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Modelling the impact of iceberg melt on glacier-ocean interaction, east Greenland

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The melting of icebergs within Greenland's iceberg-choked fjords provides a large and distributed source of liquid freshwater throughout the year. However, the impact of this freshwater flux on fjord properties and circulation remains unclear, in part because icebergs have typically been neglected in modelling studies that seek to examine interaction between glacier and fjord processes. Here, we modify a general circulation model to simulate the impact of iceberg submarine melting within Kangerdlugssuaq and Sermilik fjords in east Greenland, home to two of Greenland's largest glaciers. We find that iceberg submarine melting results in cooling of up to 5°C and freshening of up to 0.6 psu throughout the upper 100-200 metres of both fjords, compared to experiments without icebergs. The resulting freshwater flux, which is of the order of hundreds of cumecs, is capable of driving a weak overturning circulation. This augments the runoff-driven circulation at depth but can oppose the up-fjord flow of warm near-surface waters, resulting in an increase in up-fjord heat flux at depth but a decrease near the surface. By increasing subsurface iceberg melt rates, ocean warming will therefore expedite iceberg deterioration within ice mélange and may further increase ocean thermal forcing of tidewater glacier grounding lines. Our results highlight the significant impact that icebergs have on fjord water properties and circulation in Greenland's iceberg-choked fjords, demonstrating the importance of including these processes in studies that seek to examine interactions between the ice sheet and the ocean.