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Global Energy and Water Cycle Experiment

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New Directions for CEOP

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First, I would like to take this opportunity to thank my co-chair, Toshio Koike, for his long service to CEOP and GEWEX. Toshio has been involved in CEOP since its inception almost 10 years ago, and the community owes him a great debt for his hard work in establishing and fostering its activities.

While many in the CEOP community are aware of its history, some may not be, so I will attempt to give an abbreviated version. In the early days of GEWEX, a central concept was that the Mississippi River basin was to be a testbed ("Continental Scale Experiment," or CSE) for development, diagnosis, and testing of coupled land-atmosphere models and continental scale data sets. The motivation for this choice was that the Mississippi is well instrumented compared to most river basins of its size, the hydroclimatological data are freely available, almost all of the basin lies within one country, and the Next Generation Weather Radar (NEXRAD) precipitation radar data were becoming available over most of the basin. In retrospect, though, it was probably naïve to expect participation from scientists globally in a U.S. river basin. It soon became apparent that the single river basin model would not work; the realities of international participation dictated that there would have to be more than one CSE. Subsequently, four additional CSEs were formed. The GEWEX Hydrometeorology Panel (GHP) developed a set of criteria for a regional hydrometeorological study to qualify as a CSE. These were:

1) Have the co-operation of a numerical weather prediction center;
2) Have a commitment of resources for the development of atmospheric-hydrological models, assimilation, and a program of numerical experimentation and climate change studies;
3) Have a regional scientific co-operation mechanism for collecting and managing hydrometeorological data sets;
4) Promote international exchange of scientific information and data;
5) Have interactions with water resource agencies or related groups;
6) Help in the evaluation of GEWEX global data products; and
7) Contribute to CEOP and transferability databases.

In the late 1990s, the first phase of GEWEX was completed, and there was a need to "reinvent" the program. A new Coordinated Enhanced Observing Period (the original root of the CEOP acronym) became part of the second phase of GEWEX. The seventh CSE qualification criterion hints at its motivation. It was recognized that the regional land-atmosphere models that had been developed and applied in the CSEs largely had been tailored to the host CSE, and transferability had not been demonstrated. The CEOP concept was to develop data sets, both in situ and satellite, for a fixed observing period of several years' duration. These data sets were to be used to test model transferability.

CEOP has evolved primarily as a data archive–one part is for "reference sites," which basically are flux towers that measure land surface radiative and surface fluxes (among other variables). Most, but not all, of these sites are also part of other continental and global networks like Ameriflux and FLUXNET. The larger part of the CEOP archive hosts satellite data, mostly from the Earth Observing System (EOS) satellites, as well as other satellite data sources and global weather analysis and reanalysis output. Unfortunately, transferability activities were never as prominent as originally hoped.

For completeness, CEOP developed other components related to monsoons and regional modelling that turned out to have strong overlap with GHP. As a result, the WCRP JSC requested a merger of GHP and CEOP, which took effect in 2007. On its face, the decision made sense–GHP had a focus on activities, like the Water and Energy Balance Synthesis, that use available data sets to get at core GEWEX issues (specifically, water and energy balance closure at the CSE scale). Toshio Koike agreed to help lead what became the new CEOP. Ron Stewart became its co-chair, and it was renamed the Coordinated Energy and Water Cycle Observations Program. The argument for the merger was made in part on the basis of data issues [terms like "data interoperability," "data integration and information fusion," and "climate data flow" lace the 2007 background

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WCRP World Climate Research Programme | WMO | IOC | ICSU International Council for Science

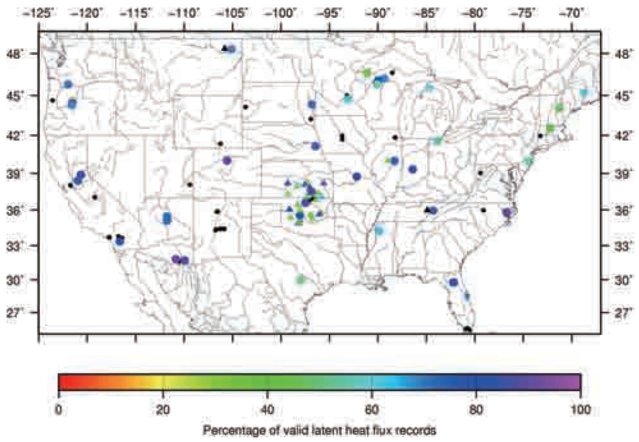

Figure 1: *Locations of FLUXNET stations (circles) and CEOP reference sites (triangles) within the continental U.S. with latent heat flux records. Stations with two years or less of valid data are shown as black, and for stations with more than two years of data, the color indicates the fraction of reporting periods (half hour interval) with valid data. FLUXNET sites generally have higher reporting ratios, and a more uniform spatial distribution, than do CEOP reference sites, even though most CEOP reference sites are also FLUXNET stations. Figure courtesy of Ben Livneh, University of Washington.*

document (www.gewex.org/GHP-CEOPmerger-whitepaper.pdf)]. Much less is said about how the merged entity would address core GEWEX issues.

Much has been accomplished by CEOP, which is now on track to produce a decade-long data set that should be useful for diagnosis of climate models in particular. It has provided a template for data management that is becoming a standard in other parts of WCRP. We nonetheless now find ourselves at a crossroads. GEWEX is embarking on a new path, where a new set of "imperatives" (see GEWEX News, May 2010) emphasize things like modelling of energy and water cycle processes, feedbacks, parameterizations, attribution and predictability of regional energy and water cycles, hydrological nonstationarity, climate extremes, land surface modelling, and climate data records. Some of the existing CEOP activities map well onto the new imperatives, but others do not. The challenge before us is to evolve CEOP. In my view, it is time to wrap up some aspects of CEOP and look ahead. Below, I suggest four major actions that I feel are essential.

1) ***Back to basics.*** The original GHP was closely aligned with the CSEs and the needs of the weather services (so-called "fast climate processes"). We now need a set of core activities that align CEOP much more closely with the new GEWEX imperatives. In some cases (e.g., the extremes activity) the alignment is obvious. For the CEOP legacy activities however, especially data archiving, the links are much less apparent. As an example, tower flux data have become the main source of land-atmosphere moisture and energy flux observations. There are good examples of the use of these data to improve land-atmosphere models (Alan Betts's work with FIFE and BOREAS flux tower data comes immediately to mind). The CEOP reference site activity has focused more on data formats and processing than on record completeness and use of the data. Furthermore, the CEOP reference site network density is much less than that of FLUXNET, as is data record completeness even in cases where the stations in the two networks coincide (see Figure 1). As FLUXNET has evolved, we find that some of the CEOP reference site archiving activities are duplicative. Would we be better off to work with FLUXNET to designate a subset of stations that pass certain minimum quality control screens?

2) ***Change the name.*** As noted above, CEOP was originally the Coordinated Enhanced Observing Period. The revised title assigned following the CEOP/GHP merger (Coordinated Energy and Water Cycle Observations Project) sounds like all of GEWEX. In my view, we would be better off with a name that relates to what we actually do, or should be doing. Why not go back to GHP (perhaps the "H" should stand for hydroclimatology rather than hydrometeorology)? CEOP has come to connote a data archive, and I think we need to separate ourselves from that notion.

3) ***Revisit the RHP interaction.*** The Regional Hydroclimate Projects (RHPs; the current name for the old CSEs) once were the crown jewels of GHP, but this aspect of CEOP has fallen on hard times. The criteria that are supposed to be used to "qualify" RHPs (see above) are not enforced, and in any event, are out of sync with the new GEWEX imperatives. The relationships between GEWEX and the RHPs are a two way street–the RHPs should bring something to GEWEX, and GEWEX must provide a motivation for their participation. I suggest that we consider a two tier RHP system in the "new GHP." The bar for tier two would be relatively low–some agreement as to common interests, and perhaps minimal sharing of data and modelling results. Initially, all RHPs would be assigned to tier two. Tier one would require agreement that the RHP would address GEWEX goals related to the imperatives. One example could be the provision of climate data records for the key water and energy cycle variables over the RHP domain.

4) ***Strengthen hydrological activities.*** Within WCRP, GEWEX is the main home for land hydrology, and within GEWEX, GHP was the center of most hydrological activities. With the GHP/CEOP merger, some of that identity was lost. At present, there are a range of hydrological process and prediction issues that do not have a "home" within GEWEX. One example is land surface model development–the PILPS experiments over a decade ago showed that the hydrological process representations in land surface models used in most weather and climate models are poor. For the most part, the current generation of models isn't much better. Yet these models are now used for a broader set of purposes, such as climate change impact assessments. Shouldn't the new GHP be helping to foster the next generation of hydrologically realistic land surface schemes?

In closing, I want to applaud the hard work of many over the years who have participated in GEWEX, CEOP/GHP, and its elements such as the RHPs. At the same time, I do want to emphasize that the time has come for a fundamental rethinking of CEOP and its interactions with GEWEX. All programs are eventually faced with the choice of being revitalized or dying. What I have suggested here is what I consider an essential process of revitalization of a new GHP.

Asian Summer Monsoon and Mediterranean Coupling in the Decadal Climate Modulation

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The remote influence of the Asian summer monsoon (ASM) on the Mediterranean has been widely investigated (e.g., Rodwell and Hoskins, 2001; Raicich, 2003). There is the significant anti-correlation, i.e., anomalous wet (dry) summer in the ASM is associated with the anomalous dry (wet) Mediterranean summer. Here, we will be showing that the recent drier Mediterranean in early summer over recent decades is closely related with the decadal oscillation of the Pacific sea surface temperature (SST) under the ASM playing its crucial role as a media for its teleconnection.

Figure 1 shows the time-series of the outgoing longwave radiation (OLR) over the ASM domain (60º–100ºE, 10º–20ºN) in May and Mediterranean domain (0º–40ºE, 30º–45ºN) in June. We can find not only the significant anti-correlation, but also the trend of the wetter ASM and the drier Mediterranean. There has been increasing precipitation over the ASM associated with the enhanced monsoon circulation especially in May, owing to the earlier shift of the monsoon onset. Even though previous studies implied that the drier condition around the Mediterranean is related to the wetter ASM in respect to interannual variability, the cause of such decadal modulations has yet to be sufficiently understood.

Figure 2 shows the time series of upper-level potential temperature at 200 hPa over the Tibetan Plateau and monsoon precipitation in May. Precipitation data based on satellite observations have only been available since 1979; nevertheless they indicate that upper-level temperature reflects monsoon precipitation quite reasonably. Even though temperature increase over the Tibetan Plateau has been considered a result of its elevated land surface heating, our previous study (Tamura et al., 2010) demonstrated that upper-level warming such as at 200 hPa around the Tibetan Plateau in early summer results from compensating adiabatic warming in response to tropical convective heating.

Tamura and Koike (2010) further demonstrated the crucial role of convective activity in the seasonal march of the ASM. For instance, convective activity around the Maritime Continent before the monsoon onset plays an important role in inducing the ASM initially around the Indochina Peninsula and Bay of Bengal, together with the warming upper-layer around the southeastern Tibetan Plateau. Subsequently, convective activity around Southeast Asia produces a favorable condition for the Indian summer monsoon onset, together with the warming upper-layer to the southwest of the Tibetan Plateau. Therefore, convection around the Maritime Continent before monsoon onset is essential to drive the following seasonal march of the ASM.

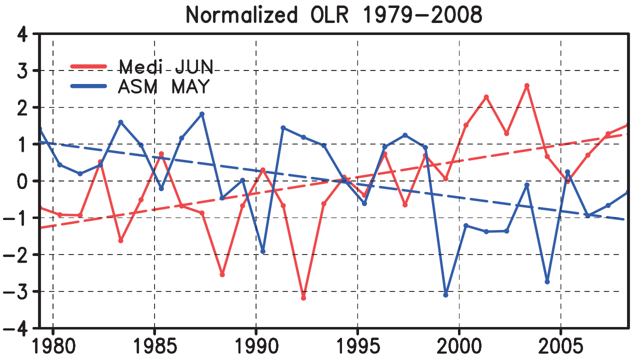

Figure 1: Time-series of normalized OLR over the Mediterranean in June (red) and ASM in May (blue). Values departing from monthly climatology are normalized. Dashed lines indicate the linear regressed lines to show trends.

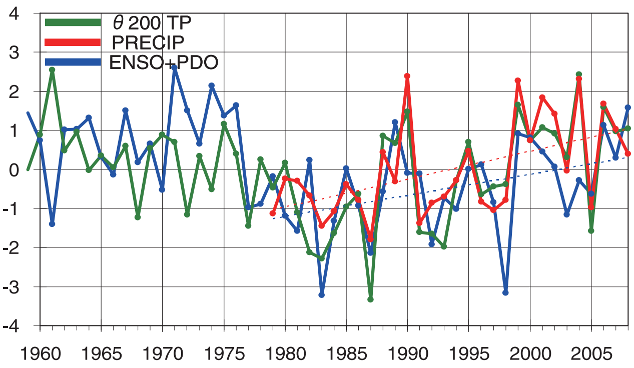

*Figure 2: Time series of the 200 hPa potential temperature (NCEP/NCAR reanalysis data) around the TP (60º–100ºE, 20º–40ºN), GPCP monsoonal precipitation (60º–100ºE, 10º–20ºN) in May, and the hindcast using the SOI and PDO index (–0.25*SOI –0.23*PDO Index). All are normalized values. The dotted lines are the linear trends.*

Convection around the Maritime Continent is strongly related with the Walker circulation that is influenced by the ENSO (Ju and Slingo, 1995) as well as the Pacific Decadal Oscillation (PDO; Mantua et al., 1998). Thus, the Pacific SST forcings are implied to be a dominant controller of the decadal modulation of the ASM–Mediterranean system. To confirm that, we used the bilinear regression of the upper-level temperature around the Tibetan Plateau in May onto the Southern Oscillation Index and the PDO index. We can see that the ENSO and PDO indices project well to the following ASM (Fig. 2). Over recent decades, an increase in the monsoon precipitation is found to be associated with the decreasing positive phase of the PDO that is accompanied by the increasing La Nina

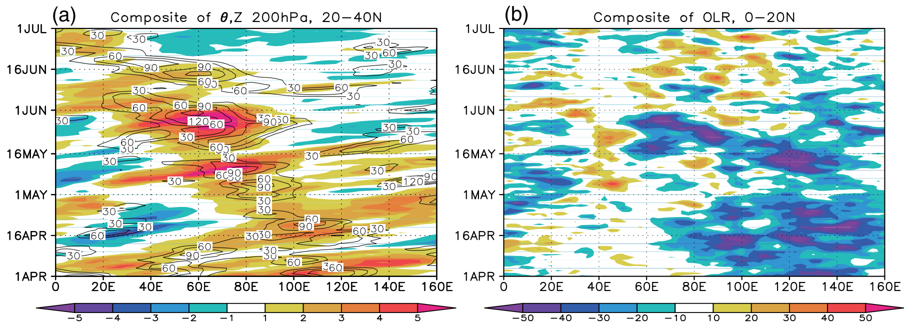

Figure 3: Longitude-time cross section of positive minus negative composites derived from the Pacific SST indices. (a) 200 hPa potential temperature (color, unit; K) and geopotential height (contour, unit; m) averaged over 20º–40ºN. (b) OLR (unit; W m^{-2}) averaged over 0º–20ºN.

phases of the ENSO.

To illustrate the role of the SST forcings to induce interannual variations of the ASM and Mediterranean in early summer, we composed positive (1989, 1999, 2006, 2008) and negative (1983, 1987, 1992, 1998) based on the Pacific SST indices in Figure 2. Results in Figure 3 clearly indicate that there is westward propagation of the warm and anticyclonic anomalies in the upper troposphere (Fig. 3a), which causes drier conditions. The origin of the anomalies can be traced back to those over the Tibetan Plateau (60º–100ºE) in April and May. Meanwhile, over the ASM domain, there is westward propagation of the enhanced convection during May that can be traced back to that around the Maritime Continent (100º–140ºE) in April (Fig. 3b). Thus it indicates that enhanced convection around the Maritime Continent before monsoon onset owing to the Pacific SST forcings results in enhanced activity of the ASM and drier condition over the Mediterranean during the following early summer.

As indicated here, the Mediterranean climate is largely influenced by the Pacific oscillations via the ASM. We need to consider not only the local factors but also those of the global scale for better understanding and projection of the Mediterranean climate and its water cycle. Recent collaboration between the global observation project of CEOP and the Mediterranean project of the Hydrological cycle in the Mediterranean Experiment (HyMeX) would contribute to these targets.

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Report on the 4th International HyMeX Workshop

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The 4th international HyMeX workshop was held from June 8th to 10th, 2010 in Bologna (Italy). It was followed by a meeting of the HyMeX ISSC (International Scientific Steering Committee) on June 11th, 2010 and preceded on June 7th, 2010 by a meeting of the working group and task team leaders in charge of the HyMeX international implementation plan, and a parallel coordination meeting of the Italian groups. It was the last meeting before the kick-off of the long-observation period (2010-2020) in September 2010 based on data collection from operational and research hydrometeorological sites and regional climate and process modelling.

More than 180 participants attended the 3-day workshop, coming from France, Italy, Croatia, Spain, Germany, Greece, USA, Austria, Switzerland, Canada, the Netherlands, Sweden, Morocco, Japan, and Ukraine (see picture). Representatives of WWRP (S. Nickovic) and WCRP/GEWEX/CEOP (S. Williams), and the French funding agencies (S. Godin-Beekman) attended the workshop and gave overview talks. After presenting the science plans of each of the five working groups, 31 talks and 105 posters presented scientific results on the main HyMeX topics (water budget of the Mediterranean hydrological cycle, precipitating events and floods, air-sea interaction processes, and socio-economic impacts). A plenary session was

Picture of the participants to the 4th international HyMeX workshop held in Bologna (Italy) at ISAC-CNR from June 8th to 10th, 2010.

devoted to the implementation plan with a presentation of the experimental set-up for each of the three target areas: the North-Western Mediterranean, the Adriatic Sea, and the South-Eastern Mediterranean. Finally, nine roundtables allowed discussions on the long-term observations, on the instrument deployment for the enhanced and special observation periods, and on the modelling strategies. The workshop program, oral presentations, and some posters are available on the HyMeX web site at http://www.hymex.org/index.php?lang=english&page=workshops.

In the context of CEOP, three regions are covered by the HyMeX RHP (Regional Hydroclimate Project), which are underway to provide hydrometeorological data (France, Italy, and Israel) to the CEOP database. The workshop was also an opportunity for discussing with G. Tartari the contribution of the Italian reference sites of the CEOP high elevation element to the HyMeX program.

For more information about HyMeX, the general overview and status of HyMeX are summarized in the presentation http://www.hymex.org/global/documents/Presentation_HYMEX_23JUNE2010.ppt

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Report on the CAS-CEOP Lhasa Workshop

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The Chinese Academy of Sciences (CAS) and CEOP jointly organized “The 2nd International Workshop on the Energy and Water Cycle over the Tibetan Plateau and High-elevations” which was held in Lhasa, China, on 19 - 21 July 2010. The workshop was in conjunction with “The Fourth International Workshop on Catchment-scale Hydrological Modeling and Data Assimilation (CAHMDA-IV)” that took place in the same venue, on 21 -23 July 2010.

More than 150 participants, including 60 foreigners from 11 countries, joined this workshop. Among them were Prof. Toshio Koike, CEOP co-chair, Dr. Adrian Simmons, WCRP/GCOS chair, Dr. Peter van Oevelen, GEWEX IPO director, Prof. Daqing Yang, CliC IPO director, and many other Tibetan Plateau hydro-meteorological scientists.

More than 40 oral presentations and 20 posters were presented at the meeting, covering five sessions: observing systems over high elevations, satellite remote sensing and data assimilation, land water and energy processes, land-atmosphere interactions and their impact on monsoon variability and extreme events, and climate change and response of high altitude aquatic ecosystems and cryosphere. This workshop provided a forum for scientists to strengthen the exchanges of the achievements and information and promote research cooperation. The workshop closed after a half-day intensive discussion on future research foci, data exchange, and international cooperation concerning the water and energy cycle over the Tibetan Plateau and other high elevations. Video records of all oral presentations were taken by Prof. G. Greenwood of the Mountain Research Initiative (MRI) of Switzerland. The records and the presentational materials in PDF will soon be accessible at the MRI webpage (http://mri.scnatweb.ch/).

The workshop was sponsored by the Chinese Academy of Sciences, National Natural Science Foundation of China, and the Lhasa Branch of Institute of Tibetan Plateau Research. Two relevant CEOP projects (WEBS and HE) and CEOP-AEGIS (an EU FP7 project) office also greatly contributed to the organization of the workshop.

Picture of the participants to the 2nd International Workshop on the Energy and Water Cycle over the Tibetan Plateau and High-elevations held in Lhasa, China, on 19 - 21 July 2010.

An Update on Extremes within CEOP

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Extreme events, particularly those associated with hydrometeorology, are of special interest for CEOP. The objectives of extremes-related activities within CEOP are to better document, understand and simulate their occurrence, evolution, and structure; to contribute to their better prediction at various time scales; and to address associated societal concerns.

Phenomena such as drought, heavy precipitation, floods and related issues such as heat waves and fires occur essentially everywhere. The specific issues being addressed include:

- How are extremes defined?
- How do extremes develop, evolve, and end within the climate system?
- Have extremes changed in occurrence and character and why or why not?
- Given our progress, how can we contribute to assessing whether extremes may change in the future?

Each of the Regional Hydrometeorology Projects (RHPs) and many of the other components of CEOP are studying extremes (Table 1), which are explicitly or implicitly part of the objectives of all of the RHPs.

A great deal of progress is being made on extremes within these individual components. A few illustrative examples follow:

- A recent article summarized many extremes within the Mediterranean region (Diodato and Bellocchi, 2010) and addressed for the first time hydrological extremes and their variations and trends in this region. In general, autumn is the most hazardous season for extremes in this region and there has been a shift towards more intense rainfall (Figure 1).
- Some of the basic considerations surrounding drought need to be assessed. For example, the notion of drought being a 'hot' phenomenon is not always the case (Figure 2). Periods of cold air can also lead to far below normal precipitation, at least over the Canadian Prairies.
- Prediction studies of extremes are ongoing in several of the RHPs and these range from short-term to at least seasonal scales. Short-term predictions mainly focus on heavy precipitation and flooding although, even in a drought, such predictions are very useful. Any improvements in seasonal-scale predictions would have an enormous impact.
- Research in support of future extreme occurrence, and adaptation to these, is being carried out within several of the RHPs.

Table 1: Some of the extremes-related activities within CEOP. Phenomena include drought (D), heavy precipitation (HP), flooding (F), land slides (LS), glacial retreat (GR), temperature extremes (TE) and fire (FI). Research-related activities underway include data collection (DC), data integration (DI), definitions (DE), trends (T), science and simulation (S), prediction (PR), aquatic ecosystem impact (AQ), and research contributing to or in support of adaptation (A). Drought Research Initiative (DRI) is a Canadian regional activity. Some activities have undoubtedly been missed.

RHPs	Phenomena	Studies
AMMA	D	DI, S, PR
BALTEX	HP, F, TE	T, S, PR R, A
CPPA	D, HP, F, TE	DI, DE, T, S, PR
HyMeX	D, HP, F, LS	D, PR, A
LBA	D, HP, F	DI, S, PR
LPB	D, HP, F	T, S, PR, A
MAHASRI	D, HP, F	DI, T, S, PR, A
MDB	D, HP, F, TE, FI	T, S, PR, A
NEESPI	D, HP, F, FI	T, S, PR, A
DRI	*D, HP, F, FI*	*DC, DI, T, S, PR, A*
Other Components		
Water Budgets	D, HP, F	S
High Elevation	HP, GL, F	DC, DI, T, S, AQ
Isotopes	HP	DI, S
Modelling	-	S
Monsoon	D, HP, F	DI, T, S, PR
Hydrologic Applications	D, HP, F	PR

Collective work is also underway. A few illustrations are as follows:

- A summary of extremes efforts within CEOP has recently been completed.
- There are over 70 references to scientific publications on extremes within CEOP available on the CEOP Extremes website.
- CEOP Extremes is jointly organizing the extremes symposium at IUGG 2011 in Melbourne, Australia.
- A collective scientific article is expected to soon be started. A key issue is understanding reasons for similarities and differences in extremes in different regions.
- These CEOP efforts are contributing to the larger issue of Extremes within the World Climate Research Programme. A new WCRP cross-cutting effort is being developed with myriad implications worldwide.

References:

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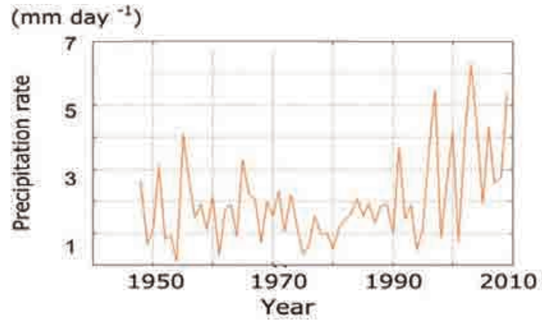

Figure 1: The September trend of rainfall rate over Sicily from 1948 to 2009. Adapted from Diodato and Bellocchi 2010.

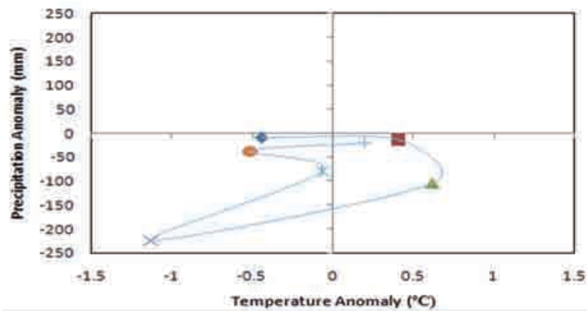

Figure 2: Annual temperature and precipitation anomalies over Edmonton, Alberta for every year of a recent 1999-2005 drought. Adapted from Stewart et al., 2010.

CEOP Reference Site Data Update

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The NCAR Earth Observing Laboratory (EOL) continues to provide the archive for the CEOP Reference Site (RS) in-situ data under sponsorship from NOAA's Climate Projects Of ce (CPO). Data are archived and available in the standard CEOP column ASCII format, organized by four file types: surface (SFC), Tower (TWR), Soils (STM), and Flux (FLX). EOL is in the process of converting these data to NetCDF format (following CF conventions) for use in data integration and comparison with model output and satellite data. In addition, some supporting observations such as upper air soundings and other ancillary measurement data are included in the archive for some sites where available.

Some RS data holdings go back to 2002 and are complete and continuous through 2009. Current long-term RS archives include: (1) ARM Southern Great Plains, North Slope of Alaska, and Tropical Western Pacific (Oct 2002 – Dec 2009); (2) Lindenberg, Cabauw, and Sodankylä (Oct 2002-Dec 2008); (3) Himalayas and Murrumbidgee (Oct 2002-Dec 2007); and (4) BERMS (Oct 2002-Dec 2006). The CEOP Data Management web page is located at: http://www.eol.ucar.edu/projects/ceop/dm/, from which you may access RS documentation and available data. The "Reference Site Data Gateway" is updated as new data become available. Site specific documentation includes contact information, site/station descriptions, maps (including Google Earth KMZ files), photographs, vegetation, land use, soils characterization, climate, parameters/instrumentation, and references.

As CEOP begins a collaboration with the Hydrology cycle in Mediterranean Experiment (HyMeX) Project (*see Report in this issue describing the 4th International HyMeX Workshop*), discussions with the HyMeX Project were initiated to include three new proposed Reference Sites (Southern France, Italy, and Israel). These sites vary from single station to networks of precipitation and soils observations.

10-Year Dataset Development

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In confronting the risks and challenges posed by changing climate, we must acknowledge the fundamental uncertainty in projections of future climatic and water resources conditions, and work to improve the ability to identify effective responses while reducing this uncertainty. For this, a simple framework to identify, organize, and disseminate comprehensive, quality, and long-term observational datasets should be provided to modelling communities and analysis and impact study research groups as it is also stressed in the GEWEX Post 2013 Imperatives.

In response to this need, an idea of a collaborative effort among in-situ and satellite earth observation groups and modelling communities to develop a high-quality comprehensive dataset of meteorological and hydrological variables based on the most advanced and complex land reference sites distributed over the world and complemented with relevant satellite observations has emerged. The 10-year Dataset Project (10-YDP) activity was proposed at the WCRP Observation and Assimilation Panel (WOAP) Meeting in Hamburg, March 2010, at which achievements of CEOP and CMIP in providing frameworks for access to observational and model datasets, including metadata standards, were acknowledged. At the occasion of the 2nd Hydrology delivers Earth System Science to Society (HESSS2) international conference held in Tokyo, 22 – 25 June 2010, the rationale of the 10-YDP was introduced to representatives of relevant observation and data evaluation and analysis communities including FLUXNET/AsiaFlux, GSWP/GLASS, and LandFlux-EVAL and a basis for collaboration on this activity was formulated that has been then elaborated in the 10-YDP Whitepaper draft presented and discussed at the Pan-GEWEX meeting in Seattle.

The envisioned dataset has advantages over "reanalysis" datasets by providing (a) observational data and by (b) enabling a single commodity that includes all data in a standardized format, fulfilling high quality requirements in accordance with the CEOP standards, and equipped with appropriate metadata assuring full interoperability and "easy" use. The 10-year period has been decided based on the requirements for a minimum length of such a dataset for targeted model output evaluations, while considering opportunities provided by available in-situ and satellite observations. The 10-year period is suf cient to derive climatologically sensible mean diurnal cycles and is also useable for analyzing intra-seasonal variability or extreme events under the current climate.

The main aims of the dataset include but are not limited to: (i) evaluation of the climate model output applicability for climate change impact assessment, in particular evaluation of the CMIP5 near-term and time-slice experiment results; and (ii) quantification of uncertainties of model predictions/projections and thus making the model output information useable for decision and policy makers.

The Project is a collaborative effort among observing and modelling communities primarily involving GEWEX (CEOP, GRP, GMPP), FLUXNET, CMIP5, CEOS, WOAP, GCOS, and possibly others. It will build on the CEOP experience in data management, archival and access and the data will be archived at the Data Integration and Analysis System (DIAS) at the University of Tokyo taking advantage of its visualization and analysis capabilities. Data use policy is adopted from the CEOP Reference Site and Satellite Data Release and Use Guidelines and adjusted to the specifics of the 10-YDP project.

Monitoring Flooding in Pakistan Using ALOS & GSMaP Data Provided by JAXA

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Serious damage has occurred in Pakistan recently due to floods and mudslides caused by heavy rain, which occurred continuously since July 29, 2010. The flood damage has spread from north to south in Pakistan. The Japan Aerospace Exploration Agency (JAXA) has made observations using the Advanced Land Observing Satellite (ALOS, "Daichi") to monitor the state of the damage.

Figure 1 shows images of Hyderabad, 1,200 km south-southwest from Islamabad, which were taken after the disaster on August 23, 2010 (left) and before the disaster on March 23, 2009 (right). It is obvious that the flooded area along the Indus river basin has greatly expanded.

Figure 2 shows the inundation area image obtained from data acquired with the Phased Array type L-band Synthetic Aperture Radar (PALSAR) onboard ALOS on August 19, 2010. The data was acquired using the ScanSAR observing mode (WB1); therefore it covered an approximately 350 km wide strip at 100 m spatial resolution. The blue color on the topographical map derived from the ASTER Global Digital Elevation Model (ASTER GDEM) shows the inundation area, which was identified by analyzing the backscattering coef cients observed before and after the flood.

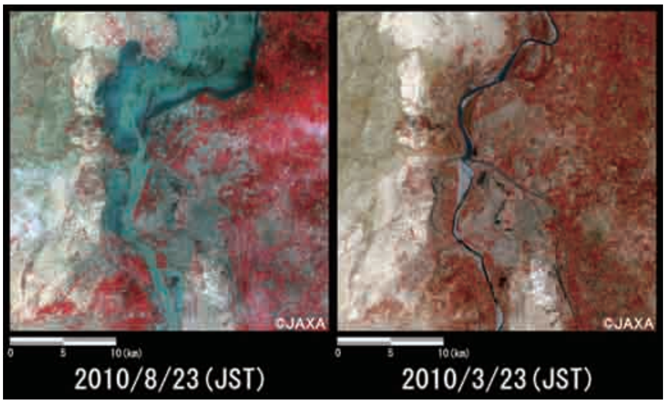

__Figure 1:__ Enlarged AVNIR-2 images of the swollen rivers at Hyderabad (left: August 23, 2010; right: March 23, 2010).

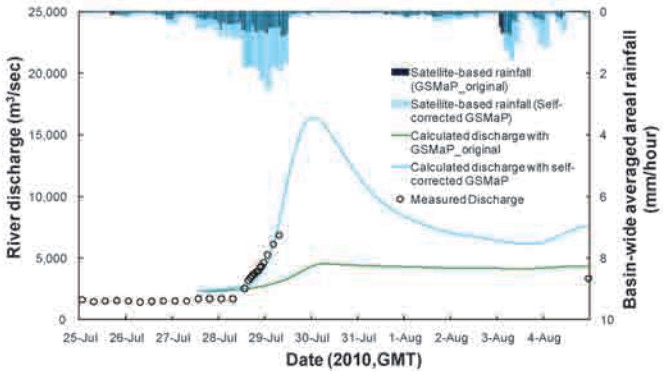

__Figure 3:__ Comparison of preliminary IFAS-PDHM simulations using the corrected GSMaP data with the observed in-situ river discharge data at Nowshera, Kabul River (from July 25, 0:00 to August 6, 0:00 GMT)

A preliminary runoff analysis was done at the Nowshera hydrological station of the Kabul River, which is one of the major tributaries of the Indus River, using the Integrated Flood Analysis System (IFAS) - Public Work Research Institute (PWRI) Distributed-parameter Hydrologic Model (PDHM, grid-size 4 km) and the Global Satellite Mapping of Precipitation (GSMaP) as shown in Figure 3. The GSMaP data corrected by the ICHARM's correction method based solely on rainfall-area movement information, without regarding ground-based rainfall data, was used as the input to the IFAS-PDHM. According to the estimation of this preliminary simulation, the flash-flood runoff peak at the Nowshera point (watershed area approximately 92,000 km^2) appeared to be over 16,000 m^3/s near the time of 0:00 (GMT) on July 31, but in reality, most of the high-flow discharge must have been inundating the floodplains (valley plains) along the Kabul River.

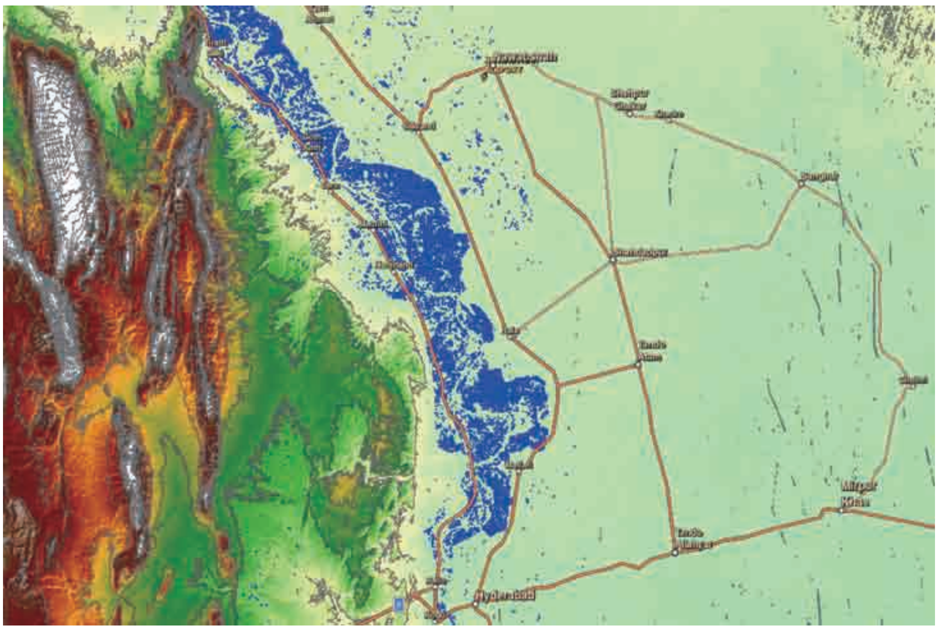

__Figure 2:__ Inundation area on August 19, classified by using the PALSAR overlaid on the topographical map derived from the ASTER GDEM. (JAXA, METI Analyzed by UT)