Compilation of posters

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Background mortality drivers of European tree species: climate change matters

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Increases of tree mortality rates have been highlighted in different biomes over the past decades**.** However, disentangling the effects of climate change on the temporal increase of tree mortality from those of management and forest dynamics remains a challenge. Using a modeling approach taking tree and stand characteristics into account, we sought to evaluate the impact of climate change on background mortality for the most common European tree species. We focused on background mortality, which is the mortality observed in a stand in the absence of abrupt disturbances, to avoid confusion with mortality events unrelated with long-term changes in temperature and rainfall. We studied 372,974 trees including 7,312 dead trees from forest inventory data surveyed across France between 2009 and 2015. Factors related with competition, stand characteristics, management intensity, and site conditions were the expected preponderant drivers of mortality. Taking these main drivers into account, we detected a climate change signal on 45% of the 43 studied species, explaining an average 6% of the total modeled mortality. For 18 out of the 19 species sensitive to climate change, we evidenced greater mortality with increasing temperature or decreasing rainfall. By quantifying the mortality excess linked to the current climate change for European temperate forest tree species, we provide new insights into forest vulnerability that will prove useful for adapting forest management to future conditions.

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Resource INFrastructures for monitoring, adapting and protecting European Atlantic FORests under Changing climatE (REINFFORCE): presentation of the arboreta network and first results

Christophe Orazio, Hernán Serrano-León, António Correia

The forestry sector is strongly dependent on a limited number of tree species whose long-term performance is increasingly threated by climate change impacts. In order to sustain their productivity and mitigation capacity, the adaptation potential of our productive forests needs to be increased by diversifying the number of available species with better-adapted provenances. It is therefore crucial to provide forest owners and managers with empirical evidences on the potential performance of alternative species/provenances under a future climate. However, most of the current available information is originated from models that do not account for species/provenance plasticity, nor climatic conditions outside their current distribution.

With the aim of reducing the uncertainty in the selection of adapted material, the REINFFORCE arboreta network was established along the European Atlantic arc (between latitudes 37°- 58° N) to test current and alternative species/provenances under contemporary and future climates. We present the field performance results at early stage of 33 different tree species under the wide gradient of climatic conditions covered by the 38 network sites. We identified the climate drivers which better explain growth and survival performance, and the best and worst performing species under different climatic conditions. We also present a risk analysis for predicted performance for RCP 4.5 and 8.5 climate change scenarios.

Our results will improve the knowledge about the site - climate matching of alternative planting species and the prediction of its behavior in response to future climate, providing evidences for recommended plantation material with real adaptive capacity to climate change.

An economic comparison of adaptation strategies towards a drought-induced risk of forest decline

Article written by Sandrine Brèteau-Amores, Marielle Brunette and Hendrik Davi

Drought is one of the main sources of stress to forest health (Zierl, 2004), although its impacts have been underestimated for a very long time due to inconspicuous damage at first sight (Spiecker, 2003). Drought results in a loss of tree growth, which results in both economic and social losses. Indeed, forests play a role in wood production, but also offer many ecosystem services (carbon storage, soil erosion preservation, biodiversity). At the same time, drought-induced tree decline is increasing significantly worldwide (Bréda and Badeau, 2008), especially as climate change increases the frequency, duration and intensity of extreme events (Dale *et al*., 2001).
Human interventions also affect drought through silviculture. Indeed, sustainable forest management is necessary to maintain the resilience of forest ecosystems and to address climate threats such as drought (Bréda and Badeau, 2008). More specifically, forest owners can protect their forests by adapting and several strategies are recommended to adapt forests to the increasing risks of drought. These measures include reducing the rotation length or the initial stand density, as well as substituting species that are better adapted to drought (Spittlehouse and Stewart, 2003).
In the literature, few studies have addressed the issue of climate change adaptation from the perspective of forest economics (Hanewinkel *et al*. (2010), Brunette *et al*. (2014), Yousefpour and Hanewinkel (2014)). Only the article by Bréda and Brunette (2019) deals with adaptation to the risk of forest decline induced by drought. Moreover, the entire literature reveals that the articles always focus on only one strategy at a time. They have never compared different strategies or analysed their combinations. The study by Jönsson *et al*. (2015), which compares different adaptation strategies to storms, is probably an exception. Finally, climate scenarios are rarely taken into account.
In this context, the objective of our article is to compare economically different adaptation strategies to fight against drought-induced risk of forest decline. To do this, we propose an original approach that combines CASTANEA, a process-based forest-growth model, with a classical forest economic analysis. CASTANEA is a mechanistic model for simulating the functioning of the main European species (Davi *et al*., 2005; Dufrêne *et al*., 2005). The model simulates the main stocks of the forest ecosystem (carbon, water, nitrogen) aboveground and belowground. CASTANEA was chosen because it is the only model that simulates both carbon sequestration (Davi *et al*., 2006) and tree growth (Davi *et al*., 2009), while integrating the mortality risk associated with water stress (Davi and Cailleret, 2017) and taking into account the specificities of each species, unlike global models.
We focus on a case study of a beech forests in Burgundy (France). Beech (*Fagus sylvatica* L.) is a natural species representing 15% of the forest area of production in France. However, due to climate change, it could decline or even disappear from France (Charru *et al*., 2010). Indeed, the increase in the frequency and intensity of spring droughts and heat waves has already negatively affected the annual growth of beech trees (Latte *et al*., 2015). We are therefore studying several options for adapting beech forests: reducing the initial stand density, reducing the rotation length and substituting beech by Douglas-fir, a more drought-tolerant species.
We simulate forest stands according to these different adaptation strategies, under two IPCC climate scenarii (RCP 4.5 and 8.5) and for two levels of drought risk related to a variation in soil water capacity (intermediate and high). We also consider spatial and climatic variability by performing these simulations through four SAFRAN points. We then use the outputs of CASTANEA to make an economic comparison of adaptation strategies.
We perform a classical forest economics analysis based on the Faustmann's formula and Hartman's formula. Faustmann's LEV takes into account the costs and benefits of wood production, while

Hartman's LEV also takes into account the benefits from amenities, in our case, carbon sequestration. Maximizing these criteria shows that adaptation offers the best economic return, as opposed to the baseline or the “do-nothing” scenario. Indeed, substitution with Douglas, combined with a reduced initial density and a reduced rotation length, seems to be the best strategy under both levels of drought risk and both climate scenarii. From an economic point of view, the combination of different strategies is therefore more beneficial for the forest owner than each strategy separately (synergy vs. additionality). Indeed, the combination of strategies offers flexibility to owners in addition to adaptive capacity. The same result is obtained by integrating the valuation of carbon sequestration into the economic analysis, but with higher land values.

Our study therefore shows the need to adapt beech forests in Burgundy. More generally, we show the importance of comparing and combining different adaptation strategies, while integrating climate change. In this context of climate uncertainty, it is essential to take carbon into account in this type of analysis. Finally, we highlight the importance of considering the different ecosystem services, in order to preserve the multifunctionality of forests, and to strengthen the link between forest ecology and forest economy.

References

Bréda, N. and Badeau, V. (2008). Forest Tree Responses to Extreme Drought and Some Biotic Events: Towards a Selection According to Hazard Tolerance? *Comptes Rendus Geoscience*, 340(9): 651-662.

Bréda, N. and Brunette, M. (2019). Are 40 years better than 55? An analysis of the reduction of forest rotation to face drought event in a Douglas fir stand. *Annals of Forest Science*. DOI: 10.1007/s13595-019-0813-3.

Brunette, M. *et al*. (2014). Economics of Species Change Subject to Risk of Climate Change and Increasing Information: a (Quasi-) Option Value Analysis. *Annals of Forest Science*, 71(2): 279-290.

Charru, M. *et al*. (2010). Recent Changes in Forest Productivity: an Analysis of National Forest Inventory Data for Common Beech (*Fagus sylvatica* L.) in North-Eastern France. *Forest Ecology and Management*, 260(4): 864-874.

Dale, V. *et al*. (2001). Climate Change and Forest Disturbances. *BioScience*, 51:723–734.

Davi, H. and Cailleret, M. (2017). Assessing Drought-Driven Mortality Trees with Physiological Process-Based Models. *Agricultural and Forest Meteorology*, 232:279–290.

Davi, H. *et al*. (2005). Modelling Carbon and Water Cycles in a Beech Forest. Part II: Validation of the Main Processes from Organ to Stand Scale. *Ecological Modelling*, 185(2): 387-405.

Davi, H. *et al*. (2006). Sensitivity of Water and Carbon Fluxes to Climate Changes from 1960 to 2100 in European Forest Ecosystems. *Agricultural and Forest Meteorology*, 141(1):35–56.

Davi, H. *et al*. (2009). The Fundamental Role of Reserves and Hydraulic Constraints in Predicting LAI and Carbon Allocation in Forests. *Agricultural and Forest Meteorology*, 149(2):349–361.

Dufrêne, E. *et al*. (2005). Modelling Carbon and Water Cycles in a Beech Forest. Part I: Model Description and Uncertainty Analysis on Modelled NEE. *Ecological Modelling*, 185(2): 407-436.

Hanewinkel, M. *et al*. (2010). Modelling and Economic Evaluation of Forest Biome Shifts under Climate Change in Southwest Germany. *Forest Ecology and Management*, 259(4): 710-719.

Jönsson, A.M. *et al*. (2015). Forest Management Facing Climate Change - an Ecosystem Model Analysis of Adaptation Strategies. *Mitigation and Adaptation Strategies for Global Change*, 20(2): 201-220.

Latte, N. *et al*. (2015). Dendroécologie du Hêtre en Forêt de Soignes: les Cernes des Arbres Nous Renseignent sur les Changements Récents et Futurs. *Forêt Nature*, 137(Octobre-Novembre-Décembre): 24-37.

Spiecker, H. (2003). Silvicultural Management in Maintaining Biodiversity and Resistance of Forests in Europe—Temperate Zone. *Journal of Environmental Management*, 67(1): 55-65.

Spittlehouse, D.L. and Stewart, R.B. (2003). Adaptation to Climate Change in Forest Management. *BC Journal of Ecosystems and Management*, 4(1).

Yousefpour, R. and Hanewinkel, M. (2014). Balancing Decisions for Adaptive and Multipurpose Conversion of Norway Spruce *(Picea abies* L. Karst) Monocultures in the Black Forest Area of Germany. Forest Science, 60(1): 73-84.

Zierl, B. (2004). A Simulation Study to Analyse the Relations Between Crown Condition and Drought in Switzerland. *Forest Ecology and Management*, 188(1): 25-38.

An economic comparison of adaptation strategies towards a drought-induced risk of forest decline

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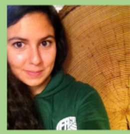


INTRODUCTION

Context:

- **Drought** is a **source of stress affecting forest growth** and resulting in **financial losses** for forest owners and **amenity losses** for society.
- Such natural event will be **more frequent and intense** in the future due to **climate change**.
- A way to cope with this increasing risk is to **implement adaptation strategies (through silviculture)**.

Objective:

Comparison, from an economical perspective, of different forest adaptation strategies towards drought-induced risk of decline, in terms of financial balance (forest owner) and carbon balance (society).

MATERIAL AND METHODS

Combination of a forest growth simulator (CASTANEA) with a traditional forest economics approach

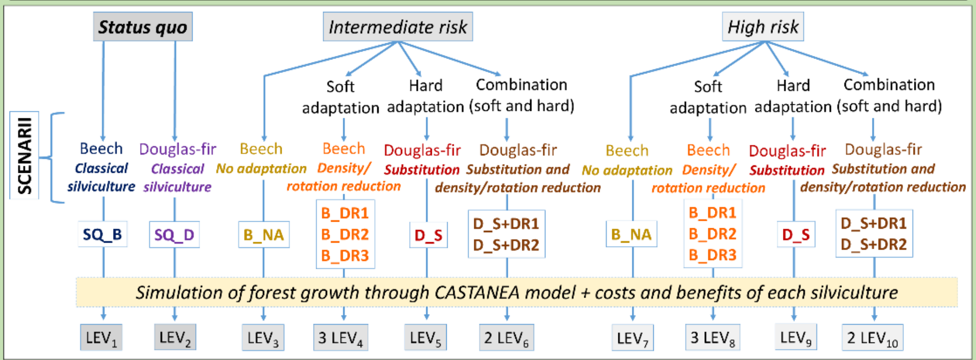
Case study

Beech forests in Burgundy (France) is predicted to **decline** or even more to **disappear**.

Silvicultural options tested to adapt beech forests (separately and jointly):

- **Density reduction** or **reduction of the rotation length** (DR).
- **Substitution by Douglas-fir** (S).

16 scenarii for each IPCC scenario



Material

2 climate scenarii from IPCC:

RCP 4.5 (the most optimistic) | RCP 8.5 (the most pessimistic)

x

2 status quo: Beech | Douglas

\+

2 levels of drought risk: Intermediate risk | High risk

x

7 scenarii: No adaptation (NA) | 3 DR | S | 2 Combinations (DR+S)

32 scenarii

Costs-benefits analysis for each scenario

Outputs of CASTANEA (volume of wood, carbon sequestration)

Faustmann's model

$$LEV_F = \sum_{i=0}^{\infty} \frac{B_i^W - C_i^W}{(1+r)^i}$$

Hartman's model

$$LEV_H = \sum_{i=0}^{\infty} \frac{B_i^W - C_i^W}{(1+r)^i} + \sum_{i=0}^{\infty} \frac{B_i^C}{(1+r)^i}$$

with B the benefits, C the costs, r the discount rate, i the time, for wood production (W) and carbon sequestration (C).

MAIN RESULTS

- Best economic return provided by **adaptation**: **combining strategies** as a relevant way to adapt forest towards a drought-induced risk of forest decline.
  - **Scenario D_S+DR2** : the best one regardless the level of drought risk, the climate, the LEV model and the discount rate.
- Considering **carbon sequestration** gave the **same** economical results. **Higher values of Hartman's LEV** than Faustmann's LEV show the importance to take carbon into account to **not under-estimate the forest value**.
- Drought and climate change can act in concert or not:

Effects	Drought	Climate change
Mortality	-	- (Beech)
Growth		+ (Douglas-fir)
Carbon sequestration		**0**
LEV (F, H)		

DISCUSSION AND CONCLUSION

Our article shows the **need to :**

- Compare and combine **different strategies of adaptation**.
- Improve the **link between forest ecology and economics.**
- Integrate **climate change** and **different ecosystem services**.
- Take into account **carbon** in economic analysis.

REFERENCES

- Brunette, M., Costa, S., and Lecocq, F. (2014). Economics of Species Change Subject to Risk of Climate Change and Increasing Information: a (Quasi-) Option Value Analysis. *Annals of Forest Science*, 71(2): 279-290.
- Jönsson, A.M., Lagergren, F., and Smith, B. (2015). Forest Management Facing Climate Change - an Ecosystem Model Analysis of Adaptation Strategies. *Mitigation and Adaptation Strategies for Global Change*, 20(2): 201-220.
- Lebourgeois, F., Bréda, N., Ulrich, E., and Granier, A. (2005). Climate-Tree-Growth Relationships of European Beech (*Fagus sylvatica* L.) in the French Permanent Plot Network (RENECOFOR). *Trees*, 19(4): 385-401.
- Yousefpour, R., Hanewinkel, M., and Le Moguédec, G. (2010). Evaluating the Suitability of Management Strategies of Pure Norway Spruce Forests in the Black Forest Area of Southwest Germany for Adaptation to or Mitigation of Climate Change. *Environmental Management*, 45(2): 387-402.

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OPTMix - Oak Pine Tree Mixture - A long-term experimental site in temperate oak-pine forest

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In the context of the climate change, increase of wood demand, and development of the populations of wild ungulates, management practices have to evolve.

The objective of the field experimental site OPTMix (https://optmix.irstea.fr) is to study the cross effects of

- stand composition (pure oak, pure pine, mixed pine-oak) and
- stand density (number of trees/ha) combined with
- presence of wild ungulates (roe deer, wild boar, red deer),

on the ecosystem functioning such as tree productivity, resource use and allocation (including water and nutrients), biodiversity and understory vegetation dynamics including regeneration.

OPTMix is an experimental site composed of 33 plots (of 0,5 ha) selected in even-aged lowland temperate forest stands of 60-80 years old (Orleans state forest in Central France, (47 ° 49 'N, 2 ° 29' E). The experiment consists of a partially crossed factorial experiment. Stand composition and tree density (low and medium) have a completely crossed factorial design, while the third factor, herbivory, is completely crossed with stand composition only for the low tree density. We added mixed control stands without any harvest (with the aim to study self-thinning process).

Each stand is equipped with a sensor network (temperature, light, relative humidity, rainfall, soil water content, soil water table depth) connected to a datalogger. We study various parameters on soil (physico-chemical parameters, water, nutrient cycle), plants (diversity, cover, litter quantity and chemistry) and animals (diversity, predation) in order to understand:
the functioning of mixed stands vs monospecific stands,
the role of biotic and abiotic factors on forest dynamic including biodiversity and tree regeneration,
benefits and limits of managements practices to face the climate change and (iv) the vulnerability of forests towards global change.
This experiment will benefit to forest managers and industry players to meet the socio-eco-environmental challenges.

OPTMix
Oak Pine Tree Mixture

https://optmix.irstea.fr/

A long-term experimental site in temperate oak-pine forest

Korboulewsky N., Balandier P., Ballon P., Boscardin Y., Dauffy-Richard E., Dumas Y., Ginisty C., Gosselin M., Hamard J.P., Laurent L., Mårell A., Menuet C., NDiaye A., Novara E., Pérot T., Perret S., Rocquencourt A., Seigner V., Vallet P.

IRSTEA - Centre de Nogent-sur-Vernisson, Unité de Recherche **Ecosystèmes Forestiers**

In the CONTEXT of

the climate change, increase of wood demand, and development of the populations of wild ungulates, management practices have to evolved.

THE OBJECTIVE IS TO STUDY the cross effects of

- **stand composition** (pure oak, pure pine, mixed pine-oak) and
- **stand density** (number of trees/ha) combined with
- **presence of wild ungulates** (roe deer, wild boar, red deer),

on the ecosystem functioning such as tree productivity, resource use and allocation (including water and nutrients), biodiversity and understory vegetation dynamics including regeneration.

OPTMix is an experimental site

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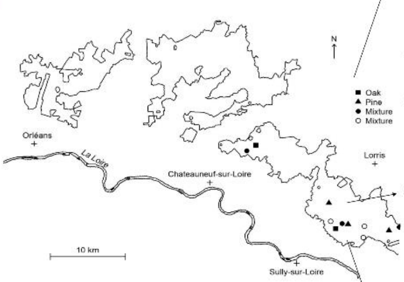
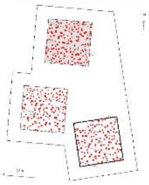
Irstea, G. Maisonneuve



Study site in Orleans state forest in Central France, and example of the experimental design for one of the three replicates.

■ Pure sessile Oak, *Quercus petraea*

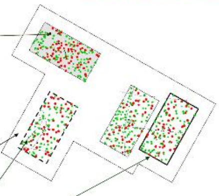
▲ Pure Scot Pine, *Pinus sylvestris*



● Mixture oak-pine

Stand density
- **medium** (RDI=0,7, grey background)
- **low** (RDI=0,4, white background)

Buffer zone (>20 m-wide)



Total or selective fenced plots

We study various parameters on soil (physico-chemical parameters, water, nutrient cycle), plants (diversity, cover, litter quantity and chemistry) and animals (diversity, predation) in order to understand:

(i) the functioning of mixed stands vs monospecific stands, (ii) the role of biotic and abiotic factors on forest dynamic including biodiversity and tree regeneration, (iii) benefits and limits of managements practices to face the climate change and (iv) the vulnerability of forests towards global change.

Some figures: 10 000 trees measured, ≈ 400 sensors for 80 000 data measured /day, 800 plots to study regeneration and flora diversity, 100 vegetal and animal species identified.

This experiment will benefit to forest managers and industry players to meet the socio-eco-environmental challenges.

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More information on http://optmix.irstea.fr or scan the QR code

Plurifor: Transnational Plans for the Management of Forest Risks

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Forest ecosystems play an important role in South West Europe. They occupy more than 30% of the territory in France, Spain, and Portugal. These ecosystems are subject to increasing multiple biotic (e.g. insects and fungi) or abiotic (storms, fires) hazards. Although European forests are managed at a national level, forest damages often have effects beyond administrative borders. PLURIFOR is a three-year project which aimed to facilitate cross-border collaboration in South-west Europe and to improve regional or transnational risk management plans for forest areas susceptible to forest hazards. The project focused on five biotic (Eucalyptus weevil, Pinewood nematode, Chestnut gall wasp, Pine pitch canker, emerging pests, and diseases) and three abiotic (Storm, fire, soil degradation) hazards currently prevailing in southwestern forests. Research institutes, universities, forest-related organisations, councils and governments at local, regional and national levels exchanged their expertise through survey questionnaires and during technical workshops to build innovative risk tools and up to date risk management plans. In France, field inventory and laboratory analyses were conducted to test new methodologies for early detection of emerging pests and diseases and pinewood nematode prevention. Remote sensing tools (lidar, UAV) were tested for a fine characterize of tree mortality in the Landes forest. GIS and programming tools were developed to improve forest storm prevention. Finally, a mobile application, Silvalert, has been implemented to report damages observed in the forests. Altogether, Plurifor contributed to the development of 27 risk management tools and 13 risk management plans.

The Aubrac wooded strips, a multifunctional forest network at the service of the territory

Dorian Cablat, Romain Ribière, TEYSSEDRE Rémy (Aubrac RNP)

The wooded strips are an essential element of the current agri-silvi-pastoral system in the Aubrac department. These are plantations, mainly of common spruce 76%[1], planted between 1960 and 1980 on the Aubrac's summer pastures, with the support of the "Fond Forestier National". The wooded strips fulfil a protective role against the variations of the local climate. They limit the formation of snowdrifts along roads and protect herds from winds and bad weather.

A Regional nature park is a tool for territorial development oriented towards the enhancement of natural, cultural and landscape resources. This is why the future of wooded strips is a priority subject for the Aubrac RNP[2]. As part of its Territorial Forest Charter, a complete diagnosis was carried out in 2016 and 2017. This revealed an ageing of the wooded strips. In recent years, the first effects of climate change have been observed: a greater recurrence of summer drought periods. However, Aubrac had a humid mountain climate.
Aging and water stress increase the susceptibility of spruce stands to diseases (bark beetle). Rapid and global decline represents a medium- to long-term risk. The resilience of the current wooded strip system (single-species planting of isolated common spruce trees in open areas) is very low due to reduced adaptability to pathogens and low growth in a context of climate change.

The exploitation of wooded strips has been initiated in recent years and their reforestation is a climate issue. Today, stakeholders in the region are becoming aware of the many environmental externalities offered by wooded strips: carbon storage, regulation of the water cycle through snow storage, groundwater recharge, biological control, ecological corridors for forest species, improvement of snow conditions on cross-country ski trails, maintenance of grass resources, etc.

In light of this, the Aubrac RNP wishes to implement a proactive policy to preserve the functionalities of the wooded strips. In 2019, it launched a call for initiatives to identify pilot projects for the rehabilitation of wooded strips. The latter includes experimental silvicultural routes combining MFR forest species and bushy or shrubby plants under the "vegetal local" label. The greater diversity of species promoted by this label strengthens the ability of wooded strips to adapt to climate change. Indeed, at the time of seed harvest, a non-phenotypic based selection allows a greater genetic diversity, guaranteeing a better resilience to climatic hazards. In addition, the cultivation techniques used under the local plant label (without inputs, without irrigation and in open ground) promote the success and sustainability of plantations in the face of expected climate change.
The recommendation of a wide variety of species and long-term management through the stratification of wooded strips will contribute to a better resilience of Aubrac's forest systems. The monitoring of the pilot projects will be undertaken in order to measure their responses to climate change and will be the basis for future interventions.

[1] RNP of Aubrac (2015). Territorial forest diagnosis, Aubrac, France.
[2] RNP: Regional nature park.

Drias*Futures of climate*, climate projections for adaptation of our societies

http://www.drias-climat.fr/

Drias*Futures of climate* aims to provide regionalized climate projections computed by several French laboratories involved in climate modeling (IPSL, CERFACS, CNRM-GAME). Climate informations are delivered in a variety of graphical or numerical forms.

Drias*Futures of climate* offers a process of appropriation in three steps : **Education Space** shows an user guide and best practices for climate projections. **Discover Space** allows to view and **locate geographically** « nearest you » climate projections, in **France** and **Overseas :** you can get all the informations provided by the different climate models for the **most recent scenarii** which are showed in the **last IPCC report (RCP)**. Finally in **Data and Products Space**, you can download all these parameters and climate indices as numerical data.

1 – Education area : about climate change and climate projections informations

NetCDF or Text file

About DRIAS

- Presentation sheets
- Objectives
- To whom ?
- By whom ?
- Informations

Climate change

- A reality
- What causes it ?
- Impacts
- Adaptation

Climate projections

- Methodology
- Available on the portal

Recommendations

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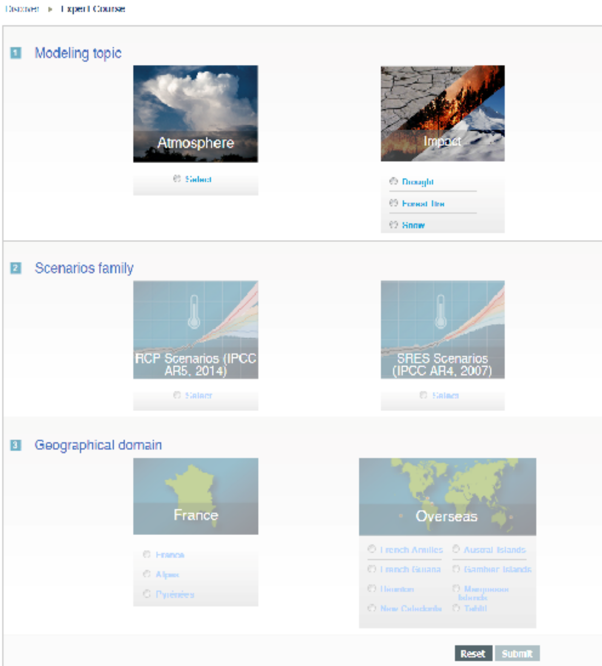
Drias*Futures of climate*, climate projections for adaptation of our societies

http://www.drias-climat.fr/

DRIAS portal enables access to various simulations obtained from different models, scenarios, and downscaling techniques. The scope of this service is limited to French regional climate simulations. These various data sets correspond to different projects of climate modelling, scenario delivery, and impact studies in France.

- French regionalized climate projections
  - France domain with overseas territories
  - Bias corrected with Safran re-analysis
  - Essential Climate Variables : *temperature, precipitation, wind, humidity, radiation*
  - Indices : *monthly, seasonal, annual quartiles by horizon (Q25, Q50, Q75)*
  - Different dataset issued from different modelisation projects, with different bias-correction methods :
    - Scratch 08, SCAMPEI, JOUZEL 2014, EURO-CORDEX-France, …
    - State of art at different periods
    - Quantile mapping, DSClim, CDF-t, ADAMONT



Understanding the potential impacts of climate change is essential for informing both adaptation strategies and actions to avoid dangerous levels of climate change. A range of valuable national studies have been carried out and provided specific indicators for some sector.

The impact models are forced by the regional climate projection previously presented and are frequently employ further analytical techniques such as pattern scaling and downscaling.

- Impact dataset
  - Drought from Climsec project
    Standardized Precipitation Index = SPI and Standardized Soil Wetness Index = SSWI
  - Wildfire
    Fire Weather Index = FWI
  - Snow cover from Adamont project
    Snow Depth, Number of days with snow depth> 5, 50, 100 cm and Snow Water Equivalent = SWE

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A reduced regional climate projection ensemble for the French national climate service : DRIAS

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1. The French Climate Service : DRIAS

Climate services are developed as decision aide derived from climate information that assists government officials, policy-makers, and the general public to improve decision-making and support adaptation to climate change.

The French portal : **DRIAS** (for '**D**eliver **R**egional climate scenarios for **I**mpacts and **A**daptation of our environment and **S**ociety') was opened in 2012. It offers an easy access to data and products, including a quick-look discovery, as well as the associated expertise to facilitate impact and adaptation studies.

However a climate service requires an appropriate and iterative engagement to produce state of the art climate data, that respond to user requirements and provide clear timely advisory. In this way end-users can understand its implications and consequences.

DRIAS **Futures of climate** contains three main areas:

AREA Education

A range of documents is offered to help users make the best use of available climate information *(description of methods and climate models, diagnostics,…).*

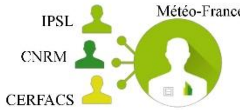
AREA Discover

A visualization tool to facilitate the exploration of climate projections : *temperature, precipitation, models, IPCC scenarios.*

AREA Data and Products

Enables users to download, in digital format, data and products they have identified on the catalog of products.

Contributors



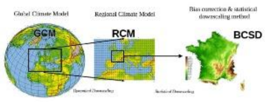
Funding by the french Ministry of Ecology and Sustainable Development (MTES)

Users committee

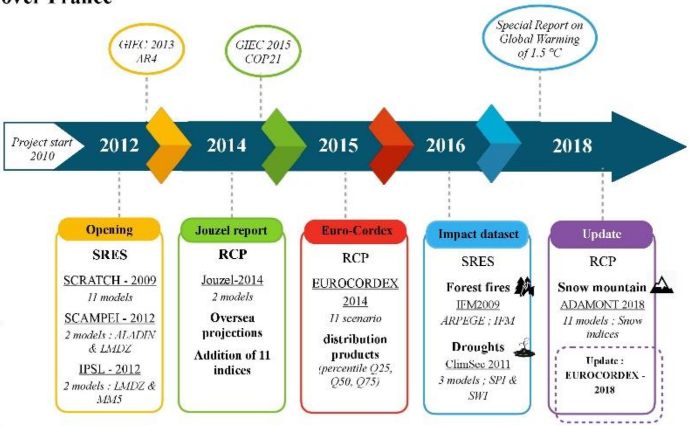
2. Data and Products

Regionalized climate projections over France

- **Domain** French metropolitan ; Oversea territories
- **High resolution** Grid : 8 km



- **Biais adjusted data** Obs : *SAFRAN re-analysis* Methods : *CDF-t, ADAMONT, Q-Q, DSClim*
- **Daily ECVs** *(Essential Climate Variables)* Temp, Precip, Radiation, Wind, Humidity, …
- **Indices** monthly, seasonally, annually, …
- **Uncertainty assessment** Comparison between each model and distribution products from EURO-CORDEX ensemble *(percentiles : Q25, Q50, Q75)*
- **Impact dataset** Drought, Wildfire, Snow cover



Documenting climate projections

DRIAS services have focused on collecting and making available documentation of climate simulations and standardize data, in order to facilitate their use.

Global climate model configuration (GCM)

Global climate model :	CNRM-CM5 v5.1 r11
Horizontal grid resolution :	1.4° ~ 150 km with 255 × 128 pts
Vertical levels number :	31 vertical levels from 10 m up to 10 hPa
GCM institute :	CNRM : Centre National de Recherches Météorologiques
Components of global model	ARPEGE-Climat v5.2 (atmospheric model) with SURFEXv5 which includes the land surface scheme ISBA, coupled through the OASIS (v3) system to the ocean model NEMO v3.2 1°L42 (ORCA1 configuration), the sea ice model GELATO (v5), and the TRIP model (river routing). Parametrization of the effect of aerosols (tropo - volcanic strato).
Date / version of the simulation :	2011-10-06

Regional climate model configuration (RCM)

Regional climate model	ALADIN-Climat v5.3
Horizontal grid resolution :	0.11° ~ 12 km with 432 × 288 pts
Horizontal grid projection :	Lambert conformal conic projection (LCC)
Vertical levels number :	31 vertical levels
Boundary conditions :	CNRM-CM5
Frequency forcing :	6 hours
RCM institute :	CNRM : Centre National de Recherches Météorologiques
Date / version of the simulation :	2014-08-01

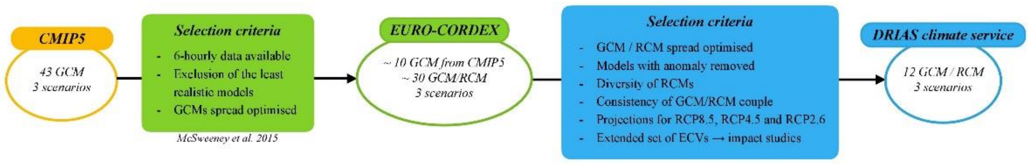
Bias correction – statistical downscaling (BCSD)

BCSD method(s) :	CDF-t
Horizontal grid mapping :	On the SAFRAN grid of 8 km resolution (134 × 143 pts) Lon = 5W : 12E Lat = 38N : 54N
BCSD institute :	IPSL : Institut Pierre-Simon Laplace
Date of the realization :	2015-01-07

3. How to choose the most convenient ensemble for national purposes ?

In the frame of the update of the EURO-CORDEX ensemble, around ~ 30 GCM/RCM couples will be available in the near future. However, for various practical reasons (size of the dataset, complexity of use, …) the DRIAS portal will only provide access to a reduced number of simulations.

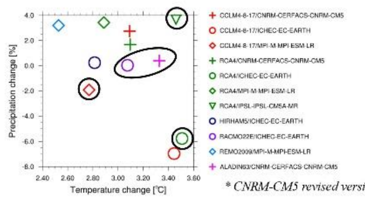
A procedure to reduce the size of the EURO-CORDEX ensemble has therefore been design to ensure that the reduced ensemble still represents the desired characteristics of the full ensemble.



GCM	RCM	Histo	RCP 2.6	RCP 4.5	RCP 8.5
CNRM-CM5 *r1* *	/ ALADIN63	Histo	RCP 2.6	RCP 4.5	RCP 8.5
MPI-ESM-LR *r1*	/ CCLM4-8-17	**Histo**	**RCP 2.6**	**RCP 4.5**	**RCP 8.5**
HadGEM2-ES *r1*	/ RegCM4-6	Histo	RCP 2.6		RCP 8.5
EC-EARTH *r12*	/ RCA4	**Histo**	**RCP 2.6**	**RCP 4.5**	**RCP 8.5**
IPSL-CM5A-MR *r1*	/ WRF381P	Histo		RCP 4.5	RCP 8.5
NorESM-M *r1*	/ REMO2015	**Histo**	RCP 2.6	RCP 4.5	**RCP 8.5**
CNRM-CM5 *r1* *	/ RACMO22E v2	Histo			RCP 8.5
MPI-ESM-LR *r1*	/ RegCM4-6	Histo	RCP 2.6		RCP 8.5
HadGEM2-ES *r1*	/ HadGEM-RA	Histo	RCP 2.6		RCP 8.5
EC-EARTH *r12*	/ RACMO22E v2	**Histo**	**RCP 2.6**	**RCP 4.5**	**RCP 8.5**
IPSL-CM5A-MR *r1*	/ RCA4	**Histo**		**RCP 4.5**	**RCP 8.5**
NorESM-M *r1*	/ WRF318P	Histo			RCP 8.5

Table 1: EURO-CORDEX simulations selected for updating the DRIAS dataset (preliminary version). Color circles represent the expected scenarios, those currently available have a black border.

Spread in climate change signal over France from EURO-CORDEX simulations



* *CNRM-CM5 revised version*

Figure 1: Annual mean temperature vs. precipitation changes (2071-2100 minus 1976-2005) spatially averaged over France, assuming RCP8.5 emissions scenario (preliminary work). Selected simulations are highlighted by black circles.

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REFERENCES

- Lemond et al. (2011): DRIAS: A step towards Climate Services in France, Adv. Sci. Res., 6, 179 -186
- « Le climat de la France au XXIe siècle - Vol 4: Scénarios régionalisés pour la métropole et les régions d'outre mer » sous la direction de J. Jouzel (Ed 2014)
- « Euro-CORDEX: COoRdinated Downscaling Experiment for the European domain » (http://www.euro-cordex.net/) + EURO-CORDEX Errata web page
- Dalelane et al. (2018) : A Pragmatic Approach to Build a Reduced Regional Climate Projection Ensemble for Germany Using the EURO-CORDEX 8.5 Ensemble, JAMC March 2018, Vol. 57, No. 3
- McSweeney et al. (2015) : Selecting CMIP5 GCMs for downscaling over multiple regions. Climate Dynamics. 44. 3237-3260. 10.1007/s00382-014-2418-8.

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Maps based on database analysis for species choice in forest management

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Climate change makes references to current local species useless for forestry planning at many forest plots. Besides, existing forest information databases document ecological and silvicultural success achieved in a variety of situations. The use of this information in forest management requires appropriate visualization tools.

The approach

The SILVA research unit ([2]) showed that the presence of forest tree species on 42 000 National Forest Inventory (IFN) plots can be described quite well using 2 climate parameters (the average annual temperature and the edaphic summer water deficit), and 4 edaphic parameters. For each species a digital relation is established between the values of these 6 parameters and the frequency at which each species occurs in the IFN database ([3]).

The protocol uses the following local data, mapped across the study area:

- The field measured SWHC (soil water holding capacity),
- the indicator values of pH, C/N ratio, temporary and permanent water logging, bio indicated with the spontaneous flora,
- the average climate observed by Météo France during the period 1986-2010: temperature, precipitation, solar radiation. The values are used as monthly averages and spatialized taking into account topography and cloudiness.
- The climate in the middle of the 21st century, obtained by correcting the previous values by the results of the CNRM-CM5 model (Météo France - CNRS) applied to the RPG8.5 emission scenario.

The digital relation previously adjusted on the IFN observations is then applied to the data mapped in the studied area. The result is the frequency at which a species occurs at present on this type of soil and for the future climate expected locally: the pedoclimatic frequency, FPC.

A case in North East France illustrates the visualization tools used by FORESTYS ([4]):

- maps relative to a single species (current and future FPC, FPC evolution),
- map of species with the highest FPC, defining current and future pedoclimatic forest types,
- diagram of the present and future FPC values for all species on a single forest plot.

Use and perspective

These representations deliver information relevant to the choice of species to be introduced, kept or abandoned. The protocol adapts easily to other databases, other plot descriptors, other climate data or projections.

The limits

The method applies well to species whose distribution in France match the ecological niche, to ancient naturalized species (chestnut, …), to contemporary domestic migrants (scots pine, Norway spruce,...). It is less relevant to the recently introduced species (locust) or mainly planted species (douglas fir, maritime pine, red oak,...), or present in France at the limit of their natural distribution (larch, cork oak, ...). It is inoperative in the Mediterranean areas and in the Aquitaine basin because upcoming climates are at present absent or rare in France. The method takes into account neither the plasticity of trees

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[2] https://www6.nancy.inra.fr/silva/UMR-Silva

[3] Soil aeration, water deficit, nitrogen availability, acidity and temperature all contribute to shaping tree species distribution in temperate forests. Piedallu, Christian & Gégout, Jean-Claude & Lebourgeois, François & Seynave, Ingrid. (2016). Journal of Vegetation Science, Wiley, 2016, 27 (2), pp.387-399.

[4] https://www.forestys.fr/

nor the genetic diversity within species, nor the interactions within a stand. Its implementation also depends on the quality of the data used.
Climate projections are also very uncertain beyond the middle of the 21st century.

Confronting the Available Water Capacity concept with forest soils: the Haut-Languedoc case study

Baptiste ALGAYER1, Philippe LAGACHERIE2, Jean LEMAIRE3, Jérôme GOUIN4

Water resource becomes a critical issue for forestry management with the context of climate changes. Soil acts as a reservoir storing the rainwater and restoring it gradually to forest trees. Soil Available Water Capacity (AWC) assess this potential available water for a given soil. AWC is usually assessed by describing a soil profile probed with a pickaxe and a manual auger. This method is useful and operative but it also shows important and identified limits: limited depth of the probe, available water contained in the pebbles not integrated, maladapted pedotransfer functions. The objectives of this study, carried on within the LIFE FORECCAsT project framework, are 1) to measure forest soil AWC by a more detailed approach of its parameters, and 2) to assess the efficiency of the proposed innovations regarding the forest stand vitality.

A 100 plots sampling design was set up in the Haut-Languedoc Regional Nature Park (Pnr HL). Three diagnostics are made 1) a forest stand diagnostic; 2) soil AWC estimation using the common method; 3) soil AWC estimation using a deep soil pit. AWC parameters are measured (soil horizon depth, soil texture, organic matter content and stones content). Specific moisture content and bulk density are also measured on 35 soil samples and rock fragments from various mineralogy.

The results show that the pedotransfer functions that are commonly used to describe the fine earth water holding capacity are not valid for the studied soils. A local pedotransfer function combining organic matter content and soil texture is calculated. The sampled rock fragments contain various available water depending on their geological type and weathering. Soil AWC measurement has to take rock fragments AWC into account. The considered soil depth (until 5-meter-deep) is the most influent parameter in AWC calculation.

For each plot, soil AWC was calculated integrating 3 innovations: adapted pedotransfer function, integration of the rock fragment AWC and the depth limit application. Soil AWC data was compared to forest stand fertility and dieback. The innovative AWC explains 21% of the forest stand fertility variability, while the conventional AWC measurement only explains 5%. Considering a constant climate sub-sample, the innovative AWC explains 25% of the forest dieback variability, while the common AWC measurement only explains 5%.

As showed by the results, an update of the method of forest soil AWC assessment is necessary. Forest stand plot diagnostic would greatly benefit from such innovation especially in the context of climate changes. These results will be included in the forest diagnosis of climate vigilance “FORECCAsT by BioClimSol” application, developed by the FORECCAsT project in the Pnr HL territory.

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« FORECCAsT by BioClimSol », a digital decision-making tool to adapt silviculture to global change.

Maxime JOURDE[1], Raphaël BEC[2], Baptiste ALGAYER[1], Constance PROUTIERE[1], Thomas BRUSTEN[3], Juliane CASQUET[1], Jean LEMAIRE[4]

Sitting in an area of meeting point for three climates (Mediterranean, Atlantic, Alpine), the Haut-Languedoc Regional Nature Park (Pnr HL) is particularly sensitive to climate changes. Moreover, forest, which covers the two thirds of the Pnr HL, is locally a major economic, environmental and social resource. Modifications of the climate, such as for example the multiplication of intense drought episodes, will most likely have a strong negative impact on this key component of the territory.

For all these reasons, it was essential to develop locally several actions of forest adaption to climate change. The Pnr HL joined forces with the National Forest Ownership Centre (CNPF) and the forest cooperative group Forest and Wood Alliance (AFB) to carry on the LIFE FORECCAsT projet. Its aim is twofold: to provide forest owners, forest managers and elected representatives with tools to adapt their silviculture to global changes, and to raise awareness among stakeholders and the general public about these subjects. This poster is about the creation of one of these tools: the "FORECCAsT by BioClimSol" mobile application.

The application general principle is that it is a decision-making tool working at the forest stand scale and usable directly on the field. It combines information about the forest stand climatic, dendrometric and topographic characteristics with models of climate change to provide its user with diagnoses that complete the field expertise of foresters. These diagnoses are linked to forest management propositions adapted to the climate to come and the forest stand purpose (wood production, habitat conservation…).

The application geolocates the user on the forest stand and combines the local data he collects with georeferenced data to provide him with two diagnoses:

- A "Forest stand" diagnosis for existing forest stands
- A "Reforestation" diagnosis for reforestation projects.

The application is based on the BioClimSol method, developed by the CNPF. The diagnoses it gives are built upon present and future climate, topographic, dendrometric, sanitary and pedologic (soil) data, from which are calculated to types of indices:

- For well-known tree species with national dieback data available, we calculate a BioClimSol Index which takes into account climate, soil, topography and biotic factors
- For tree species that are less studied or that are more experimental, we build an autecologic niche model from a national climate niche model crossed with the pedological and topographic requirements of each species.

The application, of which the diffusion will start in 2019, can be used everywhere in France. Its underlying models will be continuously improved thanks to diagnoses carried out by users, which will append a national database. Depending on the available databases, it will be possible later to develop new models, more precise at a local scale, to better reflect the regional features of French forests.

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Forest management procedures adapted to global change in Haut-Languedoc: the FORECCAsT test sites

Raphaël BEC[1], Constance PROUTIERE[2*], Jean-Michel D'ORAZIO[1], Pascal MATHIEU[3], Magali MAVIEL[3], Michèle LAGACHERIE[4]*

Sitting in an area of meeting point for three climates (Mediterranean, Atlantic, Alpine), the Haut-Languedoc Regional Nature Park (Pnr HL) is particularly sensitive to climate changes. Moreover, forest, which covers the two thirds of the Pnr HL, is locally a major economic, environmental and social resource. Modifications of the climate, such as for example the multiplication of intense drought episodes, will most likely have a strong negative impact on this key component of the territory.

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Twelve of these sites are existing forest stands, of various age and composition, in which we test protocols to decrease their water consumption, mitigate climate risks, favor the natural regeneration and/or preserve the natural habitat of community interest.

For nine other sites, we set up mixed forest stands. Mixing species in forest stand instead of planting just one tree species can help mitigating risks in an uncertain future climate context, better sharing the water resource of forest stands, favor their biodiversity and improve their resilience.

Finally, in three sites corresponding to the three Pnr HL climate types, we planted three arboretums containing 21 experimental tree species potentially better adapted to the climate to come, including species never tested before in the territory.

The long-term monitoring of these test sites is insured through a three-party 10-years renewable agreement between the Pnr HL, the CNPF and the owners of test sites. The CNPF will monitor forest stands vitality, fire risk and carbon sequestration. The Pnr HL will monitor how our actions impact on the local biodiversity. All these test sites will be accessible to forest owners, forest managers and elected representatives who will therefore benefit from valuable demonstrators of methods to adapt their forest management procedures to climate change.

Authors'detail

*These two authors equally contributed to this poster.

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Raising awareness among forestry and wood professionals, local elected representatives and the general public about the adaptation of forest to climate change: the input of the FORECCAsT project.

Juliane CASQUET[1], Raphaël BEC[2], Baptiste ALGAYER[1], Maxime JOURDE[1], Constance PROUTIERE[1]

Sitting in an area of meeting point for three climates (Mediterranean, Atlantic, Alpine), the Haut-Languedoc Regional Nature Park (Pnr HL) is particularly sensitive to climate changes. Moreover, forest, which covers the two thirds of the Pnr HL, is locally a major economic, environmental and social resource. Modifications of the climate, such as for example the multiplication of intense drought episodes, will most likely have a strong negative impact on this key component of the territory.

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Our outreach actions for Pnr HL professionals and elected representatives started with the implementation of the action plan “Gérer les crises liées au changement climatique en forêt du Haut-Languedoc” (“Managing climate change related crises in the Haut-Languedoc forest”). This guide, written with the help of local stakeholders, was widely distributed to Pnr HL forest professionals and elected representatives.

FORECCAsT then organized a symposium to introduce them to this approach and initiate a series of exchanges at the territory scale. This first symposium will be followed by a second one, in November 2019, in which we will widen the discussion to European scientists and project holders working on the adaptation of forests to climate change. To facilitate exchanges between similar initiatives, FORECCAsT also manages an international newsletter about forest and climate change, released to worldwide stakeholders of this issue.

Concerning outreach actions for the general public, they consist in a traveling exhibition wandering across the Pnr HL territory since 2017. We are also involved yearly in the International Day of Forests through the organization of outreach events and educational projects, in which FORECCAsT enables everyone to know more about forest and climate change through artistic, recreational or educational activities.

FORECCAsT also develop some information medias for both the professionals, elected representatives and the general public. Among these are several digital communication tools (website, newsletter, social networks) as well as the organization of a conference cycle titled “Le climat change: les forêts du Haut-Languedoc font face !” (“Climate is changing: Haut-Languedoc forests stand strong!”). Made of a common core about forest and climate change followed by a more applied module, these conferences are available for free to each municipality of the Pnr HL territory.

Finally, in parallel to these actions, we perform yearly a survey of forest and climate change perception in order to monitor the mentalities of these three publics as well as their perception of the FORECCAsT project and of its actions.

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My Sustainable Forest

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Partners

MySustainableForest project is composed of 11 European partners. The institutions in partnership represent a comprehensive range of:

- SMEs, academia and research, forest owners associations and large industrial and technological corporations.
- The various forest types across Europe through the chosen AOI sites: Portugal, Spain, France, Croatia, the Czech Republic and Lithuania.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776045.

- Earth observation services for silviculture

About the project

MySustainableForest provides Earth Observation (EO) geo-information products across the wood sector to support the production chain from sustainable forest management procedures to wood quality entering sawmills, pulp mills or other wood transforming industries.

MySustainableForest leverages Copernicus Data and Information Access Services (DIAS), namely Sentinel data, and heterogeneous local data sets provided by users. The data is transformed into modular processing components such as LIDAR models, satellite models, wood quality models and socio-economic models that are accessed through a user-friendly web platform.

EO products support forest users' decision-making relative to site and wood characterisation, biomass and CO2 stocking, forest health, vulnerabilities and socioeconomic accounting of forests and wood resources. Users include forest owners and managers, transport fleets, sawing mills and quality industries. By providing timely, high quality geo-information about forests, these products promote the "coherent, holistic view of forest management, cover the multiple benefits of forests, integrate internal and external forest-policy issues, and address the whole forest value-chain" - EU Forest Strategy, 2013.

Objectives

Satellites enable communication devices to operate globally, providing geo-information and geo-localisation capabilities. **MySustainableForest** integrates satellite data across the silvicultural chain, deriving valuable information on forests and wood quality from satellites, LIDAR, and sound waves to serve the wood-industry realm. **MySustainableForest** tackles challenging technological, commercial, societal and political objectives:

1. Support forest managers with site-specific geo-information products derived from satellite, LIDAR, meteorological and in-situ data, together with customised forestry models
2. Provide the products in an easy-to-access manner through a web-based platform
3. Demonstrate the quality, usability and cost-benefits of products across the broad community of wood stakeholders in Europe
4. Contribute recommendations for policy makers to support EU forest owners and wood transformation industries

Services

MySustainableForest provides kits of specialised forest or wood quality geo-information products that support sustainable forest management, good forest practices and high standards of wood quality entering the industry. The following six services are offered:

Forest site characterisation

Provides information on the status and condition of forest components, such as: forest extension; stand delineation; forest infrastructures; main forest types; stand variables, consisting of dominant height, stand age, and stand density; forest disturbances, including clear cuts and fire scars; and topography, which considers DEM, slope, and aspect.

Wood characterisation

Models and maps wood fibre attributes linked to the wood product potential and performance such as pulp yield, density, strength and stiffness of lumber.

Biomass and CO2 stocking

Estimates the living volume of trees in a forest and its CO2 stock. The above ground biomass and CO2 stock products are key for the biomass industry and carbon accounting.

Forest condition

Monitors and measures forest health condition, identifying stressed vegetation due to drought, frost, plagues or any other hampering cause.

Ecosystem vulnerabilities

Identifies and informs an array of ecosystem descriptors and vulnerabilities, namely: watershed extent, hydrological network, biodiversity indicators, habitat fragmentation, floods and soil erosion.

Socioeconomic conditions

Produces analytics based on the System of Environmental Economic Accounting (SEEA) proposed by United Nations.

Case demos

MySustainableForest's services and products are tested across Europe's bioclimatic regions and most representative forest types: temperate natural forests (oaks) and plantations (*Pinus* spp.) in Spain; Mediterranean and temperate continental forests (heterogeneous stands and lowland pedunculated oak forests) in Croatia; Mediterranean (*Eucalyptus* spp.) plantations in Portugal; oceanic forests in France and temperate continental forests in the Czech Republic and Lithuania.

Case demos represent the diverse and multi-pronged nature of geo-information toolkits; the examples below illustrate just a sample of the varied products being tested in each region.

Croatia

Forest mask, site index, wood density ranking, CO2 stock

Lithuania

AGB, main forest types, burnt scars, clear cuts

Czech Republic

Forest infrastructure, stand height, forest age year, burnt scars

Portugal

Drought estimation, forest vitality, biotic damages, frost damages

France

Snow damages, DEM-elevation, wood stiffness, wind damages

Spain

Strength class, stand density, wood density ranking, stand delineation