

# A multi-satellite concept in support of high latitude permafrost modeling and monitoring - The ESA DUE Permafrost project

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## 1 INTRODUCTION

A number of remotely sensed products have been developed in the past which provide information relevant to permafrost distribution on circumpolar scale. They comprise parameters such as land surface temperature, land cover, soil moisture, disturbances, snow, terrain and methane. A monitoring system of high latitude permafrost requires regular and multiscale observation of all these parameters. Further on, the datasets need to meet requirements of permafrost models as well as support related research in geomorphology, botany and hydrology.

Such a comprehensive database is setup within the framework of the European Space Agency's (ESA) Data User Element (DUE) program. The ESA DUE Permafrost project establishes a monitoring system on local to pan-boreal/arctic scale based on satellite data. Within this project permafrost relevant remotely sensed products are assessed and eventually provided to users. The complexity of the phenomenon permafrost requires the close cooperation with the scientific community working in this field.

The consortium is led by I.P.F, Vienna University of Technology and supported by four partners: Gamma Remote Sensing, University of Waterloo, Friedrich Schiller University Jena and the Alfred Wegener Institute for Polar and Marine Research.

## 2 SATELLITE DATA PRODUCTS

Permafrost is a subsurface phenomenon and cannot be directly observed with satellite data. Yet, monitoring can be done based on indicators and via permafrost models. Indicators are especially thermokarst lake dynamics and surface elevation changes.

Those phenomena need to be observed on a local scale. Regional to circumpolar monitoring requires the use of permafrost models for which the following dataset will be provided:

- Land surface temperature is available from passive sensors such as MODIS, AATSR, and AMSR-E. It can be used as a forcing parameter for all permafrost models.
- The amount of snow determines insulation properties. An operational monitoring service for snow extent and SWE is currently being set up within the ESA DUE project GlobSnow.
- Vegetation layer also insulates the ground. A number of global and regional land cover maps are available (e.g. from GlobCover). They need to be merged and assessed for the purpose of modelling of permafrost and fluxes.
- Thermal conductivity is influenced by soil moisture. A near real-time (NRT) product based on METOP ASCAT is available from EUMETSAT. This service will be improved within the project under the viewpoint of frozen ground conditions.

## 3 OBSERVATION STRATEGY

The circumpolar datasets will be provided weekly to monthly with a spatial resolution of 25 km x 25 km. Selected areas will also be monitored at 1 km x 1 km for snow extent (SE), LST, soil moisture, and vegetation. High resolution satellite data are used at selected local sites. All satellite data products will eventually be made freely available via a WebGIS.

Further Information:  
[www.ipf.tuwien.ac.at/permafrost](http://www.ipf.tuwien.ac.at/permafrost)