EGU24-9480, updated on 17 Feb 2025
https://doi.org/10.5194/egusphere-egu24-9480
EGU General Assembly 2024

Linking deep learning-based forest cover maps to treeline spatio-temporal patterns

Thiên-Anh Nguyen[1], Marc Rußwurm[2], Gaston Lenczner[1], and Devis Tuia[1]
[1]ECEO, EPFL, Sion, Switzerland (thien-anh.nguyen@epfl.ch)
[2]Geo-information Science and Remote Sensing Laboratory, Wageningen University, Wageningen, the Netherlands

Over the last decades, the position of the upper treeline in the Swiss Alps has been highly affected by drivers such as climate change and land use change interacting at various spatial and temporal scales. To better understand these interactions, it is necessary to quantify treeline dynamics over large areas at high spatial resolution and over long time scales. This can be decomposed into three tasks: mapping forest cover, delineating the treeline, and comparing the treeline position through time.

We leverage archives of optical aerial imagery acquired over the Swiss Alps to map forest cover. These images constitute a large dataset of time series of 12 to 20 ortho-rectified aerial images at 1 m spatial resolution acquired throughout the time period 1946-2020. We have developed a deep learning-based method to automatically extract multi-temporal forest masks from these aerial images (under review).

We then explore how treeline dynamics can be characterized using these forest cover maps. More specifically, we look at designing a spatio-temporal processing pipeline that implements widely used definitions of the treeline and treeline displacement, while being robust to potential errors in our deep learning-generated maps, such as noise caused by differing sensors and imaging conditions. We find that through a series of pixel-based processing steps, based solely on the generated forest cover maps and a Digital Elevation Model, we manage to 1. delineate the treeline at a chosen spatial scale and 2. measure the elevational treeline shift between two dates. The flexible choice of the spatial scale enables multi-scale analysis and comparison with existing treeline shift measurements derived from different data sources and methods.

We hope that this automatic and flexible spatial analysis pipeline can link deep learning-based forest cover maps to ecologically relevant variables in a way that can foster the understanding of treeline dynamics.