GEWEX Hydroclimate Panel:
Coordinated Energy and Water-Cycle Observations Project (CEOP)

Reporting Period: 2008

URL: http://www.ceop.net

Chair(s) and Term Dates: Co-Chairs Drs Toshio Koike and Ron Stewart. 2-year terms beginning in 2007 renewable for additional 2 years and set to coincide with the regular annual CEOP International Planning Meetings that take place in August or September of each year.

Overview

***Objectives*:**
CEOP's goal is **to understand and predict continental to local-scale hydroclimates for hydrologic applications**. To achieve this goal, CEOP's strategic objectives include:

Objective 1: Producing consistent research-quality data sets complete with error descriptions of the Earth's energy budget and water cycle and their variability and trends on interannual to decadal time scales, for use in climate system analysis and model development and evaluation.

Objective 2: Enhancing the understanding of and quantification of the ways in which energy and water cycle processes contribute to climate feedbacks.

Objective 3: Improving the predictive capability of key water and energy cycle variables and feedbacks through improved parameterizations to better represent hydrometeorological processes, and determine the geographical and seasonal characteristics of their predictability over land areas.

Objective 4: Undertaking joint activities with operational hydrometeorological services, related Earth System Science Partnership Program (ESSP) projects like the Global Water System Project (GWSP) and hydrological research programs to demonstrate the value of GEWEX research, data sets and tools for assessing the consequences of climate predictions and global change for water resources

Some technical issues that are being addressed as part of the CEOP objectives are:

1. Applying an integrated hydroclimate data set to address a variety of scientific topics, which must be advanced in order for the Project to meet its objectives.

2. Developing the capability to handle and disseminate a large amount of data from diverse sources.

3. Analyzing and comparing with model simulations diverse data to understand the underlying mechanisms and model deficiencies.

4. Assimilating and integrating data with newly-developed models.

5. Transferring CEOP methodologies to other regions, sectors and applications.

Status:

- The CEOP community began working as a unified research group following the merger of the Coordinated Enhanced Observing Period with the GEWEX Hydrometeorology Panel (GHP), which was endorsed by the GEWEX Scientific Steering Group (SSG) in early 2007. The first Coordinated Energy and water-cycle Observations Project (CEOP) Annual Meeting was subsequently held in September 2007, in Bali, Indonesia. In September of 2008, CEOP held its second Annual Meeting in Geneva, Switzerland.

- Worldwide in-situ CEOP reference site data sets, CEOP satellite products and Model Location Time Series continue to be delivered and applied in ways that have shown strengths and weaknesses of the models at each modeling Center that participates in CEOP.

- CEOP has developed metadata and distributed and centralized data integration systems, and is continuing to evolve and be applied to useful initiatives being undertaken by both operational and research groups.

- CEOP has accepted a new role in undertaking unique scientific studies and promoting research on the use of model prediction ensembles and associated statistics by comparing them with observations, and making these results available to other researchers for further analysis.

- CEOP has devoted considerable effort and resources to assembling and making available sustained regional reference observations of key meteorological and radiation parameters, together with analysis tools and methods and standards for archiving, distributing, analyzing and visualizing these observations for scientists around the world.

- CEOP has focused its efforts over the past year on contributions to GEWEX that support World Climate Research Programme (WCRP) mission objectives as established in the WCRP Strategic Framework 2005–2015, to "support climate-related decision making and planning adaptation to climate change by developing science required to improve climate predictions, the understanding of human influence on climate, and use this scientific knowledge in an increasing range of practical applications of direct relevance, benefit and value to society." This work has led to the reduction of uncertainties associated with the climatically sensitive and key hydrological processes in regions where CEOP is active, and ensured their proper representation in climate system models.

Key Results and Accomplishments

Science Foci Key Results:

- The scope of CEOP science activities has expanded; in addition to the Regional Hydroclimate Projects (RHPs), CEOP includes groups focused on studies in high elevations, monsoon, extremes, cold regions and semi-arid regions.

- The CEOP Monsoons Study has been shown through a special session at the CEOP Second Annual Meeting to be synergistic with the overall WCRP Monsoon crosscut initiative.

- A CEOP High Elevation study special session at the CEOP Second Annual Meeting resulted in plans to organize a global high elevation watch period.

- CEOP Extremes studies have begun focusing on drought, heavy precipitation, floods and low flows and the ways in which these events intermesh.

- Links between the CEOP Cold Regions Study and several RHPs have now been clearly identified. This work is also being coordinated with the WCRP Climate and Cryosphere (CliC) Project.

- The CEOP Semi-arid Regions study has recently shown progress on meeting the goals created for it as an element of CEOP, particularly by the establishment of a joint U.S.- and China-based semi-arid region study.

- CEOP science continues to provide a traditional focus for Water and Energy Budget Studies (WEBS), which will now extend efforts to understand average conditions to conditions throughout the entire CEOP period.

- Other CEOP science efforts related to water and energy budget studies have been expanded, including a study of the influence of aerosols and of water isotopes.

- CEOP modeling efforts now include explicit global, regional, land surface and Hydrologic Applications Project (HAP) efforts. All of these groups have now begun to look at an ensemble of international models in regions focused on CEOP reference sites.

- A CEOP satellite data set is now being populated with data from instruments flown on spacecraft from the Japan Aerospace Exploration Agency (JAXA), the European Space Agency (ESA) and the National Aeronautics and Space Administration (NASA) and tools for handling historical data, which have been provided by the National Oceanic and Atmospheric Administration (NOAA). This work is being carried out as part of the CEOP Data Management component.

Integrated Data Set Key Results:
CEOP has fulfilled its most ambitious goals to address a number of key scientific issues through comprehensive improvement in access to integrated observational (in-situ and satellite) and model data. Data Management, a focal point of the Coordinated Enhanced Observing Period, has now successfully implemented a data policy allowing the sharing of in-situ reference site data, model output data and satellite data, and has set up archival centers of this data at the National Center for Atmospheric Research (NCAR) and the Max Planck Institute (MPI). Satellite data has gone online at the University of Tokyo (UT), and along with other data has been moved to a central data archive where it can be accessed and distributed to interested users.

The CEOP Data Management web page was revised in August 2008 and is available directly at http://www.eol.ucar.edu/projects/ceop/dm, with improved links to all CEOP RHP (and related data provider) data archives.

Completed in-situ data are now available from 28 of 32 reference sites (including data from 12 sites that contain full annual cycles for both Enhanced Observing Periods (EOP) 3 and 4).

The CEOP Model Output Center (located at the World Climate Data Center, Max Planck Institute for Meteorology, Germany) continues to maintain the archives and Model Output Gateway at http://www.mad.zmaw.de/projects-at-md/ceop. To date, 5.6 terabytes of data have been submitted and are available online. Metadata from the 11 Numerical Weather Prediction (NWP) Centers participating in CEOP continues to be updated at http://www.eol.ucar.edu/projects/ceop/dm/model/model_table.html. Periodic conference calls are conducted between these various Centers to coordinate data submission and data formatting issues.

The CEOP Satellite Data Center (UT, Japan) continues to add EOP3/4 satellite data to its archives. A new Satellite Data Gateway web page has been developed and is available at http://monsoon.t.u-tokyo.ac.jp/ceop2/satellite. This page provides current data policy, format, inventory and access information. Data access is also available through the CEOP Centralized Data Integration System at http://monsoon.t.u-tokyo.ac.jp/ceop-dc/ceop-dc_top.htm.

An unprecedented international effort resulted in the specialized data integration function developed by CEOP, which has in turn has begun to add value to work in both the meteorological and climate science and operational communities, especially the numerical weather prediction centers involved in CEOP.

An improvement of models has been achieved based on insights developed through CEOP validation studies and intercomparisons, as well as the provision of new capabilities and tools for integrating the model products with satellite and in-situ data.

Plans for 2008

Science Foci Plans for CEOP in the Coming Year:
While each element of CEOP has made progress toward meeting its goals and has presented its status and plans in detail at the Second Annual CEOP Meeting in Geneva, Switzerland (17–19 September 2008), CEOP will place a great deal of emphasis during the coming year on advancing scientific work in monsoon studies, high elevations initiatives and extremes. Each of these topics was the subject of a special session at the CEOP Second Annual Meeting. The outcome of these special sessions was used

in breakout sessions that resulted in points to be addressed within the CEOP scientific framework and that specified the data needed to carry out the science plans.

All of the presentation material provided by the participants at the meeting, including abstracts of talks and posters, is available through the CEOP home page at http://www.ceop.net.

CEOP High Elevations (HE) will address the following activities in the coming year:

1. Collecting information on key high elevation monitoring sites where physical and dynamic processes are being studied, and inviting site managers to become part of the CEOP-HE network;

2. Creating a database of HE stations worldwide;

3. Developing CEOP-approved installation procedures and long-term maintenance guidelines for HE sites and quality assurance / quality control policies for data acquisition;

4. Producing high-quality data sets in line with CEOP data policy.

CEOP Monsoon Studies plans for the coming year include attempts to improve understanding, modeling and prediction of heating, circulation and rain components of the monsoon system by:

- Dealing with data concerning continental forcing including trends, as well as inter-decadal and inter-annual variability.

- Identifying Large-scale Orographic forcing, particularly over the Tibetan Plateau on time scales including inter-decadal, inter-annual and low-frequency variability (LFV).

- Detecting the land/sea breeze, inter-decadal, inter-annual, LFV and diurnal variability.

- Contributing to a synthesis paper (s) providing input to the next Intergovernmental Panel on Climate Change (IPCC) assessment.

- Improving predictions of seasonal march, intraseasonal variations and extreme events in the monsoon systems, using cloud resolving models (CRMs).

CEOP Extremes has a number of specific steps currently underway for the coming year. These include:

- Assessing current definitions of extremes and determining whether further definitions are needed.

- Assessing existing extreme event catalogues (heat waves, floods, droughts on a global basis from 1948–present) and incorporate this into the Extremes information base as appropriate.

- Producing a high-resolution data set on global precipitation.

- Pulling together at least one comprehensive, continental-scale data set on multi-year drought.

- Assessing whether re-analyses are capable of detecting and determining the trend of extremes events over the last 30 years.

- Providing a “recipe book” for others to follow in terms of conducting comprehensive drought studies.

- Assessing whether a review article on extremes is warranted.

Data Set Development Plans for CEOP in the Coming Year:

It has been concluded that a systematic effort is needed to match the expanded CEOP science framework with new and better specialized data sets and data integration tools. This has led to a number of points associated with the need for:

1. Better data sets and data integration tools with increased focus on defining and generating new multi-sensor, multi-scale integrated data sets;

2. CEOP to coordinate RHP efforts in the provision and integration of the new data types necessary to achieve CEOP science objectives; and

3. Cooperation with other groups within WCRP and GEWEX who are producing specialized data sets that are necessary to meet CEOP data set requirements.

New Directions:

By 2013, CEOP will have developed a functioning CEOP data center that be used by all of the CEOP science groups. It should be noted that CEOP data is already open to outside groups; CEOP data management is in the process of developing links to a number of associated groups, such as the Global Runoff Data Centre and Global Precipitation Climatology Centre.

CEOP is contributing to the Group On Earth Observations (GEO) water activities Water Task WA-06-02 (Droughts, Floods and Water Resource Management) and Water Task WA-08-01 (Integrated Products for Water Resource Management and Research) in the near term (2009–2011). CEOP will meet its commitments to GEO by maintaining its continued efforts to improve models and enhance the quality and integration of important hydroclimate data sets. Additionally, CEOP will make a lasting contribution to the GEO Portal, a web-based interface for searching and accessing the data, information, imagery, services and applications.

CEOP will expand on the unique collaborative arrangement between itself, the international group of numerical weather prediction centers, and the broader climate research community represented by the World Meteorological Organization (WMO), WCRP and GEWEX as they all move toward the implementation of the Global Earth Observation System of Systems (GEOSS). In this context, the GEOSS 10-Year Implementation Plan Reference Document states that CEOP should be considered as a prototype of GEOSS. This may be recognized in the future as the ultimate achievement of CEOP.

Issues

Recommendations/Issues for the SSG:

1. CEOP needs the support of the SSG to aggressively pursue the fulfillment of commitments made by international participants in CEOP to provide, validate, archive and stage the complete baseline data set prescribed in the initial CEOP requirements.

2. CEOP must have the support of the SSG to maintain its relationship with data archive centers at NCAR, the Max-Planck Institute, JAXA and the University of Tokyo. In particular, NOAA funding to NCAR for support of the in-situ data archive and the oversight of CEOP data management activities may be in jeopardy beyond FY2009.

3. The CEOP Co-Chairs need the assistance of the SSG to ensure that space agencies—including the Committee on Earth Observation Satellites (CEOS)—are encouraged to actively support the CEOP implementation process through funding support and contributions to CEOP data needs.

4. The CEOP Co-Chairs may need the approval and endorsement of the GEWEX SSG to reclassify one or more RHPs as only affiliate activities. CEOP recently reported to the GEWEX SSG that a few GHPs have evolved or begun work along courses of development that have made them unable or at least limited by external factors such as funding constraints to continue to meet the scientific and technical criteria they had initially committed to abide by in order to become GEWEX/CEOP experiments. The SSG needs to address this situation.

Contributions to WCRP Strategic Themes:
In the future, CEOP must continue to focus on contributions to GEWEX that support WCRP mission objectives to "support climate-related decision making and planning adaptation to climate change by developing science required to improve:

1. climate predictions;

2. understanding of human influence on climate; and

3. use this scientific knowledge in an increasing range of practical applications of direct relevance, benefit and value to society" (WCRP Strategic Framework 2005-2015).

In this way, CEOP can maintain its role in the process that WCRP-sponsored scientists and programs/projects have undertaken to make seminal contributions to international environmental assessments such as the IPCC.

Summary

The Coordinated Energy and water cycle Observations Project (CEOP) is a merger of the previous WCRP GEWEX Hydrometeorology Panel (GHP) and the Coordinated Enhanced Observing Period, which was an element of WCRP initiated by GEWEX. This formal merger into the new CEOP was meant to enhance the efforts of both GHP and the Coordinated Enhanced Observing Period. The merger was accomplished without losing sight of any GHP or Coordinated Enhanced Observing Period strategic goals or any of their ongoing science work. It did, however, necessitate a refocusing of some activities toward the new CEOP goal and objectives. With this in mind, CEOP developed a new Strategic Implementation Plan (SIP). Through the process of a thorough review of the initial SIP draft by the GEWEX SSG in 2008 and by addressing all of the SSG's comments and concerns in a final draft of the SIP, CEOP has now reconciled its implementation plans with all of the other elements of GEWEX and WCRP. This process has provided the basis for CEOP to make its unique and separate but equal contributions to the success of the overall objectives of the broader International Climate Research community represented by GEWEX and WCRP and to extend its influence into the future as a part of GEOSS. The latest version of the SIP can be found at http://www.ceop.net.

List of Key Publications
References to technical work that have been citied in reports to CEOP and GEWEX by members of the CEOP science community.

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Saito, M., and J. Asanuma, 2008: Eddy covariance calculation revisited with wavelet cospectra. *SOLA*, 49, 49–52, doi:10.2151/sola.2008-013.

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Sato, T., and F. Kimura, 2007: How does the Tibetan Plateau affect the transition of Indian monsoon rainfall? *Mon. Wea. Rev*., 135, 2006–2015.

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References/Publications

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Coordinated Enhanced Observing Period 'CEOP' Special Issue of the Journal of Meteorological Science of Japan (JMSJ): February 2007.

Coordinate Energy and Water-cycle Observations Project (CEOP) Strategic Implementation Plan: October 2008.

List of Meetings, Workshops in 2008

4–5 January, Executive meeting in San Diego
2–4 February, GEWEX SSG Buenos Aires, Argentina
May, CEOP Extremes Workshop
2 Sept, CEOP Annual Meeting, Geneva, Switzerland

List of Planned Meetings, Workshops

The **CEOP Third Annual Meeting** will be held in Melbourne, Australia from 19–21 August 2009, just ahead of the joint GEWEX/iLEAPS Science Conference scheduled for 24–28 August 2009.

Other elements of CEOP will hold small topical meetings and workshops but these are usually planned within a few months of the time of the meeting; announcements will be forthcoming in due course. Other more mature CEOP initiatives plan larger meetings that can be known in advance such as BALTEX and Regional Modeling.

BALTEX: Four major events are planned and organized or co-organized by BALTEX that will focus on issues for future study, including:

- 2nd International Workshop on "21st Century Challenges in Regional Climate Modeling", in Lund, Sweden, 4–8 May 2009
- International conference on "Climate Change - The environmental and socio-economic response in the Southern Baltic Region" in Szezecin, Poland, 25–29 May 2009
- BALTEX Summer School on "Ecosystems of the Baltic Sea basin under climate change" in Bornholm, 24 August—4 September 2009 (tentative title, venue and time window)
- 6th Study Conference on BALTEX, Miedzyzdroie, Wolin, Poland, 2010 (dates still to be defined)

Regional Modeling
4– 8 May 2009, The 2nd Lund Regional-scale Climate Modeling Workshop: 21st Century Challenges in Regional Climate Modeling, Lund, Sweden

18–20 March 2009, The International Conference on Land Surface Radiation and Energy Budgets: Observations, Modeling, and Analysis, Beijing, China

List of Members

The list below is current; all leaders are in place for 2 more of 3-year terms, which will be reviewed at the fourth CEOP Annual Meeting in August/September 2010. Renewals or changes at that time will be made at the end of the CEOP Annual Meeting in August/September 2013, the current horizon for GEWEX/CEOP.

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