A Fully Implicit Solution Method Capability in CAM-HOMME

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Grid refinement of the Community Climate System Model creates new algorithmic challenges including coupled nonlinear dynamics, physics, and chemistry, multiple disparate time scales, and scalability requirements. In addition, new capabilities to analyze model sensitivities are desired. Solution methods that address these issues are becoming increasingly important. A fully implicit (FI) solution method is applied to the shallow water equations on a sphere and early results are presented. FI provides a coherent nonlinear solution to all dependent variables and allows relatively large time steps to be taken stably. The model equations are solved within the High-order Method Modeling Environment (HOMME) model, which uses a cubed sphere grid and spectral element spatial discretization. A second order FI method is illustrated in the shallow water test cases 1 and 2 from Williamson et al. (1992). The solver implementation is occurring through the development of a Fortran interface package for the Trilinos project. The FI solution framework using coarse time steps acts as an accelerator for smaller time steps on relatively fine grids that resolve all the relevant physics, and can allow time stepping to occur in parallel.

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