Capsis Project Activity 2024 - 2025

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

Francois de Coligny

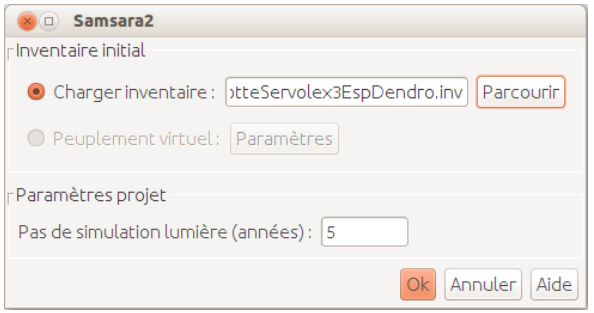
INRAE - AMAP
botany and modelling of plants architecture and vegetations

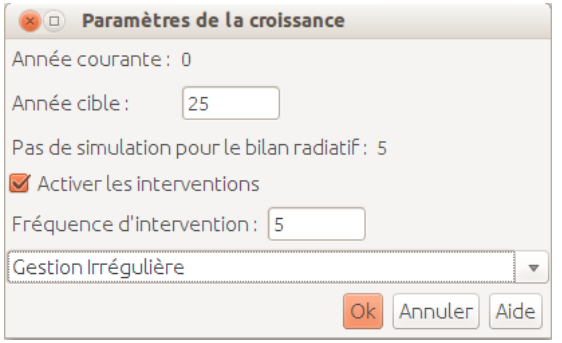
Capsis objective

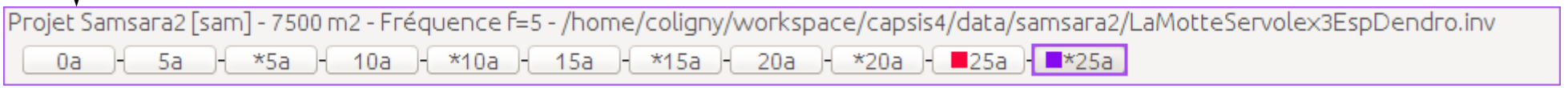
Computer-Aided Projections of Strategies In Silviculture

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

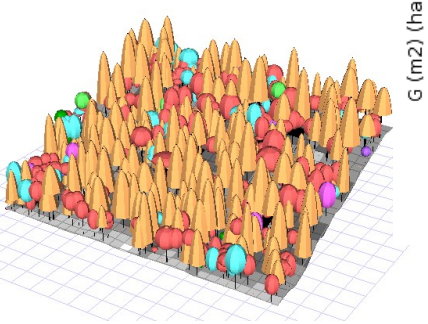
1. initialisation

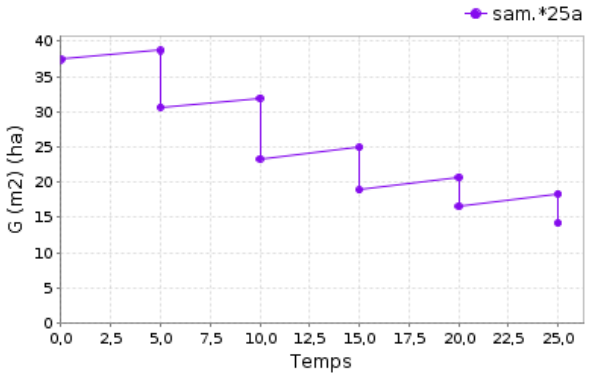


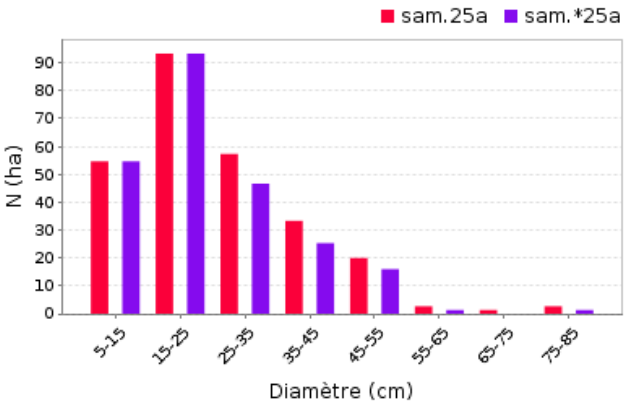




2. growth

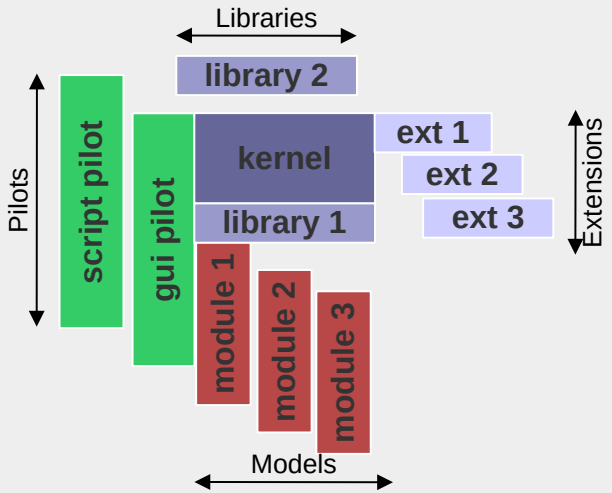




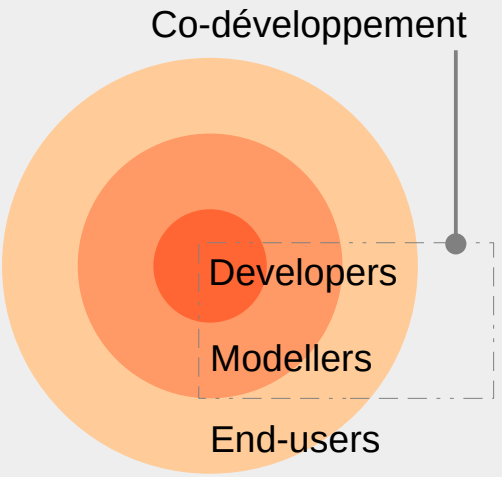


export

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 property respect
- compatible with academic and private field partners

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

Main points

Capsis Charter

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: take care of the modellers

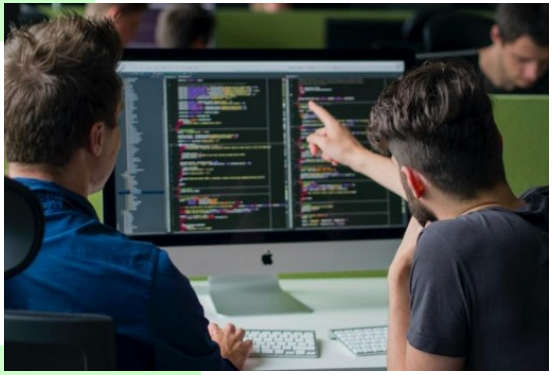
Targeted public: a modeller has designed a forestry growth model and wishes to integrate it in Capsis to get a simulator for his own objectives

- 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):

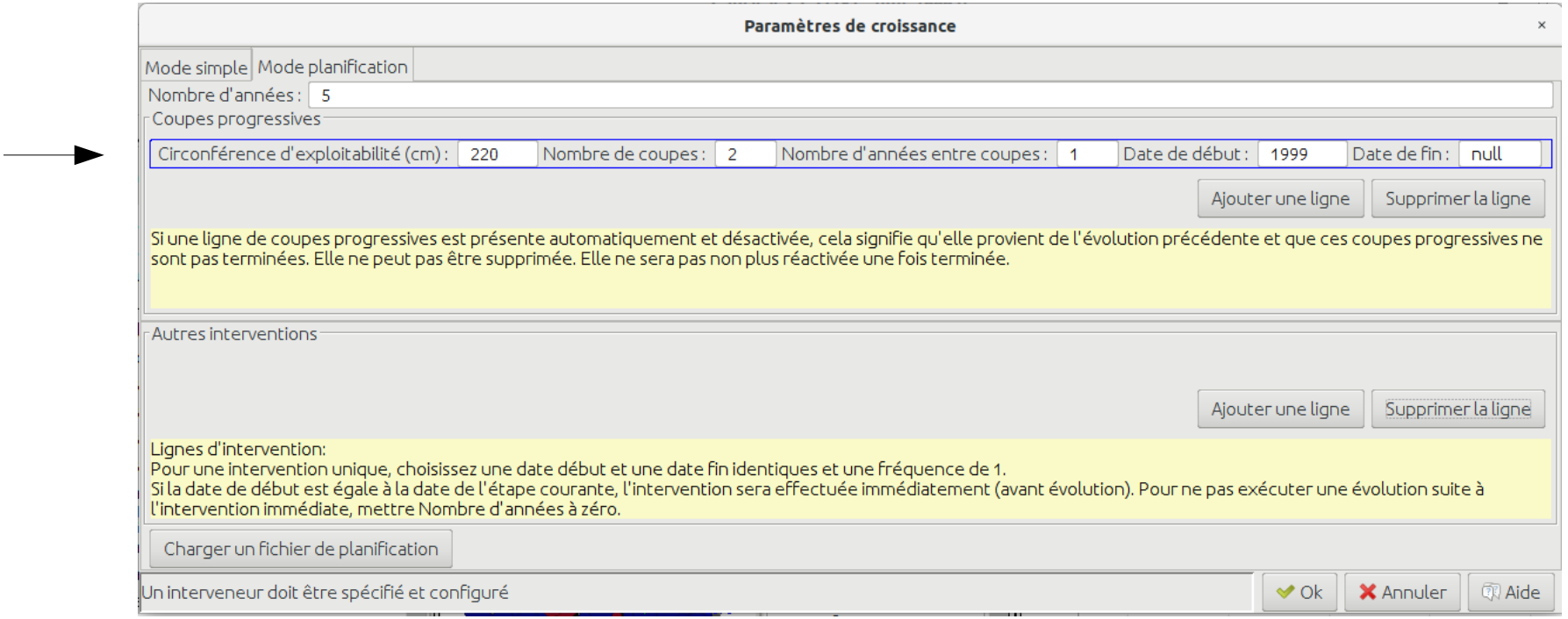
- **Mathieu Jonard** (UCL, Louvain la Neuve, Belgium), Heterofor management planification system, progressive cuts, decaying functions for litter and deadwood, American beech root resprouting and beech bark disease, flexible script...
- **Nicolas Martin** (INRAE URFM Avignon), SurEAU model tuning
- **Benoit 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
- **AlbinLobo** (University of Copenhagen, Denmark), new Fraxinus model based on Silva
- **Robert Schneider** (UQAR, Rimouski, Québec), refactored CEP, added repetitions

Mathieu Jonard, Frédéric André (UCL, Louvain la Neuve, Belgium)

Heterofor - 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

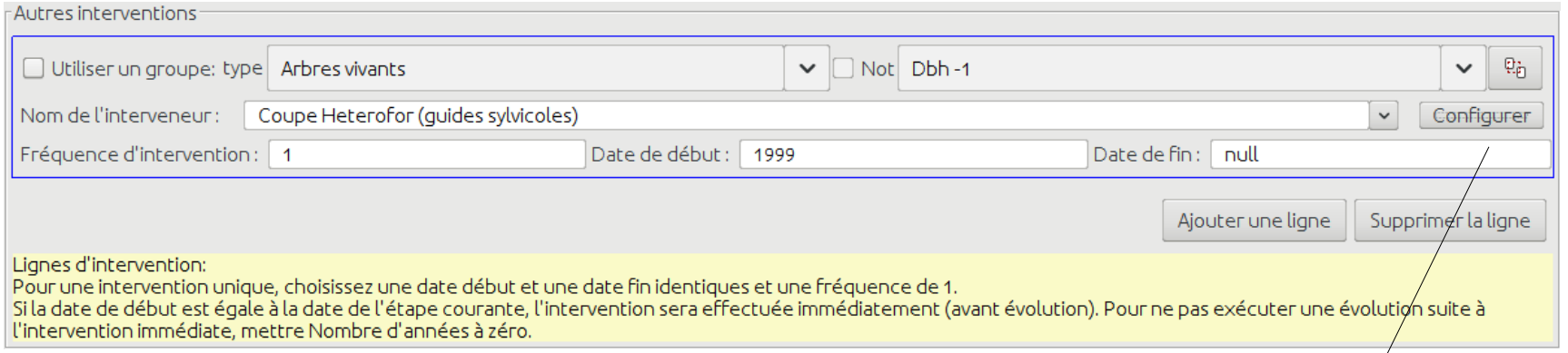


Mathieu Jonard, Frédéric André (UCL, Louvain la Neuve, Belgium)

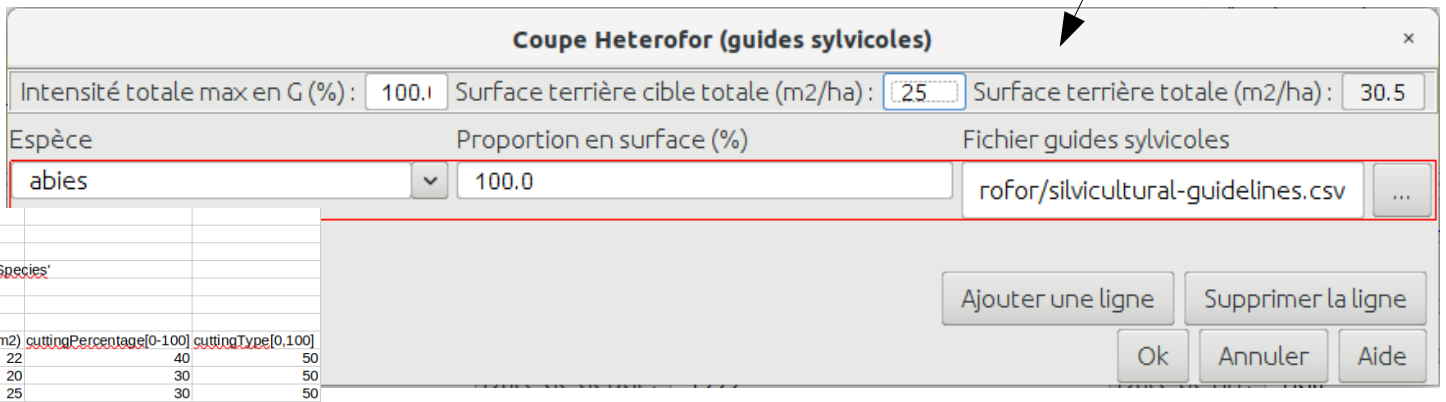
Heterofor - progressive cuts and management planification 2/3

Planification / Interventions

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



Configuration



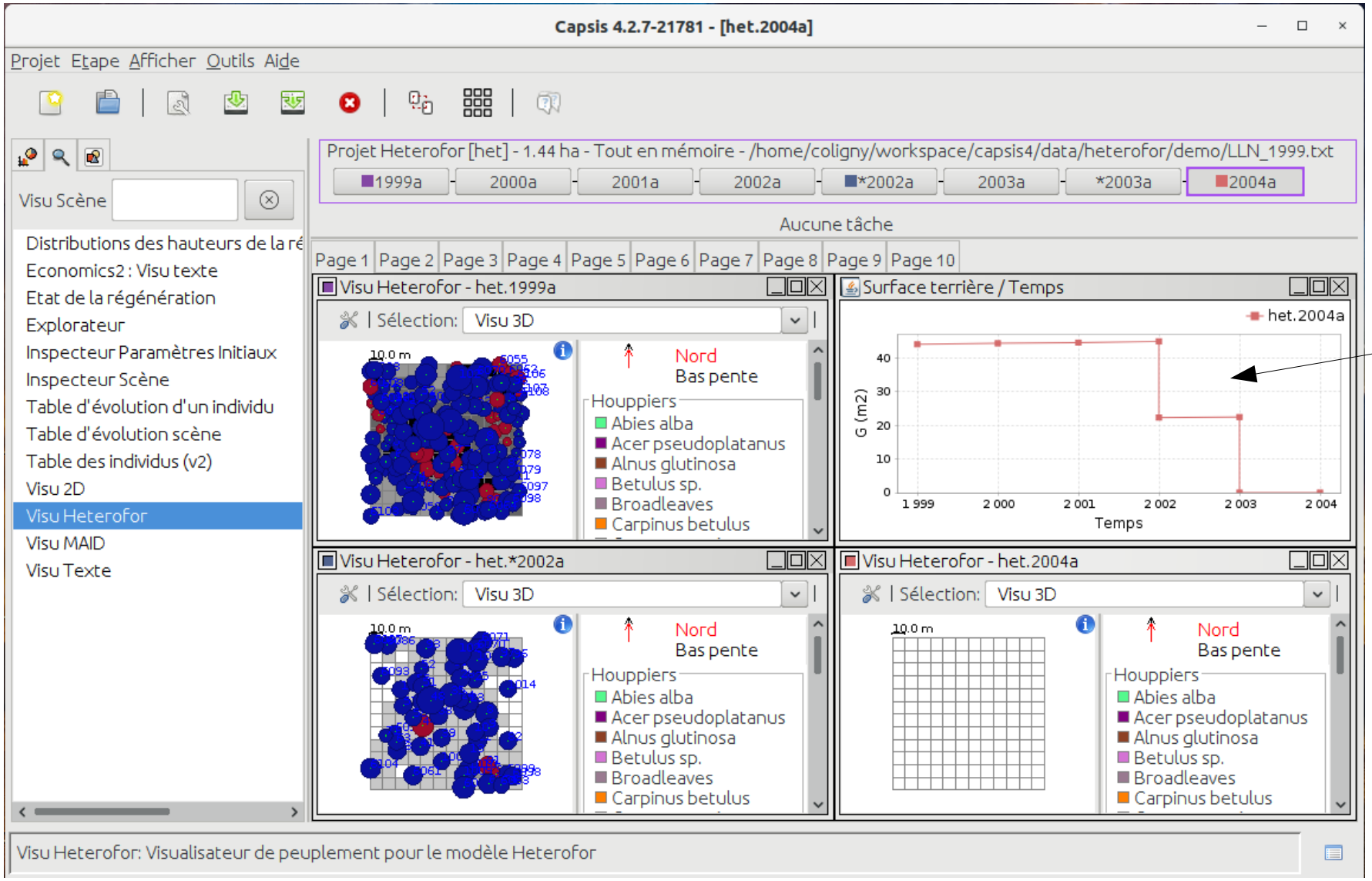
A silvicultural guidelines file for Heterofor HetIntervenerPlus extension
fc-23.9.2024

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

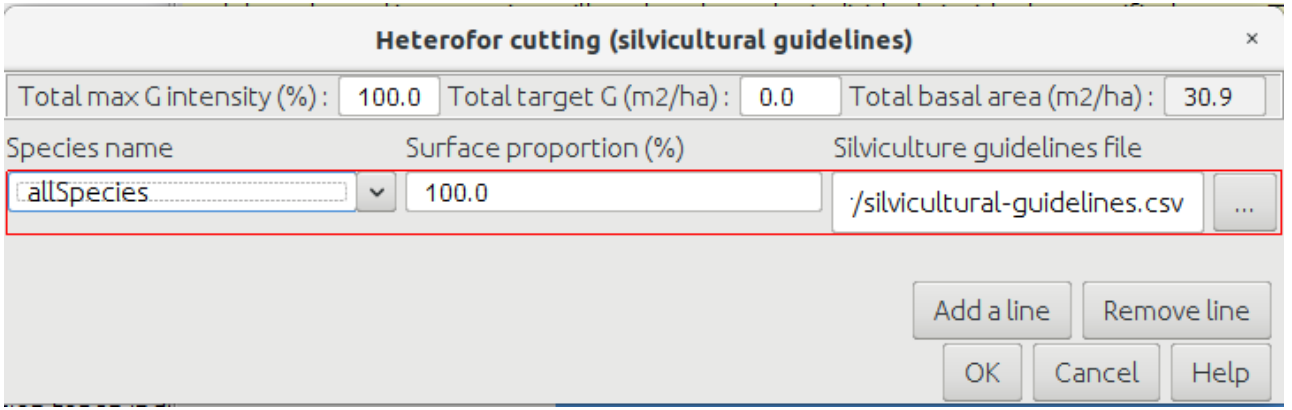
Mathieu Jonard, Frédéric André (UCL, Louvain la Neuve, Belgium)

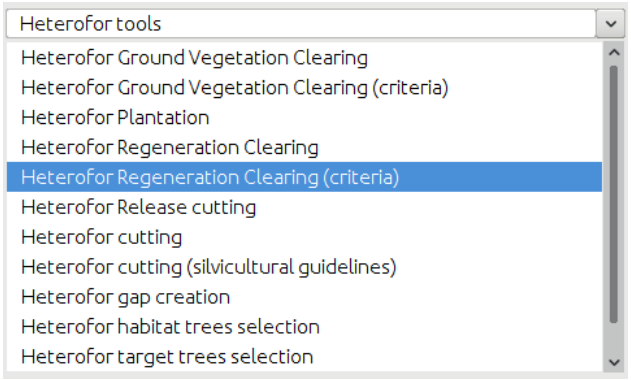
Heterofor - progressive cuts and management planification 3/3

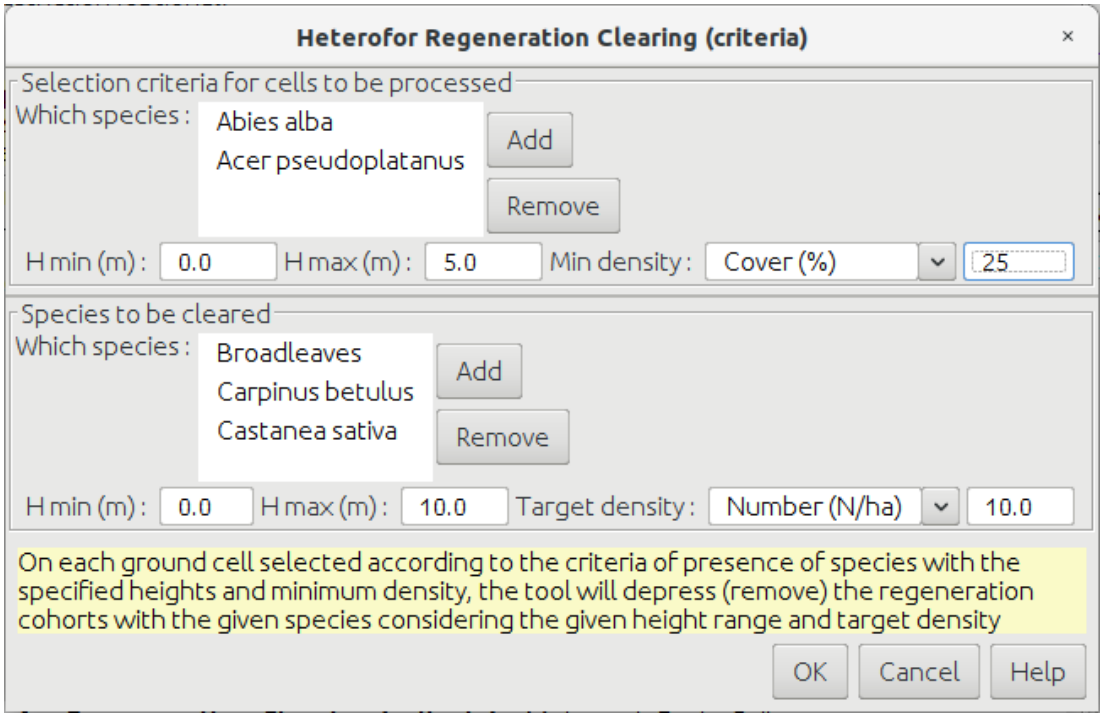


Heterofor - new interveners

- Apply silvicultural guidelines from a file
- Regeneration clearing

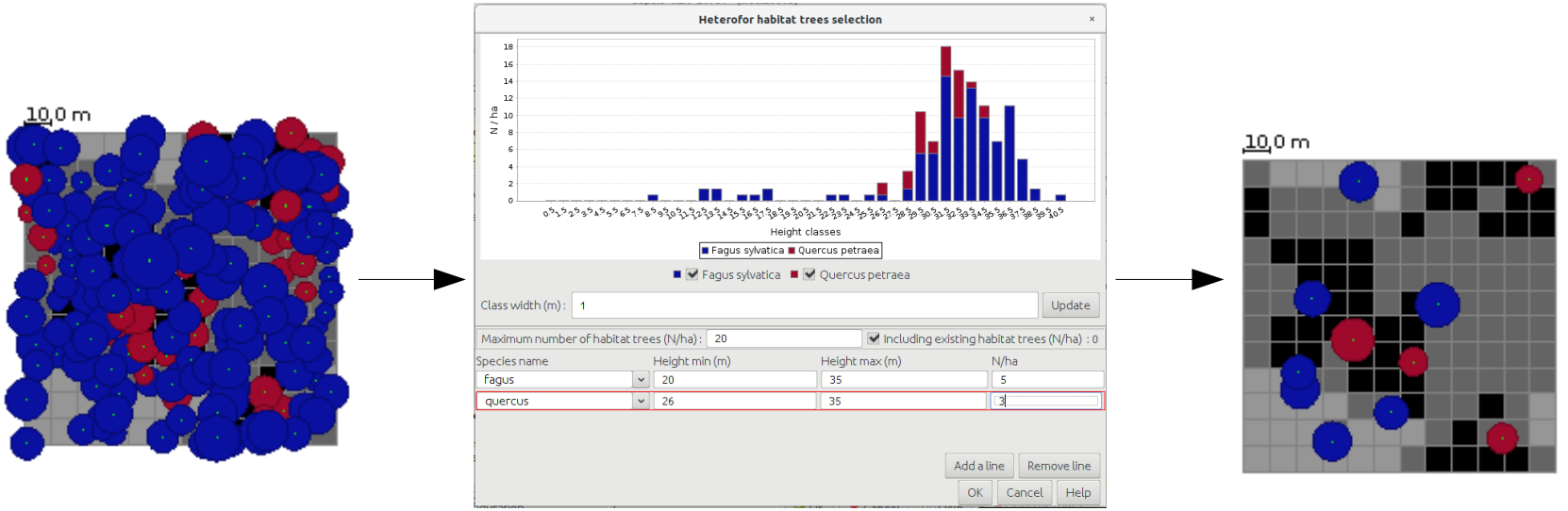


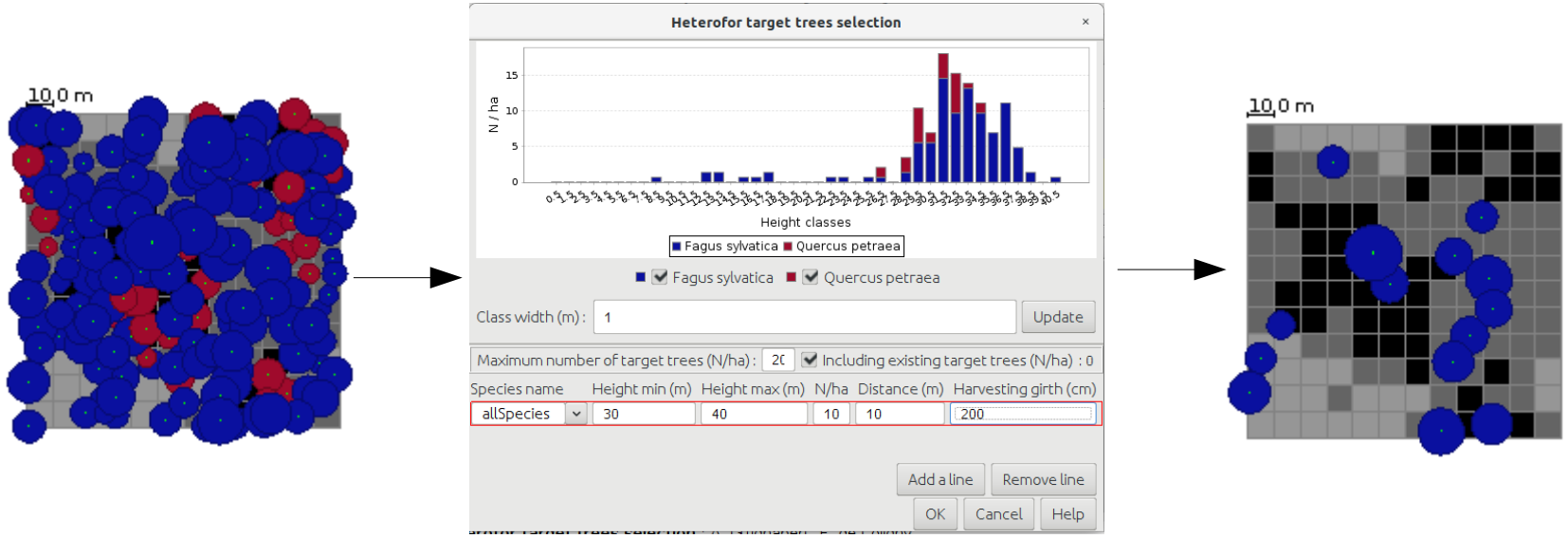




Heterofor - new interveners

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

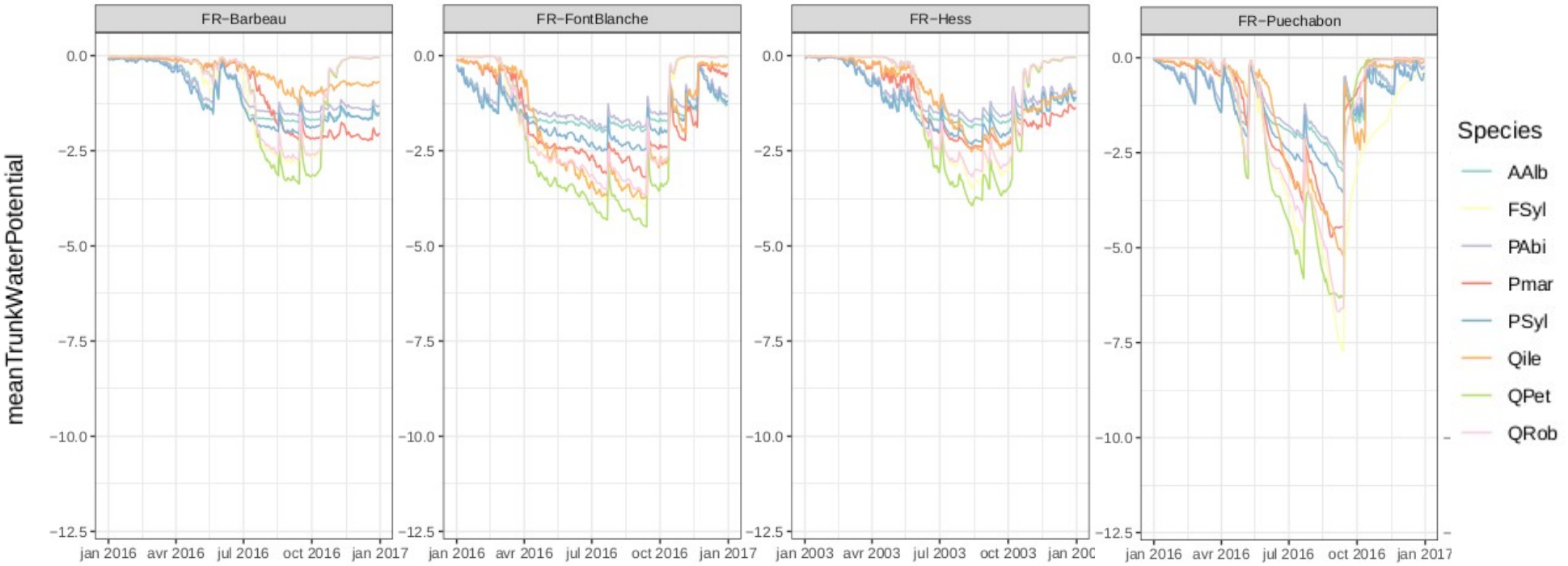


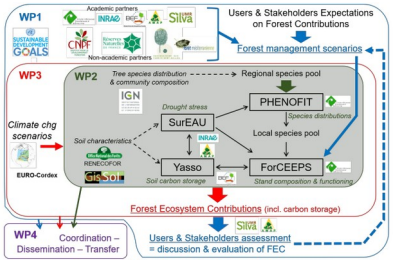


Xavier Morin, Tanguy Postic, Isabelle Chuine (CNRS CEFE Montpellier), Nicolas Martin (INRAE URFM Avignon), Florian Mézerette (INRAE BEF, Champenoux), Zhun Mao (INRAE AMAP, Montpellier)

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".

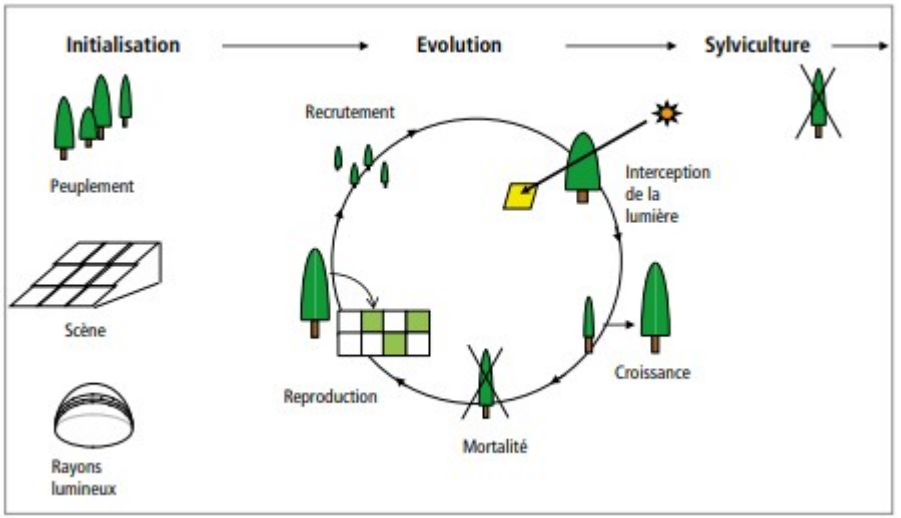




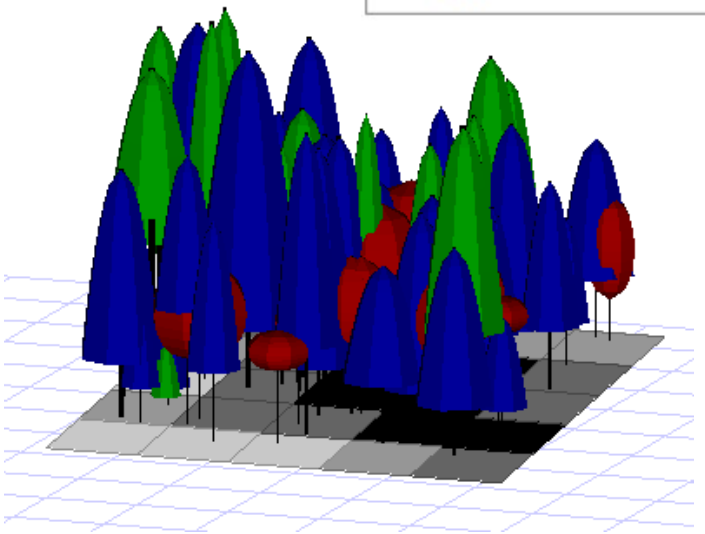
Projet Fissa (X. Morin et al.) Forecasting forest Socio-ecosystems' Sensitivity and Adaptation to climate change
Forceeps-SurEAU: now operational (fine water balance)
Yasso (soil carbon storage): rewriting of Yasso20 in Java, done
Phenofit (phenology): loose coupling done in 2023.

Samsara2

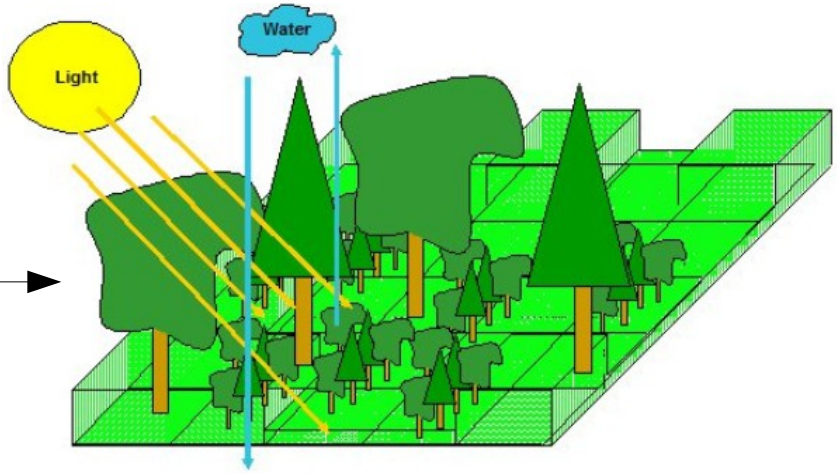
- Connection to the Regeneration lib for understorey
- Cohorts (larges numbers) > saplings (already existing) > trees (recruitment)



The processes simulated by the Samsara2 model



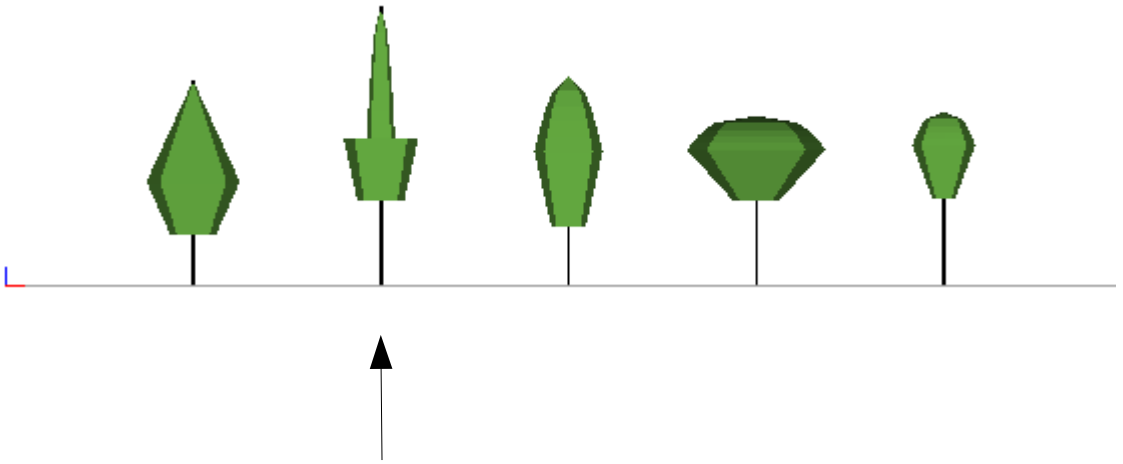
Samsara2: saplings and trees



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 heterofor: 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   Heterofor: 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   heterofor: conversion soil water potential to MPa in tree hy
21608   2025-01-30 20:59        aguignabert 1   entry   heterofor: lln 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   Heterofor: 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 regelib in Samsa2, fixed Samsa2invent
21603   2025-01-29 13:59        aguignabert 1   entry   heterofor: 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   Heterofor: 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 Heterofor: added a habitat tree selector intervener
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   heterofor: 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 ?)

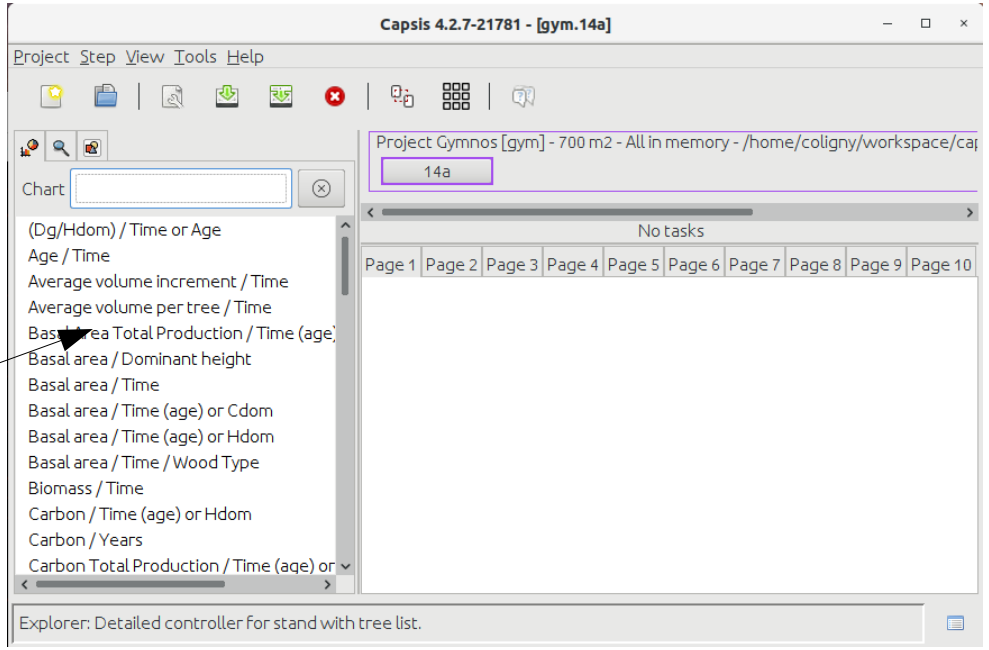
- some users suddenly experimented a long delay at Capsis start time in the terminal -> fixed

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

Under Windows only (since 2025 ?)

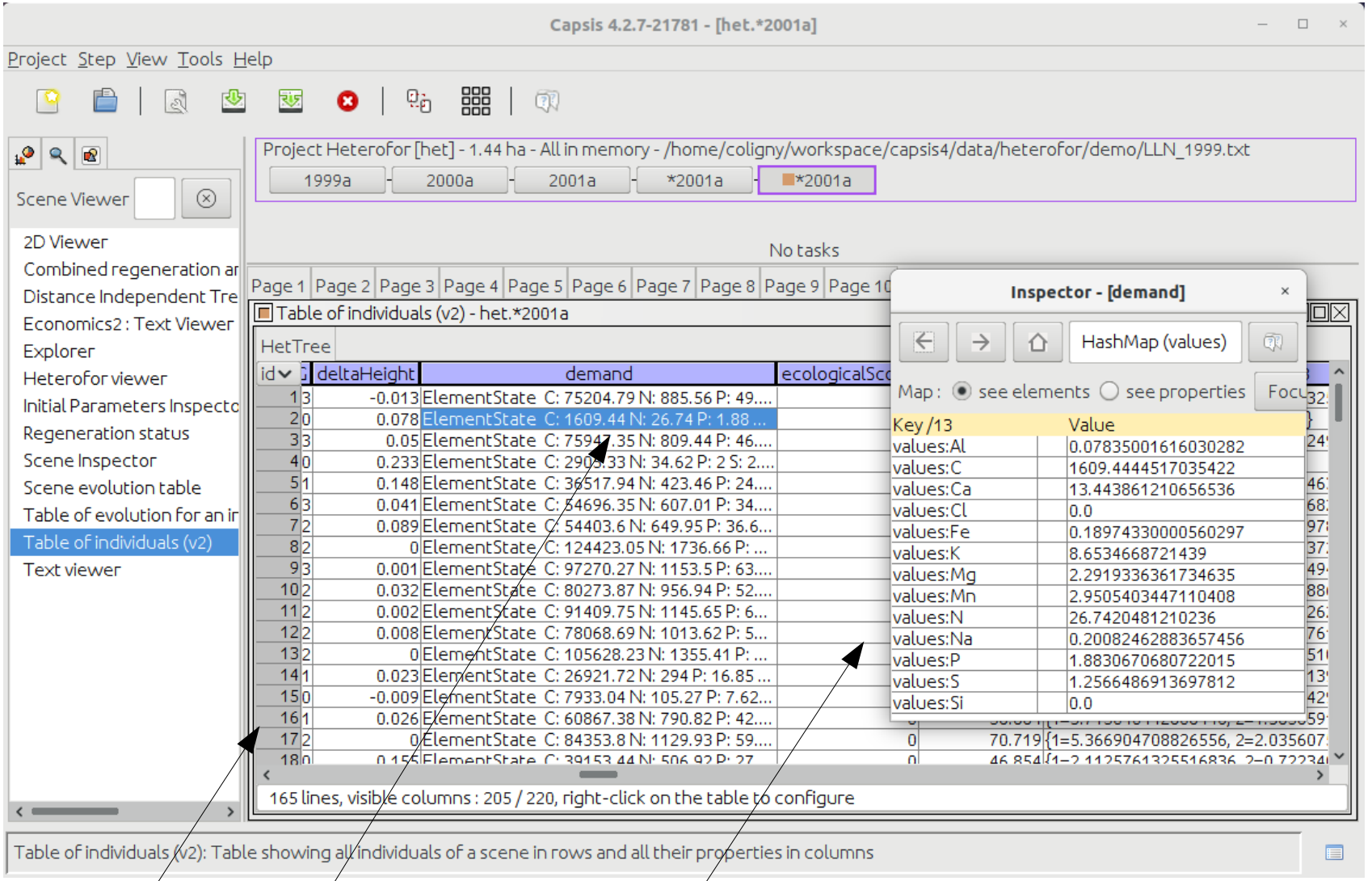
- some users recently experimented a long delay in the GUI after a project initialization -> under investigation

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 →

Tree id

Tree 2 > demand

Right click > Inspect the selected object

Capsis web site

Capsis

Computer-aided projection of strategies in silviculture

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- **Transfer/Teaching**
- Development
- FOREM
- Contact

AMAP

cirad

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

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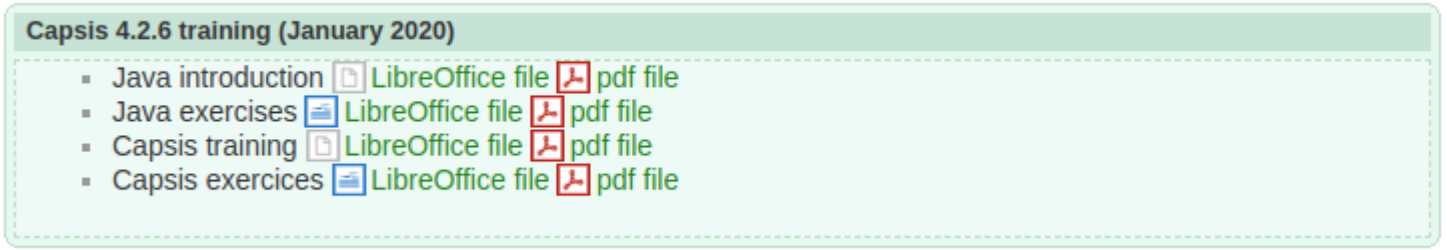
Capsis Training Sessions

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

7 people attended the session



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

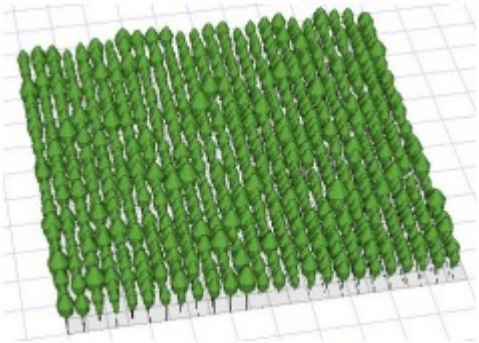
Rouet C., Davi H., Druel A., Fady B., Morin X. **2024**. PDG-Arena: An ecophysiological model for characterizing tree-tree interactions in heterogeneous and mixed stands, **bioRxiv**, ver.3, peer-reviewed and recommended by PCI Forest and Wood Sciences (preprint) doi

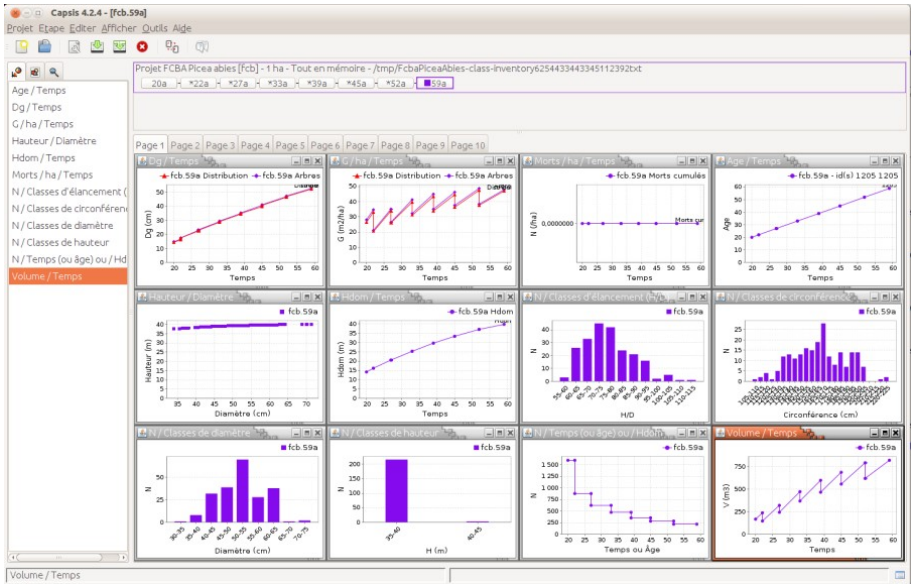
Guignabert A., Jonard M., Messier C., André F., de Coligny F., Doyon F., Ponette Q. **2024**. Adaptive forest management improves stand-level resilience of temperate forests under multiple stressors. **Science of the Total Environment**. Accepted

Grünig M., Rammer W., Albrich K., André F., Augustynczik A.L.D., Bohn F., Bouwman M., Bugmann H., Collalti A., Cristal I., Dalmonech D., De Caceres M., de Coligny F., Dobor L., Dollinger C., Forrester D.I., Garcia-Gonzalo J., Ramón González J., Hiltner U., Hlásny T., Honkaniemi J., Huber N., Jonard M., Jönsson A.M., Lagergren F., Nieberg M., Mina M., Mohren F., Moos C., Morin X., Muys B., Peltoniemi M., Reyer C.P.O., Storms I., Thom D., Toïgo M., Seidl R. **2024**. A harmonized database of European forest simulations under climate change. **Data in Brief**, Volume 54, ISSN 2352-3409, doi

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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- 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 Evod … e future of Capsis
- -> The request fo … ıt in standby...

Thanks for your attention