Quantum GIS

User Guide

Version 1.4.0 *'Enceladus'*

Préambule

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This document has been typeset with LaTeX. It is available as LaTeX source code via subversion and online as PDF document via http://qgis.osgeo.org/documentation/manuals.html. Translated versions of this document can be downloaded via the documentation area of the QGIS project as well. For more information about contributing to this document and about translating it, please visit: http://www.qgis.org/wiki/

Links in this Document

This document contains internal and external links. Clicking on an internal link moves within the document, while clicking on an external link opens an internet address. In PDF form, internal links are shown in blue, while external links are shown in red and are handled by the system browser. In HTML form, the browser displays and handles both identically.

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Internet: http://qgis.osgeo.org

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Foreword

Welcome to the wonderful world of Geographical Information Systems (GIS)! Quantum GIS (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://www.trolltech.com) and C++. This means that QGIS feels snappy to use and has a pleasing, easy-to- use graphical user interface (GUI).

QGIS aims to be an easy-to-use GIS, providing common functions and features. The initial goal 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 (see Appendix **??** for a full list of currently supported data formats).

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 **??**.

Tip QGIS 1 UP-TO-DATE DOCUMENTATION

The latest version of this document can always be found at http://download.osgeo.org/qgis/doc/manual/, or in the documentation area of the QGIS website at http://qgis.osgeo.org/documentation/

Features

QGIS offers many common GIS functionalities provided by core features and plugins. As a short summary they are presented in six categories to gain a first insight.

View data

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

- spatially-enabled PostgreSQL tables using PostGIS, vector formats supported by the installed OGR library, including ESRI shapefiles, MapInfo, SDTS and GML (see Appendix **??** for the complete list) .
- Raster and imagery formats supported by the installed GDAL (Geospatial Data Abstraction Library) library, such as GeoTiff, Erdas Img., ArcInfo Ascii Grid, JPEG, PNG (see Appendix **??** for the complete list).
- SpatiaLite databases (see Section **??**)
- GRASS raster and vector data from GRASS databases (location/mapset),
- Online spatial data served as OGC-compliant Web Map Service (WMS) or Web Feature Service (WFS),
- OpenStreetMap data.

Explore data and compose maps

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

- on the fly projection
- map composer
- overview panel
- spatial bookmarks
- identify/select features
- edit/view/search attributes
- feature labeling
- change vector and raster symbology
- add a graticule layer now via fTools plugin
- decorate your map with a north arrow scale bar and copyright label

- save and restore projects

Create, edit, manage and export data

You can create, edit, manage and export vector maps in several formats. Raster data have to be imported into GRASS to be able to edit and export them into other formats. QGIS offers the following:

- digitizing tools for OGR supported formats and GRASS vector layer
- create and edit shapefiles and GRASS vector layers
- geocode images with the Georeferencer plugin
- 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)
- visualize and edit OpenStreetMap data
- create PostGIS layers from shapefiles with the SPIT plugin
- improved handling of PostGIS tables
- manage vector attribute tables with the new attribute table (see Section **??**) or Table Manager plugin
- save screenshots as georeferenced images

Analyse data

You can perform spatial data analysis on PostgreSQL/PostGIS and other OGR supported formats using the fTools python plugin. 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 300 modules (See Section **??**).

Publish maps on the internet

QGIS can be used to export data to a mapfile and to publish them on the internet using a webserver with UMN MapServer installed. QGIS can also be used as a WMS or WFS client, and as WMS server.

Extend QGIS functionality through plugins

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

Core Plugins

1. Add Delimited Text Layer (Loads and displays delimited text files containing x,y coordinates)
2. Coordinate Capture (Capture mouse coordinates in different CRS)
3. Decorations (Copyright Label, North Arrow and Scale bar)
4. Diagram Overlay (Placing diagrams on vector layer)
5. Dxf2Shp Converter (Convert DXF to Shape)
6. GPS Tools (Loading and importing GPS data)
7. GRASS (GRASS GIS integration)
8. Georeferencer GDAL (Adding projection information to raster using GDAL)
9. Interpolation plugin (interpolate based on vertices of a vector layer)
10. Labeling (Smart labeling for vector layers)
11. Mapserver Export (Export QGIS project file to a MapServer map file)
12. OGR Layer Converter (Translate vector layer between formats)
13. OpenStreetMap plugin (Viewer and editor for openstreetmap data)
14. Oracle Spatial GeoRaster support
15. Python Plugin Installer (Download and install QGIS python plugins)
16. Quick Print (Print a map with minimal effort)
17. Raster terrain analysis (Raster based terrain analysis)
18. SPIT (Import Shapefile to PostgreSQL/PostGIS)
19. WFS Plugin (Add WFS layers to QGIS canvas)
20. eVIS (Event Visualization Tool)

21. fTools (Tools for vector data analysis and management)
22. Python Console (Access QGIS environment)
23. Python Plugin Installer

External Python Plugins

QGIS offers a growing number of external python plugins that are provided by the community. These plugins reside in the official PyQGIS repository, and can be easily installed using the Python Plugin Installer (See Section **??**).

What’s new in version 1.4.0

These are the most relevant additions and improvements:

- Advanced symbology engine (was Symbology-NG branch) in addition to old engine
- Labeling plugin (part of new symbology engine)
- User interface cleanups to copyright, delim text and n-arrow plugins, and map composer interface
- ’Tools’ menu renamed to ’Vector’
- Added ’newgis’ theme which is a revision by Anita Graser of the original GIS theme by Robert Szczepanek
- Added ’Configure shortcuts’ dialog
- Added ’Export to PDF’ feature to map composer menu
- Added support to user-specific SVG path in the map composer
- Added ’newgis’ icon theme, a revision of the original ’gis’ theme
- Possibility to add/remove attributes also in attribute table. Small modification to attribute table such that adding / removing columns is visible
- Field Calculator
- New analysis tools: Zonal statistics, TIN interpolation and Overlay analyzer

Conventions

This section describes a collection of uniform styles throughout the manual. The conventions used in this manual are as follows:

GUI Conventions

The GUI convention styles are intended to mimic the appearance of the GUI. In general, the objective is to use the non-hover appearance, so a user can visually scan the GUI to find something that looks like the instruction in the manual.

- Menu Options: Layer > Add a Raster Layer

  or

  Settings > Toolbars ▶ > ✓ Digitizing
- Tool: Add a Raster Layer
- Button: Save as Default
- Dialog Box Title: **Layer Properties**
- Tab: General
- Toolbox Item: nviz - Open 3D-View in NVIZ
- Checkbox: Render
- Radio Button: Postgis SRID EPSG ID
- Select a Number: Hue 60
- Select a String: Outline style — Ligne solide

A shadow indicates a clickable GUI component.

Text or Keyboard Conventions

The manual also includes styles related to text, keyboard commands and coding to indicate different entities, such as classes, or methods. They don't correspond to any actual appearance.

- Hyperlinks: `http://qgis.org`
- Single Keystroke: press p
- Keystroke Combinations: press Ctrl+B , meaning press and hold the Ctrl key and then press the B key.
- Name of a File: `lakes.shp`
- Name of a Class: **NewLayer**
- Method: *classFactory*
- Server: *myhost.de*
- User Text: `qgis --help`

Code is indicated by a fixed-width font:

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

Platform-specific instructions

GUI sequences and small amounts of text can be formatted inline: Click { File QGIS} > Quit to close QGIS. This indicates that on Linux, Unix and Windows platforms, click the File menu option first, then Quit from the dropdown menu, while on Macintosh OSX platforms, click the QGIS menu option first, then Quit from the dropdown menu. Larger amounts of text may be formatted as a list:

- do this;
- do that;
- do something else.

or as paragraphs.

Do this and this and this. Then do this and this and this and this and this and this and this and this and this.

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

Screenshots that appear throughout the user guide have been created on different platforms; the platform is indicated by the platform-specific icons at the end of the figure caption.

1 Introduction To GIS

A Geographical Information System (GIS)**mitchel05**[1] is a collection of software that allows you to create, visualize, query and analyze geospatial data. Geospatial data refers to information about the geographic location of an entity. This often involves the use of a geographic coordinate, like a latitude or longitude value. Spatial data is another commonly used term, as are: geographic data, GIS data, map data, location data, coordinate data and spatial geometry data.

Applications using geospatial data perform a variety of functions. Map production is the most easily understood function of geospatial applications. Mapping programs take geospatial data and render it in a form that is viewable, usually on a computer screen or printed page. Applications can present static maps (a simple image) or dynamic maps that are customised by the person viewing the map through a desktop program or a web page.

Many people mistakenly assume that geospatial applications just produce maps, but geospatial data analysis is another primary function of geospatial applications. Some typical types of analysis include computing:

1. distances between geographic locations
2. the amount of area (e.g., square meters) within a certain geographic region
3. what geographic features overlap other features
4. the amount of overlap between features
5. the number of locations within a certain distance of another
6. and so on...

These may seem simplistic, but can be applied in all sorts of ways across many disciplines. The results of analysis may be shown on a map, but are often tabulated into a report to support management decisions.

The recent phenomena of location-based services promises to introduce all sorts of other features, but many will be based on a combination of maps and analysis. For example, you have

[1] This chapter is by Tyler Mitchell (`http://www.oreillynet.com/pub/wlg/7053`) and used under the Creative Commons License. Tyler is the author of *Web Mapping Illustrated*, published by O'Reilly, 2005.

a cell phone that tracks your geographic location. If you have the right software, your phone can tell you what kind of restaurants are within walking distance. While this is a novel application of geospatial technology, it is essentially doing geospatial data analysis and listing the results for you.

1.1 Why is all this so new?

Well, it's not. There are many new hardware devices that are enabling mobile geospatial services. Many open source geospatial applications are also available, but the existence of geospatially focused hardware and software is nothing new. Global positioning system (GPS) receivers are becoming commonplace, but have been used in various industries for more than a decade. Likewise, desktop mapping and analysis tools have also been a major commercial market, primarily focused on industries such as natural resource management.

What is new is how the latest hardware and software is being applied and who is applying it. Traditional users of mapping and analysis tools were highly trained GIS Analysts or digital mapping technicians trained to use CAD-like tools. Now, the processing capabilities of home PCs and open source software (OSS) packages have enabled an army of hobbyists, professionals, web developers, etc. to interact with geospatial data. The learning curve has come down. The costs have come down. The amount of geospatial technology saturation has increased.

How is geospatial data stored? In a nutshell, there are two types of geospatial data in widespread use today. This is in addition to traditional tabular data that is also widely used by geospatial applications.

1.1.1 Raster Data

One type of geospatial data is called raster data or simply "a raster". The most easily recognised form of raster data is digital satellite imagery or air photos. Elevation shading or digital elevation models are also typically represented as raster data. Any type of map feature can be represented as raster data, but there are limitations.

A raster is a regular grid made up of cells, or in the case of imagery, pixels. They have a fixed number of rows and columns. Each cell has a numeric value and has a certain geographic size (e.g. 30x30 meters in size).

Multiple overlapping rasters are used to represent images using more than one colour value (i.e. one raster for each set of red, green and blue values is combined to create a colour image).

Satellite imagery also represents data in multiple "bands". Each band is essentially a separate, spatially overlapping raster, where each band holds values of certain wavelengths of light. As you can imagine, a large raster takes up more file space. A raster with smaller cells can provide more detail, but takes up more file space. The trick is finding the right balance between cell size for storage purposes and cell size for analytical or mapping purposes.

1.1.2 Vector Data

Vector data is also used in geospatial applications. If you stayed awake during trigonometry and coordinate geometry classes, you will already be familiar with some of the qualities of vector data. In its simplest sense, vectors are a way of describing a location by using a set of coordinates. Each coordinate refers to a geographic location using a system of x and y values.

This can be thought of in reference to a Cartesian plane - you know, the diagrams from school that showed an x and y-axis. You might have used them to chart declining retirement savings or increasing compound mortgage interest, but the concepts are essential to geospatial data analysis and mapping.

There are various ways of representing these geographic coordinates depending on your purpose. This is a whole area of study for another day - map projections.

Vector data takes on three forms, each progressively more complex and building on the former.

1. Points - A single coordinate (x y) represents a discrete geographic location
2. Lines - Multiple coordinates (x1 y1, x2 y2, x3 y4, ... xn yn) strung together in a certain order, like drawing a line from Point (x1 y1) to Point (x2 y2) and so on. These parts between each point are considered line segments. They have a length and the line can be said to have a direction based on the order of the points. Technically, a line is a single pair of coordinates connected together, whereas a line string is multiple lines connected together.
3. Polygons - When lines are strung together by more than two points, with the last point being at the same location as the first, we call this a polygon. A triangle, circle, rectangle, etc. are all polygons. The key feature of polygons is that there is a fixed area within them.

2 Getting Started

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.

2.1 Installation

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

Installation from source

If you need to build QGIS from source, please refer to the coding and compiling guide available at http://qgis.osgeo.org/documentation/. The installation instructions are also distributed with the QGIS source code.

2.2 Sample Data

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

The MS 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 can either

- use GIS data that you already have;

- download the sample data from the QGIS website http://qgis.osgeo.org/download; or
- uninstall QGIS and reinstall with the data download option checked, only if the above solutions are unsuccessful.

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 ZIP or TAR archive from http://download.osgeo.org/qgis/data/ and unzip or untar the archive on your system. The Alaska dataset includes all GIS data that are used as examples and screenshots in the user guide, and also includes a small GRASS database. The projection for the QGIS sample dataset is Alaska Albers Equal Area with unit 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 graphical frontend 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/data.php.

2.3 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`.

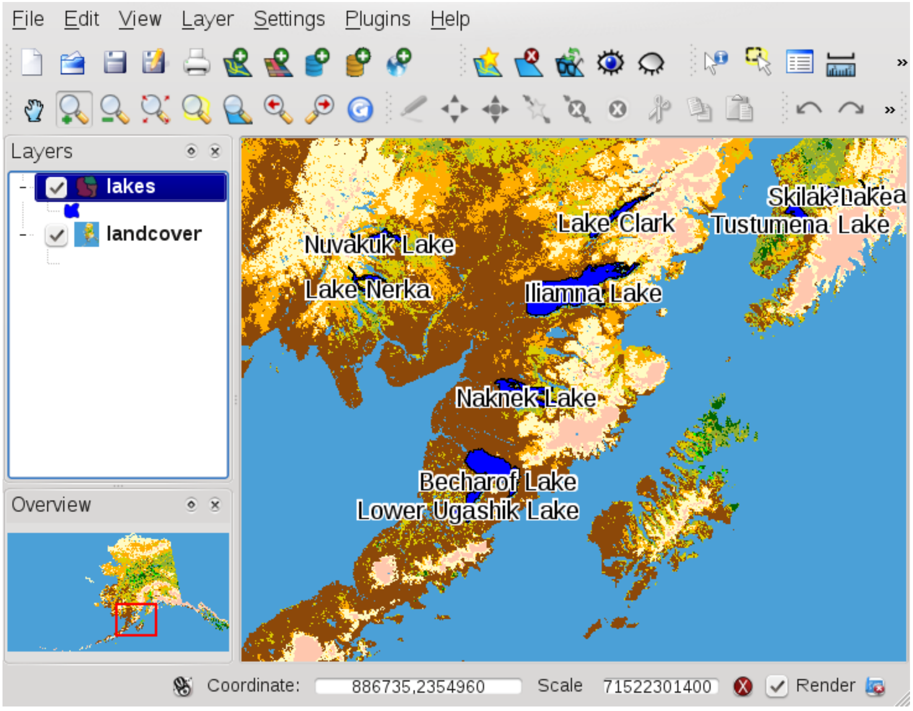
start QGIS

- Start QGIS by typing: `qgis` at a command prompt, or if using precompiled binary, using 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.

Load raster and vector layers from the sample dataset

1. Click on the Load Raster 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 Filetype combobox 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 Load Vector 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 "GML" from the filetype combobox, then select the [itemsep=2pt]GML file `lakes.gml` and click Open, then in Add Vector dialog click OK

Figure 2.1: A Simple QGIS Session



7. Zoom in a bit to your favorite area with some lakes.
8. Double click the `lakes` layer in the map legend to open the **Layer Properties** dialog.
9. Click on the Symbology tab and select a blue as fill color.
10. Click on the Labels tab and check the ☐ Display labels checkbox to enable labeling. Choose NAMES field as Field containing label.
11. To improve readability of labels, you can add a white buffer around them, by clicking "Buffer" in the list on the left, checking ☐ Buffer labels? 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.