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Investing the role of buoyancy in iceberg calving dynamics from tidewater glaciers

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The Greenland Ice Sheet (GIS) currently makes a major and accelerating contribution to sea level rise (SLR), with its contribution split roughly evenly between surface mass balance changes due to increased melting and dynamic ice loss through calving. In recent decades, many of Greenland's major outlet glaciers have retreated dramatically due to increased iceberg calving, associated with an increase in velocity and inland thinning. The potential contribution to SLR of a complete collapse of the GIS is $\sim$7m.

Iceberg calving is an important process not only as a major source of mass loss from the GIS, but also for the controlling influence it has on the dynamics of the grounding line and over the ice sheet as a whole. Despite plenty of scientific attention and a diverse body of literature, the processes involved in calving, their controlling factors and how it feeds back into glacier and ice sheet dynamics are still not fully understood. This presents a major uncertainty into projections of SLR over the coming decades and centuries.

Using Elmer/Ice, a state-of-the-art full-Stokes finite-element model, we are able to resolve the stress distributions in high resolution at the calving front. Buoyancy forces have been proposed as a major influencing factor in inducing calving. By investigating the stress distributions induced in a buoyant calving front, we hope to gain an understanding of how environmental influences such as surface thinning and waterline notch-cutting influence the calving rate, and compare this to observations from calving glaciers in Greenland.