Geophysical Research Abstracts
Vol. 21, EGU2019-332, 2019
EGU General Assembly 2019

Mathematical Modelling of Iceberg Calving

Maryam Zarrinderakht
University of British Columbia, Earth, Ocean and atmospheric science, Vancouver, Canada (mzarrinderakht@eoas.ubc.ca)

Iceberg calving contributes more than half of mass loss in both Greenland and Antarctica. Despite its importance, the dynamic of calving glaciers are only partially understood. We analyse a model of calving based on linear elastic fracture mechanics, extending prior work due to van der Veen (1998). Crack propagation is assumed to occur along a predefined, vertical failure plane until the stress intensity factors at the tips of two mutually aligned vertical crevasses reaches the "fracture toughness" of ice. One of the crevasses extends upwards from the base, and the other downwards from the surface, with the latter potentially confining water that extends upwards to a prescribed water table. Such solutions are stable if further lengthening of the cracks results in an increase in the stress intensity factors. Calving occurs when the stable solution disappears under an infinitesimal changes in geometrical (thickness, distance from ice edge) or hydrological (water table height) parameter.

By contrast with van der Veen, we model both crevasses simultaneously and compute stress intensity factors directly using a displacement discontinuity method rather than relying on tabulated or interpolated elasticity kernels. We find that, for a prescribed water table height, calving occurs at a critical ice thickness (or vice versa), generalizing the more ad hoc model of Nick et al. (2010).

This is a joint work with Christian Schoof.