Capsis: progress status 2016-2017

CAQSIS 2017 meeting - 28-30 March 2017
FCBA Bordeaux

Francois de Coligny
Nicolas Beudez

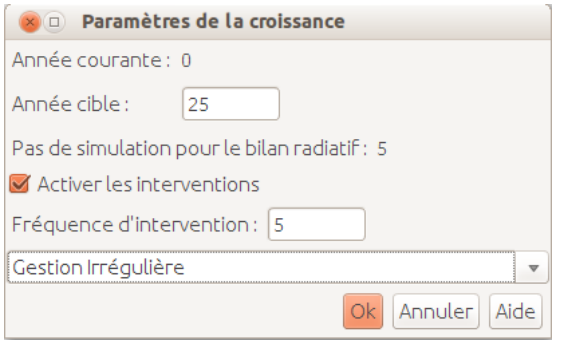
INRA - AMAP
botAny et Modelling of Plant Architecture and vegetation

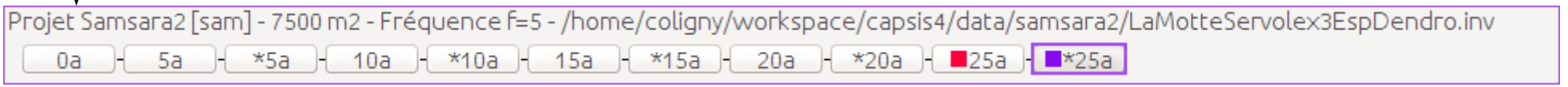
Capsis objective

Computer-Aided Projections of Strategies In Silviculture

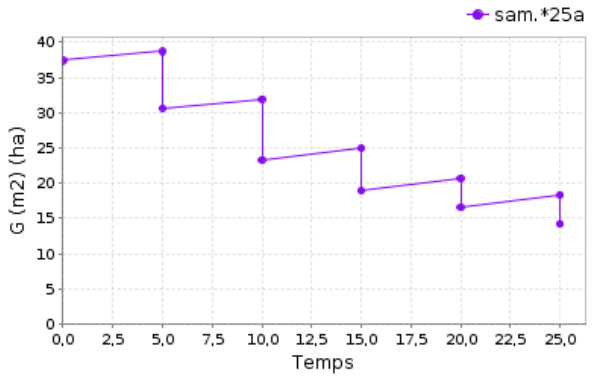
Build **a software platform** to integrate **forest growth and dynamics models** for **modellers, forest managers and training**

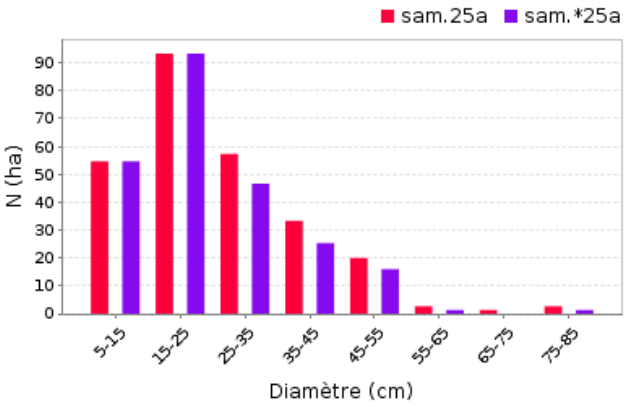
1. initialisation





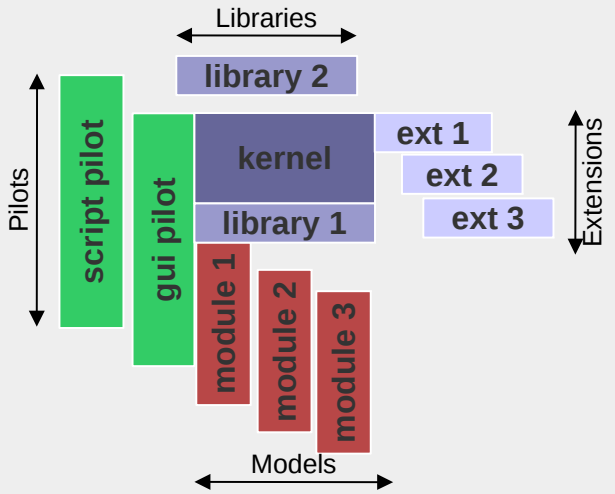
2. growth



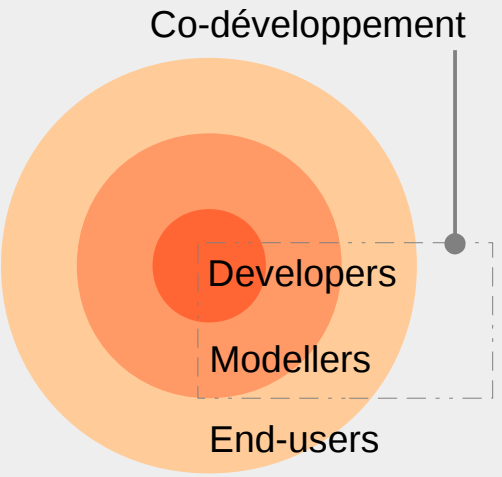


export

A co-development oriented organisation



Software architecture



Actors and roles

Free software (LGPL)

Capsis charter :
- property
- sharing with other co-developers

Clear property rules

Capsis charter

Accepted by all members

- aims at sharing and intellectual propserty respect
- compatible with academic and private field partners

http://www.inra.fr/capsis/charter

Capsis Charter

Main points

1. **Free kernel**: the Capsis4 kernel is a free software (LGPL licence) : kernel + generic pilots + extensions + libraries (all the capsis.* packages)
2. **Development**: the modellers are in charge of the development of their models into Capsis
3. **Support**: They can have support from the developers : training sessions, design, starting help, further assistance
4. **Free access in the community**: All the source codes are freely accessible by all members in the Capsis community, modules may become the base for new modules, code can be shared…
5. **Respect of intellectual property**: all members respect the intellectual property of the other members.
6. **Validations**: developers deal with technical validation, modellers deal with functionnal validation.
7. **Distribution**: the stabilized / validated modules may be distributed when the author decides and chooses a licence (LGPL free license suggested), possible download from a ftp site.
8. **Decentralization**: modellers manage directly the relations with their end-users: financing, training, assistance, models documentation, contracts…

To comply with the charter, the modellers may **distribute** the Capsis platform with their own modules but **NOT with the modules of the other modellers**. The modules (i.e. the growth models) are indeed not free and belong to their authors who may decide to distribute them with the license they choose. The section 4 of the charter grants access on all the modules to the modellers of the Capsis community but only to them, resulting in this distribution restriction.

Method: care for the modellers

Targeted public: a modeller has designed a forestry growth model and whishes to integrate it in Capsis to get a simulator for his own objectives

- discussion
- accept the charter
- training
- immediate working session to start together
  (never start alone)

Goal: get quickly a running prototype
-> often in few days / during few weeks

Start in 'pair programming' on the same machine
-> the developer master the technique
-> the modeller masters his model
-> the simulator is valid technically and fonctionally

The modeller can then continue by himself with simple tools...

... and a Long term support

Activity 2016-2017

- New projects

  - **Walltree :** Gauthier Ligot (ULg, Gembloux Agro-Bio Tech, Belgium)
  - **SYDY :** Philippe Dreyfus (ONF RDI, Avignon)
  - **AlloStand3D :** Philippe Verley, Nicolas Barbier, Pierre Ploton (IRD AMAP)

-Bigger demands, on existing projects (>= 5 days)

  - **Heterofor** (Mathieu Jonard, UCL, Belgium)
  - **Phenofit5** - **Phelib** (Isabelle Chuine, CNRS CEFE, Montpellier)
  - **Samsara2** (Benoit Courbaud, IRSTEA, Grenoble)
  - **Forceeps** (Xavier Morin, CNRS CEFE, Montpellier)
  - **PlantaBSL** (Robert Schneider, UQAR, Québec)
  - **Artemis 2014** (Isabelle Auger, Hugues Power, MRNF Québec)
  - **Woudyfor** (Florian Delerue, Bordeaux-INP, ENSEGID)

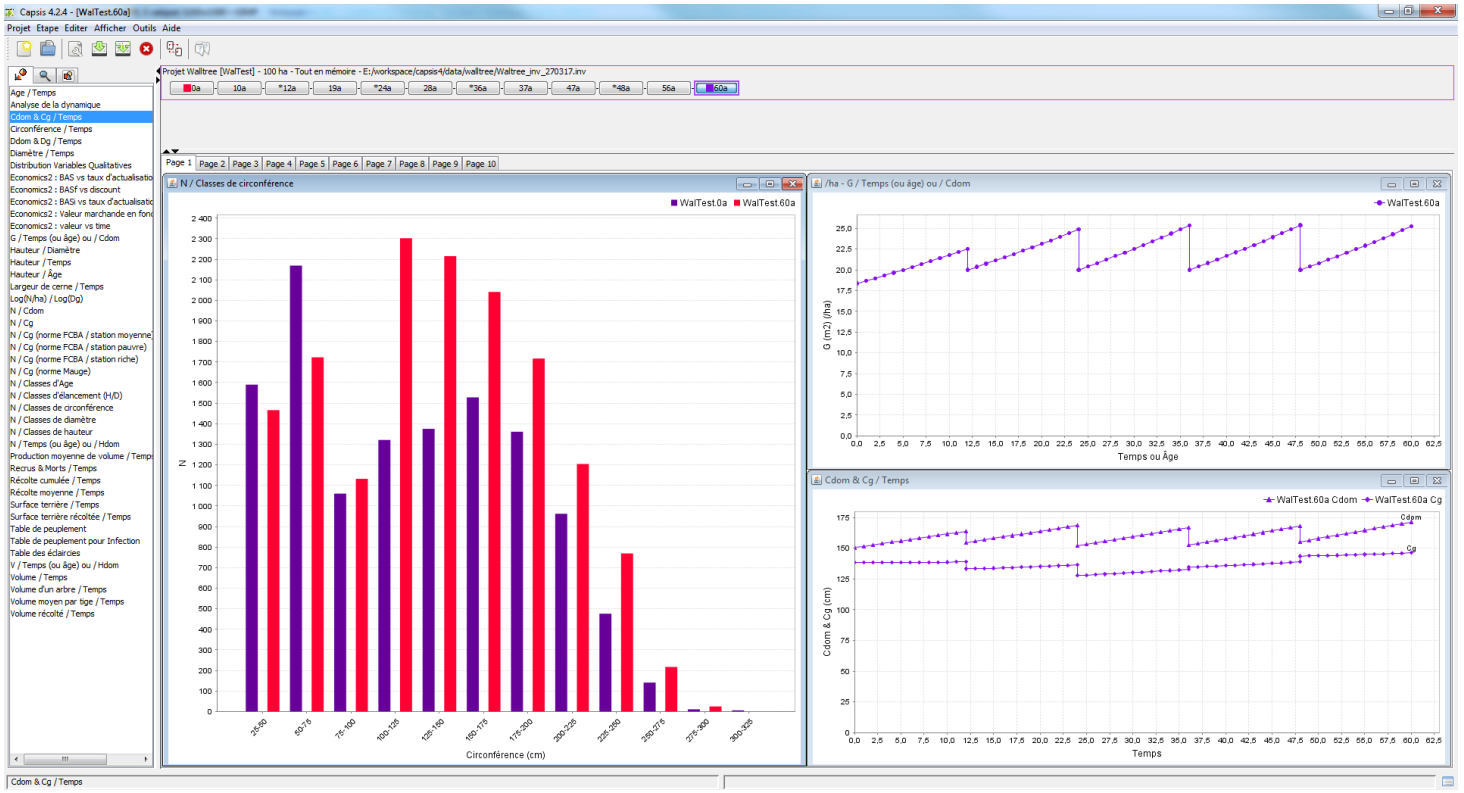
- Usual support

WallTree

A simple generic tree growth model to be used to simulate the evolution of the Walloon forest (Southern part of Belgium)

Will be used for large scale simulations (whole region)

Will accept data from classical forest inventories or other large scale technologies (aerial LiDAR)



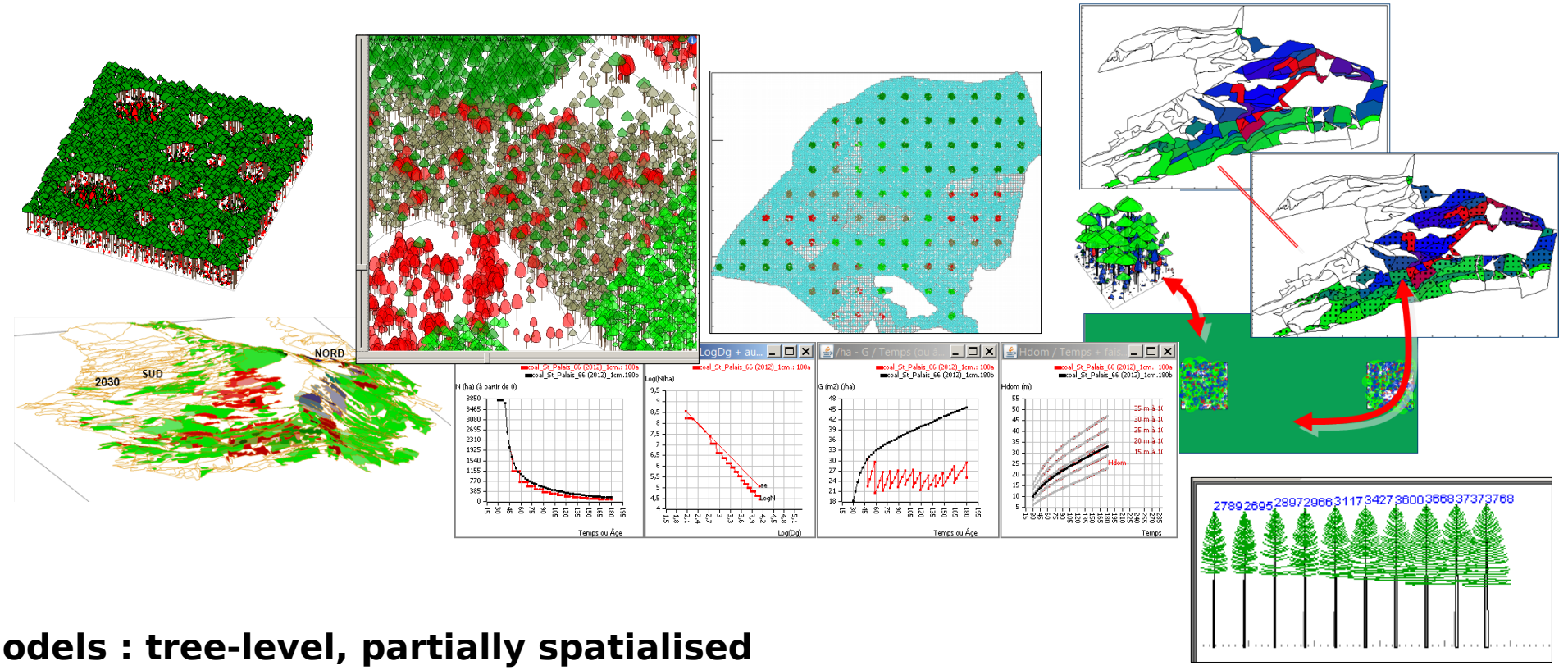
SYDY - SYlviculture & forest DYnamics

Multiples aims

- study of Beech & Silver fir colonization dynamics in pine stands of the mediterrean mountains (south-east of France)
- support to building thinning strategies for several Silviculture Guides

Specific Features

- simulation at multiple levels: tree - stand - forest / small massif
- automated silvicultures: for one stand, or for all compartments of a forest together
- simulation of various spatial structures, of forest inventory designs (fixed radius/ fixed angle plots)



Models : tree-level, partially spatialised

* *Pinus nigra, P. sylvestris, P. uncinata, Abies alba, Fagus sylvatica* in south-eastern France, including mixed, uneven-aged stands – growth, mortality (trees, seedlings), recruitment
* *Pinus halepensis* in south-eastern France - pure, even-aged stands – growth, mortality
* *Quercus petraea, Fagus sylvatica* in northern France (Fagacées models) - pure, even-aged stands

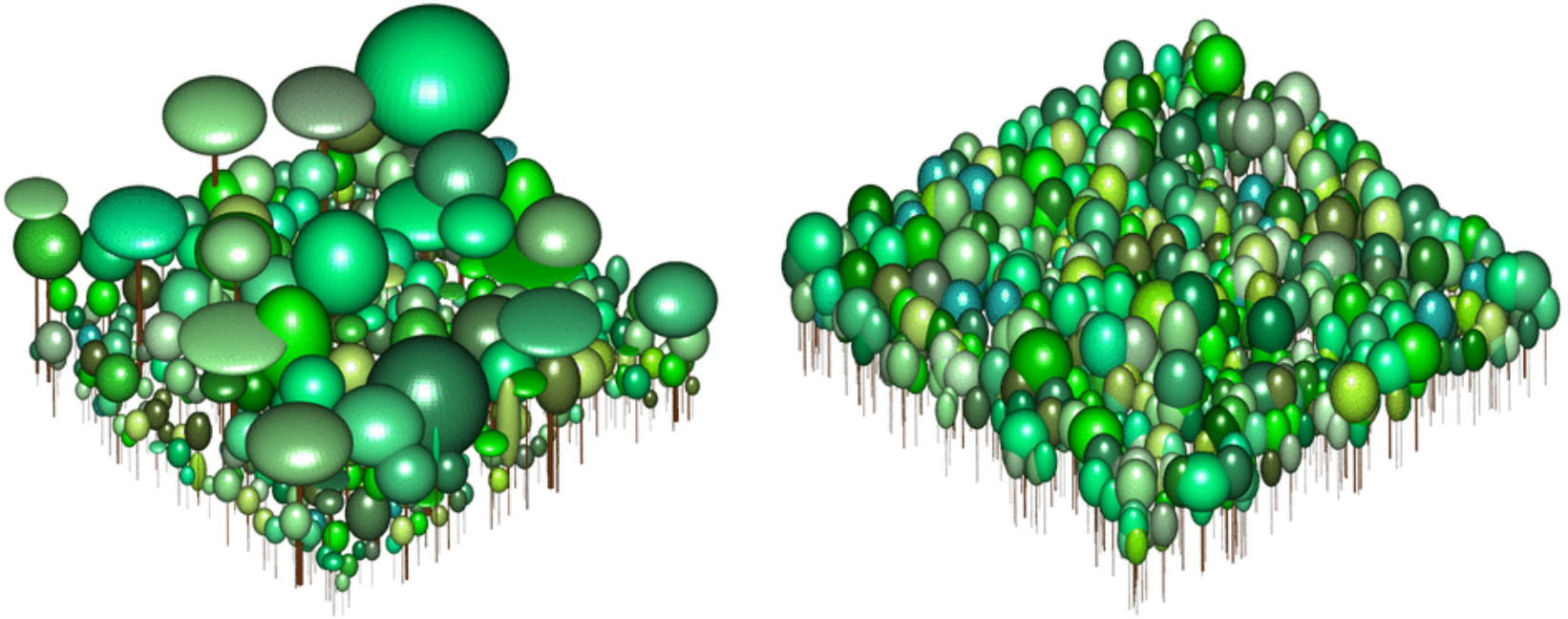
Dreyfus Ph. (2012) Joint simulation of stand dynamics and landscape evolution using a tree-level model for mixed uneven-aged forests - *Annals of Forest Science 69:283 – 303*

AlloStand3D

Objectives: reconstructs 3D stand mockups from DBH inventories

Tree height and crown dimensions derived from regional allometric equations

Tree placement at random but constrained by crown overlap thresholds



Mathieu Jonard, Louis de Wergifosse, Frédéric André (UCL, Belgium)

Heterofor

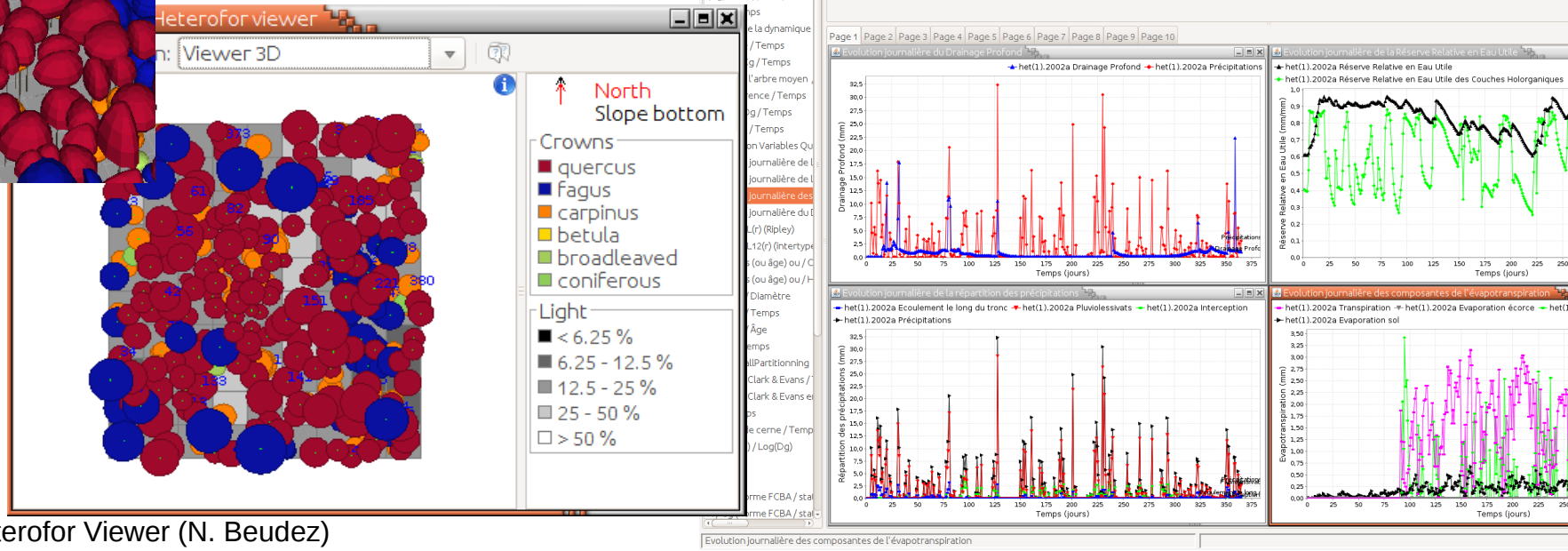
- a spatially-explicit and individual-based model
- a model describing tree growth and resource use (solar radiation, water and nutrients) in heterogeneous forests (mixed and uneven-aged).

Connection to SamsaraLight (B. Courbaud) →

Connection to PhreeqC (USGS) →

Connection to Castanea (H. Davi)
phenology, photosynthesis →

Water cycle →



Heterofor Viewer (N. Beudez)

Other actions

Phenofit5 (Isabelle Chuine, CNRS CEFE, Montpellier)
Connection to the Phelib phenology library
(Gauthier Boaglio, Inaki Garcia, David Delannoy, Olivier Maury (INRA Agroclim)

Samsara2 (Benoit Courbaud, IRSTEA Grenoble)
Graphics, export, charts and displays

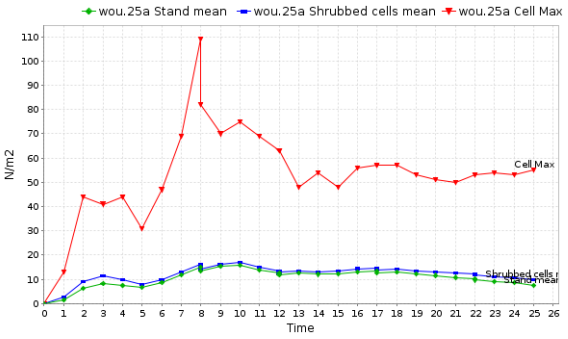
Forceeps (Xavier Morin, CNRS CEFE, Montpellier)
Thinning tools, options for regeneration
Marianne Bernard : effect of cervidae and climate on regeneration
Marion Jourdan : sensitivity analyses

WoodQC conference in Québec
Alexi Achim et al., Université Laval
June 2016

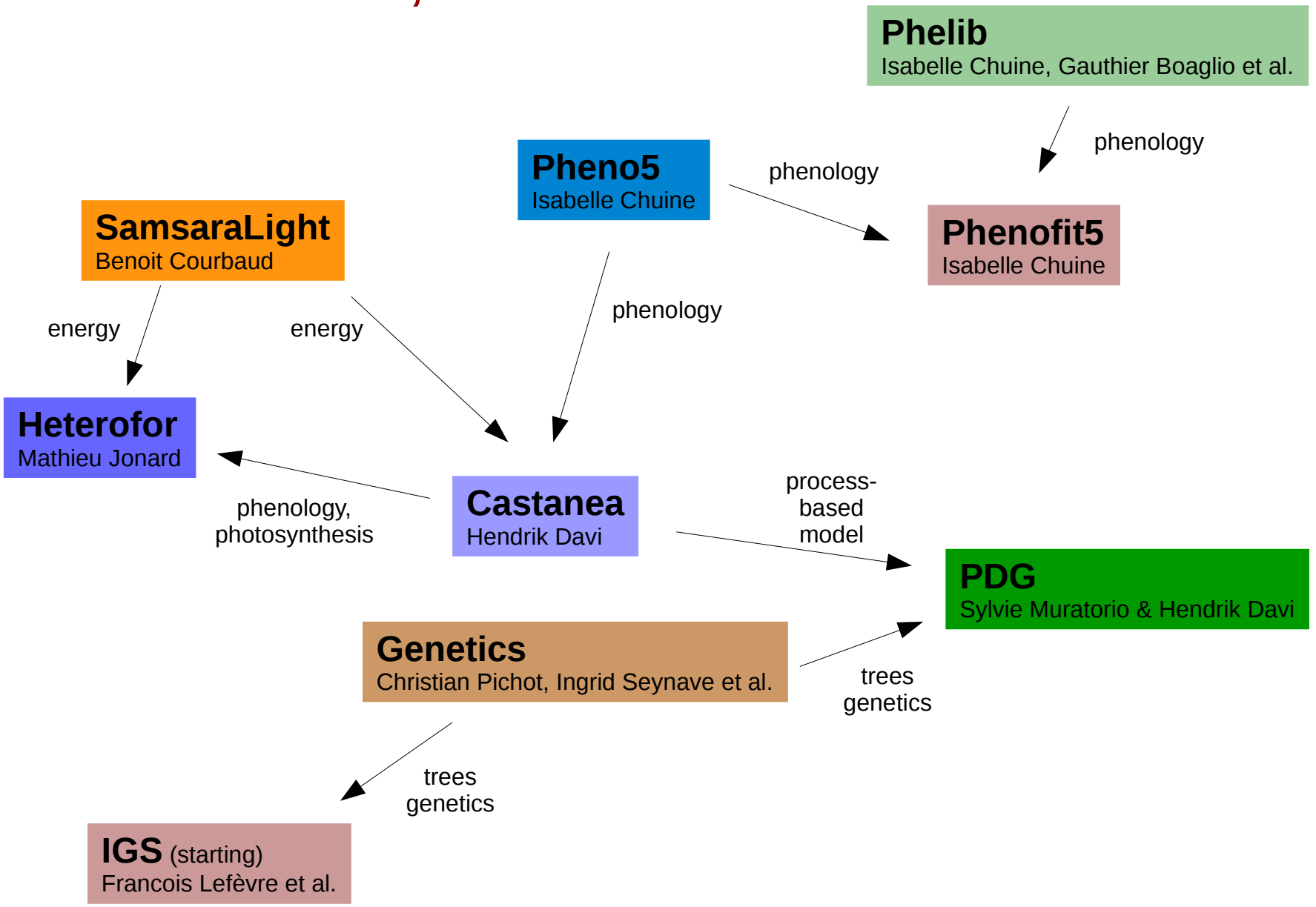
PlantaBSL (Robert Schneider, UQAR, Rimouski, Québec)
Tony Franceschini : competition index
Emmanuel Duchateau : spatialization algorithm

Artemis 2014 (Isabelle Auger, Hugues Power, Québec)
1 week training on Capsis and the Québec models architecture
-> Isabelle Auger, Hugues Power, Filip Havreljuk, Francois Guillemette and Charles Ward
at the Ministère des Forêts, de la Faune et des Parcs / Direction de la Recherche Forestière

Woudyfor (Florian Delerue, Bordeaux-INP, ENSEGID)
Shrub dynamics (common gorse) under a pine plantation (PP3, Céline Merdieu, INRA Biogeco)
Effect of the plantation pattern and related management on the shrub management and dynamics



Connections 2016-2017, a focus



A new developer for Capsis

Nicolas Beudez (**INRA**, UMR AMAP). I work on the **Capsis project** :

- since **October 2016**

- as a **developer** (**INRA** external competitive exam, **design engineer**)

Education

2008 – 2009 : **Research Master « Physique des Matériaux, Mécanique et Modélisation Numérique »,** master of the **École Nationale Supérieure des Mines de Paris** (University of Nice/Sophia-Antipolis, partnership with CEMEF)

2006 – 2009 : **Institut des Sciences de l'Ingénieur de Toulon et du Var** (**ISITV** today become **SeaTech**), speciality **Scientific calculation**, engineering degree

2005 – 2006 : **Preparation for mathematics aggregation**, University of Montpellier 2

2004 – 2005 : **DEA of Applied Mathematics**, University of Montpellier 2

2002 – 2004 : **License and Master of Mathematics**, University of Avignon

2000 – 2002 : **Preparatory DEUG to « Concours Communs Polytechniques »**, University of Avignon

Training in **scientific calculation :**

- **mathematics** and numerical calculation (**numerical methods, parallel computing**)
- **mechanical** (solid, fluid, strength of materials)
- computer programming (**C, Fortran, C++, Java, Matlab, SQL**)

A new developer for Capsis

Professionnal career : public research + private field

Two internships made in CEA (Marcoule site)

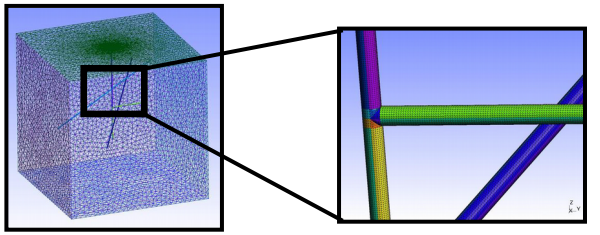
- *Research and implementation under* ***Scilab*** *of* ***methods for outliers detection***

- *3D thermo-hydraulic* ***modelization:*** building geometry and **mesh** (Gambit) and numerical simulation (**Fluent**)

03/2010 – 10/2010 : Mennesson Manutention company (fixed-term contract), *computer automation of management operations (Ability Plus software)*

11/2010 – 05/2016 : Research engineer (fixed-term contract), UMR EMMAH (INRA / Avignon University)

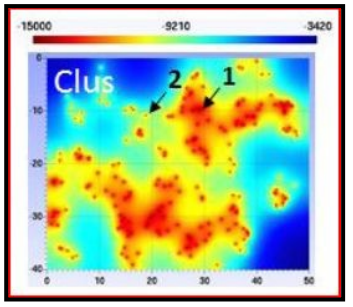
a) Hydromineral uptake by **plants root systems** (*Rhizopolis* project), implementation in **C++ / MPI / PETSc** in **FAFEMO** (**F**ast **A**daptive **F**inite **E**lement **M**odular **O**bject), *C. Doussan, G. Lefeuve-Mesgouez*:



A 3D root system (Gmsh software)

- **finite element** resolution of 3D **solutes transfer** equation in soils (*advection - diffusion – dispersion equation*)

- **coupling** of **solutes transfer** equation / **water transfer** equation (*Richard's equation*)



Root water uptake: 2D cartography of matrix potentials (Gmsh software)

- **coupling** of **water transfer model** / **root processes** (calculation of **matrix potential** at the **soil/root interface**):

  fine meshing of roots

  VS

  coarse meshing of soil + equivalent sink term + superposition theorem (contribution of neighbor roots) + analytic transfer equations (calculation of matrix potential at the soil/root interface)

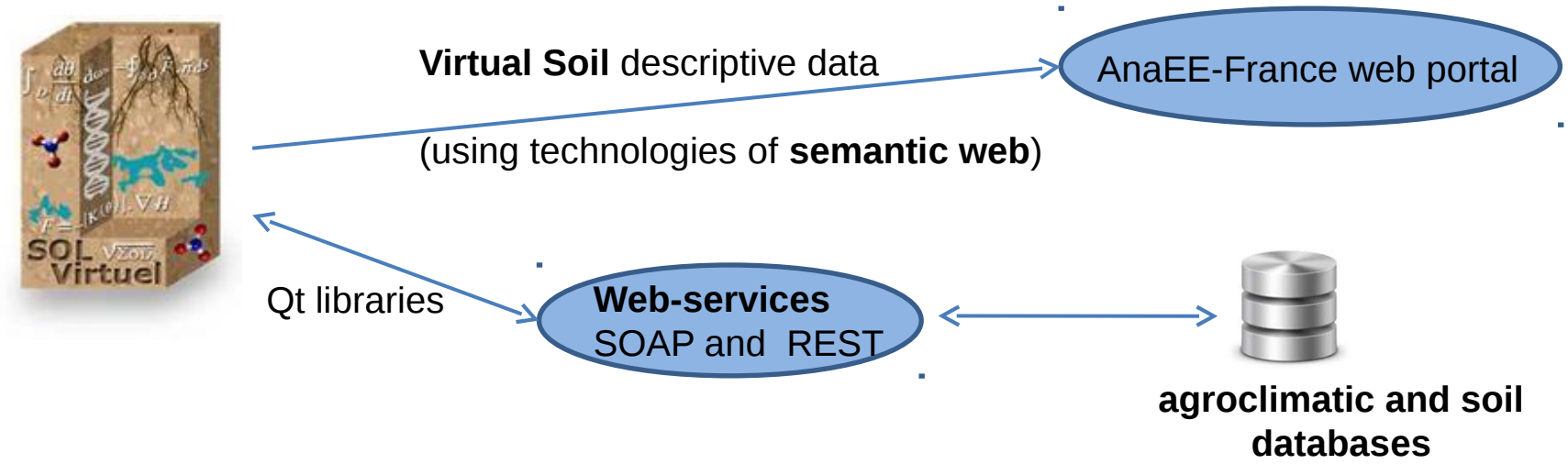
A new developer for Capsis

Professionnal career : public research + private field

11/2010 – 05/2016 : Research engineer (fixed-term contract), UMR EMMAH (INRA / Avignon University)

b) **Virtual Soil**

- **AnaEE-France** project (« **Ana**lyses et **E**xpérimentations sur les **E**cosystèmes ») :



- Development under **R** of a **sensitivity analysis** tool (**C++/R** and **Fortran/R** connections)

c) Avignon University : **Parallelization** in **OpenMP** of the Kuma **C++** code (code allowing to scan an heterogeneous material) + simple **non-regression tests**

A new developer for Capsis

What I have done in Capsis project

- ***Improved the process of the creation of a new module :***

« *template* » module → *CreateModule.groovy* → **Automated generation** of the **source files** of the « *newModule* »

Step 1

should be done by hand before

Write new module's name in *etc/capsis.models*

Step 2

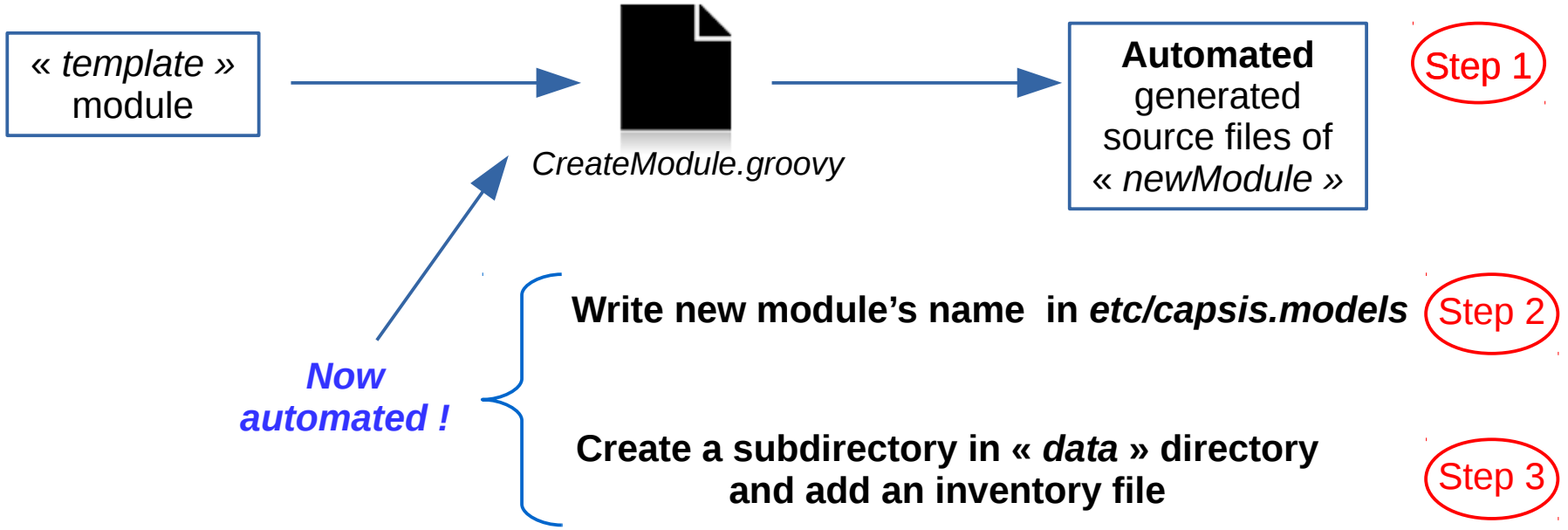
Create a subdirectory in « *data* » directory and **add an inventory file**

Step 3

A new developer for Capsis

What I have done in Capsis project

- ***Improved the process of the creation of a new module :***



\+ added a **simple thinner** in the « *template* » module (available for the new module)

⇒ The **creation** of a **new module** is **completely automated** and generated new module is **ready for use**

A new developer for Capsis

What I have done in Capsis project

- ***Worked on Javadoc :***
  - add **custom Javadoc tags** in ***Ant*** *build.xml* file that can be used in Java source files
  - **fixed Javadoc warnings** in whole project

- ***Worked on a few Capsis software improvements:***
  - add the possibility to **manage** the **tooltip dismiss delay** (Edit > Options > User interface)
  - **ergonomy** of user interface: some little interventions
  - **refactoring**: cleaning, commenting source codes...

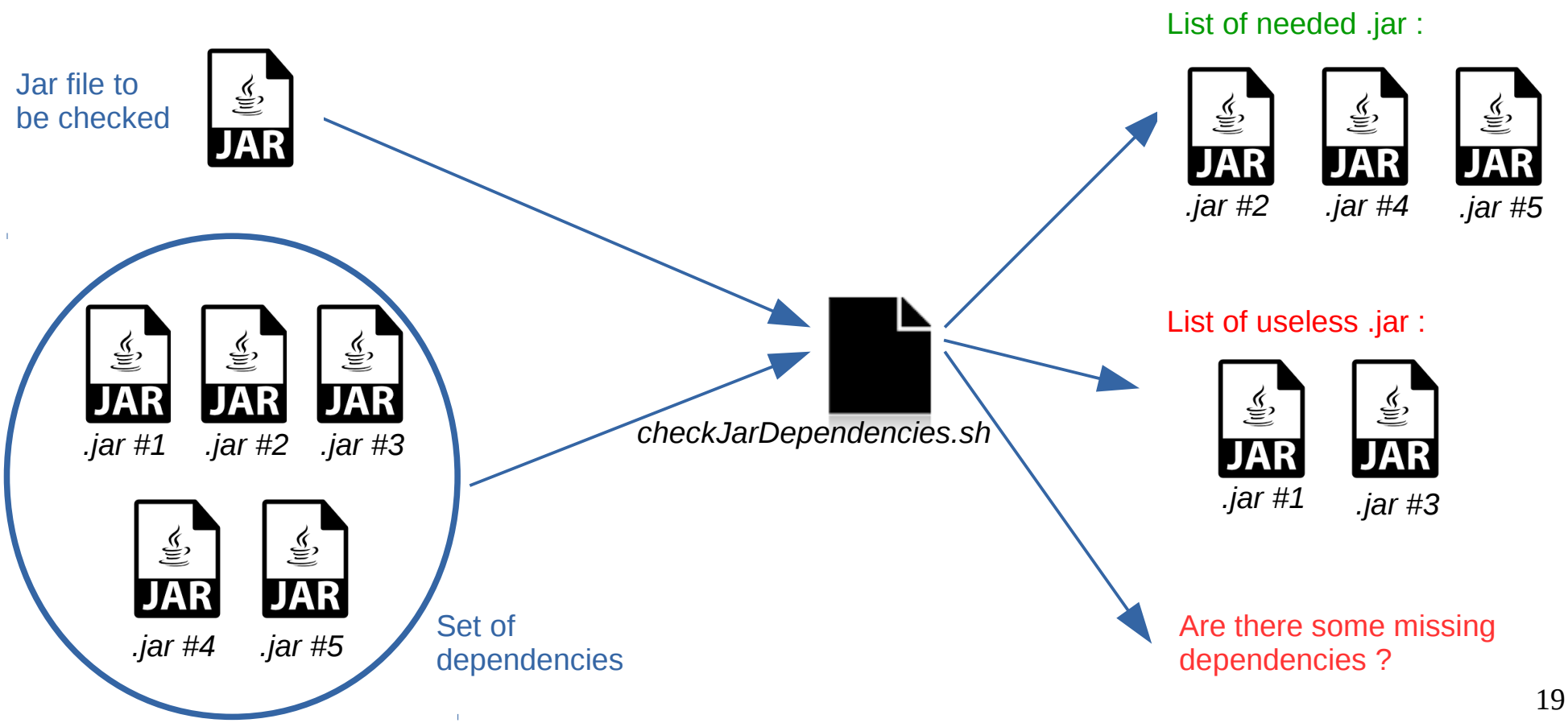
- ***Worked on non-regression tests (beginning)*** : write at least one non-regression test for each model of the project

A new developer for Capsis

What I have done in Capsis project

- ***Created a tool to check dependencies of a jar file (finalization phase)***

Capsis : depends on **jeeb-util.jar** (utilitary made with **AMAPstudio** software's source files)
AMAPstudio : depends on **capsis-kernel.jar** (kernel of **Capsis** software)



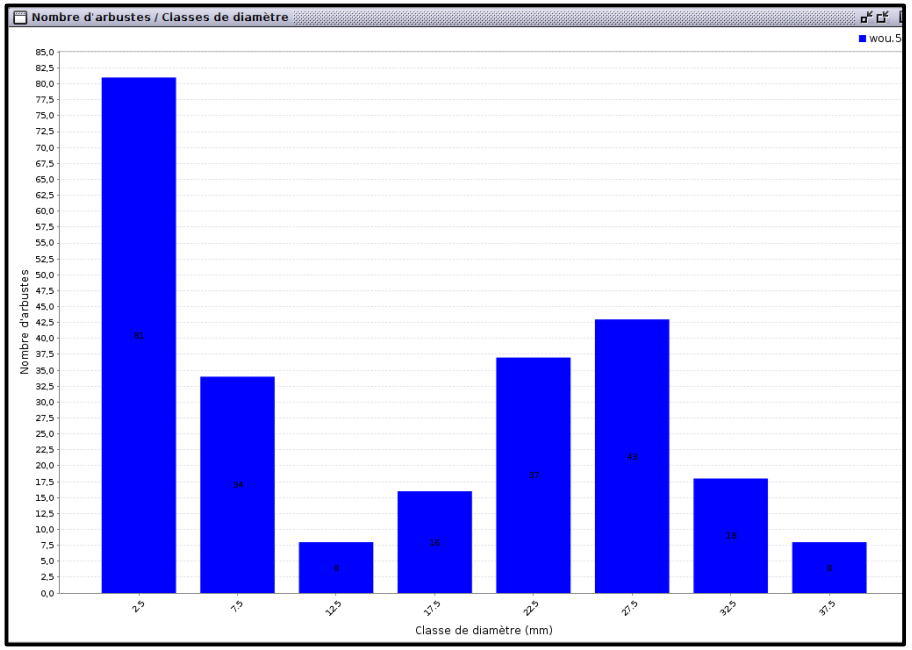
A new developer for Capsis

What I have done in Capsis project

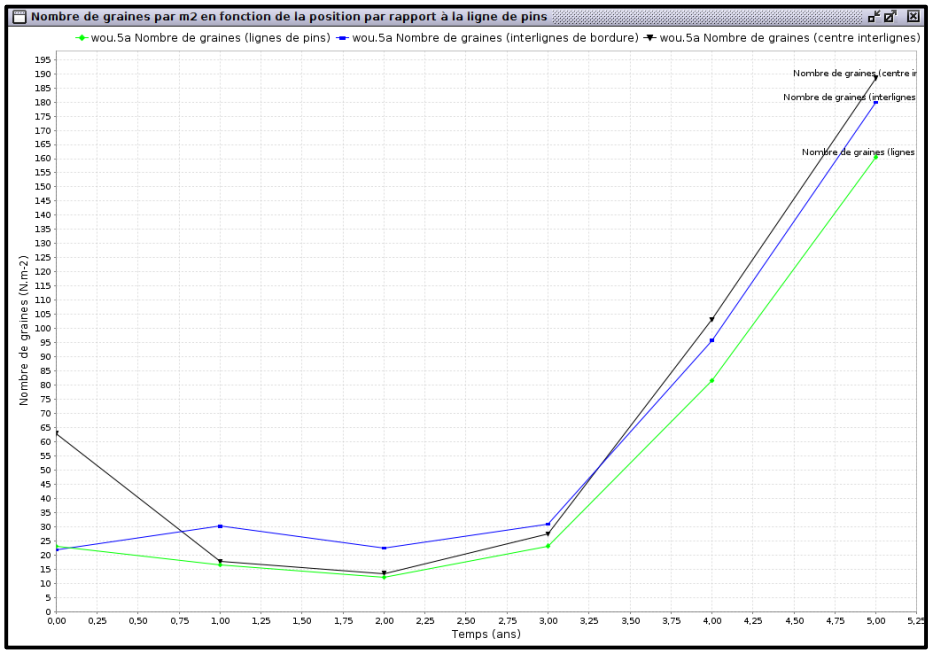
- ***Co-working with modelers :***

  - worked on exports, graphics and stand viewers building *(for different models)*:

  Heterofor (Mathieu Jonard, UCL Belgium)
  Samsara2 (Benoît Courbaud, IRSTEA Grenoble)
  Woudyfor (Florian Delerue)
  ForCEEPS (Xavier Morin, CNRS, UMR CEFE Montpellier)



Woudyfor model : number of shrubs per diameter classes



Woudyfor model : evolution of the number of seeds per m² with time according to pine line position

- worked on implementation of a phenology module in Heterofor model
(Louis de Wergifosse and Mathieu Jonard, UCL Belgium)

Capsis training course 2017 in Avignon

Standard 2-days training course

- by N. Beudez and F. de Coligny
- Java language introduction
- Capsis training course

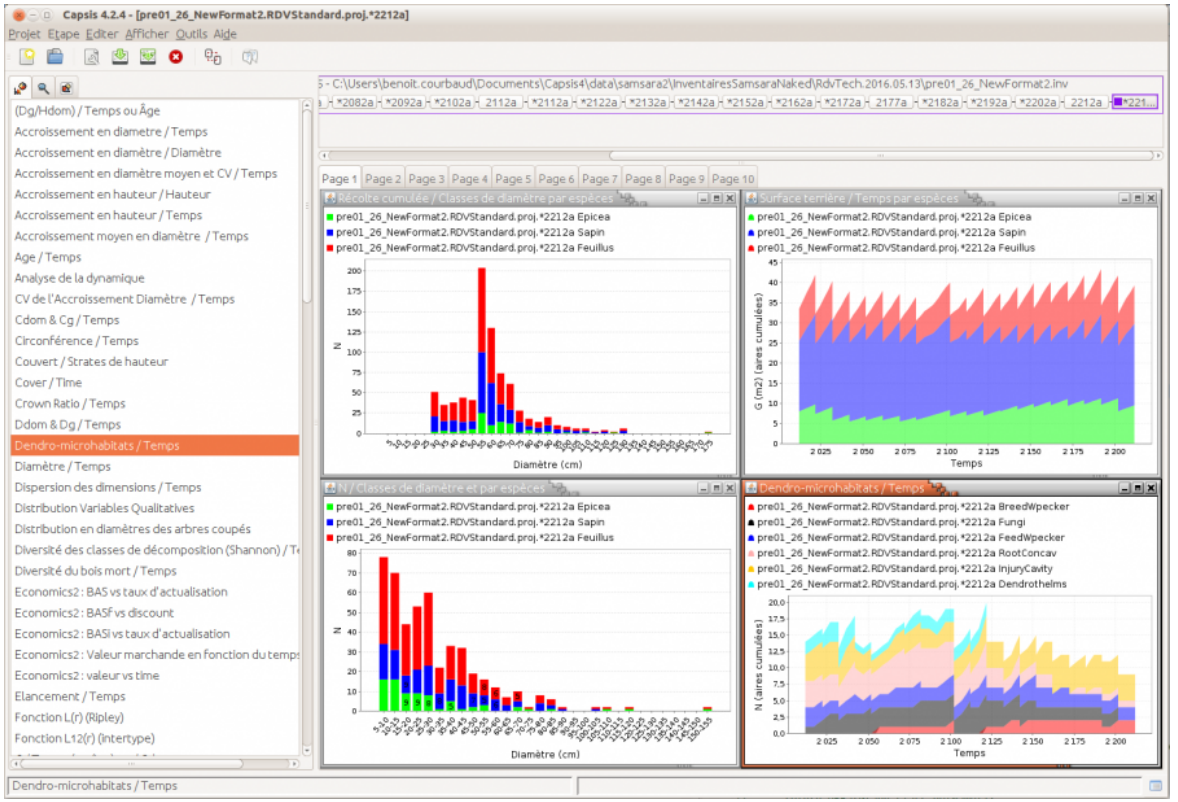
17-18 Januray
-> Avignon URFM
-> for scientists and students of URFM and
Mathieu Jonard's team from UCL, Belgium

Immediately followed by a connection session between **Heterofor** (Mathieu Jonard, Frédéric André, Louis de Wergifosse) and **Castanea** (Hendrik Davi)

And by a 3 days stay in Montpellier for Louis de Wergifosse (Phenology module for Heterofor)

Other

Cumulative areas charts
and cumulative histograms
(with Benoit Courbaud)



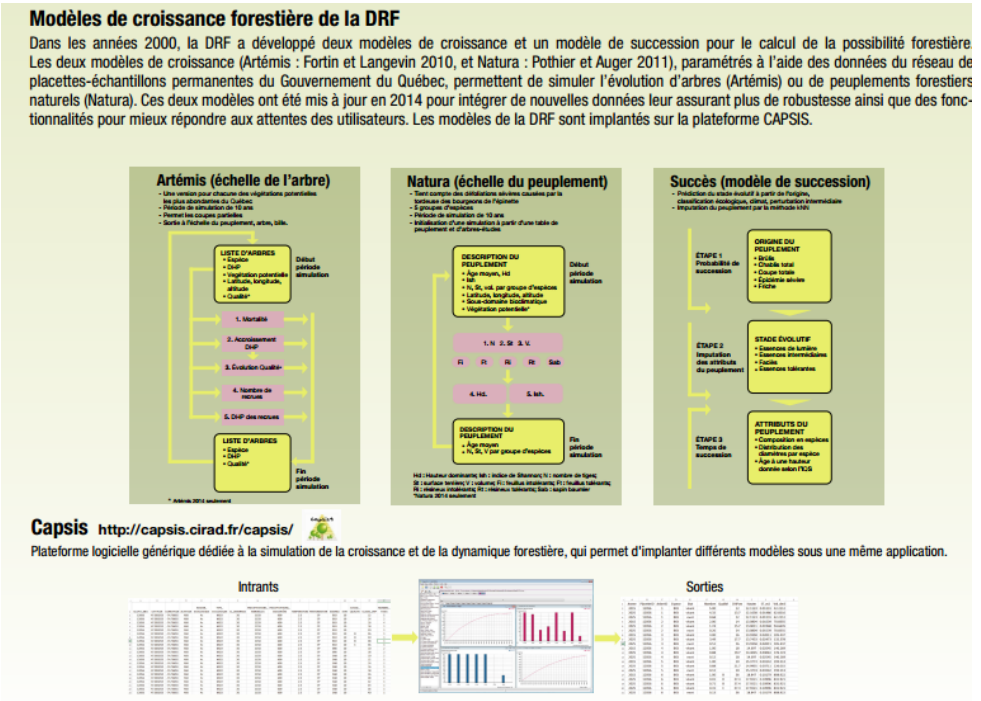
Installers built on Windows and run under
Linux and Mac now work better
(tested under Linux)

Publications

Pimont F., Parsons R., Rigolot E., de Coligny F., Dupuy, J.-L., Dreyfus P., Linn R., 2016. Modeling fuels and fire effects in 3D : model description and applications. **Environmental Modelling and Software** 80, 225-244.

Power H., Auger I., 2016. Modélisation de la croissance forestière à la Direction de la recherche forestière. **Poster**. Ministère des Forêts, de la Faune et des Parcs du Québec.

Extrait



Transfert

Capsis-ONF-2016 distribution - Christine Deleuze, Philippe Dreyfus

-> 25 models distributed to the ONF experts through Capsis

Followed by an **ONF 2-days modelling training**, for the forest managers, with several modellers and focused on :
-> Artemis, Fagacées, Mathilde, Sydy, PP3, Lemoine, ModisPinaster, Organon, Samsara

Conclusions and perspectives

Nicolas Beudez was hired thanks to the INRA EFPA division support :-)

More capacity for the project...

...and a maths competence

Works on tools for the modellers, will become more and more efficient

Pending technical issues are now processed

Methodology is unchanged : co-development with the modellers

More and more connections between projects

Thanks for your attention

Capsis

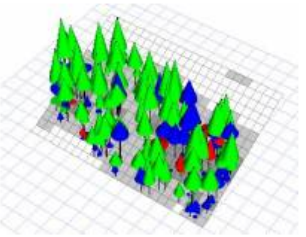
Computer-aided projection of strategies in silviculture

Sitemap Login

- Home
- Presentation
- Download
- FAQ
- Screenshots
- Charter
- Publications
- Documentation
- Projects
- Development
- Contact

Capsis is a simulation platform for forestry growth / dynamics models. It is a tool for forest scientists, forest managers and education. It has been developed in the AMAP laboratory since 1999.

See the Capsis presentation page, download the Capsis brochure (fr) or go to the projects page for a quick overview. Have a look at the documentation page for more details.



Community news

- Florian Delerue (Bordeaux-INP, ENSEGID) spent a week in AMAP to work on the dynamics of his **Woudyfor model**. A focus was made on the plantation patterns and their effect on the shrub management and dynamics. *fc-24.3.2017*
- The **connection of Phenofit5 with the Phelib phenology library** by Isabelle Chuine and Gauthier Boaglio (CNRS-CEFE) was performed last 13-16 March. Phenofit5 can now rely either on the Pheno5 library previously integrated in Capsis, or on the more flexible Phelib library supported by Inaki Garcia, Olivier Maury and David Delannoy (INRA Agroclim Avignon). *fc-20.3.2017*
- The **CAQSIS 2017** meeting will take place in Bordeaux next 28-30 March, hosted by the FCBA. The schedule contains 24 contributions. *fc-16.3.2017*
- Mathieu Jonard (UCL ELI-e, Louvain, Belgium) spent 1 week in AMAP to work on the **Heterofor** model : debugging, added a stand viewer, created exports. *nb-10.03.2017*
- Benoît Courbaud (IRSTEA, Grenoble) spent 3 days to work on the **Samsara2** model : created new graphics. *nb-10.03.2017*
- Marion Jourdan (CNRS, UMR CEFE, Montpellier) spent 1 day in AMAP to create a **sensitivity analysis script** for the **Forceps** model. *nb-20.02.2017*
- Sylvie Oddou Muratorio (INRA, UMR URFM, Avignon) spent 1 day in AMAP to **simplify** and **accelerate processes** in the **PhysioDemoGenetics** model. *nb-17.02.2017*