



QGIS

Open Source GIS on the Desktop

qgis.org

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Slides: http://geoapt.net/usgs/USGS_2017.pdf

Let's get this out of the way first...

How do you pronounce QG/S?

1. Q-G-I-S
2. Q-*jis*
3. Q-*giss* (*giss* as in *give*)



QGIS is Open Source



Sponsors of the 2017 Free and Open Source Software for GIS (FOSS4G) conference



QGIS is Mainstream

- Project is 15 years old with stable developer community
- Worldwide installed user base estimated to exceed 250K
 - Likely much higher
 - Difficult to track since there is no purchase or registration requirement
- Used by academia, NGOs, media, United Nations, NASA, NSA, and more
- Supported by both the community and commercial entities



A Brief History

- Project founded in 2002 as an open source endeavor
- Originally named “Quantum GIS” with QGIS acronym
- Primary motivation for creating: A PostGIS spatial database viewer on Linux
- First versions didn’t support other vector formats or rasters—no projection support or cartography capabilities
- Version 1.0 in 2007 added support for plugins written in Python
- Current Long Term Release (LTR) version is 2.14.x
- Latest release 2.18.13—will become LTR at 3.0 release
- Version 3.0 is due end of 2017



Project Governance

- QGIS Board (legal entity)
- QGIS Project Steering Committee (PSC)
- PSC consists of a number of positions, including:
 - Chair and Co-chair
 - Release Manager
 - Treasurer
 - Infrastructure Manager
 - Design Adviser
- The PSC manages the project and its goals/direction, with continual involvement of the community



Development

- Currently 38 developers with direct commit access
- 240 contributors overall (submit patches, pull requests, etc)
- Translators — QGIS supports 39 languages



Cross Platform by Design

- Decision of language and toolkit driven by cross platform requirement
- Core is written in C++, with Python interface to the majority of classes
- Uses the Qt widget library
- Runs on Windows and any POSIX system: Linux, Fedora, Mac OSX, Unix



Versions

- The QGIS team maintains long-term, release, and development versions
- The long term versions are called “Long Term Release” (LTR) and maintained with patches for a period of 3-4 years
- Release versions build upon the LTR and eventually lead to another long-term version
- The development version is the bleeding edge code
 - Prior to release, available by nightly or weekly snapshots
- Release schedule can be found under “Get Involved” on qgis.org



License and Fees

- Cost: \$0
- Annual maintenance fee: \$0
- Upgrade fee: \$0
- License: GNU General Public License
 - www.gnu.org/licenses



Data Formats

QGIS Supports tons of data formats

- Access to data stores is through a *data provider*
- The provider is written using a standard interface, and serves as the bridge between QGIS and the data
- Currently data providers are written in C++



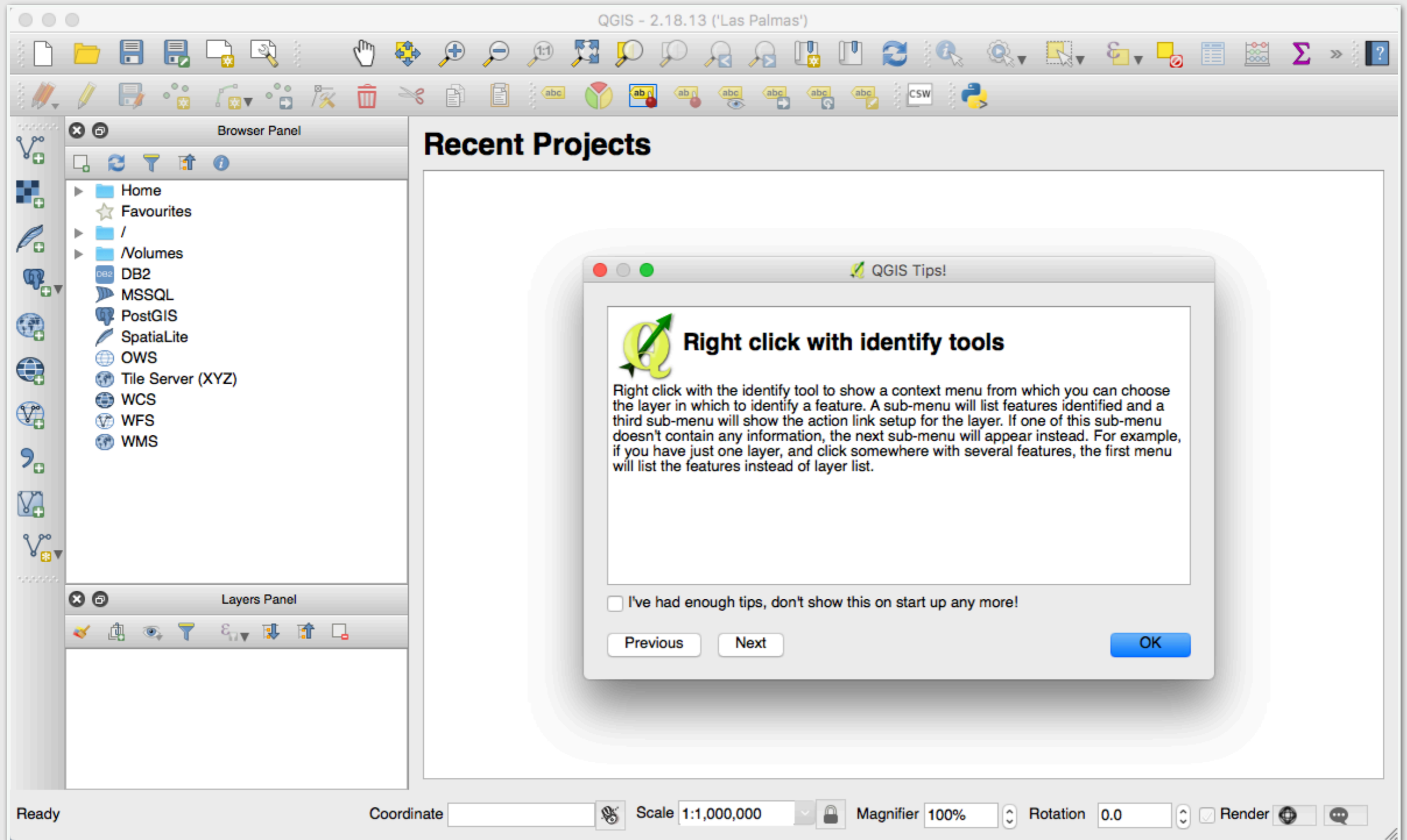
Data Providers

- **ArcGIS Feature Server provider**
- **ArcGIS Map Server provider**
- **DB2 Spatial Extender provider**
- **Delimited text data provider**
- **GDAL provider (134 raster formats)**
- **GPS eXchange format provider**
- **GRASS 7 raster provider**
- **GRASS 7 vector provider**
- **MSSQL spatial data provider**
- **Memory provider**
- **OGC Web Coverage Service provider**
- **OGC Web Map Service data provider**
- **OGR data provider (78 vector formats)**
- **OWS meta provider**
- **PostgreSQL/PostGIS data provider**
- **SpatiaLite data provider**
- **Virtual layer data provider**
- **WFS data provider**

New in QGIS 3.0



QGIS at Startup



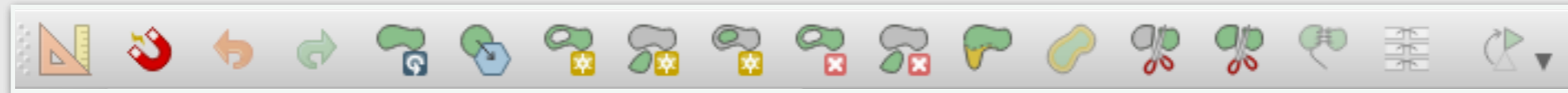
Features

A few of them anyway...

- Advanced digitizing/editing tools
- Advanced layer rendering/styling
- Expression-based viewing/filtering/styling
- Query Builder
- Data defined settings for nearly all styling/labeling settings
- Feature-rich labeling
- Map compositions
- Export map canvas/composition to image formats
- Vast array of Python plugins to extend capabilities
 - Fully extensible through Python scripts and plugins
- Graphic modeler for geoprocessing
- Export to web map (OpenLayers or Leaflet)
- QGIS Server—web map server for QGIS projects



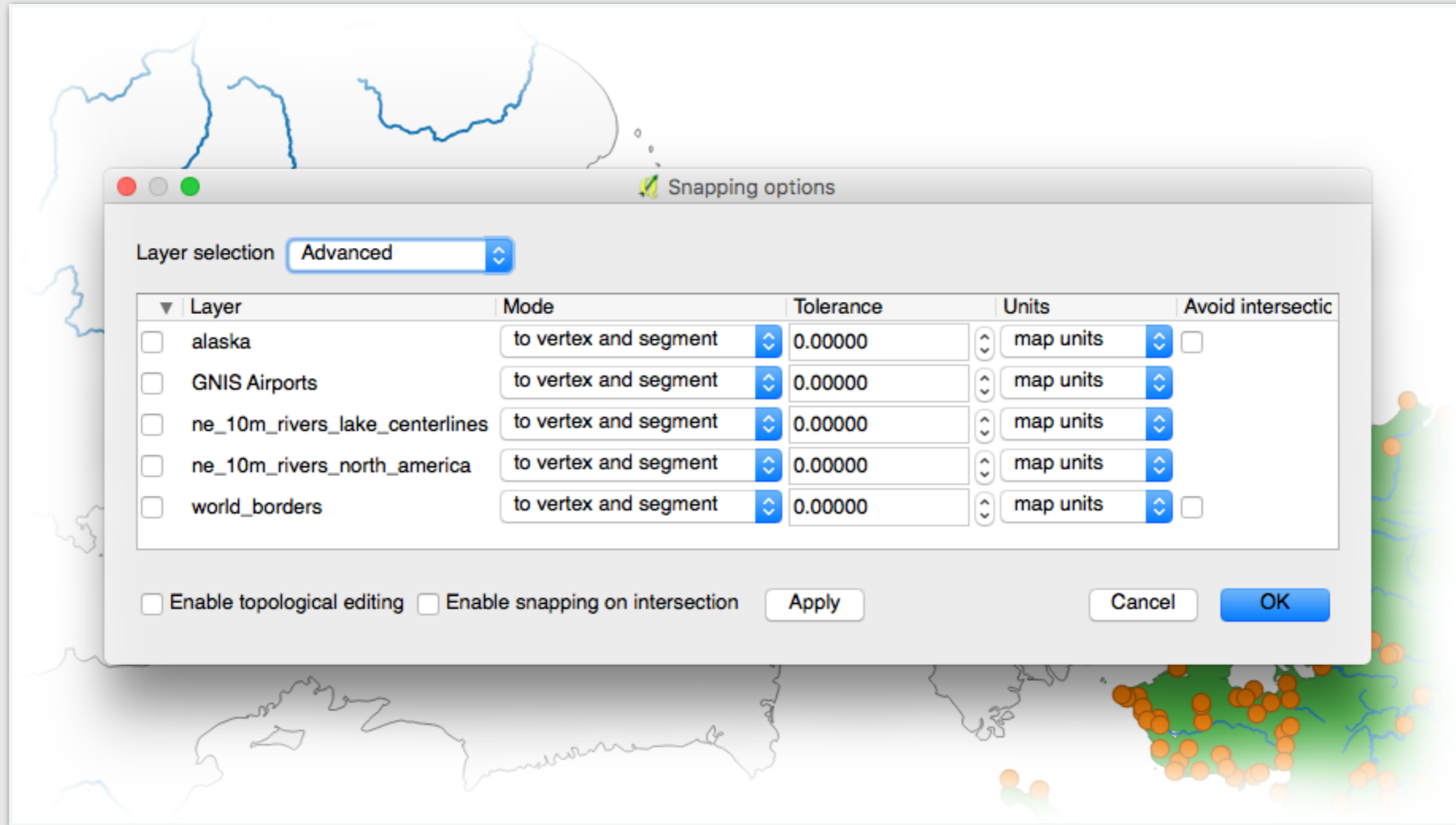
Advanced Editing Tools



- Tracing
- Undo/redo
- Rotate features
- Simplify features
- Add ring
- Add part
- Fill ring
- Delete ring
- Delete part
- Reshape features
- Offset curve
- Split features
- Split parts
- Merge attributes
- Rotate point symbols

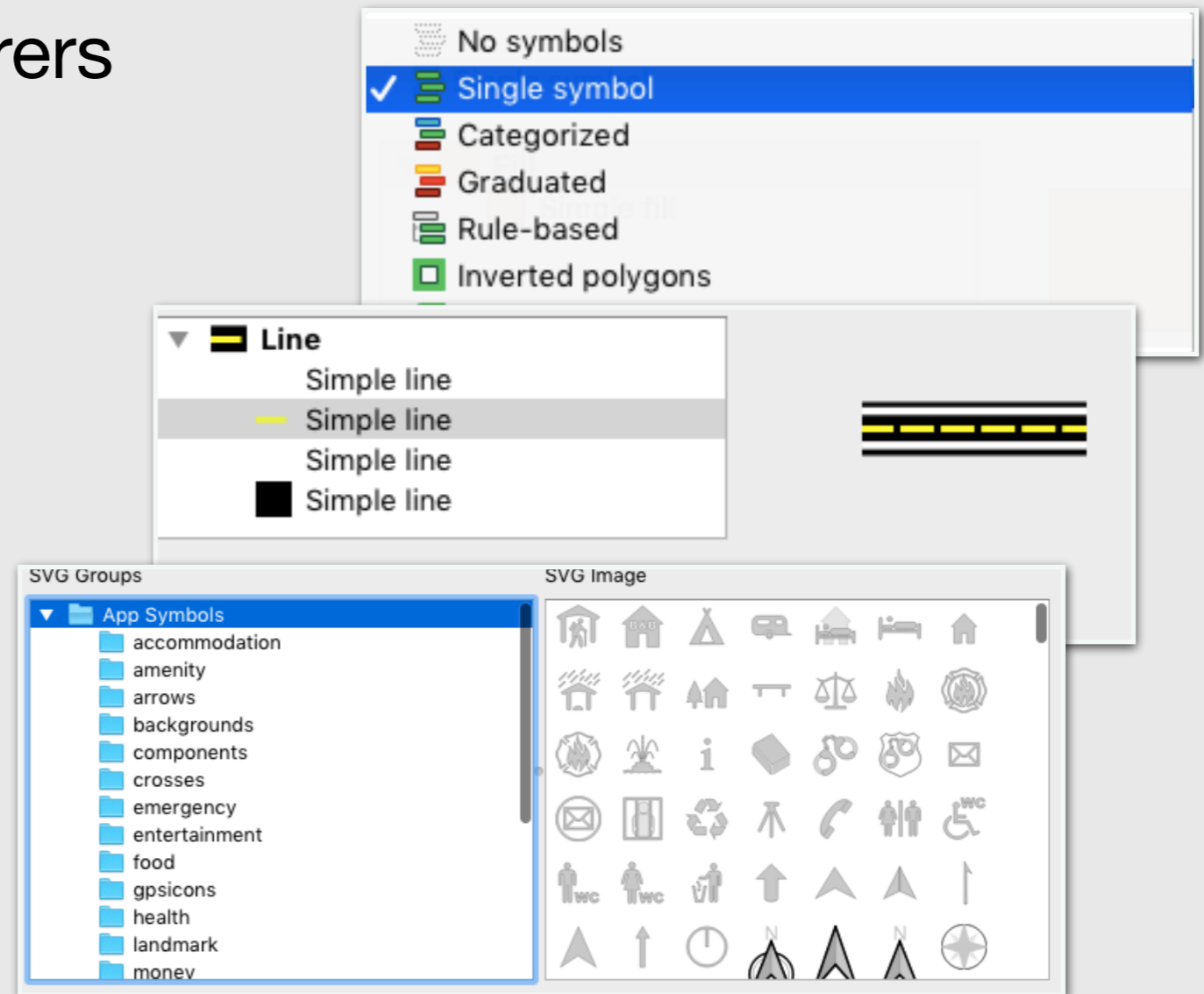


Topology



Layer Styling

- QGIS has multiple renderers
- Rule-based renderers
- Layered symbols
- SVG symbol libraries



Query Builder

Query Builder

Set provider filter on alaska_gnis

Fields

- gid
- FEATURE_ID
- FEATURE_NA
- FEATURE_CL
- STATE_ALPH
- STATE_NUME
- COUNTY_NAM
- COUNTY_NUM
- PRIMARY_LA
- PRIM_LONG_
- PRIM_LAT_D
- PRIM_LON_1
- SOURCE LAT

Values

- Crater
- Bench
- Channel
- Bay
- Airport
- Bend
- Building
- Arch
- Bar
- Forest

Sample All

Use unfiltered layer

Operators

= < > LIKE % IN NOT IN
<= >= != ILIKE AND OR NOT

Provider specific filter expression

```
"FEATURE_CL" = 'Airport'
```

The where clause returned 736 row(s).

OK

Help Test Clear Cancel OK



Labels

- Font, size, opacity
- Word wrap
- Placement options and offsets
- Buffers and drop shadows
- Backgrounds (rectangle, square, ellipse, circle, SVG)
- Expression-based labeling
- Scale dependent rendering





Layers Panel

- ne_10m_rivers_north_ameri...
- ne_10m_rivers_lake_centerl...
- rivers
- lakes
- alaska

Layer Styling

ne_10m_rivers_north_america

Show labels for this layer

Label with name || ' River'

Buffer

Draw text buffer

Size: 1.0000

Unit: Millimeter

Color: [Color Picker]

Color buffer's fill

Opacity: 100.0 %

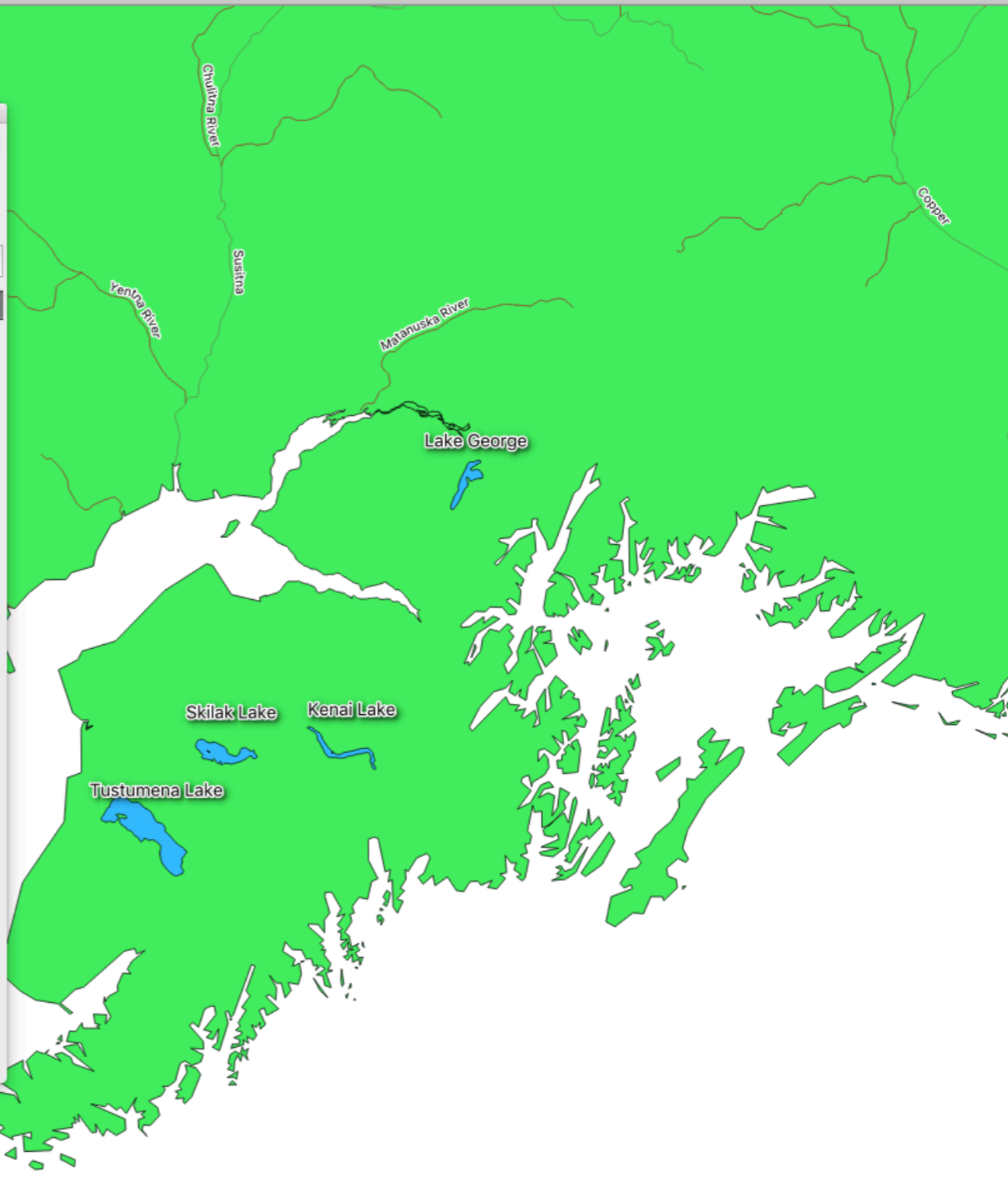
Pen join style: Round

Blend mode: Normal

Draw effects

Live update

Apply



Projections

Project Properties | CRS

Enable 'on the fly' CRS transformation (OTF)

Filter

Recently used coordinate reference systems

Coordinate Reference System	Authority ID
* Generated CRS (+proj=merc +a=6356752.3142 +b=6356752.31...	USER:100001
NAD83(NSRS2007) / Alaska Albers	EPSG:3467
WGS 84 / Pseudo Mercator	EPSG:3857
Google Mercator	EPSG:900913
NAD83 / Alaska Albers	EPSG:3338
NAD83(HARN) / New Mexico Central	EPSG:2826
NAD27 / UTM zone 7N	EPSG:26707
WGS 84	EPSG:4326

Coordinate reference systems of the world Hide deprecated CRSs

Coordinate Reference System	Authority ID
Geographic Coordinate Systems	
Projected Coordinate Systems	
Albers Equal Area	
Africa_Albers_Equal_Area_Conic	EPSG:102022
Alaska_Albers_Equal_Area_Conic	EPSG:102006
Asia_North_Albers_Equal_Area_Conic	EPSG:102025
Asia_South_Albers_Equal_Area_Conic	EPSG:102028
Canada_Albers_Equal_Area_Conic	EPSG:102001
Europe_Albers_Equal_Area_Conic	EPSG:102013
GDA94 / Australian Albers	EPSG:3577
Hawaii_Albers_Equal_Area_Conic	EPSG:102007
NAD27 / Alaska Albers	EPSG:2964
NAD27 / California Albers	EPSG:3309
NAD27 / Conus Albers	EPSG:5069
NAD83 / Alaska Albers	EPSG:3338
NAD83 / BC Albers	EPSG:3005

Selected CRS: NAD27 / Alaska Albers

```
+proj=aea +lat_1=55 +lat_2=65 +lat_0=50 +lon_0=-154 +x_0=0 +y_0=0 +datum=NAD27 +units=us-ft +no_defs
```

Help Apply Cancel OK



Cartography

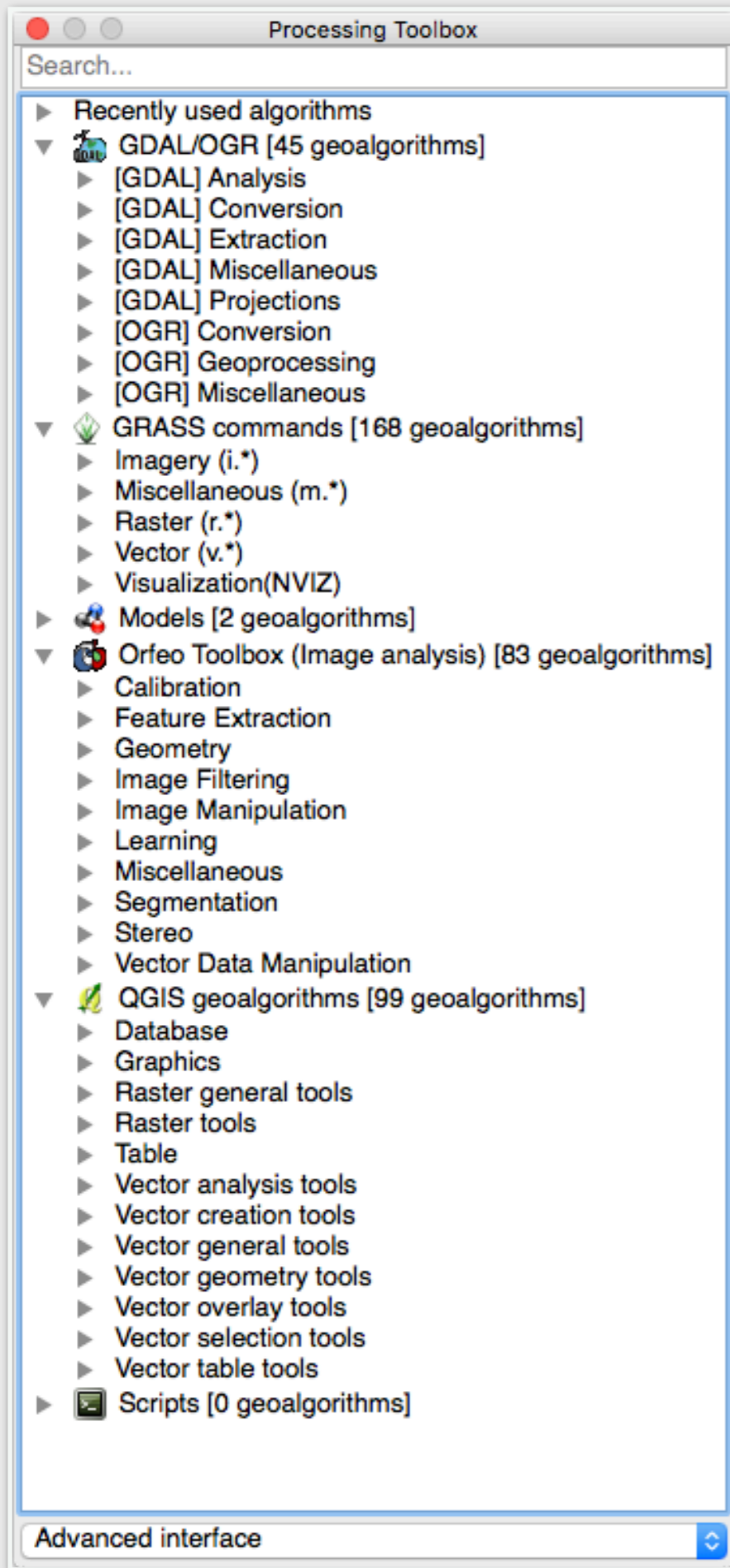
The screenshot displays the QGIS Lakes application interface. The main window shows a map of Alaska with several lakes labeled: Illamna Lake, Lake Clark, Tustumena Lake, Skilak Lake, and Lake George. A legend in the top right of the map area identifies the following layers: ne_10m_rivers_north_america (red line), ne_10m_rivers_lake_centerlines (blue line), rivers (purple line), lakes (blue area), and alaska (green area). A scale bar at the bottom of the map indicates distances up to 200 km.

The right-hand panel contains the following sections:

- Items:** A list of items with checkboxes: <scale bar>, Legend, Map 0, and <rectangle>.
- Item properties:** A section for configuring the selected item, including:
 - Main properties:** Title (text input), Title alignment (Left), Map (Map 0), Wrap text on (text input), and a checked checkbox for Resize to fit contents.
 - Legend items:** A checked checkbox for Auto update and an Update all button. Below this is a legend preview showing the same layers as the map: ne_10m_rivers_north_america, ne_10m_rivers_lake_centerlines, rivers, lakes, and alaska.

The status bar at the bottom of the application shows: x: 249.873 mm y: -54.2131 mm page: 1 71.6% 1 item selected.





Processing and Analysis Tools



Modeler

The screenshot displays the Processing Modeler window with a workflow diagram. The workflow consists of three main components: an input layer labeled 'Rivers', a processing step 'Fixed distance buffer', and an output layer labeled 'riverbuffer'. The 'Fixed distance buffer' step has an 'In' port connected to the 'Rivers' layer and an 'Out' port connected to the 'riverbuffer' layer. The left sidebar shows a tree view of tool categories, with 'QGIS geocalgorithms' expanded to show various vector geometry tools. The 'Fixed distance buffer' tool is highlighted in the list. The top of the window shows the title 'Processing modeler' and a toolbar with icons for file operations and help.

Processing modeler

Search...

- GDAL/OGR
- GRASS commands
 - Imagery (i.*)
 - Miscellaneous (m.*)
 - Raster (r.*)
 - Vector (v.*)
 - Visualization(NVIZ)
- Modeler-only tools
- Models
 - Buffers
 - Buffer rivers
 - Cartography
- Orfeo Toolbox (Image analysis)
- QGIS geocalgorithms**
 - Database
 - Graphics
 - Raster general tools
 - Raster tools
 - Table
 - Vector analysis tools
 - Vector creation tools
 - Vector general tools
 - Vector geometry tools
 - Concave hull
 - Convert geometry type
 - Convex hull
 - Create points along lines
 - Delaunay triangulation
 - Densify geometries
 - Densify geometries given an interval
 - Dissolve
 - Eliminate sliver polygons
 - Explode lines
 - Extract nodes
 - Fill holes
 - Fixed distance buffer
 - Keep n biggest parts

Buffer rivers

Buffers

Rivers

In

Fixed distance buffer

Out

riverbuffer

Inputs Algorithms



Web Mapping

- Two options:
 - Using the qgis2web plugin
 - QGIS Server



Web Mapping

qgis2web

- Generates a web map from your current QGIS project
- Can be used with either OpenLayers or Leaflet
- No server-side software required



qgis2web

Export to web map

Export Settings Help Time

Layers and Groups

- cb_2014_us_state_500k
 - Visible
 - Popup fields
 - STATEFP no label
 - STATENS no label
 - AFFGEOID no label
 - GEOID no label
 - STUSPS no label
 - NAME no label
 - LSAD no label

Data export

Exporter Export to folder

Mapping library location Local

Minify GeoJSON files

Precision maintain

Use debug libraries

Scale/Zoom

Extent Canvas extent

Max zoom level 28

Min zoom level 1

Restrict to extent

Appearance

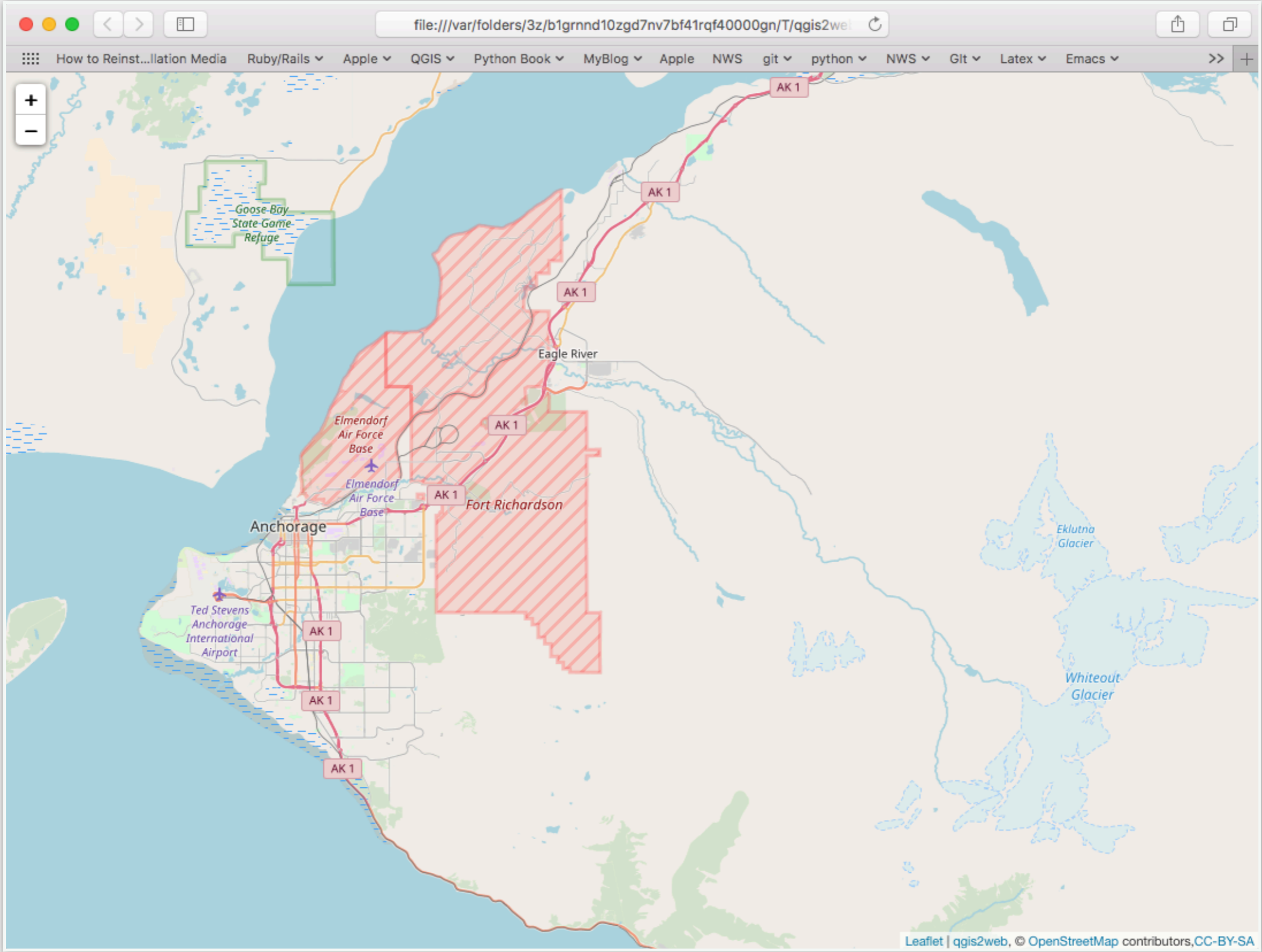
OpenLayers Leaflet Update preview Export

OSM

- OSM B&W
- Stamen Toner
- OSM DE
- OSM HOT
- Thunderforest Cycle

Leaflet | qgis2web,

qgis2web



Web Mapping

QGIS Server

- QGIS Server is an open source WMS 1.3, WFS 1.0.0 and WCS 1 1.1.1 implementation
- Publishes your QGIS project to the web
- Implements advanced cartographic features for thematic mapping
- Is a FastCGI/CGI (Common Gateway Interface) application written in C++
- Works together with a web server (e.g., Apache, Lighttpd)
- Requires server side deployment

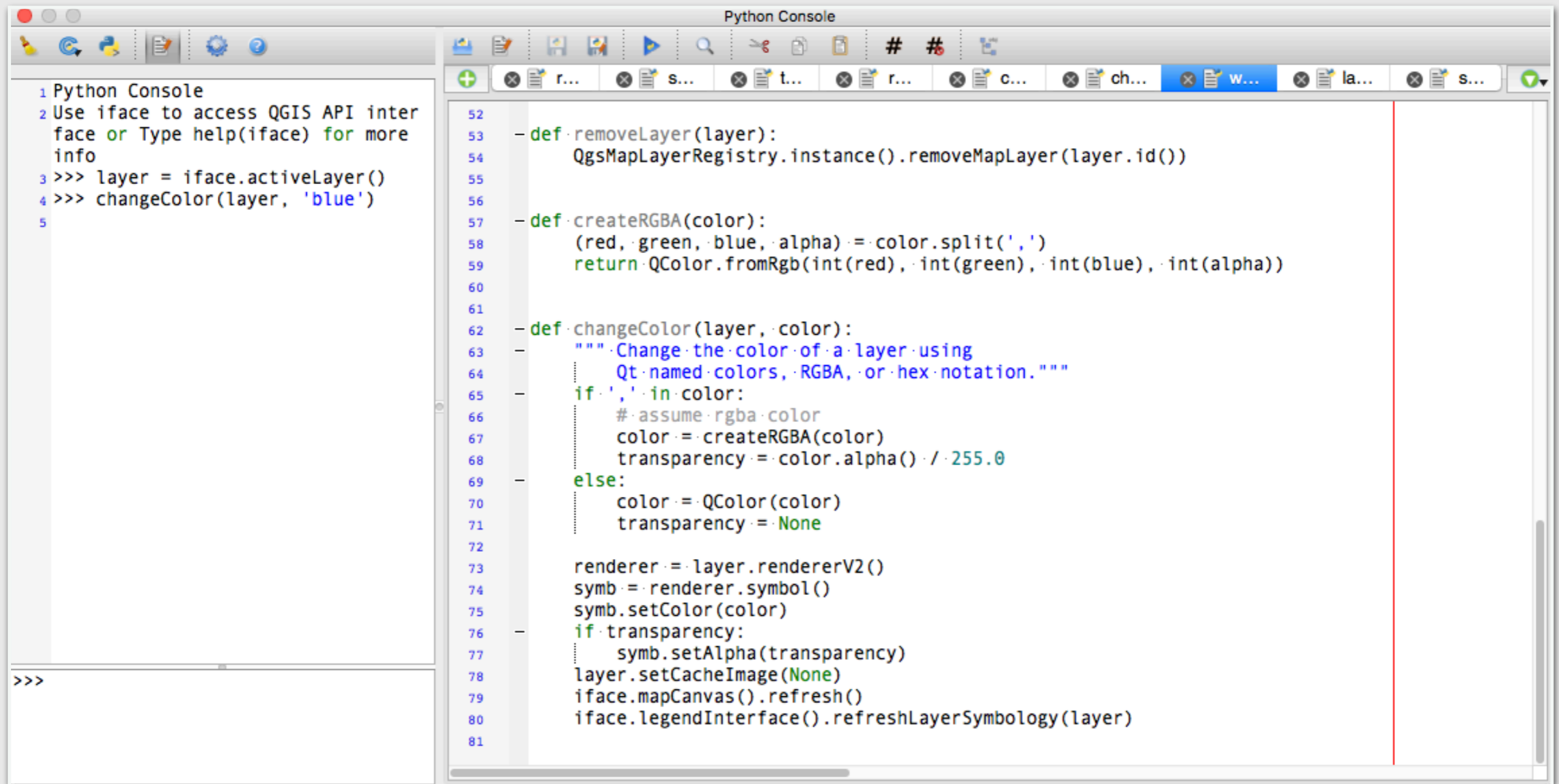


Python

- QGIS has Python bindings to most of the underlying API
- The Python Console allows you to interact directly with QGIS
 - Includes a script editor



Python Console



The image shows a screenshot of a Python Console window. The window has a title bar that says "Python Console" and a toolbar with various icons. Below the toolbar, there are several tabs for different files, including "r...", "s...", "t...", "r...", "c...", "ch...", "w...", "la...", and "s...". The main area of the window contains Python code. On the left side, there is a list of steps: 1 Python Console, 2 Use iface to access QGIS API interface or Type help(iface) for more info, 3 >>> layer = iface.activeLayer(), 4 >>> changeColor(layer, 'blue'), and 5. The code in the main area is as follows:

```
52
53 - def removeLayer(layer):
54     QgsMapLayerRegistry.instance().removeMapLayer(layer.id())
55
56
57 - def createRGBA(color):
58     (red, green, blue, alpha) = color.split(',')
59     return QColor.fromRgb(int(red), int(green), int(blue), int(alpha))
60
61
62 - def changeColor(layer, color):
63     """ Change the color of a layer using
64         Qt named colors, RGBA, or hex notation. """
65     if ',' in color:
66         # assume rgba color
67         color = createRGBA(color)
68         transparency = color.alpha() / 255.0
69     else:
70         color = QColor(color)
71         transparency = None
72
73     renderer = layer.rendererV2()
74     symb = renderer.symbol()
75     symb.setColor(color)
76     if transparency:
77         symb.setAlpha(transparency)
78     layer.setCacheImage(None)
79     iface.mapCanvas().refresh()
80     iface.legendInterface().refreshLayerSymbology(layer)
81
```

>>>

Extending with Python

- Plugins have access to the majority of the QGIS API
- User contributed plugins are stored in a repository, accessible from the QGIS Plugin Manager
- The repository currently houses over 800 plugins, targeting QGIS 1.x through 3.x



Extending with Python

The screenshot shows the QGIS Plugins Manager window with the following components:

- Window Title:** Plugins | All (792)
- Left Sidebar:** Filter buttons for 'All', 'Installed', 'Not installed', 'Upgradeable', 'Invalid', and 'Settings'.
- Search Bar:** A text input field for searching plugins.
- Plugin List:** A scrollable list of plugins. 'Plugin Builder' is selected and highlighted in blue. Other visible plugins include PCA, PDF Filler, PDOK BAG Geocoder, PDOK services plugin, Perl Processing Provider, Pghydro Tools, pgRoutingLayer, PgVersion, photo2kmz, Photo2Shape, Physiocap, Pic2Map, pickLayer, Pin Point, pktools, Place Marker, Plain Geometry Editor, Plugin Load Times, Plugin Mapotempo, Plugin Reloader, pluginmenu, pluginname, POI Exporter, Point sampling tool, PointConnector, Points2One, and pointShifter.
- Plugin Details Panel (Right):**
 - Status:** A green banner with a checkmark icon and the text 'This plugin is trusted'.
 - Title:** 'Plugin Builder' with a hammer icon.
 - Description:** 'Creates a QGIS plugin template for use as a starting point in plugin development'.
 - Function:** 'Create a template for a QGIS plugin'.
 - Rating:** 4.5 stars (93 rating vote(s), 77477 downloads).
 - Tags:** development.
 - More info:** [homepage](#), [bug tracker](#), [code repository](#).
 - Author:** [GeoApt LLC](#).
 - Version Info:** Installed version: 2.16.0 (in /Users/gsherman/.qgis2/python/plugins/pluginbuilder); Available version: 2.16.0 (in QGIS Official Plugin Repository).
 - Changelog:** 2015-09-29 Remove webkit dependency; Delay init of dialog until called for by the toolbutton.
- Buttons:** 'Upgrade all', 'Uninstall plugin', 'Reinstall plugin', and 'Close'.
- Help:** A 'Help' button at the bottom left of the plugin list.



Future Roadmap



QGIS 3.x

- Change widget toolkit (GUI) from Qt4 to Qt5
- Change from Python 2.7 to Python 3.x
- This breaks the underlying API, requiring update to existing Python scripts and plugins
- Why the move?
- Qt4 and Python 2 are going away
 - Python 2.7 end of life: 2020
 - There will be no 2.8
 - Qt4 already at end of life

“End of life”

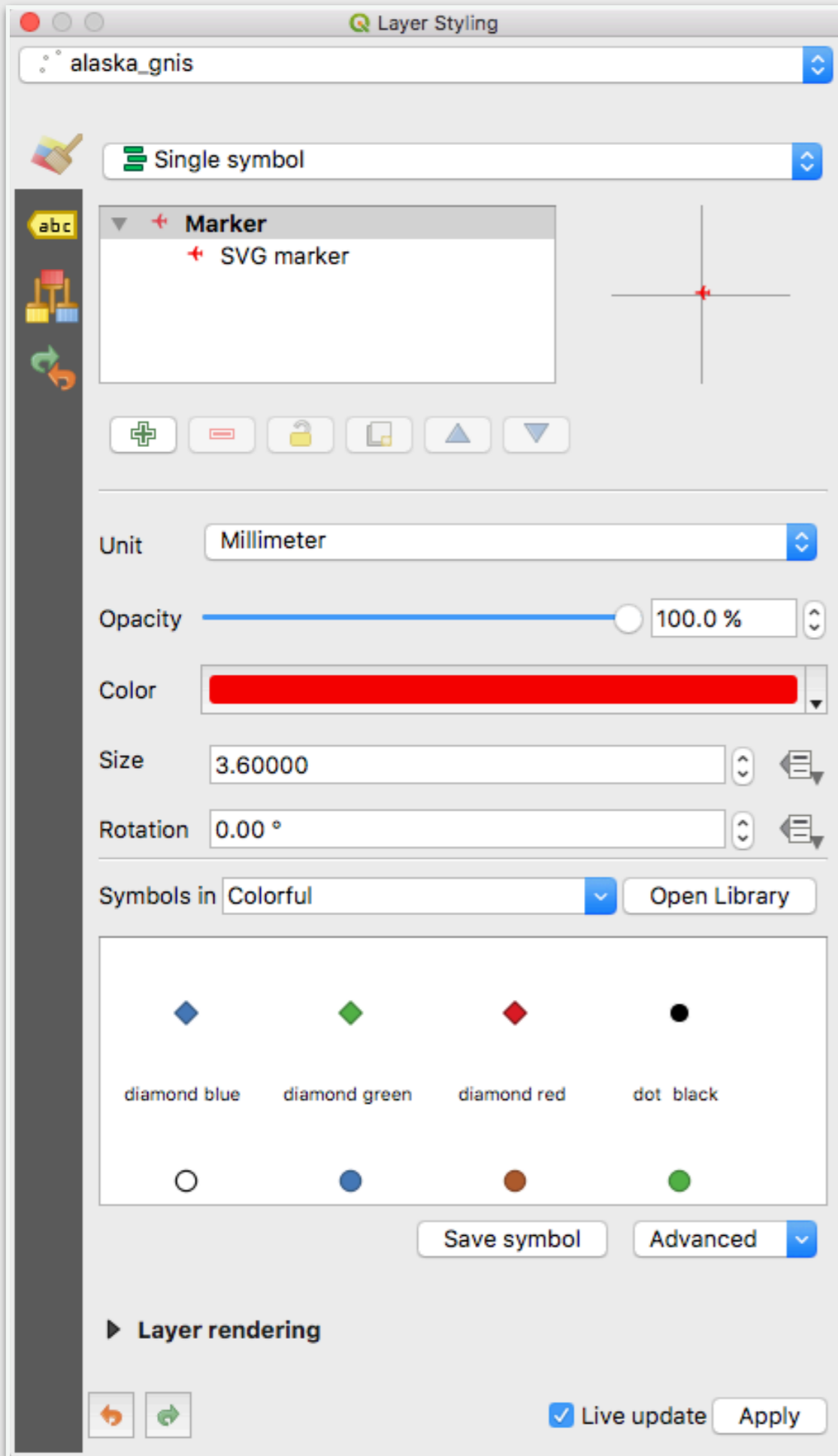
- No new versions
- No patches or fixes
- No support



What's New in 3.0

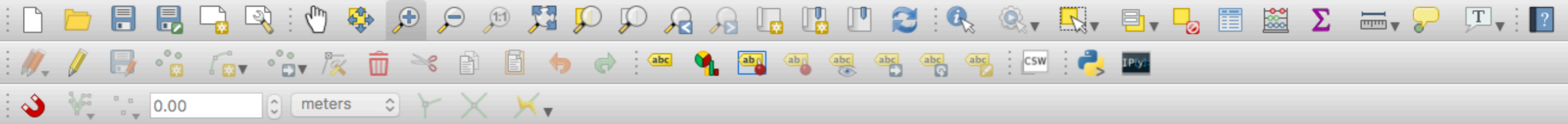
- Live layer styling via the Layer Styling panel
This has been backported into 2.18
- Unified Data Source Manager/Browser
- New symbols and predefined symbol groups
- Save map images at custom sizes
- 3D support
- A whole lot more...





Live Layer Styling



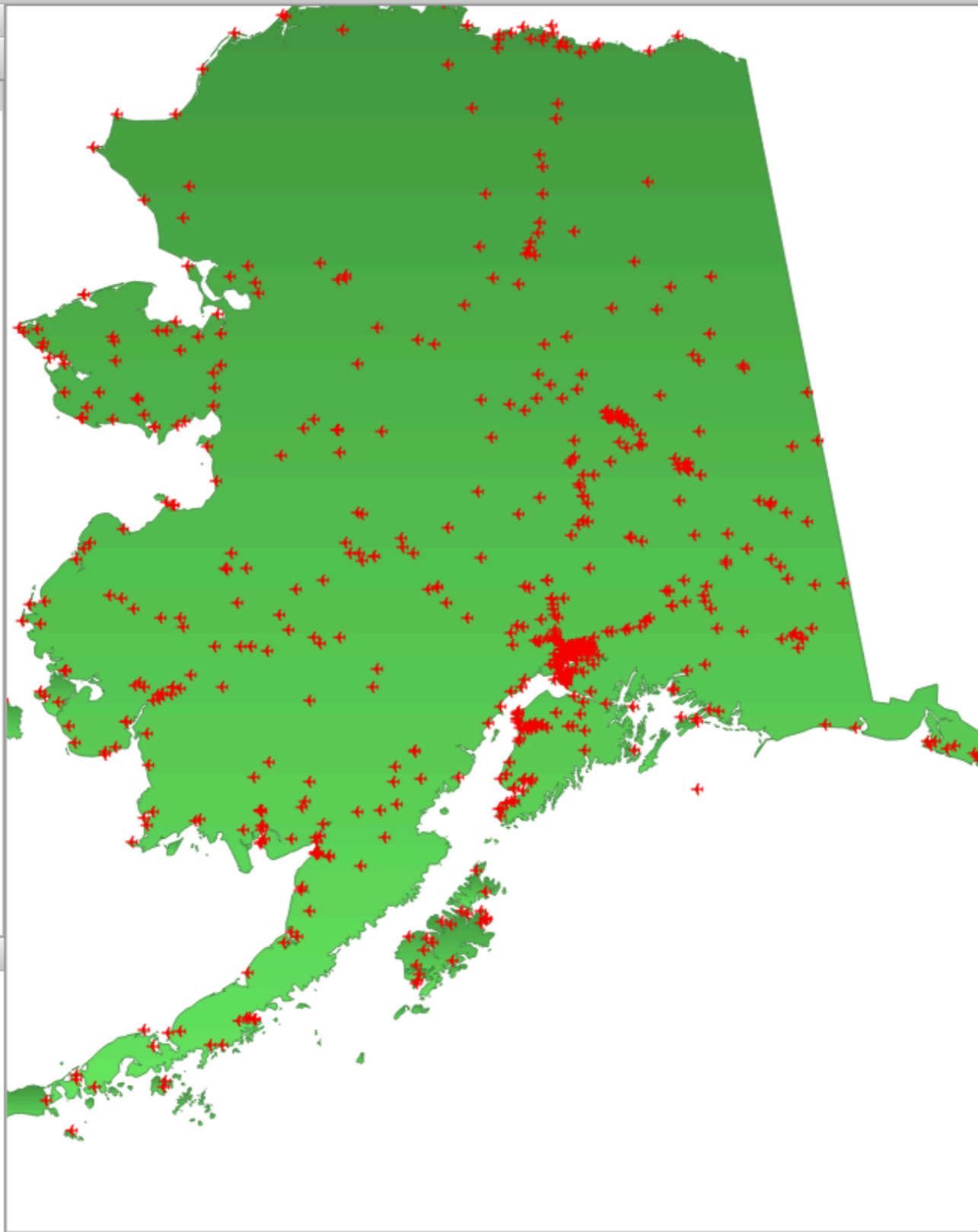


0.00 meters

Layers Panel

- + alaska_gnis
- alaska

Overview Panel



Layer Styling

alaska_gnis

Single symbol

Marker

- + SVG marker

Unit: Millimeter

Opacity: 100.0 %

Color:

Size: 3.60000

Rotation: 0.00 °

Symbols in: Colorful Open Library

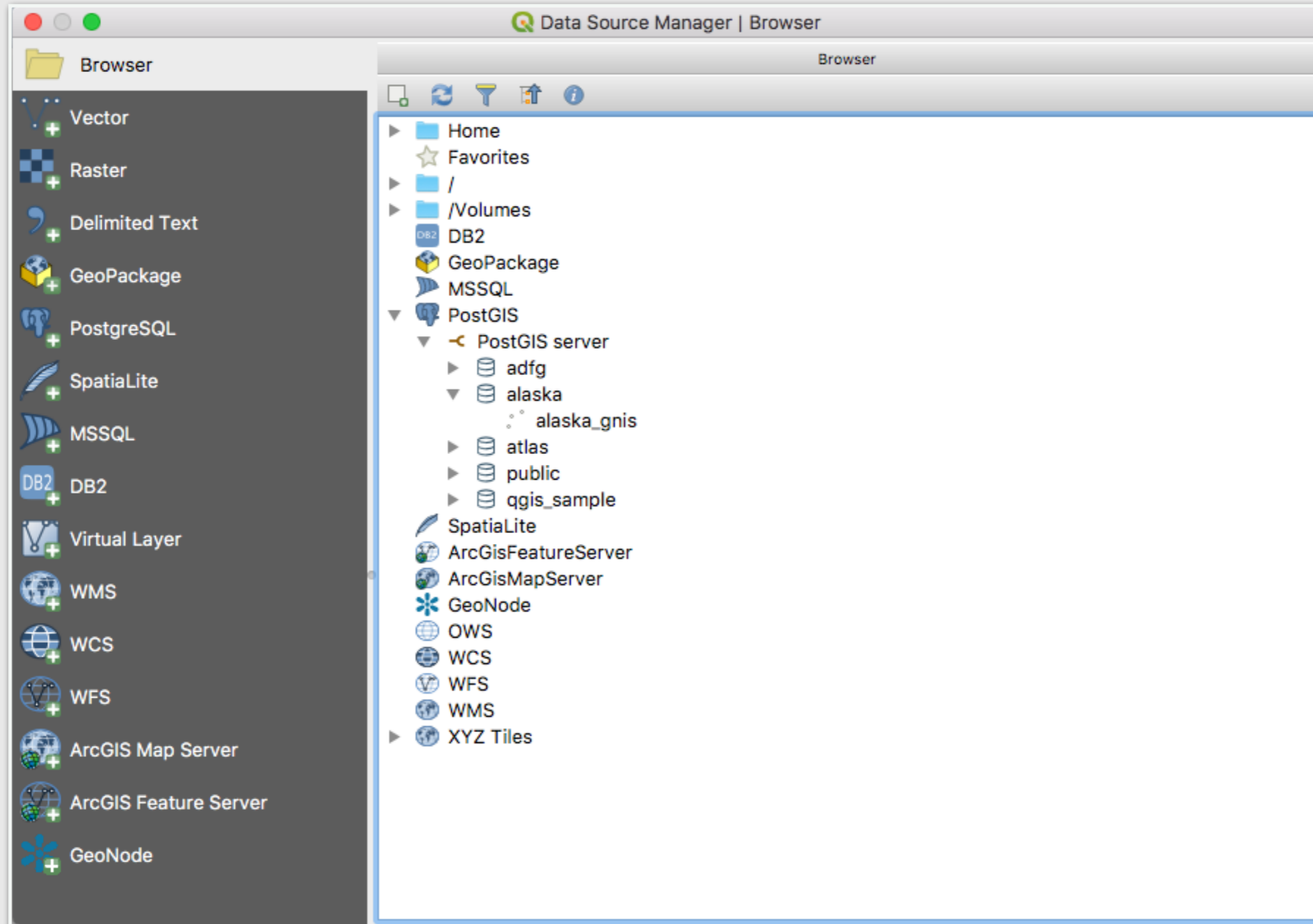
◆	◆	◆	●
diamond blue	diamond green	diamond red	dot black
○	●	●	●

Save symbol Advanced

Layer rendering

Live update Apply

Unified Browser



Support

- Mailing lists (searchable)
- StackExchange (gis.stackexchange.com)
- Chat — #qgis channel on freenode.net (IRC)
- User Groups
- Website
- Commercial support (see list on qgis.org)



Try it

- **Install the current release 2.18.13 from download.qgis.org**
 - Windows, Mac, Linux
- **Install the nightly development build (soon to be 3.0) using the OSGeo4W installer**
 - Download Windows OSGeo4W Network Installer (download.qgis.org)
 - Select Advanced Install, then choose qgis-dev from the list of Desktop Packages
- **OSgeo Live (live.osgeo.org)**
 - Self-contained bootable DVD, USB thumb drive or Virtual Machine
 - Try QGIS and a bunch of other FOSS4G software without installing anything
- **Portable GIS (portablegis.xyz)**
 - Windows-only set of FOSS4G packages ready to install or copy onto a USB stick

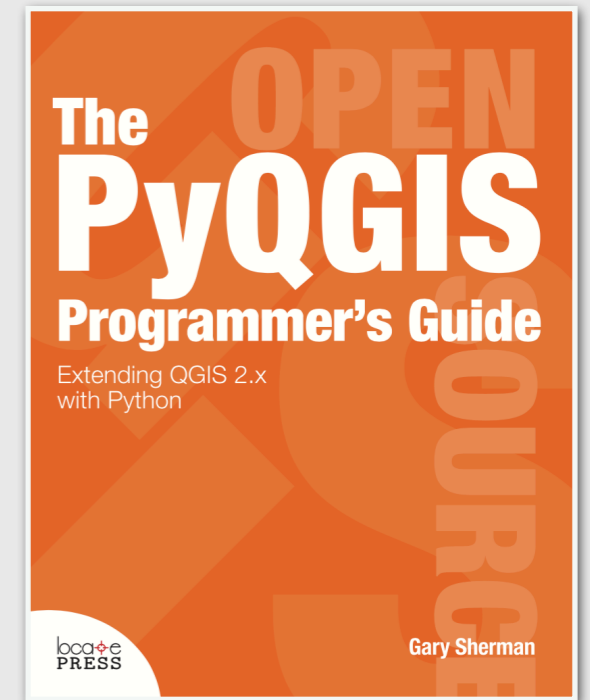


Books

(shameless plug)



locatepress.com
Coupon: usgs_2017



http://geoapt.net/usgs/USGS_2017.pdf

