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Coupling of ice-shelf melting and buttressing is a key process in ice-sheets dynamics

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Ocean warming and the consequent increase of ice-shelf melting are presumed to be the trigger of coastal ice-sheet thinning. Using a full-Stokes finite element model which includes a proper description of the grounding line dynamics, we investigate the impact of melting below ice shelves. We argue that the influence of ice-shelf melting on the ice-sheet dynamics induces a complex response, and the first naive view that melting could steadily encroach on grounded ice is erroneous. We demonstrate that melting acts directly on the magnitude of the buttressing force by modifying both the area experiencing lateral friction and the ice-shelf velocity, indicating that the decrease of back stress imposed by the ice-shelf is the prevailing process responsible of inland dynamical thinning. We further show that feedbacks between melting and buttressing forces may lead to counterintuitive results as an increase of the average melting rate may lead to inland ice thickening.