



Capsis Project Activity : 2018-2019

CAQSIG 2019 meeting - 26-28 March 2019
IRSTEA RECOVER - Aix en Provence



Francois de Coligny
Nicolas Beudez

INRA - AMAP
botany and modelling of plants architecture and vegetations

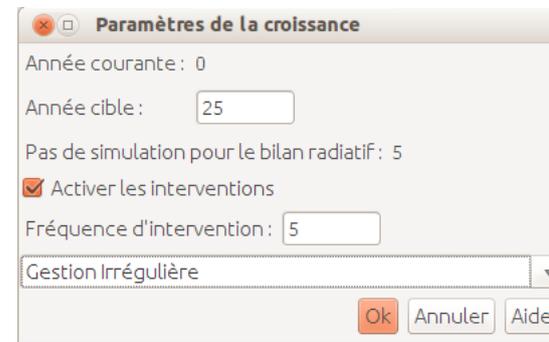
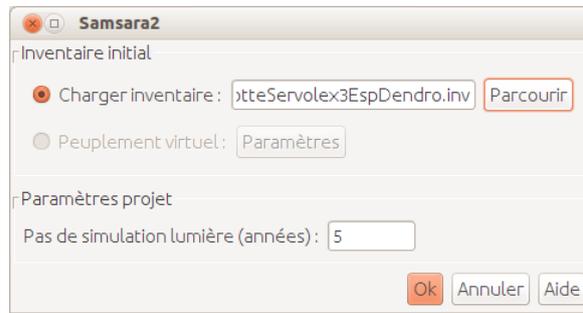


Capsis objective

Computer-Aided Projections of Strategies In Silviculture

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

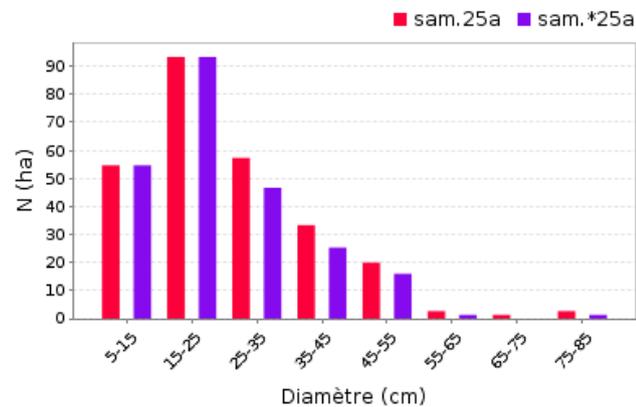
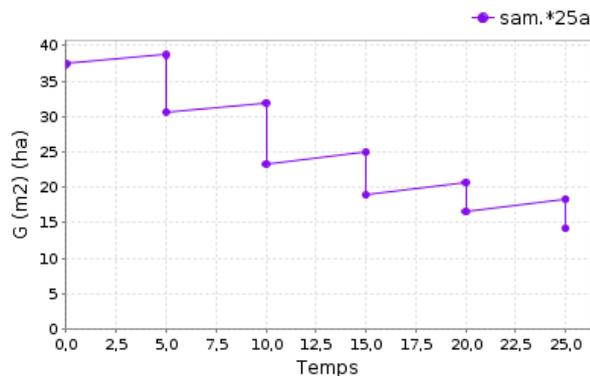
1. initialisation



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

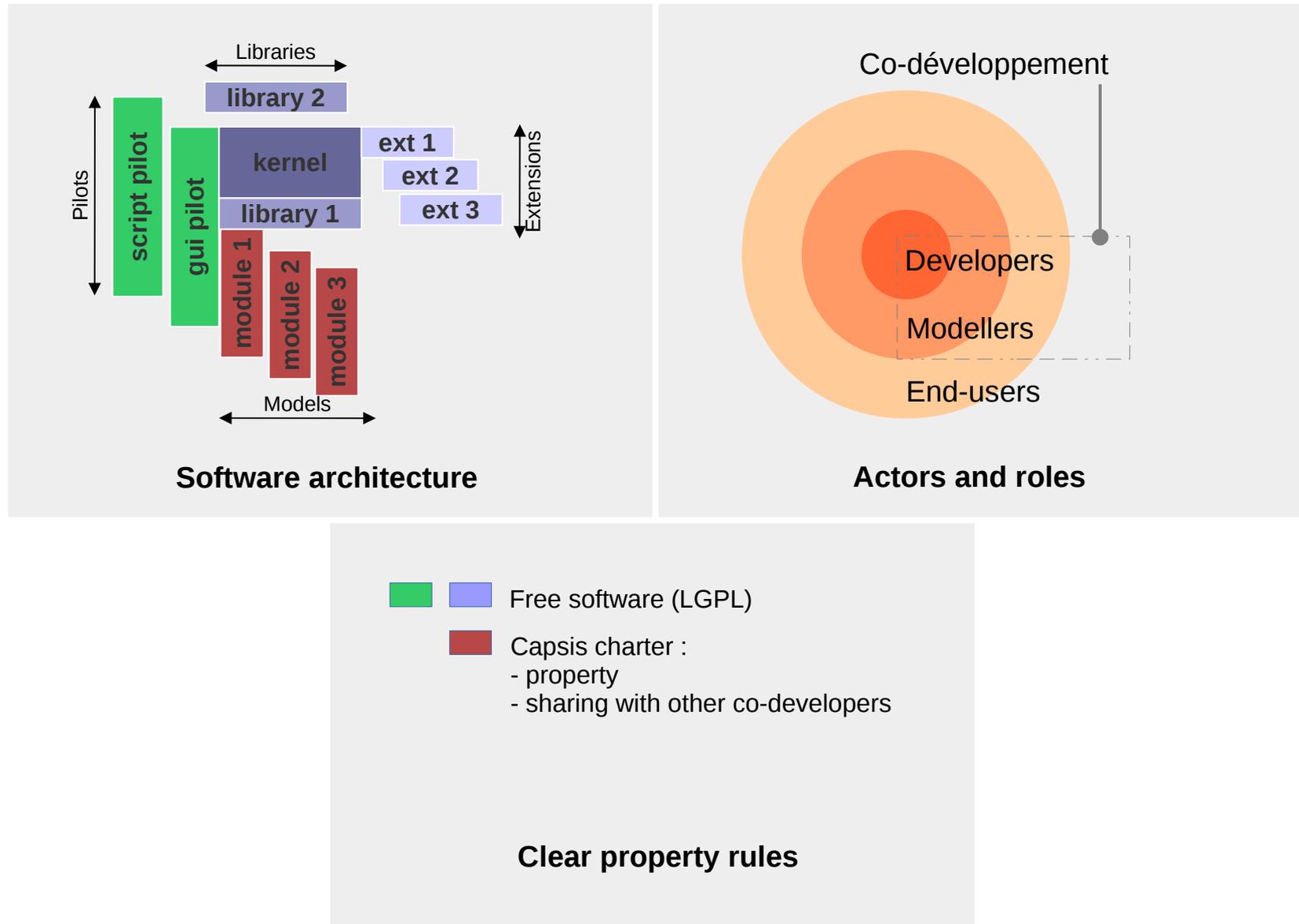
0a - 5a - *5a - 10a - *10a - 15a - *15a - 20a - *20a - 25a - *25a

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: 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)

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



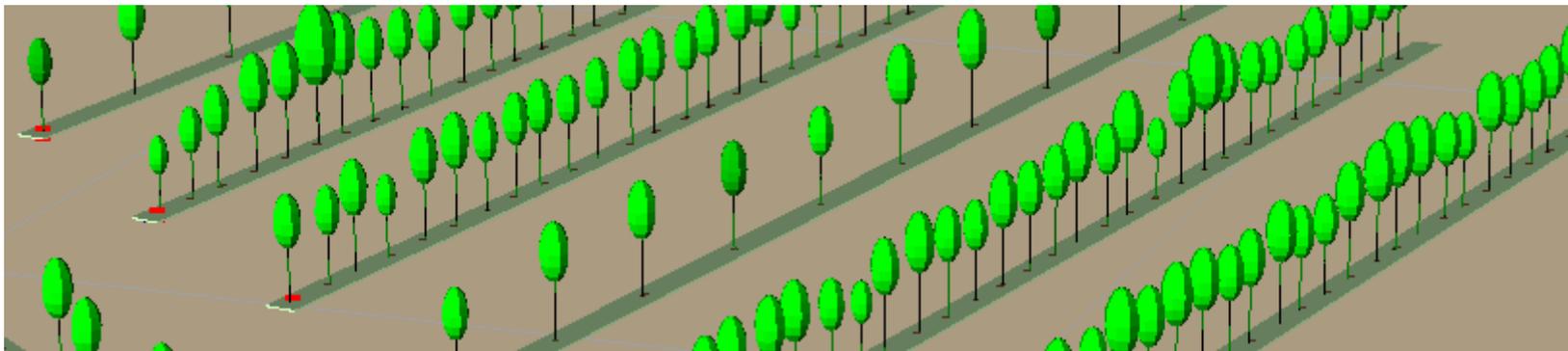
Activity 2018-2019

- Main actions, on existing projects

- **Ecoaf** (Frédérique Santi, INRA Biofora Orléans, Christophe Sotteau, Agro-Eco-Expert, Fabien Liagre, Agroof)
- **Luberon2** (Francois Lefèvre, Claire Godineau, INRA URFM Avignon)
- **Phenofit5** (Isabelle Chuine, Daphnée Asse, CNRS CEFE, Montpellier)
- **Heterofor** (Mathieu Jonard, Louis de Wergifosse, Frédéric André, UCL, Belgium)
- **Castanea** (Hendrik Davi, Valentin Journée, INRA URFM Avignon)
- **Samsara2** (Benoit Courbaud, IRSTEA, Grenoble)
- **Forceeps** (Xavier Morin, Maude Toïgo, CNRS CEFE, Montpellier)
- **RReShar** (Manon Helluy, IRSTEA Recover, Aix en Provence)

...

- Usual support



Ecoaf

Ecoaf

A tool to test, compare and demonstrate Agroforestry hypotheses and options

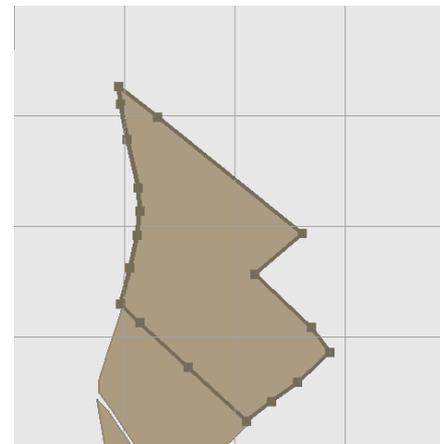
- Built collaboratively by scientists and experts
- For research + experts + farmers + students

- A set of features to dress up the agroforestry parcels
 - inside the parcels
 - on their borders
- A growth model
- Future options
 - a competition module
 - an economic module
 - others

farmer cadastral allotment
(ESRI shapefile)



Ecoaf



Ecoaf

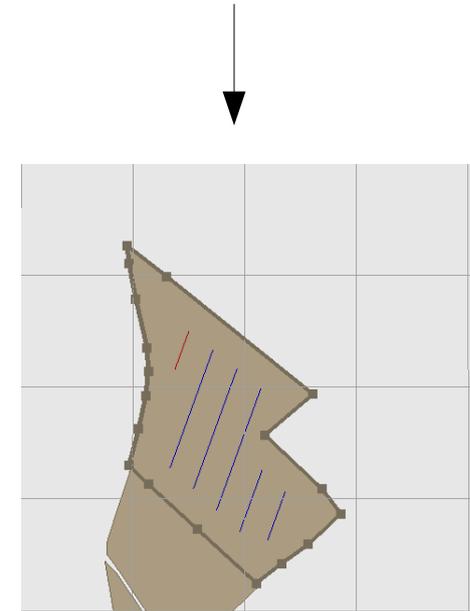
Add lines in the parcel

Oriented lines

Orientation: Angle (deg): Selected border Inverse ? -

Border to first tree line (m): Distance between two tree lines (m):

Headland (m): Min length (m): Max number of lines: Set tags: ?



Add positions on lines

Regular positions

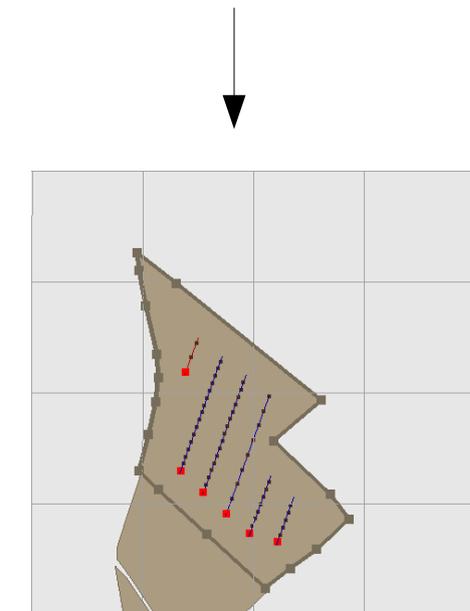
On lines tagged: Start margin (m): End margin (m): Inverse ? -

Positions spacing (m): Approximation for each position (m): Set tags: ?

Regular positions

On lines tagged: Start margin (m): End margin (m): Inverse ? -

Positions spacing (m): Approximation for each position (m): Set tags: ?



Ecoaf

Add trees on the positions

Monospecific tree planter

On positions tagged:

Tree selector

Species / variety:

Order: Height category:

Age: Min height (m): Max height (m):

Monospecific tree planter, doubled

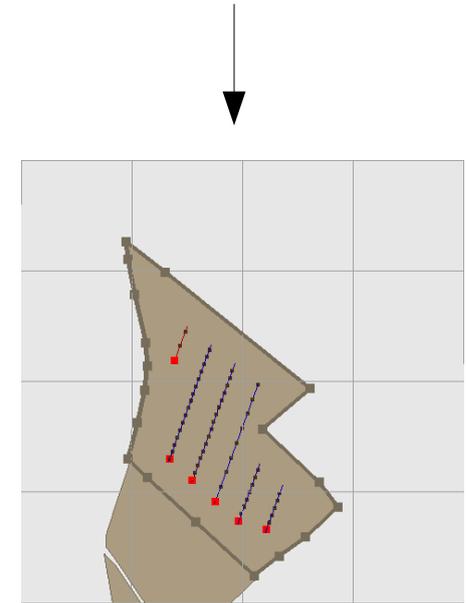
On positions tagged: Space between two trees (m):

Tree selector

Species / variety:

Order: Height category:

Age: Min height (m): Max height (m):



Add vegetation bands below the lines

Simple Strips

On lines tagged: Width (m): Mean height (m):

Vegetation

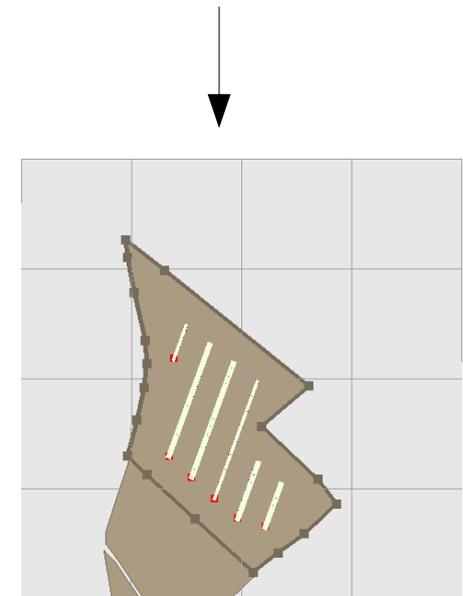
Species: %

Simple Strips

On lines tagged: Width (m): Mean height (m):

Vegetation

Species: %



Ecoaf

Add borders...



10 years after

Ecoaf is still under progress...

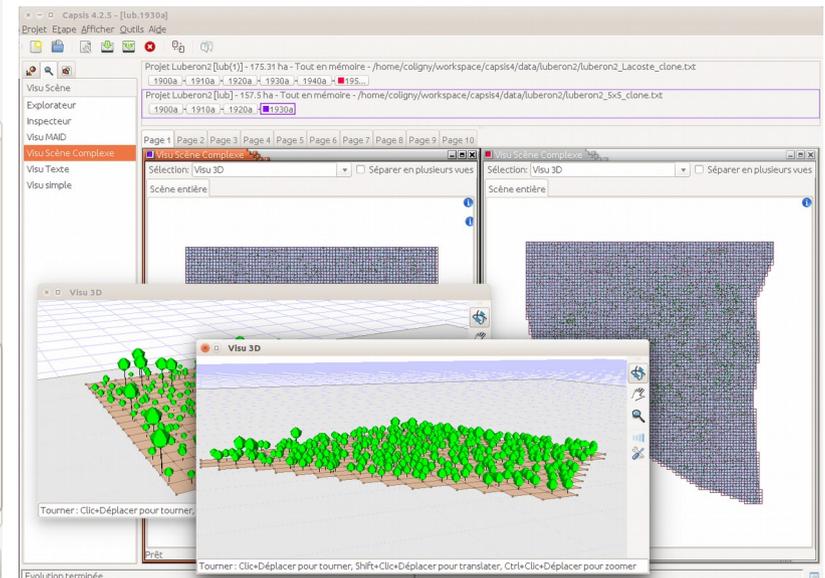
Luberon2

Connection to Metatrom (a Fortran genotype generator) by Leopoldo Sanchez (INRA AGPF, Orleans)

- technical connection with on the fly user reporting
- **assign the genotypes returned by Metatrom** to the Luberon2 trees
- work on Luberon2 growth and mortality
- interventions, graphs

```

0.001000 0.000100
target_additive_value_sd, size: 2...
7.435052 0.300000
chisq_threshold: 1.0000000000000000E-002
neu_gene_chrom, size: 20...
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
neu_gene_posit, size: 20...
41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
neu_gene_nalle, size: 20...
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
sel_gene_funct, size: 40...
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
sel_gene_chrom, size: 40...
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
sel_gene_posit, size: 40...
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33
exp_Qst: 0.0000000000000000 0.0000000000000000
ind_per_pop: 2475
  
```



Nicolas Beudez participated to meetings for Luberon2 users with F. Lefèvre and C. Godineau :

- 20 juin 2018, INRA Avignon : ONF-gestion et le Parc Naturel Régional du Luberon
- 21 juin 2018, INRA Avignon : RMT AFORCE (Adaptation des forêts au changement climatique) et IDF (Institut pour le Développement Forestier)
- 5 juillet, ONF de Paris : ONF-recherche, IDF, INRA

The Metatrom connection **was made generic** with Sylvie Muratorio and used for PDG

Phenofit5

Helped Daphnée Asse to transform latitudes / longitude from **Lambert to degrees**
Fine configuration support for **simulations with big amounts of memory**

Proposed a refactoring of capsis.lib.phenofit for phenofit5 and the daily level

-> **fit2018**

-> an additional package, better design, **easier to use and reuse** in other models

-> connection capsis.lib.castanea - fit2018

-> the users of the castanea lib have a better access to phenofit phenology functions

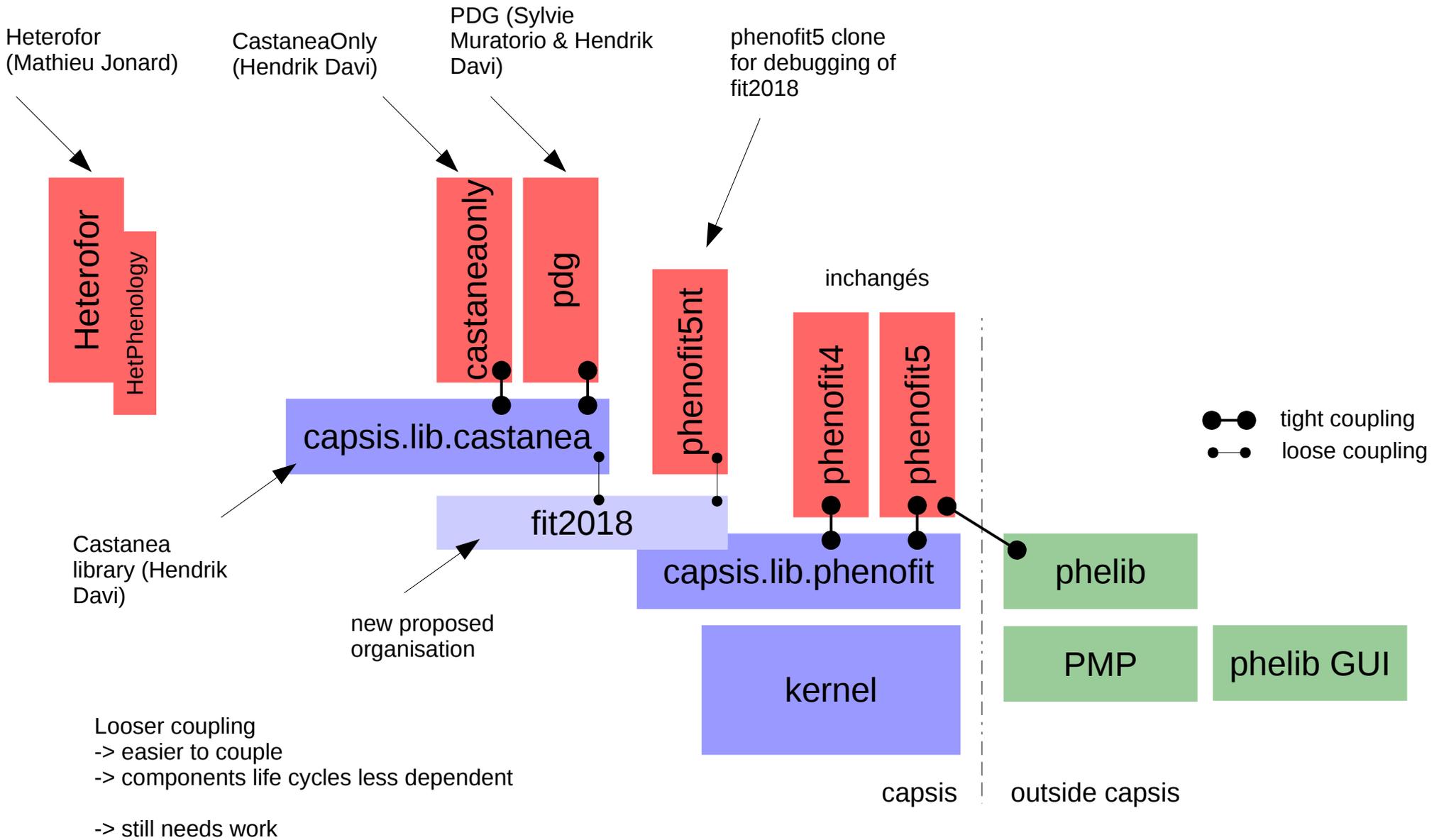
-> Valentin Journée in **CastaneaOnly**

-> Sylvie Muratorio in **PhysioDemoGenetics**

-> but the fit2018 functions need a technical rewriting

-> working on a test method to validate them against the original ones

Fit2018 - coupling models to phenofit phenology



Heterofor

Various actions :

- Heterofor was **connected to the capsis.lib.regeneration library** (P. Balandier, Irstea, Nogent sur Vernisson & N. Donès, INRA, Clermont-Ferrand) by Mathieu Jonard, Briec Ryelandt (UCL Louvain, Belgium) and Nicolas Donès
- Managed choice between **several radiative balance options**
- Added a **variable CO2 atmospheric concentration** during time
- Worked on the **phenology module** (Heterofor specific)
- Work under progress for better **performances while using an R optimisation package**
- Added tables and graphs
- Specific fixes, refactoring...

Castanea

R-Java connection : calling Capsis-Castaneaonly scripts from R (H. Davi)

Work on with **R + Java packaging** problems (Katalin Csillery, Stefan Zoller, ETH Zurich)

Built a **custom script** for Cathleen Petit, to perform many simulations with various inputs

Castanea - phenofit connection through the intermediary of fit2018

The screenshot shows the Capsis 4.2.5 software interface. The main window displays a project titled 'Projet Castaneaonly [cas] - 400 m2 - Tout en mémoire' with a file path: '/home/coligny/workspace/capsis4/data/castaneaonly/testPhenoVentoux-fc.txt'. Below the project name, there are buttons for years: 1958a, 1959a, 1960a, 1961a, 1962a, and 1963a. The 'Fichiers Log' window is open, showing a table of simulation results for the year 1963. The table has columns for date, fit4Day, leafDormancyBrea..., leafUnfoldingState, leafUnfoldingDate, leafSenescenceSta..., and leafSenescenceDate. An arrow points to the 'leafUnfoldingDate' column.

#date	fit4Day	leafDormancyBrea...	leafDormancyBrea...	leafUnfoldingState	leafUnfoldingDate	leafSenescenceSta...	leafSenescenceDate	flowe
1.12.1963 (335)	335	1.00373	12.1.1963 (12)	1.00238	12.5.1963 (132.83)	2.21758	3.10.1963 (276)	
2.12.1963 (336)	336	1.00373	12.1.1963 (12)	1.00238	12.5.1963 (132.83)	2.23361	3.10.1963 (276)	
3.12.1963 (337)	337	1.00373	12.1.1963 (12)	1.00238	12.5.1963 (132.83)	2.24957	3.10.1963 (276)	
4.12.1963 (338)	338	1.00373	12.1.1963 (12)	1.00238	12.5.1963 (132.83)	2.26778	3.10.1963 (276)	
5.12.1963 (339)	339	1.00373	12.1.1963 (12)	1.00238	12.5.1963 (132.83)	2.28798	3.10.1963 (276)	
6.12.1963 (340)	340	1.00373	12.1.1963 (12)	1.00238	12.5.1963 (132.83)	2.30853	3.10.1963 (276)	
7.12.1963 (341)	341	1.00373	12.1.1963 (12)	1.00238	12.5.1963 (132.83)	2.32934	3.10.1963 (276)	
8.12.1963 (342)	342	1.00373	12.1.1963 (12)	1.00238	12.5.1963 (132.83)	2.35048	3.10.1963 (276)	

leaf unfolding date

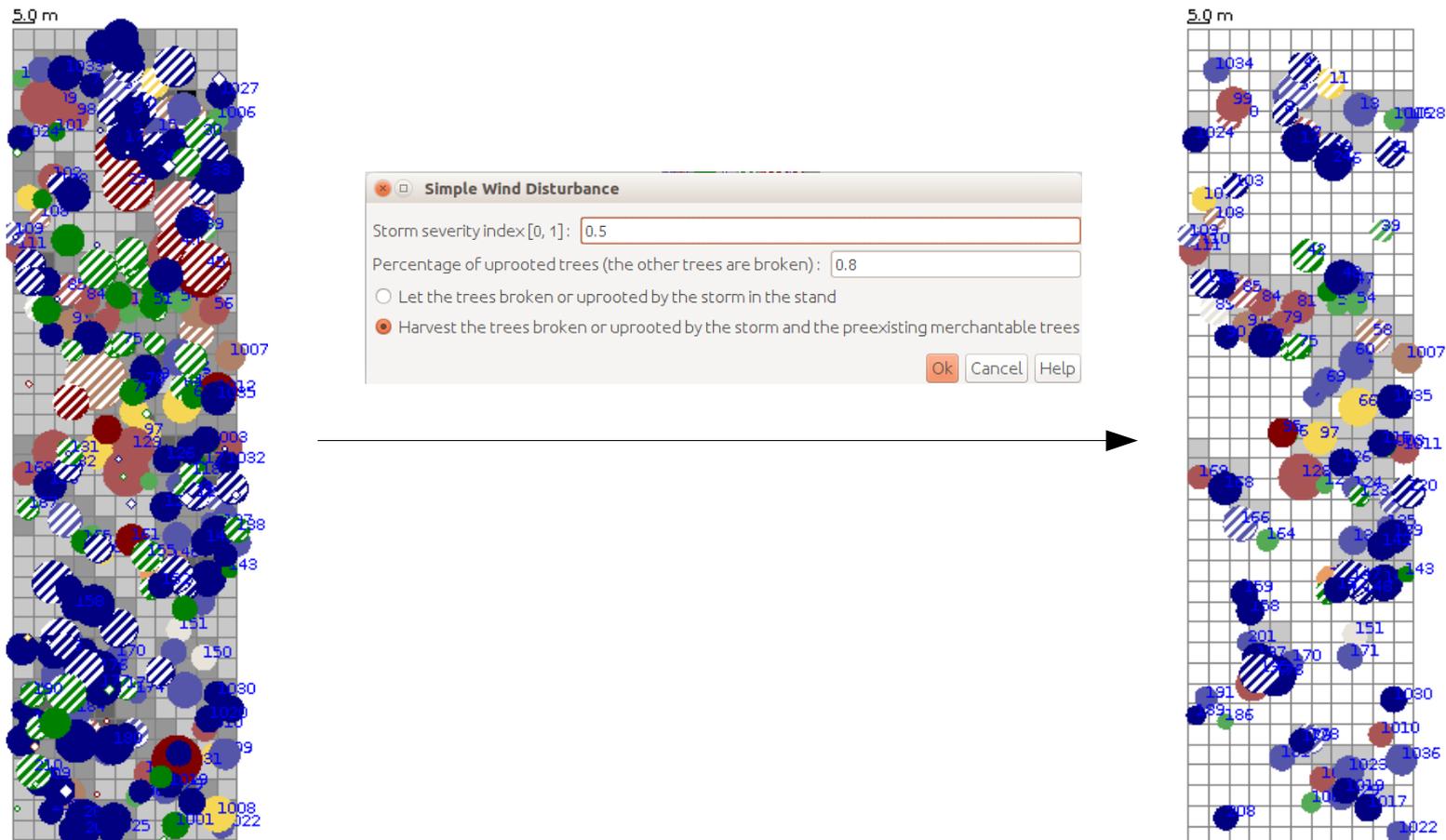
Samsara2

Dead wood in the simulation at inventory load time

A new intervention simulating a **simple wind disturbance**

Linked to dead wood compartments (uprooted...)

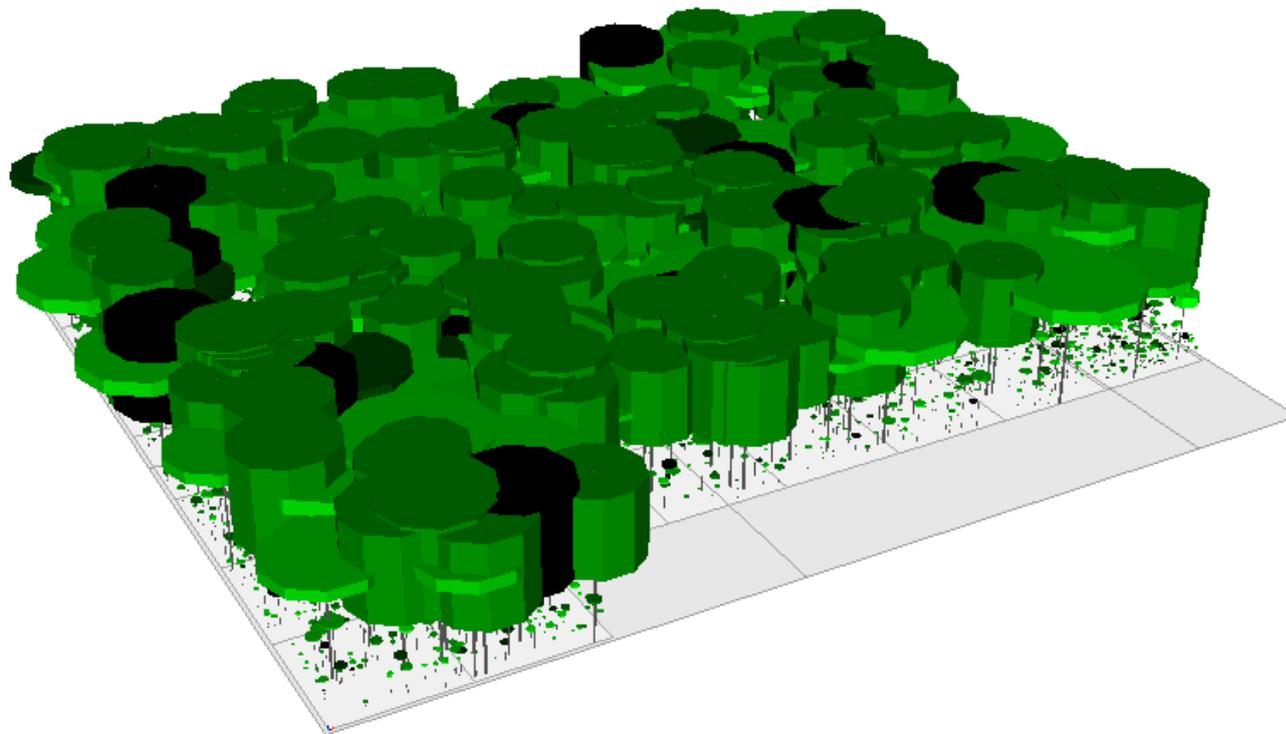
New graphs...



Forceps

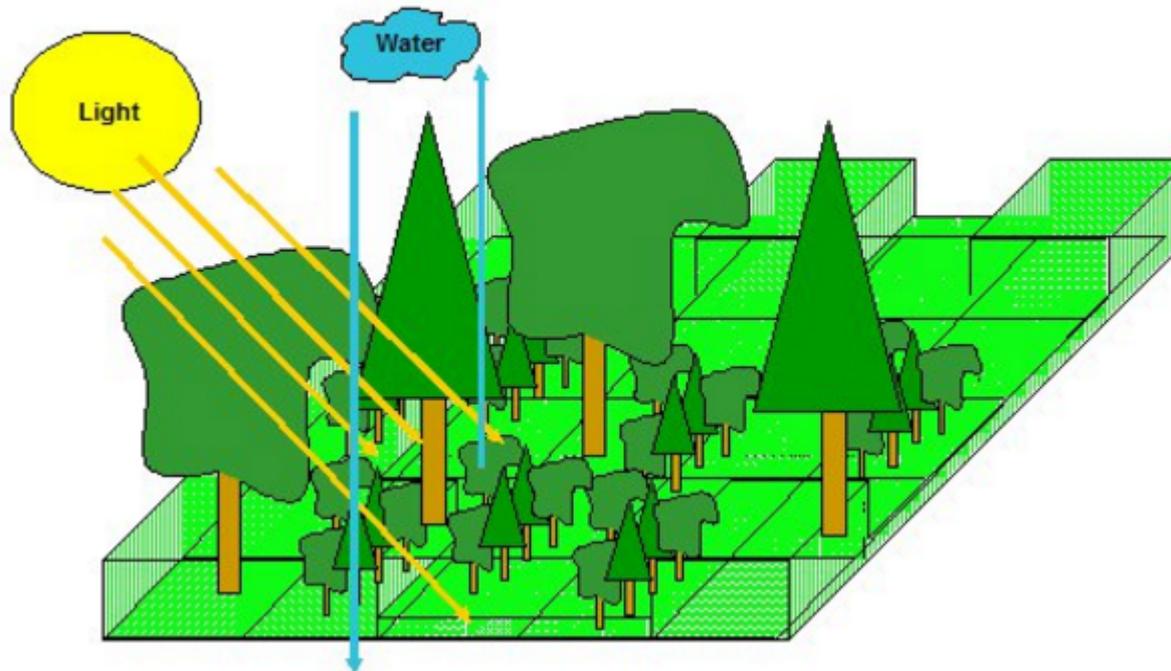
Added a crown length

- Changed the **competiton model** to take the crown length into account
- Restored a broken feature about **parameters intra specific variability**
- Added an intervention feature for Maude Toïgo



RReShar

- Water transfert in the soil
- Trees growth
- Soil layer physical characteristics
- Better hydric balance
- Exports for a better control
- Changed the inventory format, better graphical user interface, code cleaning...



Other actions

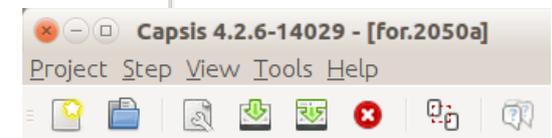
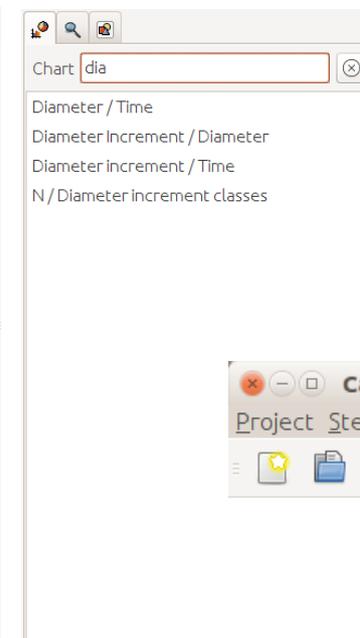
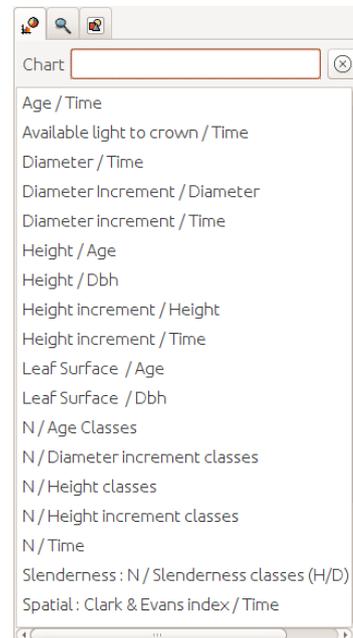
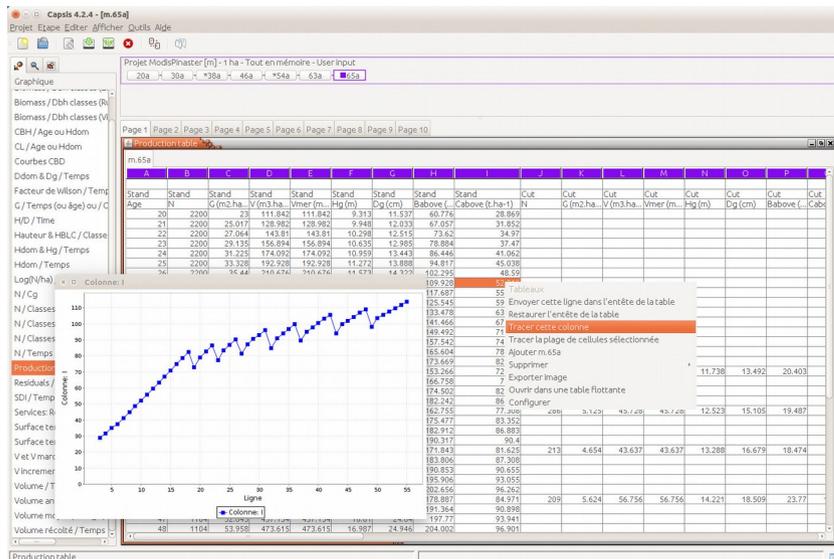
Forceps (Xavier Morin, CNRS CEFE, Montpellier)

Adapted the Capsis Frequency Memorizer to also keep in memory the previous step

Salem (Patrick Vallet, IRSTEA Grenoble) : worked on climatic files

PhysioDemoGenetics (Sylvie Muratorio, INRA URFM, Avignon) : redirection to a frozen instance of the castanea library (castanea2019) to isolate PDG from changes occurring on Castanea

- Worked on a big refactoring and cleaning of the Capsis extensions
- Better management for large legends in graphs, now opened in a separate dialog
- Added filtering features in the lateral selectors
- Added features to plot data from within a floating table
- Capsis 4.2.6



Capsis training course 2019 in Montpellier

Annual standard 2-days training course

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

31 January - 1 February

-> AMAP Montpellier

-> 7 attendees



Transfert

Capsis-ONF-2018 by Christine Deleuze (ONF RDI, Dole)

- January 2019
- contains 24 growth models, an additional installation documentation
- made available with the agreement of their authors to the french National Forest Office experts

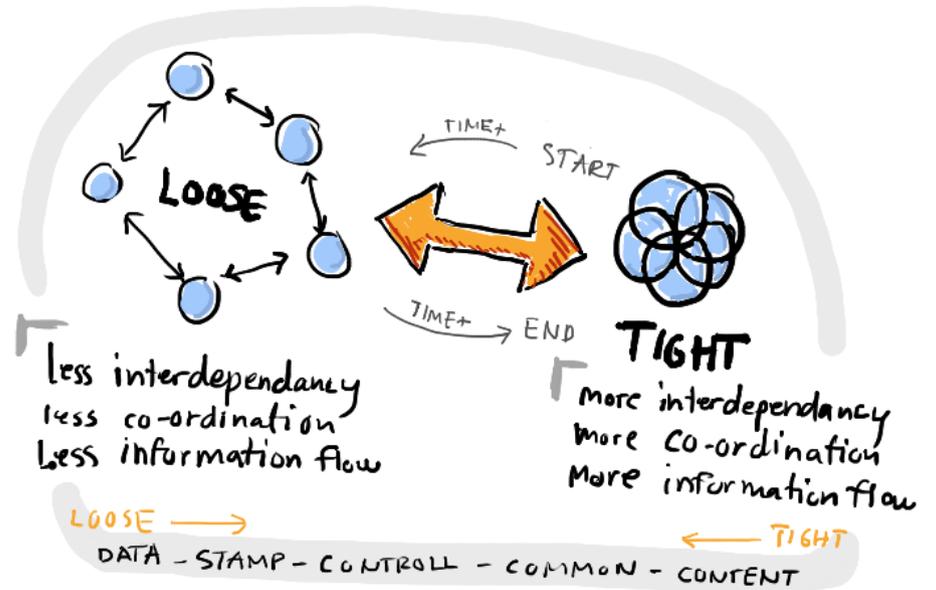
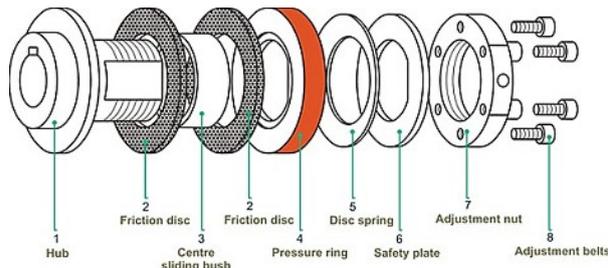
Module	Développeur /contact	Organisme	Description	Type	Espèces
Abial	Fred Mothe	INRA-LERFoB Nancy	Modèle de peuplement pur et équienne de sapin pour les Vosges et le Jura	MAID	<i>Abies alba</i>
Artémis	Mathieu Fortin	RMNF : Ressources naturelles et de la Faune du Québec	Modèle de Mathieu Fortin pour des peuplements mélangés du Québec	MAID	Mélange québécois
CA1	François Courbet	INRA-URFM	Modèle de peuplement pur et équienne de cèdre	MAID	<i>Cedrus atlantica</i>
Deesses	Patrick Vallet	IRSTEA-Ngent	Modèle de mélanges deux à deux sapin, épicéa et hêtre développé dans le cadre de la convention IRSTEA-ONF en 2013 Modèle de surface terrière par essence	Stand	<i>Abies alba & Picea abies & Fagus sylvatica</i>
Economics	Priscilla Cailly	FCBA	Module de calcul économiques		
Fagacées	Fred Mothe	INRA-LERFoB Nancy	Modèle de peuplement pur et équienne de chêne sessile ou hêtre, tenant compte des changements de productivité avant 2000 pour le hêtre (hêtre nord-Est ou hêtre Nord-Ouest et millésime)	MAID	<i>Quercus petrae & Fagus sylvatica en pures</i>
ForCeps	Xavier Motin	CNRS-CEFE, Montpellier	Modèle de dynamique forestière à plus large échelle tenant compte de la composition spécifique http://capsis.cirad.fr/capsis/_media/documentation/reports/2_morinxforceps.pdf	Trouées	
Gymnos	Gauthier Ljgot	Université de Liège Gembloux	Modèle de peuplement pur et équienne d'épicéa, de douglas ou de mélèze	MAID	<i>Pseudotsuga menziesii, picea abies & Larix sp.</i>
Heterofor	Mathieu Jonard	Université Catholique de Louvain	Modèle de croissance à base de processus : photosynthèse, bilan hydrique et nutritif http://capsis.cirad.fr/capsis/help_en/heterofor	MADD	<i>Quercus petrae, Fagus sylvatica</i>
Laricio	Sandrine Perret	IRSTEA-Ngent	Modèle de peuplement pur et équienne de pin laricio	MAID	<i>Pinus nigra Arn. ssp. laricio</i>
Mathilde	Mathieu Fortin	INRA	Modèle d'arbre dépendant des distances, possiblement en mélange	MADD	<i>Quercus petrae, Fagus sylvatica</i>
Modispinaster	Teresa Fidalgo Fonseca	UTAD CIFAP, Vila Real, Portugal	Modèle de peuplement pur et équienne de pin maritime	MAID	<i>Pinus pinaster</i>
NRG	Philippe Dreyfus	INRA-URFM	Modèle de peuplement pur et équienne de pin d'Alep avec branchaison	MAID	<i>Pinus halepensis</i>
Oakpine1	Thomas Perot	IRSTEA-Ngent	Modèle de mélange chêne sessile-pin sylvestre avec spatialisation des arbres	MAID	<i>Quercus petrae & Pinus sylvestris en mélange intime</i>
Oakpine2	Thomas Perot	IRSTEA-Ngent	Modèle de mélange chêne sessile-pin sylvestre avec environnement moyen des arbres	MADD	<i>Quercus petrae & Pinus sylvestris en mélange intime</i>
Organon	Nathaniel Osborne	Oregon State University	Modèle de Doug Maguire	MAID	<i>Pseudotsuga menziesii</i>
Piceaabies	Sébastien Cavaignac / Priscilla Cailly	FCBA	Modèle de peuplement pur et équienne d'épicéa	MAID	<i>Picea abies</i>
PNN2	Philippe Dreyfus	INRA-URFM	Modèle de peuplement pur et équienne de pin noir	MAID	<i>Pinus nigra nigricans</i>
Pseudotsugame	Sébastien Cavaignac	FCBA	Modèle de peuplement pur et équienne de douglas	MAID	<i>Pseudotsuga menziesii</i>
Regix	Olivier Pain / Priscilla Cailly	FCBA	Modèle pour TCR d'eucalyptus ou peuplier	Stand	<i>Eucalyptus & populus en pures</i>
Samsara	Benoit Courbaud	IRSTEA-Grenoble	Modèle de peuplement irrégulier et mélangé de sapin, épicéa et hêtre dans les alpes	MADD	<i>Abies alba & Picea abies & Fagus sylvatica en mélange irrégulier</i>
samsara2	Benoit Courbaud	IRSTEA-Grenoble	Evolution de Samsara	MADD	<i>Abies alba & Picea abies & Fagus sylvatica</i>
sydy	Philippe Dreyfus	ONF	Module expérimental Philippe Dreyfus sur ergonomie pour gestionnaires	MAID	<i>Quercus petrae, Fagus sylvatica</i>
Sylvestris	Sandrine Perret	IRSTEA-Ngent	Modèle de peuplement pur et équienne de pin sylvestre	MAID	<i>Pinus sylvestris</i>



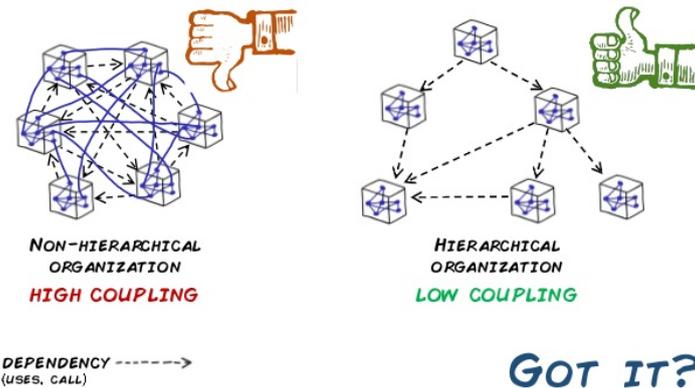
Conclusions and perspectives

Worked more this year on existing projects
New features, interconnections
Proposed a support for R - Java connections
Connections between libraries
More powerful
More complex





Thank you



GOT IT?