CEOP Annual Enhanced Observing Period Starts

http://www.ceop.net

Toshio Koike
Department of Civil Engineering, the University of Tokyo, Bunkyo-ku, Tokyo, Japan
Phone: +81-3-5841-6106 Fax: +81-3-5841-6106 Email: tkoike@hydra.t.u-tokyo.ac.jp

ABSTRACT

Toward more accurate determination of the water cycle in association with climate variability and change as well as baseline data on the impacts of this variability on water resources, the Coordinated Enhanced Observing Period (CEOP) was launched on July 1, 2001. The preliminary data period, EOP-1, was implemented from July to September in 2001. The first annual enhanced observing period, EOP-3, is going to start on October 1, 2002.

CEOP is seeking to achieve a database of common measurements from both in situ and satellite remote sensing, model output, and four-dimensional data analyses (4DDA; including global and regional reanalyses) for a specified period. In this context, a number of carefully selected reference stations are linked closely with the existing network of observing sites involved in the GEWEX Continental Scale Experiments, which are distributed across the world. The initial step of CEOP is to develop a pilot global hydro-climatological dataset with global consistency under the climate variability that can be used to help validate satellite hydrology products and evaluate, develop and eventually predict water and energy cycle processes in global and regional models. Based on the dataset, we will address the studies on the inter-comparison and inter-connectivity of the monsoon systems and regional water and energy budget, and a path to down-scaling from the global climate to local water resources, as the second step.

Key words: climate, water cycle, satellite, modeling, validation, prediction

1. INTRODUCTION

Water resources management, flood control and water supply (to human activities and ecosystems), is strongly affected by water cycle variations. Sometimes, we suffer very sever floods and droughts, which are caused by anomalous state of the water cycle. The water cycle on local, regional and global scales fluctuates interactively among atmosphere, land and ocean. Even we concern local water resources management, we should understand the regional and global water cycle variation as well as local one and improve their predictability.

However, there is no physically consistent and comprehensive water cycle data set, which covers interactions among phenomena on local, regional, and global scales. By considering the launching schedule of new satellites which are very useful for the global water cycle monitoring, the World Climate Research Programme (WCRP) and the space agencies proposed the Coordinate Enhanced Observing Period (CEOP) Project. We organized many science communities who are implementing field research work on the water cycle all over the world under the framework of the WCRP, Global Energy and Water Cycle Experiment (GEWEX). At this moment, 36 research groups are joining and going to provide the observed data, which covers the global climate variability.

Space agencies have already launched 4 new satellites, TRMM, Terra, ENVISAT, Aqua. One more satellite, ADEOS-II will be launched at the end of this year. By integrating the data to be obtained by those new satellites, we will be able to generate firstever entire water cycle data sets.

In addition, the national and international meteorological bureaus and agencies will provide the special outputs of the numerical weather prediction models to the CEOP. At this moment, US National Center for Environment Prediction (NCEP), NASA Data Assimilation Office(DAO), UK Met Office, Japan Meteorological Administration(JMA), Indian Center for Medium Range Weather Forecast (ICMRWF) are joining the CEOP. They will provide the very high temporal resolution model outputs at each reference site and 2D and 3D regional and global products.

CEOP is an element of WCRP initiated by GEWEX. The requirements of GEWEX, the Climate Variability and Predictability (CLIVAR) initiative, the Climate and Cryosphere (CliC) Project and the other WCRP core

projects as well as the climate research community at large have been taken fully into account in planning the assembly of a co-ordinated data set that will serve numerical modeling and analyses needs. Plans are for CEOP to assist research into the global atmospheric circulation and changes in water resources. CEOP has gained the interest of other international organizations outside of the WCRP community, as evidenced by the proposal for an Integrated Global Water Cycle Observations (IGWCO) theme within the framework of the International Global Observing Strategy Partnership (IGOS-P), which has re-affirmed CEOP as 'the first element of the IGWCO'. IGOS is a component of the Committee on Earth Observation Satellites (CEOS).

The existing projects and sub-activities in CEOP have been grouped under four main scientific and technical thrusts namely Water and Energy Simulation and Prediction, Monsoon Systems, Satellite Data Integration and Data Management.

2. OBJECTIVES

The specific scientific and technical sub-objectives of CEOP are:

- *Water and Energy: To use enhanced observations to better document and simulate water and energy fluxes and reservoirs over land on diurnal to annual temporal scales and to better predict these on temporal scales up to seasonal for water resource applications.*
- *Monsoon Systems: Document the seasonal march of the monsoon systems, assess their physical driving mechanisms, and investigate their possible physical connections.*

1) Water and energy simulation and prediction (WESP)

WESP studies are designed to understand what components of the global water and energy cycles can be measured, simulated, and predicted at regional and global scales? In particular: (1) what are the gaps in our measurements? (2) What are the deficiencies in our models? (3) What is our skill in predicting hydroclimatological water and energy budgets?

Starting from the current GEWEX Hydrology Panel (GHP) efforts to close simplified vertically integrated water and energy budgets with observations and analyses, and beginning efforts to simulate these budgets regionally, CEOP WESP will begin the effort to transfer this knowledge to global scales, include more water and energy cycle processes, and begin to examine the vertical structure in the atmosphere and land. Specific tasks for the WESP working group during CEOP include:

- Summarizing component and coupled system modelling studies currently underway.
- Articulating scientific issues that need to be addressed in light of advances in each CSE.
- Defining guidelines for commonality and standards in the background fields and measure of progress.
- Devising the detailed nature of the experimental periods.

Water and Energy Budget Syntheses (WEBS) activities will be reported on at the upcoming 2002 fall GHP meeting, which will discuss the eventual transition to CEOP. Scientific meetings for the community are being planned as part of upcoming special sessions at the 2003 Spring EGS/AGU and 2003 Summer IUGG meetings. Transferability projects over the Baltic Sea and La Plata River Basin catchments have begun. Global and regional land data assimilation projects have also begun. Initial WESP activities will help to define and analyze in situ reference site data, satellite data, model output location time series (MOLTS), and gridded model output data for the CEOP period. WESP strongly encourages the international research community to begin making plans to cooperate on the development and utilization of the planned CEOP data sets.

2) Monsoon system study

Detailed plans are being developed for the accomplishment of one of the main CEOP aims associated with the documenting of the seasonal march of the monsoon systems, assessing the monsoon systems driving mechanisms, and investigating the possible physical connections between such systems. The result is an initial definition of a CEOP Inter-monsoon Model Validation Project (CIMVP). CIMVP will be an international research project to assess, validate and improve the capabilities of climate models in simulating physical processes in monsoon regions around the world. The objectives are 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, and 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. The aim is to give CIMVP a unique characteristic by placing its focus on model physics improvement, via simulations, and cross-validation of model outputs with detailed observations. The synergistic use of global data, in conjunction with high-resolution space and time observations from field sites is, therefore, critical. For CIMVP, validation data will be derived from CEOP reference sites, which include GEWEX continental scale experiments (CSE) and planned CLIVAR field campaign sites. Numerical experiments will be designed to target the simulation of fundamental physical processes that are likely to uncover limitations in model physics.

2. DATA SRATEGY

Data archiving and integration is very essential in the CEOP. All ground data will be submitted to US University Cooperation for Atmospheric Research (UCAR) and will be archived and transformed to unified formatted data sets. NASA Goddard Space Flight Center will provide a global 4DDA products by combining the observed data and modeling. The satellite data and the other all data will be archived be the efforts of the University of Tokyo and NASDA. Max-Plank Institute, Homburg, Germany, takes an important role as a model out put archiving center. The total amount of data is more than 200 tera byte. We are cooperating with the Information Technology research group to establish a system for archiving, handling and analyzing the obtained data.

1) Reference Site Data

New information concerning the CEOP reference sites continues to be incorporated into the Table of CEOP Site Characteristics at:
http://www.joss.ucar.edu/ghp/ceopdm/rsite.html

In order to stay on schedule with the CEOP Data Management Working Group Major Activities Plan, priority has been given to the collection and formatting of the data available for the CEOP EOP-1 data set (1 July through 30 September 2001). To expedite delivery of the data from the reference sites to the CEOP Central Archive, a CEOP EOP-1 File Transfer Protocol (FTP) Procedure has been implemented. Representatives of the CEOP Reference Sites have all acknowledged their willingness to ensure the data are submitted according to this protocal, which requires a naming convention for the files, that includes the reference site name, start/stop dates, and an identifier related to the data type (e.g. soundings, flux, surface met, tower, soil, etc.). The files identified in this manner are to be transferred to ftp.joss.ucar.edu using an anonymous login and the site representatives email as a password. Each regional experiment can then be specifically recognized by their sign in, which is formatted as: cd pub/incoming/ceop/cse, where "cse" is substituted for the respective experiment name (e.g. BALTEX, LBA, MAGS, GAPP, GAME/CAMP, etc.). It is planned that all EOP-1 data will be transferred in this manner by the end of August 2002 and that the data will be sorted and composited into a CEOP EOP-1 reference site data set by the end of 2002.

2) Satellite and GLDAS Products

To provide satellite data integration products of water cycle including 4DDA "value-added" Global Land Data Assimilation System (GLDAS) datasets, two CEOP Satellite Data Integration Centers (CSDICs) were established, one at the University of Tokyo (UT) under the cooperation with NASDA and the other at NASA's Goddard Space Flight Center (GSFC).

The CSDIC at UT will receive CEOP customized level 1b & level 2 and standard level 3 earth observation satellite data from space agencies and archive them by using a 500 tera-byte data archival system at the Institute of Industrial Sciences of UT. The Committee on Earth Observation Satellite (CEOS) Working Group on Information Systems and Services (WGISS) Test Facility for CEOP (CEOP-WTF) led by NASDA and NASA will be developed for providing catalogue interoperability with CEOS agencies' systems by using CEOS' protocols and exchanging data and information with CEOS agencies and affiliates as well as users through networks. Integrated CEOP satellite products overlaid with in-situ data and model output will be delivered to users by Web Mapping Technology and other visual technologies through networks. UT and NASDA propose a three phased approach for production and archiving of satellite data products; Phase I, started in June, 2002, for the reference sites, Phase II, started in June, 2003, for the monsoonal regions, and Phase III, started in September, 2005, for operational. To support phenomena detection, knowledge discovery and coincident search capabilities across a huge amount of very heterogeneous datasets, "Visual Data Mining"

combined with the artificial intelligence approach in the computer sciences is now being developed as an important function of the CSDIC at UT.

Scientists at GSFC have developed a high-resolution GLDAS in cooperation with researchers at NOAA's National Centers for Environmental Prediction (NCEP). The goal of GLDAS is to produce optimal output fields of land surface states and fluxes by making use of data from advanced observing systems (see GEWEX News May 2002 and http://ldas.gsfc.nasa.gov/ for further details). GLDAS uses various new satellite and ground based observation systems within a land data assimilation framework to produce optimal output fields of land surface states and fluxes. GLDAS includes four components implemented globally at ¼ degree resolution (higher resolutions are planned) in near real time: land modeling, land surface observation, land surface data assimilation and calibration and validation. The core advantage of GLDAS is its use of satellite-derived observations (including precipitation, solar radiation, snow cover, surface temperature, and soil moisture) to realistically constrain the system dynamics. This allows it to avoid the biases that exist in near-surface atmosphere fields produced by atmospheric forecast models, minimize the impact of simplified land parameterizations, and to identify and mitigate errors satellite observations used in data assimilation procedures. These value-added GLDAS data will improve land surface, weather, and climate predictions by providing global fields of land surface energy and moisture stores for initialization.

GLDAS is a valuable tool for CEOP because it assimilates the information from multiple models and observation platforms to provide the best available assessment of the current state of the land surface. In addition, an interface to access data from the near-realtime GLDAS operational model runs is provided through the web site:

http://ldas.gsfc.nasa.gov/map/webout.html

A region can be specified by either manually entering the coordinates in the text boxes or automatically by creating a rectangle on the map. Users can subset the data by time period as well as parameter type. The international GEWEX and CEOP communities have recognized that GLDAS can be leveraged and further developed to address the needs of CEOP. The CSDIC at NASA GSFC is working with the CEOP-GLDAS products in cooperation with NASA Data Assimilation Office (DAO).

3) Model Outputs

The Numerical Weather Prediction Centers (NWPCs) provides; (1) high temporal resolution time-series output at the reference sites; (2) three-dimensional (3D and 2D) gridded output.

The first type of output above is referred to as Model Output Location Time Series or MOLTS. At some numerical weather prediction centers, this type of output is also referred to as "meteograms" and is typically output in the World Meteorological Organization (WMO) format standard known as BUFR. In any case, this type of output refers to model output at individual sites in vertical model columns (including the earth surface and subsurface) at hourly or more frequent intervals. Hence, MOLTS represents the model-output analog of "observing station" time series and such output is needed by researchers for studying local processes.

Equally important, we also request 3D and 2D gridded output processed as synoptic snapshots at a minimum of six hourly intervals (three hourly intervals strongly preferred if possible). At NWP centers, such gridded synoptic snapshots are often output in the WMO format standard known as GRIB. An example of 2D gridded output is earth-surface specific states or fluxes (e.g. snowpack water content), which are not defined throughout the atmospheric or subsurface medium. The 3D gridded output is typically provided as a set of 2D gridded fields spanning the vertical levels.

The NWPCs develop their own archive of this output for the moment. In that regard, given the high temporal resolution of the requested MOLTS output (hourly) it may be better to output the MOLTS during model execution. However, it may be easiest to simply archive the gridded model output and then develop the more user-friendly MOLTS output later. All model output will be sent to Max-Planck Institute, Hamburg, Central Model Output Archive. and be archived and opened to the international community.

REFERENCES

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