Geophysical Research Abstracts
Vol. 19, EGU2017-8326, 2017
EGU General Assembly 2017

Fjord circulation promotes significant glacier-wide submarine melting at a west Greenland tidewater glacier

Donald A. Slater (1), Fiamma Straneo (2), Sarah B. Das (2), and Peter W. Nienow (1)
(1) School of Geosciences, University of Edinburgh, United Kingdom, (2) Woods Hole Oceanographic Institution, USA

In recent decades, rapid change at Greenland's marine-terminating glaciers has significantly impacted the contribution of the ice sheet to sea level. While these changes have been widely linked to a warming of the ocean around Greenland, process understanding linking ocean forcing to glacier response, for example by submarine melting, remains at an early stage. The most rapid submarine melting likely occurs where buoyant plumes, initiated by subglacial discharge, rise up tidewater glacier calving fronts. Plumes have therefore received much attention, yet a plume typically occupies only a small fraction of the submerged calving front area. Thus melting within the plume itself may be a small contributor to the front-wide melting experienced by the glacier. A plume may however promote melting over a much larger area by inducing a fjord-scale circulation which, by increasing water velocities at the ice/ocean interface, can give rise to increased melting over the entire glacier face.

Here we address this fjord-scale, plume-driven circulation and its impact on submarine melting by combining observations collected within 100 m of marine-terminating Saqqarliup Sermia in west Greenland with high-resolution fjord modelling using the MITgcm. Both field data and modelling show that water from the main plume flows away from the glacier as a subsurface jet, and that entrainment into this jet generates regions of fjord water recirculating back towards the glacier. The modelling further suggests that these recirculations drive elevated across-glacier water motion thereby promoting significant submarine melting over the full 4 km-width of the calving front, resulting in total melt volumes which substantially exceed those generated directly by the relatively narrow plume. Our results highlight the value of combining detailed field observations with modelling and demonstrate how the secondary fjord circulation generated by plumes may play a significant role in driving submarine melting at tidewater glaciers.