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Regional permafrost distribution based on remote sensing data

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The detection of permafrost phenomena and its distribution in mountain environments as well as the monitoring of changes of permafrost with respect to climatic changes is important for alpine risk, infrastructure, natural hazards and climate change studies. It is assumed that in Iceland less than ten percent of the land surface is underlain by permafrost and that most of it may disappear under global warming in the 21st century. In particular regions these changes will cause sincere problems for the society in mountainous regions. But because of the complexity of permafrost detection, the knowledge about its distribution in Iceland is currently not very well evaluated and only based on small-scale observations.

As permafrost is at most not directly observable, different indicators, e.g. rock glaciers and perennial snow patches, can be mapped to identify the distribution of permafrost. The study site is situated on the Tröllaskagi peninsula, in Northern Iceland. The peninsula is situated between Skagafjörður and Eyjafjörður and the highest summits reach an altitude of about 1400.

For large-scale identification of perennial snow patches (PSP) over the Tröllaskagi peninsula remote sensing techniques are a practicable technique. In our study, we use optical satellite (Landsat-5/7/8 and Sentinel-2B) data in combination with aerial images to map and monitor the spatial distribution of perennial snow patches, indicating a low or negative ground temperature underneath. After an atmospheric correction of the satellite data, pan sharpening of the Landsat data and resampling the Sentinel-2B data, and Normalized Difference Snow Index (NDSI) calculations, the perennial snow patches are classified in i) mainly permafrost, ii) mainly wind and iii) mainly avalanche induced origin. For that purpose, topographic information such as slope angle, aspect and curvature are determined from a DEM of Tröllaskagi peninsula. In a first step a digital elevation model with a grid size of 25 m is used, which will be replaced after the release of the ArcticDEM offering a grid size of 5 m. Furthermore, the wind atlas from the Icelandic Met Office (IMO) is used to identify the main wind direction. The analysis of the satellite data in combination with topographic as well as wind atlas information will result in a PSP distribution map of the Tröllaskagi peninsula.