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. 6

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CEOP Web Site: http://www.ceop.net

CEOP-on the Way to Successfully Developing Water and Energy–Cycle Simulation and Prediction

Xu Guanhua, Chairman of CEOS, Minister of the ministry of science and technology of China

Mr. Xu Guanhua

As the age of water, the 21st century must focus on the water cycle, which has constantly increased its impact on human activities and the world's sustainable development. To achieve a more accurate determination of the water cycle in association with climate variability and change, as well as to provide the baseline data on the impact of this variability on water resources, the Coordinated Enhanced Observing Period (CEOP) was launched on July 1, 2001. Initiated by the international efforts of WCRP's GEWEX, CEOP is focused on measuring, understanding and modelling of the water and energy cycles within the climate system. CEOP will enable us to address such crucial issues through a 'hands-on', examination of the water cycle over a particular time period. After three year's excellent work, now CEOP is at the end of the planned two annual cycle periods, from 2002 to 2004.

As you all know, in the past 20 years, the Committee on Earth Observation Satellites (CEOS) has made great contribution to international co-ordination in global earth observation activities. CEOS agencies are providing their best efforts to contribute to CEOP and, in particular, to assist with CEOP satellite data integration and data collection at worldwide reference sites. Also, through the Working Group on Information Systems and Services (WGISS), CEOS agencies are providing key satellite products in the coming year. As the 2004 chairman of CEOS, the co-chair of IGOS-P, and the Minister of Science and Technology, P.R. China, as well as a researcher in Remote Sensing, I will do my utmost to perform my duty of continually pursuing the international community on the common priorities, such as, the Water Cycle Theme, one of the themes of IGOS-P, and Module-2 within the WSSD follow-up program, and the water resources management approach approved by the members of CEOS and IGOS-P. I hope that with the long-standing and extensive support of countries and organizations across the world, CEOS and IGOS-P will play their role in a more effective manner by having a close association with all the related international organizations including CEOP.

In the last 6 months, we have witnessed the rapid development of coordination of observing networks by the international Earth Observation community. In the Earth Observation Summit-2 meeting in Tokyo on April 25th 2004, the 10-year Implementation Plan for a comprehensive, coordinated, and sustained Earth observation system or systems has been approved and the Implementation Planning Task Team (IPTT) is drafting the document for the GEOSS. This is a milestone of the international cooperation of the Earth Observing community. "Improving global water-resource management and understanding of the water cycle" is recognized as one of the most important societal issues with many potential benefits by the Subgroup on User Requirements and Outreach under the ad hoc Group on Earth Observations (GEO). Dr. Toshio Koike, a member of the IPTT and CEOP Lead Scientist, is making great contributions to the implementation planning for the GEO initiative. During the just closed meeting of the IGOS Partners in Rome in May, the Water Cycle Theme presented its splendid report. As the first element of the integrated Global Water Cycle Observations (IGWCO), confirmed at the 8th meeting of IGOS-P in November 2001, CEOP played a very important role. An emerging theme of IGOS-P, the Cryosphere theme, which is an important element of CEOP, was also approved to begin its building phase. ESA has launched its "Tiger" project in Africa and "Dragon" project in China. The first one is to support Africa in managing water resources using Earth Observing technology, and the second one is a cooperation framework with China, which includes emphasis on water resources, floods, droughts and ocean observations.

We will continue to push forward CEOS and IGOS-P efforts in the global comprehensive earth observation system, which includes the close linkage to the water cycle and water resources highlighted by CEOP as well. At present, CEOS and IGOS-P are making efforts to promote the establishment of a regional cooperation mechanism with countries and UN agencies concerned so as to implement in developing data products and services, and provide direct and quality services for society, especially those of developing countries. I believe that with strong support from CEOS and CEOP, the cooperation activities will be promoted and more common interest and progress will be developed.

Contents:

First CEOP Model Output Workshop and Third Implementation Planning Meeting 8-12 March 2004 University of Irvine

Sam Benedict, CEOP International Coordination Function, CA, USA

Over 60 participants from the international climate and water cycle modeling and research community attended the Coordinated Enhanced Observing Period (CEOP) Model Output Development and Analysis Workshop (8-9 March) and Third Implementation Planning Meeting (10-12 March). Both events were supported by the recently formed Japanese Aerospace Exploration Agency (JAXA) and by the USA National Aeronautics and Space Administration (NASA) and National Oceanic & Atmospheric Administration (NOAA). The meetings were hosted by the the Department of Earth System Science and the Department of Civil and Environmental Engineering at the University of California, Irvine.

All of the participants at the Workshop agreed that the priority activities for the Model Output Component of CEOP are related to having all the contributing centers take the following actions by the end of 2004: (i) Achieve routine transfer of CEOP model output data by electronic means for placement in the CEOP Database, (ii) Access CEOP Model Output Database through the web-page at: http://www.mad.zmaw.de/CEOP or through the CEOP Data Management Internet Page, Model Output and Information section, and (iii) Access CEOP data sets, including in situ, model and satellite and use them in model intercomparison/validation exercises to improve model parameterizations and predictability.

CEOP has been selected as the first element of the Integrated Global Water Cycle Observations (IGWCO) theme within the framework of the International Global Observing Strategy-Partnership (IGOS-P), thus linking it to the broad association of international organizations, which make up the Committee on Earth Observation Satellites (CEOS). The CEOP Science Steering Committee (SSC) chaired by Dr Hartmut Grassl, Director of the Max Planck Institute for Meteorology (MPIM), noted that the implications of this commitment to the IGWCO, require the following actions: (i) Identify representatives from within the CEOP organization/community to serve as a subcommittee to the IGWCO science committee. (ii) Arrange for a written report to be prepared on its activities that can be presented at a future IGOS meeting in 2005. (iii) Coordinate the development of a plan that defines CEOP activities beyond the completion of its initial observational phase at the end of 2004 to be integrated with the IGWCO implementation plan. A preliminary version of the CEOP extended activites plan will be available in June 2004.

The Space Agency Representatives at the meeting, which included Dr. Naoto Matsuura of JAXA, Dr. J. Kaye, Director of the Research Division, NASA, and Co-Chair of the CEOP Advisory and Oversight Committee (AOC), and Dr. M. Colton, Director of Research and Applications, NOAA, National Environmental Satellite, Data, and Information Service (NESDIS), and member of the CEOP AOC; reported on the issues and concerns they have with respect to the CEOP implementation process and their commitments to the CEOP infrastructure. Earlier meetings with European Space Agency (ESA) representatives have also resulted in important commitments to assist CEOP in its quest for specialized satellite data sets. These agreements are an important initial step in the development of a formal framework within which CEOP Satellite Data Requirements will be recognized and responded to by the international community. All of the participants jointly acknowledged the importance of CEOP's role in increasing the focus on the important topic of water resources applications. Many aspects of CEOP parallel activities within the international community related to building new global descriptions of the Earth's environment and upgrading model representations on which to base predictions and improve descriptions of key local and regional processes. The global products and data sets derived through the exploitation of new satellite sensors, in CEOP, will be critical to these developments and will extend our current knowledge. The most important task levied on the CEOP Organization by the participants was to develop a strategy to continue the work being carried out within the International framework built up in CEOP beyond the current CEOP observational phase.

The Fourth CEOP International Implementation Planning meeting is planned for 28 Feburary to 4 March 2005 at the University of Tokyo (UT), Tokyo, Japan, possibly in conjunction with an IGOS-P meeting.

Calendar of CEOP Meetings:

- **Tenth Session of the GEWEX Hydrometeorology Panel (GHP)**
  13-16 September 2004, Montevideo, Uruguay
- **CEOP Inter-Monsoon Model Study (CIMS) Americas Monsoon Workshop**
  17-18 September 2004, Montevideo, Uruguay
  http://ecpc.ucsd.edu/projects/ghp/ghp10/index.html
- **The Fourth CEOP International Implementation Planning Meeting jointly with IGOS-P, IGWCO**
  28 February - 4 March 2005, Tokyo, Japan

A Validation Study of a New Land Surface Scheme - with the CEOP EOP-1 Reference Site Data Set

Masayuki Hirai and **Takayuki Matsumura**, Japan Meteorological Agency, Tokyo, Japan

1. Introduction

JMA plans to upgrade a current SiB (Simple Biosphere) model in the operational Global Spectral Model (JMA-GSM) and thus has been developing a new SiB model. In this article, results from a validation study of the new SiB model coupled with JMA-GSM against the operational SiB are reported. The CEOP EOP-1 (from July 2001 to September 2001) in-situ data is used as a reference. The CEOP integrated database is of great benefit for evaluating the performance of an NWP model.

2. Outline of the operational SiB and the new SiB models

Figure 1 schematically illustrates the processes related to the energy balance considered in the operational and the new SiB models. In the new SiB, the snow and soil processes are designed more elaborately than those in the operational SiB. Major changes from the operational SiB to the new SiB are as follows:

- A conventional force restore method for predicting soil temperature is abandoned and heat conduction among multiple soil layers is explicitly calculated.
- Multiple snow layers are introduced.
- Phase change of water is considered in both soil and snow layers.
- Sophisticated snow processes are introduced such as aging of albedo, temporal change of density and so on.

3. Evaluation method

120-hour forecast experiments from several initial conditions in EOP-1 are executed. Initial conditions of the land surface variables for the new SiB model are set basically in the same way as in the operational global analysis, except that the initial temperature of the soil layers are interpolated from the operational analysis of the surface temperature and the deep soil temperature.

Predicted variables are compared with observations at respective CEOP reference sites. The reference sites presented here are listed in Table 1.

4. Results

Figure 2 shows the time series of the forecast and the observation at BALTEX Cabauw in the Netherlands, MAGS BERMS in Canada and GAME Eastern Siberian Taiga (Yakutsk) in Russia, respectively. The initial time of the forecast is 12UTC 1 July 2001. The observational data at MAGS BERMS, which consists of three observing stations (Aspen, Black Spruce, Jack Pine), are used after averaging the data at three constituent stations.

For each sites, short wave radiation is well predicted by both SiB models for the clear weather. However, incoming long wave radiation at each site is underestimated, which reveals a systematic error in the cloud and/or radiation schemes of JMA-GSM.

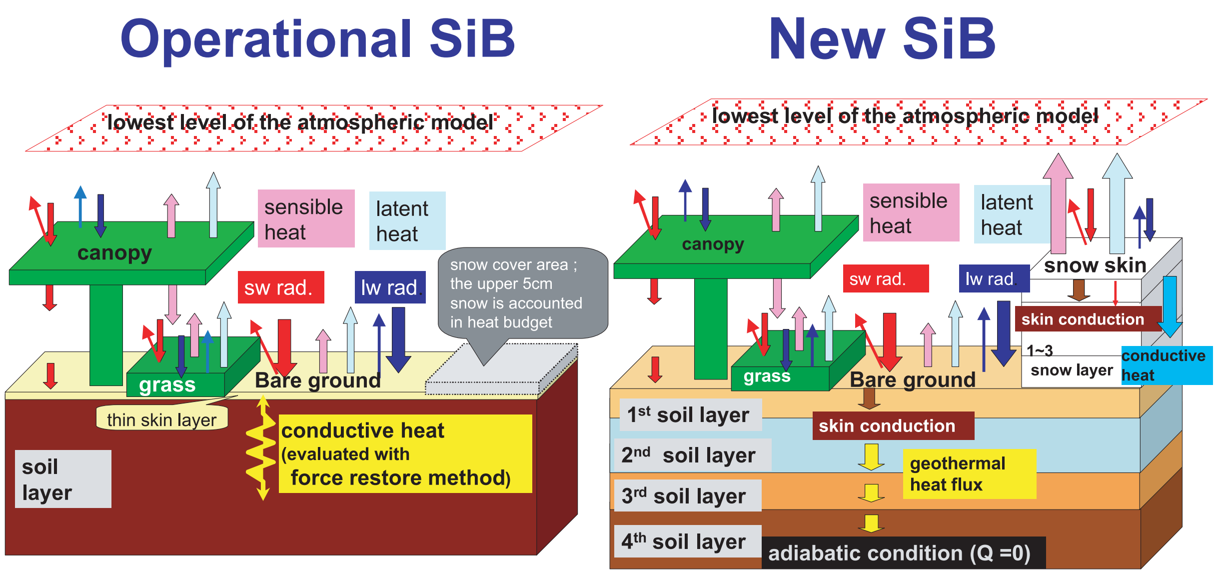


Figure 1. Schematic illustrations of the processes related to energy balance considered in the operational SiB (left) and the new SiB (right).

Table 1. Properties of the reference sites illustrated in Figure 2.

Site Name	GEWEX CSE (Continental Scale Experiment)	Elevation [m] (actual/model)	Model Vegetation Type	Model Vegetation Coverage in July (canopy/glass)
Cabauw (The Netherlands)	BA LTEX (Baltic Sea Experiment)	-1/-10	savanna	0.30 / 0.83
BERMS (Canada)	MAGS (Mackenzie GEWEX Study)	601/539 (Aspen) 629/527 (Black Spruce) 579/465 (Jack Pine)	taiga (evergreen)	0.75 / 0.00
Yakutsk (Russia)	CAMP (CEOP Asia-Australia Monsoon Project)	220/186	taiga (deciduous)	0.50 / 0.00

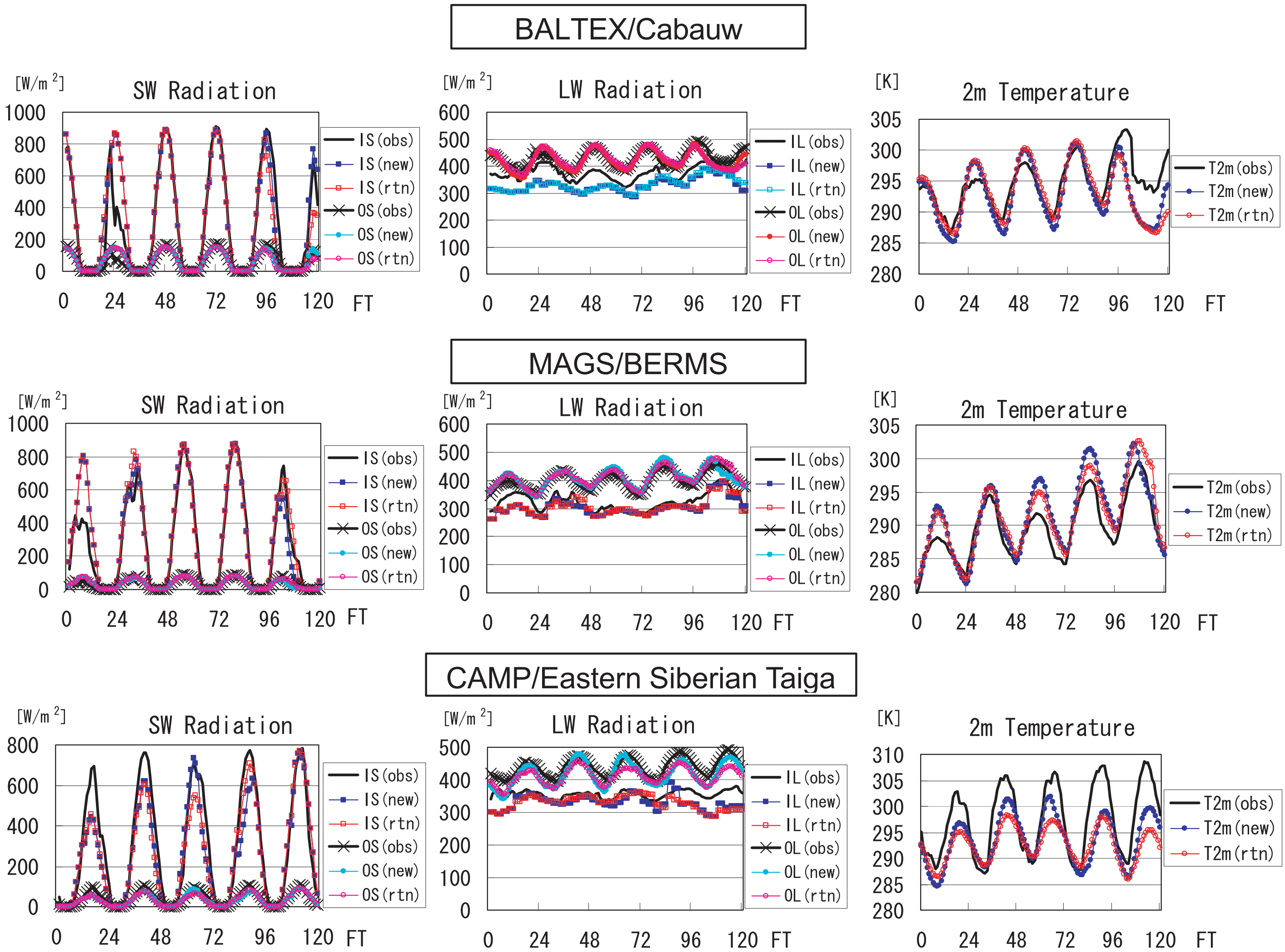
Diurnal ranges of surface and 2m temperatures predicted by the new SiB are generally larger than the operational one. For Yakutsk sites, the new SiB predicts the diurnal range of 2m temperature more properly, though the forecasts of the new SiB for Cabauw and BERMS are rather overestimated. Especially, the improvement in the surface temperature forecasts by the new SiB at Yakutsk is remarkable. According to the observations at Yakutsk, soil temperature deeper than 60 cm is below the freezing point, suggesting a formation of frozen soil. Since the multiple soil layers are introduced and phase change of soil water and ice are calculated explicitly in the new SiB, the accuracy of near surface temperature in frozen soil areas is improved by using the new SiB.

As regard to the diurnal variation, the daily maximum and minimum temperatures from both SiB models occur about 1 hour later than observations for many cases.

5. Summary

A validation study of the new SiB model coupled with JMA-GSM against the operational SiB is carried out. The CEOP EOP-1 in-situ data is used as a reference. It is found that the diurnal range of near surface temperature is predicted adequately by the new SiB in comparison with the operational one. In particular, the accuracy of near surface temperature in frozen soil areas is improved by using the new SiB. However, simulation of diurnal variations is not sufficient in terms of phase. An underestimation of incoming long wave radiation is revealed. It suggests that there is a systematic error in the atmospheric model.

CEOP integrates a huge volume of observation results from various reference sites with a common format and easy access for users, which afford a unique opportunity for a validation study of a land surface model. Some CEOP reference sites consist of more than one observing stations. Such a site has an advantage of bring-



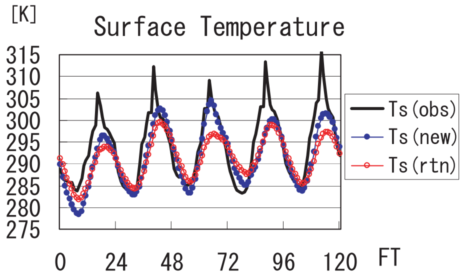


Figure 2. Time series of the observations at the reference site listed in Table 1 (black) and the forecast produced by the operational SiB (red, purple) and the new SiB (blue, pale). The time series for short wave radiation (left), long wave radiation (middle), 2m temperature (right) are illustrated. For Yakutsk sites, the time series for surface temperature is also illustrated. IS(L), OS(L) denotes incoming short (long) wave radiation, outgoing short (long) wave radiation respectively.

ing the representativeness or heterogeneity of observations into consideration. By making use of the CEOP integrated database, we plan to evaluate further both the operational SiB and the new SiB with the CEOP annual cycle data sets and to assess the other physical processes of the atmospheric model, such as a boundary layer process and cloud radiation process.

Acknowledgement

The authors gratefully acknowledge the contributions and efforts of the National Center for Atmospheric Research (NCAR) in elaborating the CEOP integrated database. We also express sincere appreciations to site managers of Cabauw/BALTEX, BERMS/MAGS and Yakutsk/CAMP. The reference site data is highly valuable for evaluation of the JMA global model.

EOP-3 (October 2002 – September 2003) Annual Cycle Reference Site Data Now Available From Four CEOP Reference Sites

Steve Williams and **Scot Loehrer**, UCAR Joint Office for Science Support (JOSS), Boulder, Colorado, USA

Enhanced observations of sub-surface (soil profiles), surface (standard meteorological and radiation), near surface (flux and tower), atmospheric soundings (rawinsonde and profiler), and ancillary (radar and special observations) are fundamentally necessary for CEOP to achieve its main scientific objectives. There are 36 designated CEOP Reference Sites (see http://www.joss.ucar.edu/ghp/ceopdm/ref_site.html) that provide CEOP with these basic resources. Data from 18 of these sites were provided for an initial (EOP-1) CEOP, seasonal (July-September 2001) data set. JOSS developed a prototype "composite" EOP-1 data set by converting these data to a common format and applied a final quality control review prior to release of the data. This prototype "composite" data set was delivered to the CEOP Scientific Community in February 2003. Following its successful application in a number of model analyses, it was evaluated during the CEOP Reference Site Manager's Workshop and the 2nd Implementation Planning Meeting (Berlin, Germany) in March 2003. From these meetings, a series of improvements were agreed upon for future CEOP Reference Site data submissions of CEOP annual cycle EOPs data sets (see report at: http://www.joss.ucar.edu/ghp/ceopdm/refdata_report/).

In addition to the data itself, JOSS also maintains a complete Reference Site documentation database from each of the Reference Sites (http://www.joss.ucar.edu/ghp/ceopdm/rsite.html) which includes (but is not limited to) web site links, location information (latitude, longitude, elevation), maps, photos, land characterization, canopy height, and measurements (parameters, frequency, instrumentation, specifications, and exposure).

Initial EOP-3 data (October 2002 through September 2003) were received at JOSS starting in October 2003. Since that time, as data have been received, JOSS has inventoried the data/documentation, applied automated and manual quality control and consistency checks, and performed visual inspection of data and time series plots. Issues or problems identified in the data are being communicated back to the respective data sources for resolution after which the data are merged and provided on-line. JOSS maintains a configuration management database containing data set status, detailed notes, and site statistics to track the evolution of the data sets.

As of 8 July 2004, 4 sites have provided the complete EOP-3 data set (full annual cycle) that meet all the criteria established by the CEOP Data Management Working Group. These data are now available for continuation of the analyses, at an annual cycle time scale, that were accomplished, up to now, only on a seasonal basis with the EOP-1 data set. These 4 full annual cycle data sets and partial year (EOP-3) data from 11 other sites, that has met all CEOP requirements, are provided through the CEOP Data Management web pages or directly through a dynamic access table at: http://www.joss.ucar.edu/ghp/ceopdm/archive/eop3_data/ . The sites providing these data have been commended for meeting their commitments to CEOP in as timely a manner as possible.

The difficulty in achieving the near routine reference site data collection and submittal process envisaged at the start of CEOP, has been made exceedingly clear, however, since as of this time, although some data from the EOP-3 time period have been received from 28 of the total 36 CEOP Reference Sites only data from the 15 sites (as noted above), have been finalized and made available. Problems have been identified in the remaining 13 sites ranging from complicated formatting and quality control issues, to less difficult incomplete data/documentation submission items. These issues are currently being evaluated by the respective data sources. Because the CEOP reference sites were selected to take advantage of the six most comprehensive Global Energy and Water Cycle Experiment (GEWEX), Continental-Scale Experiments (CSEs) namely, GAPP (Americas Region), BALTEX (Baltic Sea region), MAGS (Canadian Mackenzie River Basin), LBA (Amazon region), CAMP (Asian monsoon region) and AMMA (West African Region), the CSE spokespersons, including Drs Huang/Williams, Grassl/Isemer, Goodison/Mackay, Marengo/Horta, Koike, and Depraetere, respectively, or their representatives, have been asked to undertake an action to assist with the resolution of the remaining issues associated with the EOP-3 data submissions.

A complete summary of available data is provided in Table 1. Data from each Reference Site are organized by separate files of surface meteorological and radiation, flux, soil temperature and moisture profiles, tower, and other ancillary data sets (e.g. rawinsonde, profiler, etc.). Available documentation is provided with the data. Please contact Steve Williams at sfw@ucar.edu. for additional information or for data inquiries.

Table 1: CEOP Reference Site Data Summary (X = 1st half EOP-3; XX = full year EOP-3)

CSE	Reference Site	CEOP IN-SITU DATA SET TYPES				
		Surface Meteorology and Radiation	Soil Temperature and Moisture	Flux	Meteorological Tower	Soundings
BALTEX	Cabauw	X	X	X	X	X
BALTEX	Lindenberg	XX	XX	X	XX	
CAMP	Equatorial Island	X				X
CAMP	Himalayas	X	X	X		
CAMP	Mongolia	X	X	X		
CAMP	Northern South China Sea - Southern Japan					X
CAMP	Siberia Tundra	X	X	X	X	
CAMP	Tibet	X	X	X		
GAPP	Bondville	X	X	X		XX
GAPP	Ft. Peck	X	X	X		XX
GAPP	Mt. Bigelow					XX
GAPP	Oak Ridge	X	X	X		XX
GAPP	SGP	XX	XX	XX	XX	XX
ARM	NSA	XX			XX	XX
ARM	TWP	XX				XX

A note on the use of CEOP reference site data for comparison with the output of global models: The Lindenberg example

F. Beyrich and **W. Adam**, Meteorological Observatory Lindenberg, German Meteorological Service, Germany

The Meteorological Observatory Lindenberg (MOL) of the German Meteorological Service (Deutscher Wetterdienst, DWD) is one of the four European (BALTEX) reference sites providing data to the Central Data Archive (CDA) in CEOP. Data from Lindenberg have already been used by various modelling groups (e.g., Tamagawa et al., *CEOP-Newsletter* 4, p. 4, Lu and Mitchell, *CEOP-Newsletter* 5, p. 5-6). With this note we would like to draw the attention of current and potential users of data from Lindenberg (and most likely other reference sites as well) within CEOP at an issue that might not have found proper attention yet - namely the heterogeneity of terrain.

The topography around Lindenberg has been formed by the inland glaciers during the last ice age and exhibits a slightly undulating surface with height differences between about 40 m and 130 m above sea level. The land use (see Figure 1) is dominated by a mixture of forest (43 %) and agricultural farmland (45 %) with a number of small and medium-sized lakes embedded (7 %). This type of heterogeneous landscape is rather typical for large parts of northern Central Europe south of the Baltic Sea.

To study land-surface atmosphere interaction processes under heterogeneous terrain conditions is one of the major research activities of the MOL. In addition to the operational boundary layer measurement program at the GM Falkenberg, micrometeorological measurements have been performed both at a forest and at a lake site during the last 4 years. Moreover, major field experiments have been organised in 1998 (Beyrich et al., *Theor. Appl. Climatol.* 73 (2003), 3-18) and in 2003 (Beyrich et al., AMS: Proc. 16th Symposium on

Figure 1. Aerial View across the heterogeneous landscape around Lindenberg (with GM Falkenberg indicated by an arrow)

Boundary Layer and Turbulence, 2004), for detailed studies of land surface and boundary layer processes.

The terrain heterogeneity is a fact the user of the CEOP data from Lindenberg should be aware of when performing validation studies against model output or satellite data. It is obvious, that the two major land use classes - forest and agricultural farmland - behave different with respect to surface - atmosphere exchange processes. This is illustrated in Figure 2 showing the averaged diurnal cycle of the mean (2 m) air temperature, net radiation and sensible heat fluxes during two months of CEOP EOP-1 and EOP3, respectively. Monthly mean air temperature may differ by about 1 K which is mainly due to the topography. Differences in net radiation during daytime amount up to about 25 %, and the differences in the sensible heat flux are even more pronounced (up to about a factor of 2, or 100 %). The Lindenberg data for CEOP available via the CDA so far include the near surface measurements carried out at GM Falkenberg, representing the farmland (low vegetation) part of the area, and hence only "half of the truth". When comparing model output against our measurements, the user should be aware of what type of land use his model assumes for the Lindenberg grid cell. This may be highly dependent on grid size, actual position of the grid cell, global land use data set used in the model, and on the scheme applied to describe land surface characteristics (dominant land use, tile / mosaic approach etc.). Data from the forest site (representing "the second half of the truth") will be made available upon request.

We believe, that heterogeneity effects are comparably important also at other CEOP reference sites, taking into account the typical grid cell size of global NWP and climate models being in the order of $10^3..10^4$ km^2.

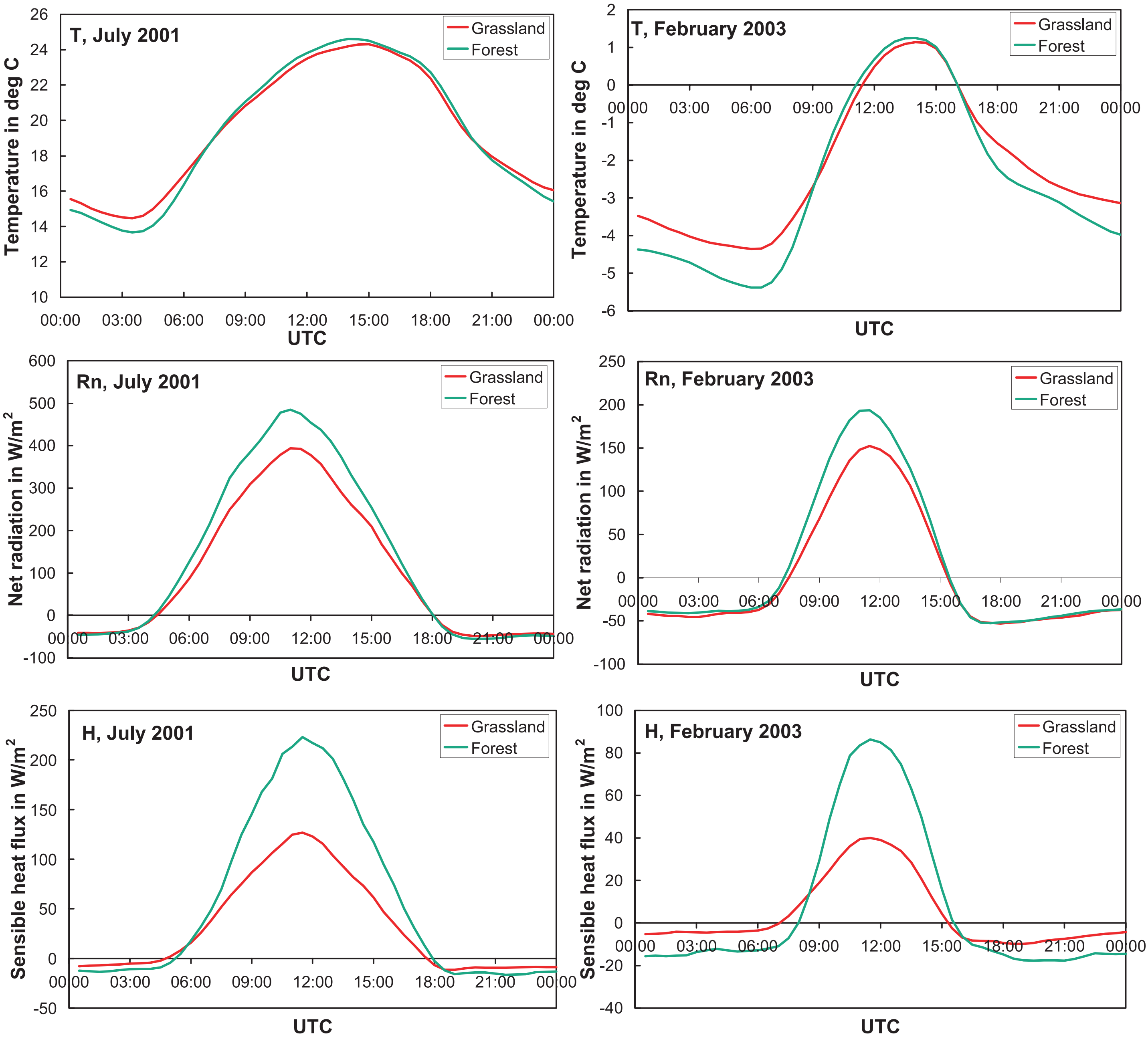


Figure 2. Mean diurnal cycle of air temperature, net radiation and sensible heat flux during July, 2001 and February, 2003 at GM Falkenberg and at a forest site nearby.

Report from CEOP Asian Monsoon Project (CAMP) Reference Sites

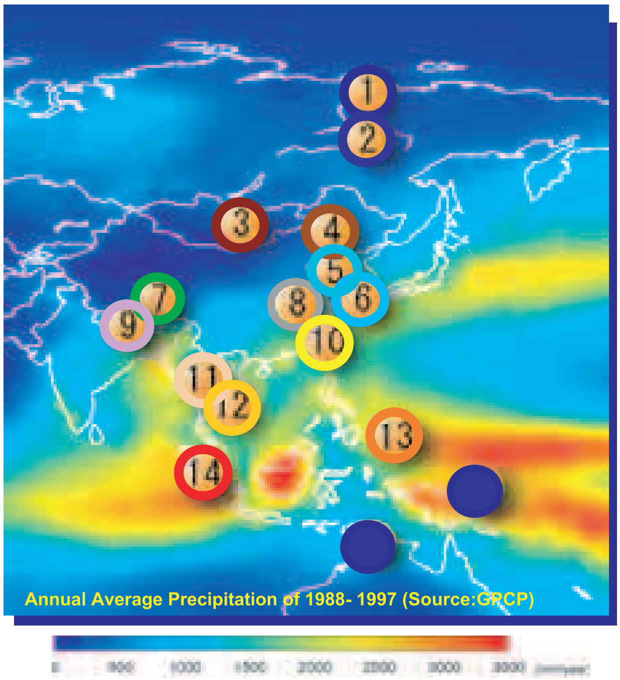
Katsunori Tamagawa and **Toshio Koike**, CAMP Data Centre, University of Tokyo, Japan

The CEOP Asian Monsoon Project (CAMP) has 14 different reference sites (See Figure 1) in the Asian region, which will greatly contribute to the CEOP project. This project covers the whole Asian Monsoon area with diverse climates from Tundra, Tropical and high altitude zones.

Each reference site is supported by individual funding, but all sites are coordinated under the CAMP project. Currently the Surface and Sub-surface observations are carried out in each reference site. Some sites include also Upper-Air observation with Doppler radar, Wind profiler and Radio sonde.

The Figure 2 shows the monthly averaged temperature during the first-half of EOP-3 (October 2002 to March 2003). The temperature differs by 70ºC between Eastern Siberian Taiga and Western Pacific Ocean in December 2002.

The CAMP data centre manages the Quality control of the field-observed data and re-format the raw data into a unified format for the CEOP Data Archiving Centre in the UCAR.



No.	Reference Site Name	Site Representative.
1	*Eastern Siberian Tundra*	*T.Ohata, H.Yabuki*
2	*Eastern Siberian Taiga*	*T.Ohata, T.Ohta*
3	*Mongolia*	*Davva.G, I.Kaihotsu*
4*)	*Tongyu (Inner Mongolia)*	*W.Dong, H.Liu*
5	*Korean Peninsula*	*J.Kim*
6	*Korean Haenam*	*J.Kim, C.Cho*
7	*Tibet*	*Y.Ma, K.Ueno, S.Haginoya*
8	*Yangtze River*	*N.Yunqi*
9	*Himalayas*	*G.Tartari, M.Bollasina*
10	*Northern South China Sea - Southern Japan*	*M.Chen*
11	*Chao-Phraya River*	*M.Aoki, J.kim*
12	*North-East Thailand*	*M.Aoki*
13	*Western Pacific Ocean*	*R.Shirooka*
14	*Equatorial Island*	*T.Sribimawati, M.Yamanaka*

* The Inner Mongolia reference site was changed to Tongyu at EOP-3

Figure 1. Location of the CAMP

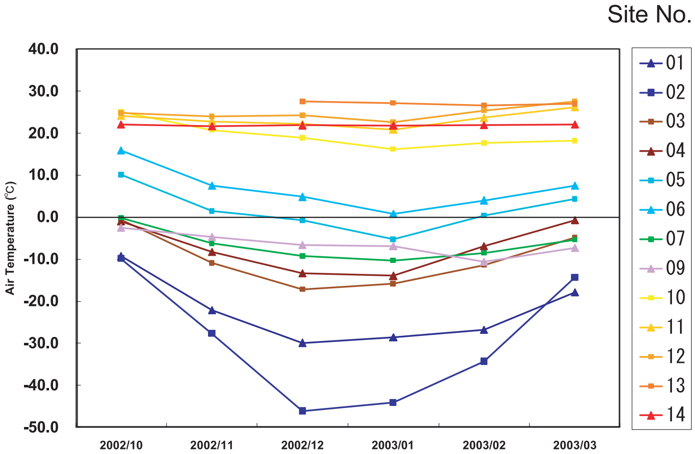


Figure 2. Monthly Averaged Air Temperature

Schedule of CEOP

	2001	2002	2003	2004
The CEOP Preliminary Data Period	1 July	30 September		
The CEOP Buildup phase		1 October	30 September	
The First CEOP Annual Cycle Period			1 October	30 September
The Second CEOP Annual Cycle Period				1 October – 31 December

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