Coordinated Enhanced Observing Period

An Element of the World Climate Research Programme (WCRP),
initiated by the Global Energy and Water Cycle Experiment (GEWEX)

Newsletter No. 5
January 2004
CEOP Web Site: http://www.ceop.net

Contributions of Satellite Data Are Fundamental to Success of the Coordinated Enhanced Observing Period (CEOP)

Gregory W. Withee, NOAA Assistant Administrator for Satellite and Information Services, Washington D.C.

Dr. Gregory W. Withee

I am pleased to have an opportunity to comment on the CEOP program and its relation to the Committee on Earth Observation Satellites (CEOS) and the Integrated Global Observing Strategy Partnership (IGOS-P). Over the past year I have had the privilege of chairing CEOS. Created in 1984 under the aegis of the G7, CEOS is tasked with ensuring cooperation in mission planning as well as acting as the focal point for international coordination in remote sensing activities. CEOS unities all space agencies with civilian Earth observation satellite programs and major user entities; its programs rely on the "best efforts" of its member organizations. A primary focus of CEOS has been Satellite Data Utilization and the integration of these data with other types of data as part of IGOS while remaining a strong promoter of Sustainable Development.

During my tenure as the Chair of CEOS I was able to witness first hand the level of support for the coordination of observing networks by the international community. During the last meeting of the IGOS Partners in Colorado Springs in November 2003, three themes, including the water cycle theme, that had been developed over the past year with considerable guidance from CEOS were approved. An important component of the Integrated Global Water Cycle Observations (IGWCO) Theme has been the Coordinated Enhanced Observing Period (CEOP). It is critically important to measure, understand and model the water and energy cycles within the climate system, but to do this takes broad international initiatives that encourage multi-disciplinary involvement by the scientific community at large. In my view CEOS has been fortunate in having a close association with the World Climate Research Programme (WCRP) which has asked national agencies to support such work through the CEOP. CEOP, which is an element of WCRP that was initiated by the Global Energy and Water Cycle Experiment (GEWEX), has many common goals with CEOS members in terms of the development of observing systems and integrated products. Given these connections it is very understandable that CEOP was selected as 'the first element of IGWCO within the framework of IGOS-P'. CEOS recognizes the need for an integrated approach to understanding the water cycle and is undertaking the development of methodologies that seek to promote the integration, not only of the science but of the observations, observational systems and models that support that science. The initial success CEOP has had in assembling data sets from different sources on different continents and its continuing work and plans represents an innovative effort to acquire global data and use data assimilation to integrate in situ and remote sensing data with model output to develop a global understanding of the water cycle. This approach is directly synergistic with the IGOS-P Global Water Cycle theme's integration goals.

Professor Toshio Koike, the scientific leader for CEOP, has made a number of visits to agencies, including NOAA, to seek support in terms of data services. It is clear that CEOP is evolving as a unifying and integrating framework supported by the scientific community, space agencies and modeling centers that is designed to benefit from and build on existing and future activities within the climate research community. As part of WCRP's efforts to meet its global research objectives, CEOP has been timed to take advantage of the fact that data, which are fundamental to water and energy budget studies, are available from the existing suite of operational satellites. Because of their consistency and maturity, these data are of critical importance to on-going and planned water cycle research initiatives that are developing within a number of national and international projects. CEOP is also hoping to exploit data that have begun to arrive from the new series of Earth system satellites. This group of satellites includes several that have already been successfully launched, such as TERRA, TRMM, AQUA, and ENVISAT.

During CEOS deliberations we have exercised some ownership of CEOP by putting steps in place to ensure that CEOP takes into account the requirements of the climate research community at large in planning the assembly of coordinated data sets that will serve numerical weather prediction and climate research and analyses needs. This work has proven its value as successful comprehensive CEOP intercomparisons of in situ data, satellite products and model outputs are already underway. I wish, therefore, to appeal to heads of all relevant Agencies and Organizations receiving requests to assist CEOP by contributing to its basic need for satellite data to consider their decision seriously as we are doing at NOAA and as has been undertaken through discussions at CEOS, and to ultimately commit the necessary intellectual and fiscal resources to help establish and exploit this important coordinated database. I firmly believe that the exploitation of satellite data in this way will lead to improved models and better predictions of key climate processes at all scales.

As noted earlier CEOS has a strong interest in the use of satellites to promote Sustainable Development. CEOS was heavily involved in the World Summit on Sustainable Development (WSSD) and has developed an active follow-up program. In return for our data support, I expect CEOP to actively contribute to the water and climate modules within our CEOS/ WSSD program. Furthermore, the close partnership between research and operations that is evident in CEOP may be a model for other CEOS activities. In order to strengthen the ties between CEOS and CEOP, I would encourage more activities such as the CEOP testbed facility that is being developed as part of the CEOS Working Group on Information Systems and Services (WGISS) activities.

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Diurnal variability in the monsoon region: Preliminary results from the CEOP Inter-Monsoon Studies (CIMS)

William K. M. Lau, Laboratory for Atmospheres, NASA/Goddard Space Flight Center, Greenbelt, MD 20771, USA
J. Matsumoto, Dept. of Earth & Planetary Science, University of Tokyo, Tokyo, Japan
Massimo Bollasina, Epson Meteo Centre, Milan, Italy
H. Berbery, Department of Meteorology, University of Maryland, College Park, Maryland, USA

1. Introduction

CIMS is a CEOP scientific initiative to assess, validate and improve the capabilities of climate models in simulating physical processes in monsoon regions around the world. CIMS will be conducted in conjunction with the two other CEOP initiatives; the Water and Energy Balance Studies and the Watershed Hydrology to demonstrate the utility of CEOP data for better understanding of the regional and global water cycle and for model physics improvement. Model validation data will be derived from CEOP global data sets, model location time series (MOLTS), as well as in-situ observations from reference sites, which include GEWEX continental scale experiments (CSE). In CIMS, numerical experiments will be designed and targeted towards simulation of fundamental physical processes that will likely lead to identification of basic errors and biases in model physics. For this purpose, a hierarchy of models including general circulation models (GCM), regional climate models (RCM) and cloud resolving models (CRM) will be used. Monsoon processes are targeted in CIMS because of their scientific values and their importance in improving weather and climate predictions in the global tropics and extratropics. Moreover, monsoon processes involve strong interactions of atmosphere, the land, the biosphere and the oceans, and constitute the basic building blocks of climate models.

CIMS should be considered not only as a research project for CEOP but also a pilot research effort, towards the broader goal of improving model physics parameterization for climate predictions and global change projections. As such, the coordination with on-going model inter-comparison projects and GEWEX and CLIVAR modeling initiatives are critically important for CIMS. For more details of CEOP and CIMS, the readers are referred to the CIMS report on http://www.ceop.net.

2. Objectives of CIMS

There are myriad physical processes governing the variability of monsoon regions ranging from supercloud cluster organization, cumulus, stratocumulus cloud formation, boundary layer processes, surface radiative and hydrologic forcings, air-sea, and air-land interactions to biosphere feedbacks, and anthropogenic impacts. From a modeling viewpoint, the most fundamental processes are those associated with the diurnal cycles, the annual cycles and monsoon intraseasonal oscillations. Identifying model errors and biases in the these fundamental processes will provide important clues for improving model physics particularly with respect to the better understanding of the water and energy cycles, and interactions of the atmosphere with land and oceanic surface processes. Realistic simulation of these processes is a pre-requisite for better climate predictions on seasonal, interannual and longer time scales. Specific objectives of CIMS are:

i) To provide better understanding of fundamental physical processes underpinning the diurnal and annual cycles, and intraseasonal oscillations in monsoon land and adjacent oceanic regions of Asia, Australia, North America, South America and Africa.
ii) To demonstrate the synergy and utility of CEOP integrated satellite data, *in situ* observations and assimilated data in providing a pathway for model physics evaluation and improvement

3. Preliminary results

All monsoon regions of the world are known to have pronounced diurnal cycle variability. According to previous studies, deep convection and associated precipitation tend to peak in the late afternoon or evening over land areas, and in mid-night to early morning over adjacent oceanic regions. However, there are large variations to this basic theme in different monsoon regions. In addition, the amplitudes of the diurnal cycle are often strongly modulated by daily and synoptic scale forcings. In the following, we provide some highlights of CIMS-related ongoing research focusing on the daily and diurnal variability over different monsoon regions.

a. Himalayas regions

The Himalayas region provides strong orographic and thermal forcings on the Asian monsoon. The daily and diurnal rainfall in this region is very complex. A preliminary analysis of precipitation variability during the EOP-1 was conducted at the CEOP Himalayas Reference Site (HRS). Surface data were collected at the Pyramid AWS (5035 m above sea level), established by a collaboration effort among Ev-K2-CNR, the Epson Meteo Centre and the Water Research Institute/CNR, and at Syangboche AWS (3833 m above sea level), established by the Glaciological Expedition of Nepal and maintained by GAME-AAN project. The two AWSs are located about 20 km apart along the Khumbu Valley, that runs from southwest to northeast reaching Mt. Everest. AWSs data were compared to TRMM 2A25 PR instantaneous observations and 3B42 daily rainfall rate gridded at 1°x1° resolution, and with NASA's Global Modeling and Assimilation Office (GMAO, formerly the Data Assimilation Office) GEOS-3 3-hr accumulated precipitation data at the HRS (27.96°N, 86.81°E, which is Pyramid AWS' location). The current analysis was limited to July 2001, when air temperature was constantly above 0°C, to avoid errors related to solid precipitation measurement.

Daily total precipitation is represented in Fig.1a, together with estimated values from NASA's GMAO MOLTS and TRMM (average over the mesh 27°-28°N; 86°-87°E, which encloses the two AWSs). Both measured precipitation series exhibit a strong and similar intra-seasonal cycle. The only discrepancy around 10-11 July was checked by the snapshot of TRMM/PR at 1230 UTC, when the satellite passed just over the Khumbu Valley showing isolated meso-scale convection prevailing only over Syangboche AWS. Such convective cells with sub-regional fine structure may cause large discrepancy even at points only 20 km apart.

A large precipitation event on 19-20 July is evident in all of the series. The agreement of GMAO with observations is good; however, GMAO tends to underestimate precipitation during the most intense events, even if the monthly total is close to observations (about 91% of what is observed at the Pyramid). TRMM estimates reproduce observations very well. Daily variations of precipitation are strongly correlated with synoptic scale forcings associated with the fluctuations of the Tibetan High. The synoptic scale forcings strongly modify the amplitude, and possibly the phases of the diurnal cycle (e.g., Ueno et al., 2001a; Bollasina et al., 2002).

Figure 1b shows the diurnal variation of 3-hourly precipitation at the two AWSs, in comparison with NASA's GMAO MOLTS. At higher altitude (Pyramid), precipitation has two distinct peaks, one in the (local) early afternoon, and the other at midnight. At lower altitude (Syangboche), precipitation is more concentrated from the evening to the early morning. Differences in precipitation as a function of elevation is very important for surface hydrology, and its mechanisms have been discussed based on thermally induced local circulation under the condition of constant large scale monsoon upslope flow (e.g., Ueno et al., 2001b; Barros and Lang, 2003). For instance, strong daytime precipitation may be caused around the ridges, and local scale convergence or radiative cooling may cause night time precipitation at lower elevation. The MOLTS data show comparable magnitude, with a single peak about 3 hours (6 hours) advance of Pyramid (Syangboche).

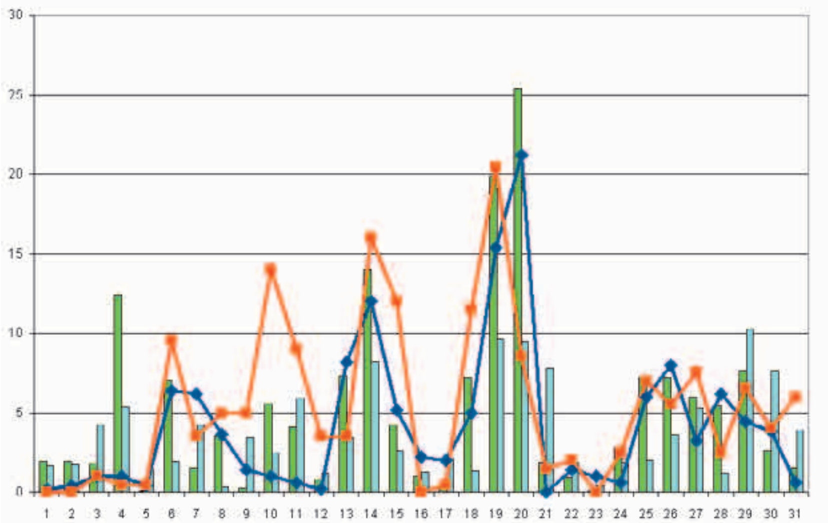

Figure 1a Time series of daily total precipitation (mm) observed at Pyramid (dark blue line) and at Syangboche (red line), estimated by GMAO MOLTS (light blue rectangles) and TRMM data (green rectangles) during July 2001.

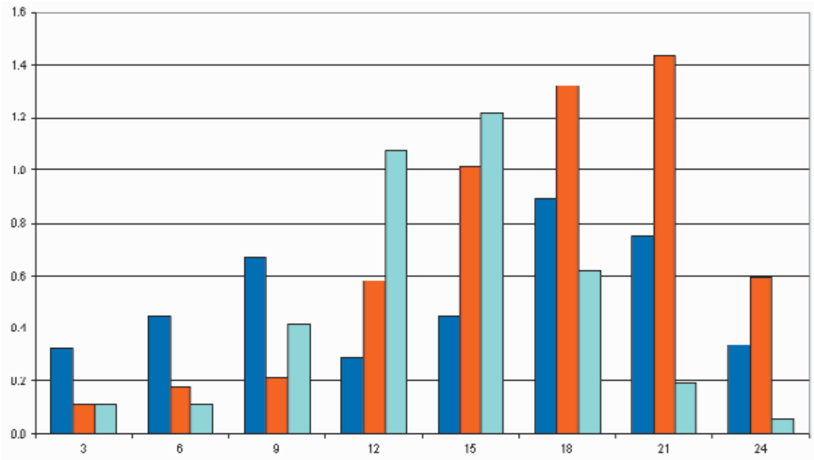

Figure 1b Diurnal cycle of average 3-hourly total precipitation (mm) at Pyramid (dark blue) , Syangboche (red) and estimated by GMAO MOLTS (light blue) during July 2001. Time is in UTC (Nepal LT – 6-hr).

b. Other monsoon regions

Diurnal convection generated locally in monsoon regions may propagate systematically away from its source. Satomura (2000) simulated the diurnal variation of convective activity along east-west cross-sections of Indochina using 2-dimensional cloud resolving model (RAMS). Diurnal convection excited by topography in the afternoon propagates eastward during the nighttime, with an estimated speed of 7 ms-1. These results were consistent with radar observations from the GAME-tropics project. However, other more complex features such as early morning peak of convection in northeastern Thailand have not been simulated realistically. Thee-dimensional cloud resolving models is strongly recommended in CIMS.

In the equatorial region over the Sumatera Island, with the mountain range above 3000m, interesting diurnal movement of convective activity has been noted, based on analysis of GMS IR1 data by Sakurai et al. (2003). They found a diurnal cycle of convective activities which became active in mountainous region in the afternoon and migrated westward and/or eastward at a distance of several hundreds kilometers from midnight to morning (Fig. 2). The westward migration of cloud systems occurred in all areas almost throughout a year except in August. An area of eastward migration was observed in/near the ITCZ around 100oE. The area appeared to shift northward and southward with annual cycle. The reasons for the preferred eastward or westward propagations of diurnal oscillations are unknown, and should be clarified in future. Interaction between the diurnal cycle and seasonally varying monsoonal circulation will be a focus for CIMS.

In the American monsoon region, diurnal variability manifests itself not only in convection but also in low-level jet (LLJ). The LLJ's are generally found flowing parallel to north-south oriented mountain ranges such as the Andes for the South American monsoon (SAM), and the Sierra Madre for the North American monsoon (NAM) (e.g., Douglas 1995; Berbery 2001; Berbery and Fox-Rabinovitz 2003). The SAM LLJ is important in transporting moisture from tropical South America towards the subtropical monsoon region of southern Brazil and the La Plata Basin. Its diurnal cycle is not well known, with modeling studies suggesting a nighttime maximum that is consistent with the predominantly nighttime precipitation over La Plata basin (Berbery and Collini 2000), while other studies suggest that the strongest wind in the afternoon and its core maximum wind is located between 1600-2000 m (Marengo et al. 2002).

For the NAM, the Gulf of California (GC) LLJ is most pronounced in the early morning, along the coast of Mexico reaching the southwestern Arizona. This can be seen in Fig.3, which shows the 3-hourly moisture flux at 925 hPa, simulated by the ETA model and satellite estimated precipitation that includes TRMM. As the inland heats up during the afternoon, the LLJ gives way to a predominantly eastward flow, transporting moisture from the GC, which in terms leads to strong moisture convergence and peak diurnal precipitation along the coastal region of Mexico. Synoptic scale fluctuations of the LLJ of the GC are responsible for moisture surges, which may lead to the onset the monsoon rain in southwestern United States.

As shown in the aforementioned examples, diurnal variability in the monsoon regions represent a complex interplay of responses of convection, moisture and circulation to solar heating, thermal and mechanical effects from topography, latent heating from precipitation, and surface heating. As the first step for model physics improvement, climate models should be validated against their ability to reproduce the diurnal cycle.

Acknowledgement

The authors would like to express thanks to participants of CIMS who have provided background material for this newsletter articles. Dr. M. Bosilovich provided the GMAO MOLTS for the comparison analysis.

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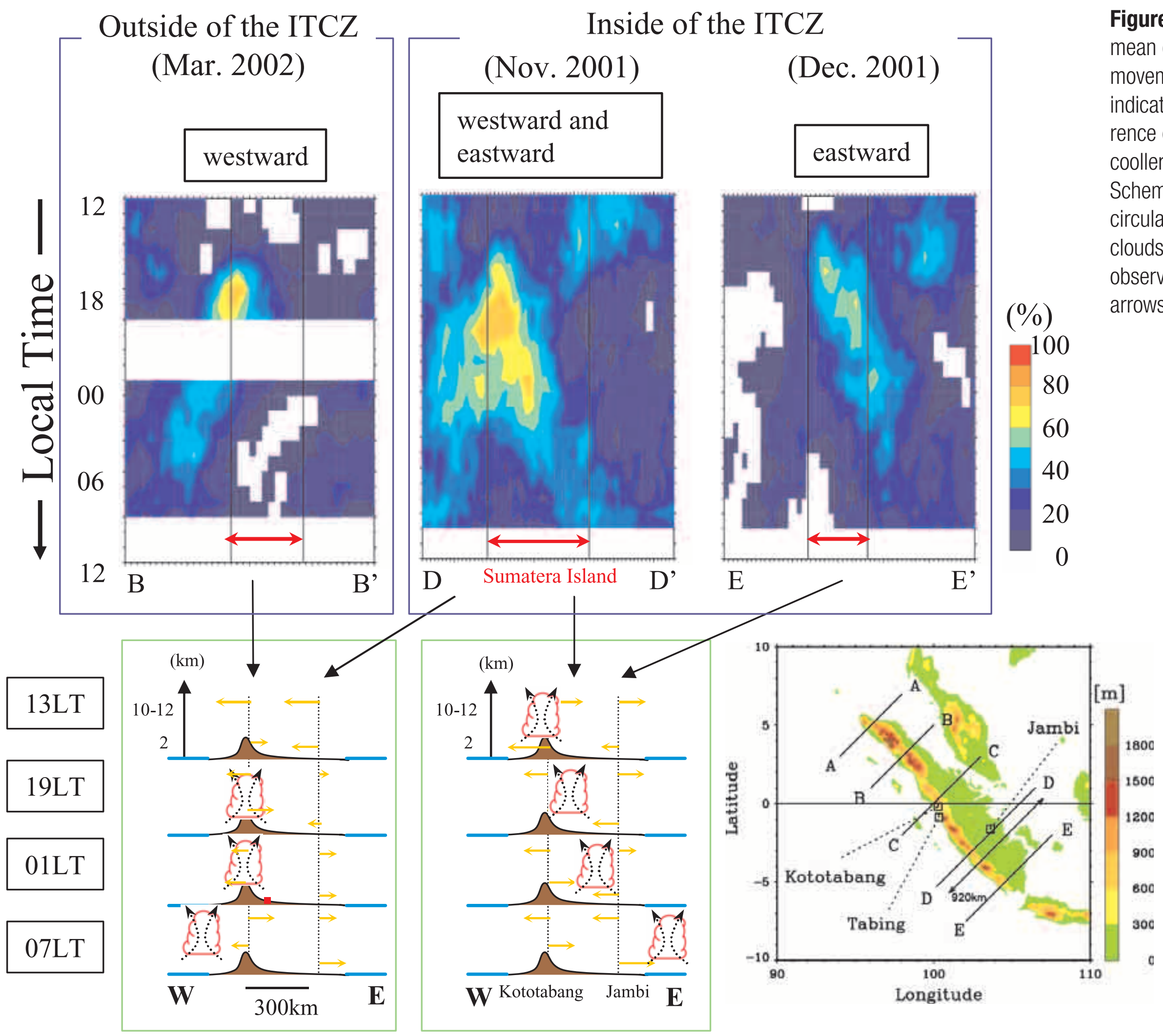

Figure 2 Upper panels: Monthly mean diurnal cycles of cloud movement over Sumatra Island, indicated by frequency of occurrence of cloud top temperature cooller tan 230K. Lower panels: Schematic showing structures of circulation around convective clouds based on rawinsonde observations indicated by yellow arrows (Sakurai et al., 2003).

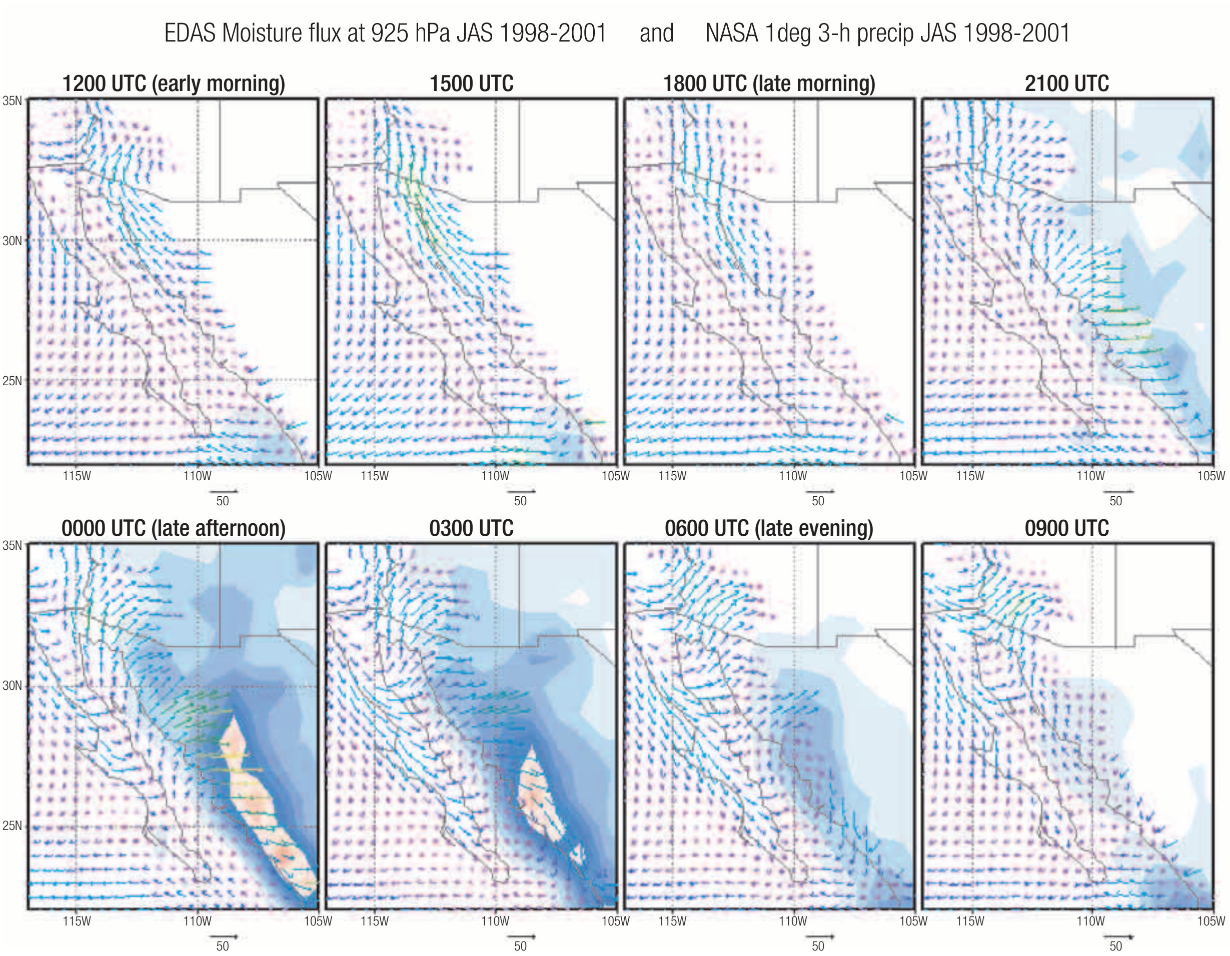

Figure 3 Diurnal cycle of vertically integrated moisture flux (gm $Kg^{-1}ms^{-1}$), and precipitation (mm/day) for the North American monsoon.

Land Surface Processes Simulated from the Noah LSM in the NCEP Global Model: A Comparative Study using the CEOP EOP-1 Reference Site Observations

Cheng-Hsuan Lu [1,2] and **Kenneth Mitchell** [2]
[1] RS Information Systems Inc, McLean, VA
[2] Environmental Modeling Center, NCEP, NOAA/NWS, Camp Springs, MD

1. Introduction

The Coordinated Enhanced Observing Period (CEOP) is an element of the World Climate Research Program (WCRP) initiated by the Global Energy and Water Cycle Experiment (GEWEX). Observations at CEOP reference sites are used in this study to evaluate land surface processes in the NCEP Global Forecast System (GFS), and for comparison, in NCEP's North American Land Data Assimilation System (NLDAS).

2. CEOP Reference Sites

We highly commend the representatives and operating agencies and institutions that sponsor and operate the CEOP reference sites for providing their observations for broad use by the scientific community. Under WCRP coordination, the site managers and CEOP have striven diligently with the National Center for Atmospheric Research (NCAR) to establish a centralized database for reference-site data in a common format. This greatly facilitates use of the CEOP data for model assessment.

Here the GFS is assessed at three CEOP reference sites during EOP-1 (1 July-30 September 2001), including the Pantanal site in Brazil (19.56S, 57.01W) from LBA (The Large Scale Biosphere Atmosphere Experiment) *(This data was provided by Dr. A. Manzi, leader of the Interdisciplinary Pantanal Experiment, which is a partnership from National Institute for Space Research and the Federal University of Mato Grosso do Sul, in Brazil. This project was funded by FAPESP under Grant Number 98/00105-5.)*, the Lindenberg site in Germany (52.17N, 14.12E) from BALTEX (The Baltic Sea Experiment), and a Southern Great Plains (SGP) site (48.31N, 105.1W) from GAPP (GEWEX America Prediction Project). The reported dominant vegetation is forest at the Lindenberg site, wetland at the Pantanal site and short grass at the SGP site. The default vegetation type in the GFS at Lindenberg, Pantanal and SGP, respectively, is mixed forest, savanna, and grass/crop.

3. Global Model and Experiment Setup

This study uses the global spectral model of the NCEP GFS, configured with T62 spatial resolution (~ 200km) and 28 vertical levels, matching that of NCEP's current seasonal forecast system. Aside from resolution, the model is only slightly modified from the operational medium-range weather forecasting model and is targeted for a future upgrade of NCEP's seasonal forecast system. Parameterizations include simplified Arakawa Schubert convection, longwave and shortwave radiation, explicit cloud microphysics, non-local vertical diffusion and gravity wave drag.

The operational version of GFS utilizes the Oregon State University (OSU) Land Surface Model (LSM) of Pan and Mahrt (1987). As part of NCEP efforts with GAPP to upgrade the land component in all NCEP global and regional models and data assimilation systems, the newer NCEP Noah LSM (Ek et al., 2003) has been implemented in the test bed of the NCEP GFS. The Noah LSM, an advanced descendant of the OSU LSM, was developed at NCEP and executed in NCEP's recently completed 25-year Regional Reanalysis (Mesinger et al., 2004). Key advances in the Noah vs. OSU LSM include soil layers changed from 2 (10 and 90 cm thick) to 4 (10, 30, 60, 100 cm thick), addition of frozen soil physics and patchy snowpack treatments, and improvements in bare soil evaporation, snow albedo and ground heat flux under snowpack and non-sparse vegetation.

Thus we compare two versions of the GFS model: control (CNTRL/OSU) using the OSU LSM and experimental (TEST/Noah) using the Noah LSM.

For both, daily 5-day forecasts with hourly output are executed during EOP-1. Day-1 forecast results are presented here. Initial conditions are taken from the 00Z analysis of the NCEP Global Data Assimilation System (GDAS). To date, the GDAS has been executed using only the OSU LSM, which yields non-optimal initial land states for the Noah LSM in the TEST runs (implications discussed more below).

4. Results

Figure 1 shows the monthly mean diurnal cycle of near-surface air temperature, surface solar insolation, sensible heat flux and latent heat flux at the Lindenberg site during 1-31 July 2001 from observations, CNTRL/OSU runs and TEST/Noah runs. The corresponding mean diurnal cycle at the Pantanal and SGP sites are shown in Figures 2 and 3, respectively. The shorter period (July 7-12) depicted at the Pantanal site reflects the available observations during EOP-1, e.g., latent heat flux was reported only during this 6-day window.

At the three sites, the TEST/Noah runs yield notably higher daytime latent heat flux (and cooler 2-m air temperature) than the CONTRL/OSU runs, with both having higher latent heat flux than the observations. Yet the daytime sensible heat flux of both GFS runs are closer to each other and to the observations. Thus net radiation and ground heat flux differences must contribute notably to the latent heat flux differences.

Assessment of LSM physics in the global model is hindered by surface forcing errors in the parent atmospheric model. For example, at the Lindenberg and SGP sites, a high bias in the GFS surface solar insolation compared to the in situ observations is evident (top-right in Figures 1 and 3). The precipitation forcing errors (not shown) of the parent model will be quantified in near-future follow-on study. Additionally, the Noah LSM assessment to date is hindered by the aforementioned lack of Noah-based, continuously-cycled land states in the GDAS.

Parent model surface-forcing biases and lack of Noah-cycled initial land states spur us to consider the uncoupled results of the Noah LSM in the North American Land Data Assimilation System (NLDAS). The NLDAS is fully described in Mitchell et al. (2003). It is a land-only (uncoupled) system that integrates forward in time the land states of four land models in parallel (including the Noah LSM) in a continuously cycled fashion over the continental U.S. from common initial land states on 01 October 1996 to present realtime (for the Noah LSM) using shared, externally specified, atmospheric surface forcing. The seven NLDAS surface forcing fields include observation-based precipitation (from gauges and radar) and satellite-based surface solar insolation (Pinker et al., 2003), both of which manifest substantially less bias in NLDAS than in the GFS, as illustrated for solar insolation in Figure 3 (top-right). Using the same Noah LSM as in the coupled GFS TEST/Noah runs, the NLDAS at the SGP site yields simulations of both latent heat flux and sensible heat flux (lower panels in Figure 3) that agree well with the CEOP in situ observations during July of EOP-1. The improvement in the latent heat flux of the Noah LSM in the NLDAS vs. the GFS TEST/Noah runs is especially dramatic. Hence the NLDAS offers an appealing and complementary uncoupled assessment of the Noah LSM via improved surface forcing and properly spun-up land states.

5. Conclusions

This preliminary pilot study, illustrates the utility of the CEOP reference site observations for assessing land-surface processing.
Caveats in this study to the LSM assessment in the coupled model were highlighted: (a) surface forcing biases in the parent atmospheric model and (b) lack of Noah-LSM compatible initial land states. The simultaneous assessment of the Noah LSM in the uncoupled NLDAS is a useful companion analysis that largely avoids caveats (a) and (b) above.

Conclusive LSM assessment for the coupled model awaits follow-on study including the following:

- Cycle the coupled GDAS using the Noah LSM for at least one year to provide initial land states compatible with the Noah LSM,
- Include other surface and sub-surface fields in the comparison (soil moisture and temperature, all radiation components, ground heat flux),
- Extend the number of reference sites examined and add the periods of EOP-2 through EOP-4.
- Quantify other surface forcing errors in the parent model (e.g., precipitation).

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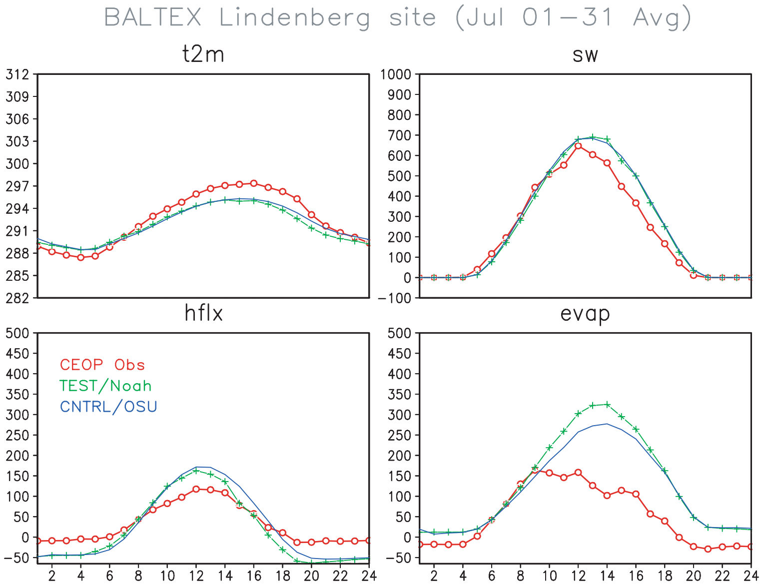

Figure 1. For in situ observations (red with circles) and GFS runs of CNTRL/OSU (blue line) and TEST/Noah (green with crosses), the mean diurnal cycle for 1-31 July 2001 at the BALTEX Lindenberg reference site for 2-m air temperature (K) (top-left), surface solar insolation (W/m^2) (top-right), sensible heat flux (W/m^2) (bottom-left), latent heat flux (W/m^2) (bottom-right). Y-axis range for latent and sensible heat flux differs from that of solar insolation.

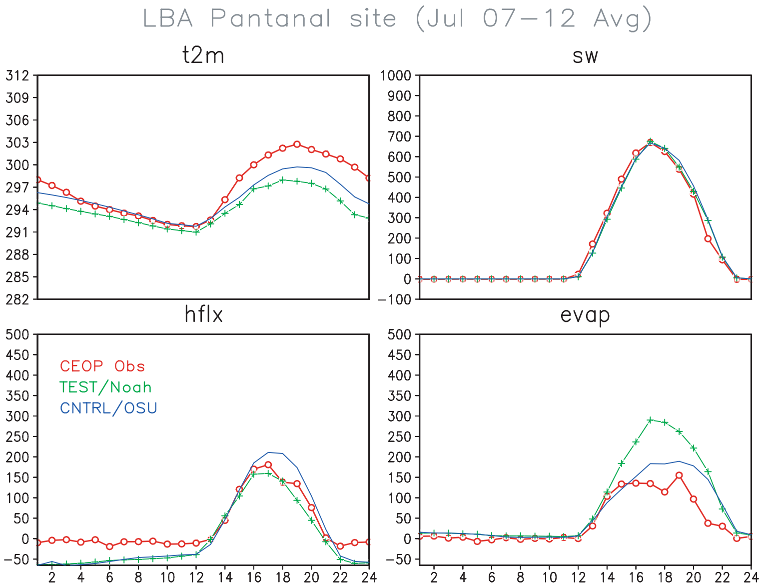

Figure 2. Same as Figure 1, except for 7-12 July 2001 at the LBA Pantanal site.

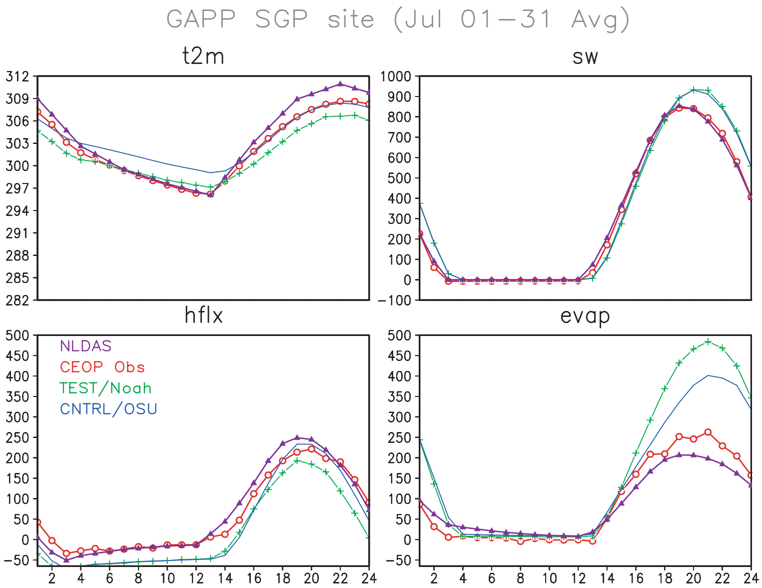

Figure 3. Same as Figure 1, except for the GAPP SGP site and addition of NLDAS time series (purple with triangles).

Mourning Dr. Hajime Nakamura's passing

Toshio Koike, CEOP Lead Scientist and Professor, the University of Tokyo

Dr. Hajime Nakamura, Director of the Numerical Prediction Division at the Japan Meteorological Agency, passed away suddenly on October 18, 2003. Dr Nakamura had led the CEOP Model Output Integration effort and enthusiastically supported other CEOP activities. I am certain that not only CEOP but the world wide numerical prediction and meteorological communities will feel the loss of this important and respected colleague. As the CEOP Lead Scientist and as a personal friend of Dr Hajime Nakamura I wish to express my sincere sorrow at his passing.

Notes from the CEOP Session at the 9th Meeting of the Gewex Hydrometeorology Panel (GHP-9; Luneburg, Germany, September 2003)

Sam Benedict, CEOP International Coordination Function, CA, USA

The CEOP Science Strategy and Direction Overview was provided at the meeting by Drs H. Grassl, CEOP Science Steering Committee Chairman and J.Matsumoto, who was acting on behalf of Dr T. Koike, CEOP Lead Scientist. Dr Matsumoto's presentation included a report on the initial Earth Observation Summit (Washington DC, USA, July 2003) and provided information on the development of the Group on Earth Observations (GEO). The group was informed that Dr T. Koike, was a member of two of the GEO sub-working panels that would assist with the Japanese and overall international contribution to the implementation of the GEO initiative and especially to the planning of the Earth Observation Summit-2 to be held in Japan in May 2004. The participants agreed that the implementation of CEOP and GEWEX/GHP needed to remain complementary to the plans and evolution of these extensive international initiativies.

Dr R. Lawford, reported that CEOP had gained broad recognition as an initial element of the Integrated Global Water Cycle Observations (IGWCO)' theme within the framework of the Integrated Global Observing Strategy Partnership (IGOS-P). See more on this edorsement of CEOP in the Commentary by Dr Gregg Withee in this Newsletter.

Dr S. Williams reported that CEOP Reference Site data/metadata is continuing to be maintained on the Internet at: http://www.joss.ucar.edu/ghp/ceopdm/rsite.html. The success of the initial (EOP-1) CEOP dataset (July to September 2001) was evidenced by several model evaluations based on this data that were presented at the meeting. The initial results are available at: http://monsoon.t.u-tokyo.ac.jp/ceop/model/telecon/ (See also the article in this Newsletter by Drs Mitchell and Lu).

A request for Reference Site Data collected during the CEOP third Enhanced Observing Period (EOP-3) from October 2002 through September 2003 was submitted to the GEWEX Continental Scale Experiments (CSEs) in August 2003. Data began arriving at the CEOP Central Data Archive immediately. An initial "composite" data set (first half of EOP-3) is planned for release in early 2004.

The CEOP Inter-monsoon Model Study (CIMS) concept was endorsed at the meeting. The group welcomed the provisional plans presented by Drs Marengo and Mechoso to hold a targeted CEOP Monsoon Workshop in South America that would be a joint CEOP-CIMS/VAMOS meeting for the North and South American monsoon to be held in September 2004, after the GHP-10 meeting in Montevideo, Uruguay.

Dr J. Roads reaffirmed that progress has been made on CEOP's Water and Energy Simulation and Prediction (WESP) sub-projects related to water and energy budget analyses, transferability studies, and land data assimilation.

Summary of the CEOP Session at AGU 2003 Meeting

J. Roads, CEOP/WESP co-chair, **R. Lawford**, GEWEX Program Manager, **S. Benedict**, CEOP international coordinator

A CEOP session was recently convened at the 2003 fall AGU meeting by J. Roads and R. Lawford. The talks and posters provided an overview of the data and scientific aspects of the CEOP initiative as well as CEOP's links with climate programs. Even while CEOP continues its observational phase, these papers provide early scientific results, using CEOP's initial dataset (EOP1), that show the direction the CEOP Research phase will take.

T. Koike provided an overview of some of the first in-situ data sets and model output being developed for CEOP. The CEOP data will be used to address studies on the inter-comparison and inter-connectivity of the monsoon systems and regional water and energy budgets, and will provide a means for downscaling from the global climate to local water resources. Recent results on the downscaling and the mountain valley circulation were discussed by Koike's research group.

S. Loehrer described the 36 reference site in-situ data sets being archived and quality controlled for CEOP at UCAR's Joint Office for Science Support. These reference sites provide observations of surface meteorology, radiation, fluxes, soils, and atmospheric profiles in a uniform format. B. Burford described the developing integrated data archive being developed at University of Tokyo. There will be a user interface, which will allow users to select the type of data, the location and the time period for the data request. Of special interest was the isotope data being collected over Australia, as described by K. McGuffie. R. Lawford described the many opportunities for creative use of all of the data sets.

J. Roads et al. described the model output being provided by the Scripps Experimental Climate Prediction Center and the National Centers for Environmental Prediction. The model output is being used to diagnose model problems as well as provide beginning descriptions of the processes governing the diurnal cycle of atmospheric and surface water and energy cycles. W. Lau and J. Matsumoto described beginning studies associated with the CEOP Inter-Monsoon Study (CIMS) which is a major initiative under CEOP to engage the modeling and the observational communities to join in a coordinated effort to use CEOP data to better understand the monsoons in various regions of the world.

Calendar of CEOP Meetings:

- **The 3rd CEOP Implementation Planning Meeting:** *Irvine, California, USA 10-12 March 2004*
- **CEOP and Asian Monsoon Systems Session, Joint AOGS 1st Annual Meeting & APHW 2nd Conference:** *Singapore, Singapore, 5-9 July 2004*

Accident on Earth Observation Operation of Midori-II

From Press Release by Japan Aerospace Exploration Agency (JAXA) on October 31, 2003

The Japan Aerospace Exploration Agency (JAXA) has been investigating the possibility of recovering the observations of Midori-II (also called ADEOS-II) after an anomaly was detected in the satellite on October 25th, 2003. JAXA has been continually trying to send the satellite commands to restore its functions, and analyze its current status. However, as a result of investigation, analysis, and inability to re-establish any communications with the satellite, JAXA found today that the possibility of restoring the operations of Midori-II is extremely remote.

Water and CO_2 Exchange at the Mt. Bigelow Reference Site

Constance Brown-Mitic, W. James Shuttleworth, Eleanor Burke, Jonathan Petti, and Soroosh Sorooshian. SAHRA, Dept. of Hydrology and Water Resources, University of Arizona, Tucson, AZ, U.S.A.

The Mt Bigelow reference site is located at 2583 m a.s.l. in the Santa Catalina Mountains NE of Tucson, Arizona, U.S.A., Latitude 32º 25' 00" N and Longitude 110º 43' 31" W in a Douglas fir/Pine mixed forest. The fetch for the tower includes the mature forest cover as well as some areas that were recently burnt. There was minimal effect from the 2002 Bullock forest fire but the 2003 Aspen fire resulted in some tree removal within a 1km radius. The tower site and its footprint area are in the only unburned pine/fir forest along the Catalina ridge line.

Air temperature rarely exceeds 32º and the soil moisture clearly indicates the ecosystem's pronounced annual wet-dry cycle (Figure 1). Energy closure for this complex ecosystem is very good with daytime recovery, approaching 100%. The energy and CO_2 fluxes illustrate the pre/post monsoon and winter characteristics (Figure 2). During the pre-monsoon season when essentially all the winter precipitation had been evaporated and the soil was extremely dry, the trees essentially closed down. Daytime CO_2 uptake was very low, latent heat flux remained close to zero all day with daytime vpd greater than 2 kPa. Soon after the monsoon, the daytime Bowen ratio fell to about 0.3, while the net CO_2 uptake remained significant, as it did throughout the winter months. These are some of the unique eco-hydro-micrometeorological behavior of semi arid ecosystem (Brown-Mitic et al 2004), which have the potential to significantly impact the dynamics of the annual carbon and water cycles. Figure 3 shows the 32-day running mean for the fraction of photosynthetically active radiation (FPAR) obtained from TERRA-MODIS for 2002. It detects the pronounced response of the vegetation to water availability and is expected to prove useful not only in diagnosing drought stress but also for improving estimates of ET and net ecosystem exchange.

References

Brown-Mitic C, Shuttleworth W.J., Harlow C., Petti J., Burke E., Bales R. (2004): Water, Heat, and CO_2 Exchange for a Sky Island, Subalpine Forest In Southwestern U.S., J. Agri. and Forest Meteorol. (Submitted).

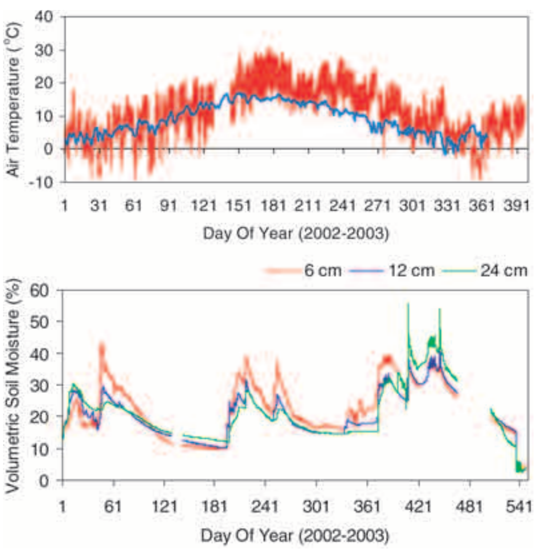

Figure 1. Air Temp. and soil moisture in the vicinity of the tower

Acknowledgement

Primary funding: NSF STC SAHRA under Agreement EAR-9876800. Additional funding: NOAA project NA16GP2002.

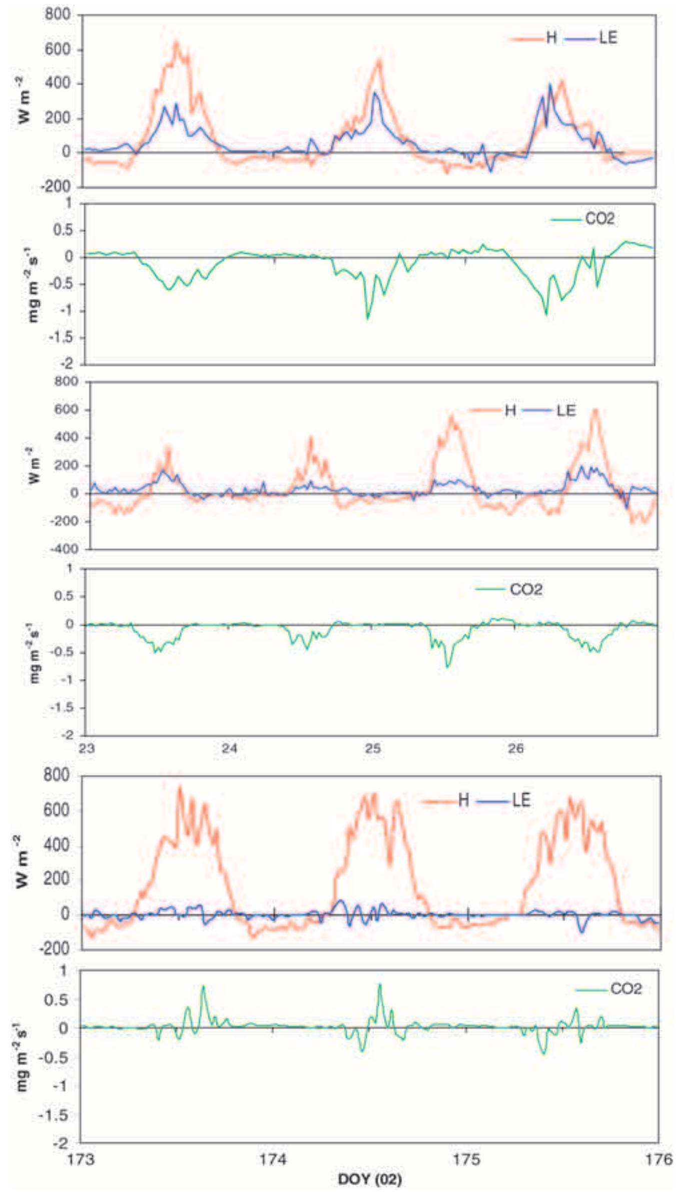

Figure 2. Pre-monsoon, post-monsoon & winter fluxes.

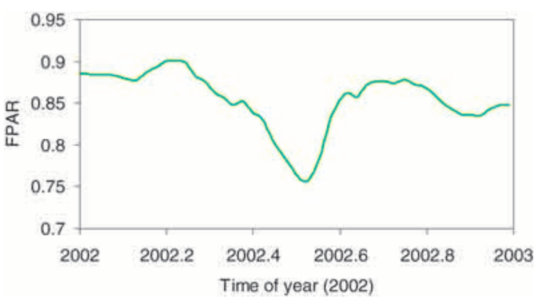

Figure 3. FPAR from MODIS on TERRA for the tower site

Contact Address of International Coordination Body:

Sam BENEDICT (International Coordinator)
742 "H" Avenue
Coronado, CA, 92118, USA
Phone: +1-619-437-7904 Fax: +1-619-437-6814
E-mail: seb@www.wmo.ch

Dawen YANG (Secretary General), Akiko GODA, Katsunori TAMAGAWA
Department of Civil Engineering, University of Tokyo
7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8656, Japan
Phone: +81-3-5841-6132 Fax: +81-3-5841-6130
E-mail: ceop@monsoon.t.u-tokyo.ac.jp

Supported by: Japan Aerospace Exploration Agency (JAXA), Japan Science and Technology Agency (JST)