# Understanding the dynamics of glacier front and iceberg capsize through analysis and modelling of seismic waves

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One current concern in climate science is the estimation of the annual amount of ice lost by glaciers and the corresponding rate of sea-level rise. Greenland ice sheet contribution to the global ice-mass losses is about 30%. Ice loss in Greenland is distributed approximately equally between loss in land by surface melting and loss at the front of marine-terminating glaciers that is modulated by dynamic processes. Dynamic mass loss includes both submarine melting and iceberg calving. The processes that control ablation at tidewater glacier termini, glacier retreat and calving are complex, involving interactions between bedrock, glacier, icebergs, ice-mélange, water and atmosphere. Moreover, the capsize of huge icebergs of cubic-kilometer scale can destabilize the glacier triggering its basal sliding, generate tsunami waves, and induce mixing of the water column which can impact the local fauna and flora.

The objective of this project is to improve our understanding of capsize using a mechanical modeling of iceberg capsize in contact with a deformable glacier, which interacts with the solid earth through frictional contact. This investigation is constrained by the analysis the generated seismic waves recorded at teleseismic distances. To achieve this objective we make an attempt to simulate the entire system involving solid earth, glacier, capsizing iceberg and their interaction with water. Even though state of the art fluid-structure interaction models enable accurate simulation of complex fluid flows in presence of deformable solids floating near the free surfaces, such models are computationally very expensive. Therefore, our strategy is to construct a simple solid dynamics model involving contact, friction and fluid-structure interaction, which is governed by parametrized forces and moments. We fine-tune them with the help of reference direct numerical simulations of fluid-structure interactions involving full resolution of Navier-Stokes equations. We assess the sensitivity of the glacier dynamics to the glacier-bedrock friction law and the conditions for triggering sliding motion of the glacier due to iceberg capsize. The seismogenic sources of the capsizing iceberg in contact with a glacier simulated with our model are then compared to recorded seismic signals of well documented iceberg-capsize events.