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On the forces at play during kilometer-scale iceberg calving: insight from numerical simulations

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Iceberg calving is a complex process often followed by the capsize of the newborn iceberg because of the torque created by the buoyancy and gravity forces. In the case of kilometer-scale icebergs, calving/capsize events can trigger seismic waves (glacial earthquakes) recorded hundreds of kilometers away by global seismic networks. These recordings contain information on the seismic source such as the calved-iceberg volume as well as the contact force applied by the iceberg on the glacier, the glacier dynamical response but also water waves and flow following the capsize.

To obtain an accurate estimation of the iceberg volume, it is necessary to couple seismic inversion of glacial earthquakes with numerical modeling of the capsize [Sergeant 2019]. Therefore, based on our previous work, we use a Computational Fluid Dynamics (CFD) model to simulate the fluid-structure interaction between the ocean and an iceberg capsizing against a glacier terminus. The model reproduces with great accuracy lab experiments (rotation kinematics, effect of calving type, hydrodynamic pressure, etc).

In this talk, we will focus on field-scale simulations. We will show that the forces applied on the glacier terminus due to the hydrodynamic pressure and to the iceberg-glacier contact appear to have similar magnitude, are of opposite signs, and depend on the iceberg geometry. We also give a first estimation of the glacier deformation under the action of these forces.

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Sergeant, A. et al. (2019) 'Monitoring Greenland ice sheet buoyancy-driven calving discharge using glacial earthquakes', Annals of Glaciology, 60(79), pp. 75–95. doi:10.1017/aog.2019.7.

Speaker information

PhD 3rd year

Author: DE PINHO DIAS, Nicolas (IPGP/ECN)

Co-auteurs: M. LEROYER, Alban (ECN); M. BURTON, Justin (Emory University); Mme MANGENEY, Anne (IPGP); M. CASTELNAU, Olivier (ENSAM)

Orateur: DE PINHO DIAS, Nicolas (IPGP/ECN)

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