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Creating a new ice sheet geometry of Pine Island Glacier, West Antarctica, for use in high resolution ice flow modelling

Isabel Nias, Stephen Cornford, and Antony Payne
Centre for Polar Observation and Modelling, University of Bristol, Bristol, United Kingdom

Previous high resolution ice flow modelling studies have shown that interpolation-based products for ice thickness (e.g. Bedmap2) can be inconsistent with the conservation of mass, given observations of velocity, surface mass balance and surface elevation change (Morlighem et al., 2011). For Pine Island Glacier, there is a thickening tendency of order 100 m/yr in the region of the grounding line, which is not observed in the pattern of elevation change. Poor geometric representation has implications for ice sheet stability, when modelling grounding line dynamics. Here we introduce an implicit algorithm to solve an advection-diffusion problem and use it to find an ice thickness field covering the Pine Island Glacier catchment, given observations of velocity and point data of ice thickness obtained from airborne radar surveys.
Radar data points falling within the fast flowing region of the grounding line were removed, because basal crevassing in this region has likely resulted in an underestimation of ice thickness here. Our method performs well in fast flowing regions, but is less effective in slow flowing regions, where the algorithm relies on the diffusive term, rather than advection of thickness information downstream. Using the BISICLES ice flow model, we employ the newly created thickness field in an inverse problem to find fields for the basal traction coefficient and viscosity stiffening factor. We then use these fields to run the model forward, and compare the results to simulations using other geometries (Bedmap2 and a relaxed modification).