U.S. CONTRIBUTIONS TO THE CEOP

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The diverse U.S. involvement in an international effort to develop an integrated global data system for the simulation and prediction of water and energy budgets, monsoons, and river flows reveals many opportunities for readers during its new data analysis phase.

The Coordinated Enhanced Observing Period (CEOP) was proposed by the Global Energy and Water Cycle Experiment (GEWEX) to develop an integrated global dataset for use in addressing issues related to water and energy budget simulations and predictions, monsoon processes, and the prediction of river flows. A two-and-a-half-year period of enhanced observations was initially proposed in 1997 during a GEWEX Hydrometeorology Panel (GHP) meeting, and since that time has been endorsed by the GEWEX Scientific Steering Group (SSG), the Joint Scientific Committee (JSC) of the World Climate Research Programme (WCRP), and the Integrated Global Observing Strategy Partnership (IGOS-P). In particular, CEOP is a central component of the Integrated Global Water Cycle Observations (IGWCO) theme of IGOS-P. IGWCO harnesses the energies and interests of a community of water cycle scientists who plan strategies for expanded use of Earth observations in the water resources sector. The science questions that motivate GEWEX and other WCRP projects in the areas of water and energy budget simulations and predictions and monsoon studies have guided the development of CEOP so that it contributes to the numerical modeling and observational analysis needs of these projects and climate research. CEOP takes advantage of the infrastructure, data systems, and heritage of the mature GEWEX Continental Scale Experiments (CSEs) located in a number of critical regions around the world (Sorooshian et al. 2005; Lawford et al. 2004), and makes maximum use of the datasets being provided by new satellites, including *Terra* and *Aqua*. While many countries have contributed to this global initiative, the leadership for this effort has come primarily from Japan and the United States.

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As outlined by Koike (2004), the guiding goal of CEOP is "to understand and model the influence of continental hydroclimate processes on the predictability of global atmospheric circulation and changes in water resources, with a particular focus on the heat source and sink regions that drive and modify the climate system and anomalies." CEOP has two major phases. During phase I the emphasis was on the development of datasets and tools for addressing scientific problems. The three areas that have been developed during phase I are the reference site data management, satellite data integration, and model output data products and handling. Scientific research has progressed under the guidance of two working groups: one that focuses on water and energy simulation and prediction and the other on intermonsoonal model studies. In both of these areas CEOP has maintained very close ties with its roots in GEWEX. In addition, through its activities in Earth system observations and data management, it has developed links with the Committee on Earth Observation Satellites (CEOS), IGOS-P and its IGWCO theme, and the Group on Earth Observations (GEO).

The following article outlines the contributions of U.S. partners to different components of the CEOP program, including its scientific objectives and observational strategies, and the benefits of this effort for U.S. science. This article is intended to provide the U.S. meteorological and hydrological communities with more information about the program in general, and about U.S. contributions in particular. It also is intended to provide the reader with some background on how he/she can become more actively involved with the program.

BACKGROUND. CEOP is focused on the measurement, understanding, and modeling of water and energy cycles within the climate system. It is motivated by the synchronism of the new generation of Earth observing satellites and the existence of mature GEWEX CSEs. The primary goal of its first phase was to develop a consistent, comprehensive, integrated dataset for 2001–04 to support research objectives in climate prediction and monsoon system studies. GEWEX nurtured the development of CEOP because it could potentially contribute to many of its global initiatives including the Global Soil Wetness Project (GSWP), the International Satellite Land Climatology Project (ISLSCP), the Project for Intercomparison of Land Surface Parameterizations (PILPS), the GEWEX Cloud System Study (GCSS), and the Global Land–Atmosphere System Study (GLASS). CEOP data will also contribute to studies of the global atmospheric circulation and water availability. Detailed implementation planning for CEOP began in 2000 with a workshop at the National Aeronautics and Space Agency (NASA) Goddard Space Flight Center (GSFC) (Bosilovich and Lawford 2002).

CEOP was officially launched at a kickoff meeting in Tokyo, Japan, in March 2001. It has gained commitments from a broad range of international organizations including both IGOS-P and CEOS, which have recognized CEOP as the first element of the IGWCO.

While the initial planning inputs for U.S. involvement came through the GEWEX Americas Prediction Project (GAPP), which is sponsored by the National Oceanic and Atmospheric Administration (NOAA) and NASA, it soon expanded to include other U.S. groups whose interests were broader than those of GAPP. The reference station data were provided by three U.S. agencies including the Department of Energy's (DOE's) Atmospheric Radiation Measurement–Cloud and Radiation Testbed (ARM–CART) site; three sites funded through the NOAA portion of GAPP and managed by NOAA's Air Resources Laboratory; and a site in Arizona that is part of the National Science Foundation (NSF) Science and Technology Center (STC) for the Sustainability of semi-Arid Hydrology and Riparian Areas (SAHRA) at the University of Arizona (Sorooshian et al. 2002). The data management capabilities developed at the University Corporation for Atmospheric Research [UCAR; and most recently at the National Center for Atmospheric Research (NCAR)] in large measure to deal with GAPP data, are now being used to control the quality of, archive, and distribute the datasets from all 35 CEOP reference stations around the world.

SUMMARY AND CONCLUSIONS/ INVITATION. CEOP has completed its first phase and the datasets have either been completed or are nearing completion. Datasets from the buildup phase (see Table 1) have undergone preliminary analyses and the results look promising both in terms of their quality as datasets to be used in modeling and in terms of the information that can be acquired regarding a range of land–atmosphere interactions.

The United States has made major contributions to CEOP through its observational capabilities, modeling expertise, and data services. The U.S. scientific community benefits from access to all of the datasets from other countries, including data from a number of countries that have restrictive data policies. CEOP is progressing well due to NCAR's (formerly UCAR's) processing of the reference site datasets that are being used in process studies and model evaluations. The U.S. CEOP community is encouraging interested scientists to utilize these unique datasets and to assess their value in model and algorithm development and related applications.