# Simulating the driving effects of planning policies or future variables on LUCC with the PLUS model


**Team：High-performance Spatial Computational Intelligence Lab @ CUG**

**Contact：Dr. Xun Liang（liangxun@cug.edu.cn）**

**Supervised by：Prof. Qingfeng Guan（guanqf@cug.edu.cn）**

China University of Geosciences

School of Geography and Information Engineering

National Engineering Research Center of GIS

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## 3. Consider the driving effects of development zone on LUCC

Note that these functions are only integrated in PLUS v1.3.5 and later versions. Please learning tutorial A before reading this tutorial . The planning data in this tutorial is the dummy data for model test. Please don’ t regard them as real planning data.

# 01

# Methodology

01

# The update mechanism

We proposed a update mechanism of planning transport infrastructure based on random forest (RF) and a random seeding mechanism based on planning development zone, which can consider the driving effects of planning policies or future variables on LUCC into simulation。

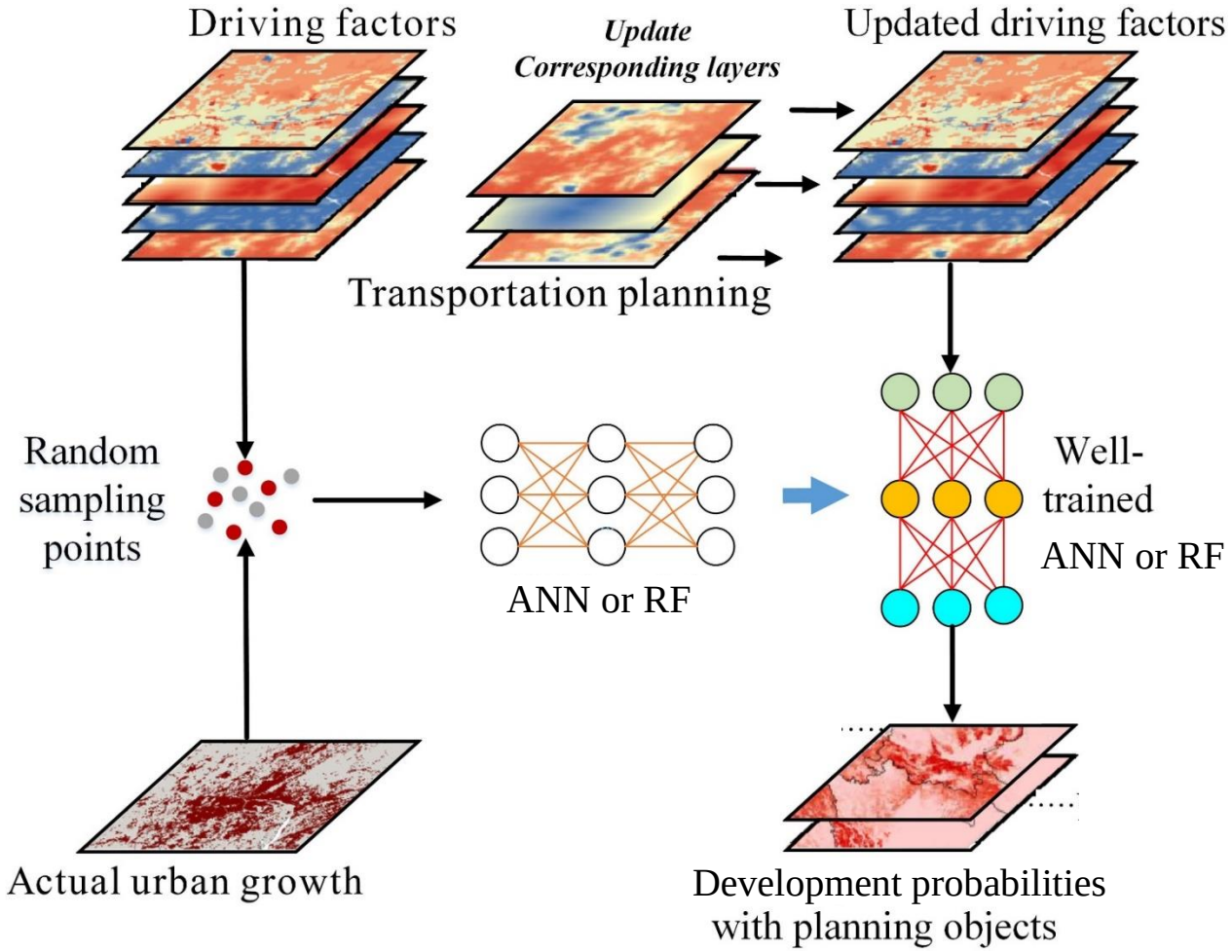
This study only consider planning policies in space， not macro-scale policies, including 1） planning traffic lines or sites and 2） planning development zone. Moreover， predicted variables exported by other models can also be imported to the PLUS model with the same way, for example, the future population, GDP, temperature, precipitation and etc.

References： Liang, X., Liu, X., Li, D., Zhao, H., Chen, G., 2018, Urban growth simulation by incorporating planning policies into a CA-based future land-use simulation model, International Journal of Geographical Information Science, 32(11): 2294-2316. . (ESI highly cited paper)

Liang X., Guan Q.*, Clarke KC, Liu S., Wang B., Yao Y., 2021. Understanding the drivers of sustainable land expansion using a patch-generating simulation (PLUS) model: A case study in Wuhan, China, Computers, Environment and Urban Systems, 85:101569

01

# The update mechanism




## Flow chart

- First, sampled land-use map data and historical driving force data are employed to train the RF.
- The driving factors that will be updated are specified in this step (only driving factors with both historical and planning schemes (or future variables) can be updated).
- In the RF prediction process, the historical driving forces in the specified layers are replaced with data that include both historical and future driving forces and output the development probabilities

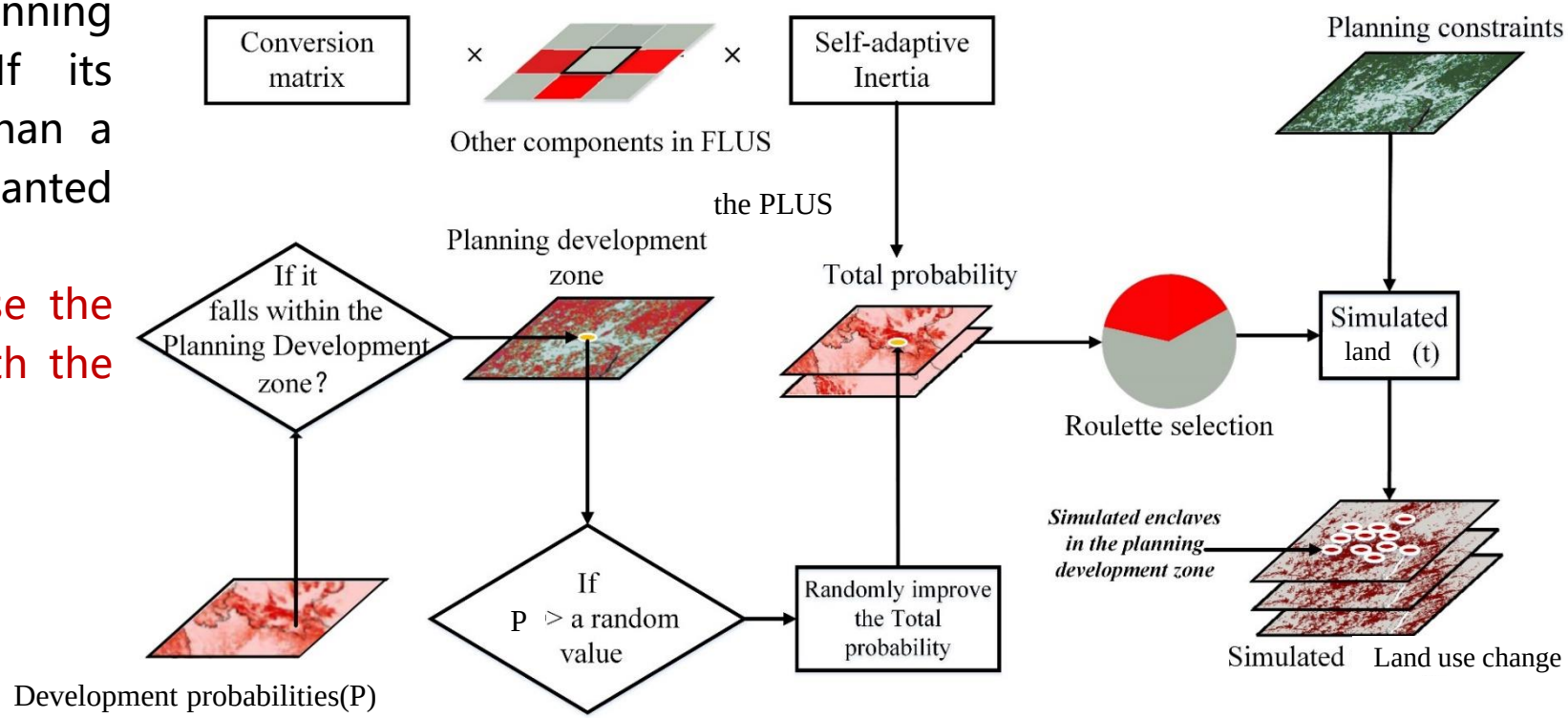
01

# The random seeding mechanism

## Flow chart

- A cell that is located in the planning development zones is selected. If its development probability is greater than a random value within [0, 1], a seed is planted in the cell.
- A planted seed will randomly increase the total probability of an urban area with the following rule:

$$TP_k = \begin{cases} r + TP_k & if\ r + TP_k \le 1 \\ 1 & if\ r + TP_k > 1 \end{cases}$$




$TP_k$ - denotes the total probability of specific land k

r - a random value within [0, 1]

# 02

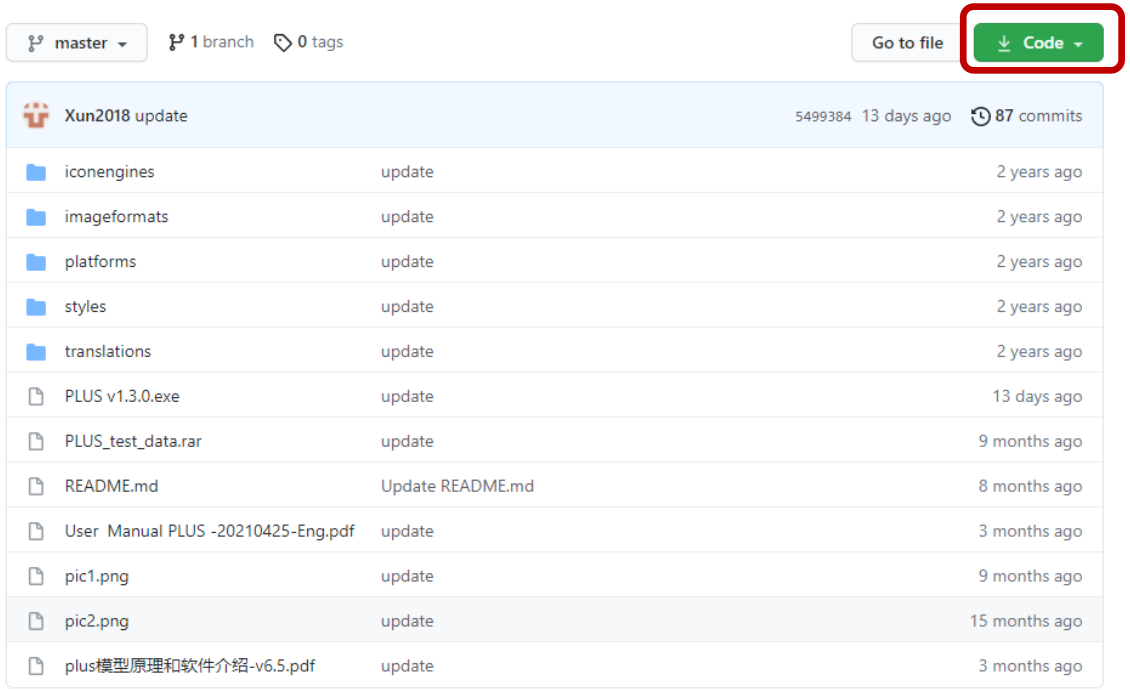
# Consider the driving effects of planning transport infrastructure on LUCC

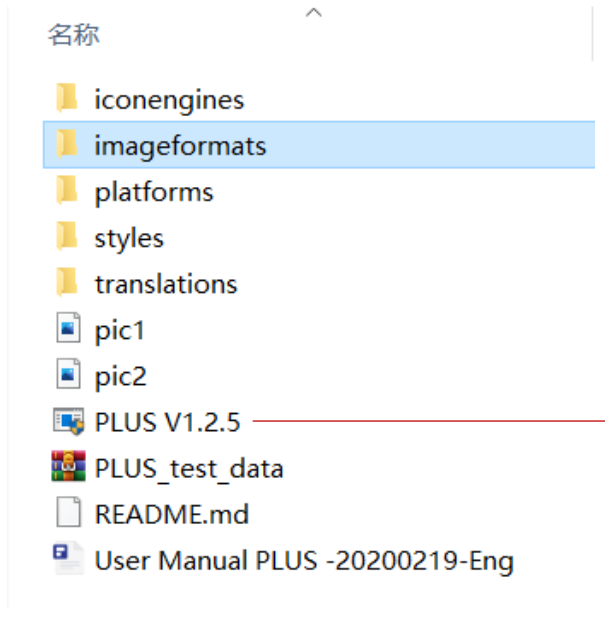
02

# Download PLUS v1.3.5

Link： https://github.com/HPSCIL/Patch-generating_Land_Use_Simulation_Model

Click here to download



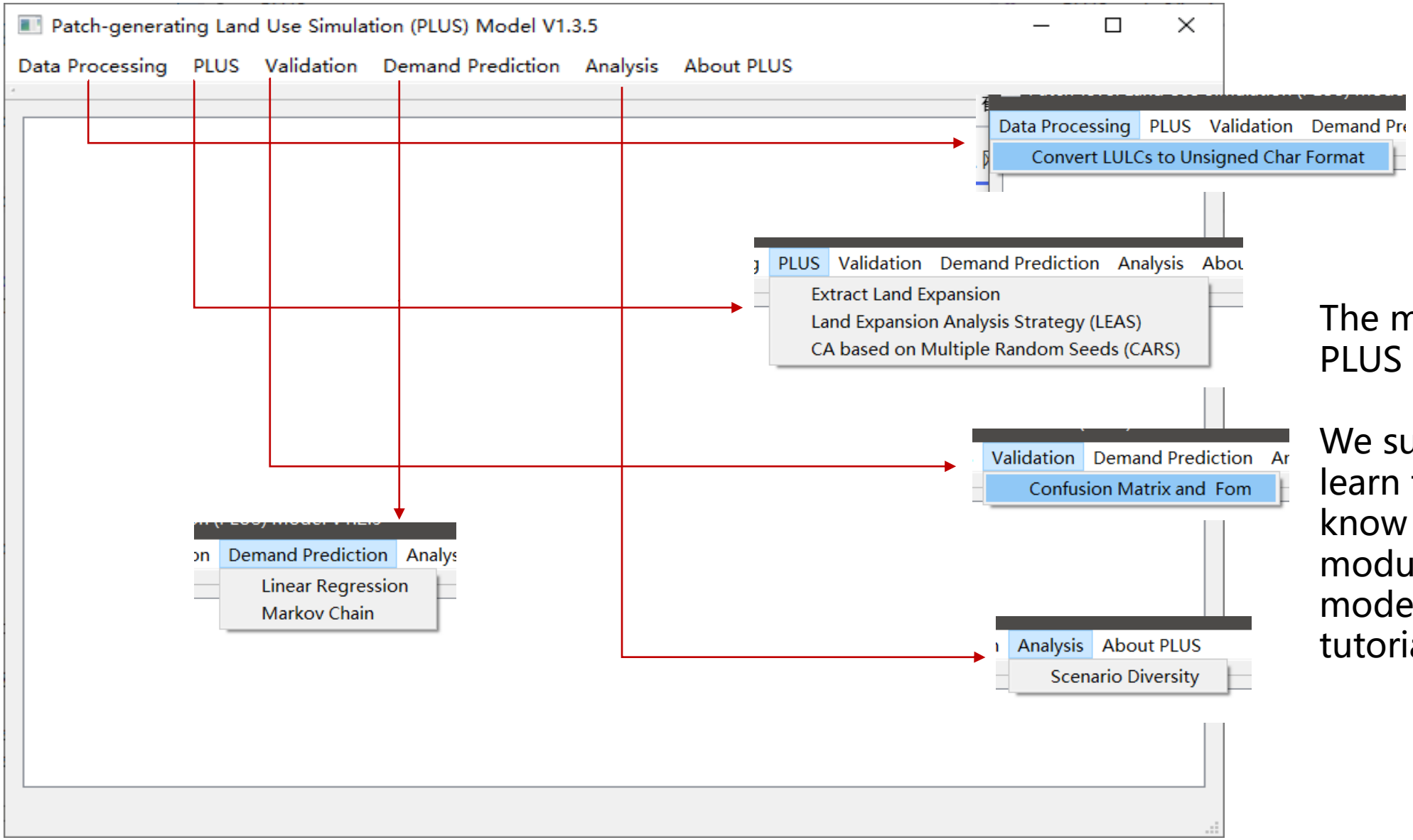




Click here to start

PLUS can run in the environment of Windows Vista/7/8/X64 without install process and the support of other software

02

# Main interface

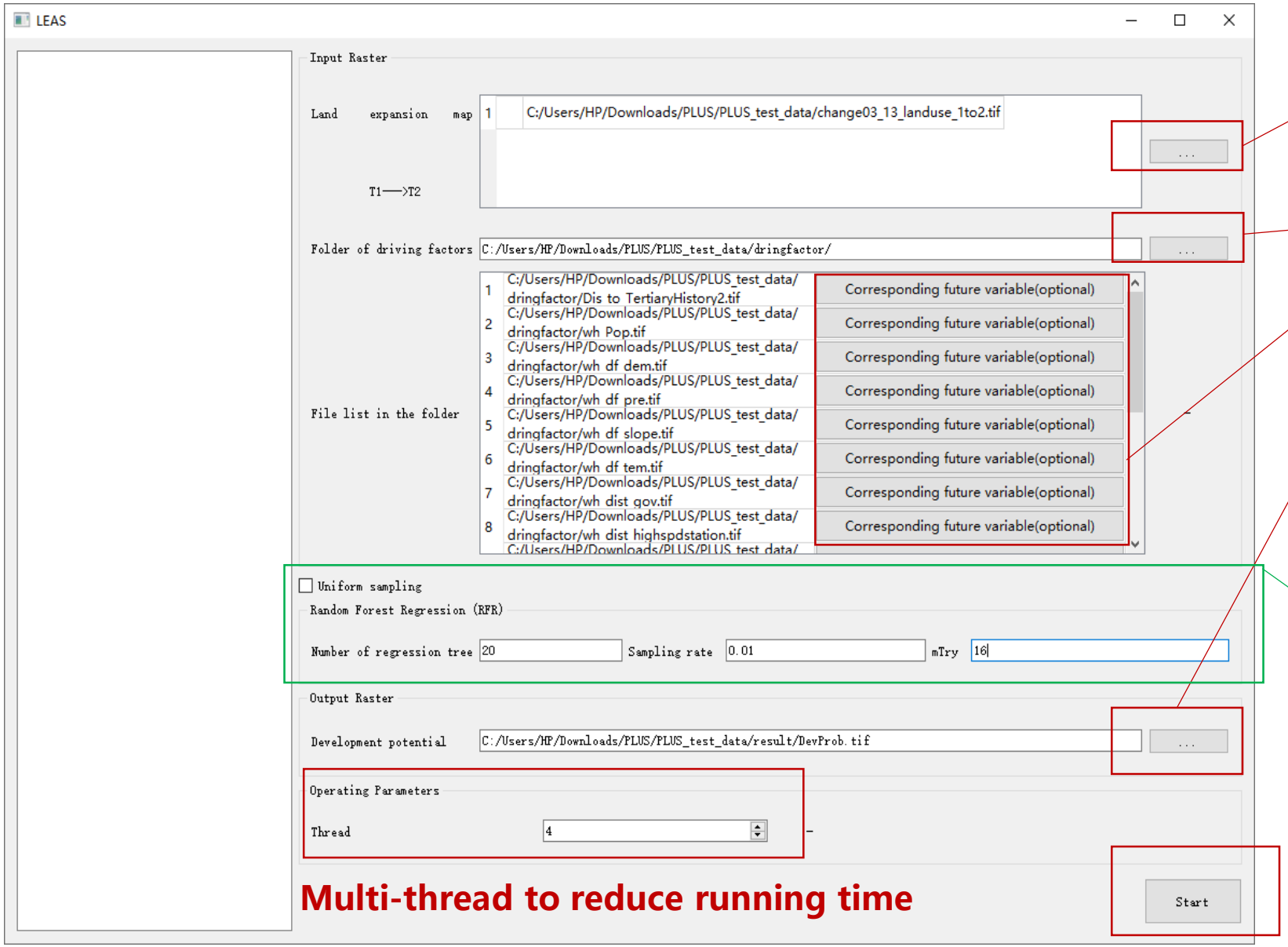



The main interface of the PLUS software.

We suggest the users learn the tutorial A to know about all the modules of the PLUS model before read this tutorial .

02

# Add in the planning traffic data




## *Input&Output*

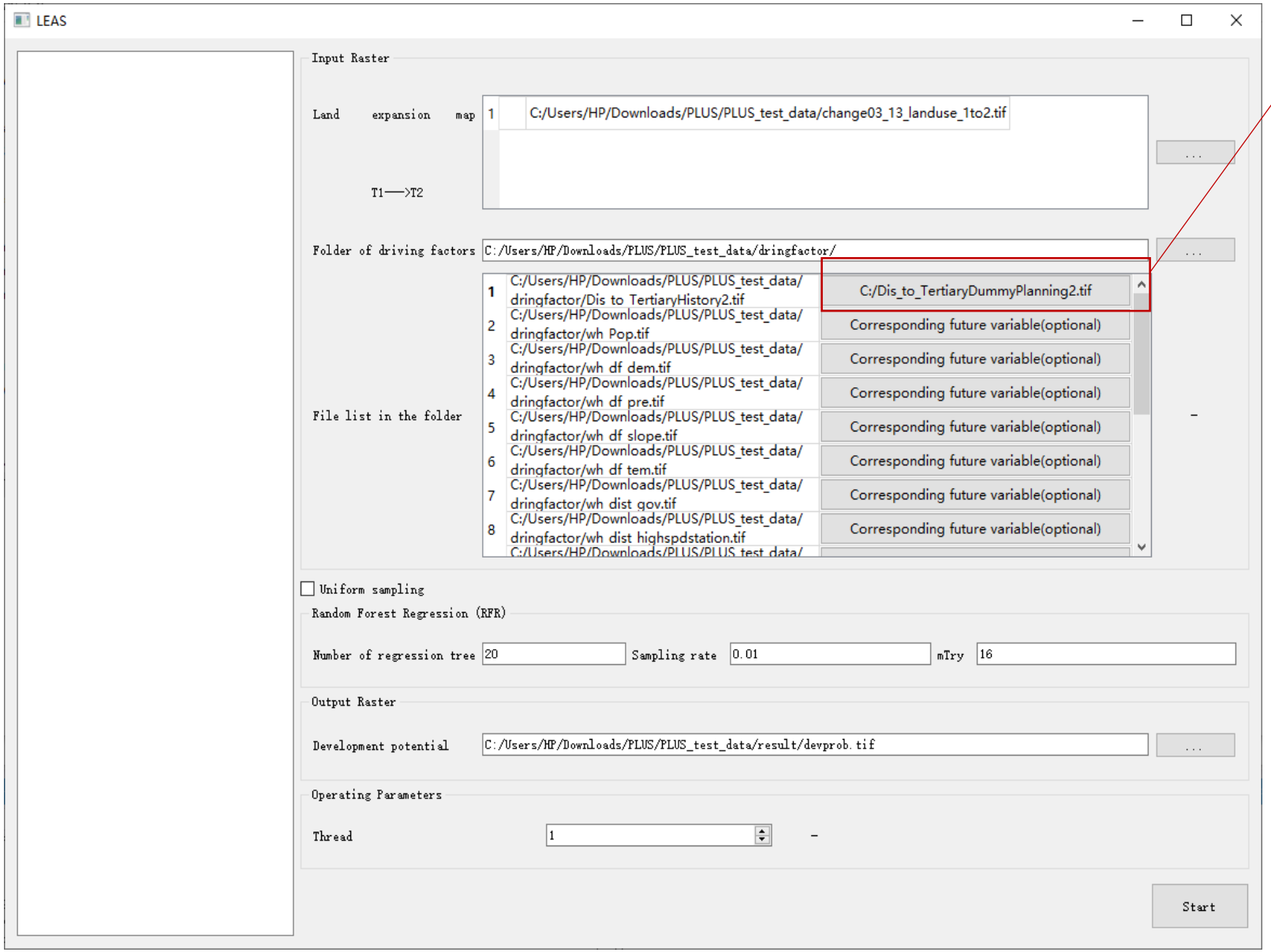
- ✓ Land expansion map (see tutorial A to know how to obtain this file)
- ✓ Driving factors of LUCC
- ✓ **Import the planning polices or future variables (optional)**
- ✓ Output path

## *Other parameters*

- ✓ *See tutorial A*

02

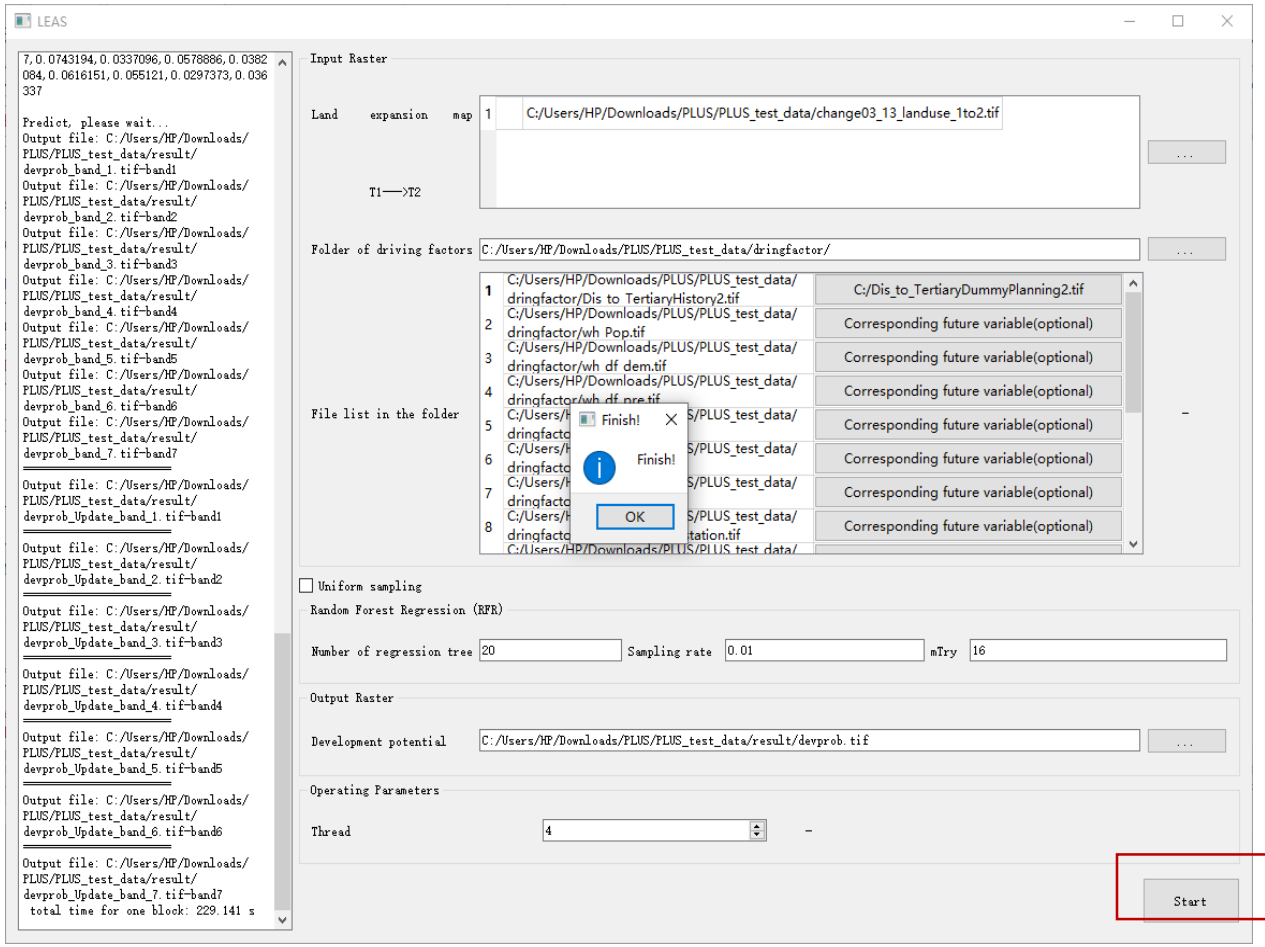
# Add in the planning traffic data



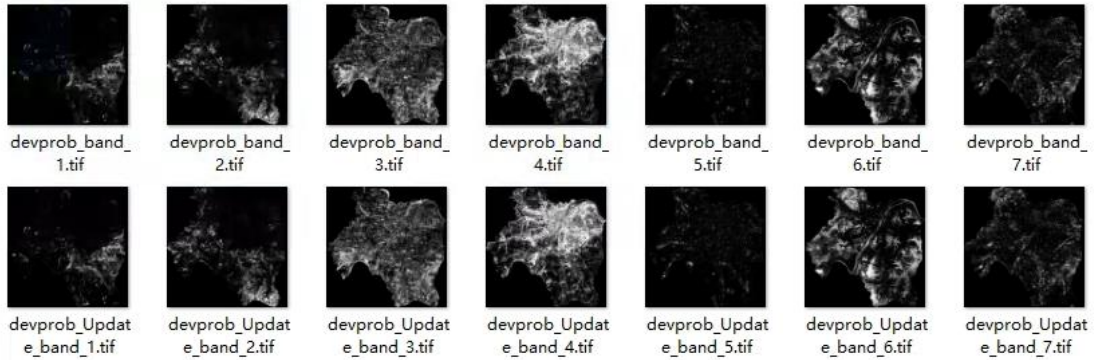

✓ Click the button that corresponding to the proximity to the historical tertiary road "Dis_toTertiaryHistory2.tif" to import the planning tertiary road data "Dis_to_TertiaryDummyPlanning.tif" (All the test data can be found in the zip file PLUS_test_data.rar)

02

# Output results




✓ Click "Start" button and wait for the output files




✓ Output two groups of development probabilities:

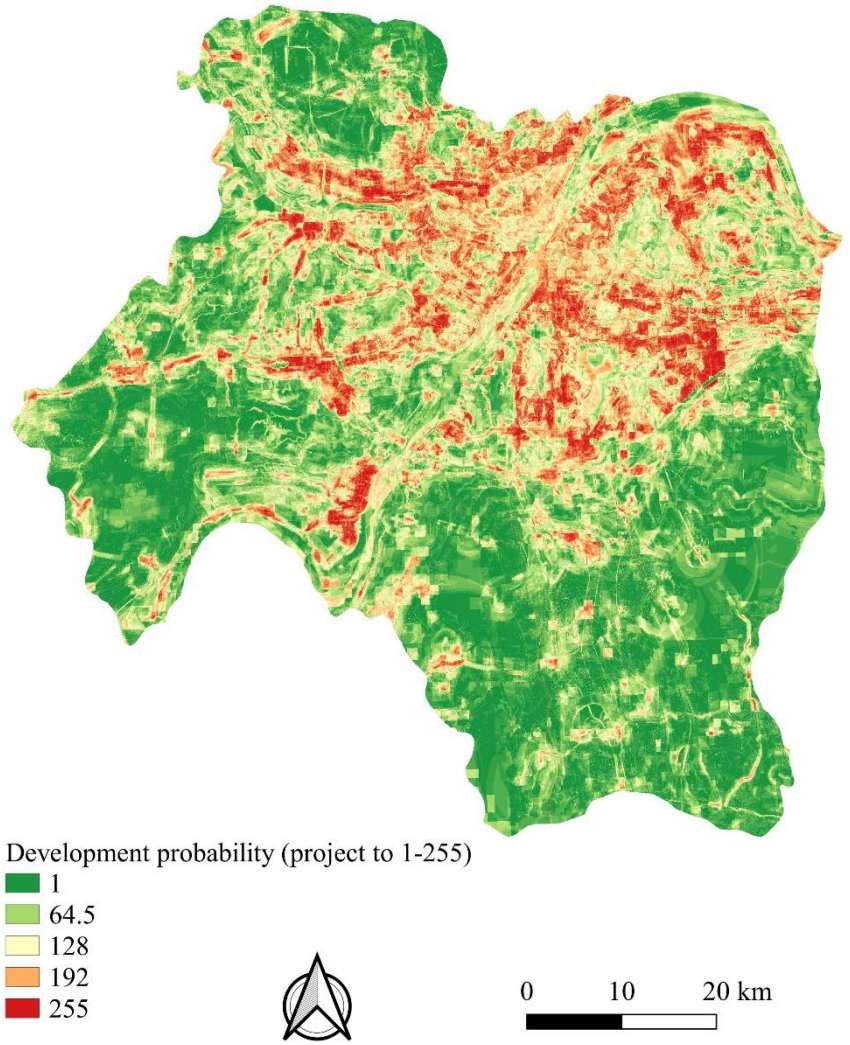
**devprob_Update_band1-7.tif:** development probabilities under the influences of planning policies, which is the input of the next step.

**devprob_band1-7.tif:** development probabilities without the influences of planning policies, which is used to compare with the one with the influences of planning policies.

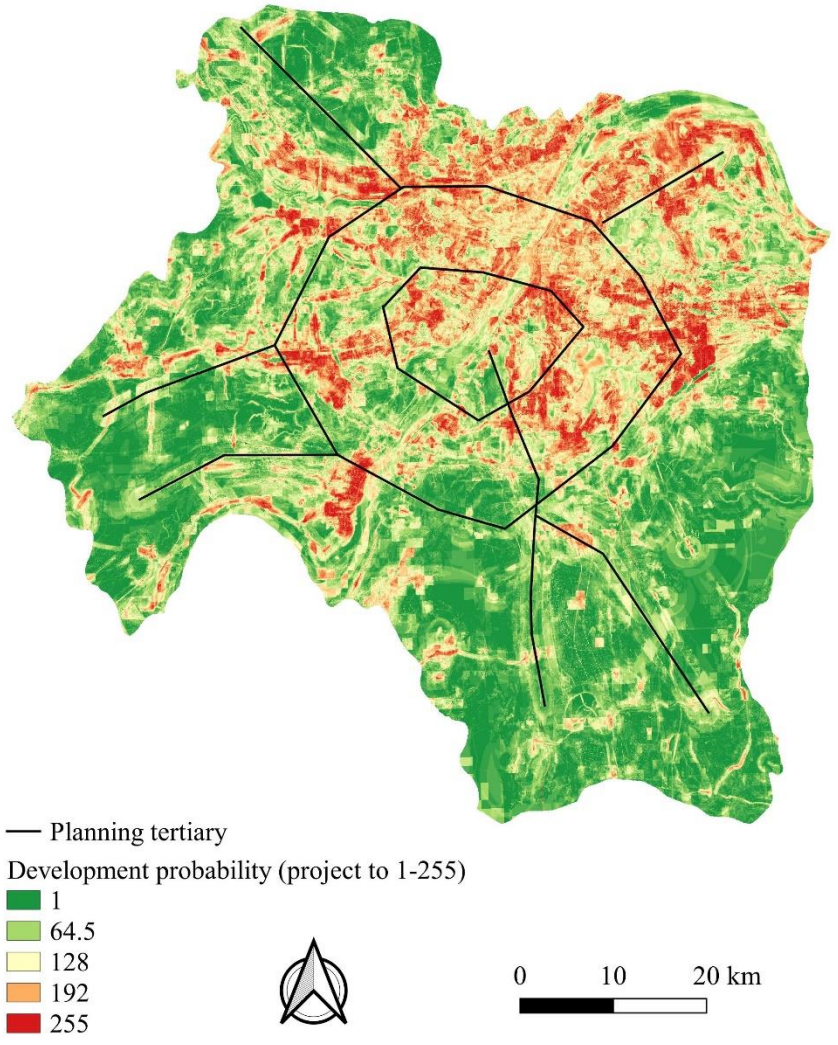
02

# Output results

Urban development potential without the influences of planning policies




Urban development potential under the influences of planning policies

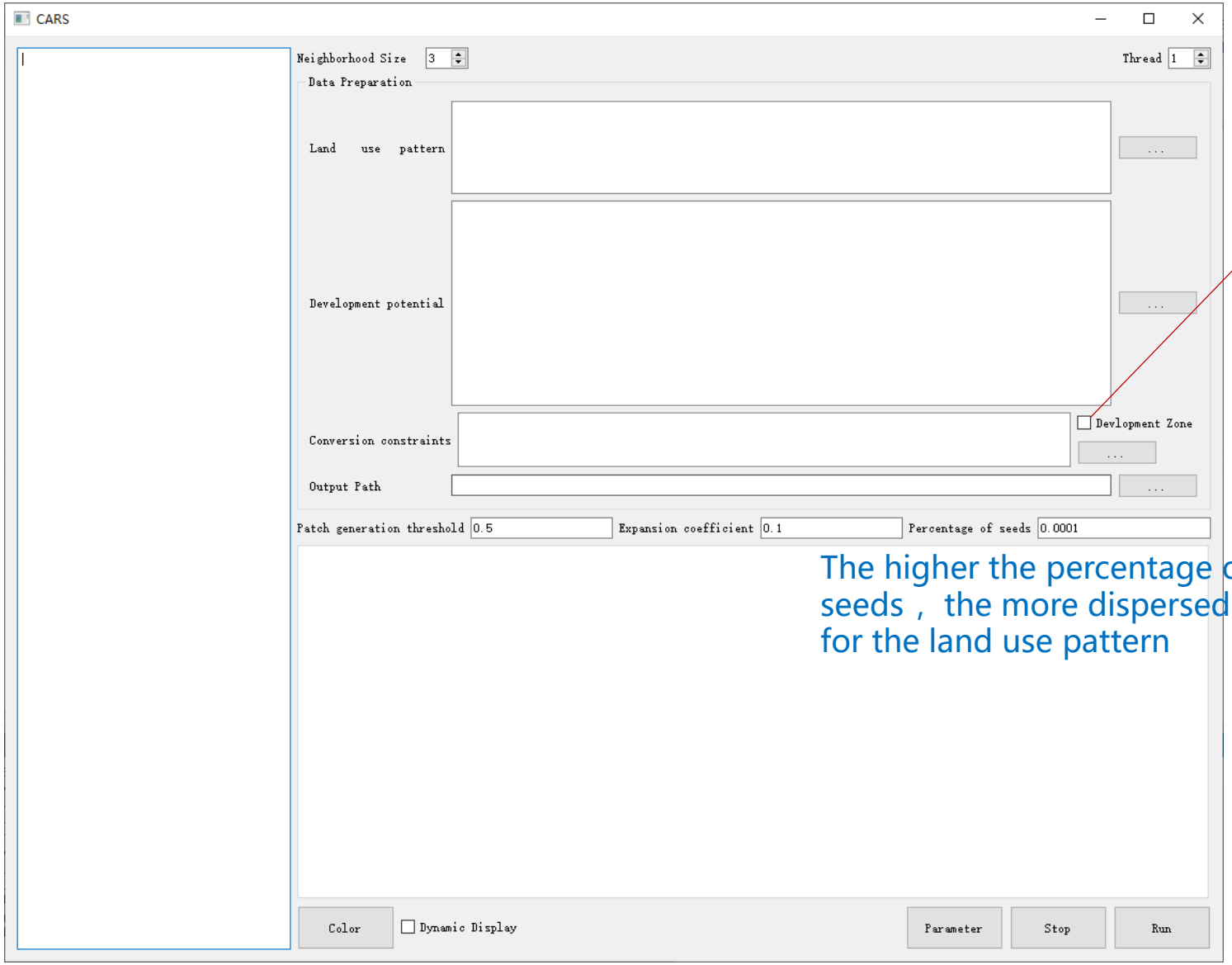


# 03

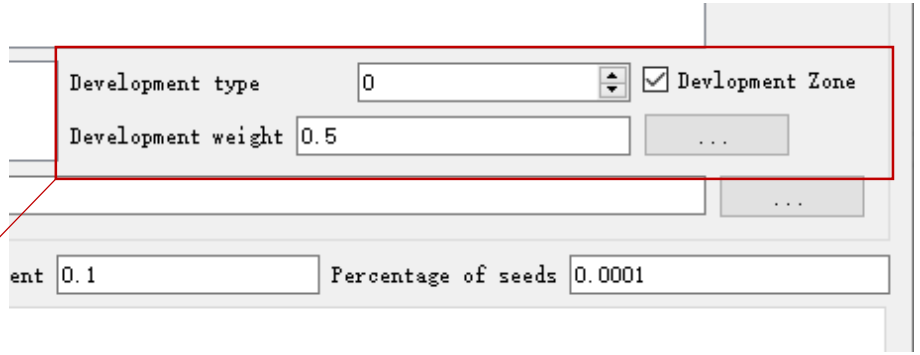
# Consider the driving effects of development zones on LUCC

03

# Add in the planning development zones




The higher the percentage of seeds , the more dispersed for the land use pattern

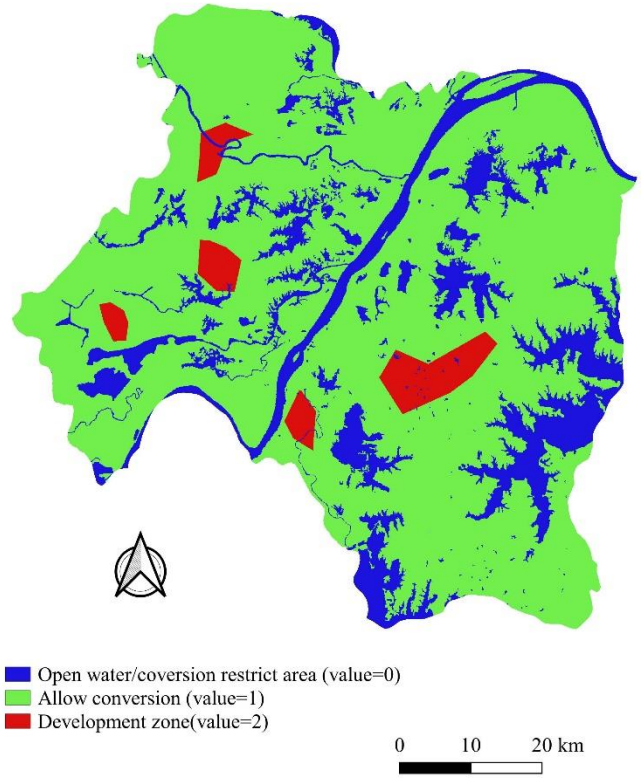



- ✓ Click the "Development Zone" checkbox to active the " Develoment type " and " Development weight" parameters
- ✓ "Development Zone" is used to define the land use type that influenced by the planning policies ; "Development weight" ranges from 0-1, which is used to define the strength of the planning policies.

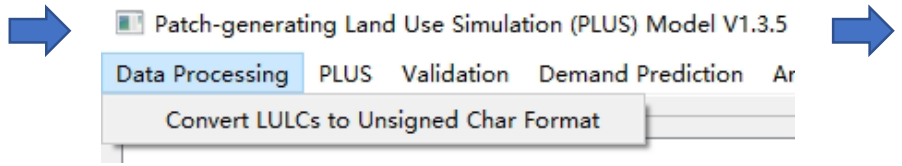
03

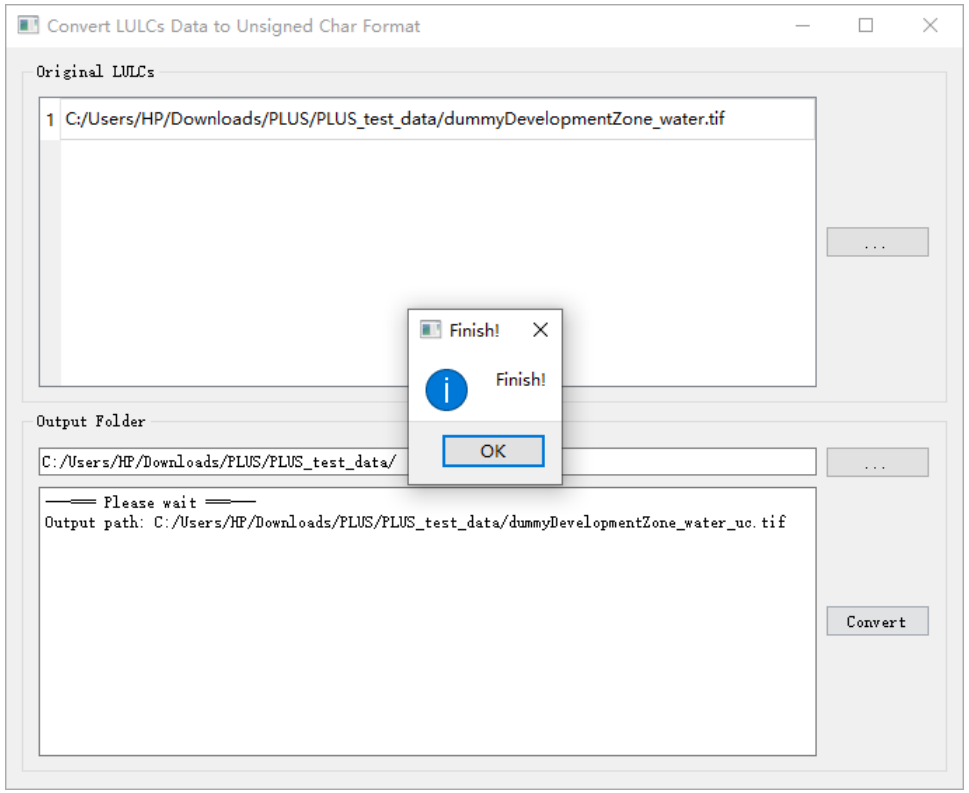
# Add in the planning development zones

Make the “conversion constraints area and planning development zones”， the value of conversion constraints area is 0，and the value of planning development zone is 2. Value 1 means transitions are allowed

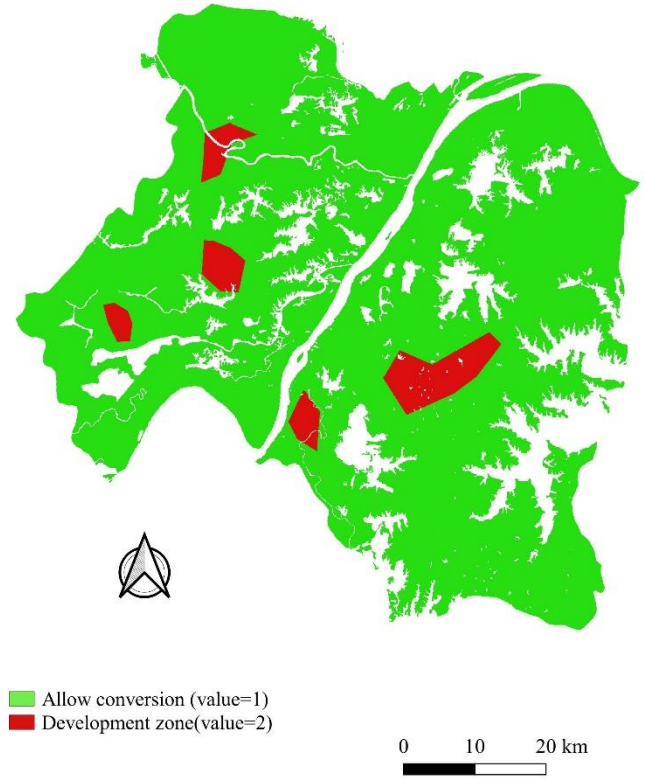



Import this file to the conversion tools of the PLUS model to convert it to ‘unsigned char’ format

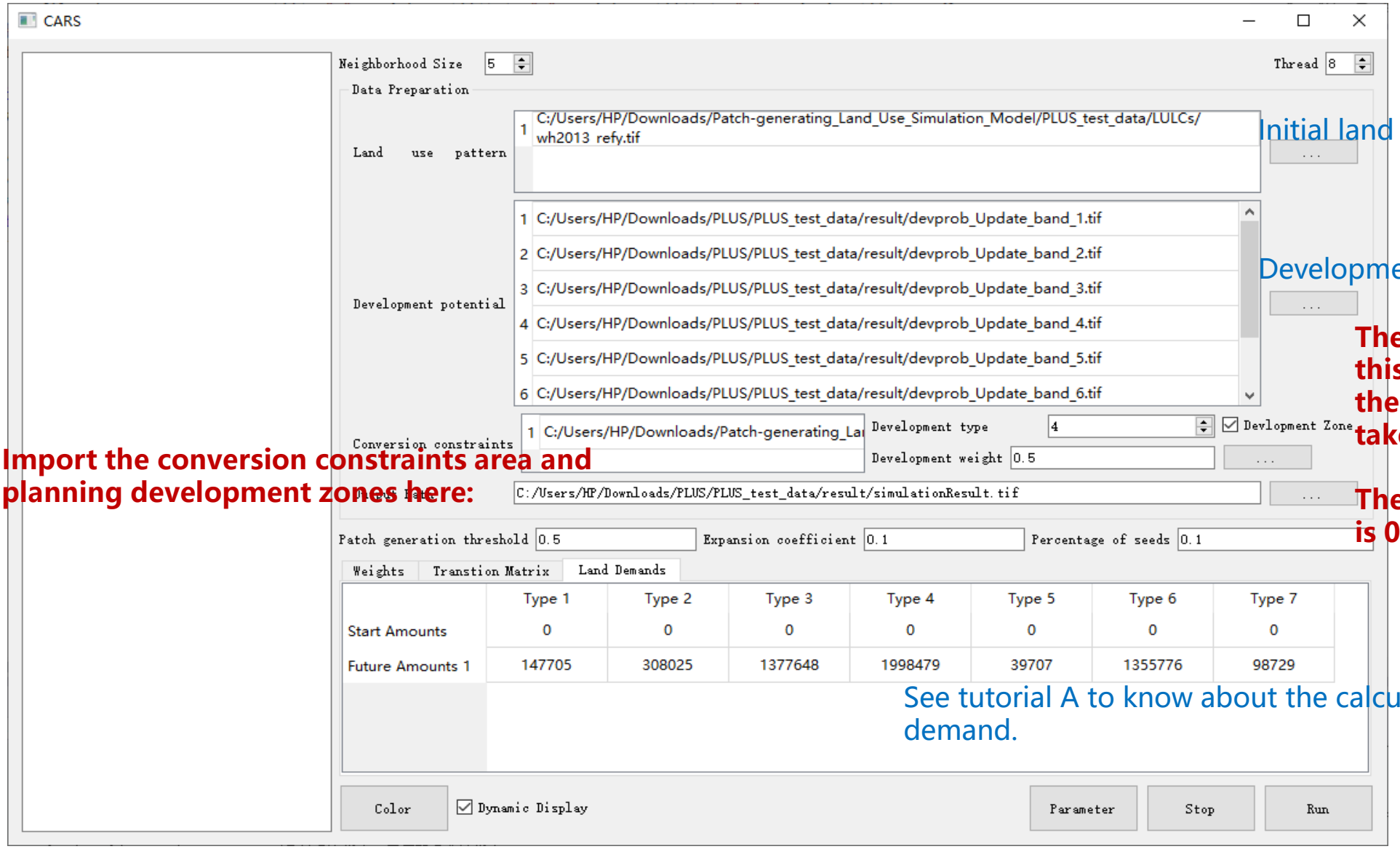



The value 0 will be convert to nodata value in this tool and will not be showed in the final results.



# 03 Parameter setting




Initial land use data

Development potential

**The value of urban land is 4 in this data. When the value is 0, the development zone will not take effects.**

**The default development weight is 0.5**

**Import the conversion constraints area and planning development zones here:**

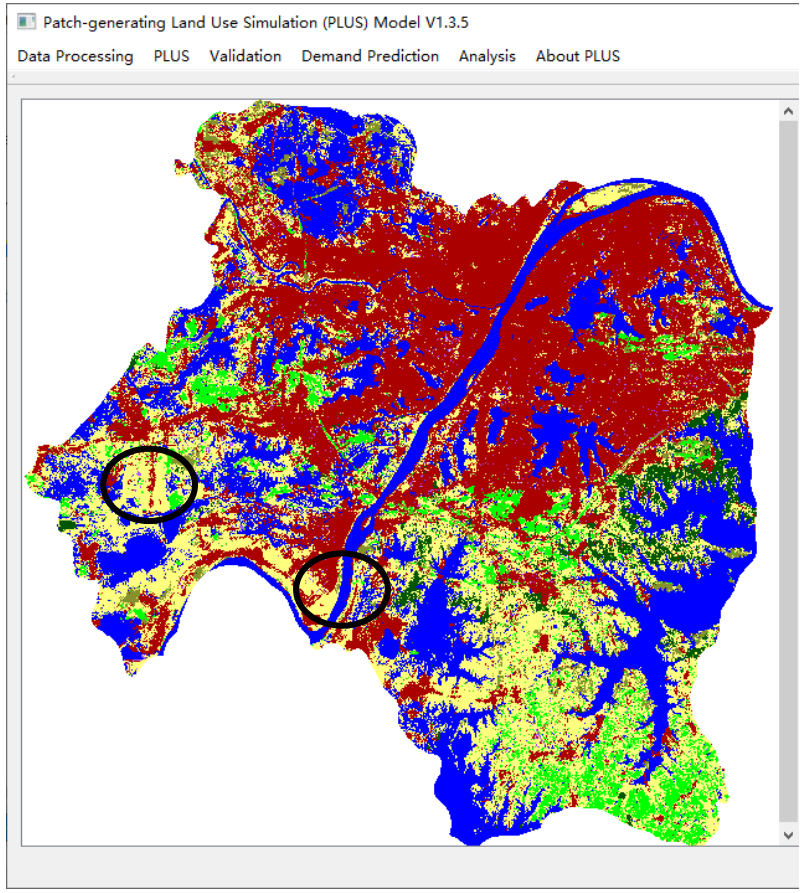
See tutorial A to know about the calculation of future Land use demand.

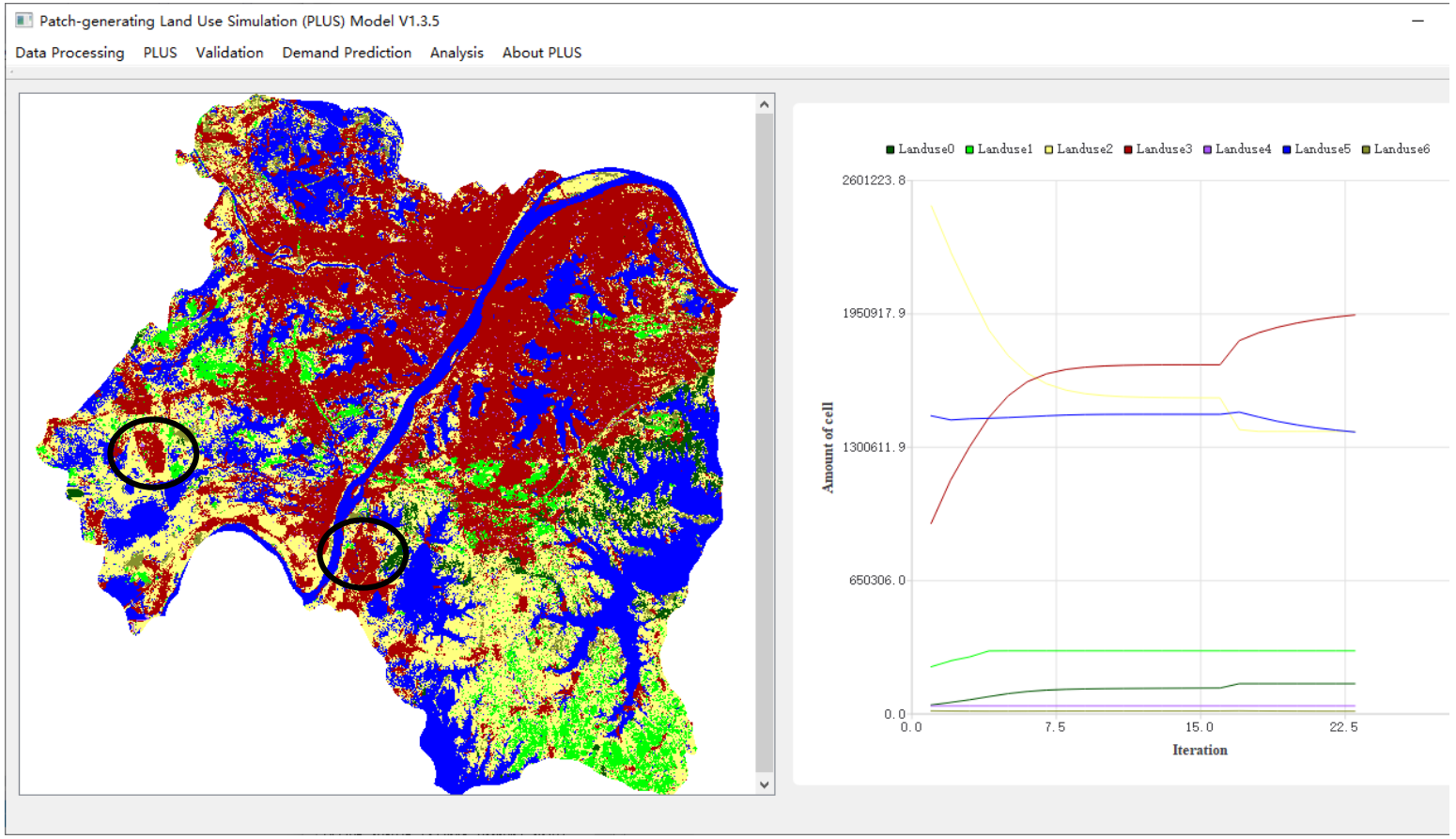
**Click 'Run' to start simulation**

# 03 Results affected by the development zones

The picture on the left is the result without the influences of planning development zones

The picture on the right is the result under the influences of planning development zones .We can see the new developed urban patches affected by the planning development zones.



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# Thanks!