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Estimating the glacial melt water contribution to the fresh water budget from salinity and δ^{18}O measurements in Godthåbsfjord

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The mass loss of the Greenland ice sheet increases due to changes in the surface mass balance and accelerated ice discharge through numerous outlet glaciers at the margins. The melt has global and local consequences. Globally the sea level rises and locally the increased fresh water inflow affects fishery and transportation.

In this study we focus on the fjord system near Nuuk in West Greenland, Godthåbsfjord. Godthåbsfjord is a unique fjord with its length of about 300 km and a shallow sill at the fjord entrance that protects the fjord system. There are several tidewater glaciers terminating into the fjord and two land-terminating glaciers along the fjord contributing to the fresh water content in the fjord. The largest tidewater glacier is Kangiata Nunåta Sermia. The freshwater originates primarily from three processes: surface melt, ice berg calving and basal melt.
Observations and climate models can give estimates for calving and surface melt. Basal melt, however, cannot be observed directly. Even though mass loss by basal melting is neglected on the global scale, it plays an important role in the small regional environment like fjords and the glaciers itself. Warmer ocean temperatures increase basal melt, and resulting lubrication accelerates tidewater glaciers. Overall, the freshwater content in the fjord increases.

Salinity measurements taken in the fjord between 2007 and 2011 show a seasonal variability originating from the variation in fresh water inflow. Based on salinity records only, it is not possible to distinguish between the different fresh water sources like precipitation and melt. Hence, $\delta^{18}O$ measurements are used in addition to salinity records to determine the origin of the fresh water because of the different $\delta^{18}O$ signatures of run-off and glacial melt water. The resulting fresh water inflow and the glacial melt contribution are compared to independent estimates and regional climate model output.