MEETINGS

Planning for a Soil Moisture Satellite Mission

SMAP Algorithms & Cal/Val Workshop; Oxnard, California, 9–11 June 2009

PAGE 300

The Soil Moisture Active and Passive (SMAP) mission aims to gather high-resolution global soil moisture and freeze/thaw state data, which should enable improvements to weather and climate forecasts, flood prediction and drought monitoring, and estimations of net carbon dioxide (CO_2) uptake in forested regions. Targeted for launch in 2014, SMAP is one of four missions recommended by the U.S. National Research Council Committee on Earth Science and Applications From Space for launch in the early part of the next decade (*Earth Science and Applications From Space: National Imperatives for the Next Decade and Beyond,* Natl. Acad. Press, 2007).

The SMAP mission concept utilizes an L-band (1.20–1.41 gigahertz) radar and a radiometer that share a rotating 6-meter mesh reflector antenna to provide high-resolution and high-accuracy global maps of soil moisture and freeze/thaw state every 2–3 days.

The mission is currently in its formulation phase. During this phase, SMAP project science activities include development of sensor and geophysical product algorithms and a calibration/validation (cal/val) plan. A number of related scientific issues, including algorithm performance assessment and selection and ground-based validation infrastructure, could also benefit from resolution and review by the broad science community. Plans and decisions arising from community discussions of these issues are important in identifying research needs and allocating resources.

To address these issues, a SMAP Algorithms & Cal/Val Workshop was held in California. The workshop, open to the science community, attracted approximately 80 attendees, including international participants from Europe, Asia, and Australia. The workshop provided a forum for the science community to review the status of algorithm development for SMAP data products and to provide input into the development of the science data calibration and validation plan.

Overview presentations covered the SMAP science objectives and requirements, project status, the measurement system, the science data system, and the algorithm test bed. Presentations were also given on each of the data product algorithms, and participants had the opportunity to provide feedback on the algorithm plans and to make brief presentations of their own work on related algorithm topics.

In the cal/val portion of the workshop, presentations described the major in situ soil moisture networks and measurement techniques including the U.S. Department of Agriculture Soil Climate Analysis Network (SCAN), National Oceanic and Atmospheric Administration Climate Reference Network (CRN), Oklahoma Mesonet, U.S. Department of Agriculture/Agricultural Research Service watersheds, Cosmic-ray Soil Moisture Observing System (COSMOS), Global Positioning System (GPS), and others.

The workshop presentations can be viewed through the Algorithms & Cal/Val Workshop link on the SMAP events Web page (http://smap.jpl.nasa.gov/events).

The SMAP mission has established four working groups to facilitate community engagement with the mission science. These include the (1) algorithms working group, (2) cal/val working group, (3) applications working group, and (4) radio-frequency interference working group. The calendar of future working group workshops is posted on the SMAP Web site.

—MAHTA MOGHADDAM, Department of Electrical Engineering and Computer Science, University of Michigan, Ann Arbor; E-mail: mmoghadd@umich.edu; and THOMAS JACKSON, Hydrology and Remote Sensing Laboratory, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Md.

New Methods to Integrate Paleodata Into Climate Models

Data-Assimilation Techniques for Paleoclimate Data; Vienna, Austria, 25 April 2009

PAGE 300

Data assimilation has become an important approach for estimating or forecasting the state of the atmosphere and oceans. This method, though, is difficult to apply to paleodata due to their sparse spatial distribution and the uncertainties associated with proxy reconstructions. To debate the applicability of the various techniques in a paleoclimate context, a group of 12 scientists from Europe, Japan, and the United States convened at a workshop in Vienna.

Participants noted that several groups have recently started to work on the assimilation of paleodata into numerical models of the circulation in the ocean and/or atmosphere. The majority of work has been directed toward estimating the state of the large-scale ocean circulation during the Last Glacial Maximum (LGM; ~21,000 years ago) because the corresponding proxy data coverage is relatively good. The goal is to find the best estimate of the LGM ocean circulation that is dynamically consistent with model and proxy data. These methods have incorporated tracer observations from sediments, such as stable carbon isotope measurements, over the whole depth range of the oceans to estimate the glacial circulation. A grand challenge for these efforts is a LGM "reanalysis" project, which is aimed at estimating the climate state at LGM as well as the changes from LGM to the present.

In addition to work on the LGM ocean circulation, workshop participants described new efforts under way to assimilate proxies to reconstruct surface temperature of the past 600 years and to incorporate more proxy data from the North Atlantic and Arctic into the state estimate of a warm interval during the Pliocene (~3 million years ago).

Participants also discussed several existing data assimilation techniques. All techniques aim to reduce the model-data misfit that is summarized in a cost function (a measure of the deviation between modeled state and data). One technique requires an adjoint (which provides the sensitivity of the actual state with respect to each control variable), while other techniques require a large ensemble of states.

Workshop attendees pointed out that all of these methods have several problems in common, including model uncertainties, data uncertainties, and difficulties in defining the cost function. Models have systematic errors (for example, in the representation of turbulent ocean mixing), which, if not properly considered, can lead to biases in state estimations. Equally important are data uncertainties, which arise because of errors in the measurement and calibration and uncertainties in the age model.

Although data assimilation techniques have some difficulties, the benefits of applying these techniques to paleodata are large, participants noted. For instance, these methods can provide dynamically consistent, quantitative reconstructions of past climatic states with information on the uncertainty of the state. Paleodata assimilation can also test the consistency of data with models and the consistency between different