



# GGMN Portal

## Instruction Manual

Date: 11-05-2018

Version: 4.7


### Introduction

The GGMN portal gives insights on the availability of groundwater monitoring data through space and time. Groundwater level data and changes occurring in groundwater levels can be displayed on a regional scale. Additional data layers and information are available to understand the monitoring data in a broader water-related context. The web-based software application assists in the spatial and temporal analysis of monitoring data.

Besides the online tools, the GGMN Portal also provides a plugin to work locally on groundwater monitoring data using an open source GIS: QGIS. This provides the power and accessibility of desktop applications, while still using an online database and online viewer.



## GGMN Portal

Global 


The global map is the ideal starting point for less-frequent users that want to 'stroll' through the data. It gives a quick insight on availability of groundwater monitoring data through space and time and adds extra data layers and information in a broader water-related context.

Regional 

The regional map gives access to the screen that is focused on analyzing more local sets, to display, mean, range and changes in groundwater levels taking a regional perspective.

Log in 

If the privacy settings are adjusted from public to private (via IGRAC) the time series are visible only after logging in. User account and authorization credentials can be obtained via IGRAC. On the top-right of the screen the log-in icon is visible. Logging in gives you the possibility to see the time series from the organization the user belongs to. If you click on your name, you reach the Profile page, where you can change password and user information. To log out, you can click on the log-out icon on the top-right side of the page.

Organisation 

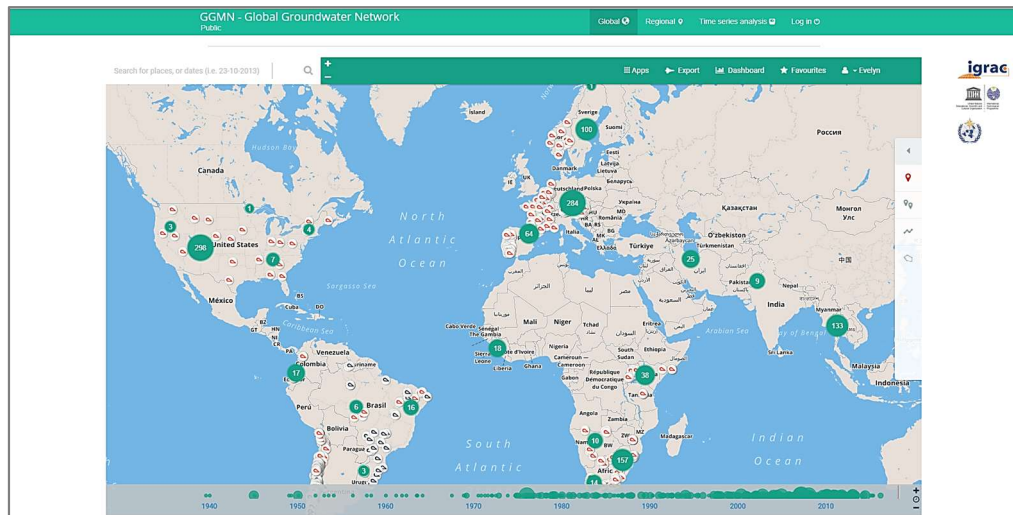
A user can be authorized for multiple organizations. With the organization button one can select easily the organization to show the data for. This selection is necessary to work with non-public data.







## Global Portal



On the global map, the data availability and the locations of the measuring stations are visible. A worldwide overview gives direct information on the number of countries involved in the GGMN. Time series are visible for organisations that accepted to make them publicly available.

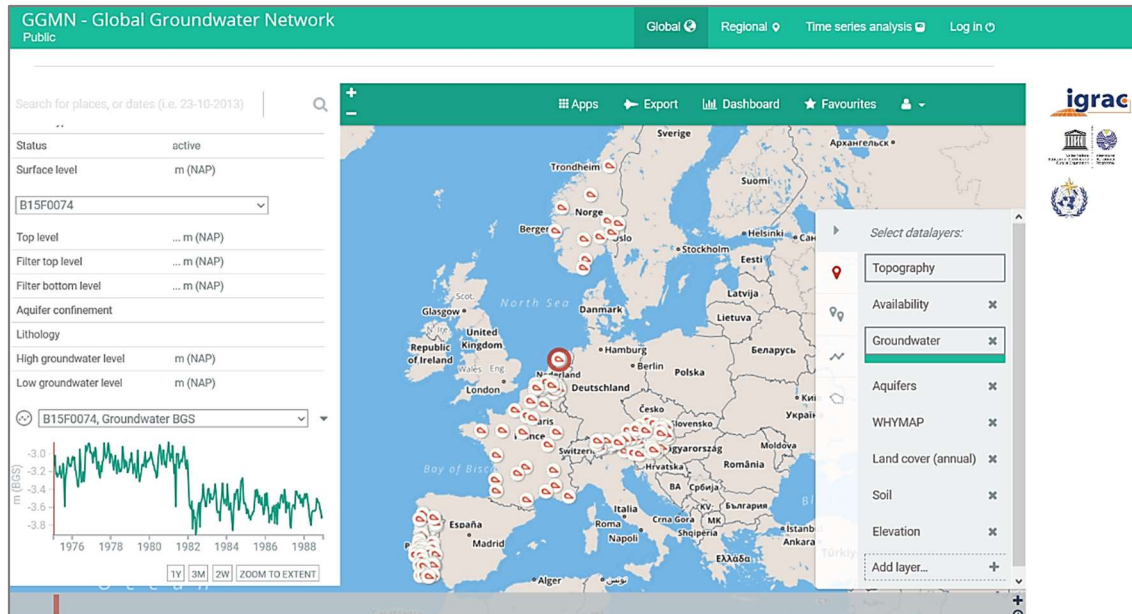


The data menu can be folded open by selecting the grey arrow on the top right. In the data menu there are 4 selection tools to query data on the map. The first one is point selection: , is used to select a layer and/or a groundwater station. The second one is a multiple selection pointer: , is used to select more than one ground water station or other layers. The third tool is the line option: , is used to draw a line in a raster layer to obtain the profile information. The line tool option is mostly used to obtain a cross section figure of the elevation information. The fourth tool is the region selection tool: , is used to select a region (country, state or other demarcation) and obtain the information contained on it.

Groundwater station locations are displayed by default on the map and correspond to the layer 'groundwater' in the data menu. Information on the monitoring stations and the corresponding time series are presented by selecting the monitoring station icon on the map. A textbox with the station information will be displayed. If the time series are publicly available, the time series will appear below the information box.

To obtain an overview of available groundwater stations, the map layer 'availability' is shown by default (green circles). Zooming in provides more detail on where the measuring stations are located. Zooming out to full extent is possible by clicking on the compass icon next to the layer name in the layer panel. By scrolling through the timeline at the bottom of the screen, the start of the monitoring stations can be seen.

Currently the GGMN portal requires to log-in twice using the same credentials. The first log-in is located in the upper green menu bar (next to "Time Series Analysis"). The second log-in is located the second green menu bar (next to "Favourites").



When a groundwater station is selected, at the bottom-left corner of the screen you will see a time-series of groundwater dynamics over time. You can adjust the vertical scaling of this diagram by hovering over the graph and scrolling with your mouse/trackpad. The horizontal scaling (time) can be adjusted by selecting any of the buttons underneath (1Y, 3M, 2W, ZOOM TO EXTENT), or by zooming to the desired period using the time bar at the bottom of the screen. At the bottom-right of the screen you will see a + and – icon allowing you to zoom to and select the period of your choice.

Other layers include Topography, Landcover, Soil, Digital Elevation Model, Aquifers, displaying the transboundary aquifers of the world map (IGRAC, 2015) and the WHYMAP layer showing the data from the world-wide hydrogeological mapping and assessment program. You can adjust the opacity of the layers by sliding the green line beneath the layer box.



## Further analysis on the Global Portal

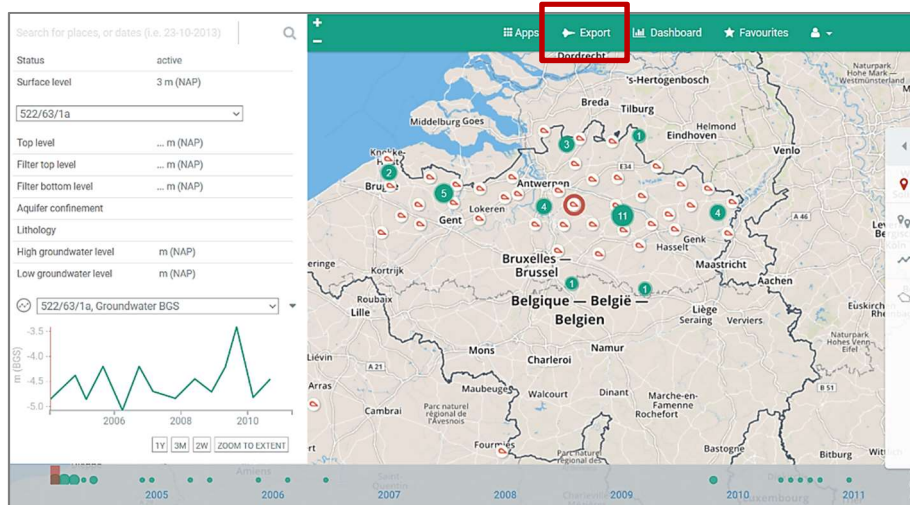
Several analytical functionalities in the global portal can be used to explore the data in the GGMN portal in more detail. The following section will describe several of these functions.

In order to use these functions, head to the Global tab of GGMN.

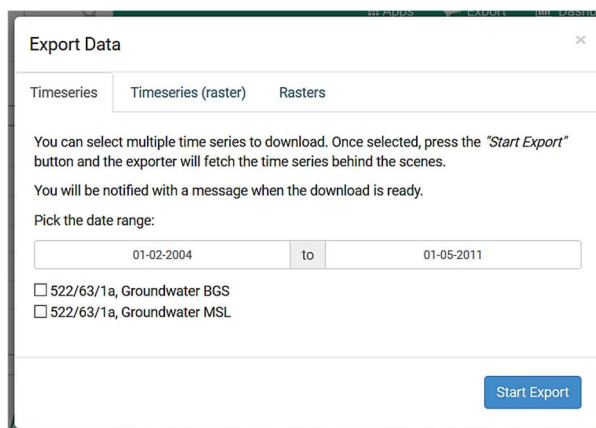


### Export time series

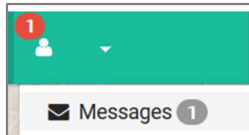
For each ground water stations, the platform allows you to download the time series as an Excel (.xlsx) file. First, select a groundwater station of your choice.



The timeline can be seen in the bottom-left part of the screen. In order to export the data, select 'Export' in the top bar. The export menu will appear:



Here you can select the period over which you would like to retrieve the data, as well as which of the data types (Groundwater BGS or Groundwater MSL) you want to download. After making your choices, click 'Start Export'. The platform will process your export request in the background. When the export is finished, you will see a notification badge next to your account name. Click the notification and select 'Messages'.

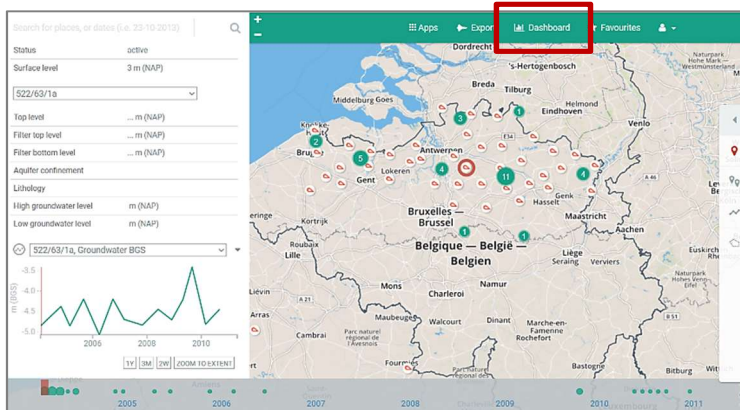


Lastly, you can download your .xlsx-file by clicking 'Download'.

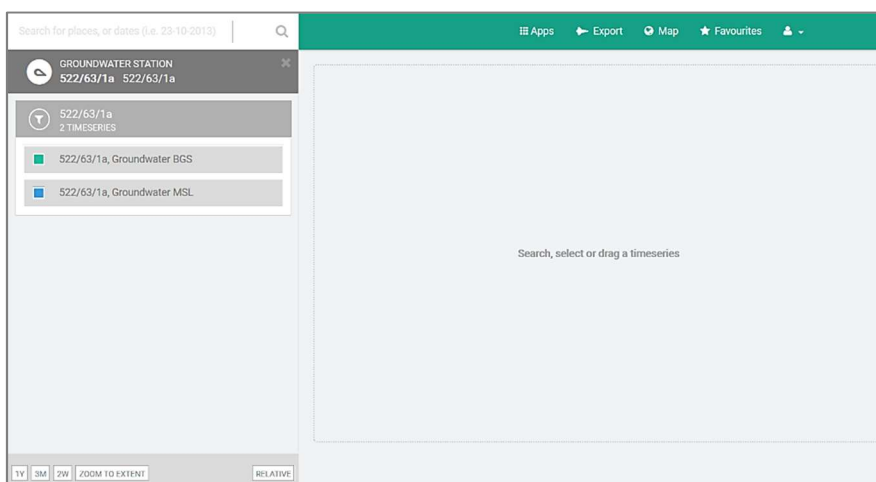


## Dashboard

The dashboard provides a more elaborate way of analysing the timeseries in the platform. To use the dashboard, first select a groundwater station in the map view.

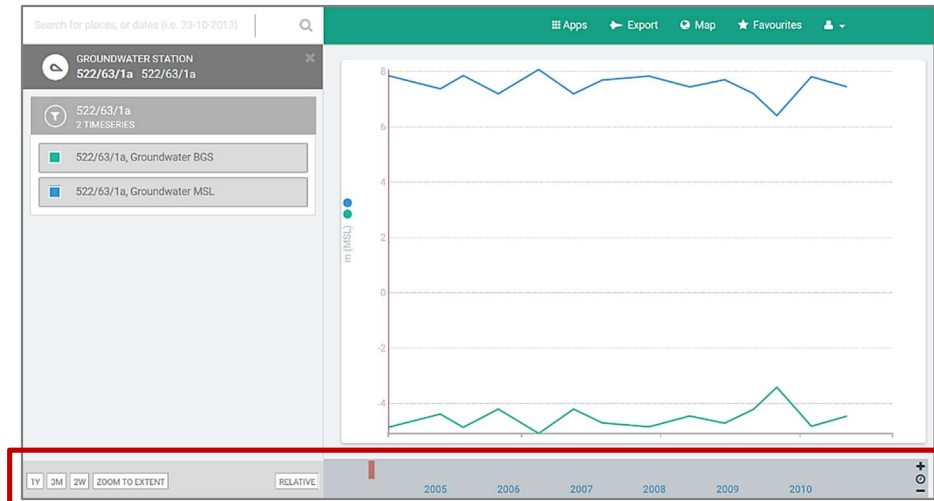


The timeline for this groundwater station is visible in the bottom-left corner of the screen. In order to switch to dashboard view, select 'Dashboard' in the top bar. You will now see the empty dashboard:



On the left side of the screen you will see the available timeseries (groundwater BGS and groundwater MSL). By clicking on the timeseries name and dragging it to the grey canvas on the right, the timeline will open in a detailed view. It is possible to open two timeseries at the same time, by dragging the second timeseries on the graph.






The bar at the bottom-left side of the screen allow you to zoom on a specific period. Hovering over the chart and scrolling will allow you to change the scaling of the y-axis.

To compare different groundwater stations, the multiple selection tool can be used on the global portal.

### Favourites

If you have selected a view on the map that you'd like to revisit easily (zoom level, selection of groundwater stations), you can make a favourite by clicking the 'Favourite' button in the top green bar: 

In the favourites menu, you can choose a name for your favourite. By clicking 'Make time relative', the favourite will automatically adjust to show the most recent data, even when the favourite was created some time ago. Once your favourite view is saved it is possible to share the link to other interested persons or save it for your own use later.

## Regional Portal

The regional map is focused on analyzing more local sets and to display basic statistics of the groundwater levels (mean, range and changes) taking a regional perspective.

### Statistics

One can see the groundwater data values in two variants: Below Ground Surface (BGS) or Mean Sea Level (MSL).

- **Below Ground Surface:** These layers show the depth to groundwater below the ground surface and are based on water level measurements collected from wells.
- **Mean Sea Level:** Groundwater elevations are shown as meter above or below mean sea level (positive values indicate groundwater elevations above mean sea level, negative values indicate groundwater elevations below mean sea level).



**Difference:** These layers show changes in groundwater levels over time. Each point shows the calculated difference between the measured groundwater levels from the selected time period. The change in groundwater level is plotted on the map only if a measurement exists in both time periods at a well.

#### Statistic

#### Daterange

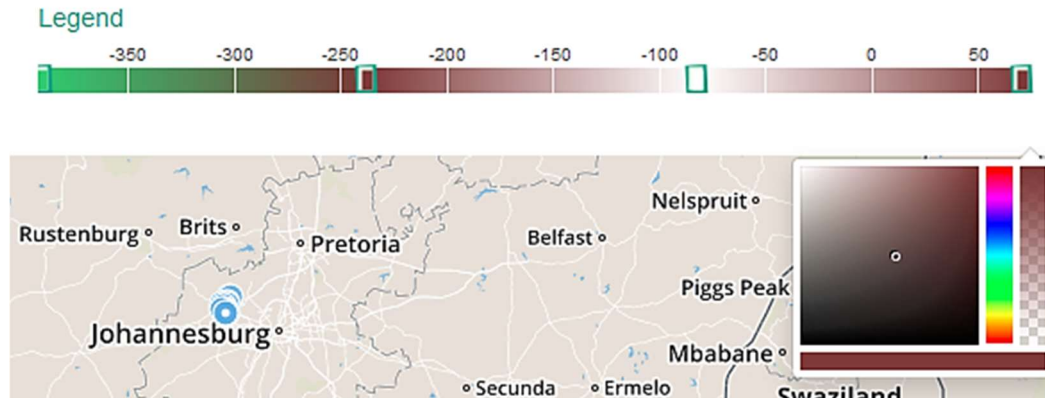
GWmBGS | mean

01-01-1930
to
01-02-2016

GWmBGS | min  
GWmBGS | max  
GWmBGS | mean  
GWmBGS | range (max - min)  
GWmBGS | difference (mean last - first year)  
GWmMSL | min  
GWmMSL | max  
GWmMSL | mean  
GWmMSL | range (max - min)  
GWmMSL | difference (mean last - first year)

#### Legend

The primary scale of the legend is set according to the minimum and maximum of the visualized data. The scale can be adjusted by clicking on the bar. A single click adds an extra legend-point, which one can give a custom colour by single-clicking it again. A double click removes a legend point.



#### Values on the map

The values are visualized on the map with coloured dots, according to the chosen legend. By hovering above the dots, the last value is displayed. By clicking on the dot, a graph is showed at the bottom of the page. If no data is available, the dots are coloured grey and are not clickable. The dots are recoloured when selecting a new parameter, a new period or by changing the extent. The colours of the legend can be changed by double clicking the buttons in the legend as seen above.

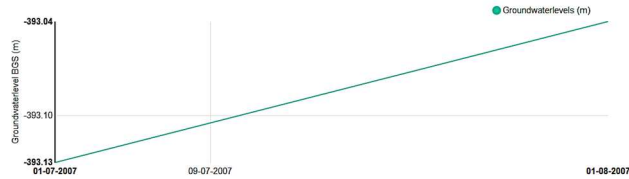


When clicking a dot on the map, a description of the data at that location will appear below the map.





### Groundwater well: G00277NC



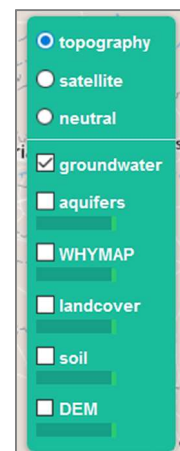
Metadata	
Organisation:	-
Lithology:	-
Surface level:	-
Top level:	None
Bottom level:	None

### Extra layers

Extra layers can be selected by clicking on the layers-icon:



The layers on the top are the background layers. The transparency of these layers can be adjusted by sliding the transparency bar to the left (more transparent) or to the right (less transparent).





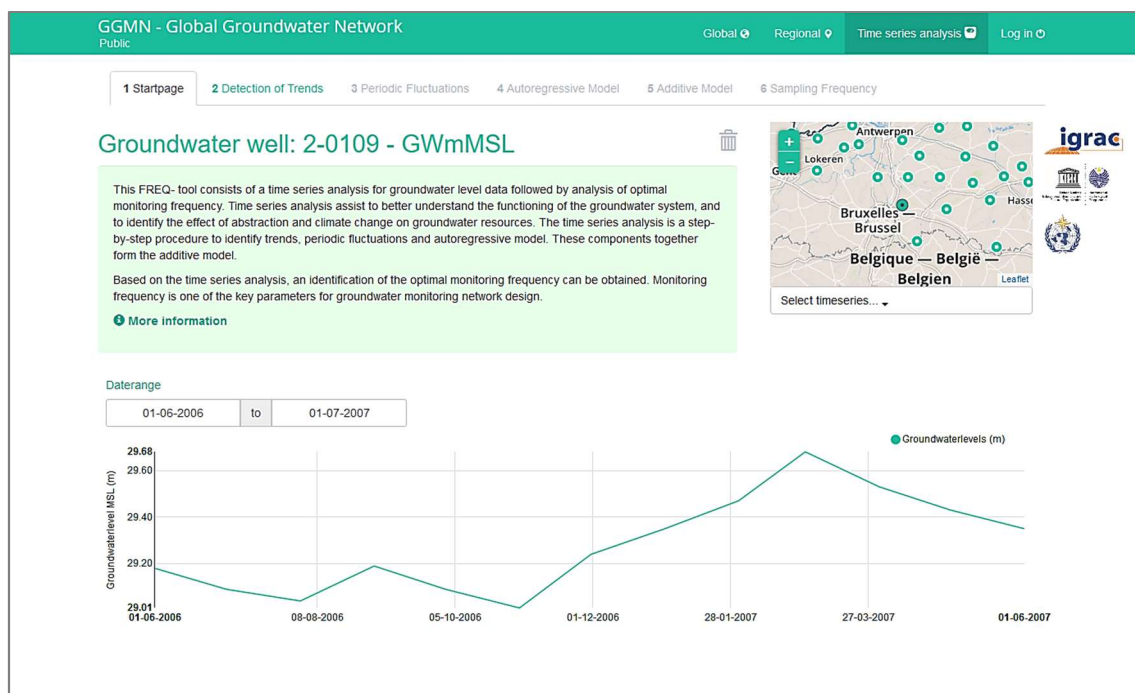
## Time series analysis

### Time series analysis

This tool consists of a time series analysis for groundwater level data followed by analysis of optimal monitoring frequency. The FREQ tool consists of the following components

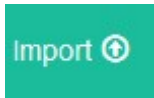
- **Start page**
  - o Select monitoring well
  - o Select time period
  - o Graph: original time series
- **Detection of trend**
  - o Select: no trend, linear trend, or step trend
  - o alpha significance
  - o graphs: original time series / trend / detrended time series
- **Periodic fluctuations**
  - o Select: number of harmonics
  - o Graph: accumulated power spectrum vs number of harmonics; periodic fluctuations / time series with periodic fluctuations removed
- **Autoregressive model**
  - o Select: correlation lag, order of autoregressive model (p)
  - o Graph: serial correlation coefficient vs time lag; result of autoregressive model / removed)
- **Additive model**
  - o Graph: original time series / additive time series model
- **Monitoring frequency**
  - o Graph: Power of trend detection vs number of observations in a trend detection period.

Select data by clicking on a dot in the map and choosing the parameter to work on. The next steps are explained in the information window presented on the online application. During the process of analysis one can easily start over by clicking the bin icon.





## Import



Groundwater monitoring data can be imported to the GGMN portal via the import screen. To import data, you require admin privileges. The import portal consists of two different components: Import a File and Interpolate a Time series. After the station has been uploaded to the portal, you can add the groundwater measurements belonging to that station (information on data upload is also available via: [https://ggmn.lizard.net/doc/import\\_screen.html#upload-assets-as-a-shapefile](https://ggmn.lizard.net/doc/import_screen.html#upload-assets-as-a-shapefile)).

### Upload groundwater station locations as a shapefile

Station location and related metadata can be uploaded to the GGMN portal using shapefiles. These shapefiles contain information about the station information (assets) and/or meta information on the filter data (nested assets). A shapefile can be uploaded as a zipped archive. The zipfile should contain at least a .dbf, .shp, .shx, .prj and .ini file. All files must have the same name. In case of nested assets (data coupled to a filter), this information should be found in the same shapefile record (row) as their assets. The following section provides an example of an .ini file for groundwater stations.

#### Groundwater stations (no information on filter data)

An .ini file is used to map shapefile attributes to the GGMN database tables, organisations and attributes. An .ini file consists of three sections:

- **[general]**: indicates asset name to upload to and optionally organisation uuid.
- **[columns]**: maps database columns to shapefile columns
- **[default]**: optionally provide default values for columns

A groundwater station .ini file would look like this:

```
[general]
asset name = GroundwaterStation

[columns]
code = ID_1
name = NAME
surface level = HEIGHT

[defaults]
frequency = daily
scale = 1
```

This example.ini creates a new asset from each record of the shapefile, with:

- A **code** taken from the ID\_1 column of the shapefile;
- A **name** taken from the NAME column of the shapefile;
- A **surface\_level** taken from the HEIGHT column of the shapefile;
- A **frequency** that defaults to 1, which means this asset can be seen at world scale, when the asset-layer in Lizard-nxt is configured accordingly.

#### Groundwater station with filter information (Assets with nested assets)



In case of filter information our multiple filters belonging to the same groundwater station another section should be added to the .ini file. A groundwater station with filters (its nested assets) would look like this:

```
[general]
asset name = GroundwaterStation
nested asset = Filter

[columns]
code = ID 1
name = NAME
surface level = HEIGHT

[defaults]
frequency = daily
scale = 1

[nested]
first = 2 code
fileds = [code, filter bottom level, filter top level, aquifer confinement]
```

The **[nested]** categories describe:

- **First:** indicates the first column in the shapefile that maps Lizard columns to shapefile columns. This column and all columns to its right configure nested assets. These columns should be a multiple (the number of nested assets) of the fields.
- **fields:** lizard-nxt fields. Each column in the shapefile (including the 'first') is mapped to these fields in order, without considering the shape column names.

This example .ini create (a) new nested asset(s) from each record of the shapefile, with:

- A link to an asset that conforms to the asset as described in the Assets without nested assets .ini.
- A **code** taken from the **2\_code** column of the shapefile. And a new nested asset with a **filter\_bottom\_level** for each 5<sup>th</sup> column from that column onwards.
- A **filter\_bottom\_level** taken from the column directly next to the **2\_code** column of the shapefile. And a new nested asset with a **filter\_bottom\_level** for each 5<sup>th</sup> column from that column onwards;
- A **filter\_top\_level** taken from the column 2 columns next ot the **2\_code** column of the shapefile. And a new nested asset with a **filter\_top\_level** for each 5<sup>th</sup> column from the column onwards;
- An **aquifer\_confinement** taken from the column 3 columns next ot the **2\_code** column of the shapefile. And a new nested asset with an **aquifer\_confinement** for each 5<sup>th</sup> column from that column onwards;
- A **lithology** taken from the column 4 columns next to the **2\_code** column of the shapefile and each. And a new nested asset with a **lithology** for each 5<sup>th</sup> column from that column onwards.

It is possible to add multiple nested assets for one asset. You can copy-paste this code in your own .ini file and zip it together with the shapefile.



### Import time series (data) as a csv

Time series can be uploaded through a 4 column csv. Select both the organization you want to upload and the asset type the time series belongs to (e.g. groundwater station). The csv should not contain a header.

timestamp	unit id / name	value	asset id
2015-01-01T00:00:00Z	GWmMSL	248.0	your_own_code_1
2015-01-01T01:00:00Z	GWmBGS	248.0	your_own_code_2
2015-01-01T00:00:00Z	GWmMSL	252.3	your_own_code_3
2015-01-02T05:00:00Z	GWmMSL	234.2	your_own_code_4

The columns should contain:

- **timestamp:** a timestamp in ISO8601 format.
- **unit id / name:** This is both the name of the parameter referenced unit name and this will become the time series name.
- **value:** value as either a float or integer number.
- **asset id:** either an asset uuid or an organization-code (an identifier for an asset, unique for your organisation). In case the assets have been added with a *code* under category *[columns]*.

Multiple timeseries can be uploaded in one .csv-file, by adding more rows. Since a csv file should not contain a header, your csv should look like this.

2015-01-01T00:00:00Z	GWmMSL	248.0	your_own_code_1
2015-01-01T01:00:00Z	GWmBGS	248.0	your_own_code_2
2015-01-01T00:00:00Z	GWmMSL	252.3	your_own_code_3
2015-01-02T05:00:00Z	GWmMSL	234.2	your_own_code_4

*Example of the content of the time series in a .csv-file. The first column is the date and time of the measurement, in ISO 8601 format, 2nd column contains the parameters, 3rd column the value. The last column is the code linking the time series to its measuring station. This example shows data for three different measuring stations and parameters.*

## Export

Download 

All the data of the GGMN-portal can be downloaded for further use. The data of the selected organization will be downloaded to a CSV-file. In the CSV-file the station information and timeseries data are presented. The UUID column can be used to relate the correct timeseries with the correct station.



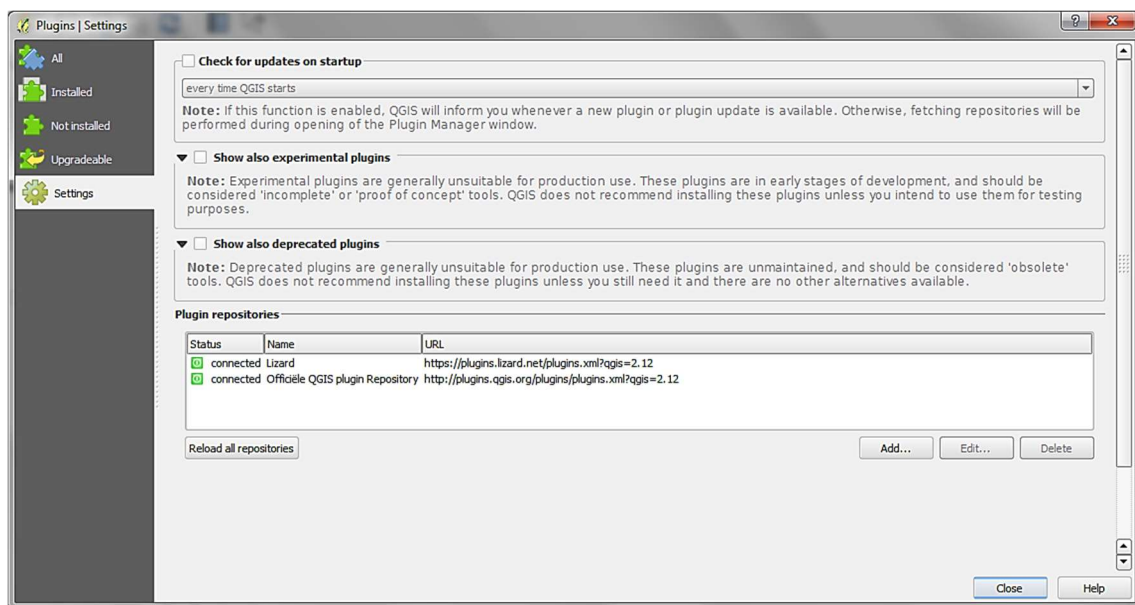
## GGMN and QGIS

QGIS is an open source Geographic Information System (GIS), that aims to be user-friendly providing common functions and features. This tool is very useful for data viewing, editing and analysis. For simple interaction between QGIS and the GGMN-database (named Lizard) a plug-in has been developed. The GGMN Lizard integration plug-in enables users to download data, add custom 'virtual' points (meant for interpolation) and upload groundwater interpolation rasters to the database. After uploading, the rasters can be seen in the GGMN-portal.

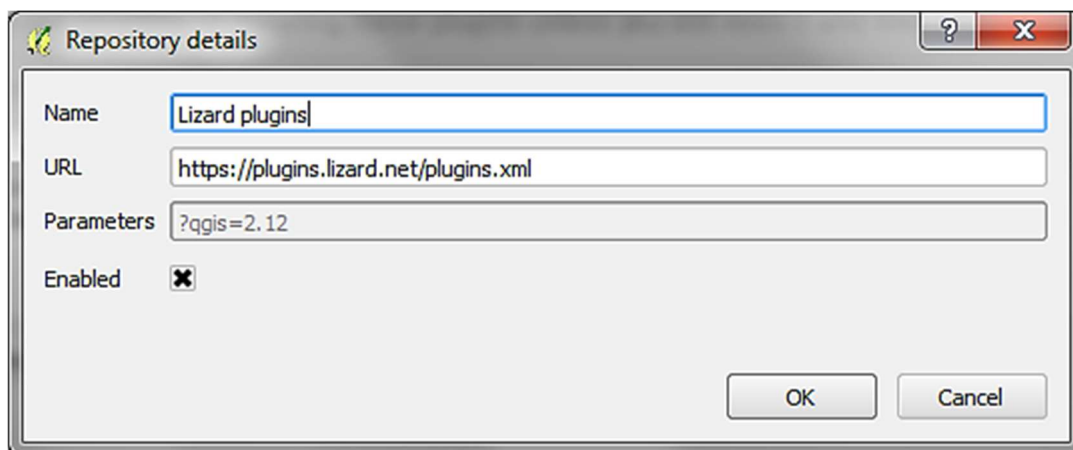
The plug-in has been tested for QGIS 2.8 (stable version) and QGIS 2.12 (latest version). The screenshots used in this manual are from QGIS 2.12.

### Installing the plugin

To install the plugin, go to the menu: Plugins-> Manage and Install Plugins... -> select Settings



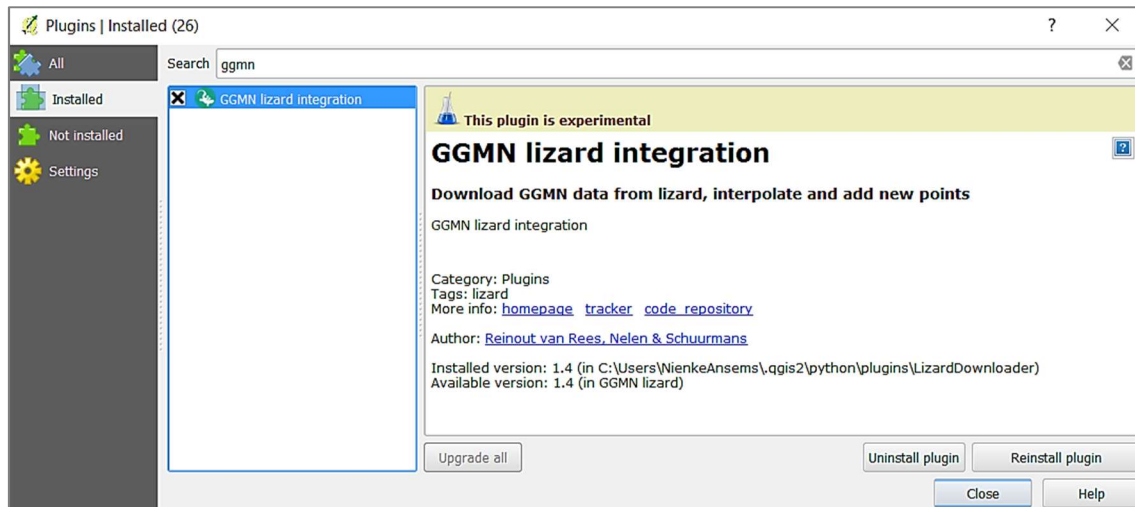
Click on 'Add' under the Plugin-repositories part -> use a applicable name (e.g. Lizard plugins) and type the following URL: <https://plugins.lizard.net/plugins.xml>. Click on 'OK' to create the repository.







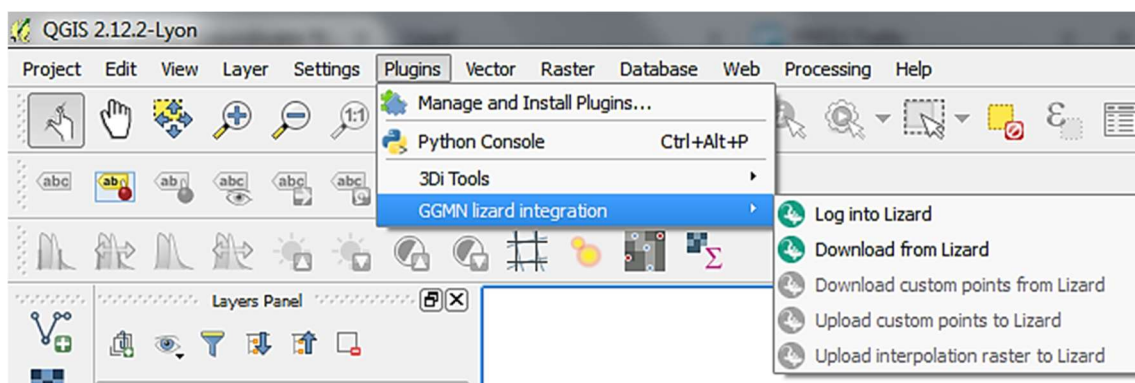
Next, select the 'All' tab and search for 'ggmn'.



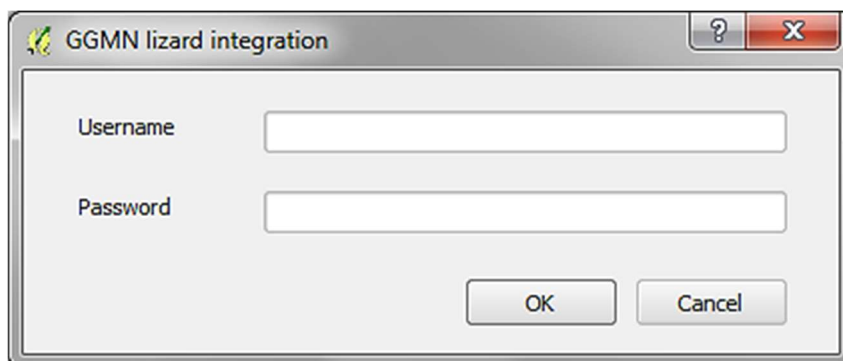
Select the 'GGMN lizard integration' plug-in and click on 'Install plugin'. After installation, the plug-in has been added to the Plugins-menu in QGIS.

### Log in

For downloading the data of your organisation you need to log in. Go to the menu bar, select Plugins-> GGMN Lizard integration -> Log into Lizard.



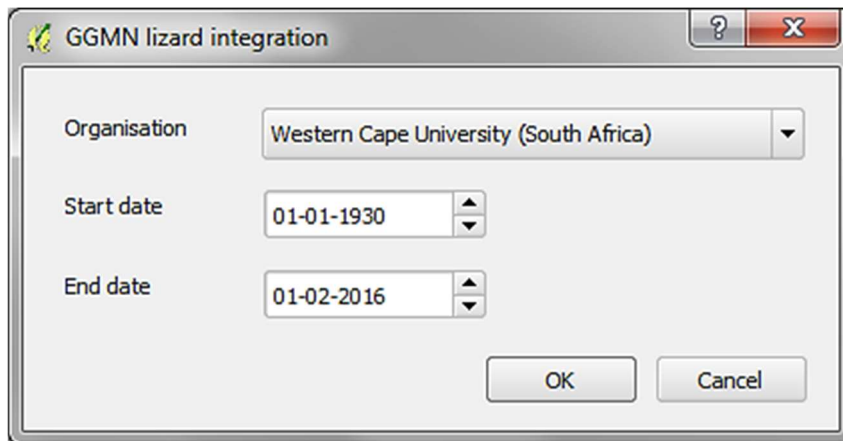
Insert your Username and Password and click 'Ok'.



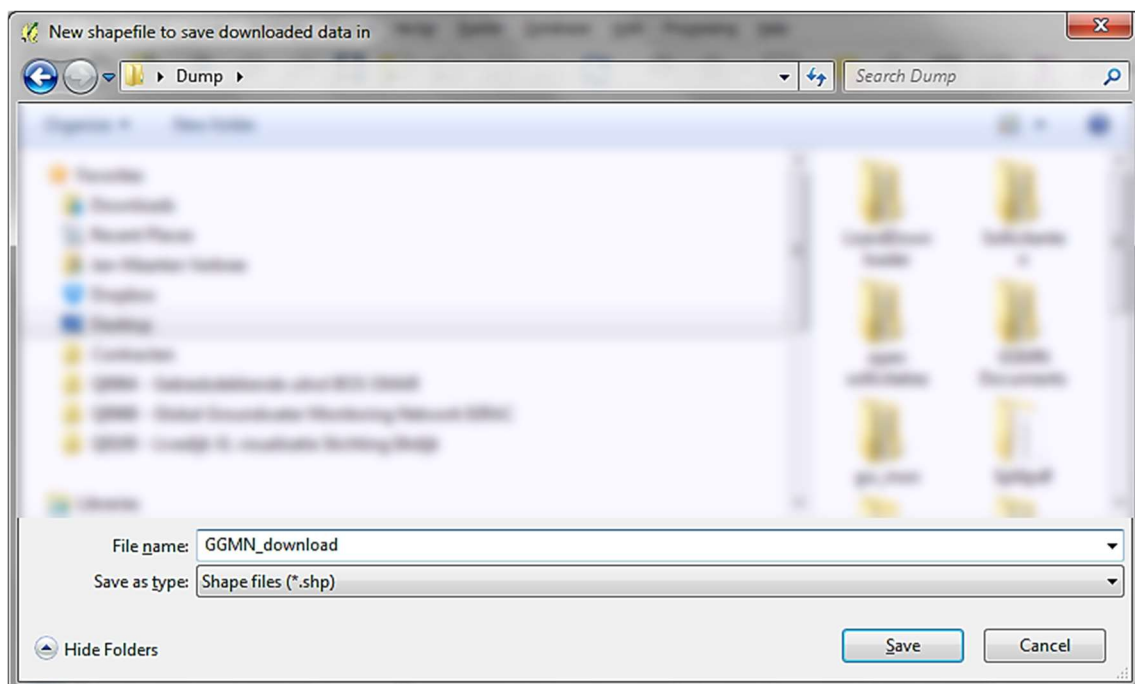


## Download data

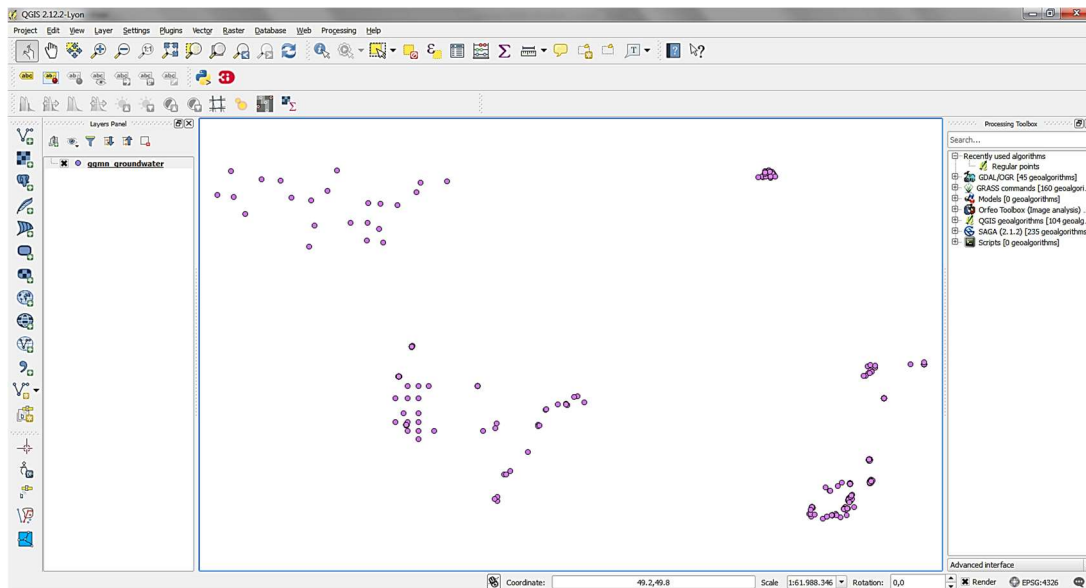
For downloading the data of your organisation you need to log in. Go to the menu bar, select Plugins-> GGMN Lizard integration -> Download from Lizard. If you are authorized to see data of multiple organisations you can select the organisation you want to download data from. You also have to select a period, by choosing a Start date and an End date. The data is download with values in the format 'mean sea level'.



After clicking OK the plug-in asks to enter a filename for the file to save the data to, e.g. GGMN\_download. By clicking Ok the data is downloaded and a new layer is added to the QGIS-project.



The new layer is opened in a new QGIS-project, if there is no open project. For each point data is download and aggregated to get a single value.



To see the values of a location, make sure that the 'Attributes Toolbar' is visible (click on View -> Toolbars -> Attributes Toolbar if it is unchecked). Then click on the 'Identify Features' icon.



Next, select a location to see the attributes:

Name = name as given when uploaded

Loc\_UUID = unique ID of the location (for internal use)

Ts\_UUID = unique ID of the timeseries (for internal use)

Latitude = the latitude of the location

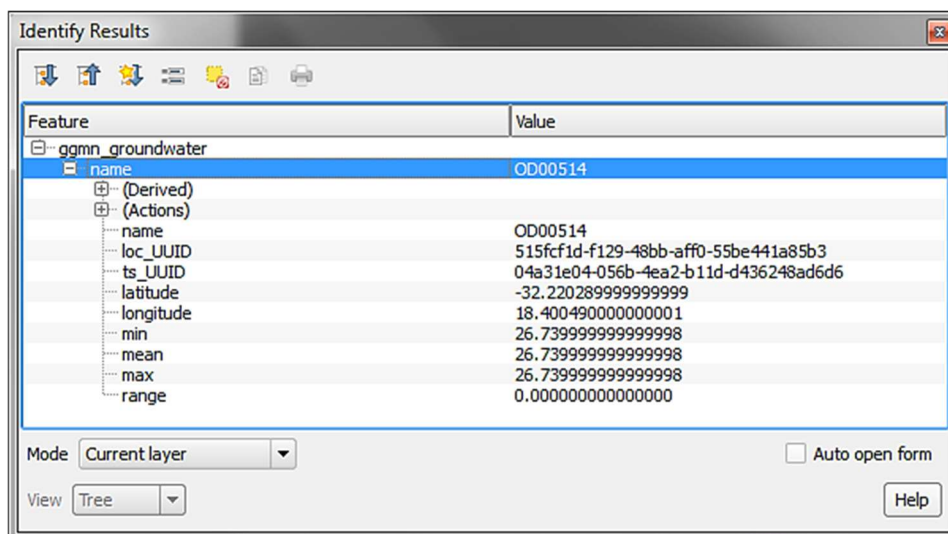
Longitude = the longitude of the location

Min = the minimum of the timeseries values of the selected period

Mean = the mean of the timeseries values of the selected period

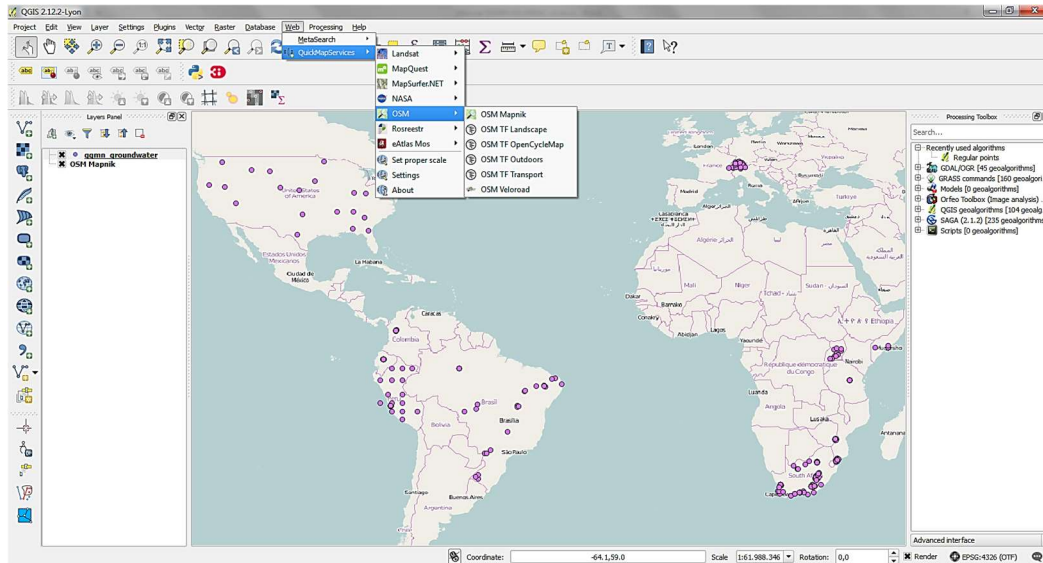
Max = the maximum of the timeseries values of the selected period

Range = the range (difference between maximum and minimum) of the timeseries values of the selected period



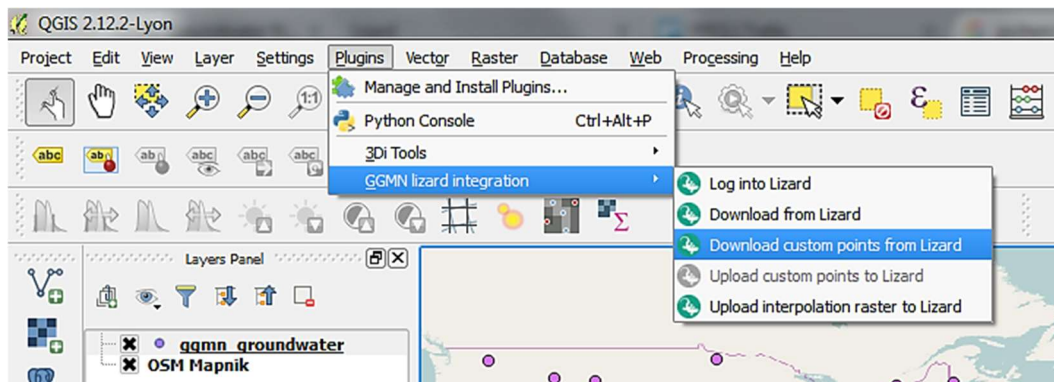


To get background layers, install plugins like QuickMapServices and select a background-layer.

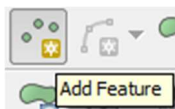


### Custom points

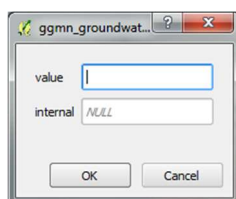
Custom points are 'virtual' measuring point for which one can save values. These values are stored in the Lizard backend for the organisation the user belongs to. Before creating or adding custom points, one needs to click on 'Download custom points from Lizard'. Just like downloading the 'normal' points, a file name has to be given to save the data to. A new layer is created with the custom points. If there are no custom points yet, the layer is empty.



To add a new custom point, click the 'Add feature'-icon (make sure the 'Digitizing' toolbar is displayed)



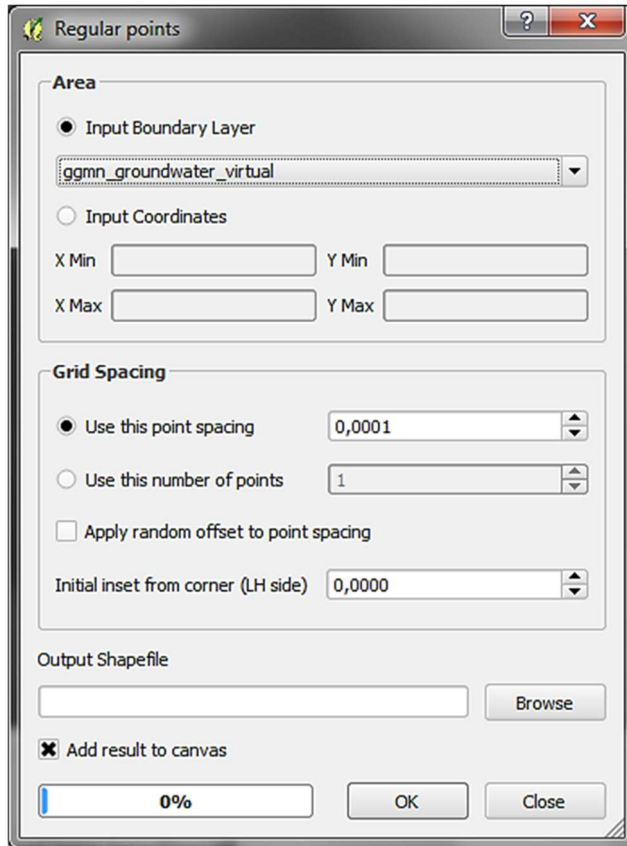
Click on the location where you want to add a custom point. A popup demands for a *value* and an *internal*. Enter a value in meters relative to mean sea level. The internal is used for internal QGIS-registration and needs to remain NULL.





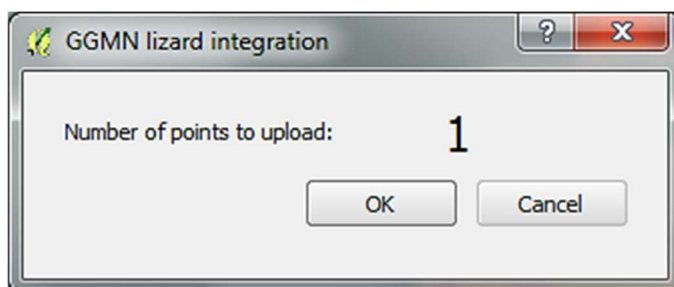
To create multiple points in a simple way, one can choose to use the 'Regular Points'-tool. Select this tool by going to the menu: Vector -> Research Tools -> Regular Points...

Select a layer of a smaller extent by entering coordinates, the grid spacing and an output shapefile.



### Uploading custom points

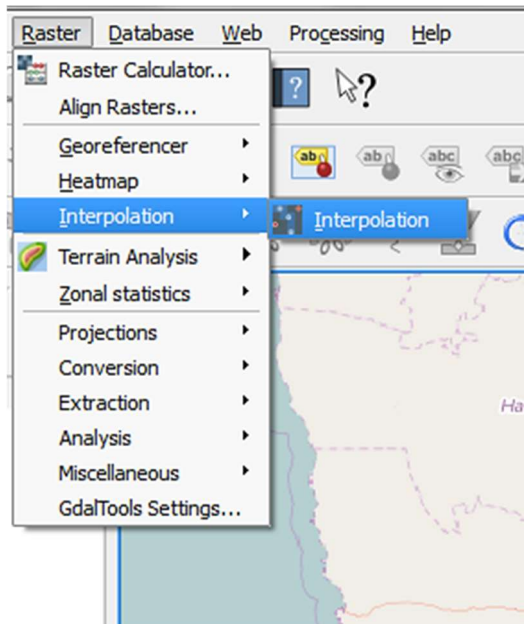
For uploading the custom points to the organisation go to the menu bar, select Plugins-> GGMN Lizard integration -> Upload custom points to Lizard. A popup message gives the number of points to be uploaded and asks for conformation.



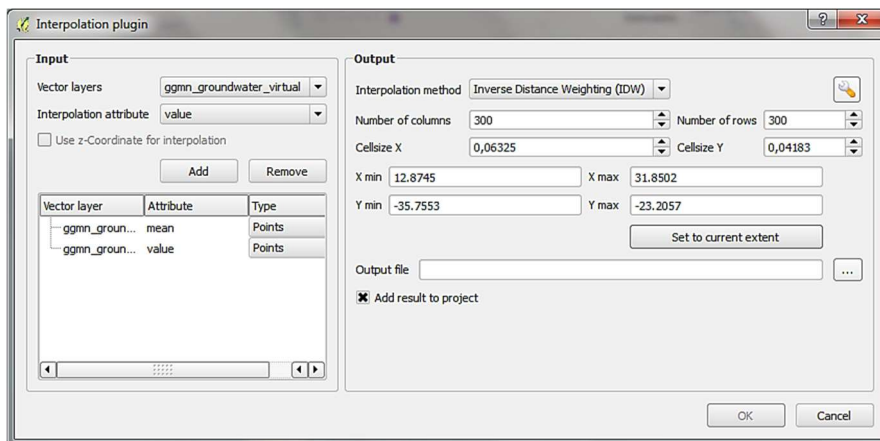
### Interpolation

An interpolated raster can be created using the QGIS-tools. Select from the menu bar Raster -> Interpolation -> Interpolation or click on the 'Interpolation'-icon on the raster-toolbar.

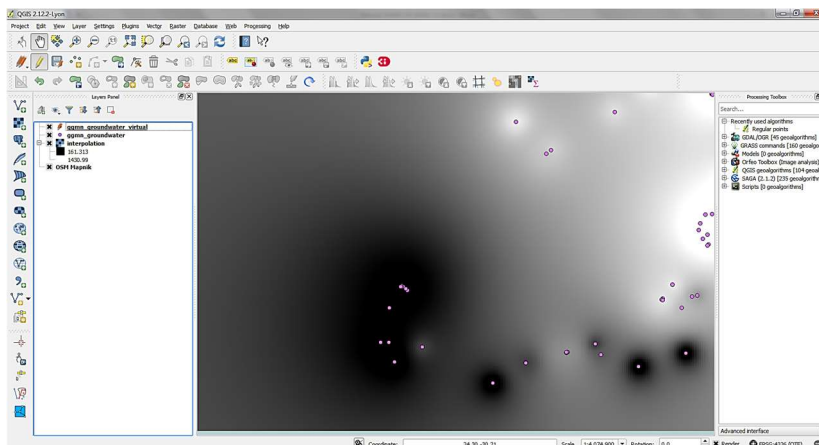




In the popup menu the interpolation input and output can be chosen. First select the layer with the GGMN data and select the interpolation attribute (min, max or mean are probably the best to use). Click on 'Add' and select for example the custom points layer with interpolation attribute *value*. Also click on 'Add'. Next, choose an interpolation method (e.g. IDW), an extent and an output file for the raster. Click 'OK' and the interpolation will start and create a new layer.



An example of an interpolation.







## Upload raster

For uploading the raster to the database, make sure the raster file is selected and click Plugins-> GGMN Lizard integration -> Upload interpolation raster to Lizard. A message confirms that the upload was successful. The raster will be processed and after a short period displayed in the GGMN portal.

If there was already one raster available for the organisation, the raster will be overwritten.

