New tool clears the air on cloud simulations

October 26 2011, by Anne M Stark

(PhysOrg.com) -- Climate models have a hard time representing clouds accurately because they lack the spatial resolution necessary to accurately simulate the billowy air masses.

But Livermore scientists and international collaborators have developed a new tool that will help scientists better represent the clouds observed in the sky in climate models.

Traditionally, observations from satellites infer the properties of clouds from the radiation field (reflection of sunlight back into space, or thermal emission of the planet). However, to accurately utilize satellite data in climate model assessment, a tool is required that allows an apples-to-apples comparison between the clouds simulated in a climate model and the cloud properties retrieved from satellites.

"The models are becoming more interactive and are taking into account

the radiation data from the satellite observations and is an important part of the process of making better climate models," said the Lab's Stephen Klein, who along with LLNL's Yuying Zhang and other collaborators have developed the Cloud-Feedback-Model Intercomparison Project Observation Simulator Package (COSP).

"The models have been improving and refining their representations of clouds and COSP will play an important role in furthering this improvement," Klein said.

Climate models struggle to represent clouds accurately because the models lack the spatial resolution to fully represent clouds. Global climate models typically have a 100-kilometer resolution while meteorological models have a 20-kilometer range. However, to accurately represent clouds as seen in satellite measurements, the scale would need to be from the 500-meter resolution to 1-kilometer range.

"But those small scales are not practical for weather or global climate models," Klein said. "Our tool will better connect with what the satellites observe – how many clouds, their levels and their reflectivity."

The COSP is now used worldwide by most of the major models for climate and weather prediction, and it will play an important role in the evaluation of models that will be reviewed by the next report of the Intergovernmental Panel on Climate Change, Klein said.

The COSP allows for a meaningful comparison between model-simulated clouds and corresponding satellite observations. In other words, what would a satellite see if the atmosphere had the clouds of a climate model?

"COSP is important and necessary development because modeled clouds cannot be directly compared with observational data; the model

representation of clouds is not directly equivalent to what satellites are able to see," Klein explained. "The COSP eliminates significant ambiguities in the direct comparison of model simulations with satellite retrievals."

COSP includes a down-scaler that allows for large-scale climate models to estimate the clouds at the satellite-scale. The tool also allows modelers to diagnose how well models are able to simulate clouds as well as how climate change alters clouds. The tool already has revealed climate model limitations such as too many optically thick clouds, too few mid-level clouds and an overestimate of the frequency of precipitation. Additionally, COSP has shown that climate change leads to an increase in optical thickness and increases the altitude of high clouds and decreases the amount of low and mid-level clouds.

More information: More information about the COSP appears in the August issue of the *Bulletin of the American Meteorological Society*. journals.ametsoc.org/doi/pdf/1 … .1175/2011BAMS2856.1

Provided by Lawrence Livermore National Laboratory