

Conclusion:

Gaussian Kriging is the best method.

Brief:

Apply Spherical, Circular, Exponential, and Gaussian on the 5 most and 5 least populous FUA. Among 7 comparable cities, Gaussian wins in 6 FUA (i.e. Gaussian has the lowest value of average standard error). Spherical wins in FUA. In that situation the difference of average standard error between Gaussian and Spherical is about 0.008.

How to compare different ordinary Kriging methods?

from the beginning:

CBD_centerBOPN_IC.shp - CBD points

FUA_extentBwithCentersOPN_IC.shp - FUA polygons with CBD coordinates

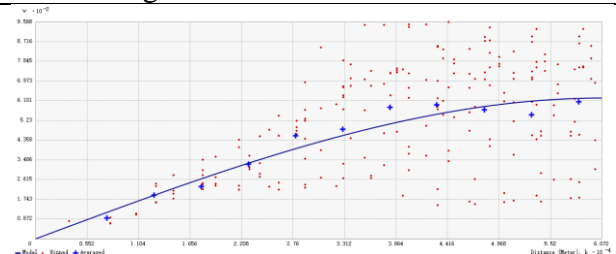
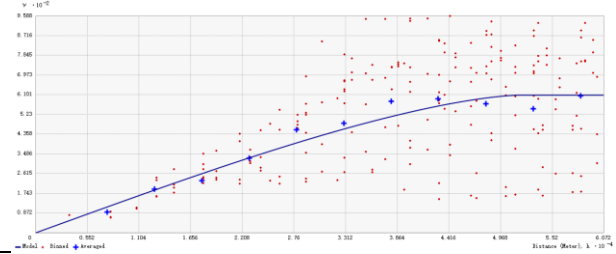
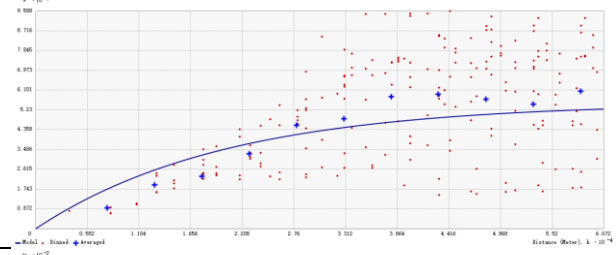
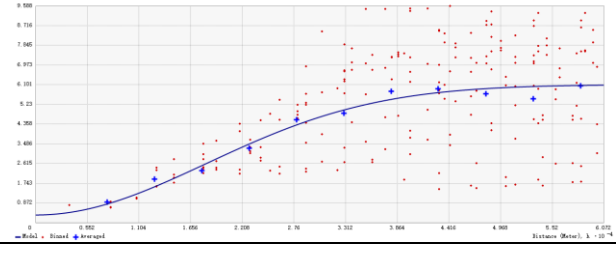
annualMeanTropoNO2Projected1000000Cliped_IC.tif - NO₂ raster at the resolution of 7 km x 7 km

- 1) Use raster to point on annualMeanTropoNO2Projected1000000Cliped_IC.tif to get NO2rasterToPoint_IC.shp
- 2) Use Intercept on NO2rasterToPoint_IC.shp and FUA_extentBwithCentersOPN_IC.shp to get NO2rasterToPoint_IC_K.shp
- 3) Selection → Select by Attributes. Select NO2rasterToPoint_IC_K.shp for Layer, double click “eFUA_name”, click “=”, click Get Unique Values, double click ‘Istanbul’, click OK.
- 4) Click customize → Extensions, check Geostatistical Analyst, and let the toolbar of Geostatistical Analyst appear
- 5) Select Geostatistical Analyst toolbar, select Geostatistical Wizard, select Kriging / CoKriging, select NO2rasterToPoint_IC_K.shp for Source Dataset, select grid_code for Data Field, click Next.
- 6) Select Ordinary for Kriging Type, select Prediction for Output surface type. Keep others default. Click Next.
- 7) Select Spherical, click Next, click Next, and record the values of Root-Mean-Square Standardized and Average Standard Error.
- 8) Change the FUA names in the step 3) and the type 7) (i.e. switch between Spherical, Circular, Exponential, and Gaussian) to compare the results. (why not include linear? They are straight lines after all, reference: <https://pro.arcgis.com/en/pro-app/2.7/tool-reference/3d-analyst/how-kriging-works.htm>)

Population

The 5 most populous cities

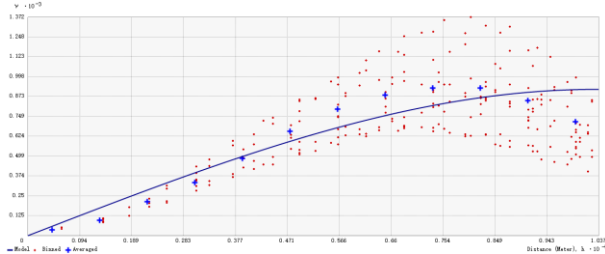
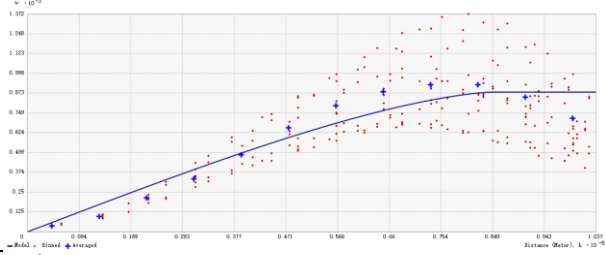
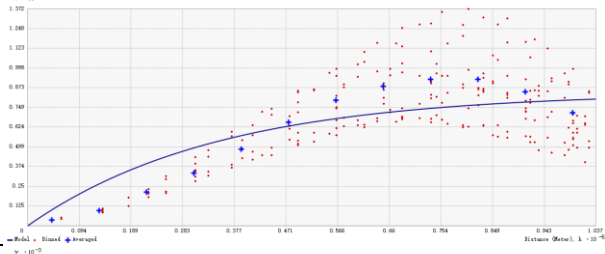
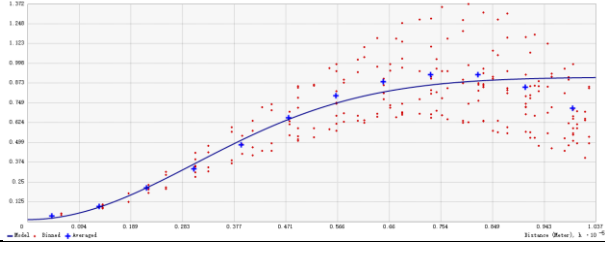
1. Istanbul, Turkey, population 14921594.99, Gaussian wins

	Semivariogram	Average Standard Error
Spherical		10.033707161194073
Circular		9.91236335623524
Exponential		12.971289323580047
Gaussian		7.412856677102744

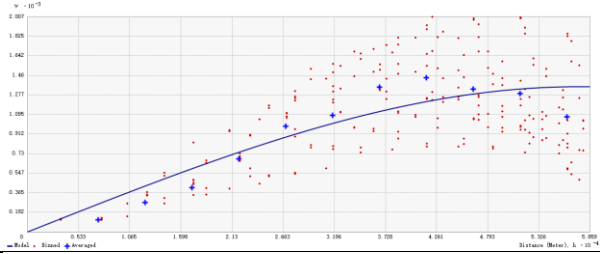
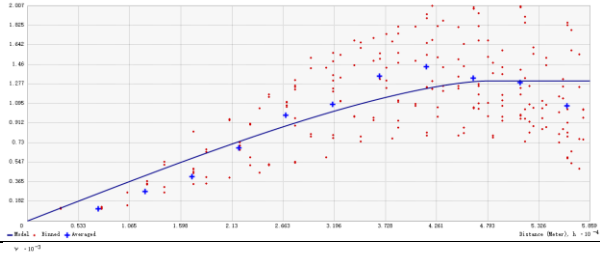
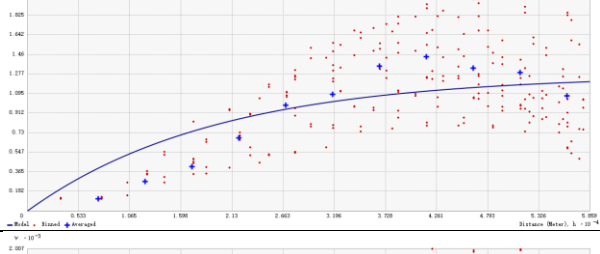
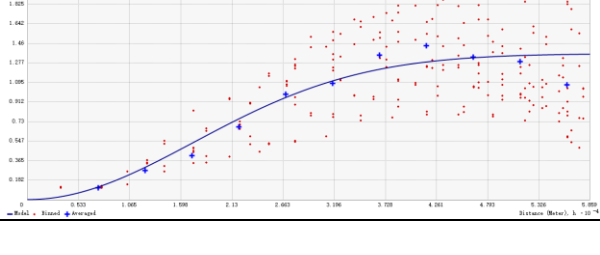
2. London, United Kingdom, population 12598186.45, Gaussian wins

	Semivariogram	Average Standard Error
Spherical		7.3040773292151835
Circular		7.176992223115986
Exponential		9.792238740745402
Gaussian		5.146169128004079

3. Paris, France, population 11709852.56

	Semivariogram	Average Standard Error
Spherical		8.751707702665415
Circular		8.685418570770985
Exponential		11.739735118996995
Gaussian		4.189436402117362

4. Madrid, Spain, population 6131918.998

	Semivariogram	Average Standard Error
Spherical		14.504580577957217
Circular		14.368542930738435
Exponential		19.210263856642747
Gaussian		2.9707340215434646

5. Milan, Italy, population 5121995.63, Gaussian wins

	Semivariogram	Average Standard Error
Spherical		13.408271481533966
Circular		13.308732439465263
Exponential		17.20069864418507
Gaussian		4.079786802326408

The 5 least populated cities

1. Elk, Poland, population 67160.94704, N/A

(Unable to compare Kriging methods because 4 data points are arranged in a straight line)

2. Valjevo, Serbia, population 69563.7366, Spherical wins

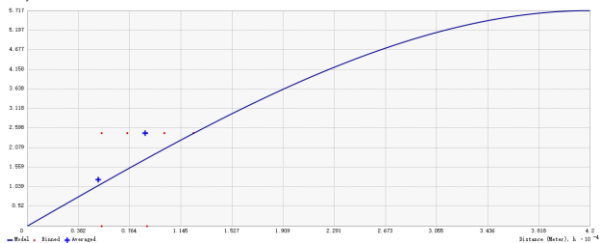
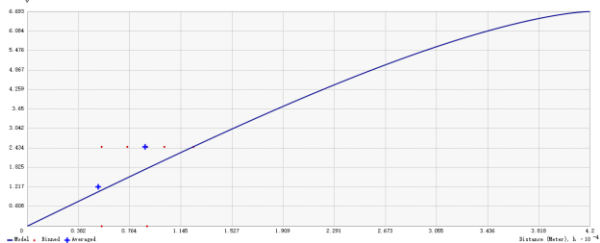
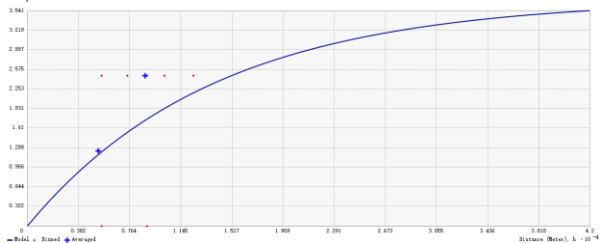
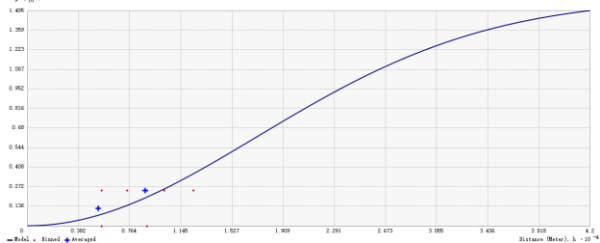
	Semivariogram	Average Standard Error
Spherical		1.3107114999135319
Circular		1.3294958379266824
Exponential		1.3439392222410813
Gaussian		1.3189247518709244

3. Grosseto, Italy, population 69811.20733, N/A (4 points are arranged as the four corners of a parallelogram)

	Semivariogram	Average Standard Error
Spherical		1.0306036304133386
Circular		1.0306036304133386
Exponential		1.0306036304133386
Gaussian		1.0306036304133386

4. Altamura, Italy, population 70389.22029, N/A
(Unable to compare Kriging methods because 2 data points are arranged in a straight line)

5. Sopron, Hungary, population 72235.90642, Gaussian wins

	Semivariogram	Average Standard Error
Spherical		1.5270567341813046
Circular		1.5264934826575918
Exponential		1.5395488229002676
Gaussian		1.4618033192138997