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Block Preconditioners for Fully Implicit Atmospheric Climate Simulation in CAM-SE

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Atmosphere is a key component of the multiphysics climate system. Understanding the sensitivity of Earths climate to radiative forcing requires ensemble forecasts over long time periods. Dynamical models of atmospheric climate account for phenomena occurring on multiple timescales including gravity, advection and background waves. Explicit time integration methods render long-term forecasts intractable at high resolution due to CFL restriction. Implicit time-integration methods allow simulations to be performed more efficiently by stepping over time-scales that are not relevant. However, implicit methods require efficient and scalable nonlinear and linear solvers. We will discuss the application of preconditioning techniques based on approximate block factorizations of the shallow-water equations as part of the spectral element dynamical core of the Community Atmospheric Model (CAM-SE).