LUBERON2, a simulation tool for the evaluation of genetic impacts of silviculture practices (IGS)

Claire Godineau (INRA, ISEM) and Sabine Girard (CNPF)

LUBERON2 is a model of the CAPSIS platform consisting of three components: a model of demographic dynamics of the Atlas cedar (growth, self-thinning mortality, reproduction), a model of inter-individual genetic variation of demographic performances, a model of random disturbances regime. It is a tool for population simulation and graphical visualization of its demographic and genetic characteristics over time, allowing the effects of various different silvicultural routes in different disturbance contexts to be compared. This simulator works on spatially individualized trees, at the scale of a stand, over a few regeneration cycles.

A first distinctive feature of LUBERON2 is that genetic diversity is taken into account in both directions, it is a coupled demo-genetic model: genetic diversity has an effect on stand dynamics and the response to silviculture and, conversely, dynamics and silviculture influence the evolution of genetic diversity. A second original feature is that it takes into account a random disturbance regime that can be set.

This workshop will present a method of using LUBERON2 for educational purposes, to generally illustrate the potential genetic impacts in the short and medium term of a choice of silvicultural route, and to better understand the mechanisms of these impacts. The goal of the simulations presented is to open a new perspective regarding silvicultural practices: what is the impact of silviculture on the management of genetic resources?

LUBERON2 can also be used in a sharper and more detailed manner in management, in order to compare different silvicultural options specifically in the Atlas cedar, for example in the framework of adaptation strategy. It is also a research tool for analyzing the interaction mechanisms between silvicultural practices and disturbance regimes. The challenges of validating the quantitative predictions of simulations are complex: if each of the three components of the model results from empirical calibration or theoretical validation, we do not have readily available empirical data to compare the predictions of the coupled model, in particular in terms of genetics. A sensitivity study of the model coupled with the different demographic and genetic parameters remains to be realized. LUBERON2 continues to develop, and the approach initiated with LUBERON2 on the Atlas cedar case will soon be extended to other species, or even other types of forest stands.

LUBERON2 was developed at INRA by **Claire Godineau, Nicolas Beudez, François de Coligny, Sylvie Muratorio, Leopoldo Sanchez, François Courbet, Christine Deleuze** (ONF), **Christian Pichot and François Lefèvre**, with the help of the project partners Evaluation of genetic impacts of silvicultural practices for adaptation, co-funded by RMT AFORCE and GC84.

Démonstration d'outils en groupes
Colloque Aforce 2019

LUBERON2, un outil de simulation pour l'évaluation des impacts génétiques des pratiques sylvicoles

Claire Godineau, Nicolas Beudez, François de Coligny, Sylvie Oddou-Muratorio, François Courbet, Christian Pichot, Leopoldo Sanchez, Christine Deleuze, François Lefèvre

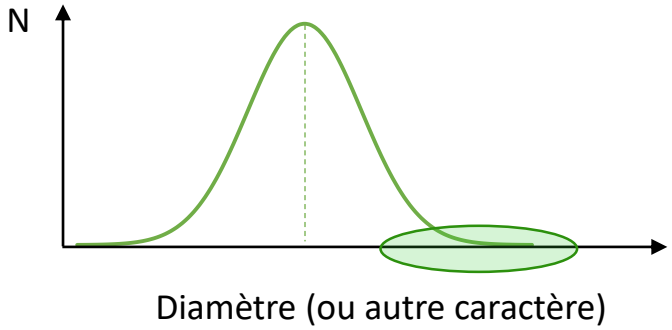
Démonstration d'outils en groupes
Colloque Aforce 2019

IGS : Impacts Génétiques de la Sylviculture

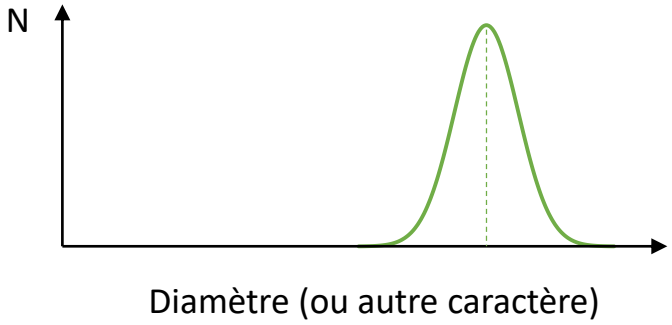
Coordination : François Lefèvre, INRA

Elimination des arbres et sélection génétique

Avant élimination



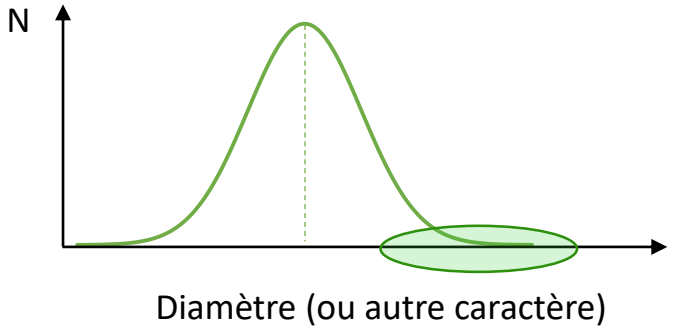
Après élimination



- Diamètre moyen ↗
- Variance des diamètres ↘

Elimination des arbres et sélection génétique

Avant élimination



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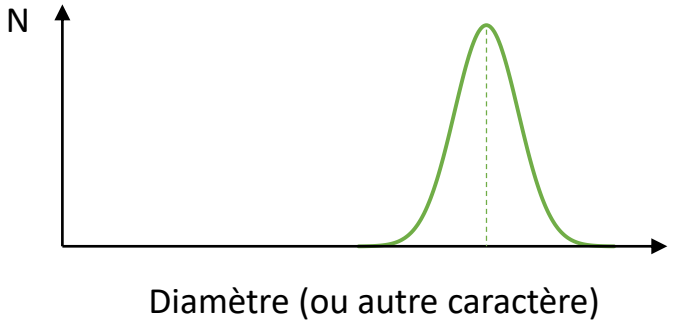
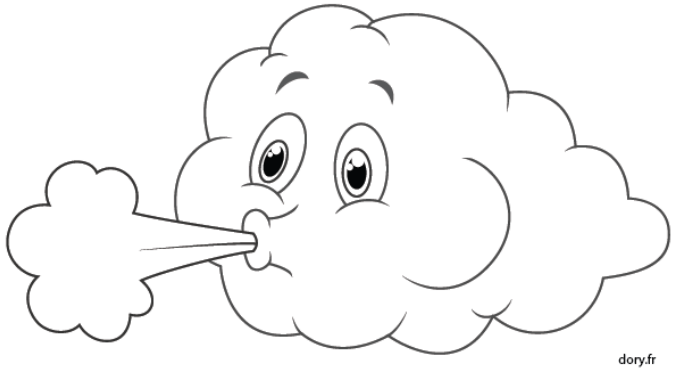


- Diamètre moyen ↗
- Moyenne génétique ↗
- Variance des diamètres ↘
- Variance génétique ↘

Deux paramètres importants: la **moyenne** (qualité génétique actuelle) et la **variance** (potentiel d'évolution future)

Perturbations

https://terremag.fr



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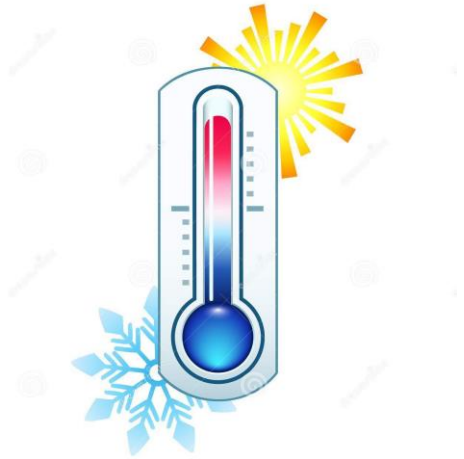

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Perturbations

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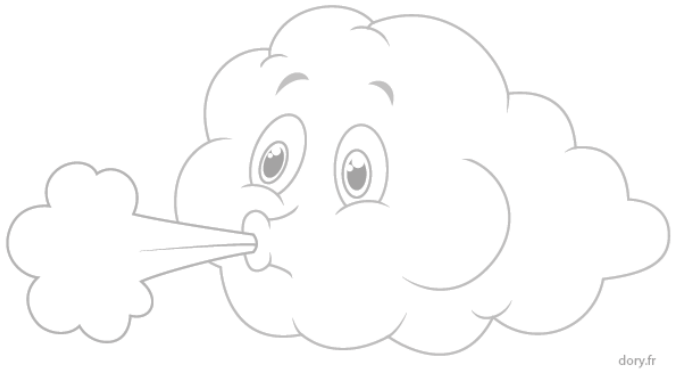

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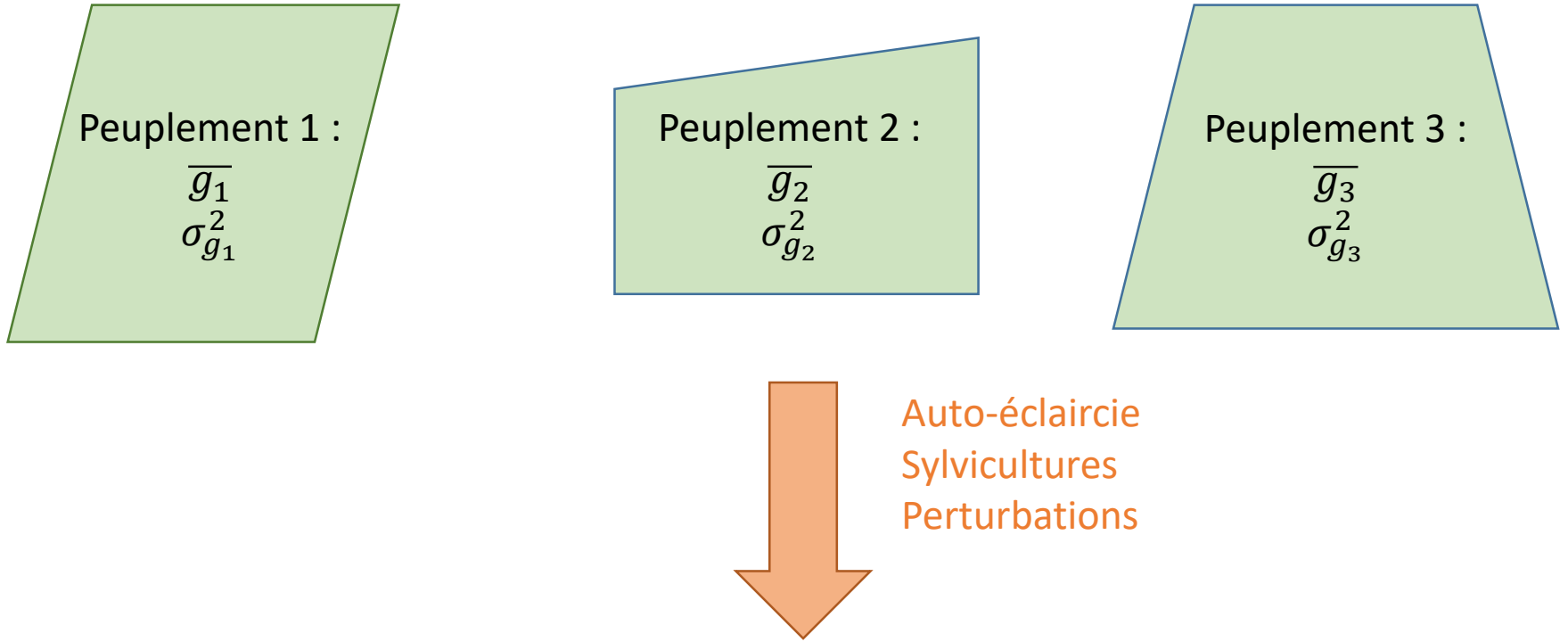
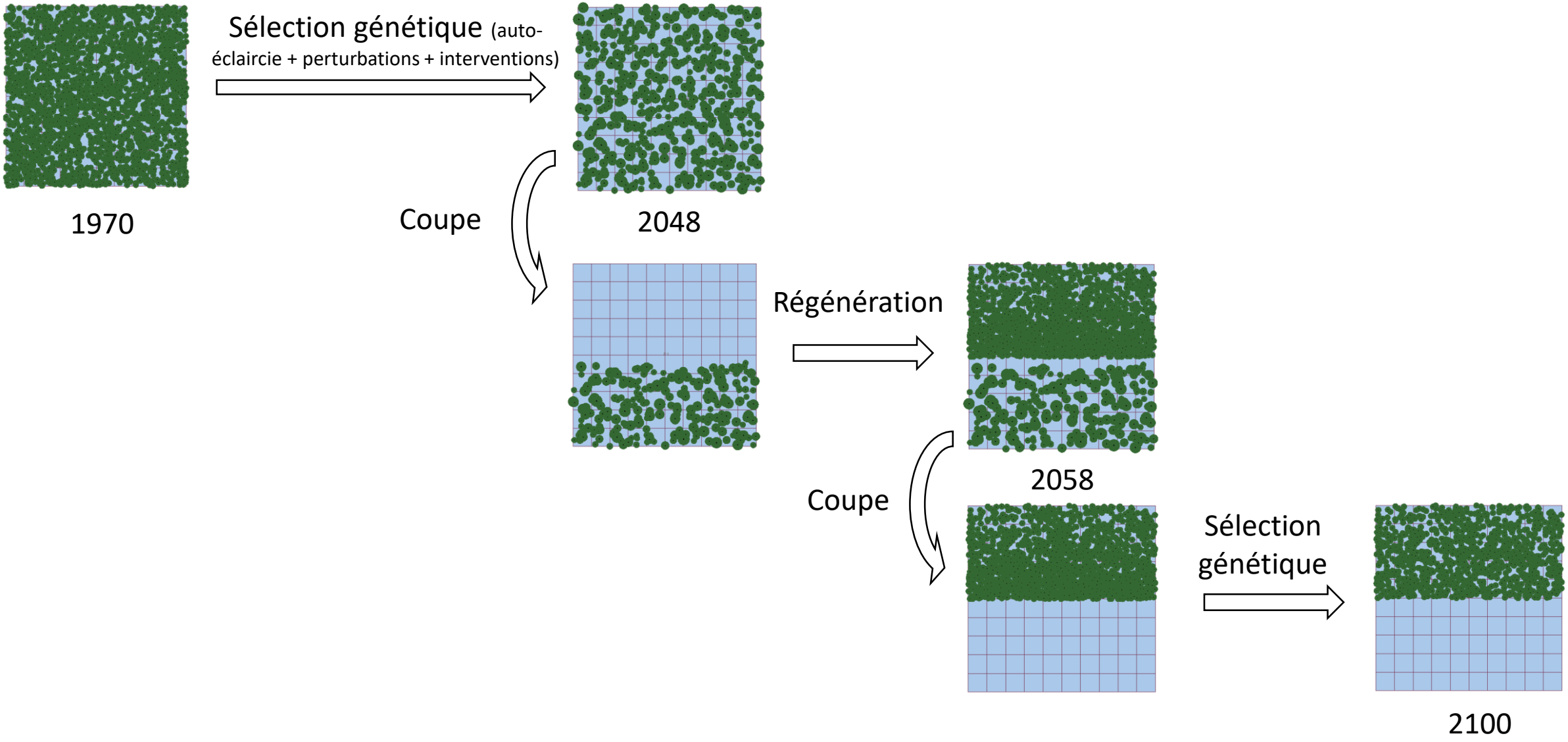
https://thumbs.dreamstime.com

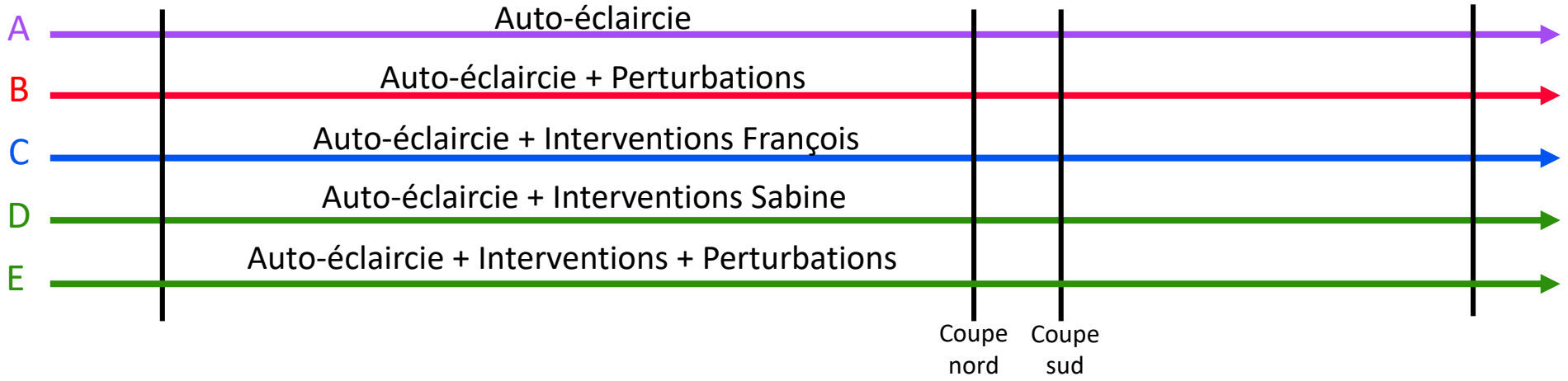
Comment évoluent la moyenne et la variance génétique ?

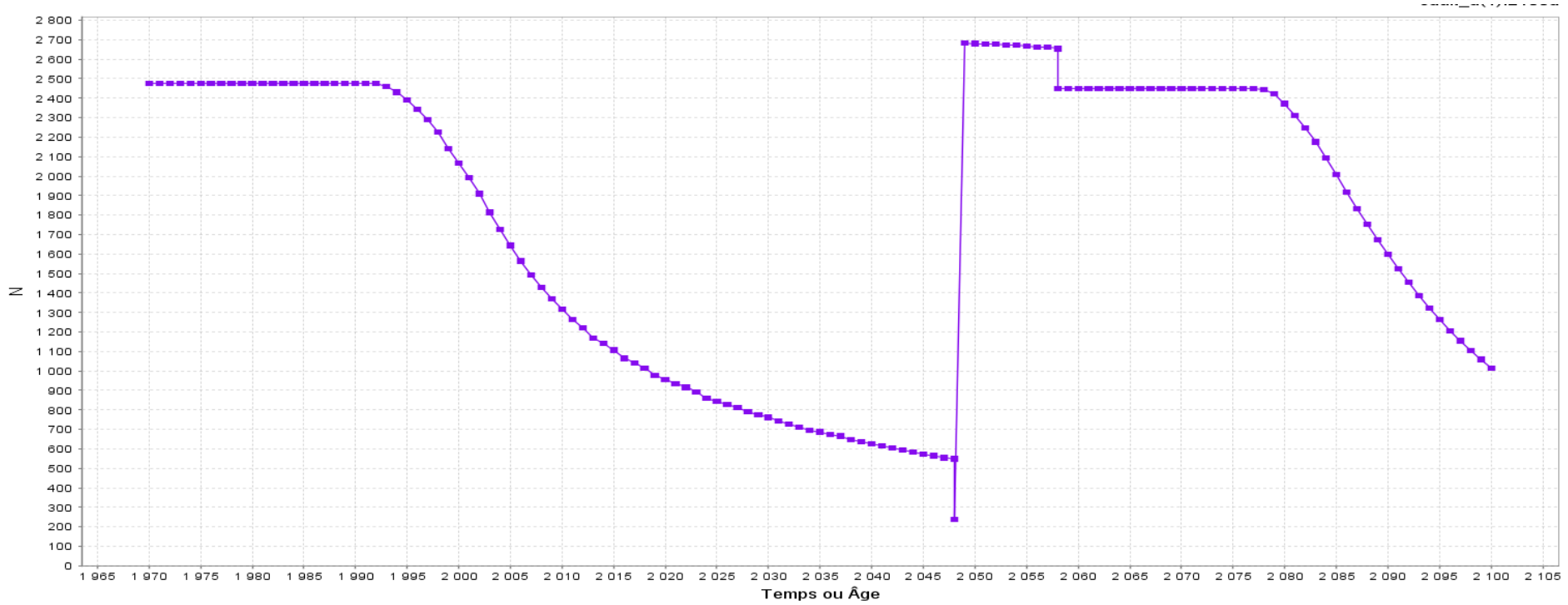


Scenarios

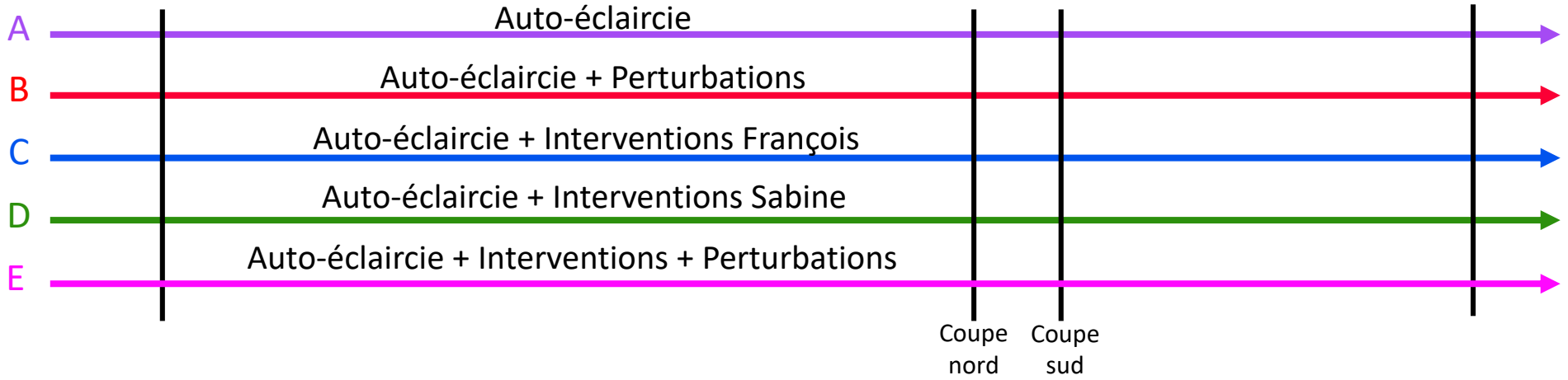

Sélection génétique (auto-éclaircie + perturbations + interventions)
1970
2048
Coupe
Régénération
2058
Coupe
Sélection génétique
2100

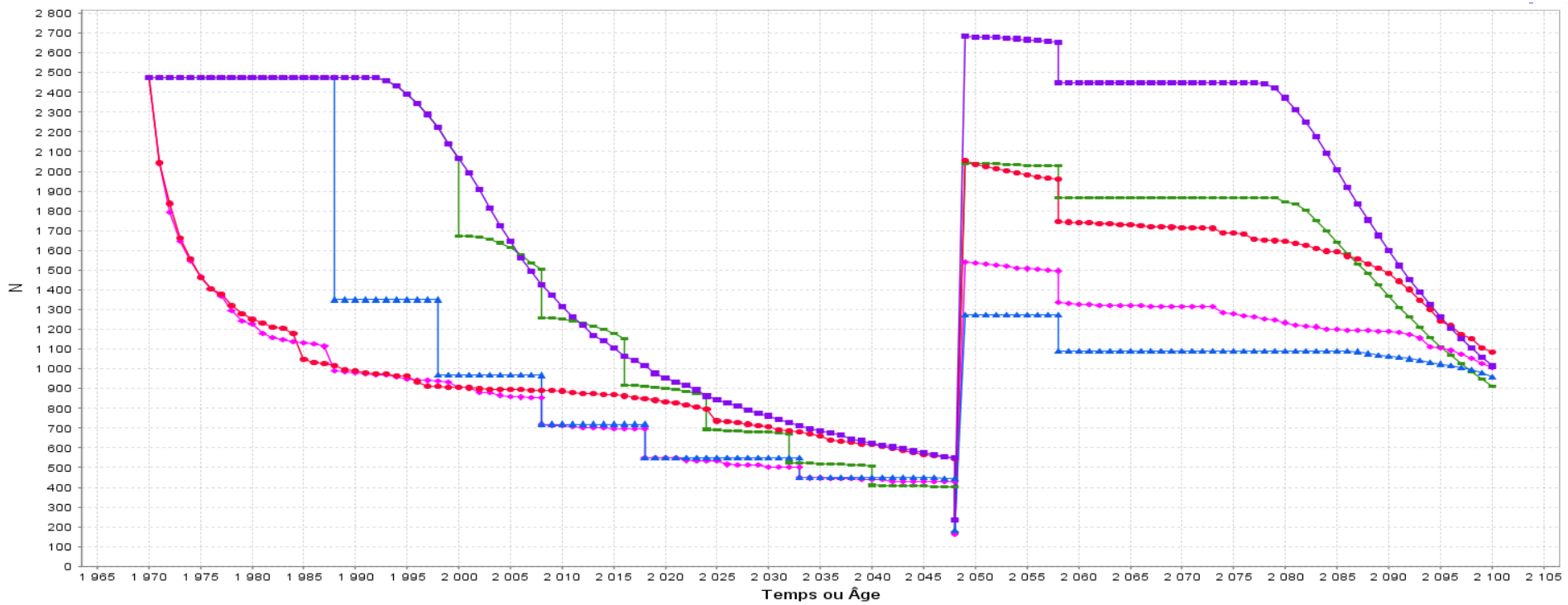
Effectif au cours du temps



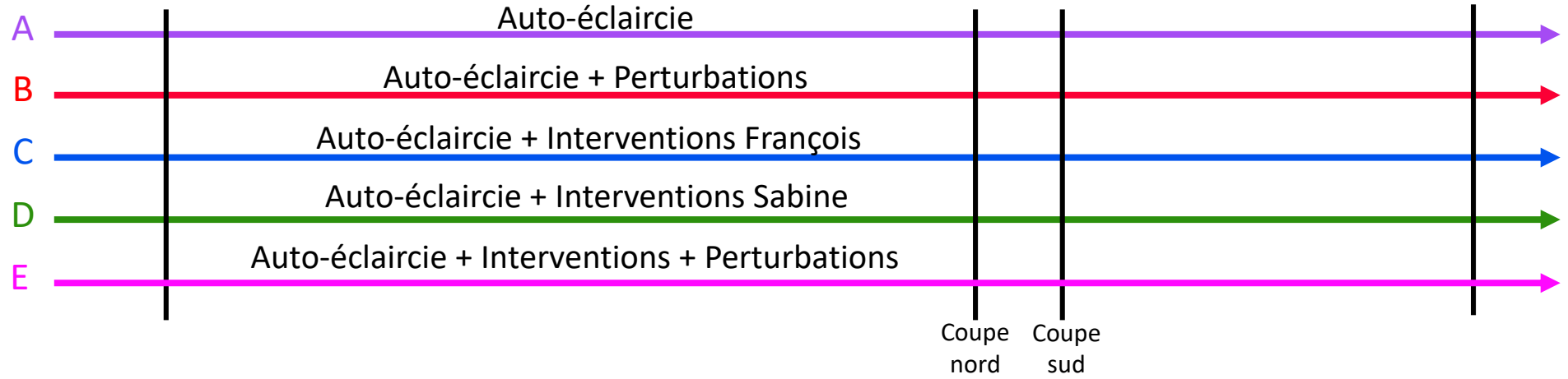


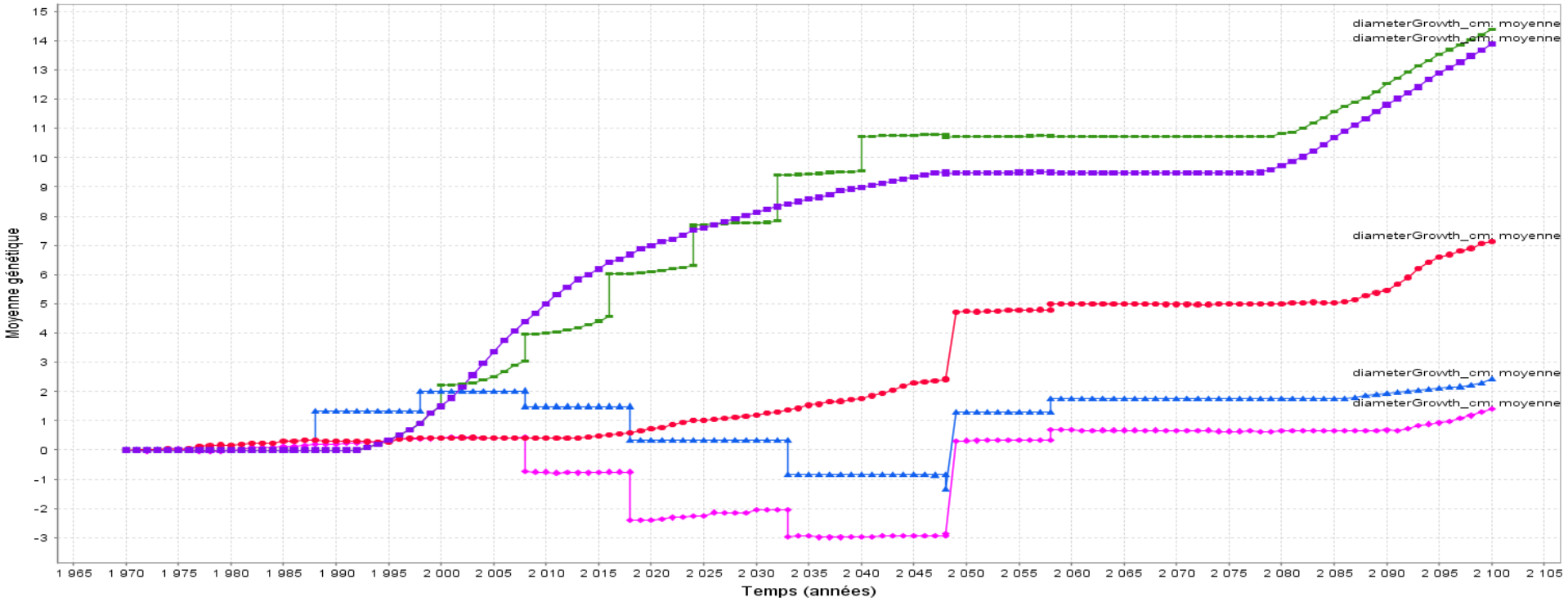
Effectif au cours du temps



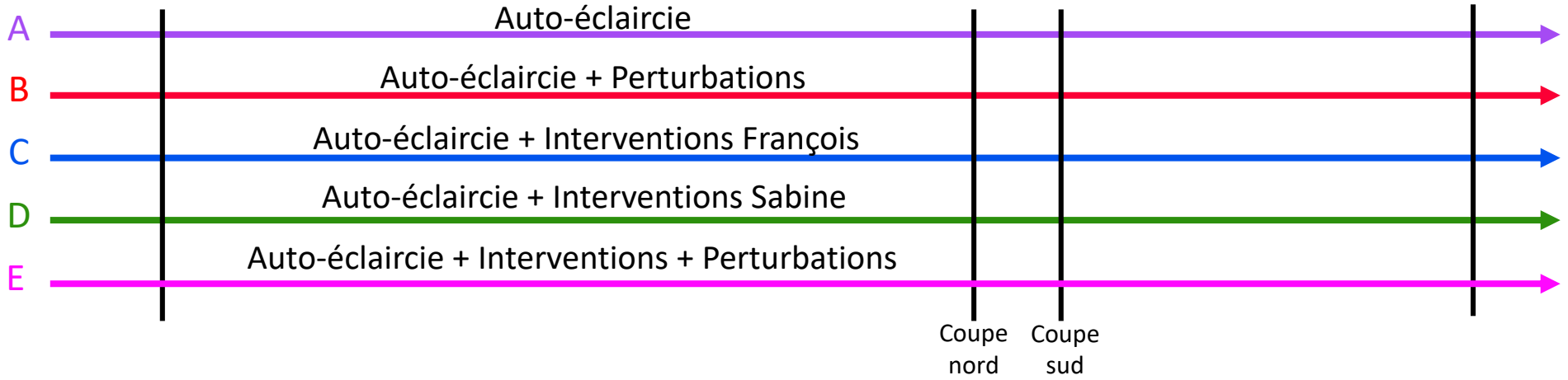


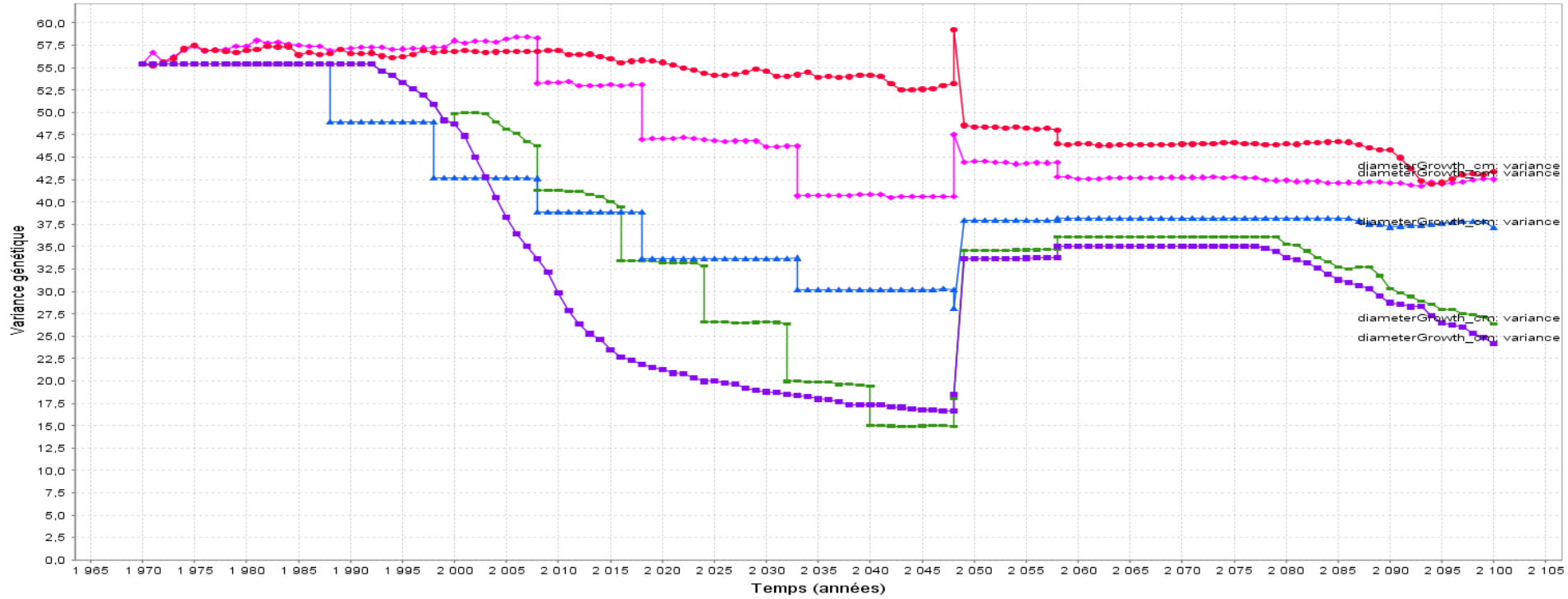
Moyenne génétique au cours du temps





Variance génétique (potentiel évolutif) au cours du temps





Merci de votre attention