Remote sensing and multi-scale integration for investigating 'Changing permafrost in the Arctic and its global effects in the 21st century – PAGE21'

Annett Bartsch[1], Elin Högström[1], Birgit Heim[2], Marcel Buchhorn[2], Catherine Ottlé[3], Fabienne Maignan[3], Michel Fily[4], Nicolas Delbart[5]

Presenter: A. Bartsch, annett.bartsch@tuwien.ac.at, +43 158801 12221, fax +43 158801 12299

[1]Institute of Photogrammetry and Remote Sensing, Vienna University of Technology
[2]Alfred Wegener Institute for Polar and Marine Research, Potsdam, Germany
[3]Laboratoire des Sciences du Climat et de l'Environnement, CEA-CNRS-UVSQ, Gif-sur-Yvette, France, catherine.ottle@lsce.ipsl.fr
[4]Laboratoire de Glaciologie et Géologie de l'Environnement, UJF-CNRS, Grenoble, France, michel.fily@lgge.ob.ujf-grenoble.fr
[5]Université Paris Diderot (Paris 7), PRODIG (UMR 8586), Paris, France.

PAGE21 (ENV.2011.1.1.3-1, www.page21.eu) aims to understand and quantify the vulnerability of permafrost environments to a changing global climate, and to investigate the feedback mechanisms associated with increasing greenhouse gas emissions from permafrost zones. This research will make use of a unique set of Arctic permafrost investigations performed at stations that span the full range of Arctic bioclimatic zones. As part of the project remotely sensed data will be integrated with in situ measurements for improved process understanding and model validation. A wide range of Earth Observation datasets at model scale are available for this purpose, but there is a lack of representation of heterogeneity and dynamics, in particular. This needs to be addressed, as well as the actual suitability of the available data, by incorporating state-of-the-art approaches regarding surface cover distribution and the dynamics of biogeophysical properties, for all observation sites and across all scales.

Landsurface temperature (LSCE, LGGE)

Microwave radiometers will be used to assess land surface temperature diurnal variations at regional scale (25km) for all the Arctic region. Thermal infrared measurements will helped to downscale the data to the kilometric scale for all the observations sites. The downscaling procedure will use a priori land surface temperatures estimated with a land surface model, to constrain the inversion process. The methodology under development at LSCE, will be presented.

Landsurface Hydrology (TUW)

ERS and Metop scatterometer derived soil moisture (25-50 km resolution) will be combined with ENVISAT ASAR data (150 m - 1 km resolution), and Sentinel 1 data if it becomes available, for periods with unfrozen conditions for across scale assessment of land surface hydrology. The potential of data from these active microwave sensors for high latitude land surface characterization will be discussed.

Phenology (UPD)

A remote sensing methodology has been developed to measure the timing of ecosystem green-up, closely related to the timing of leaf appearance, based on medium spatial resolution optical sensors (NOAA/AVHRR and SPOT/VGT). This methodology allows us to analyse the inter-annual variations of this key functionnal trait of arctic ecosystems. The comparison of these time series with those obtained with active and passive microwave remote sensing, that detects timing of key events such as the freezing or defreezing of soil, snowmelt and snowfalls, will permit an assessment of artic ecosytems functionning at scales that are not accessible by ground observations only. Moreover, the analysis will be completed by a comparison by the remote sensing products of surface temperature.

NDVI_tundra, fAPAR_tundra, LAI_tundra (AWI)

Remote sensing algorithms for the Normalized Differenced Vegetation Indices (NDVI), Leaf Area Index (LAI), fraction of Absorbed Photosynthetically Active Radiation (fAPAR) all use the NIR spectral bands. Due to low NIR reflectances from low-growing biomes, NDVI, LAI and fAPAR values for tundra fall into low ranges. Within the further preprocessing for models (permafrost/climate) the low values are falsely parametrised as large areal contributions of barren soil. Spectro-radiometrical field investigations at various Arcitc sites representing a range of tundra landscapes with varying moisture regimes and vegetation structures shall provide ranges for fAPAR_tundra, LAI_tundra.