Global Land/Atmosphere System Study (GLASS) Panel Meeting

23 October 2011
Denver, Colorado, USA

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The Global Land/Atmosphere System Study (GLASS) Panel, co-chaired by Martin Best and Joseph Santanello, has completed its first year as a stand-alone Panel under GEWEX modeling activities. The first item of business at the Meeting was a discussion on the Terms of Reference for Panel membership. The Panel agreed upon 4-year term limits for Panel chairs, and to have a "young scientist" category of Panel membership. Other topics at the Meeting included updates on current and future activities with a special emphasis on refining plans for three new projects to be launched by spring 2012: (1) the African Monsoon Multidisciplinary Analysis (AMMA) Land-surface Model Intercomparison Project Phase-2 (ALMIP-2); (2) the Global Soil Wetness Project Phase-3 (GSWP-3); and (3) the Project for the Intercomparison of Land Data Assimilation Systems (PILDAS).

Global Land Atmosphere Coupling Experiment (GLACE)

Results from GLACE-2 show that skill in temperature and precipitation increases mainly in areas where the precipitation forcing quality is high (high station density gives better initial soil moisture data), when soil moisture is relatively extreme, and where potential predictability is high (see figure on page 17). Three publications have resulted from this work that review and discuss the diagnostics of predictability, including a new measure related to general circulation characteristics (e.g., blocking over Russia leading to heat waves) and a study of Integrated Forecast System results of 2000–2010 potential predictability.

GLACE-Future, which is in the planning stages, will involve the Coupled Model Intercomparison Project-5 (CMIP5) and Representative Concentration Pathway 8.5 models and will aim to quantify the role of soil moisture-climate feedbacks for climate change projections. The matrix of runs will include 1950-2100 simulations with fixed soil moisture (1970–2000) versus soil moisture from a transient running mean on climatology. Thus far, ECHAM6 [Max-Planck Institute/Swiss Federal Institute of Technology (ETH)], EC-EARTH (Royal Netherlands Meteorological Institute, KNMI), and the Community Earth System Model (CESM)/Community Climate System Model 5 (CCSM5) (National Center for Atmospheric Research) have confirmed participation.

Local Land-Atmosphere Coupling (LoCo)

The GLASS LoCo activity has evolved into a working group comprised of both Panel and non-Panel member research. A thorough review of current and future LoCo research can be found in a companion article on page 7. A LoCo poster cluster was convened by Joseph Santanello during the WCRP Open Science Conference as part of the session on "Improving the Representation of Energy and Water Cycles in Atmospheric Models" (co-conveners: Annette Rinke, Bart van den Hurk, Carlos Jimenez). This cluster included eight posters on various aspects of LoCo research from both the working group and also the greater community, and was successful in entraining new efforts and focus for the U.S. Southern Great Plains (SGP) synthesis study.

LoCo Southern Great Plains (SGP) Testbed

The concept for a focused, observationally-driven testbed for LoCo research centered upon the U.S. SGP was discussed. The first phase would consist of the development of a 10-year data set of all LoCo-related variables that would be used to evaluate disparate models and methods. The Panel agreed that a large LoCo intercomparison project, such as the Project for the Intercomparison of Land-Surface Parameterization Schemes (PILPS), GSWP, or GLACE should not be carried out at this time, and that expansion and momentum should continue using the SGP testbed as a focal point for process studies.

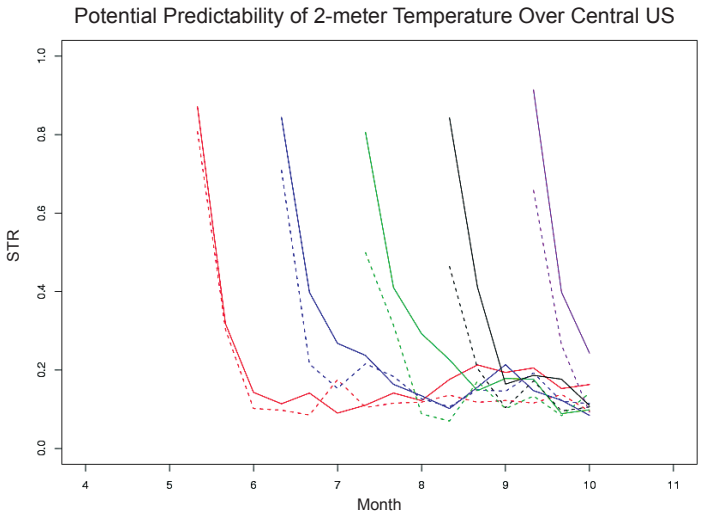
PILPS-Urban Studies

Core results from the recently completed PILPS-Urban studies indicate that: (1) it is important to get the vegetation treatment correct in urban areas; (2) initial soil moisture is important; and (3) simple models are almost as good as complex, heavily parameterized models. Further analysis is ongoing and more papers are expected over the next few years.

Protocol for the Analysis of Land-Surface Models (PALS)

The PALS website at: *http://pals.unsw.edu.au* is designed to analyze in a standard way uploaded single site land-surface model simulations with observations, focused mostly on FLUXNET sites. Currently, PALS is operating as a validation tool, but the ultimate goal of this system is to serve as a true benchmarker of modeling systems. This requires further progress by the benchmarking working group and the community to explicitly define the minimum performance required by a model to achieve predictive goals. For example, empirical models (e.g., evaporation as a function of radiation), climatology and persistence, and simple models (Penman-Monteith) are to be included in PALS.

In a discussion on the limited availability to date of Coordinated Energy and Water Cycle Observations Project (CEOP)-produced data for a demonstration of PALS, it was concluded that the GEWEX Hydroclimatology Panel (GHP) would provide 10–20 high-quality FLUXNET data sets for this purpose. Synchronization with the National Aeronautics and Space Administration development of a Land-surface Verification Toolkit (LVT) is also planned, which will maximize design and development of LVT and PALS. The Benchmarking Working Group in GLASS will drive these efforts forward. During the American Meteorological Society Annual Meeting in New Orleans in January 2012, this group will convene a session on land model benchmarking.



The figure above was derived from GLACE-2-type simulations with the ECMWF forecast model for 2000–2010. Potential predictability is defined here as the ratio between the signal variance (temporal variability of temperature) over the total variance (temporal plus random variability, derived from the spread in an ensemble). Forecasts are shown that have been initialized with "observed" soil moisture (solid lines) and "randomized" soil moisture (dotted line). Higher potential predictability is evident from the "observed" soil moisture and is particularly evident in the forecast range between 10 and 30 days after initialization in summer. All forecasts start on the first day of months May–September and last until 1 October.

ALMIP-2

An international call for participation in ALMIP Phase-2 was announced in mid-November. With an expected start in spring 2012, ALMIP-2 will be coordinated with GHP and the GLASS Benchmarking Working Group. Experiments are being planned with 10 times higher spatial resolution (5 km) than ALMIP-1 and will focus on distributed models and data sets, including subtle hydrology and vegetation processes (e.g., very large rooting depths, land use change, sloping bedrocks removing water from the catchment, strong variability in runoff). The study will cover a 4-year period and will use a blend of in situ, radar, Landsat, and other satellite data, including evapotranspiration (ET) measurements from the U.S. Department of Agriculture Atmosphere-Land Exchange Inverse (ALEXI) model.

GSWP-3

The experimental plan for GSWP Phase 3 was presented by Hyungjun Kim. The white paper was distributed to GLASS members at the WCRP Drought Conference in Barcelona in March 2011. A great deal of work has been completed in preparing the forcing data set based on the 20th Century Reanalysis product, in particular, performing bias correction on a number of critical variables, namely Global Precipitation Climatology Centre (GPCC) precipitation and Surface Radiation Budget (SRB) data. There are three phases, the first being the retrospective run (1901–2008) that will serve as a land reanalysis product. This long historical period was designed to entrain the carbon modeling community and explore possible carbon-related effects or changes in ecosystem function related to those trends and uncertainties in forcings (e.g., precipitation) with multiple data sets. While still focusing on traditional hydrology such as water and energy fluxes, this will enable collaboration with communities, such as the International Land Model Benchmarking (ILAMB) Project in the design and evaluation of GSWP-3.

Originally, the plan for the second phase was to look at future (CMIP5) climate scenarios, but it was recommended that this be moved back as there should be core versus optional experiments in attracting community participation. Along with phase one, the second phase will be a core experiment and instead will look at uncertainties in forcing data (e.g., MERRA, ERA-Interim) from the recent past, 1980 to the present. When learning of the multi-scale synthesis and intercomparison project (MsTMIP) experiments being carried out by the carbon community, it was suggested that the GSWP-3 plan be distributed to that group to determine any overlaps and/or lessons learned that could be incorporated here. The same applies for the Land-Use and Climate, Identification of robust impacts phase two (LUCID-2) Project. A kick-off workshop for GSWP-3 is tentatively planned in Tokyo in spring 2012.

PILDAS

The overarching goal of PILDAS is to organize a community effort through GLASS that provides a framework for comparing and assessing land-surface data assimilation systems, particularly those used in operational centers. PILDAS-1 will focus on the assimilation of synthetic observations of surface soil moisture in preparation for satellite missions. The initial design is for a multi-year period with a limited domain in the U.S. (e.g., the Red Arkansas River Basin). A number of operational centers are committed to PILDAS-1, which is expected to begin in early 2012.

LBA-Data Model Intercomparison Project (LBA-DMIP)

The objective of LBA-DMIP is to bring together international biosphere-atmosphere modeling groups to understand how different models simulate the ecosystems and biogeophysical processes in the Amazon of South America. It has produced a rather extensive analysis of a range of models at eight sites, and made a number of specific recommendations to improve treatment of carbon uptake and canopy interception. This is an ongoing project that has some traditional land-surface and hydrological model involvement, and so it was concluded that GLASS should monitor these results and, particularly in the context of GSWP-3 and ALMIP-2, consider making connections for future projects.

Land-Use and Climate, Identification of Robust Impacts (LUCID)

The objective of LUCID is to quantify the impacts of land-use-induced land-cover changes on the evolution of climate between the pre-industrial epoch and the present day. LUCID-1 is now complete, with six papers published and seven more in preparation. Planning for LUCID-2 is underway, and it was agreed that GLASS should support this work and keep an active member from LUCID involved in GLASS.

GLASS members are also involved with a new International Geosphere-Biosphere Programme initiative to study land-use/land-cover change (LULCC). The goals of LULCC are to provide historical maps of land use and land cover change to enable simulations and impact studies from a climate perspective. Coordination with the GSWP-3 experimental design for the long-term runs (Phase-1) is planned.

Cross-Cutting Activities and Next Meeting

A number of current and developing GLASS links were identified with projects in other GEWEX Panels. In particular, the implementation of CEOP reference site data (i.e., ten to twenty LandFlux sites with additional quality control) in the PALS system. ALMIP-2 will be circulating its proposal through GHP to coordinate activities related both to the AMMA Regional Hydroclimate Project (RHP) and to GLASS modeling. Similarly, new links between the Hydrological Cycle in the Mediterranean Experiment (HyMeX) and GLASS have been identified and a starting point for collaboration will be GLASS representation at the HyMeX conference in May 2012, and inviting a HyMeX scientist onto the GLASS Panel following that. The foci of HyMeX in terms of snow, terrain, groundwater, and runoff are all identified as current gaps in GLASS.

The idea of a joint GLASS-GEWEX Atmospheric Boundary Layer Study (GABLS) project on land-planetary boundary layer (PBL) coupling was discussed. It was thought that the extension of the stable boundary layers to a full diurnal cycle analysis (in the form of a column model testbed) would interest both groups, as well as revisiting the GABLS-1 intercomparison during the Cooperative Atmosphere-Surface Exchange Study–1999 (CASE99) study in the SGP.

GLASS was represented by Joseph Santanello at the 27th Working Group for Numerical Experimentation (WGNE) meeting held in October 2011 in Boulder, Colorado. Potential cross-cutting activities were presented and discussed, mostly furthering the participation of operational centers and models in PILDAS, and investigating the potential for PALS to be used as a coupled model benchmark for operational centers. The PALS demonstration study will rely heavily on National Centers for Environmental Prediction involvement and will therefore serve as a pilot study, the results of which will be relayed to WGNE members. One hurdle will be acquiring observations in near real time for PALS, which could require saving operational model output streams. WGNE is also very supportive of a joint GLASS-GASS project, similar to the GABLS proposal discussed above, with the long-term objective of improving the diurnal cycle of convection representation in coupled models. This has long remained a challenge for the community.

The next GLASS Panel meeting will be held in conjunction with the 1st Pan-GASS Meeting on 10–14 September 2012 in Boulder, Colorado (see announcement on page 20). This will allow for a dedicated session on the GLASS-GABLS experiments and a session or workshop on LoCo and the SGP testbed.

ECMWF/GABLS Workshop on Diurnal Cycles and the Stable Atmospheric Boundary Layer

7–10 November 2011
Reading, United Kingdom

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Sixty participants from Europe, Japan, North and South America, and Australia attended the Workshop, which was co-sponsored by the European Centre for Medium-Range Weather Forecasting (ECMWF) and the GEWEX Atmospheric Boundary Layer Study (GABLS). The purpose of the Workshop was to review the ongoing research related to the diurnal cycles and stable atmospheric boundary layer, and to make recommendations for future work, particularly on the options for improved parameterization in large-scale models.

The Workshop was divided into two-and-a-half days of oral and poster presentations covering the topics mentioned above, and one day of working group discussions followed by a plenary discussion session. Many of the participants are actively involved in GABLS (*http://www.gewex.org/gass_panel.html*), which is an international platform for boundary layer research applied to regional and large-scale models. The GABLS Project began 10 years ago with an initial study that defined a series of cases for model intercomparison and model evaluation of the stable boundary layer (SBL). Large Eddy Simulation (LES) models and observations were used extensively as references. The Study showed that the spread between models is large and that many models have highly diffusive boundary layers schemes, mainly to avoid "decoupling" of the atmosphere from the surface in low wind conditions and to maintain sufficient drag at the surface. It was also confirmed that the more research-oriented schemes (which tend to be less diffusive) have a better boundary layer structure in terms of profiles of temperature, wind speed, and direction. The GABLS-3 LES intercomparison case is based on a moderately stratified, baroclinic, mid-latitude boundary layer observed over Cabauw in The Netherlands. Encouraging news is that intermodel dispersion between LES models is fairly low within the most recent GABLS-3 intercomparison and that it shows very realistic boundary layer structures.

One of the strategic goals of ECMWF is to improve the quality of near-surface weather products, such as temperature, wind, and atmospheric composition. It is well known that the diurnal cycles of temperature and wind are strongly influenced by small-scale atmospheric processes in the SBL, and in particular by turbulent diffusion, gravity waves, and radiation, but also by the thermal coupling with the underlying soil through vegetation and snow. Most large-scale atmospheric models use rather diffusive boundary layer schemes that result in SBLs that are too thick and show too little wind turning. Climate projections also show strong temperature signals at high latitudes that are affected by these processes.