**Assessing and improving the numerical solution of atmospheric physics in E3SM**

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**Abstract**

I will present an overview and introduce some recent highlights from a SciDAC project that addresses a crucial but largely overlooked source of error in E3SM and similar global models, namely numerical issues in the atmospheric physics parameterizations.

The objectives of the project are to (1) understand the cause of strong time step sensitivity and poor time step convergence in recent version of the atmosphere model EAM, (2) develop new time integration and process coupling methods to improve convergence and accuracy for physics parameterizations related to boundary-layer clouds, and (3) develop new parameterization and discretization methods for complex atmospheric processes using model reduction methods and the theory of stochastic differential equations.

In the first phase of the project, we used models simpler than but still relevant for EAM to demonstrate that time step convergence is a relevant concept despite the fact that parameterizations are often considered empirical and/or pragmatic. Revisions of numerical algorithms that address convergence issues can lead to more consistent representation of the physics and significant impacts on the simulated long-term climate. In the second phase, our focus has shifted to the current and planned versions of EAM, where we identify numerical artifacts and improve solution accuracy for the parameterizations and process coupling methods used in EAM. Highlights from our recent work will be presented.