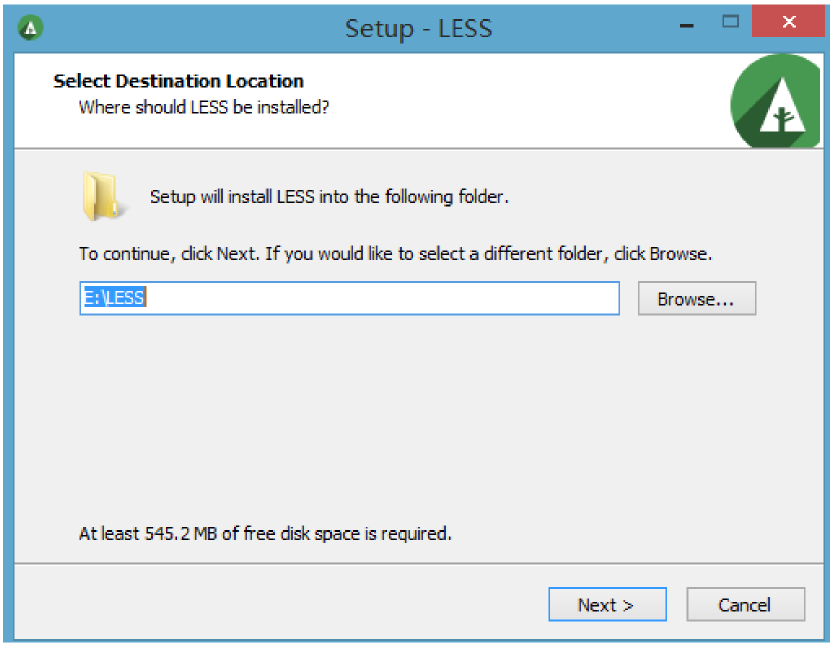
Documentation

Installation

Download the installer from here [LESS1.8 (win64bit)]. All you need is just to choose a place to install it. (Usually, LESS cannot be installed in c:\program files, since it does not have administrative rights.). After installation, LESS will be automatically started. When you start installation, it should be like this:



LESS Overview

LESS window is divided into four areas (Figure 2):

- The area 1 is Preview Panel
- The area 2 is Parameter Control Panel
- The area 3 is Progress Panel
- The area 4 is Menu Panel

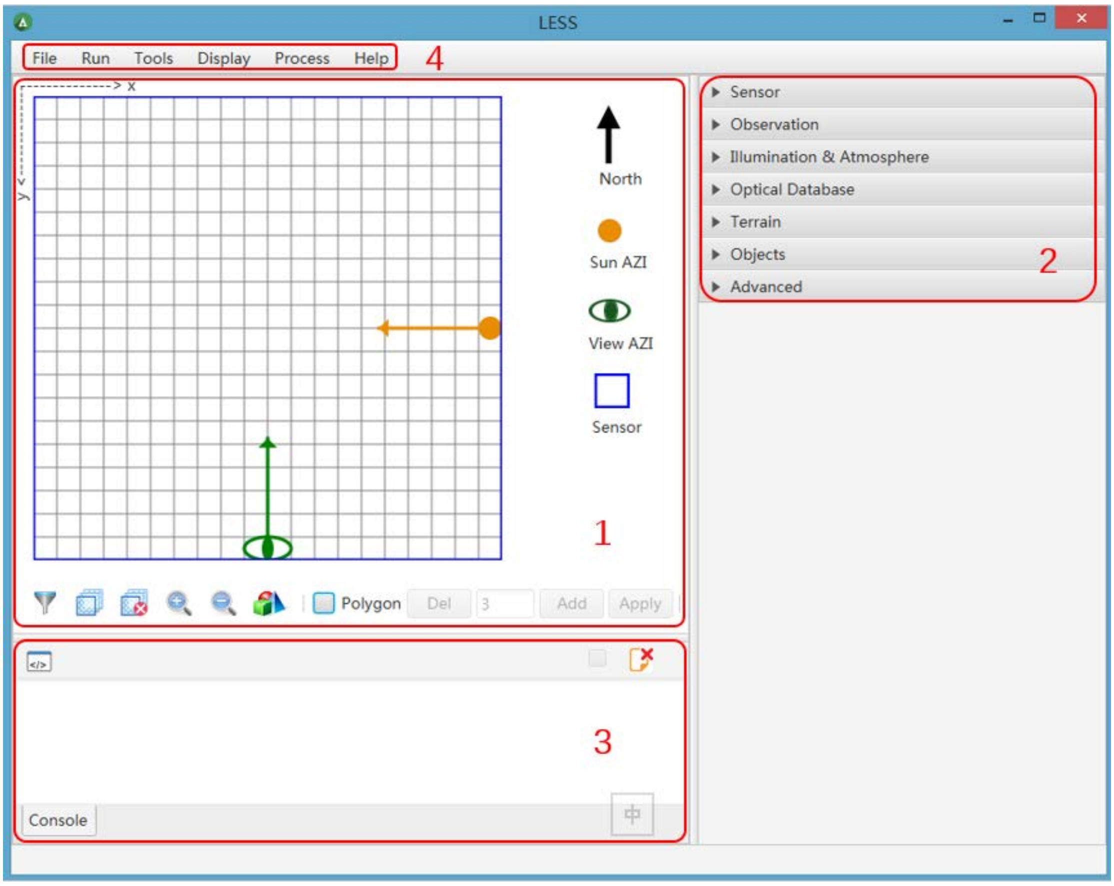


Figure 2

Preview Panel

Panel 1 is for displaying some information, such as view azimuth angle ( ), sun azimuth angle ( ), sensor footprint ( ) and tree positions. This will make it easier for user to set parameters, because this display is automatically updated when related parameters are changing.

Background Image ( ) - When you click the icon, you can choose a picture as background image, and it will be displayed in sensor footprint.

Delete Background Image ( ) - When you click the icon, background image will be delete.

Zoom-in ( ) - This icon allows you to zoom-in the area covered by grids.

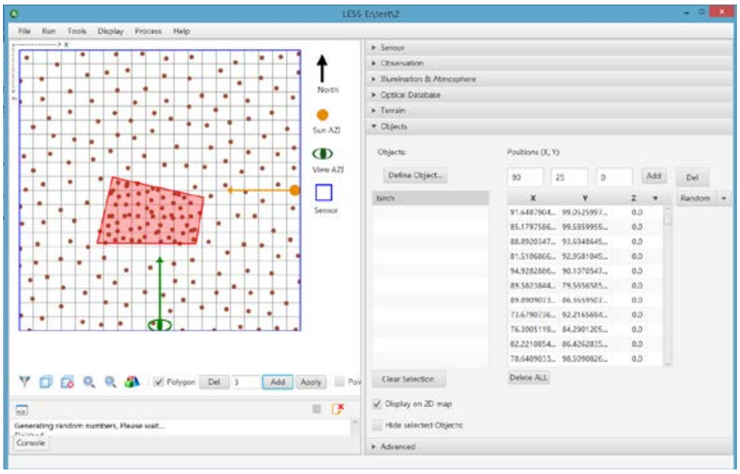
Zoom-out () - This icon allows you to zoom-out the area covered by grids.

3D Viewer () - If you click this icon, 3D Viewer will be activated. In 3D Viewer windows, you can view scene you simulate from multiple angles.

Polygon (

) - When you check the icon, you can draw a polygon in the area covered by grid and set polygon parameter (such as the minimum distance between trees, tree position in the polygon) in the panel after it (

).If you just want to allocate objects in some particular areas, the solution is using Polygon tool. Check the option of Polygon under the display panel. This time when your mouse enters the display panel, it will become a hand. you can create a polygon by left click. If you want to remove the polygon, just use your right click of mouse. After the creation of polygon, you can delete or add object instances in this area. If you click Add, then all the generated instances will only apprear in the polygon, the position and number of each object are still random within the polygon. However, if you choose one of the objects in the Objects List. then the generated instances only contains this object. This tool can create some forest scene which contains one species of trees in some area and another species of tree in another areas.



Point (Point) - When you check the icon, you will see the cursor changing to a hand. You can choose the position of tree by clicking the place where you want the tree to be without inputting coordinates.

Parameter Control Panel

Panel 2 is for setting parameter which can control the scene you simulate.

Sensor

To simulate a sensor you need, you can input parameter here to control image type, the number of pixels in width and height, sample count per square meter,

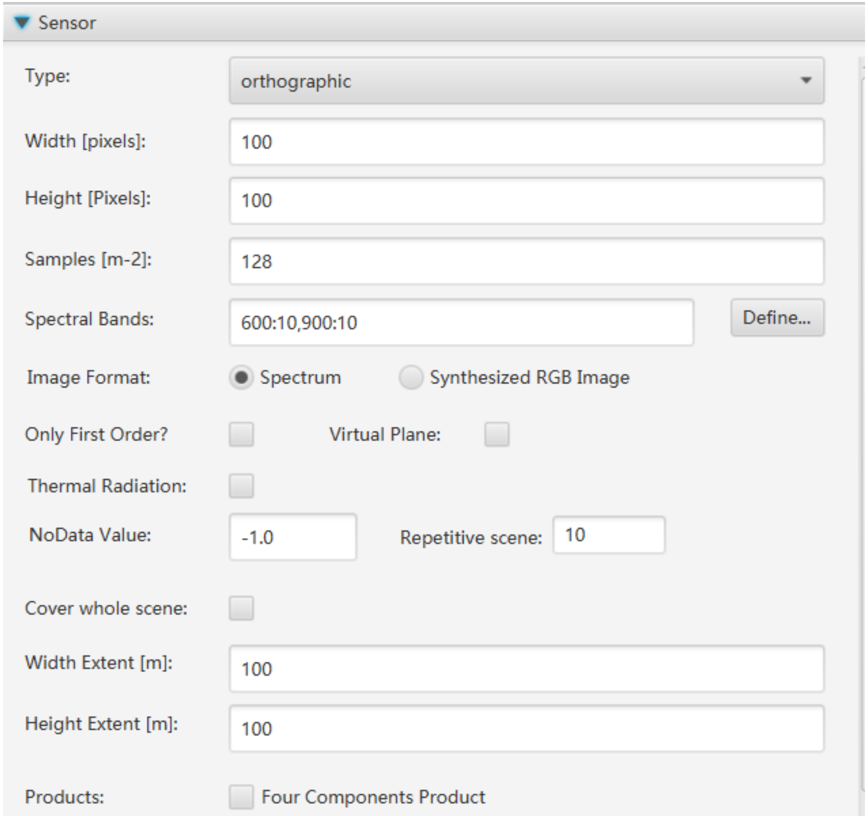


Figure 3

Type - Up to now, there are four types that you can choose. They are orthographic, perspective, CircularFisheye, PhotonTracing.

Width - The number of pixels in width.

Height - The number of pixels in height.

Samples - sample count per square meter. Usually 128 is sufficient. If you increase to 256, 512, the quality of the simulated image will be better.

Spectral Bands - It represents the which band you want to simulate. For example, RED and NIR: 660nm， 900nm. Now, you must also input a bandwidth for each band with the format of “center band: bandwidths”, e.g. 660:10,900:10. These bandwidths will be used for determining the irradiance. If you have no special requirement, it can just set the bandwidth to zero. And when you click [Define], you can define the bands by input some parameter in the pop-up window (Figure 4).

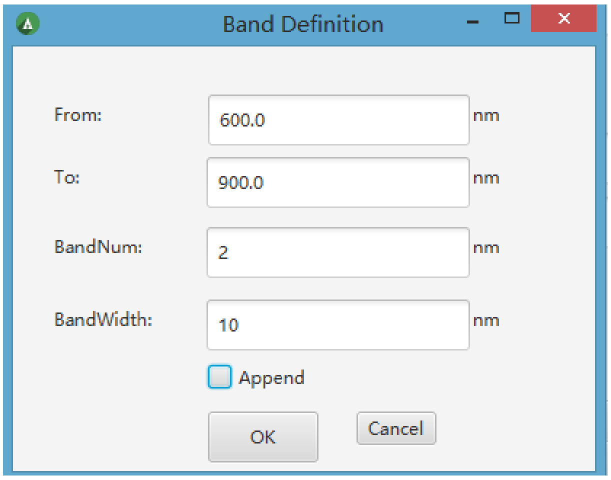


Figure 4

Image Format - "Spectrum" means generating spectral image. "Synthesized RGB Image" means generating RGB image.

Only First Order? - If it is true, it means LESS only simulate the first-scattering event (sun * radiation reflected by objects only one time). If set to false, then both first-scattering and multi-scatting will be simulated.

Virtual Plane – When you check it, a virtual plane is defined, and only the radiant exitance of the plane is calculated. In figure 5, you can define the location of the virtual plane in "Center" and the size of the virtual plane in "Size".

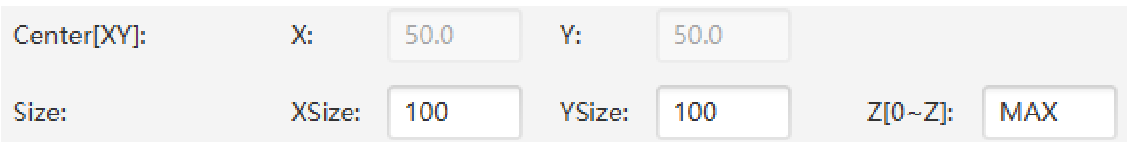


Figure 5

Thermal Radiation - When you need to get thermal infrared image, you can check it. After checking, you can input surface temperature parameter in Optical Database (Figure 6).

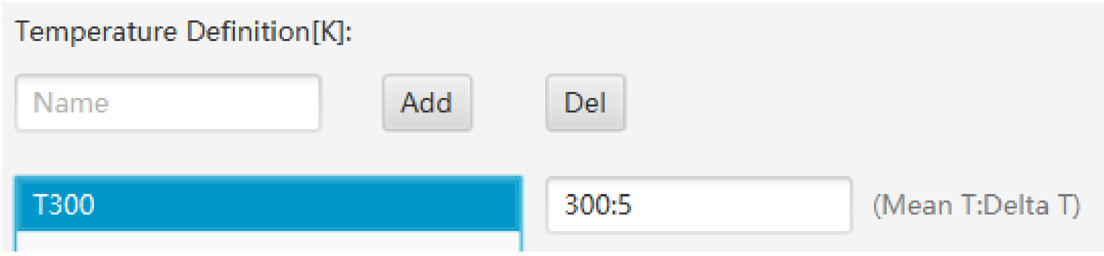


Figure 6

NoData Value - Set the background value when sensor footprint is beyond the scene scale. If the image opened by envi, you should set it as 0.

Repetitive scene - Sets the number of copies that distributed around the scene.

Width Extent/Height Extent - The actual extend of the orthographic sensor can simulate. It is similar to FOV of perspective sensor.

Four Components Product - If you check it, a classification image will be generated. The classification image has four components, and they are Light canopy, shadow canopy, light background, shadow background.

Observation

Figure 7

View Zenith - Set view zenith angle (angle between vertical direction).

View Azimuth - Set view azimuth （0° is north, clock-wise to 360°).

Sensor Height - Set the height of the sensor.

Illumination & Atmosphere

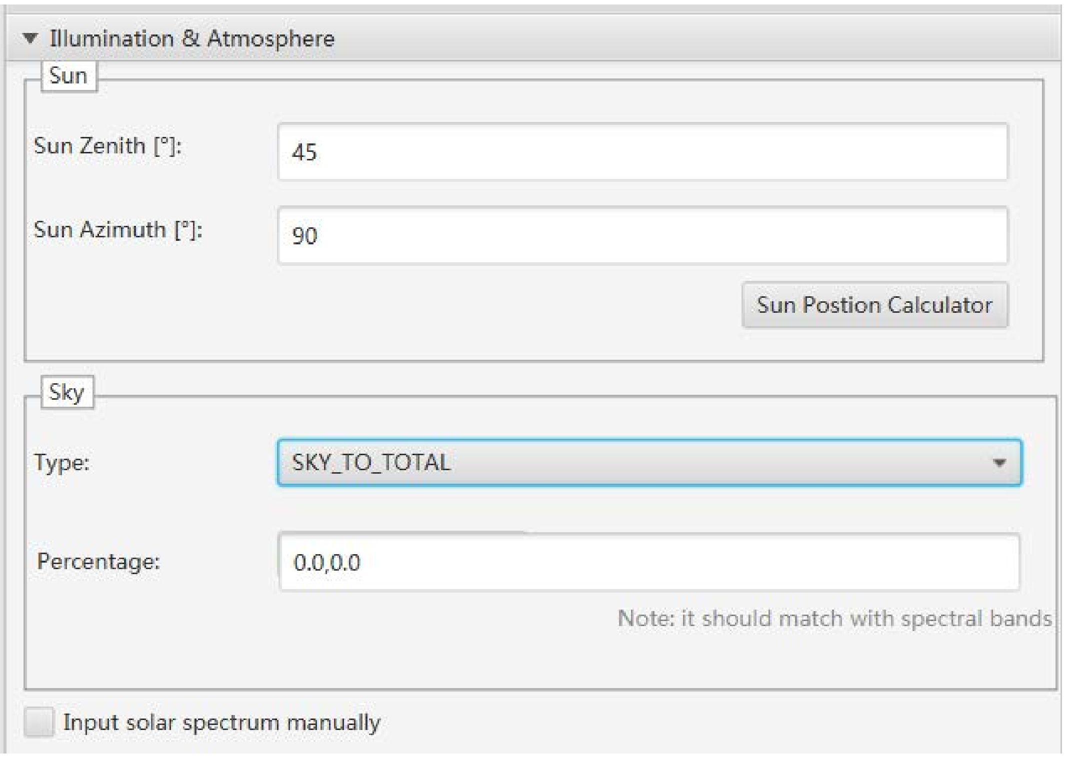


Figure 8

There are two groups of illuminations, one is from sun, other is from atmosphere.

Sun Zenith - Zenith angle of sun.

Sun Azimuth - Azimuth angle of sun (0° is north, clock-wise to 360°). This defines the position of sun. That means if you set it as 90° (East), then it will produce shadows in West.

Sun Position Calculator - If you clicked [Sun Position Calculator] (Figure 9), you can fill in above two parameters by inputting the time and place parameters for the scene.

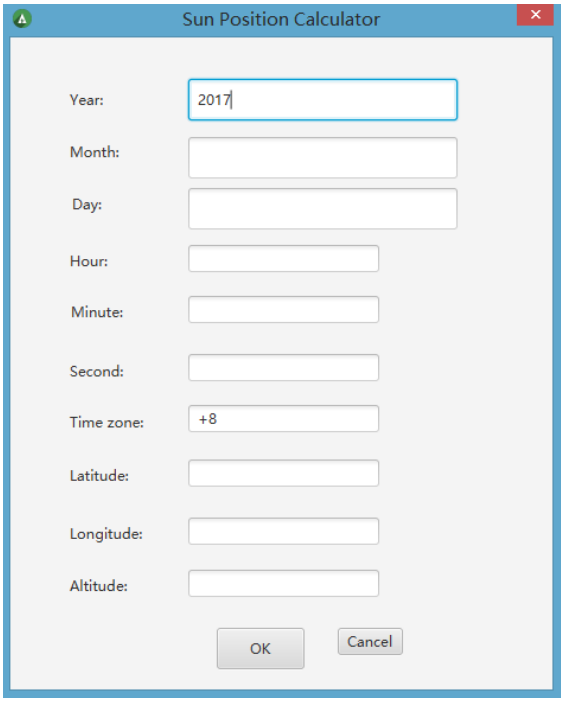


Figure 9

Next is the parameter setting for the sky.

Type - It represents the type of atmosphere radiation, now only one option can be used - “SKY_TO_TOTAL”, it means the ratio between diffuse radiation and total incident radiation. Thus (1-SKYL) * T (T is sun radiation above atmosphere) is the sun radiation under atmosphere. Under this mode, atmosphere is isotropic diffuse radiation from upper hemisphere.

Percentage - It define the actual ratio between atmosphere radiation and total radiation. What should be noticed is that when you input the value, the number of values should be equal to the number of bands (under the sensor section). That is, for each band, it may have different values.

Input solar spectrum manually - If you check it (Figure 10), you can input the solar spectrum and the sky spectral in terms of wavelength manually (in $W/m^2/nm$).

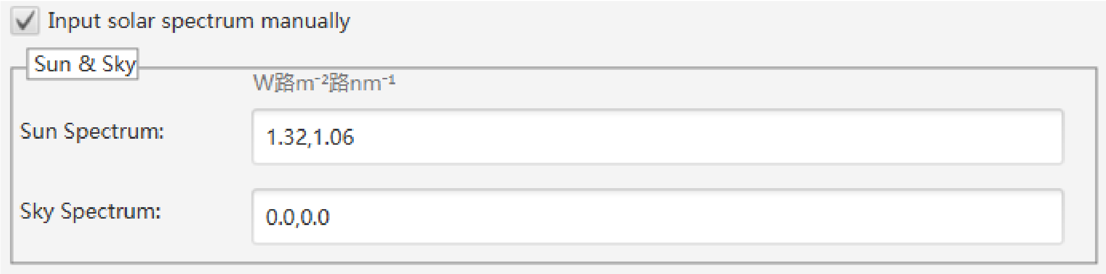


Figure 10

Optical Database

Since objects in LESS are represented as triangular meshes, thus for each triangle, it can have at least three kinds of optical properties: reflectance of front side, reflectance of back side, and transmittance (we assume transmittance of both side is the same).

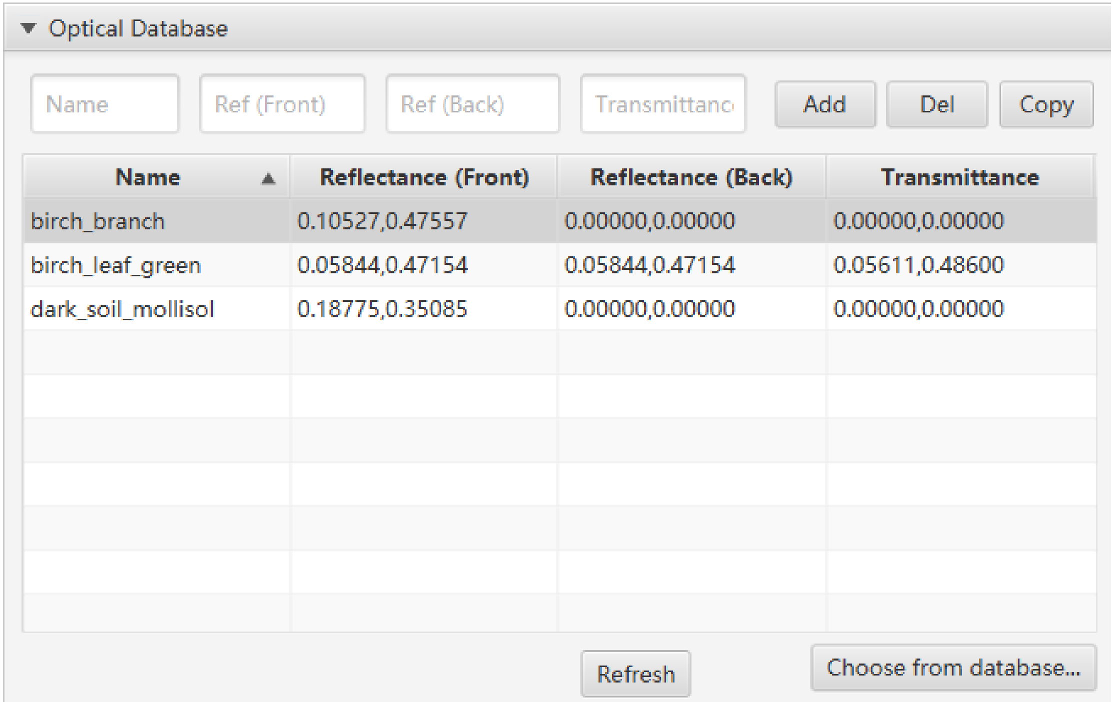


Figure 11

In Optical database, we should first define some optical model, and then they can be used in the following terrain or forest definition. By default, there are three optical model defined, you can delete them, or modified them directly. you can also add new optical model. For each reflectance or transmittance, values of different bands are connected by comma.

Terrain

There are mainly three types of terrain: PLANE, RASTER, MESH.

PLANE just represents simple plane lies at altitude of 0.

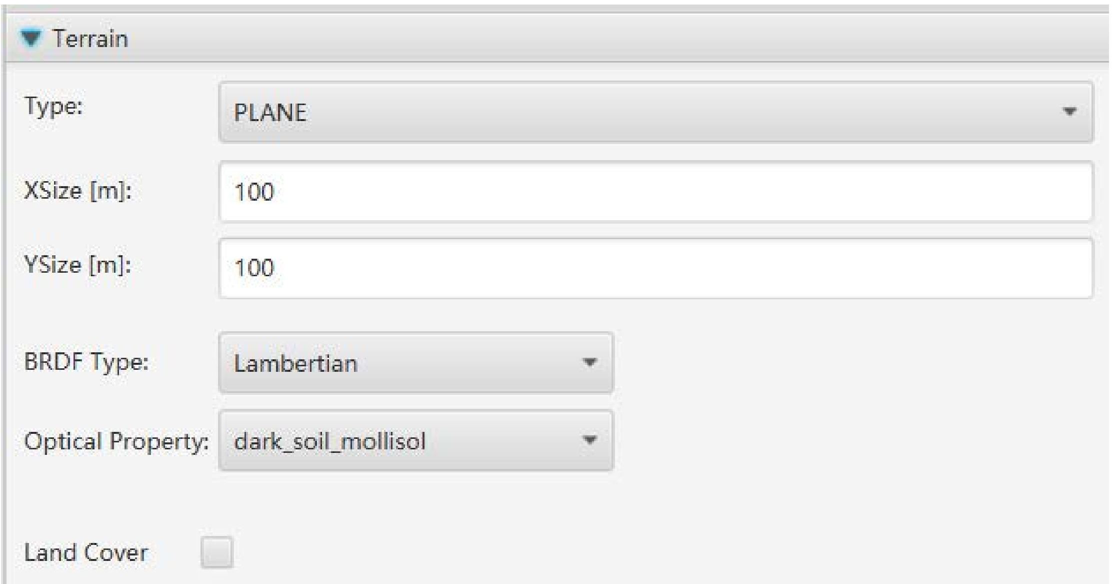


Figure 12

XSize - Size in the X direction.

YSize - Size in the Y direction.

There are two BRDF types: Lambertian, Soilspect. If Lambertian is chosen, it means you think of the ground as a Lambertian. If Soilspect is chosen (Figure 13), you can input parameters to define the model.

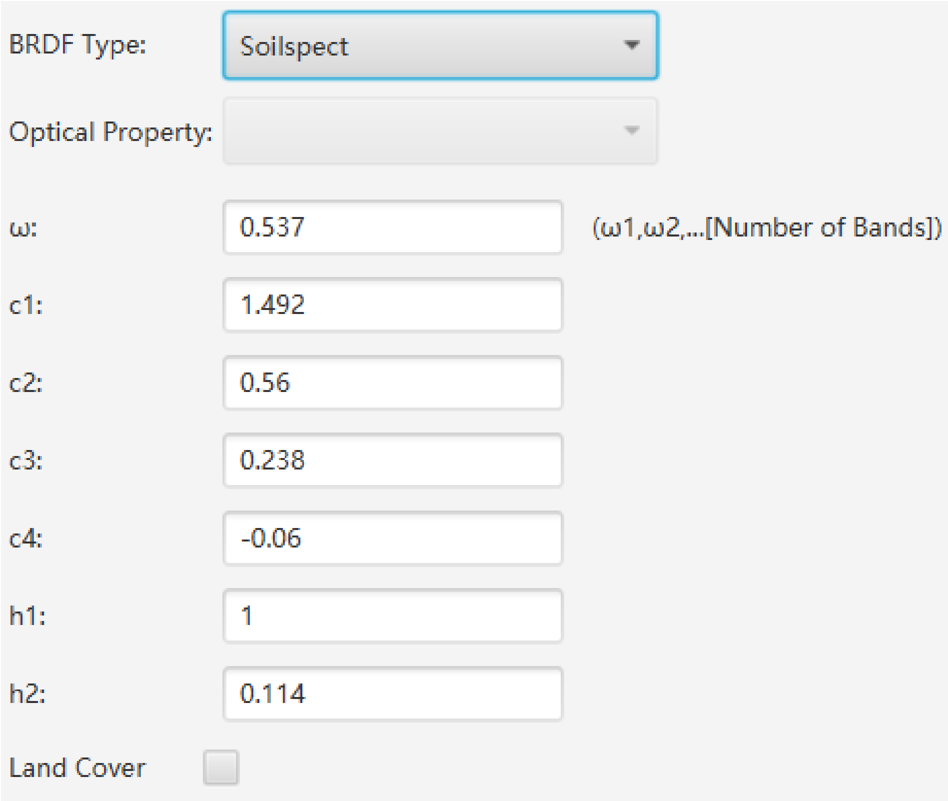


Figure 13

Land Cover - If you check it (Figure 14), you can input surface classification data generated by envi, and then set different spectrum for different ground classes.

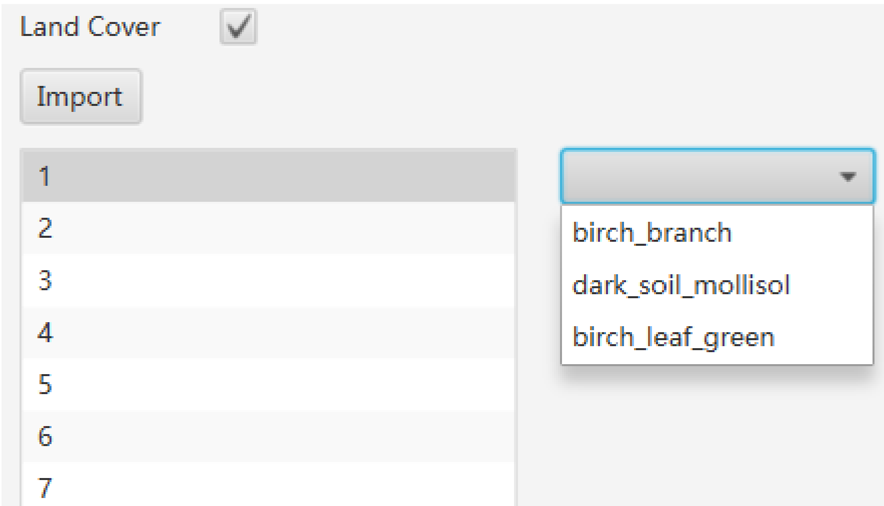


Figure 14

Objects

Objects define what you want to put in the scene. For example, forest is formed by a number of single trees, which are describe by triangle mesh (obj file) in LESS. Usually, we cannot input a obj for each single trees, since forest contains a lot of trees and the tree itself contains numerous triangles, it may not be possible even for large memory computers. The alternative is to use a “instance” technique. That means we define a single tree, and we can place it at different places, just using reference, thus the program only keeps one copy of the triangle mesh, but it represents trees at different places (they have exactly the same structures, but we can do rigid transformations).

Objects Overview

Objects window is divided into three areas (Figure 15):

- The area (1) is Objects Define Panel;
- The area (2) is Position Parameter Control Panel;
- The area (3) is Display Panel.

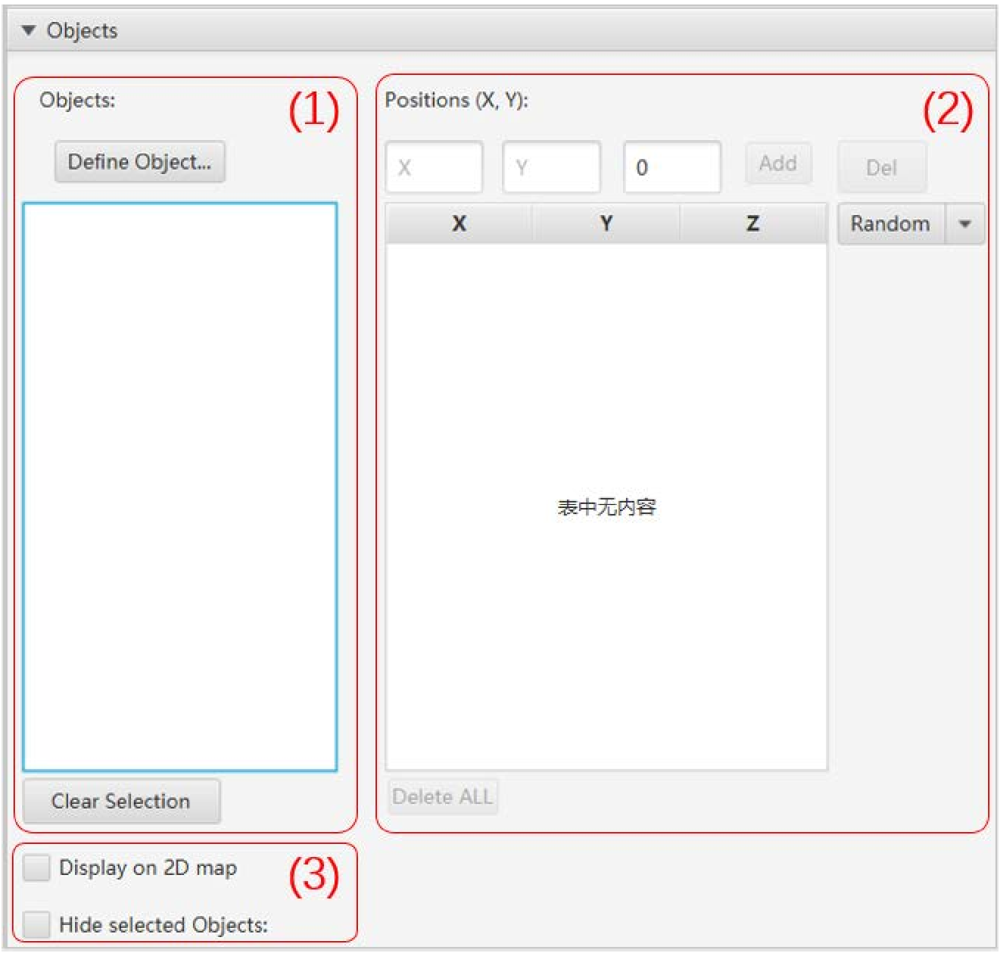


Figure 15

(1) Objects Define Panel

The first step is to define some objects (single tree).

Define Object… - You can click it to define objects (Figure 16).

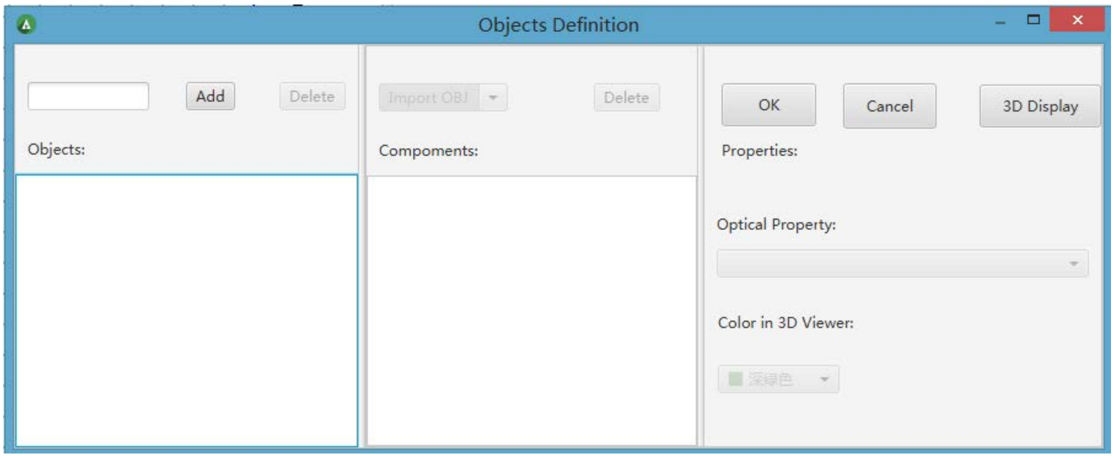


Figure 16

Add - We give a name for our first object, such as "birch".After clicking

[Add] button, “birch” will appear in the Objects list.

Import OBJ - Selecting the name we write in “Objects” area, then the button [Import OBJ] is activated. If you clicked the button [Import OBJ] (Figure 17), you can choose a obj file in the window and input it as the object.

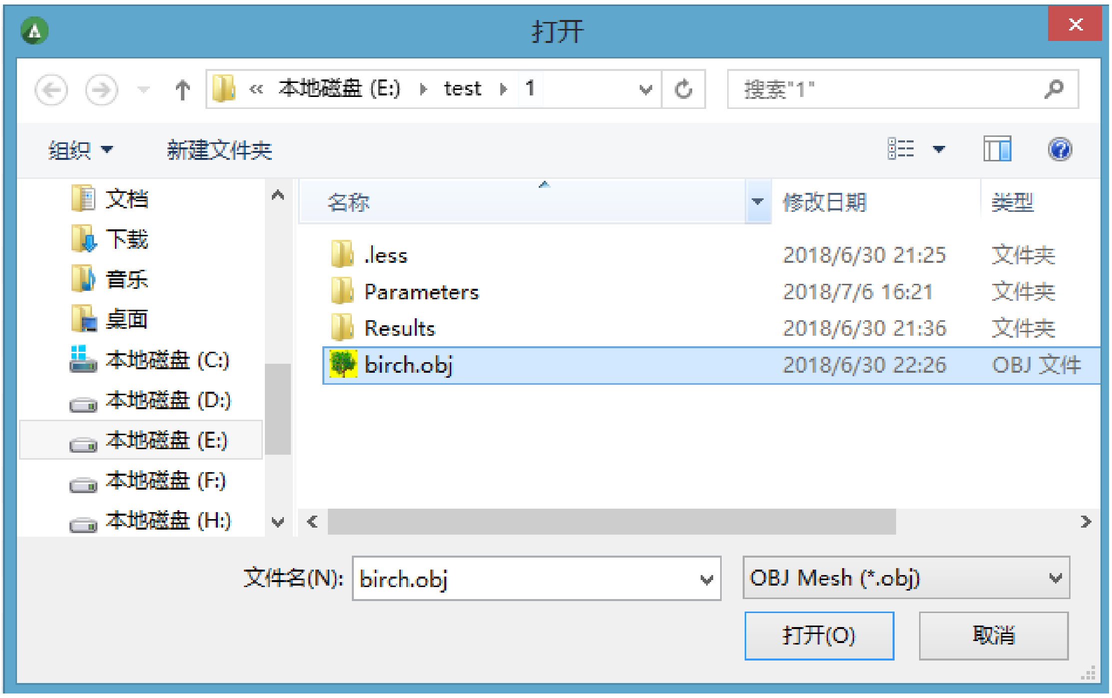


Figure 17

And then you need to determine the scale by the units of the tree model that you enter into (Figure 18). If the units of the tree model that you enter into is cm, the scale should be 0.01. And if the units of the tree model that you enter into is m, the scale should be 1.00.

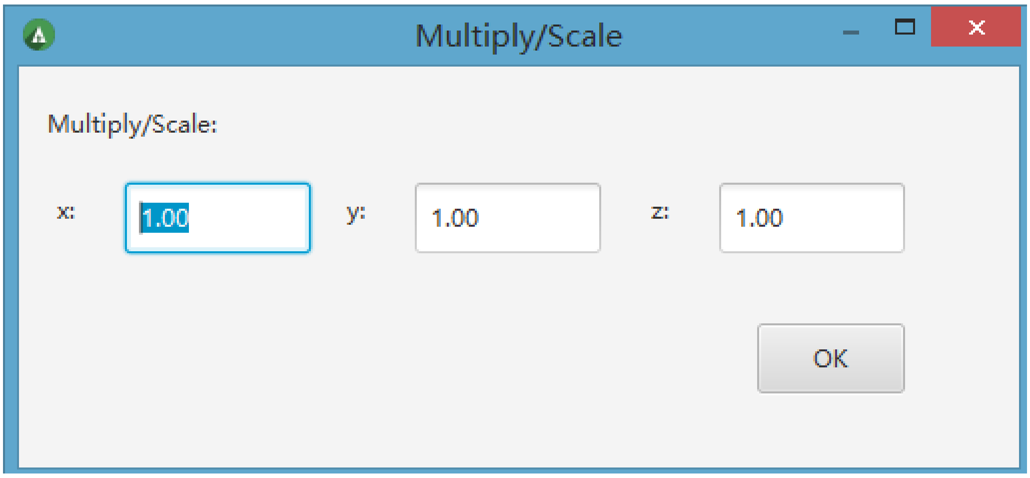


Figure 18

Import from RAMI - Import objects from the model file on the rami website (Figure 18).

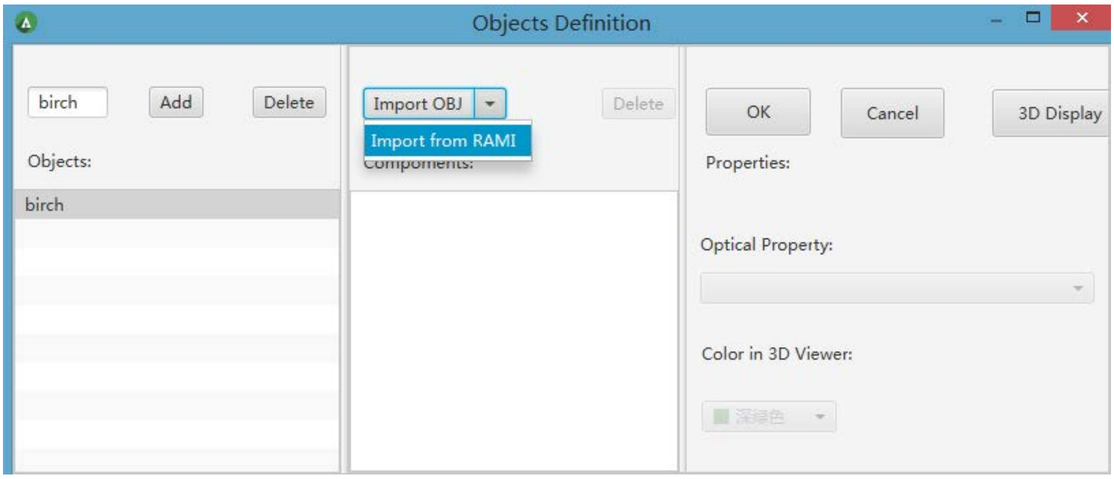


Figure 18

After importing objects, each component of the obj file will appear in the "Components" list (Figure 19). Component is a part of the object, e.g. a tree contains leaves and branches (usually they have different optical properties). **You should be aware that the obj file itself will be copied to the simulation folder, so you can safely delete it from your original place.**

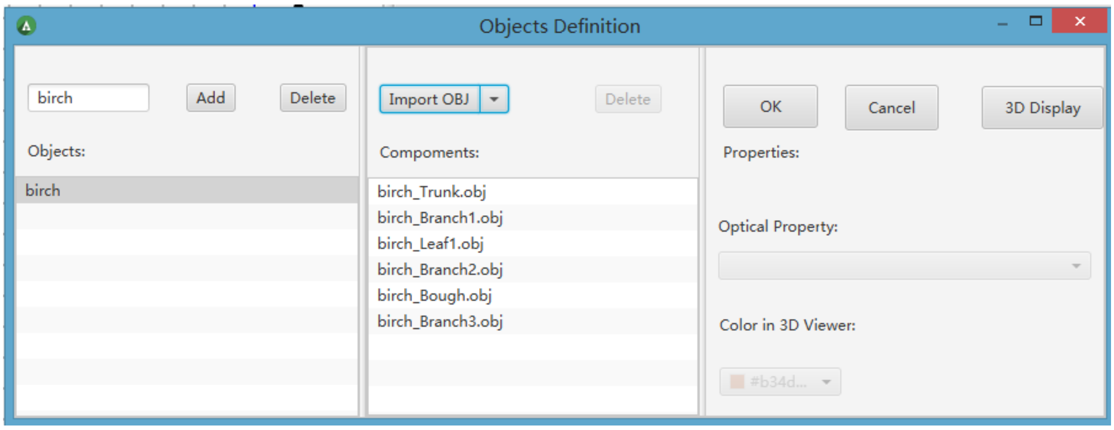


Figure 19

Optical Property - Selecting one of the components, the [Optical Property] is activated (Figure 20), and you can choose an optical property for the selected component. These optical properties are also from "Optical Database". If you need to define a new optical model, you can go back to "Optical Database" page without closing the current window. When you finish, the optical models are automatically synchronized.

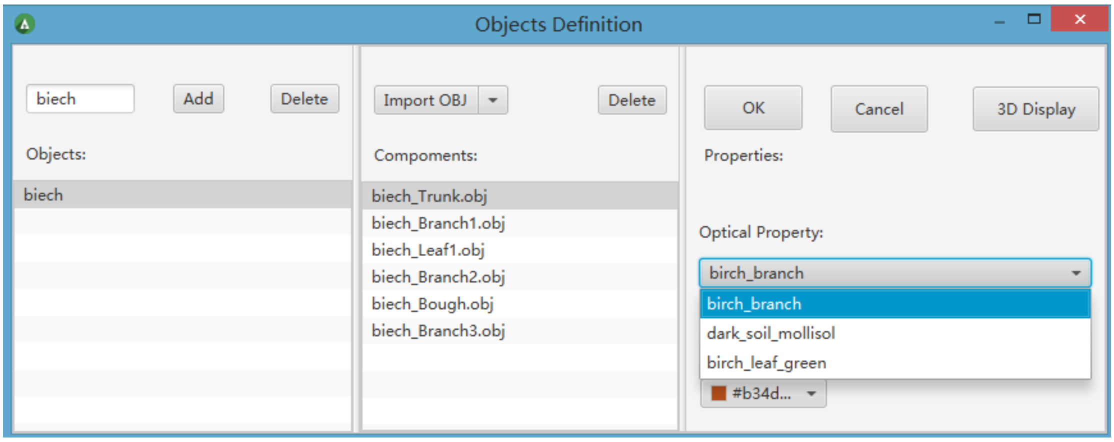


Figure 20

3D Display - After clicking it (Figure 21), you can see the 3D model of object.

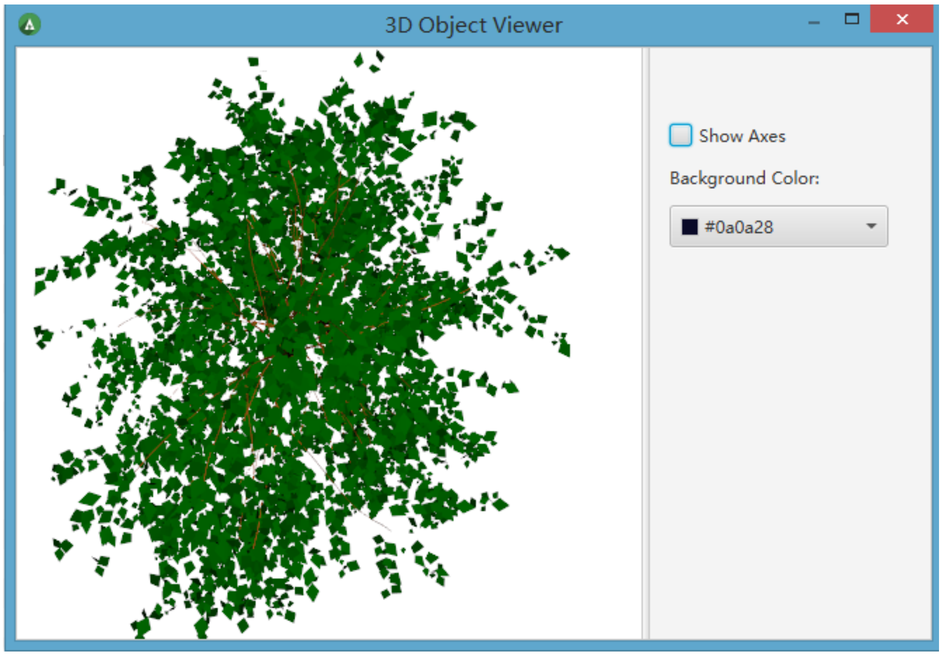


Figure 21

After defining objects, you should click [OK] button, and then we will go back to Objects page with the defined objects shown in Objects list.

(2) Position Parameter Control Panel

If we select the defined objects it, we can define its positions. There are three methods to define positions. The first method is inputting coordinate for the object directly. The second method is using [Point] tool provided by LESS (introduced in Panel 1). The third method is using [Random] tool provided by LESS. The last method is import CHM data to control position.

Add - You can enter coordinates in the table before [Add] button, and then clicking [Add], the object is added to the specified location (Figure 22).

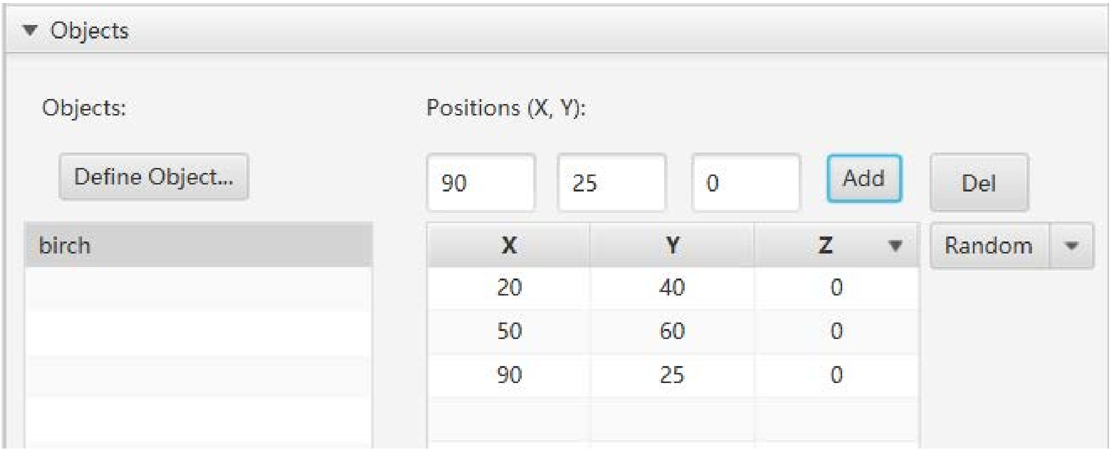


Figure 22

Random - Clicking the button [Random], it will open a new window (Figure 23), Now the only choice is Poisson distribution (This is very normal for trees in forest). The only parameter you need to provide is the minimum distance between two objects. Click OK, LESS will automatically generate instances of defined objects. The number and position of each object in the Objects list is also random. Thus, you can get a reasonable distribution of objects.

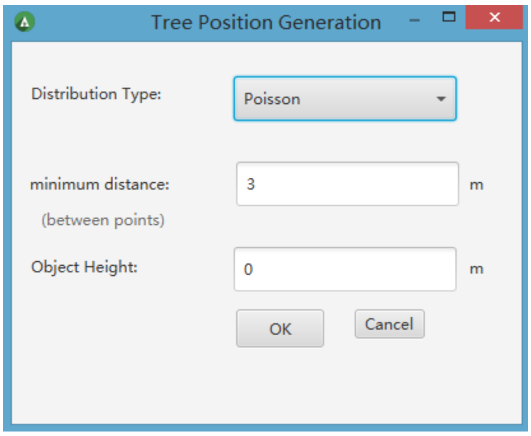


Figure 23

From CHM - Clicking the inverted triangle next to the button [Random], you can open the drop-down menu, and find the [From CHM] button. If click it, you can choose a CHM data as a basis for objects location.

(3) Display Panel

Display on 2D map - If a position is added when you check it, the position will appear on the grid area in Preview Panel, which will help you to check whether it is correct.

Hide selected Objects - If there are multiple plants in this scene, you can hide the location of the model you don't want to see by checking it.

Progress Panel

This panel shows the running state of the current program. When an error occurs, you can find the reason of the error by reading this panel.

Menu Panel

Menu bar holds 6 menus.

- File
- Run
- Tools
- Display
- Process
- Help

File menu

File > New Simulation - Create a new simulation.

File > Open Simulation - Opens a chosen LESS file and loads its parameter values into LESS modeler.

File > Save - Saves current parameter values on a disk as LESS file.

File > Save as - Saves the tree image into another file.

File > Close - Close the simulation.

Run menu

Run > Run All - Run this program and output results.

Run > Generate 3D Model -

Run > Generate View & Illumination -

Run > less -

Tools menu

Tools > Open Results Folder - Open Results Folder of current simulation.

Tools > Batch Tools -

Tools > Server Setting -

Tools > LAI Calculator - Calculate LAI in different resolution, and output the results as txt.

Tools > Python Console -

Display menu

Display > 3D Viewer - Display scene you simulate from multiple angles.

Display > 3D Viewer (Bounding BOX) - Display scene you simulate from multiple angles with replacing objects with boxes.

Display > 2D Polygon - Draw a polygon in the area covered by grid and set polygon parameter (such as the minimum distance between trees, tree position in the polygon) in the panel after it.

Process menu

Process > BRF Processing - Generate BRF image.

Process > Brightness Temperature Processing -

Help menu

Help > Documentation -