Geophysical Research Abstracts, Vol. 9, 10418, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-10418

Assessment of space-borne passive microwave detected melting events and visible albedo changes over the Greenland Ice Sheet

M. Tedesco

(with contributions by J. Stroeve, J. Box and K. Steffen)

University of Maryland, Baltimore County, Baltimore, MD, USA

NASA Goddard Space Flight Center, Greenbelt, MD, USA

mtedesco@umbc.edu

Studying the extent and duration of melting in Greenland is an important step to improve the understanding of the implications related to the ice sheet mass change, increase of the mean temperature and extreme precipitation events. Snowmelt can be detected by using microwave brightness temperatures measured by space-borne radiometers. These can provide information on the scene under observation also in case of cloudy skies and without solar illumination, guaranteeing a high temporal coverage.

A recently proposed approach by the author makes use of the difference between night- and day-time passes for detecting snowmelt over Greenland. Differently from the existing literature approaches, the technique uses separately either the 19 or 37GHz brightness temperatures. The highest frequency (e.g., 37 GHz) is generally more sensitive to wetness than the lowest one and to changes occurring in the upper part of the snowpack where the lowest frequency (19.35 GHz) is capable of providing information also below the surface. Moreover, data collected at 19.35 GHz also require a greater amount of liquid water than the 37 GHz in order for melting to be detected.

Changes in the surface albedo as a consequence of melting are related to both increase of the snow absorption coefficient and clustering of snow grains. However, there is a little difference between the absorption coefficients of ice and water, so that the main effect of melting is the decrease of albedo (e.g. increase in the absorption) as a

consequence of the bounding of grains, which act optically as larger grains. Because of the higher penetration depth and sensitivity to liquid water of microwave with respect to optical and infra-red wavelengths data, it might happen that passive microwave-based approaches detect melting that it is not directly affecting visible albedo. For example, it is possible that, due to the surface radiation balance, initial melting occurs first a few grains below the surface. In this case brightness temperatures (especially at 37 GHz) will detect melting but this phenomenon will not affect the visible albedo, at least initially. As melting goes on, then, surface grains will be likely involved in the constructive metamorphism. Another condition might occur when the duration and intensity of the melting event might not create the conditions to generate an increase of grain size such that significant decrease on the albedo is observed.

In this talk we report initial results regarding the comparison between space-borne passive microwave detected melting events and visible albedo changes over the Greenland Ice Sheet. This is important to understand at which degree maps of melt extent and duration derived from space-borne microwave brightness temperatures can benefit climate studies. We compare the changes occurring at the surface during and after melting events detected by microwave-based approaches, by analyzing the trend of albedo either measured on ground by the Greenland Climate Network Stations (GCNET) or derived from satellite measurements (Moderate Resolution Imaging Spectroradiometer, MODIS). Results are reported for several sites over the Greenland ice sheet.

The comparison of the different datasets require attention and it is not a simple task. Presence of clouds, precipitation and different spatial resolution provide sources of uncertainty, making the comparison difficult. In general, results show that no change in the albedo is observed when the microwave-based technique does not detect any melting. Changes in the visible albedo are observed when the 19 GHz-based approach detects melting. However, in the case of the 37 GHz data, there exist cases when the microwave technique detects melting but no significant change is observed in the albedo.

The analysis performed in this study provides also a comparison between ground- (GC-Net) and satellite-based (MODIS) albedo values, providing information for the validation of space-borne derived daily MODIS albedo (not-validated) over Greenland.