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Numerical modelling of iceberg calving force responsible for glacial earthquakes

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Glacial earthquakes is a class of seismic events of magnitude up to 5, occurring primarily in Greenland, in the margins of large marine-terminated glaciers with near-grounded termini. They are caused by calving of cubic-kilometer scale unstable icebergs which penetrate the full-glacier thickness and, driven by the buoyancy forces, capsize against the calving front. These phenomena produce seismic energy including surface waves with dominant energy between 10-150 s of period whose seismogenic source is compatible with the contact force exerted on the terminus by the iceberg while it capsizes. A reverse motion and posterior rebound of the terminus have also been measured and associated with the fluctuation of this contact force. Using a finite element model of iceberg and glacier terminus coupled with simplified fluid-structure interaction model, we simulate calving and capsize of icebergs. Contact and frictional forces are measured on the terminus and compared with laboratory experiments. We also study the influence of geometric factors on the force history, amplitude and duration at the laboratory and field scales. We show first insights into the force and the generated seismic waves exploring different scenarios for iceberg capsizing.