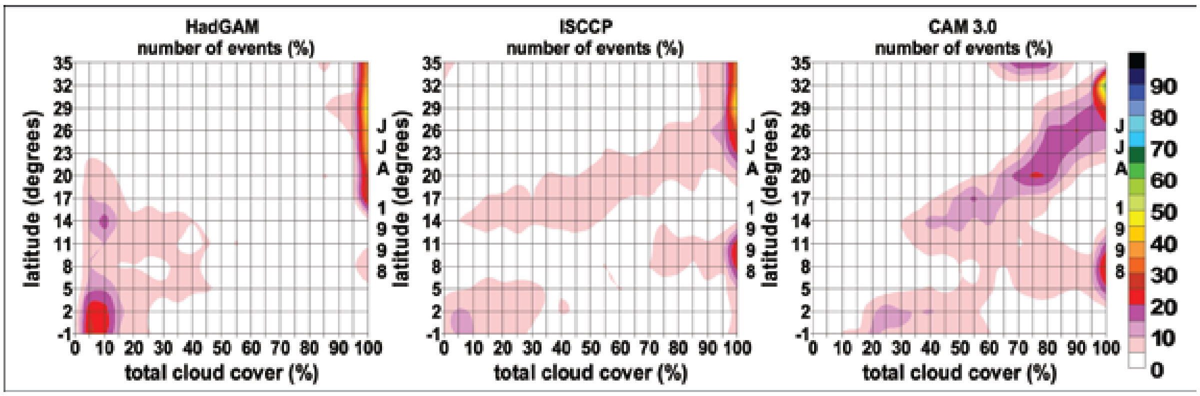
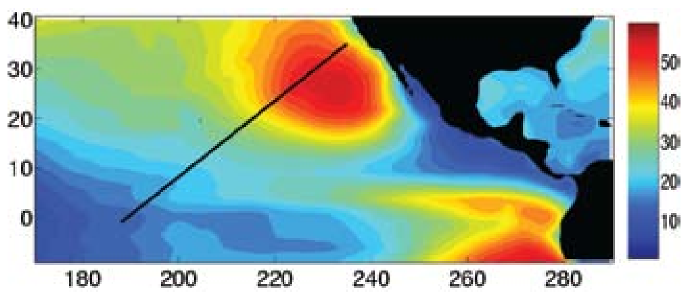
GEWEX WCRP
Global Energy and Water Cycle Experiment
NEWS

Vol. 18, No. 4
WCRP World Climate Research Programme
WMO IOC ICSU International Council for Science
November 2008

GEWEX Modelling and Prediction Panel (GMPP) Studies Advancing Parameterization Research



GPCI analyzes weather and climate models along a cross section of the Pacific Ocean. Histograms of total cloud cover versus latitude along the GPCI cross section for June–July–August 1998 from the UKMO/HadGAM model, ISCCP and the NCAR/CAM3 model. These show that some climate models (e.g., UKMO/HadGAM) exhibit a quasi-bimodal structure with cloud cover being either close to 100 percent or close to zero, while other climate models (e.g., NCAR/CAM3) show a more continuous transition. See article below.



GPCI cross section (black line) and the International Satellite Cloud Climatology Project (ISCCP) annual mean low cloud cover (in percent). (Courtesy of C. Hannay)

Results from the First 2 Years of the GCSS Pacific Cross Section Intercomparison

Joao Teixeira[1], Sambingo Cardoso[2], A. Pier Siebesma[3] and the GPCI Team

[1]Jet Propulsion Laboratory, Pasadena, CA, USA; [2]National Center for Atmospheric Research, Boulder, CO, USA; [3]Royal Netherlands Meteorological Institute (KNMI), De Bilt, The Netherlands

The GEWEX Cloud System Studies (GCSS) Pacific Cross Section Intercomparison (GPCI) Working Group was initiated in 2005 to evaluate and improve the representation of tropical and subtropical cloud and precipitation processes in

(Continued on Page 4)

GMPP Activities Highlighted in this Issue

See Back for Details
2009 Conferences
GEWEX and iLEAPS in Melbourne

Commentary

Reflections on My Term as Chairman of the GEWEX SSG

Soroosh Sorooshian, Ph.D., N.A.E.
Chair, GEWEX Scientific Steering Group

Before I reflect on my 8-year term as the GEWEX Scientific Steering Group (SSG) Chair, I would like to express my appreciation for a number of people who have made my term a most rewarding and educational experience. Paul Try, as the first International GEWEX Project Office (IGPO) Director, succeeded by Rick Lawford, are perhaps two of the most intelligent, remarkable, and yet humble individuals I had the pleasure of working with. I learned so much from them during these past years that sharing the experiences would fill a book. The energy level of Peter van Oevelen, the new IGPO Director, has not only re-energized me during these last months of my chairmanship, but has also reassured me that the GEWEX community has been so fortunate as to attract some of the most dedicated and talented colleagues to direct the IGPO. While Directors and SSG chairs have come and gone, Dawn Erlich has been the anchor and most loyal and caring guardian GEWEX has had over the years. I am also grateful to my assistant, Diane Hohnbaum at University of California-Irvine for her help and service over the past 5 years.

Needless to say, I have also had the pleasure of working with an outstanding group of panel and working group chairs and hundreds of volunteers, including all the SSG members over the years. My thanks go to all of you, and my apologies that I cannot mention everyone by name in this commentary. (The GEWEX News Editorial Board would not allow me the space!)

I had the good fortune of becoming the second SSG Chair after a remarkable tenure by our colleague Moustafa "Mous" Chahine of the Jet Propulsion Laboratory. Under Mous' leadership the GEWEX program truly flourished, as best documented in the GEWEX Phase I (1990–2002) report. The accomplishments of our various panels, including widely-used data sets such as the International Satellite Cloud Climatology Project (ISCCP) by the GEWEX Radiation Panel (GRP); contributions by the GEWEX Modelling and Prediction Panel (GMPP) such as the Project for the Intercomparison of Land-Surface Parameterization Schemes and the GEWEX Cloud System Study; and the accomplishments of the Continental-Scale Experiments (CSEs) initiated by the GEWEX Hydrometeorology Panel (GHP), are just a few examples.

We started Phase II of GEWEX with each of our three panels (GRP, GMPP and GHP) to address the critical challenging scientific questions that were identified in Phase I and the initiation of the Coordinated Enhanced Observation Period (CEOP). Most recently, CEOP was merged with GHP and transformed into the new Coordinated Energy Water Cycle Observations Project (also CEOP) under the leadership of Toshio Koike and the late John Roads.

Perhaps one of the most interesting experiences of chairing the SSG has been the appreciation I have gained for the wide range of scientific questions and activities that the GEWEX program is addressing. None of us, no matter how broadly we are educated, can expect to be an expert in all aspects of the GEWEX program. During the past 8 years, even though I have been exposed to a wide range of topics under the GEWEX umbrella, in no way can I claim that I have become an expert in all aspects. One thing is certain however: the duties of the SSG Chair force one to "think outside the box" (in my case, hydrology). During my term as Chairman, I have heard comments such as "GEWEX has become a purely land-hydrology activity" as well as comments from many of my hydrology colleagues that "GEWEX has not paid as much attention to the land-hydrology aspects." For better or worse, the complexities of multidisciplinary projects such as GEWEX require a balanced approach, and therefore one should not expect an optimal outcome based on one's disciplinary point of view.

Throughout the years we have maintained that GEWEX should "Stay the Course" and minimize reorganizing itself to focus on the science and observation issues that are the core of the panel activities. I still feel strongly that this is the best approach to produce the desired outcomes; let me elaborate using the critical issue of prediction as an example. Prediction of future climate scenarios at various scales has been a key focus of the World Climate Research Programme (WCRP) and in more recent years has been highly emphasized. Much of the recent emphasis is perhaps due to the Intergovernmental Panel on Climate Change (IPCC) process. While the IPCC has mainly focused on climate models at the global scale, it is becoming more apparent that the issue of regional-scale predictions will be dominant in the next round of IPCC assessments. As a result, any downscaling to regional scales will require some degree of testing and validation with real data. Therefore, the role for the GEWEX program is crucial, not only because of its long-term focus on providing global observations, but also for its role in conducting process and modelling studies at the scales required for the finer spatial and temporal resolutions.

Only time will tell, but I nevertheless predict that the importance of the GEWEX program will only grow as we move forward into the future. I am sure under the leadership of the incoming chair, Thomas Ackerman, and in cooperation with the WCRP programs, particularly the Climate Variability and Predictability Project, the GEWEX program will remain a core activity that benefits the international community currently faced with addressing the uncertainties associated with the impact of climate change on resources such as water.

Recent News of Interest

New CEOP Co-Chair

Prof. Ronald Stewart, Centre for Earth Observation Science, University of Manitoba, Canada, has generously agreed to serve as interim co-chair of the Coordinated Energy and Water Cycle Observations Project (CEOP). He replaces Dr. John Roads, who passed away in June. Dr. Stewart also serves as project manager of the CEOP cross-cutting study on extremes and is a member of the GEWEX Scientific Steering Group.

GEWEX Scientist Awarded Prestigious Japan Academy Medal

Dr. Taikan Oki of the Institute of Industrial Science at the University of Tokyo was selected as a recipient of the 2007 Japan Society for the Promotion of Science PRIZE, an award given to young researchers "with fresh ideas who have the potential to become world leaders in their fields." Of the 23 PRIZE recipients, 5 researchers were singled out to receive the prestigious Japan Academy Medal; Dr. Oki was given the honor of addressing Their Imperial Highnesses Prince and Princess Akishino on behalf of himself and his colleagues. His research subject is "Predicting the Variations of Global Hydrological Cycles and the Balance of World Water Resources."

Contents

GABLS Third Large Eddy Simulation and Single Column Model Case

Currently, eight model groups are participating in the GEWEX Atmospheric Boundary Layer Study (GABLS) Third Large Eddy Simulation (LES) Case. The case is still open and the deadline for sending in model results has been extended to 15 January 2009. Preliminary results will be presented at the American Geophysical Union Fall Meeting on 15–19 December 2008 in San Fransisco, California, USA. Please see *http://www.atmo.ttu.edu/basu/GABLS3* for the agenda, details of the case, model setup, and requested model output. Anyone wishing to participate should send an e-mail to *sukanta.basu@ttu.edu*.

The GABLS Third Single Column Model case is now closed. A significant number of model groups (10 groups, 16 models) have successfully run this case and sent in their results. Preliminary results were presented at the American Meteorological Society 18th Symposium on Boundary Layer and Turbulence, 9–13 June 2008 in Stockholm, Sweden, and at the European Meteorological Society Annual Meeting/European Conference on Applied Climatology, 29 September – 3 October 2008 in Amsterdam, The Netherlands. Please see *http://www.knmi.nl/samenw/gabls* for agenda and announcements. For further information, please e-mail *fred.bosveld@knmi.nl*.

2008 Nordberg Award for Earth Science

GEWEX congratulates Dr. Wei-Kuo Tao, recipient of the 2008 William Nordberg Memorial Award for Earth Science. This honor is the highest NASA Goddard Space Flight Center award in the Earth sciences..

In Memoriam

Dr. Christopher Bishop (formerly Brest), NASA Goddard Institute for Space Studies, passed away on 10 August 2008. He supported GEWEX Projects for many years, especially the International Satellite Cloud Climatology Project (ISCCP). Chris started work at the ISCCP Global Processing Center in 1983, shortly after routine data collection began, and took over early tasks involved with quality checking all of these data. However, when it was realized that the polar orbiting satellite imagers (AVHRR) which serve as the ISCCP radiance calibration reference standard needed to be calibrated and monitored, Chris quickly stepped into this key role. The calibration problem was a huge undertaking because of the large number of radiometers. His work achieved the first, and still only, comprehensive and consistent absolute calibration of all the radiometers in the entire constellation of operational weather satellites. Chris also built a quality-checking system that monitored the ISCCP cloud products to detect smaller calibration discrepancies. Since new radiometers were continually being introduced into the satellite observing system, this work continued to occupy much of Chris' time. Chris will be missed as a colleague and friend.

Results from the First 2 Years of GPCI

(continued from page 1)

weather and climate prediction models. The approach used by GPCI builds on the EUROpean Cloud Systems Project (EUROCS; Siebesma et al., 2004) where weather and climate prediction models are analyzed along a Pacific Ocean cross section, from the stratocumulus regions off California, across the shallow convection trade-wind areas, to the deep convection regions of the Intertropical Convergence Zone. This approach provides a simple framework for 3-dimensional model evaluation that includes several important cloud regimes such as stratocumulus and shallow and deep cumulus, as well as the transitions between them. The fact that data are needed only along a cross section provides a technically easier intercomparison.

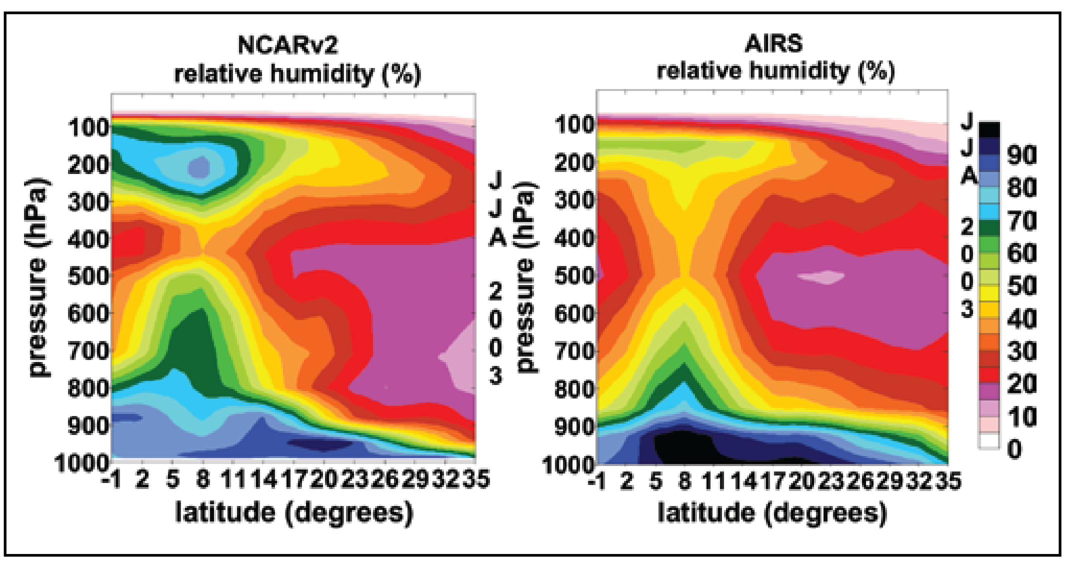
Over 20 weather and climate prediction organizations participated during the first phase of GCPI and submitted model output, including: the National Center for Atmospheric Research (NCAR), the National Aeronautics and Space Administration /Goddard Institute for Space Studies, the National Oceanic and Atmospheric Administration/Geophysical Fluid Dynamics Laboratory, the National Centers for Environmental Prediction, the European Centre for Medium-range Weather Forecasts, the United Kingdom Meteorological Office (UKMO), MeteoFrance, the Japanese Meteorological Agency, and the Max Planck Institute for Meteorology. Instantaneous model output was collected every 3 hours for the periods of June–August 1998 and 2003, which allowed for detailed studies on the temporal variability of cloud properties.

The first results and model evaluation were presented at a joint GPCI and GCSS Boundary Layer Cloud Working Group workshop in September 2006. A comparison of monthly mean properties between models and observations showed that although most models often suffer from similar problems (e.g., negative stratocumulus cloud bias and positive shallow cumulus cloud bias) they also have quite different characteristics (e.g., the depth of the boundary layer evolving from a low to a high sea surface temperature region can be substantially different from model to model).

Also, histograms of cloud cover along the cross section differed from model to model. The figure at the top of page 1 shows that some climate models (e.g., UKMO/HadGAM) exhibit a quasi-bimodal structure with cloud cover being either close to 100 percent or close to zero, while other climate models (e.g., NCAR/CAM3) show a more continuous transition. The GEWEX International Satellite Cloud Climatology Project (ISCCP) observations showed results that are somewhere between these two extreme behaviors. These patterns reflect the different nature of the cloud, convection and boundary layer parameterizations, with some models basing their parameterizations on the idea of distinct regimes (with the consequent sharp transitions between them) while others base their parameterizations in climatological values.

GPCI is now entering Phase II, where the models are to be confronted along the GPCI transection with cloud observations derived from new satellite products. Model results have been submitted for June–July–August 2003 and are being evaluated with a number of satellite products including the Atmospheric Infrared Sounder (AIRS)-derived temperature and humidity data, and cloud-top heights derived from the Multi-angle Imaging SpectroRadiometer.

The combination of infrared and microwave radiances using AIRS and the Advanced Microwave Sounding Unit and Humidity Sounder for Brazil allows the retrieval of high



Relative humidity cross section along the GPCI transection from the NCAR model and AIRS for June–July–August 2003 suggests that the NCAR model produces a boundary layer that is unrealistically shallow.

resolution temperature and humidity profiles for infrared cloud fraction (the product of emissivity and coverage) up to about 70 percent. The AIRS retrievals have a nominal 45 km horizontal spacing. Standard retrieved products include surface temperature, infrared cloud fraction, cloud top temperatures and pressures, and profiles of temperature and water vapor. The vertical resolution of the AIRS system is specified as 1 km for temperature and 2 km for water vapor in the troposphere. The actual resolution may be better, and some results suggest sensitivity to sub-kilometer temperature structure under certain conditions. AIRS achieves accuracies of 1 degree Kelvin per kilometer in temperature and 10 percent per 2 km in relative humidity.

The figure on page 4 shows two relative humidity cross sections along the GPCI transection from AIRS and the NCAR climate model for June–July–August 2003. It is clear that compared to AIRS the NCAR model produces a boundary layer that is unrealistically shallow. This is a result that has been confirmed by other sources. Major differences above the boundary layer may also be due to sampling issues related to the AIRS data.

Finally, in order to incorporate Cloudsat and Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) cloud data, it is planned to extract data from these instruments for the June-July-August period of 2008 along the transection, together with GPCI Phase II model simulations.

All GPCI model data are available at the Data Integration Model Evaluation (DIME) web site (*http://gcss-dime.giss.nasa.gov/gpci/modsim_gpci.html*), where users may intercompare individual models with observations. GPCI is partially supported by the NASA Modelling, Analysis, and Prediction (MAP) Program.

Reference

Siebesma, A. P., et al., 2004. Cloud representation in general circulation models over the Northern Pacific Ocean: A EUROCS intercomparison study. *Quart. J. Roy. Meteor. Soc.* 103, 3245–3268.

Participants at the 24th Meeting of the Working Group on Numerical Experimentation (WGNE), Montreal, Canada, 3-7 November 2008.

GEWEX and WGNE Join Forces on Parameterization

Christian Jakob[1] and Martin Miller[2]
[1]Chair, GEWEX Modelling and Prediction Panel, Monash University, Victoria, Australia; [2]Chair, Working Group on Numerical Experimentation, European Centre for Medium-range Weather Forecasts, Berkshire, United Kingdom

For many years the GEWEX Modelling and Prediction Panel (GMPP) and the Working Group on Numerical Experimentation (WGNE) have successfully collaborated on the development and evaluation of the representation of subgrid scale processes in terms of larger-scale parameters, (i.e., parameterization for atmospheric and land-surface models). A recent initiative, described below, has strengthened this collaboration further by bringing the two groups even closer together and aligning their activities.

Background

GEWEX has a long tradition in research, observations, and modelling of the global water and energy cycles, where parameterization science features strongly. Most of the GEWEX parameterization development activities are facilitated in the groups of GMPP, namely the GEWEX Cloud System Study (GCSS), the GEWEX Land/Atmosphere System Study (GLASS), and the GEWEX Atmospheric Boundary Layer Study (GABLS). Over the past decade or so, these groups have changed the research landscape in their respective areas by developing unique approaches to parameterizations and the means by which they are evaluated, which are now widely adopted in the community. Despite these successes, some of which have gone relatively unnoticed, a feeling has emerged that interest and activities in the development of parameterizations for atmospheric models is somehow in decline.

Many of the processes that are important to weather and climate act on scales smaller than the grid-sizes of contemporary models used in numerical weather prediction (NWP), seasonal prediction and climate simulation. Examples of such processes are turbulence and convection in both the atmosphere and the ocean, cloud processes, and processes related to the energy, water and biogeochemical exchanges at land and ocean surfaces. As these processes affect the evolution of the Earth System on all time-scales, they need to be represented in models—this is usually achieved by means of parameterization. It is generally accepted that the key deficiencies, and hence uncertainties, in our current climate projections are directly related to our ability to represent these parametrized processes. Modern parameterizations are comprised of conceptual models of the processes they are aiming to represent. Importantly, this extends their usefulness well beyond the application in a model, as the conceptualization of a process requires a deep understanding of the important mechanisms and feedbacks. It can be argued that in many areas the need for improved parameterizations has driven research progress such as in the design and implementation of both field experiments and research satellites.

Recent decades have seen great advances in both computing and model design, leading to the application of models with smaller and smaller grid-sizes, particularly in the NWP area. Limited-area NWP models are now routinely used at grid-sizes well below 10 kilometers. These grid-sizes begin to approach scales where certain processes that have traditionally been parametrized can be resolved by the model. Perhaps the prime example for such a process is that of atmospheric deep convection. This development has led to the erroneous impression in some quarters that parameterizations, in particular those of deep convection, do not require much further development as they will become obsolete in the foreseeable future.

While it is likely that a small number of research activities will employ global models of high enough resolution to be able to abandon the parameterization of deep convection, it is highly unlikely that even the most advanced prediction centers will be routinely using models of such resolution for several decades to come. This is particularly true for efforts in medium- and extended-range prediction as well as climate prediction and simulation, where the requirements of ensemble methods will prohibit the use of such high-resolution models. Even where these can be used, the parameterization of processes other than deep convection will remain of crucial importance to climate research.

In contrast to the great advances in computing and general model development, the scientific field of parameterization development has not advanced correspondingly, least of all for key moist processes such as clouds and convection. There are a number of likely reasons for this. Parameterization research requires a team effort where all aspects of development are covered in a holistic manner. It needs to be embedded in a global or limited area modelling effort to ensure that the work is relevant and practicable in the context of the overall model development. This makes it difficult to establish sustainable efforts away from large modelling centers and, with only a few notable exceptions, many centers have reduced their relative efforts in parameterization in recent years.

It is likely that the perceived weaknesses in progress also comes from a lack of visibility and promotion of parameterization research through relevant international organizations. In the World Climate Research Programme (WCRP), parameterization development activities have a relatively low profile and are mostly concentrated in GMPP, which in itself is a modest component of one of several large WCRP projects. The research efforts of the World Meteorological Organization (WMO) on weather prediction, which are coordinated by the Comission for Atmospheric Science (CAS), have had relatively few specific parameterization efforts. It has been through the strong collaboration of GMPP with WGNE that parameterization development was connected to the main NWP and global models. Given the current and future importance of parameterization to ALL applications used in the many WCRP and CAS programmes, it is notable how little visibility and support has been given to parameterization development.

New Plan for Parameterization Activities

Given the arguments outlined above, it is suggested that it is time to rethink the organization of parameterization development in the various WMO activities, with the specific aims of:

(1) re-establishing parameterization development as an important scientific discipline;

(2) promoting throughout all WMO research programmes the need for additional investment in parameterization development;

(3) facilitating the necessary dialogue between parametrization developers and model users in all areas of model application;

(4) facilitating scientific activities, such as coordinated research programmes, workshops, and scientific conferences on parameterization;

(5) embracing parameterization development as an important contribution to enhance our predictive capabilities on all space and time-scales; and

(6) building a critical mass within the WMO structure to make significant progress in critical areas of parameterization development over the next 10 years.

To achieve these ambitious aims, it was agreed that it would be best to form one central, highly visible parameterization expert group within WMO. As WGNE provides links to all modelling communities from weather to climate, the most natural place for the parameterization expert team is under its auspices. The parameterization group will engage with all projects and working groups and aims to become the focal point for parameterization development within WMO and the community it represents. As this new group adds substantially to WGNE's portfolio, a new WGNE co-chair with specific responsibility for the parameterization activities has been appointed. The membership of the expert group is drawn from existing groups within WCRP and CAS and the current chairs of the GEWEX projects GMPP, GCSS, GLASS and GABLS. It is a stated aim of the group to investigate and encourage the inclusion of parameterization efforts beyond the atmosphere and land surface, such as the ocean and the cryosphere, to enable cross-fertilization of concepts.

While the reorganization of parameterization research in itself is unlikely to bring about the required reinvigoration of this important area of modelling, it can serve as a launch platform. It is our sincere hope that the wider research and applications community will embrace this effort and make optimal use of it by engaging with and supporting parameterization developers. This is crucial if the improved models called for by all user communities are to be developed.

RAMI4PILPS: Assessing Shortwave Radiation Fluxes in Land Surface Schemes

Jean-Luc Widlowski[1], Kendal McGuffie[2] and Bernard Pinty[1]
[1]European Commission, Directorate General Joint Research Centre, Institute for Environment and Sustainability, Ispra, Italy; [2]University of Technology, Sydney, Australia

Remotely sensed information about crucial surface properties—such as albedo, leaf area index and the fraction of photosynthetically active radiation—is now available operationally and can be used in assimilation mode by Land Surface Schemes (LSS) of climate and/or numerical weather prediction models. It is thus more pertinent than ever to assess the accuracy and consistency of the absorbed, reflected and transmitted shortwave radiation fluxes in LSS.

At the Pan-GEWEX Meeting in 2006, the GEWEX Global Land Atmosphere System Study (GLASS) endorsed the Radiation Transfer Model Intercomparison reference solutions for the Project for Intercomparison of Land-surface Parameterization Schemes (RAMI4PILPS) suite of experiments. The goal of RAMI4PILPS is to evaluate current radiative transfer formulations, look-up table approaches, and parametric solutions that quantify the shortwave radiation transfer within and beneath vegetation canopies in a manner suitable for inclusion in LSS of climate simulation and weather prediction models.

All RAMI4PILPS experiments focus exclusively on (solar) shortwave radiation, specifically on its partitioning into reflected (R), absorbed (A) and transmitted (T) flux components in the visible and near-infrared spectral regions. RAMI4PILPS experiments do not involve quantities pertaining to longwave radiation, nor do they involve forcing terms or temporal evolutions. Instead, these experiments are "instantaneous snapshots" of how direct or diffuse shortwave radiation (impinging at the top of a vegetation canopy) is partitioned into the aforementioned flux components, such that the energy balance can be written as: $A=1-R - (1-\alpha)T$, where α is the soil albedo.

Within the RAMI4PILPS suite of experiments, two different sets of test cases are proposed: (1) structurally homogeneous environments that are reminiscent of grasslands and closed forest canopies, where participants are required to deliver all three radiative surface fluxes (R, A, and T) on the basis of detailed spectral and structural canopy descriptions; and (2) structurally heterogeneous environments that are reminiscent of shrublands and open forest canopies, where participants are provided with detailed canopy descriptions and the surface reflectance, R (often available in real application from remote sensing observations) and are requested to deliver their model's estimate of the partitioning of the remaining energy into A and T.

In all cases the soil albedo, illumination conditions and foliage spectral properties are given, as are detailed structural properties of the various canopies. RAMI4PILPS will assess the quality of the submitted radiative fluxes by direct comparison with reference solutions obtained from Monte Carlo models that were evaluated during the various phases of the RAMI benchmarking exercise (Pinty et al., 2001, 2004; Widlowski et al., 2007).

RAMI4PILPS directly benefits participants of PILPS by: (1) quantifying the typical errors associated with different modes of estimating the partitioning of shortwave radiative surface fluxes in LSS; (2) identifying the impact that structural and spectral sub-grid variability may have on these flux estimates; and (3) verifying the conservation of energy at the level of the surface. RAMI4PILPS can thus be envisaged as a quality control mechanism to assess the appropriateness of radiative flux formulations in current and future LSS in light of assimilation efforts of remote sensing products into climate and weather prediction models.

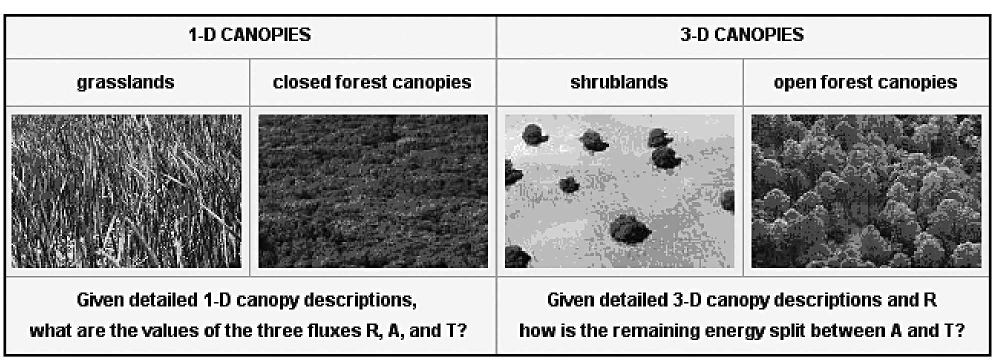
Interested participants are asked to contact the RAMI4 PILPS coordinator (*rami.webadmin@jrc.it*) and submit their flux estimates before 15 April 2009 using the procedure outlined on the RAMI4PILPS web site at *http://rami-benchmark.jrc.ec.europa.eu/*. For both sets of RAMI4PILPS test cases, the submission of simulation/look-up table results from stand-alone radiation transfer models as well as modules that are part of larger simulation models are encouraged, be they Soil Vegetation Atmosphere Transfer, numerical weather prediction or regional/global circulation models.

References

Pinty, B., et al., 2001. Radiation Transfer Model Intercomparison (RAMI) exercise. *J. Geophys. Res.*, 106, 11,937–11,956.

Pinty, B., et al., 2004. Radiation Transfer Model Intercomparison (RAMI) Exercise: Results from the Second Phase. *J. Geophys. Res.*, 109, pp. D06210.1-D06210.19.

Widlowski, J.-L., et al., 2007. The Third Radiation Transfer Model Intercomparison (RAMI) Exercise: Documenting Progress in Canopy Reflectance Modelling. *J. Geophys. Res.*, 112, 28 pgs..



Overview of RAMI4PILPS experiments.

Advances in Modelling and Observing Clouds and Convection Highlighted at the 4th PAN-GCSS Meeting

A. Pier Siebesma, Chair, GCSS Panel
Royal Netherlands Meteorological Institute (KNMI), De Bilt, The Netherlands; Delft University of Technology, Delft, The Netherlands

More than 230 scientists participated in discussions on the future of observing and modelling clouds during the 4th Pan-GEWEX Cloud Systems Studies (GCSS) Meeting held at MeteoFrance in Toulouse on 2–6 June 2008. The Pan-GCSS meetings are held every 3 years to promote interaction between its many working groups, discuss advances on relevant topics in the field of clouds and convection, and attract new scientists to its activities.

GCSS investigates cloud systems, their role in the climate system, and their representation in models in order to improve prediction of weather and climate using state-of the-art modelling and data assimilation systems. This research is presently conducted through four working groups that concentrate on different cloud systems: (1) boundary layer clouds, (2) cirrus clouds, (3) precipitating convective cloud systems, and (4) polar clouds. The strategy of these groups is to conduct process-oriented studies based on field experiments using high-resolution models such as Large Eddy Simulation (LES) models and Cloud Resolving Models (CRMs) as a virtual laboratory. Observational data, LES model and CRM output are analyzed and compared among different model codes and used to develop and evaluate parameterizations to be used in large-scale climate and numerical weather prediction (NWP) models. This parameterization evaluation is performed by Single Column Model (SCM) versions of General Circulation Models (GCMs) that are challenged to reproduce similar cloud and turbulent transport properties as observed and simulated in virtual laboratories. The critical premise of this strategy is that the intermodel differences between the high resolution model (i.e., CRM and LES) output is substantially smaller than the intermodel differences of the parameterized processes in the SCMs.

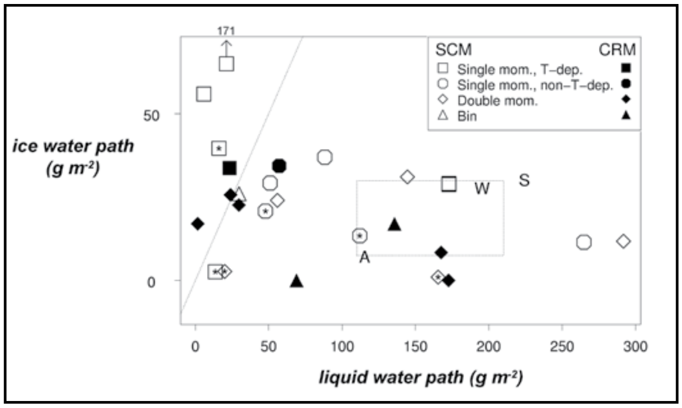
A new and overarching theme of GCSS is related to cloud microphysics, precipitation, and the influence of these processes on the mean thermodynamic atmospheric state. Three examples of the present research are given below.

The first example deals with warm maritime shallow clouds such as those observed during the Rain in Cumulus over the Ocean (RICO) experiment, which has quantified convincingly that precipitation is a common feature for these clouds, a feature often neglected in large-scale models. The tenth intercomparison case for LES models and SCMs of the Working Group of Boundary Layer Clouds showed that precipitation limits the growth of these cumulus clouds and hence the depth of the boundary layer, while consecutive sensitivity studies reveal that moister boundary layers lead to deeper clouds that rain more. The LES ensemble mean value of the surface rain rate is 21 Wm^{-2}, which is in close agreement with the SPOL-radar estimates of 18 Wm^{-2}. The individual LES model results, however, exhibit a wide spread ranging from 0 to 25 Wm^{-2}. More worrying is the observation that the LES models with sophisticated binned microphysics schemes do not provide more accurate precipitation rates than the ones with simpler two-moment bulk microphysical schemes for these warm clouds. SCMs show an equivalent large range of uncertainty in precipitation. Many of these uncertainties can be attributed to uncertainties in the assumed probability distribution functions of the raindrop sizes and the evaporation rates of rain; more details can be found at *http://www.knmi.nl/samenw/rico*.

The second example is based on mixed-phase stratocumulus clouds such as those observed during the U.S. Department of Energy's Atmospheric Radiation Measurement (ARM) Program's Mixed-Phase Arctic Cloud Experiment (MPACE) at the Alaskan coast near Barrow. The upper half of the well-mixed boundary layer contained a mixed-phase cloud with a cloud top temperature of -15°C. The observed liquid water path was 160 g m^{-2} and the ice water path, computed as the mass of ice between the surface and cloud top, was 15 g m^{-2}. A model intercomparison study of SCMs, CRMs and LES models has been organized jointly by the GCSS Polar Clouds Working Group and the ARM Program (Klein et al., 2008). This study shows that, on average, all three classes of models strongly underestimate the amount of supercooled water by a factor of three (see figure on next page). This underestimation is most prominent for models using a single moment microphysics scheme in which the split-up between ice and water is a simple diagnostic function based on temperature only. The bias is reduced for more sophisticated two-moment bulk microphysics schemes. However, further reduction through the use of even more sophisticated explicit binned microphysics did not improve on the underestimation tendency, which is in line with findings for the warm clouds of RICO. Sensitivity studies show that the underestimation of the supercooled liquid water is predominantly due to the conversion rates of liquid water to ice.

The third and last example concerns cirrus ice clouds based on observations from 9 March 2000 at the Oklahoma ARM Southern Great Plains site; these observations form the basis of a model intercomparison study organized by the Cirrus Working Group. The main focus of this study is on evaluation of these ice clouds for ice water path (IWP), ice number concentration (ICN) and ice particle fall speeds. While there is fair agreement between observations and the CRM results for IWP and ICN, all models seem to underestimate the ice particle fall velocity. Moreover, SCMs tend to overestimate ice amount and underestimate the decay of ice water content with time. The errors point toward problems with the vertical velocity, the influence of subgrid variability, and the specification of ice particle fall velocity in present day parameterizations for ice clouds.

These three examples demonstrate that cloud microphysics is one of the larger uncertainties for all cloud types (warm, ice and mixed-phase) and that further dedicated research is needed.



Scatterplot of median liquid water path and ice water path from observations and model simulations based on MPACE. The dashed rectangle indicates the likely range of the regionally averaged liquid and ice water path. Note that most models (SCMs as well as CRMs) tend to strongly underpredict the liquid water path for these arctic mixed-phase clouds (taken from Klein et al.).

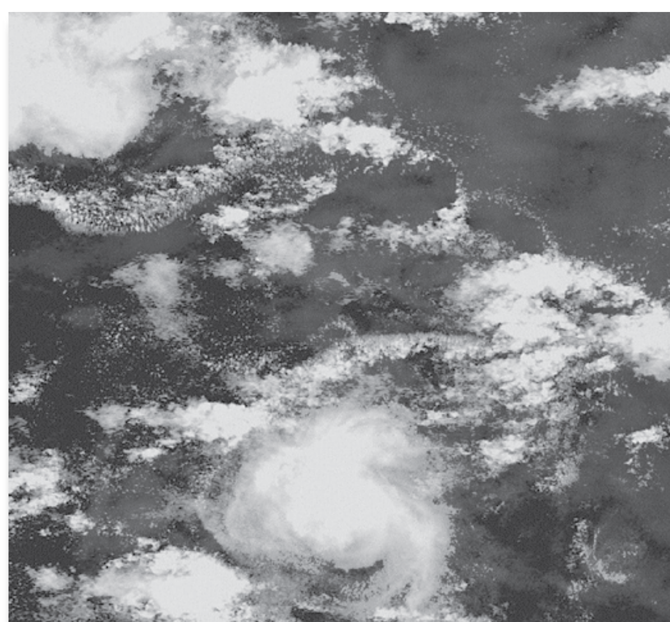
To respond to this urgent need, a new cloud microphysics working group was established, chaired by Ulrike Lohmann, with a kick-off meeting held during the Pan-GCSS meeting. Two different approaches are currently being put forward. One approach is to conduct idealized simulations for the CRM (and where possible for the SCM) community. Ben Shipway of the UK Met Office has proposed three idealized cases: (1) one warm rain maritime cumulus case based on RICO; (2) a deep convective case from the Kwajalein Experiment; and (3) one mixed-phase case from MPACE (Klein et al., 2008). In order to separate uncertainties caused by dynamics from uncertainties caused by the microphysical formulation itself, dynamics are partially prescribed through simple transient updraughts that advect moisture and hydrometeors, keeping the temperature fixed (including negation of latent heat release) and allowing only positive increments to the initial vapor field. This way uncertainties due to different formulations in the microphysics can be more easily quantified.

The second approach uses long-term SCM intercomparisons at the atmospheric profiling site Cabauw (The Netherlands) using the CloudNet classification scheme. Participating SCMs are nudged with European Centre for Medium-range Weather Forecasts reanalyses and the outputs are evaluated with CloudNet data, which provides information about cloud phase and the type of precipitation. This approach can be used for the validation of freezing parameterizations and precipitation development in SCM/GCM and NWP. If successful, it can be extended to ARM sites and others.

Although parameterization evaluations of large-scale models using SCMs based on individual cases—such as is done routinely in the four working groups—are a necessary step in parameterization development, it is not necessarily sufficient to evaluate new parameterization schemes in a broader 3-dimensional (3-D) context. Therefore, the GEWEX Pacific Cross Section Intercomparison (GPCI) Working Group is evaluating cloud properties of 3-D climate and numerical weather predictions along a transection over the Pacific Ocean encompassing regions of persistent stratocumulus, shallow cumuli, and deep convective tropical clouds, the three prevalent cloud types over the marine subtropics. For recent developments and background, please see the article on the cover page of this newsletter.

A new focal point of GCSS deals with cloud climate feedback. The Cloud Feedback Model Intercomparison Project (CFMIP) was launched in 2003 to encourage coordinated research in the area of cloud feedback in climate models. CFMIP has been successful in quantifying the uncertainties in cloud climate feedback and has identified low clouds as being highly influential. The project is now entering its second phase, during which a prime question is, Which modelling assumptions in the parameterizations of clouds, boundary layer, and convective processes affect their response to climate change? To this purpose, a collaboration between CFMIP and GCSS has been initiated and practical working plans were discussed during breakout sessions at the Pan-GCSS Meeting. For more details on the future plans of the GCSS/CFMIP collaboration, see page 10 in this newsletter.

A special theme at the meeting was high-resolution modelling on large domains. Ever increasing computer resources allow us to resolve spatial scales over more than three orders of magnitude on time scales of several days to weeks. Marat Kharoutdinov, of Stony Brook University, showed the potential of LES modelling of tropical deep convection on large domains of 200 km at a resolution of 100 meters based on observations from the Global Atmospheric Research Program (GARP) Atlantic Tropical Experiment (GATE). It is encouraging to see that realistic mesoscale structures such as precipitation-induced cold pools do show up in such simulations, provided that LES is conducted on large enough domains (see figure below). This opens the opportunity to use LES modelling as a virtual laboratory for deep convection in a way



Top view of a 100x100 km zoom-in area of an LES of tropical convection based on GATE showing cold pools, cumulus congestus, and deep convection (Courtesy Marat Khairoutinov, Stony Brook University).

that is similar to its application to smaller scale boundary layer clouds during the last decade.

Another interesting development is the use of CRMs as operational high resolution numerical weather prediction models. Axel Seifert (Deutscher Wetterdienst) showed results of the German convective-scale short range model Consortium for Small-scale Modelling, Germany (COSMO-DE) that is operationally running with a resolution of 2.8 km. This development addresses new parameterization issues, such as how to parameterize cloud-related processes at resolutions of 1–5 km. This is a difficult resolution (a "physics no man's land") at which convective cloud processes are partially resolved but it is not clear whether standard parameterization approaches and quasi-equilibrium assumptions are applicable. The interaction between parameterized boundary layer processes and the resolved convection appears to be crucial.

A final new development is the use of Global Cloud Resolving Models, such as the Japanese Nonhydrostatic Icosahedral Atmospheric Model that operates at a resolution of 3.5 km, albeit for short periods only (Miura et al., 2007). Despite the fact that dependency of the resolved convection on unresolved processes exists, these model results offer an unprecedented and interesting model database to analyze interactions between large-scale atmospheric circulation and tropical convection in a global context.

Finally, in order to strengthen the interaction between the GCSS modelling community and the observational community, there was a special session on: results of recent field campaigns such as the African Monsoon Multidisciplinary Analysis Project (AMMA), the Climate Observation and Prediction Strategy, and the Tropical Warm Pool International Cloud Experiment (TWP-ICE); cloud climatologies of new satellite products such as those derived from Cloudsat and the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations; and new products from atmospheric profiling stations such as ARM and CLOUDNET. As a result, new GCSS cases based on TWP-ICE and AMMA are being designed by the GCSS Working Group on Precipitating Convective Systems, and satellite products from the A-Train satellite constellation will be used for model evaluation on GPCI.

It was encouraging to see such a fruitful collaboration among model developers, the cloud observational community and the climate model evaluation community. The challenge of GCSS for the coming years will be to keep the dialogue among these three communities alive. All the meeting presentations can be downloaded at *http://knmi.nl/~siebesma/PAN-GCSS/presentations.html*

References

Klein S., et al., 2008. Intercomparison of model simulations of mixed-phase clouds observed during the ARM Mixed-Phase Arctic Cloud Experiment. Part I: Single layer cloud. Submitted for publication in *Quart. J. Roy. Met. Soc*, *http://www.ral.ucar.edu/projects/GCSS/WG5/*.

Miura H., M. Satoh, T. Nasumo, A. T. Noda, and K. Oouchi, 2007. A Madden-Julian Oscillation event realistically simulated by a global cloud-resolving model. *Science*, 318, 1763–1765.

CFMIP-GCSS Plans for Advancing Assessments of Cloud-Climate Feedbacks

Sandrine Bony[1], Mark Webb[2], Bjorn Stevens[3], Chris Bretherton[4], Steve Klein[5] and George Tselioudis[6]

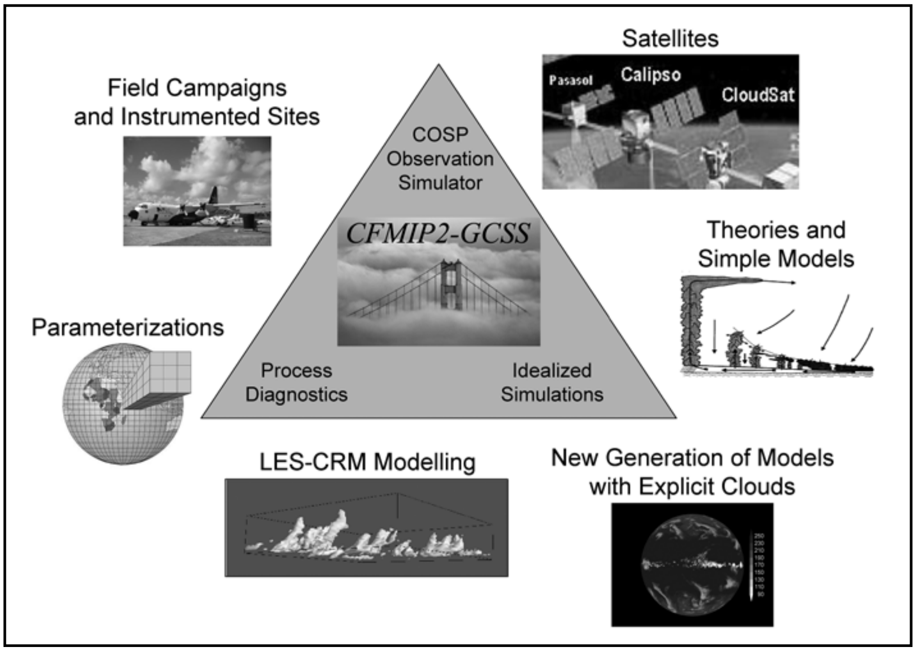
[1]Centre National de la Recherche Scientifique, Laboratoire de Météorologie Dynamique (LMD), Paris, France; [2]Hadley Centre, Met Office, Exeter, UK; [3]Max Planck Institute for Meteorology, Hamburg, Germany; [4]Department of Atmospheric Sciences, University of Washington, Seattle, WA, USA; [5]National Oceanic and Atmospheric Administration Geophysical Fluid Dynamics Laboratory, Princeton, NJ, USA; [6]National Aeronautics and Space Administration Goddard Institute for Space Studies, NY, USA

Background

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) reaffirms the spread in equilibrium climate sensitivity and in transient climate response among current climate models. Intermodel differences in cloud feedbacks remain the primary source of this spread (Randall et al., 2007; Dufresne and Bony, 2008). It should be emphasized, however, that uncertainties in cloud processes and feedbacks are not the sole problem of climate sensitivity estimates.

Clouds play a critical role in anthropogenic aerosol-induced climate forcing. In addition to modulating the Earth's radiation balance, clouds also play a key role in the hydrological cycle and in the large-scale atmospheric circulation, at both planetary and regional scales. By affecting precipitation and atmospheric dynamics, uncertainties in cloud and moist processes are a concern for virtually all aspects of climate modelling and climate change research. In a context where the climate modelling community is increasingly focusing its efforts on the assessment of regional climate change impacts and biochemical (e.g., carbon and aerosols) climate feedbacks, improving our understanding of cloud-climate interactions and the representation of cloud and moist processes in climate models remains imperative. It is in fact an urgent need if we are to gain confidence in simulations of future climate changes, both at the global and regional scales.

The difficulty that general circulation models (GCMs) have in predicting clouds, which was first emphasized 30 years ago by A. Arakawa and J. Charney, has been an unresolved problem for the modelling community. Fortunately there are now new resources available to observe clouds, such as the A-Train constellation of satellites, the long time-series of ground-based observations from instrumented sites, and many observational campaigns. On the modelling side, cloud-resolving models (CRMs) and large-eddy simulation models (LES) now run on increasingly large space and time scales, and a new generation of climate models is emerging that uses CRM physics in place of conventional parameterizations and performs global simulations of the Earth's atmosphere. In such a context, two questions arise: (1) Why has progress been so slow in the representation and understanding of cloud-climate interactions? and (2) How can we ensure that these new resources will actually lead to progress?



To better evaluate and improve the representation of cloud and moist processes by climate models and to better understand cloud-climate feedbacks, CFMIP2 (in close collaboration with GCSS) is engaged in three main activities:

(1) the development of an observation simulator package to evaluate models' clouds using satellite observations;

(2) process diagnostics to better evaluate and understand the processes responsible for the large-scale behavior of clouds in general circulation models; and

(3) idealized simulations to better understand the cloud-climate feedbacks produced by climate models.

CFMIP Phase 2

Part of the problem is that bridges have been missing between different research communities involved in cloud studies. To remedy this problem, Phase 2 of the Cloud Feedback Model Intercomparison Project (CFMIP-2), in close collaboration with the GEWEX Cloud System Study (GCSS), is currently engaged in the construction of three such bridges.

Bridge 1: CFMIP Observation Simulator Package (COSP)

COSP is a community software tool, which was developed at several research centers (the Hadley Centre of the Met Office, LMD Institut Pierre Simon Laplace, Colorado State University and the Lawrence Livermore National Laboratory) and allows us to diagnose from climate model outputs some quantities (e.g., brightness temperatures at specific wavelengths, radar reflectivities and lidar scattering ratios) that can be directly and consistently compared to satellite retrievals, while taking into account issues related to the viewing geometry, the cloud vertical overlap, the sensitivity of instruments and the attenuation of the remote signals (Klein and Jakob, 1999; Webb et al., 2001; Chepfer et al., 2008; Bodas-Salcedo et al., 2008). COSP includes modules capable of simulating the International Satellite Cloud Climatology Project (ISCCP), CloudSat and Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) data, and will be widely distributed to modelling groups (*http://www.cfmip.net*).

Bridge 2: Process-Oriented Diagnostics

The evaluation of general circulation model simulations—not only at the large-scale level and on long time-scales but also at the process level—will contribute to a better understanding of the physical processes involved in the large-scale behavior of clouds and their dependence on model parameterizations, and help to better assess the credibility of these simulations by comparison with LES/CRM models and *in-situ* observations from instrumented sites or field campaigns.

Bridge 3: Idealized Simulations

One condition to narrow the widening gap between simulation and understanding in climate modelling (Held, 2005) is to better understand the reasons why complex climate models behave the way they do and why they differ from one another. Examining moist processes and cloud-climate feedbacks in a suite of simplified or idealized contexts, such as in aqua-planet experiments (Medeiros et al., 2008) or through uni-dimensional cloud feedback experiments that aim to mimic the behavior of specific cloud types predicted by GCMs under climate change (Zhang and Bretherton, 2008), will help to determine and prioritize the most critical processes. Such guidance is critical if we are to design observational and modelling strategies to improve our confidence in climate model predictions. These experiments will also help to build a bridge between global climate modelling, very fine-scale modelling and conceptual or theoretical representations of the climate system. The benefits associated with each approach may complement each other in a constructive way.

Recommendations for Advancing Cloud-Climate Feedback Assessments

To foster the above activities, the CFMIP and GCSS communities, with the endorsement of the GEWEX Scientific Steering Group and the World Meteorological Organization (WMO) Commission for Atmospheric Sciences (CAS) Working Group on Numerical Experimentation (WGNE), have prepared a set of recommendations for advancing the assessment of cloud-climate feedbacks. Those recommendations were discussed at the last meeting of the WCRP Working Group on Coupled Modelling (WGCM) held in Paris, France, in September 2008, which led the WGCM to recommend that:

(1) COSP be used in a subset of the main numerical experiments that will be coordinated by the Coupled Model Intercomparison Project (CMIP) in support of the next IPCC assessment report;

(2) a few idealized experiments be included in the set of the next climate model intercomparison project (CMIP5) experiments; and

(3) additional cloud diagnostics proposed by CFMIP-GCSS be extracted from the models participating in CMIP5.

A broad scientific community interested in cloud studies, both on the modelling and observation sides, is keen to participate in this effort and contribute to advances in cloud-climate feedback assessments by the time of the Fifth Assessment Report of the IPCC. By that time and beyond, these initiatives will also benefit from and support GEWEX-WGNE joint efforts on the improvement of physical parameterizations in climate models.

References

Bodas-Salcedo, A., M. J. Webb, M. E. Brooks, M. A. Ringer, S. F. Milton, and D. R. Wilson, 2008. Evaluation of cloud systems in the Met Office global forecast model using CloudSat data. *J. Geophys. Res.* (in press).

Chepfer, H., S. Bony, D. Winker, M. Chiriaco, J.-L. Dufresne, and G. Seze, 2008. Use of CALIPSO lidar observations to evaluate the cloudiness simulated by a climate model. *Geophys. Res. Lett.*, 35, L15704.

Dufresne, J.-L., and S. Bony, 2008. An assessment of the primary sources of spread of global warming estimates from coupled ocean-atmosphere models. *J. Climate*, 21(19), 5135–5144.

Held, I. M., 2005. The gap between simulation and understanding in climate modelling. *Am. Met. Soc.*, Nov, 1609–1614.

Klein, S. A., and C. Jakob, 1999. Validation and sensitivities of frontal clouds simulated by the ECMWF model. *Mon.Wea.Rev.*, 127,2514–2531.

Medeiros, B., B. Stevens, I. M. Held, M. Zhao, D. L. Williamson, J. G. Olson, and C. S. Bretherton, 2008. Aquaplanets, climate sensitivity, and low clouds. *J. Climate*, 21, 4974–4991.

Randall, D. A., R. A. Wood, S. Bony, R. Colman, et al., 2007. Climate models and their evaluation. In: *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor, and H. L. Miller (Eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Webb, M., C. Senior, S. Bony, and J.-J. Morcrette, 2001. Combining ERBE and ISCCP data to assess clouds in the Hadley Centre, ECMWF and LMD atmospheric climate models. *Climate Dyn*, 17, 905–922.

Zhang, M., and C. Bretherton, 2008. Mechanisms of low cloud-climate feedback in idealized single-column simulations with the community atmospheric model, Version 3 (CAM3). *J. Climate*, 21, 4859–4878.

Meeting/Workshop Reports

WATCH/LoCo Workshop

25–27 June 2008
De Bilt, The Netherlands

Bart van den Hurk[1] and Eleanor Blyth[2]
[1]KNMI, De Bilt, The Netherlands; [2]Centre for Ecology and Hydrology (CEH) Wallingford, Oxfordshire, UK

The joint workshop of the European Union Water and Global Change (WATCH) Project and GEWEX Local Coupled Project (LoCo) Workshop brought together experts on hydrological land-atmosphere coupling to assess current knowledge of land-atmosphere coupling and develop plans for future studies. Research in modelling and observing the degree of land-atmosphere coupling and feedbacks on local and regional scales has been evolving since the start of the well-known GEWEX Global Land Atmospheric Coupling Experiment (GLACE). WATCH addresses hydrological land-atmosphere coupling, and LoCo under the GEWEX Global Land Atmosphere System Study is studying local land-atmosphere coupling to identify conditions or areas where land-atmosphere interaction has a significant impact on the local climate. LoCo also designs model intercomparison studies. Results from the workshop included a better definition of local coupling and an outline of an overview scientific paper on the topic.

A good conceptual definition of local land-atmosphere coupling involves the temporal and spatial scale of all land surface-related processes directly influencing the state of the Planetary Boundary Layer (PBL) (see figure on page 13). These processes include:

(1) direct moistening/drying and heating/cooling of the PBL, and the feedback exerted by this PBL change on the surface fluxes;

(2) impact of the change of the PBL depth or thermodynamic state on the formation/disappearance of PBL clouds (shallow cumulus) induced by land surface fluxes;

(3) triggering and fuelling of shallow or deep convection; and

(4) accumulation of hydrological anomalies in the soil water or snow reservoir, as well as the subsequent impacts of these surface states on the surface energy balance.

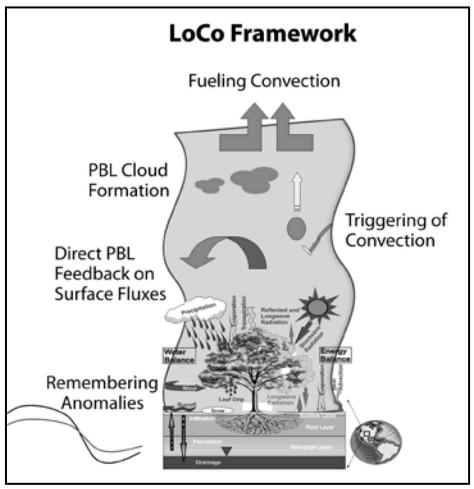
It was also recognized that many expressions of land-atmosphere coupling are not easily tied to the local scale, such as precipitation response to changing soil moisture in GLACE. Large-scale atmospheric circulation—under certain conditions—is also clearly affected by the state of the land surface. These examples are considered to be beyond the immediate scope of the LoCo theme. Each of the processes listed above is briefly discussed below, guided by the presentations and discussions that emerged during the workshop.

Direct Land-PBL Feedback

While evaporation clearly moistens the atmosphere, it does (partly) rely on the atmospheric demand for water, depending on the moisture condition: a straightforward feedback loop is evident. However, the state of the (well-mixed dry) PBL is not only dependent on the surface fluxes of heat and moisture but also on the overlying free atmosphere. Daytime PBL drying occurs due to a mixing-in of dry air, in spite of an upward surface moisture flux. This feedback needs to be considered when trying to estimate surface evaporation from simple environmental variables, like available energy (A) or vapor pressure deficit (D).

A number of diagnostics and concepts were discussed at the workshop. Jim Shuttleworth used the definitions of "climatological resistance" (defining the ratio between A and D) and the "area average surface resistance" to give a theoretical explanation for differences in trends between open water and actual evaporation rates, depending on the aridity of the climate. Compared to earlier concepts of the Priestly-Tailor coefficient or McNaughton's coupling coefficient, the role of PBL feedback in the characterization of the surface state is clear.

Likewise, Joe Santanello expanded on earlier work by Alan Betts by decomposing the diurnal evolution of the surface temperature and humidity into a surface driven and entrainment driven component. Pilot studies with the National Aeronautics and Space Administration's (NASA) Land Information System (LIS) were carried out to identify the impact of switching between a suite of land surface or PBL models. The diagnostic is also built into the Single Column Model (SCM) testbed environment developed by Roel Neggers, which is used more and more in GEWEX Cloud System Study (GCSS) and GEWEX Atmospheric Boundary Layer Study (GABLS) model intercomparison studies.



Cumulus Formation

Michael Ek cast the relative contribution of land wetness versus atmospheric entrainment nicely in an expression of the PBL relative humidity tendency. He performed SCM studies for a few special cases where PBL cloud formation appeared to be highly sensitive to both surface evaporation and atmospheric stability above the PBL. However, cloud formation (and its impact on surface radiation and conditional stability) is not well embedded in the diagnostics above, so more attention should be focused on these feedbacks in future diagnostic studies.

Triggering and Fuelling Convection

Although she was not present at the workshop, the work of Kirsten Findell proved a valuable component of the LoCo theme, particularly those pieces dealing with the creation of area maps and conditions where soil moisture values affect the formation of convection (Findell and Eltahir, 2003). SCM models were forced with observed atmospheric profiles that were used to identify when and where different soil moisture states were able to determine whether or not convection was triggered. Although in many cases convective triggering is not determined by the local soil moisture state, cases can be found where convection is preferably triggered over either moist or dry soils. Craig Ferguson expanded on this concept by calculating the Convective Triggering Potential (CTP) and the atmospheric dewpoint depression from Atmospheric Infrared Sounder satellite data as a first promising step to creating land-atmosphere feedback maps from spaceborne observations. In addition, he explored the correlations between soil moisture and Lifting Condensation Level (LCL) using Advanced Microwave Scanning Radiometer - Earth Observing System data.

On a somewhat smaller scale, Chris Taylor studied the formation and dynamics of Mesoscale Convection Systems in the Sahel region, depending on the spatially varying surface temperature pattern induced by earlier rain storms. He argues that convective triggering often takes place at the interface between wet and dry soil patches, where both a sufficient surface heating and further fuelling of the convective system with moisture occur. His work clearly points at the need to consider spatial variability as a contributor to convective activity and land-atmosphere feedback within the scope of LoCo.

Accumulation of Anomalies

The (hydrological) land state has a long memory; many observational and modelling studies have shown the importance of hydrological anomalies in the past to explain extreme conditions in the present. Local land-atmosphere interaction may turn into long-lasting positive feedback loops when critical thresholds are exceeded. Sonia Seneviratne used a plot of monthly mean surface evaporation /sensible heat versus a soil moisture index to demonstrate a clear difference in memory (causing hysteresis in the plot) for a Northern and Southern European Fluxnet site. This type of analysis can be used to evaluate the realism of land-atmosphere coupling representation in current climate models.

One of the ultimate goals of the LoCo community is to produce comprehensive global distributions of where and when the land surface and the atmosphere have a strong mutual feedback, either positive or negative. The importance of this work is demonstrated by Stefan Hagemann, who reviews the various pathways of land-atmosphere coupling and their representation in global climate models (GCMs) used for present-day and future climate calculations. Bernie Bisselink's precipitation recycling analysis made clear that on relatively short mutual distances within Europe, strong recycling is favored under very different climatological conditions. Since multiple diagnostics and processes are involved, multiple maps already exist. Randy Koster provided observational support of the earlier defined hotspots of land atmosphere coupling by pinpointing areas where the correlation between temperature and precipitation identifies regions where evaporation is both highly variable (by a variation in the degree to which it is controlled by radiation or soil water content) and highly coherent (expressing a strong surface control on the evaporation). Such hotspot regions are highly dynamic and are expected to be geographically shifted with climate change, as highlighted by Sonia Seneviratne. Richard de Jeu used satellite imagery of surface soil moisture to plot the global distribution of typical time scales of changes in soil moisture, another way to express the potential soil control on evaporation variability. Together with the remote sensing based maps of Craig Ferguson, a suite of coupling products will become available that highlights different aspects of the coupling: the PBL feedback (Betts' soil moisture LCL diagram), convective triggering, soil memory (satellite soil moisture), and pathways possibly including large-scale processes (Koster's coupling coefficient).

A global map with coupling strength diagnostics needs to incorporate these various coupling mechanisms. As a start, we propose to apply a hierarchy approach where the coupling pathway may be associated with an index, which is subsequently plotted. The first level of coupling is the direct PBL feedback, which may be expressed as the degree to which evaporation is sensitive to soil moisture. A positive feedback may emerge when low evaporation/high sensible heat flux may enhance PBL growth that leads to further drying and a higher Bowen ratio. A second level would cover the formation of PBL clouds and its radiative consequences. A positive feedback here might be a case where clouds develop at high moisture contents, reducing surface radiation, surface heating, and PBL growth and allowing for a further build-up of PBL humidity. The third level is the triggering of convection, which may show positive or negative feedback via the likelihood of generating precipitation that moistens the soil, as detailed by Findell and Taylor. Finally, level four expresses an overall hydrological feedback signature that is produced by the impact of land surface on precipitation, i.e., diagnosed from the coupling coefficient detailed by Koster.

What would such a map look like? Starting from the first level coupling, areas will be highlighted where changes in soil moisture do have a pronounced effect on the daytime PBL. For instance, the ratio between the surface and entrainment Bowen ratio diagnosed from Santanello's framework changes significantly for small soil moisture perturbations. Where this is not the case, a strong impact of land surface on the atmospheric state cannot be expected, and further analysis is not necessary. For areas where index 1 is significant, the second and third feedback via cloud formation or convective triggering can be tested. Likewise, a small soil moisture perturbation leads to cloud formation which is either shallow without rain (index 2) or deeper with possible rainfall (index 3). The formation of rainfall will at the end be labeled as index 4. If somewhere in the chain this feedback appears weak or even negative, a strong impact of (local) land state on (local) precipitation is not expected.

This framework is still maturing; a proof of concept will be examined using the NASA LIS coupled to the Weather Research Foundation atmospheric model featuring a suite of land, PBL and convection parameterization schemes. For a number of different climate regimes, a set of snapshot experiments will be set up and perturbation experiments applied to determine the hierarchy of coupling indices. If this setup is successful, we will extend it to the multi-year global scale. For more information, visit *http://www.knmi.nl/~hurkvd/LoCo_workshop_2008.html.*

References

Findell, K. L., and E. A. B. Eltahir, 2003. Atmospheric control on soil moisture-boundary layer interactions; Part I: Framework development. *J. Hydromet.* 4, 552–569.

10th BSRN Scientific Review and Workshop

De Bilt, The Netherlands
7–11 July 2008

Ellsworth Dutton[1] and Dawn Erlich[2]
[1]National Oceanic and Atmospheric Administration, Boulder, CO, USA; [2]International GEWEX Project Office, Silver Spring, MD, USA

More than 50 scientific talks and 20 posters were given at the tenth biennial Baseline Surface Radiation Network (BSRN) Scientific Review and Workshop, held at the Royal Netherlands Meteorological Institute (KNMI). Over 60 BSRN station managers, data users and experts in the field of surface radiation measurements attended.

Dr. Reinout Boers, KNMI, gave the first presentation, an overview of the observations and research activities at the Cabauw Experimental Site for Atmospheric Research (CESAR). In addition to its monitoring activities for BSRN, CESAR participates in other projects such as the GEWEX Coordinated Energy and Water Cycle Observations Project and the World Meteorological Organization (WMO) Global Atmosphere Watch Programme.

Gert König-Langlo of the Alfred Wegener Institute (AWI), reported on the progress of the relocation of the World Radiation Monitoring Center (WMRC), housing the BSRN data archive, from the Federal Institute of Technology Zurich to the Alfred Wegener Institute (AWI) in Bremerhaven, Germany. In June 2008, full responsibility for the operation of WRMC was transferred to AWI. Currently, the archive holds 4,032 station-months from 43 stations. Data can be accessed at *http://www.bsrn.awi.de.*

Four new BSRN sites are now operational in Brazil (Rolim de Moura, Brasília, Petrolina, and São Martinho da Serra), along with the two existing sites in Florianopolis and Balbina. The Florianopolis site is being moved to a new location outside the city and there is a proposal to move Balbina (now in the Amazon) to a Large-scale Biosphere Atmosphere Experiment in Amazonia site because its current location is too remote and hard to maintain. The National Renewable Energy Centre in Pamplona, Spain, and Eureka station in Nunavut, Canada, were approved as new BSRN stations.

Richard Thigpen, Global Climate Observing System (GCOS) Secretariat, reported on WMO Activities aimed at improving the operation of GCOS networks, mainly the surface (GSN) and upper air (GUAN) networks. Several upper air and surface stations have been renovated, and workshops focused on surface and upper air measurements have led to improved quality of observations. Four technical support projects have been established in developing areas to provide direct technical support to GCOS stations. Nine Commission for Basic Systems Lead Centers for GCOS have been established around the world to provide better coordination with operating stations.

The BSRN Project Manager noted that activities beyond basic data collection have been constrained during the past 2 years as a result of BSRN management focusing on the data archive transition, and also due to widespread tightening of budgets. Considerable work on other topics related to surface radiation and associated interests continues both within and outside BSRN. While there has long been an emphasis on the open publication of results obtained within the BSRN project, this meeting saw a renewed request that all substantial undertakings related to the organization—and particularly its working groups—should lead to and result in such publication or results needed to ensure that the work receives appropriate credit and will be readily available for future generations who will pursue this work.

It was noted that BSRN should consider providing a broader range of data products through its archive in order to be more responsive to its user community, and to extend the utility of the information acquired as part of the effort. Future guidance will be provided to the BSRN archive as to which products might be most useful.

Results were summarized from the International Workshop on Global Dimming and Brightening (GDB), held 10–14 February 2008 in Ein Gedi, Israel. In particular, BSRN is well positioned to address GDB issues, and was recognized as a world leader in surface radiation measurement activities. There was general agreement at the conference that longer, better spatially distributed surface radiation measurement records are needed, especially over the oceans. In addition, agreement was reached that the GDB phenomenon is real and that the next step is to determine the causes.

The Surface Radiation Budget Project has produced a continuous record of shortwave/longwave radiation data (SRB V3.0) for the top of the atmosphere as well as the Earth's surface at a 1° longitude by 1° latitude resolution for the time span of 23 years, from July 1983 to June 2006. The data are given at 3-hourly, 3-hourly-monthly, daily, and monthly means. Since these data are derived from satellite-based observations, it is important to validate the data set against ground-based measurements such as those of BSRN.

The culmination of several years' work as reported in three defining publications has resulted in a proposed reference group of pyranometers for diffuse solar irradiance. This work has established the certain accuracy uncertainty in diffuse solar irradiance observations, considering all the major known sources of uncertainty are found to be within 2–4 W/m^2. The work provides a reference through which current and future diffuse solar irradiance observations can be evaluated, although the work provides more for a methodology and set of evaluation criteria by which other independent approaches can be evaluated and related to the same level agreement.

Large uncertainties were still reported to exist in our knowledge of the Earth radiation balance and its representation in climate models. Accordingly, global mean radiation budgets simulated by climate models differ largely, particularly at the surface. BSRN data provide a unique opportunity to constrain these uncertainties. The data suggest that many models overestimate downward solar radiation and underestimate downward longwave radiation.

BSRN data also allowed the detection of widespread surface solar brightening since the early 1990s, after decades of dimming. Global climate model simulations performed at the Swiss Federal Institute of Technology (ETH) with the ECHAM5-HAM model suggest that brightening will turn back into a dimming in the coming decades, and downward longwave radiation will increase at 2–3 Wm^{-2} per decade. It will therefore be exciting to see what BSRN data will show over coming years, and whether they will support or disprove the model predictions.

Many additional focused papers were presented on the work of BSRN site scientists and other topics related to surface radiation observation and quantification. The meeting provides an excellent forum for these papers, where many of those in attendance share similar interests and often conduct related investigations. All presentations were directly related to some aspect of quantitative surface radiation determination, as well as the use and evaluation of that information. While there were too many presentations to review here, the complete agenda and most presentation materials are available on the BSRN website at *http://www.gewex.org/bsrn.html*.

As of early 2008, BSRN has 3,941 site-months of data in the archive from 39 ground sites located on all continents; the earliest data go all the way back to 1992. The measurements are made at 1-minute, 2-minute, 3-minute or 5-minute intervals. Considerable work is needed to process the BSRN data to make them comparable with the GEWEX SRB data. Additionally, the BSRN data files contain 11 quality flags for each data point. A procedure needs to be designed to appropriately use the information in order to exclude possibly erroneous data.

The exceptional hospitality of the KNMI staff, particularly Dr. Wouter Knap, in hosting the meeting and arranging for the site tour of the Cabauw Experimental Site for Atmospheric Research was greatly appreciated.

New Publication: Journal of Advances in Modelling Earth Systems (JAMES)

A new peer-reviewed international journal reporting on all aspects of Earth System Modelling is open for submissions. JAMES has sections for research articles, short topics, review articles, and a special section for articles on policy and science education related to climate science. JAMES is an open-access journal, so anyone with internet access can read and download articles at no cost.

See the JAMES web site for more details *at http://adv-model-earth-syst.org/*.

25th ISCCP Anniversary Symposium

23–25 July 2008
New York, NY, USA

William B. Rossow
NOAA/CREST, City College of New York, NY, USA

In July 2008, the International Satellite Cloud Climatology Project (ISCCP), the first project of the World Climate Research Programme, marked the 25th Anniversary of the beginning of data collection. Not bad for a project that originally was to last for only 5 years! The original concept for ISCCP was to collect and distribute enough global satellite data to facilitate research on the role of clouds in climate, specifically their effects on the radiation budget and their role in the atmospheric water cycle. These data were to be sampled at sufficiently fine space-time intervals to capture the mesoscale-to-global scale and diurnal-to-interannual variations of cloud physical properties.

In addition to calibrating, navigating, quality checking and distributing the satellite radiance data for the research community to use (one of the earliest projects to invest in more "user-friendly" Level 1 data), ISCCP conducted a comparison of the then-existing cloud algorithms and then processed the radiance data to provide several different cloud data products for research. After more research and evaluation results accumulated, the ISCCP analysis was revised, particularly to include a treatment for ice clouds. The ISCCP product line has continued to expand, now including radiative flux profiles, cloud particle sizes and several subsets concerning specific cloud system types (i.e., convective tracking, cyclone tracking, pattern recognition analysis for tropics and midlatitudes).

To celebrate this occasion, as well as to take stock of research progress and discuss plans for the future, a Symposium was held at the National Aeronautics and Space Administration (NASA) Goddard Institute for Space Studies (GISS), the Global Processing Center for ISCCP. About 40 scientists from six countries participated. The presentations are posted on the ISCCP website at: *http://isccp.giss.nasa.gov/index.html*.

Invited speakers began each topic session: J. Hansen (NASA GISS, *Clouds in Climate*); R. Schiffer [University of Maryland, Baltimore County, *International Satellite Cloud Climatology Project (ISCCP) Evolution from Lake Balaton to GEWEX*]; J.J. Bates [National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center, *Producing Climate Data Records*]; C. Stubenrauch [Laboratoire de Météorologie Dynamique, *Cloud Properties from Remote Sensing*]; A.D. Del Genio (NASA GISS, *Cloud Behavior from Remote Sensing*); E. Raschke (Hamburg University, *Cloud Effects on the Radiation Budget*); C. Kummerow [Colorado State Unicersity (CSU), *Clouds in the Hydrological Cycle*]; and G. Stephens (CSU, *New Frontiers in Cloud Remote Sensing*).

Three discussion sessions took place at the meeting, concerning: (1) making ISCCP "operational," (2) the way forward to understanding cloud-climate feedbacks and (3) future cloud research. One idea that was discussed for the operational version of ISCCP involved a more intimate merger of the imaging and sounding instruments on the polar orbiting satellites that form the anchor for the data set: several possible approaches were suggested. Another concern was about "operational" climate data set production, particuarly the need for continual evaluation (and correction if needed) by the research community. No clear way forward on cloud-climate feedback was identified, so it is clear that new analysis approaches need to be developed that can reduce the complexity of the problem without sacrificing the validity of the results. Some early steps along these lines were presented at the Symposium and many informal discussions took place during breaks about new approaches and collaborations. The discussion of the newer cloud measurements indicates that the next several years of research should produce important results; there were also discussions about how to combine results from many different kinds of instruments most effectively. In particular, the time resolution of the geostationary imaging measurements has to be combined with the more extensive spectral information and vertical profiling from polar orbiting instruments to construct a complete view of the dynamics of cloud systems.

The ISCCP products have now developed into one of the longest time records of global cloud variations and have become part of the Global Climate Observing System. Approval of continuing funding now makes it possible to switch the analysis from the 30-km sampled radiances to the 10-km sampled radiances, which will provide results at nearly the full (infrared) resolution and make the products statistically more robust for cloud process studies. While ISCCP was not originally designed as a "climate data record," with the record length growing there is more interest in that use. There are a number of features that make the current products less useful for that purpose, but approval has been obtained to re-engineer the ISCCP processing system to improve the quality enough to form a cloud Climate Data Record and to make the whole project "operational" to continue into the future.

Participants at the ISCCP Anniversary Symposium

GEWEX Executive and Joint CLIVAR-GEWEX Executive Meetings

25–26 August 2008
Silver Spring, Maryland USA

Peter van Oevelen
Director, International GEWEX Project Office, Silver Spring, MD, USA

The GEWEX Executive Meeting was hosted by the International GEWEX Project Office (IGPO). IGPO staff met with the three GEWEX Panel Chairs and the Chair of the Scientific Steering Group (SSG) to review GEWEX activities and planning based on guidance given by the SSG and the World Climate Research Programme (WCRP) Joint Scientific Council. Following the GEWEX Executive Meeting, IGPO hosted a 2-day joint meeting with the Climate Variability and Predictability Project (CLIVAR) Executive members to discuss current and future collaboration between the two programs and their roles within WCRP for the next 2 to 5 years.

During the GEWEX Executive Meeting, the GEWEX Panels presented their progress and future plans, emphasizing cross-panel cooperation. While we are clearly on the right track as we tighten links between the panels, much can still be done. Discussions included how to strengthen the ways in which modelling development completed by the GEWEX Modelling and Prediction Panel relates to modelling activities completed by other GEWEX projects and working groups, particularly in acquiring clarity on matters such as model parameterization and model improvement activities versus model diagnostics. One of the challenges for the GEWEX Radiation Panel (GRP) is how to create data sets from the latest observing systems that enhance rather than replace long time series such as the International Satellite Cloud Climatology Project. To address this issue GRP is looking at "families" of products that each serve distinct needs but share underlying properties. Under the Coordinated Energy and Water Cycle Observations Project (CEOP), the GEWEX Panel for hydroclimate studies, work on a Multi-Model Analysis for CEOP to produce an ensemble mean and variance data set to support CEOP science activities was presented. Both CEOP co-chairs also showed how CEOP has been progressing since the its merger with the GEWEX Hydrometeorology Panel in 2007.

At the joint GEWEX/CLIVAR Executive Meeting, two primary issues were addressed. The first, how to implement WCRP crosscuts—in particular, Monsoons and Extremes. For the crosscuts it was agreed that a new panel or steering group would be counterproductive and difficult to manage for both projects. Instead, the idea to have short-term (1–3 year) thrusts focusing on tangible tasks that address a specific aspect of monsoons or extremes was deemed very useful and feasible. These so-called foci would be led by a small team of dedicated scientists involved in the actual work. The joint executive proposed to bring this idea forward during the Pan-WCRP Monsoon meeting held in Beijing, China, on 20–25 October 2008. For the extremes crosscut, Ronald Stewart and David Legler took up the challenge to work this out with respect to droughts.

The second issue focused on a strategy for the production of a "legacy document" in which each program addresses its vision with respect to the future of WCRP as a whole. GEWEX will take a two-tier approach in which its panels and working groups will be asked to contribute to a document much like the GEWEX Phase I Accomplishment Brochure (*http://gewex.org/GEWEXAccompBroc.pdf*) that contains short descriptions of the areas where significant advancements have been made and the challenges that have been addressed. The second step will look forward, both in the relative short to medium timeframe of 2–5 years and the longer term (beyond 2013). An overview will be assembled based upon the input from the GEWEX community in which the research areas and activities that need to be instigated, continued or phased out will be presented, along with a rationale. The challenges that remain or that have not yet been addressed will be presented as well. The collection of the legacy documents from all the WCRP-involved projects will serve as the basis for discussions related to future WCRP plans.

The GEWEX and CLIVAR Executive members reiterated their intention to continue working together to serve the international research community.

Participants at the GEWEX Executive and Joint CLIVAR-GEWEX Executive Meetings

2nd CEOP Annual Meeting

15–17 September 2008
Geneva, Switzerland

Sam Benedict
International GEWEX Project Office, Silver Spring, MD, USA

The meeting, hosted by the World Climate Research Programme (WCRP), focused on the finalization of the Scientific Implementation Plan (SIP) for the GEWEX Coordinated Energy and Water Cycle Observations Project (CEOP). The SIP and copies of all of the meeting presentation materials—including abstracts of talks and posters—are available at the CEOP home page: *http://www.ceop.net*.

In his opening talk, Dr. Ghassem Asrar, the Director of WCRP, noted that since CEOP assumed responsibility for all GEWEX hydroclimate activities in 2007, the Project has accepted a new role in undertaking unique scientific studies and promoting research on the use of model prediction ensembles and associated statistics by comparing them with observations, and making these results available to other researchers for further analysis. CEOP has also devoted considerable efforts and resources to assemble and make available sustained regional reference observations of key meteorological and radiation parameters, together with analysis tools and methods, standards for archiving, distributing, analysis and visualization of these observations for scientists around the world. In this context CEOP is encouraged to continue its focus on contributions to GEWEX that support WCRP mission objectives as established in the WCRP Strategic Framework 2005–2015: to "support climate-related decision making and planning adaptation to climate change by developing science required to improve climate predictions, the understanding of human influence on climate, and use this scientific knowledge in an increasing range of practical applications of direct relevance, benefit and value to society."

In his presentation, the Chairman of the GEWEX Scientific Steering Group called on CEOP to contribute significantly more to major efforts that are underway to reduce uncertainties associated with the climatically sensitive and key hydrological processes in regions where CEOP is active, and ensure their proper representation in the climate system models.

Also addressed at the meeting was the Global Earth Observation System of Systems (GEOSS) 10-Year Implementation Plan Reference Document, which states that CEOP should be considered as a prototype of GEOSS. Recognizing this as an ultimate achievement of CEOP, part of the meeting was organized around this theme with the intent of showing the unique nature of the collaboration between CEOP, the international group of numerical weather prediction centers, and the broader climate research community represented by the World Meteorological Organization, WCRP and GEWEX as they all move toward the implementation of GEOSS.

In this context, the Senior Scientific Expert for the Group on Earth Observations (GEO) water activities recommended that CEOP pay close attention to actions related to its contributions to Water Task WA-06-02 (Droughts, Floods and Water Resource Management) and Water Task WA-08-01 (Integrated Products for Water Resource Management and Research) in the near term (2009–2011). CEOP will meet its commitments to GEO by maintaining its continued efforts to improve models and enhance the quality and integration of important hydroclimate data sets. Additionally, CEOP will make an immediate contribution to the GEO Portal, a web-based interface for searching and accessing the data, information, imagery, services and applications at *http://www.earthobservations.org*.

The presentations and breakout periods organized at the meeting emphasized the expansion of the scope of CEOP science activities. In addition to the Regional Hydroclimate Projects (RHPs), CEOP includes groups focused on studies in high elevations, monsoon, extremes, cold regions and semi-arid regions. A special session associated with the CEOP Monsoons Study showed how it is synergistic with the overall WCRP Monsoon Crosscut Initiative. A special session on the CEOP High Elevation Study identified the possibility of organizing a global high elevation watch period. The review of CEOP Extremes studies showed that CEOP will continue to focus on drought, heavy precipitation, floods and low flows, including (in some instances) the intermeshing of these extremes. At the same time the links between the CEOP Cold Regions Study and several RHPs were clearly identified. This work will also be coordinated with the WCRP Climate and Cryosphere (CliC) Project. A review of semi-arid regions studies showed progress on meeting the goals established for this element of CEOP.

Participants at the 2nd Annual CEOP Meeting

The talks also showed that CEOP science continues to provide a traditional focus on Water and Energy budgets, which will extend efforts to understand average conditions as well as conditions during the entire CEOP period. The other CEOP science efforts reviewed at the meeting included a study of the influence of aerosols and the study of water isotopes. A review of CEOP modelling efforts was also undertaken at the meeting including explicit global, regional, land surface, and Hydrologic Applications Project (HAP) reports. All of these modelling groups are looking at an ensemble of international models in many different regions focused on the CEOP reference sites that were described at the meeting, along with the CEOP satellite data set during a review of the CEOP Data Management component. With respect to the data issues facing CEOP, it was concluded that a systematic effort was needed to match this expanded CEOP science framework with new and better specialized data sets and data integration tools. This led to a number of points of discussion associated with the need for:

(1) Better data sets and data integration tools with increased focus on defining and generating new multi-sensor, multi-scale integrated data sets.

(2) CEOP to aggressively pursue the fulfillment of commitments made by international participants in CEOP to provide, validate, archive and stage the complete baseline data set prescribed in the initial CEOP requirements.

(3) CEOP to maintain its relationship with data archive centers at the University Corporation for Atmospheric Research, the Max-Planck Institute, the Japan Aerospace Exploration Agency and the University of Tokyo.

(4) CEOP Co-Chairs to ensure that space agencies—through the Committee on Earth Observation Satellites and other important funding groups—are encouraged to actively support the CEOP implementation process.

(5) CEOP to coordinate Regional Hydroclimate Projects efforts in the provision and integration of the new data types necessary to achieve CEOP science objectives.

(6) Cooperation with other groups within WCRP and GEWEX that are producing specialized data sets necessary to meet the CEOP data set requirements.

The 3rd Annual CEOP Meeting is scheduled to be held 19–21 August 2009 in Melbourne, Australia, prior to the parallel GEWEX and Integrated Land Ecosystem-Atmospheric Processes Study Science Conferences with joint sessions being held the following week.

GEWEX/WCRP Meetings Calendar

For a complete listing of meetings, see the GEWEX web site: http://www.gewex.org

1–5 December 2008—**International Conference on Water Scarcity, Global Changes, and Groundwater Management Responses**—Irvine, California, USA.

9–12 December 2008—**Arctic Change 2008 Meeting: Measurements and Numerical Modelling of Precipitation in Cold Climates**—Quebec City, Quebec, Canada.

11 December 2008—**1st Workshop of the IGCP 565 Project "Developing the Global Geodetic Observing System into a Monitoring System for the Global Water Cycle"**—San Francisco, California, USA.

15–19 December 2008—**AGU Fall Meeting**—San Francisco, California, USA.

11–15 January 2009—**89th AMS Annual Meeting**—Phoenix, Arizona, USA.

19–23 January 2009—**GEWEX Scientific Steering Group Meeting**—Irvine, California, USA.

11–12 March 2009—**3rd Meeting of the International Soil Moisture Working Group**—Lisbon, Portugal.

16–22 March 2009—**The 5th World Water Forum**—Istanbul, Turkey.

6–9 April 2009—**13th Session of the WCRP Joint Scientific Committee**—College Park, Maryland, USA.

4–8 May 2009—**2nd Lund Regional-Scale Climate Modelling Workshop: 21st Century Challenges in Regional Climate Modelling**—Lund, Sweden.

25–28 May 2009—**International Conference on Climate Change: The Environmental and Socio-Economic Response in the Southern Baltic Region**—Szczecin, Poland.

7–11 July 2009—**IGARSS 2009**—Cape Town, South Africa.

20–24 July 2009—**3rd International AMMA Conference**—Ouagadougou, Burkina Faso.

24–28 August 2009—**6th International Scientific Conference on the Global Energy and Water Cycle and 2nd iLEAPS Science Conference**—Melbourne, Australia.

GEWEX NEWS

Published by the International GEWEX Project Office

Peter J. van Oevelen, Director
Dawn P. Erlich, Editor
Cathryn E. Kulat, Assistant Editor

International GEWEX Project Office
8403 Colesville Rd, Suite 1550
Silver Spring, MD 20910, USA

Tel: 240-485-1855
Fax: 240-485-1818
E-mail: *gewex@gewex.org*
Web Site: *http://www.gewex.org*

CALL FOR PAPERS

Parallel Science Conferences with Joint Sessions

Water in a Changing Climate

Progress in Land-Atmosphere Interactions and Energy/Water Cycle Research

24-28 August 2009 — Melbourne, Australia

The **Sixth International Scientific Conference on the Global Energy and Water Cycle** and the **Second Integrated Land Ecosystem-Atmosphere Processes Study (iLEAPS) Science Conference** are holding joint sessions to present and discuss the latest scientific developments in the areas of water, energy, and biogeochemical cycles through keynote talks and oral and poster presentations.

The venue will provide an opportunity for cross-fertilization efforts between the sciences represented by GEWEX, as part of the World Climate Research Programme (WCRP), and iLEAPS, as part of the International Geosphere-Biosphere Programme (IGBP), in addressing present and future climate and global change challenges.

Papers are invited for all sessions of the GEWEX and iLEAPS conferences as well as for the following joint session themes: (1) Land in the Climate System; (2) Aerosol, Cloud, Precipitation and Climate Interactions; and (3) Future Generation of Integrated Observation and Modelling Systems.

For a full description of the conferences, joint sessions, program updates, and to submit an abstract, see:

http://www.gewex.org/2009gewex_ileaps_conf.html

ABSTRACTS DUE: 15 January 2009

Preliminary Program and Co-Chairs

Sixth International Scientific Conference on the Global Energy and Water Cycle

Sunday, 23 August 2009
Early Registration

Monday, 24 August 2009
Registration

Introductions

Keynote Speakers
- Prof. Roger R. Pielke, Jr., CIRES
- Prof. John Thwaites, Monash Sustainability Institute

(others to be confirmed)

Session 1: Regional Forecasting and Predictions for Hydrological Applications in Arid Zones
(S. Sorooshian, UCI; A. Lipponen, UNESCO)

Session 2: Rainfall Variability and Drought in Australia
(A. Pitman, UNSW; N. Nicholls, BMRC)

Tuesday, 25 August 2009
John Roads Symposium: Prediction, Reanalyses and Regional Downscaling

Session 3: Modern Era Reanalyses
(M.Bosilovich, NASA/GSFC; S. Uppala, ECMWF)

Session 4: Climate Prediction Systems
(J. Hurrell, CLIVAR; S. Schubert, NASA/GSFC)

Session 5: Regional Downscaling
(B.Rockel, ICTS; L. Mearns, NARCCAP)

Session 6: Regional Hydroclimate Projects and Studies
(J. Huang, CPPA; R. Stewart, University of Manitoba)

Wednesday, 26 August 26 2009
GEWEX/iLEAPS Joint Sessions*

Session A: Land in the Climate System
(R. Koster, NASA/GSFC; J. Kim, Yonsei University)

Session B: Aerosol, Cloud, Precipitation, Climate Interactions
(W. Lau, NASA/GSFC; T. Ackerman, JISAO)

Session C: Future Generation of Integrated Observation and Modelling Systems *(M. Miller, ECMWF; K. Trenberth, NCAR)*

Thursday, 27 August 2009

Session 7: Observing Surface Fluxes: From Local to Global Scales
(J. Finnigan, CSIRO; C. A. Clayson, FSU)

Session 8: Multiscale Properties of the Tropical Energy and Water Cycles: From Thunderstorms to Monsoons
(H. Hendon, CAWCR; T. Yasunari, HyARC)

Session 9: Advances in the Representation of the Energy and Water Cycle in Models *(D. Randall, CSU; G. Feingold (NOAA/ESRL)*

Session 10: Cloud Climate Feedbacks
(W. Rossow, CREST/City College of NY; R. Colman, BMRC)

Friday, 28 August 2009

Session 11: The Role of Integrated Observing Systems in Closing Regional and Global Water and Energy Budgets
(T. Koike, University of Tokyo; P. Ingmann, ESA-ESTEC)

Session 12: Climate Change and Global Precipitation
(P. Siebesma, KNMI; C. Kummerow, CSU)

Conference Close

*Note: only GEWEX co-chairs are listed per session.
See conference website for iLEAPS sessions and co-chairs.