

FOREVERS



Mortalité de sapin dans la vallée de la Doller-Vosges- novembre 2021

FOREsts Vulnerability to climate Evolution using Range Shifts of species

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Action(s) thématique(s) concernée(s) : WP2

Context —

Increases of tree mortality were recorded all around the world, in temperate, boreal, and tropical forest. They were correlated in different studies to the increase in temperatures or decrease of water availability. Currently, foresters mainly based the choice of the species on site type recommendations provided by catalogues or simplified guides but these studies don't exist everywhere and maps are costly to realize. Even in cases where such document exist, climate change effects are taken into account in a very simplified way due to the lack of information about species vulnerability. The spatial risk assessment according to local climate and soil properties over broad areas remains an important challenge. Species Distribution Models (SDM) require easy to collect information (presence and/or absence of the species), and relate species occurrence to environmental factors that explain their distribution, mainly linked to climate and soil characteristics. The climatic parameters selected in SDM allow to calculate the probability of presence (also called 'habitat suitability') of the species for different periods, and then to determine areas with changes in probability of presence by comparing different period.

Objectives —

The aim of this study is to evaluate SDM relevance to predict tree mortality and thus anticipate climate change effects. The availability of observed species occurrence at different dates, time series describing climate over the 50 previous years, soils properties predictive maps, and the presence of important diebacks for coniferous species in the Vosges Mountains, represent an opportunity to evaluate the interest of the SDM approach to map species vulnerability in the context of climate change.

Approaches —

We focused on the Vosges Mountains in the North East of France, to study the vulnerability of Silver Fir and Norway spruce. We selected these species because they are among the most important in this region and they show important decline symptoms. We use the IGN dataset from the forest inventory collected before 2005 (IGN old method dataset) to extract the presences and absences of the studied species at the French scale. We consider climatic information for the 1961-1987 period (here called “reference period”) to describe climatic conditions prior to climate warming in France. Using models calibrated at the French scale, probabilities of presence are mapped for the Vosges mountains, with a dataset of high spatial resolution environmental variables (50m cell size) existing for this area. The climatic variables selected in the models for the reference period are calculated for the contemporary climatic conditions (the 2010-2020 period, here called “contemporary climate”) and mapped. The evolution of presence probability between the reference period and contemporary climate depict the possible consequences of the recent climate change in habitat suitability for the species. We then evaluate if the decrease in probabilities of presence correspond to areas with important dieback. We use “sentinel 2” remote sensing images at 10 m resolution to identify mortality patterns at the Vosges mountains scale. Dieback patches are delimited using automatic classification. To determine the species names, we use stand maps identifying the dominant species produced by the ONF for the public forests, and ancien aerial photographs allowing to identify the stand composition for 2000 plots scattered on the studied area..

Key results —

The study started in 4/2021 and will finish in 9/2023. The main results in 1/2022 are:

- Calculation of new climatic models for the 1961-2020 period (database Digitalis v3)
- Classification of the sentinel 2- images for 2019
- Creation of a database of 2000 plots for Silver fir and Norway spruce stands, with for each plot information about tree health status and the main species in the stand (collected by photointerpretation)
- Calculation of a first silver fir model for different periods of time, evaluation of the relationships between decrease in probabilities of presence and tree mortality. The correspondence seems good in some places but not everywhere. The model should be improved for a better evaluation of these results

Main conclusions including key points of discussion —

It is too early to have conclusions, we are at the beginning of the study ...

Perspectives —

For the next few months:

- An trainee was hired and the internship will start at the beginning of march, for 6 months
- A meeting with all the project participants will be planed after the beginning of the internship.
- The silver fir model should be improved
- The spruce model should be calculated

Valorization —

A scientific publication aiming to estimate the interest of this approach to evaluate tree species vulnerability is planned at the end of the study.

Leveraging effect of the project—

Information for scientist and managers about the interest and the limits of the method.