Increasing the Multiscale/multiphysics Capability of CAM-SE using Implicit Time Integration and GPU Accelerators

Rick Archibald, Katherine J. Evans, Patrick Worley, Matthew Norman, David Gardner, Andy Salinger, Mark A. Taylor, Carol Woodward

The inclusion of new physics, chemistry, and grid refinement of the recently released Community Atmosphere Model (CAM5) creates new algorithmic challenges, including coupled nonlinear multiscale processes and enhanced scalability requirements. These finer and more complex model configurations have led to recent work to utilize GPU processors within a supercomputer as well as numerical methods that can handle a variety of time scales and maintain acceptable accuracy and efficiency. Efforts to port the scalable spectral element dynamical core to incorporate these developments is presented, with early results, challenges, and next steps outlined in detail. The current implicit solver and preconditioner implementations utilize a Fortran interface package within the Trilinos project, third party software that allows fully tested, optimized, and robust code with a suite of parameter options to be included a priori. Merging this coding strategy with GPU libraries has been accomplished for a few targeted kernels. A full port of the implicit method with pre-conditioning is a priority.