Module 3

SELES – the Program

User Interface and Data Exploration

Andrew Fall

Landscape Systems Ecologist

Gowlland Technologies Ltd.

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Module 3 Objectives

What you can expect to learn from this module:

- SELES
  - How to open, view and save raster grids
  - How to make basic spatial queries
  - How to make basic modifications to raster grids (content extent and resolution)
  - How to create new raster grids with content from basic queries

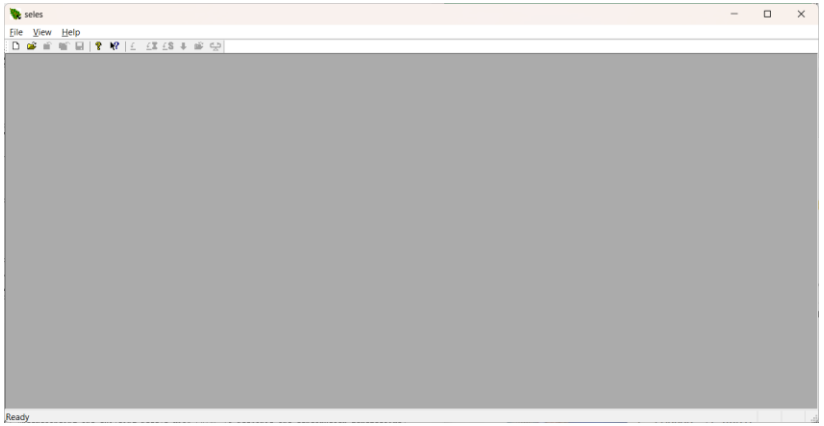
➢ See SELES User Documentation: Part 2 - sections 1 and 2 and Appendix 1

Hands-on

First steps

- Download and install SELES
- Download and unzip the tutorial model files
  - The main model files for this module are in the “CaseStudy” folder
  - Read the readme.txt file to details on the files and a data dictionary

- Start SELES, which should look like this (a blank slate):



File Menu

files, windows and rasters

File menu

- New — new layer with specified dimensions
- Open — open raster or scenario file
- DryRun — run a scenario, except don't simulate
- Close — close current window/raster
- Close All — close all windows/rasters and models
- Save — save raster as a data or image (JPEG)
- Save As — same as Save

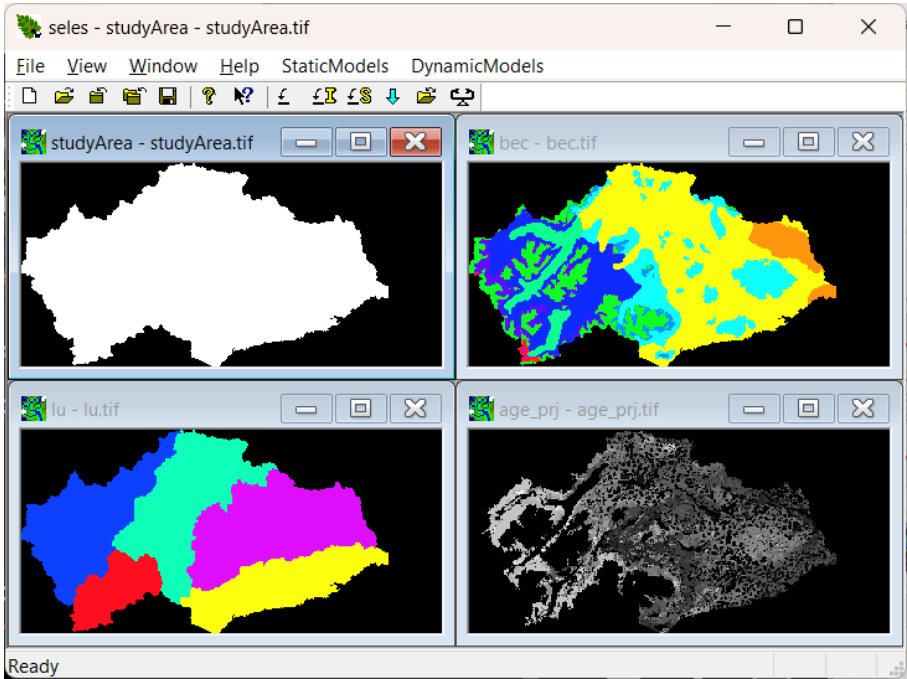
* Note: little used and advanced features are shown in grey

Hands-on

open grids

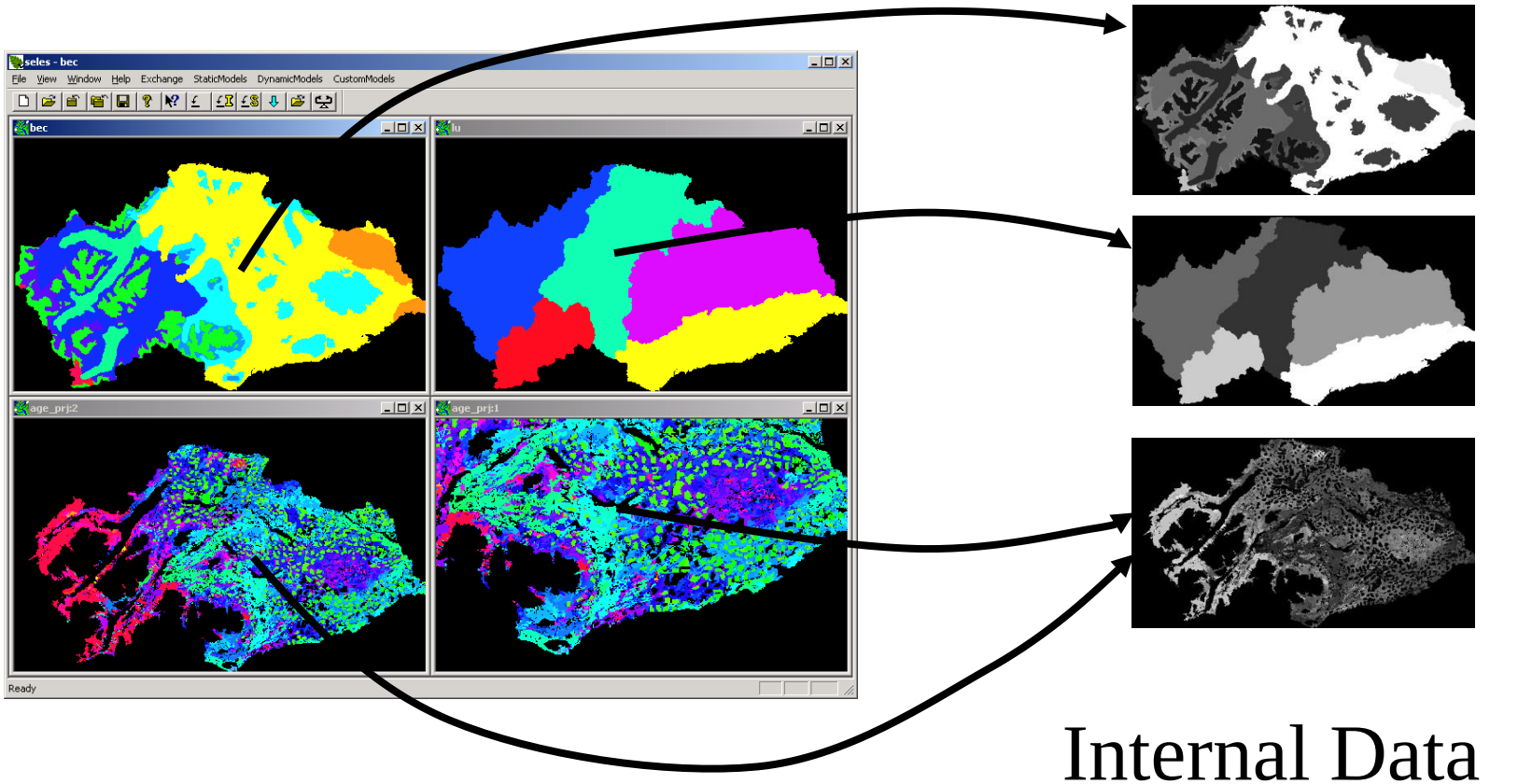
Open the following GeoTiff raster files

- File menu: Open (or click on the  icon on the toolbar)
- Open GeoTiff files: age_prj, bec, lu and studyArea
- Select Window menu: Tile
- The SELES interface should look something like this:



- Note: raster data is stored in arrays; the screen shows views of the raster data

Views (images) vs. Rasters (data)



User Interface

Internal Data Representation

Changing Views

pan, zoom and select

Mouse operations

- Right button + left/right — zoom in/out
- Left button + move — move raster view
- Double-click right button — reset display

– Box selection (used for resize, value model)

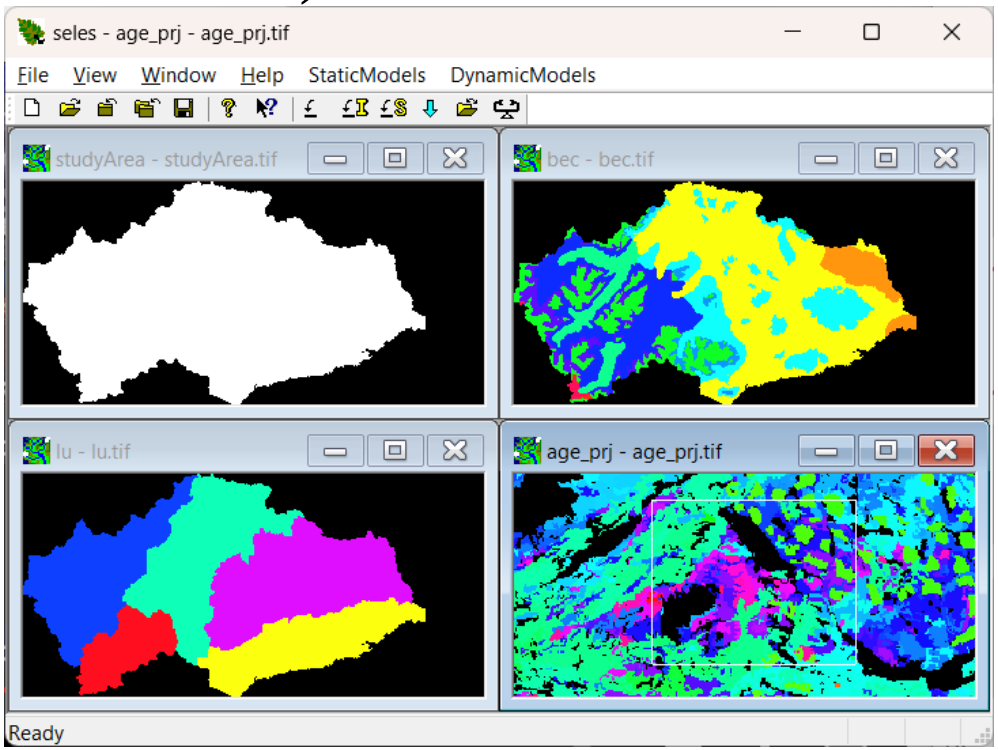
- Left then right + move — select new box
- Right then left + move — adjust box
- Double-click right button — reset box to full raster

Hands-on

zooming and bounding boxes

- Select the age_prj layer (by one left mouse click)
- Hold right mouse button down and move right to zoom in
- Press left then right (both buttons down) and move to select a box

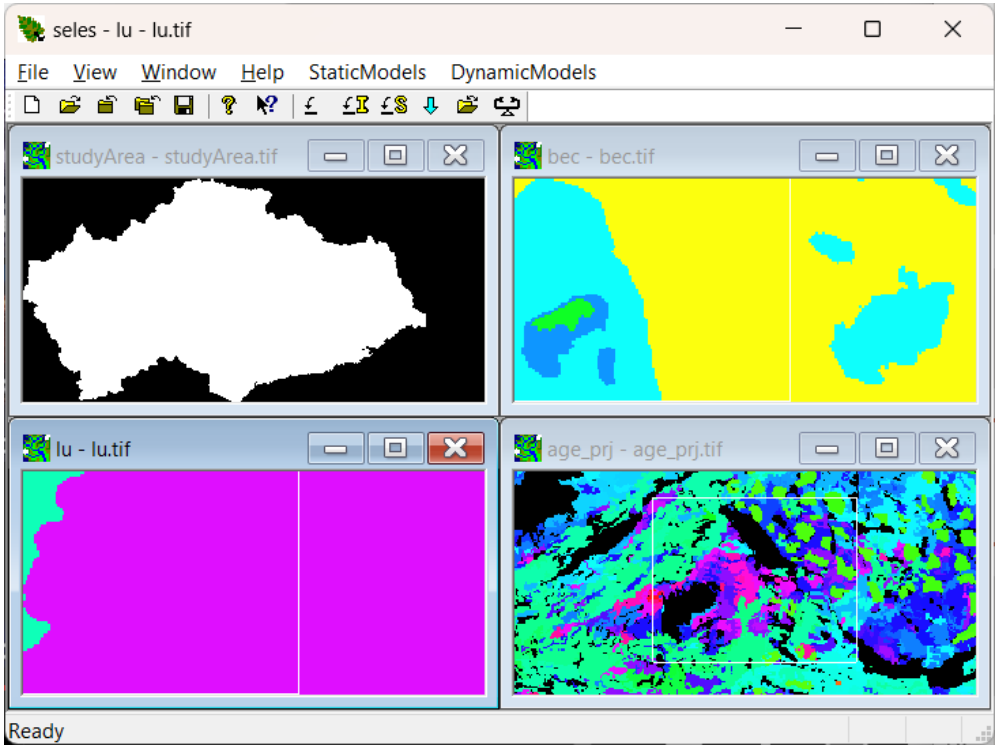
- Should look something like this:



Hands-on

zoom-to-bounding box

- Select the bec layer
- Press the Shift key and double left-click to zoom to the selected bounding box.
- Do the same for the lu layer
- Should look something like this:



View Menu

managing raster display

View menu

- Raster View Properties
  - visualization
- Legend
  - data exploration
- Histogram
  - data exploration
- Histogram2
  - more advanced data exploration

Hands-on

grid attributes

Examine some aspects of the loaded raster grids

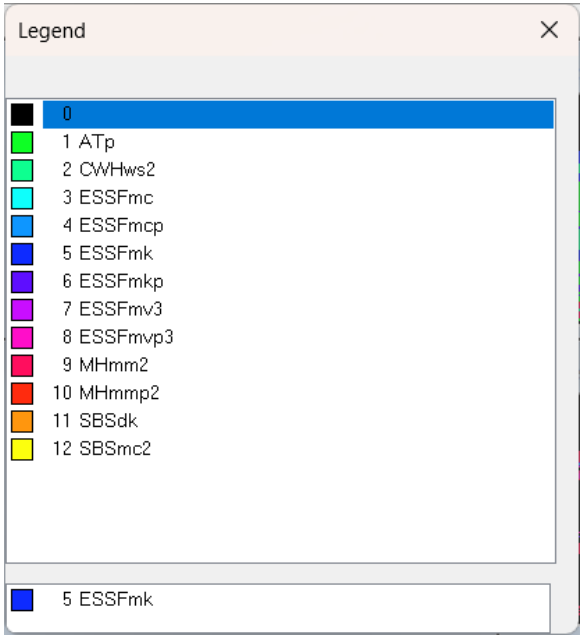
- View menu: Raster View Properties
- Select the age_prj layer
  - Shows the number of rows & cols
  - Shows the range (-1 to 431 years)

- Check the Colour Display box and press OK to show in colour
  - See the User Documentation for a description of the default colour scale used by SELES
- Try Use Raster as Mask and/or Hue to overlay other layers on the currently selected layer (e.g. age_prj > 100 on bec)

Hands-on

legends

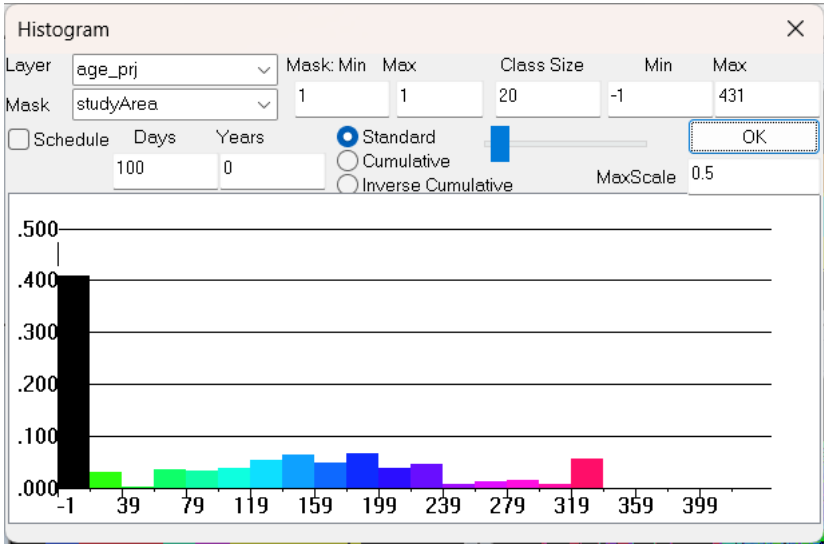
- View menu: Show Legend
  - Shows the legend labels (if any) associated with a raster grid
- Select the bec layer
- The legend should look like this:
- Moving point over the layer shows the value and legend label at the underlying cell



Hands-on

histograms

- View menu: Histogram
  - Allows a simple frequency histogram of a layer
- Select age_prj as the Layer
- Select studyArea as the mask
- Change MaxScale to 0.5
- Press OK



- Note: since the mask is the entire study area, there is a high frequency of 0's (mostly non-forest)
- The default class size is the square root of the number of values (rule of thumb)

Windows Menu

managing raster display

Windows menu

- New window — multiple views on same raster
- Cascade
- Tile
- Arrange icons
- Minimize … — minimize multiple windows
- Name Document — change name of window/raster
  - rarely used
- Layer list (or “more windows”): list of open layers
  - Useful to find a layer when there are many loaded rasters

Help Menu

where to find help

Help menu

- Help topics out-of-date (non-functional)

➢ Use the User Documentation and tutorial information

Static Models Menu

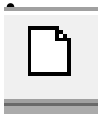
simple queries a generating new layers

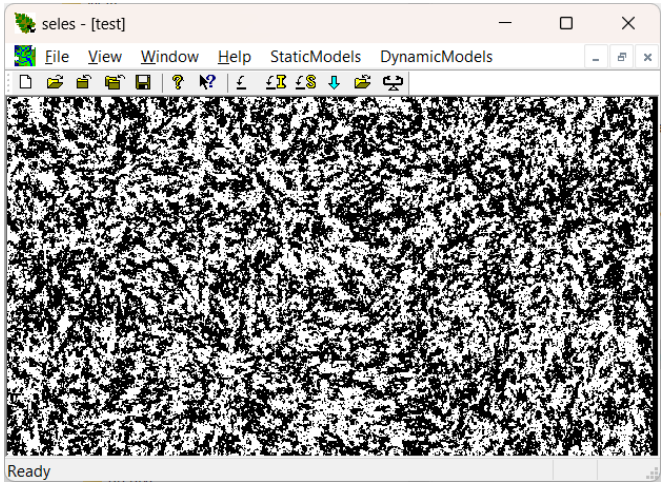
Static Models menu

- Neutral Model — generate neutral patterns
- Site Model — semi-neutral models
  - rarely used
- Fractal Model — generate fractal patterns
  - rarely used
- Value Model — spatial summary and data modification
  - Value Models are very useful for queries, raster modification and raster creation
  - hands-on after basic SELES expressions are presented

Hands-on

Neutral Models

- Create a new binary test layer:
  - File menu: New (or click on the  icon on the toolbar)
  - Number of rows & cols will be taken from the currently selected layer
  - Set Value Range Min to 0 and Max to 1
  - Set Name to test
- StaticModels menu: Neutral Model
  - Revise controls for Relative Abundance (probability) and Contagion
  - press OK



➢ move, resize or double-click the *test* layer to get the view to update

Static Models Menu

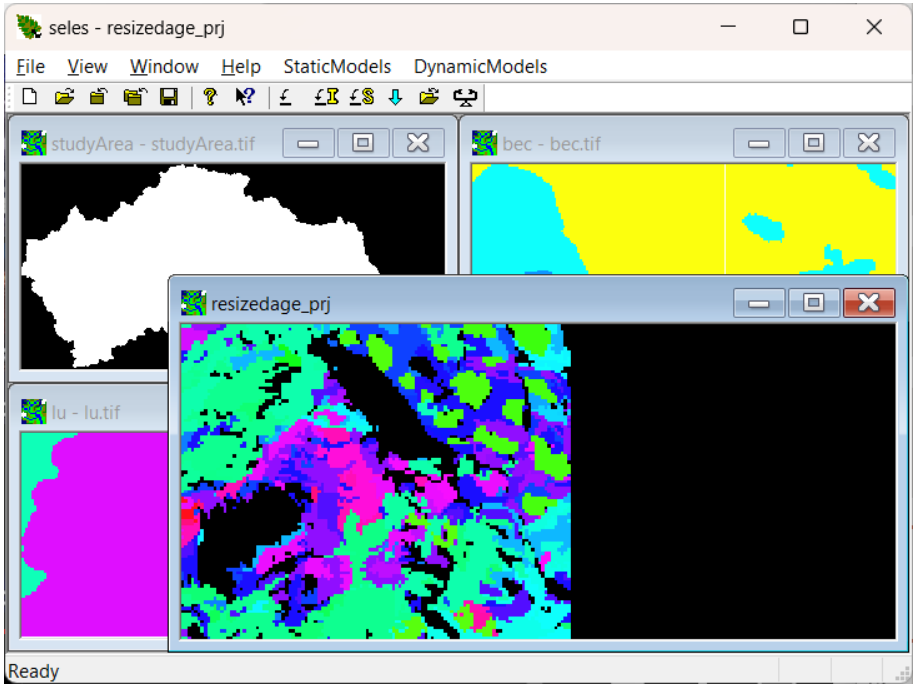
modifying raster extent and resolution

- Align Layer modify extent
  - useful for data preparation
  - set georeferencing of current layer using selected layer
  - areas not covered set to zero (or min. value)
- Resize Layer modify extent
  - useful for selecting a sub-area
- Rescale Layer modify cell size
  - increasing cell size (scale factor > 1): select function to use
  - decreasing cell size (scale factor < 1): simple super-sampling
  - try to use even ratios

Hands-on

resize

- Select the age_prj layer (with the selected box still there)
- StaticModels menu: Resize
  - The default minimum and maximum rows and columns are from the bounding box (can be changed if desired)
- Press OK
- Should look something like this:

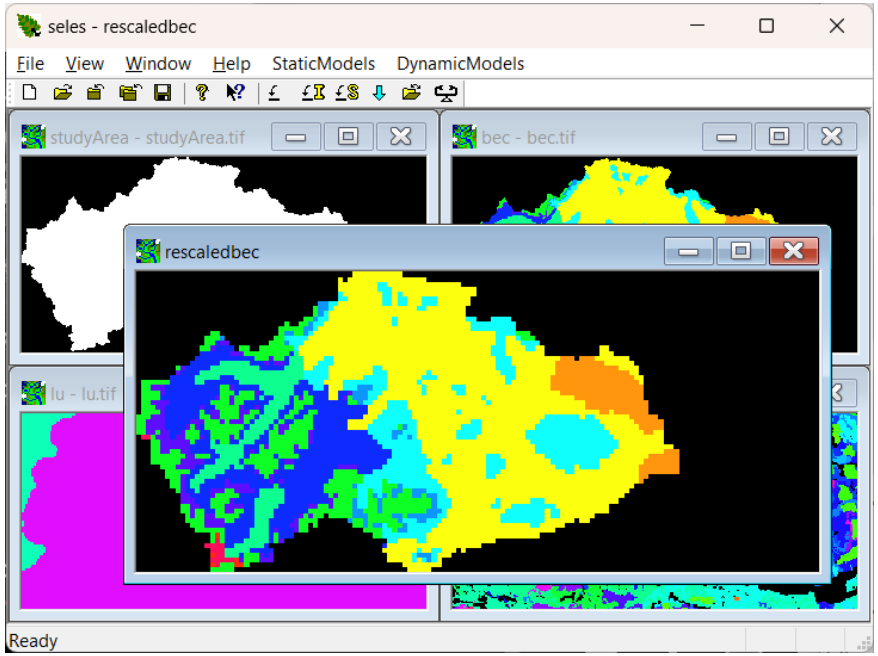


Hands-on

rescale

- Select the bec layer
- StaticModels menu: Rescale
- Set Scale Factor to 10 (meaning cells in rescaled layer will be 10 times larger in each direction – i.e. 100 cells will be used to produce 1 rescaled cell
- Select Mode (dominant)
- Press OK

- Should look something like this:



Dynamic Models Menu

only useful with a model loaded

Dynamic Models menu

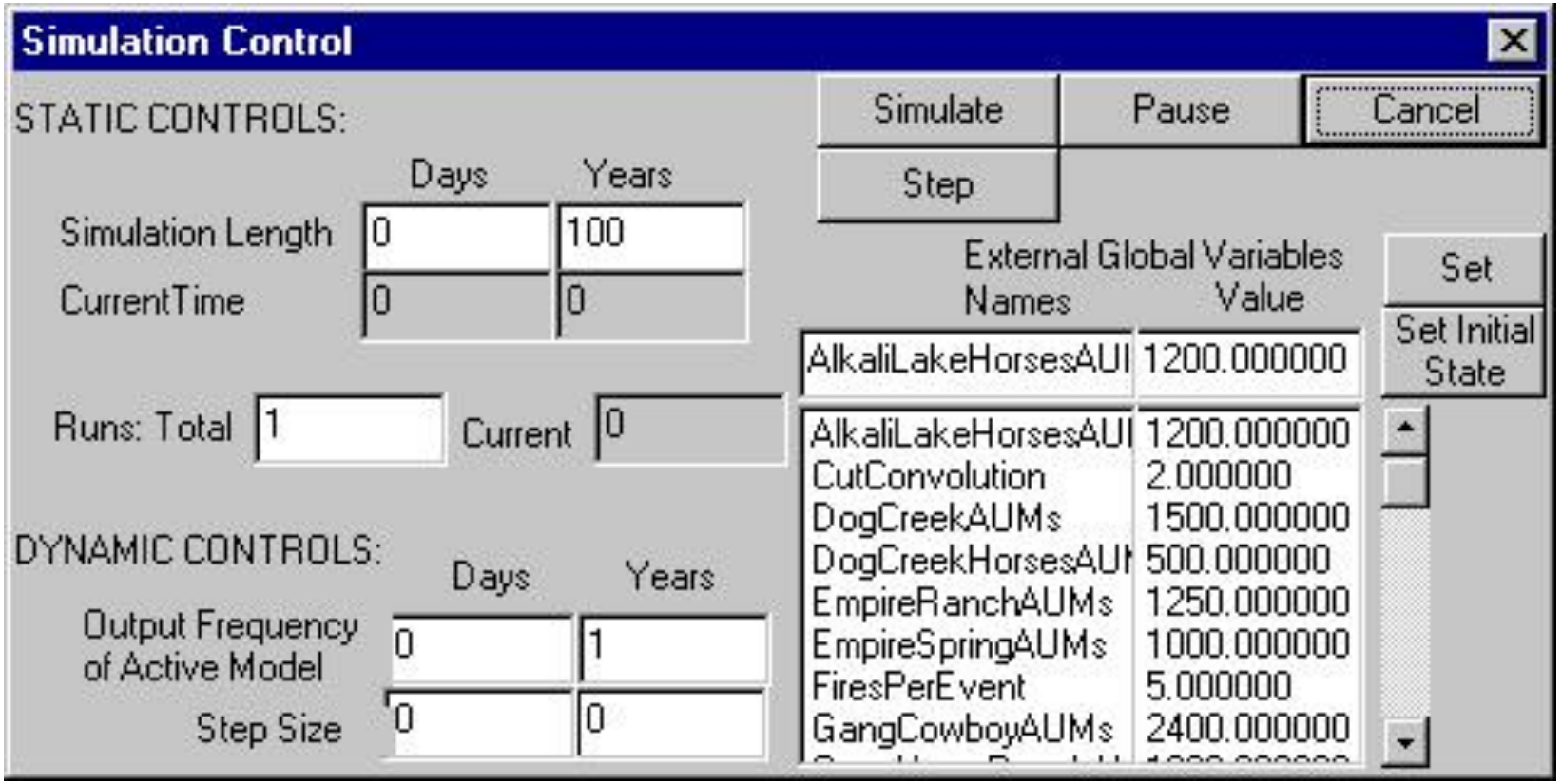
- Dynamic Site Model — schedule site model
  - rarely used
- Dynamic Value Model — schedule value model
  - may be useful for graphing dynamic values
- Model Output — save spatial time series
  - don't use (do this in a .sel model file)

- SELES Model — managed loaded model
  - can be used to enable/disable landscape events
  - don't change file or variable/view links

Dynamic Models Menu

only useful with a model loaded

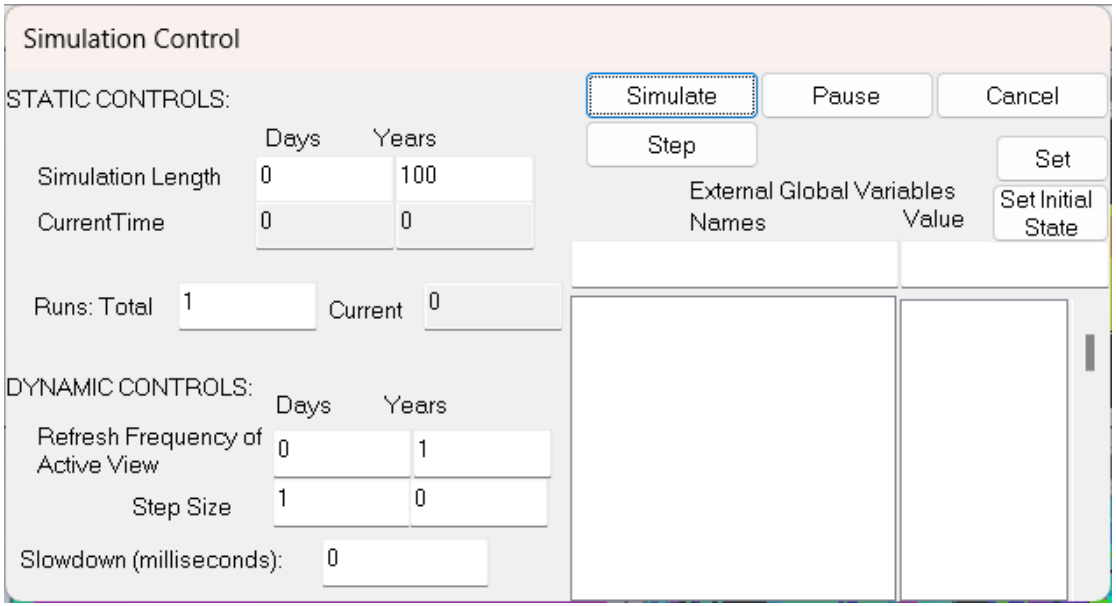
- Simulate main simulation control
  - start/stop/step/pause a loaded dynamic model



Hands-on

simulate dialog

- DynamicModels menu: Simulate (or the  icon on the toolbar)
- There is no model loaded, so no landscape events and no global variables
  - Won't do anything until a model is loaded
- Should look like this:



Dynamic Models Menu

only useful with a model loaded

- Simulation probe
  - – useful for model debugging during a simulation
- Model report
  - – create state-space report (selesModelReport.txt)
  - – only useful after a model is loaded
- Simulation priority
  - – set priority of simulation process
  - – better to do this in a .sel model file

Value Models

spatial queries and data modification

StaticModels menu: Value Model

- very useful for data exploration and modification
- uses the SELES modelling language

- Result is the Operation applied to the value of the *main expression* (starts with '=') computed in each cell of the Region

- The Region is a rectangle plus a Boolean "*decision*" expression
  - » only cells that evaluate to TRUE will be included

- The *main expression* includes
  - one main function (starting with "=") used for the Result
  - any number of additional expressions before or after the main expression

Value Models

spatial queries and data modification

Value Model uses:

- To summarize values from one or more spatial layer
- To modify existing layers and generate content of new layers

Guidelines and requirements

- All open raster layers must have the same spatial resolution and extent (like a layer cake)
- In the main expression box:
  - variables on the right-hand side of assignments must exist
  - if a variable on the left-hand side of an assignment does not exist, it will be created as a temporary variable
- Multiple Value Models can be open at any time
- Save complex sets of expressions to a file for later use
- If expressions become complex, consider creating a full model

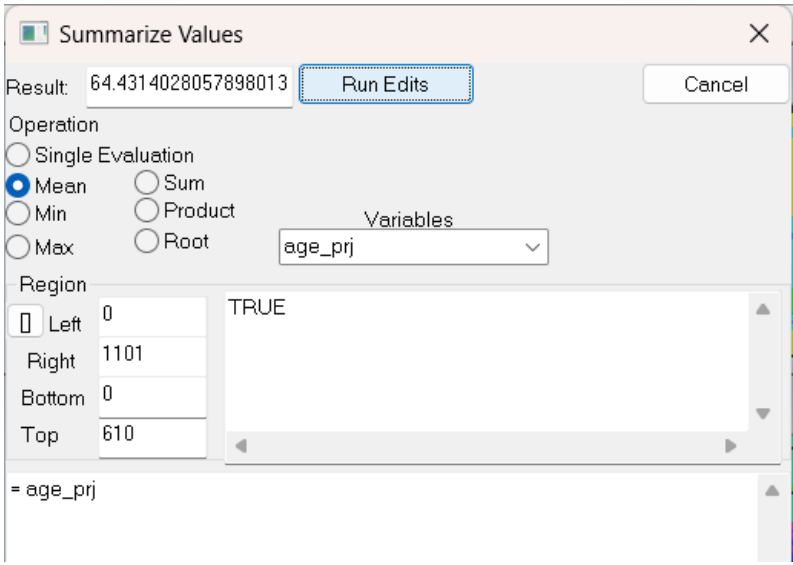
Hands-on

value model queries

- StaticModels menu: Value Model
- Clear bounding box (double-click right)
- Operation: Select Mean
- Region: leave at default (bounding box with condition “TRUE”
- Function: set to “= age_prj”
- Press: Run Edits

- Result: should be 64.431…

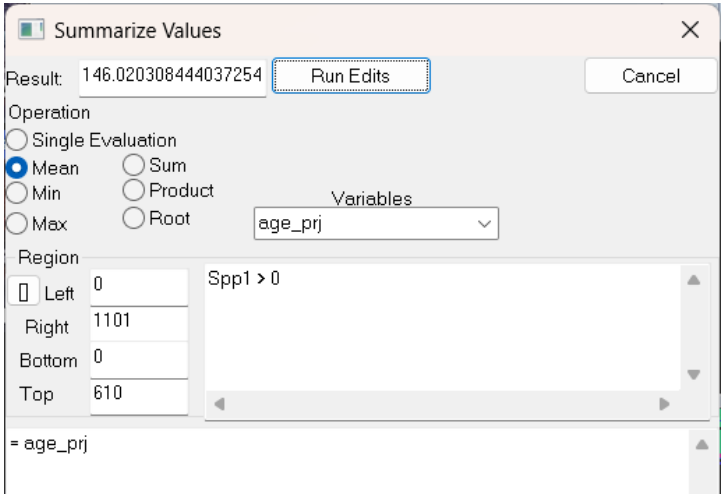
- “*calculate mean of age_prj over entire grid*”



Hands-on

value model queries

- The *Region decision* (or *condition*) is "TRUE" by default, but can be any Boolean expression
  - The decision has an implicit "AND" (Boolean conjunction) to allow more than one condition to be written more simply
- Open the Spp1.tif GeoTiff
- Replace "TRUE" with: "Spp1 > 0"
- Leave function as "= age_prj"
- Result: should be 146.020…
- "*calculate mean of age_prj over all forested cells*" (i.e. mean stand age)



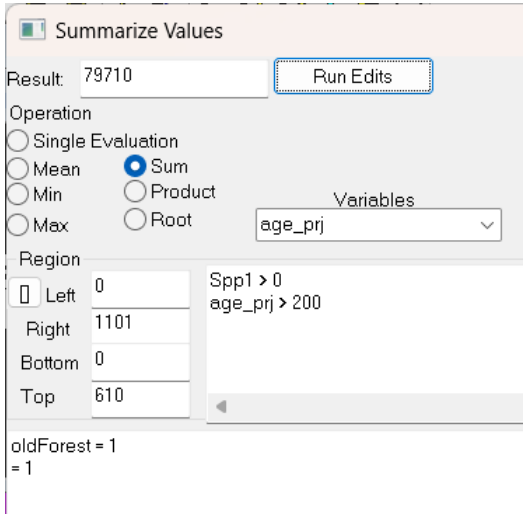
Hands-on

data creation using a Value Model

- Create a new binary layer: with Max 1 and Name "oldForest"
- Operation: Sum
- Set the *Region Decision* to "(Spp1 > 0) AND (age_prj > 200)"
- Set the main expression to:

  oldForest = 1

  = 1
- Result: should be 79,710



- *"count (sum with value 1) number of cells with age > 200"* and create a binary layer of cells with age > 200

➢ move, resize or double-click the oldForest layer to get the view to update

SELES Modelling Language

basics for Value Models

- *Expressions* are the core of the SELES modelling language
  - include functions (e.g. n + 1), control procedures (e.g. “while loops”), output commands, etc.
  - unless otherwise stated, values are treated as real values
- Expressions can be built from many components
  - use parentheses to ensure clarity (especially when mixing real value functions, relations and Boolean expressions)
- For this module: the focus is on basic expressions commonly used in Value Models
  - see the User Documentation Appendix 1 for a full list of expressions
  - see Modules 5 and 7 for more advanced expressions

Basic Expression Types

Covered in this module:

- Arithmetic
- Relation and Boolean
- Basic Control (“if”)
- Display

Covered in later modules:

- Continuous
- Classified (Discrete)
- Control (loops and iteration)
- Probability Distributions and Density Functions
- Region and Spatial
- Output
- **Bit-Vector**
- **Matrix**
- **Set, list, tree, graph**

Variable Assignments

Assignment:

variable = expression

If the variable on the left-hand side does not exists as a state variable, it will be created as a temporary variable

Examples:

x = 6

isOldPine = (Spp1 EQ 5) AND (age_prj > 100)

Arithmetic Expressions

+ - * / % ^

Expression + *Expression*

Expression ^ *Expression* (exponentiation)

Expression % Expression (modulo – remainder on division)

Note: use parentheses to ensure clarity

Example:

X = (age_prj + 5) / 10

Relations

Expression < *Expression*

Expression <= *Expression*

Expression EQ Expression (or *Expression* == *Expression*)

Expression NEQ Expression (or *Expression* != *Expression*)

Expression <= *Expression* <= *Expression*

EQ can alternatively be written as "==" and NEQ as "!="

Example:

isMature = (age_prj > 100)

Boolean Expressions

Expression AND Expression

Expression OR Expression

NOT Expression

AND can alternatively be written as “&&”, OR as “||” and NOT as “!”

Examples (in-line or multi-line forms):

```
isMature = (age_prj > 100) AND (Spp1 > 0)

isOldPineSBSdk = AND
                 Spp1 EQ 5
                 bec EQ 11
                 age_prj > 100
               END
```

Boolean Expressions

- Relations take real values and return TRUE/FALSE
- Boolean expressions take TRUE/FALSE values and return TRUE/FALSE
- "IF" statements take TRUE/FALSE and return real values or TRUE/FALSE

- Equivalencies among data types:

FALSE = 0
TRUE = 1

AND ≈ product (but limited to 0 and 1)
e.g. TRUE AND FALSE = FALSE 1 * 0 = 0
OR ≈ sum (but limited to 0 and 1)
e.g. TRUE OR FALSE = TRUE 1 + 0 = 1
e.g. TRUE OR TRUE = TRUE (1) but 1 + 1 = 2 !

Control Expressions

Functional if-statement: *returns a value*

IF Expression THEN Expression ELSE Expression

Procedural if-statement: *controls if sub-expressions are run*

IF Expression
...
END

IF Expression
...
ELSE
...
END

Control Expressions

Examples:

Functional if-expression:

```
oldForest = IF age_prj > 100 THEN 1 ELSE 0
```

Procedural if-expression:

```
IF age_prj > 100
    oldForest = 1
    areaOld = areaOld + 1
ELSE
    oldForest = 0
    areaNotOld = areaNotOld + 1
END
```

Display Expression (basic)

Display a record with the specified fields

DISPLAY
? condition
label: Expression
varName
$varName
...
END

Where condition is a Boolean decision (whether to display)

Example:

```
DISPLAY
? Spp1 > 0
    age: age_prj
    Spp
    $Spp1
    bec
END
```

Comments

Used to document code (in any SELES file type), and may be useful in complex value model expressions

// single line comment

/ multiline comment … */*

Example:

```
// identify pine stands older than 100 in the SBSdk bec zone
isOldPineSBSdk = AND
        Spp1 EQ 5 // 5 means pine (use label if a legend is loaded)
        bec EQ 11 // 11 means SBSdk
        age_prj > 100
    END
```

Exercises

data queries

Use the data in the tutorial case study. See the readme.txt file included in the case study .zip file for a data dictionary

1) How many cells (or hectares) are there in

a) the overall raster?

b) the study area?

c) the forested area?

d) stands over 100 years?

e) stands over 100 years in the SBSmc2 bec zone?

f) stands over 100 years in the SBSmc2 bec zone above 1000m?

Exercises

data queries

2) What is the min/max

a) stand age?

b) age in the in the SBSmc2 bec zone?

c) age of Trembling Aspen stands?

3) What is the mean

a) stand age? (careful that the denominator is the forest)

b) age of stands in the SBSmc2 bec zone?

c) age of stands in the SBSmc2 over 1000 m?

d) age of stands over 100 years?

Exercises

data queries

4) What is the frequency distribution

a) of stand ages (in 10 year classes)?

b) of stand ages in the SBSmc2 bec zone?

This is a trick question: How can a histogram be done using multiple layers?

Exercises

data creation

5) Create a binary layer with forest over 100 years old

a) Create a new layer called “matureForest”

b) Set value 1 to all stands older than 100 years

c) Save as a GeoTiff (in the grids folder)

6) Create a binary layer with the value of the bec layer in forested cells, and zeros elsewhere (e.g. “becInForest”)

Use this to re-address question 4b

Exercises

data modification

7) Modify age_prj layer

a) To be 100 in all forested cells (but unchanged elsewhere)

Note: the contents of the original GeoTiff file will only be modified if you save the raster layer and overwrite the old content. Any modified values will otherwise be lost when SELES is closed.