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Arctic polynya and glacier interactions

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Major uncertainties surround future estimates of sea level rise attributable to mass loss from the polar ice sheets and ice caps. Understanding changes across the Arctic is vital as major potential contributors to sea level, the Greenland Ice Sheet and the ice caps and glaciers of the Canadian Arctic archipelago, have experienced dramatic changes in recent times. Most ice mass loss is currently focused at a relatively small number of glacier catchments where ice acceleration, thinning and calving occurs at ocean margins. Research suggests that these tidewater glaciers accelerate and iceberg calving rates increase when warming ocean currents increase melt on the underside of floating glacier ice and when adjacent sea ice is removed causing a reduction in 'buttressing' back stress. Thus localised changes in ocean temperatures and in sea ice (extent and thickness) adjacent to major glacial catchments can impact hugely on the dynamics of, and hence mass lost from, terrestrial ice sheets and ice caps.

Polynyas are areas of open water within sea ice which remain unfrozen for much of the year. They vary significantly in size ($\sim$3 km^2 to $>$ $\sim$50,000 km^2 in the Arctic), recurrence rates and duration. Despite their relatively small size, polynyas play a vital role in the heat balance of the polar oceans and strongly impact regional oceanography. Where polynyas develop adjacent to tidewater glaciers their influence on ocean circulation and water temperatures may play a major part in controlling subsurface ice melt rates by impacting on the water masses reaching the calving front. Areas of open water also play a significant role in controlling the potential of the atmosphere to carry moisture, as well as allowing heat exchange between the atmosphere and ocean, and so can influence accumulation on (and hence thickness of) glaciers and ice caps. Polynya presence and size also has implications for sea ice extent and therefore potentially the buttressing effect on neighbouring tidewater glaciers.

The work presented discusses preliminary satellite observations of concurrent changes in the North Water and Nares Strait polynyas and neighbouring tidewater glaciers in Greenland and the Canadian Arctic where notable thinning and acceleration of glaciers have been observed. Also included is an outline of how these observations will fit into a much wider project on the topic involving ocean, atmosphere and sea ice modelling and short-term and longer-term in-situ measurements.