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A 70-year record of outlet glacier retreat in northern Greenland

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Over the past two decades, the Greenland Ice Sheet (GrIS) has undergone accelerated mass loss increasing its contribution to sea level rise. This is partly attributed to increased mass loss from dynamic marine-terminating outlet glaciers. Despite marine-terminating outlet glaciers in northern Greenland draining 40% of the ice sheet by area, they are comparatively less well-studied than other regions of the ice sheet (e.g. central west or south-east). This region could be susceptible to marine-ice sheet instability due to large proportions of the bedrock rested below sea level and is also unique in the presence of large floating ice tongues. Here, we use a range of satellite imagery sources, accompanied by historical maps, to examine multi-decadal front position changes at 21 outlet glaciers in northern Greenland between 1948 and 2016. We accompany these terminus changes, with annual records of ice velocity, climate-ocean forcing data, and glacier-specific factors (e.g. fjord-width and basal topography) to understand the dominant forcing on glacier dynamics in the region.

Over the last 70 years, there has been a clear pattern of glacier retreat in northern Greenland. This is particularly notable during the last two decades, where 62% of our study glaciers showed accelerated retreat. This was most notable at Humboldt, Tracy, Hagen Brae, C. H. Ostenfeld and Petermann Glaciers, and in the case of the latter three glaciers, this involved substantial retreat of their floating ice tongues (> 10 km). Alongside retreat, several study glaciers underwent simultaneous velocity increases. However, the collapse of floating ice tongues did not always result in increased velocity. Similar to other regions of the ice sheet, recent glacier retreat in the northern regions of the Greenland Ice Sheet could be linked to climatic-oceanic forcing, but at this stage this remains largely unknown. This response to external forcing is further complicated by the presence of glacier-surging recorded at several of our study glaciers. As northern Greenland is predicted to undergo greater warming due to Arctic amplification during the 21st century, we conclude that the region could become an increasingly important source of mass loss.