Glacier submarine melt rate and circulation in an East Greenland Fjord

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ABSTRACT: Idealized laboratory experiments investigate the ice-ocean boundary dynamics near a vertical 'glacier' (i.e. no floating ice tongue) in a two-layer stratified fluid, similar to Sermilik Fjord where Helheim Glacier terminates. In summer, the discharge of surface runoff at the base of the glacier (subglacial discharge) causes the circulation near the glacier to be much more vigorous and is associated with a larger melt rate than in winter. In the laboratory, the effect of subglacial discharge is simulated by introducing fresh water at melting temperatures from point and line sources at the base of the ice block representing the glacier. The circulation pattern observed with and without subglacial discharge is similar to those observed in previous studies. The buoyant plume of cold melt water and subglacial discharge water entrains ambient waters and rises vertically until it finds either the interface between the two layers or the free surface. The results suggest that the melt water deposits within the interior of the water column and not entirely at the free surface, as confirmed by field observations. The submarine melting increases with subglacial discharge. Furthermore, the same subglacial discharge produces a larger submarine melting if it exits from a point source rather than from a line source. When the subglacial discharge exits from two point sources, two buoyant plumes are formed which rise vertically and interact. The results suggest that the distance between the two subglacial discharges influences the amount of submarine melting and the final location of the melt water within the interior of the water column. Hence, the distribution and number of sources of subglacial discharge may play an important role in glacial melt rates and the fiord stratification and circulation. Finally, the influence of the bottom layer temperature on submarine melting has also been investigated.

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