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Adaptive mesh modelling of grounding line migration

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Even with detailed knowledge of the bedrock topography and current ice thickness, numerical models struggle to calculate the response of Antarctica's ice streams to increased melting of their attached ice shelves. A central difficulty is the treatment of mechanical stresses at the grounding line, where, at least in conventional uniform mesh discretizations, such high resolution is needed that the calculation becomes prohibitively expensive. BISICLES, a new dynamical core for the Glimmer-CISM code based on Schoof and Hindmarsh's vertically integrated (L1L2) stress model, attempts to overcome this by use of block structured adaptive mesh refinement provided by the Chombo toolkit. This permits high resolution to be limited to regions where the ice sheet changes rapidly, including those close to the grounding line even as it retreats and advances.

We will demonstrate that BISICLES' treatment of the grounding line works correctly for an idealized case, namely the MISMIP3D p075 perturbation experiment [Pattyn and others, http://homepages.ulb.ac.be/∼fpattyn/mismip3d/welcome.html]. We will also present simulations showing rapid retreat of Pine Island Glacier driven by strong melting of the ice shelf. In both of these, we need to make use of sub-kilometer resolution at the grounding line, otherwise at the rate of retreat is grossly underestimated.