Radiological Data Assessment Guidance for Emergency Response

Job Aid: Calculate Spatial Estimates with Kriging

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This job aid has been developed to guide readers through performing geostatistical analysis using Visual Sample Plan (VSP)[1]. More information about data quality assessment can be found in the Radiological Data Assessment Guidance for Emergency Response[2] document on CBRN Responder.

Geostatistical analysis helps estimate data spatial distribution by calculating likely values between sample points. For example, kriging uses known data points to interpolate a surface map, identifying areas above or below an action threshold.

Use Case: Determine an estimate of the geospatial distribution of contamination. One example is using spread and confidence estimates to determine if a site can remain open.

Assumptions:

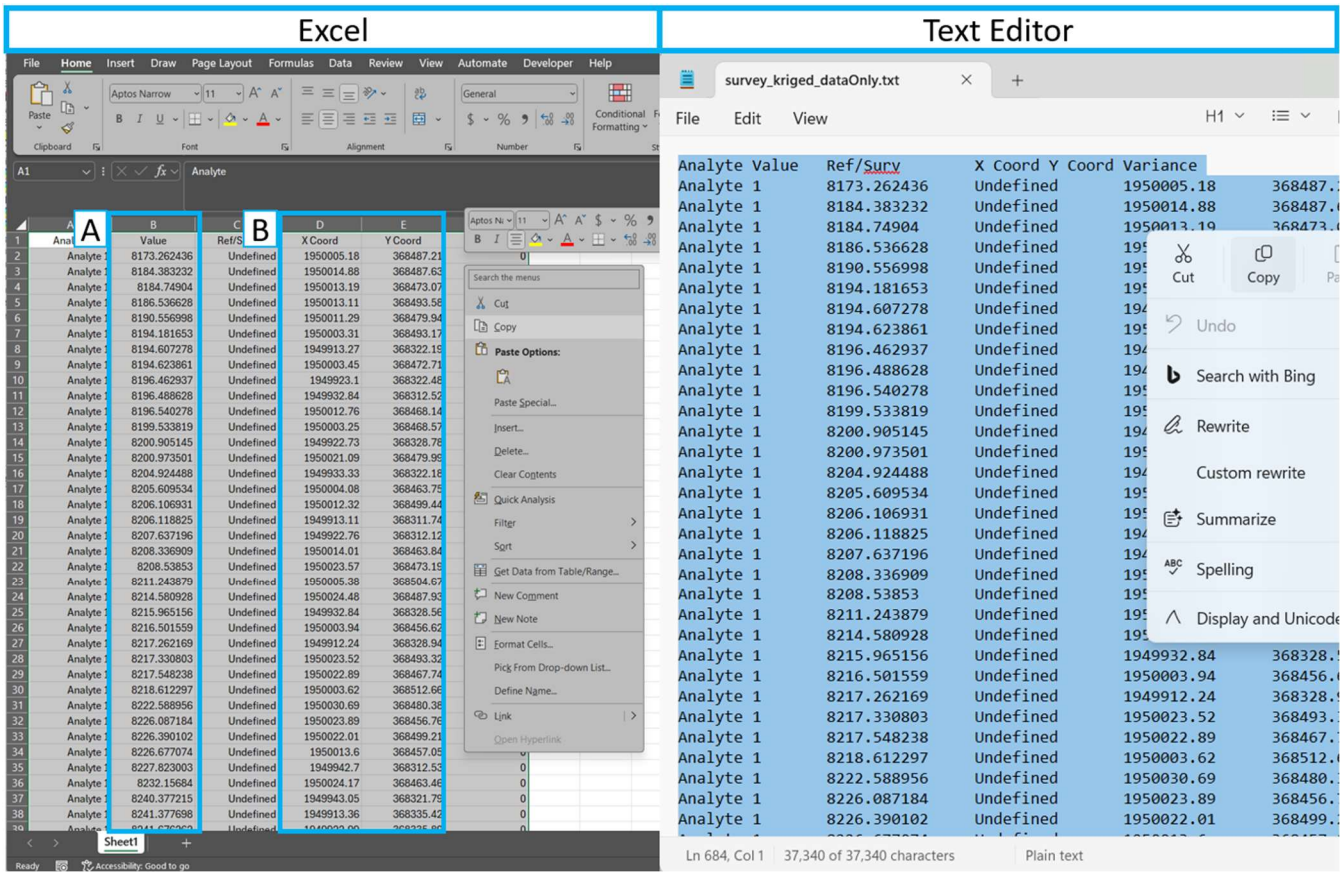
- The constituent being measured follows a definable spatial pattern.
- This analysis is performed on data collected in various locations over a period in which conditions have not significantly changed.
- The data have all already been transformed into the same units.
- The data have one value per time point.
- The reader has already successfully installed VSP version 7.24 or later on their computer. VSP is currently only compatible with Windows operating systems.
- This analysis requires at least 4 measurement values, but 30+ are recommended.

If any of the assumptions above are not true for your situation or data, this analysis may not be appropriate.

Throughout this job aid, markers such as “(A)” indicate a highlight in the relevant VSP screenshot.

1. **Prepare your data to be loaded into VSP:** VSP does not accept comma delimited data, only tab delimited. Ensure that the data is in a columnar format (i.e., tab delimited).
   1.1. Open your data in **Excel** (recommended) or a text editor.
   1.2. Select and copy the *rows* to be imported into VSP. The analysis can still be computed if there are missing data, extra columns, or if the order of the rows differs from the example shown here but ensure that there are columns for the (A) **value** and (B) **location data** of each sample.

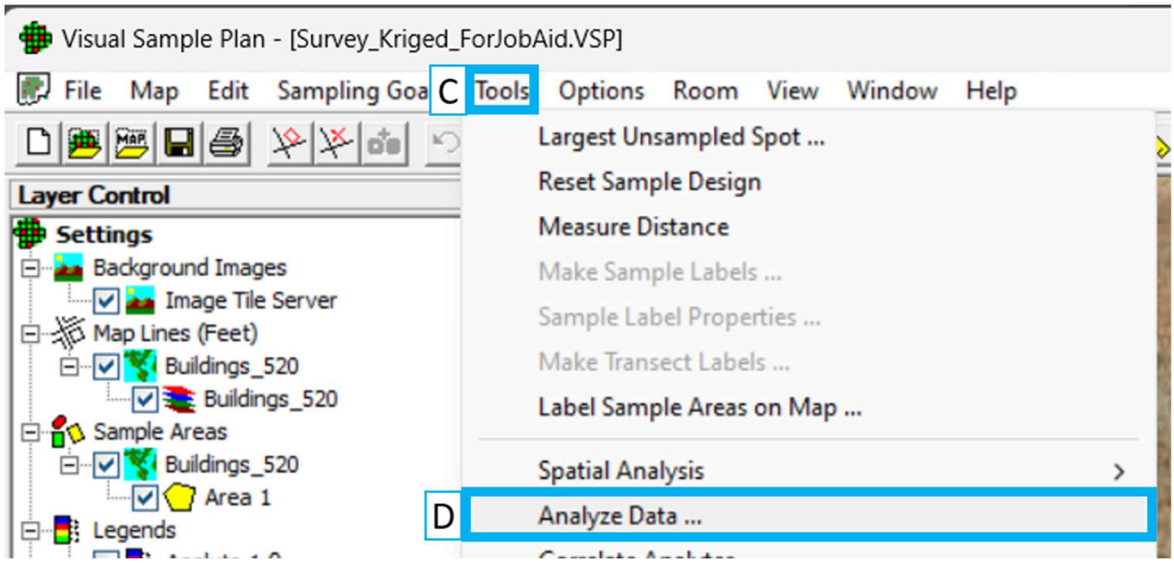
[1] https://www.pnnl.gov/projects/visual-sample-plan
[2] https://www.cbrnresponder.net/app/index#resources/documents/download/2308



2. **Launch the Data Analysis dialog in VSP**:

   2.1. In the top-left menu bar, select (C) **Tools**.

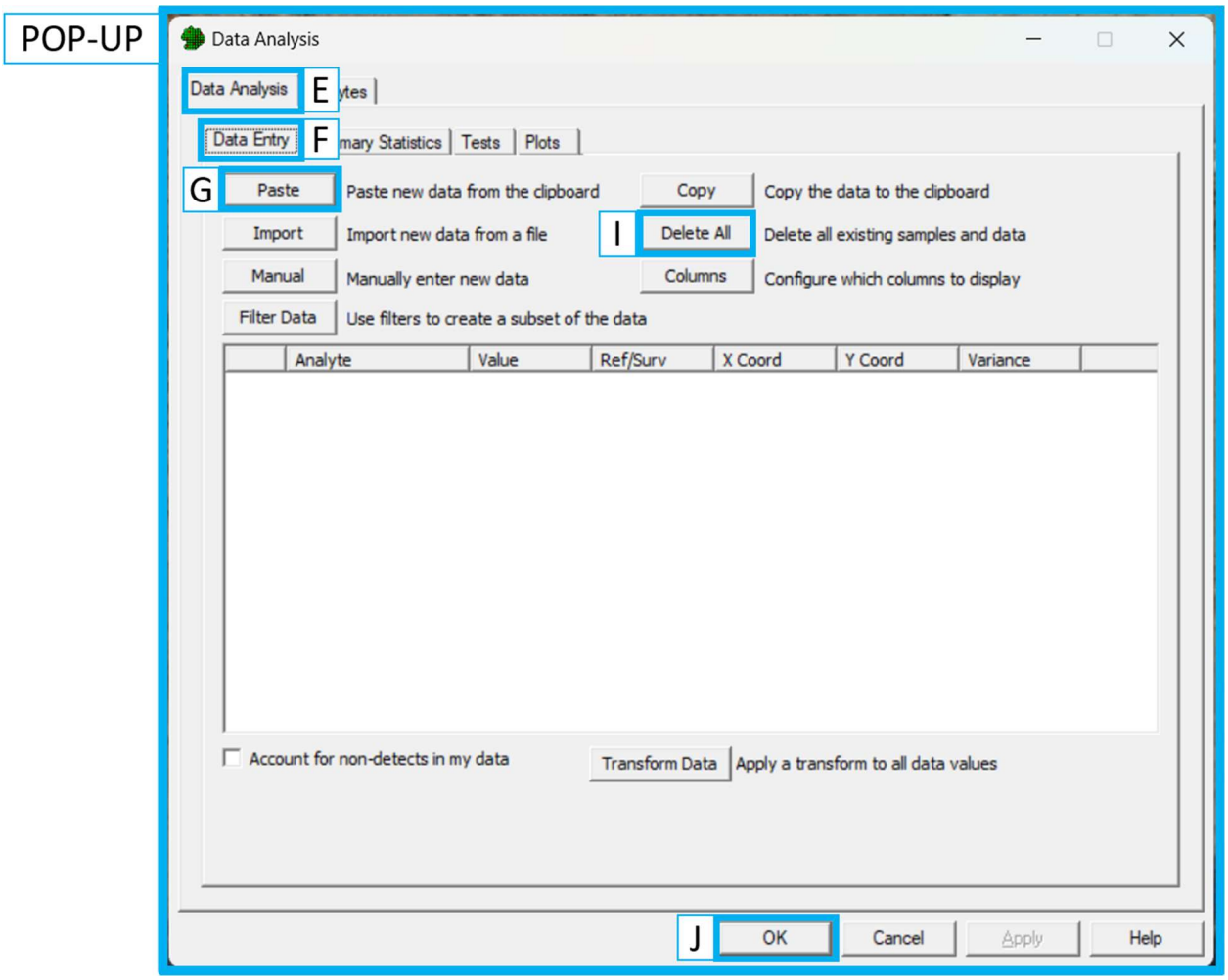
   2.2. In the drop-down menu, select "**Analyze Data…**" (D) to launch a new **dialog** that will pop up.



3. **Load the data into VSP:**

   3.1. In the (E) "**Data Analysis**" dialog, make sure the (F) "**Data Entry**" tab is active.

   3.2. Press the (G) **Paste** button.

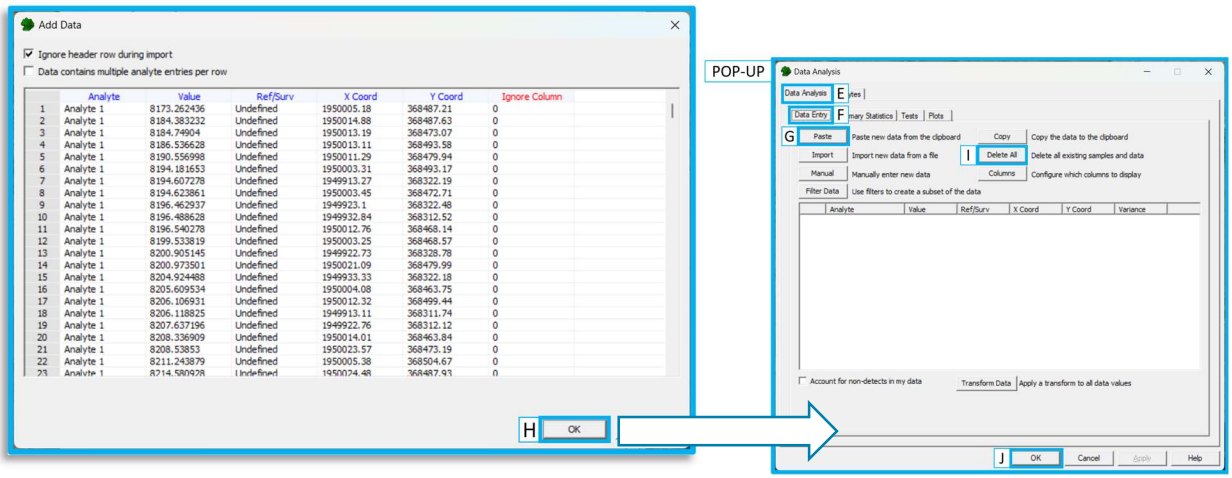


3.3. In the new pop-up dialog, preview the pasted data and ensure it matches what was copied in step **3.3**.

3.4. Select the column headers to map the appropriate columns to **Location** or **X/Y Coord** and **Value**.

3.5. Check the box **"Ignore header row during import"** if copied data has a header row.

3.6. Press (H) **OK** to import data.



3.7. Ensure the data has been imported as expected. If data was not imported correctly and needs to be reimported, press the (I) "**Delete All**" button and follow steps **3.1 - 3.6** again.

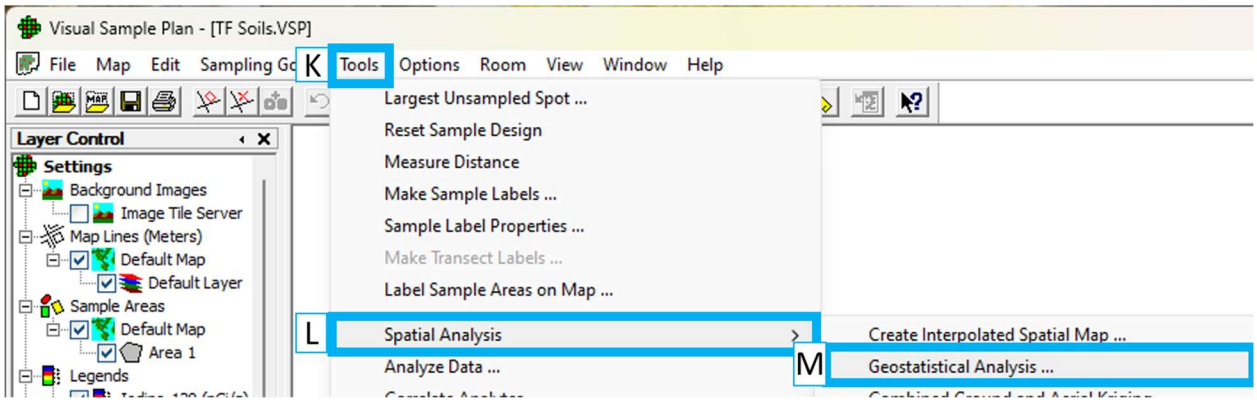
3.8. Once satisfied with the data, press (J) **OK** to import the data to the map and close the dialog.

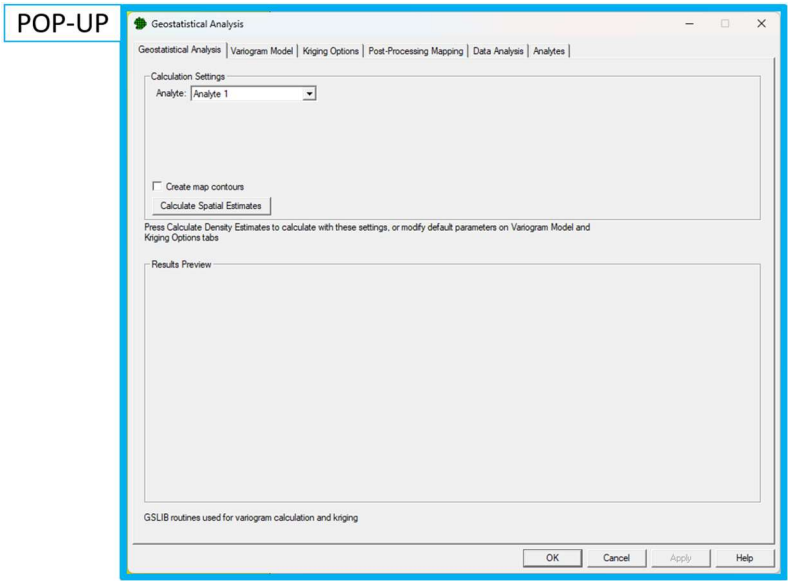
4. **Launch the Geostatistical Analysis dialog in VSP**:

4.1. In the top-left menu bar, select (K) **Tools**.

4.2. In the pop-up drop-down menu, hover over "**Spatial Analysis**" (L)

4.3. Select "**Geostatistical Analysis**" (M) to launch a new **dialog** that will pop up.



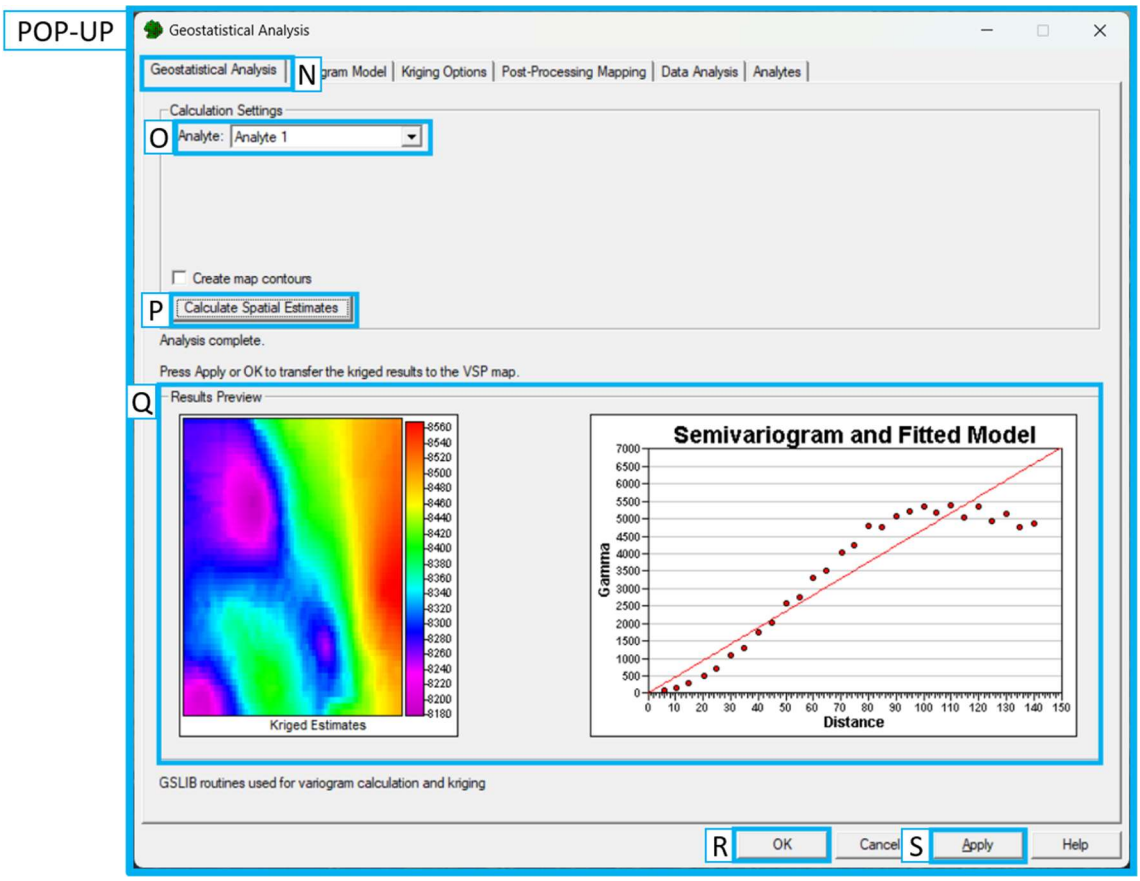


5. **Perform an initial Kriging Estimate:**

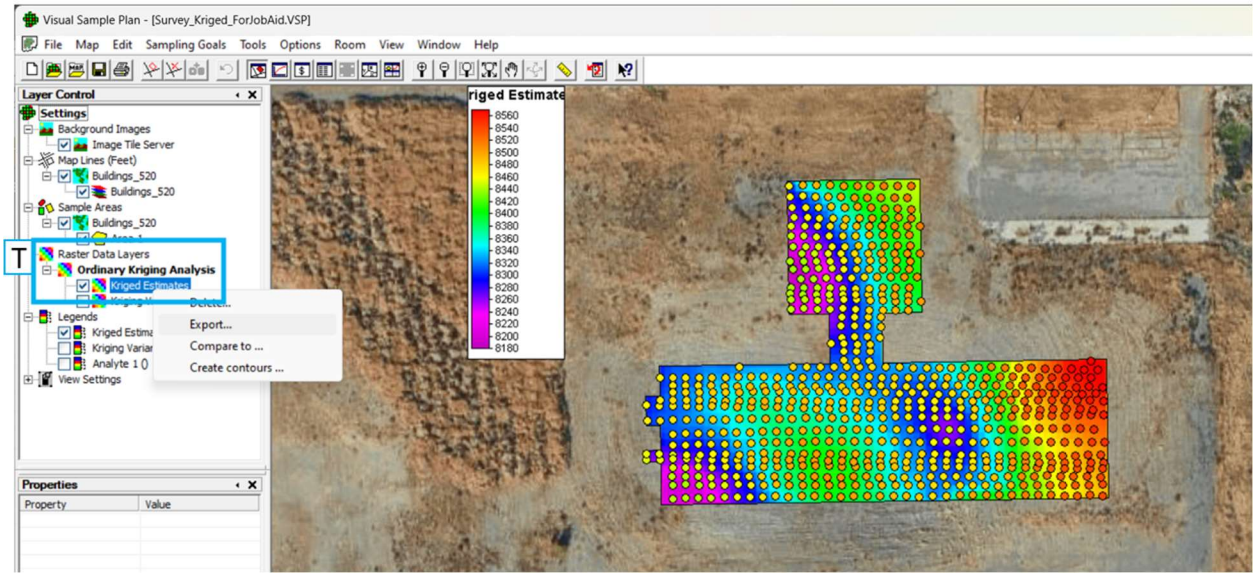
5.1. The dialog defaults to the (N) "**Geostatistical Analysis**" tab. Select the (O) **Analyte** to analyze. All analytes present in the data are shown as options.

5.2. Press the (P) "**Calculate Spatial Estimates**" button to trigger the kriging algorithm. "Calculate" does not need to be clicked to run the analysis. The default settings are recommended unless skewed data are noted.

5.3. The kriged map appears in the (Q) "**Results Preview**" pane when the analysis is completed. To transfer the kriged map into your VSP project, press (R) **Apply** or (S) **OK**.

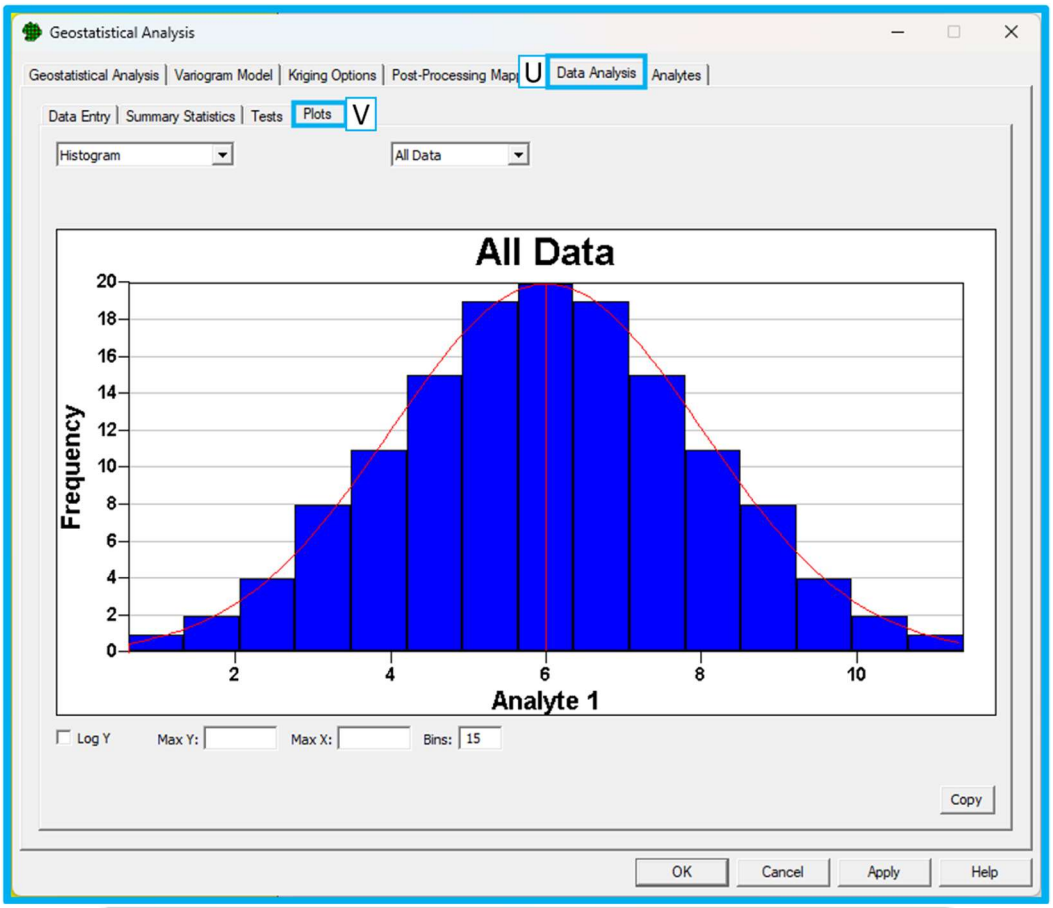


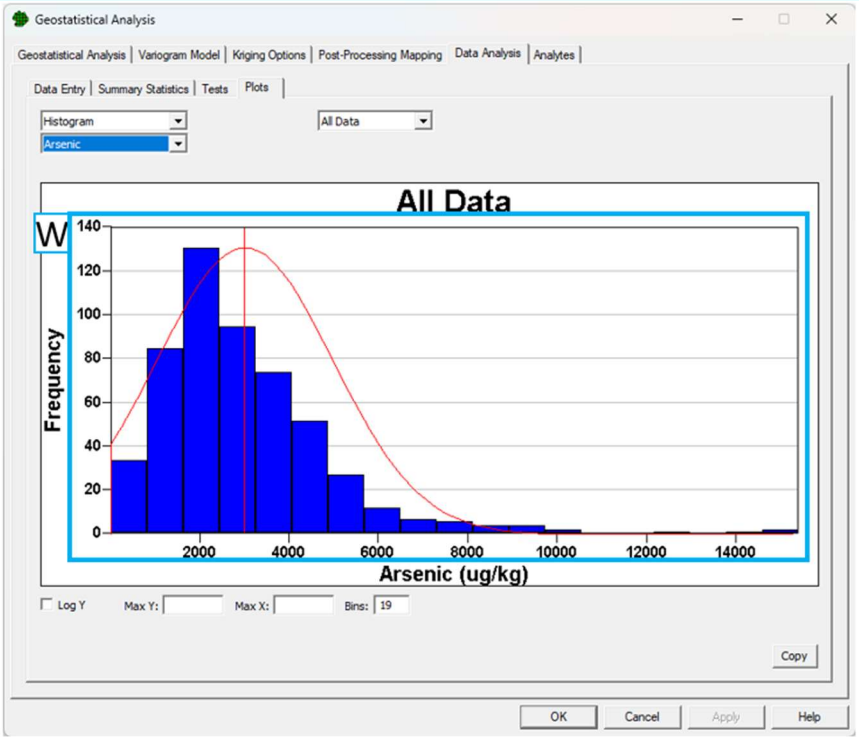
5.4. Once transferred to your VSP project, the kriged map will appear as a (T) **raster data layer** in the sidebar.



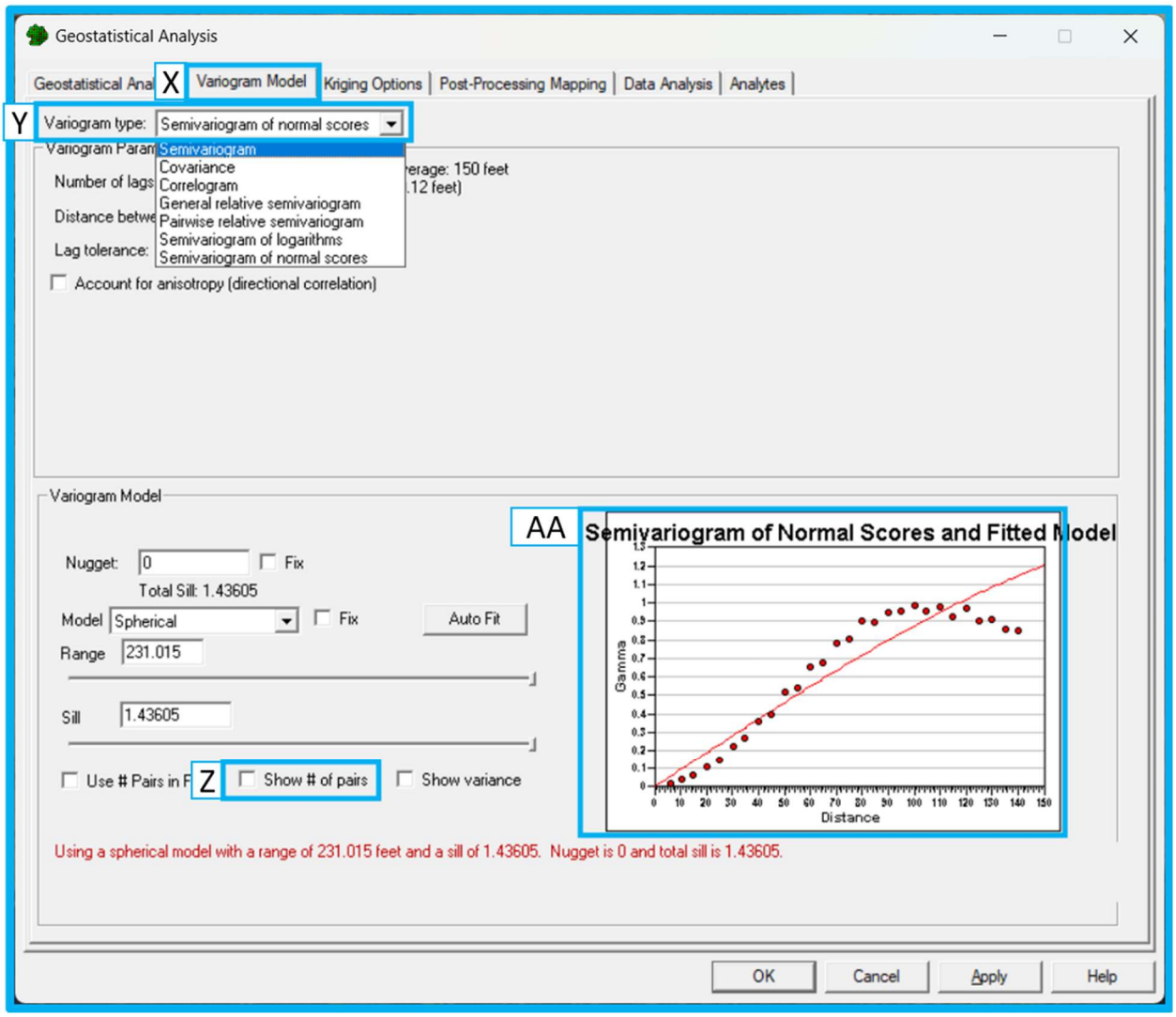
6. **Handling Skewed Data:** A variogram describes the spatial relationship between points. For best results with kriging, skewed data should use a non-default variogram. Follow the steps below to adjust the parameters in VSP for the variogram.

6.1. To verify the data are skewed, select the (U) "**Data Analysis**" tab and then select the nested (V) **Plots** tab. Skewed data will have a long tail on the histogram plot, as shown in (W).





6.2. To change the Variogram type for skewed data, select the (X) "**Variogram Model**" tab. Change the (Y) "**Variogram Type**" drop down to either "Semivariogram of normal scores" or "Semivariogram of logarithms".



7. **Troubleshooting Common Issues**

7.1. *The map looks different than expected:* A map that looks "off" may indicate the kriging settings may need adjusting.

7.1.1. On the (X) "**Variogram Model**" tab, check the box next to (Z) "**Show # of pairs**". If there are some points with very few pairs associated, select a different option from the (Y) "**Variogram type**" dropdown.

7.1.2. Examine the (AA) **plot** in the Variogram Model section. A good fit is most important on the left side of the graph. Select different options from the (Y) "**Variogram type**" dropdown to find the best fit.

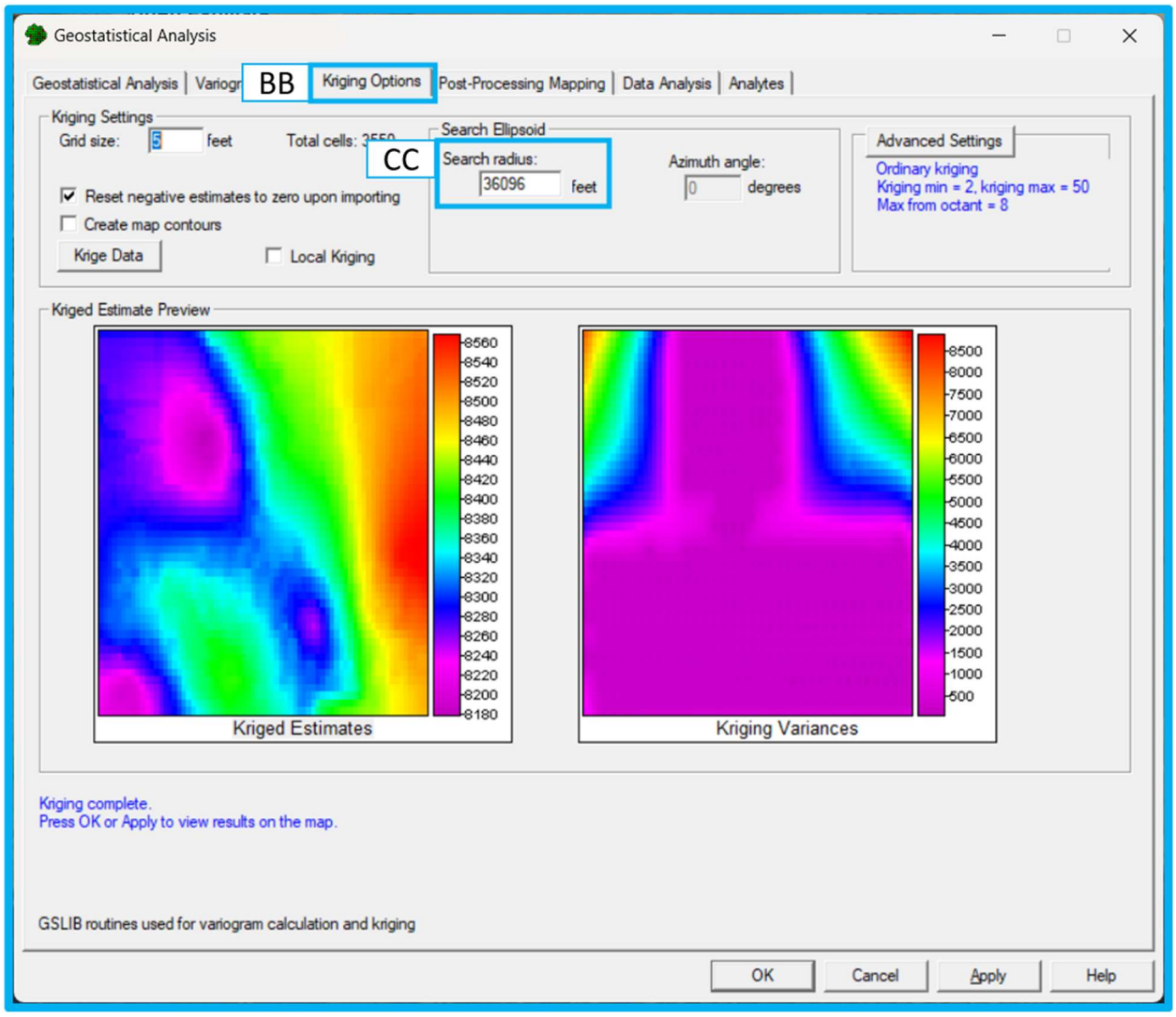
7.1.3. Be sure to adjust the type of variogram to account for skewed data (see 5).

7.2. *Grey areas on the map:* Grey areas mean the algorithm cannot create an estimate for that area.

7.2.1. First check if enough data points are available (30+ required for accurate Kriging)

7.2.2. If you've ruled out insufficient data, adjust the search radius. The (BB) "**Kriging Options**" tab contains the "**Search Ellipsoid**" section, which allows the user to adjust the (CC) "**Search radius**". Increase this radius to decrease grey areas.

7.2.3. If there are sufficient data, and the radius is large, but grey areas remain, look for points that are duplicated or very close. These points can throw off the estimation and should be deleted or otherwise handled in pre-processing.


Geostatistical Analysis
Geostatistical Analysis
Variogr
BB
Kriging Options
Post-Processing Mapping
Data Analysis
Analytes
Kriging Settings
Grid size:
5
feet
Total cells:
CC
Search Ellipsoid
Search radius:
36096
feet
Azimuth angle:
0
degrees
Advanced Settings
Ordinary kriging
Kriging min = 2, kriging max = 50
Max from octant = 8
Reset negative estimates to zero upon importing
Create map contours
Krige Data
Local Kriging
Kriged Estimate Preview
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Kriging Variances
Kriging complete.
Press OK or Apply to view results on the map.
GSLIB routines used for variogram calculation and kriging
OK
Cancel
Apply
Help