Ice-ocean interactions on Ryder Glacier in North Greenland

Johan Nilsson1, Martin Jakobsson2, Christian Stranne2, Matt O'Regan2, and Larry Mayer3

1Stockholm University, Department of Meteorology, Stockholm, Sweden (nilsson@misu.su.se)
2Stockholm University, Department of Geological Sciences, Stockholm, Sweden
3Center for Coastal and Ocean Mapping, University of New Hampshire, USA

Here, we report oceanographic observations and multi-beam bathymetry from the previously uncharted Sherard Osborn Fjord in North Greenland, collected in the summer of 2019 by the Swedish icebreaker Oden. Ryder Glacier, which has Greenland’s third largest floating ice tongue, discharges into Sherard Osborn Fjord. The observations show that Arctic Atlantic Water interacts with the ice tongue, creating a prominent intermediate layer of glacially-modified water in the fjord. However, a secondary sill in the inner fjord restricts the heat carried by the Atlantic Water towards Ryder Glacier’s floating tongue, thereby reducing basal melt rates. The observations indicate that the inflow of Atlantic Water over the inner sill is limited by hydraulic control, and that shear-driven vertical mixing cools the inflow reaching the ice tongue. The interactions between the flow and the sill geometry suggest a negative feedback, which reduces the sensitivity of the basal melt rate to variations of Atlantic Water temperature. This may help to explain why the extent of Ryder’s Glacier’s ice tongue has remained stable over the past 50 years, whereas the neighbouring Petermann Glacier’s ice tongue, with a different sill geometry, has retreated significantly.