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Icebergs slow glacier retreat in a Greenland fjord

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The interface between ice and ocean in Greenlandic fjords is the main source of uncertainty in the sea level contribution estimates from the Greenland ice sheet in the coming century. So far, research has shown tight coupling between the glacier and the water column in the fjord, but several main processes remain unclear. The role of icebergs in narrow fjords is poorly understood, and until recently research has focused mostly on the buttressing effect iceberg melange can have on the calving front. However, icebergs provide a substantial fresh water flux in the fjord that can exceed subglacial discharge annually. Iceberg melt is distributed at depth and produced throughout the year, and contributes to the stratification of the fjord, impacting the glacier terminus.

We model the high-silled Ilulissat Icefjord in Western Greenland with the MITgcm ocean model, using IceBerg package to study the effect different iceberg distributions have on this fjord. We compare our results to available XCTD profiles from the fjord. Our results demonstrate that including icebergs is essential to correctly understand the stratification of the fjord. We show that larger icebergs with drafts close to, or deeper than sill depth cool the fjord basin at depth. More specifically, we show that — while the inflowing water looses heat as it passes icebergs — a significant part of this iceberg-induced cooling at depth is due to entrainment of iceberg-cooled intermediate waters into the basin. Furthermore, we demonstrate that icebergs affect glacier melt rate by modifying the melt rate distribution along the glacier face both in shape and magnitude.