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# Hydrologically-induced slow-down as a mechanism for tidewater glacier retreat

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Outlet glaciers flowing into the ocean often terminate at a calving front, whose position is sensitively determined by the balance between ice discharge and calving/terminus-melting. Rapid retreat of tidewater glaciers can be initiated when the front is perturbed from a preferred pinning point, particularly when the glacier sits in an overdeepened trough. This is believed to make certain areas of ice sheets particularly vulnerable to ice loss. A number of factors may cause a previously stable front position to become unstable, including changes in buttressing provided by an ice shelf, and changes in ocean temperature. Another possibility is that initial retreat is induced by a reduction in the supply of ice from the interior of the ice sheet. Such a reduction can naturally arise from an increase in surface melting and runoff (in the absence of accumulation changes), and this may be amplified if more efficient meltwater routing reduces basal lubrication, as has been observed in some areas of the Greenland ice sheet. Since the initiation of rapid retreat often results in an increase of ice discharge at the front (due to increased ice thickness), such a process may not be easy to detect.

In this study, I employ a simplified model of an outlet glacier and its frontal behaviour to examine the extent to which hydrologically induced slow-down of the feeding ice sheet may induce (or help to induce) calving front retreat. The model builds on earlier parameterisations of grounding line fluxes, and assumes that calving occurs according to a criterion that keeps the front close to the flotation thickness. The glacier bed is assumed to be plastic. This allows for a transparent identification of the different forcing terms affecting margin position. We conclude that hydrologically-induced slow-down of ice sheets is likely to have a more significant effect on mass loss than hydrologically-induced speed-up.