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Using improved surface boundary conditions for mass balance modelling in large-scale ice sheet models of Greenland

Robert Fausto, Andreas Ahlstrøm, and Dirk van As

Geological Survey of Denmark and Greenland (GEUS), Marine geology and Glaciology, Copenhagen, Denmark (rsf@geus.dk)

Improving surface boundary conditions for large-scale ice sheet models of Greenland is the main focus and simple parameterizations are used to calculate surface melt, snow densification and meltwater retention. Near-surface air temperature (2m) and its standard deviation from the monthly means over the Greenland Ice Sheet (GrIS) are parameterized using data from automatic weather stations (AWS) located on land and on the ice sheet. The parameterizations are used in a surface mass balance model based on a positive degree day (PDD) approach. The PDD approach accounts for firn warming, rainfall, and refreezing of melt water, with different PDD-factors for ice and snow under warm and cold climate conditions. The snow densification and meltwater retention processes achieves a separation of volume and mass changes of the surface layer to determine the surface melt contribution to runoff. Experiments for present-day conditions show the simulated surface elevation is found to have a reasonable agreement with observations. Experiments that compare the modelled surface elevation for the Eem period with present day using the updated version of the PDD-approach are also presented.