YangCZGIS User Guide

This guide provides comprehensive instructions for installing, configuring, and using all features of YangCZGIS

--Version 1.0

--January 2026

Developed by:

Jie Yang, Qiliang Liu*, Yueda Wu, Yuxuan Chen, Zhankun Liu, Xiancheng Mao, Min Deng

Department of Geo-informatics

Central South University, Changsha, China

1 Introduction

1.1 Development Purpose

YangCZGIS is an open-source software designed for temporal, spatial, and spatiotemporal scanning statistical analysis of time-series, spatial, or spatiotemporal data. It aims to facilitate scientific research while promoting and developing the Yang Chizhong (YangCZ) filtering and interpolation methods. The software integrates various YangCZ algorithms and incorporates functionalities for spatial data visualization, basic GIS spatial data processing, Exploratory Spatial Data Analysis (ESDA), Kriging algorithms, and a 3D interface, providing users with a systematic set of tools and methods.

1.2 Data Types

When using this software, you will encounter the following data types:

Point Data: Represents discrete points in space, where each point contains a set of coordinates and a value. The software supports both 2D and 3D point data. This is typically used to describe point features with specific locations and attributes, such as sensor observation data or earthquake source locations.

In this system, point data is primarily used for spatial analysis and processing. Specific usage methods will be detailed in subsequent chapters.

1.3 Development Team

Geostatistics Research Group, Central South University.。

2 System Requirements

To ensure the normal operation and performance of this system, it is recommended

that your computer system meets the following requirements:

- **Operating System:** Windows 10 or newer.
- **Processor:** 64-bit architecture processor; dual-core or higher is recommended.
- **Hard Disk Space:** At least 1 GB of available space for program installation and data storage.
- **Display:** Resolution of 1024 x 768 or higher is recommended.
- **Other:** Stable internet connection for software updates and online functions.

Please ensure your computer meets these requirements to achieve optimal system performance and user experience.

3 Installation and Startup

3.1 System Installation

1. Download Installer:

We provide both an installer and a portable version. You can download the latest release from our GitHub Releases page: Releases · Geostatistics-CSU/YangCZGIS , as shown in Fig. 3-1.

- Installer (.exe): Recommended. Follow the setup wizard to install.
- Portable (.zip): No installation required. Unzip and run YCZSoftware_VS.exe directly.

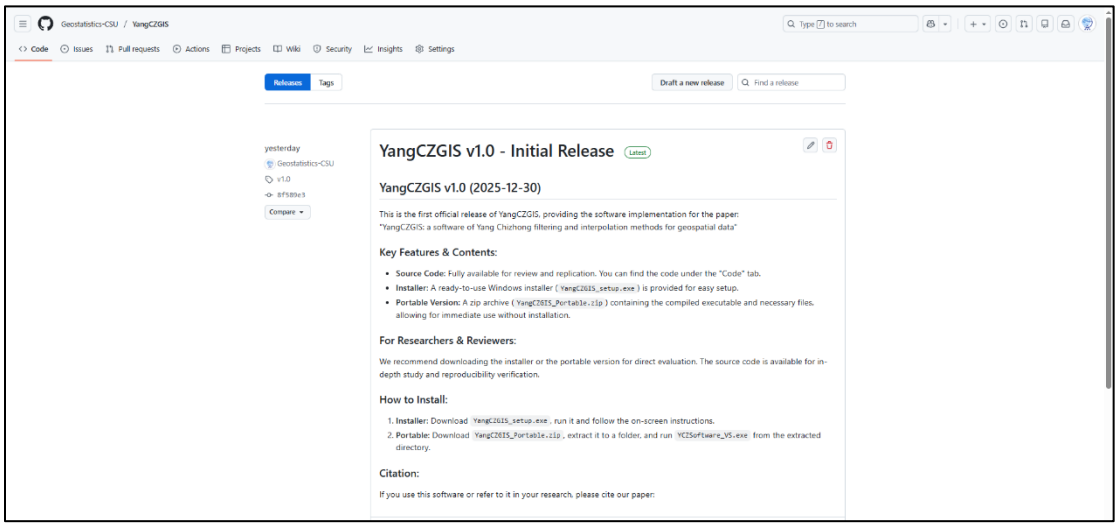


Fig. 3-1 Download Website

2. **Run Installer:** Double-click the installation program and follow the on-screen prompts.

3. **Select Installation Location:** Choose the destination folder for the installation. By default, the system installs to a preset directory, but you may choose a different location, as shown in Fig. 3-2.

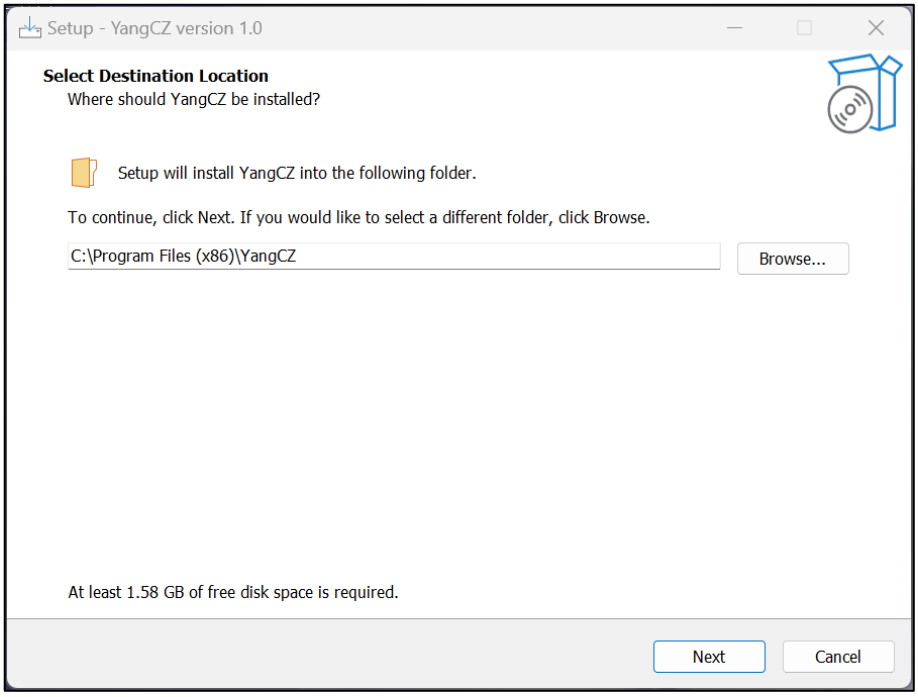


Fig. 3-2 Select Installation Path

4. **Set Desktop Shortcut:** By default, the system does not create a desktop shortcut. Users can check the box to create one if desired, as shown in Fig. 3-

3.

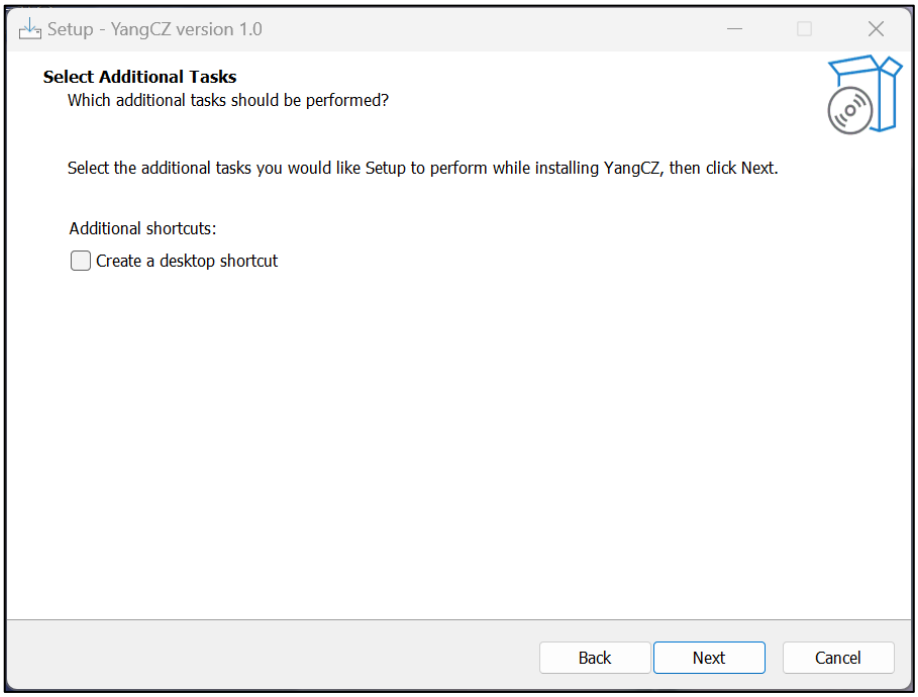


Fig. 3-3 Create Desktop Shortcut

5. Complete Installation: The installer will begin copying files and configuring the system. Please wait patiently until the installation is complete. A prompt interface will appear upon completion, as shown in Fig. 3-4.

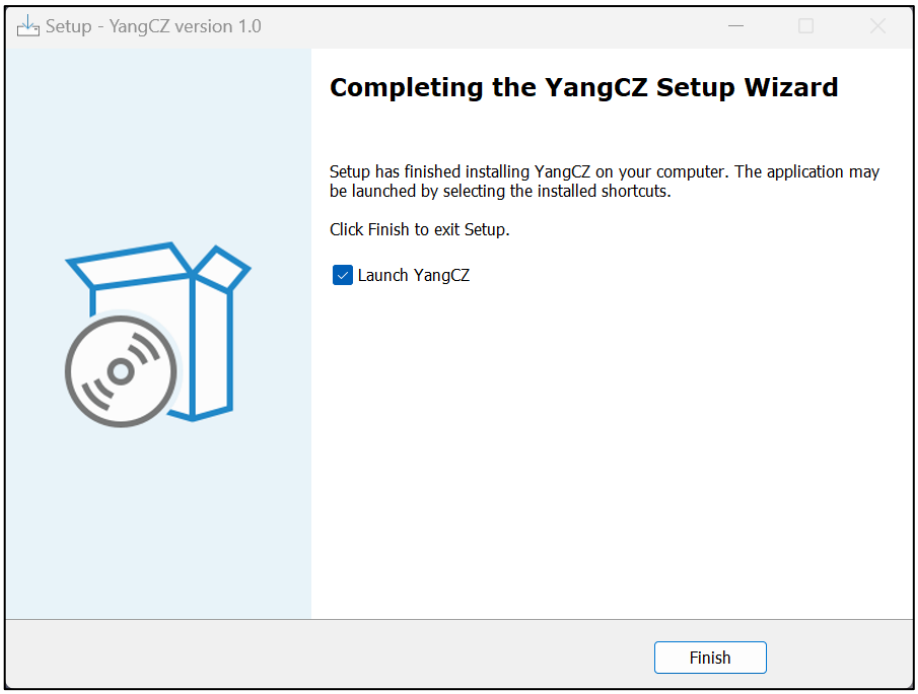


Fig. 3-4 Installation Complete

3.2 System Startup

After installation, you can find the system shortcut in the Start Menu or on the Desktop. Double-click the shortcut to launch YangCZGIS.

3.4 Notes

If you encounter any issues during installation, please refer to the installation guide or contact our technical support team for assistance. Ensure your computer meets the system requirements for the best experience.

4 Interface and Functions

4.1 Interface Overview

The main interface of YangCZGIS consists of six parts: Title Bar, Menu Bar, Toolbar, Layer Panel, Map View, and Overview Map, as shown in Fig. 4-1.

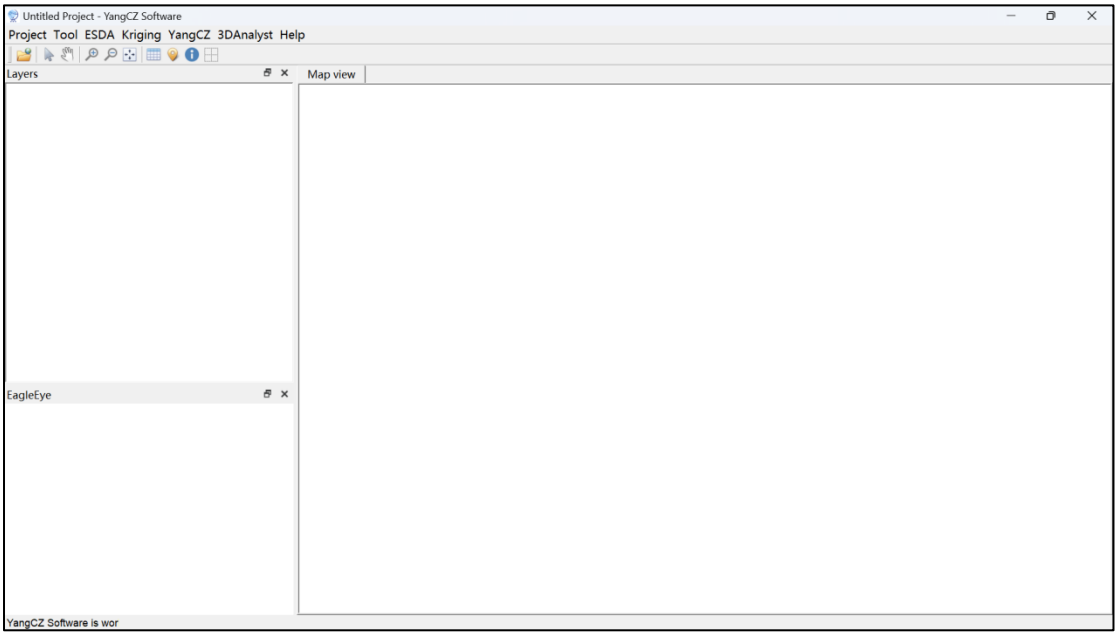


Fig. 4-1 Main Software Interface

4.2 Function Introduction

Characterized by the YangCZ methods, this software is designed with 7 core functional modules:

(1) Spatial Data/Layer Management

(2) Exploratory Spatial Data Analysis (ESDA)

(3) Kriging Interpolation Methods

(4) YangCZ Filtering and Interpolation Methods

(5) 2D Visualization Mapping

(6) 3D Visualization Mapping

(7) Toolbox

The software utilizes the cross-platform Qt framework to integrate these modules and generate a user-friendly Graphical User Interface (GUI).

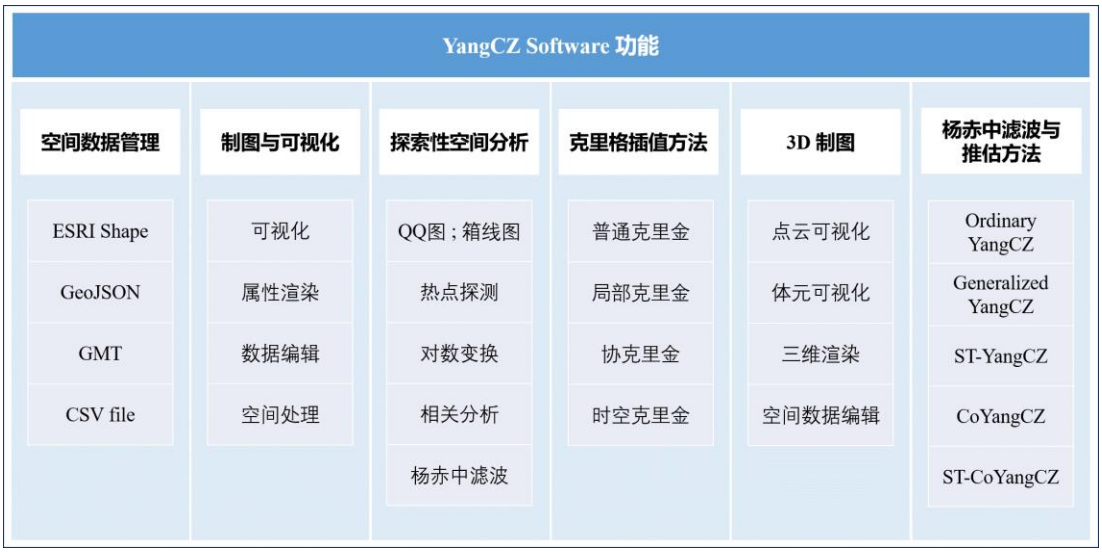


Fig. 4-2 System Functions

4.2.1 Toolbar Functions

Users can perform the following actions via the toolbar buttons:

-  -- Import Data
-  -- Switch to Pointer Mode

-  -- Pan Map
-  -- Zoom In
-  -- Zoom Out
-  -- Zoom to Layer
-  -- View Attribute Table
-  -- View Coordinates
-  -- Identify Feature Attributes
-  -- Select Features

4.2.2 Menu Bar Functions

The software functionalities are concentrated in the menu bar, categorized into six main types:

1. **Data and Layer Management:** Provides import capabilities for various geospatial data formats (ESRI Shapefile, GeoJSON, GMT) into YangCZGIS for visualization and standardized management. We also integrate the GDAL library to support more formats. Additionally, CSV and TXT files are supported for data reading and importing.
2. **Basic GIS Functions:** Supports visual display of spatial data, offering an overview map for easy navigation. Integrates attribute rendering, data editing, and spatial data processing.
3. **Exploratory Spatial Data Analysis (ESDA):** Provides tools like Histograms, QQ Plots, and Box Plots to help users comprehensively analyze the spatial characteristics and distribution patterns of experimental data and interpolation results.
4. **Kriging Functions:** Integrates mainstream Kriging interpolation methods. This allows users to compare YangCZ methods with Kriging results, enhancing software

operability.

5. **YangCZ Algorithms Module:** As the core functionality, this includes Ordinary YangCZ (OYangCZ), Co-YangCZ, Spatiotemporal YangCZ (STYangCZ), Generalized YangCZ (GYangCZ), etc. Each method offers functions for raster generation and accuracy validation (cross-validation).
6. **3D Window Module:** Used for 3D data modeling and visualization, integrating 2D interface functions while adding 3D data processing and rendering capabilities.

5 Software Operation

5.1 Project - Data/Layer Management

5.1.2 Project File Management

The [Project] button in the menu bar provides management functions for project files (.ycz), including Open, New, Save, and Save As.

Fig. 5-1 Project File Management Functions

- Open: Open an existing project file (.ycz) from a specified directory.
- New: Create a new project file.
- Save: Save the current project.
- Save As: Save the current project to a new file.

5.1.3 Data Import

YangCZGIS provides two import methods:

1. Import CSV/TXT: Select [Project] -> [Import] -> [Import CSV/TXT] to read and import text-based data.

2. Import SHP: Select [Project] -> [Import] -> [Import SHP] to read and import ESRI Shapefiles.

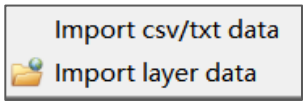


Fig. 5-2 Data Import Functions

5.1.4 Layer Management

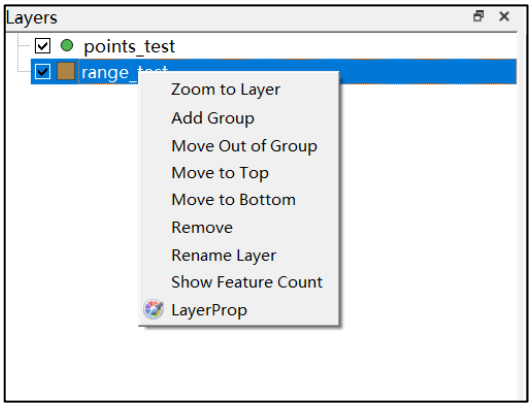


Fig. 5-3 Context Menu

Locate the target layer in the Layer List. Right-click the layer to open the Context Menu (as shown in Fig. 5-3), which includes functions such as Zoom to Layer, Add Group, Move Out of Group, Move to Top/Bottom, Remove, Rename, Properties, and Visualization.

- Zoom to Layer: Adjusts the map view to fit the bounding box of the selected layer.
- Add Group: Adds selected layer files or data sources to a group.
- Move Out of Group: Removes the layer from the current group.
- Move to Top/Bottom: Reorders the layer in the drawing order.
- Remove: Removes the layer from the project.

- Rename Layer: Renames the selected layer via a dialog box.

5.1.5 Layer Properties

Click [Layer Prop] in the context menu and select the [Information] tab to view the attribute table of the corresponding layer (Example: Fig. 5-4).

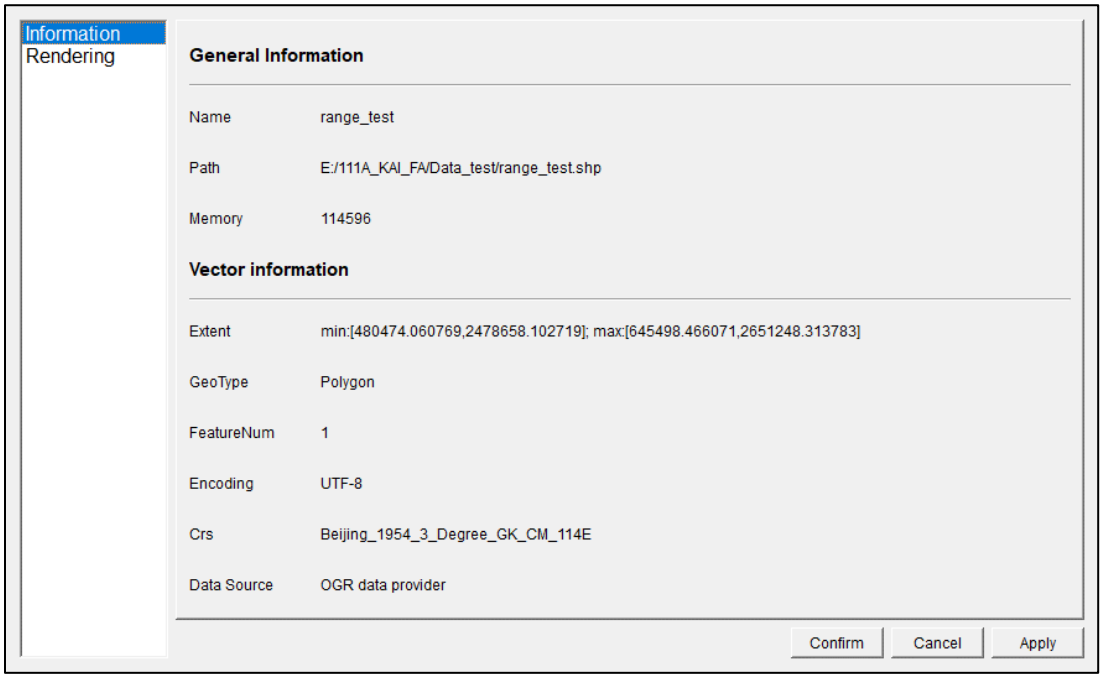


Fig. 5-4 View Layer Properties

5.1.6 Layer Rendering and Visualization

Click [Layer Prop] and select the [Symbology] (or Rendering) tab. Choose a rendering method suitable for your data type (Categorized, Single Symbol, Graduated Colors, Graduated Symbols, etc.), as shown in Fig. 5-5.

Set parameters such as fields, symbol styles, colors, and sizes. Click [Apply] to preview and [Confirm] to finish.

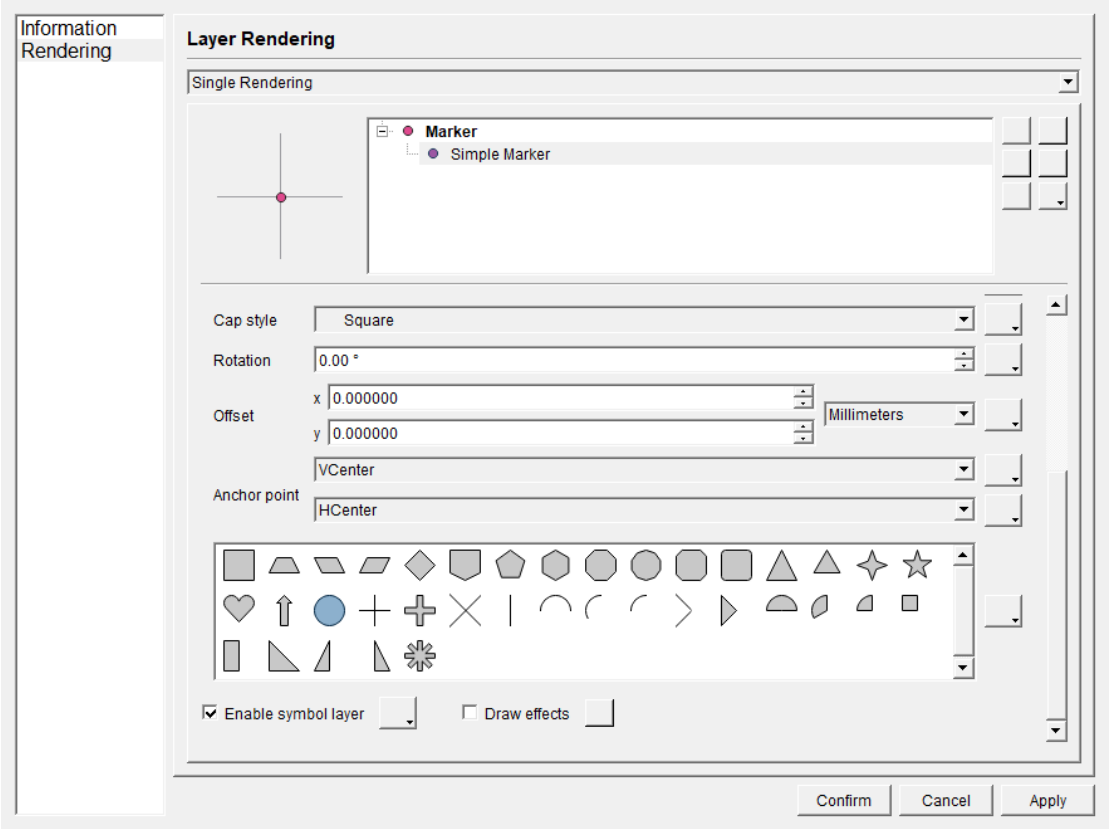


Fig. 5-5 Layer Rendering Dialog

5.2 TOOL - Mathematical and Statistical Analysis

The [TOOL] menu provides algorithms for Logarithmic Operation, Inverse Logarithmic Operation, and Correlation Coefficient calculation.

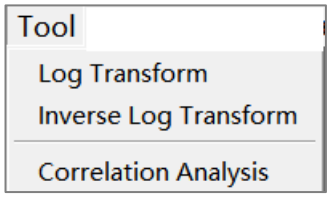


Fig. 5-6 TOOL Functions

5.2.1 Log Transform

Click [TOOL] -> [Log Transform] to open the dialog (Fig. 5-7). Select the target layer and attribute field (Fig. 5-8). Click [Confirm] to calculate. The software automatically calculates the offset and prompts a completion dialog. The result is added as the last column in the attribute table (Fig. 5-10).

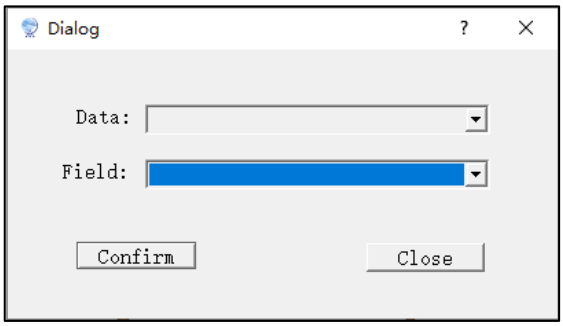


Fig. 5-7 Log Transform Dialog

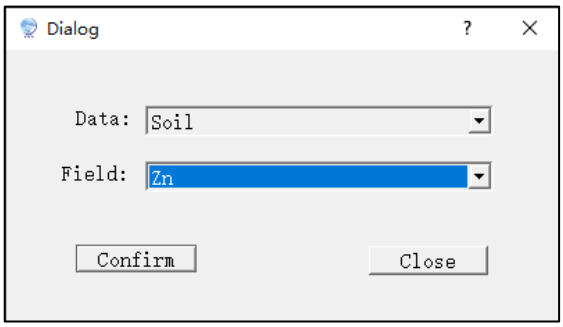


Fig. 5-8 Log Transform Parameter Settings

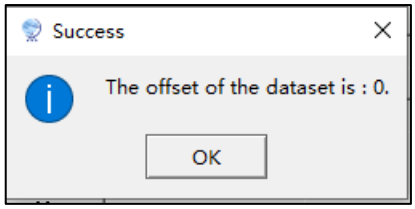
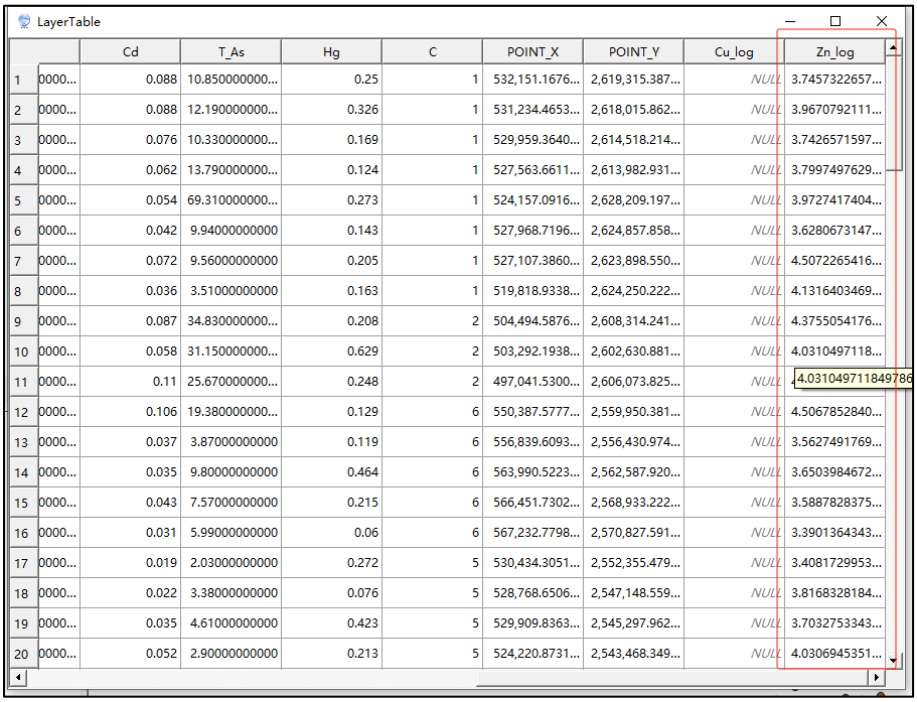


Fig. 5-9 Offset Prompt



		Cd	T_As	Hg	C	POINT_X	POINT_Y	Cu_log	Zn_log
1	0000...	0.088	10.850000000...	0.25	1	532,151.1676...	2,619,315.387...	NULL	3.7457322657...
2	0000...	0.088	12.190000000...	0.326	1	531,234.4653...	2,618,015.862...	NULL	3.9670792111...
3	0000...	0.076	10.330000000...	0.169	1	529,959.3640...	2,614,518.214...	NULL	3.7426571597...
4	0000...	0.062	13.790000000...	0.124	1	527,563.6611...	2,613,982.931...	NULL	3.7997497629...
5	0000...	0.054	69.310000000...	0.273	1	524,157.0916...	2,628,209.197...	NULL	3.9727417404...
6	0000...	0.042	9.94000000000	0.143	1	527,968.7196...	2,624,857.858...	NULL	3.6280673147...
7	0000...	0.072	9.56000000000	0.205	1	527,107.3860...	2,623,898.550...	NULL	4.5072265416...
8	0000...	0.036	3.51000000000	0.163	1	519,818.9338...	2,624,250.222...	NULL	4.1316403469...
9	0000...	0.087	34.830000000...	0.208	2	504,494.5876...	2,608,314.241...	NULL	4.3755054176...
10	0000...	0.058	31.150000000...	0.629	2	503,292.1938...	2,602,630.881...	NULL	4.0310497118...
11	0000...	0.11	25.670000000...	0.248	2	497,041.5300...	2,606,073.825...	NULL	4.031049711849786
12	0000...	0.106	19.380000000...	0.129	6	550,387.5777...	2,559,950.381...	NULL	4.5067852840...
13	0000...	0.037	3.87000000000	0.119	6	556,839.6093...	2,556,430.974...	NULL	3.5627491769...
14	0000...	0.035	9.80000000000	0.464	6	563,990.5223...	2,562,587.920...	NULL	3.6503984672...
15	0000...	0.043	7.57000000000	0.215	6	566,451.7302...	2,568,933.222...	NULL	3.5887828375...
16	0000...	0.031	5.99000000000	0.06	6	567,232.7798...	2,570,827.591...	NULL	3.3901364343...
17	0000...	0.019	2.03000000000	0.272	5	530,434.3051...	2,552,355.479...	NULL	3.4081729953...
18	0000...	0.022	3.38000000000	0.076	5	528,768.6506...	2,547,148.559...	NULL	3.8168328184...
19	0000...	0.035	4.61000000000	0.423	5	529,909.8363...	2,545,297.962...	NULL	3.7032753343...
20	0000...	0.052	2.90000000000	0.213	5	524,220.8731...	2,543,468.349...	NULL	4.0306945351...

Fig. 5-10 Log Transform Results

5.2.2 Inverse Log Transform

Click [TOOL] -> [Inverse Log Transform] to reverse the logarithmic effect. Select the layer, attribute field, and set the data offset (usually 0). Click [Confirm]. The result is added to the attribute table.

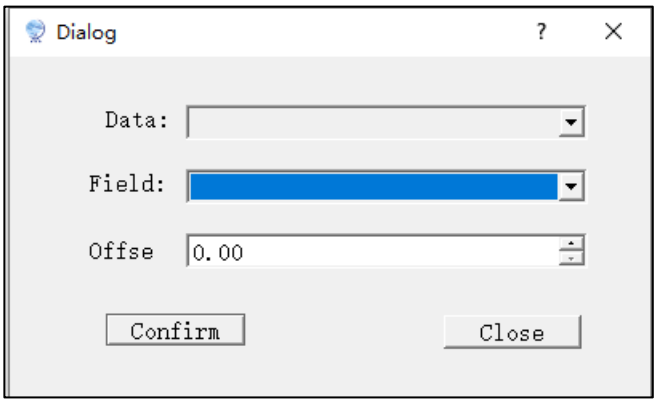


Fig. 5-11 Inverse Log Transform Dialog

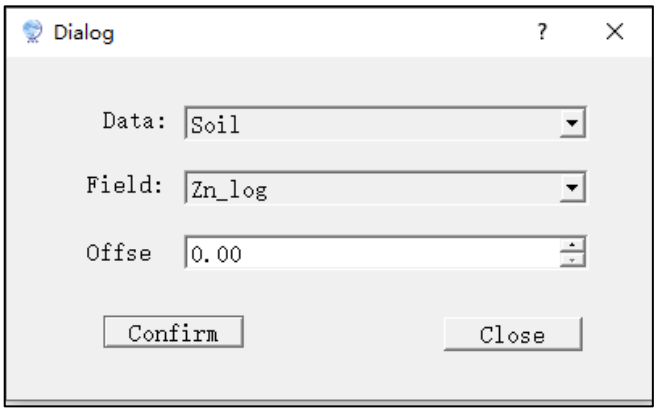


Fig. 5-12 Inverse Log Transform Settings

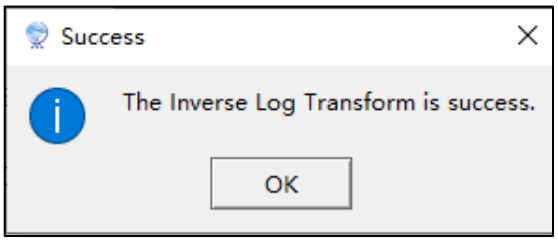
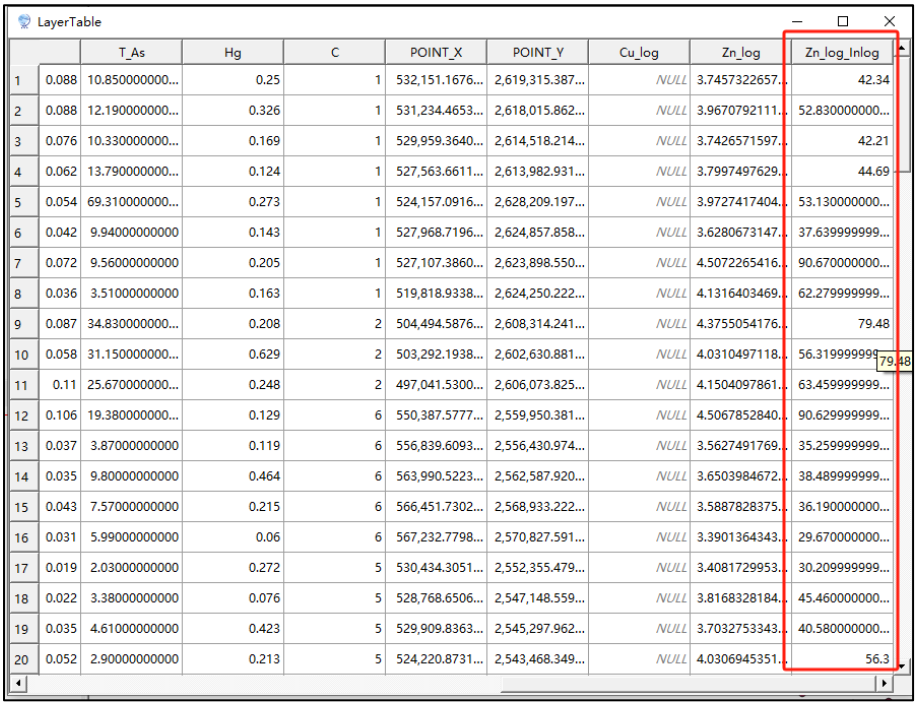


Fig. 5-13 Calculation Complete Prompt



	T_As	Hg	C	POINT_X	POINT_Y	Cu_log	Zn_log	Zn_log_Inlog
1	0.088	10.850000000...	0.25	1	532,151.1676...	2,619,315.387...	NULL	3.7457322657...	42.34
2	0.088	12.190000000...	0.326	1	531,234.4653...	2,618,015.862...	NULL	3.9670792111...	52.830000000...
3	0.076	10.330000000...	0.169	1	529,959.3640...	2,614,518.214...	NULL	3.7426571597...	42.21
4	0.062	13.790000000...	0.124	1	527,563.6611...	2,613,982.931...	NULL	3.7997497629...	44.69
5	0.054	69.310000000...	0.273	1	524,157.0916...	2,628,209.197...	NULL	3.9727417404...	53.130000000...
6	0.042	9.94000000000	0.143	1	527,968.7196...	2,624,857.858...	NULL	3.6280673147...	37.639999999...
7	0.072	9.56000000000	0.205	1	527,107.3860...	2,623,898.550...	NULL	4.5072265416...	90.670000000...
8	0.036	3.51000000000	0.163	1	519,818.9338...	2,624,250.222...	NULL	4.1316403469...	62.279999999...
9	0.087	34.830000000...	0.208	2	504,494.5876...	2,608,314.241...	NULL	4.3755054176...	79.48
10	0.058	31.150000000...	0.629	2	503,292.1938...	2,602,630.881...	NULL	4.0310497118...	56.319999999
11	0.11	25.670000000...	0.248	2	497,041.5300...	2,606,073.825...	NULL	4.1504097861...	63.459999999...
12	0.106	19.380000000...	0.129	6	550,387.5777...	2,559,950.381...	NULL	4.5067852840...	90.629999999...
13	0.037	3.87000000000	0.119	6	556,839.6093...	2,556,430.974...	NULL	3.5627491769...	35.259999999...
14	0.035	9.80000000000	0.464	6	563,990.5223...	2,562,587.920...	NULL	3.6503984672...	38.489999999...
15	0.043	7.57000000000	0.215	6	566,451.7302...	2,568,933.222...	NULL	3.5887828375...	36.190000000...
16	0.031	5.99000000000	0.06	6	567,232.7798...	2,570,827.591...	NULL	3.3901364343...	29.670000000...
17	0.019	2.03000000000	0.272	5	530,434.3051...	2,552,355.479...	NULL	3.4081729953...	30.209999999...
18	0.022	3.38000000000	0.076	5	528,768.6506...	2,547,148.559...	NULL	3.8168328184...	45.460000000...
19	0.035	4.61000000000	0.423	5	529,909.8363...	2,545,297.962...	NULL	3.7032753343...	40.580000000...
20	0.052	2.90000000000	0.213	5	524,220.8731...	2,543,468.349...	NULL	4.0306945351...	56.3

Fig. 5-14 Inverse Log Transform Results

5.2.3 Correlation Analysis

Click [TOOL] -> [Correlation Analysis]. Select the target layer and the number of variables (default is 2, range 2-6), then select the corresponding fields. Click [Confirm] to display the correlation coefficient visualization result (Fig. 5-17).

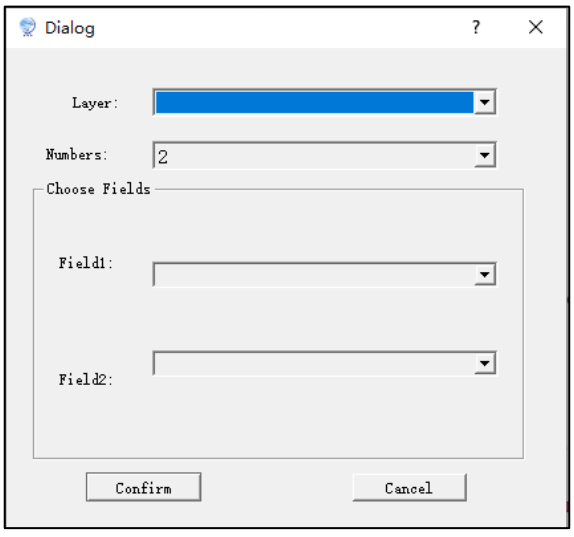


Fig. 5-15 Correlation Analysis Dialog

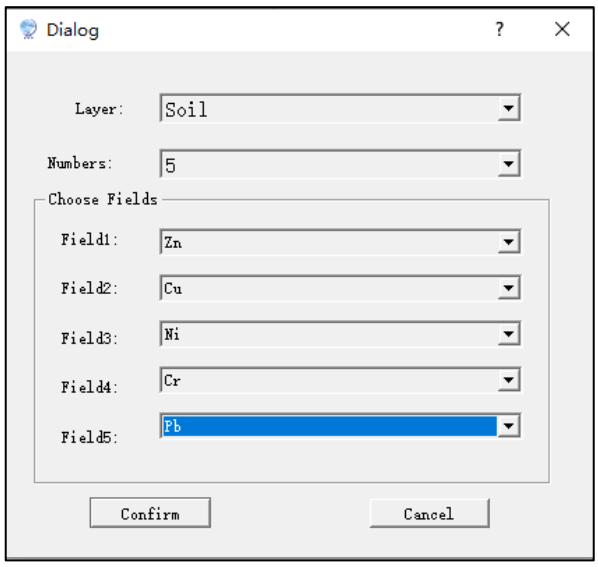


Fig. 5-16 Correlation Parameter Settings

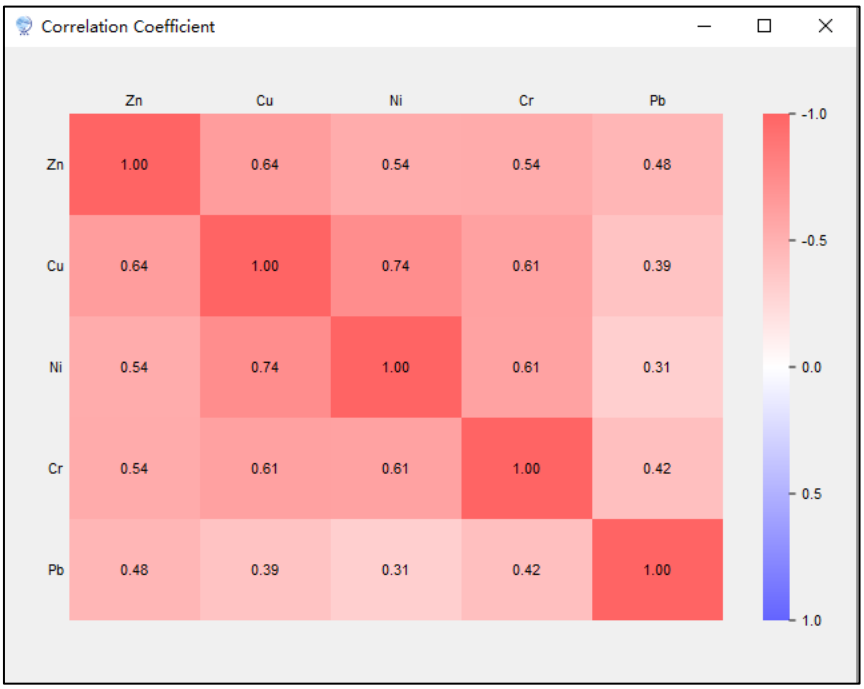


Fig. 5-17 Correlation Visualization Results

5.3 Kriging Functions

The [Kriging] menu offers various Kriging interpolation algorithms, including Ordinary Kriging, Simple Kriging, Co-Kriging, and Spatiotemporal Kriging.

5.4 ESDA - Exploratory Spatial Analysis Tools

The [ESDA] menu provides tools including Histogram, QQ Plot, Box Plot, AMOEBA algorithm, and HTMSCAN algorithm.

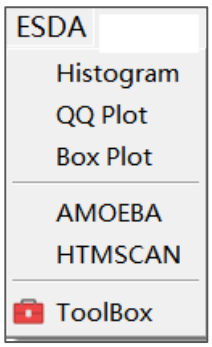


Fig. 5-18 ESDA Functions

5.4.1 Histogram

Click [ESDA] -> [Histogram]. Select the data source, attribute field, and number of bins (default is 5). Click [Draw] to display the result.

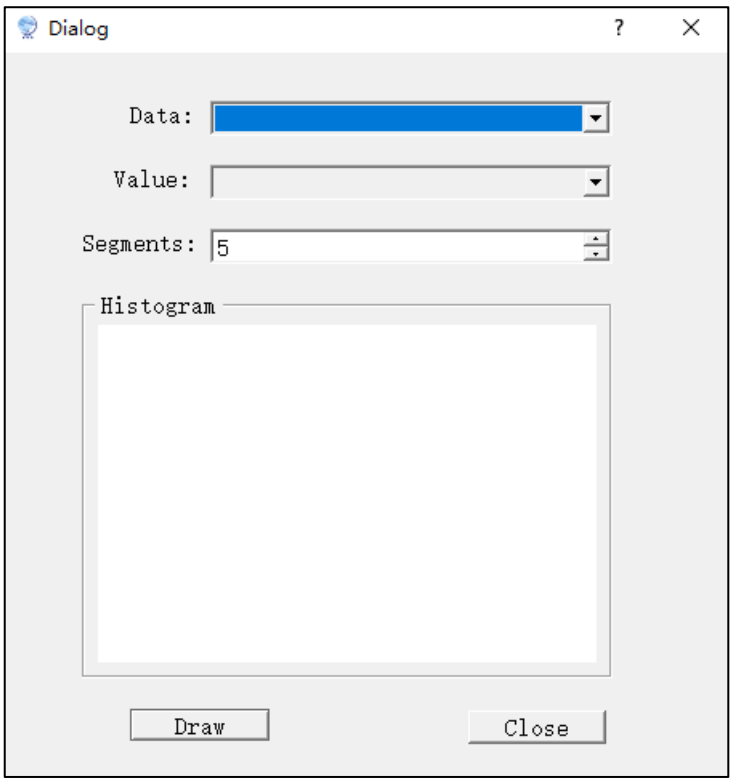


Fig. 5-19 Histogram Dialog

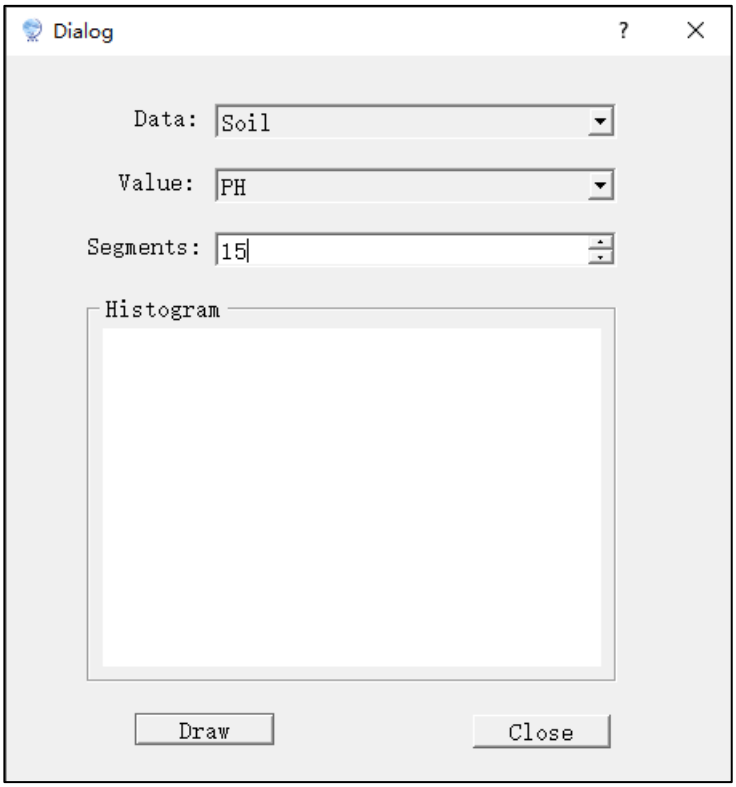


Fig. 5-20 Histogram Parameter Settings

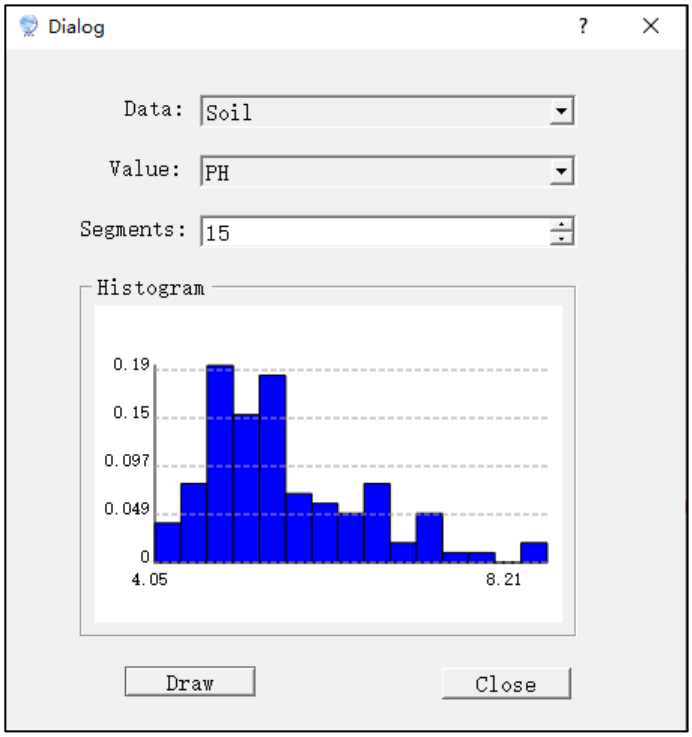


Fig. 5-21 Histogram Plot Results

5.4.2 QQ Plot

Click [ESDA] -> [QQ Plot]. Select data source and attribute field. Click [Draw] to display.

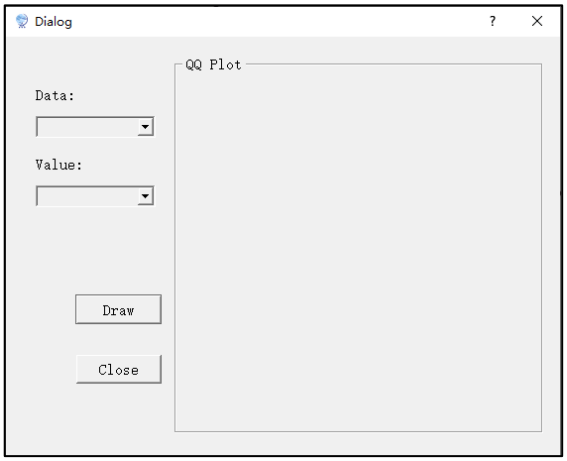


Fig. 5-22 QQ Plot Dialog

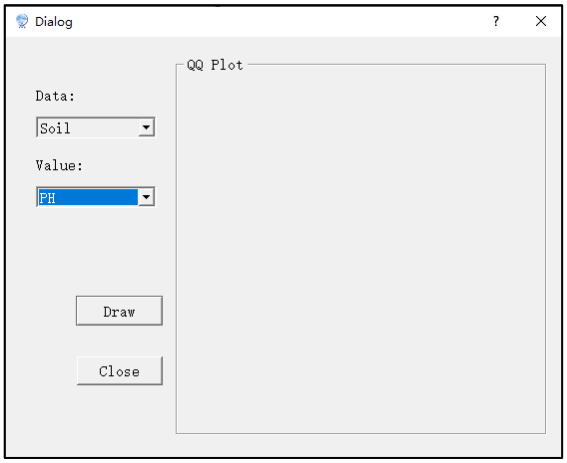


Fig. 5-23 QQ Plot Parameter Settings

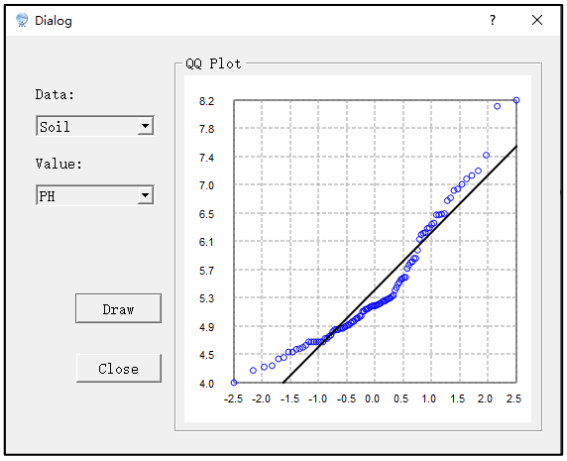


Fig. 5-24 QQ Plot Results

5.4.3 Box Plot

Click [ESDA] -> [Box Plot]. Select data source and attribute field. Click [Draw]. The interface displays the plot and calculated statistics: Minimum, Q1, Median, Q3, Maximum, IQR, Mean, and Standard Deviation.

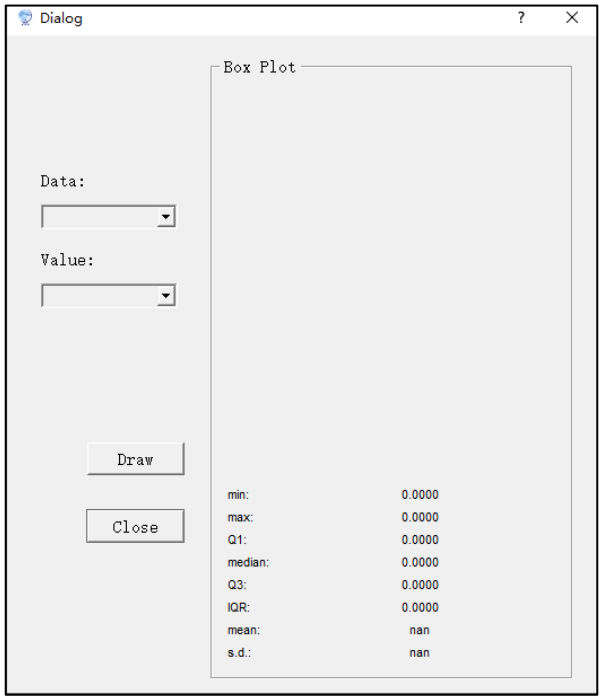


Fig. 5-25 Box Plot Dialog

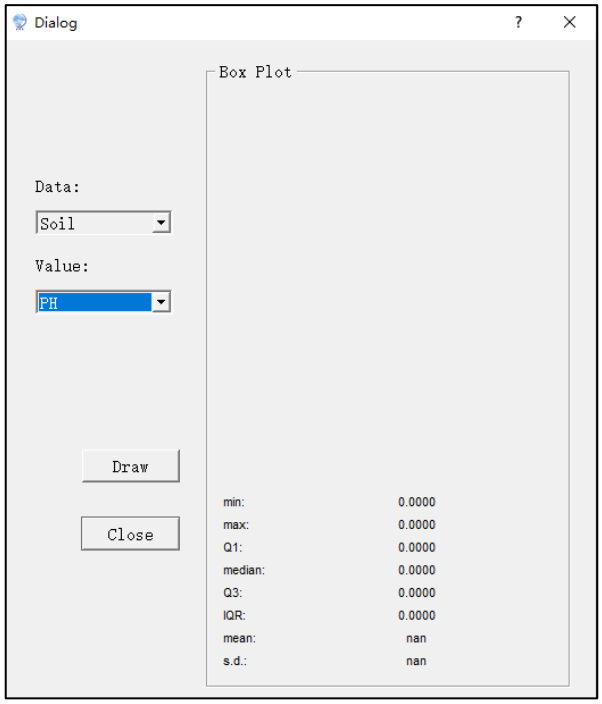


Fig. 5-26 Box Plot Parameter Settings

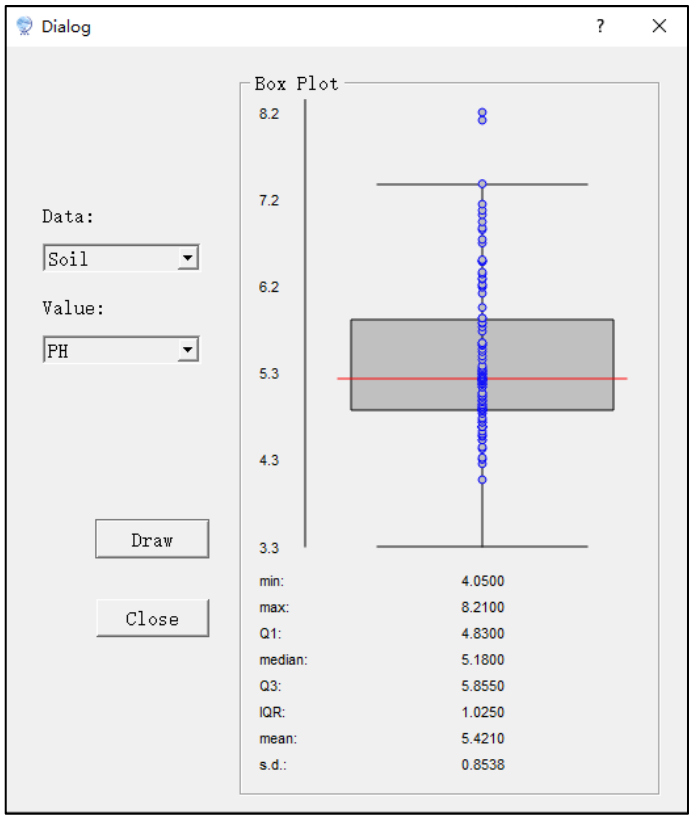


Fig. 5-27 Box Plot Results

5.4.4 AMOEBA Algorithm

Click [ESDA] -> [AMOEBA].

- With Neighbor File: Input observation layer, attribute, coordinates, significance level, Monte Carlo simulations, neighbor file path, and output path.
- Without Neighbor File: Similar inputs but requires setting a Distance Threshold instead of a neighbor file.

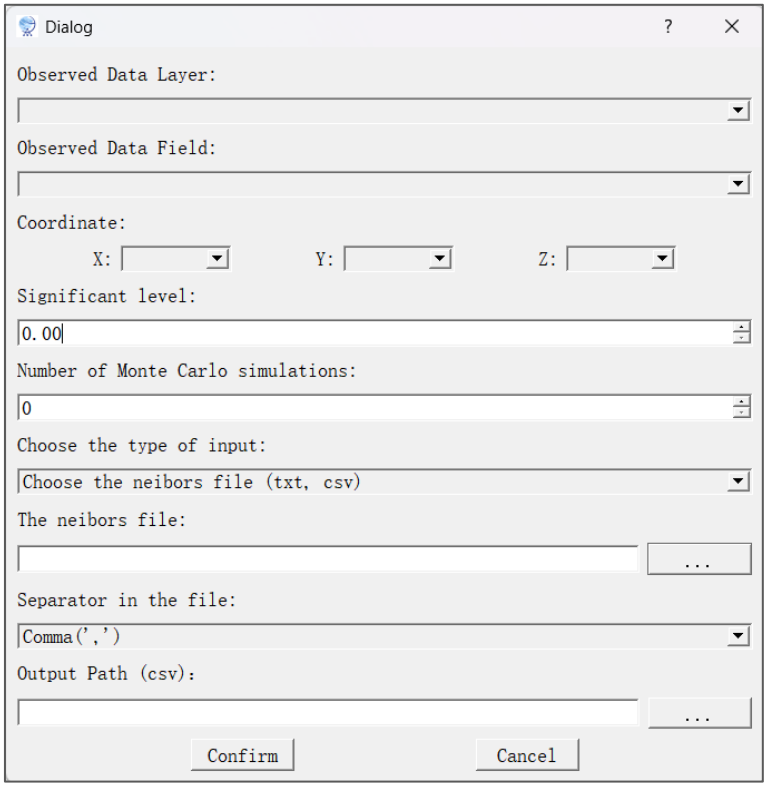


Fig. 5-28 AMOEBA Parameter Settings (With Neighbor File)

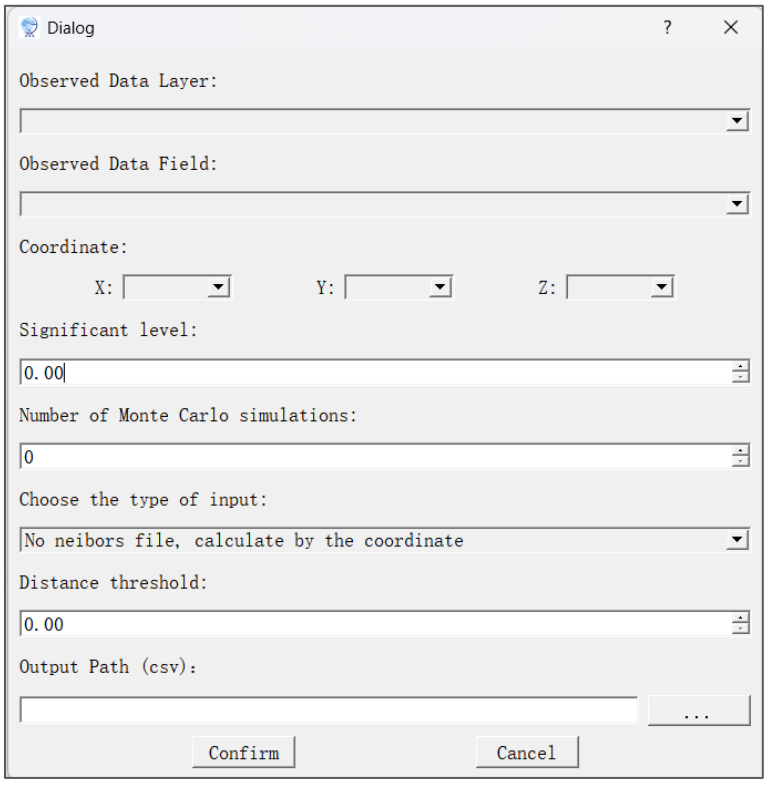


Fig. 5-29 AMOEBA Parameter Settings (Without Neighbor File)

5.4.5 HTMSCAN Algorithm

HTMSCAN is a high-efficiency 3D multi-directional spatial scan statistic method.

Click [ESDA] -> [HTMSCAN]. Configure parameters similar to AMOEBA (Significance level, Simulations). Results (mineralization centers/hotspots) can be visualized in the 3D window (Fig. 5-32).

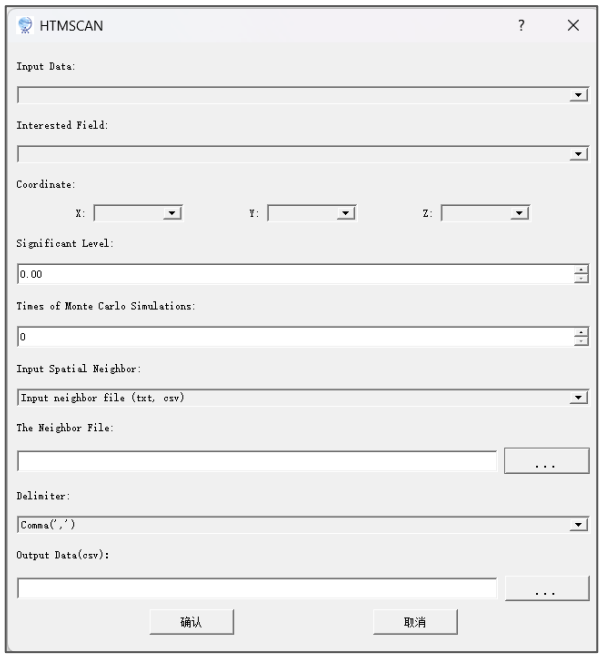


Fig. 5-30 HTMSCAN Parameter Settings (With Neighbor File)

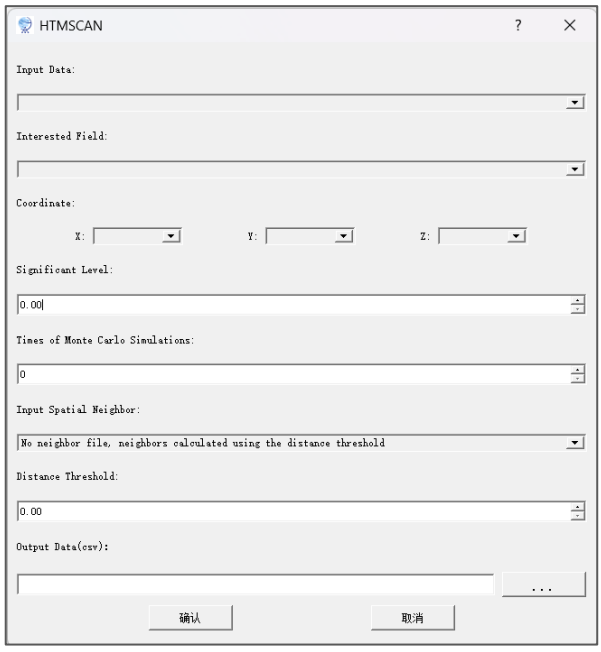


Fig. 5-31 HTMSCAN Parameter Settings (Without Neighbor File)

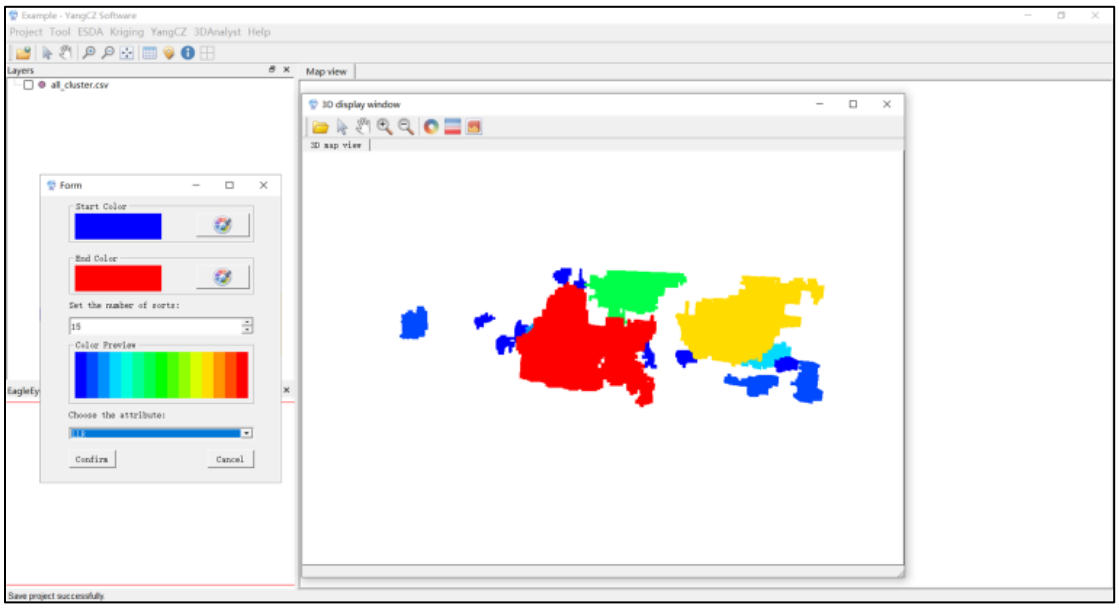


Fig. 5-32 Mineralization Center (or Hotspot) Results

5.5 YangCZ - Yang Chizhong Algorithm Functions

The [YangCZ] menu provides core algorithms: OYangCZ, GYangCZ, CoYangCZ, STYangCZ, STCoYangCZ, and NYangCZ.

Fig. 5-33 YangCZ Algorithm Functions

5.5.1 OYangCZ - Ordinary Yang Chizhong Method

Click [YangCZ] -> [OYangCZ].

1. Parameters: Select input feature, coordinate fields, output type, interpolation field, grid size, random variation function c-value (default 0.3), number of neighbors (default 15), accuracy validation option, and output path.
2. Output Type:

- CSV: Requires setting unknown point data.
- Raster: Does not require unknown point data (automatically generates grid).

3. Execution: Click [Confirm]. A progress bar indicates status.
4. Results: Displays model fitting curve, parameters, and cross-validation accuracy.
5. Visualization: Upon completion, you can load the interpolation result into the map view or the 3D window (for 3D data) as points or voxels.

Note: For 3D data, input the 3D CSV file. The process supports 3D visualization of results (Points/Voxels).

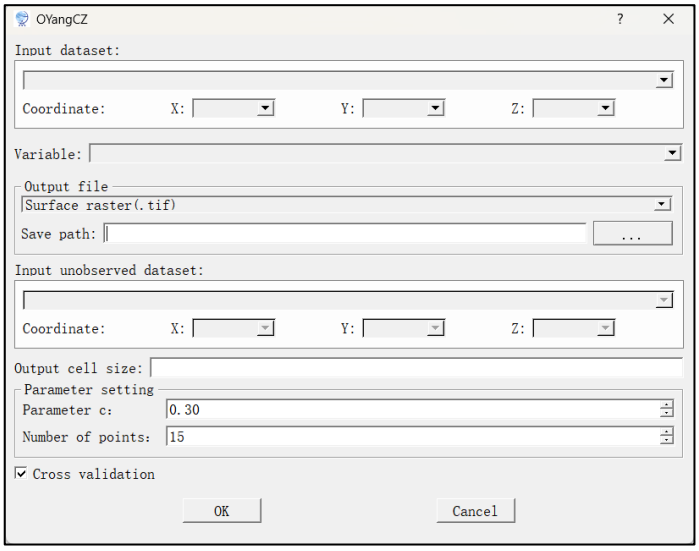


Fig. 5-34 OYangCZ Parameter Window

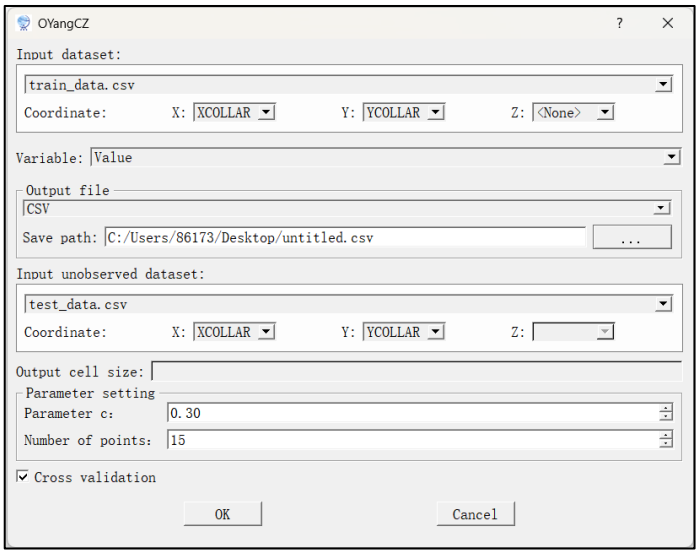


Fig. 5-35 2D Data Parameter Settings

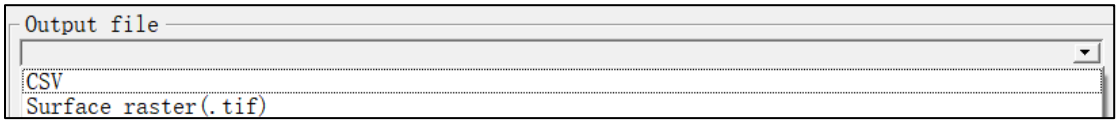


Fig. 5-36 Output Type Selection

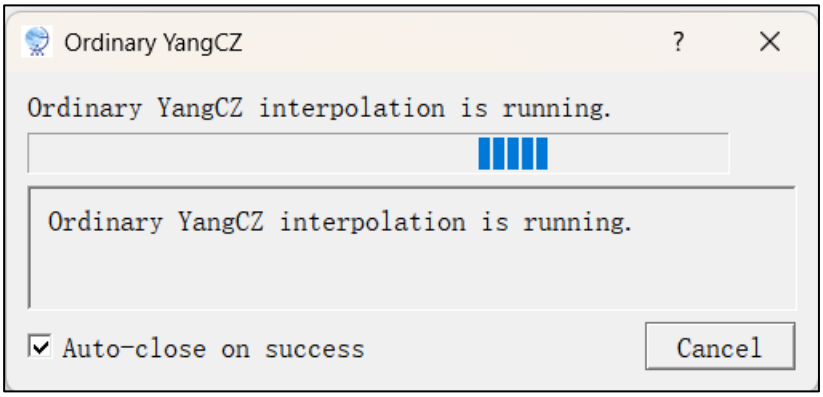


Fig. 5-37 Progress Bar

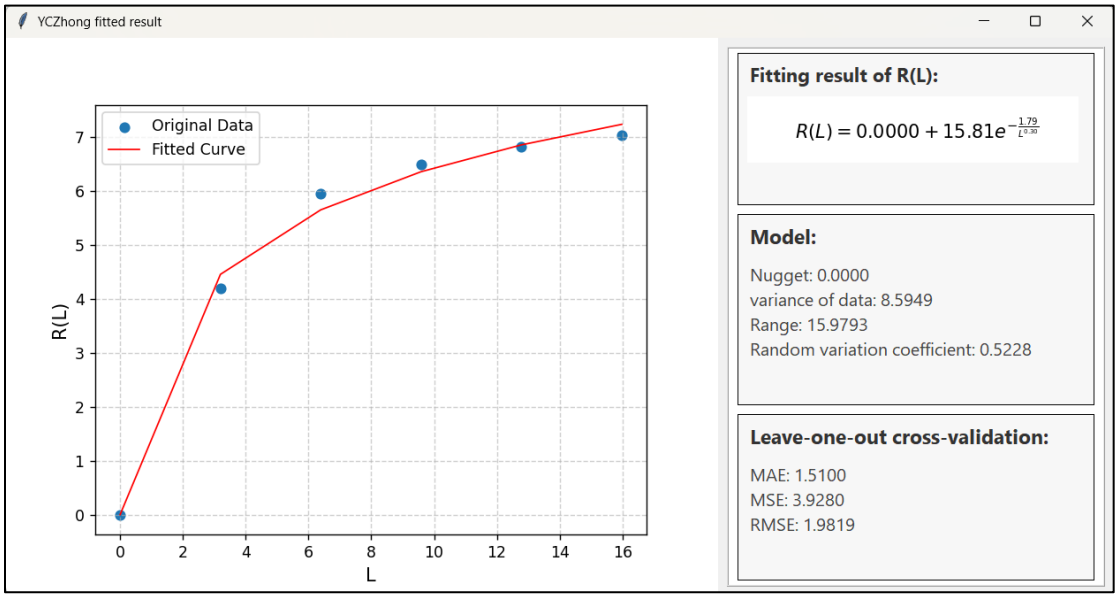


Fig. 5-38 Model Fitting Function and Cross-Validation Results

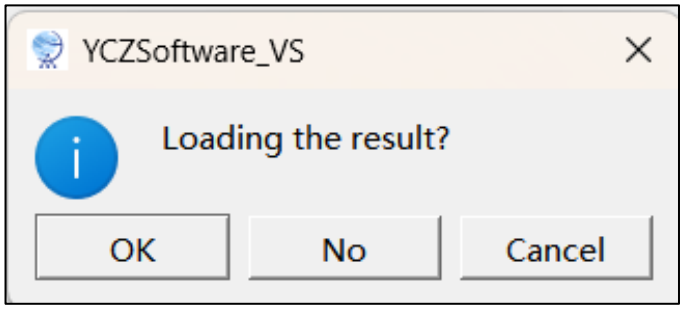


Fig. 5-39 Load Interpolation Data Prompt

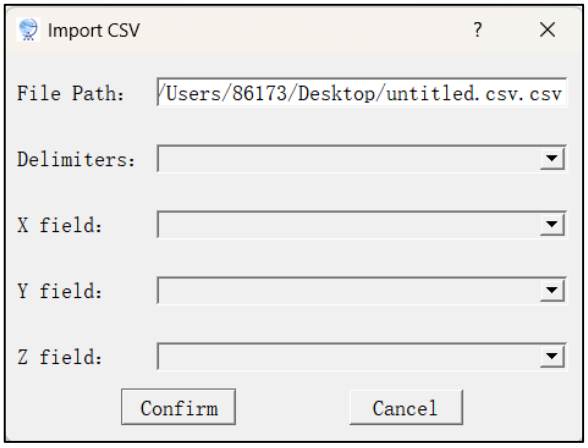


Fig. 5-40 Imported Interpolated Data

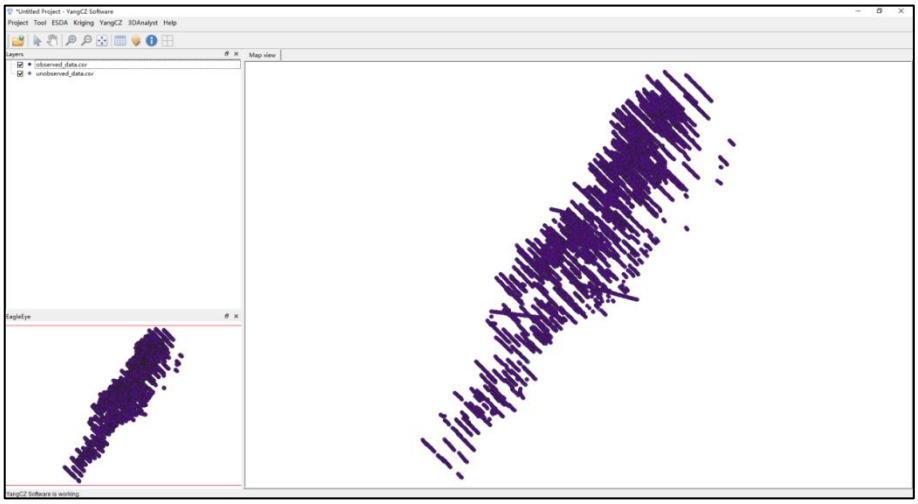


Fig. 5-41 Import 3D Data

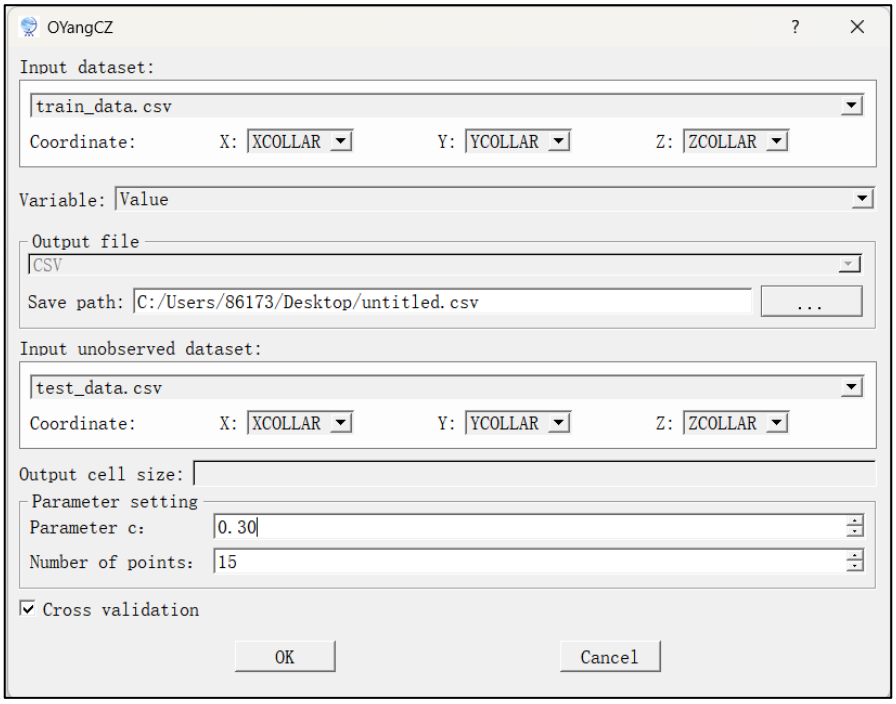


Fig. 5-42 OYangCZ Parameter Settings for 3D Data

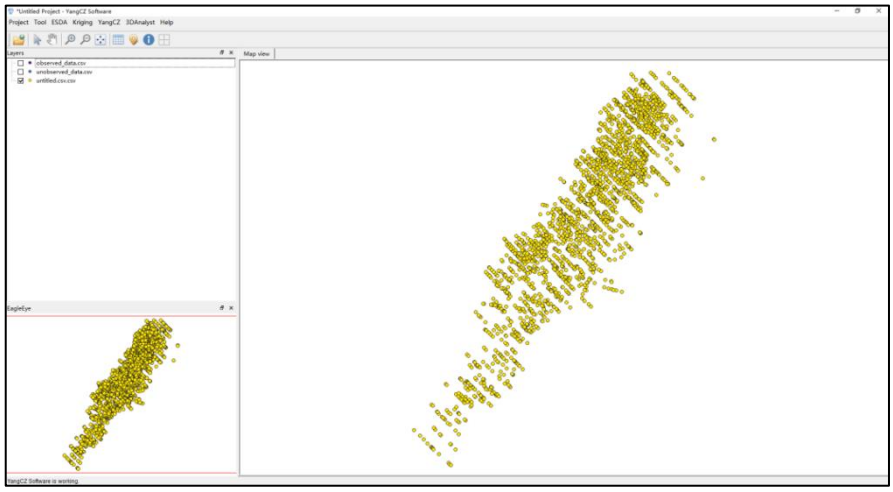


Fig. 5-43 3D Data Interpolation Results

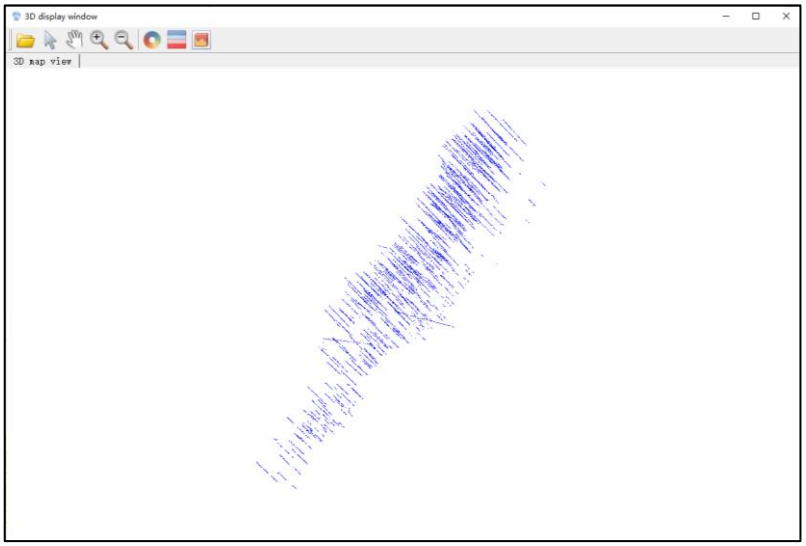


Fig. 5-44 3D Visualization of Point Data

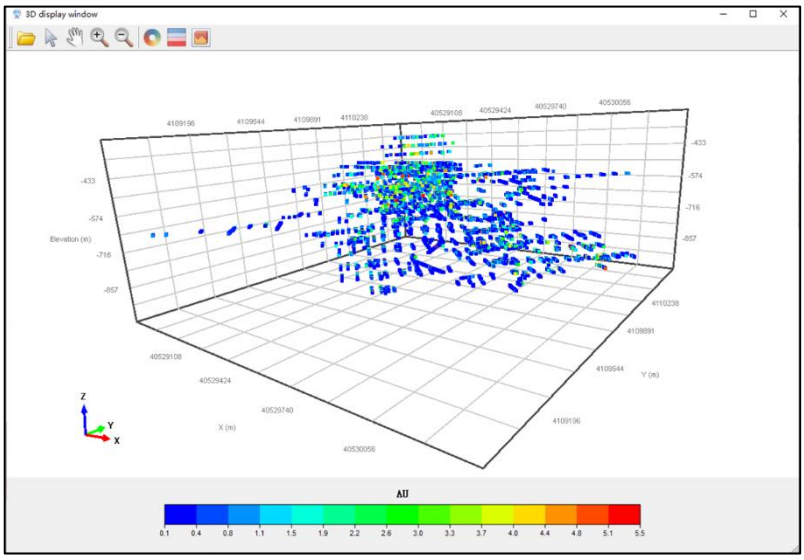


Fig. 5-45 Voxel Visualization

5.5.2 GYangCZ - Generalized Yang Chizhong Method

Click [YangCZ] -> [GYangCZ].

Parameters are similar to OYangCZ but include a Label Field and Number of Neighbors for R-function construction. Output options depend on the presence of unknown point data.

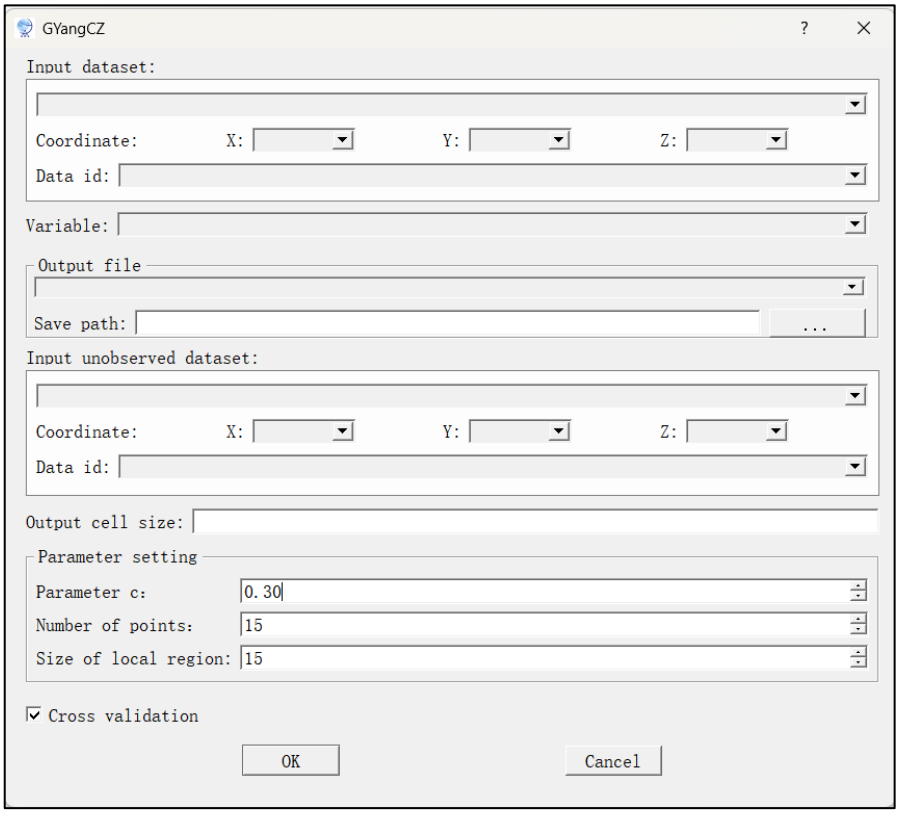


Fig. 5-46 GYangCZ Parameter Settings

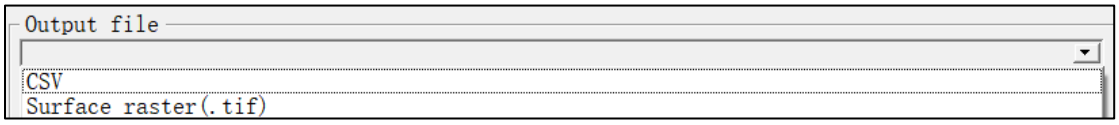


Fig. 5-47 Output Type Selection

5.5.3 CoYangCZ - Co-Yang Chizhong Method

Click [YangCZ] -> [CoYangCZ].

Requires selecting Auxiliary Variables (Co-variables) in addition to the primary variable. Set c-values for both primary and secondary variables.

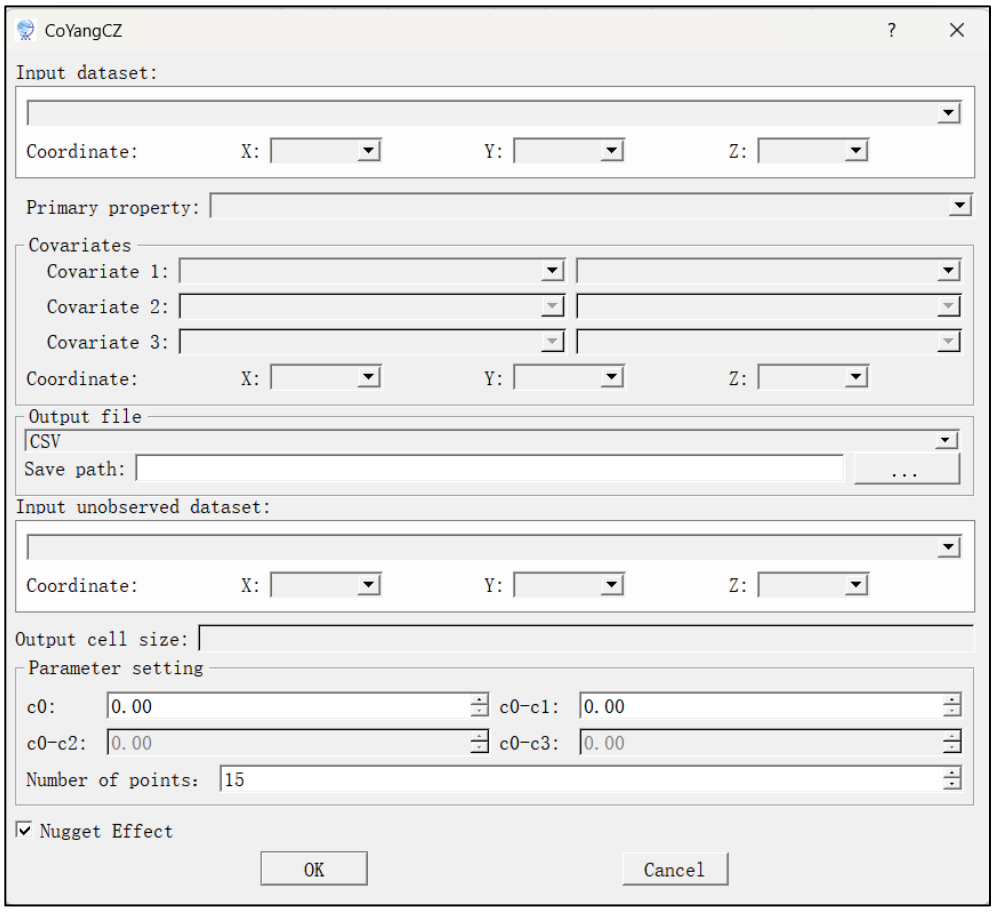


Fig. 5-48 CoYangCZ Parameter Settings

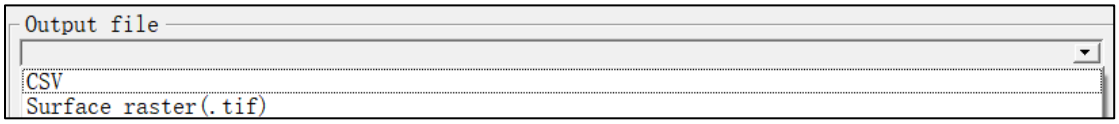


Fig. 5-49 Output Type Selection

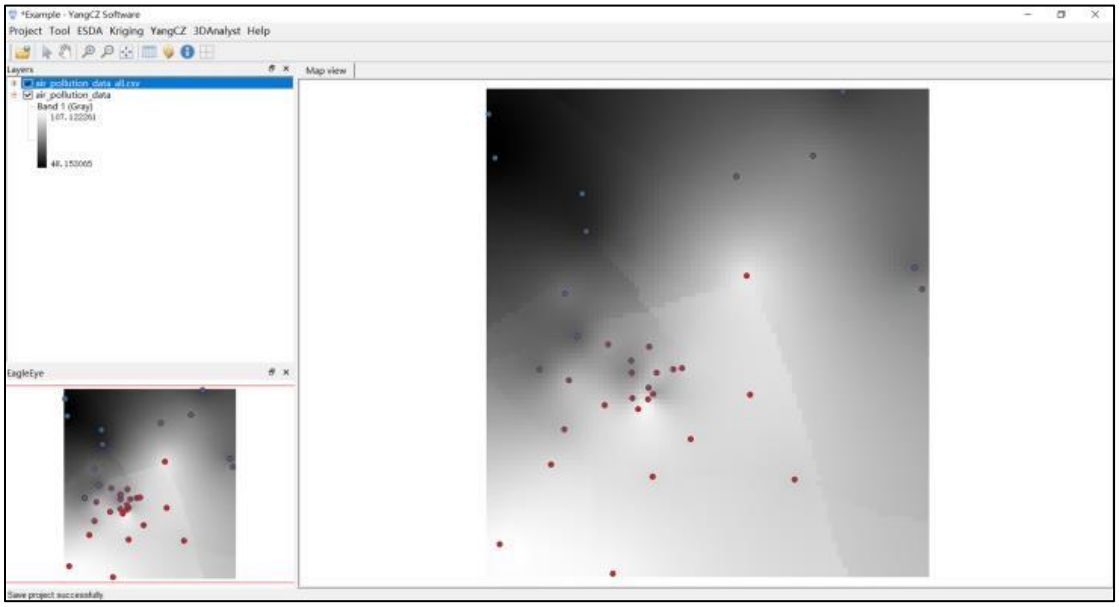


Fig. 5-50 Interpolation Result Visualization

5.5.4 STYangCZ - Spatiotemporal YangCZ Method

Click [YangCZ] -> [STYangCZ].

Requires inputting spatiotemporal datasets.

- Parameters: Start Time, End Time, Spatial c-value, Temporal c-value, Spatial neighbors, Temporal neighbors.
- Visualization: Results can be visualized in the 3D window, treating time as the third dimension (Fig. 5-65).

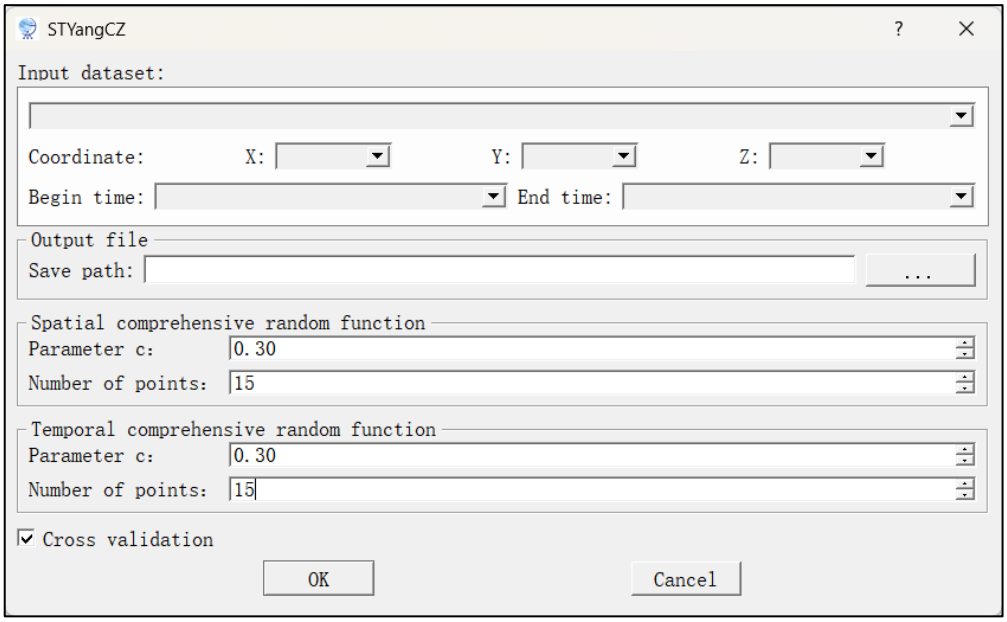


Fig. 5-51 STYangCZ Parameter Settings

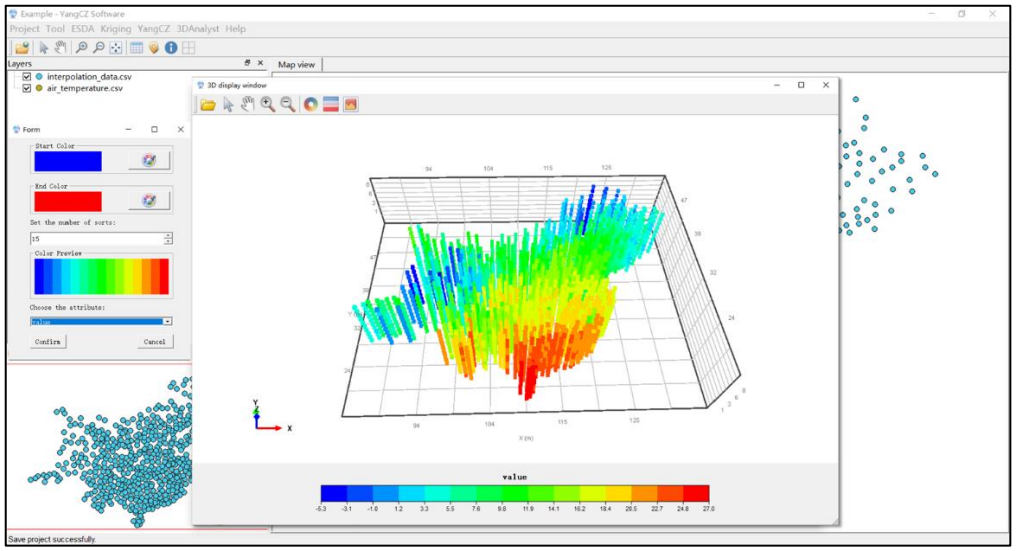


Fig. 5-52 3D Visualization of STYangCZ Interpolation Results

5.5.5 STCoYangCZ (To Be Developed)

Spatiotemporal Co-YangCZ method.

5.5.6 NYangCZ (To Be Developed)

Non-linear YangCZ method.

5.6 3D Analyst - 3D Window Module

Click [3D Analyst] -> [Open 3D Window].

5.6.1 Visualization and Rendering

1. Import Data: Click the [Import Layer] button in the 3D window. Select the target data.
2. Layer Rendering: Click the [Rendering] button. Choose HSV or RGB colors to change layer color.
3. Graduated Rendering: Click the [Graduated Rendering] button. Set High/Low colors, number of classes, and attribute field.
4. 3D Visualization: Click the [3D Viz] button. Choose display type (Points or Voxels) and set unit size.

Fig. 5-53 3D Interface Window

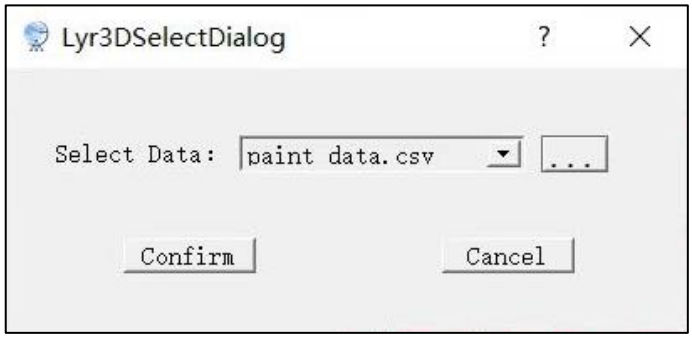


Fig. 5-54 Import 3D Data Button

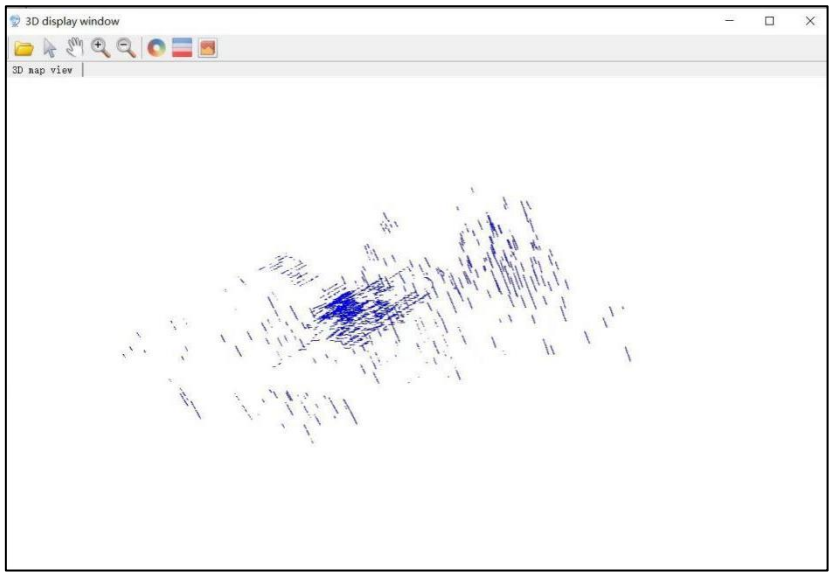


Fig. 5-55 3D Data Visualization Example (Blue; Point Type)

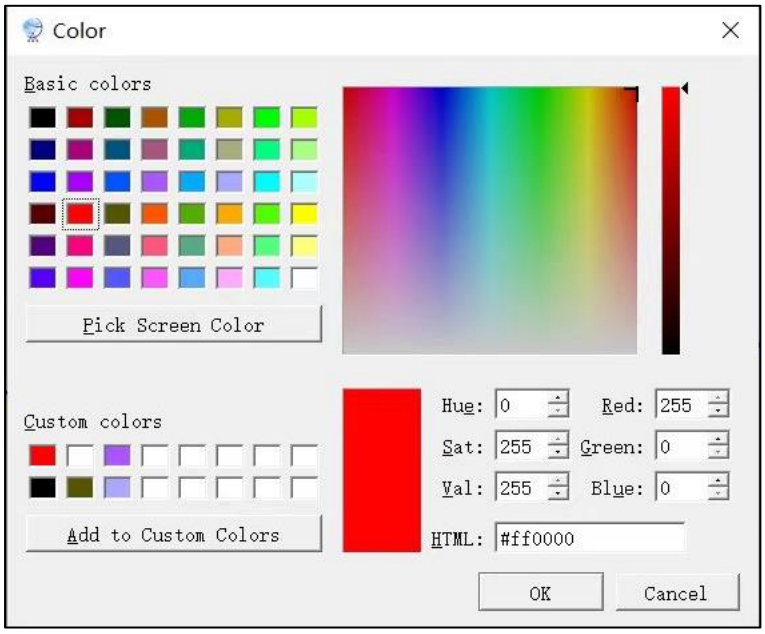


Fig. 5-56 Rendering Settings Window

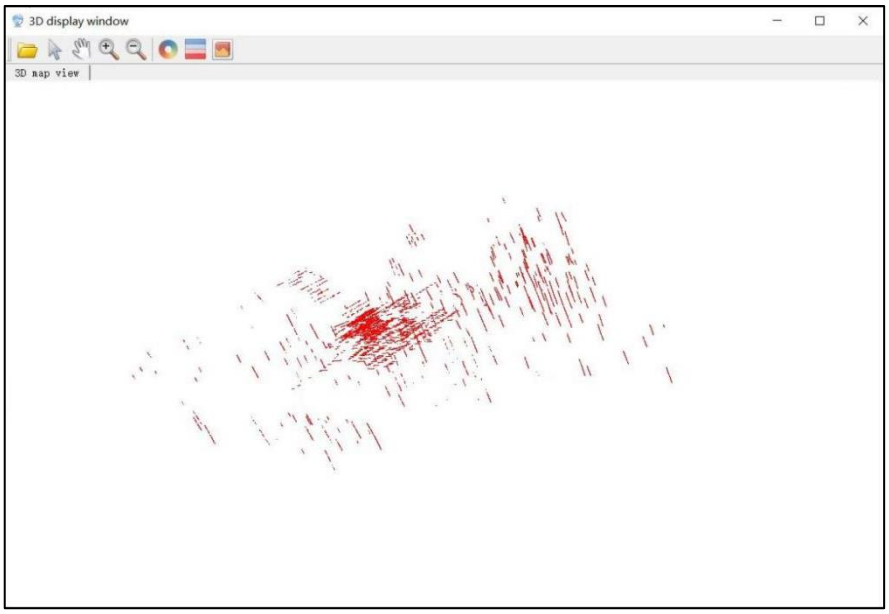


Fig. 5-57 Rendering Effect Example

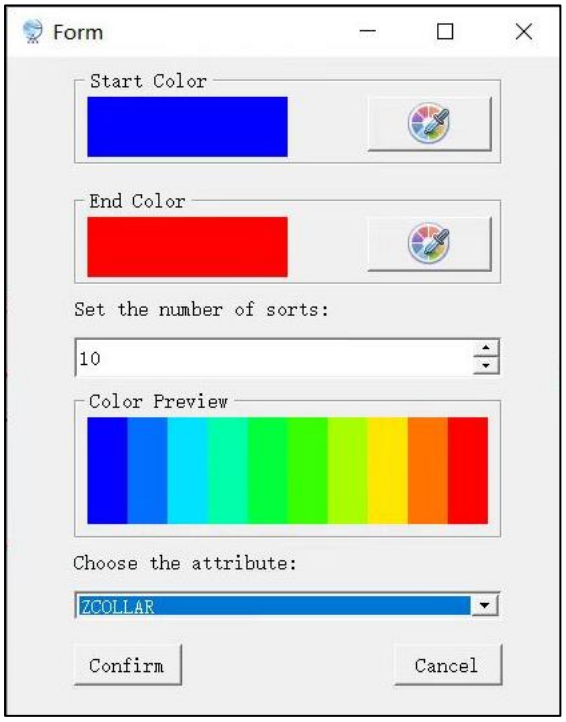


Fig. 5-58 Graduated Rendering Settings Window

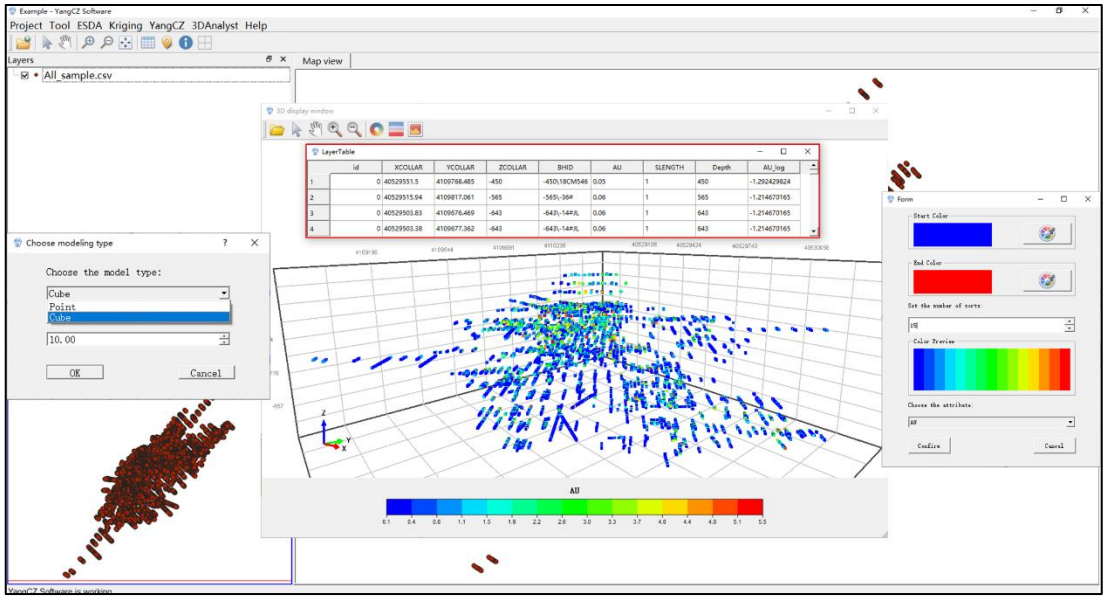


Fig. 5-59 Graduated Rendering Effect

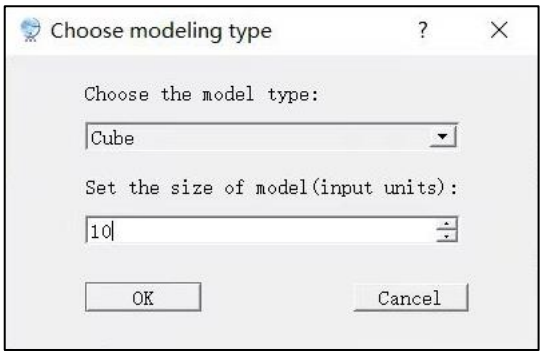


Fig. 5-60 Visualization Type Settings Window

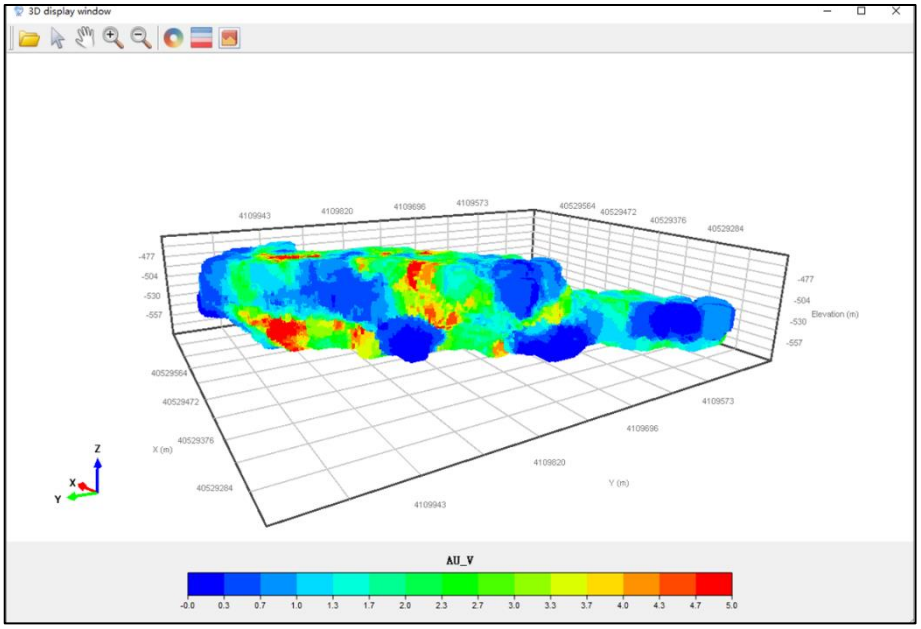


Fig. 5-61 Voxel Visualization Effect Example

6 Contact and Support

If you encounter any issues or need technical support, please contact us:

- Online Support: Visit our GitHub repository (Issues page) to submit requests or view FAQs.
- Email: qiliang.liu@csu.edu.cn
- Required Info: When contacting, please provide:

➢ Software Version

➢ Operating System

➢ Steps to reproduce the issue

➢ Error messages or screenshots

7 Version History

v1.0 - Released on 2025-12-30. Initial Release.

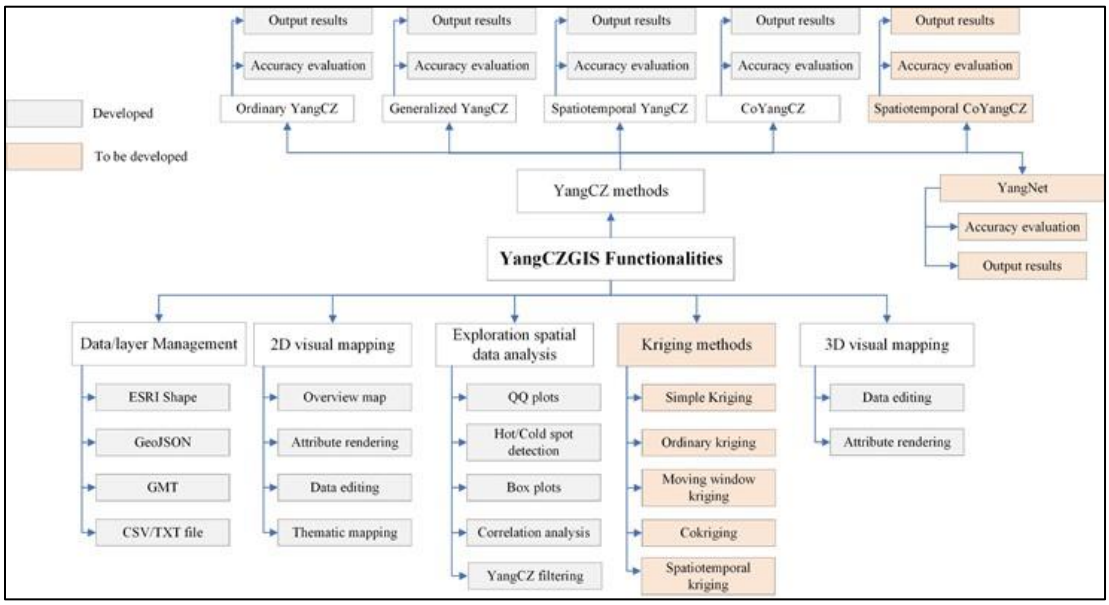


Fig. 7-1 YangCZGIS Beta Version Development Status

8 Terms and License

- **Scope:** This software is provided by the development team for personal or organizational use under the MIT License.
- **Intellectual Property:** All intellectual property rights belong to the development team.
- **Disclaimer:** Users assume all risks associated with the use of this software. The development team is not liable for any direct or indirect losses.

9 Other Resources

- **Source Code**: Available on GitHub: Geostatistics-CSU/YangCZGIS: YangCZGIS: a software of Yang Chizhong filtering and interpolation methods for geospatial data
- **Academic Paper:** Please refer to the related publication for theoretical details: Yang, J., Liu, Q., et al. (2025). YangCZGIS: a software of Yang Chizhong filtering and interpolation methods for geospatial data.