

# Mapping shrub dynamics in Berchtesgaden National Park using spectral unmixing and Sentinel-2 time series

**Start Date:** Anytime

## Description of Project:

Shrubs are an important component of subalpine ecosystems in Berchtesgaden National Park, where they shape habitat structure, successional trajectories and ecosystem functioning. At the same time, recent vegetation changes have increased the need for spatially explicit monitoring. Of particular relevance is the recent occurrence of *Lecanosticta acicola*, a fungal pathogen that affects *Pinus mugo* and was first detected in Berchtesgaden National Park in 2022. This development highlights the need for improved mapping and monitoring of shrub and shrub-like mountain pine vegetation in the park.

This Master's thesis will develop a remote sensing workflow to map shrubs using Sentinel-2 time series and spectral unmixing approaches. The project will investigate whether fractional information derived from multispectral imagery can improve the detection of shrub cover compared to conventional discrete land cover mapping. Depending on the final scope, the thesis may include the generation of shrub fraction maps, the analysis of temporal dynamics, and an evaluation of mapping performance using reference data.

**Possible Research Question:** How well can spectral unmixing of Sentinel-2 time series quantify shrub cover in Berchtesgaden National Park? What do the resulting shrub fraction maps reveal about the distribution and temporal dynamics of shrub vegetation in Berchtesgaden National Park?

## Key Outcomes:

- Development of a workflow for shrub mapping based on Sentinel-2 time series
- Application and evaluation of spectral unmixing for estimating shrub cover or shrub fractions
- Spatially explicit shrub maps for Berchtesgaden National Park
- Assessment of the strengths and limitations of the approach in complex alpine terrain
- Interpretation of shrub distribution patterns and, if feasible, temporal changes

## Prerequisites:

- ++ Interest in the topic
- ++ Earth observation
- + Basic programming skill (Python, R,...)
- + Basic knowledge in machine learning



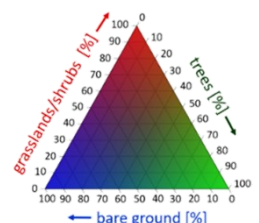
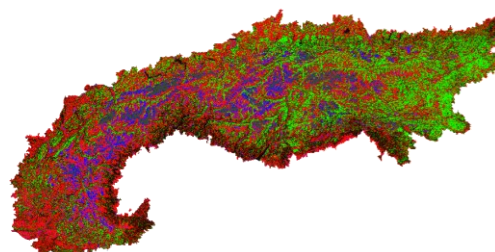
Very early state of needle browning, which might end in large-scale shrub dieback

## Suggested readings:

- Viana-Soto et al. (2022): Quantifying post-fire shifts in woody-vegetation cover composition in Mediterranean pine forests using Landsat time series and regression-based unmixing (<https://doi.org/10.1016/j.rse.2022.113239>)
- Mandl et al. (2024): Unmixing-based forest recovery indicators for predicting long-term recovery success (<https://doi.org/10.1016/j.rse.2024.114194>)
- Vanneste et al. (2026): Widespread Shrubification on European Mountain Summits (<https://doi.org/10.1111/gcb.70786-9>)
- SZ: Spirken und Latschen in großer Gefahr (<https://www.sueddeutsche.de/bayern/latschen-berge-krankheit-berchtesgaden-pilzbefall-lux.AykcgJiMe9KbahLNzmTD3d>)

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Fractional land cover map based on spectral unmixing for the Alps. This master thesis focuses on fractional shrub cover in Berchtesgaden National Park.