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Ground surface temperatures (GST) modeling in the Russian Altay Mountains by using MODIS Land Surface Temperatures (LST). Assessment of the impact of snow cover, topography, landcover and sub-pixel variability on the GST-LST relationship.

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The Russian Altay Mountains are a challenging area for large scale permafrost modeling. The lack of meteo-data, strong temperature-inversions, rapid changing snow cover patterns and complicated landcover demand an in-depth approach. As a solution, time and spatially covering MODIS land surface temperature (LST) might be used as a proxy replacing the interpolated air and ground surface temperatures (GST).
Recent studies show the potential of this method on large continental areas (e.g. Canadian Arctic, Siberia), by using sinusoidal fits to eliminate the data-gaps both spatially as temporally out of the time-series. These studies use isotherms and analytical solutions for freezing and thawing to model permafrost distribution. However to use the LST-values as an upper boundary condition at heterogeneous mountain ranges as the Russian Altay, further research needs to be conducted. In detail the relation between this parameter and surface temperatures beneath areas covered with snow and vegetation requires more attention. In addition the effect of sub-pixel variability and topographic influence needs to be considered as the LST pixels come at 1km resolution.
This study tries to answer these questions by showing results of 96 surface temperature time-series recorded in and around the valley of Dzhazator and on the Tarkhata plain (Kosh Agatch District) from July 2008 until July 2009, areas both characterized by discontinuous permafrost, together with spatial dynamics in LST, GST, snow cover and NDVI.
iButtons and Onset dataloggers were installed in order to cover surface temperatures beneath a broad range of landcovers, different topographical positions and in grids to measure the sub-grid variability. LST time-series were interpolated by using the relationship with air temperatures. This enables to incorporate high frequency temperature variations in GST modeling.
Correlations both for the summer as the winter season are presented between LST, GST, snow cover and NDVI (Normal Difference Vegetation Index) time-series. Sub-grid variability is examined by a combination of SPOT landcover classification (20m resolution), ASTER DEM (30m resolution) and multiple temperature observations in one MODIS pixel.
Results show the potential of this method to model surface temperatures, and in a next step, permafrost, in areas without any other temperature observations, solely on satellite observations.