

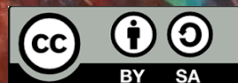
# A short intro to FLOSS, GIS and QGIS

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## Preamble

This work:

- was created, during the “Covid-19 quarantine”, for training purpose only
- would introduce to Geographic Information System, QGIS and other Free/Libre Open Source Software (FLOSS) Software, information and open data.



A part of this document is get from the net. Notes and links bring back, always, to the source. Each image is an hypertext that recall the original one<sup>[3]</sup>.

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All citations, images and tables that comes from “external source” follow their respective licenses.

## Before Starting

To follow this document, these “ingredients” are need (according to Your System specifications):

- **QGIS** (Software)
- **LibreOffice** (or **Microsoft Office**) (Software)
- a **Text Editor** (Notepad, Notepad++, Geany or other, similar) (Software)
- An **Internet Connection** (to download QGIS Plugins and/or to display network background basemap)
- **Syria Cultural Site**, Shapefile, from HDX<sup>[6]</sup> for Ex. “Add a Shapefile to QGIS”
- **Syria (Boundaries)**, Geopackage, from Gadm<sup>[7]</sup>
- **Mozambique Drought**, Raster, from HDX<sup>[8]</sup> for Ex. “Add a Raster to QGIS”
- **World Heritage List**, from WHC<sup>[9]</sup> for Ex. “From data to maps”

If You are using a Windows PC (Desktop, Laptop...) and if You don’t want to install other software than QGIS probably You need “**PortableApps**”<sup>[10]</sup>. This application “**Keep Work and Personal Separate**”. “Use

3 Updated on 03/27/2020

4 <https://creativecommons.org/licenses/by-sa/4.0/>

5 <https://creativecommons.org/licenses/by-sa/4.0/legalcode>

6 <https://data.humdata.org/dataset/syria-cultural-sites>

7 [https://biogeo.ucdavis.edu/data/gadm3.6/gpkg/gadm36\\_SYR\\_gpkg.zip](https://biogeo.ucdavis.edu/data/gadm3.6/gpkg/gadm36_SYR_gpkg.zip)

8 <https://data.humdata.org/dataset/mozambique-drought>

9 <https://whc.unesco.org/en/list/>

10 [portableapps.com](http://portableapps.com)

PortableApps.com for your personal apps on your work PC or for your work apps on your personal PC: Download for Free”.

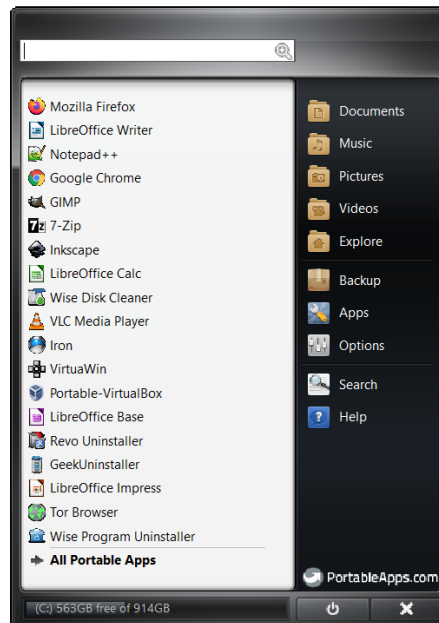


Figure 1 - The PortableApps Interface

With the “Apps” button it is easy to browse and access to a variety of application: **LibreOffice** (Office App), **GIMP** (image editor), **Inkscape** (Vector Drawings), **Scribus** (Desktop Publishing), **File and Disk utilities**, **Text Editor** and so on. To download PortableApps and to get more applications an internet connection is required.

“**PortableApps**” is available into several languages:

عربي, Deutsch, Español, Français, עברית, Bahasa Indonesia, Italiano, 日本語, Nederlands, Português Brasil ou Europeu, Русский, Türkçe, 中文 (简体), 正體中文 (繁體)

I suggest to use PortableApps installing, at least:

- LibreOffice
- Notepad++

And, if You like,

- Gimp
- Inkscape
- ...



Why use an open source software instead a proprietary one?

“There are lots of reasons why people choose open source over proprietary software, but the most common ones are:

- **Peer review:** Because **the source code is freely accessible** and the open source community is very active, open source code is actively checked and improved upon by peer programmers. Think of it as living code, rather than code that is closed and becomes stagnant.
- **Transparency:** Need to know exactly **what kinds of data are moving where, or what kinds of changes have happened in the code?** Open source allows you to check and track that for yourself, without having to rely on vendor promises.

- **Reliability:** Proprietary code relies on the single author or company controlling that code to keep it updated, patched, and working. Open source code outlives its original authors because it is **constantly updated** through active open source communities. Open standards and peer review ensure that open source code is tested appropriately and often.
- **Flexibility:** Because of its emphasis on modification, you can use open source code to address problems that are unique to your business or community. **You aren't locked in to using the code in any one specific way**, and you can rely on community help and peer review when you implement new solutions.
- **Lower cost:** **With open source the code itself is free**—what you pay for when you use a company like Red Hat is **support, security hardening, and help managing interoperability**.
- **No vendor lock-in:** Freedom for the user means that you can take your open source code anywhere, and use it for anything, at anytime<sup>[11][12]</sup>.
- **Open collaboration:** The existence of active open source communities means **that you can find help, resources, and perspectives** that reach beyond one interest group or one company".<sup>[13]</sup>

**COMPARISON OF OPEN SOURCE AND PROPRIETARY SOFTWARE**

	proprietary software	open source software
license fee		
maintenance and support	commercial support	community or commercial support, if available
source code access	no access	access, modification possible


 by Sandra Schön - <http://sandra-schoen.de>

Figure 2 - Comparison of Open Source and Proprietary Software

To investigate the reason «Why “Free Software” is better than “Open Source”» instead, it is possible to read the GNU dedicated [page](#)<sup>[14]</sup>.

11 “In economics, vendor lock-in, also known as proprietary lock-in or customer lock-in, makes a customer dependent on a vendor for products and services, unable to use another vendor without substantial switching costs. Lock-in costs that create barriers to market entry may result in antitrust action against a monopoly”.

[https://en.wikipedia.org/wiki/Vendor\\_lock-in](https://en.wikipedia.org/wiki/Vendor_lock-in)

12 Think about a particular data format that change on changing the software. Without paying for the last software version You'll not be able to “access” the new format loosing on “interoperability”.

13 <https://www.redhat.com/en/topics/open-source/what-is-open-source>

14 <https://www.gnu.org/philosophy/free-software-for-freedom.html>



By the way, free software and/or open source software allow the user to be free, “participating” and “collaborating” to a common project: the freedom of knowledge. This opinion may explain by using a simple image:

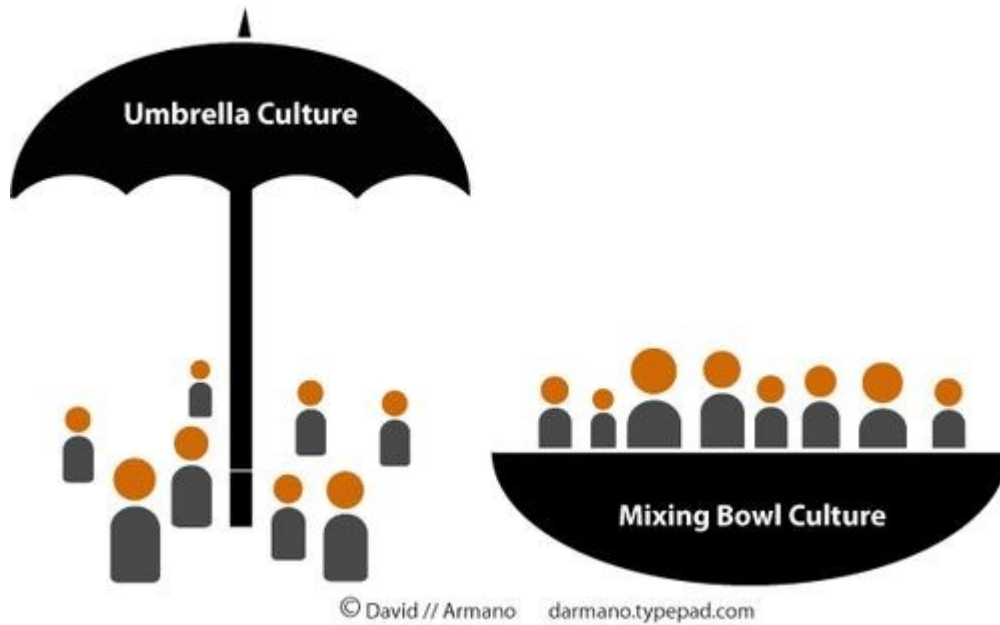


Figure 3 - Umbrella vs Mixing Bowl Culture

The “Umbrella Culture” is a sort of shield that protect us but limit our freedom; the “Mixing Bowl Culture” instead let us to share and improve our knowledge.

## Conventions

In this document:




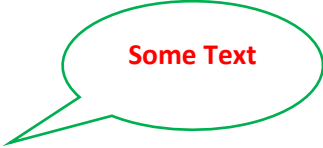
Symbol	Description
	Highlight, Point of interest
	A Problem, a critical point...
	Final Action (i.e. press an "OK" button...)
<b>Text highlight</b>	in yellow would capture the attention
<b>This is</b>	a Text Hyperlink
<b>Settings &gt; Options &gt; General &gt; Locale</b>	follow QGIS Manual and show "single step" (for example, from the "Menu Bar", go to the "Settings", then "Option" then "Locale"... )
<b>Ctrl+Alt+P</b>	is a <b>shortcut</b>
	A "Ballon Shape" with "some text" highlight a particular "area of interest"

Table 1 –Conventions

All the information and the links are updated on the date of the last revision:

Revision	Author	Type (Draft/Final)	Use (Private/Public)	Date
0	F. Fiermonte	Draft	Private	03/13/2020
0.5	F. Fiermonte	Draft	Private	03/20/2020
0.9	F. Fiermonte	Draft	Public	04/06/2020

Table 2 - Document Revisions

## Warnings

Based on my experience, I feel to give You “ten suggestion” in order to work - I hope- in a “better” way.

### “GIS DECALOGUE” - *Plus Edition*

- 1.a **Do not use Windows Desktop** (or other **system folders** such as “Documents”, “Downloads”, “Images” etc) to save Your files and/or Your Project<sup>[15][16]</sup>
- 1.b **Meditate and plan at well** Your “working space”
- 1.c Place the “working package” (project file, data and docs) into a convenient structure of folder<sup>[17]</sup>
2. Use “**relative path**” option in Your GIS project always<sup>[18][19]</sup>
3. **Do not use** files stored on USB pen drive and/or external HDD device<sup>[20]</sup>
- 4.a **Do not use long file names**
- 4.b **Do not use long folder names**
5. **Never use special characters**, open quote, spaces and other “strange” symbols<sup>[21][22]</sup>
6. Add **suffix** to file name to describe the process of data elaboration
7. **Remind** to **backup** often Your data
8. Use a **Text Editor** to **track** Your work
9. Consider to “**swich**” from **shapefile** towards a GIS compliant structured container<sup>[23]</sup>
10. (If Internet is OK) Prefer base maps “**as services**” (**WMS, WCS, WFS**)

<https://www.computerhope.com/jargon/s/specchar.htm>

For files or folders name, use “underscore” or “minus” character instead of special characters.

---

15 Windows Desktop (Documents, Downloads, etc) is not a “normal folder”. This path take the “user name” and put it into a predefined path for example C:\Users\Administrator\Desktop\ (where the “Administrator” is the user). This do not follow rules #4.a; #4.b.

16 [https://answers.microsoft.com/en-us/windows/forum/windows\\_10-files/automated-windows-10-updates-deleted-all-my/33ce1539-788f-490e-9243-c3b2d3acab83](https://answers.microsoft.com/en-us/windows/forum/windows_10-files/automated-windows-10-updates-deleted-all-my/33ce1539-788f-490e-9243-c3b2d3acab83)

17 For example, You could create a WORK directory. In this “root” folder You should save the QGIS project(s) files and in subfolders - starting from the “root” - place data, doc, output into separated folders. Maybe it is better to distinguish between “ORIGINAL DATA” from “MODIFIED DATA” (created by You) to preserve the original ones, downloaded, from Your elaborations. This is a good method also to performs incremental backup.

18 Refer to chapter “Project management”

19 QGIS lets us to save our works into “projects” (QGZ or QGS format). When We save a project we store our work into a document in which the data we have used (vectors, rasters, services...) are linked to it and not embedded into the files. So, when we have to pass our work to a colleague is better to give a project containing, as pathname “/WORK/” instead of “C:/WORK” to avoid a “corruption” of related objects. (If my colleague, to whom I gave the package, do not have the [c:] drive and will save our project into [d:] drive, when QGIS will try to open the project file will not be able to restore the data and will ask to us to re-established all the links).

20 In general, external devices are slower than internal storage resources. And if we are not patient enough to wait until the end of saving procedures, we will risk disconnecting the device while the PC is still writing the data: a perfect storm (cat’s out of the bag)

21 <https://www.computerhope.com/jargon/s/specchar.htm>

22 For files or folders name, use “underscore” or “minus” character instead of special characters.

23 A Geopackage, a PostgreSQL-PostGIS database, a Spatialite Database...

## Introduction

“Imagine you are flying from New York to Los Angeles. As the airplane descends over the L.A. basin, you look out the window. How would you describe what you see?”<sup>[24]</sup>



Figure 4 - The Los Angeles Basin

“Because you cannot describe all the details of the complex cityscape below, you might break it down into objects: you might describe features such as buildings and streets, events such as a traffic jam, or phenomena such as a rainstorm. To describe the location of features, events, and phenomena, you might use terms such as “in front of” or “next to” or even geographic directions such as “north of the freeway” or “southwest of downtown.”

What you did was the first step in creating geographic data. You identified features, events, and phenomena and associated them with a location. In your head, you created a model of the cityscape below you. If you recorded this model by drawing a map, taking a photo, or just writing the information down on a piece of paper, the result would be geographic data.



Figure 5 - A City Rendering

Geographic data is recorded information about the earth's surface and the objects found on it, associated to a geographic location. In this module, you will learn more about geographic data—how it is organized and stored in a GIS, and how it can be assembled into a useful GIS database”.<sup>[25]</sup>

24 <http://www.geography.hunter.cuny.edu/~jochen/GTECH361/lectures/lecture05/concepts/>

25 <http://www.geography.hunter.cuny.edu/~jochen/GTECH361/lectures/lecture05/concepts/>



## What is a Geographic Information System (GIS)?

“A geographic information system (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present spatial or geographic data. GIS applications are tools that allow users to create interactive queries (user-created searches), analyze spatial information, edit data in maps, and present the results of all these operations” [26] [27]

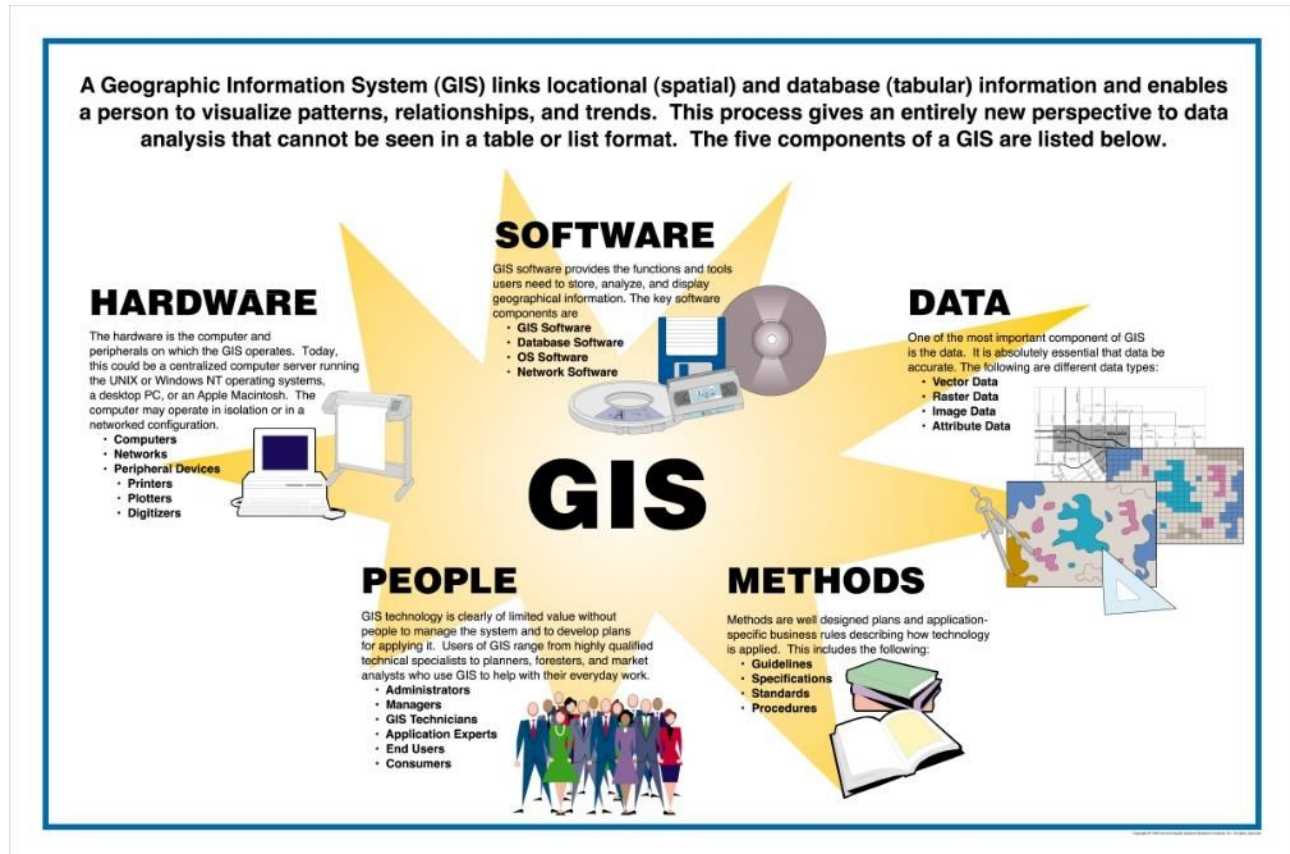


Figure 6 - What is a Geographic Information System

“GIS can refer to a number of different technologies, processes, techniques and methods. It is attached to many operations and has many applications related to engineering, planning, management, transport/logistics, insurance, telecommunications, and business”.[28]

“GIS can relate unrelated information by using location as the key index variable. Locations or extents in the Earth space–time may be recorded as dates/times of occurrence, and x, y, and z coordinates representing, longitude, latitude, and elevation, respectively. All Earth-based spatial–temporal location and extent references should be relatable to one another and ultimately to a "real" physical location or extent”.[29]

By the way, the power of GIS is the capability to put into relationship the geographic information with data to create a System of Geographic Information. We can consider the first example of GIS the “Original map by

26 Clarke, K. C., 1986. Advances in geographic information systems, computers, environment and urban systems, Vol. 10, pp. 175–184.

27 Maliene V, Grigonis V, Palevičius V, Griffiths S (2011). "Geographic information system: Old principles with new capabilities". Urban Design International. 16 (1): 1–6. doi:10.1057/udi.2010.25.

28 Maliene V, Grigonis V, Palevičius V, Griffiths S (2011). "Geographic information system: Old principles with new capabilities". Urban Design International. 16 (1): 1–6. doi:10.1057/udi.2010.25.

29 Wikipedia, GeEographic Information System, [https://en.wikipedia.org/wiki/Geographic\\_information\\_system#cite\\_note-](https://en.wikipedia.org/wiki/Geographic_information_system#cite_note-)

Maliene\_V,\_Grigonis\_V,\_Palevičius\_V,\_Griffiths\_S\_2011\_1–6-2

John Snow showing the clusters of cholera cases in the London epidemic of 1854, drawn and lithographed by Charles Cheffins”<sup>[30]</sup>.

John Snow, “by talking to local residents (with the help of Reverend Henry Whitehead), **identified the source of the outbreak as the public water pump on Broad Street** (now Broadwick Street). Although Snow's chemical and microscope examination of a water sample from the Broad Street pump did not conclusively prove its danger, his studies of the pattern of the disease were convincing enough to persuade the local council to disable the well pump by removing its handle (force rod). This action has been commonly credited as ending the outbreak, but Snow observed that the epidemic may have already been in rapid decline.

**Snow later used a dot map to illustrate the cluster of cholera cases around the pump.** He also used statistics to illustrate the connection between the quality of the water source and cholera cases”.

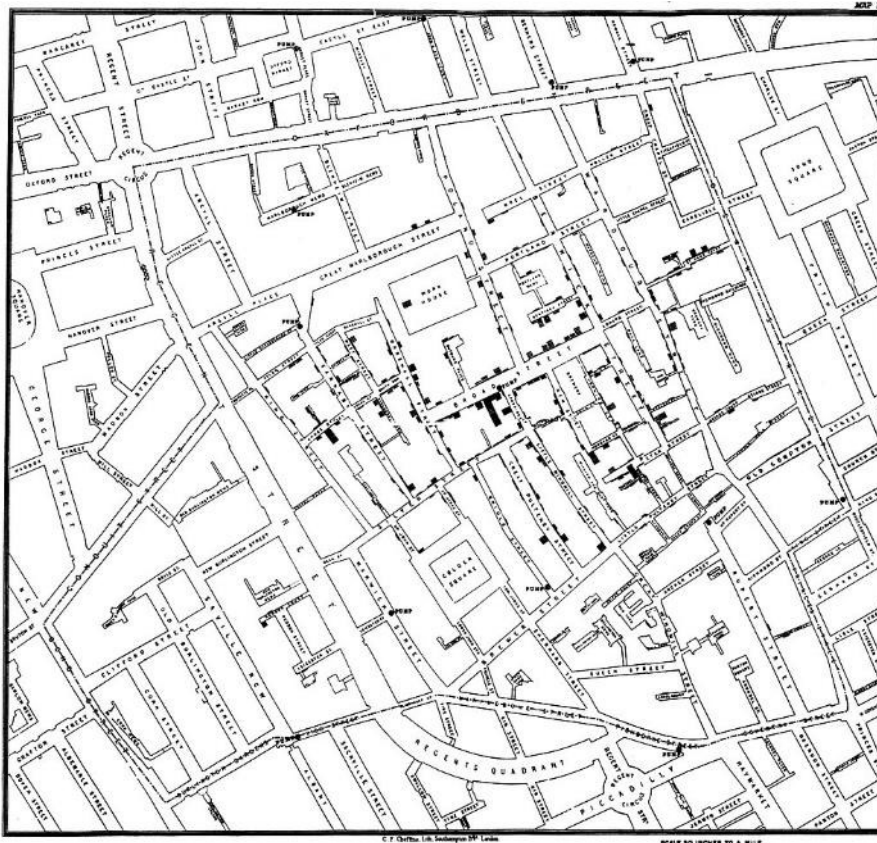


Figure 7 - The map by John Snow (clusters of cholera cases). Drawn and lithographed by Charles Cheffins

“He showed that the Southwark and Vauxhall Waterworks Company was taking water from sewage-polluted sections of the Thames and delivering the water to homes, leading to an increased incidence of cholera. Snow's study was a major event in the history of public health and geography. It is regarded as the founding event of the science of epidemiology”.<sup>[31]</sup>

### What is QGIS?

“QGIS is a professional GIS application that is built on top of and proud to be itself Free and Open Source Software (FOSS)<sup>[32]</sup>.

30 [https://en.wikipedia.org/wiki/John\\_Snow#/media/File:Snow-cholera-map-1.jpg](https://en.wikipedia.org/wiki/John_Snow#/media/File:Snow-cholera-map-1.jpg)

31 [https://en.wikipedia.org/wiki/John\\_Snow](https://en.wikipedia.org/wiki/John_Snow)

32 [http://freeopensourcesoftware.org/index.php/Main\\_Page](http://freeopensourcesoftware.org/index.php/Main_Page)

# QGIS

## A Free and Open Source Geographic Information System



Create, edit, visualise, analyse and publish geospatial information on Windows, Mac, Linux, BSD (Android coming soon)

For your desktop, server, in your web browser and as developer libraries

Download Now

Version 3.12.1  
Version 3.10.4 LTR

Support QGIS

Donate now!

Figure 8 - QGIS Site

QGIS is a user friendly Open Source Geographic Information System (GIS) licensed under the [GNU General Public License](#)<sup>[33]</sup>. QGIS is an official project of the Open Source Geospatial Foundation ([OSGeo](#))<sup>[34]</sup>. It runs on Linux, Unix, Mac OSX, Windows and Android and supports numerous vector, raster, and database formats and functionalities.

**QGIS is a volunteer driven project.** We welcome contributions in the form of code contributions, bug fixes, bug reports, contributed documentation, advocacy and supporting other users on our mailing lists and [gis.stackexchange.com](#). If you are interested in actively supporting the project, you can find more information under the development menu and on the QGIS [Wiki](#)<sup>[35]</sup>.

QGIS provides a continuously growing number of capabilities provided by core functions and plugins. You can visualize, manage, edit, analyse data, and compose printable maps.

To explore the QGIS features it is possible to use this [link](#)<sup>[36]</sup>. To get a copy of QGIS 3.10 User Guide use this [link](#)<sup>[37]</sup> instead".

33 <https://www.gnu.org/licenses/licenses.html>

34 <https://www.osgeo.org/>

35 <https://en.wikipedia.org/wiki/QGIS>

36 [https://docs.qgis.org/3.10/en/docs/user\\_manual/preamble/features.html](https://docs.qgis.org/3.10/en/docs/user_manual/preamble/features.html)

37 [https://docs.qgis.org/3.10/en/docs/user\\_manual/index.html](https://docs.qgis.org/3.10/en/docs/user_manual/index.html)



## How get the software?

To get a copy of QGIS please follows “Download QGIS for your **platform**”<sup>[38]</sup> and choose the appropriate version: MS-Windows, macOS, Linux, BSD, Apps for mobile and tablet, and so on.

If You are using a Windows Operating System I suggest the “**Standalone installers from OSGeo4W packages**” (check Your PC technical info to know if the system is running on 32 of 64 bit platform):

### \*\*\* Latest release (richest on features):

- \* QGIS Standalone Installer Version 3.12 (**64 bit**)

[https://qgis.org/downloads/QGIS-OSGeo4W-3.12.1-1-Setup-x86\\_64.exe](https://qgis.org/downloads/QGIS-OSGeo4W-3.12.1-1-Setup-x86_64.exe)

- \* QGIS Standalone Installer Version 3.12 (**32 bit**)

<https://qgis.org/downloads/QGIS-OSGeo4W-3.12.1-1-Setup-x86.exe>

### \*\*\* Long term release repository (most stable):

- \* QGIS Standalone Installer Version 3.10 (**64 bit**)

[https://qgis.org/downloads/QGIS-OSGeo4W-3.10.4-1-Setup-x86\\_64.exe](https://qgis.org/downloads/QGIS-OSGeo4W-3.10.4-1-Setup-x86_64.exe)

- \* QGIS Standalone Installer Version 3.10 (**32 bit**)

<https://qgis.org/downloads/QGIS-OSGeo4W-3.10.4-1-Setup-x86.exe>

To download and use the “most stable version”, is better to refer to **Long term release repository**.

## How contribute to the Project (without donate money)

### *Bugs, Features and Issues*

“QGIS is a largely volunteer driven project, and is the work of a dedicated team of developers, documenters, translators and supporters. Despite the efforts of the team to release QGIS without bugs, there may remain some bugs. If you find a bug or want new features to be added, please report it”! <sup>[39]</sup>

### *Where to report?*

“Each part of the QGIS Project has a dedicated place where issues (feature requests or bugs) can be reported, managed and discussed. Depending on the area you encountered the issue, the table below indicates the right repository to report it:

Place you found the bug or request a feature for:

- Applications (QGIS Desktop, QGIS Server): <https://github.com/qgis/QGIS/issues>
- QGIS Website (<https://qgis.org>): <https://github.com/qgis/QGIS-Website/issues>
- QGIS Documentation (<https://docs.qgis.org>): <https://github.com/qgis/QGIS-Documentation/issues>
- External plugins: the author repository set in the plugin description

For help and questions, please contact the Mailing lists”.

38 <https://www.qgis.org/en/site/forusers/download.html>

39 <https://qgis.org/en/site/getinvolved/development/bugreporting.html>



## Reporting issues on QGIS applications

“QGIS applications (QGIS Desktop and QGIS Server) issues are available in Github. In order to submit or comment a report, you need to register and login”.

### Before reporting an issue

“Before filing an issue, review the currently open issues to make sure that you aren’t creating a duplicate. If you have additional information on an issue, you can add it to the existing ticket. Third party plugins might also cause problems. If you have installed any, you should also verify that the problem is still reproducible without them. Please don’t report multiple unrelated bugs in a single bug report.

Before sending the report, please check the formatting of your report by clicking on “Preview”. Please avoid editing existing reports, if not for typos. Better add further comments in any other case”.

### QGIS Translation

QGIS is natively developed in English, either for the user interface (GUI) or for its documentation and web site. However, all these components are available in many other languages since it is designed to be translated into any language quite easily. At this moment about forty languages are already available in the Desktop user interface and about eighty languages are available in transifex ready to be translated. Nearly the same apply for the web site and documentation.

The translation process is managed by the Translation Team and all the activities are done under the Transifexplatform.

### QGIS GUI Translation

The QGIS interface is natively programmed in English. However, at this moment over forty other languages are already available.

To start QGIS with the appropriate localization, run `qgis --lang<language code>` in command line or change localization in QGIS under **Settings ▶ Options ▶ General ▶ Locale** menu.

If you want to find out if your language is already present in QGIS Applications or who is currently working on your language you have to take a look in the **Help ▶ About ▶ Translators** Box in the QGIS Desktop Application.

You will also find the progress of the translation there (but remember in every “stable” version it will always stay at the same level). For finding the current percentage of translation you will either have to install the nightly build of QGIS or checkout the source code of QGIS.

The entire interface contains over ten thousand pieces of text and a complete translation will take days if not weeks to be finished. Besides that, the rapid development of the application continuously causes new and edited texts to be translated. **A huge effort and your help will be appreciated!**

## User Guide, Manuals and Tutorial

### QGIS 3.10

**For users:**<sup>[40]</sup>

- Read the **QGIS User guide**
- Follow the tutorials in the **QGIS Training manual**
- Learn GIS basics in **A gentle introduction in GIS**

### For documentation writers:

- Learn how to write docs using the [Documentation Guidelines](#)

### For developers:<sup>[41]</sup>

- Go Python, study the [PyQGIS cookbook](#) (for plugins and scripting)
- [C++ Api documentation](#)
- [PyQGIS - QGIS Python Api documentation](#)

### *QGIS testing*

We are still updating (not translating yet) the documentation for releases newer than QGIS 3.10. We call this version 'QGIS testing' and the documentation can be found here: <http://docs.qgis.org/testing>

- [User guide/Manual](#)
- [QGIS Training manual](#)
- [PyQGIS Cookbook](#)
- [QGIS Developers Guide](#)
- [Building QGIS from Source](#)
- [Documentation Guidelines \(how to write the docs\)](#)
- [A gentle introduction in GIS](#)
- PDF versions of all above, eg for printing are available here: <http://docs.qgis.org/testing/pdf>
- [C++ Api documentation](#)
- [PyQGIS - QGIS Python Api documentation](#)

### *QGIS 3.4*

#### For users:

- Read the [QGIS User guide](#) (or as [PDF](#))
- Follow the tutorials in the [QGIS Training manual](#) (or as [PDF](#))
- Learn GIS basics in [A gentle introduction in GIS](#)

#### For documentation writers:

- Learn how to write docs using the [Documentation Guidelines](#)

#### For developers:

- Go Python, study the [PyQGIS cookbook \(for plugins and scripting\)](#) (or as [PDF](#))
- [C++ Api documentation](#)
- [PyQGIS - QGIS Python Api documentation](#)

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41 <https://www.qgis.org/en/docs/index.html>

*QGIS Tutorials and Tips*

For extraordinary Guides and Documentation, refer to the Official Page of QGIS Project<sup>[42]</sup>. Thanks to the Community, several docs, guide, tutorial and video are available on the Net:

- “Documentation for QGIS 3.10”<sup>[43]</sup>
- “QGIS Training Manual”<sup>[44]</sup>
- “Training Material”<sup>[45]</sup>
- “A Gentle Introduction to GIS”<sup>[46]</sup>
- QGIS Tutorials and Tips<sup>[47]</sup>
- “Klas Karlsson QGIS Video”<sup>[48]</sup>
- And many others...
- 

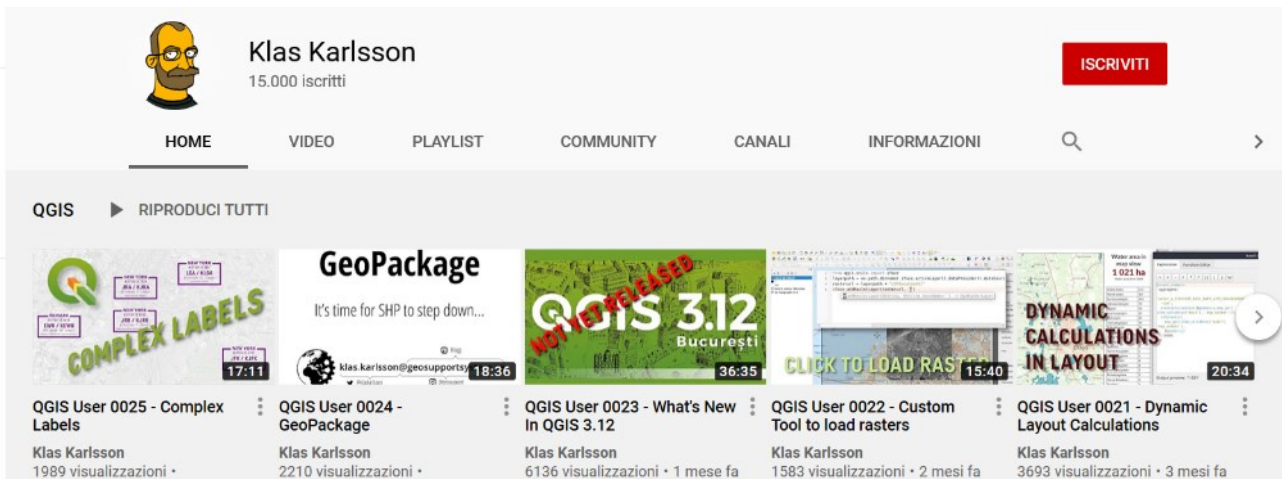


Figure 9 - Klas Karlsson QGIS You Tube Channel

42 <https://www.qgis.org/en/site/>

43 <https://docs.qgis.org/3.10/en/docs/>

44 [https://docs.qgis.org/3.10/en/docs/training\\_manual/index.html](https://docs.qgis.org/3.10/en/docs/training_manual/index.html)

45 [qgis.org/en/site/forusers/trainingmaterial/index.html](https://www.qgis.org/en/site/forusers/trainingmaterial/index.html)

46 [https://docs.qgis.org/3.10/en/docs/gentle\\_gis\\_introduction/index.html](https://docs.qgis.org/3.10/en/docs/gentle_gis_introduction/index.html)

47 <http://www.qgistutorials.com/en/index.html>

48 <https://www.youtube.com/user/klakar70>

## Where find GIS data?

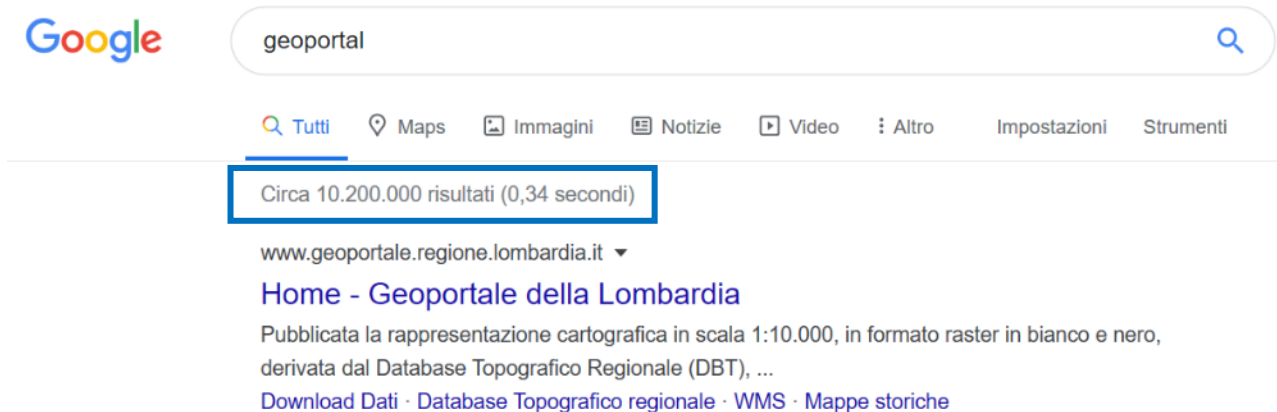
The better way to search, browse and download data is to use **GOOGLE** (or another search engine). For example:

Search engine



Figure 10 - Google Search for the GIS Data

Broadly speaking, many sites that contains GIS data are following a sort of “common standardisation” by calling “GEOPORTAL”<sup>[49]</sup> their site.



As we have seen before, searching for geoportal will return 10.200.000 result in all over the world. Maybe it is better to limit the search procedure, inserting other information, such as the name of the geographic region or the country.

## Advanced Search

It is very easy to use Google for searching a particular kind of data. For example, if we need to get data in PDF format try using the following syntax:



The results will talk by themselves: all the results of **cultural+heritage** will be in **PDF** file format only. Text between quotes is the “search string” while the “extension” (filetype:pdf is an option) allows to search for a particular subset kind of formats.

<sup>49</sup> A geoportal is a type of web portal used to find and access geographic information and associated geographic services via the Internet. Geoportals are important for effective use of geographic information systems and a key element of Spatial Data Infrastructure. [Wikipedia](#)



Circa 18.200.000 risultati (0,80 secondi)

Suggerimento: Cerca risultati solo in italiano. Puoi specificare la lingua di ricerca in [Preferenze](#).

[www.reach-culture.eu](#) › uploads › 2018/12 › In... PDF Traduci questa pagina

### Cultural Heritage - Reach Culture

Innovation in **Cultural Heritage** - For an integrated European Research Policy. European Commission. Directorate-General for Research and Innovation.

“Filetype” option is obviously valid for the most common file format (DOC, DOCX, XLS, XLSX, PPT, PPTX..., PDF...) but do not allows (of course) to search MP3, AVI... files. But, we can say, it is very “hard” to use a PDF file into a MAP...

This is why is better to try other extension, such as SHP (that stands for Shapefile) or, better, CSV (that stand for Comma Separated Value)<sup>[50]</sup>.

So, following the guide<sup>[51]</sup> if we are searching for “Geoportal” we should use the **allintitle:geoportal** and/or **allinurl:geoportal** option:



About 8,830,000 results (0.54 seconds)

[www.geoportal.org](#) ▼

### GEO Portal

We use cookies to track visits to our website only, no personal information is collected. If you wish to restrict or block our use of cookies, please follow the ...

[inspire-geoportal.ec.europa.eu](#) › ... › INSPIRE › Geoportal ▼

### INSPIRE Geoportal

The INSPIRE **Geoportal** is the central European access point to the data provided by EU Member States and several EFTA countries under the INSPIRE ...

For best results, remember to switch on the Google search language from the local default to “english” (or other language)<sup>[52]</sup>.

Not only “Geoportal” but also “Open Data” portal may share (geographic) information.

### Open Data

“Open data is **data** that **anyone** can **access, use and share**. Governments, businesses and individuals can use open data to bring about social, economic and environmental benefits”<sup>[53]</sup>.

50 [https://en.wikipedia.org/wiki/Comma-separated\\_values](https://en.wikipedia.org/wiki/Comma-separated_values)

51 <https://ahrefs.com/blog/google-advanced-search-operators/>

52 <https://support.google.com/customsearch/answer/2633296?hl=en>

53 <https://www.europeandataportal.eu/elearning/en/module1/#/id/co-01>



The **European Data Portal** says<sup>[54]</sup>:

- “Data is open if anyone can access, use and share it.
- “Open data becomes usable when made available in a common, machine-readable format.”
- “Open data must be licensed. Its licence must permit people to use the data in any way they want, including transforming, combining and sharing it with others, even commercially.”

And, again:

“There are some simple things to consider when defining openness:”

“LIMITATIONS”

- “For data to be open, it should have no limitations that prevent it from being used in any particular way
- Anyone should be free to use, modify, combine and share the data, even commercially”

“COST”

- “Open data must be free to use, but this does not mean that it must be free to access.
- There is often a cost to creating, maintaining and publishing usable data.
- Ideally, any fee for accessing open data should be no more than the reasonable reproduction cost of the unit of data that is requested.
- This reproduction cost tends to be negligible for many datasets.
- Live data and big data can incur ongoing costs related to reliable service provision”.

“REUSE”

- “Once the user has the data, they are free to use, reuse and redistribute it – even commercially.
- Open data is measured by what it can be used for, not by how it is made available.
- Aspects like format, structure and machine readability all make data more usable, and should all be carefully considered.
- However, these do not make the data more open”.



Figura 1 - European Data Portal

### Map representation of Open Data Sites

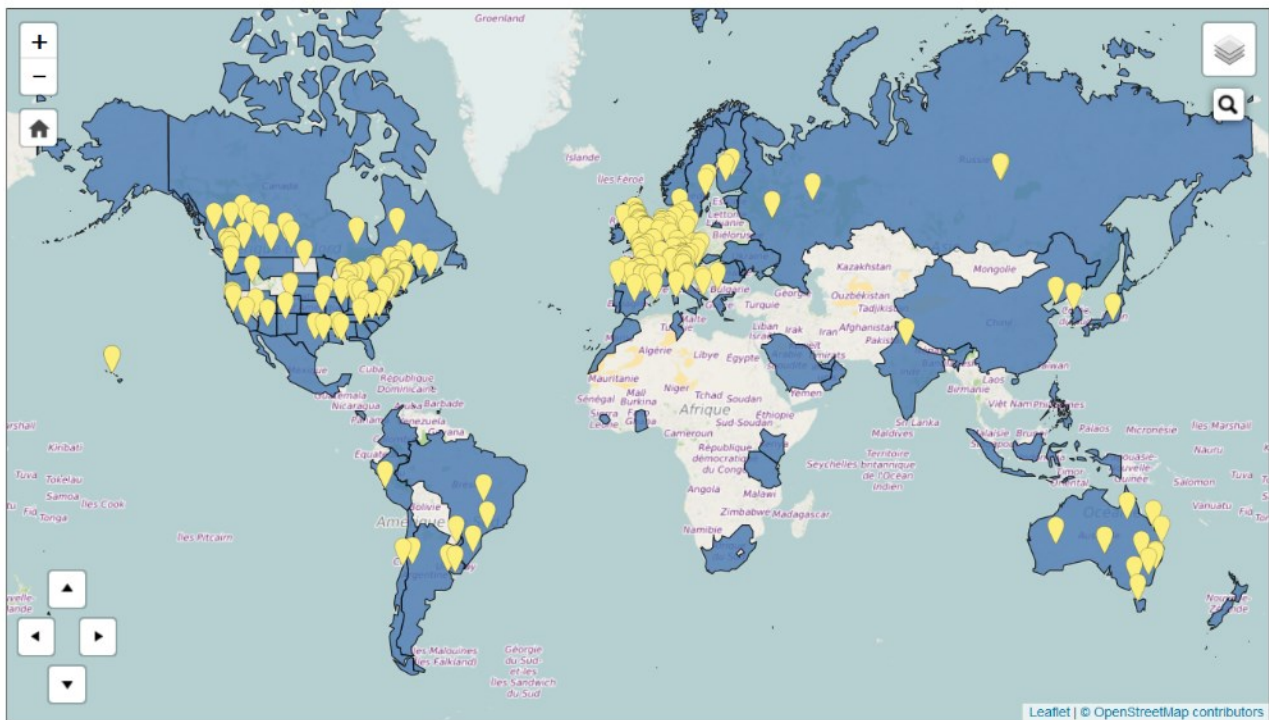


Figura 2 - Map representation of Open Data Sites (Data.gov)



Figura 3 - DATA.GOV



Figura 4 - European Open Data Portal

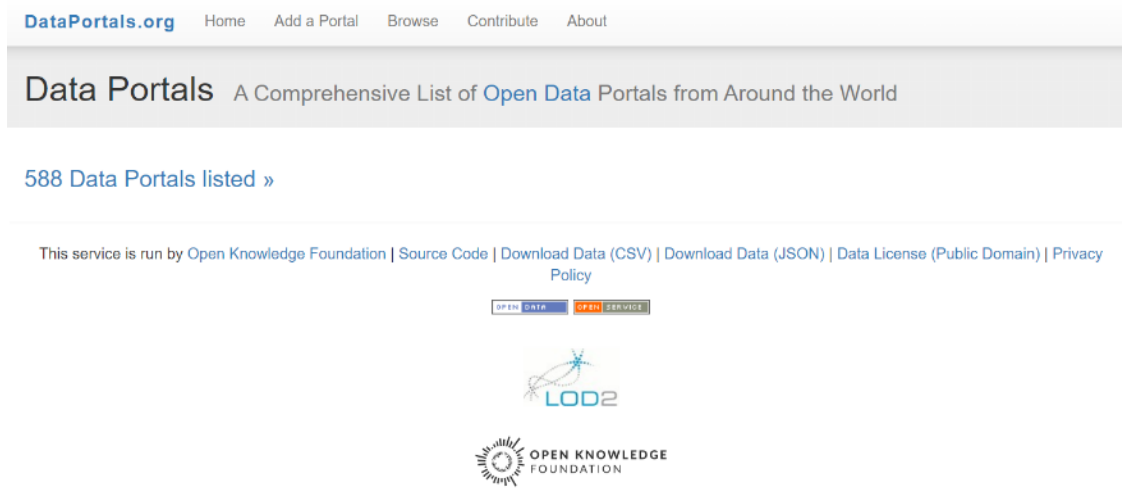


Figura 5 - Data Portals

So, take into account these suggestions also and browse with patience!

## GIS data

In a GIS system we can use vector data, raster data or even tabular data to store and manage geographic information. To use Vector data we have to think about geometry: points, polylines and polygons are the geometric primitives that help us to describe the real world.

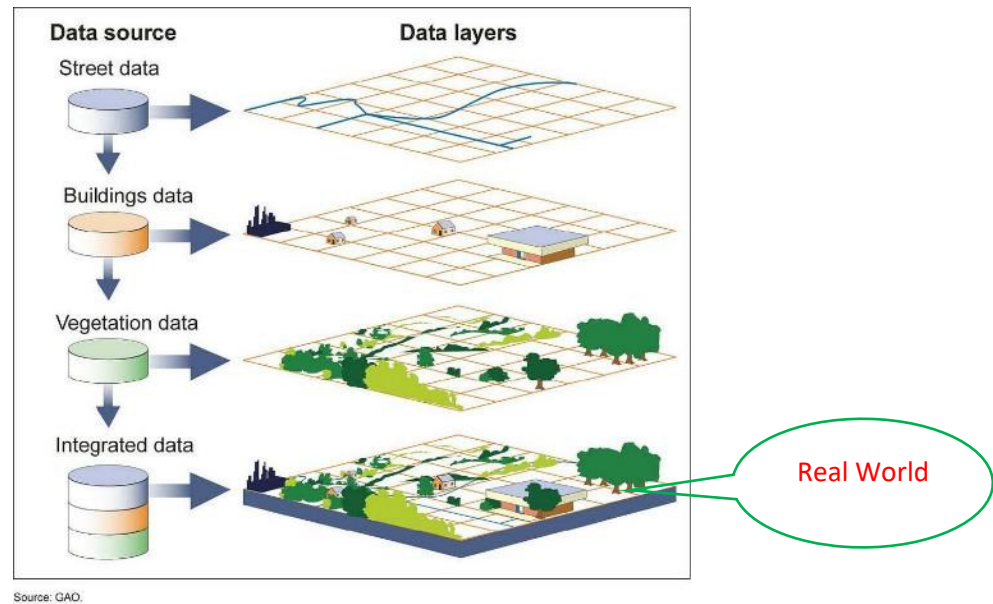


Figure 11 - From Real World to GIS Layers

**Depend on the scale** we can use a point to identify a hospital (a public phone, a traffic light); a polyline to describe a river (a road); a polygon to show an hospital (a road, a river) and so on. Raster data are (georeferenced) images and the resolution depend on the pixel width. Tabular data may contain addresses (it is possible to transform them into points using a “geocoding” tool).

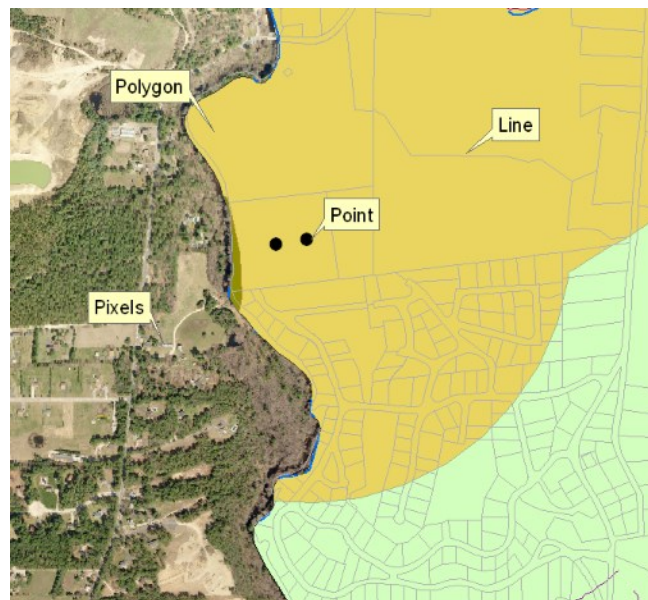


Figure 12 – Vector Layer: the Geometries

Vector data are commonly stored and shared into a file format called “Shapefile” (but maybe we could find the same data into “Geopackage”, “Geodatabase” and other GIS formats).

Raster data are images (TIF, JPG...) that are correctly “positioned” on the map by using an auxiliary file (TFW, JGW...).

Raster resolution is based on pixel depth.

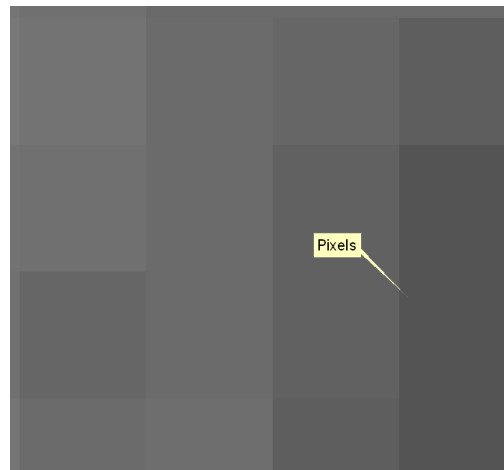


Figure 13 - Raster Layer: the Pixel

Not only the pixel size can influence the image quality resolution (small pixel means very good image even if the size of the file “increase”) but also the “colour depth”<sup>[55]</sup> could You save or not disk space.

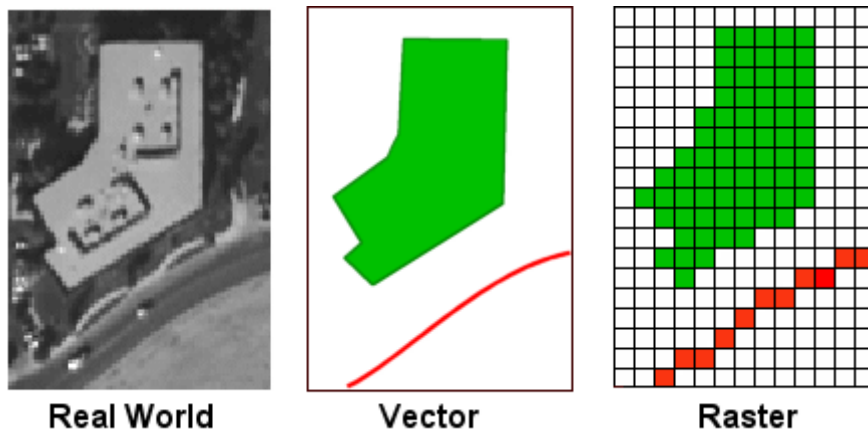


Figure 14 - Vector Model, Raster Model

Tabular data, instead, could be a simple text file. Commonly is used a Comma Separated Value (CSV) format. All of these file format will be described later.

## Vector data

### Shapefile

The shapefile format is a (one of the most common) “geospatial vector data format for geographic information system (GIS) software. It is developed and regulated by Esri as a mostly open specification for data interoperability among Esri and other GIS software products.<sup>[56]</sup> The shapefile format can spatially describe vector features: points, lines, and polygons, representing, for example, water wells, rivers, and lakes. Each item usually has attributes that describe it, such as name or temperature”.<sup>[57]</sup>

Each Shapefile can store and manage only one kind of “geometric data”. It is not possible to “merge” points, polylines and/polygons together. If we need to store a variety of data we have to use several shapefiles, one for each kind of geometric data.

<sup>55</sup> [https://en.wikipedia.org/wiki/Color\\_depth](https://en.wikipedia.org/wiki/Color_depth)

<sup>56</sup> ESRI (July 1998). "ESRI Shapefile Technical Description", <http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf>

<sup>57</sup> <https://en.wikipedia.org/wiki/Shapefile>



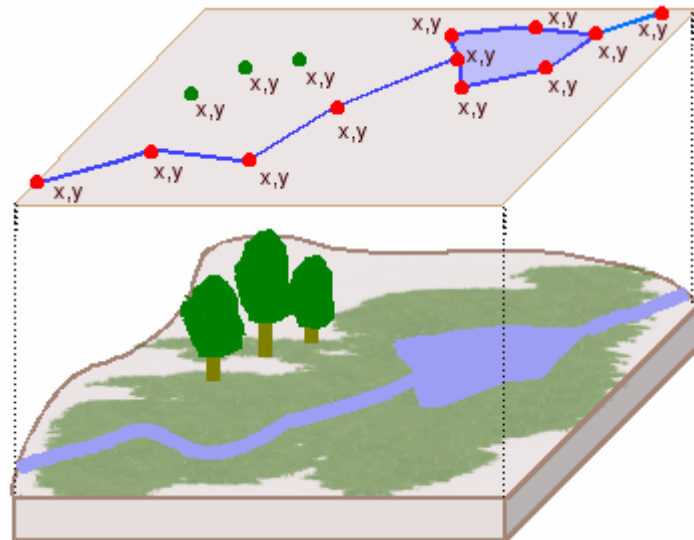


Figure 15 - Vector Model

Shapefile examples: {rivers.shp, rivers.shx, rivers.dbf} plus {rivers.prj (ESRI) or rivers.qpj (QGIS)}

#### Mandatory files

**.shp** — shape format; the feature geometry itself {content-type: x-gis/x-shapefile}

**.shx** — shape index format; a positional index of the feature geometry to allow seeking forwards and backwards quickly {content-type: x-gis/x-shapefile}

**.dbf** — attribute format; columnar attributes for each shape, in dBase IV format {content-type: application/octet-stream OR text/plain}

#### Other files

**.prj** — projection description, using a well-known text representation of coordinate reference systems {content-type: text/plain OR application/text}. QGIS use a **.qpj** file also.

**.sbn** and **.sbx** — a spatial index of the features {content-type: x-gis/x-shapefile}

**.fbn** and **.fbx** — a spatial index of the features that are read-only {content-type: x-gis/x-shapefile}

**.ain** and **.aih** — an attribute index of the active fields in a table {content-type: x-gis/x-shapefile}

**.ixs** — a geocoding index for read-write datasets {content-type: x-gis/x-shapefile}

**.mxs** — a geocoding index for read-write datasets (ODB format) {content-type: x-gis/x-shapefile}

**.atx** — an attribute index for the **.dbf** file in the form of shapefile.columnname.atx (ArcGIS 8 and later) {content-type: x-gis/x-shapefile}

**.shp.xml** — geospatial metadata in XML format, such as ISO 19115 or other XML schema {content-type: application/fgdc+xml}

**.cpg** — used to specify the code page (only for **.dbf**) for identifying the character encoding to be used {content-type: text/plain OR x-gis/x-shapefile}

.qix — an alternative quadtree spatial index used by MapServer and GDAL/OGR software {content-type: x-gis/x-shapefile}

In each of the .shp, .shx, and .dbf files, the shapes in each file correspond to each other in sequence (i.e., the first record in the .shp file corresponds to the first record in the .shx and .dbf files, etc.). The .shp and .shx files have various fields with different endianness, so an implementer of the file formats must be very careful to respect the endianness of each field and treat it properly.

**The shapefile format does not have the ability to store topological information.**<sup>[58]</sup>

In general, each geometry links to an attribute (record) that is stored into the DataBase File (DBF):

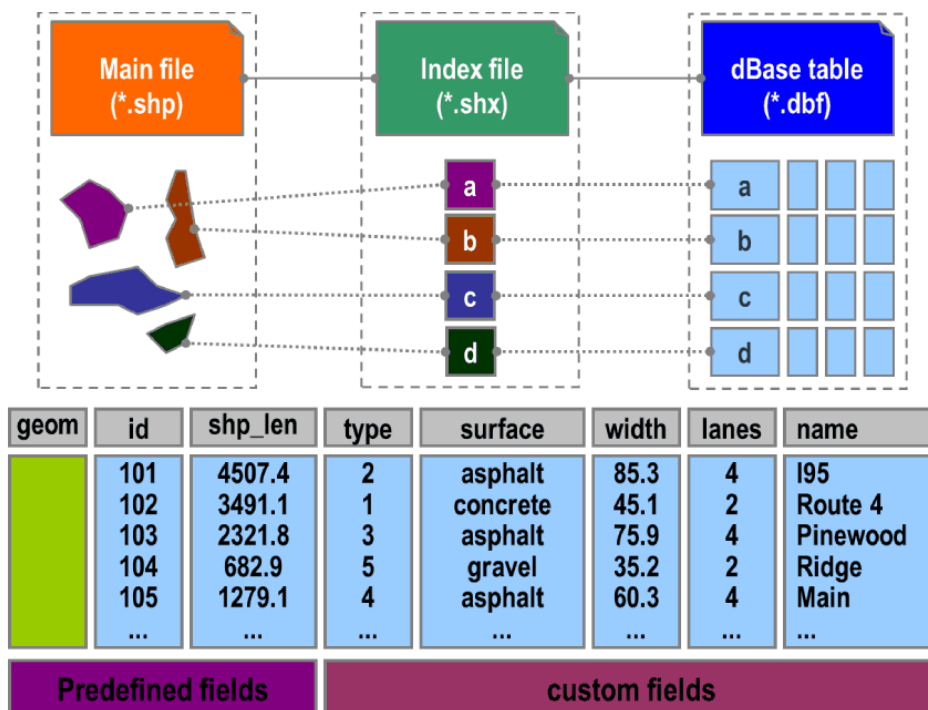


Figure 16 - How Shapefile "Works"

### Raster data

"In the raster data model, the earth is represented as a grid of equally sized cells. An individual cell represents a portion of the earth such as a square meter or a square mile.

Unlike the vector data model, where x,y coordinates are used to define feature shapes and locations, in the raster data model, only one x,y coordinate pair is normally present. This x,y coordinate pair (called the origin) is used to define the location of every cell. That is, each cell's location is defined in relation to the origin.

Each raster cell is assigned a numeric value, which can represent any kind of information about that geographic location—an elevation measurement in meters, for example, or a code number that specifies a type of vegetation".<sup>[59]</sup>

58 <https://en.wikipedia.org/wiki/Shapefile>

59 <http://www.geography.hunter.cuny.edu/~jochen/GTECH361/lectures/lecture05/concepts/03%20-%20Geographic%20data%20models.html>

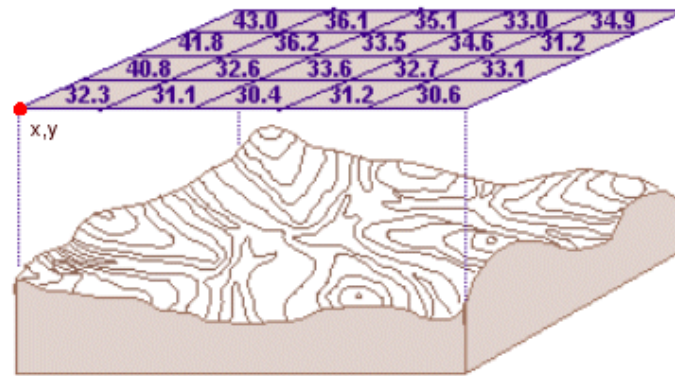


Figure 17 - Raster Model

### Image format

Broadly speaking, images could be in TIF or JPG (...) format but we have to manage their “position” into the space. This is because, without any other information, the images will placed in the center of the screen (think about what happen when we use an Image Software like GIMP, Paint, Adobe Photoshop or other ones). So, we need auxiliary data or files that tell to the software where place the image. This file are called “world file”<sup>[60]</sup> and these are some examples of file format with related “sidecar file”:

- TIF image need a TFW file
- JPG image need a JGW file
- PNG image ned a PGW file
- SID<sup>[61]</sup> image need a SDW file

“For example, “a world file (is) a 6-line ASCII file file such as:

```
2.4384
0.0000
0.0000
-2.4384
441794.4342
5094101.4520
```

“These are the 6 coefficients of a three-by-three transformation matrix. They indicate that a pixel is 2.4384 meters square, and that the center of the upper left pixel has an easting (x coordinate) of 441794.4342 and a northing of 5094101.4520. For fans of the matrix:

$$x = 2.4384 * \text{column} + 0.0 * \text{row} + 441794.4342$$

$$y = (-2.4384) * \text{row} + 0.0 * \text{column} + 5094101.4520$$

The second and third values are zero because there is no rotation or skew”.

60 [https://en.wikipedia.org/wiki/World\\_file](https://en.wikipedia.org/wiki/World_file)

61 MrSID (Multi-resolution Seamless Image Database) is a patented, wavelet-based file format designed to enable portability of massive bit-mapped (raster) images. The format was designed to enable instantaneous viewing and manipulation of large imagery both locally and over networks without sacrificing quality. Created by LizardTech, MrSID works by putting together hundreds of small image tiles into one large seamless image that can be compressed and decompressed with little or no degradation (<https://kb.iu.edu/d/atbf>).

“The convention is that a world file is named by jamming a «w» into the extension. For example, o47122d3.jpg might have a o47122d3.jgw file and o47122d3.tif might have a o47122d3.tfw file”<sup>[62]</sup>.

After loading a “section” the corresponding image will placed into the “correct space” using the appropriate world file.

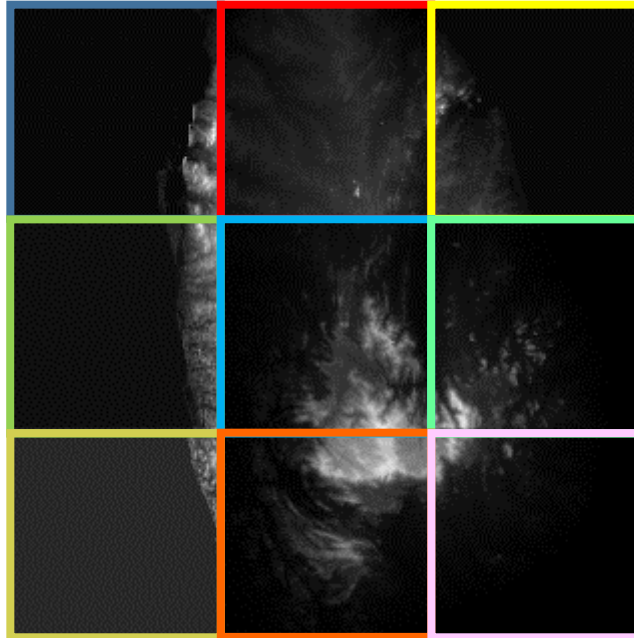


Figure 18 - Raster "Mosaic"

The coloured box to display only the single section only and there are not other messages.

Other images do not need of the “sidecar file” because they are capable to store inside the information about their georeferencing. These images should be, for example, “**GeoTIFF**”. “GeoTIFF is a public domain metadata standard which allows georeferencing information to be **embedded** within a TIFF file. The potential additional information includes **map projection, coordinate systems, ellipsoids, datums**, and everything else necessary to establish the exact spatial reference for the file. The GeoTIFF format is fully compliant with TIFF 6.0, so software incapable of reading and interpreting the specialized metadata will still be able to open a GeoTIFF format file”.<sup>[63]</sup>

62 <http://gis.ess.washington.edu/data/raster/drg/tfw.html>

63 <https://en.wikipedia.org/wiki/GeoTIFF>

## QGIS Graphic User Interface (GUI)

This not the place to describe ALL the buttons and the functionalities of QGIS. Nevertheless, it is appropriate to give You a “panorama” of the QGIS GUI and the links to the reference guide<sup>[64]</sup>. Before coming, just a note about the language in use.

Use a different language

QGIS lets us to set up and use a different language or settings about numbers, date and currency format.

Go to **Settings > Options > General**

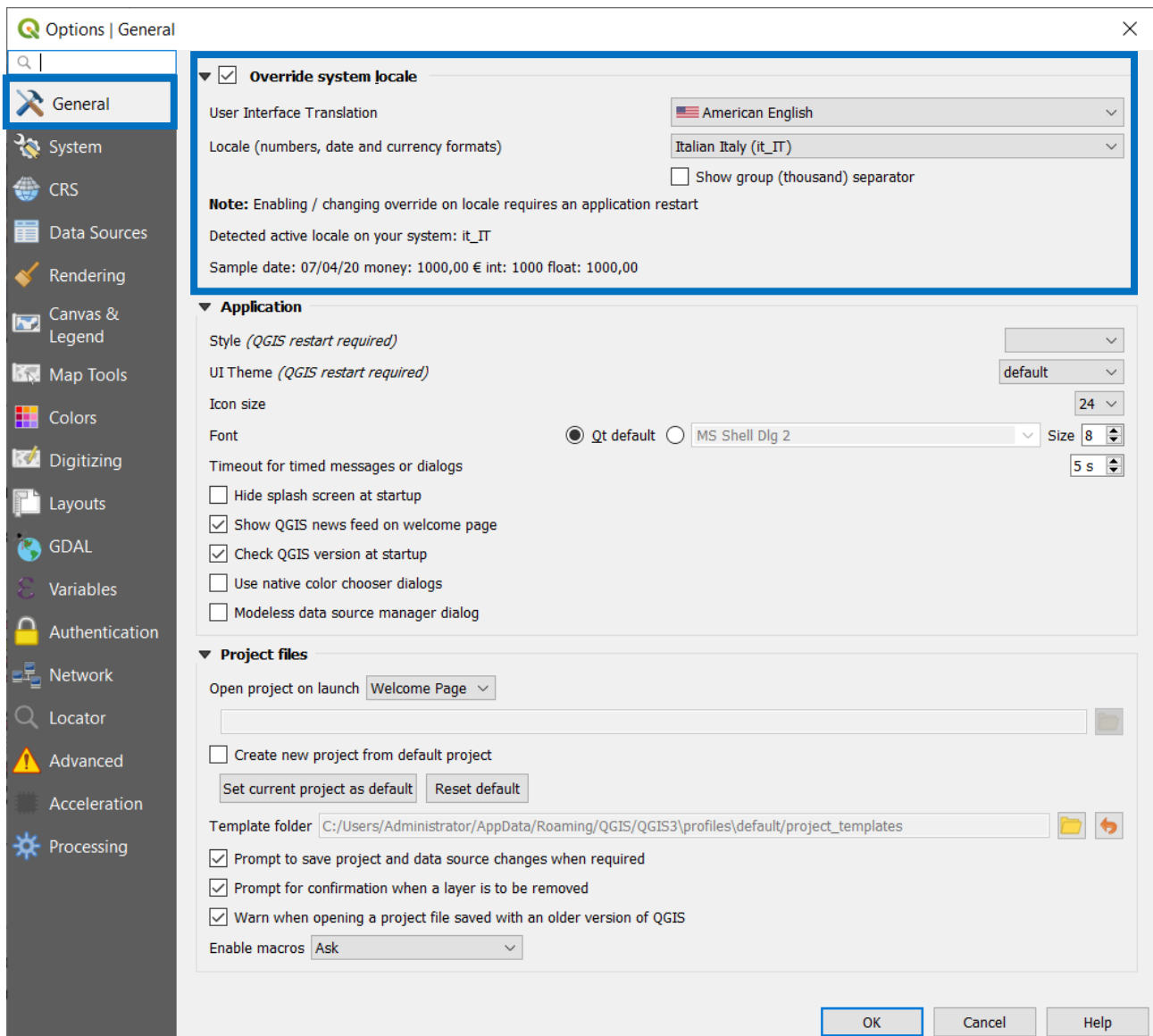


Figure 19 - QGIS GUI - Change the Language

Nowadays, thanks to a great voluntary participation, there are 39 languages ready to use:

64 [https://docs.qgis.org/3.10/en/docs/user\\_manual/introduction/qgis\\_gui.html](https://docs.qgis.org/3.10/en/docs/user_manual/introduction/qgis_gui.html)



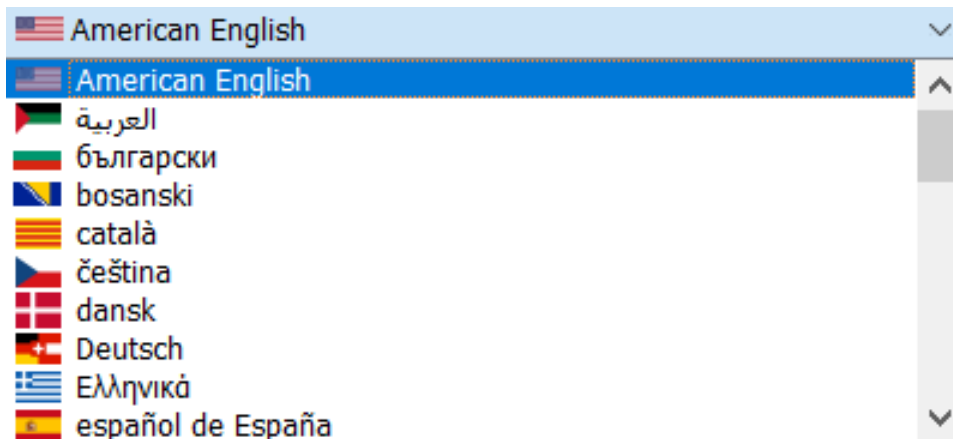


Figure 20 - QGIS GUI - Choose a Language

By the way, I prefer the English language. This is because many suggestions, video or tutorial are released in the English language. However, feel free to choose the language you like.

After modifying the language in use it is mandatory close QGIS and restart it to use the new language.

Now, we are ready to explore the GUI:

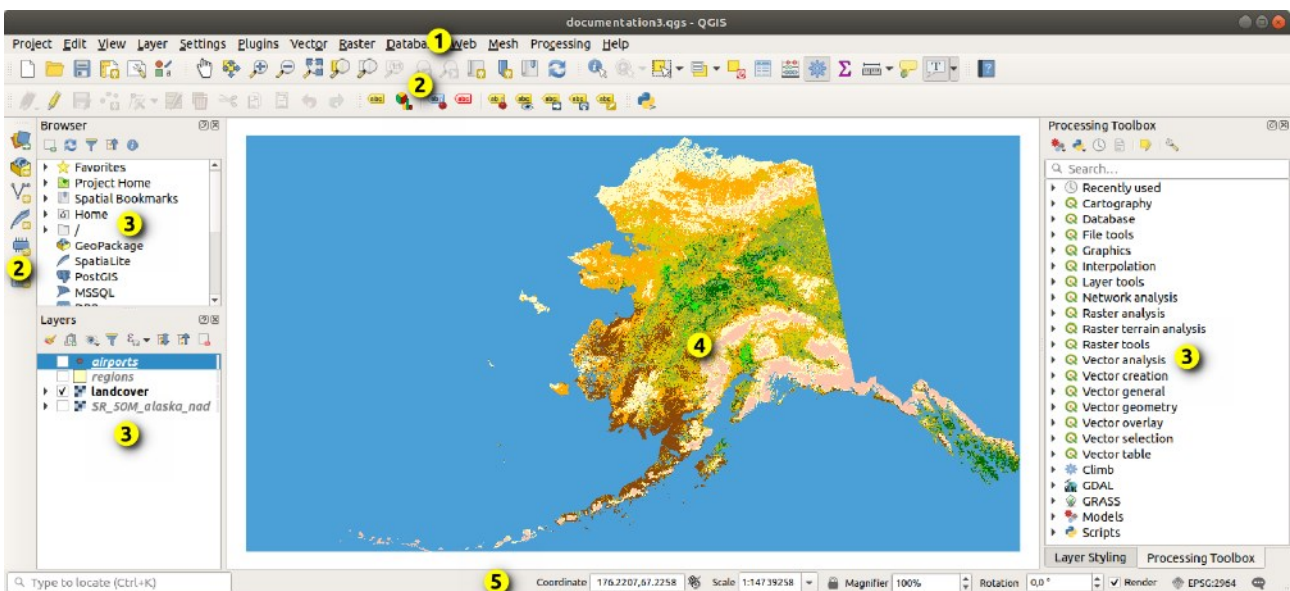


Figure 21 - QGIS GUI

In this image we can recognise:

**Menu Bar** (1); **Toolbars** (2); **Panels** (3); **Map View** (4) **Status Bar** (5)

The “**Menu Bar**” contains several menu: **Project, Edit, View, Layer, Settings, Plugins, Vector, Raster, Database, Web, Mesh, Processing, Help.**

Toolbars and Panels contain the software “tools” and the “space” in which is possible to display, to perform an action, to give or get “information”

Map View is the “**canvas**” in which the data are displayed. Take a tour about “**Exploring the map view**” and “**Exporting the map view**”

3D visualization support is available through the **3D map view** in which there are a **Scene Configuration** and info about **3D vector layers.**

Last but not least, the **Status Bar** “provides you with general information about the map view and processed or available actions, and offers you tools to manage the map view”.<sup>[65]</sup>

---

65 [https://docs.qgis.org/3.10/en/docs/user\\_manual/introduction/qgis\\_gui.html#d-vector-layers](https://docs.qgis.org/3.10/en/docs/user_manual/introduction/qgis_gui.html#d-vector-layers)

In other words, to simplify:

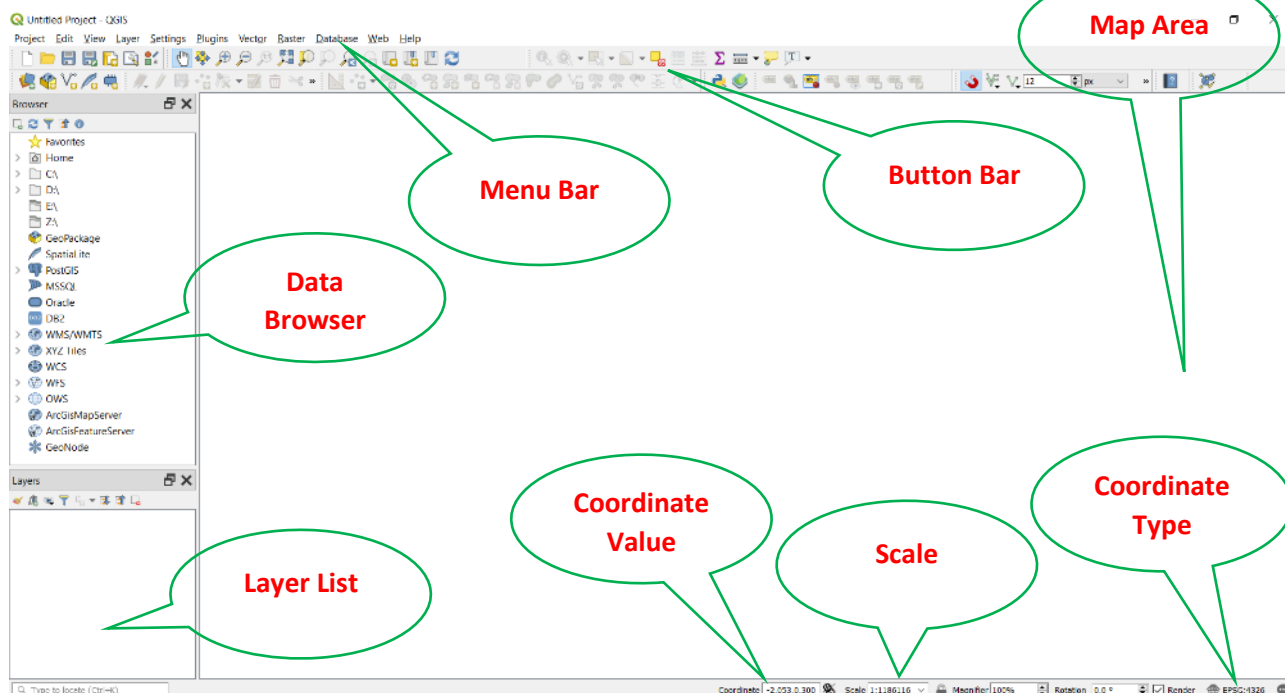


Figure 22 - QGIS GUI by Baloons

What kind of data can I use into QGIS?

In QGIS software we'll be able to use a great variety of data:

Add Vector Layer...	Shapefiles...
Add Raster Layer...	Tiff Images...
Add Delimited Text Layer...	Comma Separated Values (CSV)
Add PostGIS Layers...	Load data from PostgreSQL/PostGIS database
Add SpatialLite Layer...	Load data from SpatialLite database
Add MSSQL Spatial Layer...	Load data from MS-SQL database
Add DB2 Spatial Layer...	Load data from DB2 database
Add Oracle Spatial Layer...	Load data from Oracle Spatial database
Add/Edit Virtual Layer...	Virtual Layer
Add WMS/WMTS Layer...	OGC Web Map Service / Web Map Tile Services
Add ArcGIS MapServer Layer...	ESRI ArcGIS Map Server
Add WCS Layer...	OGC Web Coverage Service
Add WFS Layer...	Web Feature Service


 Add ArcGIS FeatureServer Layer...	ESRI ArcGIS Feature Server
---	----------------------------

Table 3 - GIS Layers

The highlighted format will be used in this tutorial.

By opening a «Add a Vector Layer» **Layer ► Add Layer... ► Add Vector Layer...** we'll see a variety of formats (looks “how long” is the scroll bar in the following dialog):



Figure 23 - Vector Formats

By opening «Add a Raster Layer» menu we'll see a variety of formats (looks “how long” is the scroll bar in the following dialog):

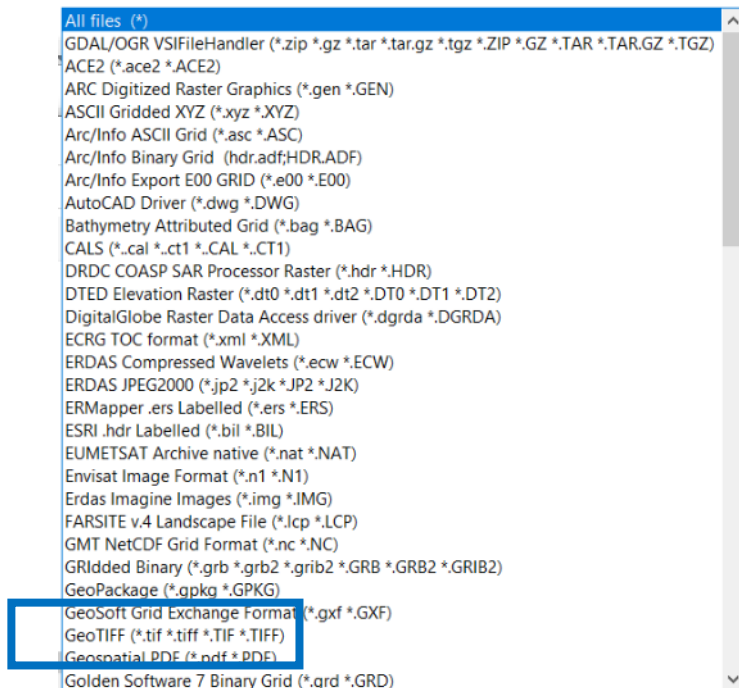


Figure 24 - Raster Formats

The QGIS “compatibility list” is very wide and this represent a powerful input. To get some ideas about GIS format take a look of “The Ultimate List of GIS Formats and Geospatial File Extensions”<sup>[66]</sup>.

*Add a Shapefile to QGIS*

Before starting we have to *feed* our software searching for appropriate GIS data. Maybe, considering the goals of this Master should be useful starting from the Humanitarian Data Exchange (HDX)<sup>[67]</sup> site:

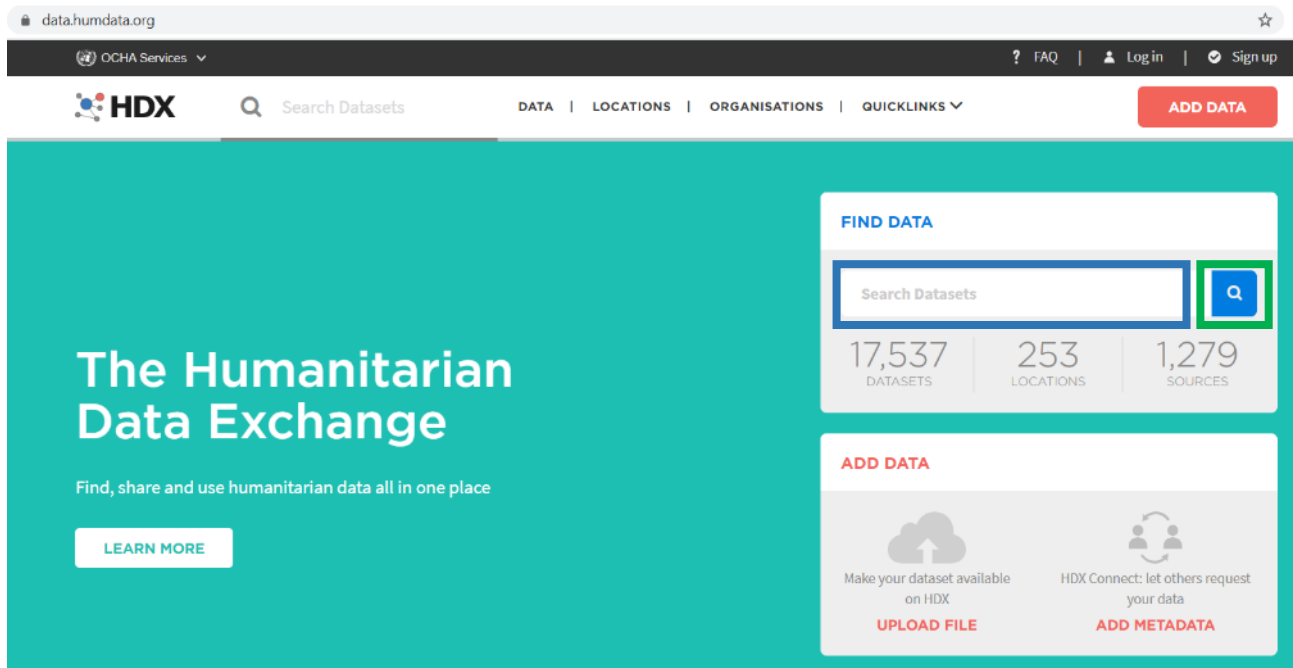


Figure 25 - The Humanitarian Data Exchange (HDX) #1

we could search for “heritage” string:

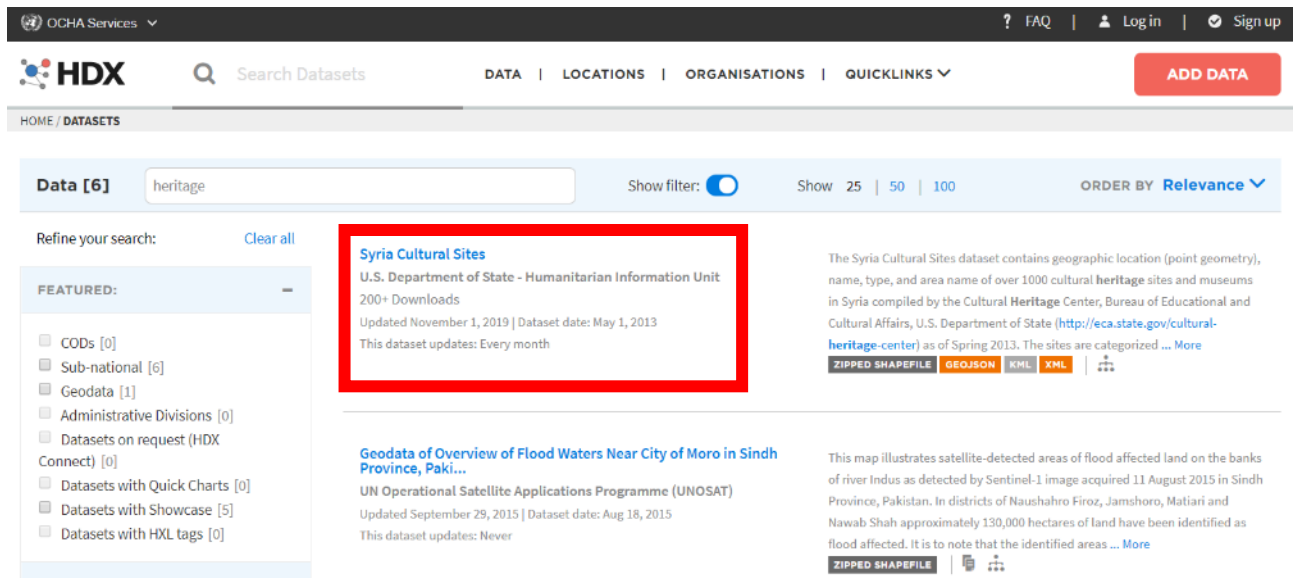


Figure 26 - The Humanitarian Data Exchange (HDX) #2

The first “answer” could be:

<sup>66</sup> <https://gisgeography.com/gis-formats/>

<sup>67</sup> <https://data.humdata.org/>



**Syria Cultural Sites**<sup>[68][69]</sup>

U.S. Department of State - Humanitarian Information Unit

200+ Downloads

Updated November 1, 2019 | Dataset date: May 1, 2013

This dataset updates: Every month

The Syria Cultural Sites dataset contains geographic location (point geometry), name, type, and area name of over 1000 cultural heritage sites and museums in Syria compiled by the Cultural Heritage Center, Bureau of Educational and Cultural Affairs, U.S. Department of State (<http://eca.state.gov/cultural-heritage-center>) as of Spring 2013. The sites are categorized by type, which include but not limited to, archaeological sites, roman ruins, mosques, schools, churches, cemeteries, and towns. The data contained herein is entirely unclassified.

**Data and Resources**

**Metadata**










	<b>Syria_CulturalSites_2013May22_HIU_USDoS.zip</b> Zipped Shapefile	 <b>DOWNLOAD</b>
	<b>Syria_CulturalSites_2013May22_HIU_USDoS.geojson</b> GeoJSON	 <b>DOWNLOAD</b>
	<b>geonode-Syria_CulturalSites_2013May22_HIU_USDoS ...</b> Static KML	 <b>DOWNLOAD</b>
	<b>geonode-Syria_CulturalSites_2013May22_HIU_USDoS ...</b> Network-Link KML	 <b>DOWNLOAD</b>  <b>MORE</b>

Figure 27 - HDX Download Data

Choose the first one (Syria\_CulturalSites\_2013May22\_HIU\_USDoS.zip) and download and decompress it into an appropriate folder. To get more information it is mandatory to read the related “Metadata”:

**Source:** U.S. Department of State

**Contributor:** U.S. Department of State - Humanitarian Information Unit

**Date of Dataset:** May 01, 2013

**Updated:** November 1, 2019

**Expected Update Frequency:** Every month

**Location:** Syrian Arab Republic

**Visibility:** Public

**License:** Public Domain / No Restrictions

68 [https://data.humdata.org/search?q=heritage&ext\\_search\\_source=main-nav](https://data.humdata.org/search?q=heritage&ext_search_source=main-nav)

69 <https://data.humdata.org/dataset/syria-cultural-sites>

**Methodology:** Other

**Caveats / Comments:** All data are strictly unclassified with no restrictions on distribution. Accuracy of geographic data is not assured by the U.S. Department of State. All data elements extracted from source data listed in the abstract.

**Tags:** CULTURAL SITES; EDUCATION; EDUCATION FACILITIES–SCHOOLS; GEODATA

**File Format:** ZIPPED SHAPEFILE, GEOJSON, KML, XML

Method 1 – Drag&Drop

Start QGIS and place the Software window next to the Windows File Explorer. Search for Syria\_CulturalSites\_2013May22\_HIU\_USDoS.shp. Then Drag-and-Drop it until the QGIS Map Area and release the mouse button:

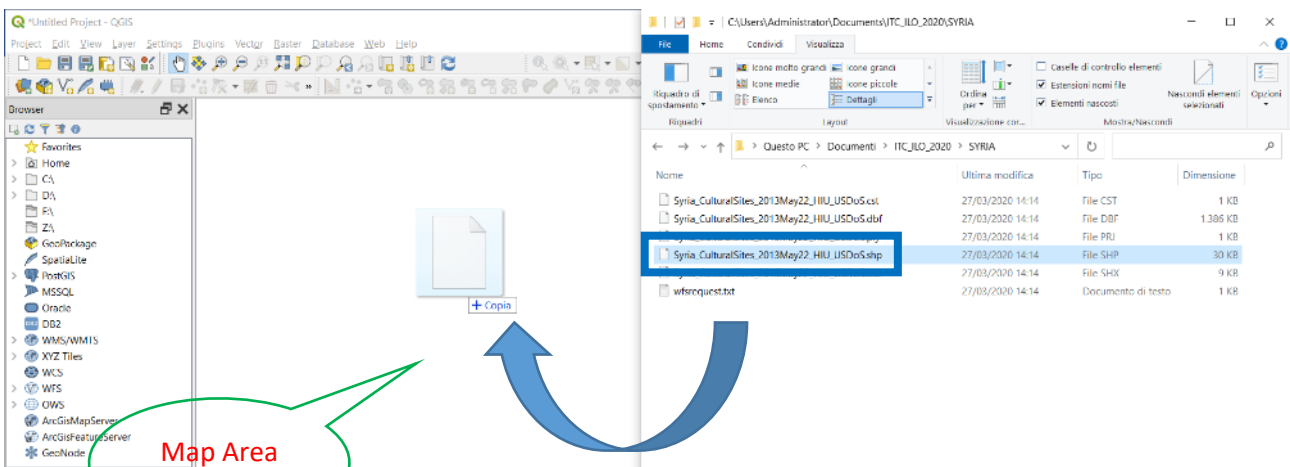


Figure 28 - Add Vector Layer #1

The result of this operation will displayed in the QGIS Map Area:

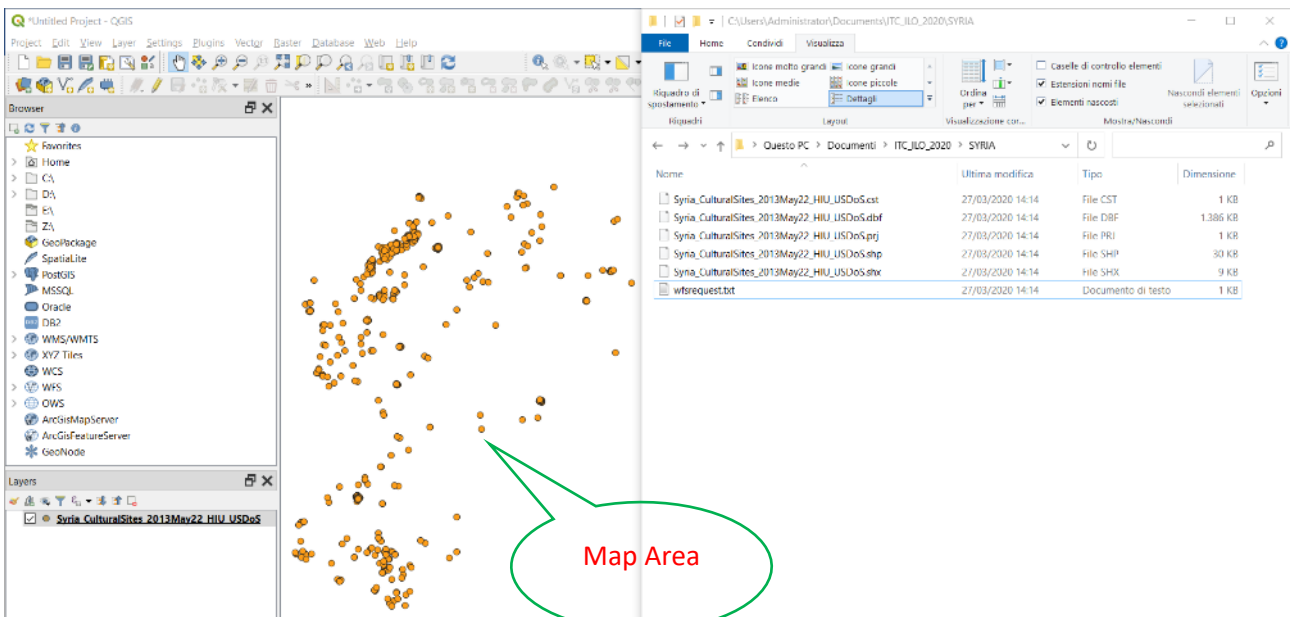


Figure 29 - Add Vector Layer #1a

## Method 2 – Data Source Manager (Button)

Search for the Data Source Manager Button and click on it.

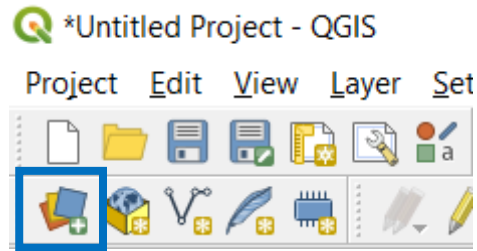


Figure 30 - Add Add Vector Layer #2

Choose “Vector” (shapefile is a “vector container”):

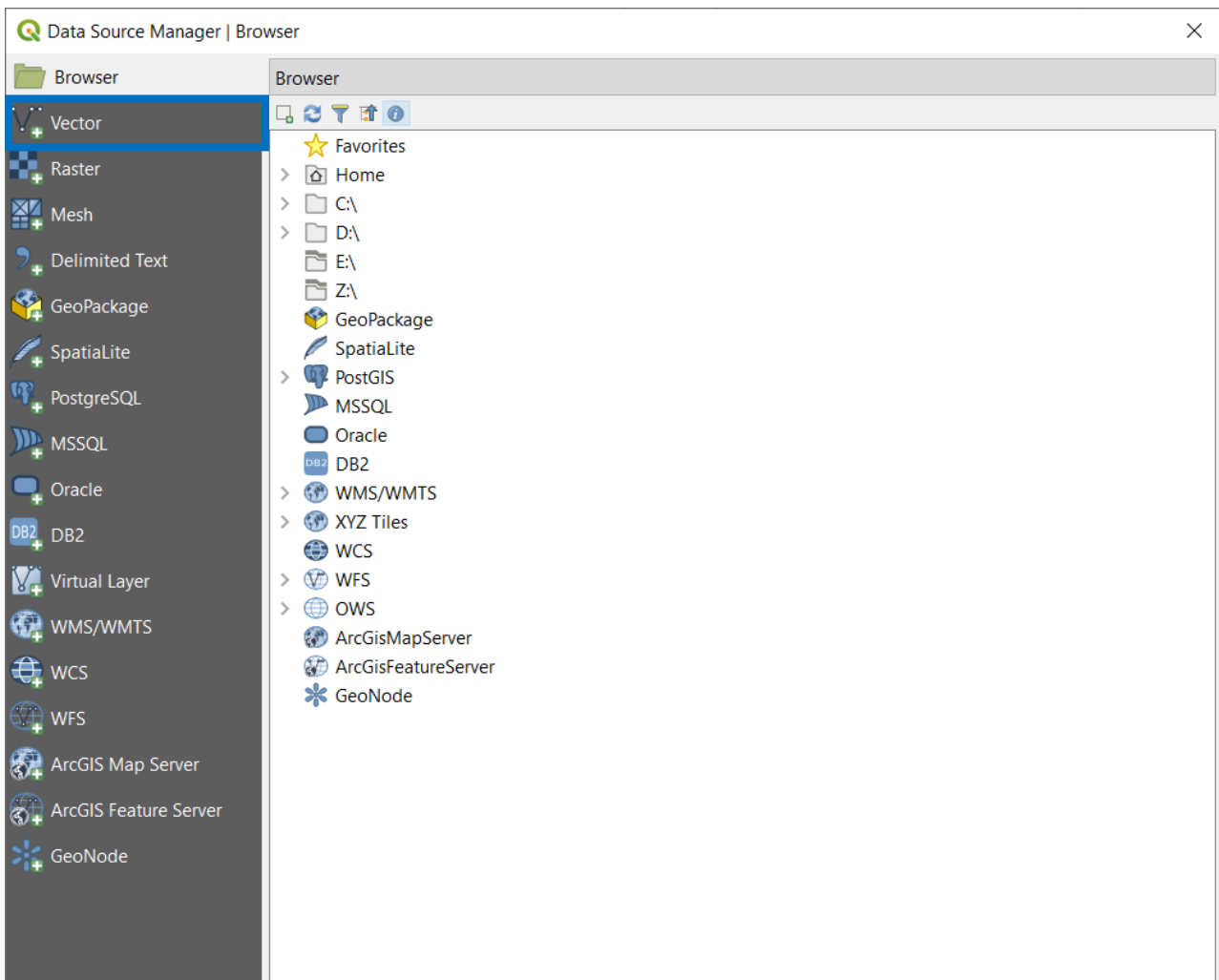


Figure 31 - Add Vector Layer #2a

Then, Browse the Source Vector Dataset:

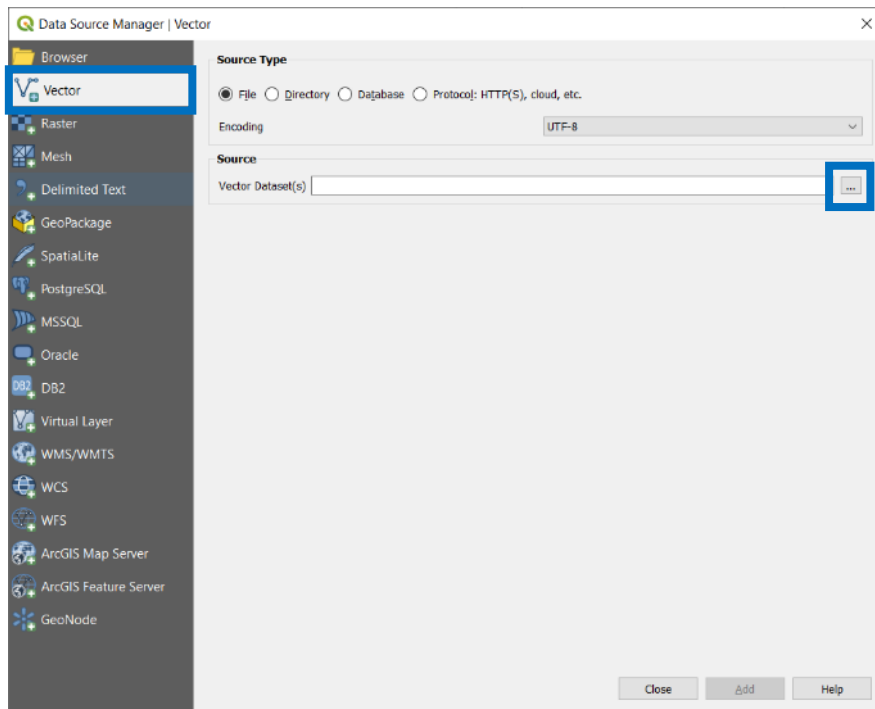


Figure 32 - Add Vector Layer #2b

Search for the data You desire to load and select it. To improve the searching procedure, could be useful to set the data filetype on: ESRI Shapefile.

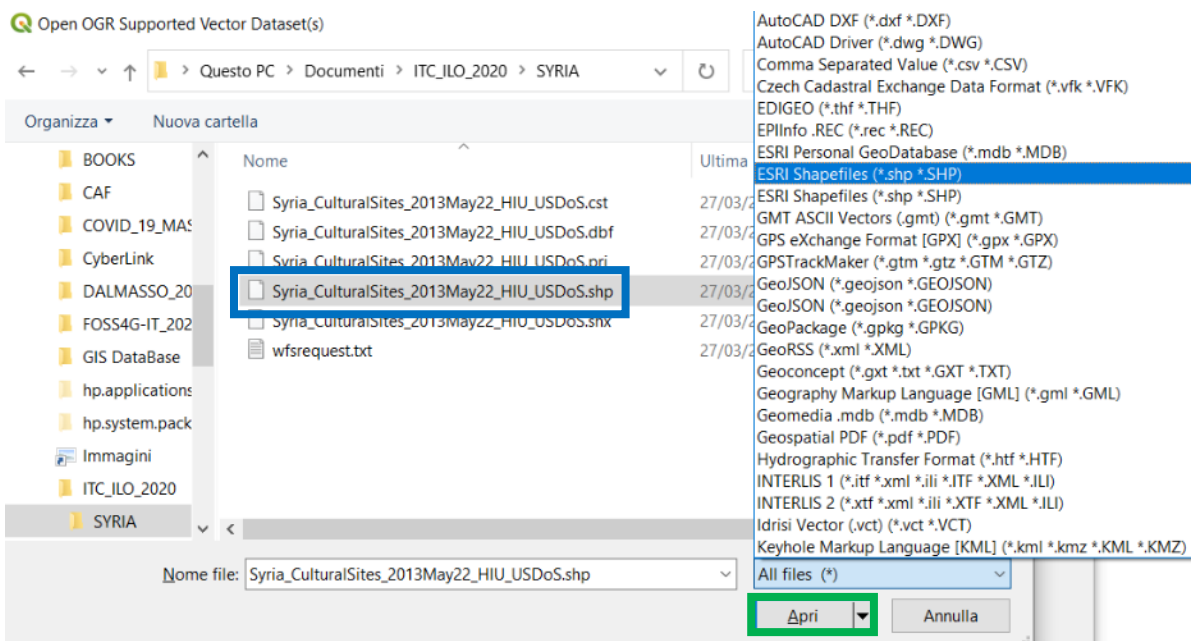


Figure 33 - Add Vector Layer #2c

### Method 3 – Data Browser (Window)

Search for the Data Browser. Open the appropriate folder and search for the data.

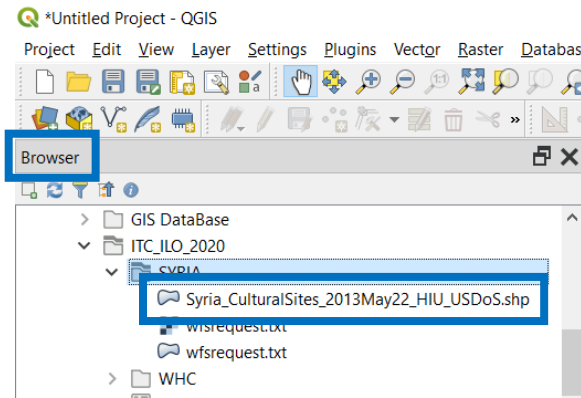


Figure 34 - Add Shapefile #3

Search for **Syria\_CulturalSites\_2013May22\_HIU\_USDoS.shp**. Then Drag-and-Drop it until the QGIS Map Area and release the mouse button.

#### Method 4 – Add Layer (Menu)

From the Menu Bar, search for “Layer”, “Add Layer”, “Add Vector Layer”

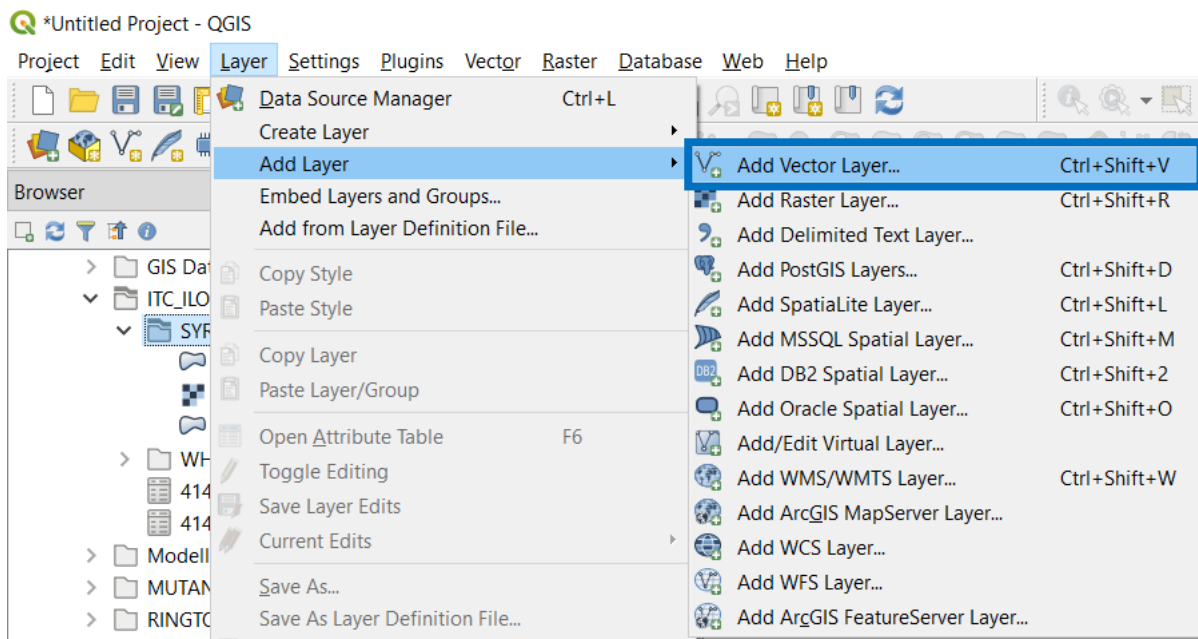


Figure 35 - Add Vector Layer #4

As done previously, browse folders and data, look for the shapefile and load it using the usual series of dialogs.

#### Method 5 – Use a “shortcut”

Last but not least, it is possible to use a "keyboard combination" to “Add shapefile”. The shortcut is: Control (CTRL) + Shift (⇧) + “V”. The dialog “Data Source Manager | Vector” will appear and - as done previously - browse folders and data, look for the shapefile and load it using the usual series of dialogs.



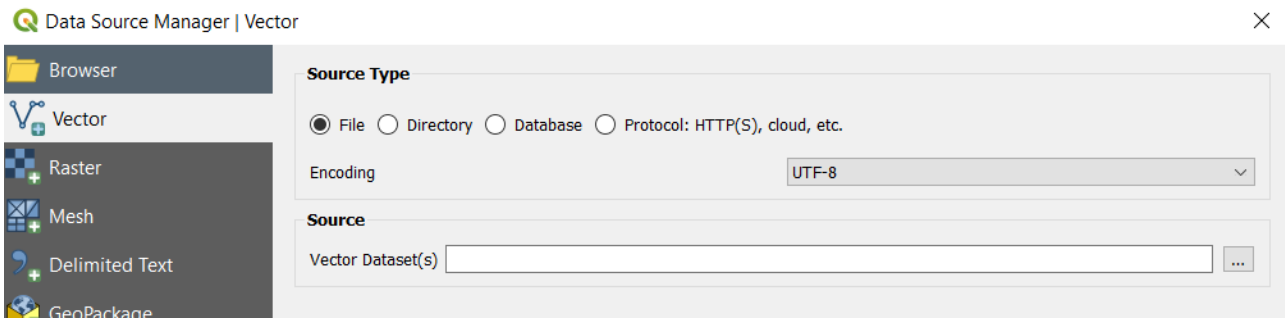


Figure 36 - Add Vector Layer #5

### Moving on the map

The point layer containing the geographic location of the Cultural Sites of Syria. After loading the shapefile into the canvas the points will be displayed on the map.

To have interactions with the map it is possible use the “Map Navigation Toolbar”



Figure 37 - Moving on the Map

The meaning of the buttons is intuitive. You can try without any problem (no modification will be performed on the data).

### QGIS Attribute Table

On the layer name, a right click of the mouse will displayed a contextual menu. Choose the “Open Attribute Table”:

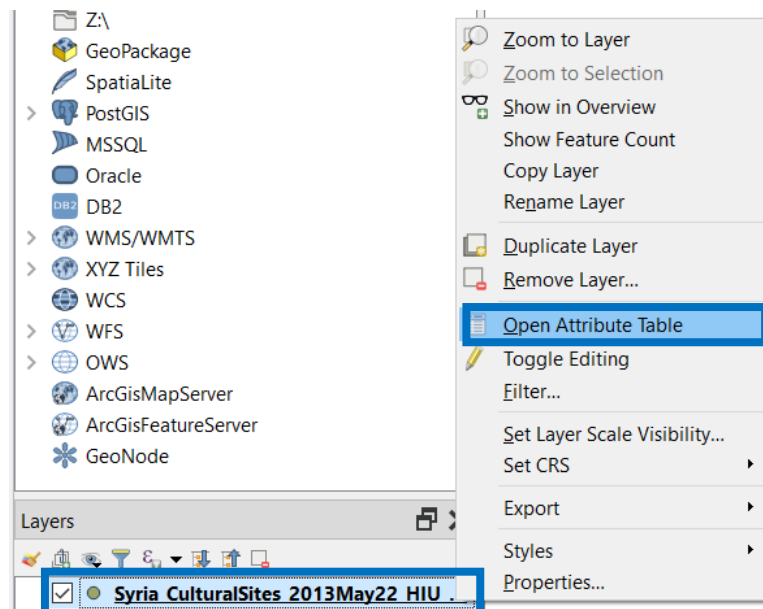


Figure 38 - Open Attribute Table

The attribute table (the data that are stored into the “Shapefile” or, better, into the \*.DBF file of the Shapefile) will be displayed.

	FACILITY_N	DMS_LAT	FAC_DES	CLASS	DMS_LONG	LENGTH_M	WIDTH_M
1	Meez, Porticoed Enclosure	36 8 47.72N	standing remains of dead city	civic site	36 39 55.98E	0,000000000000...	0,000000000000...
2	Meghara, dead city	35 44 22.26N	standing remains of dead city	ancient city	36 34 58.73E	150,0000000000...	100,0000000000...
3	Meez, West Church	36 8 50.94N	standing remains of dead city	religious site	36 39 45.87E	0,000000000000...	0,000000000000...
4	Menbij, Roman temple site	36 31 39.71N	archaeological site	religious site	37 56 53.29E	150,0000000000...	150,0000000000...
5	Melah, Byzantine monastery	32 30 19.63N	building	religious site	36 51 18.11E	0,000000000000...	0,000000000000...
6	Meskene, minaret from Siffin mosque (appro...	35 58 33.39N	historic minaret moved from lake	religious site	38 6 5.65E	0,000000000000...	0,000000000000...
7	Meskene (Emar), ancient city	35 59 13.47N	archaeological mound with standing re...	archaeological ...	38 6 40.02E	600,0000000000...	550,0000000000...
8	Mari (Tell Hariri)	34 33 2.56N	archaeological mound with standing re...	archaeological ...	40 53 16.83E	2000,0000000000...	1400,0000000000...
9	Maracî, sea fortress, castle	35 1 29.29N	underwater castle	fortification	35 53 35.30E	350,0000000000...	250,0000000000...
10	Mashquq, Roman temple	32 25 33.71N	standing remains in modern town	religious site	36 43 40.61E	0,000000000000...	0,000000000000...
11	Mariamin North, fortress	36 4 27.32N	standing remains	fortification	36 27 16.80E	100,0000000000...	80,0000000000...
12	Meez, Andron	36 8 49.64N	standing remains of dead city	civic site	36 39 47.46E	0,000000000000...	0,000000000000...
13	Meez (formerly Kafar Aruk), dead city	36 8 47.30N	standing remains of dead city	ancient city	36 39 54.17E	600,0000000000...	400,0000000000...
14	Meez, East Church	36 8 44.04N	standing remains of dead city	religious site	36 40 0.90E	0,000000000000...	0,000000000000...
15	Meez, Cistern	36 8 49.31N	standing remains of dead city	civic site	36 39 52.06E	0,000000000000...	0,000000000000...
16	Maarat al-Numan, Ayyubid citadel, fortificati...	35 39 20.44N	standing remains	fortification	36 40 17.68E	150,0000000000...	150,0000000000...
17	Maalula, Monastery of St. Sergius	33 50 43.39N	building	religious site	36 32 36.49E	0,000000000000...	0,000000000000...
18	Maarat al-Numan, Khan Assaad Pasha al-Aze...	35 38 53.78N	building	commercial site	36 40 47.56E	0,000000000000...	0,000000000000...
19	Maarat al-Numan, Great Mosque	35 38 59.90N	building	religious site	36 40 41.00E	0,000000000000...	0,000000000000...

Figure 39 - The Attribute Table

On the “Title bar”, QGIS give us some extra details. The name of the Layer from which derived, the feature number: “Total”, “Filtered” and “Selected”. “Total” means: in this layer there are 1061 points; “Filtered” means that we haven’t performed any filtering on data (the value is zero); “Selected” means that we haven’t performed any selection on data (the value is zero).

Look at the table. In this case, each point corresponds to a ROW (a RECORD) into the table. Looking at the buttons and try to remember the “meanings”.

On the bottom left there is a menu that allows to manage and apply a “dynamic filter” to data:

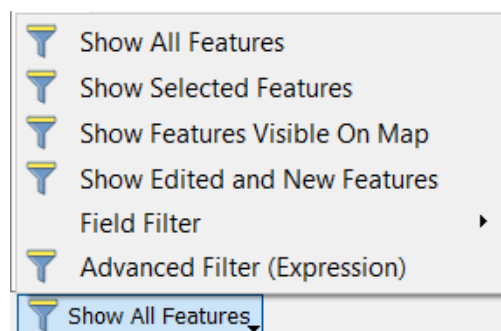


Figure 40 - The Attribute Table - Show all -features (or the Selected Feature or...)

Try it (if You do not have geometries or records selected the second filter will operate not).

On the bottom right there are two button that will switch the table display from “table wiew” to “form view” and viceversa:



Figure 41 - The Attribute Table - "Table View" or "Formi View"

Try them.

### Build a thematic map

When You load a vector data (containing points, polylines or polygons, never mind) all the geometries will be drawn usin the same colour (same outline, same fill). In general, this representation of data does not help the reader.

The colour is “random”: this mean that QGIS has not an Artificial Intellicence (AI) capable to display the rivers in blue or the road in grey...

Imagine that we would display the information based on the data (the attribute data) that the Shapefile Creator has stored inside the geometries.

### The “Layer Properties”

As seen before, a right click of the mouse on the layer name will displayed a contestual menu. Choose the “Properties...”(that means: the layer properties):

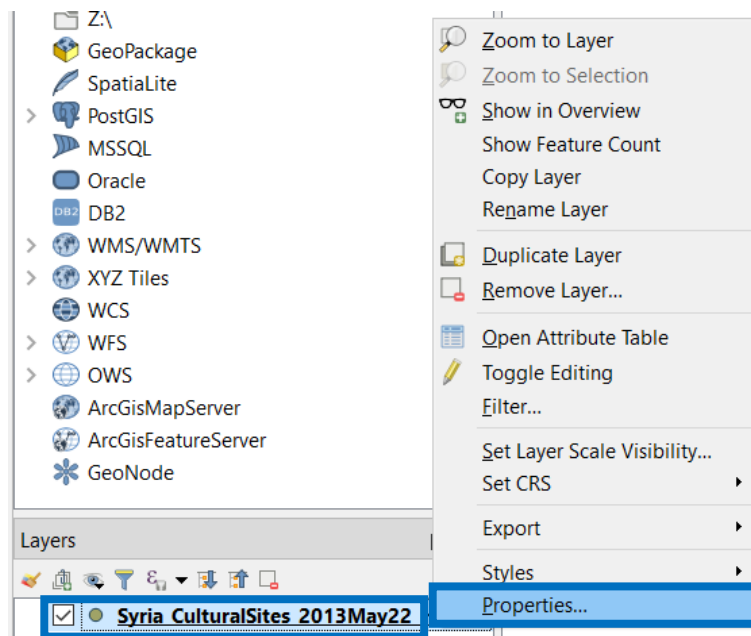


Figure 42 - Vector Layer - Properties

A new dialog will appear. Take a look on the single tab:

Information; Source; Symbology; Labels; Diagrams; 3D View; Source Fields; Attribute fields; Joins; Auxiliary Storage; Actions; Display; Rendering; Variables; Metadata; Dependencies; Legend

The detail is complete and these properties let You know all the necessary information about the layer and the relating settings (that we are able to modify also).

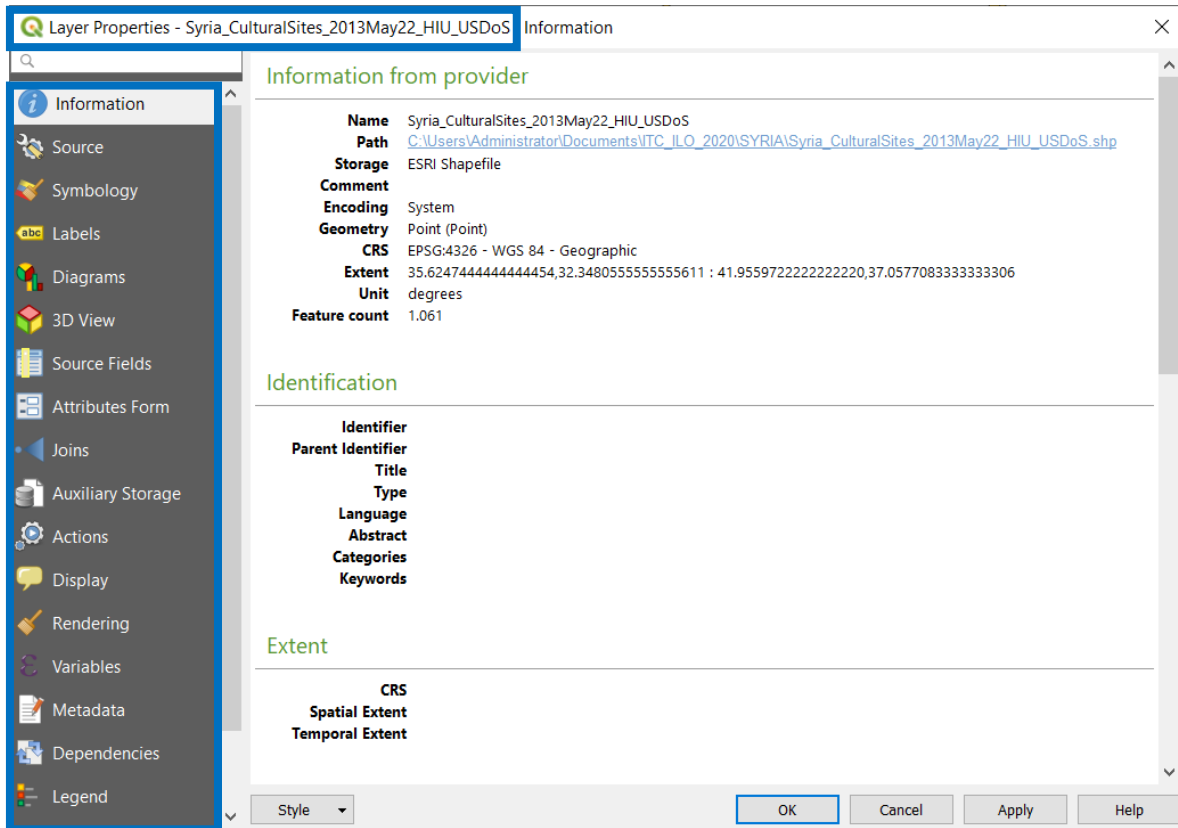


Figure 43 - The Layer Properties

Click on “Symbology”. This menu let us to change the way in which the data is displayed. By default, the data use a “Single symbol” (that means: all the geometries will be displayed using a singol colour/style).

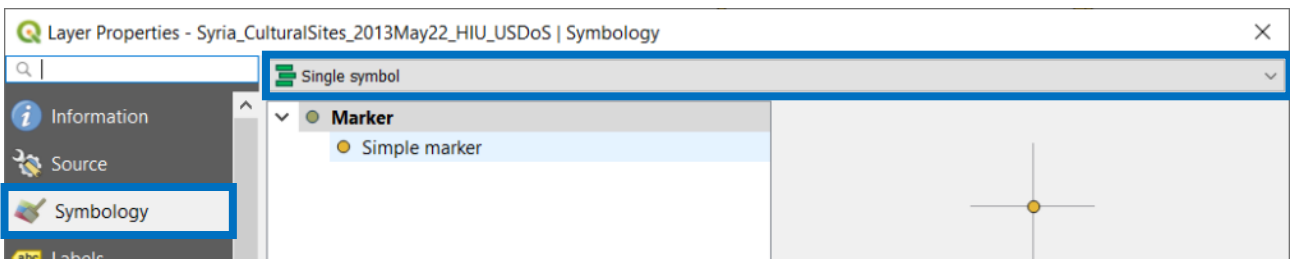


Figure 44 - The Layer Properties – Symbology – Single Symbol #1

Click on the pull down menu and look at the values:

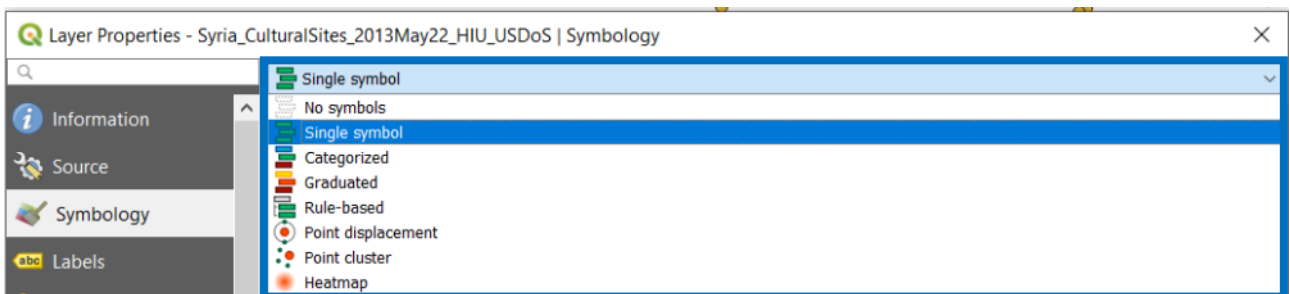


Figure 45 - The Layer Properties – Symbology Single Symbol #2

To display “Categories” perhaps we need of the “**Categorized**” option (while if we would operate with numeric values we have to choose the following one, “**Gratuated**”).

Choose the “Categorized” option:

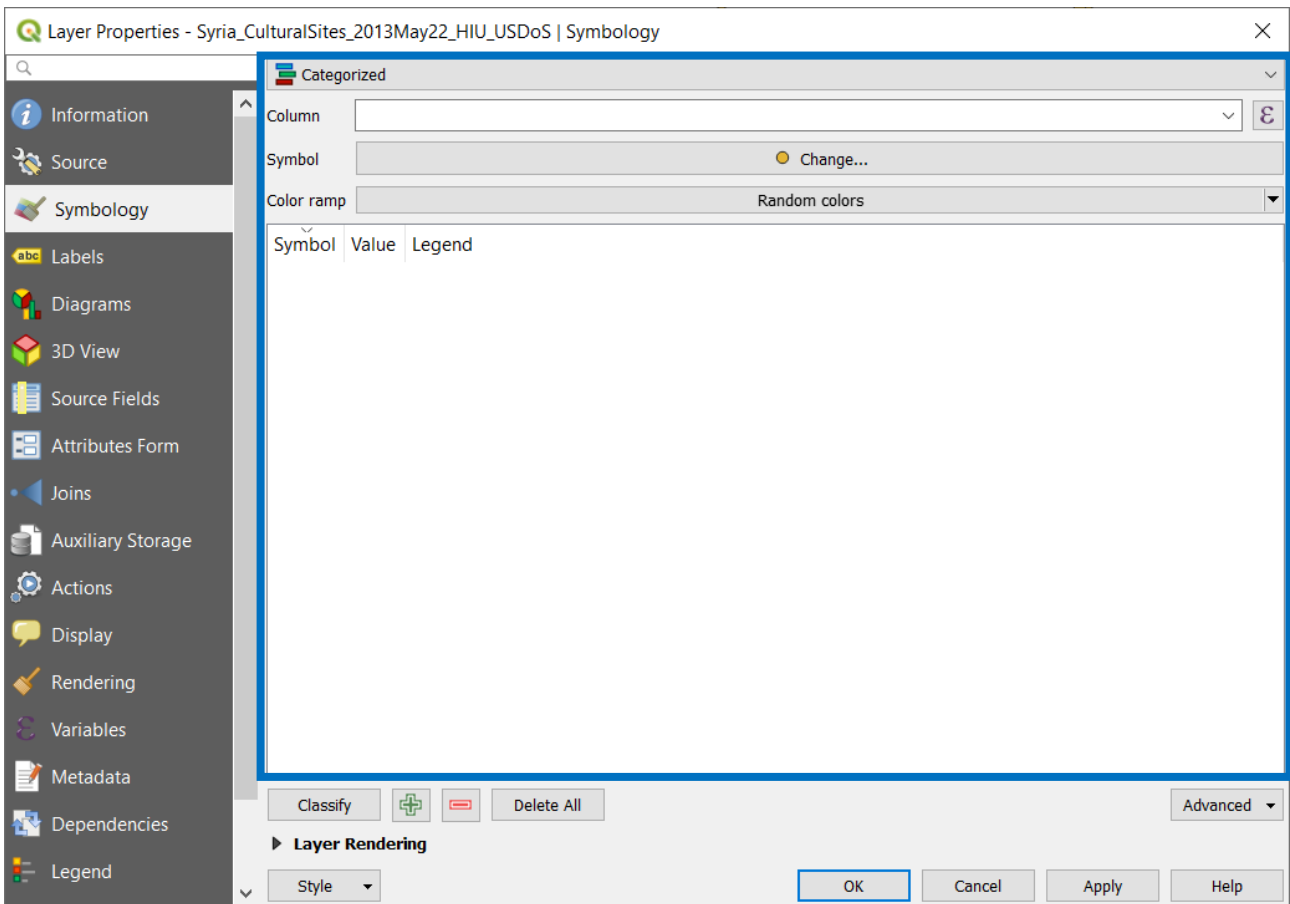


Figure 46 - The Layer Properties - Symbology - Categorized#1

The dialog is a *white blackboard*: this means that we have to give some input to QGIS in order to perform some operations. Do You remeber what the table contains?

	FACILITY_N	DMS_LAT	FAC_DES	CLASS	DMS_LONG	LENGTH_M	WIDTH_M
1	Meez, Porticoed Enclosure	36 8 47.72N	standing remains of dead city	civic site	36 39 55.98E	0,000000000000...	0,000000000000...
2	Meghara, dead city	35 44 22.26N	standing remains of dead city	ancient city	36 34 58.73E	150,0000000000...	100,0000000000...
3	Meez, West Church	36 8 50.94N	standing remains of dead city	religious site	36 39 45.87E	0,000000000000...	0,000000000000...
4	Menbij, Roman temple site	36 31 39.71N	archaeological site	religious site	37 56 53.29E	150,0000000000...	150,0000000000...
5	Melah, Byzantine monastery	32 30 19.63N	building	religious site	36 51 18.11E	0,000000000000...	0,000000000000...

Figure 47 - Attribute Data

It is not useful to distinguish the name of the site (each site has a different name...) but should be great to “group by” the value using a description (“FAC\_DES” field or “CLASS” instead).

Choose the **FAC\_DES** field (on the left of the column name QGIS will show the kind of data: abc meand that the field contain text; 123 if the field contains number...):



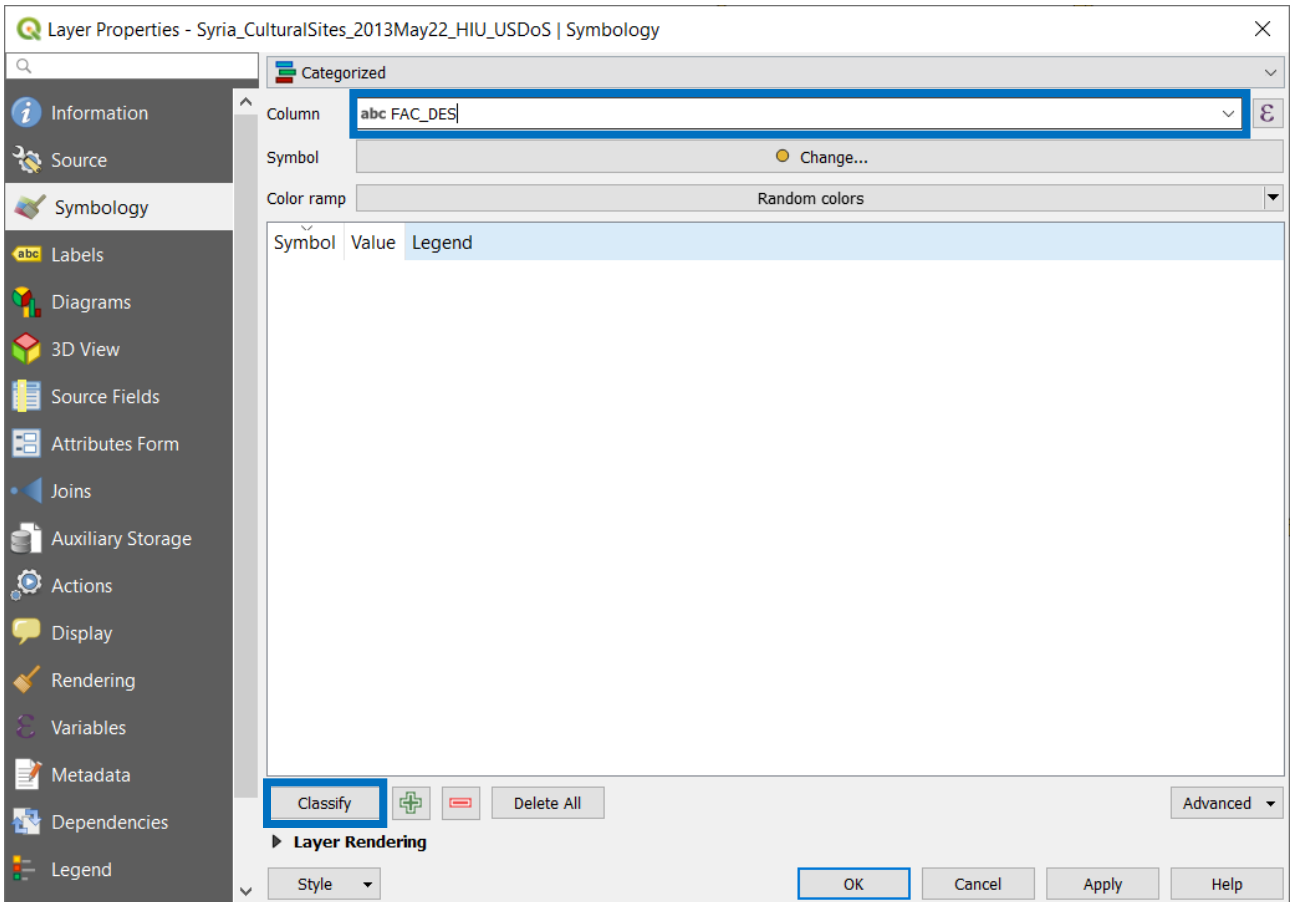


Figure 48 - The Layer Properties - Symbology - Categorized#2

and select "Classify" button:

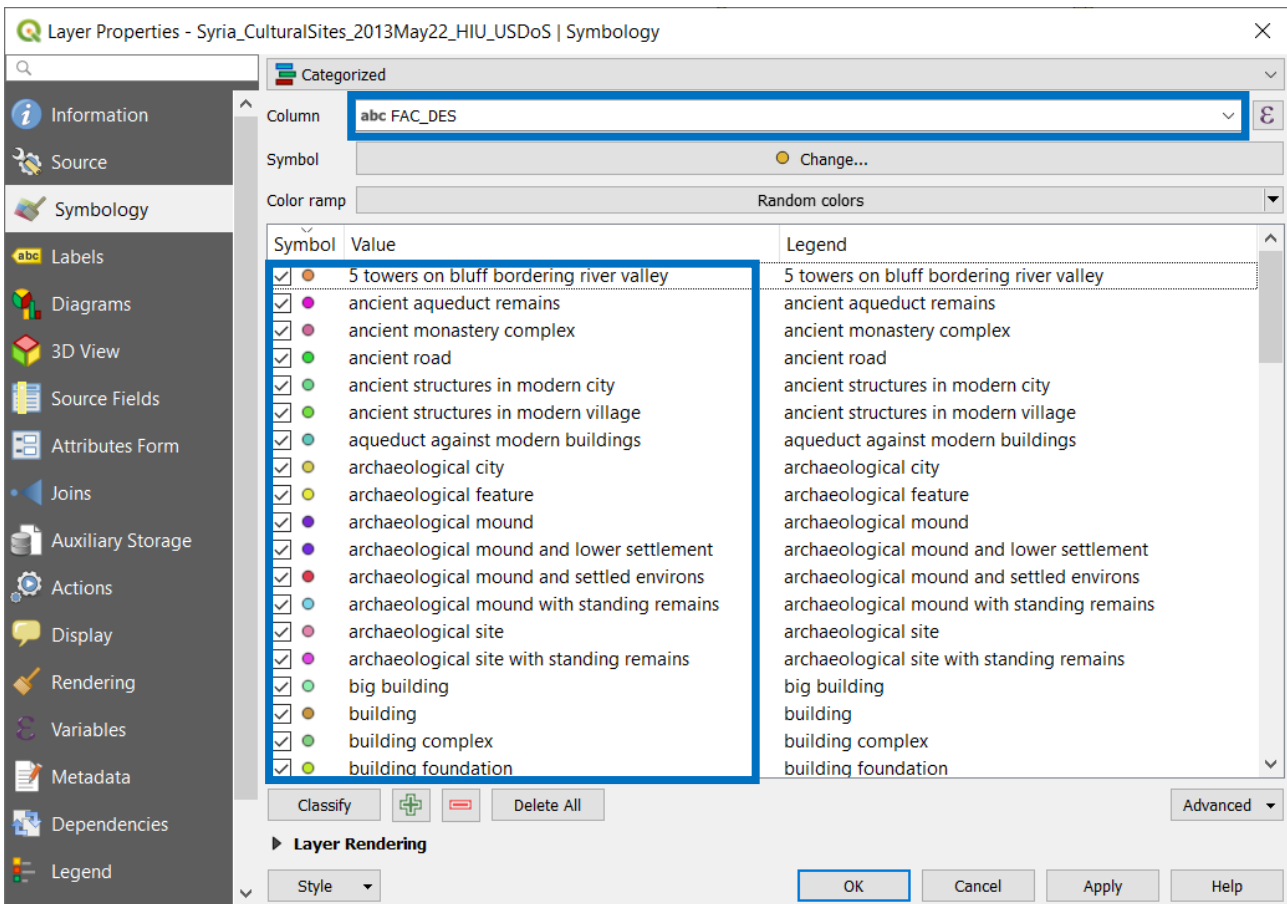


Figure 49 - The Layer Properties - Symbology - Categorized#3

This thematic representation is not very useful because the “DESCRIPTION” is not so strict... In the map a variety of colour will displayed and the User will no be able to read in a correct way the representation of the data.

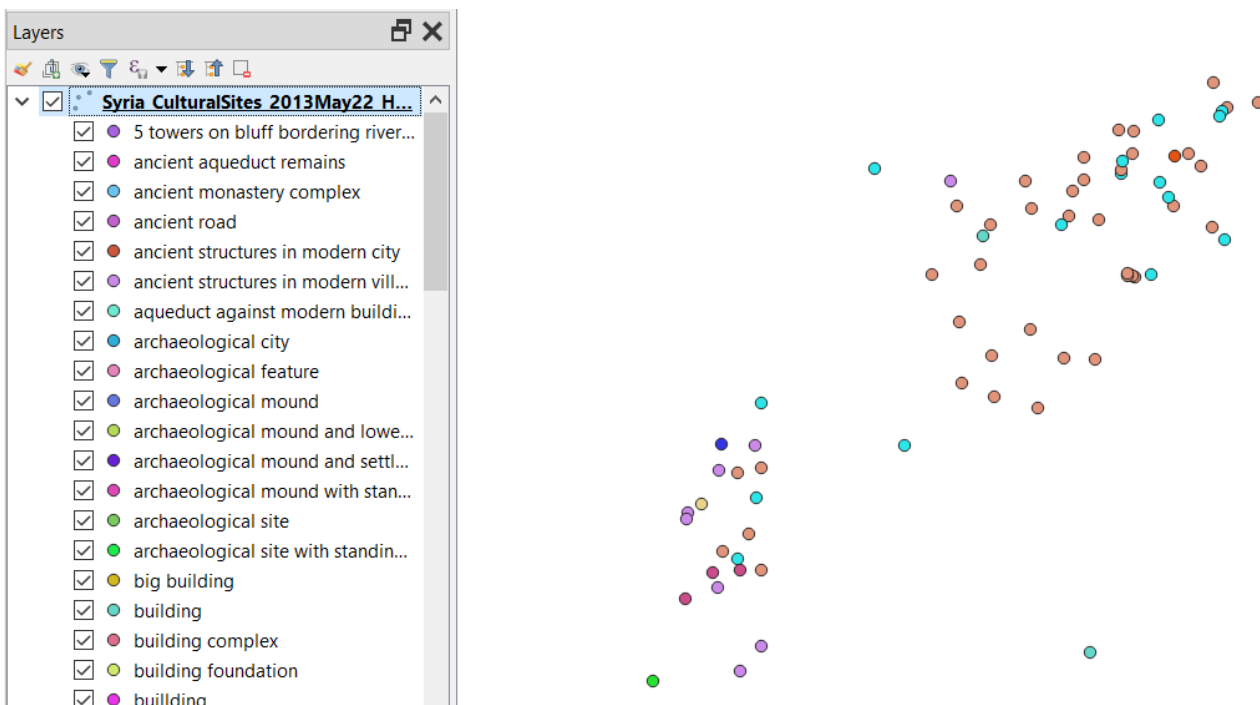


Figure 50 - The Layer Properties - Symbology - Categorized#4

In this case, maybe, is better to change the field to another one, “CLASS” for example.

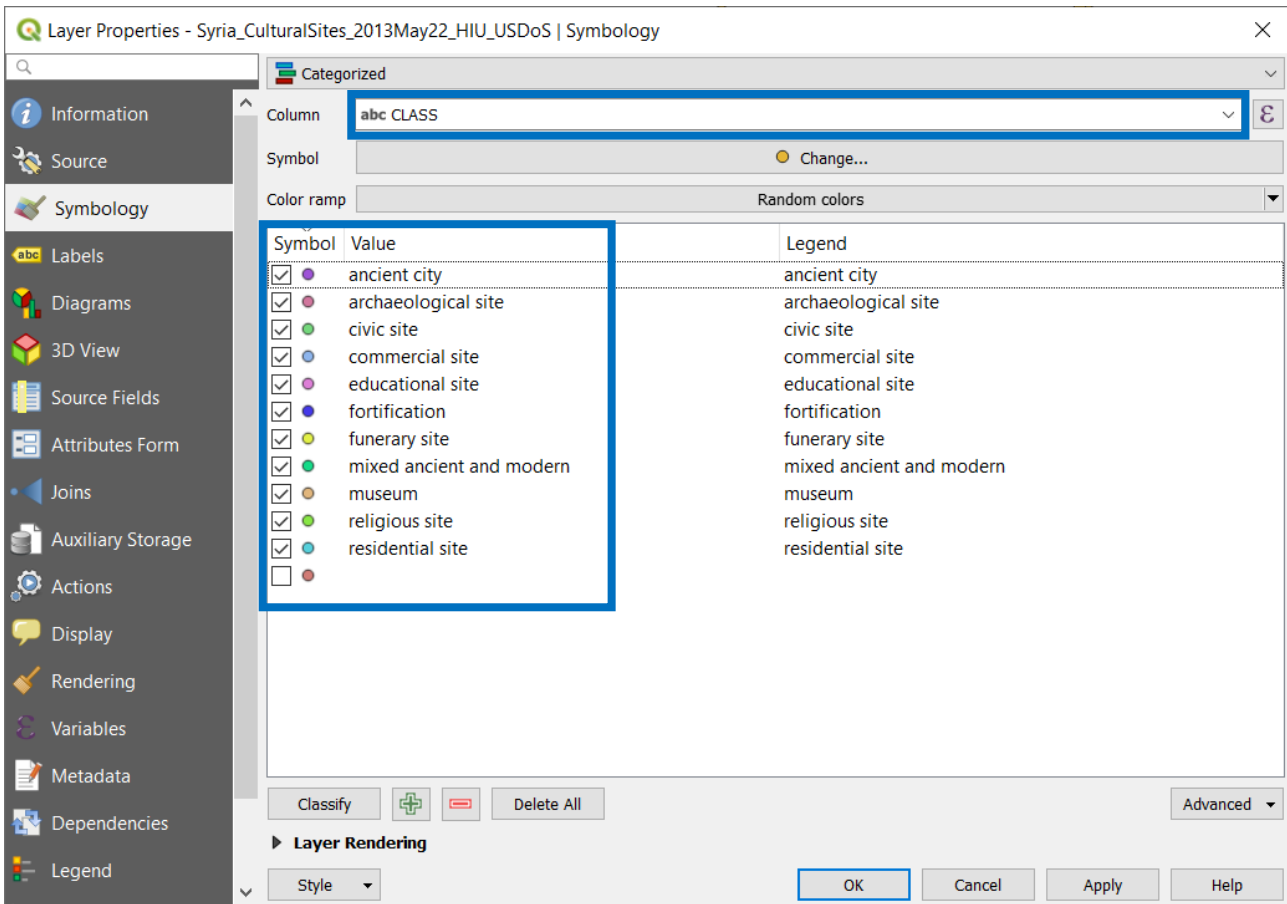


Figure 51 - The Layer Properties - Symbology - Categorized#5

This is a great result! Now it is possible to change the symbols, the colours and the “Legend” value. Try it and at the end of the exercise remember to “Apply” and close the dialog in order to see the updating map!

Last, but not least, if you have found a good data representation, why don't You save Your style? Under the Style pull down menu:

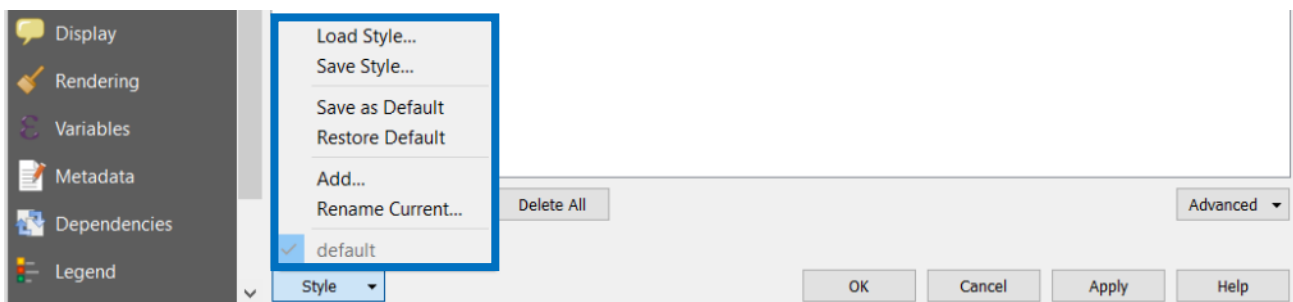


Figure 52 - The Layer Properties - Symbology - Categorized#6

try to save the Style You have just created.

### Add a Raster to QGIS

We can use the same HDX site to search for a raster dataset.

- **Mozambique Drought**
- OCHA Mozambique HAT

- 30+ Downloads
- Updated April 12, 2019 | Dataset date: Apr 12, 2019
- This dataset updates: Never
- Data produced under the ADRF Sub Saharan Africa Risk Profiles project. The project provides also risk data produced, exposure and hazard data used in the analyses.

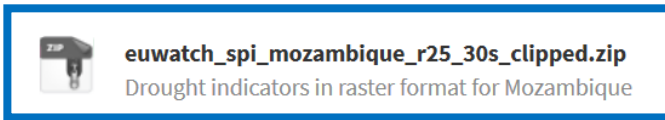


Figure 53 - Download Raster

### Method 1 – Drag&Drop

Start QGIS and place the Software window next to the Windows File Explorer. Search for euwatch\_spi\_mozambique\_r25\_30s\_clipped.tif. Then Drag-and-Drop it until the QGIS Map Area and release the mouse button:

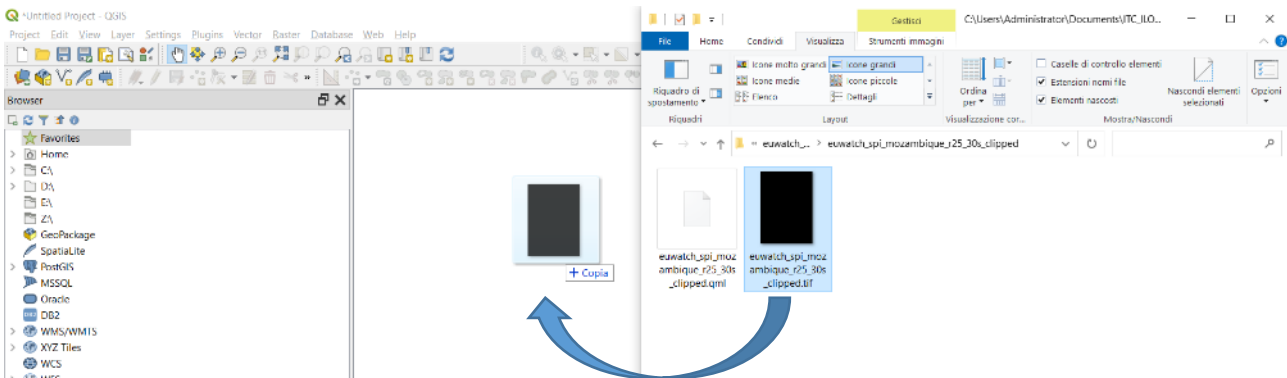


Figure 54 - Add Raster Layer #1a

The result of this operation will be displayed in the QGIS Map Area:

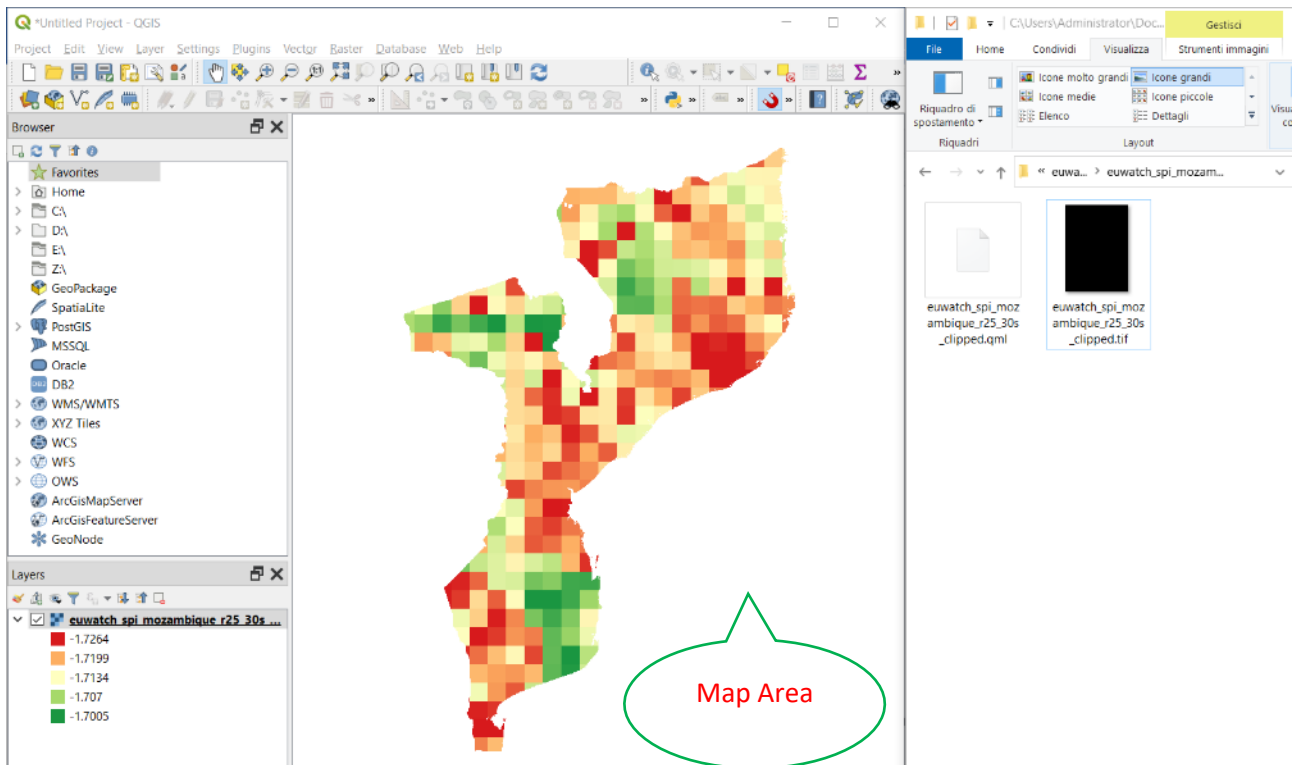


Figure 55 - Add Raster Layer #1b

The “pixel” are “coloured” because of the presence, in the same folder of the data, of another file, euwatch\_spi\_mozambique\_r25\_30s\_clipped.qml. This file contains style information and therefore can assign a “predefined legend style” to a raster layer also.

Method 2 – Data Source Manager (Button)

Search for the Data Source Manager Button and click on it.

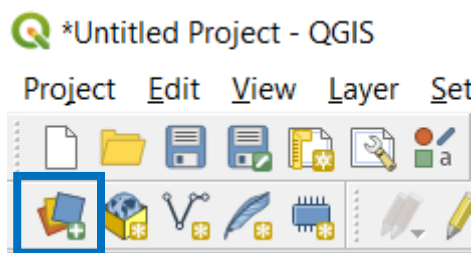


Figure 56 - Add Raster Layer #2a

Choose “Raster” (TIFF is a “raster container”):



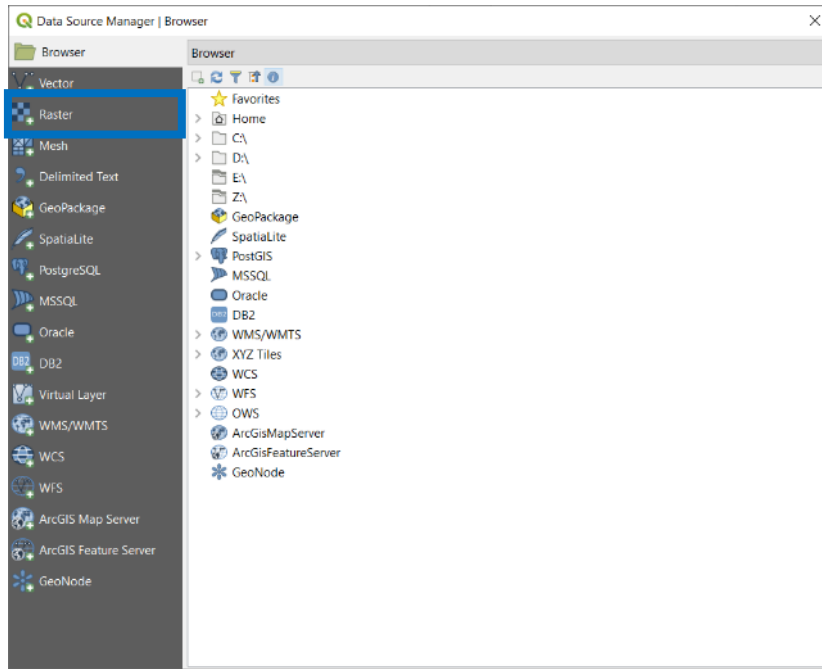


Figure 57 - Add Raster Layer #2b

Then, Browse the Source Raster Dataset:

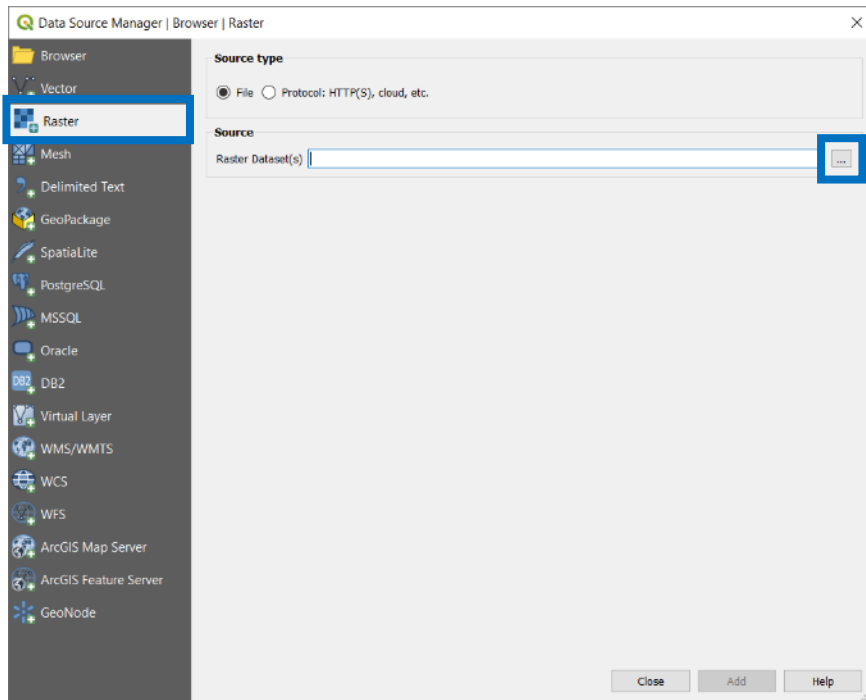


Figure 58 - Add Raster Layer #2c

Search for the data You desire to load and select it. To improve the searching procedure, could be useful to set the data filetype on: GeoTIFF Images.

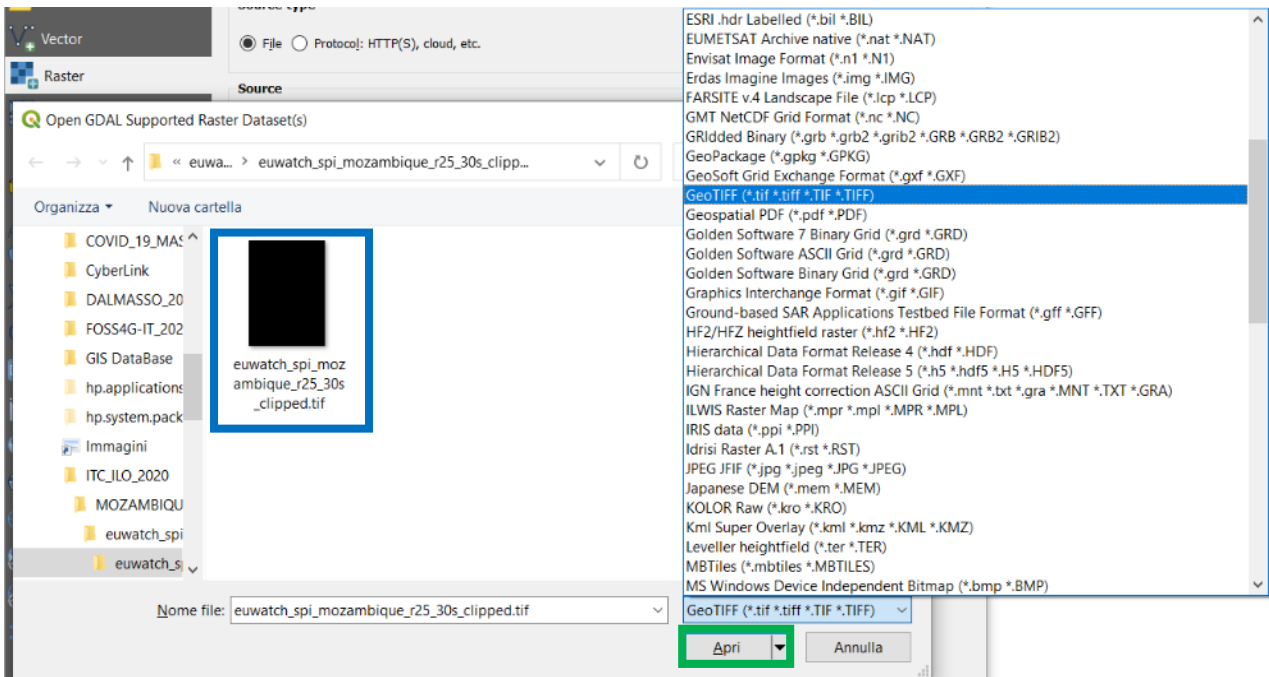


Figure 59 - Add Raster Layer #2d

### Method 3 – Data Browser (Window)

Search for the Data Browser. Open the appropriate folder and search for the data.

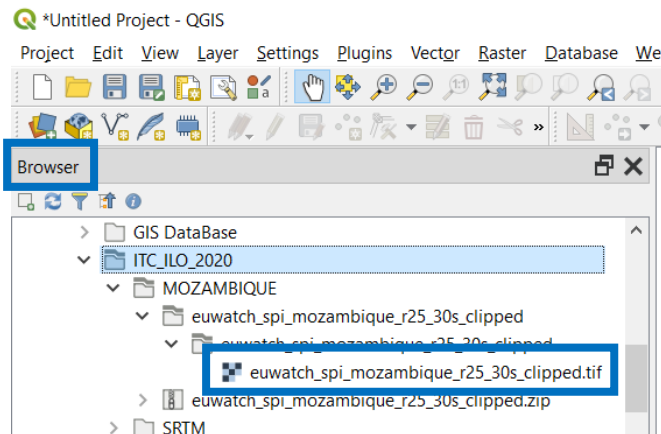


Figure 60 - Add Raster Layer #3

Search for **euwatch\_spi\_mozambique\_r25\_30s\_clipped.tif**. Then Drag-and-Drop it until the QGIS Map Area and release the mouse button.

### Method 4 – Add Layer (Menu)

From the Menu Bar, search for “Layer”, “Add Layer”, “Add Raster Layer”

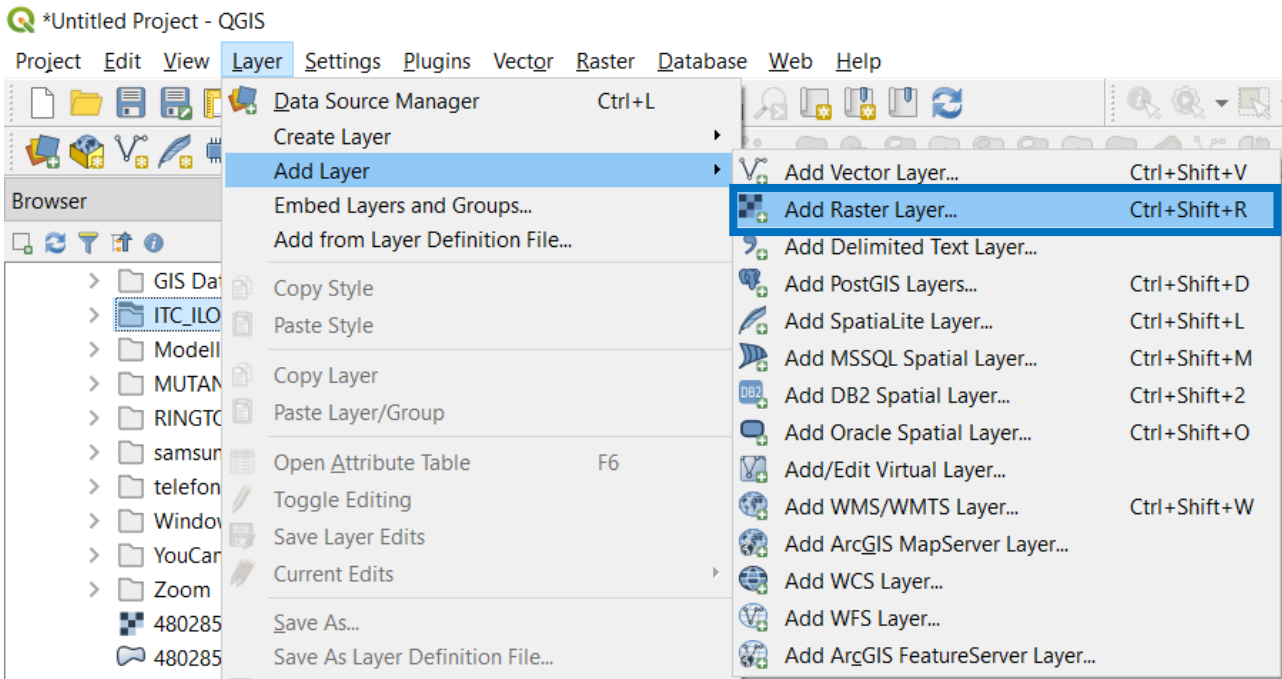


Figure 61 - Add Raster Layer #4

As done previously, browse folders and data, look for the image and load it using the usual series of dialogs.

#### Method 5 – Use a “shortcut”

Last but not least, it is possible to use a "keyboard combination" to "Add shapefile". The shortcut is: Control (CTRL) + Shift (⇧) + "R". The dialog "Data Source Manager | Raster" will appear and - as done previously - browse folders and data, look for the shapefile and load it using the usual series of dialogs.

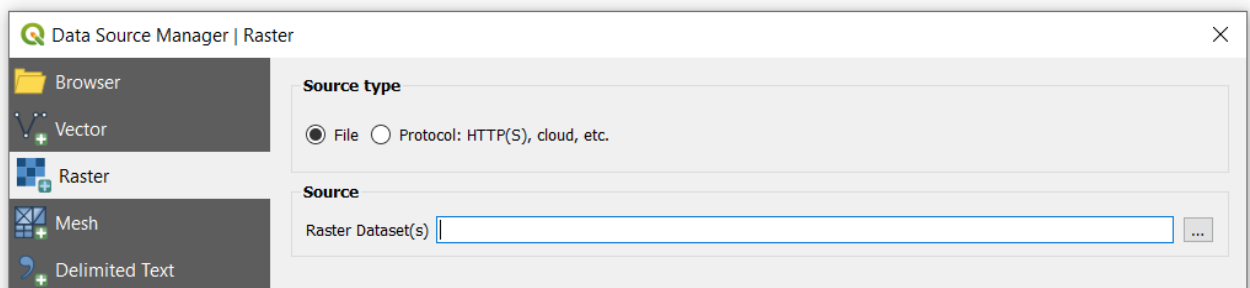


Figure 62 - Add Raster Layer #5

### Open Geospatial Consortium (OGC) Services

“The **Open Geospatial Consortium (OGC)**, an international voluntary consensus standards organization, originated in 1994. In the OGC, more than 500 commercial, governmental, nonprofit and research organizations worldwide collaborate in a consensus process **encouraging development and implementation of open standards for geospatial content and services, sensor web and Internet of Things, GIS data processing and data sharing**”.<sup>[70]</sup>

The OGC standards baseline comprises more than 30 standards<sup>71</sup>, including, among the others:

- **CSW** – Catalog Service for the Web: access to catalog information

70 [https://en.wikipedia.org/wiki/Open\\_Geospatial\\_Consortium](https://en.wikipedia.org/wiki/Open_Geospatial_Consortium)

71 <https://www.ogc.org/standards/>

- **GML**– Geography Markup Language: XML-format for geographical information
- **KML** – Keyhole Markup Language: XML-based language schema for expressing geographic annotation and visualization on existing (or future) Web-based, two-dimensional maps and three-dimensional Earth browsers
- **SLD** - Styled Layer Descriptor
- **SRID**, an identification for spatial coordinate systems
- **WCS** – Web Coverage Service: provides access, subsetting, and processing on coverage objects
- **WFS** – Web Feature Service: for retrieving or altering feature descriptions
- **WMS** – Web Map Service: provides map images
- **WMTS** – Web Map Tile Service: provides map image tiles
- **WPS** – Web Processing Service: remote processing service
- **WTS** – Web Terrain Service (WTS)

We'll use **WMS (WMTS)**, **WCS** and **WFS** services and, if applicable, **CSW**.

How add a Service using QGIS

First of all we need a “service”. We can search for them usign “Google” but, as an example, we could use the Humanitarian Data Exchange (HDX) site<sup>[72]</sup>.

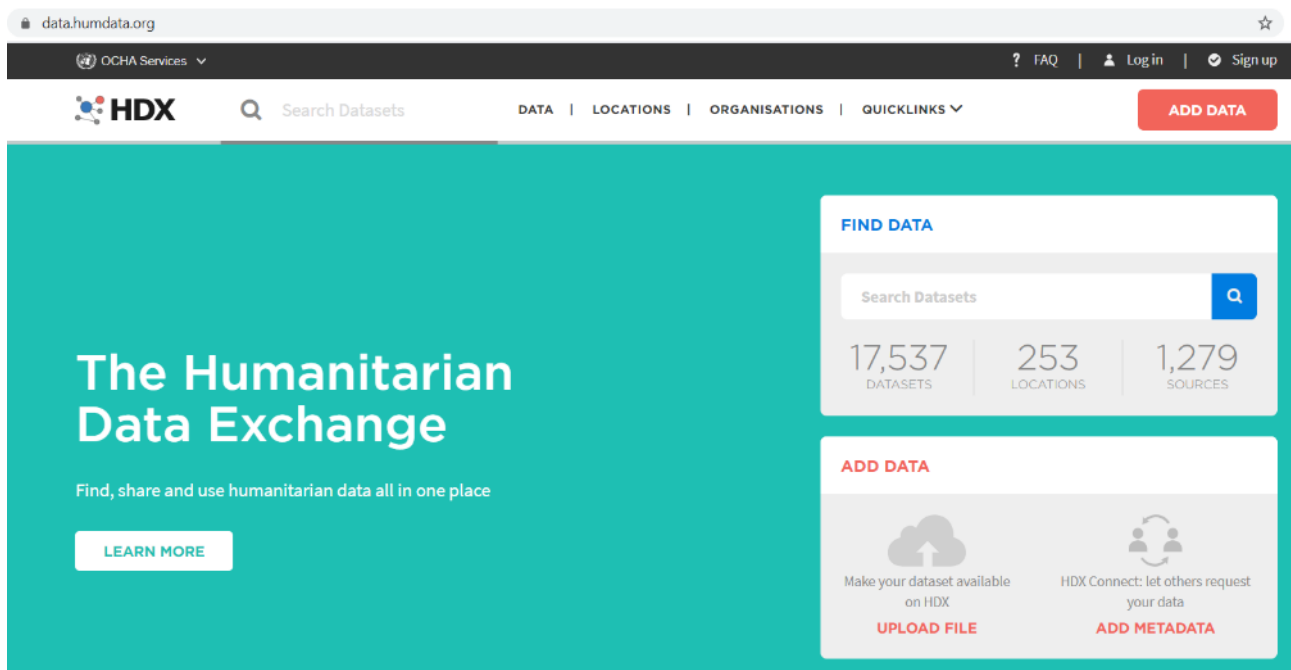


Figure 63 - The Humanitarian Data Exchange Site - WMS Services #1

Searching hor “WMS”...

72 <https://data.humdata.org/>

**Lebanon Administrative Boundaries (levels 0-3)**

OCHA ROMENA

2800+ Downloads

Updated September 12, 2019 | Dataset date: Jun 20, 2017

This dataset updates: Every year

Lebanon Administrative Boundary (levels 0-3) polygons and lines, and Administrative level 3 capitals Vetting and live service provision by Information Technology Outreach Services (ITOS) with funding from USAID.

**ZIPPED SHAPEFILE** | **ZIP** | **XLSX** | **KMZ** | **LIVE SERVICE** |

Figure 64 - The Humanitarian Data Exchange Site - WMS Services #2

Browse the result list:

Data and Resources	Metadata
<b>lbn_admbnda_adm0_cdr_20160822.zip</b> (233.6K) Lebanon Administrative Boundary (level 0)	<a href="#">DOWNLOAD</a>
<b>lbn_admbnda_adm1_cdr_20160822.zip</b> (553.7K) Polygons represent current Level 1 Administrative Boundaries for Lebanon. Data Format: ESRI <a href="#">... More</a>	<a href="#">DOWNLOAD</a>
<b>lbn_admbnda_adm2_cdr_20160822.zip</b> (927.7K)	<a href="#">DOWNLOAD</a>

Figure 65 - The Humanitarian Data Exchange Site - WMS Services #3

until find the section containg “service” or “server” string:

<b>LBN_AR (FeatureServer)</b> Service Description: This map service contains OCHA Common Operational Datasets for Lebanon: <a href="#">... More</a>	<a href="#">DOWNLOAD</a>
<b>LBN_AR (MapServer)</b> This map service contains OCHA Common Operational Datasets for Lebanon: Administrative Boundaries <a href="#">... More</a>	<a href="#">DOWNLOAD</a>
<b>LBN_EN (FeatureServer)</b> This map service contains OCHA Common Operational Datasets for Lebanon: Administrative Boundaries <a href="#">... More</a>	<a href="#">DOWNLOAD</a>
<b>LBN_EN (MapServer)</b> This map service contains OCHA Common Operational Datasets for Lebanon: Administrative Boundaries <a href="#">... More</a>	<a href="#">DOWNLOAD</a>
<b>LBN_pcode (FeatureServer)</b> This map service is intended as a labelling layer for PCODES from OCHA's Common Operational	<a href="#">DOWNLOAD</a>

Figure 66 - The Humanitarian Data Exchange Site - WMS Services #4

A “Map Server” is a WMS and the nit is possible toload it, as “basemap”, into QGIS. Press the button “Download”. In this case, a new page will be displayed:

**ArcGIS REST Services Directory**  
[Home](#) > [services](#) > [COD\\_External](#) > [LBN\\_AR \(MapServer\)](#) [Login](#) | [Get Token](#)

---

[JSON](#) | [SOAP](#) | **WMS** [Help](#) | [API Reference](#)

**COD\_External/LBN\_AR (MapServer)**

**View In:** [ArcGIS JavaScript](#) [ArcGIS Online map viewer](#) [Google Earth](#) [ArcMap](#) [ArcGIS Explorer](#)

**View Footprint In:** [ArcGIS Online map viewer](#)

**Service Description:** This map service contains OCHA Common Operational Datasets for Lebanon: Administrative Boundaries and Populated Places. The service is available as ESRI Map, WMS, and KML Services.

**Map Name:** Layers

[Legend](#)

[All Layers and Tables](#)

[Dynamic Legend](#)

[Dynamic All Layers](#)

**Layers:**

- [National Capital](#) (0)
- [Mohafazah Capitals \(Admin1\)](#) (1)
- [Kadda Capitals \(Admin2\)](#) (2)
- [Populated Places](#) (3)
- [Admin0](#) (4)
- [Admin1](#) (5)
- [Admin2 Lines](#) (6)
- [Admin2](#) (7)
- [Admin3 Lines](#) (8)
- [Admin3](#) (9)
- [Base Map](#) (10)

Figure 67 - ArcGIS REST Services Directory #1

Search in the page for “WMS”:

**ArcGIS REST Services Directory**  
[Home](#) > [services](#) > [COD\\_External](#) > [LBN\\_AR \(MapServer\)](#)

---

[JSON](#) | [SOAP](#) | **WMS**

**COD\_External/LBN\_AR (MapServer)**

**View In:** [ArcGIS JavaScript](#) [ArcGIS Online map viewer](#)

**View Footprint In:** [ArcGIS Online map viewer](#)

Figure 68 - ArcGIS REST Services Directory #2

and click on the hypelink. An XML file will appear on the screen:

← → ↻ [gistmaps.itos.uga.edu/arcgis/services/COD\\_External/LBN\\_AR/MapServer/WMServer?request=GetCapabilities&service=WMS](http://gistmaps.itos.uga.edu/arcgis/services/COD_External/LBN_AR/MapServer/WMServer?request=GetCapabilities&service=WMS) ☆

---

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```

<?xml version="1.0" encoding="UTF-8" ?>
<Capabilities xmlns="http://www.opengis.net/wms" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:esri_wms="http://www.esri.com/wms" version="1.3.0"
xsi:schemaLocation="http://www.opengis.net/wms http://schemas.opengis.net/wms/1.3.0/capabilities_1_3_0.xsd http://www.esri.com/wms
https://gistmaps.itos.uga.edu/arcgis/services/COD_External/LBN_AR/MapServer/WMServer?request=GetCapabilities&service=WMS" ?>
  <Service ?>
    <Name ?>
      <![CDATA[ WMS ]]>
    </Name ?>
    <Title ?>WMS</Title ?>
    <Abstract ?>WMS</Abstract ?>
    <KeywordList ?>
      <Keyword ?>
        <![CDATA[ ]]>
      </Keyword ?>
    </KeywordList ?>
    <OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:type="simple" xlink:href="https://gistmaps.itos.uga.edu/arcgis/services/COD_External/LBN_AR/MapServer/WMServer?" ?>
    </OnlineResource ?>
    <ContactInformation ?>
      <ContactPersonPrimary ?>
        <ContactPerson ?>
          <![CDATA[ ]]>
        </ContactPerson ?>
        <ContactOrganization ?>
          <![CDATA[
  </ContactOrganization ?>
        </ContactPersonPrimary ?>
      </ContactInformation ?>
    </Service ?>
  </Capabilities ?>

```

Figure 69 - WMS (XML) #1

Inside the text, search for an internet address, such as:



xlink:href="https://gistmaps.itos.uga.edu/arcgis/services/COD\_External/LBN\_AR/MapServer/WmsServer? />

Figure 70 - WMS (XML) #2

Copy the address (without quotes). Open QGIS and look for the “Browser” panel, in particular, the section containing “Services”:

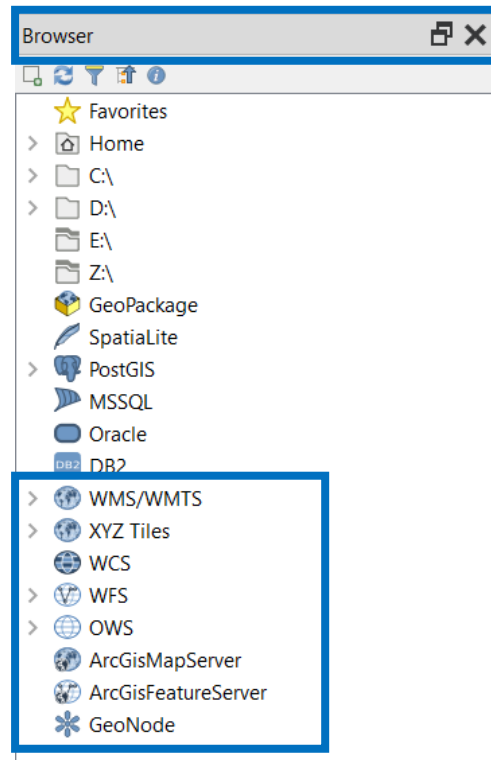


Figure 71 - OGC Services and Other Connections

Look for **WMS/WMTS** and, with a right click of the mouse, create a “New connection”:

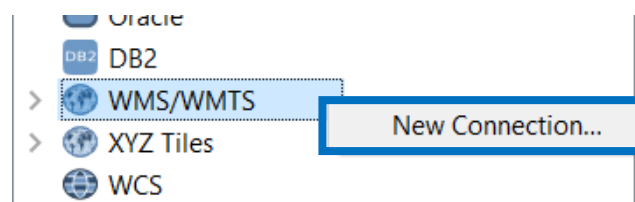


Figure 72 – WMS / WMTS Services - New Connection...

A “Create a New WMS/WMTS Connection” dialog will appear:

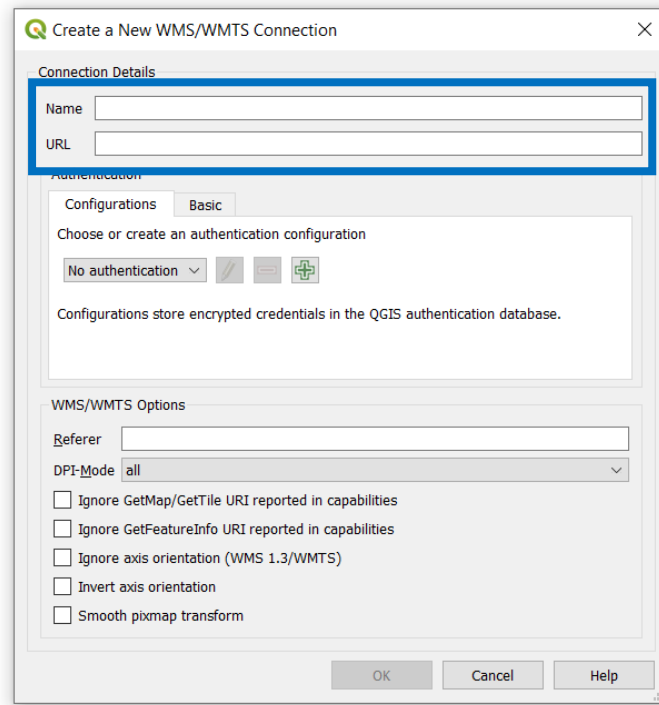


Figure 73 - Create a New WMS/WMTS Connection #1

In the “Connection Details”

- Name = insert a name You like
- URL = paste the address found before<sup>[73]</sup>

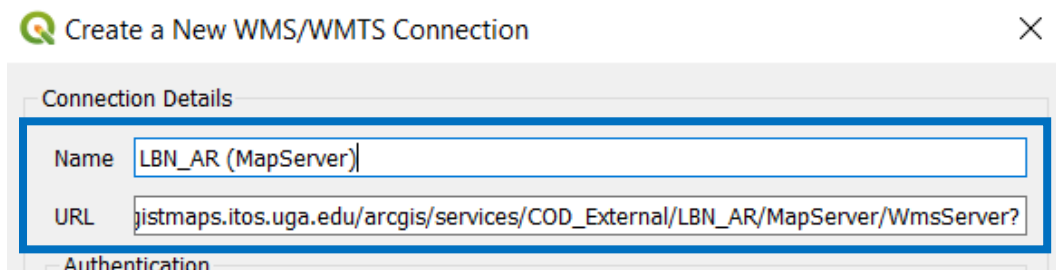


Figure 74 - Create a New WMS/WMTS Connection #2

And presso “OK”. Go back to the “Browser” and search for the name You have assigned to the connection.

73 [https://gismaps.itos.uga.edu/arcgis/services/COD\\_External/LBN\\_AR/MapServer/WmsServer?](https://gismaps.itos.uga.edu/arcgis/services/COD_External/LBN_AR/MapServer/WmsServer?)

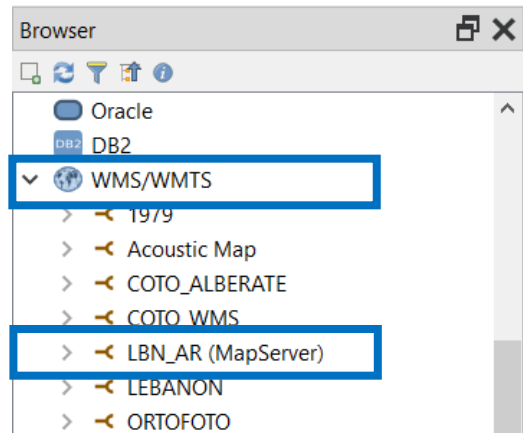


Figure 75 - New WMS/WMTS Layers #1

Click on the > sign to explode the connection details until the layer list is visible:

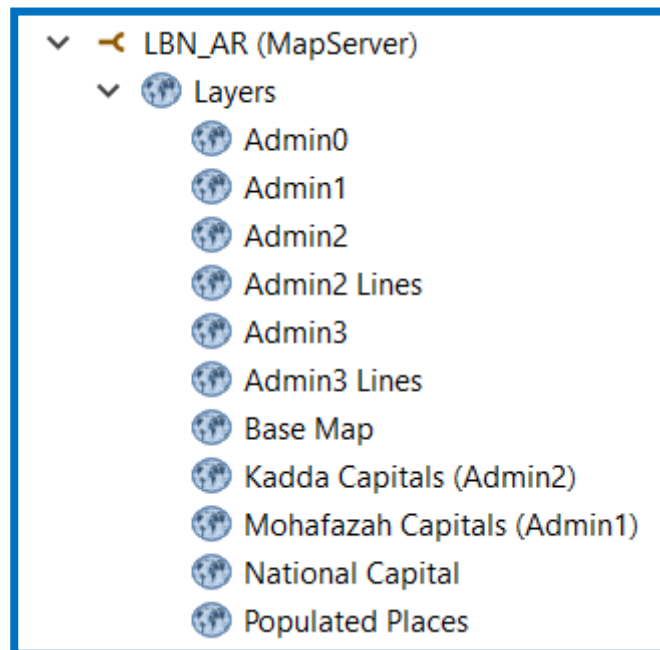


Figure 76 - New WMS/WMTS Layers #2

A simple double click of the mouse on the layer name will load the related data into the map space.

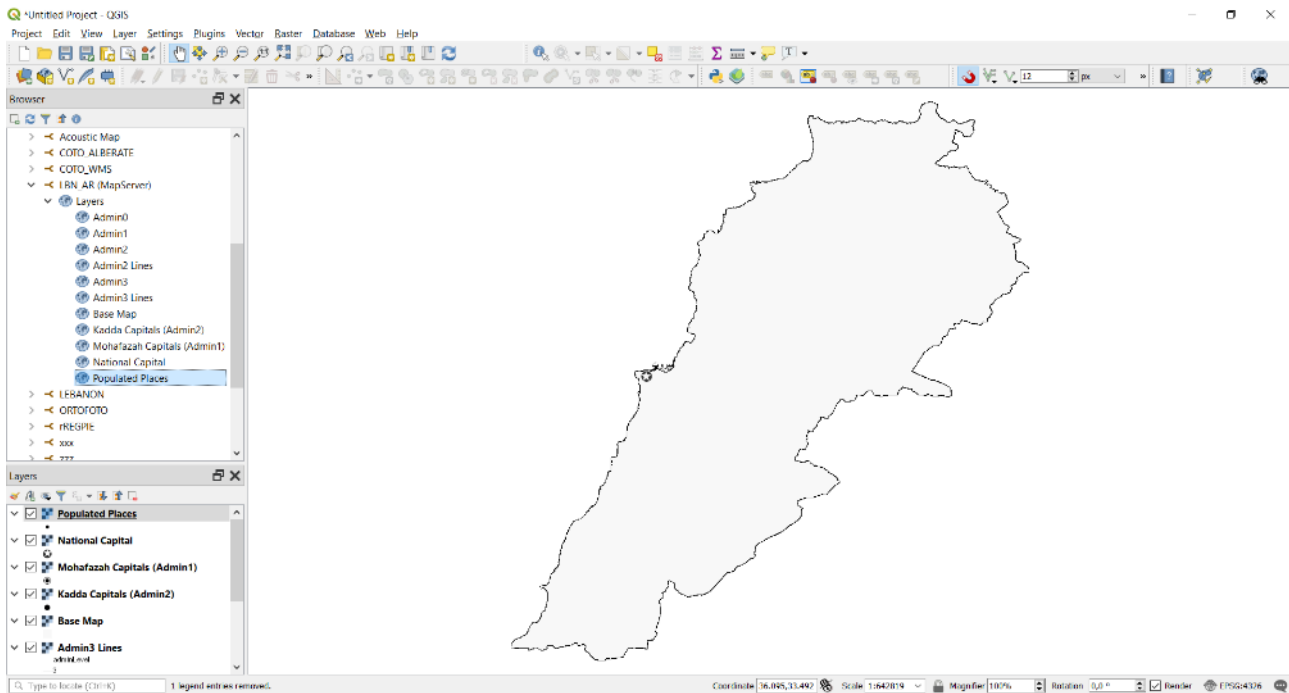


Figure 77 - WMS/WMTS Display

By using “services” no data will be downloaded or, better, the data displayed comes from the net (in this case, as a background map without the possibility of modify or change data).

Maybe, all that we have seen now, is a “complex example”. In many other cases, searching for “OGC Services” it is very easy to find resources “ready-to-use”. For example, using Google Searching Engine it is possible to find, among the other, the “United Nations Clear Map”<sup>[74]</sup>.

## United Nations Clear Map



Here you can find various versions of Clear Map and a guide on how to consume the clear map services in different platforms (ArcMap, ArcGIS Pro, QGIS, JavaScript API, Leaflet, Open Layers)

PDF by [United\\_Nations\\_Geospatial](#)

Created: Aug 19, 2019   Updated: Mar 24, 2020   View Count: 488

Figure 78 - United Nation Clear Map #1

“Here you can find various versions of Clear Map and a guide on how to consume the clear map services in different platforms (ArcMap, ArcGIS Pro, QGIS, JavaScript API, Leaflet, Open Layers)”.

“The United Nations Clear Map (hereinafter “Clear Map”) is a background reference web mapping service produced to facilitate “the issuance of any map at any duty station, including dissemination via public electronic networks such as Internet” and “to ensure that maps meet publication standards and that they are not in contravention of existing United Nations policies” in accordance with the in the Administrative Instruction on “Regulations for the Control and Limitation of Documentation – Guidelines for the Publication of Maps” of 20 January 1997<sup>[75]</sup>”.

“Clear Map is created for the use of the United Nations Secretariat and community. All departments, offices and regional commissions of the United Nations Secretariat including offices away from Headquarters using

74 <https://geoportal.dfs.un.org/arcgis/home/item.html?id=541557fd0d4d42efb24449be614e6887>

75 <http://undocs.org/ST/AI/189/Add.25/Rev.1>

Clear Map remain bound to the instructions as contained in the Administrative Instruction and should therefore seek clearance from the UN Geospatial Information Section (formerly Cartographic Section) prior to the issuance of their thematic maps using Clear Map as background reference” .<sup>[76]</sup>

In this site the links are clearly expressed:



Style	URL
 <p>ClearMap_Dark</p>	<ul style="list-style-type: none"> <li>• ArcGIS - <a href="https://geoservices.un.org/arcgis/rest/services/ClearMap_Dark/MapServer">https://geoservices.un.org/arcgis/rest/services/ClearMap_Dark/MapServer</a></li> <li>• WMS - <a href="https://geoservices.un.org/arcgis/services/ClearMap_Dark/MapServer/WMServer?request=GetCapabilities&amp;service=WMS">https://geoservices.un.org/arcgis/services/ClearMap_Dark/MapServer/WMServer?request=GetCapabilities&amp;service=WMS</a></li> </ul>
 <p>ClearMap_Gray</p>	<ul style="list-style-type: none"> <li>• ArcGIS - <a href="https://geoservices.un.org/arcgis/rest/services/ClearMap_Gray/MapServer">https://geoservices.un.org/arcgis/rest/services/ClearMap_Gray/MapServer</a></li> <li>• WMS - <a href="https://geoservices.un.org/arcgis/services/ClearMap_Gray/MapServer/WMServer?request=GetCapabilities&amp;service=WMS">https://geoservices.un.org/arcgis/services/ClearMap_Gray/MapServer/WMServer?request=GetCapabilities&amp;service=WMS</a></li> </ul>

Figure 79 - United Nation Clear Map #2

It is possible to find, on the net, many resources on OGC Services. Sometimes well find National or Local Geoportals, other time could be happen to find list of resources like this one:



The spatial data search engine

Figure 80 - GeoSeer - The Spatial Data Search Engine

Or this one, based on CSW catalogues:

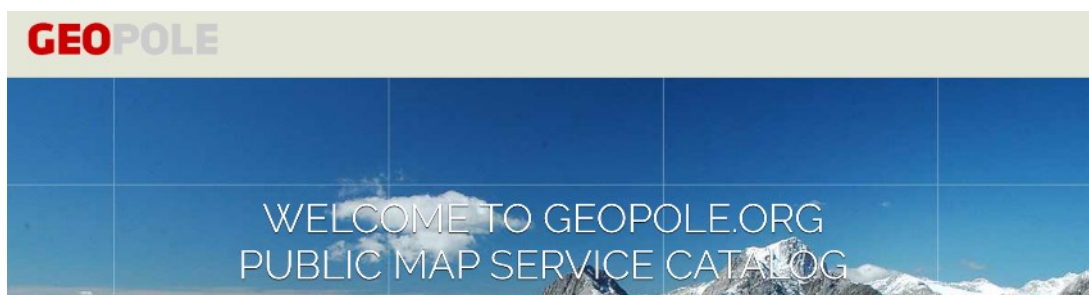


Figure 81 - GEOPOLE - Search on CSW Catalogue

### XYZ Tiles

76 <https://geoportal.dfs.un.org/arcgis/home/item.html?id=541557fd0d4d42efb24449be614e6887>

“A tiled web map or tile map (raster or vector) is a map displayed in a browser by seamlessly joining dozens of individually requested image or vector data files over the internet. It is the most popular way to display and navigate maps, replacing other methods such as WMS which typically display a single large image. (...).

There are several advantages to tiled maps. Each time the user pans, most of the tiles are still relevant, and can be kept displayed, while new tiles are fetched. This greatly improves the user experience, compared to fetching a single map image for the whole viewport. It also allows individual tiles to be pre-computed, a task easy to parallelize. Also, displaying rendered images served from a web server is less computationally demanding than rendering images in the browser, a benefit over technologies such as WFS<sup>[77]</sup>.

### How add Tile Server using a Python script

Nowadays there are many tutorial and tile server providers<sup>[78][79][80]</sup> but using the **QGIS Python Console (Plugin ► Python Console** or press **CTRL+ALT+P** that is the QGIS *shortcut*) it is very easy to add, on-the-fly, a variety of servers.

The best resource is the following one<sup>[81][82]</sup>. All the code between «`"""`» and «`"""`» are «comments» and, a part the disclaimer, the license and the notes, it is possible to ignore while pasting it into QGIS.

```
"""
```

This script should be run from the Python consol inside QGIS.

It adds online sources to the QGIS Browser.

Each source should contain a list with the following items (string type):

```
[sourcetype, title, authconfig, password, referer, url, username, zmax, zmin]
```

You can add or remove sources from the sources section of the code.

Script by Klas Karlsson

Sources from <https://qms.nextgis.com/>

Licence GPL-3

Regarding the terms of use for these background maps YOU will need to verify that you follow the individual EULA that comes with the different services, Most likely they will restrict how you can use the data.

```
"""
```

```
# Sources
```

```
sources = []
```

---

77 [https://en.wikipedia.org/wiki/Tiled\\_web\\_map](https://en.wikipedia.org/wiki/Tiled_web_map)

78 <https://www.spatialbias.com/2018/02/qgis-3.0-xyz-tile-layers/>

79 <https://github.com/nextgis/quickmapservices>

80 [https://github.com/nextgis/quickmapservices\\_contrib/tree/master/data\\_sources](https://github.com/nextgis/quickmapservices_contrib/tree/master/data_sources)

81 [https://raw.githubusercontent.com/klakar/QGIS\\_resources/master/collections/Geosupportsystem/python/qgis\\_basemaps.py](https://raw.githubusercontent.com/klakar/QGIS_resources/master/collections/Geosupportsystem/python/qgis_basemaps.py)

82 <https://twitter.com/klaskarlsson>



```

sources.append(["connections-xyz", "Google
Maps", "", "", "", "https://mtl.google.com/vt/lyrs=m&x=%7Bx%7D&y=%7By%7D&z=%7Bz%7D",
"", "19", "0"])

sources.append(["connections-xyz", "Google Satellite", "", "", "",
"https://mtl.google.com/vt/lyrs=s&x=%7Bx%7D&y=%7By%7D&z=%7Bz%7D", "", "19",
"0"])

sources.append(["connections-xyz", "Google Terrain", "", "", "",
"https://mtl.google.com/vt/lyrs=t&x=%7Bx%7D&y=%7By%7D&z=%7Bz%7D", "", "19",
"0"])

sources.append(["connections-xyz", "Google Terrain Hybrid", "", "", "",
"https://mtl.google.com/vt/lyrs=p&x=%7Bx%7D&y=%7By%7D&z=%7Bz%7D", "", "19",
"0"])

sources.append(["connections-xyz", "Google Satellite Hybrid", "", "", "",
"https://mtl.google.com/vt/lyrs=y&x=%7Bx%7D&y=%7By%7D&z=%7Bz%7D", "", "19",
"0"])

sources.append(["connections-xyz", "Stamen Terrain", "", "", "Map tiles by Stamen
Design, under CC BY 3.0. Data by OpenStreetMap, under ODbL",
"http://tile.stamen.com/terrain/%7Bz%7D/%7Bx%7D/%7By%7D.png", "", "20", "0"])

sources.append(["connections-xyz", "Stamen Toner", "", "", "Map tiles by Stamen
Design, under CC BY 3.0. Data by OpenStreetMap, under ODbL",
"http://tile.stamen.com/toner/%7Bz%7D/%7Bx%7D/%7By%7D.png", "", "20", "0"])

sources.append(["connections-xyz", "Stamen Toner Light", "", "", "Map tiles by
Stamen Design, under CC BY 3.0. Data by OpenStreetMap, under ODbL",
"http://tile.stamen.com/toner-lite/%7Bz%7D/%7Bx%7D/%7By%7D.png", "", "20", "0"])

sources.append(["connections-xyz", "Stamen Watercolor", "", "", "Map tiles by
Stamen Design, under CC BY 3.0. Data by OpenStreetMap, under ODbL",
"http://tile.stamen.com/watercolor/%7Bz%7D/%7Bx%7D/%7By%7D.jpg", "", "18", "0"])

sources.append(["connections-xyz", "Wikimedia Map", "", "", "OpenStreetMap
contributors, under ODbL", "https://maps.wikimedia.org/osm-
intl/%7Bz%7D/%7Bx%7D/%7By%7D.png", "", "20", "1"])

sources.append(["connections-xyz", "Wikimedia Hike Bike Map", "", "",
"OpenStreetMap contributors, under ODbL",
"http://tiles.wmflabs.org/hikebike/%7Bz%7D/%7Bx%7D/%7By%7D.png", "", "17", "1"])

sources.append(["connections-xyz", "Esri Boundaries Places", "", "", "",
"https://server.arcgisonline.com/ArcGIS/rest/services/Reference/World_Boundaries
_and_Places/MapServer/tile/%7Bz%7D/%7By%7D/%7Bx%7D", "", "20", "0"])

sources.append(["connections-xyz", "Esri Gray (dark)", "", "", "",
"http://services.arcgisonline.com/ArcGIS/rest/services/Canvas/World_Dark_Gray_Ba
se/MapServer/tile/%7Bz%7D/%7By%7D/%7Bx%7D", "", "16", "0"])

sources.append(["connections-xyz", "Esri Gray (light)", "", "", "",
"http://services.arcgisonline.com/ArcGIS/rest/services/Canvas/World_Light_Gray_B
ase/MapServer/tile/%7Bz%7D/%7By%7D/%7Bx%7D", "", "16", "0"])

sources.append(["connections-xyz", "Esri National Geographic", "", "", "",
"http://services.arcgisonline.com/ArcGIS/rest/services/NatGeo_World_Map/MapServe
r/tile/%7Bz%7D/%7By%7D/%7Bx%7D", "", "12", "0"])

sources.append(["connections-xyz", "Esri Ocean", "", "", "",
"https://services.arcgisonline.com/ArcGIS/rest/services/Ocean/World_Ocean_Base/M
apServer/tile/%7Bz%7D/%7By%7D/%7Bx%7D", "", "10", "0"])

sources.append(["connections-xyz", "Esri Satellite", "", "", "",
"https://server.arcgisonline.com/ArcGIS/rest/services/World_Imagery/MapServer/ti
le/%7Bz%7D/%7By%7D/%7Bx%7D", "", "17", "0"])

sources.append(["connections-xyz", "Esri Standard", "", "", "",
"https://server.arcgisonline.com/ArcGIS/rest/services/World_Street_Map/MapServer
/tile/%7Bz%7D/%7By%7D/%7Bx%7D", "", "17", "0"])

```

```

sources.append(["connections-xyz","Esri Terrain", "", "", "",
"https://server.arcgisonline.com/ArcGIS/rest/services/World_Terrain_Base/MapServer/tile/%7Bz%7D/%7By%7D/%7Bx%7D", "", "13", "0"])

sources.append(["connections-xyz","Esri Transportation", "", "", "",
"https://server.arcgisonline.com/ArcGIS/rest/services/Reference/World_Transportation/MapServer/tile/%7Bz%7D/%7By%7D/%7Bx%7D", "", "20", "0"])

sources.append(["connections-xyz","Esri Topo World", "", "", "",
"http://services.arcgisonline.com/ArcGIS/rest/services/World_Topo_Map/MapServer/tile/%7Bz%7D/%7By%7D/%7Bx%7D", "", "20", "0"])

sources.append(["connections-xyz","OpenStreetMap Standard", "", "",
"OpenStreetMap contributors, CC-BY-SA",
"http://tile.openstreetmap.org/%7Bz%7D/%7Bx%7D/%7By%7D.png", "", "19", "0"])

sources.append(["connections-xyz","OpenStreetMap H.O.T.", "", "", "OpenStreetMap contributors, CC-BY-SA",
"http://tile.openstreetmap.fr/hot/%7Bz%7D/%7Bx%7D/%7By%7D.png", "", "19", "0"])

sources.append(["connections-xyz","OpenStreetMap Monochrome", "", "",
"OpenStreetMap contributors, CC-BY-SA", "http://tiles.wmflabs.org/bw-mapnik/%7Bz%7D/%7Bx%7D/%7By%7D.png", "", "19", "0"])

sources.append(["connections-xyz","OpenTopoMap", "", "", "Kartendaten: © OpenStreetMap-Mitwirkende, SRTM | Kartendarstellung: © OpenTopoMap (CC-BY-SA)",
"https://tile.opentopomap.org/%7Bz%7D/%7Bx%7D/%7By%7D.png", "", "17", "1"])

sources.append(["connections-xyz","Strava All", "", "", "OpenStreetMap contributors, CC-BY-SA", "https://heatmap-external-b.strava.com/tiles/all/bluered/%7Bz%7D/%7Bx%7D/%7By%7D.png", "", "15", "0"])

sources.append(["connections-xyz","Strava Run", "", "", "OpenStreetMap contributors, CC-BY-SA", "https://heatmap-external-b.strava.com/tiles/run/bluered/%7Bz%7D/%7Bx%7D/%7By%7D.png?v=19", "", "15", "0"])

sources.append(["connections-xyz","Open Weather Map Temperature", "", "", "Map tiles by OpenWeatherMap, under CC BY-SA 4.0",
"http://tile.openweathermap.org/map/temp_new/%7Bz%7D/%7Bx%7D/%7By%7D.png?APPID=1c3e4ef8e25596946eelf3846b53218a", "", "19", "0"])

sources.append(["connections-xyz","Open Weather Map Clouds", "", "", "Map tiles by OpenWeatherMap, under CC BY-SA 4.0",
"http://tile.openweathermap.org/map/clouds_new/%7Bz%7D/%7Bx%7D/%7By%7D.png?APPID=ef3c5137f6c31db50c4c6f1ce4e7e9dd", "", "19", "0"])

sources.append(["connections-xyz","Open Weather Map Wind Speed", "", "", "Map tiles by OpenWeatherMap, under CC BY-SA 4.0",
"http://tile.openweathermap.org/map/wind_new/%7Bz%7D/%7Bx%7D/%7By%7D.png?APPID=f9d0069aa69438d52276ae25c1ee9893", "", "19", "0"])

sources.append(["connections-xyz","CartoDb Dark Matter", "", "", "Map tiles by CartoDB, under CC BY 3.0. Data by OpenStreetMap, under ODbL.",
"http://basemaps.cartocdn.com/dark_all/%7Bz%7D/%7Bx%7D/%7By%7D.png", "", "20", "0"])

sources.append(["connections-xyz","CartoDb Positron", "", "", "Map tiles by CartoDB, under CC BY 3.0. Data by OpenStreetMap, under ODbL.",
"http://basemaps.cartocdn.com/light_all/%7Bz%7D/%7Bx%7D/%7By%7D.png", "", "20", "0"])

sources.append(["connections-xyz","Bing VirtualEarth", "", "", "",
"http://ecn.t3.tiles.virtualearth.net/tiles/a{q}.jpeg?g=1", "", "19", "1"])

# Add sources to browser

```

for source in sources:

```

connectionType = source[0]
connectionName = source[1]

QSettings().setValue("qgis/%s/%s/authcfg" % (connectionType, connectionName),
source[2])

QSettings().setValue("qgis/%s/%s/password" % (connectionType,
connectionName), source[3])

QSettings().setValue("qgis/%s/%s/referer" % (connectionType, connectionName),
source[4])

QSettings().setValue("qgis/%s/%s/url" % (connectionType, connectionName),
source[5])

QSettings().setValue("qgis/%s/%s/username" % (connectionType,
connectionName), source[6])

QSettings().setValue("qgis/%s/%s/zmax" % (connectionType, connectionName),
source[7])

QSettings().setValue("qgis/%s/%s/zmin" % (connectionType, connectionName),
source[8])

# Update GUI
iface.reloadConnections()

```

After running this code, a large list of Tiles server will be loaded into QGIS Browser and, of course, these layers can be added to the map.

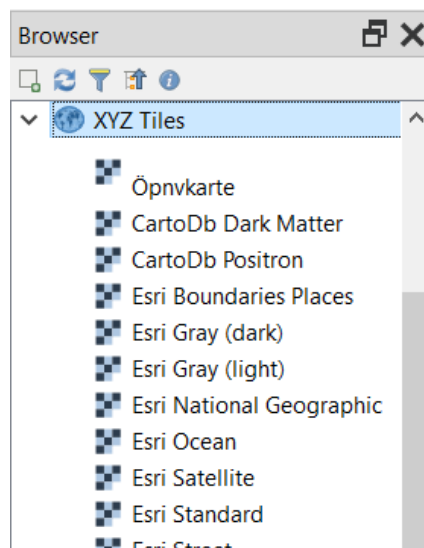


Figure 82 - XYZ Tiles (Browser)

It is easy to modify the list, or modify the parameter (right click of the mouse on the single “connection”):

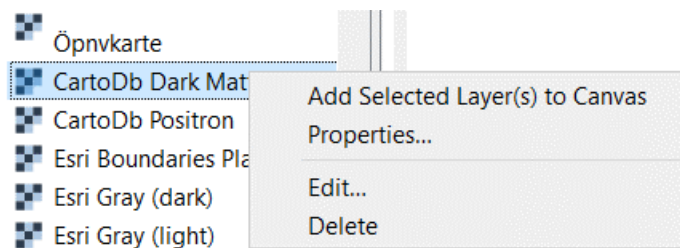


Figure 83 - XYZ Tiles - Manage the Connections

The list can be saved and retrieved (right click of the mouse on the “XYZ Tiles”):

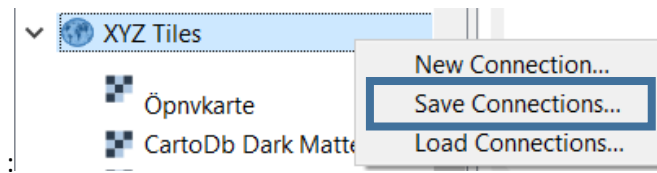


Figure 84 - XYZ Tiles . New, Save, Load Connections...

Before exporting the “connections” it is necessary to select the the name of the connections that we desire to save:

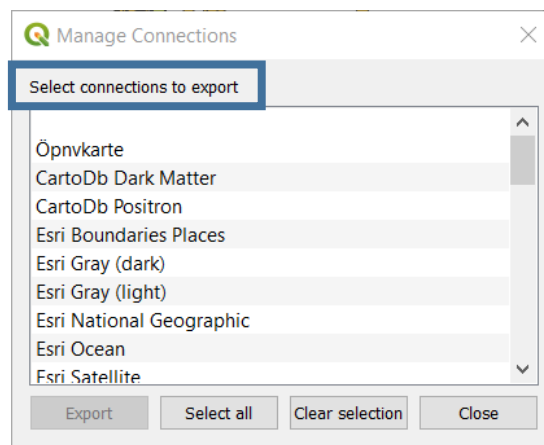


Figure 85 - Select the Connections to Export... #1

After selecting a list (or “Select all”) we have to confirm using the “Export” button:

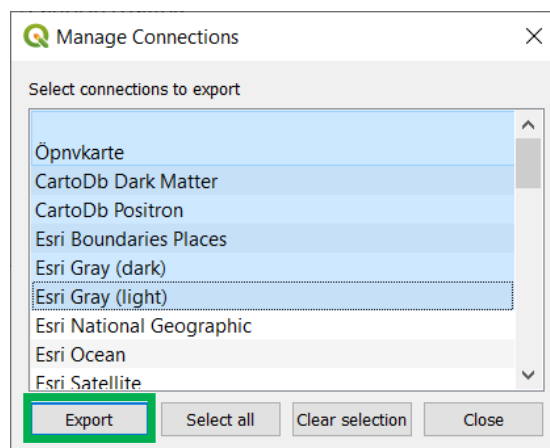


Figure 86 - Select the Connections to Export... #2

QGIS will ask You to select a name and a folder in which save the XML file:



Figure 87 - Select the Connections to Export... #3

## From data to maps

To improve our ability to “make maps” it is useful to search “ready to use” data, in GIS format. Previously we have talked about “Shapefile” but many other format exist. For example, GIS data can be “hidden” into a Text File or lives inside a Spreadsheet. The followin exercise will explain how to manage these information also.

### From Spreadsheet (to CSV) to Map

The following image comes from World Heritage Center<sup>[83]</sup> and from this page it is possible to download the “World Heritage list”.

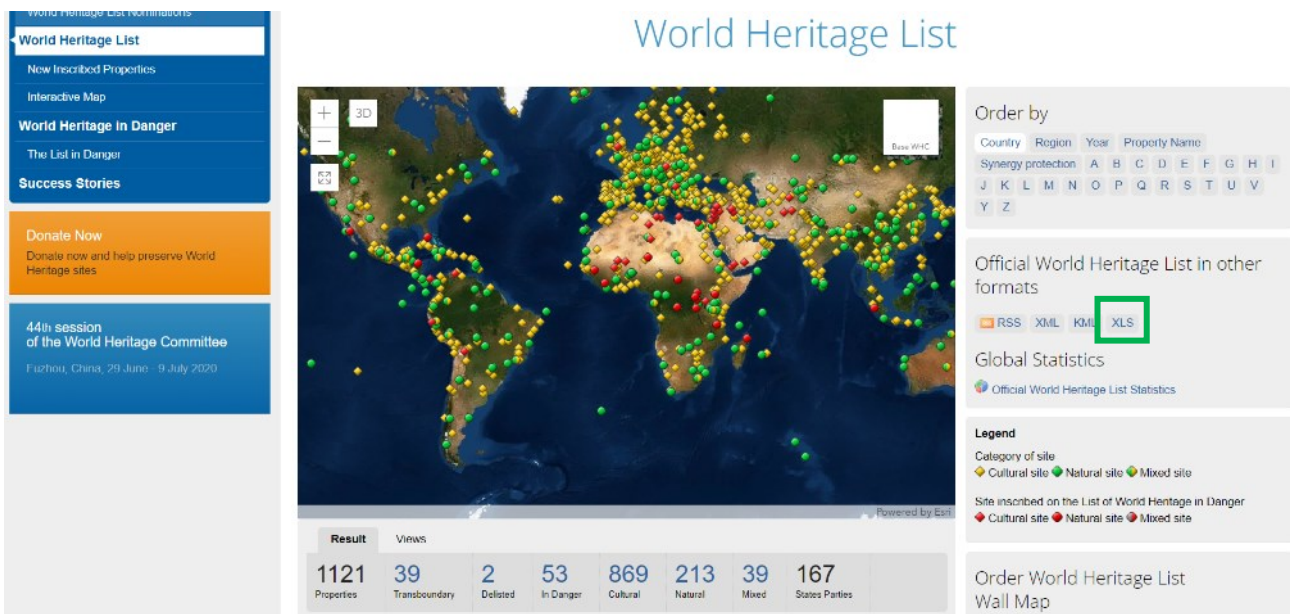


Figure 88 - World Heritage List (WHC)

By clicking on the download link (RSS, XML, KML, XLS) a page of “Terms and Conditions of Use” will be displayed:

“Terms and Conditions of Use”<sup>[84]</sup>

“UNESCO/WHC makes some of its web content available via syndication (XML/RSS/KML/XLS). An RSS icon appears on the syndication page, indicating those sections available for syndication. Whether you register as a subscriber or not, you must observe the following rules

83 <https://whc.unesco.org/en/list/>

84 <https://whc.unesco.org/en/syndication>

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Once upon the data (**whc-sites-2019.xls**) will be downloaded, we can use a spreadsheet software (**Libre Office Calc** or **MS-Excel**) to browse the data.

The file just downloaded contains a great variety of information like:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	unique_id	id_no	rev_bis	name_e	name_f	short_d	short_d	justifica	justifica	date_in	secondi	danger	date_et	danger	longitud	latitude	area_hé	C1	C2	C3	C4
2	230	208	Rev	Cultural La Paysage cu	<p>The cu	<p>Le pay;	<p><em>C</em><p><em>C			2003		1		Y 2003	67,82525	34,84694	158,9265		1	1	1
3	234	211	Rev	Minaret ar Minaret et	<p>The 65	<p>Haut d	<p><em>C</em><p><em>C			2002		1		Y 2002	64,51589	34,39642	70		0	1	1
4	1590	569	Bis	Historic Ce Centres hii	<p>Berat é	<p>Berat et	Gjirokastra sont insc			2005	2008	0			20,13333	40,06944	58,9		0	0	1
5	1563	570	ter	Butrint Butrint	<p>Inhabit	<p>Habit&eacute;	depuis les ten			1992	1999	0	2005	P 1997-20	20,02611	39,75111			0	0	1
6	111	102		Al Qal'a of La Kalâa di	<p>In a m	<p>Dans un site montagneux d&				1980		0			4,78684	35,81844	150		0	0	1

Figure 89 - World Heritage List (WHC) -The List of Sites - Spreadsheet

This is the complete attribute list (extract from the QGIS Layer Properties, after loading the dataset):



unique_number	danger_list	N9
id_no	longitude	N10
rev_bis	latitude	criteria_txt
name_en	area_hectares	category
name_fr	C1	category_short
short_description_en	C2	states_name_en
short_description_fr	C3	states_name_fr
justification_en	C4	region_en
justification_fr	C5	region_fr
date_inscribed	C6	iso_code
secondary_dates	N7	udnp_code
danger	N8	transboundary
date_end	N9	

Figure 90 - World Heritage List (WHC) -The List of Sites - Spreadsheet Fields detail

All these fields need a “description”. All (GIS) data need appropriate “**metadata**”, or a “description” of the data itself (see “**Metadata and License**” section) to know “something more” about the fields. Among these, will find “several lines” (RECORDS) and “many columns” (**FIELDS**). Among these, **LONGITUDE** (X) and **LATITUDE** (Y) field will display info about the “position” of the related data.

O	P
longitude	latitude
67,82525	34,84694
64,51588889	34,39641667
20,13333333	40,06944444
20,02611111	39,75111111
4,78684	35,81844
9	25,5
3,68333	32,48333
5,73667	36,32056
2,38333333	36,55
6,46886111	35,48416667
3,06028	36,78333

Figure 91 - Longitude and Latitude Fields

The presence of these two columns (look at the value: a comma is used to separate the integer part from the decimal one) means that (maybe):

- all the 1121 records have a “geographic location” (expressed by the coordinates)
- each record (considering a couple of coordinates, LON and LAT) refers to a point expressed into Geographic Coordinate System (GCS)

To make this MS-EXCEL a valid (Q)GIS data file is necessary to “export” it by using the command “Save as” into a Comma Separated Value (CSV) format.

A CSV file is a (database saved into a) simple text file containing, in the first row, the **column names separated** by a **special character**. In many cases, is useful to use a semicolon (;) to divide the columns to avoid potential

loss of data (in fact, if we have decimal numeric value, according to the international settings of the Operating System in use into our PC, they are expressed using points or virgulas to separate decimal values). Nevertheless, it is possible use a “new” separator, for example a “pipe character” (“|”) or another one.

The “command”: “from MS-Excel to CSV” should be made using MS-EXCEL but... if we try to load it, as delimited text, into QGIS, the preview box will displayed “bad information”.

Look at the “Sample data” box into the following image.

In the first column should be appear the unique numbers (the codes) of the Heritage Site but it is clear that in the Sample data box are living other information (such as the “Criterion”, descriptions and other notes).

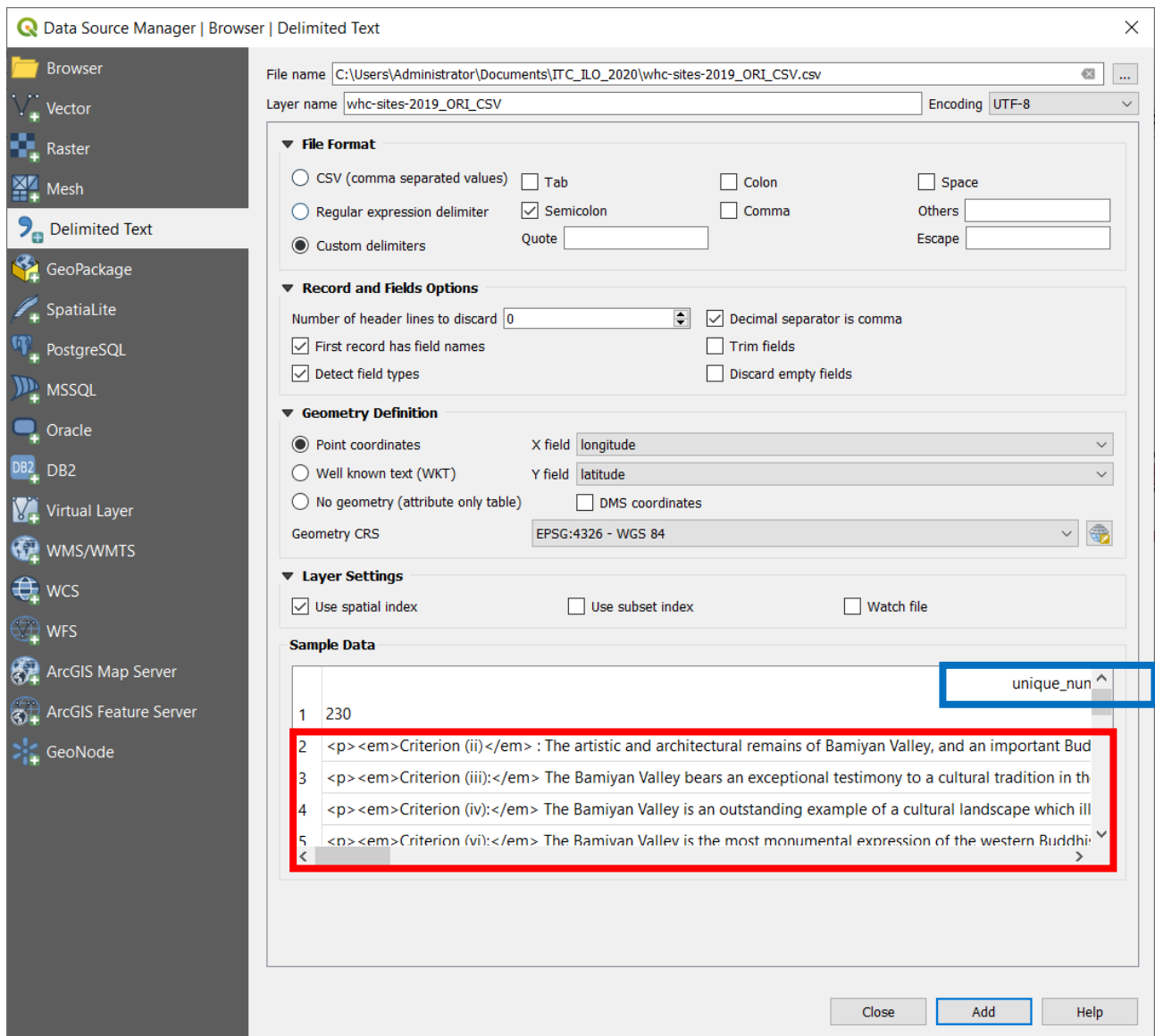


Figure 92 - Data Source Manager - Delimited Text #1

Adding it to the map.

Look at the blue points. If the creation of the map show several error (all the blu dots should be covered by the red ones: the data are the same...)

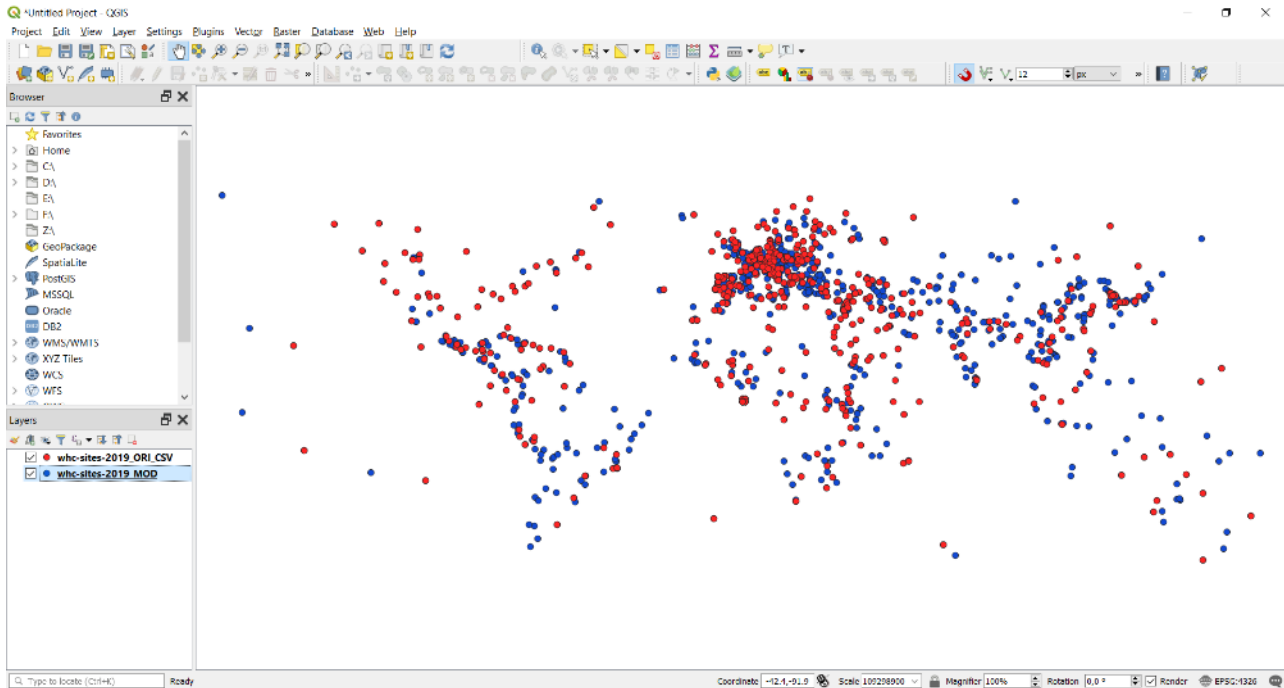


Figure 93 -Wrong Display of CSV

The result is not compliant with QGIS “quality standards” because:

- There are “special character” inside: `<p>... <em>... <sup>... </sup>` maybe from the HTML language that could “confuse” the data import process

MS-Excel does not allow to modify directly the “field separator” (by default the software use a particular character, derived from the International Settings of Your PC) when export a spreadsheet into Comma Separated Value (CSV)<sup>[85] [86]</sup>. In general, the semicolon character is used but inside the text are existing more semicolon yet. For example, in the record UNIQUE\_NUMBER=1590, ID\_NO=569 there is the following text:

- `<p>Berat and Gjirokastra are inscribed as rare examples of an architectural character typical of the Ottoman period. Located in central Albania, Berat bears witness to the coexistence of various religious and cultural communities down the centuries. It features a castle, locally known as the Kala, most of which was built in the 13th century, although its origins date back to the 4th century BC. The citadel area numbers many Byzantine churches, mainly from the 13th century, as well as several mosques built under the Ottoman era which&nbsp;began&nbsp;in 1417. Gjirokastra, in the Drinos river valley in southern Albania, features a series of outstanding two-story&nbsp;houses which were developed in the 17th century. The town also retains a bazaar, an 18th-century mosque and two churches of the same period.</p>`

- The last but not least trouble comes from the the presence of “numbered list” in many cells:
  - `<p><em>Criterion (ii)</em>` The innovative architecture and decoration of the Minaret of Jam played a significant role in the development of the arts and architecture of the Indian sub-continent and beyond. `</p><p><em> Criterion (iii): </em>` The Minaret of Jam and its associated archaeological remains constitute exceptional testimony to the power and quality of the Ghurid civilization that dominated its region in the 12th and 13th

85 To operate this change: Click the Windows Start menu. Click Control Panel. Open the Regional and Language Options dialog box. Click the Regional Options Tab. Click Customize / Additional settings (Win10). Type a new separator in the List separator box. Click OK twice.

86 <https://superuser.com/questions/606272/how-to-get-excel-to-interpret-the-comma-as-a-default-delimiter-in-csv-files>

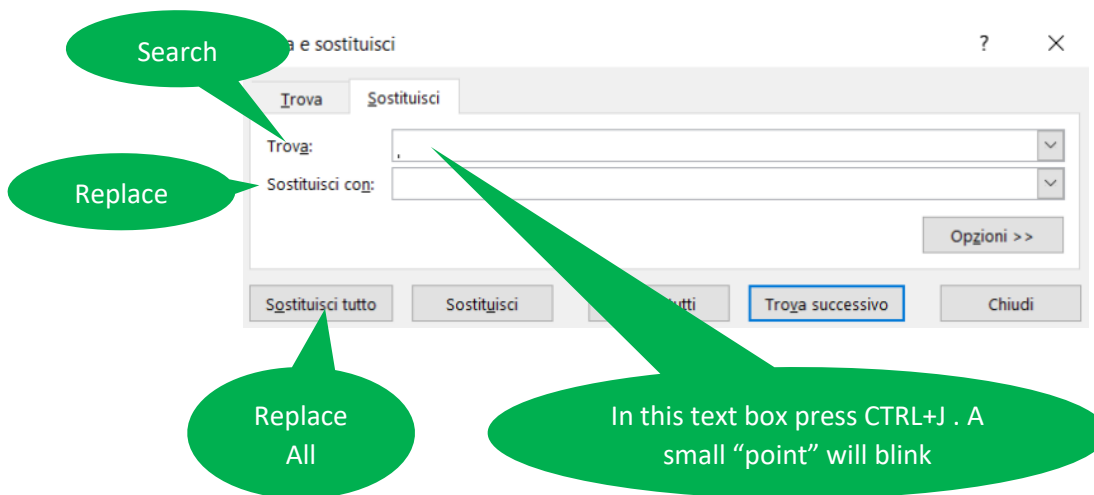
centuries.

Criterion (iv): The Minaret of Jam is an outstanding example of Islamic architecture and ornamentation in this region and played a significant role in their further dissemination.

Maybe, in the text, there are many “carriage return” codes (CR) that could make the transformation an hard process.

All this warning will be dispalyed into QGIS also when the original MS-Excel file were exported into CSV without “processing” the data itself.

By the way, if we’ll use “on the fly” MS-Excel we could “eliminate” the “Carriage Return” using the “search and replace” tool. In the dialog box (I apologize myself but the software I use is into italian language):



- in the search option, press **CRTL** key + **J** letter
- in the replace option, **leave blank**

and press “Replace all” and then close the dialog. A message will say “603 replacements have been made”. Remember to save the XLS using another name.<sup>87</sup>

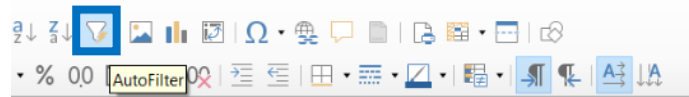
Now, if You do not want to change the international setting of our PC (or You can not operate as Administrator or You prefer to use an **open source software**), it is possible to use **Libre Office CALC**. It is easy to export the spreadsheet choosing the separator character on-the-fly.

Now, will try to use LinbreOffice Calc.

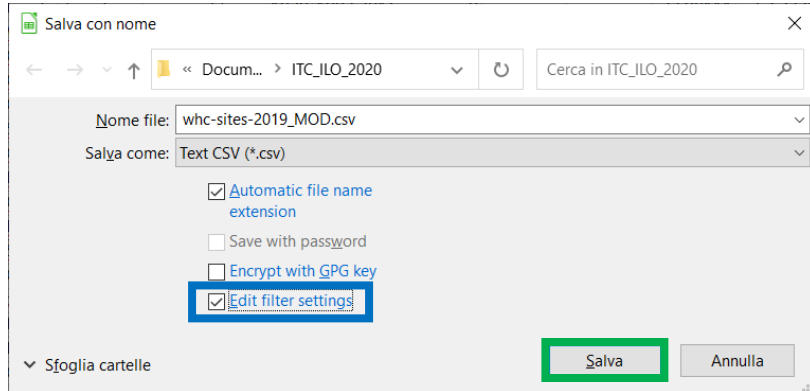
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	unique_id_no	rev_bis	name_e	name_f	short_d	short_d	justifica	justifica	date_in	seconda	danger	date_er	danger	longitud	latitude	area_he	C1
2	230	208	Rev	Cultural L	Paysage	<p>The cu	<p>Le pay	<p><em>	<p><em>	2003				67,82525	34,84694	158,9265	
3	234	211	Rev	Minaret a	Minaret e	<p>The 6	<p>Haut o	<p><em>	<p><em>	2002				64,51589	34,39642	70	
4	1590	569	Bis	Historic C	Centres h	<p>Berat	<p>Berat et	Gjirokastra	sont ins	2005	2008			20,13333	40,06944	58,9	
5	1563	570	ter	Butrint	Butrint	<p>Inhab	<p>Habit&eac	depuis les	ter	1992	1999		2005	20,02611	39,75111		
6	111	102		Al Qal'a o	La Kalâa o	<p>In a m	<p>Dans un	site montag	neux d&	1980				4,78684	35,81844	150	
7	198	179		Tassili n'A	Tassili n'A	<p>Locat	<p>Cet étr	ange paysa	ge lunaire	1982				9	25,5	7200000	
8	209	188		M'Zab Va	Vallée du	<p>A trad	<p>Le paysa	ge de la	vallée du	1982				3,68333	32,48333	665,03	

First, we have to deactivate the button “Autofilter”:

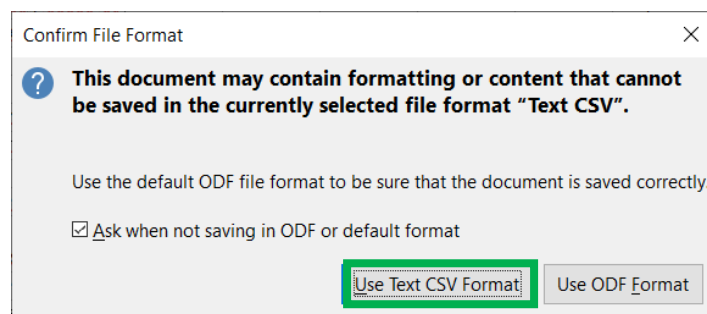
<sup>87</sup> When we manage data, it is useful to store the original one use a particular suffix like **\_ORI** (that means “ORIGINAL”) to manage version and save backup data. The new output will take another suffix, like **\_MOD** (that means “MODIFY”). Following this method, the former will be “whc-sites-2019\_ORI.xls” and the latter: “whc-sites-2019\_MOD.xls”



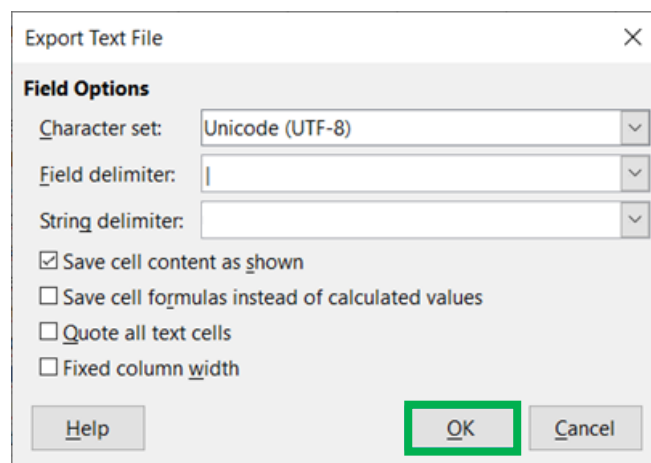
And then: File, Save as... Choose "Text CSV" and check "Edit Filter Settings":



In the following dialog, LibreOffice CALC asks if we really want to use a "Text CSV format". Confirm it.



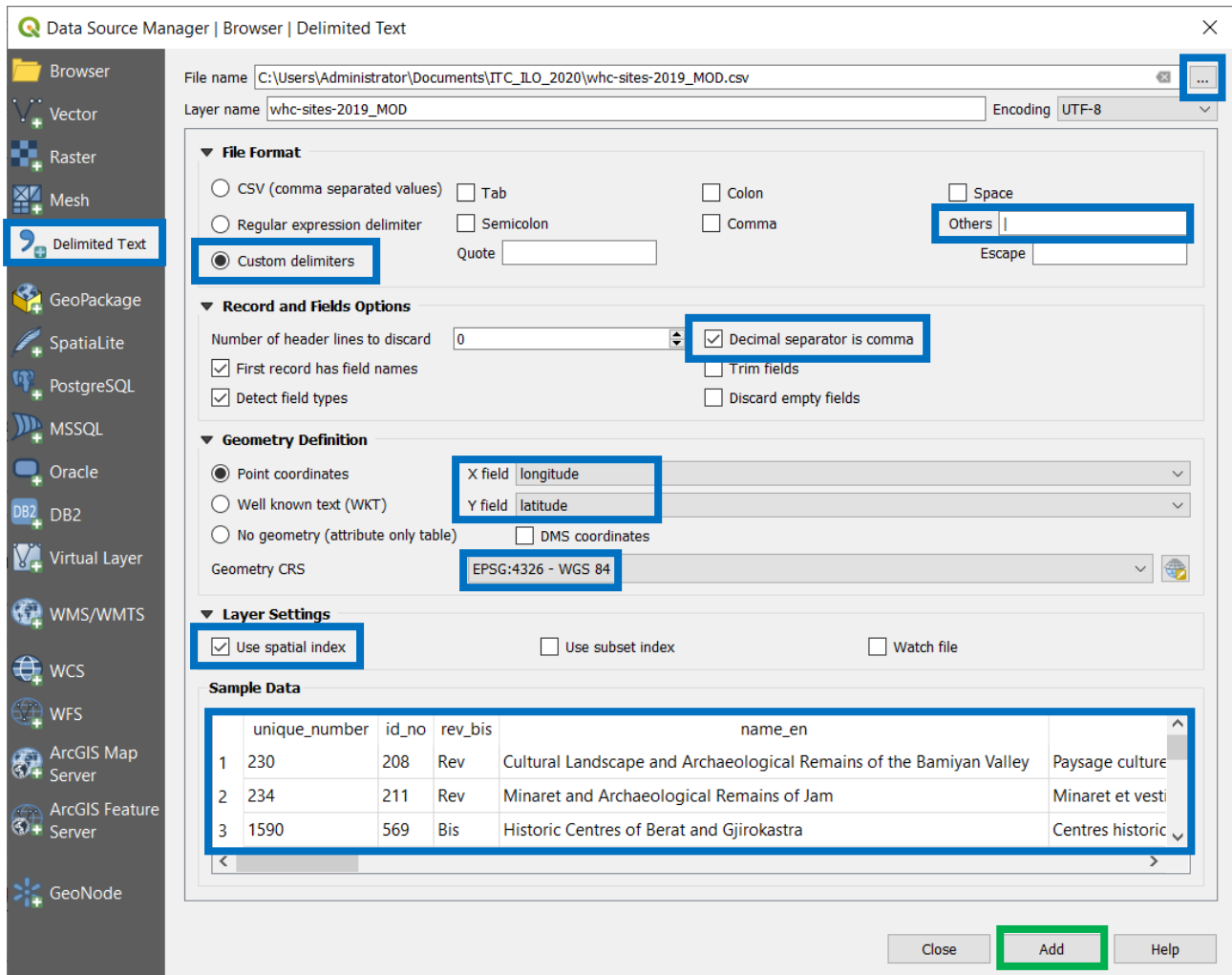
In the following dialog, LibreOffice CALC asks something about the "Character set" (depend on Your country and/or system settings); "Field Delimiter" (the separator character between the columns). Choose a "pipe" [character ("|")] and leave blank the "String delimiter". Confirm it and close the dialog.



Now, we'll try and use QGIS software.



From the QGIS “Open Data Source Manager” button we must select “Delimited Text” and browse to look for the CSV file.



Look at the “data preview” (Sample data): if this is “correct” we can go on. Press the “Add” button and then, “Close”. The Layer will be loaded as Point inside the QGIS map space.

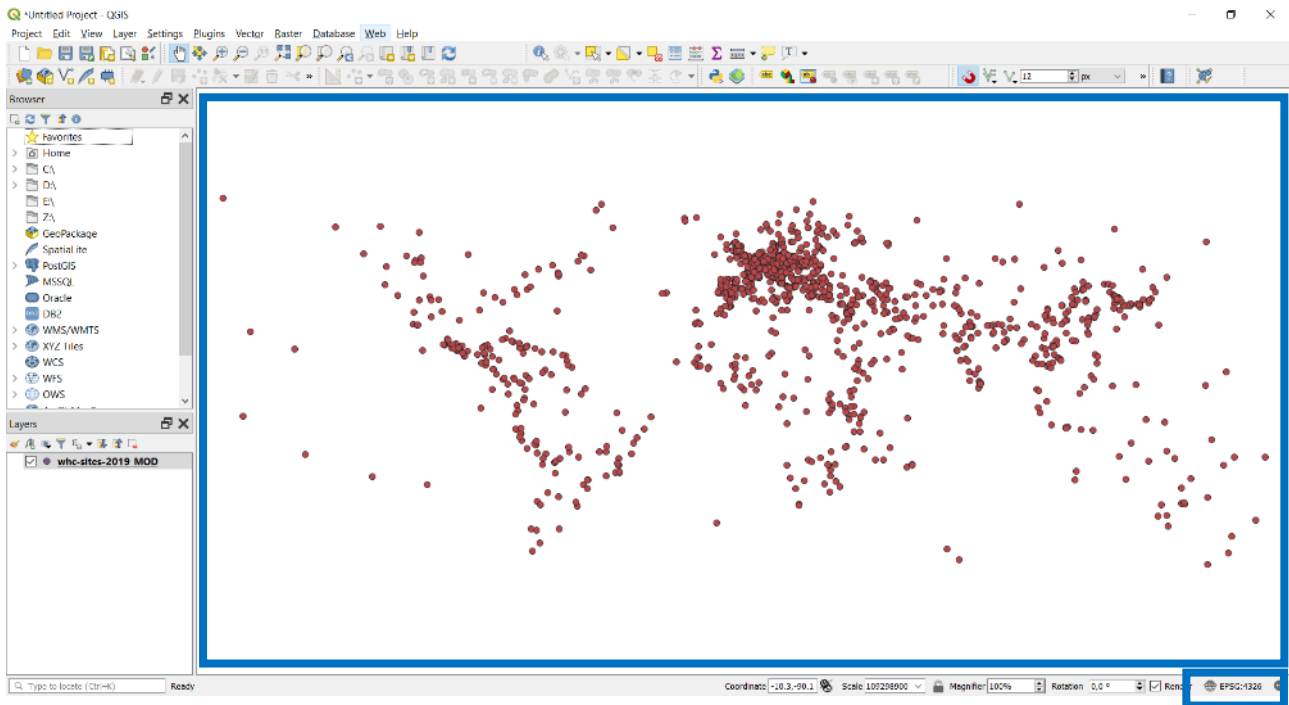
Please note that:

- The background is missing. A blank page will appear “by default”. We can add basemap “as services” (WMS, WCS, WFS, Tiles...) and/or as “Raster Data”
- The Longitude and Latitude fields - coming from the original XLS - have been “transformed” into points (X,Y)
- Longitude and Latitude information means that the data are expressed into Geographic Coordinate System. You can see this information in the little box, lower right of of screen. The code 4326 (EPSG=4326)<sup>[88]</sup> <sup>[89]</sup> means that our project is working on that type of coordinates.

88 EPSG stands for European Petroleum Survey Group and is an organization that maintains a geodetic parameter database with standard codes, the EPSG codes, for coordinate systems, datums, spheroids, units and such alike. Additionally, this database contains the parameters for these objects or - if they can not easily be expressed as values - at least references to where such parameters can be found. Every geographic object (coordinate system, spheroid, unit etc.) gets assigned a unique number. The database is under active maintenance. (<http://support.virtual-surveyor.com/en/support/solutions/articles/1000261353-what-is-an-epsg-code->)

89 <http://support.virtual-surveyor.com/en/support/solutions/articles/1000261353-what-is-an-epsg-code->

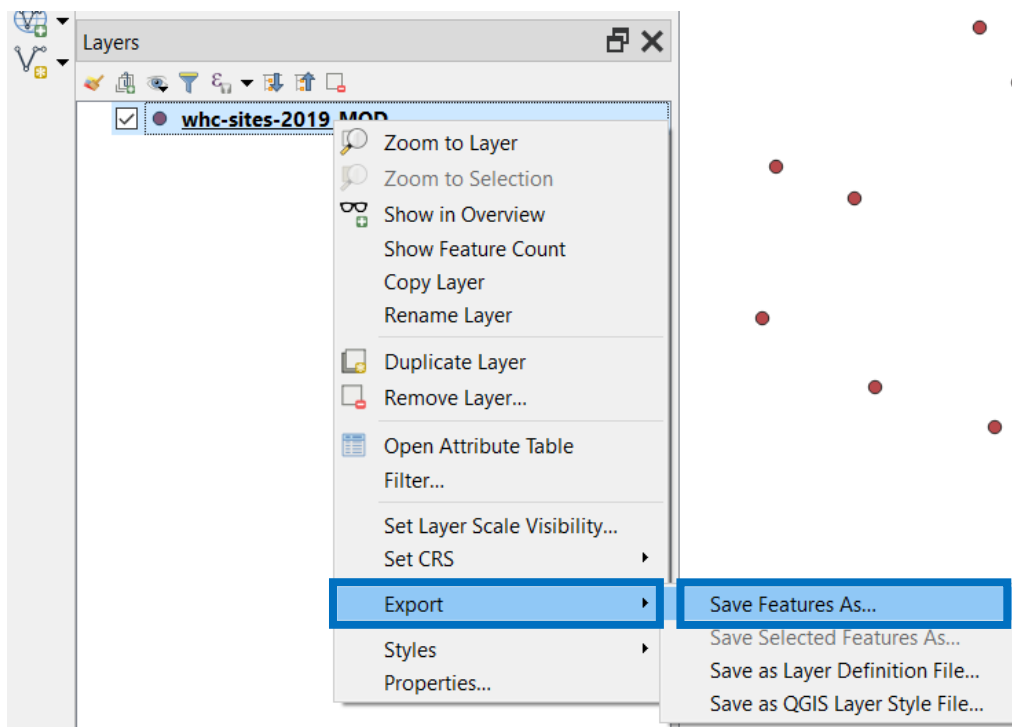




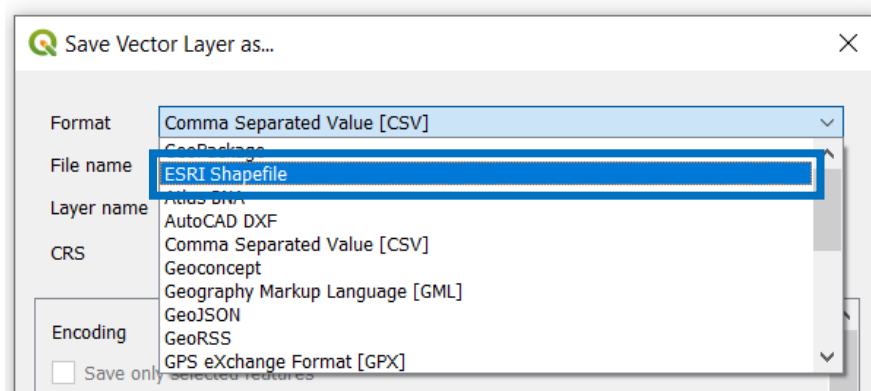
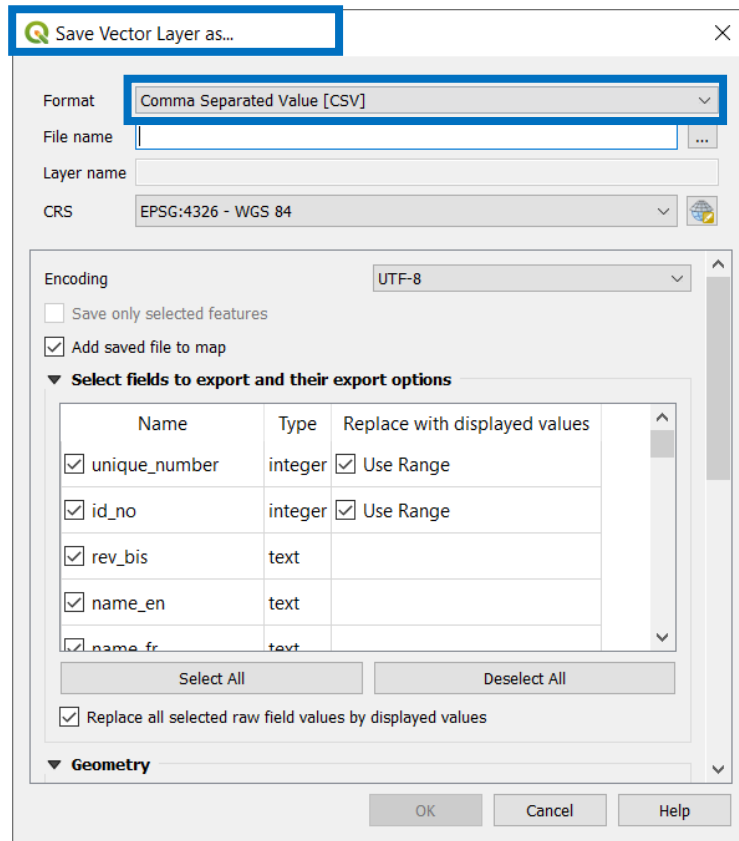
Once upon the data will loaded into a correct way, it is better to save it into Shapefile format in order to create a GIS data format.

[Export Layer \(Save as... command\)](#)

To perform a data export, right click of the mouse on the layer name:

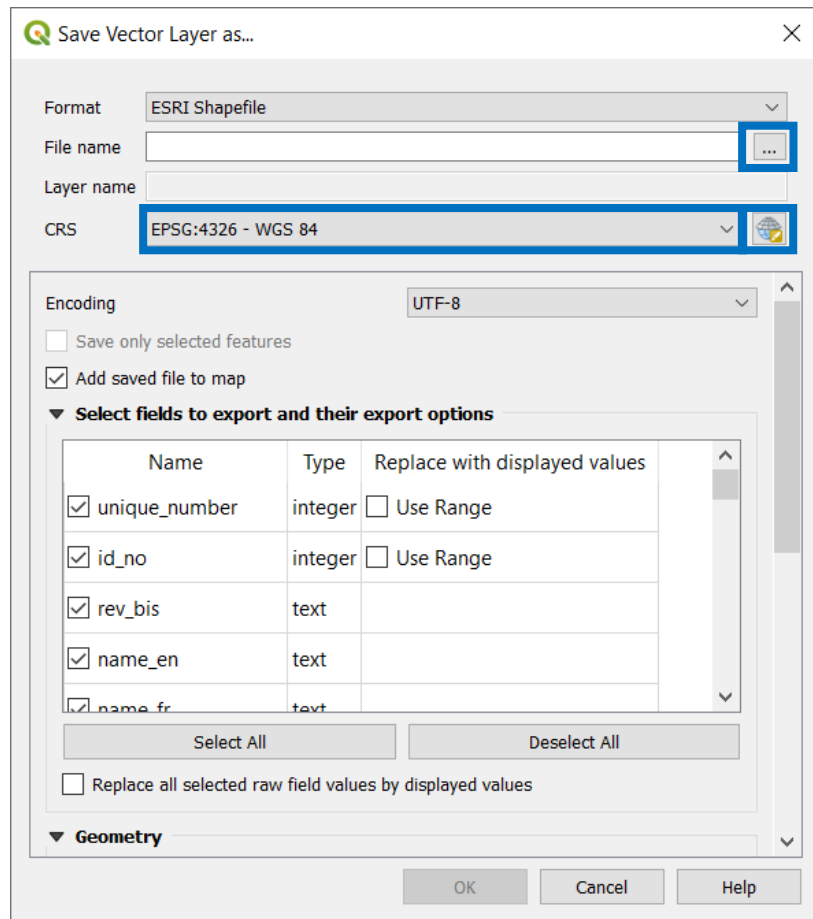


A “Save Vector Layer as” dialog will appears. First of all, we need to change to output, fromn CSV to Shapefile (or other GIS format, if You like)

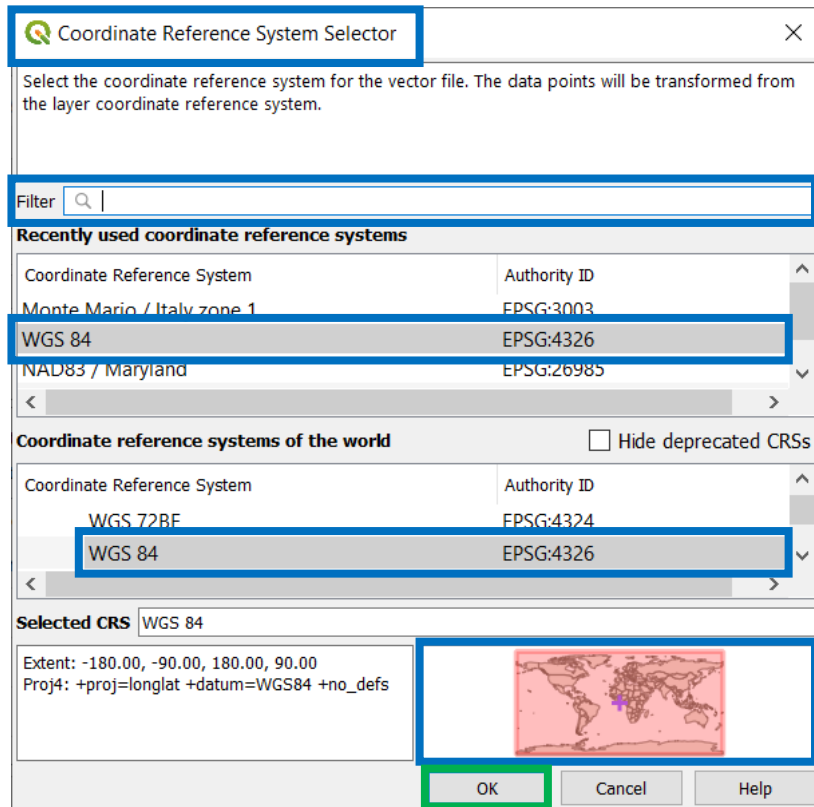


After choosing the file format, we need to browse for searching an appropriate folder and set the output file name. Remember, also, we need to specify the Coordinate Reference System (CRS)<sup>[90]</sup>

<sup>90</sup> A spatial reference system (SRS) or coordinate reference system (CRS) is a coordinate-based local, regional or global system used to locate geographical entities. A spatial reference system defines a specific map projection, as well as transformations between different spatial reference systems. Spatial reference systems are defined by the OGC's Simple Feature Access using well-known text representation of coordinate reference systems, and support has been implemented by several standards-based geographic information systems. Spatial reference systems can be referred to using a SRID integer, including EPSG codes defined by the International Association of Oil and Gas Producers. It is specified in ISO 19111:2007 Geographic information—Spatial referencing by coordinates, prepared by ISO/TC 211, also published as OGC Abstract Specification, Topic 2: Spatial referencing by coordinate.



Browse the folder and set the file name. Concerning the CRS, we have to remember that we are using data in which the coordinate were expressed into **Longitude** and **Latitude**. This means the data are in **EPSG=4326, WGS 84 Geographic**. If You remember the EPSG code You can put ii into the "Filter" to get the related CRS



On the bottom right of the dialog, a “validity zone” for that kind of EPSG is displayed. If You don’t know the CRS, please read the “Metadata” (a description of the data that should follows always the GIS layers) or, if we’re looking for vector data, open the \*.PRJ or \*.QPJ file using a Notepad:

```
whc-sites-2019_MOD.qpj - Blocco note di Windows
File Modifica Formato Visualizza ?
GEOGCS["WGS 84", DATUM["WGS_1984", SPHEROID["WGS 84", 6378137, 298.257223563, ]
```

At the end, remember to click on “Save” to confirm the file export and close the dialog.

### Adding a label

A new shapefile was created. Now we can use it on the map, maybe representing the data using a thematic view (distinguish them by type or characteristic) and so on. QGIS offer many other functions. For example, we can display not only the geometries but also some related information about the data itself, by placing a “Label”. To display a small label on the features, taking the information to display from the attribute table, go to the “Layer Properties” search for “Label” tab.

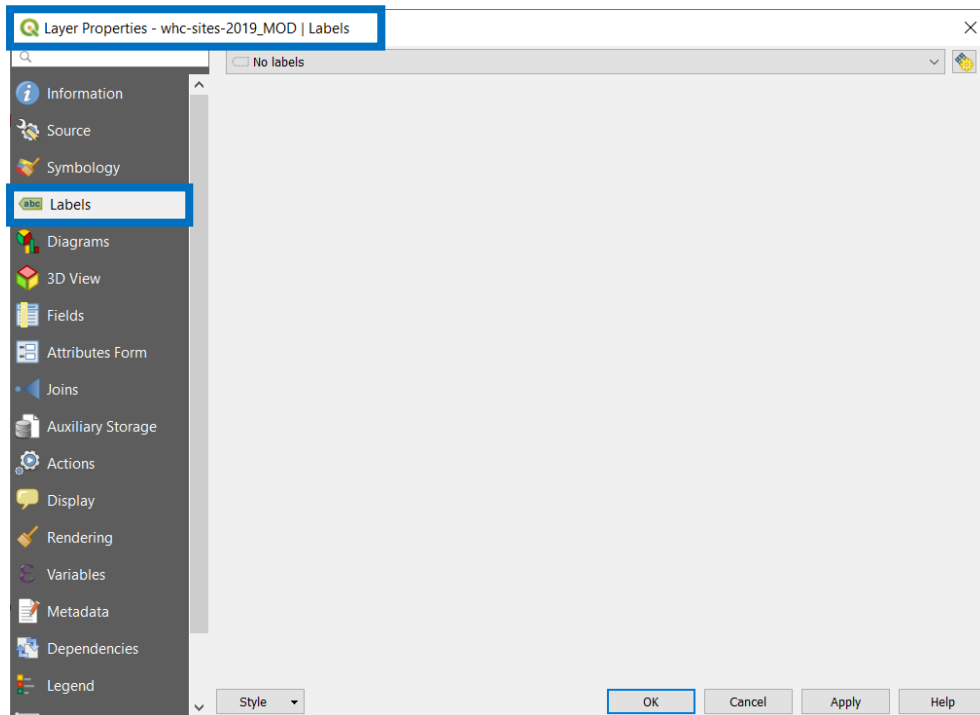


Figure 94 - Layer Properties – Labels #1

Click on the pull down menu “No labels” and choose, for example, “Single label”. Search for the field containing the info that You want to use in the labels (for example, the site name or its characteristic). Try to use other option

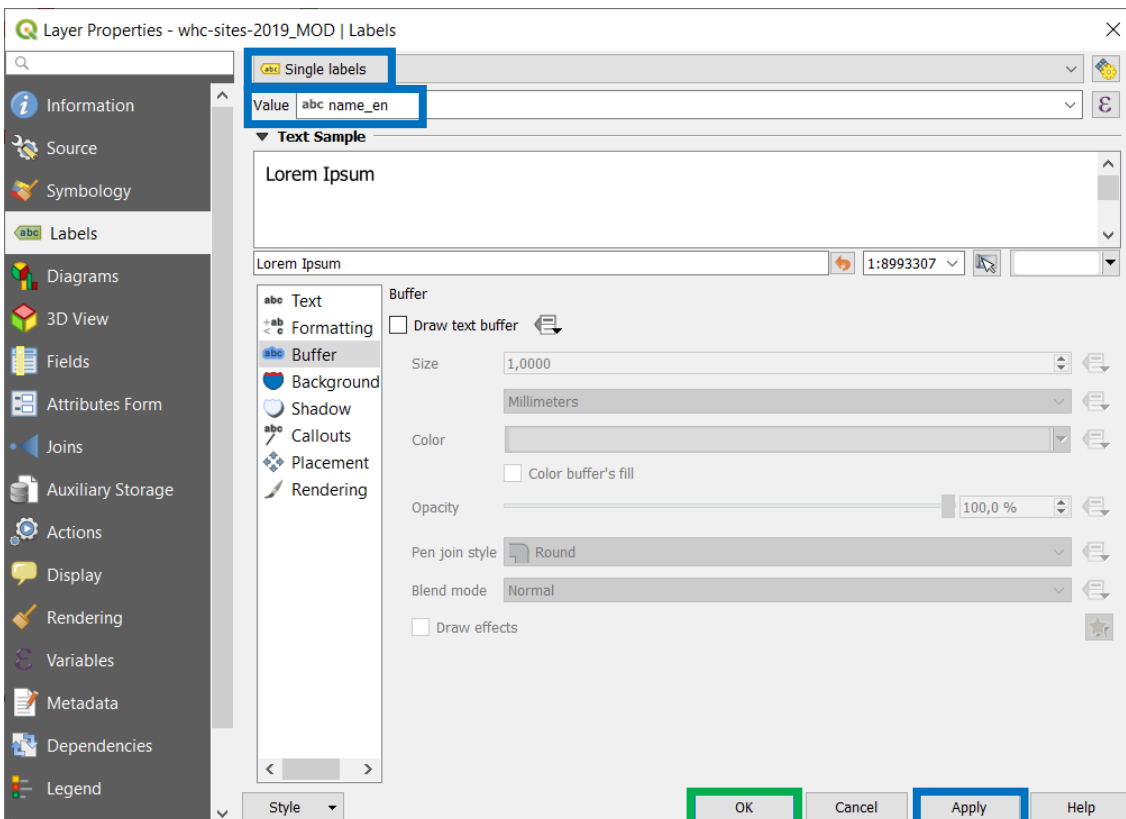


Figure 95 - Layer Properties – Labels #2

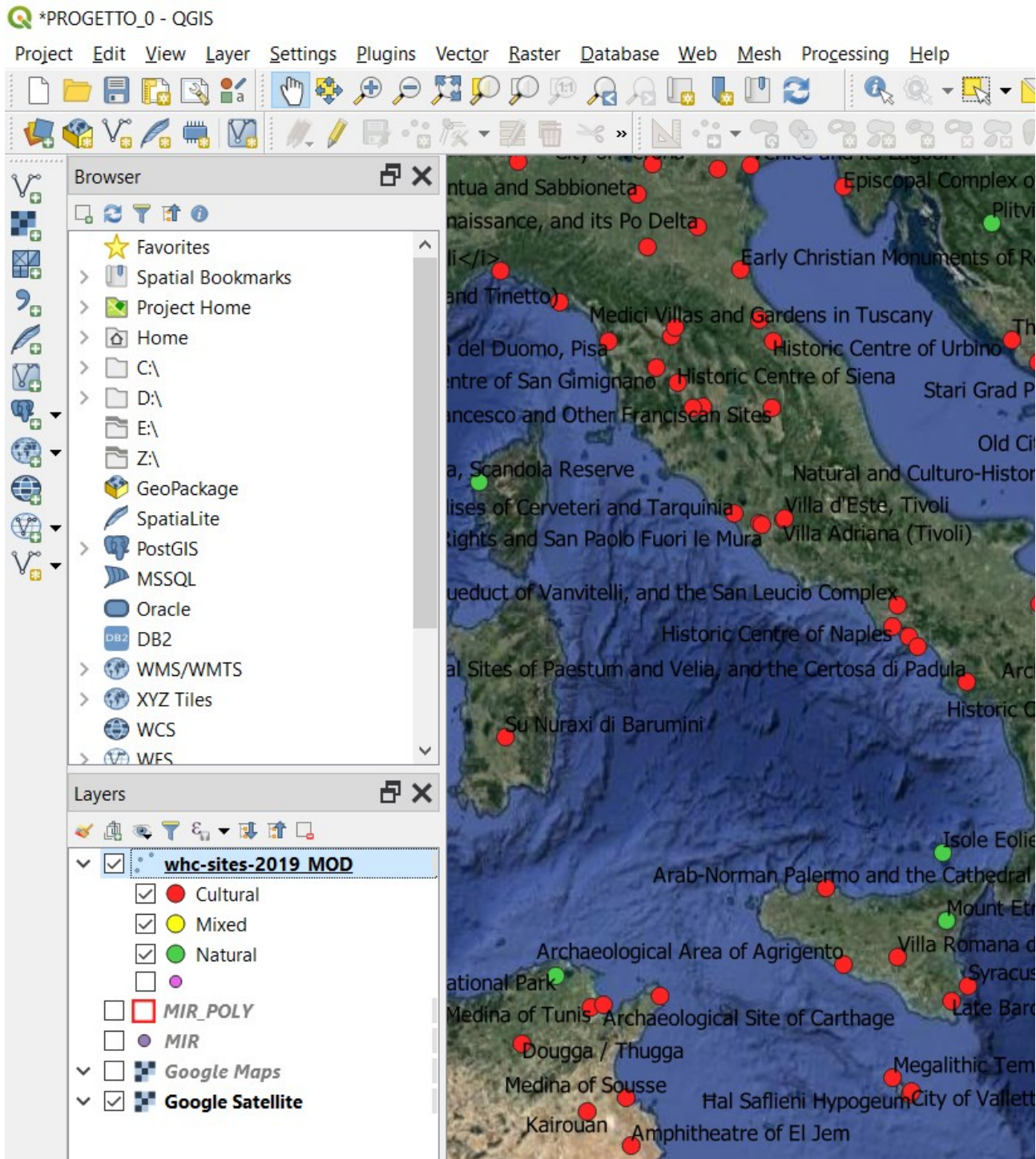


Figure 96 - Show Labels on Map

### Geographic or Projected Coordinate System?

Before going on, we have to remember that, when we manage geographic data, we need to pay attention to “coordinates” (and, last but not least, to the “geographic conventions” of the place in which we want to operate). When we download (especially) GIS data we have to **read the related metadata** to know all about the creation process (including the CRS in use) and so on. If we need to “create” data, this procedure will depend on, for example, the basemap we are using and, in this case, we must derive the CRS [EPSG code] from it.



“Locations on earth are often expressed in geographic degrees (**latitude and longitude**). But when you are surveying you need to talk in **meters and feet**. This is because - depending on the application - you use a geographic or projected coordinate system”<sup>[91]</sup>.

“Earth is a big blue marble that’s the shape of a sphere (or close to it). This is why a globe is the best way to represent the Earth”.

“But globes are hard to carry in your suitcase and you can only see one side of the globe. On top of that, it’s hard to measure distances and they’re just not as convenient as paper maps.

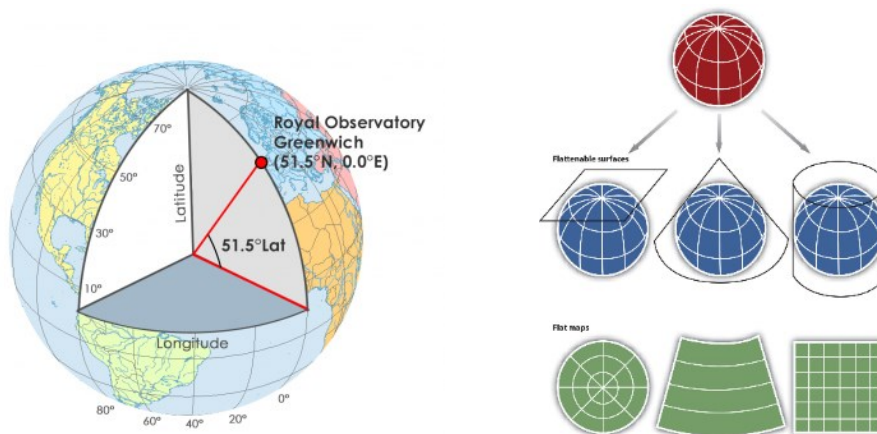
This is why we use map projections on globes and flatten it out in two-dimensions. But as you’re about to find out, you can’t represent Earth’s surface in two dimensions without distortion.

On top of that, all types of map projections have strengths and weaknesses preserving different attributes”.

“However, when you transfer a spherical shape to a flat surface, you approximate the true shape of the Earth. Depending on the map projection you choose, some projections may cause distance between features on a map to be preserved while distortion is introduced to shape. In some cases, area may be preserved while direction is distorted”.

“Cartographers choose map projections that best represents the purpose, size and shape of the area of interest on the map”<sup>[92]</sup>.

In the following image, on the left, geographic coordinates and, on the right, how to projected the coordinates.



## Geographic

“A **geographic coordinate system** (GCS) is a coordinate system which uses a three-dimensional spherical surface (ellipsoid) to define locations on the earth. A common choice of coordinates is latitude and longitude. For example, Leuven, Belgium is located on 50°52'47" North<sup>[93]</sup> and 4°42'01" East<sup>[94]</sup> in the WGS84 coordinate system”<sup>[95]</sup> <sup>[96]</sup>

91 <http://support.virtual-surveyor.com/en/support/solutions/articles/1000261350-the-difference-between-a-geographic-and-a-projected-coordinate-system->

92 <https://gisgeography.com/map-projections/>

93 “N” corresponds to Latitude (Y)

94 “E” corresponds to Longitude (X)

95 The value are expressed into DMS. **DMS** is the abbreviation for *Degrees Minutes Seconds* (...). DMS are special type of units used for measuring angles, as an alternative to decimal way to stating the size of an angle. It is a known fact that there are 360 degrees in a whole circle, with 1/60th of those being 1 minute, and 1/60th of one minute being 1 second. DMS includes degrees (°), minutes (′), seconds (″), with the corresponding symbols. <https://www.latlong.net/lat-long-dms.html>

96 But you can also express geographic coordinates in **decimal degrees**. It’s just another way to represent that same location in a different format. For example, here is New York City in decimal degrees: **LATITUDE**: 40.714 **LONGITUDE**: -74.006 (that is the same of **LATITUDE**: 40 degrees, 42 minutes, 51 seconds N **LONGITUDE**: 74 degrees, 0 minutes, 21 seconds W). <https://gisgeography.com/decimal-degrees-dd-minutes-seconds-dms/>

“A geographic coordinate system is constituted by a datum (DATUM), a prime meridian (PRIMEM) and unit (UNIT). The datum is constituted by an ellipsoid model (SPHEROID) and an anchor point.

An example is:

- **WGS84 coordinate system** with unique **EPSG code 4326**

When working with data in a geographic coordinate system, it is sometimes useful to equate the longitude values with the X axis and the latitude values with the Y axis<sup>[97]</sup>. “Because degrees of latitude and longitude don't have a standard length, you can't measure distances or areas accurately or display the data easily on a flat map or computer screen<sup>[98]</sup>”.

### Projected

“In a **projected coordinate system** (PCS) you project the geographic coordinate that you have measured, to, for example, a cylinder which you roll out easily on two-dimensional surface (the map). There exist many different projections and we'll not go in further detail about that here.

Typically every country, state or region has its optimal projected coordinate system which minimizes distortions for particular applications like mapping.

Examples are:

- South central Texas in the United States uses "NAD83( NSRS2007) / Texas South Central (ftUS)" with unique **EPSG code 3674**
- Belgium uses "ETRS89 / Lambert 2008" with unique **EPSG code 3812**

A projected coordinate system is constituted by a geographic coordinate system from which it is projected (GEOGCS) and other projection parameters like the measurement unit (UNIT) like meter or US Survey Foot), the projection technique and its projection parameters<sup>[99]</sup>.

### Working with the table

We have seen previously an “attribute table”. This “database” can store several information. We can manage the data, perform calculations, adding and removing columns (i.e. a **FIELDS**) without modifying the number of geometric feature existing in the layer. When we delete a row (i.e. a **RECORD**), instead, will delete also the related geometry (a point, a polyline, a polygon).

Look at the layer of the World Heritage Center, “whc-sites-2019”, and open the attribute table. We have to decode some “information” (**METADATA**). Fields from [C1] to [C6] are referring to “Cultural Heritage” while fields from [N7] to [N10] to “Natural Heritage”.<sup>[100]</sup>

### List of Criteria

- (i) represent a masterpiece of human creative genius;
- (ii) exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design;
- (iii) bear a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared;

97 <https://desktop.arcgis.com/en/arcmap/10.3/guide-books/map-projections/about-projected-coordinate-systems.htm>

98 <https://desktop.arcgis.com/en/arcmap/10.3/guide-books/map-projections/about-geographic-coordinate-systems.htm>

99 <http://support.virtual-surveyor.com/en/support/solutions/articles/1000261350-the-difference-between-a-geographic-and-a-projected-coordinate-system->

100 <https://whc.unesco.org/en/guidelines/>

- (iv) be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history;
- (v) be an outstanding example of a traditional human settlement, land-use, or sea-use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change;
- (vi) be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance. (The Committee considers that this criterion should preferably be used in conjunction with other criteria);
- (vii) contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;
- (viii) be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features;
- (ix) be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals;
- (x) contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of Outstanding Universal Value from the point of view of science or conservation.

The table is an “internal database” and it is possible to find, manage, assemble, disassemble the “tabular information”.

Select feature by expression



This function allows to search for a particular value or string inside the database. For example, We decide to select all the feature that:

category = Cultural <and> region\_en = Europe and North America

Press the Button and open the “Select by Expression” dialog:

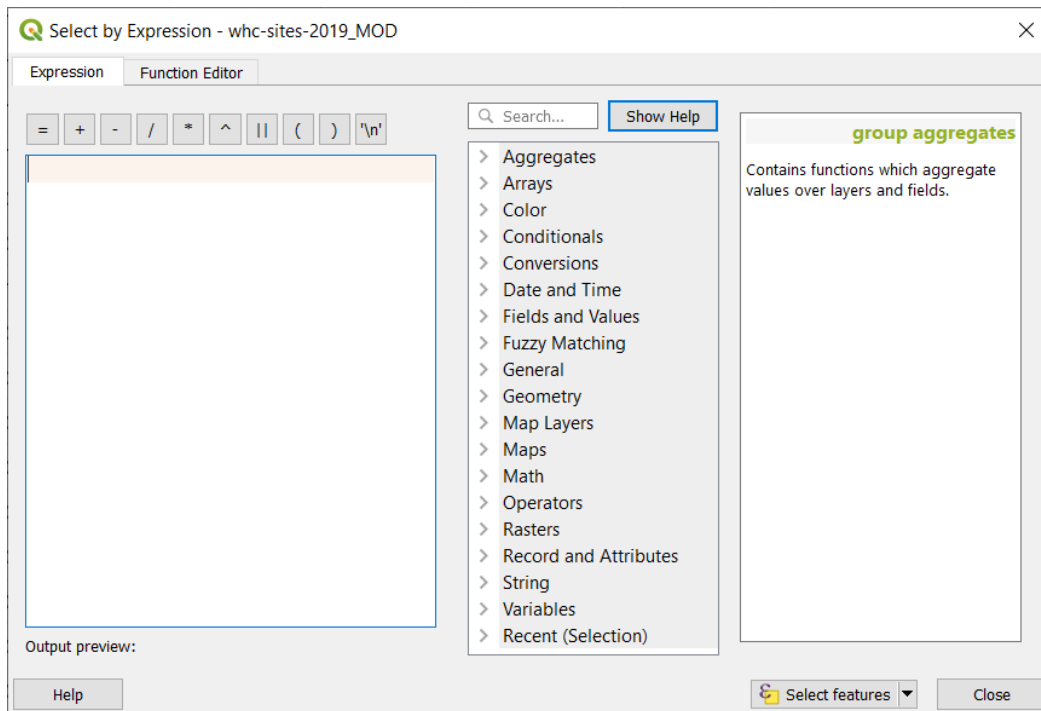


Figure 97 - Select by Expression #1

In the “central frame” click on “Fields and Value”. This will show all the fields existing into the attribute table. Other functions are group by title. Browse Yourself and explore!

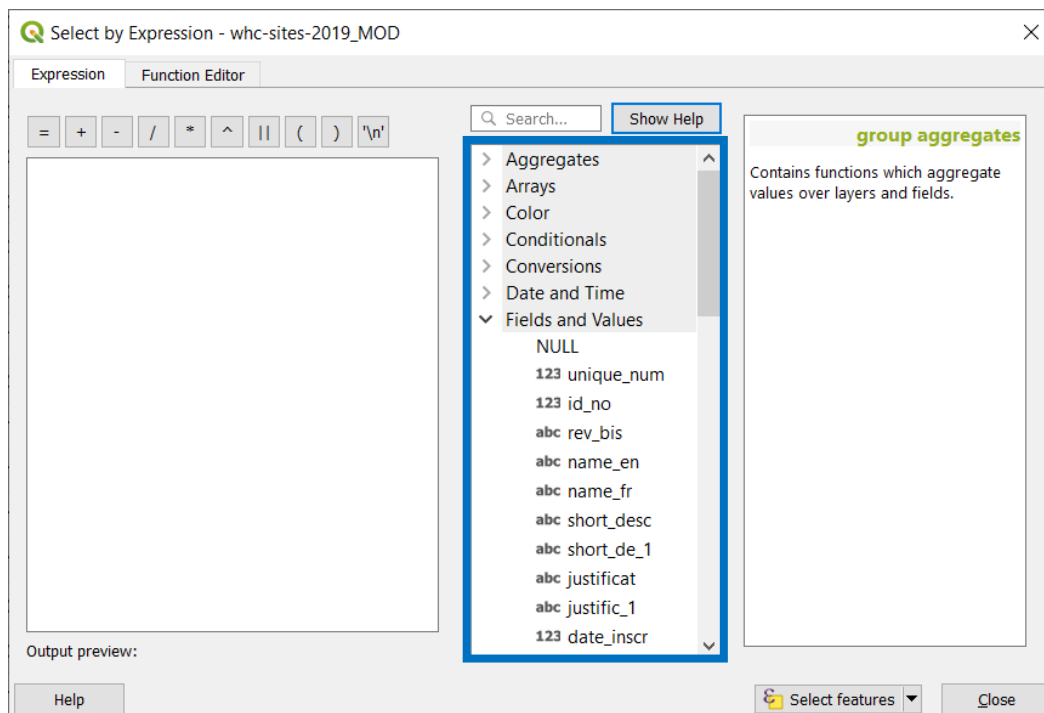


Figure 98 - Select by Expression #2

Search for the field “category” and double click it; search for the field “region\_en” and double click it. An error message will be displayed on the bottom left:

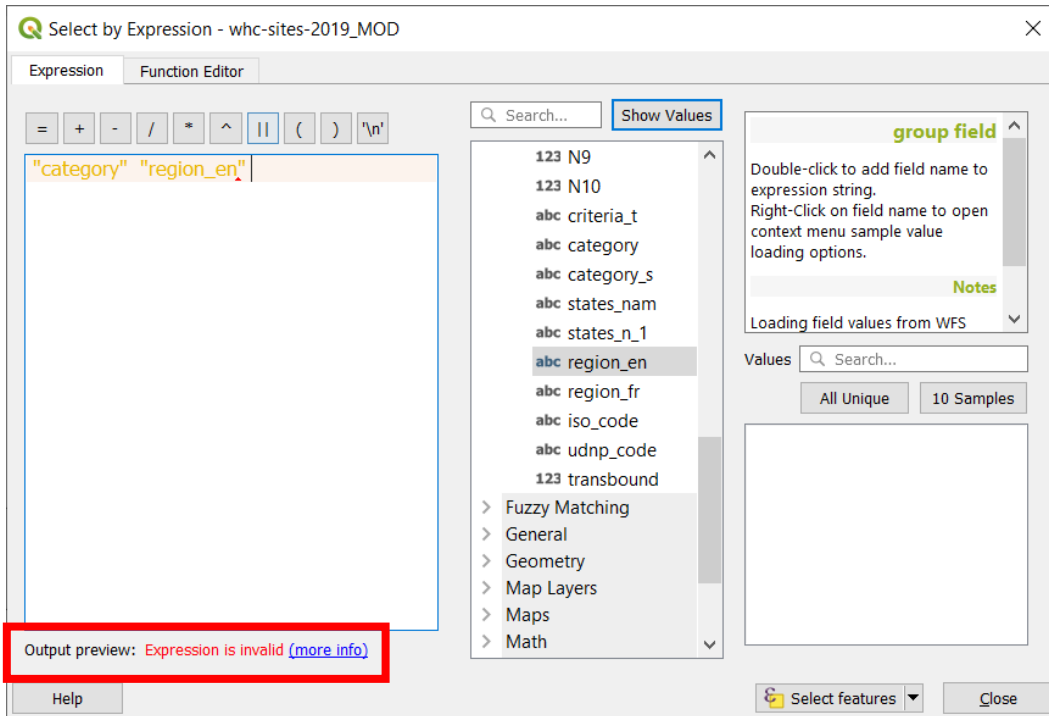


Figure 99 - Select by Expression #3

The “Output preview”, when a syntax error is detected, will show an error message.

The frame under “All Unique” and “10 Sample” buttons will show the unique value or ten sample only:

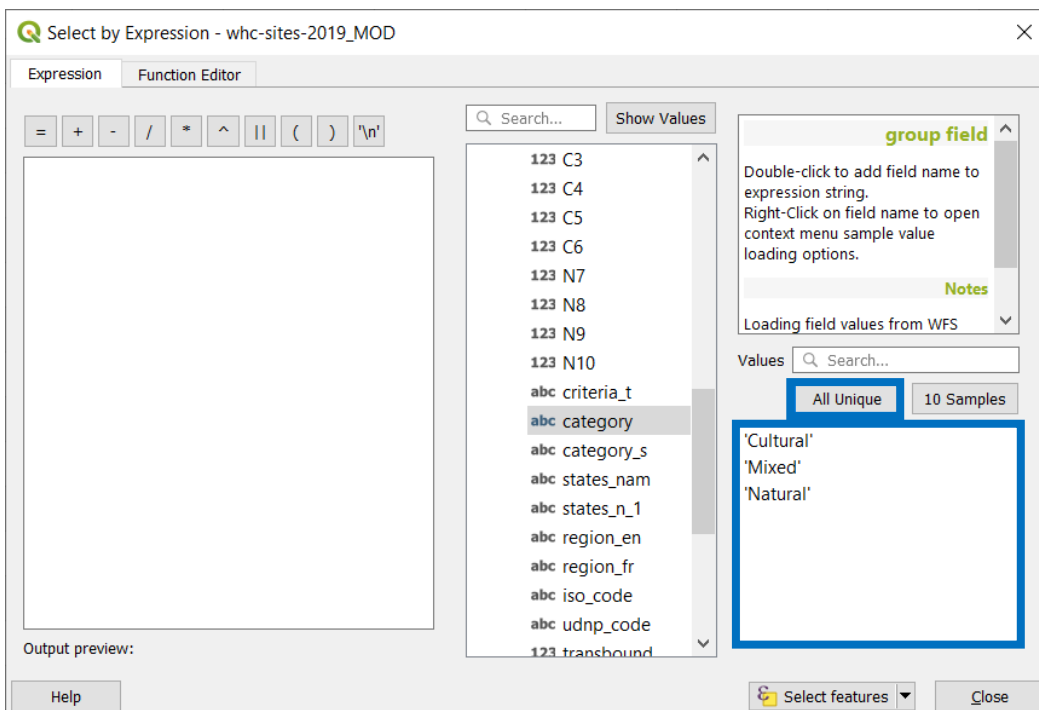


Figure 100 - Select by Expression #4

If you select a Field and press "All Unique" (value) in the related windows will appear the unique value(s) that existing in the selected column. This derives from SQL language, "select" command with the "distinct" option.<sup>[101]</sup>

We have added the fields but we need to set the "conditions". Write (or compose it using the dialog facilities) the following string and paste it into the dialog:

"category" = 'Cultural' AND "region\_en" = 'Europe and North America'

In the previous expression, **AND** means that the two condition must be contemporary satisfied. **OR**, instead, means or the first condition or the second and, probably, will returns more hits.

Note that **fields** are written into "double quotes" while **text** is into 'single quotes' (**number** will be written without any other particular character).

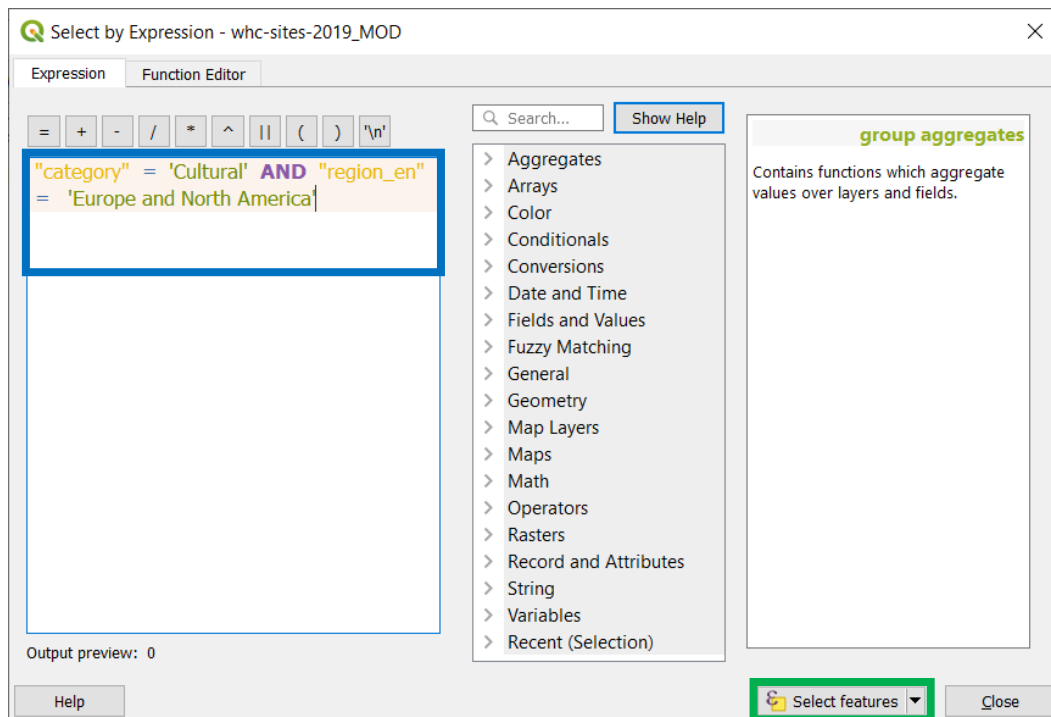


Figure 101 - Select by Expression #5

The results of this selection will be displayed both on the table and both on the map canvas. By default, in the table the selected records are in **blue**:



whc-sites-2019\_MOD : Features Total: 1121, Filtered: 1121, Selected: 452

	N8	N9	N10	criteria_t	category	category_s	states_nam	states_n_1	region_en
76	0	0	1	(vii)(x)	Natural	N	United Republic...	République-Uni...	Africa
77	0	0	0	(iii)	Cultural	C	Canada	Canada	Europe and North America
78	0	0	0	(vi)	Cultural	C	Canada	Canada	Europe and North America
79	0	1	1	(vii)(ix)(x)	Natural	N	Panama	Panama	Latin America and the Caribbean
80	0	0	0	(ii)(vi)	Cultural	C	France	France	Europe and North America
81	0	0	0	(ii)(iv)	Cultural	C	France	France	Europe and North America
82	1	0	0	(iii)(viii)	Mixed	C/N	Australia	Australie	Asia and the Pacific
83	0	0	0	(ii)	Cultural	C	Germany	Allemagne	Europe and North America
84	0	0	0	(ii)(v)	Cultural	C	Morocco	Maroc	Arab States
85	0	0	0	(i)(ii)(iii)	Cultural	C	Pakistan	Pakistan	Asia and the Pacific

Figure 102 – Records Selected

On the map, the selected objects are in **yellow**:

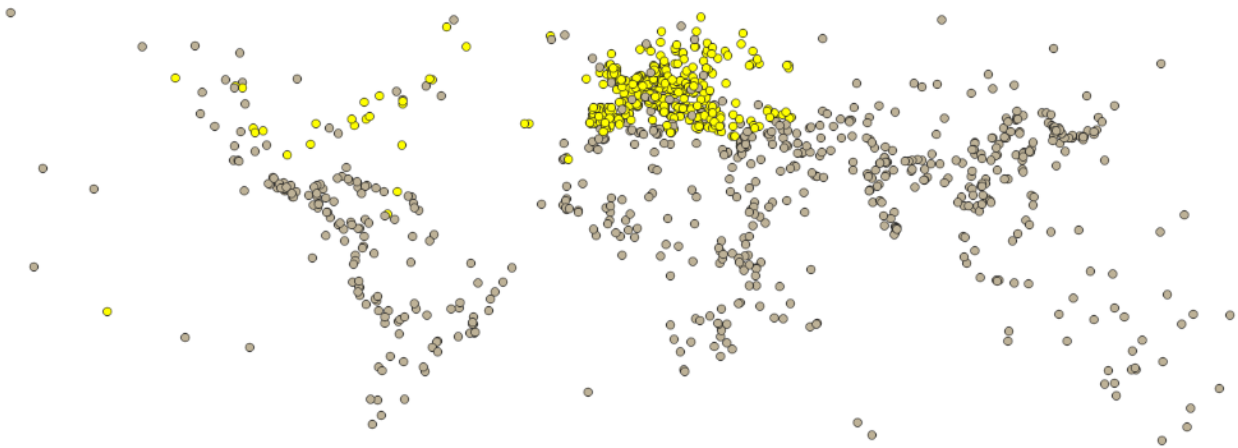


Figure 103 – Feature Selected

Starting with the active selection, we could create a new vector layer, exporting only the selected feature. Using the right click of the mouse on the layer name:

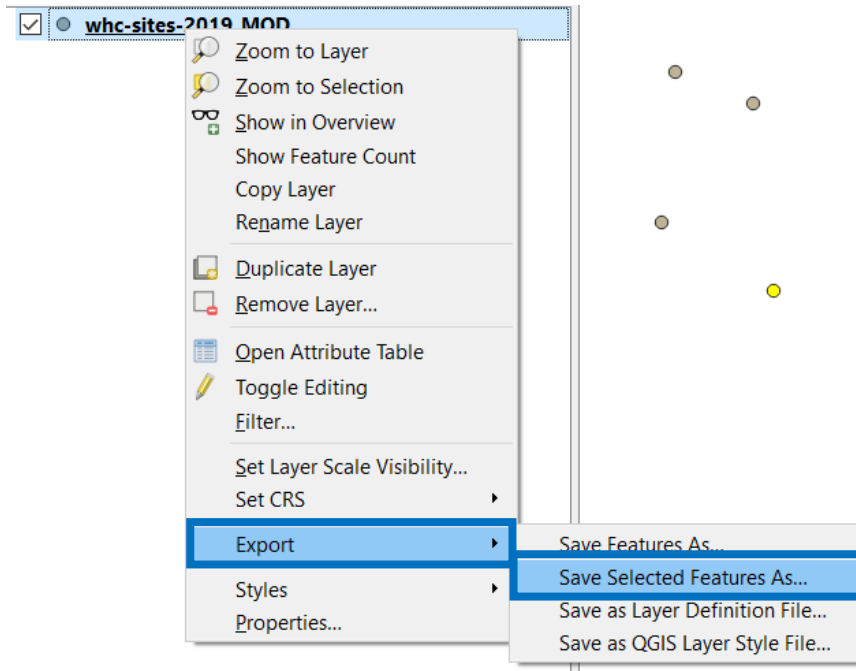


Figure 104 - Save Selected Features As... #1

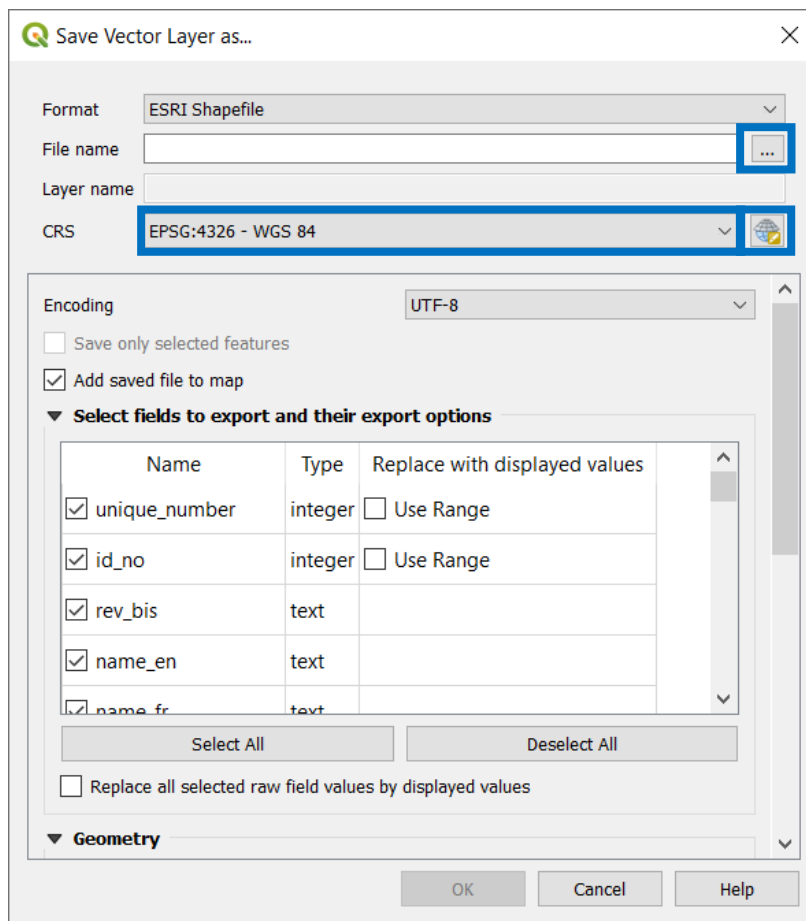


Figure 105 - Save Selected Features As... #2

Browse the folder structure, choose a name for the new layer and press OK. If You need to change the Coordinate Reference System (CRS), reprojecting the data,press the CSR button and select the appropriate reference system before confirming the export procedure and close the dialog.

If we need to create (or to delete) a column it is necessary to open an “edit session”

### Editing functions

Depending on the situation (we are working on a map or on a table?) the button will change consequently. In a table we can not draw (“geometrically”) a point and in the map, displaying a vector layer, we can not add a field in the related table.

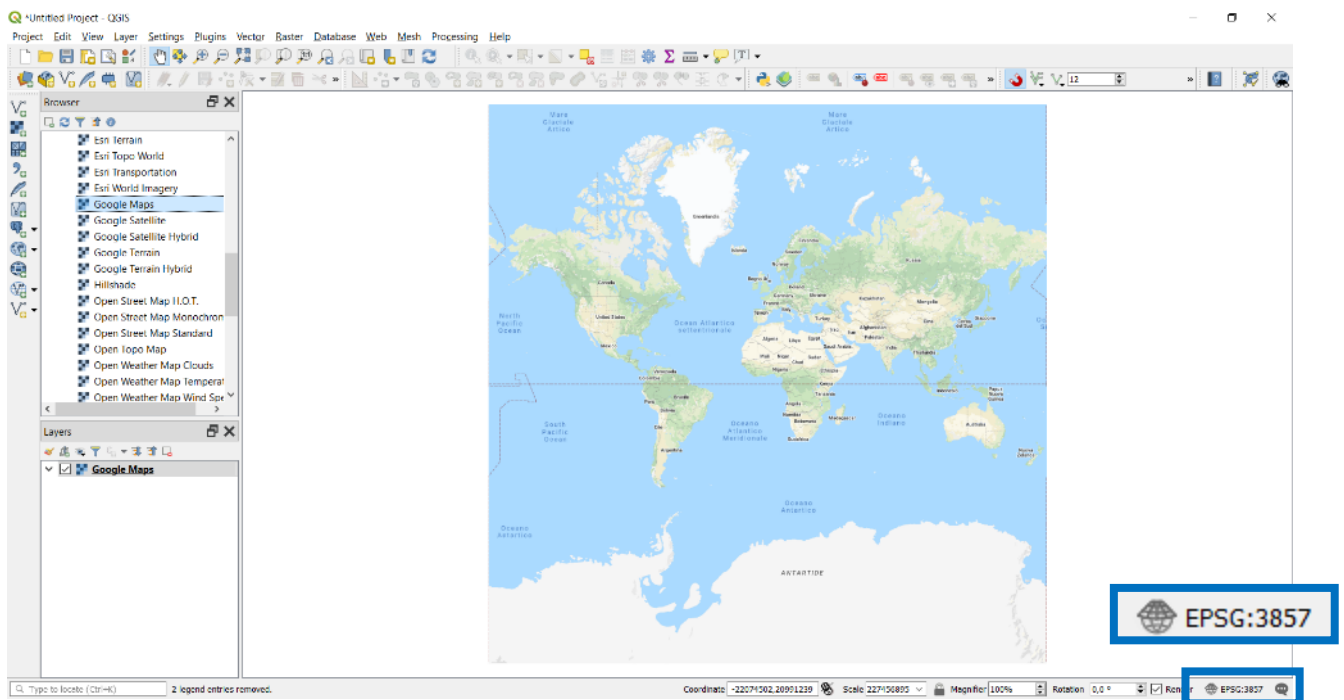
### Edit (Geometric) Feature

Following table comes from QGIS Manual<sup>[102]</sup>

Before starting, we need a basemap. Is is possible to use a raster image, an OGS Service (WMS, WCS, WFS) or an XYZ Tiles. Depending on the situation, we can choose. By the way, if We can use an internet access, the XYZ Tiles are faster and cover all the world.

### Add a XYZ Tiles Basemap

We have seen how to load a list of XYZ Tiles and to display a basemap. Choose from the XYZ Tiles “Google Maps” and double click on it to add to layer list. Search for Vatican City (Rome, Italy), St. Peter’s Basilica. To recognize the place add “Google Satellite” also



Note that the CRS is changed from EPSG 4326 to EPSG 3857 (Keep it in Your mind). Add Google Satellite also.

102 [https://docs.qgis.org/testing/en/docs/user\\_manual/working\\_with\\_vector/editing\\_geometry\\_attributes.html](https://docs.qgis.org/testing/en/docs/user_manual/working_with_vector/editing_geometry_attributes.html)



Figure 106- Google Maps



Figure 107 - Google Satellite

If you do not see the Basilica move the layer up or down the image (dragging and dropping it into the Layer Panel). Remember that in GIS, layers follow the “Rule of Sandwich”: the slice of ham hide cheese. So, if You want to see the first You have to put it on the other one (*when You eat a sandwich, instead, the taste will be a complex and will never mind the ingredients order*).

Zoom on it.



Figure 108 - St. Peter Basilica

Add a Spatial Bookmark

When we have found the “place” we could add a “Spatial Bookmark” just to retrieve it easier next ime. To “save” this location: **View > New Spatial Bookmark...** (or **CTRL+B**). In Figure 110 the dialog in which to operate to set a name of the bookmark (a Group...) and other options.

Spatial Bookmark can managed or retrieved using the Panel or the Browser.

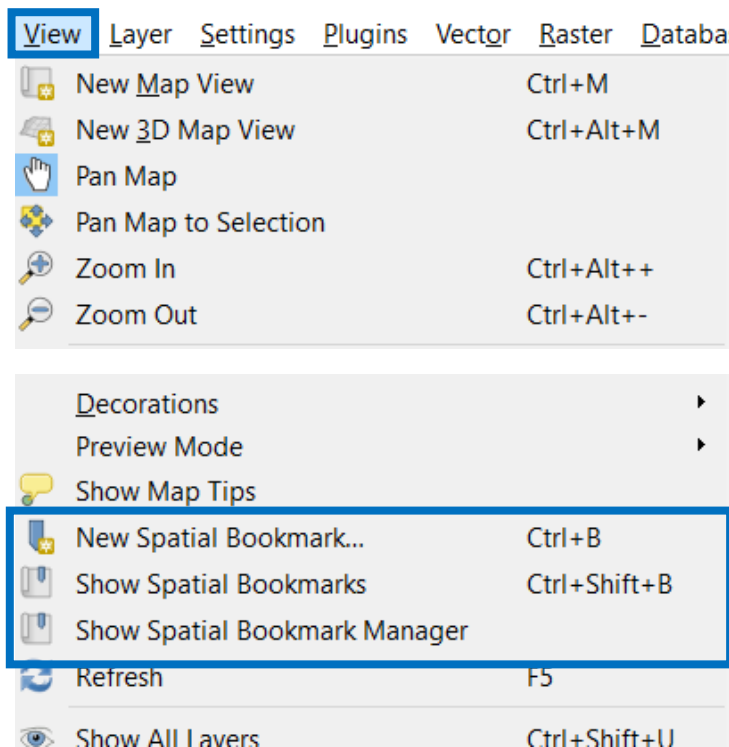


Figure 109 - Spatial Bookmark

New Spatial Bookmark... (**CTRL + B**) : Create a New Bookmark (Figure 110)

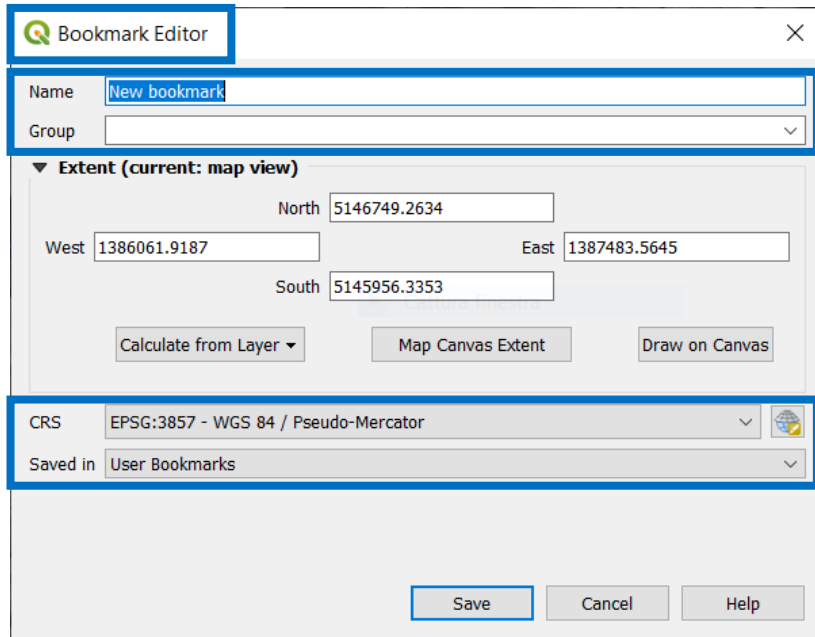


Figure 110 – Bookmark Editor - Add a Spatial Bookmark #1

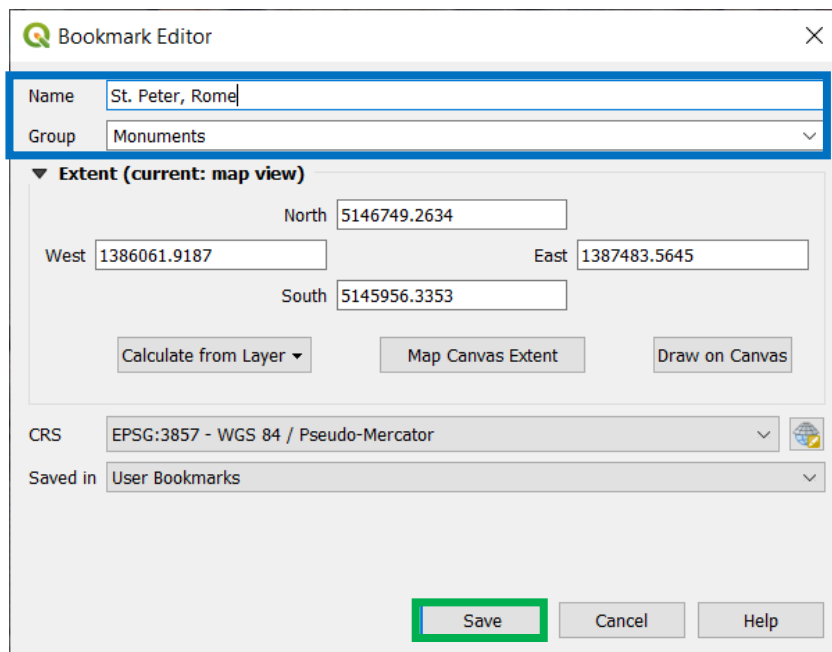


Figure 111 – Bookmark Editor - Add a Spatial Bookmark #2

Show Spatial Bookmarks (**CTRL + SHIFT + B**): Show Spatial Bookmark in “**Browser Panel**” (Figure 112)

The “**Save**” button will set the Spatial Bookmark - and the Group, if present – into the “**Browser**”, “**User Bookmark**”, “**Spatial Bookmark**”:



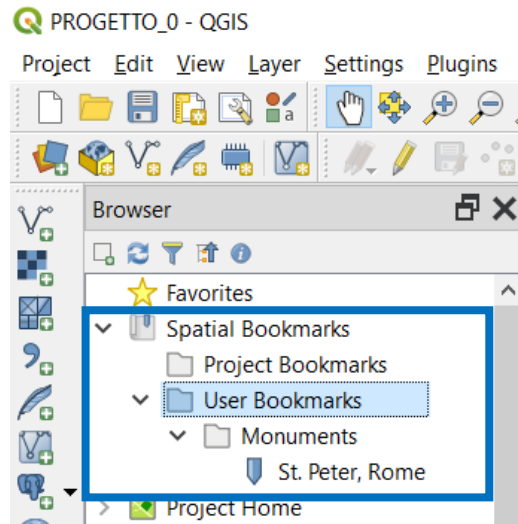


Figure 112 - Spatial Bookmarks - User Bookmarks

Show Spatial Bookmark Manager: show the new “Spatial Bookmark Manager” Panel.

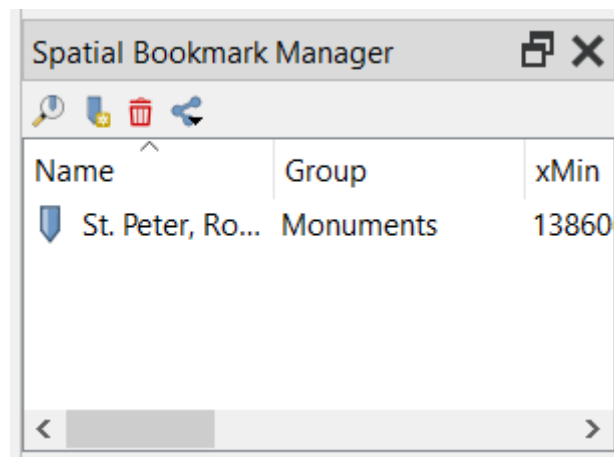


Figure 113 - Spatial Bookmark Manager

### Start Editing

The goal is to create a two vector layers: **MONUMENTS OF ROME (POINTS)** and **MONUMENTS OF ROME (POLYGON)**.

- in the former, a point layer (in which save “monuments” such as “obelisk” and so on)
- in the latter, a polygon layer (in which save “monuments” such as a “colonnade”, the “Colosseo”, drawing a polygon that “wrap” completely the object).

Of course, we need of an empty shapefile in wich save our work (or we could use an existing one, but this is not the case).

Create a Point Layer

To create a new vector layer, **Layer ► Create Layer ► New Shapefile Layer:**

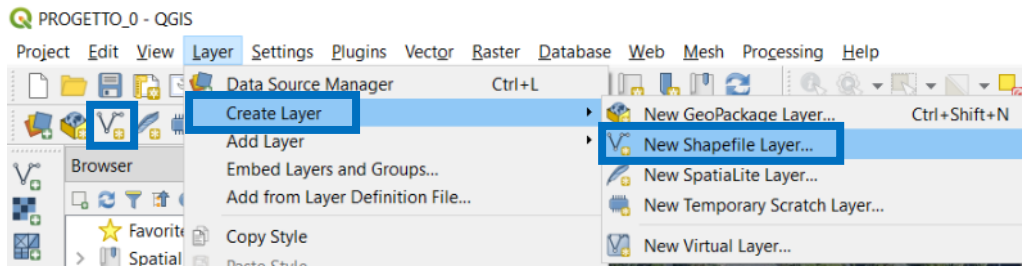



Figure 114 - Create a Vector Layer

or, if You prefer, it is possible to use a button . A new dialog will appears:

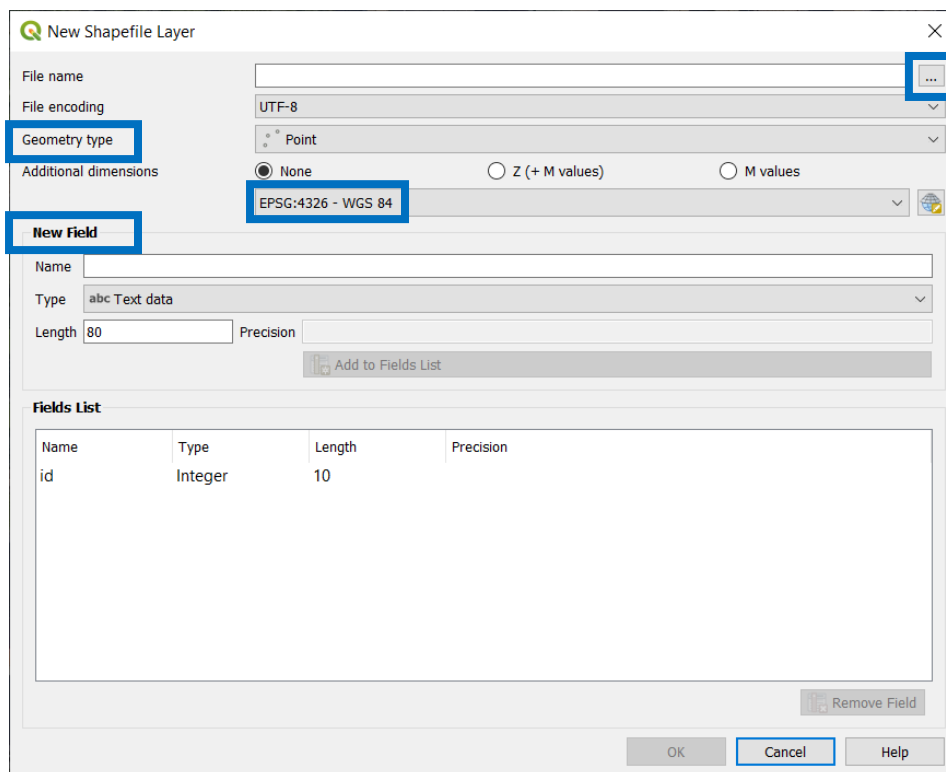


Figure 115 - Create a Vector Layer (detail #1)

- Browse for an appropriate folder in which save the shapefile and choose for a file name "Monuments in Rome" (MIR);
- Choose the "Geometry type" (Point, Multipoint<sup>[103]</sup>, Line, Polygon);
- Set the Coordinate Reference System (do you remember anything the base map we are using?);
- Add some attribute fields (a "code", numeric; a description, text).

The basemap we are using uses an **EPSG = 3857**. This is why we need to put it into the related field in order to make the base map and the vector layer "compatible".

<sup>103</sup> Sometimes one geometry is actually a collection of simple (single-part) geometries. Such a geometry is called a 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.

[https://docs.qgis.org/2.18/en/docs/pyqgis\\_developer\\_cookbook/geometry.html](https://docs.qgis.org/2.18/en/docs/pyqgis_developer_cookbook/geometry.html)

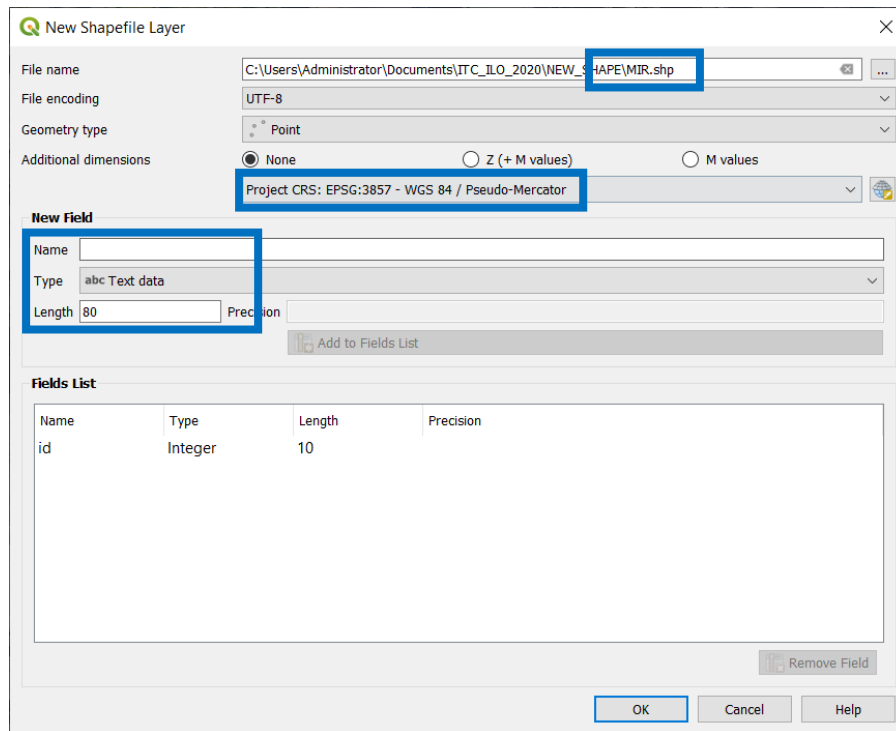


Figure 116 - Create a Vector Layer (detail #2) –MIR = Monuments in Rome

Add an attribute field: [code], numeric, length = 10. Using “Add to Fields List” this field will saved into the attribute table

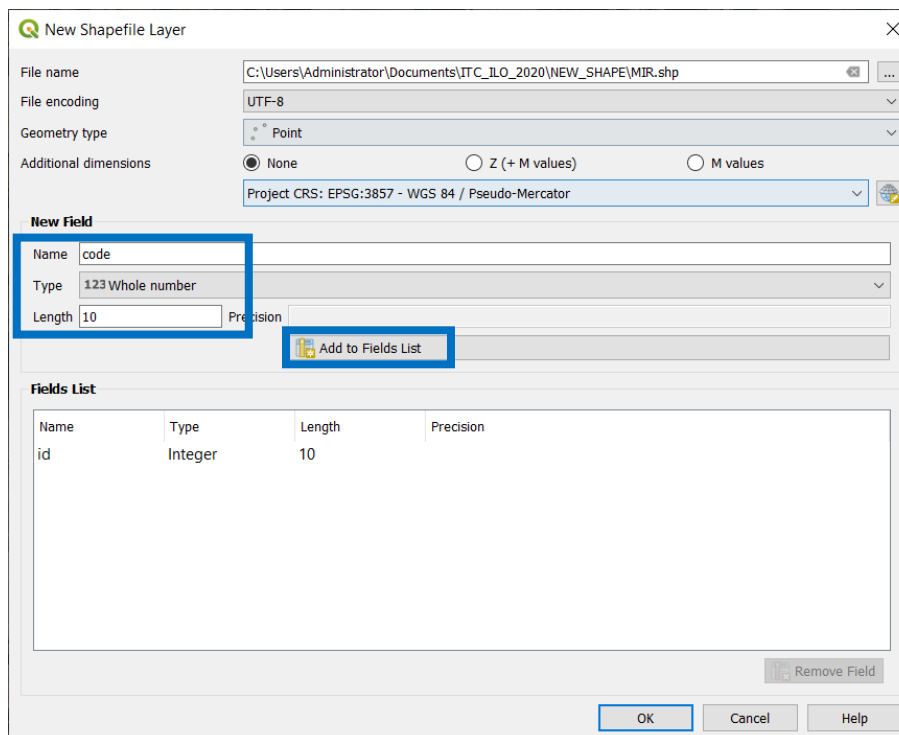


Figure 117 - Create a Vector Layer (detail #3)

Add an attribute field: [desc], text, length = 255. Using “Add to Fields List” this field will saved into the attribute table.

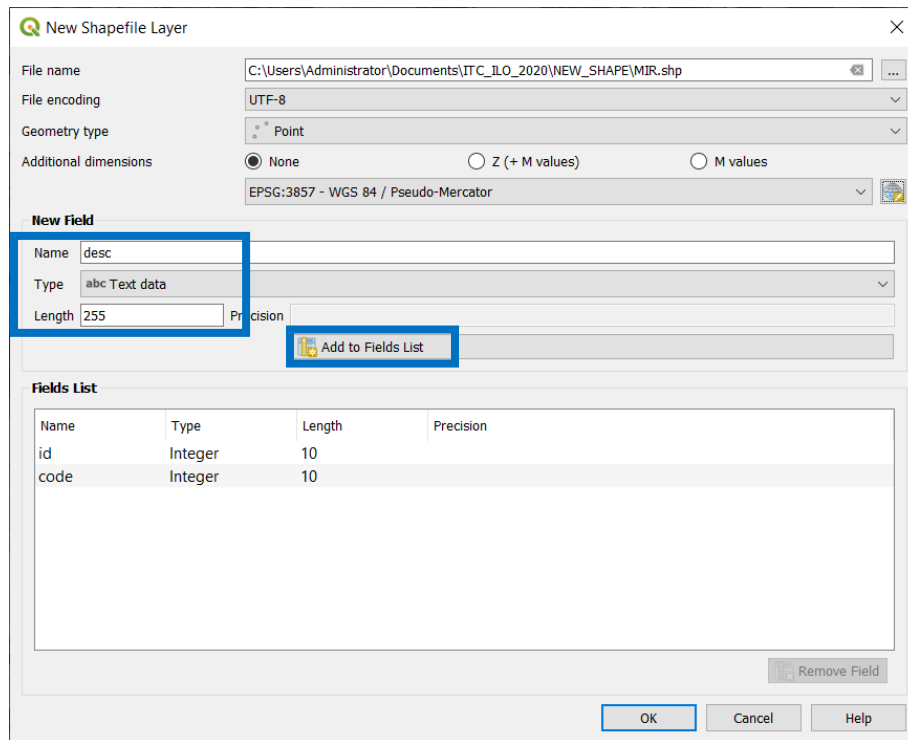


Figure 118- Create a Vector Layer (detail #4)

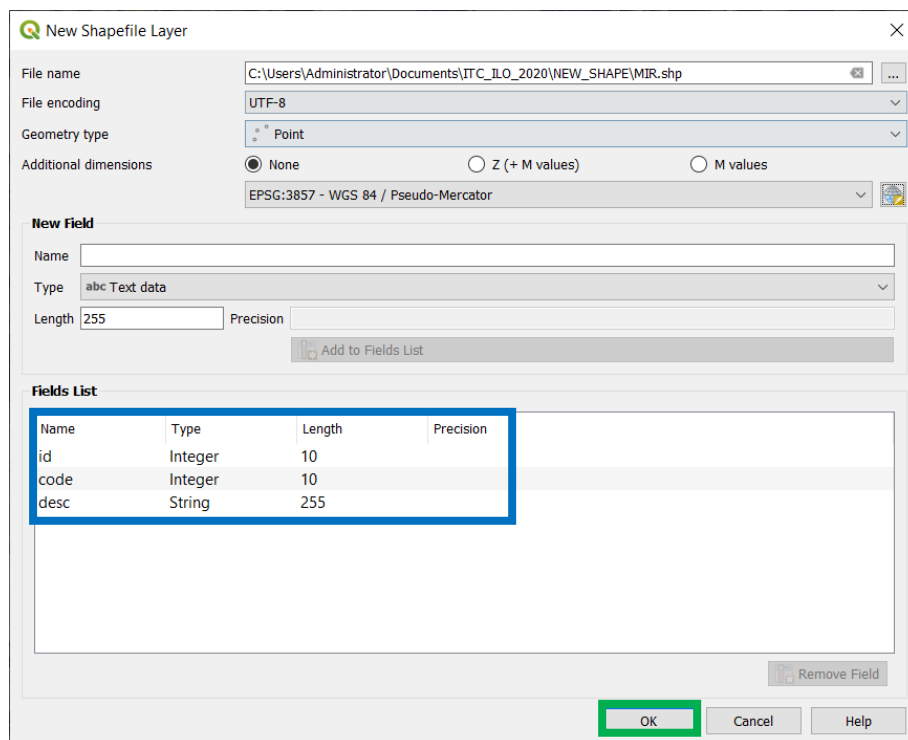


Figure 119 - Create a Vector Layer (detail #5)

Press “OK” to save the new shapefile with the fields described before. The new “empty” layer will be displayed into the Layer Panel:

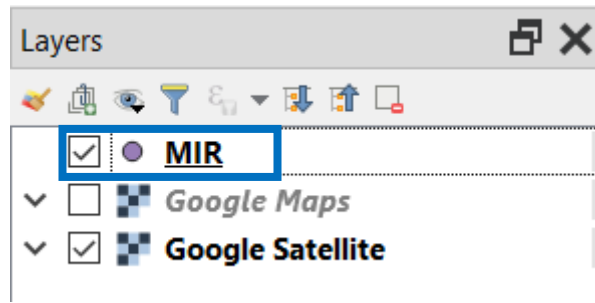


Figure 120- The new layer is loaded into the Layer Panel

Before starting, look at the buttons that we can use inside an “edit session”:

Icon	Purpose	Icon	Purpose
	Current edits		Toggle editing
	Save layer edits		
	Add new record		Add Feature: Capture Point
	Add Feature: Capture Line		Add Feature: Capture Polygon
	Vertex Tool (All Layers)		Vertex Tool (Current Layer)
	Modify the attributes of all selected features simultaneously		
	Delete Selected		Cut Features
	Copy Features		Paste Features
	Undo		Redo

Table 4 - Editing Geometries (buttons)

Click on the layer name. Press the “Pencil” button to start an “Edit Session”. The “status” of the layer “obelix” will change:

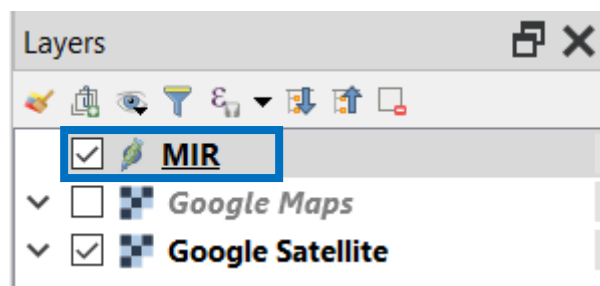

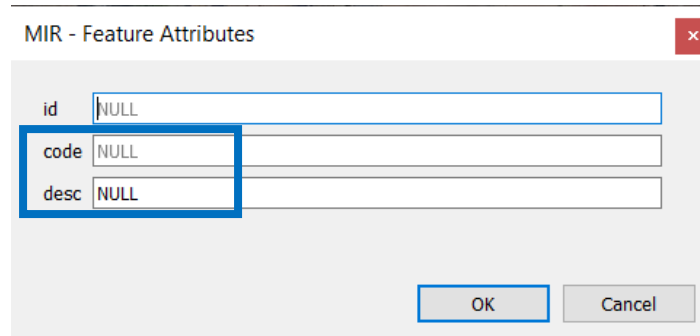



Figure 121 - An editing session is started on the new layer

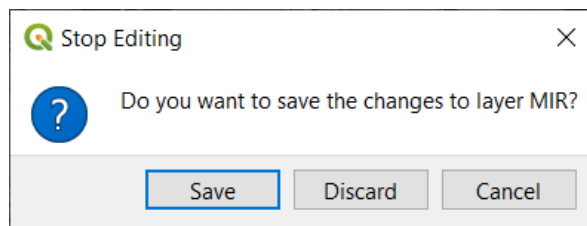
Look for the button  (Add Point Feature) and click on it. Now, go to the map and click on the “obelisk”. A new dialog will appear:



The dialog box titled "MIR - Feature Attributes" contains three input fields: "id", "code", and "desc", each with "NULL" entered. The "code" and "desc" fields are highlighted with a blue border. At the bottom, there are "OK" and "Cancel" buttons.

Figure 122- Adding attribute values

The [id] field was created by the system (at least, one field is mandatory to manage a GIS layer). [code] and [desc] are the two fields create just a couple of seconds before. Insert values (i.e. a numeric value, a description) and press “OK”. Try to insert other “monuments” (the code=1 is not usable for other objects: create a new code for each one). Remember to save  regularly Your works. At the end, press the pencil again to “Toggle Editing”. QGIS will ask to You:

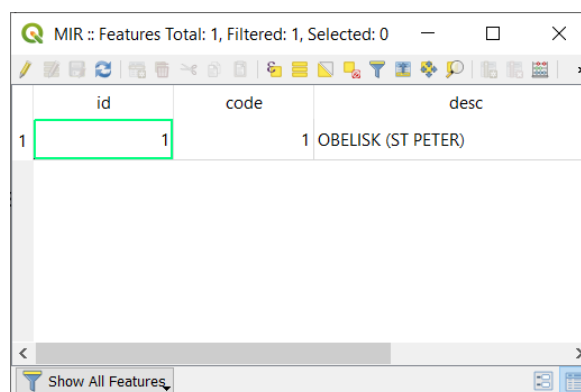


The dialog box titled "Stop Editing" asks "Do you want to save the changes to layer MIR?". It features a question mark icon and three buttons: "Save", "Discard", and "Cancel".

Figure 123 - Stop Editing dialog

“Cancel” interrupt the request and go back to editing; “Discard” close the edit session without saving; “Save” stores the information and exit from editing.


Open the attribute table:



The attribute table for layer "MIR" shows 1 feature. The table has columns for "id", "code", and "desc". The first row contains the values "1", "1", and "1 OBELISK (ST PETER)".

id	code	desc
1	1	1 OBELISK (ST PETER)

Figure 124 - The Attribute table after editing

Look for the button  (“Identify Features”) and click on the “obelisk”:



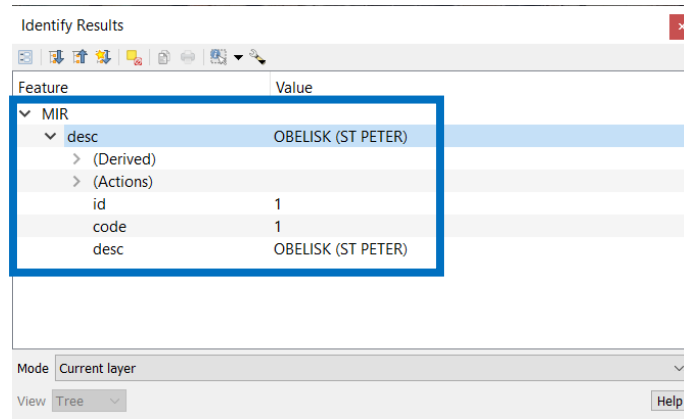


Figure 125 - Identify Feature dialog

Create a Polygon Layer

Following the previous part, try to create a Polygon Layer. Take into account that when you are working on polylines or polygon, to avoid errors, is better to set the **Tolerance**, the **Snap** and - enable the **“Topological Editing”**<sup>[104][105]</sup>. Try to look at the **Project ► Snapping Options...** settings and related help<sup>[106]</sup>.

When a Polygon Layer is created it appears:

in the Layer Panel:

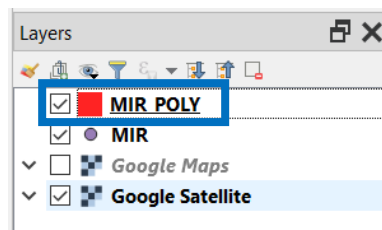


Figure 126 - Layer Panel (polygon)

on the map, when You draw a polygon

104 [https://docs.qgis.org/testing/en/docs/user\\_manual/working\\_with\\_vector/editing\\_geometry\\_attributes.html#id32](https://docs.qgis.org/testing/en/docs/user_manual/working_with_vector/editing_geometry_attributes.html#id32)

105 [https://docs.qgis.org/testing/en/docs/user\\_manual/working\\_with\\_vector/editing\\_geometry\\_attributes.html?highlight=edit%20feature](https://docs.qgis.org/testing/en/docs/user_manual/working_with_vector/editing_geometry_attributes.html?highlight=edit%20feature)

106 [https://docs.qgis.org/3.10/en/docs/user\\_manual/working\\_with\\_vector/editing\\_geometry\\_attributes.html?highlight=snapping](https://docs.qgis.org/3.10/en/docs/user_manual/working_with_vector/editing_geometry_attributes.html?highlight=snapping)

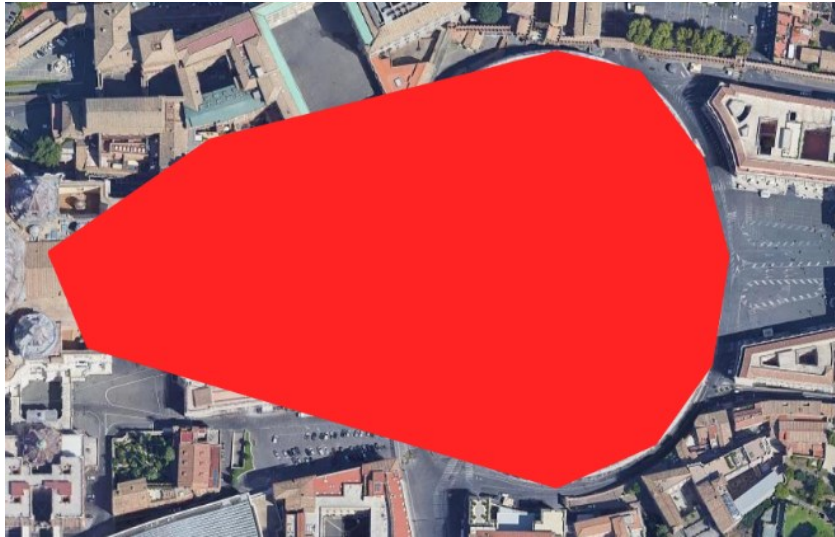


Figure 127 - Draw a Polygon

As result from Figure 127, when we have to “digitize” a polygon is better tho change the representation of the “geometry”, choosing, in the Layer Properties, Fill style = “No Brush” in order to obtain:

in the Layer Panel:

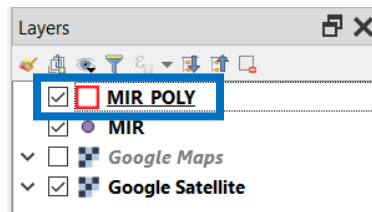


Figure 128 - Layer Panel (polygon, "no brush")

on the map:

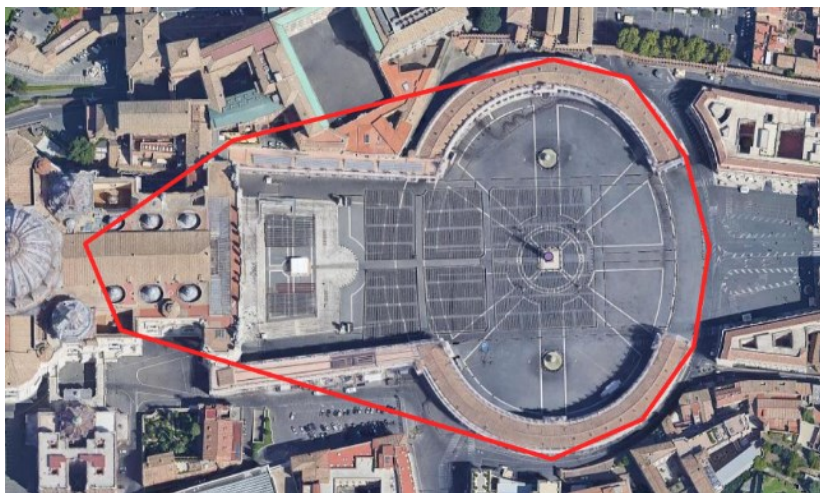


Figure 129 - Figure 17 - Draw a Polygon (no brush)

To change the Symbology (see «The “Layer Properties”» section). In order to pass from this representations:

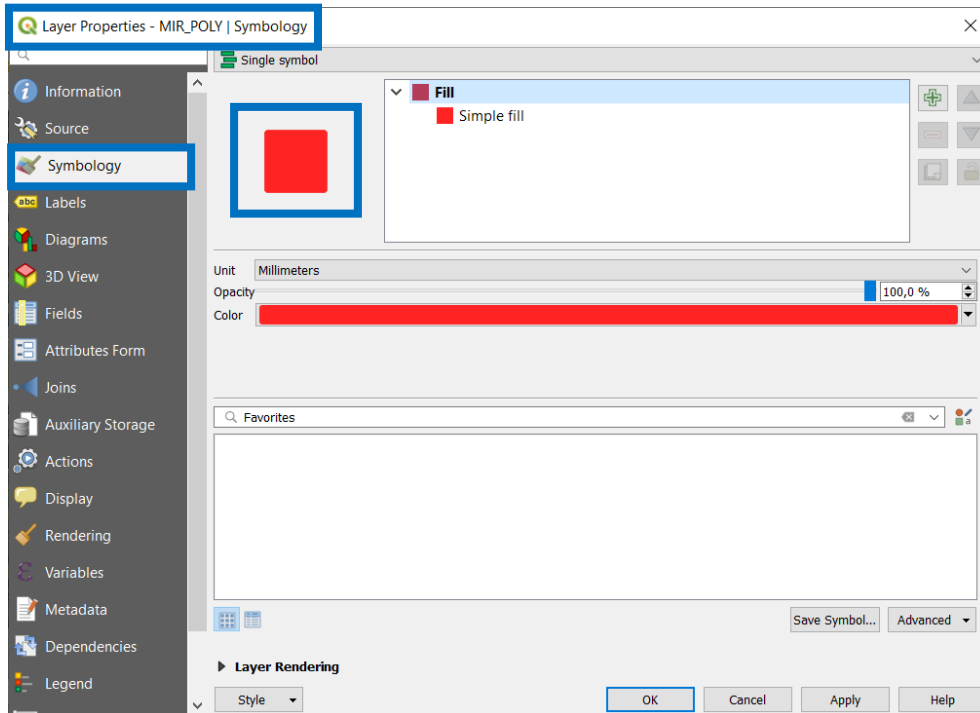


Figure 130 - Layer Properties (Polygon Symbology #1)

to this one:

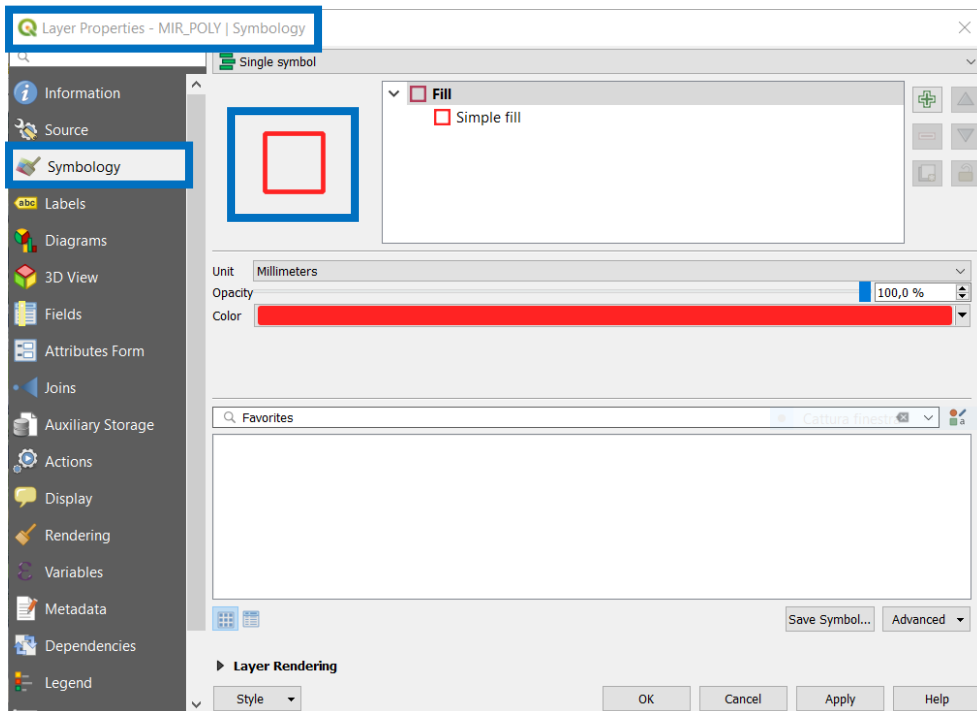


Figure 131 - Layer Properties (Polygon Symbology #2)

We have to click on “Simple fill” and, then, “Fill style” = “No Brush”. Maybe it is convenient to modify also the “Stroke width” in order to make more visible the “boundaries” of the geometries.

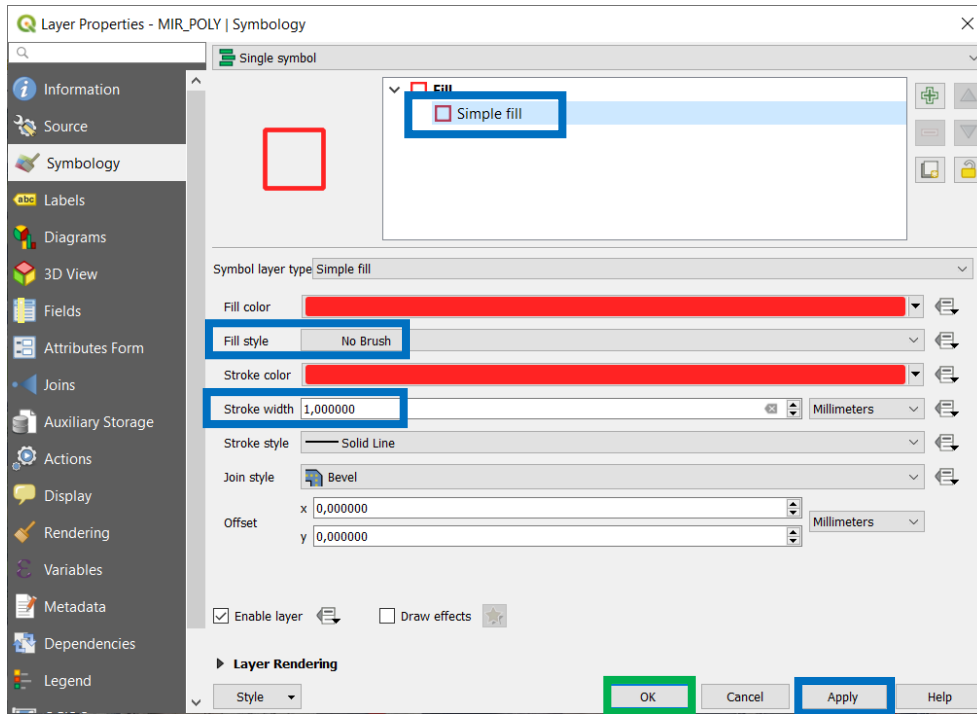



Figure 132 - Layer Properties (Polygon Symbology #3)

Use the “Vertex Tool”  to refine the “boundary”. Double click on a shape add a vertex.

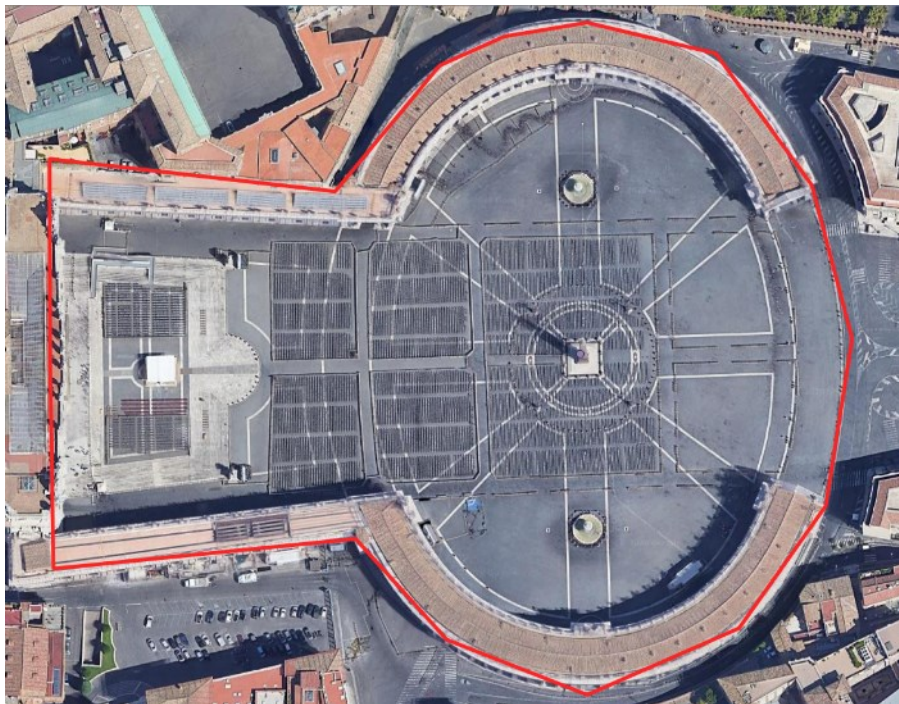


Figure 133 - Vertex Tool #1

When You have finished, “Toggle Editing”:

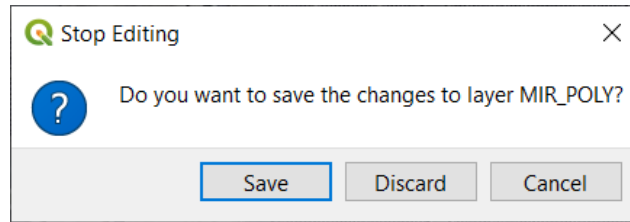


Figure 134 - Stop Editing Dialog

And save Your work.

But... “Houston... we have a problem”! If we change again the “Layer Properties” and roll back to activate the “Fill style” = “Solid”, the polygon we have just drawn will be the following one:

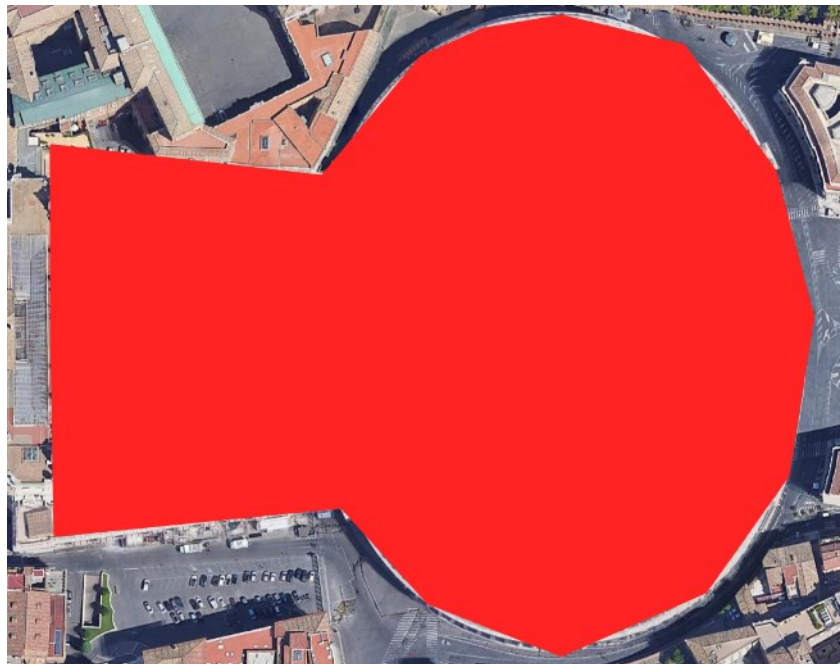


Figure 135 - Fill style = Solid


What is the problem? Our work is missing of an “hole”... so, go back to an “Edit Session” and look for the “Add Ring” button (  ). Then draw “a shape” inside the previous one.





Figure 136 - Adding a Ring

Then go back to the “Vertex Tool” and adjust the vertices (creating, deleting...). To do this is better to use the “No Brush” option in order to see the basemap on the background.

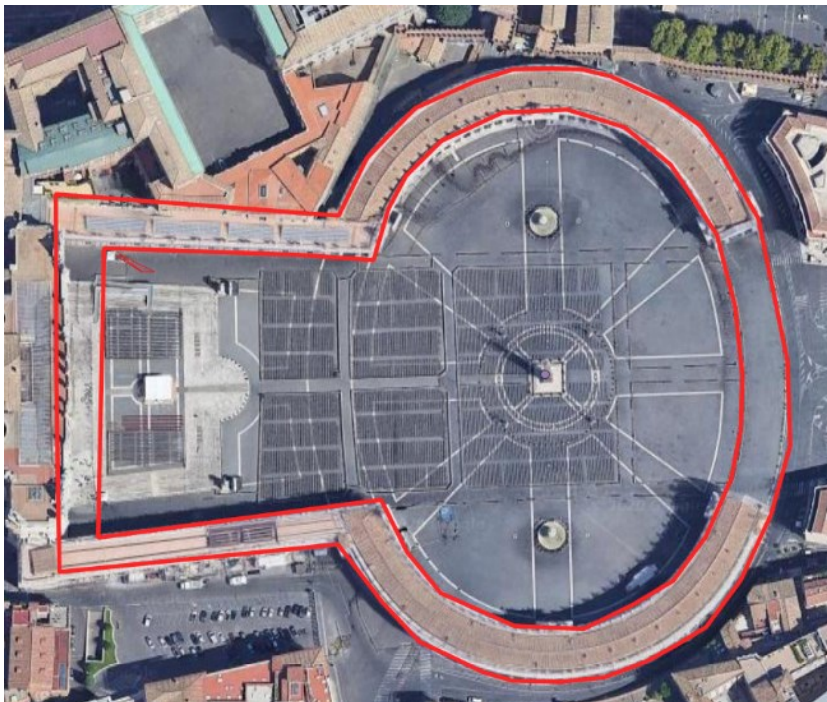

















Figure 137 - Vertex Tool #2

Edit the attribute table

The first button on the left of the table is a “Pencil”. This icon stands for “Start an edit session” or “Toggle Editing”. Remember that the table is linked to the data layer so when you’ll delete a record a feature (in this case, a point) will be deleted from the map.

Following table comes from QGIS Manual<sup>[107]</sup>

Icon	Label	Purpose	Default Shortcut
	Toggle editing mode	Enable editing functionalities	Ctrl+E
	Toggle multi edit mode	Update multiple fields of many features	
	Save Edits	Save current modifications	
	Reload the table		
	Add feature	Add new geometryless feature	
	Delete selected features	Remove selected features from the layer	
	Cut selected features to clipboard		Ctrl+X
	Copy selected features to clipboard		Ctrl+C
	Paste features from clipboard	Insert new features from copied ones	Ctrl+V
	Select features using an Expression		
	Select All	Select all features in the layer	Ctrl+A
	Invert selection	Invert the current selection in the layer	Ctrl+R
	Deselect all	Deselect all features in the current layer	Ctrl+Shift+A
	Filter/Select features using form		Ctrl+F
	Move selected to top	Move selected rows to the top of the table	

107 [https://docs.qgis.org/testing/en/docs/user\\_manual/working\\_with\\_vector/editing\\_geometry\\_attributes.html](https://docs.qgis.org/testing/en/docs/user_manual/working_with_vector/editing_geometry_attributes.html)











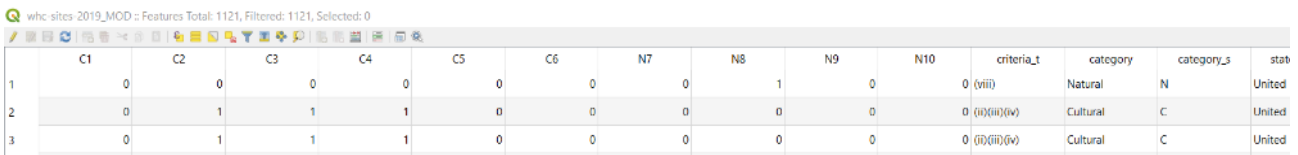
	Pan map to the selected rows		Ctrl+P
	Zoom map to the selected rows		Ctrl+J
	New field	Add a new field to the data source	Ctrl+W
	Delete field	Remove a field from the data source	
	Open field calculator	Update field for many features in a row	Ctrl+I
	Conditional formatting	Enable table formatting	
	Dock attribute table	Allows to dock/undock the attribute table	
	Actions	Lists the actions related to the layer	

Table 5 - Editing Attribute Table (buttons)

Starting from the attribute table:



	C1	C2	C3	C4	C5	C6	N7	N8	N9	N10	criteria_t	category	category_s	stat
1	0	0	0	0	0	0	0	1	0	0	0 (viii)	Natural	N	United
2	0	1	1	1	0	0	0	0	0	0	0 (ii)(iii)(iv)	Cultural	C	United
3	0	1	1	1	0	0	0	0	0	0	0 (ii)(iii)(iv)	Cultural	C	United

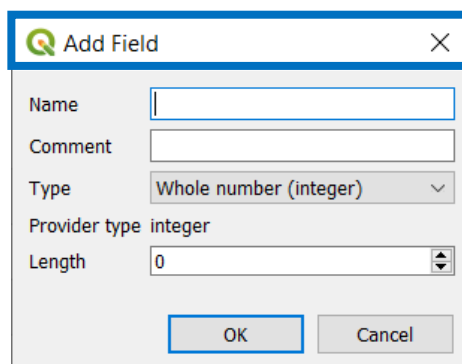
Figure 138 - The Attribute Table

The exercise could be to try to “transpose” the value of field [criteria\_t] as the “concatenation” of the fields: [C1];[C2];[C3];[C4];[C5];[C6];[N7];[N8];[N9];[N10], putting between values a “minus sign”.

In other words, we would insert in all the record a sting like this: “0-0-0-0-0-0-0-1-0-0”

(this is valid for the first record and will be change for the others).

After pressing the “Toggle editing” mode  , the button “New field”  will be active.



**Add Field** [X]

Name:

Comment:

Type: Whole number (integer)

Provider type: integer

Length:

OK Cancel

Figure 139 - Add Field Dialog #1

Choose a name for the field, i.e. "CRITERIA\_N" (sorry: max 10 character are allowed in DBF files), even a comment for the field (it is not mandatory), choose the field type (Number, Text) and the "length" (How many characters? How many numbers?).

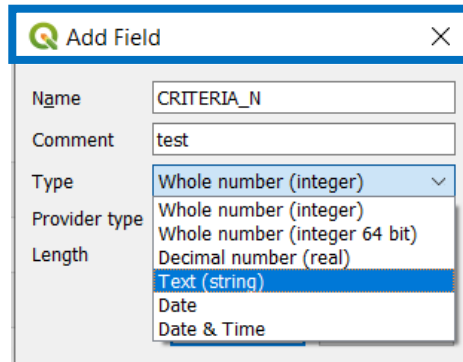


Figure 140 - Add Field Dialog #2

Fill the dialog with the information required:

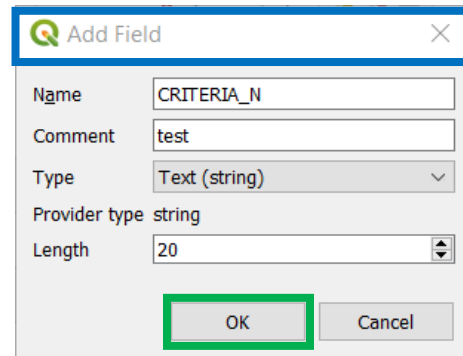

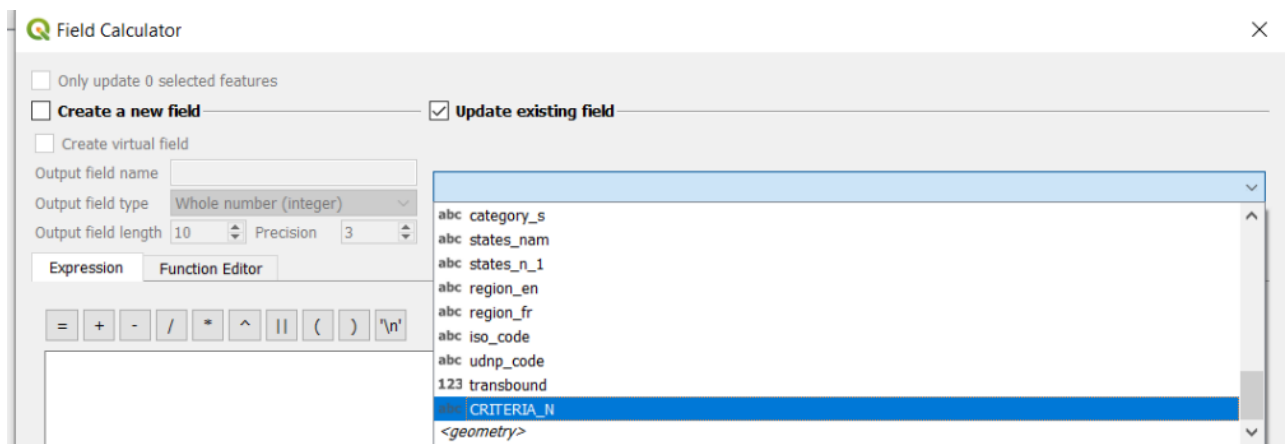
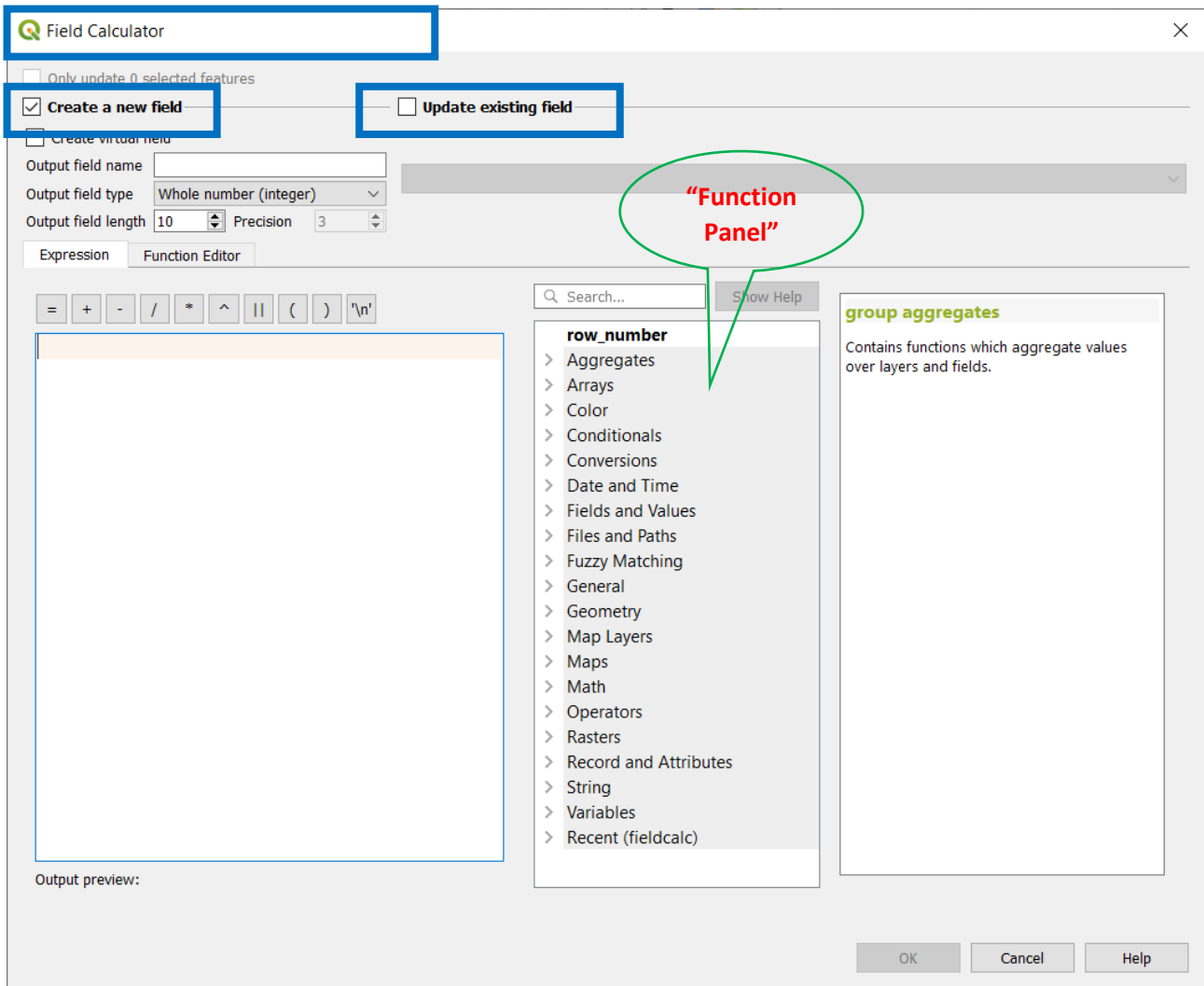


Figure 141 - Add Field Dialog #3

and press **OK** to confirm.

The new field will appear on the table, as the last field on the right.

Open the "Field Calculator" . We can choose between to "Create a new field" or "Update an existing one". Choose the second option (we have just created a new field) and choose the field to update:



In the “Function Panel” in the center of the dialog, search for “Fields and Values” and explode the list: all the fields of the table will be displayed. Double click on the single field of interest, i.e. [C1];[C2];[C3];[C4];[C5];[C6];[N7];[N8];[N9];[N10].

These fields will be placed, into the left frame, inside the “Query Composer” frame.

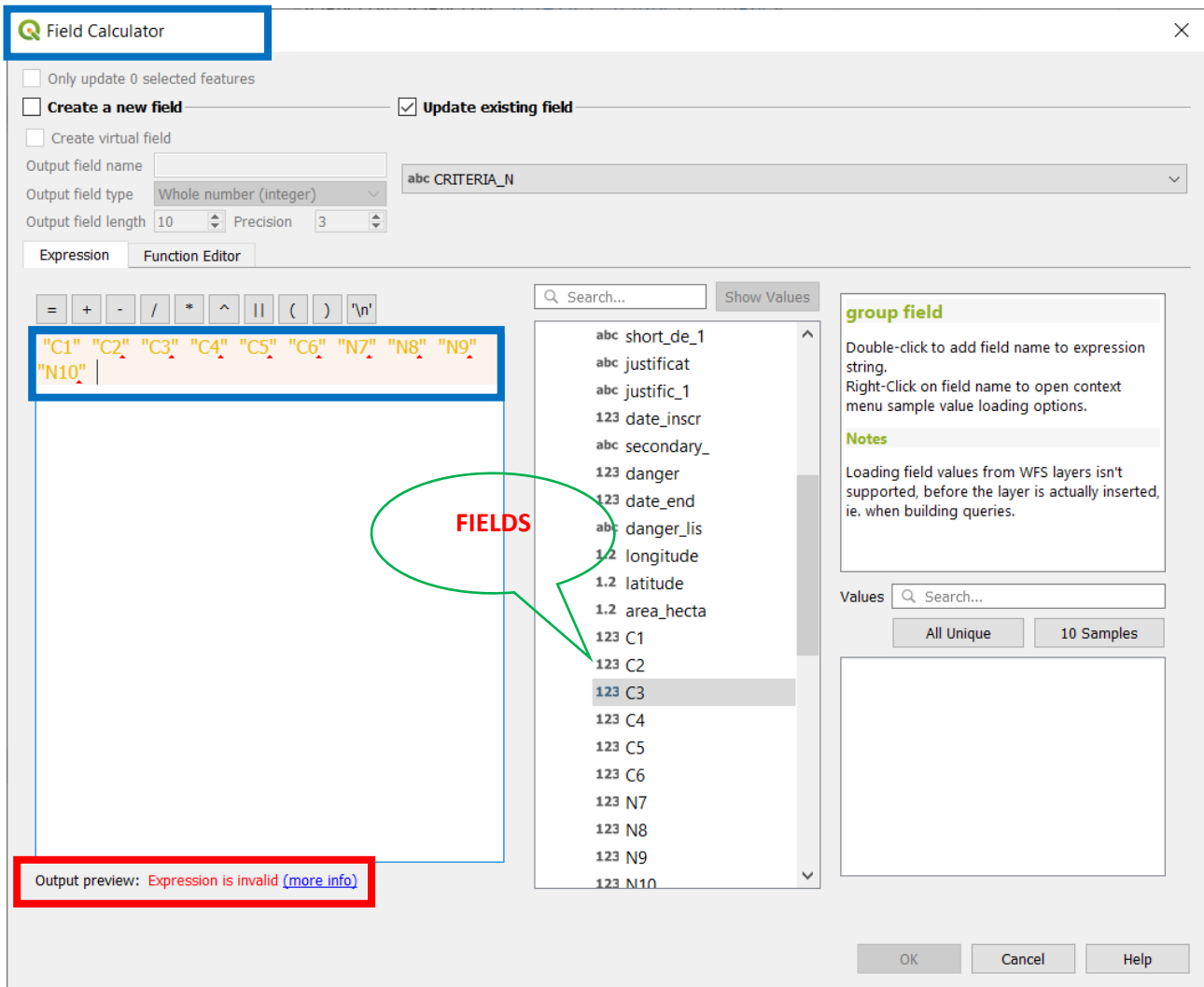


Figure 142 - Field Calculator - Concatenate Function #1

In the “Output preview” an error is displayed: the syntax of the query is not correct. We have to insert the missing operators. In other word, we want to “concatenate” several values. To perform this operation we need the appropriate function: “concat”. Browse the “Function Panel” and search for: **String ▶ Concat**

An help will displayed:

## function concat

Concatenates several strings to one. NULL values are converted to empty strings. Other values (like numbers) are converted to strings.

### Syntax

**concat** (*string1*, *string2*...)

### Arguments

*string* a string value

### Examples

- `concat('sun', 'set') → 'sunset'`
  - `concat('a','b','c','d','e') → 'abcde'`
  - `concat('Anno ', 1984) → 'Anno 1984'`
- `concat('The Wall', NULL) → 'The Wall'`

Starting from the example, to correct the syntax error in the query we have composed, we need to insert the concat function as follow:

```
concat("C1",-1,"C2",-1,"C3",-1,"C4",-1,"C5",-1,"C6",-1,"N7",-1,"N8",-1,"N9",-1,"N10")
```

Where

- Concat() is the function that we want to apply
- "C1"... are the fields (between double quotes)
- '-1' is the separator value (it is a text, so we need to put it into single quotes)

If no errors are detected, the "Output preview" will display:

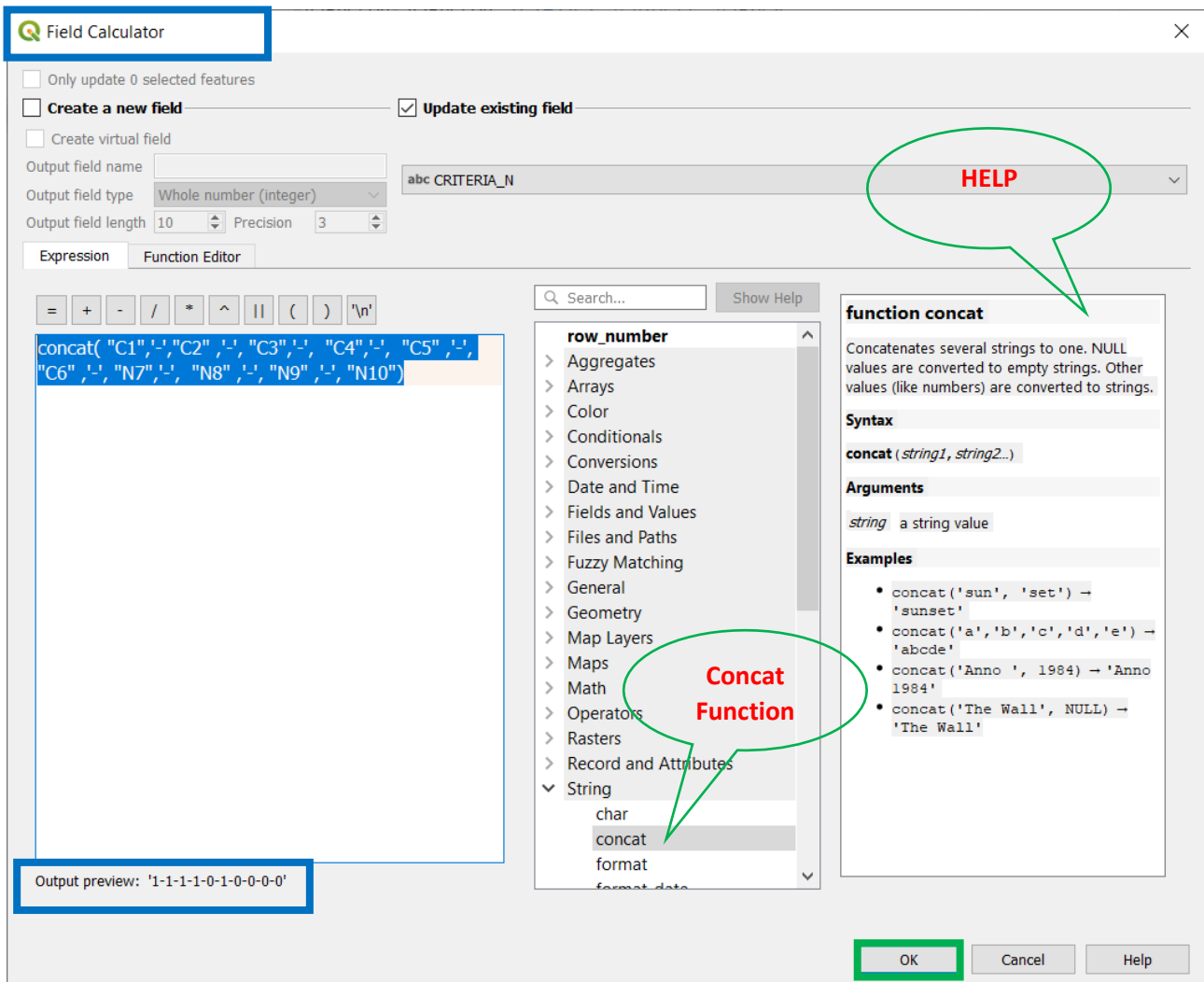


Figure 143 - Field Calculator - Concatenate Function #2

The button "OK" will confirm the operation and all the new values will be written for all the records.

If You do not want to use "a function" and prefer a single operator You can use the || instead. The new expression will be:

"C1" || '-' || "C2" || '-' || "C3" || '-' || "C4" || '-' || "C5" || '-' || "C6" || '-' || "N7" || '-' || "N8" || '-' || "N9" || '-' || "N10"

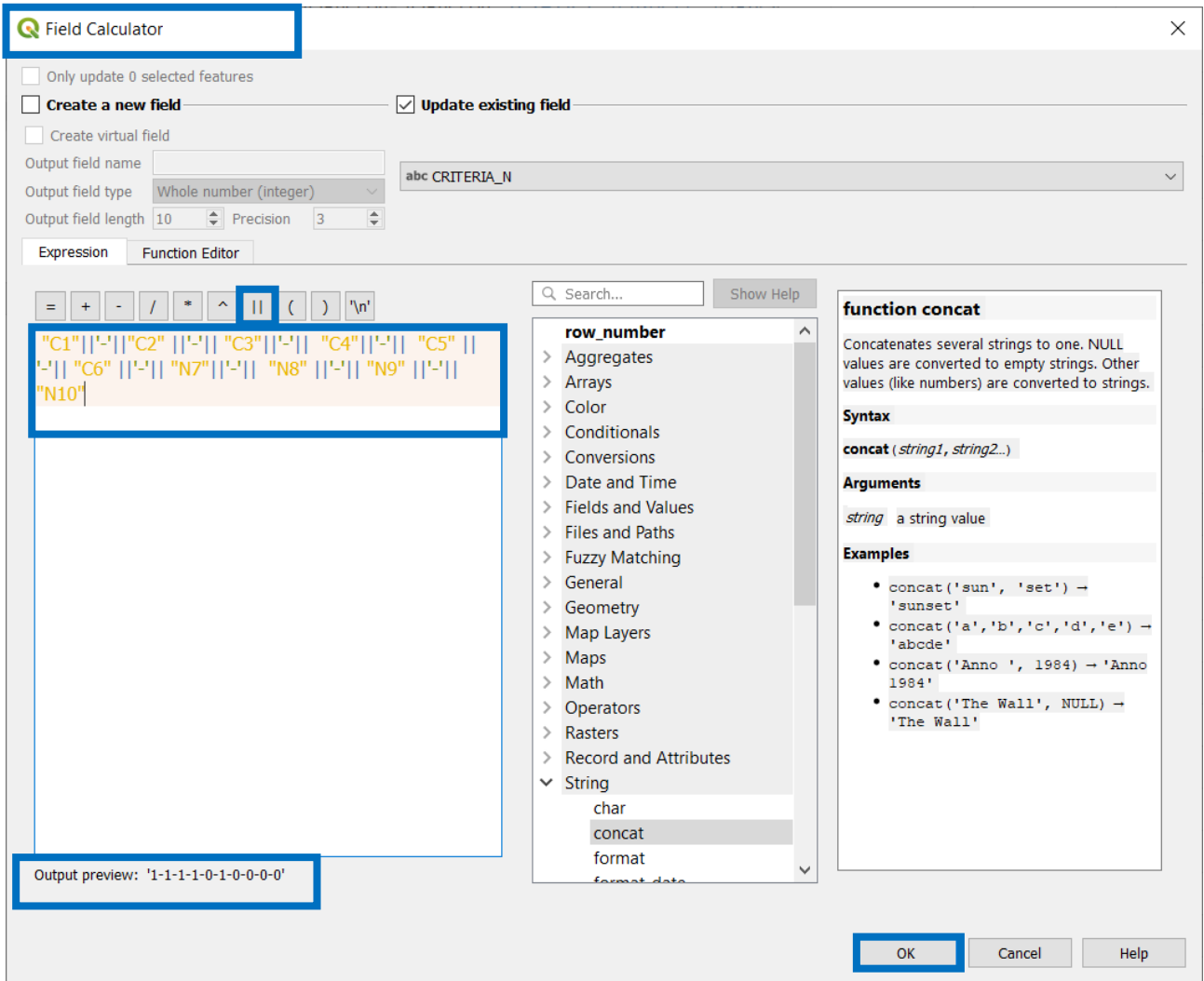



Figure 144 - Field Calculator - Concatenate Function #3

All the data will be re-written in the same field. To save Your editing it is mandatory to press again the “Toggle editing” mode  . A dialog will appears:

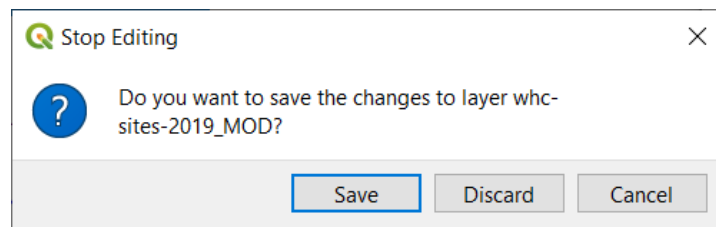


Figure 145 - Stop Editing Dialog

Press “Save” to confirm the operation; “Discard” will “undo” the “editing” and “Cancel” will exit without do anything. By saving the edit session the attribute table will populated with new values.

Look at the table:

	category	states_nam	states_n_1	region_en	region_fr	iso_code	inp_cod	nsbou	CRITERIA_N
1	N	United Kingdo...	Royaume-Uni d...	Europe and Nor...	Europe et Amér...	gb	gbr	0	0-0-0-0-0-0-0-1-0-0
2	C	United Kingdo...	Royaume-Uni d...	Europe and Nor...	Europe et Amér...	gb	gbr	0	0-1-1-1-0-0-0-0-0-0
3	C	United Kingdo...	Royaume-Uni d...	Europe and Nor...	Europe et Amér...	gb	gbr	0	0-1-1-1-0-0-0-0-0-0
4	C	United Kingdo...	Royaume-Uni d...	Europe and Nor...	Europe et Amér...	gb	gbr	0	1-1-0-1-0-0-0-0-0-0
5	C	United Kingdo...	Royaume-Uni d...	Europe and Nor...	Europe et Amér...	gb	gbr	0	0-1-1-1-0-0-0-0-0-0
6	C	United Kingdo...	Royaume-Uni d...	Europe and Nor...	Europe et Amér...	gb	gbr	0	0-0-1-0-0-0-0-0-0-0
7	C	United Kingdo...	Royaume-Uni d...	Europe and Nor...	Europe et Amér...	gb	gbr	0	1-0-0-1-0-0-0-0-0-0
8	C/N	United Republic...	République-Uni...	Africa	Afrique	tz	tza	0	0-0-0-1-0-0-1-1-1-1
9	C	United Kingdo...	Royaume-Uni d...	Europe and Nor...	Europe et Amér...	gb	gbr	0	1-1-0-1-0-1-0-0-0-0
10	N	United Republic...	République-Uni...	Africa	Afrique	tz	tza	0	0-0-0-0-0-0-1-0-0-1
11	C	United Republic...	République-Uni...	Africa	Afrique	tz	tza	0	0-0-1-0-0-0-0-0-0-0
12	N	United Republic...	République-Uni...	Africa	Afrique	tz	tza	0	0-0-0-0-0-0-0-0-1-1
13	C	United Republic...	République-Uni...	Africa	Afrique	tz	tza	0	0-1-1-0-0-1-0-0-0-0
14	C	United Republic...	République-Uni...	Africa	Afrique	tz	tza	0	0-0-1-0-0-1-0-0-0-0

Figure 146 - The Attribute Table after the "Concatenate"

These values are LEFT ALIGNED because are TEXT (NUMERIC VALUES will be aligned on the RIGHT instead).

In the "Function Panel" we can find a lot of functions and commands. For example, how calculate the area, the perimeter and the length of a geometry. If our database should contains information about population will be easy to calculate the variation (%) between two years or between two different census. In this case, the formula to apply is:

$$\text{PopVariation}(\%) = \frac{\text{Pop}(\text{Ending Period}) - \text{Pop}(\text{Starting Period})}{\text{Pop}(\text{Starting Period})} * 100$$

### Add new ("external") data (JOIN function)

GIS data have geometries and attribute data "inside", into the same container. But the attribute data (DBF stands for Data Base File) is suitable itself to "JOIN" other "external" table.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	unique_num	id_no	rev_bis	name_e	name_f	short_d	short_d	justifica	justifica	date_in	secondi	danger	date_et	danger	longitud	latitude	area_ha	C1	C2	C3	C4
2	230	208	Rev	Cultural La Paysage c	The cu	Le pay				2003		1	Y 2003	67,82525	34,84694	158,9265		1	1	1	
3	234	211	Rev	Minaret ar Minaret et	The 65	Haut d				2002		1	Y 2002	64,51589	34,39642	70		0	1	1	
4	1590	569	Bis	Historic Ce Centres hi	Berat e	Berat e	Gjrokastra sont	insc		2005,2008		0		20,13333	40,06944	58,9		0	0	1	
5	1563	570	ter	Butrint	Butrint	Inhabit	Habit	depuis les ten		1992,1999		0	2005	P 1997-200	20,02611	39,75111		0	0	1	
6	111	102		Al Qal'a of La Kalâa di	In a m	Dans un site	montagneux d&			1980		0		4,78684	35,81844	150		0	0	1	

Figure 147 - The Attribute Table

The [unique\_num] field is, probably, the primary key of the database.

Imagine that we desider plan a journey and visit cultural and natural sites listed before [unique\_num]:

230; 234; 1590; 1563; 111



We would add to the table some information, such as a “Y” (YES), a month and a year (for the travel).

Open Your text editor and create Your first Database (CSV format).

In the first line, we have to **write the column names, separated by a semicolon**, for example:

CODE;VISIT;MONTH;YEAR;

In the other lines, the data You want to JOIN to the shapefile:

230;Y;JANUARY;2022;

234;Y;JUNE;2021;

1590;Y;SEPTEMBER;2225;

1563;Y;DECEMBER;2223;

111;Y;APRIL;2225;

The result will be:

CODE;VISIT;MONTH;YEAR;

230;Y;JANUARY;2022;

234;Y;JUNE;2021;

1590;Y;SEPTEMBER;2225;

1563;Y;DECEMBER;2223;

111;Y;APRIL;2225;

Save Your File into Your working folder as “journey.csv” (before saving, change the type from text to All files” \*.\*).

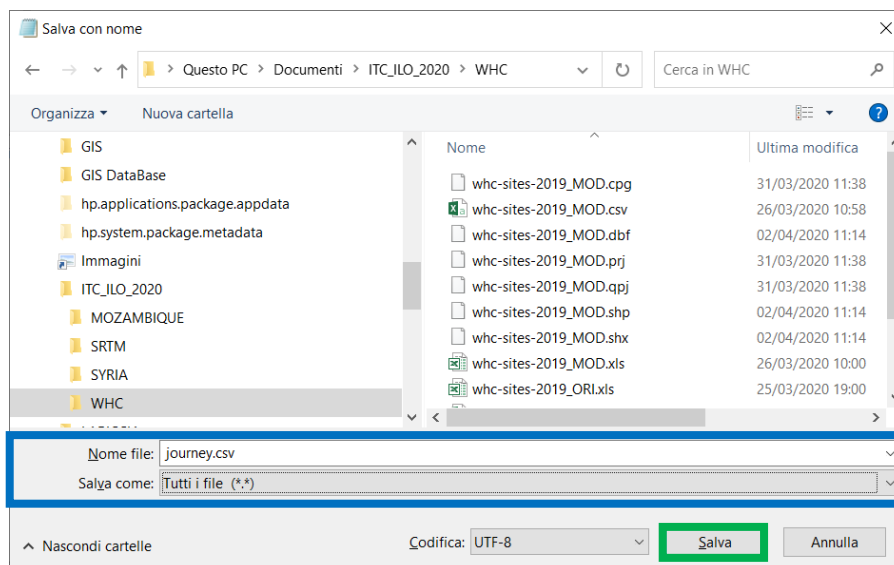



Figure 148 - Save as Dialog - CSV format

As seen before, open the  Data Source Manager (**Ctrl+L**) and search for “Delimited Text”. Browse the file explorer until “journey.csv”:

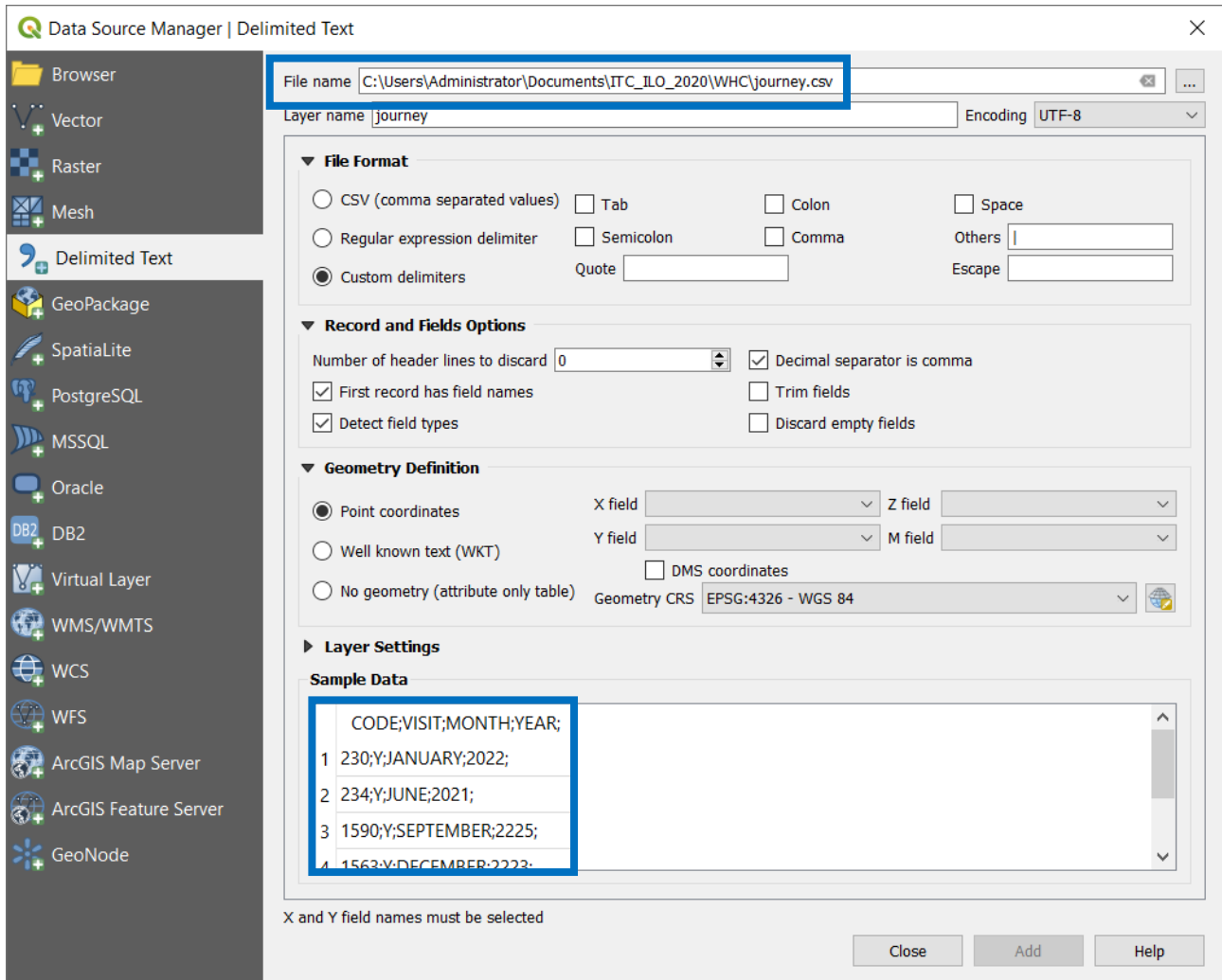


Figure 149 - Data Source Manager - Add a Demimited Text #1

Click on “Custom delimiters”, than on “semicolon” and – under the **Geometry definition** – “No geometry (attribute only table)”

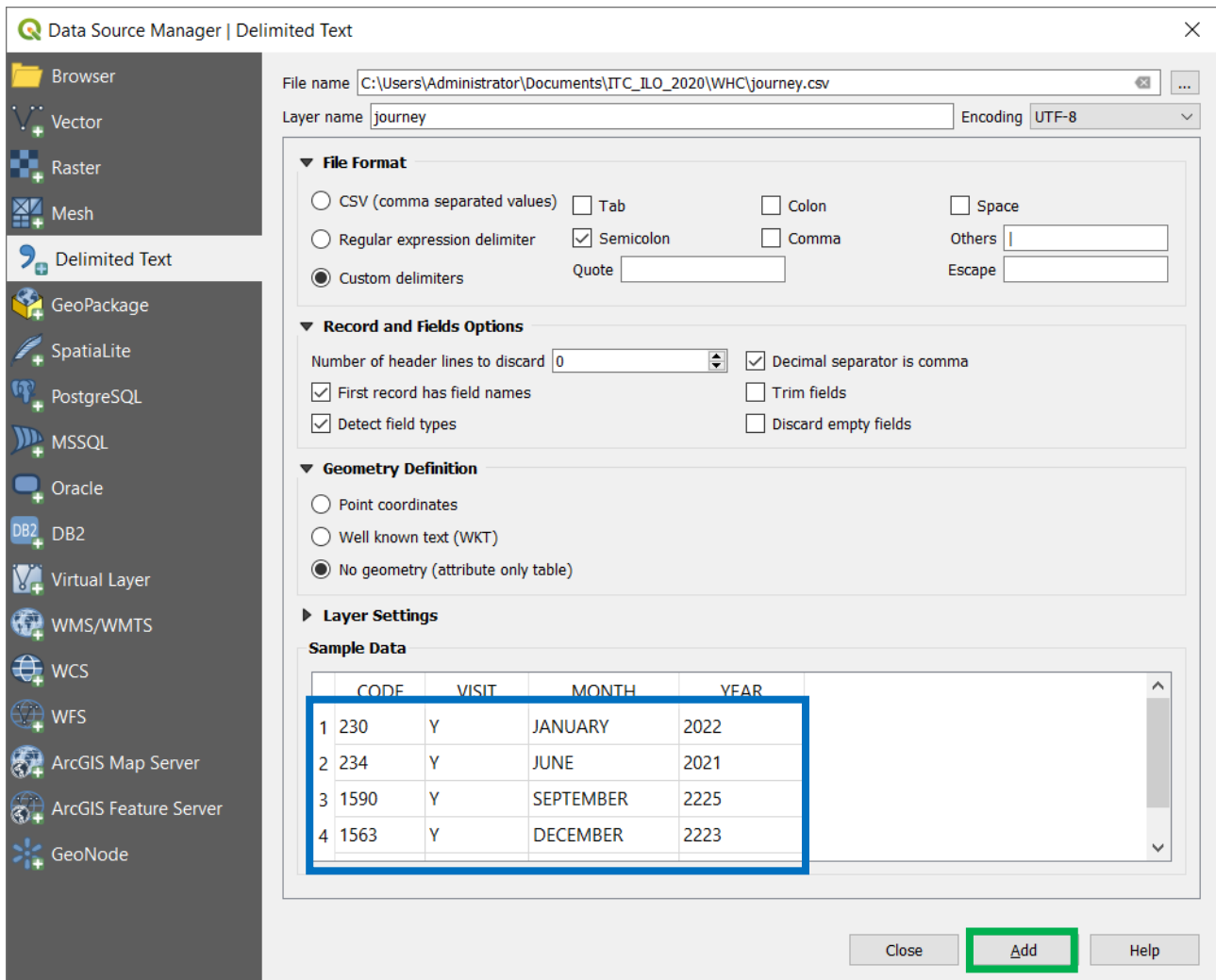


Figure 150 - Data Source Manager - Add a Demimited Text #2

Now, "Add" and "Close" the dialog.

The table will added to the "Layers Panel":

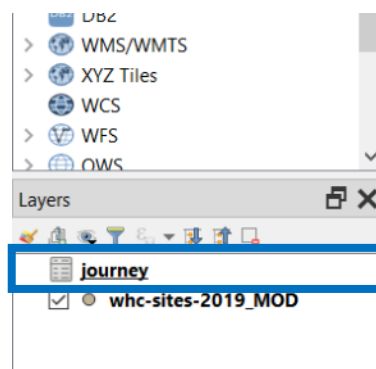


Figure 151 - Layer Panel - Add Table

With the mouse on the table name, right click and open the table:

	CODE	VISIT	MONTH	YEAR
1	1563	Y	DECEMBER	2223
2	1590	Y	SEPTEMBER	2225
3	111	Y	APRIL	2225
4	234	Y	JUNE	2021
5	230	Y	JANUARY	2022

Figure 152 - The Journey Table

We have created a DB and we have loaded it into QGIS. Now we want to **JOIN** this table with the data coming from WHC.

Right click on the WHC layer name and choose “Properties”. Search for “**JOIN**” and click on it”.

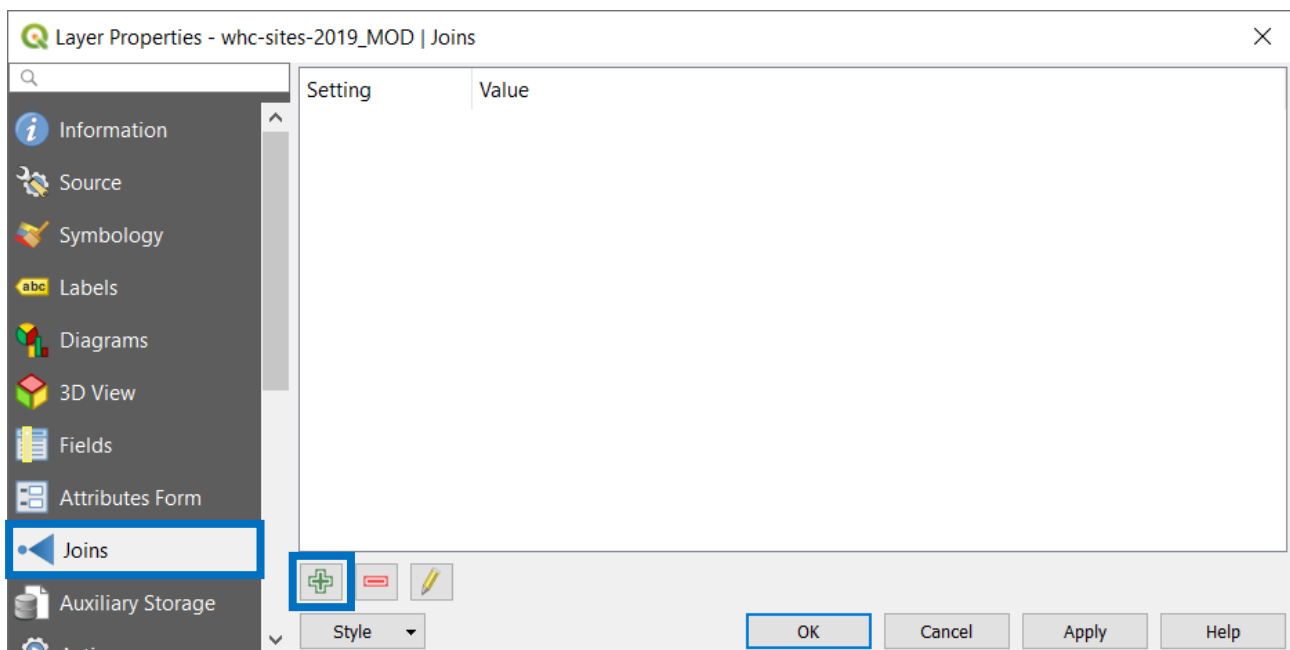


Figure 153 - Layer Properties - Join #1

In order to add a condition (create a relationship between WHC data and the new table) we have to select the Plus sign. As “Join layer”, select the new table; as “Join field”, select the field of the new table [CODE] that contains the “unique code”, useful to link data with WHC; as “Target field”, the unique code [unique\_name] of WHC data.

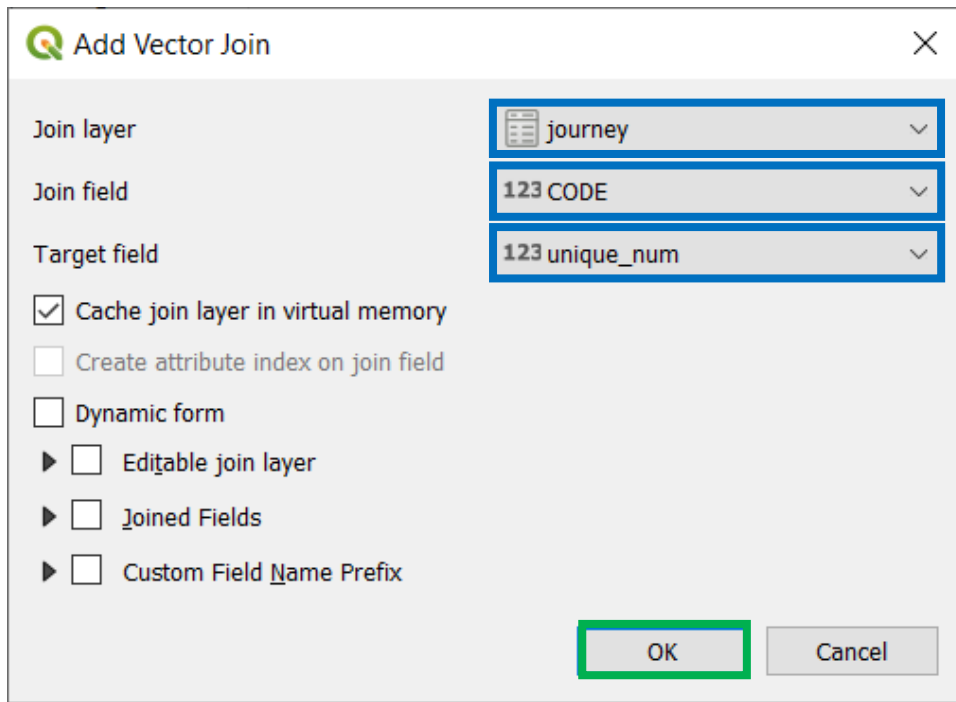


Figure 154 - Layer Properties - Join #2

Press "OK" to confirm and close the dialog.

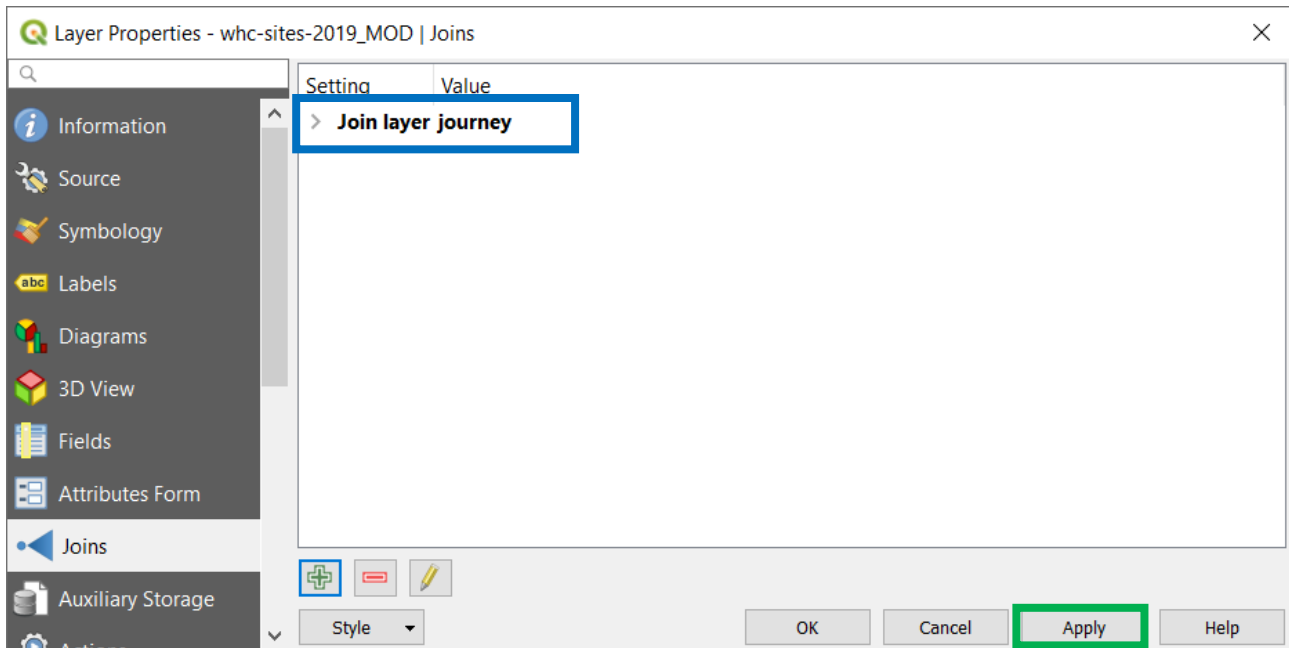


Figure 155 - Layer Properties - Join #3

Press "Apply" to confirm and "OK" to close the dialog and exit.

Now re-open the attribute table of WHC:

whc-sites-2019\_MOD : Features Total: 1121, Filtered: 1121, Selected: 0

	unique_num	id_no	rev_bis	name_en	name_fr
1	100	93	NULL	Church and Do...	L'église et le
2	1000	849	NULL	Archaeological ...	Site archéolo

Figure 156 - The WHC Table after a Join #1

The number of (geometric) feature are the same (1121) but the procedure has added more columns:

CRITERIA_N	journey_VISIT	journey_MONTH	journey_YEAR
1-1-0-0-0-0-0-0-0-0	NULL	NULL	NULL
0-1-1-0-0-1-0-0-0-0	NULL	NULL	NULL
0-0-1-1-0-0-0-0-0-0	NULL	NULL	NULL
1-1-0-0-0-0-0-0-0-0	NULL	NULL	NULL
0-0-1-1-0-0-0-0-0-0	NULL	NULL	NULL
0-0-0-0-0-0-0-0-1-0	NULL	NULL	NULL
0-1-1-1-0-0-0-0-0-0	NULL	NULL	NULL
0-0-1-1-0-0-0-0-0-0	NULL	NULL	NULL
0-1-0-1-0-0-0-0-0-0	NULL	NULL	NULL
0-0-1-0-0-1-0-0-0-0	NULL	NULL	NULL

Figure 157 - The WHC Table after a Join #2

The “field names” have, as suffix, the table name of origin: **journey\_VISIT**; **journey\_MONTH**; **journey\_YEAR**.

No data (**NULL**) values are show because the **JOIN** puts into relationship only the matching codes

Try to search for the code<sup>[108]</sup> that we have considered and use the “Select features using an expression” to build an appropriate query.

The correct syntax should be:

"unique\_num" = 230 or "unique\_num" = 234 or "unique\_num" = 1590 or "unique\_num" =1563 or "unique\_num" = 111

Remember that “Based on layer data and prebuilt or user defined functions, **Expressions** offer a powerful way to manipulate attribute value, geometry and variables in order to dynamically change the geometry style, the content or position of the label, the value for diagram, the height of a layout item, select some features, create virtual field ...”<sup>[109]</sup>

108 230; 234; 1590; 1563; 111

109 [https://docs.qgis.org/testing/en/docs/user\\_manual/working\\_with\\_vector/expression.html#the-expression-string-builder](https://docs.qgis.org/testing/en/docs/user_manual/working_with_vector/expression.html#the-expression-string-builder)

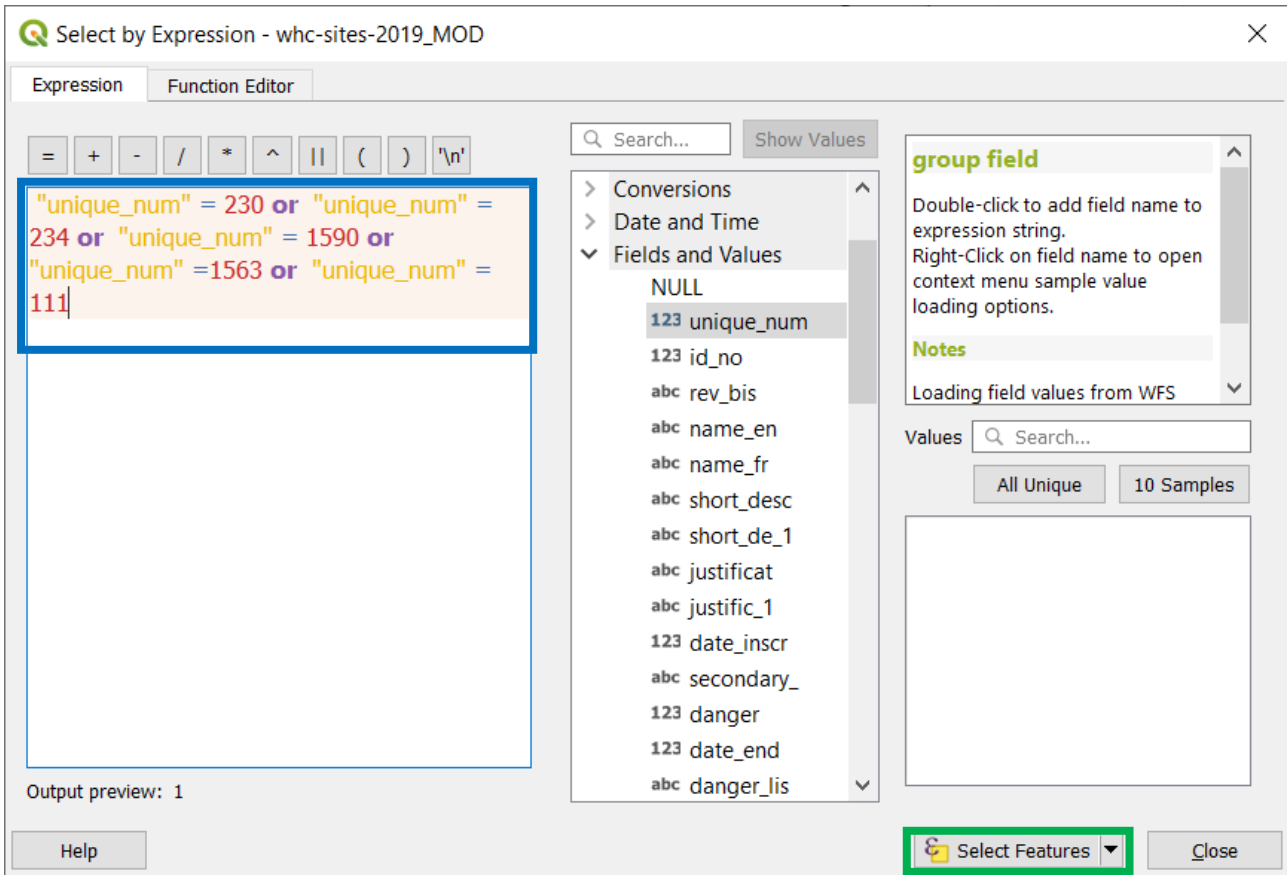


Figure 158 - Select by Expression

Select Features and close the dialog.

In the table, five record are selected (use the "Show Selected Feature" filter)

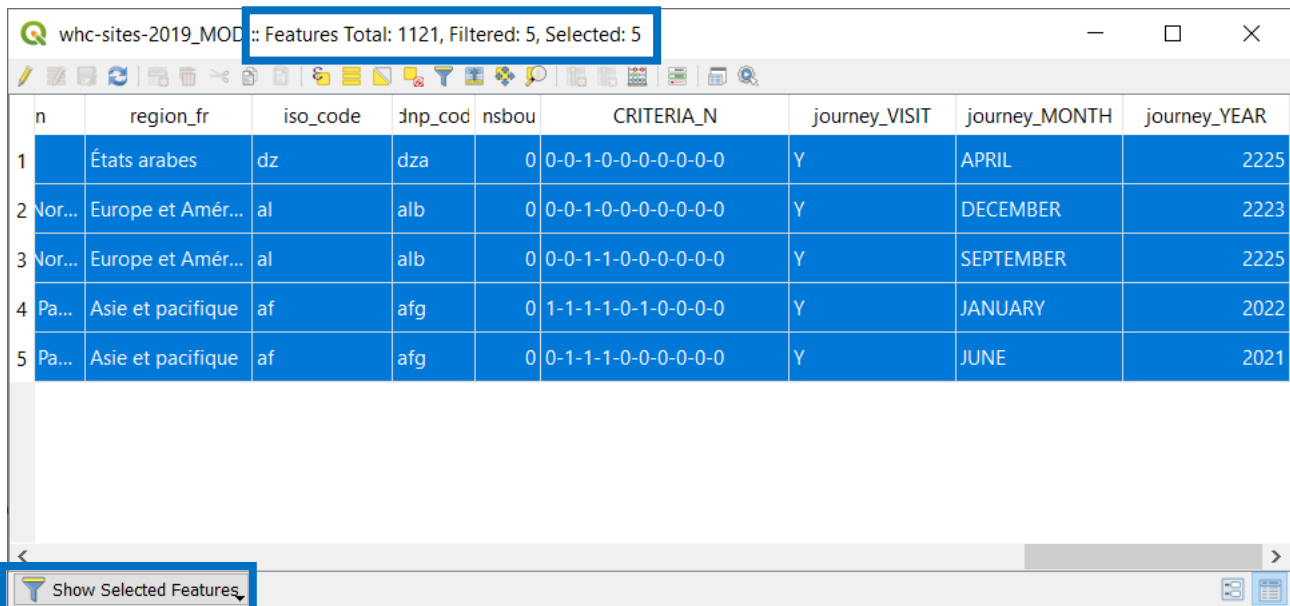


Figure 159 - The result of a "Select by Expression"

In the map, five point are highlight (right click on the layer name and choose "Zoom to Selection")



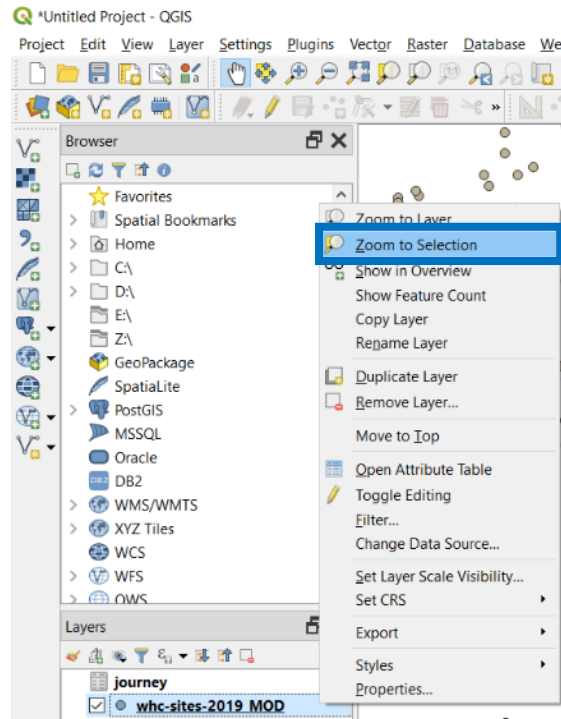


Figure 160 - Zoom to Selection

And, changing the layer fill colour (in yellow the points selected):

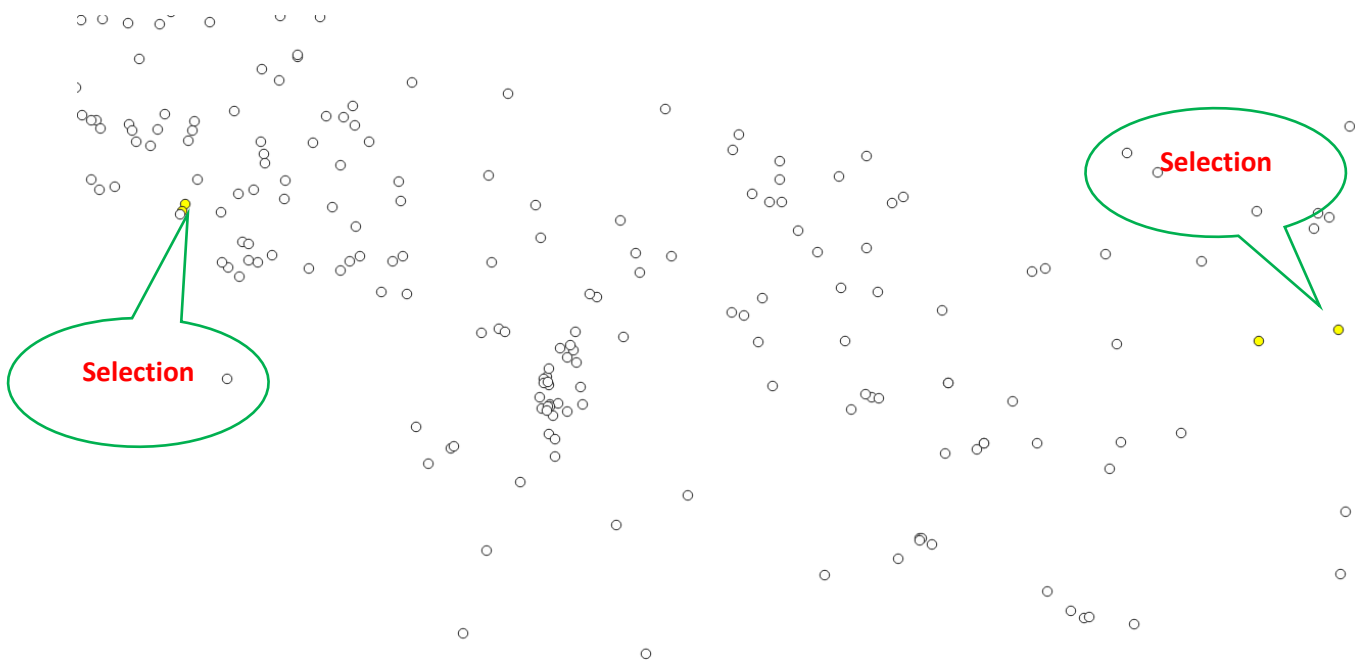


Figure 161 - A Zoom to Selection

### Create Your Output

Once upon our map is “complete” probably we decide to produce an “output”, i.e. a simple image, maybe a printed version or a professional template to publish it into an article or in a book.

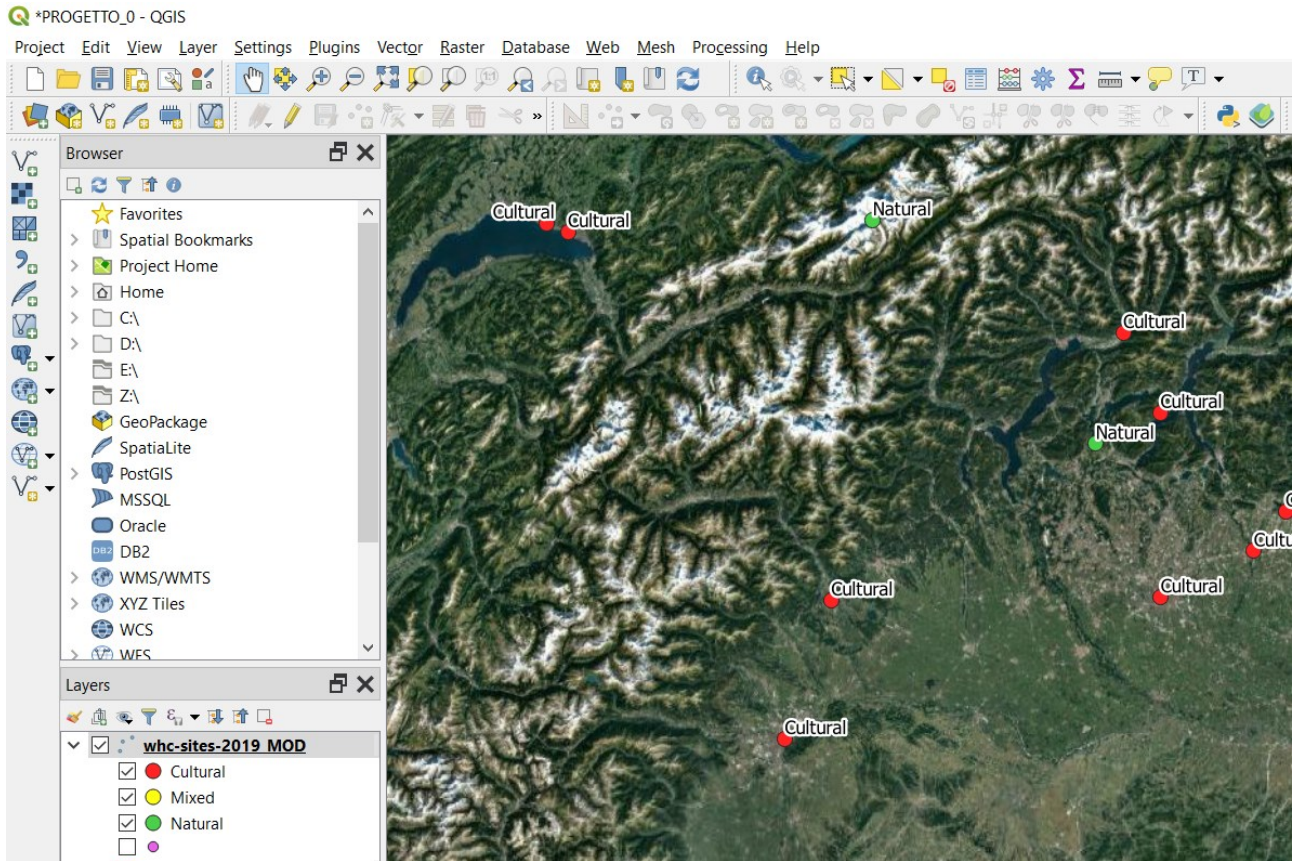


Figure 162 - A simple map display

### Method 1: Export Map

The easiest way is to export an image. From **Project > Import / Export > Export Map to Image**.

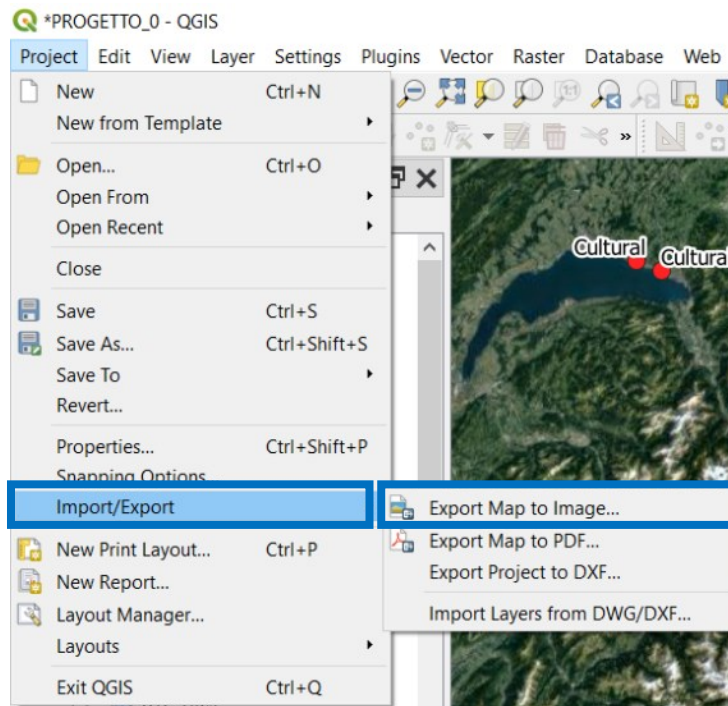


Figure 163 - Export Map to Image

This command will display a dialog in which we can set out some parameters (such as the scale, the resolution, output width and height and so on):

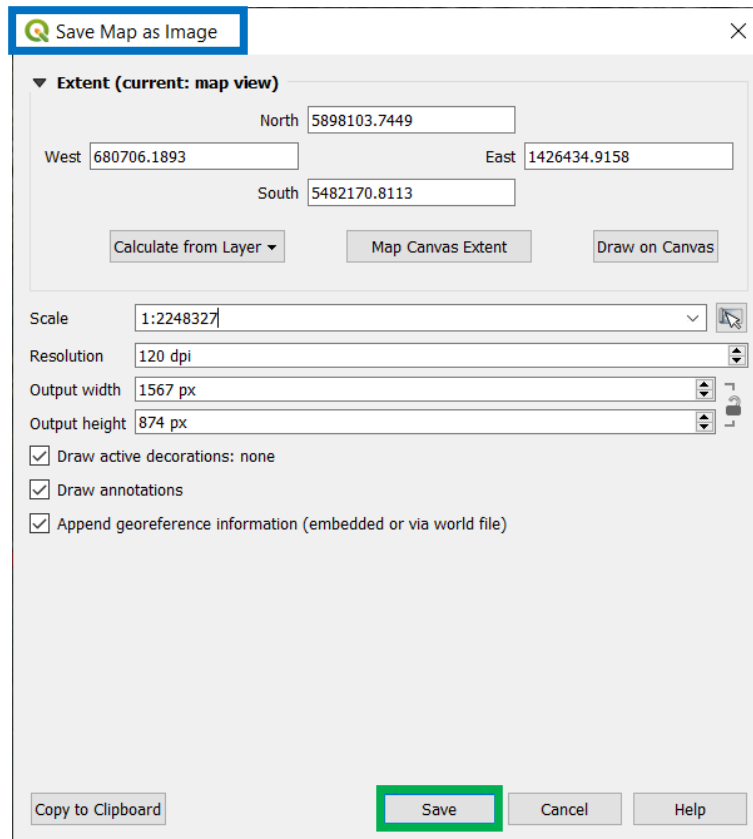


Figure 164 - Save Map as Image

By pressing the “Save” button will open a new dialog, in which we have to browse for a folder, to set an appropriate file name and a file format among these:

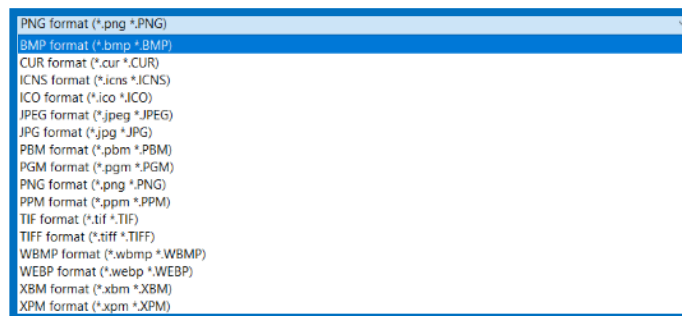


Figure 165 - Choose an Image file format

Accord the settings, the procedure will export a georeferenced image:

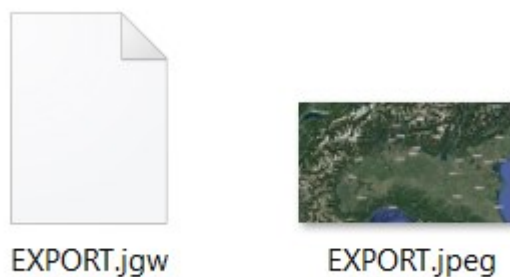


Figure 166 - Export a Georeferenced Image (with a SideCar file)

Export image or PDF

As seen before, an export versus PDF is very similar. **Project ► Import / Export ► Export Map to PDF...**

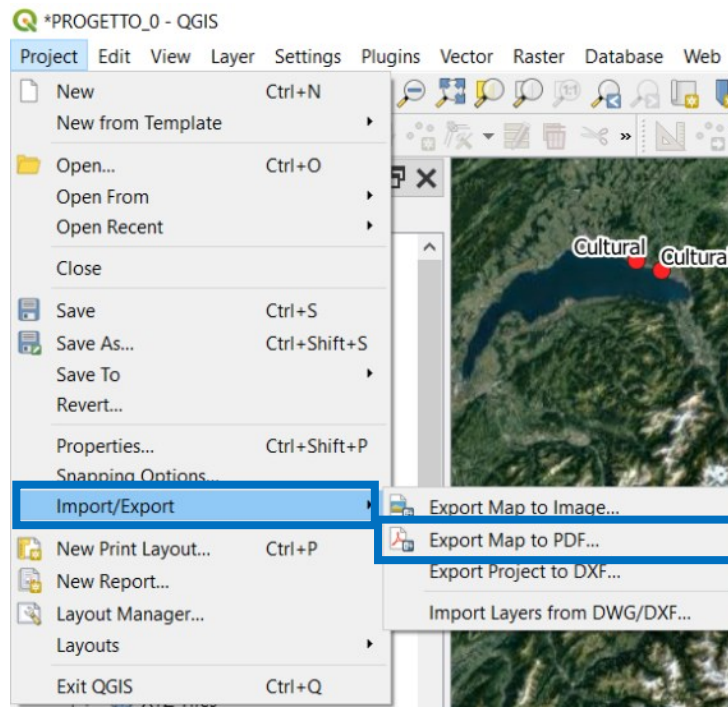


Figure 167 - Export Map to PDF

The dialog is similar to the previous one. Explore You the difference:

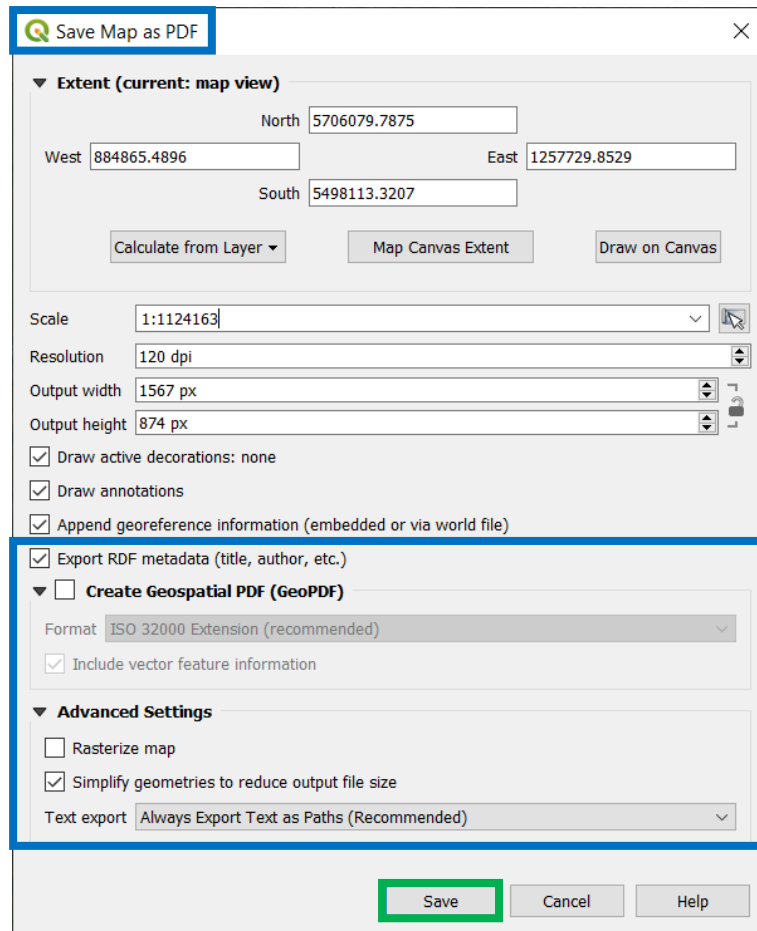


Figure 168 - Save Map as PDF

### Creating a Layout

We have produced simple images: these are missing several pieces of information (a sort of short metadata just to describe the map process) such as:

- Title
- Legend
- Scale (graphic and/or numeric)
- North Arrow
- Author name and / or note
- Images
- Diagrams
- Copyright advice
- Other



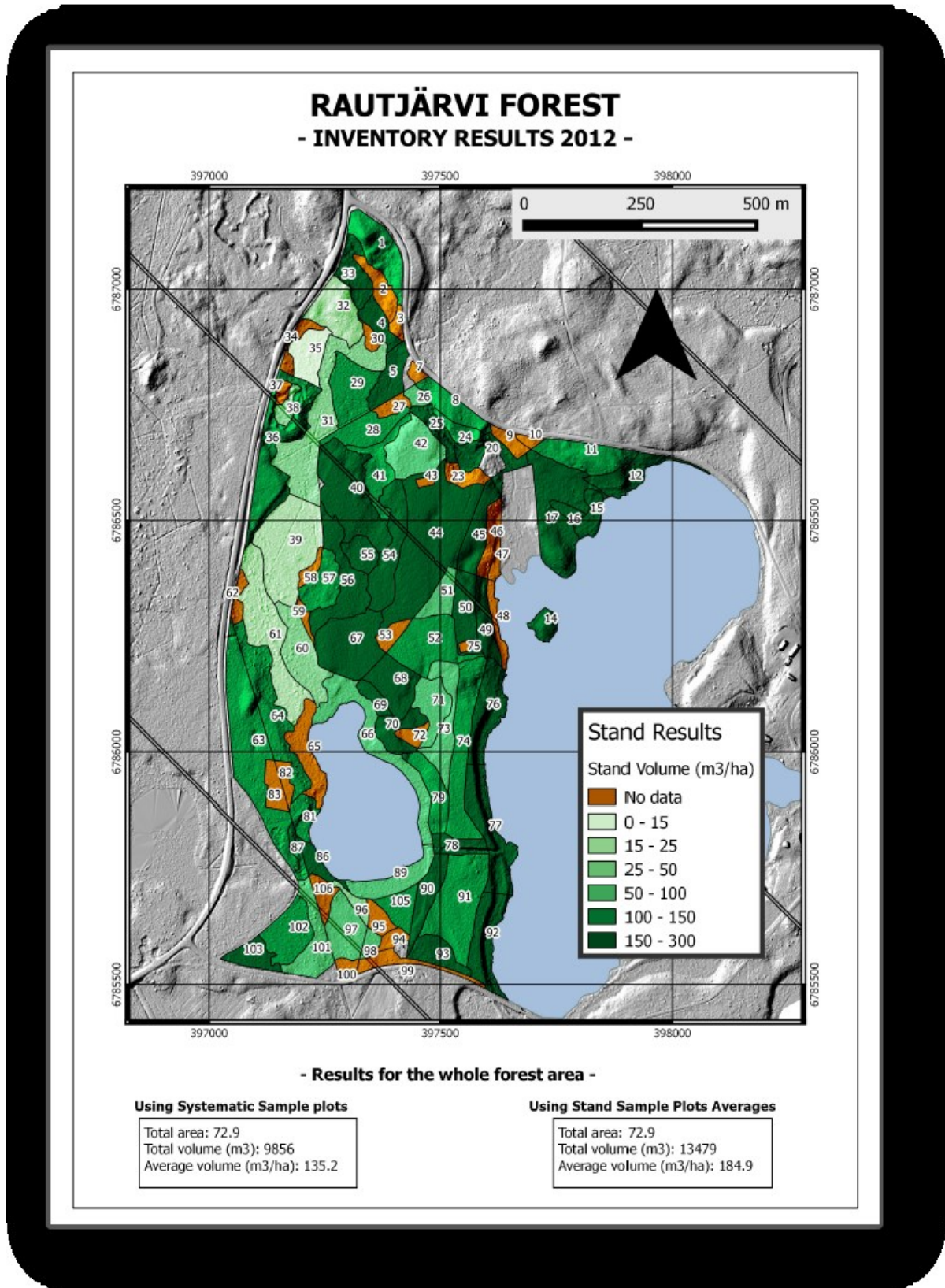


Figure 169- Example of Printed Map<sup>111</sup>

110 [https://docs.qgis.org/3.10/en/docs/training\\_manual/forestry/results\\_map.html?highlight=layout](https://docs.qgis.org/3.10/en/docs/training_manual/forestry/results_map.html?highlight=layout)

This is why we have to create a Print Layout: **Project ► New Print Layout...** or (**Ctrl+P**). Enter a “unique print layout title”:

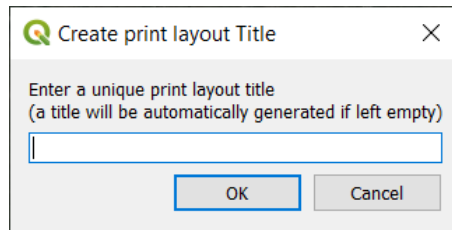


Figure 170 - Create a Print Layout Title #1

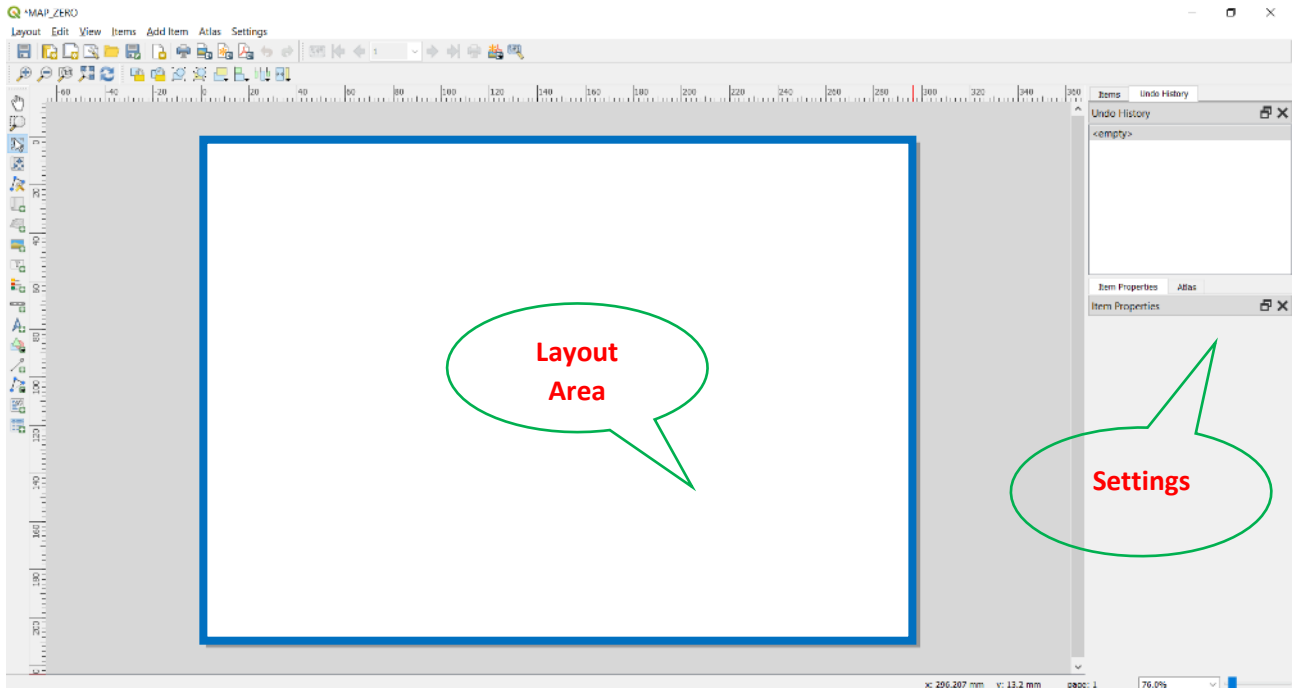


Figure 171 - Create a Print Layout

Right click of the mouse into the “Layout Area” will let us to choose the “Page Properties...” and “Manage Guides for Page”:

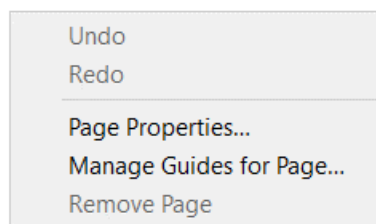


Figure 172 - Layout - Page Properties commad



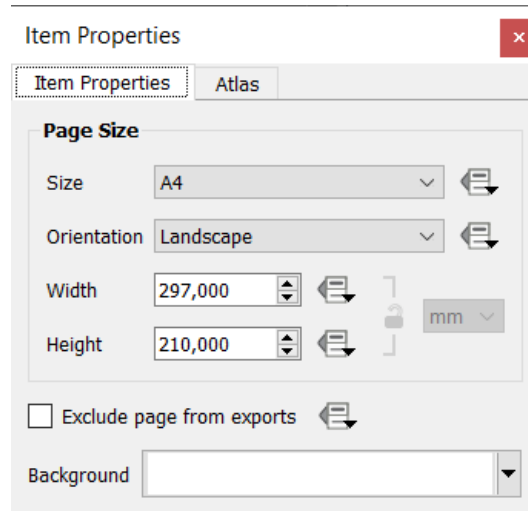



Figure 173 - Layout - Page Size

In this dialog is possible to set up the page format (A4, A3...), the orientation and so on.

Add a Map

“The map item is the main frame that displays the map you’ve designed in the map canvas.”<sup>[112]</sup> Use the  (Adds a New Map to the Layout) button to insert a “New Map”. After clicking, click with the left button of the mouse, draw a box in the map area and release the mouse button. Remember to leave space for the title, for the legend and for the other objects (but map space can be modify later also).

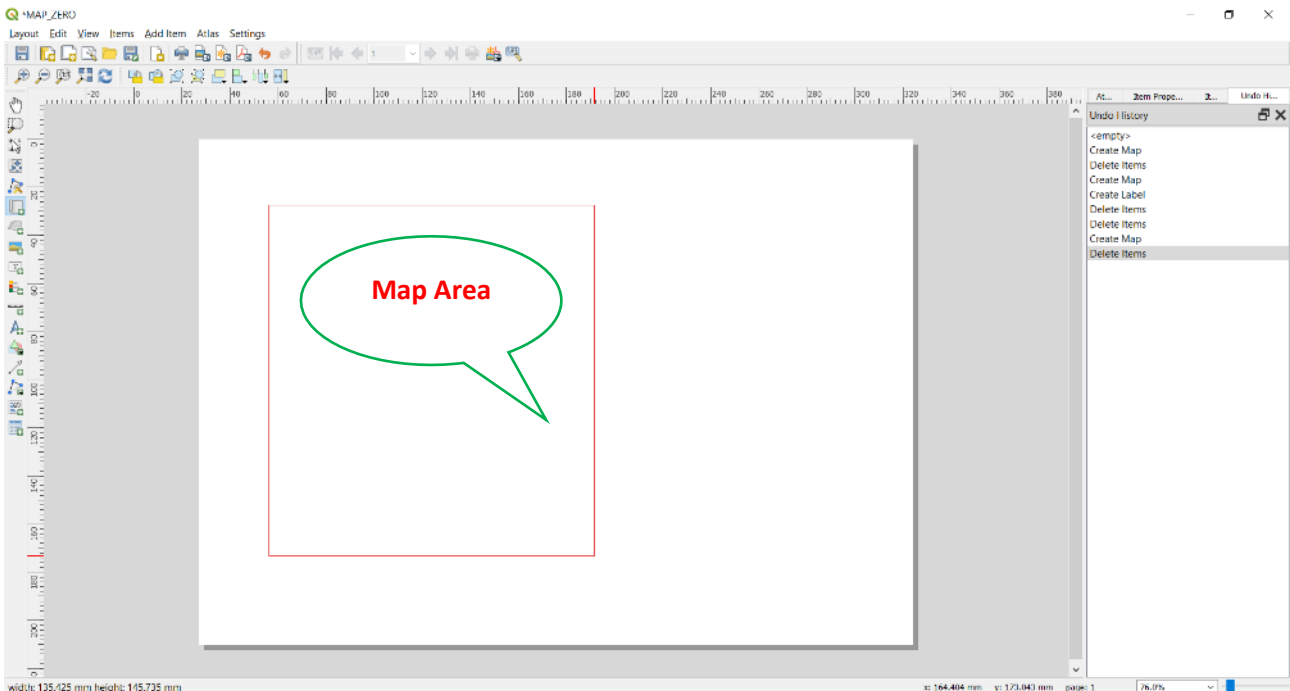


Figure 174 - Layout - Insert Map#1

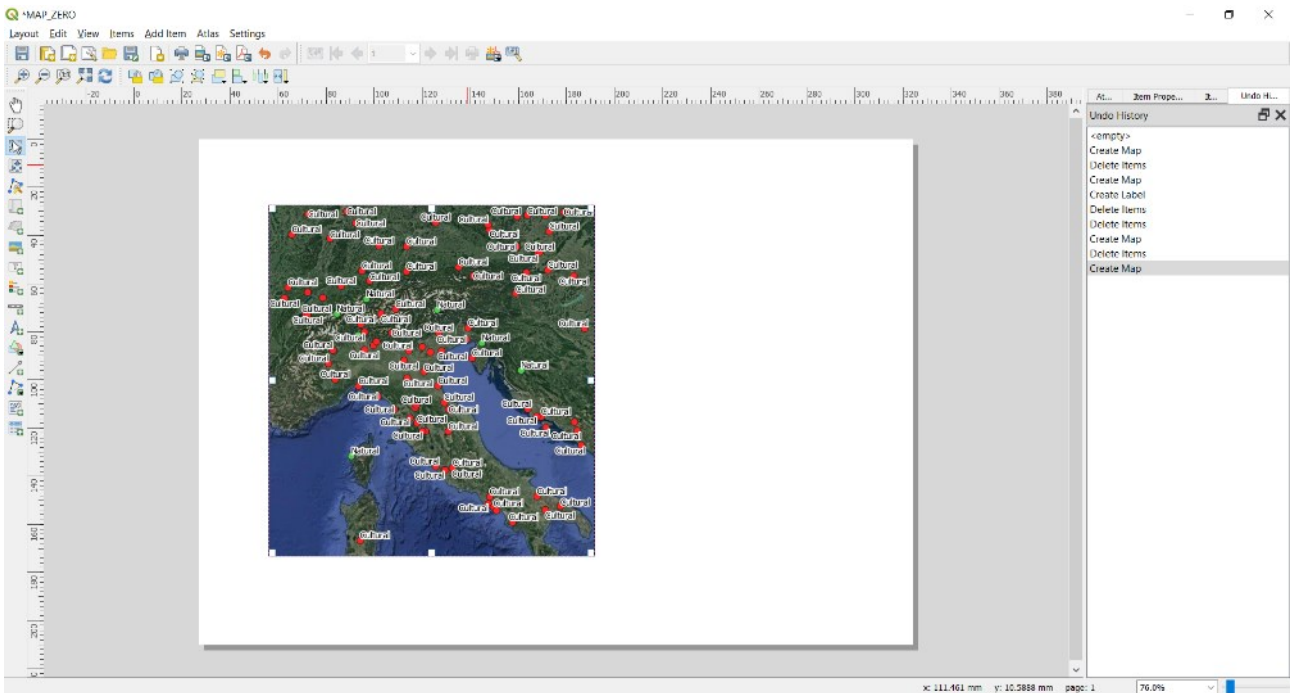



Figure 175 - Layout - Insert Map#2

Add a Title or a Text Box

To insert a title or a text box, use the button  (Adds a New Label to the Layout), click on the layout and if necessary, set the “New Item Properties”:

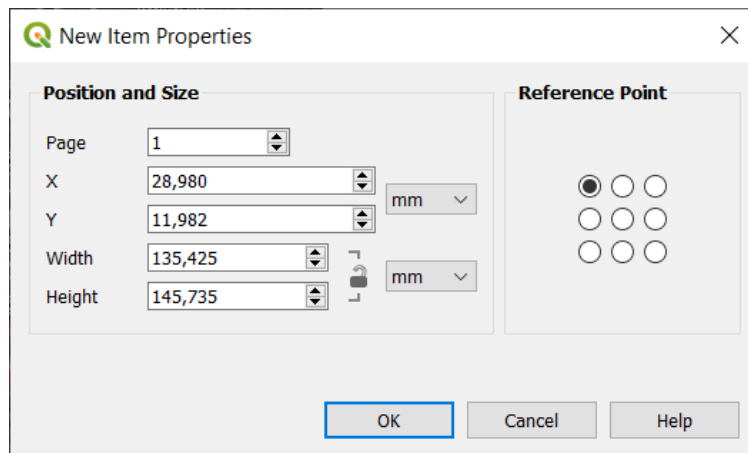


Figure 176 - Layout - New Item Properties

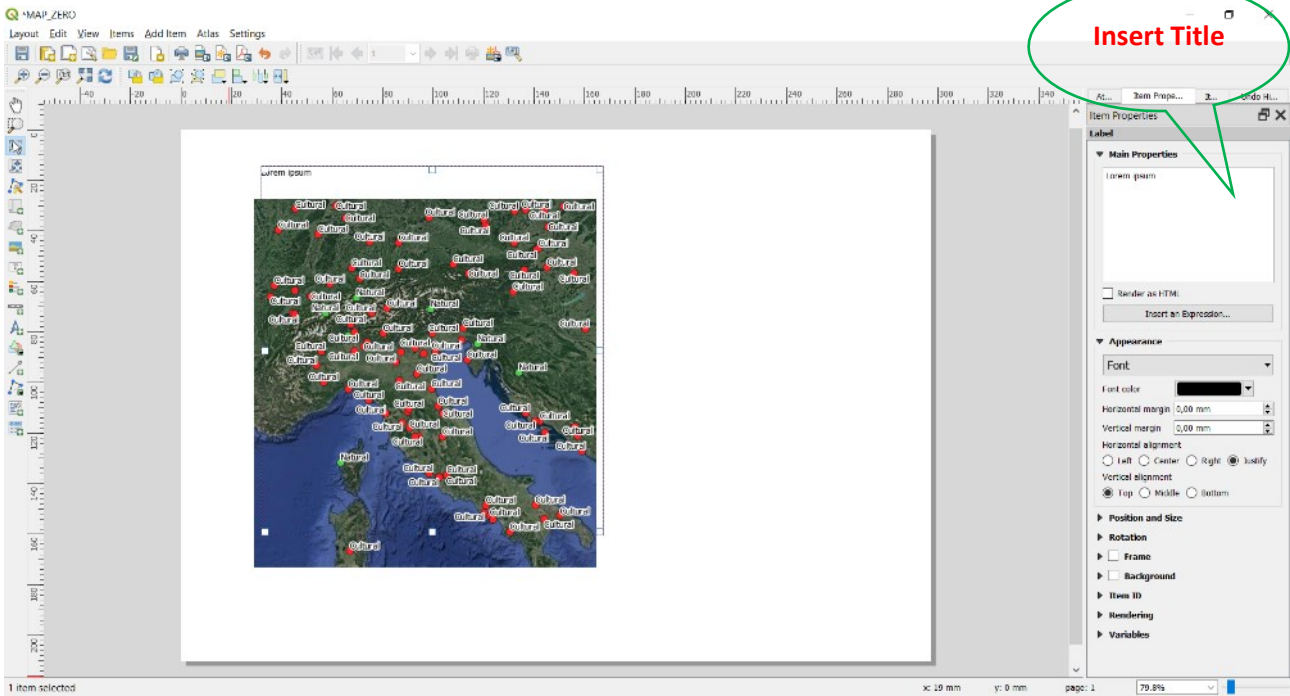


Figure 177 - Layout – Insert Title#1

Click on the “Main Properties” and type the title. It is possible to choose the font, the position and size, margins, alignment and so on.

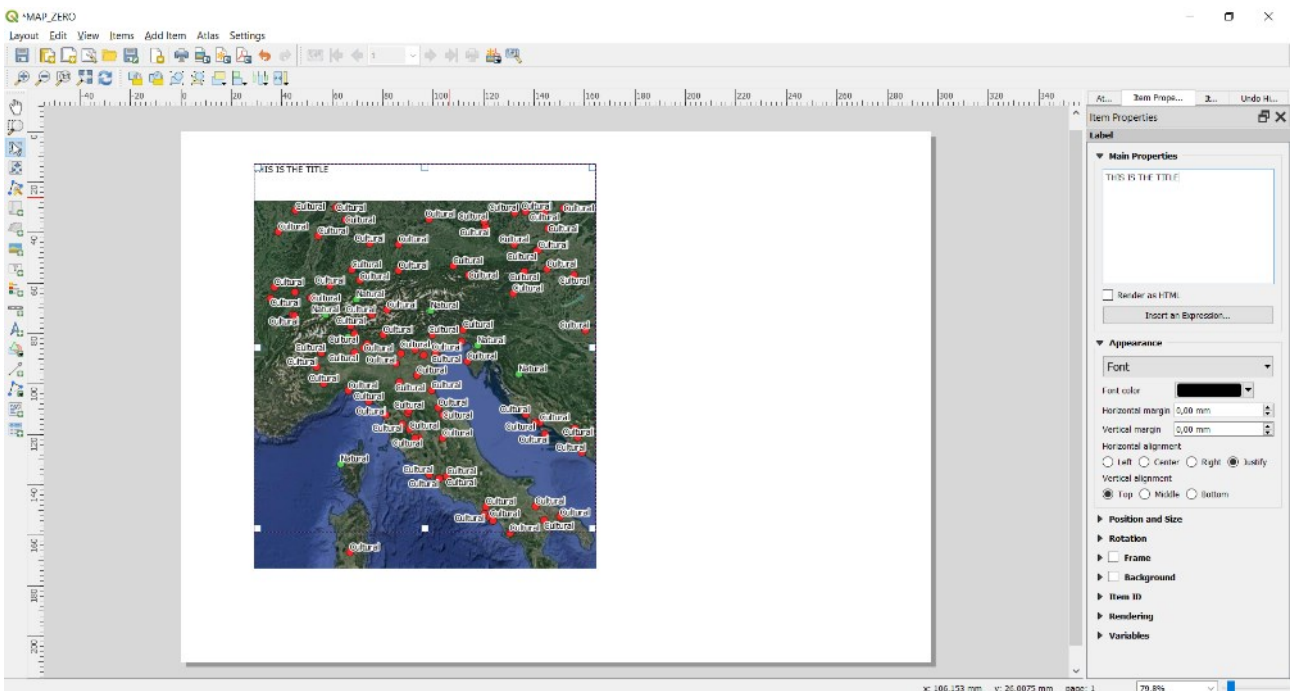



Figure 178 - Layout . Insert Title#2

Add a Legend

Click on the button  (Adds a New Legend to the Layout) and, then, on a “white space”. As seen before, click on the layout and set the “New Item Properties”. Close the dialog and, if necessary, resize the object.

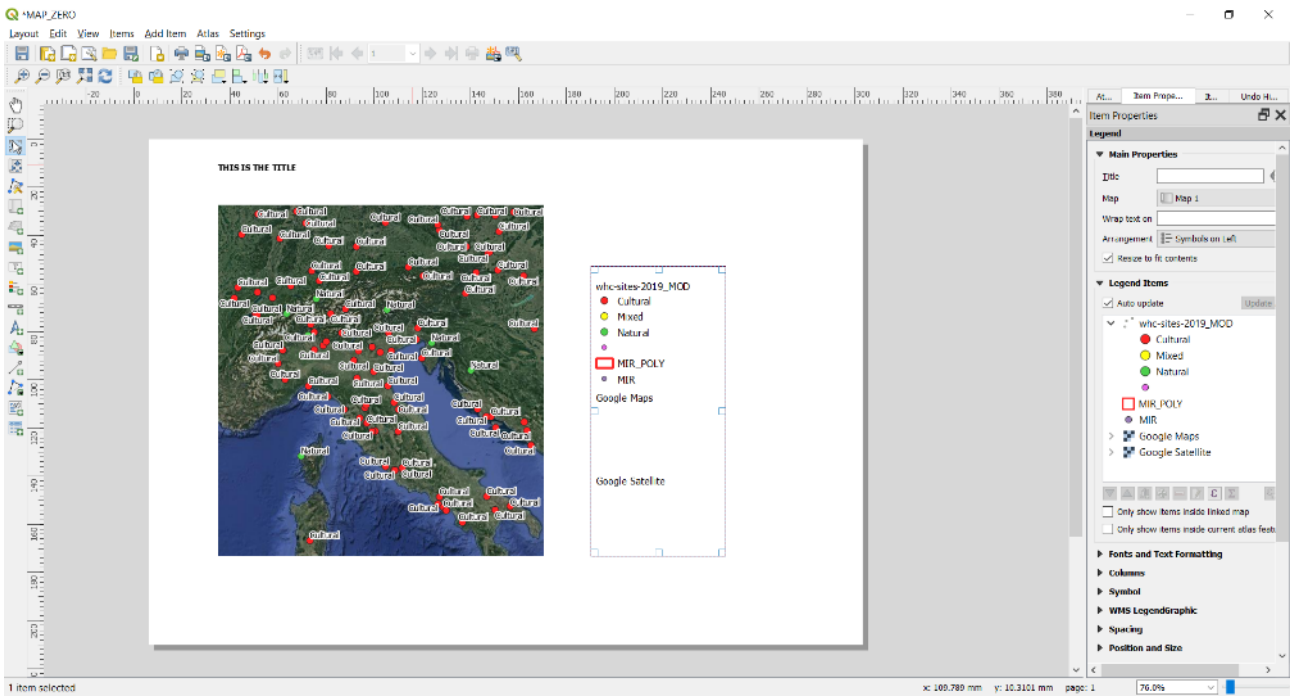



Figure 179 - Layout - Insert Legend

Add a Scale

To add a scale bar<sup>[113]</sup> use the button  (Adds a New Scale\_Bar to the Layout). As seen before, click on the layout and set the “New Item Properties”. Close the dialog and resize if necessary, the object.

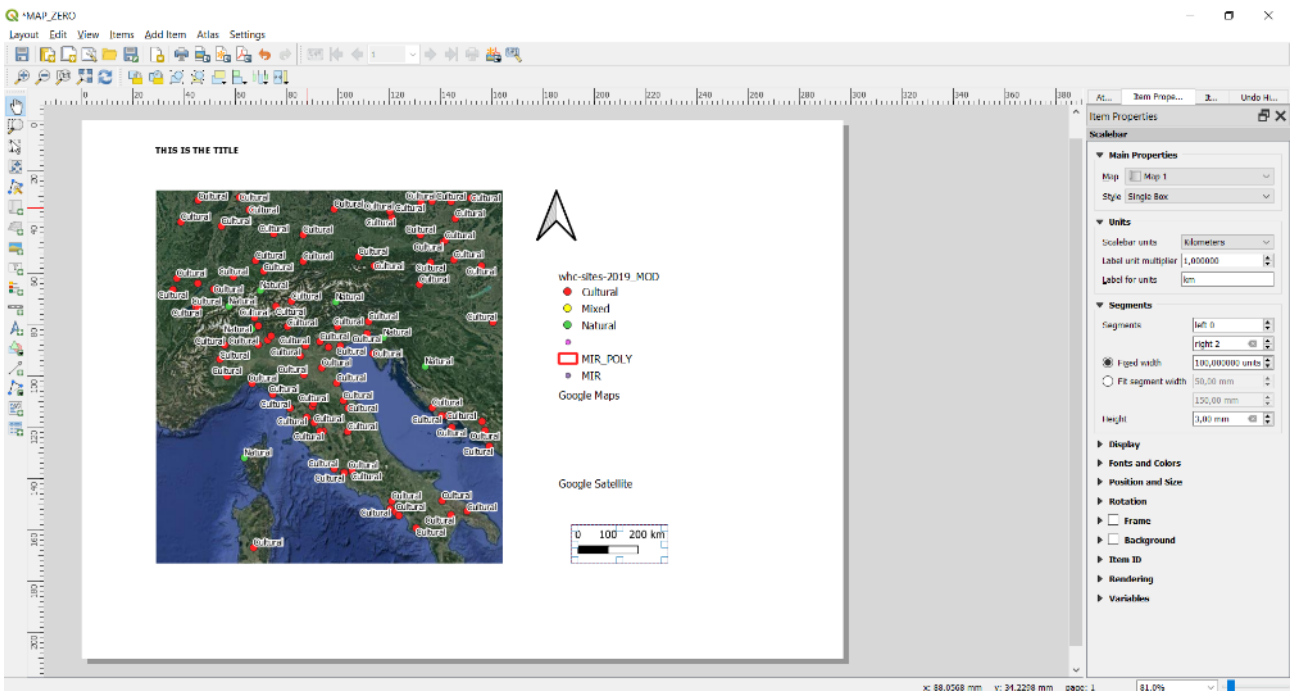


Figure 180 - Layout . Insert Scale Bar

113 [https://docs.qgis.org/3.10/en/docs/user\\_manual/print\\_composer/composer\\_items/composer\\_scale\\_bar.html](https://docs.qgis.org/3.10/en/docs/user_manual/print_composer/composer_items/composer_scale_bar.html)

Add a North Arrow

Click on the button “Add a New North Arrows to the Layout”<sup>[114]</sup>. As seen before, click on the layout and set the “New Item Properties”. Close the dialog and resize, if necessary, the object.

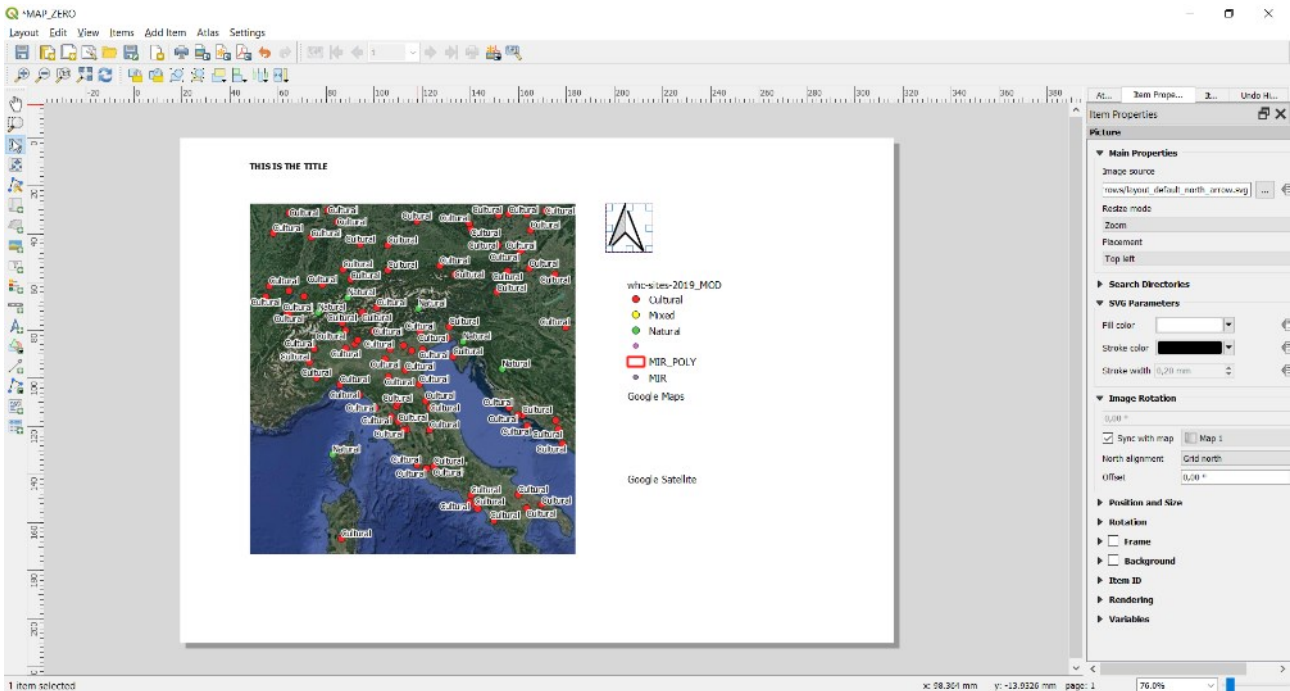


Figure 181 - Layout - Insert North Arrow

Export as PDF, SVG or Image

The buttons let You to Export (Print) Your Layout. If Your Project contains WMS layers, a warning will be displayed:

Some WMS servers (e.g. UMN mapserver) have a limit for the WIDTH and HEIGHT parameter. Printing layers from such servers may exceed this limit. If this is the case, the WMS layer will not be printed

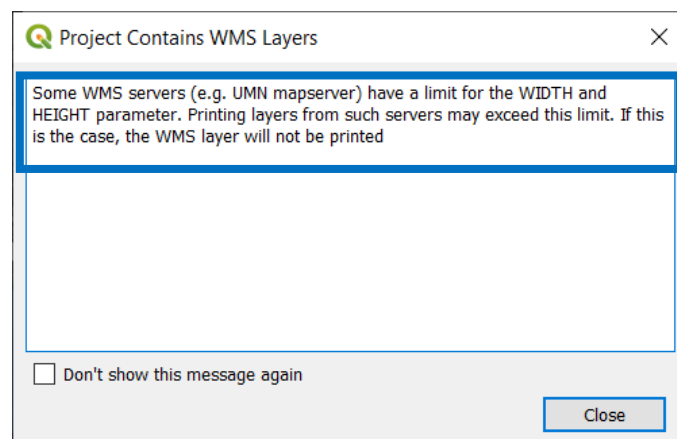


Figure 182 - Layout - Project Contains WMS Layers

Create and Publish a (simple WebGIS) using qgis2web

“Web mapping is a great medium to publish your GIS data to the web and make it accessible by other users. Creating a web map is a very different process than creating one in a GIS. GIS users are typically aren’t web

114 [https://docs.qgis.org/3.10/en/docs/user\\_manual/print\\_composer/composer\\_items/composer\\_image.html?highlight=north](https://docs.qgis.org/3.10/en/docs/user_manual/print_composer/composer_items/composer_image.html?highlight=north)

programmers and it presents a challenge when one needs to create a web map that is of the same quality as a map creating in a GIS. Fortunately, there are tools available to easily translate your work in QGIS to web maps”<sup>[115]</sup>.

This chapter would introduce to WebGIS publishing. If we have to manage a “million of information” this is not the correct tool. To manage “hard data” is better and choose other architecture based on database: for example, LIZMAP on PostgreSQL+PostiGIS database

QGIS lets the user to add more functionalities to core software. This is possible by using the **Plugins ► Manage and Install Plugins** Menu. The system will check the network

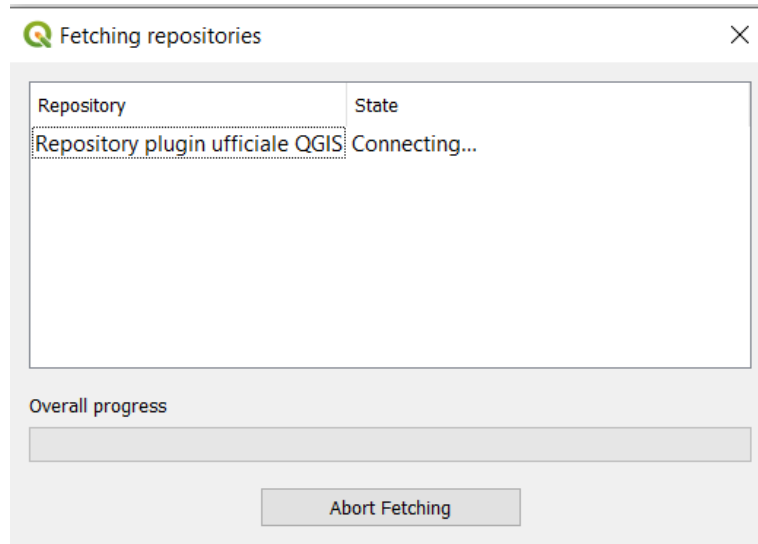


Figure 183 - Plugins - Fetching Repositories

and, if OK, a complete list of PLUGINS will displayed on the screen. Look at the Plugin counter:



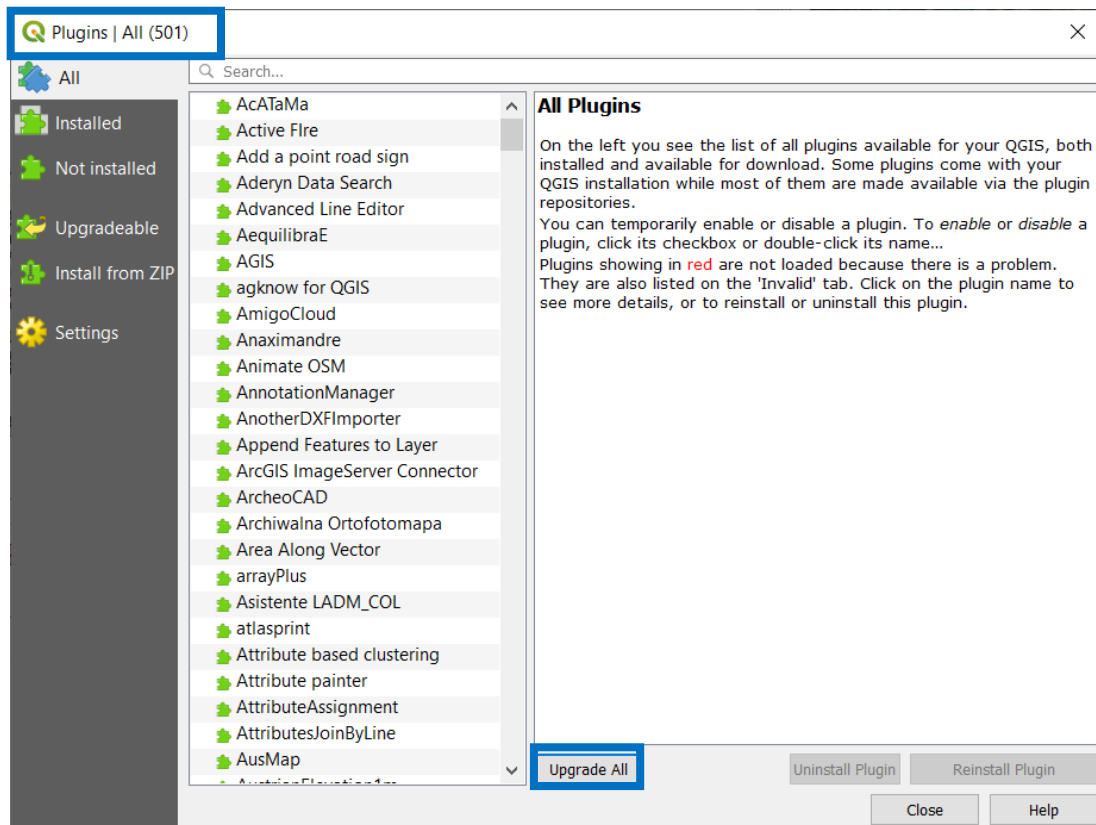


Figure 184 - The Plugins List

It is possible to “Upgrade” a single plugin or use the Upgrade All (the installed plugin) in order to keep align the software with the plugin version.

If the Plugin counter does not show a similar numer probably there is a network trouble and maybe it is necessary:

- Check the connection
- Modify the Lan / Proxy Settings

To check the connection, look at Your Router. Then, browse to the [Plugins ► Manage and Install Plugins ► Settings](#) and look for the Status. If the sign is **green** all is OK:



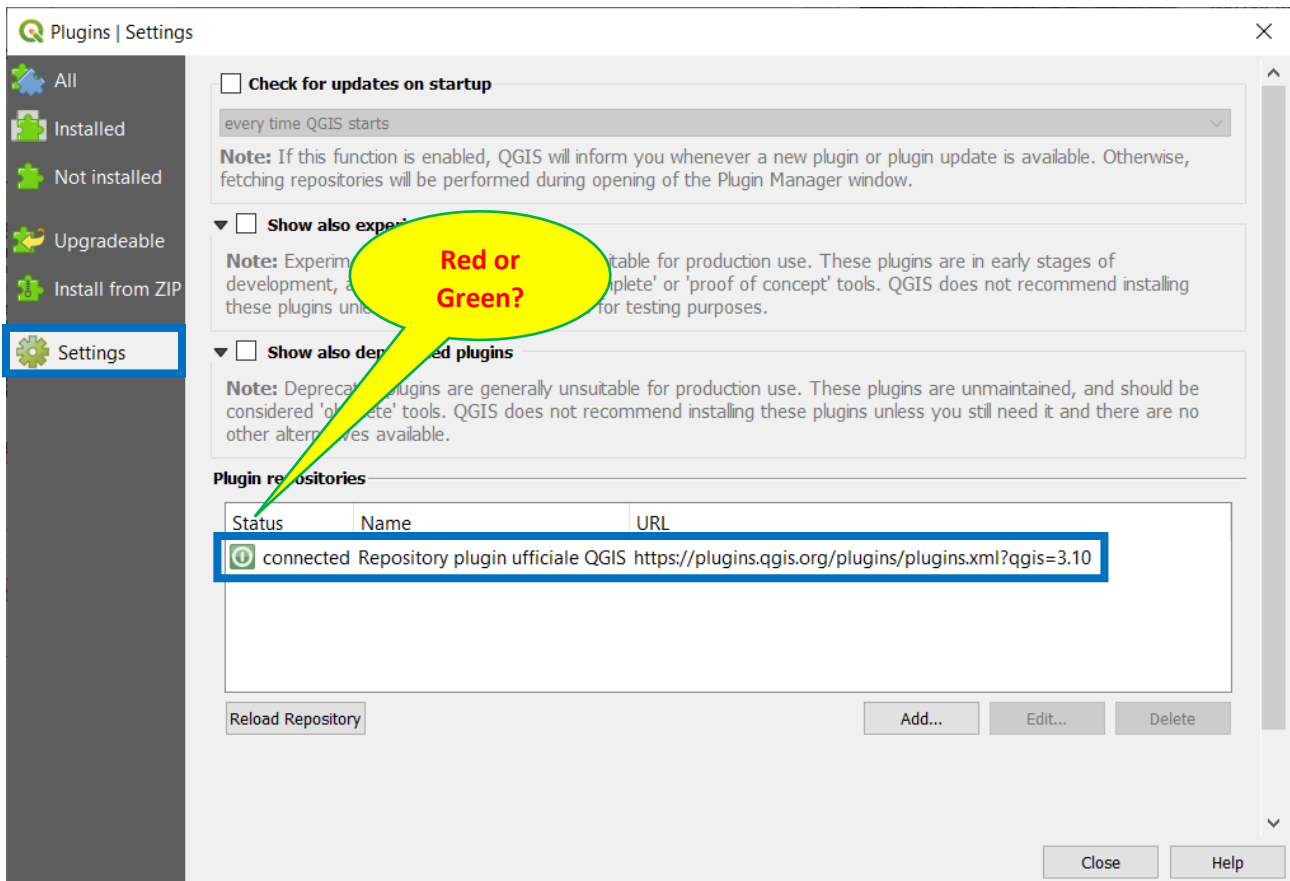


Figure 185 - Plugins - Check the Internet Connection#1

To verify, “globally”, the network, go to **Settings > Options > Network** and try to check “Use proxy for web access” and, in the **Proxy type** window, choose “DefaultProxy”. If these procedure do not resolve, ask to You System Administrator or Network Provider.

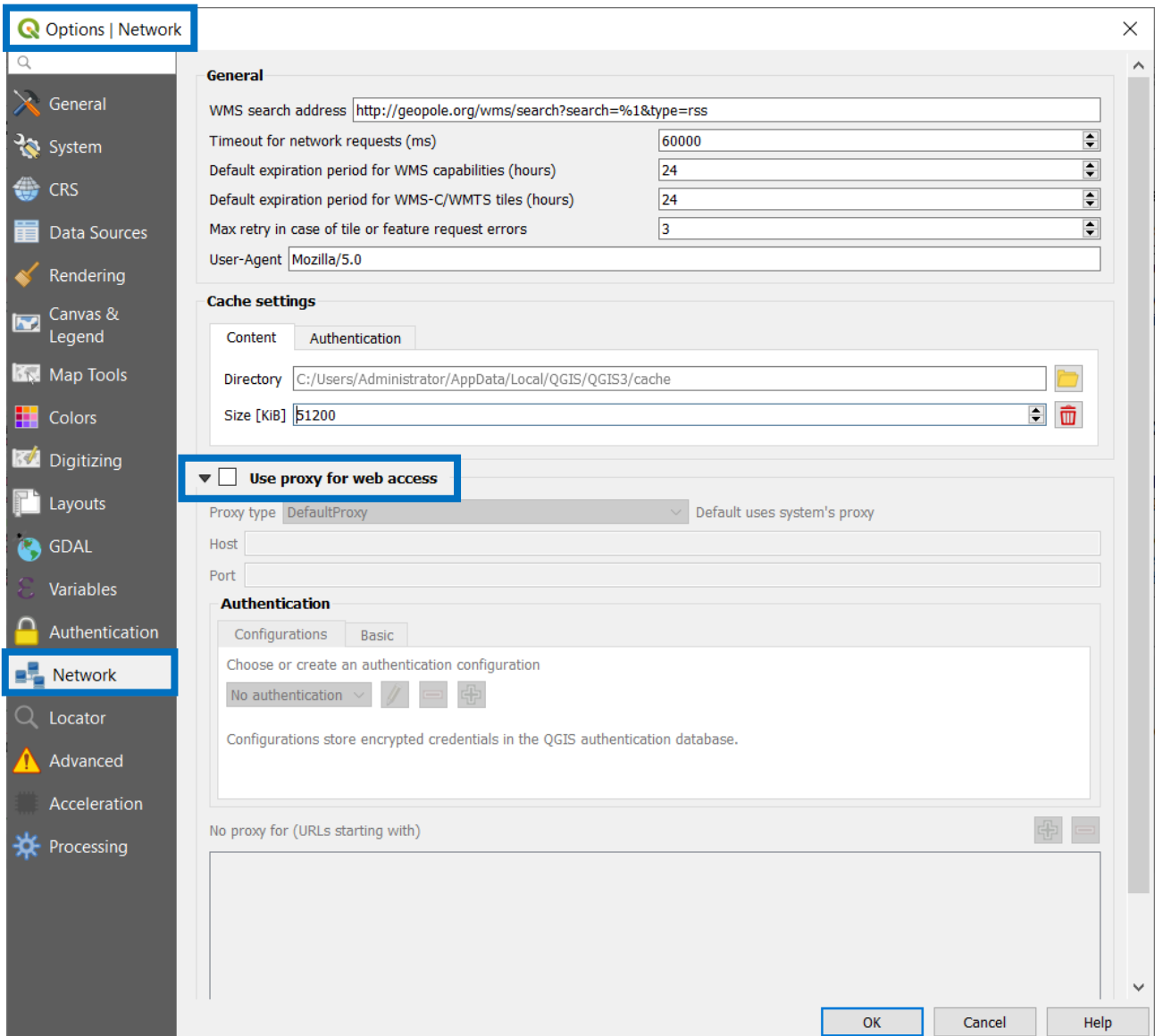


Figure 186 - Check the Internet Connection#2

After resolving the network, we have to install the **qgis2web** plugin. Search for its name into the search window:

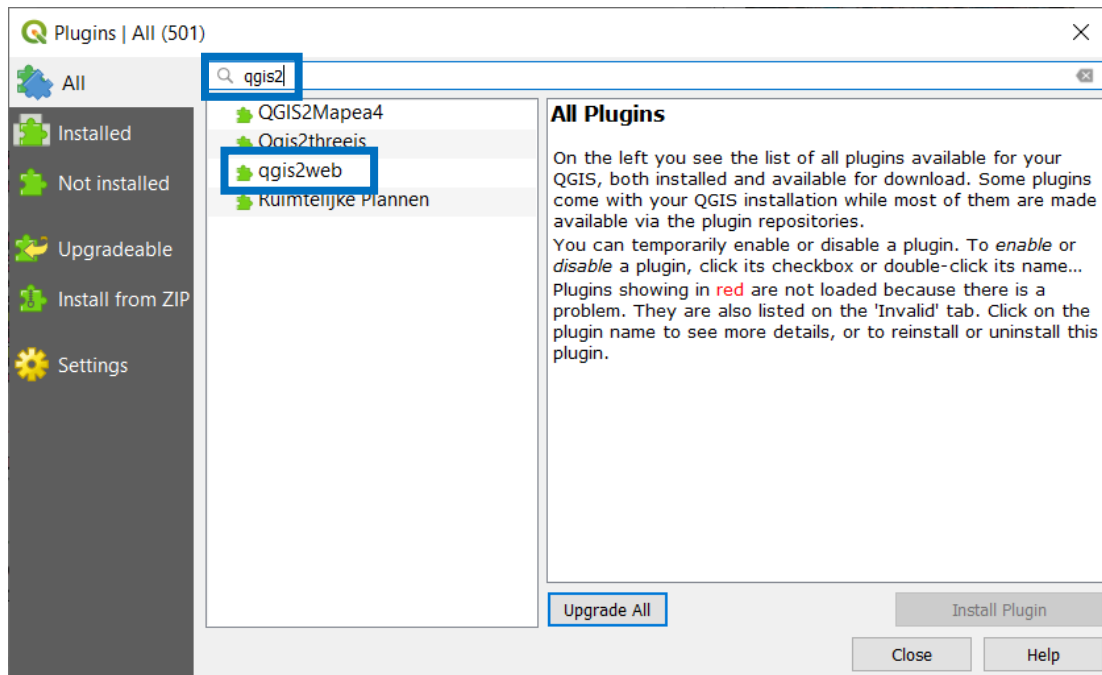


Figure 187 - Plugins - QGIS2WEB#1

Select “qgis2web” and install the Plugin:

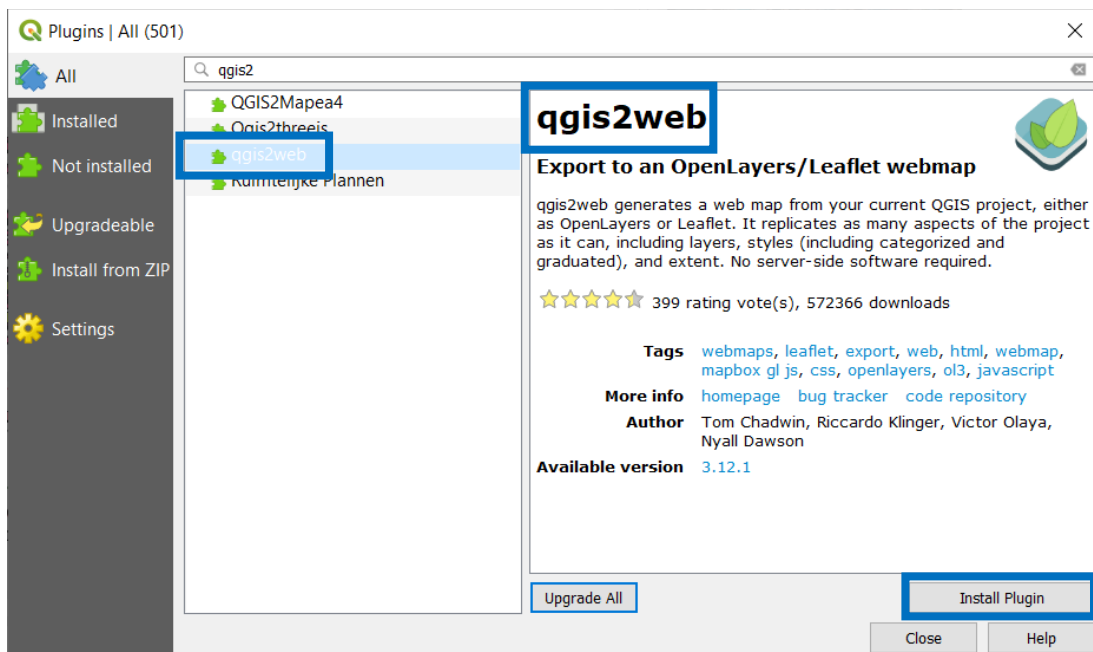


Figure 188 - Plugins - QGIS2WEB#2

After installing, the qgis2web appears with a check on the left. Now, it is possible to close the dialog.

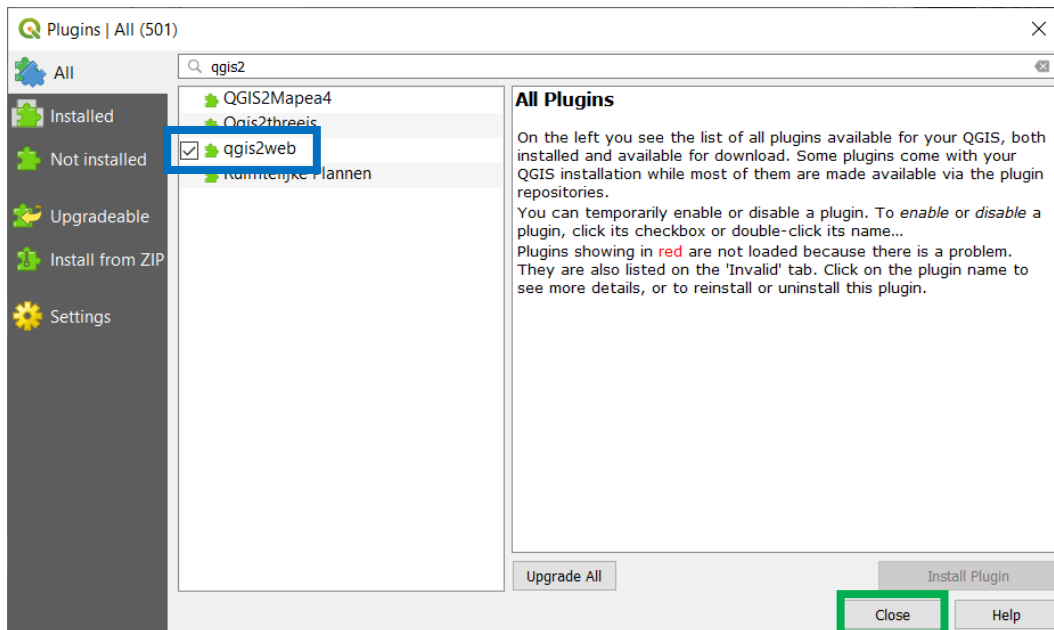


Figure 189 - Plugins - QGIS2WEB#3

After installing the Plugin, a new Menu will appear. Go to **Web > qgis2web > Create web map**:

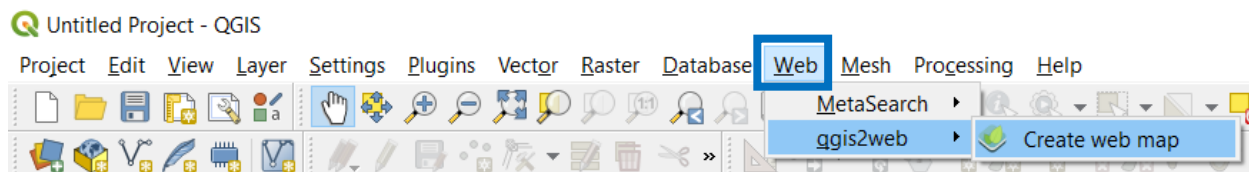


Figure 190 - Web - QGIS2WEB Menu

When “Create web map” is pressed a new window will appear. In this dialog there are many tabs (Layers and Groups; Appearance; Export; Settings; Help) in order to set up many parameters. Many of these speak for themselves

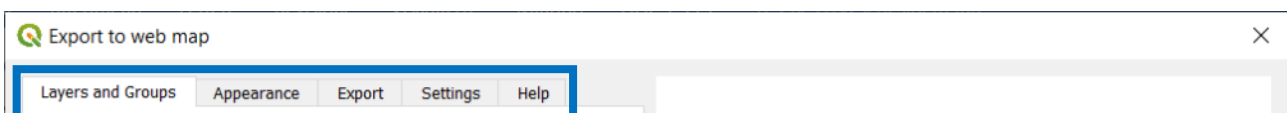


Figure 191 - Web - QGIS2WEB Interface #1

The “Update Preview” button shows a WEBGIS preview on the right panel; in order to produce a “service”, the radio button on the left lower lets us choose the “library”. In this example we will use the “Leaflet”<sup>[116]</sup> one. Finally, the “Export” button will produce the map.



Figure 192 - Web - QGIS2WEB Interface #2

116 <https://leafletjs.com/>

**Layers and Group:** in this Tab is possible to operate on the single Layer: setting the visibility; activate popups; make clustering on; setting the label visibility for each field (no label, inline label or header label).

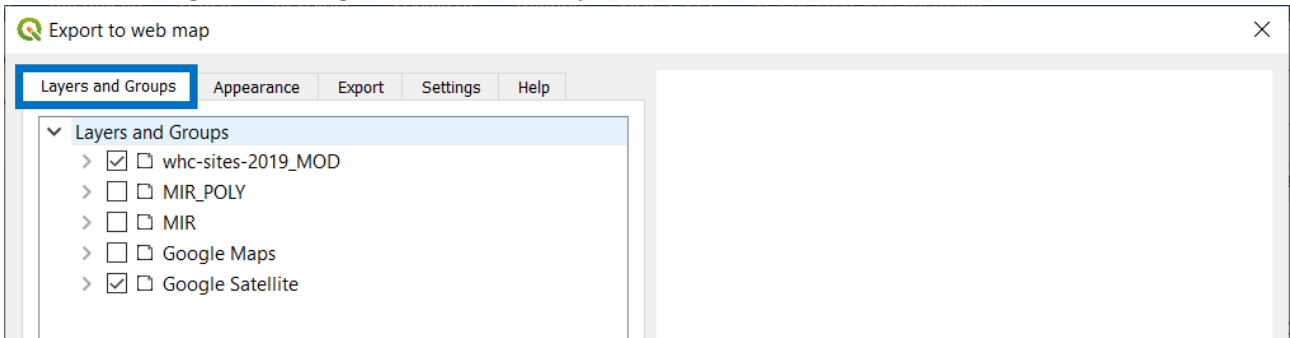


Figure 193 - Web - QGIS2WEB Interface - Layers and Groups #1

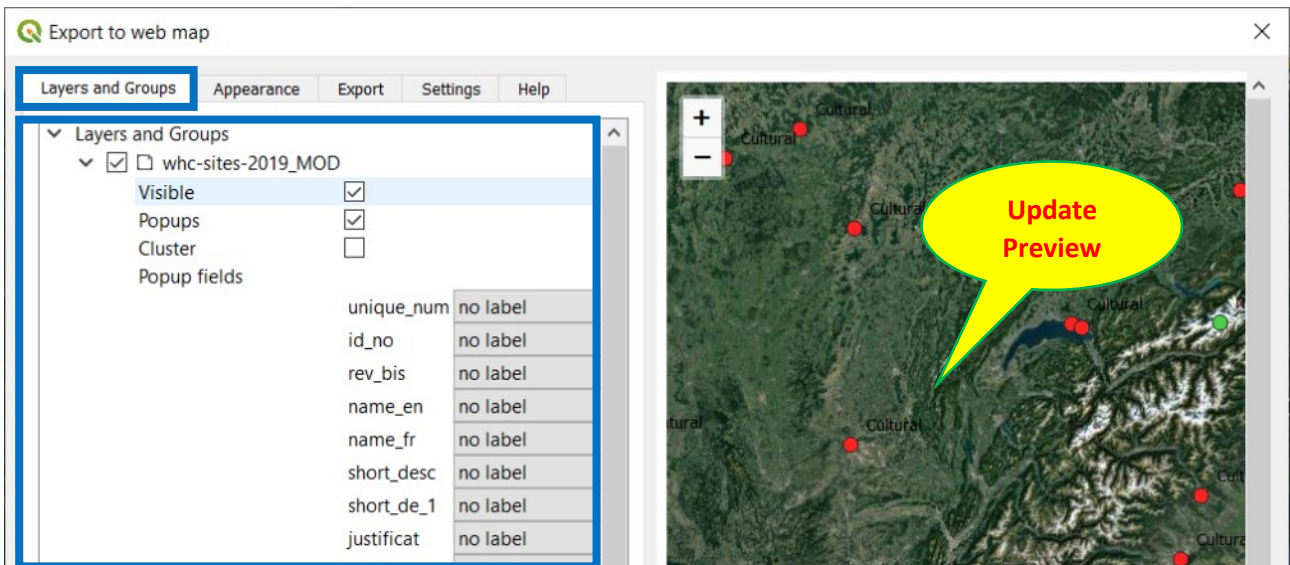


Figure 194 - Web - QGIS2WEB Interface - Layers and Groups #2

**Appearance:** in this Tab we could add an abstract (None; Upper right; Lower right; Lower left; Upper left); add a search engine based on the addresses; add a layer list (None; Collapsed; Expanded); add a layer search engine; add a measure tool; set the template (canvas-size; full screen) and so on.



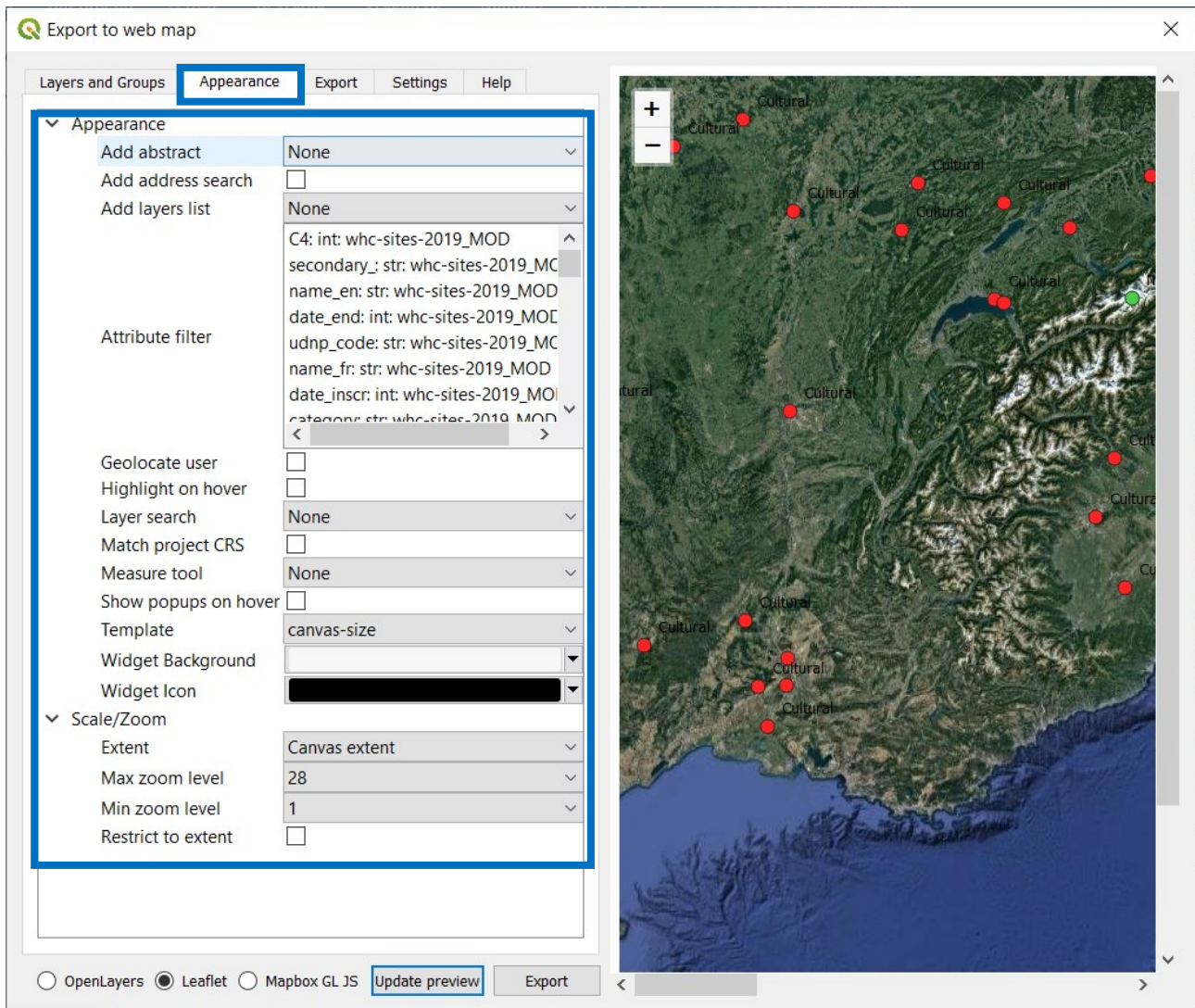


Figure 195 - Web - QGIS2WEB Interface - Appearance

**Export:** in this tab it is possible to set up the folder in which export the output process. It is better to change the default one in order to set up out working folder.

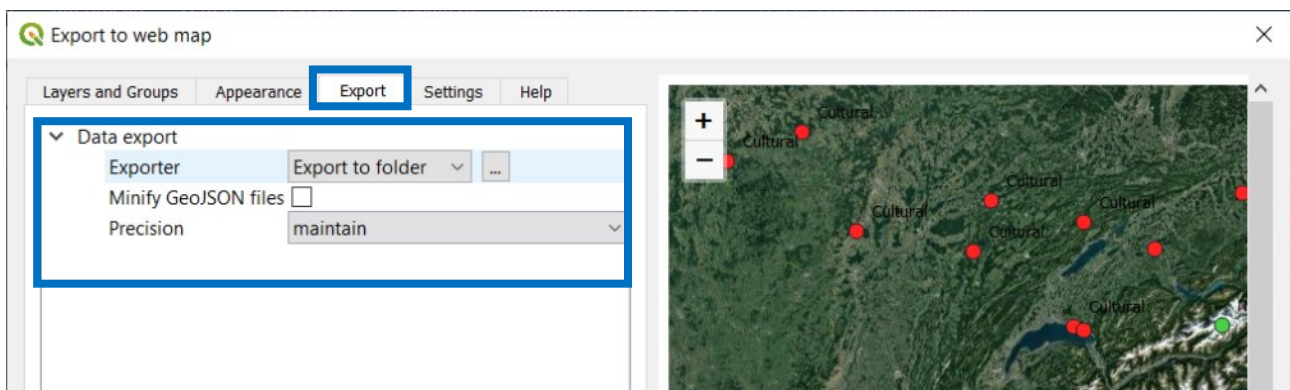


Figure 196 - Web - QGIS2WEB Interface - Export

**Settings:** in this tab, some options

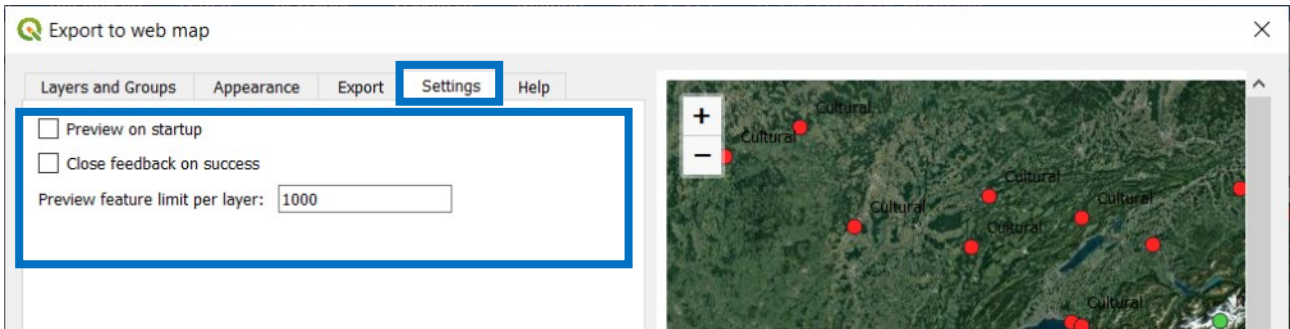


Figure 197 - Web - QGIS2WEB Interface - Settings

**Help:** an help

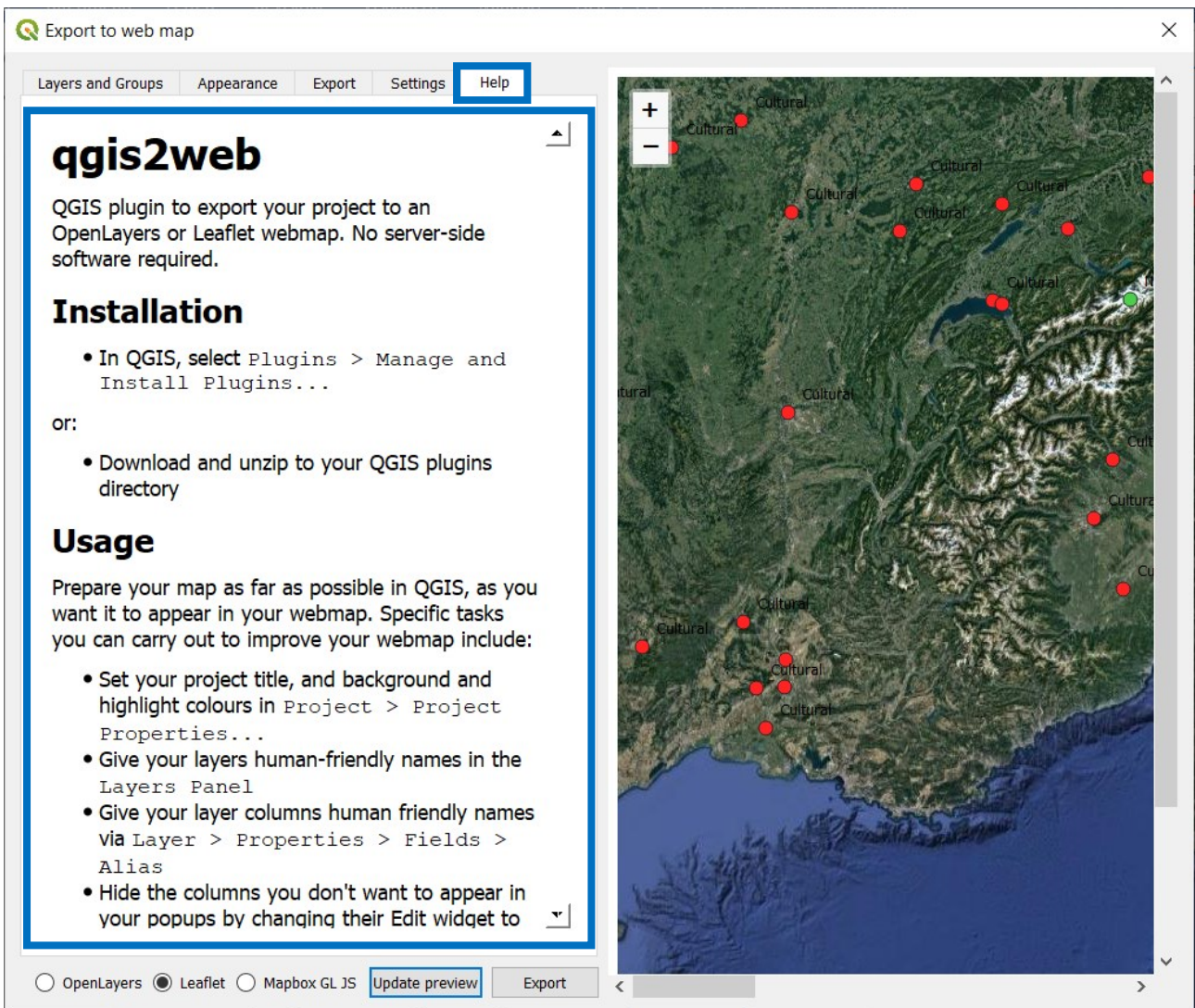


Figure 198 - Web - QGIS2WEB Interface - Help

Once upon all the setting are OK it is possible to Export the map into an appropriate folder. Depending on the number of the features (and the basemap service, of course), the export process can take more or less time. When if finish, a dialog will appears. Press the “OK” button.



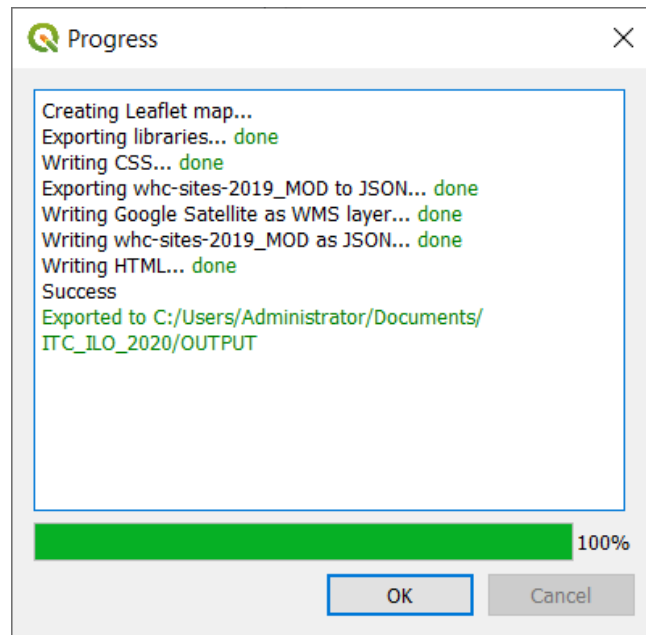


Figure 199 - Web - QGIS2WEB Interface - Exporting Progress Bar

Depending on your system settings, a browser (Google Chrome, Microsoft Edge, Mozilla Firefox or others) will start and the service will be loaded from local PC:

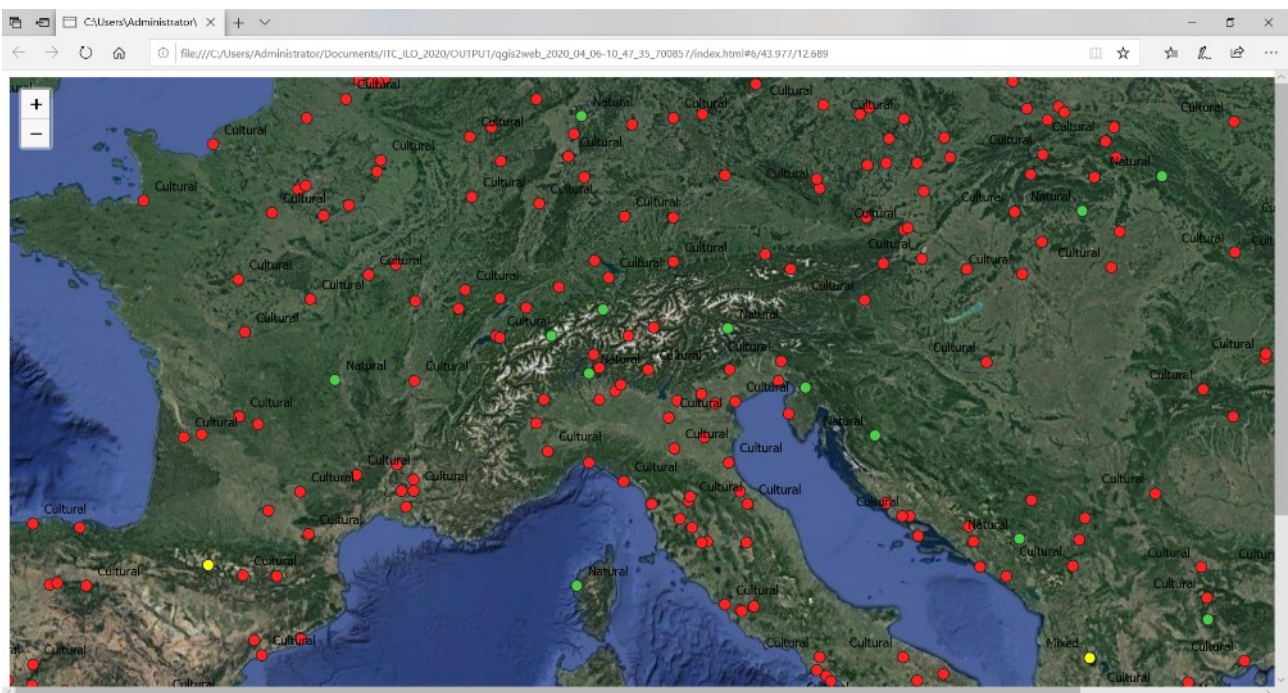


Figure 200 - Web - The WEBGIS#1

Since we have not added any extra functions, only the Zoom-In (+) and Zoom-Out(-) are available. But if we click on a point, we'll get information coming from the attribute data:

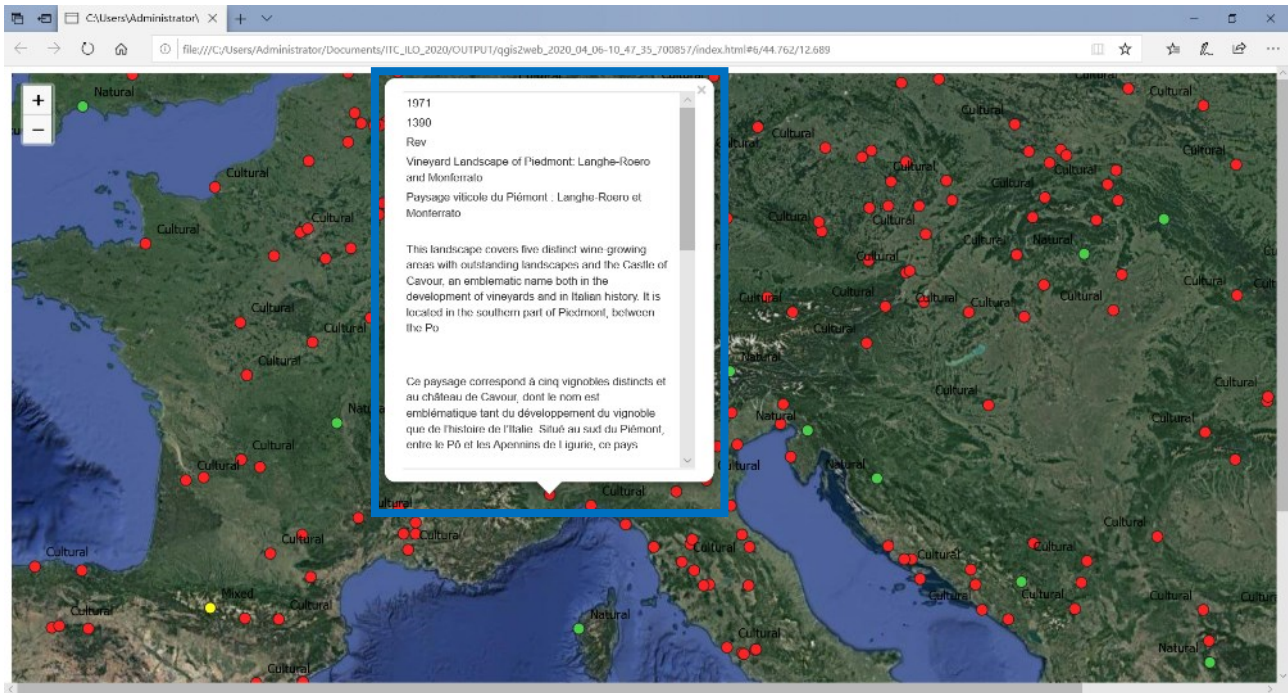


Figure 201 - Web - The WEBGIS#2

The “package” was saved into the specified folder (system we’ll use a system name such as “qgis2web + “the\_date” + “a\_code”):

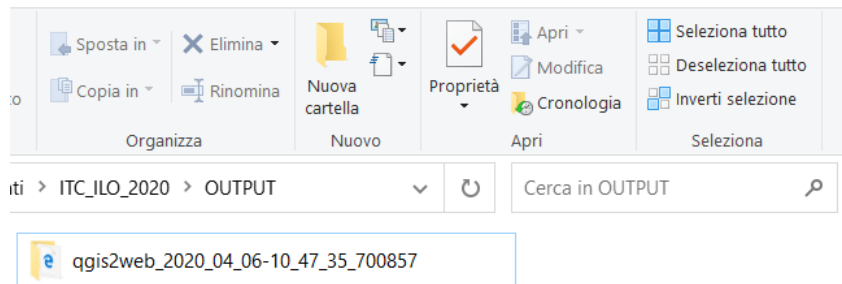


Figure 202 - Web - The Export Folder

In this folder will be created “subfolders”, in order to save “css (Cascade Style Sheet)”<sup>[117]</sup>, data (converted into JSON format)<sup>[118]</sup>, images, js (Leaflet javascript), legend, markers, webfonts.

The “index.html” file is the “core” of the WEBGIS and manage the “service”.

If we have the possibility to manage a WEB Server (i.e. Apache, Tomcat...), to “publish” our WEBGIS is enough to copy-and-paste all the folders (plus the HTML file) into a WWW folder of the WEB Server. If we have not this possibility, we can use it from local, starting it by clicking on the HTML file.

117 en.wikipedia.org/wiki/Cascading\_Style\_Sheets

118 https://www.json.org/json-en.html

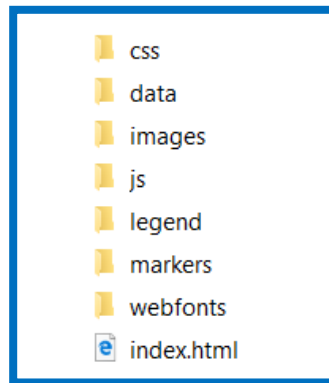


Figure 203 - Web - The System Folders and Files

Adding some options (i.e. “clustering” “address search”, “layer list”, layer search on the english name of the site) the “Preview” will be:

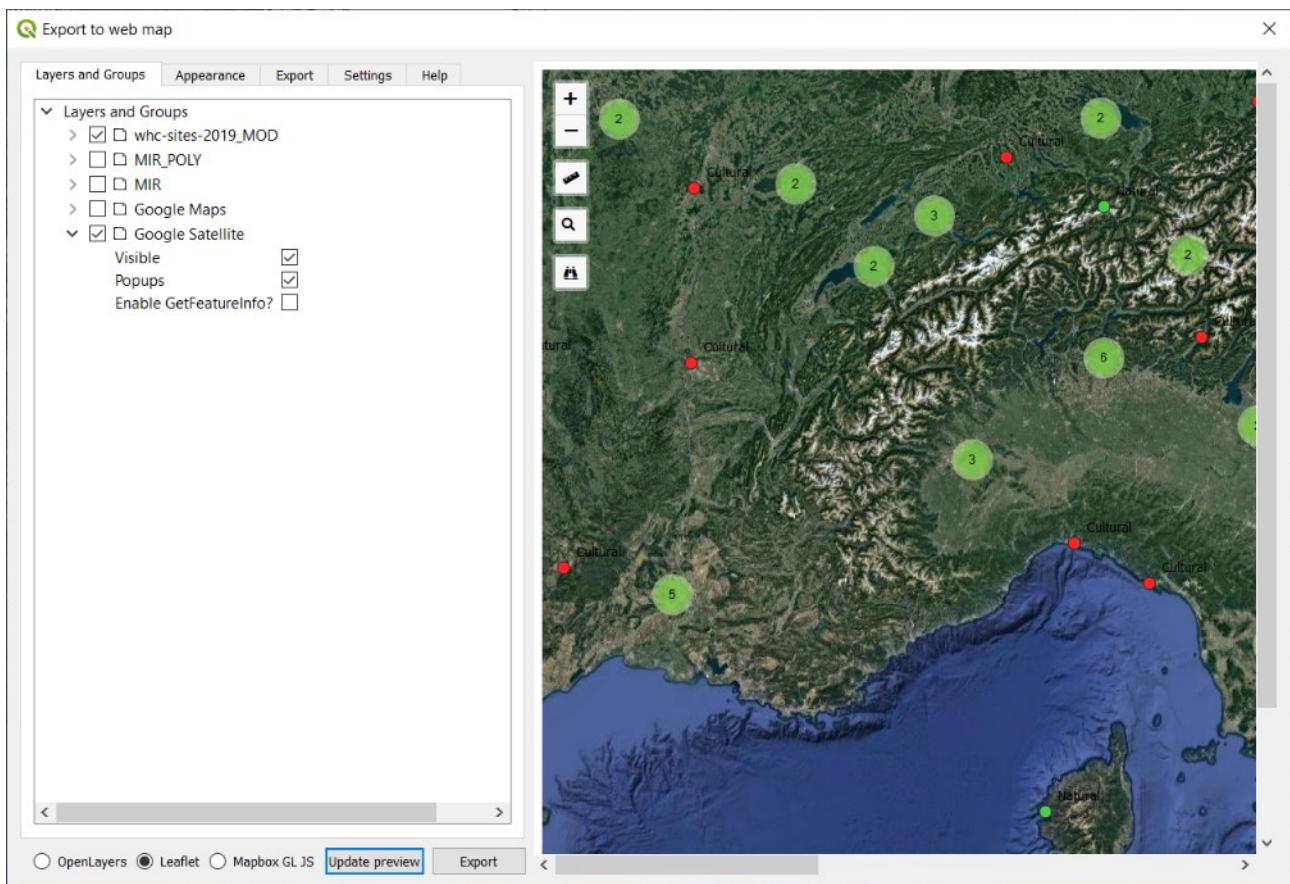


Figure 204 - Web - The WEBGIS with Option Buttons

This is the “final” output:



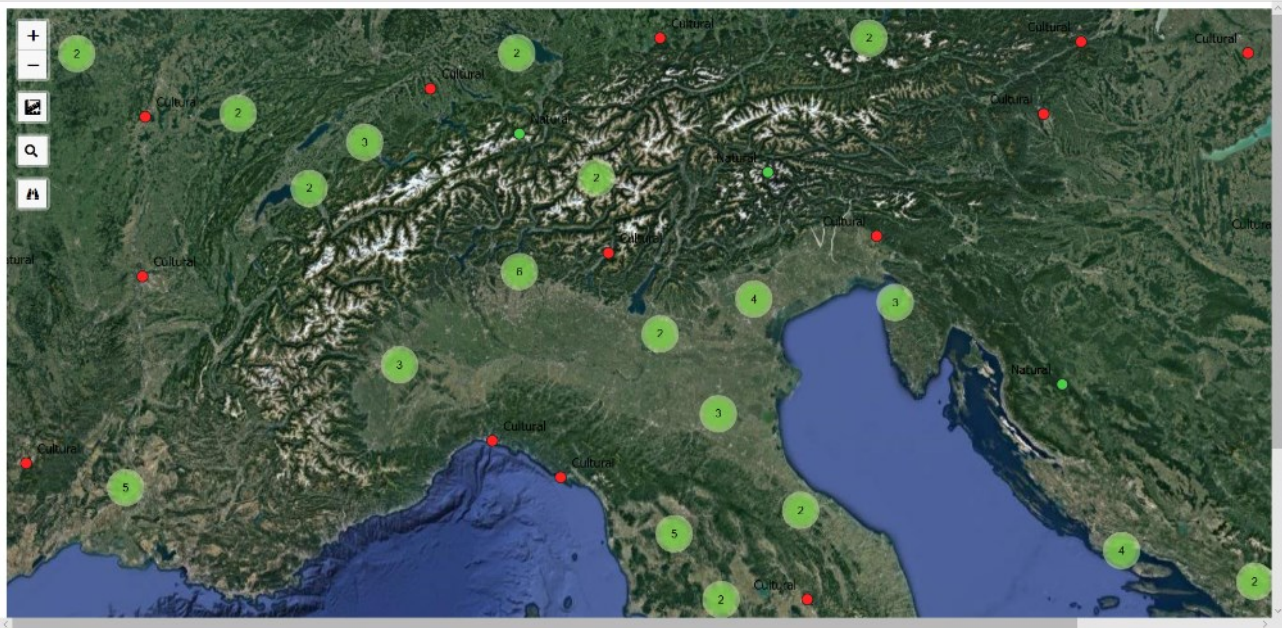


Figure 205 - The WEBGIS - Final Output






	Zoom In
	Zoom Out
	Measure Distances and Areas
	Search for a Place
	Search... (inside the Layer)

Table 6 - The WEBGIS - Buttons and Tools

If Leaflet JS is able to “understand” HTML code, it is possible to modify the popups in order to display images and / or PDT or other hyperlink.

For example, for the International Project: “Woman’s Creativity since the Modern Movement (MoMoWo), 1918-2018” we have built a WEBGIS in order to display Architects, Designers, Artist... on a map.

*MoMoWo - A WEBGIS Example:*

Let me to introduce you shortly to the [MoMoWo Project](#)

**Description:** the Database includes biographies of women architects (civil engineers), interior and landscape designers, and urban planners. It will include entries on prominent and less-known figures from the past to the present days going beyond national partners interests in order to represent the different architecture and design movements in Europe. It’ll also include entries of European women who have worked and are still working in the EU and beyond. The Database will contain biographical data, sketches, projects and drawings/graphics, photos and related documents also submitted by the audience.

**Objectives:** the Database underpins the cultural activities of MoMoWo, it provides useful data and materials for lectures and public talks on European women’s role in design professions. The Database will provide scholars with new skills, capacities and know-how on the specific focus, including the encouragement to the use of digital technologies.

**Beneficiaries:** families, friends, colleagues of women architects and designers, critics, historians, scholars, journalists, curators, students, scholars and educators.

**Communication:** selected results of the Database will be published on this website in order to disseminate to the public at large the knowledge of the lives and works of European women involved in design professions. Museums, private and public archives, such as companies archives, and foundations who will provide their documents for the database will be invited to spread the activity through links on their own official websites.

**Sustainability:** the Database is designed to further develop the MoMoWo project as an European platform to be implemented throughout consequent attraction of participants from the EU and beyond. Beyond the project duration the data collected will be used for didactic purposes.

This is the result of the (customized) WEBGIS:

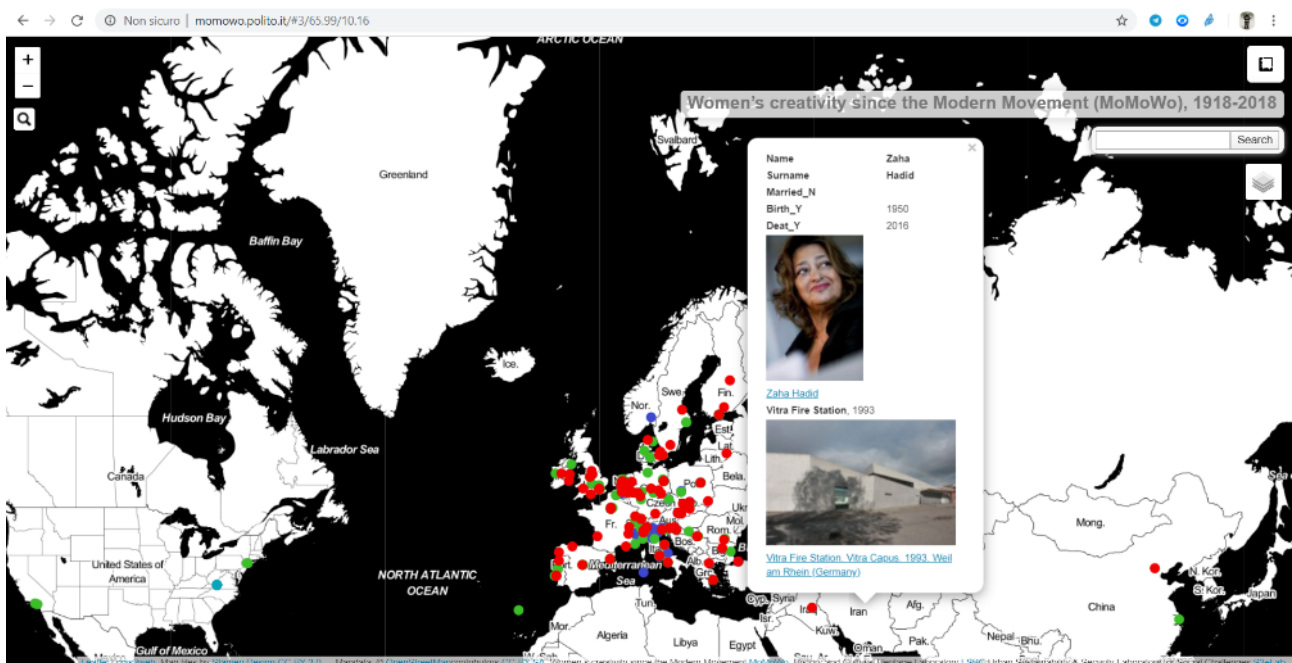


Figure 206 - The MoMoWo WEBGIS

Customize Popups

In this exercise, will use and operate on **HTML language**<sup>[119]</sup>

Starting from the data loaded into QGIS and from the structure of folders created by qgis2web (Figure 203) it is possible to customize the "popups". Go to QGIS and load the "WHC sites" (refer to "Add a XYZ Tiles Basemap").

Zoom to the St Peter Basilica.



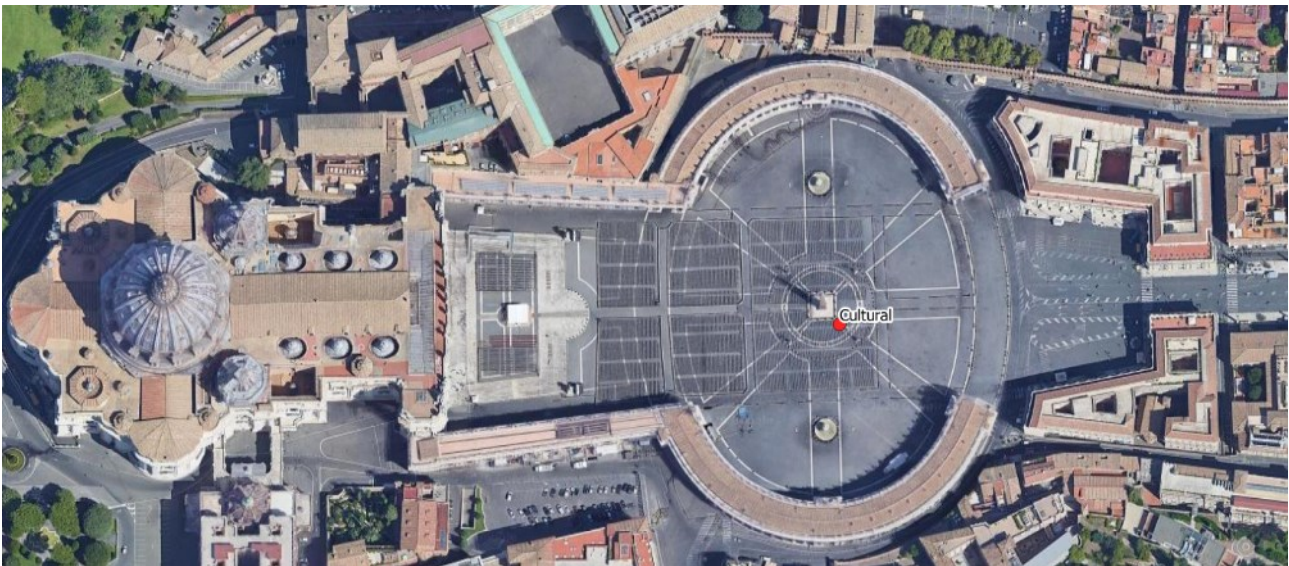



Figure 207 - The St. Peter Basilica

In the “Attribute Toolbar” search and use the “Select Features by area or single click” . Use the tool to select the point labeled as “Cultural”. The point will “selected “by yellow:

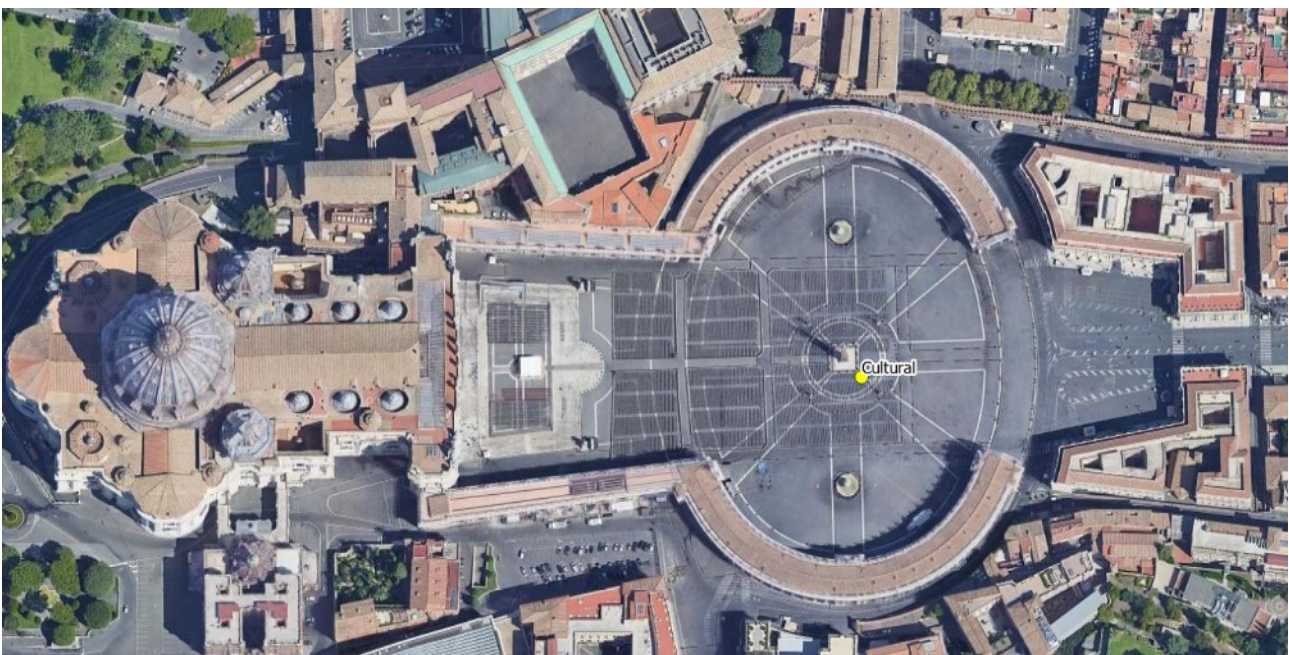


Figure 208 - The St. Peter Basilica - A point selection

Open the “Attribute table”



whc-sites-2019\_MOD :: Features Total: 1121, Filtered: 1121, Selected: 1

	unique_num	id_no	rev_bis	name_en	name_fr	short_desc	short_de_1	justificat	justific_1	date_inscr
1	1180	1010	NULL	Land of Frankin...	Terre de l'encens	<p>The frankin...	<p>Les arbres ...	<p>Criterion iii ...	<p>Critère iii L'...	200
2	1384	1207	NULL	<i>Aflaj</i> Irr...	Systèmes d'irrig...	<p>The proper...	<p>Les cinq sys...	NULL	NULL	200
3	403	352	NULL	Rock Art of Alta	Art rupestre d'A...	<p>This group ...	<p>Les pétrogl...	NULL	NULL	198
4	2254	1143	NULL	Vegaøyen – The...	Vegaøyen – Arc...	<p>A cluster of...	<p>Ce groupe ...	<p><em>Criter...	<p><em>Critèr...	200
5	1372	1195	NULL	West Norwegia...	Fjords de l'Oues...	<p>Situated in ...	<p>Situ&eacut...	<p><em>Criter...	<p><em>Crit&...	200
6	2047	1486	NULL	Rjukan-Notodd...	Site du patrimo...	<p><span>Loc...	<p>Situé au sei...	NULL	NULL	201
7	1298	1118	NULL	Osun-Osogbo S...	Forêt sacrée d'...	<p>The dense f...	<p>La dense fo...	<p><em>Criter...	<p><em>Critèr...	200
8	1667	55 Bis		Rørøs Mining T...	Ville minière de...	<p>Rørøs Mini...	<p>L'histoire d...	NULL	NULL	198

Show All Features

Figure 209 - The Attribute Data (Show All Records)

Switch from “Show All Features” to “Show Selected Features”

whc-sites-2019\_MOD :: Features Total: 1121, Filtered: 1, Selected: 1

	unique_num	id_no	rev_bis	name_en	name_fr	short_desc	short_de_1	justificat	justific_1	date_inscr
1	320	286	NULL	Vatican City	Cité du Vatican	<p>The Vatican...	<p>Haut lieu d...	NULL	NULL	1984

Show Selected Features

Figure 210 - The Attribute Data (Show Selected Features)

To edit the data is better to switch to the “form view” instead:

whc-sites-2019\_MOD :: Features Total: 1121, Filtered: 1, Selected: 1

Expression

Vatican City

name\_en Vatican City

short\_desc history and a formidable spiritual venture. A unique collection of artistic and architectural masterpieces lie within the boundaries of this small state. At its centre

danger\_lis NULL

category Cultural

region\_en Europe and North America

CRITERIA\_N 1-1-0-1-0-1-0-0-0

IMAGE 

LINK <a href="https://en.wikipedia.org/wiki/St\_Peter%27s\_Basilica" target="\_blank">St. Peter Basilica</a>

PDF <a href=".:PDF/STPETER.PDF">ST. PETER</a>

Show Selected Features

Figure 211 - The Attribute Data (Show Selected Features) - Form View

The goal is to modify the attributes just for this record only in order to display a “customized popup”. The procedure can be used for all the others records.

Browse the WEB. Choose an image of St. Peter and save it on your working folder. Choose a PDF file about St. Peter (or another PDF) and save it. Search for a related hyperlink and save into a Text Editor.

Start an editing session, open the attribute table and add some fields:

- PDF (Text, 255)
- Image (Text, 255)
- Links (Text, 255)

Before going on, we have to remember a couple of HTML useful “commands” (just adapted to the data we have found):

Open a Link

```
<a href="https://en.wikipedia.org/wiki/St._Peter%27s_Basilica" target="_blank">St. Peter Basilica</a>
```

Open an Image

```
[120]
```

Link to a document (PDF)

```
<a href=".\\PDF\\STPETER.PDF">ST. PETER</a>[121]
```

As we have seen before, **qgis2web** creates “a system” of files and folder in which it saves data, javascripts, and settings (Figure 203). After creating a WEBGIS (**Web ▶ qgis2web ▶ Create web map**) we need to add two subfolder, PDF and PHOTO, just to separate them from the system folders:

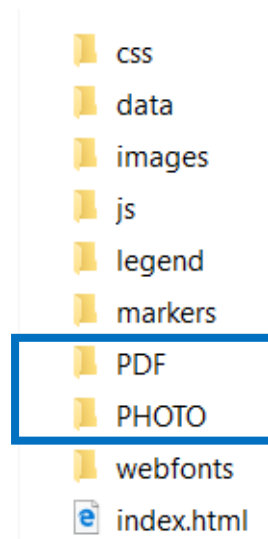


Figure 212 - Web - The System Folders and Files - Custom Folders

In these subfolders we must copy the PDF and the PHOTO that we decide to publish. We have to follow these steps each time will recreate the “webgis”.

120 If you are using a WEB Server (Apache...) it is mandatory to use a link to the WEB resource and not a local file

121 If you are using a WEB Server (Apache...) it is mandatory to use a link to the WEB resource and not a local file

May be useful to “limit” the fields in the attribute table hiding the fields that we do not want to display.

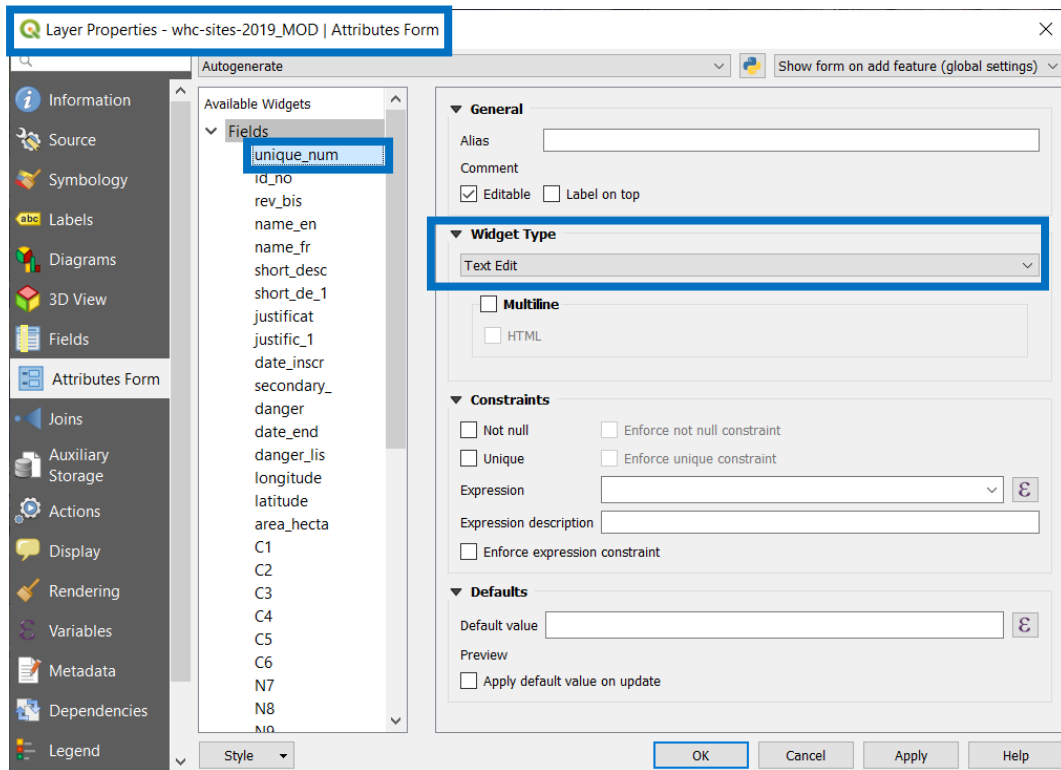


Figure 213 - Layer Properties - Attribute Form - Hide Fields #1

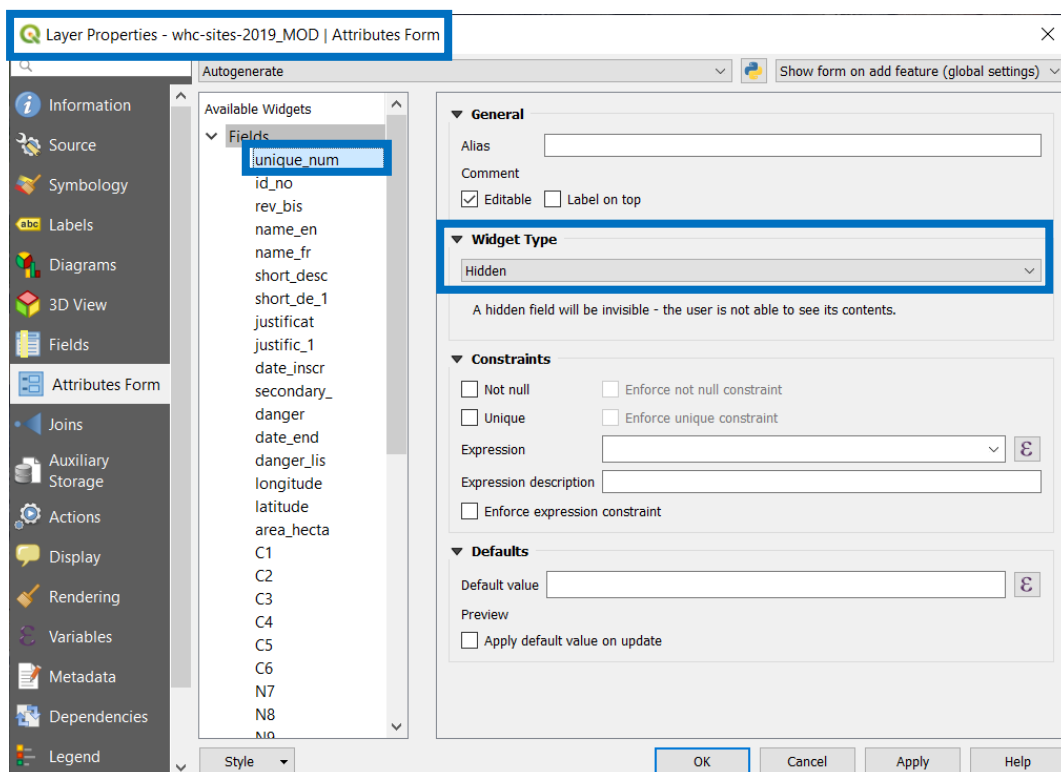


Figure 214 - Layer Properties - Attribute Form - Hide Fields #2

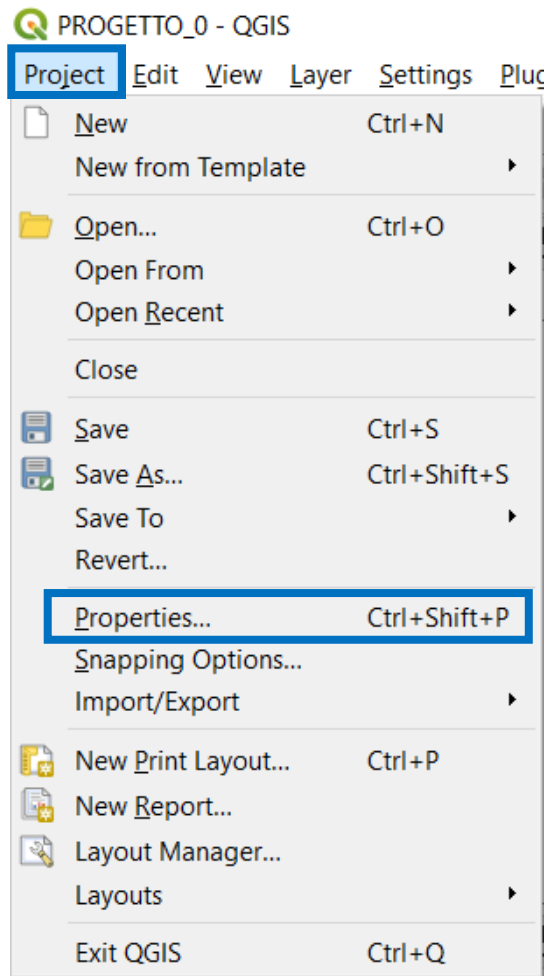
At the end of the settings, try again the [Web > qgis2web > Create web map](#), create the folders, paste de files, and run the WEBGIS from local PC:



Figure 215 - WEB - QGIS2WEB - Custom Popup

## Project “management”

In the “Project Environment”, we can “Create a New Project” or open an existing one, save, access to “Spatial Bookmarks” and set several options and parameters.



When we save a Project we are saving a “link” to data and not data themselves. So, if we would to pass to a Collegue of us a “Project” we have to share with him also the linked data.

QGIS project file has \*.QGZ extension (but we can still use \*.QGS for backward compatibility).

### Important Settings

In the **Project > Properties** save “relative path” is very usefull.

Imagine to create your **workspace** – a folder: call it “**FIRSTWORK**” - on disc “C”. This folder will be the “root folder” for **YOURPROJECT**. Starting from this **FIRSTWORK** folder create several subfolder in which store or save the original data, the data that you have modified, the output produced by you (images, layout export and so on), the documentation...

If we have chosen to store relative path we can compress (**ZIP**) the root folder (“**FIRSTWORK**”) and pass it to a Collegue without any problem. Even if the Collegue should not have a disc “C” the project file will open itself and all the related data without any problem. If we do not use this option (leaving “**absolute path**”), moving the Project into another space will cause “problems”. At the startup, QGIS will ask you: where is the SHP1? Where is SHP2? And son on...

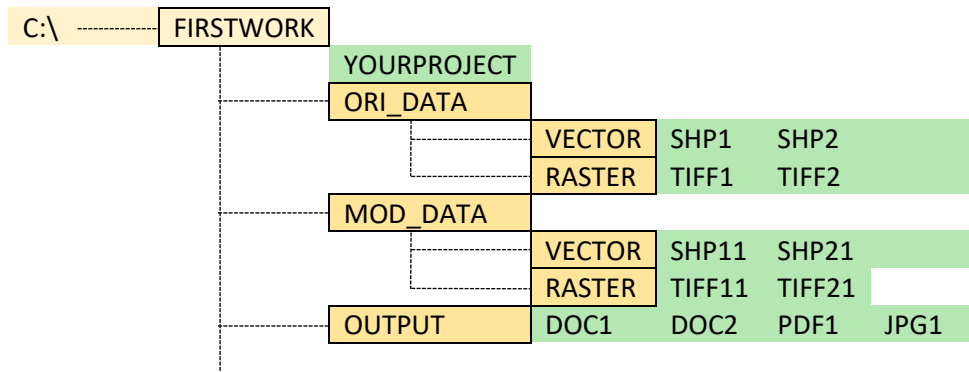


Table 7 - How organise a Workspace

	Are FOLDERS
	Are FILES

Given the above, to set up the relative path, go the “Project Properties” (**CTRL + SHIFT + P**) and, in the Generale Tab, set this option:

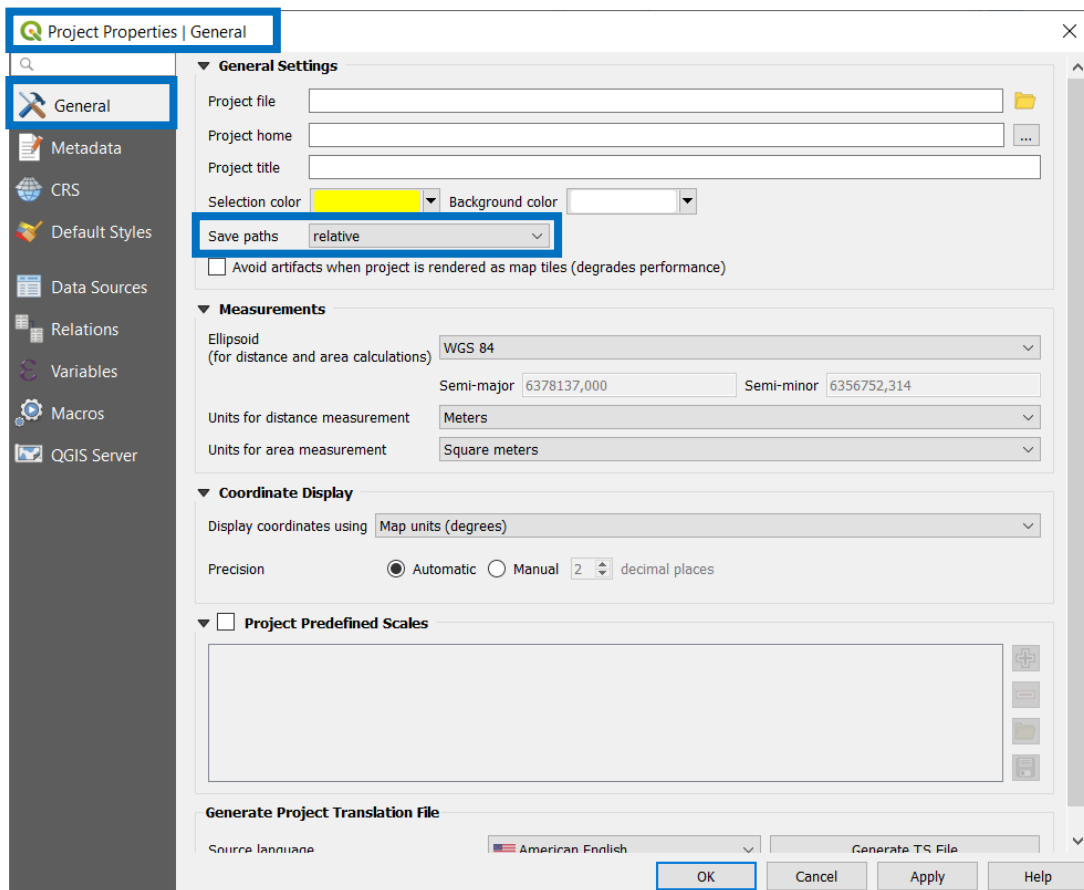


Figure 216 - Project Properties - Set Relative Path



*Figure 217 - Project Properties . General - Save Relative Path*

**Settings ▶ Options ▶ Network**

Store “relative path”

## Metadata and License

### Metadata

In general, **Metadata** are data that provides information about other data<sup>[122]</sup>. A description of the information in use is always useful but using GIS is crucial. “Similar to a library catalog record, metadata records document the who, what, when, where, how, and why of a data resource. Geospatial metadata describes maps, Geographic Information Systems (GIS) files, imagery, and other location-based data resources. The **Federal Geographic Data Committee (FGDC)**, (USA), is tasked by **Executive Order 12906** to enable access (see **GeoPlatform.gov**) to **National Spatial Data Infrastructure (NSDI)** resources and by **OMB Circular A-16** and the **A-16 Supplemental Guidance** to support the creation, management, and maintenance of the metadata required to fuel data discovery and access.”<sup>[123]</sup>

In Europe, “According to Article 5(1) of **INSPIRE Directive 2007/2/EC**, **Member States shall ensure that metadata are created for the spatial data sets and services** corresponding to the themes listed in **Annexes I, II and III**, and that those metadata are kept up to date.

The Regulation as regards metadata (and subsequent amendments) and **Technical guidelines** set out the requirements for the creation and maintenance of this **metadata**”<sup>[124]</sup>.

### License

When we use “data” we have to pay attention to the Terms and Conditions (in other world, the “license”) about the usage.

Creative Commons, for example, has created several predefined licenses that help the user in a clear way

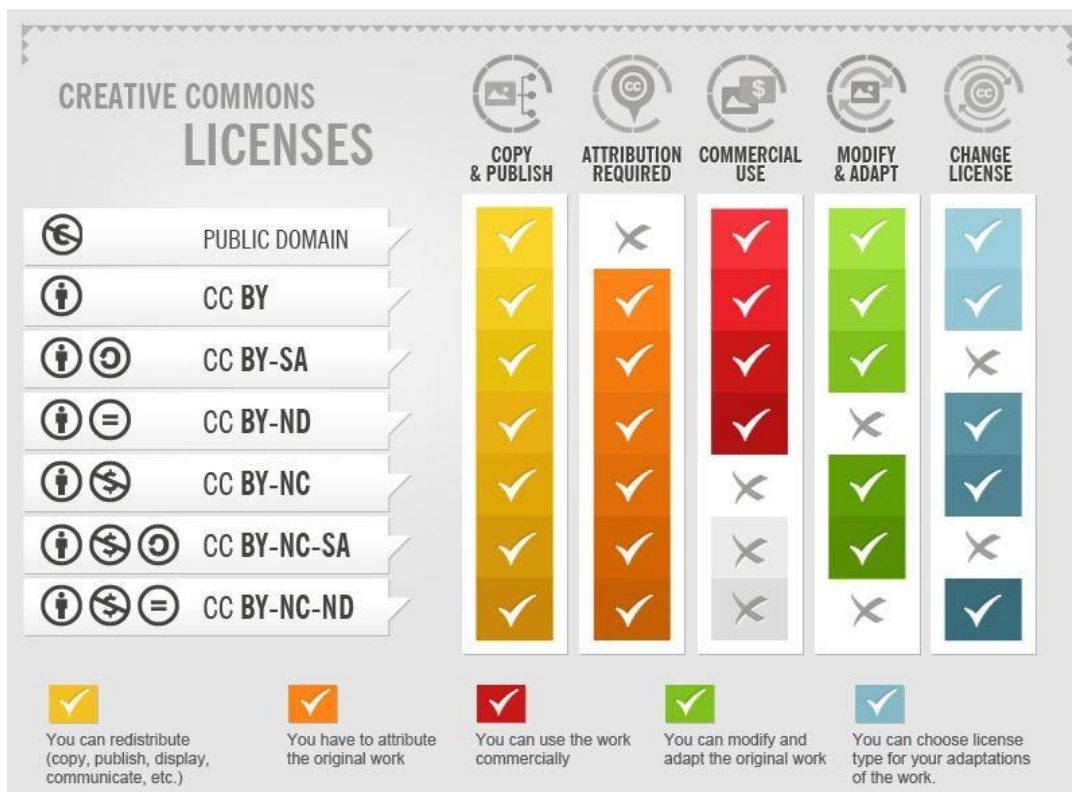


Figure 218 - Creative Commons License - Compatibility Matrix

122 <https://www.merriam-webster.com/dictionary/metadata>

123 <https://www.fgdc.gov/metadata>

124 [inspire.ec.europa.eu/metadata/6541](https://inspire.ec.europa.eu/metadata/6541)

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## Credits, Sitography and Links

- 361 Lectures (concepts)
  - <http://www.geography.hunter.cuny.edu/~jochen/GTECH361/lectures/>
- European Petroleum Survey Group (EPSG)<sup>[126]</sup>
  - <http://www.epsg.org/>
- GFOSS.it
  - [www.gfoss.it](http://www.gfoss.it)
- Google Search Operators: The Complete List (42 Advanced Operators)
  - <https://ahrefs.com/blog/google-advanced-search-operators/>
- QGIS.org
  - [www.qgis.org](http://www.qgis.org)
- Wikipedia

## Lecture

- Geographic Information System Basics [Book]
  - <https://2012books.lardbucket.org/books/geographic-information-system-basics/index.html>
- GIS in Sustainable Urban Planning and Management : A Global Perspective [Book]
  - <http://oopen.org/search?identifier=1002491>
- Manual of Digital Earth [Book]
  - <http://oopen.org/download?type=document&docid=1006981>
- Step-by-Step Guide to Vulnerability Hotspots Mapping: Implementing the Spatial Index Approach [Book] [ArcGIS]
  - [http://www.ciesin.org/documents/vmapping\\_guide.pdf](http://www.ciesin.org/documents/vmapping_guide.pdf)
- 

## Data

- Australia, World Heritage Areas
  - <https://data.gov.au/dataset/ds-nsw-4000651a-96da-4f07-85a7-54cd54704aca/details>
- DATA.GOV
  - <https://www.data.gov/>
- Data Portal
  - <https://dataportals.org/>
- Diva GIS – Download data by Country
  - <http://www.diva-gis.org/gData>
- European Commission, Eurostat, GISCO, Geodata
  - <http://ec.europa.eu/eurostat/web/gisco/geodata>
- FAO Soil Database
  - <https://www.isric.org/explore/soil-geographic-databases>
- Free GIS DATA
  - <http://freegisdata.rtwilson.com>
- Geofabrik Map and Data (Openstreetmap Download)
  - <http://www.geofabrik.de/>
- Global Administrative Areas - GADM maps and data
  - <http://gadm.org/country>
- Global Forest Watch

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126 EPSG stands for European Petroleum Survey Group. They publish a database of coordinate system information plus some very good related documents on map projections and datums. The Projection Engine uses a modified version of the EPSG model. POSC is the Petrotechnical Open Software Corporation

- <http://data.globalforestwatch.org/>
- Global Open Data Index
  - <https://index.okfn.org/>
- ICPAC Geoportal
  - <http://geoportal.icpac.net/>
- IPUMS INTERNATIONAL
  - <https://international.ipums.org/international/gis.shtml>
- The Humanitarian Data Exchange (HDX)
  - <https://data.humdata.org/>
- Ireland Maps and Data
  - <http://npws.ie/maps-and-data>
- National Heritage List for England (NHLE)
  - <https://historicengland.org.uk/listing/the-list/data-downloads>
- OverpassTurbo (Extract Point of Interest from Openstreetmap)
  - <https://overpass-turbo.eu/>
- Protected Planet
  - <https://www.protectedplanet.net>
- UNEP-WCMC - Resources & data
  - <https://www.unep-wcmc.org/resources-and-data>
- UNEP-WCMC - World Heritage Sites KMZ File
  - <https://www.unep-wcmc.org/resources-and-data/kml-file-of-world-heritage-sites>