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Keynote: Towards Earth System Modeling Systems at Storm Resolving Resolutions

Wednesday, 22 September 2021 14:50 (1 hour)

Research applications employing global atmospheric models of weather, climate and air-quality are moving to ever higher resolutions. One of the most important motivations for doing this is to remove the need to parameterize clouds, which requires horizontal meshes with cell spacing of a few kilometers and a vertical spacing of a few hundred meters. While we can perform exploratory regional or locally-refined global simulations on today's systems, further advances are needed to bring these capabilities to the Earth System research community on a routine basis. It is now becoming clear that achieving this goal will not only require accelerated architectures and new programming models, but also a blend of new computational and data science algorithms.

This lecture will focus on efforts at the National Center for Atmospheric Research to tackle these challenges. Next year, NCAR will deploy a new ˜20 petaflops hybrid CPU/GPU system, Derecho. At the same time, an NSF-funded CSSI project called EarthWorks aims to develop a (mostly) GPU-resident Earth System model capable of running at global storm-resolving (GSR) resolutions. EarthWorks, a partnership between NCAR and Colorado State University, leverages the infrastructure of the Community Earth System Model (CESM) model as well as scalability improvements made to the Community Atmosphere Model (CAM) within the CESM, through another NCAR initiative called the System for Integrated Modeling of the Atmosphere (SIMA). A significant departure from current CESM model configurations made in EarthWorks is the use of the MPAS-Ocean model developed and maintained at Los Alamos National Laboratory as part of the Climate, Ocean and Sea Ice Modeling (COSIM) project.

Beyond the modeling aspects, EarthWorks also focuses on identifying and testing frameworks for integrating machine learning inference capabilities into ES models, and the development of parallel data compression and analysis workflows designed to handle the enormous data volumes produced by GSR simulations.

Primary author: LOFT, Richard (National Center for Atmospheric Research)

Presenter: LOFT, Richard (National Center for Atmospheric Research)

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