Mooring measurement near a marine-terminating glacier in Bowdoin Fjord in northwestern Greenland

*Yoshiki Fujishi[1,2], Yasushi Fukamachi[1,3], NAOYA KANNA[3], Shin Sugiyama[1,3]

1. Institute of Low Temperature Science, Hokkaido University, 2. Graduate School of Environmental Science, Hokkaido University , 3. Arctic Research Center, Hokkaido University

Submarine melting of calving glaciers is considered as an important process in the mass loss of the Greenland ice sheet (Straneo et al., 2013). Moreover, freshwater runoff has been increasing in recent years and its impact on marine ecosystem is recognized. Bowdoin Glacier, a marine-terminating outlet glacier in northwestern Greenland, has experienced rapid retreat since 2008 (Sakakibara et al., 2018). However, oceanographic observations are sparse in Greenlandic fjords, especially near the calving front of glaciers. The lack of a long-term in-situ data makes it difficult to quantify submarine melting. To better understand seasonal variability in current, temperature, and salinity in this proglacial fjord, mooring measurement was performed in Bowdoin Fjord, a 20-km-long fjord in front of Bowdoin Glacier.

Two moorings were deployed in Bowdoin Fjord, one at 17 km from the glacier front (BF17) and another at approximately 1 km from the glacier front (BF01), respectively. The ocean depth was 540 m at BF17 and 186 m at BF01. The moorings were equipped with a pressure sensor (DEFI2-D50HG, JFE Advantech), thermistors (NWT-SN, Nichiyu Giken and SBE56, Seabird), current meters (INFINITY-EM, JFE Advantech) and conductivity-temperature sensors (SBE-37SM, Seabird). At BF17, a current meter and a conductivity-temperature sensor were at the depths 527 m and 530 m, respectively. A pressure sensor and seven thermistors were at 220 m and 222, 246, 268, 318, 368, 418, and 468 m, respectively. At BF01, a current meter and a conductivity-temperature sensor were at the depths of 167 m and 170 m, respectively. The instruments were operated from August 2016 to July 2018 at BF17 and from July 2017 to July 2018 at BF01.

At BF17, temperature near the bottom was lower during northward current (towards the glacier). Temperature variations corresponded well with that of salinity throughout the year, i.e. temperature increased when salinity decreased. From August to October, we observed fortnightly temperature variations suggesting the influence of tide on water exchange in the fjord. In early August, water near the bottom at BF01 flowed towards the glacier and temperature near the bottom rapidly decreased. This event occurred when the daily mean air temperature measured at Qaanaaq Airport exceeded 0 ˚C, indicating the initiation of subglacial discharge. Temperature variations near the bottom at BF01 correlated with salinity, i.e. temperature and salinity increased at similar timings. Both at BF17 and BF01, temperature variations were small in winter and spring, which we attribute to sea ice cover usually observed in Bowdoin Fjord from November to June. Our data suggested that tide plays a key role in water exchange in the fjord, whereas water property near the glacier front was strongly influenced by meltwater discharge. In the presentation, water property variations and fjord circulation are discussed with weather conditions, and the data obtained at BF17 are compared with those at BF01.

ACKNOWLEDGEMENTS

This research was funded by the Arctic research project Arctic Challenge for Sustainability (ArCS).

REFERENCE

Straneo F., et al., (2013): Challenges to understanding the dynamic response of Greenland’s marine terminating glaciers to oceanic and atmospheric forcing. *Amer. Meteor. Soc.*, 94, 1131–1144

Sakakibara D., et al. (2018) Ice front and flow speed variations of marine-terminating outlet glaciers along the coast of Prudhoe Land, northwestern Greenland. J. Glaciol., 64(244), 300–310

Keywords: Greenland, Fjord, Marine-terminating glacier

