
GLASS Panel Meeting

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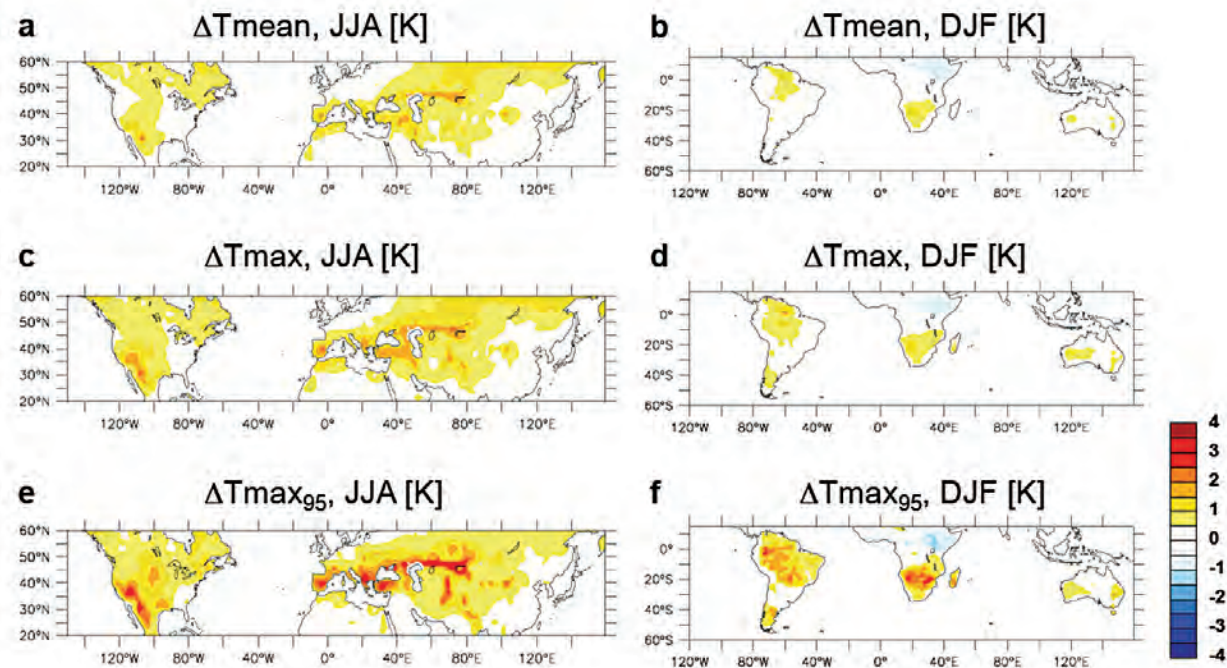
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Twenty-two people attended the Global Land/Atmosphere System Study (GLASS) Meeting, including representatives from current projects, activities and working groups, as well as potential new Panel members. GLASS completed its second year as a stand-alone GEWEX panel for modeling activities with Drs. Martin Best and Joe Santanello serving as co-chairs. Dr. Martin will step down at the end of the year and Dr. Aaron Boone takes his place (see page 3).

The first item of business at the meeting was to present the newly adopted Terms of Reference (TOR) for GLASS Panel membership. These were originally proposed at the 2011 GLASS meeting, subsequently modified according to feedback, and then ratified by the GEWEX Scientific Steering Group. The TOR includes term limits for GLASS co-chairs of 4 years, staggered in 2-year intervals to ensure continuity of leadership. Two main categories of membership were established without term limits: (1) Experienced Scientists (including project leads); and (2) Young Scientists. There is also a protocol for new members of each category, where they may attend a GLASS meeting and present their interests and its relevance to Panel activities. The adoption of the TOR has already improved the expectations of the Panel members, shed inactive members, brought new experienced and young scientists into the fold, and allowed the outside community better access to and understanding of the Panel operations.

GLASS has a representative mix of established and new projects, each of which corresponds to one of the three GLASS themes (Model Data Fusion, Benchmarking, and Land-Atmosphere Coupling). The Panel also has a number of collaborative projects with the GEWEX Hydroclimatology Panel (GHP), is launching projects with the GEWEX Atmospheric Boundary Layer Study (GABLS), and continues to be engaged with the World Climate Research Programme (WCRP) Working Group on Numerical Experimentation (WGNE) on benchmarking and data assimilation activities.

Updates on current and future GLASS activities were presented with a special emphasis on refining plans for three new projects [African Monsoon Multidisciplinary Analysis (AMMA) Land-surface Intercomparison Project-Phase 2 (ALMIP-2); Global Soil Wetness Project-Phase 3 (GSWP-3); and the Project for the Intercomparison of Land-Surface Parameterization Schemes (PILDAS)] that have started or will soon. In addition, discussions were held on current gaps in GLASS membership and activities, and the mapping of GLASS projects to the new WCRP Grand Science Questions and GEWEX Science Ques-



Impact of 2071–2100 soil moisture conditions vs. 1971–2000 soil moisture fields in CMIP5 projections (ECHAM6, GFDL, and CESM models): Effects on mean daily temperature (T_{mean}) (top), mean T_{max} temperature (middle) and 95th percentile T_{max} temperature (bottom) in June-July-August (JJA, left) and December-January-February (DJF, right). The plots are centered on the regions with largest effects, which coincide with those displaying the largest changes in soil moisture in the projections. The effect of mean changes in soil moisture alone account for up to 1–3 degrees warming in the projections, the effect is stronger for extreme midday temperature (95th percentile of T_{max}) than mean daily temperature.

tions. Lastly, two prospective Experienced Scientist members (Nate Brunzell and Lifeng Luo) were invited to the Panel and given an opportunity to share their research interests and connections to GLASS.

GLACE-CMIP5

Benoit Guillod presented results from Phase II of the Global Land/Atmosphere Coupling Experiment (GLACE-2; Sonia Seneviratne). GLACE-2 uses the Coupled Model Intercomparison Project-Phase 5 (CMIP5; Representative Concentration Pathway 8.5) models, and aims to quantify the role of soil moisture-climate feedbacks for climate change projections. Experiments 1A and 1B of GLACE-CMIP5 have been completed, and consist of reruns of climate change projections using a 1971–2000 soil moisture climatology evaluated against a seasonal transient cycle of soil moisture during the 2070–2100 period. The Geophysical Fluid Dynamics Laboratory (GFDL), European Centre for Medium-Range Weather Forecasts (ECMWF) Hamburg model (ECHAM), Community Earth System Model (CESM), and Institut Pierre-Simon Laplace (IPSL) have completed the full analysis and a first article on these results has been submitted. Simulations with the EC-Earth model are currently ongoing.

Results show that the imposed soil moisture anomalies strongly affect the land energy balance and resulting air temperature, and correlate well with study regions projected to experience drought increases (see figure above). In addition, soil moisture changes were identified to affect daily maximum temperature

more strongly than minimum temperature, and extreme high temperatures more strongly than average temperatures. Precipitation impacts are less clear, and additional analysis over the next year will be conducted to analyze the feedbacks and water balance effects, including impacts on biogeochemical fluxes, and interactions with land cover change.

LoCo

The Local Land-Atmosphere Coupling (LoCo; Joe Santanello) activity continues as a GLASS Working Group, and is comprised of both Panel and non-Panel member research activities. A breakout session was held earlier in the week at the Pan-Global Atmospheric System Studies (GASS) Meeting, focusing on the proposed “LoCo/US Southern Great Plains (SGP) Testbed Project.” The Working Group spent the last year producing and publishing work on the diagnostics of land-atmosphere interactions and coupling using an array of scales and models. For example, a trilogy of papers has been written based on the coupling of NASA’s Land Information System (LIS) with the Weather Research and Forecasting (WRF) mesoscale model that includes model coupling behavior evaluation during wet and dry extreme periods over the SGP. Other diagnostics have produced global maps of coupling metrics from global circulation model (GCM) output and reanalysis products such as the North American Regional Reanalysis (NARR) and the Modern-Era Retrospective analysis for Research and Applications (MERRA). Some examples of the diagnostics are the traditional mixing diagrams, two-legged metric, lifting condensation level (LCL) deficit, Findell-Eltahir diagnostics of

triggering of convection, revised relative humidity tendency variables, McNaughton coupling coefficient, and triggering feedback strength (TFS) and amplification feedback strength (AFS). A wide net has been cast in developing coupling metrics and producing maps, but it was recognized that now is the time to reel in these efforts and synthesize them, to get to more science-driven questions of coupling.

LoCo-SGP Testbed

The LoCo Working Group is embarking on a testbed project that will allow an array of diagnostics to be consistently applied to the same location in order to understand their hierarchy and to develop a coupling classification system based on metrics. During the Pan-GASS Meeting, Craig Ferguson and Joe Santanello presented the concept of a focused observationally driven testbed for LoCo research centered on the SGP site. In Phase 1, a consistent 5–10 year data set of all LoCo-related variables would be developed, and compiled and supported by the Atmospheric Radiation Measurement (ARM) Program. A survey on LoCo data needs has been distributed to the community for inputs and these will be reviewed before the ARM data is compiled. From this benchmark data set, the currently disparate models and LoCo diagnostics will be evaluated in a consistent manner across time and spatial scales. The LoCo/SGP Testbed breakout session included a combination of land and Planetary Boundary Layer (PBL) modelers and data measurement experts, and provided excellent feedback on the best way forward, including potential caveats related to PBL data availability and scale issues.

PALS

The Protocol for the Analysis of Land Surface (PALS) online land surface model benchmarking system (<http://pals.unsw.edu.au>; Gab Abramowitz) has progressed to a more advanced version that includes gap filling, empirical benchmarks, and automated metrics along with a large suite of FluxNet data. PALS is designed to analyze uploaded single site model simulations with site observations in a standard way. Extensions to other data sets and the creation of benchmarking tests are under development. For example, implementation of the Manabe bucket model and the Priestly-Taylor approach to flux estimation will be performed in order to use as standard benchmarks of the “goodness” of current land-surface models (LSMs). A joint GHP-GLASS project to demonstrate benchmarking through PALS is ramping up as well.

ALMIP-2

Phase 2 of the AMMA Land Surface Model Intercomparison Project (ALMIP-2; Aaron Boone) is a 4-year project that began in spring 2012, and includes 22 LSMs, five hydrological models, and one evapotranspiration (ET) model. ALMIP-2 experiments will be performed at the mesoscale (5 km) and local scale to focus on subtle hydrology and vegetation processes (e.g., very large rooting depths; contrasting land use; sloping bedrocks that move water out of the catchment; strong variability in runoff). The forcing data will be derived from a blend of in situ, radar, and satellite data (e.g., Landsat). The goal of the project is to provide recommendations for the pa-

rameterization of runoff scaling. As this project has regional hydrological aspects, it is also considered to be an ideal candidate for a collaborative project between GLASS and GHP.

GSWP-3

The updated implementation plan for the Global Soil Wetness Project Phase-3 (GSWP-3; Hyungjun Kim) was presented. GSWP-3 will include three experiments, with the first one being a retrospective run (1901–2008) that will serve as a land reanalysis product. This long historical period was designed to entrain the carbon modeling community. In addition to traditional hydrology, possible carbon-related effects will be explored, including changes in ecosystem functioning related to these trends, and uncertainties in forcings (e.g., precipitation) with multiple data sets. Over the past year, a great deal of bias correction has been applied to the Twentieth Century Re-analyses forcing data set (20CR), which uses global dynamical downscaling and Climate Research Unit (CRU) observations for near-surface fields, and a radiation correction is applied using the GEWEX Surface Radiation Budget (SRB) product. A summary of the experimental plan will be distributed to the carbon community to obtain its buy-in before the project begins. This will enable both carbon and water models, and energy cycle LSMs to be included, and simultaneously evaluated in each (e.g., the hydrology of carbon models and vice-versa). A GSWP-3 workshop on first results is planned in Tokyo, Japan in April 2013.

PILDAS

The Project for the Intercomparison of Land Data Assimilation Schemes (PILDAS; Rolf Reichle) has completed circulating its experimental plan for feedback and participation. The Project is expected to begin in early 2013. The experimental design is nearly complete, and a pilot study is underway by the project leads to use two LSMs with one data assimilation (DA) algorithm in NASA's Land Information System (LIS). Phase-1 is focused on the operational centers (rather than niche research projects), synthetic observations, and different DA algorithms with different LSMs for a 1/8-degree domain over the U.S. Southern Great Plains. Later phases will focus on coupled DA systems and actual satellite observations from the Soil Moisture Observing System (SMOS) and the Soil Moisture Active Passive (SMAP) satellite. GLASS will present the experimental plan and pilot results to WGNE to engage agencies that are not currently involved.

LUCID

The objective of the Land-Use and Climate, IDentification of robust impacts (LUCID; Andy Pitman) Project is to quantify the impacts of land-use-induced land cover changes on the evolution of climate between the pre-industrial epoch and today. Phase 1 is complete and LUCID-2 is underway. Results from LUCID-1 showed the impact of land cover change in the five GCMs that use the Land Use Harmonization (LUH) land cover data set. The Project also demonstrated the need to engage both LSM and land cover change (LCC) data set providers to better determine how to implement LCC in models. Linkages with GSWP-3 and the land cover treatment in the 20C simulations are being investigated.

Pan-GEWEX and Future Activities

A number of crosscutting projects were identified at the Pan-GASS and GLASS meeting, and include the following:

- *GLASS/GABLS Diurnal cycle Coupling Experiment (DICE)*. This project will run fully coupled single column models (SCMs) during the GABLS-2 CASES 99 study period over the SGP region. The experiments will isolate the impact of surface fluxes (from the land surface models) vs. atmospheric forcing (from the PBL scheme) to determine the impact of land-atmosphere coupling in the SCMs over the full diurnal cycle (stable and unstable PBLs). Martin Best and Bert Holtslag will lead this effort that begins in early 2013.
- *LoCo/SGP Testbed Project*. ARM data providers and the GEWEX community have participated in a data needs survey for land-atmosphere coupling studies. In early 2013, ARM will produce a land best estimate data product for LoCo at the SGP site, which will then be used to establish a benchmark of land-atmosphere coupling based LoCo-derived diagnostics. Craig Ferguson and Joe Santanello are leading this effort.
- *PALS/Benchmarking Study*. Demonstration of the PALS system will be performed using GHP reference site data. Phase 1 will involve the GLASS members' land surface model contribution to PALS from 10–15 sites. The results will be presented during a GLASS-hosted benchmarking session at the American Meteorological Society meeting in January 2013, and is being led by Martin Best.
- *GABLS Stable Boundary Layer Project*. GLASS will assist in assessing the thermal coupling and flux momentum in a polar climate (this has been lacking in GLASS activities and focus).

GLASS is also exploring connections with the GHP Hydrological Cycle in the Mediterranean Experiment (HyMeX) Project. A GLASS representative attended the HyMeX Workshop held in Croatia in May 2012 and a HyMeX representative attends GLASS meetings. There are many “land activities” in HyMeX and the length and design of the study make it essential that GLASS at least monitor the modeling activities. GLASS is also interested in connections with the Coordinated Regional Climate Downscaling Experiment (CORDEX).

GLASS also participates in the new WCRP Modeling Advisory Council (WMAC), and continues its annual representation at WGNE meetings. GLASS is an instrumental part of the GEWEX response to the WCRP Grand Challenges and related workshop activities that will be planned.

GLASS has made good progress this year and is composed of many activities of high relevance to the GEWEX mission. The next GLASS Panel meeting will be held in mid- or late 2013.