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A new parametrization and minimal model for glacier calving

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The iceberg calving process influences the geometry of a tidewater glacier, and is in turn controlled by the terminus geometry through the stress field which controls damage and fracture of the ice. A simple parametrization of the stress field at the glacier terminus is obtained from the results of a Finite Element model with varying water depths. Using this stress field in an isotropic damage evolution equation yields calving rates in dependence of calving front thickness and water depth. These parametrized calving rates compare favorably with observations, and extend well established parametrizations. The proposed calving parametrization is easy to implement in numerical ice sheet models. Using these parametrized calving rates in a minimal calving model allows us to analyze the intricate feedbacks of the calving process, reproduce observed tidewater glacier dynamics, and to analyze the stability of glacier termini.

Significance statement

This work presents a new, physics-based and experimentally validated parametrization for glacier calving. Parameters of a damage evolution law applicable to glacier ice can therefore be inferred.

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