



Interpolation Techniques

Using QGIS

Tutorial ID: IGET_SA_002



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Interpolation Techniques

Objective: To understand the concept of Interpolation using QGIS

Software: QGIS

Level: Advance

Time required: 1.5 Hour

Prerequisites and Geospatial Skills

1. QGIS should be installed on your computer
2. Basic knowledge about the QGIS interface (Refer: [IGET_GIS_001](#))

Reading

1. Mitas, L., & Mitasova, H. (1999). [Spatial interpolation](#). *Geographical information systems: principles, techniques, management and applications*, 1, 481-492.
http://www.geos.ed.ac.uk/~gisteac/gis_book_abridged/files/ch34.pdf

References

1. Singh, P., & Khan, I. A. (2011). [Ground water quality assessment of Dhankawadi ward of Pune by using GIS](#). *International Journal of Geomatics and Geosciences*, 2(2), 688-703.

Introduction

Seamless spatial data is one of the key dataset used in many spatial analysis operations. However, acquiring seamless spatial dataset is often tedious, expensive and time consuming. Therefore, representative samples collected from the field observation will be used to estimate the continuous spatial surface by using interpolation techniques, known as '*spatial interpolators*'. The representative samples used in spatial interpolation are also called as '*control points*' or simply '*samples*'. The quantity, quality and spatial distribution of these samples along with proper spatial interpolators has great influence in the accuracy of the interpolated spatial surface. The spatial interpolators are grouped into several categories based on their nature of fit, viz., global vs local, exact vs inexact, deterministic vs stochastic and Geostatistical vs non-Geostatistical etc.

The spatial interpolator which uses all available data in the area of interest to estimate and capture the general trend of the surface is known as '*global interpolator*' where as '*local interpolators*' operates within a small area around the samples to capture the local trend. If the estimated spatial surface passes through the samples then the spatial interpolator termed as '*exact interpolator*', otherwise termed as '*inexact interpolator*'. If the interpolator incorporates the concept of randomness and provide both estimations and associated of errors, it is known as '*stochastic interpolator*' otherwise only if it provides estimations known as '*deterministic interpolator*'. In this tutorial, we will focus on two most widely used interpolators i.e., '*Inverse Distance Weighted (IDW)*' and '*Triangular Irregular Network (TIN)*'.

IDW using QGIS

'*Inverse Distance Weighted (IDW)*' is a local interpolator that estimates the value at un-sampled location using a combination of samples weighted by an inverse function of distance from the point of interest to the sampled points. The samples near to the un-sampled location have more influence than the further. A power factor (k) is used to control the weights. If we increase the value of power factor that increases the influence of nearby points. IDW is a local exact interpolation technique. The general equation for IDW method is,

$$Z_o = \frac{\sum_{i=1}^s Z_i \cdot \frac{1}{d_j^k}}{\sum_{i=1}^s \frac{1}{d_j^k}}$$

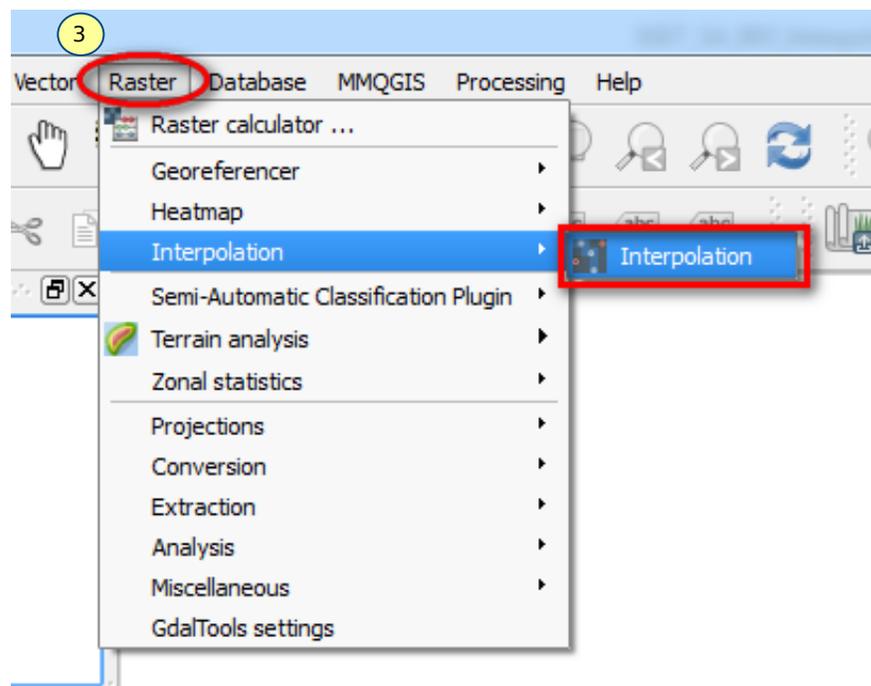
Where,

- Z_o = estimated value at un-sampled point o
- Z_i = Z value at control point i ,
- d_j = distance between sample point i and point o
- s = the number of sample points used in estimation
- k = Power factor

In this section, we use IDW interpolator to model the ground water quality parameters of Dhankawadi ward in Pune.

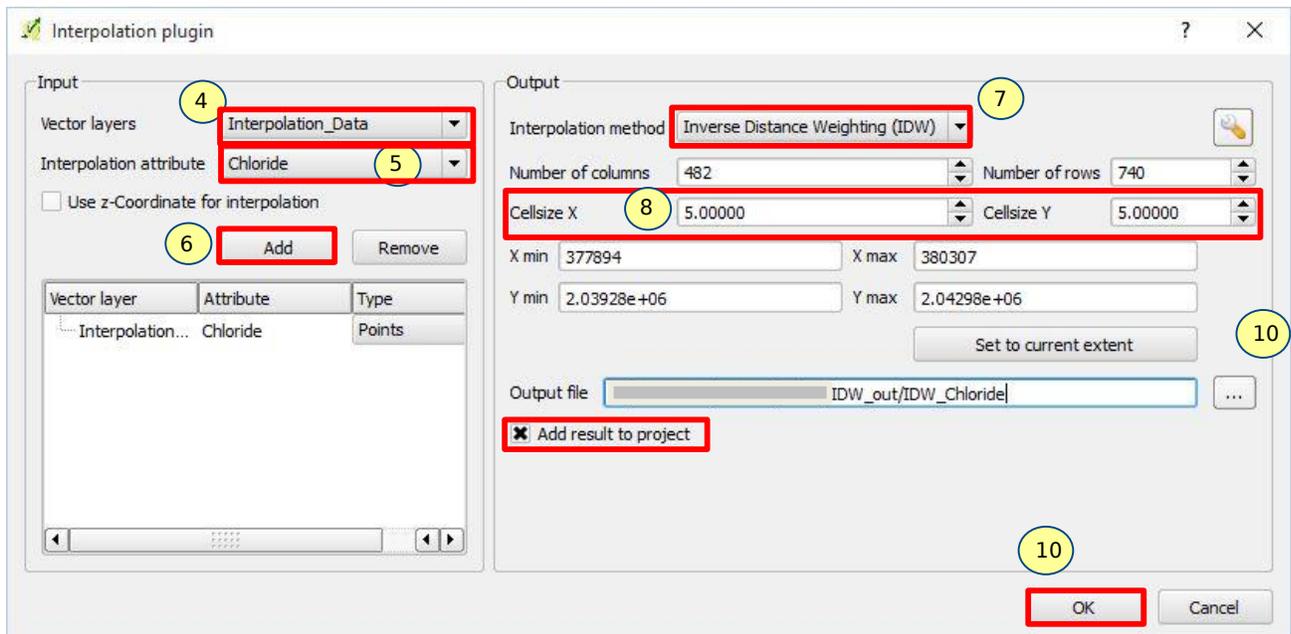
Before proceeding further, make sure 'Use project CRS' radio button is selected under 'CRS' section in 'Options' window. It can be accessed via, **Menu → Settings → Option → CRS**.

1. Open "Interpolation_Data" shapefile in QGIS via, **Menu → Layer → Add Vector Layer → Browse (for the data folder) → select 'Interpolation_Data.shp' → click on Open**. Check the projection information of layer.
2. Open attribute table via, Right click on '**Interpolation_Data.shp**' under *Layer* section and select '**Open Attribute Table**'. It opens the attribute table of shape file. It contains the sample IDs and water quality parameters. We will use these ten samples to create a spatial distribution of map of one water quality parameter i.e., '**Chloride**' using IDW technique. Close the table after reading it.
3. Go to **Menu → Raster → Interpolation → Interpolation**. The interpolation window will open up.

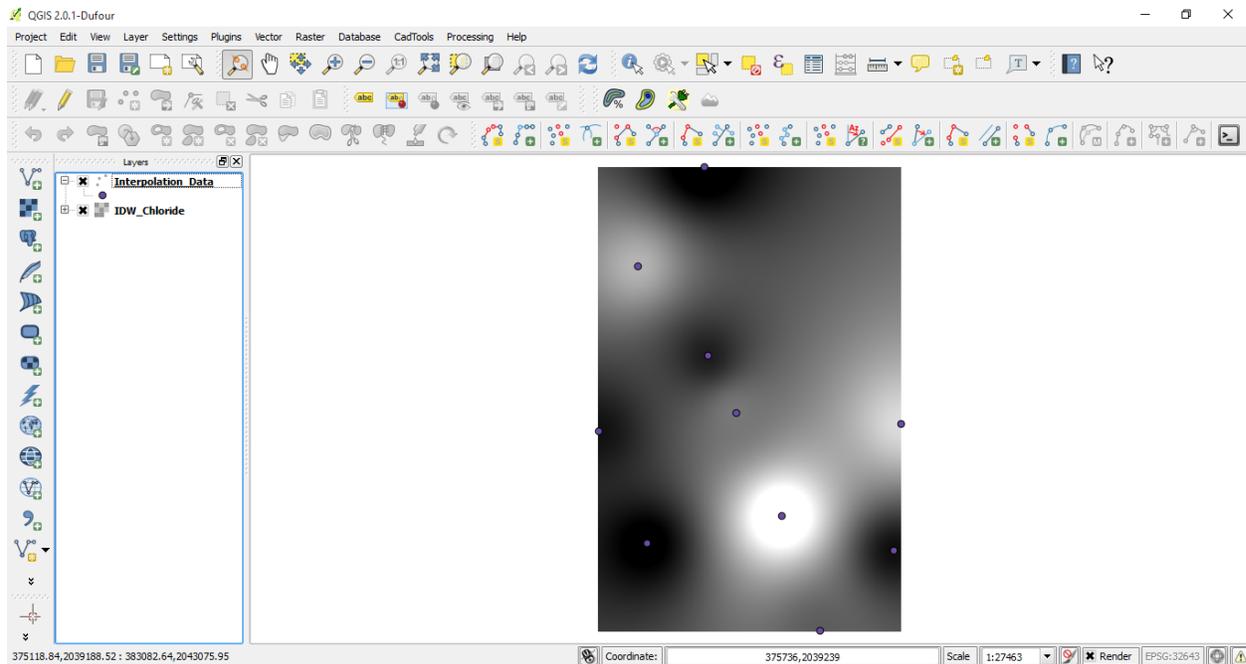


4. In the *Interpolation* window, select '**Interpolation_Data**' from the drop down menu just after '*Vector layers*'.
5. Now specify the parameter need to be interpolated, here we will interpolate chloride content of the study area. Select '*Interpolation attribute*' as '**Chloride**'.
6. After selecting the attribute click on '**Add**' button just below it. Now '**Chloride**' is added for interpolation in the below column.

7. Now we will move on to filling up of output details. Select '**Inverse Distance Weighting (IDW)**' from drop-down menu just after '*Interpolation method*' tab.
8. We are interested in creating a spatial surface of chloride with five meter resolution. Hence, we need to specify the cell size for X and Y. Enter '**5**' in both '*Cellsize X*' and '*Cellsize Y*'.
9. The extent of the interpolation raster is selected automatically based on location of 10 points. We can change the extent if required. But for now we will keep as it is and will proceed.
10. Finally assign proper path for the output file created by the interpolator and name it as '**IDW_Chloride**'. Don't forget to check the check box '*Add result to project*'. Please refer the screen shot below before proceeding further. Once you have filled up with all the details click '**OK**'.



11. After few minutes, you will notice '**IDW_Chloride**' added to the map canvas. Try out different colour ramp to make it more legible. Create a map with appropriate legend to define concentration of chloride over the area.



Exercise

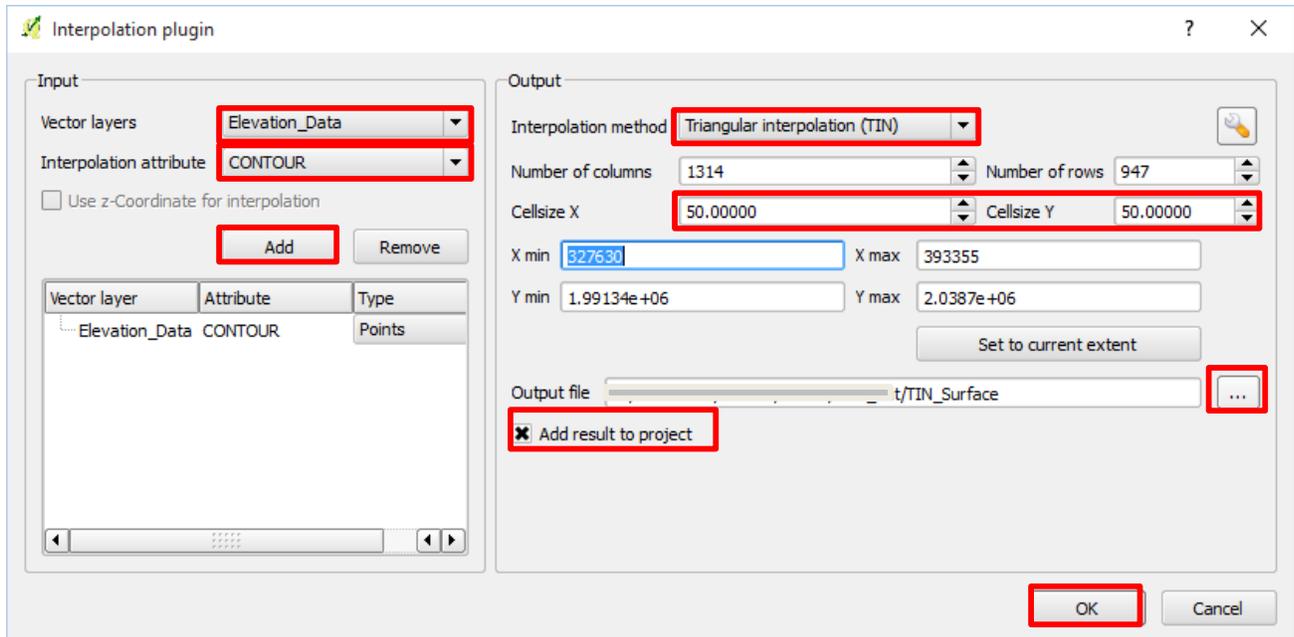
Create an interpolated surface for WQI and Hardness and note down the range of the values in the interpolated image (min and max).

TIN using QGIS

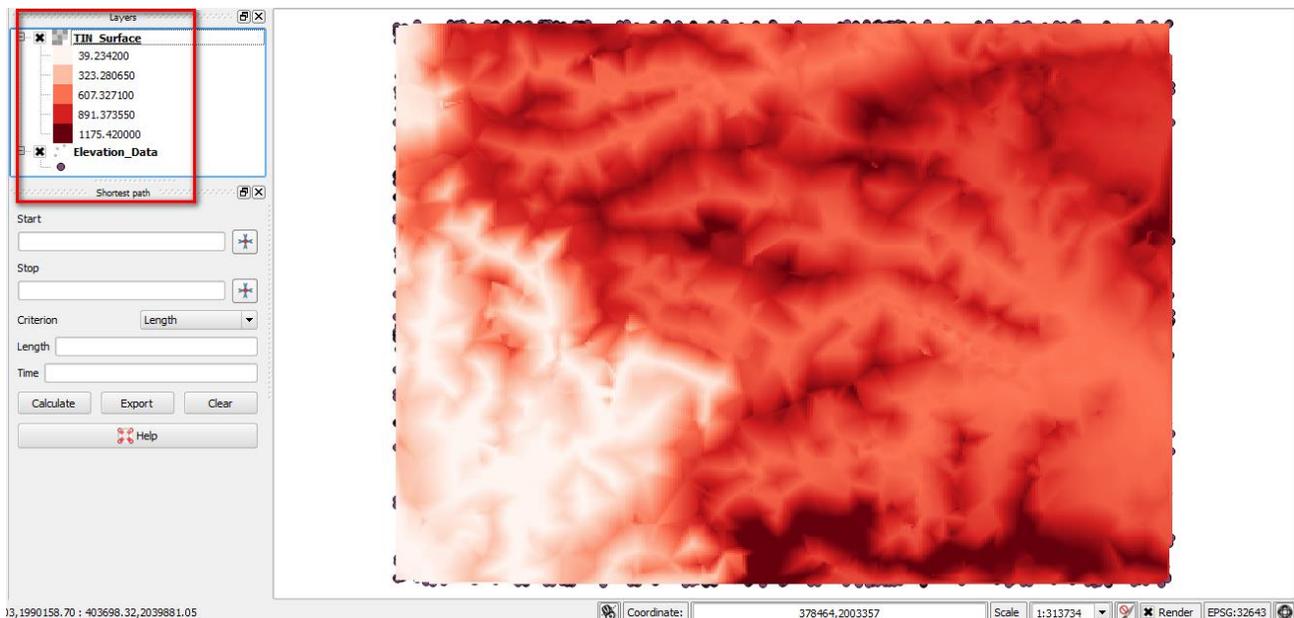
Triangular Irregular Network (TIN) method is a non-geostatistical interpolator. Generally, it is used to interpolate the elevation surface from irregular spaced samples. The samples are called as mass points. These mass points will be used as nodes to create a set of continuous non-overlapping triangles. These triangles are known as facets. To create these triangles most of GIS software use *Delaunay triangulation* method. The main principle of *Delaunay triangulation* is a circle drawn through three nodes of each triangle should not include any other nodes (mass points) and these triangles should be equatorial as much as possible. The number and distribution of the mass points plays a crucial role in the accuracy of the TIN. One needs more number of mass points in undulating terrain than the flat terrain to create a good TIN surface. The main advantages of TIN is, its ability to store a large dataset efficiently and also it is capable to describe the terrain at different level of resolution. However, performing some of the spatial analysis operation on TIN is difficult than Digital Elevation Model (DEM). In this section we will focus on creating a TIN surface from the samples that contains elevation information of south Pune.

12. Open given data "Elevation_Data" shapefile in QGIS. Go through the given data set. Understand the various attributes of the point data (refer step: 1).

13. Go to **Menu** → **Raster** → **Interpolation** → **Interpolation**. The interpolation window will open up.
14. Fill in the attributes of window as given in the screen shot below. Refer Steps 4-10 for details.



15. Once you fill in details click 'OK'. Sometimes you may be prompted to assign a coordinate system via a new window, in that case assign WGS84/UTM zone 43N as CRS.
16. After few minutes TIN will be loaded into your Map canvas. Try out different colour combination to make it more legible. Play around the TIN by overlapping the mass points.



Questions:

1. What is the minimum and maximum elevation of the TIN surface created using interpolation technique?
2. What is the extent of created TIN surface?