

PROJECT INFORMATION

Project title: Specification of threshold values for cultivation of tree species facing climate change using marginal occurrences

Project ID: 52

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PROJECT DESCRIPTION

Project Consortium

The MARGINS consortium consists of the Technical University of Munich (TUM), the Bavarian State Institute of Forestry (LWF), Weihenstephan University of Applied Sciences (HSWT) and the Bavarian State Authority for Forest Tree Breeding (ASP).

Aims

Funded by the Bavarian State Forest Authority, the MARGINS project will forecast reactions of important forest tree species to increasing temperature and drought based on a combination of species distribution modeling (SDM) and study of populations at the warm and dry edges of the distributions. The specification of thresholds for the cultivation of commercially important tree species of Bavaria is the central scope of the MARGINS project. Combining the strengths of both statistical niche modeling and effect-oriented case studies in a space-for-time approach, the MARGINS project aims to define the geographic zones where Bavaria's six most important tree species (Norway spruce, Scots pine, silver fir, common beech, sessile oak and pedunculate oak) grow at or very near their distributional margins, localize populations in these zones, by

1. characterize the environmental conditions defining the boundaries of the distribution area,
2. validate, correct, and specify state-of-the-art niche models in the most critical warmer part,
3. derive thresholds for commercial use of the species,
4. identify reactions when reaching or transgressing critical thresholds,
5. and to apply the improved thresholds to diverse regional climate scenarios in Bavaria.

Methods

Occurrences close to the distributional margins represent populations under extreme climatic influence. Hence, symptoms induced by climatic change should become visible in these populations "at the rear edges" first. Studying these extreme populations is the core part of the MARGINS project, and SDM are used to identify interesting populations, and later to transfer the obtained results to future conditions in Bavaria. Species distribution models (SDM) identify thresholds for physiological existence (i.e., fundamental niche) or observability of species (i.e., realized niche). The model output is probabilities of occurrence, whereas the highest probabilities are found in the niche center, with probabilities converging to zero towards the margins. Validation with real observations reveals that beyond certain thresholds no occurrences of the species in question can be ascertained. For referring probabilities of occurrence to forest monitoring data, predicted probabilities derived from SDMs should be related to vitality, mortality, and growth potentials of forest tree species.

In a preceding study at the Bavarian State Institute of Forestry (LWF) SDMs have been developed within the project "Trees for the Future" (Falk & Mellert 2011) to serve as a tool for site specific tree species selection. Regional models only covering a small portion of the species niche space are not appropriate for assessing effects of climate change on tree species (Mellert et al. 2011). Therefore, SDMs at the European level have been developed. The models base on Level-I-monitoring plots (Fischer et al. 2010) unified with potential occurrences according to the Map of the Natural Vegetation of Europe. Macroclimate variables (WORLDCLIM, Hijmans et al. 2005) served as predictors. The results suggest measures and data needs to improve the first generation of SDMs within the following up project MARGINS.