



# Capsis Project Activity : 2021 - 2022

FOREM 2022 meeting  
22-23 March 2022 - Orléans



Francois de Coligny

INRAE - AMAP

*botany and modelling of plants architecture and vegetations*



INRAE

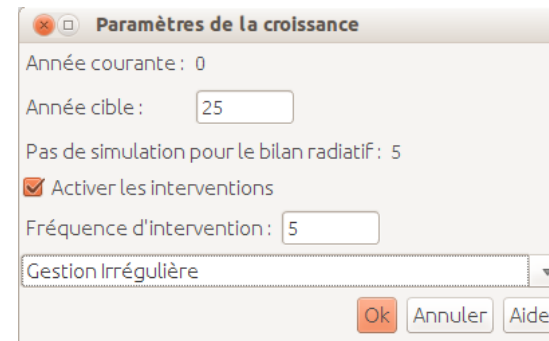
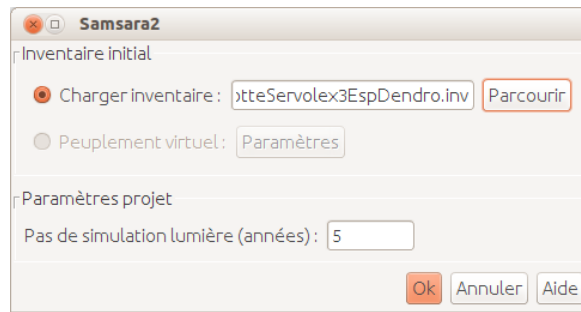


# Capsis objective

Computer-Aided Projections of Strategies In Silviculture

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

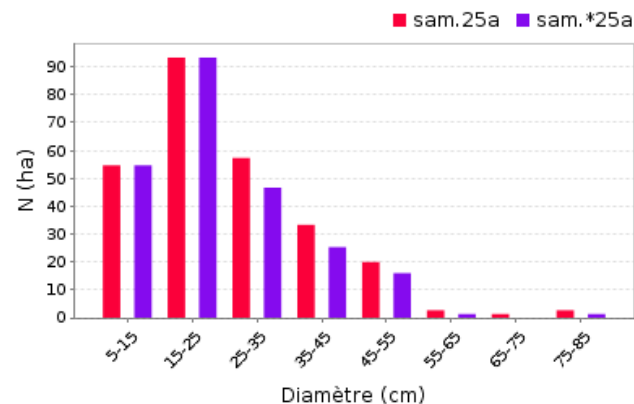
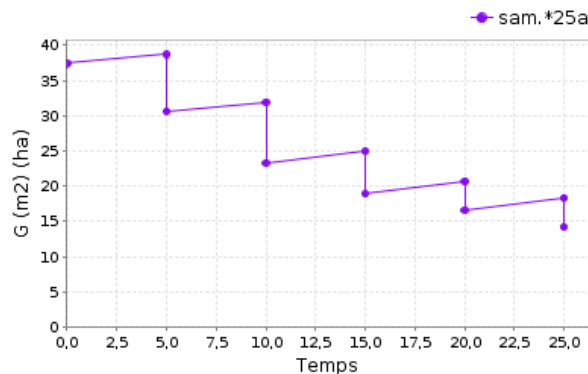
1. initialisation



Projet Samsara2 [sam] - 7500 m2 - Fréquence f=5 - /home/coligny/workspace/capsis4/data/samsara2/LaMotteServolex3EspDendro.inv

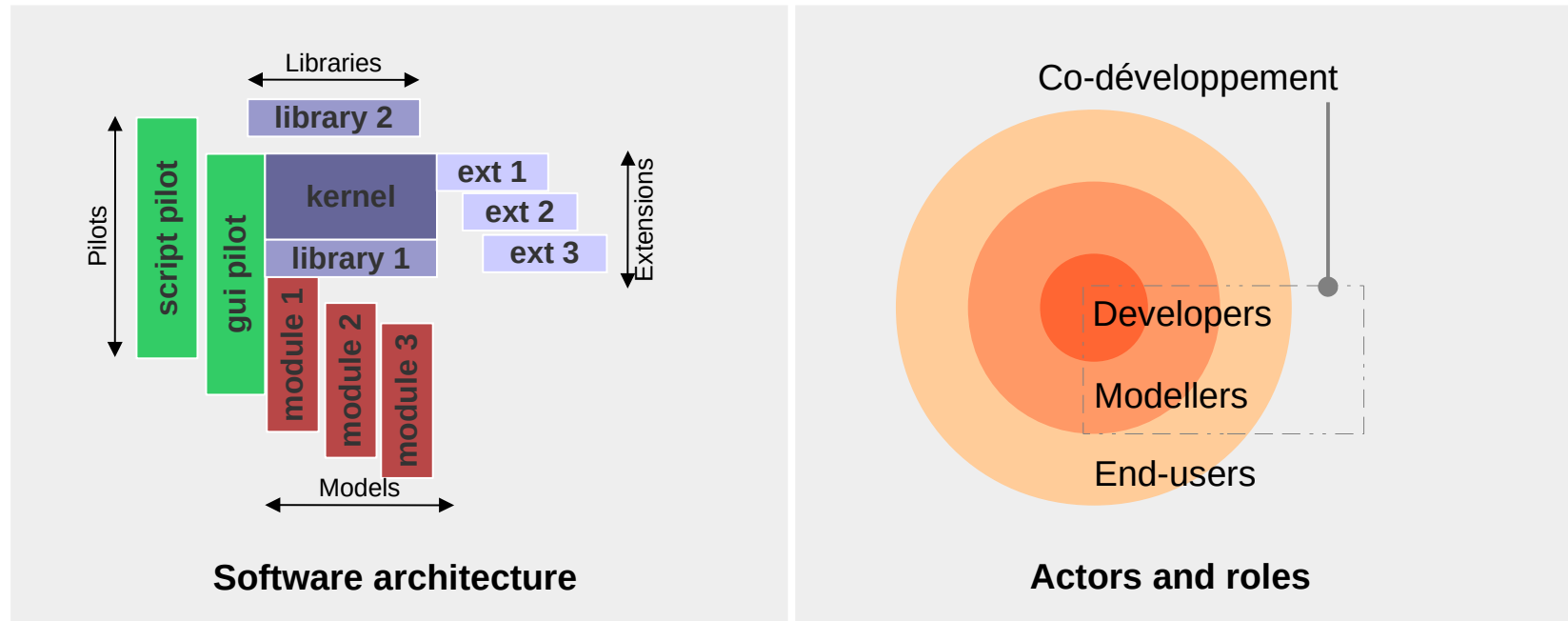
0a - 5a - \*5a - 10a - \*10a - 15a - \*15a - 20a - \*20a - 25a - \*25a




2. growth



export

# A co-development oriented organisation



-   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 property 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 fonctionnal 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 wishes 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)

Or in video conference...

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

Start in 'pair programming' on the same machine  
-> the developer masters 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



# Main activity 2021-2022

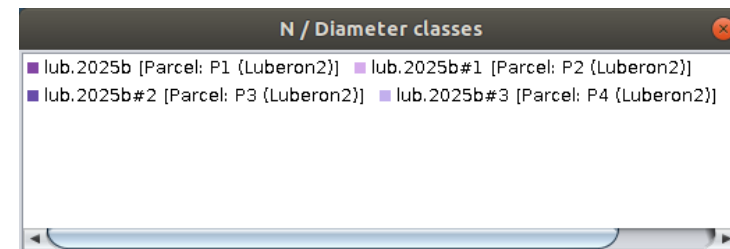
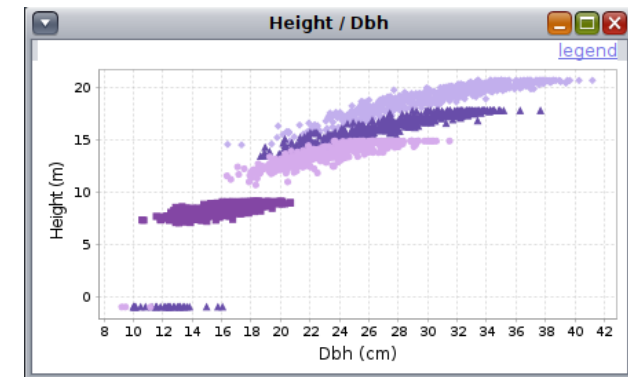
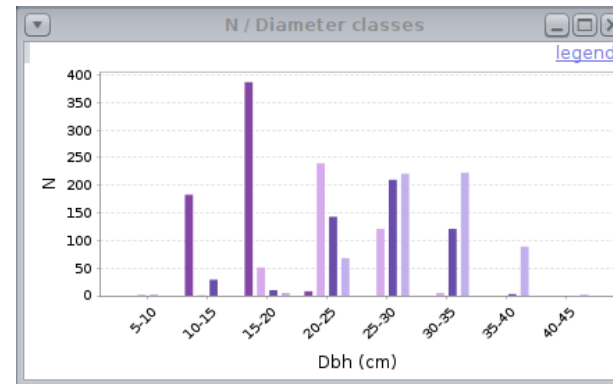
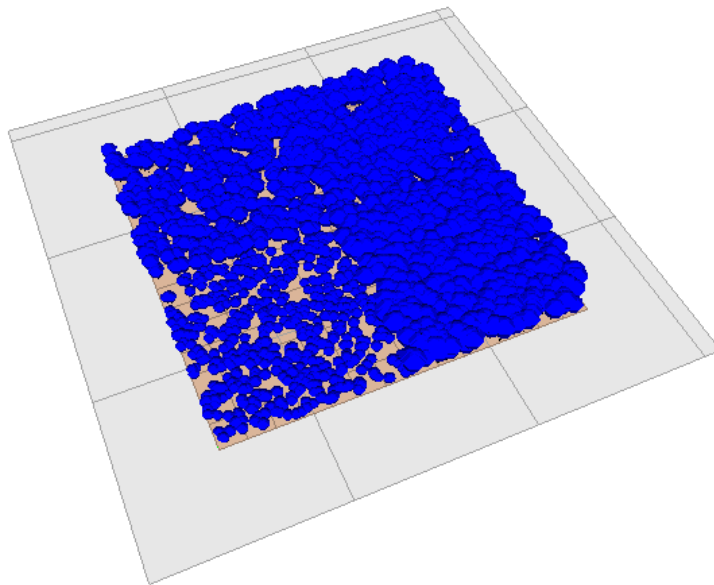
Main actions on existing projects:

- **Luberon2** (Victor Fririon, Francois Lefèvre, INRAE URFM Avignon) (> 16 days)
- **PDGLight** (Camille Rouet, Hendrik Davi, INRAE URFM Avignon)
- **Heterofor** (Arthur Guignabert, Frédéric André, Mathieu Jonard, UCL, Belgium)
- **Sureau / planthydraulics lib** (Nicolas Martin, INRAE URFM Avignon)
- **Samsara2** (Benoit Courbaud, INRAE Lessem Grenoble)
- **Ecoaf** (Frédérique Santi, INRAE Biofora Orléans, Francois Warlop, GRAB Avignon, Fabien Liagre, Agroof Anduze)
- **Forceeps** (Xavier Morin, Freya Way, CNRS CEFÉ Montpellier)
- **Phenofit 4 et 5** (Isabelle Chuine, Victor Van der Meersch, CNRS CEFÉ Montpellier)
- **Ibasam** (Amaia Lamarins, Mathieu Buoro, INRAE Ecobiop, St Pée / Nivelle)
- **C-Stability, SimcopQual** (Julien Sainte-Marie, AgroParisTech Silva Nancy, Thomas Aiguier, INRAE Silva Nancy)
- **Woudyfor** (Florian Delerue, ENSEGID Bordeaux)

## Focus - Luberon2

A distance-dependent tree model for Cedrus with genetics

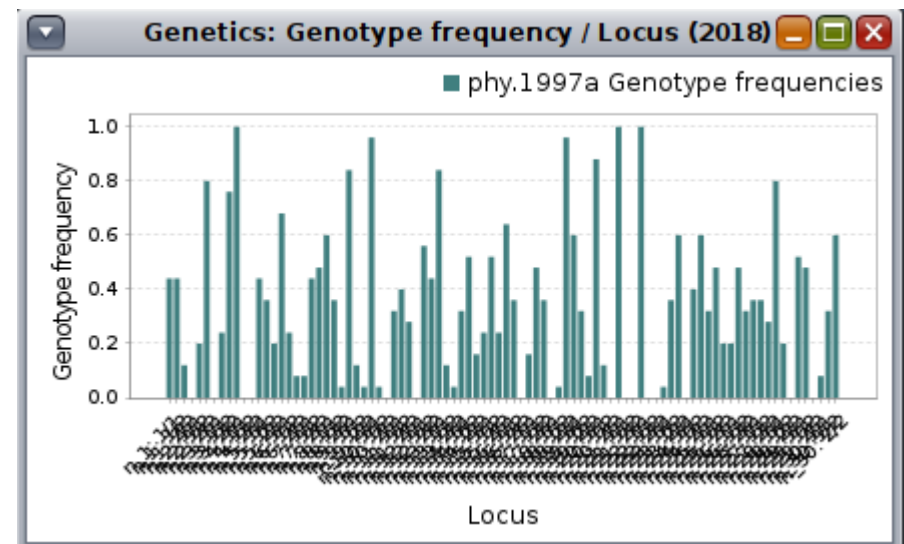
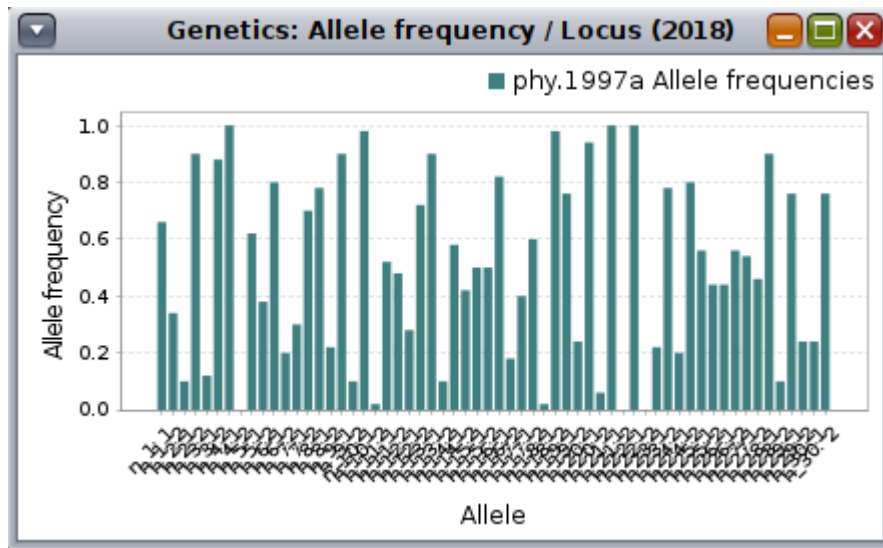
- adapted to accept several species (was Cedrus only)
- **added Douglas** species (from Gymnos, G. Ligot, Gembloux Belgium)
- Hdom, diameter and height growth, regeneration, disturbances...
- new graphs
- adapted Gymnos thinning tools to Luberon2
- species groups auto-creation



## Focus - PDGLight

PhysioDemoGenetics (PDG) aims at studying the genetic adaptation through natural selection driven by climatic variables in a continuous tree population.

- Demography + Castanea + genetics + altitude
- **Adapted PDG to the SamsaraLight** radiative balance
- Implemented Legacy and Tag mode (with the help of Frédéric André) to get details during leaves unfolding and senescence

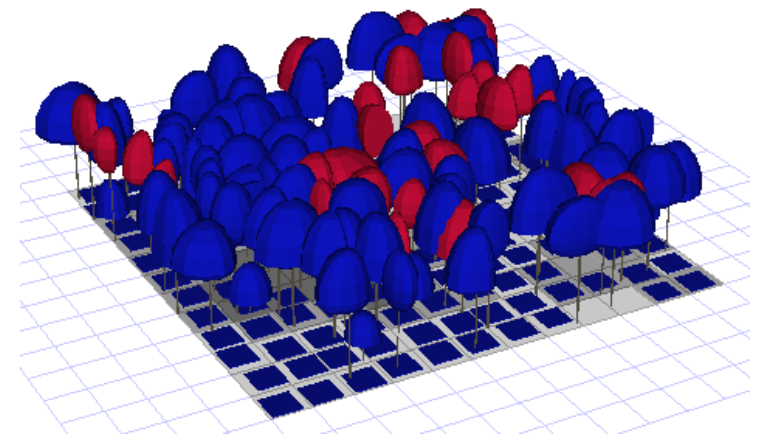
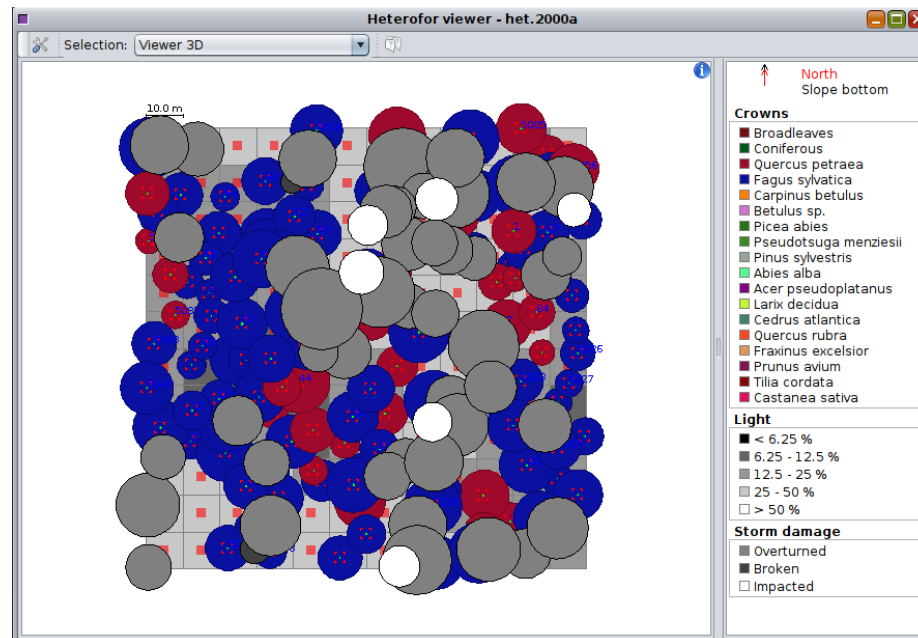




## Focus - Heterofor

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

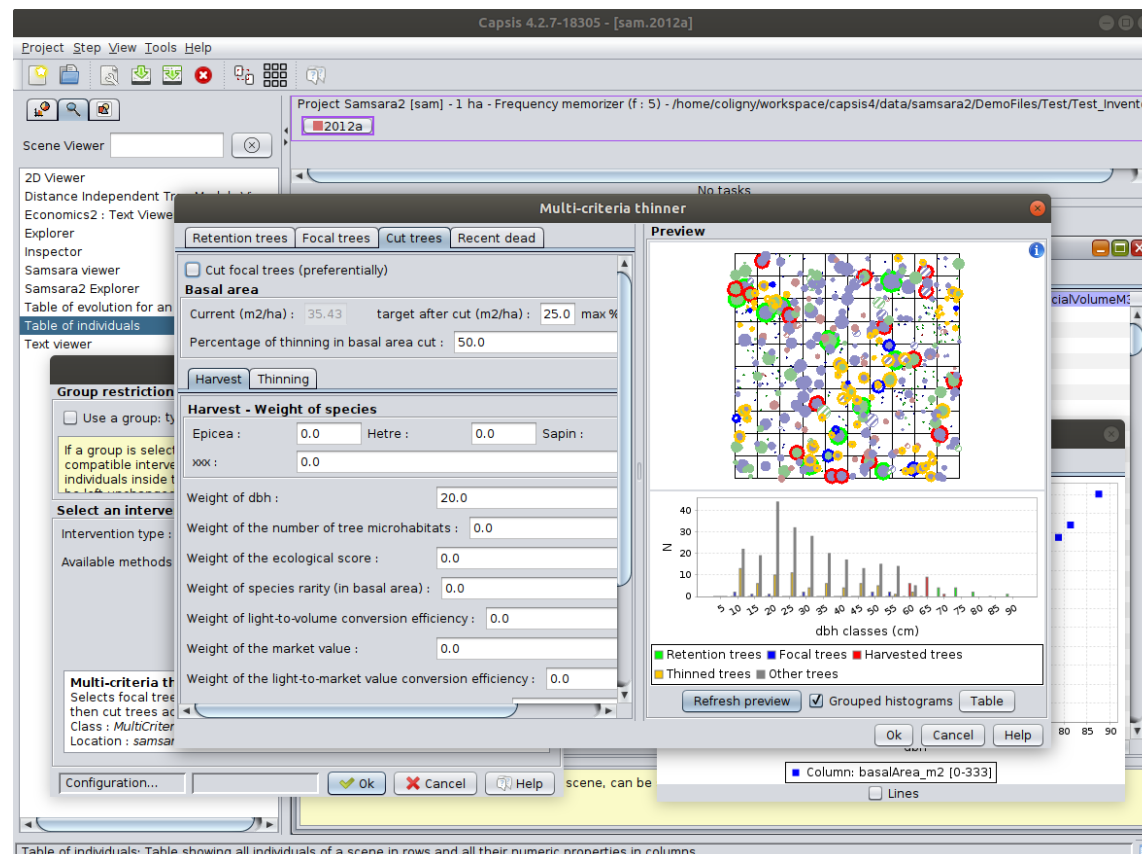
- Added a **ForestGales Tree Level** library (Nicoll et al. 2006)  
`capsis.lib.forestgalestreelevel2022`
- Detect wind gusts from the climate file, with a direction and a strength
- Apply it to the scene, find falling trees (broken or uprooted)
- Report their impact: neighbouring trees may fall too
- Added **ungulate browsing**
- Adapted to the `capsis.lib.regeneration understorey`



## Focus - Samsara2

A Distance-Dependent Tree Model for several mountain species (Spruce, fir, broadleaved...)

- Adapted by Samuel Quevauvillers to the **SamsaraLight library** (now parallel)
- Adapted by Samuel Quevauvillers to the **regeneration library** (Ph. Balandier)
- More features in the **Multi criteria thinner** (harvest / thinning, histograms, more variables...)
- Upgraded the **species id** management, not in sequence any more, more stable



# Focus - Ecoaf

## An Agroforestry model

- Species production over time graph
- Production export
- Possible to run a **SamsaraLight** simulation on a given parcel
- The plot radiative conditions are picked from the **HelioClim / Soda** website

The screenshot displays the Capsis 4.2.7-18305 software interface for the Ecoaf Radiative Balance simulation. The interface is divided into several panels:

- Map Panel (Top Left):** Shows a map of Europe with a search address field and coordinates: `Coord: x = 935, y = 68 | lat = 51.71337, lon = 156.68988 | zoom = 2`.
- Configuration Panel (Middle Left):** Contains settings for the simulation:
  - HelioClim-3 Version: `hc3v5 (recommended)`
  - Add meteo data: `True`
  - Latitude (in [-66°, 66°]): `47.23027`
  - Longitude (in [-66°, 66°]): `1.92697`
  - Altitude (in meters, Automatic if empty): `Automatic`
  - Start date (from 2004-02-01): `20`
  - End Date (up to 2006-12-31): `20`
  - Time Step: `15`
  - Time Reference: `Ur`
  - Compute Relief Shadows (if lat < 60°): `Tr`
- Light map Panel (Middle Right):** Shows a 3D view of a tree plantation with a legend for light on the ground. The legend includes categories: `0-10%`, `10-20%`, `20-30%`, `30-40%`, `40-50%`, `50-60%`, `60-70%`, `70-80%`, `80-90%`, `90-100%`, and `Outside parcel`.
- Light distribution Panel (Bottom Middle):** A bar chart titled "Light on the ground" showing the distribution of light classes. The x-axis represents light classes (%) from 0 to 100, and the y-axis represents the number of individuals (N) from 0 to 1,500. The chart shows a peak in the 90-100% range.

# Recent Features in Capsis

Plot the tables content

From stand viewers...

Table of individuals - eco.2015a

id	dbh	girth_mm	height
8752	35.48	1114.78	
8753	38.45	1208.06	
8754	34.64	1088.31	
8755	35.16	1104.73	
8756	36.26	1139.22	
8757	27.82	873.9	
8758	24.18	759.66	
8759	39.46	1239.59	
8760	45.6	1432.47	
8761			

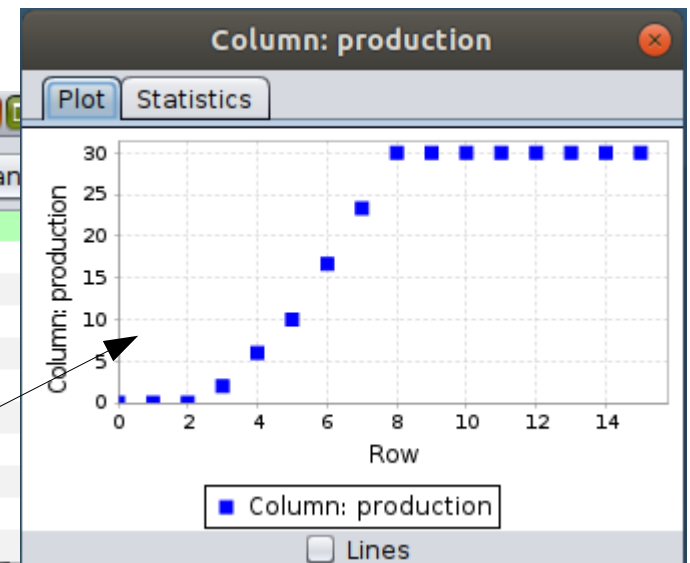
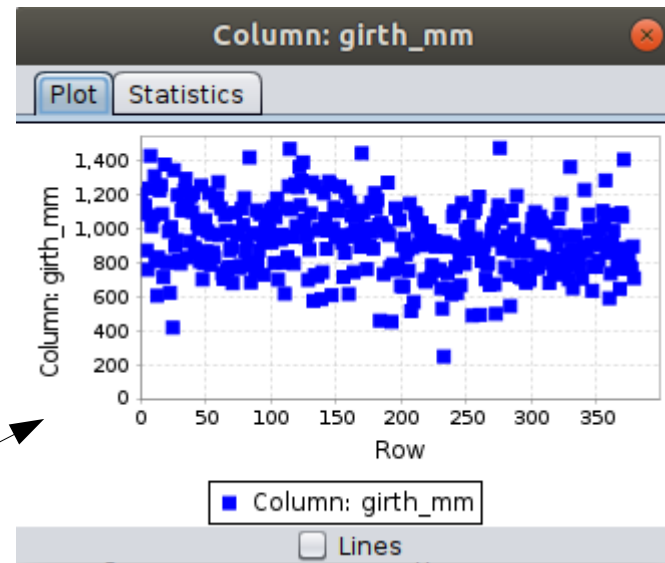


Table of evolution for an individual - eco.2015a

Id of the individual : 1

date	antation	production
2000	0	0
2001	1	0
2002	2	0
2003	3	2
2004	4	6
2005	5	10
2006	6	16.67
2007	7	23.33
2008	8	30
2009	9	30

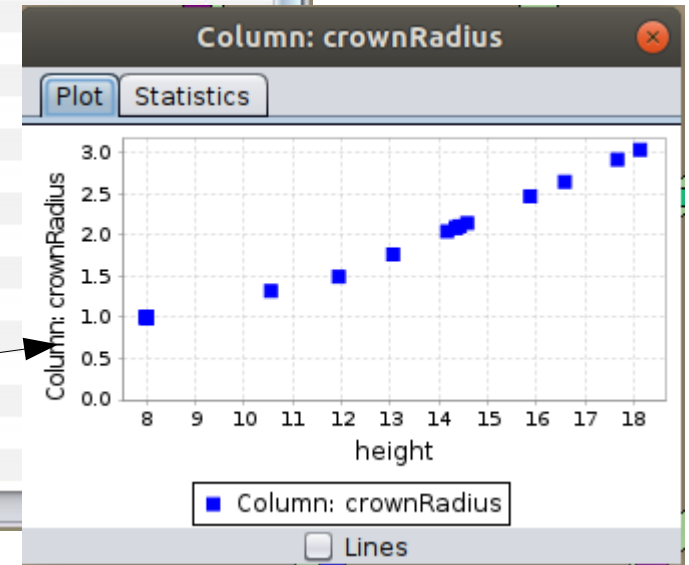
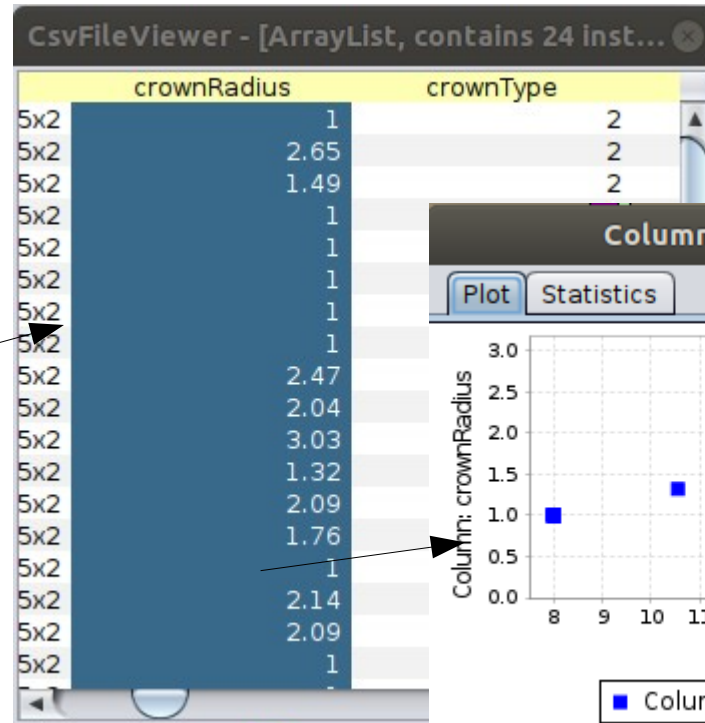
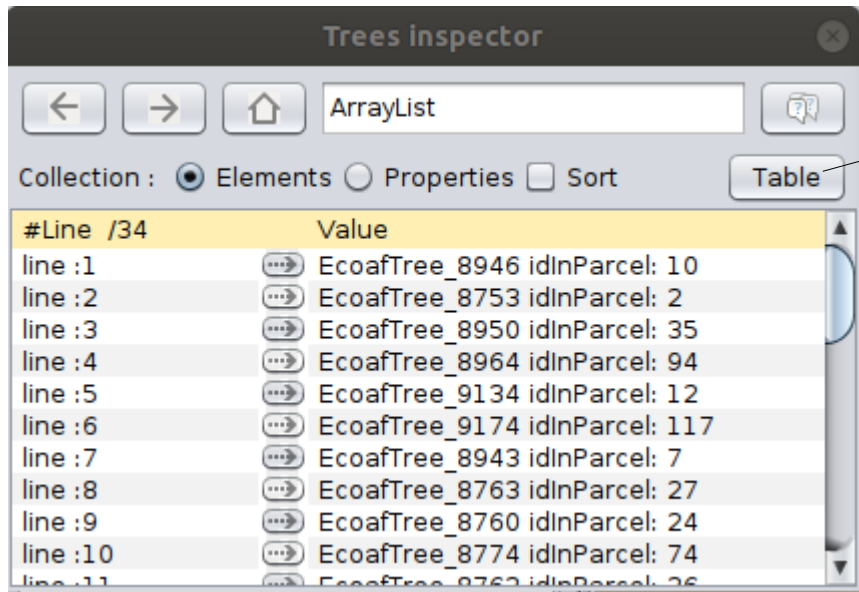
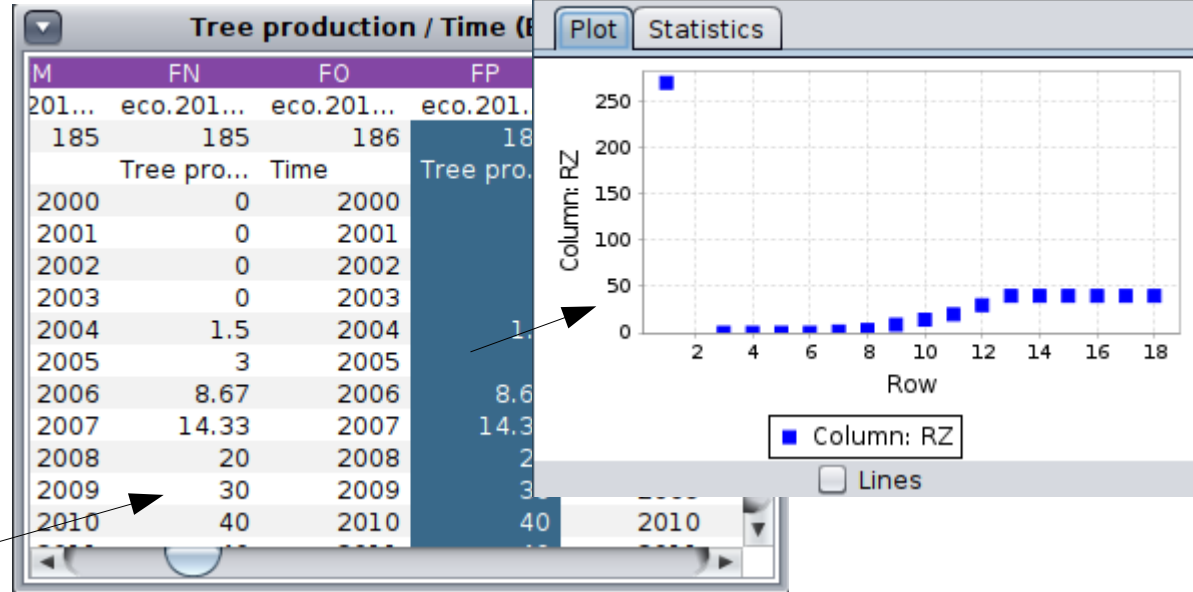
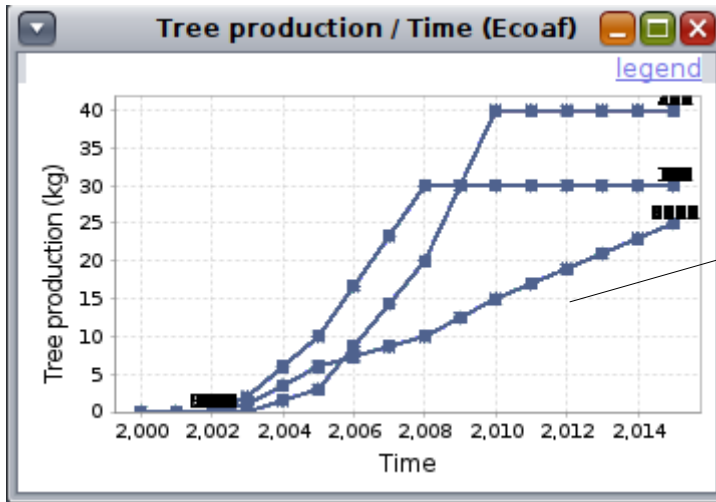
Numeric properties of a right-click to plot

Evolution of the numeric properties of one individual (id) over time, can be sorted, right-click to plot

# New Features in Capsis

Plot the tables content

From graphs and lists in inspectors...





# Capsis web site upgrade

Upgrade required for security reasons -> https://

- A new version of Dokuwiki
- Restored access with the 'Capsis login' (Redmine login data base)
- Moved to a new Cirad virtual machine (no change for users)
- With the key help of Philippe Verley (IRD AMAP)

Logged in as: François de Coligny (coligny) [Admin](#) [Log Out](#)

Search

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- [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](#) or [the Capsis impacts 10 minutes video \(fr\)](#) for more details.

## Community news

- The **2022 Capsis training in video conference** took place last 8-9 March with 9 attendants. *fc-11.3.2022*
- **The next FOREM seminar will take place next 22-23 March in Orleans.** The participants will be hosted by the BioforA lab. *fc-8.3.2022*
- Arthur Guignabert (UCL, Belgium) spent a week to co-develop a wind risk tool for Heterofor, based on the **ForestGALES-TMC tree level method** by Sophie Hale (Forest Research, [GB](#)) and Barry Gardiner (INRAE ISPA). *fc-17.2.2022*
- The **Capsis ONF 2021 installer for ONF internal use has been packaged** and distributed by Christine Deleuze (ONF RDI). It contains 25 models with the permission of their authors: Abial, Artemis, CA1, Castaneaonly, Economics, Fagacees, Forceps, Gymnos, Heterofor, Laricio, Lemoine, Luberon2, Mathilde, ModisPinaster, Oakpine 1 and 2, Picea-abies, Pseudotsuga menziesii, PP3,

AMAP  
cirad  
CNRS  
INRAE

# Capsis Training Sessions

8-9 March 2022 : 9 people  
 Online supports and exercises  
 Video conference mode



**Capsis**  
 Computer-aided projection of strategies in silviculture

- Home
- Presentation
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- FAQ
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- Charter
- Publications
- Documentation
- Projects
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## The Capsis training online

fc-January 2021

This is an online version of the supervised exercises within the Capsis training, built to better fit the training by video conference.

**Note:** this training online material is part of the annual session of the Capsis training course, for registered modelers or students.

## Installation, video links and organisation

Before d-day, please see the installation section below:

- 0. Installation

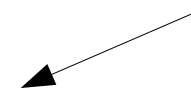
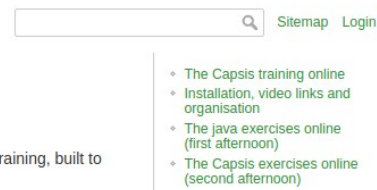
On d-day, video conference links (will be updated):

- **Foxtrot** video (Francois), click or copy this link in your browser: <https://meet.google.com/quf-jrru-uxw>
- **Papa** video (Philippe) click or copy this link in your browser: <https://meet.google.com/ces-eznb-mbi>
- **Golf** shared document (Google Doc) editable by all (hopefully) [click here](#)

In the morning, **everybody connects to the Foxtrot** video conference for the courses. In the afternoon, we will start on Foxtrot, then some may switch to Papa.

**Problems:**

- I'm lost, I don't remember where to go... → go to the Foxtrot video link upper, will always stay open (hopefully)
- I can not connect to this video link
  - try with **another browser** (Chrome, Firefox...)
  - try **from your phone** (if it is smart enough), you might join us this way and you could download the presentation pdfs on your computer to follow the courses

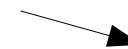


## The java exercises online (first afternoon)

1. Create a minimal program
2. Create a Tree class
3. Create a SpatializedTree class
4. Add instance variables in the tree
5. Add methods in the tree
6. Write a method to create a list of trees
7. Write the trees in a file
8. Pass parameters on the command line

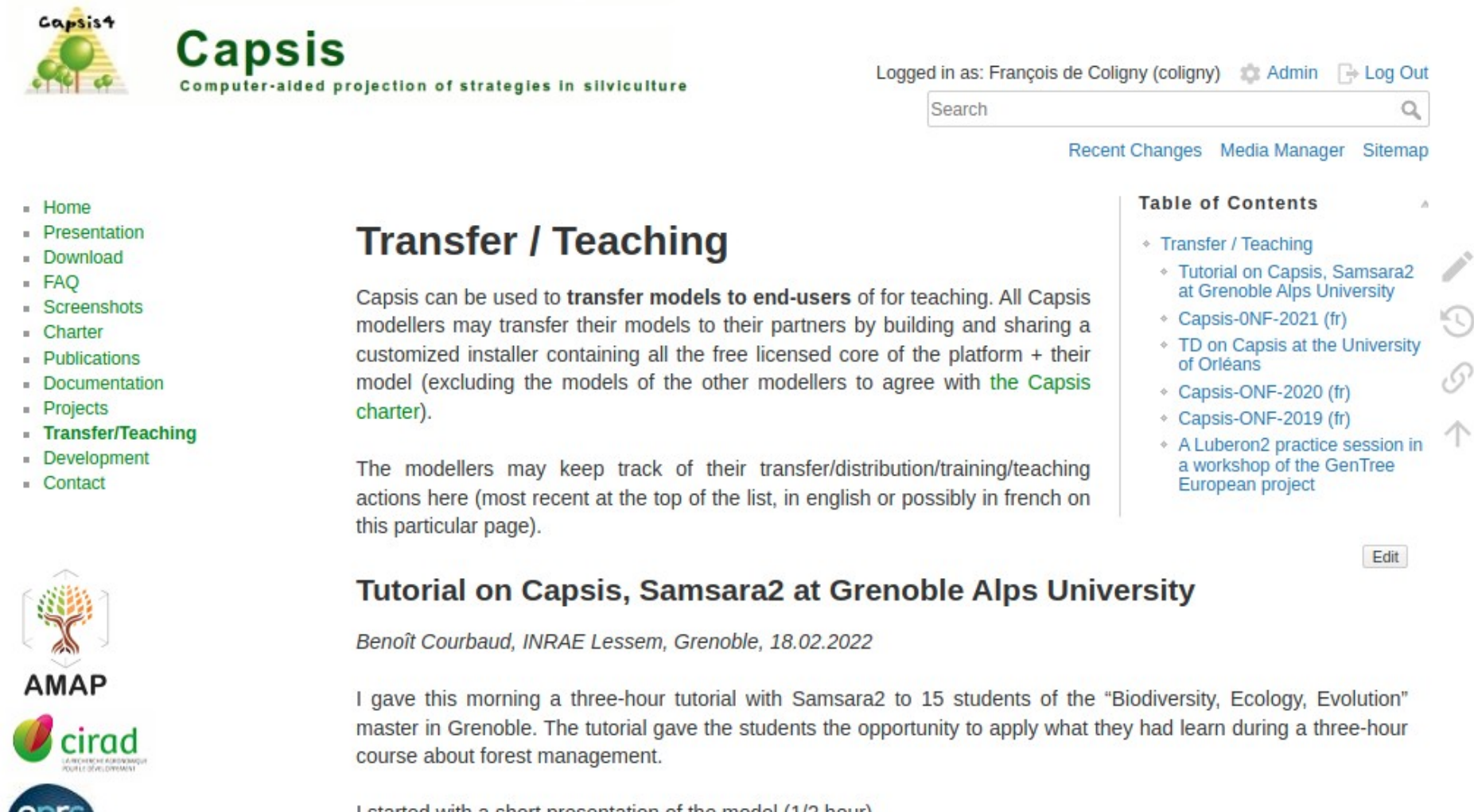
## The Capsis exercises online (second afternoon)

10. Create a new module in Capsis called training
11. Random regeneration
12. Mortality
13. Add a geometrical plot made of square cells
14. Make a graph: N / Time
15. Script
16. Regeneration around the mothers



# Transfer 1/2

The Capsis transfer page : <https://capsis.cirad.fr/capsis/transfer>



The screenshot shows the Capsis website interface. At the top left is the Capsis logo with the tagline "Computer-aided projection of strategies in silviculture". On the right, it shows the user is logged in as "François de Coligny (coligny)" with links for "Admin" and "Log Out". A search bar is present. Below the navigation menu, the main heading is "Transfer / Teaching". The text explains that Capsis can be used to transfer models to end-users for teaching, and that modellers can track their transfer actions on this page. A "Table of Contents" sidebar on the right lists various transfer activities, including a tutorial at Grenoble Alps University. At the bottom left, logos for AMAP, cirad, and forem are visible.

**Capsis**  
Computer-aided projection of strategies in silviculture

Logged in as: François de Coligny (coligny) [Admin](#) [Log Out](#)

Search

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## Transfer / Teaching

Capsis can be used to **transfer models to end-users** of for teaching. All Capsis modellers may transfer their models to their partners by building and sharing a customized installer containing all the free licensed core of the platform + their model (excluding the models of the other modellers to agree with [the Capsis charter](#)).

The modellers may keep track of their transfer/distribution/training/teaching actions here (most recent at the top of the list, in english or possibly in french on this particular page).

### Tutorial on Capsis, Samsara2 at Grenoble Alps University

*Benoît Courbaud, INRAE Lessem, Grenoble, 18.02.2022*

I gave this morning a three-hour tutorial with Samsara2 to 15 students of the "Biodiversity, Ecology, Evolution" master in Grenoble. The tutorial gave the students the opportunity to apply what they had learn during a three-hour course about forest management.

I started with a short presentation of the model (1/2 hour)

#### Table of Contents

- Transfer / Teaching
  - Tutorial on Capsis, Samsara2 at Grenoble Alps University
  - Capsis-ONF-2021 (fr)
  - TD on Capsis at the University of Orléans
  - Capsis-ONF-2020 (fr)
  - Capsis-ONF-2019 (fr)
  - A Luberon2 practice session in a workshop of the GenTree European project

Edit

AMAP

cirad  
LA RECHERCHE AGRICOLE POUR LE DEVELOPPEMENT

forem



## Transfer 2/2



### The **Capsis-ONF-2021** distribution

- packaged by Christine Deleuze (ONF RDI) in January 2022
- **25 modules in 2021** : abial, artémis, CA1, castaneaonly, economics, fagacees, forceps, gymnos, heterofor, laricio, lemoine, luberon2, mathilde, modispinaster, oakpine 1 et 2, picea-abies, pseudotsuga menziesii, pp3, regix, salem, samsara2, sydy, sylvestris and simcop



**Direction Forêt et Risques Naturels – Département RDI**

Tel : 06 10 33 10 47, Mél : [christine.deleuze@onf.fr](mailto:christine.deleuze@onf.fr)

Objet :	 <b>CR d'installateur Capsis ONF 2021 version 4.2.6</b>
Date :	31 janvier 2022
Rédacteur :	 Christine Deleuze
Destinataires :	DFRN-RDI, Thierry Sardin, Médéric Aubry, Fabrice Coq, Marie-Claire Maréchal, Anna Schmitt, Paul Del-Rey, Stéphane Dumas, Francis Maugard, Denis Feuillerat, Pauline Delord, Sébastien Laguet, tous les développeurs CAPSIS participants et François de Coligny !

Dossier partagé : PartageRDI\04-Outils\06-Capsis\Capsis\_ONF2021

# Publication

## The Capsis Publication page, 2022, extract :

Delalandre L., Gaüzère P., Thuiller W., Cadotte M., Mouquet N., Mouillot D., Munoz F., Denelle P., Loiseau N., Morin X. and Violle C. **2022**. Functionally distinct tree species support long-term productivity in extreme environments. **Proc. R. Soc. B.** 289:20211694 <http://doi.org/10.1098/rspb.2021.1694>

de Wergifosse, L., André F., Goosse, H., Boczon, A., Cecchini, S., Ciceu, A., Collalti, A., Cools, N., D'Andrea, E., De Vos, B., Hamdi, R., Ingerslev, M., Alban Knudsen, M., Kowalska, A., Leca, S., Matteucci, G., Nord-Larsen, T., GM Sanders, T., Schmitz, A., Termonia, P., Vanguelova, E., Van Schaeybroeck, B., Verstraeten, A., Vesterdal, L., Jonard, M., **2022**. Simulating tree growth response to climate change in structurally diverse oak and beech forests. **Science of The Total Environment**, Volume 806, Part 2, ISSN 0048-9697, <https://doi.org/10.1016/j.scitotenv.2021.150422>.

Aussenac R., Pérot T., Fortin M., de Coligny F., Monnet J-M., Vallet P. **2021**. The Salem simulator version 2.0: a tool for predicting the productivity of pure and mixed forest stands and simulating management operations. **Open Research Europe 2021**, 1:61, accepted (<https://open-research-europe.ec.europa.eu/articles/1-61>)

André, F., de Wergifosse, L., de Coligny, F., Beudez, N., Ligot, G., Gauthray-Guénét, V., Courbaud, B., Jonard, M., **2021**. Radiative transfer modeling in structurally-complex stands: towards a better understanding of parametrization. **Annals of Forest Science**, (2021) 78:92, <https://doi.org/10.1007/s13595-021-01106-8>, view

Jourdan, M., Cordonnier, T., Dreyfus, P., Riond, C., de Coligny, F., Morin, X, **2021**. Managing mixed stands can mitigate severe climate change impacts on French alpine forests. **Regional Environmental Change**, Springer Verlag, 2021, 21 (3), (10.1007/s10113-021-01805-y). (hal-03349111)

Costa, P., Cerveira, A., Kašpar, J., Marušák, R., Fonseca, T.F. **2021**. Forest Management of Pinus pinaster Ait. in Unbalanced Forest Structures Arising from Disturbances—A Framework Proposal of Decision Support Systems (DSS). **Forests** 2021, 12, 1031. <https://doi.org/10.3390/f12081031>

Cochard, H., Pimont, F., Ruffault, J., Martin-StPaul, N. **2021** . SurEau: a mechanistic model of plant water relations under extreme drought. **Annals of Forest Science** 78, 55 (2021). <https://doi.org/10.1007/s13595-021-01067-y>

Serrano-León H, Ahtikoski A, Sonesson J, Fady B, Lindner M, Meredieu C, Raffin A, Perret S, Perot T, Orazio C, **2021**. From genetic gain to economic gain: simulated growth and financial performance of genetically improved Pinus sylvestris and Pinus pinaster planted stands in France, Finland and Sweden. **Forestry: An International Journal of Forest Research**. <https://doi.org/10.1093/forestry/cpab004>

# Conclusions

- A request to replace Nicolas Beudez has been resent
- Continuing work in video conference with the modellers on a routine basis, 2 to 4 days per week
- Video training with online support for the exercises

Thanks for your attention

