

WCRP Open Science Conference 2011
24-28 October 2011
Sheraton Denver Downtown Hotel
Denver, Colorado, USA

Validation of a Climate-Data Record of the “clear-sky” surface temperature of the Greenland Ice Sheet

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Abstract

Surface temperatures on the Greenland Ice Sheet have been studied on the ground, using automatic weather station (AWS) data from the Greenland-Climate Network (GC-Net), and from analysis of satellite sensor data. Using Advanced Very High Frequency Radiometer (AVHRR) weekly surface temperature maps, warming of the surface of the Greenland Ice Sheet has been documented since 1981. We extended and refined this record using higher-resolution Moderate-Resolution Imaging Spectroradiometer (MODIS) data from March 2000 to the present. We developed a daily and monthly climate-data record (CDR) of the “clear-sky” surface temperature of the Greenland Ice Sheet using an ice-surface temperature (IST) algorithm developed for use with MODIS data. Validation of this CDR is ongoing.

MODIS Terra swath data are projected onto a polar stereographic grid at 6.25-km resolution to develop binary, gridded daily and mean-monthly IST maps. Each monthly map also has a color-coded image map that is available to download. Also included with the monthly maps is an accompanying map showing number of days in the month that were used to calculate the mean-monthly IST. This is important because no IST decision is made by the algorithm for cells that are considered cloudy by the internal cloud mask, so a sufficient number of days must be available to produce a mean IST for each grid cell.

Validation of the CDR consists of several facets: 1) comparisons between ISTs and in-situ measurements; 2) comparisons between ISTs and AWS data; and 3) comparisons of ISTs with surface temperatures derived from other satellite instruments such as the Thermal Emission and Reflection Radiometer (ASTER) and Enhanced Thematic Mapper Plus (ETM+). Previous work shows that Terra MODIS ISTs are about 3°C lower than in-situ temperatures measured at Summit Camp, during the winter of 2008-09 under clear skies. In this work we begin to compare surface temperatures derived from AWS data with ISTs from the MODIS CDR.

The Greenland Ice Sheet IST CDR will be useful for monitoring surface-temperature trends and can be used as input or for validation of climate models. The CDR can be extended into the future using MODIS Terra, Aqua and NPOESS Preparatory Project Visible Infrared Imager Radiometer Suite (VIIRS) data.