Project Database of ICP Forests

PROJECT DESCRIPTION

PROJECT INFORMATION

Project title:	Alterations in the lifetime of forest stands: Spatial patterns and robustness of survival models in forestry
Project ID:	200
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PROJECT DESCRIPTION

Project Consortium

The project consortium consists of the Expert Panel on Crown Condition and Damage Causes, Technical University of Munich (PhD candidate) and the Bavarian State Institute of Forestry.

Aims

Climate change does not only lead to changes in species distribution and productivity, but also causes additional risks, e.g. an increase in droughts or in the frequency of storms (Hanewinkel et al. 2010). To secure a sustainable wood production and the provision of ecosystem services it is essential that these risks are taken into account in decision-making (Kölling et al. 2013). The effects of risks on forest stands can be captured by looking at the survival times or the mortality rates of trees. Within the project "Survival-KW" (ICP-project-list ID 98) we generated models describing the entire range of survival times and risks for mortality and the factors that influence them (climate and tree species mixture) based on the German crown condition survey as well as pan-European crown condition data from Level I and Level II plots, thus encompassing large environmental gradients (Brandl et al. 2020). Unfortunately, uncertainty in estimations remains high due to limitations of the length of time series, methodology and rareness of events. Therefore, the project aims at improving the survival models of the most important tree species in Germany (*Picea abies, Pinus sylvestris, Abies alba, Fagus sylvatica, Quercus robur, Quercus petraea, Pseudotsuga menziesii*) by using longer time series and testing spatio-temporal models. Especially the latest drought years in Europe with higher mortality rates (Schuldt et al. 2020) seem to be promising to improve the models. The project also looks at the robustness of survival models with regard to single extreme years. We will also use yearly climate-co-variables and compare results with those models that use long term averages. The new parameterized models will be used to develop potential management options to optimize the risk-return ratio under a changing climate by assessing their economic outcomes (e.g. Paul et al. 2019).

Methods

- Data: based on the German crown condition survey as well as pan-European crown condition data from Level I and Level II plots
- Use of parametric accelerated failure time models assuming Weibull- or log-normal distribution of survival times. The models allow to estimate survival probability in dependence on age, climate and species mixture (Brandl. et al. 2020, Neuner et al. 2015, Nothdurft 2013)
- Spatial patterns are explored e.g. by visualizing techniques comparable to those described by Wikle et al. 2019

- Spatio-temporal models (Wikle et al. 2019) will be compared with existing survival models (e.g. Brandl et al. 2020)
- Models will be put into practice by analyzing the returns and risk for different forest types and situations based on portfolio theory (Neuner et al. 2013, Paul et al. 2019).

Data requirements

- Crown Condition (Level I and Level II) in order to derive mortality rates
- BioDiv and Growth and Yield data in order to check Crown Condition data (i.e. age estimation) and mortality rates for plausibility
- European climate data (WorldClim, Hijmans et al. 2005 or CRU, Harris et al. 2020) as explanatory variables in the models
- European soil data (BioSoil) as explanatory variables in the models
- Foliage data in order to test the effect of nutrient supply on tree survival
- Meteorological data of Level II plots in order to investigate more closely the cause and effect relationships between site variables and mortality (i.e. wind).

Expected Results

- The knowledge of mortality dynamics of the most important German tree species will be improved
- The study should provide a generalizable quantification of changes in mortality rates in European forest stands under increasing temperatures and decreasing precipitation
- Spatial patterns within mortality and robustness of published survival models will be analyzed
- Development of new analysis-tools of mortality data for the Expert Panel on Crown Condition and Damage Causes

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