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Assessment of modeled accumulation and albedo for development of a data-assimilation framework over the Greenland ice sheet

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Recent studies have suggested that the Greenland Ice Sheet (GrIS) is losing mass at an accelerating rate, indicating the importance of making accurate measurements and predictions about changes in the ice sheet mass balance. Regional Climate Models (RCMs) have played an important role in quantifying the Greenland Surface Mass Balance (SMB), a substantial component of the overall mass balance. The Modèle Atmosphérique Régional (MAR) is one such model, validated against in-situ and satellite data, that has been used successfully to quantify changes in GrIS melting and SMB over time. Nevertheless, MAR and other RCMs are still subject to biases that limit their accuracy. For instance, MAR has been shown to produce errors in melting as a result of precipitation biases that can affect the timing of bare ice exposure, potentially impacting SMB estimates. In order to optimize model precision and accuracy with regard to the SMB, we are engaged in the development of a data assimilation framework for the MAR model.

Here, we discuss accumulation and albedo biases in MAR identified using in-situ measurements and remote sensing data, and discuss an initial effort to assimilate satellite data into the model so as to improve melt estimates. Modeled accumulation (2003-2010) is assessed using independent datasets, including mass changes from the Gravity Recovery and Climate Experiment (GRACE), and changes in surface elevation from CryoSat-2 and ICESat. Modeled albedo is compared against data from the Moderate Resolution Imaging Spectroradiometer (MODIS) 16-day and 1-day albedo products. A set of relatively simple techniques is then used to assimilate these MODIS albedo data into MAR (for the period from 2001-2010), and data from the updated model are then compared against melt estimates using microwave brightness temperatures from the Special Sensor Microwave/Imager (SSM/I) and Special Sensor Microwave Imager/Sounder (SSMIS). Ultimately, multiple remote sensing and in-situ measurements will be employed as part of a comprehensive data assimilation framework.