



# Capsis Project Activity : 2022 - 2023

FOREM 2023 meeting  
9-11 May 2023 - Grenoble



Francois de Coligny

INRAE - AMAP

*botany and modelling of plants architecture and vegetations*



INRAE

IRD Institut de Recherche  
pour le Développement  
FRANCE

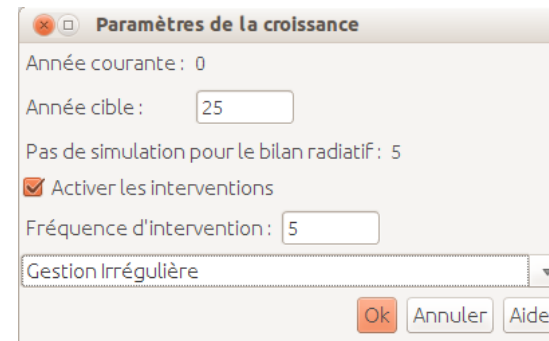
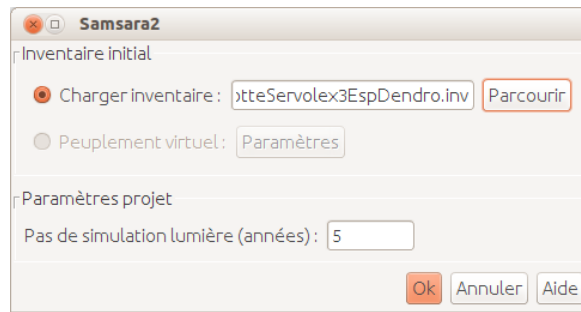


# Capsis objective

## Computer-Aided Projections of Strategies In Silviculture

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

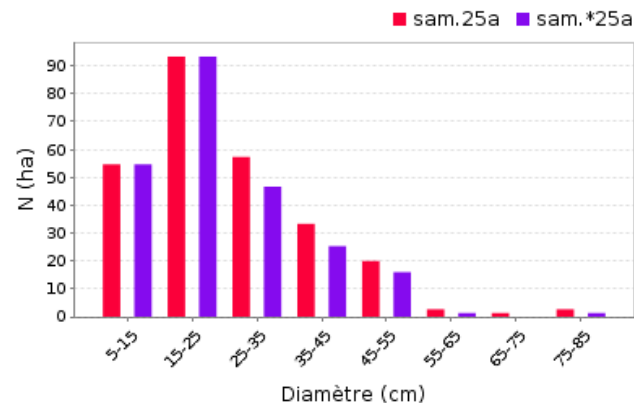
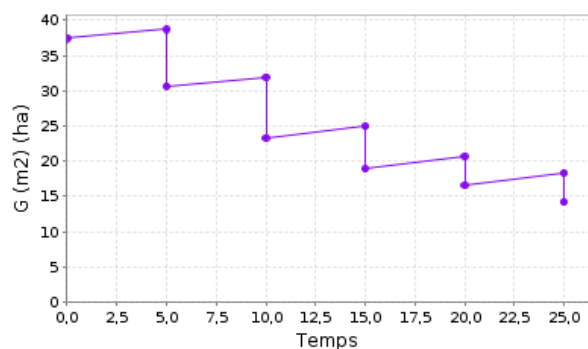
1. initialisation



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

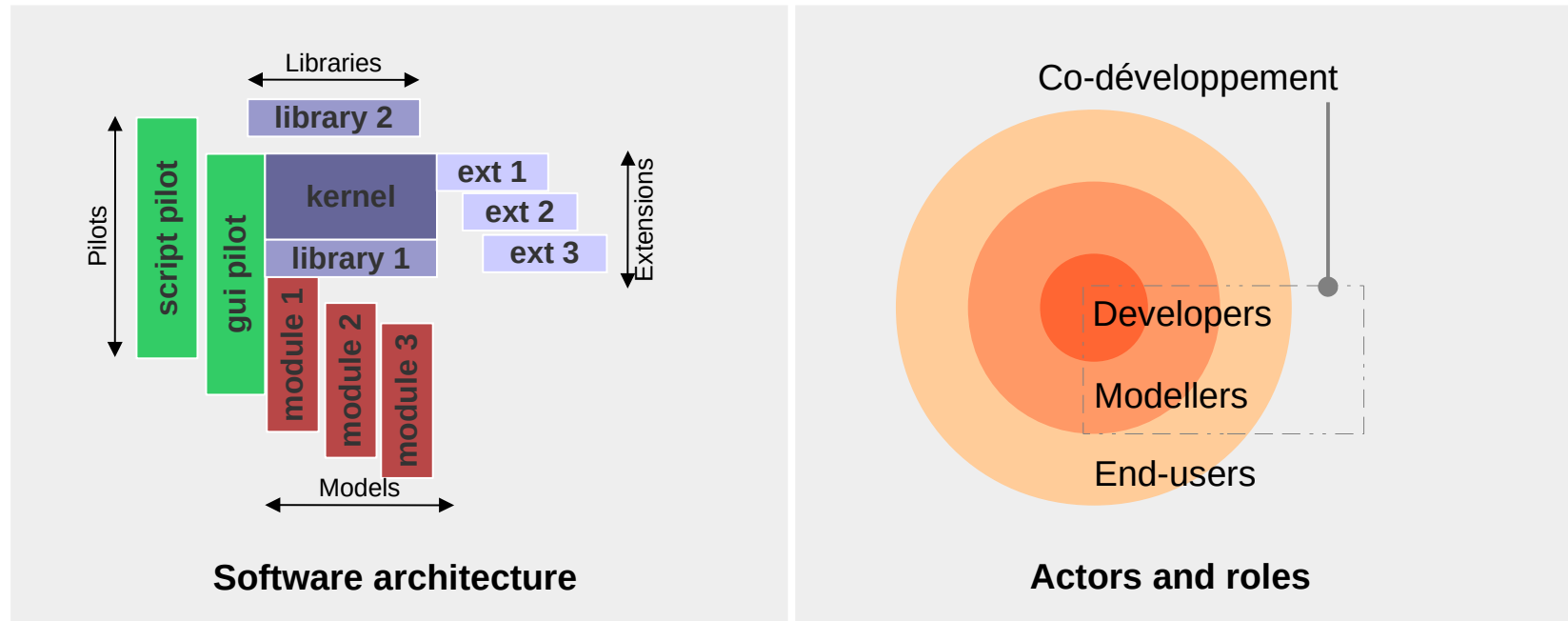
0a - 5a - \*5a - 10a - \*10a - 15a - \*15a - 20a - \*20a - 25a - \*25a




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 2022-2023

Between 5 and 30 days each...

New project :

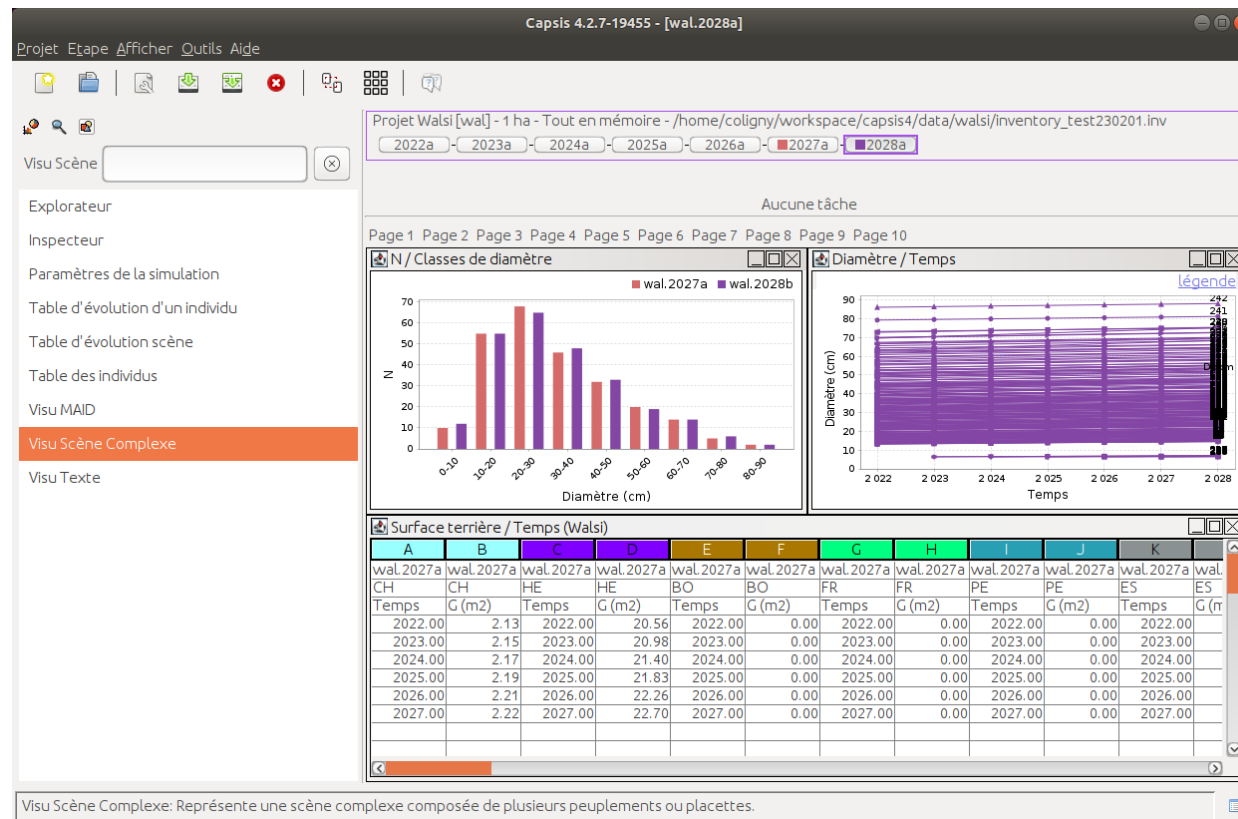
- **Walsi** : Violette Van Keymeulen, Gauthier Ligot (U Liège Gembloux, Belgium)

Main actions on existing projects:

- **Fissa project : Forceps-Sureau-Phenofit** : Nicolas Martin (INRAE URFM Avignon), Tanguy Postic, Xavier Morin (CNRS CEFE Montpellier)
- **Ecoaf** : Frédérique Santi (INRAE Biofora Orléans), Fabien Liagre, Pierrick Gouhier, Ambroise Martin-Chave, Camille Beral (Agroof Anduze), Gauthier Ligot (U Liège Gembloux, Belgium)
- **Samsara2** : Benoit Courbaud, Nathéo Beauchamp (INRAE Lessem Grenoble)
- **Forceps regional scale** : Louis Devresse, Xavier Morin (CNRS CEFE Montpellier)
- **Phenofit4-5** : Florence Tauc, Alexandre Granier, Isabelle Chuine (CNRS CEFE Montpellier)
- **Ibasam** : Amaia Lamarins, Mathieu Buoro (INRAE Ecobiop, St Pée / Nivelles)
- **Luberon2** : Victor Fririon, Francois Lefèvre (INRAE URFM, Avignon)
- **Heterofor** : Arthur Guignabert, Matt Willecome, Frédéric André, Mathieu Jonard (UCL, Louvain la Neuve, Belgium)

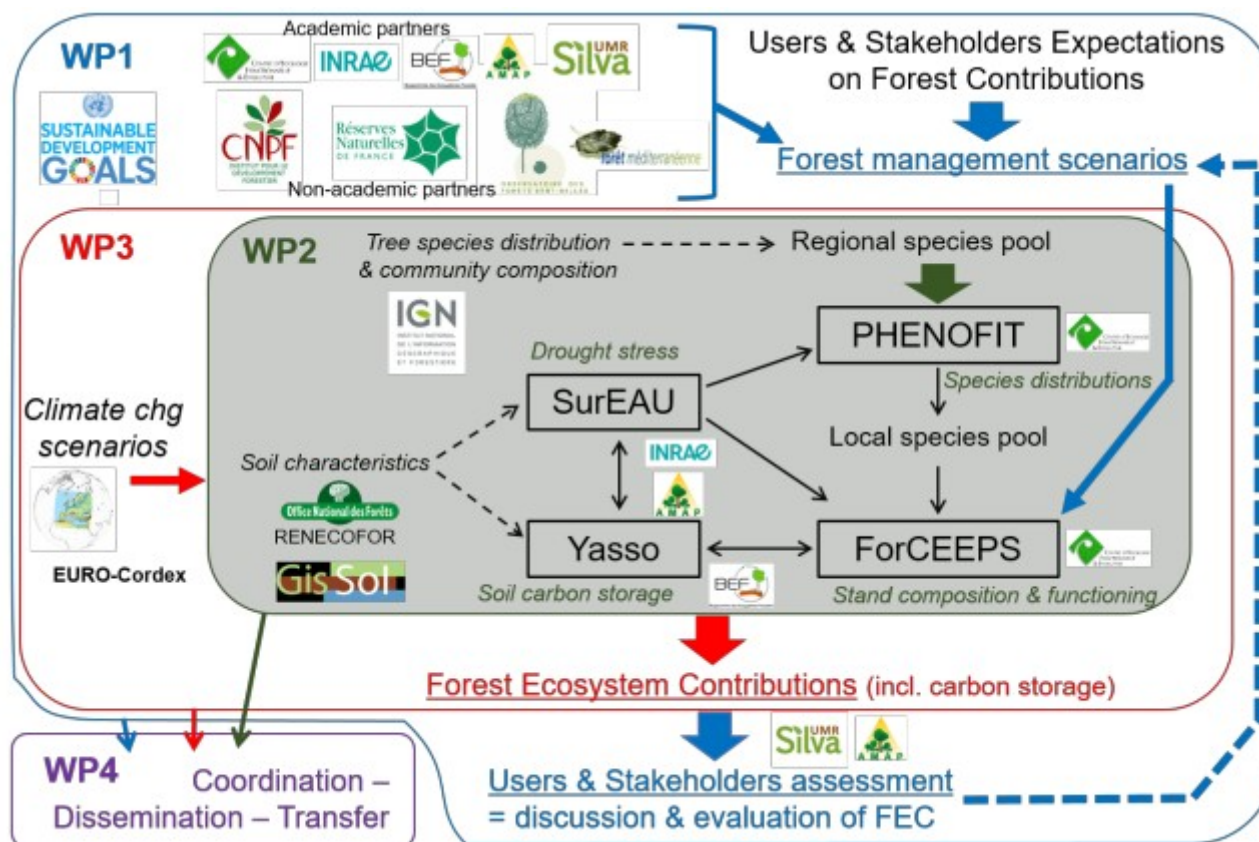
# Walsi - A stand growth model for Wallonia forests

- An individual based distance independant tree model (several species)
- Growth based on SIMREG by Jérôme Perin, Mikhail Pitchugin, Gauthier Ligot (ULiege Gembloux) : a non-deterministic tree-level distance independent forest model that can simulate forest growth, yield and management on a regional scale while representing the wide diversity of composition, structure and management found in forest stands.
- Uses mortality by Nathéo Beauchamp (INRAE Lessem, Grenoble)
- Multi-species recruitment process
- Objective : build a regional level simulator based on Walsi



## FISSA - linking Forceceps, Sureau and Phenofit

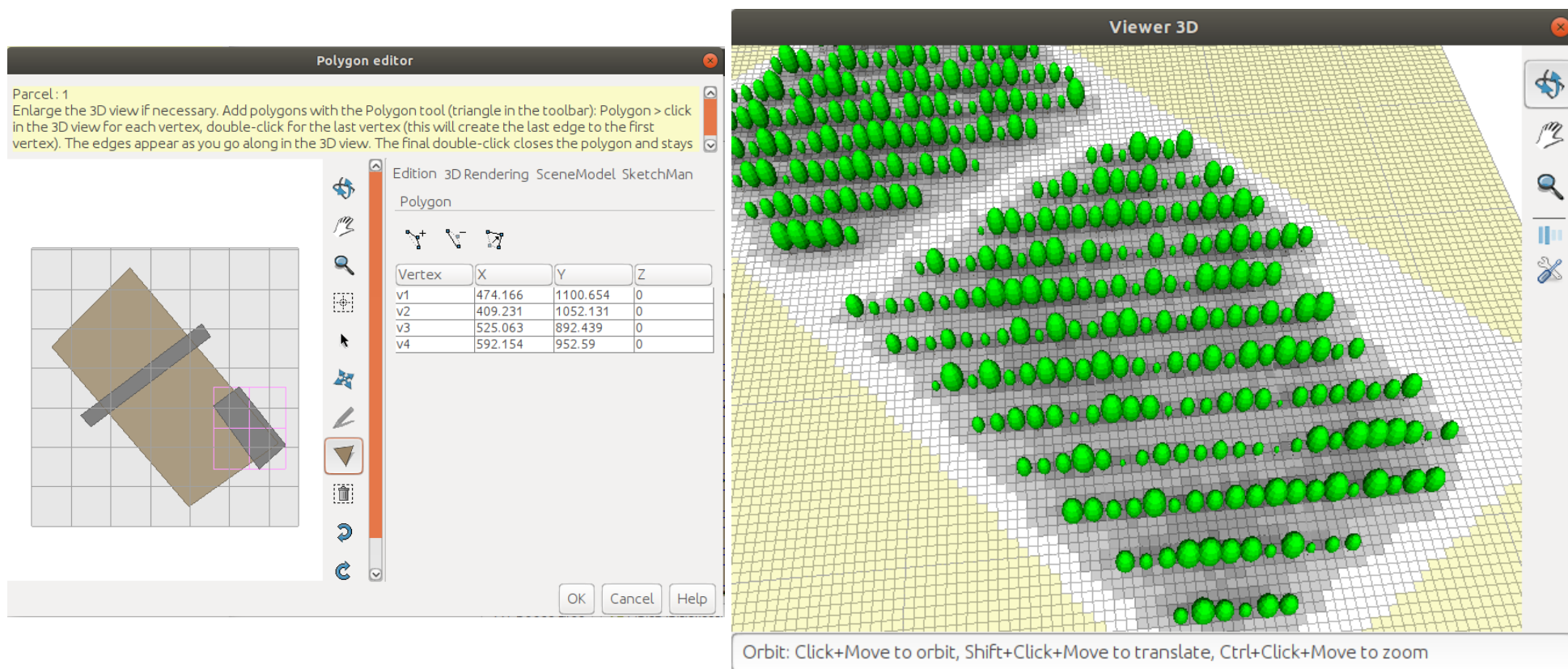
- Forecasting forest Socio-ecosystems' Sensitivity and Adaptation to climate change
- Coupling several simulators in Capsis
- Phenofit for phenology: preliminary simulations / file reading
- Forceceps - Sureau : internal link each year or for the driest years
- ... and Yasso (soil carbon storage, later)





## EcoAF

- An Agroforestry model
- Added exclusion polygons interactive addition / edition
- Linked to the SamsaraLight library by Benoit Courbaud (INRAE Lessem, Grenoble) and Gauthier Ligot (U Liège Gembloux)

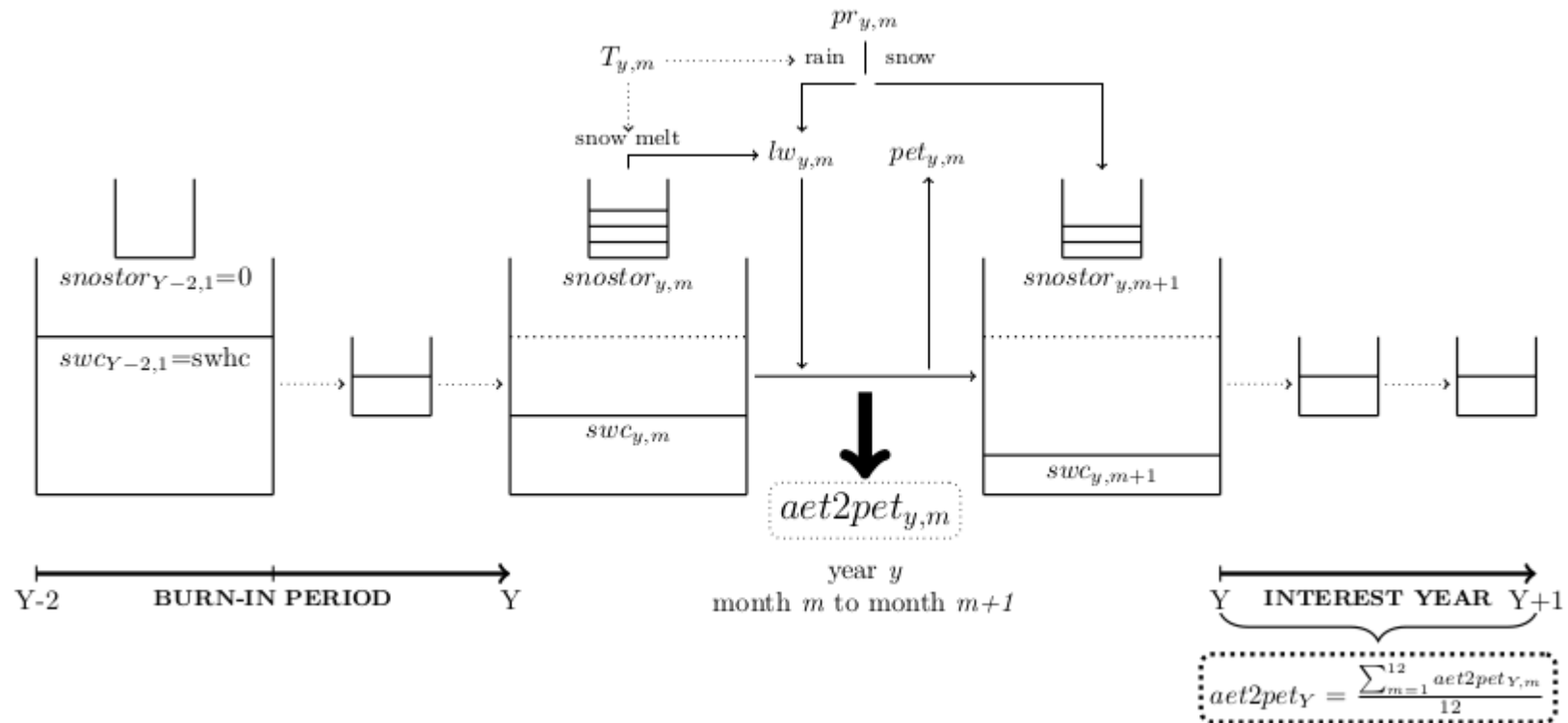


Add / edit exclusion polygons at the simulation starting time, then evolution for 25 years, then radiative balance with SamsaraLight

# Samsara2

Added mortality and growth by Nathéo Beauchamp

- Based on a simplified water balance
- In a library to help reusing (see the Walsi Model by Violette Van Keymeulen)



## Forceps Regional Scale

- Run Forceps on **several regions** with several sites
- Each year, for each site, manage regeneration coming from other sites in the same region and from other regions
- The Forceps Regional Simulator is a Capsis script

```

public void execute() throws Exception {
    for (int i = 1; i <= numberOfYears; i++) {
        for (Region region : regionMap.values()) {
            region.runOneYear();
        }

        // Create the complete contribution pool (of all sites of all regions with
        // original weights)
        Pool pool = new Pool(regionMap, regionMigrationRates);
        for (Region region : regionMap.values()) {
            List<CepsSpeciesContribution> regionContributions = region.getSiteContributions();
            pool.add(regionContributions);
        }

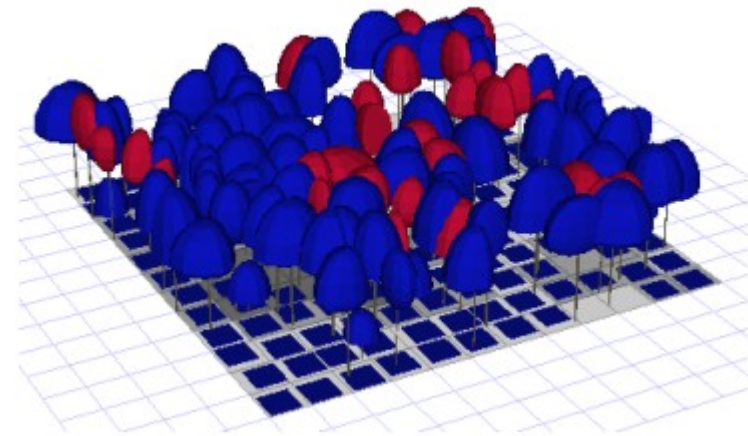
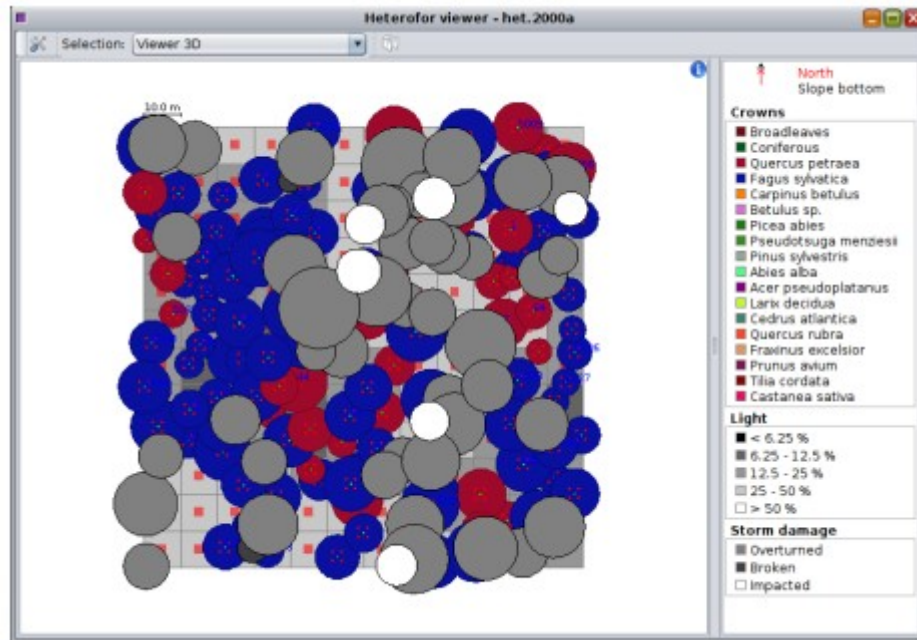
        for (Region region : regionMap.values()) {
            region.manageRegeneration(pool);
        }
    }
}

```

## Heterofor and ForestGales (tree level)

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) in Capsis: 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



# Ecole Chercheur Multirisques

- 'Développer une approche scientifique autour des risques multiples dans un contexte de changements globaux - Partager et co-construire les concepts, les outils et les méthodes'
- Chantilly - 16 nov 2022
- Invitation to talk about Capsis and risk + Nicolas Martin Sureau and the Fissa project
- Rock fall risk - Samsara2 and RockforNet
- Pest risk (1/2) - PinusPinaster: Pine processionary (*Thaumetopoea pityocampa*)
- Pest risk (2/2) - PinusPinaster: Fomes (*Heterobasidion annosum*)
- Wind risk 1/3 - Samsara and Foreole
- Wind risk 2/3 - PP3 and ForestGales (stand level)
- Wind risk 3/3 - Heterofor and ForestGales (tree level)
- Fire risk - FuelManager / StandFire
- Drought risk - Sureau



PinusPinaster - Pine processionary, Céline Meredieu, Margot Régolini, Hervé Jactel, Thierry Labbé et al. (INRAE Biogeco)

# Recent Features in Capsis

Check more easily the Simulation **initial parameters** values in an inspector

The screenshot displays the Capsis 4.2.7-19432 [for.2007a] application window. The interface includes a menu bar (Project, Step, View, Tools, Help), a toolbar with various icons, and a left sidebar with several view options. The 'Simulation parameters' view is selected and highlighted in orange. The main area shows a table of simulation parameters for the project 'ForCEEPS [for] - 100 m2 - All in memory - /home/coligny/workspace/capsis4/data/forceps/tanguy/SurEa'. The table is titled 'Simulation parameters (ForCEEPS) - for.2007a' and contains the following data:

Parameter	Value
initDate	2007
initScene	CepsScene_2007
intraSpecificPhenologyVariability	false
inventory	true
inventoryFileName	/home/coligny/workspace/capsis4/data/forceps/tanguy/SurE
inventoryPatchArea	0.0
inventoryPatchN	0
inventorySpeciesList	List - 25 items
leafLossAgeDependant	false
leafLossImpactOnGrowthFactor	0.5
leafPhenologyImpactOnGDD	true
leafPhenologyImpactOnLightCompetiti...	false
leafPhenologyImpactOnLightCompetiti...	false
localFitnessMode	false
management	false
managementFileName	/home/coligny/workspace/capsis4/data/forceps/tanguy/SurE
phenofitActivated	true
potentialSpeciesList	List - 26 items
ppMoth	null

The 'ppMoth' parameter is highlighted in red. A black arrow points to the 'CepsInitialParameters' header in the table. Another black arrow points to the 'Simulation parameters' view in the left sidebar. The status bar at the bottom reads: 'Simulation parameters: Displays the simulation initial parameters of the model linked to the project'.

# Capsis web site



## Capsis

Computer-aided projection of strategies in silviculture

Log In

Search



- Home
- Presentation
- Download
- FAQ
- Screenshots
- Charter
- Publications
- Documentation
- Projects
- Transfer/Teaching**
- Development
- Contact

## Transfer / Teaching

Capsis can be used to **transfer models to end-users** 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).

### A tutoring session with Capsis

by Céline Meredieu (INRAE BIOGECO, Pierroton), 31.03.2023

Céline Meredieu conducted a 1-hour tutoring session with Capsis, using FAGACEES and ModisPinaster models as examples, after a classroom course on forest models and their uses for forest management.

This morning was intended for 19 students of Bordeaux Sciences Agro and University of Bordeaux during the semester of Pre-specialization "Sustainable Forest Management and territories" (2nd year Engineering School and Master 1), supervised by Marie Charru.

One week ago, a tutorial to check the java version and install Capsis on their computer was sent (with all the internet links to the Capsis website). We ran short of time to do all exercises.

### Capsis-ONF-2022 (fr)

by Philippe Dreyfus, ONF RDI Avignon, 15.2.2023

Bonjour,

(je prends le relais de Christine Deleuze : merci à elle pour son action sur ce dossier depuis une dizaine d'années !)

#### Table of Contents

- Transfer / Teaching
- A tutoring session with Capsis
- Capsis-ONF-2022 (fr)
- Tutoring session with Fagacees at Bordeaux Sciences Agro / University of Bordeaux
- 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



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# Capsis Training Sessions

The annual training session was Initially planned on March 28-29

-> Cancelled due to unexpected social movement



Should be reorganized next June...




# Transfer

## The **Capsis-ONF-2022** distribution

- packaged by Philippe Dreyfus (ONF RDI) in February 2023
- **26 modules** : artemis, ca1, castaneaonly, economics, (fcba/)piceaabies, (fcba/)pseudotsugamenziesii, forceps, gymnos, heterofor, laricio, lemoine, (lerfob/)fagacees, (lerfob/)abial, luberon2, mathilde, modispinaster, oakpine1, oakpine2, pp3, regix, salem, samsara, samsara2, simcop, sydy, sylvestris.




Direction Forêt et Risques Naturels – Département RDI

Objet :		CR d'installateur Capsis ONF 2022 (février 2023)
Date :		15 février 2023
Rédacteur :		Philippe Dreyfus - <a href="mailto:philippe.dreyfus@onf.fr">philippe.dreyfus@onf.fr</a>
Destinataires :		DFRN-RDI, Thierry Sardin, Christine Deleuze, Médéric Aubry, Fabrice Coq, Marie-Claire Maréchal, Anna Schmitt, Paul Del Rey, Stéphane Dumas, Francis Maugard, Denis Feuillerat, Pauline Delord, Sébastien Laguet ( <i>et autres, éventuellement</i> ) Copie aux développeurs CAPSIS : François de Coligny, référents des modules


Dossier partagé : [PartageRDI]\04-Outils\06-Capsis\Capsis\_ONF2022


# Publication


The Capsis Publication page, 2023, extract :


Bilot N., Deleuze C., Saint-André L., Rogaume Y., Fournier M., Wernsdörfer H. **2023**. Management-related energy, nutrient and worktime efficiencies of the wood fuel production and supply chain: modelling and assessment. **Annals of Forest Science**, 80, 15,  [doi](#)


Ligot G., Gheysen T., Perin J, Candaele R., de Coligny F., Claessens H., Licoppe A., Lejeune P. **2023**. From the simulation of the dynamics of coniferous pure even-aged stands to the quantification of bark- tripping damages by ungulates. **European Journal of Forest Research**. Accepted

Guignabert A., Ponette Q., André F., Messier C., Nolet P., Jonard M. **2023**. Validation of a new spatially explicit process-based model (HETEROFOR) to simulate structurally and compositionally complex forest stands in eastern North America, **Geoscientific Model Development**, 16, 1661–1682,  [doi](#)

Fournier S., Sardin T., Dreyfus Ph., Francois D., Mandret X., Simeoni M., Renaud J.-P., Akroume E., Bouvet A., Berthelot A., Wernsdörfer H., Riviere M., Sainte-Marie J., Breteau-Amores S., de Coligny F., Deleuze C. **2022**. Dendrometric data from the silvicultural scenarios developed by Office National des Forêts (ONF) in France: a tool for applied research and carbon storage estimates. **Annals of Forest Science** 79:48  [doi](#)

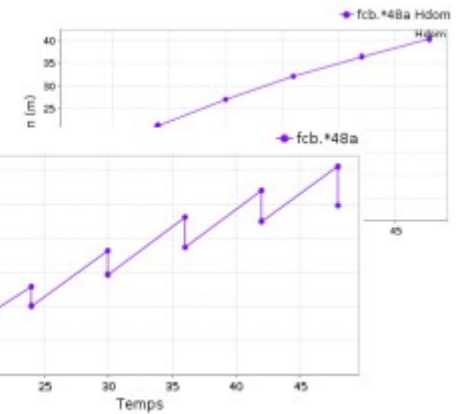
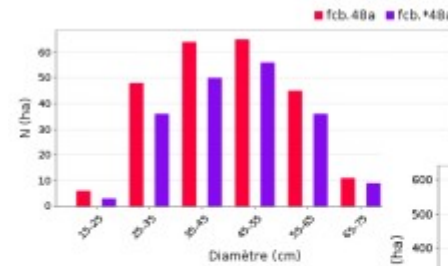
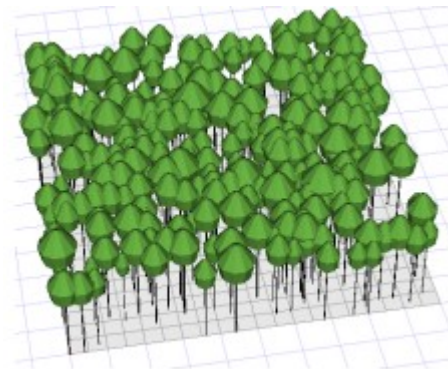
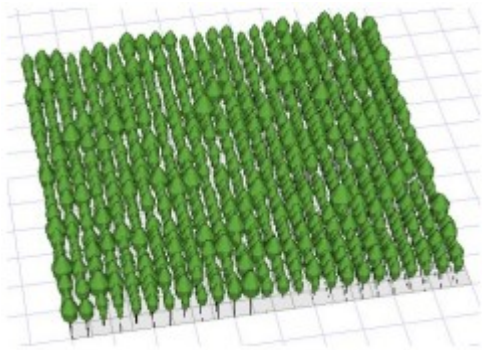
Fortin M., Lavoie J.-F., Régnière J., Saint-Amant R. **2022**. A Web API for weather generation and pest development simulation in North America, **Environmental Modelling & Software**, in press,  [doi](#)

Fortin M. and Lavoie J.-F. **2022**. Reconciling individual-based forest growth models with landscape-level studies through a meta-modelling approach. **Canadian Journal of Forest Research**. e-First  <https://doi.org/10.1139/cjfr-2022-0002>

Ruffault J., Pimont F., Cochard H., Dupuy J.-L., Martin-StPaul N. **2022**. SurEau-Ecos v2.0: a trait-based plant hydraulics model for simulations of plant water status and drought-induced mortality at the ecosystem level. **Geosci. Model Dev.**, 15, 5593–5626, 2022.  [doi](#)

# Conclusions

- A request to replace Nicolas Beudez is resented every year
- Still working in video conference with the modellers on a routine basis, 2 to 4 days per week
- Video training with online support for the exercises



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Thanks for your attention

