COMBINING MODIS AND QUIKSCAT DATA TO DELINEATE SURFACE AND NEAR-SURFACE MELT ON THE GREENLAND ICE SHEET

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ABSTRACT

Over the last two decades, increasing melt has been measured on the Greenland Ice Sheet, along with mass loss as determined from satellite data. Monitoring the state of the Greenland Ice Sheet becomes critical especially because it is actively losing mass, and the ice sheet has a sea-level rise potential of ~7 m. However measurement of the extent of surface melt varies depending on the sensor used, whether it is passive or active microwave or visible or thermal infrared. We have used remote-sensing data products to study surface and near-surface melt characteristics of the Greenland Ice Sheet. We present a blended MODIS-QS melt daily product for 2007 [1]. The products, including Moderate Resolution Imaging Spectroradiometer (MODIS) daily land-surface temperature (LST) and a special daily melt product derived from the QuikSCAT (QS) scatterometer [2, 3] show consistency in delineating the melt boundaries on a daily basis in the 2007 melt season [1], though some differences are identified.

An assessment of maximum melt area for the 2007 melt season shows that the QSCAT product detects a greater amount of melt (862,769 km^2) than is detected by the MODIS LST product (766,184 km^2). The discrepancy is largely because the QS product can detect both surface and near-surface melt and the QS product captures melt if it occurred anytime during the day while the MODIS product is obtained from a point in time on a given day. However on a daily basis, other factors influence the measurement of melt extent.

In this work we employ the digital-elevation model of Bamber et al. [4] along with the National Centers for Environmental Prediction (NCEP) data to study some areas and time periods in detail during the 2007 melt season. We focus on times in which the QS and MODIS LST products do not agree exactly.

We use NCEP and elevation data to analyze the atmospheric factors forcing the melt process, to gain an improved understanding of the conditions that lead to melt and melt persistence, and our ability to capture surface melt accurately using MODIS and QS data.

Though the MODIS and QS products generally agree on the melt boundary, there are places and times when they disagree. Through the use of the NCEP and meteorological data such as from the automatic weather stations on the ice sheet, analysis of the causal factors of the movement in the melt boundaries, and differences in melt boundaries between the products will be possible to discern.

Increasingly it is necessary to reduce errors in the detection of the melt boundaries and this work allows us to refine the satellite methods to achieve improved results. The overall consistency of melt/freeze boundaries from different sensors and algorithms demonstrates unequivocally that real geophysical conditions (representing different melt intensities) are being detected. We show that, although the MODIS LST and QS melt products generally agree well, certain atmospheric forcing and cloud-cover conditions cause discrepancies. Understanding these discrepancies allows us to improve our estimates of the uncertainties of the blended MODIS-QS product, and thus better characterize surface melt extent.

References

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