Towards a parameterization of cliff calving

Tanja Schlemm (1) and Anders Levermann (1,2,3)

(1) Potsdam Institute for Climate Impact Research, Potsdam, Germany, (2) Institute of Physics and Astronomy, University of Potsdam, Potsdam, Germany, (3) Lamont–Doherty Earth Observatory, Columbia University, New York, USA

Cliff calving could cause rapid retreat of the antarctic ice sheet in response to climate warming and therefore fast sea level rise. In previous studies, the maximum stable cliff height has been determined using depth averaged stresses. As a consequence, calving laws using such cliff height estimation generally assume a linear relation between calving rate and glacier freeboard. Here, we propose a more physically motivated cliff calving law. To this end, we solve the 2D full-Stokes equations with the finite elements method and discuss the stress field close to the calving front. A failure region is defined as the region where some stress relating to failure is larger than a given yield stress. Assuming that the size of this failure region determines the size of the calving event, we propose a cliff calving law where the calving rate is proportional to ice thickness and increasing water depth stabilizes the calving front.