A large-eddy simulation of upwelling meltwater plume at marine-terminating glacier fronts

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To investigate the behavior of subglacier discharge of meltwater and its impact on the oceanic environment in Greenland fjords, large-eddy simulations of upwelling meltwater plume were performed using a three-dimensional non-hydrostatic ocean model.

The model setup was idealized based on in-situ measurements at the glacier front in the Bowdoin fjold, northwestern Greenland. The model resolution was 2.0 m horizontally and vertically and the time step interval was less than 0.1 second, which were sufficiently fine to capture the turbulent nature of upwelling plume and its high frequency disturbance recorded in the in-situ data.

The buoyancy supply caused by the underwater discharge of fresh meltwater induced immediate and strong upwelling, then the plume reached the surface with vertical momentum that radially pushed out the surface water and clearly formed semicircular structure of ~200 m adjoined to the glacier front, which was visualized by high turbidity in reality.
Since the turbulent plume entrains the saline and nutrient-rich water of Atlantic origin below thermocline, the underwater meltwater discharge acts as a pump for providing nutrients to the photic layer, that may support primary production and ecosystem in the fjold.

In the presentation, we will introduce results of sensitivity experiments with different shapes of glacier front cavity and discharge conduit, and quantitative comparison with in-situ observations will be discussed.

Keywords: meltwater discharge, large-eddy simulation

