WCRP REPORT

World Climate Research Programme

Global Energy and Water Exchanges

Report of the

Twenty-Fifth Session of the GEWEX Scientific Steering Group

SSG-25: Sydney, Australia, 15-18 October 2012

October 2013

WCRP Report No. 10/2013

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1. RECOMMENDATIONS AND ACTION ITEMS

From the 25th Session of the GEWEX Scientific Steering Group (SSG)
15-18 October 2012, Sydney, Australia

1.1 Recommendations to GEWEX Panels

1. The SSG approves Aaron Boone as the new co-chair of the Global Land/Atmosphere System Study (GLASS) Panel, effective 1 January 2013 and acknowledges the contributions of the former co-chair, Martin Best.

2. The SSG approves Jason Evans as the new co-chair of the GEWEX Hydroclimatology Panel (GHP), effective 1 October 2012 and acknowledges the contributions of the former co-chair, Dennis Lettenmaier.

3. The SSG recommends that the Climate Variability and Predictability (CLIVAR) Project Asian-Australian Monsoon Panel (AAMP) consult with GEWEX to determine the best way forward in managing WCRP pan-monsoon issues (programmatically and administratively). The SSG supports the proposal of having a Pan-WCRP Panel (I-S-I Monsoon Panel) focused on monsoon research challenges. Names recommended for GEWEX representatives to be on the panel are Jun Matsumoto (Monsoon Asian Hydro-Atmosphere Scientific Research and Prediction Initiative, MAHASRI) and Steve Woolnough [Global Atmospheric System Studies (GASS) Panel) (Action: IGPO to contact proposed representatives)

4. SSG accepts the new GHP two-tier structure in which the Regional Hydroclimate Projects (RHPs) form one tier and a number of limited duration projects, such as those on extremes and seasonal hydrological forecasting, form the second.

1.2 Recommendations to the WCRP Joint Scientific Committee (JSC)

1. The SSG recommends two-year extensions to the terms of GEWEX SSG members Eleanor Blyth and Peter Bauer. Ron Stewart and Olga Zolina will rotate off at the end of 2013. Kevin Trenberth is planning to step down as SSG Chair at the end of 2013. Discussions are needed as to whether a single chair and vice-chair (as at present) or co-chairs should take over. It is highly desirable to have the replacement chair (or co-chair) appointed to the SSG as soon as possible.

2. To address the WCRP Grand Challenges led by GEWEX, a two-tier strategy is proposed. The first step is a series of small focused workshops to provide guidance to a larger conference that attracts and builds the community. The latter is proposed as the next international GEWEX Science Conference in 2014.

3. The GEWEX SSG endorsed the following three workshops for developing implementation plans to address the WCRP Grand Challenges: (1) workshop on observations and precipitation (12-15 attendees) hosted by Chris Kummerow in Ft. Collins, Colorado on 24-26 June 2013, co-chaired by

the GEWEX Data and Assessment Panel (GDAP) and GASS; (2) workshop on global water resource systems (12-15 attendees) hosted by Howard Wheater in Saskatoon, Canada on 10-12 June 2013, co-chaired by GHP and GLASS; and (3) workshop on changes in extremes to be organized by David Karoly with GEWEX/GHP and CLIVAR support at a non-North American location. The workshop will bring together about 30 scientists together from different geographic groups and communities, including experts on observations and modeling. Plans for the workshops will be submitted to the JSC for approval.

4. The SSG endorsed the invitation of Bert Holtslag, Wageningen University, to be the local host/organizer for the 7th International GEWEX Science Conference in The Netherlands. The SSG endorsed Kevin Trenberth and Howard Wheater to co-chair the 3.5–day conference, which is expected to attract 250-400 attendees. A 1.5-day Pan-GEWEX meeting is planned immediately after the conference. The format of the conference will be similar to that of the WCRP Open Science Conference, with a plenary in the morning and a maximum of three parallel sessions and posters in afternoon. The conference theme will be focused on the WCRP Grand Challenges on water resources, extremes, and climate sensitivity, which include the GEWEX Science Questions.

1.3 Action Items

A. General

A.1 Nominations for new SSG members to replace the SSG Chair and two SSG members whose terms end at the end of 2013 should be sent to IGPO by November 14. (Action: SSG members)

A.2 IGPO will meet with the local host to explore potential dates and locations in The Netherlands for the 7th International GEWEX Conference, and will present this to the SSG for approval. (Action: IGPO, B. Holtslag)

A.3 The Panel Rapporteur reports are due one week after the SSG Meeting. They should be sent to the IGPO with a copy to the SSG chair. These reports will be distributed to the Panel co-chairs and SSG members for comments (due the week after they are received). IGPO and the SSG will incorporate the comments and return them to the rapporteurs. The rapporteurs then will have a week to incorporate the SSG comments and send the final reports to IGPO to post on the website. (Action: GDAP: Chia Chou; GASS: Minghua Zhang, Paolo Ruti; GLASS: Li Xin, Howard Wheater; GHP: Ron Stewart, Howard Wheater)

A.4 GDAP and GHP have agreed that it would be beneficial to have a joint meeting to foster cross-cut projects and activities between the two Panels. The likely arrangement is for Panel meetings for two days and one day joint, followed by a joint meeting with the South American community. The University of Rio has offered to host the joint meeting in Rio, as well as hold a two-day conference following the Panel meetings to foster GEWEX interactions with Latin American researchers. Tentative dates for these meetings are early (in the first two weeks) September 2013. IGPO will coordinate scheduling with other WCRP activities planned or underway in Latin American (Action: IGPO, Ana Nunes)

A.5 GEWEX SSG endorses the organization of the WCRP State of the African Climate Conference and IGPO and Richard Anya are asked to provide input on behalf of GEWEX to the agenda. IGPO will inform the new SSG member, Richard Ayna, and bring him up to speed on the wider GEWEX issues. Several other components of GEWEX should be included and kept informed, including the Hydrologic Applications Project (HAP), African Monsoon Multidisciplinary Analysis (AMMA)

project, the Hydrology of the Lake Victoria Basin (HyVIC) project, and the second West African Monsoon Model Evaluation (WAMME2).

A.6 After the GEWEX SSG meeting, and with the oral comments received, David Karoly will send the updated white paper on extremes to GEWEX to distribute to the SSG and Panel co-chairs for review. Response to the paper is due two weeks after IGPO sends it out. IGPO will consolidate SSG and Panel member responses and send these back to Karoly. (Action: D. Karoly, IGPO).

A.7 Update the 2013 meeting planner and send to JPS with a copy to Valery D. with proforma forms (Action: IGPO)

A.8 Implementation plans for each of the Grand Challenge kickoff workshops are to be sent to IGPO at the end of October.

- A workshop is planned on the observations and precipitation Grand Challenge (12-15 attendees) and will be hosted by Chris Kummerow in Ft. Collins, Colorado on 24-26 June 2013, co-chaired by GDAP and GASS. GDAP and GASS will develop a workshop implementation plan to send IGPO, which will consolidate it with the other workshop plans and send to the JSC for approval. (Action: GDAP, GASS, IGPO)

- A workshop on global water resource systems (12-15 attendees) will be hosted by Howard Wheater in Saskatoon, Canada on 10-12 June 2013, co-chaired by GHP and GLASS. GHP and GASS will develop a workshop implementation plan to send IGPO, which will consolidate it with the other workshop plans and send to the JSC for approval. (Action: GHP, GLASS, IGPO)

- A workshop on changes in extremes to be organized by David Karoly with GEWEX/GHP and CLIVAR support at a non-North American location. The workshop will bring together about 30 scientists from different geographic groups and communities, including experts on observations and modeling. Plans for the workshops will be submitted to the JSC for approval. D. Karoly and GHP will develop a workshop implementation plan to send IGPO, which will consolidate it with the other workshop plans and send to the JSC for approval. (Action: D. Karoly, IGPO)

- One or more workshops on clouds and climate sensitivity related to the WCRP Grand Challenge on Water and Energy Cycles will be held in 2013 by the JSC/CLIVAR Working Group on Coupled Modeling (WGCM) with GASS support. WGCM and GASS will develop an implementation plan for the workshops and send it to IGPO, which will send it to the JSC for approval (S. Klein, S. Bony). Clarification of the management of the WCRP Grand Challenge on Climate Sensitivity is needed.

A.9 Update the GEWEX Science Questions (GSQ) document to reflect the WCRP Grand Challenges, then edit the GSQ document and publish it with the GEWEX Imperatives, including the WCRP Grand Challenges as a preamble. (IGPO, Chair)

B. GHP

B.1 GHP will explore having a crosscut activity with the Coordinated Regional climate Downscaling Experiment (CORDEX). (Action: J. Polcher)

C. GDAP

C.1 The Working Group on Data Management (WGDMA) was originally formed to coordinate ancillary data sets for the individual GDAP products. The Working Group has accomplished its goals and has been closed. The former WGDMA Chair (Bill Rossow) will be formally thanked for his service and contributions. (Action: IGPO, C. Kummerow)

C.2 Enio Pereira (Instituto Nacional de Pesquisas Espaciais, INPE) and Mark Ringer (Met Office) will be rotating off the GDAP Panel, and will be sent formal thank-you letters. (Action: IGPO, C. Kummerow)

D. GASS

D.1 The Panel would like to see an archive set up on a website to house data, publications, etc. from past GEWEX Cloud System Study (GCSS) and GASS projects and working groups. Agencies such as the Jet Propulsion Laboratory (JPL) might be interested in hosting such an archive or the GEWEX website could host it. (Action: S. Klein, IGPO)

2. INTRODUCTION AND OVERVIEW

This report summarizes the main developments in GEWEX during the year 2012 and includes the major items and recommendations from the 25th Session of the GEWEX Scientific Steering Group (SSG), held in Sydney, Australia on 15–18 October 2012. The meeting was hosted by Dr. Jason Evans of the Climate Change Research Centre and Dr. Matthew McCabe of the Water Research Centre at the University of New South Wales (UNSW) in Sydney, Australia on 15-18 October 2012. The meeting was generously sponsored by the Australian Research Council (ARC) Centre of Excellence for Climate System Science and the University of New South Wales School of Civil and Environmental Engineering. During the meeting, Prof. Andrew Pitman, the Director of the ARC Centre of Excellence for Climate System Science, gave a special in-depth presentation on UNSW research related to GEWEX activities.

2.1 Major Activities and Achievements in 2012

The SSG meeting marked the end of a two-plus year period where GEWEX, under the guidance of the WCRP Joint Scientific Committee (JSC), made changes in both its structure and scientific direction. The results are recorded in two documents: *GEWEX Imperatives: Plans for 2013 and Beyond*, which outline a long-term strategy focusing on seven categories of development, and the four *GEWEX Science Questions*, which contribute to the WCRP Grand Challenges.

IGPO polled the GEWEX community and sponsors to see if a new name was desired based on the new research priorities and scientific challenges that give GEWEX a stronger focus on Land-Atmosphere coupling. The majority of the responses received preferred to keep the acronym "GEWEX" but to redefine it as the "Global Energy and Water Exchanges" Project.

A major effort by IGPO in 2012 was its central role in the overall coordination and planning for the 4th WCRP International Conference on Reanalyses in Silver Spring, Maryland held on 7-11 May 2012. Almost 250 people from 26 countries attended the conference and 63 oral and 138 poster presentations were given. Among the IGPO activities related to this conference were choosing and securing the venue, developing and maintaining the conference website, soliciting conference sponsorship, and submitting proposals to US and international agencies for support. IGPO assisted the conference program committee in finalizing the agenda, including the selection of agency representatives to participate in the open panel discussion on agency priorities. IGPO also organized the poster sessions and provided onsite registration and logistical conference support.

Major activities related to the GEWEX Panels are given below.

Under the **GEWEX Data and Assessments Panel (GDAP)**, the International Satellite Cloud Climatology Project (ISCCP, cloud data), the Global Aerosol Climatology Project (GACP, aerosol data), the Surface Radiation Budget Project (SRB, radiation data), SeaFlux and LandFlux (turbulent fluxes), and the Global Precipitation Climatology Project (GPCP, precipitation data) are preparing for a data reprocessing cycle that will result in common ancillary data, assumptions, and space and time grids that will be merged into the GEWEX Integrated Water and Energy Product. The first year of the integrated product is scheduled for delivery in 2013. The integrated product will further quantify flux estimates and their uncertainties, and bring closure issues to a head.

The SeaFlux product, a high-resolution satellite-based data set of turbulent surface fluxes over the global oceans, is being developed with input from the CLIVAR ocean flux community. Both SeaFlux and LandFlux data sets will be released in mid-2013 with relatively better quality than reanalysis. Both products have improved agreement with in situ measurements than current reanalyses.

GDAP recently completed assessments of cloud and radiation data products. Journal versions have been submitted in order to make them available to the Intergovernmental Panel on Climate Change (IPCC) assessments. The Radiation Assessment shows some differences between ISCCP, SRB, and the Clouds and the Earth's Radiant Energy System (CERES) products. These differences, however, are often much smaller than among climate models. The Cloud Assessment focuses significant attention on the question of cloud amount, which is often used as a metric in climate studies. Although cloud amount is quite inconsistent among data sets, owing to different sensitivity of sensors, the effective cloud amount, which includes the influence of optical depth, is in much better agreement. In addition to these activities, GDAP has initiated two new assessments: a new water vapor assessment that includes new sounders, reference radiosondes, and Global Positioning System (GPS)-based methods, and an assessment of satellite simulators. The latter is intended to document the assumptions made within the simulators that are often not recognized, and it is hoped that this will foster interaction with the modeling community.

The **Global Atmospheric System Studies (GASS) Panel** supports the community that carries out and uses observations, process studies, and model experiments with a focused goal of developing and improving the representation of the atmosphere in weather and climate models. Almost 220 scientists attended the 1st Pan-GASS Science Conference held in September 2012. GASS has eleven current and planned projects. Newer projects of note include: (i) a joint GASS/GLASS Panel study on land-atmosphere interactions; (ii) a joint effort with WGCM and the European Union Cloud Intercomparison, Process Study and Evaluation Project (EUCLIPSE) to examine the interactions of moist process parameterizations with large-scale circulation under the weak-temperature gradient approximation; and (iii) the Grey-Zone Intercomparison Project to examine how models parameterize convective processes when the model horizontal resolution only partially permits convective clouds to be simulated (2-10 km range).

GASS has collaborative activities with many projects. A study on the vertical structure and diabatic heating of the Madden Julian Oscillation (MJO) is a joint project of GASS and the WCRP-World Weather Research Programme (WWRP) MJO Task Force. The GASS Low-Cloud Feedbacks Project is conducted jointly with the Cloud Feedback Model Intercomparison Project of the WGCM. Also, GASS representatives participate in the planning meetings of the new polar project initiatives of WWRP and WCRP, and the joint WWRP/WCRP Subseasonal to Seasonal Prediction Project.

The **Global Land/Atmosphere System Study (GLASS) Panel** supports the improvement of estimates and representation of land-surface states and fluxes, the interaction with the overlying atmosphere, and maximizing the fraction of inherent predictability in models. An important achievement of GLASS has been the development of easy-to-use, comprehensive evaluation methods for surface models using single site data, based on the Protocol for the Analysis of Land Surface models system (PALS). The PALS capability has been extended beyond traditional validation methods to include a priori benchmarking with the aim of defining the added value that a land-surface model can deliver in comparison with alternative methods (e.g., empirical models). A catalogue of reference sites' flux tower sites has been developed, and progress made in a synthesis of longwave and net radiation methods.

The focus of the GLASS Project for the Intercomparison of Land Data Assimilation Systems' first experiment (PILDAS-1) is on operational weather and seasonal forecasting, soil moisture retrieval, and development of a framework for comparisons. Early experiments have been completed and target dates for full experiments and analyses are August and October 2013 respectively.

The kick-off meeting for the GLASS Global Soil Wetness Project-3 (GSWP-3) is planned in early 2013. The goal of the Project is to develop a comprehensive set of land state data to investigate coupled energy-water-carbon cycles for a long-term period covering the entire 20th and 21st centuries. GSWP-3 activities will include: (i) the comparison of coupled energy-water-carbon cycle models with different configurations of model components (i.e., without a dynamic ecosystem component, with a static carbon cycle component, and with a dynamic carbon cycle component); (ii) the comparison of model simulations with time-varying land cover maps and different soil maps (e.g., the Harmonized World Soil Map); (iii) the validation of models using observations collected from in situ observations from all over the world; and (iv) development of a data portal. As GSWP-3 plans include a global river model, there is considerable potential for collaborative activities with the GHP RHPs.

The **GEWEX Hydroclimatology Panel (GHP)** has been reorganized around the RHPs and cross-cutting projects. Several RHPs have ended and potential new projects have been identified in the US, Canada, Australia, and Africa. GHP confirmed the Saskatchewan River Basin Project in Canada as an "Initiating" RHP. A community benchmarking project (PALS) is underway with GLASS, where reference site and model output data sets gathered previously for different regions, seasons, and variables are being used in the validation of land-surface models. GHP is also focused on the SSG challenge to foster collaborations with other groups having common interests in land-surface processes, including the CORDEX, GDAP, GLASS, and CLIVAR, to deal with a number of important issues that range from monsoons to extremes and how to help coordinate the multitude of national initiatives in those areas.

GHP's HAP successfully implemented, under the auspices of the United Nations Educational, Scientific, and Cultural Organization (UNESCO), an Experimental African Drought System. This was undertaken and training was conducted at the Centre Regional de Formation et d'Application en Agrométéorologie et Hydrologie Opérationnelle (AGRHYMET) in Niamey, Niger and the IGAD Climate Prediction and Applications Centre (ICPAC) in Nairobi, Kenya. The HAP Seasonal Forecasting Working Group under the leadership of Dr. Albert van Dijk has been very active, with an emphasis on dynamic seasonal forecasts derived from climate models and their propagation through hydrological models.

2.2 GEWEX Planning for Post-2013

Over the past year, the SSG and the GEWEX science community refined the GEWEX Imperatives and developed four GEWEX Science Questions (GSQs), which are comprised of research efforts that are likely to demonstrate significant progress in the next 5-10 years. These GSQs are complementary to the WCRP Grand Challenges introduced at the last Joint Scientific Committee (JSC) meeting. The primary objective of one session of the SSG was to review the activities of the GEWEX Panels and their plans for contributing to the GEWEX GSQs.

GEWEX Science Questions

- How can we better understand and predict precipitation variability and changes?
- How do changes in the land-surface and hydrology influence past and future changes in water availability and security?
- How does a warming world affect climate extremes, especially droughts, floods, and heat waves, and how do land area processes contribute in particular?
- How can understanding of the effects and uncertainties of water and energy exchanges in the current and changing climate be improved and conveyed?

At the recent 33rd JSC meeting, GEWEX and the other WCRP Projects were asked to take a fresh look at their regional activities in Africa, as well as in Latin America and the Caribbean. Starting with stakeholder needs in the region, GEWEX, in coordination with the other Projects, will develop research initiatives that are in line with the new WCRP research priorities. In particular, CLIVAR and GEWEX are taking the lead in forming organizing committees for conferences or workshops that will identify future directions for WCRP in these regions. CLIVAR and GEWEX will also coordinate pan-WCRP monsoon activities, with the CLIVAR Asian-Australian Monsoon Panel (AAMP) taking the lead on global monsoons with activities in Africa, Asia, and the Americas.

Activities related to extremes will be guided by the new WCRP Grand Challenge on extremes, and this would necessarily involve a great expansion over what currently exists in the Commission for Climatology (CCI)/CLIVAR/Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) Expert Team (ET) on Climate Change Detection and Indices (ETCCDI). The extremes activity could be centered anywhere, but seems to be a logical fit with land (GEWEX) since it includes drought, ETCCDI, and activities in the GEWEX Regional Hydroclimate Projects.

2.3 Goals and Plans for Major Activities for 2013

To address the WCRP Grand Challenges led by GEWEX, a series of small focused workshops are planned to provide guidance for a larger conference intended to attract and build the community. The latter is proposed as the next international GEWEX science conference in 2014. The GEWEX SSG endorsed the following three workshops for developing implementation plans to address the WCRP Grand Challenges: (1) a workshop on observations and precipitation hosted by Chris Kummerow in Ft. Collins, Colorado on 24-26 June 2013, and co-chaired by GDAP and GASS; (2) a workshop on global water resource hosted by Howard Wheater in Saskatoon, Canada on 10-12 June 2013, and co-chaired by GHP and GLASS; and (3) a workshop on changes in extremes to be organized by TBD with GEWEX/GHP and CLIVAR support at a non-North American location. The workshop will bring together about 30 scientists from different geographic groups and communities, including experts on observations and modeling. Joint GHP/GDAP annual meetings that include time for participation by local researchers in related fields are tentatively planned in Rio de Janeiro, Brazil in early September 2013.

Dr. Bert Holtslag of Wageningen University is the local host/organizer for the 7th international GEWEX science conference in The Netherlands planned for June 2014. A 1.5-day Pan-GEWEX meeting will be held immediately after the conference. The format of the conference will be similar to that of the WCRP Open Science Conference with a plenary in the morning and a maximum of three parallel sessions and posters in afternoon. The conference theme will be focused on the WCRP Grand Challenges on water resources, extremes, and climate sensitivity, which include the GEWEX Science Questions. IGPO will assist Dr. Holtslag in the planning of this conference.

2.4 Interactions (Especially with WCRP Sponsors and Partners)

More than 30 participants from research institutes, universities, weather services, ground-based and in situ measurement communities, and space agencies attended the 2nd GEWEX Water Vapor Assessment (G-VAP) Workshop, which was hosted by the Deutscher Wetterdienst (DWD) and the Satellite Application Facility on Climate Monitoring (CM SAF). The primary goal of G-VAP is to quantify state-of-the-art water vapor products for climate applications, thus enabling the GEWEX Data and Assessments Panel (GDAP) to select the most appropriate water vapor products for the construction of a globally-consistent

water and energy cycle product. G-VAP activities began in 2011 with a workshop on satellite-derived water vapor data records and their quality assessment. The overall goal of this workshop was to finalize the strategy and technical implementation for G-VAP.

NASA continues to strongly support the IGPO and there appears to be interest by NASA and NOAA in a US GEWEX coordinator.

Continued collaboration with the Group on Earth Observations (GEO) is provided through the Director of IGPO, in particular to the Integrated Global Water Cycle Observations (IGWCO) activities.

The Director of IGPO attended the Future Earth Meeting on Global Environmental Change Programs and Projects held in Paris, France on 28-29 November 2012.

2.5 Publications and Other Projects

IGPO publishes a quarterly GEWEX Newsletter and a monthly E-Newsletter. Representation of GEWEX at numerous national and international conferences, meetings, and workshops has resulted in various publications, including proceedings, peer-reviewed literature, and more.

Both the Cloud and Radiation Assessments have been submitted as WCRP reports and BAMS articles where both are currently under review. The GDAP products publish their papers independently.

Abramowitz, G., 2012. Towards a public, standardized, diagnostic benchmarking system for land surface models. *Geoscientific Model Development*, 5, 819-827, doi:10.5194/gmd-5-819-2012.

Basu, S., et al., 2012. GABLS Intercomparison of Large-Eddy Simulation models with Cabauw observations. In preparation for *Boundary Layer Meteorology*.

Bosveld F.C., P. Baas, E. van Meijgaard, E.I.F. De Bruijn, G.-J. Steeneveld, and A.A.M. Holtslag, 2012. The third GABLS intercomparison case for model evaluation, part A: Case Selection and Set-up. Submitted to *Boundary Layer Meteorology*.

Bosveld F.C., P. Baas, G.-J. Steeneveld, and A.A.M. Holtslag et al., 2012. The third GABLS intercomparison case for model evaluation, part B: Single Column Model results and Process Understanding. Submitted to *Boundary Layer Meteorology*.

Holtslag, A.A.M., G. Svensson, P. Baas, S. Basu, B. Beare, A.C.M. Beljaars, F.C. Bosveld, J. Cuxart, J. Lindvall, G.J. Steeneveld, M. Tjernström, and B.J.H. Van De Wiel, 2012. Diurnal cycles of temperature and wind – A challenge for weather and climate models. Submitted to *Bulletin of the American Meteorological Society*.

Hurk, B.J.J.M, M. Best, P. Dirmeyer, A. Pitman, J. Polcher, J.A. Santanello, 2011. Acceleration of Land Surface Model Development over a Decade of GLASS. *Bull. Amer. Meteor. Soc.*, **92,** 1593–1600.

Kumar, S.V., C.D. Peters-Lidard, J.A. Santanello, K.W. Harrison, Y. Liu, and M. Shaw, 2012. Land surface Verification Toolkit (LVT) - A generalized framework for land surface model evaluation. *Geosci. Model Development,* **in press.**

Santanello, J.A., C.D. Peters-Lidard, and S.V. Kumar, 2011. Diagnosing the Sensitivity of Local Land–Atmosphere Coupling via the Soil Moisture–Boundary Layer Interaction. *J. Hydrometeor.*, **12,** 766–786.

Santanello, J.A., C. Peters-Lidard, A. Kennedy, and S. Kumar, 2012. Diagnosing the Nature of Land-Atmosphere Coupling During the 2006-7 Dry/Wet Extremes in the U.S. Southern Great Plains. *J. Hydrometeor.,* **in press.**

2.6 Outreach and Capacity-Building Activities

The Director of IGPO organized scientific sessions at the European Geophysical Union as well as the American Geophysical Union on remote sensing of land-surface/atmosphere interaction processes and a session on Remote Sensing and Hydrology. For the Hydrology-Satellite Application Facilities (SAF) Workshop at the Vienna University of Technology, he arranged a session and invited lecture on Microwave Remote Sensing.

With encouragement from both the GEWEX SSG and WCRP, GHP is exploring the Coordinated Regional Climate Downscaling Experiment (CORDEX) and GLASS as the most suitable options for enhancing exchanges between these modeling projects and the RHPs and other GHP activities, given the common interests in land-surface processes.

The Director of IGPO accepted an invitation to represent the European Geophysical Union Hydrological Sciences Division in the Outreach Committee.

The Director of IGPO was one of the organizers and coveners of the American Geophysical Union (AGU) Chapman Conference on Remote Sensing of the Terrestrial Water Cycle (Kona, Hawaii, 20-24 February 2012), which drew top scientists from all over the world to discuss the most recent advances in remote sensing of the water cycle. More than 300 abstracts were registered, and 230 scientists from over 18 countries attended the Conference with approximately 60 Early Career Scientists and students.

The Director of IGPO co-leads two WCRP cross-cutting projects, one on monsoons and one on extremes, and serves on the Executive Board of the Science Committee for the IGWCO Community of Practice (COP) of the GEO. He is also co-chair of the International Soil Moisture Working Group, one of the drivers in establishing a global soil moisture in situ network, and he supports the European Space Agency (ESA) Water Cycle Multi-Mission Observation Strategy (WACMOS) as the Chair of the Advisory Board. He supports the European Union project Global Water Scarcity Information Service (GLOWASIS) as a scientific advisor and is a member of its Science Advisory Board. GLOWASIS combines in-situ satellite data and hydrological forecasting models to create a global information portal on water scarcity; as such, it tries to directly link to the stakeholders of interest.

3. GEWEX PANEL STATUS REPORTS

3.1 GEWEX Hydroclimatology Panel (GHP)

URL: *http://www.gewex.org/projects-ghp.html*
Chair(s) and Term Dates:

Co-Chairs: Drs. Dennis Lettenmaier and Jan Polcher
(Dr. Lettenmaier asked to step down as co-chair and Dr. Jason Evans is Co-Chair "Elect" to replace him. Drs. Polcher and Evans will Co-Chair GHP for 2-year renewable terms upon approval by the GEWEX SSG.)

Panel Activities

GHP has essentially made a full transition from its former identity as the Coordinated Energy and Water Cycle Observations Project (CEOP), and there are a number of developments within and beyond GHP that have influenced the form and content of its activities. GHP, along with the other GEWEX Panels, has undergone realignment in all of its activities. The Co-Chairs have developed an outline of plans for further study and implementation over the next 2-3 year period. Decisions have been made concerning the priority of each element in the context of the contribution GHP must make to the GEWEX Imperatives and Grand Challenges. This evaluation has allowed the Co-Chairs to make recommendations to the SSG about consolidating GHP work and redirecting priorities to be more in line with the next phase of GEWEX. As a result, a new organization chart was developed. GHP is focused on evaluating each Regional Hydroclimate Project (RHP) using new criteria approved by the SSG that will ensure GHP retains its leadership role in hydrologic science and modeling within WCRP/GEWEX. Each RHP and the supporting science elements in GHP will continue to build on progress it has already achieved in seasonal forecasting, the detection and attribution of change, and the development and analysis of climate projections. GHP is also focused on the SSG challenge to foster collaborations with other groups with common interests in land-surface processes, including CORDEX, GDAP, GLASS, and CLIVAR, to deal with a number of important issues that range from monsoons to extremes and how to help coordinate the multitude of national initiatives in those areas.

Science Highlights

Reference site data sets (from the National Center for Atmospheric Research) have been placed into the Protocol for the Analysis of Land Surface Models (PALS) website (*www.pals.unsw.edu.au*), and the Global Forecast System (GFS) Model Output Location Time Series (MOLTS) and gridded data sets have been converted to the netCDF format for archival. MOLTS (converted to netCDF) model output has also been sent to the PALS website in specific for the reference site of Bondville, USA. In addition, an updated spreadsheet of the MOLTS variables which have the latest National Centers for Environmental Prediction (NCEP) attributes has been created, an updated spreadsheet of the reference site characteristics per the NCEP GFS model is also available now, and a sample Grads 2.0 control file that can be used to display the data of a netCDF file was also produced.

Science Issues

GHP has not achieved agreement on how to proceed with a joint monsoon initiative with CLIVAR. The GHP Executive committee (Co-Chairs, International Coordinator, Director IGPO) has agreed to be open to

such a joint initiative; however, this issue has morphed into a broader discussion of the GEWEX/CLIVAR interface. In this respect, GHP has agreed to look for other opportunities to contribute to monsoon science that are more in line with the further development of its own strategic plans, including the possibility of a North American Water Project (NAWP) RHP. NAWP may include an American monsoon regional component that would provide the basis for GHP to meet its goal of having a monsoon study element as part of its contribution to the GEWEX Imperatives and Science Questions.

New Projects in Place

In terms of projects in Africa and South America, there are a number of new RHPs "in the making" that will be reported on at the 11-13 October 2012 GHP Meeting at UNSW, Sydney Australia. One of the proposed projects is in Africa, but none are associated with South America, although there are two projects under consideration for North America and all are expected to have elements that will contribute to the GEWEX Grand Challenges (GCs). The list includes the following.

(i) The Saskatchewan River Basin Project (SRB), which should have advanced to the level of formal acceptance as a GHP Regional Hydroclimate Project (RHP) in accordance with new criteria established for RHP status.
(ii) The Hydrology of the Lake Victoria Basin (HyVic) Study is developing under the auspices of GHP, but needs formal recognition as a potential RHP in order to garner more international visibility and support.
(iii) The North American Water Project (NAWP) is evolving toward meeting the new criteria for eventual RHP status.
(iv) The Third Pole Environment (TPE) initiative has been discussed at international meetings and is expected to take initial steps toward RHP status by the end of 2012.

Workshops/Meetings Held

- GHP meeting held in Boulder, CO, USA, October 2011
- Ad Hoc meeting on data set development with GLASS participants held at AGU Meeting, San Francisco, CA, USA, December 2011
- Three strategic planning telecons held between October 2011 and October 2012

Contributions to Developing GEWEX Science and the Imperatives

In terms of a GHP contribution to an implementation strategy, GHP is poised to initiate crosscutting projects that will actively involve, but not be limited to, the participation of RHPs. These projects are to be focused on specific science issues that will be contributions to the GEWEX Imperatives and Grand Science Questions. They will be one or two year initiatives, so that big topics such as droughts can be addressed in a series of projects that are focused enough to be done in a relatively short time period. A brief project proposal has been developed for further discussion and review. The form of the proposal follows a generalized template, developed by GHP, for submittal of such ideas.

Two projects in this format will be proposed for kick-off in October 2012, wrapping up by the end of 2014. One is drought-related and will include international coordination with the Chinese as a follow-on study from the Global Drought Information System (GDIS), which left much to be addressed in this arena. GHP, with its regional focal points and its examination of land-area issues, is perfectly positioned to move forward to address some of these. A second project of this type to kick-off in October 2013 is short time-scale precipitation extremes. This project aims to better characterize the global distribution and temporal trends in precipitation extremes at daily and shorter time-scales. It will also examine future changes in

these extremes as projected by climate models (CMIP5 and CORDEX). This will provide more robust knowledge of the global state of precipitation extremes, the relationship between daily and shorter time-scale extremes, and the potential changes due to global warming.

The commitment by GHP to the regional activities of Grand Challenge 1 (GC1) and Grand Challenge 5 (GC5) is essential and the proposed crosscut on extremes is a good approach. It is understood that there is still a need to discuss if short time scales is the only or optimal choice. Some doubt was expressed in GHP regarding the availability of data for such an initiative. The way around this could be to take the longer scales (droughts) as implied in the complimentary second proposal, which is more in line with GC5 (water availability) and more realistic for GC1 (intra-seasonal to seasonal prediction).

Workshops/Meetings Planned

(a) HyVic Planning Workshop
Meeting date: 17-20 December 2012
Venue: Kampala, Uganda, Speak Hotel, Munyonyo (shore of Lake Victoria)
Desired sponsorship: WCRP/GEWEX and relevant national/international institutions (this could be more than a few and may particularly include some young/early career scientists besides a few mainstream GEWEX/GHP)

(b) Joint GHP/CORDEX Session at Pan-CORDEX Meeting November 2013 at Brussels. This will be attended by a small number of individuals.

Contributions to the GEWEX Grand Science Questions

The GHP Co-Chairs reviewed the JSC report and concluded that the actions for GHP are largely related to the "Prediction and Attribution of Extreme Events" Grand Challenge (7.6). Specifically GHP was asked for feedback on reducing the number of initiatives. I3 and I4 (seasonal and longer predictions) are already covered in the Regional GC (7.1), which means they could be removed from this GC (7.6).

The request for action from the SSG Chairman suggests that it would be advantageous to combine workshops on the "Changes in Water Availability" Grand Challenge and the "Prediction and Attribution of Extreme Events" Grand Challenge. The initial reaction to this in GHP was that it was not a good idea, given that the scope of the Water Availability Grand Challenge is so large as to practically be a Pan-GEWEX meeting itself. Adding in the work on extremes as well, it was thought, would be too much for a single workshop.

Key Science Questions for the Next 5-10 Years

Some issues that need to be addressed from the global/regional perspective of GHP in regard to a project associated with drought include:

- What is the observationally based global (regional) distribution of drought?
- What kind of drought is it (hot, cold, devoid of precipitation, some precipitation, etc.)?
- What is its extent and severity?
- What are the pathways of evolution, including its cessation?
- How does it interact with precipitation regions, including internal variations?
- How have human influences affected drought?
- How can drought and its features be better predicted?

GHP Activities Contributing to the WCRP Grand Challenges (GC)

- GC1: Provision of skillful future climate information on regional scales (includes decadal and polar predictability)
- GC2: Regional sea-level rise
- GC3: Cryosphere response to climate change (including ice sheets, water resources, permafrost, and carbon)
- GC4: Improved understanding of the interactions of clouds, aerosols, precipitation, and radiation and their contributions to climate sensitivity
- GC5: Past and future changes in water availability (with connections to water security and hydrological cycle)
- GC6: Science underpinning the prediction and attribution of extreme events

GHP's commitment to the regional activities of GC1 and GC5 is essential. The proposed crosscut on extremes is, therefore, a good approach. It is understood that there is still a need to discuss whether or not short time scales is the optimal choice for such studies. Some doubt was expressed in GHP regarding the availability of data for such an initiative. The way around this could be to take the longer scales (droughts) as implied in the complimentary second proposal, which is more in line with GC5 (water availability) and more realistic for GC1 (intra-seasonal to seasonal prediction).

Cooperation with other WCRP Projects, Outside Bodies, and Links to Applications

GHP/GEWEX has discussed the possibility of a joint monsoon initiative with CLIVAR and this matter is still being iterated upon.

GHP expects to enlist the RHPs to make use of the CORDEX simulations either by validating them or using the output for impact studies. RHPs, which will present their current status, will be asked how they envision using the CORDEX data.

List of Panel Members and Term Dates

Hugo Berbery
Mike Ek
Jeff Walker
Richard Harding
Ana Nunes
Vincenzo Levizzani
Shinjiro Kanae
Xiaodong Zeng

3.2 GEWEX Data and Assessments Panel (GDAP)

URL: *http://gewex.org/projects-GRP.htm; http://rain.atmos.colostate.edu/GRP/index.html*
Chair(s) and Term Dates:
Christian Kummerow (2008–present)
Vice Chair Joerg Schulz (2010–2013)

Panel Activities

The activities of GDAP can be divided simply into Data Products, Product Assessments, and Radiative Transfer Code Assessments. The individual products for clouds (the International Satellite Cloud Climatology Project, ISCCP), aerosols (the Global Aerosol Climatology Project, GACP), radiation (the Surface Radiation Budget, SRB), turbulent fluxes (SeaFlux and LandFlux), as well as precipitation (Global Precipitation Climatology Project, GPCP) continue with reasonable support except for GACP, which is currently unfunded. Each of the GEWEX reference products is currently preparing for a reprocessing cycle that will result in common space and time grids as well as ancillary data and assumptions. These will be merged into a single product called the GEWEX Integrated Water and Energy Product.

With independent products available for the water and radiative terms of the Earth system, GDAP is now focused on creating an integrated reference product in which the individual products use a common space and time grid as well as common ancillary data and procedures in order to ensure that geophysical signals and their co-variances are tied to the data and products themselves rather than inconsistencies in their assumptions. Reviewing the readiness of GEWEX reference products for this reprocessing with common assumptions and setting realistic goals for product deliveries was the primary objective of the GDAP team meeting held in Paris on 1-3 October 2012.

The first year of the Integrated Product is now scheduled for delivery by 30 June 2013. Clouds and aerosols will be delivered first (by January 2013). Radiation and precipitation products will follow by March 31, as they serve as input to the turbulent fluxes. LandFlux and SeaFlux will deliver the first year of products by May 31 so that the full product can be composited by 30 June 2013. Once completed, GDAP will undertake an assessment of the state of the water and energy budgets based upon this new Integrated Product. This assessment, which is intended to document the state of our observing system, is meant to be the first in a periodic re-evaluation of the state of the water and energy observing system. The assessment will consist of closure tests on the global scale; temporal variability in the fluxes and states; attribution of changes to observed forcings; and a maturity index of various components based upon ongoing assessments of individual components of the budget. Panel members and Peter Bauer from the SSG were identified for this evaluation that is intended to assess not only products, but also their stated uncertainties.

With respect to assessments, the Panel has now finished the precipitation, clouds and radiation products. Journal versions of the last two assessments were submitted in order to make them available to the IPCC assessments. GDAP is currently actively involved in the aerosol assessment as well as the newly initiated water vapor assessment. LandFlux and SeaFlux have proceeded along the lines of combining initial assessments with product recommendations; those two are still ongoing, but with a different character as they are recommending the GEWEX standard product rather than assessing an existing one.

A new assessment is underway for the satellite simulators that are being actively developed to simulate a number of active and passive sensors. The assessment of these simulators is seen as beneficial to highlight the internal assumptions made by the simulators.

Science Highlights

- All GEWEX reference products agreed to deliver the first year of the Integrated Product parameters (including uncertainties) by 30 June 2013.
- ISCCP and GPCP are being transitioned to operational agencies for sustained processing.
- GDAP completed assessments of clouds and radiation products. Reports are available from WCRP. Short versions have also been submitted as journal articles.
- GDAP will continue to update the "Assessments Lessons Learned" document on its web page for use by other groups.
- SRB project has computed new surface and top of atmosphere fluxes. Discrepancies at the surface now amount to ~15W/m2 relative to precipitation in terms of the overall budgets.

Science Issues

The Panel views in situ reference measurements of radiation (Baseline Surface Radiation Network, BSRN), precipitation (Global Precipitation Climatology Centre, GPCC), water vapor (through well calibrated radiosondes), and latent heat flux from ships and towers around the world as an important reference for climate data records. The SSG and WCRP might consider a concerted effort to foster small but highly characterized networks (similar to BSRN) that can be used to assess satellite stability over very long periods. The maintenance of these activities is central to satellite derived products and GDAP cannot emphasize their importance enough.

New Projects in Place

GDAP has not formally initiated any new projects.

Workshops/Meetings Held

- GEWEX Water Vapor Assessment meeting, Offenbach, Germany, 26-28 September 2012
- GEWEX Data and Assessments Panel meeting, Paris, France, 1-3 October 2012
- LandFlux Assessment meeting, Paris, France, 4-5 October 2012

Contributions to Developing GEWEX Science and the Imperatives

GDAP provides global products designed to test model processes related to the water and energy budgets.

New Projects and Activities Planned

GDAP is evaluating the feasibility of formalizing the Satellite Simulator Assessment as well as initiating a Working Group on Water Storage. Decisions should be made at the next GDAP meeting in the fall of 2013.

Workshops/Meetings Planned

(a) ISCCP at 30 Workshop, NY, NY, 22-26 April 2013

(b) Joint SeaFlux/LandFlux WG meeting (currently considering EGU), April 2013

(c) Water Vapor Assessment meeting, August 2013

(d) GDAP meeting (Rio de Janeiro), October 2013 (Exact dates TBD)

(e) GEWEX Integrated Product Session (currently considering AGU), December 2013

Contributions to the GEWEX Grand Science Questions

Observations and Predictions of Precipitation
GDAP works closely with NASA and the Japan Aerospace Exploration Agency (JAXA) to promote the Global Precipitation Mission and to ensure that its products meet GEWEX objectives for both process studies and climate trends. The same is true for work with the German Weather Service (DWD) to ensure that gauge data meet the same needs.

Global Water Resource Systems
The Panel does little related to water resource systems.

Changes in Extremes
Satellite observations of precipitation are being used to examine changes in precipitation distributions, including extremes in many parts of the world. GDAP is also engaged with the gauge analysis community. While it is not possible to release individual station data, the Panel is actively searching for ways to work with DWD to provide statistics suitable to studying extremes.

Water and Energy Cycles
Observation of the water and energy cycles is the central theme of GDAP. The Panel strives to close those budgets on global as well as regional scales as a measure of fundamental uncertainties in today's observations. The Panel strives also to make the products consistent and accessible to promote process understanding.

Key Science Questions for the Next 5-10 Years

The Panel would like to add terrestrial water storage (both in terms of soil moisture, snow depth, and reservoir storage) and fluxes (runoff) to its set of global products in order to expand the closure requirements of the water and energy budgets over land. This leads to the same goals of establishing uncertainties and providing process information as the current data sets.

The Panel would like to gain confidence in the Arctic products currently being produced with the goal of ascribing ice melt to specific feedbacks in the local water and energy budgets as distinct from circulation changes induced by global change.

The Panel will also continue to focus on questions related to the onset of precipitation and the impact of aerosols on this question. We have begun this activity but progress is slow while global data sets are still being developed.

GDAP Activities Contributing to the WCRP Grand Challenges

Provision of skilfull future climate information on regional scales (includes decadal and polar predictability)
While the Panel is not in a position to predict future climate, it can focus on process studies at regional scales that would be essential to verify that the regional climate models are indeed capturing the key elements of each region's unique physics.

Regional Sea-Level Rise

Cryosphere response to climate change (including ice sheets, water resources, permafrost and carbon)
The Panel would like to gain confidence in the Arctic products currently being produced with the goal of ascribing ice melt to specific feedbacks in the local water and energy budgets as distinct from circulation changes induced by global change.

Improved understanding of the interactions of clouds, aerosols, precipitation, and radiation and their contributions to climate sensitivity
The Panel will also continue to focus on questions related to the onset of precipitation and the impact of aerosols on this question. This activity has started, but progress is slow while global data sets are still being developed.

Past and future changes in water availability (with connections to water security and hydrological cycle)
While GDAP can certainty help with past precipitation amounts and the distribution of rain rates that might be viewed as important for water availability, the Panel has no particular information on water availability or changes therein.

Science underpinning the prediction and attribution of extreme events
GDAP global products are designed at 1-degree and 3-hourly time steps so that extremes and processes related to extremes may be seen in the data.

Cooperation with other WCRP Projects, Outside Bodies, and Links to Applications

The SeaFlux product is being developed with input from the CLIVAR community and joint workshops are being held. The Stratospheric Processes And their Role in Climate (SPARC) community will be consulted soon about its evaluation of upper tropospheric humidity products to be integrated with the GDAP water vapor assessment. Coordination with the Climate and Cryosphere Project (CLiC) on high altitude water and energy budgets is clearly desirable.

Issues for the SSG

The Working Group for Data Management (WGDMA) was initially responsible for identifying the various ancillary data products to be used by the community. As this activity is now finished, GDAP recommends that this Working Group be discontinued.

GDAP would like to replace two retiring members (Enio Pereira and Mark Ringer) with new members to represent soil moisture and water storage. No names are being put forth yet, and the time between the GDAP panel meeting and the SSG is too short this year. We would like to thank Enio Pereira and Mark Ringer for their contributions as their terms have expired.

The Continuous Intercomparison of Radiative Codes (CIRC) now is sponsored by GDAP and GASS. This seems to work out quite well.

List of Key Publications

Both the Cloud and Radiation Assessments have been submitted as WCRP reports and BAMS articles where both are currently under review. The GDAP products publish their papers independently.

List of Panel Members and Term Dates

Christian Kummerow 2008 – present

Joerg Schulz	2010 – present
Carlos Jimenez	2010 – present
Norman G. Loeb	2005 – present
Hirohiko Masunaga	2010 – present
Matthew McCabe	2008 – present
Enio Pereira	2010 – 2012
Mark Ringer	2010 – 2012
Axel Schweiger	2008 – present
Sonia Seneviratne	2008 – present
B.J. Sohn	2007 – present
Claudia Stubenrauch	2007 – present
Susan Van den Heever	2008 – preset
Tianjun Zhou	2011 – present
Andrew Heidinger	2012 – present

3.3 Global Land Atmosphere System Study (GLASS) Panel

URL: *http://www.gewex.org/glass.html*
Chair(s) and Term Dates:
Joseph Santanello (2011–2014)
Martin Best (2009–2012) (will step down 31 December 2012)
Aaron Boone (2013–2016 (will begin 1 January 2013)

GLASS Overview and Summary

GLASS's mission statement is to "support improved estimate and representation of (land) states and fluxes in models, the interaction with the overlying atmosphere, and maximize the utilized fraction of inherent predictability."

The aim of GLASS is to promote community activities that improve best estimates and the model representation of state variables (e.g., soil moisture) and fluxes (e.g., evaporation), or to improve understanding of land/atmosphere feedbacks and the role of land surface in predictability. To achieve these aims, GLASS has been restructured into three elements: (1) benchmarking, (2) model data fusion (MDF), and (3) land-atmosphere coupling (LAC). The concept of benchmarking (rather than validation) will enable the modeling community to identify the current strengths and weaknesses of models in relation to their required applications. This is a complete shift of focus for the modeling community and will require careful definitions of the a priori metrics that a model needs to achieve. The new Benchmarking/PALS project will directly address this theme with the goals of demonstrating this approach to benchmarking for the community through an American Meteorological Society session and GEWEX Newsletter article.

The second strand of model data fusion will bring data assimilation techniques to both the initial value problem and to constrain the bounds of unknown parameters by using historical data sets. In the past, land data assimilation has been limited due to restrictions in observational data of the land components (e.g., soil moisture), but new satellite data enables an opportunity to explore more advanced data assimilation techniques. The new PILDAS project led by Reichle will directly address this theme of GLASS.

The final strand of GLASS aims at understanding the physical interactions between the land and the atmosphere and how feedbacks can change the subsequent evolution. While the first Global Land Atmospheric Coupling Experiment (GLACE1) and GLACE2 projects have demonstrated regions of the globe and situations where the land can have a significant impact on atmospheric evolution, they also highlighted large differences between modeling systems. Hence, GLASS will help to facilitate two aspects of land/atmosphere coupling, the first being to understand the physical processes while the second will strive to understand how both land and atmospheric parameterizations interact. The focus is at both the process/local level (the Local Coupled Project, LoCo) and the global behavior of the coupling (GLACE). This understanding will help to maximize the inherent predictability of the coupled land/atmosphere system.

In summary, the adoption of new Terms of Reference (TOR) for the Panel has already improved the expectations of and for Panel members, shed former members who were no longer contributing, brought new experienced and young scientists into the fold, and allow the outside community better access to and understanding of the Panel operations. GLASS currently has a good mix of established and new projects getting off the ground and in the planning stages, each of which maps well to the themes (MDF, Benchmarking, LAC). GLASS has reached out substantially to GHP on a number of projects, is launching projects with the GEWEX Atmospheric Boundary Layer Study (GABLS), and continues to engage the

WMO (CAS)/JSC Working Group on Numerical Experimentation (WGNE) on benchmarking and data assimilation activities. Interaction with GDP could be improved, however, particularly with regards to LandFlux activities and modeling.

Panel Activities and Science Highlights

GSWP3 (Hyungjun Kim)

A follow-up project to the Global Soil Wetness Project 2 is in the near-launch stage, with a kick-off meeting scheduled for 5-7 November 2012 in Tokyo. The new components being considered for this project are:

1. Covering a longer period of the 20th Century (~1900-recent), which includes some interesting global trends in hydrology, but is also long enough for carbon processes
2. Including carbon models, to explore/attribute a possible carbon-related effect or changes in eco-system functioning on these trends. This could make a bridge to the terrestrial carbon cycle modeling community
3. Exploring uncertainties in (precipitation) forcings by using multiple data sets
4. Including simulations using CMIP5 models, both present day and future conditions
5. Use a routing scheme (TRIP) and GRACE data for evaluation and diagnostics

Over the last year, a great deal of bias correction has been applied to the forcing data set [Twentieth Century Reanalysis (20CR) forcing], which uses global dynamical downscaling and Climate Research Unit (CRU) observations for 2-m fields. Radiation correction is applied using the GEWEX SRB product. A "white paper" (experimental protocol) has been refined since the 2011 GLASS Panel meeting, from which a 2-pager will be produced and circulated with the carbon community to get their buy-in before the project begins. This will enable both carbon and water and energy cycle land surface models to be included, and simultaneously evaluated in them (e.g., the hydrology of carbon models and vice-versa). After the kick-off meeting, it is anticipated the project will begin in early 2013.

LoCo and the SGP Testbed (Joe Santanello)

The LoCo Working Group has spent the last year producing and publishing work on diagnostics of land-atmosphere interactions and coupling across an array of scales and models. A trilogy of papers has been written based on the coupling of NASA's Land Information System (LIS) with the Weather Research Foundation (WRF) Mesoscale model that includes model coupling behavior evaluation during wet and dry extreme periods over the US Southern Great Plains. Other diagnostics have produced global maps of coupling metrics from GCM output and reanalysis products such as the North American Regional Reanalysis (NARR) and Modern Era Retrospective-analysis for Research and Applications (MERRA). A wide net has been cast in developing coupling metrics and producing maps, but it is recognized that now is the time to reel in these efforts, and synthesize them to get at more science-driven questions of coupling. Some examples of these diagnostics are the traditional mixing diagrams, LCL-deficit, Findell-Eltahir diagnostics of triggering of convection, revised relative humidity tendency variables, McNaughton coupling coefficient, and TFS/AFS. To this end, the LoCo Working Group is embarking on a test bed project (see details below) that will produce an ARM-supported data set for coupling studies over the US SGP. This data set will allow the array of diagnostics to be applied consistently to the same location in order to understand their hierarchy and to develop a classification system based on the metrics.

PALS and Benchmarking (Gab Abramowitz)

The Protocol for the Analysis of Land Surface models (http://pals.unsw.edu.au) 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 has been designed to analyze in a standard way uploaded single site model simulations with site observations. Extensions to other data sets and the development 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 LSMs. The joint GHP-GLASS project to demonstrate benchmarking through PALS is ramping up with a deadline to produce results for the AMS Annual Meeting and GEWEX Newsletter. Site and model selection is to take place in the coming weeks, with a subset of contributions to be the focus for January deadline.

LUCID (Andy Pitman)

Two papers have been published in the last year summarizing the first Land-Use and Climate IDentification of Robust Impacts (LUCID1) and LUCID2 results. This includes evaluation the impact of land cover change in five GCMs using the Land-use Harmonization (LUH) dataset. A key result supports the need to engage both LSM and LCC data set providers so they can see how to intelligently implement LCC in models. LUCID would also like to gauge interest of the LCC community in c20c/CMIP5, but it has been tough to get their attention. There may be linkages between GSWP3 and the land cover treatment in the 20c simulations and LUCID efforts that will be investigated.

GLACE2-CMIP5 (Sonia Seneviratne and Bart van den Hurk)

Experiment#1A and #1B of the second Global Land Atmospheric Coupling Experiment (GLACE2)-fifth Coupled Model Intercomparison Project (CMIP5) has been completed. This involved AR5 reruns of climate change projections using a 1971-2000 soil moisture climatology versus using a seasonal transient cycle of soil moisture and evaluated during the 2070-2100 period. Three groups have completed (the Geophysical Fluid Dynamics Laboratory, GFDL; the European Centre Hamburg Model, ECHAM; and the Community Earth System Model, CESM) the full analysis and papers have been submitted. Future phases of experiments involve land cover change. Highlights show that the imposed SM anomalies show similar regions as those projecting drought increase, and a larger impact of soil moisture change on daily max temperature. Precipitation changes are less clear, and additional analysis will be conducted to analyze the feedbacks and water balance (E-P). This is expected to be completed over the next 12 months.

PILDAS (Rolf Reichle)

PILDAS is expected to launch in early 2013, once participants from all the major operational centers have confirmed participation. The experimental design is nearly complete, and a pilot study is underway by the project lead to use two LSMs with one DA algorithm in NASA's LIS. Phase-1 is focused on operational centers (rather than niche research projects), synthetic observations, and different data analysis algorithms with different LSMs for a 1/8-degree domain over the SGP. Later phases will focus on coupled DA systems and actual satellite observations from the Soil Moisture and Ocean Salinity Mission (SMOS) and the Soil Moisture Active Passive (SMAP) mission. GLASS will take the experimental plan and pilot results to WGNE to put pressure on centers that are not currently listed (e.g., the UK Met Office).

ALMIP2 (Aaron Boone)

The 2nd AMMA Land MIP was launched in Spring 2012 and is currently wrapping up Phase 1 with submissions due in mid-September. Twenty-two land-surface models, five hydrological models, and one evapotranspiration model are all included in Phase 1. In this experiment, the focus is on a much higher spatial resolution (5 km) than in ALMIP1, to focus on the subtle hydrology and vegetation processes that dominate there (occasionally very large rooting depths, land use change, sloping bedrocks removing water from the catchment, strong variability in runoff), and to enable use of high resolution satellite data. The

period covers four years, where the forcing is coming from a blend of in situ and radar/Landsat/other satellite data. The project will give recommendations on the parameterization of runoff scaling. As this project has regional hydrological aspects, it is also considered to be in ideal candidate for a collaborative project between GLASS and GHP to foster close working relationships. However, efforts to connect with GHP have thus far failed, despite circulating the white paper and experiment details.

Science Issues

1. The GSWP3 science details still need to be defined and issues resolved with regards to the forcing data choice and corrections applied. A two-page document summarizing the key goals and methods of GSWP3 has been commissioned by the GLASS co-chairs before the kick-off meeting, such that it can also be distributed to entrain the carbon community up front.
2. The definition of "local" vs. "non-local" coupling and representation of each by the array of LoCo diagnostics is a non-trivial issue. This will be addressed directly by the SGP Testbed data set and diagnostic intercomparison, and will include the effect on coupling metrics of spatial and temporal scales.
3. Forcing height used to force the PILDAS experiments needs to be resolved (either 2/10 m or lowest model level). There is not an optimal best solution here at the moment, as some models have only one or the other available.

New Projects in Place

ALMIP2, PILDAS, and GSWP3 are in the "just-launching" phases. Specifically:

- Launch of the GSWP3 project will happen in November 2012 in collaboration with the terrestrial carbon cycle modeling community.
- ALMIP2 is underway in Phase 1 and about to begin Phase 2, and is in collaboration with GHP.
- Refinement of a white paper and completion of experimental design for PILDAS has taken place. A pilot study is underway and contributors will be finalized by Spring 2013.

New Projects and Activities Planned

1) The GLASS/GABLS DIurnal Coupling Experiment (DICE) was presented during a breakout session at the Pan-GASS meeting in Boulder. It was decided that phase 1 will proceed, culminating in a workshop tentatively scheduled for the fall of 2013. This project will involve the GABLS and GLASS members running fully coupled SCMs at the 1999 Cooperative Atmosphere-Surface Exchange Study (CASES 99) (which was the GABLS2 project) and controlling for surface fluxes vs. atmospheric forcing in each component to isolate the impact of land-atmosphere coupling in the models over the full diurnal cycle (stable and unstable PBLs). Project leads of Martin Best, Bert Holtslag, Gunilla Svensson, and Adrian Lock will ensure that progress is made in both communities.

2) The LoCo/SGP Testbed Project was presented during a breakout session at the Pan-GASS meeting where the ARM data providers attended and the community was invited to participate in a data needs survey for land-atmosphere (L-A) coupling studies. The ARM group has agreed to produce a Climate Best Estimate data product for LoCo at the ARM SGP site, which will then be used to establish a benchmark of L-A coupling based on LoCo-derived diagnostics by the working group. Craig Ferguson and Joe Santanello will be leading this effort.

3) A benchmarking study has been proposed through GLASS whereby the PALS system will be demonstrated using data acquired in conjunction with GHP. The first phase will involve GLASS members' land surface model contribution to PALS at an array of sites (10-15). The results will be

presented at AMS in January 2013 during a GLASS-hosted benchmarking session, and also published as a GEWEX Newsletter article.

4) A GABLS Stable Boundary Layer project has been proposed, and GLASS would like to be involved in terms of assessing the thermal coupling and momentum flux in a polar climate (to date, GLASS activities and focus have been lacking). However, it was agreed that GLASS does not currently have members with the right skills to investigate cold region processes in such a climate, so a link to CLiC needs to be established. An approach to CLiC will be made to find someone who could join the GLASS Panel and form a link between GLASS, GABLS and CLiC for this project. It was also agreed at the Pan-GASS GABLS breakout session that the first step of a joint project should have both communities concentrating on their components of the system to fully understand these. A second step could then be to investigate the impact of land/atmosphere coupling in this environment.

Workshops/Meetings Held

- GLASS panel meeting at Pan-GASS Meeting in Boulder, CO, USA, 13-14 September 2012
- GLASS/GABLS breakout session at Pan-GASS Meeting, Boulder, CO, USA, 12 September 2012
- LoCo/SGP Testbed breakout session at Pan-GASS Meeting in Boulder, CO, USA, 11 September 2012

Workshops/Meetings Planned

- GSWP3 Kick-Off Meeting, Tokyo, November 2012
- WGNE Annual Meeting (GLASS presentation), Toulouse, November 2012
- AMS Annual Meeting (Benchmarking session hosted by GLASS), Austin, January 2013
- GLASS/GABLS Diurnal Cycle Workshop, TBD Fall 2013
- "Land Conference" idea has been proposed for 2014 timetable
- GLASS Panel Meeting, TBD, fall 2013

Contributions to Developing GEWEX Science and the Imperatives

GLASS contributes most directly to the following GEWEX Imperatives:

Develop diagnostic approaches to improve process-level understanding of energy and water cycles in support of improved land and atmosphere models.

- Identify feedbacks and the interactions among different processes, and build confidence in their replication in models (GLACE2, LoCo).
- Spin-up activities in *advanced diagnostics* through a joint pan-GEWEX effort/workshop (GRP, GLASS, GHP, and others).
- Develop metrics to aid benchmarking activities for both un-coupled and coupled modeling activities.
- With the current and expected increasing complexity of land models in terms of various hydrologic and vegetation treatments, model optimization (i.e., parameter estimation approaches) will continue to be relevant to GLASS efforts (through Model Data Fusion).
- Investigate alternative representations of sub-grid processes in land surface schemes (heterogeneity).
- Develop improved understanding of climate variability and change on land surface properties, including soils, vegetation and hydrological processes, and an associated modeling capability (GSWP3).

- Investigate the scope for development of next generation land surface models with improved representation of subsurface hydrology, including groundwater processes; identify suitable areas for their evaluation.

Improve global and regional simulations and predictions of precipitation, clouds, and land hydrology, and thus the entire climate system, through accelerated development of models of the land and atmosphere.

- Coordinate the construction of a global land reanalysis system, building on ongoing and preparatory activities in Landflux, GSWP3, GLDAS and operational weather centers.
- Develop a framework and infrastructure for evaluation of land-atmosphere feedbacks. This should include the development of more quantitative estimates of uncertainty in the land condition and how this uncertainty propagates through to the atmosphere (e.g., PBL, convection, water and energy). This objective will be advanced in conjunction with the Processes Imperative in developing diagnostics.
- Organize coordinated intercomparison experiments for a range of model components in state of the art land models, especially with regard to: groundwater hydrology; surface water treatment (snow, river routing, lakes, irrigation, and dynamic wetlands); vegetation phonology and links between carbon and water; and Land Data Assimilation systems (follow-up the PILDAS initiative).
- Evaluation of these land model components will also have to be considered in their interactive (coupled) context with the PBL, while taking into account and developing more quantitative measures of uncertainty in the land parameters and states will enable more robust evaluation of data assimilation systems.

Contributions to the GEWEX Grand Science Questions

Grand Science Question Number 1: How can we better understand and predict precipitation variability and changes?

*****The GLASS activities below address the linkages of precipitation (and its accuracy) to land surface processes and LSM predictability.

Related current GLASS activities:

- GLACE – Land/SM impact on precipitation and predictability (POC: Sonia/Bart; 1 and 2 complete; CMIP in progress)
- LoCo – Regional/Local Process-Level Quantification of land-PBL interactions and impact of land surface on precipitation (POC: Joe)
- ALMIP2 – Specific precipitation event studies and heterogeneity issues in soil moisture-precipitation feedbacks (POC: Aaron)
- PILDAS – Land DA of soil moisture; multi-variate coupled DA (precipitation and soil moisture) in a future phase (POC: Rolf)
- GSWP3 – Precipitation as a key forcing for 20th Century simulations – this effort should quantify the error bounds on the 'land reanalysis' generated due to precipitation uncertainty (POC: Hyungjun)
- Benchmarking – How does precipitation uncertainty impact offline and coupled model evaluation – spread of LSM physics vs. spread due to precipitation errors? (POC: Martin, Gab)

Future activities:

- Incorporation of new satellite products (GPM, SMOS, SMAP) into these efforts more explicitly.

Grand Science Question Number 2: How do changes in the land surface and hydrology influence past and future changes in water availability and security?

*Water Use, Resources, and Sustainability issues are at the heart of this challenge. How can GEWEX be positioned to meet this challenge given the current structure and makeup, currently focused on modeling groups and model intercomparisons with loose ties only (at best) with water resource and planning communities? Current activities are trying to answer various aspects of the science issues here (e.g., soil moisture and drought in a changing climate), but not yet at the stage of integrating the entire terrestrial water budget. GRACE is the only current tool we have in this regard, but is very limited in space and time scales such that regional and diurnal studies and models cannot be improved or assessed using this data set. Carbon, ecosystem, cryosphere, ground water, and distributed hydrology models are not traditionally GEWEX activities – but fully integrated Earth System and Land models are the future, so we need to be forward thinking. It seems this challenge is really the overarching challenge of all land hydrology for climate studies.

As a result, this challenge also intersects directly with other entities (iLEAPS, iLAMB, CLiC, DMIP, LULCC). This challenge might boil down to coordinating model development from previously disparate disciplines and applications, and based on CMIP5 results in terms of the limitations and sensitivities to the land hydrology (e.g. LUCID recent results). iLEAPS-GEWEX Newsletter collaboration will be a good start to this.

Related current GLASS activities:

- LUCID1/2 (POC: Andy)
- ALMIP1/2 (POC: Aaron)
- PILDAS/SMAP (DA of surface>root zone will be critical to link with GRACE)
- PILPS-Urban (POC: Martin)
- LULCC w/iLEAPS (POC: Bart)

Future activities:

- TRACE (now NAWP): The first workshop (2011) ended up discussing many of these water resource and sustainability questions as “themes” of a potential TRACE RHP. These questions are the ones that agencies seem most willing to support in the current climate, and communication from pure science/models to stakeholders is something we need to address.

Grand Science Question Number 3: How does a warming world affect climate extremes, and especially droughts, floods and heat waves, and how do land area processes, in particular, contribute?

*This seems to be the ”hot topic of the year,” e.g., how will the frequency and location of extremes change due to “x” amount of warming in the future? The NASA Energy and Water Cycle Study (NEWS) chose “Extremes” as one of its core integration projects, and could be looked at as a model both of what and what not do, and what can be learned by a limited subset of the community (material available online). Model evaluation and benchmarking becomes critical here as well. Most models are tested offline and only for average conditions, and once into extreme realms of forcing or states tend to behave much differently. Recent LSM calibration/parameter estimation studies suggest that a vastly different set of parameters (lookup tables) is required for extremes vs. average conditions. As observational data improves (e.g., Grand Science Question Number 1), this is no guarantee the models will behave better as a result. DA and Calibration studies should be a focus here. Calibration is a weak component of GLASS currently, and should be expanded under “Model Data Fusion.” You can learn a lot about model behavior and limitations that way, especially in concert with DA.

Related current GLASS activities:

- PILDAS – DA with calibration for improved soil moisture representation during extreme conditions

- LoCo – Quantification during extremes to get at model behavior & how LSMs impact the persistence of droughts/floods and feedbacks. Seasonal drought prediction needs a lot of improvement with the emphasis on the land impact (http://www.climatecentral.org/news/lack-of-warning-on-2012-us-drought-reflects-flaws-in-forecasting-14823/)
- ALMIP2 – Inherently encompasses dry extremes/feedbacks over AMMA with monsoon precipitation
- GLACE2-CMIP – Examining impact of SM on extremes in CMIP5 (IPCC report just out on the subject)
- Benchmarking – Should look at model performance stratified by regime

Future activities:

- CORDEX-GLASS collaboration possibly needs to a) exist and b) accelerate to answer these questions in the context of climate model predictions. This might be most feasible in conjunction with HyMeX over the next 5-10 years

Grand Science Question Number 4: How can understanding of the effects and uncertainties of water and energy exchanges in the current and changing climate be improved and conveyed?

*This seems to be the most traditional GEWEX-type challenge in that it promotes a lot of activities in the current Panels and relies on the strengths of the current makeup. What this challenge also shows is how much more work needs to be done in quantifying and improving water and energy cycle prediction in models of all scales and types. Results and improvements as a result are felt throughout the remaining three challenges, WCRP, and other communities as well. In order to close the land surface energy balance, we need to address all the issues and model evaluation and development listed in this challenge, and it will require SMOS/SMAP, GPM, GRACE, etc. to get right.

Related current GLASS activities:

- GSWP3 – Land reanalysis and sensitivity of surface fluxes to forcing uncertainties including radiation
- LoCo – Determining Processes; How are land and PBL fluxes quantified and interact with each other
- PILDAS – Constraining LSMs with observations for improved land surface energy balance
- Benchmarking – Asses land surface energy balance in models vs. empirical models, and evaluating the 'goodness' of a model prediction

Future activities:

- GLASS-GDAP – Improve connection between SRB, Landflux, and GLASS modeling and prediction and consistency between data products and models

Overall Comment:
*Having reviewed the GEWEX Grand Science Questions as a GLASS member, I was also trying to envision myself as a GABLS or GASS member. It seems their expertise lies most prominently

in Question Number 1, but that is focused on precipitation only. What about all their work on other things like the stable PBL? Otherwise, they are mostly implicit amongst challenges, the majority of which are quantified at the land surface.

Key Science Questions for the Next 5-10 Years

- The impact of the land surface, soil moisture and vegetation, and L-A coupling on Seasonal/Drought Prediction
- A common modular interface for LSMs, such that different models and components can be more easily transferred to other's platforms, intercompared, and swapped. This would also include a common land-atmosphere coupling modularity such that different atmospheric and land models can be intercompared in order to evaluate the impact of each on the coupling results.

GLASS Activities Contributing to the WCRP Grand Challenges

- GC1: Provision of skillful future climate information on regional scales (includes decadal and polar predictability)
  GLASS Activities
  - GSWP3, ALMIP2
  - Benchmarking (defining skillful), MDF (improved prediction and skill), and LAC (process-level improvement in L-A coupling)
- GC2: Regional sea-level rise
  GLASS Activities
  - None
- GC3: Cryosphere response to climate change (including ice sheets, water resources, permafrost, and carbon)
  GLASS Activities
  - Possible links to GABLS4 experiment and stable PBL coupling
- GC4: Improved understanding of the interactions of clouds, aerosols, precipitation, and radiation and their contributions to climate sensitivity
  GLASS Activities
  - None direct, but L-A Coupling theme addressing the soil moisture-precipitation feedbacks.
- GC5: Past and future changes in water availability (with connections to water security and hydrological cycle)
  GLASS Activities
  - GSWP3, GLACE (CMIP), and GPM/GRACE/SMOS/SMAP synergy
  - LAC (process-level improvement in water and energy cycle feedbacks)
- GC6: Science underpinning the prediction and attribution of extreme events
  GLASS Activities
  - See above with respect to GEWEX Challenge #3 (strongest contribution from GLASS is here?)
  - Benchmarking (model goodness during extreme conditions), MDF (data assimilation and model calibration during extremes), and LAC (improvements in coupling leading to improved predictability of extreme events from local to global scales)

Cooperation with other WCRP Projects, Outside Bodies, and Links to Applications

1) A connection to CliC has been proposed through the GABLS Stable PBL Project over the arctic region. A suitable GLASS representative for both cold processes and stable PBLs has yet to be identified, however.

2) GLASS and iLEAPS are collaborating on a joint newsletter (to be produced by iLEAPS but equally weighted between GLASS and iLEAPS contributions. The iLEAPS IPO is very happy to hear that we all agreed to contribute to the next iLEAPS Newsletter, "Bridging the gap between the iLEAPS and GEWEX land-surface modeling communities." The deadline for original submissions is 31 October 2012. The newsletter will include the following:

- Editorial (Gordon Bonan and Joe Santanello as GLASS co-chair)
- NWP-perspective (Mike Ek, NOAA/NCEP)
- ESM-perspective (Nathalie de Noblet, LSCE)
- JULES joint perspective (Martin Best, Chris Jones, UK Met Office)
- CLM joint perspective (Dave Lawrence, Rosie Fisher, NCAR)
- Model benchmarking (Eleanor Blyth, Dave Lawrence)

Issues for the SSG

GHP involvement and data for the Benchmarking/PALS project has been very slow in coming together. Gab has acquired FluxNet data on his own, but we are awaiting a higher QC set of data from 10-20 sites (formerly CEOP) to participate in the pilot study of PALS. This slow progress has not been from a lack of trying, side meetings, telecons, or email exchanges with GHP (and help from Sam) and we are hopeful that finally this effort will come to fruition in the next 6-12 months.

The ALMIP2 leads reached out multiple times to GHP as well for feedback on the white paper/proposal before the project launched earlier this year. There was some limited response by GHP and feedback for Aaron, but were hopeful for a more tangible collaboration in this regard.

In response to an earlier SSG request, we have reached out to HyMeX and now have a GLASS representative (Aaron) who attended the HyMeX workshop in Croatia in May 2012. Likewise, HyMeX has provided a representative (Pere) who will attend GLASS meetings in the future. There are many "land activities" as part of HyMeX, and the length and design of the study make it essential that GLASS at least monitor the modeling activities therein. In addition, the HyMeX-CORDEX connection is something GLASS can look to as we attempt to strengthen the land component of CORDEX going forward (to date non-existant).

The idea of a "Land Conference" has been loosely proposed by GLASS. This would be similar to Pan-GASS Meeting, but for the land modeling community, and would be open to land data assimilation, carbon, and distributed modeling communities as well. The timetable would be 2013-2014 and a host/venue would need to be acquired. The idea of Santa Fe, New Mexico was proposed (and likely US-host given funding limitations in Europe). We would coordinate with iLEAPS as well, but not to an extent that the iLEAPS Science Conference would be in conflict. The upcoming GEWEX-iLEAPS joint newsletter (Winter 2013) co-edited by Bonan and Santanello is an ideal opportunity to pursue this idea further.

List of Key Publications

<u>PALS</u>

- Abramowitz, G., 2012. Towards a public, standardized, diagnostic benchmarking system for land surface models, *Geoscientific Model Development*, 5, 819-827, doi:10.5194/gmd-5-819-2012.

- Kumar, S.V., C.D. Peters-Lidard, J.A. Santanello, K.W. Harrison, Y. Liu, and M. Shaw, 2012. Land surface Verification Toolkit (LVT) - A generalized framework for land surface model evaluation. *Geosci. Model Development,* **in press.**

LoCo

- Santanello, J.A., C. D. Peters-Lidard, and S.V. Kumar, 2011. Diagnosing the Sensitivity of Local Land–Atmosphere Coupling via the Soil Moisture–Boundary Layer Interaction. *J. Hydrometeor*, **12,** 766–786.
- Santanello, J.A., C. Peters-Lidard, A. Kennedy, and S. Kumar, 2012. Diagnosing the Nature of Land-Atmosphere Coupling During the 2006-7 Dry/Wet Extremes in the U.S. Southern Great Plains. *J. Hydromet.,* **in press.**

GEWEX-GLASS

- Hurk, B.J.J.M, M. Best, P. Dirmeyer, A. Pitman, J. Polcher, J.A. Santanello, 2011. Acceleration of Land Surface Model Development over a Decade of Glass. *Bull. Amer. Meteor. Soc.*, **92,** 1593–1600.

List of Panel Members and Term Dates

The GLASS Terms of Reference have been presented at the Panel meetings in 2011 and 2012, and have since been ratified by the GEWEX SSG. These TORs include term limits on chairs of 4 years, staggered in 2-year intervals for continuity of leadership. Two main categories of Panel members have been established and without term limits: Experienced Scientists (including project leads) and Young Scientists, as well as a protocol for new members of each category that they attend the next panel meeting and establish their interest and relevance to the panel activities. Template letters signed by GEWEX/Kevin Trenberth have also been developed to welcome new panel members and to thank departing members for their service.

Martin Best (Co-chair through 31 Dec 2012)
Joe Santanello (Co-chair through 31 Dec 2014)
Aaron Boone (Co-chair beginning 1 Jan 2013)
Michael Ek
Hyungjun Kim
Rolf Reichle
Paul Dirmeyer
Eleanor Blyth
Andy Pitman
Bart vd Hurk
Gianpaolo Balsamo
Matt Rodell
Christa Peters-Lidard
Patricia de Rosnay
Sonia Seneviratne
Gab Abramowitz
Craig Ferguson (*New YS)
Nathan Brunsell (*New ES)
Lifeng Luo (*New ES)
Fei Chen (*New ES)
Pierre Gentine (*New YS)
Tomo Yamada (*New YS)

3.4 Global Atmospheric System Studies (GASS) Panel

Starting Date: GCSS and GABLS combined at the end of 2010 to form GASS
URL: *http://gewex.org/gass_panel.html*
Chair(s) and Term Dates:
Jon Petch (ends March 2014)
Steve Klein (ends March 2015)

Panel Activities

GASS facilitates and supports the community that carries out and uses observations, process studies, and numerical model experiments with a focused goal of developing and improving the representation of the atmosphere in weather and climate models. It aims to address this primarily through the coordination of scientific projects that bring together experts from around the world to contribute to the development of atmospheric models. GASS primarily oversees intercomparison projects based upon observational field campaigns or more idealized studies that typically take 2-5 years from initiation to completion with publication of the results. In the past year the primary activity was the planning, organization, and execution of the 1st Pan-GASS Meeting.

New Projects in Place

GASS has 11 current and planned projects; one project was completed in the past year. Newer projects of note include:

- Collaboration with GLASS on land-atmosphere interactions
- Examination of interactions of moist processes parameterizations with the large-scale circulation under the Weak-Temperature Gradient approximation. This effort will be joint with WGCM and the European Union Cloud Intercomparison, Process Study & Evaluation Project (EUCLIPSE)
- The Grey-Zone intercomparison project will examine how models parameterize convective processes when the model horizontal resolution only partially permits convective clouds to be simulated (2-10 km range)

For more detail on these and all of the GASS projects, see the supplemental material to this report.

Contributions to GEWEX Grand Science Questions and WCRP Grand Challenges

GASS is currently planning to be an active participant under the WGCM-led Clouds and Climate Sensitivity Grand Challenge project. There are numerous ways in which GASS will be an active participant as current (Low-Cloud Feedbacks) and new (the Weak Temperature Gradient) projects will make significant contributions to identified research challenges listed in the white paper for this Grand Challenge. The Grey Zone and Microphysics projects are also expected to play a role in this Grand Challenge.

GASS is the key group internationally that support the coordination of work to improve our understanding and representation of physical processes in the atmosphere – this directly leads to improvements of weather and climate prediction systems. Therefore GASS activities are a critical underpinning component of all the GEWEX Grand Science Questions. GASS projects can be indirectly linked to specific GCs. For example, the current project involving the analysis of the simulation of the MJO by models is related to predictions of precipitation. Also the cloud microphysics project is related as it studies the microphysical

evolution of clouds including the precipitation formation process. However, these links are not the critical drivers of these projects and GASS plans to continue to focus their energies on the key underpinning activities of improving the representation of atmospheric processes in weather and climate models. Indeed, we are confident that if models improve their simulations of the key processes we study, then the specific phenomena listed in the Grand Science Questions will markedly improve.

Workshops/Meetings Planned

GASS held the 1st Pan-GASS Science Conference on 10-14 September 2012 in Boulder, CO. Attendance was around 220, including those who came for the simultaneous meeting of the GEWEX Land-Atmosphere System Studies (GLASS) Panel. At the Pan-GASS meeting, all GASS projects were discussed in afternoon breakout sessions that followed the morning plenary presentations. For this meeting about $49,000 was raised to support student travel expenses; organizations that contributed funds to this purpose included WCRP, NASA, NOAA, DOE, and NSF. The National Center for Atmospheric Research (NCAR) is thanked for providing the meeting space and the time of administrative assistants to organize the meeting. The GEWEX project office is also thanked for their support of this meeting with its help in website support and the lobbying of WCRP for travel funding.

No current meetings are planned for the next year; more likely individual projects may have meetings in conjunction with other planned meetings. The next pan-GASS meeting will be held in three years (2015).

Cooperation with other WCRP Projects, Outside Bodies, and Links to Applications

GASS maintains various interactions with other bodies. These include:

- The vertical structure and diabatic heating of the MJO project is conducted jointly between GASS and the WCRP-WWRP MJO task force
- GASS is supervised in part by WGNE and presents reports to the annual WGNE meetings
- The Low-Cloud Feedbacks project (CGILS) has been conducted jointly with the Cloud Feedback Model Intercomparison Project (CFMIP) project of WGCM
- A GASS Scientific Steering Committee (SSC) member, Gunilla Svensson, has been attending the meetings associated with the new polar project initiatives of WWRP and WCRP
- Steve Woolnough represents GASS on the joint WWRP/WCRP seasonal prediction project

Key Publications

Please see the list of publications provided in the progress reports of the individual projects below.

GASS Science Steering Committee (SSC)

GASS is managed by its SSC, which holds a conference call usually every 4-8 weeks. Each project has a GASS SSC member as a sponsor and typically at least one project lead who may not be part of the SSC. Current members of the SSC include: Chris Bretherton, Ann Fridlind, Christian Jakob, Adrian Lock, Hugh Morrison, Robert Pincus, Pier Siebesma, Gunilla Svensson, and Steve Woolnough. There is not a formal term length for the membership of SSC, although it is felt that 4 years is a good length to review member's contributions. In the past year, Bjorn Stevens stepped down from the SSC.

Archiving Needs

GASS continues to have a requirement for a resource to archive its project data. This will need IT equipment to deliver data over the Internet and human resources to do the work in gathering and

documenting the cases. This has in the past been done at an ad-hoc level for the working groups (to a mixed level), but as we have moved away from having working groups there is now no system to ensure our valuable case studies are easily available to the community.

Supplemental Material: Progress Reports of GASS Projects

The following pages present progress reports for activities in the reporting period involving planned, current, and recently completed projects. The projects reported on include:

- Stable Boundary Layers
- Weak Temperature Gradient
- Grey-Zone
- Microphysical Modeling
- Low Cloud Feedbacks (CGILS)
- Land-Atmosphere Interactions
- Radiative Processes in Observations and Models
- Mid-latitude Cirrus
- Polar Clouds
- Stratocumulus-to-Cumulus Transition
- Vertical Structure and Diabatic Processes of the MJO
- Convective Systems: Tropical Warm Pool - International Cloud Experiment (TWP-ICE)

3.4.1 Stable Boundary Layers Projects

SSC Sponsor: Gunilla Svensson
Project Leads: Gunilla Svensson and Bert Holtslag
Project Status: Mature (for GABLS3), Early (for GABLS4)

Accomplishments

The third GABLS intercomparison is based on a case selected in Cabauw, the Netherlands, with the aim to study the model's performance for low level jet (LLJ) development, morning and evening transitions, and surface-atmosphere coupling. The intercomparison consists of a single column model (SCM) and a large eddy simulation (LES) case coordinated by Fred Bosveld and Sukanta Basu, respectively. The latter is focusing on a shorter time span than the SCM. Two papers on the SCM case have been submitted to *Boundary-Layer Meteorology*. The LES case focusing on the morning transition is also in the writing phase. Main findings from these studies are that the LES is able to capture the transition fairly well after considerable effort was put on the case setup. The SCM results show large variability and strong sensitivity to the forcing provided and the results are analyzed using a method which allows the interpretation of differences among models in terms of the dominating physical processes in the stable boundary layer, i.e. coupling to the soil, turbulent mixing, and long wave radiation. Substantial differences among models are found in the representation of these three processes.

Activities for Next 1-2 Years

A new model intercomparison case with even stronger stability than had been the case in the previous studies was discussed and is being prepared by a small group formed at the workshop in November. The case is based on Antarctic data and some preliminary regional modeling has already been performed by the project lead Timo Vihma. The proposition has been presented and discussed at two meetings during summer 2012, the American Meteorological Society (AMS) Symposium on Boundary Layer Turbulence

(BLT) and the Pan-GASS meetings, and further investigations will be done before releasing the case as an intercomparison study, possibly during spring 2013.

Other activities include involvement in the land-atmosphere interactions project (see this report) and a proposed intercomparison study for mixing of tracers in boundary layers, likely based on already documented cases as well as new, more-idealized ones where both the LES and SCM communities will likely be involved.

List of Key Publications

ECMWF, Reading, UK. Workshop report, 2012. Available at: *http://www.ecmwf.int/publications/library/do/references/list/201111*.

Basu, S., et al., 2012. GABLS Intercomparison of Large-Eddy Simulation models with Cabauw observations. In preparation for *Boundary Layer Meteorology*.

Bosveld, F.C., P. Baas, E. van Meijgaard, E.I.F. De Bruijn, G.-J. Steeneveld, and A.A.M. Holtslag, 2012. The third GABLS intercomparison case for model evaluation, part A: Case Selection and Set-up. Submitted to *Boundary Layer Meteorology*.

Bosveld, F.C., P. Baas, G.-J. Steeneveld, and A.A.M. Holtslag et al., 2012. The third GABLS intercomparison case for model evaluation, part B: Single Column Model results and Process Understanding. Submitted to *Boundary Layer Meteorology*.

Holtslag, A.A.M., G. Svensson, P. Baas, S. Basu, B. Beare, A.C.M. Beljaars, F.C. Bosveld, J. Cuxart, J. Lindvall, G.J. Steeneveld, M. Tjernström, and B.J.H. Van De Wiel, 2012. Diurnal cycles of temperature and wind – A challenge for weather and climate models. Submitted to *Bulletin of the American Meteorological Society*.

List of Meetings

A workshop was held together with ECMWF at their premises in Reading, UK, 5-8 November 2011. The workshop, titled "Diurnal cycles and the stable atmospheric boundary layer," attracted about 60 participants from Europe and other parts of the world, such as Japan, North and South America, and Australia. Conclusions and recommendations are found in the workshop report and new studies are initialized and a result of that.

Planned Meetings, Workshops

The aim is to release the Antarctic case such that a first workshop on the results can be held during 2013, likewise with the tracer study.

3.4.2 Weak Temperature Gradient

SSC Sponsor: Steve Woolnough
Project Leads: Steve Woolnough, Adam Sobel, Sharon Sessions
Project Status: Formation

Accomplishments

During summer 2012, discussion began between the project leads on a proposal for a GASS-sponsored project on methods of representing the interaction between convection and the large-scale dynamics in process models through parameterizations of the large-scale circulation. This led to a breakout session at the Pan-GASS meeting in Boulder, September 2012 at which the proposal was discussed and a draft project specification was developed.

Activities for Next 1-2 Years

During the next 6 months, the project specification will be finalized and an invitation to participate advertised. The project is expected to start in spring 2013 with analysis beginning in late summer 2013.

List of Key Publications

There are no publications in print or preparation.

List of Meetings

A small breakout discussion occurred during the Pan-GASS meeting in September 2012, but no formal meetings were held.

Planned Meetings, Workshops

The following meetings have been proposed:

- Kick-off meeting in spring 2013
- Likely meeting in autumn/winder 2013-14 to discuss initial analysis

3.4.3 Grey Zone Project

SSC Sponsor: Pier Siebesma
Project Committee: Pier Siebesma, Andy Brown, Christian Jakob, and Jeanette Onvlee
Case Leaders: Paul Field, Adrian Hill, Stephan de Roode, Pier Siebesma, Verena Grutzun, and Axel Seifert
Project Status: Early

Accomplishments

WGNE has recently expressed the need to organize a systematic evaluation project of atmospheric models that operate in the so-called Grey Zone Resolution range of 1~10 km. As a response, a Grey Zone Project has been established and the project committee has performed a survey and came to the conclusion that (especially from the mesoscale model community) there was a strong preference to select a cold air outbreak as a first intercomparison study for the Grey Zone Project.

The case leaders have worked over the last 12 months to set up a cases for a full hierarchy of models (global, LAM, and LES) based on observations from the CONSTRAIN experiment during which a classic cold air outbreak over the North Sea north of Great Britain was observed. Realistic high-resolution simulations with the correct classic spatial mesoscale features with two independent LES models have been produced.

As a result the case will be released early October after the Max-Planck Institute (MPI) Hamburg group has come up with an output list for the global model experiments.

Activities for Next 1-2 Years

The following activities are planned for this project:

- October 2012: Release of the Cold Air Outbreak as a first part of the Grey Zone
- Early 2013: Deadline for submission of model results
- Late 2013: Workshop on intercomparison results

List of Key Publications

There are no publications in print or preparation.

List of Meetings

No meetings were organized over the period of this report.

Planned Meetings, Workshops

A meeting is envisioned to occur in Late 2013 to discuss the results of the first cold air outbreak intercomparison, possibly in conjunction with another GASS meeting.

3.4.4 Microphysics

SSC Sponsor: Hugh Morrison
Project Leads: Ben Shipway, Adrian Hill
Project Status: Mature

Accomplishments

The 2-dimensional Kinematic Driver (2D-KiD) model was released in this period (http://appconv.metoffice.com/microphysics). It provides both 1D or 2D kinematic cases. The KiD model was documented in a publication in the Quarterly Journal of the Royal Meteorological Society (see below). Other publications using KiD are listed at http://appconv.metoffice.com/microphysics/publications.shtml.

Activities for Next 1-2 Years

An intercomparison of warm rain microphysics using the 2D-KiD will be organized and conducted. The differences between models of differing complexity will be investigated. This activity will be combined into a joint activity with the Cloud Modeling Workshop aerosol processing case. A publication for this work will be written in the next year.

List of Key Publications

Bretherton, C., A. Fridlind, H. Morrison, and B. Shipway, 2010. GCSS workshop on microphysics and polar/precipitating clouds. *GEWEX News*, 20, no. 4, 17-19.

Shipway, B.J., and A.A. Hill, 2012. Diagnosis of systematic differences between multiple parameterizations of warm rain microphysics using a kinematic framework. *Q.J.R. Meteorol. Soc*.. doi: 10.1002/qj.1913.

Shipway, B.J., and A.A. Hill, 2011. The Kinematic Driver model (KiD). Met Office Technical Report No. 549.

List of Meetings

Participants working on this project met at the Cloud Modelling Workshop (CMW) in Warsaw, 2012.

Planned Meetings, Workshops

No meetings are currently planned.

3.4.5 CFMIP-GASS Intercomparison of LES and SCMs (CGILS): Low Cloud Feedbacks

SSC Sponsor: Chris Bretherton and Adrian Lock
Project Leads: Minghua Zhang, Peter Blossey, and Chris Bretherton
Project Status: Mature

Accomplishments

CGILS was formulated in 2008 to help understand physical mechanisms of low cloud feedback in climate models, and why these feedbacks differ substantially across models. The strategy has been to use an observationally-grounded column modeling framework to intercompare subtropical marine boundary layer cloud response to idealized climate changes between different LES and SCMs, based on three GCSS Pacific Cross-Section Intercomparison (GPCI) locations with representative summer cloud regimes: S12 (well-mixed Sc), S11 (Cu under Sc), and S6 (trade cumulus). The climate perturbation ('P2S') studied in the Phase 1 of CGILS was a 2 K SST increase, a corresponding moist-adiabatic increase of free tropospheric temperature, and an 11% decrease in mean subsidence. After some iteration, 15 SCMs (representing single-column versions of many of the world's leading climate models) and 6 LESs submitted final results, described in a set of papers submitted in July 2012. For the S12 case, the LESes ran a variation 'P2' on the climate perturbation with no subsidence change, and one LES also considered other climate perturbations.

The cloud response of the SCMs scattered widely between each other and away from their parent GCMs. Because of the smallness of the climate perturbation and the use of steady forcings, the SCMs responses were distorted by locking of cloud features to discrete grid levels. In general, models and cases with active shallow cumulus parameterizations tended to show positive cloud feedbacks. After harmonization of the radiation and surface flux schemes, the LES models produced more similar responses. Without subsidence, all LESes showed cloud thinning in the warmer climate, but reduced subsidence counteracted this to varying degrees in the different models. Thus LES suggested that the overall cloud feedback is the net result of multiple compensating cloud responses. In the shallow cumulus case, the LES equilibrium cloud-layer depth was also sensitive to microphysics.

Activities for Next 1-2 Years

The next 1-2 years, comprising Phase 2 of CGILS, will focus on two main activities, to be organized by the current leaders of CGILS. The first activity is designed to help interpret and support GCM simulations of rapid adjustment to a step CO_2 increase. All participating SCM and LES models will conduct a sensitivity experiment to quadrupling CO_2 with no change in surface or free-tropospheric temperature, using the same protocol as in Phase 1.

The second activity is to run all SCMs and LESes forced by realistically time-varying forcings extracted from ECMWF analysis that reflect natural synoptic variability at the S6 (trade Cu) location, not with the steady climatological forcing used in Phase 1. The goal is to make a better connection between the column modeling results and global simulations and observed climatology, and to see how the transient variability affects simulated cloud feedbacks. The S6 location was chosen because the cloud layer is deeper and the required LES resolution is coarser than at the other CGILS points, lessening the issues of vertical under-resolution and grid locking (for SCMs) and overwhelming computational expense (for LES). A pilot SCM-only version of this activity was carried out by some SCMs in phase 1, but only with transient vertical motion, not fully realistic forcings. Brient and Bony (2012) showed the value of a modified version of this CGILS case for interpreting global cloud feedbacks in a French GCM.

Lastly, Pier Siebesma and Sara Del Gasso of the Royal Netherlands Meteorological Institute (KNMI) encouraged interested CGILS participants to participate a 'parameter space' sensitivity study of SCM/LES simulations of an idealized steadily-forced marine boundary layer to the inversion jumps of temperature and humidity. For now, this will be regarded as a EUCLIPSE activity, but it may later be revisited as a possible GASS or CGILS project.

List of Key Publications

Bretherton, C. S., P.N. Blossey, and C.R. Jones, 2012. Mechanisms of marine low cloud sensitivity to idealized climate perturbations: A single-LES exploration extending the CGILS cases. Submitted to Journal of Advances in Modeling Earth Systems.

Brient, F., and S. Bony, 2012. Interpretation of the positive low-cloud feedback predicted by a climate model under global warming. *Clim. Dyn*., doi:10.1007/s00382-011-1279-7.

Blossey, P.N., C.S. Bretherton, M. Zhang, A. Cheng, S. Endo, T. Heus, Y. Liu, A. Lock, S.R. de Roode, and K.-M. Xu, 2012. Marine low cloud sensitivity to an idealized climate change: The CGILS LES Intercomparison. Submitted to *Journal of Advances in Modeling Earth Systems.*

Zhang, M. and 39 co-authors, 2012. CGILS: First Results from an International Project to Understand the Physical Mechanisms of Low Cloud Feedbacks in General Circulation Models. Submitted to *Bulletin of the American Meteorological Society.*

Zhang, M., C.S. Bretherton, P.N. Blossey, Sandrine Bony, Florent Brient, and Jean-Christophe Golaz, 2012. The CGILS Experimental Design to Investigate Low Cloud Feedbacks in General Circulation Models by Using Single-Column and Large-Eddy Simulation Models. *J. Adv. Model. Earth Syst.*, submitted 07/2012.

List of Meetings

Afternoon breakout at the 1st Pan-GASS meeting, Boulder, CO, USA, September 2012

Planned Meetings, Workshops

Joint EUCLIPSE/CFMIP meeting to be held at MPI, Hamburg, Germany, June 2013

3.4.6 Land-Atmosphere Interactions (Joint with GLASS)

SSC Sponsor: Adrian Lock
Project Leads: Martin Best and Adrian Lock
Project Status: Early

Accomplishments

This project grew out of the GABLS/ECMWF workshop in November 2011, where there was a consensus that the atmospheric boundary layer and land surface communities needed to work more closely together. At the Pan-GASS meeting in September 2012, it was proposed to initiate a joint GASS/GLASS project on a clear-sky diurnal cycle case study, from the same observational campaign as was used for GABLS2. The period chosen consists of three full diurnal cycles covering a range of different stable boundary layer regimes. The intercomparison would, initially, have three components. Land surface models would be run forced by observed atmospheric variables, PBL models would be run forced by observed surface fluxes and stress, and finally the two models would be run coupled. Additionally, initial profiles of soil moisture and temperature will be generated by multi-year runs of the land surface model to ensure these are in balance for each model. Overall this project should both promote greater understanding of each model's strengths and weaknesses and also help quantify the importance of coupling the two systems together.

Activities for Next 1-2 Years

The following activities are envisioned for this project:

- Develop case specifications and release to the community by the end of 2012.

List of Key Publications

There are no publications in print or preparation.

List of Meetings

The timing and location of a workshop to discuss the results is still to be decided.

3.4.7 Radiative Processes in Observations and Models

SSC Sponsors: Lazaros Oreopoulos and Robert Pincus
Project Leads: Lazaros Oreopoulos, Robert Pincus, and Eli Mlawer
Project Status: Early

Accomplishments

This project is new within GASS. It is envisioned as an outgrowth/extension/expansion of the Continual Intercomparison of Radiation Codes (CIRC) Project, which also resides in GDAP. CIRC's main accomplishment during the reporting period was the wrap-up of Phase I activities that culminated in the publication of a paper in *Journal of Geophysical Research: Atmospheres*.

Activities for Next 1-2 Years

The following activities are envisioned for GASS efforts in radiation:

- Develop the next suite of cases for CIRC Phase II with possibly greater emphasis on heating rates.
- Collaborate with the "Stable Boundary Layer Project" to investigate discrepancies between measured and modeled downwelling thermal infrared fluxes.
- Collaborate with the "Cirrus Project" to evaluate cirrus-modulated surface radiation fluxes in the modeling intercomparison built around Small Particles In Cirrus (SPARTICUS) Atmospheric Radiation Measurement (ARM) Southern Great Plains (SGP) flights.
- Assess current ability of radiative transfer codes and required future steps towards incorporating the radiative effects of precipitating particles at solar and thermal IR wavelengths.

List of Key Publications

Oreopoulos, L., et al., 2012. The Continual Intercomparison of Radiation Codes: Results from Phase I. *J. Geophys. Res.*, 117, D06118, doi:10.1029/2011JD016821.

List of Meetings

No meetings were organized over the period of this report.

Planned Meetings, Workshops

No meetings are currently planned.

3.4.8 Mid-Latitude Cirrus

SSC Sponsors: Hugh Morrison
Project Leads: Andreas Muhlbauer and Thomas Ackerman
Project Status: Early

Accomplishments

Initiation of the cirrus model intercomparison project based on a case study from the US Department of Energy (DOE) Small Particles in Cirrus (SPARTICUS) field campaign. The objective of this case study is to investigate the microphysical and macrophysical evolution and life cycle of a deep-wave cirrus observed over the ARM Southern Great Plains (SGP) site in Oklahoma and to compare simulated cirrus cloud properties and radiative effects among models and with observations. Special emphasis is on the contribution of small ice crystals in cirrus and the role of homogeneous and heterogeneous ice nucleation. Simulations are compared and evaluated with in situ aircraft observations and with various ground-based and space-borne remote sensors. This project specifically targets cloud-system resolving (CSRM) models, cloud-resolving (CRM) models, large eddy simulation (LES) models and single column models (SCM) with advanced cloud microphysics schemes such as multi-moment bulk microphysics parameterizations or bin microphysics schemes. A detailed description of the project can be found at http://www.atmos.washington.edu/~andreasm/case3_midlatitude_cirrus/case3_midlatitude_cirrus.html.

Activities for Next 1-2 Years

The following activities are envisioned:

- Finalize case setup and logistics for participating models.
- Analyze model results, focusing on cirrus macrophysical and microphysical properties through detailed intercomparison of models and comparison of models with in-situ and remotely sensed observations.
- Draft a paper detailing results from the model intercomparison.

List of Key Publications

Muhlbauer, A., W.W. Grabowski, S.P. Malinowski, T.P. Ackerman, G. Bryan, Z. Lebo, J.A. Milbrandt, H. Morrison, M. Ovchinnikov, S. Tessendorf, J.M. Theriault, and G. Thompson, 2012. Eighth International Cloud Modeling Workshop Meeting Summary. Submitted to *Bulletin of the American Meteorological Society.*

Muhlbauer, A., T.P. Ackerman, J.M. Comstock, M. Deng, G. Diskin, and P. Lawson, 2012. An observationally-based case of mid-latitude cirrus for cloud-permitting and cloud-resolving models. *Geoscientific Model Development,* in preparation.

List of Meetings

- Introduction of the project during the MACPEX/SPARTICUS Science Team Meeting. Salt Lake City, UT, USA, January 2012
- Discussion of the project at a breakout meeting on cirrus, where the case was introduced during the US DOE ASR Science Team Meeting. Arlington, VA, USA, March 2012
- Breakout session devoted to the cirrus intercomparison project, International Cloud Modeling Workshop. Warsaw, Poland, July 2012

- Breakout session on cirrus clouds centered around the intercomparison project including preliminary results, 1st Pan-GASS Conference. Boulder, CO, USA, September 2012

3.4.9 Polar Cloud

SSC Sponsors: Ann Fridlind
Project Leads: Mikhail Ovtchinnikov
Project Status: Early/Mature

Accomplishments

The Indirect and Semi-Direct Aerosol Campaign (ISDAC) intercomparison project for Arctic mixed-phase boundary layer clouds has been initiated:

- A case description has been finalized and released (https://engineering.arm.gov/~mikhail/ISDAC_F31.html)
- This case is a follow up to previous Mixed-Phase Arctic Cloud Experiment (M-PACE) and Surface Heat Budget of Arctic Ocean (SHEBA) intercomparisons, but under different conditions and more constrained model setup
- The case is conducted jointly with the US DOE Atmospheric System Research Program (ASR) and 2012 International Cloud Modeling Workshop (CMW)

Activities for Next 1-2 Years

The following activities are envisioned:

- Complete analysis of submitted simulations
- Focus on attribution of inter-model differences to variations in the treatment of microphysics and dynamics

List of Key Publications

Muhlbauer, A., W.W. Grabowski, S.P. Malinowski, T. P. Ackerman, G. Bryan, Z. Lebo, J. A. Milbrandt, H. Morrison, M. Ovchinnikov, S. Tessendorf, J.M. Theriault, and G. Thompson, 2012. Eighth International Cloud Modeling Workshop Meeting Summary. Submitted to the Bulletin of the American Meteorological Society.

List of Meetings

The following meetings have been held for this project:

- ASR Science Team Meeting (March 2012, Arlington, VA, USA); at a breakout session on Arctic Clouds the ISDAC intercomparison case was introduced and preliminary results were discussed
- 2012 International Cloud Modeling Workshop (July 2012 in Warsaw, Poland); a breakout session devoted to the ISDAC intercomparison case
- 1st Pan-GASS conference (September 2012, Boulder, CO, USA); a breakout session on Polar Clouds included presentations on and discussion of the ISDAC intercomparison

3.4.10 Stratocumulus-to-Cumulus Transition

SSC Sponsor: Adrian Lock
Project Leads: Stephan de Roode, Irina Sandu, and Roel Neggers
Project Status: Mature

Accomplishments

This project studies the stratocumulus to trade cumulus transition, one that is of climatological importance for understanding low cloud cover variations in the marine subtropics. There are two parallel LES intercomparisons as well as SCM intercomparisons. These intercomparisons are being run in collaboration with a European project, EUCLIPSE. In combination, these cases challenge models to produce both a realistic transition compared to detailed in situ data and also a realistic sensitivity of the speed of transition to changes in environmental forcing. Results so far suggest the LES do a good job of capturing these details, although requiring very high (5m) vertical resolution. One of the motivations for this intercomparison was that these transitions would present a particular challenge for SCMs, many of which would need to make the transition between different parameterizations of vertical mixing. Although many SCMs do indeed struggle to generate realistic transitions, it is encouraging that those organizations that have worked hard to develop these aspects of physical parameterizations (invariably using previous GCSS intercomparison cases) can do a much better job. Further work is investigating the difference between forcing the SCM with mean forcing compared to running an ensemble of SCM and taking the mean. Papers are in preparation describing these studies in much more detail.

Activities for Next 1-2 Years

Writing of papers for the project will take place in the next year.

List of Key Publications

De Roode, S.R., et al. 2012. LES Results of the GASS-EUCLIPSE Lagrangian Stratocumulus to Shallow Cumulus Transition Cases. *AMS-BLT Conference*, https://ams.confex.com/ams/20BLT18AirSea/webprogram/Manuscript/Paper208663/intercomparison_lags.pdf.

Lock, A.P., 2011. GCSS/CFMIP/EUCLIPSE Meeting on Cloud Processes and Climate Feedbacks. *GEWEX News*, August 2011.

List of Meetings

The following meetings have been held for this project:

- Joint workshop with EUCLIPSE on the Transition and CGILS cases held at KNMI, deBilt, Netherlands, September 2010
- Joint meeting with CFMIP and EUCLIPSE including further discussions on the Transition and CGILS cases held at the Met Office, Exeter, Devon, UK, June 2011
- Some discussion of progress alongside an otherwise EUCLIPSE-only meeting at MeteoFrance Toulouse, France, April 2012
- Discussion of project at the 1st Pan-GASS meeting, Boulder, CO, USA, September 2012

3.4.11 Vertical Structure and Diabatic Processes of the MJO

SSC Sponsors: Jon Petch and Steve Woolnough
Project Leads: Jon Petch, Duane Waliser, Prince Xavier, Nick Klingaman, Xianan Jiang, and Steve Woolnough
Project Status: Early

Accomplishments

This project is studying the vertical structure of diabatic process in the MJO in global models and its relationship to MJO simulation fidelity using three sets of model integrations: 20-year climate simulations; 2-day hindcasts from two Year of Tropical Convection (YOTC) MJO cases (E&F), and 20-day hindcasts of the same events. Over the spring/summer of 2012, data submissions for one or more components of the project were received from 23 modeling centers. Preliminary analysis of these models was presented at the Pan-GASS meeting in Boulder during September 2012. At that meeting, the decision was made to request centers to perform an additional set of hindcasts for the November 2011 MJO observed during the Cooperative Indian Ocean experiment on intraseasonal variability in the Year 2011 (CINDY)/Dynamics of the Madden-Julian Oscillation (DYNAMO) campaign, with details forthcoming following additional analysis of the YOTC case and considerations of keeping/altering the experimental framework.

This project is conducted jointly between GASS and the WCRP-WWRP MJO task force.

Activities for Next 1-2 Years

Activities involve continued analysis of the three components of the experiment focusing on the diabatic tendencies and their relationship to MJO simulation, including the relationships between forecast skill, climate simulations, and details of physical processes and representation. The following activities are envisioned for this project:

- Deadline for submission of model output in time for inclusion in the initial papers is December 2012
- Request for CINDY/DYNAMO hindcasts to be performed will take place in January 2013 with deadline approximately 6 months later
- Draft papers on each component and model output will be made publicly available by June 2013
- Synthesis paper and recommendations for future process study will be available in autumn 2013

List of Key Publications

Petch, Jon, Duane Waliser, Xianan Jiang, Prince Xavier, and Steve Woolnough, 2011. A Global Model Intercomparison of the Physical Processes Associated with the Madden-Julian Oscillation. *GEWEX News*, 21, 3-5.

List of Meetings

1st Pan-GASS meeting in Boulder, CO, in September 2012, where preliminary results were discussed

Planned Meetings, Workshops

The following meetings have been proposed:

- Proposed workshop in spring 2013, possibly attached to WGNE systematic errors workshop
- Proposed workshop in autumn 2013 to discuss future plans

3.4.12 Convective Systems: TWP-ICE

SSC Sponsors: Ann Fridlind and Jon Petch
Project Leads: Ann Fridlind, Yanluan Lin, Ping Zhu, and Laura Davies
Project Status: Completed

Accomplishments

This completed project examined simulations of convective clouds in the environment of Darwin, Australia in early 2006. This was the first model intercomparison project to:

- Involve four model types (CRM, LAM, SCM, GAM) with multiple international modeling groups participating
- Use ensemble forcing data in the SCM component

Activities for Next 1-2 Years

The following wrap-up activities are envisioned:

- Submit final two publications
- Ensure that lessons learned are applied to future projects

List of Key Publications

Bretherton, C., A. Fridlind, H. Morrison, and B. Shipway, 2010. GCSS workshop on microphysics and polar/precipitating clouds. *GEWEX News*, 20, no. 4, 17-19.

Varble, A., et al., 2011. Evaluation of cloud-resolving model intercomparison simulations using TWP-ICE observations. Precipitation and cloud structure. *J. Geophys. Res.*, 116, D12206, doi:10.1029/2010JD015180.

Fridlind, A.M., et al., 2012. A comparison of TWP-ICE observational data with cloud-resolving model results, *J. Geophys. Res.*, 117, D05204, doi:10.1029/2011JD016595.

Lin, Y., et al., 2012. TWP-ICE global atmospheric model intercomparison: Convection responsiveness and resolution impact. *J. Geophys. Res.*, 117, D09111, doi:10.1029/2011JD017018.

Zhu, P., et al. (2012), A limited area model (LAM) intercomparison study of a TWP-ICE active monsoon mesoscale convective event, *J. Geophys. Res.*, 117, D11208, doi:10.1029/2011JD016447

Petch, J., et al., 2012. An evaluation of intercomparisons of four different types of model simulating convection duringTWP-ICE. To be submitted to *Quarterly Journal of the Royal Meteorological Society.*

Davies et al., 2012. A Single Column Model Ensemble approach applied to the TWP-ICE experiment. To be submitted to *Journal of Geophysical Research.*

List of Meetings

- Plenary talk containing all results at the spring science team meeting of the US DOE ARM/ASR program, March 2012

25TH GEWEX SCIENTIFIC STEERING GROUP (SSG) MEETING
SYDNEY, AUSTRALIA • 15-18 OCTOBER 2012

List of Participants

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AGENDA for SSG-25

25th Session of the Scientific Steering Group (SSG) of the Global Energy and Water Exchanges (GEWEX) Project

Tyree Room in the John Niland Scientia Building, Kensington Campus
University of New South Wales, Sydney, Australia
15-18 October 2012

Monday, 15 October 2012

7.45 – 8.30	Registration
	SESSION 1. CHAIR: H. WHEATER
8.30 – 8.35	Opening
8.35 – 8.45	Welcomes from Local Hosts (Evans, McCabe)
8.45 – 9.15	Chairman's Report (Trenberth)
9.15 – 9.45	Update on WCRP Activities and JPS (Detemmerman)
9.45 – 10.15	IGPO Report and SSG-24 Actions and Recommendations (van Oevelen)
10.15 – 10.45	BREAK
10.45 – 11.15	JSC-33 Outcome and WCRP Grand Challenges Introduction and Overview (Trenberth)
11.15 – 12.00	GEWEX Grand Science Questions: Introduction and Discussion (Trenberth/Wheater)
12.00 – 12.30	Next International GEWEX Science Conference (Science Committee, Conveners, Venue, etc.)
12.30 – 14.00	LUNCH and **SSG Executive Session**
	SESSION 2. CHAIR: P. VAN OEVELEN
14.00 – 14.20	CLIVAR (Hendon)
14.20 – 14.40	JAXA (Oki)
14.40 – 15.00	SPARC (Bodeker)
15.00 – 15.30	BREAK
15.30 – 16.00	WGNE and WMAC (Jakob)
16.00 – 16.20	iLEAPS (Hansson)
16.20 – 16.40	WMO Hydrology (Tuteja)
16.40 – 17.00	CliC (Ryabinin via Skype)
17.00 – 17.20	ESA (Rast)
17.20 – 17.45	Discussion of Project Interactions

Tuesday, 16 October 2012

	SESSION 3. CHAIR: K. TRENBERTH
08.15 – 08.45	NASA (Entin via Skype)
08.45 – 10.15	NOAA/GLASS (Ek)
10.15 – 10.45	BREAK
10.45 – 12.15	GASS (Klein)
12.15 – 13.15	LUNCH
	SESSION 4. CHAIR: H. WHEATER
13.15 – 13.45	WCRP Grand Challenges on Clouds, Circulation and Climate Sensitivity (Klein)
13.45 – 15.15	GDAP (Kummerow)
15.15 – 15.45	BREAK
15.45 – 17.15	GHP (Polcher/Evans)
17.15 – 17.30	Discussion
18.30	Public Lecture: Kevin Trenberth (Leighton Hall, John Niland Scientia Bldg.)

Wednesday, 17 October 2012

	SESSION 5. CHAIR: P. VAN OEVELEN
8.30 – 9.15	WCRP Grand Challenges + Discussion (Busalacchi via Skype)
9.15 – 10.00	Australian Research Council Centre of Excellence for Climate System Science – Future of Australian Climate Research (A. Pitman)
10.00 – 10.30	GLASS Rapporteur Report and Discussion
10.30 – 10.45	BREAK
10.45 – 11.15	WCRP Grand Challenge on Water Availability: Panel Contributions
11.15 – 11.45	GHP Rapporteur Report and Discussion
11.45 – 12.15	GDAP Rapporteur Report and Discussion
12.15 – 13.45	LUNCH
	SESSION 6. CHAIR: K. TRENBERTH
13.45 – 14.05	WDAC and WGRCI (Detemmerman)
14.05 – 14.25	CORDEX (Ruti)
14.30 – 15.00	WCRP Grand Challenge Sensitivity (GASS)
15.00 – 22.00	Excursion/Dinner

Thursday, 18 October 2012

	SESSION 7. CHAIR: H. WHEATER
8.30 – 9.00	Regional Workshops: South America (?) / Africa (HYVIC)
9.00 – 9:15	Other Workshops: DOE, GRACE, etc.
9.15 – 9.30	2014 GEWEX Science Conference
9.30 – 9.50	WCRP Grand Challenge on Water
9.50 – 10.15	WCRP Grand Challenge on Extremes (Karoly)
10.15 – 10.45	BREAK
10.45 – 11.05	Monsoons and CLIVAR Collaboration (Hendon)
11.05 – 11.20	DOE Water Cycle Workshop (Klein)
11.20 – 11.50	GASS Rapporteur Report and Discussion
11.50 – 12.30	GEWEX Organization and Planning: Grand Science Questions/ Grand Challenges Implementation (van Oevelen/Trenberth) GEWEX Science Questions Draft
12.30 – 14.00	LUNCH
	SESSION 8. CHAIR: K. TRENBERTH
14.00 – 15.00	Kick-off Workshop(s): Extremes and Water Availability (van Oevelen)
15.00 – 15.30	BREAK
15.30 – 17.00	Actions and Recommendations/Summary and Conclusions (van Oevelen/Wheater)
17.00 – 17.15	Next Meeting and Any Other Business
17.30	Adjourn