desde que saiba o URL de acesso ao servidor WMS, tenha uma ligação capaz a esse servidor, e que o servidor use HTTP como um mecanismo de transferência de dados.

Visão Geral do Suporte WMTS

QGIS can also act as a WMTS client. WMTS is an OGC standard for distributing tile sets of geospatial data. This is a faster and more efficient way of distributing data than WMS because with WMTS, the tile sets are pre-generated, and the client only requests the transmission of the tiles, not their production. A WMS request typically involves both the generation and transmission of the data. A well-known example of a non-OGC standard for viewing tiled geospatial data is Google Maps.

De forma a exibir os dados a várias escalas aproximadas ao que o utilizador deseja ver, os conjuntos de mosaicos WMTS são produzidos a vários níveis de escala diferentes e são disponibilizados ao cliente SIG mediante pedido.

Este diagrama ilustra o conceito dos conjuntos de mosaicos
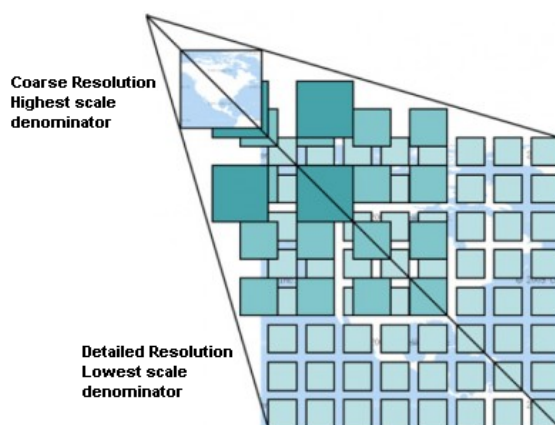
Figure 14.1: Conceito dos conjuntos de mosaicos WMTS

The two types of WMTS interfaces that QGIS supports are via Key-Value-Pairs (KVP) and RESTful. These two interfaces are different, and you need to specify them to QGIS differently.

1) In order to access a **WMTS KVP** service, a QGIS user must open the WMS/WMTS interface and add the following string to the URL of the WMTS tile service:

```
"?SERVICE=WMTS&REQUEST=GetCapabilities"
```

Um exemplo deste tipo de endereço é

```
http://opencache.statkart.no/gatekeeper/gk/gk.open_wmts?\
    service=WMTS&request=GetCapabilities
```

A camada topo2 funciona lindamente para testar neste WMTS. Adicionando esta linha e texto indica que é um serviço web WMTS que deverá ser usado em vez de o serviço WMS.

2. O serviço **WMTS RESTful** torna-se uma forma diferente, é um URL simples, a forma recomendada pela OGC é:

```
{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.

Note: 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.

Quando lê o WMTS pode muitas vezes pensar em WMS-C.

Seleccionar Servidores WMS/WMTS

The first time you use the WMS feature in QGIS, there are no servers defined.

Begin by clicking the Add WMS layer button on the toolbar, or selecting *Layer → Add WMS Layer....*

A janela *Adicionar Camada(s) do Servidor* para adicionar camadas dos servidores WMS aparecem. Pode adicionar alguns servidores para brincar clicando no botã0 **[Adicionar servidores padrões]** . Isto irá adicionar dois servidores WMS demonstração para que possa usar, os servidores WMS do DM Solutions Group e Lizardtech. Para definir uma novo servidor WMS no separador *Camadas*, seleccione o botão **[Novo]** . De seguida introduza os parâmetros de ligação que deseja para o Servidor WMS, como está listado na table_OGC_1:

Nome	Um nome para esta ligação. Este nome será usado para a lista de Ligações do Servidor para que possa distingui-la de outros Servidores WMS.
URL	URL do servidor que fornece os dados. Isto deverá ser um nome de alojamento válido – o mesmo formato que irá usar para abrir a ligação telnet ou o ping a um alojamento.
Utilizador	Nome de Utilizador para aceder a um Servidor WMS protegido. Este parâmetro é opcional.
Palavra-passe	Palavra-chave para autenticação básica no Servidor WMS. Este parâmetro é opcional.
Ignorar GetMap URI	✔ *Ignorar GetMap URI reportado nas capacidades*. Use um URI dado em cima para o campo URL.
Ignorar GetFeatureInfo URI	✔ *Ignorar GetMap URI reportado nas capacidades*, use um URI dado em cima para o campo URL.

Tabela 1 OGC : Parâmetros de Ligação WMS

If you need to set up a proxy server to be able to receive WMS services from the internet, you can add your proxy server in the options. Choose *Settings → Options* and click on the *Network & Proxy* tab. There, you can add your proxy settings and enable them by setting ✔ *Use proxy for web access*. Make sure that you select the correct proxy type from the *Proxy type* ▾ drop-down menu.

Once the new WMS server connection has been created, it will be preserved for future QGIS sessions.

Tip: Em URLs de Servidores WMS

Certifique-se, que quando introduzir o URL do servidor WMS, seja o URL base. Por exemplo, não deve ter fragmentos como `request=GetCapabilities` ou `version=1.0.0` no seu URL.

Carregar camadas WMS/WMTS

Uma vez preenchido os parâmetros com sucesso pode usar o botão **[Ligar]** para responder às capacidades do servidor seleccionado. Isto inclui a codificação da imagem, Camadas, Estilos de Camadas, e Projecções. Uma vez que isto é uma operação de rede, a velocidade de resposta depende da qualidade da ligação da sua rede ao servidor WMS. Enquanto faz a transferência de dados do servidor WMS, o progresso da transferência é visualizada no canto inferior esquerdo da janela do WMS.

O seu ecrã deve assemelhar-se agora à figure_OGR_1, que mostra a resposta dada pelo servidor do Portal Europeu do Solo.

Codificação da Imagem

A secção *Codificação de Imagem* agora apresenta uma lista de formatos suportados pelo cliente e servidor. Escolha de acordo com as exigências de precisão da sua imagem.

Tip: Codificação da Imagem
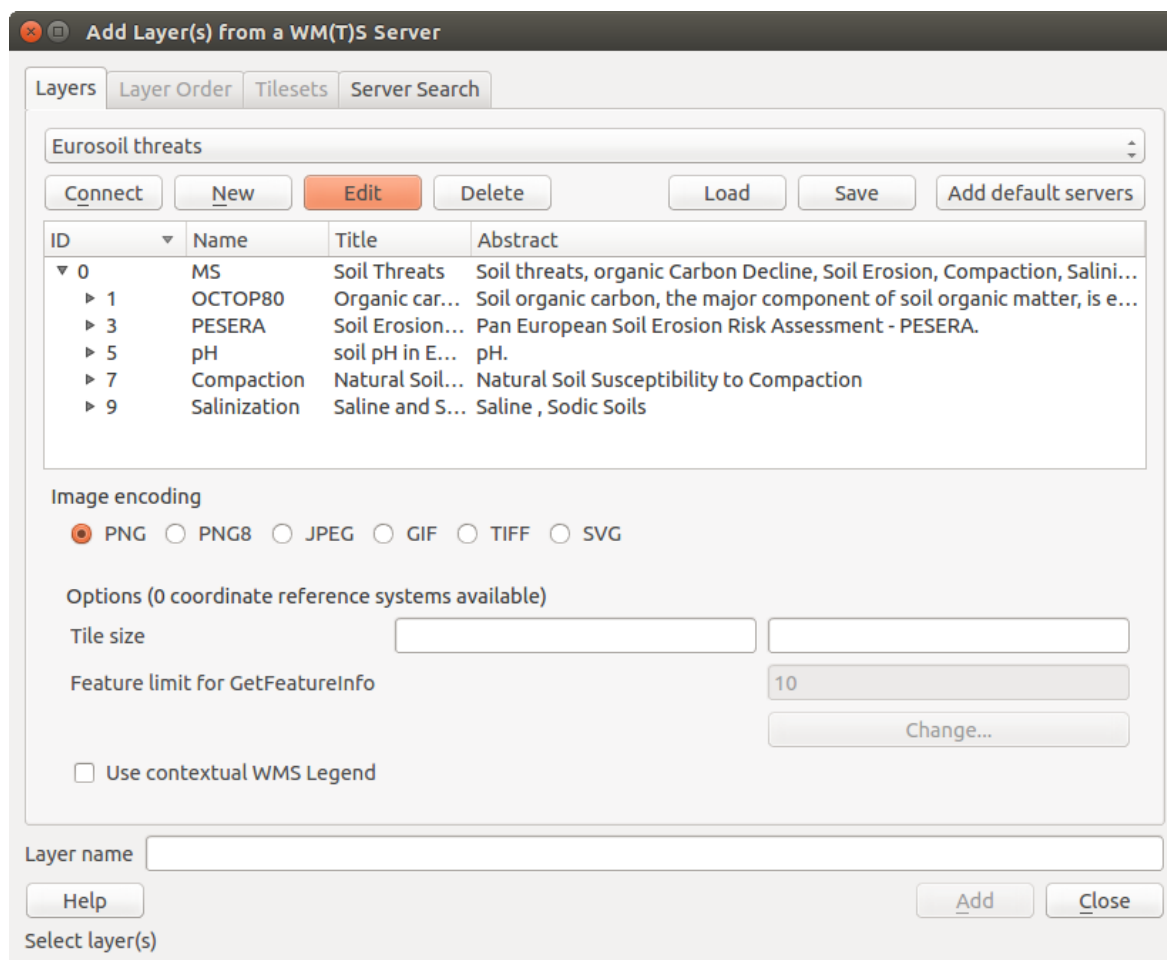
Figure 14.2: Dialog for adding a WMS server, showing its available layers 🐧

Descobrirá que tipicamente os servidores WMS permitem a escolha da codificação de imagem em JPEG ou PNG. O JPEG é um formato comprimido com perda de informação, enquanto que o PNG reproduz fielmente os dados matriciais originais.

Use JPEG se espera dados WMS para fotografia na natureza e/ou não se importa da perda de alguma qualidade na imagem. Este típico trade.off reduz em 5 vezes o requerimento de transferência comparado ao PNG.

Use o PNG se necessitar representações precisas dos dados originais, e não se importa dos requerimentos de transferência de dados.

Opções

O campo Opções fornece um campo de texto onde pode adicionar *Nome da Camada* para a camada WMS. Este nome irá ser apresentado na legenda após carregamento da camada.

Em baixo do nome da camada pode definir *Tamanho do mosaico*, se quiser configurar os tamanhos do mosaico (ex.: 256x256) para dividir o pedido do WMS em pedidos múltiplos.

O *Limite de elementos para GetFeatureInfo* define quais os elementos do servidor a consultar.

Se seleccionou um WMS da lista, um capo com a projecção padrão, fornecida pelo mapserver, aparece. Se o botão **[Change...]** está activo, pode clicar e mudar para a projecção padrão do WMS para outro SRC fornecido pelo Servidor WMS.

Por fim, caso o servidor WMS suporte esta funcionalidade, pode activar ☑ *Use contextual WMS-Legend*. Assim, apenas apenas será mostradas a parte da legenda relevante para a extensão actual do mapa e não são incluído itens da legenda que não sejam visíveis no mapa actual.

Ordem das Camadas

O separador *Ordem de Camada* tem uma lista das camadas seleccionadas disponíveis do WMS actual ligado. Poderá reparar que algumas camadas expansíveis, isto significa que a camada pode ser exibida na escolha dos estilos de imagem.

You can select several layers at once, but only one image style per layer. When several layers are selected, they will be combined at the WMS server and transmitted to QGIS in one go.

Tip: Ordenar Camadas WMS

As camadas WMS renderizadas por um servidor são sobrepostas na ordem da lista da secção de Camadas, de cima para baixo da lista. Se quiser alterar a ordem de sobreposição, pode usar o separador *Ordem de camadas*.

Transparência

In this version of QGIS, the *Global transparency* setting from the *Layer Properties* is hard coded to be always on, where available.

Tip: Transparência em Camada WMS

A disponibilidade de transparência da imagem do WMS depende da codificação da imagem usada: PNG e GIF suportam transparência, enquanto que o JPEG não suporta.

Sistema de Referência de Coordenadas

A coordinate reference system (CRS) is the OGC terminology for a QGIS projection.

Cada Camada WMS pode ser apresentada em múltiplos SRC, depedendo da capacidade do servidor WMS.

Para escolher o SRC seleccione **[Alterar...]** e a janela semelhante à da Figura Projecção 3 na *Trabalhando com Projecções* aparecerá. A diferença principal com a versão do WMS do ecrã é que neste apenas os SRC suportados apareceram no Servidor WMS.

Pesquisar servidor

Within QGIS, you can search for WMS servers. Figure_OGC_2 shows the *Server Search* tab with the *Add Layer(s) from a Server* dialog.
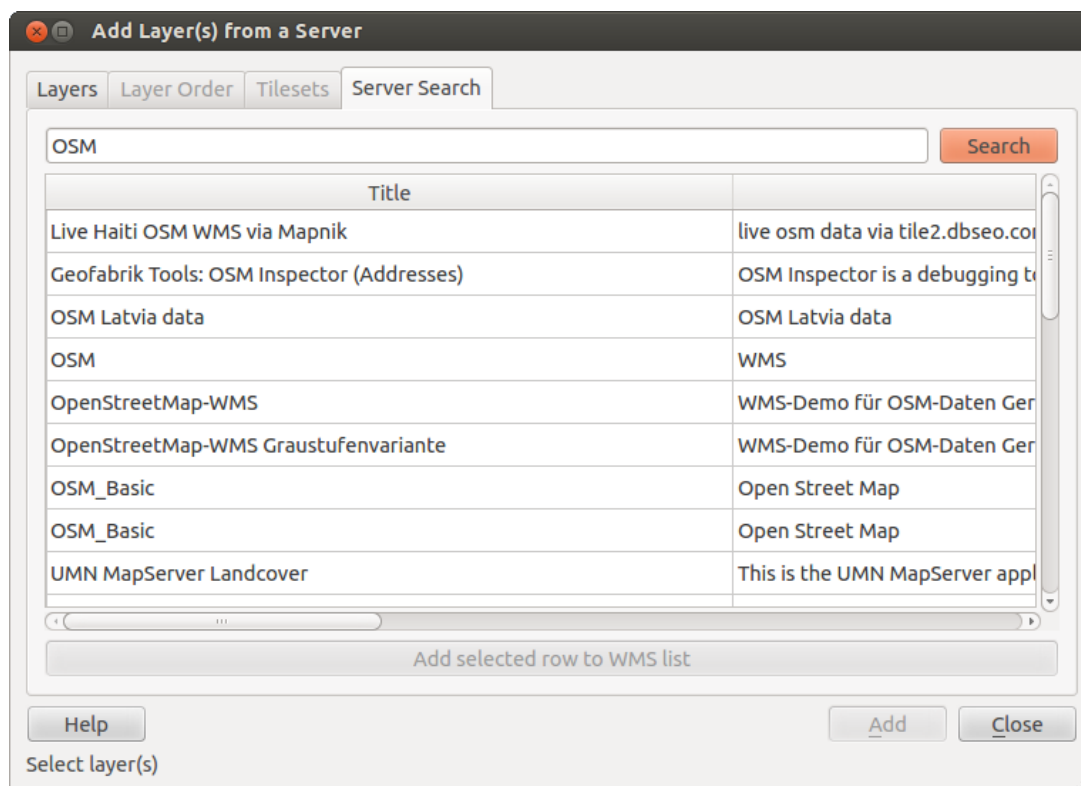
Figure 14.3: Dialog for searching WMS servers after some keywords

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 of layers by clicking the **[Connect]** button. This option is quite handy when you want to search maps by specific keywords.

Basicamente esta opção é um frontend para a API do http://geopole.org.

Mosaicos

Ao usar Serviços WMTS (WMS em cache) 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 *Settings → Panels* (KDE and Windows) or *View → Panels* (Gnome and MacOSX), then choosing *Tile scale*. This gives you the available scales from the tile server with a nice slider docked in.

Usar a Ferramenta Identificar

Once you have added a WMS server, and if any layer from a WMS server is queryable, you can then use the Identify tool to select a pixel on the map canvas. A query is made to the WMS server for each selection made. The results of the query are returned in plain text. The formatting of this text is dependent on the particular WMS server used. **Selecção do formato**

Se múltiplos formatos são suportados pelo servidor, uma caixa de combinação com os formatos suportados é automaticamente adicionado aos resultados da janela de identificação e o formato seleccionado irá armazenar no projecto para a camada. **Suporte do formato GML**

The Identify tool supports WMS server response (GetFeatureInfo) in GML format (it is called Feature in the QGIS GUI in this context). If "Feature" format is supported by the server and selected, results of the Identify tool are vector features, as from a regular vector layer. When a single feature is selected in the tree, it is highlighted in the map and it can be copied to the clipboard and pasted to another vector layer. See the example setup of the UMN Mapserver below to support GetFeatureInfo in GML format.

```
# 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"
```

Propriedades de Visualização

Uma vez ter adicionado o servidor WMS, pode ver as suas propriedades clicando com o direito do rato na legenda, e seleccionando *Propriedades*. **Separador dos Metadados**

O separador *Metadados* exibem a riqueza de informação sobre o servidor WMS, geralmente recolhidos a partir da declaração de de Capacidades devolvidos a partir desse servidor. Muitas das definições podem ser removidas através da leitura dos padrões WMS (veja OPEN-GEOSPATIAL-CONSORTIUM *Literatura e Referências Web*), mas aqui estão algumas definições uteis:

- **Propriedades do Servidor**

    - **Versão do WMS** — Versão do WMS suportada pelo servidor.

    - **Image Formats** — The list of MIME-types the server can respond with when drawing the map. QGIS supports whatever formats the underlying Qt libraries were built with, which is typically at least `image/png` and `image/jpeg`.

    - **Identity Formats** — The list of MIME-types the server can respond with when you use the Identify tool. Currently, QGIS supports the `text-plain` type.

- **Propriedades da Camada**

– **Seleccionado** — Se esta camada foi ou não seleccionada quando o servidor foi adicionado a este projecto.

– **Visible** — Whether or not this layer is selected as visible in the legend (not yet used in this version of QGIS).

– **Pode Identificar** — Se a camada retorna ou não resultados quando a ferramenta Identificar é usada.

– **Can be Transparent** — Whether or not this layer can be rendered with transparency. This version of QGIS will always use transparency if this is `Yes` and the image encoding supports transparency.

– **Can Zoom In** — Whether or not this layer can be zoomed in by the server. This version of QGIS assumes all WMS layers have this set to `Yes`. Deficient layers may be rendered strangely.

– **Contagem em cascata** — Os servidores WMS podem funcionar como proxies de outros servidores WMS de forma a obter dados matriciais para uma camada. Este campo mostra quantas vezes o pedido desta camada é redireccionado por outros servidores WMS para obter um resultado.

– **Fixed Width, Fixed Height** — Whether or not this layer has fixed source pixel dimensions. This version of QGIS assumes all WMS layers have this set to nothing. Deficient layers may be rendered strangely.

– **WGS 84 Bounding Box** — The bounding box of the layer, in WGS 84 coordinates. Some WMS servers do not set this correctly (e.g., UTM coordinates are used instead). If this is the case, then the initial view of this layer may be rendered with a very 'zoomed-out' appearance by QGIS. The WMS webmaster should be informed of this error, which they may know as the WMS XML elements `LatLonBoundingBox`, `EX_GeographicBoundingBox` or the CRS:84 `BoundingBox`.

– **SRC disponíveis** — As projecções em que esta camada pode ser renderizada pelo servidor WMS. As mesmas encontram-se listadas no formato original WMS.

– **Disponível em estilo** — Os estilos de imagem em que esta camada pode ser renderizada pelo servidor WMS.

Mostra a legenda gráfica do WMS no tabela de conteúdos e compositor

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.

Se a legendaGraphic estiver disponível, é exibido em baixo da camada. é pequeno e tem de clicar nele para este ser aberto na sua dimensão real (devido à limitação da arquitectura do QgsLegendInterface). Ao clicar na legenda da camada irá ser aberto uma moldura com a legenda na sua resolução completa.

In the print composer, the legend will be integrated at it's original (dowloaded) dimension. Resolution of the legend graphic can be set in the item properties under Legend -> WMS LegendGraphic to match your printing requirements

A legenda irá exibir informação de contexto baseada na sua escala actual. A legenda WMS será exibida apenas se o WMS tiver capacidade GetLegendGraphic e a camada tiver um url getCapability específico, possa que possa seleccionar um estilo.

Limitações do Cliente WMS

Not all possible WMS client functionality had been included in this version of QGIS. Some of the more noteworthy exceptions follow.

Editar Configurações da Camada WMS

Once you've completed the ![icon] Add WMS layer procedure, there is no way to change the settings. A work-around is to delete the layer completely and start again.

Servidores WMS que Requerem Autenticação

Actualmente o acesso público e serviços WMS protegidos são suportados. Os servidores WMS protegidos podem ser acedidos pela autenticação pública. Pode adicionar credenciais (opcionais) quando adiciona o servidor WMS. Veja a secção *Seleccionar Servidores WMS/WMTS* para detalhes.

Tip: Aceder a camadas protegidas OGC

Se necessitar de proteger camadas com outros métodos seguros além da autenticação básica, pode usar o InteProxy como proxy transparente, que suporta vários métodos de suporte. Mais informação pode ser encontrada no manual InteProxy no sítio na internet http://inteproxy.wald.intevation.org.

Tip: |qg| WMS Mapserver

Since Version 1.7.0, QGIS has its own implementation of a WMS 1.3.0 Mapserver. Read more about this in chapter *QGIS as OGC Data Server*.

14.1.2 Cliente WCS

O Web Coverage Service (WCS) fornece acesso a dados matriciais em formatos úteis a renderização no lado do cliente, como input a modelos científicos, e para outros clientes. O WCS pode ser comparado ao WFS e ao WMS. Enquanto instâncias de WMS e WFS, o WCS permite aos clientes escolher porções de informação guardada num servidor com base em condicionantes espaciais e outros critérios de consulta.

QGIS has a native WCS provider and supports both version 1.0 and 1.1 (which are significantly different), but currently it prefers 1.0, because 1.1 has many issues (i.e., each server implements it in a different way with various particularities).

The native WCS provider handles all network requests and uses all standard QGIS network settings (especially proxy). It is also possible to select cache mode ('always cache', 'prefer cache', 'prefer network', 'always network'), and the provider also supports selection of time position, if temporal domain is offered by the server.

14.1.3 Cliente WFS e WFS-T

In QGIS, a WFS layer behaves pretty much like any other vector layer. You can identify and select features, and view the attribute table. Since QGIS 1.6, editing WFS-T is also supported.

De uma forma geral adicionar uma camada WFS é muito semlehante ao procedimento usado com o WMS. A diferença é que não existe servidores padrões definidos, portanto nós teremos de adicionar o nosso.

Carregar uma camada WFS

Como exemplo nós usaremos o servidor WFS DM Solutions e exibiremos uma camada, O URL é: http://www2.dmsolutions.ca/cgi-bin/mswfs_gmap

1. Clique na ferramenta Adicionar Camada WFS na barra de ferramentas Camadas, a janela *Adicionar Camada WFS do Servidor* aparecerá.

2. Clique em **[Novo]**.

3. Introduza 'DM Solutions' como nome.

4. Introduza o URL (veja em cima).

5. Clique **[OK]**.

6. Choose 'DM Solutions' from the *Server Connections* drop-down list.

7. Clique **[Ligar]**.

8. Espera pela lista de camadas a ser preenchida.

9. Seleccione a camada *Parques* da lista.

---

10. Clique **[Aplicar]** para adicionar a camada ao mapa.

Repare que as configurações proxy que definiu nas suas preferências são também reconhecidas.
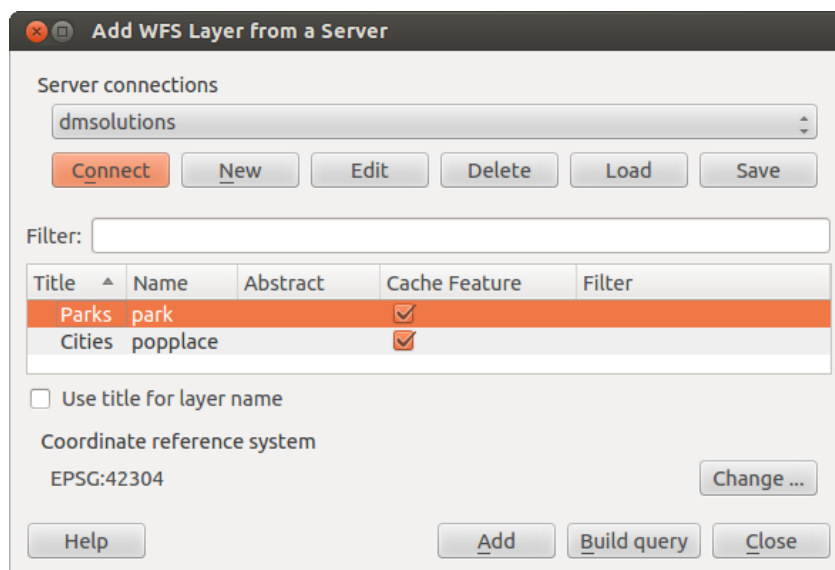
Figure 14.4: Adding a WFS layer 🐧

You'll notice the download progress is visualized in the lower left of the QGIS main window. Once the layer is loaded, you can identify and select a province or two and view the attribute table.

Apenas o WFS 1.0.0 é suportado. Até este momento não houve muitos testes contra versões WFS implementadas em outros servidores WFS. Se encontrar problemas com outros servidores WFS, por favor não hesite em contactar a equipa de desenvolvimento. Por favor dirija-se à Secção *Ajuda e Suporte* para mais informação sobre as listas de discussões.

Tip: Procurar Servidores WFS

You can find additional WFS servers by using Google or your favorite search engine. There are a number of lists with public URLs, some of them maintained and some not.

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14.2 QGIS as OGC Data Server

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. The 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. It is funded by the EU projects Orchestra, Sany and the city of Uster in Switzerland.

QGIS Server uses QGIS as back end for the GIS logic and for map rendering. Furthermore, the Qt library is used for graphics and for platform-independent C++ programming. In contrast to other WMS software, the QGIS Server uses cartographic rules as a configuration language, both for the server configuration and for the user-defined cartographic rules.

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 one of the following manuals, we will provide a sample configuration to set up a QGIS Server. For now, we recommend to read one of the following URLs to get more information:

- http://karlinapp.ethz.ch/qgis_wms/

- http://hub.qgis.org/projects/quantum-gis/wiki/QGIS_Server_Tutorial

- http://linfiniti.com/2010/08/qgis-mapserver-a-wms-server-for-the-masses/

14.2.1 Sample installation on Debian Squeeze

At this point, we will give a short and simple sample installation how-to for a minimal working configuration using Apache2 on Debian Squeeze. Many other OSs provide packages for QGIS Server, too. If you have to build it all from source, please refer to the URLs above.

Firstly, add the following debian GIS repository by adding the following repository:

```
$ cat /etc/apt/sources.list.d/debian-gis.list
deb http://qgis.org/debian trusty main
deb-src http://qgis.org/debian trusty main

$ # Add keys
$ sudo gpg --recv-key DD45F6C3
$ sudo gpg --export --armor DD45F6C3 | sudo apt-key add -

$ # Update package list
$ sudo apt-get update && sudo apt-get upgrade
```

Now, install QGIS-Server:

```
$ sudo apt-get install qgis-server python-qgis
```

Installation of a HelloWorld example plugin for testing the servers. You create a directory to hold server plugins. This will be specified in the virtual host configuration and passed on to the server through an environment variable:

```
$ 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
```

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
    FcgidInitialEnv QGIS_PLUGINPATH "/opt/qgis-server/plugins"

    # ABP: needed for QGIS HelloServer plugin HTTP BASIC auth
  <IfModule mod_fcgid.c>
      RewriteEngine on
      RewriteCond %{HTTP:Authorization} .
      RewriteRule .* - [E=HTTP_AUTHORIZATION:%{HTTP:Authorization}]
  </IfModule>

  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
```

Test the server with the HelloWorld plugin:

```
$ wget -q -O - "http://localhost/cgi-bin/qgis_mapserv.fcgi?SERVICE=HELLO"
HelloServer!
```

You can have a look at the default GetCpabilities of the QGIS server at:
http://localhost/cgi-bin/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.3.0&REQUEST=GetCapabili

---

Tip: If you work with a feature that has many nodes then modyfying 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>
```

14.2.2 Creating a WMS/WFS/WCS from a QGIS project

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.

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.

WMS capabilities

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 CRS from the Coordinate Reference System Selector, or click *Used* to add the CRS used in the QGIS project to the list.
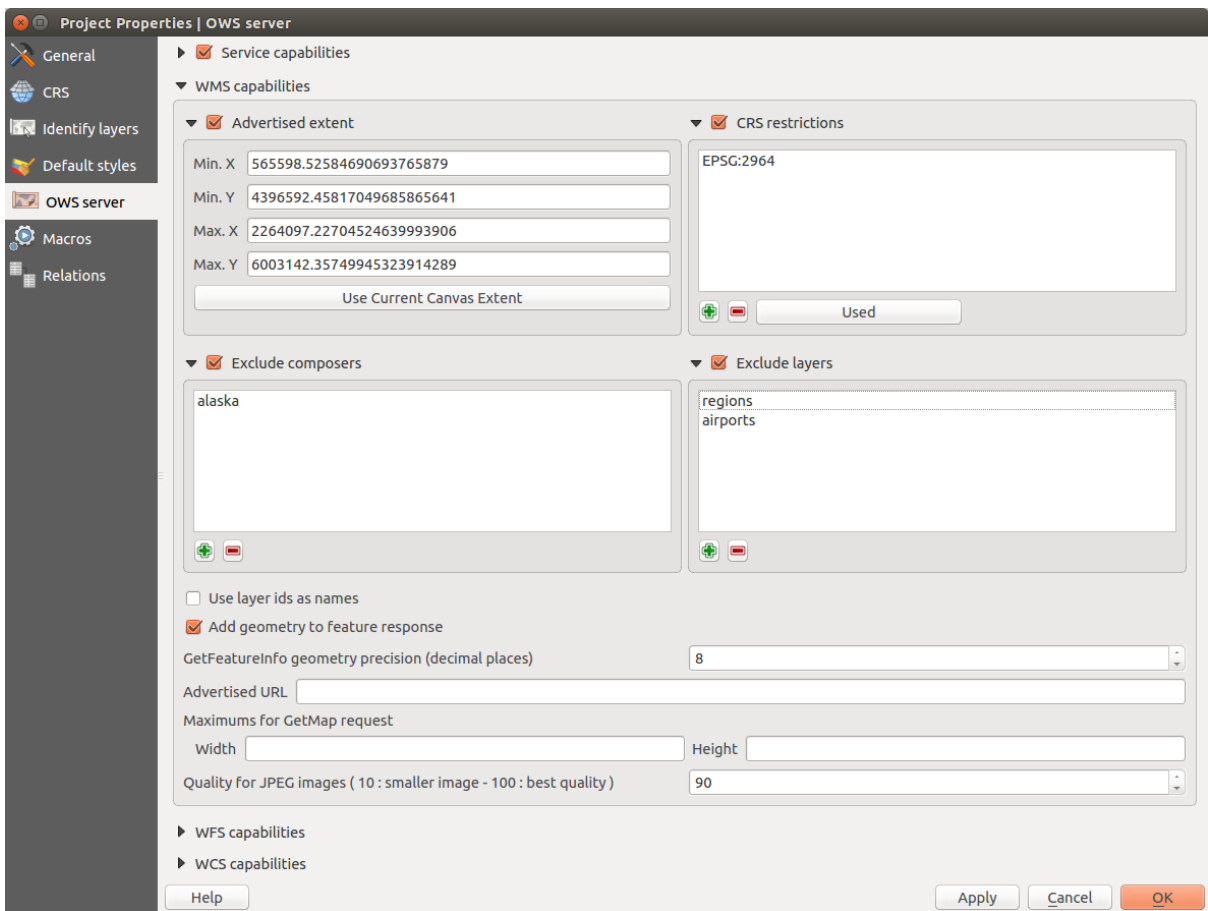
Figure 14.5: Definitions for a QGIS Server WMS/WFS/WCS project (KDE)

If you have print composers defined in your project, they will be listed in the GetCapabilities 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 at once.

You can receive requested GetFeatureInfo as plain text, XML and GML. Default is XML, text or GML format depends the output format choosen 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 his attributes, also this information will be shown in the GetFeatureInfo output.

QGIS support the following request for WMS service:

- GetCapabilities
- GetMap
- GetFeatureInfo
- GetLegendGraphic (SLD profile)
- DescribeLayer (SLD profile)
- GetStyles (custom QGIS profile)

WFS capabilities

In the *WFS capabilities* area, you can select the layers that you want to publish as WFS, and specify if they will allow the 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.

QGIS support the following request for WFS service:

- GetCapabilities
- DescribeFeatureType
- GetFeature
- Transaction

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.

Now, save the session in a project file `alaska.qgs`. To provide the project as a WMS/WFS, we 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 we test our project WMS, WFS and WCS. Add the WMS, WFS and WCS as described in *Carregar camadas WMS/WMTS*, *Cliente WFS e WFS-T* and *Cliente WCS* to QGIS and load the data. The URL is:

```
http://localhost/cgi-bin/project/qgis_mapserv.fcgi
```

QGIS support the following request for WCS service:

- GetCapabilities
- DescribeCoverage
- GetCoverage

Afinando o seu 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 want a specific attribute not 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 section Annotation Tools in *Ferramentas gerais* for instructions on creating annotations. For annotations to be displayed as watermarks on the WMS output, the *Fixed map position* check box 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 in a way that it represents a valid relative path.

Os parâmetros extra suportados pelo pedido WMS GetMap

In the WMS GetMap request, QGIS Server accepts a couple of extra parameters in addition to the standard parameters according to the OCG WMS 1.3.0 specification:

- **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.

  Exemplo:

  ```
  http://localhost/cgi-bin/qgis_mapserv.fcgi?\
      REQUEST=GetMap&MAP=/home/qgis/mymap.qgs&...
  ```

- Parâmetro **DPI** : O parâmetro `DPI` pode ser usado para especificar o pedido de saída da resolução.

  Exemplo:

  ```
  http://localhost/cgi-bin/qgis_mapserv.fcgi?REQUEST=GetMap&DPI=300&...
  ```

- Parâmetro **OPACIDADE**: A opacidade pode se definida numa camada ou ao nível do grupo. O intervalo de valores permitido vai de 0 (totalmente trasnaprente) a 255 (totalmente opaco).

  Exemplo:

  ```
  http://localhost/cgi-bin/qgis_mapserv.fcgi?\
      REQUEST=GetMap&LAYERS=mylayer1,mylayer2&OPACITIES=125,200&...
  ```

QGIS Server logging

To log requests send to server, set the following environment variables:

- **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. Available values are:

- – 0 INFO (log all requests),

- – 1 WARNING,

- – 2 CRITICAL (log just critical errors, suitable for production purposes).

Exemplo:

```
SetEnv QGIS_SERVER_LOG_FILE /var/tmp/qgislog.txt
SetEnv QGIS_SERVER_LOG_LEVEL 0
```

Note

- When using Fcgid module use FcgidInitialEnv instead of SetEnv!

- Server logging is enabled also if executable is compiled in release mode.

Environment variables

- **QGIS_OPTIONS_PATH**: The variable specifies path to directory with settings. It works the same ways as QGIS application –optionspath option. It is looking for settings file in <QGIS_OPTIONS_PATH>/QGIS/QGIS2.ini. For exaple, 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/"
```

.

Trabalhando com dados GPS

.

15.1 Módulo GPS

15.1.1 O que é o 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.

15.1.2 Carregando dados GPS a partir de um ficheiro

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 →* ![icon] *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 →* :

- ![icon] GPS Tools

- ![icon] *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 *Amostra de Dados* for more information about the sample data.

1. Select *Vector → GPS → GPS Tools* or click the ![icon] GPS Tools icon in the toolbar and open the *Load GPX file* tab (see figure_GPS_1).

2. Pesquisa na pasta `qgis_sample_data/gps/`, seleccione o ficheiro GPX `national_monuments.gpx` e clique **[Abrir]**.

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.
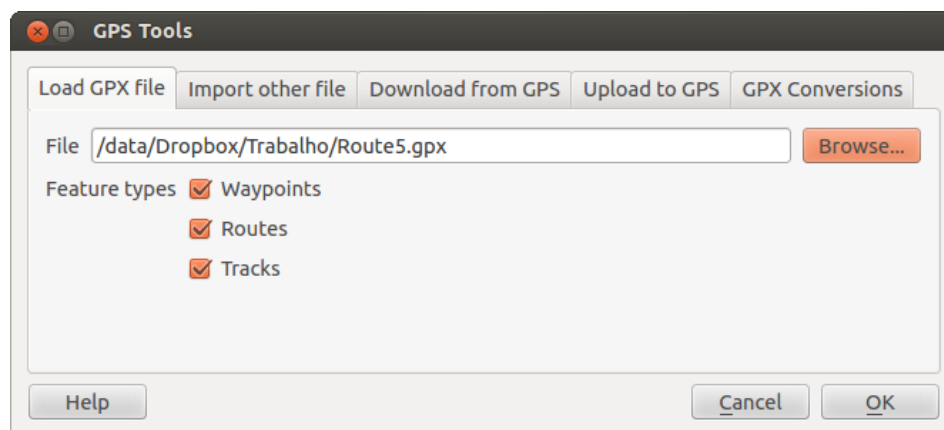
Figure 15.1: The *GPS Tools* dialog window 🐧

Note: 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/.

15.1.3 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.

15.1.4 Importando dados GOS

Para importar dados GPS a partir de um ficheiro que não é ficheiro GPX, pode usar a ferramenta *Importar outro ficheiro* na janela das Ferramentas GPS. Aqui selecciona o ficheiro que que importar (e o tipo de ficheiro), que tipo de elemento quer importar, onde quer armazenar o ficheiro GPX convertido e que nome da nova camada irá ter. Tenha atenção que nem todos os formatos de dados GPS irão suportar os três tipos de elementos, portanto para muitos formatos apenas poderá escolher entre um ou dois tipos.

15.1.5 Transferindo dados GPS a partir do dispositivo

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_2). 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.

O tipo de dispositivo que seleciona no menu do dispositivo GPS determina como o GPSBbabel tentará comunicar com o seu dispositivo GPS. Se nenhum dos tipos disponíveis não trabalha com o seu dispositivo GPS pode criar um novo tipo (veja secção *Definindo novos tipos de dispositivos*).

A porta pode ser um nome de ficheiro ou outro nome que o seu sistema operativo usa como referência a uma porta física no seu computador no qual o dispositivo GPS está ligado. Pode ser um simples USB, para dispositivos GPS com USB.

- 🐧 No Linux é algo do género como `/dev/ttyS0` ou `/dev/ttyS1`.
- 🪟 No Windows é `COM1` ou `COM2`.
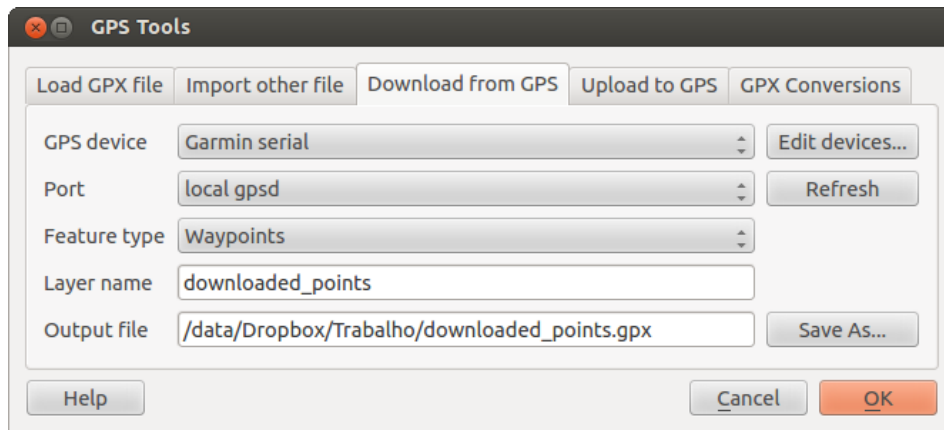
Figure 15.2: A ferramenta de transferência

When you click **[OK]**, the data will be downloaded from the device and appear as a layer in QGIS.

15.1.6 Uploading os dados GPS para o dispositivo

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.

15.1.7 Definindo novos tipos de dispositivos

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` será substituído por `-w` se está a transferir sítios de interesse, `-r` se está a transferir rotas e `-t` se está a transferir trilhos. Estes são as opções da linha de comandos que informam o GPSBabel que tipo de elemento irá transferir.

`%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`.

O comando de upload é o comando que é usado para fazer upload de dados para o dispositivo. As mesmas palavras-chave são usadas, mas `%in` é agora substituída pelo o nome do ficheiro GPX para a camada que vai ser feita um upload, e `%out` é substituída pelo nome da porta.

Pode aprender mais sobre o GPSBabel e as suas opções de linhas de comandos em http://www.gpsbabel.org.

Após ter criado um novo tipo de dispositivo irá aparecer na lista de dispositivos para as ferramentas de transferência e upload.

15.1.8 Transferência de pontos/trilhos a partir de unidades GPS

Como está descrito em secções anteriores do QGIS ele usa o GPSBabel para transferir pontos/trilhos directamente para o projecto. O QGIS abre uma caixa com o perfil pré-definido para transferir a partir de dispositivos Garmin. Infelizmente existe um erro que não permite criar outros perfis, portanto por agora só pode transferir directamente via USB com aparelhos Garmin usando as Ferramentas GPS.

Garmin GPSMAP 60cs

MS Windows

Instale os controladores USB do Garmin a partir do http://www8.garmin.com/support/download_details.jsp?id=591

Ligue o aparelho. Abra as Ferramentas GPS e use `type=garmin serial` e `port=usb:` Preencha os campos *Nome da camada* e *Ficheiro de saída*. Poderá ter problemas algumas vezes a guardar numa pasta, usando algo como `c:\temp` funcionará.

Ubuntu/Mint GNU/Linux

É preciso ter em conta as permissões do dispositivo, como é descrito em https://wiki.openstreetmap.org/wiki/USB_Garmin_on_GNU/Linux. Pode tentar criar um ficheiro `/etc/udev/rules.d/51-garmin.rules` contendo esta regra

```
ATTRS{idVendor}=="091e", ATTRS{idProduct}=="0003", MODE="666"
```

Depois disto é necessário ter a certeza que o módulo kernel do `garmin_gps` não está carregado

```
rmmod garmin_gps
```

e de seguida pode usar as Ferramentas GPS. Infelizmente, parece existir um bug #7182 e normalmente o QGIS pára várias vezes antes da operação trabalhar bem.

BTGP-38KM datalogger (apenas com Bluetooth)

MS Windows

O erro atrás referido não permite que possa transferir os dados a partir do QGIS, por isso é necessário usar o GPSBabel a partir da linha de comandos ou usá-lo através da sua interfac. O comando que o executa é

```
gpsbabel -t -i skytraq,baud=9600,initbaud=9600 -f COM9 -o gpx -F C:/GPX/aaa.gpx
```

Ubuntu/Mint GNU/Linux

Use o mesmo comando (ou configurações se usa o GUI do GPSBabel) como no Windows. No Linux aparecerá uma mensagem como

```
skytraq: Too many read errors on serial port
```

É uma questão de desligá-lo e ligá-lo no datalogger e voltar a tentar.

BlueMax GPS-4044 datalogger (com BT e USB)

MS Windows

Note: É necessário instalar os controladores antes de usar o Windows 7. Veja o site do fabricante para a transferência correcta.

Transferindo com o GPSBabel, com o USB e BT retorna sempre um erro como

```
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 unsucessfully with code 1
```

Ubuntu/Mint GNU/Linux

Com USB

Após ter ligado o cabo use o comando `dmesg` para perceber que porta está a ser usada, por exemplo `/dev/ttyACM3`. De seguida como é habitual use o GPSBabel a partir do CLI ou GUI

```
gpsbabel -t -i mtk -f /dev/ttyACM3 -o gpx -F /home/user/bluemax.gpx
```

Com Bluetooth

Use o Gestor de Dispositivos Blueman para emparelhar os dispositivos e torná-los disponíveis através do sistema de portas, e de seguida corra o GPSBabel

```
gpsbabel -t -i mtk -f /dev/rfcomm0 -o gpx -F /home/user/bluemax_bt.gpx
```

.

15.2 Live GPS tracking

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.

> **Warning:** 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.

15.2.1 Position and additional attributes

🖉 If the GPS is receiving signals from satellites, you will see your position in latitude, longitude and altitude together with additional attributes.

15.2.2 GPS signal strength

📊 Here, you can see the signal strength of the satellites you are receiving signals from.
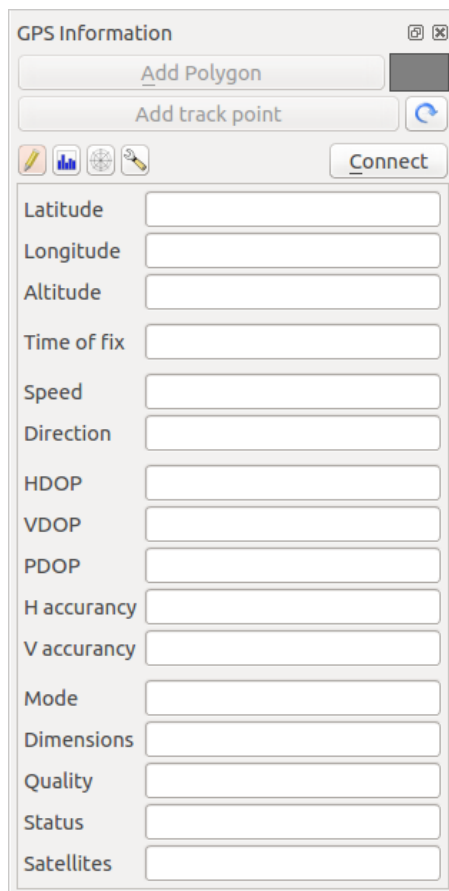
Figure 15.3: GPS tracking position and additional attributes
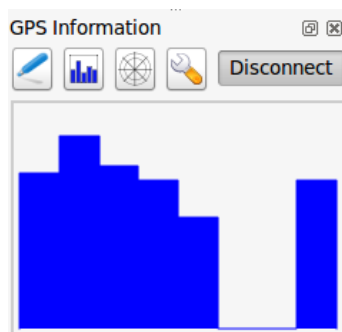
Figure 15.4: GPS tracking signal strength

15.2.3 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.
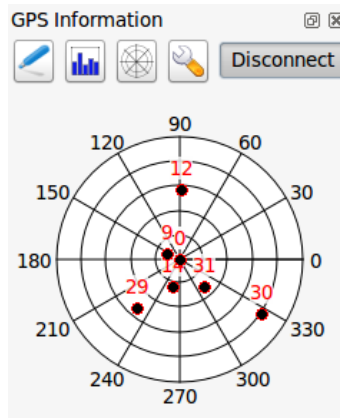
Figure 15.5: GPS tracking polar window 🐧

15.2.4 GPS options

🔧 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]**.

15.2.5 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.
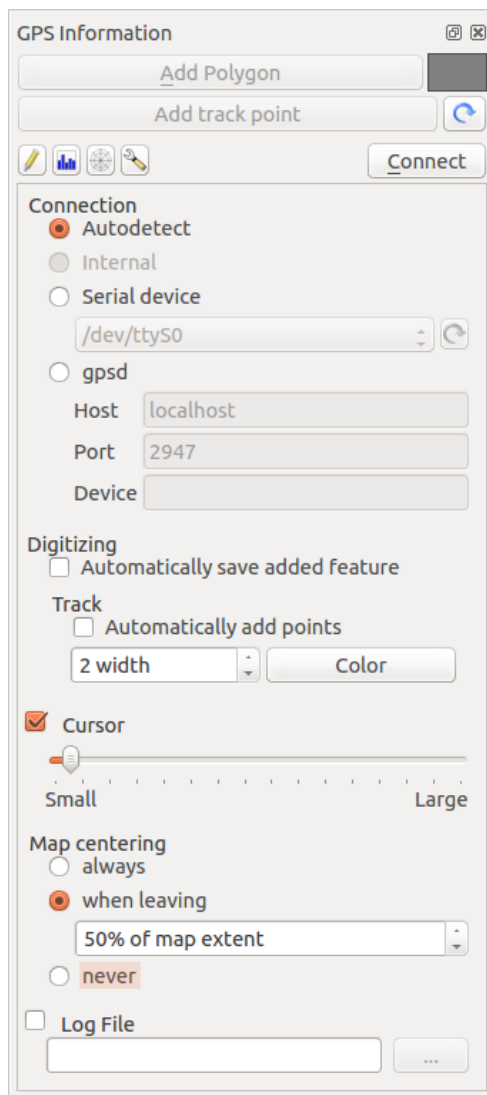
Figure 15.6: GPS tracking options window

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 autorization code is `0000`.

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.

15.2.6 Using 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

As for Windows the easiest way is to use a server in the middle, in this case GPSD, so

```
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
```

And finally connect with the QGIS live tracking tool.

15.2.7 Using BTGP-38KM datalogger (only Bluetooth)

Using GPSD (under Linux) or GPSGate (under Windows) is effortless.

15.2.8 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

For 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`).

For 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`).

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Integração GRASS SIG

The GRASS plugin provides access to GRASS GIS databases and functionalities (see GRASS-PROJECT in *Literatura e Referências Web*). This includes visualizing GRASS raster and vector layers, digitizing vector layers, editing vector attributes, creating new vector layers and analysing GRASS 2-D and 3-D data with more than 400 GRASS modules.

In this section, we'll introduce the plugin functionalities and give some examples of managing and working with GRASS data. The following main features are provided with the toolbar menu when you start the GRASS plugin, as described in section sec_starting_grass:

- Open mapset
- New mapset
- Close mapset
- Add GRASS vector layer
- Add GRASS raster layer
- Create new GRASS vector
- Edit GRASS vector layer
- Open GRASS tools
- Display current GRASS region
- Edit current GRASS region

16.1 Iniciando o módulo GRASS

To use GRASS functionalities and/or visualize GRASS vector and raster layers in QGIS, you must select and load the GRASS plugin with the Plugin Manager. Therefore, go to the menu *Plugins → Manage Plugins*, select *GRASS* and click **[OK]**.

You can now start loading raster and vector layers from an existing GRASS LOCATION (see section sec_load_grassdata). Or, you can create a new GRASS LOCATION with QGIS (see section *Criando uma nova LOCALIZAÇÃO GRASS*) and import some raster and vector data (see section *Importando dados para uma LOCALIZAÇÃO GRASS*) for further analysis with the GRASS Toolbox (see section *The GRASS Toolbox*).

16.2 Carregando as camadas raster e vectoriais GRASS

With the GRASS plugin, you can load vector or raster layers using the appropriate button on the toolbar menu. As an example, we will use the QGIS Alaska dataset (see section *Amostra de Dados*). It includes a small sample GRASS LOCATION with three vector layers and one raster elevation map.

1. Create a new folder called `grassdata`, download the QGIS 'Alaska' dataset `qgis_sample_data.zip` from http://download.osgeo.org/qgis/data/ and unzip the file into `grassdata`.

2. Start QGIS.

3. If not already done in a previous QGIS session, load the GRASS plugin clicking on *Plugins → Manage Plugins* and activate ☑ *GRASS*. The GRASS toolbar appears in the QGIS main window.

4. In the GRASS toolbar, click the Open mapset icon to bring up the *MAPSET* wizard.

5. For `Gisdbase`, browse and select or enter the path to the newly created folder `grassdata`.

6. You should now be able to select the *LOCATION* alaska and the *MAPSET* demo.

7. Click **[OK]**. Notice that some previously disabled tools in the GRASS toolbar are now enabled.

8. Click on Add GRASS raster layer, choose the map name `gtopo30` and click **[OK]**. The elevation layer will be visualized.

9. Click on Add GRASS vector layer, choose the map name `alaska` and click **[OK]**. The Alaska boundary vector layer will be overlayed on top of the `gtopo30` map. You can now adapt the layer properties as described in chapter *Janela das Propriedades da Camada Vectorial* (e.g., change opacity, fill and outline color).

10. Also load the other two vector layers, `rivers` and `airports`, and adapt their properties.

As you see, it is very simple to load GRASS raster and vector layers in QGIS. See the following sections for editing GRASS data and creating a new LOCATION. More sample GRASS LOCATIONs are available at the GRASS website at http://grass.osgeo.org/download/sample-data/.

Tip: Carregamento de Dados GRASS

If you have problems loading data or QGIS terminates abnormally, check to make sure you have loaded the GRASS plugin properly as described in section *Iniciando o módulo GRASS*.

16.3 LOCALIZAÇÃO GRASS e CONJUNTO DE MAPAS

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 *Literatura e Referências Web*). In order to analyze vector and raster layers with GRASS modules, you must 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. But because this is not the usual way for beginners to work with GRASS, this functionality will not be described here.)
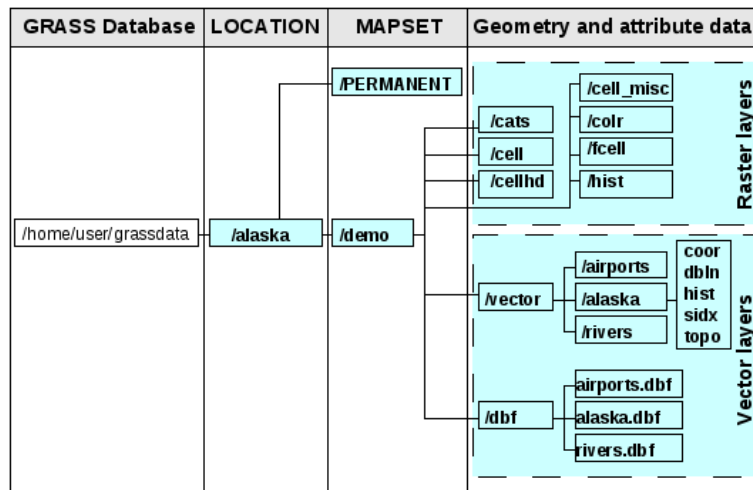
Figure 16.1: Dados GRASS na LOCALIZAÇÃO alaska

16.3.1 Criando uma nova LOCALIZAÇÃO GRASS

As an example, here is how the sample GRASS `LOCATION alaska`, which is projected in Albers Equal Area projection with unit feet was created for the QGIS sample dataset. 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 *Amostra de Dados*).

1. Start QGIS and make sure the GRASS plugin is loaded.

2. Visualize the `alaska.shp` shapefile (see section *Loading a Shapefile*) from the QGIS Alaska dataset (see *Amostra de Dados*).

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 *Adicionando um novo CONJUNTO DE MAPAS*) or to create a new `LOCATION` altogether. Select ⦿ *Create new location* (see figure_grass_location_2).

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. We are using Albers Equal Area Alaska (feet) projection. Since we happen to know that it is represented by the EPSG ID 2964, we enter it in the search box. (Note: If you want to repeat this process for another `LOCATION` and projection and haven't memorized the EPSG ID, click on the 🌐 CRS Status icon in the lower right-hand corner of the status bar (see section *Trabalhando com Projecções*)).

9. In *Filter*, insert 2964 to select the projection.

10. Clique **[Seguinte]**.

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 |qg| extent]**, to apply the extent of the loaded layer `alaska.shp` as the GRASS default region extent.

12. Clique **[Seguinte]**.

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 *Literatura e Referências Web*).

14. Verifique o sumário para ter a certeza que está correcto e clique em **[Concluído]**.

15. The new `LOCATION`, 'alaska', and two `MAPSET`s, 'demo' and 'PERMANENT', are created. The currently opened working set is 'demo', as you defined.

16. Repare que algumas das ferramentas na barra de ferramentas GRASS que estão desactivadas agora estão activas.
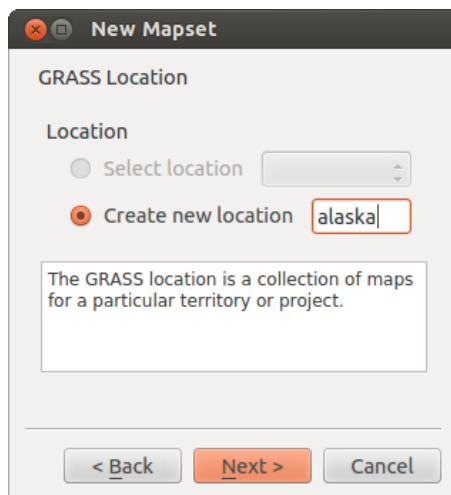
Figure 16.2: Creating a new GRASS LOCATION or a new MAPSET in QGIS

If that seemed like a lot of steps, it's really not all that bad and a very quick way to create a `LOCATION`. The `LOCATION` 'alaska' is now ready for data import (see section *Importando dados para uma LOCALIZAÇÃO GRASS*). You can also use the already-existing vector and raster data in the sample GRASS `LOCATION` 'alaska', included in the QGIS 'Alaska' dataset *Amostra de Dados*, and move on to section *O modelo de dados vectoriais do GRASS*.

16.3.2 Adicionando um novo CONJUNTO DE MAPAS

A user has write access only to a GRASS `MAPSET` he or she created. This means that besides access to your own `MAPSET`, you can read maps in other users' `MAPSET`s (and they can read yours), but you can modify or remove only the maps in your own `MAPSET`.

All `MAPSET`s include a `WIND` file that stores the current boundary coordinate values and the currently selected raster resolution (see Neteler & Mitasova 2008 in *Literatura e Referências Web*, and section *A ferramenta da região GRASS*).

1. Start QGIS and make sure the GRASS plugin is loaded.

2. In the GRASS toolbar, click on the ![icon] New mapset icon to bring up the *MAPSET* wizard.

3. Select the GRASS database (GISDBASE) folder `grassdata` with the `LOCATION` 'alaska', where we want to add a further `MAPSET` called 'test'.

4. Clique **[Seguinte]**.

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 ![icon] *Select location* (see figure_grass_location_2) and click **[Next]**.

6. Enter the name `text` for the new `MAPSET`. Below in the wizard, you see a list of existing `MAPSET`s and corresponding owners.

7. Clique **[Seguinte]**, e verifique o sumário para ter a certeza que está tudo correcto e clique em **[Concluído]**.

16.4 Importando dados para uma LOCALIZAÇÃO GRASS

This section gives an example of how to import raster and vector data into the 'alaska' GRASS `LOCATION` provided by the QGIS 'Alaska' dataset. Therefore, we use the landcover raster map `landcover.img` and the vector GML file `lakes.gml` from the QGIS 'Alaska' dataset (see *Amostra de Dados*).

1. Start QGIS and make sure the GRASS plugin is loaded.

2. In the GRASS toolbar, click the Open MAPSET icon to bring up the *MAPSET* wizard.

3. Select as GRASS database the folder `grassdata` in the QGIS Alaska dataset, as `LOCATION` 'alaska', as `MAPSET` 'demo' and click **[OK]**.

4. Now click the Open GRASS tools icon. The GRASS Toolbox (see section *The GRASS Toolbox*) dialog appears.

5. To import the raster map `landcover.img`, click the module `r.in.gdal` in the *Modules Tree* tab. This GRASS module allows you to import GDAL-supported raster files into a GRASS `LOCATION`. The module dialog for `r.in.gdal` appears.

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 **Succesfully finished**, click **[View output]**. The `landcover_grass` raster layer is now imported into GRASS and will be visualized in the QGIS canvas.

9. To import the vector GML file `lakes.gml`, click the module `v.in.ogr` in the *Modules Tree* tab. This GRASS module allows you to import OGR-supported vector files into a GRASS `LOCATION`. The module dialog for `v.in.ogr` appears.

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.

16.5 O modelo de dados vectoriais do 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 labeled) by the **centroid** of the area.

Besides boundaries and centroids, a vector map can also contain points and lines. All these geometry elements can be mixed in one vector and will be represented in different so-called 'layers' inside one GRASS vector map. So in GRASS, a layer is not a vector or raster map but a level inside a vector layer. This is important to distinguish carefully. (Although it is possible to mix geometry elements, it is unusual and, even in GRASS, only used in special cases such as vector network analysis. Normally, you should prefer to store different geometry elements in different layers.)

It is possible to store several 'layers' in one vector dataset. For example, fields, forests and lakes can be stored in one vector. An adjacent forest and lake can share the same boundary, but they have separate attribute tables. It is also possible to attach attributes to boundaries. An example might be the case where the boundary between a lake and a forest is a road, so it can have a different attribute table.

The 'layer' of the feature is defined by the 'layer' inside GRASS. 'Layer' is the number which defines if there is more than one layer inside the dataset (e.g., if the geometry is forest or lake). For now, it can be only a number. In the future, GRASS will also support names as fields in the user interface.

Attributes can be stored inside the GRASS `LOCATION` as dBase or SQLite3 or in external database tables, for example, PostgreSQL, MySQL, Oracle, etc.

Os atributos nas tabelas das base de dados estão ligados aos elementos de geometria usando o valor 'categoria'.

'Categoria' (chave, ID) é um inteiro anexado às primitivas da geometria, e é usado como ligação a uma coluna de chave na tabela da base de dados.

Tip: Aprendendo o 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.

16.6 Criando uma nova camada vectorial GRASS

To create a new GRASS vector layer with the GRASS plugin, click the ![icon]Create new GRASS vector toolbar icon. Enter a name in the text box, and you can start digitizing point, line or polygon geometries following the procedure described in section *Digitalizando e editando as camadas vectoriais GRASS*.

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 *Criando novas camadas Vectoriais*).

Tip: Creating an attribute table for a new GRASS vector layer

If you want to assign attributes to your digitized geometry features, make sure to create an attribute table with columns before you start digitizing (see figure_grass_digitizing_5).

16.7 Digitalizando e editando as camadas vectoriais GRASS

The digitizing tools for GRASS vector layers are accessed using the ![icon]Edit GRASS vector layer icon on the toolbar. Make sure you have loaded a GRASS vector and it is the selected layer in the legend before clicking on the edit tool. Figure figure_grass_digitizing_2 shows the GRASS edit dialog that is displayed when you click on the edit tool. The tools and settings are discussed in the following sections.

Tip: Digitalizando polígonos no GRASS

If you want to create a polygon in GRASS, you first digitize the boundary of the polygon, setting the mode to 'No category'. Then you add a centroid (label point) into the closed boundary, setting the mode to 'Next not used'. 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.

Barra de Ferramentas

In figure_grass_digitizing_1, you see the GRASS digitizing toolbar icons provided by the GRASS plugin. Table table_grass_digitizing_1 explains the available functionalities.
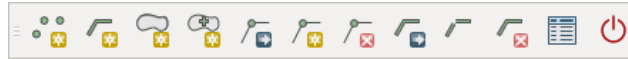
Figure 16.3: GRASS Digitizing Toolbar

Ícone	Ferramenta	Finalidade
	Novo Ponto	Digitalizar um novo ponto
	Nova Linha	Digitalizar nova linha
	Novo Limite	Digitize new boundary (finish by selecting new tool)
	Novo Centróide	Digitalizar um novo centróide (rótulo com a área existente)
	Move vertex	Move one vertex of existing line or boundary and identify new position
	Add vertex	Add a new vertex to existing line
	Delete vertex	Delete vertex from existing line (confirm selected vertex by another click)
	Move element	Move selected boundary, line, point or centroid and click on new position
	Split line	Split an existing line into two parts
	Delete element	Delete existing boundary, line, point or centroid (confirm selected element by another click)
	Edit attributes	Edit attributes of selected element (note that one element can represent more features, see above)
	Close	Close session and save current status (rebuilds topology afterwards)

Tabela GRASS Digitalização 1: Ferramentas de Digitalização GRASS

Category Tab

The *Category* tab allows you to define the way in which the category values will be assigned to a new geometry element.
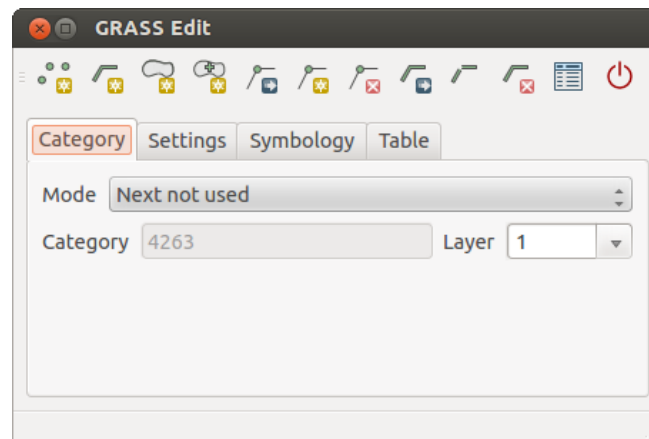
Figure 16.4: GRASS Digitizing Category Tab

- **Mode**: The category value that will be applied to new geometry elements.

    - Next not used - Apply next not yet used category value to geometry element.

    - Manual entry - Manually define the category value for the geometry element in the 'Category' entry field.

- **No category** - Do not apply a category value to the geometry element. This is used, for instance, for area boundaries, because the category values are connected via the centroid.

- **Category** - The number (ID) that is attached to each digitized geometry element. It is used to connect each geometry element with its attributes.

- **Field (layer)** - Each geometry element can be connected with several attribute tables using different GRASS geometry layers. The default layer number is 1.

Tip: Creating an additional GRASS 'layer' with |qg|

If you would like to add more layers to your dataset, just add a new number in the 'Field (layer)' entry box and press return. In the Table tab, you can create your new table connected to your new layer.

Settings Tab

The *Settings* tab allows you to set the snapping in screen pixels. The threshold defines at what distance new points or line ends are snapped to existing nodes. This helps to prevent gaps or dangles between boundaries. The default is set to 10 pixels.
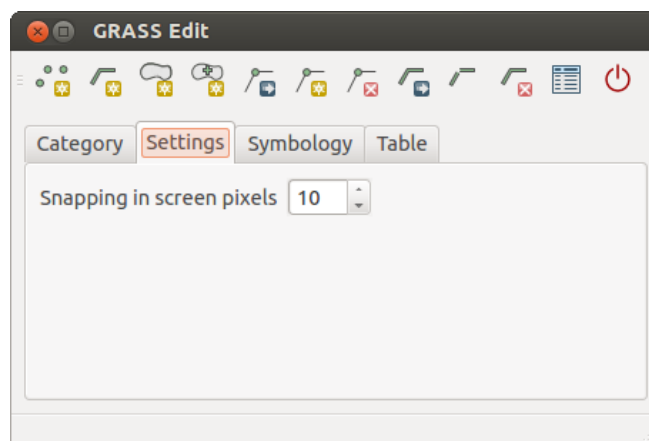
Figure 16.5: GRASS Digitizing Settings Tab

Symbology Tab

The *Symbology* tab allows you to view and set symbology and color settings for various geometry types and their topological status (e.g., closed / opened boundary).
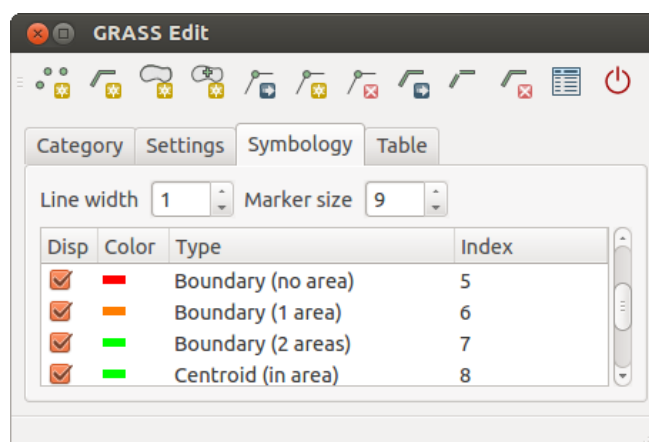
Figure 16.6: GRASS Digitizing Symbology Tab

Table Tab

The *Table* tab provides information about the database table for a given 'layer'. Here, you can add new columns to an existing attribute table, or create a new database table for a new GRASS vector layer (see section *Criando uma nova camada vectorial GRASS*).
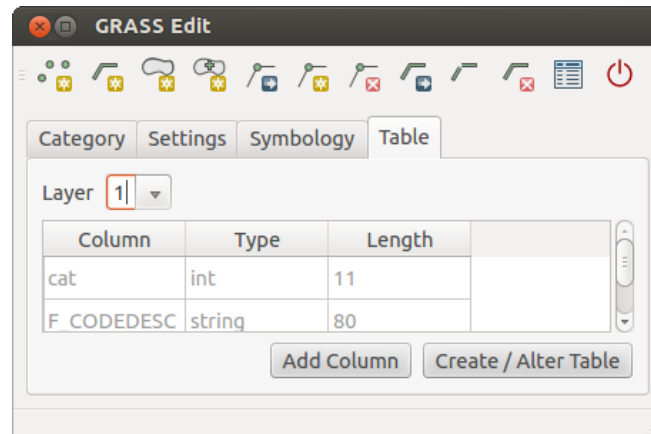
Figure 16.7: GRASS Digitizing Table Tab

Tip: Editar Permissões GRASS

You must be the owner of the GRASS `MAPSET` you want to edit. It is impossible to edit data layers in a `MAPSET` that is not yours, even if you have write permission.

16.8 A ferramenta da região GRASS

The region definition (setting a spatial working window) in GRASS is important for working with raster layers. Vector analysis is by default not limited to any defined region definitions. But all newly created rasters will have the spatial extension and resolution of the currently defined GRASS region, regardless of their original extension and resolution. The current GRASS region is stored in the `$LOCATION/$MAPSET/WIND` file, and it defines north, south, east and west bounds, number of columns and rows, horizontal and vertical spatial resolution.

It is possible to switch on and off the visualization of the GRASS region in the QGIS canvas using the Display current GRASS region button.

With the Edit current GRASS region icon, you can open a dialog to change the current region and the symbology of the GRASS region rectangle in the QGIS canvas. Type in the new region bounds and resolution, and click **[OK]**. The dialog also allows you to select a new region interactively with your mouse on the QGIS canvas. Therefore, click with the left mouse button in the QGIS canvas, open a rectangle, close it using the left mouse button again and click **[OK]**.

The GRASS module `g.region` provides a lot more parameters to define an appropriate region extent and resolution for your raster analysis. You can use these parameters with the GRASS Toolbox, described in section *The GRASS Toolbox*.

16.9 The GRASS Toolbox

The Open GRASS Tools box provides GRASS module functionalities to work with data inside a selected GRASS `LOCATION` and `MAPSET`. To use the GRASS Toolbox you need to open a `LOCATION` and `MAPSET` that you have write permission for (usually granted, if you created the `MAPSET`). This is necessary, because new raster or vector layers created during analysis need to be written to the currently selected `LOCATION` and `MAPSET`.
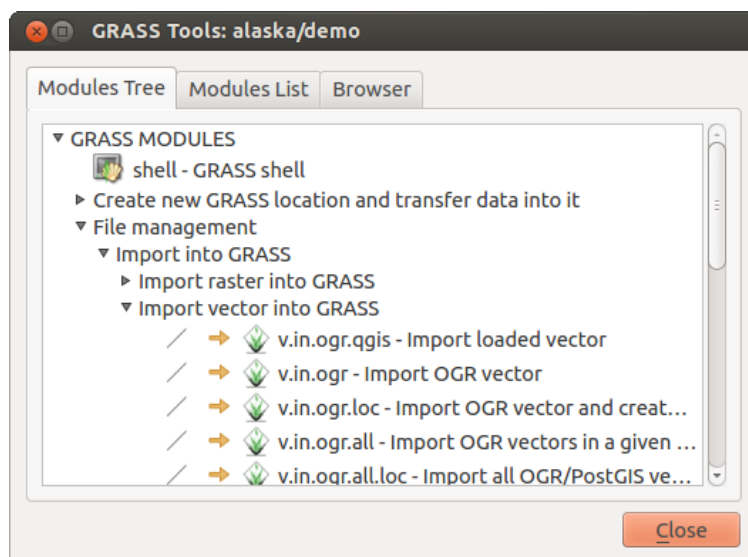
Figure 16.8: Árvore de Módulos e Caixa de Ferramentas GRASS 🐧

16.9.1 Trabalhando com os módulos do GRASS

The GRASS shell inside the GRASS Toolbox provides access to almost all (more than 300) GRASS modules in a command line interface. To offer a more user-friendly working environment, about 200 of the available GRASS modules and functionalities are also provided by graphical dialogs within the GRASS plugin Toolbox.

A complete list of GRASS modules available in the graphical Toolbox in QGIS version 2.8 is available in the GRASS wiki at http://grass.osgeo.org/wiki/GRASS-QGIS_relevant_module_list.

It is also possible to customize the GRASS Toolbox content. This procedure is described in section *Personalizar a Caixa de Ferramentas GRASS*.

As shown in figure_grass_toolbox_1, you can look for the appropriate GRASS module using the thematically grouped *Modules Tree* or the searchable *Modules List* tab.

By clicking on a graphical module icon, a new tab will be added to the Toolbox dialog, providing three new sub-tabs: *Options*, *Output* and *Manual*.

Opções

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.

The provided module parameters are often not complete to keep the dialog clear. 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.

A new feature since QGIS 1.8 is the support for a *Show Advanced Options* button below the simplified module dialog in the *Options* tab. At the moment, it is only added to the module v.in.ascii as an example of use, but it will probably be part of more or all modules in the GRASS Toolbox in future versions of QGIS. This allows you to use the complete GRASS module options without the need to switch to the GRASS shell.

Ficheiro de Saída

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.

Manual

The *Manual* tab shows the HTML help page of the GRASS module. You can use it to check further module parameters and flags or to get a deeper knowledge about the purpose of the module. At the end of each module manual page, you see further links to the Main Help index, the Thematic index and the Full index. These links provide the same information as the module g.manual.
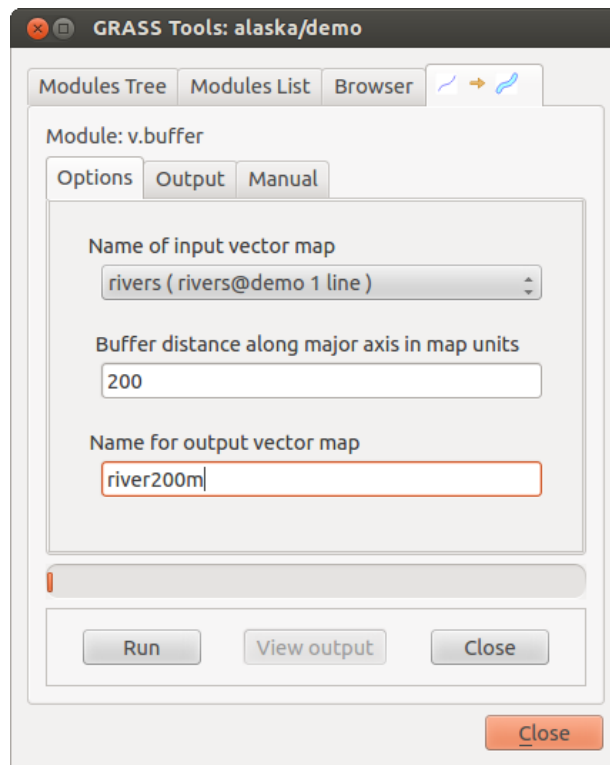
Figure 16.9: Opções dos Módulos da Caixa de Ferramentas do GRASS
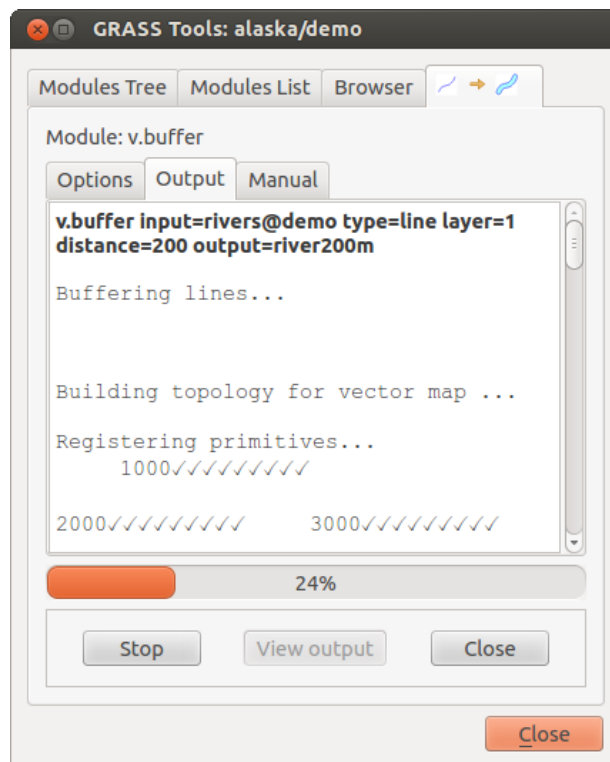
Figure 16.10: GRASS Toolbox Module Output
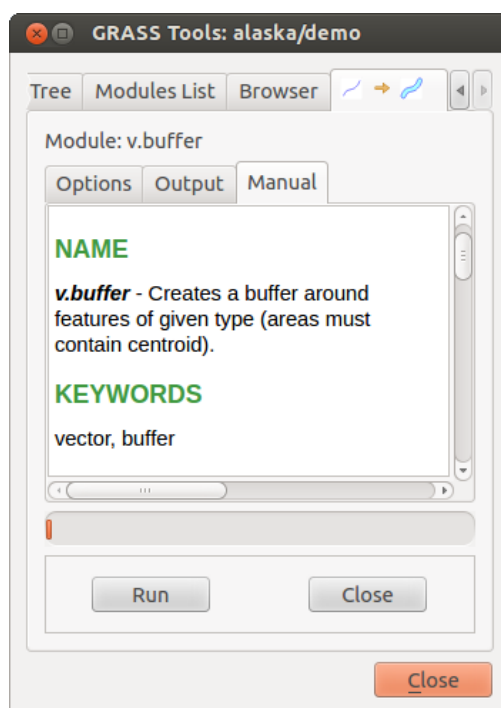
Figure 16.11: GRASS Toolbox Module Manual

Tip: Exibir os resultados imediatamente

Se quiser exibir os seus resultados do cálculo imediatamente no seu enquadramento do mapa, pode usar o botão 'Ver ficheiro de saída' no fundo do separador do módulo.

16.9.2 Exemplos de módulos GRASS

Os seguintes exemplos irão demonstrar o poder de alguns módulos GRASS.

Criando linhas de contorno

The first example creates a vector contour map from an elevation raster (DEM). Here, it is assumed that you have the Alaska `LOCATION` set up as explained in section *Importando dados para uma LOCALIZAÇÃO GRASS*.

- First, open the location by clicking the Open mapset button and choosing the Alaska location.

- Now load the `gtopo30` elevation raster by clicking Add GRASS raster layer and selecting the `gtopo30` raster from the demo location.

- Now open the Toolbox with the Open GRASS tools button.

- In the list of tool categories, double-click *Raster → Surface Management → Generate vector contour lines*.

- Now a single click on the tool **r.contour** will open the tool dialog as explained above (see *Trabalhando com os módulos do GRASS*). The `gtopo30` raster should appear as the *Name of input raster*.

- Type into the *Increment between Contour levels* [1,00 ◇] the value 100. (This will create contour lines at intervals of 100 meters.)

- Type into the *Name for output vector map* the name `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]**.

Since this is a large region, it will take a while to display. After it finishes rendering, you can open the layer properties window to change the line color so that the contours appear clearly over the elevation raster, as in *Janela das Propriedades da Camada Vectorial*.

Next, zoom in to a small, mountainous area in the center of Alaska. Zooming in close, you will notice that the contours have sharp corners. GRASS offers the **v.generalize** tool to slightly alter vector maps while keeping their overall shape. The tool uses several different algorithms with different purposes. Some of the algorithms (i.e., Douglas Peuker and Vertex Reduction) simplify the line by removing some of the vertices. The resulting vector will load faster. This process is useful when you have a highly detailed vector, but you are creating a very small-scale map, so the detail is unnecessary.

Tip: ******A ferramenta de simplificação

Note that the QGIS fTools plugin has a *Simplify geometries* → tool that works just like the GRASS **v.generalize** Douglas-Peuker algorithm.

However, the purpose of this example is different. The contour lines created by `r.contour` have sharp angles that should be smoothed. Among the **v.generalize** algorithms, there is Chaiken's, which does just that (also Hermite splines). Be aware that these algorithms can **add** additional vertices to the vector, causing it to load even more slowly.

- Open the GRASS Toolbox and double-click the categories *Vector → Develop map → Generalization*, then click on the **v.generalize** module to open its options window.

- Check that the 'ctour_100' vector appears as the *Name of input vector*.

- 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]**.

- You may change the color of the vector to display it clearly on the raster background and to contrast with the original contour lines. You will notice that the new contour lines have smoother corners than the original while staying faithful to the original overall shape.

Tip: **Outros usos para o r.contour**

The procedure described above can be used in other equivalent situations. If you have a raster map of precipitation data, for example, then the same method will be used to create a vector map of isohyetal (constant rainfall) lines.

Creating a Hillshade 3-D effect

Several methods are used to display elevation layers and give a 3-D effect to maps. The use of contour lines, as shown above, is one popular method often chosen to produce topographic maps. Another way to display a 3-D effect is by hillshading. The hillshade effect is created from a DEM (elevation) raster by first calculating the slope and aspect of each cell, then simulating the sun's position in the sky and giving a reflectance value to each cell. Thus, you get sun-facing slopes lighted; the slopes facing away from the sun (in shadow) are darkened.

- Begin this example by loading the `gtopo30` elevation raster. Start the GRASS Toolbox, and under the Raster category, double-click to open *Spatial analysis → Terrain analysis*.

- De seguida clique em **r.shaded.relief** para abrir o módulo.

- Change the *azimuth angle* `1,00 ⬍` 270 to 315.

- Introduza `gtopo30_shade` para o novo raster de ensombramento, e clique **[Executar]**.

- Quando o processo concluir, adicione o raster de ensombramento ao mapa, Deverá vê-lo numa escala de cinzentos.
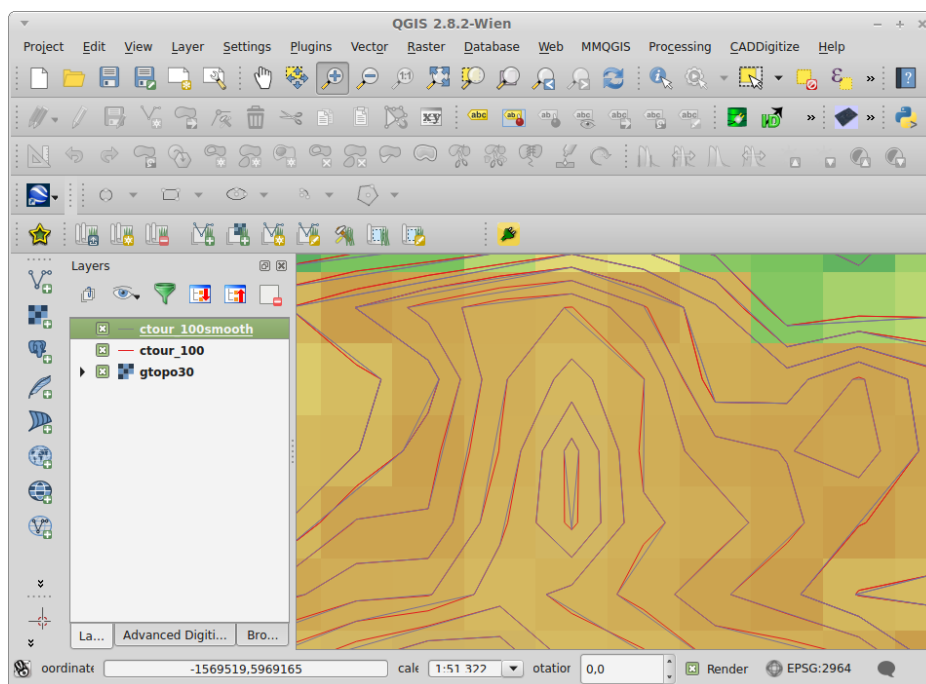
Figure 16.12: GRASS module v.generalize to smooth a vector map

- To view both the hillshading and the colors of the `gtopo30` together, move the hillshade map below the `gtopo30` map in the table of contents, then open the *Properties* window of `gtopo30`, switch to the *Transparency* tab and set its transparency level to about 25%.

You should now have the `gtopo30` elevation with its colormap and transparency setting displayed **above** the grayscale hillshade map. In order to see the visual effects of the hillshading, turn off the `gtopo30_shade` map, then turn it back on.

Usando a linha de comandos do 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.

The module **r.shaded.relief** can take a parameter `zmult`, which multiplies the elevation values relative to the X-Y coordinate units so that the hillshade effect is even more pronounced.

- 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.

- As explained above, move the shaded relief raster below the `gtopo30` raster in the table of contents, then check the transparency of the colored `gtopo30` layer. You should see that the 3-D effect stands out more strongly compared with the first shaded relief map.

Estatísticas Raster num mapa vectorial

The next example shows how a GRASS module can aggregate raster data and add columns of statistics for each polygon in a vector map.
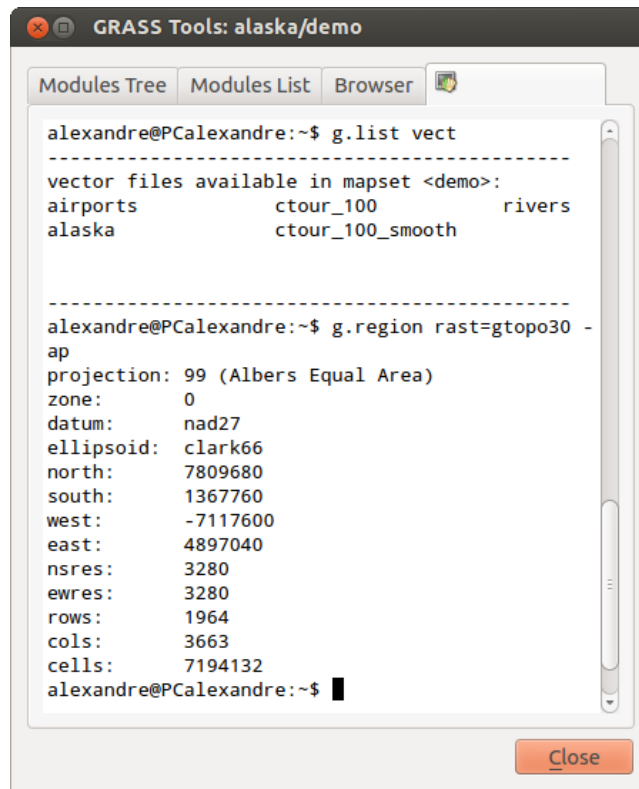
Figure 16.13: The GRASS shell, r.shaded.relief module
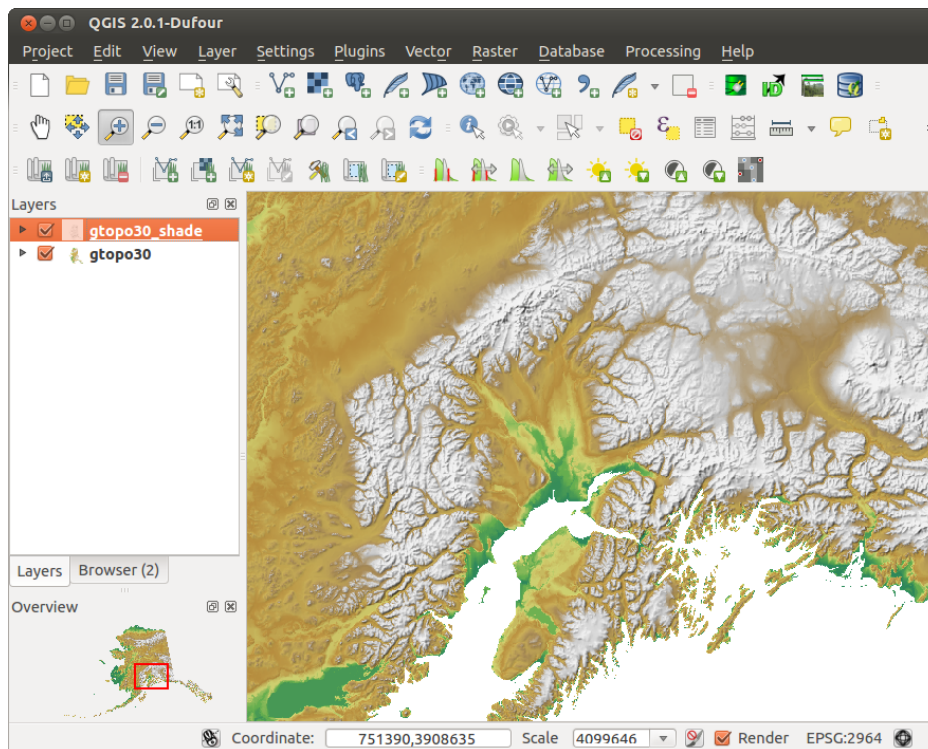
Figure 16.14: Displaying shaded relief created with the GRASS module r.shaded.relief

- Again using the Alaska data, refer to *Importando dados para uma LOCALIZAÇÃO GRASS* to import the trees shapefile from the `shapefiles` directory into GRASS.

- Now an intermediate step is required: centroids must be added to the imported trees map to make it a complete GRASS area vector (including both boundaries and centroids).

- From the Toolbox, choose *Vector → Manage features*, and open the module **v.centroids**.

- Introduza como *mapa vectorial de saída* 'forest_areas' e execute o módulo.

- Now load the `forest_areas` vector and display the types of forests - deciduous, evergreen, mixed - in different colors: In the layer *Properties* window, *Symbology* tab, choose from *Legend type* [⋯▼] 'Unique value' and set the *Classification field* to 'VEGDESC'. (Refer to the explanation of the symbology tab in *Estilos* of the vector section.)

- Next, reopen the GRASS Toolbox and open *Vector → Vector update* by other maps.

- Click on the **v.rast.stats** module. Enter `gtopo30` and `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).

- Finally, open the `forest_areas` attribute table, and verify that several new columns have been added, including `elev_min`, `elev_max`, `elev_mean`, etc., for each forest polygon.

16.9.3 Working with the GRASS LOCATION browser

Another useful feature inside the GRASS Toolbox is the GRASS `LOCATION` browser. In figure_grass_module_7, you can see the current working `LOCATION` with its `MAPSETs`.

In the left browser windows, you can browse through all `MAPSETs` inside the current `LOCATION`. The right browser window shows some meta-information for selected raster or vector layers (e.g., resolution, bounding box, data source, connected attribute table for vector data, and a command history).
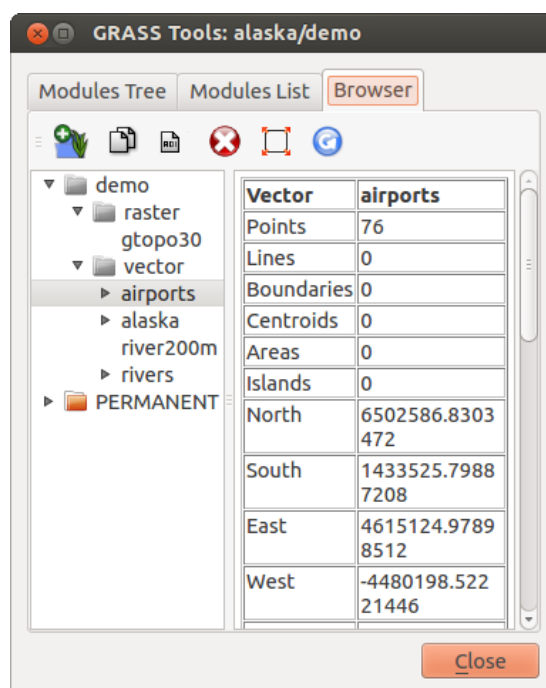
Figure 16.15: GRASS LOCATION browser 🐧

The toolbar inside the *Browser* tab offers the following tools to manage the selected `LOCATION`:

- 🌱 *Add selected map to canvas*

- *Copy selected map*

- *Rename selected map*

- *Delete selected map*

- *Set current region to selected map*

- *Refresh browser window*

The *Rename selected map* and *Delete selected map* only work with maps inside your currently selected `MAPSET`. All other tools also work with raster and vector layers in another `MAPSET`.

16.9.4 Personalizar a Caixa de Ferramentas GRASS

Nearly all GRASS modules can be added to the GRASS Toolbox. An XML interface is provided to parse the pretty simple XML files that configure the modules' appearance and parameters inside the Toolbox.

A sample XML file for generating the module `v.buffer` (v.buffer.qgm) looks like this:

```
<?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.

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Infraestrutura do Processamento QGIS

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17.1 Introdução

This chapter introduces the QGIS processing framework, a geoprocessing environment that can be used to call native and third-party algorithms from QGIS, making your spatial analysis tasks more productive and easy to accomplish.

In the following sections, we will review how to use the graphical elements of this framework and make the most out of each one of them.

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, 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.)

- A caixa de ferramentas. O elemento principal do GUI, é usado para executar um algoritmo único ou correr um processo batch baseado nesse algoritmo.
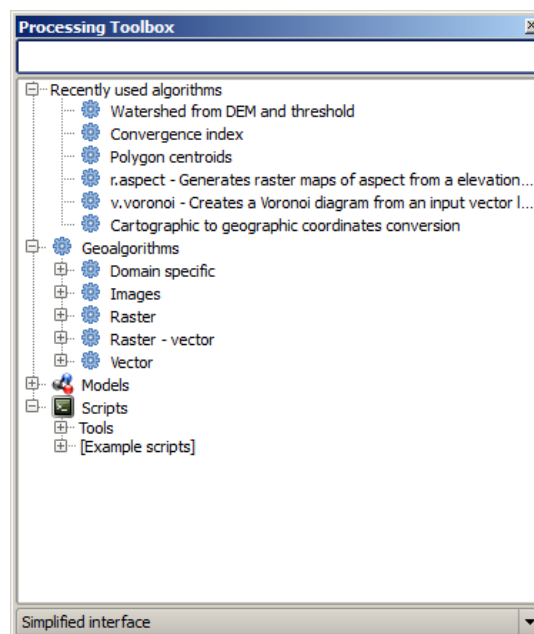
Figure 17.1: Processing Toolbox

- The graphical modeler. Several algorithms can be combined graphically using the modeler to define a workflow, creating a single process that involves several subprocesses.
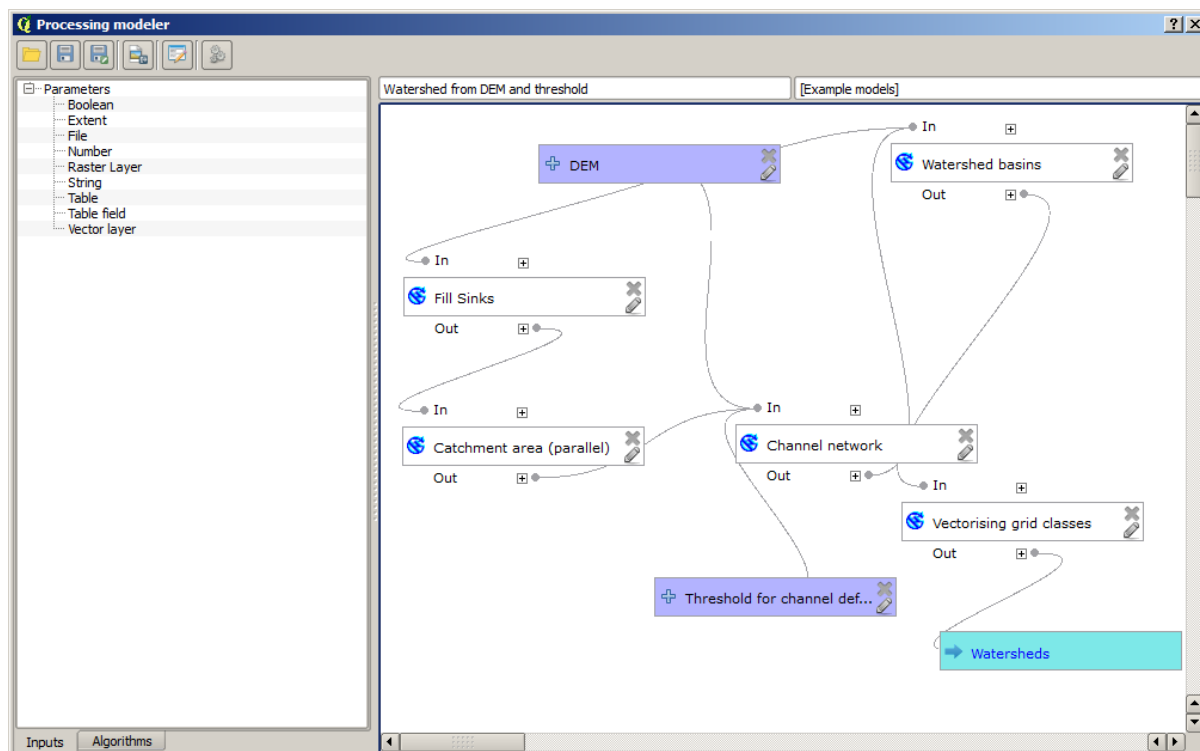
Figure 17.2: Processing Modeler

- 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.

- A interface de processamento batch. Esta interface permite que possa executar processos batch e automaticamente a execução de um único algoritmo num múltiplo conjunto de dados.

In the following sections, we will review each one of these elements in detail.

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17.2 A caixa de ferramentas

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.

The toolbox contains all the available algorithms, divided into predefined groups. All these groups are found under a single tree entry named *Geoalgorithms*.

Additionally, two more entries are found, namely *Models* and *Scripts*. These include user-created algorithms, and they allow you to define your own workflows and processing tasks. We will devote a full section to them a bit later.

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.

In the lower part, you will find a box that allows you to switch between the simplified algorithm list (the one explained above) and the advanced list. If you change to the advanced mode, the toolbox will look like this:
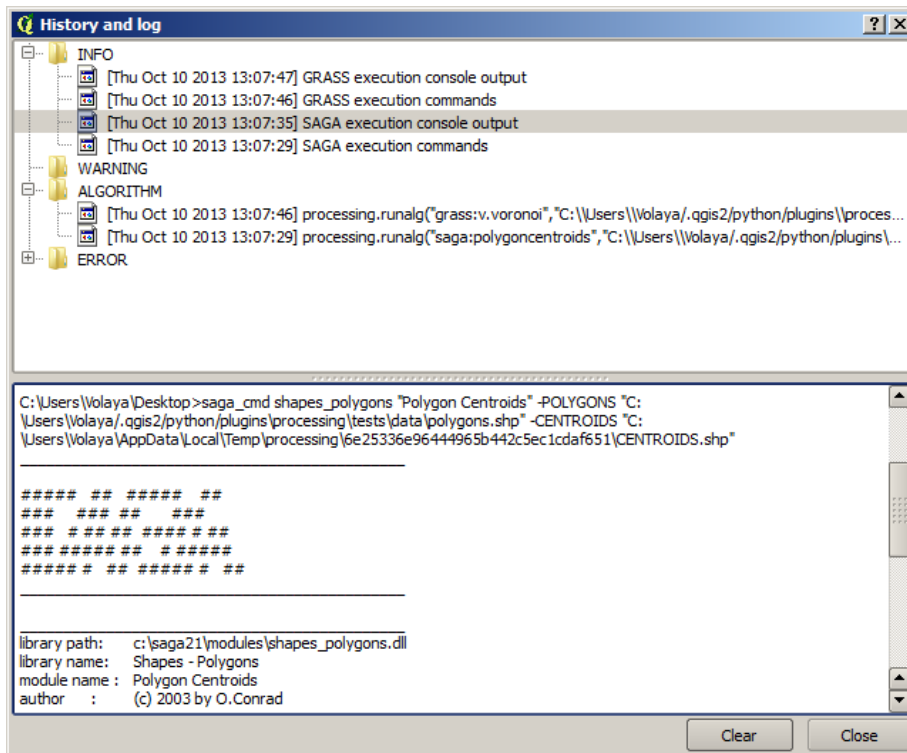
Figure 17.3: Processing History
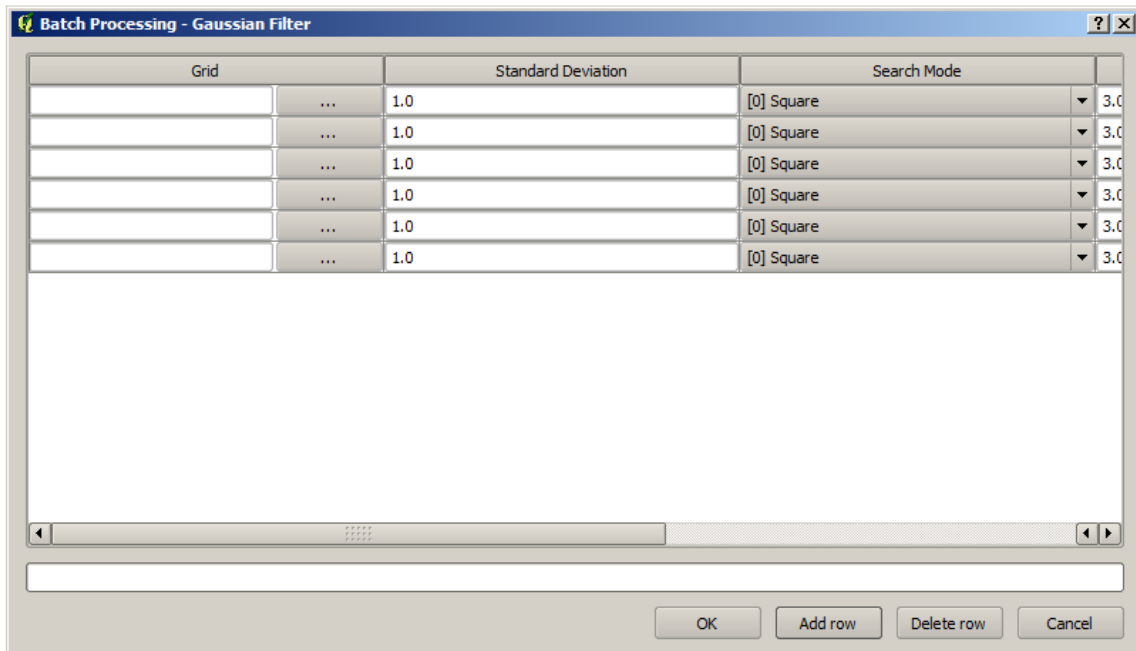
Figure 17.4: Batch Processing interface
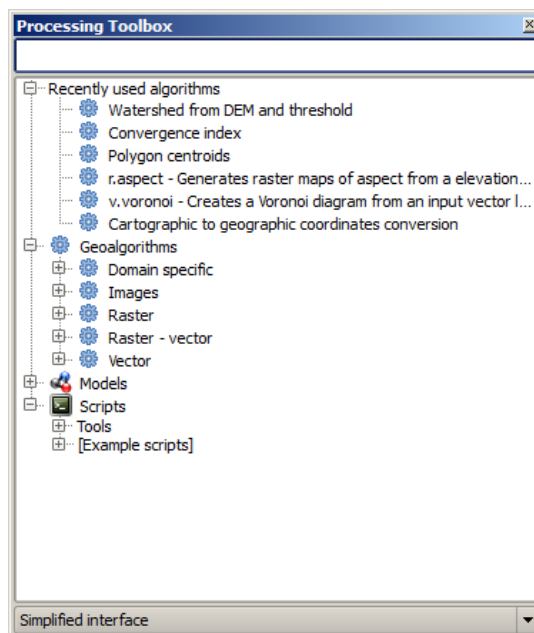
Figure 17.5: Processing Toolbox
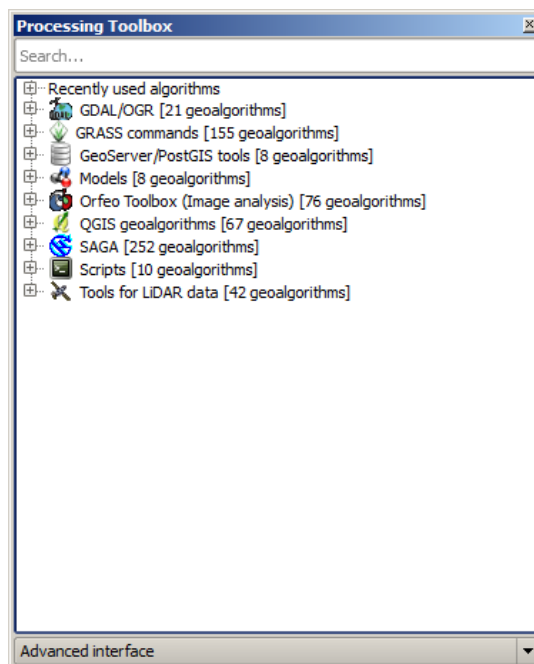
Figure 17.6: Processing Toolbox (advanced mode)

In the advanced view, each group represents a so-called 'algorithm provider', which is a set of algorithms coming from the same source, for instance, from a third-party application with geoprocessing capabilities. Some of these groups represent algorithms from third-party applications like SAGA, GRASS or R, while others contain algorithms directly coded as part of the processing plugin, not relying on any additional software.

This view is recommended to those users who have a certain knowledge of the applications that are backing the algorithms, since they will be shown with their original names and groups.

Also, some additional algorithms are available only in the advanced view, such as LiDAR tools and scripts based on the R statistical computing software, among others. Independent QGIS plugins that add new algorithms to the toolbox will only be shown in the advanced view.

In particular, the simplified view contains algorithms from the following providers:

- GRASS
- SAGA
- OTB
- Native QGIS algorithms

In the case of running QGIS under Windows, these algorithms are fully-functional in a fresh installation of QGIS, and they can be run without requiring any additional installation. Also, running them requires no prior knowledge of the external applications they use, making them more accesible for first-time users.

If you want to use an algorithm not provided by any of the above providers, switch to the advanced mode by selecting the corresponding option at the bottom of the toolbox.

Para executar um algoritmo, faça duplo clique no seu nome na caixa de ferramentas.

17.2.1 O diálogo do 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 SAGA 'Convergence index' algorithm).
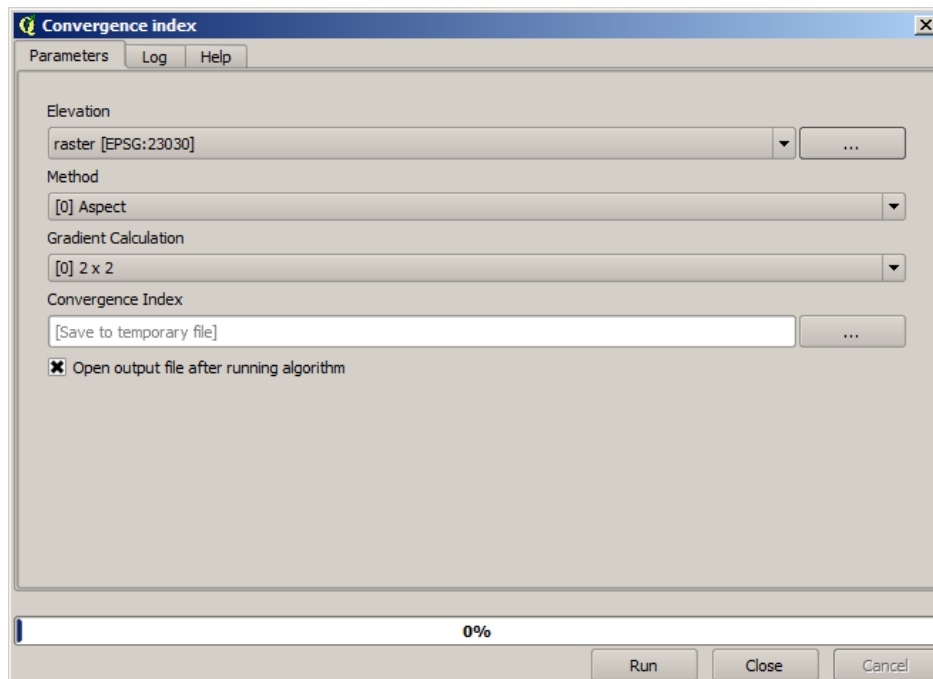
Figure 17.7: Parameters Dialog

This dialog is used to set the input values that the algorithm needs to be executed. It shows a table where input values and configuration parameters are to be set. It of course has a different content, depending on the require-

ments of the algorithm to be executed, and is created automatically based on those requirements. On the left side, the name of the parameter is shown. On the right side, the value of the parameter can be set.

Although the number and type of parameters depend on the characteristics of the algorithm, the structure is similar for all of them. The parameters found in the table can be of one of the following types.

- 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.

- 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.

  Irá ver um botão por cada seleccionador de camada vectorial, como é exibido na figura em baixo.
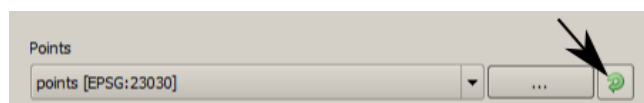
Figure 17.8: Vector iterator button

If the algorithm contains several of them, you will be able to toggle just one of them. If the button corresponding to a vector input is toggled, the algorithm will be executed iteratively on each one of its features, instead of just once for the whole layer, producing as many outputs as times the algorithm is executed. This allows for automating the process when all features in a layer have to be processed separately.

- 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.

- Uma opção, a escolher de uma lista de selecção de uma lista de opções possíveis.

- A numerical value, to be introduced in a text box. You will find a button by its side. Clicking on it, you will see a dialog 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.
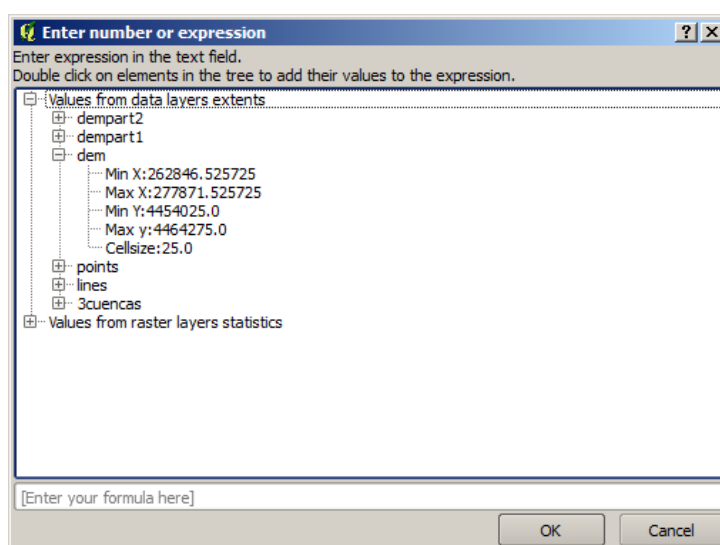
Figure 17.9: Number Selector

- Um intervalo, com valores min e máx para serem introduzidos em duas caixas de texto.

- Uma cadeia de texto, a ser introduzida na caixa de texto.

- Um campo, para escolher a partir de uma tabela de atributos de uma camada vectorial ou uma tabela única de outro parâmetro.

- 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 two options: to select the value from a layer or the current canvas extent, or to define it by dragging directly onto the map canvas.

Figure 17.10: Extent selector

Se seleccione a primeira opção, irá ver uma janela igual a próxima.
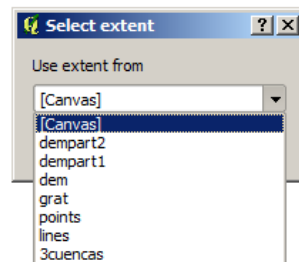
Figure 17.11: Extent List

Se seleccionar o segundo, os parâmetros da janela irão esconder-se, para que possa clicar e arrastar para o enquadramento. Uma vez definido o rectângulo seleccionado, o diálogo irá reaparecer, contendo os valores na caixa de texto da extensão.
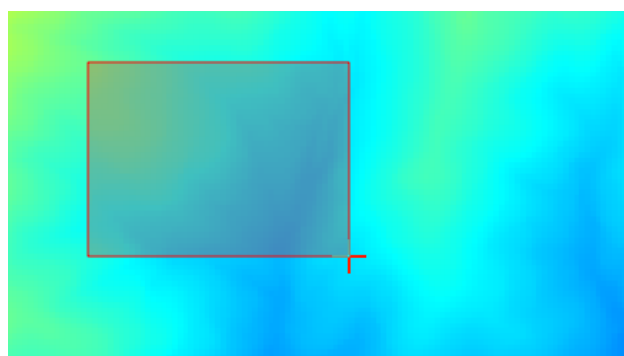
Figure 17.12: Extent Drag

- 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.

- Uma pequena tabela para ser editada pelo utilizador. Estes são usados para definir os parâmetros como tabelas lookup ou kernels de convolução, entre outros.
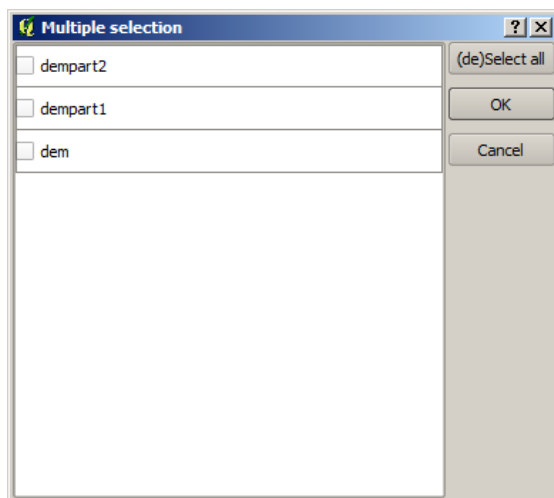
Figure 17.13: Multiple Selection
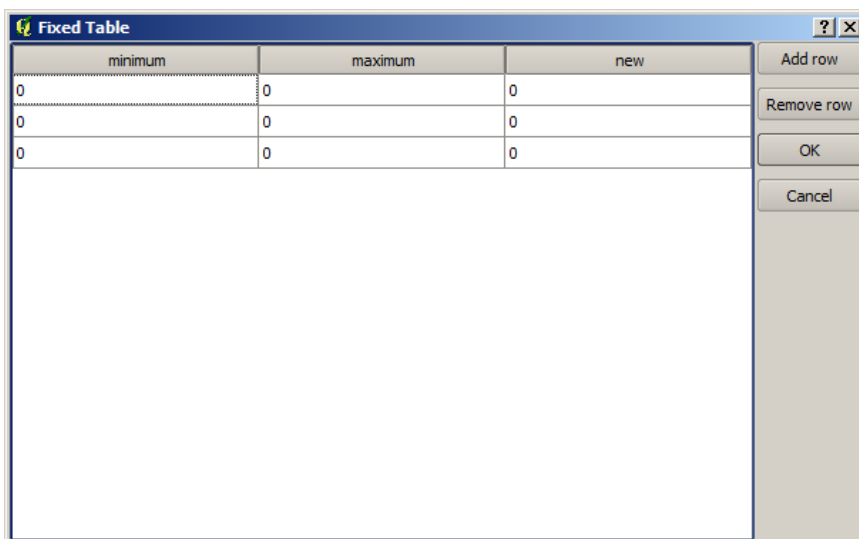
Figure 17.14: Fixed Table

Clique no botão do lado direito para ver a tabela e editar os seus valores.

Depending on the algorithm, the number of rows can be modified or not by using the buttons on the right side of the window.

You will find a **[Help]** tab in the the parameters dialog. If a help file is available, it will be shown, giving you more information about the algorithm and detailed descriptions of what each parameter does. Unfortunately, most algorithms lack good documentation, but if you feel like contributing to the project, this would be a good place to start.

Uma nota nas projecções

Algorithms run from the processing framework — this is also true of 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 analized. 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 configuration 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.

Pode continuar a executar o algoritmo, mas tenha atenção que na maioria dos casos irá produzir resultados errados, tais como, camadas vazias devido à falta de sobreposição das camadas usadas como ficheiros de entrada.

17.2.2 Objecto de dados gerados por algoritmos

Objectos de dados gerado por um algoritmo podem ser dos seguintes tipos:

- Uma camada raster
- Uma camada vectorial
- Uma tabela
- Um ficheiro HTML (usado para ficheiro de saída de texto e gráficos)

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 the architecture allows for any other way of storing it. For instance, a vector layer can be stored in a database or even uploaded to a remote server using a WFS-T service. Although solutions like these are not yet implemented, the processing framework is prepared to handle them, and we expect to add new kinds of output channels in a near feature.

To select an output channel, just click on the button on the right side of the text box. That will open 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 (usually `.dbf`' for tables, `.tif` for raster layers and `.shp` for vector layers) will

be appended to the file path, and the file format corresponding to that extension will be used to save the layer or table.

If you do not enter any filename, 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 configuration 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.

When running an algorithm that uses a vector layer in iterative mode, the entered file path is used as the base path for all generated files, which are named using the base name and appending a number representing the index of the iteration. The file extension (and format) is used for all such generated files.

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.

Some external applications might have files (with no particular extension restrictions) as output, but they do not belong to any of the categories above. Those output files will not be processed by QGIS (opened or included into the current QGIS project), since most of the time they correspond to file formats or elements not supported by QGIS. This is, for instance, the case with LAS files used for LiDAR data. The files get created, but you won't see anything new in your QGIS working session.

For all the other types of output, you will find a checkbox that you can use to tell the algorithm whether to load the file once it is generated by the algorithm or not. By default, all files are opened.

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).

17.2.3 Configurando a infraestrutura do processamento

Como foi mencionado, o menu de configuração dá acesso a um novo diálogo onde pode configurar a forma como o algoritmo trabalha. Os parâmetros de configuração são estruturados em blocos separados que podem ser seleccionados no lado esquerdo do diálogo.

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 SEXTANTE and added to the QGIS canvas, it will be rendered with that style.

Os estilos de renderização podem ser configurados individualmente para cada algoritmo e cada um para os seus ficheiros de saída. Apenas clique com o direito do rato no nome do algoritmo na caixa de ferramentas e seleccione *Editar estilos de renderização*. Irá ver um diálogo como o que é exibido a seguir.

Seleccione o ficheiro de estilo (`.qml`) que quer para cada ficheiro de saída e pressione **[OK]**.

Os outros parâmetros de configuração no grupo *Geral* estão em baixo referidos:

- *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.
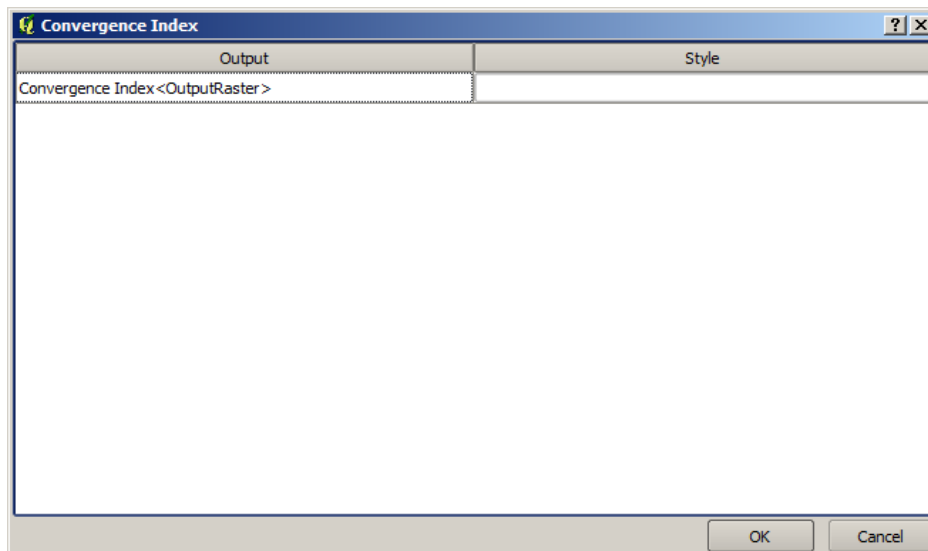
Figure 17.15: Rendering Styles

- *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.

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17.3 O modelador gráfico

The *graphical modeler* allows you to create complex models using a simple and easy-to-use interface. When working with a GIS, most analysis operations are not isolated, but rather part of a chain of operations instead. Using the graphical modeler, that chain of processes can be wrapped into a single process, so it is as easy and convenient to execute as a single process later on a different set of inputs. No matter how many steps and different algorithms it involves, a model is executed as a single algorithm, thus saving time and effort, especially for larger models.

O modelador pode ser aberto a partir do menu processamento.

O modelador tem uma área de trabalho onde a estrutura do modelo e o seu fluxo de trabalho são representados como está exibido. Na parte esquerda da janela, um painel com dois separadores podem ser usados para adicionar novos elementos ao modelo.

A criação de um modelo involve dois passos:

1. *Definição dos dados entrada necessários*. Estes dados de entrada serão adicionados na janela de parâmetros, para que o utilizador possa configurar os seus valores quando executa o modelo. O modelo por si é um algoritmo, portanto os parâmetros da janela é gerado automaticamente como acontece em todos os algoritmos disponíveis na infraestrutura de processamento.

2. *Definição do fluxo de trabalho*. Usando os dados de entrada do modelo, o fluxo de trabalho é definido adicionando algoritmos e seleccionando como vão usar esses ficheiros de entrada ou de saída gerados por outros algoritmos que já existem no modelo
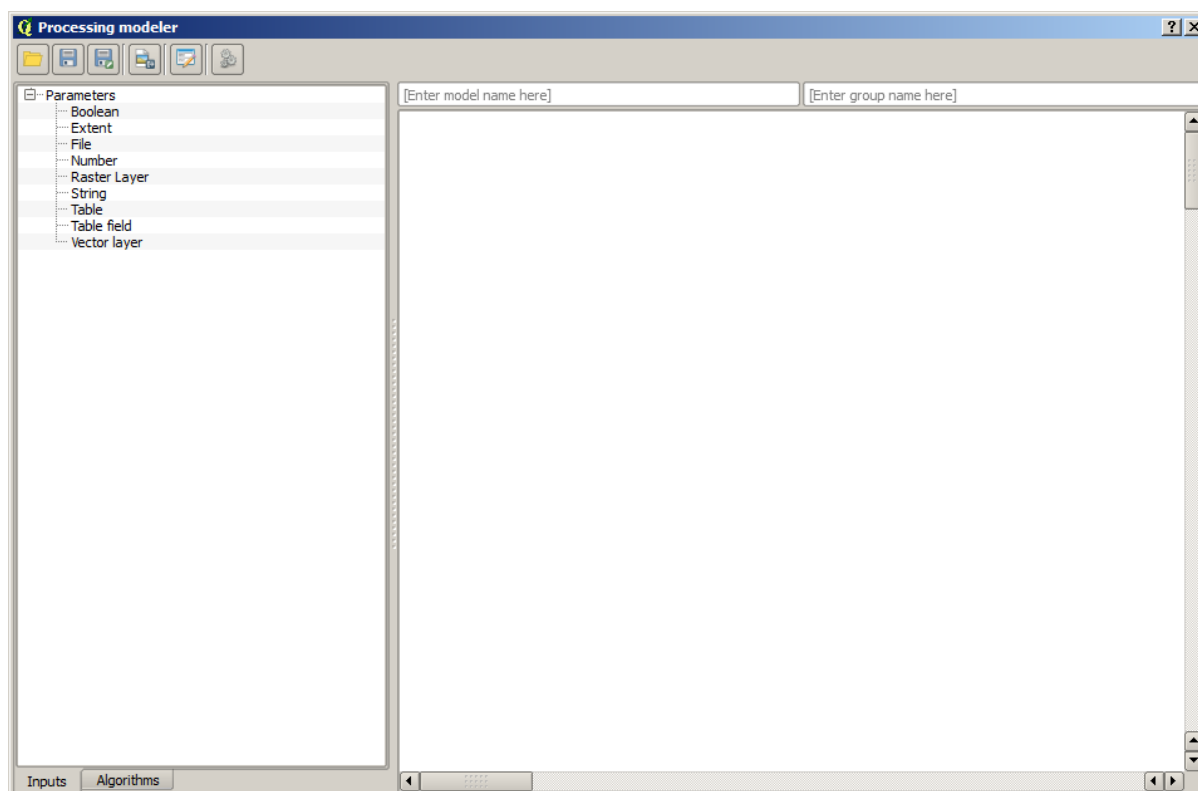
Figure 17.16: Modeler

17.3.1 Definição das entradas

O primeiro passo para criar um modelo é definir as entradas que necessita. Os seguintes elementos são encontrados no separador *Entradas* no lado esquerdo da janela do modelador:

- Camada matricial
- Camada vectorial
- Cadeia de texto
- Campo da tabela
- Tabela
- Extensão
- Número
- Booleano
- Ficheiro

Faça duplo clique em qualquer um, e será exibida uma janela de diálogo para definir as suas características. Dependendo do parâmetro, o diálogo irá conter apenas um elemento básico (a descrição, que será o que o utilizador irá ver quando executar o modelo) ou outros mais. Por exemplo, quando adiciona um valor numérico, como aparece na próxima figura, além da descrição do parâmetro é necessário definir o valor por defeito e o intervalo de valores válidos.

Para cada entrada adicionada, um novo elemento é adicionado ao enquadramento do modelador.

Pode também adicionar ficheiros de entrada arrastando o tipo de entrada a partir de uma lista e largar no enquadramento do modelador, na posição onde quer que fique.
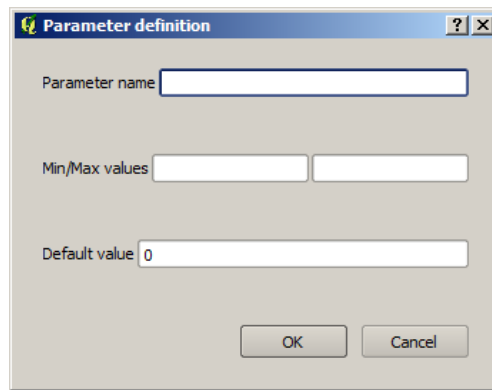
Figure 17.17: Model Parameters 🪟

Figure 17.18: Model Parameters 🪟

17.3.2 Definição do fluxo de trabalho

Uma vez as entradas definidas, é tempo de definir os algoritmos que vamos aplicar. Os algoritmos podem ser encontrados no separador *Algoritmos*, agrupados na mesma forma que estão na caixa de ferramentas.

The appearance of the toolbox has two modes here as well: simplified and advanced. However, there is no element to switch between views in the modeler, so you have to do it in the toolbox. The mode that is selected in the toolbox is the one that will be used for the list of algorithms in the modeler.

To add an algorithm to a model, double-click on its name or drag and drop it, just like it was done when adding inputs. An execution dialog will appear, with a content similar to the one found in the execution panel that is shown when executing the algorithm from the toolbox. The one shown next corresponds to the SAGA 'Convergence index' algorithm, the same example we saw in the section dedicated to the toolbox.

Como pode ver, existem algumas diferenças. Em vez da caixa de saída do ficheiro ser usada para configurar o caminho do ficheiro para as camadas e tabelas de saída, é usado apenas uma caixa de texto simples. Se a camada gerada pelo algoritmo é apenas um resultado temporário, este será usado como o ficheiro de entrada de outro algoritmo e não será mantido como resultado final, mas não edite essa caixa de texto. Introduzindo alguma coisa nela, significa que o resultado é final, e o texto que forneceu será a descrição para o ficheiro de saída, que será aquele que o utilizador irá ver quando executar o modelo.

A selecção do valor para cada parâmetro é também um pouco diferente, uma vez que existem diferenças importantes entre o contexto do modelador e a caixa de ferramentas. Vamos ver como é introduzido os valores para cada tipo de parâmetro.

- Layers (raster and vector) and tables. These are selected from a list, but in this case, the possible values are not the layers or tables currently loaded in QGIS, but the list of model inputs of the corresponding type, or other layers or tables generated by algorithms already added to the model.

- Valores numéricos. Valores literais podem ser introduzidos directamente na caixa de texto. Mas esta caixa de texto é também uma lista que pode ser usada para seleccionar qualquer valor numérico de entrada do modelo. Nesse caso, o parâmetro irá tomar o valor introduzido pelo utilizador quando executado o modelo.

- Cadeia de texto. Como no caso dos valores numéricos, as cadeias de texto podem ser introduzidas, ou uma cadeia de texto de entrada pode ser seleccionada.

- Campo da Tabela. Os campos de uma tabela origem ou camada não podem ser conhecidas na altura do seu desenho, uma vez que dependem da selecção do utilizador cada vez que o modelo é executado. Para definir o valor para este parâmetro, introduza o nome do campo directamente na caixa de texto, ou usa a
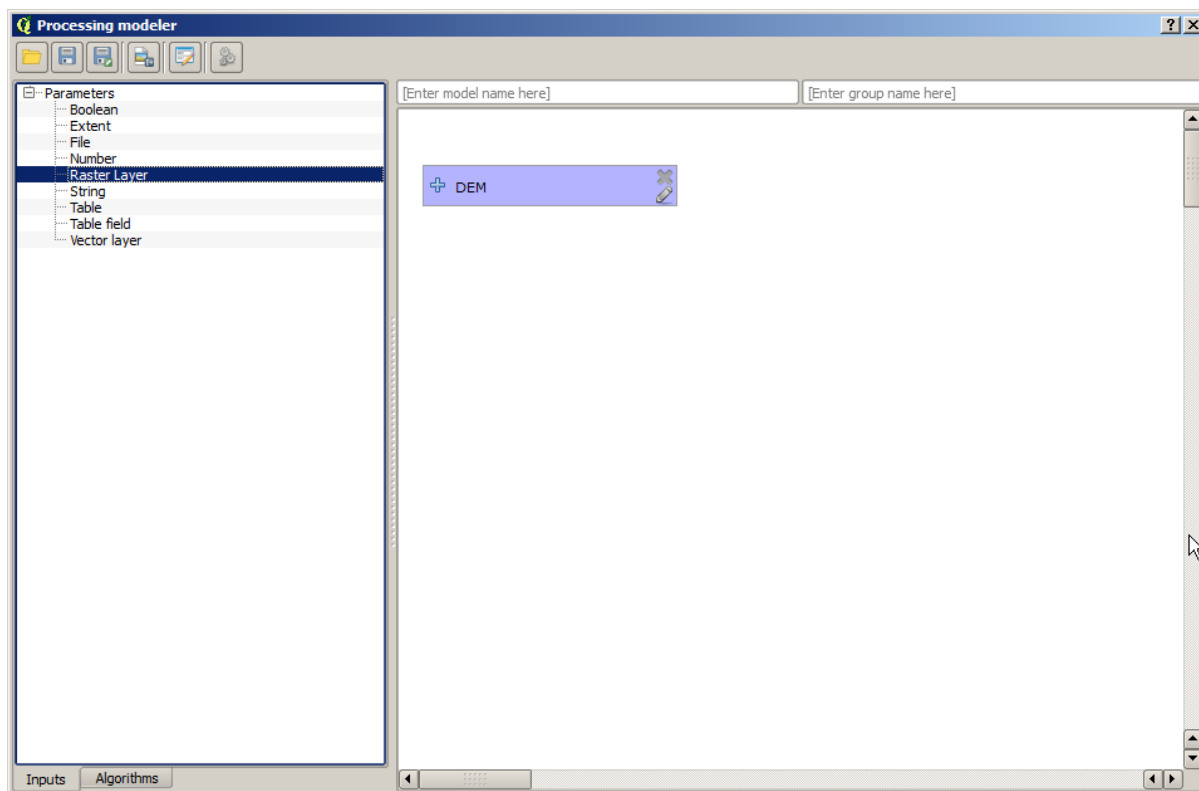
Figure 17.19: Model Parameters
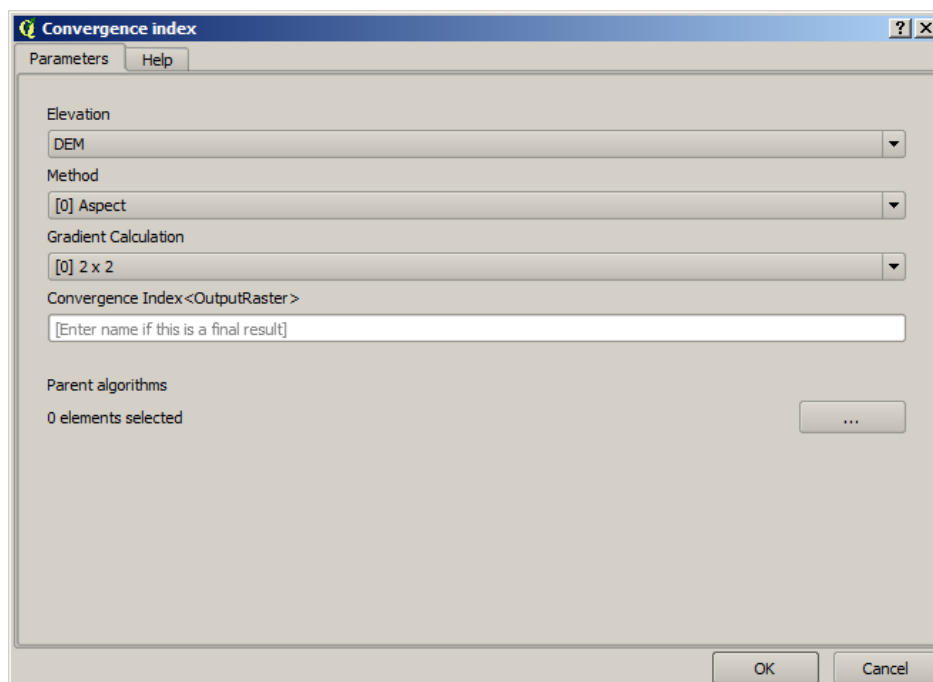
Figure 17.20: Model Parameters

lista para seleccionar a entrada do campo de tabela que já está adicionada no modelo. A validade de um campo seleccionado irá ser verificado no seu processo de execução.

Em todos os casos, irá encontrar um parâmetro adicional denominado de *Algoritmos Parent* que não está disponível quando é chamado o algoritmo a partir da caixa de ferramentas. Este parâmetro permite que possa definir a ordem de como os algoritmos são executados, definindo explicitamente um algoritmo como parent do actual, que irá força-lo a executá-lo antes.

When you use the output of a previous algorithm as the input of your algorithm, that implicitly sets the previous algorithm as parent of the current one (and places the corresponding arrow in the modeler canvas). However, in some cases an algorithm might depend on another one even if it does not use any output object from it (for instance, an algorithm that executes an SQL sentence on a PostGIS database and another one that imports a layer into that same database). In that case, just select the previous algorithm in the *Parent algorithms* parameter and the two steps will be executed in the correct order.

Uma vez todos os parâmetros estiver relacionados a valores válidos, clique no botão **[OK]** e o algoritmo irá ser adicionado ao enquadramento. Será ligado a todos os outros elementos do enquadramento, sejam eles algoritmos ou ficheiros de entrada, o que irá fornecer objectos que foram usados como ficheiros de entrado para esse algoritmo.

Os elementos podem ser arrastados para diferentes posições dentro do enquadramento, para alterar a forma como é exibida a estrutura do módulo e tornar mais claro e intuitivo. As ligações entre os elementos são actualizados automaticamente. Pode ampliar ou afastar usando a roda do rato.

You can run your algorithm anytime 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.

17.3.3 Guardando e e carregando os modelos

Use o botão **[Guardar]** para guardar o modelo actual e o **[Abrir]** para abrir qualquer modelo anteriormente guardado. Os modelos são guardados com a extensão: `.model`. Se o modelo for previamente guardado da janela do modelador, não lhe irá ser solicitado por um nome de ficheiro, uma vez que já existe um ficheiro associado ao modelo, e será usado.

Antes de guardar o modelo, necessita de introduzir o nome e o grupo do modelo, usando as caixas de texto para parte superior da janela.

Os modelos guardados na pasta `modelos` (a pasta padrão quando é pedido o nome do ficheiro para guardar o modelo) irá aparecer na caixa de ferramentas na ligação correspondente. Quando a caixa de ferramentas é chamada, ele procura na pasta `modelos` por ficheiros com a extensão :file:`‘.model’`e carrega os modelos guardados. Uma vez que o modelo é um próprio algoritmo, este pode ser adicionado na caixa de ferramentas como qualquer outro algoritmo.

The models folder can be set from the processing configuration dialog, under the *Modeler* group.

Os modelos carregados a partir da pasta `modelos` aparecem na caixa de ferramentas, mas também na árvore de algoritmos do separador *Algoritmos* da janela do modelador. Isto significa que pode incorporar o modelo como parte de um modelo maior, tal como adiciona qualquer outro algoritmo.

In some cases, a model might not be loaded because not all the algorithms included in its workflow are available. If you have used a given algorithm as part of your model, it should be available (that is, it should appear in the toolbox) in order to load that model. Deactivating an algorithm provider in the processing configuration window renders all the algorithms in that provider unusable by the modeler, which might cause problems when loading models. Keep that in mind when you have trouble loading or executing models.

17.3.4 Editando um modelo

Pode editar o modelo que criou, redefinindo o fluxo de trabalho e as relações entre os algoritmos e os dados de entrada que defeniu no modelo.

Se clicar com o direito do rato num algoritmo na área que representa o modelo, irá ver o menu contexto como é mostrado a seguir:
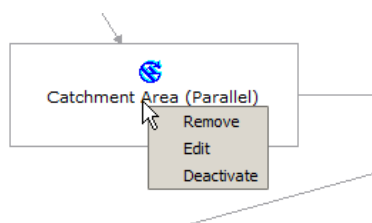
Figure 17.21: Modeler Right Click

Seleccionando a opção *Remover* irá fazer com que o algoritmo para ser removido. Um algoritmo só pode ser removido apenas se existir outros algoritmos dependentes dele. Isto é, se não estiver a ser usado um ficheiro de saída de um algoritmo usado como ficheiro de entrada diferente. Se tentar remover um algoritmo que tenha outros que dependa dele, uma mensagem de aviso igual à que vê aqui em baixo:
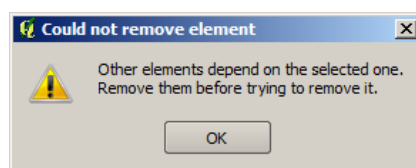
Figure 17.22: Cannot Delete Algorithm

Selecting the *Edit* option or simply double-clicking on the algorithm icon will show the parameters dialog of the algorithm, so you can change the inputs and parameter values. Not all input elements available in the model will appear in this case as available inputs. Layers or values generated at a more advanced step in the workflow defined by the model will not be available if they cause circular dependencies.

Seleccione novos valores e de seguida clique no botão **[OK]** como comum. As ligações entre os elementos do modelo irão alterar de acordo com o enquadramento do modelador.

17.3.5 Editando os ficheiros de ajuda do modelo e a meta-informação

Pode documentar os seus modelos a partir do próprio modelador. Basta apenas clicar no botão **[Editar ajuda do modelo]** e o diálogo como aquele que irá aparecer.

No lado direito irá ver uma página simples HTML, criada usando a descrição dos parâmetros de entrada e de saída do algoritmo, juntamente com itens adicionais como uma descrição geral do modelo ou o seu autor. A primeira vez que abre o editor da ajuda, todas as ajudas estão vazias, mas pode editá-los usando os elementos do lado esquerdo do diálogo. Seleccione um elemento na parte superior e escreva a descrição na caixa de texto em baixo.

Model help is saved in a file in the same folder as the model itself. You do not have to worry about saving it, since it is done automatically.

17.3.6 Sobre os algoritmos disponíveis

Poderá notar que alguns algoritmos podem ser executados a partir da caixa de ferramentas mas não aparecem na lista de algoritmos disponíveis quando está a desenhar o modelo. Para ser incluído no modelo, o algoritmo deve ter uma semântica correcta, assim como ligações apropriadas a outros fluxos de trabalho. Se um algoritmo não tiver uma boa semântica bem definida (por exemplo, se o número de camadas de saída não são conhecidas), portanto não é possível usá-lo dentro do modelo, e não aparece na lista na janela do diálogo do modelador.

Adicionalmente, irá ver algoritmos no modelador que não se encontram na caixa de ferramentas. Esses algoritmos são para ser usados exclusivamente como parte do modelo, e eles não têm interesse noutro contexto diferente. O algoritmo 'Calculadora' é um exemplo disso. É apenas uma simples calculadora aritmética que pode usar para modificar valores numéricos (introduzidos pelo utilizador ou gerados por outro tipo de algoritmo). Estas ferramentas são realmente úteis dentro do modelo, mas fora do contexto, não fazem sentido.
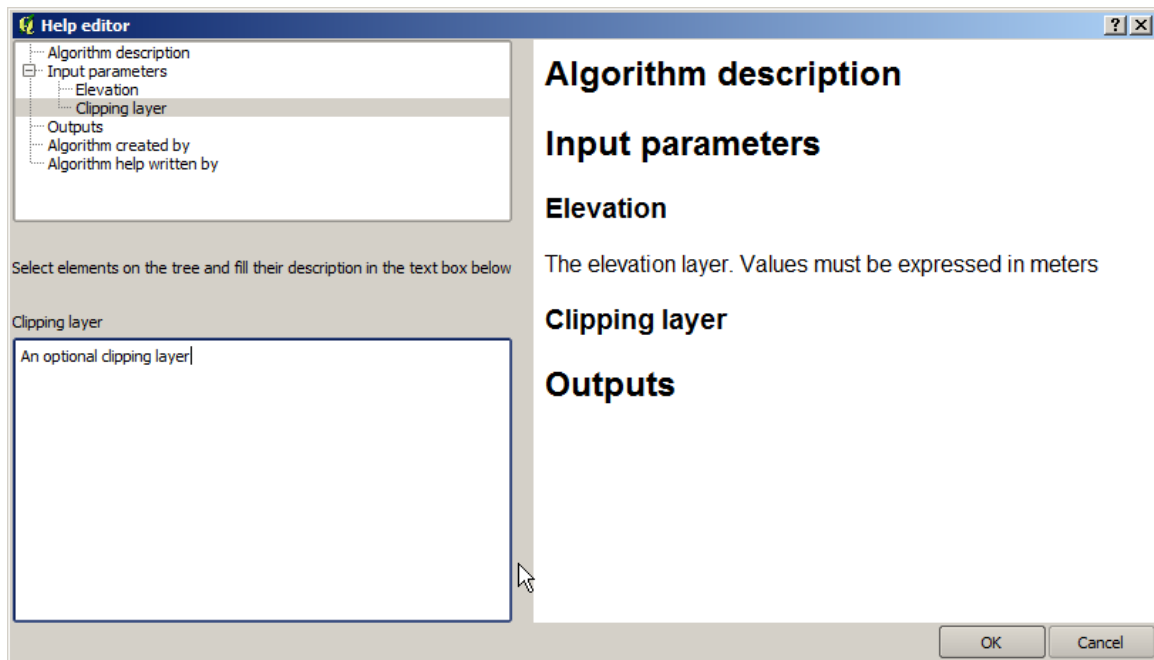
Figure 17.23: Help Edition

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17.4 A interface do processamento em lote

17.4.1 Introdução

Todos os algoritmos (incluindo os modelos) podem ser executados como um processo em lote. Quer dizer, que podem ser executados não apenas com um mas com conjunto de ficheiros de entradas, executando o algoritmo quantas vezes forem necessárias, Isto é útil quando processamos grandes quantidades de dados, uma vez que não é necessário lançar o algoritmo a partir da caixa de ferramentas.

Para executar um algoritmo como um processamento em lote, clique com o direito do rato na caixa de ferramentas e seleccione a opção *Executar como processamento em lote* no balão de opções que irá aparecer.
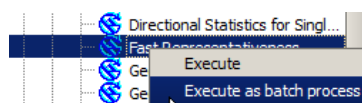
Figure 17.24: Batch Processing Right Click

17.4.2 Os parâmetros da tabela

A execução de um processamento em lote é semelhante à execução única de um algoritmo. Os valores do parâmetro têm de ser definidos, mas neste caso nós necessitamos um conjunto de parâmetros, uma para cada vez que o algoritmo é executado. Os valores são introduzidos usando uma tabela como é mostrada a seguir.

Cada linha desta tabela representa uma única execução do algoritmo, e cada célula contém o valor de um dos parâmetros. É semelhante aos parâmetros do diálogo que vê quando executa o algoritmo a partir da caixa de ferramentas, mas com uma diferente disposição.

Por defeito, a tabela contém apenas duas linhas. Pode adicionar ou remover linhas usando os botões na parte inferior da janela.
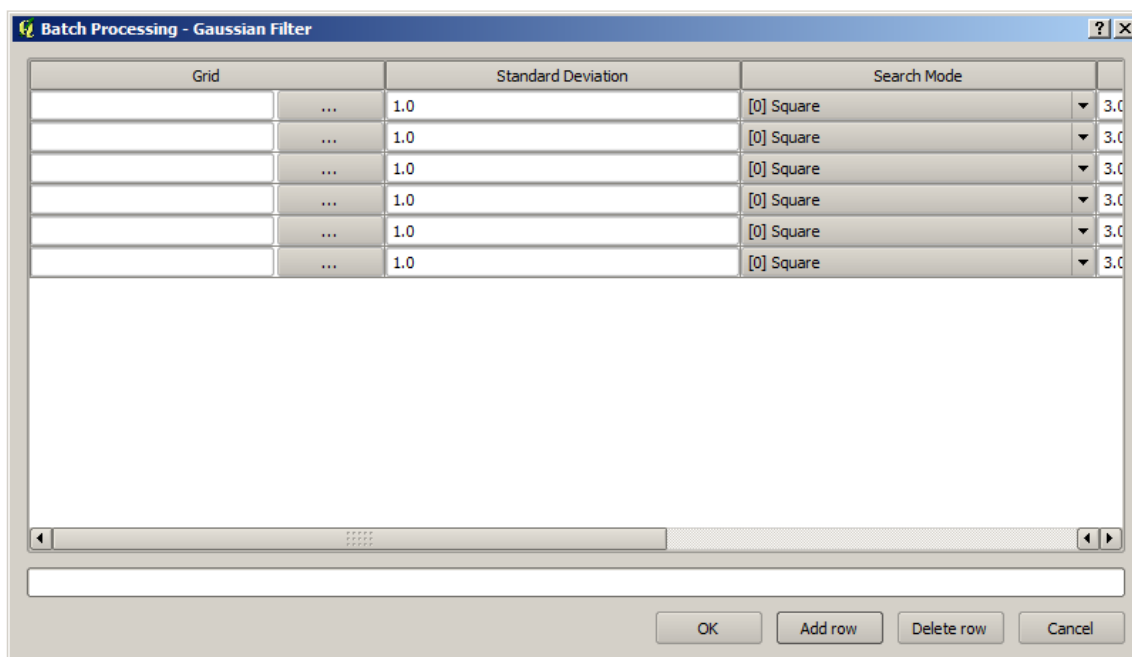
Figure 17.25: Batch Processing

Uma vez o tamanho da tabela ser configurado, terá de ser preenchido com os valores desejados.

17.4.3 Preenchendo os parâmetros da tabela

Para a maioria dos parâmetros, a configuração de um valor é trivial. Apenas introduza o valor ou seleccione-o a partir de uma lista de opções disponíveis dependendo do tipo de parâmetro.

The main differences are found for parameters representing layers or tables, and for output file paths. Regarding input layers and tables, when an algorithm is executed as part of a batch process, those input data objects are taken directly from files, and not from the set of them already opened in QGIS. For this reason, any algorithm can be executed as a batch process, even if no data objects at all are opened and the algorithm cannot be run from the toolbox.

Filenames for input data objects are introduced directly typing or, more conveniently, clicking on the [...] button on the right hand of the cell, which 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 (;).

Output data objects are always saved to a file and, unlike when executing an algorithm from the toolbox, saving to a temporary file is not permitted. You can type the name directly or use the file chooser dialog that appears when clicking on the accompanying button.

Um vez seleccionado o ficheiro, um novo diálogo será exibido para permitir que faça o auto-preenchimento das outras células na mesma coluna (o mesmo parâmetro).

Se o valor padrão ('Não efectuar auto-preenchimento') é seleccionado, irá apenas por o nome de ficheiro seleccionado na célula seleccionada da tabela de parâmetros. Se alguma das outras opções estiver seleccionada, todas as células abaixo da seleccionada irão automaticamente ser preenchidas baseando-se no critério definido. Desta forma, é mais fácil preencher a tabela, e o processamento em lote pode ser definido com menor esforço.

O preenchimento automático pode ser feito de forma simples adicionando números correlativos ao caminho do ficheiro seleccionado, ou anexando o valor de outro campo na mesma linha. Isto é particularmente útil para dar o nome ao objecto de dados de saída de acordo com os dados de entrada.
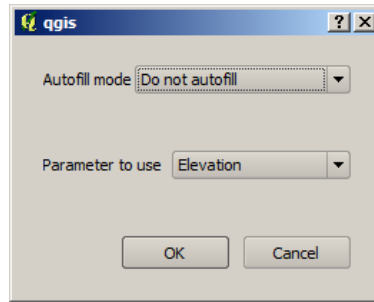
Figure 17.26: Guardar o Processamento em Lote
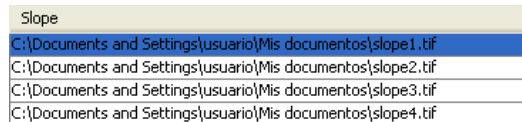
Figure 17.27: Batch Processing File Path

17.4.4 Executando o processo em lote

Após a introdução de todos os valores necessários pode executar o processamento em lote, apenas clicando em **[OK]**. O progresso global da tarefa de processamento será exibido na barra de progresso na parte inferior do diálogo.

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17.5 Usando os algoritmos do processamento a partir da consola

The console allows advanced users to increase their productivity and perform complex operations that cannot be performed using any of the other GUI elements of the processing framework. Models involving several algorithms can be defined using the command-line interface, and additional operations such as loops and conditional sentences can be added to create more flexible and powerful workflows.

There is not a procceing 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.

O código que pode executar a partir da consola Python, mesmo quando não chama nenhum método específico do processamento, pode ser convertido num novo algoritmo que pode mais tarde chamar da caixa de ferramentas, o modelador gráfico ou qualquer outro componente, como faz para outro algoritmo. De facto, alguns algoritmos que encontra na caixa de ferramentas são scripts simples.

In this section, we will see how to use processing algorithms from the QGIS Python console, and also how to write algorithms using Python.

17.5.1 Chamando os algoritmos a partir da consola Python

A primeira coisa que tem de fazer é importar as funções do processamento com a seguinte linha:

```
>>> 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()
```

Irá ver algo como isto.

```
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
...
```

Esta é a lista de todos os algoritmos disponíveis, ordenados alfabeticamente, juntamente com os seus nomes da linha de comandos correspondentes.

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]
```

Este resultado pode mudar dependendo dos algoritmos que estão disponíveis.

Agora é mais fácil encontrar o algoritmo que procura e o seu nome da linha de comandos, neste caso `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>
```

Agora tem tudo o que necessita de correr qualquer algoritmo. Como já tínhamos mencionado, existe apenas um comando para executar algoritmos: `runalg()`. A sua síntaxe é como está descrito a seguir:

```
>>> processing.runalg(name_of_the_algorithm, param1, param2, ..., paramN,
        Output1, Output2, ..., OutputN)
```

A lista de parâmetros e ficheiros de saída para adicionar dependem do algoritmo que quer correr, e é exactamente a lista que o método `alghelp()` lhe dá, na mesma ordem que é exibido.

Depending on the type of parameter, values are introduced differently. The next list gives a quick review of how to introduce values for each type of input parameter:

- 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`.

- Selecção. Se algum algoritmo tiver um parâmetro de selecção, o valor desse parâmetro deve ser introduzido usando um valor inteiro. Para saber as opções disponíveis, pode usar o comando `algoptions()`, como é exibido no seguinte exemplo:

```
>>> 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.

- Multiple input. The value is a string with input descriptors separated by semicolons (`;`). As in the case of single layers or tables, each input descriptor can be the data object name, or its file path.

- Campo da Tabela de XXX. Use uma cadeia de texto com o nome do campo a usar. O parâmetro é caso sensitivo.

- Fixed Table. Type the list of all table values separated by commas (`,`) and enclosed between quotes (`"`). Values start on the upper row and go from left to right. You can also use a 2-D array of values representing the table.

- SRC. Introduza o número do código ESPG do SRC desejado.

- Extensão. Deve usar uma cadeia de texto com `xmin`, `xmax`, `ymin` e `ymax` valores separados por vírgulas (`,`).

Os parâmetros booleanos, de ficheiro, cadeia de texto e numéricos não necessitam de explicações adicionais.

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.

17.5.2 Funções adicionais para a manipulação dos dados

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 Table of Contents.
- `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.

17.5.3 Criando scripts e correndo-os a partir da caixa de ferramentas

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.

O nome do algoritmo (aquele que irá ver na caixa de ferramentas) é criado a partir do nome do ficheiro, removendo a extensão e substituindo os hífens inferiores com espaços em branco.

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.

A parte do código onde este processamento tem lugar não é difícil de perceber se leu-o as secções anteriores deste capítulo. Contudo, as primeiras linhas, necessitam de uma explicação adicional. Eles fornecem a informação que é necessária para tornar o código num algoritmo que possa ser corrido a partir qualquer componente do GUI, como por exemplo a caixa de ferramentas ou o modelador gráfico.

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`.

- `múltiplos raster`. Um conjunto de camadas rasters de entrada.

- `vectores múltiplos`. Um conjunto de camadas vectoriais de entrada.

- `campo`. Um campo da tabela de atributos de uma camada vectorial. O nome da camada tem de ser adicionada depois da etiqueta `campo`. Por exemplo, se declarou um ficheiro de entrada vectorial com `mylayer=vector`, poderá usar `myfield=field mylayer` para adicionar o campo a partir dessa camada como parâmetro.

- `folder`. A folder.

- `file`. A filename.

O nome do parâmetro é o nome que será exibido ao utilizador quando executa o algoritmo, e também o nome da variável a usar no código do script. O valor introduzido pelo utilizador para esse parâmetro será atibuído à variável com esse nome.

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 (`;`).

Os ficheiros de saída são definidos numa maneira semelhante, usando as seguintes etiquetas:

- `raster de saída`

- `vector de saída`

- `tabela de saída`

- `html de saída`

- `ficheiro de saída`

- `número de saída`

- `cadeia de texto de saída`

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
```

a linha seguinte irá configurar o valor de saída para 5:

```
average = 5
```

Em adição às etiquetas para os parâmetros e ficheiros de saída, pode também definir o grupo onde o algoritmo será exibido, usando a etiqueta `group`.

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.

17.5.4 Documentando os seus scripts

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.

17.5.5 Pré- e pós-execução de encaixe da script

Os scripts podem também ser usados para definir um encaixe de pré- e pós-execução que correm antes e depois do algoritmo correr. Isto pode ser usado para automatizar tarefas que serão executados quando qualquer algoritmo é executado.

A sintaxe é identica à sintaxe explicada em cima, mas uma variável global `alg` está disponível, representando o algoritmo que foi (ou está prestes a ser) executado.

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.

.

17.6 Gestão do histórico

17.6.1 O histórico do processamento

Cada vez que executa um algoritmo, a informação do processo é armazenado no gestor histórico. Juntamente com os parâmetros usados, a data e o tempo de execução são também guardados.

This way, it is easy to track and control all the work that has been developed using the processing framework, and easily reproduce it.

The history manager is a set of registry entries grouped according to their date of execution, making it easier to find information about an algorithm executed at any particular moment.

A informação do processo é mantida como uma expressão de linha de comandos, mesmo se o algoritmo seja lançado a partir da barra de ferramentas. Isto permite ser útil para aqueles que querem aprender como se usa a interface da linha de comandos, uma vez que podem chamar o algortimo usando a barra de ferramentas e verificar o gestor histórico para ver como o mesmo algoritmo pode ser chamado a partir da linha de comandos.

Apart from browsing the entries in the registry, you can also re-execute processes by simply double-clicking on the corresponding entry.
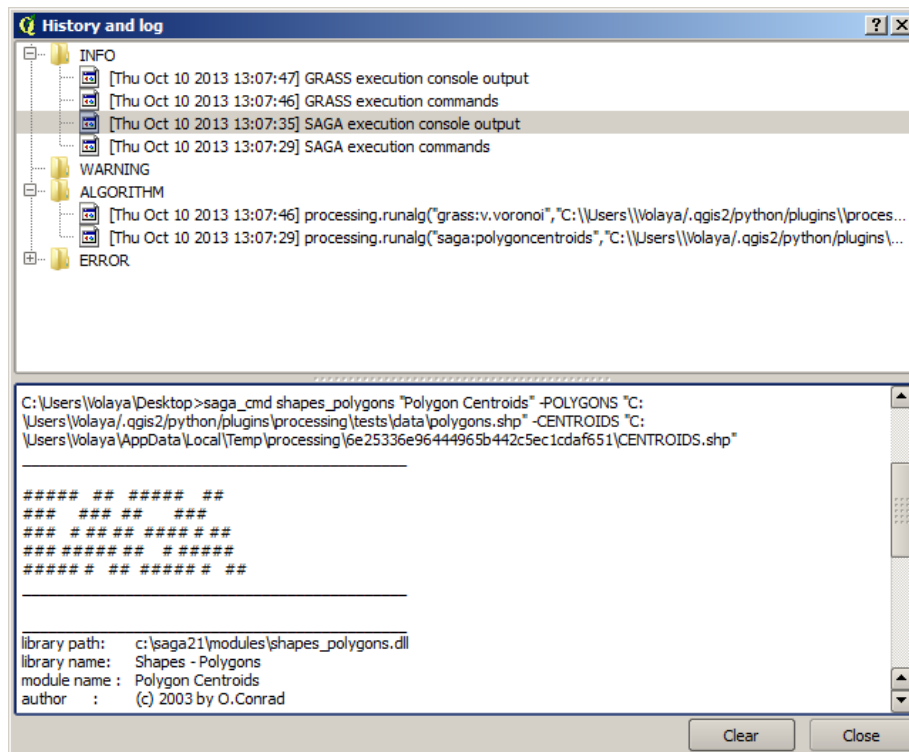
Figure 17.28: Histórico

Along with recording algorithm executions, the processing framework communicates with the user by means of the other groups of the registry, namely *Errors*, *Warnings* and *Information*. In case something is not working properly, having a look at the *Errors* might help you to see what is happening. If you get in contact with a developer to report a bug or error, the information in that group will be very useful for her or him to find out what is going wrong.

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 stored in the *Information* group each time you run one of those algorithms. If, for instance, you are having problems executing a SAGA algorithm, look for an entry named 'SAGA execution console output' to check all the messages generated by SAGA and try to find out where the problem is.

Some algorithms, even if they can produce a result with the given input data, might add comments or additional information to the *Warning* block if they detect potential problems with the data, in order to warn you. Make sure you check those messages if you are having unexpected results.

17.7 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 low hyphens 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 ones, but since we have the DEM, we can calculate them 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 processign 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.
- `folder`. A folder
- `file`. A filename
- `crs`. A Coordinate Reference System

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 it 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 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

17.8 Handing data produced by the algorithm

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
```

17.9 Communicating with the user

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...)
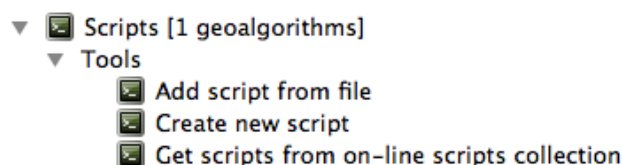
17.10 Documenting your scripts

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 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 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 to a filename, saving is done automatically.

17.11 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.

```
▼  Scripts [1 geoalgorithms]
   ▼  Tools
         Add script from file
         Create new script
         Get scripts from on-line scripts collection
```

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.

17.12 Best practices for writing script algorithms

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.

- Do not load resulting layers. Let Processing handle your results and load your layers if needed.

- 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.

17.13 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.

.

17.14 Configurando as aplicações 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 application 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 appplication not shipped with QGIS are not enabled. You can enable them in the configuration dialog. Make sure that the corresponding application is already installed in your system. Enabling an algorithm provider without installing the application it needs will cause the algorithms to appear in the toolbox, but an error will be thrown when you try to execute them.

This is because the algorithm descriptions (needed to create the parameters dialog and provide the information needed about the algorithm) are not included with each application, but with QGIS instead. That is, they are part of QGIS, so you have them in your installation even if you have not installed any other software. Running the algorithm, however, needs the application binaries to be installed in your system.

17.14.1 Uma nota para utilizadores 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 in the simplified view of the toolbox will be ready to be run without needing any further configuration. If installing through OSGeo4W application, make sure you select for insttallation SAGA 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.

17.14.2 Uma nota para os formatos dos ficheiros

When using an external software, opening a file in QGIS does not mean that it can be opened and processed as well in that other software. In most cases, other software can read what you have opened in QGIS, but in some cases, that might not be true. When using databases or uncommon file formats, whether for raster or vector layers, problems might arise. If that happens, try to use well-known file formats that you are sure are understood by both programs, and check the console output (in the history and log dialog) to know more about what is going wrong.

Usando as camadas raster GRASS, por exemplo, um dos casos em que pode ter problema e não seja possível completar o seu trabalho é se chamar um algoritmo externo usando uma camada como ficheiro de entrada. Por esta razão, essas camadas não irão aparecer como disponíveis para os 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 raster layer 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.

If the extension of the filename specified when calling an algorithm does not match the extension of any of the formats supported by QGIS, then a suffix will be added to set a default format. In the case of raster layers, the `.tif` extension is used, while `.shp` is used for vector layers.

17.14.3 Uma nota para as selecções da camada vectorial

External applications may also be made aware of the selections that exist in vector layers within QGIS. However, that requires rewriting all input vector layers, just as if they were originally in a format not supported by the external application. Only when no selection exists, or the *Use only selected features* option is not enabled in the processing general configuration, can a layer be directly passed to an external application.

Noutros casos, exportando apenas os elementos seleccionados é necessário, o que em alguns casos os tempos de execução serão mais longos.

SAGA

SAGA algorithms can be run from QGIS if you have SAGA installed in your system and you configure the processing framework properly so it can find SAGA executables. In particular, the SAGA command-line executable is needed to run SAGA algorithms.

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 (remember, you need version 2.1), 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 SEXTANTE, so you have to download and install the software yourself. Please check the SAGA website for more information. SAGA 2.1 is needed.

In this case, there is no need to configure the path to the SAGA executable, and you will not see those folders. Instead, you must make sure that SAGA is properly installed and its folder is added to the PATH environment variable. Just open a console and type `saga_cmd` to check that the system can find where the SAGA binaries are located.

17.14.4 Sobre as limitações do sistema de grelhas do 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).

The definition of that common grid system is controlled by the user, and you will find several parameters in the SAGA group of the settings window to do so. There are two ways of setting the target grid system:

- Setting it manually. You define the extent by setting the values of the following parameters:

    - *Reamostragem do X min*

    - *Reamostragem do X máx*

    - *Reamostragem do Y min*

    - *Reamostragem do Y máx*

    - *Reamostragem do tamanho da célula*

    Notice that QGIS will resample input layers to that extent, even if they do not overlap with it.

- Setting it automatically from input layers. To select this option, just check the *Use min covering grid system for resampling* option. All the other settings will be ignored and the minimum extent that covers all the input layers will be used. The cell size of the target layer is the maximum of all cell sizes of the input layers.

Para algoritmos que não usam camadas raster múltiplas, ou para aquelas que não necessitam de um único sistema de grelha de entrada, não será feito uma reamostragem antes de chamar o SAGA, e esses parãmetros não serão usados.

17.14.5 Limitações para camadas multi-banda

Unlike QGIS, SAGA has no support for multi-band layers. If you want to use a multiband layer (such as an RGB or multispectral image), you first have to split it into single-banded images. To do so, you can use the 'SAGA/Grid - Tools/Split RGB image' algorithm (which creates three images from an RGB image) or the 'SAGA/Grid - Tools/Extract band' algorithm (to extract a single band).

17.14.6 Limitations in cell size

SAGA assumes that raster layers have the same cell size in the X and Y axis. If you are working with a layer with different values for horizontal and vertical cell size, you might get unexpected results. In this case, a warning will be added to the processing log, indicating that an input layer might not be suitable to be processed by SAGA.

17.14.7 Registando

When QGIS calls SAGA, it does so using its command-line interface, thus passing a set of commands to perform all the required operations. SAGA shows its progress by writing information to the console, which includes the percentage of processing already done, along with additional content. This output is filtered and used to update the progress bar while the algorithm is running.

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.

A maioria dos outros fornecedores que usam uma aplicação externa e chamam a partir da linha de comandos têm opções semelhantes, portanto irá encontrar noutros sítios da lista de configurações do processamento.

R. Creating R scripts

R integration in QGIS is different from that of SAGA in that there is not a predefined set of algorithms you can run (except for a few examples). Instead, you should write your scripts and call R commands, much like you would do from R, and in a very similar manner to what we saw in the section dedicated to processing scripts. This section shows you the syntax to use to call those R commands from QGIS and how to use QGIS objects (layers, tables) in them.

The first thing you have to do, as we saw in the case of SAGA, is to tell QGIS where your R binaries are located. You can do this using the *R folder* entry in the processing configuration dialog. Once you have set that parameter, you can start creating and executing your own R scripts.

Uma vez mais, isto é diferente no Linux, e só tem de ter certeza que a pasta do R está incluída na variável de ambiente PATH. Se conseguir iniciar o R, apenas introduza `R` na consola, e estará pronto a começar.

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.

R script files have the extension `.rsx`, and creating them is pretty easy if you just have a basic knowledge of R syntax and R scripting. They should be stored in the R scripts folder. You can set this folder in the *R* settings group (available from the processing settings dialog), just like you do with the folder for regular processing scripts.

Let's have a look at a very simple script file, which calls the R method `spsample` to create a random grid within the boundary of the polygons in a given polygon layer. This method belongs to the `maptools` package. Since almost all the algorithms that you might like to incorporate into QGIS will use or generate spatial data, knowledge of spatial packages like `maptools` and, especially, `sp`, is mandatory.

```
##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 SEXTANTE scripts that we have already seen, so they will not be described here again.

When you declare an input parameter, QGIS uses that information for two things: creating the user interface to ask the user for the value of that parameter and creating a corresponding R variable that can later be used as input for R commands.

In the above example, we are declaring an input of type `vector` named `polyg`. When executing the algorithm, QGIS will open in R the layer selected by the user and store it in a variable also named `polyg`. So, the name of a parameter is also the name of the variable that we can use in R for accesing the value of that parameter (thus, you should avoid using reserved R words as parameter names).

Spatial elements such as vector and raster layers are read using the `readOGR()` and `brick()` commands (you do not have to worry about adding those commands to your description file – QGIS will do it), and they are stored as `Spatial*DataFrame` objects. Table fields are stored as strings containing the name of the selected field.

Tables are opened using the `read.csv()` command. If a table entered by the user is not in CSV format, it will be converted prior to importing it into R.

Additionally, raster files can be read using the `readGDAL()` command instead of `brick()` by using the `##usereadgdal`.

If you are an advanced user and do not want QGIS to create the object representing the layer, you can use the `##passfilename` tag to indicate that you prefer a string with the filename instead. In this case, it is up to you to open the file before performing any operation on the data it contains.

Com a informação em cima, podemos agora perceber a primeira linha do nosso primeiro script exemplo (a primeira linha que não começa com o comentário Python).

```
pts=spsample(polyg,numpoints,type="random")
```

A variável `polygon` já contém o objecto `SpatialPolygonsDataFrame`, portanto pode ser usado para chamar o método `spsample`, tal como o `numpoints`, que indica o número de pontos a ser adicionados à grelha de amostra criada.

Since we have declared an output of type vector named `out`, we have to create a variable named `out` and store a `Spatial*DataFrame` object in it (in this case, a `SpatialPointsDataFrame`). You can use any name for your intermediate variables. Just make sure that the variable storing your final result has the same name that you used to declare it, and that it contains a suitable value.

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. In you have used it, layers are saved using the `writeGDAL()` method. If not, the `writeRaster()` method from the `raster` package will be used.

Se usou a opção `#passfilename`, os ficheiros de sáida são gerados usando o pacote `raster` (com `writeRaster()`), mesmo que não seja usado nos ficheiros de entrada.

If your algorithm does not generate any layer, but rather a text result in the console instead, you have to indicate that you want the console to be shown once the execution is finished. To do so, just start the command lines that

produce the results you want to print with the > ('greater') sign. The output of all other lines will not be shown. For instance, here is the description file of an algorithm that performs a normality test on a given field (column) of the attributes of a vector layer:

```
##layer=vector
##field=field layer
##nortest=group
library(nortest)
>lillie.test(layer[[field]])
```

The output of the last line is printed, but the output of the first is not (and neither are the outputs from other command lines added automatically by QGIS).

Se o seu algoritmo criar qualquer tipo de gráficos (usando o método ''plot()), adicione a seguinte linha:

```
##showplots
```

This will cause QGIS to redirect all R graphical outputs to a temporary file, which will be opened once R execution has finished.

Tanto os gráficos como os resultados da consola serão exibidos no gestor de resultados do processamento.

For more information, please check the script files provided with SEXTANTE. Most of them are rather simple and will greatly help you understand how to create your own scripts.

Note: `rgdal` and `maptools` 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. Just add the necessary commands at the beginning of your script. You also have to make sure that the corresponding packages are installed in the R distribution used by QGIS. The processing framework will not take care of any package installation. If you run a script that requires a package that is not installed, the execution will fail, and Processing will try to detect which packages are missing. You must install those missing libraries manually before you can run the algorithm.

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. Additionaly, 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.

Se está a trabalhar em Linux, só necessita de ter a certeza que o GRASS está correctamente instalado, e pode ser executado sem problema a partir da consola.

GRASS algorithms use a region for calculations. This region can be defined manually using values similar to the ones found in the SAGA configuration, or automatically, taking the minimum extent that covers all the input layers used to execute the algorithm each time. If the latter approach is the behaviour you prefer, just check the *Use min covering region* option in the GRASS configuration parameters.

The last parameter that has to be configured is related to the mapset. A mapset is needed to run GRASS, and the processing framework creates a temporary one for each execution. You have to specify if the data you are working with uses geographical (lat/lon) coordinates or projected ones.

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.

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 runing 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 the OSGeo4W installer, then install `otb-bin` package and enter `C:\OSGeo4W\apps\orfeotoolbox\applications` as *OTB applications folder* and `C:\OSGeo4W\bin` as *OTB command line tools folder*. These values should be configured by default, but if you have a different OTB installation, configure them to the corresponding values in your system.

TauDEM

To use this provider, you need to install TauDEM command line tools.

17.14.8 Windows

Please visit the TauDEM homepage for installation instructions and precompiled binaries for 32-bit and 64-bit systems. **IMPORTANT**: You need TauDEM 5.0.6 executables. Version 5.2 is currently not supported.

17.14.9 Linux

There are no packages for most Linux distributions, so you should compile TauDEM by yourself. As TauDEM uses MPICH2, first install it using your favorite package manager. Alternatively, TauDEM works fine with Open MPI, so you can use it instead of MPICH2.

Download TauDEM 5.0.6 source code and extract the files in some folder.

Open the `linearpart.h` file, and after line

```
#include "mpi.h"
```

add a new line with

```
#include <stdint.h>
```

e irá obter

```
#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. Create a build directory and cd into it

```
mkdir build
cd build
```

Configure your build with the command

```
CXX=mpicxx cmake -DCMAKE_INSTALL_PREFIX=/usr/local ..
```

and then compile

```
make
```

Finally, to install TauDEM into `/usr/local/bin`, run

```
sudo make install
```

.

17.15 The QGIS Commander

Processing includes a practical tool that allows you to run algorithms without having to use the toolbox, but just by typing the name of the algorithm you want to run.

This tool is known as the *QGIS commander*, and it is just a simple text box with autocompletion where you type the command you want to run.
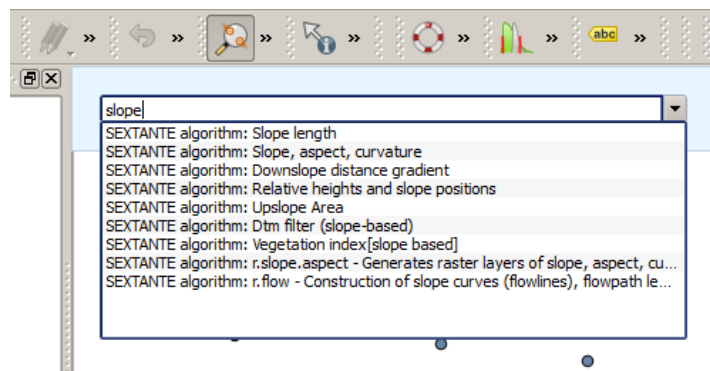
Figure 17.29: The QGIS Commander

The Commander is started from the *Analysis* menu or, more practically, by pressing `Shift + Ctrl + M` (you can change that default keyboard shortcut in the QGIS configuration if you prefer a different one). Apart from executing Processing algorithms, the Commander gives you access to most of the functionality in QGIS, which means that it gives you a practical and efficient way of running QGIS tasks and allows you to control QGIS with reduced usage of buttons and menus.

Moreover, the Commander is configurable, so you can add your custom commands and have them just a few keystrokes away, making it a powerful tool to help you become more productive in your daily work with QGIS.

17.15.1 Comandos disponíveis

The commands available in the Commander fall in the following categories:

- Processing algorithms. These are shown as `Processing algorithm: <name of the algorithm>`.

- Menu items. These are shown as `Menu item: <menu entry text>`. All menus items available from the QGIS interface are available, even if they are included in a submenu.

- Python functions. You can create short Python functions that will be then included in the list of available commands. They are shown as `Function:    <function name>`.

To run any of the above, just start typing and then select the corresponding element from the list of available commands that appears after filtering the whole list of commands with the text you have entered.

In the case of calling a Python function, you can select the entry in the list, which is prefixed by `Function:` (for instance, `Function: removeall),   or just directly type the function name (``removeall` in the previous example). There is no need to add brackets after the function name.

17.15.2 Criando funções personalizadas

Custom functions are added by entering the corresponding Python code in the `commands.py` file that is found in the `.qgis/sextante/commander directory` in your user folder. It is just a simple Python file where you can add the functions that you need.

The file is created with a few example functions the first time you open the Commander. If you haven't launched the Commander yet, you can create the file yourself. To edit the commands file, use your favorite text editor. You can also use a built-in editor by calling the `edit` command from the Commander. It will open the editor with the commands file, and you can edit it directly and then save your changes.

Por exemplo, pode adicionar a seguinte função, que remove todas as camadas:

```python
from qgis.gui import *

def removeall():
    mapreg = QgsMapLayerRegistry.instance()
    mapreg.removeAllMapLayers()
```

Once you have added the function, it will be available in the Commander, and you can invoke it by typing `removeall`. There is no need to do anything apart from writing the function itself.

Functions can receive parameters. Add `*args` to your function definition to receive arguments. When calling the function from the Commander, parameters have to be passed separated by spaces.

Aqui está um exemplo de uma função que carrega uma camada e que tome como parâmetro o nome do ficheiro da camada para carregar.

```python
import processing

def load(*args):
  processing.load(args[0])
```

If you want to load the layer in `/home/myuser/points.shp`, type `load /home/myuser/points.shp` in the Commander text box.

.

Compositor de Impressão

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 powerfull way to share geographical information produced with QGIS that can be included in reports or published.

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 the 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. See a list of tools in table_composer_1:

Ícone	Finalidade	Ícone	Finalidade
	Guardar Projecto		Novo Compositor
	Duplicar Compositor		Gestor de Compositores
	Carregar a partir do modelo		Guardar como modelo
	Print or export as PostScript		Exportar como imagem
	Exportar como SVG		Exportar como PDF
	Reverter à última alteração		Restaurar a última alteração
	Zoom Total		Zoom to 100%
	Aproximar		Afastar
	Refresh View		
	Pan		Zoom to specific region
	Seleccionar/ Mover item		Mover conteúdo do item
	Adicionar novo mapa do QGIS no enquadramento do mapa		Adicionar imagem
	Adicionar nova etiqueta		Adicionar nova legenda
	Add scale bar to print composition		Adicionar forma básica
	Adicionar seta		Adicionar tabela de atributos
	Add an HTML frame		
	Agrupar itens		Desagrupar itens
	Lock Selected Items		Unlock All items
	Elevar itens seleccionados		Abaixar itens seleccionados
	Trazer para a frente		Enviar para trás
	Alinhar à esquerda		Alinhar à direita
	Alinhar ao centro		Centraliza na vertical
	Alinhar ao topo		Alinhar ao fundo
	Preview Atlas		First Feature
	Previous Feature		Next Feature
	Last feature		Print Atlas
	Export Atlas as Image		Atlas Settings

Tabela 1 do Compositor: Ferramentas do Compositor de Impressão

Todas as ferramentas do Compositor de Impressão estão disponíveis nos menus e como ícones na barra de ferramentas. A barra de ferramentas pode ser desligada ou ligada usando o botão direito do rato sobre a barra de ferramentas.

18.1 Primeiros passos

18.1.1 Abrir um novo Modelo de de Compositor de Impressão

Before you start to work with the Print Composer, you need to load some raster and 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.

18.1.2 Overview 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.
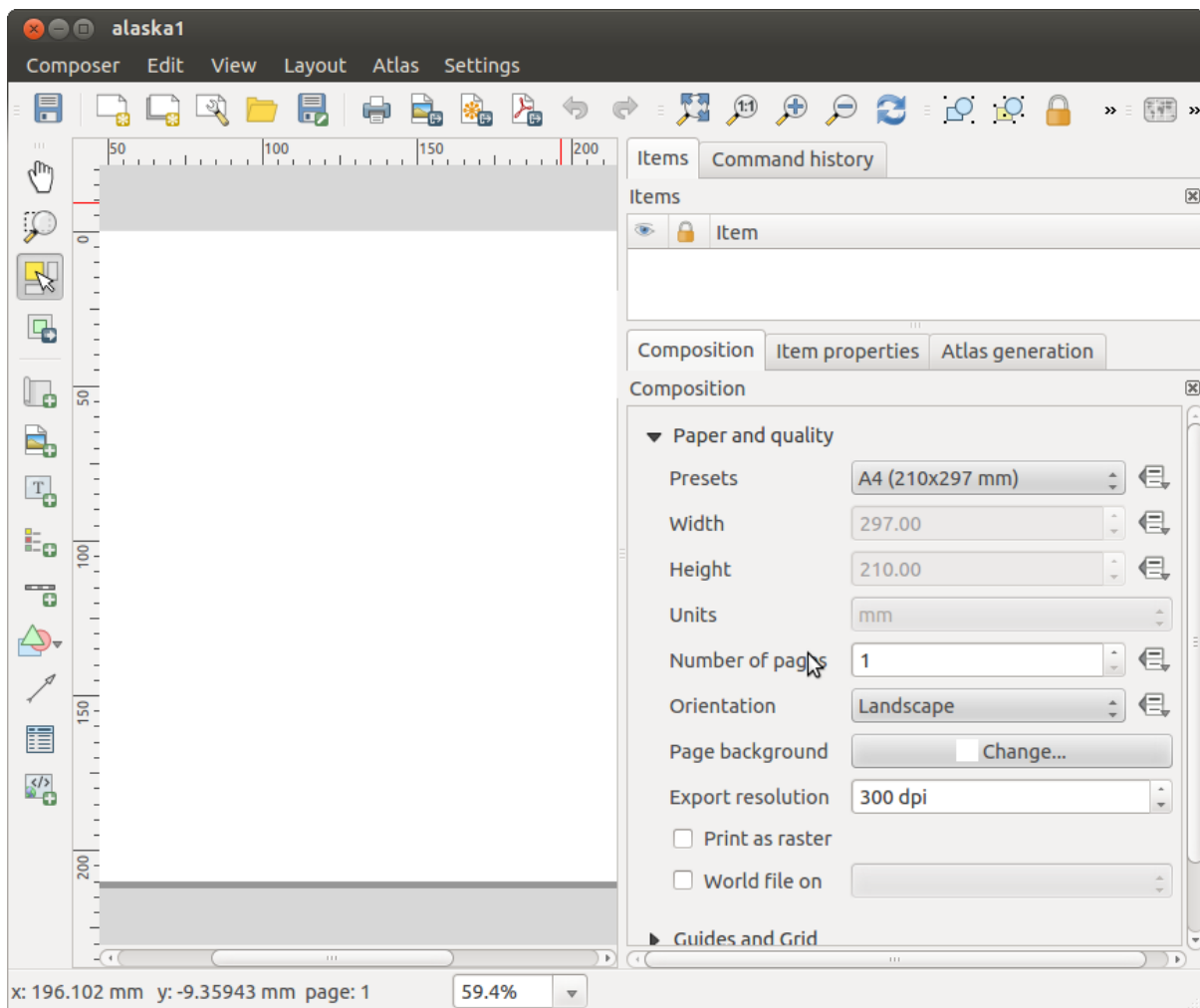
Figure 18.1: Compositor de Impressão

On the right beside the canvas you find two panels. The upper panel holds the tabs *Items* and *Command History* and the lower panel holds the tabs *Composition*, *Item properties* and *Atlas generation*.

- The *Items* tab provides a list of all map composer items added to the canvas.

- The *Command history* tab 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* tab 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 tab, you can also customize settings for grid and smart guides.

- The *Item Properties* tab displays the properties for the selected item. Click the ![icon] Select/Move item icon to select an item (e.g., legend, scale bar or label) on the canvas. Then click the *Item Properties* tab and customize the settings for the selected item.

- The *Atlas generation* tab allows you to enable the generation of an atlas for the current Composer and gives access to its parameters.

- Finally, you can save your print composition with the ![icon] Save Project button.

In the bottom part of the Print Composer window, you can find a status bar with mouse position, current page number and a combo box to set the zoom level.

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.

Ferramentas de Navegação

To navigate in the canvas layout, the Print Composer provides some general tools:

- ![icon] Aproximar
- ![icon] Afastar
- ![icon] Zoom full
- ![icon] Zoom to 100%
- ![icon] Refresh view (if you find the view in an inconsistent state)
- ![icon] Pan composer
- ![icon] Zoom (zoom to a specific region of the Composer)

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 the mouse wheel. With `Ctrl+Spacebar`, you can temporarily switch to zoom mode, and with `Ctrl+Shift+Spacebar`, to zoom out mode.

18.1.3 Sample Session

To demonstrate how to create a map please follow the next instructions.

1. On the left site, select the ![icon] 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 ![icon] Add new scalebar toolbar button and place the map item with the left mouse button on the Print Composer canvas. A scalebar will be added to the canvas.

3. Select the ![icon] 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 ![icon] 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 it's size.

6. Click the *Item Properties* tab on the left lower panel 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. Finally, you can save your print composition with the 💾 Save Project button.

18.1.4 Print Composer Options

From *Settings → Composer Options* you can set some options that will be used as default 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.

18.1.5 Separador de Composição — Configuração geral da composição

No separador *Composição*, pode definir as configurações globais à sua composição.

- You can choose one of the *Presets* for your paper sheet, or enter your custom *width* and *height*.
- Composition can now 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 choose the page *Orientation* and its *Exported resolution*. When checked, ☑ *print as raster* means all elements will be rasterized before printing or saving as PostScript or PDF.
- *Grid and guides* lets you customize grid settings like *spacings*, *offsets* and *tolerance* to your need. The tolerance is the maximum distance below which an item is snapped to smart guides.

Snap to grid and/or to smart guides can be enabled from the *View* menu. In this menu, you can also hide or show the grid and smart guides.

18.1.6 Composer items common options

Composer items have a set of common properties you will find on the bottom of the *Item Properties* tab: Position and size, Rotation, Frame, Background, Item ID and Rendering (See figure_composer_common_1).

- A janela *Posição e tamanho* permite que defina o tamanho e posição da moldura que contém o item. Pode também escolher que *Ponto de referência* será configurado nas coordenadas **X** e **Y** previamente definidas.
- The *Rotation* sets the rotation of the element (in degrees).
- The ☑ *Frame* shows or hides the frame around the label. Use the *Frame color* and *Thickness* menus to adjust those properties.
- Use the *Background color* menu for setting a background color. With the dialog you can pick a color (see *Color Picker*).
- Use the *Item ID* to create a relationship to other Print Composer items. This is used with QGIS server and any potential web client. You can set an ID on an item (e.g., a map and 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 what items and which IDs are available in a layout.
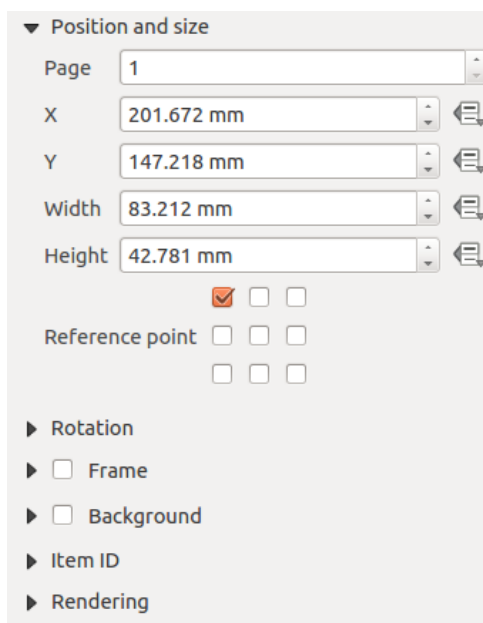- *Rendering* mode can be selected in the option field. See Rendering_Mode.

Note:

Figure 18.2: Janela comum das propriedades do item

- 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 atlas_data_defined_overrides).

18.2 Modo de Renderização

QGIS now allows advanced rendering for Composer items just like vector and raster layers.
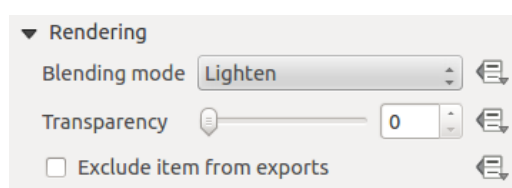
Figure 18.3: Modo de Renderização

- *Transparency* ⟨slider⟩: 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 not visible in all exports. After activating this checkbox, the item will not be included in PDF's, prints etc..

- *Blending mode*: You can achieve special rendering effects with these tools that you previously only may know from graphics programs. The pixels of your overlaying and underlaying items are mixed through the settings described below.

  - 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.

– Lighten: This selects the maximum of each component from the foreground and background pixels. Be aware that the results tend to be jagged and harsh.

– 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 layer with another layer (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.

– Addition: This blend mode simply adds pixel values of one layer with pixel values of the other. In case of values above 1 (as 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 layer are multiplied with the numbers for the corresponding pixel of the bottom layer. The results are darker pictures.

– Burn: Darker colors in the top layer cause the underlying layers 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 mode is supposed to emulate shining a soft light onto an image.

– Muita luz: Este modo é muito semelhante ao modo de sobreposição. É suposto simular a projecção de uma luz muito intensa numa imagem.

– 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 layer with pixel values of the other. In case of negative values, black is displayed.

18.3 Itens do Compositor

18.3.1 The Map item

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* tab:

• **Rectângulo** é a configuração padrão. Apenas exibe uma caixa vazia com a mensagem 'O mapa será impresso aqui'.

• **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 element by clicking on the Select/Move item button, selecting the element, and dragging one of the blue handles in the corner of the map. With the map selected, you can now adapt more properties in the map *Item Properties* tab.

To move layers within the map element, select the map element, click the [icon] Move item content icon and move the layers within the map item frame with the left 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 icon] Lock Selected Items or the *Items* tab to Lock the item. A locked item can only be selected using the *Items* tab. Once selected you can use the *Items* tab to unlock individual items. The [unlock icon] Unlock All Items icon will unlock all locked composer items.

Propriedades principais

The *Main properties* dialog of the map *Item Properties* tab provides the following functionalities (see figure_composer_map_1):
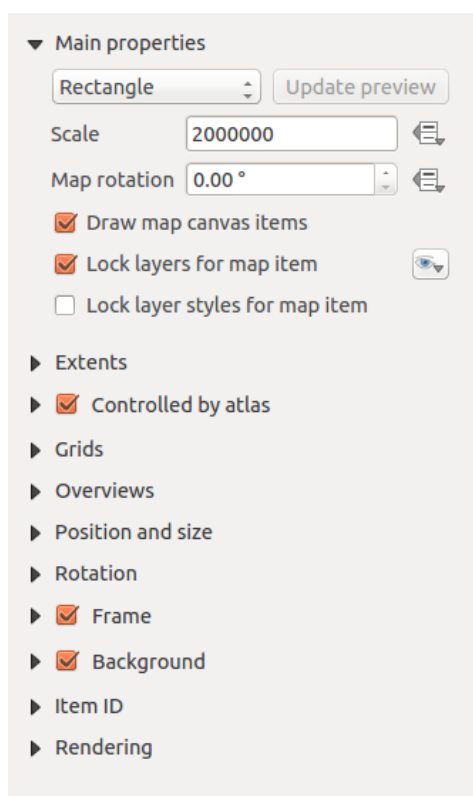
Figure 18.4: Separador das propriedades da Mapa [icon]

- The **Preview** area allows you to define 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 in the Print Composer and clicking the **[Update preview]** button.

- O campo *Escala* [1,00] define a escala manual.

- The field *Map rotation* [1,00] allows you to rotate the map element content clockwise in degrees. The rotation of the map view can be imitated here. Note that a correct coordinate frame can only be added with the default value 0 and that once you defined a *Map rotation* it currently cannot be changed.

- [checkbox] *Draw map canvas items* lets you show annotations that may be placed on the map canvas in the main QGIS window.

- You can choose to lock the layers shown on a map item. Check [checkbox] *Lock layers for map item*. After this is checked, any layer that would be displayed or hidden in the main QGIS window will not appear or be

hidden in the map item of the Composer. But style and labels of a locked layer are still refreshed according to the main QGIS interface. You can prevent this by using *Lock layer styles for map item*.

- The ![eye icon] button allows you to add quickly all the presets views you have prepared in QGIS. Clicking on the ![eye icon] button you will see the list of all the preset views: just select the preset you want to display. The map canvas will automatically lock the preset layers by enabling the ![check] *Lock layers for map item*: if you want to unselect the preset, just uncheck the ![check] and press on the ![refresh icon] button. See *Map Legend* to find out how to create presets views.

Extensões

The *Extents* dialog of the map item tab provides the following functionalities (see figure_composer_map_2):
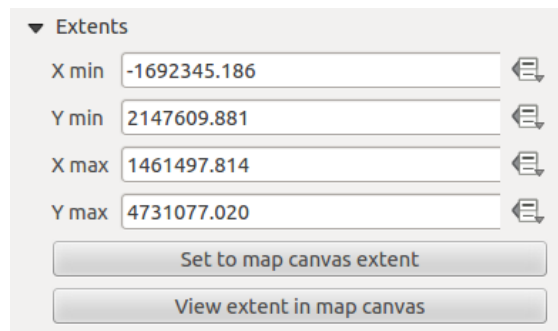

Figure 18.5: Janela de Extensões do Mapa

- 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* tab (see figure_composer_map_1).

Grids

The *Grids* dialog of the map *Item Properties* tab provides the possibility to add several grids to a map item.

- With the plus and minus button you can add or remove a selected grid.
- With the up and down button you can move a grid in the list and set the drawing priority.

When you double click on the added grid you can give it another name.

Figure 18.6: Map Grids Dialog ![tux icon]

After you have added a grid, you can activate the checkbox ☑ *Show grid* to overlay a grid onto the map element. Expand this option to provide a lot of configuration options, see Figure_composer_map_4.
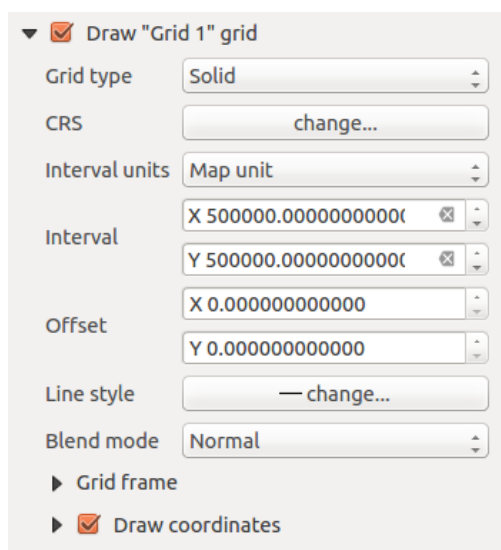

Figure 18.7: Draw Grid Dialog

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 devisions section of the Grid Frame Dialog mentioned below you then have a corresponding setting. Symbology of the grid can be chosen. See section Rendering_Mode. 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.
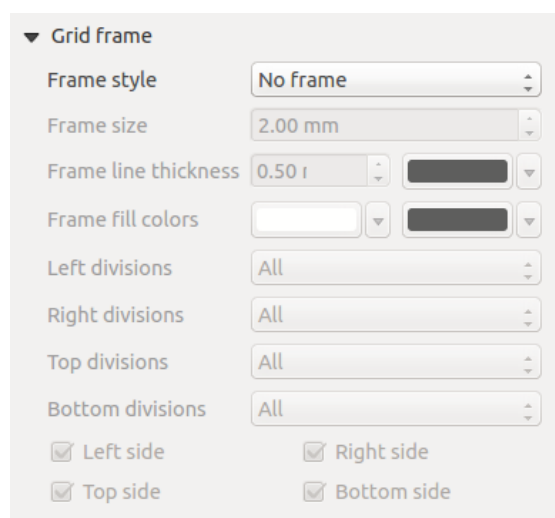

Figure 18.8: Grid Frame Dialog

- 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 'LatitudeY/ only' and 'Longitude/X only' setting in the devisions 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 (see section Rendering_mode).

- 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, and aligned or not. You can choose which annotation 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. In case of map rotation you can 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.
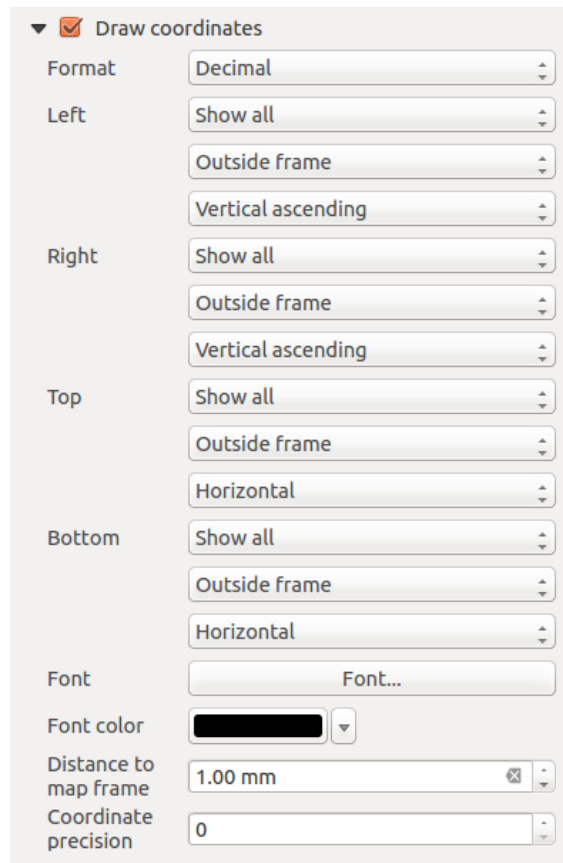

Figure 18.9: Grid Draw Coordinates dialog

Overviews

The *Overviews* dialog of the map *Item Properties* tab 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. Next you create the map you want to use as the overview map, just like a normal map.

- 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.

Open *Overviews* and press the green plus icon-button to add an overview. Initially this overview is named 'Overview 1' (see Figure_composer_map_7). 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.

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.
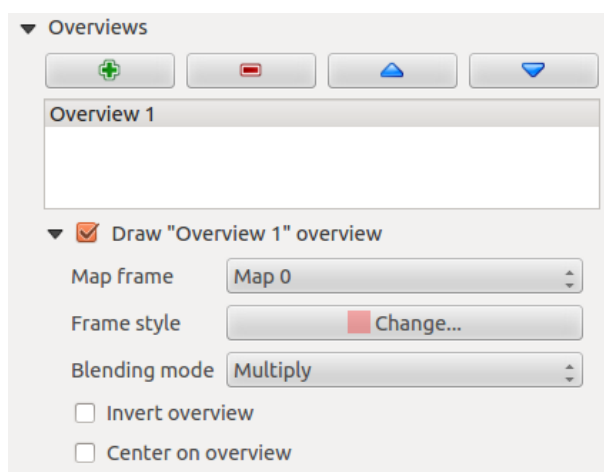
Figure 18.10: Map Overviews Dialog

- 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. See Rendering_Mode.

- The ☑ *Invert overview* creates a mask around the extents when activated: the referenced map extents are shown clearly, whereas everything else is blended with the frame color.

- The ☑ *Center on overview* puts the extent of the overview frame in the center of the overview map. You can only activate one overview item to center, when you have added several overviews.

18.3.2 The Label item

To add a label, click the ⊞T 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* tab.

The *Item Properties* tab of a label item provides the following functionality for the label item (see Figure_composer_label):

Propriedades principais

- 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.

- Labels can be interpreted as HTML code: check ☑ *Render as HTML*. You can now insert a URL, a clickable image that links to a web page or something more complex.

- 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 functions and records functions. At the bottom, a preview of the expression is shown.

Appearance

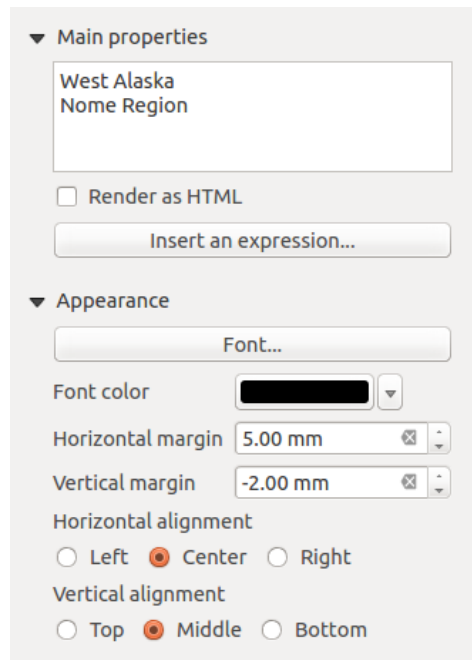- Define *Font* by clicking on the **[Font...]** button or a *Font color* selecting a color using the color selection tool.

Figure 18.11: Separador das propriedades da Etiqueta

- 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.

18.3.3 The Image item

To add an image, click the *Add image* icon, place the element with the left mouse button on the Print Composer canvas and position and customize its appearance in the image *Item Properties* tab.

The picture *Item Properties* tab provides the following functionalities (see figure_composer_image_1):

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.
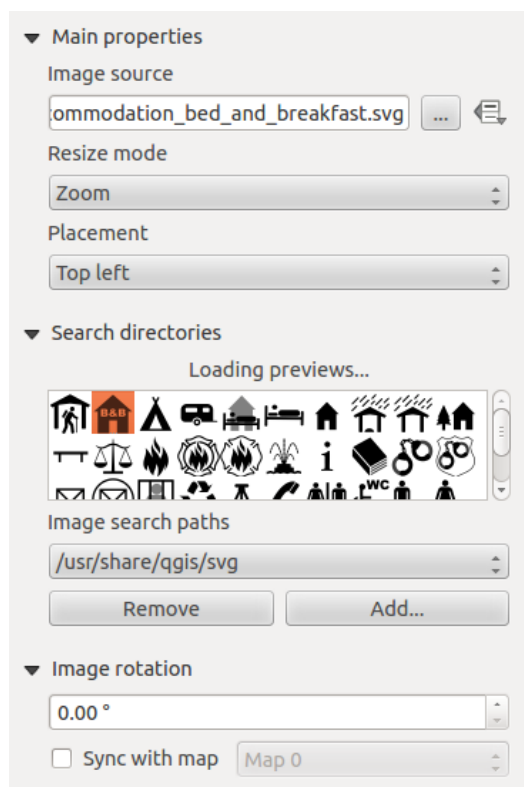- Stretch: Stretches image to fit inside the frame, ignores aspect ratio.

Figure 18.12: Separador Propriedades do Item da Imagem

- 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 it's 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.

Images can be rotated with the *Image rotation* field. Activating the ☑ *Sync with map* checkbox synchronizes the rotation of a picture in the QGIS map canvas (i.e., a rotated north arrow) with the appropriate Print Composer image.

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_2.

Note: Many of the north arrows do not have an 'N' added in the north arrow, this is done on purpose for languages that do not use an 'N' for North, so they can use another letter.

18.3.4 The Legend item

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* tab.
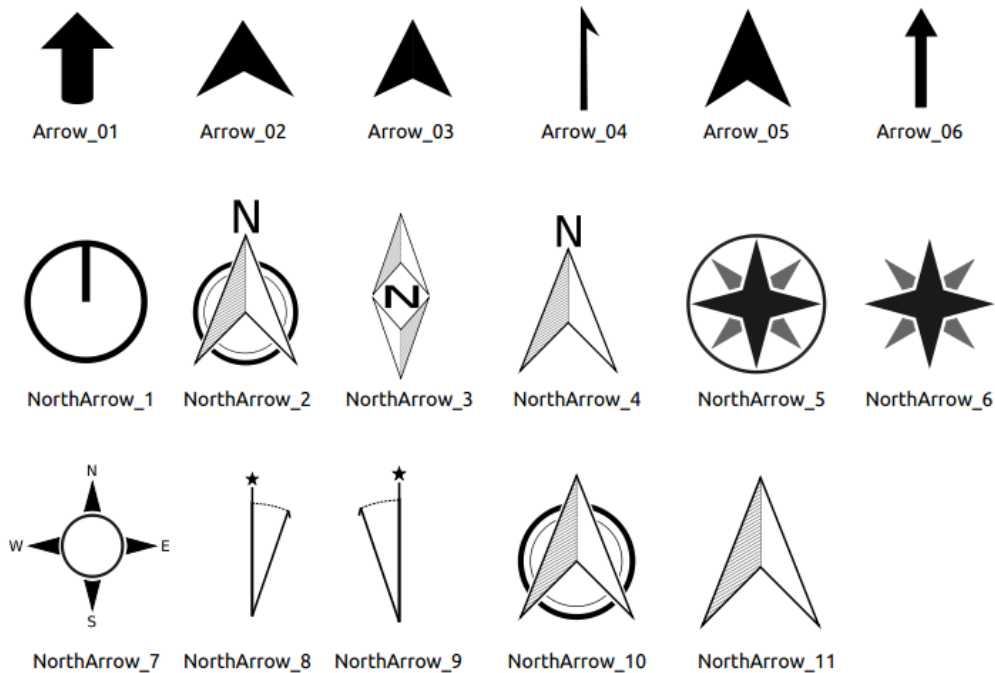
Figure 18.13: North arrows available for selection in provided SVG library

The *Item properties* of a legend item tab provides the following functionalities (see figure_composer_legend_1):

Propriedades principais

The *Main properties* dialog of the legend *Item Properties* tab provides the following functionalities (see figure_composer_legend_2):

In Main properties you can:

- Change the title of the legend.

- Set the title alignment to Left, Center or Right.

- You can choose which *Map* item the current legend will refer to in the select list.

- You can wrap the text of the legend title on a given character.

Itens Legenda

The *Legend items* dialog of the legend *Item Properties* tab provides the following functionalities (see figure_composer_legend_3):

- The legend will be updated automatically if *Auto-update* is checked. When *Auto-update* is unchecked this will give you more control over the legend items. The icons below the legend items list will be activated.

- The legend items window lists all legend items and allows you to change item order, group layers, remove and restore items in the list, edit layer names and add a filter.

  - The item order can be changed using the **[Up]** and **[Down]** buttons or with 'drag-and-drop' functionality. The order can not be changed for WMS legend graphics.

  - Use the **[Add group]** button to add a legend group.

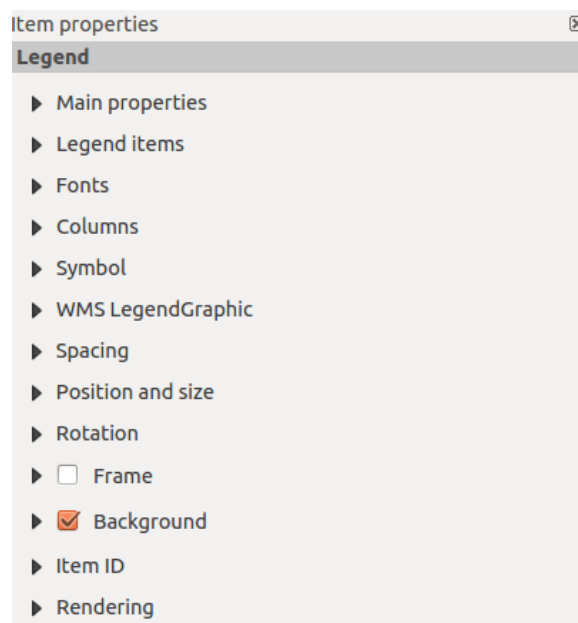 - Use the **[plus]** and **[minus]** button to add or remove layers.

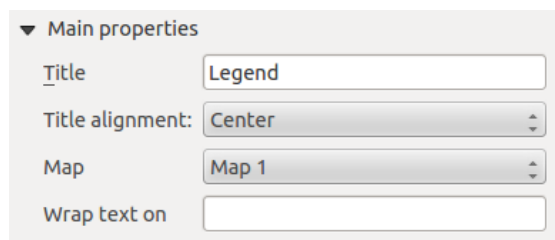Figure 18.14: Propriedades do Separador da Legenda

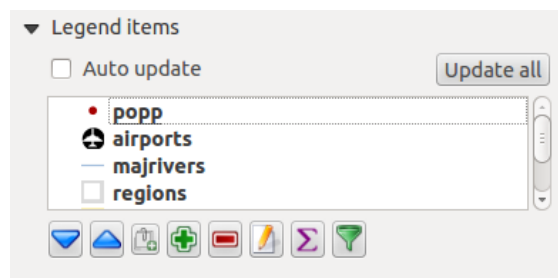Figure 18.15: Janela das Propriedades principais da Legenda

Figure 18.16: Legenda da Janela dos itens da Legenda

– The **[Edit]** button is used to edit the layer-, groupname or title, first you need to select the legend item.

– The **[Sigma]** button adds a feature count for each vector layer.

– Use the **[filter]** button to filter the legend by map content, only the legend items visible in the map will be listed in the legend.

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.

Fonts, Columns, Symbol

The *Fonts*, *Columns* and *Symbol* dialogs of the legend *Item Properties* tab provide the following functionalities (see figure_composer_legend_4):
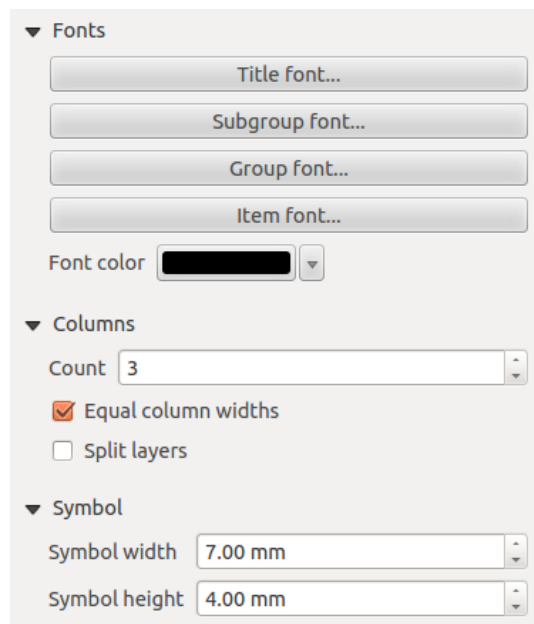

Figure 18.17: Legenda da Janela Fontes, Colunas, Símbolos e Espaçamento

- Pode mudar a fonte do título, grupo, subgrupo, e item (camada) no item legenda. Clique no botão da categoria para abrir a janela de **Seleccionar fonte**.

- 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.

   – ☑ *Equal column widths* sets how legend columns should be adjusted.

   – The ☑ *Split layers* option allows a categorized or a graduated layer legend to be divided between columns.

- You can change the width and height of the legend symbol in this dialog.

WMS LegendGraphic and Spacing

The *WMS LegendGraphic* and *Spacing* dialogs of the legend *Item Properties* tab provide the following functionalities (see figure_composer_legend_5):

When you have added a WMS layer and you insert a legend composer item, a request will be send 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.
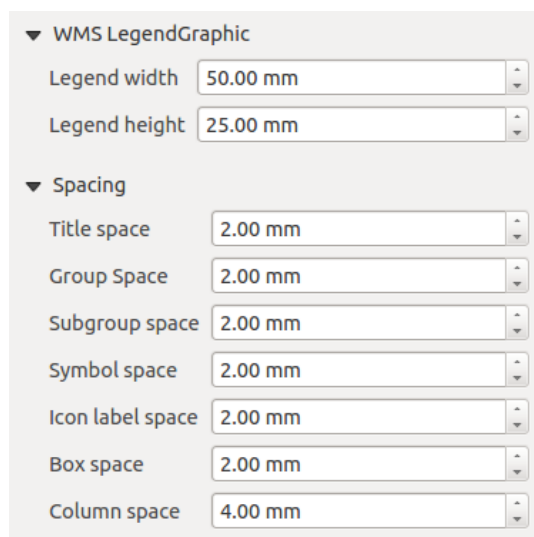
Figure 18.18: WMS LegendGraphic Dialogs

WMS LegendGraphic is used to be able to adjust the *Legend width* and the *Legend height* of the WMS legend raster image.

Spacing around title, group, subgroup, symbol, icon label, box space or column space can be customized through this dialog.

18.3.5 The Scale Bar item

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* tab.

The *Item properties* of a scale bar item tab provides the following functionalities (see figure_composer_scalebar_1):
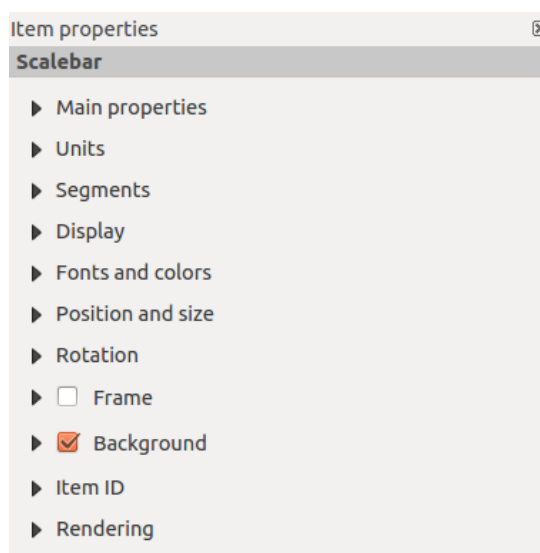

Figure 18.19: Scale Bar Item properties Tab

Propriedades principais

The *Main properties* dialog of the scale bar *Item Properties* tab provides the following functionalities (see figure_composer_scalebar_2):
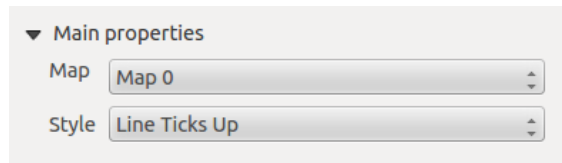

Figure 18.20: Scale Bar Main properties Dialog

- 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.
  - **Numeric**, where the scale ratio is printed (i.e., 1:50000).

Unidades e Segmentos

The *Units* and *Segments* dialogs of the scale bar *Item Properties* tab provide the following functionalities (see figure_composer_scalebar_3):
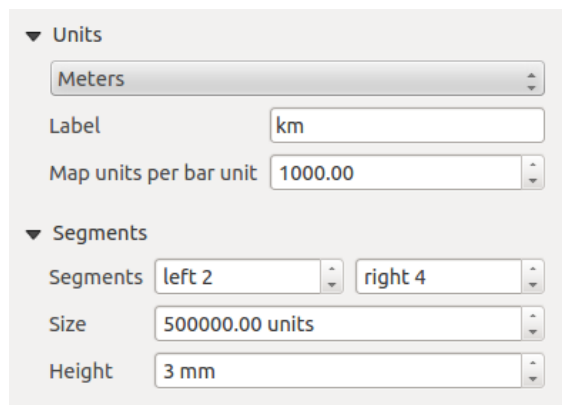

Figure 18.21: Scale Bar Units and Segments Dialogs

In these two dialogs, you can set how the scale bar will be represented.

- Select the map units used. There are four possible choices: **Map Units** is the automated unit selection; **Meters**, **Feet** or **Nautical Miles** force unit conversions.
- The *Label* field defines the text used to describe the units of the scale bar.
- The *Map units per bar unit* allows you to fix the ratio between a map unit and its representation in the scale bar.
- You can define how many *Segments* will be drawn on the left and on the right side of the scale bar, and how long each segment will be (*Size* field). *Height* can also be defined.

Figure 18.22: Scale Bar Display 🐧

Display

The *Display* dialog of the scale bar *Item Properties* tab provide the following functionalities (see figure_composer_scalebar_4):

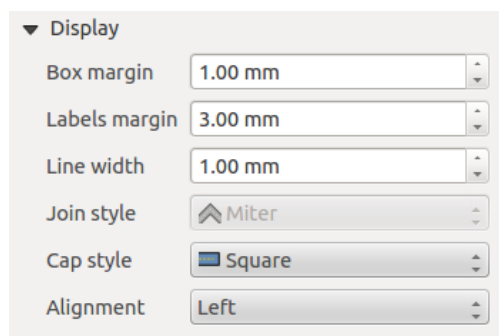You can define how the scale bar will be displayed in its frame.

- *Box margin* : space between text and frame borders
- *Labels margin* : space between text and scale bar drawing
- *Line width* : line widht 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)

Fonts and colors

The *Fonts and colors* dialog of the scale bar *Item Properties* tab provide the following functionalities (see figure_composer_scalebar_5):
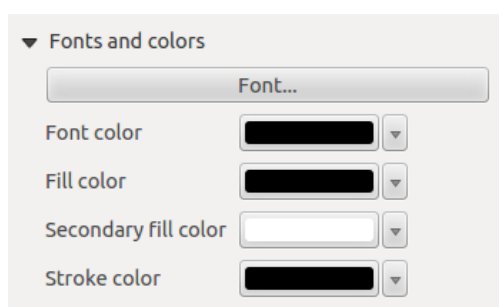

Figure 18.23: Scale Bar Fonts and colors Dialogs 🐧

You can define the fonts and colors used for the scale bar.

- Use the **[Font]** button to set the font
- *Font color*: set the font color
- *Fill color*: set the first fill color
- *Secondary fill color*: set the second fill color

- *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.

18.3.6 The Basic Shape Items

To add a basic shape (ellipse, rectangle, triangle), click the ![Add basic shape] Add basic shape icon or the ![Add Arrow] Add Arrow icon, place the element holding down the left mouse. Customize the appearance in the *Item Properties* tab.

When you also hold down the `Shift` key while placing the basic shape you can create a perfect square, circle or triangle.
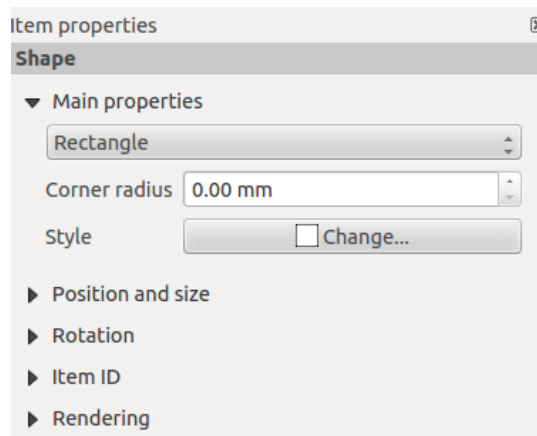

Figure 18.24: Separador de propriedades da Forma 🐧

The *Shape* item properties tab 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 etcetera.

For the rectangle shape, you can set the value of the corner radius to round of the corners.

Note: Unlike other items, you can not style the frame or the background color of the frame.

18.3.7 The Arrow item

To add an arrow, click the ![Add Arrow] 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* tab.

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 tab allows you to configure an arrow item.

Figure 18.25: Separador das propriedades da Seta 🐧

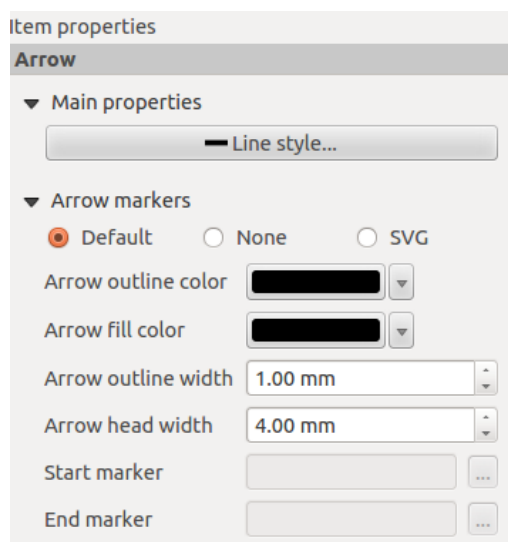The **[Line style ...]** button can be used to set the line style using the line style symbol editor.

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*

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*: Sets the size of Start and/or End marker

SVG images are automatically rotated with the line. The color of the SVG image can not be changed.

18.3.8 The Attribute Table item

It is possible to add parts of a vector attribute table to the Print Composer canvas: Click the 📇 Add attribute table icon, place the element with the left mouse button on the Print Composer canvas, and position and customize the appearance in the *Item Properties* tab.

The *Item properties* of an attribute table item tab provides the following functionalities (see figure_composer_table_1):

Propriedades principais

The *Main properties* dialogs of the attribute table *Item Properties* tab provide the following functionalities (see figure_composer_table_2):
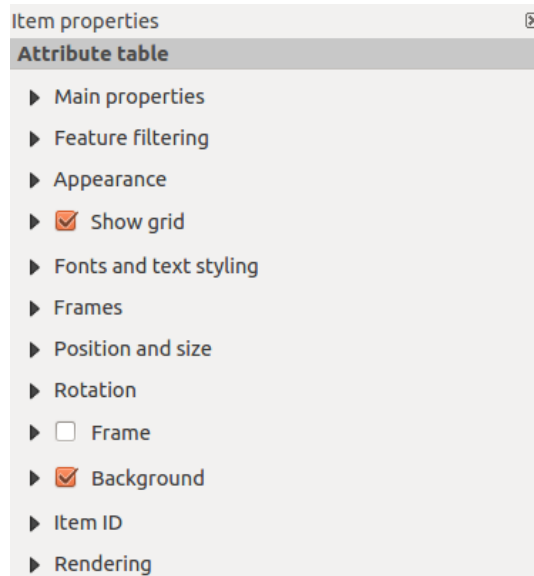
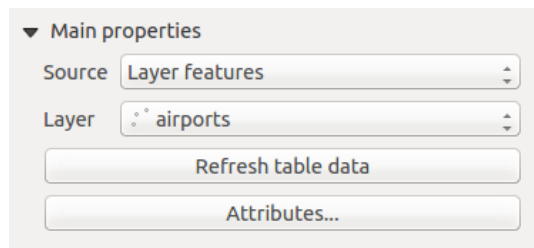Figure 18.26: Attribute table Item properties Tab 🐧

Figure 18.27: Attribute table Main properties Dialog 🐧

- For *Source* you can normally select only 'Layer features'.

- With *Layer* you can choose from the vector layers loaded in the project.

- The button **[Refresh table data]** can be used to refresh the table when the actual contents of the table has changed.

- In case you activated the ☑*Generate an atlas* option in the *Atlas generation* tab, there are two additional *Source* possible: 'Current atlas feature' (see figure_composer_table_2b) and 'Relation children' (see figure_composer_table_2c). Choosing the 'Current atlas feature' 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. Choosing 'Relation children', an option with the relation name will show up. The 'Relation children' option can only be used if you have defined a relation using your atlas coverage layer as parent, and it will show the children rows of the atlas coverage layer's current feature (for further information about the atlas generation see atlasgeneration).
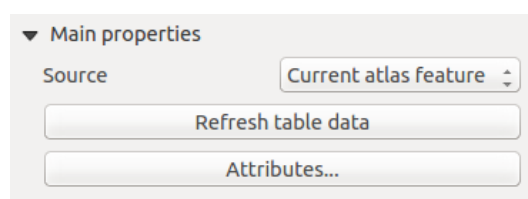
Figure 18.28: Attribute table Main properties for 'Current atlas feature'
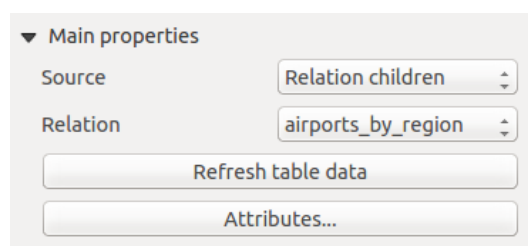
Figure 18.29: Attribute table Main properties for 'Relation children'

- The button **[Attributes...]** starts the *Select attributes* menu, see figure_composer_table_3, 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.

  In the *Columns* section you can:

  - Remove an attribute, just select an attribute row by clicking anywhere in a 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 cel in the Headings column to change the Heading, just type in a new name.

  - Select a cel in the Alignment column and you can choose between Left, Center or Right alignment.

  - Select a cel in the Width column and you can 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.

  - The **[Reset]** button can always be used to restore it to the original attribute settings.

  In the *Sorting* section you can:

- 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.

- use the minus button to remove an attribute from the sort order list.
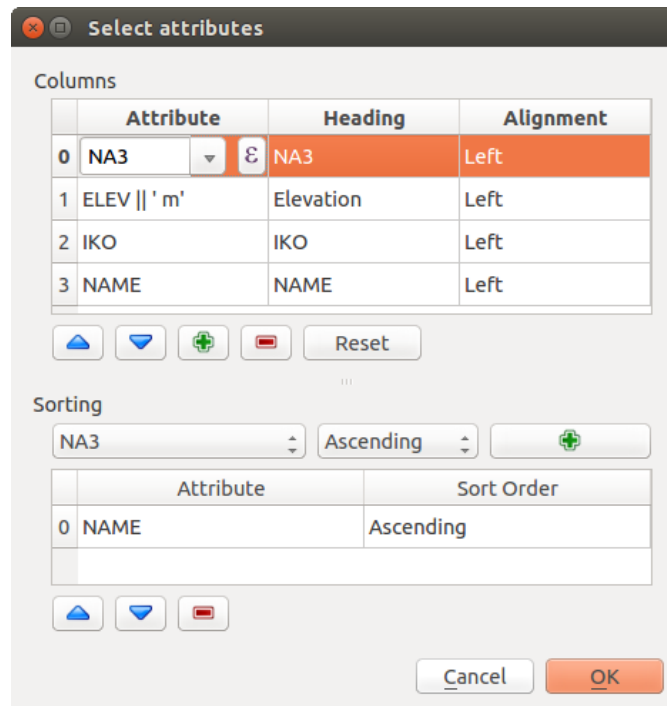
Figure 18.30: Janela Secção de atributos da tabela de atributos

Feature filtering

The *Feature filtering* dialogs of the attribute table *Item Properties* tab provide the following functionalities (see figure_composer_table_4):
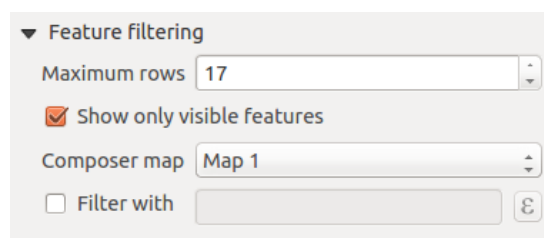
Figure 18.31: Attribute table Feature filtering Dialog

You can:

- Define the *Maximum rows* to be displayed.

- Activate ☑ *Remove duplicate rows from table* to show unique records only.

- 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 shown on the map of that particular page of the atlas.

- Activate ☑ *Filter with* and provide a filter by typing in the input line or insert a regular expression using the given ε expression button. A few examples of filtering statements you can use when you have loaded the airports layer from the Sample dataset:

    - `ELEV > 500`

    - `NAME = 'ANIAK'`

    - `NAME NOT LIKE 'AN%`

    - `regexp_match( attribute( $currentfeature, 'USE' ) , '[i]')`

  The last regular expression will include only the arpoirts that have a letter 'i' in the attribute field 'USE'.

Appearance

The *Appearance* dialogs of the attribute table *Item Properties* tab provide the following functionalities (see figure_composer_table_5):
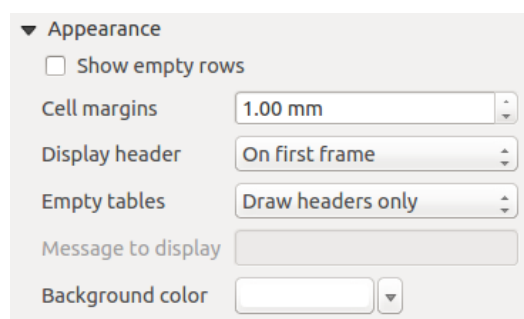
Figure 18.32: Attribute table appearance Dialog

- Click ☑ *Show empty rows* to make empty entries in the attribute table visible.

- 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.

    - **Draw headers only**, will only draw the header except if you have choosen 'No header' for *Display header*.

    - **Hide entire table**, will only draw the background of the table. You can activate ☑ *Don't draw background if frame is empty* in *Frames* to completely hide the table.

    - **Draw empty cells**, will 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!

    - **Show set message**, will draw the header and adds a cell spanning all columns and display a message like 'No result' that can be provided in the option *Message to display*

- The option *Message to display* is only activated when you have selected **Show set message** for *Empty table*. The message provided will be shown in the table in the first row, when the result is an empty table.

- With *Background color* you can set the background color of the table.

Show grid

The *Show grid* dialog of the attribute table *Item Properties* tab provide the following functionalities (see figure_composer_table_6):

Figure 18.33: Attribute table Show grid Dialog

- Activate ☑ *Show grid* when you want to display the grid, the outlines of the table cells.
- With *Stroke width* you can set the thickness of the lines used in the grid.
- The *Color* of the grid can be set using the color selection dialog.

Fonts and text styling

The *Fonts and text styling* dialog of the attribute table *Item Properties* tab provide the following functionalities (see figure_composer_table_7):


Figure 18.34: 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* and choose from *Follow column alignment*, *Left*, *Center* or *Right*. The column alignment is set using the *Select Attributes* dialog (see Figure_composer_table_3).

Frames

The *Frames* dialog of the attribute table *Item Properties* tab provide the following functionalities (see figure_composer_table_8):
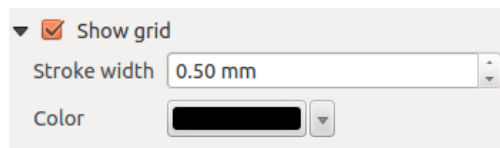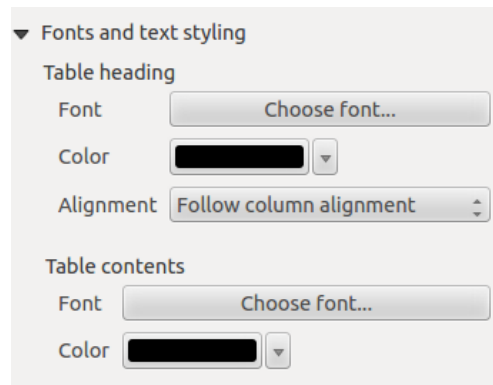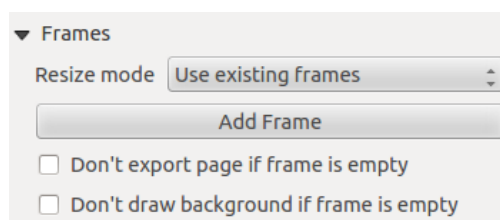

Figure 18.35: Attribute table Frames Dialog

- 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.

    - *Extent 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.

- Activate ✅ *Don't draw background if frame is empty* prevents the background to be drawn when the table frame has no contents.

18.3.9 The HTML frame item

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* tab (see figure_composer_html_1).

Figure 18.36: HTML frame, the item properties Tab 🐧

HTML Source

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* tab provides the following functionalities (see figure_composer_html_2):
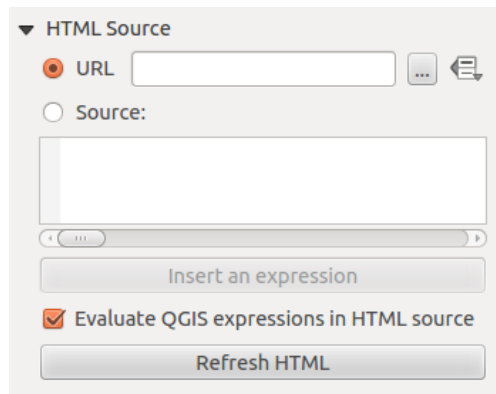
Figure 18.37: HTML frame, the HTML Source properties

- 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.

- In *Source* you can enter text in the textbox with some HTML tags or provide a full HTML page.

- 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.

- Activate ☑ *Evaluate QGIS expressions in HTML code* to see the result of the expression you have included, otherwise you will see the expression instead.

- Use the **[Refresh HTML]** button to refresh the HTML frame(s) to see the result of changes.

Frames

The *Frames* dialog of the HTML frame *Item Properties* tab provides the following functionalities (see figure_composer_html_3):
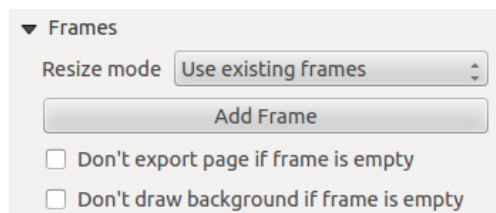
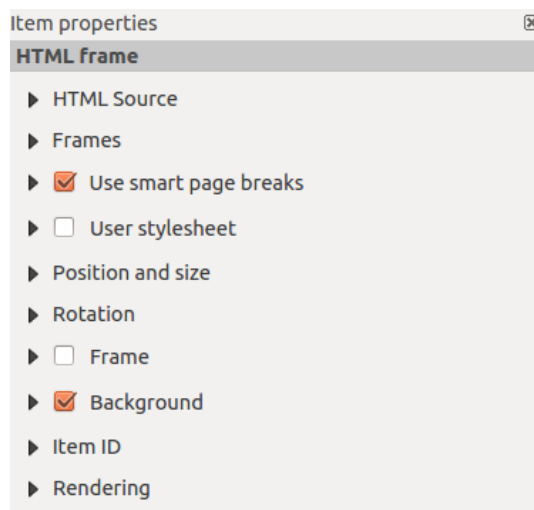Figure 18.38: HTML frame, the Frames properties

- With *Resize mode* you can select how to render the HTML contents:
  - *Use existing frames* displays the result in the first frame and added frames only.
  - *Extent 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.

- Activate ☑ *Don't draw background if frame is empty* prevents the HTML frame being drawn if the frame is empty.

Use smart page breaks and User style sheet

The *Use smart page breaks* dialog and *Use style sheet* dialog of the HTML frame *Item Properties* tab provides the following functionalities (see figure_composer_html_4):
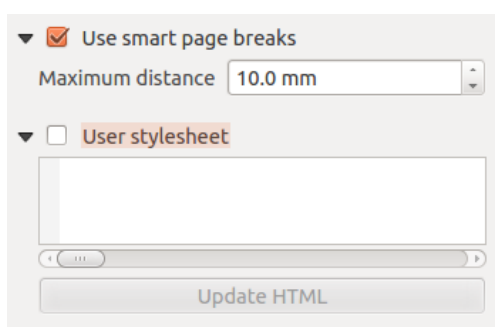
Figure 18.39: HTML frame, Use smart page breaks and User stylesheet properties 🐧

- Activate ☑ *Use smart page breaks* to prevent the html frame contents from breaking mid-way a line of text so it continues nice and smooth in the next frame.

- Set the *Maximum distance* allowed when calculating where to place page breaks in the html. This distance is the maximum amount of empty space allowed at the bottom of a frame after calculating the optimum break location. Setting a larger value will result in better choice of page break location, but more wasted space at the bottom of frames. This is only used when *Use smart page breaks* is activated.

- 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.

18.4 Manage items

18.4.1 Size and position

Each item inside the Composer can be moved/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

while moving the mouse. If you need a 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 snapping to grid or smart guides. Guides are set by clicking and dragging in the rulers. Guides are moved by clicking in the ruler, level with the guide and dragging to a new place. To delete a guide move it off the canvas. If you need to disable the snap on the fly just 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 just 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* tab. Locked items are **not** selectable on the canvas.

Locked items can be unlocked by selecting the item in the *Items* tab 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.

18.4.2 Alignment

Raising or lowering functionalities 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 (see table_composer_1). This order is shown in the *Items* tab. You can also raise or lower objects in the *Items* tab by clicking and dragging an object's label in this list.

There are several alignment functionalities available within the Align selected items pull-down menu (see table_composer_1). To use an alignment functionality, you first select some elements and then click on the matching alignment icon. All selected elements will then be aligned within to their common bounding box. When moving items on the Composer canvas, alignment helper lines appear when borders, centers or corners are aligned.

18.4.3 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.

Note: HTML items can not be copied in this way. As a workaround, use the **[Add Frame]** button in the *Item Properties* tab.

18.5 Ferramentas de Reverter e Restaurar

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
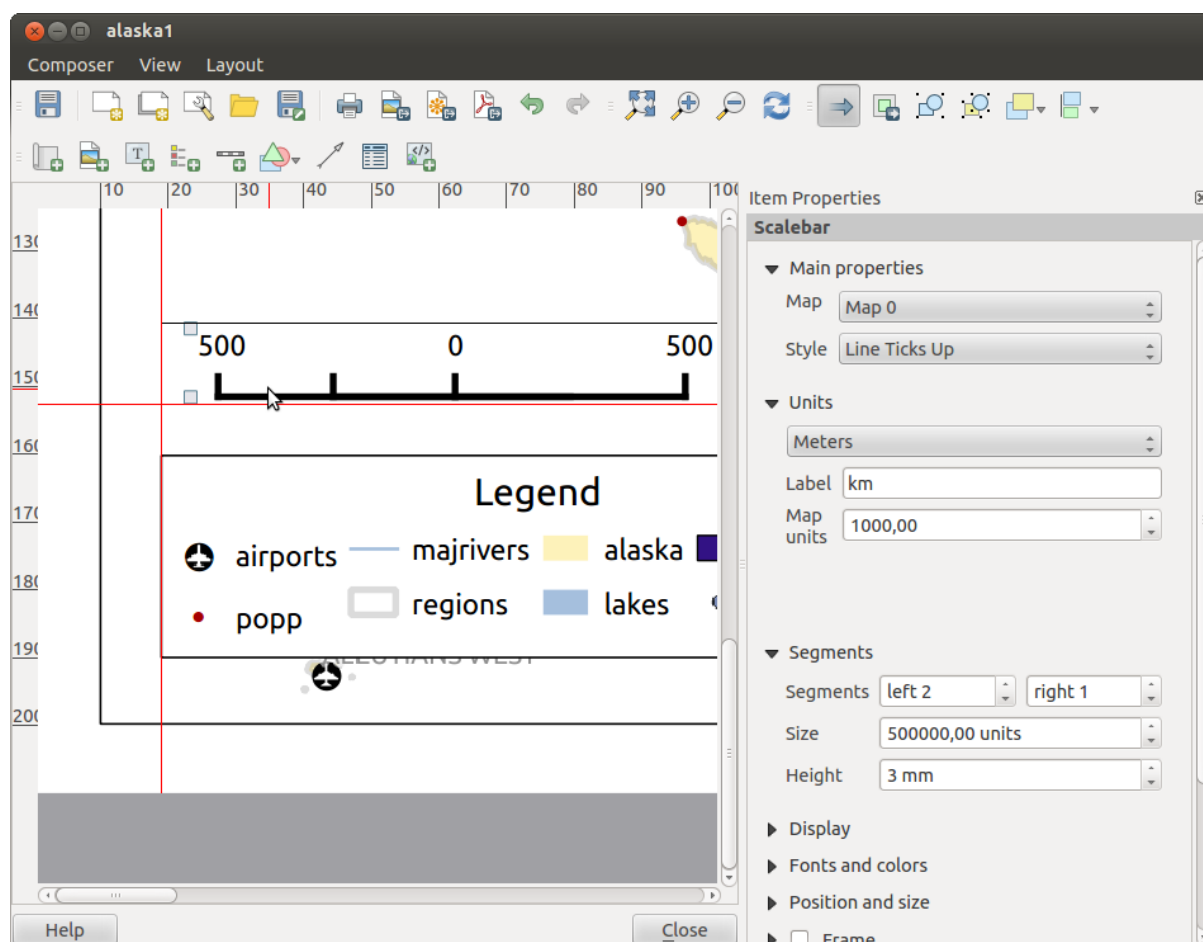
Figure 18.40: Linhas Guia de alinhamento no Compositor de Impressão

This can also be done by mouse click within the *Command history* tab (see figure_composer_29).
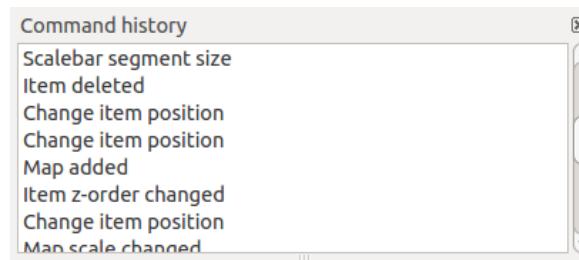
Figure 18.41: Histórico de comandos no Compositor de Impressão 🐧

18.6 Geração de 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* tab. This tab contains the following widgets (see Figure_composer_atlas):
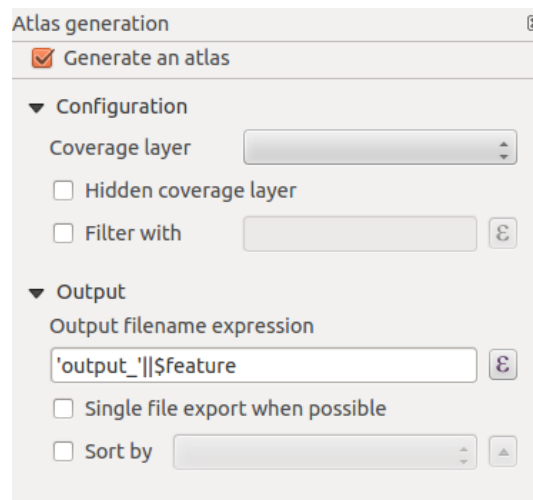
Figure 18.42: Separador de Geração de Atlas 🐧

- ☑ *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 geometries 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 *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.

- A caixa de texto *Expressão do nome do ficheiro de saída* que é usada para criar o nome do ficheiro para cada geometria se necessária. É baseado em expressões. Este campo é significativo apenas para a renderização de múltiplos ficheiros.

- 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.

- 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.

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 radiobutton ⦿ *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.

18.6.1 Labels

In order to adapt labels to the feature the atlas plugin iterates over, you can include expressions. 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
```

The information *[% upper(CITY_NAME) || ',' || ZIPCODE || ' is ' format_number($area/1000000,2) %]* is an expression used inside the label. That would result in the generated atlas as:

The area of PARIS,75001 is 1.94 km2

18.6.2 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 usefull 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* tab 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 it's 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. Give following expression:

```
CASE WHEN bounds_width($atlasgeometry) > bounds_height($atlasgeometry) THEN 'Landscape' ELSE 'Por
```

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) - 
```

Use the ⊟ button of field *Heigth* to provide following expression:

```
(CASE WHEN bounds_width($atlasgeometry) > bounds_height($atlasgeometry) THEN 210 ELSE 297 END) -
```

When you want to give a title above 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 following expression for field *X* :

```
(CASE WHEN bounds_width($atlasgeometry) > bounds_height($atlasgeometry) THEN 297 ELSE 210 END) /
```

For all other composer items you can set the position in a similar way so they are correctly positioned when page is automatically rotated in portrait or landscape.

Information provided is derived from the excellent blog (in english and portugese) on the Data Defined Override options Multiple_format_map_series_using_QGIS_2.6 .

This is just one example of how you can use Data Defined Overrides.

18.6.3 Preview

Once the atlas settings have been configured and map items selected, you can create a preview of all the pages by clicking on *Atlas → Preview Atlas* and using the arrows, in the same menu, to navigate through all the features.

18.6.4 Criação

The atlas generation can be done in different ways. For example, with *Atlas → Print Atlas*, you can directly print it. You can also create a PDF using *Atlas → Export Atlas as PDF*: The user will be asked for a directory for saving all the generated PDF files (except if the ☑ *Single file export when possible* has been selected). If you need to print just a page of the atlas, simply start the preview function, select the page you need and click on *Composer → Print* (or create a PDF).

18.7 Hide and show panels

To maximise the space available to interact with a composition you can use *View –> ☑ Hide panels* or press F10.

:: note:

```
It's also possible to switch to a full screen mode to have more space to interact by pressing
:kbd:'F11' or using :guilabel:'View --> |checkbox| :guilabel:'Toggle full screen'.
```

18.8 Criando um ficheiro de Saída

Figure_composer_output shows the Print Composer with an example print layout, including each type of map item described in the sections above.

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.
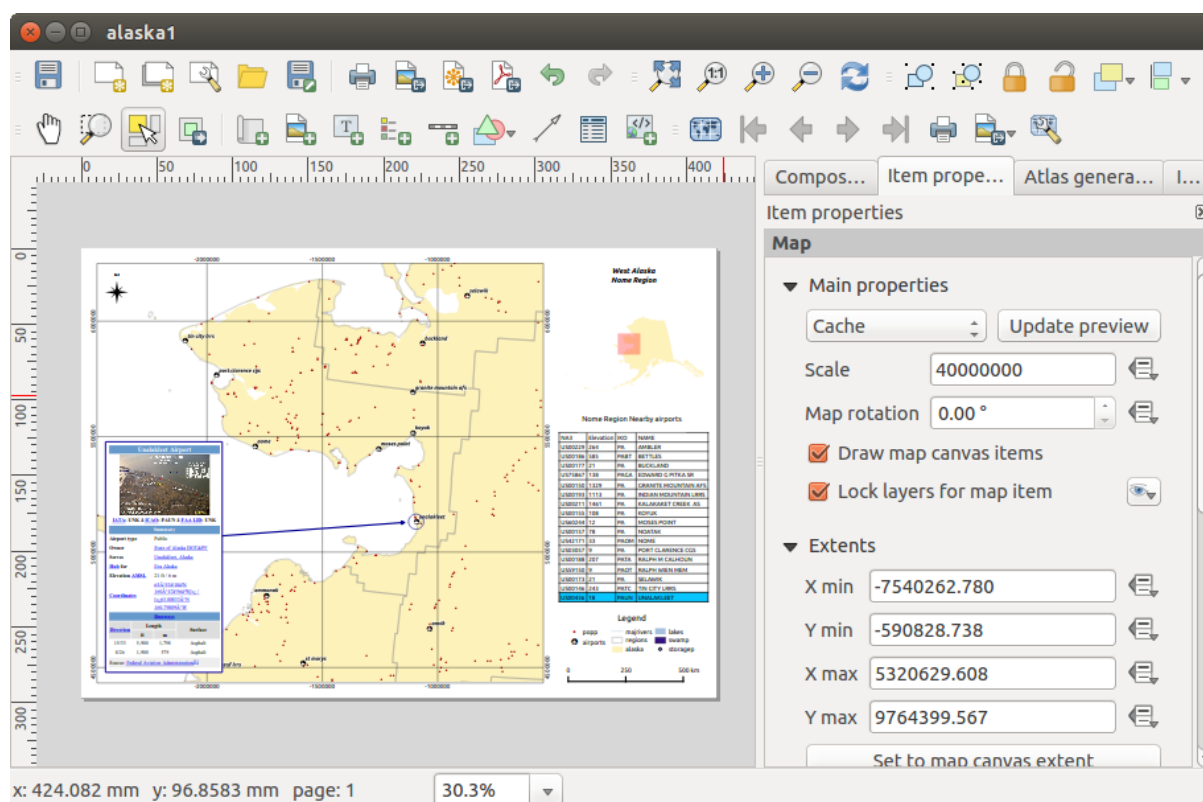
Figure 18.43: Print Composer with map view, legend, image, scale bar, coordinates, text and HTML frame added

- The [icon] Export as image icon exports the Composer canvas in several image formats, such as PNG, BPM, TIF, JPG,...

- [icon] Export as PDF saves the defined Print Composer canvas directly as a PDF.

- The [icon] Export as SVG icon saves the Print Composer canvas as an SVG (Scalable Vector Graphic).

If you need to export your layout as a **georeferenced image** (i.e., to load back inside QGIS), you need to enable this feature under the Composition tab. Check [icon] *World file on* and choose the map item to use. With this option, the 'Export as image' action will also create a world file.

Note:

- Currently, the SVG output is very basic. This is not a QGIS problem, but a problem with the underlying Qt library. This will hopefully be sorted out in future versions.

- Exporting big rasters can sometimes fail, even if there seems to be enough memory. This is also a problem with the underlying Qt management of rasters.

18.9 Gerir o Compositor

With the [icon] Save as template and [icon] Add items from template icons, you can save the current state of a Print Composer session as a `.qpt` template and load the template again in another session.

The [icon] Composer Manager button in the QGIS toolbar and in *Composer → Composer Manager* allows you to add a new Composer template, create a new composition based on a previously saved template or to manage already

existing templates.
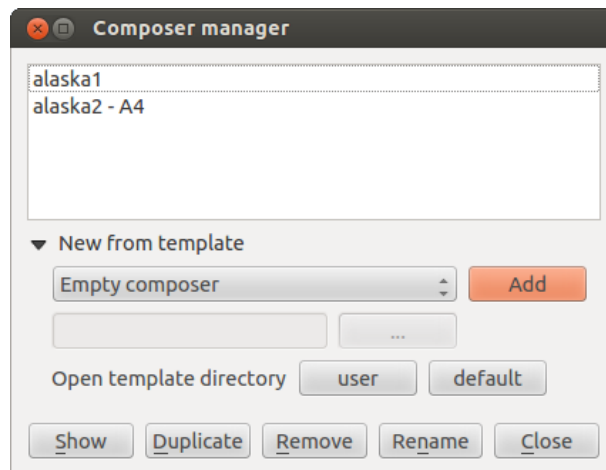
Figure 18.44: O gestor do Compositor de Impressão

By default, the Composer manager searches for user templates in ~/.qgis2/composer_template.

The New Composer and Duplicate Composer buttons in the QGIS toolbar and in *Composer → New Composer* and *Composer → Duplicate Composer* allow you to open a new Composer dialog, or to duplicate an existing composition from a previously created one.

Finally, you can save your print composition with the Save Project button. This is the same feature as in the QGIS main window. All changes will be saved in a QGIS project file.

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Módulos

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19.1 QGIS Plugins

QGIS has been designed with a plugin architecture. This allows many new features and functions to be easily added to the application. Many of the features in QGIS are actually implemented as plugins.

You can manage your plugins in the plugin dialog which can be opened with *Plugins > Manage and install plugins* ....

When a plugin needs to be updated, and if plugins settings have been set up accordingly, QGIS main interface could display a blue link in the status bar to tell you that there are some updates for plugins waiting to be applied.

19.1.1 The Plugins Dialog

The menus in the Plugins dialog allow the user to install, uninstall and upgrade plugins in different ways. Each plugin have some metadatas displayed in the right panel:

- information if the plugin is experimental
- description
- rating vote(s) (you can vote for your prefered plugin!)
- tags
- some useful links as the home page, tracker and code repository
- author(s)
- version available

You can use the filter to find a specific plugin.

All

Here, 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, and **[Uninstall plugin]** as well as **[Reinstall plugin]**, if a plugin is installed. If a plugin is installed, it can be de/activated using the checkbox.

Installed

Neste menu, só encontra apenas os módulos instalados. Os módulos externos podem ser desinstalados e re-instalados usanso os botões **[Desinstalar módulo]** and **[Reinstalar módulo]**. Pode também **[Actualizar Tudo]**.
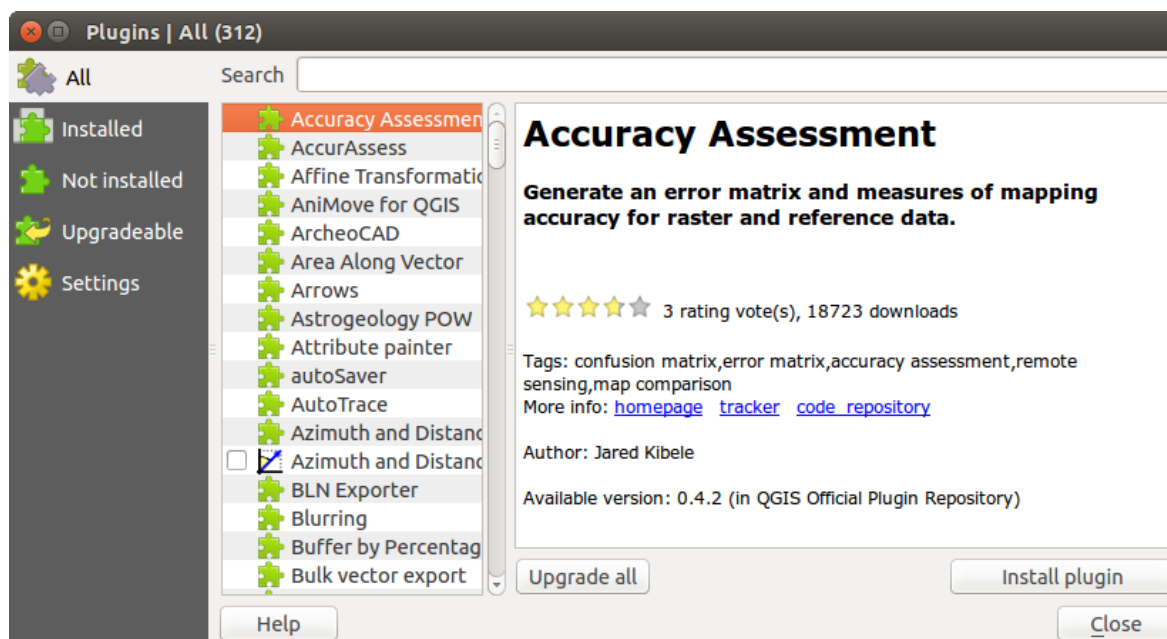
Figure 19.1: The 🧩 *All* menu 🐧

Figure 19.2: The 🧩 *Installed* menu 🐧

 Não instalado

This menu lists all plugins available that are not installed. You can use the **[Install plugin]** button to implement a plugin into QGIS.

Figure 19.3: The *Not installed* menu

 Upgradeable

If you activated *Show also experimental plugins* in the *Settings* menu, you can use this menu to look for more recent plugin versions. This can be done with the **[Upgrade plugin]** or **[Upgrade all]** buttons.

 Settings

Neste menu, pode usar as seguintes opções:

- *Check for updates on startup*. Whenever a new plugin or a plugin update is available, QGIS will inform you 'every time QGIS starts', 'once a day', 'every 3 days', 'every week', 'every 2 weeks' or 'every month'.

- *Show also experimental plugins*. QGIS will show you plugins in early stages of development, which are generally unsuitable for production use.

- *Mostrar módulos obsoletos*. Estes módulos estão obsoletos e geralmente são instáveis para produção de dados.

Para adicionar um repositório externo de um autor, clique **[Adicionar]** na secção *Repositórios de módulos*. Se não quiser um ou mais repositórios adicionados, estes podem ser desactivados através do botão **[Editar...]** , ou remover completamente com o botão **[Apagar]** .

The *Search* function is available in nearly every menu (except *Settings*). Here, you can look for specific plugins.

Tip: Core and external plugins

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. **External Plugins** are currently all written in Python. They are stored in external repositories and are maintained by the individual authors.

19.1. QGIS Plugins
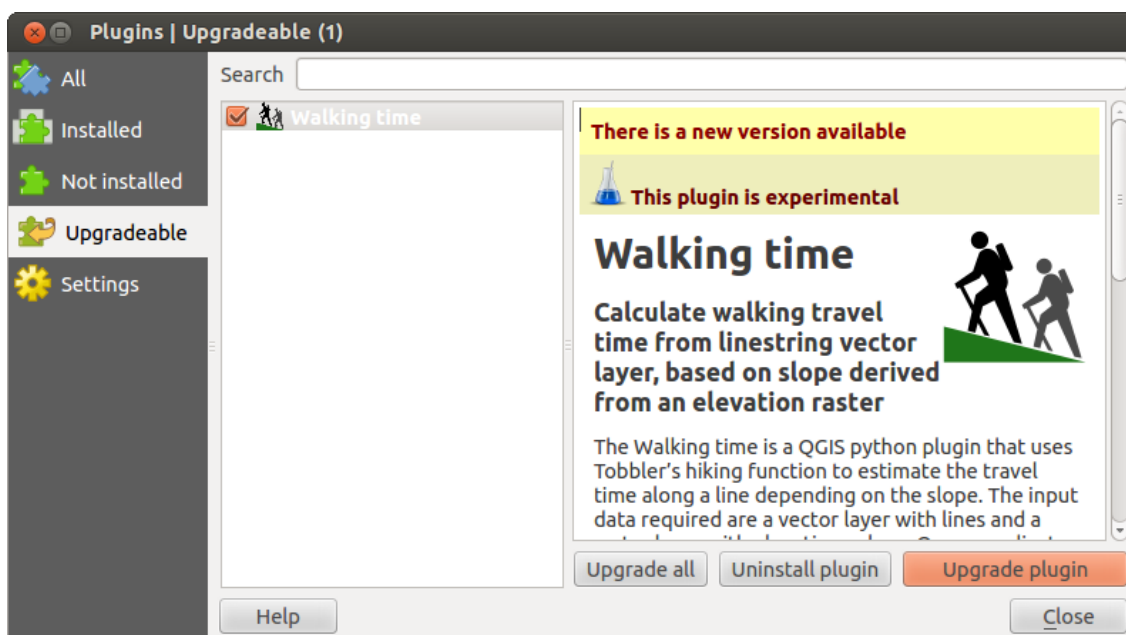
Figure 19.4: The *Upgradeable* menu 🐧
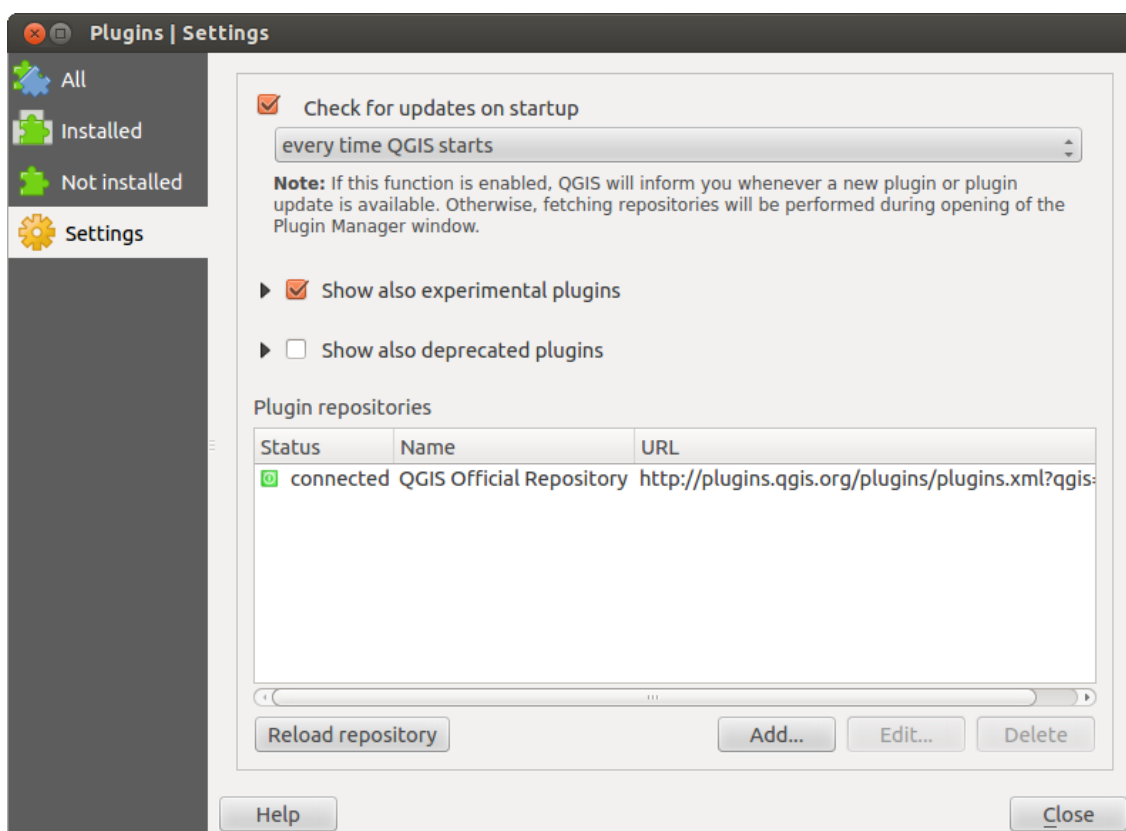
Figure 19.5: The *Settings* menu 🐧

Detailed documentation about the usage, minimum QGIS version, home page, authors, and other important information are provided for the 'Official' QGIS Repository at http://plugins.qgis.org/plugins/. For other external repositories, documentation might be available with the external plugins themselves. In general, it is not included in this manual.

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19.2 Using QGIS Core Plugins

Ícone	Módulo	Descrição	Referência do Manual
	Accuracy Assessment	Generate an error matrix	*accuracy*
	CadTools	Perform CAD-like functions in QGIS	*cadtools*
	Captura de Coordenadas	Capture coordenadas com o rato em diferentes SRC	*Módulo de Captura de Coordenadas*
	Gestor BD	Manage your databases within QGIS	*Módulo Gestor BD*
	Conversor DXF2Shape	Converte do DXF para o formato de ficheiro SHP	*Módulo de Conversão Dxf2Shp*
	eVis	Ferramenta de Visualização Event	*Módulo eVis*
	fTools	Um conjunto de ferramentas vectoriais	*Módulo fTools*
	Ferramentas GPS	Ferramentas para carregamento e importação de dados GPS	*Módulo GPS*
	GRASS	Funcionalidade GRASS	*Integração GRASS SIG*
	Ferramentas GDAL	Funcionalidade matricial GDAL	*Módulo de Ferramentas GDAL*
	Georeferenciador GDAL	Georeferenciar Rasters com o GDAL	*georeferenciar*
	Mapa de Densidade	Criar um mapa de densidade a partir da entrada de pontos vectoriais	*Módulo de Mapa de Densidade*
	Módulo de Interpolação	Interpolação baseada nos vértices da camada vectorial	*Módulo de Interpolação*
	Edição Offline	Edição Offline e sincronização com a base de dados	*Módulo Edição Offline*
	Oracle Spatial GeoRaster	Acesso ao Oracle Spatial GeoRasters	*Módulo Oracle Spatial GeoRaster*
	Gestor de módulos	Gerir módulos core e externos	*The Plugins Dialog*
	Análise do Terreno Matricial	Computar características geomorfológicas a partir de MDE	*Módulo de Análise do Terreno Matricial*
	Módulo de Análise de Grafos	Análise do Caminho mais curto	*Módulo de Cálculo de Rotas*
	SQL Anywhere plugin	Access SQL anywhere DB	*sqlanywhere*
	Interrogação Espacial	Interrogação espacial nos vectores	*Módulo de Consulta Espacial*
	SPIT	Shapefile to PostgreSQL/PostGIS Import Tool	*Módulo SPIT*
	Estatísticas Locais	Calcular estatísticas matriciais a partir de polígonos vectoriais	*Módulo de Estatística Zonal*
	MetaSearch	Interage com os serviços de catálogo de metadados (CSW)	*MetaSearch Catalogue Client*

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19.3 Módulo de Captura de Coordenadas

O módulo de captura de coordenadas é de uso fácil e fornece a habilidade de exibir as coordenadas no enquadramento do mapa em dois Sistema de Referência de Coordenadas (SRC) seleccionados.
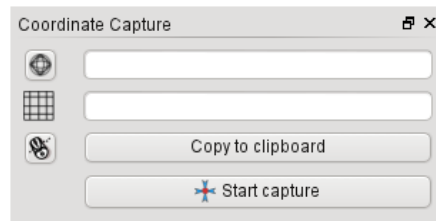
Figure 19.6: Coordinate Capture Plugin

1. Start QGIS, select 🔧 *Project Properties* from the *Settings* (KDE, Windows) or *File* (Gnome, OSX) 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. Clique na caixa de verificação ☑ *Activar projecção "on the fly"* e seleccione o sistema de coordenadas projectado à sua escolha (veja também *Trabalhando com Projecções*).

3. Activate the coordinate capture plugin in the Plugin Manager (see *The Plugins Dialog*) 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_1. Alternatively, you can also go to *Vector → Coordinate Capture* and see if ☑ *Coordinate Capture* is enabled.

4. Clique no ícone 🌐 Clique para seleccionar o SRC para a exibição de coordenadas e seleccione um SRC diferente a partir do que seleccionou acima.

5. Para iniciar a capturar coordenadas, clique em **[Iniciar captura]**. Pode clicar agora em qualquer sítio do enquadramento do mapa e o módulo irá mostrar as coordenadas em ambos os SRC seleccionados.

6. Para activar o rastreio das coordenadas do rato clique no ícone 🖱 rastreio do rato.

7. Pode também copiar as coordenadas seleccionadas para a área de trasnferência.

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19.4 Módulo Gestor BD

The DB Manager Plugin is officially part of the QGIS core and is intended to replace the SPIT Plugin and, additionally, to integrate all other database formats supported by QGIS 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. .. _figure_db_manager:

O menu *Base de Dados* permite ligar a uma base de dados existente, para começar a janela de SQL e sair do módulo Gestor BD. Quando estiver ligado a uma base de dados existente os menus *Esquema* e *Tabela* apareceram adicionalmente.

O menu *Esquema* inclui ferramentas para criar e apagar esquemas (vazias) e, se estiver topologia disponível (ex.: PostGIS 2), para iniciar o *TopoViewer*.

The *Table* menu allows you to create and edit tables and to delete tables and views. It is also possible to empty tables and to move tables from one schema to another. As further functionality, you can perform a VACUUM and then an ANALYZE for each selected table. Plain VACUUM simply reclaims space and makes it available
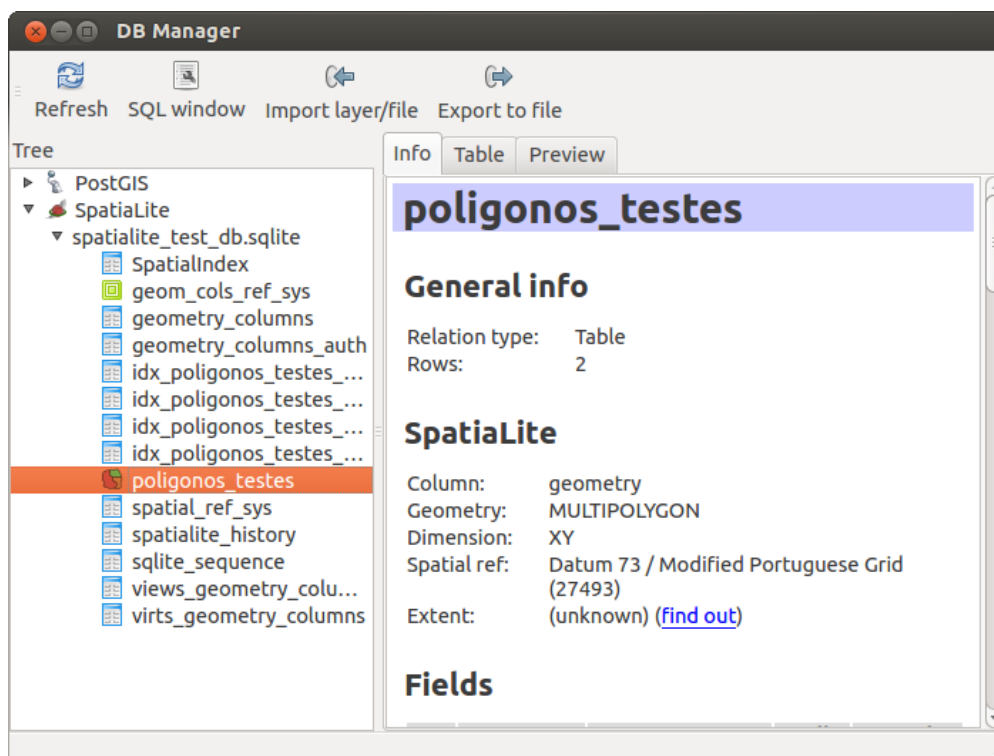
Figure 19.7: DB Manager dialog

for reuse. ANALYZE updates statistics to determine the most efficient way to execute a query. Finally, you can import layers/files, if they are loaded in QGIS or exist in the file system. And you can export database tables to shape with the Export File feature.

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.

Se estiver ligado à base de dados, a janela **principal** do Gestor DB oferece três separadores. O separador *Informação* fornecem informação sobre a tabela e a sua geometria assim como os campos existentes, restrições e indíces. Permite também correr a Análise de Vácuo e criar um índice espacial na tabela seleccionada, se não estiver actualmente feita. O separador *Tabela* mostra todos os atributos e o separador *Pré-visualização* renderiza as geometrias como pré-visualização.

19.4.1 Working with the SQL Window

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.

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19.5 Módulo de Conversão Dxf2Shp

The dxf2shape converter plugin can be used to convert vector data from DXF to shapefile format. It requires the following parameters to be specified before running:

- **Input DXF file**: Enter the path to the DXF file to be converted.
- **Output Shp file**: Enter desired name of the shapefile to be created.
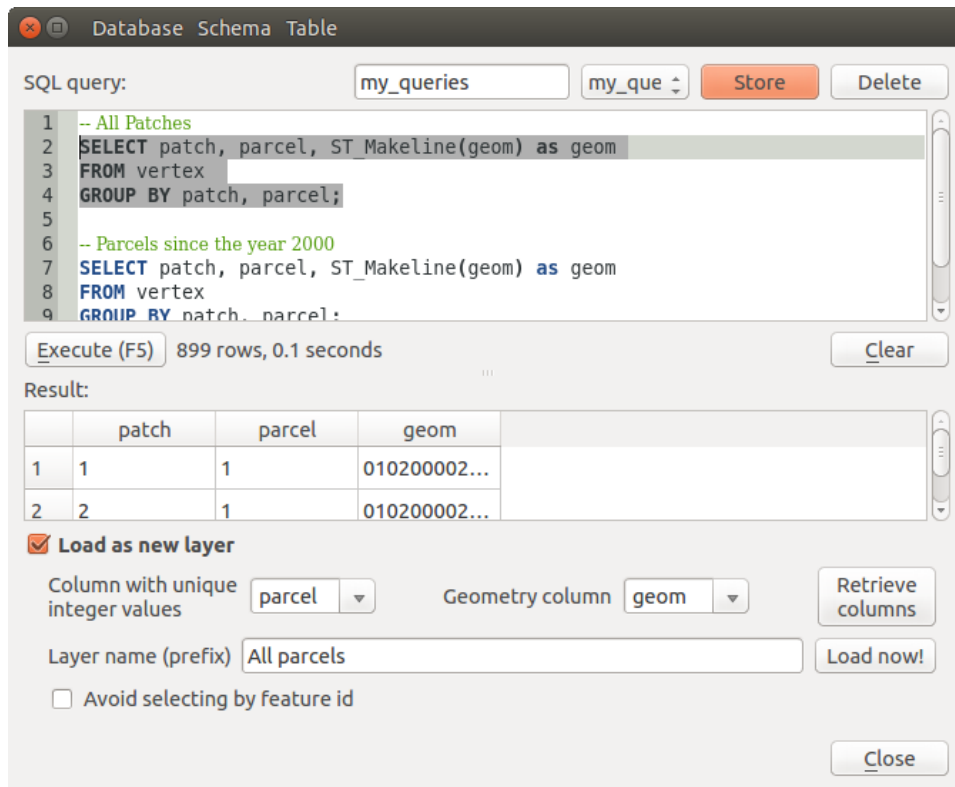
Figure 19.8: Executing SQL queries in the DB Manager SQL window
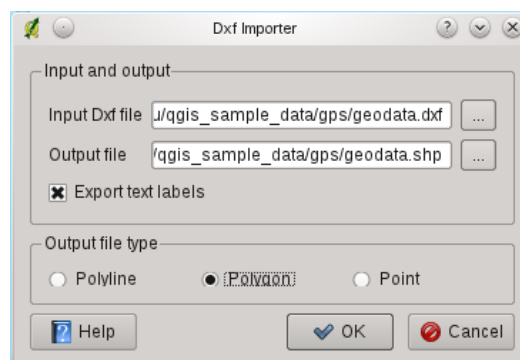
Figure 19.9: Módulo de Conversão Dxf2Shp

- **Output file type**: Specify the geometry type of the output shapefile. Currently supported types are polyline, polygon, and point.

- **Export text labels**: When this checkbox is enabled, an additional shapefile point layer will be created, and the associated DBF table will contain information about the "TEXT" fields found in the DXF file, and the text strings themselves.

19.5.1 Usando o módulo

1. Start QGIS, load the Dxf2Shape plugin in the Plugin Manager (see *The Plugins Dialog*) and click on the
   Dxf2Shape Converter icon, which appears in the QGIS toolbar menu. The Dxf2Shape plugin dialog appears, as shown in Figure_dxf2shape_1.

2. Enter the input DXF file, a name for the output shapefile and the shapefile type.

3. Active a caixa de verificação ✅ *Exportar rótulos de texto* se quer criar uma camada extra de pontos com os rótulos.

4. Clique **[OK]**.

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19.6 Módulo eVis

(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.)

The Biodiversity Informatics Facility at the American Museum of Natural History's (AMNH) Center for Biodiversity and Conservation (CBC) has developed the Event Visualization Tool (eVis), another software tool to add to the suite of conservation monitoring and decision support tools for guiding protected area and landscape planning. This plugin enables users to easily link geocoded (i.e., referenced with latitude and longitude or X and Y coordinates) photographs, and other supporting documents, to vector data in QGIS.

eVis is now automatically installed and enabled in new versions of QGIS, and as with all plugins, it can be disabled and enabled using the Plugin Manager (see *The Plugins Dialog*).

O módulo eVis é constituído por três módulos: a 'ferramenta de Ligação à Base de Dados', ferramenta do ID de Evento', e a 'Pesquisa de Eventos'. Tudo isto junto, permitirá ver fotografias geocodificadas e outros documentos que estão ligados aos elementos armazenados nos ficheiros vectoriais, base de dados ou folhas de cálculo.

19.6.1 Pesquisa de Eventos

The Event Browser module provides the functionality to display geocoded photographs that are linked to vector features displayed in the QGIS map window. Point data, for example, can be from a vector file that can be input using QGIS or it can be from the result of a database query. The vector feature must have attribute information associated with it to describe the location and name of the file containing the photograph and, optionally, the compass direction the camera was pointed when the image was acquired. Your vector layer must be loaded into QGIS before running the Event Browser.

Iniciar o módulo de Pesquisa de Eventos

To launch the Event Browser module, click on *Database → eVis → eVis Event Browser*. This will open the *Generic Event Browser* window.

The *Event Browser* window has three tabs displayed at the top of the window. The *Display* tab is used to view the photograph and its associated attribute data. The *Options* tab provides a number of settings that can be adjusted to

control the behavior of the eVis plugin. Lastly, the *Configure External Applications* tab is used to maintain a table of file extensions and their associated application to allow eVis to display documents other than images.

Percebendo a janela de Exibição

To see the *Display* window, click on the *Display* tab in the *Event Browser* window. The *Display* window is used to view geocoded photographs and their associated attribute data.
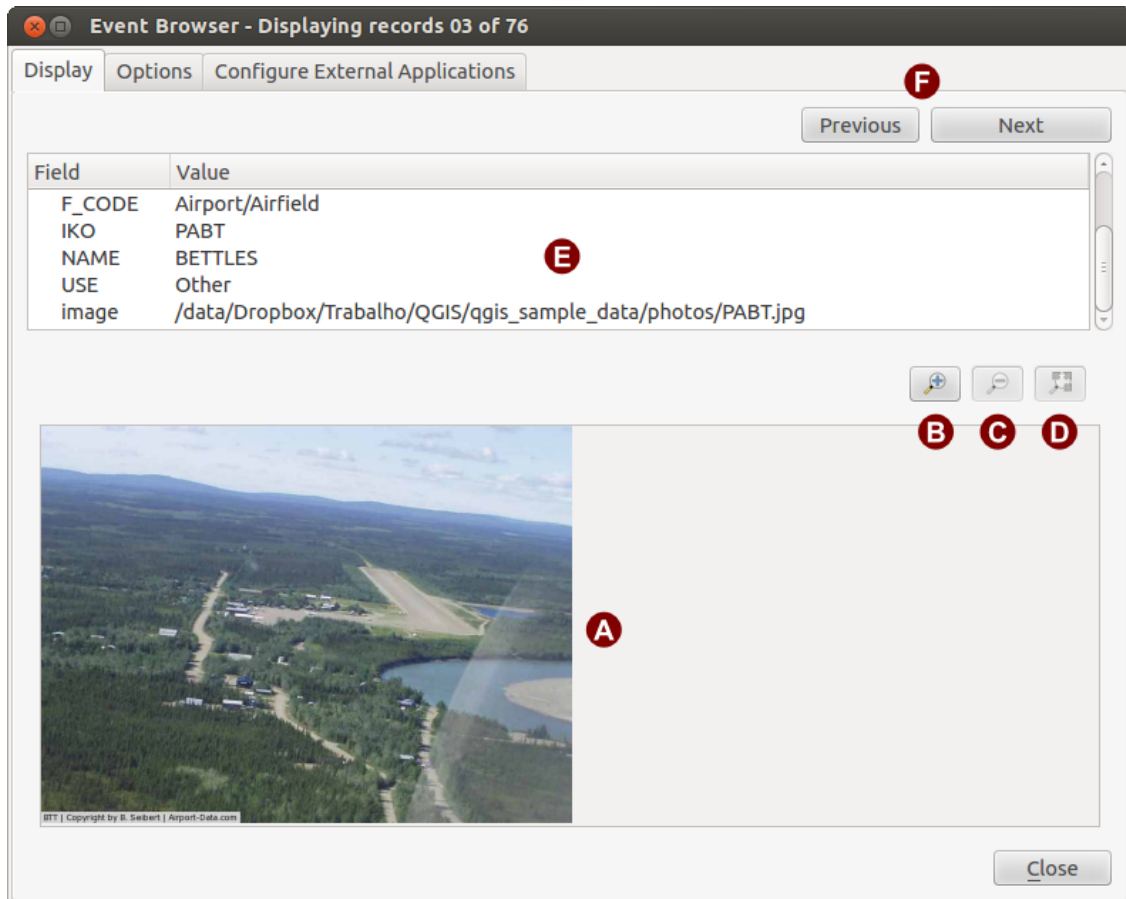
Figure 19.10: A janela de exibição *eVis*

1. ******Janela de exibição*: A janela onde a fotografia irá aparecer.

2. **Botão Aproximar**: Aproxima para ver com mais detalhe. Se a imagem inteira não for possível de exibir na janela de exibição, uma barra de deslocamento aparecerá no lado esquerdo e no fundo da janela para que possa mover à volta da imagem.

3. **Botão Afastar**: Afastar para visualizar mais área.

4. **Zoom to full extent** button: Displays the full extent of the photograph.

5. **Attribute information window**: All of the attribute information for the point associated with the photograph being viewed is displayed here. If the file type being referenced in the displayed record is not an image but is of a file type defined in the *Configure External Applications* tab, then when you double-click on the value of the field containing the path to the file, the application to open the file will be launched to view or hear the contents of the file. If the file extension is recognized, the attribute data will be displayed in green.

6. **Botões de Navegação**: Use o botão Anterior e Seguinte para carregar o elemento anterior e seguinte quando mais que um elemento é seleccionado.

Entendendo a janela de Opções
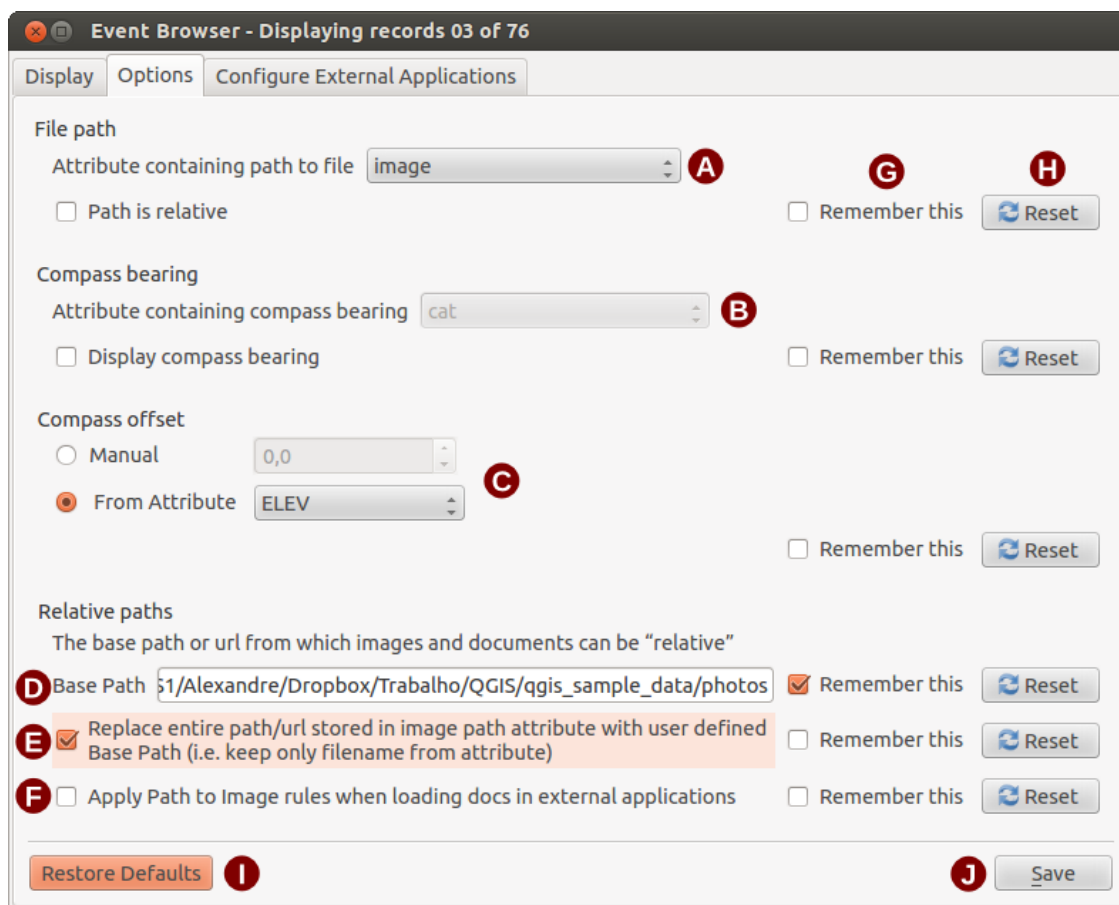
Figure 19.11: A janela de Opções *eVis*

1. **File path**: A drop-down list to specify the attribute field that contains the directory path or URL for the photographs or other documents being displayed. If the location is a relative path, then the checkbox must be clicked. The base path for a relative path can be entered in the *Base Path* text box below. Information about the different options for specifying the file location are noted in the section *Especificando a localização e nome da fotografia* below.

2. **Compass bearing**: A drop-down list to specify the attribute field that contains the compass bearing associated with the photograph being displayed. If compass bearing information is available, it is necessary to click the checkbox below the drop-down menu title.

3. **Compass offset**: Compass offsets can be used to compensate for declination (to adjust bearings collected using magnetic bearings to true north bearings). Click the ⊙ *Manual* radio button to enter the offset in the text box or click the ⊙ *From Attribute* radio button to select the attribute field containing the offsets. For both of these options, east declinations should be entered using positive values, and west declinations should use negative values.

4. **Directório do caminho base**: O caminho base para o caminho relativo definido na Figure_eVis_2 (A) será anexado.

5. **Replace path**: If this checkbox is checked, only the file name from A will be appended to the base path.

6. **Apply rule to all documents**: If checked, the same path rules that are defined for photographs will be used for non-image documents such as movies, text documents, and sound files. If not checked, the path rules will only apply to photographs, and other documents will ignore the base path parameter.

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. **Restaurar valores**: Restaurar os valores nesta linha para a configuração padrão.

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**: Isto guardará as configurações sem fechar o painel das *Opções*.

Entendendo a janela de Configuração de Aplicações Externas

Figure 19.12: A janela de aplicações Externas *eVis*

1. **File reference table**: A table containing file types that can be opened using eVis. Each file type needs a file extension and the path to an application that can open that type of file. This provides the capability of opening a broad range of files such as movies, sound recordings, and text documents instead of only images.
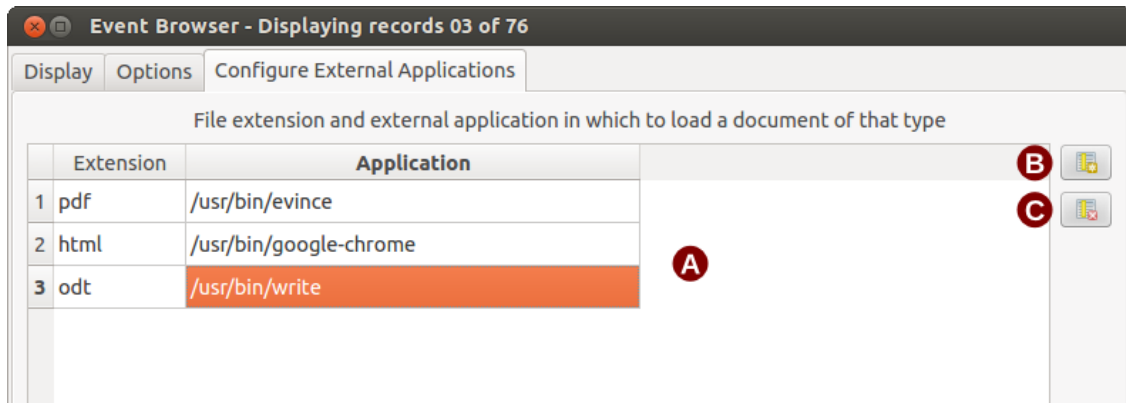
2. **Adicionar novo tipo de ficheiro**: Adicionar um novo tipo de ficheiro com uma extensão única e o caminho para a aplicação que pode abrir o ficheiro.

3. **Apagar a linha actual**: Apagar o tipo de ficheiro destacado na tabela e definido por uma extensão de ficheiro e o caminho para aplicação associada.

19.6.2 Especificando a localização e nome da fotografia

The location and name of the photograph can be stored using an absolute or relative path, or a URL if the photograph is available on a web server. Examples of the different approaches are listed in Table 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
```

19.6.3 Especificando a localização e nome de outros documentos suportados

Supporting documents such as text documents, videos, and sound clips can also be displayed or played by eVis. To do this, it is necessary to add an entry in the file reference table that can be accessed from the *Configure External Applications* window in the *Generic Event Browser* that matches the file extension to an application that can be used to open the file. It is also necessary to have the path or URL to the file in the attribute table for the vector layer. One additional rule that can be used for URLs that don't contain a file extension for the document you want to open is to specify the file extension before the URL. The format is — file extension:URL. The URL is preceded by the file extension and a colon; this is particularly useful for accessing documents from wikis and other web sites that use a database to manage the web pages (see Table evis_examples).

19.6.4 Usando a Pesquisa de Eventos

When the *Event Browser* window opens, a photograph will appear in the display window if the document referenced in the vector file attribute table is an image and if the file location information in the *Options* window is properly set. If a photograph is expected and it does not appear, it will be necessary to adjust the parameters in the *Options* window.

If a supporting document (or an image that does not have a file extension recognized by eVis) is referenced in the attribute table, the field containing the file path will be highlighted in green in the attribute information window if that file extension is defined in the file reference table located in the *Configure External Applications* window. To open the document, double-click on the green-highlighted line in the attribute information window. If a supporting document is referenced in the attribute information window and the file path is not highlighted in green, then it will be necessary to add an entry for the file's filename extension in the *Configure External Applications* window. If the file path is highlighted in green but does not open when double-clicked, it will be necessary to adjust the parameters in the *Options* window so the file can be located by eVis.

If no compass bearing is provided in the *Options* window, a red asterisk will be displayed on top of the vector feature that is associated with the photograph being displayed. If a compass bearing is provided, then an arrow will appear pointing in the direction indicated by the value in the compass bearing display field in the *Event Browser* window. The arrow will be centered over the point that is associated with the photograph or other document.

To close the *Event Browser* window, click on the **[Close]** button from the *Display* window.

19.6.5 Ferramenta de Eventos ID

The 'Event ID' module allows you to display a photograph by clicking on a feature displayed in the QGIS map window. The vector feature must have attribute information associated with it to describe the location and name of the file containing the photograph and, optionally, the compass direction the camera was pointed when the image was acquired. This layer must be loaded into QGIS before running the 'Event ID' tool.

Iniciar o módulo de Eventos ID

To launch the 'Event ID' module, either click on the Event ID icon or click on *Database → eVis → Event ID Tool*. This will cause the cursor to change to an arrow with an 'i' on top of it signifying that the ID tool is active.

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 ref:*evis_browser* section of this guide.

19.6.6 Ligação da Base de Dados

The 'Database Connection' module provides tools to connect to and query a database or other ODBC resource, such as a spreadsheet.

eVis can directly connect to the following types of databases: PostgreSQL, MySQL, and SQLite; it can also read from ODBC connections (e.g., MS Access). When reading from an ODBC database (such as an Excel spreadsheet), it is necessary to configure your ODBC driver for the operating system you are using.

Iniciar o módulo da Ligação à Base de Dados

To launch the 'Database Connection' module, either click on the appropriate icon eVis Database Connection or click on *Database → eVis → Database Connection*. This will launch the *Database Connection* window. The window has three tabs: *Predefined Queries*, *Database Connection*, and *SQL Query*. The *Output Console* window at the bottom of the window displays the status of actions initiated by the different sections of this module.

Ligar à base de dados

Click on the *Database Connection* tab to open the database connection interface. Next, use the *Database Type* combo box to select the type of database that you want to connect to. If a password or username is required, that information can be entered in the *Username* and *Password* textboxes.

Enter the database host in the *Database Host* textbox. This option is not available if you selected 'MS Access' as the database type. If the database resides on your desktop, you should enter "localhost".

Enter the name of the database in the *Database Name* textbox. If you selected 'ODBC' as the database type, you need to enter the data source name.

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.
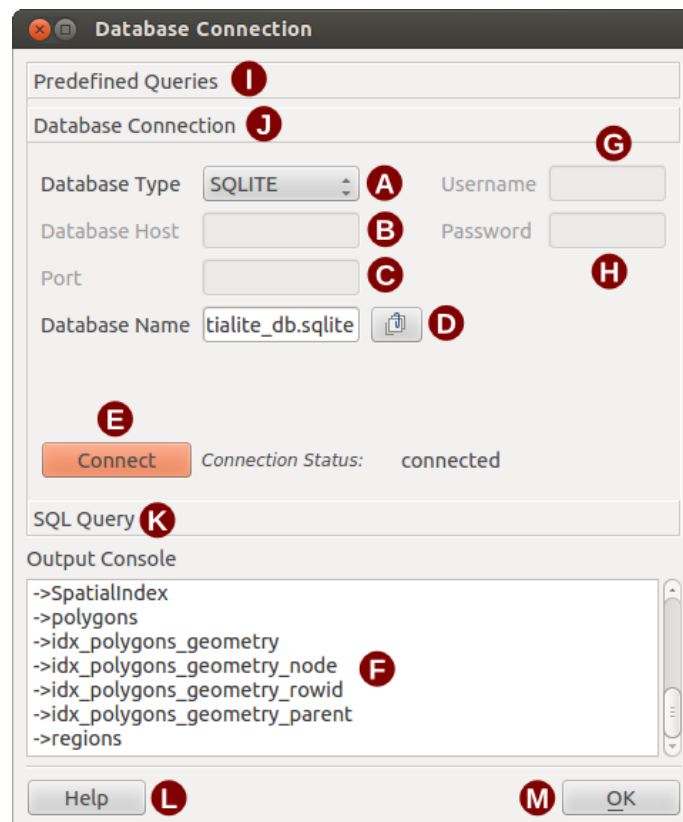
Figure 19.13: A janela de ligação da Base de Dados *eVis*

1. **Database Type**: A drop-down list to specify the type of database that will be used.

2. **Servidor da Base de Dados**: O nome do servidor da base de dados.

3. **Port**: The port number if a MySQL or PostgreSQL database type is selected.

4. **Database Name**: The name of the database.

5. **Connect**: A button to connect to the database using the parameters defined above.

6. **Output Console**: The console window where messages related to processing are displayed.

7. **Utilizador**: Utilizador para usar quando a base de dados é protegida por uma palavra-passe.

8. **Palavra-passe**: Palavra-passe para usar quando a base de dados é protegida por uma palavra-passe.

9. **Consultas Pré-Definidas**: Separador para abrir a janela "Consultas Pré-definidas".

10. **Ligação da Base de Dados**: Separador para abrir a janela "Ligação à Base de Dados".

11. **Consulta SQL**: Separador para abrir a janela da "Consulta SQL".

12. **Help**: Displays the online help.

13. **OK**: Fecha a janela principal da "Ligação à Base de Dados".

Correndo 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.

In the *Database File Selection* window, enter the name of the layer that will be created from the results of the query in the *Name of New Layer* textbox.
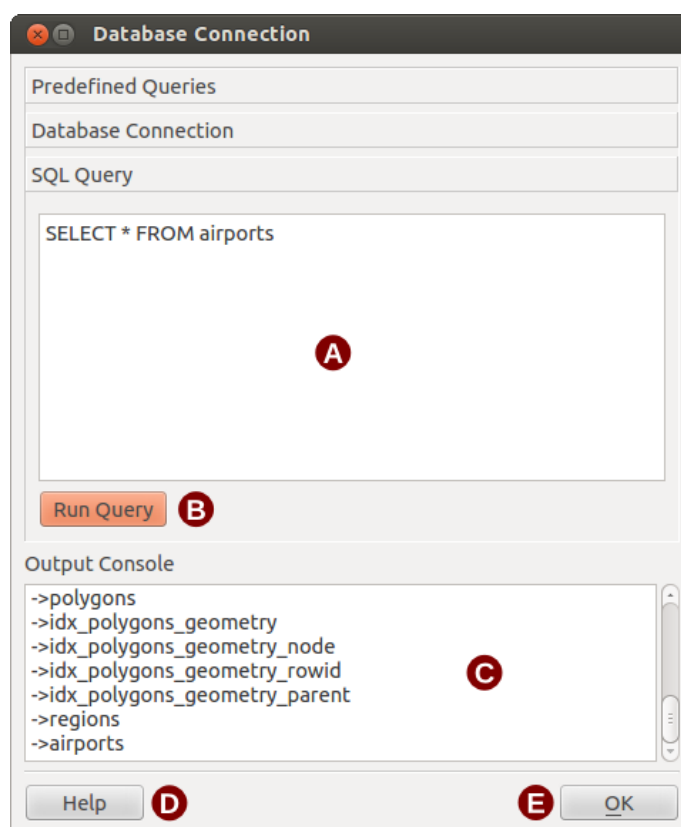
Figure 19.14: O separador de Consulta SQL eVis

1. **Janela de texto da Consulta SQL**: Um ecrã para introduzir as consultas SQL.

2. **Correr Consulta**: Botão para executar a consulta introduzida na *Janela de Consulta SQL*.

3. **Janela da Consola**: A janela da consola onde as mensagens relacionadas com o processamento são exibidas.

4. **Help**: Displays the online help.

5. **OK**: Fecha a janela principal *Ligação à base de daos*.

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.

To save this vector file for future use, you can use the QGIS 'Save as...' command that is accessed by right-clicking on the layer name in the QGIS map legend and then selecting 'Save as...'

Tip: Criando uma camada vectorial a partir de uma folha de cálculo Microsoft Excel

When creating a vector layer from a Microsoft Excel Worksheet, you might see that unwanted zeros ("0") have been inserted in the attribute table rows beneath valid data. This can be caused by deleting the values for these cells in Excel using the `Backspace` key. To correct this problem, you need to open the Excel file (you'll need to close QGIS if you are connected to the file, to allow you to edit the file) and then use *Edit → Delete* to remove the blank rows from the file. To avoid this problem, you can simply delete several rows in the Excel Worksheet using *Edit → Delete* before saving the file.

Correndo consultas pré-definidas

With predefined queries, you can select previously written queries stored in XML format in a file. This is particularly helpful if you are not familiar with SQL commands. Click on the *Predefined Queries* tab to display the predefined query interface.

To load a set of predefined queries, click on the 🖼 Open File icon. This opens the *Open File* window, which is used to locate the file containing the SQL queries. When the queries are loaded, their titles as defined in the XML file will appear in the drop-down menu located just below the 🖼 Open File icon. The full description of the query is displayed in the text window under the drop-down menu.

Select the query you want to run from the drop-down menu and then click on the *SQL Query* tab to see that the query has been loaded into the query window. If it is the first time you are running a predefined query or are switching databases, you need to be sure to connect to the database.

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.

1. **Open File**: Launches the "Open File" file browser to search for the XML file holding the predefined queries.

2. **Predefined Queries**: A drop-down list with all of the queries defined by the predefined queries XML file.

3. **Query description**: A short description of the query. This description is from the predefined queries XML file.

4. **Janela da Consola**: A janela da consola onde as mensagens relacionadas com o processamento são exibidas.

5. **Help**: Displays the online help.

6. **OK**: Fecha a janela principal da "Ligação à Base de Dados".

XML format for eVis predefined queries
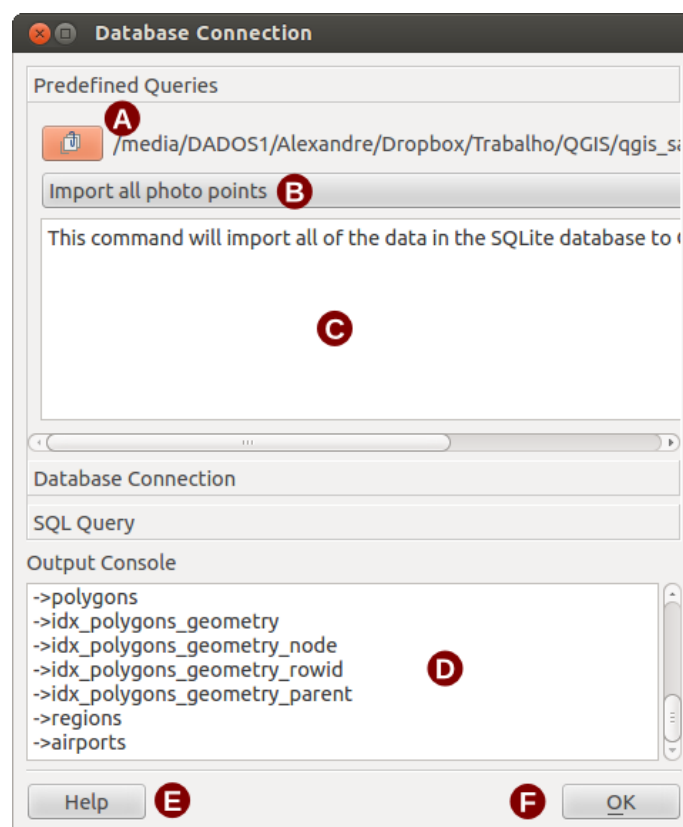
The XML tags read by eVis

Figure 19.15: The *eVis* Predefined Queries tab

Etiqueta	Descrição
consulta	Define o início e o fim da instrução da consulta.
descrição curta	A short description of the query that appears in the eVis drop-down menu.
descrição	Uma descrição detalhada da consulta exibida na janela de texto da Consulta Pré-Definida.
database-type	The database type, defined in the Database Type drop-down menu in the Database Connection tab.
database-port	The port as defined in the Port text box in the Database Connection tab.
database-name	The database name as defined in the Database Name text box in the Database Connection tab.
databaseuser-name	The database username as defined in the Username text box in the Database Connection tab.
databasep-assword	The database password as defined in the Password text box in the Database Connection tab.
sqlstate-ment	O comando SQL.
ligação automática	A flag ("true"" or "false") to specify if the above tags should be used to automatically connect to the database without running the database connection routine in the Database Connection tab.

A complete sample XML file with three queries is displayed below:

```
<?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>
```

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19.7 Módulo fTools

O objectivo do módulo python fTools é fornecer um recurso único para várias tarefas SIG comuns aos dados vectoriais, sem a necessidade de software adicional, bibliotecas, ou trabalho complexo. Fornece um conjunto em crescimento de formas de gestão de dados espaciais e funções de análise que são rápidas e funcionais.

fTools is now automatically installed and enabled in new versions of QGIS, and as with all plugins, it can be disabled and enabled using the Plugin Manager (see *The Plugins Dialog*). When enabled, the fTools 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.

19.7.1 Ferramentas de Análise

Ícone	Ferramenta	Finalidade
	Matriz de Distância	Mede a distância entre duas camadas de pontos, e fornece resultados como a) matriz de distância quadrado, b) matriz de distância linear, ou c) Somatório de distâncias. Pode limitar distâncias usando k elementos próximos.
	Soma de comprimentos de linha	Calcula o somatório total de comprimentos de linha para cada polígono de uma camada vectorial do tipo polígono.
	Pontos no polígono	Conta o número de pontos que ocorrem em cada polígono numa camada vectorial do tipo polígono.
	Lista de valores únicos	Origina uma lista de valores únicos num campo de uma camada vectorial.
	Estatísticas básicas	Computa estatísticas básicas (média, desvio-padrão, N elementos, soma, CV) de um campo de entrada.
	Análise de Vizinhança	Calcula as estatísticas de vizinho mais próximo avaliando o nível de agrupamento numa camada de pontos vectorial
	Coordenada(s) média	Computa o centro médio normal ou com pesos de toda a camada vectorial, ou elementos múltiplos baseados num campo ID único.
	Intersecções de Linha	Localiza intersecções entre linhas, e resulta numa shapefile de pontos. É útil para localizar intersecções em estradas ou linhas de água, ignora intersecções de linha com um comprimento > 0.

Tabela Ftools 1: Ferramentas de Análise fTools

19.7.2 Ferramentas de investigação

Ícone	Ferramenta	Finalidade
	Selecção aleatória	Selecciona aleatoriamente n números de elementos, ou n percentagem de elementos.
	Selecção aleatória dentro de subconjuntos	Selecciona aleatoriamente elementos dentro de subconjuntos baseando-se num campo ID único.
	Pontos aleatórios	Gera pontos pseudo-aleatórios sobre uma camada vectorial.
	Pontos regulares	Gera uma grelha de pontos regulares sobre uma região específica ou enquadramento e exporta-os para uma shapefile de pontos.
	Grelha vectorial	Gera uma grelha de linhas ou polígonos baseada num espaçamento específico dado pelo utilizador.
	Seleccionar por localização	Seleccione elementos baseados na sua localização relativa a outra camada para formar uma nova selecção, ou adicionar ou subtrair da selecção actual.
	Polígono a partir da extensão da camada	Cria uma camada do tipo polígono com um rectângulo único a partir da extensão de uma camada matricial ou vectorial.

Tabela Ftools 2: Ferramentas de investigação fTools

19.7.3 Ferramentas de geoprocessamento

Ícone	Ferramenta	Finalidade
	Formas convexa(s)	Cria forma convexa(s) mínimas para uma camada, ou baseada num campo ID.
	Buffer(s)	Cria buffer(s) à volta dos elementos baseando-se na distância ou num campo de distância.
	Cruzar	Sobrepõe camadas e obtém como resultado áreas onde ambas as camadas intersectam.
	Unir	Sobrepõe camadas e obtém como resultado áreas com e sem intersecção.
	Diferença simétrica	Sobrepõe camadas e obtém como resultado áreas de diferenças de camadas que não intersectam.
	Cortar	Sobrepõe camadas e obtém como resultado áreas que intersectam a camada de corte.
	Diferença	Sobrepõe camadas e obtém como resultado áreas que não intersectam a camada de corte.
	Dissolver	Junta elementos baseados num campo de entrada. Todos os elementos com valores idênticos são combinados de forma a obter um elemento único.
	Eliminar fragmento de polígonos	Merges selected features with the neighbouring polygon with the largest area or largest common boundary.

Tabela Ftools 3: Ferramentas de geoprocessamento fTools

19.7.4 Ferramentas de geometria

Ícone	Ferramenta	Finalidade
	Verificar a validade da geometria	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 behaviour. Another tools exists which shows different result as well: Topology Checker plugin and 'must not have invalid geometries' rule.
	Exportar/Adicionar geometrias de colunas	Adiciona a informação da camada vectorial para camadas de pontos (XCOORD, YCOORD), linha (LENGTH), ou polígono (AREA, PERIMETER).
	Centróides de polígonos	Calcula os verdadeiros centróides para cada polígono numa camada do tipo polígono.
	Triangulação Delaunay Polígonos de Voronoi	Calcula e produz uma saída baseada na triangulação de delaunay (como polígonos) de uma camada de pontos vectorial. Calcula polígonos de voronoi de uma camada de pontos vectoriais.
	Simplificar geometrias	Generaliza linhas ou polígonos com o algoritmo modificado Douglas-Peucker.
	Adensar geometrias	Adensa linhas ou polígonos através de adição de vértices.
	Multipartes para partes simples	Converte elementos multiparte para múltiplos elementos de +artes simples. Cria polígonos e linhas simples.
	Partes simples para multipartes	Junta elementos múltiplos para um único elemento multiparte baseado no campo ID único.
	Polígonos para linhas	Converte polígonos para linhas, polígonos multiparte para múltiplos partes simples de linhas.
	Linhas para polígonos	Converte linhas para polígonos, linhas multiparte para múltiplas partes simples de polígonos.
	Extrair Nós	Extrai nós de camadas de linhas e polígonos e resulta numa camada de pontos.

Tabela Ftools 4: Ferramentas de Geometria fTools

Note: A ferramenta *Simplificar geometrias* pode ser usada para remover nós duplicados em geometrias de linhas e polígonos, faça este truque definindo o parâmetro *Tolerância de generalização* para 0.

19.7.5 Ferramentas de Gerenciamento de dados

Ícone	Ferramenta	Finalidade
	Definir a projecção actual	Especifica o SRC para shapefiles que não tenham SRC definidos.
	Juntar atributos por localização	Junta atributos adicionais à camada vectorial baseando-se na relação espacial. Os atributos de uma camada vectorial são acrecentados à tabela de atributos de outra camada e é exportado como shapefile.
	Separar uma camada vectorial	Divide uma camada em múltiplas camadas separadas através de um campo de entrada.
	Unir shapefiles para num só Criar índice espacial	Une várias shapefiles dentro de uma pasta num novo shapefile tendo como base o tipo de camada (ponto, linha, área). Cria um índice espacial para os formatos OGR suportados.

Tabela Ftools 5: Ferramentas de Gerenciamento de Dados fTools

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19.8 Módulo de Ferramentas GDAL

19.8.1 O que são as Ferramentas GDAL?

O módulo Ferramentas GDAL oferece uma colecção GUI de ferramentas da Biblioteca de Abstracção de Dados Geoespaciais, http://gdal.osgeo.org . Estes são ferramentas de gestão raster para consultar, reprojectar, torcer e unir um conjunto variado de formatos raster. Inclui também ferramentas para criar camadas de contornos (vector), ou relevos sombreados a partir de MDT matriciais, e para fazer um vrt (Virtual Raster Tile em formato XML) a partir de uma colecção de um ou mais ficheiros raster. Estas ferramentas estão disponíveis quando o módulo está instalado e activado.

Biblioteca GDAL

The GDAL library consists of a set of command line programs, each with a large list of options. Users comfortable with running commands from a terminal may prefer the command line, with access to the full set of options. The GDALTools plugin offers an easy interface to the tools, exposing only the most popular options.
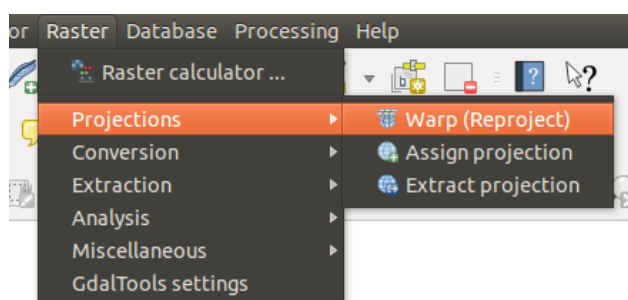
19.8.2 Lista das ferramentas GDAL

Figure 19.16: Lista do menu *Ferramentas GDAL*

Projecções

Warp (Reproject)	Este utilitário serve para os mosaicos de imagem, reprojecção e torções. O programa pode reprojectar para qualquer projecção suportada, e pode também ser aplicado a PC armazenados na imagem se a imagem tiver dados em "bruto" com controlo da informação. Para mais informação pode ler no sítio na internet do GDAL http://www.gdal.org/gdalwarp.html.
Assign projection	Esta ferramenta permite definir uma projecção para os rasters que estão georeferenciados mas não têm a informação da projecção. Com isto também ajuda na possibilidade de alterar a definição de uma projecção actual. Tanto o modo ficheiro único como o modo batch são suportados. Para mais informações, visite a página do utilitário no sítio na internet do GDAL, http://www.gdal.org/gdalwarp.html.
Extract projection	Este utilitário ajuda-o a extrair a informação da projecção de um ficheiro de entrada. Se quiser extrair a projecção do directório pode usar o modo Batch. Irá criar os ficheiros `.prj` e `.wld`.

Conversão

Rasterize	Este programa torna geometrias vectoriais (pontos, linhas e polígonos) em banda(s) de uma imagem raster. Os vectores são lidos a partir de formatos OGR suportados. Repare que os dados do vector devem ser do mesmo sistema de coordenadas que os dados rasters; a projecção "on-the-fly" não é fornecida. Para mais informação veja http://www.gdal.org/gdal_rasterize.html.
Poly-gonize	Este utilitário cria polígonos vectoriais para todas as regiões de pixeis ligadas num matricial que partilha um valor comum de pixel. Cada polígono é criado com um atributo que indica o valor do pixel desse polígono. O utilitário irá criar um vector de saída se não existir, por defeito em formato ESRI shapefile. Veja também http://www.gdal.org/gdal_polygonize.html.
Translate	Este utilitário pode ser usado para converter matriciais em diferente formatos, potencialmente executa algumas operações como subconfigurações, amostragem, rescalonamento de pixeis no processo. Para mais informações pode ler em http://www.gdal.org/gdal_translate.html
RGB to PCT	Este utilitário irá computar uma tabela pseudo-cor optimizada para uma dada imagem RBG usando um algoritmo da mediana cortado num histograma RGB de resolução reduzida. De seguida converte a imagem numa imagem de pseudo-cor usando tabelas de cor. Esta conversão utiliza o pontilhado de Floyd-Steinberg (erro de difusão) para maximizar a qualidade visual da imagem de saída. Este utilitário é também descrito em http://www.gdal.org/rgb2pct.html
PCT to RGB	Este utilitário irá converter uma banda de pseudo-cor num ficheiro de entrada para um ficheiro RGB de saída do formato desejado. Para mais informação veja http://www.gdal.org/pct2rgb.html

Extracção

Con-tour	Este programa gera um ficheiro de contornos vectoriais a partir de um modelo digital do terreno (MDT) matricial. Pode encontrar mais informação em http://www.gdal.org/gdal_contour.html .
Clip-per	Este utilitário permite o corte (extracção de um subconjunto) usando um enquadramento seleccionado ou baseado no limite de um vector. Mais informação pode ser encontrado em http://www.gdal.org/gdal_translate.html.

Análise

Sieve	Este utilitário remove polígonos rasters mais pequenos que o tamanho de limiar (em pixeis) fornecido e substitui-os com o valor do pixel mais alto do vizinho mais próximo. O resultado pode ser escrito na banda raster existente, ou copiado para um novo ficheiro. Para mais informação veja see http://www.gdal.org/gdal_sieve.html .
Near Black	Este utilitário irá digitalizar a imagem e tentar definir todos os pixeis que existem perto do preto (ou perto do branco) à volta do limite para exactamente preto (ou branco). Isto é usado usualmente para "corrigir" perdas em fotos áreas comprimidas para que esses pixeis de cor possam ser tratadas como transparentes nas operações de mosaico. Veja também http://www.gdal.org/nearblack.html.
Fill nodata	Este utilitário preenche as regiões raster seleccionadas (usualmente conhecidas com áreas sem valor) por interpolação de de pixeis validados à volta das bordas da área. Pode encontrar mais informação em http://www.gdal.org/gdal_fillnodata.html .
Proximity	Este utilitário gera um mapa de proximidade raster indicando a distância desde o centro de cada pixel para o centro do pixel mais próximo identificado como pixel alvo. Os pixeis alvo são os que estão presentes no raster inicial em que cada valor do pixel é definido como valores pixeis alvo. Para mais informação veja http://www.gdal.org/gdal_proximity.html .
Grid (Interpolation)	Este utilitário cria um grelha regular (raster) a partir da leitura de dados dispersos de um fonte de dados OGR. Os dados de entrada serão interpolados para preencher os nós da grelha com valores, pode escolher vários métodos de interpolação. O utilitário também é descrito no sítio na internet do GDAL http://www.gdal.org/gdal_grid.html .
DEM (Terrain models)	Ferramentas para analisar e visualizar MDT. Podem ser criados, relevos sombreados, declives, exposições, relevo colorido, indíce de rugosidade do terreno, indice de posição topográfica e mapas de irregularidades a partir de matricias GDAL suportados. Para mais informação poderá ler em http://www.gdal.org/gdaldem.html

Diversos

Build Virtual Raster (Catalog)	Este programa constrói um VRT (Conjunto de Dados Virtual) que é um mosaico da lista dos conjuntos de dados do GDAL. Veja também http://www.gdal.org/gdalbuildvrt.html .
Merge	Este utilitário irá criar mosaicos de imagem a partir de um conjunto. Todas as imagens devem ter o mesmo sistema de coordenadas e ter o mesmo número de bandas correspondentes, mas podem ser sobrepostas, e em diferentes resoluções. Nas áreas de sobreposição, a última imagem será copiada sobre as mais recentes. O utilitário é também descrito em http://www.gdal.org/gdal_merge.html .
Information	Este utilitário cria uma lista com várias informações sobre o conjunto de dados raster GDAL suportado. Pode encontrar mais informação em http://www.gdal.org/gdalinfo.html .
Build Overviews	O utilitário gdaladdo pode ser usado para construir ou reconstruir imagem de visualização para a maioria dos formatos suportados com um dos algoritmos de redução de escala. Para mais informação veja http://www.gdal.org/gdaladdo.html .
Tile Index	Este utilitário constroi uma shapefile com o registo de cada ficheiro raster de entrada, um atributo contendo um nome do ficheiro, e a geometria do polígono do limite do raster. Veja também http://www.gdal.org/gdaltindex.html .

configurações das Ferramentas GDAL

Use este diálogo para embeber variáveis GDAL.

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19.9 Módulo Georeferenciador

O módulo Georeferenciador é uma ferramenta para gerar world files para rasters. Permite a possibilidade de referenciar rasters para sistemas de coordenadas projectadas ou geográficas através da criação de um novo GeoTiff ou adicionando um world file à imagem existente. A georreferenciação do raster passa por uma abordagem simples de localização de pontos no raster para que possa com precisão determinar as suas coordenadas.

Características

Ícone	Finalidade	Ícone	Finalidade
	Abrir matricial		Iniciar Georeferenciamento
	Gerar Script GDAL		Carregar pontos GCP
	Salvar pontos GCP como		Configurações da transformação
	Adicionar Ponto		Apagar Ponto
	Mover ponto GCP		Movimentar
	Aproximar		Afastar
	Aproximar à Camada		Última Visualização
	Próxima Visualização		Link Georeferencer to QGIS
	Link QGIS to Georeferencer		Esticar totalmente o histograma
	Esticar localmente o histograma		

Tabela 1 Georeferenciador: Ferramentas do Georeferenciador

19.9.1 Procedimento comum

Dois procedimentos alternativos podem ser usados, como coordenadas X e Y (DMS (dd mm ss.ss), DD (dd.dd)) ou coordenadas projectadas (mmmm.mm) que correspondem ao ponto seleccionado na imagem:

- O raster por si próprio por vezes fornece cruzes com coordenadas "escritas" na imagem. Neste caso, pode introduzir as coordenadas manualmente.
- Using already georeferenced layers. This can be either vector or raster data that contain the same objects/features that you have on the image that you want to georeference and with the projection that you want for your image. In this case, you can enter the coordinates by clicking on the reference dataset loaded in the QGIS map canvas.

O procedimento normal do georeferenciamento de uma imagem involve múltiplos pontos seleccionados no matricial, especificando as suas coordenadas, e escolhendo o tipo de transformação mais relevante. O módulo, baseado nos parâmetros de entrada e da informação irá computar os parâmetros do world file. Quanto mais coordenadas fornecer, melhor o resultado que irá obter.

The first step is to start QGIS, load the Georeferencer Plugin (see *The Plugins Dialog*) and click on *Raster →* *Georeferencer* , which appears in the QGIS menu bar. The Georeferencer Plugin dialog appears as shown in figure_georeferencer_1.

Para este exemplo, estamos a usar uma carta militar do Sul de Dakota do SDGS. Pode ser visualizada mais tarde juntamento com a informação proveniente da localização do GRASS `spearfish60` . Pode transferir a carta militar aqui: http://grass.osgeo.org/sampledata/spearfish_toposheet.tar.gz.
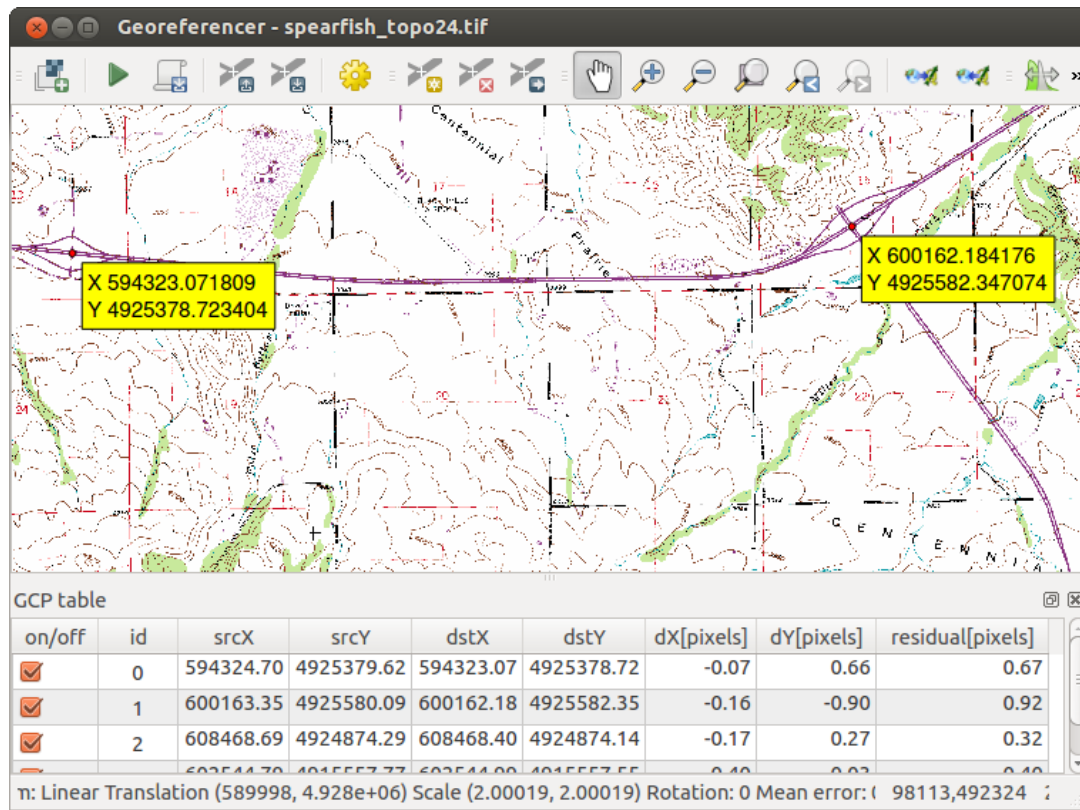
Figure 19.17: Janela do Módulo Georeferenciador

Introduzindo pontos de controlo (GCPs)

1. To start georeferencing an unreferenced raster, we must load it using the button. The raster will show up in the main working area of the dialog. Once the raster is loaded, we can start to enter reference points.

2. Using the Add Point button, add points to the main working area and enter their coordinates (see Figure figure_georeferencer_2). For this procedure you have three options:

   • Clique num ponto na imagem matricial e introduza as coordenadas X e Y manualmente.

   • Click on a point in the raster image and choose the From map canvas button to add the X and Y coordinates with the help of a georeferenced map already loaded in the QGIS map canvas.

   • With the button, you can move the GCPs in both windows, if they are at the wrong place.

3. Continue a introduzir pontos. Deve ter no mínimo quatro pontos, e quanto mais coordenadas fornecer, melhor o resultado será. Existe ferramentas adicionais na janela do módulo para aproximar e movimentar a área de trabalho de forma a localizar o conjunto relevante de pontos GCP.

The points that are added to the map will be stored in a separate text file (`[filename].points`) usually together with the raster image. This allows us to reopen the Georeferencer plugin at a later date and add new points or delete existing ones to optimize the result. The points file contains values of the form: `mapX, mapY, pixelX, pixelY`. You can use the Load GCP points and Save GCP points as buttons to manage the files.
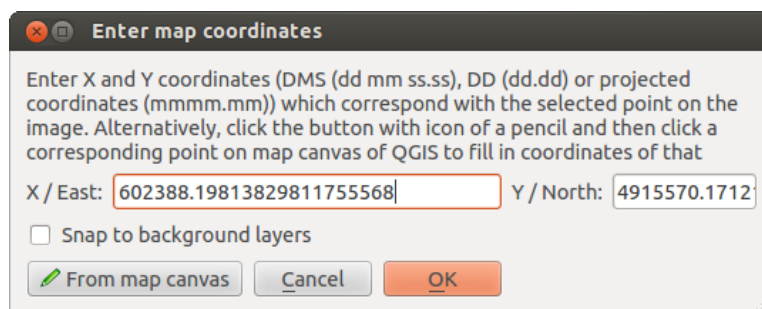
Figure 19.18: Adicionar pontos à imagem matricial

Definindo as configurações de transformação

Depois de adicionar os GCP à imagem matricial, necessita de definir as configurações de transformação para o processo de georeferenciamento.
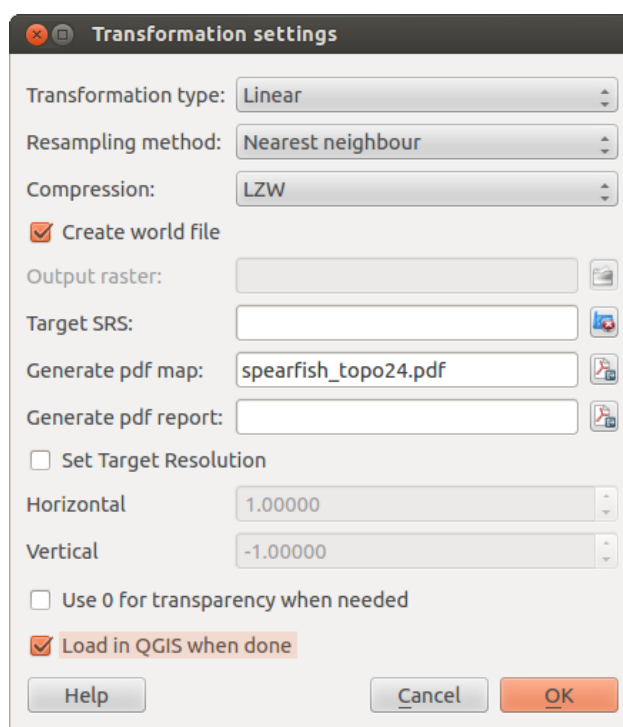
Figure 19.19: Definindo as configurações de transformação do georeferenciador

Algoritmos de Tranformação disponíveis

Dependendo da quantidade de pontos de controlo que registe, pode querer usar diferentes algoritmos de transformação. A escolha do algoritmo de transformação também depende do tipo e qualidade dos dados de entrada e a quantidade de distorção geométrica que está disposto a introduzir no resultado final.

Actualmente, os seguintes *Tipos de transformação* estão disponíveis:

- O algoritmo **Linear** é usado para criar o world-file, e é diferente dos outros algoritmos, e não transforma verdadeiramente o raster. Este algoritmo provavelmente não será suficiente se estiver a lidar com material digitalizado.

- A transformação de **Helmert** executa um simples escalonamento e transformações de rotação.

- The **Polynomial** algorithms 1-3 are among the most widely used algorithms introduced to match source and destination ground control points. The most widely used polynomial algorithm is the second-order polynomial transformation, which allows some curvature. First-order polynomial transformation (affine) preserves colliniarity and allows scaling, translation and rotation only.

- O algoritmo **Suavizador de Placas Finas** (TPS) é o método mais moderno de georeferenciação, que permite deformações locais nos dados. Este algoritmo é útil quando originais de baixa qualidade estão a ser georeferenciados.

- A transformação **Projectiva** é uma rotação linear e de translação de coordenadas.

Definir o método de Reamostragem

O tipo de amostragem que escolhe irá depender dos seus dados de entrada e do objectivo do exercício. Se não quiser mudar as estatísticas da imagem, deverá querer escolher 'Vizinho mais próximo´, visto que a 'Amostragem cúbica' irá fornecer um resultado mais suavizado.

É possível escolher entre cinco diferentes métodos de amostragem.

1. Vizinho mais próximo

2. Linear

3. Cúbica

4. Cúbico Suavizado

5. Lanczos

Definindo as configurações de transformação

Existe várias opções que necessitam ser definidos para a saída do matricial georeferenciado.

- A caixa de verificação ☑ *Criar world file'está apenas disponível se decidir usar o tipo de transformação linear, pois significa que a sua imagem raster actualmente não será transformada. Nesse caso, o campo :guilabel:'Raster de Saída* não está activo, porque apenas será criado um novo world-file.

- Para outro tipo de transformação necessita de definir um *Raster de Saída*. Por defeito um novo ficheiro ([filename]_modified) será criado na mesma pasta junto da imagem raster original.

- Como próximo passo, necessita de definir *SRC de Destino* (Sistema de Referência Espacial) para o matricial georeferenciado (veja *Trabalhando com Projecções*).

- Se quiser, pode **gerar um mapa em pdf** e também um **relatório em pdf**. O relatório inclui informação acerca dos parametros de transformação usados. Uma imagem com os resíduos e a lista com todos os pontos de controlo e os seus EMQ.

- Além disso, pode activar a caixa de verificação ☑ :guilabel:'Definir a Resolução do Alvo'e definir a resolução do pixel do raster de saída. A resolução horizontal e vertical por defeito é de 1.

- ☑ :guilabel:'Usar 0 para a transparência quando necessário'pode ser activado, se os pixeis com o valor 0 será visualizado como transparente. No nosso exemplo, todas as áreas brancas da carta militar seriam transparentes.

- Finally, ☑ *Load in QGIS when done* loads the output raster automatically into the QGIS map canvas when the transformation is done.

Mostrar e adaptar as propriedades do matricial

Clicando na janela das *Propriedades do matricial* no menu *Configurações* abre as propriedades do matricial da camada que quer georeferenciar.

Configurar o georeferenciador

- You can define whether you want to show GCP coordiniates and/or IDs.

- Assim como as unidades de resíduos pixel e as unidades de mapa podem ser escolhidos.

- Para o relatório PDF a margem esquerda e direita pode ser definida e pode também configurar o tamanho da folha para o mapa PDF.

- Finalmente pode activar o ☑ *Mostrar a janela do georeferenciador ancorada*.

Correndo a transformação

After all GCPs have been collected and all transformation settings are defined, just press the ▶ Start georeferencing button to create the new georeferenced raster.

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19.10 Módulo de Mapa de Densidade

The *Heatmap* plugin uses Kernel Density Estimation to create a density (heatmap) raster of an input point vector layer. The density is calculated based on the number of points in a location, with larger numbers of clustered points resulting in larger values. Heatmaps allow easy identification of "hotspots" and clustering of points.

19.10.1 Activar o módulo de Mapa de Densidade

Primeiramente, este módulo base necessita de ser activado usando o Gestor de Módulos (veja *load_core_plugin*).

Depois da activação do Mapa de Densidade 🟡 o ícone pode ser encontrado na barra de ferramentas do Raster, e no menu *Raster → Mapas de Densidade*.

Seleccione o menu *Ver → Barra de Ferramentas → Matricial* para exibir a Barra de Ferramentas Matricial se não estiver vísivel.

19.10.2 Usando o módulo de Mapa de Densidade

Ao clicar no botão da ferramenta |**hetmap**| *Mapas de Densidade* abre a janela do módulo Mapas de Densidade (veja figure_heatmap_2).

A janela tem as seguintes opções:

- **Camada de entrada de pontos**: Apresenta todas as camadas de pontos vectoriais no projecto actual e é usado para seleccionar a camada que vai ser analisada.

- **Output raster**: Allows you to use the … button to select the folder and filename for the output raster the Heatmap plugin generates. A file extension is not required.

- **Output format**: Selects the output format. Although all formats supported by GDAL can be choosen, in most cases GeoTIFF is the best format to choose.

- **Raio**: usado para especificar o raio de pesquisa (ou largura do kernel) do mapa de densidade em metros ou em unidades de mapa. O raio especifica a distância em torno de um ponto no qual se fará sentir a influência do ponto. Os valores altos resultam em maior suavização, mas valores pequenos podem mostrar detalhes finos e a variação da densidade de pontos.

Quando a caixa de verificação ☑ *Advançada* é activada, opções adicionais serão disponibilizadas:

- **Linhas** e **Colunas**: usada para mudar as dimensões do raster de saída. Esses valores estão também ligados aos valores **Tamanho de célula X** e **Tamanho de célula Y**. Aumentando o número de linhas ou colunas irá diminuir o tamanho de célula e aumenta o tamanho do ficheiro de saída. Os valores nas Linhas e Colunas também estão ligados, portanto duplicando o número de linhas irá automaticamente duplicar o número de colunas e o tamanho da célula irá passar para metade. A área geográfica do raster de saída irá ser o mesmo!

- **Tamanho da célula X** e **Tamanho da célula Y**: controle o tamanho geográfico de cada pixel para o raster de saída. Alterando estes valores irá também mudar o número de Linhas e Colunas do raster de saída.

- **Kernel shape**: The kernel shape controls the rate at which the influence of a point decreases as the distance from the point increases. Different kernels decay at different rates, so a triweight kernel gives features greater weight for distances closer to the point then the Epanechnikov kernel does. Consequently, triweight results in "sharper" hotspots, and Epanechnikov results in "smoother" hotspots. A number of standard kernel functions are available in QGIS, which are described and illustrated on Wikipedia.

- **Rácio de declínio**: pode ser usado com kerneis triangulares para maior controlo de como a densidade a partir dos elementos decrescem com a distância a partir do elemento.

  - O valor de 0 (=mínimo) indica que a densidade irá ser concentrada no centro do raio dado e será extinto no borda.

  - O valor de 0.5 inca que esses pixeis da borda do raio serão atribuídos metade da densidade dos pixeis que estão no raio do centro de pesquisa.

  - O valor de 1 refere que a densidade espalha-se por todo o raio do circulo de pesquisa. (Isto é equivalente ao kernel 'Uniforme').

  - Um valor maior que 1 indica que a densidade é mais alta para a borda do raio de pesquisa, e em seguida, no centro.

A camada de pontos de entrada pode ter também campos de atributos que podem afectar como influencia o mapa de densidade:

- **Usar o raio a partir do campo**: define o raio de pesquisa para cada elemento da camada de entrada.

- **Usar o peso a partir do campo**: permite a introdução de elementos para ser pesado por um campo de atributo. Isto pode ser usado para aumentar a influência de certos elementos existente no resultado de mapa de densidade.

Quando o nome do ficheiro matricial de saída é especificado, o botão **[OK]** pode ser usado para criar o mapa de densidade.

19.10.3 Tutorial: Criando um Mapa de Densidade

For the following example, we will use the `airports` vector point layer from the QGIS sample dataset (see *Amostra de Dados*). Another exellent QGIS tutorial on making heatmaps can be found at http://qgis.spatialthoughts.com.

Na Figure_Heatmap_1 estão demonstrados os aeroportos do Alaska.

1. Seleccione o botão da ferramenta |**hetmap**| *Mapa de Densidade* para abrir a janela do módulo Mapas de Densidades (veja Figure_heatmap_2).

2. In the *Input point layer* field, select `airports` from the list of point layers loaded in the current project.

3. Specify an output filename by clicking the button next to the *Output raster* field. Enter the filename `heatmap_airports` (no file extension is necessary).

4. Deixe o *Formato de Saída* o formato `GeoTIFF` como padrão.

5. Altere o *Raio* para `1000000` metros.

6. Clique em **[OK]** e carregue o mapa de temperatura dos aeroportos (veja Figure_Heatmap_3).
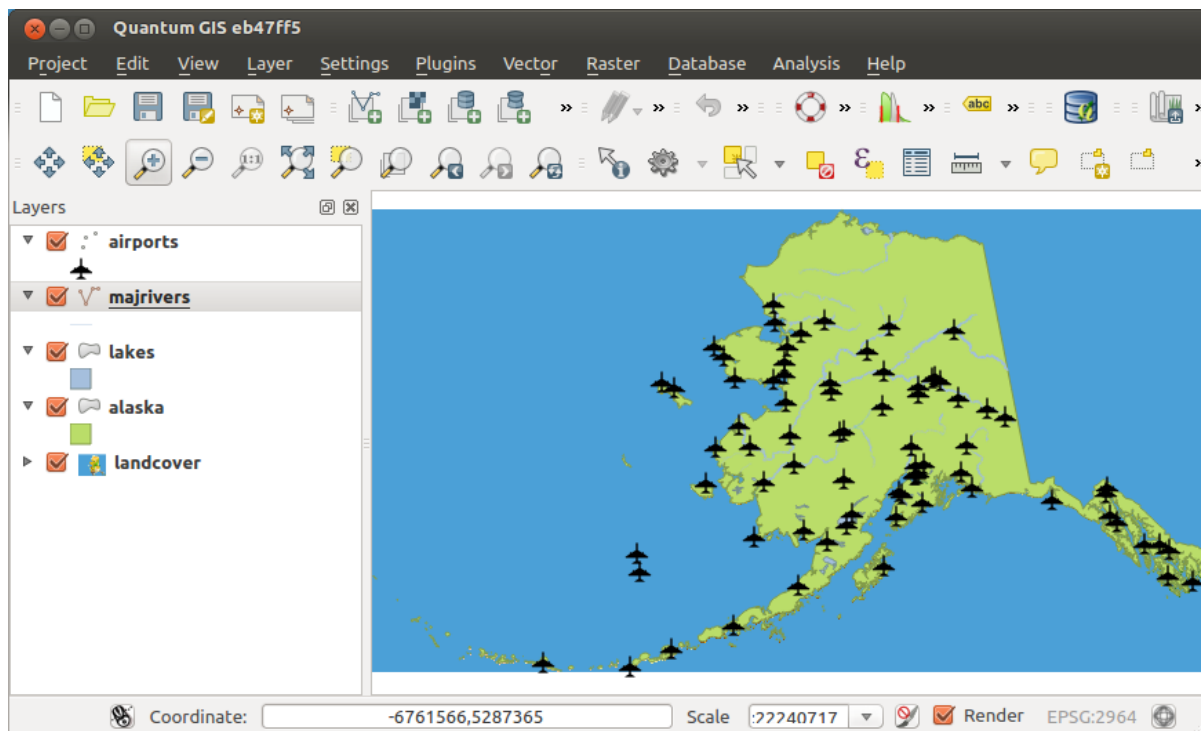
Figure 19.20: Airports of Alaska
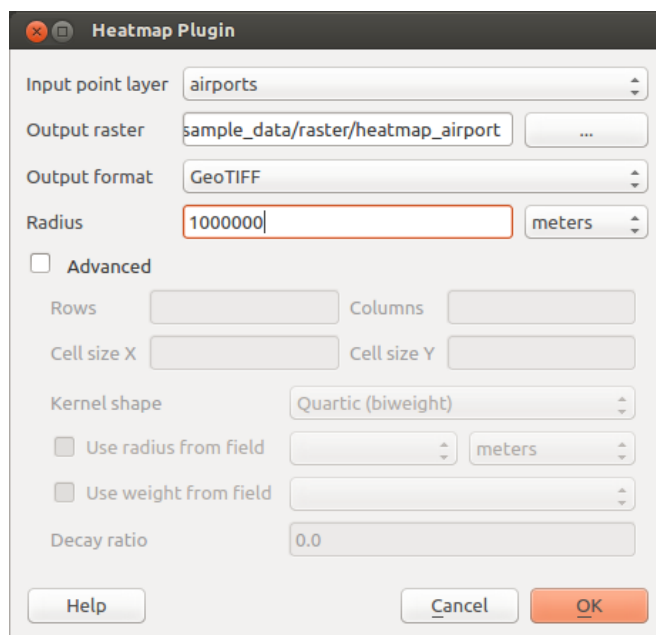
Figure 19.21: The Heatmap Dialog

QGIS will generate the heatmap and add the results to your map window. By default, the heatmap is shaded in greyscale, with lighter areas showing higher concentrations of airports. The heatmap can now be styled in QGIS to improve its appearance.
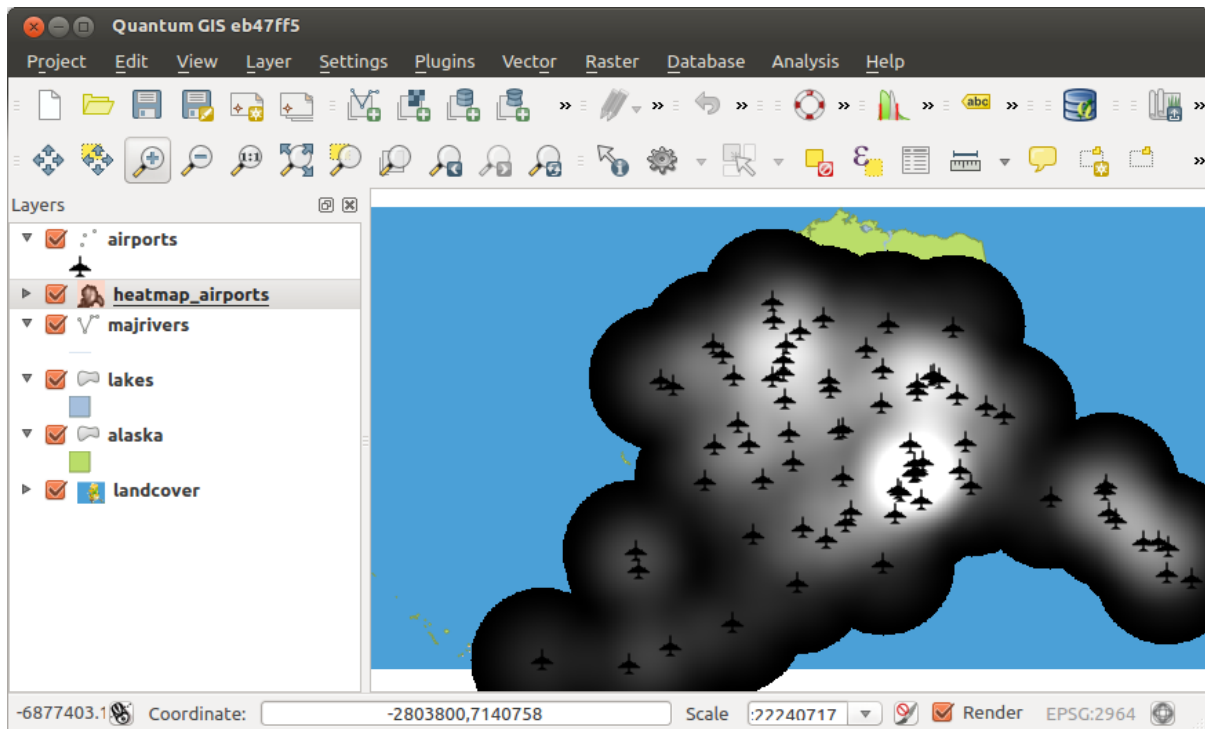
Figure 19.22: The heatmap after loading looks like a grey surface

1. Abra a janela de propriedades da camada do `heatmap_airports` (seleccione a camada `heatmap_airports`, abre o menu de contexto com o botão direito do rato e seleccione *Propriedades*).

2. Seleccione o separador *Estilo*.

3. Change the *Render type* [...▼] to 'Singleband pseudocolor'.

4. Select a suitable *Color map* [...▼], for instance `YlOrRed`.

5. Clique no botão **[Carregar]** para recolher os valores mínimos e máximos para cada matricial, de depois clique **no botão [Classificar]**.

6. Pressione **[OK]** para actualizar a camada.

O resultado final é demonstrado na Figure_Heatmap_4.

.

19.11 Módulo de Interpolação

The Interplation 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_1). The plugin requires the following parameters to be specified before running:

- Input **Vector layers**: Specify the input point vector layer(s) from a list of loaded point layers. If several layers are specified, then data from all layers is used for interpolation. Note: It is possible to insert lines or polygons as constraints for the triangulation, by specifying either "points", "structure lines" or "break lines" in the *Type* [...▼] combo box.
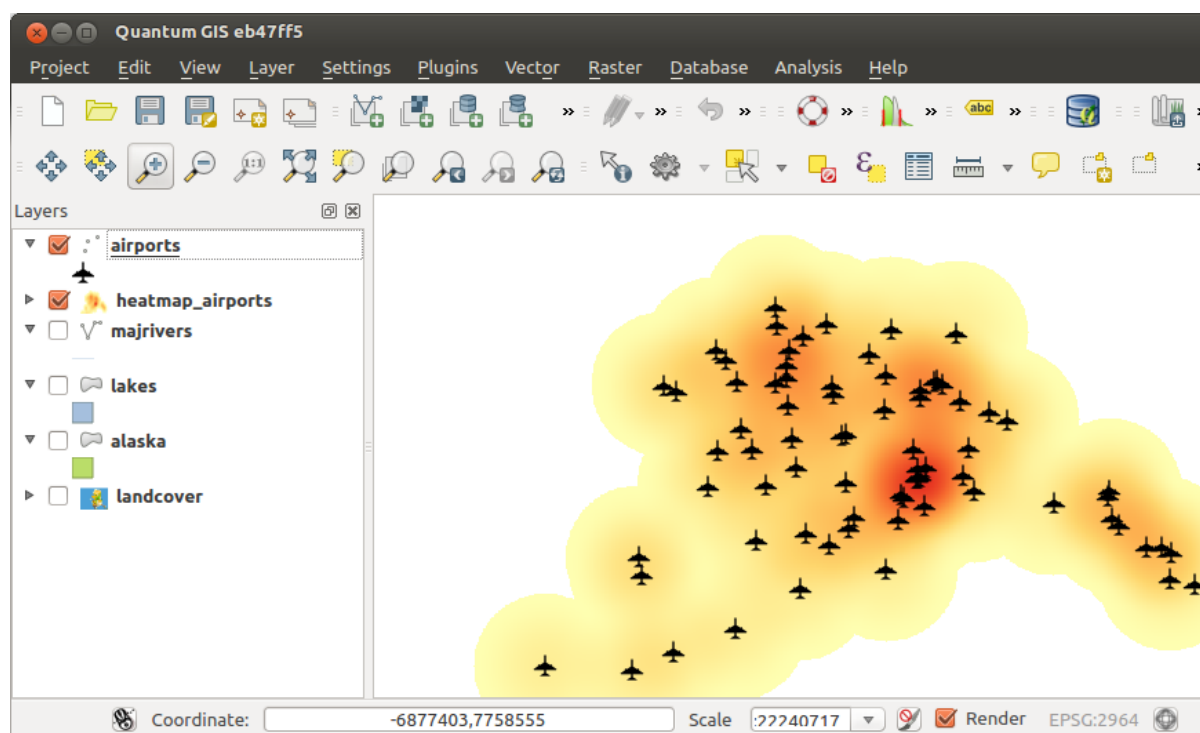
Figure 19.23: Styled heatmap of airports of Alaska

- **Interpolation attribute**: Select the attribute column to be used for interpolation or enable the ☑ *Use Z-Coordinate* checkbox to use the layer's stored Z values.

- **Interpolation Method**: Select the interpolation method. This can be either 'Triangulated Irregular Network (TIN)' or 'Inverse Distance Weighted (IDW)'. With the TIN method you can create a surface formed by triangles of nearest neighbour points. To do this, circumcircles around selected sample points are created and their intersections are connected to a network of non overlapping and as compact as possible triangles. The resulting surfaces are not smooth. When using the IDW method the sample points are weighted during interpolation such that the influence of one point relative to another declines with distance from the unknown point you want to create. The IDW interpolation method also has some disadvantages: the quality of the interpolation result can decrease, if the distribution of sample data points is uneven. Furthermore, maximum and minimum values in the interpolated surface can only occur at sample data points. This often results in small peaks and pits around the sample data points.

- **Number of columns/rows**: Specify the number of rows and columns for the output raster file.

- **Ficheiro de Saída**: Especifique o nome para o ficheiro raster de saída.

- ☑ *Adicionar resultado ao projecto* para carregar o resultado para o enquadramento do mapa.

Note that using lines as constraints for the interpolation the triangulation (TIN method) you can either use 'structure lines' or 'break lines'. When using 'break lines' you produce sharp breaks in the surface while using 'structure lines' you produce continous breaks. The triangulation is modified by both methods such that no edge crosses a breakline or structure line.

19.11.1 Usando o módulo

1. Start QGIS and load a point vector layer (e.g., `elevp.csv`).

2. Load the Interpolation plugin in the Plugin Manager (see *The Plugins Dialog*) and click on the *Raster* → *Interpolation* → 🖼️ *Interpolation* , which appears in the QGIS menu bar. The Interpolation plugin dialog appears as shown in Figure_interpolation_1.
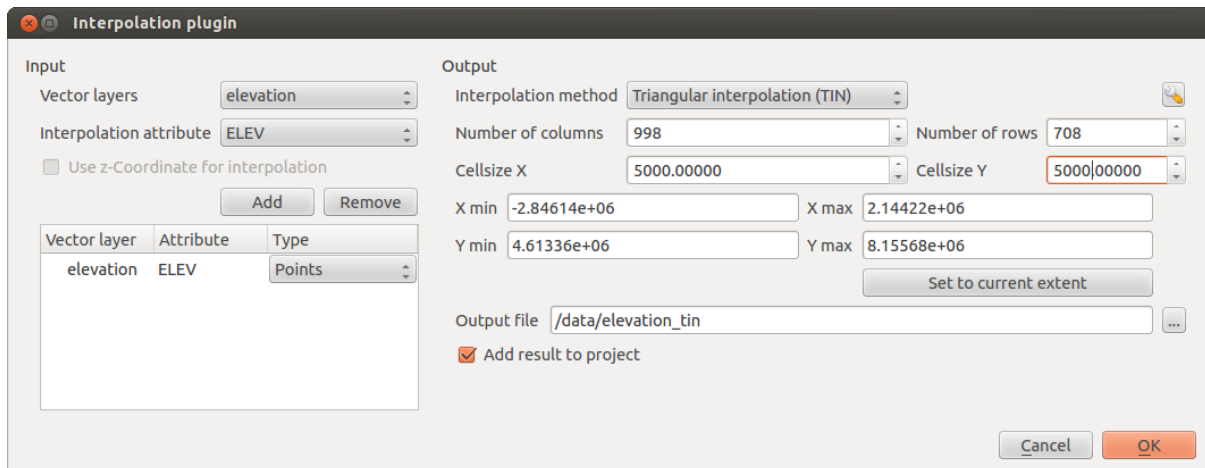
Figure 19.24: Interpolation Plugin 🐧

3. Select an input layer (e.g., *elevp* [...▼]) and column (e.g., `ELEV`) for interpolation.

4. Select an interpolation method (e.g., 'Triangulated Irregular Network (TIN)'), and specify a cell size of 5000 as well as the raster output filename (e.g., `elevation_tin`).

5. Clique **[OK]**.

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19.12 MetaSearch Catalogue Client
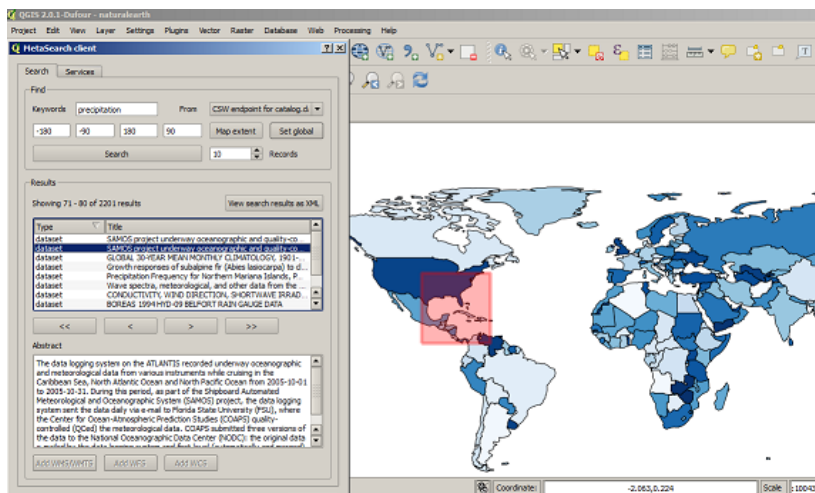
19.12.1 Introduction

MetaSearch is a QGIS plugin to interact with metadata catalogue services, supporting the OGC Catalogue Service for the Web (CSW) standard.

MetaSearch provides an easy and intuitive approach and user-friendly interface to searching metadata catalogues within QGIS.

19.12.2 Installation

MetaSearch is included by default with QGIS 2.0 and higher. All dependencies are included within MetaSearch.

Install MetaSearch from the QGIS plugin manager, or manually from http://plugins.qgis.org/plugins/MetaSearch.

19.12.3 Working with Metadata Catalogues in QGIS

CSW (Catalogue Service for the Web)

CSW (Catalogue 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.

Startup

To start MetaSearch, click the MetaSearch icon or select Web / MetaSearch / MetaSearch via the QGIS main menu. The MetaSearch dialog will appear. The main GUI consists of two tabs: 'Services' and 'Search'.

Managing Catalogue Services
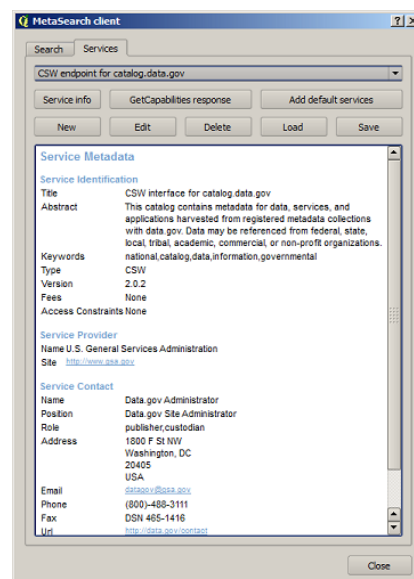
The 'Services' tab allows the user to manage all available catalogue services. MetaSearch provides a default list of Catalogue Services, which can be added by pressing 'Add default services' button.

To all listed Catalogue Service entries, click the dropdown select box.

To add a Catalogue 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 Catalogue 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 Catalogue 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
<?xml version="1.0" encoding="UTF-8"?>
<qgsCSWConnections version="1.0">
    <csw name="Data.gov CSW" url="http://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/geonetwo
    <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'.

The 'Service info' button displays information about the selected Catalogue 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 Catalogue Services
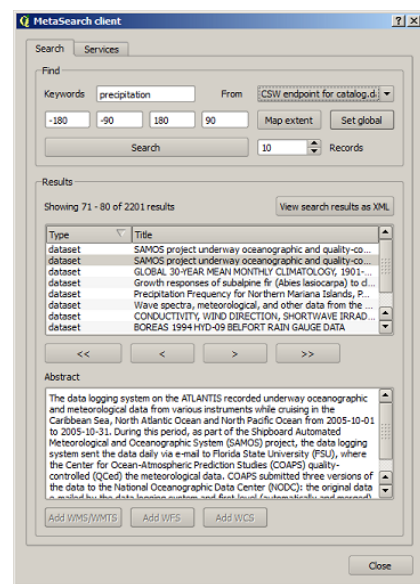
The 'Search' tab allows the user to query Catalogue Services for data and services, set various search parameters and view results.

The following search parameters are available:

- **Keywords**: free text search keywords
- **From**: the Catalogue Service to perform the query against
- **Bounding box**: the spatial area of interest to filter on. The default bounding box is the map view / canvas. Click 'Set global' to do a global search, or enter custom values as desired
- **Records**: the number of records to return when searching. Default is 10 records

Clicking the 'Search' button will search the selected Metadata Catalogue. 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 show the record's abstract in the 'Abstract' window and 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 dialogue will then appear
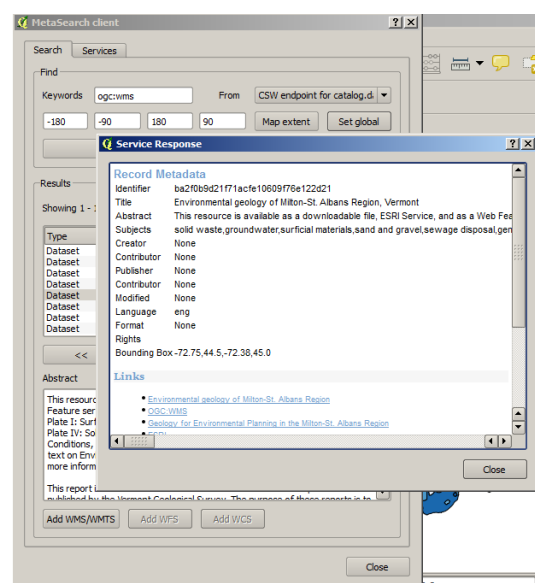
Settings

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 catalogues, the number of results to show per page

- **Timeout**: when searching metadata catalogues, the number of seconds for blocking connection attempt. Default value is 10

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19.13 Módulo Edição Offiline

For data collection, it is a common situation to work with a laptop or a cell phone offline in the field. Upon returning to the network, the changes need to be synchronized with the master datasource (e.g., a PostGIS database). If several persons are working simultaneously on the same datasets, it is difficult to merge the edits by hand, even if people don't change the same features.

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.

19.13.1 Usando o módulo

- Open some vector layers (e.g., from a PostGIS or WFS-T datasource).

- Save it as a project.

- 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.

- Edite as camadas offline.

- After being connected again, upload the changes using *Database → Offline Editing →* Synchronize.
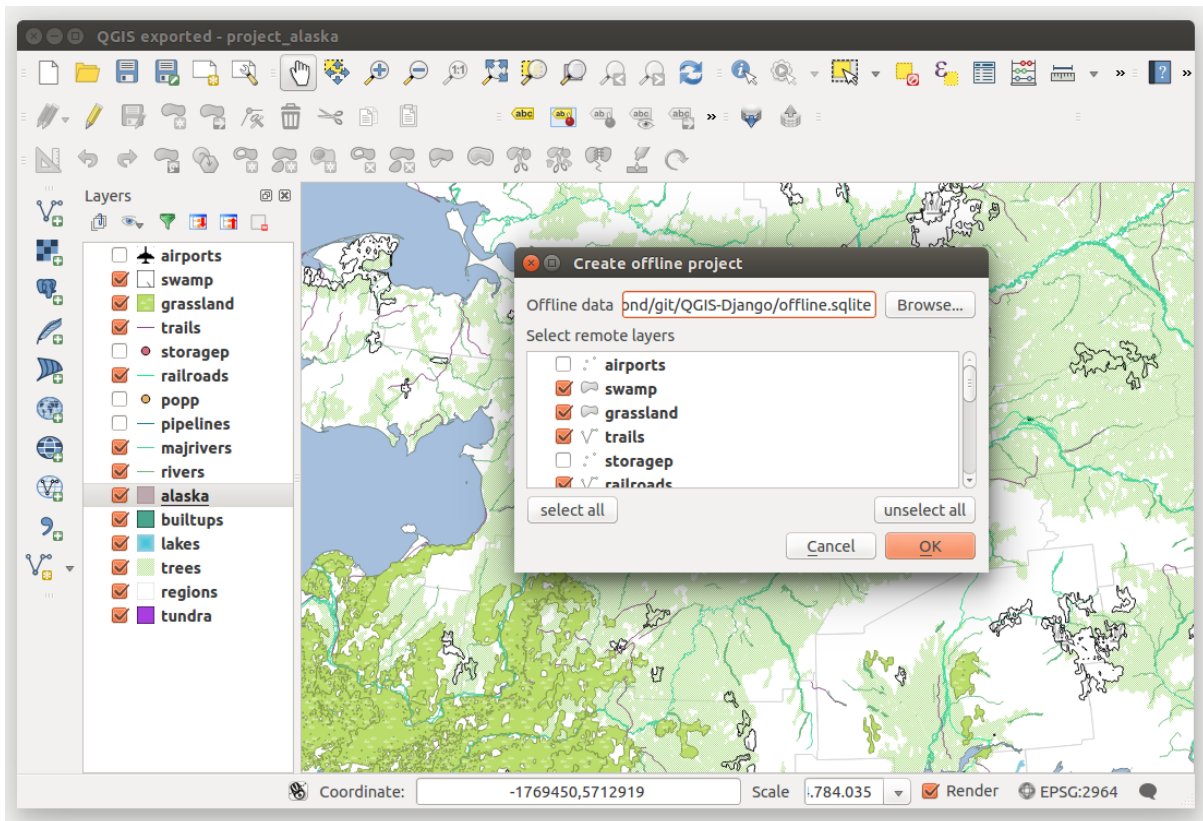
Figure 19.25: Criação de um projecto offline de camadas PostGIS ou WFS

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19.14 Módulo Oracle Spatial GeoRaster

In Oracle databases, raster data can be stored in SDO_GEORASTER objects available with the Oracle Spatial extension. In QGIS, the Oracle Spatial GeoRaster plugin is supported by GDAL and depends on Oracle's database product being installed and working on your machine. While Oracle is proprietary software, they provide their software free for development and testing purposes. Here is one simple example of how to load raster images to GeoRaster:

```
$ gdal_translate -of georaster input_file.tif geor:scott/tiger@orcl
```

Isto irá carregar o raster para a tabela padrão GDAL_IMPORT table, como coluna designada de RASTER.

19.14.1 Gerindo ligações

Firstly, the Oracle GeoRaster Plugin must be enabled using the Plugin Manager (see *The Plugins Dialog*). The first time you load a GeoRaster in QGIS, you must create a connection to the Oracle database that contains the data. To do this, begin by clicking on the Add Oracle GeoRaster Layer toolbar button – this will open the *Select Oracle Spatial GeoRaster* dialog window. Click on **[New]** to open the dialog window, and specify the connection parameters (See Figure_oracle_raster_1):

- **Nome**: Introduza um nome para a ligação de base de dados.

- **Instância da Base de Dados**: Introduza o nome das bases de dados que se irá ligar.

- **Nome de Utilizador**: Especifique o seu nome de utilizador que irá usar para aceder à base de dados.

- **Palavra-chave**: A palavra-chave associada ao seu nome de utilizador que é requerido ao acesso à base de dados.
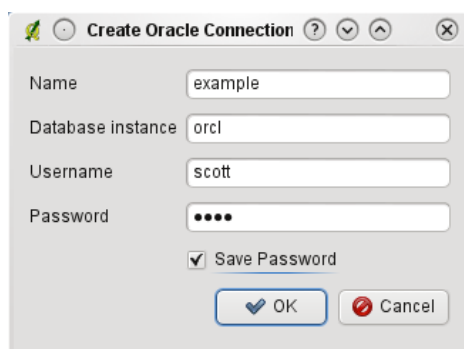
Figure 19.26: Janela de Criação de Ligação Oracle

Agora, volte à janela principal *Oracle Spatial GeoRaster* (veja Figure_oracle_raster_2), use a lista drop-down para escolher uma ligação, e use o botão **[Ligar]** para estabelecer a ligação. Pode também **[Editar]** a ligação, abrindo a janela anterior e efectuar alterações na informação da ligação, ou usar o botão **[Apagar]** para remover a ligação da lista drop-down.

19.14.2 Seleccionando um GeoRaster

Uma vez a ligação estar estabelecida, a janela exibirá os nomes dos sub-conjunto de dados de todas as tabelas que contêm as colunas GeoRaster nessa base de dados no formato de um nome do subconjunto de dados GDAL.

Clique num dos subconjuntos de dados listados e de seguida clique em **[Seleccionar]** para escolher o nome da tabela. Agora, outra lista de subconjunto de dados irá mostrar os nomes das colunas GeoRaster nessa tabela. Geralmente costuma ser uma lista pequena, uma vez que a maioria dos utilizadores não irá ter mais de um ou duas colunas GeoRaster na mesma tabela.

Clique numa dos subconjuntos de dados listados e depois clique em **[Seleccionar]** para escolher uma das combinações tabela/coluna. A janela irá agora mostrar todas as linhas que contêm os objectos GeoRaster. Repare que essa lista de subconjuntos de dados irá agora aparecer em pares a Tabela de dados e Id's do Raster.

A qualquer altura a entrada de Selecção pode ser editada de forma a ir directamente a um GeoRaster conhecido ou voltar para o princípio e seleccionar outro nome da tabela.

A entrada de Selecção de dados pode ser também usada para introduzir cláusulas `WHERE` no fim da string de identificação (ex.: `geor:scott/tiger@orcl,gdal_import,raster,geoid=`). Veja http://www.gdal.org/frmt_georaster.html para mais informação.

19.14.3 Exibindo o GeoRaster

Finally, by selecting a GeoRaster from the list of Raster Data Tables and Raster Ids, the raster image will be loaded into QGIS.

A janela *Seleccionar Oracle Spatial GeoRaster* pode ser agora fechada e na próxima vez que abrir irá manter a mesma ligação, e irá mostrar previamente a mesma lista do subconjunto de dados tornando-se assim mais fácil abrir outra imagem do mesmo contexto.

Note: GeoRasters that contain pyramids will display much faster, but the pyramids need to be generated outside of QGIS using Oracle PL/SQL or gdaladdo.

O seguinte é um exemplo usando `gdaladdo`:
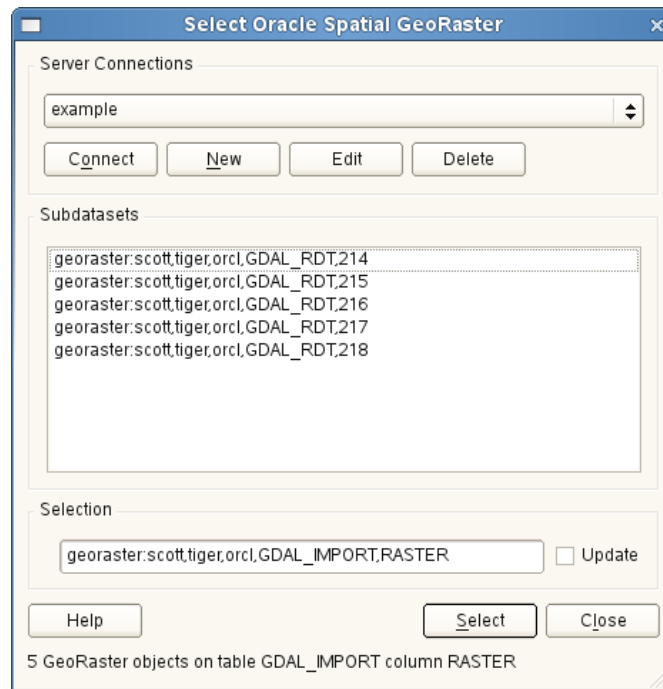
Figure 19.27: Janela de Selecção Oracle GeoRaster

```
gdaladdo georaster:scott/tiger@orcl,georaster\_table,georaster,georid=6 -r
nearest 2 4 6 8 16 32
```

Este é um exemplo 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;
```

.

19.15 Módulo de Análise do Terreno Matricial

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_1).

Descrição das análises:

- **Declive**: Calcula o ângulo de declive para cada célula em graus (baseado na primeira derivada de estimação).

- **Exposições**: Exposição (começando com o 0 para direcção norte, em graus contra-relógio).

- **Hillshade**: Creates a shaded map using light and shadow to provide a more three-dimensional appearance for a shaded relief map. The output map is a Single band gray reflecting the gray value of the pixels.

- **Índice de Rugosidade**: Medição quantitativa da heterogeneidade do terreno como é descrito por Riley et al. (1999). É calculado para cada localização, pelo resumo da alteração da elevação dentro de uma grelha

de 3x3 pixeis.

- **Relief**: Creates a shaded relief map from digital elevation data. Implemented is a method to choose the elevation colors by analysing the frequency distribution. The output map is a multiband color with three bands reflecting the RGB values of the shaded relief.
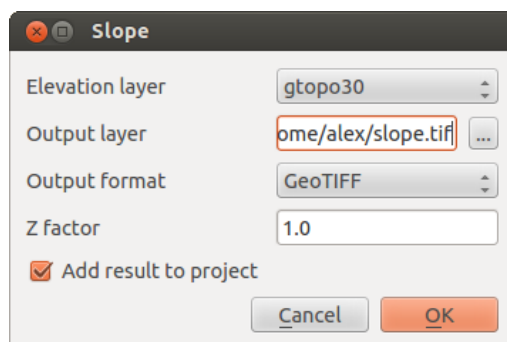
Figure 19.28: Módulo Modelação Matricial do Terreno (cálculo do declive)

19.15.1 Usando o módulo

1. Start QGIS and load the `gtopo30` raster layer from the GRASS sample location.

2. Carregue o módulo de Análise do Terreno Raster no Gestor de Módulos (veja *The Plugins Dialog*).

3. Seleccione um método de análise do menu (ex.: *Raster → Análises do Terreno → Declive*). A janela *Declive* aparece como é mostrado na Figure_raster_terrain_1.

4. Especifique um caminho de saída do ficheiro, e o tipo de ficheiro.

5. Clique **[OK]**.

.

19.16 Módulo de Cálculo de Rotas

The Road Graph Plugin is a C++ plugin for QGIS that calculates the shortest path between two points on any polyline layer and plots this path over the road network.

Características principais:

- Calcula o caminho, o seu comprimento e o tempo de viagem.

- Optimiza por comprimento ou por tempo de viagem.

- Exporta o caminho para uma camada vectorial.

- Destaca as direcções na estrada (isto é lento e usado principalmente para fins de depuração e para testes de configuração).

As a roads layer, you can use any polyline vector layer in any QGIS-supported format. Two lines with a common point are considered connected. Please note, it is required to use layer CRS as project CRS while editing a roads layer. This is due to the fact that recalculation of the coordinates between different CRSs introduces some errors that can result in discontinuities, even when 'snapping' is used.

Na tabela de atributos da camada os seguintes campos podem ser usados:

- Velocidade na secção da rede viária (campo númerico).

- direcção (qualquer tipo, que possa ser usada para string). Direcções com avanço e recuo corresponde a uma estrada de sentido único, para ambas as direcções corresponde a estradas de dois sentidos.
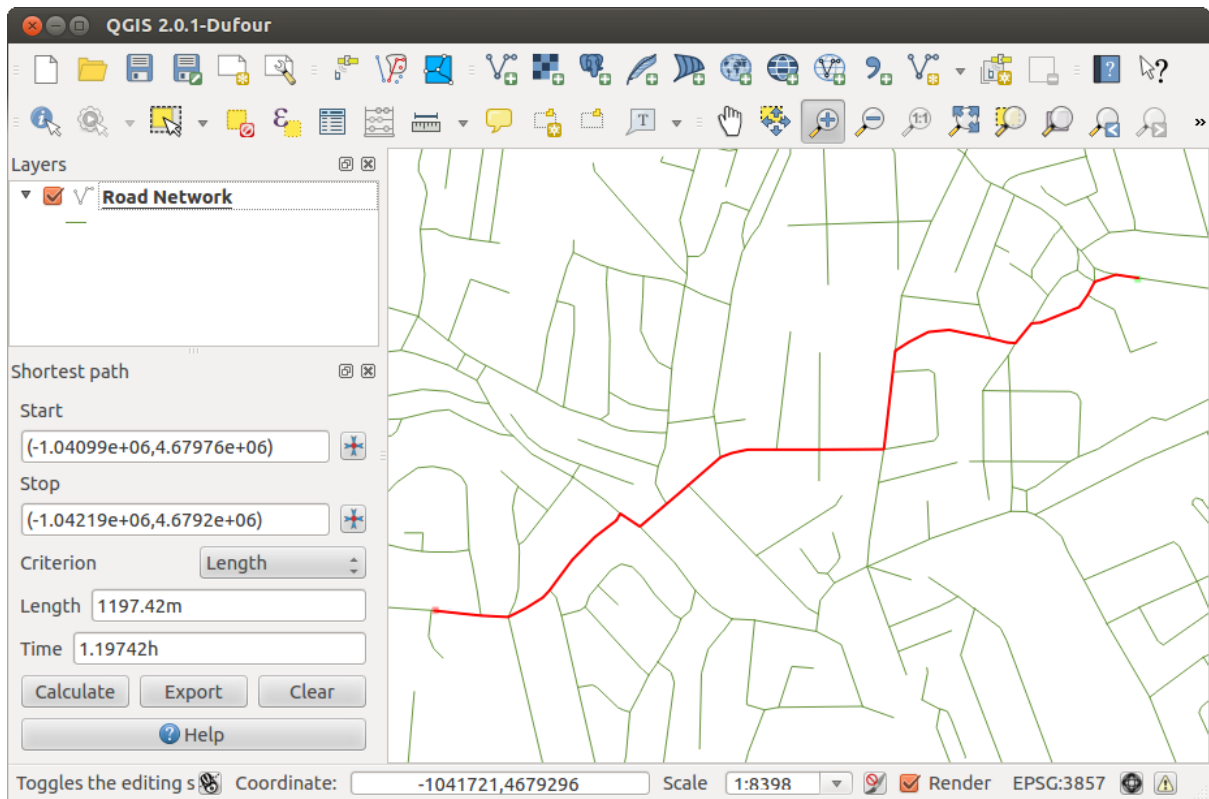
Figure 19.29: Road Graph Plugin

Se alguns campos não tiverem qualquer valor ou não existam serão usados valores por defeito. Pode mudar os valores por defeito e algumas configurações na janela de configurações do módulo.

19.16.1 Usando o módulo

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_2).

Após configurar a *Unidade de tempo*, *Unidade de distância* e *Tolerância da topologia* pode escolher a camada vectorial no separador *Camada de Transportação*. Aqui pode também escolher *Campo de direcção* e o *Campo da velocidade* . No separador *Configurações padrão*'pode definir :guilabel:'Direcção para o cálculo.

Finalmente no painel :guilabel:`Caminho mais curto`seleccione um ponto de Iniciar e Parar na camada de rede viária e clique em **[Calcular]**.

.

19.17 Módulo de Consulta Espacial

The Spatial Query Plugin allows you to make a spatial query (i.e., select features) in a target layer with reference to another layer. The functionality is based on the GEOS library and depends on the selected source feature layer.

Os operadores possíveis são:

- Contém
- Igual
- Sobrepõe-se
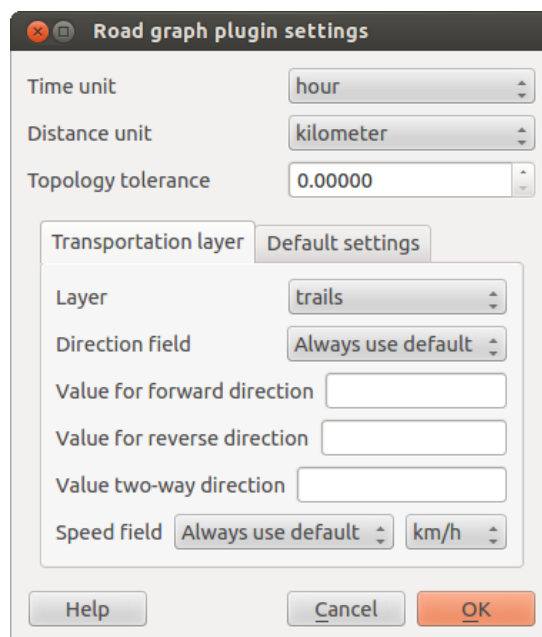
Figure 19.30: Road graph plugin settings

- Cruza

- Instersecta

- É separado

- Toca

- Dentro de

19.17.1 Usando o módulo

Como exemplo, nós queremos encontrar as regiões no conjunto de dados do Alaska que contém os aeroportos. Os seguintes passos são necessários:

1. Start QGIS and load the vector layers `regions.shp` and `airports.shp`.

2. Load the Spatial Query plugin in the Plugin Manager (see *The Plugins Dialog*) and click on the Spatial Query icon, which appears in the QGIS toolbar menu. The plugin dialog appears.

3. Seleccione a camada `regions` como camada fonte e `airports` como camada de elementos referência.

4. Seleccione 'Contém' como operador e clique **[Aplicar]**.

Agora obtém uma lista de elementos ID da consulta e tem várias opções como é mostrado na figure_spatial_query_1.

- Click on Create layer with list of items.

- Select an ID from the list and click on Create layer with selected.

- Select 'Remove from current selection' in the field *And use the result to* .

- You can *Zoom to item* or display *Log messages*.

- Additionally in *Result Feature ID's* with the options 'Invalid source' and 'Invalid reference' you can have a look at features with geometries errors. These features aren't used for the query.

.
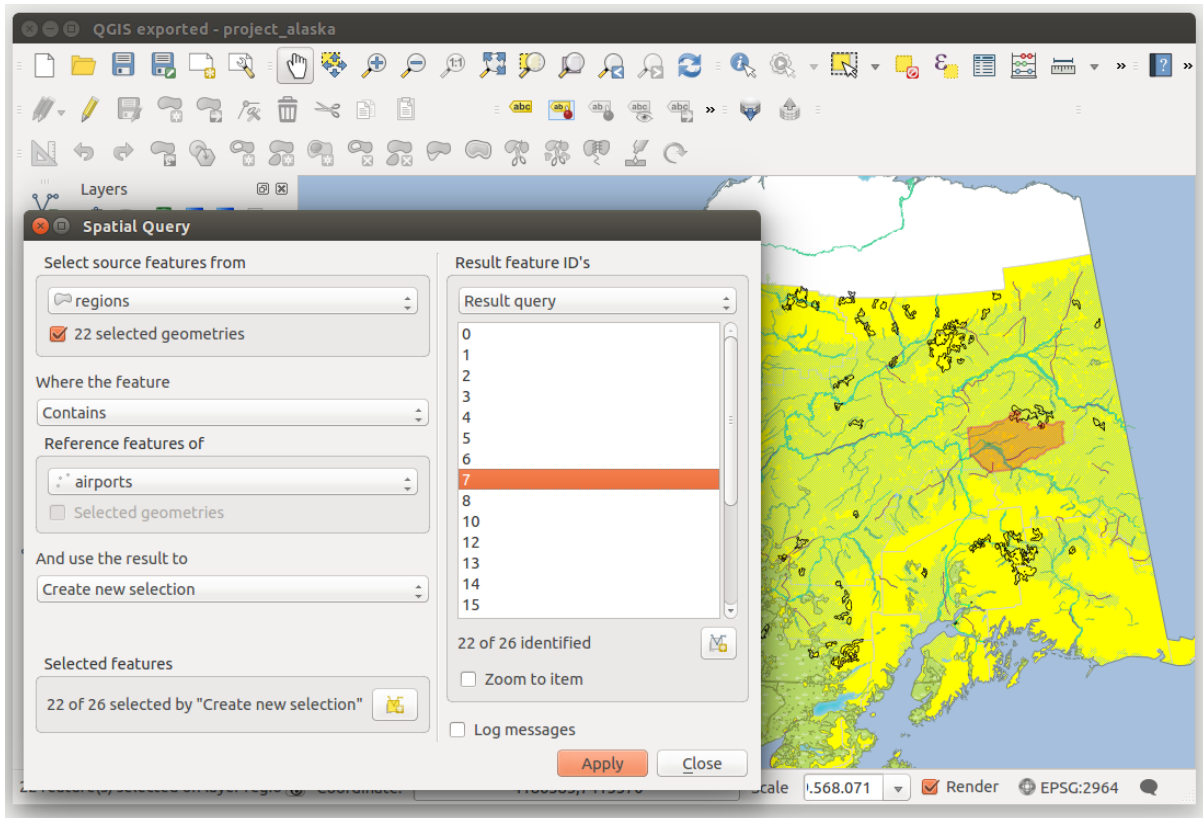
Figure 19.31: Spatial Query analysis - regions contain airports

19.18 Módulo SPIT

QGIS comes with a plugin named SPIT (Shapefile to PostGIS Import Tool). SPIT can be used to load multiple shapefiles at one time and includes support for schemas. To use SPIT, open the Plugin Manager from the *Plugins* menu, in the Installed menu check the box next to the SPIT and click **[OK]**.

To import a shapefile, use *Database → Spit → Import Shapefiles to PostgreSQL* from the menu bar to open the *SPIT - Shapefile to PostGIS Import Tool* dialog. Select the PostGIS database you want to connect to and click on **[Connect]**. If you want, you can define or change some import options. Now you can add one or more files to the queue by clicking on the **[Add]** button. To process the files, click on the **[OK]** button. The progress of the import as well as any errors/warnings will be displayed as each shapefile is processed.

19.19 Módulo Verificador de Topologia

A topologia descreve as relações entre pontos, linhas e polígonos que representam elementos de uma região geográfica. Com o módulo Verificador de Topologia pode ver os seus ficheiros vetoriais e verificar a topologia com várias regras topológicas. Estas regras verificam, através de relações espaciais, se qualquer daqueles elementos 'Iguala', 'Contém', 'Abrange', é 'AbrangidoPor', 'Cruza', é 'DijuntoDe', 'Intersecta', se 'SobrepõeA', 'Toca' ou 'EstáContidoEm' outro(s) elemento(s). Das suas questões individuais dependerão as regras topológicas a aplicar aos seus dados vetoriais (ex: normalmente não aceitará ultrapassagens na junção de linhas, mas, se aquelas figurarem becos ou ruas sem saída, então já não irá removê-las da sua camada vetorial).

QGIS has a built-in topological editing feature, which is great for creating new features without errors. But existing data errors and user-induced errors are hard to find. This plugin helps you find such errors through a list of rules.

É muito simples para criar regras topológicas com o módulo Verificador de Topologia

Nas **camadas do tipo vector** as seguintes regras estão disponíveis:
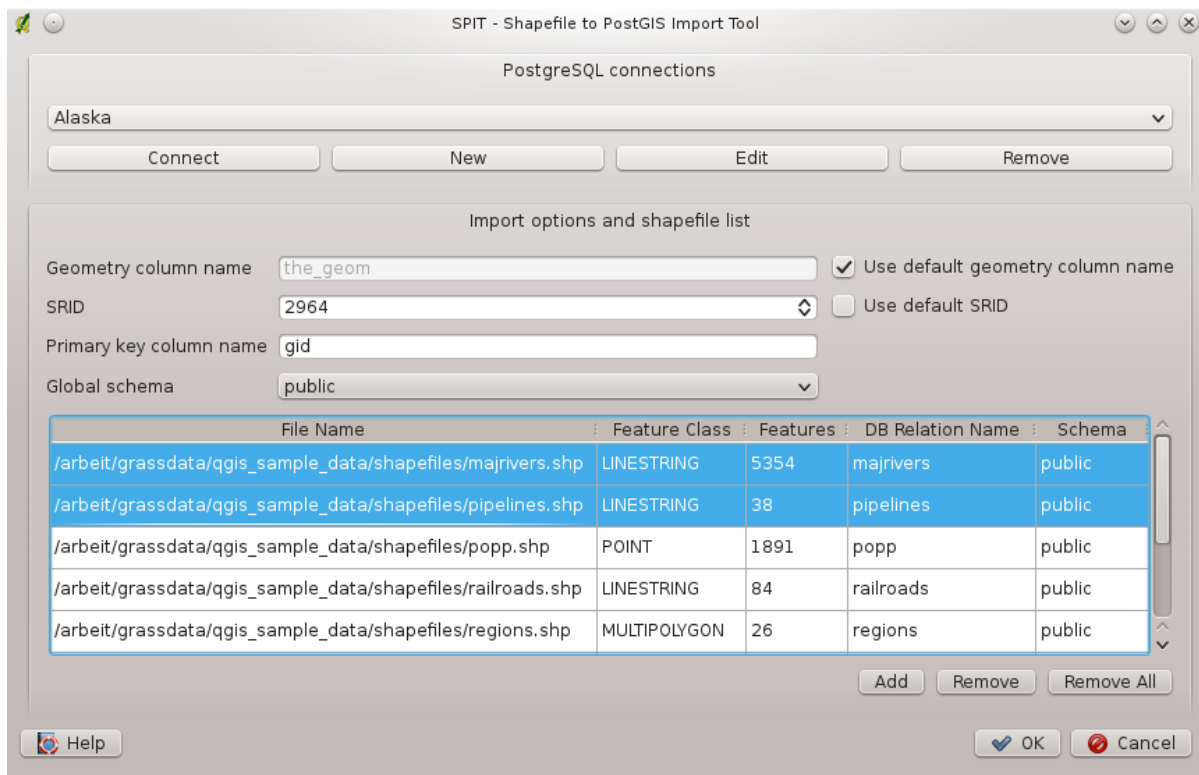
Figure 19.32: Usando o Módulo SPIT para importar Shapefiles para PostGIS
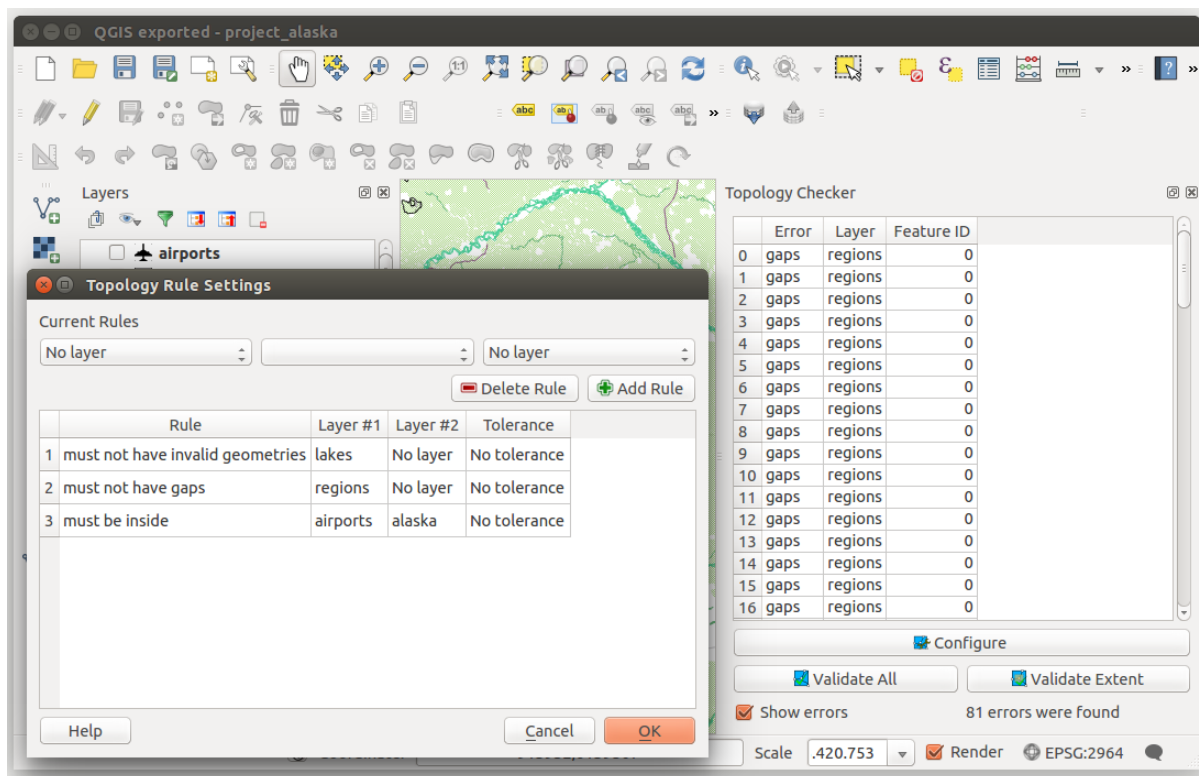
Figure 19.33: O Módulo Verificador de Topologia

- **Must be covered by**: Here you can choose a vector layer from your project. Points that aren't covered by the given vector layer occur in the 'Error' field.

- **Must be covered by endpoints of**: Here you can choose a line layer from your project.

- **Must be inside**: Here you can choose a polygon layer from your project. The points must be inside a polygon. Otherwise, QGIS writes an 'Error' for the point.

- **Must not have duplicates**: Whenever a point is represented twice or more, it will occur in the 'Error' field.

- **Must not have invalid geometries**: Checks whether the geometries are valid.

- **Must not have multi-part-geometries**: All multi-part points are written into the 'Error' field.

On **line layers**, the following rules are available:

- **End points must be covered by**: Here you can select a point layer from your project.

- **Must not have dangles**: This will show the overshoots in the line layer.

- **Must not have duplicates**: Whenever a line feature is represented twice or more, it will occur in the 'Error' field.

- **Must not have invalid geometries**: Checks whether the geometries are valid.

- **Must not have multi-part geometries**: Sometimes, a geometry is actually a collection of simple (single-part) geometries. Such a geometry is called multi-part geometry. If it contains just one type of simple geometry, we call it multi-point, multi-linestring or multi-polygon. All multi-part lines are written into the 'Error' field.

- **Must not have pseudos**: A line geometry's endpoint should be connected to the endpoints of two other geometries. If the endpoint is connected to only one other geometry's endpoint, the endpoint is called a psuedo node.

On **polygon layers**, the following rules are available:

- **Must contain**: Polygon layer must contain at least one point geometry from the second layer.

- **Must not have duplicates**: Polygons from the same layer must not have identical geometries. Whenever a polygon feature is represented twice or more it will occur in the 'Error' field.

- **Must not have gaps**: Adjacent polygons should not form gaps between them. Administrative boundaries could be mentioned as an example (US state polygons do not have any gaps between them...).

- **Must not have invalid geometries**: Checks whether the geometries are valid. Some of the rules that define a valid geometry are:

    - Os anéis do polígono devem estar fechados.

    - Anéis que definem buracos devem estar dentro de anéis que definem os limites exteriores.

    - Os anéis não se podem intersectar a si mesmo (nem mesmo tocar ou cruzar um no outro).

    - Os anéis não podem tocar outros anéis, à excepção de um ponto.

- **Must not have multi-part geometries**: Sometimes, a geometry is actually a collection of simple (single-part) geometries. Such a geometry is called multi-part geometry. If it contains just one type of simple geometry, we call it multi-point, multi-linestring or multi-polygon. For example, a country consisting of multiple islands can be represented as a multi-polygon.

- **Must not overlap**: Adjacent polygons should not share common area.

- **Must not overlap with**: Adjacent polygons from one layer should not share common area with polygons from another layer.

.

19.20 Módulo de Estatística Zonal

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 fig-ure_zonal_statistics). You can calculate the sum, the mean value and the total count of the pixels that are within a polygon. The plugin generates output columns in the vector layer with a user-defined prefix.
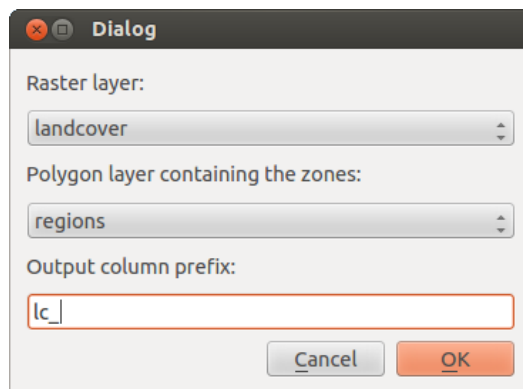
Figure 19.34: Zonal statistics dialog (KDE)

.

Ajuda e Suporte

20.1 Listas de Discussão

QGIS is under active development and as such it won't always work like you expect it to. The preferred way to get help is by joining the qgis-users mailing list. Your questions will reach a broader audience and answers will benefit others.

20.1.1 qgis-users

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

20.1.2 fossgis-talk-liste

For the German-speaking audience, the German FOSSGIS e.V. provides the fossgis-talk-liste mailing list. This mailing list is used for discussion of open-source GIS in general, including QGIS. You can subscribe to the fossgis-talk-liste mailing list by visiting the following URL: https://lists.fossgis.de/mailman/listinfo/fossgis-talk-liste

20.1.3 qgis-developer

Se não for um programador que está a enfrentar problemas de natureza técnica, vai desejar juntar-se À lista de discussão qgis-developer aqui: http://lists.osgeo.org/mailman/listinfo/qgis-developer

20.1.4 qgis-commit

Each time a commit is made to the QGIS code repository, an email is posted to this list. If you want to be up-to-date with every change to the current code base, you can subscribe to this list at: http://lists.osgeo.org/mailman/listinfo/qgis-commit

20.1.5 qgis-trac

A lista fornece notificações de email relacionadas com a gestão do projecto, incluindo relatórios de erros, tarefas, pedidos de novas características. Pode subscrever esta lista em: http://lists.osgeo.org/mailman/listinfo/qgis-trac

20.1.6 qgis-community-team

Esta lista lida com tópicos como a documentação, conteúdos de ajuda, manual de utilizador, experiência online incluindo sítios na internet, blogues, listas de discussão, fóruns, e apoio nas traduções. Se também desejar trabalhar no guia de utilizador, esta lista é boa para começar a fazer perguntas para as suas questões. Pode subscrever na lista em: http://lists.osgeo.org/mailman/listinfo/qgis-community-team

20.1.7 qgis-release-team

Esta lista lida com os tópicos relacionados com os processos de lançamento, empacotamento de binários para os vários SO e anúncio de novos lançamentos para o mundo. Pode subscrever esta lista em: http://lists.osgeo.org/mailman/listinfo/qgis-release-team

20.1.8 qgis-tr

This list deals with the translation efforts. If you like to work on the translation of the 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

20.1.9 qgis-edu

This list deals with QGIS education efforts. If you would like to work on QGIS education materials, 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-edu

20.1.10 qgis-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

You are welcome to subscribe to any of the lists. Please remember to contribute to the list by answering questions and sharing your experiences. Note that the qgis-commit and qgis-trac lists are designed for notification only and are not meant for user postings.

20.2 IRC

Nós também mantemos um IRC - visite-nos ao juntar-se no canal #qgis no irc.freenode.net. Por favor espere por uma resposta para a sua questão porque as outras pessoas do canal podem estar a fazer outras coisas que podem demorar um pouco a repararem na sua questão. Se perder a discussão no IRC, não é problema! Nós registamos toda a discussão, portanto é fácil estar actualizado. Vá a http://qgis.org/irclogs and read the IRC-logs.

Suporte comercial para o QGIS está também disponível. Verifique o sítio na internet http://qgis.org/en/commercial-support.html for more information.

20.3 BugTracker

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 tenha em atenção que o seu erro pode nem sempre ter a prioridade que deseja (vai depender da severidade). Alguns erros podem requer esforços significativos de programadores para remediar e a mão-de-obra nem sempre está disponível para isso.

Os pedidos de novas características também podem ser submetidos usando o mesmo sistema de senhas que é usado para os erros. Por favor certifique-se que selecciona o tipo `Feature`.

If you have found a bug and fixed it yourself, you can submit this patch also. Again, the lovely redmine ticketsystem at http://hub.qgis.org/wiki/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.

20.4 Blogue

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!

20.5 Módulos

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'.

20.6 Wiki

Finalmente, nós mantemos uma página WIKI em http://hub.qgis.org/projects/quantum-gis/wiki onde pode encontrar uma variedade de informação útil relacionada com o desenvolvimentos so QGIS, planos de lançamento, hiperligações para sítios de transferência, mensagens de dicas de tradução entre outros. Dê uma vista de olhos, tem lá boas explicações!

.

Apêndice

21.1 Licença Geral Pública GNU

Versão 2, Junho de 1991

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Renderer_Categorized, 85
Renderer_Graduated, 85
Renderer_Point_Displacement, 87
Renderer_Single_Symbol, 83
Rendering halting, 34
rendering update during drawing, 35
Rendering_Mode, 234
Rendering_Rule-based, 87
Renderização, 33
Renderização dependente da escala, 34
Revert_Layout_Actions, 259
ring polygons, 123
Rotate_Point_symbols, 125
Rotated_North_Arrow, 241
Rule-based_Rendering, 87

SC, 57
SC_Prédefinido, 60
SC_prédefinido, 57
Search_Radius, 117
Secured_OGC_Authentication, 157
Selecionar_usando_Consulta, 134
Serviço de Cobertura Web, 157
SFS, 149
Shapefile, 65
Shapefile_to_Postgis_Import_Tool, 310
Shared_Polygon_Boundaries, 118
shp2pgsql, 72
Simbologia, 92, 139
Single_Symbol_Renderer, 83
Sistema_de_Coordenadas, 57
SLD, 158
SLD/SE, 158
Snapping_On_Intersections, 118
Snapping_Tolerance, 116
Spatialite, 74
Spatialite_Manager, 75
SPIT, 310
Split_Features, 124
SQLite, 74
SRC, 153
ST_Shift_Longitude, 74

teclas de direcções para mover, 32
Tiger_Format, 68
Toggle Editing, 119
Topological_Editing, 118
Três_Bandas_Cor_Raster, 139
Transparência, 143

UK_National_Transfer_Format, 68
US_Census_Bureau, 68

Vértice, 120
Vértices, 120
visibilidade da camada, 29

WCS, 149, 157
WFS, 149, 157

WFS-T, 157
WFS_Transactional, 157
WKT, 57, 121
WMS, 149
WMS-C, 154
WMS_1.3.0, 157
WMS_client, 149
WMS_identify, 155
WMS_layer_transparency, 153
WMS_metadata, 155
WMS_properties, 155
WMS_tiles, 154
WMTS, 154
WMTS_client, 149
Work_with_Attribute_Table, 128

Zoom_In Zoom_Out, 117