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Monitoring of Surface Temperatures with Thermal Camera Systems at a High-Arctic Permafrost Site on Svalbard, Norway

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Surface temperature is a crucial parameter in proposed schemes that are aimed at assessing the thermal state of permafrost by remote sensing. However, the spatial resolution of satellite-based surface temperature measurements is usually not sufficient to capture the variations that occur in highly structured terrain typical of permafrost regions. Moreover, in arctic regions, cloud cover is likely to preclude measurements for prolonged periods that can result in a biased surface temperature record. To further explore these problems and develop suitable correction algorithms, ground-based surface temperature studies with adequate spatial and temporal resolution are required.
We present a continuous surface temperature record from a high-arctic continuous permafrost site on Svalbard, Norway, obtained with two thermal camera systems, each mounted on a 10m mast. Both systems featured a sensor size of 384 x 288 pixels, allowing for spatial resolutions ranging from several cm^2 per pixel to several m^2 per pixel. The first thermal camera system covered a single scene that included different expositions, surface covers and soil water contents with a temporal resolution of 10min. The second system was mounted on a rotating head that captured 15 different images every hour. The total area monitored with this system was approximately 300 x $100m^2$.
The study was performed from mid-July to September 2008, thus covering a large part of the snow-free season. The study area is characterized by hilly tundra with sparse vegetation, alternating with exposed soil and rock fields. The volumetric soil water content spatially varied from approximately 10% to more than 50%. The data set is discussed with respect to the following issues:
1. Do systematic differences in average surface temperature exist between regions with different soil water contents, surface covers and expositions?
2. What is the minimum monitoring frequency to correctly determine average surface temperatures for different time periods?
3. Is it possible to determine a correct average surface temperature if only measurements from periods with little or no cloud cover are considered?