

*Technical Manual*

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# HOW TO CREATE AN INTERPOLATION MAP IN ARCMAP USING KRIGING

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*A step-by-step guide to Geostatistical Analyst tool*

Version 1.1

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THESSALONIKI, GREECE

# How to create an interpolation map in ArcMap using Kriging

*A step-by-step guide to Geostatistical Analyst tool*

*Koutsos M. Thomas*

Aim: Create an interpolation map in ArcMap (Geostatistical Analyst tool) using Kriging as interpolation method to estimate values over the selected area of interest.

Case study and data: soil data from the valley of Thessaloniki, Greece.

*An introduction to the ArcGIS Geostatistical Analyst Tutorial can be found [here](#).*

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## 1. Input data

We will use as data the following: (a) Samples500.shx (soil data) and (b) Samples500\_BorderC.shp (border of the region). Right click on “layers” and then select “Add data ...” (Figure 1). The result is shown in Figure 2.

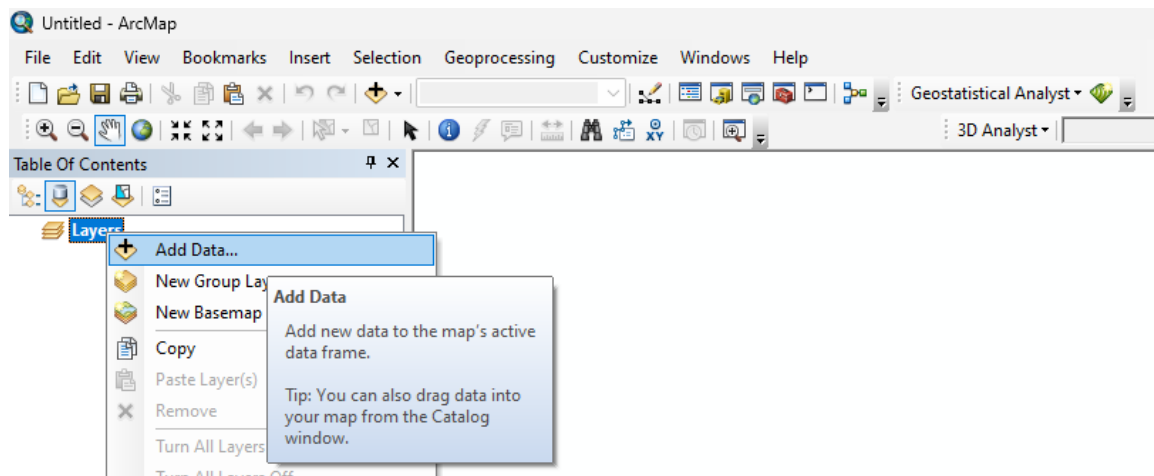


Figure 1. Add data to ArcMap project.

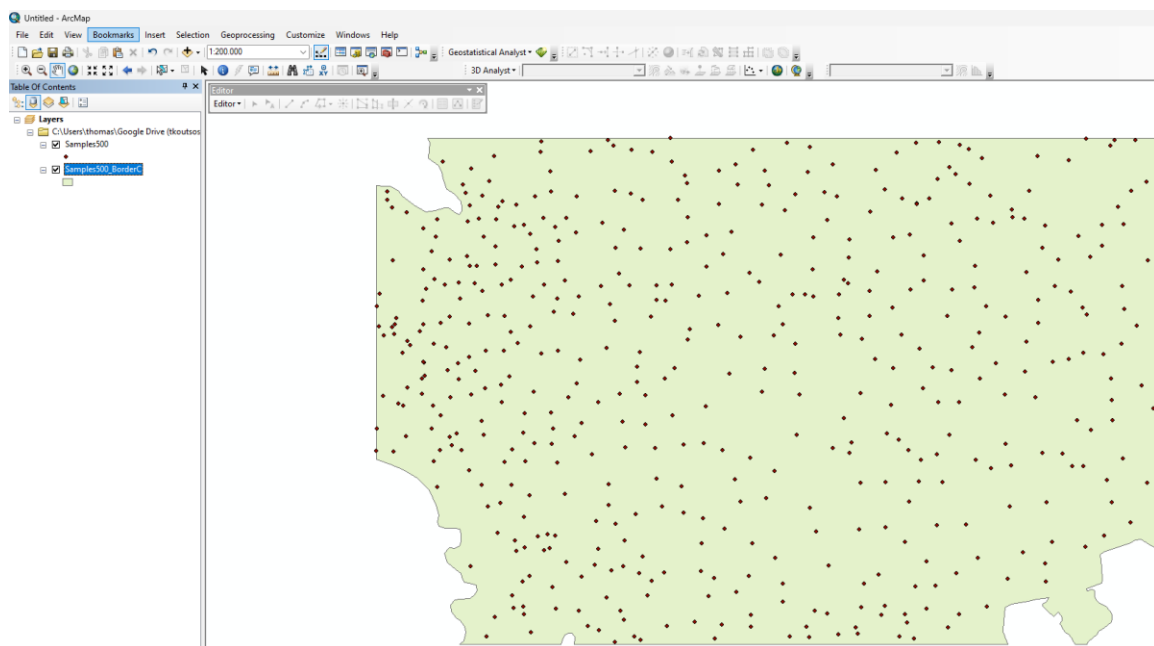
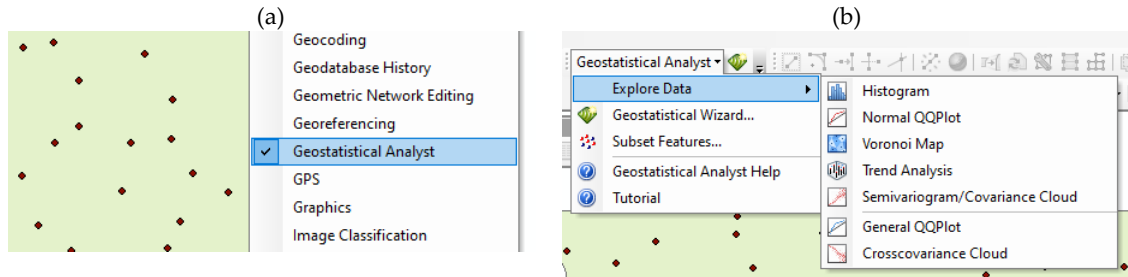


Figure 2. ArcMap project after soil data (samples500) and border (samples500\_BorderC) added.

## 2. Activate the Geostatistical Analyst tool

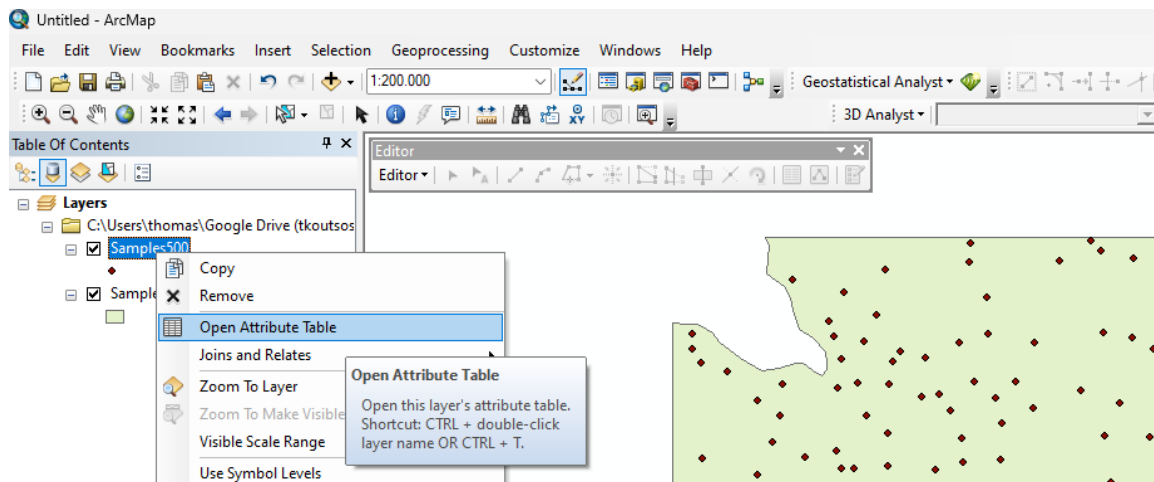
If the “Geostatistical Analyst” tool is not already available, then just right click on an empty space on the menu bar and then check/select it. Several options for analyzing spatial data are available after activating the Geostatistical Analyst tool (Figure 3).



**Figure 3.** Geostatistical Analyst tool: (a) activate the Geostatistical Analyst tool from the menu; (b) options after activating the Geostatistical Analyst tool.

## 3. Check the data that will be used for the interpolation

It is always good practice to check the data that will be used for the interpolation. For this reason, right click on the layer containing the data (soil data samples) and then select the option “Open Attribute Table” (Figure 4). A new window-table will be appeared with all the records of this layer (Figure 5).



**Figure 4.** Check the data that will be used; open the attribute table for the data by right click on the corresponding layer and then select "Open Attribute Table".

File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help

1:200,000

Geostatistical Analyst

3D Analyst

Drawing

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Layers

- C:\Users\thomas\Google Drive (thomas) \
- Samples500
- Samples500\_BorderC

Table

Editor

Samples500

ID	SHAPE	SAMPLE_ID	REGION_ID	SAMPLE_TYP	COORD_X	COORD_Y	SML_ID	S_ID	AVAL	SA_DEPTH	SAND	SILT	CLAY	PH	TCA	OM	OC	EC	AVAIL_P	NITROGEN	EXCH_K	GRAVELS	CEC	Type	
1	Point ZM	1200001	112	SA	338325	4519113	1200001	5477	30.49	87.3	14	18.7	7.1	8.1	1.5	8.5	9.29	3.1	0.89	131	36.1	9.97	Validation		
2	Point ZM	1200004	112	SA	338909	4517858	1200004	2479	30.49	49.3	22	28.7	8.2	3.8	0.38	8.21	0.83	3.3	0.39	209	24.2	11.79	Normal		
3	Point ZM	1200005	112	SA	339053	4514671	1200005	2481	30.49	67.3	18	14.7	8.2	3.8	0.75	5.44	0.92	12.3	0.1	103	36.8	7.94	Validation		
4	Point ZM	1200006	112	SA	339319	4512611	1200006	2483	30.49	39.3	24	38.7	8.1	5.1	2.15	1.25	0.41	18.4	1.26	178	38.7	20.02	Normal		
5	Point ZM	1200007	112	SA	339598	4509526	1200007	2485	30.49	43.3	28	38.2	8.0	5.2	1.42	2.59	0.71	22.8	2.4	433	28.6	24.88	Validation		
6	Point ZM	1200008	112	SA	341804	4509949	1200008	2487	30.49	47.3	32	38.7	7.5	12	1.89	0.95	0.9	5.9	0.95	209	22.1	16.40	Normal		
7	Point ZM	1200009	112	SA	341850	4511941	1200009	2489	30.49	39.3	38	28.7	8.1	7.4	1.33	0.77	0.78	5.1	0.71	187	29.8	15.12	Normal		
8	Point ZM	1200010	112	SA	342132	4513268	1200010	2491	30.49	47.3	32	28.7	8.1	25	8.04	1.18	1.51	6.9	1.25	222	29.8	14.33	Normal		
9	Point ZM	1200011	112	SA	342514	4511178	1200011	2493	30.49	27.3	24	48.7	7.8	1.8	1.32	0.77	0.84	3.5	0.84	341	35	24.16	Normal		
10	Point ZM	1200012	112	SA	342719	4515745	1200012	2495	30.49	37.3	28	28.7	8.1	2	1.41	0.82	0.42	52.2	0.7	287	31.4	14.96	Normal		
11	Point ZM	1200013	112	SA	343852	4512687	1200013	2497	30.49	41.3	28	32.7	7.7	8.7	1.31	0.76	0.57	3.9	0.75	213	29.6	16.16	Normal		
12	Point ZM	1200014	112	SA	344359	4510952	1200014	2499	30.49	31.3	32	38.7	7.8	1.1	2.11	1.23	0.79	6.2	1.2	235	29.5	20.14	Normal		
13	Point ZM	1200015	112	SA	344467	4509797	1200015	2501	30.49	35.3	34	38.7	7.8	0.8	2.22	1.29	0.98	2.9	1.3	152	22.2	18.42	Validation		
14	Point ZM	1200016	112	SA	345133	4496959	1200016	2503	30.49	31.3	38	32.7	7.5	0.8	1.86	0.97	0.89	18.5	0.99	146	26.5	17.51	Validation		
15	Point ZM	1200017	112	SA	345209	4510762	1200017	2505	30.49	71.3	24	4.7	8.1	4.9	0.15	0.99	0.6	3.7	0.2	141	9.5	2.85	Normal		
16	Point ZM	1200018	112	SA	345254	4489326	1200018	2507	30.49	47.3	29	32.7	7.8	0.7	1.2	0.7	0.75	5.7	0.74	187	26	15.85	Normal		
17	Point ZM	1200019	112	SA	345743	4512201	1200019	2509	30.49	45.3	24	38.7	8.3	12	2	1.16	0.67	0.83	3.9	0.74	156	25	14.95	Normal	
18	Point ZM	1200020	112	SA	346086	4490558	1200020	2511	30.49	39.3	38	22.7	8.1	6.3	1.32	0.77	0.91	8	0.86	118	18.4	13.95	Validation		
19	Point ZM	1200021	112	SA	346150	4510295	1200021	2513	30.49	23.3	24	52.7	8.2	1.2	1.7	0.99	0.86	4.5	0.1	277	37.8	26.9	Validation		
20	Point ZM	1200022	112	SA	346562	4493988	1200022	2515	30.49	37.3	32	32.7	7.8	0.4	1.86	0.97	0.99	3.5	0.96	242	29	16.73	Normal		
21	Point ZM	1200023	112	SA	346599	4508437	1200023	2517	30.49	23.3	32	44.7	8.1	2.4	1.55	0.9	0.68	6.2	1.05	261	29.7	23.49	Normal		
22	Point ZM	1200024	112	SA	347180	4513673	1200024	2519	30.49	49.3	28	12.7	8.5	12	0.85	0.49	0.41	5.7	0.96	140	0.5	8.14	Normal		
23	Point ZM	1200025	112	SA	347175	4512387	1200025	2521	30.49	41.3	48	18.7	8.1	5.3	1.07	0.62	1.42	3.9	0.1	127	22	10.96	Normal		
24	Point ZM	1200026	112	SA	347333	4491884	1200026	2523	30.49	49.3	24	28.7	8.1	3.9	1.53	0.89	0.47	4.7	0.96	113	40	14.66	Normal		
25	Point ZM	1200027	112	SA	347541	4484187	1200027	2525	30.49	45.3	28	28.7	7.5	0.4	1.6	0.81	0.31	52.9	0.9	263	31.5	15.63	Normal		
26	Point ZM	1200028	112	SA	347648	4510779	1200028	2527	30.49	51.3	34	14.7	8.7	8	1.01	0.59	1.35	6.6	0.86	80	7.1	3.2	Normal		
27	Point ZM	1200029	112	SA	347843	4497284	1200029	2529	30.49	61.3	28	12.7	8.1	15	0.72	0.42	0.85	2.1	0.95	64	18.1	7.39	Normal		
28	Point ZM	1200030	112	SA	348306	4507177	1200030	2531	30.49	39.3	34	38.7	8.1	7.6	1.84	0.95	0.45	8.9	1	125	20.6	16.89	Normal		
29	Point ZM	1200031	112	SA	348340	4511124	1200031	2533	30.49	67.3	24	8.7	8.0	3.8	1.4	0.81		34.9	0.9	174	9.3	7.97	Normal		
30	Point ZM	1200032	112	SA	348376	4495553	1200032	2535	30.49	31.3	38	38.7	7.8	0.3	1.75	1.02	0.58	5.9	1	254	26	19.7	Normal		
31	Point ZM	1200033	112	SA	348401	4498244	1200033	2537	30.49	23.3	38	48.7	8.2	0.6	1.31	0.78	0.74	5.1	0.8	224	23.8	21.29	Normal		
32	Point ZM	1200034	112	SA	348589	4510512	1200034	2539	30.49	57.3	28	16.7	8.1	7.3	0.71	0.41	0.83	16.2	0.91	140	20	8.76	Normal		
33	Point ZM	1200035	112	SA	349151	4512140	1200035	2541	30.49	45.3	42	12.7	8.6	8.7	0.85	0.49	0.39	5.1	0.52	49	7.5	8.26	Validation		
34	Point ZM	1200036	112	SA	349299	4499490	1200036	2543	30.49	23.3	34	42.7	7.9	1.7	1.65	0.96	0.71	2.8	1.02	215	31	23.95	Validation		
35	Point ZM	1200037	112	SA	349305	4493989	1200037	2545	30.49	37.3	24	38.7	7.9	8	1.26	0.73	0.45	5.1	0.75	293	31.8	18.95	Normal		
36	Point ZM	1200038	112	SA	349389	4498779	1200038	2547	30.49	21.3	29	58.7	7.8	1.9	1.62	0.59	0.1	3.3	0.62	400	27.8	27.14	Normal		
37	Point ZM	1200039	112	SA	349490	4497262	1200039	2549	30.49	31.3	24	44.7	7.9	0.7	1.76	1.02	0.84	6.8	1.1	109	28.8	23.88	Normal		
38	Point ZM	1200040	112	SA	349759	4484731	1200040	2551	30.49	21.3	39	48.7	8.2	0.6	1.04	0.5	0.34	3.7	0.86	287	31.6	25.5	Normal		
39	Point ZM	1200041	112	SA	349805	4514653	1200041	2553	30.49	39.3	48	14.7	8.5	1.1	1.03	0.6	0.47	3.5	0.63	94	1.3	8.62	Normal		
40	Point ZM	1200042	112	SA	350019	4508892	1200042	2555	30.49	81.3	18	8.7	8.1	2.4	0.86	0.97	0.39	5.1	0.86	172	2	6.29	Normal		
41	Point ZM	1200043	112	SA	350099	4498729	1200043	2557	30.49	57.3	22	28.7	8.2	3.8	1.5	0.87	0.81	6.4	0.88	111	19.6	12.41	Normal		

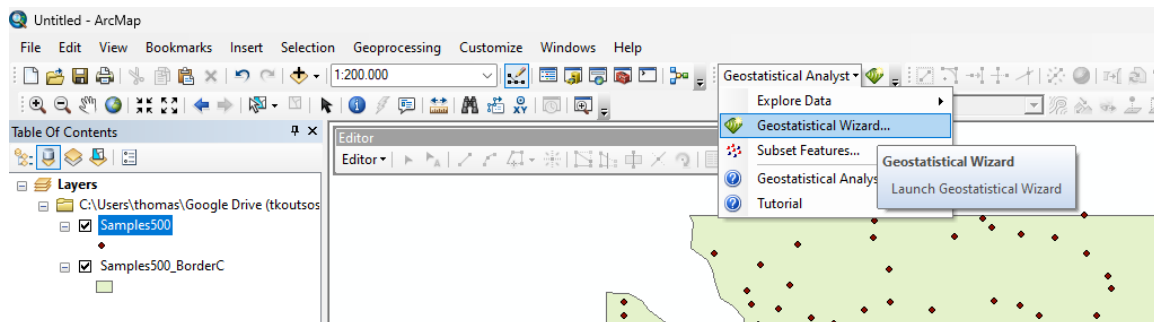
1 4 1 300 (0 out of 500 Selected)

Samples500

**Figure 5.** Attribute Table with all the data records from the layer Samples500 that will be used for the interpolation process.

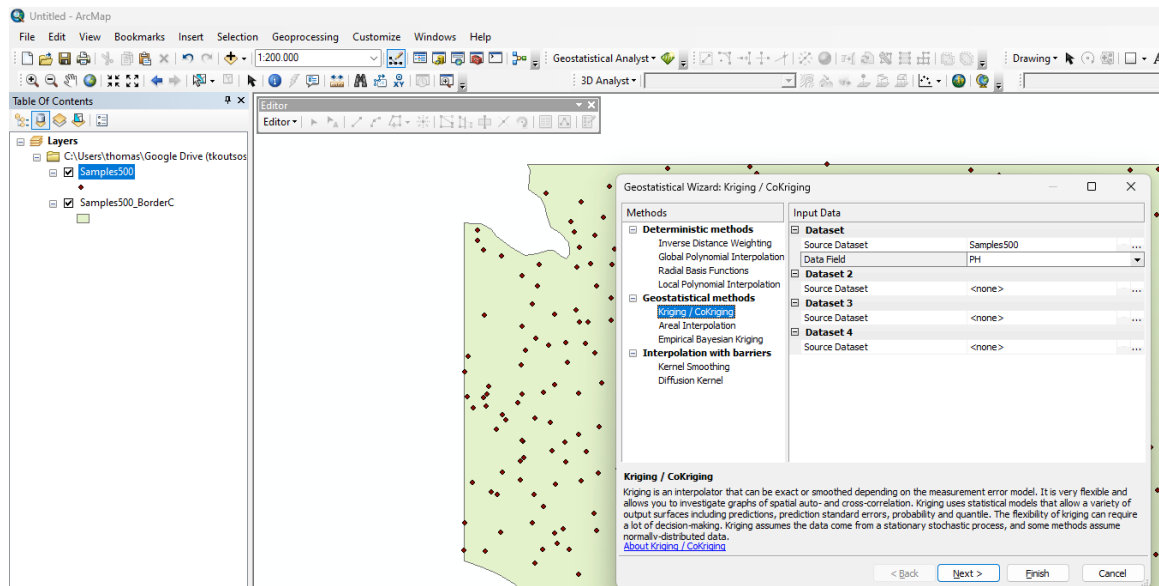
## 4. Interpolation process

ArcMap provides a useful tool called “Geostatistical Wizard” to facilitate the process of selecting the parameters needed for the interpolation process. To open the Geostatistical Wizard, we only must left click on the Geostatistical Analyst and then select the option “Geostatistical Wizard” from the menu (Figure 6).



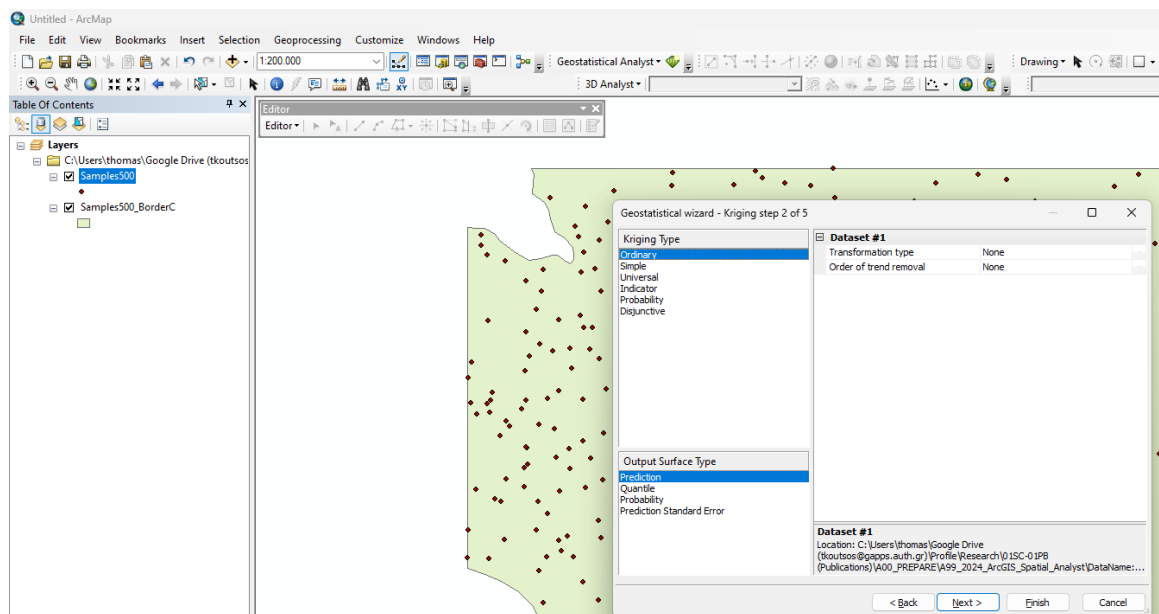
**Figure 6.** Open the Geostatistical Wizard to proceed with the interpolation process.

We must make sure that “Kriging/Cokriging” is selected as the interpolation method that will be used and that the correct layer of data (Samples500) is selected in the Source Dataset along with the correct data field (PH) that will be used for the interpolation (Figure 7).



**Figure 7.** Selecting the parameters for the interpolation with Kriging/Cokriging method; selecting the data (PH) that will be used for the “Kriging/Cokriging” interpolation method.

After clicking on next, we move on to the selection of the proper Kriging type for the interpolation (Figure 8).



**Figure 8.** Selection of the Kriging type that will be applied for the interpolation.

For more information on how Kriging works and on the different types available please check the following link:

<https://pro.arcgis.com/en/pro-app/3.1/tool-reference/3d-analyst/how-kriging-works.htm>

Click on next we move on to a new window that provides all the information about the interpolation (Figure 9). We can right click on Semivariogram plot and then select “copy” to copy and paste the graph in a text. In tab “General” at the right side of the window “Optimized model” is selected by default, so we do not have to make changes.

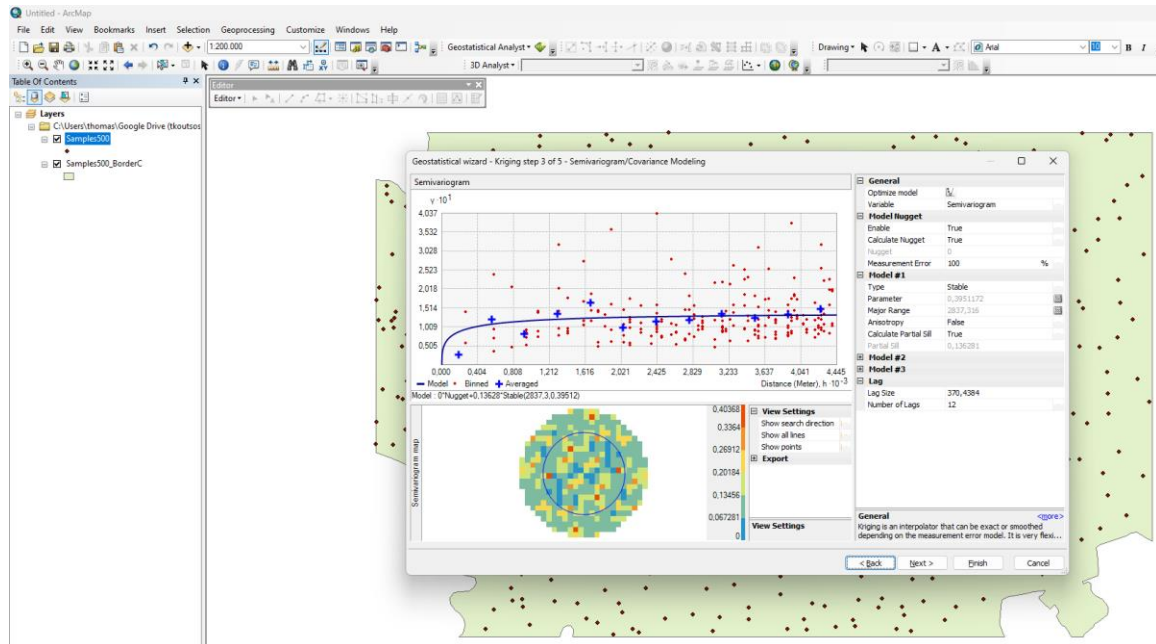
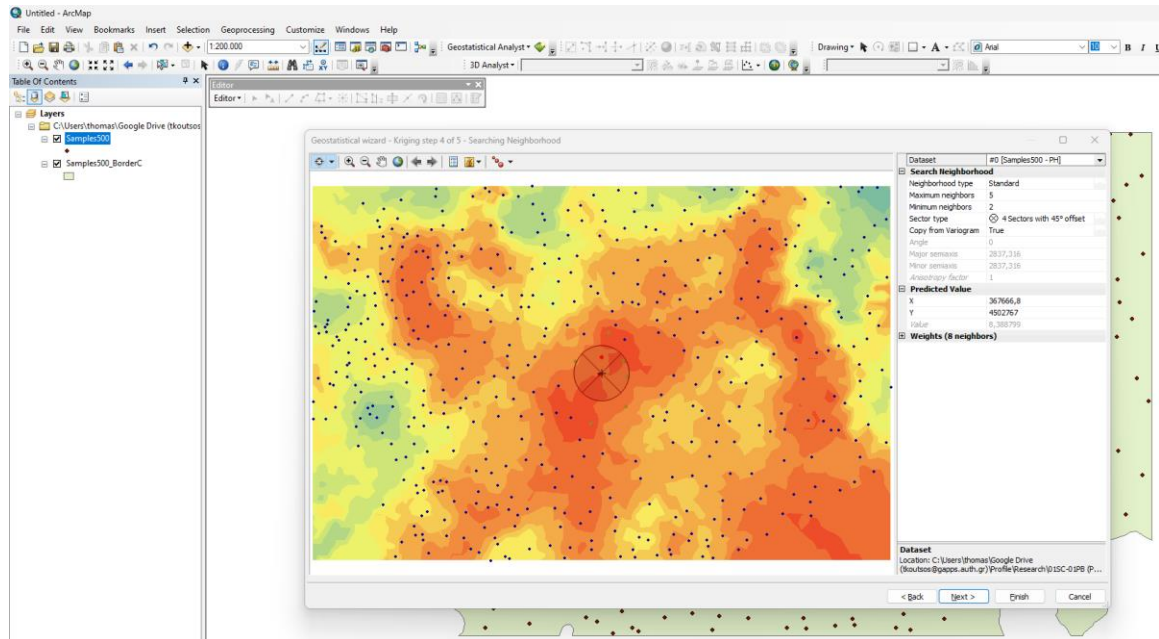


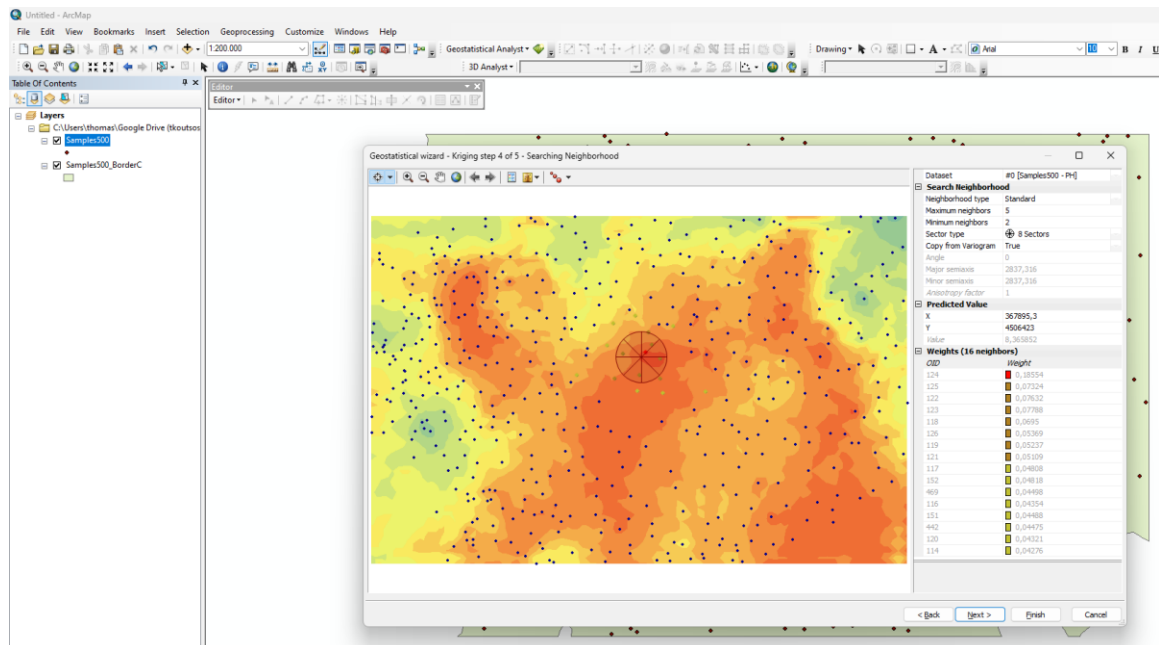
Figure 9. Semivariogram/Covariance Modeling with Kriging



Clicking on next we get a preview of the interpolation results. We can change the “Sector Type” to the left side of the window to “8 Sectors” instead of “4 sectors with 45° offset”, which is the default option (**Figure 10**), to take into consideration more neighboring data values (**Figure 11**). To check the weights that are being calculated we can expand the “Weights (16 neighbors)” to examine the weights that have been assigned to each of the neighboring data measurement.



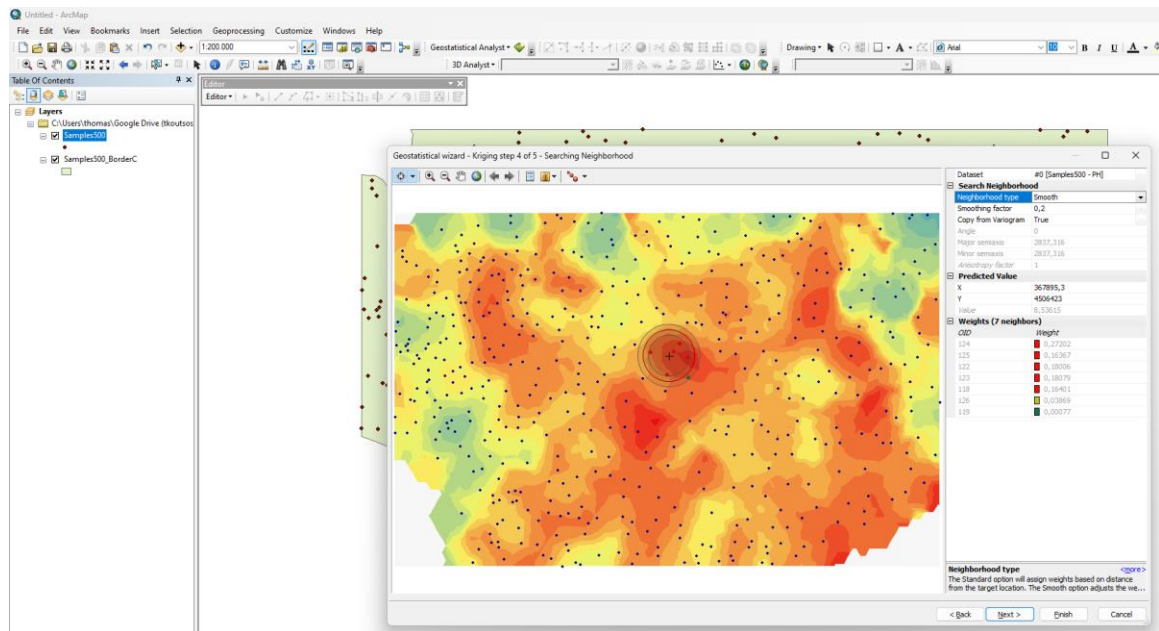
**Figure 10.** Searching Neighborhood in Kriging; default option the "4 sectors with 45o offset (8 neighbors)"



**Figure 11.** Searching Neighborhood in Kriging; selecting 8 sectors (16 neighbors)



We can also have the option to define the neighbor type of the search in searching neighbors in each neighborhood of the data that can be either “normal” or “smooth”. We usually select “normal”.



**Figure 12.** Selecting the type of neighbor type in searching neighbors: normal (default) or smooth.

Moving to the next step, we finally get a window with cross validation results (Figure 13) presenting the predicted values. Plots are available for (a) Predicted vs measured; (b) Error; (c) Standardized Error, and (d) Normal QQ-Plot for normality check.

The plots can be copied and pasted into a new document by right clicking on them and selecting “copy”. At the down right side of the window the primary interpolation metrics are available and can be exported to file. These are the main statistical metrics that must be reported for each interpolation.

By clicking on “Finish” a small window appears presenting all the corresponding interpolation information and it can also be exported in a xml file.

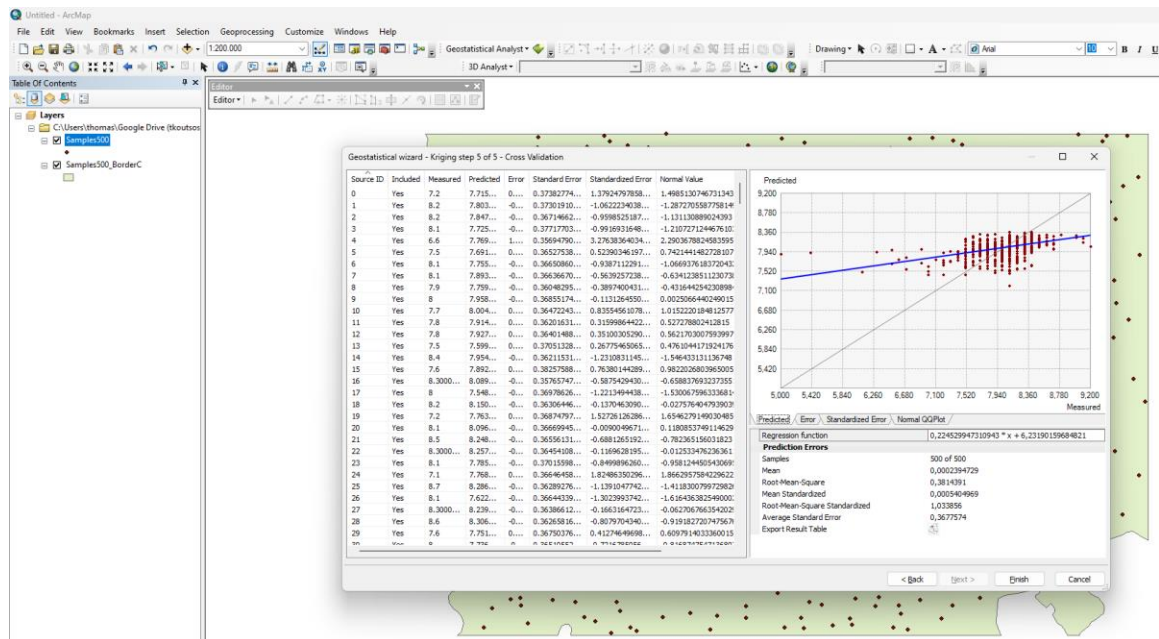
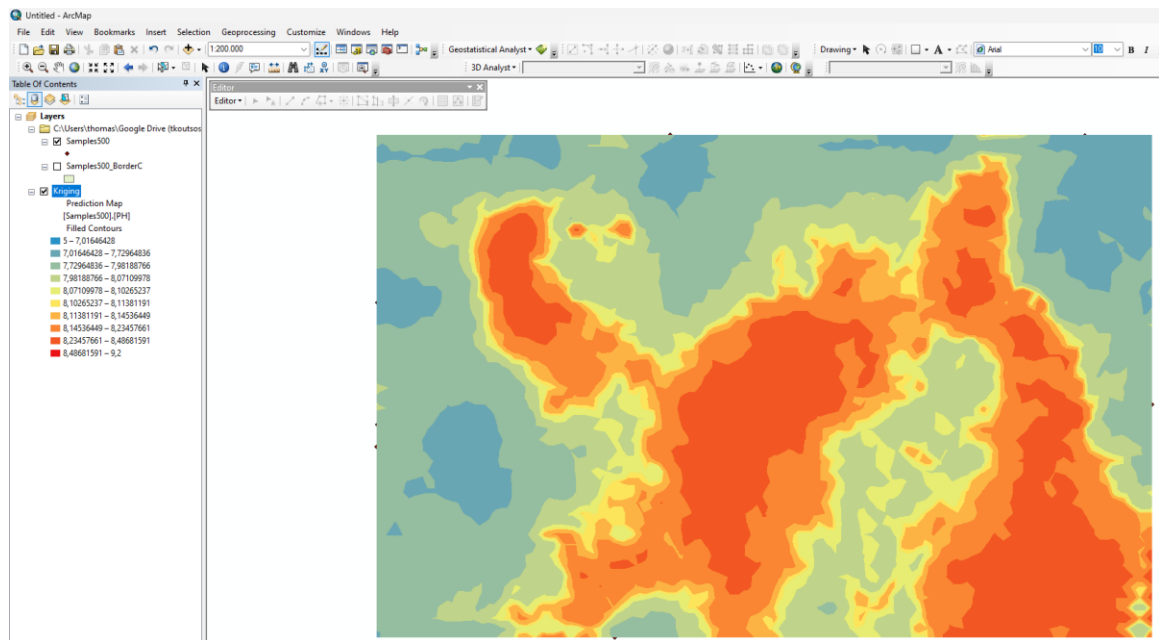


Figure 13. Cross validation results for the interpolation and corresponding plots.

The final interpolation product is an interpolation map that provides estimates for the given parameter (pH) over the study area (Figure 14).



**Figure 14.** Interpolation map as the result of the interpolation process using Kriging and the Geostatistical Analyst tool of ArcMap.

In case we want to crop this final interpolation map to the extent of the border then we export the “Kriging” layer to raster and then we search for the tool “Extract by mask” (Figure 15).

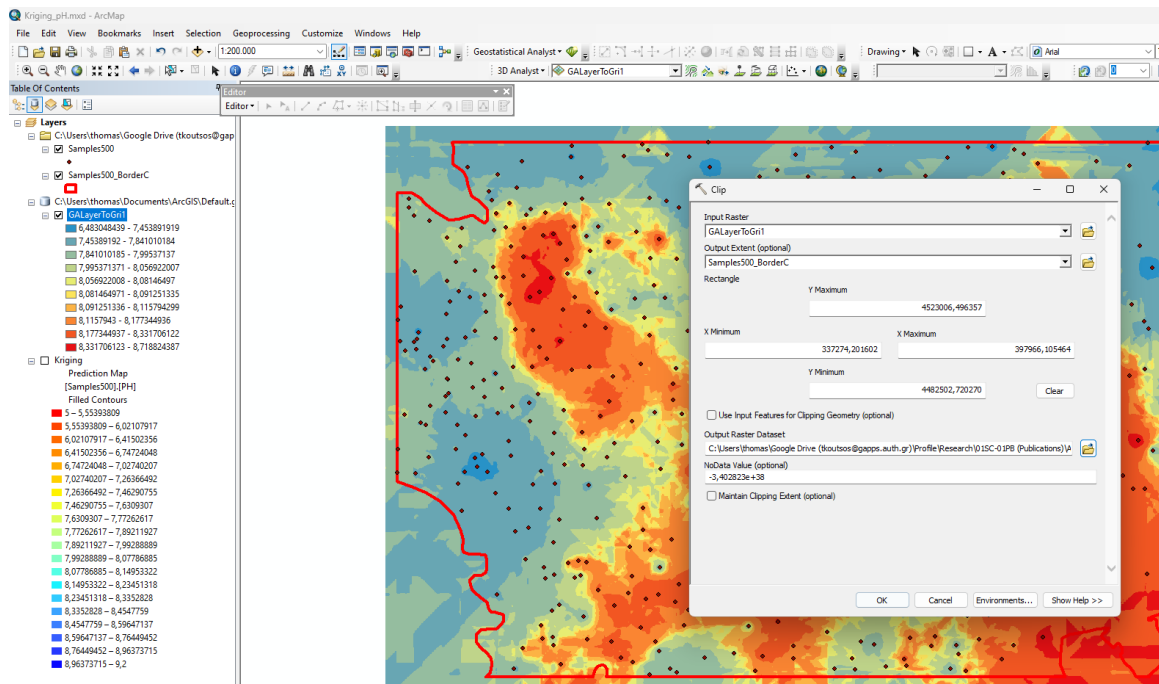
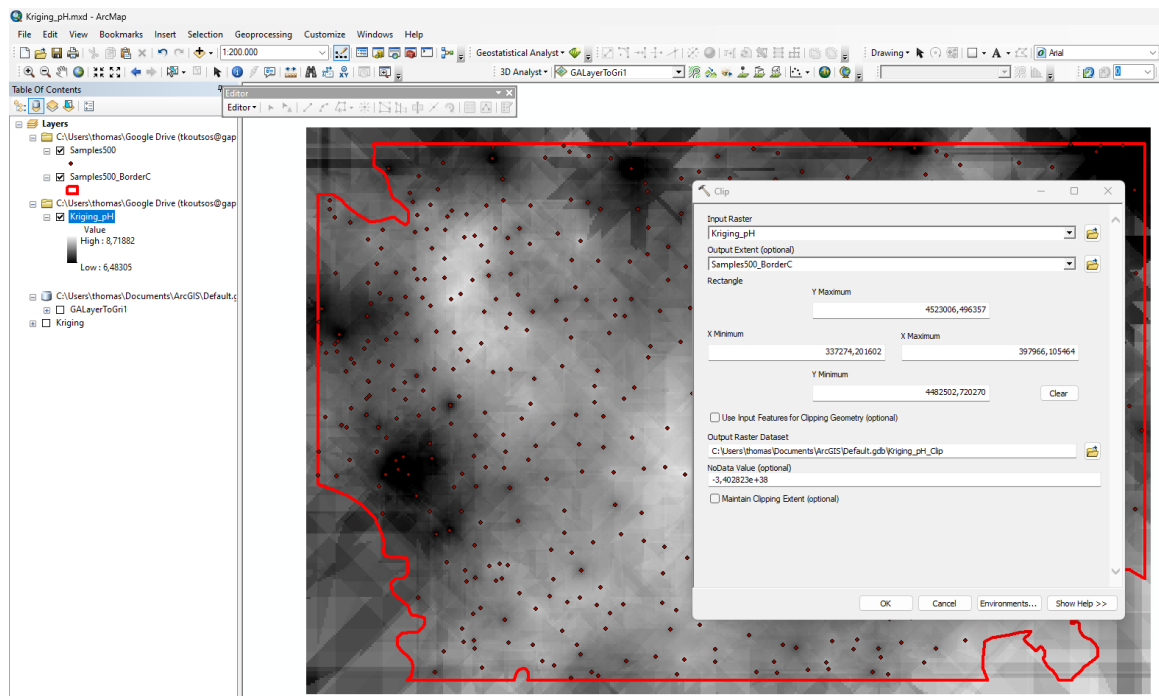


Figure 15. Cropping the interpolation map to the extent of the border layer.



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