PROJECT INFORMATION

Project title: **Forest disturbance in a changing world**

Project ID: 161

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PROJECT DESCRIPTION

Anthropogenic climate change has profound impacts on ecological processes and is rapidly changing the composition, structure, and functioning of ecosystems. For long-lived ecosystems such as forests the unprecedented pace of these changes will strongly limit the ability for adaptation through genetic and evolutionary processes. As systems are increasingly ill-adapted to their environment, abrupt and disruptive changes are getting increasingly likely. Over the past decades, disturbance events such as windthrow, bark beetle outbreaks, and wildfires have already increased markedly in forests around the globe. Yet, our understanding of the long-term changes in forest disturbance regimes and their impacts is still limited, hampering our ability to address these changes in ecosystem management. Using an innovative multi-method approach the research proposed here will (i) improve our systems understanding of the drivers of forest disturbance regimes, (ii) lead to a comprehensive appraisal of the impacts of current and future disturbance regimes on biological diversity and ecosystem services, and, based on these insights, (iii) develop strategies on how ecosystem management and 2

society at large can cope with changing forest disturbance regimes. To address these questions we will investigate paired study landscapes replicated over Central Europe, contrasting unmanaged forests (e.g., national parks) with managed forest landscapes in similar biogeographical settings. For this network of study landscapes we will use dendroecology to reconstruct the disturbance regimes of past centuries, apply remote sensing to estimate current disturbance severity and extent, and harness simulation modeling to project future trajectories under an ensemble of climate change scenarios.

Based on this multi-century analysis we will for the first time in Europe be able to determine whether and how current and future disturbance regimes transgress the historical range of variability, and whether no-analog disturbance regimes are likely to emerge in the future. We will furthermore assess how changing disturbance regimes will affect biodiversity, and quantify their impacts on provisioning (e.g., timber production), regulating (e.g., carbon storage, water retention), cultural (e.g., the recreational value of a landscape), and supporting (e.g., primary productivity) ecosystem services of forest ecosystems. Using simulation modeling embedded in a stakeholder process we will develop strategies of how to deal with such disturbance impacts, and how to optimally manage landscapes under different management objectives (conservation of biological diversity, provisioning of different ecosystem services). Novel simulation approaches and high performance computing will furthermore be used to scale results up to the continental scale, and provide policy makers and disaster risk managers with detailed information on future forest-related risks. The project will thus not only strongly advance the frontiers in disturbance ecology both with regard to process understanding and science-based ecosystem management, but will also deliver novel solutions for mitigating risks and fostering resilience to abrupt and disruptive changes in the environment in general. More information on the project can be found at: http://resin.boku.ac.at

Envisioned usage of ICP Forests data

The project follows a multi-proxy approach to quantify changes in forest disturbance at the continental scale. An important methodological approach for the analysis of recent patterns in forest disturbances is remote sensing data based on Landsat satellite image analysis. While these data are a powerful means for large-scale assessments of forest change, they also have important limitations, e.g. only capturing changes in canopy trees at a resolution of 30x30m pixels. It is thus of paramount importance to quantitatively asses these limitations, and evaluate satellite-based assessments with ground-true data. As the ICP Forests dataset is the most comprehensive and consistent ground inventory conducted for European forests, we aim to use the data in evaluating our remote sensing based analyses. Our hypothesis is that the remote sensing-based mortality rates are conservative estimates, as both subcanopy mortality and individual-tree mortality are not captured.

The second envisioned usage of the ICP Forests dataset within our project concerns the modeling of future forest development and disturbance regimes. Here we aim to apply a number of complementary modeling approaches, from empirical species distribution models to highly detailed process-based simulation models. These models will be used to assess how forest disturbance regimes might change in the future, in response to a variety of possible climate change scenarios. Our hypothesis is that climate change will further amplify future disturbance regimes, with increasing disturbance area and severity over the coming decades. In order to robustly test this hypothesis it is of paramount importance that the underlying models are calibrated and evaluated against the best possible dataset, representing the full heterogeneity of European forest ecosystems. Again, the ICP Forests dataset is the – to our knowledge – best and most comprehensive dataset available for this task, which is why we are highly interested in using it in our project.