Nonlinearly consistent simulations of continental-scale ice sheets within the Community Earth System Model

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A scalable, efficient, and accurate Community Ice Sheet Model (SEACISM)

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Abstract

The current ice sheet modeling capability within the Glimmer-CISM continental ice sheet model solves the ice sheet momentum and thickness equations sequentially, so complex problems on fine grids experience convergence difficulties. Recently, a Jacobian-Free Newton-Krylov solution method has been implemented into Glimmer-CISM to produce more robust and scalable solutions for a suite of test cases that mimic the Greenland ice sheet. The solver interface has been generalized for use in other components of the Community Earth System Model (CESM), and several examples are presented. Simulation results and a performance analysis of the solution method within a new parallel capability are presented. Ongoing work to extend the solution method to incorporate scalable preconditioning and more intricate boundary conditions have uncovered the necessity for a layered solution approach. These efforts, as well as progress on developing coupled ice sheet simulations within CESM are presented.