Land Ice Sheets

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Background

Understanding the dynamics of large ice sheets (like Greenland and Antarctica) is crucial to projections of future sea level rise. The dynamics of ice sheets span a wide range of scales. There are localized regions (like grounding lines and ice streams) where very fine spatial resolution (better than 1 km) is needed to accurately resolve the dynamics. At the same time, there are large regions (much of the interior of Antarctica, for example) where such fine resolution is unnecessary and represents a waste of computational resources. This makes it a prime candidate for adaptive mesh refinement.

Approach

The goal of the BISICLES project is to build a parallel, adaptive, high-performance ice sheet model built on Chombo. Ice is a shear-thinning non-Newtonian fluid, and is well-described by the Stokes equations. However, using the full Stokes equations is too computationally expensive, so we are using the vertically-integrated model of Schoof and Hindmarsh (2010).

Gallery

AMR computation of Antarctic Ice velocity magnitude.

Plot showing spatial resolution in the Antarctica AMR computation. White is 5 km, purple is 2.5 km, blue is 1.25 km, and black is 625 m.