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REPORT OF THE EIGHTH SESSION

OF THE GEWEX HYDROMETEOROLOGY PANEL (GHP)

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1.0 INTRODUCTION

The International Research Institute (IRI) for Climate Research hosted the eighth meeting of the GHP at the Lamont-Doherty Earth Observatory in Palisades, New York. The goals of GHP-8 included taking specific action to advance progress on the GHP scientific focus, which relates to assisting GEWEX to demonstrate skill in predicting variabilities in water resources and soil moisture on time scales up to seasonal and annual as an element of the World Climate Research Programme's (WCRP's) prediction goals for the climate system. A series of technical presentations were made on topics, which covered research of relevance to the global hydrological issues being promoted by WCRP/GEWEX. Focused workshops on the Water Resources Application Project (WRAP) and the Water and Energy Balance Study (WEBS) were held the day before the GHP meeting, and a Coordinated Enhanced Observing Period (CEOP) meeting was held the day afterwards.

A review of contributions to GHP/GEWEX by various national and international projects and organizations including those within and outside the GEWEX framework was given by representatives of such activities as IRI, the International Association of Hydrological Sciences (IAHS); the limited international regional study in West Africa, CATCH; the proposed Continental Scale Experiment in South America, PLATIN; the North American Monsoon Experiment (NAME); the Isotope Hydrology Section of the International Atomic Energy Agency; the Data Assimilation Office of NASA Goddard Space Flight Center; and others. The work of the GHP Working Group on Data Management was also reviewed.

This report summarizes the meeting of GHP-8 and the main issues, actions (Appendix A) and recommendations taken under advisement by the Panel. The meeting agenda can be found in Appendix B and the list of participants in Appendix C.

2.0 INTERNATIONAL RESEARCH INSTITUTE (IRI)

IRI was established in 1996 as a cooperative agreement between the U.S. NOAA Office of Global Programs and Columbia University. The vision of IRI is to assist the ability of societies worldwide to cope with climate fluctuations, especially those that cause devastating impacts on humans and the environment. The focus of research activity at IRI is the advancement of skill in predicting climate variations (i.e. El Nino).

IRI has hydroclimatology research projects in many countries, including Brazil, the third largest producer of hydropower in the world. The goal of an IRI pilot study in the in the Parana Basin of Brazil is to use climate forecasts to enhance reservoir management. These forecasts are important to the reservoir managers who must decide to what extent they will increase reservoir releases to safely accommodate incoming floodwaters. Inherent to this decision process are potential tradeoffs. An underestimation of flood volume leaves the reservoir system unable to fully regulate flow and results in water being discarded into spillways, which can result in environmental damage due to flooding and financial loss to the hydroplant due to decreased generating capacity. An overestimation of flood volume can result in drawing the reservoir down too far, causing decreased output/reduced hydraulic head on turbines and less water is available for uses such as public water supply. Financial losses can vary as much as several million dollars per year.

To test whether the use of climate forecasts can enhance reservoir management decisions, IRI will attempt to identify and quantify dominant modes of climate variability, such as ENSO, the Tropical Atlantic Dipole, the North Atlantic Oscillation, and global warming present in temperature, precipitation, and streamflow records in the Parana watershed. IRI will estimate the expected response of Parana streamflow and hydroelectric production variation in these large-scale modes of climate variability and produce ensembles of GCM predictions in order to quantify the complete probability distribution of flooding levels for model and historical data. Three and 6-month lead forecasts of reservoir output will be compared with standard procedures. A stochastic model is applied to model/historical observations (preconditioned on dominant modes of climate) to generate ensembles, which resolve high frequency variability. Using this information, IRI will develop a decision system, which integrates climate and streamflow forecasting to assist reservoir managers in day-to-day reservoir management.

3.0 STATUS REVIEW

Dr. R. Stewart, GHP Chair, continues to consider the qualitative status of GHP, which is reviewed by the CSE Points of Contact (POCs) and utilized as a means of gauging progress on the overall elements of GHP and the specific components that make up the GHP Global Applications and Transferability Strategy (GATS). This effort acknowledges that GHP is moving towards the realization of its goals through several overall efforts and a number of specific ones. Periodically, the status of each of these elements will be briefly assessed. The designations of status will be the descriptors **P**, **F**, **I** and **B**, **Pr** and **C.** These are applied to illuminate the status of the on-going work without any other assessment.

P = In Planning = Activity is underway with definite movement toward implementation

I = Implemented = Plans or projects are in the implementation phase, but may take several years to be fully functioning (e.g., due to funding restrictions or other complications)

F = Functioning = An activity has been implemented and is fully functioning. Schedules are set and delivery of products is assured.

The transition designation such as **I-F**, can mean that implemented studies are producing experimental results and later when this activity is deemed fully functioning the work would be in an operational mode.

B = Beginning = Plans have been implemented and preliminary data has been collected

Pr = Progressing = Data exists to accomplish the task and work is underway to organize it for analysis

C = Concluding = Data is organized into appropriate data bases and analyses are being finalized.
A dual designation i.e. **B-Pr** indicates that most of the work required to collect the appropriate data has been accomplished and structuring of databases has begun.

3.1 Consolidated Status Review

A consolidated overall assessment of the status of GHP in the context of the qualitative measurement scheme the participants recommended at the 1999 GHP session has been updated to reflect the status as of September 2001. The current consensus of the status of the key components of GHP is as follows:

- Water/Energy Budget Closure "Pr"
- Hydrological Modelling (full Coupling) "Pr"
- CEOP "Pr"
- Transferability "B-Pr"
- Predictability "B-Br"
- Water-Resource Community Interactions "Pr"

3.2 Continental Scale Experiments (CSEs) Contributions Matrix

The GHP CSE Matrix of Contributions to GEWEX has been set up to gauge CSE contributions to specific technical/logistical and scientific needs of GHP/GEWEX. The criteria that have been set are associated with work that is necessary for GHP/GEWEX to accomplish its global objectives including the successful accomplishment of CEOP especially that aspect associated with the transferability of results across regions of differing climatic regimes. The matrix is given in Figure 1. Action is on the CSE POCs to review and advise the GHP Chair of any updates to the matrix in the time leading up to the next GHP meeting.

FIGURE 1: STATUS OF CONTINENTAL-SCALE EXPERIMENTS (September 2002)

TECHNICAL/LOGISTICAL CRITERIA	GAPP	MAGS	LBA	GAME	BALTEX	MDB	CATCH
1.) NWP centre atmospheric and surface data assimilation and estimates of hydro-meteorological properties.	F	F	F	F	F	F	P
2.) Suitable atmospheric-hydrological models and numerical experimentation and climate change studies.	F	F	I-F	F	F	F	P
3.) Mechanism for collecting and managing adequate hydrometeorological data sets.	F	F	F	F	F	F	I
4.) Participate in the open international exchange of scientific information and data.	F	F	F	F	F	I	I
5.) Interactions with water resource agencies and related groups to address the assessment of impacts on regional water resources.	F	I-F	F	F	I-F	I	F
6.) Evaluation of GEWEX global data products.	I	I	F	I	I	I	N/A-Not applied
7.)Contributions to CEOP and transferability databases.	I	P	P	P	I	Pr	P
SCIENTIFIC CRITERIA							
1.) Simulate the diurnal, seasonal, annual and interannual cycles.	Pr	Pr	Pr	Pr	Pr	Pr	Pr
2.) Close water and energy budgets.	C	Pr	Pr	Pr	Pr	Pr	N/A
3.) Determine and understand climate system variability and critical feedbacks.	Pr	Pr	C	Pr	Pr	Pr	Pr
4.) Demonstrate improvements in predictions of water-related climate parameters.	Pr	Pr	Pr	Pr	Pr	Pr	N/A
5.) Demonstrate the applicability of techniques and models to other regions.	Pr	B-Pr	Pr	Pr	Pr	Pr	Pr

P Planning	**Activity is underway with definite movement toward implementation**
I Implemented	**Plans or projects are in the implementation phase, but may take several years to be fully functioning**
F Functioning	**An activity has been implemented and is fully functioning. Schedules are set and delivery of products is assured.**
B Beginning	**Plans have been implemented and preliminary data have been collected**
Pr Progressing	**Data exist to accomplish the task and work is underway to organize it for analysis**
C Concluding	**Databases have been organized and analyses are being finalized**

4.0 STATUS SUMMARIES

4.1 Baltic Sea Experiment (BALTEX)

The aim of the Baltic Sea Experiment (BALTEX) is to enhance the scientific understanding of the mechanisms responsible for energy and, in particular, water transports within the atmosphere, the land surface including rivers and lakes and the Baltic Sea with the objective of improving weather forecasts and climate models. BALTEX also is studying the effects of the Baltic Sea on the weather and climatological conditions in the region. A further aspect of BALTEX is the development of better modelling support for flood forecasting and the design of integrated meteorological/hydrological forecasting systems for the area.

Phase I of BALTEX (1993-2002) brought an improved understanding of the energy and water cycle in the Baltic Sea Basin. Phase II builds upon the results of Phase I and enlarges the network of observations. New satellite observations for pre-operational applications will be integrated. Transferability studies will use coupled BALTEX models in several Continental Scale Experiments (CSEs). The enlarged scope of BALTEX Phase II includes:

- Climate variability for 1800-2100, including climate change scenarios.
- Transport of nutrients and pollutants in air and water using regional coupled models.
- Impact analysis (responding to society needs and support decision makers in global change issues related to the Baltic Sea basin).

The Swedish Meteorological and Hydrological Institute (SMHI) Rossby Centre has developed an interactively coupled model, the Rossby Centre Atmosphere Ocean (RCAO) model. RCAO is currently applied to control and scenario climate runs based on global model simulations from the Hadley Centre HC and DMI/MPI, each 30 years long. The control runs show generally realistic means for ocean and atmosphere surface quantities. Recent improvements to the Rossby Centre Regional Climate (RCA) Model include better representation of sub grid variability in soil moisture parameterization and river routing of runoff to the Baltic Sea. Use of the HBV Baltic hydrological model continues to provide estimates of observed river discharge to the Baltic Sea, updated for 2000/2001 using synoptic preparation and temperature observations. SMHI is running the BALTEX Hydrological Data Centre (BRDC) and is currently implementing the Oceanographic Data Centre for BALTEX (ODCB).

BALTEX contributions to the Coordinated Enhanced Observing Period (CEOP) include:

- Reference sites (3+1 new)
- Data archive for MOLTS: MPI Hamburg
- Basin-wide products: Radar and GPS
- Two coupled model systems under development: BALTIMOS and RCAO
- Envisat data and evaluation (extended region)

4.2 GEWEX Asian Monsoon Experiment (GAME)

In 1998, GAME conducted the Intensive Observing Period (IOP) in cooperation with many Asian countries and the international/national projects such as South China Sea Monsoon Experiment (SCSMEX), Chinese Tibetan Plateau Experiment (TIPEX), and Korean Monsoon Experiment (KORMEX). The enhanced radiosonde observations, as well as surface hydrometeorological observations, were operated at more than a hundred stations in the monsoonal Asian countries. Four-dimensional data assimilation (4DDA) of atmospheric fields was conducted over monsoonal Asia, and Version 1.5 of GAME-reanalysis has been released and is available as a CD-ROM set (6-hour interval data, gridded at 2.5 degrees; http://gain-hub.mri-jma.go.jp/). Some scientific results, particularly from GAME-Tropics and GAME-Tibet were reported in the special issue of *Journal of the Meteorological Society* of Japan (Yasunari, ed., 2001). GAME is now in its Phase II, which includes further research and data analysis, some additional process studies, and modeling needed for the synthesis of the overall GAME objectives.

GAME has obtained new scientific results on the hydrometeorological processes in the Asian monsoon region from the Tropics to the Siberian Arctic region. Particularly, the land-atmosphere interaction process in some typical climate and vegetation monsoonal Asia have been revealed in diurnal through seasonal time scales. Cloud and precipitation processes have also been scrutinized in the tropical region, the Meiyu-Baiu frontal zone in the subtropical China, and on the Tibetan plateau area.

A key issue for the energy and water cycle of monsoonal Asia is cloud and precipitation processes and their interaction with large-scale atmospheric circulation. In the GAME region, the interaction with the monsoon circulation, including the influence of surface topography and vegetation is the most important process. As part of GAME-HUBEX and GAME-Tibet, the intensive observation of the 3-dimensional cloud/precipitating systems was observed by using the Doppler-radar systems, with the enhanced radiosonde observations. The interaction between the mesoscale cloud/precipitation systems and the large-scale monsoon circulation is being investigated by combining the objectively analyzed reanalysis data. The regional 4DDA analysis for the HUBEX

region is planned for the detailed interactive process between the mesoscale cloud systems and the ambient monsoon and westerly flow regimes.

Another issue may be the interaction between the cloud/precipitation system and the land surface conditions, including topography and land use/land cover conditions. One important problem may be the role of water-fed rice paddy field (which is a typical land surface condition in monsoonal Asia) in the development and/or modifying of the precipitation systems. The observational as well as model-based evidence of this aspect have been suggested in the tropical (GAME-Tropics) and subtropical (GAME-HUBEX) regions. The large scale and regional scale topography is also a key factor controlling the precipitation system in the monsoon region. The observational as well as modeling studies in the tropics (GAME-Tropics) and in the Tibetan Plateau (GAME-Tibet) have presented some interesting processes in the diurnal as well as in the synoptic-scale. The regional model studies are essential for these problems, including improvement of land-surface schemes and the atmospheric boundary layer processes based on GAME data sets.

GAME has focused on the interaction and feedback processes between land and atmosphere. Observational results of the regional experiments have revealed some important processes on the land-atmosphere interaction, including the roles of snow cover, soil moisture, and vegetation. For example, the regional and continental-scale vegetation, such as tropical monsoon forest in Southeast Asia, and the boreal forest in east Siberia, have been suggested to play an important role in controlling seasonal surface energy and water balance. This role of vegetation, in turn, modifies the seasonal cycle of the climate and atmospheric circulation. Some model experiments also have strongly suggested these processes.

GAME data from the IOP in 1998 have been compared with those of 1999, when the second IOP was conducted in the GAME-Tropics and GAME-HUBEX regions. The anomalies of the overall monsoon circulation and precipitation between these 2 years are well contrasted, so that the inter-comparison of the processes related to the monsoon activity in each region seems to be very beneficial for understanding the interannual variability of the Asian monsoon.

To fully understand the seasonal cycle and interannual variation of the Asian monsoon, GAME will include the large-scale atmosphere-ocean processes and their interaction with land surface processes. GAME modeling activity includes these processes using atmospheric GCMs and coupled atmosphere-ocean GCMs. However, almost all current GCMs have very large systematic errors in simulating the mean monsoon climate and circulation (Kang et al, 2001). For example, the simulated monsoon precipitation on land, particularly near the coast in south and Southeast Asia tend to be far larger than the observation, whereas that over the warm pool region in the western Pacific tend to be smaller compared to the observation. These defects in GCMs both in the seasonal cycle and spatial distribution need to be overcome by improve land-atmosphere as well as ocean-atmosphere processes. The Coordinated Enhanced Observation Period (CEOP) will provide sufficient data for further understanding the Asian monsoon with its interannual variability.

4.3 GEWEX Americas Prediction Project (GAPP)

GAPP is considering processes and factors influencing the predictability of precipitation and hydrological variables in the USA on seasonal time scales and will accelerate the use of this knowledge in global prediction systems and regional applications. In order to give GAPP a sharper focus on predictability and prediction system issues, its first objective has been defined as: ”to develop and demonstrate a capability to make reliable monthly and seasonal predictions of precipitation and land surface hydrologic variables through improved understanding and representation of land surface and related hydrometeorological and boundary layer processes in climate prediction models.” This objective will be addressed through a series of modeling, process, and observational studies in the areas of land memory effects, orographic hydrometeorology, and monsoonal processes. GAPP is also working towards this objective through its involvement in CEOP and transferability studies. GAPP will build upon the data sets, reanalysis products, process understanding and models that have been developed through its predessor, the GEWEX Continental-scale International Project (GCIP). GAPP considers a much larger domain than the Mississippi River Basin and has initiated studies in the southwestern and western USA.

Efforts related to land memory processes are underway with studies of the persistent effects of anomalies in soil moisture, snow cover and vegetation condition. The development of a Land Data Assimilation System (LDAS) had been central to these efforts. Monsoonal processes are being studied in conjunction with CLIVAR/ PACS by support to the North American Monsoon Experiment (NAME). GAPP is currently supporting

several studies to assess the relative role of land surface conditions and SSTs in affecting the intensities and centers of atmospheric anomalies. These efforts are supportive of the new directions in Seasonal to Interannual Prediction that NOAA plans to pursue as it encourages closer collaboration between GAPP and CLIVAR in the seasonal to interannual time frame. Initial studies of the Southwest monsoon indicate that the strength of the Low Level jet in California is inversely correlated with the strength of the Gulf of Mexico Low Level Jet.

GAPP research covers a broad range of issues of importance to the objectives of GHP and WCRP/GEWEX. A number of new GAPP projects have been initiated through joint NOAA and NASA funding that address land surface and monsoonal processes. These include multi-model ensembles in both climate and hydrology, the use of satellite data in model development, the calibration of soil moisture sensors across the USA, and the simulation of the boundary layer over mountain snow pack. GAPP has completed its analysis of the climatology of the Mississippi River basin and distributed its WEBS CD to attendees at its May 2002 Climate and Hydrology Conference in New Orleans (Copies are still available for readers of this report who wish to contact richard.lawford@noaa.gov). GAPP has contributed a number of demonstration studies to the WRAP activities and has undertaken hydrologic model development in support of an Advanced Hydrologic Prediction System (AHPS). GAPP CEOP efforts have resulted in a much broader CEOP effort with the Goddard Space Flight Center now playing a major role in areas such as Global Land Data assimilation, data integration and monsoonal studies. The National Centers for Environmental Prediction (NCEP) are also playing a central role in these efforts.

4.4 Large-Scale Biospheric Experiment in Amazonia (LBA)

LBA is a multi-disciplinary, international research effort, designed to understand the climatological, ecological, biogeochemical and hydrological functioning of Amazonia, its interaction with the Earth system, and its response to land use change.

Over the past year, several levels of climate and hydrological modeling have been implemented and include the CPTEC global model (at a resolution of approximately 70 km and 40 vertical levels), and the Eta/CPTEC regional model with SsiB coupled over South America (with a resolution of 20 km and 50 vertical levels). It can reach up to 10 km using hydrostatic or nonhydrostatic versions of the Eta/CPTEC. LBA has started the downscaling of different climate change scenarios (IPCC) for the Amazon basin and South America using the Eta/CPTEC model nested on the HadCM3 coupled model from the Hadley Centre.

The involvement of LBA in CEOP field campaigns during 2001-2005, and the implementation and planning of field experiments in Amazonia (linked to GEWEX and CLIVAR initiatives) from 2002 to 2005 guarantee the availability of high-resolution time-space data from all CSEs. These experiments are the South American Low Level Jet-SALLEX (SMOCC), and LBA WET to DRY AMC (the last is currently undergoing).

In addition, data from flux towers and radiosonde stations from reference sites all across the basin guarantee the availability of continuous high-resolution data for model validation and improvements. The use of model data from the reference sites (MOLTs) which is available from the CPTEC models, as well as models from other major numerical centers (NCEP, JMA, ECMWF, etc.), and satellite data from the reference sites and basins is also a major advance in science and data analysis, relevant to the objectives of the CSEs.

Currently, there are 102 ongoing field projects in LBA. The CIRSAN experiment quantifies the mesoscale circulation along the Tapajos River in central Amazonia. During the rest of 2002, the LBA-WET TO DRY field campaign will study the atmospheric forcing linked to the dry season and the onset of the rainy season in the southern Amazon, including the role of aerosols from biomass burning, and the South American Low Level Jet field that will take place during January-February 2003. This field experiment will allow for a better knowledge of the moisture transport between Amazonia and the La Plata River Basin.

There are 13 flux towers distributed across the basin that are measuring meteorological, radiative and specific soil moisture measurements. Observations include: surface fluxes of momentum, energy, water vapor and CO_2 exchange by eddy-correlation technique; profiles of soil moisture and temperature/energy flux soil respiration; complete radiation budget including upward and downward longwave components profiles of temperature specific humidity, wind speed, and CO_2 inside the tropical forest. Some of these sites have become LBA reference sites for CEOP.

The Amazon Surveillance System (SIVAM) became operational in July 2002. It includes 13 upper air stations with two soundings a day (00Z and 12Z), plus 70 new stations of surface, 20 lighting detection stations, 10 meteorological Doppler radars, an upgrade of the current surface observational network, and approximately 200 automatic meteorological stations (hydrology, meteorology, water quality).

Fifteen projects were approved for the MCT Millennium Project in Amazonia, including a project on land use and land cover change and the relationship to the carbon cycle. The project also includes more detailed studies of the aerosol CCN/clouds/climate links and the extension of the studies on regional hydrology in Rondonia with a complete ion cromatography and water chemistry facility installed in Rondonia.

The Second LBA Science Conference was held in Manaus, Brazil on July 2002, and more than 200 oral and poster presentations were given on the role of the Amazon region in the local and world climate. A special issue of Theoretical and Applied Climatology will be devoted to this conference. In addition, a special issue of the Journal of Geophysical Research with the major findings of the First LBA Science Conference has been recently published.

4.5 Mackenzie GEWEX Study (MAGS)

The period 2001-02 represents the transition of MAGS from Phase-1 to Phase-2, and the inception of Phase-2 activities. The initiation of MAGS-2 brings a shift in the focus of the research program from data acquisition and experimentation to modelling and prediction. The major objectives of MAGS-2 are:

- Integrate knowledge of atmospheric and hydrological cycles into a unified system
- Develop hierarchy of models for a range of spatial and temporal scales
- Apply improved predictive ability to environmental and social issues

MAGS research in this past year had been focused on addressing the first two objectives. For example, the development of intermediate level coupled models (e.g. coupled atmosphere-surface and coupled surface-hydrologic models) had been completed and preliminary results from these models (e.g. CAGES WY simulations) are very encouraging. The development of a fully coupled atmosphere-surface-hydrologic model is actively underway right now. Other highlight activities of the MAGS program over the past year have been:

- Completion of CAGES Water Year Analysis and holding of the CAGES and MAGS Data Workshop (Edmonton, Mar, 2002); preparation of a CAGES special issue in J. Hydrometeorology
- Holding the MAGS 7th Scientific Workshop (Hamilton, November, 2001)
- Holding of the MAGS Water and Energy Budget Study (WEBS) Workshop (Toronto, May, 2002)
- Holding of the 2nd GAME-MAGS Workshop (Sapporo, October 2001)
- Holding of the Model Cross-Training Workshop (Toronto, September, 2002)

MAGS continues to foster interaction at the national and international levels with other organizations and agencies with common interests (e.g., GAME-Siberia, CLIC, WRAP and CASES).

4.6 Murray-Darling Basin (MDB) Project

Following the recommendation of GHP, the GEWEX SSG at its meeting in 2002 approved the MDB Project as a GEWEX CSE, acknowledging that the project could make an important contribution to GHP/GEWEX global objectives and that the project meets all the established criteria for a CSE.

The objectives of the Murray Darling Basin Project are:

- Monitor in real-time key components of the daily water budget across the MDB on a scale of about 10 km
- Predict routinely key components of the daily water budget across the MDB on a scale of about 10 km up to two days ahead
- Develop real-time products on key components of the water budget across the MDB for use by water agencies

- Observe, understand and model the processes controlling soil moisture in the MDB
- Observe, understand and model the surface fluxes of water, momentum, heat, radiation and carbon in the MDB
- Improve the representation of land surface processes in weather and climate models

The MDB Project was started as a component of the Cooperative Research Centre for Catchment Hydrology (CRC-CH), which involves thirteen Commonwealth and State organizations including three universities, CSIRO and the Bureau of Meteorology. The initial collaboration between Melbourne University and the Bureau of Meteorology Research Centre (BMRC) was focused on the use of soil moisture data from a network of measurements in the Murrumbidgee Catchment to evaluate and improve the representation of the water budget in the BMRC numerical model. Since GHP-7, four other research groups have joined the Project. Macquarie University is developing land surface parameterisations and carrying out parameter calibration and model intercomparison studies (e.g. PILPS, GSWP2, AMIP). CSIRO Atmospheric Research will develop data sets (e.g. land surface reflectance, albedo, NDVI), conduct limited-area modelling, and develop land surface schemes. ANSTO is participating in the Global Network for River Isotopes (GNIP) and modelling activities (such as, PILPS, AMIP, and isotopic studies). CSIRO Land and Water Studies will provide Fluxnet observations and conduct modelling activities involving the carbon and nutrient cycles.

4.7 AMMA/CATCH

The Couplage de l'Atmosphère Tropicale et du Cycle Hydrologique (CATCH) initiative was granted Continental Scale Associate (CSA) Project status at the Fifth Session of the GHP (Hamburg, 1999). This designation acknowledges that CATCH will make an important contribution to GHP/GEWEX global objectives, but recognizes the difficulty CATCH will have in fully meeting all of the CSE criteria. The CATCH initiative has developed from work accomplished during the HAPEX-Sahel experiment that was carried out under GEWEX auspices in Niger from 1991 to 1993. HAPEX-Sahel was a mesoscale experiment aimed at studying atmosphere/ land surface interactions in the Sahelian region of West Africa (Goutorbe et al., 1997). It has been agreed that in order to understand the mechanisms controlling the hydrological variability of the West Africa region it is necessary to study its unique features as a climatic ensemble. Therefore, in 1997, CATCH as a regional experiment that could be undertaken on a time scale that could account for the interannual and decadal variabilities of the water cycle of the region, was promoted.

A new experiment, the African Monsoon Multidisciplinary Analysis (AMMA) is being planned to cover the entire West African monsoon region and will incorporate CATCH. AMMA will implement a multi-scale and integrated monitoring network providing key parameters to perform detailed investigations into the physical and chemical processes influencing the land-ocean-atmosphere system over West Africa with the aim of quantifying interactions within the system, as well as impacts on local, regional and global climate. The aim is to improve the weather forecasts and simulations of the West African climate in models for sub-seasonal to decadal prediction, as well as those used for producing scenarios of future climate change. The observational strategy will include current observing systems, operational observations and long-term observations obtained from ongoing projects, such as CATCH, IMPETUS, AERONET, etc.

AMMA is planned as a multi-year project with three observing periods. During the Long-term Observing Period (LOP), observations in the West African monsoon region from the past 50 years will be collected and analyzed. The Enhanced Observing Period (EOP) will be 2-3 years in duration and have the main objective to document over a climatic transect, the annual cycle of the surface conditions and of the atmospheric state variables at convective-to-synoptic spatial scales. The Special Observing Period (SOP) will focus on detailed observations of specific processes at various key stages of the rainy season during three periods in 2005: 1) monsoon outset, 2) peak monsoon, and 3) late monsoon.

Institutions such as CNES, CNRS/INSU, IRD, and Meteo-France have agreed to sponsor this integrated project. Scientists from Africa, Germany, the UK and the USA are participating in the implementation of AMMA and other countries have shown interest. GEWEX/GHP will be working with AMMA/CATCH as it develops to see how it fits in with the overall GEWEX objectives.

4.8 International Satellite Land Surface Climatology Project (ISLSCP) Global Data Sets

ISLSCP has played a leading role in defining, acquiring and developing data collections for climate change research in collaboration with other projects within WCRP and the International Geosphere-Biosphere Program (IGBP). The ISLSCP Initiative I data set (13,000 CD-ROMs and 289,000 ftp files distributed on request only) produced the first data collection that included monthly surface meteorology, soils, surface routing and runoff, and atmospheric radiation data for 1987-88.

The Initiative II collection, consisting of a 10-year core global data collection spanning the years 1987 to 1995 with improved spatial and temporal resolution (one-quarter to one-degree) using improved data generation algorithms, is being finalized. Initiative II also includes some data sets spanning the 18-year period 1982-1999. This data collection includes carbon data sets uniquely designed to support global carbon cycling studies. A number of WCRP and IGBP initiatives are leveraged on Initiative II, including the GEWEX Global Soil Wetness Project-2, the Global Carbon Observing System, NASA's Seasonal to Interannual Prediction Project and the GEWEX Global Land Atmosphere System Study.

An Initiative III data set is planned that would expand the physical and biophysical near-surface global compilation to over 25 years (1982-2007) and would focus on exploiting the data from the new series of satellite sensors becoming available (TERRA, AQUA, ENVISAT, ADEOS II, etc.), as well as the carbon/biophysical data needed for addressing the broad climate change issues of concern. A major change from Initiative II to III is the increased focus on validation by examining not only the accuracy of the individual data series but also the impact of the errors on components of surface-atmosphere flux exchange. This added component will permit the examination and selection among the several alternative data series that are available to Initiative III, for example, precipitation data, runoff data, and land cover data sets.

4.9 Global Runoff Data Centre (GRDC)

At the request of the World Meteorological Organization, GRDC was established at the Federal Institute of Hydrology in Koblenz, Germany in 1988, to support Global Change Research and Water Resources Assessment by collecting and disseminating stream flow data. GRDC provides a mechanism for international exchange of data pertaining to river flows on a continuous, long-term basis. The scope of data collection is global, regional and river basin scale. More information about GRDC is available at http://www.bafg.de/grdc.htm.

Approximately 150 countries have contributed to the development of the GRDC database, which currently comprises monthly discharge data from over 6,400 stations (of which daily data for 3,400 stations is also available) The average time series length is about 30 years. GRDC is contributing station data for the period 1986 to 1995 to the ISLSCP Initiative II data set.

GRDC aims at cooperation and data exchange with the hydrological data centres of the Continental Scale Experiments (CSEs). However, experiences with the BALTEX Hydrological Data Centre (BHDC) during the past year have shown the potential difficulties involved, as there exist slightly different data policies in BHDC and GRDC.

Based on updated data, GRDC is currently reiterating its estimate of mean annual freshwater surface water fluxes into the world oceans (for the current version of 1998 see http://www.bafg.de/html/internat/grdc/projects/projects.html). Based on a new GIS based methodology involving a digital elevation model (DEM) it will be possible to estimate freshwater fluxes from arbitrary reaches of the coastline. Depending on data availability, GRDC aims to extend this analysis to estimates of individual years later on.

Large numbers of GRDC station data has been used in a couple of global studies including (i) the Global Composite Gridded Runoff Fields (http://www.grdc.sr.unh.edu/, in cooperation with the University of New Hampshire, USA) and (ii) the Global Water Assessment and Prognosis model WaterGAP, which also accounts for water uses (http://www.usf.uni-kassel.de/english/personal/petrasub/watergap.htm, in cooperation with the Center for Environmental Systems Research, University of Kassel, Germany).

The GEWEX community frequently shows interest in estimates of "naturalized flow". This information is not easy to derive for two reasons:

- Availability of data: To date there is no comprehensive global database on man-made structures/schemes affecting water resources and its operation rules.

- Complexity of the hydrological cycle and its tight relation to the energy cycle: Estimating "naturalized flow" requires modelling. If this has to be done on a larger scale it will include processes already covered by GEWEX studies such as WEBS. It thus seems to be more reasonable to incorporate information on regional scale anthropogenic impacts into the existing water and energy balance models rather than develop an offline approach to eliminate it. Moreover, major water resources management schemes, such as the Volga reservoirs and irrigation schemes, are likely to leave their traces in other measurements of regional water and energy cycle components used for calibration of existing models.

GRDC has produced a compilation of GRDC stations close to CEOP MOLTS and reference sites. However, GRDC stresses that the flow rates measured at these stations are, at most, loosely connected to the information modelled or measured at MOLTS or REF-sites. The use of this stream flow information is thus suspected to be rather limited.

GRDC is involved in a GCOS/WMO-sponsored project entitled *Global Terrestrial Network for Hydrology* (GTN-H). Several meetings have taken place to develop an implementation strategy. At these meetings it was recognized that there is a critical need for improved availability and access to global hydrological data, information and products for climate and hydrological research and applications in order to quantify key environmental change processes, identify significant trends, assess variability and develop response strategies. The GTN-H would consist of existing networks, global databases and global data product centres, capturing ten key hydrological variables. The following are the main objectives for the network:

- Respond to urgent information requirements with regard to climate prediction, impacts and adaptation, including the characterisation of hydrological variability to detect climate change.

- Assess water sustainability as a function of water use versus water availability,

- Improve understanding of hydrological processes.

Further information is available from two GCOS-reports of the following two expert meetings:

- Establishment of a Hydrological Network for Climate, Geisenheim, 26-30 June 2000. Report is at http://www.wmo.ch/web/homs/documents/english/geisenheim.pdf.

- Expert Meeting on the Implementation of a Global Terrestrial Network - Hydrology (GTN-H), Koblenz, 21-22 June 2001. Report is at http://www.wmo.ch/web/gcos/Publications/gcos-71.pdf.

Two follow-up meetings are scheduled, the WMO Expert Meeting on GTN-H, 18-20 October 2002 and the GTN-H Panel Meeting, 21-22 Oct 2002, both in Toronto.

4.10 Global Precipitation Climatology Centre (GPCC)

GPCC is operated by the Deutscher Wetterdienst (DWD, National Meteorological Service of Germany) and was established in 1989 at the invitation of WMO as a German contribution to WCRP. The Centre supports the Global Precipitation Climatology Project (GPCP), the Global Climate Observing System (GCOS), and the Arctic Climate System Study (ACSYS). GPCC is active in the GHP and is a component of the GCOS/GTOS Terrestrial Network – Hydrology (GTN-H).

GPCC regularly collects monthly precipitation totals for about 7,000 stations worldwide via the WMO World Weather Watch Global Telecommunication System (GTS). GPCC also acquires additional precipitation data from national weather services, hydrological institutes etc. to enlarge the database. Thus far, institutes from about 160 countries have supplied additional data on a voluntary basis, following WMO requests and bilateral negotiation with GPCC. GPCC's full database includes monthly precipitation totals of more than 50,000 stations for which monthly precipitation data are available in the period since 1986.

The monthly GPCC products, gridded data sets based on rain-gauge observations, are available in two resolutions, 2.5° by 2.5° and 1.0° by 1.0° geographical latitude and longitude, and for two different databases, i.e. near real-time based upon GTS data only (GPCC Monitoring Product) and non real-time including complemented GTS data, and additionally, the data delivered later by national institutions (GPCC Full Data Product). A re-analysis based upon the expanded database (Full Data Product) has been carried out for the period January 1986 up to December 1995 (ca. 28,000 to 40,000 stations). The results have been calculated on a 0.5°-grid (and 1°-grid) and have been provided in January 2002 to NASA/GSFC for publication on the ISLSCP-II CD-ROM.

The Full Data Product delivers sharper gradients due to the higher station density compared to the Monitoring Product. The differences of monitoring and full data precipitation are large where the precipitation itself or the gradient is large, and where the Full Data Product is based on significantly more rain gauges than the Monitoring Product. One reason may be that the heavy rainfall areas, which generally are quite local in extent, are depicted better by a dense station network. However, interpretation of the differences is complicated by the effect of possible errors in the precipitation data of the "Full Data Product", which have not been manually quality-controlled as for the "Monitoring Product". Therefore more research is required before a recommendation pointing toward any one of the two products can be given.

There is a strong demand from the international research community for analyses of daily precipitation. However, going from monthly to daily precipitation analyses, as well as from a 2.5° to a 1° resolution will increase the uncertainties of the analysis products as a consequence of the larger variability of daily compared to monthly precipitation fields and the reduced spatial sampling (less stations per grid). The database is fairly sufficient for Europe for daily precipitation analyses on a 1°-grid, but for most other regions it is clearly insufficient. Another hindering problem are the different precipitation observation and daily summation times in different parts of the world, so that it is not possible to derive a complete global land-surface analysis of daily precipitation from rain-gauge data.

The GPCC started daily precipitation analyses on a 1°-grid for Europe (31°-72° N, 11°W-44°E) on a routine basis with January 1st 2001. The heavy rainfall leading to the extreme Elbe flooding in August 2002 has been analyzed. Preliminary reports (in German) including maps are available on the internet at: http://www.dwd.de/de/FundE/Klima/KLIS/prod/spezial/regen/index.htm. Reports on earlier flooding events, i.e. Odra, 1997, Yangtze, 1998, Wisla, 2001 can also be found there.

A new operational method for correction of daily gauge data due to systematic measuring errors has been developed at the University of Vienna (F. Rubel) in the framework of BALTEX. The new method for on-event correction is based on synoptic data and has been extended for applications on a global scale in co-operation between Dr. Rubel and GPCC. This method was adapted for the GPCC to correct global daily rain gauge measurements routinely transmitted via GTS.

Intercomparison studies between Legates' climatological correction and the on-event correction method have been carried out for the regions of the GEWEX Continental Scale Experiments except MAGS. Overall the new method gives slightly lower correction factors than Legates' bulk correction, mainly because Legates' method seems to have a tendency to overestimate the correction in the case of snowfall, but also for intense tropical rains. Up to now the new method is not applicable in the GPCC Monitoring or Full Data Product because the method requires the full information from SYNOP data, which is not available from the large collective of raingauge-only stations. The development and implementation of an interpolation technique for the SYNOP-based correction factors to non-SYNOP stations is planned for the current year.

The GPCP operationally provides a new product of daily global precipitation on a 1° by 1° grid (http://www.ncdc.noaa.gov/wdcamet-ncdc.html) termed GPCP-1DD (satellite-based, adjusted on a monthly basis to match the GPCC analysis). The GPCC validates this product regionally using precipitation data being collected for the Baltic Sea Experiment (BALTEX) and for the Mesoscale Alpine Project (MAP) from national high-resolution surface networks. A more detailed study investigating the occasional discrepancies between GPCP-1DD and rain gauge analyses with regard to large-scale synoptic patterns is based on the daily high-resolution gauge analyses for the BALTEX area for the 4-year period 1996–1999. This study will be completed in 2002.

A research project Variability Analysis of Surface Climate Observations (VASClimO), which is funded by the German Climate Research Programme (DEKLIM), began in October 2001 in co-operation with GPCC and the Institute for Meteorology and Geophysics, University of Frankfurt/Main. The two main goals of VASClimO are: 1) the compilation of a comprehensive global climate data base for precipitation, snow cover, surface air temperature (average and extremes) and mean sea level pressure, including existing historical data collections and additional data to be acquired, and 2) a detailed statistical analysis of the data set.

GPCC is funded by the German Polar Research Programme to continue operation of the Arctic Precipitation Data Archive (APDA). The new project (follow-up to an earlier ACSYS-APDA project) began on 1 September this year and will continue until March 2005. Its aim is to collect and analyse snow depth data and to develop an improved Arctic precipitation climatology.

4.11 IAHS/WMO Working Group on GEWEX

The International Association of Hydrological Sciences (IAHS) Decade on Prediction in Ungauged Basins (PUB) is an international research initiative to promote the development of science and technology to provide the hydrological data where the ground observations are needed but are missing. PUB has been initiated in response to the decline of ground based observation network in Africa, Central Asia, South-East Asia and elsewhere, including North America. The hydrological data are urgently needed, especially in developing countries, for water resources assessment and efficient management. PUB will draw contributions from theoretical hydrology, remote sensing, *in situ* observations combined with modelling of water quantity and water quality, and capacity building for people in need of advanced science and technology to predict the hydrological phenomena of basins within their jurisdiction. PUB will have connectivity with existing programs in and out of IAHS that are concerned with predictions of hydrological responses, and will provide a forum, a network and the theoretical framework for integration of all existing related initiatives.

Some of the tasks of IAHS for PUB are identified as: developing a coordinating role as the voice of the international hydrological community in related programs; identifying science needs and opportunities that can help focus the attention of funding agencies; promoting the initiation of national and multinational projects on the scientific issues of interest to PUBs; organizing a series of scientific events (symposia, seminars, workshops) in support of the PUB scientific issues and technology transfer to developing countries; facilitating agreements necessary to make data and model output freely available, and develop protocols for archiving of catchment data and model output; facilitating “self testing” activities, in addition to coordinated inter-comparisons, through enhanced data access and archiving policy; and demonstrating the economic and environmental value of existing traditional gauging networks.

Following a Workshop on PUB attended by 70 people from 15 countries held in Kofu, Japan in March 2002 the resulting plan for PUB was approved by the IAHS Bureau in June 2002. The Kickoff Meeting of PUB will be held in Brazilia 20-22 November 2002. At the Third World Water Forum, Kyoto, Japan March 2003 there will be a PUB Workshop, “Hydrology for Society: What can hydrology do in ungauged basins?” At IUGG/IAHS in Sapporo, Japan in July 2003 there are two PUBs activities - HS01, International Symposium on Erosion Prediction in Ungauged Basins (PUBs): Integrating Methods and Techniques and HW07, International Workshop Towards a Science Programme for the Prediction of Ungauged Basins. Further details on PUBs can be found on the IAHS Website at http://www.cig.ensmp.fr/~iahs.

The Second International MOPEX Workshop, Tucson, Arizona, April 8-10, 2002, was designed to bring together interested US and international hydrologists and land surface modelers to exchange experience in developing techniques for *a priori* estimation and calibration of hydrologic model parameters. Participants of the Workshop were given data for 12 basins selected in the Southeastern United States and were asked to carry out a set of numerical experiments using a priori parameters as well as calibrated parameters developed for their respective hydrologic models. More than 30 scientists from 8 countries directly participated in the workshop and a few more have submitted results of their hydrologic model simulations to the workshop. Due to the preliminary nature of the results of the 8 participating models, only a brief analysis was conducted to understand the differences in the results from various models. More complete results will be obtained and further analysis undertaken to help MOPEX participants to enhance their parameter estimation procedures. From the discussions at the Workshop it was agreed that future MOPEX activities will have two thrusts. The first is to push forward on developing improved *a priori* parameter estimation techniques. The second is to work together on a few key science areas to broaden community participation in MOPEX. There was considerable discussion about science issues. Each participant submitted a list of five important science issues. These will be used by

the Workshop organizers to propose the focus science areas for MOPEX and to foster collaborative activities in these areas. A report of this Workshop is being prepared for the MOPEX website, http://www.nws.noaa.gov/oh/mopex. A third MOPEX workshop is scheduled for July 2003, in Sapporo, Japan, as a part of the 22nd IUGG General Assembly – HW08 International Workshop on Parameter Estimation Techniques. This will precede the HW07 PUB Workshop as parameter estimation and transferability will be an important component of the PUB initiative.

The current MOPEX database concentrates on 438 US basins with 1948-1997 hourly precipitation and daily streamflow which meet the basin selection criteria. A subset of 188 US basins is being used in the validation strategy for the North American Land data assimilation (N-LDAS) project. In the last year data sets for 18 UK basins were contributed by the Center for Ecology and Hydrology (CEH, formally IH) and Meteo France contributed 18 basins from the Rhone River study area. Additional data sets have been promised from Sweden, the Ruhr basin in Germany, Canada, Japan and Tanzania.

4.12 North American Monsoon Experiment (NAME)

NAME is an internationally coordinated, joint CLIVAR-GEWEX process study aimed at determining the sources and limits of predictability of warm season precipitation over North America, with emphasis on time scales ranging from seasonal-to-interannual. Field activities in the core region of the North American monsoon will occur during the summers of 2003-2004, including build-up, field, analysis and modeling phases (2003-2008).

Some anticipated benefits of NAME that will contribute directly to CEOP objectives include 1) joint international experience in the exploitation of in situ data and new satellite sensors measuring atmospheric, surface and hydrological parameters over the Americas; 2) joint international experience in assessing the capabilities and limitations of assimilated data products for capturing these parameters; 3) the production of consistent data sets over North America that can act as test beds for the validation of numerical model products and remote sensing data; 4) advancements in coupled model development over land and ocean areas; and 5) advancements in the development of the climate observing system (including land-based and ocean-based components).

4.13 PLATIN

After the presentation of the PLATIN science plan at GHP2001 (available at http://www.clivar.org/organization/vamos/#ACTIV) the panel considered that the program addressed important scientific issues that have substantial water resource implications, particularly related to the connection with the water cycle in the Amazon and the role of the Pantanal Marsh. GHP2001 encouraged the involvement of resources and experts from participating countries to address this problem without negatively affecting the critical LBA hydrometeorological activities. GHP2001 also considered that to ensure that the effort can fully contribute to (and benefit from) the overall global effort, the project's science plan should carefully consider its associated data management aspects.

The GHP2002 report on PLATIN was concentrated on new advancements in the funding of PLATIN and the proposal for PLATIN to be considered as a CSE, using the data management structure of LBA.

A large multidisciplinary program entitled "Climate variability and change in the Plata Basin water resources sustainable development" is in the process of submission to the Global Environmental Funding (GEF). The first activity of this project is entitled: "Prediction of the impacts of climate variability and change in the hydrology of the Plata Basin" and it is focused on: (a) Variability and climate change (global to regional perspectives), (b) Climate variability and change in selected parts of the basin, (c) Hydrological behavior of the basin and main sub-basins under different climate scenarios, (d) Time evolution of the river discharge and surface runoff in the main rivers of the basin and (e) Extreme climatological events such as flooding and drought. The GEF project is an initiative of several research and management groups and coordinating committees:

- PROSUR - an Inter- American Institute for Global Change Research (IAI) project on climate variability in the Plata Basin involving (several universities/research institutions in the Plata Basin);
- RIGA – Environmental Management and Investigation Network for the Plata Basin (a Non Governmental Organization);

• AAAS – strong link to the International Research Institute for Climate Prediction (IRI) and with a focus on applications;
• CIC - The Plata Basin Intergovernmental Coordinating Committee.

The fact that a GEF project is involved is a guarantee that besides institutional support by universities/research institutions, the participating nations support the goals of the program. PLATIN will play a major role in GEF program as the leader in the climate variability and change issues. PLATIN activities will have an important benefit to the operational hydrometeorological forecast as well as a positive contribution to the understanding of the impacts of global change, including land use change, on the regional hydrometeorological system.

The data management structure of PLATIN is expected to capitalize on the LBA structure. However, there is no clear commitment yet from regional weather services. This is a critical issue, which depends on the national weather/hydrological services involvement in research activities. The GEF project will be fundamental to overcome some of these difficulties in view of the official commitment by the participating nations. The Brazilian Center for Weather Forecasting and Climate Research will play a fundamental role in PLATIN as the NWP center which has implemented a state-of-the-art atmospheric and surface data assimilation procedure, and will deliver estimates of hydro-meteorological properties in a form directly comparable to observables. From this point on the presentation stressed the technical/logistical and scientific criteria for acceptance as a GEWEX Continental Scale Experiment.

5.0 WATER AND ENERGY BALANCE STUDY (WEBS)

One of the major objectives of the GEWEX Continental Scale Experiments (CSEs) is to assess the accuracy to which water and energy budgets can be characterized and "closed" on a continental scale. This was recognized as a major GHP initiative at the 1998 meeting in Boulder and thereafter, WEBS became an established GHP wide initiative. A number of workshops have been held at subsequent annual GHP meetings, including GHP-8. The purpose of these workshops has been to summarize all of the CSE WEBS activities and to begin to develop a global water and energy budget synthesis, which could provide a possible break point for the transition of CSE WEBS to future Coordinated Enhanced Observing Period (CEOP) Water and Energy Simulations and Prediction (WESP) activities. The following WEBS activities were reviewed at the WEBS workshop and summarized.

Using representative models, available observations and various reanalyses, GCIP WEBS has produced a CD-ROM, which is available from the International GEWEX Project Office. A summary article has been submitted to the GCIP3 special issue. MAGS WEBS has started budget studies over the Mackenzie Basin using numerical weather prediction, as well as regional climate models. These show general agreement with available measurements for some parameters but problems with others (such as orographic precipitation). LBA WEBS is using a combination of station rainfall and the NCEP re-analysis to characterize the annual cycle of critical water budget parameters and their variations for the northern and southern sections of the Amazon River Basin. Future efforts will involve CPTEC analyses. BALTEX WEBS studies have been hampered while waiting for funding. GAME WEBS is developing a comprehensive data set through a special re-analysis effort by JMA and the bringing together of many observational measurements taken over many of the GAME regions of Asia. Model studies are using a hierarchy from high-resolution reanalyzes from JMA and standard re-analysis products from NCEP. AMMA/CATCH is using reanalysis to identify the sources of moisture for the Sahelian rainfall. It has also been shown that GCMs do not reproduce correctly the monsoon onset. The influence of rain variability on the computation of catchment water budgets is also explored. MDB WEBS has begun by examining individual weather events but future climatic efforts are being contemplated. The Global Land Data Assimilation System (GLDAS) project is using a combination of NWP modeled and observation-derived data to force and constrain (via data assimilation) multiple, sophisticated land surface models at 1/4 degree spatial resolution, 60S - 90N, on a 15 minute timestep. ISLSCP is producing consistent surface forcing data for the 1989-95 time period and is proposing an ISLSCP follow on (1996-present).

To summarize, the GHP has been working on individual CSE WEBS for some time and we really need to begin to bring this together, despite the different levels of WEBs maturity in the individual projects and despite the different level of maturity for the global products. Such an effort could lead to a global understanding and pave the way for the development of a GEWEX-wide WEBS.

Although there were a number of widely differing opinions, the GHP-wide community encouraged us to move forward on the development of a GHP WEBS and to encourage the eventual development of a global GEWEX WEBS. Several ad-hoc meetings were subsequently held during the GHP meeting to develop a detailed plan for the GHP WEBS. It was decided to begin by first making available the NCEP reanalysis WEBS products, the GPCP precipitation, the GRP radiation products, the GRDC climatological precipitation, to each of the CSEs and ask them to use these as products to develop regional WEBS following the general outline developed by GCIP WEBS as well as the recent global paper by Roads et al. (2002 J. Hydrometeorology). Such a regional comparison should make use of not only the global products but also regional products available from each of the CSEs. Global products covering the 1987-2001 time period should be available toward the end of the year. These years are limited mostly by the availability of GEWEX water vapor data (1987-1998), although further limitations may occur depending upon availability of regional data. At the same time, there are a number of interesting interannual features that could be covered within each CSE and it would be desirable to perhaps look at even longer time periods. However, the desired coincidence in time may further limit this period and it may well be that we should consider an even shorter time period. Further GHP WEBS meetings have been tentatively scheduled around two upcoming WEBs sessions at the AGU/EGS meeting in Nice, France in the spring 2003, and the IUGG meetings in Sapporo, Japan. We will attempt to meet at these times so that we can accelerate progress toward a GHP WEBS before the next WEBS workshop at the annual GHP meeting in the fall of 2003.

6.0 GHP DATA MANAGEMENT WORKING GROUP (DMWG)

The DMWG was formed in 1999 to assist in the coordination and facilitation of observational data sets from the Continental-Scale Experiments (CSEs) and ISLSCP. The broader modeling community will use coordinated ground, atmospheric and satellite measurements of the type taken during these experiments to test such formulations as prognostic cloud schemes and the representativeness of related interactions being implemented in their global models. This process can be made much more efficient if these data sets are gathered into a uniform database easily accessible by the various modeling centers represented across the CSEs.

During the 2001-2002 period, the DMWG membership remained stable and they worked on the following tasks:

1. Maintained the DMWG Web Page located at: http://www.joss.ucar.edu/ghp/ . Each member was asked to update their data policy, access, and protocol. The DMWG page(s) were re-organized and additional information was provided. In addition, a DMWG e-mail alias was maintained to facilitate communication between DMWG members (ghp-dmwg@joss.ucar.edu).

2. Several GEWEX CSE's submitted gridded data sets for distribution as GHP data sets. These data sets were archived and are available from the DMWG Web page (under "data access").

3. A presentation including DMWG activities was presented to the CLIVAR Scientific Steering Group in May 2002. Discussions included ways to keep data activities between the projects better coordinated. Initially, appropriate WWW links to CLIVAR data activities were added to the DMWG Home page. Plans are in place for a September 2002 visit by the DMWG chair to the International CLIVAR Project Office (Southampton, UK) and WCRP (Geneva, Switzerland) to discuss broader data management coordination between programs.

4. Most of the DMWG work this year involved the organization of CEOP data management between the various CSEs. A CEOP Data Management Web page was maintained and is available directly at: http://www.joss.ucar.edu/ghp/ceopdm/. Links are available to CEOP data sets and metadata, documents, information regarding Reference Sites and Model Location Time Series (MOLTS) profiles (both global and regional), and other pertinent links. This Web page is linked to both the CEOP, GHP, and the DMWG home pages.

5. An inventory of CEOP Reference Sites was initiated and is continuously being updated. A matrix table is located directly at: http://www.joss.ucar.edu/ghp/ceopdm/rsite.html and summarizes specific information and metadata about the individual Reference Sites (locations, descriptions, maps, site contacts, sample data sets, instrumentation, parameters measured, etc.).

6. A March 2002 CEOP "Kick-off" meeting was conducted in Tokyo, Japan. This meeting brought together Reference Site Managers and a Draft Reference Site data policy (including data exchange) was developed. This policy (based on a modification of the BSRN data policy) was later approved by the CEOP SSG. The complete data policy is available from the CEOP Data Management Web page or directly at: http://www.joss.ucar.edu/ghp/ceopdm/ceop_policy.html.

7. A request to the CSEs was submitted in May 2002 for Reference Site Data collected during the CEOP first Enhanced Observing Period (EOP-1) from July through September 2001. Data sets began arriving at UCAR's Joint Office for Science Support (JOSS) in August 2002. These data sets are being analyzed for development of a "compositing" strategy. See further details under the DMWG Action Items section.

8. Each of the DMWG members was asked to update information on satellite data holdings currently in their archives. This information included satellite name, channels, spatial coverage, temporal and spatial resolution, data format, and period of archive(s).

9. A meeting (August 2002) was conducted at NASA's Goddard Space Flight Center to coordinate U.S. CEOP activities. Discussions involved strategy to incorporate U.S. CEOP data activities with the global CEOP.

7.0 WATER RESOURCES APPLICATION PROJECT (WRAP)

Recognizing that the GHP needed to develop stronger links with the water resource community, a WRAP Working Group was formed in the Spring of 2000. The first WRAP workshop was held in conjunction with the Third International Conference on Water Resources and Environmental Resources (ICWRER) and co-organized with IAHS/WMO Working Group on GEWEX, July 22-26, 2002 in Dresden, Germany. The broad objective of the workshop was to initiate a dialogue with water managers on their needs and the GEWEX data/model products that are available to address those needs. This was intended to identify useful forecast/modelling products for water managers, understand how these are used in decision-making, and determine preferred product delivery mechanisms. A report of the workshop was published in the August issue of *GEWEX News* and will also be published in the IAHS newsletter.

A WRAP working group meeting was held on September 9th at Columbia University, New York City. Discussions at the meeting included the WRAP contribution to first World Water Assessment Report, a WRAP web site, collaboration with WWAP to review scientific indicators for global water resources assessment, CSE-based user workshops and transfer of knowledge between CSEs, and a journal article on demand for GEWEX hydroclimatological inputs to water resource management.

The next WRAP workshop will be held at the IUGG in Sapporo, Japan, June 30 - July 11, 2003 (JWH02 The Role of GEWEX Hydrometeorological Science in Improved Water Resources Management)
Presentations are invited on:

– Case studies on the use of GEWEX products
– Planned GEWEX products under development
– Varying needs of water resource managers under different climates
– Quantification and effects of errors and/or bias in models
– Assessment of risk and the quantification of the probability distribution associated with GEWEX products
– Coupling atmospheric and hydrologic models for water resource applications.

8.0 TRANSFERABILITY OF REGIONAL MODELS BETWEEN CSES

The BALTEX Pilot Study for Intensive Data Collection and Analysis of Precipitation (PIDCAP) was chosen at GHP-7 in September 2001 for a pilot transferability study for regional atmospheric models with a main focus on water and energy budget components. In November a concise information package was compiled for this transferability study and in December an email including the information package was sent to several CSE representatives. In March 2002, a high resolution analysis data set was made available for initial and boundary conditions via Internet.

The following table lists the models taking part in the transferability study. Additional models are welcome (contact B. Rockel via email: rockel@gkss.de).

CSE	Representative	Name of Model
GAPP	Roads	RSM
MAGS	Szeto	CRM+CLASS
GAPP/PLATIN	Berbery	Eta
BALTEX	Rockel / Jacob	8 different model versions

Initial and boundary conditions are from the High Resolution Limited Area Model (HIRLAM) regional analysis from the Danish Meteorological Institute. Simulations can be performed either in forecast mode (i.e. 30h forecasts starting each day at 00 UTC) or in climate mode (continuous three months simulation). Results will be compared to several observational data sets regarding the energy and water cycle components (e.g. precipitation, runoff, precipitable water).

Within the next year the simulations of different regional atmospheric models over the BALTEX area will be performed and analyzed with main stress on the energy and water cycle components. A future perspective may be using the CEOP model data to drive the regional models and compare their results with CEOP observations.

9.0 PREDICTION AND PREDICTABILITY STUDIES

During the GHP-7 meeting in Paris 2002, a proposal was presented for a study that would assess the seasonal to interannual predictability for each CSE region and provide linkages to global (monsoon) circulation studies. Hydrologic modeling and *in situ* characteristics, river routing, etc., would provide basis for studies on "hydrologic predictability", especially important for applications to hydroelectric generation and agriculture. The CSE data sets could be used for verification of skill and validation of model at regional and global scale. The Centro de Previsao de Tempo e Estudos Climáticos (CPTEC) is carrying out some studies in liaison with the Amazon basin using seasonal forecasts from IRI, ECMWF, and CPTEC using different skill scores (ROC, Brier scores, LEPS, Anomaly correlation). This is primarily for rainfall, but will be extended to air temperature too. Even though the validation and predictability assessments are made using global data sets (CMAP, CRU), CPTEC also started to use GEWEX global products (ISCCP, GVAP, GPCP). We would expect some data sets and input from the other CSEs to extend CPTEC studies to the other major basins of the world under the umbrella of GEWEX. The Water and Energy Simulation and Prediction (WESP) component, together with the monsoon component would take advantage of the knowledge and interactions generated by predictability studies.

It is feasible to do seasonal to interannual climate variability studies, including simulations and model validation, predictability assessments and studies in Brazil at CPTECD/INPE, using the CPTEC AGCM. Examples are given below.

LBA-related seasonal to interannual climate variability studies, including simulations and model validation predictability assessments are:

- Feasibility studies at CPTEC/INPE, using the CPTEC/COLA AGCM, for the CSEs in South America (Amazonia and La Plata basins) and other regions (Northeast Brazil).
- Initial results based on 10 years (1982-91), 9 members, new developments at CPTEC include 50 years (1950-2000) with 10 members curently being run at IRI.
- Boundary conditions: observed SST anomalies.
- Regional modeling experiences: Eta/CPTEC for seasonal and interannual climate simulation and prediction.
- Assessment of predictability and skill scores at regional and global levels

- Assessments on the hydrologic cycle in both South America's CSEs, using regional data, with the idea of checking on the closure of the water balance, the sensitivity of its components to situations such as El Nino of scenarios of global warming, and the dependence of each of the components of the water balance to errors in measuremens and in model parameterizations (if reanalyses are used to estimate evaporation and moisture conbvergence).

GHP needs to develop a regional strategy (CSEs) leading to a global strategy (GHP, GMPP, WGNE) for guidance for model validation and predictability assessments, which includes:

- Testing several GCMs for one CSEs/test all CSEs with one GCM, or both. This could follow the example of the AMIP model.

- Taking advantage of the regional knowledge for each CSE to validate regional climate simulations from several models. GMPP, GRP, GPCP, etc.. can provide a set of observational data sets usable for validations of estimates of water and energy balance terms from several GCMs (IRI, AMIP) to assess predictability.

- Developing a Task Force Group chaired by GHP to deal with simulation, predictions and predictability.

- Using IRI experience in the model's predictability assessment.

- Interacting with other GEWEX and CLIVAR groups for key regional aspects (WEBS, NAME, MESA) for prediction and predictability studies.

10.0 CARBON CYCLE STUDIES

At GHP-6 it was agreed to form a working group to consider issues related to the role of the carbon cycle in GEWEX relevant research. Each CSE agreed to nominate a representative to support the work of the group. This GHP-wide activity is progressing relatively slowly although carbon research efforts are advancing within several CSEs. The issue of the WCRP contributions to improved understanding of the role of the carbon cycle in the global climate system extends beyond GHP and requires close coordination within WCRP and other international frameworks. In particular, it will be necessary to ensure there is effective coordination with the IGBP efforts in this area, either through iLEAPS or some related initiative.

Examples of research being undertaken in carbon are the IGBP/WCRP/IHDP "Carbon Project", the CEOS/TCO Carbon team (terrestrial and ocean) (Terrestrial Carbon Observing program = TCO), and many highly visible regional/continental "carbon initiatives" (CarboEurope, North American Carbon budget study, Australia, LBA, etc.) Possible activities for a GHP contribution to carbon research is to contribute to a scientific basis for determining if, when and where land areas are a sink for CO_2. GHP could also provide enhanced observations and predictions for geophysical variables. R. Lawford has agreed to monitor progress and make recommendations for further action at the next GHP meeting. CSE representatives are asked to send him comments on new directions for CSE efforts in this area.

Carbon issues/questions that GHP could address include:

- How can we most effectively coordinate energy flux and CO_2 flux measurements?
- How can we effectively link interactive vegetation models and ecosystem carbon models?
- How can we use column measurements of CO_2 to understand lower atmosphere and land surface processes?
- What can we contribute to the debate on whether land areas are a sink or source for atmospheric CO_2?

11.0 CLIMATE AND CRYOSPHERE (CLIC) STUDY

CLIC and GEWEX organized a workshop on the determination of solid precipitation in cold climate regions, which was held in Fairbanks, Alaska on 9-14 June 2002. Over 50 invited scientists representing 13

countries participated in this workshop. The primary objectives of the workshop were to review the current status of measuring or determining precipitation, especially solid precipitation, in cold climate regions and recommend actions that will allow precipitation to be determined over a range of time and space scales for climatological and hydrological analyses, regional water budgets, validation and process experiments and models. The workshop program and the abstracts for all the presentations are available at: http://acsys.npolar.no/meetings/precip/ws.htm. The proceedings for the workshop will be published by WMO/WCRP by the end of 2002.

Some of the recommendations made at the workshop include:

- Establish a WCRP working group to develop guidelines on the minimum station density required for climate research studies on solid precipitation in cold climate regions.

- Conduct urgently needed research to determine how to obtain climate quality data from automated weather observing systems—need to define and attribute "climate"-quality to operational weather observing systems/sites.

- Develop a strategy for exploiting new technologies in the development of algorithms and models for third and fourth generation precipitation climatologies.

- Use daily precipitation as a building block for precipitation climatologies.

12.0 IAEA ISOTOPE HYDROLOGY

This presentation focused on the International Atomic Energy Agency's (IAEA's) program in Isotope Hydrology and the application of isotopes for tracing moisture sources in precipitation. The IAEA's Global Network of Isotopes in Precipitation (GNIP) has been collecting global isotope data in precipitation and these data, in particular, stable oxygen and hydrogen isotope compositions reflect the climatology of precipitation and its moisture sources. A specific case study from the Asian Monsoon region was discussed in detail. Precipitation in the Asian monsoon system is controlled primarily by two large scale, low level circulation systems that are modulated by sea surface temperatures (SSTs) in the Indian and Pacific oceans. The western system produces the South Asian or Indian monsoon roughly between 70-100°E and 10-30°N, covering the Indian subcontinent and the Bay of Bengal. The eastern circulation pattern produces the Southeast Asian monsoon roughly between 100-130°E and 5-25°N, covering South China Sea, western Pacific and Indo-China. Air circulation in this area is related to the easterlies in the tropical western Pacific, northerlies from the South China Sea, and southwesterlies across the Korean Peninsula and Japan.

Amount weighted annual means of isotopic composition of present day precipitation from Yangon, Myanmar, located in the Indian Ocean monsoon regime, are heavier (less negative) compared to those from Bangkok, Thailand, and Manila, located in the Pacific Ocean monsoon regime. Observed differences in precipitation isotope compositions are consistent with different circulation patterns and moisture sources. Moisture in the Indian monsoon is derived from the southern Indian Ocean and the Bay of Bengal with only minimal transport (and rainout/recycling) over the continental areas. In the South-East Asian monsoon, the moisture source appears to be a mixture from low and high latitudes. The high latitude moisture is transported over northeast China to the South China Sea and the Pacific and consequently has more negative isotope values due to rainout over continental areas.

In addition to the above study, other ongoing efforts to better characterize continental scale water balance, through isotope monitoring of river flow, and to understand the relationship between isotope and upper-air physical data were included in the presentation.

13.0 GCM PASSIVE TRACER DIAGNOSTICS FOR REGIONAL WATER VAPOR

The NASA Data Assimilation Office (DAO) has adapted passive tracer methodology to the Finite Volume GCM (FVGCM) to simulate the movement of regional sources of water (following Koster et al., 1986 and documented by Bosilovich and Schubert, 2002, in the NASA GEOS GCM). These passive tracers are termed

Water Vapor Tracers (WVT) because they simulate the model's water vapor prognostic variable at the model time step. The model dynamics and physics compute tendencies for the WVT in proportion to the model's water vapor. While the WVTs evolve according to the model dynamics and physical parameterizations, they are entirely passive, in that they do not affect the simulated hydrological cycle. Evaporation within a limited region is used as the source for a WVT. The amount and location of precipitation that falls can be diagnosed because of evaporation from each region. The FVGCM uses semi-Lagrangian advection that is particularly useful for tracer calculation.

The WVTs provide a diagnostic tool to evaluate the hydrologic cycle in atmospheric numerical models. The diagnostic considers the instantaneous evaporation and precipitation rates as well as transport processes. Such diagnostics should be useful in evaluating the water cycle of extreme conditions such as flood and drought, as well as the intensity of regional water cycles in climate change experiments. Of course, the quality of the WVT diagnostics depends on the veracity of the GCM simulation. At present, DAO is implementing the WVT diagnostics in their Data Assimilation System to evaluate real data case studies and the impact of water vapor assimilation on the hydrologic cycle. These diagnostics may be useful in other studies, such as synoptic meteorology, mesoscale meteorology and paleoclimatology. It may also be possible to validate the WVT diagnostic data with precipitation isotope data.

For more information about the DAO's use of GCM passive tracer diagnostics, see the article "GEWEX CSE Sources of Precipitation Using GCM Water Vapor Tracers" by Bosilovich, et al., in the August 2002 issue of *GEWEX News*.

14.0 GEWEX RADIATION PANEL (GRP)

The GRP Chair (W.B. Rossow) presented a brief overview of the status of the global satellite data sets, outlined the thinking behind the idea to attempt to complete the quantitative description of the global energy and water cycles, and discussed the key contributions that GHP could make to this effort.

The Global Precipitation Climatology Project (GPCP) now has two products available: one with 2.5-degree and both pentad and monthly resolution covering 1979-2001 and one with 1-degree, daily resolution covering 1997-2001. GPCP is working to develop a new version of these data that is anchored on the TRMM results. The Surface Radiation Budget (SRB) project is about to release shortwave (SW) fluxes covering 1983-1995; the longwave (LW) fluxes will be released early next year. Both SW and LW fluxes for 1996-2002 will be available in summer 2003. It was noted that a research surface radiation flux product, similar in concept to SRB, is now available for 1983-2000 from NASA Goddard Institute for Space Studies (GISS). These two projects provide the main forcing data for land surface processes.

Additional GRP projects are the International Satellite Cloud Climatology Project (ISCCP) provides cloud and surface property information covering 1983-2001 at 0.3 and 2.5 degrees, 3-hr and monthly resolutions. As soon as the calibration standard is transferred to the new AVHRR that began operation in late 2001, the ISCCP processing will be advanced through 2002 by spring of 2003. The ISCCP cloud products are used by SRB (and the research project at NASA GISS) to determine surface radiative fluxes. The Global Aerosol Climatology Project (GACP) has released a tropospheric aerosol product (ocean-only) covering 1983-2001 at 2.5 degree, monthly resolution.

Now that the various GRP projects provide global precipitation, clouds, aerosols and top-of-atmosphere and surface radiative fluxes covering almost two decades, these data could be combined with the operational sounder products (atmospheric temperature and humidity) and the reanalyses (atmospheric circulation) to determine the global energy and water cycles "if" some source of surface evaporative fluxes could be obtained. To this end, the GRP organized SeaFlux to figure out how to get the turbulent heat and water fluxes over oceans from satellite data. A similar effort is needed over land areas, including refined determinations of surface skin temperatures and methods for determining turbulent heat and moisture fluxes that use quantities that can be inferred from satellite observations. The GHP projects can contribute directly to this goal by participating in a coordinated effort that would include testing of process models and satellite-based measurements or inferences against the CSE and CEOP datasets. The GRP chair made three requests: (1) that the GHP and its CSEs forward suggestions of interested participants and experts who could join such a pan-GEWEX effort (called LandFlux) to the GRP chair who has been asked to lead the effort for GEWEX, (2) that the CSEs now specifically focus attention on using their field data to verify the global precipitation, surface radiative flux, cloud

and aerosols datasets and also provide specific datasets to the GRP projects for such purposes and (3) that the CSE's specifically identify datasets for the verification and/or improvement of satellite determinations of land surface skin temperatures and near-surface atmospheric properties.

The last two requests should now be easier to carry out as the GRP project data management activities have now been consolidated into a single Working Group that can directly interact with the GHP Data Management Working Group to facilitate the collection and exchange of data sets.

15.0 GEWEX MODELLING AND PREDICTION PANEL (GMPP)

The GEWEX Modeling and Prediction Panel (GMPP) has the objective of developing the numerical representation of the processes linked to the water and energy cycle in the climatic system. The focus is on three topics, clouds, land-surfaces and the planetary boundary layer. These processes share one important characteristic: a very high spatial heterogeneity. This Panel includes the GEWEX Cloud System Study (GCSS), the Atmospheric Boundary Layer Study (GABLS) and the Global Land-Atmosphere System Study (GLASS). GLASS serves as an interface between the land-surface community and other GEWEX projects and has four subprojects: the Global Soil Wetness Project (GSWP), the Project for Intercomparison of Land-Surface Parameterization Schemes (PILPS), a project on the local coupling of the surface and the atmosphere and finally the action on the global interactions between the surface and the climate. The overarching goal of the GSWP is to produce the best model estimates of the global land-surface water and energy fluxes. This entails an evaluation of the uncertainties linked to the land surface schemes, their parameters and the forcing variables, which drive them. GSWP will help the CSE's close the water budget and provide "best estimates" of surface fluxes to GRP and other GEWEX panels.

GMPP would like to promote inter-panel activities within GEWEX and is prepared to take specific steps toward cooperation in the establishment of requirements for commonality of collection and production of GEWEX data sets and products, leading to preparation of common global data sets (same grid and time resolution, i.e. monthly mean and daily) with supportive ancillary information that can facilitate joint diagnostic studies dealing with variability of global energy and water cycles. These initiatives encompass work in GMPP (GCSS, GLASS and GABLS), GRP (climatological data projects) and GHP (CEOP). Interactions with the GHP and GRP should help GMPP to use the right data to validate its models. In return GMPP should be able to provide the tools, which help other GEWEX projects to analyze and understand their data.

16.0 COORDINATED ENHANCED OBSERVING PERIOD (CEOP)

CEOP is currently in a build-up phase and is on schedule. Work during this period is focusing on the development of an initial enhanced observing period (EOP-1) data set, which covers the period July through September 2001. The implementation of two other enhanced observing periods covering annual cycles will be undertaken using data collected from October 2002 to December 2004. CEOP held its initial implementation planning meeting at the Earth Observation Research Center of NASDA in Tokyo, Japan, from 6–8 March 2002. More specifics about CEOP and the Kick-off Meeting can be found at: http://monsoon.t.u-tokyo.ac.jp/ceop/. All of the main actions and recommendations in CEOP are being undertaken in reference to the goals and objectives contained in the CEOP Implementation Plan. The Plan, which was finalized following recommendations formulated at a CEOP Implementation Workshop held at the GSFC in March 2001, was published in May 2001 and can be found at: http://www.gewex.com/ceop/ceop_ip.pdf.

A number of important issues related to the efficient organization and management of CEOP to achieve the main science objectives have been addressed by the CEOP Science Steering Committee. These actions have included finalizing the CEOP Data Policy statement; setting minimum standards for temporal sampling of CEOP Reference Site parameters, maximizing the science and technology benefits from CEOP, especially associated with setting a goal for delivery of a CEOP seasonal data product (EOP-1); and providing inputs on CEOP publications including the CEOP Brochure (see the CEOP web site at http://www.ceop.net). It was also confirmed that the CEOP Advisory and Oversight Committee would be activated by the end of 2002 under the co-chairmanship of Drs. A. Sumi (NASDA) and J. Kaye (NASA).

A File Transfer Protocol (FTP) for delivery of data from the CEOP Reference Sites to the CEOP Central Archive at the University Corporation for Atmospheric Research has been established and a large amount of information about the characteristics of the CEOP reference sites has been provided by the CSEs and placed in the CEOP Reference Site Table at: http://www.joss.ucar.edu/ghp/ceopdm/rsite.html.

A data integration, storage and access scheme under development by the National Space Development Agency of Japan (NASDA) and the University of Tokyo (UT) has been demonstrated as an integral part of the satellite integration process in CEOP. The 500 tera-byte data integration and archival system at UT will be available for the CEOP satellite data products work. The scheme that utilizes the NASDA/UT capability for production and archiving of satellite data products for CEOP reference sites has been presented as a three-phased process. The new schedule shows that the first phase (June 2002 to November 2002) will focus on data received from NASDA and the University of Tokyo related to all of the CEOP Reference Sites. Specifically this will be for the DMSP Special Sensor Microwave/Imager and Tropical Rainfall Measuring Mission Microwave Imager and Precipitation Radar data. NASDA and the UT will host a CEOP Satellite Data Integration Issues Workshop from 9 to 10 October 2002 in Tokyo, Japan. The proposed agenda included a discussion of details associated with a NASDA proposal for a CEOP Committee on Earth Observation Satellites Working Group on Information Systems and Services Test Facility (CEOP-WTF) that would be developed to assist with the derivation of CEOP special products from each satellite sensor. The CEOP WTF proposal, which now includes a Satellite Data Integration Center in Japan and, possibly, one in the USA, has already been accepted for further implementation with the support of the Integrated Global Observing Strategy Partnership (IGOS-P), including Space Agencies.

As a result of an action to standardize the CEOP Model Output requirements, a document has been produced that provides guidance for CEOP model output generation at numerical weather prediction centers, meteorological agencies and data assimilation centers. Commitments have been obtained for the provision of CEOP model products from major national and multinational centers including the Japan Meteorological Agency, National Oceanic and Atmospheric Administration, National Centers for Environmental Prediction, National Aeronautics and Space Administration/Goddard Space Flight Center Data Assimilation Office, the European Centre for Medium-Range Weather Forecasting, the United Kingdom Met Office, the Center for Weather Forecasting and Climate Research of the Brazilian Agency for Space Research and the Australian Bureau of Meteorology Research Center. The Max Planck Institute for Meteorology (MPIM) at Hamburg, Germany would contribute support to CEOP by assisting with the centralized handling and retention of the CEOP model output data being generated by the various contributing centers. Work is underway to integrate CEOP data into a World Data Center on Climate database scheme at MPIM. The most efficient input, storage and access structure is currently being defined. Mirror sites for some or all of the CEOP model output data products may be established in Asia and the USA.

A CEOP Water and Energy Simulation and Prediction (WESP) Working Group has been organized to address the accomplishment of one of the main CEOP aims associated with the use of 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. The CEOP WESP Working Group is building on work by the GHP related to closing simplified vertically integrated water and energy budgets with observations and analyses, and beginning efforts to simulate these budgets regionally. The effort for WESP will, therefore, be 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.

The CEOP Monsoon Systems Working Group held its first implementation planning workshop, in parallel with the GHP meeting from 10 to 11 September 2002. This working group will address the implementation 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. It was recommended that the Working Group proceed with a CEOP Inter-monsoon Model Study (CIMS) as developed during the Workshop. CIMS will be an international research project to validate and assess the capabilities of climate models in simulating physical processes in monsoon regions around the world. For CIMS, a major effort will be devoted to defining the data requirements, and modeling strategy for validating model physics. Validation data will be derived from CEOP reference sites, which include the GEWEX CSEs and planned Climate Variability and Predictability (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. A draft report of the workshop findings with the versions of the

presentations made at the meeting have since been put on the internet at: http://monsoon.t.u-tokyo.ac.jp/ceop/meeting/CEOP-MSS/index.html.

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 IGOS-P, which has reaffirmed CEOP as "the first element of the IGWCO." The next implementation planning meeting will be held in Berlin, Germany from 2–4 April, 2003. Presentations associated with preliminary results from the application of the available site data in the EOP-1 data set will be part of the agenda.

ACTION ITEMS

LA PLATIN (R. Stewart) – Before 2003 GEWEX SSG meeting, provide GHP response/guidance regarding proposal for PLATIN to become a CSE.

WEBS (J. Roads) –

- For 2003 GEWEX SSG meeting, using the standard methodology for calculating percentages, develop a table of estimates for closing the water and energy budgets for each CSE.
- Organize WEBS meetings at EGS (7-11 April 2003, Nice, France) and IUGG (30 June – 11 July 2003, Sapporo, Japan)

WRAP (L. Martz) –

- By end of 2002, finalize report on GEWEX–IAHS workshop held on July 24, 2002 on the application of GEWEX scientific research to water resources management.
- Organize next WRAP workshop for IUGG in Sapporo.

Data Management Working Group (S. Williams)

- Continue compilation of CEOP Reference Site descriptions and associated metadata. This information will be maintained on the CEOP data management Web page(s), directly at: http://www.joss.ucar.edu/ghp/ceopdm/rsite.html. An additional Reference Site from BALTEX, as well as MDB will be added.

- The DMWG members will continue to maintain updated CSE information on data policy, data inventory, data access, and data contacts. This information will continue to be linked from the DMWG Home Page.

- The DMWG will investigate the possibility of preparing a "composite CSE" data set(s) (such as gridded precipitation). In addition, the DMWG will re-organize the current GHP data set access Web page with the incorporation of pertinent available global data sets.

- The DMWG will continue work on the design and development of a CEOP EOP-1 "composite" Reference Site data set. This data set should incorporate common parameters, format, and temporal resolution. It is hoped that such a data set could be released in early 2003.

- The DMWG will form an ad-hoc committee comprising the chairs of other GEWEX projects (i.e. GRP, GMPP, and ALMA) to better improve cross reference/access to and coordination of project data sets within GEWEX.

Transferability Issues (B. Rockel) – For GHP-9, present results from BALTEX (PIDCAP) pilot study.

Predictability Studies (J. Marengo)

- Organize predictability workshop in conjunction with GHP-9.
- Investigate formal membership in WGSIP (need further interactions between GHP and WGSIP).

Moisture Sources (M. Bosilovich/ K. Szeto/P. Aggarwal)

- Before 2003 GHP meeting, develop a plan for applying passive water vapor tracers diagnostics to the CSEs and investigate cross-validation with isotopic data.
- Determine recycling rates for CSEs for comparison with other methods.

Feedbacks/Extremes (R. Stewart) – Develop a draft plan for discussion at GHP-9.

GRP Interaction

- Summarize global product evaluation (R. Stewart)
- Plan Landflux Workshop (B. Rossow)

GMPP Interaction

- GSWP2 (B. Rocket) – Provide CSE data for case studies (CSEs). Provide BALTEX (PIDCAP) data for model intercomparison.

Carbon (LBA Representative/R. Lawford) – Attend IGBP-iLEAPS meeting in October. Compile a summary of current CSE carbon measurements. Draft coordinated GHP carbon initiative.

GRDC (H-J Isemer/T. Maurer) – Draft letter from WCRP requesting GRDC development of a database with annual amounts of fresh water flowing into the ocean (emphasis on major rivers with time coincident data).

APPENDIX B

AGENDA

GEWEX Hydrometeorology Panel (GHP-8) Meeting

September 10-12, 2002

September 10:

09:00 – 09:15	GEWEX Developments
09:15 – 09:30	GHP Objectives, Status, and Plans
09:30 – 10:00	Break
10:00 – 11:30	IRI Overview and Activities

Ongoing GHP Components

Continental Scale Experiments (11:30 – 2:40)

11:30 – 11:50	GAPP
11:50 – 01:00	Lunch
01:00 – 01:20	BALTEX
01:40 – 02:00	LBA
02:00 – 02:20	MAGS
02:20 – 02:40	MDB
02:40 – 03:00	CATCH
03:00 – 03:20	ISLSCP
03:20 – 03:40	GRDC
03:40 – 04:00	GPCC
04:00 – 04:20	IAHS
04:30 – 05:15	Potential New Continental-Scale Experiment, PLATIN (La Plata Basin)

September 11:

09:00 – 09:20	GAME
09:20 – 10:00	9/11 Memorial Service
10:00 – 10:20	NAME
10:20 – 10:40	GRP
10:40 – 11:10	Break
11:10 – 11:20	GMPP
11:20 – 11:55	Collective Issues
11:55 – 12:25	WEBS

September 11 (Continued):

12:25 – 01:40	Lunch
01:40 – 02:10	Data Management
02:10 – 02:40	Transferability
02:30 – 03:10	Predictability
03:10 – 03:40	Break
03:40 – 03:50	IAEA
03:50 – 04:20	Moisture Sources
04:20 – 04:50	Feedback/Extremes
04:50 – 05:05	Carbon
05:05 – 05:20	CLIC/Precipitation

September 12:

09:00 – 09:20	World Summit on Sustainable Development
09:20 – 10:00	Summary of Actions
10:00 – 10:20	GHP Progress and CEOP implications
10:20 – 10:30	GHP Status
10:30 – 10:40	GHP at GEWEX SSG 2003
10:40 – 10:50	Next GHP Meeting

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