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The impact of intrinsic ocean variability on the Totten Glacier's contribution to sea level rise

Felicity Graham (1), David Gwyther (1), Ben Galton-Fenzi (2,3)

(1) Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, Tasmania, Australia (felicity.graham@utas.edu.au), (2) Australian Antarctic Division, Kingston, Tasmania, Australia, (3) Antarctic Climate and Ecosystems Cooperative Research Centre, Hobart, Tasmania, Australia

The Totten Glacier, East Antarctica, drains a sector that contains enough ice to raise global mean sea level by approximately 4m and geophysical surveys indicate that the Totten Glacier is susceptible to the marine ice sheet instability. However, the Totten Ice Shelf thickness has fluctuated over recent decades, with no clear evidence to suggest persistent ice shelf thinning and glacier retreat. We present results from an ice sheet model forced by ocean melt rates containing intrinsic variability characteristic of the present day. Basal melting produces an almost instantaneous response in the ice shelf dynamics, through thickness and velocity changes, with lagged feedbacks to the grounded ice upstream persisting for decades. We find that intrinsic variability in ocean melt rates drives ice shelf thickness and velocity changes that can reproduce the magnitude of observed elevation changes over the Totten Glacier. Changes in mass flux over the grounding line resulting from the variability in ice sheet dynamics are consistent with the magnitude of ice mass loss over the satellite period. Our results highlight the importance of accounting for variability in ice sheet dynamics when modelling the evolution of Antarctic glaciers and their contribution to sea level rise.