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Resolving Grounding Line Dynamics with the BISICLES Adaptive Mesh

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The dynamics of ice sheets span a wide range of scales. Correctly resolving the dynamics of localized regions such as grounding lines and ice streams requires extremely fine (better than 1 km in places) resolution. Modeling an entire continental-scale ice sheet at such resolutions is impractical or impossible with current computational resources. At the same time, such fine resolution is unnecessary over large dynamically quiescent regions, which makes ice sheets ideal candidates for adaptive mesh refinement (AMR).

BISICLES is a scalable AMR ice sheet modeling code built on the Chombo framework and is a part of the Community Ice Sheet Model (CISM). With a dynamical core based on the vertically-integrated model of Schoof and Hindmarsh (2010), BISICLES can resolve dynamically important regions at the sub-kilometer scale while using much coarser resolution where appropriate. We present results justifying the applicabilty of our model for grounding line problems. In particular, we compare our results with those computed using Full-Stokes and Shallow-Shelf Approximation models.

Recent improvements to the BISICLES model include the development of an "Embedded Boundary" discretization to improve the discretization of the scheme around grounding lines, which may relax the stringent resolution requirements near grounding lines.