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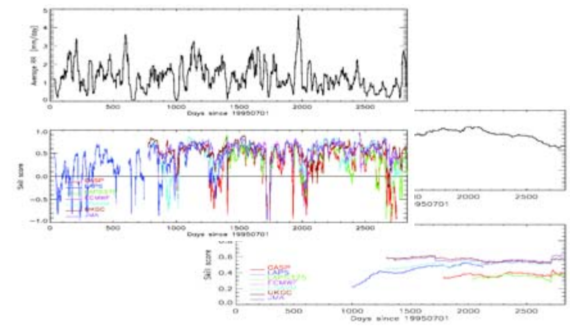
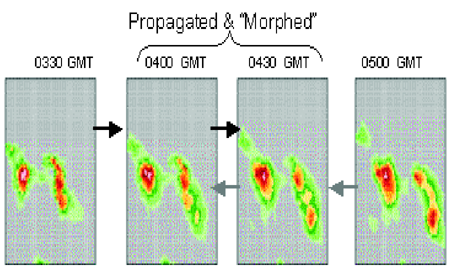
PRECIPITATION, SOIL MOISTURE, SURFACE WATER BUDGET – NEW RESULTS AND RECENT PROGRESS

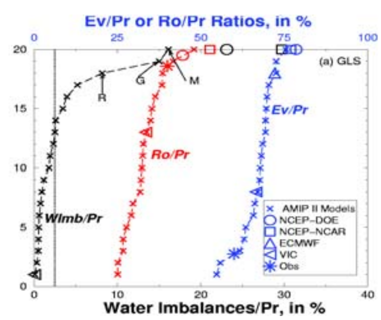
New Verification Study Shows NWP Basin Average Precipitation Forecasts Not Improving (see Page 10).

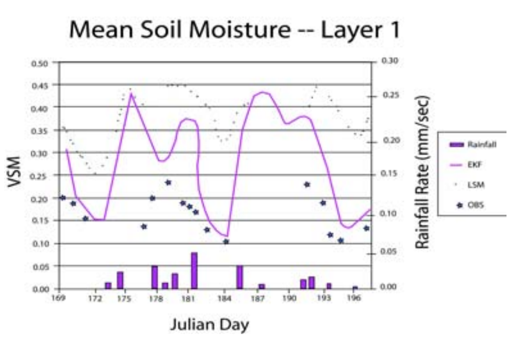




New Morph and Neural Net Methods Representing Global Precipitation Showing Excellent Results (see Pages 8 and 11).

AMIP II Models Show Success in Closing the Surface Water Budget Over the Seven GEWEX Continental-Scale Experiments (see Page 3).





New Soil Moisture Observations and Assimiliation Techniques are Leading the Way to Improved Water Cycle Prediction (see Pages 7 and 14).

What's New

- **First GRP Working Group on Data Management and Analysis Sets Path for Added IPCC Support (See Page 17)**
- **Uniformly Formatted CEOP EOP-1 Data Sets Now Available on the Web (See Page 14)**

COMMENTARY

GEWEX PHASE II
NOT REINVENTING THE WHEEL, BUT STAYING THE COURSE

Soroosh Sorooshian, Chairman
GEWEX Scientific Steering Group

The proliferation of acronyms naming new climate research programs and iniatives has been evident at both international and national levels. Acronyms relative to the hydrologic cycle and water resource initiatives are also increasing. The impact of this expansion is apparent in a number of ways.

First, with any new initiative there is the increased competition for resources. Unfortunately, the level of financial resources is not necessarily increasing to keep pace with the required needs. I recall a comment made by a very distinguished NASA program manger a few years ago at a US National Academy panel meeting. He warned the scientific community that while it is ok for new programs to be launched, don't expect the "size of the pie to increase." This comment has turned out to be very true. The second impact is the additional demand placed on the time of our key scientists and program office personnel who have to attend an ever-increasing number of meetings. Last, but not least, is the challenge of the required coordination between the different initiatives at both national and international levels.

In the case of GEWEX, we have tried to minimize the launching of new initiatives unless it has been absolutely necessary to do so. The Coordinated Enhanced Observing Period (CEOP) initiative, which has been covered a number of times in this newsletter, is the only major initiative launched by GEWEX within the last decade. What is unique about CEOP is that **there exists no other program with similar goals and objectives**. Therefore, the support for CEOP by the community at large has been universal, leaving no doubt about its critical role in filling an important gap.

As for the rest of GEWEX, we are in the early stages of Phase II, where we are trying to meet the very challenging main GEWEX objectives. We are doing this through our three primary panels—the GEWEX Hydrometeorology Panel, the GEWEX Radiation Panel, and the GEWEX Modeling and Prediction Panel. The fact that GEWEX has decided to maintain its primary panel structure (rather than repackaging and renaming them) should not be viewed as "GEWEX doing the same things they have been doing over the past 13 years," but as "GEWEX continuing to move forward toward its stated goals." It is our strong belief that many of the key uncertainties and questions about the water and energy cycle that have emerged either as a direct result of the scientific findings and/or were not fully addressed in GEWEX Phase I, can still best be addressed by our three primary panels and their working groups. Our primary challenge in GEWEX is to ensure that this message is communicated clearly to the program managers at various funding agencies so that future funding opportunities include GEWEX priorities in their relevant announcements. This is an important challenge for the GEWEX and WCRP leadership. I am looking forward to the selection and appointment (very soon) of the next International GEWEX Project Office Director, who will be playing a major role in this regard.

Contents

MAJOR UPDATE AND REVISION OF GEWEX HOME PAGE

www.gewex.org

The GEWEX Home Page has been updated and redesigned to make navigation through the website easier and provide more up-to-date information about GEWEX projects and activities. The front page will be periodically updated to include examples of recent GEWEX results. An example of some of the changes to the website is the new publications/documents section, which includes pdf formatted versions of all the GEWEX Newsletters (1991–2003); listings (by project) of GEWEX publications and research papers; reports on project status and related activites; summaries of special workshops; recent GEWEX brochures and related publications for downloading; presentation materials; and pdf versions of recent IGPO documents.

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EVALUATING GEWEX CSEs' SIMULATED LAND-SURFACE WATER BUDGET COMPONENTS

A. Henderson-Sellers[1], P. Irannejad[1], S. Sharmeen[1], T. J. Phillips[2], K. McGuffie[3], H. Zhang[4]

[1]Environment, Australian Nuclear Science and Technology Organization, Australia; [2]PCMDI, Lawrence Livermore National Laboratory, USA; [3]University of Technology, Sydney, Australia; [4]Bureau of Meteorology Research Centre, Melbourne, Australia

Atmospheric General Circulation Models (AGCM) are the predominant tools with which we predict future climate. For people to have confidence in such predictions, AGCMs require evaluation. An important difficulty in evaluating AGCM simulated land-surface climates is the lack of high quality global observational data sets. Also, many land-surface variables (e.g., evapotranspiration) are not directly observable at scales appropriate to atmospheric model grid areas. **In this paper we evaluate simulations by 20 AGCMs (referred to by the letters A–T), participating in the second phase of the Atmospheric Model Intercomparison Project (AMIP II) (Phillips et al., 2002; Henderson-Sellers et al., 2003; Irannejad et al., 2003) under the auspices of the Project for Intercomparison of Land-surface Parameterization Schemes (PILPS, Henderson-Sellers et al., 1995; 1996; 2002), against available observations.** Land-surface products from the reanalyses, such as the European Centre for Medium-Range Weather Forecasts (ECMWF) (Gibson et al., 1997), the National Centers for Environmental Prediction (NCEP) - National Center for Atmospheric Research (Kistler et al., 2001) and NCEP-Department of Energy (Kanamitsu et al., 2002), along with one global off-line land surface simulation set by the Variable Infiltration Capacity (VIC) land-surface scheme (Liang et al., 1994), are also analysed to assess the value of such data for AGCMs' evaluation.

The analysis has been performed over the global land surfaces (GLS) and in the seven GEWEX Continental Scale Experiments (CSE) and the Continental Scale Affiliate (CSA) (hereafter referred to as GEWEX regions): BALTEX over the Baltic Sea, CATCH over Sub-Saharan Africa, GAME over Siberia, GCIP over the Mississippi, LBA over the Amazon, MAGS over the Mackenzie and MDB over the Murray-Darling Basin. The estimated runoff from the Global Runoff Data Center (GRDC, Fekete et al., 2000) and the Climate Prediction Center (CDC) Merged Analysis of Precipitation (CMAP) (Xie and Arkin, 1997) have been used for model evaluation. Our evaluation has been conducted in two ways:

(i) By investigating the closure of the simulated land-surface water budget, which is one of the fundamental requirements for any land-surface scheme (LSS), i.e.:

$$\mathrm{Pr} - Ev - Ro - \frac{dW}{dt} = 0 \qquad (1)$$

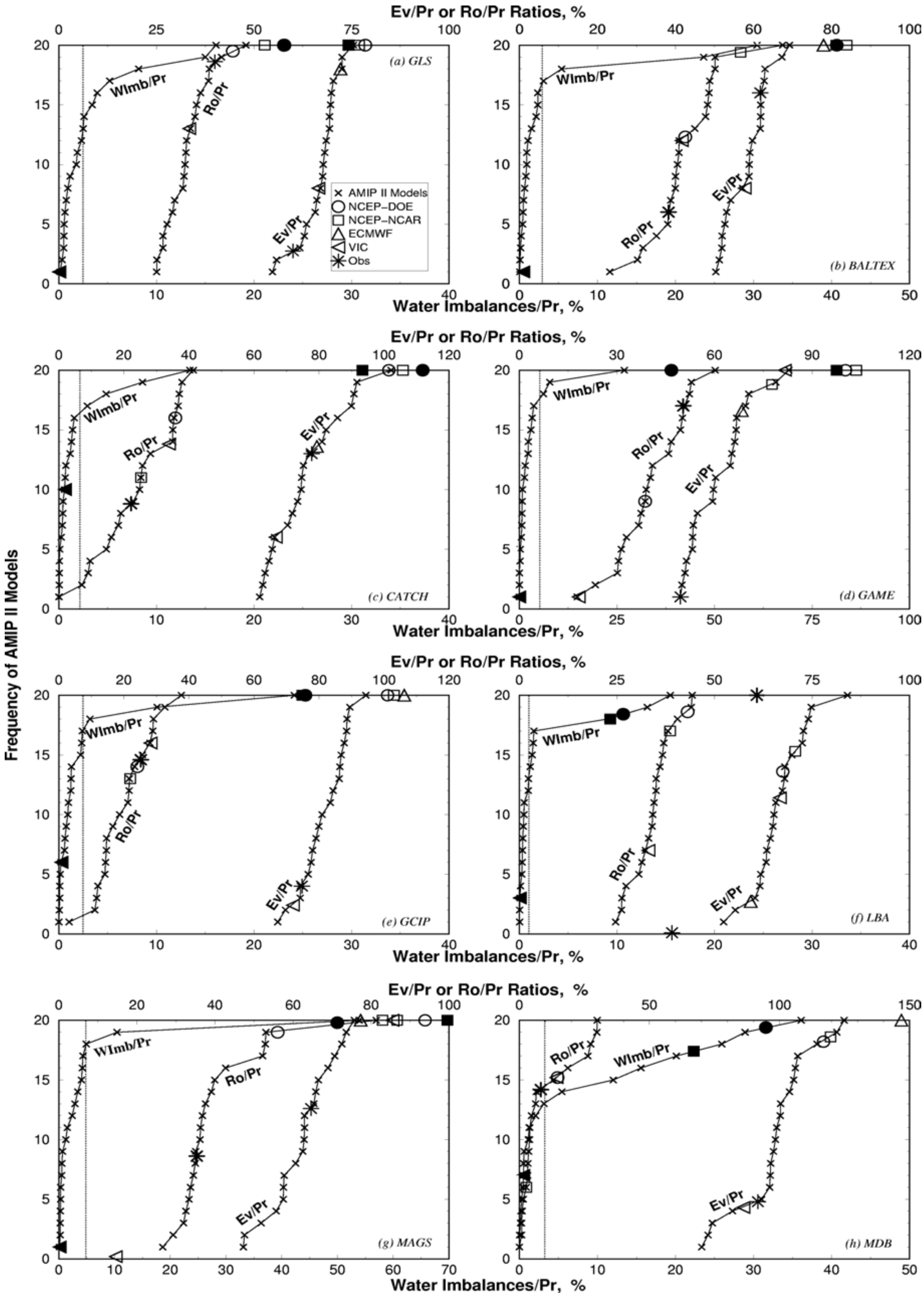
where dt is the simulation time, Pr is precipitation rate, Ev is evapotranspiration rate, Ro is runoff (surface+subsurface+drainage) rate and dW is the difference between the final and initial values of the surface water storage (i.e., water stored in the soil, canopy, and as snow and ice on the surface). The information needed to calculate $\frac{dW}{dt}$ is not provided by AMIP or reported with non-standard definitions and/or units by many AGCMs. Over a long period of time, i.e., large dt, the rate of change of the surface water storage in (1) becomes negligible and hence, balance should be achieved between Pr, Ro and Ev. For the 17-year AMIP II period we conservatively assume that a rate of change in the surface water storage of ± 0.05 mm d^{-1} can potentially occur due to poor initialization of W.

(ii) By comparing the simulated land-surface water budget components against observations, since a good model should exhibit only small differences from accepted observations.

The figure on page 5 shows the frequency distribution of the AMIP II models' 17-year mean relative water imbalance values as a percentage of precipitation $\left(\frac{100}{\mathrm{Pr}} \times \frac{dW}{dt}\right)$, total (surface+drainage) runoff ratio $\left(100 \times \frac{Ro}{\mathrm{Pr}}\right)$ and evaporation ratio $\left(100 \times \frac{Ev}{\mathrm{Pr}}\right)$ for all of the seven GEWEX regions and also for the GLS. Observations, reanalyses and VIC are included in the figure as symbols. Here the observed runoff ratio is calculated using mean GRDC runoff and CMAP precipitation, while the observed evaporation ratio is calculated as the residual from the surface water balance equation (1) assuming that the rate of change in the surface water storage is negligible. The vertical dotted line shows the assumed acceptable water imbalance threshold value of 0.05 mm d^{-1} as the percentage of the observed precipitation for each GEWEX region. Models are assumed to conserve water when their relative imbalances remain to the left of the threshold line.

Based on the figure on page 5, globally and in all the GEWEX regions, NCEP reanalyses fail to conserve water within the assumed threshold. In MDB the imbalance, caused mainly by soil moisture nudging and a decrease in the soil moisture, is more than 65% of the mean precipitation. ECMWF may have similar problems. However, we were unable to assess this because we could not acquire its runoff data. VIC is seen to conserve the surface water everywhere. Because VIC simulation is constrained by observed precipitation and tuned for large river flows, it might be argued that VIC provides a reliable surface water simulation, at least when averaged over a large area and a long period of time (Wood et al., 1998). It is worth mentioning here that VIC simulations have been challenged recently (Robock et al., 2003). However, we use the water balance mode of VIC (Nijssen et al., 2001) not the energy balance mode used by Robock et al. (2003).

Around 16–18 AMIP II AGCMs conserve surface water over five (out of seven) GEWEX basins while 13–14 AGCMs conserve water globally (GLS) and in the other two basins (MDB and LBA). Among the models that have problems closing the budget in most of the regions, two (M, R) have incorrectly reported their runoff component while one (G) seems to have a coding problem especially in the colder climates (e.g., BALTEX, GAME, MAGS). Of the 17 models with no obvious reporting error, six models (C, D, E, K, L and S) fail to conserve surface water in the MDB, three models over the GLS (A, B and C) and the LBA (B, C and D), two models (B and C) in the CATCH and one model (D) in GCIP. All of the 17 models conserve water in the remaining three colder basins (BALTEX, GAME and MAGS). AGCM F reported negative runoff (probably due to a sign error) in the first 2 years of simulations. These 2 years are excluded from calculations for Model F. It should be noted that, in our analysis, evaporation is calculated from latent heat flux using a constant value as the latent heat of vaporization which might have introduced an analysis-based water imbalance due to sublimation from snow/ice-covered land surfaces.



Cumulative frequency of the 17-year mean AMIP II AGCMs' relative water imbalance (WImb/Pr), total runoff ratio (Ro/Pr) and evaporation ratio (Ev/Pr) over the global land surface (GLS) and in seven GEWEX regions. The positions of evaluation data sets among the model simulations are shown by different symbols. Observations are based on GRDC runoff and CMAP precipitation data sets. The vertical dotted line shows the assumed acceptable water imbalance threshold of 0.05 mm d^{-1}.

VIC and 18 AGCMs simulate a smaller runoff ratio over the GLS than the observations. The VIC simulated runoff ratio is the smallest compared to the AGCMs and other evaluation data sets in GAME and MAGS. However, this is not the case for other regions, with VIC and many AGCMs overestimating the runoff ratio in CATCH and BALTEX. NCEP reanalyses generally simulate both evaporation and runoff ratios larger than observations. For NCEP-NCAR, the runoff ratio is greater than 100% over GAME while for all three reanalyses evaporation ratios are greater than 100% in three relatively drier regions (MDB, CATCH, GCIP). Among the reanalyses and VIC, the NCEP-DOE simulated runoff ratio and the VIC simulated evaporation ratio generally compare well with observations over GLS and in five GEWEX regions. However, in some regions the VIC simulated runoff ratio is as good as NCEP-DOE (e.g., BALTEX and MDB) while in all regions NCEP-DOE's evaporation ratio significantly differs from "observations."

The purpose of evaluating reanalyses and VIC against observations is to identify alternative data sets that can be used to evaluate the AMIP II AGCMs especially when the global observations are not available. For example, here we calculate the 17-year mean observed evaporation as a residual of the observed precipitation and runoff by assuming that, over the multi-annual time scale, balance should be achieved between these variables. This assumption is not valid on a monthly (or seasonal) time scale, where surface water storage change is usually an important term in Equation (1). Therefore, for evaluating evaporation on a monthly or seasonal time scale, we need to rely on the model derived evaluation data sets. Furthermore, GRDC has reported only the long-term monthly mean values of runoff based on observed river discharge records. These records are distributed to 0.5^{o}x0.5 grid spacing using a very simple water balance model (Fekete et al., 2000). By contrast, the reanalyses and VIC use complex physical models to generate the spatial distribution of the surface variables. Thus, compared to available observations, reanalyses and/or VIC may be the appropriate tool for evaluating the temporal and spatial distribution of the runoff data. Based on the above analysis, VIC conserves water and simulates the observed mean evaporation ratio better (compared to GRDC and CMAP data) than reanalyses. Though reanalyses, especially NCEP-DOE, simulate the runoff ratio better than VIC in some regions, because of the non-closure of the surface water budget and very different evaporation ratios from observations, they are not appropriate tools for evaluating the AGCMs' simulated surface water budget components.

Like reanalyses, seven (out of 17) AGCMs in the MDB (h, page 5) and one in the CATCH (c, page 5) simulate mean evaporation greater than precipitation, due, to some extent, to the poor initialization of the soil moisture and problematically long spin-up period of these AGCMs. As the spin-up period for some AGCMs lasts over the entire 17-year period, it is not possible to solve the initialization problem from the data by excluding the first few years of the simulation period. So far, there are no global or regional observations against which AGCMs' soil moisture trends can be evaluated. It is also difficult to compare them against each other and deduce any reasonable explanations for such behaviour, because of the very large (orders of magnitude) difference in their values. This is because many modelling groups have not submitted soil moisture outputs according to the definition and in the standard units suggested by the AMIP.

In LBA all reanalyses and AMIP models' estimated runoff ratios are smaller than observations (f, page 5). Considering the relatively high available energy and dense vegetation canopy of the catchment, an observed mean runoff ratio of about 61% is arguably too high. Investigation reveals that the GRDC mean runoff over some areas of LBA is greater than the CMAP mean precipitation.

In summary, the analysis performed here shows that most of the AMIP II AGCMs close the surface water budget to within an acceptable margin of $\pm$ 0.05 mm d^{-1}. Among the models that do not close the water balance, some have not followed the AMIP protocol for reporting values of the required variables. The magnitudes of the water imbalance vary with regions, MDB being the worst where six models, out of 17 models with no obvious reporting error, fail to close the water balance to within $\pm$ 0.05 mm d^{-1}. Also, seven models in the MDB implausibly simulate 17-year mean evaporation greater than precipitation, due in some extent to poor soil water initialisation. Despite the emphasis in the AMIP II protocol, soil water initialization is still a problem in the GEWEX regions, especially in MDB and probably for other arid and semi-arid regions. Problems concerning the lack of reliable global observations for evaluating land-surface simulations persist. **The non-closure of the surface water budget and very different evaporation ratios from observations suggest that reanalyses are not appropriate tools for evaluating the AGCMs' simulated surface water budget components.** The GRDC runoff data set is problematic (e.g., in Amazon), and at best is not consistent

(Continued on page 19)

SPATIAL VARIABILITY OF ASSIMILATED SOIL-MOISTURE FIELDS

Praveen Kumar and Srinivas Chintalapati

Department of Civil and Environmental, Engineering, University of Illinois

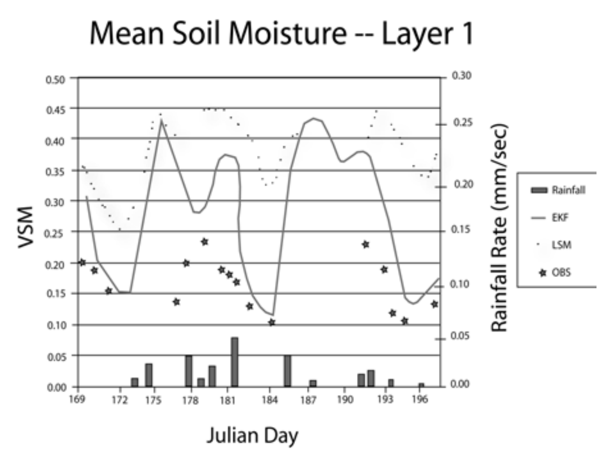
The data collected during the Southern Great Plains '97 Hydrology Experiment was used to study the spatial variability of assimilated soil-moisture fields. The L-band Electronically Scanned Thinned Array Radiometer (ESTAR) instrument flown on an aircraft was used to measure brightness temperature (Jackson, 1999). Algorithms were developed to retrieve the near surface soil moisture estimates from the measured brightness temperatures and calibrated against ground observations. The ESTAR observations were taken for 16 days of the 29-day study period over an area greater than 10,000 km^2.

The extended Kalman filtering (EKF) algorithm (Grewal and Andrews, 1993) was implemented using the National Center for Atmospheric Research land surface model (LSM) (Bonan, 1996) model for a rectangular domain, chosen so as to encompass the region where the ESTAR mapping was available on all of the 16 days. The domain is 256 km x 128 km, which is divided into 1 km x 1 km grid boxes. Each grid box is considered as a single soil column of 6 layers and the soil moisture and temperature along with associated energy fluxes are calculated for each of these grid boxes. The surface boundary data (i.e., the vegetation distribution and soil texture properties) for the domain are obtained from Earth System Science Centre (ESSC) of Pennsylvania State University. The forcing data was obtained from 111 Oklahoma Mesonet Stations in and around the domain and was interpolated for each grid box using the inverse square distance method. The soil moisture mapping time was usually around mid-morning local time and varied across the domain depending on the flight time of the aircraft. The assimilation in our study was performed at a fixed time of 10:30 AM.

The figure at the right shows the mean daily average soil moisture over the footprint area for LSM predictions, EKF estimates and the ESTAR observations for the top layer soil moisture content over the footprint area (hereby, referred to as footprint statistics), to assess the performance of the assimilation scheme. **The footprint-mean soil moisture performs predictably with the rainfall events, but the EKF estimates show a better performance than LSM predictions when compared to that of observations.** The effect of absence of observations on the assimilation results during periods encompassing Julian days 172–175 and 185–191 can also be noticed, as well as the effect of rainfall events during periods 173–175, 177–181 and 185–193, when the effect of assimilation progressively decreases and the mean values of EKF estimated soil moisture approaches the LSM predictions. But the EKF estimates recover well in the presence of observations during the subsequent dry down periods. Such a recovery can also be seen in the presence of observations during a rainfall event during days 181 to 185 and days 191 to 193. The footprint-standard deviation and footprint-coefficient of variation for the top layer soil moisture for EKF estimates capture the spatial variability in a much better way compared to the LSM predictions. This variability is partly a result of the varied soil and vegetation types in the footprint area, which is not captured well in the LSM predictions. The general trends of these statistics relative to the rainfall events can also be noticed, where there is an increase in values of standard deviation and coefficient of variation with decrease in soil moisture content, as the rainfall is spatially distributed as well. These trends are not captured well in the LSM predictions and they tend to persist with wetter moisture fields even during the inter-storm periods. The EKF estimations show a decreasing positive skew during the rainfall events and increasing positive skew during the drying periods. The LSM predictions show a near zero skew, indicating a normal distribution, which may not be true, given its tendency to overpredict the soil moisture, especially during rainfall events.

These results are in direct agreement with the findings of Faminglietti et al., 1999 during their analysis of the site measurements. The assimilated results for the lower layers and associated energy fluxes also capture these trends well and these results will be presented in a future publication.

References: www.gewex.org/refs.htm



Footprint of daily average volumetric soil moisture (VSM) of layer 1 of LSM predictions, EKF estimates and top layer soil moisture observations. The rainfall rate is also shown.

CMORPH: A NEW HIGH-RESOLUTION GLOBAL PRECIPITATION ANALYSIS SYSTEM

Robert J. Joyce[1], John E. Janowiak[2], Phillip A. Arkin[3] and Pingping Xie[2]

[1]RS Information Systems
[2]Climate Prediction Center/NWS/NOAA
[3]ESSIC/University of Maryland

A new high-resolution global precipitation analysis technique called CMORPH (CPC MORPHed precipitation) has been developed at the National Oceanic and Atmospheric Administration's Climate Prediction Center (CPC) for real-time monitoring of global precipitation. CMORPH provides precipitation estimates on a latitude/longitude grid that is approximately 8 km at the equator and covers the globe from 60°N-60°S, with a temporal resolution of 30 minutes. Analyses are available back to December 1, 2002 and are updated routinely. Plans have been made to extend these analyses back to early 1998.

The motivation for developing such an analysis system stems from the well-known fact that passive microwave (MW) observations yield more direct information about precipitation than is available from Infrared (IR) data, but because of the low orbits of the platforms that house these instruments, the MW-derived estimates have poor spatial and temporal sampling characteristics. Conversely, while the IR data provide relatively poor estimates of precipitation, they provide extremely good spatial and temporal sampling. Given these facts, the natural course of action is to attempt to combine the data from these disparate sensors to take advantage of the strengths that each has to offer. To this end, a number of techniques have been developed in which the IR data are manipulated in a statistical fashion to mimic the behavior of microwave-derived precipitation estimates. Vincente (1994) developed a scheme to merge IR and MW information over the GOES domain. Subsequently, Turk et al. (2003) developed a global scheme that determines the IR brightness temperature threshold for precipitation by comparing the distribution of IR temperatures with co-located estimates of rainfall from microwave data, and the resulting relationship is used to estimate rainfall from IR data in locations and instances where microwave data are not available. Similarly, Miller et al. (2001) developed a technique in which microwave-derived precipitation estimates are regressed with co-located observations of IR brightness temperatures to generate precipitation estimates when and where microwave data are unavailable.

CMORPH is a radically different method in which precipitation estimates from IR and MW are combined. This new method uses precipitation estimates that have been derived from low orbiter satellite microwave observations exclusively, and whose features are transported via spatial advection information that is obtained entirely from geostationary satellite IR data. Note that this technique is not a precipitation estimation algorithm, but a means by which estimates from existing algorithms can be combined. Therefore, this method is extremely flexible, permitting precipitation estimates from any satellite source to be incorporated. In effect, IR data are used as a means to transport the microwave-derived precipitation features during periods when microwave data are not available at a location. Advection vector matrices are produced by computing spatial lag correlations on successive images of geostationary satellite IR and are then used to propagate the microwave-derived precipitation estimates. This process governs only the movement of the precipitation features. At a given location, the shape and intensity of the precipitation features in the intervening one-half hour periods between microwave scans are determined from a time-weighting interpolation between microwave-derived features that have been propagated forward in time from the previous microwave observation and those that have been propagated backward in time from the following microwave scan. We refer to this latter step as "morphing" of the features. A schematic of the process is shown in Figure 1 on page 9.

To date, the CMORPH technique uses precipitation estimates that have been derived from seven separate instruments: the Special Sensor Microwave Imager (SSM/I) instruments aboard the three Department of Defense meteorological satellites; the Advanced Microwave Sounding Unit-B aboard three NOAA polar orbiters; and the Tropical Rainfall Measuring Mission (TRMM) Microwave Imager (TMI) aboard the TRMM spacecraft. We soon hope to incorporate precipitation estimates from the Advanced Microwave Sensing Radiometer (AMSR) on the

	Spatial Correction	RMSE	Skill Score	Threat Score	Probability of Detection	False Alarm Ratio
CMORPH	0.691	5.7mm/day	0.535	0.418	0.559	0.073
Mwcomb	0.561	6.6mm/day	0.437	0.333	0.453	0.053

Statistics of a comparison of the Australian rain gauge analysis with CMORPH and with a composite of passive microwave estimates for the same day but without any propogation or morphing (Mwcomb) for 15 May 2003.

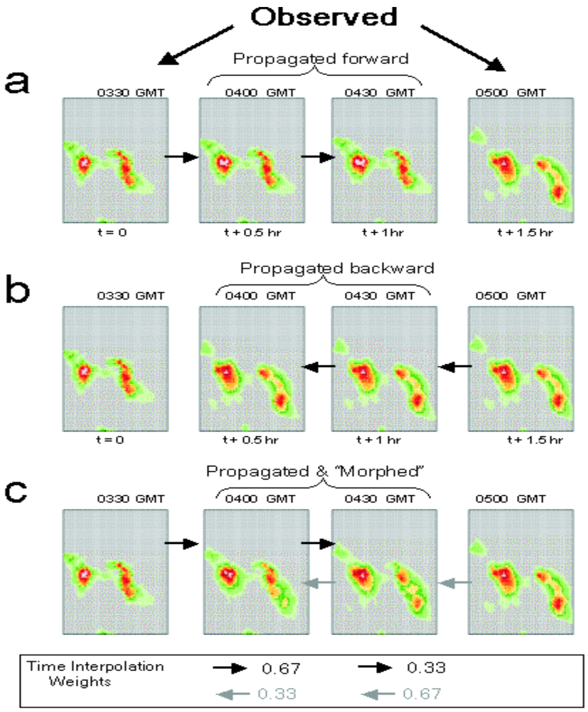


Figure 1. A graphic depiction of how the CMORPH technique works for a region in the South Pacific. The analyses at 0330 GMT and 0500 GMT are actual passive microwave estimates (i.e., no propagation or morphing has been applied to these data). The 0400 GMT and 0430 GMT are (a) propagated forward in time; (b) propagated backward in time; and (c) propagated and morphed.

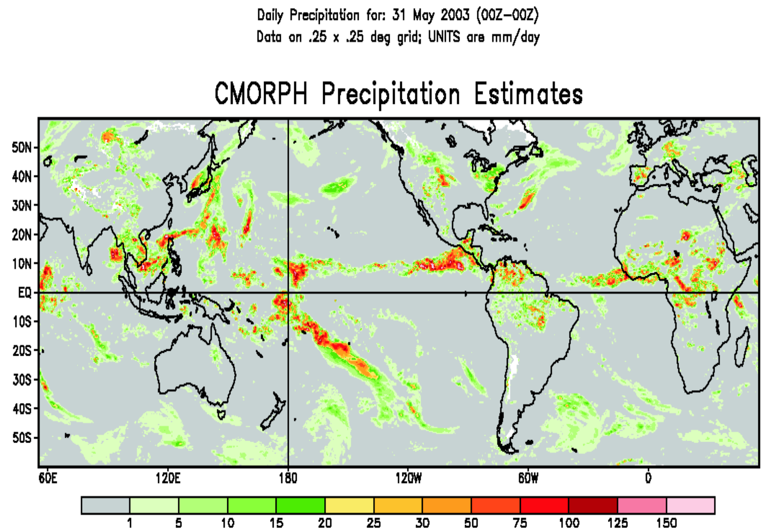


Figure 2. An example of global CMORPH analysis for 31 May 2003.

More information about CMORPH methodology, the availability of the analyses, and daily comparisons with radar and rain gauges can be obtained from:

http://www.cpc.ncep.noaa.gov/products/janowiak/MW-precip_index.html.

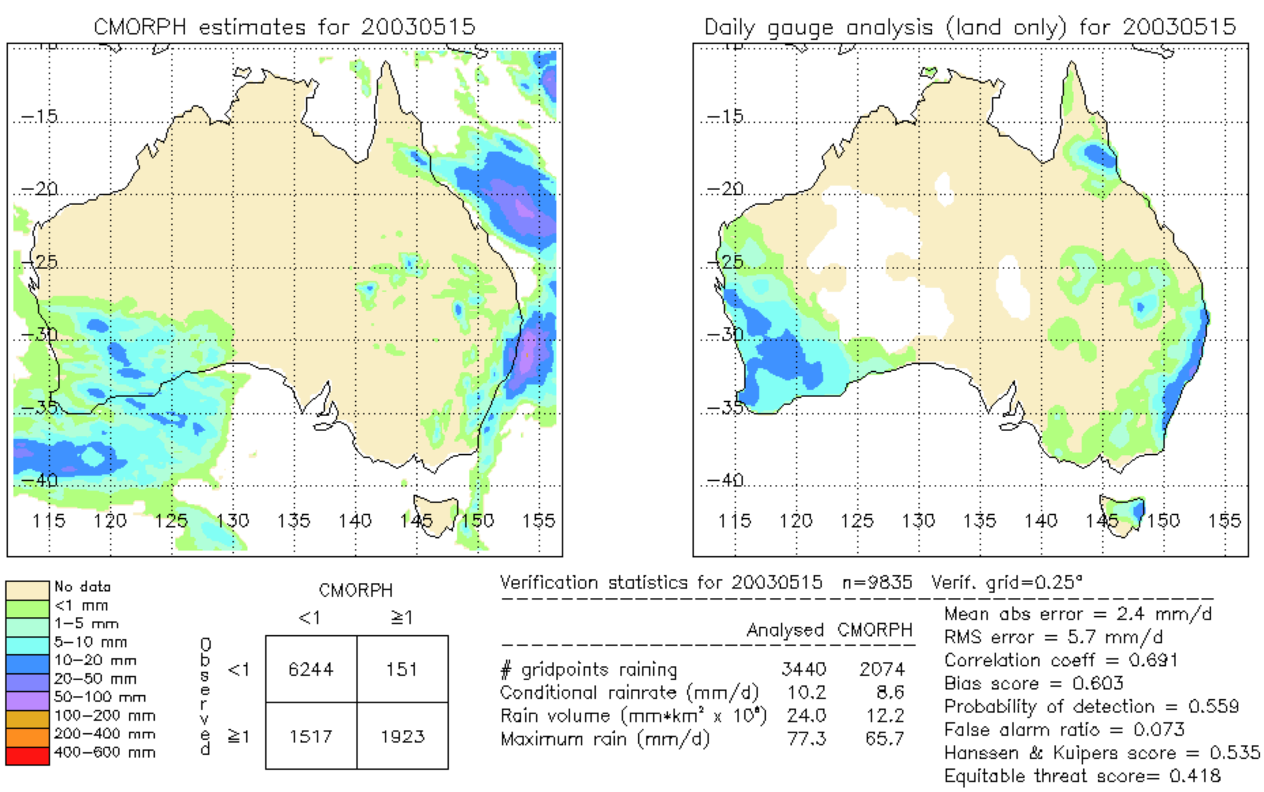


Figure 3. A comparison between CMORPH and a rain gauge analysis over Australia for 15 May 2003.

Advanced Earth Observing Satellite (ADEOS)-II and the AMSR-E aboard Aqua. The algorithms that produce the precipitation estimates that are used by CMORPH at present are Ferraro et al. (1994) for SSM/I, Weng et al. (2003) for AMSU-B, and Kummerow et al. (2001) for TMI. An example of a global CMORPH analysis is presented in Figure 2 on page 9.

As a cursory validation of the CMORPH precipitation estimates, we show in Figure 3 (page 9) a comparison between the product and a daily rain gauge analysis over Australia. The graphic in Figure 3 was obtained from the Australian Bureau of Meterology web site (http://www.bom.gov.au/bmrc/wefor/staff/eee/SatRainVal/sat_val_aus.html) that is maintained by Dr. Elizabeth Ebert of the Bureau of Meteorology Research Center (BMRC). A visual comparison shows that all major precipitation features have been detected by CMORPH and with reasonable intensity. Statistics of a comparison of the Australian rain gauge analysis with CMORPH and with a product that is a composite of all available passive microwave estimates for the same day but without any propagation or morphing are shown in the table on page 8. The results clearly show that the IR data propagation and morphing of the features is superior to a simple composite of all available passive microwave data. Although this is demonstrated for a single case for brevity here, the result is consistent on a daily basis, and readers are invited to view the BMRC web site listed above. Note that all three estimates compare well both visually and statistically. Daily validation information over the U.S. back to April 2, 2003 is available from the web page that appears in the box on page 9.

It is clear from these figures that the CMORPH precipitation estimates compare well with the reference rain gauge analyses and the radar estimates. **This good agreement with validation data suggests the potential for CMORPH to provide reasonably accurate precipitation measurements over areas of the globe where gauges and radars are sparse or non-existent, such as over oceans and over many meteorologically important land areas.** Furthermore, the temporal and spatial scales of these estimates make them suitable for use in a variety of applications in the hydrologic, climate and modeling communities. Initial studies indicate that the accuracy of the estimates produced by this method can be improved dramatically with more sampling from MW instruments and thus will benefit greatly from the Global Precipitation Measurement (GPM) mission, which is scheduled for launch in 2008.

References: www.gewex.org/refs.htm

BASIN AVERAGE PRECIPITATION VERIFICATION OF NWP OUTPUT

Elizabeth E. Ebert

Bureau of Meteorology Research Centre, Australia

The verification of several global numerical weather prediction (NWP) forecast models for basin average rainfall was conducted for the Murray-Darling Basin in southeastern Australia. The skill of the models was compared with that of the 1-day persistence forecast using the mean average error (MAE) based skill score:

(MAEfcst – MAEpersis) / (0.0 – MAEpersis)

The MAE was calculated from the time series of matched daily predicted and observed basin average rainfall values. Using persistence for comparison helps to account for the apparent trends that could occur if the weather was easier or harder to predict. **An increase in skill score with time would show that the NWP models are improving over time.**

The 30-day and 1000-day time series shown on page 20, respectively, show the average daily rainfall in the basin and associated skill scores for all of the models. The models used were the Bureau of Meteorology Research Centre's (BMRC) global model (GASP), its regional model (LAPS) with 0.75-deg. resolution, (LAPS375 has 0.375-deg. resolution), and the European Centre for Medium-Range Forecasts (ECMWF), United States, United Kingdom, and Japanese Meteorological Agency global models. All were 1-day forecasts except for ECMWF's 36-hour forecasts. The time series extends from August 1995 (or July 1996 for 365-day running values) until December 2002.

The 30-day running scores were very noisy, but show some structure. In particular, the models have a tendency to show poorer skill (relative to persistence) when the mean rainfall is low. This makes sense since persistence is a good forecast during dry periods. The 365-day running scores (not shown) are much less noisy.

The 1000-day scores have a very low pass filter applied. Looking for positive skill trends, the only model that clearly improved over time was BMRC's coarser resolution regional model. When it went to higher resolution the skill with respect to persistence decreased (although the high-resolution model did have other advantages). ECMWF quantitative precipitation forecasts may have improved; however, its time series is relatively short so it's hard to know for sure. The other curves are flat.

These results show that over the past few years, NWP models have not improved in their ability to forecast average rainfall in the Murray-Darling Basin. However, if rainfall verification results were available for the past decade or more, it is likely that they would show improvement.

GLOBAL PRECIPITATION OBSERVATIONS FROM THE PERSIANN SYSTEM

Kuo-lin Hsu, Soroosh Sorooshian, Xiaogang Gao, and Bisher Imam

Department of Hydrology and Water Resources, University of Arizona

Reliable measurement of precipitation for various hydrologic and water resource applications has been a very high priority, particularly for many regions of the world where *in situ* observations are lacking. In recent years, precipitation estimation from satellite remote sensing has been evolving to a point that it promises to help augment traditional means of observation from ground surface (i.e., use rain-gauge networks and radar). The satellite remote-sensing technology is capable of providing global monitoring and measurement of precipitation covering regions, such as mountains and oceans, unable to be reached by ground-based observations. In late 1997, with the launch of the National Aeronautics and Space Administration (NASA) Tropical Rainfall Measurement Mission (TRMM) platform, a variety of precipitation algorithms and products are generated and evaluated, which raises the satellite precipitation estimation to a new level of finer resolutions and better quality (Kummerow et al., 2000).

Under the support of the NASA TRMM, Earth Observing System Interdisciplinary Science (EOS/IDS) and National Oceanic and Atmospheric Administration (NOAA) GEWEX Continental-scale International Project (GCIP)/GEWEX Americas Prediction Project (GAPP) programs, the system of Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks (PERSIANN) was developed and has been continuously updated and reported on (Hsu et al., 1997; Hsu et al., 1999; Sorooshian et al., 2000; Sorooshian et al., 2002). The May 1997 issue of *GEWEX News* covered the main features of the PERSIANN system. What follows is an update of the latest progress.

To improve the PERSIANN estimates, the current implementation of PERSIANN merges the global geostationary infrared data from GOES-8,10, GMS-5, and MeteoSat-6,7 satellites (Janowiak et al., 2000) with the precipitation products produced from multi-channel microwave sensors carried by the low-orbiting satellites of TRMM, NOAA-15,16,17, and DMSP F-13,14,15 (Ferraro and Marks, 1995; Kummerow et al., 1998). By including multiple microwave rainfall measurements, the model deficiencies associated with low frequency of reference samples are overcome substantially. For example, for a testing site within a 6-hour period, there is only one or no training sample available from TRMM sensing, while using those seven low-orbiting satellites, training sample counts may have increased from 1 to 3 for most of the regions. Figure 1 on page 12 shows the monthly precipitation estimates (August 2002) from the PERSIANN system trained by 7 low-orbiting satellite rainfall estimates (1a) and trained by the TRMM Microwave Imager 2A-12 algorithm rainfall estimates only (1b). The difference between (1a) and (1b) is displayed in (1c). It shows that the rainfall increased over the tropical oceans and high-latitude region of the Northern Hemisphere, but reduced over the cold high-latitude regions of the Southern Hemisphere. The difference between (1a) and (1b) may have come from the PERSIANN system that is trained by more frequent samples and its referenced rainfall from multiple satellites. Further evaluation of the PERSIANN estimates in the region with high rain-gauge density is under investigation.

For many hydrologic applications, such as flood control and water resource management, precipitation variations at daily and watershed scales (hundreds km^2) are demanded. **Currently, the PERSIANN system produces near-real-time precipitation data for global coverage from 50°S to 50°N at 6-hourly and 0.25 x 0.25 resolutions, which roughly meet the requirements for watershed hydrological modeling and mesoscale model data assimilations.** In addition to providing long-term historical records for the hydrologic simulation, the operational PERSIANN system has a significant add-on value to the response of disasters happening, such as flood and drought, in a timely fashion. In the modeling of the flood events, for example, the quantity of runoff is depended on the amount, intensity, distribution, and duration of precipitation and the soil moisture conditions of the watershed. Progressively monitoring the space and time distribution of precipitation in the initial stage of the event is critical. **Figure 2 on page 12 shows the PERSIANN system was operated to monitor Mozambique's worst flooding event in 50 years during February 2001**. In this event, more than 700 people were killed and few hundred thousands of people were made homeless. The PERSIANN observation of torrential rain in the incipient period of flooding (February 4–9) is shown in Figure 2a-f. Following continuous torrential rain for days, river flow started to rise and flood spread around the villages around February 9.

The PERSIANN products from 2000 to present are now available through the Hydrologic Data and Information System (HyDIS) (http://www.hydis.hwr.arizona.edu). A new merged product of the PERSIANN precipitation with the GPCC rain-gauge data is under development. The ongoing deployment of NASA's Global Precipitation Mission (GPM) is planned to employ constellation satellites and greatly enhance the global precipitation observations. The objective of the GPM is to provide low-orbiting microwave precipitation estimates with sampling intervals of less than 3 hours for more than 90% of the Earth's surface. We expect that, in conjunction with the geostationary satellites, the PERSIANN system will use the future GPM data and products for producing a more reliable fine-resolution precipitation data useful to hydrologic applications.

References: www.gewex.org/refs.htm

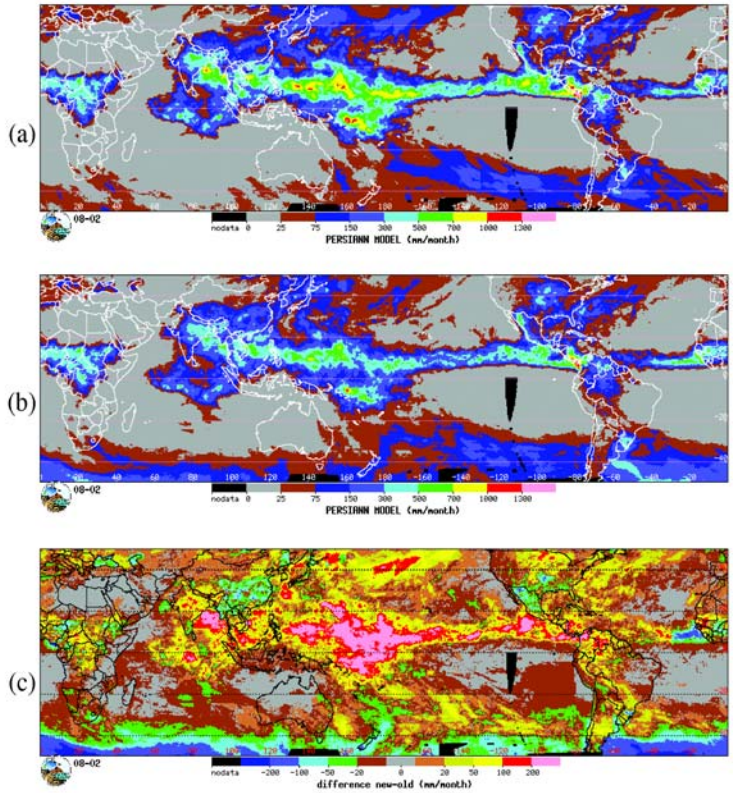


Figure 1. Monthly rainfall estimates (August 2002) from PERSIANN system trained by rainfall estimates from (a) TRMM, NOAA (15, 16, 17), DMSP (13, 14, 15) and (b) TRMM only; (c) is the difference map between (a) and (b).

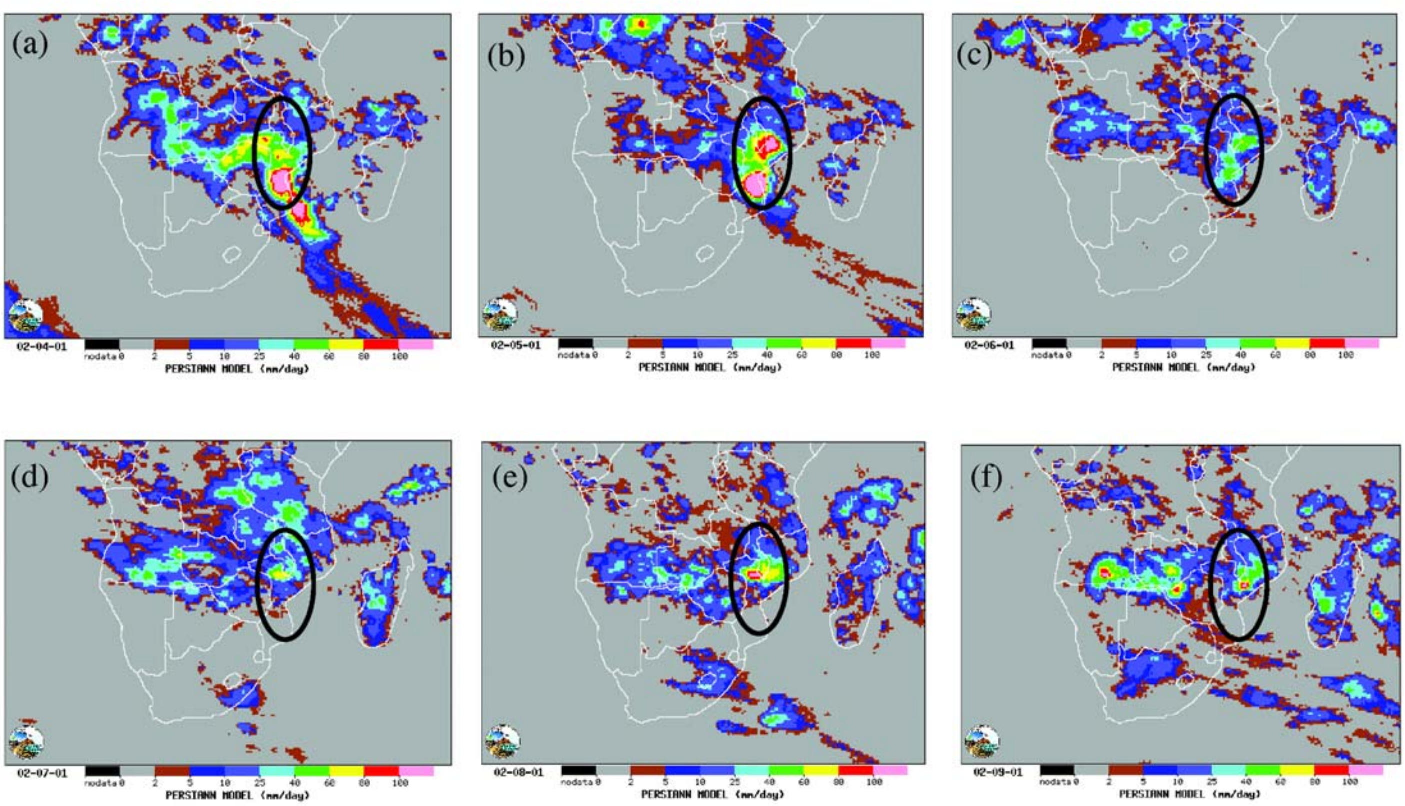


Figure 2. PERSIANN daily rainfall estimates from (a) February 4 to (f) February 9, 2001, over southern Africa during the incipient period of Mozambique flooding.

SOIL MOISTURE OBSERVATIONS FROM THE OKLAHOMA MESONET

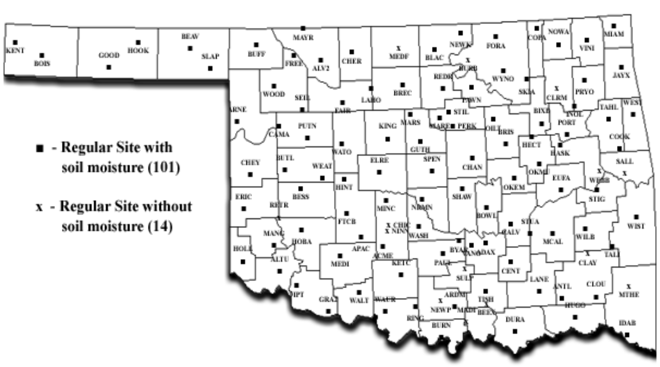
Bradley G. Illston, Jeffrey B. Basara, and Kenneth C. Crawford

Oklahoma Climatological Survey

The Oklahoma Mesonet (see figure below) is an automated network of remote, meteorological stations across Oklahoma (Brock et al., 1995; Shafer et al., 2000). Each station measures nine core parameters: air temperature and relative humidity at 1.5 m, wind speed and direction at 10 m, atmospheric pressure, incoming solar radiation, rainfall, and bare and vegetated soil temperatures at 10 cm below ground level. For additional information about the Oklahoma Mesonet, see http://www.ocs.ou.edu/programs/mesonet.html.

During 1996, heat dissipation sensors to measure soil moisture were installed at 60 sites in the Oklahoma Mesonet at depths of 5, 25, 60, and 75 cm. Based upon the initial success in using data from this initial deployment of soil moisture sensors, additional sensors were installed at 43 Mesonet sites during 1998 and 1999. A key aspect to the network of soil moisture sensors is that estimates of both soil-water potential and water content are collected every 30 minutes (Reece 1996; Starks 1999; Basara and Crawford 2000).

Through support from GEWEX programs, including the GEWEX Continental-scale International Project (GCIP) and the GEWEX Americas Prediction Project (GAPP), Mesonet soil moisture data were rigorously analyzed and quality assurance procedures were developed and implemented. The results of the analyses are displayed in the following Table.



Location of Oklahoma Mesonet stations.

Soil moisture data statistics from the Oklahoma Mesonet based on over 30 million possible observations.

Year	Number of Research Quality Data Points	Percentage of Research Quality Data Points
1997	3,525,738	91
1998	3,659,388	89
1999	4,211,868	89
2000	5,381,817	93
2001	5,476,006	95
2002	5,334,563	93
6-Year	27,589,376	92

The soil moisture data have become critical in research projects seeking to quantify the interactive processes within the land-atmosphere continuum. For example, a climatology of soil moisture characteristics of Oklahoma was created for the first 6 years of the soil moisture archives (Illston, 2002) to provide a better understanding of the subterranean hydrological aspects of Oklahoma. The continued monitoring of soil moisture conditions by the Mesonet will allow the climatology to expand and grow each year.

Soil moisture data from the Oklahoma Mesonet have also been used to validate model output and lead to model modifications. One study compared the soil moisture output of various land surface models (LSM), (e.g., VIC, Mosaic, and NOAH) used in the North American Land Data Assimilation System with *in situ* measurements of soil moisture from the Oklahoma Mesonet (Robock et al., 2003). **It was found that the LSMs performed quite well in the analysis of spatial and temporal variations in soil moisture, but performed less well estimating the magnitude of soil moisture.** By comparing model output with observational data, studies such as Robock et al. (2003) facilitate the verification and modification of models to improve the simulation of land-atmosphere interactions and the overall predictive capability of coupled soil-vegetation-atmosphere numerical models.

The soil moisture data also provided unique insight into two severe droughts that impacted Oklahoma during the summer of 1998 and the fall of 2000 (Illston and Basara, 2003). One important case in 1998 (and into 1999) was documented using data from the Hollis, Oklahoma site in southwest Oklahoma which experienced some of the most severe drought conditions. The figure in the middle of page 20 represents a meteogram of normalized soil moisture values (1=wet, 0=dry) for the four depths at the Hollis site over 1998 and 1999. Typically, the storm season in Oklahoma occurs from early March (day 60) through mid-June (day 160). However, during 1998, limited precipitation during the storm season resulted in rapid drying through the soil profile. As a result, during the summer period (day 180 to 270), soil moisture reached very minimal values. The conditions were so severe that when the autumn rains occurred, the deeper depths (60 and 75 cm) showed no response to the rainfall. It was not until late April of 1999 that these depths began to return to more moist conditions. Due to such a late recovery date, the deeper depths remained at moist levels for only two months before entering back into the dry, summer conditions. As a result, the dry conditions once again proceeded into the following year (2000). **While the Hollis site portrays an extreme case, it does show how severely dry conditions in one year can have major impacts on following years.**

The collection and archival of research quality soil moisture data by the Oklahoma Mesonet represents a successful partnership between the State of Oklahoma and the GEWEX community. Data files from the Mesonet are copyrighted. However, GCIP/GAPP Investigators can access soil moisture data beginning in 1998 through the CODIAC web site at: www.ofps.ucar.edu/codiac/.

Acknowledgements

The successful collection of soil moisture observations from the Oklahoma Mesonet was made possible by NSF-EPSCOR and NSF MRI grants and by the NOAA Office of Global Programs through GCIP and GAPP. The authors would also like to thank Dr John Leese, Dr. Richard Lawford, and Dr. Jared Entin for their continuous support of the Oklahoma Mesonet.

References: www.gewex.org/refs.htm

PAUL HOUSER TO CHAIR THE GAPP ADVISORY GROUP

Dr. Paul Houser, Head of the Hydrological Sciences Branch at NASA's Goddard Space Flight Center, has agreed to chair the GEWEX Americas Prediction Project (GAPP) Science Advisory Group (SAG) for 2 years. The GAPP SAG provides advice and direction on the implementation of GAPP and its interactions with national and international groups.

WORKSHOP/MEETING SUMMARIES

CEOP REFERENCE SITE MANAGERS WORKSHOP

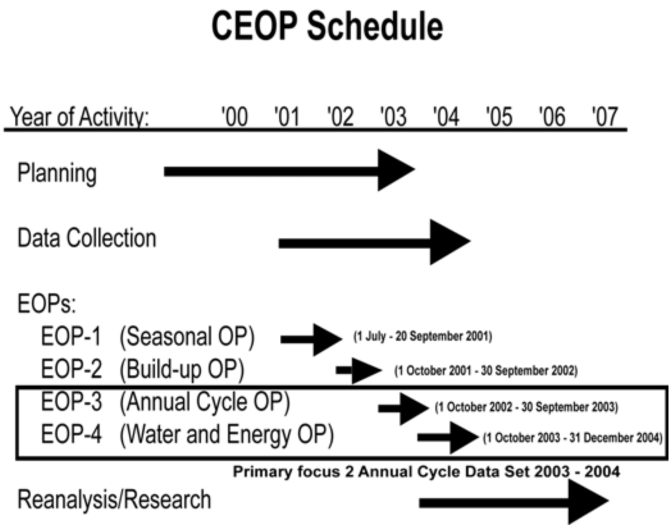
31 March – 1 April 2003
Berlin, Germany

Sam Benedict
CEOP International Coordinator

The Workshop, which was organized by Drs Steve Williams and Hans-Joerg Isemer, Co-Chairs of the Coordinated Enhanced Observing Period (CEOP) Data Management Working Group, was held in conjunction with the second formal CEOP Implementation Planning Meeting. The focus of the Workshop was on the reference site contributions to the assembly and timely delivery of the CEOP annual cycle data sets. The reference site representatives were asked to collectively assist in defining the format for future CEOP data sets and to discuss individually their plans to deliver data that meet the established criteria.

The *in situ* data gathered from the CEOP reference sites and reference hydrological basins from the GEWEX Continental Scale Experiments (CSE) located around the world are the most fundamental component of the CEOP strategy. **The Enhanced Observing Period-1 (EOP-1) (July to October 2001) uniformly formatted hourly reference site data sets are available now on the Internet at: http://www.joss.ucar.edu/ghp/ceopdm/archive/eop1_data/index.html.** Collection of the data from the CSE sites for this first CEOP seasonal data has shown that adherence by the reference sites, to a consistent format is especially important to ensure an efficient continuation of the CEOP data set development and delivery process.

An important part of the discussion included the current status of the Prototype CEOP EOP-1 Reference Site Data Set that was developed by the CEOP Data Archive (CDA) at the University Corporation for Atmospheric Research/Joint Office for Scientific Support. Several changes were suggested and approved. All Reference Site spokespersons agreed to be responsible for immediate submittal and continued maintenance of complete site documentation. The required information includes: on-line site links, location(s) [latitude, longitude, and elevation], maps and photos, land characterization, canopy height, measurements (parameters, frequency, instrumentation and specifications, exposure).



Another outcome of the Workshop was the interchange of information related to critically important data from the CEOP reference sites that had not been provided earlier. The CEOP Reference Site Table at: http://www.joss.ucar.edu/ghp/ceopdm/rsite.html has been updated with the newest information obtained at the meeting. The CSE spokespersons from the five most mature GEWEX CSEs (Baltic Sea Experiment; Large-Scale Biosphere-Atmosphere Experiment in Amazonia; Mackenzie GEWEX Study, GEWEX Asian Monsoon Experiment; and the GEWEX Americas Prediction Project) were asked to undertake another review of the CEOP Reference Site characteristics table for completeness. This action has become more important as the data for the CEOP annual cycle data sets are about to be received and fashioned into appropriate composited sets.

It was agreed that a detailed document containing the complete "composite" data set description was necessary for reference by the *in situ* data site managers by the end of July 2003. It was decided that the report would include the details associated with the standard format for continued submission of Reference Site data (ASCII column) and notes that all data submitted must be accompanied by a corresponding Metadata file(s) and that the data Quality Check (QC) will be expected to have been performed by the individual Reference Sites prior to data submission to CDA. It was agreed that the CDA will be funded to perform a "gross" and visual QC on the entire data set to ensure completeness and consistency once all data sets have been submitted.

In response to this request for action a CEOP Reference Site Data Report has been produced. The report is based on the feedback received so far on the EOP-1 Prototype Data Set and the discussions that had taken place at the Workshop and the CEOP Implementation Planning Meeting. An Internet version of the report can be found at: http://www.joss.ucar.edu/ghp/ceopdm/refdata_report.

The report forms the basis for provision of future *in situ* data for CEOP. The agreement reached at the meeting that directly impacts CEOP's ability to meet its commitment to produce an initial composited annual cycle data set in line with the previously documented CEOP data policy (http://www.joss.ucar.edu/ghp/ceopdm/ceop_policy.html) was that EOP-3 data collected during the first half of annual cycle (October 2002 through March 2003) will be submitted to the CDA, in the agreed-to format, so that Category 1 data (e.g. Rawinsonde, surface standard meteorology) would arrive on or before 1 October 2003 and Category 2 data (e.g. flux or tower data, soil profile data, wind profiler) would follow on or before 1 June 2004. **This commitment by the reference site managers ensures that CEOP will meet its delivery milestones as reflected in the CEOP Schedule.**

The participants at the CEOP Managers Reference Site Workshop in Berlin, Germany, 31 March – 1 April 2003.

GLASS WORKSHOP ON THE PILPS CARBON EXPERIMENT

6–7 May 2003
Gif sur Yvette, France

Nicolas Viovy
LSCE, France

The first workshop of the Project for Intercomparison of Land-surface Parameterization Schemes (PILPS)-Carbon project was held from 6–7 May 2003 on the Centre National de la Recherche Scientifique (CNRS) campus in Gif-sur-Yvette, France. The aim of the workshop was to discuss the results of the first phase of the PILPS carbon project. As described in Viovy (2002) the goal of this project was to compare net CO_2, sensible and latent heat fluxes simulated by several land surface models (LSM) with *in situ* data. The site chosen for this experiment was Loobos, a temperate coniferous forest located in The Netherlands. For this site 2 years (1997–1998) of half-hourly fluxes and meteorological data are available. This forest was planted 80 years ago on sand. This means that at plantation, the soil contained less than 1 percent of the current carbon contant and thus simplifying the initial conditions for these numerical experiments.

Moreover, it was possible to reconstruct a 100-year time series of meteorological data using measurements of a nearby station. Two simulations were performed. For the first one, named "free-equilibrium," the models were run to equilibrium of state variables (e.g., carbon and water pools) looping through the two years of data (1997 and 1998). For the second simulation, named "free-100 years," the participants were asked to simulate the growth of the forest from its plantation to 1998 starting without any carbon in the soils and without vegetation. For the two simulations only the forcing data were given to the participants without any calibration or adaptation done for the site.

Several analyses have been performed to compare model output. These include systematic and non-systematic root mean square error and index of agreement (Willmott 81). For the 100-year run the annual net CO_2 flux simulated by the models has been compared between models and to observations for the last two years. The evolution of several parameters (i.e., assimilation, productivity, net CO_2 flux, soil carbon and vegetation biomass) simulated by the different models during the 100 years of simulation have been compared.

The results show first that most of the models underestimate the higher fluxes for latent heat and net CO_2 (NEE=Net Ecosystem Exchange). The greatest dispersion is observed for sensible heat flux. One would have expected a higher dispersion for the NEE because LSMs have only introduced its parameterizations recently. All models seem to overestimate night flux. Some models tend to overestimate this flux all the time (the heat flux is biased but the correlation with observation is good) whereas the others models have correct fluxes during the day (and then the slope of the fit between model and observation is lower than 1). All the models tend to underestimate CO_2 net fluxes.

The decomposition of Root Mean Square Error (RMSE) between systematic and not systematic contributions indicate that for equivalent total RMSE models show very different behavior since some have a good correlation with data but with high dispersion, whereas others show a systematic bias but with low dispersion.

In the century long runs, all models simulate a net sink as observed. Most of the models are also able to reproduce the increase of the net sink for year 1998 compared to 1997. However, most of the models underestimate this sink. If models converge around relatively similar annual NEE at the end of the run, the evolution of the simulated total living biomass and soil carbon are very different from one model to the other. The total living biomass can vary for instance from 1 kg to 16 kg of carbon in the vegetation and from 1 kg to 10 kg of carbon in the soil. However, for soil carbon where data are available for Loobos, several models are close to the 7 kg of carbon per square meter observed (see the figure at the bottom of page 20).

The preliminary analysis has already shown that LSMs do not perform worse for the net CO_2 flux than they do for the energy fluxes. On the other hand the long-term evolution of the carbon pools can be very different from one LSM to another and reminds of the discrepencies found in previous PILPS for soil moisture. To conclude this first phase of the project a new set of simulations will be performed by the participants. These numerical experiments will be the same as previously, except that ancillary information on the surface properties will be provided to the participants so that the models can be calibrated for this site. New participants are welcome to participate in these new sets of simulations.

All of the results and the full report can be found at http://www.pilpsc1.cnrs-gif.fr.

References: www.gewex.org/refs.htm

FIRST GRP WGDMA MEETING

12–16 May 2003, Asheville, North Carolina, USA

William B. Rossow
NASA/Goddard Institute for Space Studies

The first meeting of the GEWEX Radiation Panel (GRP) Working Group on Data Management and Analysis (WGDMA) was held at the National Climatic Data Center (NCDC) of the National Oceanographic and Atmospheric Administration (NOAA) in Asheville, North Carolina, USA, on 12–16 May 2003. About 30 people attended the meeting, representing 21 different institutions in six different countries. The WGDMA is composed of the data management groups from all of the GEWEX data projects under the purview of GRP and includes the International Satellite Cloud Climatology Project (ISCCP), the Surface Radiation Budget (SRB) Project, the Baseline Surface Radiation Network (BSRN), the Global Precipitation Climatology Project (GPCP), the Global Precipitation Climatology Center (GPCC), and the Global Aerosol Climatology Project (GACP).

At the start of the meeting, the history of GEWEX satellite data projects and plans for Phase II were discussed. In Phase II, activities are shifting away from the production of data products to fostering more diagnostic analyses of the global energy and water cycle. The GEWEX project data management groups were combined into the WGDMA to facilitate more coordination and collaboration among the GRP projects, as well as with other projects within GEWEX and the World Climate Research Programme (WCRP).

The overall status of the individual projects was reviewed; all project operations are running smoothly. The session ended with a discussion about re-activating the Global Water Vapor Project (GVaP). GVaP has completed a successful pilot phase, producing the NVaP data set sponsored by NASA, and is participating in key field campaigns to evaluate measurement systems. Recent results from the Atmospheric Radiation Measurement (ARM) Program indicate that satellite measurements are capable of more accurate water vapor measurements, although with lower vertical resolution than radiosondes. **Considering the number of water vapor data sets currently available, several covering long periods of time, WGDMA recommends that the next phase of GVaP be a rigorous assessment of the accuracy of these water vapor data sets, both to set the stage for a possible re-analysis, and to provide input to the next Intergovernmental Panel on Climate Change (IPCC) assessment.** It was proposed that this assessment be carried out in partnership with the International TIROS Operational Vertical Sounder (TOVS) Working Group, which has a lot of the experts needed for this activity. This idea will be presented at their next meeting in October–November 2003. Also discussed were possible opportunities for exploiting newer satellites to improve the analysis of the longer data records.

Reports from the individual data centers ended with a discussion of ways to better coordinate these activities. Presentations were made by the NOAA National Satellite Data and Information Service (NESDIS), the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), the Meteorological Satellite Center of the Japanese Meteorological Agency (MSC of JMA), the Colorado State University (CSU), the GPCP GeoSat processing center (NOAA/NESDIS), and the GPCP microwave processing centers [National Aeronautics and Space Administration (NASA)/ Goddard Space Flight Center (GSFC) and NOAA/NESDIS]. A brief report was also made on behalf of representatives from the National Space Development Agency of Japan (NASDA), the Meteorological Service Canada (MSC) and the China Meteorological Administration (CMA). Notable events are the successful launches of the METEOSAT Second Generation (MSG-1) and the Advanced Earth Observation Satellite (ADEOS-2) last year; the transition of MSC operations from Geostationary Operational Environmental Satellite (GOES)-8 to GOES-12 (East position) at the beginning of April 2003; and the planned transition of JMA operations from GMS-5 to GOES-9 later in May 2003. MSC reported that there will be a delay in beginning processing of GOES-12 data, so CSU is processing GOES-12 as a backup. CMA reported that their geostationary satellite, FY-2B, is operational except during eclipse seasons. A sample data set has been provided to the ISCCP Global Processing Center (GPC) to prepare for processing. Special attention was focused on the groups within these projects working on radiance calibration, the GPCP GeoSat center, the ISCCP Satellite Calibration Center (Centre Meteorologie Spatiale) and the ISCCP Global Processing Center (NASA/Goddard Institute for Space Studies), and the archival centers (NOAA/NCDC, BSRN Archives at Swiss Federal Institute of Technology (ETH) and NASA Langley Research Center). Currently, most centers are funded or awaiting decisions on renewed funding. **Data sets are now available and the periods they cover are: ISCCP clouds (1983–2001), GPCP precipitation (1979–2001), GPCC gauge precipitation (1979–2001), SRB radiative fluxes (1983–1995), BSRN radiative fluxes (1994–2001), and GACP aerosols (1983–2001).**

Special presentations were given by NOAA/NCDC regarding their plans for advancing the production of global, long-term climate data records and from EUMETSAT about the activities of their Satellite Application Facilities (SAF) with regard to producing climate data products. A report was presented on the WCRP Working Group on Satellite Matters, which has now been tasked by the JSC with producing a comprehensive re-analysis plan for global, long-term (mostly satellite-based) data products. This was followed by a lengthy discussion of how the WGDMA activities and plans could contribute to these larger WCRP plans.

Three specific decisions about enhanced activities were made. The first is for WGDMA to explore the feasibility and value of merging its data products by first trying to do this with the global, monthly mean products that provide the long-term climate data record. To that end, information on covered time periods, map grids and quantities reported in each data product will be collected and actions taken to produce such a merged product. The second decision was to compile a list of statistical analysis methods to be applied to all of the data sets as a way to begin a joint analysis; this analysis could later be repeated using the merged product. The third decision was to recommend to the GRP [seeking endorsement from the GEWEX Scientific Steering Group (SSG) and WCRP Joint Scientific Committee (JSC)] that they undertake (with WGDMA participation) an assessment of the available global, long-term data products relevant to the global energy and water cycle for input to the next IPCC report and as an appropriate precursor to plans for the re-analysis of these data sets. The quantities that would seem ready for assessment are water vapor (as part of the re-start of GVaP), clouds, precipitation and radiative fluxes (both top-of-atmosphere and surface). Now that ISCCP, GPCP and SRB have all completed long data records, it is an opportune time to assess their accuracy, along with other available products being produced from other sources.

An afternoon was devoted to the liaison reports from the various groups that GRP/WGDMA needs to work with more closely to achieve the new GEWEX goals. The main contact with the GEWEX Modeling and Prediction Panel (GMPP) activities to-date has been the GEWEX Cloud System Study-Data Integration for Model Evaluation (GCSS-DIME), where the GRP projects are supplying many of the key large-scale data sets. Some of the GRP products are also supplied for the International Satellite Land-Surface Climatology Project (ISLSCP) data compilation initiatives. GRP has organized an effort, called SeaFlux, to evaluate methods for estimating ocean surface turbulent fluxes of heat and freshwater that also employs a number of GRP data products, but there could be closer coordination with Climate Variability and Predictability (CLIVAR) activities in this area to enhance the quality of these products. The GEWEX Hydrometeorology Panel (GHP) has several activities that could benefit from closer collaboration and data exchange with GRP/WGDMA and that would also benefit GRP projects by providing validation data sets: the Global Soil Wetness Project (GSWP), the Continental Scale Experiment's Water and Energy Budget Study (CSE WEBS) and the Coordinated Enhanced Observation Period (CEOP) projects. Currently, the GSWP gets some GRP products through ISLSCP, but this very indirect interaction does not take full advantage of the GRP expertise. There was also discussion about possible contacts with the Climate in the Cryosphere (CLiC) with regard to polar region precipitation, clouds and radiation; plans have already started towards a joint workshop on the latter two topics, but it was recommended that precipitation be added. The day ended with a discussion of the motivation behind plans for a more coordinated re-analysis of global data sets.

Two notable recommendations/actions items from the meeting are:

(1) The GPCP/SRDC should expand its activities to include mountainous regions and high latitude validation sites. The GPCC will explore the feasibility of separating liquid and solid precipitation in its climatologies by reprocessing a subset of its holdings. The GPCP/GPCP Merge Development Center (GMDC) will explore the capability for separating the high-time resolution satellite precipitation product into solid and liquid forms with a temperature threshold by using a global, near-surface air temperature data set, relying on advice from CLiC. The feasibility of preparing the ISCCP B1 data set, to be processed by GPCP, will be explored.

(2) The BSRN archives at ETH will explore the feasibility of expanding their collection of long-term measurements of "all" surface flux components, not just radiation. Discussions have begun between GRP/BSRN and Global Climate Observing System (GCOS) to find a way to solidify BSRN as the core of a GCOS surface radiative flux monitoring capability.

Beginning in 2004, WGDMA meetings will be held in conjunction with the annual GRP meetings. The former will occur in the two days following the GRP meeting. Mid-year discussions will also occur to expedite any needed actions.

EVALUATING GEWEX CSES'...

(Continued from page 6)

with precipitation data. Due to constrained atmospheric forcing, off-line land-surface schemes, such as VIC, close the surface water balance and simulate evaporation ratios better than any reanalyses but in some regions runoff ratios are very different from observations. **However, as a whole VIC simulates surface water budget components better than reanalyses and thus can be regarded as an alternative tool for the evaluation of AGCMs' surface water budget components especially for variables for which we do not have global observations or when we need additional data for the evaluation.**

References: www.gewex.org/refs.htm

THREE GEWEX SCIENTISTS SELECTED AS AGU FELLOWS

Drs. Witold Krajewski, University of Iowa; Michael I. Mishchenko, NASA Goddard Institute for Space Studies; and Graeme L. Stephens, Colorado State University, were selected as American Geophysical Union (AGU) Fellows of 2003. AGU members who are selected as Fellows have attained an acknowledged eminence in a branch of the geophysical sciences. The number of Fellows selected annually is limited to no more than 0.1 percent of the AGU.

GAME AAN DATA SET NOW AVAILABLE ON CD-ROM

Version 1 of the GEWEX Asian Monsoon Experiment (GAME) Asian Automatic Weather Network (AAN) data set (GAME data CD-ROM No. 6) is now available to the general scientific community. It contains up to 4 years of flux, meteorology, and hydrology data obtained through the year 2000 at AAN's 14 surface automatic weather stations deployed over the GAME study areas.

The CD-ROM may be ordered from the AAN website at (http://www.suiri.tsukuba.ac.jp/Project/aan/aan.html) or from the AAN office at the Terrestrial Environment Research Center, University of Tsukuba Tsukuba, Ibaraki 305-8577, Japan (fax: 81-298-53-2530; phone: 81-298-53-2533; E-mail: aan@suiri.tsukuba.ac.jp). The data from the CD-ROM may also be downloaded at: ftp://gamecenter.ihas.nagoya-u.ac.jp/pub/GAME1/cdrom_pub/.

GEWEX/WCRP MEETINGS CALENDAR

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

25–27 August 2003—GLASS MEETING, Tucson, Arizona, USA.

27–29 August 2003—PILPS SAN PEDRO-SEVILLETA EXPERIMENT WORKSHOP, Tucson, Arizona, USA

22–25 September 2003—GABLS WORKSHOP ON MODEL INTERCOMPARISON AND FUTURE DIRECTION, University of the Balearic Islands, Mallorca, Spain.

22–26 September 2003—9TH MEETING OF THE GEWEX HYDROMETEOROLOGY PANEL AND WORKING GROUP MEETINGS, GKSS, Geesthacht, Germany.

29 September – 3 October 2003—ILEAPS OPEN SCIENCE CONFERENCE, Helsinki, Finland.

15–17 October 2003—WCRP WORKING GROUP ON SATELLITES, Geneva, Switzerland.

27-31 October 2003—GCSS SSG MEETING AND GCSS WORKING GROUPS 1, 3, AND 4 WORKSHOPS, Broomfield, Colorado, USA.

10–13 November 2003—14TH SESSION OF THE GEWEX RADIATION PANEL, Victoria, British Columbia, Canada.

10–14 November 2003—19TH SESSION OF THE CAS/JSC WORKING GROUP ON NUMERICAL EXPERIMENTATION (WGNE)/7TH SESSION OF THE GEWEX MODELLING AND PREDICTION PANEL (GMPP), Salvador, Brazil.

12–14 November 2003—MAGS ANNUAL MEETING #9, Montreal, Canada.

13–14 November 2003—WORKSHOP ON PROBLEMS WITH CLOUDS AND 3-D RADIATIVE TRANSFER, Victoria, British Columbia, Canada.

10–15 January 2004—84TH AMS ANNUAL MEETING, Seattle, Washington, USA.

26–30 January 2004—16TH SESSION OF THE GEWEX SSG, Marrakesh, Morocco.

2–4 Febuary 2004—WORKSHOP ON SEMI-ARID REGIONS, Marrakesh, Morocco.

GEWEX NEWS

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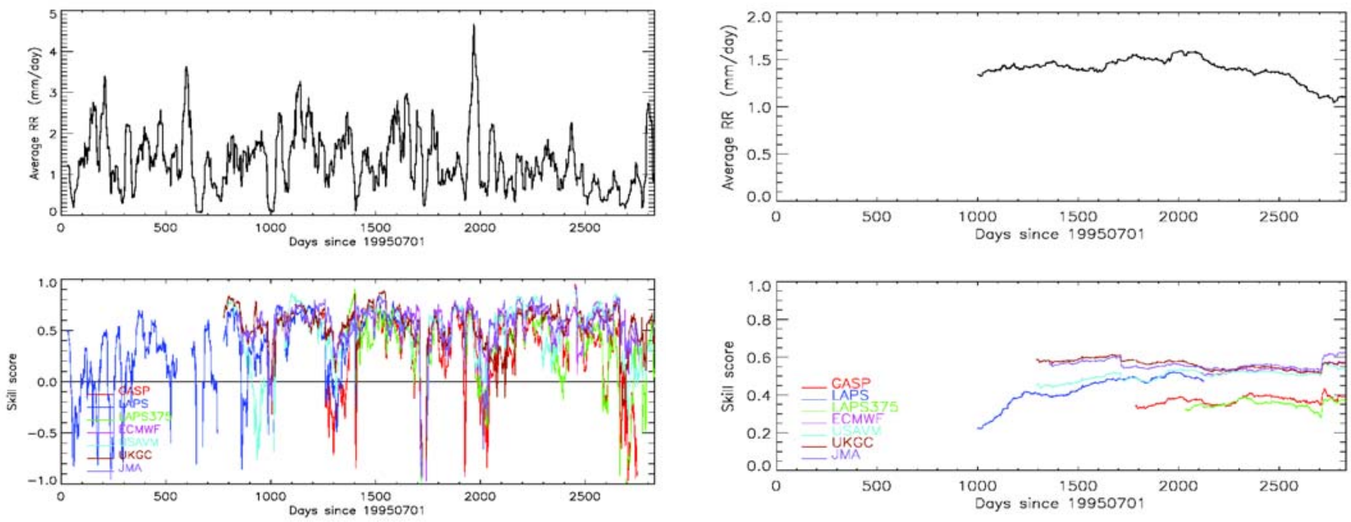
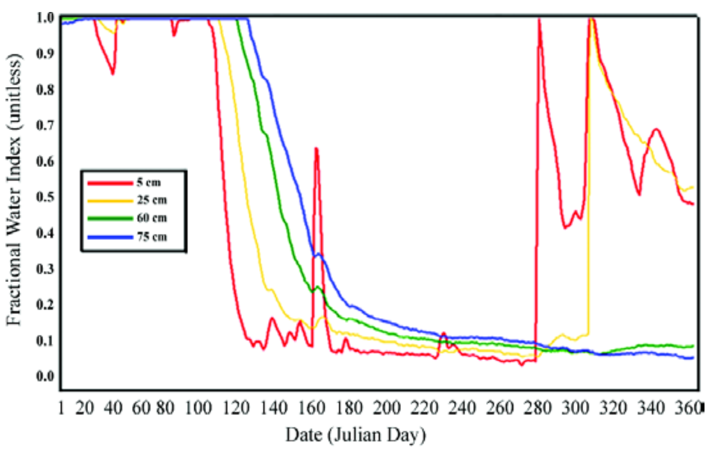
Mail: International GEWEX Project Office
1010 Wayne Avenue, Suite 450
Silver Spring, MD 20910, USA
Tel: (301) 565-8345
Fax: (301) 565-8279
E-mail: gewex@gewex.org
WWW Site: http://www.gewex.com

Dr. Robert Schiffer, Director
Editor: Dawn P. Erlich
Layout: Erin McNamara

1995–2002 BASIN/AREAL AVERAGE PRECIPITATION VALIDATION OF NWP OUTPUT SHOWS LITTLE IMPROVEMENT



The upper left panel shows the average daily rainfall for a 30-day period in the Murray-Darling Basin using NWP models, and the lower left panel shows the associated mean average error based skill score. The right panels show the average daily rainfall for a 1000-day period and the associated skill score. See article on page 10.



OKLAHOMA MESONET SOIL MOISTURE DATA SHOW THE IMPACT OF DROUGHT SEVERITY ON FUTURE RESPONSE

(Note: 60 and 75 cm lack of response to heavy rain precipitation)

The figure at the left is a meteogram of normalized soil moisture values (1=wet, 0=dry) for the four depths at the Hollis site over 1998–1999. See article on page 13.

GLASS WORKSHOP ON PILPS CARBON EXPERIMENT SHOWS WIDE DISPERSION DUE TO DIFFERENT LAND SURFACE MODELS

(However, several are close to observed soil carbon)

Trajectories of total biomass (left) and total soil carbon (right) simulated by the different model during growth of the forest. See workshop report on page 16.