A physically-based crevasse-depth calving model applied in two dimensions to marine outlet glaciers: implications for predicting future ice sheet dynamics

A.D. Taylor[1], S.L. Cornford[1], F.M. Nick[2], A.J. Payne[1]

[1] *Bristol Glaciology Centre, School of Geographical Sciences, University of Bristol, Bristol, BS8 1SS. Email: at7155@bris.ac.uk*

[2] *Institute for Marine and Atmospheric Research Utrecht, Utrecht University, Princetonplein 5, 3584 CC Utrecht, The Netherlands*

Improving the simulation of dynamic processes occurring at the front of marine outlet glaciers is important for increasing confidence in ice sheet projections. A key process is iceberg calving. Fluxes in calving can cause changes in ice sheet mass balance, leading to periods of rapid (seasonal to intra-annual) mass loss. Whilst the loss of ice from floating ice tongues has a negligible impact on sea level change, the removal of floating ice can have significant impacts on grounding line position.

A common feature of calving events is fracture propagation. The depth and location of fractures is primarily controlled by changes in strain rate. Benn et al. (2007) and Nick et al. (2010) make use of crevasse propagation models to predict calving fluxes in one-dimensional models. These studies have demonstrated that such calving parameterisations produce physically realistic results, allowing glaciers to develop floating sections and stabilise on reverse bed slopes. Extending these methods to two-dimensional (2D) models is therefore the next logical step.

The calving model of Benn et al. (2007) is added to the 2D BISICLES Ice Sheet Model (Cornford et al., 2013). Idealised geometries representative of marine outlet glaciers are used, similar to those used in Nick et al. (2010). The response of the simulated outlet glaciers to changes in model parameters, in particular the depth of water in crevasses and basal topography, are investigated. Comparison is made between presented results and those in Nick et al. (2010).