



# Capsis Project Activity 2024 - 2025

FOREM 2025 meeting  
1-3 April 2025 - CNRS-CEFE Montpellier



Francois de Coligny

INRAE - AMAP

*botany and modelling of plants architecture and vegetations*

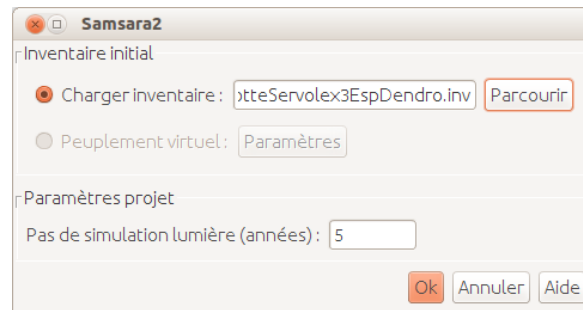


# Capsis objective

## 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



Samsara2

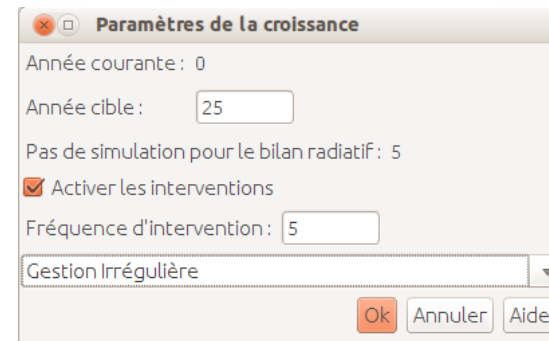
Inventaire initial

☒ Charger inventaire :

☐ Peuplement virtuel :

Paramètres projet

Pas de simulation lumière (années) :



Paramètres de la croissance

Année courante : 0

Année cible :

Pas de simulation pour le bilan radiatif : 5

☒ Activer les interventions

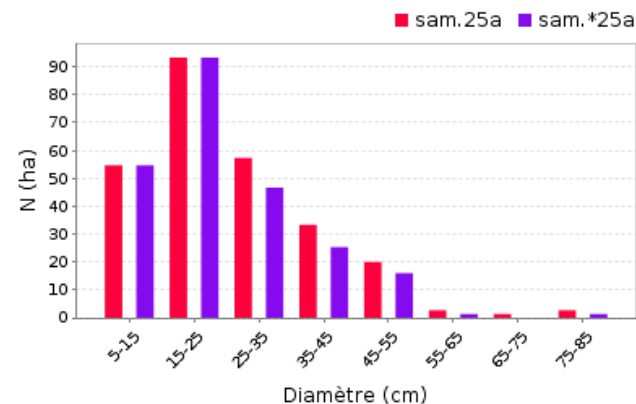
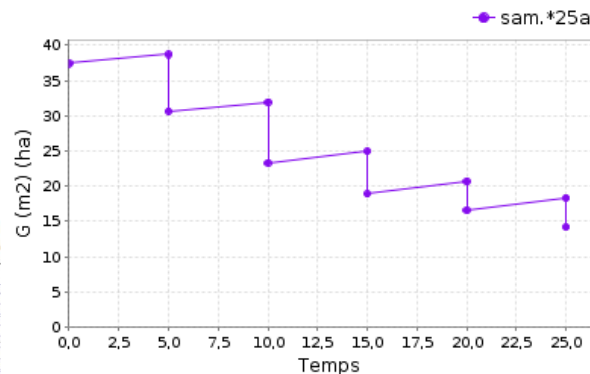
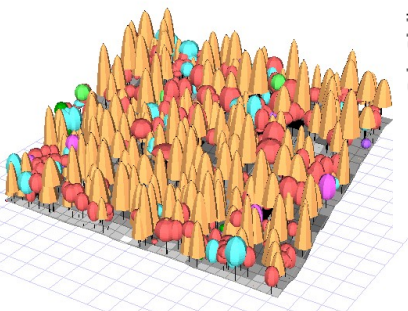
Fréquence d'intervention :

Gestion Irrégulière

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

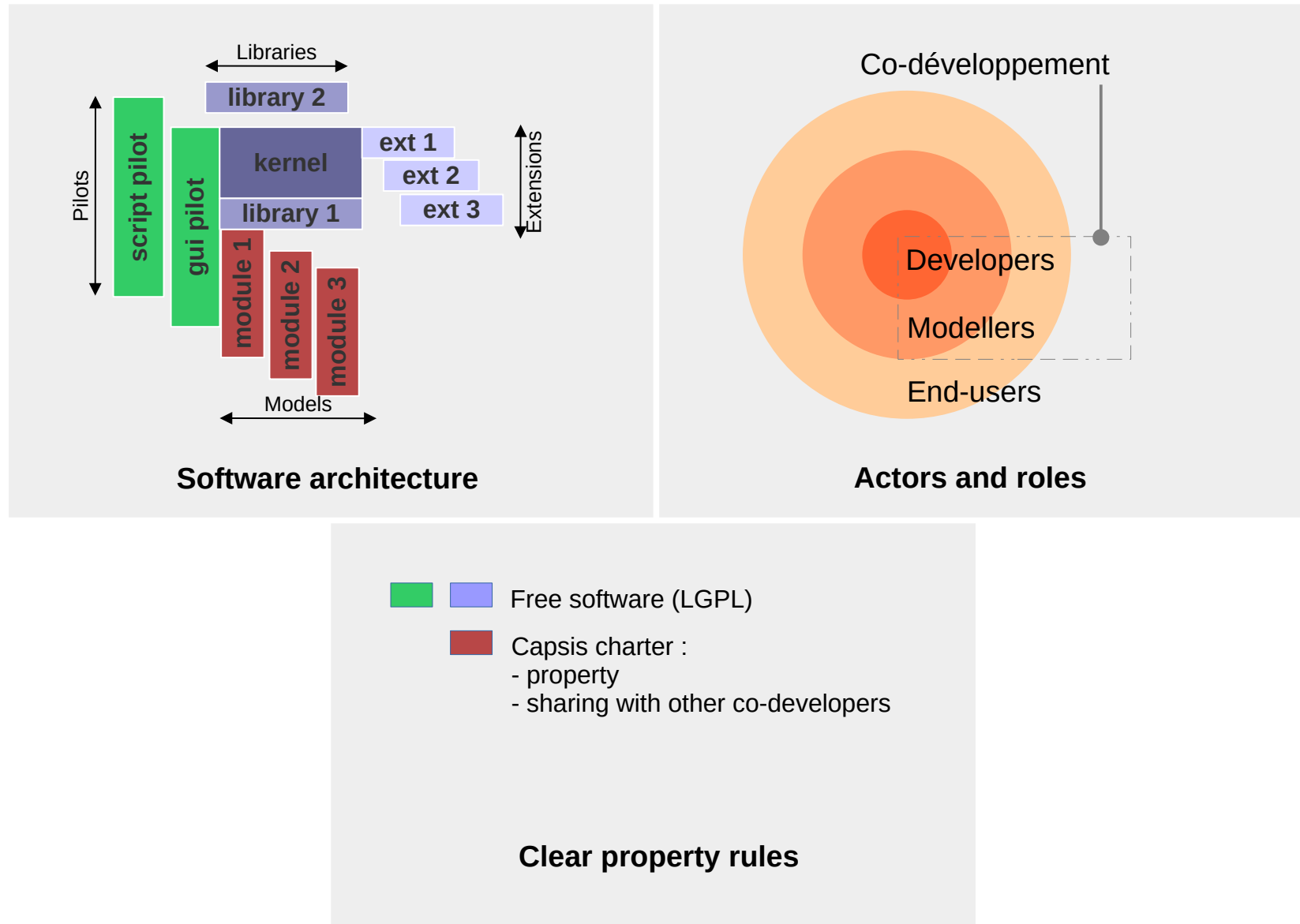
0a - 5a - \*5a - 10a - \*10a - 15a - \*15a - 20a - \*20a - 25a - \*25a

2. growth



export

# A co-development oriented organisation



# 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: take care of 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 support activity in 2024-2025

Sorted by decreasing number of days together, from > 20 days to >= 5 days (+ approx. 15 persons < 5 days):

- **Mathieu Jonard** (UCL, Louvain la Neuve, Belgium), Hetero for management planification system, progressive cuts, decaying functions for litter and deadwood, American beech root resprouting and beech bark disease, flexible script...
- **Nicolas Martin** (INRAE URFM Avignon), SurEAU model tuning
- **Benoit Courbaud** (INRAE Lessem, Grenoble), MultiCriteriaThinner, 2 modes for allometries, connection to the Regeneration lib, volumes
- **Tanguy Postic** (CNRS CEFE Montpellier), connecting Forceeps and SuReAU
- **Philippe Balandier, Mostafa Moradzadeh** (INRAE PIAF, Clermont-Ferrand), Regeneration lib, root system
- **Louis Devresse** (CNRS CEFE Montpellier), Forceeps - SurEAU in adaptive mode, big simulations
- **Frédérique Santi** (INRAE Biofora, Orléans), EcoAF, parcels fertility, Dbh growth model, radiative balance...
- **Arthur Guignabert** (UCL, Louvain la Neuve, Belgium), several interveners, water balance, cavitation...
- **Julien Sainte-Marie** (AgroParisTech Silva, Nancy), Simcop\_Qual logging
- **Xavier Morin** (CNRS CEFE Montpellier), Fissa project: connection Forceeps, Phenofit, SurEAU and Yasso
- **Florian Mézerette** (INRAE BEF, Champenoux), Yasso in Capsis
- **Albin Lobo** (University of Copenhagen, Denmark), new Fraxinus model based on Silva
- **Robert Schneider** (UQAR, Rimouski, Québec), refactored CEP, added repetitions

# Heterofofor - progressive cuts and management planification 1/3

## Planification / Progressive cuts

- Harvesting girth to trigger the process
- Number of cuts and time between two cuts
- Start / end dates

Paramètres de croissance

Mode simple Mode planification

Nombre d'années : 5

Coupes progressives

Circonférence d'exploitabilité (cm) :	220	Nombre de coupes :	2	Nombre d'années entre coupes :	1	Date de début :	1999	Date de fin :	null
---------------------------------------	-----	--------------------	---	--------------------------------	---	-----------------	------	---------------	------

Ajouter une ligne Supprimer la ligne

Si une ligne de coupes progressives est présente automatiquement et désactivée, cela signifie qu'elle provient de l'évolution précédente et que ces coupes progressives ne sont pas terminées. Elle ne peut pas être supprimée. Elle ne sera pas non plus réactivée une fois terminée.

Autres interventions

Ajouter une ligne Supprimer la ligne

Lignes d'intervention:  
Pour une intervention unique, choisissez une date début et une date fin identiques et une fréquence de 1.  
Si la date de début est égale à la date de l'étape courante, l'intervention sera effectuée immédiatement (avant évolution). Pour ne pas exécuter une évolution suite à l'intervention immédiate, mettre Nombre d'années à zéro.

Charger un fichier de planification

Un interveneur doit être spécifié et configuré


Ok Annuler Aide

# Heterofor - progressive cuts and management planification 2/3

## Planification / Interventions

- Which intervention / Configure
- Frequency
- Start / end dates

Autres interventions

☐ Utiliser un groupe: type Arbres vivants ▼ ☐ Not Dbh -1 ▼ 

Nom de l'interveneur : Coupe Heterofor (guides sylvicoles) ▼ Configurer

Fréquence d'intervention : 1 Date de début : 1999 Date de fin : null

Ajouter une ligne Supprimer la ligne

Lignes d'intervention:  
Pour une intervention unique, choisissez une date début et une date fin identiques et une fréquence de 1.  
Si la date de début est égale à la date de l'étape courante, l'intervention sera effectuée immédiatement (avant évolution). Pour ne pas exécuter une évolution suite à l'intervention immédiate, mettre Nombre d'années à zéro.

## Configuration

**Coupe Heterofor (guides sylvicoles)** ×

Intensité totale max en G (%) : 100.1 Surface terrière cible totale (m2/ha) : 25 Surface terrière totale (m2/ha) : 30.5

Espèce Proportion en surface (%) Fichier guides sylvicoles

abies ▼ 100.0 rofor/silvicultural-guidelines.csv ...

Ajouter une ligne Supprimer la ligne

Ok Annuler Aide

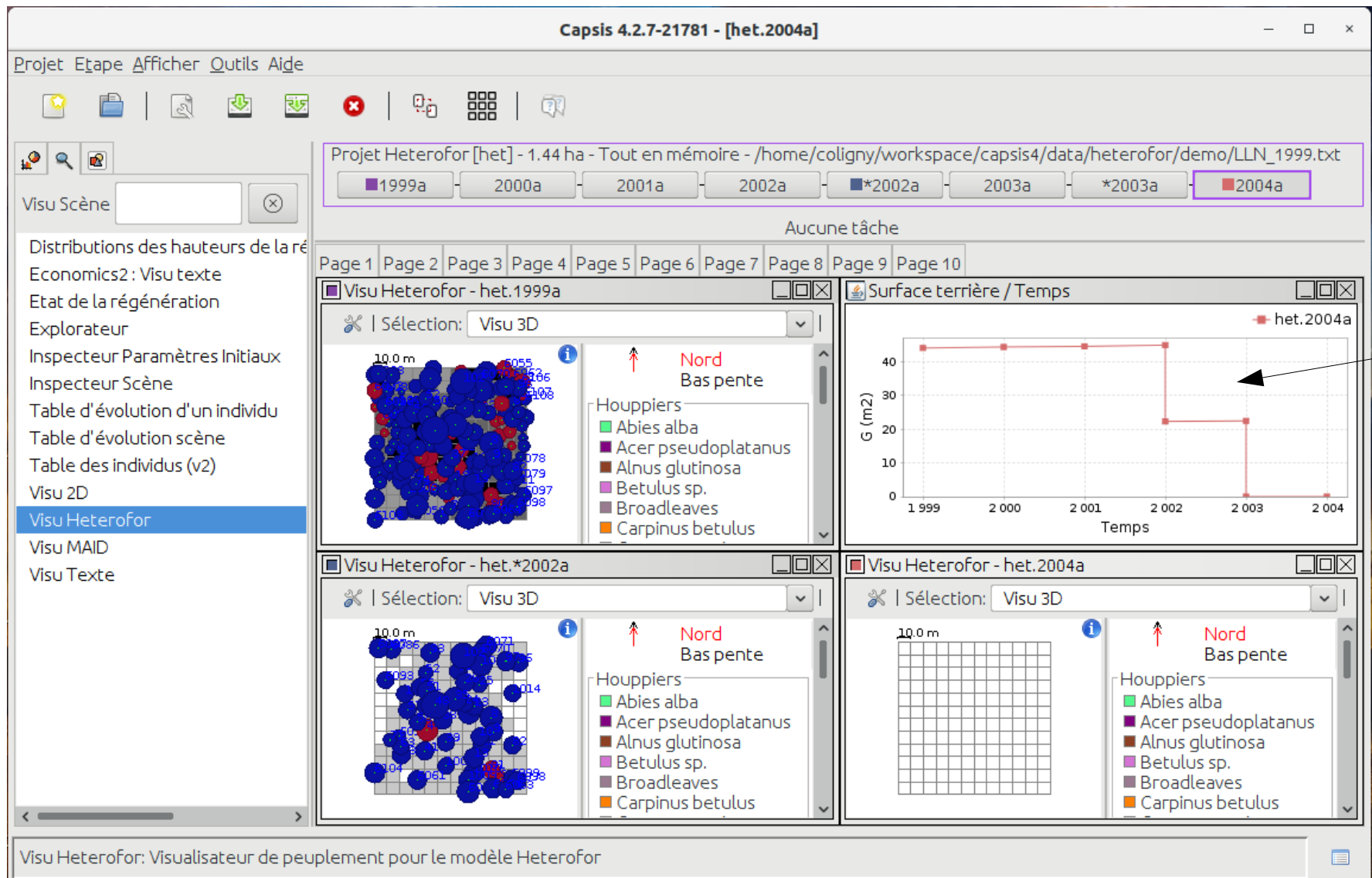
# A silvicultural guidelines file for Heterofor - HetIntervenerPlus extension  
# fc-23.9.2024

# targetSpecies: heterofor nomenclature, HetSpecies.getName () OR 'allSpecies'  
# e.g. fagus, fagusGrandifolia, quercusAlca OR 'allSpecies'  
# cuttingType: 0 from below / 100: from top

# targetSpecies	HdomMin(m)	HdomMax(m)	targetBasalArea(m2)	cuttingPercentage[0-100]	cuttingType[0,100]
allSpecies	0	50	22	40	50
picea	0	14	20	30	50
picea	14	17	25	30	50
picea	17	20	29	30	50
picea	20	23	32	30	50
picea	23	25	33	30	50
picea	25	27	35	30	50
picea	27	29	36	30	50
picea	29	31	37	30	50
picea	31	32	38	30	50
picea	32	34	39	30	50



# Heterofor - progressive cuts and management planification 3/3



## HeteroFor - new interveners

- Apply silvicultural guidelines from a file
- Regeneration clearing

**HeteroFor cutting (silvicultural guidelines)**

Total max G intensity (%): 100.0    Total target G (m2/ha): 0.0    Total basal area (m2/ha): 30.9

Species name: allSpecies    Surface proportion (%): 100.0    Silviculture guidelines file: /silvicultural-guidelines.csv

Add a line    Remove line

OK    Cancel    Help

HeteroFor tools

- HeteroFor Ground Vegetation Clearing
- HeteroFor Ground Vegetation Clearing (criteria)
- HeteroFor Plantation
- HeteroFor Regeneration Clearing
- HeteroFor Regeneration Clearing (criteria)**
- HeteroFor Release cutting
- HeteroFor cutting
- HeteroFor cutting (silvicultural guidelines)
- HeteroFor gap creation
- HeteroFor habitat trees selection
- HeteroFor target trees selection

**HeteroFor Regeneration Clearing (criteria)**

Selection criteria for cells to be processed

Which species: Abies alba    Add    Remove

Acer pseudoplatanus

H min (m): 0.0    H max (m): 5.0    Min density: Cover (%)    25

Species to be cleared

Which species: Broadleaves    Add    Remove

Carpinus betulus

Castanea sativa

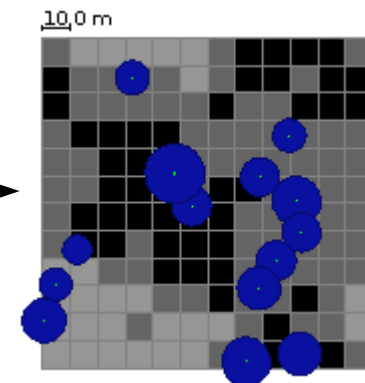
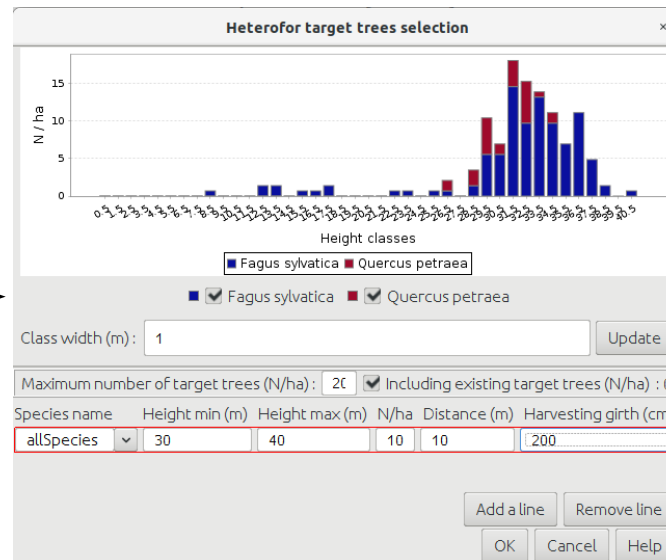
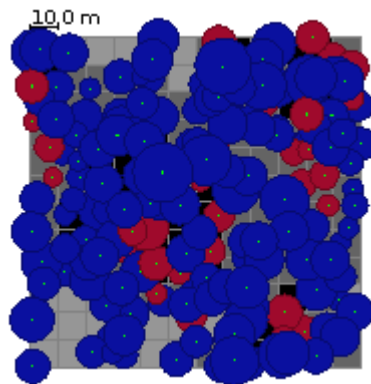
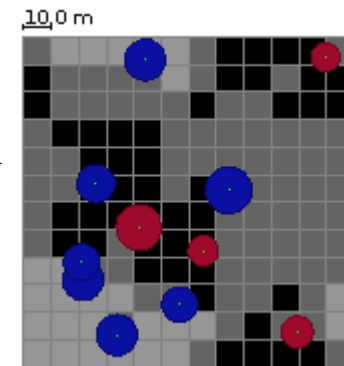
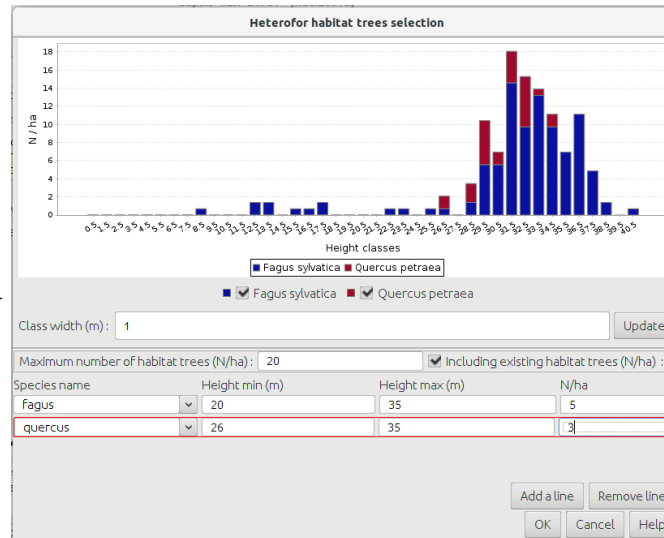
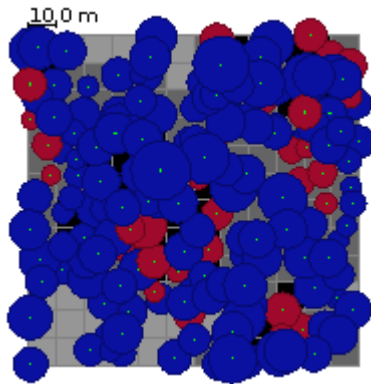
H min (m): 0.0    H max (m): 10.0    Target density: Number (N/ha)    10.0

On each ground cell selected according to the criteria of presence of species with the specified heights and minimum density, the tool will depress (remove) the regeneration cohorts with the given species considering the given height range and target density

OK    Cancel    Help

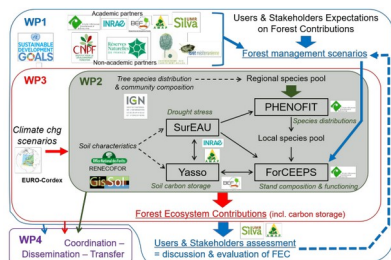
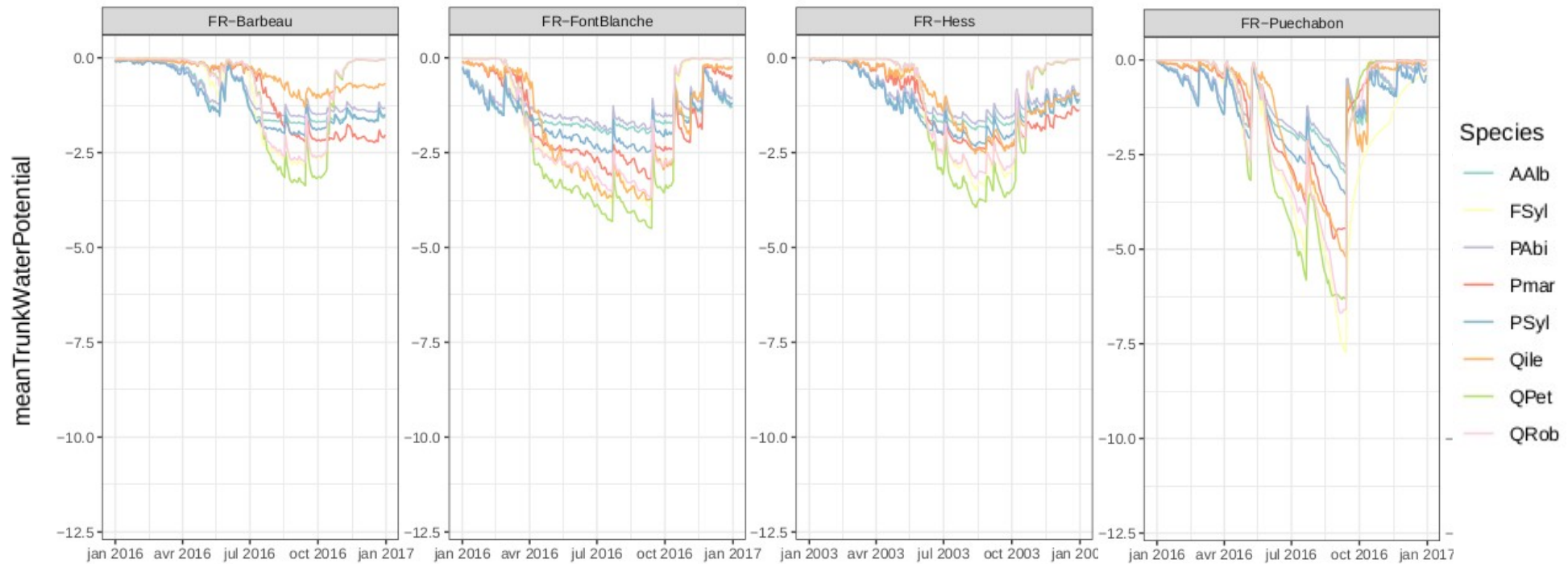
# Heterofor - new interveners

- Habitat trees
- Target trees will be ignored in following interventions



## Phoreau: Forceeps - SurEAU - Yasso - Phenofit

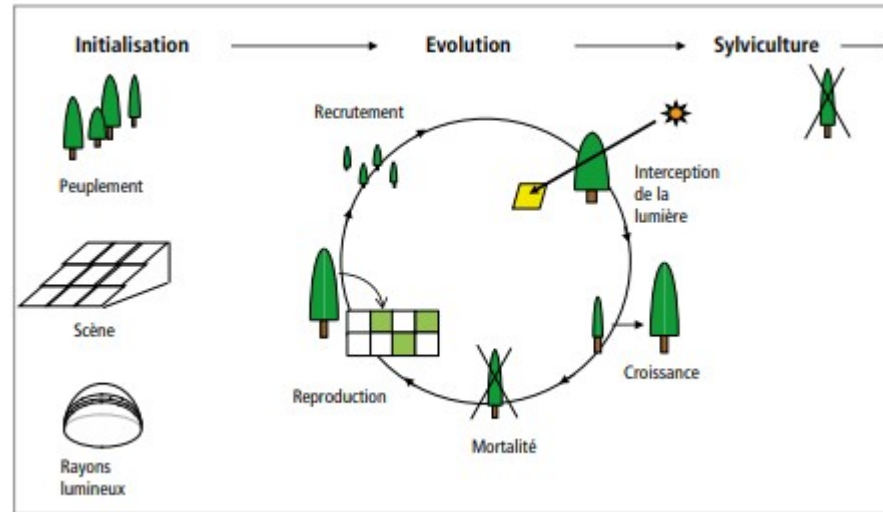
**Tanguy Postic** (20 juin 2024, extrait): "premiers résultats d'un script R de validation de SurEAU - Capsis sur les 4 sites ICOS de France avec une dizaine d'espèces".



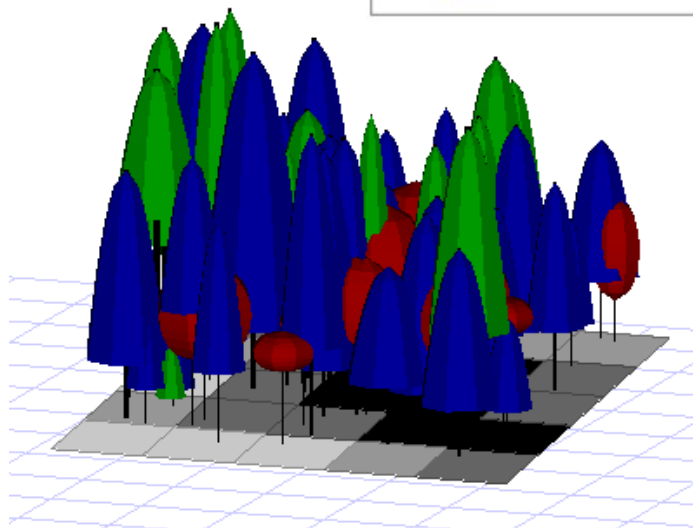
**Projet Fissa** (X. Morin et al.) Forecasting forest Socio-ecosystems' Sensitivity and Adaptation to climate change  
**Forceeps-SurEAU**: now operational (fine water balance)  
**Yasso** (soil carbon storage): rewriting of Yasso20 in Java, done  
**Phenofit** (phenology): loose coupling done in 2023.

## Samsara2

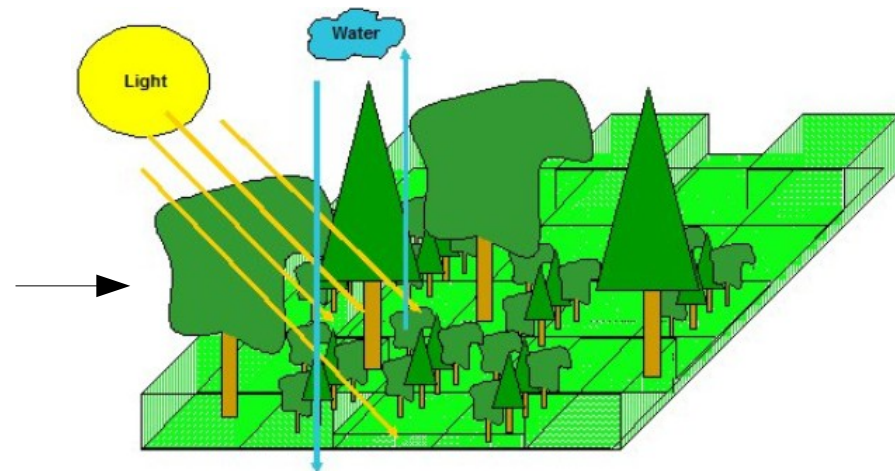
- Connection to the Regeneration lib for understorey
- Cohorts (larges numbers) > saplings (already existing) > trees (recruitment)



The processes simulated by the Samsara2 model



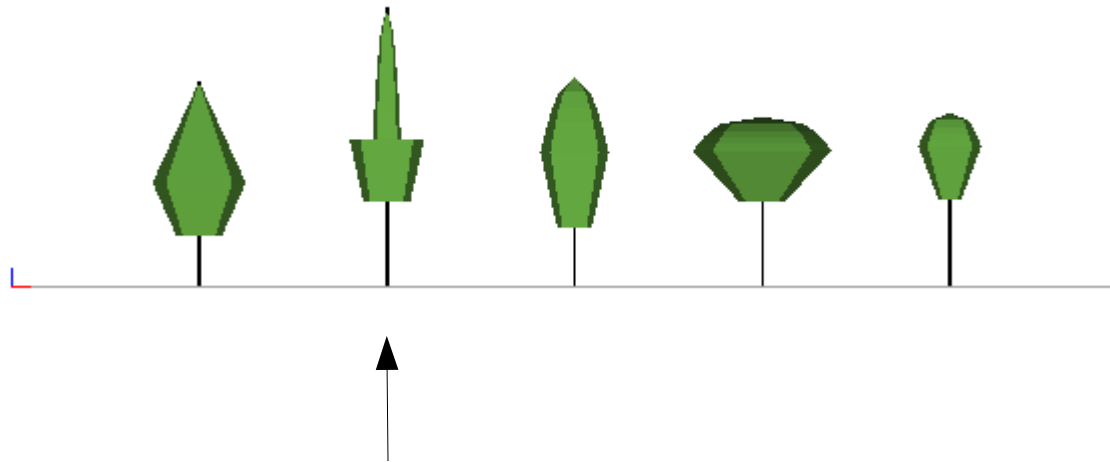
**Samsara2:** saplings and trees



**Samsara2 + Regeneration:** cohorts, saplings, vegetation layers and trees

## Fraxinus

- Another demo genetic project (Luberon2...)
- Based on Silva (Pretzsch et al. 2002)
- Capsis training in video conference in November 2024
- Visit in Montpellier for the first working session in January 2025
- Under progress with the help of the team in TU Munchen



You noticed ? (under progress)



## Some modelers are autonomous

More than **1000 commits in 1 year**, not all by coligny...

Extract (24 jan - 4 fev 2025):

21620	2025-02-04 15:27	S.Fournier_ONF	1	entry	Cell information for Melbac
21619	2025-02-04 14:30	aguignabert	66	entries	heterofo: merged soil horizons <2.5cm to avoid problems in
21618	2025-02-04 14:24	vallet	1	entry	New simulation folder for Melbac Project
21617	2025-02-03 20:12	mfortin	1	entry	Committing forgotten library
21616	2025-02-03 19:10	mfortin	17	entries	Removing dependency to json-io-4.13.0.jar
21615	2025-02-03 14:07	vallet	1	entry	MiniBug on Quercus Robur D-H relationship
21614	2025-02-03 11:07	courbaud	9	entries	added documentation
21613	2025-02-03 11:06	courbaud	1	entry	removed : shifted to the marteloscope R package
21612	2025-02-03 11:05	courbaud	1	entry	configuration model Benoit
21611	2025-01-31 17:59	andref	1	entry	Heterofo: fix bug (cohort GPP = NaN when intercepted energy = 0)
21610	2025-01-31 14:07	chuine	2	entries	change name (remove ".txt")
21609	2025-01-31 09:19	aguignabert	1	entry	heterofo: conversion soil water potential to MPa in tree hy
21608	2025-01-30 20:59	aguignabert	1	entry	heterofo: llm meteo file up to dec 2024
21607	2025-01-30 16:44	Jonard	1	entry	HetWaterBalanceCalculator: fix bug
21606	2025-01-30 10:45	andref	1	entry	Heterofo: refactored computation of average values for tree and
21605	2025-01-29 16:09	coligny	3	entries	Script Nicolas Ponsa, debugging
21604	2025-01-29 15:09	coligny	6	entries	Added vegetation layers of <code>regelib</code> in Samsa2, fixed Samsa2invent
21603	2025-01-29 13:59	aguignabert	1	entry	heterofo: bound root water uptake values in uptakeWeighting
21602	2025-01-29 11:52	chuine	1	entry	add an example of file to use the option restrictedZone in Comma
21601	2025-01-29 11:15	andref	1	entry	Heterofo: patch to enable the use of Capsis interveners (not in
21600	2025-01-28 22:55	mfortin	4	entries	Removing GeneralHarvesterThinner from extension.list
21599	2025-01-28 18:02	coligny	1	entry	Detail
21598	2025-01-28 16:07	coligny	1	entry	Detail
21597	2025-01-28 15:37	alamarins	11	entries	changed name environment files for conditions files
21596	2025-01-28 15:34	alamarins	9	entries	changed name environment files for conditions files
21595	2025-01-28 12:09	coligny	9	entries	Adapted Nicolas Ponsa's script
21594	2025-01-28 10:26	chuine	3	entries	added script and commandfile for Nicolas Ponsa
21593	2025-01-27 18:20	coligny	15	entries	Heterofo: added a habitat tree selector intervenier
21592	2025-01-27 15:46	Tanguy.postic	11	entries	Added scene and patch IBP diversity exports
21591	2025-01-27 09:19	aguignabert	1	entry	heterofo: add line header to cohort export
21590	2025-01-24 14:38	Louis_Devresse	25	entries	Data files for debugging purposes

# Brand new bugs

Under Windows only (since 2023 ?)

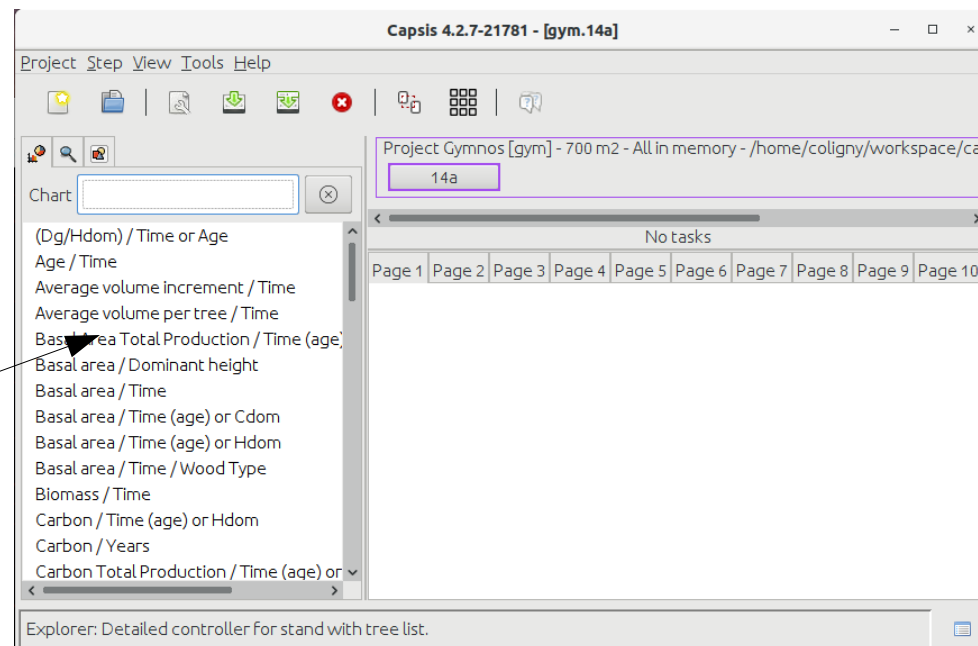
- some users suddenly experimented a long delay at Capsis start time in the terminal  
-> fixed

```
Loaded extension manager buffer: /home/coligny/workspace/capsis4/capsis.app.CapsisExtensionManager_extensionByType.txt, #entries: 1609
CapsisExtensionManager.init (), entering readExtensionListFile()...
CapsisExtensionManager.init (), exited readExtensionListFile()
```

Under Windows only (since 2025 ?)

- some users recently experimented a long delay in the GUI after a project initialization  
-> under investigation

Long time  
before these  
extension lists  
update





# Recent Features in Capsis

**Table of individuals:** possible to open any object of the table in an inspector

Viewer →

The screenshot shows the Capsis 4.2.7-21781 interface. The main window displays a 'Table of individuals (v2)' with columns: id, deltaHeight, demand, and ecologicalSc. The 'Inspector - [demand]' window is open, showing a table of values for the selected object. The 'Viewer' label points to the left sidebar. The 'Tree id' label points to the 'id' column in the table. The 'Tree 2 > demand' label points to the 'demand' column. The 'Right click > Inspect the selected object' label points to the 'Inspector - [demand]' window.

id	deltaHeight	demand	ecologicalSc
13	-0.013	ElementState C: 75204.79 N: 885.56 P: 49...	
20	0.078	ElementState C: 1609.44 N: 26.74 P: 1.88 ...	
33	0.05	ElementState C: 7594.35 N: 809.44 P: 46...	
40	0.233	ElementState C: 2903.33 N: 34.62 P: 2 S: 2...	
51	0.148	ElementState C: 36517.94 N: 423.46 P: 24...	
63	0.041	ElementState C: 64696.35 N: 607.01 P: 34...	
72	0.089	ElementState C: 54403.6 N: 649.95 P: 36.6...	
82	0	ElementState C: 124423.05 N: 1736.66 P: ...	
93	0.001	ElementState C: 97270.27 N: 1153.5 P: 63...	
102	0.032	ElementState C: 80273.87 N: 956.94 P: 52...	
112	0.002	ElementState C: 91409.75 N: 1145.65 P: 6...	
122	0.008	ElementState C: 78068.69 N: 1013.62 P: 5...	
132	0	ElementState C: 105628.23 N: 1355.41 P: ...	
141	0.023	ElementState C: 26921.72 N: 294 P: 16.85...	
150	-0.009	ElementState C: 7933.04 N: 105.27 P: 7.62...	
161	0.026	ElementState C: 60867.38 N: 790.82 P: 42...	
172	0	ElementState C: 84353.8 N: 1129.93 P: 59...	
180	0.155	ElementState C: 39153.44 N: 506.92 P: 27...	

Inspector - [demand]

Key/13	Value
values:Al	0.07835001616030282
values:C	1609.4444517035422
values:Ca	13.443861210656536
values:Cl	0.0
values:Fe	0.18974330000560297
values:K	8.6534668721439
values:Mg	2.2919336361734635
values:Mn	2.9505403447110408
values:N	26.7420481210236
values:Na	0.20082462883657456
values:P	1.8830670680722015
values:S	1.2566486913697812
values:Si	0.0

165 lines, visible columns : 205 / 220, right-click on the table to configure


Table of individuals (v2): Table showing all individuals of a scene in rows and all their properties in columns

Tree id

Tree 2 >  
demand

Right click > Inspect the selected object

# Capsis web site



## Capsis

Computer-aided projection of strategies in silviculture

Log In

Search

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- FAQ
- Screenshots
- Charter
- Publications
- Documentation
- Projects
- Transfer/Teaching**
- Development
- FOREM
- Contact

## 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).


### Using Luberon2 for a simulation practice exploring the genetic impacts of silviculture in a Master course.

by Francois Lefèvre (Inrae URFM Avignon, December 2024)


Kathrin Streit (WSL) organized a simulation practice with Luberon2 for Master

#### Table of Contents

- ♦ Transfer / Teaching
  - ♦ Using Luberon2 for a simulation practice exploring the genetic impacts of silviculture in a Master course.
  - ♦ Modeling workshops at AgroParisTech Nancy
  - ♦ Using Luberon2 in a 2 hours simulation practice in an advanced course at CIHEAM Zaragoza to illustrate the facilitation of genetic adaptation by silviculture
  - ♦ 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)



AMAP











cirad

# Capsis Training Sessions

The Capsis annual training session took place on 4-5 February 2025 in visio-conference


7 people attended the session


## Capsis 4.2.6 training (January 2020)

- Java introduction  LibreOffice file  pdf file
- Java exercises  LibreOffice file  pdf file
- Capsis training  LibreOffice file  pdf file
- Capsis exercices  LibreOffice file  pdf file


# Publication

The Capsis Publication page, 2025, extract :

Morin X., Toïgo M., Fahse L., Guillemot J., Cailleret M., Bertrand R., Cateau E., de Coligny F., García-Valdés R., Ratcliffe S., Riotte-Lambert L., Zavala M., Vallet P. **2025**. More species, more trees: the role of tree packing in promoting forest productivity. **Journal of Ecology**,  [doi](#)

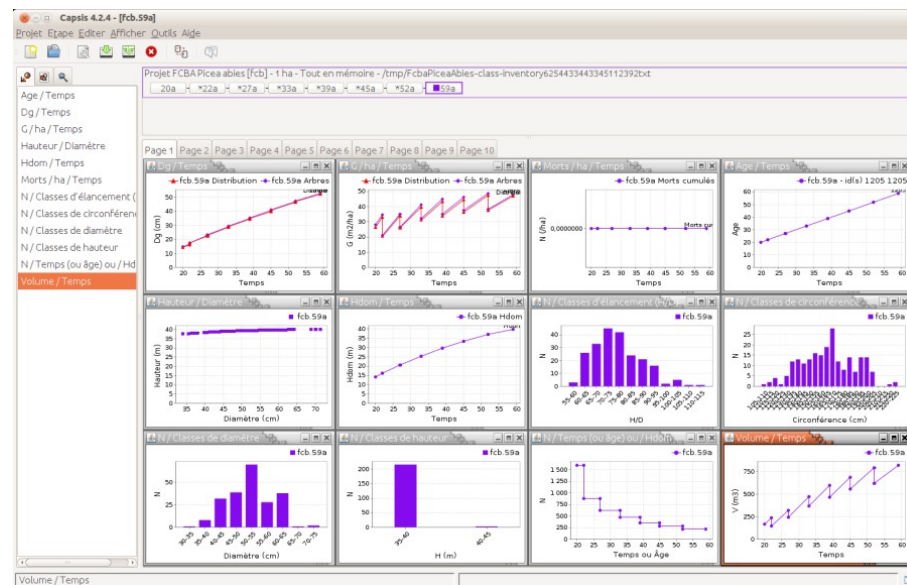
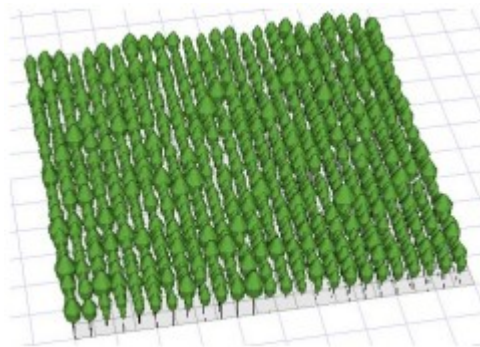
Rouet C., Davi H., Druel A., Fady B., Morin X. **2024**. PDG-Arena: An ecophysiological model for characterizing tree-tree interactions in heterogeneous and mixed stands, **bioRxiv**, ver.3, peer-reviewed and recommended by PCI Forest and Wood Sciences (preprint)  [doi](#)

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# Conclusions

- Capsis is still in a period of deepening
- Still less new projects but more model coupling (climate, soil, roots, litter, dead wood, carbon...) -> model coupling results in more complex code
- Still working in video conference with the modellers on a routine basis, up to 4.5 days per week
- Video conference is more efficient -> co-development is more intense and more tiring
- The INRAE Ecodiv department wants us to propose scenarios for the future of Capsis
- -> The request for a replacement of Nicolas Beudez in AMAP was put in standby...





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**Thanks for your attention**

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