

Exploring the relationship between environmental gradients and fractional land cover in the Alps



Start Date: Anytime

Description of Project:

Mountain ecosystems, such as those found in the European Alps, are highly sensitive to environmental changes. Understanding the relationships between climatic and topographic gradients - such as precipitation, temperature, and elevation - and vegetation patterns is critical for predicting ecosystem responses to climate change. This thesis will focus on investigating how these environmental gradients influence fractional land cover, an advanced remote sensing indicator that quantifies vegetation cover at the sub-pixel scale. Fractional land cover data will be provided, and analyses will integrate climatic datasets, such as CHELSA or ERA-5 data, and digital elevation models to understand how environmental factors shape vegetation distributions across the Alps.

Research Question: Do patterns observed in fractional land cover reflect environmental and topographical gradients and land use management practices within the study area?

Key Outcomes:

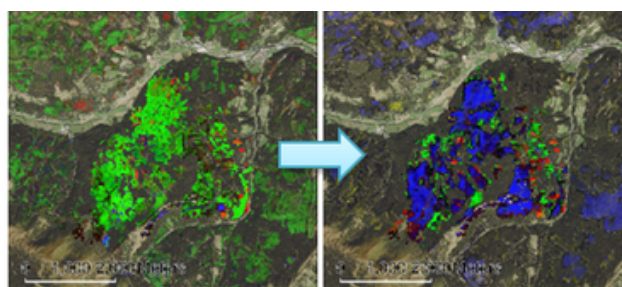
- Development of a methodological workflow integrating fractional land cover, climatic datasets and topographic data
- Quantitative analysis of the relationship between fractional land cover and environmental variables
- Creation of spatially explicit maps highlighting areas particularly vulnerable or resilient to climate- and land use change, informed by fractional cover maps

Suggested readings:

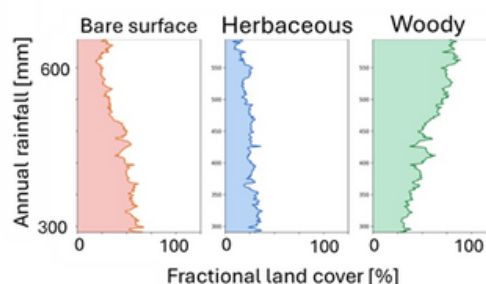
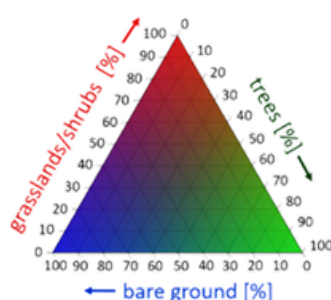
- Anselmetto, N., Weisberg, P.J., & Garbarino, M., 2024. Global change in the European Alps: A century of post-abandonment natural reforestation at the landscape scale. *Landscape and Urban Planning*, 243, <https://doi.org/10.1016/j.landurbplan.2023.104973>
- Harkort, L., Okujeni, A., Amputu, V., Mahler, J., Nill, L., Pflugmacher, D., Röder, A., & Hostert, P., 2025. Mapping fractional vegetation cover in Sub-Saharan rangelands using phenological feature spaces. *Remote Sensing of Environment*, 319, <https://doi.org/10.1016/j.rse.2025.114646>
- Obuchowicz, C., Poussin, C., & Giuliani, G., 2024. Change in observed long-term greening across Switzerland – evidence from a three decades NDVI time-series and its relationship with climate and land cover factors. *Big Earth Data*, 8, <https://doi.org/10.1080/20964471.2023.2268322>



SafeNet



Fractional cover maps illustrating temporary land cover change due to a disturbance event. How do land cover changes behave along different gradients?



Relationship between fractional cover and annual rainfall, here for an example in Namibia (source: Harkort et al. 2025). The graph illustrates changes in woody, bare surface, and herbaceous cover along a rainfall gradient.

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