GSWP-2 KICKOFF WORKSHOP

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The Center for Ocean-Land-Atmosphere Studies (COLA), with support from the National Aeronautics and Space Administration (NASA) Program on Terrestrial Hydrology hosted the kickoff workshop of the Second Global Soil Wetness Project (GSWP-2). The project is the principal element of the large-scale uncoupled land surface modeling action in the Global Land-Atmosphere System Study (GLASS; Polcher et al., 2000) and a major element of the International Satellite Land-Surface Climatology Project (ISLSCP), both contributing projects of GEWEX. The overarching goal of the GSWP is to produce as a community effort the best model estimates of the global land-surface water and energy cycles (Dirmeyer et al., 1999). This will entail an evaluation of the uncertainties linked to the land surface schemes (LSS), their parameters and the forcing variables that drive them.

GSWP-2 will take advantage of the 10-year (1986–1995) ISLSCP Initiative II data set (http://islscp2.sesda.com) and LSS simulations will be conducted at a spatial resolution of 1-degree, sans Antarctica. The project will also adhere to the Assistance for Land-Surface Modeling Activities (ALMA) data standards developed in GLASS.

The main goal of the kickoff workshop was to discuss details of the project planning with members of the scientific community who would be participating in GSWP-2, address unresolved issues and complete the draft Science and Implementation Plan for the project. Specifically, the workshop provided a forum to resolve uncertainties and requirements for input data to the various LSSs; address more general modeling group issues; introduce the GSWP-2 Inter-Comparison Center (ICC), housed at the University of Tokyo, and the data submission process; solidify the new remote sensing element of GSWP-2; outline the validation program; narrow options for model sensitivity studies; and discuss other science that can leverage off of GSWP-2. The workshop also established participants and leadership for elements of the project, and demonstrated the data server and software tools that should make model participation and data access much easier than for past experiments.

Execution of GSWP-2 will follow in three streams—data, modeling and evaluation—given in the figure on page 16. COLA is processing the 3-hourly meteorological forcing and complete boundary condition data for GSWP-2, including an extension of the data back in time to 1982. LSS integrations will begin at July 1982, and loop through the first 12 months of forcing data until the modeler is satisfied that soil moisture has spun up and sufficiently equilibrated. A lesson from the GSWP pilot project was that this spin-up process overly amplifies the impact of climate anomalies from that year on the land surface state variables. Therefore, the models will then proceed with their integrations forward from June 1983 – December 1985 so as to converge to a realistic "land climate" at the start of the evaluation period. The 10-year baseline integration, which will be evaluated within the group of GSWP participants and later released to the community at large, covers the period from January 1986 to December 1995. Daily global output will be reported from all models during this period. In addition, for the last year (1995) there will be an "intensive model output period" where model results will be reported at a 3-hour interval, but likely with a reduced set of variables. These data will be especially useful for validation and remote sensing applications. We may also specify a subset of points for full 10-year histories at 3-hour output. The data server system will make such limited re-integrations simple for the models to perform.

A major product of GSWP-2 will be a multi-model land surface analysis for the 1986–1995 period. This will be a land surface analog to the atmospheric reanalyses. There will be a climatological annual cycle data set, and a larger data set for the entire series. Compiling the results of multiple LSSs to produce a single analysis will provide a model-independent result. Of particular value, uncertainty estimates can be put on all of the fields, based on inter-model spread. Additional uncertainties regarding forcing data can be quantified, based on the results of the sensitivity studies. The act of constructing an ideal multi-model analysis is a research topic in itself, and much can be learned from the experience of multi-model ensembling in the atmospheric and oceanic modeling communities. There will be three main modes of *in situ* validation of participating LSSs:

Field campaigns. The GSWP-2 period overlaps a number of relevant field campaigns, including older GEWEX experiments, which can provide validation

Participants attending the GSWP-2 workshop.

data. Comparison of measured meteorological variables from these campaigns with the reanalysis-based forcing data will also provide an evaluation of those products.

Observational networks and long-term monitoring. There are also long-term monitoring networks of soil moisture, carbon, radiative and turbulent fluxes that can provide local or regional validation for LSSs. These will be predominantly available for the latter years of the period.

Streamflow. Runoff fluxes from all participating LSSs will be routed with common river routing schemes to compare with streamflow measurements across a large portion of the globe, as an assessment of the simulation of annual, seasonal, and interannual variations in surface hydrology. Similarly, large basin comparison of model water storage change with observed atmospheric moisture flux convergence minus discharge may also uncover problems in the forcing data and models at basin scales.

It is recognized that discrepancies exist between the observed meteorology and land surface conditions at the validation sites, and the 1-degree gridded data that drive the models, and that those differences can contribute to errors at least as much as the shortcomings in the various models. Representativeness of gridded data at the plot scale can also be evaluated in these locations. PILPS, in its Phase 2, has conducted and continues to craft local land surface modeling experiments built around nearly complete sets of forcing and validation data at a single location (Henderson-Sellers et al., 2002). It is not the intent of this *in situ* validation program to duplicate that effort. Rather, using the global forcing data sets, local validation may be performed when and where such data are available.

One of the new thrusts for GSWP-2 is a stronger connection to applications in remote sensing. The principal goal of the effort in remote sensing applications is to expand validation beyond those few areas where *in situ* data on land surface state variables are readily available. In addition to the classical attempts to validate the typical land-surface state variables using satellite retrievals, GSWP-2 also intends to expand the capabilities of current LSSs. This is to be done by the application of algorithms by which LSSs can directly report brightness temperatures, like those sensed by instruments in orbit. These may be applied as forward algorithms for infrared/skin temperature and microwave/soil wetness (and vegetation index for LSSs that predict vegetation phenology).

Modeling sensitivity studies will involve re-integrating the LSSs over part or all of the global 10-year domain to test the response of the models to changes in forcing data and surface parameters. Each participant will be encouraged to take part in some or all of the proposed studies. The sensitivity studies are still being defined, but will likely include sensitivity to choices in meteorological forcing data, such as choice of near-surface reanalysis product (NCEP/DOE Reanalysis versus ECMWF ERA-40), impact of hybrid forcing data (combining observed and reanalysis products for precipitation and air temperature), and an assessment of the impact of rain gauge under-catch. There are also multiple land surface parameter data sets available in ISLSCP Initiative II, such as three choices of global vegetation maps. GSWP-2 will also investigate sensitivity to basic choices of surface vegetation data, as well as the impact of inclusion/exclusion of sub-grid information (for LSSs that include surface tile schemes).

Forcing data and model results will be made available to participants as data sets accessible from three Distributed Oceanographic Data System (DODS) servers (http://www.unidata.ucar.edu/packages/dods/; http://grads.iges.org/grads/gds/) in the United States, Europe, and Japan. Using the ALMA data exchange standards (http://www.lmd.jussieu.fr/ALMA/), and DODS data subsetting capabilities, individual LSSs will be able to run globally each time step, each grid point from start to finish, or in any other sequence of integration, accessing the data directly over the Internet without the need to download or otherwise a priori process the complete data set on their local system. Software tools and source code to aid in access and production of ALMA-standard data, DODS client software libraries, PILPS consistency checks of model results, and interpolation of 3-hourly forcing data to shorter time intervals will also be provided to the community. Additionally, standard and customizable browse images will be made available to the public via the web.

Release of all forcing and boundary condition data to the modeling groups is scheduled for February 2003, with baseline simulations due to the GSWP Inter-Comparison Center (ICC) in August 2003 (see figure on page 16). Complete descriptions and current information concerning this evolving project are available at: http://www.iges.org/gswp/ and anyone interested in participating in land surface modeling, validation or other scientific participation should contact the project at gswp@cola.iges.org.

References

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FOLLOW-ON GLOBAL SOIL WETNESS PROJECT (GSWP-2) TIMELINE