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A method for obtaining initial conditions for the Antarctic ice sheet

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An important step in making future projections of sea level rise, is to obtain a set of initial conditions for ice geometry, temperature and basal properties which match the present day ice sheet. Typically this has been achieved by running a model through a glacial-interglacial cycle. However, when longitudinal stress gradients are included this process becomes computationally expensive. Other approaches are to infer a basal traction field using velocity observations (Price 2010) or to use inverse methods (Macayeal 1993; Arthern and Gudmundsson 2010).
We use the glimmer-cism ice sheet model to simulate changes in the Antarctic ice sheet (Rutt et al. 2009). Initial conditions for the ice sheet are obtained by tuning the basal water field in order to find the model configuration which provides the best agreement with present day velocity observations and ice thicknesses. The model has a subglacial water flow scheme based on the 'Weertman' water-film model (Budd and Jenssen, 1987). Water is routed beneath the ice from regions of high elevation to low elevation using the scheme by (Quinn et al. 1991). The basal slip parameter, used to calculate basal velocity, is assumed to be a tanh function of the water depth.
This work forms part of the ice2sea project, which aims to reduce uncertainty in estimates of sea levels rise for the next 200 years using a range of models and future climate scenarios.

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