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The influence of subglacial hydrology on Antarctic ice sheet dynamics

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Current observed mass loss of the Antarctic ice sheet is tightly linked to the loss of buttressing of ice shelves, leading to increased inland mass flux and concomitant grounding-line retreat. However, the rate of mass loss is also a function of the basal friction regime of the grounded ice sheet, exemplified by the type of sliding law governing basal sliding and/or sediment deformation. Recent studies (Ritz et al., 2015; Pattyn, 2017; Bulthuis et al., 2018) clearly advocate for higher mass losses with plastic sliding laws compared to viscous sliding. However, more elaborated processes leading to increased lubrication at the bed, such as subglacial hydrology, are often neglected.

In this study we employ a basic subglacial hydrology model (Lebrocq et al., 2009) coupled to a thermomechanical ice-sheet model (f.ETISh; Pattyn, 2017) to investigate both the effect of sliding law power laws and subglacial water distribution on the sensitivity of Antarctic mass loss to ocean perturbations (represented by sub-shelf melting). Results show that while subglacial hydrology changes the sensitivity of the ice-sheet system, the choice of sliding law impacts sensitivity to a larger extent.