# CarbonVCA

## Instructions for use

June 2022

HPSCIL
https://www.urbancomp.net/

# Catalog

# 1.Product introduction

## 1.1Product introduction

CarbonVCA V1.0.0 (Urban Micro-scale Carbon Emission Accounting and Prediction System Based on Real Land Parcels)Based on vector cellular automata model, clustering algorithm and random forest model, a bottom-up parcel-scale carbon emission accounting and prediction framework is proposed by combining driving factor data, carbon emission inventory data, land use data and other multi-source data; The future carbon emission change simulation can be effectively realized from the cadastral plot scale, the coupling problem of land use modeling and carbon emission assessment is solved, and the spatial resolution of carbon emission change simulation is further improved.At the same time, urban land use planning policies and emission reduction policies will be included in the assessment of urban carbon emissions, providing policy recommendations and references for the construction of low-carbon cities.

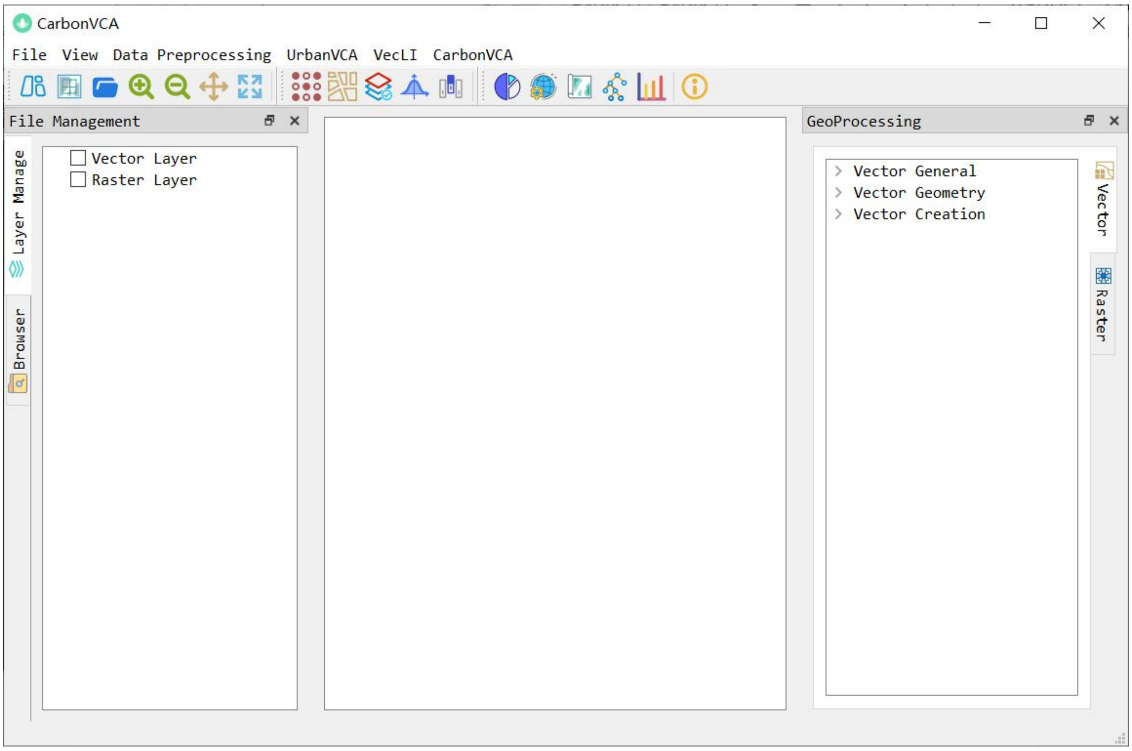
## 1.2Use objects

Urban planning related practitioners and scientific researchers.

## 1.3Installation method

**Decompress the software package, open the decompressed folder, click the setup. Exe, and follow the wizard to complete the installation. Click the CarbonVCA. Exe or shortcut to use the software.**

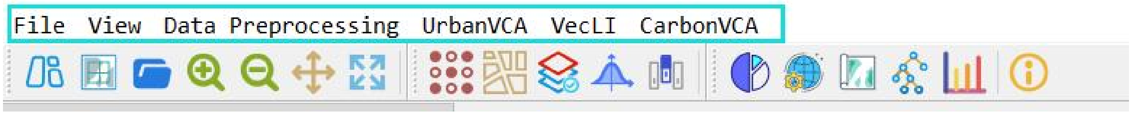
## 1.4Interface display effect



# 1.5Software control description

## 1.5.1 Menu bar

The menu bar contains the following 6 sections: “File”, “View”, “Data Preprocessing”, “UrbanVCA”, “VecLI”, “CarbonVCA”。

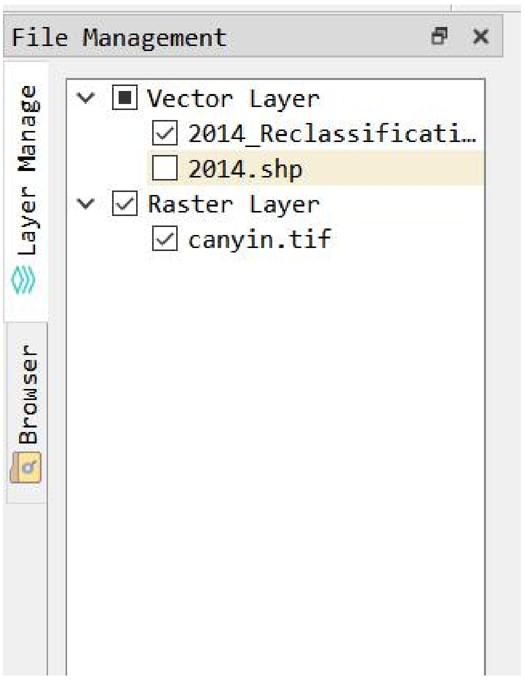



## 1.5.2 Toolbar

The toolbar contains the following functions: “Open Vector File”、“Open Raster File”、“Open Work Folder”、“Zoom In”、“Zoom Out”、“Pan”、“Full Extent”、“Category Relation”、“DLPS Split”、“ParcelMatch”、“Raster Normalization”、“Raster Resample”、“Calculating Pg”、“UrbanVCA”、“VecLI”、“Model Training”、“CarbonEmission”、“AboutUs”。

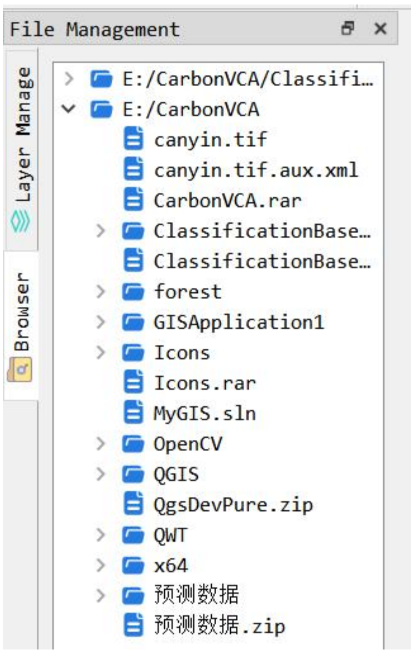

## 1.5.3 Data directory module

This area is used to display the opened data and perform some of the basic functions of GIS. The "Layer Manage" section contains two parts, "Vector Data" and "Grid Data", which are used to display the data that has been imported into the system.

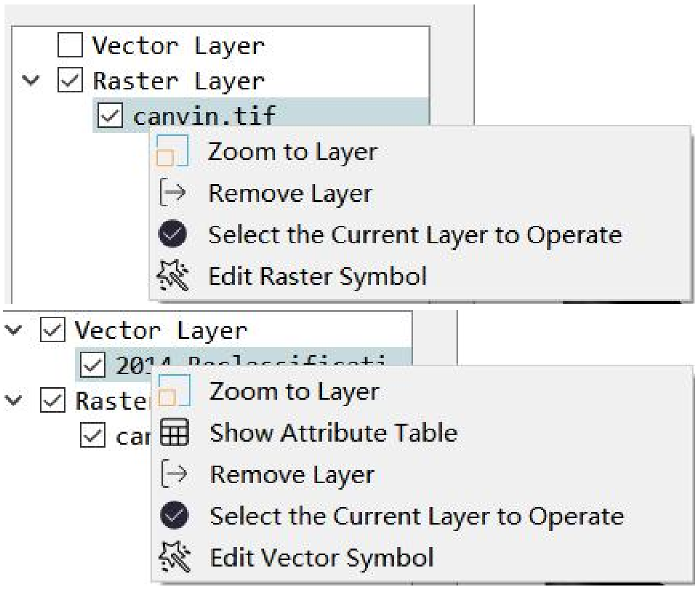



The "Browser" on the left side is used to display the folders opened by the user.

CarbonVCA




Right click the layer to open the menu, and the menu functions are as shown in the figure:




"Zoom to Layer" refers to zooming to the current layer, and the full image of the image can be displayed in the central visualization area; "Remove Layer" refers to removing the layer; "Select the Current Layer to Operate" refers to the layer set as the current operation;

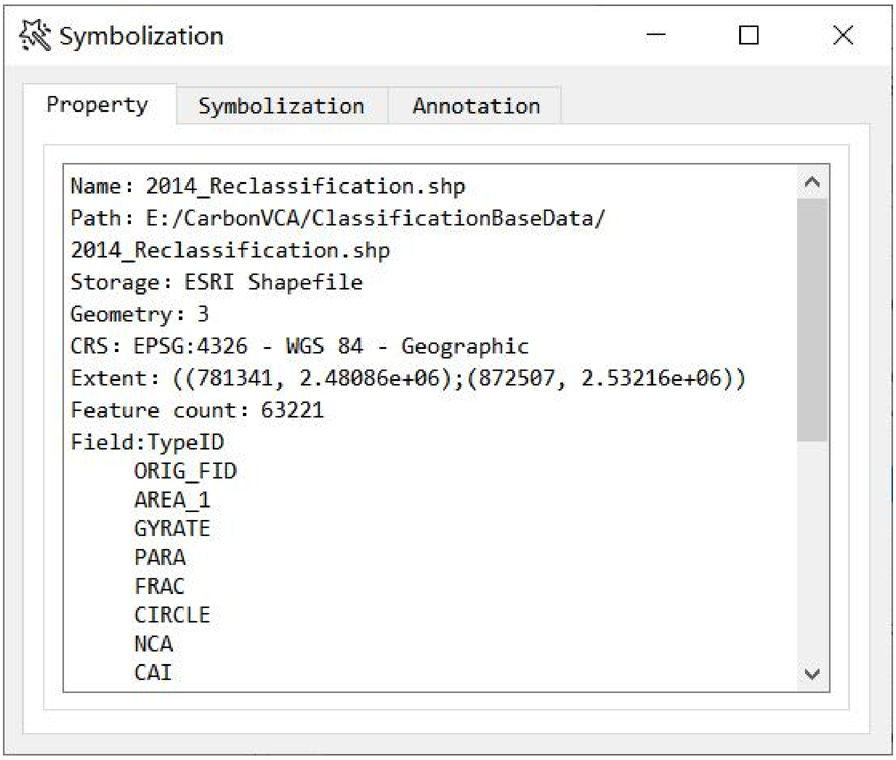
"Show Attribute Table" is used to display the attribute table of vector graphics, as shown in the following figure:

| | TypeID | ORIG_FID | AREA_1 | GYRATE | PARA | FRAC | CIRCLE | NCA | CAI | ECON | ENN | SIMI | PROX | SHDI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 1 | 2.379 | 43.849 | 0.024 | 1.013 | 0.339 | 1.000 | 76.726 | 0.000 | 1097.950 | 0.000 | 548.578 | 5.615 |
| 2 | 0 | 1 | 1.720 | 119.570 | 0.111 | 1.290 | 0.957 | 3.000 | 7.994 | 97.879 | 1097.950 | 0.000 | -2147483.648 | 79.86 |
| 3 | 0 | 1 | 0.882 | 26.857 | 0.040 | 1.016 | 0.404 | 1.000 | 63.026 | 0.000 | -2147483.648 | 0.000 | 0.000 | 0.000 |
| 4 | 0 | 1 | 7.880 | 79.767 | 0.013 | 1.005 | 0.184 | 1.000 | 87.374 | 0.000 | 1219.870 | 0.000 | 0.000 | 0.000 |
| 5 | 0 | 1 | 0.059 | 8.185 | 0.178 | 1.065 | 0.574 | 0.000 | 0.000 | 0.000 | 17.217 | 6.160 | 6.422 | 3.970 |
| 6 | 0 | 1 | 0.181 | 15.435 | 0.128 | 1.116 | 0.781 | 2.000 | 4.261 | 0.000 | 17.217 | 2.146 | 2.777 | 4.733 |
| 7 | 0 | 1 | 0.077 | 9.599 | 0.188 | 1.118 | 0.747 | 0.000 | 0.000 | 0.000 | 79.398 | 0.306 | 2.153 | 6.073 |
| 8 | 0 | 1 | 0.076 | 8.417 | 0.142 | 1.032 | 0.505 | 1.000 | 6.173 | 0.000 | 821.982 | 0.000 | 0.010 | 1.638 |
| 9 | 0 | 1 | 0.892 | 58.744 | 0.161 | 1.320 | 0.947 | 1.000 | 0.001 | 74.185 | 7.983 | 1862.320 | 78757.296 | 0.863 |
| 10 | 0 | 1 | 0.432 | 22.117 | 0.090 | 1.124 | 0.636 | 1.000 | 31.032 | 67.691 | 3.019 | 374.112 | 279646.016 | 2.806 |
| 11 | 0 | 1 | 0.341 | 20.867 | 0.139 | 1.205 | 0.793 | 1.000 | 4.281 | 79.408 | 3.019 | 474.885 | 281631.008 | 1.763 |
| 12 | 0 | 1 | 0.116 | 11.346 | 0.132 | 1.070 | 0.630 | 1.000 | 4.107 | 0.000 | 11.032 | 201.403 | 318.538 | 1.226 |
| 13 | 0 | 1 | 0.251 | 19.045 | 0.100 | 1.089 | 0.743 | 1.000 | 13.276 | 0.000 | 3.883 | 209336.000 | 268251.008 | 7.374 |
| 14 | 0 | 1 | 0.082 | 9.699 | 0.166 | 1.089 | 0.644 | 0.000 | 0.000 | 0.000 | 11.032 | 30.141 | 126.156 | 1.246 |
| 15 | 0 | 1 | 11.868 | 108.241 | 0.016 | 1.085 | 0.514 | 1.000 | 86.092 | 58.795 | 7.657 | 1125.150 | 69175.400 | 0.811 |
| 16 | 0 | 1 | 0.715 | 26.201 | 0.048 | 1.032 | 0.405 | 1.000 | 56.287 | 100.000 | 14.625 | 14759.700 | 51134.500 | 4.184 |
| 17 | 0 | 1 | 0.134 | 48.660 | 0.773 | 1.577 | 0.984 | 0.000 | 0.000 | 100.000 | 1.257 | 37112.200 | 78911.000 | 0.829 |

"Edit Vector Symbol" is used to edit the vector symbol. You can view the file attribute according to the vector data, set its classification display according to the attribute field, and set its annotation display according to the attribute field. A pop-up window as shown in the following figure will pop up:

◆ Attribute

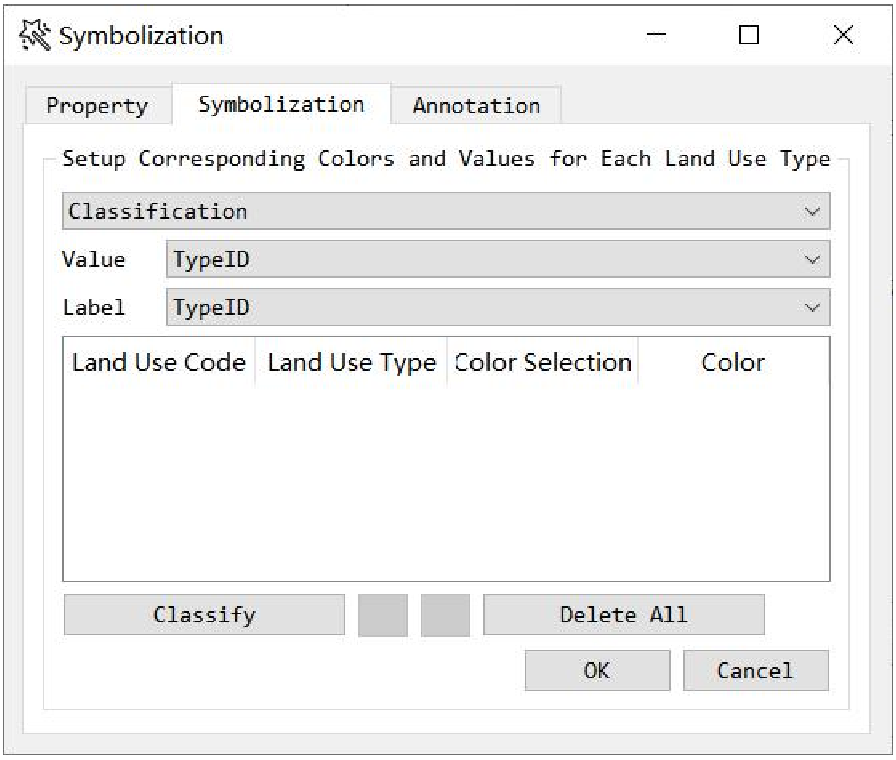
Select "Property" in the current pop-up window function option to view the property information of the current vector file.




This area displays the name, path, storage (file type), geometric information, CRS (coordinate reference system), range, feature count (number of features) and field information of the current layer for the user to consult.

◆ Symbolization

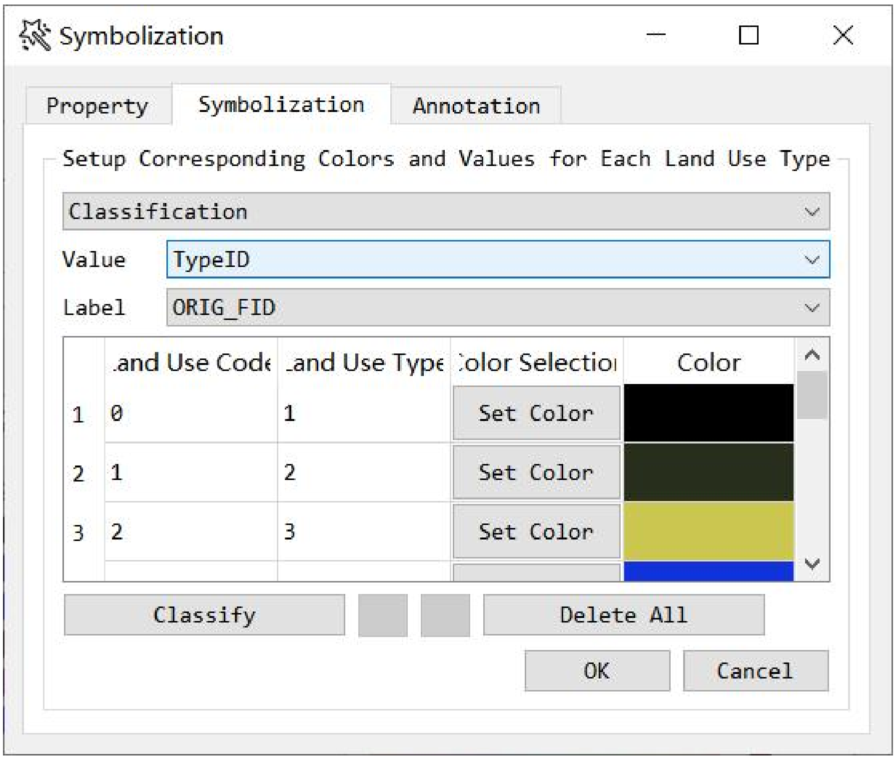
Click the "Symbolic Rendering" option in the current interface to open the interface as shown in the following figure:



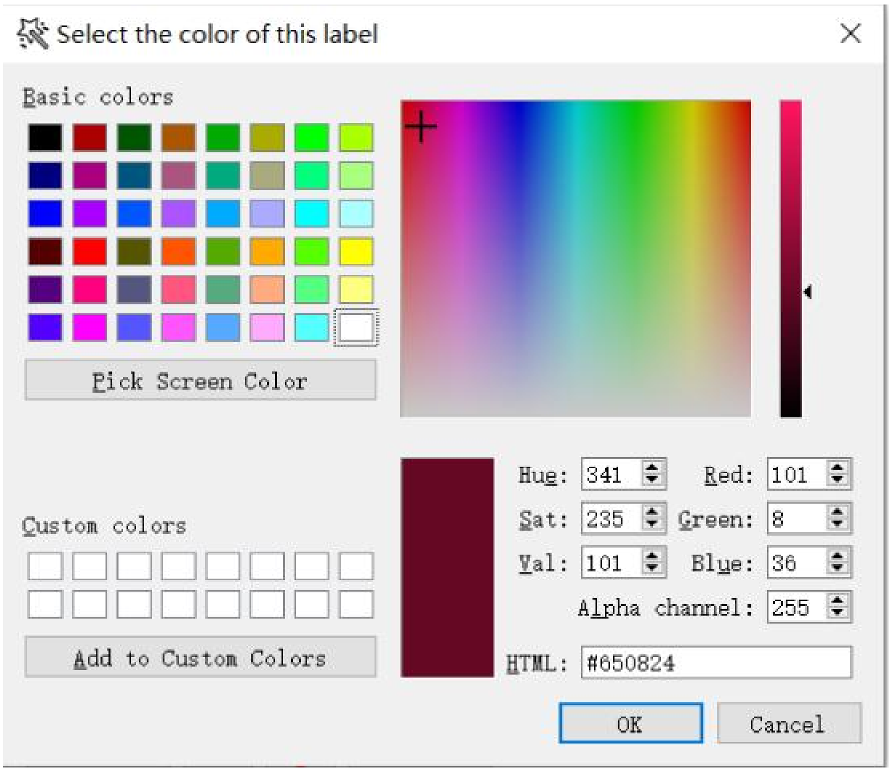

The "Classification" drop-down box can be used to select the method for symbolizing the current operation data, and the "Value" drop-down box can be used to select the field name for classifying the current layer. In addition, the "Label" drop-down box is a label field.

After adjusting the parameters, click the "Classify" button to perform classification and symbolization based on the current parameters.

As shown in the following figure:



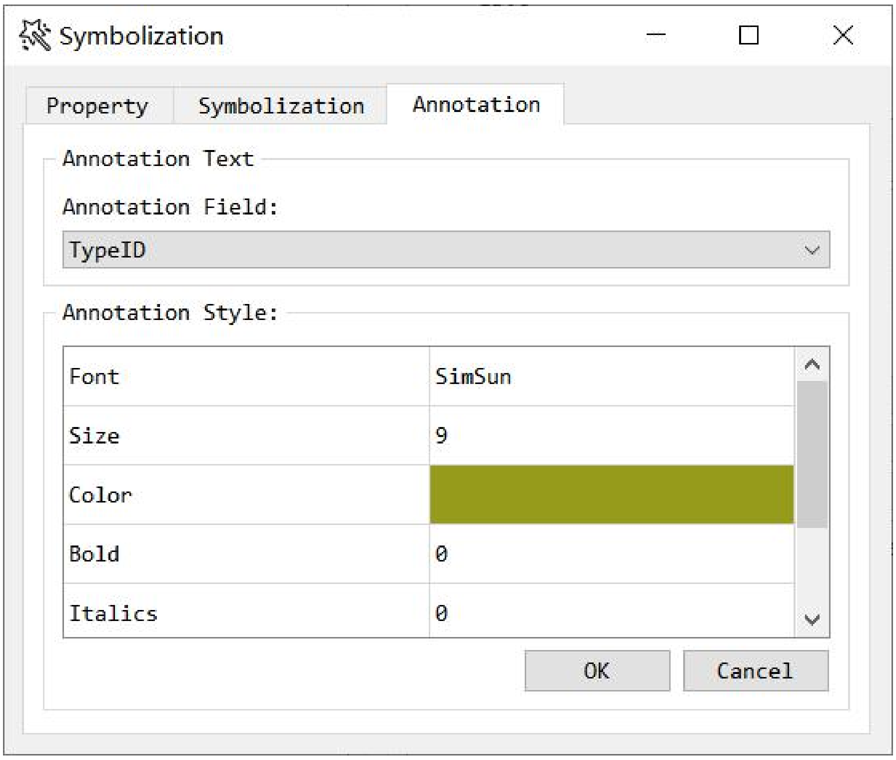

Click "Set Color" to select the color required by the user, which can be adjusted according to the RGB value.



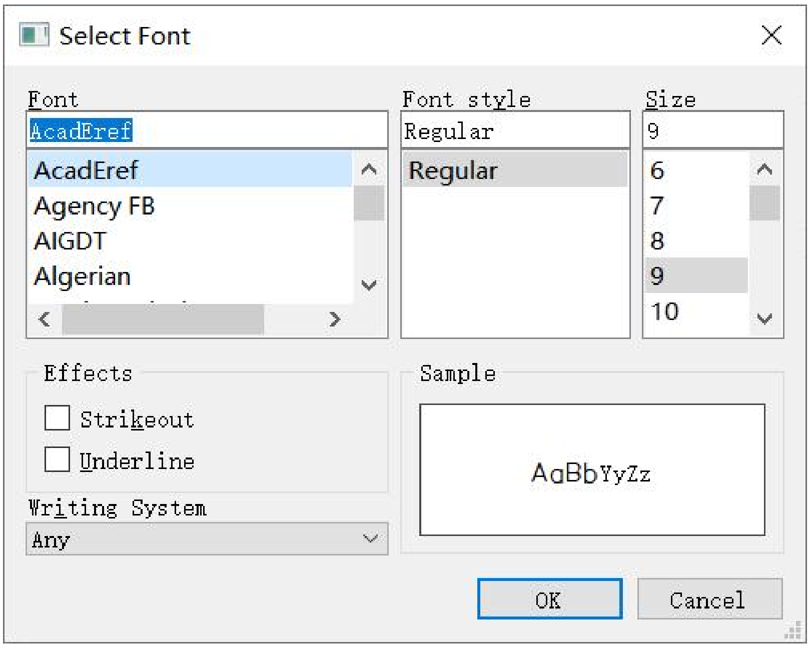

Click "Delete All" to delete all the current classification effects and automatically clear the table contents. However, if the user adjusts the classification value and label value through the drop-down box after classification, click the "Classify" button again to re-initialize and complete the setting of reclassification parameters.

- Mark

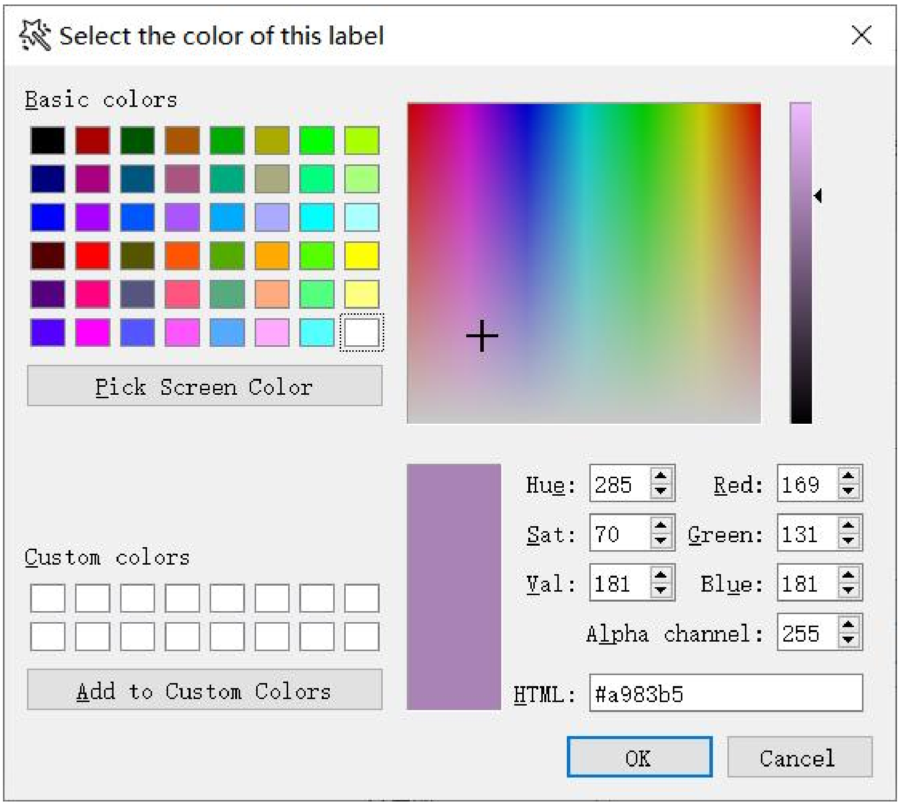
Click "Annotation" to switch to the following interface:




The Dimension Field drop-down box allows you to select a dimension field. Click the "Font", "Font Size", "Bold" or "Italic" attribute to open the interface as shown in the following figure:



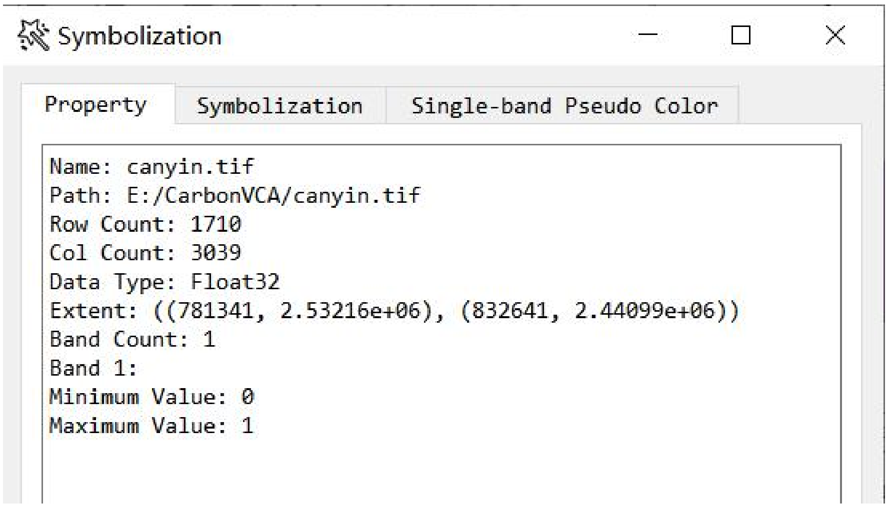

Click the "Color" attribute in the previous interface to open the interface as shown below:




Users can adjust the annotation color according to their personal needs. After adjustment, click the "OK" button to save the current color settings and return to the "Annotation" interface. Click the "OK" button in the "Annotation" interface to add a text annotation based on the current parameter to the current layer.

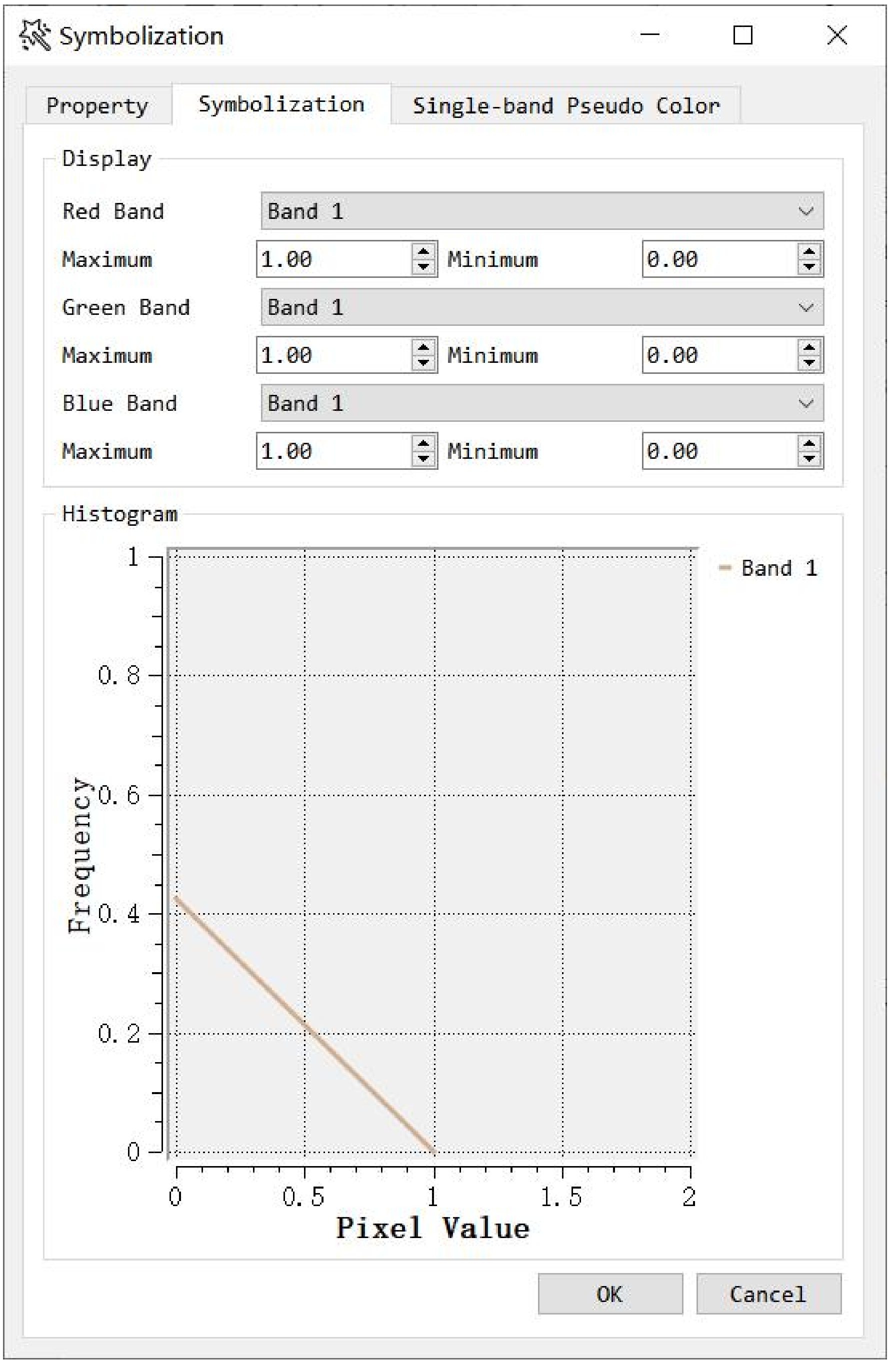
"Edit Raster Symbol" is used to edit the grid symbol. You can view the file attribute according to the grid data, display the histogram according to the band information, and render the color according to the single band attribute. A pop-up window as shown in the following figure will pop up:

◆ Attribute




This area will display the name, path, line width, column width, data type, range, number of bands and band information of the current layer for the user to consult.

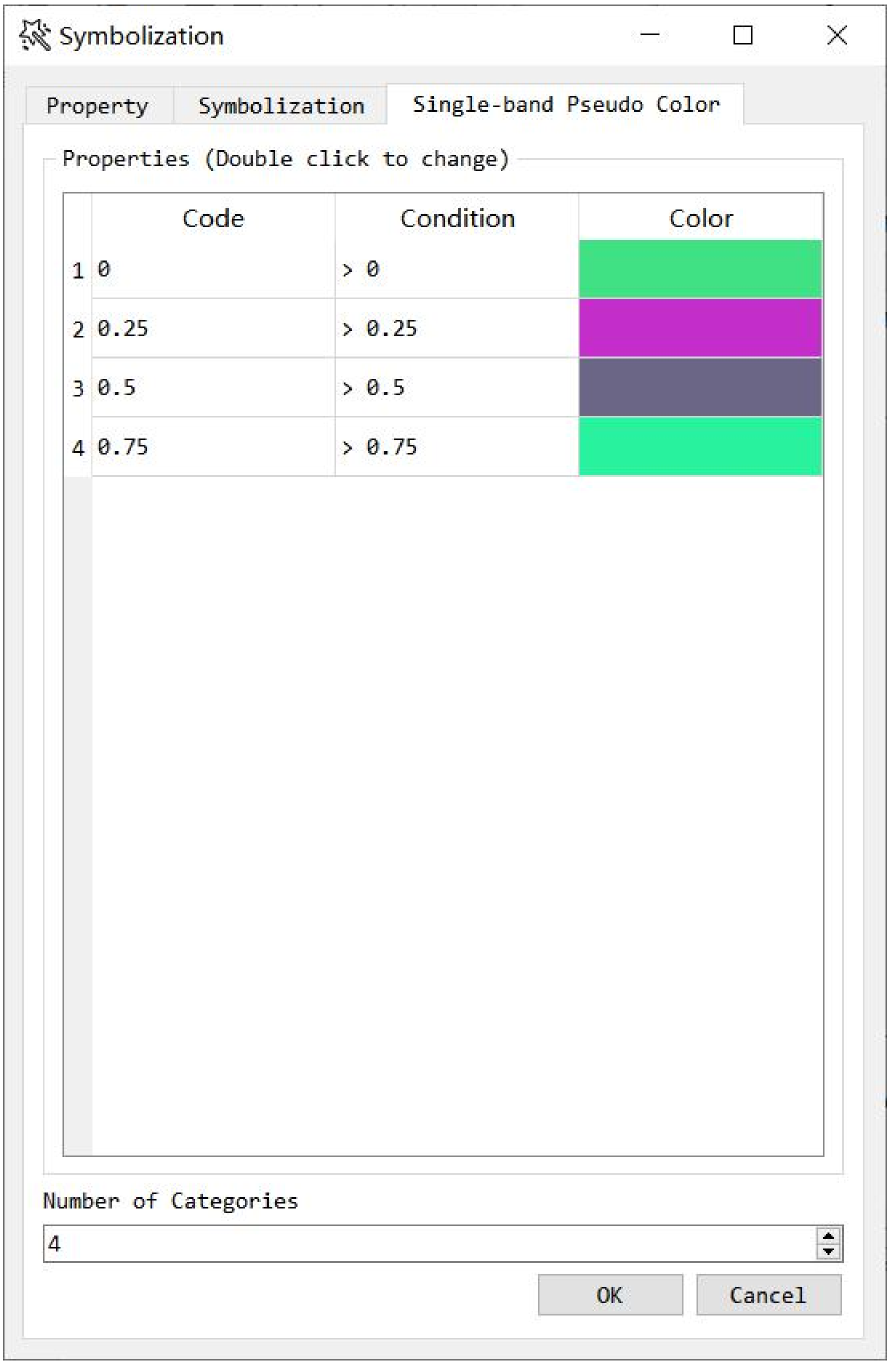
- ◆ Features




This area is used to display the characteristics of the raster graphics, including band information and histogram information. Users can click the drop-down box on the right side of "Red Band", "Green Band" and "Blue Band" to change the channel bands of RGB three primary colors.

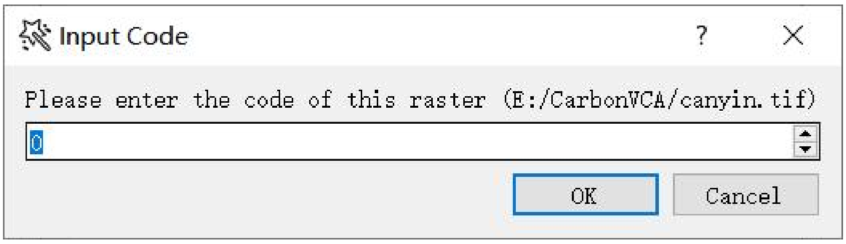
Click "OK" to change the RGB band.

- Rendering

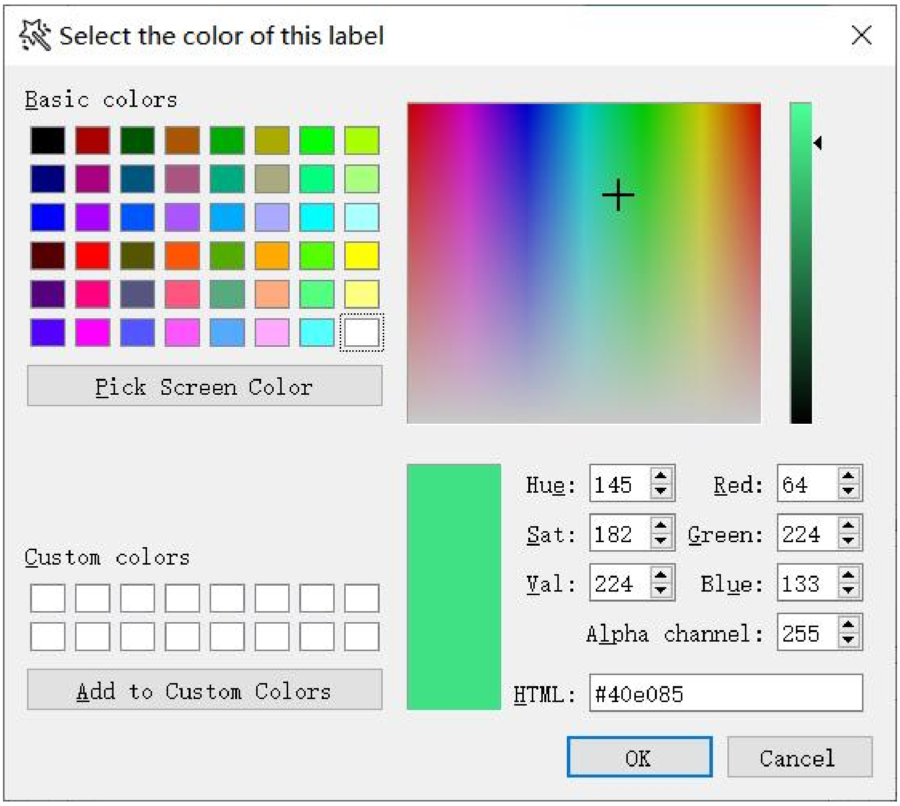



This area is used to render single-band raster data, and you can modify the number of ramp colors (also known as the number of ranges of colors) at the Number of Categories ".

Double-click Code to modify the range value. The following pop-ups will appear;



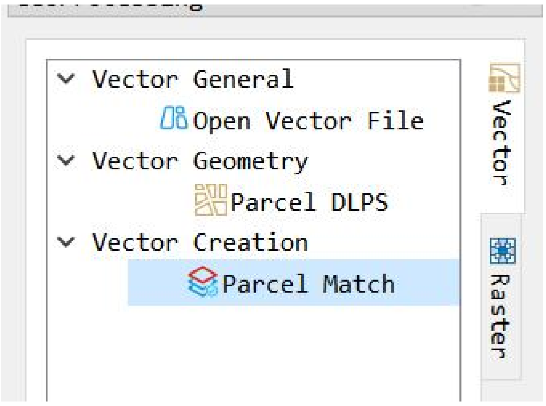

Double-click Color to modify the color of the range, and the following window appears:



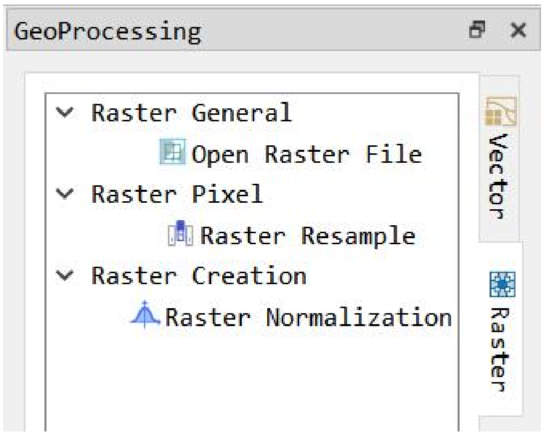

Click "OK" to change the color of the range.

### 1.5.4 Image processing tool module

This area displays tools for working with vector and raster images. The Vector section shows the following functions: Open Vector File ", Parcel DLPS", Parcel Match ".

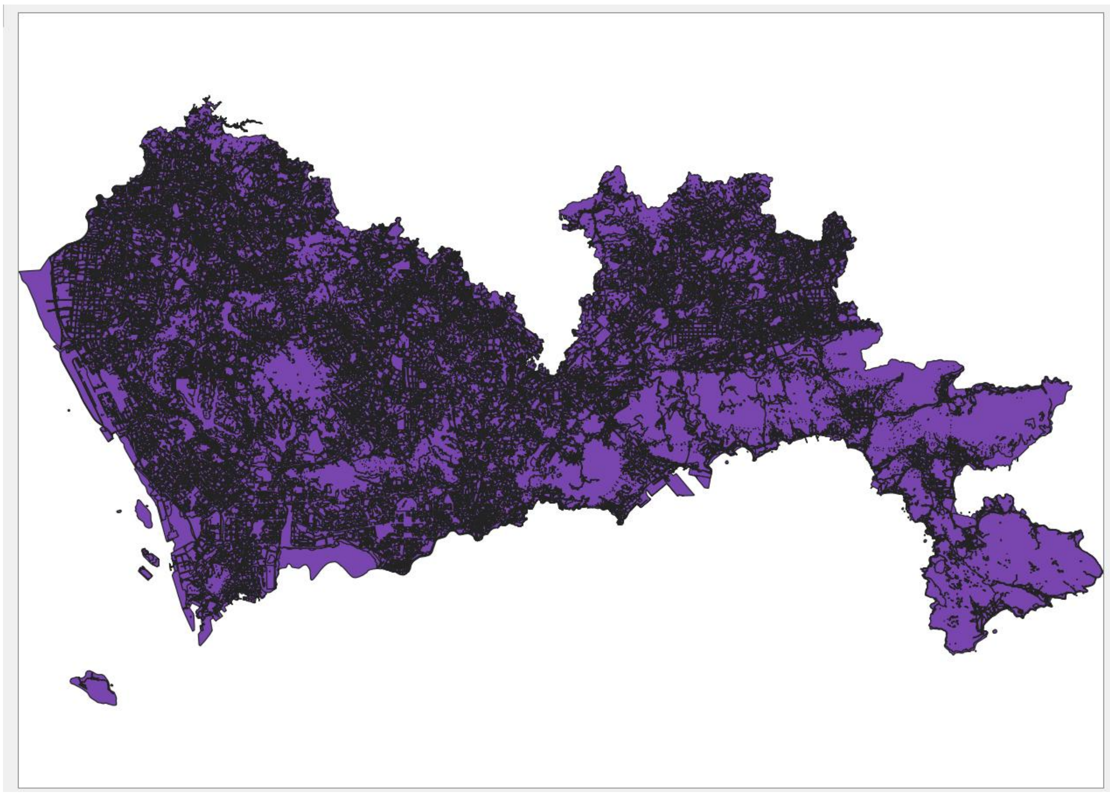


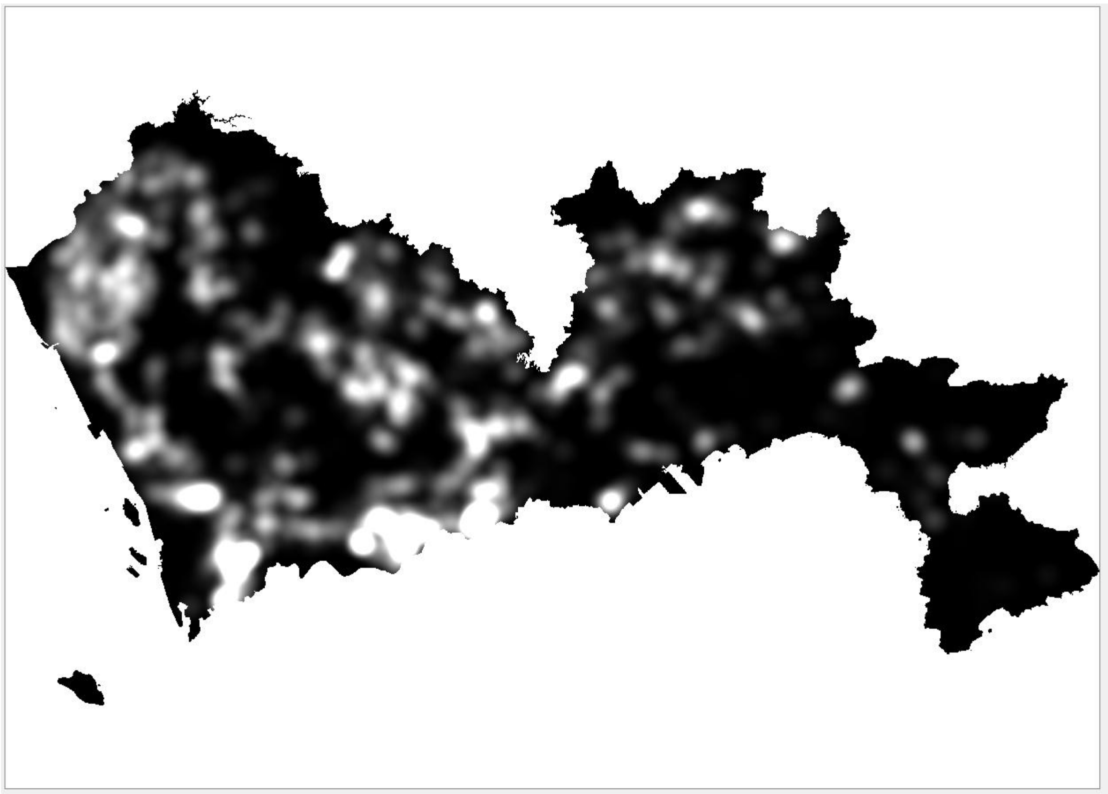

The Raster section displays the following functions: Open Raster File ", Raster Resample", and Raster Normalization ".



### 1.5.5 Data visualization area

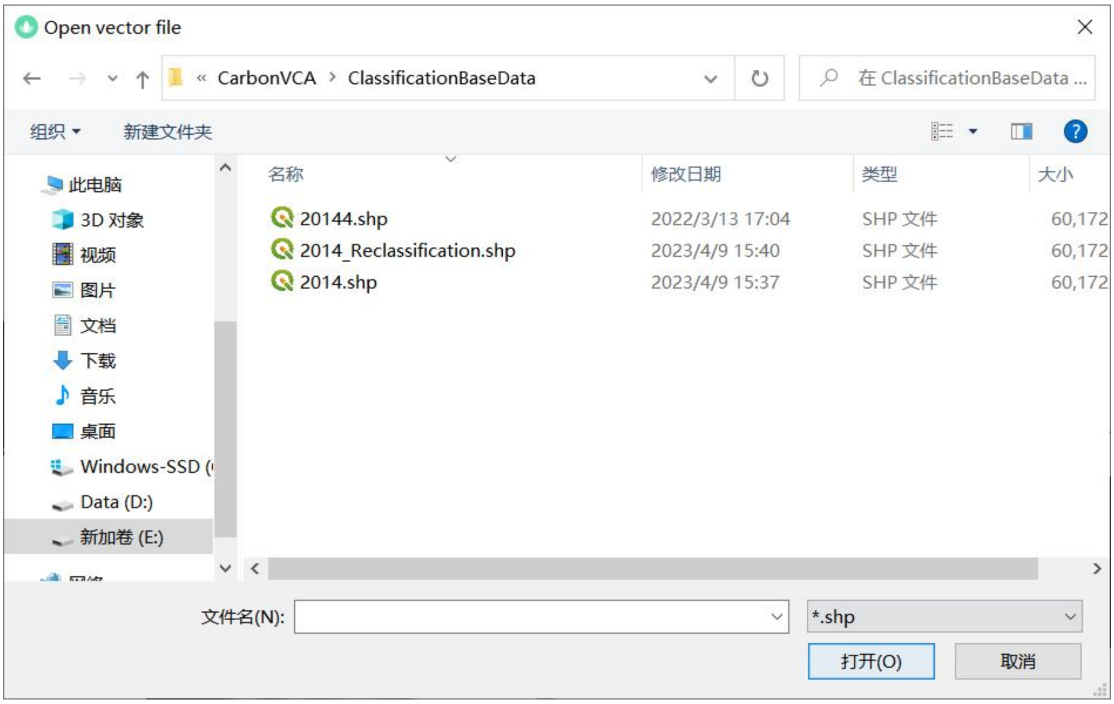
This area is used to display the vector file and grid file imported into the software, and support the data display after classification and other operations. As shown in the following figure:





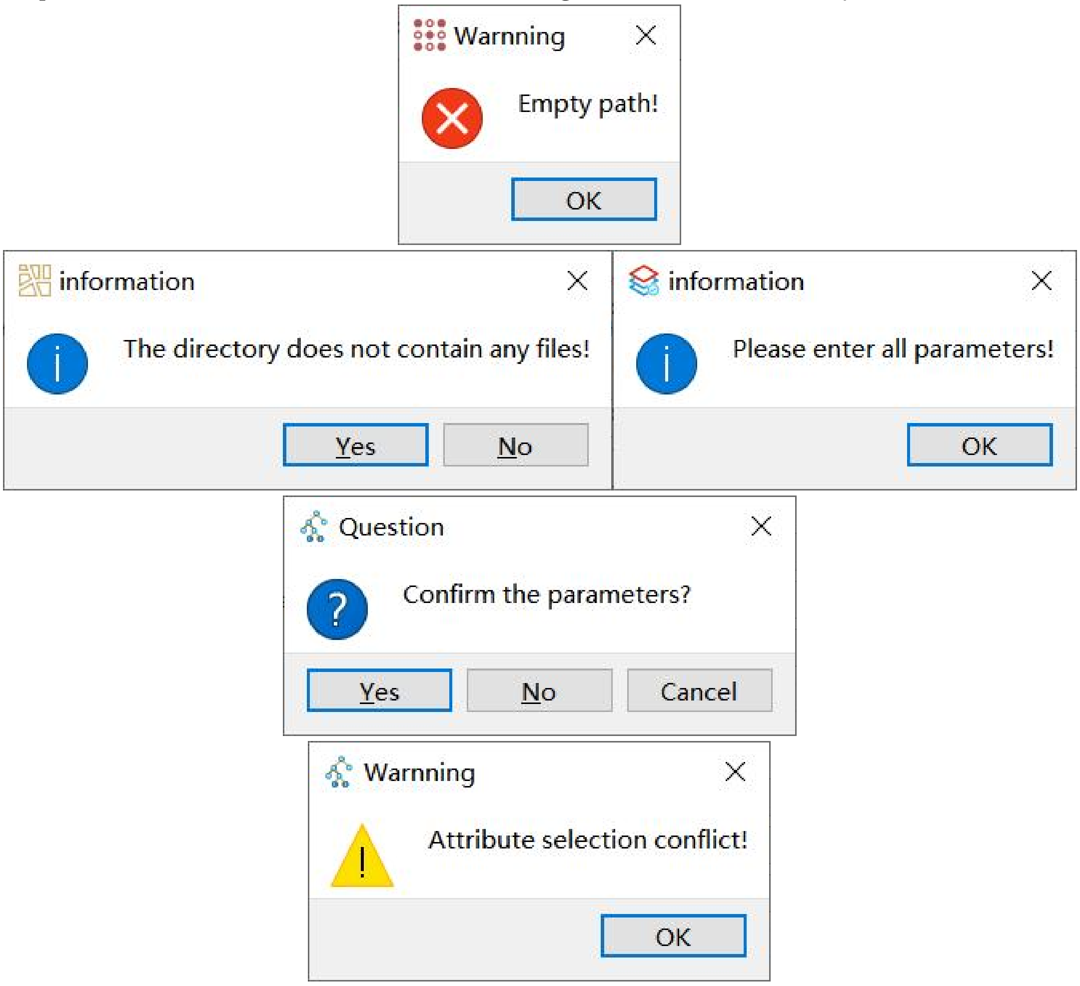
### 1.5.6 Function dialog box

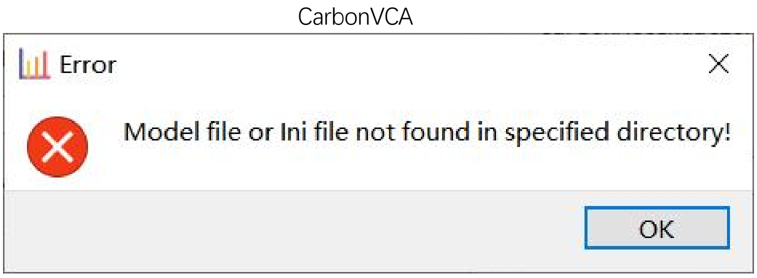
Use this dialog box to select a location to import and save files.




## 1.5.7 Exception prompt dialog box

This dialog box is used to remind the user of the current abnormal operation status and reasons during the use of the system.

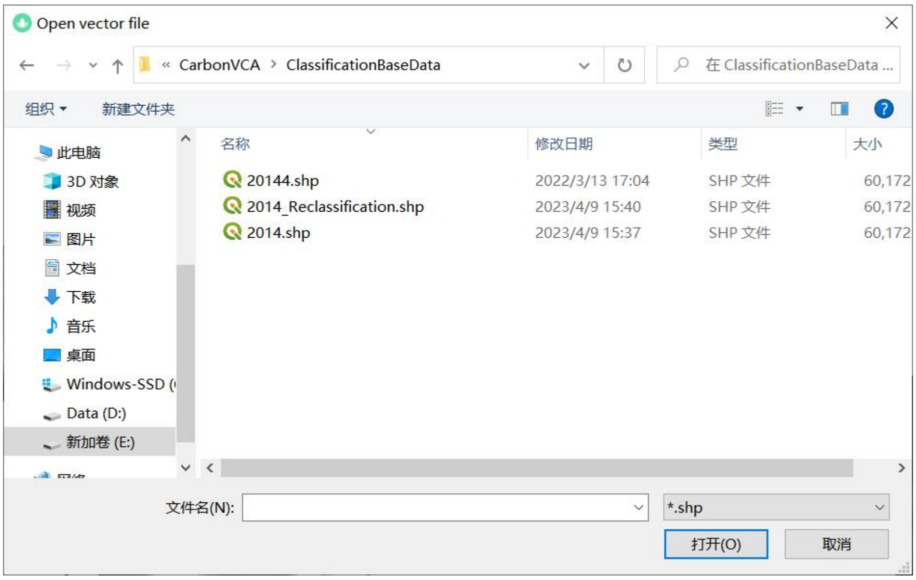





# 2. File module

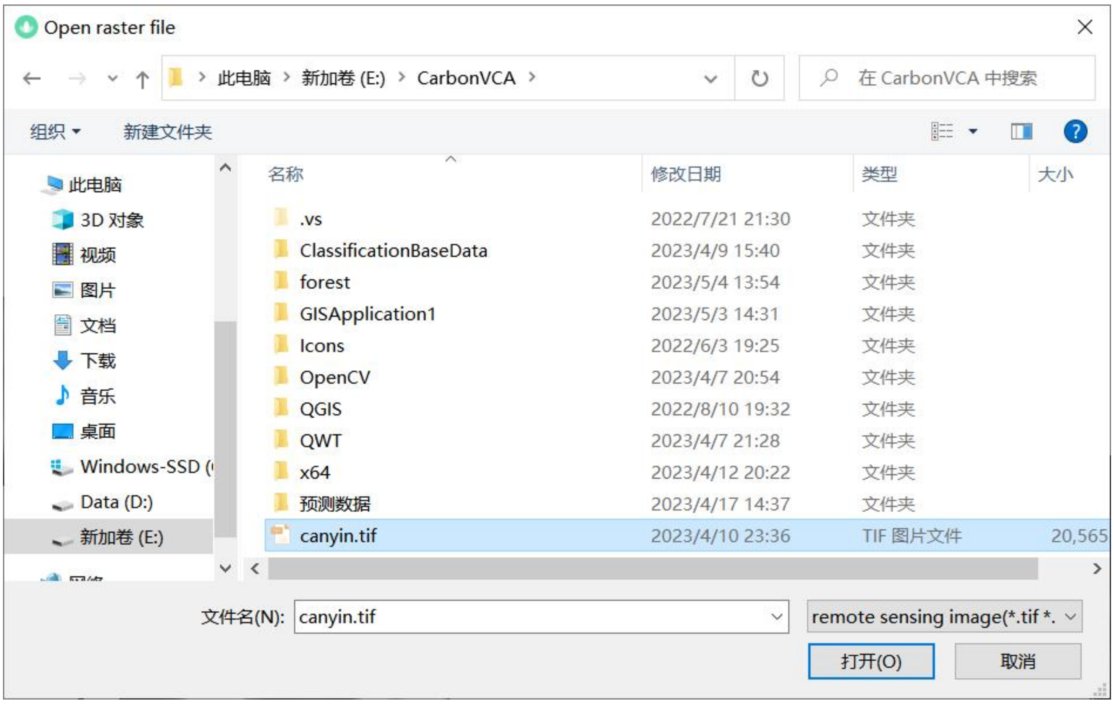
## 2.1 Open the vector file

This section is used to import vector files. Click "File/Open Vector File" in the toolbar of the initial interface of the system or click the button  to jump to the Open Vector File dialog box. By selecting the vector file to be opened, it can be imported into the system to facilitate subsequent operations.



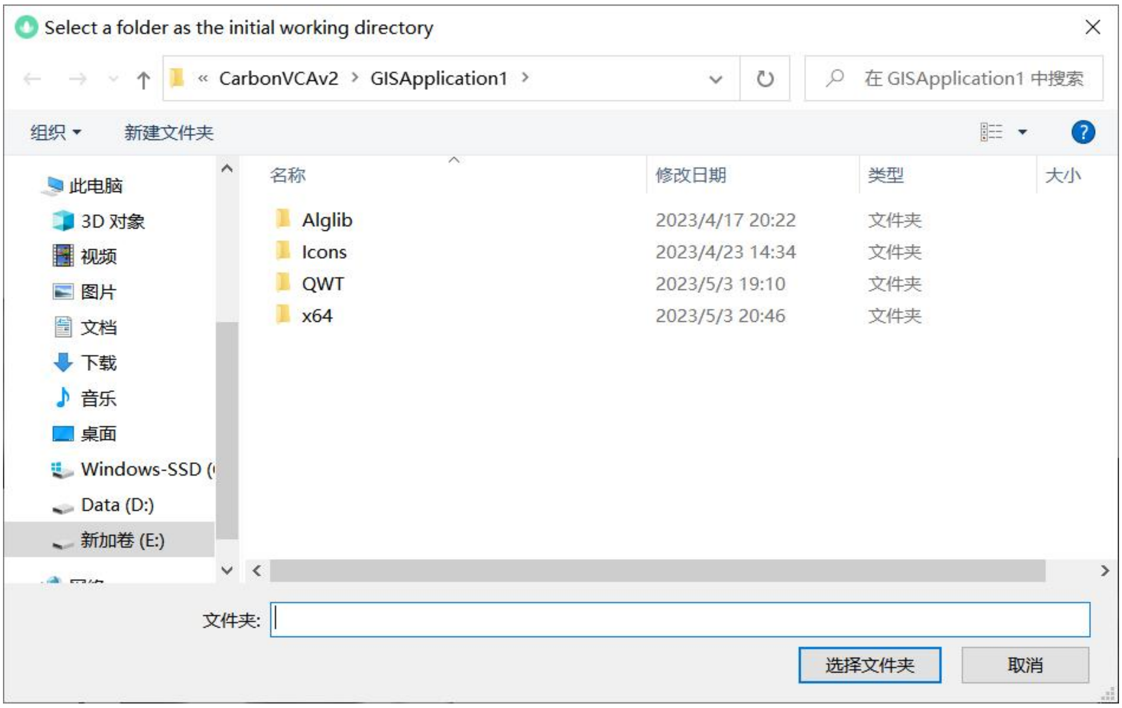

## 2.2 Open the grid file

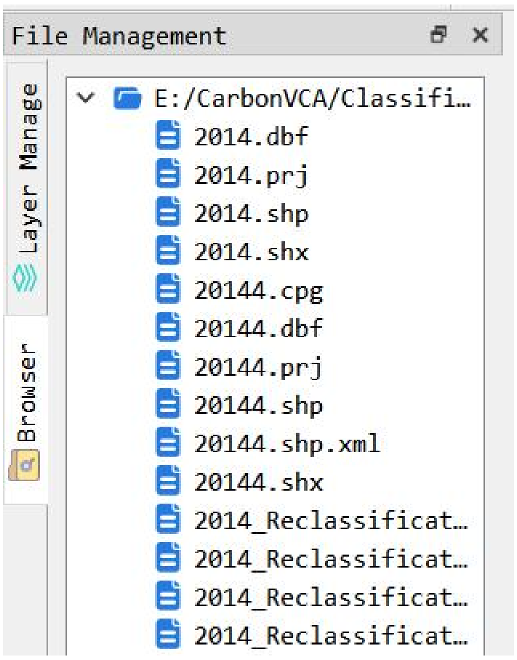
This section is used to import the grid file. Click "File/Open Raster File" in the toolbar of the initial interface of the system or click the button  to jump to the Open Raster File dialog box. By selecting the grid file to be opened, it can be imported into the system to facilitate subsequent operations.




## 2.3Open the folder

This section is used to import the action folder. Click "File/Open Work Folder" in the toolbar of the initial interface of the system or click the button  to jump to the open operation folder dialog box. Select the desired folder to view its files in the Browser and prepare for subsequent operations.





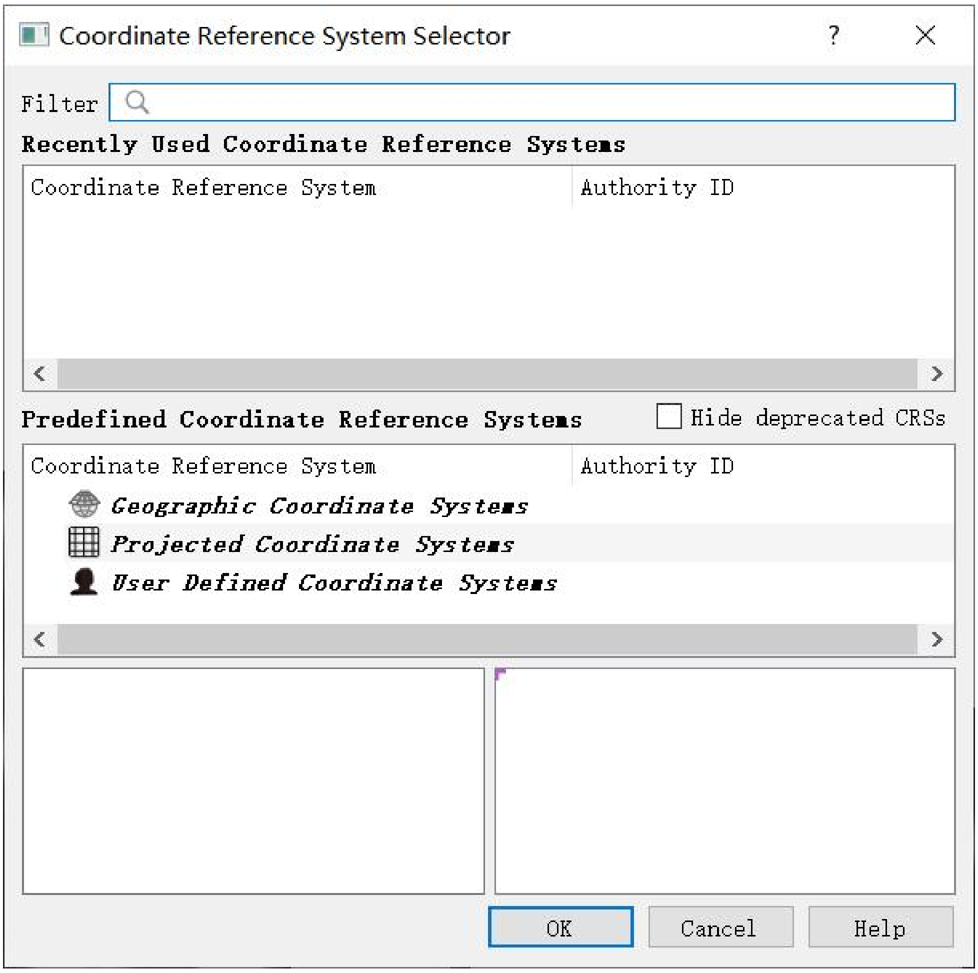

# 3. View module

## 3.1 Copy coordinates

This section requires the user to click the right mouse button 

on the displayed picture.

The user can copy the coordinates under the general coordinates or select the appropriate coordinate system.



## 3.2 Zoom function

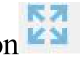
This section is used to scale the image in the system. Click "View/ZoomIn, ZoomOut" in the toolbar of the initial interface of the system or click the button  to open the zoom mode. The image can be scaled up or down. The user can also zoom the image through the wheel of the mouse.

## 3.3 Translate the image

This part is used to translate the image in the system. Click "View/Pan" in the toolbar of the initial interface of the system or click the button  to start the panning mode. The user can pan the displayed image using the left mouse button.

Users can also pan the image by pressing the middle mouse button for a long time and moving the mouse.

## 3.4 Zoom to Full Image

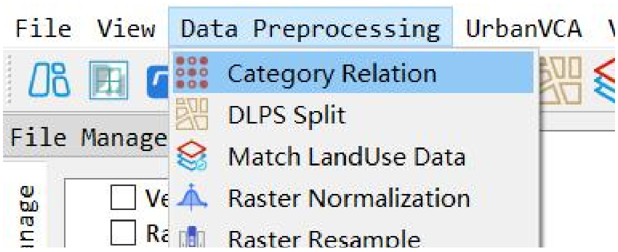
This section is used to zoom to the current image in the system. Click "View/Full Extent" in the toolbar of the initial interface of the system or click the button  to zoom to the current image.

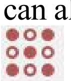
# 4. Data preprocessing module

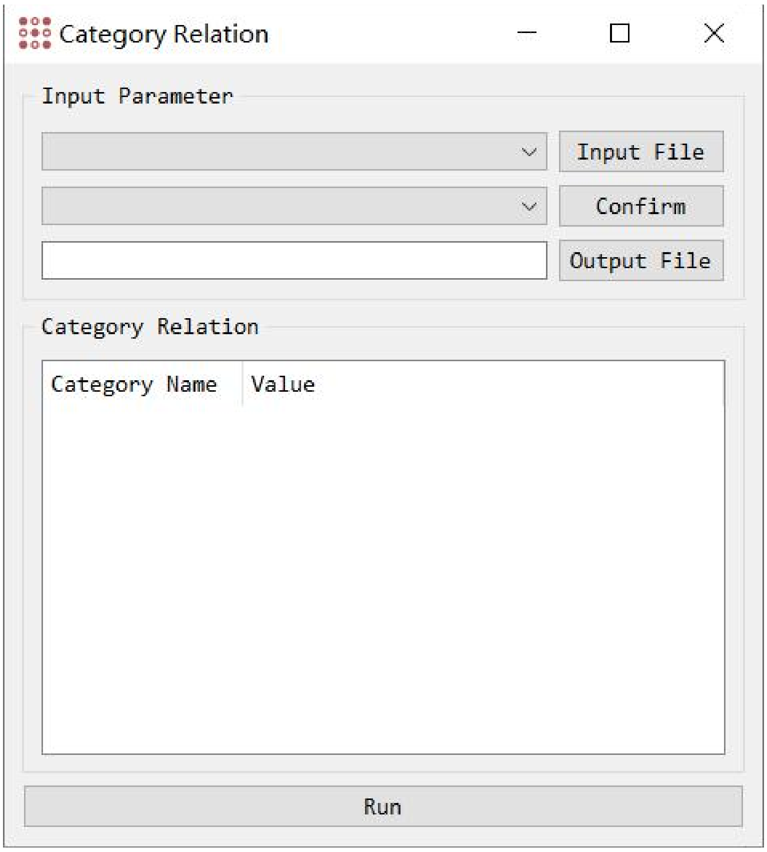
## 4.1 Land Use Reclassification

### 4.1.1 Function selection

Click "Data Processing" in the menu bar, and select " Category Relation " in the pop-up menu.




We can also open the land use reclassification function through the " Category Relation " button  on the toolbar, as shown in the following figure:

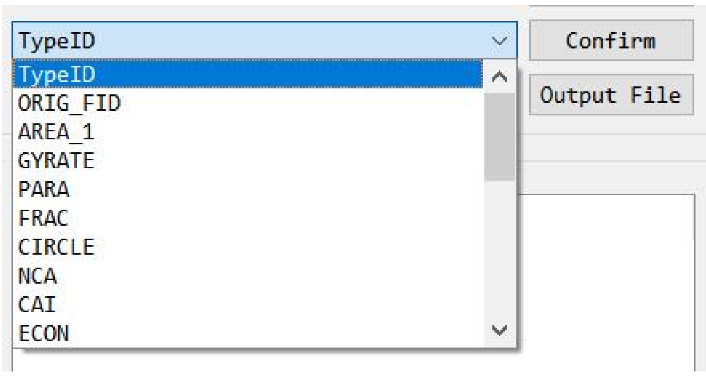



### 4.1.2 Land Use Reclassification

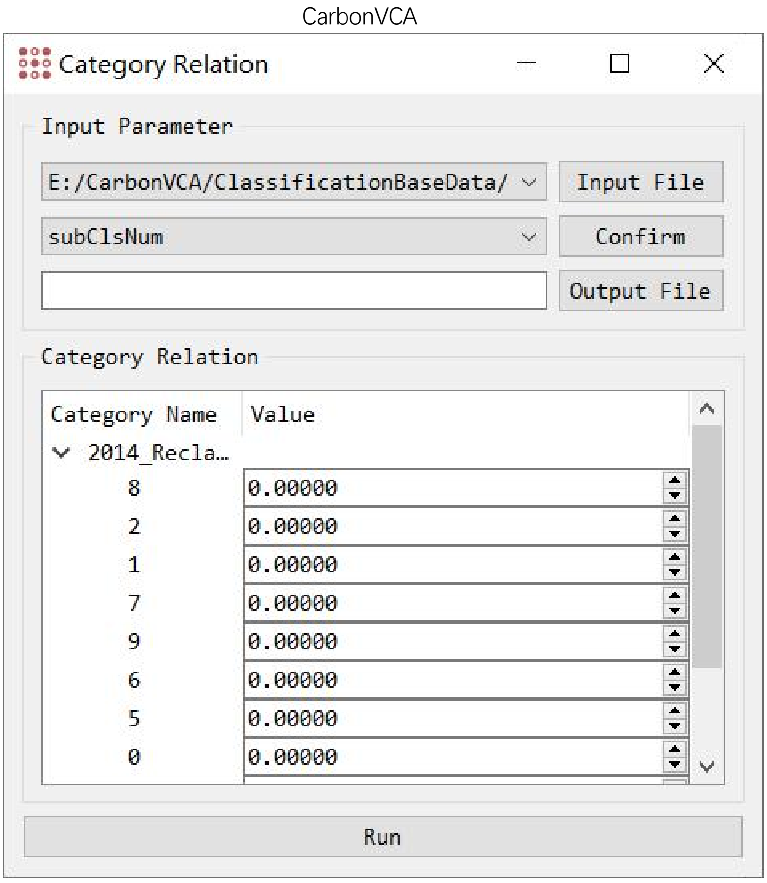
The user selects the button 

and selects the vector file in the pop-up dialog box, as shown in the following figure:


Then, the user needs to select the field name of the secondary land use type, as shown in the following figure:




After the user clicks "Confirm", the field will be confirmed, and the specific category and corresponding value of the field will be displayed below. As shown in the following figure:



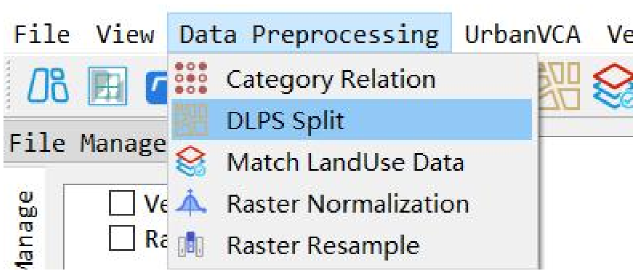

The user needs to fill in according to the specific value of the land use type. The system will re-classify according to the value filled in by the user to obtain SuperClass.

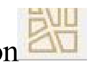
The user needs to select the output file, click the "Output File" button, select the location of the file to be output in the pop-up window, name it below, and click the "Save" button. Click the "Run" button, and the system will run until the system runs and the result is obtained.

## 4.2Vector dynamic block splitting function

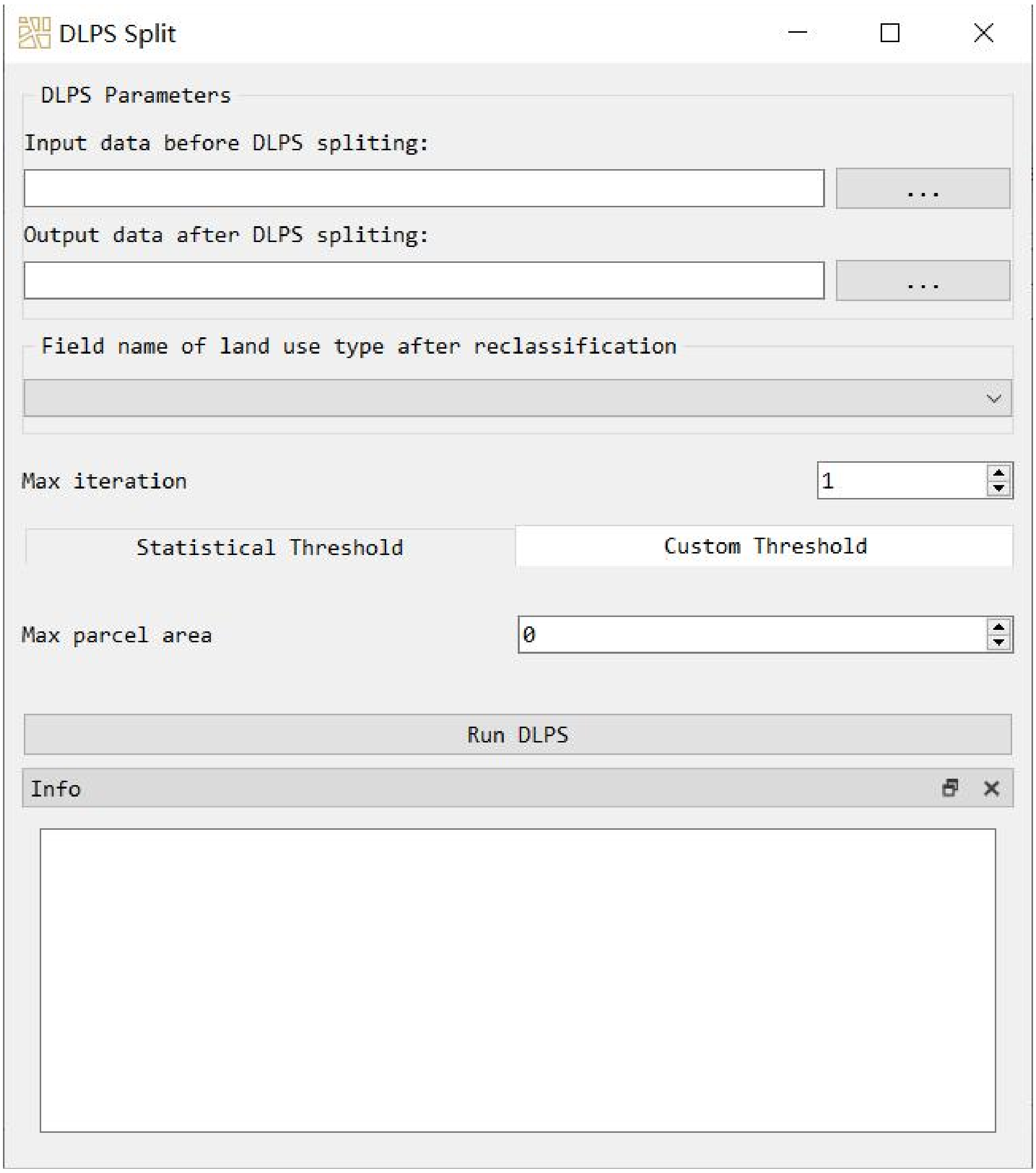
### 4.2.1 Function selection

Click "Data Processing" in the menu bar and select " DLPS Split " in the pop-up menu.




We can also open the vector dynamic plot splitting through the "DLPS Split " button  on the toolbar

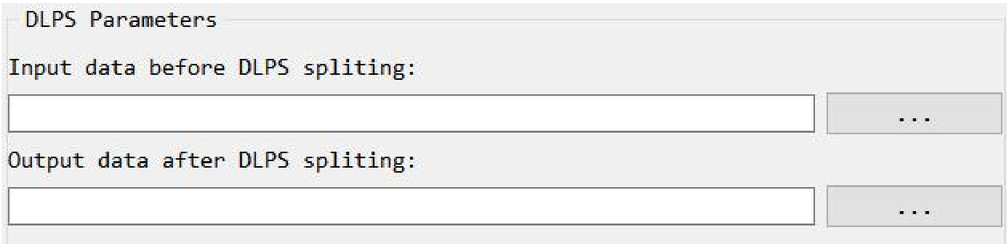
Parameter setting function module, as shown in the figure below:


DLPS Split
DLPS Parameters
Input data before DLPS spliting:
...
Output data after DLPS spliting:
...
Field name of land use type after reclassification
Max iteration
1
Statistical Threshold
Custom Threshold
Max parcel area
0
Run DLPS
Info

### 4.2.2 Vector dynamic block splitting

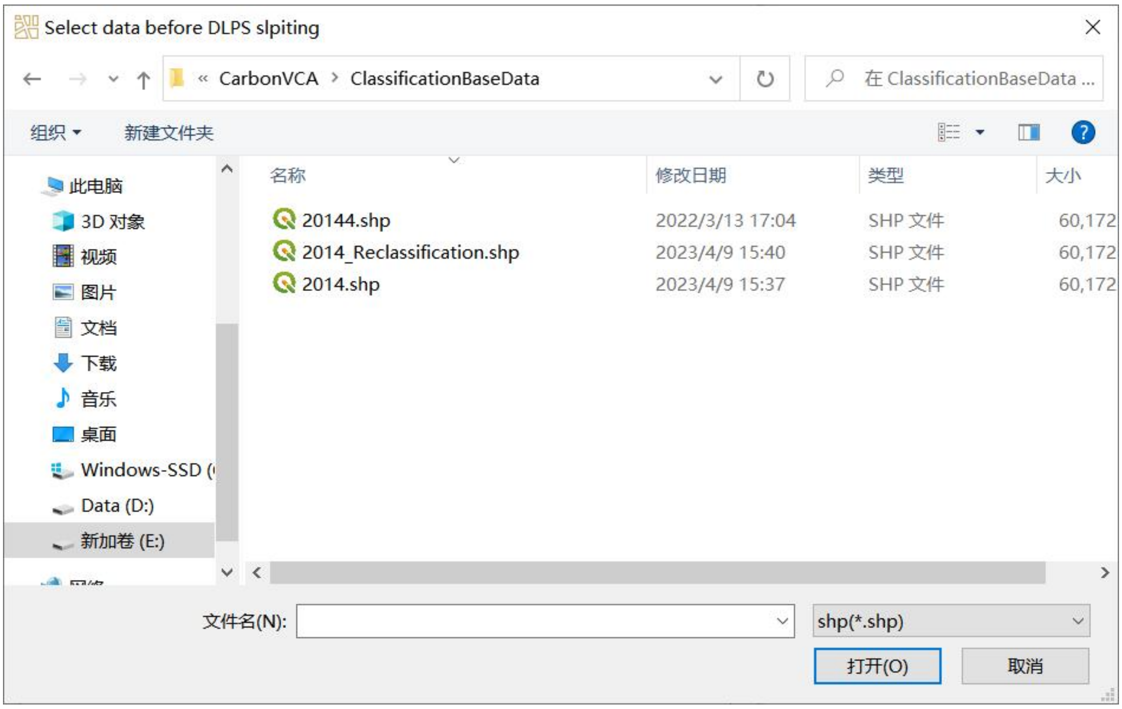
First of all, we need to select the path of the vector land use file to be split and the vector after splitting.

Path to save land use data:

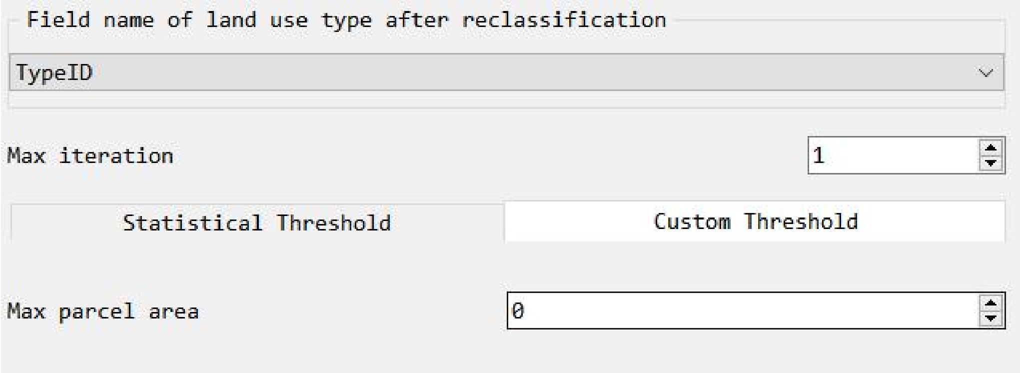



Through the "Input File Selection" button 

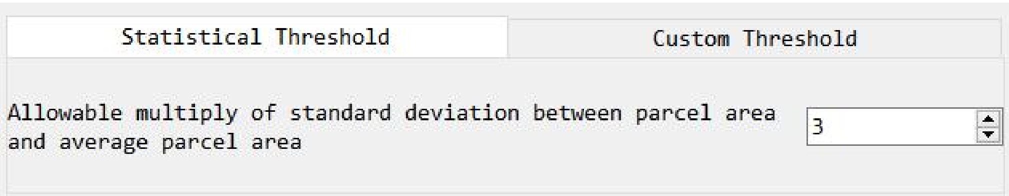
, we can select the vector file through the vector file selection dialog box, as shown in the following figure:



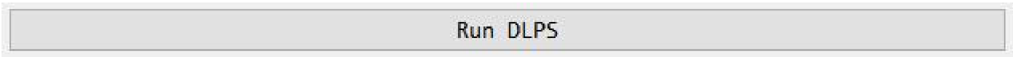

Then, the user needs to set the parcel splitting parameters, including the iteration times of parcel splitting, the maximum parcel area threshold, and the field name of the land use type after reclassification. The function of the maximum plot area threshold is to split if the plot area exceeds the threshold. If it is set to "0", the system will automatically set the threshold to the average plot area according to the current data. The dynamic parcel splitting parameter setting interface is shown in the following figure:



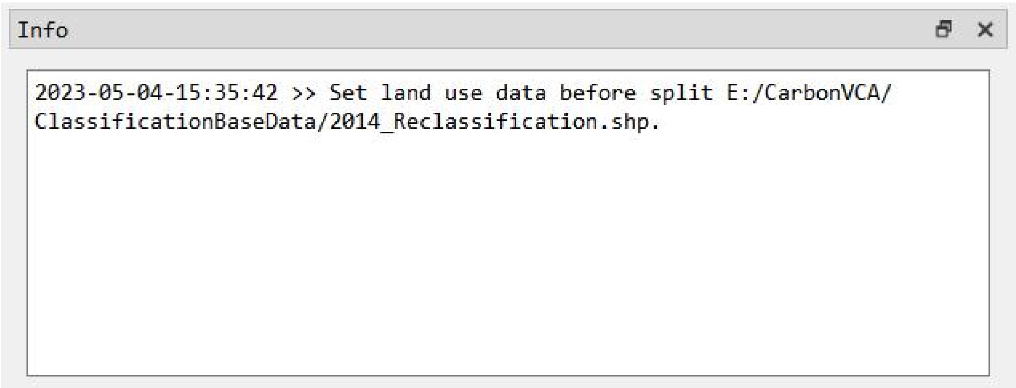

In addition, when the maximum parcel size threshold is 0, parcels with an area greater than Average Parcel Size + n * dStd are split. The allowable product parameter (n) of the area standard deviation and the average area standard deviation is set as follows (default is 3):




After setting the above parameters, the user can click the "Run DLPS" button to split.




In addition, the user can observe the operation of the function in the log status bar.



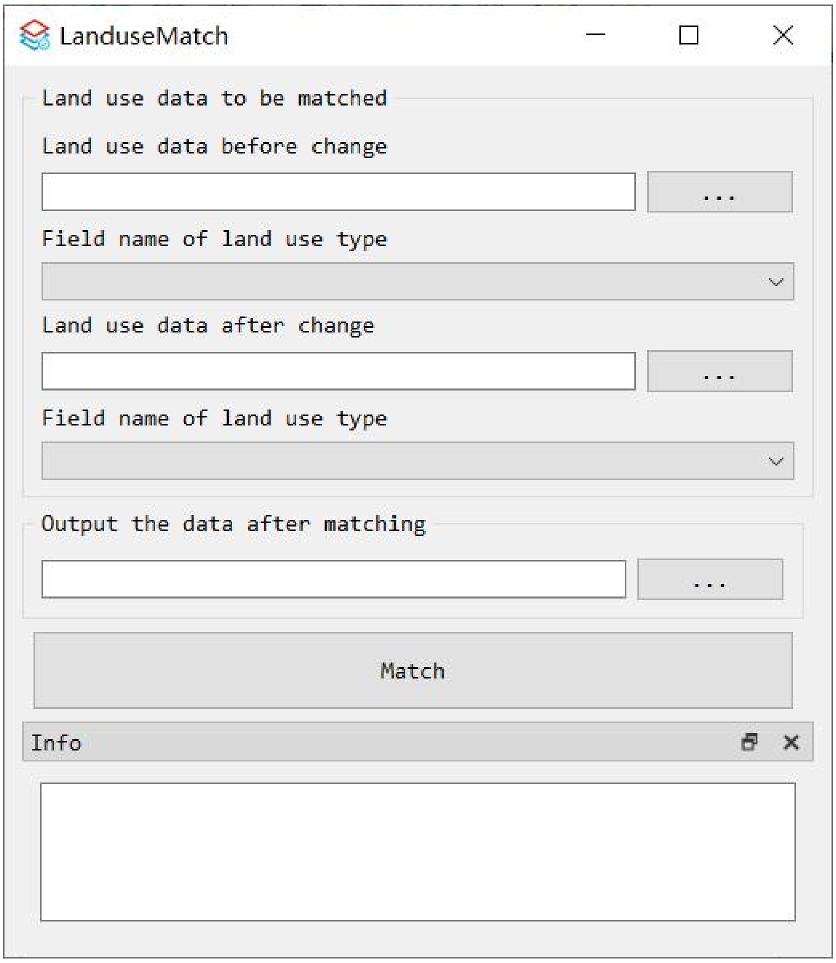

## 4.3Land use data matching function

It is considered that the vector parcel size, shape, land use type, location, etc. May be different before and after the land use change. Therefore, in order to accurately obtain the land use type of each plot before and after the land use change, the team designed and developed the function of "land use data matching".

### 4.3.1 Function selection

Click "Data Processing" in the menu bar, and select "VectorMatch" in the pop-up menu.

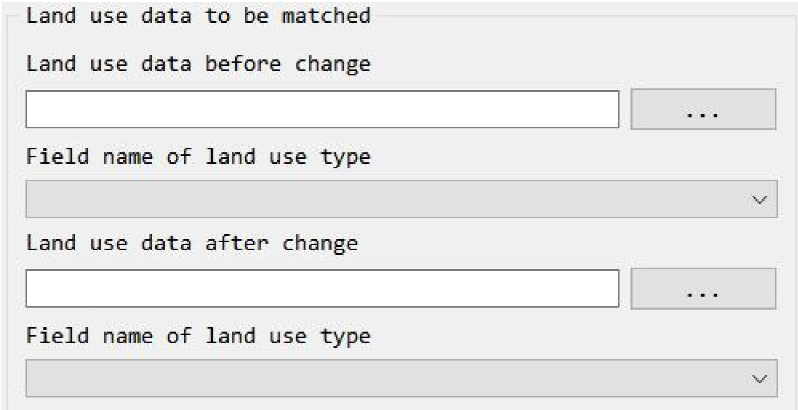
We can also open the data matching function through the "ParcelMatch" button  on the toolbar, as shown in the following figure:


LanduseMatch
Land use data to be matched
Land use data before change
Field name of land use type
Land use data after change
Field name of land use type
Output the data after matching
Match
Info

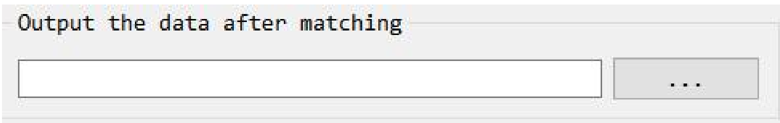
### 4.3.2 Land use data matching

First, the user needs to input the land use data before and after the land use change, as well as the field name containing the digital code of land use type. The user can select land use data in the pop-up dialog box by clicking the button 

, and then the system will automatically identify all attribute list field names of the current data. The user can select the field name containing the digital code of the land use type in the drop-down list.




After completion, the user sets the saving path of the matched land use data, and then clicks the "Match" button, and the system will automatically run the land use data matching function.




The exported land use data will automatically generate the fields: ID, before, simulated, after, Pr, area, centerX, centerY, Pg0, Pg1 ··· Pgn、N0、N1··· Nn。Which respectively represent a plot ID serial number, a plot land use type before the land use change, a plot land use type after the land use change is simulated by the land use, the plot land type after the land utilization change, a limiting factor, the plot area, a mass center coordinate X of the plot, a mass center coordinate Y of the plot, an overall development probability that the plot is developed into the 0th land use type, The overall development probability that the plot develops into the first type of land use ··· The plot is developed into the nthThe overall development probability of each land use type, the neighborhood effect of the plot by the first land use type, and the neighborhood effect of the plot by the second land use type. The plot is subject to the nth land use type

The neighborhood effect of. The attribute list automatically generated by the data is as follows:

| ID | before | simulated | after | Pr | area | centerX | centerY | Pq0 | Pq1 | Pq2 | Pq3 | Pq4 | N0 | N1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 4 | 4 | 1 | 995.242 | [illegible]4.047 | [illegible]2.624 | 0.00000 | 0.00000 | 0.01000 | 0.00000 | 0.00000 | 226.58650 | 65.18 |
| 1 | 2 | 2 | 2 | 1 | 1931.316 | [illegible]4.353 | [illegible]6.845 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 156.29756 | 63.22 |
| 2 | 4 | 4 | 4 | 1 | 31470.403 | [illegible]1.390 | [illegible]7.615 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 82.63017 | 117.18 |
| 3 | 4 | 4 | 4 | 1 | 180.024 | [illegible]4.665 | [illegible]0.527 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 134.11854 | 113.18 |
| 4 | 0 | 0 | 0 | 1 | 5632.520 | [illegible]9.798 | [illegible]1.302 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 193.86280 | 43.05 |
| 5 | 0 | 0 | 0 | 1 | 14002.342 | [illegible]6.702 | [illegible]5.212 | 0.00000 | 0.02000 | 0.00000 | 0.00000 | 0.00000 | 137.03221 | 50.30 |
| 6 | 4 | 4 | 4 | 1 | 828.783 | [illegible]9.683 | [illegible]6.478 | 0.01000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 130.62466 | 31.22 |
| 7 | 0 | 0 | 0 | 1 | 791.812 | [illegible]3.932 | [illegible]3.411 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 154.73698 | 0.00 |
| 8 | 4 | 4 | 4 | 1 | 21152.570 | [illegible]5.499 | [illegible]4.771 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 152.85248 | 14.08 |

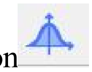
(Image from QGIS)

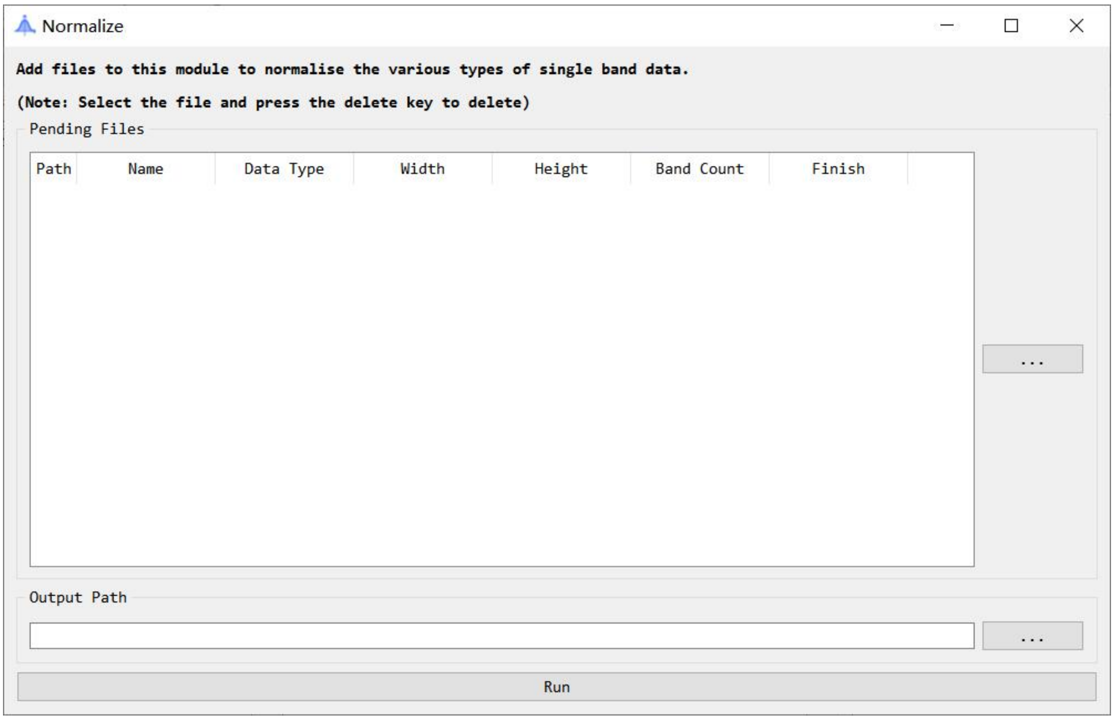
In addition, the user can observe the operation of the function in the log status bar.


# 4.4Raster image rendering function

## 4.4.1 Function selection

Click "Data Processing" in the menu bar, and select "RasterNormalization" in the pop-up menu.

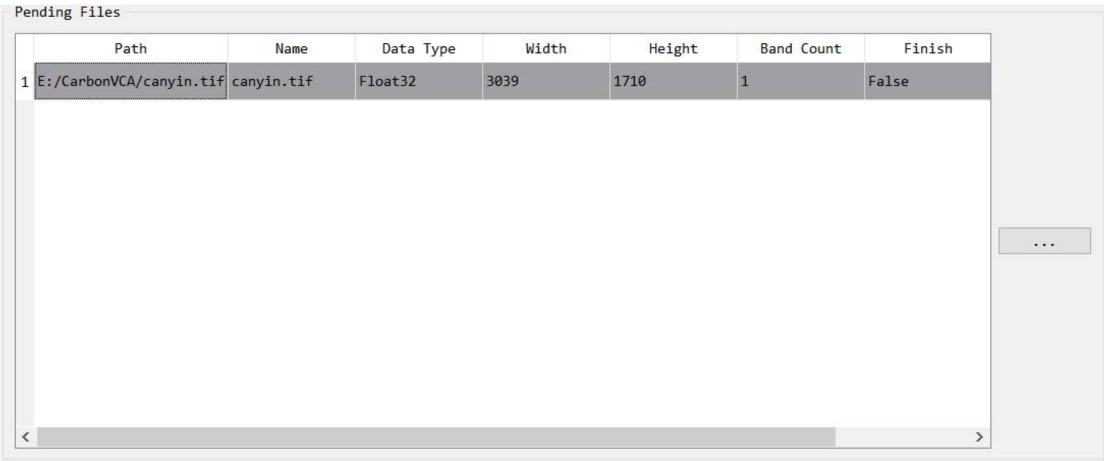
We can also open the image rendering function through the toolbar "RasterNormalization" button, as shown in the following figure:




## 4.4.2 Image normalization

First, the user needs to click a button  to add various types of single-band raster data.

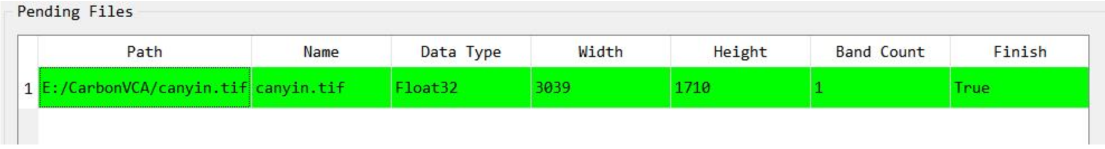
After adding, the path of the image will appear in the central module, as shown in the following figure.



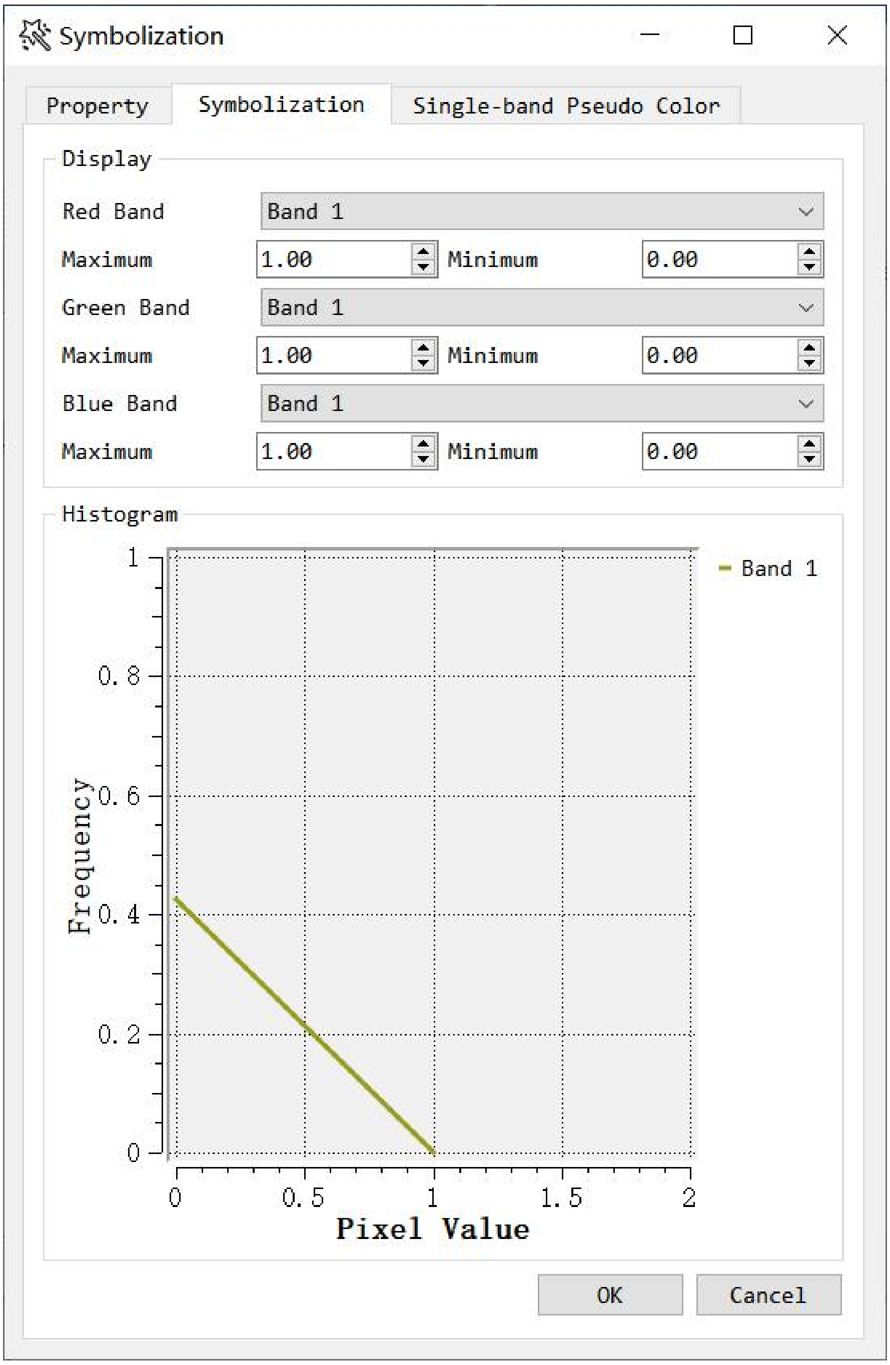

Select the folder path for the output.


Click "Run", and the system will output the rendered raster image to the specified folder.

And change its status to "Completed", as shown in the following figure:




The normalized image data is shown in the following figure:

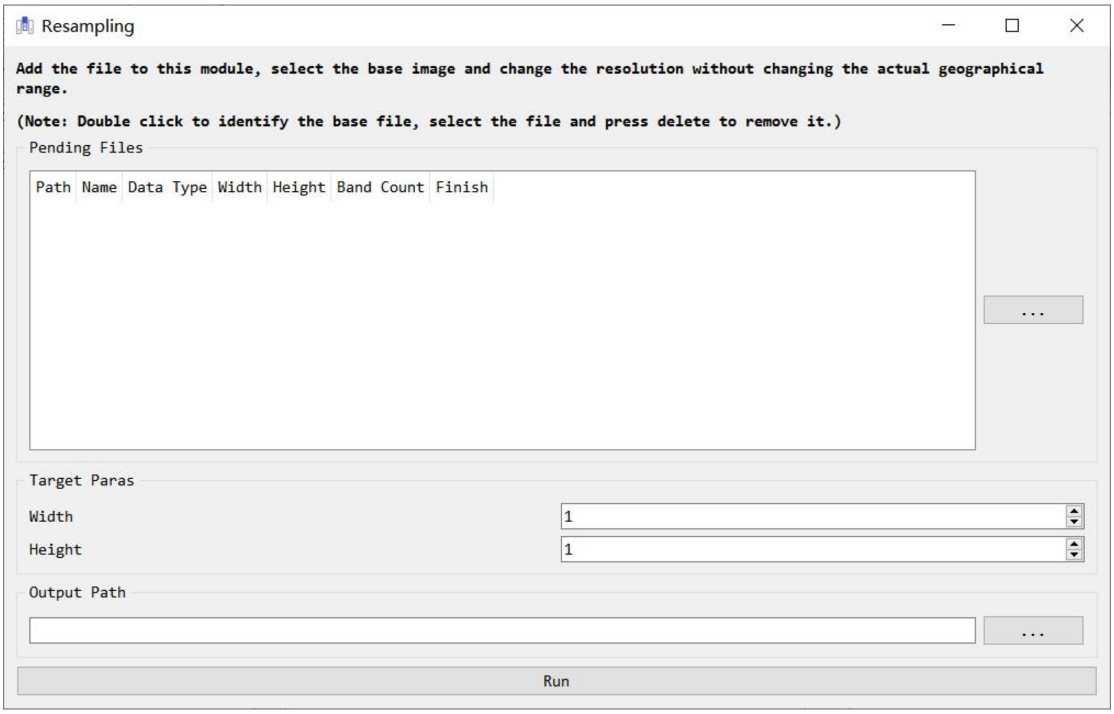


# 4.5Raster image resampling function

## 4.5.1 Function selection

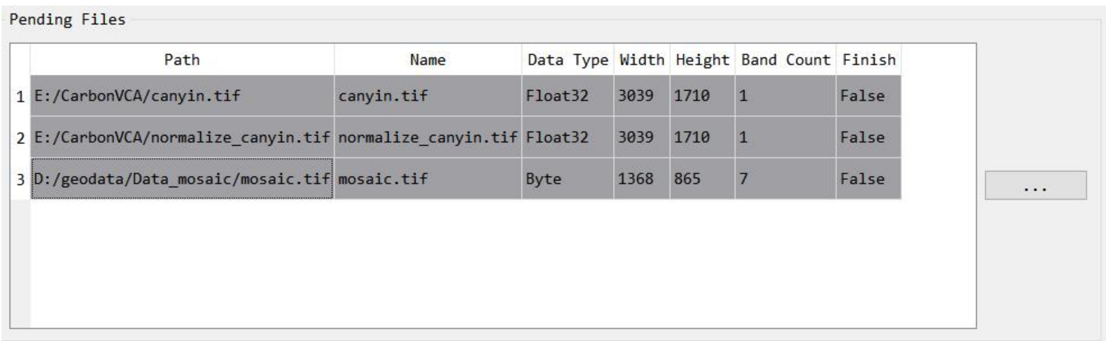
Click "Data Processing" in the menu bar, and select "Raster Resample" in the pop-up menu.

We can also open the raster image resampling function through the toolbar "RasterResample" button , as shown in the following figure:

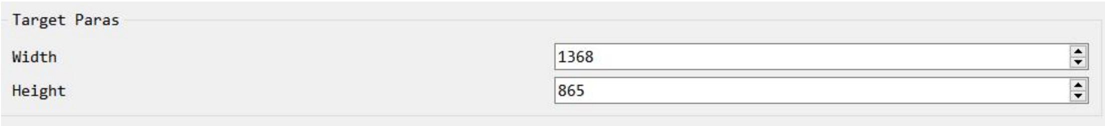



## 4.5.2 Image resampling

The user needs to click the button  to select the raster image to import into the module. As shown in the following figure:




The user can double-click one of the images as the target image (Delete to delete the image). Subsequently, the "Target Paras" section below will be assigned according to the width and height of the image selected by the user. As shown in the following figure:




Select a folder for the output.

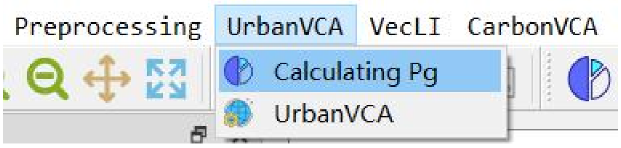

Click "Run" to resample the image.

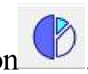
# 5. Urban VCA module

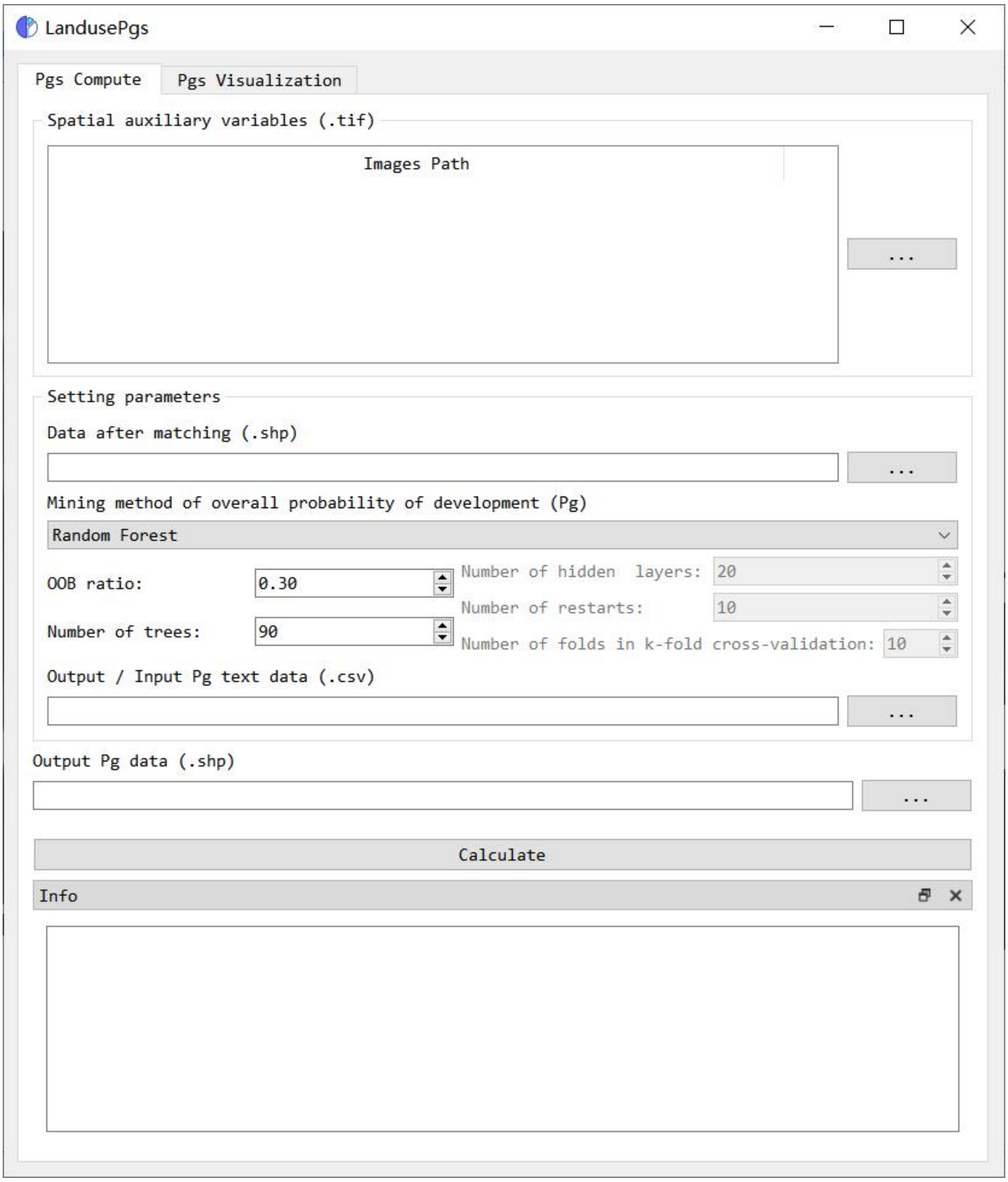
## 5.1 Overall development probability calculation module

### 5.1.1 Function selection

Click "UrbanVCA" in the menu bar, and select "Calculating Pg" in the pop-up menu.



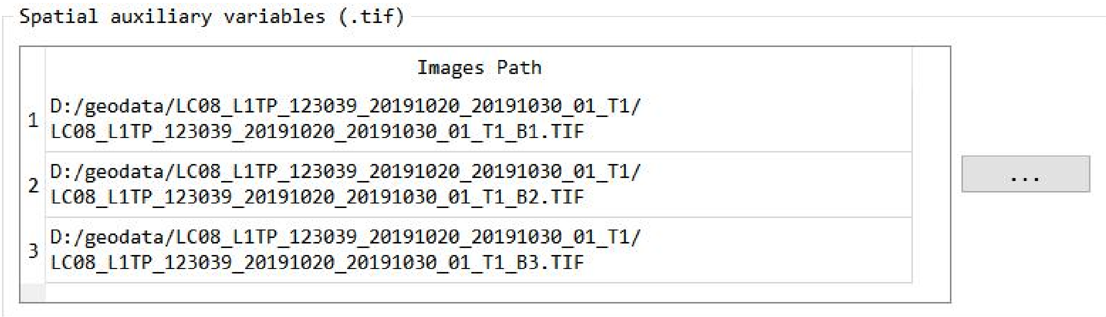

We can also open the overall development probability calculation function through the toolbar "Calculating Pg" button , as shown in the following figure:




## 5.1.2 Calculation of overall development probability

First, you need to import the space auxiliary variables in the Tiff format. Click the button 

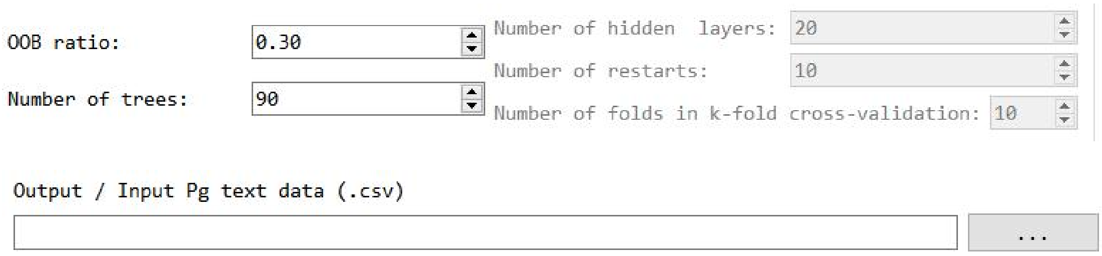
to select multiple space auxiliary variables in the pop-up dialog box, as shown in the following figure:



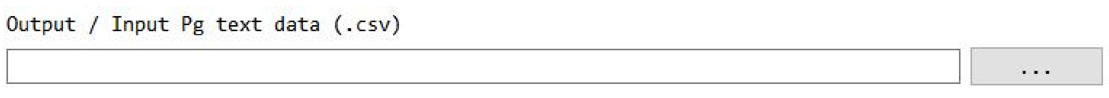

The user then needs to import the land use data matching data file (see 4.3.2) as follows:


Then, users can select multiple machine learning models such as random forest, neural network, logistic regression, etc. According to their needs, or directly import Pg files from outside:

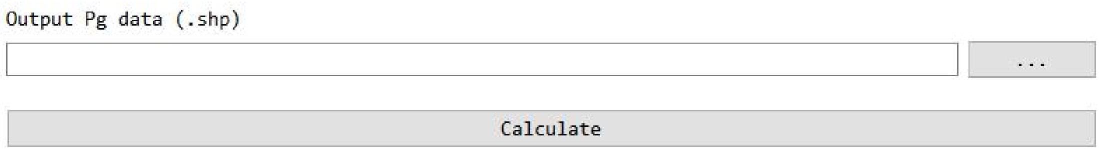

If the user selects the machine learning model, he can set the parameters of the model and select the path to save the Pg file obtained by training:



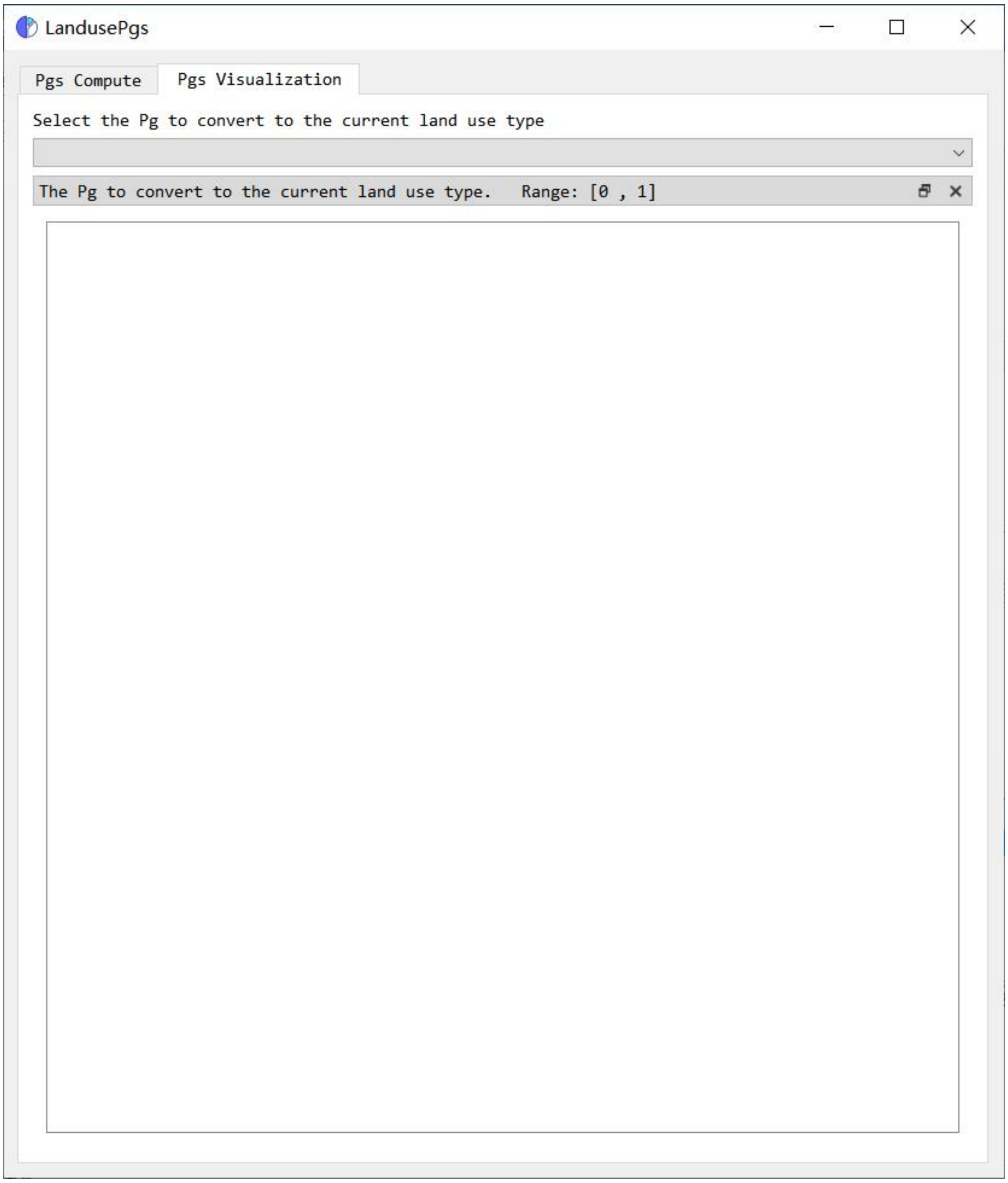

If you choose to directly import the Pg file externally, you do not need to import the spatial auxiliary variables. Note that the format of Pg is.csv, and the format of each line is: "Pg0, Pg1 …" Pgn, ID ", where the ID of each plot is the value corresponding to the" ID "field in the attribute list generated by land use data matching (refer to the Pg file obtained by training above for the format). The user needs to import the path of the Pg file in the following figure:



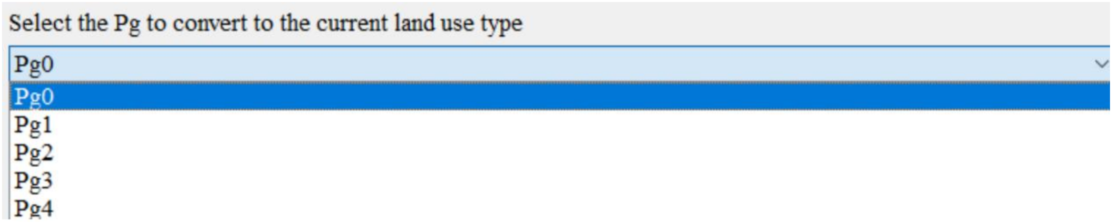

After completing the above settings, the user can set the storage path of the overall development probability data file, and then click the "Calculation" button, as shown in the following figure:



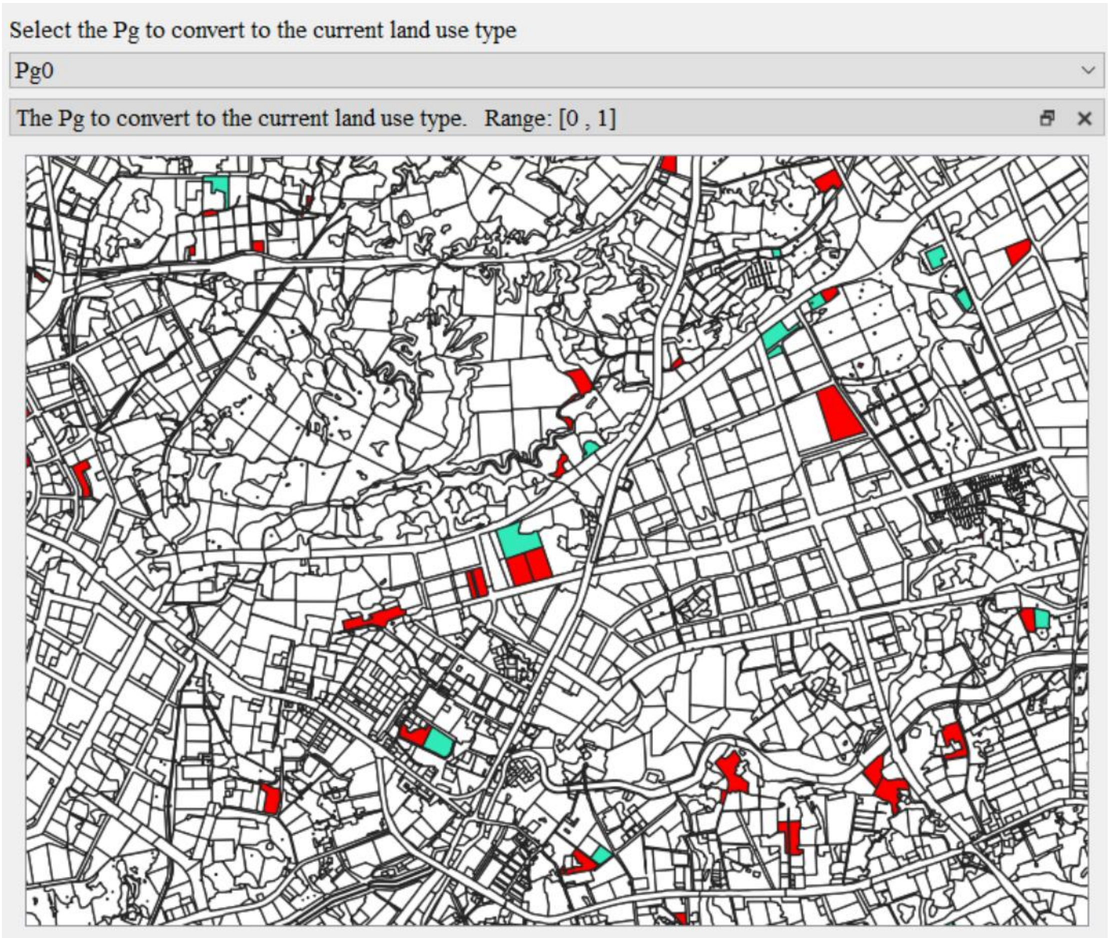

The software also provides an overall development probability visualization function. After the calculation is completed, the user can observe in "Pgs Visualization", as shown in the following figure:




Select the overall development probability of the i-th land use type in the drop-down list box, as follows:




Then, the software will automatically display the visual dynamic effect map of the overall development probability on the right side of the interface. The redder the color, the greater the probability value. As shown in the following figure:




The user can also observe the function operation in the log status bar.


Of course, that us can also skip this module and directly modify the content of the Pg field in the matched land use data attribute list.

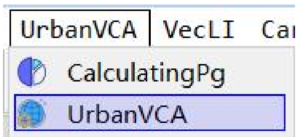
| Pg0 | Pg1 | Pg2 | Pg3 | Pg4 |
|---|---|---|---|---|
| 0.08889 | 0.27778 | 0.13333 | 0.12222 | 0.18889 |
| 0.13333 | 0.07778 | 0.11111 | 0.34444 | 0.27778 |
| 0.14444 | 0.15556 | 0.22222 | 0.40000 | 0.23333 |
| 0.14444 | NULL | 0.21111 | 0.17778 | 0.11111 |
| 0.02222 | 0.12222 | 0.08889 | 0.41111 | 0.17778 |
| 0.08889 | 0.27778 | 0.06667 | 0.38889 | 0.08889 |
| 0.07778 | 0.20000 | 0.07778 | 0.43333 | 0.16667 |
| 0.42222 | 0.12222 | 0.13333 | 0.33333 | 0.22222 |
| 0.06667 | 0.15556 | 0.35556 | 0.07778 | 0.30000 |

(Image from QGIS)

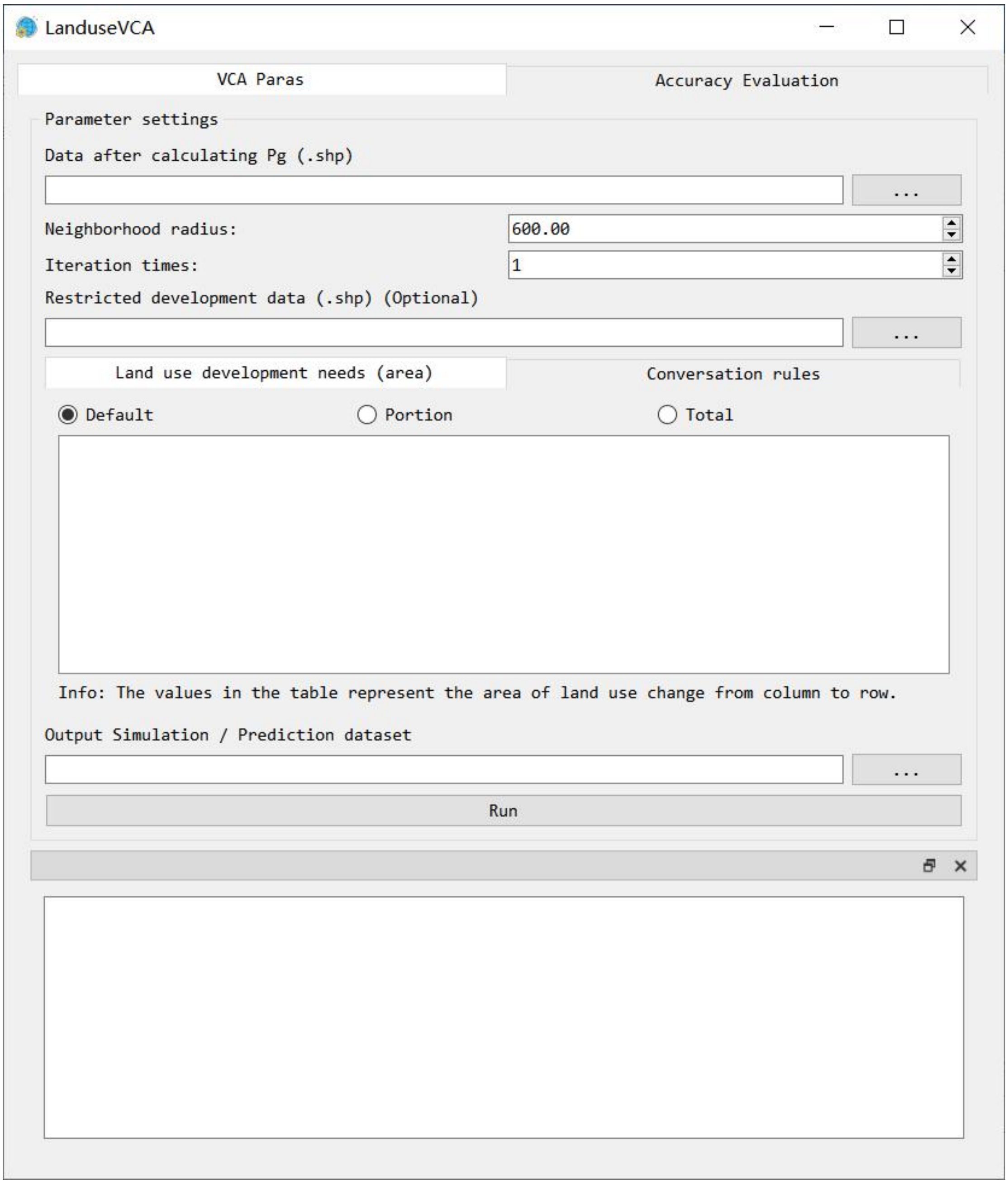
## 5.2 UrbanVCA simulation module

### 5.2.1 Function selection

Click "UrbanVCA" in the menu bar, and select "UrbanVCA" in the pop-up menu.

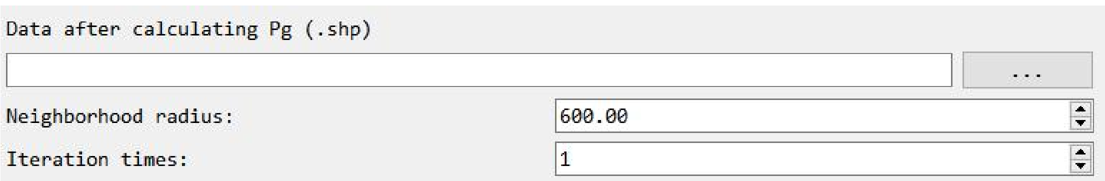



We can also open the UrbanVCA model simulation function through the "UrbanVCA" button  on the toolbar, as shown in the following figure:

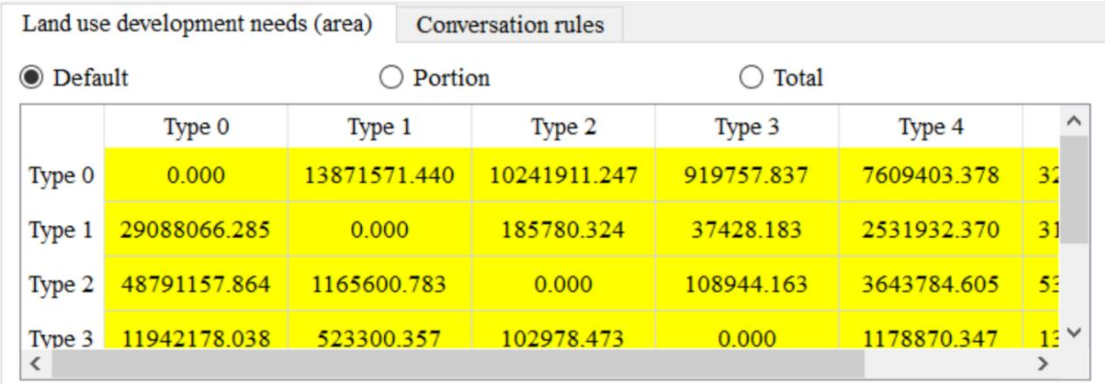



## 5.2.2 UrbanVCA model simulation

First, the user needs to import the overall development probability calculation file (see 5.1.2 for details), and set the neighborhood radius value and the number of iterations as follows:



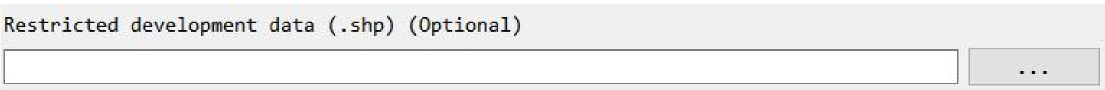
After completion, the system will automatically count and display the area converted between various land use types, as shown below:



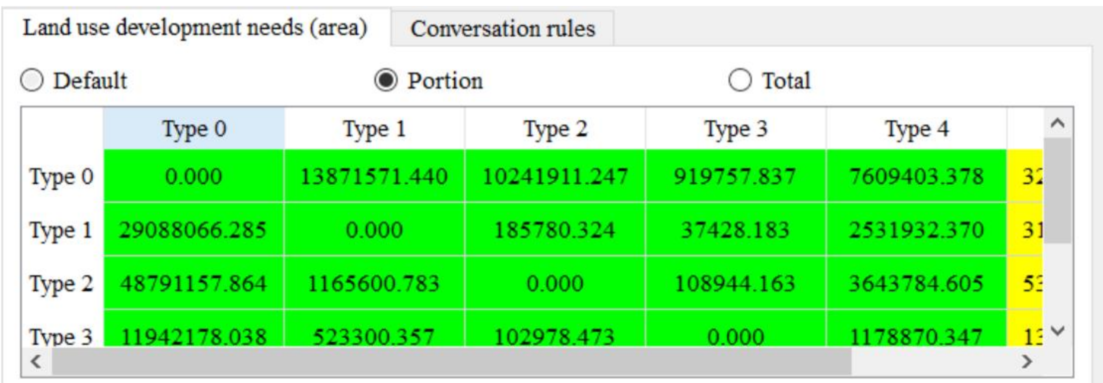

| | Type 0 | Type 1 | Type 2 | Type 3 | Type 4 | |
|---|---|---|---|---|---|---|
| Type 0 | 0.000 | 13871571.440 | 10241911.247 | 919757.837 | 7609403.378 | 32 |
| Type 1 | 29088066.285 | 0.000 | 185780.324 | 37428.183 | 2531932.370 | 31 |
| Type 2 | 48791157.864 | 1165600.783 | 0.000 | 108944.163 | 3643784.605 | 53 |
| Type 3 | 11942178.038 | 523300.357 | 102978.473 | 0.000 | 1178870.347 | 13 |

Each value of the table in the figure represents the area of the land use type corresponding to the column to the land use type corresponding to the row, regardless of the unchanged land use type.

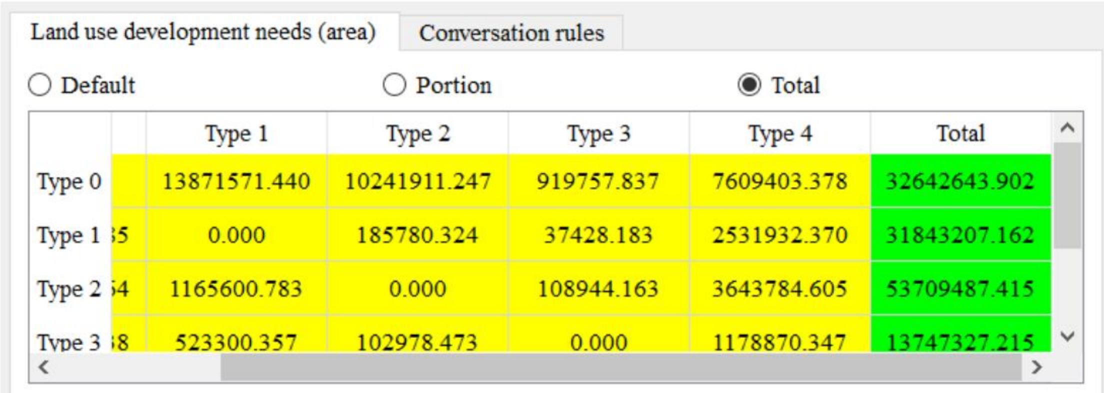
Then, the user can set the restricted development area as required. By importing the.shp file of the restricted area in the following figure, the system will automatically prohibit the development of the plot located in the restricted area (this function is optional, not necessary).



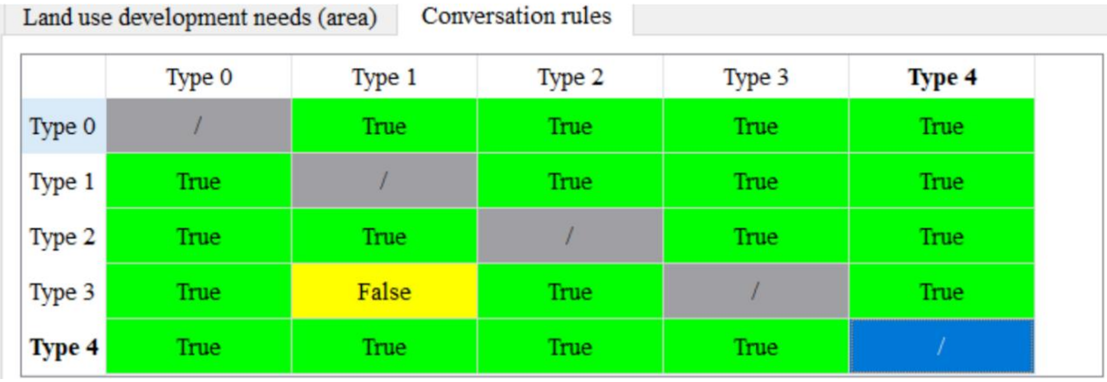

Next, the user can set the land use change area as shown in the figure. If "Default" is selected, the system uses the statistical results of the imported overall development probability calculation file; if "Portion" is selected, the conversion area between various land use types can be manually modified, and the system uses the manually modified value; If "Total" is selected, the development area of various land use types can be modified manually, and the system adopts the modified value.


| | Type 0 | Type 1 | Type 2 | Type 3 | Type 4 | |
|---|---|---|---|---|---|---|
| Type 0 | 0.000 | 13871571.440 | 10241911.247 | 919757.837 | 7609403.378 | 32 |
| Type 1 | 29088066.285 | 0.000 | 185780.324 | 37428.183 | 2531932.370 | 31 |
| Type 2 | 48791157.864 | 1165600.783 | 0.000 | 108944.163 | 3643784.605 | 53 |
| Type 3 | 11942178.038 | 523300.357 | 102978.473 | 0.000 | 1178870.347 | 13 |

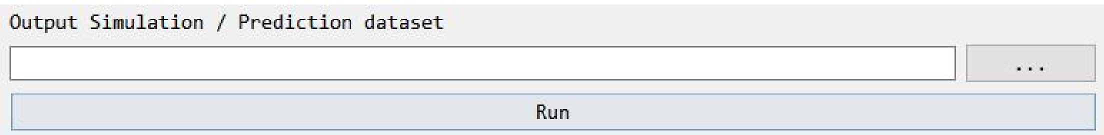



At the same time, users can set land-use conversion rules by clicking "Conversation rules" ", and set whether conversion occurs between land-use types by double-clicking the value in the table.




Each value of the table in the figure represents a case where the land use type corresponding to the column is transferred to the land use type corresponding to the row, regardless of the case where the land use types are not changed.

After setting the above parameters, the user selects the folder path where the simulation results are saved and exported, and clicks the "Run" button to start running.




Note: The result file contains the land use simulation data (.shp) and the corresponding accuracy evaluation (.txt). For land use simulation data, the user can view the "simulated" field after opening the attribute list, which represents the simulated land use type of each plot (see 4.3.2 for the meaning of each field in the attribute list).

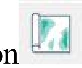
In addition, the user can observe the operation of the function in the log status bar.

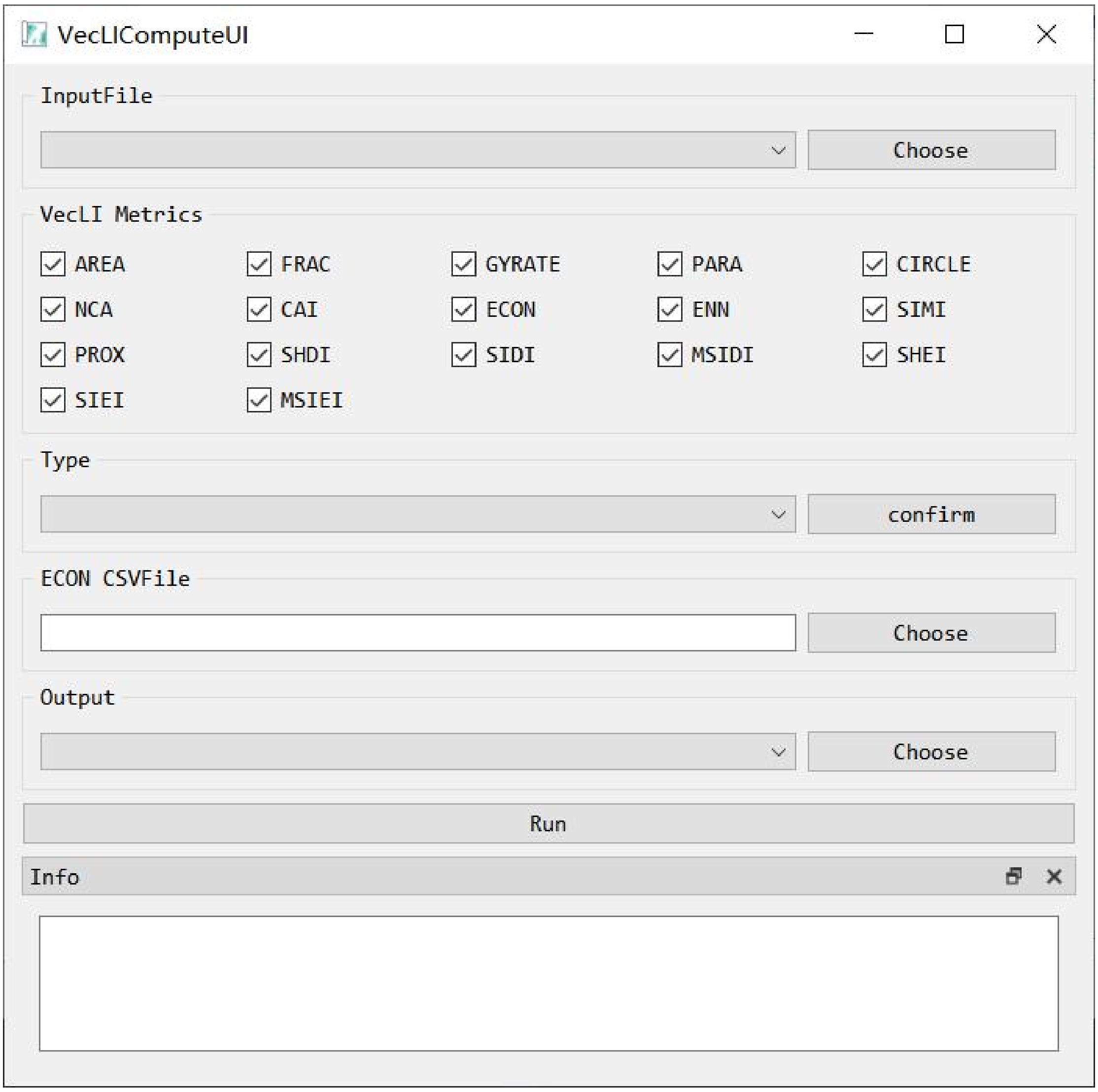
After the model simulation is completed, the accuracy evaluation results obtained from each iteration will be displayed in the "Accuracy Evaluation" table. The user can also click the "Export accuracy table" button to export the accuracy evaluation results. As shown in the following figure:


# 6. VecLI module

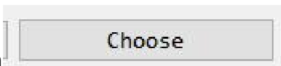
## 6.1 Vector landscape index calculation module

### 6.1.1 Function selection

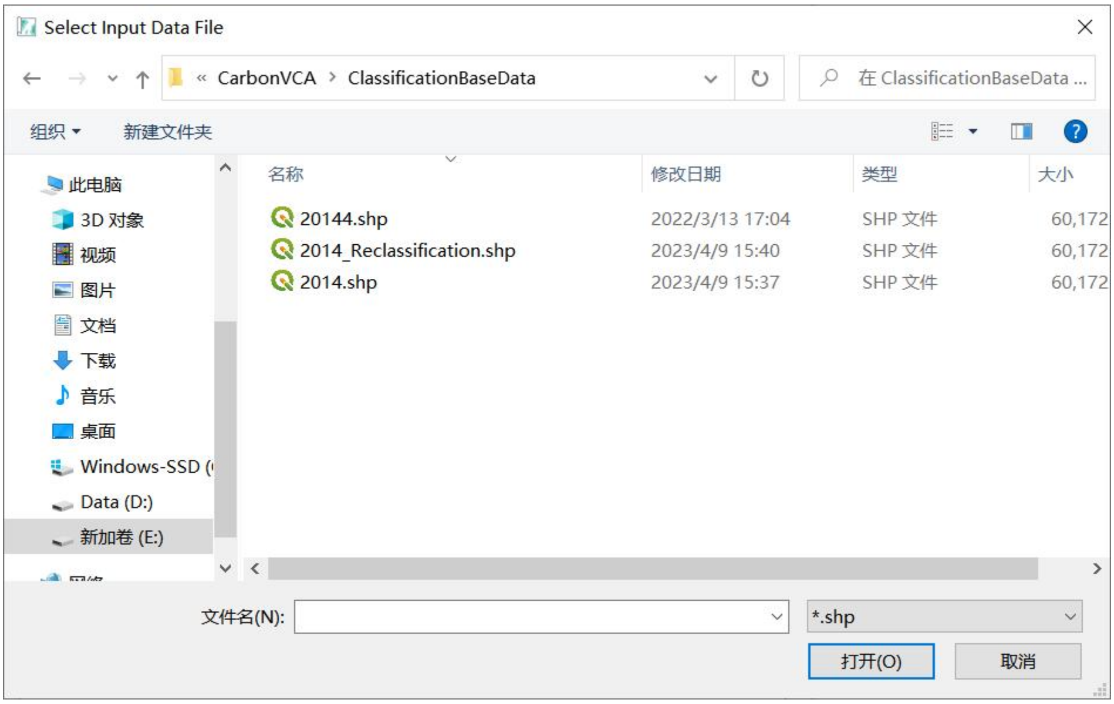
Click "VecLI" in the menu bar and select "VecLI" in the pop-up menu. We can also open the vector landscape index calculation function through the "VecLI" button  on the toolbar, as shown in the following figure:



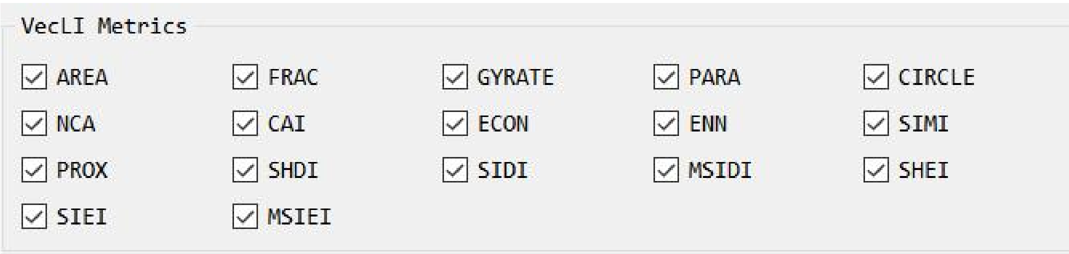

## 6.1.2 Calculation of vector landscape index

First, you need to import the vector data in.shp format. Click the button 

to select the vector data in the pop-up dialog box, as shown in the following figure:




Subsequently, users can select a specific landscape index according to their own needs, as shown in the following figure:




Next, the user needs to select the "Land Use Type" field. "Land Use Type" refers to the attribute field name with the parcel type in the vector file. The drop-down box will automatically read all the fields contained in the vector file, and the user can select the appropriate fields in the drop-down menu as shown in the following figure:


Then, the user needs to pass in the "ECON" file, which refers to the contrast file between different types of plots that needs to be passed in when calculating the contrast index. Click the "Choose" button to open the corresponding file.

The format of the ECON file is as follows. Each line contains three numbers, separated by spaces. The first two numbers are the land use type, and the third number is the contrast value (default is 1). You can use this file to set up comparisons between different parcel types.

1 2 0.8
1 3 1.2
1 4 0.9
2 3 1.0
2 4 1.1
3 4 1.0

And finally, output that result to the specified path. The user needs to click "Choose" to select the output file path and name it. Click "Run" to get the result.



In addition, the user can observe the operation of the function in the log status bar.

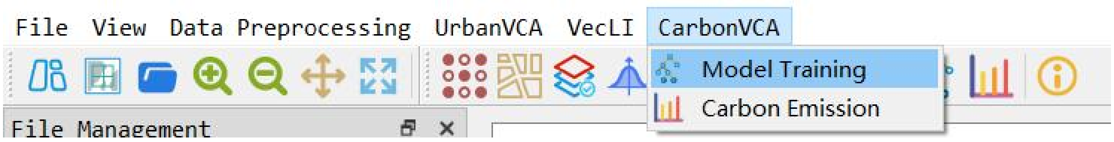

# 7.CarbonVCA module

## 7.1Training random forest module

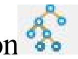
In order to keep the random forest model trained by the user in the local memory for subsequent use. The team saved the trained random forest model in a user-specified folder and stored it in.model format to achieve the effect of model separation.

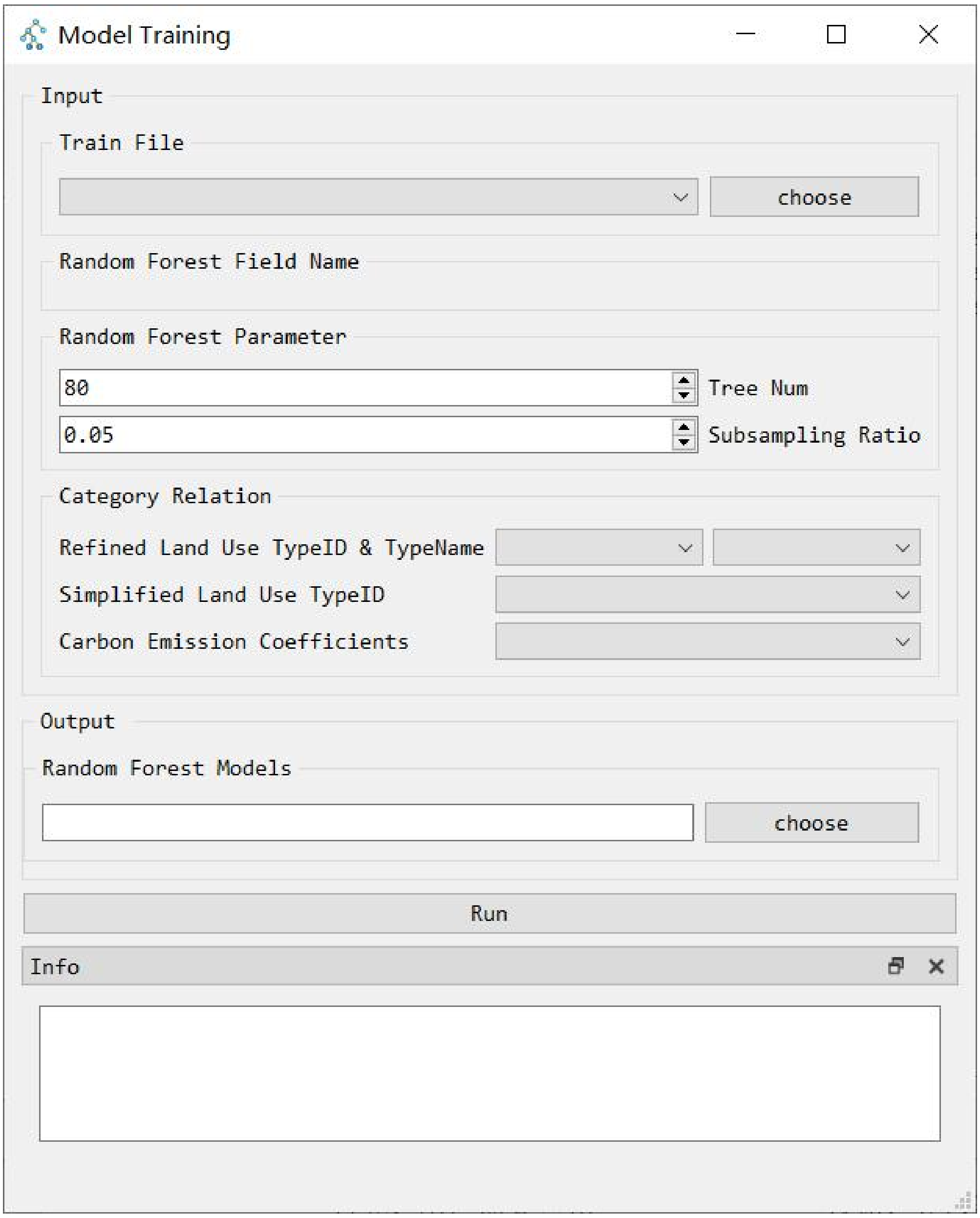
### 7.1.1 Function selection

Click "Carbon VCA" in the menu bar and select "Model Training" in the pop-up menu.

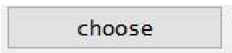



We can also open the training function of random forest through the toolbar "Model

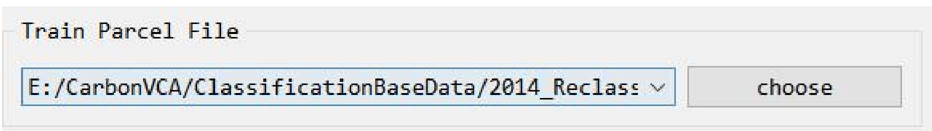
Training" button  . As shown in the following figure:



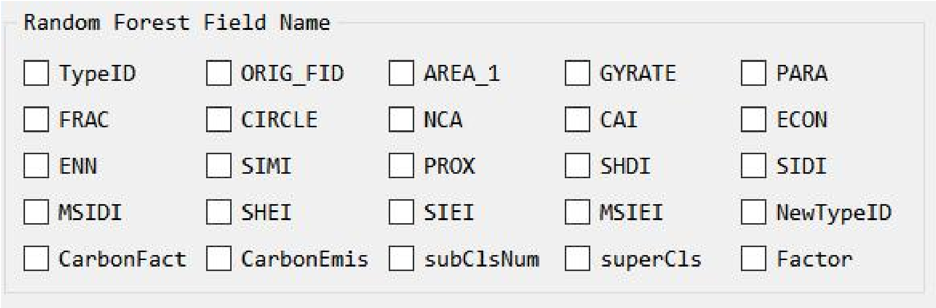

## 7.1.2 Training random forest model

First, the user needs to click the button 

to import the vector file to be trained. As shown in the following figure:

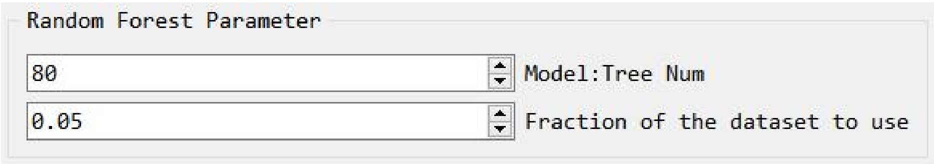



When the user imports the vector file, the field name of the vector data will appear in the "Random Forest Field Name" section. As shown in the following figure:

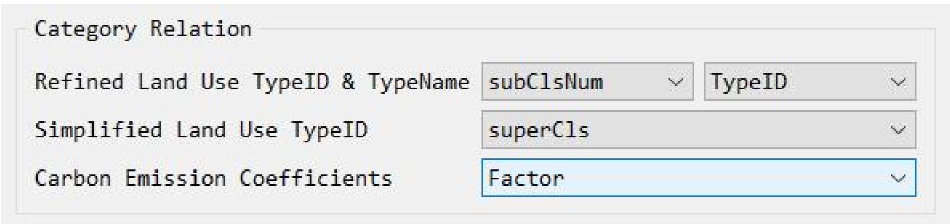



Users can check the name of the field to be trained to participate in the training parameters of the random forest model.

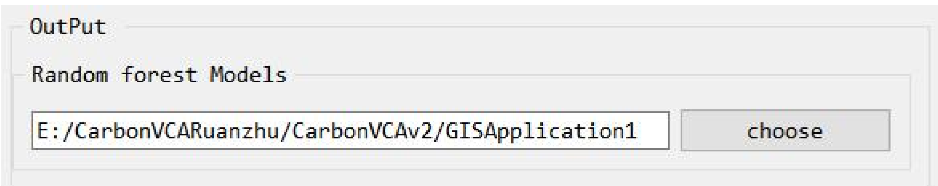
Subsequently, the user can select other parameters of the random forest model: the number of decision trees and the proportion of data sets involved in the operation. (Default value: number of decision trees = 80, scale is 5%) as shown in the following figure:



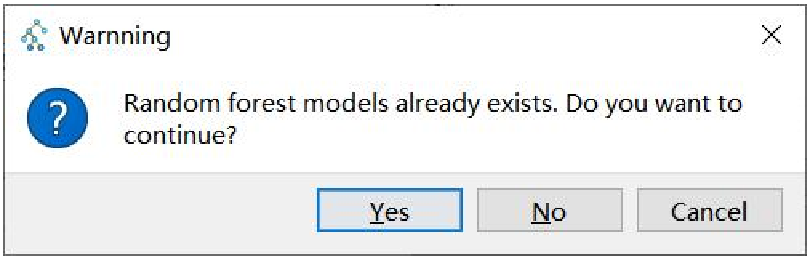

Next, the user needs to select the secondary category to be trained, the field name of the secondary category, the primary category, and the impact factor (here is the impact factor of carbon emissions) in the "Class Relation" section. As shown in the following figure:




Finally, the user needs to select the output folder to store the trained random forest model. Click "choose" to select the folder to be stored. As shown in the following figure:




If there is a previously trained random forest model in the folder, the pop-up window will appear.




If "Yes" is selected, all model data in the folder will be overwritten; if "No or Cancel" is selected, you need to reselect another folder.

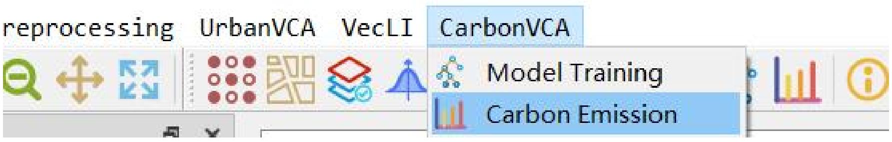
Click "Run" to start training the random forest model.

In addition, the user can observe the operation of the function in the log status bar.

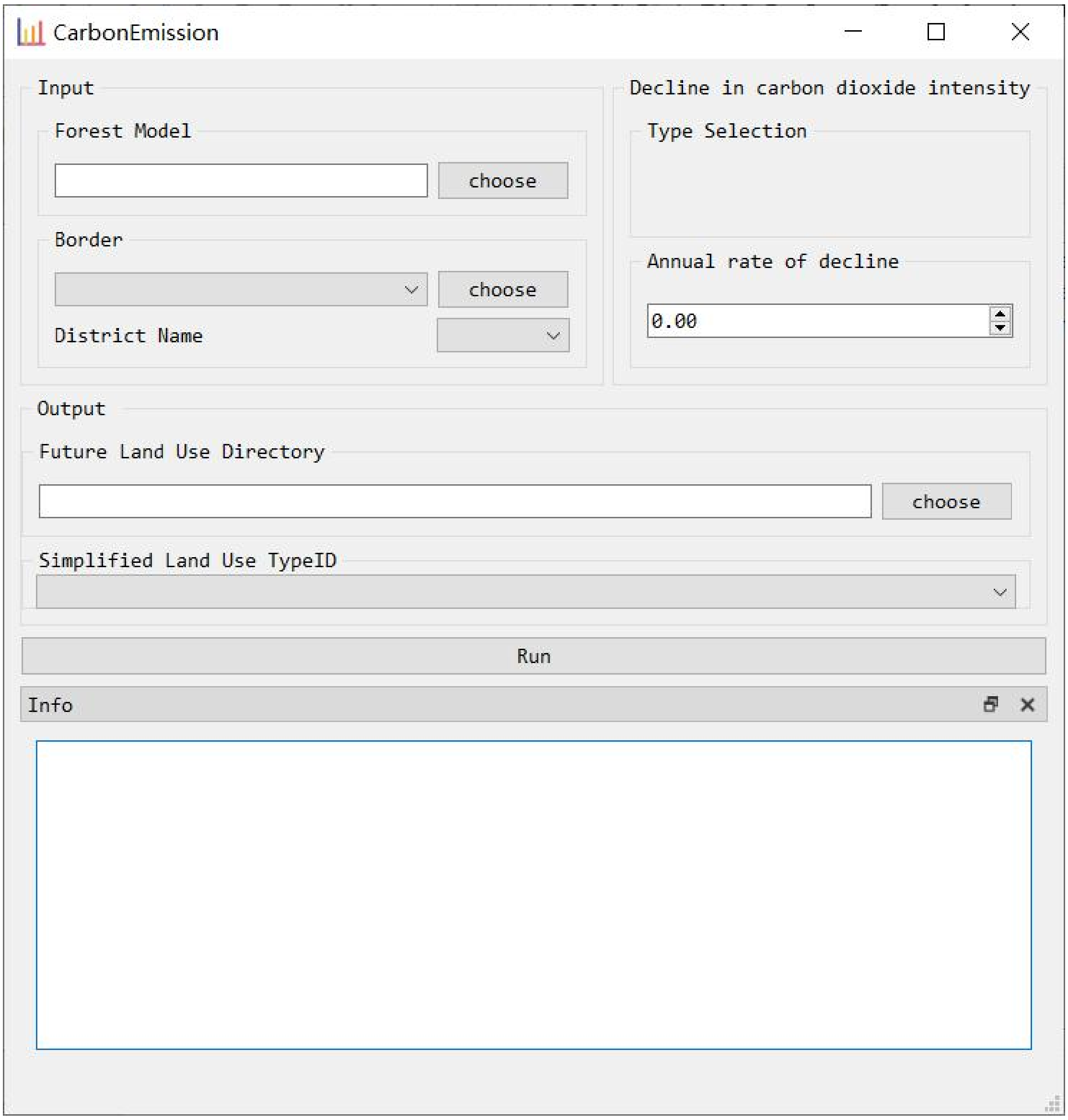

## 7.2 Carbon emission prediction calculation module

### 7.2.1 Function selection

Click "Carbon VCA" in the menu bar and select "Carbon Emission" in the pop-up menu.

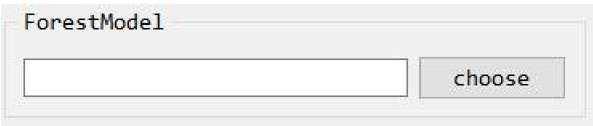



We can also open the function of predicting carbon emissions through the "Carbon Emission" button  in the toolbar. As shown in the following figure:

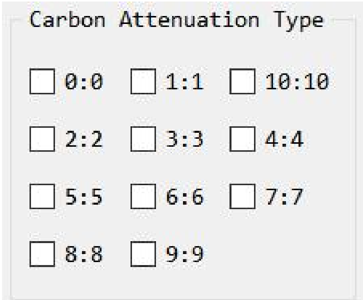



## 7.2.2 Predicting and calculating carbon emission

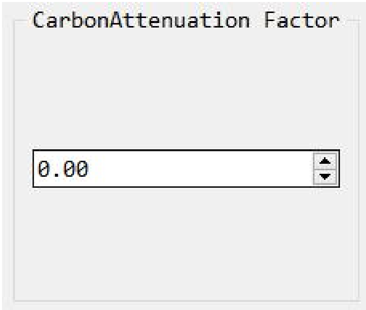
First, select the folder containing the trained random forest model.



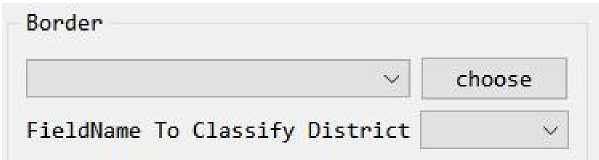

At this time, the secondary land use of the model will appear in the "Carbon Attenuation Type" plate on the right, as shown in the following figure:



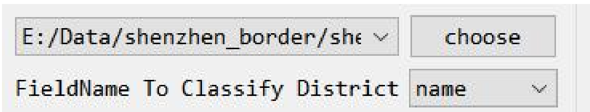

If a secondary land use has emission reduction policies or requirements, you can check the serial number corresponding to the land use, and enter the emission reduction ratio in the "CarbonAttenuation Factor" "plate below (0% by default).




Then, the user needs to select the boundary vector data (such as division data) of the training area of the model.



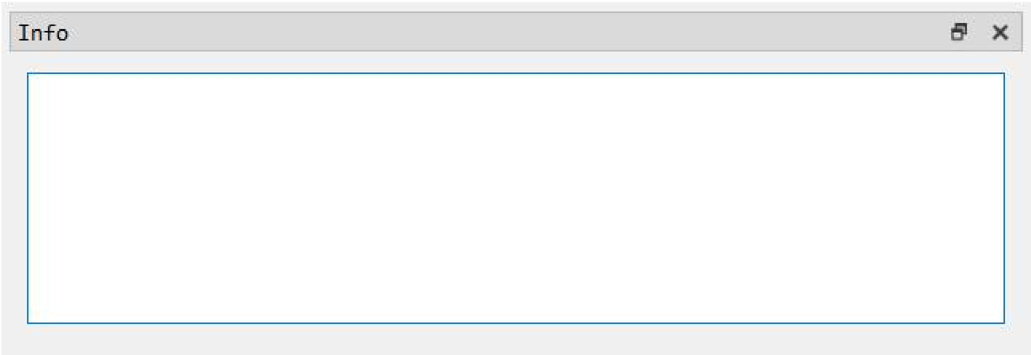

After selecting the boundary vector data, the required boundary field can be found in the drop-down box below. As shown in the following figure:



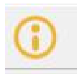

Finally, the user needs to select the output folder (the folder should contain the vector data to be predicted, such as the land use data to be predicted in the next five years), and select the field name of its first-level classification.


Click the "Run" button to start running.

In addition, the user can observe the operation of the function in the log status bar.




# 8. About Us

You can learn the Introduce about us through the "About Us" button  in the toolbar. As shown in the following figure: