

Nearest Neighbor Analysis

QGIS Tutorials and Tips



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Nearest Neighbor Analysis

GIS is very useful in analyzing spatial relationship between features. One such analysis is finding out which features are closest to a given feature. QGIS has a tool called **Distance Matrix** which helps with such analysis. In this tutorial, we will use 2 datasets and find out which points from one layer are closest to which point from the second layer.

Overview of the task

Given the locations of all known significant earthquakes, find out the nearest populated place for each location where the earthquake happened.

Other skills you will learn

- How to do table joins in QGIS. (See [Les Jointures de tables \(JOIN\)](#) for detailed instructions.)

Get the data

We will use NOAA's National Geophysical Data Center's [Significant Earthquake Database](#) as our layer representing all major earthquakes. Download the [tab-delimited earthquake data](#).

Natural Earth has a nice [Populated Places](#) dataset. Download the [simple \(less columns\) dataset](#)

Data Sources: [NGDC] [NATURALEARTH]

Procedure

1. Open *Layer* ■ *Add Delimited Text Layer* and browse to the downloaded `signif.txt` file.



2. Since this is a *tab-delimited file*, choose *Tab* as the *File format*. The *X field* and *Y field* would be auto-populated. Click *OK*.

Note

You may see some error messages as QGIS tries to import the file. These are valid errors and some rows from the file will not be imported. You can ignore the errors for the purpose of this tutorial.

Create a Layer from a Delimited Text File

File Name:

Layer name: Encoding:

File format: ☐ CSV (comma separated values) ☒ Custom delimiters ☐ Regular expression delimiter

☐ Comma
 ☒ Tab
 ☐ Space
 ☐ Colon
 ☐ Semicolon

Other delimiters: Quote: Escape:

Record options: Number of header lines to discard: ☒ First record has field names

Field options: ☐ Trim fields ☐ Discard empty fields ☐ Decimal separator is comma

Geometry definition: ☒ Point coordinates ☐ Well known text (WKT) ☐ No geometry (attribute only table)

☒ X field: Y field: ☐ DMS coordinates

Layer settings: ☒ Use spatial index ☐ Use subset index ☐ Watch file

	I_D	FLAG_TSUNAMI	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND	FOCAL_DEPTH	EQ_MAG_MW	EQ_MAG
1	1		-2150								
2	2	Tsu	-2000								
3	3		-2000						18		7.1
4	8		-1566								
5	11		-1450								

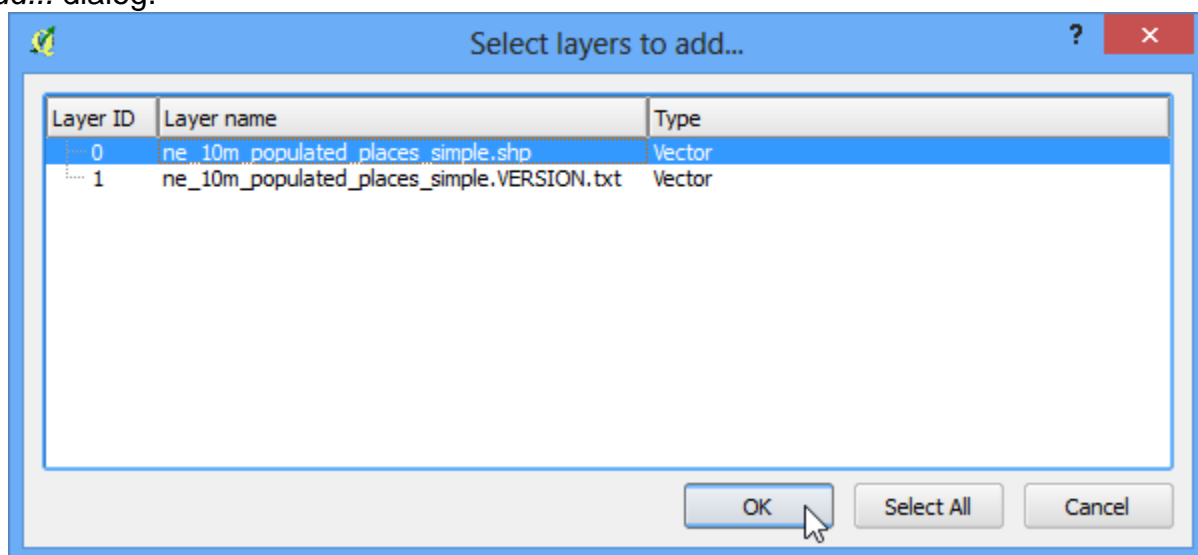
- As the earthquake dataset has Latitude/Longitude coordinates, choose *WGS 84 EPSG:436* as the CRS in the *Coordinate Reference System Selector* dialog.



4. The earthquake point layer would now be loaded and displayed in QGIS. Let's also open the Populated Places layer. Go to **Layer** ■ **Add Vector Layer**.

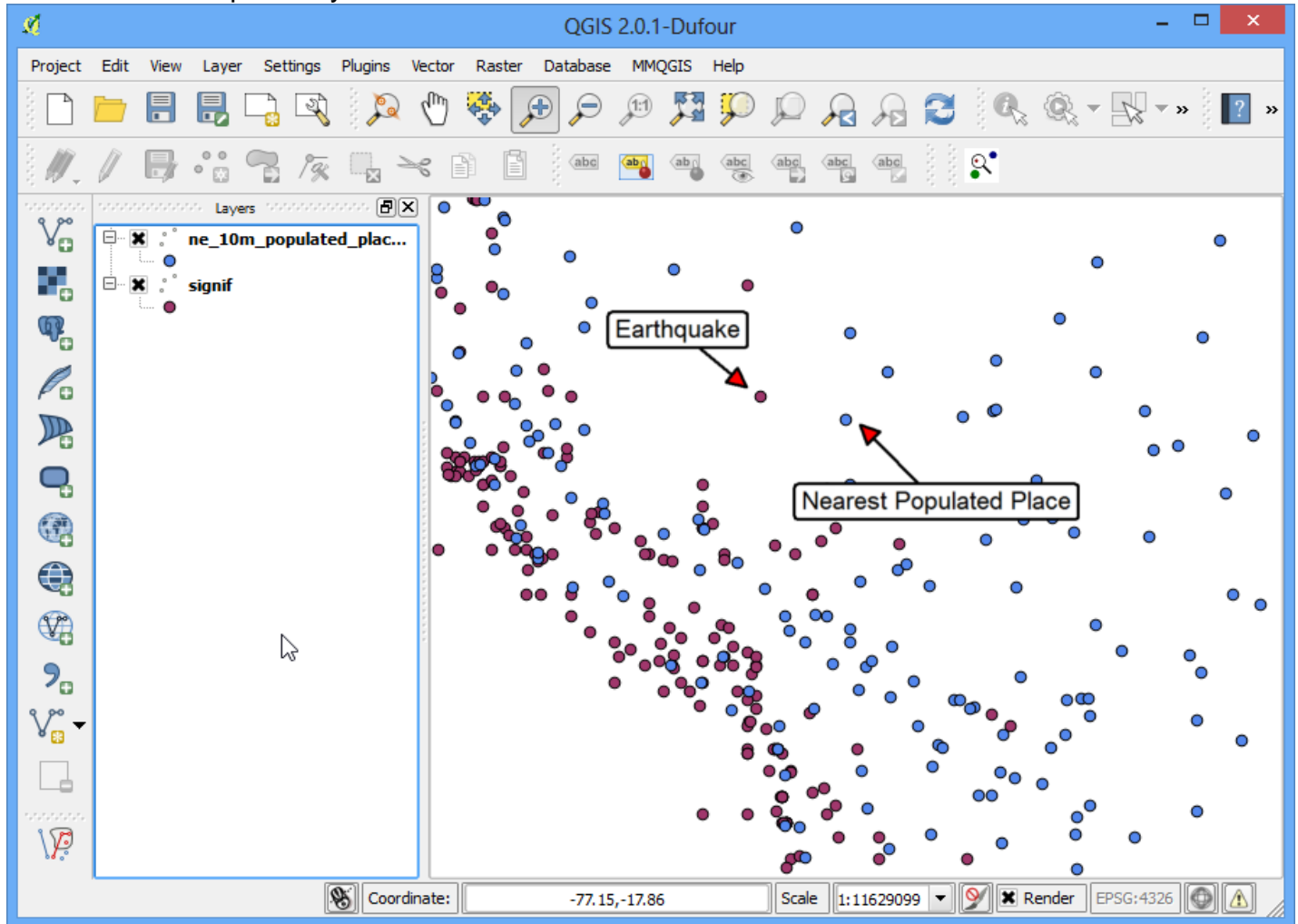


5. Browse to the downloaded `ne_10m_populated_places_simple.zip` file and click *Open*. Select the `ne_10m_populated_places_simple.shp` as the layer in the *Select layers to add...* dialog.



6. Zoom around and explore both the datasets. Each purple point represents the location of a significant earthquake and each blue point represents the location of a populated place. We

need a way to find out the nearest point from the populated places layer for each of the points in the earthquake layer.



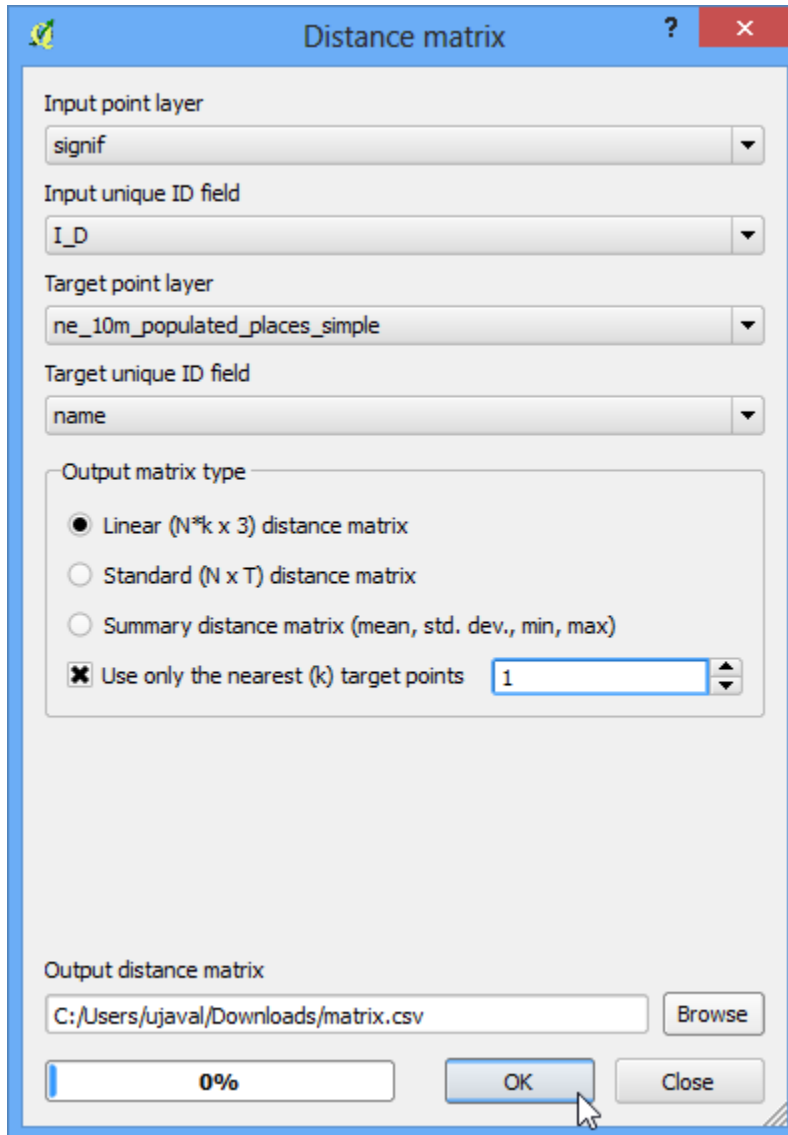
7. Go to **Vector** ■ **Analysis Tools** ■ **Distance Matrix**.



8. Here select the earthquake layer `signif` as the Input point layer and the populated places `ne_10m_populated_places_simple` as the target layer. You also need to select a unique field from each of these layers which is how your results will be displayed. In this analysis, we are looking to get only 1 nearest point, so check the *Use only the nearest(k) target points*, and enter 1. Name your output file `matrix.csv`, and click OK.

Note

A useful thing to note is that you can even perform the analysis with only 1 layer. Select the same layer as both Input and Target. The result would be a nearest neighbor from the same layer instead of a different layer as we have used here.

The image shows the 'Distance matrix' dialog box in QGIS. It has a blue title bar with a question mark and a close button. The dialog is divided into several sections. The first section, 'Input point layer', has a dropdown menu showing 'signif'. The second section, 'Input unique ID field', has a dropdown menu showing 'I_D'. The third section, 'Target point layer', has a dropdown menu showing 'ne_10m_populated_places_simple'. The fourth section, 'Target unique ID field', has a dropdown menu showing 'name'. The fifth section, 'Output matrix type', contains three radio buttons: 'Linear (N*k x 3) distance matrix' (selected), 'Standard (N x T) distance matrix', and 'Summary distance matrix (mean, std. dev., min, max)'. Below these is a checkbox labeled 'Use only the nearest (k) target points' which is checked, followed by a small input field containing the number '1'. The sixth section, 'Output distance matrix', has a text field containing 'C:/Users/ujaval/Downloads/matrix.csv' and a 'Browse' button. At the bottom, there is a progress bar showing '0%', an 'OK' button, and a 'Close' button. A mouse cursor is pointing at the 'OK' button.

Distance matrix

Input point layer
signif

Input unique ID field
I_D

Target point layer
ne_10m_populated_places_simple

Target unique ID field
name

Output matrix type

- ☒ Linear ($N \times k \times 3$) distance matrix
- ☐ Standard ($N \times T$) distance matrix
- ☐ Summary distance matrix (mean, std. dev., min, max)

☒ Use only the nearest (k) target points 1

Output distance matrix
C:/Users/ujaval/Downloads/matrix.csv Browse

0% OK Close

9. Once your file is generated, you can view it in Notepad or any text editor. QGIS can import CSV files as well, so we will add it to QGIS and view it there. Go to **Layer** ■ **Add Delimited Text Layer....**



10. Browse to the newly created `matrix.csv` file. Since this file is just text columns, select *No geometry (attribute only table)* as the *Geometry definition*. Click *OK*.

Create a Layer from a Delimited Text File

File Name:

Layer name: Encoding:

File format: ☒ CSV (comma separated values) ☐ Custom delimiters ☐ Regular expression delimiter

Record options: Number of header lines to discard: ☒ First record has field names

Field options: ☐ Trim fields ☐ Discard empty fields ☐ Decimal separator is comma

Geometry definition: ☐ Point coordinates ☐ Well known text (WKT) ☒ No geometry (attribute only table)

Layer settings: ☐ Use spatial index ☐ Use subset index ☐ Watch file

	InputID	TargetID	Distance
1	1	Al Karak	0.221721171014
2	2	Al Ladhiqiyah	0.144408036939
3	3	Buzmeyin	0.0526324624814
4	8	Al Khalil	0.208418004566
5	11	Iraklio	0.408843567409
6	5877	Iraklio	1.1082549107

11. You will see the CSV file loaded as a table. Right-click on the table layer and select *Open Attribute Table*.



12. Now you will be able to see the content of our results. The *InputID* field contains the field name from the Earthquake layer. The *TargetID* field contains the name of the feature from the Populated Places layer that was the closest to the earthquake point. The *Distance* field is the distance between the 2 points.

Note

Remember that the *distance* calculation will be done using the layers' Coordinate Reference System. Here the distance will be in *decimal degrees* units because our source layer coordinates are in degrees. If you want distance in meters, reproject the layers before running the tool.

Attribute table - matrix :: Features total: 5727, filtered: 5727, selected: 0

	InputID	TargetID	Distance
0	1	Al Karak	0.221721171014
1	2	Al Ladhihiyah	0.144408036939
2	3	Buzmeyin	0.0526324624814
3	8	Al Khalil	0.208418004566
4	11	Iraklio	0.408843567409
5	5877	Iraklio	1.1082549107
6	9712	Al Ladhihiyah	0.144408036939
7	12	As Salt	0.230569794451
8	13	Al Aqabah	0.10661139997
9	14	Al Qunaytirah	0.34713470868
10	7793	Nabatiye et Tahta	0.256395311798
11	16	Sparti	0.101878534504
12	7794	Saida	0.00326167893321
13	9713	Piraiévs	0.206150410754
14	17	Volos	0.4810609473
15	18	Sparti	0.101878534504
16	5878	Lamia	0.265998307404
17	19	Varamin	0.239101501046
18	20	Patra	0.520403483984
19	21	Iraklio	0.350232618378
20	22	Kavala	1.1152439462
21	9652	Rajkot	0.717056768568

Show All Features

13. This is very close to the result we were looking for. For some users, this table would be sufficient. However, we can also integrate this results in our original Earthquake layer using a **Table Join**. Right-click on the Earthquake layer, and select *Properties*.



14. Go to the *Joins* tab and click on the + button.



15. We want to join the data from our analysis result (`matrix.csv`) to this layer. We need to select a field from each of the layers that has the same values. Select the fields as shown below.



16. You will see the join appear in the *Joins* tab. Click *OK*.



17. Now open the attribute table of the Earthquakes layer by right-clicking and selecting *Open Attribute Table*.



18. You will see that for every Earthquake feature, we now have an attribute which is the nearest neighbor (closest populated place) and the distance to the nearest neighbor.

Attribute table - signif :: Features total: 5727, filtered: 5727, selected: 0

	DAMAGE_DESCR	L_HOUSES_DESTR	SES_DESTROYED_I	L_HOUSES_DAM	SES_DAMAGED_D	matrix_TargetID	matrix_Distance
0	NULL	NULL	NULL	NULL	NULL	Al Karak	0.221721171014
1	NULL	NULL	NULL	NULL	NULL	Al Ladhiqiyah	0.144408036939
2	1	NULL	1	NULL	NULL	Buzmeyin	0.0526324624814
3	NULL	NULL	NULL	NULL	NULL	Al Khalil	0.208418004566
4	NULL	NULL	NULL	NULL	NULL	Iraklio	0.408843567409
5	3	NULL	NULL	NULL	NULL	Iraklio	1.1082549107
6	3	NULL	NULL	NULL	NULL	Al Ladhiqiyah	0.144408036939
7	NULL	NULL	NULL	NULL	NULL	As Salt	0.230569794451
8	NULL	NULL	NULL	NULL	NULL	Al Aqabah	0.10661139997
9	NULL	NULL	NULL	NULL	NULL	Al Qunaytirah	0.34713470868
10	NULL	NULL	NULL	NULL	NULL	Nabatiye et Tahta	0.256395311798
11	NULL	NULL	NULL	NULL	NULL	Sparti	0.101878534504
12	NULL	NULL	NULL	NULL	NULL	Saida	0.00326167893321
13	NULL	NULL	NULL	NULL	NULL	Piraiévs	0.206150410754
14	NULL	NULL	NULL	NULL	NULL	Volos	0.4810609473
15	1	NULL	1	NULL	NULL	Sparti	0.101878534504
16	3	NULL	3	NULL	NULL	Lamia	0.265998307404
17	3	NULL	NULL	NULL	NULL	Varamin	0.239101501046
18	3	NULL	3	NULL	NULL	Patra	0.520403483984
19	1	NULL	NULL	NULL	NULL	Iraklio	0.350232618378
20	NULL	NULL	NULL	NULL	NULL	Kavala	1.1152439462
21	NULL	NULL	NULL	NULL	NULL	Raikot	0.717056768568

Show All Features