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 Antarcica AMR computation. White is 5km, purple is 2.5 km, blue is 1.25 km, and black is 625 m.