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Réseau de **G**énéti**q**ue **F**orestière pour la Recherche et l'**E**xpérimentation



GEN4x : an experimental network for studying adaptation of forest trees to climate change

Bruno Fady¹, Guillaume Bodineau², Catherine Ducatillon³, Céline Meredieu⁴, Célia Michotey², Michel Verger²

¹INRA URFM Avignon <bruno.fady@inra.fr>, ²INRA UE GBFor Orléans, ³INRA UEVT Antibes, ⁴INRA UEFP Bordeaux, ⁵INRA URGI Versailles



Forests are both threatened by climate change and part of the mitigation solutions

"Climate change, including increases in frequency and intensity of extremes, has adversely impacted food security and terrestrial ecosystems as well as contributed to desertification and land degradation in many regions... Sustainable land management, including sustainable forest management, can prevent and reduce land degradation, maintain land productivity, and sometimes reverse the adverse impacts of climate change on land degradation (very high confidence). It can also contribute to mitigation and adaptation (high confidence)." IPCC 2018

Options include the conservation of genetic resources *in-situ*, *ex-situ* and genetic breeding. State of art knowledge is warranted on the processes involved in genetic adaptation. This is the goal of GEN4x.

Climate change context (IPCC 2018)

"Human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate (high confidence)."

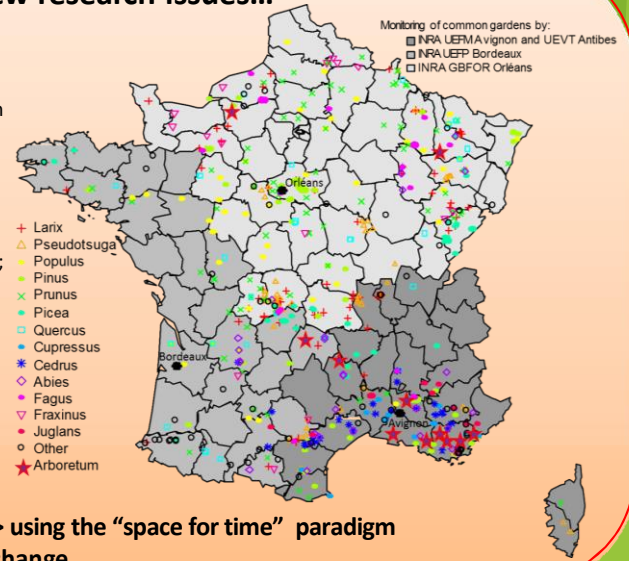
The GEN4x network : a strategic tool for new research issues...

A network of common gardens : over 1000 species tested in arboreta for their response to climate variations, among which 606 species of potential interest for forestry are in "elimination" arboreta and 50 species from 20 genera are in provenance, progeny and clonal tests. More than 2,5 million trees were planted on over 2000 hectares since the 1960s, and are monitored for key ecological and economical-value traits such as survival, growth, phenology, wood density, pest and disease resistance, tolerance to drought and frost, etc.



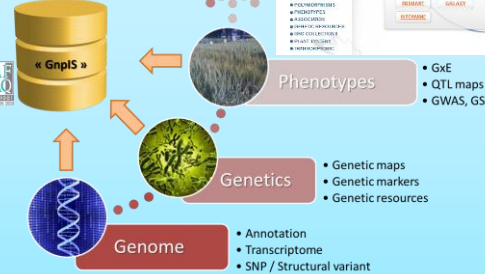
- Main strengths of the GEN4x network :
 - Inter and intra specific diversity (range wide sampling);
 - Unique spatio-temporal dimension :
 - identical "genetic units" installed in various pedo-climatic and silvicultural environments;
 - long term monitoring by specialized teams;
 - Repeated and statistically rigorous experimentations
 - A policy of open access to metadata and data
 - A dedicated information system: GnpIS
 - A biological and genetic resource for laboratory testing.

Study of interactions between genetic units and the environment => using the "space for time" paradigm for the study of adaptation to climate change.



<https://urgi.versailles.inra.fr/Tools/GnpIS>

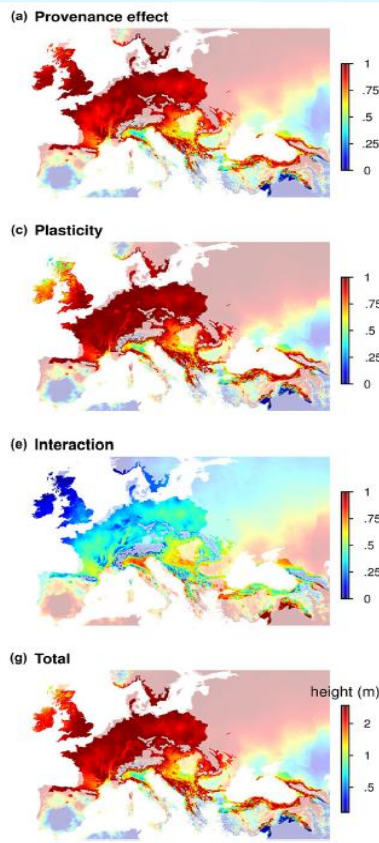
GnpIS:
a dedicated central information system for archiving, mining, sharing and using the GEN4X common garden metadata and data – and more!



The GEN4X network is a component of two national research infrastructures: **IN-Sylva** (<https://www6.inra.fr/in-sylva-france/>) and **RARE** (<https://pilierforet.inra.fr/>)

More on GEN4x at:
<http://www.efpa.inra.fr/Outils-et-Ressources/Systemes-d-experimentation-et-d-observation/Reseau-GEN4X>

Using GEN4x common garden data to predict genetic effects to suitability of *Quercus petraea* (Matt.) Liebl. across its range in Europe



The model predicts the variation of total height of 12 year old trees as a function of provenance (a), plasticity (c), genetic x environment interaction (e) and total (g) effects. Both provenance (genetic) and plasticity effects indicate significant lag in growth at the southern edge (Fréjaville et al. Global Ecology & Biogeography, 2019 - DOI: 10.1111/geb.12930).



Results from H2020 EU project **GenTree**. See:
<http://www.gentree-h2020.eu/>

