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Influence of damage and basal friction on the grounding line dynamics

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The understanding of grounding line dynamics is a major issue in the prediction of future sea level rise due to ice released from polar ice sheets into the ocean. This dynamics is complex and significantly affected by several physical processes not always adequately accounted for in current ice flow models. Among those processes, our study focuses on ice damage and evolving basal friction conditions.

Softening of the ice due to damaging processes is known to have a strong impact on its rheology by reducing its viscosity and therefore promoting flow acceleration. Damage creates where shear stresses are high enough which is usually the case at shear margins and in the vicinity of pinning points in contact with ice-shelves. Those areas are known to have a buttressing effect on ice shelves contributing to stabilize the grounding line. We aim at evaluating the extent to which this stabilizing effect is hampered by damaging processes.

Several friction laws have been proposed by various author to model the contact between grounded-ice and bedrock. Among them, Coulomb-type friction laws enable to account for reduced friction related to low effective pressure (the ice pressure minus the water pressure). Combining such a friction law to a parametrization of the effective pressure accounting for the fact that the area upstream the grounded line is connected to the ocean, is expected to have a significant impact on the grounding line dynamics.

Using the finite-element code Elmer/Ice within which both the Coulomb-type friction law, the effective pressure parametrization and the damage model have been implemented, the goal of this study is to investigate the sensitivity of the grounding line dynamics to damage and to an evolving basal friction. The relative importance between those two processes on the grounding line dynamics is addressed as well.