# Seasonal variations in the dynamics of Bowdoin Glacier, northwest Greenland

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Submarine melting and ice-mélange weakening are suspected as triggering mechanisms of rapid retreat of tidewater glaciers in the Greenland Ice Sheet (e.g. Straneo et al., 2013). To better understand these key processes at the ice-ocean interface, we measured ice-front position and glacier/ice-mélange movement by processing daily photographs taken by a time-lapse camera operated near the ice-front of Bowdoin Glacier in the northwest Greenland over two years since 2013. The results showed clear seasonal variations in the ice-front position with an amplitude of ~600 m, as well as in ice speed at the centerline of the glacier (Fig 1). During summer, the ice-front position was relatively stable, but retreated occasionally by large calving events (Figs 1a Period 1 and Fig. 2a). Most of the calving events occurred near buoyant plume caused by upwelling of subglacial discharge where a large submarine melt rate is expected. The glacier began to advance in September approximately when air temperature dropped below 0 °C (Fig. 1a Period 2). The glacier advanced the most in winter when the fjord was jammed by ice-mélange (Figs 1a Period 3 and 2b). After winter, extended portion of the glacier rapidly disintegrated by a few calving events (Figs 1a Period 4 and 2c). Such event coincided with initiation of fast ice-mélange movement in front of the glacier (Fig 1b) and temperature increase above 0 °C (Fig 1c). These results indicate both ice-mélange and submarine melting play roles in seasonal advance and retreat of Bowdoin Glacier. Moreover, the onset of glacier advance (retreat) was coincided with seasonal air temperature change from positive to negative (negative to positive), implying glacier surface melt water is a controlling process of ice-front position.

**References**

Straneo, F. and 15 others, Challenges to understanding the dynamic response of Greenland's marine terminating glaciers to oceanic and atmospheric forcing, Bulletin of the American Meteorological Society, 94(8), 1131‐1144, 2013

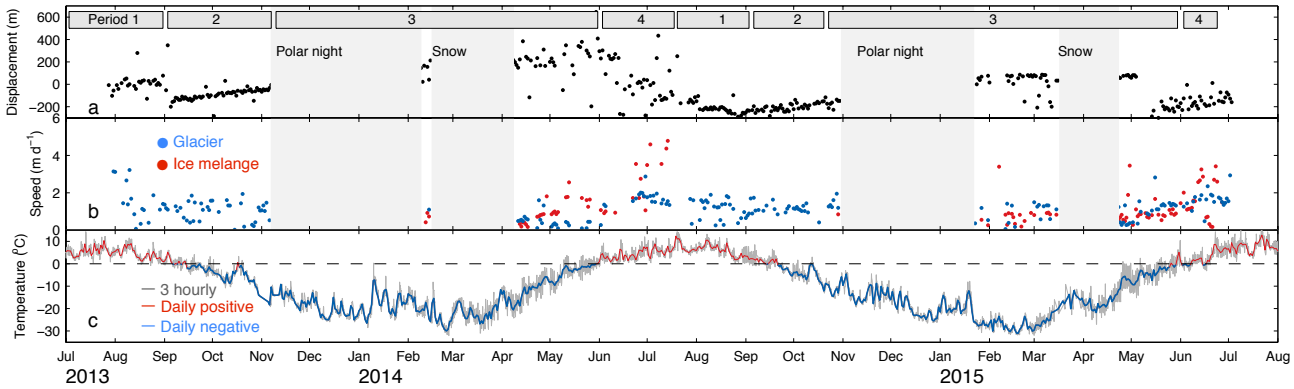


Figure 1. Seasonal variations in the ice-front position (a), glacier/ice-mélange speed (b) and air temperature at Qaanaaq air port where 30 km west from the glacier (c).


Figure 2. Time-lapse imagery of Bowdoin Glacier after mid summer (a), winter (b) and the largest calving event (c). Black lines highlighted the ice-front position of Bowdoin Glacier. During summer time, buoyant plume was continually observed at center of the ice-front.