Petascale climate modeling heats up

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The development of powerful supercomputers capable of analyzing decades of data in the blink of an eye mark a technological milestone capable of bringing comprehensive changes to science, medicine, engineering, and business worldwide. Researchers at the University of Miami's Rosenstiel School of Marine and Atmospheric Science, collaborating with NCAR (National Center for Atmospheric Research), COLA (Center for Ocean-Land-Atmospheric Studies) and the University of California at Berkeley are utilizing a $1.4M award from the National Science Foundation (NSF) to generate new "petascale" computer models depicting detailed climate dynamics, and building the foundation for the next generation of complex climate models.

The speed of supercomputing is measured in how many calculations can be performed in a given second. Petascale computers can make 1000000000000000 calculations per second, a staggeringly high rate even when compared to supercomputers. And though true "peta" processing is currently rare, the anticipated availability of petascale computing offers a golden opportunity for climate simulation and prediction scientists to dramatically advance Earth system science and help to improve quality of life on the planet.

For decades researchers assumed that, in some sense, weather and climate were independent. In other words, the large-scale climate determined the environment in which weather events formed, but weather had no impact on climate. However, investigators are finding evidence that weather has a profound impact on climate; a finding that is of paramount importance in the drive to improve weather and climate predictions, as well as climate change projections.

With this boost in computing capabilities, the research team led by Dr. Ben Kirtman, professor of meteorology and physical oceanography at the University of Miami, has developed a novel weather and climate modeling strategy, or "interactive ensembles," specifically designed to isolate interactions between weather and climate. Their interactive ensembles for weather and climate modeling are now being applied to one of the nation's premier climate change models, NCAR's Community Climate System Model (CCSM), the current operational model used by NOAA's climate forecast system (CFS). The CCSM is also a community model used by hundreds of researchers, and is one of the climate models used in the Nobel Prize-winning International Panel on Climate Change (IPCC) assessments.

The research serves as a sort of 'pilot program' to conceptualize and prepare for the implementation of such intense computational systems, which currently remain a scientific and engineering challenge. While not actually having access to petascale capability, these experiments will provide a computational environment where many of the theoretical aspects of the interactive ensembles can be tested. A computational test bed is essential for enabling the scientific development of the interactive ensembles and ensuring efficient use of limited petascale computer resources.

"This marks the first time we will have sufficient computational resources available to begin addressing these pressing scientific challenges in a comprehensive manner. The information we collect from this project will serve as a cornerstone for petascale computing in our field, and help to advance the study of the interactions between weather and climate phenomena on a global scale," said Kirtman. " The project will bring together students in computer science and climate science to address problems in an interdisciplinary manner, thus creating a next generation of informed, computational scientists."

"Through our recently developed Center for Computational Science at the University of Miami we are looking forward to creating an optimal environment where many of the theoretical aspects of the interactive ensembles can tested," Kirtman added.

While this research focuses on climate science, the byproducts of this work are applicable to coupled modeling problems in other science and engineering fields, particularly the geosciences, and can inform the long-range design plans of other coupling tools and frameworks.

Source: University of Miami