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Estimating and understanding recent changes in the energy and freshwater budget for Godthåbsfjord catchment with a 5 km regional climate model

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The freshwater input to the Godthåbsfjord (SW Greenland) is analyzed in a HIRHAM5 regional climate model experiment with special emphasis on the melt and runoff from the part of the ice sheet that drains into the fjord. The regional model covers all of Greenland and is forced by the ERA-Interim reanalysis on the lateral boundaries over the period 1989-2012.

During this period, the lower to middle parts of the ice sheet experience increasing energy input from the surface turbulent heat exchange and the middle to high parts experience increasing energy input due to shortwave radiation. These effects are related to an overall increase in atmospheric pressure over North Greenland, southerly wind anomalies and decreased cloudiness. These factors contribute to increased summer melt which dominates over changes in annual accumulation, resulting in a decline in surface mass balance and an upward migration of the equilibrium line. The increased summer melt from the ice sheet draining into the Godthåbsfjord dominates over significantly smaller changes in precipitation directly over the fjord waters and surface runoff from non-glacier land areas.

The high horizontal resolution of the model (about 5.5 km) allows great detail in the representation of topography and surface types. This makes the model particularly suited for this kind of local catchment-scale analysis. The model output is compared to a range of different hydro-meteorological observations both on and off the ice sheet and is found to represent even day-to-day weather variability well.