REGE+

Forest regeneration under climate and environmental changes

DURATION
15/01/2021 - 15/04/2025

BUDGET
711 035 €

PROJECT DESCRIPTION

Forests are key components of earth habitability since they contribute to climate change mitigation through carbon sequestration, are biodiversity hotspots and provide many other ecosystem services (among others, wood production, recreation, soil and water protection). To maintain in the long run their multiple functions including the climate services, forests must be continually regenerated.

European and specifically Belgian forests face however various threats. Warm and dry summers weaken trees and seedlings due to water shortage and trigger outbreaks of pests and pathogens. Besides these, the management of wildlife population, and particularly of ungulate population (roe deer, red deer, wild boar) could critically affect forest dynamics as abundant ungulates browse regeneration and affect preferentially some tree species over others modifying forest composition in the long term. In this uncertain and changing context, forest managers must improve the resistance and resilience of forests. It has been suggested that this can be achieved by creating uneven-aged and mixed stands following the principles of the close-to-nature or continuous-cover forestry. Indeed, mixing tree species with contrasted functional traits offers a large variety of possible responses to the various stresses and therefore improves the forest recovering capacity after disturbance.

To make the forest more resilient and test innovative management strategies, foresters need guidelines. Unfortunately, one cannot test *in situ* all possible silvicultural options for each site conditions and climate scenario. Scenario analysis based on model simulations are therefore necessary to select the most promising management practices which can then be tested *in situ*.

The models used to predict the effect of climate change on forest functioning are process-based and generally operate at stand level or larger scale without considering the within-stand spatial heterogeneity. They are therefore not adapted to test silvicultural routes in structurally-complex and species-diverse stands. In this project, we will perform simulations using an individual-based and spatially-explicit model (called HETEROFOR) describing stand dynamics based on resource use (light, water and nutrients) and silvicultural operations (https://gmd.copernicus.org/articles/13/905/2020/).

The objective of this project is to develop a highly integrated tool allowing to test various forest regeneration strategies while taking local climate evolution and various levels of ungulate density into account. To reach this goal, HETEROFOR will first be adapted to account for the effects of ungulate browsing on seedling development and mortality. The model will also be improved so that it can evaluate forest climate services (carbon sequestration, evapotranspiration, reflected solar radiation) and supply economic indicators. These model improvements will be evaluated based on existing datasets (*in situ* monitoring of regeneration dynamics and ungulate damages) and on a rainfall limitation experiment (assessment of tree seedling response to drought).

For several climate projection scenarios, simulation experiments will be carried out in a series of case studies (10 representative Belgian forest stands to be regenerated within the next 40 years) to test various regeneration and wildlife management options on tree regeneration success or failure, stand resilience after disturbance, ecosystem service provision and management sustainability (soil chemical fertility). Three greenhouse gas emission scenarios from the IPCC assessment reports will be considered. The corresponding local climate projections will be obtained using (1) downscaled global climate model simulations produced in the context of the Cordex.be project (http://www.euro-cordex.be/) and (2) corrections of these projections for the biases identified by comparison with observations during historical periods. Based on discussions with stakeholders (private and public forest owners, forest managers, hunters), new and promising forest management will be tested and compared to more classical ones.

REGE+

The information generated by the simulation experiments will be synthesized to identify the most appropriate management options. This project aims indeed at providing guidelines to the foresters who want to adopt these new practices since the pros and cons of these relatively new strategies have not been thoroughly scientifically evaluated and quantified. Our results will also help to design forest policy at the regional and national levels by allowing policy makers and forest managers to realize the possible impact of various forest and wildlife management scenarios in the climate change context.

At the start of the project, a website will be launched, serving as a platform for project presentation, for result and model dissemination and for interactive discussion with stakeholders and end-users. The scientific outcomes of the project will then be published in peer-reviewed and popularization journals and presented at regional and international conferences. Besides, the improved HETEROFOR model will be freely distributed. A final meeting will be organized near the end of the project to present its achievements and to exchange with scientists, stakeholders, forest owners and policymakers on the ground-breaking nature of the project outcomes.

CONTACT INFORMATION

Coordinator

Mathieu Jonard
Université catholique de Louvain (UCLouvain)
Earth and Life Institute (ELI)
mathieu.jonard@uclouvain.be

Partners

Gauthier Ligot
Université de Liège (ULiège)
Gembloux Agro-Bio Tech (GxABT)
gligot@uliege.be

Bert Van Schaeybroeck
Royal Meteorological Institute (RMI)
Meteorological and Climatological Research
bertvs@meteo.be