FACHHOCHSCHULE
WIENER NEUSTADT
University of Applied Sciences – Austria

QGIS training

Course: Geodata course

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Differences between QGIS versions 2.14.1 (used for the training) and the current QGIS version 3.10.14:

QGIS 2.14.1 and QGIS 3.10.14 are two different versions of QGIS that have several differences. As a recent version, QGIS 3.10 comes with an extensive list of new features and revisions to the existed ones in older versions like 2.14.1. Some of these changes are addressed within the following points (QGIS Website, version descriptions: https://www.qgis.org/en/site/forusers/visualchangelog310/index.html#):

- Graphical user interface: Toolbars and menu have been renewed and reorganized which has made it easier to explore and use. Such differences can be found in layer properties options and file management (e.g. file direction) as examples.
- General: Show news items on welcome page, changes in map tools like adding Milliradians (SI definition) and mil (NATO) units.
- Symbology: A new setting for the default resampling mode to use for newly-added raster datasets is added in QGIS 3.10. Copy paste option for symbols and center of segments are also new features been added to the new version of QGIS.
- Labeling: Libraries of custom text formats and label settings. Marker symbols, new label alignments.
- Data Management: The possibility to create layer relationships which utilize composite foreign keys.
- Analysis Tools: Stored filter expressions for attribute tables, new operators for Raster Calculator.
- Processing: New algorithms like Split features by character, combine style databases, Create style database from project, etc.
- Programmability: New class QgsBookmarkManager, new API for provider database connections.

The Layer Ordering explained on slide 112 and its execution by means of screenshots and description in a clear and neat manner:

Layer ordering in QGIS is simply done by dragging and dropping a layer in the preferred order. This feature helps in zoning different features within an area or a feature in different areas. Layer ordering is described within the following steps:

1- Firstly, the layers should be added:
2- click on Layer from Menu toolbar, click on Add layer, click on Add vector layer (Figure .1),
3- The direction of the existing files that are planned to be added should be specified in the appearing box (Figure .2),

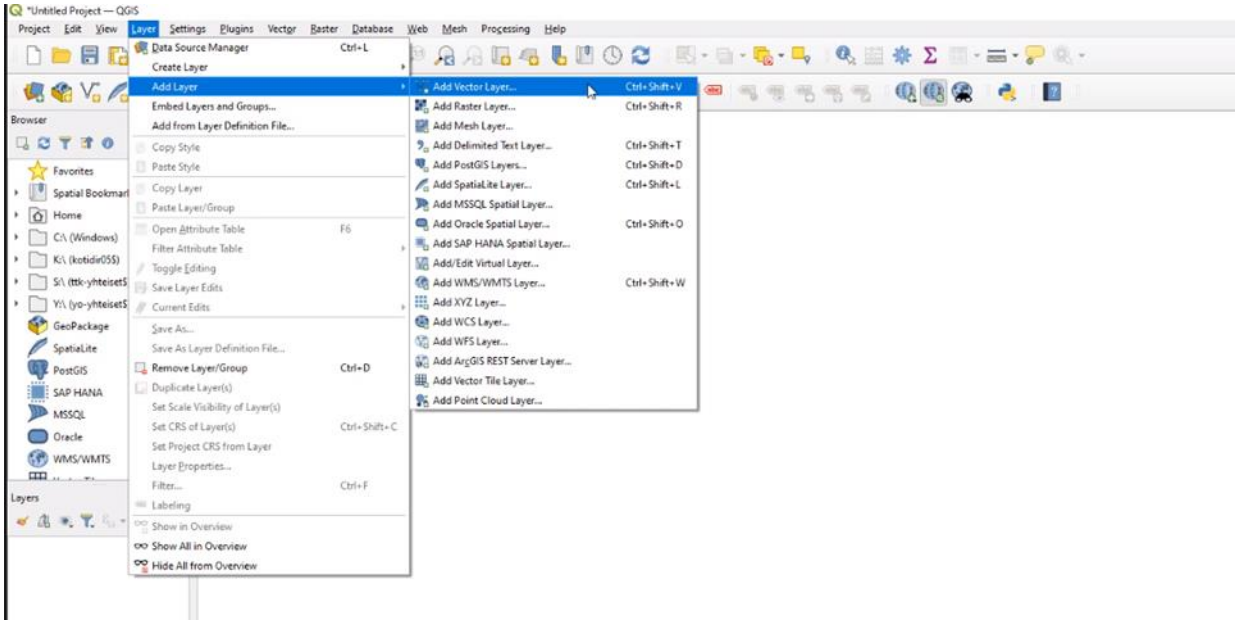

Figure 1: Adding layer, vector layer from Menu toolbar

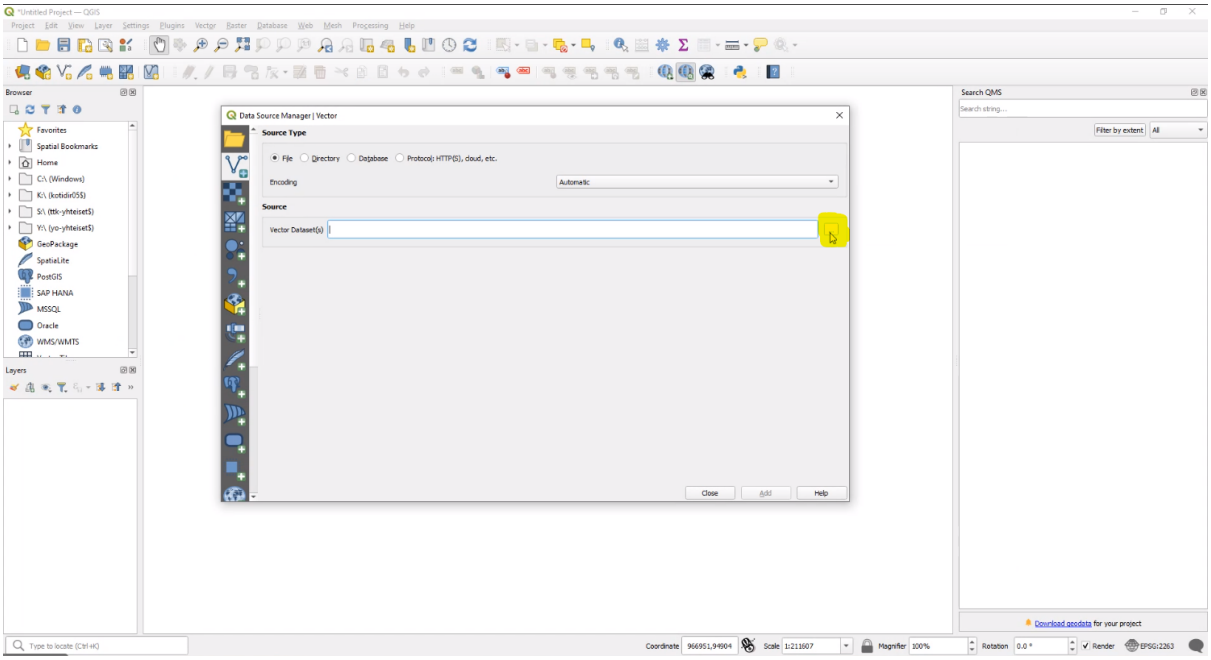

Figure 2: Specifying the layer file direction

4- A SHP file is a file format for spatial vector data in QGIS. It is one of the most commonly used formats for representing spatial data such as points, lines, and polygons. So the .shp file from the downloaded dataset called “boros” is added (Figure .3). The file name is “nybb_2263.shp”,

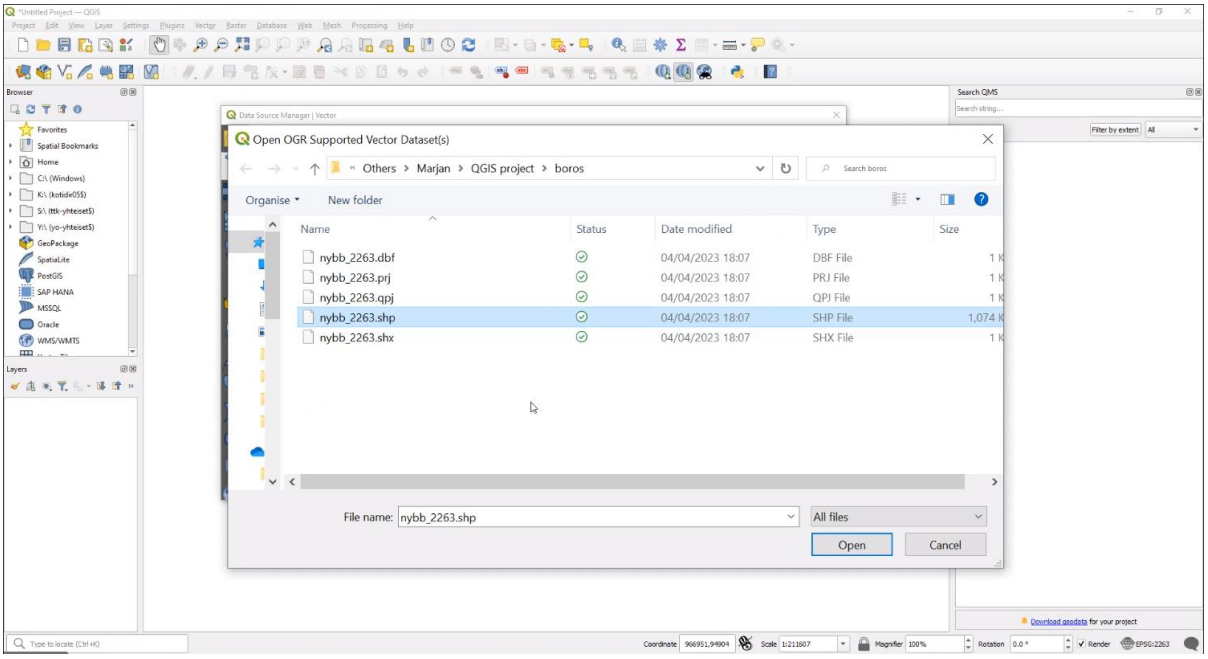

Figure 3: Adding the shapefile

5- After selecting the file and clicking on the “Open” button, another box will appear like in the Figure (4). The add button should be clicked then. At the end the shapefile will appear in map space of QGIS like the Figure (5).

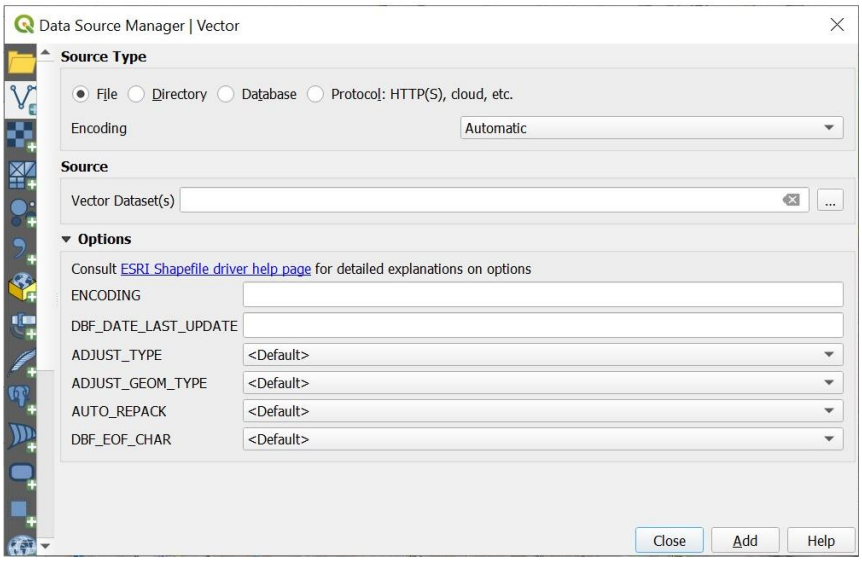

Figure 4: Adding layer box

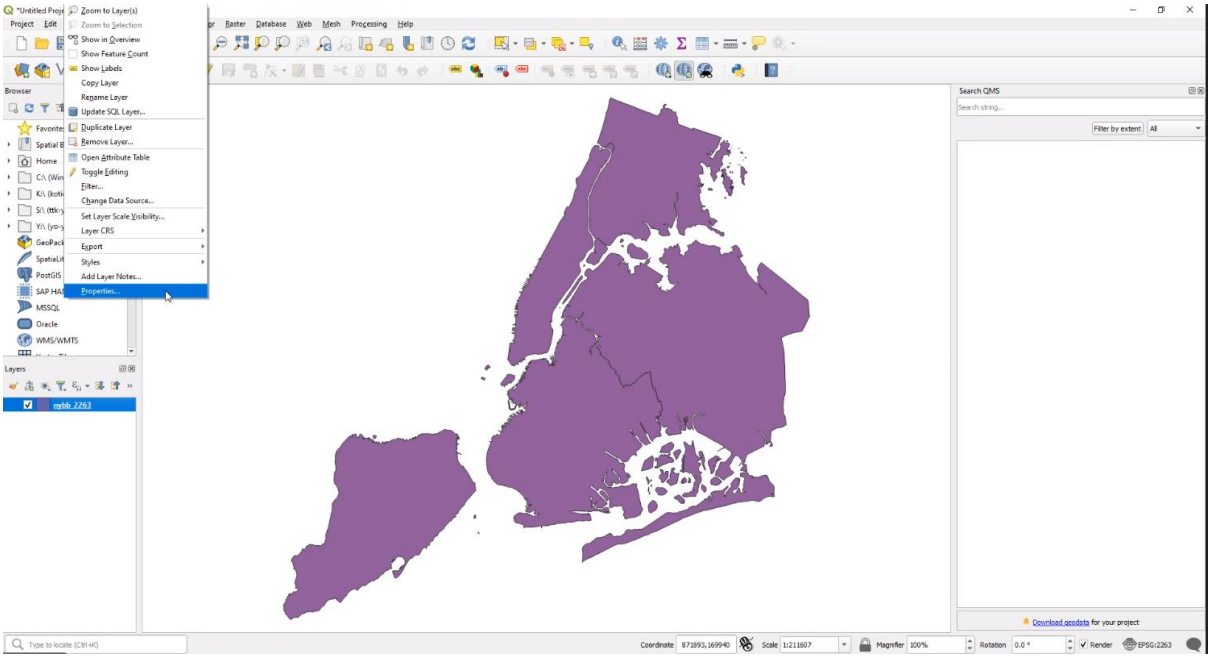

Figure 5: Shapefile appearance in map view

6- The appearance of the layer can be changed: By right-click on the uploaded layer in the layer manager and then clicking on the "Properties" (Figure .5). Under "Symbology there are multiple categories of layer colouring (Figure .6). This will help to categorize and distinguish different regions and districts based on different criteria.

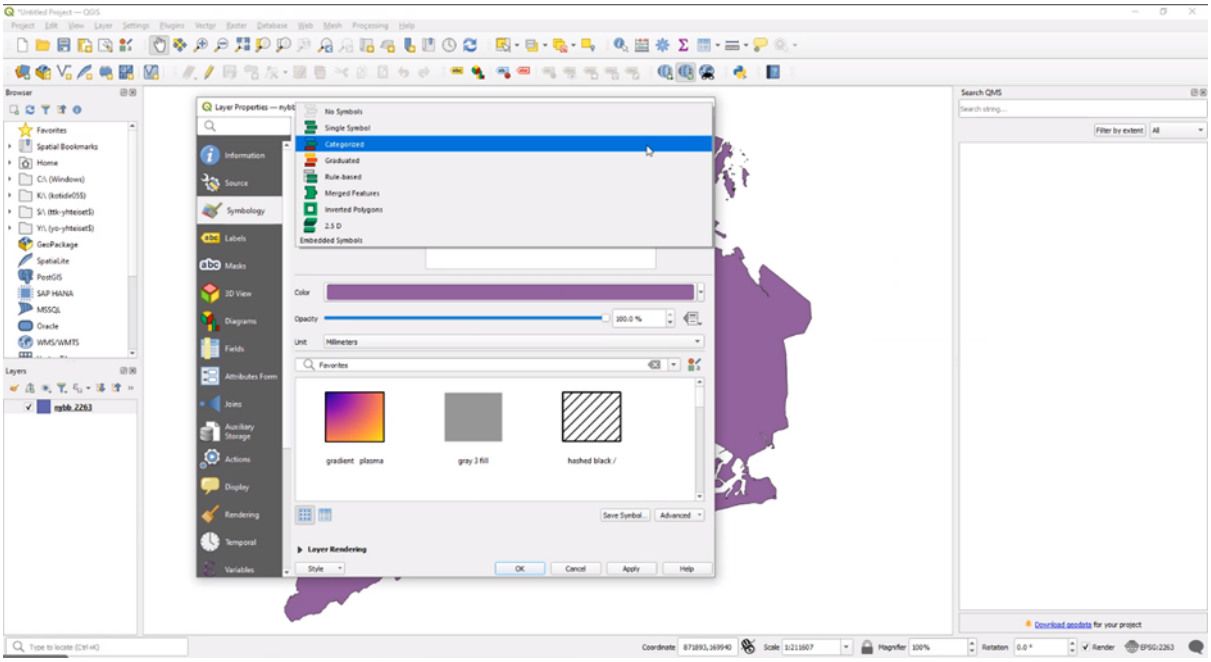

Figure 6: Layer symbology

7- The other two layers can be added in the same way as the first layer, as described above. All layers that have been added are displayed in the "Layer Manager" at the bottom right of the program (Figure .7).

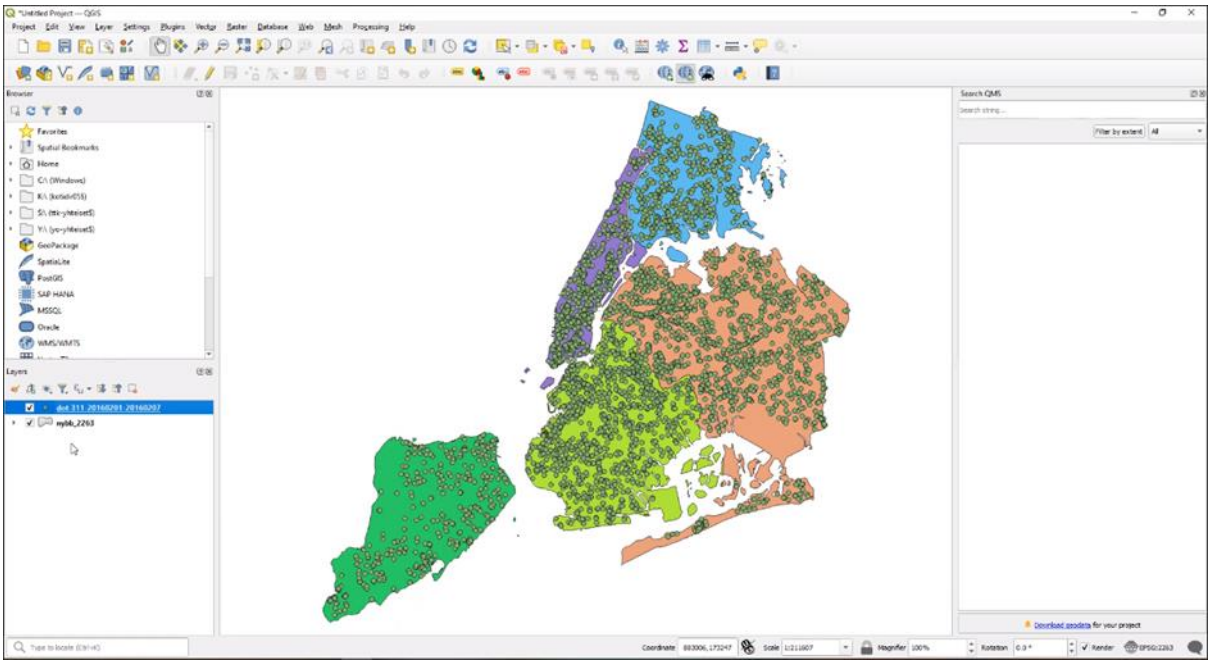

Figure 7: Symbolized layers along with new layers in map view

8- To change the order of layers in QGIS there are two ways:

- Drag and Drop: you can select a layer in the "Layer Manager" and drag and drop it to the desired position.
- Layer order options: you can also use the "Move Layers Up" or "Move Layers Down" buttons in the "Layer Manager" toolbar to change the order of the layers. These buttons are usually found in the top right corner of the "Layer Manager".
- By changing the order of layers in QGIS you can affect which layer is shown before which layer (Figure .8).

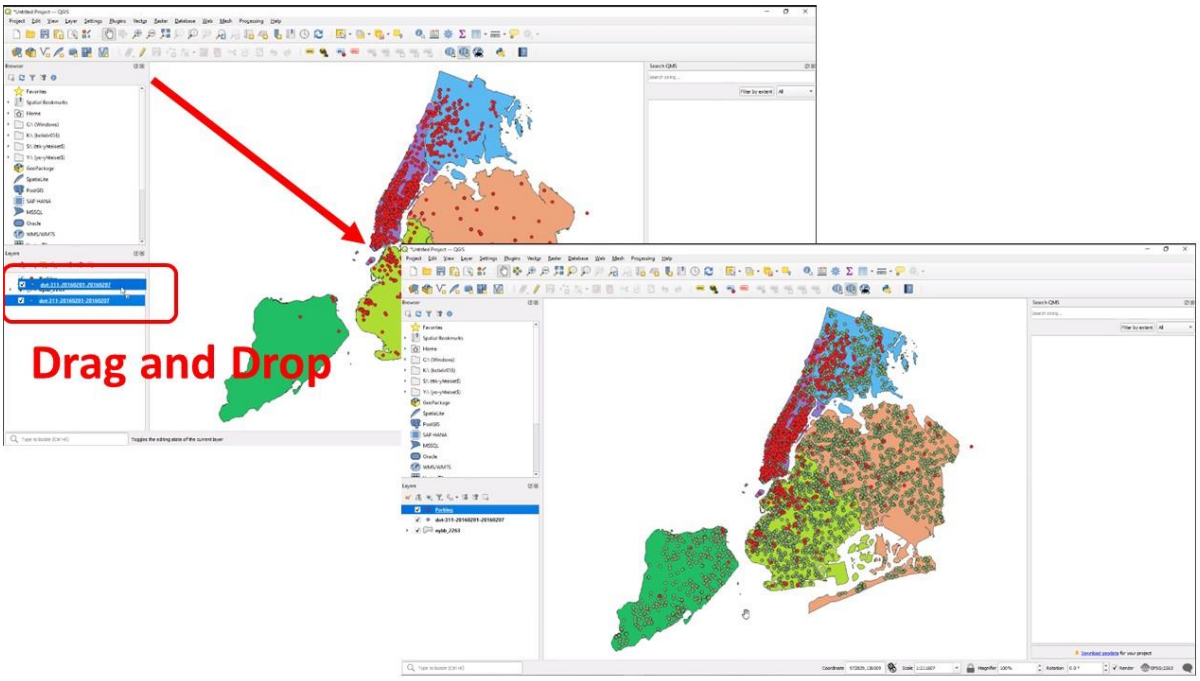

Figure 8: Layer ordering by drag and drop the layers

Create a new project QGIS_Messen; add an OpenStreetMap layer; measure using the QGIS measurement tool. "Measure line" the distance between the FH building in Tulln (center of the building) and the church St. Stephan/St. Stefan in Tulln (center of the building):

For creating a new project, the following steps should be done (Figure .9):

1- click on Project from Menu toolbar,
2- click on New (first option),
3- click on the Project from Menu toolbar again,
4- click on Save,
5- Set the preferred direction and name (QGIS_Messen) and then click on Save.

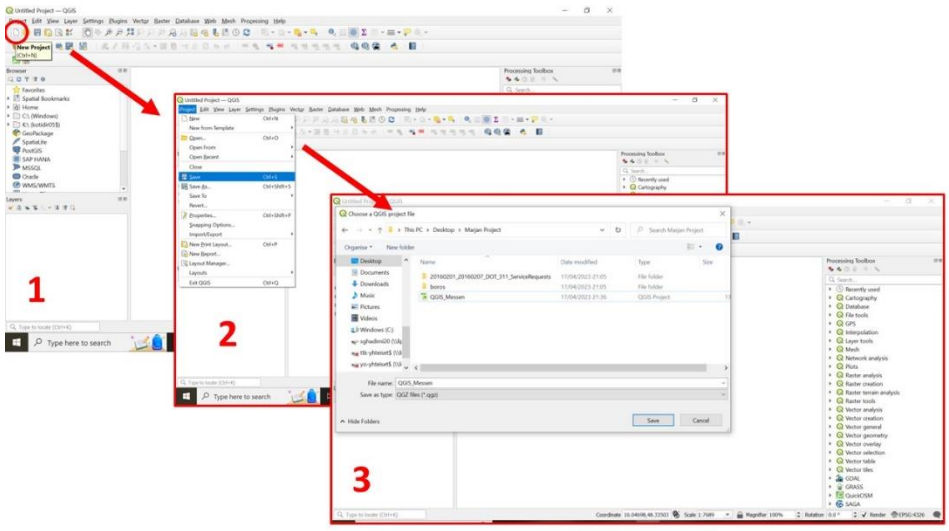

Figure 9: Defining new project

The OpenStreetMap can be found under XYZ Tiles in the browser tab (Figure .10). Zoom enough to find Tulln by scrolling the mouse.

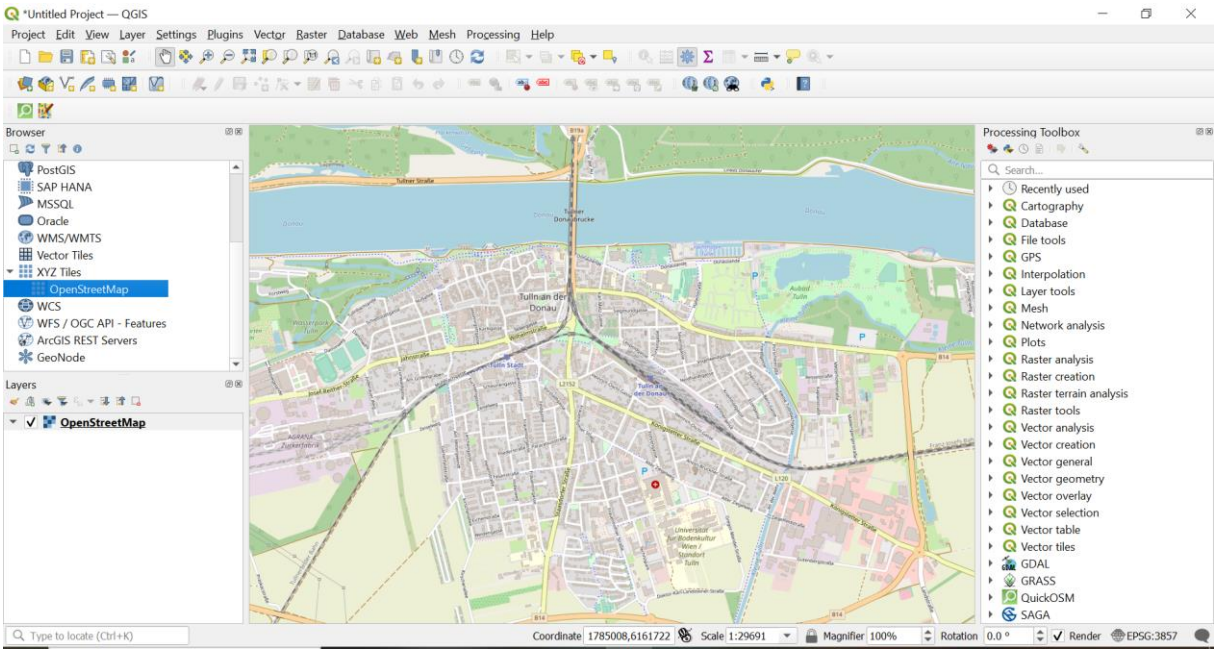

Figure 10: OpenStreetMap openning in QGIS

Select the Measure Line tool from the toolbar. Click in the middle of the FH Tulln building and pull the line to the middle of the St. Stephan church and then right click to close the line. The distance is shown in the Measure box (Figure .11),

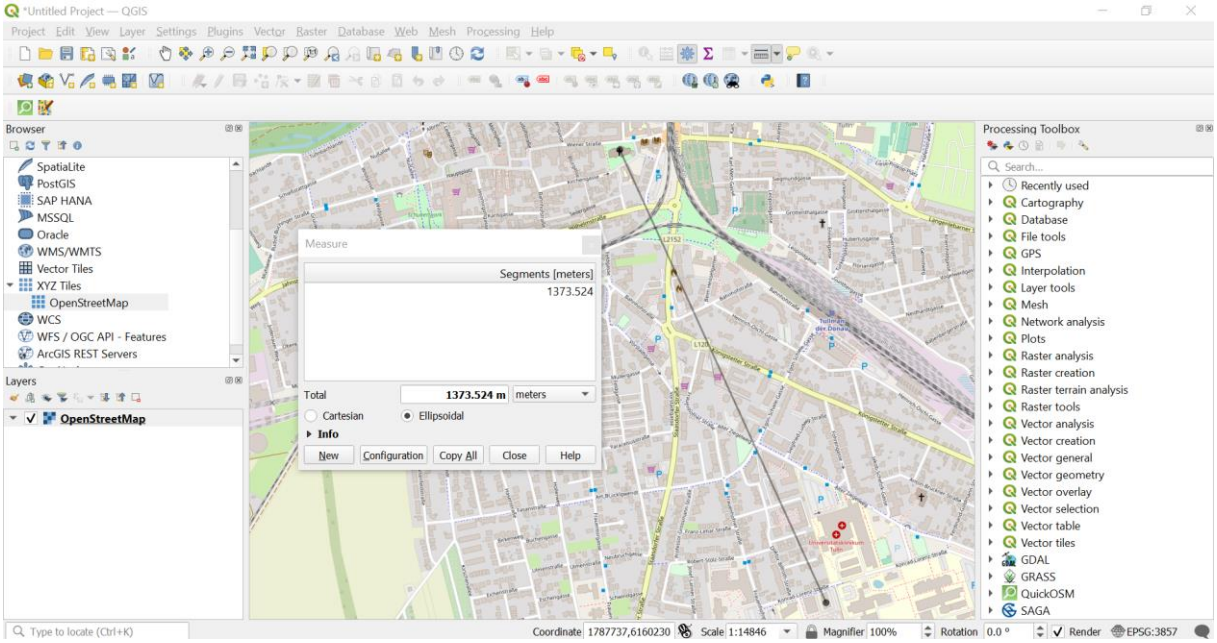

Figure 11: Using Measure line tool

As it is shown in the Figure (11), the distance is around **1373.5 meters**.

In a next step, measure the distance between the two locations using a distance matrix. (Tips: OSM - Open Street Map extract of Tulln download and visualize in QGIS; search osm_map_id for both places; Processing tools - vector selection - extract attribute; Vector - Geometry tools - centroids; vector analysis - distance matrix):

For measuring the actual distance between the two amenities, their shape should be extracted, and their centroids should be calculated. For extracting the shapes, their Osm_Id should be found from the OSM map. This process is done in the following steps:

1- Click on the QuickOSM icon in the toolbar to open the plugin.

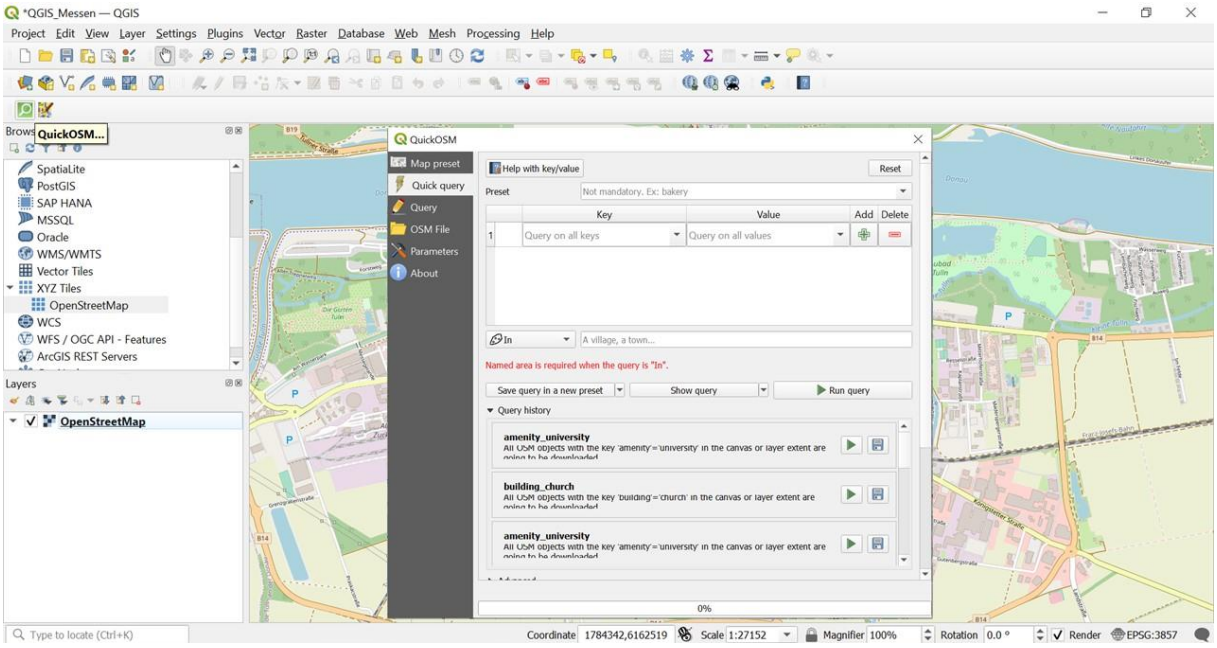

Figure 12: QuickOSM environment

2- To find the FH building, the Key and Value should be set to “amenity” and “university” as the type and useage of the building respectively. The extent of the search is better to be set on “Canvas Extent” so all the OSM objects within the canvas extent or layer are downloaded. This decrease the searching time and the volume of the downloaded layers. Then the query should be run to extract the layer (Figure .13).

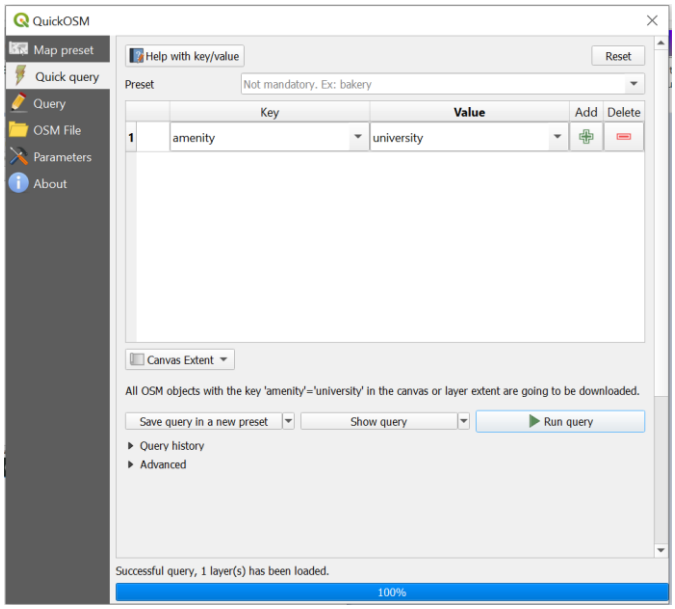

Figure 13: Running query for finding the FH building

3- Same step should be taken for finding the St. Stephan church. The Key and Value should be set to “building” and “church” respectively. The final results are two layers of building_church and amenity_university within the extent of the shown map (Figure .14).

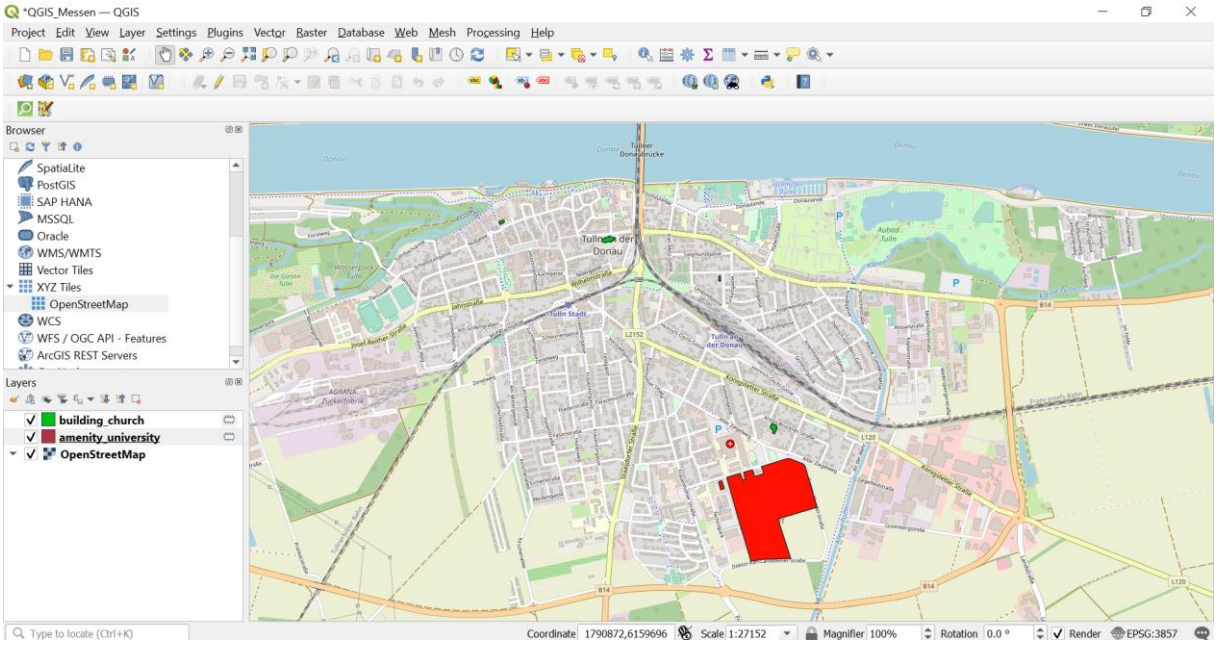

Figure 14: OSM amenity_university (red layer) and building_church (green layer)

4- The osm_map_id for the building will is available in the Attribute Table which is opened by right clicking on the layer and opening the Attribute Table. The osm_map_id for the FH building is **33551257** and for the St. Stephan church is **30533818** (Figure .15).

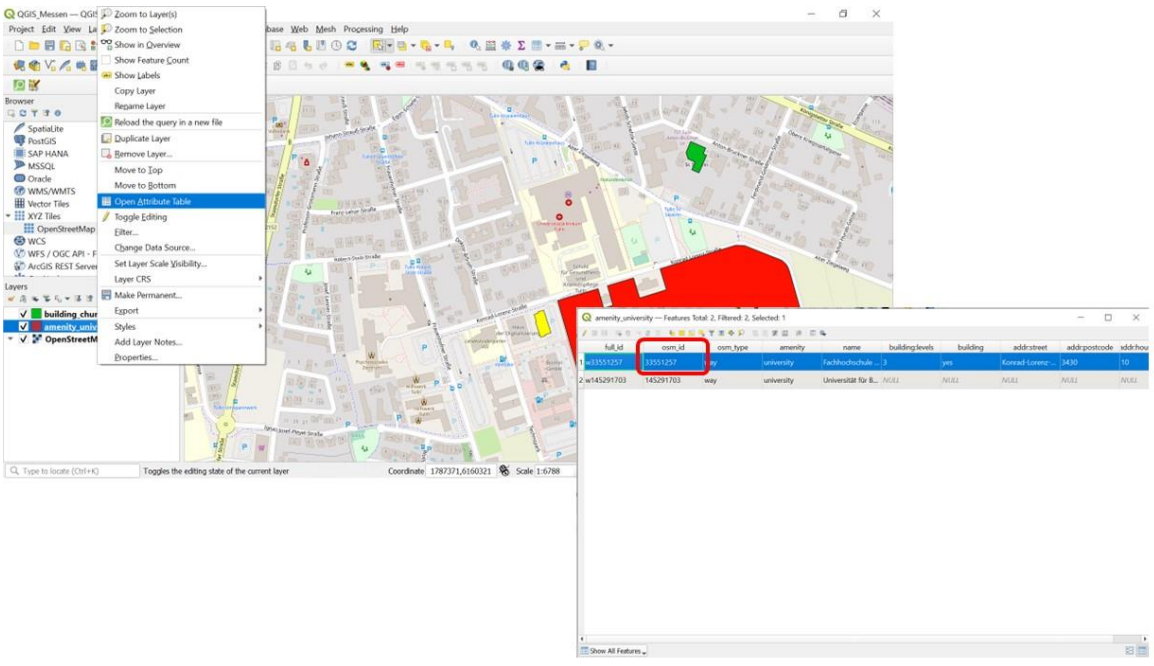

Figure 15: osm-map-id of the layer

5- In order to creat the distance matrixs, the geometry of amenities should be extracted by their identity which in this case is their osm_map_id. To do so, from the “processing” toolbar menu, “toolbox” is selected and then the "Extract by expression" should be searched and run (Figure .16).

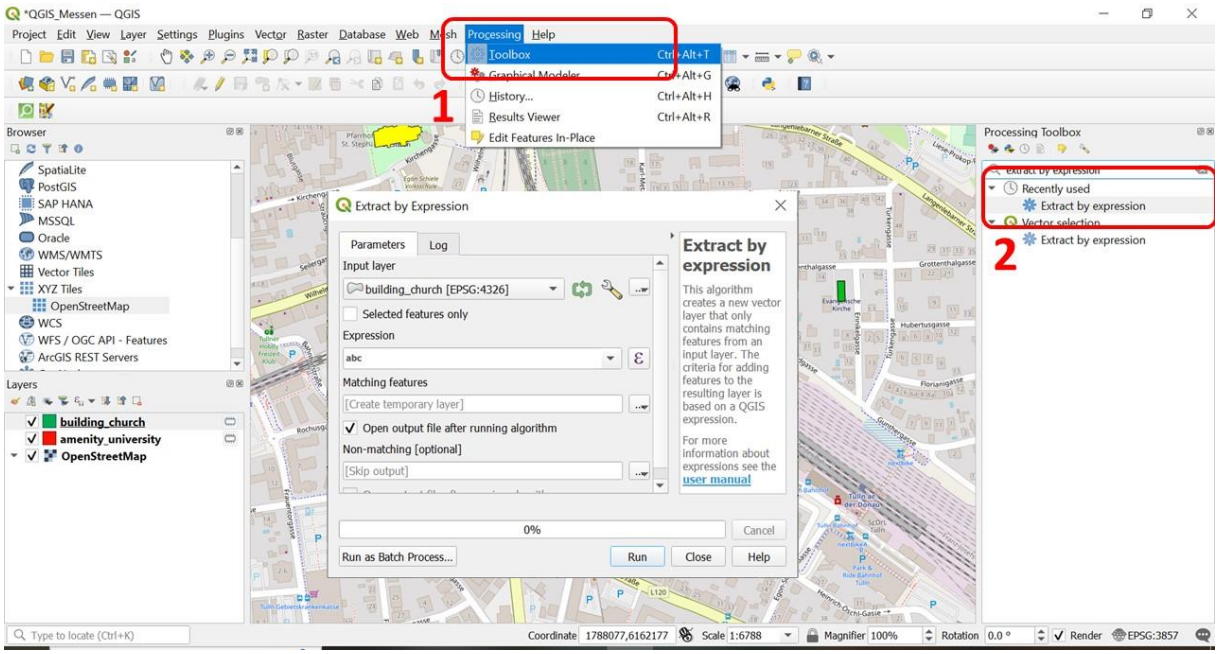

Figure 16: Opening the "Extract by expression" tool from toolbox

6- In the next step, the input layer (St. Stephan church) should be set to one of the downloaded layers (Figure .17-1) and expression to osm_id (Figure .17-2). Then the expression should be opened (Figure .17-3) and the osm_id be set to the osm_map_id of that layer (Figure .17-4). After these settings and running the tool, the geometry of the building is generated (Figure .18). The same process is done for the other layer (FH building) (Figure .19).

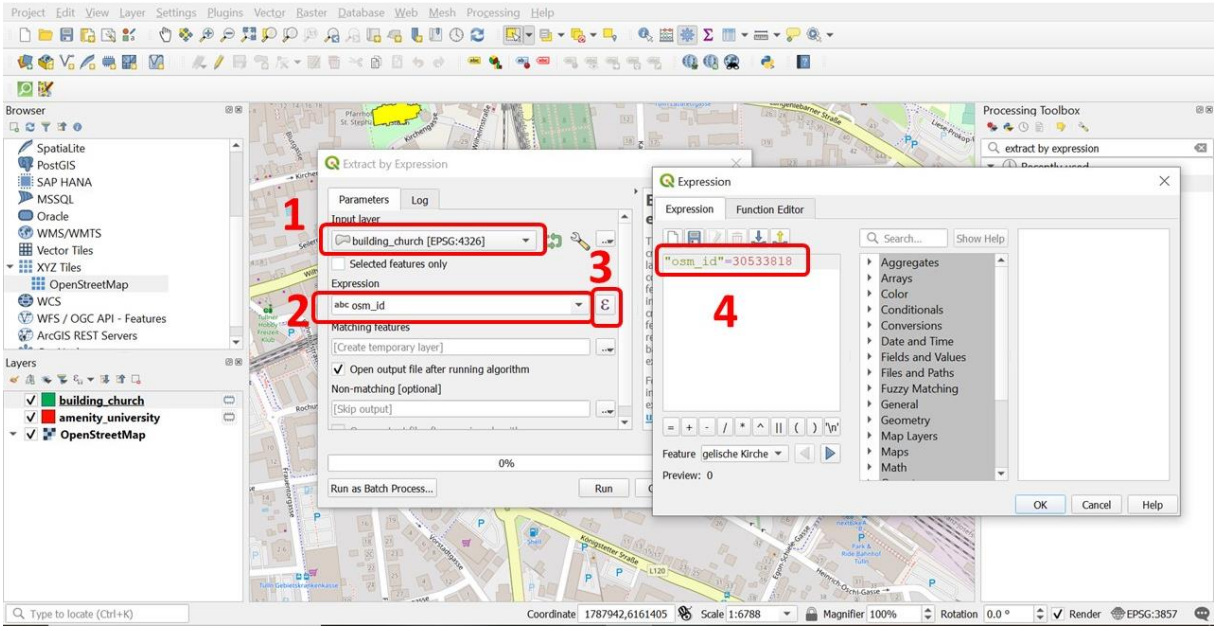

Figure 17:Expression setting for the extract by expression tool.

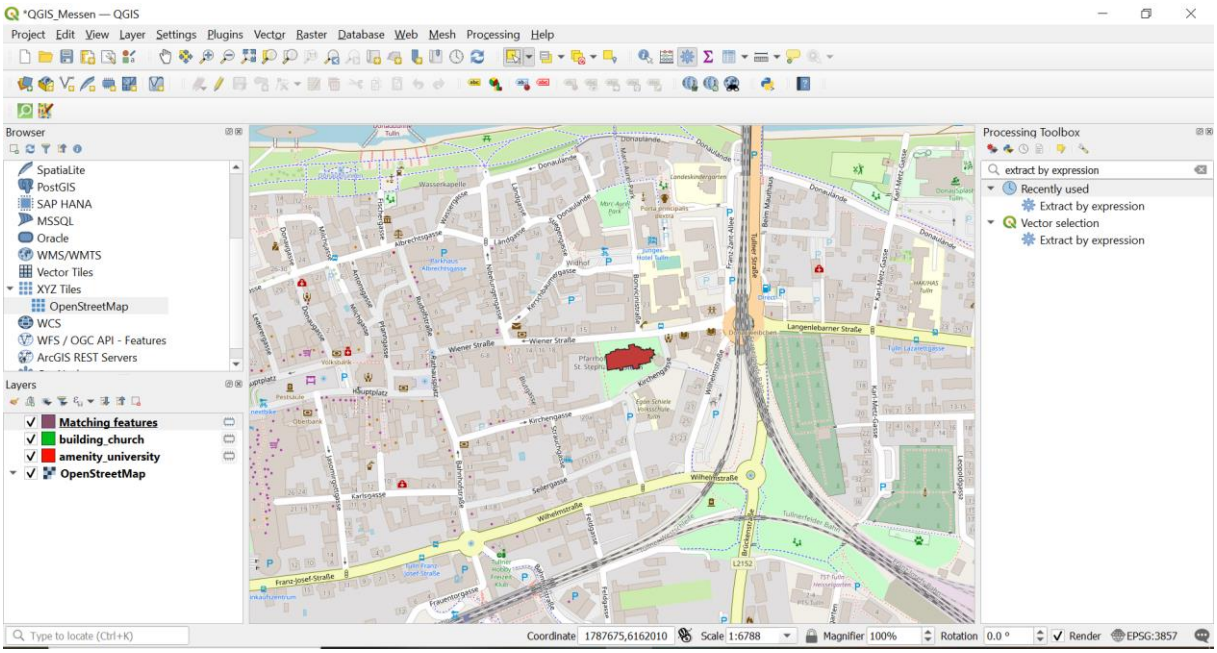

Figure 18: The extracted geometry of St. Stephans church.

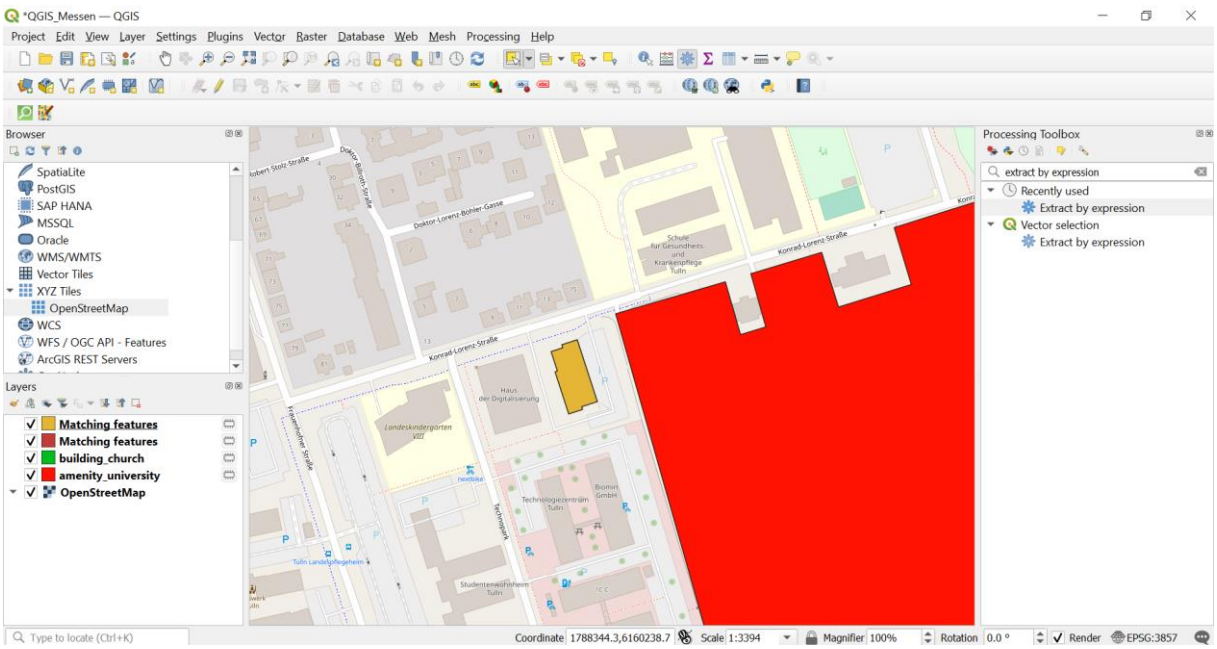

Figure 19: The extracted geometry of FH Tulln building.

7- After extracting the geometries, the centroids should be calculated using "Centroids" tool of "Geometry Tools" in the “vector” toolbar menu the input layer (FH Tulln building) should be set to one of the downloaded layers (Figure .20). After running the tool for the both layers, the centroids will be appeared in the map view (Figure .21).

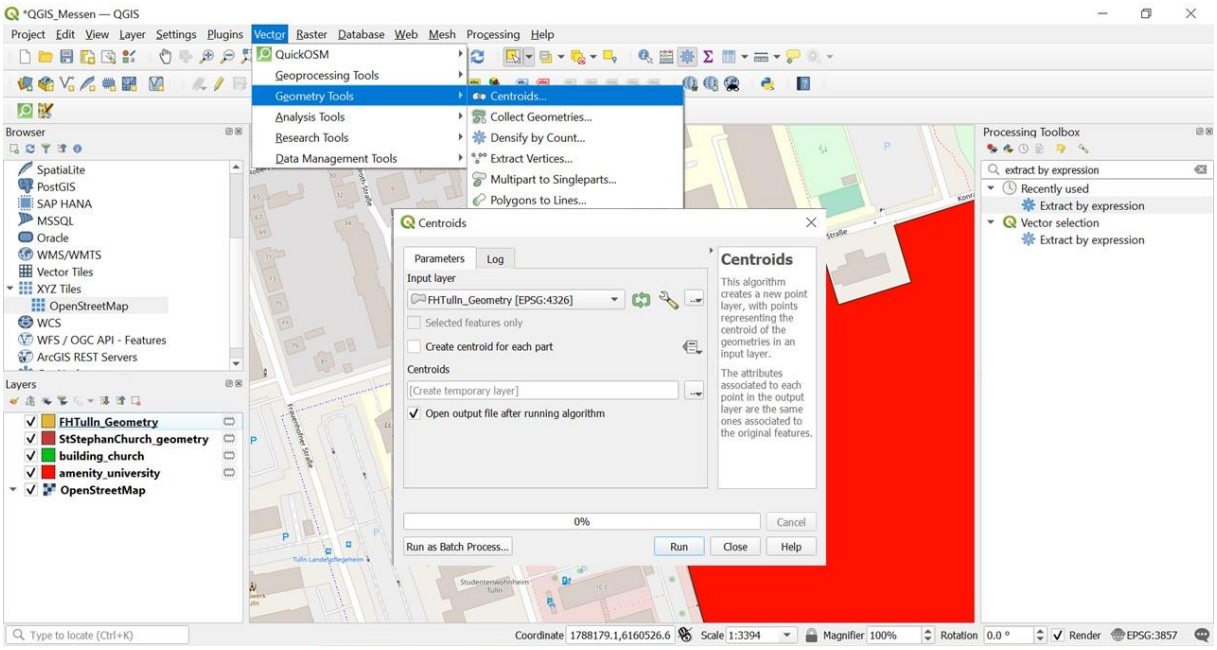

Figure 20: The Centroid tool

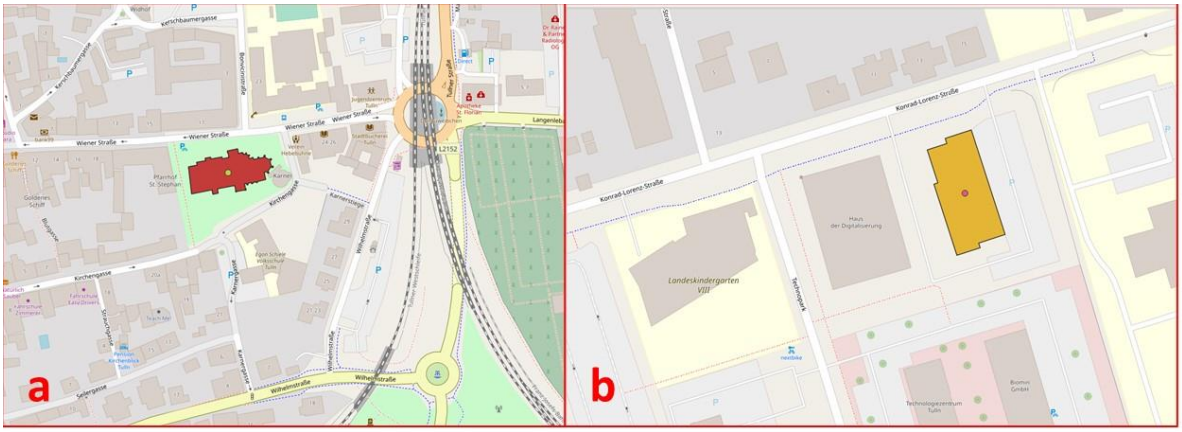

Figure 21: The centroids of the St. Stephan's church (a) and FH Tulln building (b).

8- Finally, the "Distance Matrix" tool can be used to calculate the distance between the centroids of the FH building and the church. For this purpose, the "Distance Matrix" tool should be opened from the "Analysis Tools" of the “Vector” menu. The generated centroid layers and their osm_id should be selected in order within the "Distance Matrix" toolbox (Figure .22).

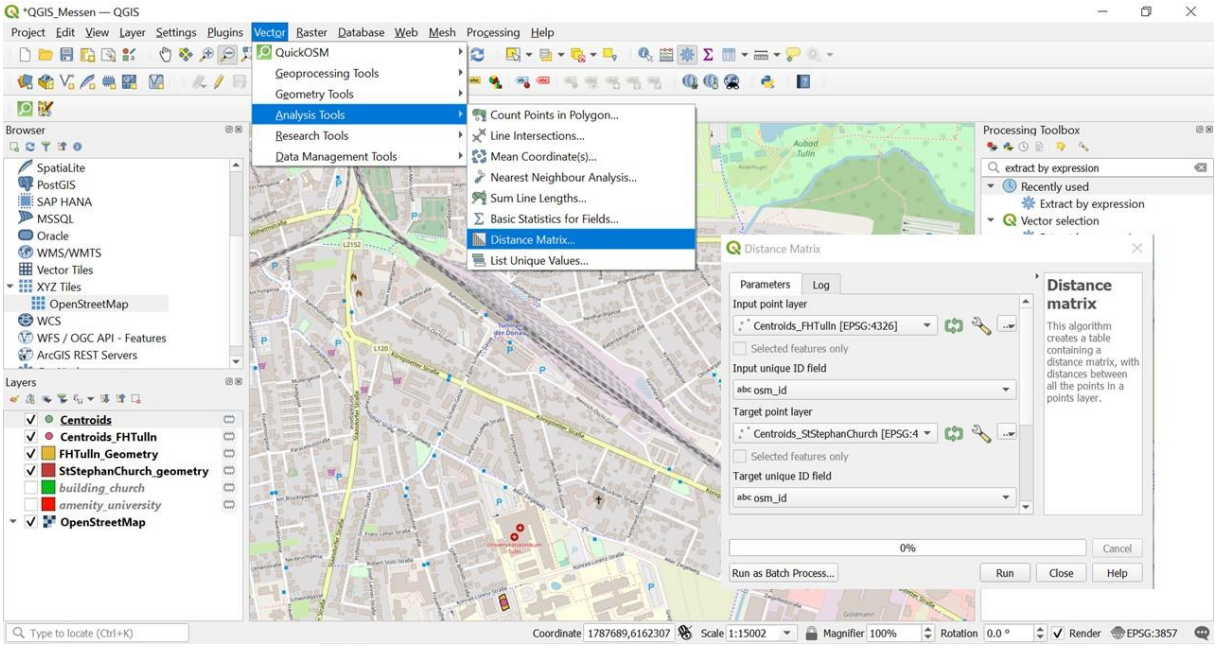

Figure 22: The Distance Matrix toolbox for measuring the distance between the two centroids.

9- After running the distance matrix tool, the "Distance Matrix" layer is created. By opening the attribute table of this layer, the distance between these two amenities can be seen (Figure .23). The distance between the two centroids of the St. Stephan church and FH Tulln building is calculated to be **1364.54 meters**.

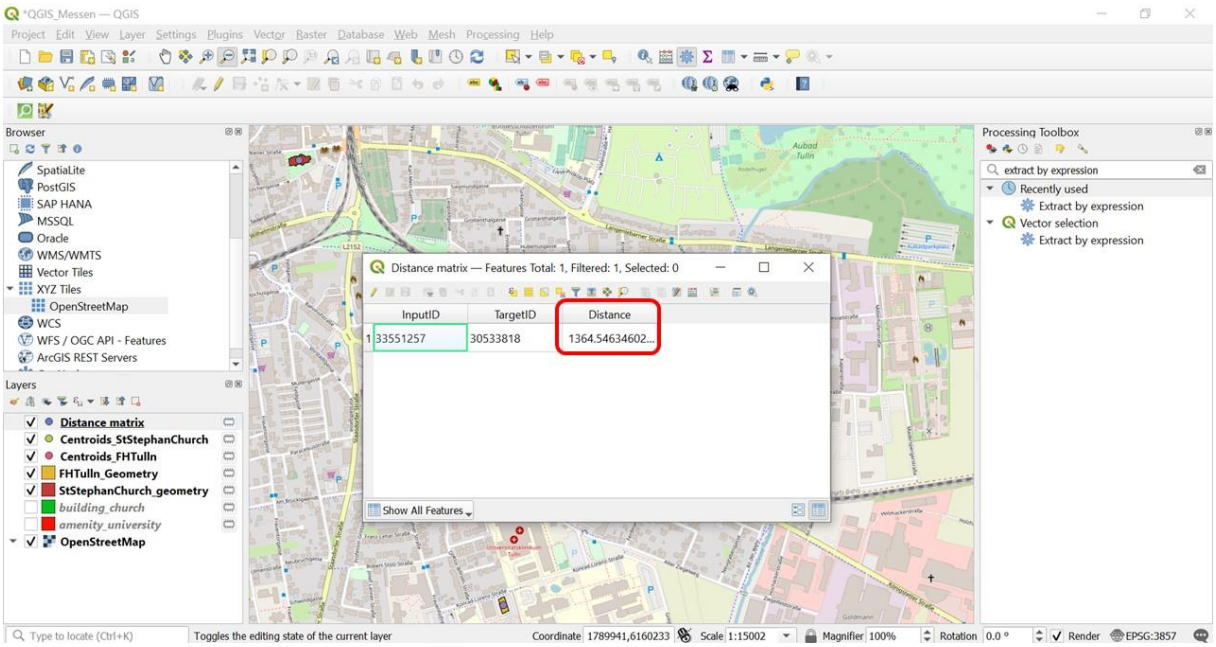

Figure 23: The distance matrix between the two centroids of the St. Stephan church and FH Tulln building

After you have completed the introduction to QGIS, think about three use cases where you see connections with a GIS in your studies, your professional activity or your private environment (at least 3 to 5 sentences per use case). (3.75 POINTS)

1. QGIS can be used to analyse spatial data from metabolomics experiments. For example, if a researcher has data on the concentration of different metabolites in different parts of a plant or animal, QGIS can be used to create maps that show the spatial distribution of the metabolites. This can help identify spatial patterns in the data and may provide insights into the metabolic processes that are occurring in different parts of the organism.

2. QGIS can be used to integrate spatial data with other types of data in bio data science. This can be particularly useful when analysing complex biological systems, such as tissues or organs. For example, a researcher might have data on the expression of a particular gene in different regions of a tissue sample, as well as data on the expression of various proteins and the concentration of different metabolites. By using QGIS to create maps that show the spatial distribution of the gene expression, the researcher can gain insights into the spatial organization of the tissue and the biological processes that are occurring in different parts of the tissue. This spatial data can then be overlaid with data on protein expression or metabolite concentrations, allowing the researcher to identify correlations between different types of data and gain a more comprehensive understanding of the biological processes that are occurring in the tissue. For example, if the researcher identifies a region of the tissue with high expression of a particular gene, they could overlay this spatial data with data on the expression of proteins that are known to interact with the gene product. This could reveal spatial patterns of protein expression that are associated with the gene of interest, providing insights into the biological pathways that are involved. Similarly, by overlaying spatial data with data on metabolite concentrations, the researcher could identify spatial patterns in metabolic processes that are associated with different regions of the tissue. This could provide insights into the regulation of metabolic processes in the tissue and how they are affected by other biological processes.

3. QGIS can also be used in conjunction with data science tools and techniques to analyze and optimize spatial data. It can be used to cluster spatial data based on similarities or differences in the data. This can be useful for identifying patterns and relationships in the data that can be used to optimize algorithms. Moreover, it could be helpful for Data preprocessing and normalization. Besides, it could then use to create visually appealing and informative maps and data visualizations, helping researchers to communicate their findings to a wider audience.

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