Geophysical Research Abstracts
Vol. 15, EGU2013-6957, 2013
EGU General Assembly 2013

Quality assessment of MODIS land surface temperatures over an Arctic ice cap

Torbjørn I. Østby, Thomas V. Schuler, and Sebastian Westermann
Department of Geoscience, University of Oslo, Norway (torbjorn.ostby@geo.uio.no)

Surface temperature is governed by the surface energy balance and therefore a key variable in climate monitoring, ecology and also in glacier melt observation and modelling. With thermal satellite remote sensing land surface temperature (LST) can be obtained with high spatial and temporal coverage. Clear sky LST derived from the Moderate Resolution Imaging Spectrometer (MODIS) has a reported uncertainty of below 1K under most circumstances. However, there are only few studies validating the product over snow and ice surface, indicating a much higher uncertainty of up to 4K.

The MODIS LST level 3 product is compared with 8 years of meteorological data of an automatic weather station (AWS) located on the Austfonna ice cap, Svalbard. The smoothness of the ice cap in terms of topography, temperature and emissivity makes it an ideal site for comparing point measurements with the 1 km MODIS resolution. We find an overall RMS between MODIS LST and measured air temperature of 6.2K; however, melting conditions are nicely reproduced by the MODIS LST. Clouds are opaque in the range of the spectrum used for LST and therefore, cloudy scenes have to be removed. The MODIS LST product considers cloudiness by an automatic cloud-detection procedure. We derive a cloud index from the meteorological data of the AWS to assess the possibility of LST being affected by deficient cloud-detection. We find that over snow and ice the MODIS procedure detects too few clouds. Of the scenes classified as cloudy according to AWS data, MODIS interpreted 42% as clear sky during winter and 20% during summer. In contrast, on bare ground outside the glacier not far from the AWS, 65% of the sunny days are interpreted as cloudy during summer. Due to prevailing cloud condition at Austfonna, 42% of the successfully produced LST are acquired during a cloudy sky, 36% during a mixed sky and only 22% during clear sky. The effect of cloud miss detection is demonstrated by the RMS of 7.4K under cloudy conditions, in contrast to the 4.5K under clear sky conditions. The MODIS LST and air temperature discrepancy increases with decreasing sun angles, indicating that the MODIS cloud algorithm performs unsatisfactory under low solar illumination. The under-detection of clouds leads to a considerable cold bias in the LST product since top-of-cloud temperatures typically are much lower than surface temperatures. The LST-data set has a great potential for glaciological applications on larger glaciers and ice caps. Nevertheless, thermal remote sensing over snow and ice surface in cloud prone areas like Svalbard remains challenging.