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High-resolution ocean/sea ice/ice shelf simulation of the 79° North Glacier and Zachariae Isstrøm

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The 79° North Glacier (79NG) is the largest of the marine terminating glaciers fed by the Northeast Greenland Ice Stream (NEGIS), which drains around 15% of the Greenland ice sheet. The 79NG is one of the few Greenland glaciers with a floating ice tongue, and is strongly influenced by warm Atlantic Water originating from Fram Strait and carried towards it through a trough system on the Northeast Greenland continental shelf.

Considering the decrease in thickness of the 79NG and also of the neighboring Zachariae Isstrøm (ZI), we aim to understand the processes that potentially lead to the decay of these glaciers. As a first step we present here an ocean-sea ice simulation which explicitly resolves the cavities of the 79NG and ZI glaciers, applying the Finite-Element Sea ice-Ocean Model (FESOM). We take advantage of the multi-resolution capability of FESOM and locally increase mesh resolution in the vicinity of the 79NG to 700 m. The Northeast Greenland continental shelf is resolved with 3 km, and the Arctic Ocean and Nordic Seas with 4.5 km. The simulation is conducted for the time period 1980 to 2018, using JRA-55 atmospheric reanalysis. Solid and liquid runoff from Greenland is taken from the Bamber et al. 2018 dataset. The flow of warm Atlantic water into the glacier and outflow of meltwater is compared to observational data from measurement campaigns. We further use current and hydrographic data from moorings deployed in Norske Trough to assess the model performance in carrying warm water towards the glacier. This simulation spanning several decades allows us to investigate recent changes in basal melt rates induced by oceanic processes, in particular warm Atlantic Water transport towards the glacier.