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Assessing modeled Greenland surface mass balance in the GISS Model E2 and its sensitivity to surface albedo

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The surface mass balance (SMB) of the Greenland Ice Sheet (GrIS) plays an important role in global sea level change. Regional Climate Models (RCMs) such as the Modèle Atmosphérique Régionale (MAR) have been employed at high spatial resolution with relatively complex physics to simulate ice sheet SMB. Global climate models (GCMs) incorporate less sophisticated physical schemes and provide outputs at a lower spatial resolution, but have the advantage of modeling the interaction between different components of the earth's oceans, climate, and land surface at a global scale. Improving the ability of GCMs to represent ice sheet SMB is important for making predictions of future changes in global sea level. With the ultimate goal of improving SMB simulated by the Goddard Institute for Space Studies (GISS) Model E2 GCM, we compare simulated GrIS SMB against the outputs of the MAR model and radar-derived estimates of snow accumulation. In order to reproduce present-day climate variability in the Model E2 simulation, winds are constrained to match the reanalysis datasets used to force MAR at the lateral boundaries. We conduct a preliminary assessment of the sensitivity of the simulated Model E2 SMB to surface albedo, a parameter that is known to strongly influence SMB. Model E2 albedo is set to a fixed value of 0.8 over the entire ice sheet in the initial configuration of the model (control case). We adjust this fixed value in an ensemble of simulations over a range of 0.4 to 0.8 (roughly the range of observed summer GrIS albedo values) to examine the sensitivity of ice-sheet-wide SMB to albedo. We prescribe albedo from the Moderate Resolution Imaging Spectroradiometer (MODIS) MCD43A3 v6 to examine the impact of a more realistic spatial and temporal variations in albedo. An age-dependent snow albedo parameterization is applied, and its impact on SMB relative to observations and the RCM is assessed.