A Look at the Challenges Of, and Some Solutions To, Evaluating Next-generation Earth System Models

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Abstract

Earth system models (ESMs) sit at the nexus of some of today's most pressing computational and societal challenges. The CMIP6 project, currently underway, provides the backbone of the climate communities future projections and will requires massive investment of resources by each participating modeling group. To minimally participate, modeling groups will be expected to run 1000 simulation years, requiring $\approx 10^7$ core-hours of computing time each, and together are expected to submit over 50PB of simulation data. At the same time these simulation are being performed, new leadership-class computers are coming online and expected to hit the exascale computing threshold in a matter of years. Porting ESMs to these exascale machines will require significant investment in developers' time to verify and optimize the codebase on the new architectures available. Likewise, scientific development to take advantage of these machines' new capabilities will require new initialization, calibration and validation studies to be performed. The explosion of available Earth observing data (e.g., NASA's EOSDIS contains over 9PB of observation) has made confronting models with observations a Big Data challenge, requiring new tools and methodologies to provide high-quality evaluations of ESMs.

Because of the scale of both human and machine resources required to comprehensively evaluate ESMs, it is critical to continuously evaluate these models as part of the development cycle so that evaluation can keep pace with model development. We present an integrated exascale testing strategy and some software packages being developed for exascale testing of the US Department of Energy's Energy Exascale Earth System Model (E3SM).

References

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