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The impact of lake fraction on circumarctic mean annual ground temperature derived from satellite surface status.

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Land surface state, frozen versus unfrozen conditions, can be captured globally with satellite data obtained by microwave sensors. The number of frozen days can be derived in case of daily availability of measurements. Such a sampling density can be achieved in high latitudes from coarse resolution sensors such as scatterometer and radiometers.
It has been hypothesized that the number of frozen days can give an estimate for mean annual ground temperature, although it does not account for crucial factors such as soil and snow properties. The aim of the study was to quantify the accuracy of such an approach and discuss the uncertainties with respect to different sensor types and environmental conditions.
Coarse spatial resolution microwave satellite data (Metop Advanced Scatterometer - ASCAT - and Special Sensor Microwave Imager - SSM/I; 12.5km and 25km nominal resolution; 2007 - 2012) which provide the necessary temporal sampling were used.
An issue in satellite microwave observations are uncertainties due to backscatter variations of water bodies in single pixels, due to water surface roughness and small lakes and ponds not seen due to the coarse resolution. The possible impact of lake fraction and the amount of ground fast ice per pixel has been evaluated using the sum of day of year frozen and unfrozen for the arctic and the modelled MAGT, derived from the relationship between day of year frozen and ground temperatures.
The MAGT from GTN-P (Global Terrestrial Network - Permafrost) borehole records at coldest sensor depth was derived and used for calibration and validation (separated into two distinct time periods). MAGT could be obtained with an RMSE of 2.2°C from ASCAT and 2.5°C from SSM/I surface state records using a linear model. Comparison to Snow Water Equivalent data (GlobSnow) and consideration of melt day information from ASCAT demonstrated the discrepancies of the simple approach. Difference between years and datasets showed that especially central Siberia and southern Yakutia are regions with higher complexity regarding MAGT retrieval. Lakes within grid cells can cause a MAGT offset of up to 0.1 degree Celsius.