



Challenges in the development of very high resolution Earth System Models for climate science

Philip J. Rasch (1), Shaocheng Xie (2), Po-Lun Ma (1), Wuyin Lin (3), Hui Wan (1), and Yun Qian (1)

(1) Pacific Northwest National Laboratory, (2) Lawrence Livermore National Laboratory, (3) Brookhaven National Laboratory

The authors represent the 20+ members of the ACME atmosphere development team.

The US Department of Energy (DOE) has, like many other organizations around the world, identified the need for an Earth System Model capable of rapid completion of decade to century length simulations at very high (vertical and horizontal) resolution with good climate fidelity. Two years ago DOE initiated a multi-institution effort called ACME (Accelerated Climate Modeling for Energy) to meet this an extraordinary challenge, targeting a model eventually capable of running at 10-25km horizontal and 20-400m vertical resolution through the troposphere on exascale computational platforms at speeds sufficient to complete 5+ simulated years per day. I will outline the challenges our team has encountered in development of the atmosphere component of this model, and the strategies we have been using for tuning and debugging a model that we can barely afford to run on today's computational platforms. These strategies include: 1) evaluation at lower resolutions; 2) ensembles of short simulations to explore parameter space, and perform rough tuning and evaluation; 3) use of regionally refined versions of the model for probing high resolution model behavior at less expense; 4) use of "auto-tuning" methodologies for model tuning; and 5) brute force long climate simulations.