Improved Solver Performance for BISICLES Ice Sheet Model

Scientific Achievement

Improved linear solver robustness for Adaptive Mesh Refinement (AMR) composite-mesh solves.

Significance and Impact

About 90% of run time in the BISICLES AMR Ice Sheet model is spent in the nonlinear momentum solve for the ice velocity field. Improving linear solver robustness directly improves BISICLES performance and robustness; coupling with PETSc AMG solvers enables solution of wider classes of problems which the native Chombo geometric multigrid solvers struggle to solve.

PETSc Solver Convergence for BISICLES Antarctic Benchmark
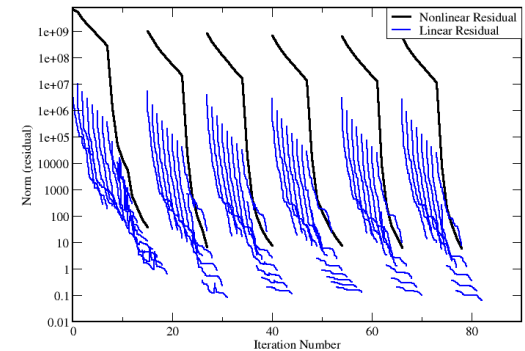
Solver convergence for full-continent ice velocity solves. Black lines are nonlinear residuals, blue are linear-solve residuals.
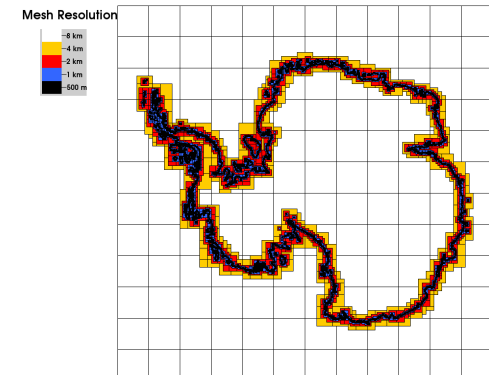
Research Details

- BISICLES spends 90% of run time in nonlinear ice velocity solves.

- FASTMath-developed Chombo-PETSc interface enables use of PETSc linear solvers for problems like ice sheets which feature sharp gradients in coefficients.

- Collaborative effort between FASTMath and ProSPecT BER SciDAC Partnership was able to significantly improve solver performance and robustness when solving realistic problems like Antarctica.

- Reference: Adams, Martin, and McCorquodale, *in preparation.*

AMR resolution distribution for Antarctic simulations

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