Geophysical Research Abstracts
Vol. 19, EGU2017-18586, 2017
EGU General Assembly 2017

Ocean impact on Nioghalvfjerdsfjorden Glacier, Northeast Greenland

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The ocean plays an important role in modulating the mass balance of the Greenland Ice Sheet by delivering heat to the marine-terminating outlet glaciers around Greenland. The largest of three outlet glaciers draining the Northeast Greenland Ice Stream is Nioghalvfjerdsfjorden Glacier (also referred to as 79 North Glacier). Historic observations showed that warm waters of Atlantic origin are present in the subglacial cavity below the 80 km long floating ice tongue of the Nioghalvfjerdsfjorden Glacier and cause strong basal melt at the grounding line, but to date it has been unknown how those warm water enter the cavity.

In order to understand how Atlantic origin waters carry heat into the subglacial cavity beneath Nioghalvfjerdsfjorden Glacier, we performed bathymetric, hydrographic, and velocity observations in the vicinity of the main glacier calving front aboard RV Polarstern in summer 2016. The bathymetric multibeam data shows a 500 m deep and 2 km narrow passage downstream of a 310 m deep sill. This turned out to be the only location deep enough for an exchange of Atlantic waters between the glacier cavity and the continental shelf. Hydrographic and velocity measurements revealed a density driven plume in the vicinity of the glacier calving front causing a rapid flow of waters of Atlantic origin warmer 1°C into the subglacial cavity through the 500 m deep passage. In addition, glacially modified waters flow out of the glacier cavity below the 80 m deep ice base. In the vicinity of the glacier, the glacially modified waters form a distinct mixed layer situated above the Atlantic waters and below the ambient Polar water. At greater distances from the glacier this layer is eroded by lateral mixing with ambient water. Based on our observations we will present an estimate of the ocean heat transport into the subglacial cavity. In comparison with historic observations we find an increase in Atlantic water temperatures throughout the last 20 years. The resulting enhanced basal melt rates may explain the observed thinning of the glacier tongue.