GEWEX WCRP
World Climate Research Programme
(A Programme of WMO, ICSU and IOC)

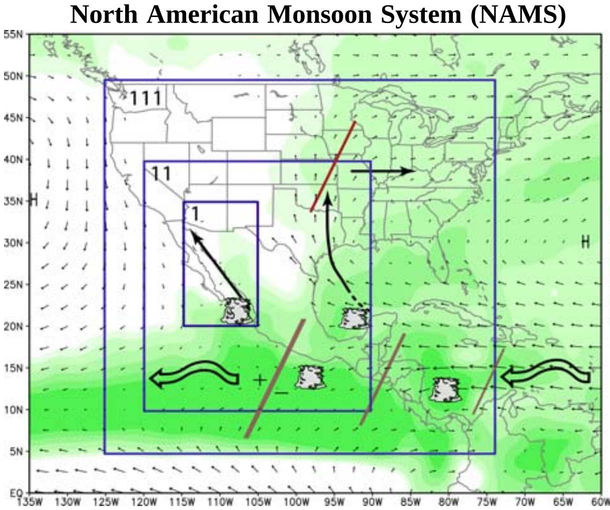
NEWS

Vol. 15, No. 1 | Global Energy and Water Cycle Experiment | February 2005

GEWEX STUDIES OF AMERICAN MONSOON SYSTEMS

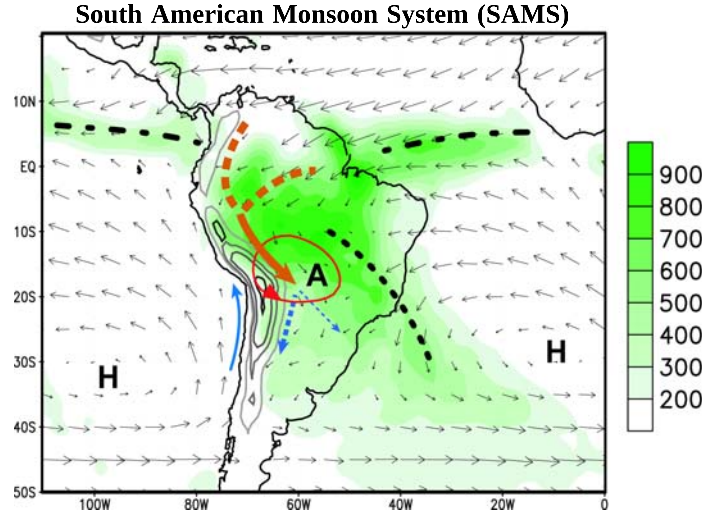
TWO HEMISPHERES WITH SIMILAR MONSOON MECHANISMS, DYNAMICS AND FEATURES

North American Monsoon System (NAMS)

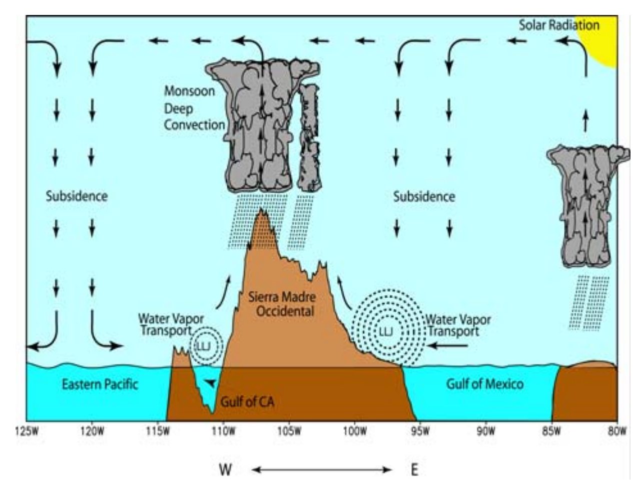


Multi-tiered approach of the North American Monsoon Experiment (NAME). Also shown are mean (July–September 1979–1995) 925-hPa vector wind and merged satellite estimates and raingauge observations of precipitation (shading) in millimeters. GAPP warm season precipitation research will benefit from NAME. *See article on page 13.*

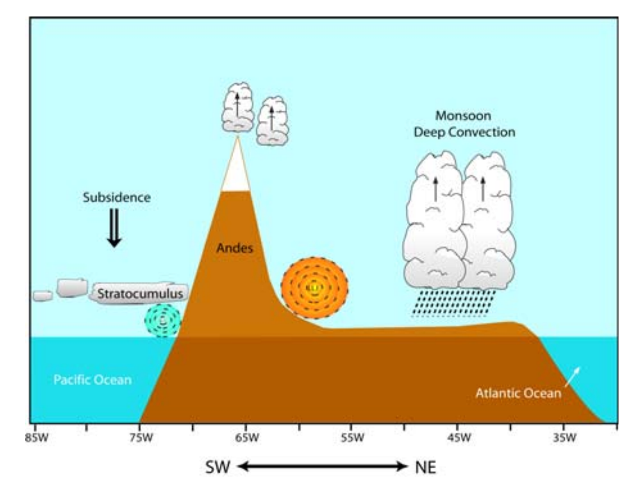
South American Monsoon System (SAMS)



Shading indicates precipitation and dashed black lines indicate convergence zones. Small arrows show low-level (900 hPa) winds, and thick dashed lines represent low-level jets. "H" shows a subtropical surface high center and "A" indicates the monsoon anticyclone. SAMS is being addressed by LBA, LPB and VAMOS studies. *See article on page 12.*



Vertical (longitude-pressure) cross section through the NAMS at 27.5°N showing the locations of the key elements of NAMS, including both low-level jets.



Schematic of SAMS showing the opposite phases of the dominant mode of variability over South America during the warm season.

5th International Scientific Conference on the Global Energy and Water Cycle
June 20–24, 2004, Costa Mesa, California ***(Program Outline on Page 4)***

COMMENTARY

PERSPECTIVES ON THE 17th GEWEX SSG MEETING

Soroosh Sorooshian, Chairman
GEWEX Scientific Steering Group

Welcome to the first issue of *GEWEX News* in 2005. This issue focuses on monsoons and is a good introduction to the discussions between GEWEX and the Climate Variability and Predictability (CLIVAR) Project on pan-WCRP monsoon research. Monsoons were also discussed at the GEWEX Scientific Steering Group (SSG) meeting, which was recently held in Kunming, China. I am happy to report that we had a very productive SSG meeting. The progress being made by the GEWEX Panels was very evident in the presentations made at the meeting. The International Satellite Land Surface Climatology Project (ISLSCP) Initiative II data sets are now complete and going through their final evaluation (see the workshop announcement on page 3). I anticipate that this product will be as successful and beneficial to the climate and educational communities as the ISLSCP Initiative I data sets. The proposal from the African Monsoon Multidisciplinary Analysis (AMMA) Project to become a Continental-Scale Experiment (CSE) was accepted, thereby facilitating strengthened collaboration between AMMA and the other CSEs, as well as with the model development activities of the Global Land-Atmosphere System Study (GLASS) and the GEWEX Cloud System Study (GCSS). The hydrometeorological transferability studies are progressing nicely and are stimulating a great deal of interest within the regional modeling community. Plans for an integrated approach between modeling land surface, boundary layer and cloud processes hold promise for an effective approach to developing coupled land-atmosphere models.

GEWEX has also been supportive of science communities beyond GEWEX. Through our European GEWEX Coordinator, Dr. Peter van Oevelen, GEWEX is starting to develop more visibility and connections with science groups in Europe. GEWEX has also addressed issues related to the Intergovernmental Panel on Climate Change. Workshops to assess satellite-based cloud, precipitation, water vapor and aerosol products are underway and will provide guidance on the opportunities and limitations of using these data sets in climate trend analysis. We are continuing to work with the CLIVAR Project to develop a strong pan-WCRP monsoon activity that will be a central focus in the Coordinated Observation and Prediction of the Earth System (COPES). GEWEX support to the Earth Observation Summit ad-hoc Group on Earth Observations (GEO) and Integrated Global Water Cycle Observations (IGWCO) data integration efforts continues to come through the Coordinated Enhanced Observing Period (CEOP) Project, which has just successfully completed its first phase and is now developing plans for its second phase.

However, GEWEX also faces significant challenges. We need to develop stronger integration across the GEWEX Panels on the three GEWEX cross-cutting themes, namely precipitation, the diurnal cycle, and the global water and energy budget studies. We also need to ensure that the GEWEX projects that support COPES move forward quickly and in close coordination with other WCRP projects. Also, maintaining and increasing the funding committed to GEWEX science, observations and data activities will continue to be a challenge given that positive changes in the fiscal climate for Earth science are not expected in the short term. Clearly we have a substantive agenda that will require the communities' commitment as we prepare for future Phase II initiatives. We look forward to seeing all of you at the 5th International Scientific Conference on the Global Energy and Water Cycle, June 20–24 in Costa Mesa, California (see preliminary program outline on page 4) and having a lively discussion about the important role of GEWEX in the international climate research agenda.

Contents

	PAGE
Commentary: Perspectives on the 17th GEWEX SSG Meeting	2
Recent News of Relevance to GEWEX	3
Preliminary Program Outline for the 5th Int'l Scientific Conference on GEWEX	4
Land-Surface Processes and the Monsoon	5
Aerosol-Hydrologic Cycle Interaction: A New Challenge in Monsoon Climate Research	7
New Geostationary Data Set for Climate Science	9
Measuring Precipitation in High Places—Space-Time Variability in the Himalayas	10
South American Monsoon System	12
Results from the NAME 2004 Field Campaign	13
GEWEX Relevant Publications of Interest	15
GCSS Pacific Cross-Section Intercomparison Project	16
Workshop/Meeting Summaries:	
– GCSS Science Panel Meeting	16
– Workshop on American Monsoon Systems	17
– 9th GISP Meeting and 6th GAME Study Conf.	19

RECENT NEWS OF RELEVANCE TO GEWEX

WATER CYCLE TRENDS WORKSHOP

On 3–5 November 2004 the Integrated Global Water Cycle Observations (IGWCO)/GEWEX/UNESCO Workshop on Trends in Global Water Cycle Variables took place at UNESCO in Paris. The Workshop attracted 50 scientists, including a number of French scientists and authors from chapters for the upcoming Working Group I Intergovernmental Panel on Climate Change (IPCC) assessment. A primary purpose of the workshop was to identify significant advances in understanding trends and to make recommendations that could be taken under consideration by the IPCC.

Preliminary conclusions from the workshop include: (1) while there is considerable confidence in the trends derived from *in situ* data records for temperature, the same confidence does not exist for water cycle variables such as precipitation or clouds; (2) current model reanalysis products do not provide an adequate basis for identifying changes in climate variables due to issues such as data inputs, model physics, and resolution; and (3) while global maps derived from satellite data are reaching the point where they have sufficiently long time series for confirming trends, many of these products have not been optimized for homogeneity of record and for climate analysis. These satellite products need to be reprocessed on an urgent basis to provide a reliable basis for future assessment of recent climate trends.

AFRICANS EXPAND USE OF SATELLITE DATA IN WATER RESOURCE APPLICATIONS THROUGH TIGER

In November 2004 the European Space Agency (ESA) held a Terrestrial Initiative in Global Environment Research (TIGER) Workshop in Pretoria, South Africa to explore the potential applications of remote sensing data in addressing water problems on the African continent and to review the large number of proposals that had been submitted by investigators wishing to use satellite data in solving African water problems. Over 120 people, including 90 from Africa, attended the Workshop. In addition to reviewing specific proposals, links with Africa Vision 2025 were developed as a result of the Workshop. Rick Lawford presented IGWCO and GEWEX activities and several African nations indicated an interest in learning more about AMMA, the newest GEWEX CSE, and in contributing to its goals. In addition, there is considerable interest in capacity building activities in the water sector.

ISLSCP INITIATIVE II WORKSHOP 4–6 May 2005

The International Satellite Land-Surface Climatology Project (ISLSCP) Initiative II data collection, containing 50 global time series spanning the 10-year period 1986 to 1995 (selected data sets span even longer periods), is complete and can be accessed at http://islscp2.sesda.com. The data were acquired from a number of U.S. and international agencies, universities and institutions, and have been quality checked and co-registered to equal-angle grids of one-degree, one-half and one-quarter degree resolution. A common land-water mask was applied, gaps filled and the data reformatted into a common ASCII format. Each data set has been uniformly documented. Both data and documentation have undergone two peer reviews focusing on quality and ease of use.

Over the next 6 months the broader community is invited to provide a thorough evaluation of the entire Initiative II data collection and its user interface. A science and evaluation workshop is being planned to present and discuss the results on 4–6 May 2005 in Greenbelt, Maryland, USA. Based on the findings of the workshop the data will be augmented and released as a DVD set. GEWEX community members are encouraged to participate in the evaluation of the Initiative II data collection. For more information, contact Forrest Hall (e-mail: fghall@ltpmail.gsfc.nasa.gov).

AMMA – NEW GEWEX CSE

The African Monsoon Multidisciplinary Analysis (AMMA) Project was accepted as the newest GEWEX Continental-Scale Experiment (CSE) at the 17th meeting of the GEWEX Scientific Steering Group in February 2005.

GEO-5 MAKES A DECISION ABOUT THE GEOSS SECRETARIAT

At the 5th meeting of the ad-hoc Group on Earth Observations (GEO) held in Ottawa in November 2004, it was agreed that the Secretariat for the new Global Earth Observing System of Systems (GEOSS) would be housed at the World Meteorological Organization (WMO) in Geneva. This development can be viewed as recognition of the important role that WMO has played in the coordination of global observing systems through its satellite program.

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

Westin Hotel, Costa Mesa, California, USA

PREMLIMINARY PROGRAM OUTLINE

(NOTE: Details of the list of speakers is not final)

Sunday, 19 June 2005

1700-2000 Early Registration and Icebreaker

Monday, 20 June 2005

0700-0900 Conference Registration

0900-1020 Introduction and Key Note Speakers

P. Lemke, Alfred-Wegener-Institut
K. Olsen, OSTP
András Szöllösi-Nagy, IHP
[Others To Be Confirmed (TBC)]

1040-1220 Simultaneous Sessions on Themes 1 & 2

1400-1500 Simultaneous Sessions on Themes 1 & 2

Theme 1 – Clouds and their Effect on the Radiation Budget
P. Try, IGPO
J. Kaye, NASA
E. Raschke, Germany
D. Randall, CSU
(Additional Oral Presentations TBC)

Theme 2 – Predictions for Water Management
G. Carter, NOAA
K. Takeuchi, Yamanashi University
P. Graham, Rossby Centre
T. Pagano, USDA
(Additional Oral Presentations TBC)

Tuesday, 21 June 2005

0830-1010 Plenary

P. Morel, France
S. Solomon, NOAA
(Others TBC)

1040-1220 Simultaneous Sessions on Themes 1 & 3

1600-1730 Simultaneous Sessions on Themes 2 & 3

Theme 1 – Clouds and their Effect on the Radiation Budget
G. Stephens, CSU
(Additional Oral Presentations TBC)

Theme 2 – Predictions for Water Management
(Oral Presentations TBC)

Theme 3 – Roles of Land Fluxes in Water and Energy Cycles
A. Betts, Atmospheric Research
C. Peters-Lidard, NASA
(Additional Oral Presentations TBC)

1830-2000 Reception & Townhall Meeting for GAPP

Wednesday, 22 June 2005

0830-1010 Plenary

P. Lemke, Alfred-Wegener-Institut
A. Busalacchi, ESSIC
J. Slingo, University of Reading
T. Koike, University of Tokyo
(Others TBC)

Wednesday, 22 June 2005 *(Cont.)*

1040-1250 Simultaneous Sessions on Themes 3 & 4

Theme 3 – Roles of Land Fluxes in Water and Energy Cycles
(Oral Presentations TBC)

Theme 4 – The Role of Modeling in Predictability and Prediction Studies
T. Palmer, ECMWF
D. Jacob, DKRZ
R. Koster, NASA
(Additional Oral Presentations TBC)

1400-1800 Special Side Sessions for Committees

1900-2130 Banquet

Thursday, 23 June 2005

0830-1010 Plenary

K. Trenberth, NCAR
M. Chahine, JPL
A. R. Ravishankara, NOAA
(Others TBC)

1040-1220 Simultaneous Sessions on Themes 4 & 5

1530-1700 Simultaneous Sessions on Themes 5 & 6

Theme 4 – The Role of Modeling in Predictability and Prediction Studies
(Oral Presentations TBC)

Theme 5 – New Strategies for Characterizing and Predicting Energy and Water Budgets
T. Yasunari, HyARC
W. Lau, NASA
(Additional Oral Presentations TBC)

Theme 6 – Measuring and Predicting Precipitation
R. Adler, NASA
B. Rudolf, Deutscher Wetterdienst
(Additional Oral Presentations TBC)

1830-2000 Reception & Townhall Meeting for CEOP

Friday, 24 June 2005

0830-1010 Plenary

R. Birk, NASA
S. Sorooshian, UCI
D. Cayan Scripps Inst. of Oceanography
(Others TBC)

1040-1250 Simultaneous Sessions on Themes 5 & 6

Theme 5 – New Strategies for Characterizing and Predicting Energy and Water Budgets
(Oral Presentations TBC)

Theme 6 – Measuring and Predicting Precipitation
(Oral Presentations TBC)

1400-1530 Possible Panel Discussion (TBC)

1530-1540 Conference Close

LAND-SURFACE PROCESSES AND THE MONSOON

Yongkang Xue
University of California, Los Angeles, USA

Monsoon circulations are forced and maintained by land-sea thermal contrasts and latent heat released into the atmosphere, which influence monsoon strength, duration, and spatial distribution (Webster et al., 1998). Land-surface processes are crucial in modulating monsoon processes through changing the heat gradient and moisture supply, and have a major influence on climate over monsoon regions (e.g., Xue et al., 2004; 2005). This article briefly reviews some results from vegetation/monsoon interaction studies, which focus on the influence of vegetation biophysical processes (VBP) and land cover and land use (LCLU) change on monsoon variability and anomalies at seasonal to decadal scales.

Monsoons possess the largest annual amplitude of any subtropical or tropical climate feature, as well as considerable variability at annual, interannual, and interdecadal time scales (Webster et al., 1998). Studies have shown that VBP contributes to monsoon annual evolution and decadal anomalies. The role of the East Asian and South American VBP on monsoon annual evolution was investigated using a general circulation model (GCM) with two different land-surface parameterizations—one with explicit vegetation processes and the other without (Xue et al., 2004; 2005). Both have similar monthly mean surface albedo and the same initial soil moisture. It was found that the GCM without explicit vegetation processes (GCM/soil) was able to simulate a wet season in both regions, but that no clear monsoon evolution processes were simulated. Only the GCM with explicit vegetation parameterization (GCM/veg) was able to simulate the abrupt northward jump of the East Asian monsoon at the early monsoon stage (see figure on left side of page 20) and its evolution process. In South America, the difference between GCM/veg and GCM/soil simulations was clear in reference to the seasonal southward displacement of the monsoon during the onset, and the monsoon's northward merging with the Inter-tropical Convergence Zone during the monsoon's mature stage. GCM/soil failed to simulate the southward movement and produced a much stronger rainy season (Xue et al., 2005). This difference in monsoon evolution caused a significant difference in monthly mean precipitation at the continental scale, which would have substantial implications for water resource management.

The impact of LCLU change on decadal climate anomalies was also explored. The Sahel and China experienced large precipitation anomalies during the 1980s. The Sahel suffered its most severe drought, but the rainfall to the south of the Sahel increased due to a shift of the maximum monsoon rainfall band to the south. In East Asia, the summer monsoon anomaly appeared in a dry-wet-dry pattern (i.e., a dry northern China, a wet Yangtze River Basin, and a dry southern China). Since both regions experienced severe desertification during the past half-century, desertification experiments using a GCM were conducted to test its impact (Xue and Shukla, 1993). The results indicated that by dramatic degradation of land surface conditions in these two regions, the models were able to simulate the observed monsoon decadal rainfall anomaly patterns and the shift of the rainfall band. In another numerical experiment using a tropical atmospheric model coupled with a simple dynamic vegetation model, 50-year simulations with/without interactive vegetation showed that the Sahelian decadal rainfall anomaly trend could be better simulated only when the model included the interactive vegetation processes (Zeng et al., 1999).

The changes in precipitation were caused by circulation changes. The characteristics of monsoon circulation and the influence of heating and mountains on the large-scale, time-mean monsoon flow are important subjects of monsoon studies (Webster et al., 1998). In the experiments of monsoon intra-seasonal evolution, it was found that the major difference between GCM/soil and GCM/veg simulations was the surface sensible heat flux, which modified the heating gradient between ocean and continent and, in turn, influenced pressure gradients, wind flow (through geostrophic balance), and moisture transport. The VBP-produced heating gradient contributed to the clockwise or counterclockwise turning of the low level wind in the East Asian, African, and South American continents at the early monsoon stage, which affects the strength and extent of monsoon development (see figure on page 6).

In the desertification experiments, the degradation of the land-surface caused less net radiation at the surface, leading to a large reduction in evaporation. The convective latent heating in the troposphere was lower and relative subsidence was produced, which in turn weakened the northward monsoon flows in East Asia and Africa.

The changes in atmospheric circulation also altered some major features in the monsoon systems. For instance, in the African desertification experiment, land degradation reduced the intensity of the easterly wave propagation, but not the total amount (Xue and Shukla, 1993). In South America, vegetation-induced heating helped simulate a Bolivian high (Xue et al., 2005). In the GCM/soil case, the Bolivian high was not simulated.

The effect of surface water and energy budgets on monsoons depends upon temporal and spatial scales, topographic features, and background climate conditions. Interaction characteristics and mechanisms are highly sensitive to different geographic situations. For example, evaporation and moisture flux convergence played different roles in our East Asia, Sahel and South American monsoon studies.

The relationship between the changes in the slowly varying boundary conditions at the Earth's surface and changes in atmospheric circulation and monsoons are the focus of many studies. It has been suggested that sea surface temperature (SST) contributed to the climate anomalies in the Sahel and East Asia. It seems that SST anomalies and land forcing work in the same direction in these two regions, such that large-scale climate anomalies were amplified. On the other hand, the causes of the anomalies in some regions could not be easily separated and sometimes were confused, for example in South America (Henderson-Sellers and Pitman, 2001). More comprehensive investigations are required to understand the role and mechanisms of land surface process interactions in different continents.

Validation and comparisons with observational data and reanalysis data are important in understanding monsoon/land-surface interactions. Recently available Coordinated Enhanced Observing Period (CEOP) data should provide a good opportunity to further explore the monsoon/land relationship.

References

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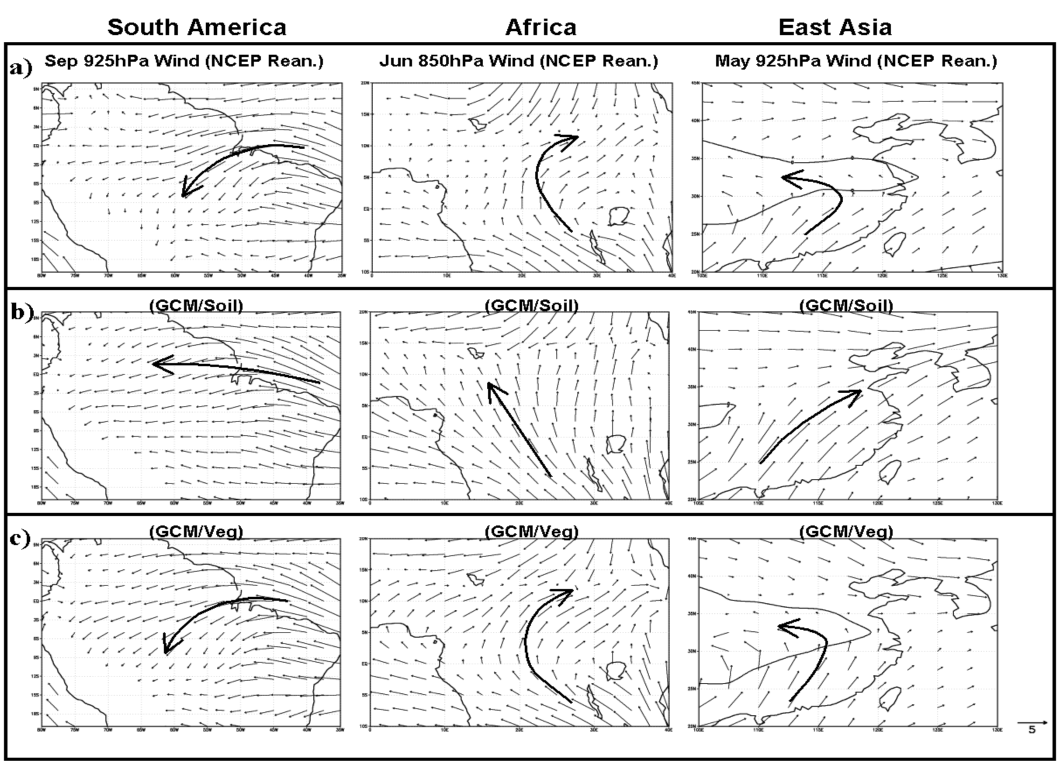


1987 wind field (ms^{-1}) 850 hPa (a) Reanalysis; (b) GCM/Soil; (c) GCM/Veg for East Asia (May, 925 hPa); Africa (June, 850 hPa); and South America (September, 925 hPa). To clarify the circulation patterns, the bold lines show the locations where the zonal wind was zero.

AEROSOL-HYDROLOGIC CYCLE INTERACTION: A NEW CHALLENGE IN MONSOON CLIMATE RESEARCH

William K. M. Lau
Laboratory for Atmospheres
NASA/Goddard Space Flight Center

It has been estimated that aerosols may reduce by up to 10% the seasonal mean solar radiation reaching the Earth's surface, producing a global cooling effect that opposes global warming (*Climate Change*, 2001). This means that the uncertainties surrounding global warming may be far greater than can be detected at the present time. As a key component of the Earth climate system, the water cycle is profoundly affected by the presence of aerosols in the atmosphere (Ramanathan et al., 2001; Rosenfeld 2000). Through the so-called "direct effect," aerosol scatters and/or absorbs solar radiation, thus cooling the Earth's surface and changing the horizontal and vertical radiational heating contrast in the atmosphere. The heating contrast drives an anomalous atmospheric circulation, resulting in changes in convection, clouds, and rainfall. Aerosols also affect the water cycle through so-called "indirect effects," whereby aerosols increase the number of cloud condensation nuclei, inhibit the growth of cloud drops to raindrops and prolong the life of clouds. This leads to more clouds, and increased reflection of solar radiation, and further cooling at the Earth's surface.

In monsoon regions, the response of the water cycle to aerosol forcing is especially complex, not only because of the presence of a diverse mix of aerosol species with vastly different radiative and hydroscopic properties, but also because the monsoon is strongly influenced by ocean and land surface processes, land use, land change, as well as greenhouse warming. Thus, to determine the impacts of aerosol forcing and that interaction with the monsoon water cycle is a very pressing problem. Up to now, besides the general idea that since aerosols significantly alter radiative heating patterns they *should* have an impact on the monsoon, there has been very little information regarding the specific signatures and mechanisms of aerosol-monsoon water cycle interaction. This article offers some insights on how aerosols may impact the Asian monsoon based on preliminary results from the National Aeronautics and Space Administration (NASA) climate model. It also discusses some future challenges that lie ahead in aerosol-water cycle dynamics research.

Numerical experiments have been conducted with the NASA finite-volume GCM (fvGCM) with microphysics of clouds in a relaxed Arakawa Schubert (McRAS) cumulus parameterization scheme to tease out possible signatures of aerosol direct forcing of the water cycle variability in monsoon regions (Sud and Walker 1999). In the control, the model is forced by three-dimensional aerosol forcing functions for all five major aerosol types (i.e., dust, black carbon, organic carbon, sulfate and sea salt) derived from outputs of the Goddard Chemistry Aerosol Radiation Transport (GOCART) model (Chin et al., 2002). In the anomaly runs, the initial and boundary conditions are identical, except that all or selected aerosol forcings were withheld. The results described here pertain to the Asian monsoon regions. Comparing the control and anomaly experiments for the Asian monsoon, we find that absorbing aerosols, consisting of dust transported from the North Africa/Middle East/Afghanistan region coupled with black carbon from local emissions over northern India can increase monsoon rainfall over northwestern India and the Bay of Bengal. The rainfall increase appears to be spurred by an elevated heat source over the Tibetan Plateau, induced by shortwave absorption by dust and black carbon aerosols, which are lofted by orographically forced ascent against the southern slope of the Himalayas. The net atmospheric heating due to aerosol absorption causes the air to warm and rise, increasing moisture convergence in the mid-troposphere, and providing a positive feedback to the aerosol heating.

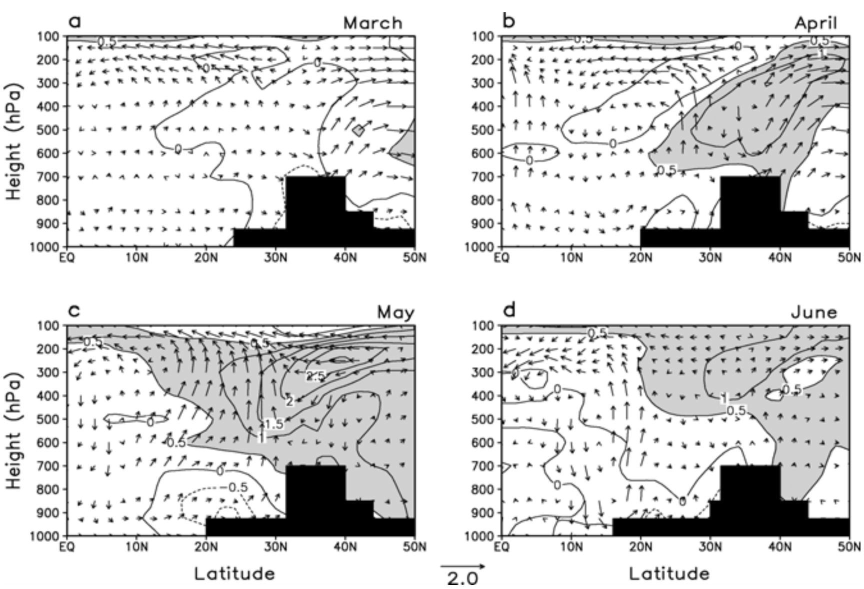
The figure on page 8 shows that the anomalous warming in the upper troposphere over the Tibetan Plateau begins in March (panel a), becomes well established in April and May (panels b and c), which correspond to the pre-monsoon dry season with heavy atmospheric loading, and maximum residence time of dust and black carbon from industrial pollution and biomass burning. The warming forces an anomalous local meridional overturning with rising motion over northern India, and subsidence over southern India, which becomes very pronounced in May and June (panels c and d). This overturning persists into July and August (not shown), resulting in an overall increase in rainfall over northern India, and suppressed rainfall in southern India and the northern Indian Ocean.

The increased rainfall over northern India and the reduction in southern India is only a part of a large-scale response of the entire Asian monsoon to aerosol-induced forcing featuring extensive rainfall reduction in southern China, the East China

Sea, an east-west oriented band of enhanced rainfall along 30–35° N in central China, southern Korea and Japan, and reduced rainfall over northeastern China (see panel a in the top right figure on page 20). The suppression of rainfall over southern China is due to surface cooling spurred by industrial pollution mainly from sulfate and black carbon. In contrast to the Indian monsoon region, the absorption heating due to black carbon over southern China remains largely within the lower troposphere due to the lack of orographic forced ascent, and consequentially is not efficient as an atmospheric heat source to initiate new convection. As a result, the stabilizing influence due to the semi-direct effect of aerosols prevails, as is evident in the wide-spread suppression of rainfall over southern China.

Panel b in the figure on page 20 shows that the aerosol-induced rainfall anomaly is associated with the development of a large-scale surface pressure and wind anomaly pattern, represented by an eastward extension and strengthening of the western subtropical high, which appears to be connected to a large-scale anticyclonic circulation anomaly over southern India and the Indian Ocean. The increase in low level westerlies over northern India and the Bay of Bengal indicates a strengthening of the Indian monsoon. The climatological southwesterly flow over the northern South China Sea is replaced by low level easterlies. Anomalous southwesterlies are found over central China, South Korea and Japan, signalling a northward shift and weakening of the *Mei-Yu* rainfall regime over East Asia. Analyses of further experiments with various combinations of aerosol forcing (not shown), suggest that the anomaly patterns are due to the combined effects of dust and black carbon aerosols, with dust playing a primary role in instigating these patterns.

Our results suggest a plausible and testable hypothesis regarding the different impacts of aerosols on the Asian monsoon that needs to be validated with further model experiments and observations. However, the validation process will be challenging for a number of reasons. First, state-of-the-art climate models either do not include aerosol-cloud interaction processes, or include them as simple, empirical parameterizations. Our present experiments deal with direct effects only. Second, the present bootstrapping strategy of using dynamics for aerosol chemistry transport, and then separately using a chemistry transport model to force dynamics has obvious inconsistencies and limitations. Ultimately, coupled chemistry-dynamic models have to be developed to simulate the full feedback between dynamics and aerosol forcing. Third, the lack of long-term global observations of aerosol emission, composition, and distribution makes it very difficult to define aerosol forcing functions, and to validate model results. At present, satellite observations from satellites [e.g., Total Ozone Mapping Spectrometer (TOMS), Moderate Resolution Imaging Spectroradiometer (MODIS), POLarization and Directionality of the Earth's Reflectances (POLDER), and the Multi-Angle Imaging Spectroradiometer (MISR)] have been providing tantalizing signals of the direct and indirect effects on the water cycle. The Aerosol Robotic Network (AERONET) has provided valuable aerosol data for characterization and calibration of satellite observations (Holben et al., 1998). However, these observations still fall short of the requirement of global, coincident observations of aerosols, clouds and rain with high temporal and spatial (horizontal and vertical) resolutions. Current efforts in assembling and integrating multi-platform local and global data for model validation such as the Coordinated Enhanced Observing



Vertical cross section of temperature and wind averaged over the Indian subcontinent in the fvGCM-GOCART simulations, showing the anomalous meridional overturning, and upper tropospheric temperature as a result of aerosol-induced heating.

Period (CEOP) must be supported, while new field campaigns and monitoring programs are being planned and incorporated into the global integrated database. Observational and model efforts on monsoon and water cycle dynamics research should be coordinated to improve physical parameterization in models.

An organized international effort on a aerosol-monsoon water cycle process study that is jointly sponsored by GEWEX and the Climate Variability and Predictability (CLIVAR) Project under the auspices of the WCRP emerging banner Coordinated Observations and Prediction of the Earth System (COPES) will go a long way in meeting these requirements and challenges.

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GEWEX AMS HONOREES

The following GEWEX scientists received awards at the 85th Annual Meeting of the American Meteorological Society.

Graeme L. Stephens, The Jule G. Charney Award *"for pioneering advances in understanding and measuring radiation processes and their role in climate"*

William B. Rossow, The Verner E. Suomi Award *"for tireless efforts using multi-satellite observations to study clouds and their role in radiation and climate"*

Dennis P. Lettenmaier, The Walter Orr Roberts Lecturer in Interdisciplinary Sciences Award *"for significant research contributions and leadership in fostering effective interchange of knowledge between atmospheric and hydrologic scientists"*

Robert A. Schiffer and **William B. Rossow** were honored as new AMS Fellows.

NEW GEOSTATIONARY DATA SET FOR CLIMATE SCIENCE

Ken Knapp, John J. Bates
National Climatic Data Center

The National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC) is developing a new data set for climate science. Originating from the International Satellite Cloud Climatology Project (ISCCP), the data are observations from all channels on the Geostationary Operational Environmental Satellite (GOES) series, the European Meteorological satellite (Meteosat) series and the Japanese Geostationary Meteorological Satellite (GMS) series. The period of record covers 1983 through the present.

The ISCCP Sector Processing Centers (SPCs) began providing geostationary and polar-orbiting satellite imagery in 1983. The geostationary data provided to ISCCP for cloud analysis are images subsampled in time and space (up to 3 hours and 32 km, respectively). However, ISCCP archived a version of the geostationary data called B1 at 3-hour and 10-km resolutions. Until now, the volume of the higher resolution B1 data was too large to be incorporated into processing.

The B1 data set consists of spectral radiances from satellite sensors and the corresponding brightness temperature or albedo for infrared and visible wavelengths, respectively (i.e., no retrievals of geophysical parameters are available). Observations at visible (near 0.6 μm) and infrared window (near 11 μm) wavelengths are available for every satellite, while information at other wavelengths is included.

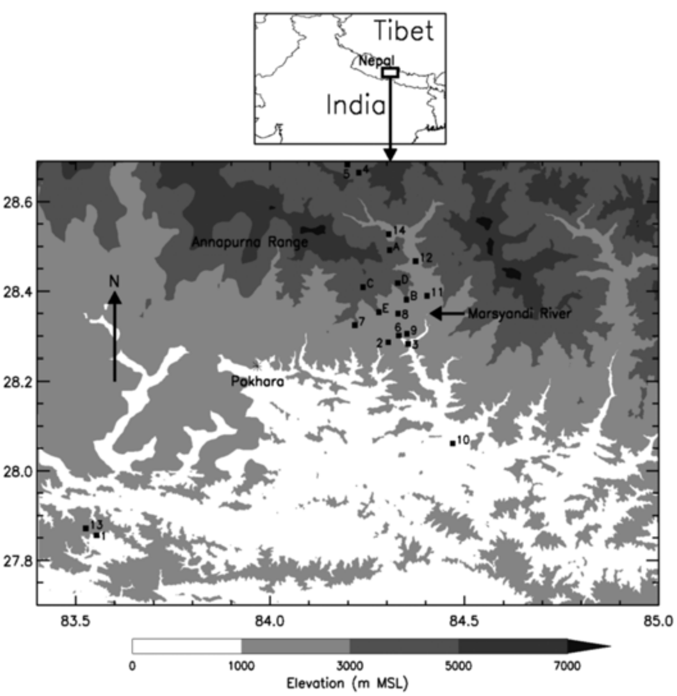
These spectral observations are available over most of the globe, except at the poles where geostationary observations are not possible. The B1 data set will include observations from future satellites as well, including Meteosat-8 and the Japan's upcoming MTSAT-1R. Thus, the B1 data set will represent one of the most comprehensive satellite climate data sets available.

Currently, the data set is available to interested users for testing. It is hoped that through intense use by scientists, data set errors or deficiencies can be found and fixed before the complete data set is released to the general public later in 2005. Scientists and students interested in using the B1 data should contact Ken.Knapp@noaa.gov for information on how to retrieve the data.

MEASURING PRECIPITATION IN HIGH PLACES—SPACE-TIME VARIABILITY IN THE HIMALAYAS

Ana P. Barros
Duke University, North Carolina, USA

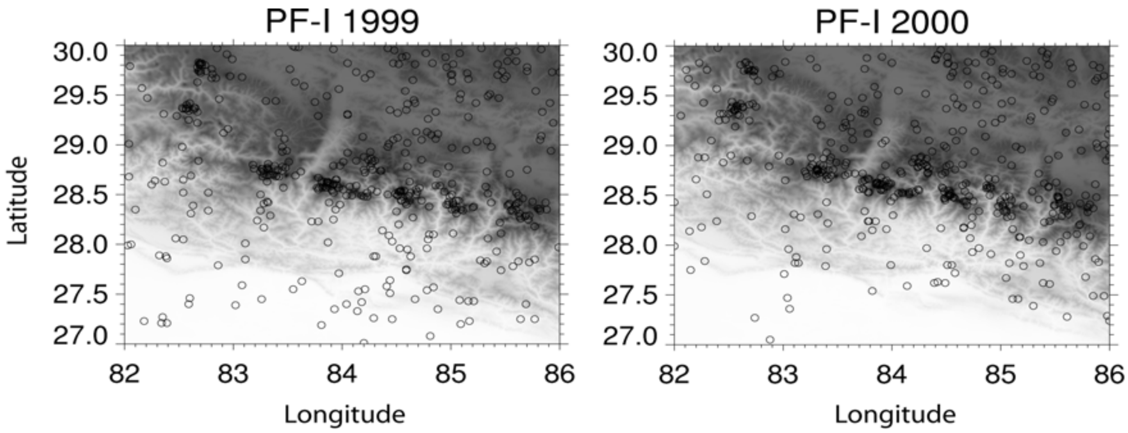
A hydrometeorological network was installed in the Marsyandi River Basin in Central Nepal to obtain high-frequency (one-half hourly) measurements of rainfall, snow depth, snow water content, temperature, relative humidity, wind direction and speed along three upwind ridges and adjacent valleys, and then into the rainshadow behind the Annapurna Range that stretches into the Tibetan Plateau (Barros et al., 2000; see figure below). The first phase of the hydrometeorological network was installed during the pre- and post-monsoon seasons in 1999 with National Aeronautics and Space Administration (NASA) Tropical Rainfall Measuring Mission (TRMM) funding to augment the existing operational network operated by the Nepalese Department of Hydrology and Meteorology. Especially noteworthy was the installation of six 10-m towers roughly spaced at 1,000-m elevation difference from each other up to 4,500 m. Five stations were added in the pre-monsoon season of 2000, and one of the network towers at 3,300 m altitude was equipped with radiation sensors [solar, longwave, Photosynthetically Active Radiation (PAR)], soil temperature, soil heat flux, and soil moisture probes at three different depths, as well as standard relative humidity, surface pressure and air temperature, and wind speed and direction sensors at 2- and 10-m levels. Streamflow measurements were conducted for selected headwater catchments within the area of the network.



Topography of the Marsyandi River Basin. The larger map shows locations of the hydrometeorological stations in the network. The inset shows the location of the network relative to the Indian subcontinent. Numbers indicate distribution of stations.

The Marsyandi network was designed to monitor the space-time variability of precipitation at high temporal and spatial resolution with the objective of understanding orographic precipitation phenomena in the Himalayas, and it has served the science community well. A comprehensive compilation and analysis of observations from the network revealed the large complexity of the relationship between elevation and precipitation in the Central Himalayas (Barros et al., 2004): (1) weak altitudinal gradients of annual rainfall between 1,000 and 4,500 m; (2) strong ridge-to-ridge zonal (east-west) gradients of monsoon rainfall (~1,500 mm/5 km); (3) strong ridge-valley gradients during rainstorms, especially in the case of deep valleys (elevation differences >1,000 m) and steep hillslopes (70%); and (4) strong altitudinal gradients in rainfall intensity and duration (convective versus stratiform), with longer (shorter) durations and lower (higher) intensities at higher (lower) elevations along the ridges. High elevations [>3000-m mean sea level (MSL)] can receive up to 40% of their annual precipitation as snowfall during the winter; with the highest altitude stations (~4000-m MSL and above) having the most total winter precipitation (Lang and Barros, 2002 and 2004).

Analysis of TRMM Precipitation Radar (PR) and infrared imagery data along the Himalayas suggests orographic precipitation processes include cells of localized shallow convection embedded in bands of stratiform rainfall from the foothills up to 5,000 m (Lang and Barros, 2002; Barros et al., 2004). The diurnal cycle of rainfall in the central Himalayas exhibits both afternoon and evening peaks with nocturnal maxima and early morning peaks during the monsoon (Barros et al., 2000 and 2004, Barros and Lang 2003). This late night/early morning rainfall maximum accounts for about one-third of the cumulative monsoon rainfall and routinely causes flash floods in headwater streams everywhere along the Himalayan range. While the large-scale spatial patterns of precipitation and the amplitude of the diurnal cycle exhibit interannual and subseasonal variability consistent with monsoon forcing (Barros



Monsoon composite of the spatial organization of nocturnal shallow precipitation features from 2 years of TRMM data. Note the remarkable spatial consistency coinciding with upwind ridges along the Himalayan range. From Barros et al., 2004.

et al., 2004), the spatial patterns exhibit remarkable spatial stationarity. Note the remarkable consistency in the spatial organization of precipitation features from year to year (see figure above).

Based on the Monsoon Himalaya Precipitation Experiment (MOHPREX) observations, Barros and Lang (2003) estimated that contributions from daily evapotranspiration (ET) to Precipitable Water (PW) can vary between 15% of daily rainfall at high elevations (>3,000 m) up to 35% in adjacent valleys (<1000 m). These estimates are quantitatively and qualitatively consistent with recent studies of the diurnal cycle of rainfall in mountainous regions elsewhere (e.g., Iwasaki, 2003; Yang et al., 2004). These studies show that evapotranspiration and mountain-valley moist transport have a strong influence in the diurnal cycle of PW and Convective Available Potential Energy (CAPE), thus ultimately affecting the location and timing of the onset of convection in the daytime, and establishing conditions for the late evening convective activity. While such studies have been conducted for unfavorable synoptic conditions and moderate topography (500-1,500-m elevation differences), it is remarkable that the diurnal cycle of rainfall in the Himalayas exhibits similar features, and a nocturnal rainfall maximum that occurs after midnight during the monsoon at all elevations independently of large-scale forcing conditions (Lang and Barros 2002; Barros and Lang 2003). This behavior suggests the ubiquity of a dynamic link between the spatial variability of evapotranspiration and soil moisture (e.g., surface sensible and latent heat fluxes), topography and the spatial organization of monsoon rainfall by which the mountains modulate precipitation processes and latent heating in the troposphere (Magagi and Barros, 2004). Whether and how regional land-surface controls have an impact on seasonal to interannual climate variability that propagates beyond the northern Indian subcontinent needs to be further investigated.

Acknowledgements: The Marsyandi network was installed and maintained with support from the NASA TRMM Program and the National Science Foundation Continental Dynamics programs.

Editor's Note: Although this data system has proved to be very valuable for monsoon research, funding has not been made available for the author to maintain the system.

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SOUTH AMERICAN MONSOON SYSTEM

C. Roberto Mechoso[1], Andrew W. Robertson[2], Alice M. Grimm[3], and Carolina S. Vera[4]

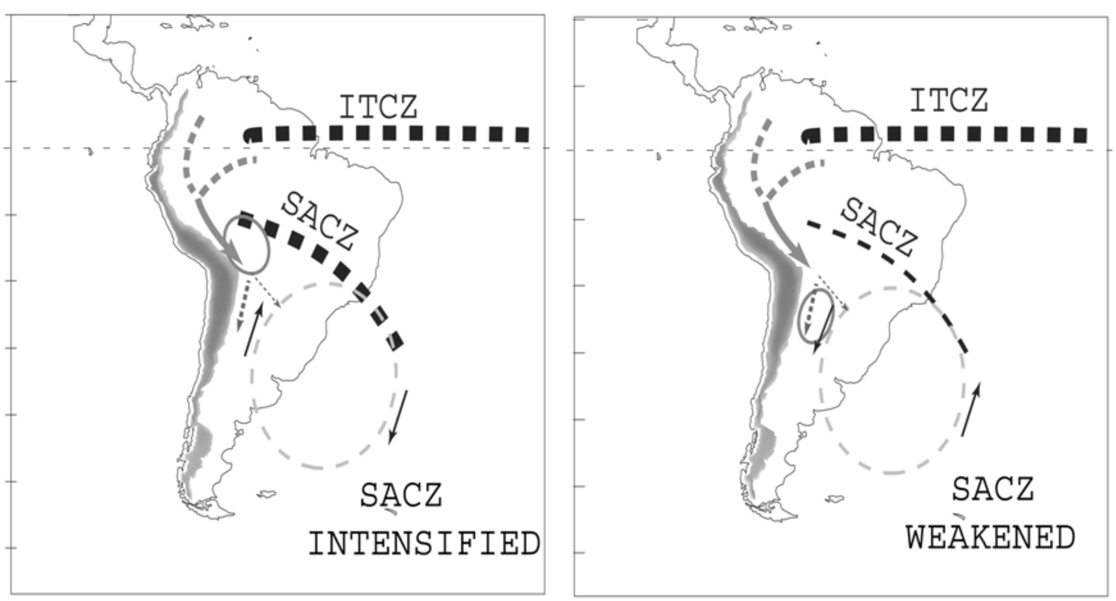
[1]University of California, Los Angeles, USA
[2]International Research Institute for Climate Prediction, New York, USA
[3]Federal University of Paraná, Brazil
[4]CIMA/University of Buenos Aires, Argentina

We refer to the flow over South America during the warm season as the South American Monsoon System (SAMS) since it (1) shows the monsoon-type surface low pressure/upper-level anticyclone configuration and intense low-level inflow of moisture from the ocean; (2) is affected by large-scale land-sea surface temperature contrasts, as well as by terrain elevations and land surface conditions (e.g., soil moisture); and (3) includes shifts in regional precipitation from low or relatively low to very intense. SAMS provides a useful framework for describing and diagnosing warm season climate. See the recent papers by Paegle et al. (2002) and Vera et al (2004) for an extensive bibliography on SAMS.

SAMS is characterized by intense precipitation over central Brazil and Bolivia and the South Atlantic Convergence Zone (SACZ) to the southeast (see top right figure on page 1). The associated upper-level anticyclone (Bolivian High) establishes close to the Altiplano. The upper-level high and accompanying low-level heat low are in spatial quadrature in longitude with ascent on the eastern side of the continent and subsidence on the western side over the eastern Pacific, where extensive stratocumulus decks provide a radiative heat sink to the tropical atmosphere. Such a configuration allows for a largely Sverdrup-type balance between the vorticity source associated with diabatically forced continental-scale vertical motion and advection of planetary vorticity. The monsoon circulation extends poleward until the midlatitude dynamical regime takes over.

The trade winds from the tropical Atlantic Ocean provide the moisture source for the SAMS. Moisture transport intensifies locally along the eastern scarp of the Andes, where the South American low-level jet (SALLJ) develops throughout the year with its strongest winds over Bolivia.

The intraseasonal, as well as interannual and interdecadal, variations of SAMS appear to be associated with a continental-scale eddy (see figure below). In the cyclonic phase of the circulation, the SACZ intensifies with anomalous descent to the southwest and weakened low-level flow east of the Andes; the anticyclonic phase shows opposite characteristics. The vertical velocity distribution associated with the mode is consistent with a dipole defined by persistent wet and dry anomalies over tropical and subtropical eastern South America during the austral summer. Two different convection "regimes" in Amazonia have been identified in recent field campaigns: (1) an intense mode consisting of a vertically developed convection associated with a westerly wind regime, and (2) a weaker, monsoon-type mode, associated with an easterly wind regime.



Opposite phases of the dominant mode of variability over South America during the warm season. Thick arrows indicate low level jets. The area bounded by the dashed ellipses are those in which enhancement of mesoscale convective systems is expected.

In the equatorial belt, El Niño and La Niña tend to be associated with anomalously dry and wet SAMS events, respectively. During El Niño convection is enhanced over the eastern tropical Pacific and subsidence increases over equatorial South America, which disfavors convection. The El Niño Southern Oscillation (ENSO) can also influence the SAMS through the extratropics and the excitation of the Pacific South American Rossby wave trains or teleconnection patterns and the subtropical eddy-circulation mentioned above, which also involve the SACZ and anomalies of the opposite sense over the subtropical plains. No modulation of SAMS involving the snow pack has been proposed, to our knowledge.

On seasonal to interannual time scales, predictability studies with global models generally indicate very modest levels of seasonal-mean precipitation skill over most of the SAMS domain. One of the possible reasons for the low predictability can be the importance of regional atmosphere-land interactions. The successful simulation of land surface processes is one of the major current challenges for numerical modeling of climate variability.

There are many unsolved questions on SAMS. These include the better understanding of the influence on its evolution of the dynamical and thermal effects of the Bolivian Altiplano, Amazonian deforestation, and other land surface processes. There are also several aspects to clarify in reference to the low-level jets, including the associated transports of water vapor and development of convective systems.

Internationally organized research on the American Monsoons has been accelerated in recent years by WCRP. The most relevant programs are the Climate Variability and Predictability (CLIVAR) panel on the Variability of American Monsoon Systems (VAMOS); the GEWEX Hydrometeorology Panel (GHP) Continental-Scale Experiments: Large-scale Biosphere Atmosphere Experiment in Amazonia (LBA) and the La Plata Basin (LPB) Project; and the Coordinated Enhanced Observing Period (CEOP). These activities have greatly strengthened multinational scientific collaboration and coordination.

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RESULTS FROM THE NAME 2004 FIELD CAMPAIGN

Wayne Higgins
NOAA Climate Prediction Center, Maryland, USA

The North American Monsoon Experiment (NAME) is an internationally coordinated process study to determine the sources and limits of predictability of warm season precipitation over North America. NAME is funded jointly by the GEWEX Americas Prediction Project (GAPP) and the Pan American Climate Studies (PACS) Project. The NAME 2004 Enhanced Observing Period (EOP) was conducted during June–September 2004 with Intensive Observing Periods (IOPs) during a 6-week period (1 July–15 August 2004). NAME 2004 collected an extensive set of atmospheric, oceanic and land-surface observations in the core region of the North American monsoon (see the figure at the bottom of page 20).

The IOPs were designed to address the following science questions: (1) How are low-level circulations along the Gulf of California/west slopes of the Sierra Madre Occidental related to the diurnal cycle of moisture and convection? (2) What are the relationships between moisture transport and rainfall variability? and (3) What is the typical life cycle of diurnal convective rainfall?

While the general behavior of monsoon precipitation has been under investigation for many years, confident analysis of detailed spatio-temporal characteristics has been lacking due to deficiencies in the operational precipitation monitoring network. This deficiency was addressed, in part, during NAME 2004 using strategic augmentations of the gauge-based observing network. Complementing national networks operated by the National Weather Service (NWS), the Mexican National Weather Service (Servicio Meteorólógico Nacional), and the Mexican Comision Nacional del Agua (CNA), hundreds of new rain gauges were installed by NAME investigators in Tier I to fill in data-sparse regions and to help ameliorate a low-elevation bias in the existing observing network. Emphasis was placed on improving the sampling of precipitation within the complex terrain of the Sierra Madre Occidental Mountains because preliminary diagnostics have shown that rainfall during the summer tends to initiate over the high terrain early in the afternoon and then propagate or reform towards the Gulf of California (GOC) later in the evening.

The NAME 2004 EOP atmospheric profiling program was aimed at gathering upper air data to study the dynamic and thermodynamic vertical structure and temporal variability of the troposphere in the core monsoon region, its relationship with large-scale systems, and the development of deep convection and rainfall in the region. The operational sounding systems of the southwestern United States and Mexico were enhanced to allow for an increased frequency of balloon launches (4 to 6 times per day, depending on the site) to better characterize the diurnal evolution of the troposphere. The enhanced operational soundings were augmented by additional soundings within the Tier I region conducted by NAME Principal Investigators and sponsoring agencies such as the Department of Defense at Yuma, Arizona, and the Salt River Project in Phoenix, Arizona. Enhanced operational soundings during IOPs were also made in the neighboring countries of Belize and Costa Rica.

During the EOP three NCAR Integrated Sounding Systems (ISSs), consisting of Global Positioning System (GPS) sounding systems, 915-MHz wind profilers, Radio Acoustic Sounding Systems (RASS) to measure virtual temperature profiles in the boundary layer, and surface meteorological stations. The ISSs were located at Puerto Peñasco, Sonora; Bahia Kino, Sonora, and Los Mochis, Sinaloa on the eastern side of the Gulf of California. These systems successfully sampled a number of aspects of the monsoon system in real time including monsoon onset, GOC low-level jets and moisture surges, the diurnal cycle of convection, land-sea breezes, influences of easterly waves and tropical cyclones, and upper-level inverted troughs. For example, the ISSs successfully captured a major influx of moisture into the southwestern United States that occurred during NAME IOP-2 (12–15 July 2004) in association with the passage of Tropical Storm Blas to the south of Tier I. This storm produced several significant changes over Tier I, including changes in the midlevel flow from southeasterly to easterly, and an increase in surface pressure over the southern Gulf, thereby enhancing the north-south pressure gradient along the GOC. The Puerto Peñasco ISS documented the Gulf surge on 13 July in real time. It was preceded by the passage of two gust fronts exhibiting wind shifts in the lowest 500 m of the atmosphere. Following that, a prominent moisture surge occurred with a peak wind exceeding 20 ms^{-1} near 1 km AGL. A rise in the surface pressure of ~5 hPa was associated with this surge. The other ISS sites at Bahia Kino and Los Mochis also recorded surges and significant surface pressure rises.

A radar network, consisting of the NCAR S-Pol polarimetric Doppler radar near Mazatlan, Sinaloa and two upgraded SMN Doppler radars in Guasave, Sinaloa and Cabo San Lucas, Baja California Sur, was operated during NAME 2004 to characterize mesoscale and convective-scale processes in Tier I. The network provided improved observations of the diurnal cycle of rainfall and storm morphology in the region. S-Pol was operated in two different scanning modes to emphasize mesoscale organization of storms and to emphasize individual storm structure. Both modes featured scans every 15-minutes to produce accurate rainfall maps, and information on microphysical structure and evolution of storms. After vigorous quality control efforts, the SMN data will be merged with S-Pol and NERN rain gauge data to create a gridded composite regional product that provides near-surface rainfall, reflectivity, and Doppler velocity every 15 minutes during the EOP. Combined, these radar products will be used to initialize and validate modeling work at multiple spatial scales, as well as to validate satellite rainfall estimates.

The data set gathered during NAME 2004 will be used to improve our ability to simulate and ultimately predict monsoon precipitation months to seasons in advance. A driving hypothesis of NAME is that we must develop proper simulations of relatively small (spatial and temporal) scale climatic variability, especially the diurnal cycle, in the core of the continental monsoon precipitation maximum in northwestern Mexico. A comprehensive modeling strategy was developed that included the NAME 2004 EOP as a critical component from the outset to help guide progress. Details of the strategy, which includes climate model assessments, data assimilation, model sensitivity and development, and prediction activities are available on the NAME webpage (www.joss.ucar.edu/name/).

The campaign generated an unprecedented data set that is freely available to the climate community (www.joss.ucar.edu/name/catalog/). NAME modeling and prediction studies will continue for the next several years. By the end of the program in 2008, NAME will deliver an improved observing system design for monitoring and predicting the North American monsoon, more comprehensive understanding of North American summer climate variability and predictability, strengthened scientific collaboration across Pan-America, and measurably improved climate models that simulate and predict monsoon variability months to seasons in advance.

GEWEX RELEVANT PUBLICATIONS OF INTEREST

Ensemble Simulations of Asian–Australian Monsoon Variability by 11 AGCMs

Reference: Bin Wang, In-Sik Kang and June-Yi Lee, 2004. Ensemble Simulations of Asian–Australian Monsoon Variability by 11 AGCMs. *Journal of Climate*: Vol. 17, No. 4, pp. 803–818.

Summary/Abstract: Ensemble simulations of Asian–Australian monsoon (A–AM) anomalies were evaluated in 11 atmospheric general circulation models for the unprecedented El Niño period of September 1996–August 1998. The models' simulations of anomalous Asian summer rainfall patterns in the A–AM region (30°S–30°N, 40°–160°E) are considerably poorer than in the El Niño region. This is mainly due to a lack of skill over Southeast Asia and the western North Pacific (5°–30°N, 80°–150°E), which is a striking characteristic of all the models. The models' deficiencies result from failing to simulate correctly the relationship between the local summer rainfall and the SST anomalies over the Philippine Sea, the South China Sea, and the Bay of Bengal: the observed rainfall anomalies are negatively correlated with SST anomalies, whereas in nearly all models, the rainfall anomalies are positively correlated with SST anomalies. While the models' physical parameterizations have large uncertainties, this problem is primarily attributed to the experimental design in which the atmosphere is forced to respond passively to the specified SSTs, while in nature the SSTs result in part from the atmospheric forcing.

Seasonal Evolution and Variability Associated with the West African Monsoon System

Reference: Guojun Gu and Robert F. Adler, 2004. Seasonal Evolution and Variability Associated with the West African Monsoon System. *Journal of Climate*: Vol. 17, No. 17, pp. 3364–3377.

Summary/Abstract: In this study, the seasonal variations in surface rainfall and associated large-scale processes in the tropical eastern Atlantic and West African region are investigated. The 6-yr (1998–2003) high-quality Tropical Rainfall Measuring Mission (TRMM) rainfall, sea surface temperature (SST), water vapor, and cloud liquid water observations are applied along with the NCEP–NCAR reanalysis wind components and a 4-yr (2000–2003) Quick Scatterometer (Quik SCAT) satellite-observed surface wind product. Major mean rainfall over West Africa tends to be concentrated in two regions and is observed in two different seasons, manifesting an abrupt shift of the mean rainfall zone during June–July. The abrupt shift of the mean rainfall zone appears to be a combination of two different physical processes: (i) evident seasonal cycles in the tropical eastern Atlantic Ocean, which modulate convection and rainfall near the Gulf of Guinea by means of SST thermal forcing and SST-related meridional gradient; and (ii) the interaction among the upper-tropospheric tropical easterly jet (AEJ), upper-tropospheric tropical easterly jet (TEJ), low-level westerly flow, moist convection, and African easterly waves (AEWs) during July–September, which modulates rainfall variability in the interior of West Africa, primarily within the ITCZ rain band.

Model Study of Evolution and Diurnal Variations of Rainfall in the North American Monsoon During June and July 2002

Reference: J. Li, X. Gao, R. A. Maddox and S. Sorooshian, 2004. Model Study of Evolution and Diurnal Variations of Rainfall in the North American Monsoon during June and July 2002. *Monthly Weather Review*: Vol. 132, No. 12, pp. 2895–2915.

Summary/Abstract: Rainfall evolution and diurnal variation are important components in the North American Monsoon System. In this study these components are numerically studied using the fifth-generation Pennsylvania State University–National Center for Atmospheric Research (PSU–NCAR) Mesoscale Model (MM5) with high resolution (12-km grids) in contrast to most previous model studies that used relatively coarse spatial resolutions (>25 km grids). The study shows that, in general, the model results broadly matched the patterns of satellite-retrieved rainfall data for monthly rainfall accumulation. The rainfall timing evolution in the monsoon core region predicted by the model generally matched the gauge observations. However, the differences among the three precipitation estimates (model, satellite, and gauge) are obvious, especially in July. The rainfall diurnal cycle pattern was reproduced in the monsoon core region of western Mexico, but there were differences in the diurnal intensity and timing between modeled and observed results. Furthermore, the model cannot capture the diurnal variation over Arizona. The simulations show that the model has deficiencies in predicting precipitation over the Gulf of Mexico. The model cannot reproduce the low-level inversion above the marine boundary layers and thus does not generate enough convective inhibition to suppress the convection. The model also cannot produce realistic variations of day-to-day atmospheric conditions with only a single initialization at the start of the month.

GCSS PACIFIC CROSS-SECTION INTERCOMPARISON PROJECT

Christian Jakob[1], Joao Teixeira[2], Pier Siebesma[3], and Roel Neggers[4]

[1]BMRC, Melbourne, Australia, [2]UCAR/VSP, NRL, California, USA, [3]KNMI, The Netherlands, [4]UCLA, California, USA

The GEWEX Cloud System Study (GCSS) Pacific Cross-Section Intercomparison (GPCI) Project is a model evaluation project to compare and evaluate the representation of clouds in climate and Numerical Weather Prediction (NWP) models, both global and regional, over the sub-tropical and tropical Pacific Ocean. The study consists of an analysis of two June/July/August periods (1998 and 2003) along an idealized cross section over the Pacific Ocean that encompasses both the ascending and descending branch of the Hadley Circulation. Three major cloud types, namely stratocumulus, shallow cumulus and deep convective cloud systems, all occur in a persistent and geographically separated way, along the chosen cross section. These cloud systems form a major focus of the process studies carried out in GCSS using single-column versions of the climate and NWP models, as well as cloud resolving models. GPCI will connect these process studies to the simulation of cloud systems in the full 3-dimensional models in a simplified and yet meaningful way.

The main focus of the study is on processes related to the hydrological cycle within the Hadley Circulation. A special focus area will be the evaluation of the vertical humidity structure in both the tropical and sub-tropical parts of the study area, using data that are becoming available from a new generation of satellite instruments, such as the Atmospheric Infrared Sounder (AIRS).

More details of the project, as well as instructions on how to carry out the simulations and data requirements can be found on the GCSS homepage (www.gewex.org/gcss.html). For questions and suggestions, please contact the lead scientist for the project, Dr. Joao Teixeira (teixeira@nrlmry.navy.mil). Results of an earlier version of the GPCI carried out as part of the European Cloud System Study (EUROCS) can be found in Siebesma et al. (2004).

Reference

Siebesma, A. P., C. Jakob, G. Lenderink, and co-authors, 2004. Cloud representation in General Circulation Models over the Northern Pacific Ocean: A EUROCS Intercomparison Study. *Quart. J. Roy. Meteorol. Soc.*, 130, 3245-3267.

GCSS SCIENCE PANEL MEETING

21–23 September 2004
New York, USA

Christian Jakob
Bureau of Meteorology Research Centre
Melbourne, Australia

The meeting was hosted by the National Aeronautics and Space Adminstration (NASA) Goddard Institute for Space Studies (GISS). The goal of the GEWEX Cloud System Study (GCSS) is to improve the parameterization of cloud systems in general circulation models (GCMs) and numerical weather prediction models through improved physical understanding of cloud system processes. The main tools for achieving this are case studies in which cloud resolving models and single column models (1D versions of full GCMs) are compared to observations and with each other. A special focus of the meeting was to discuss how to increase GCSS influence in guiding the development of the representation of clouds in models.

The GCSS Science Panel approved the 3rd Pan-GCSS Meeting on "Clouds, Climate and Models" to be held 16–20 May 2005 in Athens, Greece. The meeting will host plenary sessions, as well as meetings of all GCSS working group (WGs) and cross-WG activities. The plenary sessions will cover the following subjects: (1) Perspectives on the importance of clouds in the climate system; (2) Methodologies and metrics in assessing models; (3) The fundamental role of precipitation in cloud systems; and (4) Progress in the representation of clouds in large-scale models.

GCSS will aim at improving its alignment with GCM developments, and in that context, each GCSS WG is investigating how to more directly connect its specific process studies to GCM studies. GCSS will also aim to involve a wider community, in particular, the GCM evaluation community, as well as broader parts of the data community, more directly into the GCSS process. The 3rd Pan-GCSS Meeting will be an excellent opportunity to foster this closer collaboration. To increase the visibility of GCSS in the community, GCSS will publish an electronic GCSS newsletter on a regular basis.

A new activity is the GCSS Pacific Cross-Section Intercomparison (GPCI), see adjacent article on this page. This activity, which is led by J. Teixeira (Naval Research Laboratory), compares and evaluates GCMs along a cross section of the coast of California to the Inter-Tropical Convergence Zone, encompassing many major tropical and subtropical cloud systems. An across-WG microphysics effort is being established and the first meeting of the group will be held during the Pan-GCSS Meeting.

The **WG on Boundary Layer Clouds** (Chair: C. Bretherton – University of Washington) is continuing its investigation of marine stratocumulus clouds and is currently focussing on the role of drizzle in such clouds. This study is likely to be followed by an investigation into the role of precipitation in small cumulus clouds. The **WG on Cirrus** (Chair: S. Dobbie – University of Leeds) is currently devising a new case study for the group, most likely based on observations taken at the US Dept. of Energy Atmospheric Radiation Measurement (ARM) Program Southern Great Plains (SGP) site. The **WG on Extra-Tropical Layer Clouds** (Chair: G. Tselioudis – NASA/GISS) is continuing their analysis of model performance during the March 2000 Intensive Observation Period at the ARM SGP site in Oklahoma. New model evaluation techniques developed in this group show great promise in disentangling the causes for the model errors identified. The **WG on Deep Convective Systems** (Chair: J. Petch – UK MetOffice) is continuing its work on the diurnal cycle of deep convection and is preparing a new case study on the transition from shallow to deep convection over the tropical oceans using data from the Tropical Ocean Global Atmosphere-Coupled Ocean Atmospheric (TOGA-COARE) experiment. While geographically separate, this study will have a close physical relationship to that on the diurnal cycle. In both cases clouds grow gradually from shallow to deep convection, a process GCMs are currently only poorly representing. The **WG on Polar Clouds** (Chair: J. Pinto – National Center for Atmospheric Research) will focus on understanding and modelling mixed-phase clouds that have been found to frequently exist in the Arctic. The simulation of such clouds is a challenge from both the cloud-dynamical and microphysical viewpoint. Data recently collected during the Mixed-Phase Arctic Cloud Experiment (MPACE) will be a major source of activities for this working group.

Overall the work of GCSS is progressing well. The suggested small changes in focus, as well as the more direct inclusion of the larger GCM and observation communities, while building on our strengths in conducting detailed cloud process studies, should make GCSS an even more relevant group in GEWEX and for the global research community.

WORKSHOP ON AMERICAN MONSOON SYSTEMS

Montevideo, Uruguay 17–18 September 2004

Jose Marengo
Center for Weather Forecasting and Climate Studies-CPTEC/INPE, Brazil

The Third Workshop on Monsoon Systems associated with the Coordinated Enhanced Observing Period (CEOP) Inter-monsoon Model Study (CIMS) was held to: (1) provide a better understanding of the fundamental physical processes underpinning the diurnal and annual cycles, and intraseasonal oscillations in monsoon lands and adjacent oceanic regions, especially in the Americas, and (2) to share experiences and ideas on studies of processes and variability in the American, Asian (Indian and Australasian) and African monsoons.

Papers presented at the workshop included observational studies on intraseasonal, interannual and decadal timescale variability of the monsoon in the Americas, the water and energy balances, the diurnal cycle, predictability of monsoons, teleconnections and regional forcing in the monsoon regions. A relatively new aspect presented was the inclusion of aerosols in monsoon development. Recent LBA studies have linked the concentration of aerosols due to biomass burning in the Amazon to the physics of rainfall and the onset of the rainy season in southern Amazonia (see article in the November 2004 issue of *GEWEX News*). Conclusions from some of the workshop papers are given below.

According to R. Mechoso, the core of the North American Monsoon System (NAMS) is farther away from the equator than the South American Monsoon System (SAMS) which is consistent with the seasonal change in sea surface temperature (SST). Both SAMS and NAMS show intraseasonasl variations resembling continental-scale models, in which precipitation in the core monsoon region is negatively correlated with that over the Northeast NAMS or Southeast SAMS, and they have stronger precipitation during El Niño events and weaker during La Niña, but low overall predictability.

As introduced by H. Kim, the North American Monsoon Model Assessment Project (NAMAP) provided comparable control runs from six models for the monsoon of 1990. These were used to assess the ability of state-of-the-art regional and global models to simulate the seasonal evolution and diurnal cycle of atmospheric circulation, hydrometeorology, and land surface flux fields across the domain of the NAMS. Model simulations of the moist surges along the Gulf of California and the connection between Tropical Easterly Waves (TEW) and moist surges show that they are related to the initiation and propagation of some of the Gulf surge events (H. Berbery).

In the SAMS region El Niño events impact precipitation by enhancing or suppressing the mechanisms that produce rainfall (A. Grimm). In the case of the summer monsoon, the driving mechanism is the establishment of a continental heat flow and a thermal contrast between the continent and ocean that brings about circulation anomalies. These anomalies provide enhanced moisture convergence, which leads to moistening and destabilization of the troposphere and thus, to enhanced convection. A regional climate model, RegCM, has been used to assess the influence of given conditions for soil moisture, topography, changes in parameterizations, and short-term changes in the Atlantic SSTs. RegCM simulations of seasonal extremes and subseasonal statistics of rainfall for South America (by A. Seth) showed that RegCM has potential for improving the location of ITCZ in a larger domain. The results appear to be quite sensitive to domain size. As one of the components of the SAMS, J. Marengo discussed the South American low level jet (SALLJ) and its importance in transporting moisture and aerosols from Amazonia to subtropical South America. Recent work has shown that the frequency and intensity of the SALLJ events exhibit considerable variability on intraseasonal, interannual and even longer time scales.

According to I. Cavalcanti, prediction of SAMS during the summer must address climatological monsoon features, changes during ENSO, the low frequency and high frequency variability, the diurnal cycle and the SACZ and SALLJ features. Y. Xue showed that the land surface processes, especially vegetation, affect summer monsoon simulations at continental and synoptic scales. He concluded that vegetation affects the surface energy partitioning, modifies the heat gradients, circulation, and evaporation through non-linear and complex interactions.

According to R. Terra the diurnal phase of large-scale ascending motion and precipitation in Central Amazon and the coastal region are almost in opposite phases, suggesting different diurnal convective destabilization mechanisms: Central Amazon is dominated by surface heating over adiabatic cooling and for the Coastal Region convergence induced by coastal circulations plays a role. For NAMS, M. Lee showed that large diversities in the diurnal cycle simulations exist between GCMs in terms of amplitude and peak phase of rainfall. In general, models tend to reach their maximum phase of rainfall 2–3 hours earlier than observed over the deep convective region. T. Yasunari reported on the diurnal variability, elevated heat source, and water cycle variability in monsoon regions.

The La Plata Basin analyses of the National Centers for Environmental Prediction (NCEP) reanalyses and the Eta/NCEP (H. Berbery) gave good agreement between the basin average time-mean model precipitation and the observed precipitation, although P-E and moisture flux convergence (or observed streamflow) differ by about 0.28 mm/day, suggesting that the model is somewhat high. According to I. Camilloni the Paraná and Uruguay basins are part of a region in SE South America that has a strong precipitation signal during ENSO events, and most of the extreme monthly discharge events occur during El Niño and none during La Niña.

Both the European Center for Medium-Range Weather Forecasts (ECMWF) and the Indian National Center for Medium Range Weather Forecasts (NCMRWF) model precipitation forecasts over India have a tendency to over-predict the frequency of precipitation events in the light and moderate categories and to under-predict events in higher categories during the monsoon season (M. Basu). The magnitude of bias is larger for the NCMRWF model forecasts than the ECMWF model forecasts. Orography plays an important role in monsoons, especially in the Asian monsoon in the Himalayas (M. Bollasina). Furthermore, the phase of diurnal variation of precipitation in tropical Asia for the Indochina Peninsula and Bangladesh depends on the distance from mountains (T. Satomura). According to W. Lau the mechanisms of aerosol-water cycle interaction include a direct effect, providing cooling effects due to the reflection of sunlight and a semi-direct effect with absorbing aerosols reducing atmospheric convection by surface cooling and heating in the lower troposphere and enhancing low level heating and moisture convergence, thus increasing convection and rainfall. Aerosol transport and interaction with large-scale dynamics is also important for aerosol-atmospheric chemistry interaction. For the Southeast Asia monsoon region and adjacent oceanic regions, monsoon rainfall is generally reduced in association with aerosol-induced reduction in land surface temperature. However, heating by absorbing aerosols may cause an early onset and intensification of the Indian monsoon with an enhanced rainfall anomaly occurring over northern India and the Bay of Bengal (see page 7).

9th GISP MEETING AND 6th GAME STUDY CONFERENCE

1–5 December 2004 Kyoto, Japan

Kenji Nakamura
GAME International Project Office
HyARC, Nagoya University, Japan

The 9th GEWEX Asian Monsoon Experiment (GAME) International Science Panel (GISP) Meeting was held at the Kyoto International Community House, Kyoto, Japan, 1–2 December with the support of the Ministry of Education, Culture, Sports, Science and Technology of Japan, the World Climate Research Programme, the Japan Aerospace Exploration Agency, and the Hydrospheric Atmospheric Research Center, Nagoya University.

The major focus of discussion was on the need for and nature of a follow-on activity to the GAME Project, which through its strong international collaboration, has successfully clarified the basic processes of land-atmosphere interactions through regional experiments and monitoring. However, the mechanisms and the variations in the Asian monsoon are still not fully understood and the necessity for understanding these was recognized. Every Asian country has serious hydrometeorological problems (e.g., extreme weathers, floods, glacier retreats, permafrost degradation) and many of these are closely related to the monsoon activity. Thus, many domestic projects with international collaboration will be continued or are being planned.

For the GAME follow-on, the basic scientific objectives will remain the same: (1) understanding the role of the Asian monsoon on the hydrological cycle, and (2) improving prediction of the regional or basin scale hydrological cycle and water resources in monsoon Asia. A third objective will be added, "understanding the impact of global warming and other anthropogenic forcing on the hydrological cycle and hydro-climate in monsoon Asia." To attain these objectives, international collaboration is essential and the gap between operational agencies and research communities should be reduced.

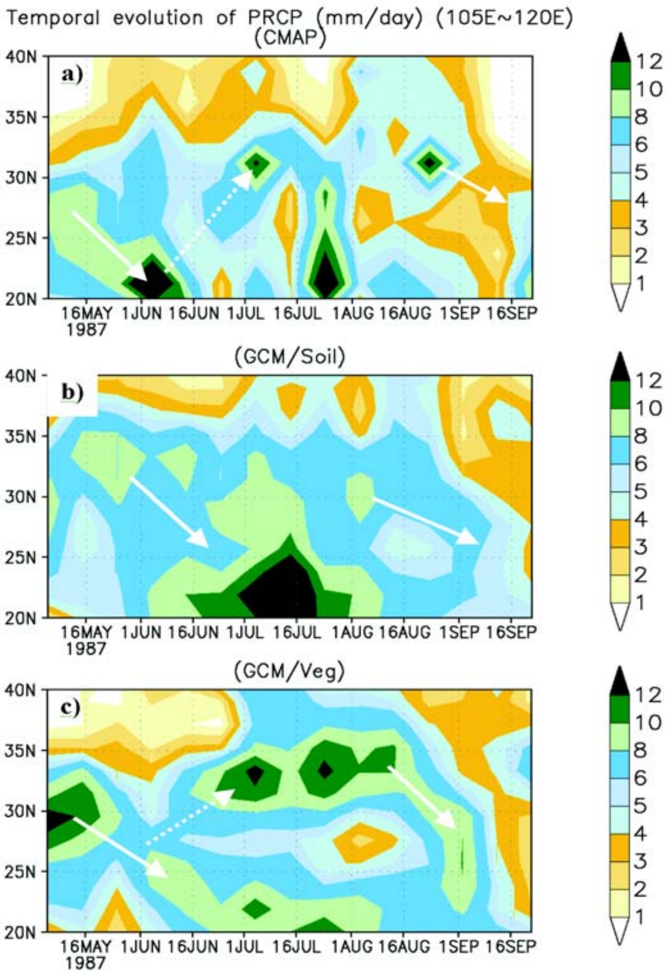
It was concluded that the GAME follow-on activity should be within GEWEX or WCRP. The tentative name of the project is the Coordinated Observation and Prediction of Asian Monsoon Climate (COPAM). The target time scale for COPAM studies will be seasonal, interannual and long-term variations. The new project will also contribute to solving and mitigating local hydrological issues, particularly through modeling. Data exchange and coordinated modeling studies will be two key parts of COPAM. The new program functions will be: (1) promotion of coordinated/cooperative studies within Asian monsoon countries; (2) modeling/prediction studies of the Asian monsoon, hydro-climate and water resources in Asia, including development, intercomparison and transfer models; (3) data collection for hydro-climate and water-resources studies; (4) promotion of international workshops and training seminars; and (5) data archival. The WMO/WCRP data policy (free and open exchange) for international research communities that was used in GAME will be continued in COPAM. Components of the new program would consist of national and international projects, a program promotion office/center, a coordinated modeling center, a data archiving and management center, and regional centers. Relationships of the new project with the Global Earth Observation System of Systems (GEOSS) and the Integrated Global Observing Strategy-Partnership (IGOS-P) Water Theme will be emphasized.

Following the GISP Meeting, **the 6th International Study Conference on GEWEX in Asia and GAME** was held on 3–5 December with about 180 participants from 14 countries. The presentations consisted of keynote talks, summary reports of subprojects, talks on proposed programs, projects, and poster presentations. GAME was recognized as a success story and a future research program/project to extend GAME's fruitful results was strongly recommended. The need for involvement of the operational agencies, particularly, for modeling activities, was emphasized. The model activity would include regional climate model development. It was agreed that the budgetary support should be from each domestic government and that the scientific and operational community should propose a budget for research. GAME was focused on the land-atmosphere interaction. However, the ocean plays a major role in the monsoon activity, and the relationship of GEWEX and CLIVAR was discussed. The winter monsoon was one of the identified themes. Thus far, much of the research is focused on the summer monsoon, but greater precipitation is associated with the winter monsoon in some regions, and many people stressed its importance. A kick-off workshop for the new program/project may be held in the Spring of 2005 in Japan.

GEWEX/WCRP MEETINGS CALENDAR

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

EXPLICIT GCM VEGETATION PARAMETERIZATION NEEDED TO SIMULATE MONSOONS



Temporal evolution of the 10-day mean precipitation (mm day^{-1}) averaged over 105–120 E from May through September. (a) CMAP; (b) GCM/Soil (c) GCM/Veg (after Xue et al., 2004a). *See article on page 5.*

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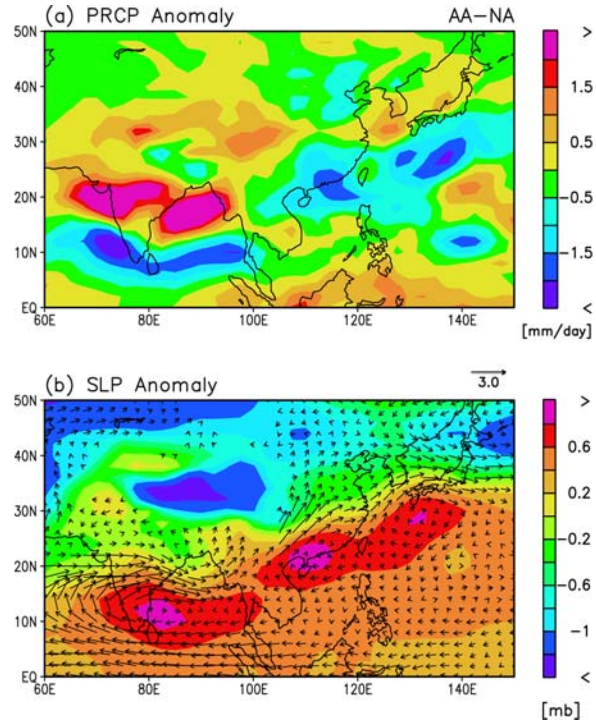
Richard G. Lawford, Director
Dawn P. Erlich, Editor

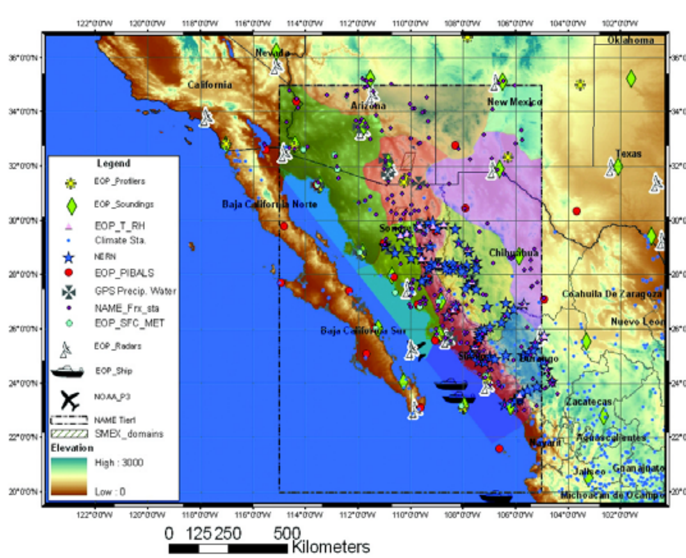
Mail: International GEWEX Project Office
1010 Wayne Avenue, Suite 450
Silver Spring, MD 20910, USA
Tel: (301) 565-8345
Fax: (301) 565-8279
E-mail: gewex@gewex.org
WWW Site: http://www.gewex.org

AEROSOL-INDUCED RAINFALL AND SURFACE PRESSURE ANOMALIES IN THE ASIAN MONSOON



Spatial pattern of aerosol-induced seasonal mean (JJA) anomalies of a) rainfall, and b) sea level pressure and 850-mb wind, based on the experiments with the NASA fvGCM-GOCART model. *See article on page 7.*

2004 NAME FIELD CAMPAIGN EXTENSIVE NEW DATA SET



Observing system enhancements for the NAME 2004 Enhanced Observing Period. *See article on page 13.*