Capsis annual workshop

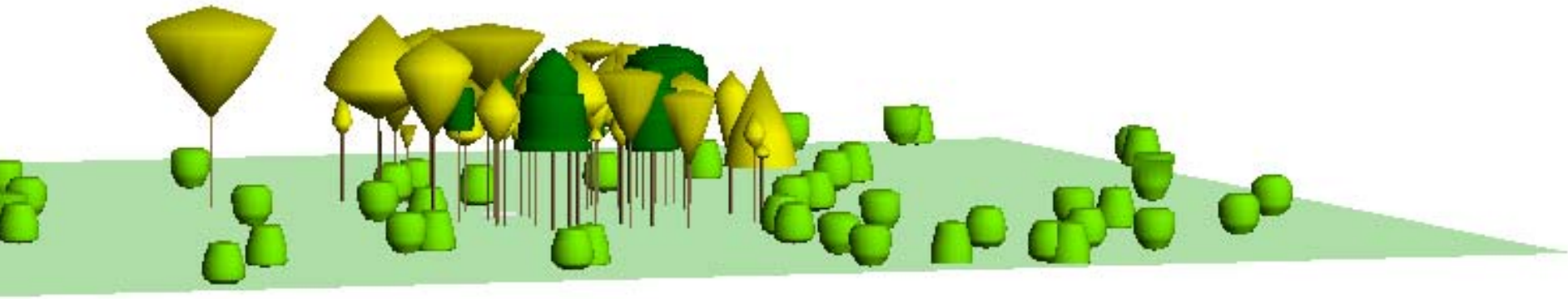
UMR AMAP, Montpellier, 17th June 2008

Fire Paradox Fuel Manager

A fuel manager for wildland fire modelling

Isabelle LECOMTE; Éric RIGOLOT; Oana VIGY
UR Ecologie des Forêts Méditerranéennes, Avignon

François de COLIGNY; Sébastien GRIFFON
UMR AMAP, Montpellier

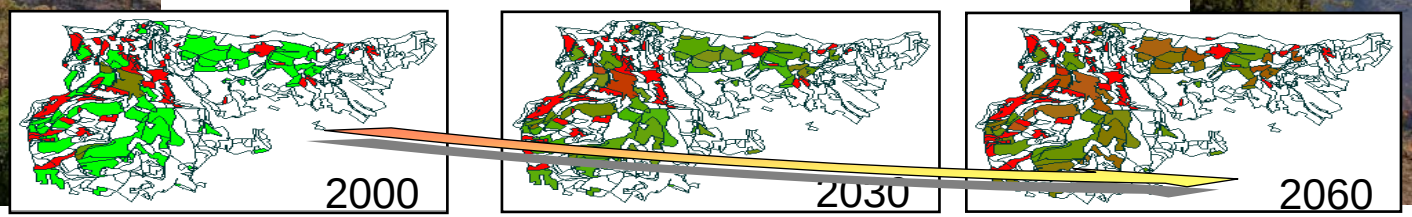


Scientific context

Fire behavior modelling

Post fire ecological effects assessment

Fire regime integration in forest dynamics



Contexte contractuel

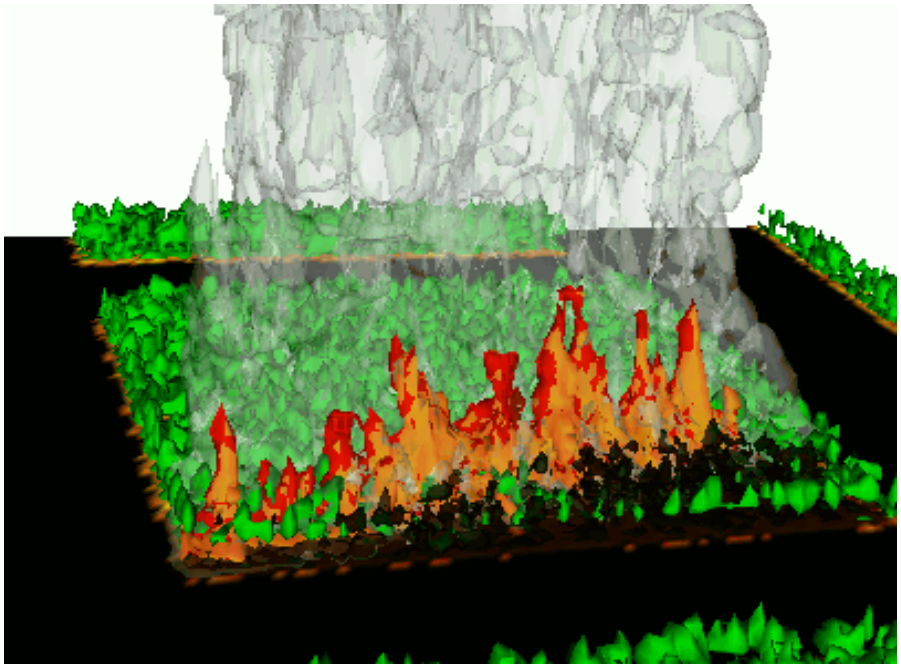
FIRE PARADOX

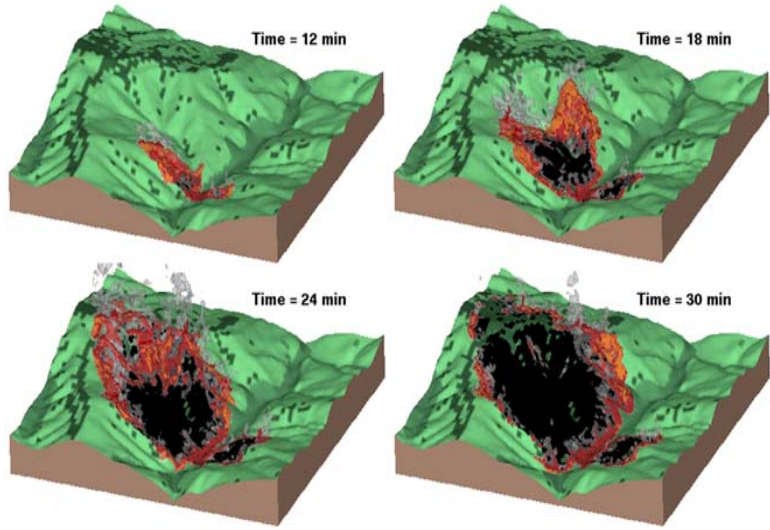
An Innovative Approach of Integrated Wildland Fire Management Regulating the Wildfire Problem by the Wise Use of Fire: Solving the Fire Paradox

- Type: 6th Framework Programme for R & D
- Topic: Integrated forest fire management
- Instrument: integrated project (research, development & dissemination)
- Partnership: 36 teams in 16 countries
- Duration: 48 mois, March 2006; February 2010

A 3D physically-based model for fire propagation FIRETEC

Representation of coupled critical physical processes of a wildfire
Explicit resolution (computation) of some processes (turbulence transport, radiation, …) and theoretical modeling of others (thermal degradation, combustion, …)
It is a coupled atmospheric transport/wildfire behavior model (HIGRAD/FIRETEC)
Spatial résolution: 2 to 10 m Domains: 300 to 3000 m in (x,y), 600 to 1500 m (z)
Predicted variables: temperatures, flux, masses consumed, oxygen, …





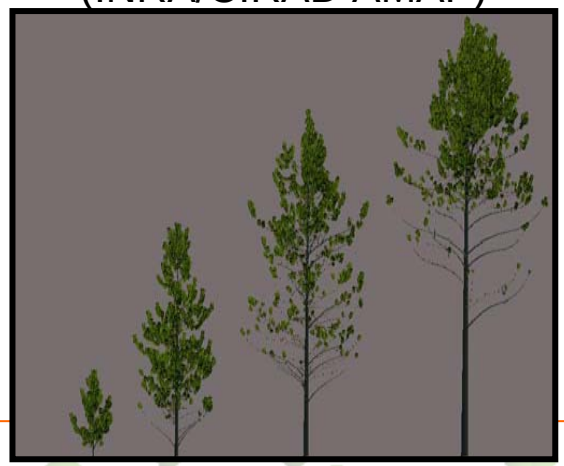
Fuel description and modeling

Fuel data requirements:
- Fine fuel particles characteristics (leaves, needles, twigs)
- Fuel density or distribution in space of crown volume fraction

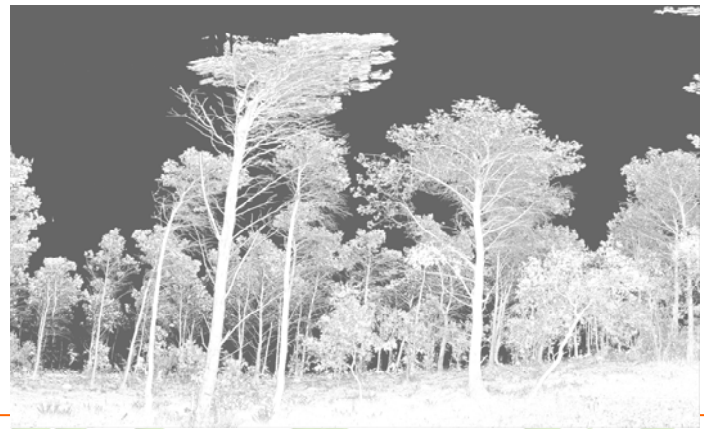
Methods to assess particles volume fraction in crown
- Specific volume fraction measurements using « cube » method 
- Architectural approach
- Terrestrial LIDAR

Cube method (FIRESTAR)

Architectural approach (INRA/CIRAD AMAP)



Lidar data



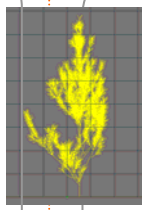
Fire behavior modeling process

Field measurements

Destructive sampling

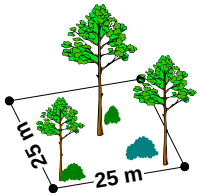
1) Particules

2) Crown



Architectural models

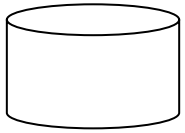
Stand description



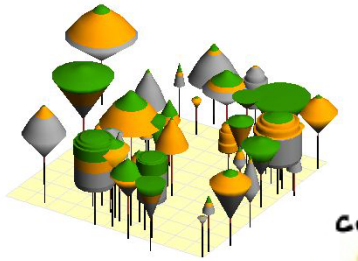
Composition
Cover
Structure

Fuel modeling

Data base
EuroForestFuels
(WLS)

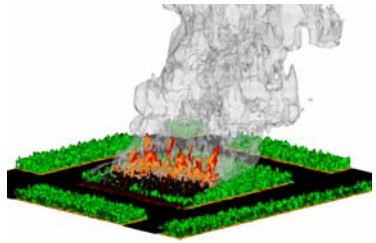


Vegetation scene
Fire Paradox Fuel Manager

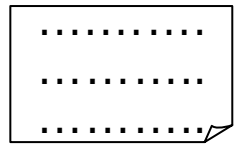


Fire modeling

Fire models
FireTec, FireStar3D



Data files



FIRE PARADOX FUEL MANAGER

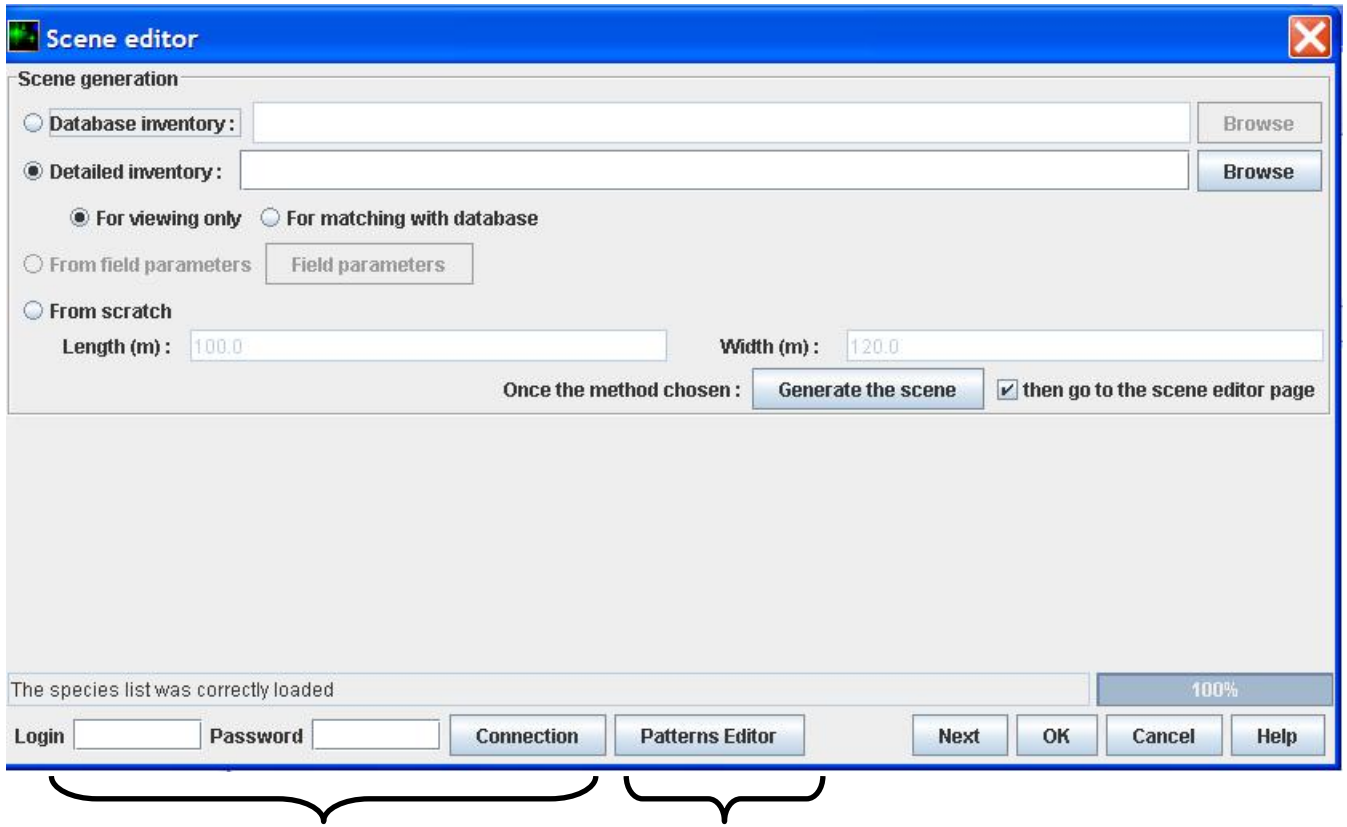
A key application in the fire modeling process with the following functionalities:

- Fuel manager: user friendly software for input files generation of fuel complexes for fire behavior models
- Fire effects visualisation on shrubs and trees
- Fuel succession visualisation after fire occurrence

FireParadox Scene Editor

Scene generation

Scene generation options



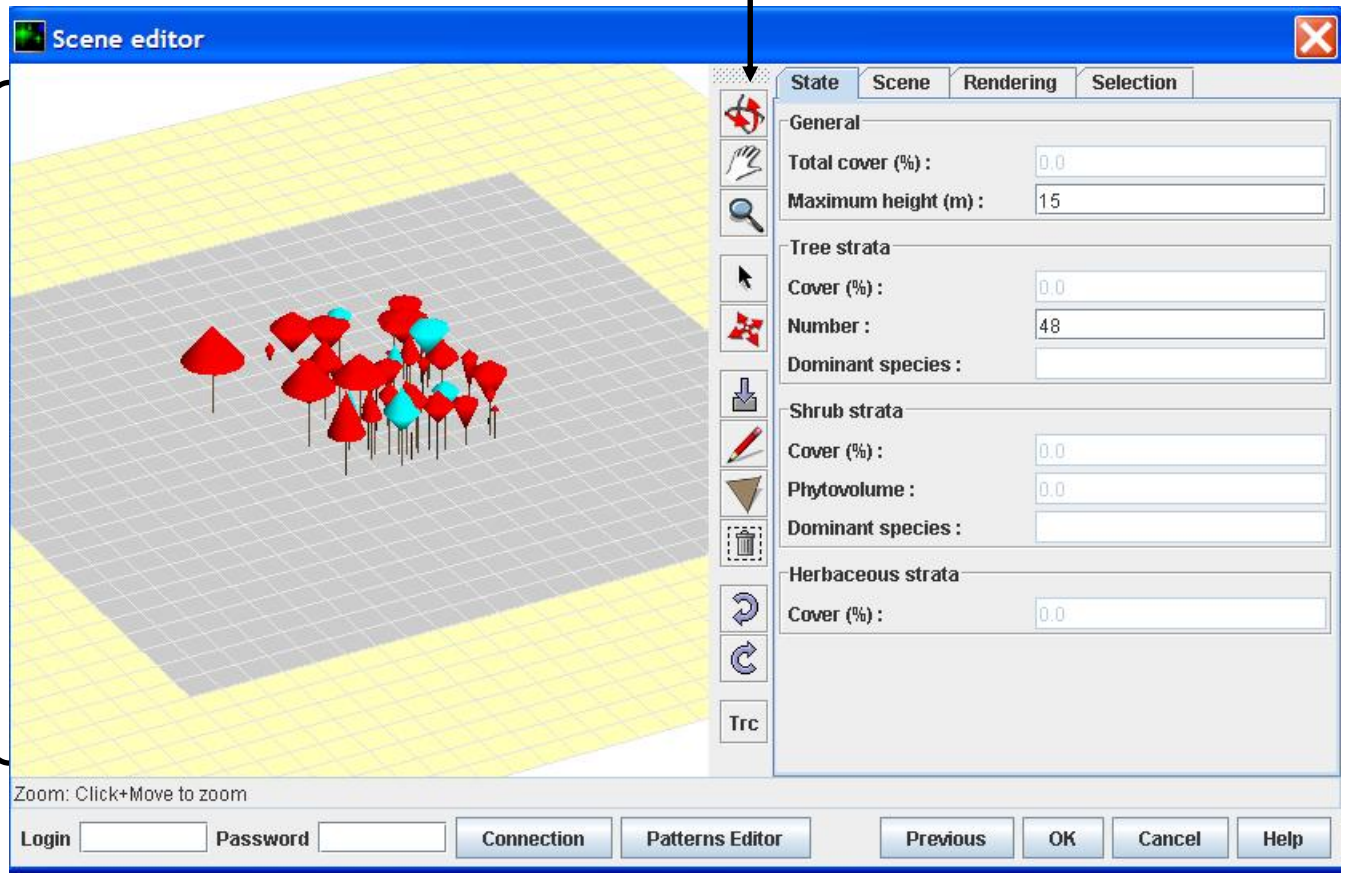
EuroforetFuel database management

Pattern editor

FireParadox Scene Editor

Scene edition

Tool bar



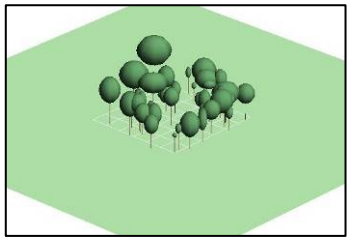
3D editor

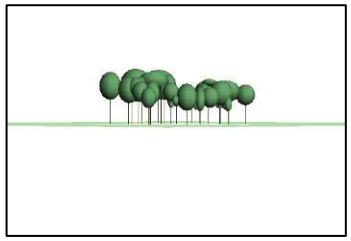
Real Time Panel

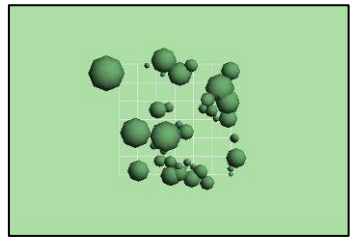
FireParadox Scene Editor

Scene edition : viewpoint motion

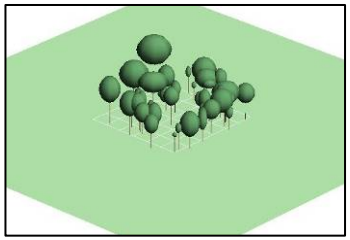
Orbit

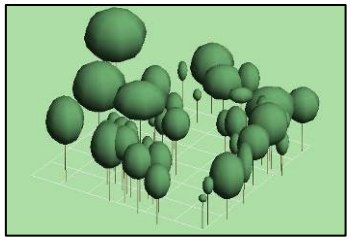




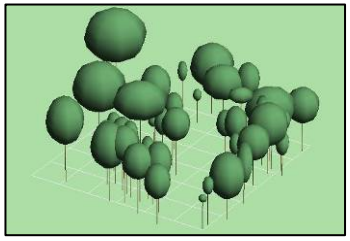


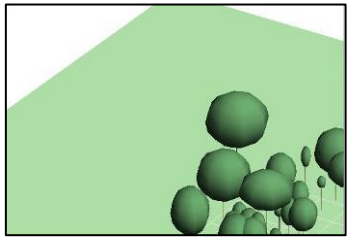
Zoom





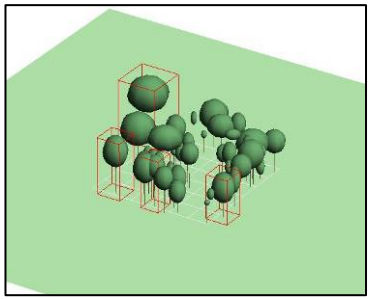
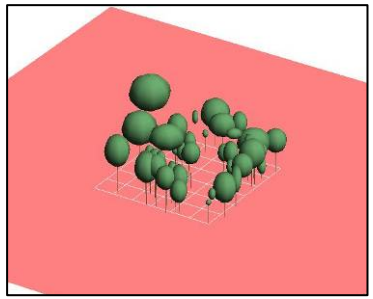
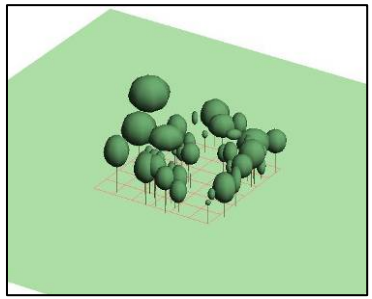
Pan

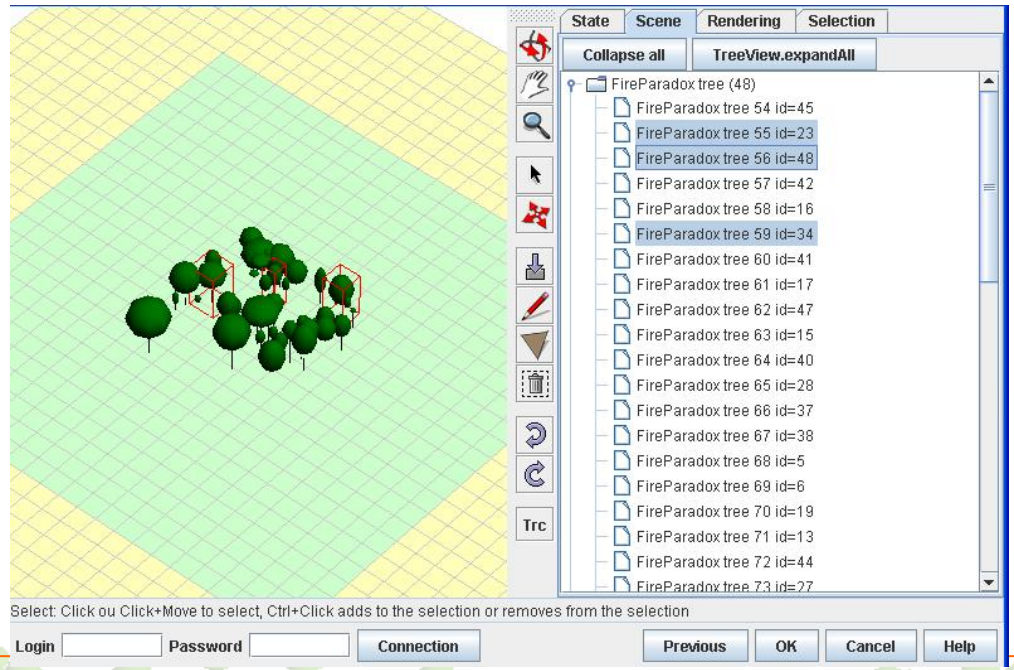




FireParadox Scene Editor

Scene edition : selection 

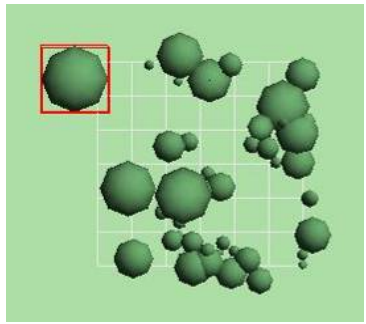




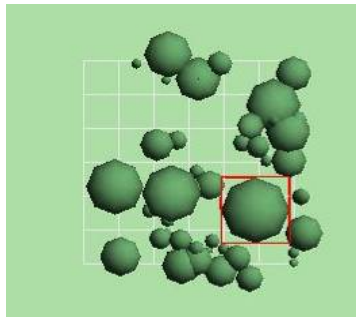


List of objects on the scene

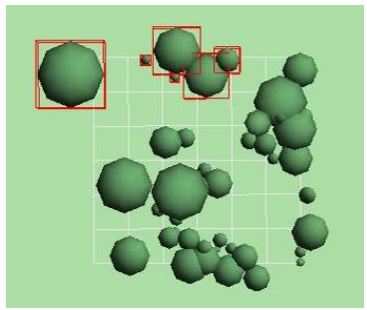
FireParadox Scene Editor

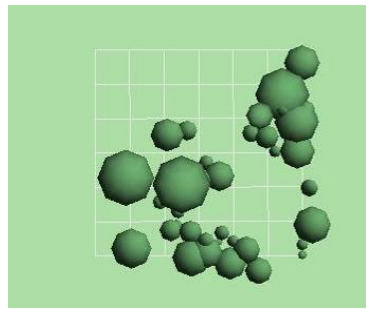
Scene edition : Moving 

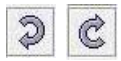




Deleting 



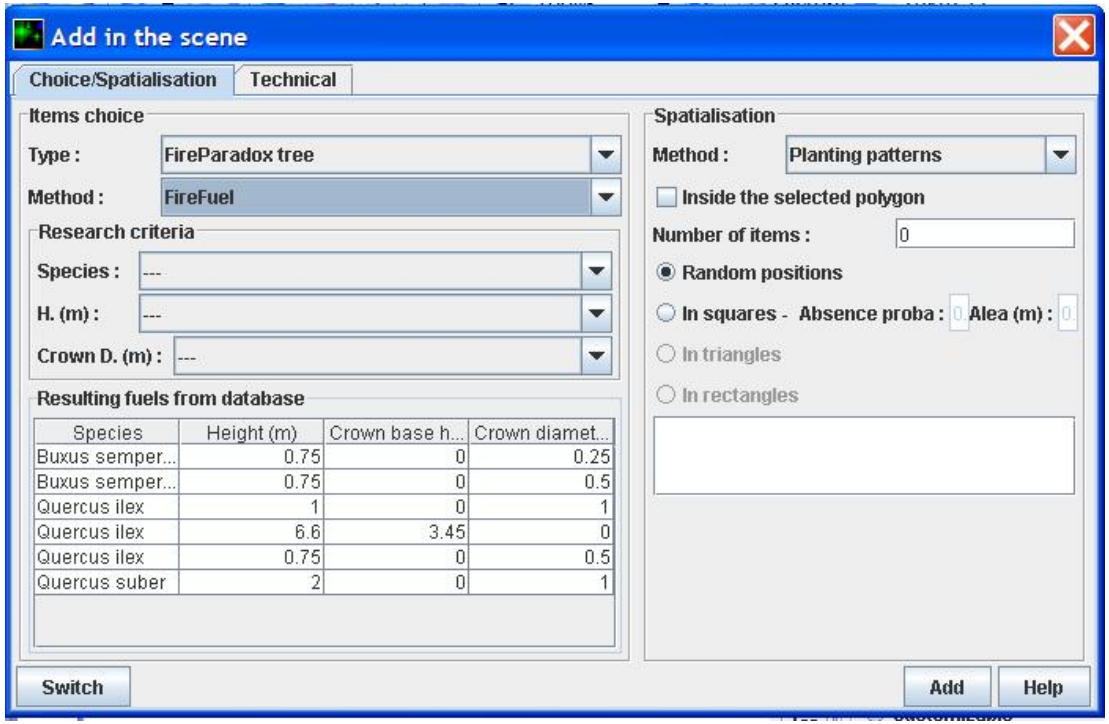


Undo/Redo 

FireParadox Scene Editor

Scene edition : adding

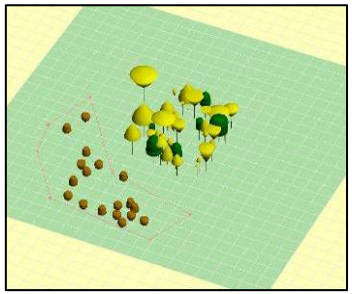
Fuels choice from EuroForestFuel Database



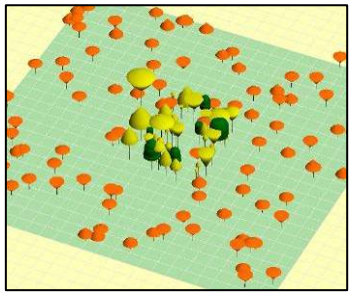
Planting options

FireParadox Scene Editor

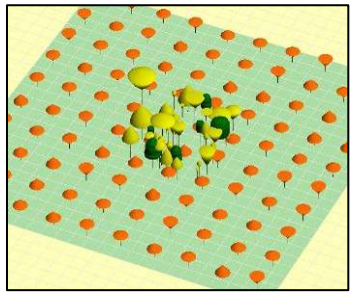
Scene edition : adding



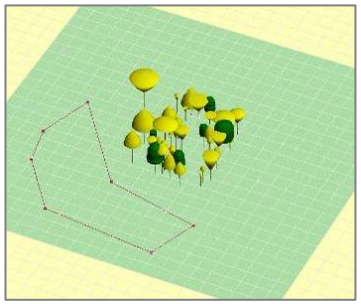
Within a polygon, random



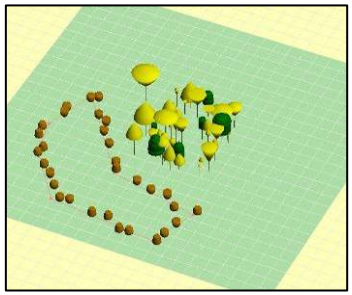
Within the scene, random



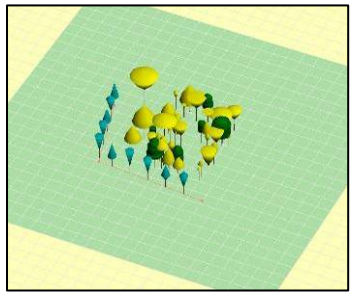
Within the scene, with a square pattern



Drawing a polygon



Along a polygon

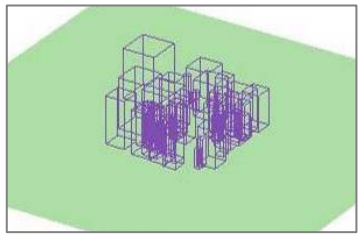


Along a line

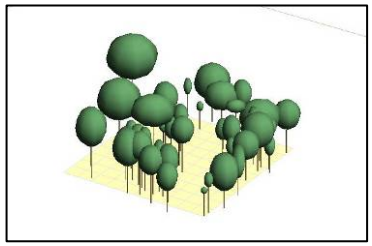
Interactive planting

FireParadox Scene Editor

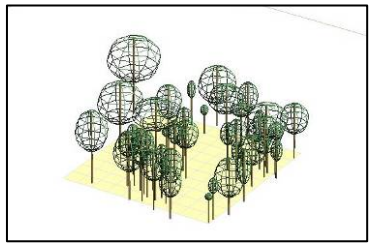
Scene edition : renderers



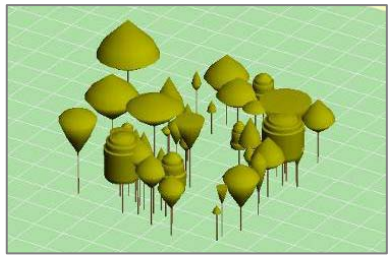
Boxes

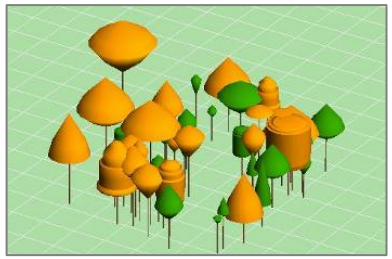


Lollypops



Outlines

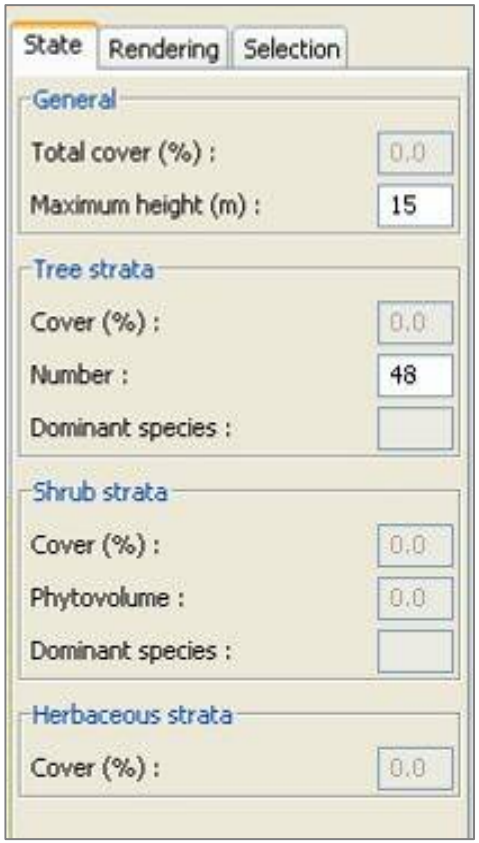


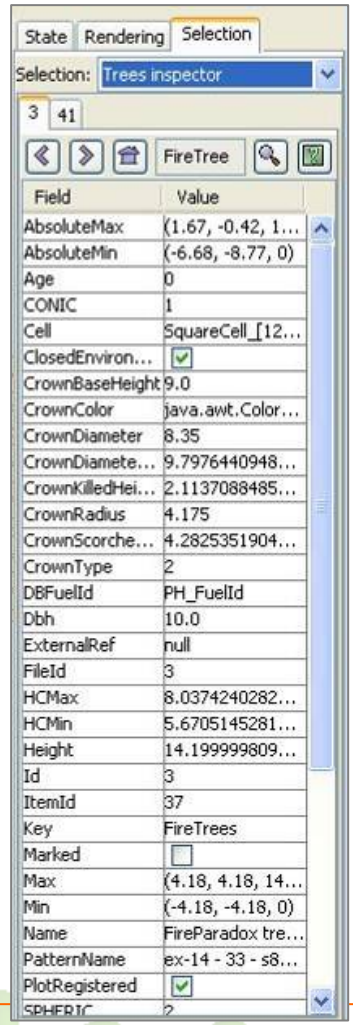


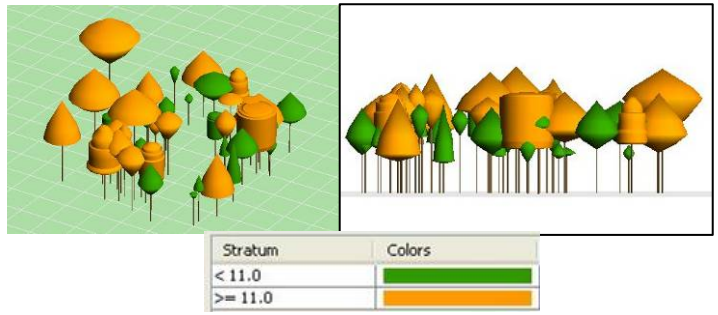
Patterns

FireParadox Scene Editor

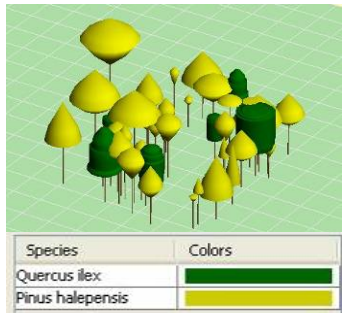
Scene analysis







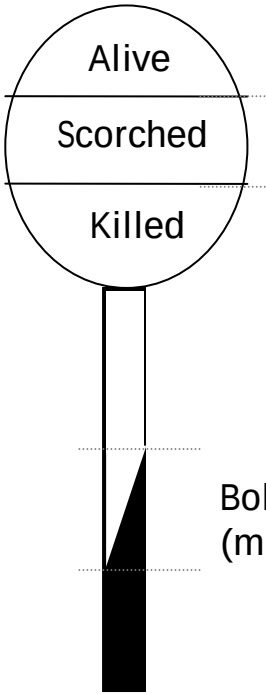
By height



By species

FireParadox Scene Editor

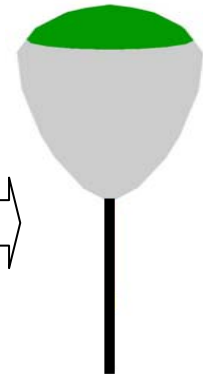
Fire damage visualisation

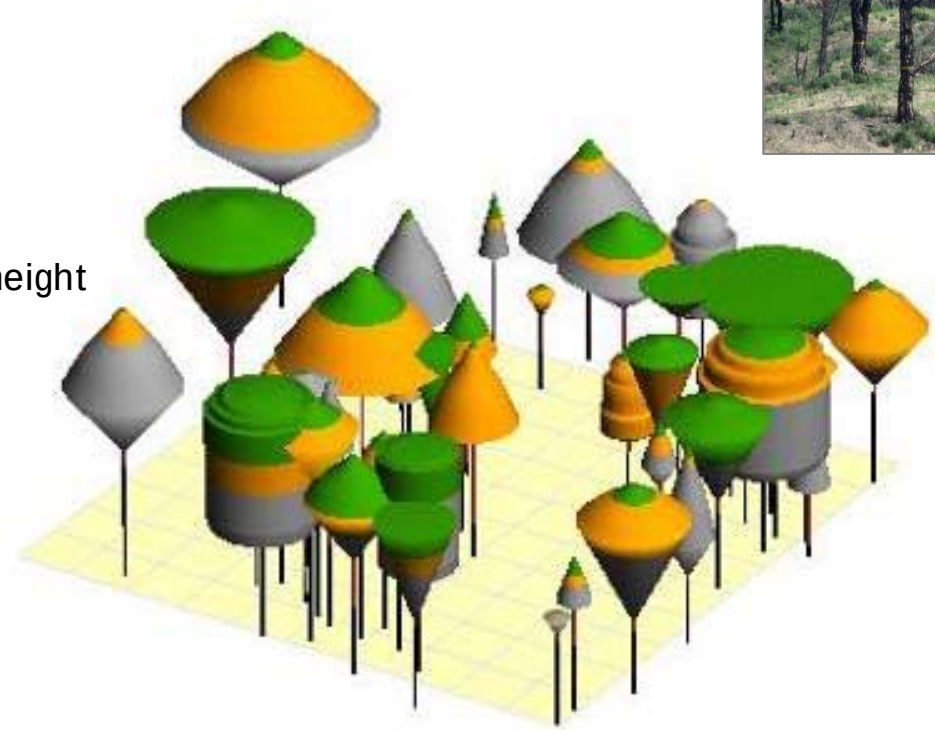


Crown scorched height

Crown killed height

Bole charred height
(min/max)

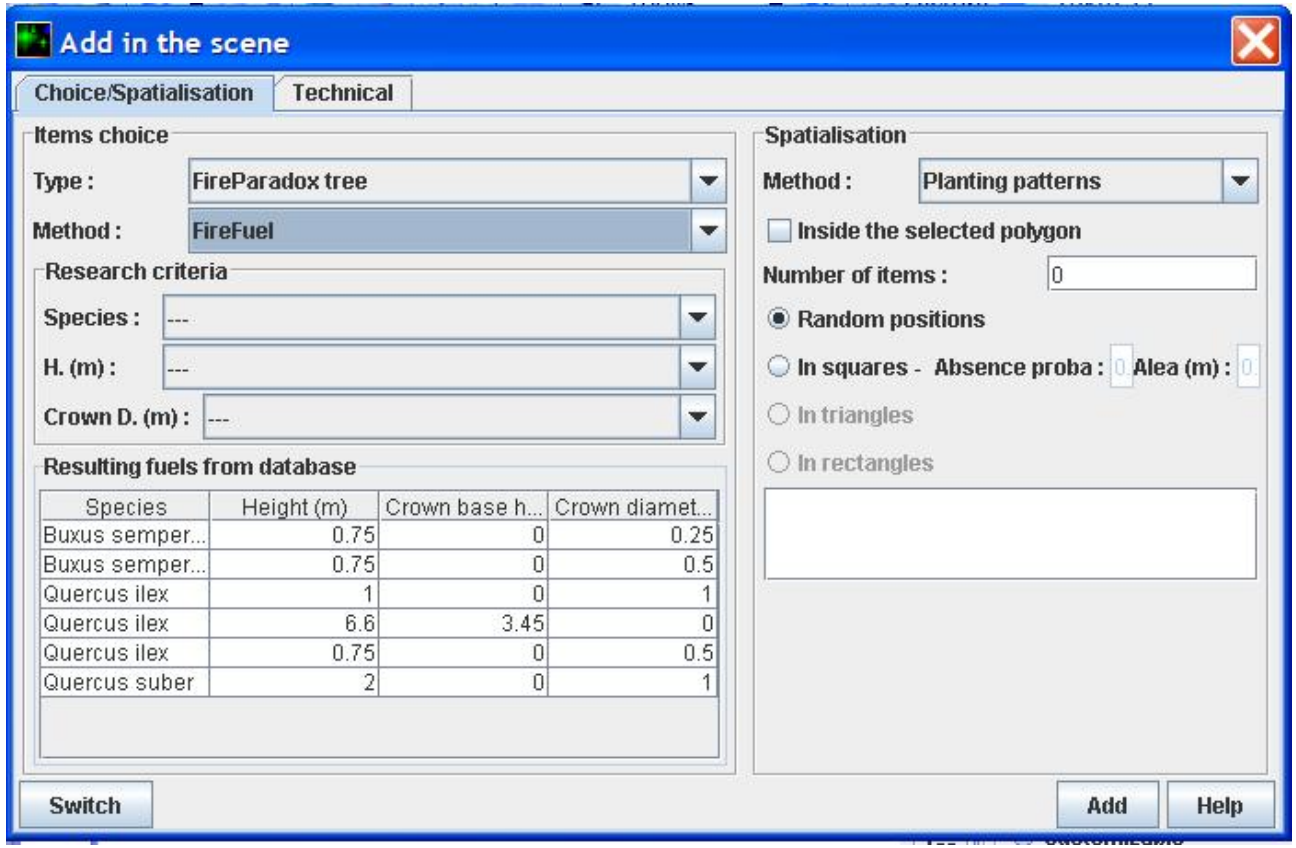




EuroForestFuels Database Management

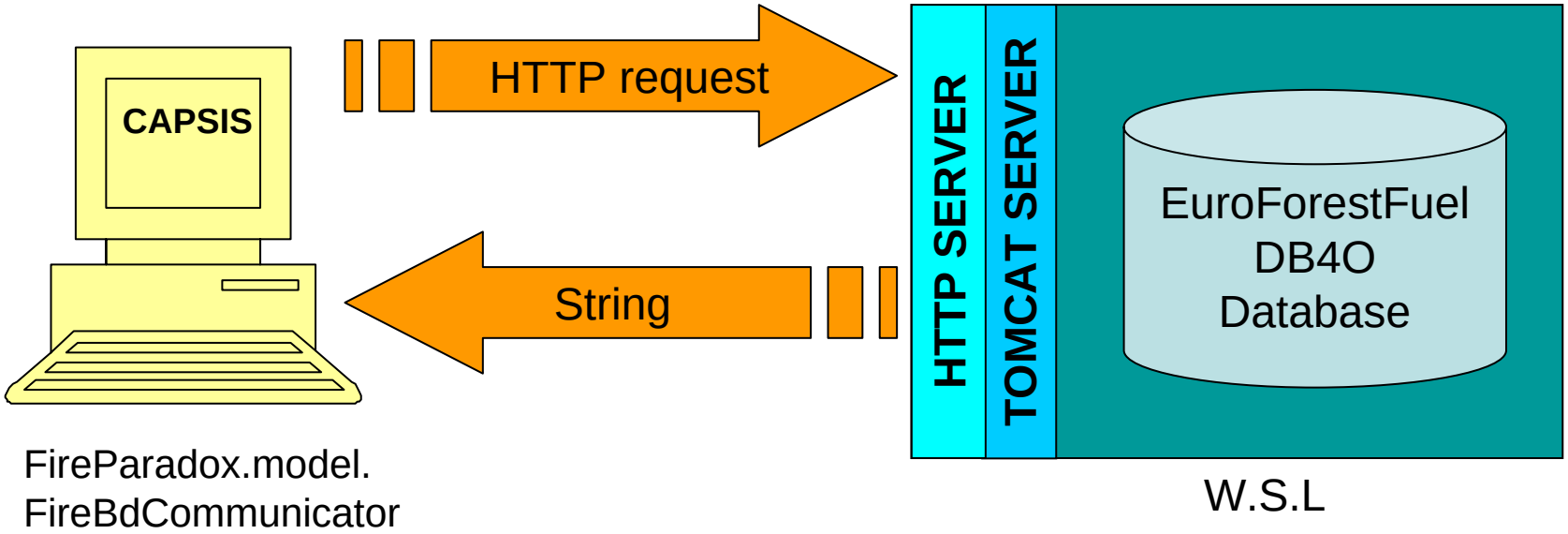
Searching data

Searching fuels in the EuroforetFuel database



EuroForestFuels Database Management

```
http://http://www.wsl.ch/WebFuel/par?numRequest=30
```




```
Shape:1153336;Plant:1156777;Buxus sempervirens;Virtual;0.75;null;0.25;null;null;0;1229055;
Shape:1187063;Plant:1145567;Buxus sempervirens;Virtual;0.75;null;0.5;null;null;0;1229055;
Shape:1191895;Plant:1166711;Quercus ilex;Measure;1.0;null;1.0;null;null;535535;0;
Shape:1194851;Plant:1166981;Quercus ilex;Measure;6.0;3.45;2.0;2.0;null;535535;0;
```

EuroForestFuels Database Management

CAPSIS

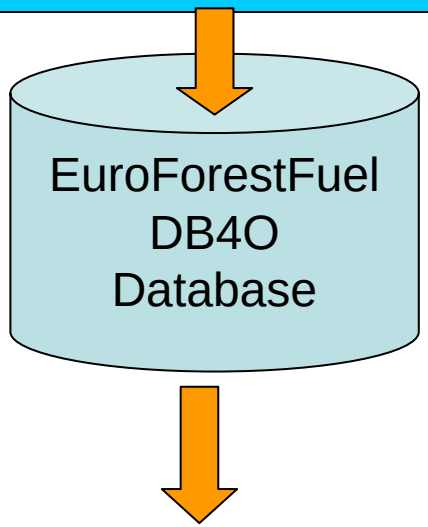
fireparadox.model.fireBdCommunicator.class

```
http://www.wsl.ch/WebFuel/par?numRequest=30&taxon=Quercus
```

HTTP SERVER

fireparadox.dbfuel.web.adapters.
FuelManagerSelector.class

TOMCAT SERVER




```
Int nb = Integer.valueOf(request.getParameter("numRequest"));
String dbTaxon = request.getParameter("taxon");
public List<String> requestdb() {
        List<String> myResult = new ArrayList<String>();
        switch (nb) {
. . .
           case 30:                    //retrieve fuel list
                myResult = queryShapes(dbTaxon);
                break;
 . . .
        }
}
private List<String> queryShapes(String taxon) {
 . . .
}
```

```
Shape:1191895;Plant:1166711;Quercus ilex;Measure;1.0;null;1.0;null;null;535535;0;
Shape:1194851;Plant:1166981;Quercus ilex;Measure;6.0;3.45;2.0;2.0;null;535535;0;
```

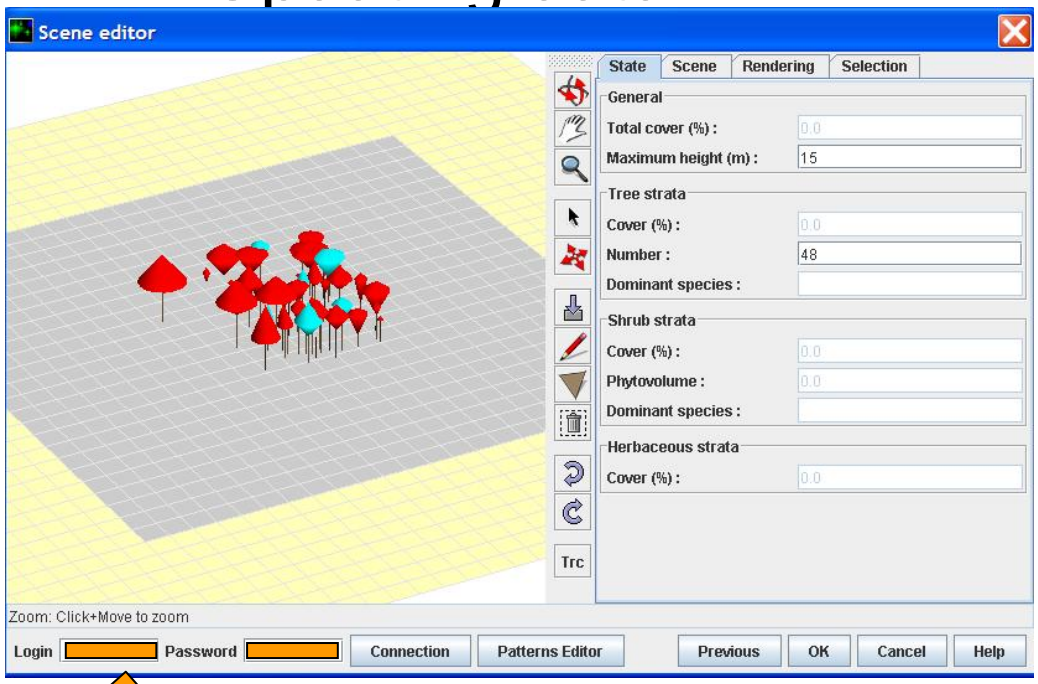
EuroForestFuels Database Management

`http://www.wsl.ch/WebFuel/par?numRequest=31&ID=534903`

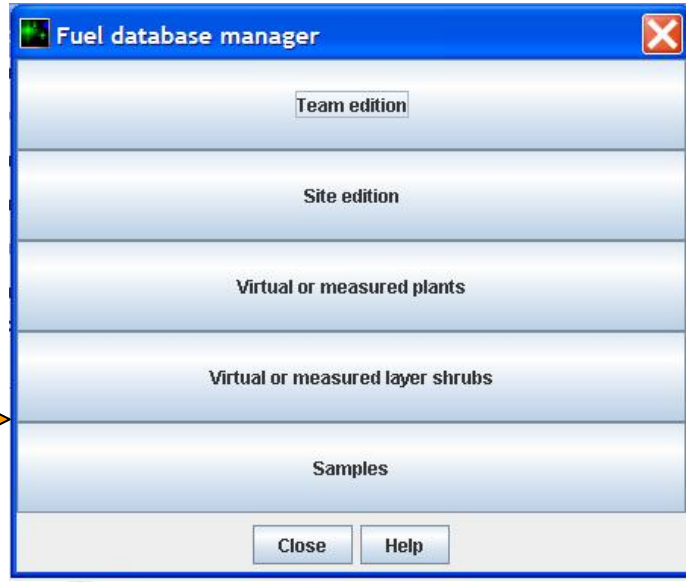
```
ShapeSample:534903;Plant:540055;Quercus coccifera;Core
isDeleted:false
Code:541191;"9"
Origin:541199;Measure
SamplingDate:538471;11/03/2003
Actors:538479;Team:1229055;INRA-AVI;Person:1229023;Cohen;
Openess:539687;Closed
Cover_PC:537751;60.0
OverShadowingSpecies:538823;Taxon:84543;Pinus halepensis;
Site:539471;Plot:533415;AntheronCiterne;false;
Height:534895;0.25
```

EuroForestFuels Database Management

Updating data

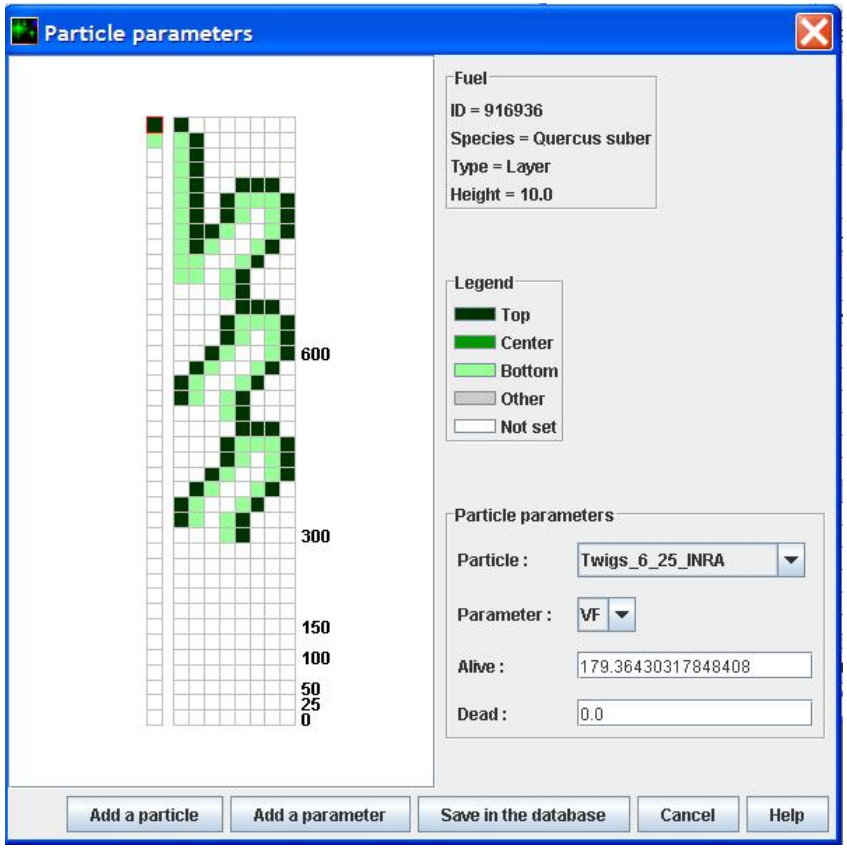


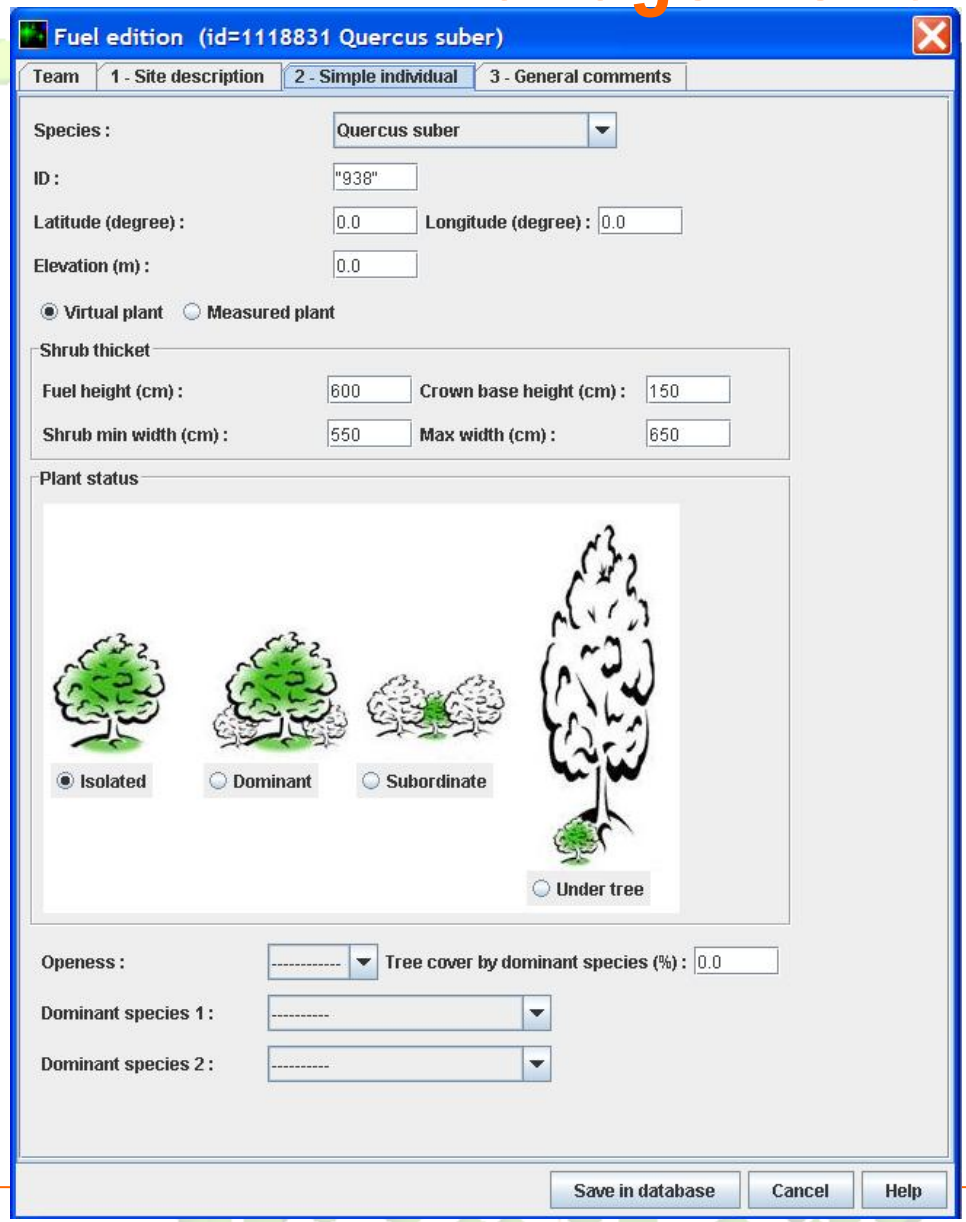
1. Super administrator
2. Administrator
3. User



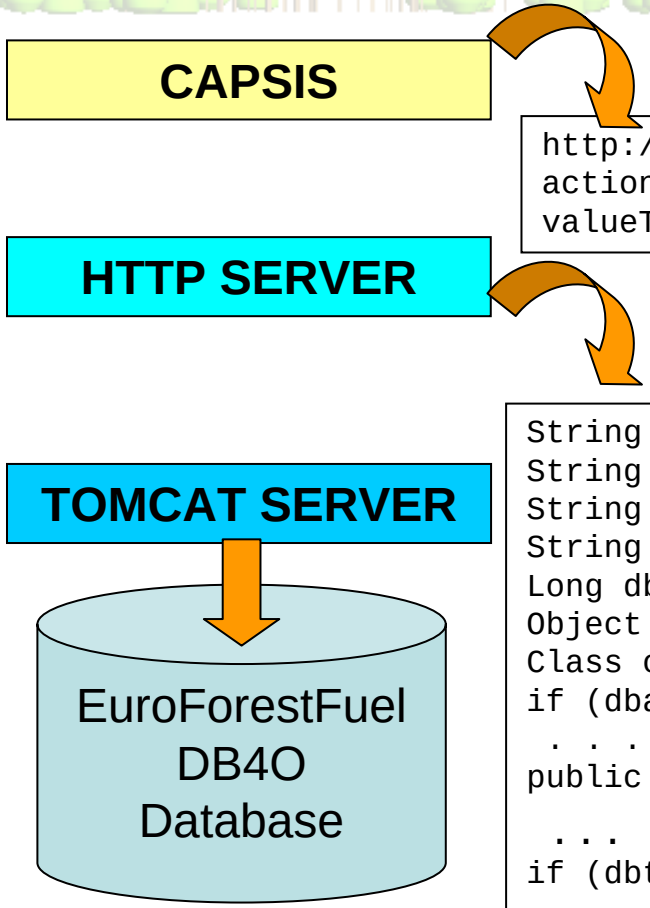
EuroForestFuels Database Management

Updating data





EuroForestFuels Database Management



fireparadox.model.fireBdUpdator.class

```
http://www.wsl.ch/WebFuel/update?
action=update&ID=123233&method=setName&value=INRA&
valueType=java.lang.String
```

fireparadox.dbfuel.web.adapters.
FuelManagerUpdator.class

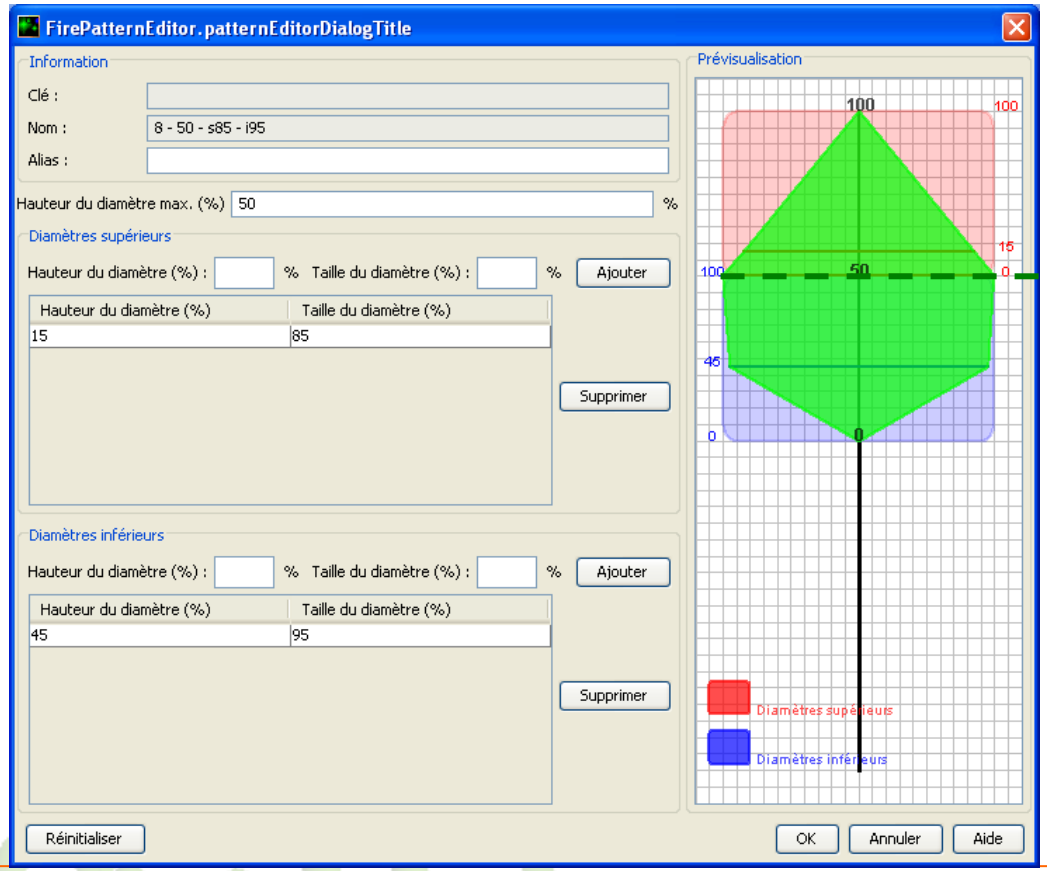
```
String dbaction = request.getParameter("action");
String dbmethod = request.getParameter("method");
String dbvalue = request.getParameter("value");
String dbtype = request.getParameter("valueType");
Long dbID = Long.valueOf(request.getParameter("ID"));
Object obj = getDbItem(dbID);
Class objType = obj.getClass();
if (dbaction.compareTo("update") == 0) result = updateInDb();
 . . .
public List<String> updateInDb () {

 . . .
if (dbtype.compareTo("java.lang.String") == 0) {
          objType.getMethod(dbmethod, String.class).
          invoke(obj, dbvalue);
}
}
```

FireParadox Pattern Editor

What is a Pattern ?

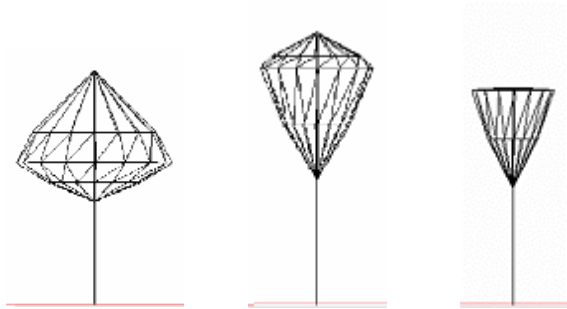
A crown shape defined by upper and lower diameters
capable to be adapted according the height/width of the “central” maximum diameter



Upper diameters

Maximum diameter

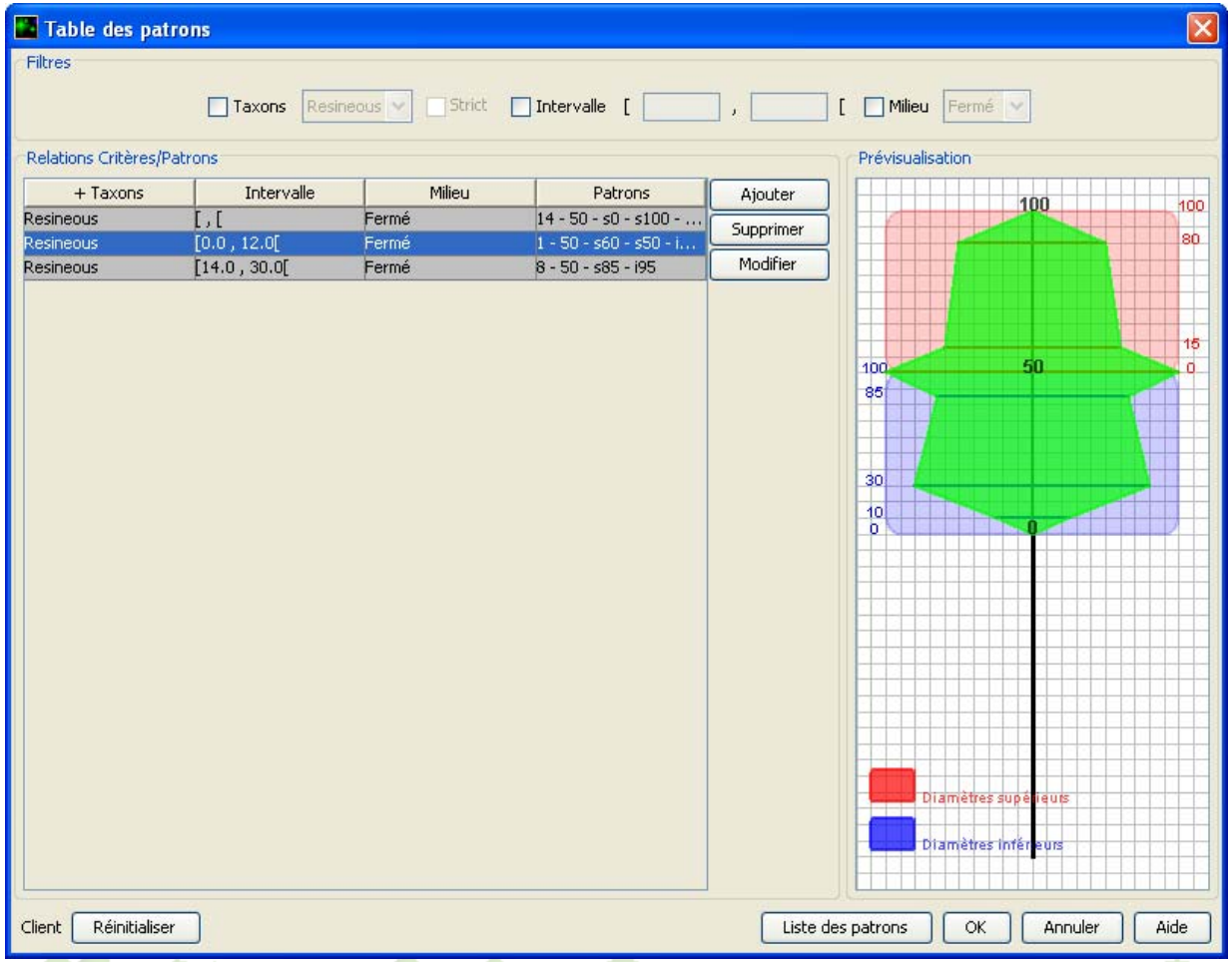
Lower diameters



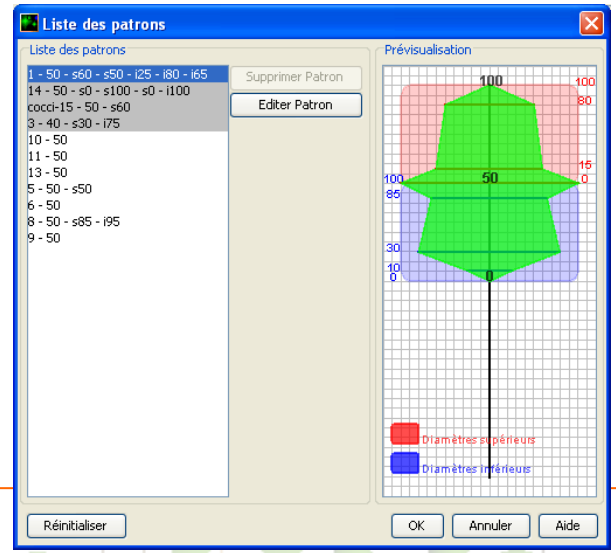
3 shapes of a single pattern with different max. diameter values

FireParadox Pattern Editor

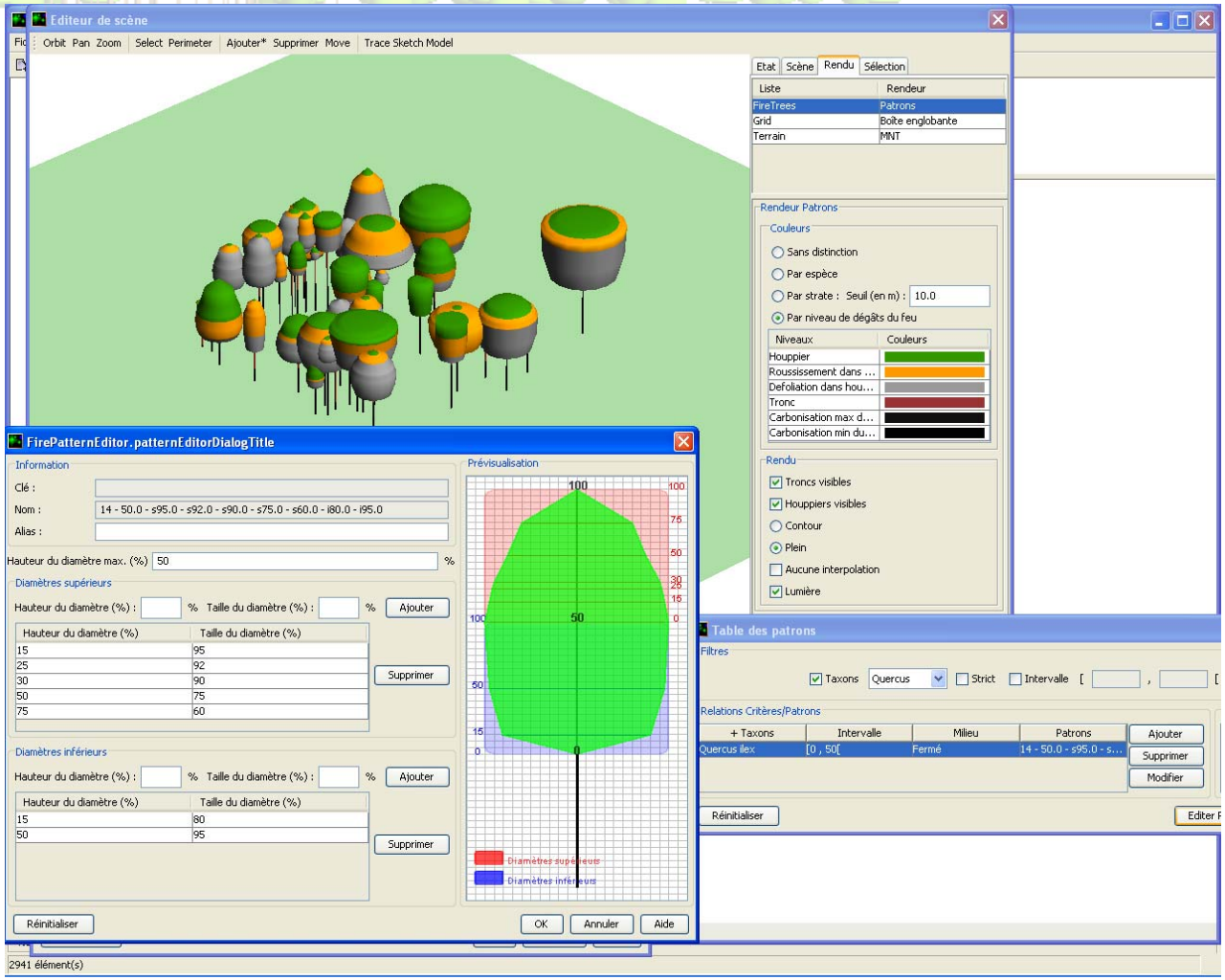
Mapping Criteria with Pattern.



Criteria based on :
-**Taxons (mandatory)**
-Intervals of heights
-Environment (opened/closed)



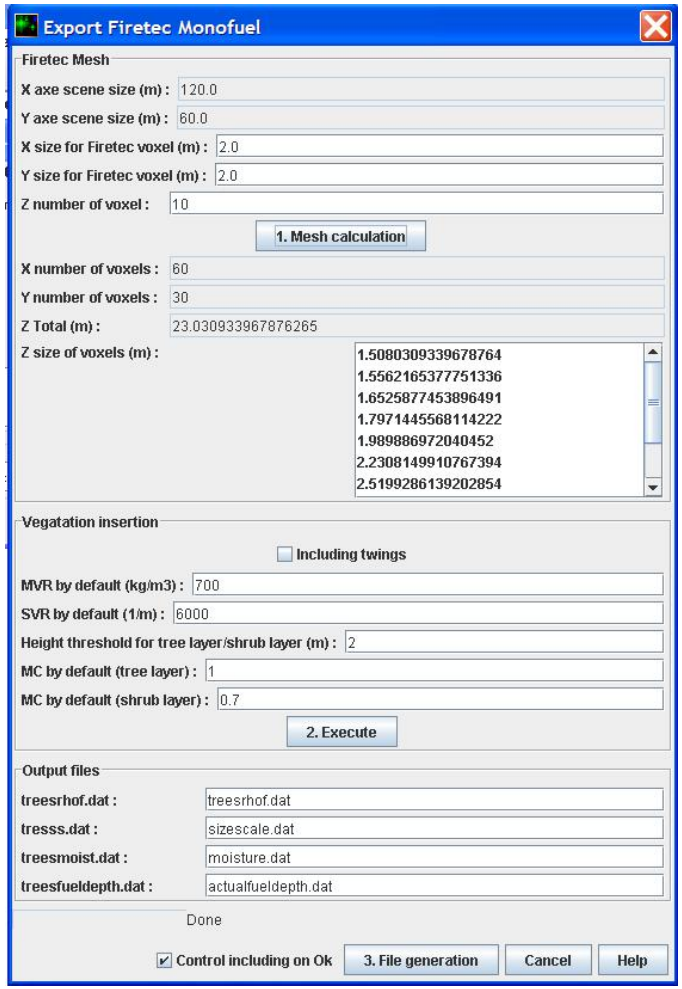
FireParadox Pattern Editor



The renderer finds the most representative pattern for a given tree and computes a revolution surface from the defined 2D profile

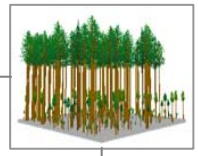
Export towards Fire model

- One of the main objectives of the FPFM is to automatically generate input files for 3D fire behaviour models from current vegetation scene.



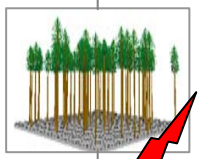
Perspectives: forest dynamics

Management and climate change



Stand initial state **t1**

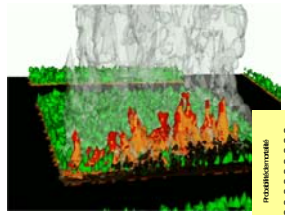
Preventive actions: *Fuel reduction, thinning, pruning*

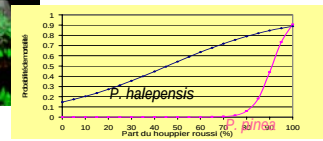


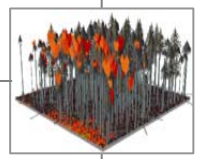
Stand at ***t1**

Fire: *propagation, impacts*

Ecological consequences on stand:
mortality, tree growth, regeneration

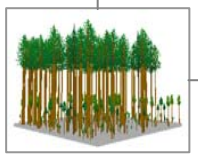






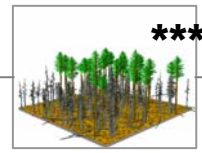
Stand at ****t1**

Interventions de restauration : *clear cut, thinning*

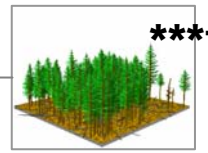


Stand at *****t1**

Regrowth



*****t1(5y)**



*****t1(10y)**