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Where Data Meet Models [1]

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Attempt a climate simulation and at once you will encounter boundaries.

Interdisciplinary team explores the model-data interface in anticipation of EOS data.

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Even before you come upon global physical boundaries like the ocean-atmosphere interface, you will confront an interface that is central to all climate simulations, the edge where models meet remotely sensed data.

Though lacking in global sweep and physical sway, the model-data interface demands much of those who simulate climate. Specifically, it demands an interdisciplinary approach. Because most models were not built with particular data sets in mind, modelers and data specialists must work together to refine the fit between their respective products.

Feedback

In anticipation of an unprecedented stream of satellite observations, NASA assigned an Interdisciplinary Science Investigation (IDS) team to assess and improve the use of EOS observations in regional and global models. "A general objective of ours is to make EOS more successful," says Principal Investigator Robert Dickinson, a University of Arizona atmospheric scientist.

Dickinson's co-investigators include other atmospheric scientists, an ecologist, a theoretician, remote sensing experts, and of course, modelers and data specialists. The investigators are studying everything from land surface processes to atmospheric circulation and cloud processes.

Team members are currently testing the fit of pre-EOS DAAC data with a regional prototype model. "The prototype is meant to be a feasibility study of the use of remotely sensed data in climate models," says Anji Seth, a National Center for Atmospheric Research (NCAR) modeler and the coordinator of the prototype effort.

"Historically, communication between modelers and 'observationalists' has been lacking. In more straightforward applications such as validation of model radiative fields there has been successful use of remotely sensed data, but for more complex problems such as the land surface, there exists a significant gap," she says.

Seth has worked closely with data and remote sensing specialists at the University of Colorado on the prototype effort, a regional modeling study of the Upper Mississippi River Basin for the drought and flood years of 1988 and 1993. The prototype group is developing a land surface parameterization for use in testing the sensitivity of their model.

"What we've done is sit down together and ask, 'What land surface parameters can we derive from the data? Have other people done this before? What are the possibilities?"

"Having that sort of interaction is critical. I need to understand what information the data can provide. If the model needs cannot be met by the data, we learn something. Perhaps the model can be restructured to accommodate the available data. Or perhaps the data collection and processing can be modified," says Seth.

Finding data of appropriate spatial and temporal scales is perhaps the principal problem the researchers face. "These climate models weren't designed with very detailed data sets in mind," says Jim Maslanik, Assistant Research Professor of Aerospace Engineering at Colorado and a remote sensing expert in the prototype group.

"If you've got 1 km data, you need to ask how to use that data in older generation models. But you also try to project what the new generation models are going to need," says Maslanik. "For example, we don't want to say 'We need this product in this form because that's what this current 1996 model uses,' only to find out in five years we need something entirely different."

For parameterization of the land surface in the Upper Mississippi River Basin, the researchers are considering 8 km AVHRR Pathfinder data from the Goddard Space Flight Center DAAC and 1 km, 14-day composite data from the Earth Resources Observation Systems (EROS) Data Center. Though the EROS product offers a finer resolution, it is not available for the 1988 drought year.

Besides looking for existing data that fit the models well, the researchers are testing the data inputs and data processing of the model. Eventually, they also expect to qualitatively validate their model experiments with 25 km SSM/I Pathfinder data currently available from the Marshall Space Flight Center DAAC.

The IDS team has been validating other model experiments with Earth Radiation Budget Experiment (ERBE) and International Satellite Cloud Climatology Project (ISCCP) data from the Langley Research Center (LaRC) DAAC, Robert Dickinson says.

"As EOS data become available, we'll become more focused on the actual use of the data," he says. "I'm particularly looking forward to the AM-1 platform and working with the instrument team products to try to turn them into something that's more useful for modelers."

The team plans to use Moderate Resolution Imaging Spectroradiometer (MODIS), Multi-angle Imaging Spectroradiometer (MISR), and Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) data from the morning sun-synchronous (AM) series of EOS spacecraft.

Given the wealth of existing DAAC data and the huge volume of data that will soon flow from EOS missions into models, the groundwork done by Dickinson's team should soften the edge where the models meet data.

The range of data available for modeling also underscores the importance of communication among those working at the interface.

"Our effort needs to be a collective, interactive, decision-making process," says Seth. "It's a learning process to try to make this whole system work, but I think we've made a lot of progress in our interactions over the past year."

Reference(s)

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