ALFRESCO

Alaska **Fr**ame Based **E**co**s**ystem **Co**de

User Guide

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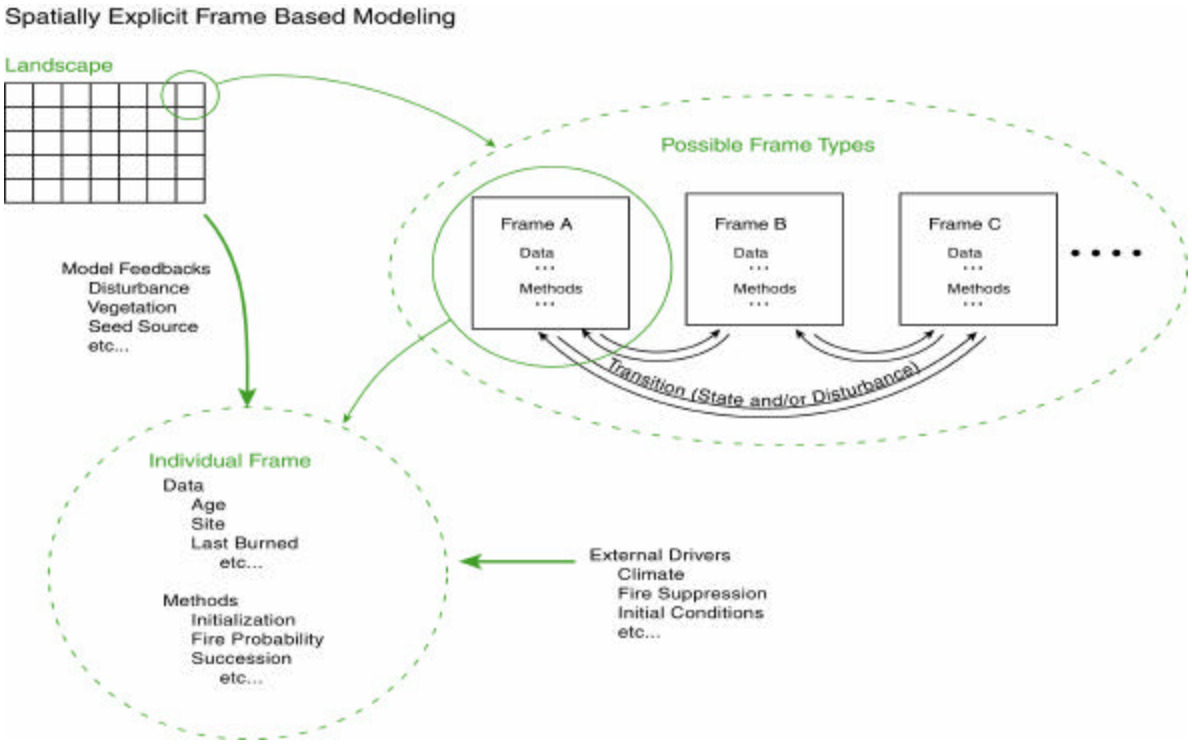
I

Introduction

ALFRESCO is a spatially explicit stochastic ecological simulation model. In its current state, it simulates the landscape dynamics unique to sub-arctic and boreal forest vegetation types – under the assumption that *climate* and *disturbance* are the primary drivers for landscape change in this region.

The ALFRESCO landscape is composed of frames (cells) of independent sub-models which represent the current *state* of the landscape at that location. Switches from one *state* to another are governed by internal factors unique to each sub-model, as well as interactions with neighboring sub-models thru disturbance factors.



The mechanics of the spatially explicit frame-based design (FRESCO) lends itself well to studying boreal landscapes of various spatial scales, as the internal factors of each sub-model may be calibrated to represent any unique sub-regional landscape characteristics.

The ALFRESCO model is currently in its fourth stage of major development (refer to section V for Stage III, IV details).

Stage	Model	Active Versions	Development Team	Language	Year
I	ALFRESCO		Scott Rupp - Programmer	Pascal	2001
II	ALFRESCO		Jonathon Henkelman - Programmer Scott Rupp	C++ (OOP)	2002
III	WALE	***WALE 1.3.2.9*** ***WALE 1.3.1.10***	Richard Howard - Programmer Scott Rupp Mark Olson Xi Chen Paul Duffy	C++ (OOP)	2004
IV	WALE2	***DEMO***	Richard Howard - Programmer Tim Glaser - Programmer Scott Rupp Mark Olson Xi Chen Paul Duffy	C++ (OOL)	2004

Technical Development is currently managed by Richard Howard and Tim Glaser of ASSISI Software, Portland, Oregon.

Front end development and research is currently conducted by the Ecosystem Dynamics Modeling Group of the University of Alaska Fairbanks.

Scott Rupp – Principal Investigator

Paul Duffy – Statistician, PhD. Candidate Forest Sciences

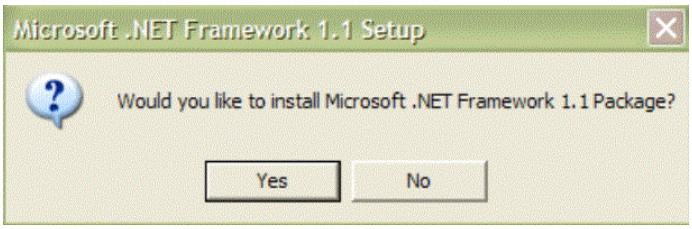
Mark Olson – Statistician

Xi Chen – M.S. Candidate Statistics

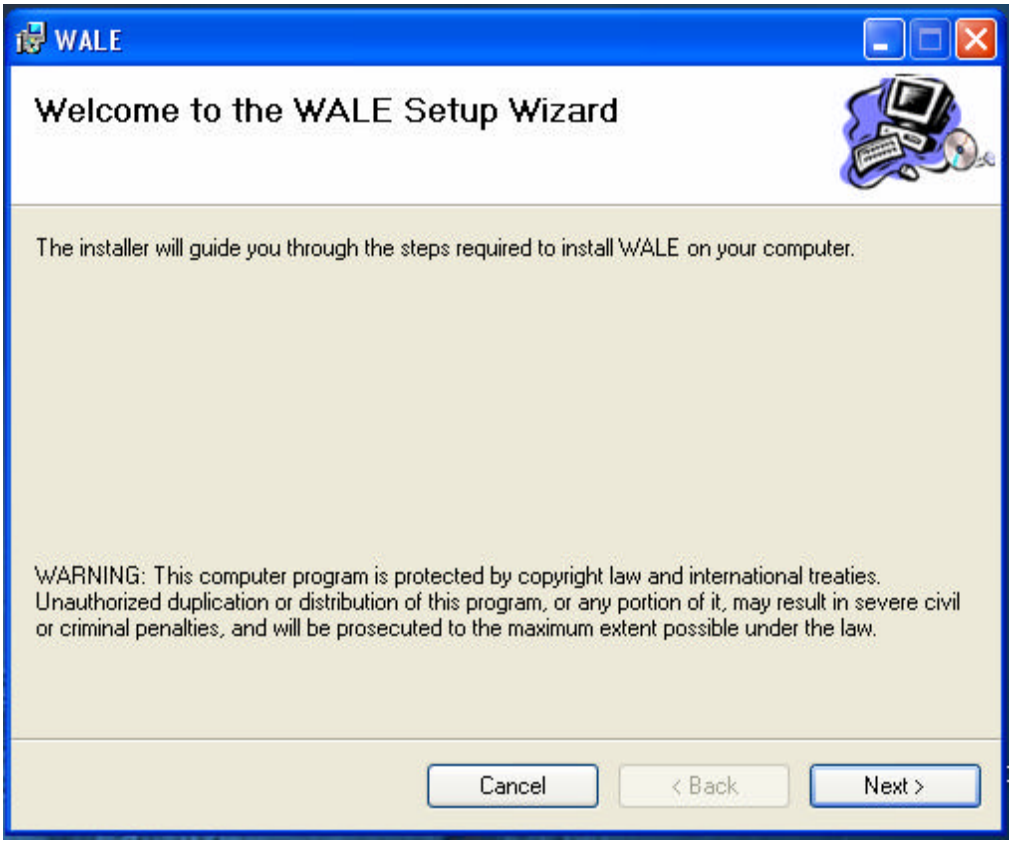
(Jonathon Henkelman – Programmer)

II Installing The Model

1) In the 'Setup' Folder, open (double-click) dotnetfx11.exe. The following Setup Wizard should appear. Select 'Yes' and follow the instructions.



2) In the 'Setup' Folder, open (double-click) Setup.exe. The following Setup Wizard should appear. Follow the instructions.

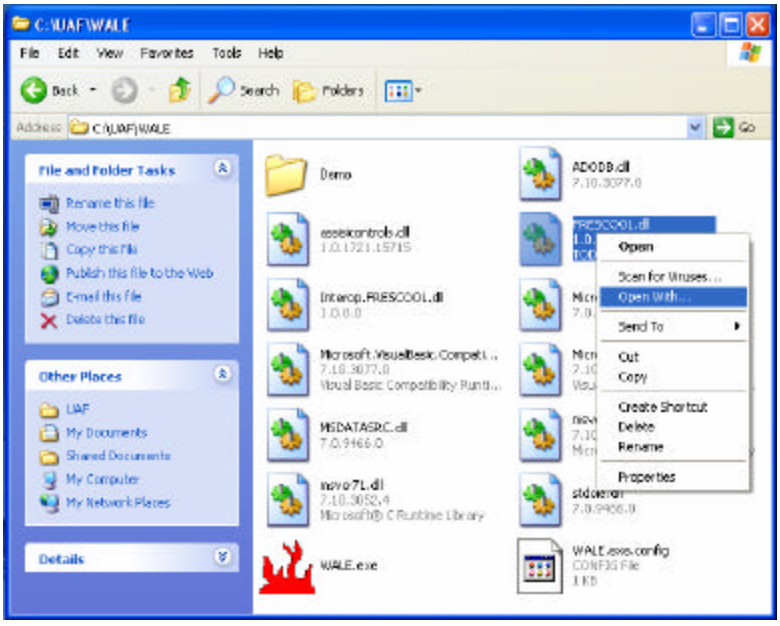


Note: The Install Wizard will automatically create the working directory C:\UAF\WALE. There is an option to define another working directory, but it is not advisable at this time.

3) If installed correctly, the following icon will appear on your 'desktop' (skip to 5)).

4) If the icon does not appear, or you get an error message, try the following (This is common if installing WALE for the first time.):

a) Navigate to C:\UAF\WALE
b) Right click on FRESCOOL.dll. Select the 'Open With...' option.

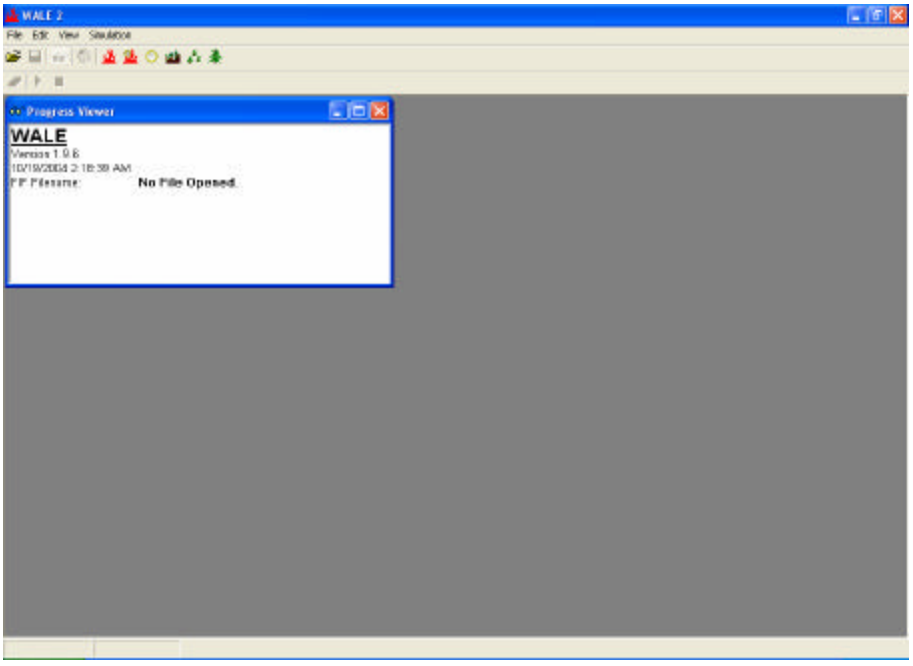


c) Select 'Browse' (or 'Other' if running Windows 2000)

Windows XP:
Navigate to '*Local Disk (C:)*' => '*WINDOWS*' => '*SYSTEM32*' => Select regsvr32.exe.

Windows 2000:
Navigate to '*Local Disk (C:)*' => '*WINNT*' => '*system32*' => Select REGSVR32.exe.

5) The program can be run either by selecting the desktop shortcut, or from the working directory by selecting WALE.exe (C:\UAF\WALE\WALE.exe). The following screen should appear if the program was installed successfully:



III

Running The Model

User Interface

Descriptions of each of the above icons can be found by holding the mouse pointer over each respective icon. These options can also be accessed by exploring the menu bar.

1) Mechanics of running a simulation:

a) Select the 'File' icon or 'File/Open' from the menu bar to open the FIF Editor (Refer to 2) for FIF details.

Note: Any changes to the FIF file must be saved for those changes to take effect in the current simulation.

b) Open any desired map viewer windows (individual icons or by selecting 'View' from the menu).

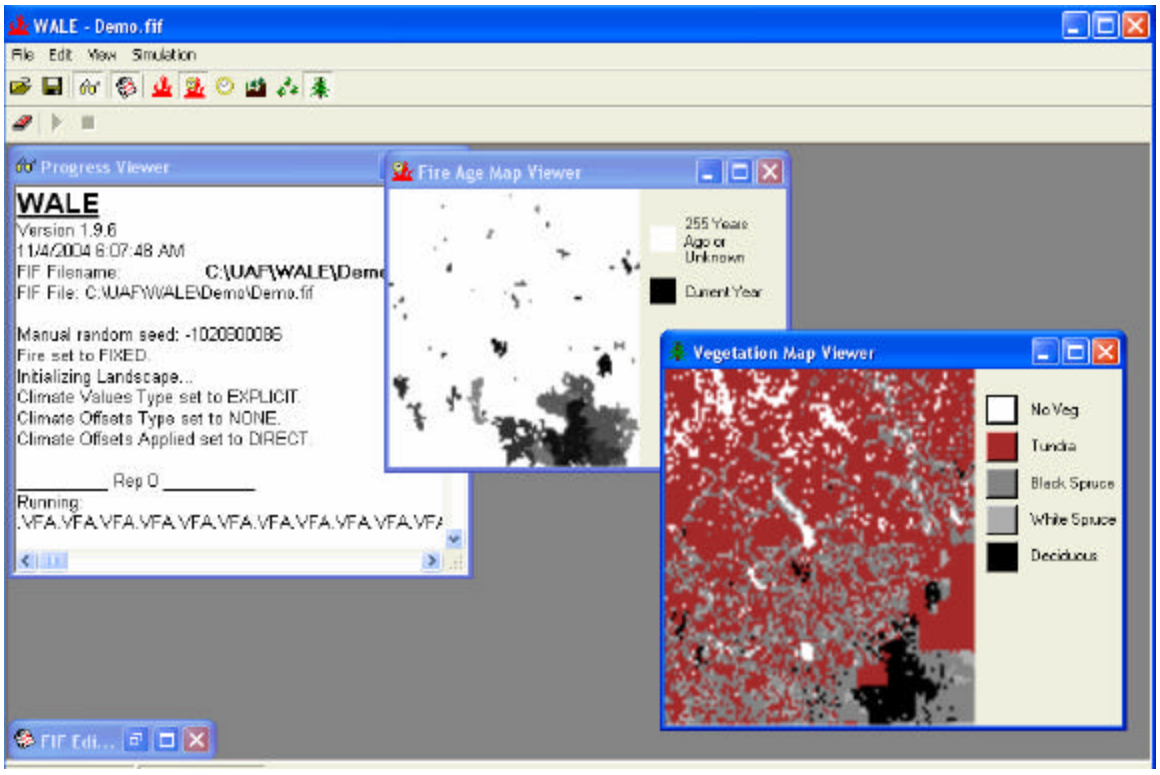
Note: The desired map view(s) must be opened prior to the current simulation in order to view the progress for that simulation. In the event that the map views are selected

out of sequence, hit the 'stop simulation' icon, followed by the 'Erase' icon. This will reset the selected viewers and you may proceed with the simulation.

c) Run the model by selecting the 'Run Simulation' icon (or choosing Simulation from the menu).

2) Example screen output:

Note: The map viewer colors can be changed by clicking on the respective color boxes.



The *FRESCO Input File* (.fif)

The FIF Editor (file extension '.fif') is where the user defines all aspects of a simulation.

General

Parameter	Description
Base Directory	Base directory where input files can be found and output will be written.
Max Years	Number of years to run a simulation.
Max Reps	Set to number of simulation replicates desired.
Time Step	Time step in years. 1 = ANNUAL, 10 = DECADAL
Random Seed	A manually set number to use to seed the random number generator. If not set (leave blank), the current time is used to seed the random number generator.
Num Header	The number of header rows in the input files. This is generally = 6 if using ArcGIS to generate the input maps
No Data ID	No Data value specified by ArcGis
Output Directory	Sub directory of base directory where output files will be found.
Output Type	**DELETE** = Delete current output directory and any files currently in it. Then recreate output directory. [****CAUTION**** Results of all prior simulations stored in this directory will be erased (even if they have been renamed).] **OVERWRITE**=Overwrite any existing output files. **APPEND**=Append current date and time on to output directory.
Large Memory Model	True=Read in historical fire and climate at beggining of run. False=Read in historical fire and climate each year.
Show Seed?	True=Show the random seed used. False=Do not show the random seed.
Console Dot Display	The period to display dots in the output display i.e. once every x years. Useful for showing that program is still executing.
Console Detail Level	This setting controls the amount of detail shown in the 'Progress Viewer'. **MINIMAL**=Show only run progress. **MODERATE**=Show some interim calculations along with run progress. **MAXIMUM**=Show maximum number of interim calculations along with run progress.

Climate

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>History</td><td>The number of years to remember climate history including the current year.</td></tr>
<tr><td>Climate Type</td><td>Determines the source of climate (Temp & Precip) values:
CONSTANT - Single Temp and Precip value used for every cell in all years and reps.
SPATIAL - Read in spatially unique temp and precip values from a map file. Reuse each year and rep.
EXPLICIT - Read in spatially unique temp and precip values from a different file each year. Year is appended as "_YR".</td></tr>
<tr><td>Temp Values
Precip Values</td><td>Specifies the path (relative to the Base Directory) to the files containing the climate information. These files can take on a variety of forms depending upon the selection of Climate Type :
<table>
<tr><th>Climate Type</th><th>Description</th></tr>
<tr><td>CONSTANT</td><td>Value to use for temperature and precipitation. Value is shared among all cells in all years.</td></tr>
<tr><td>SPATIAL</td><td>Filenames of Spatial Temp and Precip input maps.</td></tr>
<tr><td>EXPLICIT</td><td>Base filename of Spatial Temp and Precip input maps. Note: The sequence of input maps must be in the form [BASE_Year], beginning with Year 0. ALFRESCO will automatically append (and increment) Year onto this Base filename while running.</td></tr>
</table></td></tr>
<tr><td>Offsets - Offset Type</td><td>Determines how temporal offsets are calculated. Settings can be:
NONE – No offsets applied.
RAMPED - Offsets are calculated using stepping and ramping.
FILE - Offsets are read in from a file.</td></tr>
<tr><td>Offsets - Application Method</td><td>Determines how the offsets are applied. Settings can be:
DIRECT - Offsets applied directly to climate values.
STOCHASTIC - Offsets applied stochastically to climate values each year and rep.
REPLICATED - Offsets applied stochastically to climate values each year but repeated each rep.</td></tr>
<tr><td>Offsets - Offsets File</td><td>When Offset Type=FILE, this is the file of Temp and Precip offsets to use in each year of a simulation.</td></tr>
<tr><td>Offsets - Temp / Precip Offsets</td><td>
<table>
<tr><th>Climate Type</th><th>Description</th></tr>
<tr><td>Mean
Standard Deviation</td><td>When offset are applied as STOCHASTIC or REPLICATED these parameters are the mean and standard deviation of a random normal distribution of values that are added to any offset calculated above.</td></tr>
<tr><td>Constant Value</td><td>Specifies the value used for Clymate Type = CONSTANT</td></tr>
<tr><td>Step Year
StepValue
Ramp Year
Ramp Value</td><td>When offset type is set to RAMPED, these are the stepping and ramping parameters to use for the ramping feature of temp and precip offsets.</td></tr>
</table></td></tr>
</table>

Fire

Parameter	Description
Enable Fires	Enable the Fire model - usually set to TRUE.
Fire Type	Type of fire model to use. **FIXED** = Flammability factors (*Ignition Factor, Sensitivity*) constant across landscape. **SPATIAL** = Spatially explicit Flammability factors. **HISTORICAL** = Spatially / Temporally explicit fires (Fire scar maps are read in each year).
Spread Radius	The maximum distance fire can spread (meters). If CropNeighbors is set to false and this is less than CellSize, fire will spread to adjacent cells only.
Spread Mean	Mean of a Normal distribution used to randomly spread fires. (Should **not** be changed.)
Spread Std Dev	Standard deviation of above distribution (Also should not be changed).
Fire Climate Equation	Climate contribution to the overall flammability of a cell - empirically based regression results, and generally should **not** be changed.
Ignore First Interval	Ignore the first fire interval for a cell when calculating statistics - used to help eliminate startup bias in statistical calculations.
Ignition Factor	Ignition probability (e.g. lightning) contribution to the overall flammability of a cell. Used when *Fire Type* = **FIXED.**
Sensitivity	Fire spread probability (e.g. vegetation) contribution to the overall flammability of a cell. Used when *Fire Type* = **FIXED.**
Historical File	Path and base file name of historical burn maps. The year of simulation is appended on the end of the filename. For example, a setting of "Fires/Fire.txt" will cause WALE to look for maps of fires in the "Fire/" subdirectory that are named Fire_0, Fire_1, etc. (*Fire Type* = **HISTORICAL**).
Spatial Ignition Factor	Path and filename of spatial ignition map. (*Fire Type* = **SPATIAL**)
Spatial Sensitivity	Path and filename of spatial sensitivity map. (*Fire Type* = **SPATIAL**)

Map Output

Parameter	Description
Map File	Sub-directory of *Output Directory.* Path and base names for the output maps.
Map Codes	The code to output so the user knows this map has been written.
Map Flags	Output codes (* **Hexadecimal** coding)
Map Rep Start	The first replication that outputs maps.
Map Rep Freq	The replication frequency to output maps.
Map Year Start	The first year that outputs maps.
Map Year Freq	The year frequency to output maps.

* The Hexadecimal map flags use a base 16 numbering system:

Base Number 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

Hexadecimal Code 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

Map Flags:

Parameter	Description
	General codes - if not specified, nothing will get printed
0x1	Class data
0x2	Stats by year.
0x4	Stats by replicate.
	Format Codes - how should we output the data
0x10	Output format for data.
0x20	Output a headers
0x40	Output ARC header.
	Data codes - used in conjunction with Class Data (above)
0x100	Output Veg data
0x200	Output Age data
0x400	Output Site data
0x800	Output Subspecies data
0x1000	Output Fire age data
0x2000	Output Temp. offset
0x4000	Output Precip. offset
	Frame Variables - The exact data output is dependant on the implementation of the particular frame
0x10000	First Frame Variable
0x20000	Second Frame Variable
0x40000	Third Frame Variable
0x80000	Fourth Frame Variable

Statistical Output

A summary of simulation results can be saved to output files. The type of stats that are saved is set using binary flags. Binary flags (Hexadecimal) are values that are summed to give the overall setting for a statistic. There are three formats for the statistical output:

Stat Summary File

The stat summary file holds summaries of the various stats including Mean, Min, Max, Std Dev and Histogram data among others. Simulation results can be *summarized* across replicates or across years (e.g. Time-Series).

Data Files

Data Files hold the sample data used to determine the values in the summary file. These (and the Event Files below) are a useful format for exporting the stat output into other computing platforms (e.g. Excel, SAS, R).

Event Files

Event Files hold the values from individual events. Some stats (FireSize in particular) are the sum of values in a given rep and year. To see the actual values within these sums, create an event file.

Stats Available for Output

Vegetation Distribution (by Species)

Vegetation Residence Times

Fire Size

Tracks the size of ignited fires. Fires can ignite at more than one location. The fire size statistic holds the mean of number of cells burned in each ignition. The FireSizeEvents.txt lists the number of cells burned per ignition for each rep and year.

Fire Number

Tracks the number of ignitions. The fire number statistics holds the mean of the number of ignitions. The FireNumEvents.txt file lists the ignitions that occurred each rep and year.

Fire Size by Species

Tracks the size of fires by species.

Fire Intervals

Tracks the time between fires by species.

.FIF Settings (Stat Output)

Parameter	Description
Summary File	Sub-directory of *Output Directory.* The path and name of the statistical data output file.
Fire Num Flags	Output flags* for the fire number (ignitions) stats.
Fire Size Flags	Output flags* for the fire size (Area Burn) stats.
Veg Distribution Flags	Output flags* for the vegetation stats.
Veg Residence Flags	Output flags* for the vegetation residence times.
Fire Species Flags	Output flags* for the fire by species stats.
Fire Interval Flags	Output flags* for the fire interval stats.

* Hexadecimal numbering system

Base Number 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

Hexadecimal Code 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

Stat Flags:

Parameter	Description
0x1	Output the data averaged by year.
0x2	Output the data averaged by replicate.
0x4	Show row titles in output. IE “Year”, “Mean”, “Min”, “Max”, etc.
0x10	Output the number of samples.
0x20	Output the mean of the data.
0x40	Output the standard deviation of the samples.
0x80	Output the minimum of the samples.
0x100	Output the maximum of the samples.
0x200	Output a histogram of samples.
0x400	Output the sample data for the statistic. Note that sample data may already be an average or sum of event data. For example, FireSize sample data is the sum of all fires in a given rep and year.
0x800	Output the event data for the statistic. Event data is a record of individual events rather than an average or sum.

Landscape

This is where the user specifies the dimensions of the simulation landscape, as well as the providing the path and file names for the landscape initialization maps.

Parameter	Description
Max Rows	Number of rows in landscape grid.
Max Columns	Number of columns in landscape grid.
Cell Size	The size of each cell (in meters).
Num Species	Number of cell types (including the user specified *No Veg* type).
No Veg	ID of the no vegetation cell type (e.g. mountains, water). Flammability for these cells = 0.
x11 Corner	X Corner specified by ArcGis.
y11 Corner	Y Corner specified by ArcGis.
Veg Input File	Path (from *Base Directory*) and filename of initial input vegetation map.
Age Input File	Path (from *Base Directory*) and filename of initial input age map.
Site Input File	Path (from *Base Directory*) and filename of initial input site (aspect) map.
Tree Density Input File	Path (from *Base Directory*) and filename of initial input tree density (canopy) map.
Crop Neighbors?	Should the neighbors algorithm crop calls to cells outside the circular boundary defined by size or should it include all the cells within the square boundary defined by size. Usually set to False.

Species

Tundra:

Parameter	Description
Start Age Parameters	Parameters for the starting age function. If one parameter is specified assume a constant distribution, otherwise parameters are the lifetime and shape parameters for a Weibull distribution.
Fire Prob	Probablity of this species type burning.
Spruce Estimated BA	Estimate of the Basal Area of mature forest - used to calculate seed dispersal for initial BA assignment routine.
Seed Range	Distance to the maximum seed source in meters.
Seed Source	The mean travel distance(meters) and fraction of thin tail (1-fraction fat tail) in the distribution kernel.
Seed Basal Area	The number of seeds/Ha produced per unit basal area (m2/Ha).
Seedling	Seed to seedling ratio including viability factor.
Seedling BA	Initial basal area of a seedling (m2) - based on a 5mm diameter.
History	The number of years of climate this frame uses to make decisions including the current year.
Seed Est Parms	Seedling establishment parameters - {cuttoff temp, avg degree days/year cutoff}.
Mean Growth	Mean spruce growth (m) - this discounts the known trend in growth through time.
Climate Growth	Coefficients to the relative growth factor - from a regression against climate (Int, Temp, Precip).
Cal Factor	Calibration factors to move from cohort growth model to exponential growth model - {growth, seed set}
Spruce Basal Area	Basal area at which tundra transitions to spruce (m2/Ha). A mature spruce stand is assumed to be about double this.

Black Spruce / White Spruce:

Parameter	Description
Start Age Parameters	Parameters for the starting age function. If one parameter is specified assume a constant distribution, otherwise parameters are the lifetime and shape parameters for a Weibull distribution
Fire Parameters	Parameters for the fire age function : k = Max Fire Factor, a = Age Coefficient (Age = a/b), b = Slope Coefficient. Note: Age fxn currently disabled in the model.

Deciduous:

Parameter	Description
Wspruce Start Age Parameters	Deciduous cells with aspect derived White Spruce Trajectory: Parameters for the starting age function. If one parameter is specified assume a constant distribution, otherwise parameters are the lifetime and shape parameters for a Weibull distribution.
Bspruce Start Age Parameters	Deciduous cells with aspect derived Black Spruce Trajectory: Parameters for the starting age function. If one parameter is specified assume a constant distribution, otherwise parameters are the lifetime and shape parameters for a Weibull distribution.
FireProb	Probablity of this species type burning.
History	The number of years of climate this frame uses to make decisions including the current year.
Tundra Parameters	Deciduous transition to Tundra: Degree-years are integrated from base A (i.e. temp < A). A transition occurs if the integrand exceeds B*(The maximum number of steps i.e. History/TimeStep).
Bspruce Parameters	Coefficients to linear function relating age to probability of transitioning to BLACK spruce: A*Age + B.
Wspruce Parameters	Coefficients to linear function relating age to probability of transitioning to BLACK spruce: A*Age + B.

IV
Model Inner Workings

Fire Spread

Landscape Fires

Fires are started by allowing each cell to calculate a probability of burn. This probability is compared with a uniform random number to determine if the cell burns. If a burn occurs, that cell is given the opportunity to spread its fire to neighboring cells within a certain radius. The probability that a neighboring cell will burn follows a normal function of distance from the currently burning cell.

Fire Probability

Cell Ignition Probability

The probability that a cell will burn is a function of the cell's internal fire probability, and overall landscape sensitivity and ignitions factors.

P = PI * LS * LI

If (P<UNIRAND) Then Burn Cell

Where

P – Burn Probability: Probability that cell will burn.

PI – Probability cell will ignite due to internal factors. (see below)

LS – Landscape Sensitivity. An overall sensitivity to burn calibration factor; can be applied equally across the landscape (Fire Type = FIXED) or spatially explicit across the landscape (Fire Type = SPATIAL).

LI – Landscape Ignition. An overall Ignition calibration factor (see above).

UNIRAND – Uniform random number.

Internal Cell Factors

A cell's internal fire probability is a function of the cell's current climate (temperature and precipitation), and current vegetation class flammability.

BSpruce:	PI = PC * PDBS
WSpruce:	PI = PC * PDWS
Tundra:	PI = PC * (PDWS- PDT) * BA/BATS + PDT
Decid:	PI = PC * PDD

Where

PI – Probability cell will ignite due to internal factors.

PC – Probability due to climate: temp & precip. (see below)

PD.. – Default probability values for black spruce (PDBS), white spruce (PDWS), tundra (PDT) and deciduous (PDD)

BA – Basal area. Basal changes each year due to seeding and growth.

BATS - Basal area at which tundra transitions to spruce.

Climate Factors

A cell's climate response is a function of the local climate it encounters (temperature and precipitation).

$$PC = C0 + C1*TEMP + C2*PRECIP$$

Where

PC – Probability due to climate.

C0-C2 – Climate function coefficients.

TEMP – Temperature

PRECIP – Precipitation

Fire Spread

When a cell ignites, it has the opportunity to spread the fire to neighboring cells within a spread radius of the burning cell. This is done recursively until the fire burns to completion. Fire spread is a function of the cell's internal flammability, overall landscape sensitivity, and the distance from the ignition source cell.

$$PS = PI * LS * D$$

Where

PS – Probability a fire spreads to its neighbor.

D – Distance of current cell from burning cell.

PI – Probability cell will ignite due to internal factors.

LS – Landscape Sensitivity. An overall sensitivity to burn calibration factor; c an be applied equally across the landscape (Fire Type = FIXED) or spatially explicit across the landscape (Fire Type = SPATIAL).

V
WALE 2
Version
History

(Programmer Notes)

Version History

About Versions

This section summarizes the versions of the WALE. The first version of WALE was given version number 1.0 in 4/1/2004

Version Numbers

Version numbers are defined as follows: MAJOR.MINOR.REVISION
Major – Incremented when a major re-structuring of interface or code has occurred.
Minor – Incremented when one or more significant new features are added.
Revision – Incremented when one or more bugs have been fixed.

WALE 1.0

First version to use shared source with other FRESCO projects. First to be stored in source safe.

WALE 1.1

Released: 4/1/2004
Added spatially explicit fire ignition and sensitivity factors. Created a Spatial directory with demo files. Created a setup program.

WALE 1.2

Released: 5/1/2004

Climate

Spatially & temporarily explicit climate added. Temp and precip can now be specified for each cell and year using input files. The files must be named with "_#" on the end where # denotes time step.
Added Climate.Model FIF setting to set climate model to one of: 0:STOCHASTIC, 1:REPLICATED, 2:FIXED, 3:SPATIALLYFIXED or 4:SPATIALLYTEMPORARILYFIXED.

Fire

Added Fire.Type FIF setting. Fire.Type can be one of 0:FIXED, 1:SPATIAL or 2:PRESCRIBED.

Output Directory

Added OutputDirectory setting to FIF file. All output settings have this setting pre-pended so that output is always a subdirectory of OutputDirectory.

WALE 1.3

Released: 5/1/2004

Speed Improvements.

Frames are now reset between replications rather than deleted and recreated. This makes rep to rep times almost instantaneous.

WALE 1.3.1

Released: 6/9/2004

Started using standard C++ classes to simplify code.
Began “Start() and End()” functions. IE: RepStart(), RepEnd(), etc... Clarifies operations.

WALE 1.3.2

Released: 6/17/2004

Removed memory leaks from landscape input maps not being deleted properly.
Moved frame StartAge() code into constructor to simplify code.
Decreased load time by removing multiple initializing of static variables.
Added FireNum stat to track the number of ignitions.

WALE 1.3.3

Released: Pending

Latest Release: 1.3.2.10

Changes to Climate Model Settings

Climate model settings are now made using three separate enumerators so that more combinations of climate settings can be processed.
Climate.Values - determines the source of climate values. Settings can be:
CONSTANT - Single temp and precip value used for every cell in all years and reps.
SPATIAL - Read in spatially unique temp and precip values from a file. Reuse each year and rep.
EXPLICIT - Read in spatially unique temp and precip values from a different file each year. Year is appended as "_YR".
Climate.Offsets determines how temporal offsets are calculated. Settings can be:
RAMPED - Offsets are calculated using stepping and ramping.
FILE - Offsets are read in from a file.
Climate.OffsetApplied determines how the offsets are applied. Settings can be:
DIRECT - Offsets applied directly to climate values.
STOCHASTIC - Offsets applied stochastically to climate values each year and rep.
REPLICATED - Offsets applied stochastically to climate values each year but repeated each rep.

Saving Of Events

Added saving of events. An event is a single occurrence of a tracked item. Most stats are averages of tracked items. For example, the FireSize stat is total size of

fires for a given year and rep. A FireSize Event is the size of a single fire (ignition). The event files will have a listing of all events that occurred.

Output Types Added

Output can be saved in three types of ways using the Output.Type setting.
0=Delete current output directory. 1=Overwrite any existing output files.
2=Append date on to output directory.
Output.Type = 0 : Delete existing output directories and all output files..
Output.Type = 1 : Overwrite existing outputs. Leave any other files not overwritten.
Output.Type = 2 : Output to a sub directory of the output directory created using current date and time.

Changes to Map Output

Maps can now be output by rep as well as by year. Map files names are in the form File_Rep_Year.txt.
Map file names will get a ".txt" file extension by default. So map filenames should no longer include the file extension. I.e. use "Map/Veg" rather than "Map/Veg.txt".
If the MapFiles setting is not found, there will be no map output. Comment out the MapFiles setting for easy removal of map output.

Changes to Stat Flags

Removed dependency of stat flags on the StatOutputFlags setting. Now the settings for each stat (VegDist, FireSize, etc) are entirely determined by their individual stat flag setting (Stat.VegDist.Flags, Stat.FireSize.Flags, etc.).
Reversed the meaning of the format flag so that when the format flag is set, it means to SHOW the row headings rather than NOT SHOW the row headings.
Removed StatOutputFlags setting: It is no longer used.
"StatOutputFile" is now "Stat.Summary.File"
Added the flags 0x400 for outputting sample data and 0x800 for outputting event data.
FireNum and FireSize stats were moved to the top of the StatOut file.
Data was not being added to the FireNum stat in StatOut correctly. As a result it would show the total ignitions across reps (or year) as the Num value and always 1 as the Mean value. Now, the Num value shows the number of reps (or years) and the Mean is the average size of ignitions.
FireNum was not being updated when Fire.Type=HISTORICAL.
FireSpecies was being incorrectly reset between years when Fire.Type=HISTORICAL.

Memory Model

A memory model setting was added. When IsLargeMemoryModel=False, WALE will load historical fire and climate files each year. When IsLargeMemoryModel=True, WALE will load historical files for all years at the beginning of a run which will speed up rep to rep run times.

Other Changes

All directory settings should NOT include a final slash ("\"). IE the output directory should look like: "Output" not "Output/"
All path separators (the slash) should be changed from "/" to "\".
The format of the following settings has changed:

From	To
OutputDirectory	Output.Directory
DotDisplay	Output.DotDisplay
OutputSeed	Output.ShowSeed

Code Simplifications

Changed stream operators "<<" to Save() functions so that parameters can be passed to simplify code.
Moved HistoricalFire() from individual species to CFire class. They all share the same HistoricalFire() code.
Reworked CClimate. Added Run, Rep, Year Start() and End() functions. Iterate is now handled by YearStart();

Fixes

Climate types 0 (stochastic), 1 (replicated) and 2 (fixed) now all use the spatially explicit files set in Climate.Spatial.Temp and Climate.Spatial.Precip parameters. These three climate types all create an offset that is applied to the spatial values in the files. The other two climate types 3 (spatially explicit) and 4 (spatially & temporally explicit) do not have an offset applied: the values specified in the files are used directly.
A memory leak that was occurring within Year Start() of CClimate was fixed. The memory leak was caused by what is now an unnecessary call of new on the spatial climate array. This allocated new memory, but this new memory was not being deleted. The call to "new" has been removed.

FRESCOOL

Released: Pending
Latest Release: Pending

COM Object Library

FRESCOOL 2.0 is the first version of the COM object library version of FRESCO.

.Net

WALE 2.0 is the first release of WALE in the .Net format.