Modeling of intermediate water mass formation and subsurface heat transport in Godthåbsfjord

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Abstract

Godthåbsfjord, located at the Greenland capital Nuuk, is a long (~190 km) subarctic sill-fjord where the inner part of the fjord is in direct contact with the Greenland ice sheet via three tidal outlet glaciers. In addition, runoff from land-terminated glaciers and the large surrounding drainage area causes a large freshwater supply to the fjord. The deeper fjord circulation in the summer season is characterized by a large intermediate water mass formed by tidal mixing in the sill areas, where warm and relatively fresh surface water is mixed with deeper water masses, and a subsurface circulation is established where relatively warm water is transported towards the inner part of the fjord. During late summer significant amounts of subglacial freshwater discharge (SgFW) has been observed to modify the circulation near the glaciers. The role of these various dynamical processes for the heat transport in the fjord is investigated in a sensitivity study with a high-resolution primitive equation model of the area. The model domain consists of Godthåbsfjord, the neighboring fjord Amarlik and the coastal area outside the fjord. The model is based on available bathymetric data from the area, it is forced with tidal forcing at the open boundaries and observed meteorological conditions from the entrance to the fjord area.The coupling between SgFW and the intermediate baroclinic circulation is analyzed in relation to the estimated large subsurface heat transport in the SrW, equivalent to melting about 2 km^3 of ice per year.