GEWEX NEWS

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TRENDING NOW: WATER

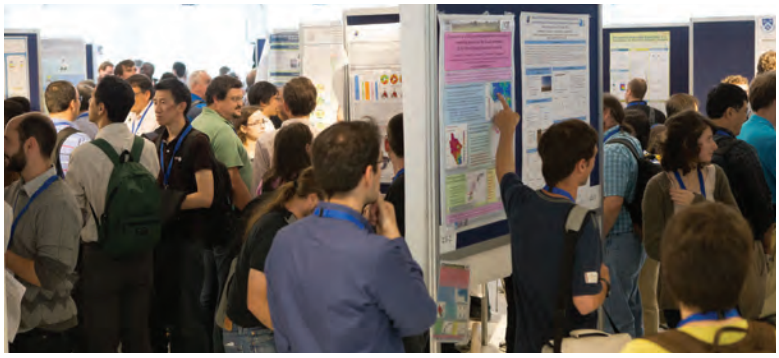
7th International Scientific Conference on the Global Water and Energy Cycle

14–17 July 2014, The Hague, The Netherlands







See highlights of the Conference on Page 2.

Inside

Highlights of the 7th International GEWEX Conference and Pan-GEWEX Meeting

Sonia I. Seneviratne and Graeme Stephens
Co-Chairs, GEWEX SSG

"What a great Conference!" was one of many complimentary remarks heard during the week of the "Trending Now: Water" Conference held in The Hague, The Netherlands on 14–17 July 2014. Over 560 scientists, managers, and students from 45 countries attended the Conference, which addressed research on water resources, extremes in water availability, such as droughts and floods, and new analyses from observations and data sets. Topics included: (i) process studies; (ii) exploitation of and developments in weather, climate, and hydrological models; (iii) applications of this information; (iv) transfer of new research into operational results; (v) research capacity development; and (vi) training the next generation of scientists. GEWEX Panel Chairs were also able to meet with their members in side meetings to discuss and advance work on science issues of importance to WCRP. In addition, over 100 CLIVAR scientists participated in both CLIVAR and GEWEX breakout sessions running parallel to the Conference.

The Conference agenda was full and each day began with plenary talks and ended with a panel session that engaged the audience on topics of the day. The poster sessions followed the lunch breaks and provided plenty of time for interaction and poster viewing. Parallel oral sessions were kept to three per time slot, thus avoiding too many conflicts. The daily plenary Panel topics included: (i) energy and water cycle budgets; (ii) analyzing, modeling, understanding, attributing, and coping with extremes; (iii) understanding and improving processes and phenomena on all aspects of water science from microphysics to monsoons; (iv) GEWEX data sets; (v) land-surface processes and hydrology; (vi) addressing the biggest weaknesses in model predictions of water; and (vii) water availability, demand, and use. The theme of the Conference and related topics fed into the WCRP Grand Challenge on water availability.

The Conference opened with welcoming remarks from the local hosts, led by Bert Holtslag and Martin Kropff from Wageningen University, then Tony Busalacchi for the Joint Scientific Committee of WCRP, and Kevin Trenberth for GEWEX. Wim Kuijken, Commissioner of the Dutch Delta Programme, spoke on recent planning to protect The Netherlands from high water in the next century, which builds upon adaptive strategies and incremental measures to balance water supply and demand. James Syvitski from the University of Colorado and Chair of the International Geosphere Biosphere Project Scientific Committee gave the keynote talk on "The Global Water Cycle in the World of the Anthropocene."

The Conference ended with a panel discussion on the WCRP Water Grand Challenge, followed by presentations from the new GEWEX Science Steering Group (SSG) Co-Chairs, Graeme Stephens and Sonia Seneviratne, on future plans for GEWEX. After the Conference, GEWEX and CLIVAR held joint sessions, followed by a meeting between the scientific steering groups of both projects. These meetings outlined joint activities that will make important contributions to the WCRP Grand Challenges, particularly those on regional climate information and climate extremes. Important joint efforts evolved out of these discussions. A new GEWEX/CLIVAR monsoons panel was formed, participants in a new working group on energy imbalance and ocean heat uptake were identified, and preliminary discussions on a new cross-panel working group on energy balance, linked to the Ocean Heat Content Working Group were undertaken.

Other important areas discussed at the Pan-GEWEX Meeting included plans for the new high resolution modeling initiative, the design and coordination of the 6th Generation Coupled Model Intercomparison Projects land multi-model projects ("LandMIPs"), new themes for GEWEX research (including land use modeling, the use of stable water isotopes in climate research, carbon-water interactions, and the closing of the global energy and water budgets), and activities to be proposed as part of the newly formed U.S. GEWEX project office. Furthermore, there were preliminary discussions of a new proposal for climate process diagnostics (GEWEX Process Evaluation Study, PROES) and of a proposed initiative to integrate research on subsurface hydrology into GEWEX activities (GEWEX-Soils). Many of these activities were posed within the context of the WCRP Grand Challenges, particularly those on Water Availability and Climate Extremes.

The International GEWEX Project Office is to be congratulated on pulling off a nearly flawless conference in an exceptional venue. Many thanks to the local organizing committee, the host institute of Wageningen University, the GEWEX SSG, the conveners of the 23 scientific sessions, and the chairs of the conference scientific program, Kevin Trenberth and Howard Wheater.

Early Career Scientists and Students Compete for Best Presentation at the 7th International GEWEX Conference

Two hundred and eighteen students and early career scientists attended the 7th International Scientific Conference on the Global Water and Energy Cycle. Over 150 of these young scientists participated in the competition for best presentation, and out of these there were 38 winners from 12 countries. Each winner received a Certificate of Excellence signed by the Conference Co-Chairs, Drs. Kevin Trenberth and Howard Wheater. Young scientists whose presentations were ranked high also received books containing climate science papers presented at the World Climate Research Programme (WCRP) Open Science Conference. Those who ranked higher received membership and meeting waivers from the American Meteorological Society for membership and meeting registration, and cash awards from the Hydrology Section of the American Geophysical Union. The top six young scientists were awarded iPad Minis and the grand prize winner received an iPad Air. The complete listing of the winners is available at: *https://www.facebook.com/pages/Global-Energy-and-Water-Exchanges-Project/154859274582*.

On behalf of WCRP and the Conference Co-Chairs, the International GEWEX Project Office (IGPO) thanks the sponsors who contributed awards, and the session conveners and other experts who served as reviewers. In addition, Sam Benedict (IGPO) and Michael Ek (NOAA), with assistance from Roberta Boscolo (WCRP), are thanked for coordinating the competition. In particular, the efforts by Joshua Roundy (NASA/GSFC) are greatly appreciated for developing a unique electronic system that streamlined the process for assigning and gathering the presentation reviews, and the judging and scoring.

We wish all the students and early career scientists much success in their education and research pursuits, and look forward to their continued participation in future GEWEX and WCRP related activities.

Cathryn Birch, the grand prize winner, with Kevin Trenberth, Conference Co-Chair.

GEWEX Summer Session for Students and Early Career Scientists

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GEWEX Summer Sessions were held on 10–12 July 2014 at the Delft University of Technology in The Netherlands. The Sessions were free of charge and attended by 35 graduate students, post docs, and early career scientists with GEWEX–wide interests. Lecturers were drawn from the GEWEX family and these three intensive days, including a full Saturday, covered energy and water exchange in the Earth–atmosphere system (day 1), data on energy fluxes (day 2), and data on water fluxes (day 3). Lectures briefly reviewed basic concepts and highlighted the challenges ahead. When dealing with water, the linkage between physical and management processes was emphasized, including aspects of the water–energy–food nexus. The lectures on data covered experiments and ground and satellite data, highlighting the development of algorithms and data products over time.

The focus of day 1 was to provide a comprehensive overview of processes to prepare participants for the case study on energy and water balance in the Earth-atmosphere system scheduled in the afternoon of days 2 and 3. This project work was carried out in groups of 3–4 people and focused on the evaluation of changes and interactions in the Earth system. The data set was extracted from model fields generated by the Community Earth System Model (CESM, *http://www.cesm.ucar.edu*). Three specific themes were suggested as foci: (a) land and climate, (b) ocean and global surface fluxes, and (c) atmosphere. The data sets provided to participants allowed the analysis of changes over time and of coupling of processes and variables. Each group summarized the findings of the case study in a short presentation at the very end of day 3.

Lectures were given by H. Russchenberg, C. Kummerow, J. Pomeroy, R. Uijlenhoet, B. Holtslag, N.v.d. Giesen, M. Menenti, J. Schulz, R. Adler, C. Jakob, and M. Rodell. The case study was prepared by M. Vizcaino. The Summer Sessions were organized by M. Menenti with the support of the International GEWEX Project Office.

Summer session participants working on case studies using observations and data generated by the Community Earth System Model.

Taking the Next Step Towards Very-High-Resolution Regional Climate Modeling

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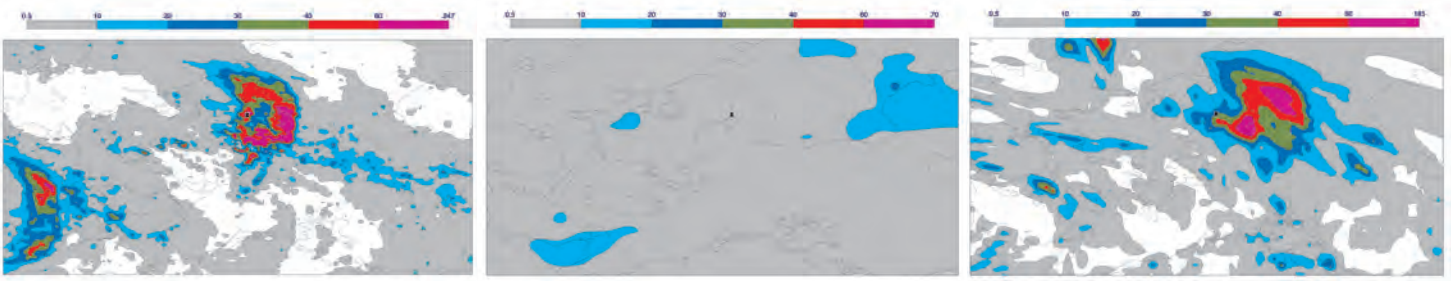
Operational numerical weather prediction (NWP) models run at grid spacings of a few kilometers have been shown to represent high-impact weather in a realistic way. An example given in the figure below shows a strong rainfall event causing severe impacts in the city of Malmö in southernmost Sweden on 31 August 2014. A 12-hour forecast with a NWP model operated at 2.5 km resolution (right panel) produces an event similar to that seen in the radar data (left panel), with more than 90 mm of rain simulated in less than 12 hours. The timing and location of the simulated event was not identical to that observed, but it is clear that the event is captured in a realistic way in terms of both extent and magnitude.

Recently, a few long-term high-resolution integrations with NWP models adapted for climate applications have been conducted. In a study focusing on the southern UK, Kendon et al. (2012) showed that heavy precipitation is more realistically simulated in a regional climate model (RCM) with very high resolution operating on a 1.5-km grid compared to a high-resolution model operating on a 12-km grid in reanalysis-driven simulations covering 1989–2008. Similar findings, including better representation of hourly rainfall rates, are presented by Ban et al. (2014) for a simulation with a 2.2-km model for the European Alps, and by Fosser et al. (2014) for a 2.8-km model for parts of southern Germany. Based on integrations with three different RCMs at 3-km grid spacing, Prein et al. (2013) found model independent improvements in the onset of summertime convective precipitation in the European Alps.

Common to all these studies is that other aspects of precipitation are also better simulated in these high-resolution models compared to RCMs or global climate models (GCMs) at coarser resolutions, which are known to have problems such as precipitation diurnal cycle and persistence of light rain. In a climate scenario for the end of the 21st century, Kendon et al. (2014) and Chan et al. (2014) show intensification of short-duration rainfall events in summer over the southern half of the United Kingdom with the 1.5-km model. They find significantly more events exceeding high thresholds indicative of serious flash flooding even if the summer climate is expected to become drier on average. Importantly, they also find a stronger intensification of these extreme events in the future climate in the 1.5-km model as compared to the 12-km model. In summary, these findings clearly indicate that: (1) high-resolution RCMs operating at scales of a few kilometers that do not rely on convective parameterization schemes to represent convection are needed to simulate short-duration high impact intense precipitation events in a realistic way; and (2) the expected intensification of extreme precipitation events in a warmer climate may be stronger than previous estimations based upon results from RCMs operated at "standard" horizontal resolutions (i.e., 10–50 km), particularly for convective rainfall-dominated seasons or regions.

These studies to date support the need to more systematically perform and evaluate convection-permitting simulations to understand and document their potential for improving simulations of not only precipitation characteristics, but also other aspects such as land-atmosphere interactions, organized convective cloud systems, and mountain or urban effects on clouds and circulation. Limited by computational resources, such investigations are only feasible using non-hydrostatic RCMs over limited areas. However, the number of studies running long-term integrations with very-high-resolution RCMs is still limited and they cover only a few relatively small regions. So far, these RCMs have not been run over the same domain, thus results are not easily comparable. This makes it difficult to draw more general conclusions about the utility of very high-resolution RCMs, even if the results discussed above are highly promising. The explicit treatment of deep convection in these convection-permitting models is believed to be a key to the improvements over coarser models that include convective parameterizations.

A fundamental requirement for evaluating the models is the availability of high-quality, high-resolution (both in space and time) observational data sets. As an example, Truhetz et al.



12-hour accumulated rainfall over parts of southern Sweden and Denmark on 31 August 2014. The panels show radar data (left), NWP model output from a 16-km global model (middle), and NWP model output from a 2.5-km regional model (right). Courtesy of Linus Magnusson, European Centre for Medium-Range Weather Forecasts and Lisa Bengtsson, Swedish Meteorological and Hydrological Institute.

(2014) found that model resolutions with 1-km grid spacing, or even less, are required for night time inversions in a hilly terrain to be captured when compared with observations from a high-density network with 151 stations over an approxiately 300 km² area (Kirchengast et al., 2014). Such high-resolution data sets are lacking in most areas but the situation can be alleviated to some extent by the use of radar and/or satellite data. A scientific challenge in this regard is how model output can be compared to these different data sets using approaches such as fuzzy verification methods (Ebert, 2008). Another key scientific question relates to how these very-high-resolution RCMs may change our understanding of future changes in extreme precipitation. One hypothesis is that by getting rid of the convective parameterizations, which are a main culprit of model uncertainty, projections of extreme precipitation changes may converge more and provide better estimates of how extreme precipitation changes scale with temperature. Given the significant computational resources needed for long-term simulations with very-high-resolution models over large domains, these challenges and questions cannot be solved by any single research institute, which calls for a broad international collaboration (e.g., Westra et al., 2014). Ideas about such collaboration include the flagship pilot regional studies put forward within the framework of the Coordinated Regional Climate Downscaling Experiment (CORDEX, Giorgi, 2014).

On June 16–19, a workshop on regional climate modeling was held in Lund, Sweden (Bärring et al., 2014). Discussions were held at a side meeting of the conference that involved 25 scientists from a number of international research institutes and universities (UNSW, Australia; University of Graz, Austria; University of Leuven, Belgium; UQAM, Canada; DTU, Denmark; CNRM, France; CS2.0, Germany; HZG, Germany; MPI, Germany; ICTP, Italy; KNMI, The Netherlands; University of Cape Town, R.S.A.; SMHI, Sweden; ETHZ, Switzerland); Met Office, UK; University of Newcastle, UK; NCAR, USA; PNNL, USA; and University of Arizona, USA). The international collaboration and coordination of very-high-resolution regional climate modeling activities were discussed and the following levels of coordination were proposed:

1. Compilation of existing runs at high resolution and comparable data sets that are available for model evaluation.
2. Identification of common metrics and diagnostics for evaluation of high-resolution models (e.g., rainfall probability distribution functions, intensity-duration characteristics, diurnal cycle, growth curve, and other extreme value diagnostics from the hydrological community, temperature-rainfall scaling relationships). The proposed initiative from the meeting was to compile a list of diagnostics/analysis methods initially informed by evaluation of NWP scale runs (event based) and ad-hoc climate scale runs, and incorporate new developments.
3. Instigation of coordinated modeling efforts over a series of common domains. The choice of domains may depend upon the phenomena of interest and availability of observational data for model evaluation. Some possibilities discussed included the U.S. Great Plains, the Alps, and the UK. The proposal of a CORDEX flagship pilot regional study on coordinated convection-permitting climate experiments was suggested.
4. Strengthening the foundation for very high-resolution modeling through synthesis of the above systematic and coordinated modeling activities (e.g., effects of domain size, resolution jumps or telescoping, and vertical resolution on model simulations through sensitivity studies).

Collection of information and ideas about possible coordinated experiments are gathered at: *https://drive.google.com/?tab=wo&authuser=0#folders/0ByIxFTw3_nHgZDA4dHNJdU1Yd3c.*Interested readers are encouraged to add their information on: (i) very high-resolution model runs they have done or are planning to run; (ii) data availability/model evaluation; (iii) diagnostics and metrics used; (iv) interest in coordinated experiments over other domains; and (v) willingness to share data or to contact any of the authors.

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Global Hourly Land Surface Air Temperature Data Sets Covering 61 Years Now Available

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Land surface air temperature (LSAT) is one of the most important variables in weather, climate, and hydrometeorological studies. Widely-used global gridded LSAT data sets based on in situ measurements [e.g., from the Climate Research Unit (CRU), National Climatic Data Center (NCDC), and Goddard Institute for Space Studies (GISS)] include daily mean temperature (Tm) and diurnal temperature range (DTR) or daily maximum (Tx) and minimum (Tn) temperatures for more than a century with their relations:

$$Tx = (Tm + DTR/2) \quad and \quad Tn = (Tm - DTR/2)$$

or

$$Tm = (Tx + Tn)/2 \quad and \quad DTR = (Tx - Tn)$$

It has long been recognized that Tm is different from the true daily mean temperature, which is defined as the integral of the continuous temperature measurements in a day and can be very accurately represented using hourly data (Tm_{24}). However, historical global hourly observational data do not exist.

Atmospheric reanalysis products offer complete temporal and spatial coverage based on the assimilation of data from different sources (e.g., satellite remote sensing, radiosondes) using the same forecasting system. However, reanalysis products have difficulty in reproducing the monthly mean and diurnal variation.

The authors developed global hourly 0.5° LSAT data sets (Wang and Zeng, 2013) by merging the in situ CRU data version 3.10 (CRU TS3.10) for 1948–2009 with four reanalysis products: [Modern-Era Retrospective Analysis for Research and Applications (MERRA, for 1979–2009); 40-year European Centre for Medium-Range Weather Forecasts (ECMWF) Re-Analysis (ERA-40, for 1958–2001); ECMWF Interim Re-Analysis (ERA-Interim, for 1979–2009); and National Centers for Environmental Prediction (NCEP)-National Center for Atmospheric Research (NCAR) reanalysis (NRA1, for 1948–2009).

The three-step adjustments include the spatial downscaling to 0.5° grid cells, the temporal interpolation from 6-hourly (in ERA-40 and NRA1 reanalyses) to hourly using the MERRA hourly LSAT climatology for each day (and the linear interpolation from 3-hourly in ERA-Interim to hourly), and the bias correction in both monthly mean Tx and Tn using the CRU data. The final products have exactly the same monthly Tx and Tn (and the same monthly Tm and DTR) as the CRU data but with different diurnal variations from different reanalyses.

As an example, the figure on page 7 (left panels) shows that the differences in the annual mean LSAT anomalies between each reanalysis and the CRU data vary significantly from year to year. Reanalysis products also show some abrupt (and unrealistic) jumps that call for further investigation, such as the abrupt increase of LSAT in 1967 over the southwestern United States in NRA1, the abrupt decrease of LSAT since 1967 over the Amazon in ERA-40, and the large LSAT oscillations over the Amazon in MERRA. The figure (right panels) demonstrates that NRA1 significantly underestimates LSAT over both regions compared with the CRU data. Over the southwestern United States, ERA-Interim and MERRA give the lower biases, while MERRA and ERA-40 give the lower biases over the Amazon.

After adjustment, the final products (solid lines) are more consistent with each other than those of the original reanalysis products (see figure), and all the abnormal jumps in the original reanalyses have been substantially eliminated (left panels). Because the LSAT anomalies from the final products agree well with the CRU data (left panels), the temporal trends of annual Tm (from CRU) and Tm_{24} (from different final products) are nearly the same.

As mentioned earlier, all adjusted reanalysis products have the same monthly mean Tm and DTR as the CRU data; however they do not necessarily have the same monthly mean Tm_{24} (right panels). The differences in the true monthly mean and the monthly averaged diurnal cycle among the four final products represent one of the uncertainties of our data sets.

Furthermore, the solid lines in the right panels essentially reflect the differences between the true monthly mean (using hourly LSAT) versus the monthly mean (using daily Tx and Tn). This suggests that monthly mean temperature from global and regional models, which is usually computed as the average of values at all time steps in a month, should be compared with the monthly Tm_{24} data, rather than the monthly Tm data.

Besides the monthly mean DTR (denoted as MDTR), the range of monthly averaged hourly temperature diurnal cycle (RMDT) can be computed from the hourly LSAT data. The use of monthly averaged diurnal cycle is a standard approach to smooth out the day-to-day variations (and hence focus on the diurnal cycle) in data analysis and model evaluations.

From the analysis of the MERRA/CRU merged data, we find that, in the polar region (north of 60°N), the January MDTR averaged from 1979–2009 remains large (e.g., as large as 7.48°C at 70°N), and is even larger than that in July (Wang and Zeng, 2014). This is much larger than the expected (small) LSAT diurnal cycle associated with zero solar heating in January and hence is driven primarily by horizontal temperature advection.

In contrast, RMDT in January is very small over high northern latitudes as it is much more affected by the diurnal radiative forcing than by the horizontal advection of temperature. As a result, the (MDTR – RMDT) differences can be quite large over high northern latitudes (e.g., as large as 6.51°C at 70°N).

Furthermore, while the MDTR trends in November, December, and January from 1979-2009 north of 40°N are negative, the corresponding RMDT trends are near zero (Wang and Zeng, 2014). These results suggest that both MDTR and RMDT should become standard metrics to evaluate the LSAT diurnal cycle of global models.

The three important types of applications of the products are:

1. definition of the daily and monthly mean based on hourly LSAT as the fundamental climate data record;
2. evaluation of the LSAT diurnal cycle of weather and climate models; and
3. use of the hourly LSAT and other variables to force land surface models in the offline simulation of energy, water, and carbon cycle as well as dynamic vegetation.

Based on these results and discussions, we also suggest that reanalysis centers save the hourly (rather than the 3 or 6 hourly) two-dimensional near-surface fields in future reanalysis activities, as has been done by MERRA and the Climate Forecast System Reanalysis (CFSR). For the surface station observing communities, it is time to save hourly observations and provide Tx and Tn (and hence Tm and DTR) as well as the true daily and monthly means using 24 hourly data for the weather and climate data record, as has been done by the U.S. Climate Reference Network.

Our value-added data sets of 1.53 terabits (TB) can be obtained at: *http://dx.doi.org/10.5065/D6PR7SZF*. The data are in netCDF Climate Forecast (CF) compliant format. Download scripts using Wget and Phyton structures are automatically prepared for the users, as is monthly granularity selection across the four data products.

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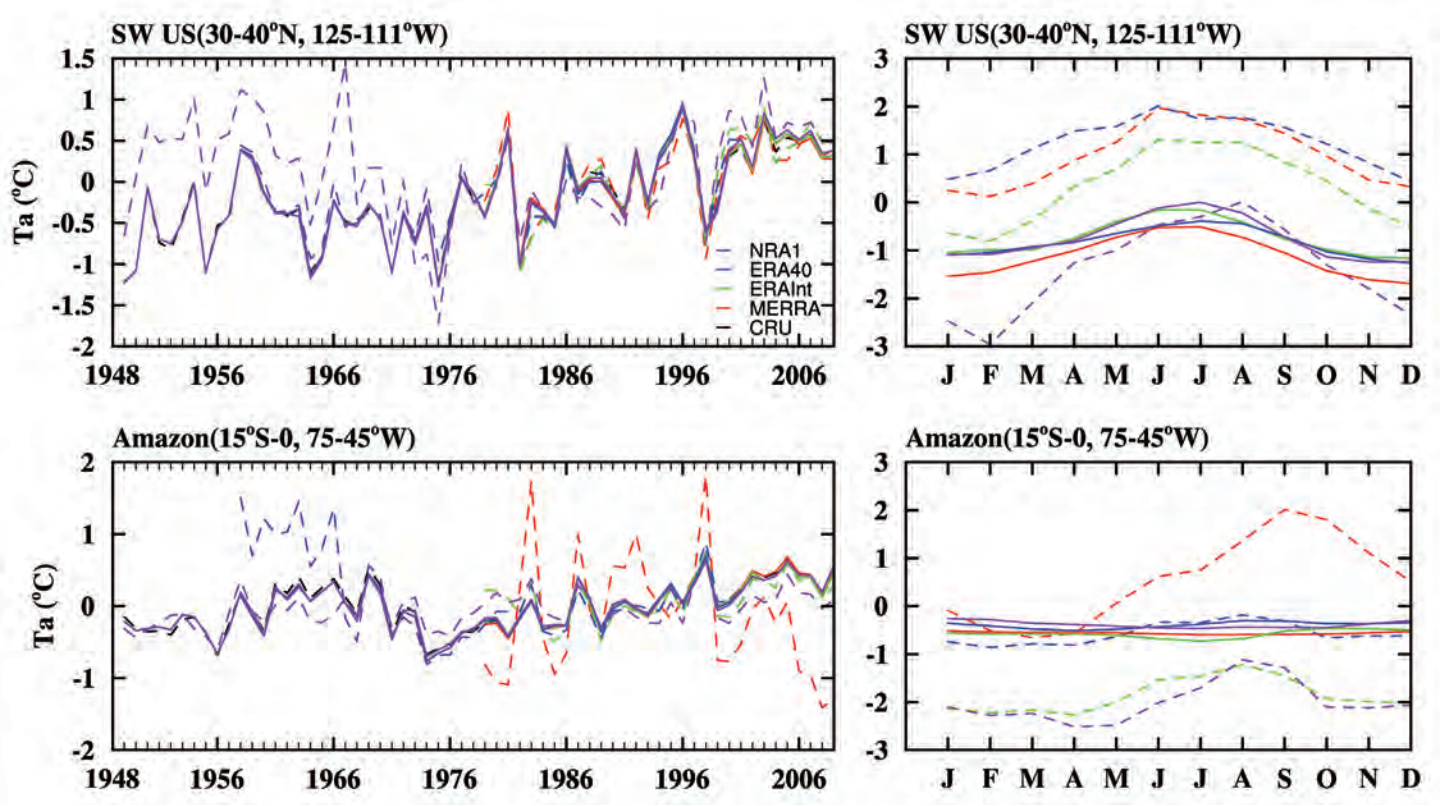

Left Panels: Annual mean LSAT anomalies (from the climatology for the common period of 1979–2001) from four reanalyses and CRU for available periods over the southwestern U.S. and the Amazon. Right Panels: differences of monthly climatology (1979–2001) between reanalyses and CRU. Average of each product was computed at its native temporal resolution. The original reanalysis results are represented by dashed lines, while the final products are indicated by solid lines (some of these lines overlap). Annual mean LSAT from CRU during 1979–2001 is 14.24° over the southwestern U.S. and 25.48° over the Amazon.

Global Atmospheric System Study Panel (GASS) Activities at the 7th International GEWEX Conference

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A large contingent of scientists from the GEWEX Global Atmospheric System Study (GASS) Panel participated in the 7th International Scientific Conference on the Global Water and Energy Cycle and side meetings to review progress in the representation of water cycle related atmospheric processes in numerical models of all types—from the small scale process-resolving and limited-area models to the global models used for weather and climate prediction. One of the Conference topics, "Improving the representation of precipitation, cloud, and radiation processes in atmospheric models," had over 50 contributed talks and posters, thus showing that clouds, precipitation, and radiation are central to atmospheric modeling across time (from hours to centuries) to global and space scales (from a few hundred meters).

One presentation discussed novel ways to parameterize ice microphysical processes (a complicated issue for all atmospheric models) and the use of large-eddy simulations (LES) to study the response of marine boundary layer clouds to climate change. Another talk of direct interest to GASS discussed the representation of precipitating mesoscale convective systems in global models with a horizontal resolution around 3–5 km, where the convection is partly resolved and partly unresolved, thus requiring parameterizations.

The topic of coupling of clouds, precipitation, and radiation to large-scale circulation is a key issue in the representation of the global water and energy cycle. A related presentation discussed how the problems in models in representing the position of tropical convergence zones might be related to cloud errors in the extra-tropics that affect the meridional transports of energy. This was further discussed at a breakout session on the new World Climate Research Programme (WCRP) Grand Challenge entitled "Clouds, Circulation, and Climate Sensitivity." There are many links with existing GASS projects relevant to this Grand Challenge, such as the need for idealized modeling frameworks to study the response of convection and climate over warm land surfaces.

The coupling of atmospheric processes with land-surface processes is an area of research that is becoming more important in GASS activities, and has strong linkages to the GEWEX Global Land Atmosphere System Study (GLASS) Panel. A joint GASS/GLASS session on this topic covered subjects including: (i) small-scale coupling of boundary layer shallow cumulus; (ii) fast reactions to cloud shadows by plant stomata; and (iii) how well the coupling of the land and atmosphere in idealized land-sea breezes varies when the atmospheric model resolution is varied from a few hundred meters (which resolves the convection) to 10–20 km (where the convection is parameterized).

Land-atmosphere coupling was also the topic of three well-attended breakout sessions where current model intercomparison projects led by GASS and GLASS were discussed. One session reviewed the Diurnal Land-Atmosphere Coupling Experiment (DICE), which is focused on a 3-day case study of a clear-sky diurnal cycle above the Kansas prairies. This project is in its middle phase and both land and atmosphere modelers reviewed recent results and discussed the next steps to further understand how to represent the physics at the land-atmosphere interface.

Plans for the 4th GASS Atmospheric Boundary Layer Study Model Intercomparison Project (GABLS4) were reviewed. The project is studying boundary layer–land surface interactions over the Antarctic Plateau in the summer and will perform simulations using land-surface models coupled with single-column models (SCMs). This will provide an interesting contrast to the models studied in DICE and the three previous GABLS model intercomparison projects. A review of the model results is tentatively planned at the next DICE meeting in spring 2015.

Clouds Above the United States and Errors at the Surface (CAUSES) is a new GASS and U.S. Department of Energy model intercomparison that uses global and regional models to determine the role of radiation and precipitation errors in surface air-temperature warm biases in simulations of summertime midlatitude climate. Figure 1 highlights the continental warm bias seen in climate models. Figure 2 is an example of one of the methodologies that will be used to analyze the cause of these biases (Van Weverberg et al., in preparation).

The week concluded with a meeting of the GASS Scientific Steering Committee (SSC). In addition to DICE, GABLS4, and CAUSES, the following GASS projects were reviewed at the meeting.

- The Radiation Forcing Model Intercomparison Project, an extension of the Continuous Intercomparison of Radiation Codes (CIRC) activities, which considers the performance of reference and broadband radiation codes in a range of geographical regions with increased greenhouse gas forcing.
- The Indirect and Semi-Direct Aerosol Campaign (ISDAC) LES intercomparison of the microphysics of Arctic mixed-phase clouds.

- The Cloud Feedback Model Intercomparison Project (CFMIP)/GASS Intercomparison of Large-eddy and Single-column models (CGILS) study of marine boundary layer cloud feedbacks.
- The transition from marine boundary layer cloud types from stratocumulus to cumulus in LES and SCMs.
- The study of diabatic processes in the Madden-Julian Oscillation involving comparisons of weather and climate models at long and short lead times.
- The Grey-Zone Project, a Working Group on Numerical Experimentation(WGNE)/GASS project using LES and regional models to study cold-air outbreak convection modeling in the grey-zone where model grid lengths are close to the scales of the convection being modeled.
- The Weak Temperature Gradient Project, a new study on the behavior of process models (cloud resolving and SCMs) with consistent parameterized representations of large-scale dynamics.
- The Small Particles in Cirrus (SPARTICUS) study of ice microphysics in middle-latitude cirrus.
- The Kinematic Driver (KiD) model project that uses KiD to study cloud microphysics and aerosol-cloud interactions in a model with specified dynamics.

A majority of the meeting was devoted to discussions related to linkages with the two WCRP Grand Challenges most closely related to GASS activities: (1) Clouds, Circulation, and Climate Sensitivity; and (2) Water Availability. While the "Clouds" Grand Challenge is well connected to GASS because the GASS co-chairs and other SSC members played a key role in the development of this Grand Challenge and the activities within it, greater interaction is needed with the "Water" Grand Challenge. The CAUSES Project and a potential GEWEX crosscutting project that will evaluate water cycle processes in high-resolution models (HiRes Project) will likely align well with this Challenge. Another potential area of interaction is related to isotope modeling. The SSC will pursue preliminary investigations on the suitability of isotope modeling in constraining the modeling of the atmospheric water cycle.

GASS continues to be a very active group with many ongoing projects at different stages. Considering all of the activities now taking place within the Panel, the SSC agreed to have the next Pan-GASS Meeting in 2016.

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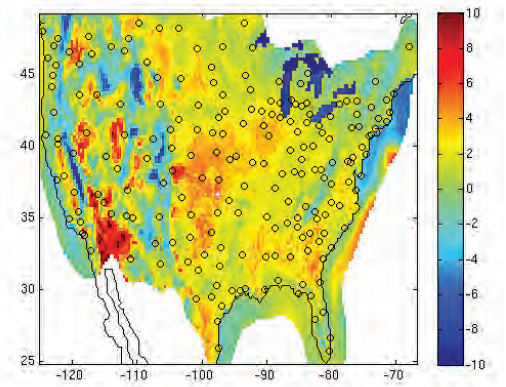

Figure 1. Difference between the screen-level temperature in the Met Office Unified Model GA6 configuration and controlled observations. The difference is calculated over the month of May 2011 and uses model data with a 4-day lead-time. This is very similar to the climate model biases shown in Ma et al. (2014).

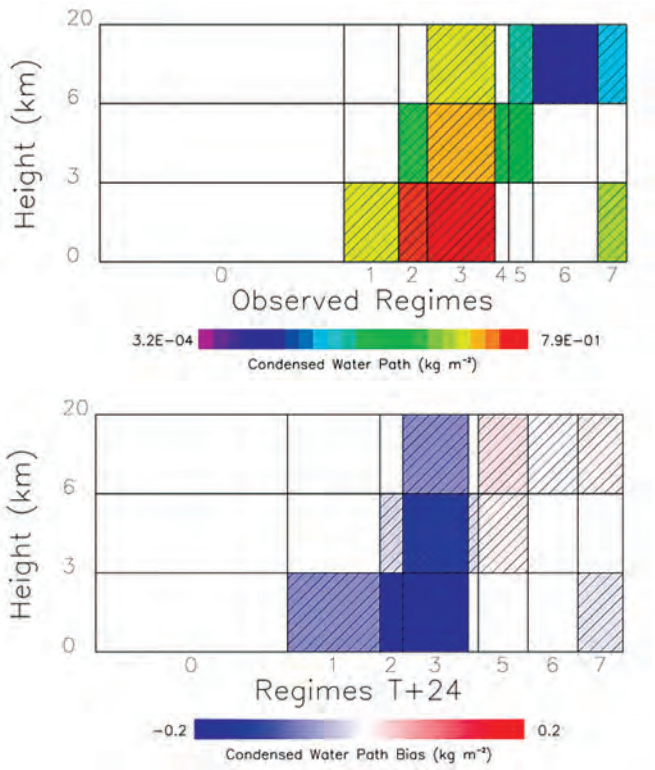

Figure 2. (Top Panel) Average condensed water path in each of eight cloud regimes defined during the Atmospheric Radiation Measurement (ARM) Climate Research Facility Midlatitude Continental Convective Clouds Experiment (MC3E) period in the spring of 2011 at the Southern Great Plains (SGP) site in Oklahoma, U.S. The cloud regimes are defined based upon the occurrence of clouds in three height categories, as shown by the location of the shading in the figure. The width of the shading for each cloud regime indicates the relative frequency of the occurrence of the cloud regime during the first month of the MC3E period.

(Bottom Panel) The bias in the condensed water path, averaged over each cloud regime, between the model and the observations. The model here is the Met Office Unified Model using the Global Atmosphere 6.0 configuration, and running with a grid spacing of 30 km over SGP. The model is initialized every 24 hours from analyses and the data shown is an average for Day 4 of the simulation (T+72 to T+96 hours). The difference in the width of the cloud regimes between the top and bottom panel shows the differences in the frequency of occurrences between the model and the observations.

Third Meeting of the GEWEX Data and Assessments Panel (GDAP)

The Hague, The Netherlands
16 and 18 July 2014

Jörg Schulz
EUMETSAT, Darmstadt, Germany

The annual meeting of the GEWEX Data and Assessments Panel (GDAP) was held in two separate sessions back-to-back with the GEWEX Science Conference and the Pan-GEWEX and Pan-CLIVAR Meetings. Christian Kummerow of Colorado State University (CSU) chaired the meeting. The first session focused on the status of the individual data products and the production of the Integrated GEWEX Product. The second session focused on new and ongoing data quality assessments and how they relate to other activities, such as the Climate Model Intercomparison Projects (CMIPs).

Some of the data products for the Integrated GEWEX Product, including radiative energy, turbulent fluxes, and condensation heating, were finalized over the past year. Other data to be included were initially hampered by delays in individual components but are now nearing completion. The integrated product is being produced at CSU with the goal to finalize the first version at the end of 2014.

William Rossow reported that processing of the International Satellite Cloud Climatology Project (ISCCP) data has not started because improved quality control for B1 radiance data is needed, as are assessments of the temperature and water vapor inputs provided by the High Resolution Infrared Radiation Sounder neural network (HIRSnn) product. This product does not provide optimal input to the processing of the surface flux (radiation and turbulent) products. The currently used microwave estimates of near-surface temperature and humidity are not consistent with the lowest levels of the profile retrievals from HIRS. A possible solution is to merge the HIRS data and microwave estimates near the surface, but this requires validation from the water vapor assessment, which is not available. ISCCP data for the period 1979–2013 containing the HIRSnn is to be finalized by December 2014.

Robert Adler provided the status of the Global Precipitation Climatology Project (GPCP) product. The GPCP test example based upon GPCP Version 2.2 (daily disaggregated from the TRMM Multi-satellite Precipitation Analysis 3-hour product) will be used for the Integrated Product. The National Oceanic and Atmospheric Administration (NOAA) is supporting the transfer of GPCP Version 2 towards "routine" processing at the National Climatic Data Center, and the University of Maryland is producing a test Interim Climate Data Record. Work has just begun work on developing a GPCP Version 3 product.

Stefan Kinne reported on the Aerosol Comparisons between Observations and Models (AeroCom) Max Planck Institute Aerosol Climatology (MAC-v1), which is a monthly global climatology of aerosol optical properties (aerosol optical depth at 550 nm, single scattering albedo and asymmetry factor) that superimposes AERONET data onto a central model background to achieve a global estimate. The current version provides information on anthropogenic change from pre-industry into the future. It does not provide aerosol-type specific information, although general size information is contained. It also lacks information about localized aerosol events. Further improvements are planned, such as integrating other reference data and using CALIPSO profiles to improve the vertical distribution. The project has found strong increases in coarse (dust) aerosol over Arabia and strong decreases west of North Africa largely related to meteorology and associated dust transports. In addition, strong increases in fine aerosols (pollution and fire-related) were found over South and East Asia. Slight decreases of fine aerosols over the U.S. and Europe may be due to policy related controls.

Paul Stackhouse reported on the status of the Baseline Surface Radiation Network (BSRN) and the Surface Radiation Budget (SRB) Project. The archive contains 50 station years. There has been a significant uptake in the use of BSRN data in scientific publications, with 12 percent growth from 2011 to 2012 and a further 32 percent growth from 2012 to 2013. BSRN will hold a workshop in Bologna, Italy on 9–12 September 2014. The SRB Version 4 data set has several flux sensitivities to changed inputs, including an increase of the longwave downwelling flux over the Sahara that is caused by sensitivity to aerosols in the new ISCCP HX clouds. Changed sea-surface temperatures derived from AVHRR provided by SeaFlux and land-surface temperature derived from HIRS provided by Landflux give significant changes in upward flux. Compared to the use of surface temperatures from the MERRA reanalysis, flux differences can reach 40–50 W/m^2 (e.g., over the Australian continent). Because Version 4 will not be finalized until 2015, the Panel decided to use a baseline Version 4 that includes changes from the new ISCCP HX cloud data.

Carol Anne Clayson reported on the ocean surface turbulent flux project, SeaFlux, whose data products contain estimates from systematic and random effects in the measurements and retrievals that are propagated to mapped air-sea turbulent flux products. The most recent version has surface wind speed estimates based on SSM/I retrievals instead of cross-calibrated multi-platform wind analysis, as not all instrument data in the combined product may have sufficient quality. All items needed for the integrated product are ready and have been delivered. SeaFlux has performed analyses of the different choices for surface and air temperature, and near-surface specific humidity microwave estimates. NOAA is supporting the setup of a routine processing of air-sea fluxes beyond the year 2008.

Eric Wood presented the LandFlux activities related to the Integrated GEWEX Product. Four algorithms that estimate terrestrial latent heat (evapotranspiration, ET) are being run globally at 0.5-degree resolution at a daily time step. Initial validation and intercomparison has been carried out at tower, small basin, large basin and continental scales. Global data sets have been developed for sensitive flux parameters (e.g., aero-

dynamic resistance and minimum surface resistance) based upon data from approximately 200 global FluxNet towers and relevant co-variates. In addition, the HIRS-consistent forcing data, including land surface, air temperature, and surface humidity, were completed for the period 1979–2010. ET processing for 1984–2007 will be completed soon.

On behalf of Tianjou Zhao, Christian Kummerow presented an evaluation of global monsoon precipitation changes from different global reanalyses (Renping Lin et al., 2014), which clearly showed that the GDAP has developed the methods to analyze the quality of the integrated product.

Wouter Dourigo presented the status of the International Soil Moisture Network (ISMN), which includes soil moisture in situ measurements from 42 networks (active and historical) from about 1600 stations. The ISMN has become indispensable for validation of satellite estimates. Improvements in the quality control procedures take into account co-varying variables, such as air, soil temperature, precipitation, and snow depth. Funding for ISMI after 2016 is uncertain at this time.

On behalf of Jim Mather, Christian Kummerow gave a brief summary on the status of the Atmospheric Radiation Measurement (ARM) reference sites. The most significant change is that ARM will develop two sites into supersites, the first being the Southern Great Plains site and the second along the North Slope of Alaska. Other locations can be served temporarily by the ARM mobile facilities. This change in strategy is a concern to satellite product validation activities that rely on ARM data (e.g., the radar site in Darwin, Australia).

Marc Schröder reported on the Water Vapor Assessment (G-VAP), which is of great importance to the development of a new standard water vapor product. Within the current GEWEX Integrated Product, water vapor estimates from different products are needed to facilitate the most accurate individual components for atmospheric parameters and surface fluxes. G-VAP is making considerable progress on all three water vapor products (total column, profiles, and upper tropospheric relative humidity) as shown in the figure at right. The project will hold a workshop at the Freie Universität Berlin, Berlin, Germany on 9–10 October 2014 and present a draft assessment report at the next GDAP meeting in fall 2015.

GDAP has begun planning a new precipitation assessment. The last one was almost solely based on evaluating the quality and applicability of the GPCP data set at that time. Now that many new products are available, there is a definite need to provide orientation to the science community in terms of the quality and applicability of these products in reference to the GPCP product.

To improve the timely delivery of assessments to the scientific community, new assessments will be restricted to what is achievable within a 2-year timeframe. This will require that assessments be independent from upcoming releases of already-existing or new data sets. Each assessment would provide the functionality for a relatively fast update of assessment results and new products.

Potential links with the next round of CMIPs by the WCRP Working Group on Climate Modeling were discussed. Jörg Schulz reported on a recent planning workshop of the Observations for Model Intercomparisons (Obs4MIPs) initiative by NASA. Obs4MIPs supports the evaluation of climate model simulations in the context of CMIPs by providing the necessary data records via the Earth System Grid (ESG). The workshop identifed ways to improve the use of satellite data sets in CMIP model evaluation and research. Other topics included process studies aimed at assisting climate model development by providing model output and observations at higher-than-daily resolution. In response to the workshop, GEWEX formulated the Process Evaluation Study (PROES). The Integrated Product will provides a linkage to PROES, with more products to be added if more synergistic variables and observations for a given process are identified. The integration of the GEWEX data sets into ESG will require resources to restructure the products.

At the end of the meeting and after seven years of leadership, Christian Kummerow stepped down from chairing GDAP. Jörg Schulz, the incoming chair, thanked him for guiding the many and diverse activities of GDAP, and especially for his perseverance in directing the GEWEX Integrated Product.

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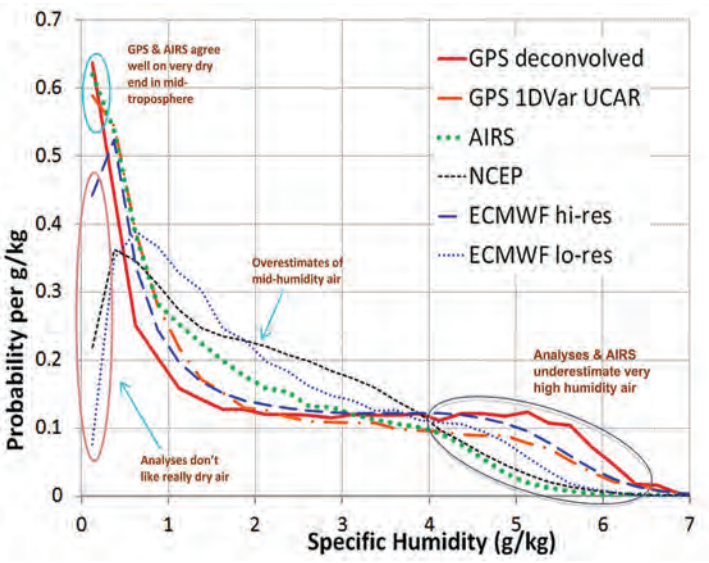

Specific humidity histograms at 5-km altitude: (1) from two different GPS COSMIC retrievals; (2) Version 5 AIRS retrieval; and (3) three NWP model analyses [NCEP 1°x1°, 17 levels up to 300 hPa; ECMWF low-resolution (2.5°x2.5°), 7 levels up to 300 hPa; and ECMWF high-resolution (25 km)², 91 levels up to 0.01 hPa]. Each histogram covers 30°S–30°N, for a full year. This type of analysis can clarify issues at the extreme ends of the humidity distribution. Courtesy of E. Robert Kursinski, Moog Advanced Missions and Science, Golden, Colorado.

GEWEX Hydroclimatology Panel (GHP) Meeting

The Hague, The Netherlands 14–17 July 2014

Sam Benedict[1], Jason Evans[2], and Jan Polcher[3]
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The GEWEX Hydroclimatology Panel (GHP) meeting was held in conjunction with the 7th International Scientific Conference on the Global Water and Energy Cycle. Drawing a large number of Panel members and experts from the GHP community, the meeting facilitated interactions between the GEWEX Regional Hydroclimate Projects (RHPs) and the GHP science crosscutting projects. Specific topics discussed included crosscutting science issues ranging from subdaily precipitation to cold regions precipitation, mountain hydrology, and validation of satellite data products.

Graeme Stephens, Co-Chair of the GEWEX Scientific Steering Group (SSG), and Jan Polcher and Jason Evans, the GHP Co-Chairs, opened the meeting by emphasizing the need for GHP to align its objectives with the WCRP Grand Challenge on Water Availability. This Grand Challenge, which is being led by GEWEX, is designed to increase understanding and improve prediction of precipitation variability, and how changes in land surface and hydrology influence changes in water availability and security. In addition to activities related to the Grand Challenge, discussions at the meeting were focused on progress in the two main elements of GHP, Crosscutting Projects and the RHPs, with an emphasis on how the RHPs can contribute to the science issues manifested in the crosscutting topics.

GHP Crosscutting Projects

A new project from Newcastle University will coordinate work in the area of the sub-daily precipitation crosscut. The "Intelligent use of climate models for adaptation to non-Stationary hydrological Extremes (INTENSE)" is funded in part by a grant from the European Research Council. The figure on this page shows how the GHP sub-daily precipitation crosscutting project, with contributions from relevant RHPs, can contribute to the development of specific tools that will help answer high-priority climate science questions.

The water resources crosscutting science topic was highlighted as a potentially "unifying" topic to bring in contributions from a number of RHPs and act as a catalyst for connections to other groups working to better understand the impacts of irrigation, reservoirs, and drainage of wetlands on regional models.

There are strong links between the mountain hydrology and mountain precipitation crosscutting science topics and the two will be linked together as they develop. For the phase transition precipitation crosscut, a core group of scientists is now being formed to consider issues related to this crosscut.

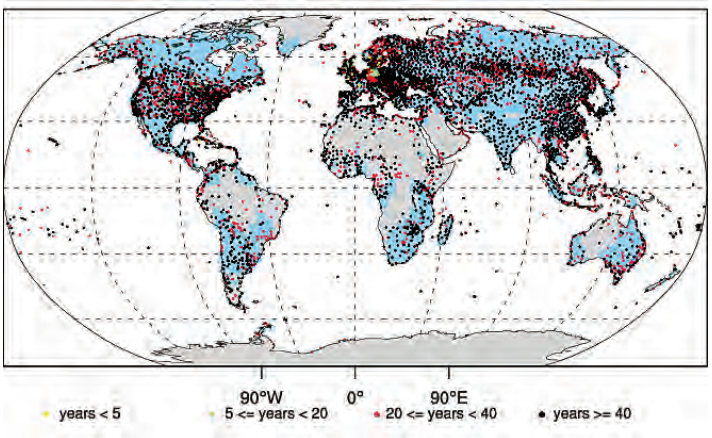
The white paper addressing how GHP can improve its contribution to seasonal forecasting through linkages with the Hydrological Ensemble Prediction Experiment (HEPEX) community will be expanded to include a proposal of an experiment that specifies the contribution that the RHPs can make to this work.

Regional Hydroclimate Projects (RHPs)

The Panel heard reports from three Regional Hydroclimate Projects that have set their completion dates. The Hydrological Cycle in the Mediterranean Experiment (HyMeX), which ends in 2016, invited the GEWEX community to the 8th HyMeX Workshop in Valletta, Malta on 15–18 September 2014. The workshop will explore ways that HyMeX can contribute to GHP science projects, including the production of data sets that could be used in a coordinated exercise between HyMeX scientists and the GHP sub-daily precipitation group.Presentations from the Monsoon Asian Hydro-Atmosphere Scientific Research and Prediction Initiative (MAHASRI, end date 2015) and the Northern Eurasia Earth Science Partnership Initiative (NEESPI, end date 2015) highlighted similar contributions.

The Saskatchewan River Basin (SaskRB) RHP is developing a contribution to GHP science on cold regions phenomena,

GHP and INTENSE: Augmenting and Quality-Controlling the HadISD Data Set



Locations of freely available sub-daily precipitation data from the UK Met Office Hadley Centre Global Sub-Daily Station Observations (HadISD) data set (Dunn et al., 2012 — updated from Robert Dunn on 13 February 2014). The blue shading represents regions where daily rainfall intensity measures are available from the HadEX2 data set, which provides gridded, station-based indices of temperature- and precipitation-related climate extremes (Donat et al., 2013b) over the period 1951–2010 (Westra et al., 2014).

which will primarily be derived from a cold region project that was added to the original SaskRB experimental area. The expanded region now includes the Mackenzie River Basin, with the legacy of the earlier Mackenzie GEWEX Study (MAGS) RHP.

The Australian Energy and Water Exchange (OzEWEX) Project requested GHP approval as an "Initiating RHP." GHP will revisit this request after the October 2014 OzEWEX workshop, as this regional effort requires slightly more focused objectives and a stronger commitment to longer-term science goals.

The Hydrology of Lake Victoria (HyVic) Project is expected to apply for "Initiating RHP" status in December 2014. Another effort, the Remote sensing of Electrification, Lightning, And Meso-scale/micro-scale Processes with Adaptive Ground Observations (RELAMPAGO), is envisioned as an international multi-agency field program to study multi-scale aspects of intense, organized convective systems that produce severe weather in subtropical South America. More clearly defined directions related to the hydrological aspects of the region, together with other longer-term perspectives, would make it a more attractive RHP candidate.

GHP is also pursuing a new RHP in an active monsoon region, such as India. The concept will be explored at the next GHP meeting, in the context of the newly constituted Monsoon Panel within WCRP.

Summary

The GHP meeting highlighted progress in several GHP science crosscutting projects, including initial interactions with the RHPs. Continued progress in these crosscutting projects and growing interactions with (and between) RHPs place GHP in a strong position to make ongoing contributions to the GEWEX Science Questions and WCRP Grand Challenges. The next annual GHP Science Update and Planning Meeting is scheduled for 10–13 December 2014 at the California Institute of Technology (Caltech) in Pasadena, California, USA. As part of the outreach to other science communities that complement GHP work, a joint open session is planned with the Global Drought Information System (GDIS) Project. Representatives of the RHPs and other local regional scientists are being invited to present on their drought-related research during this part of the meeting.

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Global Land-Atmosphere System Study (GLASS) Panel Meeting

The Hague, The Netherlands 14–18 July 2014

Joseph Santanello[1] and Aaron Boone[2]

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The annual meeting of the Global Land-Atmosphere System Study (GLASS) Panel was convened by the co-chairs, Joseph Santanello (2011–2014) and Aaron Boone (2013–2016). The meeting was held in three sessions during the week of the 7th International GEWEX Science Conference. Thirty-one people attended, including representatives from GLASS projects, working groups, other GEWEX Panels, and the World Climate Research Programme (WCRP) community.

This represents the third full year under the recently adopted Terms of Reference for GLASS Panel membership. GLASS has three new Experienced Scientists: John Edwards from the Met Office; David Lawrence of the National Center for Atmospheric Research; and Sujay Kumar from NASA Goddard Space Flight Center. Two Panel members have stepped down to serve WCRP in other capacities and a succession plan for a new co-chair to replace Joseph Santanello, whose term ends December 2014, was announced.

GLASS currently has a well-balanced mix of established and new projects, each of which corresponds to one of the three GLASS themes: (1) Model Data Fusion; (2) Benchmarking; and (3) Land-Atmosphere Coupling. GLASS also has a number of collaborative projects with the GEWEX Hydroclimatology Panel (GHP) and GEWEX Atmospheric Boundary Layer Study (GABLS) Project, and continues to be engaged with the WCRP Working Group on Numerical Experimentation (WGNE) on benchmarking and data assimilation activities, and the Seasonal to Subseasonal (S2S) Prediction Experiment. Topics discussed at the Panel meeting included updates on current and future GLASS projects and are summarized below.

LUCID

The objective of the Land-Use and Climate, Identification of Robust Impacts (LUCID) Project, chaired by Andrew Pitman, is to quantify the impacts of land-use-induced land-cover changes on the evolution of climate between the pre-industrial epoch and today. LUCID has demonstrated the importance of biophysical parameters in global climate models (GCMs), and difficulties inherent in the way land cover maps are interpreted differently by each model. Near-term plans to link LUCID and the Global Land Atmospheric Coupling Experiment (GLACE) are supported by results that show that the impact of land cover change is dependent on the coupling regime of a particular region, and that land cover and coupling can both change over time. In addition, LUCID is being aligned with the WCRP Land Use Model Intercomparison Project (LUMIP; chaired

by David Lawrence) that is focused on coordinating studies with the Coupled Model Intercomparison Project 6 (CMIP6), including offline and coupled simulations.

PALS, PLUMBER, and Benchmarking

The Protocol for the Analysis of Land Surface models (PALS, *http://pals.unsw.edu.au*) chaired by Gab Abramowitz, was initially designed to analyze single site land-surface model simulations with site observations in a standard way. Recently, with the assistance of GHP, the Project has progressed to include gap filling, empirical benchmarks, and automated metrics, along with a larger suite of Flux Tower Network (FluxNet) data. PALS is well suited to serve as a community-benchmarking tool. Implementation of the Manabe Bucket Model and the Priestly-Taylor Approach to flux estimation will be used as standard benchmarks of the "goodness" of current Land Surface Models (LSMs). A joint GHP-GLASS project, PALS Land Surface Model Evaluation Benchmarking (PLUMBER), was conceived to demonstrate benchmarking through PALS. Multiple land-surface models have been analyzed and the results will be presented at the annual meeting of the American Meteorological Society in January 2015. Results show that current LSMs are not maximizing the information content in the forcing data as well as some simple benchmarks, which suggests that improvements need to be made in parameterizations. Future work will involve additional data sets being added to PALS and a focus on carbon benchmarking of a subgroup of land surface models and coordination with CMIP6.

ALMIP-2

The first part of the African Monsoon Multidisciplinary Analysis Project (AMMA) Phase 2 Land Model Intercomparison Project (ALMIP-2; Aaron Boone) on mesoscale land surface and hydrological processes is almost completed. Results show that there is general agreement between the LSMs and the satellite products; however, big differences occur during the dry season. The agreement is better for grasslands than forest sites, part of which is related to differences in the characterization of the land cover, but also because the models have difficulties during the dry season, as rooting depths are considerably lower than what is observed in this region (see Figure 1). The analysis is ongoing and a series of papers is being prepared for submission as either a special collection or a part of a special issue in late 2014 or early 2015.

ALMIP-2 takes advantage of observational data along a meridional transect from the AMMA-Couplage de l'Atmosphère Tropicale et du Cycle Hydrologique (CATCH) network, which cuts across a zone with a large gradient in surface characteristics and climate. Several key processes that are critical to the hydrological functioning at the mesoscale over West Africa have been identified as needing improvement or representation in land surface models (since they modulate the surface flux exchange with the atmosphere via the Bowen ratio and low level moisture convergence).

The second part of ALMIP-2 is scheduled to begin in 2015 and will evaluate and intercompare local scale processes using observed flux, soil temperature, and soil moisture data. The final goal of the Project is to study how these local scale processes may be extended to larger spatial scales (partially based on work from earlier phases of ALMIP). There will be a general announcement about the project as it will not be limited to only those who have been participating thus far.

GSWP-3

The components of the Global Soil Wetness Project (GSWP-3) are: (1) Cover a period of the 20th Century (around 1950 to recent) that includes interesting global trends in hydrology, and that is also long enough to study the carbon processes; (2) Include carbon models, to explore/attribute a possible carbon-related effect or changes in ecosystem functioning on these trends; (3) Include simulations using CMIP5 models, both present day and future conditions with land cover change scenarios; (4) Explore uncertainties in (precipitation) forcings by using multiple data sets; and (5) Use a routing scheme (TRIP) and Gravity Recovery and Climate Experiment (GRACE) data for evaluation and diagnostics. The experimental design will provide a bridge to the terrestrial carbon cycle modeling community, and GLASS will actively recruit members of the Integrated Land Ecosystem-Atmospheric Processes Study (iLEAPS) to be involved in both the planning and analysis of the carbon component of GSWP-3. See the crosscutting aspects of the Project in Figure 2.

Over the past year, a great deal of work has been done on finalizing the bias correction of the forcing data set, which uses global dynamical downscaling and Climate Research Unit observations for 2-meter fields and radiation correction using the GEWEX Surface Radiation Budget product. During the GEWEX Science Conference, GSWP-3 was established as a lynchpin of LUMIP, the Trends in net land-atmosphere carbon exchange over the period 1980–2010 (TRENDY) Project, and the Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP), and will serve as a baseline for each. Next steps are to develop and distribute an explicit protocol for the first phase of simulations, and to determine the extent of the future scenario simulations (Phase-2).

LoCo and the SGP Testbed

The Local Land-Atmosphere Coupling Working Group (LoCo), chaired by Joseph Santanello, is continuing to develop and publish work on diagnostics of land-atmosphere interactions and coupling across an array of scales and models. Members of LoCo have produced a large number of publications covering diagnostics and model applications. Now is an opportune time to cross-pollinate LoCo diagnostic approaches to understanding coupling mechanisms with other GLASS projects, such as the GLASS/GABLS Diurnal Coupling Experiment (DICE). These analyses will be conducted after the first phase of DICE is complete in the coming months. The need to synthesize these efforts and associated metrics has been emphasized in the past. To this end, the LoCo Working Group has collaborated with the US Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) Program and produced an ARM-supported data set of land-atmosphere variables. The LoCo Working Group will also recommend fu-

ture instrumentation design for coupling studies over the U.S. Southern Great Plains (SGP) site. Outside of the SGP, there are other field campaigns underway that LoCo may expand into, including the southeastern U.S., Germany, and AMMA.

DICE

The Diurnal Coupling Experiment (DICE), chaired by Martin Best, began in 2013 with the first workshop held 14–16 October at the Met Office in Exeter, UK. In this project, GABLS and GLASS members are running fully coupled single column models for the Cooperative Atmosphere-Surface Exchange Study-1999 (CASES-99) experiment (formerly the GABLS2 Project) over the SGP. Surface fluxes versus atmospheric forcing in each component are controlled to isolate the impact of land-atmosphere coupling in the models over the full diurnal cycle [stable and unstable Planetary Boundary Layers (PBLs)]. An additional set of simulations with better (i.e., closer to the observed) land surface model estimates of latent heat flux (and Bowen ratio) were required and have improved the results. All three stages comprising offline and coupled iterations are now complete, and a full analysis by DICE participants is underway. A GEWEX Newsletter article on DICE was published in 2013, and a special issue of journal articles with multiple DICE contributions is being planned for 2015.

GLACE-CMIP5

The Global Land Atmospheric Coupling Experiment (GLACE)-CMIP5 Project (co-chaired by Sonia Seneviratne and Bart vd Hurk) has completed AR5 reruns of climate change projections using a 1971–2000 soil moisture climatology versus an average seasonal transient cycle of soil moisture for the 2070–2100 period. Five climate-modeling groups [the Geophysical Fluid Dynamics Laboratory, the Institut Pierre Simon Laplace, the European Centre Hamburg Model (ECHAM) group, the Community Earth System Model (CESM) group and EC-Earth modelers], have participated in the simulations, and the Swiss Federal Institute of Technology in Zurich (ETHZ) has led the analysis and the experimental design together with Royal Netherlands Meteorological Institute (KNMI), with several papers submitted, in press or published. A new group, the Australian Community Climate and Earth-System Simulator (ACCESS) modelers, contributed to GLACE-CMIP5 in 2014, and further analyses are in preparation, in particular on the impact of soil moisture-climate feedbacks on climate extremes. Future experiments will involve land cover change (see LUCID above) and the integration of the GLACE-CMIP design in the new Land Surface, Snow, and Soil moisture Multi-model Intercomparison Project (LS3MIP) linked to CMIP6.

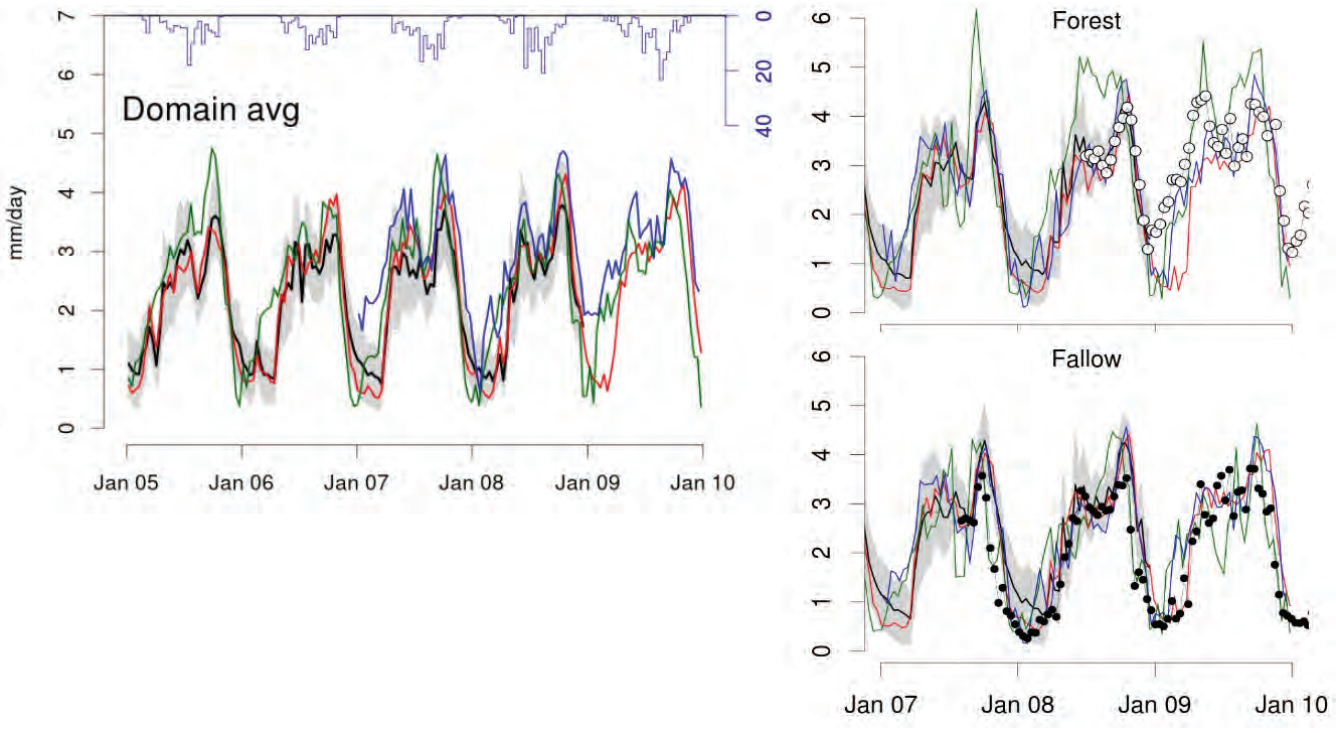

Figure 1. Comparison of surface evapotranspiration (ET) from the ALMIP2 ensemble, satellite products and observations, over the Upper Oueme Basin (10,000 km², Benin). Left: spatially averaged daily values of rainfall (top, grey), and ET from ALMIP2 ensemble (mean, black and +/– 1 standard deviation, grey area), and from MODIS (Mu et al., 2011, green), GLEAM (Miralles et al., 2011, red), and ALEXI (Anderson et al., 2011, blue) satellite-based products. Right: 10-day moving average (circles) of eddy covariance-based ET for forest (top) and fallow (bottom) sites, compared to model and satellite estimates over the corresponding grid cell. ALMIP2 model simulations covered the period 2005–2009, and observations are available from 2007 (fallow) or 2008 (forest). The overall agreement between model and satellite-based ET are generally good; however; some differences occur during the early rainy season (rising limb of ET signal), as also suggested by the comparison to observations. However, scale issues (point observation vs 0.05°x0.05° grid-cell extraction) and the vegetation seasonal dynamics prescribed in the models and satellite products have to be considered.

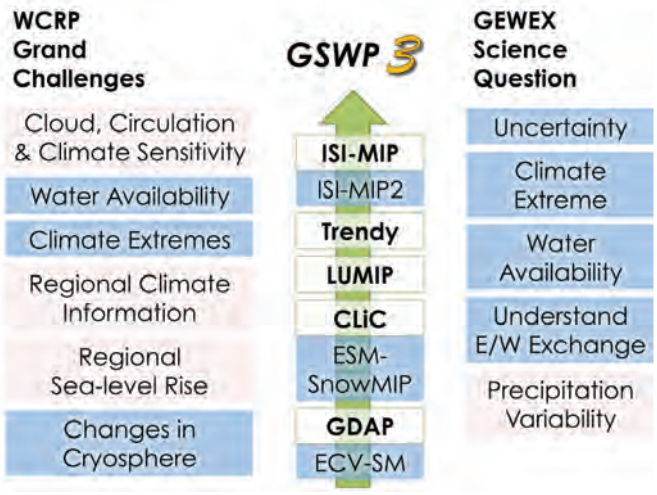

Figure 2. Schematic showing the crosscutting aspects of GSWP-3.

PILDAS

The launch of the Project for the Intercomparison of Land Data Assimilation Schemes (PILDAS; chaired by Rolf Reichle) is planned in early 2015. Phase-1 will be focused on operational centers (instead of niche research projects), and synthetic observations and different data assimilation algorithms with different LSMs for a 10-year period at one-eighth degree resolution over the SGP. Initially, two LSMs (Noah and Catchment) and one data assimilation algorithm from the NASA Land Information System will be used.

Pan-GEWEX and Future Activities

A number of new and crosscutting activities related to GLASS have been identified and launched. A GLASS representative will co-chair the new GEWEX/CLIVAR Monsoon Panel and provide guidance for an experiment to identify the impacts of land-atmosphere coupling on monsoon variability.

GLASS and the Climate and Cryosphere (CliC) Project are developing a common model intercomparison project linked to CMIP6 (land surface, snow, and soil moisture MIP, LS3MIP), which has been submitted to the CMIP6 panel for approval. The goal of the LS3MIP experiment is to provide a comprehensive assessment of land surface, snow, and soil moisture climate feedbacks, and to diagnose systematic biases in the land modules of current Earth system models using constrained land module experiments. LS3MIP is planned together with LUMIP as part of an overarching "LandMIP" set-up for CMIP6.

GLASS will participate in the GABLS Stable PBL Project by assessing the thermal coupling and momentum flux in a polar climate using data from the Dome-C Site in Antarctica. Another cold process collaboration may be conducted with CliC and GHP on a cold season intercomparison project for the Saskatchewan Basin in Canada.

GLASS is exploring connections with the GHP Hydrological Cycle in the Mediterranean Experiment (HyMeX). 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 and coordinate with GSWP-3 where possible.

The LoCo Working Group is also interested in collaborating with the Coordinated Regional Climate Downscaling Experiment (CORDEX), including an analysis of land-atmosphere interactions in CORDEX results over the SGP. GLASS and iLEAPS will continue their joint effort to improve awareness, coordination, and collaboration between the traditionally distinct land surface (water and energy focused) and ecological/biophysical (carbon focused) modeling communities.

GLASS has also recently become involved in the Seasonal to Sub-seasonal (S2S) Prediction Project, which focuses on predictability in a two-week to two-month timeframe using a multi-model ensemble approach with a special emphasis on events that have high societal or economic impacts. GLASS has ensured that sufficient land surface variable output will be saved from the S2S simulation suite in order to facilitate land and land-atmosphere analysis of the results.

GLASS participates in the WCRP Modeling Advisory Council and continues its annual representation at the WCRP Working Group for Numerical Experimentation meetings. GLASS is an instrumental part of the GEWEX response to the WCRP Grand Challenges and related workshop activities and will play an important role in the GEWEX Grand Challenges, in particular the Challenge on Water Availability and Water and Energy Cycles. These activities are being coordinated with the WCRP Grand Science Questions on Water and on Extremes, as well.

In summary, GLASS has made very good progress this year and continues to evolve with the needs of the broader community. GLASS supports many activities of high relevance to GEWEX and WCRP missions, and has some ambitious and exciting new prospects for projects that extend beyond the traditional boundaries of the Panel. A Joint Pan-GASS/GLASS Conference is planned for the September-October 2016 timeframe.

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