

# Elevation changes and ice volume loss of marine-terminating glaciers in northwestern Greenland from 1985 to 2012

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The Greenland ice sheet is losing mass under the influence of increases in surface melting, and ice discharge from marine-terminating outlet glaciers (van den Broeke et al., 2016). To project changes of the ice sheet under the changing climate, better understanding of ongoing changes and their driving process is required. To this end, we studied elevation and volume changes of 16 marine-terminating outlet glaciers in northwestern Greenland from 1985 to 2012 (Figure 1). Surface elevation was measured using digital elevation models from aerial photographs and satellite images acquired by Advanced Spaceborne Thermal Emission and Reflection Radiometer. We also calculated changes in ice discharge from study glaciers, and compared them with observed volume changes.

Thinning was observed at all of the study glaciers during a period between 1985 and 2012. The magnitude of the thinning was greater than 100 m near the termini of Tarcy and Farquhar Glaciers. During a period between 1985 and 2000, thinning rate at Tracy, Farquhar and Melville Glaciers were  $>2 \text{ m a}^{-1}$ , whereas the other glaciers indicated no remarkable change in surface elevation. All of the study glaciers thinned during a period between 2000 and 2012. Tracy, Farquhar, Bowdoin and Diebitsch Glaciers thinned at a rate of  $>2 \text{ m a}^{-1}$ , and the rate was larger near the terminus. Because these glaciers accelerated in the same period, observed thinning was likely enhanced by stretching of ice (Sakakibara and Sugiyama, 2018).

Total volume change of the study glaciers was  $-23.3 \text{ km}^3$  during a period between 1985 and 2012. Volume loss of Tracy Glacier accounted for 49% of the total. The total volume of the study glaciers slightly increased at a rate of  $0.2 \text{ km}^3 \text{ a}^{-1}$  in 1985–2000, and then substantially decreased at a rate of  $-2.2 \text{ km}^3 \text{ a}^{-1}$  in 2000–2012. During a period between 2000 and 2012, the contributions of surface mass balance and ice discharge to the volume change were 24% and 76%, respectively. At Tracy Glacier, ice discharge increased from  $0.7$  to  $1.0 \text{ km}^3 \text{ a}^{-1}$  from 1985–2000 to 2000–2012. This increase account for 60% of an increase in the volume loss of Tracy Glacier after 2000.

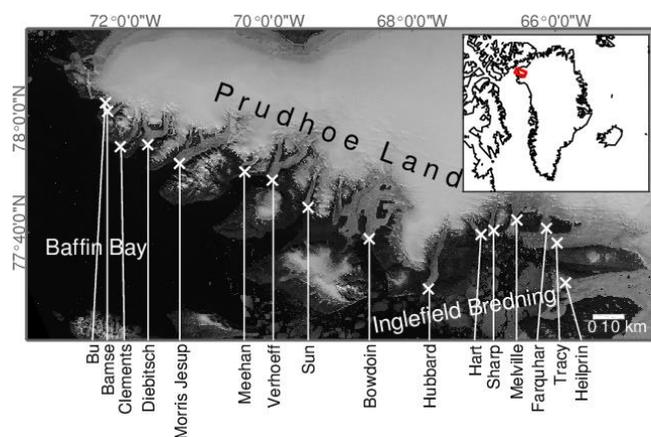


Figure 1. Study glaciers in northwestern Greenland. The inset shows the location of the study area in Greenland.

## References

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