Geophysical Research Abstracts
Vol. 19, EGU2017-12838, 2017
EGU General Assembly 2017

Model intercomparison of sea-level response to sudden Antarctic ice-shelf collapse

Frank Pattyn (1), Sainan Sun (1), and Nicholas Golledge (2)

(1) Laboratoire de Glaciologie, Université Libre de Bruxelles, Brussels, Belgium (fpattyn@ulb.ac.be), (2) Antarctic Research Centre, Victoria University of Wellington, Wellington, New Zealand (Nicholas.Golledge@vuw.ac.nz)

The magnitude of the Antarctic ice sheet's contribution to global sea level is dominated by the potential of its marine sectors to become unstable and collapse to ocean (and atmospheric) forcing. Ice shelf buttressing is a key element in the stability of the Antarctic ice sheet. Therefore, a useful model experiment to test this stability is the sudden removal of all floating ice shelves. It serves several purposes: (i) investigating an upper bound of Antarctic mass loss, and (ii) testing numerical ice sheet models on their sensitivity to grounding line migration and marine ice sheet instability (MISI). Two types of de-buttressing are investigated, i.e. (i) sudden removal followed by ice-shelf regrowth due to increased ice discharge across the grounding line, and (ii) without ice shelf regrowth after de-buttressing (so-called float-kill).

Experiments are carried out with two state-of-the-art marine ice sheet models (f.ETISh and PISM) and different settings of grounding-line treatment. For the f.ETISh model these settings pertain to grounding-line flux conditions according to power-law basal sliding and Coulomb friction; for PISM this includes different settings on transition zone width and grounding-line interpolation.

Results of the experiments show that regrowth of ice shelves after sudden de-buttressing stabilizes grounding lines and reduces the effect of MISI. Float-kill conditions lead to significant mass loss, which is further exacerbated by the type of grounding-line treatment, i.e. Coulomb friction renders grounding lines more sensitive (Tsai et al., 2015). However, compared to recent model studies where effects of hydro-fracturing and cliff-failure are considered (DeConto and Pollard, 2016), similar amounts of ice loss are only obtained when the highest grounding-line sensitivity is considered.