Global Energy and Water Cycle Experiment

GEWEX NEWS

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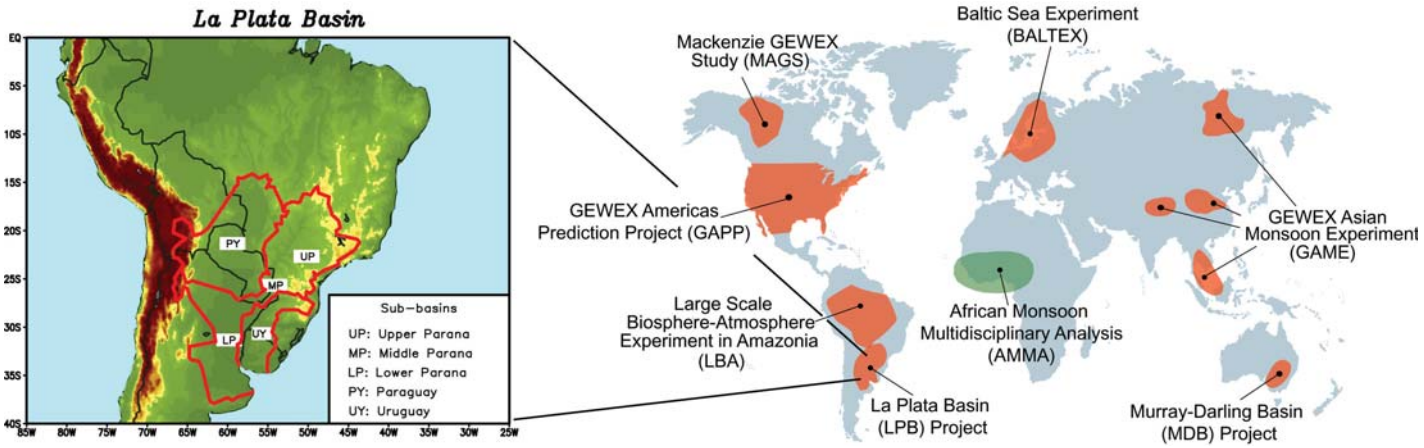
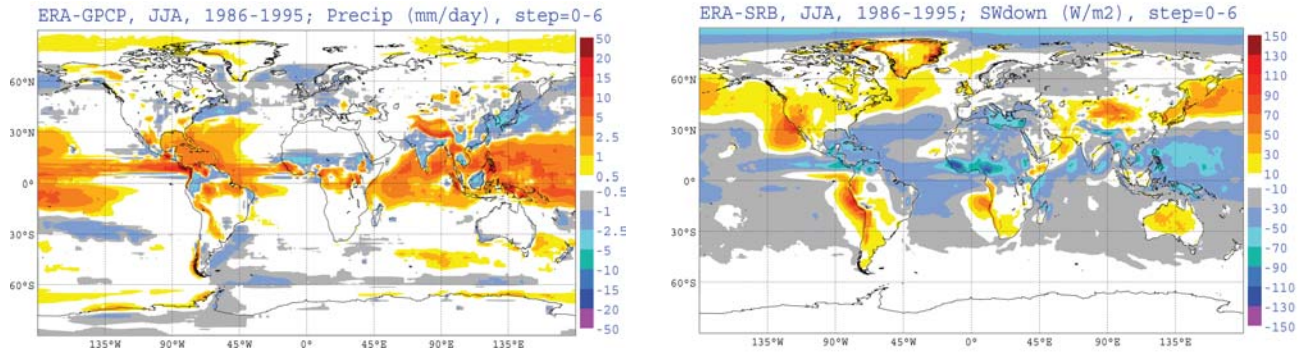
World Climate Research Programme–WCRP

INTERNATIONAL PARTNER (GEF) SPONSORS STUDY OF THE NEWEST GEWEX CSE BASIN *(See Page 4)*



GEWEX GLOBAL SATELLITE-BASED DATA (ISCCP, GPCP AND SRB) USED TO ASSESS ERA-40 PRODUCTS IN THE NEW ISLSCP II COMPILATION



Difference fields from ERA-40 with GPCP (left panel) and ISCCP derived SRB (shortwave-SW) products (right panel) show realistic representations of the seasonal fields on a global scale, with higher model precipitation and more (optically thick) clouds in the tropical regions. See article on Page 9.

What's New

- **5th International Scientific Conference on the Global Energy and Water Cycle June 20-24, 2005 Orange County, California**
- **BSRN is New GCOS Baseline Network**
- **New GMPP Focus on Diurnal Cycle**
- **ESA to Fund a European GEWEX Coordinator for the IGPO**

COMMENTARY

GEWEX SSG MEETING REAFFIRMS DIRECTIONS FOR PHASE 2

Soroosh Sorooshian, Chairman
GEWEX Scientific Steering Group

At the 16th annual GEWEX SSG meeting held in Marrakech, Morocco in January, considerable progress was made in a number of areas that bear on plans for the future of GEWEX. In view of programmatic pressures we will need to structure the program to be more effective in achieving our goals and at the same time produce "spin-offs" that contribute to the goals of other global environmental programs. While an overall report of the SSG meeting will be given in the May issue of GEWEX News, I would like to reflect on the progress we are making and the areas where GEWEX could be strengthened.

The enthusiastic response of our host country, Morroco, was a good indicator that Africa wants to be a player in GEWEX. M. Mohamed El Yazghi, Ministre de l'Aménagement du Territoire, de l'Eau et de l'Environnement, in his opening remarks emphasized the importance of both regional and global water budgets for his country's water problems. Similar problems exist in many countries in Africa. This interest, combined with the joint GEWEX/Climate Variability and Predictability Programme (CLIVAR) initiative, and the Africa Monsoon Multidisciplinary Analysis (AMMA), holds promise of being able to deliver significant progress on problems in this part of the world.

Our plans for the second phase of GEWEX will make the next 8 years a demanding period for the GEWEX science community. By accepting 2012 as the end date for GEWEX Phase 2, we have committed ourselves to a more focussed program directed at achieving our stated goals and objectives. To contribute to an improved predictive capability by 2012, we need to focus on areas where we can make the greatest contribution (improved modeling of the land surface and clouds to enable better representation and prediction of the diurnal cycle and precipitation) and to collaborate with CLIVAR and other WCRP programs. The adoption of the GEWEX/CLIVAR/Variability of the American Monsoon Systems (VAMOS) La Plata Basin Project in South America as a new Continental Scale Experiment (CSE) is an important new collaboration.

I have been heartened by a number of GEWEX's successes in the past year. The Baseline Surface Radiation Network (BSRN) has grown from a few dispersed radiation sites to a network that the Global Climate Observing System (GCOS) is now seeking to incorporate as their base radiation network. I would argue that this progress only could have happened through a coordinated international research program that focuses activities in many different nations on common research and observational objectives. The use of long-term satellite records in the analysis of trends in clouds and precipitation marks another milestone and makes our work central to many information needs arising in the next round of the Intergovernmental Panel on Climate Change (IPCC) discussions and reports. I hope investigators will participate in the 5th International Scientific Conference on the Global Energy and Water Cycle (Orange County, California, June 20–24, 2005) to present more of their successes.

As we move forward in Phase 2, it will be necessary to re-examine some of the approaches that have been fundamental to our program in the past. The International Satellite Land-Surface Climatology Project (ISLSCP) is a case in point. While in the past, ISLSCP endeavors (e.g., First ISLSCP Field Experiment, Boreal Ecosystems-Atmosphere Study, Initiative I and II) have yielded significant beneficial results, the continuation of producing compilations of diverse data sets that were of value to modelers, analysts and educators may have to be reassessed. Other roles for GEWEX, such as product intercomparisons, also may need to be considered. In addition, some of the CSEs are now nearly 10 years old and may need to re-examine their role in GEWEX with a view to possibly restructuring their goals and scope.

I think the incoming year will be an exciting one for all of us. We need to build on our past successes and be open to the new opportunities that surround us as we increase the integration of GEWEX activities and focus our efforts on the Phase 2 objectives.

Contents

RECENT NEWS OF RELEVANCE TO GEWEX

NASA Approves HYDROS

In December 2003, the National Aeronautics and Space Administration (NASA) announced that it had approved the Hydrosphere State (HYDROS) Soil Moisture Mission. This effort marks the culmination of the efforts of a number of members of our community, including Drs. Dara Entekhabi, Eni Njoku and Paul Houser. The new mission promises to provide new soil moisture measurements on a global basis. These data will be used in the development of land surface schemes and regional and global climate models. HYDROS will support the work of the GEWEX Modeling and Prediction Panel, as well as the activities of many of the Continental-Scale Experiments.

New SRB Data Set Available

A 12-year-plus (July 1983 to October 1995) global data set of surface shortwave (SW) and longwave (LW) radiative parameters on a 1°x1° grid has been developed and publicly released by the NASA/GEWEX Surface Radiation Budget (SRB) Project. Both SW and LW fluxes were computed with two algorithms: a primary algorithm and a quality-check algorithm. Cloud properties used in the project were derived on a 1° resolution using ISCCP pixel-level (DX) data sets. Other meteorological inputs, namely, the temperature and humidity profiles, were taken from the GEOS-1 reanalysis product of the Global Modeling and Assimilation Office at NASA/Goddard Space Flight Center. Ozone data were obtained from the Total Ozone Mapping Spectrometer (TOMS) archives. Three of the four algorithms provide results on a 3-hourly temporal resolution. The quality-check SW algorithm provides daily values only. All data sets were processed into daily and monthly averages for use in scientific studies. All except quality-check SW data were also processed into monthly/3-hourly averages.

The data, read files and read software are available through the NASA/Langley Atmospheric Science Data Center at: http://eosweb.larc.nasa.gov/. More information about the data set release can be obtained by contacting Dr. Paul Stackhouse at NASA Langley Research Center (Paul.W.Stackhouse@nasa.gov).

European GEWEX Coordinator

GEWEX welcomes the news that the European Space Agency (ESA) has agreed to fund and host a European GEWEX coordinator. The coordinator will spend 50 percent of his/her time working for the International GEWEX Project Office to support the development of GEWEX activities in Europe. The rest of their time will be spent coordinating ESA water cycle and hydrologic activities. It is expected that the staffing of the position will occur mid-2004. For more details, contact Rick Lawford (gewex@gewex.org) or Einar Arne Herland (Einar-Arne.Herland@esa.int).

MARK YOUR CALENDAR

5TH INTERNATIONAL SCIENTIFIC CONFERENCE ON THE GLOBAL ENERGY AND WATER CYCLE

June 20–24, 2005
Orange County, California

Observing and Predicting the Earth's Water and Energy Cycle: Current State of Knowledge and Future Research Requirements

Scientific Themes:

- The role of clouds and their effects on radiation budgets in climate prediction.
- Use of predictions of water cycle variables in water management.
- Data and analysis for understanding feedback processes in the water and energy budgets.
- The role of modeling predictability and prediction studies.
- New strategies for characterizing and predicting energy and water budgets.
- Measuring precipitation from space and on land.

THE WATER CYCLE OF LA PLATA BASIN AT REGIONAL SCALES

E. Hugo Berbery,[1] Estela A. Collini,[2] Viviane Silva,[1] Malaquias Peña,[1] Dennis L. Lettenmaier,[3] Vicente R. Barros,[4] Matthew Pyle[5]

[1]Department of Meteorology/ESSIC, University of Maryland, [2]Argentine Naval Weather Service/Argentine Hydrographical Service, [3]Department of Civil Engineering, University of Washington, [4]Department of Atmospheric and Oceanic Sciences, University of Buenos Aires, [5]National Centers for Environmental Prediction/NOAA

Editor's Note: At the annual GEWEX Scientific Steering Group Meeting, the La Plata Basin (LPB) was accepted as a new GEWEX Continental-Scale Experiment (CSE). This success was due in measure to the efforts of the authors and their transferability studies in the LPB. This work, along with the efforts of other experts, including Profs. Carlos R. Mechoso (University of California, Los Angeles) and Pedro Silva Dias (University of Sao Paulo), have led to the Global Environmental Facility granting funds for a study of the basin.

One of the most populated regions in South America is in the subtropics, a water rich region that is subject to significant climate variability. The regional economies hinge on vital water resources, which are significantly affected by that variability. South America is also undergoing a fast and large-scale process of land use change, and despite some modeling studies, its long-term effects are not known. The subtropical region encompasses LPB (see Page 1) whose mean annual discharge is second only to the Amazon Basin in South America, and fifth in the world. The basin is a combination of the Paraná, Paraguay, and Uruguay Rivers, each with its own distinct behavior and its own response to climate variability. See Berbery and Barros (2002) for a recent description of the main components of the La Plata's hydrologic cycle.

Research on climate and hydrology of the basin are at the intersection of the World Climate Research Programme (WCRP) initiatives for the Climate Variability and Predictability Programme (CLIVAR) and GEWEX in South America. In particular, the Variability of the American Monsoon Systems (VAMOS) Panel appointed a Scientific Study Group known as PLATIN, whose first activity was to develop a science plan for the basin (Baethgen et al., 2001). GEWEX research in this basin was initiated through transferability studies from the GEWEX Americas Prediction Project (GAPP) and its focus on data rich regions (Mississippi River Basin) to data sparse regions (LPB). *This note exemplifies the advances in estimating the water cycle over the LPB using a conceptual model developed for the Mississippi River Basin from regional products.*

The mesoscale regional model employed for this activity is an adaptation to South America of the current Eta model used at the National Centers for Environmental Prediction (NCEP) for their operational short-term forecasts over North America. The latest upgrades to physical parameterizations and the model land component (with four soil layers), now referred to as the "Noah" land surface model, are documented by Ek et al. (2003). Evaluations of the Eta model for hydrometeorological studies were discussed recently by Berbery et al. (2003) for North America, and Berbery and Collini (2000) for South America. Since July 2000, NCEP's Eta model is routinely run at the University of Maryland (http://www.atmos.umd.edu/~berbery/etasam). The resulting short-term forecasts constitute a database of regional products that are employed here to estimate the water cycle of LPB.

The annual means of the main components of the atmospheric hydrologic cycle are presented in Figure 1 at the top of page 16. Moisture flux is supplied to the basin directly from the tropics across the northern boundary, and via a "river of moisture" east of the Andes that crosses the middle of the basin from northwest to the southeast (Figure 1a). This stream has a low-level jet embedded, which unlike in other parts of the world, is present throughout the year (Berbery and Barros, 2002). Large moisture flux convergence (MFC) associated with these fluxes is found both toward the north and east of the basin (Figure 1b). The mean precipitation pattern (Figure 1c) is similar to the structure of the moisture flux convergence, highlighting the importance of advective processes for the basin. Evaporation (Figure 1d), on the other hand, has a continuous increase toward the north, affecting mostly the Paraguay and Upper Paraná sub-basins.

Figure 2a on page 5 shows that during this period, the time series of basin-averaged model forecast precipitation followed closely the observed estimate, although some differences exist during the 2002/2003 austral summer. The quality of the observations remains to be determined as they come from real-time weather reports. The model evaporation is about 1.5 mm day^{-1} smaller than precipitation during the austral summer (suggesting moisture flux convergence) but exceeds precipitation during the austral winter. The above results suggest that convergence of moisture flux dominates during the summer, while a slight divergence is noticed during winter. This behavior is verified from the actual computation of vertically integrated MFC (Figure 2b), whose evolution is very similar to that of P-E. Notice also that the residue

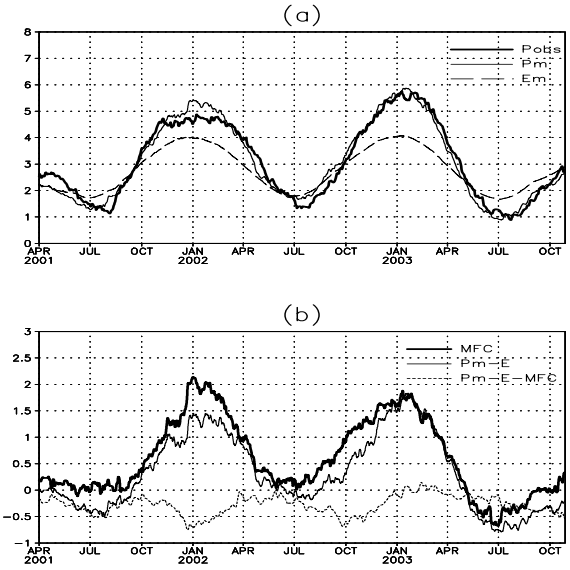


Figure 2. Time series of (a) basin-averaged observed and model precipitation, and evaporation, (b) basin-averaged moisture flux convergence, P-E, and their difference (P-E-MFC).

of the water balance equation (not including the local changes of water content) is smaller in magnitude than any of the components.

Table 1 below summarizes the atmospheric hydrologic cycle for the period April 2001–October 2003. There is a remarkable agreement between observed and forecasted precipitation; however, a cautious assessment will include further evaluation of the uncertainties in both the model and the observed estimates. The slight imbalance between P-E and MFC is partly due to not including the local changes of atmospheric water content. Nevertheless, this term is expected to be small, and indeed even if the water balance can be estimated with an uncertainty of about 0.3 mm day^{-1}, by itself this is a promising result for future activities. Comparisons of P-E or MFC with river discharge are the ultimate verification. According to Berbery and Barros (2002), the long-term river discharge is 21,000 m^{3}s^{-1}, which is equivalent to 0.61 mm day^{-1}. If these values are representative of the more recent period covered by the model products, then the model produces a correct value for MFC and in turn it suggests that the model overestimates evaporation by about 0.2–0.3 mm day^{-1} in the annual average.

Table 1. La Plata mean water cycle

	mm day^{-1}
Observed Precipitation	3.08
Model precipitation	3.09
Model evaporation	2.76
Moisture flux convergence (MFC)	0.60
Pm - Em	0.33
Pm - Em - MFC	-0.28

In view of these results, we are employing the Eta model for seasonal simulations over South America, and, in particular, to assess the effect of lower boundary conditions on the precipitation processes affecting LPB. Results indicate that the model is stable and does not drift to a different climate. In a second area of research, the Variable Infiltration Capacity (VIC) model (Liang et al., 1994; Nijssen et al., 2001) of the University of Washington has been adapted to LPB and is being given Eta model products as inputs to develop time series of simulated river discharge; the goal is to develop a regional hydrometeorological modeling system that can be employed for studies of regional climate variability and its impacts on water resources.

Acknowledgments

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BSRN IDENTIFIED AS A GCOS BASELINE NETWORK

Ellsworth G. Dutton
NOAA/CMDL

The GEWEX Baseline Surface Radiation Network (BSRN) has been invited to contribute to the Global Climate Observing System (GCOS) global baseline network system. BSRN has agreed to participate with GCOS in this capacity. In order to be designated as a GCOS baseline network, it is expected that the network will abide by the ten climate monitoring principles developed by GCOS. BSRN has reviewed its operations to evaluate its compatibility with the monitoring principles and GCOS has agreed that BSRN's fundamental operation and inherent value satisfy the requirements for a GCOS global baseline surface radiation network. BSRN will continue to function as a research project of GEWEX and will be identified within GCOS as the GEWEX/BSRN.

BSRN was formed under the auspices of the World Climate Research Programme (WCRP) in 1988 for the purpose of acquiring ground-based surface irradiances of the highest possible quality for use by WCRP supported projects. BSRN began by inviting participation of World Meteorological Organization (WMO) member nations that had demonstrated expertise in the area of surface irradiance measurement to participate in the new network with a contribution of appropriate observing sites. In addition, there would be a commitment of a portion of the radiation expert's time and resources to help develop and perpetuate the network. The project was initiated with two evaluations, first to determine the required measurement accuracies, and secondly to identify the present measurement capabilities. The next step was to specify measurement techniques, including calibration methods and reference standards that would be required to meet the research needs for these data. Measurements at nine widely distributed BSRN sites began in 1992. A central data archive was established in Zurich, Switzerland at the Swiss Technical Institute, ETHZ.

As of January, 2,561 station months of surface irradiance data from 35 sites have been acquired according to BSRN specifications and have been submitted to and accepted by the archive. BSRN continues to concentrate on expanding the network into under-represented regions and to promote general advances and improvements to irradiance measurement capabilities, especially in the development of internationally recognized measurement reference standards. For additional information and access to the BSRN data, see http://bsrn.ethz.ch.

ICE SUPERSATURATION IN THE UPPER TROPOSPHERE

Klaus Gierens and Ulrich Schumann

DLR, Institute of Atmospheric Physics, Oberpfaffenhofen, Germany

In recent years it has become evident that the relative humidity with respect to the ice phase of water (RHi) in the upper troposphere (UT) is often above saturation (i.e., RHi > 100 %). Regions containing air masses with RHi > 100 % have been termed "ice-supersaturated regions" (ISSR) (Detwiler and Pratt, 1984; Gierens et al., 1999). As a phenomenon in the water vapor field, essential for weather and climate, and because of their importance as cirrus formation regions, ISSRs should be a topic both in the GEWEX Global Water Vapor Project and the GEWEX Cloud System Study.

Although the first detection of ice supersaturation in the UT dates back at least to the 1940s, it was generally believed that ice supersaturation occurs only exceptionally and that clouds of ice particles form soon after the humidity exceeds saturation. Also, most weather and climate models still assume that cirrus clouds form immediately when the humidity reaches ice saturation. Examples include the operational weather prediction model of the European Centre for Medium-Range Weather Forecasts (ECMWF) and climate models derived from it (see figure on page 7).

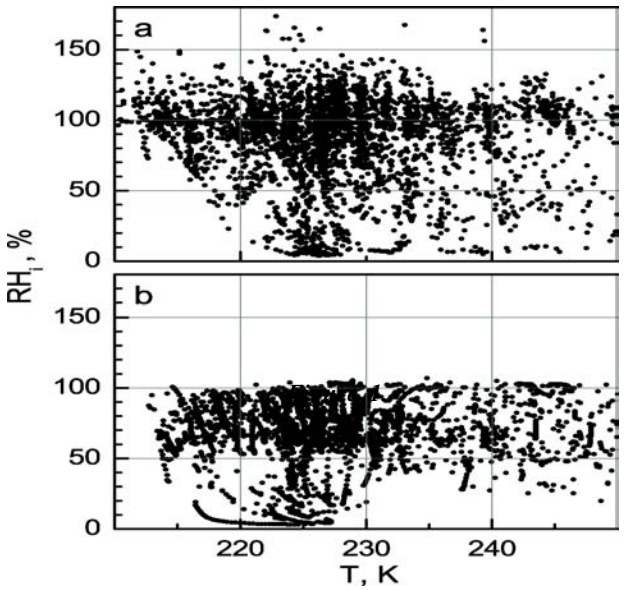
The existence of ice-supersaturated air masses in the UT has been confirmed by airborne measurements with various types of hygrometers during several campaigns (e.g., Airborne Arctic Stratospheric Expedition (AASE)/Airborne Antarctic Ozone Experiment (AAOE), First ISCCP Regional Experiment (FIRE), Pollution from Aircraft Emissions in the North Atlantic Flight Corridor (POLINAT), Measurement of ozone from Airbus in-service aircraft (MOZAIC). Radiosonde measurements in the past, mostly underestimate relative humidity in the UT. However, carefully calibrated and corrected RS80A radiosondes can now be used to detect ice supersaturation (Spichtinger et al., 2003a). More than 40% of all data collected during POLINAT over the North Atlantic and more than 15% of all MOZAIC data were taken in ISSRs (Schumann et al., 2000; Gierens et al., 1999).

Ice supersaturation occurs both inside and outside cirrus clouds as simultaneous measurements

of humidity and particles have shown during such campaigns as Subsonic aircraft contrail and cloud effects special study (SUCCESS), ozone and NOx experiment (SONEX) and Interhemispheric differences in cirrus properties from anthropogenic emissions (INCA).

Ice particles in cirrus clouds form by homogeneous or heterogeneous freezing, depending on the availability of ice nuclei and speed of vertical motions. When a stratiform cold (T<-40°C) cirrus forms by homogeneous freezing of aqueous solution droplets, the cloud must form in highly supersaturated air, because such solutions freeze only at ice supersaturation exceeding 40% (and the supersaturation necessary for freezing increases with decreasing temperature). Heterogeneous nucleation probably needs less (but finite) supersaturation, but the existence of cloud-free supersaturated air masses indicates that there is often a lack of suitable ice nuclei.

Evidence for ice supersaturation occurring in the UT is provided by cirrus fallstreaks that grow



a) One minute averages of relative humidity obtained on research flights during the INCA campaigns with a frostpoint hygrometer vs. temperature. Ice supersaturation occurs often and at all temperatures in the plot.

b) Relative humidities from the ECMWF analyses for the locations and times of the INCA flights. The model shows practically no ice supersaturation, because it assumes cirrus to be present as soon as saturation is reached.

while falling through supersaturated air layers and by contrails. Contrails can decorate the sky when no cirrus clouds are around. Since contrail persistence requires ice saturation, a sky full of contrails but without cirrus shows that there must be ice-supersaturated air above. The potential coverage of contrails in the northern midlatitude agrees well with the fractional coverage of ISSRs determined from MOZAIC data (namely about 15–20%). The average horizontal extension of ISSRs is of the order 150 km.

Global distribution maps of ISSRs on the nominal pressure levels 147 hPa and 215 hPa have been produced from MLS RHi data (Spichtinger et al., 2003b). Annual and seasonal distributions have been derived. Geographical regions where ISSRs occur most frequently are the tropics on both pressure levels, the midlatitude storm belts on 215 hPa in the respective hemispheric summer and fall seasons, and Antarctica in southern winter and spring. There is a remarkable similarity between the features of the global distribution of ISSRs and the global distribution of high clouds, which points to the role of ISSRs as cirrus formation sites.

Additional information on the subject of ice supersaturation and a full set of references for the results and conclusions mentioned above can be found in the quoted papers as well as on http://www.pa.op.dlr.de/issr.

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GMPP TO FOCUS ON THE DIURNAL CYCLE

Jan Polcher

Laboratoire de Météorologie Dynamique, Institut Pierre Simon Laplace, Paris, France

Attempts are underway to **create pan-GEWEX Modeling and Prediction Panel (GMPP) activities** that would intensify the interactions among the working groups on cloud processes (GEWEX Cloud System Study-GCSS), on land surface processes (Global Land/Atmosphere System Study-GLASS) and on the planetary boundary layers (GEWEX Atmospheric Boundary Layer Study-GABLS). The proposed cross-cut activities within GMPP are a common theme for the analysis of models and the selection of a common site for model intercomparisons.

The common theme for the proposed analysis is the diurnal cycle. It is expected that this choice will guide the activities in all three groups and encourage a closer study of the couplings that exist among them. Through collaboration with the Atmospheric Model Intercomparison Project (AMIP), the theme will also strengthen the link with global climate models. Although a number of studies have already been carried out on the ability of general circulation models to represent the diurnal cycle, there is still a lack of systematic analysis, which would identify the regions and processes where problems are most common in Global Circulation Models (GCM).

GMPP proposes to evaluate the ability of our models to represent the diurnal cycle using model intercomparisons as it has proven its value in previous GMPP activities. The strategy envisaged is to diagnose the diurnal cycle in parallel on the processes with which GMPP deals and on the global climate scale before moving on to the analysis of the interactions between clouds, the atmospheric boundary layer and land-surfaces. Three phases can thus be identified in the implementation of this GMPP proposal:

1. In a first phase GCSS, GLASS and GABLS will evaluate in off-line model intercomparisons (i.e., with limited feedbacks) currently underway or planned, the ability to reproduce the diurnal cycle.

2. During this period, AMIP should identify the geographical regions, seasons and weather regimes for which atmospheric models show the most significant deficiencies in the diurnal cycle.

3. Once the problems have been identified in the off-line mode and the large-scale atmospheric model environment, then attempts should be undertaken to reproduce them in a limited coupled environment by progressively introducing feedbacks in the GCSS, GLASS and GABLS intercomparisons.

The plan was well received by the Working Group on Numerical Experimentation (WGNE) panel, which proposes to call this a common GMPP/WGNE theme. In collaboration with WGNE the analysis of diurnal cycle could be extended to National Weather Prediction (NWP) models

It is hoped that the diurnal cycle theme and the interactions will act as a trigger to loosen the "implementation bottleneck" that exists between GMPP developments and their implementation in large scale models.

The diurnal cycle theme also offers some opportunities for the collaboration between GMPP and the Coordinated Enhanced Observing Period (CEOP). With the first data sets available through CEOP, the ability of some NWP models to reproduce the diurnal cycle on the locations chosen for the Model Output Location Time Series (MOLTS) have been evaluated. As these areas are covered by a large set of in-situ observations they would ideally be suited for more in-depth analysis through GMPP led model intercomparisons.

Another opportunity to encourage pan-GMPP collaborations and work on the coupling of cloud, land-surface and Planetary Boundary Layer (PBL) processes could be achieved if **a common site for model intercomparisons** could be found. Because of the very different needs in the three GMPP groups, the choice of a common site could prove difficult. Still the advantages that it would bring are important enough to pursue the idea. A pre-selection of possible common sites will be submitted to the GMPP panels in 2004.

The activities and plans for all of the individual components of GMPP are described in the full GMPP status report prepared for the GEWEX Scientific Steering Group meeting and can be found at http://www.gewex.org/reports.htm.

Acknowledgments

The author wishes to acknowledge the contributions of the following GMPP members in developing the diurnal cycle theme: Bert Holtslag (Wageningen University), Paul Dirmeyer (COLA), Steve Krueger (University of Utah), Peter Gleckler (PCMDI), and Christian Jacob (ECMWF).

COMPARISONS OF ECMWF ISLSCP-II NEAR-SURFACE DATA SET FROM ERA-40 WITH GEWEX OBSERVATIONAL DATA SETS

A.K. Betts[1] and A.C.M. Beljaars[2]

[1]Atmospheric Research, [2]Physical Aspects Section, Research Department, ECMWF

The European Centre for Medium-Range Weather Forecasts (ECMWF) has produced a special near-surface data set for the International Satellite Land-Surface Climatology Project (ISLSCP) Initiative II 10-year data set compilation. The data were extracted for the years 1986–95 from the ECMWF "40-year" Re-Analysis (ERA-40, 1958–2002; Simmons and Gibson, 2000). The primary reference for the reanalysis is http://www.ecmwf.int/research/era/. A full report documenting the data set and providing all the comparisons can be found at: http://www.ecmwf.int/publications/library/ecpublications/_pdf/ERA40_PRS_8.pdf. The following brief extract from this report introduces the components of the data set and shows some comparisons with other GEWEX data sets within the ISLSCP compilation.

The ERA-40 spatial resolution is T_L-159. For ISLSCP-II, the data have been interpolated from the model reduced Gaussian grid to the ISLSCP-II uniform 1-degree global grid, as much as possible consistent with the land-sea mask definitions. The fields that are supplied for ISLSCP-II are the near-surface meteorological fields (e.g., wind, humidity, temperature, pressure), fluxes (e.g., sensible and latent heat fluxes, radiative fluxes, stresses), and surface and sub-surface variables (e.g., sea surface temperatures, soil moisture, soil temperatures, snow variables). Some of these variables are constrained by observations (e.g., pressure, temperature, moisture); others are the result of parametrization (e.g., fluxes).

The advantage of surface fields from model analyses is that they have complete coverage at 3-hourly time resolution. In contrast, surface observations are not uniformly distributed globally, and are sparse over many regions in the tropics, where only monthly mean data may be available, or even just climatology. Model products, however, have biases, related to the specific model. This near-surface data set from ERA-40 is one of two in the ISLSCP-II data set that have been derived from model analysis forecast systems (the other being that from the National Centers for Environmental Prediction (NCEP). The following provides a sample of the comparisons of ERA-40 results with a selected ISLSCP-II compilation of GEWEX observational products.

As an example, for the surface temperature fields, Figure 1 on page 16 (lower half) shows the difference over land, ERA-40 – CRU, where CRU is the analysis interpolated directly from surface observations by the Climate Research Unit (CRU), University of East Anglia, as archived for ISLSCP-II. ERA-40 tends to be a little cooler in the tropics than the CRU analysis, and a little warmer in high latitudes. Over regions of high terrain, ERA-40 is typically substantially warmer. There are differences in the orography used in the two analyses, and in mountainous regions data coverage is generally more limited, and is often in mountain valleys.

For the precipitation fields, the ERA-40 0–6-hr precipitation analysis shows great similarity with the Global Precipitation Climatology Project (GPCP) analysis for the winter season, as archived for ISLSCP. The left panel of Figure 2 on page 16 shows the difference of ERA 0–6-hr precipitation from the CRU gauge precipitation analysis over land, and right panel the corresponding difference from the GPCP analysis. Comparing the two analyses, ERA-40 has generally more precipitation in the tropics (except over the Amazon where it has a low bias), and less precipitation in the mid-latitudes.

For the surface radiation budget, Figure 3 on page 16 compares the surface radiation budget of ERA-40 with the ISLSCP complied data from the Surface Radiation Budget (SRB) Project derived by Stackhouse et al. (2000, 2003) from the ISCCP cloud data (Rossow and Schiffer, 1999). Figure 3 shows surface shortwave down (SWdown) difference of ERA-40 from the corresponding SRB climatology. ERA-40 has systematically less SWdown in the tropics and more in the mid-latitudes, suggesting that ERA-40 has generally more (optically thick) cloud in the tropics and less in the mid-latitudes than SRB. ERA-40 also has a high bias of SWdown in the stratocumulus regimes in the eastern oceans, where the model predicts too little cloud cover. These comparisons suggest that ERA-40 has a realistic representation of the seasonal anomaly fields on a global scale.

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WORKSHOP/MEETING SUMMARIES

8th GAME INTERNATIONAL SCIENCE PANEL MEETING

10–11 November 2003
Khon Kaen, Thailand

Kenji Nakamura
GAME International Project Office
Nagoya University

Thirty-one scientists from 10 countries attended the GEWEX Asian Monsoon Experiment (GAME) International Science Panel (GISP) meeting, which was hosted by the National Research Council of Thailand (NRCT).

GAME and its international links, including its relationships with the World Climate Research Programme (WCRP), GEWEX, the Coordinated Enhanced Observing Period (CEOP) and the CEOP Asia-Australia Monsoon Project (CAMP) were reviewed. The global interest in the water cycle, which was demonstrated at the World Summit of Sustainable Development in 2002 and the Earth Observation Summit in 2003, was emphasized.

Working group reports were presented on many subjects, including land-surface processes, radiation, the precipitation system, monsoon system modeling, GAME-Siberia, the GAME Archive and Information Network (GAIN), the GEWEX Water Resources Applications Project (WRAP) and Water and Energy Budget Study (WEBS). Related projects in Korea, Nepal, Myanmar, China, Vietnam, Mongolia, Thailand and Laos were presented. As one of the important international initiatives relevant to the global water cycle research, the Integrated Global Observing Strategy-Partners (IGOS-P) water cycle theme was also presented. In addition, the Tropical Rainfall Measuring Mission (TRMM) re-entry issue was discussed.

GAME is scheduled to end March 2005 and the GISP discussed how to fully exploit the data that has been collected and how to extend the GAME heritage. Field observations were successfully conducted and the understanding of land-atmosphere processes have been advanced. GAME Phase II addressed synthesis, cross-cutting and modeling issues. The GISP recognized that those issues have been partly resolved; however, an ability to predict the Asian monsoon has not yet been achieved. Complete understanding of the mechanisms controlling variation in the Asian monsoon is crucial for its prediction and necessary for long-term water management, which is one of the goals of GAME. It was also recognized that one of the major achievements of GAME was the successful international collaborations that this project facilitated. Additional GAME research could contribute to the prediction of regional water cycles. Thus, it was agreed that there should be a follow-on program to GAME. The GAME follow-on program will emphasize modeling and prediction with strong international collaborations, including hydrometeorological operational organizations and agencies. A working group for the implementation of the follow-on program was proposed and adopted.

The GAME follow-on program, which was proposed at the GEWEX Scientific Steering Group Meeting, can briefly be described as a program for understanding the water and energy cycle in Asia with:

1) a focus on prediction based on the deep understanding of the Asian monsoon variations,
2) international collaboration with the research communities and operational agencies, and
3) hydrometeorological and energy exchange studies.

It was proposed and adopted that a wrap-up GAME conference and the last GISP meeting be held at the end of 2004 in Kyoto, Japan. Special issues of suitable international journals and an article in the Bulletin of the American Meteorological Society were recommended.

Recognizing the importance of TRMM data to climate studies, the GISP agreed to send letters to the Japan Aerospace Exploration Program and the National Aeronautics and Space Administration requesting that this mission be continued as long as possible.

INTERESTED IN SUBMITTING AN ARTICLE TO BE PUBLISHED IN GEWEX NEWS?

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14th SESSION OF THE GEWEX RADIATION PANEL

10–12 November 2003
Victoria, BC, Canada

William Rossow
NASA/Goddard Institute for Space Studies

The 14th Session of the GEWEX Radiation Panel (GRP) and the Workshop on 3D Clouds and Radiation that followed (see report on Page 14) were hosted by the Cloud Physics Research Division of the Meteorological Service of Canada.

The chairman opened the meeting by noting that, because of a number of factors coming together in the next year, GRP needs to review the status and accomplishments of all its projects, identify or refine its own milestones and proposed contributions to GEWEX/WCRP objectives, and decide how best to proceed towards its goals. He further noted that: (1) the maturity of the radiation budget problem (major questions answered, data products showing excellent quality, top-quality radiative transfer models exhibiting high accuracy) requires decisions on what other activities should be initiated; (2) improving cloud and aerosol observations suggest a need to reformulate the cloud-climate problem to focus on "cloud dynamics," encompassing the interactions of aerosols-clouds-radiation-precipitation; (3) the number of crucial problems involving precipitation require that some new activities be developed; and (4) a number of GRP initiatives, including the SeaFlux project and the Feedback Study, have coalesced into the preparation and analysis of a comprehensive collection of satellite-based global data sets as suggested by the Working Group on Data Management and Analysis (WGDMA), such an activity to be called the Global Water and Energy Budget Study (GWEBS).

Reports were presented by representatives from the European Space Agency, the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), the European Organization for the Exploitation of Meteorological Satellites, the Japan Aerospace Exploration Agency, and the Japanese Meteorological Agency. There are a large number of on-going satellite missions involving complex combinations of measurements that provide many new opportunities to obtain new or improved measurements of Earth. In particular, the GRP welcomed the extended operations of METEOSAT-5 over the Indian ocean sector, noted the advent of MSG-1 (to be renamed METEOSAT-8) and the continuing operations of Envisat, Terra and Aqua. Concerns were raised with regard to: (1) the threat to MeghaTropiques and EarthCare from funding shortfalls; (2) the possible gap in coverage by afternoon polar orbiting weather satellites before the first launch of the National Polar-Orbiting Operational Environmental Satellite System (NPOESS); and (3) the reversal of the decision to fly the spare Clouds and the Earth's Radiant Energy System (CERES) instrument on NPOESS Preparatory Project (NPP) to reduce the risk of a gap in Earth Radiation Budget coverage later this decade.

A major cause for concern to the whole GEWEX program is the possible early termination of the Tropical Rainfall Measuring Mission (TRMM) operations next year that NASA is considering. This would not only preclude the unique opportunity of operating two differing-sensitivity precipitation radars at the same time, when CloudSat is launched in early 2005, but would eliminate any chance that TRMM could operate until replaced by Global Precipitation Mission (GPM).

The Global Aerosol Climatology Project (GACP) monthly mean product (aerosol optical thickness and Angstrom coefficient over oceans) is now available for the period 1983–2001. The next analysis cycle will focus on use of the Stratospheric Aerosol and Gas Experiment (SAGE) data to separate stratospheric and tropospheric aerosols and on use of new land surface albedo products to extend the analysis over land areas.

International Satellite Cloud Climatology Project (ISCCP) cloud products are available for the period 1983–2001. New cloud-type subsets and a cloud particle size product will be released in the coming year. The possibility of processing the B1 (nominal 10-km sample), instead of B2 (nominal 30-km sample), radiance data set is being explored. Part of the next versions of the GACP and ISCCP products will be a merged aerosol-cloud product to facilitate studies of the so-called "indirect aerosol effect."

A SeaFlux workshop was held on 12–13 February 2003 at Long Beach, California. Work on improving the bulk formulae used to calculate surface turbulent fluxes appears to be winding down, although work is still needed for the high windspeed regime, but data are lacking. The focus of effort is now on completing the comparison of global products for 1999, culminating in another workshop either in late 2004 or early 2005. Work is also ongoing with regard to obtaining improved skin sea surface temperature (SST) data sets (in collaboration with Global Ocean Data Assimilation Experiment (GODAE) - SST) and better estimates of near-surface air temperature and humidity.

Global Precipitation Climatology Project (GPCP) main products are now available for the period January 1979 through October 2002. Also a 1-degree, daily product is available for the period October 1996 through October 2002, but the possibility of using the ISCCP B1 radiance archive to extend this product back in time is being explored. Several problems with the current precipitation analysis were outlined, including: (1) the representativeness of the gauge data in rough topography has been found to be poor, even in the U.S.; (2) the current Special Sensor Microwave Imager (SSM/I) algorithm needs to be updated based on TRMM analyses; (3) a snow algorithm is lacking; and (4) the data record is noticeably inhomogeneous because of the changing sources of information. The Global Precipitation Climatology Centre (GPCC) has started work on producing an extended (longer-term) gauge-based precipitation climatology, which would also support CLIVAR goals; the GRP welcomed this development. Based on discussions at the WGDMA meeting, GPCC is also investigating the feasibility of a reanalysis of the gauge data to separate snow and rain averages.

Two additional concerns about available precipitation products were raised: (1) precipitation in rough topography – the satellite measurements have intrinsically superior spatial sampling but care is needed to account for the changing atmospheric column height and land surface effects on the measurements; and (2) precipitation data products must be extended to higher time resolution to allow study of the interaction of the atmospheric circulation and clouds-precipitation. Also, it was emphasized that there is a general lack of quality validation data available. This discussion led to the recommendation that the GEWEX Precipitation Cross-Cut activity provide the integration of this effort into the global analysis of GPCP (TRMM, GPM) and that the GRP take the lead in investigating new satellite snow algorithms, examining high spatial resolution satellite observations in mountainous areas and high time resolution surface radar observations in combination with satellite cloud observations.

The CERES experiment currently has operating instruments (two each) on Terra and Aqua. The ERBE-like radiative flux products for TRMM, Terra and Aqua have been released. The new products, based on improved scene identification and Angular Distribution Models will become available in spring 2004. Additionally, the CERES analysis is being extended to produce surface radiative fluxes (in a similar fashion to the Surface Radiation Budget (SRB) Project using ISCCP) and eventually to radiative flux profiles. The first version of the surface and top-of-atmosphere radiative flux products from 3 years of Terra data was released in March 2003; the new radiative flux profile products will be released late in 2004.

SRB Version 2 data products are now available for the period July 1983 through 1995, when the NASA Global Modeling and Assimilation Office (GMAO) reanalysis being used for atmospheric properties ended. The next reanalysis product, GEOS-4, from NASA GMAO will be produced for more recent years first, but then extended backwards, allowing SRB to extend its record from 1995 to current. This will probably result in a discontinuity in the SRB record, but will allow for overlap and comparison with the similar CERES products. After further comparisons with the Baseline Surface Radiation Network (BSRN) data sets, the whole product will be reprocessed in 2005 using GEOS-4 or 5 for the whole period.

BSRN has more than 2,500 data-months from 35 active sites (equivalent to about 6 years of data per site) now available from the archives. Further effort will be applied in the coming year to improve the rate of data delivery and quality checking into the archives. All data, including ancillary atmospheric observations, are also now available via ftp. Another 15 sites have been proposed and are being considered. In particular, there has been progress on establishing needed sites in China. On-going activities to improve the data set involve defining procedures and standards for aerosol optical thickness measurements and improvement of the radiation measurement standards for diffuse solar (a recent experiment at the Atmospheric Radiation Measurement Program (ARM) Southern Great Plains (SGP) site showed low errors) and infrared radiation. (See related BSRN article on Page 6.)

The Intercomparison of Radiation Codes used in Climate Models (ICRCCM) Project has a new web site for the longwave test cases (temporary address is http://metsat.met.fsu.edu/jgu/LBLWeb). All of the model calculations for these test cases have been completed and the results are now being posted to the web site. Preparations have also started to conduct a study of 3D effects on infrared radiation, following a study for solar radiation. The paper reporting the results of 3D solar code comparisons and various 1D approximations will appear soon. It was proposed ICRCCM join forces with the ARM Broadband Heating Rate Profile (BBHRP) project, which has been working to set up on-line cases based on measured input atmospheric and cloud properties, with reference model calculations and

measured surface and top-of-atmosphere fluxes. An ad hoc working group was formed to represent GRP/ICRCCM ideas/concepts and to collaborate with ARM BBHRP representatives to prepare a comprehensive on-line "test kit" with a variety of synthetic and observed cases, together with baseline line-by-line radiative model calculations and corresponding verifying measurements. The plan is to organize an international workshop on code comparisons using the first released version of this test kit, possibly in early 2005. Most ICRCCM activities would then be completed in 2005.

The 3D Radiative Transfer Working Group (3DRT) was established by the International Radiation Commission to continue studies of 3D radiative effects, following on the completion of the I3RC project. This group will interact with other "process" communities to examine the importance of 3-D radiative effects. The first activity will involve radiation in vegetation canopies and the question of the effects of small-scale variations and 3-D radiative effects on surface-atmosphere interactions.

The status of "solar constant" measurements was reported, particularly from the new multi-instrument Solar Radiation and Climate Experiment (SORCE) mission. All the instruments are operating well. It was also noted that there will likely be a gap in the measurements between the end of the SORCE mission in 2008 and the NPOESS in 2013, although there is a mission in the planning (currently called GLORY) to fly a polarimeter for aerosol studies that will also fly the Thermal Imaging Spectrometer (TIMS), but not the SSI instrument.

Activities of the new GRP Working Group on Column Profiling (CPROF) were reported. The past year was spent getting organized with the first two meetings held in January 2002 in Reading, UK, and in September 2003 in Leipzig, Germany. There are now 10 participating sites, 8 of which are also BSRN sites, which is a very important achievement.

In discussing the next phase of the Global Water Vapor Project (GVAP), it was decided that, before undertaking any new data processing, the six existing global water vapor data sets (some profiles, some total column, some for specific portions of the troposphere or statosphere, including the reanalyses) should be evaluated by exploiting all available results. It was recommended that this evaluation be conducted in partnership with the International TIROS Operational Vertical Sounder (TOVS) Working Group (ITWG) and completed in time to provide input to the next Intergovernmental Panel on Climate Change (IPCC) climate assessment (late 2005). Discussions at the subsequent meeting of the ITWG on 3–4 November 2003, led to the proposal that this activity should be combined with the idea that NOAA, the Hadley Center and the ITWG were already discussing to re-evaluate all of the satellite and conventional temperature records. If the evaluation of all temperature measurements is to be performed, an evaluation of the water vapor measurements that many of the same sensors make would be required as well. A workshop is planned in summer 2004 to launch this activity.

The idea to assess the main GRP data products was expanded from water vapor to include clouds, precipitation and radiative fluxes. WGDMA made this recommendation to the GRP, which was accepted. In particular, GRP/ISCCP will lead an evaluation of all long-term cloud products, GRP/GPCP in partnership with the International Precipitation WG (IPWG) will assess long-term precipitation products, and GRP/SRB/BSRN will assess long-term surface radiation products in combination with NASA's long-term Earth radiation budget products. The IPWG agreed to participate in the evaluation of the GPCP products.

Discussions at GRP meetings for the past several years, at the WGDMA meeting and at GEWEX SSG and the Working Group on Satellite Matters meetings, have all identified many reasons for repackaging the GRP data products for more comprehensive analyses, including characterizing the global energy and water cycle and its variations and diagnosing climate feedbacks. Therefore, WGDMA will work to establish a collection of global, long-term data sets, some versions of which will be on-line, to be made available in a single comprehensive package, much like the reanalysis data products being produced by the weather forecast centers. The goal is for this data set to describe the "complete" variations of the climate over the past 10–20 years. The National Climatic Data Center has agreed to act as the archives for these data.

In summary, in the coming year the GRP will organize workshops on comparisons of satellite-based data products for aerosols, water vapor, clouds, precipitation and radiative fluxes, develop a comprehensive on-line GCM radiative transfer code test kit in collaboration with ARM, organize workshops on radiative transfer codes for application to lidar and active/passive microwave observations, produce a comprehensive collection of global, long-term data sets describing the variations of the global energy and water cycle, and formulate an integrated clouds-aerosol-precipitation-radiation research strategy.

WORKSHOP ON 3D CLOUDS AND RADIATIVE TRANSFER

10–14 November 2003
Victoria, BC, Canada

Howard Barker
Cloud Physics Division, Meteorological Service of Canada

Over 40 scientists attended a 2-day workshop that was meant to foster communication between those working in the subfields of atmospheric science who are facing, in their unique combination of ways, significant issues involving the 3D geometric structure of clouds and radiative transfer. These subfields are climate and cloud modelling, remote sensing, and theoretical radiative transfer. Seventeen invited talks were given by many of the top researchers in each subfield.

The prime motivation behind the workshop was the emergence over the past 2 years of two revolutionary lines of research involving the representation of clouds and radiative transfer in global climate models (GCM). The first is the Multi-Scale Modeling Framework (MMF) method of treating clouds in GCMs. This involves imbedding a 2D (and eventually 3D) cloud-system resolving model (CSRM) in each column of a GCM. Since the MMF method has the potential to profoundly revolutionize the representation of clouds and radiation in GCMs, it was one of the foci of the workshop. Several talks were given that presented results of seminal studies with the MMF method. These included an overview as well as talks on major issues facing the MMF method and experiments that appear to demonstrate that capturing small-scale interactions between clouds and radiation is more crucial for climate modelling. This is potentially a very important point as it is difficult to envisage how regular GCMs (with grid-spacings on the order of hundreds of kilometres) will be able to capture these small-scale interactions (i.e., at scales less than ~10 km).

The second revolution involves the Monte Carlo Independent Column Approximation (McICA) method for computing radiative fluxes in conventional GCMs. By segregating description of cloud structure from the radiative transfer solver, McICA allows for unlimited statistical detail in cloud description with the assurance of unbiased radiative fluxes. The fate of McICA rests on the, as yet not fully tested, hypothesis that the random sampling noise that it produces is 'invisible', or at least not detrimental, to the host GCM. So far, this appears to be the case, but definitive tests are only in progress. In all, 7 of the 17 talks were devoted to radiation in GCMs.

The general consensus is that that *if* the statistical properties of clouds can be diagnosed well within a GCM simulation, the problem of computing accurate domain-average radiative heating profiles has been solved to ICA standards. What the MMF simulations indicate, however, is that this might not be as all important as once thought, for the systematically unresolved interactions between radiation and cloud matter much and these may be beyond the reach of regular GCMs. If this is so, one can seriously begin to question the adequacy of the McICA method for both MMF-GCMs and stand alone CSRMs. Basically, should the ICA be abandoned and replaced by 2D and 3D radiative transfer methods? This is an open question that deserves some attention. Moreover, if regular GCMs are to be parametrized so as to capture some of these unresolved interactions, it is essential that we understand better the nature of how these interactions occur and how they tie into scales resolved by the GCM.

Discussion of GCMs merged with discussions on Cloud System Resolving Models (CSRM). Attention was devoted to CSRMs because they represent one of the primary means of developing and assessing representation of cloud processes in GCMs. Focus on CSRMs in this workshop was essential since they form the basis of the MMF approach to cloud parametrization. Moreover, there are many ways that radiative transfer can be treated in CSRMs, and as yet there is little agreement on how to balance computational efficiency with necessity. This ties back to the point made at the end of the previous paragraph.

The remainder of the talks dealt with remote sensing of clouds. Since the focus of the workshop was on the representation of clouds and radiation in global models, talks dealing with remote sensing involved either satellites or long-term surface observations. Emphasis was placed on innovative methods that bank on synergy between active and passive sensors. These types of observations characterize the National Aeronautics and Space Administration's CloudSat satellite, the European Space Agency's proposed EarthCARE satellite, and surface measurements made at advanced surface sites such as those operated by the US Department of Energy Atmospheric Radiation

Measurement (ARM) Program and at Cabauw in The Netherlands. There were, however, several talks that discussed problems and limitations of traditional passive techniques. These arise via the inherent 3D structure of clouds and our inability thus far to develop unique, stable solutions for the inverse 3D radiative transfer equation.

Advances in remote sensing of clouds are beginning to investigate properties and aspects of clouds beyond those currently represented in GCM cloud parametrizations. These advances are coming from integrated multi-instrument analyses. In light of this new information, it was agreed upon generally that simple analyses in terms of geographic location have serious limitations. Alternative approaches were discussed, in particular, the sorting of cloud information in terms of cloud type (defined in several different ways), lifecycle, and the relationships of their properties/evolution with atmospheric motions (meteorological situation). New, more sophisticated (i.e., multi-variate, non-linear) methods of analysis need to be developed. These methods should also be applied to data simulated by models thereby enabling more effective comparison with observations.

GEWEX/WCRP MEETINGS CALENDAR

For calendar updates, see the GEWEX web site: http://www.gewex.org

18–20 Febuary 2004—INTERNATIONAL ASIAN MONSOON SYMPOSIUM, Honolulu, Hawaii, USA

1–6 March 2004—25TH SESSION OF THE WCRP JOINT SCIENTIFIC COMMITTEE, Moscow, Russian Federation.

8–9 March 2004—WORKSHOP ON CEOP MODEL OUTPUT AND ANALYSES, Irvine, California.

8–10 March 2004—HYDROLOGICAL ENSEMBLE PREDICTION EXPERIMENT (HEPEX) WORKSHOP, ECMWF, Reading, UK.

10–12 March 2004—THIRD CEOP IMPLEMENTATION PLANNING MEETING, Irvine, California, USA.

26–30 April 2004—EUROPEAN GEOPHYSICAL SOCIETY (EGS) XXIX GENERAL ASSEMBLY, Nice, France.

17–21 May 2004—AGU/CGU 2004 SPRING MEETING, Montreal, Canada.

24–29 May 2004—4TH INTERNATIONAL SYMPOSIUM ON THE ASIAN MONSOON (ISAMA4), Kumming City, China.

24–28 May 2004—FOURTH STUDY CONFERENCE ON BALTEX, Island of Bornholm, Denmark.

5–9 July 2004—CEOP AND ASIAN MONSOON SYSTEMS SESSION, JOINT AOGS 1ST ANNUAL MEETING AND APHW 2ND CONFERENCE, Singapore.

26–28 July 2004—3RD LBA SCIENCE CONFERENCE (SPECIAL SESSION ON WATER AND ENERGY BALANCE IN THE AMAZON BASIN), Brasilia, Brazil.

29–30 July 2004—VIII LBA-ECO MEETING, Brasilia, Brazil.

26–30 July 2004—8TH BSRN WORKSHOP AND SCIENTIFIC REVIEW, Exeter, UK

2–6 August 2004—EARTH OBSERVATING SYSTEMS IX (AM101) AT SPIE'S 49TH ANNUAL MEETING, Denver, Colorado, USA.

8–11 August 2004—8TH INTERNATIONAL CONFERENCE ON PRECIPITATION, Vancouver, Canada.

6–10 September 2004—10TH MEETING OF THE GEWEX HYDROMETEOROLOGY PANEL, Montevideo, Uruguay.

11–15 October 2004—20TH SESSION OF THE CAS/JSC WGNE/8TH SESSION OF THE GMPP, Exeter, United Kingdom.

18–19 October 2004—GRP WORKING GROUP ON DATA MANAGEMENT AND ANALYSIS (WGDMA), Kyoto, Japan.

20–22 October 2004—15TH SESSION OF THE GEWEX RADIATION PANEL, Kyoto, Japan.

1–2 December 2004—9TH GAME INTERNATIONAL SCIENCE PANEL MEETING, Kyoto, Japan.

3–5 December 2004—6TH INTERNATIONAL STUDY CONFERENCE ON GEWEX IN ASIA AND GAME, Kyoto, Japan.

20–24 June 2005—5TH INTERNATIONAL SCIENTIFIC CONFERENCE ON THE GLOBAL ENERGY AND WATER CYCLE, Orange County, California, USA.

GEWEX NEWS

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Richard G. Lawford, Director

Mail: International GEWEX Project Office
1010 Wayne Avenue, Suite 450
Silver Spring, MD 20910, USA
Tel: (301) 565-8345
Fax: (301) 565-8279
E-mail: gewex@gewex.org
WWW Site: http://www.gewex.org

Editor: Dawn P. Erlich
Layout: Yusef L. Trowell

MOISTURE BUDGET COMPONENTS OVER THE LA PLATA RIVER BASIN

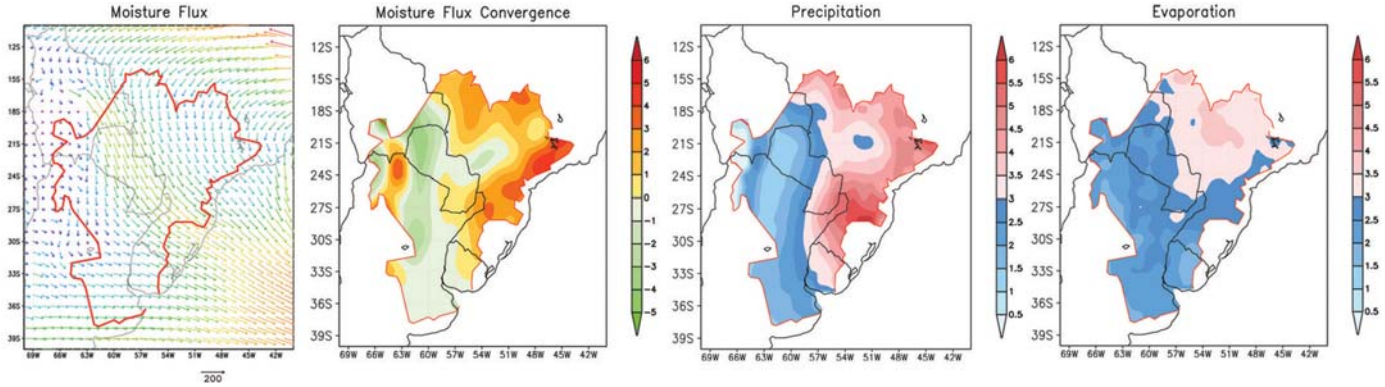

Figure 1. Eta model annual mean (a) vertically integrated moisture flux, (b) moisture flux convergence, (c) precipitation and (d) evaporation. See article on Page 4.

COMPARISONS OF ERA-40 PRODUCTS WITH GEWEX DATA PRODUCTS

(See article on Page 9)

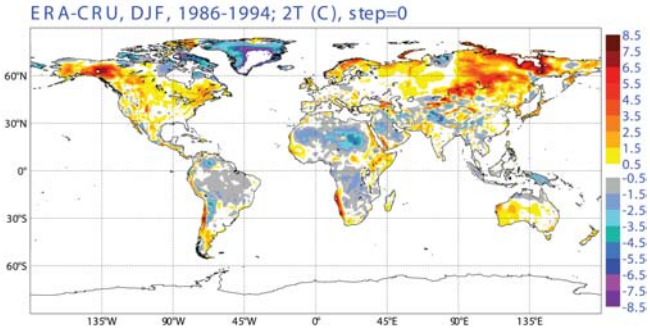

Figure 1. Winter (DJF: December, January, February) ERA-40, 2-m temperature and differences from CRU.

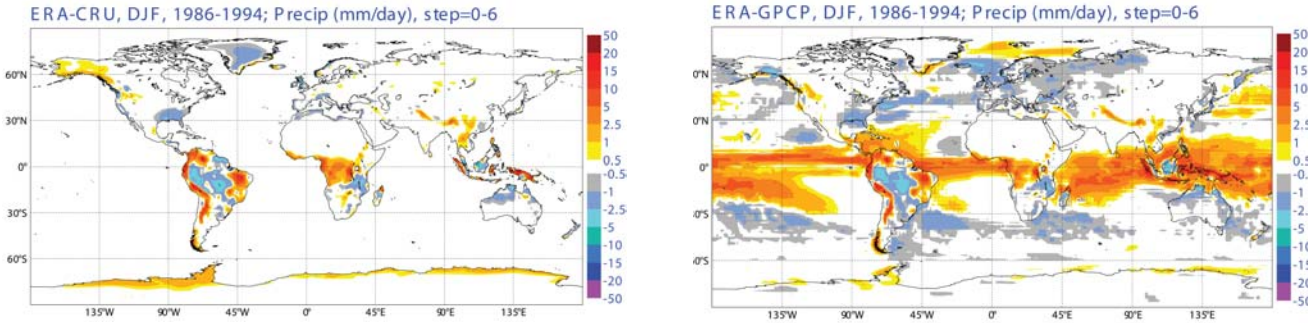

Figure 2. Comparison of the difference of the ERA 0–6-hr precipitation from the CRU gauge precipitation analysis over land (left), and from the GPCP analysis (right).

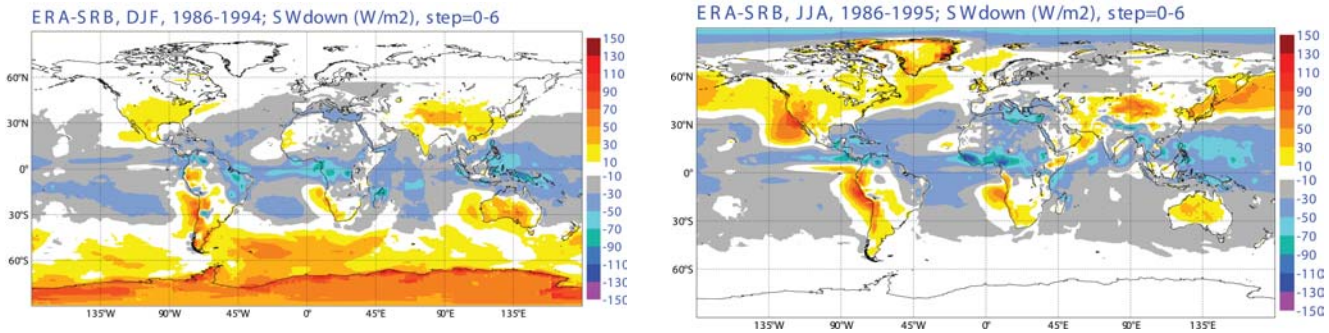

Figure 3. Surface short-wave down (SWdown) difference of ERA-40 from the corresponding SRB climatology.