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## Mechanisms of glacier/ocean interactions in a major glacial fjord in East Greenland

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Net mass loss from the Greenland Ice Sheet more than doubled over the last decade and presently accounts for a quarter of global sea-level rise. Most of the loss is attributed to the acceleration and retreat of outlet glaciers in western and southeastern Greenland as a result of changes at the glaciers' marine termini, in Greenland's deep, long fjords. One leading hypothesis is that it resulted from an increase in the submarine melt rate at the termini, leading to the thinning, ungrounding, and a reduction in frontal buttressing to glacier flow, allowing the glaciers to accelerate. Yet the glaciological, atmospheric, and oceanic controls on submarine melting are mostly unknown given the complexity to observe and model the dynamics at the ice edge. Here, we use ocean and glacier measurements from one major glacial fjord in east Greenland, Helheim Glacier and Sermilik Fjord, to show that the melt circulation at the ice-edge is more complex than previously thought and comprised of multiple overturning cells. The melt rate, in turn, is found to be strongly influenced by the layering of Atlantic and Polar Waters present in the fjord, the fjord's internal dynamics and the seasonal run-off from the glacier. Our results thus indicate that melting at the margins of Greenland's glaciers is controlled by a suite of oceanic and atmospheric processes which must included (albeit in parameterized form) in glacier, ice sheet and climate models in order to improve predictions of fresh water discharge from the Greenland Ice Sheet and sea level rise.