CarbonVCA

CarbonVCA

Instructions for use



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HPSCIL <u>https://www.urbancomp.net/</u>

Catalog

1.	Prod	luct intro	oduction	1
	1.1	Produ	act introduction	1
	1.2	Use o	bjects	1
	1.3	Instal	lation method	1
	1.4	Interf	ace display effect	1
	1.5	Softw	vare control description	2
		1.5.1	Menu bar	2
		1.5.2	Toolbar	2
		1.5.3	Data directory module	2
		1.5.4	Image processing tool module	.10
		1.5.5	Data visualization area	11
		1.5.6	Function dialog box	11
		1.5.7	Exception prompt dialog box	12
2.	File	module		13
	2.1	Open	the vector file	13
	2.2	Open	the grid file	13
	2.3	Open	the folder	14
3.	Viev	v modul	e	15
	3.1	Сору	coordinates	15
	3.2	Zoom	n function	16
	3.3	Trans	late the image	16
	3.4	Zoom	n to Full Image	.16
4.	Data	n preproc	cessing module	16
	4.1	Land	Use Reclassification	16
		4.1.1	Function selection	.16
		4.1.2	Land Use Reclassification	.17
	4.2	Vecto	or dynamic block splitting function	18
		4.2.1	Function selection	.18
		4.2.2	Vector dynamic block splitting	.20
	4.3	Land	use data matching function	21
		4.3.1	Function selection	.21
		4.3.2	Land use data matching	23
	4.4	Raste	r image rendering function	24
		4.4.1	Function selection	.24
		4.4.2	Image normalization	25
	4.5	Raste	r image resampling function	.27
		4.5.1	Function selection	.27
		4.5.2	Image resampling	27
5.	Urba	an VCA	module	.28
	5.1	Overa	all development probability calculation module	.28
		5.1.1	Function selection	.28
		5.1.2	Calculation of overall development probability	29
	5.2	Urbar	1VCA simulation module	33
		5.2.1	Function selection	.33
		5.2.2	UrbanVCA model simulation	34
6.	Vecl	LI modu	ıle	.38
	6.1	Vecto	or landscape index calculation module	.38
		6.1.1	Function selection	.38

	6.1.2	Calculation of vector landscape index	
7.	CarbonVC	A module	41
	7.1 Train	ning random forest module	41
	7.1.1	Function selection	41
	7.1.2	Training random forest model	
	7.2 Carb	oon emission prediction calculation module	
	7.2.1	Function selection	
	7.2.2	Predicting and calculating carbon emission	
		6 6	

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

[] [] () () () () () () () () () () () () ()	GeoProcessing	8
Vector Layer Raster Layer	<pre>> Vector General > Vector Geometry > Vector Creation</pre>	Vector 👪 Raster

1.5Software control description

1.5.1 Menu bar

The menu bar contains the following 6 sections: "File", "View", "Data Preprocessing", "UrbanVCA", "VecLI", "CarbonVCA". File View Data Preprocessing UrbanVCA VecLI CarbonVCA DR PR C Q + R Preprocessing UrbanVCA VecLI CarbonVCA C Q + R Preprocessing UrbanVCA VecLI CarbonVCA

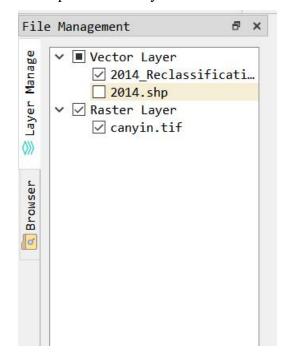
1.5.2 Toolbar

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".

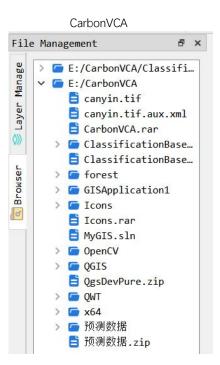


1.5.3 Data directory module

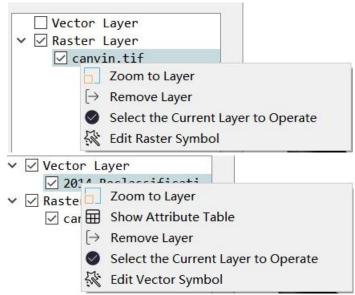
This area is used to display the opened data and perform some of the basic functions of GIS. The "Layer Manage" section contains two parts, "Vector Data" and "Grid Data", which are used to display the data that has been imported into the system.



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



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:

At	tribute Tab	le											?	× ×
	TypeID	ORIG_FID	AREA_1	GYRATE	PARA	FRAC	CIRCLE	NCA	CAI	ECON	ENN	SIMI	PROX	SHD]
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.

roperty	Symbolization	Annotation			
Name: 20	14_Reclassificati	on.shp			^
Path: E:	/CarbonVCA/Classi	ficationBaseDat	ta/		
2014_Rec	lassification.shp	6			
Storage:	ESRI Shapefile				
Geometry	: 3				
CRS: EPS	G:4326 - WGS 84 -	Geographic			
Extent:	((781341, 2.48086	e+06);(872507,	2.53216e+0	((6)	
Feature	count: 63221	201		22	
Field:Ty	peID				
	G_FID				
ARE	A_1				
GYR	ATE				
PAR	A				
FRA					
CIR	5.555 PM				
NCA					
CAT					~

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:

Symboli	zation				.030		j.	
roperty	Symbo	olization	Ann	otation				
Setup Co	orrespon	ding Colors	and	Values for	Each La	and Use	Type	
Classif	ication	1					\sim	
Value	TypeID			v				
Label	TypeID						~	
Land Us	se Code	Land Use T	ype	Color Selecti	on	Color		
-	Classify			Del	ete All	L		
	,				and the second se	501 50		

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:

Prop	erty	Symbol	ization Ann	otation		
Set	up Co	orrespondi	ng Colors and	Values for Each	n Land <mark>U</mark> se	Type
C1	assif	ication				\sim
Value TypeID						\sim
Lał	pel	ORIG_FID	8			\sim
	.and	Use Code	.and Use Type	Color Selection	Color	^
1	0		1	Set Color		
2	1		2	Set Color		
3	2		3	Set Color		
	9	Classify		Delete	A11	~
				ОК	Cance	

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

CarbonV	CA
Select the color of this label	×
Basic colors	•
Custom colors	Hug: 341 • Red: 101 • Sat: 235 • Green: 8 • Val: 101 • Blue: 36 • Alpha channel: 255 •
	OK Cancel

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:

Symboliza	uon					
Property	Symbolization	Annotation				
Annotatio Annotatio						
TypeID				~		
Annotatio	n Style:					
Font		SimSun		^		
Size		9				
Color						
Bold		0				
Italics		0		~		

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:

Select Font			>
Cont		<u>Font sty</u> le	Size
AcadEref		Regular	9
AcadEref	^	Regular	6 ^
Agency FB			7
AIGDT			8
Algerian	~		9
<	>		10 🗸
Effects		Sample	
☐ Stri <u>k</u> eout ☐ <u>U</u> nderline		AgE	3b¥yZz
/r <u>i</u> ting System			
Any	~		L.

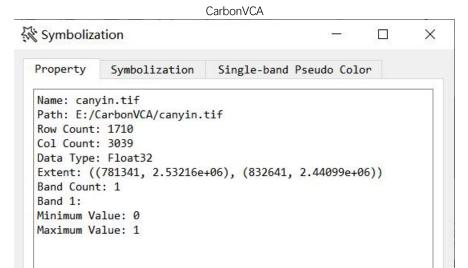
Click the "Color" attribute in the previous interface to open the interface as shown below:

🕅 Select the color of this label	×
Basic colors	+
Custom colors	Hu <u>e</u> : 285 ♣ Red: 169 ♣ Sat: 70 ♣ Green: 131 ♣ Yal: 181 ♣ Blue: 181 ♣ Alpha channel: 255 ♣ HTML: #a983b5
	OK Cancel

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

roperty Sy	vmbolization	Single-band P	seudo Color	
Display				
Red Band	Band 1			~
Maximum	1.00	Minimum	0.00	\$
Green Band	Band 1			\sim
Maximum	1.00	Minimum	0.00	
Blue Band	Band 1			~
Maximum	1.00	Minimum	0.00	\$
Lredneucy Bredne	0.5 Piv	1 1.5		
ò	0.5 Pix	i 1.5 cel Value	2	

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

CarbonVCA

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

	mboliza						
Pro	perty	Symboliz	ation	Single-band F	^o seudo Col	or	
Pr	opertie	es (Double	click	to change)			
		Code		Condition	Co	olor	
1	0		> 0				
2	0.25		> 0.	.25			
3	0.5		> 0	.5			
4	0.75		> 0	.75			
Numb	per of	Categories	5				

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;

🐼 Input Code	?	×
Please enter the code of this raster (E:	/CarbonVCA/canyi	n.tif)
	OK Can	icel

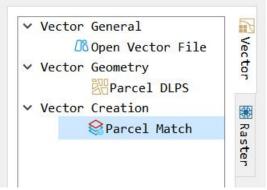
Double-click Color to modify the color of the range, and the following window appears:

CarbonV	/CA
👫 Select the color of this label	×
Basic colors	+
Custom colors	Hue: 145 • Red: 64 • Sat: 182 • Green: 224 • Val: 224 • Blue: 133 • Alpha channel: 255 •
	OK Cancel

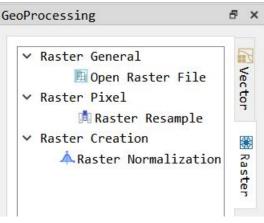
Click "OK" to change the color of the range.

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 ".

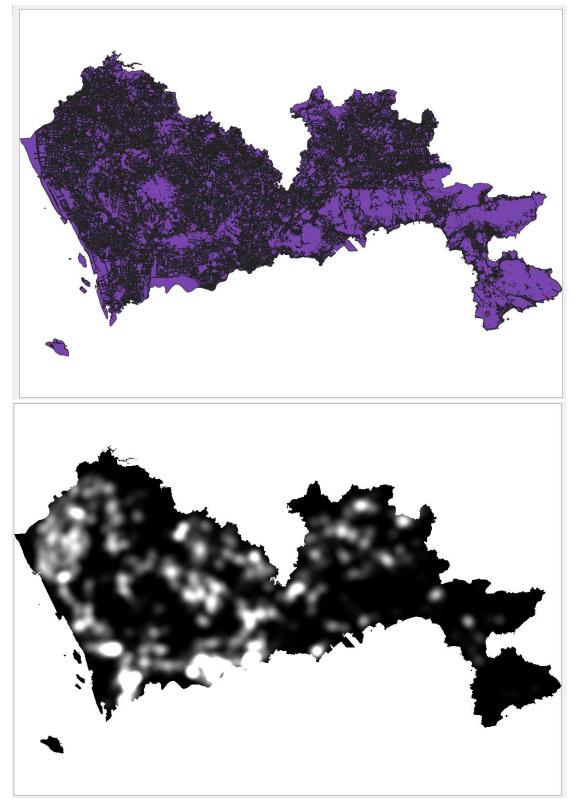


The Raster section displays the following functions: Open Raster File ", Raster Resample", and Raster Normalization ".



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:



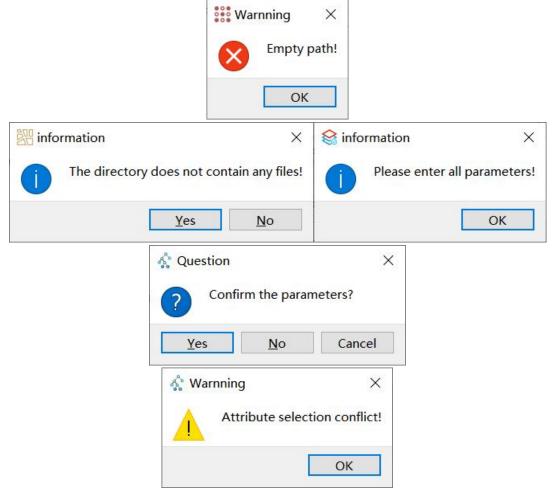
1.5.6 Function dialog box

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

く 修改日期 2022/3/13 2023/4/9 2023/4/9	15:40		and the second
2022/3/13 2023/4/9	15:40	类型 SHP 文件 SHP 文件	大小 60,17 60,17
2022/3/13 2023/4/9	15:40	SHP 文件 SHP 文件	60,17 60,17
2023/4/9	15:40	SHP 文件	60, 1 7
			and the second
2023/4/9	15:37	SHP文件	60,17
	~	*.shp	\sim
		+TT(0)	取消
	_	~	〜 *.shp 打开(O)

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

2.1Open 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.

Open vector file						×
1	« Carl	bonVCA > ClassificationBaseData	~	Ö		nBaseData
组织 • 新建文件	夹				•	
狊 此电脑	^	名称	修改日期		类型	大小
🧊 3D 对象		Q 20144.shp	2022/3/13	3 17:04	SHP文件	60,17
视频		Q 2014_Reclassification.shp	2023/4/9	15:40	SHP文件	60,17
■ 图片		🔇 2014.shp	2023/4/9	15:37	SHP文件	60,17
🖹 文档	100					
➡ 下载						
♪ 音乐						
💻 桌面						
Uindows-SSD) (I					
🥪 Data (D:)						
🧅 新加卷 (E:)						
	~	<				2
	文件名	5(N):		~	*.shp	~
					打开(O)	取消

2.2Open 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.

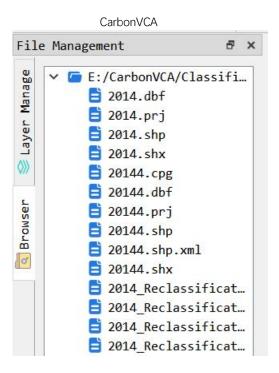
Open raster file				×
- → 丶 ↑ 📜 > 此电	脑 〉 新加卷 (E:) 〉 CarbonVCA 〉	ٽ ~		搜索
组织 • 新建文件夹				. 0
▶ 此电脑	名称 ^	修改日期	类型	大小
🧊 3D 对象	.vs	2022/7/21 21:30	文件夹	
🚽 视频	ClassificationBaseData	2023/4/9 15:40	文件夹	
▶ 图片	forest	2023/5/4 13:54	文件夹	
■ 文档	GISApplication1	2023/5/3 14:31	文件夹	
	Icons	2022/6/3 19:25	文件夹	
♪ 音乐	OpenCV	2023/4/7 20:54	文件夹	
	QGIS	2022/8/10 19:32	文件夹	
Windows-SSD (QWT	2023/4/7 21:28	文件夹	
	x64	2023/4/12 20:22	文件夹	
Data (D:)	● 预测数据	2023/4/17 14:37	文件夹	20.5
→新加卷 (E:)	📑 canyin.tif	2023/4/10 23:36	TIF 图片文件	20,5
文件名	(N): canyin.tif	~	remote sensing image	e(*.tif *. ~
			打开(O)	取消

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 for 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.

→	arbonVCAv2 > GISApplication1 >	~	Ö		tion1 中搜索
目织▼ 新建文件夹					
▶ 此电脑	名称	修改日期		类型	大小
🧊 3D 对象	📕 Alglib	2023/4/17	20:22	文件夹	
🚪 视频	📕 Icons	2023/4/23	14:34	文件夹	
■ 图片	QWT	2023/5/3 1	9:10	文件夹	
🗎 文档	📕 x64	2023/5/3 2	0:46	文件夹	
➡ 下载					
♪ 音乐					
三 桌面					
🐛 Windows-SSD (
🥪 Data (D:)					
🧅 新加卷 (E:)					
	<				
\ \ \ \ \ \ \	·				

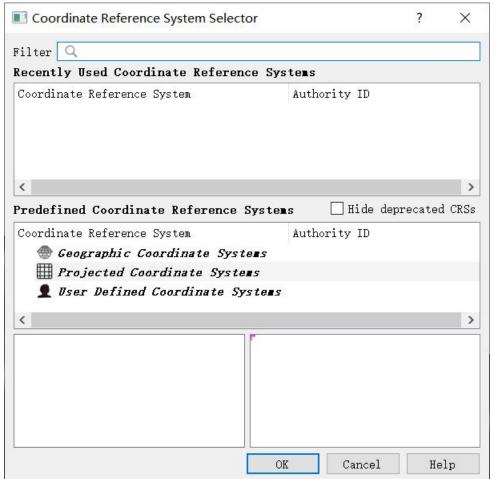


3. View module

3.1Copy coordinates

This section requires the user to click the right mouse button Copy Coordinate on the displayed picture.

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



3.2Zoom 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 votice 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.

3.3Translate 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.

3.4Zoom to Full Image

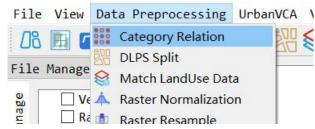
This section is used to zoom to the current image in the system. Click "View/Full Extent" in the toolbar of the initial interface of the system or click the button to zoom to the current image.

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:

	CarbonVCA		
Category Relat	tion	 .	
Input Parameter			
		~	Input File
		~	Confirm
			Output File
Category Name	Value		
category name	Value		
Caregory Hame	Value		
Caregory Hame	Value		
Caregory Hame	Value		

4.1.2 Land Use Reclassification

The user selects the button Input File and selects the vector file in the pop-up dialog box, as shown in the following figure:

E:/CarbonVCA/ClassificationBaseData/ ~ I	Input File
--	------------

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

TypeID	~	Confirm
TypeID ORIG FID	^	Output File
AREA_1		<u>H</u>
GYRATE		
PARA		
FRAC		
CIRCLE		
NCA		
CAI		
ECON	~	

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:

Category Relat	ion –	.			>
Input Parameter					
E:/CarbonVCA/C	lassificationBaseData/ \	/	[nput	Fil	.e
subClsNum	8	-	Conf	irm	S.
		0	utput	Fi	le
Category Name ✔ 2014_Recla…	Value				^
8	0.00000			+	
2	0.00000			-	
1	0.00000			\$	
7	0.00000			\$	
9	0.00000			\$	
	0.00000			-	
6				-	
6 5	0.00000				1
	0.00000 0.00000			-	~

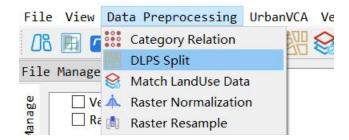
The user needs to fill in according to the specific value of the land use type. The system will re-classify according to the value filled in by the user to obtain SuperClass.

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:

arbon	VCA				
			0. 10		\times
				•••	
nocla	verifiest	ion			
recia	155111040	.101			~
			1		-
		Custom	Threshol	Ld	
0	,				
Run D	L <mark>PS</mark>				
				đ	×
	recla		reclassification Custom		- C

UrbanVCA: Real Parcel Based Urban Land Use Change Simulation and Prediction System Instructions for Use 12

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:

DLPS Parameters	
nput data before DLPS spliting:	
Output data after DLPS spliting:	

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:

→ 🔺 ↑ 📙 « Car	bonVCA > ClassificationBaseData	~	Ö	○ 在 Classification	BaseData
且织▼ 新建文件夹				∎=== ▼	. ?
▶ 此电脑	名称	修改日期		类型	大小
🧊 3D 对象	Q 20144.shp	2022/3/13	3 17:04	SHP 文件	60,17
📲 视频	Q 2014_Reclassification.shp	2023/4/9	15:40	SHP 文件	60,17
▶ 图片	Q 2014.shp	2023/4/9	15:37	SHP文件	60,17
🖹 文档					
➡ 下载					
♪ 音乐					
■ 桌面					
🐛 Windows-SSD (
🥪 Data (D:)					
新加卷 (E:)					
	<				
			~	shp(*.shp)	~

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:

UrbanVCA: Real Parcel Based Urban L for Use 14	and Use Change Simulation and Prediction System Instructio
- Field name of land use type after rec	:lassification
TypeID	~
Max iteration	1
Statistical Threshold	Custom Threshold
Max parcel area	0

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):

• button to spli
" button to spli
<u>+</u>
og status bar.
ē ×

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

or Use 14	 	
😪 LanduseMatch		\times
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		
		\sim
Output the data after matching		
Match		
Info		ð ×
10		14

UrbanVCA: Real Parcel Based Urban Land Use Change Simulation and Prediction System Instructions for Use 14

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.

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	
	~

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.

Output the data after matching	

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 type, 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	Pg0	Pg1	Pg2	Pg3	Pq4	N0	N1
0	4	4	4	1	995.242	14.047	2.624	0.00000	0.00000	0.01000	0.00000	0.00000	226.58650	65.1
1	2	2	2	1	1931.316	4.353	. 6.845	0.00000	0.00000	0.00000	0.00000	0.00000	156.29756	63.2
2	4	4	4	1	31470.403	1.390	7.615	0.00000	0.00000	0.00000	0.00000	0.00000	82.63017	117.1
3	4	4	4	1	180.024	4.665	0.527	0.00000	0.00000	0.00000	0.00000	0.00000	134.11854	113.1
4	0	0	0	1	5632.520	9.798	'1.302	0.00000	0.00000	0.00000	0.00000	0.00000	193.86280	43.0
5	0	0	0	1	14002.342	6.702	5.212	0.00000	0.02000	0.00000	0.00000	0.00000	137.03221	50.3
6	4	4	4	1	828.783	9.683	6.478	0.01000	0.00000	0.00000	0.00000	0.00000	130.62466	31.2
7	0	0	0	1	791.812	3.932	3.411	0.00000	0.00000	0.00000	0.00000	0.00000	154.73698	0.0
8	4	4	4	1	21152.570	5.499	4,771	0.00000	0.00000	0.00000	0.00000	0.00000	152,85248	14.0

(Image from QGIS)

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

info	5	×
0		

4.4 Raster 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:

d files to t	his module	e to normalise t	he various type	es of single ba	nd data.			
ote: Select Pending File		and press the de	lete key to del	lete)				
Path N	ame	Data Type	Width	Height	Band Count	Finish		
Output Path							 	

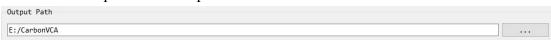
4.4.2 Image normalization

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.

Path	Name	Data Type	Width	Height	Band Count	Finish
1 E:/CarbonVCA/canyin.tif	canyin.tif	Float32	3039	1710	1	False
						1.

Select the folder path for the output.



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

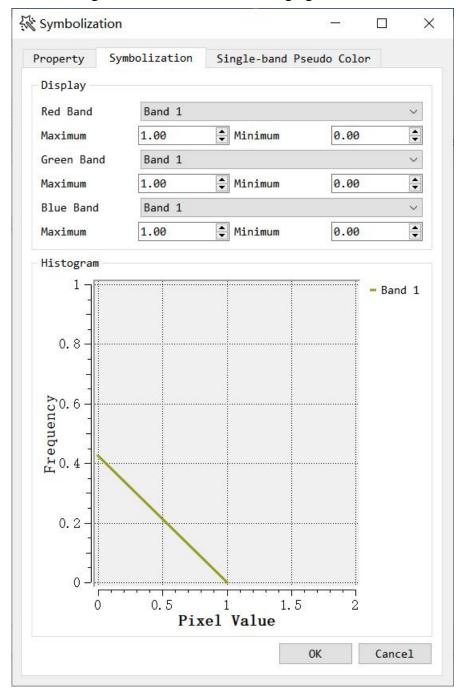
folder.

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

Pending Files

Path	Name	Data Type	Width	Height	Band Count	Finish
E:/CarbonVCA/canyin.ti	f canyin.tif	Float32	3039	1710	1	True

The normalized image data is shown in the following figure:



4.5 Raster 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:

		- 🗆 X
ange.	image and change the resolution without changin , select the file and press delete to remove in	
Path Name Data Type Width Height Band Cour	nt Finish	
Target Paras		
Target Paras Width	1	\$
	1	¢
Width		
Width Height		

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:

	Path	Name	Data Type	Width	Height	Band Count	Finish
1 E:	/CarbonVCA/canyin.tif	canyin.tif	Float32	3039	1710	1	False
2 E:	/CarbonVCA/normalize_canyin.tif	normalize_canyin.tif	Float32	3039	1710	1	False
3 D:	/geodata/Data mosaic/mosaic.tif	mosaic.tif	Byte	1368	865	7	False

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:

lidth	1368	
leight	865	
alact a falder for the output		
elect a folder for the outpu	L.	

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.

Preprocessing	UrbanVCA	VecLI	CarbonVCA
Θ ↔ 53	🕐 Calcula	ting Pg	
	🌔 UrbanV	/CA	

We can also open the overall development probability calculation function through

the toolbar "Calculating Pg" button, as shown in the following figure:

Spatial auxiliary v	variables (.tif)			
	5.25	ages Path		
	1			
				•••
Setting parameters				
Data after matching	g (.shp)			
			1	
Mining method of ov	verall probabilit	y of development (Pg)		
Random Forest				~
00B ratio:	0.30	Number of hidden layers		-
Number of trees:	90	Number of restarts:	10	-
		Number of folds in k-fold	d cross-validation	: 10 🗘
Output / Input Pg t	cext data (.csv)			
				•••
utput Pg data (.shp)			
		Calculate		
Info				8 X

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:

```
Spatial auxiliary variables (.tif)
```

Images Path	
D:/geodata/LC08_L1TP_123039_20191020_20191030_01_T1/ LC08_L1TP_123039_20191020_20191030_01_T1_B1.TIF	
D:/geodata/LC08_L1TP_123039_20191020_20191030_01_T1/ LC08_L1TP_123039_20191020_20191030_01_T1_B2.TIF	
D:/geodata/LC08_L1TP_123039_20191020_20191030_01_T1/ LC08_L1TP_123039_20191020_20191030_01_T1_B3.TIF	

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

Setting parameters	
Data after matching (.shp)	

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:

Mining method of overall probability of development (P	g)
Random Forest	~
Random Forest	
Neural Network	
Logistic Regression	
Existing Pg text data	

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:

Number of trees: 90 Number of folds in k-fold cross-validation: 10	00B ratio:	0.30	Number of hidden layers:	10	
	Number of trees:	90			10
				cross formation	

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:

Output / Input Pg text data (.csv)

....

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:

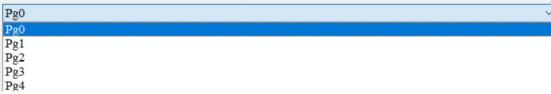
Output Pg data (.shp)	
Calculat	

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:

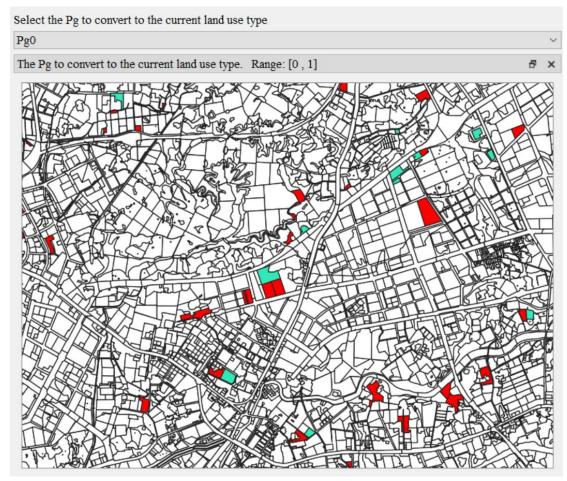
LandusePgs	8 8		
Pgs Compute Pgs Visualization			
elect the Pg to convert to the current land use type			
			2
he Pg to convert to the current land use type. Range: [0 , 1]		8)

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

Select the Pg to convert	to the current	land use type
--------------------------	----------------	---------------



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.

8 x

Info

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.

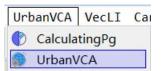
CarbonVCA PAGE * MERGEFORMAT2

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)					

5.2UrbanVCA 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:

CarbonVCA PAGE * MERGEFORMAT2

NCA	Paras	Assure of European			
	raras	Accuracy Evaluati	on		
Parameter settings					
Data after calculatin	g Pg (.shp)		_		
Neighborhood radius:		600.00			
Iteration times:		1			4
Restricted developmen	t data (.shp) <mark>(</mark> Optional)				
-					
Land use devel	opment needs (area)	Conversation rules			
Default	O Portion	○ Total			
		area of land use change from column	to r	ow.	
		area of land use change from column	to r	ow.	
		area of land use change from column	to r	ow.	
		area of land use change from column Run	to r		
Info: The values in Output Simulation / P			tor	•••	5
				•••	51
			to r	•••	j
			to r	•••	
				•••	5
				•••	
				•••	

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:

Data after calculating Pg (.shp)		
Neighborhood radius:	600.00	•
Iteration times:	1	•

Land use	e development nee	ds (area) Conv	ersation rules			
Defa	ult	○ Portic	on	○ Total		
	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 Y
<						>

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

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).

```
Restricted development data (.shp) (Optional)
```

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.

) Defau	ult	O Po	ortion	C) Total	
Land use	e development nee	ds (area) Conv	ersation rules			
🔵 Defa	ult	Portion	on	○ Total		
	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	19 ¥

) Defa	ult		○ Portion		Total	
		Type 1	Type 2	Type 3	Type 4	Total
Type 0		13871571.440	10241911.247	919757.837	7609403.378	32642643.902
Type 1	5	0.000	185780.324	37428.183	2531932.370	31843207.162
Type 2	i4	1165600.783	0.000	108944.163	3643784.605	53709487.415
Type 3	8	523300.357	102978.473	0.000	1178870.347	13747327.215

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.

Land use d	evelopment nee	ds (area) Con	nversation rules		
	Type 0	Type 1	Type 2	Туре 3	Type 4
Type 0	/	True	True	True	True
Type 1	True	/	True	True	True
Type 2	True	True	1	True	True
Type 3	True	False	True	/	True
Type 4	True	True	True	True	1

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.

utput Simulation / Prediction dataset	
Run	

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.

8 ×

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:

|--|

LanduseVCA					8 7 - 83	>
Accuracy evaluat	VCA Paras			Accuracy Eva	luation	
Iteration	FoM	PA	UA	Карра	OA	
		Export accur	acy table (.csv	/)		

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	7	on
the toolbar, as shown in the following figure:		

InputFile VecLI Metrics AREA VCA PROX	FRAC		~	Choose	
🗹 AREA 🗹 NCA	and the second sec				
	and the second sec	C. CVD ATC			
Transfer Street St		GYRATE			
		ECON	ENN	SIMI	
PRUX	SHDI	🗹 SIDI	MSIDI	SHEI	
SIEI	MSIEI				
Type					
			~	confirm	
ECON CSVFile					
				Choose	
Output					
			~	Choose	
		Run			
Info					8

6.1.2 Calculation of vector landscape index

First, you need to import the vector data in.shp format. Click the button Choose to select the vector data in the pop-up dialog box, as shown in the following figure:

CarbonVCA PAGE * MERGEFORMAT2

-> 🕆 🕇 📙 « Ca	arbonVCA > ClassificationBaseData	~	Ö		BaseData
1织▼ 新建文件夹				-	
▶ 此电脑	名称	修改日期		类型	大小
3D 对象	Q 20144.shp	2022/3/13	17:04	SHP 文件	60,17
📕 视频	Q 2014_Reclassification.shp	2023/4/9	15:40	SHP文件	60,17
■ 图片	Q 2014.shp	2023/4/9	15:37	SHP 文件	60,17
1 文档					
➡ 下载					
♪ 音乐					
二桌面					
🐛 Windows-SSD (
🥪 Data (D:)					
新加卷 (E:)					
	<				
\\ 14	名(N):		~	*.shp	~

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

VecLI Metrics				
	FRAC	GYRATE		CIRCLE
	IAJ 🖂	ECON	ENN ENN	SIMI
PROX	SHDI	SIDI	MSIDI	SHEI
SIEI	MSIEI			

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:

pe		
/peID	~	confirm

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.

		\sim	Choose
	Run		

8 ×

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

Info

7. CarbonVCA module

7.1 Training 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

✓ choose
➡ Tree Num
Subsampling Ratio
~
I
~
choose
ē ×

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:

Train Parcel File	
E:/CarbonVCA/ClassificationBaseData/2014_Reclass >>	choose

When the user imports the vector file, the field name of the vector data will appear in

Random Forest	Field Name			
TypeID	ORIG_FID	AREA_1	GYRATE	PARA
FRAC		NCA		ECON
ENN	SIMI	PROX	SHDI	SIDI
MSIDI	SHEI	SIEI	MSIEI	NewTypeID
CarbonFact	CarbonEmis	subClsNum	superCls	Factor

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:

80	Model:Tree Num
0.05	Fraction of the dataset to use

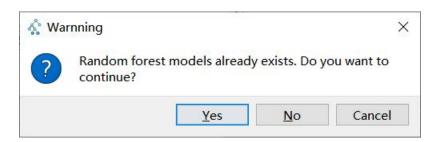
Next, the user needs to select the secondary category to be trained, the field name of the secondary category, the primary category, and the impact factor (here is the impact factor of carbon emissions) in the "Class Relation" section. As shown in the following figure:

Category Relation		
Refined Land Use TypeID & TypeName	subClsNum 🗸	TypeID \lor
Simplified Land Use TypeID	superCls	~
Carbon Emission Coefficients	Factor	~

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:

OutPut	
Random forest Models	
E:/CarbonVCARuanzhu/CarbonVCAv2/GISApplication1	choose

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.

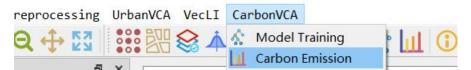
In addition, the user can observe the operation of the function in the log status bar.

Info	e >

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:

CarbonEmission			- 0	2
Input		Decline in carb	on <mark>dioxi</mark> de ir	tensit
Forest Model		Type Selection	1	
	choose	1		
	choose			
Border		Annual rate of	decline	
	✓ choose	Annual Face of	decime	
District Name	~	0.00		-
	2			
Dutput				
Future Land Use Directory				
-ucure Land Use Directory				
			cho	ose
	2		cho	ose
Simplified Land Use TypeID)		cho	
Simplified Land Use TypeID)		cho	ose ~
5implified Land Use TypeID) Run		cho	
			cho	~
Simplified Land Use TypeID			cho	
			cho	~

7.2.2 Predicting and calculating carbon emission

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

choose

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:

Carbon	Attenuat	tion Type
0:0	1:1	🗌 10:10
2:2	<mark>] 3:3</mark>	4:4
5:5	<mark>6:6</mark>	7:7
8:8	9:9	

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).

CarbonAttenuation Factor			
0.00	<u>.</u>		•

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

Border

 V
 Choose

 FieldName To Classify District
 V

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:

$\texttt{E:/Data/shenzhen_border/she} \lor$	choose	
FieldName To Classify District	name ~	

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.

OutPut	
Future Parcel Path	
E:/CarbonVCA/预测数据	choose
SuperClass Field	
simulated	~

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:

