Model & Tools for synthetic Plant to Landscape image generation

I2P Seminar, 2013, June 24th

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Gallery : http://pma.cirad.fr/MJ_PICS/

With the contributions and supports of

Philippe de Reffye, Sébastien Griffon (Xplo), F. de Coligny (Simeo), Xiaopeng Zhang (Multiresolution models)

Summary

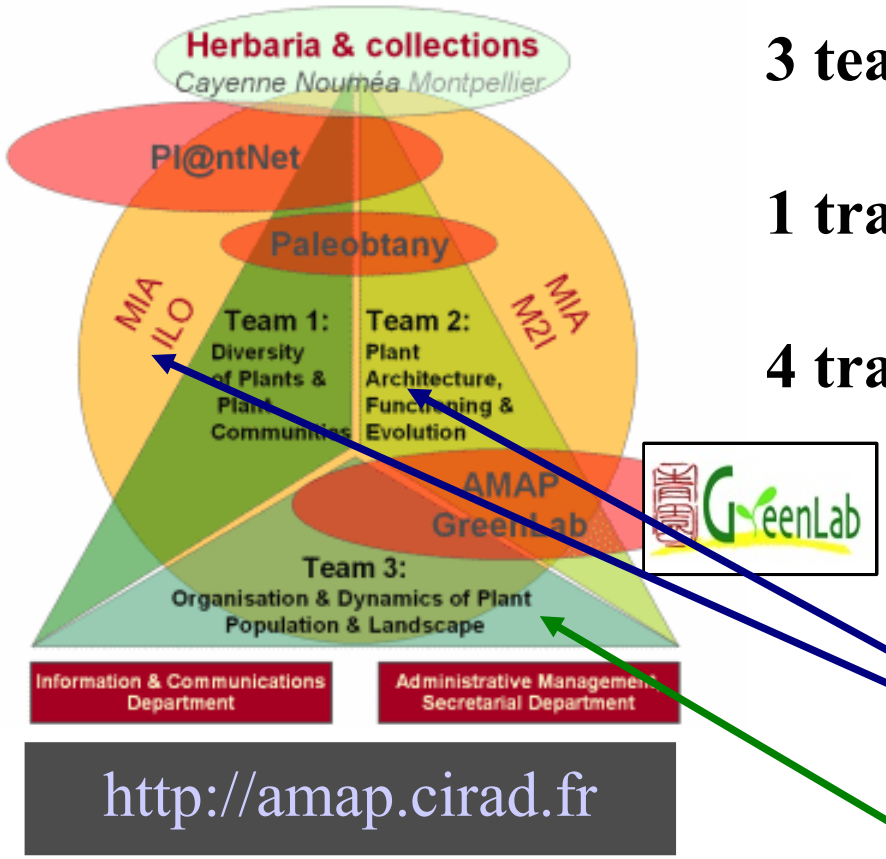
<u>Context : AMAP Unit, GreenLab Project</u>

Reminder : Principles of Computer Graphics

Software developments for 3D plants mockups

Single plant to Landscape visualization : Amap's tools

AMAP UNIT : a joint Unit of 80 permanent positions (CIRAD, IRD, INRA, CNRS, University of Montpellier 2)



3 teams

1 transversal Theme

4 transverse projects

Single plant

Stand/crop to Landscape

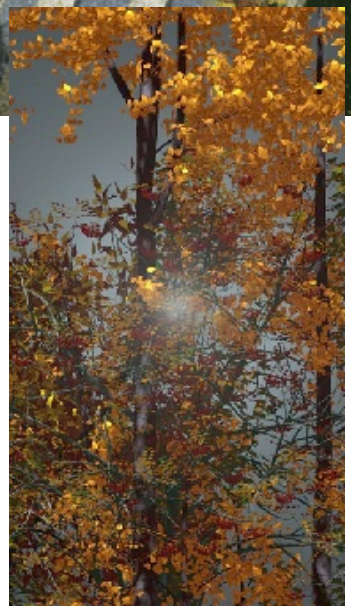
AMAP: Plant to Landscape Visualization history

Pioneer: Siggraph 86, 88, 91, 00

Strongly linked to Industry:

SESA (87), ToyoLinks (90), Var SGI (92),

JMG Graphics → Bionatics SA



AMAP UNIT : Software Developments

- Home
- Projects
- Screenshots
- Download
- FAQ
- Documentation
- Publications

- AmapSim
- Archimed
- Simeo
- Xplo

AMAPstudio is a software suite for plants architecture modelling. It contains applications and models to rebuild, explore, analyse and study the growth of plants from an architectural point of view.

It is targeted to scientists and students in the agronomic and botany fields.

These applications and models may work at the individual plant level like in Xplo or at the scene level like in Simeo.

http://amapstudio.cirad.fr/

GreenLab Amap

Http://pma.cirad.fr/GreenLab/

Model definition and its formalism

Model applications in agronomy and forestry

Software developments
Multi-scale representations of plants, crops & populations

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Principles of Computer Graphics (1)

From MJ C.A.S. Courses (2002-2006)

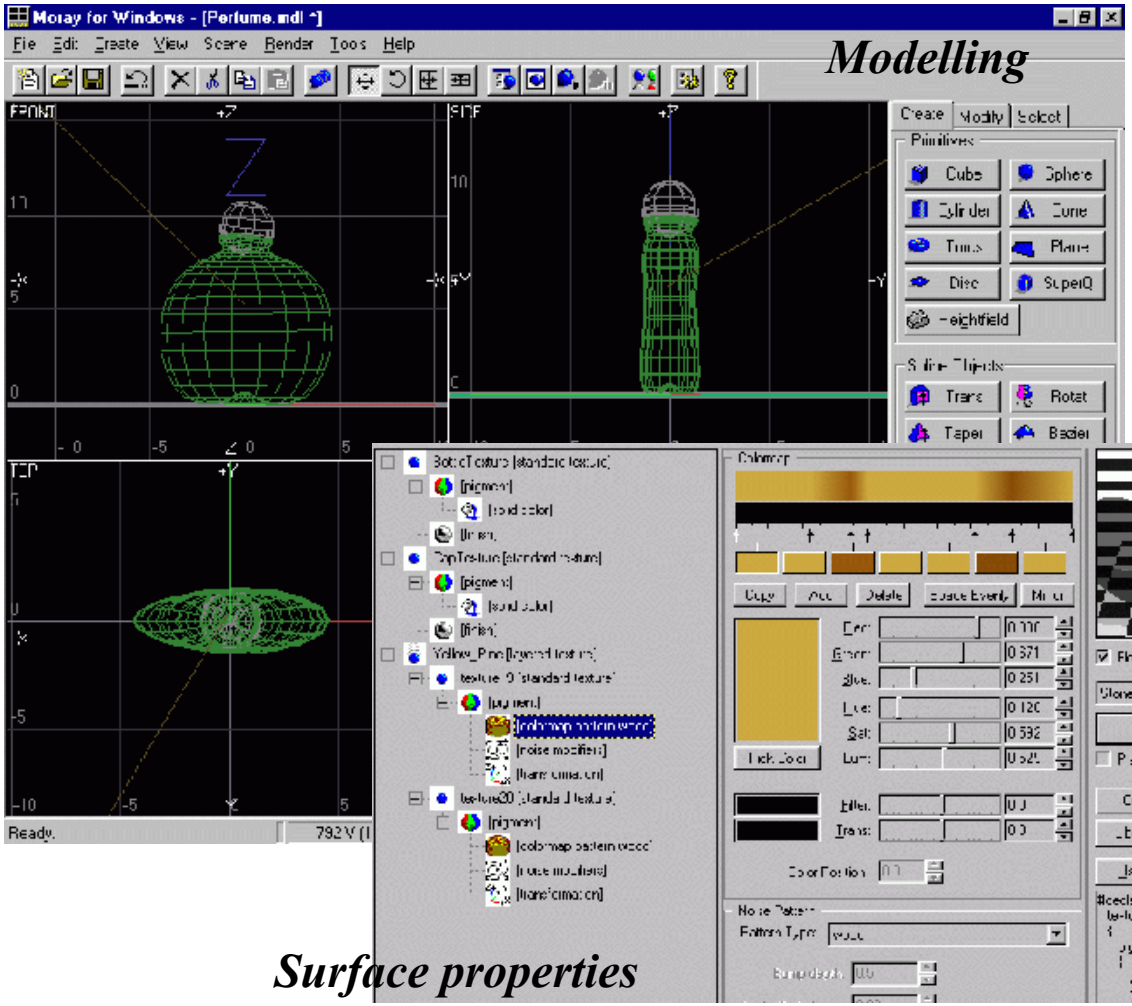
Generating 2d images from an abstract word (model)

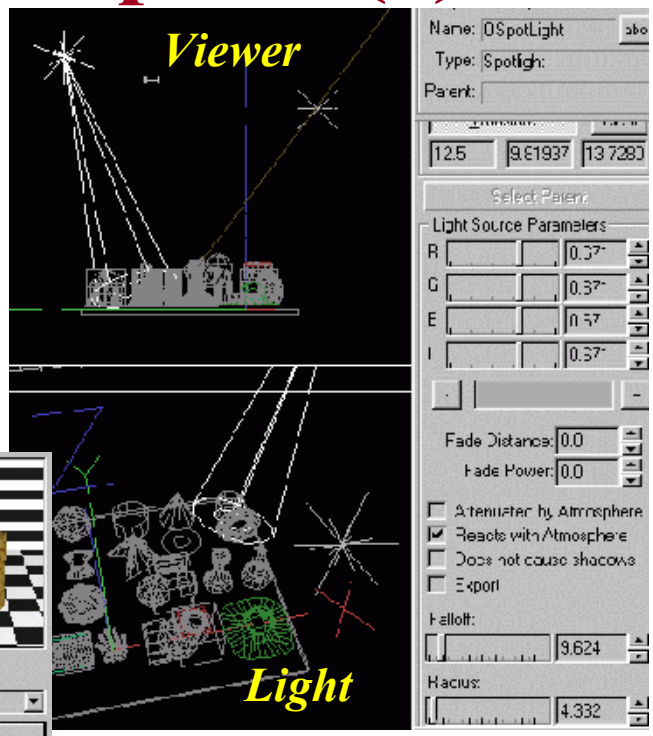
- **thanks to 3D space geometrical projection seen by a virtual camera, and colored by an illumination model interacting with object surface materials**

Basic elements of CG.
The information pipeline

Process step	*Coordinate System*
Modeling	abstract to real 3D/4D
Transformation	reals 3D or 4D
Viewer / illumination	reals 4D or 3D
Perspective/projection	normalized 3D to 2D
Image computation	normalized 2D to pixels

Principles of Computer Graphics (2)





2D output

Summary

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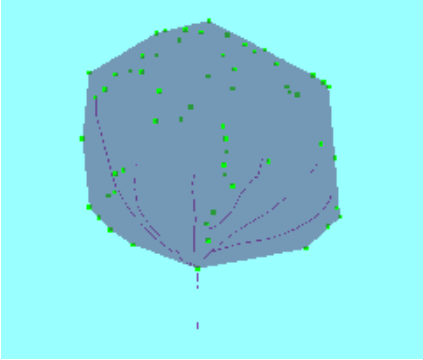
<u>Software developments for 3D plants mockups</u>

Single plant to Landscape visualization : Amap's tools

AMAP UNIT : Plant Mock up definition principles

Two ways. 1. By reconstruction (static structure) from

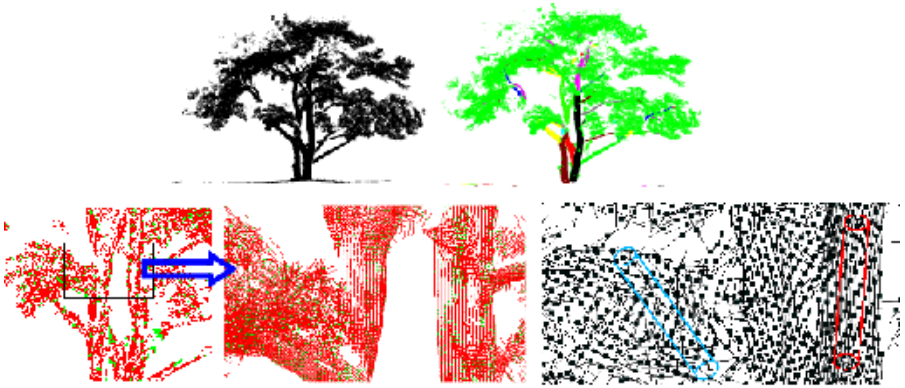
Mesurements,
(tacheometer)



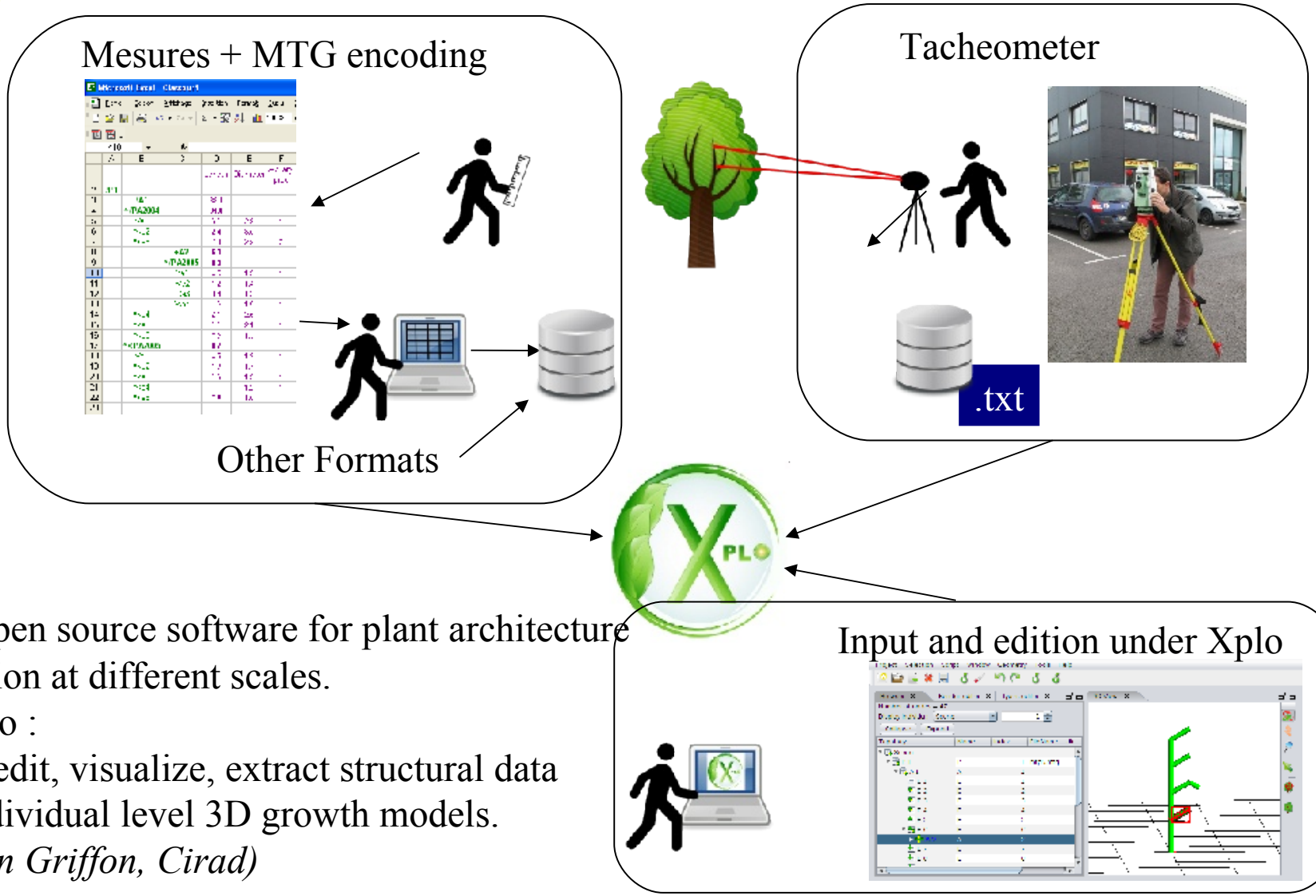
Digitalizations,

Lidar acquisitions

LI HongJun, Zhang Xiaopeng LIAMA/BJFU



AMAP UNIT : Plant Mock up definition principles



Xplo: open source software for plant architecture e**Xplo**ration at different scales.

In order to :

build, edit, visualize, extract structural data

run individual level 3D growth models.

(Sébastien Griffon, Cirad)

AMAP UNIT : Plant Mock up definition principles

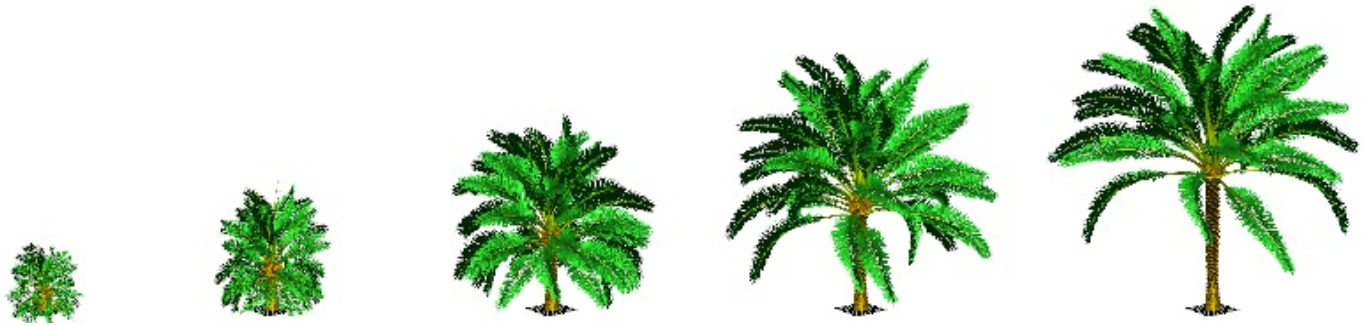
Two ways. 2. By simulation (dynamic structure)

Various simulators :

Structural : AmapSim

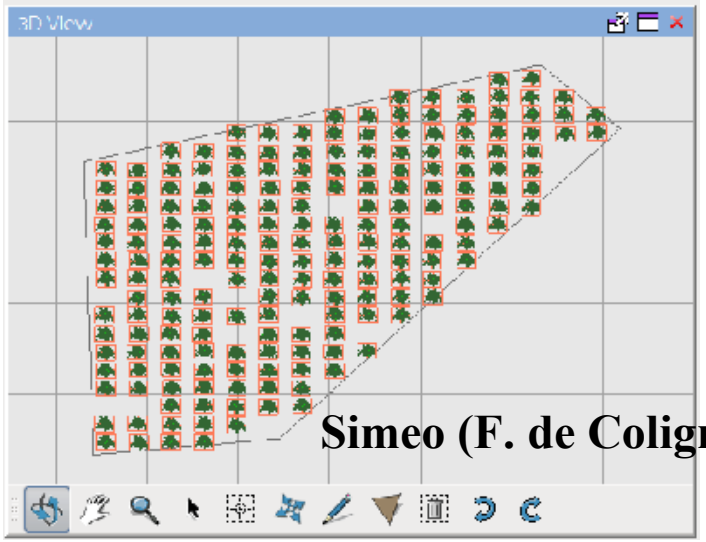
Fonctionnal : GreenLab

Specialized : Principles

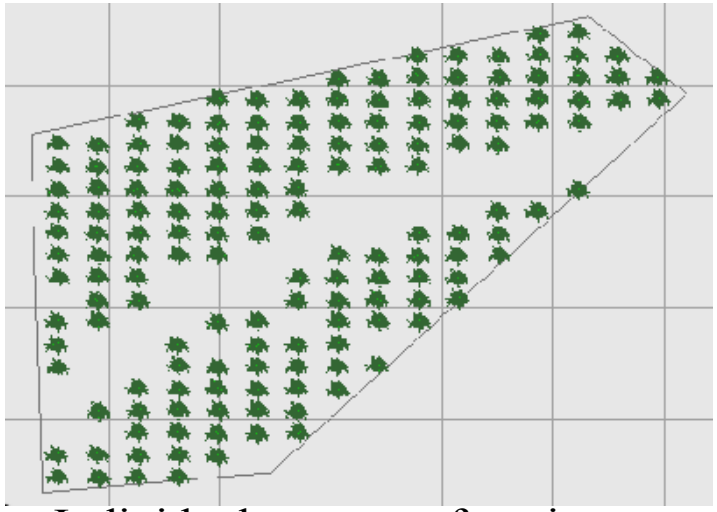


From single plant to Stands... and landscapes

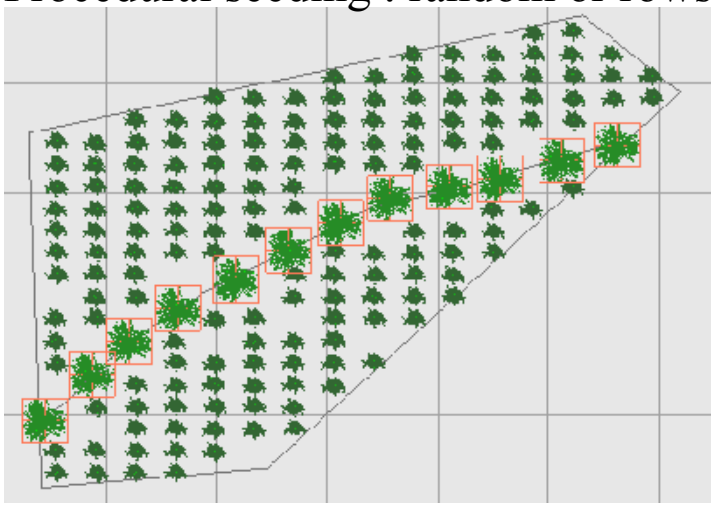
Individuals planting with procedural and editing tools (Simeo).



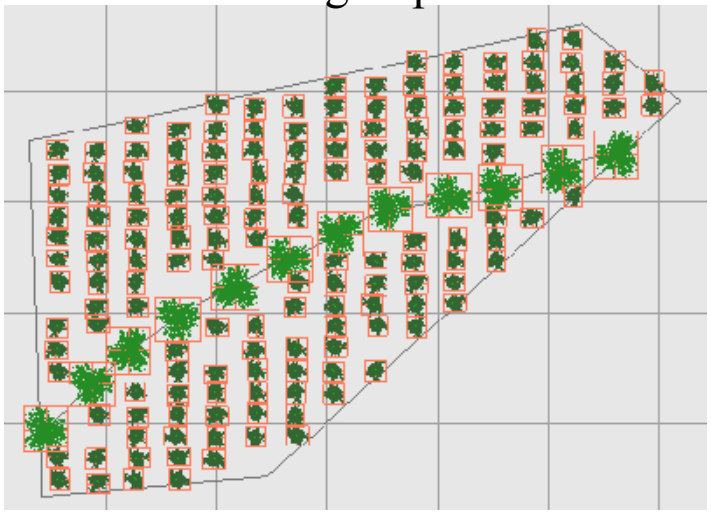
Simeo (F. de Coligny, INRA)



Procedural seeding : random or rows



Individual ou group fonctions



From single plant to Stands... and landscapes

Imports/Exports plug-ins

Imports

AMAPstudio formats:
OPF (Open Plant Format)
OPS (Open Plant Scene)

others formats :
MTG
LIG + DTA

… Add yours ...

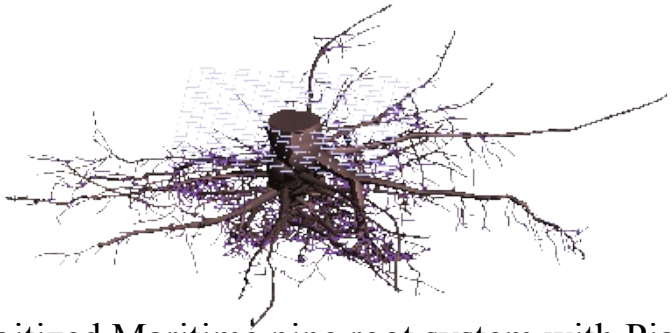
Exports

AMAPstudio formats:
OPF (Open Plant Format)
OPS (Open Plant Scene)

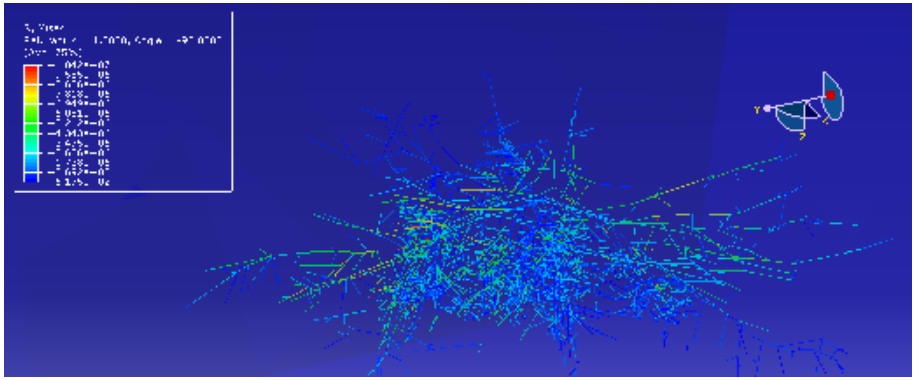
Other formats :
MTG, LIG + DTA
Sunflow, Abaqus INP
Obj (Wavefront)

… Add yours ...

Graphics



Digitized Maritime pine root system with PiafDigit
(F. Danjon - INRA)



Abaqus export for tree overturning simulation
(T. Fourcaud - CIRAD)

Summary

Context : AMAP Unit, GreenLab Project

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Software developments for 3D plants mockups

<u>Single plant to Landscape visualization : Amap's tools</u>

Tool list.

Freeware, *Amap's*, Professionals

Single image processing : XnView, Gimp, *QZIPP*

Image with Zbuffer processing : *QZIPP*

Single tree viewing : *Xplo, LigDraw,* VRML

3D Editor : Misfit, Blender

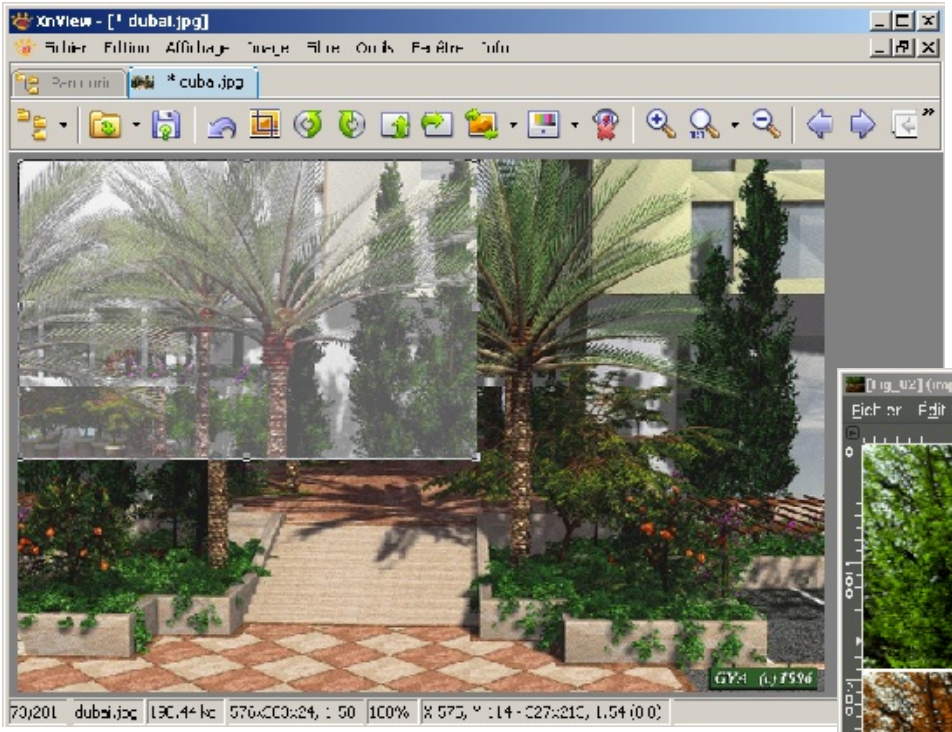
Landscape editor : *Simeo,* LandSim3D

Landscape render : Sunflow, Blender, Pov, LandSim3D

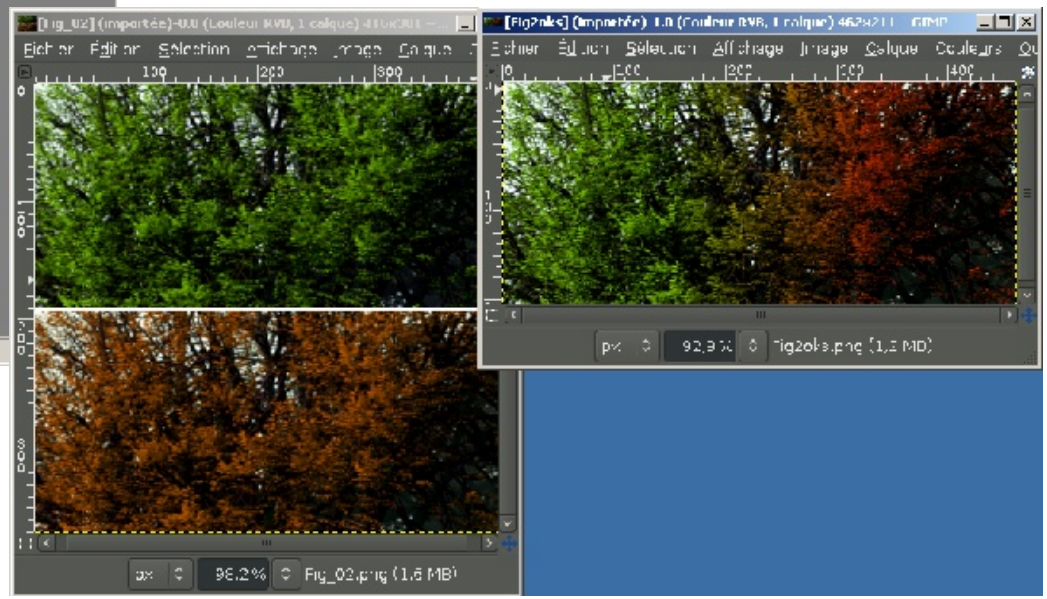
Tool list.

Freeware, *Amap's*, Professionals

Single image processing : XnView, Gimp, *QZIPP*



Xnview: Cut, resize, flip, single process, exports, ...

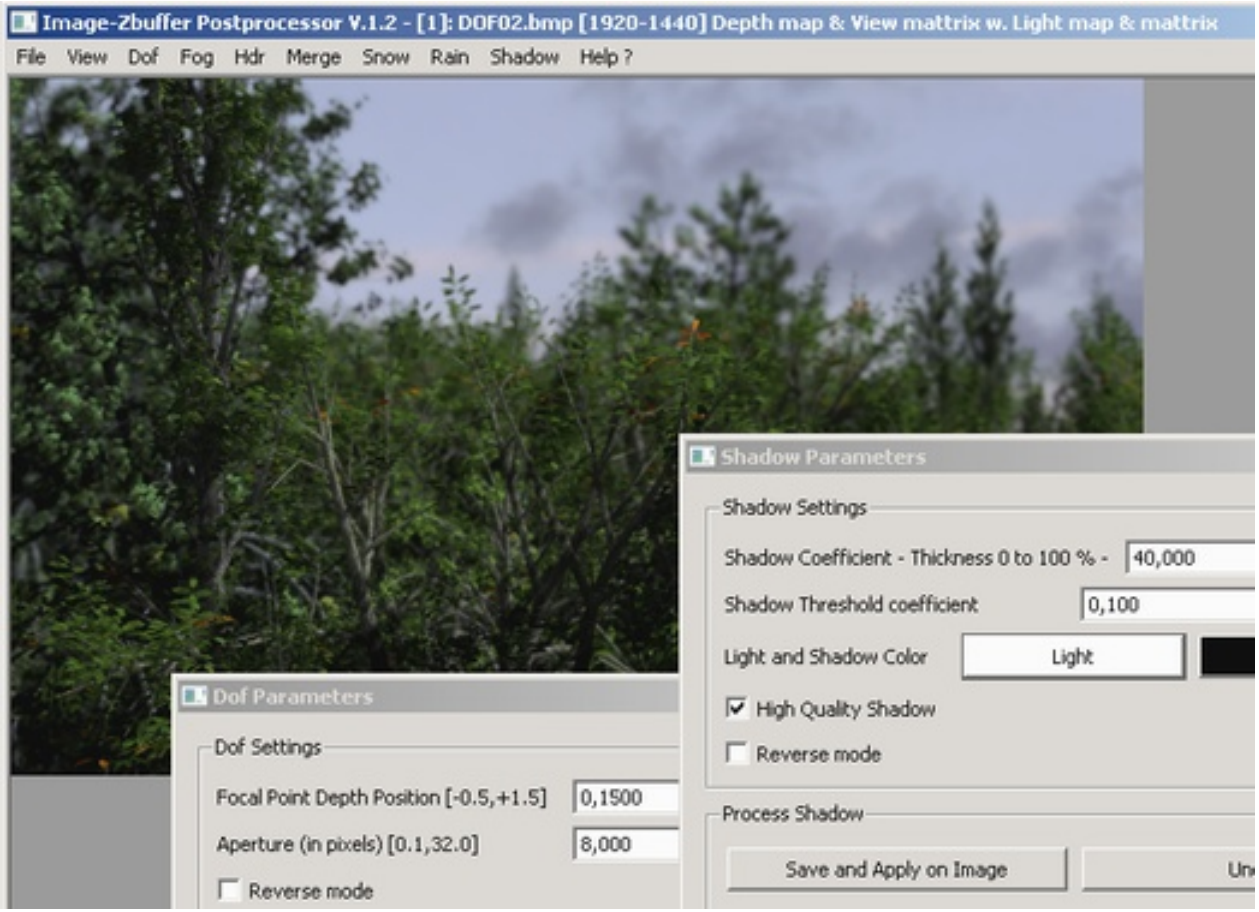


The Gimp : more advanced masks, layers, ...

Tool list.

Freeware, *Amap's*, Professionals

Image with Zbuffer processing : *QZIPP*



QZIPP – 2D process. HDR - Rain





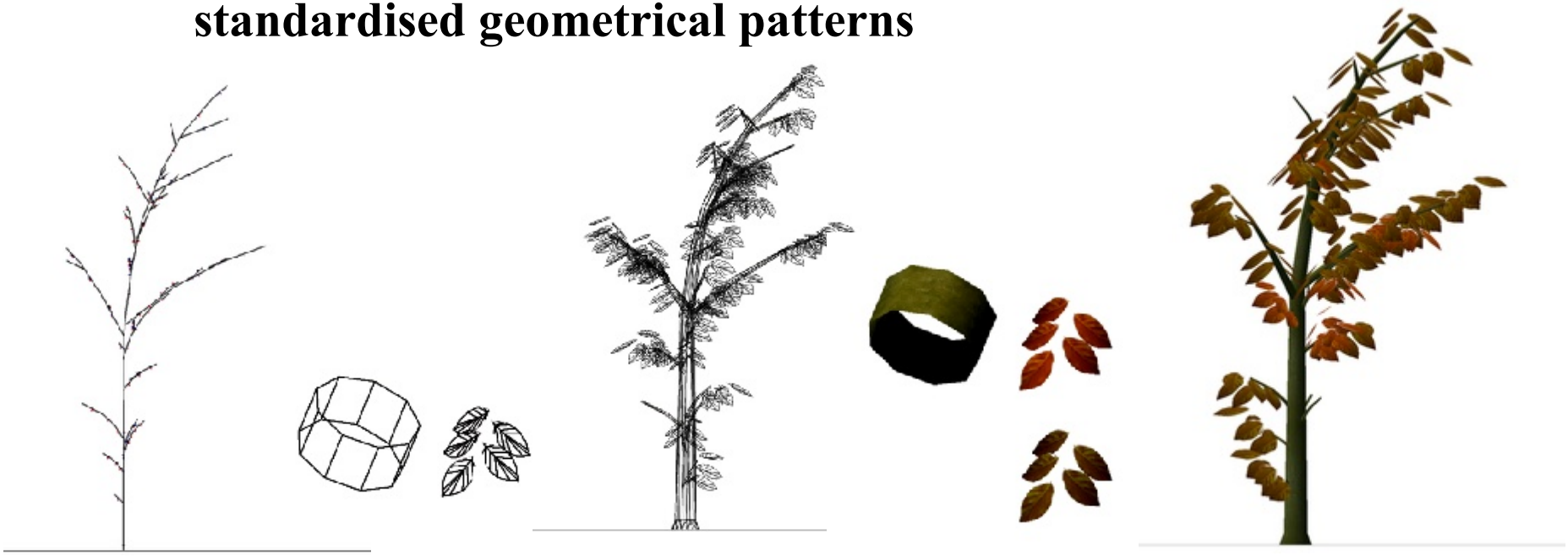

QZIPP – 2D 1/2 process. Snow - Dof

Single tree visualization principles

Line Tree: list of componants (id, position, orientations [MJ86])

Line tree drawing

- **Drawing a line from origine to origin+main direction : skeleton**
- **Full : Converting the matrix to a affine operator, applied to standardised geometrical patterns**



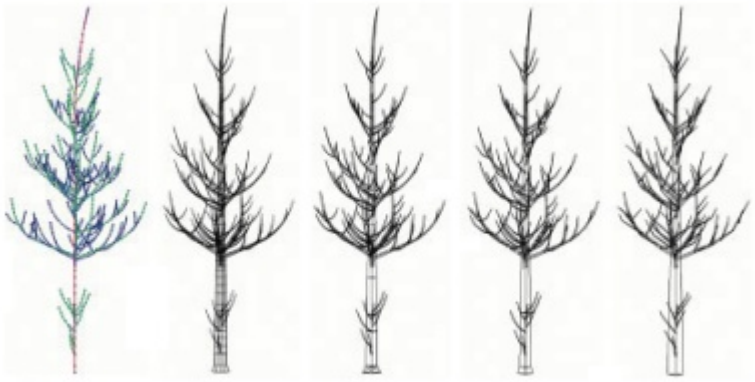
Level of details principles

Minimising the number of componants

- **Filtering according to size, or randomly**

Advanced features : with Xiaopeng Zhang

- **Componant merging**
- **Using Impostors**



(a) Skeleton (b) 100% (c) 20.9% (d) 10.06% (e) 4.85%

(a) 100% (b) 5.2% (c) 0.25% (d) 0.01%

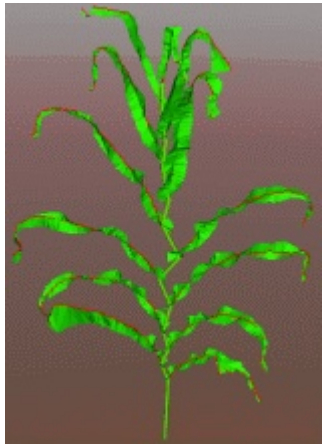
Tool list.

Freeware, *Amap's*, Professionals

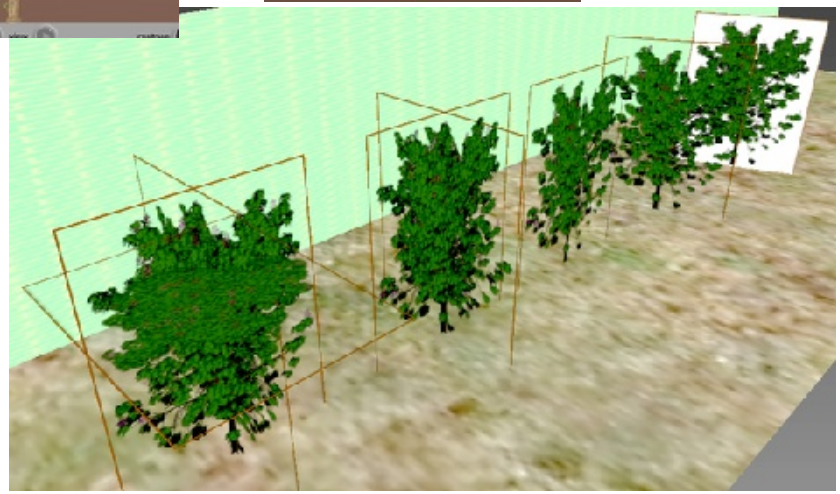
Single tree viewing : *Xplo, LigDraw,* VRML

Vrml trees :

- **From geometry**



- **From impostors**



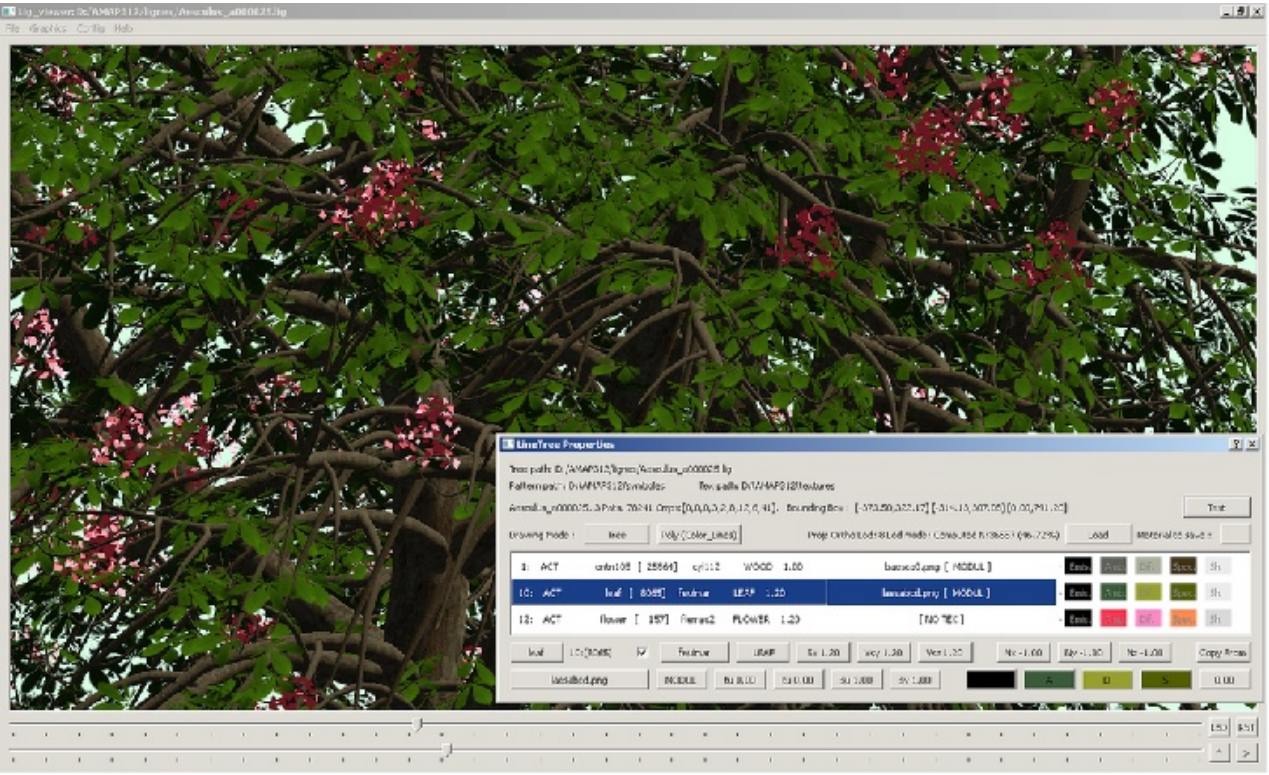
Tool list : Lig_Draw / Gloups_Draw

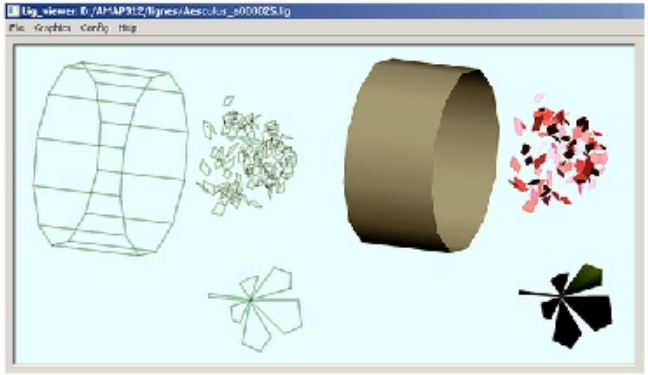
A single tree viewer (capitalizes some results and used also for tests)

- **Reads line tree (single or sequence)**

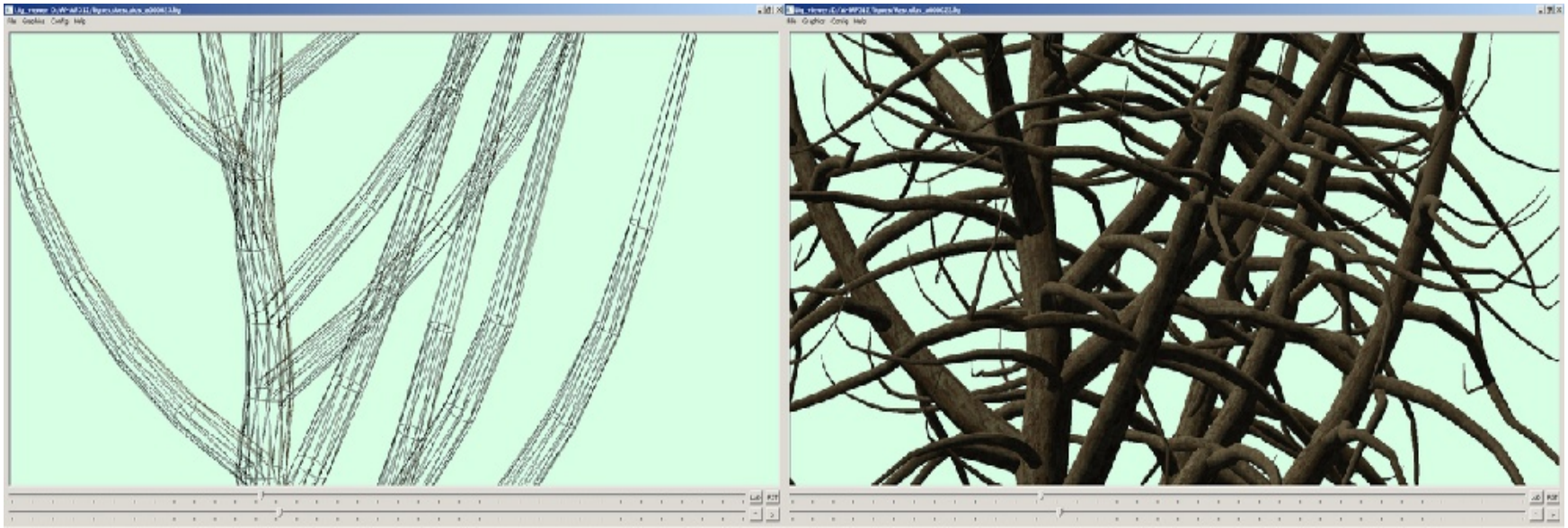
Has a pattern/material menu

- **Exports image with /without depth**





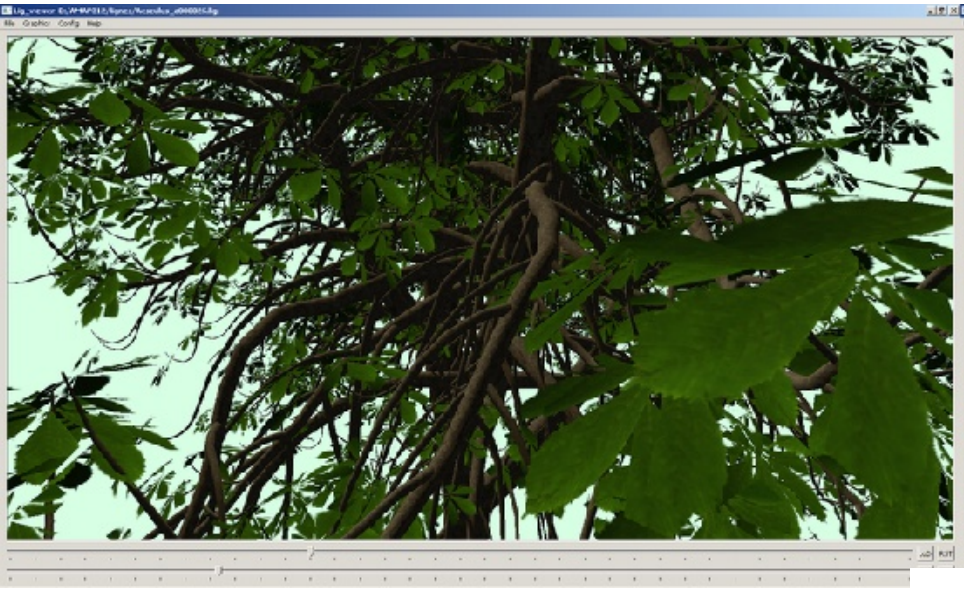
Lig_Draw / Gloups_Draw

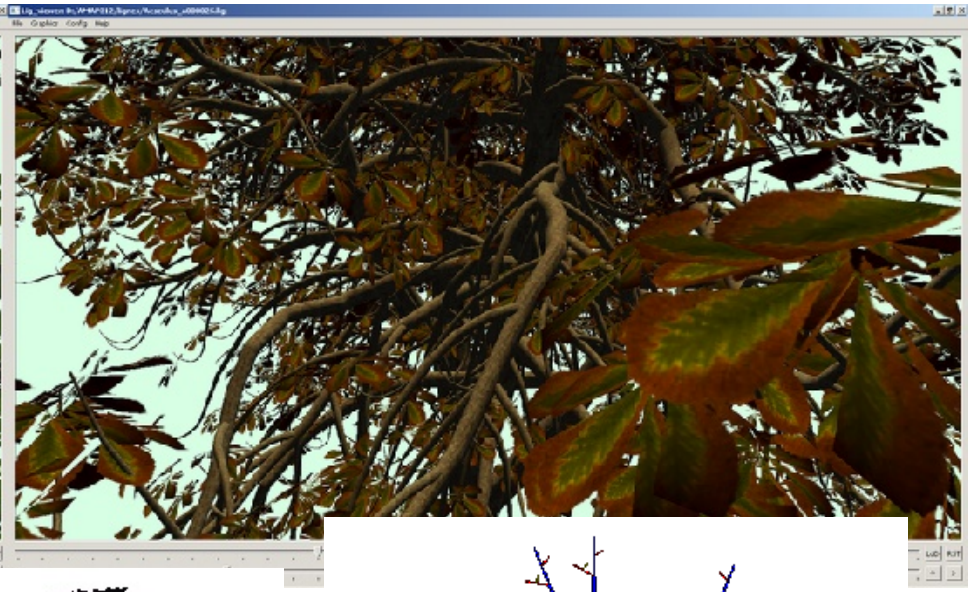


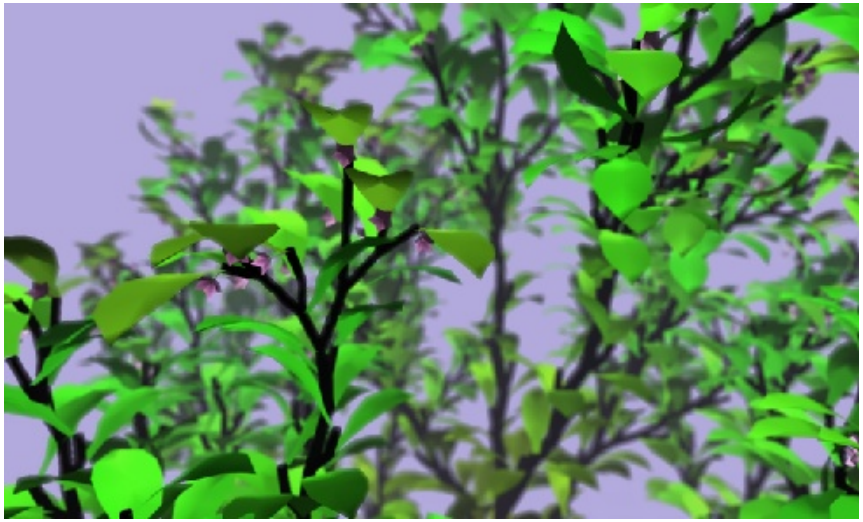
Specific Features

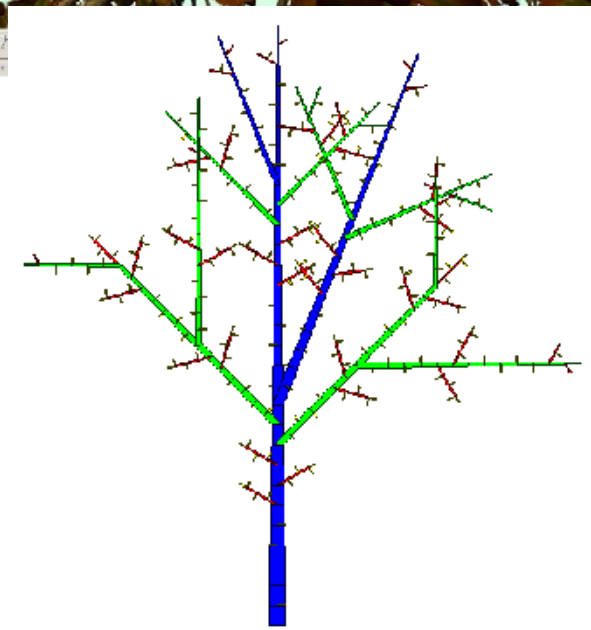
- **Tools to rebuild topolgy from line Tree → allows branch Lod**
- **Mix of line and polygon rendering**
- **Allows .obj patterns**

Lig_Draw / Gloups_Draw

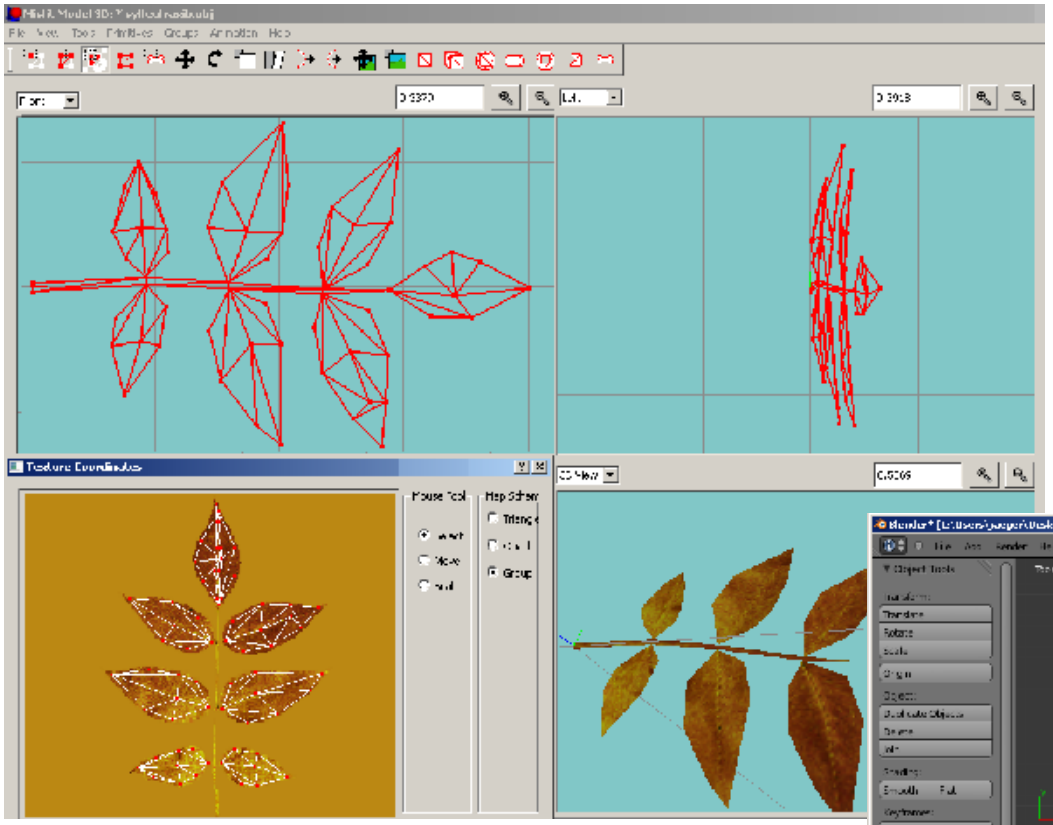




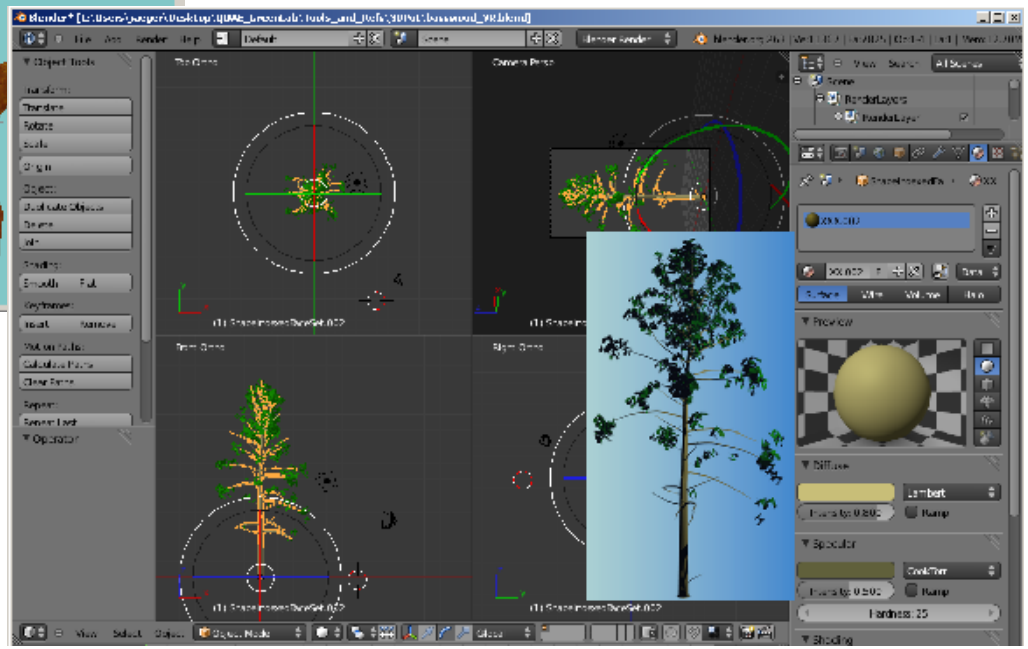




Tool list: MistFit 3D / Blender



Patterns with MisFit 3D freeware



Advanced : Blender

Lig_Draw / Gloups_Draw /QZIPP

From single plant to Stands... and landscapes

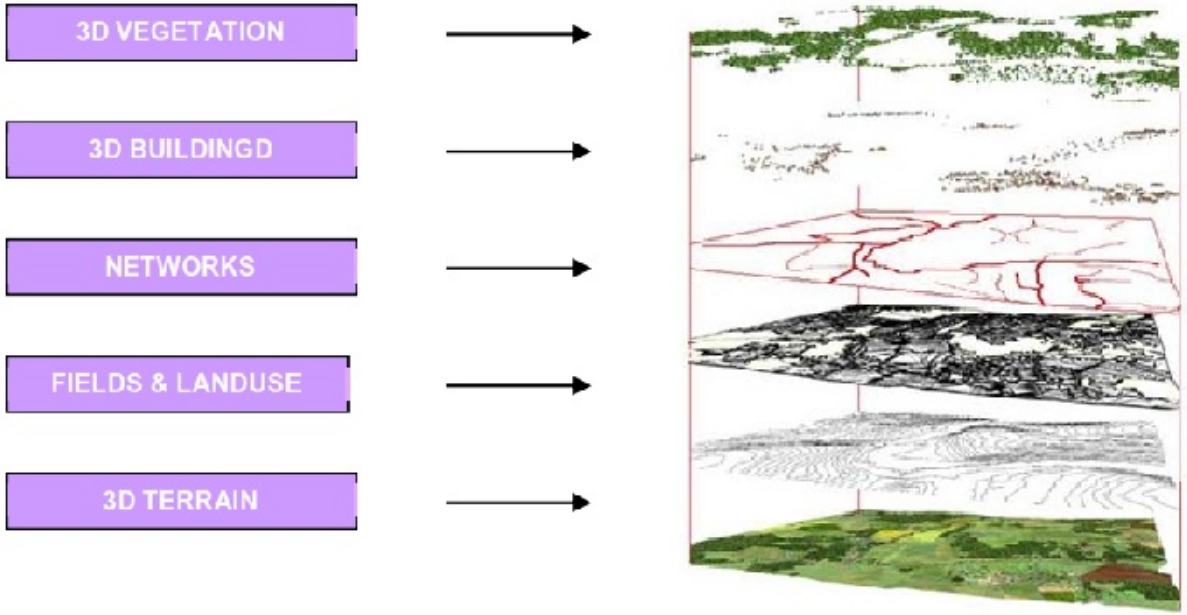
Simeo exports to freeware rendering tools

Blender

Tool list. Freeware, *Amap's*, Professionals

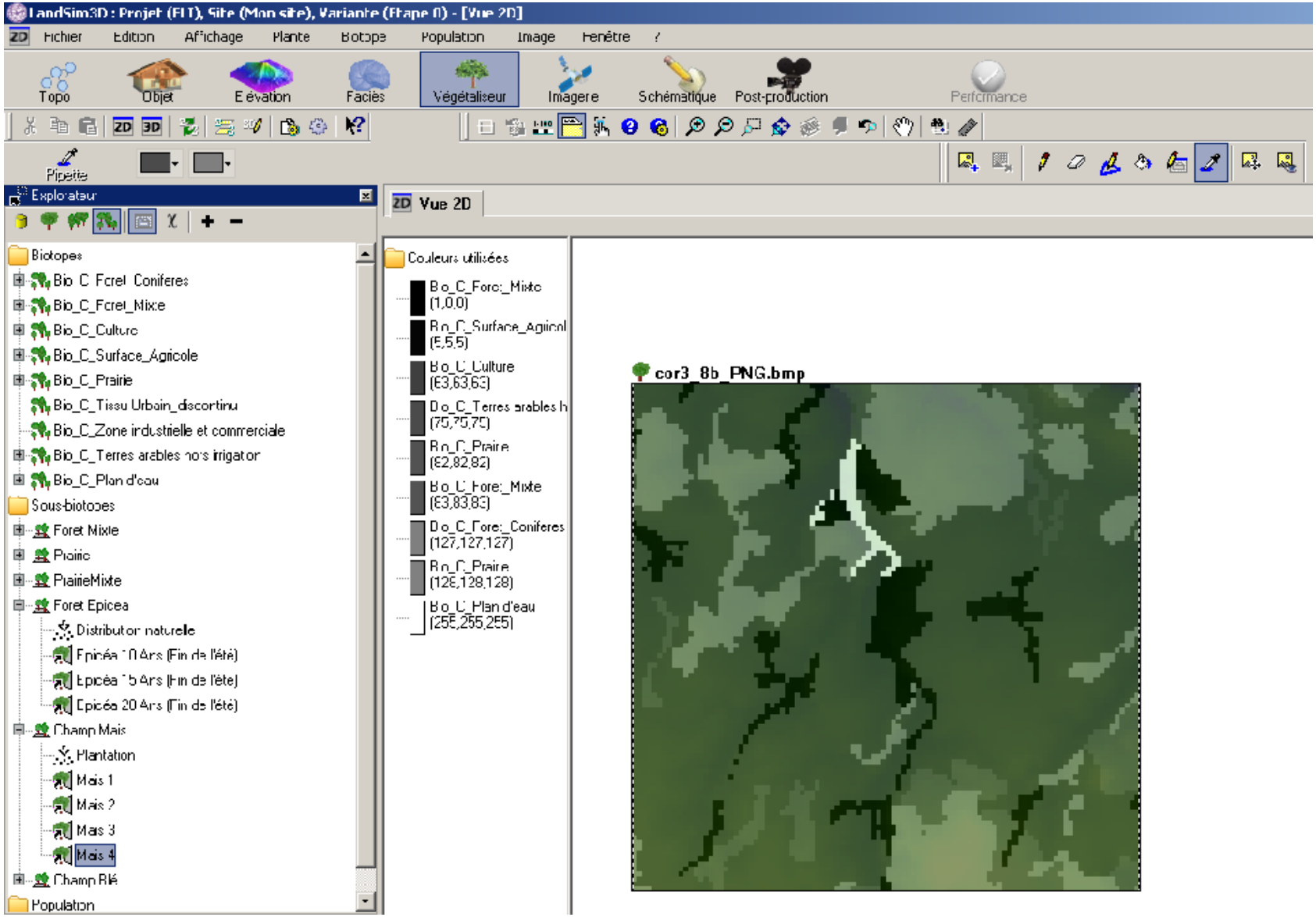
Landscape editor : *Simeo*, LandSim3D

Landscape render : Sunflow, Blender, Pov, LandSim3D



LandSim3D

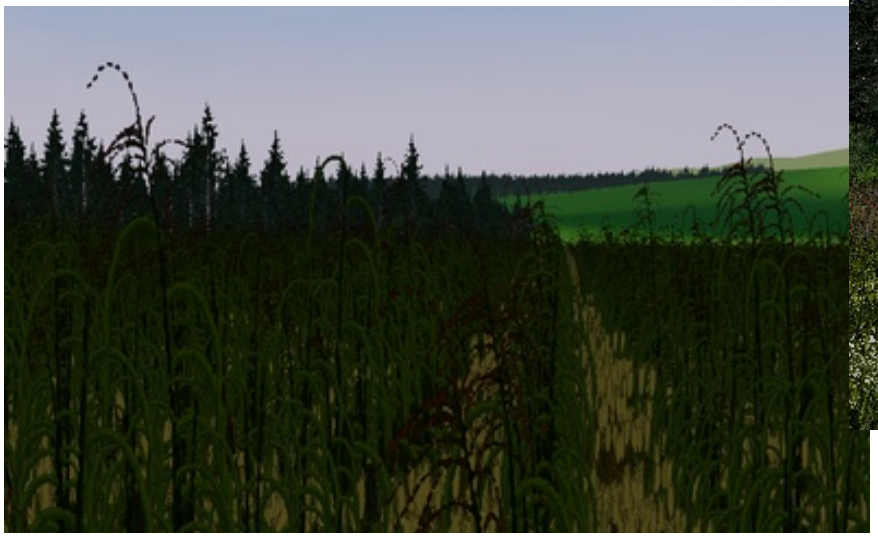
Tool list. LandSim 3D (free licence to AMAP)



Tool list : LandSim 3D

Exports 3D geometry or impostors from LigDraw to LandSIM3D

Bionatics
www.bionatics.com



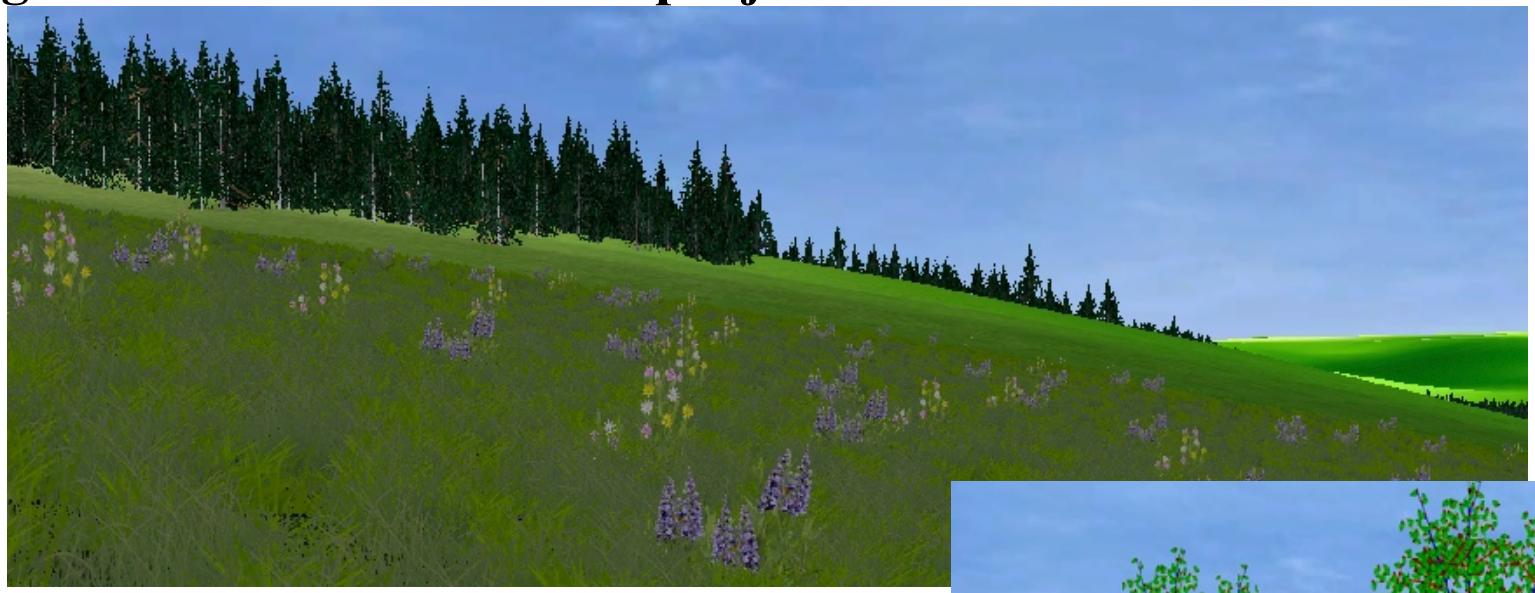
LandSim3D

From single plant to Stands... and landscape

Cooperation with Bionatics on LandSim3D

www.bionatics.com

Using LandSim3D in AMAP's projects



Export Trees (billboards from LigDraw) to LandSim3D

A full set of tools from organ to landscape

Freeware, *Amap's*, Professionals

Single image processing : XnView, Gimp, *QZIPP*

Image with Zbuffer processing : *QZIPP*

Single tree viewing : *Xplo, LigDraw,* VRML

3D Editor : Misfit, Blender

Landscape editor : *Simeo,* LandSim3D

Landscape render : Sunflow, Blender, Pov, LandSim3D

More on : http://pma.cirad.fr/MJ_PICS/ References

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