Geophysical Research Abstracts
Vol. 14, EGU2012-12388, 2012
EGU General Assembly 2012

Quantitative analysis of error sources in MODIS and AVHRR albedo products over the Greenland ice sheet

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Surface albedo is an important driver of the Greenland ice sheet energy budget, as it determines the amount of downwelling shortwave irradiance upon the ice/snow surface that is reflected. Since small changes in albedo can result in strong feedback effects, accurate assessment of ice/snow albedo is crucial to understand climate sensitivity. Satellite based albedo products provide an excellent tool to assess spatio-temporal variability in surface albedo of Greenland.

The accuracy of these satellite albedo products has been assessed in various studies. The estimated errors can be significant in climate or surface process models (e.g., an uncertainty of 0.05 for a snowpack with albedo of 0.8 results in 25% uncertainty in absorbed radiation). Therefore, improved processing of the albedo products based on an understanding of the error sources is essential, certainly if the albedo products are used for albedo parameterization. In this context, a variety of error sources has already been discussed in literature, but the quantitative contribution of each error source remains unknown.

This study provides a quantitative analysis of the error sources in MODIS and AVHRR surface albedo retrievals by comparing MODIS and AVHRR albedo products (MCD43, MxD10A1, AVHRR APP 5km) with ground based albedo measurements from automatic weather stations (AWS) on the Greenland ice sheet. Analysis of the albedo algorithm, solar zenith angle and spatial variability illustrates their effect on the albedo errors. Scale effects due to different footprint size analyzed based on Landsat albedo data were also found to be important, certainly near the edges of the ice sheet.

As a result, these quantitative estimates of different error sources give insight in the accuracy uncertainty and help to understand how each error source affects the overall accuracy.