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Evaluation of a new snow albedo scheme in RACMO2 for the Greenland ice sheet

Christiaan van Dalum[1], Willem Jan van de Berg[1], Stef Lhermitte[2], and Michiel van den Broeke[1]
[1]Utrecht University, IMAU, Physics, Utrecht, Netherlands
[2]Delft University of Technology, Department of Geoscience and Remote Sensing, Delft, Netherlands

Snow and ice albedo schemes in present day climate models often lack a sophisticated radiation penetration scheme and are limited to a broadband albedo. In this study, we evaluate a new snow albedo scheme in the regional climate model RACMO2 that uses the two-stream radiative transfer in snow model TARTES and the spectral-to-narrowband albedo module SNOWBAL for the Greenland ice sheet. Additionally, the bare ice albedo parameterization has been updated. The snow and ice albedo output of the updated version of RACMO2, referred to as RACMO2.3p3, is evaluated using PROMICE and K-transect in-situ data and MODIS remote-sensing observations. Generally, the RACMO2.3p3 albedo is in very good agreement with satellite observations, leading to a domain-averaged bias of only -0.012. Some discrepancies are, however, observed for regions close to the ice margin. Compared to the previous iteration RACMO2.3p2, the albedo of RACMO2.3p3 is considerably higher in the bare ice zone during the ablation season, as atmospheric conditions now alter the bare ice albedo. For most other regions, however, the albedo of RACMO2.3p3 is lower due to spectral effects, radiation penetration, snow metamorphism or a delayed firn-ice transition. Furthermore, a white-out effect during cloudy conditions is captured and the snow albedo shows a low sensitivity to low soot concentrations. The surface mass balance of RACMO2.3p3 compares well with observations. Subsurface heating, however, now leads to increased melt and refreezing in south Greenland, changing the snow structure.