Msc. Project in Ecology and Evolution or Climate Sciences

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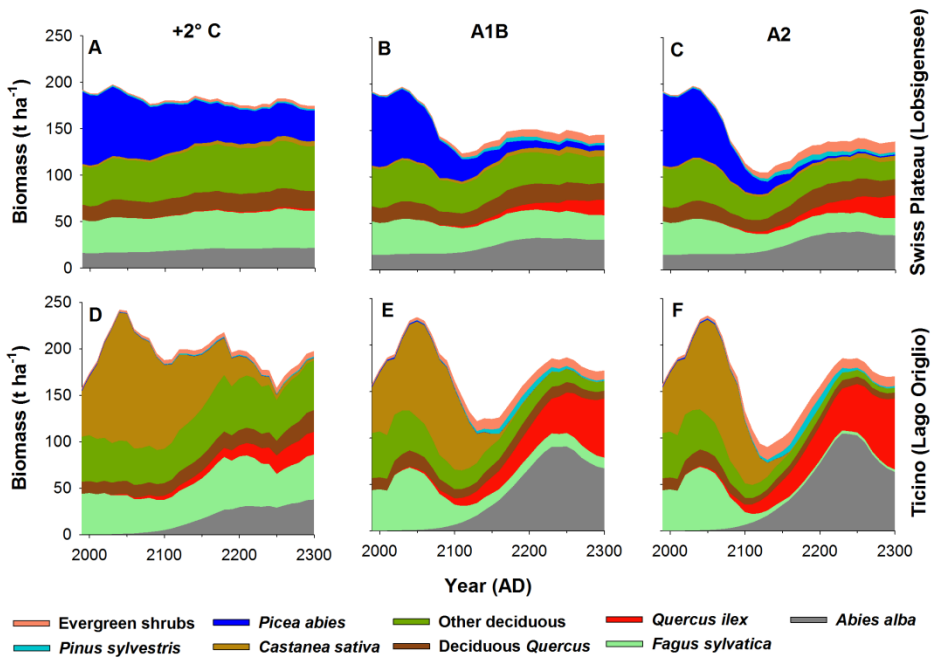
Applying paleoecological data to improve simulations of tree regeneration in Swiss forests

Paleoecology and ecological modeling are powerful tools for studying climate change impacts on forests. Whereas paleoecology provides data on climate change impacts using evidence from the past, vegetation models can project future changes. In turn, researchers combining these approaches can apply an understanding of the consequences of past environmental changes to improve projections of future impacts.

We seek a student interested in studying climate change impacts on Swiss forests by combining paleoecology with a dynamic vegetation model. Dynamic models describe rates of change, as opposed to predicting static states, and are particularly valuable for projecting the impacts of progressive environmental changes. However, because model output during periods of change is difficult to validate, dynamic vegetation models are generally run until they attain equilibrium and can be compared to an established baseline. Therefore, improvements in model performance during transitions are needed to accurately project the consequences of near-term climate change on a scale that is relevant to human observation (e.g. during the next 100 years). Because long-term forest dynamics are largely determined by changes in regeneration success among competing species, one way to improve transient simulations of vegetation change is to more accurately depict tree regeneration following disturbance events.



Vegetation projected under three future climate scenarios by the LANDCLIM dynamic vegetation model near two Swiss Lakes. Model performance was checked against pollen-inferred vegetation reconstructions at both sites.

This project aims to improve the regeneration routine of the LANDCLIM dynamic landscape vegetation model by evaluating quantitative approaches to relate a suite of ecophysiological traits (e.g. shade tolerance, drought tolerance, seed size) to regeneration success. Because both dynamic modeling and paleoecological approaches provide data on rates of vegetation change, pollen records can be used to check the ability of dynamic vegetation models to simulate transient vegetation dynamics. The student will evaluate model performance by comparison to pollen-inferred vegetation reconstructions from diverse vegetation belts in Switzerland, including warm-wet environments in Southern Switzerland, continental inner-Alpine valleys, temperate ecosystems in the Swiss Plateau, and subalpine forests. Thus, the project will benefit from the diversity of environmental settings and ecosystems in Switzerland and the unmatched abundance of high-resolution pollen-inferred vegetation reconstructions. The student will gain expertise in both paleoecology and ecological modeling, and will provide data needed to improve simulations of forest expansion at treeline in response to climate change, species invasions, afforestation of abandoned agricultural land, and post-disturbance succession.

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