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Melting of Greenland's glaciers by Atlantic waters

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Submarine melting of Greenland's glaciers has emerged as a key term in the ice sheet's mass balance and as a plausible trigger for their recent acceleration, which contributed to a doubling of Greenland's contribution to sea-level rise. Despite its importance, our knowledge of the glacier/ocean boundary is limited and the forcings that control the submarine melt rates and their variability are unclear. Here, we use ocean data collected from the margins of several major glaciers around Greenland (Petermann, Jakobshavn, Store, Helheim, Kangerdlugssuaq and Nioghalvfjerdsfjorden), to show that melting is primarily driven by warm waters of Atlantic origin (Atlantic Waters), circulating around Greenland as part of the upper limb of the Atlantic's Meridional Overturning Circulation. Moored data from several of the glacial fjords is used to demonstrate that changes in the large-scale ocean are rapidly communicated to the glacial fjords and, thus, to the glaciers' margins. These measurements thus provide evidence of a rapid advective pathway for the transmission of oceanic variability to the Greenland Ice Sheet's margins which can potentially affect the ice sheet's mass loss on interannual to longer timescales. This direct wiring of oceans and glaciers is presently missing from prognostic ice sheet and climate models and needs to be included in order to improve our ability to predict sea level rise and freshwater discharge from Greenland.