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Surface energy and mass budgets along a transect in the south-western region of the Greenland Ice Sheet

Dirk van As, Andreas Ahlstrom, Soren Nielsen, Morten Andersen, and Robert Fausto
GEUS - Geological Survey of Denmark and Greenland, Glaciology group, Copenhagen K, Denmark (dva@geus.dk)

The section of the Greenland Ice Sheet that produces melt water directly running off into the Nuuk fjord is 90 km long, and consists of five outlet glaciers, four of which are marine-based. The lower regions of the ice sheet are characterized by low amounts of precipitation, high melt, and relatively high surface velocities for the land-terminating Qamanarssup Sermia/Glacier as determined by continuous GPS measurements ($\sim$150 m per year).
In the 1980s Qamanarssup Sermia was subject to detailed glaciological investigations. Since 2007, two automatic weather stations have been measuring in the ablation zone (570 and 1150 m) as part of the PROMICE station network. The weather stations measure standard meteorological parameters, the full radiation budget, surface height change, ice temperatures and GPS location. In this study we use station data to run and validate a surface energy and mass budget transect model, which resolves the entire surface energy budget by including iterative turbulent heat flux calculations, solar radiation penetration in snow and ice, refreezing of melt water, and a tuned precipitation parameterization. The results show yearly net ablation values of 5 m at low elevation, which are considerably larger than ablation measured in the 1980s. Our calculations produce an equilibrium-line altitude of 1500 m, whereas melt water runs off up to 1700 m. In order to calculate the run-off from the ice sheet into the Nuuk fjord, we apply the transect results to the region and find a yearly value of 7 km3 of water.