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OF THE GEWEX HYDROMETEOROLOGY PANEL (GHP)

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1.0 INTRODUCTION

The eleventh annual meeting of the GEWEX Hydrometeorology Panel (GHP) was chaired by John Roads and hosted by Alan Seed at the Bureau of Meteorology Research Centre in Melbourne, Australia. The BMRC is the numerical weather prediction center associated with the Murray Darling Basin (MDB) Continental-Scale Experiment (CSE). The objective of the meeting was to review the past year's progress and refocus GHP objectives to meet the GEWEX Phase II objectives, which have been modified to reflect the recent WCRP strategy for international research and collaboration efforts called the Coordinated Observation and Prediction of the Earth System (COPES). Future GHP activities are being increasingly focused on developing a regional to global hydrometeorological analysis and predictive capability and developing applications of GEWEX science for operational hydrology.

GHP coordinates the regional CSEs: the Mackenzie GEWEX Study (MAGS), the GEWEX Americas Prediction Project (GAPP), the Large-Scale Biosphere-Atmosphere Study in Amazonia (LBA), the La Plata Basin (LPB), the Baltic Sea Experiment (BALTEX), the GEWEX Asian Monsoon Experiment (GAME), the Murray Darling Basin (MDB) and the Analyses Multidisciplinaires de la Mousson Africaine (AMMA), which was approved as a new CSE at the 2005 meeting of the GEWEX Scientific Steering Group. There are also a few hydrometeorologically relevant projects making contributions to GHP activities and these include the Global Runoff Data Centre (GRDC), the International Satellite Land Surface Climatology Project (ISLSCP), Global Precipitation Climatology Project (GPCC) and the Coordinated Enhanced Observing Period (CEOP). The International Association of Hydrologic Sciences (IAHS) is an organization that is making substantial contributions to GHP activities.

Some highlights from the meeting include the following:

- The GEWEX Asian Monsoon Experiment (GAME) and Mackenzie GEWEX Study (MAGS) are ending this year. A follow-on project for GAME, tentatively named MAHASRI, is being planned for 2006-2012 with the objective to improve the prediction of the Asian monsoon and its hydrological cycle.
- Both the Baltic Sea Experiment (BALTEX) and the Large-scale Biosphere Atmosphere Experiment in Amazonia (LBA) have now completed their Phase I activities.
- The BALTEX Phase II science plan has been published and the implementation plan will be completed this year.
- One of the major activities of LBA Phase II will be the Regional Atmospheric Carbon Budget in Amazonia (BARCA), which will address the basin-wide budgets of CO_2, CH_4 and water.
- GAPP plans to continue as part of the Coupled Prediction Project for the Americas (CPPA). Through GAPP, numerous operational model upgrades have improved the Environmental Modeling Center global forecast system, resulting in reduced high precipitation bias.
- An operational center has been established for the African Monsoon Multidisciplinary Analysis (AMMA) Project. The AMMA implementation plan will be presented at the 1st International AMMA Conference on the West African Monsoon to be held in Dakar, Senegal on 28 November - 2 December 2005.
- A presentation on the Northern Eurasian Earth Science Partnership Initiative (NEESPI), an interdisciplinary program that includes the Former Soviet Union, Northern China, Mongolia, and Eastern Europe was given. If NEESPI can meet the GHP criteria, it will be proposed at the next GHP meeting as the newest CSE.
- The Water and Energy Budget Study (WEBS) is assessing the uncertainties in observing and simulating water and energy budgets over the CSEs in particular, and global land in general, using model output and in the future, GEWEX global data sets.
- The Worldwide Integrated Study of Extremes (WISE) working group is determining the extent to which processes responsible for extremes are similar in different regions, to understand the processes that link extremes in different regions, and to assess how they may be changing. One of the first tasks for WISE is to develop a database of extreme events starting with the CEOP time period and extending back in time using the WEBS data set.
- The Stable Water Isotope Intercomparison Group (SWING) has almost completed its analysis of the first common SWING simulations under present-day boundary conditions using three different state-of-the-art isotope global circulation models.

- The Transferability Working Group (TWG) is facilitating the development of regional models and climate simulations. Of particular note, is the Inter-CSE Transferability Study (ICTS), a joint project under TWG and CEOP, to study the performance of regional climate models over all of the CSEs. The TWG agreed at the meeting to participate in the ongoing GEWEX Cloud System Study (GCSS) Pacific Cloud Transect Study.
- The Water Resources Application Project (WRAP) is redefining its role by adopting a focus on hydrometeorological applications. Examples of initiatives with promising links to WRAP include the Hydrologic Ensemble Prediction Experiment (HEPEX), the Project for Ungauged Basins (PUB) and THe Observing system Research and Predictability EXperiment (THORPEX).

This report summarizes the meeting of GHP-11 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 STATUS REVIEW

2.1 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.

Status of Continental-Scale Experiments (September 2005)

TECHNICAL CRITERIA	AMMA	BALTEX	GAPP	LBA	LPB	MDB
NWP centre atmospheric and surface data assimilation and estimates of hydro-meteorological properties.	Pr	F	F	F	F	F
Suitable atmospheric-hydrological models and numerical experimentation and climate change studies.	Pr	F	F	F	Pr	F
Mechanism for collecting and managing adequate hydrometeorological data sets.	Pr	F	F	F	Pr	F
Participate in the open international exchange of scientific information and data.	B	F	F	F	F	F
Interactions with water resource agencies and related groups to address the assessment of impacts on regional water resources.	Pr	F	F	F	I	F
Evaluation of GEWEX global data products.	P	F	F	F	I	I-F
Contributions to CEOP and transferability databases.	Pr	F	F	F	I	F

SCIENTIFIC CRITERIA	AMMA	BALTEX	GAPP	LBA	LPB	MDB
Simulate the diurnal, seasonal, annual and interannual cycles.	Pr	Pr	Pr	Pr	Pr	B
Close water and energy budgets.	P	Pr	Pr	Pr	Pr	Pr
Determine and understand climate system variability and critical feedbacks.	Pr	Pr	Pr	C	Pr	Pr
Demonstrate improvements in predictions of water-related climate parameters.	B	Pr	Pr	Pr	B	Pr
Demonstrate the applicability of techniques and models to other regions.	B	Pr	Pr	Pr	Pr	B

Table 1 shows the technical and scientific criteria for CSE assessment. Technical criterion rated as functioning (F), initiating (I), or planned (P); scientific criteria rated as completed (C), progressing (Pr), or beginning (B). *Note: GAME and MAGS are ending December 2005.*

2.2 Consolidated Status Review

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"

3.0 STATUS SUMMARIES

3.1 Continental-Scale Experiments (CSEs)

3.1.1 African Monsoon Multidisciplinary Analysis (AMMA)

AMMA is an international project to improve the knowledge and understanding of the West African monsoon (WAM) and its variability with an emphasis on daily-to-interannual timescales. AMMA is motivated by an interest in fundamental scientific issues and by the societal need for improved prediction of the WAM and its impacts on West African nations. Vulnerability of West African societies to climate variability is likely to increase in the next decades as demands on resources increase in association with one of the World's most rapidly growing populations. Vulnerability may be further increased in association with the effects of climate change and other factors linked to the fast growing population such as land degradation and water pollution. Recognizing the societal need to develop strategies that reduce the socioeconomic impacts of the variability of the WAM, AMMA will facilitate the multidisciplinary research required to provide improved predictions of the WAM and its impacts. AMMA has three major objectives:

- To improve our understanding of the WAM and its influence on the physical, chemical and biological environment regionally and globally.
- To provide the underpinning science that relates variability of the WAM to issues of health, water resources, food security and demography for West African nations and defining and implementing relevant monitoring and prediction strategies.
- To ensure that the multidisciplinary research carried out in AMMA is effectively integrated with prediction and decision making activity.

The West African monsoon (WAM) is a coupled land-ocean-atmosphere system characterized by summer rainfall over the continent and winter drought. The processes that couple the land, ocean and atmosphere take place in association with multiple interacting space and timescales. Many of the key scientific questions that relate to these scale interactions cannot be answered using routinely available observations and reanalysis datasets. This is due to a combination of the scarcity of the routine observing network, the need for specialized observations and the known deficiencies of GCMs used for weather and climate prediction and relied upon for producing reanalyses.

AMMA facilitate the multidisciplinary research required to provide improved predictions of the WAM and its impacts. The main scientific objectives and overall strategy of AMMA are defined by scientific working groups (WG) under the responsibility of the AMMA International Scientific Steering Committee (ISSC). The key issues that relate to monsoon dynamics and scale interactions are undertaken on WG1. This includes a consideration of the processes that influence the large-scale aspects of the West African monsoon and its variability and also associated weather systems including mesoscale convective systems, easterly waves and tropical cyclones.

Investigations on the efficiency of the processes controlling the advection of atmospheric moisture, its transformation into precipitation, and the behavior of rain water over land (e.g., run-off, infiltration) are achieved on WG2. The role of energy transport and exchanges related to water vapor advection and latent heat release are also central for monsoon dynamics and its variability. Analysis of the water budget at regional scale, mesoscale and local scale is promoted in this WG. The lack of a consistent regional observing system and of multiscale studies leaves us with a piecewise vision of how the hydrologic processes act to enhance or smooth out the rainfall variability, and how this affect the water resources. It is consequently necessary to build up a combined strategy for observation and modelling that will allow

monitoring and representing the variability of the continental water cycle over a broad range of space and time scales: local, mesoscale and regional.

As with all monsoon systems the evolving surface conditions are crucially important for determining the nature of the WAM and its variability. In particular, prospects for improved seasonal-to-inter annual prediction of the WAM rely heavily on the inherent predictability of these surface conditions as well as our ability to observe key surface variables needed to initialize dynamical models and the ability of these models to simulate their evolution. The WAM is a hot spot of surface-atmosphere interactions as confirmed by recent studies, but processes causing these interactions have not been identified. Those land surface-atmosphere feedbacks are investigated on the WG3.

Special observations during AMMA will concentrate on the sampling of statistically representative events at specific locations. From these data, it will be possible to evaluate the different terms of the water budget for different aspects of the WAM on ocean, land surface and atmosphere. Integrated analyses with routine observations, satellite remote sensing measurements and numerical modeling should help to generalize the local results to the regional scale.

The lack of field experiments on the African continent has weakened our ability to understand the underlying processes associated with water cycle. During the EOP and the SOP, AMMA will provide detailed measurements of key parameters concerning the water cycle.

International AMMA Implementation
The field program of AMMA is organized in three imbedded periods: LOP (Long Observing Period) (2001-2010), EOP (Enhanced Observing Period) (2005-2007), SOP (Special Observing Period) (2006). The implementation involves the following steps: i) initial setup of the long-term monitoring program; ii) definition of a detailed strategy for the EOP and the SOP iii) deployment of the EOP and SOP instruments; iv) data base, training and capacity building actions. The implementation is carried out through the establishment of task teams (TT) and support teams (ST).

The mission of the TTs is to:
1. Design an observational strategy for a given subset of scales/variables of interest, as identified to be needed to reach the scientific objectives of the International Science Plan.
2. Monitor and have final responsibility for deployment of relevant instrumentation, as defined by the IP.
3. TTs contribute to the development, writing and update of the International Implementation Plan (IIP).

The mission of the STs is:
1. To act in support of TTs;
2. To look in more detail into operational matters and funding issues related to these “transverse” actions;
3. To propose scheme of operations to be agreed upon by TTs leaders and to be submitted to the ISSC to verify that these schemes respect the integrity of AMMA.

Two operation centres (AOC) will be established in Niamey (main) and Cotonou (secondary). Depending on the evolution of the SOP downstream program, the setup of a secondary operation centre in Dakar will also have to be considered.

Despite some TTs and TTs remains to be more precisely defined and organized, the overall operational strategy is quite well defined. The IIP will be discussed on September (19th to 23rd) at Biarritz (France) during the Implementation/Process meeting.

AMMA web site: http://amma.africa-web.org/

3.1.2 Baltic Sea Experiment (BALTEX)

The science plan for BALTEX Phase II (2003-2012) has been published and it reinforces the application of BALTEX Phase I achievements to areas such as climate variability and climate change studies, including scenarios of potential future climate, and environmental investigations related to nutrients and pollutants. The major goals and objectives of Phase II are:

1. Better understanding of the energy and water cycles over the Baltic Sea Basin;
2. Analysis of climate variability and change since 1800, and provision of regional climate projections over the Baltic Sea Basin for the 21st century;
3. Provision of improved tools for water management, with an emphasis on more accurate forecasts of extreme events and long-term changes;
4. Gradual extension of BALTEX methodologies to air and water quality studies;
5. Strengthened interaction with decision-makers, with emphasis on global change impact assessments; and
6. Education and outreach at the international level.

Concerning Objective 1: While BALTEX research so far has met to a large extent BALTEX Phase I objectives, gaps still exist and further research is needed for fulfilment of the original BALTEX aims. Therefore, the basic objectives of BALTEX Phase I continue to be valid also for BALTEX Phase II. BALTEX Phase I Objectives are:

1. To explore and model the various mechanisms determining the space and time variability of energy and water budgets of the BALTEX area and its interactions with surrounding regions,
2. To relate these mechanisms to the large-scale circulation systems in the atmosphere and oceans over the globe, and
3. To develop transportable methodologies in order to contribute to basic needs of climate-, climate impact-, and environmental- research in other regions of the world.

Status: Past Year Activities

BALTEX considers itself still to be in its transition period from Phase I to Phase II. Major past year activities are therefore directed towards both summarizing and concluding Phase I achievements and results as well as making plans and giving directions for Phase II of the programme. In this context, the following highlights are mentioned here:

- DEKLIM final symposium
- BALTEX Phase I State of the art report published
- BALTEX Phase II implementation document in preparation
- BACC initiative running on schedule
- BALTIC GRID Pilot Study being set up

The German Climate Research Funding programme DEKLIM[1] (2001 – 2006) was concluded in 2005 with a final symposium conducted in Leipzig, Germany in May 2005. DEKLIM includes the funding line "Regional process studies in the Baltic Sea area" which is a direct contribution to BALTEX. Major results contributing to BALTEX objectives were obtained related to the following eight topics:

1. Development and validation of a coupled model system in the Baltic Region,
2. Regional evaporation over heterogeneous terrain at grid point/pixel scale,
3. More accurate areal precipitation measurements over land and sea,
4. Influence of the Baltic Sea and its annual ice coverage on the water and energy budget of the BALTEX area,
5. Integrated Baltic Sea Environmental Study: Analysis and Simulation of Hydrological and Ecological Variability in the last 1000 years,
6. Influence of carbon and nitrogen fluxes on the water and energy budget of the terrestrial biosphere in the Baltic Sea drainage basin,
7. Soil frost and snow metamorphism simulations for the BALTEX-region with a complex hydro-thermodynamic soil-vegetation scheme, and
8. Hyperspectral satellite data analysis over land surfaces for climate modelling applications.

An important BALTEX milestone was met by the recent publication of the state of the art report of BALTEX Phase I achievements[2]. The report is divided into 14 chapters addressing major research fields and their results conducted within BALTEX Phase I. More than 20 chapter authors contributed to the report and the latter makes reference to more than 220 peer-reviewed BALTEX journal articles and numerous additional publications.

[1] http://www.deklim.de

[2] BALTEX Phase I 1993 – 2002 State of the Art Report, Editors: Daniela Jacob and Anders Omstedt, International BALTEX Secretariat Report No 31, October 2005, 181 pages. An electronic version is available via the BALTEX website, http://www.gkss.de/baltex

BALTEX Phase II Implementation Plan
Based on the Science Plan, a Science Framework and Implementation Strategy Document for BALTEX Phase II is currently being established. The structure of this document follows the six major objectives as defined in the Science Plan for BALTEX Phase II, see above. While the earlier published Science Plan for BALTEX Phase II explains the scientific objectives in terms of several related major goals, the Research Framework and Implementation Strategy Document suggests how to achieve these goals and describes potential activities as more concrete implementation measures. It will also specify additional data needs and highlights the desired involvement of stakeholders. The document is expected to be available in early 2006.

BACC Initiative
The BALTEX Assessment of Climate Change for the Baltic Sea Basin (BACC) is an initiative contributing to objective #2 of BALTEX Phase II. In September 2004, a group of climate and environmental researchers initiated BACC with the ultimate goal to provide an assessment of ongoing climate change in the Baltic Sea Basin by reviewing existent literature on the subject and publishing an assessment book by 2006. At a dedicated meeting of representatives of BALTEX, BACC and HELCOM[3] held January 2005 in Copenhagen, Denmark, a joint BALTEX-HELCOM Climate Assessment Project was approved, with the following three organisations or groups being involved: 1) HELCOM, 2) BALTEX, as a major European science programme, and 3) the BACC group. The overall project coordination is with the International BALTEX Secretariat. The plan foresees HELCOM to use the material on climate change assessment, which is currently being compiled by the BACC group, for dedicated HELCOM Thematic Assessment Reports, to be published in 2007. The BACC initiative is chaired by Hans von Storch, director of the Institute for Coastal Research at GKSS Research Centre Geesthacht, Germany. For details, see also http://www.gkss.de/BACC.

BALTIC Grid Pilot Study
BALTIC GRID has been suggested as one major implementation means for BALTEX Phase II. A BALTIC GRID Pilot Study is therefore currently being set up to explore and demonstrate the potential of such as grid. The grid idea within the pilot study is mainly to share resources (model data, observations and expertise) within the existing BALTEX communication and cooperation network. A free-as-possible information and data exchange with respect to the BALTEX data policy is expected. Additionally to the planned simulations, re-initialisations (nudging) and data assimilation will be performed. Thus, data from the BALTEX Data Centres as well as additional observations (hydrographical and satellite data) will be needed. Furthermore, these data are important for process studies and model validation. The following objectives are planned to be dealt with in the BALTIC GRID Pilot Project:

- Quantification of the energy and water cycle for the BRIDGE period 1999-2004, including precipitation and evaporation;
- Quantification of corresponding uncertainties;
- Detailed investigation of coastal regions of the Baltic area (coastal ocean and atmospheric boundary layer);
- Analysis of extreme events and “Großwetterlagen” (forcing and response);
- Analysis of sea ice evolution, comparison with new satellite data and observations;
- Detailed investigation of atmosphere-ocean and atmosphere-sea ice-ocean fluxes;
- Detailed analysis of water mass exchange between the deep basins of the Baltic Sea.

Past activities included the kick-off meeting in December 2004, the design of dedicated subprojects during 2005, and the official implementation of a BALTEX Working Group endorsed by the BALTEX SSG in October 2005. The BALTIC GRID Pilot Study is chaired by Andreas Lehmann, GEOMAR Institute for Marine Research, Kiel, Germany.

Future: Some next year foreseen activities

- Finalization and Publication of the BALTEX Phase II implementation document
- Finalization of the BACC material and publication of the BACC assessment book
- Contributing to related HELCOM thematic assessment reports
- Conduction of an international BACC Conference

[3] HELCOM (the Helsinki Commission, see www.helcom.fi) has the status of an intergovernmental international organisation with all countries bordering the Baltic Sea, and the European Union being Contracting Parties to HELCOM.

- Input to and communication with upcoming international funding programmes relevant for BALTEX (in particular FP7 and BONUS-169)
- Establishment of four new BALTEX Working Groups (as suggested at BALTEX SSG meeting #18) and related activities: Data Management, Energy and Water Budgets, BALTIC GRID, Dissemination of BALTEX results.

Some key results

- Improved interpretation of climate change impacts on hydrology of the Baltic Sea basin from an ensemble of regional climate models;
- Climate change impact studies for sea-ice (seals), sea level (spatial planning, flooding, coastal erosion), and salinity (deepwater ventilation, residence times, ecosystem) concluded, using RCAO[4] model results;
- Extension of a land surface model by biogeochemical modules for soil and vegetation, validation and application of the model in various regions (Sweden, Finland, north eastern USA) for deciduous and coniferous forests (CANIBALT);
- Development, evaluation and testing of a frozen soil and snow module as well as methods to initialize soil temperature, moisture states and snow distribution (BOBA-DEKLIM);
- Exploration of a comprehensive and unique data set on land surface / atmosphere interaction processes over a heterogeneous land surface at the mesoscale (LITFASS-2003 at Lindenberg, EVA-GRIPS);
- A coherent picture of the circulation in the Baltic Sea and the water mass exchange with the North Sea could be achieved using the Baltic Sea Ice Ocean Model BSOIM, BSIOM has become the ocean model component of BALTIMOS (DEKLIM);
- A suit of observational both in-situ and remote sensing data was established and has been successfully used to validate the coupled regional modelling system BALTIMOS (DEKLIM);
- The superior performance of four novel precipitation sensors designed for high wind exposure was demonstrated (DEKLIM-APOLAS);
- A hyper-spectral radiative transfer model has been developed and tailored to applications in land surface data assimilation;
- Comprehensive observations and modelling of liquid water clouds (CLIWA-NET, see also http://www.knmi.nl/samenw/cliwa-net/).

BALTEX website: http://www.gkss.de/baltex

3.1.3 GEWEX Asian Monsoon Experiment (GAME)

The major focus of discussion was on the follow-on activity to the GAME Project. GAME has successfully clarified the basic processes of land-atmosphere interactions through regional experiments and monitoring. However, the mechanisms and the variations in the Asian monsoon are still not clearly understood. To improve the prediction of the Asian monsoon and its hydrological cycle, many challenging issues have to be solved. In particular, better resolution of diurnal cycles, and their multi-scale interactions with intraseasonal variability are crucial for improving prediction of convection and precipitation. Seamless understanding of surface-atmosphere interaction, boundary layer processes and cloud/precipitation processes are essential for improving models, including cumulus parameterizations. Understanding of hierarchical structure of mesoscale system embedded in large-scale fields, mutual interaction between low level jet/moist convection and large-scale field over complex terrain and warm water pool will be particularly important for prediction of severe rainfall systems in East and Southeast Asia. In addition, an important effect of vegetation and aerosols on atmospheric heating and cloud/precipitation systems and monsoon circulations in Asia has recently been recognized. Since GAME was targeted mainly on land-atmospheric interactions, land-ocean-atmospheric interactions are not completely understood. As for the regional foci, since GAME-Tropics targeted mainly monsoon processes in Indochina region, those of the whole tropical Asia including South Asia and Indonesian Maritime Continent also need to be studied. In a similar manner, a more comprehensive study on East-Asian monsoon system may also be necessary.

The First International Post-GAME Planning Workshop was held in August 2005 in Kyoto, Japan. Forty participants from ten countries met to discuss the objectives, key scientific questions, expected

[4] The Rossby Centre Regional Climate Atmosphere Ocean Model

achievements, international cooperation strategies, regional structures and schedule for a post-GAME program. The post-GAME program, tentatively named the Monsoon Asian Hydro-Atmospheric Science Research and prediction Initiative (MAHASRI) will aim to improve the prediction of the Asian monsoon and its hydrological cycle, focusing on establishing a scientific basis for predicting the hydroclimate monsoon system with a special emphasis on intraseasonal to seasonal time-scale, including developing prediction systems for droughts and flood conditions of regional river basins and similar areas in Asia. It will target processes in the Asian summer and winter monsoon. Its spatial coverage will include the tropics from the maritime continent to South and Southeast Asia, Tibet/Himalaya, East Asia, and Northeast Asia. More emphasis will be placed on the air-land-ocean interactions, the role of aerosols on monsoons, monsoon predictability, and flood/drought predictions.

It is planned that this program will undertake an essential role in the WCRP research strategy—the Coordinated Observation and Prediction of the Earth System (COPES)—and will contribute to other related international initiatives, such as the Global Earth Observation System of Systems (GEOSS), the Coordinated Enhanced Observing Period (CEOP), The Observing System Research and Predictability Experiment (THORPEX), the International Hydrology Programme (IHP)-Project for Ungauged Basins (PUB), the SysTem for Analysis, Research and Training (START), and the Global Water System Project (GWSP). A special observation period may be planned in conjunction with the International Polar Year in 2008.

GAME website: http://www.hyarc.nagoya-u.ac.jp/game/

3.1.4 GEWEX Americas Prediction Project (GAPP)

Overview

The GEWEX Americas Prediction Project (GAPP) is a science project bringing hydrologists, land surface specialists, atmospheric scientists and end-users together to advance climate prediction and water resource management. The GAPP program is sponsored by NOAA Climate Program Office and NASA Terrestrial Hydrology Program. The mission of GAPP is to demonstrate skill in predicting variability and change in water resources on time scales up to seasonal and annual, as an integral part of the climate system. GAPP has two scientific objectives: 1) to improve intraseasonal to interannual 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, and 2) to develop application products for resource managers by interpreting and transferring the results of improved climate predictions for the optimal water resource management.

Status

- Currently NOAA Climate Program Office is funding approximately 50 GAPP projects in one or more of seven areas: 1) predictability in land surface processes, 2) hydrometeorology of orographic systems, 3) predictability in monsoon systems, 4) integration of predictability into prediction systems, 5) testing of models in special climate regimes, 6) data and studies for model development (CEOP), and 7) use of prediction for water resource management. All GAPP funded projects are posted on the GAPP web site at http://www.ogp.noaa.gov/mpe/gapp/abstr/index.html
- GAPP Core Project that aims at transferring GAPP research into NOAA operations has been reviewed by external group and will continue for the next 5 years.
- GAPP supported CEOP by managing 41 CEOP reference site data, providing data (in-situ, remote sensing, and model output) in GAPP region, data analysis, demonstrating the utility of satellite data in research and climate prediction and evaluating the performance of global and regional models across climate regimes and time scales.
- GAPP participated various GEWEX and other related activities including WEBS, NLDAS, Regional Climate Modeling (RCM), GSWP I and II, CEOP, GLACE, DIMIP2, HEPEX, RFC Ensemble Forecast System and LIS (Land Information System).

New Directions

Within NOAA, the GAPP program has been integrated with the CLIVAR/PACS program into a new Climate Prediction Program for the Americas (CPPA) program. The overall CPPA goal is to improve operational intraseasonal to interannual climate prediction and the water resource applications. CPPA will continue to support GEWEX Phase-II objectives, but go beyond GAPP current focus on

land-surface/hydrology and water resource components, address ocean-land-atmosphere interaction issues, cloud-boundary layer interaction and some COPES scientific questions.

Future activities

- CPPA will establish a science advisory group consisting of scientists from GEWEX and CLIVAR communities and provide CPPA guidance on future research activities;
- Development and improvement of drought monitoring and prediction products in support of National Integrated Drought Information System (NIDIS)
- Planning of Western Mountain Hydroclimate Field Studies in FY08 and beyond

Key Results

- Under the support from GAPP, NCEP Environmental Modeling Center (EMC) implemented Noah land surface model (LSM) in NCEP Global operational Forecast System (GFS). This Noah land surface model will be incorporated into the NCEP coupled Climate Forecast System (CFS) model.
- The Noah LSM has been improved and the impacts are large elimination of early snow pack depletion bias and reduction of high bias in surface evaporation and precipitation over non-arid areas in warm season.
- Several results of GAPP projects are in the process of being transferred into NWS operations. Ex. 1: Ken Mitchell and his Core project team ported R. Pielke's dynamic vegetation model (GEMTM) to NCEP and plan to test in Noah LSM in Eta Regional Climate model. Ex. 2: GAPP PIs (D. Lettenmaier and E. Wood) and Core Project PIs are working with NWS/OHD and River Forecast Centers to test the Experimental Seasonal Streamflow Forecast System developed by research projects in operational RFC environment.
- Quantified the potential predictability of land and ocean states on seasonal precipitation and temperature within the GAPP domain. Sample activities are: Identification of regions within US where there are strong/weak linkages between surface soil moisture and atmospheric anomalies; Demonstration that dynamical downscaling and better land initialization improves precipitation forecast skill; and Articulation of the role of snow and orographic on western U.S. climate – land state connections.
- Quantified the sensitivity of seasonal climate predictions to land states, including soil moisture, snow, orography and vegetation. Sample activities are: Demonstration that surface states (soil moisture and vegetation) affect precipitation forecasts; Demonstration that dynamic vegetation phenology affects the surface heating.
- Developed operational hydrologic forecasts incorporating the use of climate forecasts. Sample activities are: Observational and validation studies of hydrological process and states; evaluation of the hydrologic forecast uncertainty and skill over a range of basins; development of verification approaches for the generated hydrologic ensembles; development of a seasonal hydrologic forecasting system that utilizes NCEP dynamical Climate Forecast System (CFS)
- Evaluated impact of data from NAME 2004 on operational analyses.
- *Applications to Decision Making and Adaptive Management in the Grand Canyon Region*

GAPP website: http://www.ogp.noaa.gov/mpe/gapp/

3.1.5 Large-Scale Biospheric Experiment in Amazonia (LBA)

Overview

Over 1200 investigators are involved in about 90 studies in the Large-Scale Biosphere Atmosphere Experiment in the Amazon Basin (LBA) related to physical climate, atmospheric chemistry and composition, carbon storage and exchange, biogeochemical cycles, land-surface hydrology and water chemistry, and land use and land cover changes and human dimension programs. The human Dimension program is a new addendum in LBA science since 2003.

Special issues of Journal of Geophysical Research, Theoretical and Applied Climatology, Global Biogeochemical Cycles, Remote Sensing of the Environment, Ecological applications, Global Change Biology and Acta Amazonica have been or will be published with papers presented on the First and Second LBA Science conferences during 2002-2004. The Third LBA Science Conference did take place in Brasilia in July 27-29 2004. About 720 participants were registered at this conference, and there was a significant number of students from Brazil and abroad. An extensive set of scientific results of LBA field experiments (LBA-TRMM, LBA-RACCI, SALLJEX-CLAIRE, LBA/SMOCC, and others) were presented in

a special session of the EGS-AGU-EUG Joint Assembly in Nice, France, and the IUGG science meeting in Sapporo, Japan in 2003, the Brazilian Congress of Meteorology in August 2004, and in the AGU Meetings in 2004.

Some other LBA issues were presented at the AGU, IUGSS, IAMAS and IAHS meetings in 2005, specifically those linked to major themes such as the South American monsoon, the interactions between Amazonia and La Plata basins and also the effects of aerosols and biomass burning in Amazonia.

An important climatic event in the Amazon basin is being studied as part of the LBA science agenda in the ecology and physical climate components. The drought of 2005 is one of the most important in the Amazon basin, as reflected by the lower levels of the Rio Negro in Manaus. The previous intense drought was during an intense El Niño 1997-98, where rainfall well below the normal was detected during the rainy season in central and normal Amazonia, and produced extended fires in the Amazon forests. In 1963 another drought also related to weak El Nino also occurred. However, these levels of the Rio Negro in 2005, 1998 and 1963 were not as low as other drought event in 1926, where the lowest levels in the whole XX Century were reached. The Rio Negro level integrates rainfall in the western side of the Basin. During the last 103 years, 7 events of intense drought have been identified, and the drought of 2005 is considered as one of the most intense. The levels of the Rio Negro in Manaus registered in September 2005 the lowest levels in history since observations started to be taken, reaching 15.78 m. In September 2004 the levels reached 21.74 metros. In Tabatinga, in the border between Brazil and Peru and at 1.106 km to the west of Manaus, the levels of the Solimões River decreased from May to September from 13.8 m to 0.46 m.

Consequences of the drought of 2005 in the region are related to increase of the mortality in the trees and animals, some of them species with the risk of extinction. This shows that the Amazon ecosystem is very vulnerable to drought and subsequent fires. In fact, as a consequence of the drought and the increased near surface temperatures warmed the surface waters of rivers and lakes above 40 C and killed fish and reptiles. Since September 2005, the western Amazon region (that includes Peru, Bolivia and the Brazilian States of Acre, Rondônia and Amazonas) has been taken by fires that have burned thousands of hectares of forest. The drought also affected fauna and flora in the region.

Some of the subjects discussed during 2005 include: Climate-Vegetation Interactions in Amazonia, Deforestation and Biomass Burning as Drivers of Regional Climate Change in Amazonia, Smoke Aerosols, Clouds, Rain and Climate**,** Patterns of land cover change and land use intensification**,** Population Dynamics in the Amazonian Frontier, Compositional Changes in Undisturbed Neo-tropical Forests and Their Implications for Carbon Dynamics**,** Carbon stocks and sequestration in above-ground wood biomass of Central Amazonian white-water floodplain forests*,* Water and Energy and Balances of the Amazon Basin, Eco-physiological and Biochemical Responses of Tropical Plants to Elevated CO2, Carbon Exchanges Between Aquatic Environments, Land, and Atmosphere, and new initiatives that include Role of Amazon Ecosystem in Determining Regional and Global Climate Variabilities, Terra/Aqua MODIS Data and Products for LBA Science: Current Results and Opportunities for Data Integration and Synthesis, Accuracy Assessments and their Implications for Fire and Deforestation Monitoring, Disturbance Events and Tropical Forest Ecology and Biogeochemistry. The fourth LBA conference is planned for 2007 in Belem, Brazil. In 2005 there was the LBA Ecology conference in November and the LBA students Conference in Manaus in June 2005.

Status

Timing and Activities in LBA Phase I and II:

The overall timeframe for LBA Phase I is 1996–2005. In 2002 and the first half of 2003, several activities took place, including the installation of the measurement and monitoring components at the LBA research sites (reference sites in flux towers and one hydrological site). During LBA Phase I, the LBA-DRY-TO-WET field campaign took place in Rondonia during September-November 2002, during the transition season from dry to wet season in Amazonia. This project was a cooperation between Brazil, Europe and USA. The objective was to analyse the evolution of cloud microphysics and rainfall from a much polluted atmosphere loaded with high concentration of aerosol and trace gases from biomass burning to a pristine condition typical of the rainy season. The Second major field campaign was the SALLJEX-Brazil that took place during the austral summer of 2003. This SALLJEX-Brazil is a Brazilian component of the SALLJEX initiative from the CLIVAR-VAMOS program on the South American monsoon, and represents a collaboration between GEWEX and CLIVAR. The focus of the experiment is to understand the low level jet to the east of the Andes and the moisture transport between the Amazon basin and the La Plata Basin

in southeastern South America. During 2004, LBA scientists are on the process of data analyses and synthesis of results from these field experiments, and observational and model analysis are and will be performed to accomplish the objectives of these field experiments in the context of LBA science questions.

In 2005, the LBA Phase II is planned to start, and is basically an integration phase of all LBA activities and projects, since the Phase I will be ending by December 2005.

LBA BARCA:
One of the major activities of LBA Phase II will be Regional Atmospheric Carbon Budget in Amazonia Balanço Atmosférico Regional de Carbono na Amazônia – LBA/BARCA, The specific objective of LBA/BARCA is address the basin-wide budgets of CO2, CH4 and water and define the origin of the signal of CO2. Major field campaigns as part of BARCA/LBA are planned for 2005. BARCA (Balanço Atmosférico Regional de Carbono na Amazônia) is a proposal emerging from Brazilian scientists for 2 intensive aircraft measurement campaigns to collect data, *quantitatively and qualitatively different from current data,* for atmospheric concentrations measured over the entire Amazon Basin and adjacent waters. This document requests a Scientific Expedition License for US colleague to participate, to complement the aircraft instrumentation and to aid in data interpretation. A new modelling framework designed to *determine spatially resolved sources and sinks of CO_2, CO, and other gases at short and long time scales* will be applied, which combines high-resolution atmospheric transport with models of surface fluxes. The framework merges data and models to derive the state of the atmosphere and the carbon cycle that is consistent with the aircraft observations as well as a variety of other data streams, such as soil properties, remotely-sensed vegetation data, and flux measurements. These optimally constrained models will provide the most reliable diagnostic and predictive capability for surface-atmosphere fluxes of CO_2 and CO in the data-rich environment of the LBA.

Extensive airborne measurements over Amazonia are envisioned to cover horizontal scales of 100~1000 km, altitudes 0.15-12 km, and most daytime hours, closely coordinated with ground measurements at LBA towers and at a coastal station (INPE-Natal). Flight planning will be guided by transport simulations using high-resolution assimilated meteorological fields, currently under development at the Universidad de São Paulo (USP) and the CPTEC. In this way, BARCA will:

- Directly quantify regional to Basin-scale fluxes in Amazonia using airborne measurements of CO_2 and other tracers in and above the planetary boundary layer (PBL);
- Establish relationships between vertical concentration gradients and exchange fluxes observed at the eddy flux towers, started in LBA, and over adjacent regions;
- Test hypotheses central to the Brazilian Millenium Institute that Amazonia is a major net source or sink for CO_2;
- Characterize horizontal and vertical distributions of atmospheric CO_2 over Amazonia for the purposes of planning remote sensing instrumentation

BARCA plans to conduct airborne measurements during both the wet and dry seasons to characterize the seasonal variability of carbon fluxes. Proposed regional experiments over natural and disturbed ecosystems will deliver regional carbon fluxes over different land surfaces, especially the developed and undeveloped districts of Rondonia and Pará, while the large-scale transects yield Basin-scale flux over the whole of Amazonia.

BARCA is inherently a collaborative effort, combining a range of disciplines and spans multiple spatiotemporal scales. The Millennium Institutes, with a tradition of cross-discipline, cross-border collaborations, will provide the institutional foundation. BARCA will enhance and be enhanced by key selected projects started in LBA and continued as collaborations between Brazilian, US and European educational and scientific institutions. Eddy covariance data from towers provide continuous time series of fluxes and concentrations, allowing correction for the fair-weather bias inherent in low-level aircraft operations and to generalize conclusions based on two seasonal studies. BARCA measurements of regional and Basin-scale exchange fluxes provide the scaling up of tower data.

LBA reference sites:
As part of the GEWEX efforts, 6 LBA references sites have been included in the CEOP strategy and they have started to report data for some particular periods (EOP-1 and 3), for intercomparison with other references sites from other GWEX CSEs. The modeling component of CEOP has allowed the release of model output from global models from menu numerical centers of the world, so intercomparison can be

made between the reference sites data-upper air profiles foe each reference site and model output for a grid box nearest to the reference sites. In relation to the GHP, studies on water and energy balances have been performed using observations from the LBA reference sites, the CPTEC COLA AGCM, the NCEP reanalyses and various rainfall gridded data sets. Issues like prediction and predictability in the water and energy balances, as well as hydrological predictability are currently being investigated.

A hydrological reference site has been implemented in northern Amazonia nearby Manaus (Igarapê Asu). The Asu catchment is located at approximated 40 km NNW of Manaus, at 3 08N, 60 07 W. The catchment, with a drainage area of a 6.37 km2, collects the discharge of five first order streams, encompassing the most common landscape forms that occur in the region.

LBA contributions to GEWEX and GHP and main issues in LBA Phase 1

- Prediction and predictability of the water balance: Simulations and model validation, Predictability assessments and studies in South America using global and regional models
- Studies on the closure of the water and energy cycles in Amazonia: Assessment of uncertainties and sensitivity of the water balance to different rainfall data sets
- Results from LBA WET AMC, DRY to WET, CLAIRE: Clouds in the Amazon are modulated by land cover and influenced by land cover change. River vs. forest contrast also modulate convection and rainfall
- Results from SALLJEX: Moisture transport from Amazonia into La Plata basin; model development and data assimilation of data from field campaigns for improvement of climate and weather predictability)
- Future field experiment: LBA-BARCA (carbon balance in Amazonia
- Applications to society: hydrological prediction for electric generation, risk of fire
- Implementation of LBA-DIS

LBA Phase II

Major issues now in the transition from Phase I and Phase Ii are:

- Define a specific “End Date” for Phase 1 of LBA (in Fall, 2005?) because otherwise:
  - The LBA dataset is a “moving target’
  - “Milestones” dates for data submission can’t be defined
- Survey all past and current LBA participants to define the data set that will be available at specified dates (e.g. December 31, 2005; June 30, 2006)
- Provide incentives and opportunities to encourage data timely data submission, in the form of
  - shared participation in “reporting and analysis” papers
  - teambuilding around “synthesis and interpretation” papers

The science questions of LBA Phase II can be summarized as:

- What are the most important recent findings and more importantly how do those findings motivate synthetic work?
- What are the most pressing needs in terms of data synthesis and modeling?
- What specific synthetic products would most greatly benefit LBA now?
- What data are most urgently needed in the DIS for synthetic studies? Are the appropriate quantities of quality data available to do synthetic work now?

Being the major science goals re-defined as:

- How does Amazonia currently function as a regional entity?
- How will changes in land use and climate affect the biological, chemical and physical 1 functions of Amazonia including its sustainability?
- How will these changes in the Amazon influence the global climate?

LBA Phase 2 strategy can be summarized as:

- Maintain an international scientific steering committee with the explicit participation of the international scientific community
- Create a “virtual institute” with participation of all Amazonian countries and promote greater participation of those countries in LBA Phase 2.
- While still led by Ministry of Science and Technology-Brazil, LBA Phase 2 should increase the participation of other ministries, would facilitate the translation of LBA results into implementation of public policies for the Amazon region
- The composition of the Directorate (Conselho Diretor) should include scientific institutions in the Amazon

- The nomination of members for the Scientific Steering Committee should be made by scientific peers for the approval by the Directorate (Conselho Diretor)
- Seminars with broad participation by the scientific community should be convened to define the scientific agenda of LBA Phase 2. In particular, "Human Dimensions"should be maintained as a theme with a specific focus on the question of the causes of land use change in Amazonia.

LBA website: http://lba.cptec.inpe.br/lba/

3.1.6 La Plata Basin (LPB)

Overview

The La Plata Basin covers about 3.2 million km^2. In terms of geographical extent, the basin is the fifth largest in the world and second only to the Amazon Basin in South America. The basin is important in different ways for the economies of those countries. Harvests and livestock are among the region's crucial resources, rivers are natural waterways, and surface transportation has greatly increased in recent years due to the integration of regional economies. Last, but not least, several hydroelectric plants provide most of the energy consumed. The countries in the basin have a history of international collaboration. Argentina and Uruguay built Salto Grande on the Uruguay River. Brazil and Paraguay built today's largest power station in the world at Itaipú on the Paraná River. Argentina and Paraguay built Yacyretá, also a very large power station downstream from Itaipú. Besides the commercial agreement within the MERCOSUR participating countries (Argentina, Brazil, Paraguay and Uruguay), there is an environmental program that deals with the exchange of observations and exchange of information.

In 2001 the VAMOS Panel of CLIVAR/WCRP named a scientific working group with the objective of identifying and describing the main climate and hydrologic features of the La Plata Basin in South America. This group, that came to be known as "PLATIN", prepared the document Climatology and Hydrology of the Plata Basin (http://www.clivar.org/publications/wg_reports/vamos/pdf_files/laplata.pdf) that identified the priority research areas that would contribute to the advancement of the relevant hydro-climate issues of the region.

New directions

PLATIN finished its term with the completion of the above-mentioned document and with the achievement of having La Plata Basin (LPB) being named a Continental Scale Experiment. In order to proceed to the next stage, a new structure was put in place. With the endorsement of GHP/GEWEX and VAMOS/CLIVAR, an **Implementation Steering Group (ISG)** was formed, co-chaired by E.H. Berbery (for VAMOS/CLIVAR) and M. A. Silva Dias (for GHP/GEWEX). This group is in the process of writing an implementation plan that will be sent to GHP in the near future.

Objective(s)

Previous research identified the need for an international research program that targets three major topics of principal interest to countries in the basin:

- What climatological and hydrological factors determine the frequency of occurrence and spatial extent of floods and droughts?
- How predictable is the regional weather and climate variability and its impact on hydrological, agricultural and social systems of the basin?
- What are the impacts of global climate change and land use change on regional weather, climate, hydrology and agriculture? Can their impacts be predicted, at least in part?

Status

The LPB Implementation Steering Group is coordinating the activities that need to be performed to address the above questions. This interdisciplinary group is working with research and operational centers on an Implementation Plan that will articulate the most efficient ways of addressing the activities to be developed. The implementation plan envisions two main activities: **monitoring of hydroclimate variables** and a **field experiment** to develop a set of unique data that will (a) help understand the land surface-atmosphere processes that may lead to persistent events, and (b) to calibrate and improve parameterizations in regional and global models employed for forecasting and prediction up to seasons. The two activities will be complemented with **modeling and diagnostics of the coupled system**. The implementation plan will become available in the coming months.

Future
During 2006 work will continue on implementation issues and seeking funds for the monitoring and field experiment activities. We expect to work with different agencies to draw their interest into this unique area. Coordination with the activities funded by the Global Environmental Fund (GEF) will continue and a closer interaction is expected.

Key results
The anticipated benefits, by the time that LPB is completed, are:
- An end-to-end coupled modeling system (including coupled atmospheric, land surface and distributed models) covering the whole LPB
- New tools for seasonal prediction
- A comprehensive observational dataset for hydro-climate studies
- A 25-yr higher resolution regional reanalysis dataset
- Climate change scenarios for hydroclimate of the LPB
- Analysis of vulnerability to Climate Change, in a form that can be reported to the policy makers
- LPB will further contribute to the enhanced integration between the research/academic community and the operational forecasting and observation centers in the area.

Issues and Recommendations
LPB recognizes the following items as critical contributions
- Being an example of strong CLIVAR-GEWEX interactions and coordination.
- Assessing the climate change scenarios that are likely to affect LPB.
- Investigate the vulnerability of the region to extreme events.
- Determine the degree of predictability of the hydro-climate system and improving prediction methods.

Summary
During 2005 all the activities of the ISP were done via email exchanges, but it is desired that meetings take place to further the LPB agenda. Plans are to hold a preliminary meeting during the Southern Hemisphere Conference of Meteorology and Oceanography to be held in Foz do Iguaçu, Brazil, in April 2006. It is unlikely that all ISG members will attend, as no specific funding is available for this group. However, we expect to have a more formal follow up meeting sometime during 2006, for which we expect support from the endorsing Programs.

Drafts of the implementation plan will become available in the coming months, and will be made publicly available through the VAMOS and LPB web pages at JOSS/UCAR (www.ucar.joss.edu/platin).

3.1.7 Mackenzie GEWEX Study (MAGS)

Major Objectives of MAGS-2 are to:
1. Integrate knowledge of atmospheric and hydrologic cycles into a unified system.
2. Develop a suite of models for a range of spatial and temporal scales.
3. Apply improved predictive ability to climatic, environmental and social issues.

Mid-term Review:
MAGS International Advisory Panel (IAP) (Dennis Lettenmaier, Tetsuo Ohata, and John Roads) was asked to conduct a midterm review and concluded that *…MAGS-2 has made impressive progress, as measured by accomplishments relative to the 5 goals and 11 objectives (of MAGS), by publication of research in archival journals, support of graduate students, and by participation in international GEWEX activities*.

Summary of Progress for 2004/05:
MAGS activities in 2004/05 have been focused on bringing the overall to a successful conclusion. Three major activities include MAGS WEBS, finalizing the development of MAGS suite of models, and transferring science to society (operations; other scientists; private sector) through links with stakeholders.

MAGS WEBS
- All calculations are complete
- Synthesis article and data CD in preparation

MAGS Suite of Models
At the forefront of MAGS modelling activities is the development of a fully-coupled atmospheric-land surface-hydrologic model:

- CLASS 3.0 hydrologic land surface scheme is now complete and is being tested on research sites.
- The hydrologic land surface scheme has now been fully-integrated with the CRCM and is being validated.

Other MAGS models, such as river models (runoff, spring break-up), lake models (evaporation, storage), frost model (permafrost), runoff models (for Canadian Shield), and blowing snow models are incorporated into the coupled model to improve its performance, but are also being used in isolation to address specific issues.

Transferring Science to Society

- MAGS is applying its improved predictive ability to climate, environmental and social issues through "Demonstration Projects" (projects established at the first scientist-stakeholder workshop held in June 2003 to demonstrate how MAGS results can be transferred to stakeholders).
- MAGS 2nd Scientist-Stakeholder Workshop is was held 15-17 September 2004.
- Two major outreach activities under the title of *Science Meets Traditional Knowledge* were conducted in predominantly aboriginal communities in the North West Territories; at Deline on Great Bear Lake and Fort Resolution on Great Slave Lake. A journal article is in production.
- A final outreach meeting is scheduled for 2-4 November in Yellowknife, NWT.

Other highlights of the MAGS scientific activities during 2004/05 have been:

- Research on large northern lakes successfully extended to Great Bear Lake.
- Gridded climate change scenarios for the Mackenzie Basin (changes in surface P and T), based on output from several GCMs, have been constructed and added to MAGS data archive.
- Proceedings of workshop *on Predicting Ungauged Streamflow in the Mackenzie Valley: Today's Techniques and Tomorrow's Solutions* (cosponsored with PUB-IAHS and CWRA) have been published.
- A special synthesis session (*The Mackenzie GEWEX Study (MAGS) – Advances in Hydrological Science*) held at CGU 2005.
- A special synthesis session (*Mackenzie GEWEX Study (MAGS): Contribution to Atmospheric Science*) held at CMOS 2005.
- 1998/99 CAGES Water Year data CD available.

MAGS also continues its strong contribution to GHP initiatives such as WEBS, WRAP and Water Sources and Cycling as well as its interaction at national and international levels with other organizations and agencies with common interests (e.g., GAME-Siberia, CEOP, CLiC, and CASES).

In summary, the MAGS scientific program is on target to meet its objectives. The establishment of strong linkages between stakeholders and scientists, and reaching out to the northern communities continue to be key elements of our ongoing activities.

Wrap-up and Future Considerations
The MAGS project funding under the Natural Science and Engineering Research Council (Canada) Research Network Grant program ends Dec 31, 2006.

Considerable effort is currently being focused on wrap-up activities to synthesize the results of ten years of scientific research, to establish a data legacy and to engage communities and policy-makers in using ours scientific outcomes. Specific activities include:

- Development of a data DVD and the establishment of a distribution system that will extend beyond MAGS
- Convening of a major scientific workshop in the national capital to present and synthesize the results of the MAGS program (22-25 November 2005, Ottawa)
- A series of press releases on major findings
- Publication of a book on cold regions hydro-climate science based on MAGS research
- The development of future research directions and programs.

Several follow-up research projects have already arisen from the MAGS initiative and several others are in development. Some recent changes in the Natural Science and Engineering Research Council (Canada) Research Network Grant program under which MAGS was supported, mean that it is not currently possible to initiate a new research network in support of GEWEX goals. However, there is a need to build on the scientific findings of MAGS and to address new issues. Toward this end, MAGS is supporting the development of a Canadian GEWEX coordinating committee and secretariat to support new research to improve understanding of the global water and energy cycle.

Publications and References to Key Summaries or Volumes:
Close to 300-refereed publications have resulted from MAGS research since the beginning of the project and with more than half of these since 2000.

MAGS website: http://www.usask.ca/geography/MAGS/

3.1.8 Murray-Darling Basin (MDB) Project

The major objectives of MDB include:
- Monitor and predict the daily water budget
- Develop real-time products for water agencies
- Observe, understand and model processes controlling soil moisture
- Improve the representation of land surface processes in weather and climate models which can assist in the prediction of land salinization and water resource management.
- Estimate carbon and moisture exchanges between the atmosphere and the land surface in the MDB, with an emphasis on emissions from salinity affected areas.

Summary of progress for 2005
Monitor and predict the daily water budget:
- A study to calculate the water and energy balance of the Murray Darling Basin continued.
- A study using naturally-occurring radioactive and stable isotopes together with nuclear techniques characterising key processes driving cycles of interaction between the land surface and the atmosphere boundary layer on diurnal and seasonal timescales continued.
- Continuing verification of daily rainfall estimates from single and ensemble modelling systems
- Continuing development of forecast systems to estimate rainfall from various NWP systems

Develop real-time products for water agencies:
- A project to provide an irrigation authority with forecasts of rainfall and evaporation continues.
- Workshop on the use of rainfall, soil moisture, and evaporation forecasts in the Australian water industry and the application of isotopic techniques has been scheduled for October 2005.
- A project to use soil moisture to predict fire hazard has been started.
- Links to the water industry are being developed though projects with the eWater Cooperative Research Centre (a consortium of 30 industry and research partners).

Observe, understand and model surface processes:
- The network of soil moisture sites has been expanded and an intensive field measurement campaign planned for October – November 2005 (NAFE, run by Jeff Walker, Uni. Melbourne).
- Flux tower observations continue at the Tumbarumba flux tower, and several papers published describing the coupled cycling of water and carbon, a study applying isotopic techniques to water balance studies in regional basins continues under the GNIR (Global Network for Isotopes in Rivers) project.
- A project on High Resolution Mapping Surface and Root Zone Soil Moisture within the Murray Darling Basin has been started.

Improve representation of land surface processes:
- iPILPS (Isotopes in the Project for Intercomparison of Land-Surface Parameterisation Schemes) initiated
  - First experimental simulations undertaken and compared at Workshop in April
  - Co-hosted International Symposium on Arid Climate Change and Sustainable Development, Lanzhou, China

- Joint China-Australia project on impacts of land-use and land surface processes on regional and global climate commenced

Steps needed to achieve objectives:
- Establish the MDB web site
- Work on the implementation plan continues.

Milestones:
- Delivery of improved rainfall forecasts due to better initialisation and/or models of surface processes
- Workshops and articles summarizing the results and achievements of the demonstration projects
- Workshops and publications summarizing improved physical understanding of the basin's climate system
- Dissemination of outputs to national/international collaborators and the scientific community via communications in peer-reviewed journals, reports and presentations on a) quantification of physical mechanisms underlying exchange, mixing and transport processes and feedback in the lower atmosphere on diurnal and seasonal timescales in the MDB, b) characterisation of the dynamics of carbon and moisture exchanges in salinity affected areas, and c) experimentally-based evaluations of atmospheric transport and dispersion models, and land surface schemes.

New Directions
- The appointment of Helen Cleugh as Chair of the Science Steering Committee
- The appointment of John Gibson, ANSTO, as project director
- The development of closer links to the water industry through a new project with eWater

Future
- Developing links to ACCESS, a new initiative to develop an Australian community climate and weather model.
- Work on techniques to present uncertainty in hydrometeorological forecasts to end-users.

Key Results
- Algorithm for estimating land surface evaporation from MODIS remote sensing (see Cleugh et al, 2005)
- Differing responses of evaporation and net ecosystem exchange to drought in the MDB (see Leuning et al, 2005)
- Use of stable isotope measurements at Tumbarumba site to constrain isotopically-enabled land surface schemes

3.2 GHP WORKING GROUPS

3.2.1 GHP Data Management Working Group (DMWG)

Overview
Objectives (Mission) - The DMWG was formed to assist the GEWEX Hydrometeorology Panel in the coordination and facilitation of data management activities of the Continental-Scale Experiments (CSEs), the Global Runoff Data Centre (GRDC), and the International Satellite Land-Surface Climatology Project (ISLSCP). These activities were later broadened to include the coordination of data management activities between GHP and the other GEWEX Panels, as well as some of the WCRP sponsored programs.

Status: Past Year Activities (Highlights: status, significant changes, and accomplishments)
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 links and information were provided this year. In addition, a DMWG e-mail alias was maintained to facilitate communication between DMWG members (ghp-dmwg@joss.ucar.edu).
2. The GAPP CSE submitted updated gridded data sets for distribution as GHP data sets. These data sets were archived and are available from the DMWG web page (under the "data access" section). However, more work is needed to define and expand additional GHP data sets (see Future Activities #3 below).

3. Discussions continued with the CLIVAR and CLIC programs to keep data activities better coordinated. A frozen precipitation questionnaire was disseminated to obtain needed metadata for the CEOP Reference Sites located in the cryosphere. In addition, an exercise is underway to incorporate sample CEOP Reference Site metadata into the Data and Information Service for CliC (DISC) system. This demonstration could eventually lead to better interoperability and shared archives between future projects. Appropriate data activities web links were maintained between CLIVAR/CliC and the DMWG web pages.
4. Discussions continued to coordinate GHP data management activities with the other GEWEX Panels. The DMWG Chair (Steve Williams) continues to coordinate with the GEWEX Working Group on Data Management and Analysis to better improve cross reference/access to and coordination of project data sets within GEWEX. CEOP was identified as a good prototype to begin to share some coordinated or "subset" datasets.
5. Most of the DMWG work this year involved the organization of CEOP data management between the various CSEs. The 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/metadata, data policies, information regarding Reference Sites and Model Location Time Series (MOLTS) profiles, and other pertinent data links. This web page is linked to the CEOP, GHP, and the DMWG home pages.
6. The inventory and metadata of CEOP Reference Sites were maintained. A dynamic 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 (i.e., locations, descriptions, maps, site contacts, sample data sets, instrumentation, parameters measured).
7. The DMWG continued to work on the CEOP EOP-3 and 4 "composite" Reference Site dataset. Each Reference Site was requested to submit their data in a common format as described in the data submission requirements report for the CEOP Reference Sites which was approved by the CEOP SSC in July 2003 (see http://www.joss.ucar.edu/ghp/ceopdm/refdata_report/). As data/ metadata were submitted, UCAR/JOSS performed consistency checks and applied a final quality assurance review to the final data. Any resulting problems or issues were subsequently solved with the respective data providers. Completed datasets were then posted to the on-line CEOP archive for distribution to the scientific community located at: http://www.joss.ucar.edu/ghp/ceopdm/archive/eop3_data/ Details (and status) of the EOP-3/4 Reference Site "composite" data set processing will be prepared and published in the CEOP Newsletter #9 (October 2005). At the time of this report, EOP-3/4 data were received from 31 Reference Sites for review and final processing. Completed on-line data are available from 25 of these Reference Sites (including data from 5 sites which contain full annual cycles for both EOP 3 and 4).
8. UCAR/JOSS has been coordinating with the CEOP Data Integration efforts and established a DODS *in-situ* server for the interactive distribution of Reference Site data. It has been demonstrated that this has facilitated the data exchange between CEOP Data Centers and allowed for the seamless integration of data between these centers. This operational DODS *in-situ* server was made available to the scientific community in May 2005 as part of the new CEOP Distributed Data Integration System.
9. A Soils and Land Cover Questionnaire for the CEOP Reference Sites was designed and developed to facilitate the metadata needed to perform model/satellite data intercomparisons and site data analysis. This questionnaire requesting information on standardized surface parameters (including profile information) such as porosity, texture class, infiltration, bulk dry density, and saturated hydraulic conductivity was distributed to the community in September 2005. In addition, standardized land cover (and seasonal changes) which is important to document the Site characteristics during CEOP was requested.
10. The DMWG Chair (Steve Williams) attended the CEOP Metadata Meeting in Tokyo (November 2004) to help formulate standardized a system and procedures to coordinate the Reference Site data with the rest of CEOP archives. The ISO 19115 standard was designated for the documentation of CEOP metadata.
11. The DMWG has initiated coordination with several of the proposed CEOP Hydrology Reference Basins to add these data to the CEOP database. Further data details (e.g., formats, resolutions) still need to be worked out.

New Directions (longer term vision)

Each member of the DMWG was requested to provide a summary of the plans for final archive of their data. The following is a brief summary by member:

AMMA/CATCH – Plans and the data policy are being formulated at the AMMA Project Office.

BALTEX – The operational data are already archived and available in long-term European Data Centres and will be available through respective data center and BALTEX policies. The BALTEX PI data/products are not included but will be available from the respective investigators.

GAME – Distributed data will be archived and available at respective institutions for 10 years (an additional 10 year extension is being discussed). Most data are also available on CD/DVD with on-line "image" versions.

GCIP/GAPP – The GCIP data are archived at NCDC and NCAR (with subsets at ARM). GAPP data are archived at NCAR and ARM. Both project datasets are expected to be available from NCAR as plans are being developed to link these data to the NCAR Community Data Portal (CDP).

LBA – The Brazil Ministry of Science and Technology has agreed to archive the data for 20 years (probably at CPTEC). Data will be available through the LBA Data Information System.

LPB – Data archive and access plans are being formulated

MAGS – The final data archive and access plans are being formulated. Selected data sets will be archived on CD/DVD.

MDB – Data archive and access plans are being formulated.

GPCC – The gridded/point data all archived at GPCC. GPCP data are archived and will be available at NASA/GSFC and NOAA/NCDC.

GRDC – All data are archived and will be available at GRDC.

ISLSCP – Data are archived at NASA/GSFC. Some datasets are archived and will be available on Compact Disk (CD).

NOTE: CEOP data (subset of GHP data) are archived and available at long-term archives at the National Center for Atmospheric Research (NCAR), the CERA Database (Max Plank Institute), and the University of Tokyo (UT).

Future: Next Year Foreseen Activities

1. The DMWG will continue the compilation of CEOP Reference Site data/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. More interaction between the CSE and the Reference Site management is needed to expedite data submission.
2. The DMWG members will be requested 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.
3. Continue interaction with CSEs on what additional regional data sets and products might be useful as "GHP datasets" as well as continuing to finalize long-term archival plans.
4. UCAR/JOSS will submit a proposal to complete work on compilation of the CEOP EOP-3 and EOP-4 "composite" Reference Site data set incorporating common parameters, format, and temporal resolution. The DMWG will work with the CSEs and reference sites to coordinate the data submission, quality assurance, and posting of data to the scientific community. It is planned to complete these EOP 3 / 4 datasets during the upcoming year.

Key results (bullets)

- Provided access to GHP data through a distributed data interface
- Coordinated GHP data management activities with other GEWEX Panels and WCRP Programmes
- Continued to develop and maintain the CEOP Data and Metadata Archives
- Began to formalize plans for long-term GHP data archival

Issues and Recommendations

- The DMWG needs feedback from the GHP (and in particular the GHP working groups) regarding their data requirements (i.e., gridded data sets, "composites", products, subsets).
- Work needs to be continued to include hydrology data/metadata into the GHP database (primarily through the CEOP activities). The CEOP Hydrology working group has the action to coordinate and provide these data.
- In the longer term, the DMWG needs to draft a GHP wide Data Policy. One suggested strategy is to use the approved CEOP Reference Site data policy as a "prototype". GHP needs to improve the integration of GHP datasets with GEWEX and other WCRP projects. One first step might be the development of a method to cross-link CSE databases and later other GEWEX and WCRP related data sets (i.e., data portals, OpeNDAP, GIS, XML, digital libraries).

Summary

The DMWG continued to coordinate data management activities between the various CSEs and GHP member groups. CEOP continues to serve as the "prototype" for this activity and is demonstrating progress that the GHP can benefit from.

DMWG website: http://www.joss.ucar.edu/ghp/

3.2.2 Water and Energy Budget Synthesis (WEBS)

Our goal is to develop a comparison of water and energy budgets over land regions in general with a focus on the GEWEX CSEs in particular. This study will involve a comparison of a number of observationally based (GEWEX) water and energy budget processes and variables to corresponding processes and variables from global atmospheric and land based reanalyses. Such a comparison will provide an overall assessment of the accuracy to which we can quantitatively observe and model bulk water and energy cycle processes including understanding their potential error and the potential error of the overall water and energy budget "closure". These "closure" errors depend on time and space scales, which will be focused here on a 2 deg. grid, aggregated to CSE basin and global land regions, and monthly to 10-year time scales.

Observations are being taken mainly from the GEWEX data sets although some additional data sets such as CMAP will also be considered. Our goal is to have at least two observations sets per variable or process in order to get some idea of the observational uncertainty. In cases where there are clear discrepancies between various observation sets, we will begin to look at comparisons to high quality in situ observations. In that regard, we should also note that we may be able to take advantage of corresponding GEWEX assessments, which may include similar comparisons

In a similar fashion, the Global Land Data Assimilation System (GLDAS), which consists of the mean of three models and the Global Soil Wetness Project (GSWP), which will provide the mean of 8 or more models will provide some measure of the uncertainty in land data assimilation systems. Finally the four reanalysis sets, NCEP RI, RII, ERA40, JRA will provide a measure of uncertainty of atmospheric reanalyses, although it will also be of interest to determine if the later generation atmospheric reanalyses are demonstrably better than 1st generation reanalyses. By comparing the global atmospheric analysis products to the observations, we will also begin to understand if current forecasts, which are usually evaluated with respect to global analyses can discriminate subtle but important interannual variations in water and energy variables and processes.

Our objective is *to better understand the current uncertainty in water and energy bulk states and processes as well as the overall budget errors.*

This uncertainty will be established by comparing at least two observation-based measures with 3-4 atmospheric analysis based measures and two land data assimilation based measures. By comparison of available observations with assimilation data we should be able to establish estimates for the errors in each of the processes, which will be useful when we have to assess the potential error in processes, such as evaporation and sensible heating that are not well observed.

Past Year Activities
The data sets continue to be gathered centrally by Roads. Actually, JRA and GSWP and GLDAS data sets only became available beginning June 2005. We are now trying to put together the generic plots and begin drafting an article, which will then draw in the CSE WEBS representatives as co-authors and expert contributors to the description of the WEBS in their specific region. This article may also involve contributors from GRP, who are developing their own WEBS effort.

John Roads has now been funded by the NASA NEWS (NASA Energy and Water Study) program (9/1/2005-8/31/2008) and will thus be able to devote more time to this effort. Roads' group leader is Bill Rossow (GRP chair), who, again, is developing a parallel GEWEX Radiation Panel (GRP) WEBS effort. We intend to merge the GRP and GHP efforts sometime in the future. It should also be noted that the GHP and GRP efforts will include the GEWEX Modelling and Prediction Panel (GMPP) GSWP products, which thus makes WEBS a complete GEWEX crosscut activity, in that members of all panels are involved in developing the WEBS assessment over land regions.

Gathering of the needed data is almost complete at this point and the assessment needs to begin. Preliminary results will be presented at the GEWEX SSG meeting.

Issues and Recommendations
GEWEX WEBS activities are really land based in that GEWEX mostly comprises scientists with expertise in the coupled land atmosphere system. In order to eventually do a complete global WEBS will require some interaction with the oceanographic and thus CLIVAR community.

Summary
A major goal of the Global Energy and Water Cycle Experiment (GEWEX) Continental-Scale Experiments (CSEs) has been to qualitatively and quantitatively describe ("close") global and regional atmospheric and land water and energy cycles. As described by Roads et al. (2003), since few regional or global hydroclimatological observations were available when these water and energy budget studies for the CSEs first began, initial studies mainly included global and regional atmospheric reanalyses and macroscale hydrologic model simulations. Although reanalysis systems and hydrologic model simulations are certainly model dependent, at least they have many more observational constraints than, say, general circulation models forced by just sea surface temperatures. However, the errors are still large. In fact, individual process errors in these models, which tend to cancel, are much larger than the overall budget errors. Preliminary NCEP reanalysis comparisons (Roads et al. 2002, 2003) show analysis precipitation errors are likely balanced in part by evaporation errors, although errors in other processes such as runoff and moisture convergence are almost as large, especially for certain regions, like the Amazon and GAME tropics. "Closure" really depends upon understanding the uncertainty attached to the value of each hydroclimatological process.

A number of additional GEWEX data sets, which have recently become available, can now be used to augment previous global regional water and energy budget studies and further assess the error in closing the water and energy cycles. GEWEX data sets include: the Global Precipitation Climatology Project (GPCP) precipitation, the International Satellite Climate Comparison Project (ISCCP) radiation as well as the Surface Radiation Project (SRB) surface radiation available through the International Satellite Land Surface Comparison Project (ISLSCP), the Global Runoff Data Centre (GRDC) runoff, and the NASA water Vapor Project (NVAP) precipitable water as well as the precipitable water available through ISCCP. These data sets as well as the available global atmospheric reanalyses (NCEP/NCAR, NCEP/DOE, ERA40, JRA), and global land data assimilations (GLDAS and GSWP) are being examined to see how well we can simulate, and "close" the water and energy budgets on climatological to monthly time scales and global to regional space scales.

3.2.3 Water Resources Application Project (WRAP)

Background
The Water Resource Applications Project (WRAP) has a mandate is to:
1. Dialogue with hydrological modeling community and operational environmental services
2. Demonstrate skill in predicting changes in water resources and soil moisture on time scales up to seasonal and annual
3. Collaborate with water resources agencies to develop better hydrometeorological predictions

WRAP includes representatives from all of the Continental Scale Experiments (CSE) and Associates (CSA), and from ISLSCP, HELP, WWAP, IAHS, and WMO.

WRAP Activities to Date

- Development of a WWW site (http://ecpc.ucsd.edu/projects/ghp/Wrap_web/)
- Workshops to dialogue with water resource community:
  - *Application of GEWEX Scientific Research to Water Resources Management, ICWRER, Germany, July 2002*
  - *GEWEX Hydrometeorological Science in Improved Water Resources Management, IUGG, Japan, July 2003*
- Participation in planning exercises and consultation with other programs and agencies with HELP, WWAP, IAHS, PUB, GWSP, IGOS-P Water.
- Collaboration with WWAP on development of scientific indicators for global water resources assessment
- Review of Chapter 4 (global water balance and water resources) for next edition of WWDR.
- Promotion of CSE scoping and demonstration projects (i.e. MAGS)
- Articles in GEWEX and IAHS newsletters
- Papers published in conference proceedings:
  - Lawford, R., Manton, M., Martz, L., Oki, T (2004): Remote sensing and indicators: Contributions of the Global Water and Energy Cycle Experiment (GEWEX) and its Water Resources Applications Project (WRAP). *Monitoring Tailor-made IV: information to support sustainable water management from local to global levels*. (in press)
  - Martz, L. (2004): The application of large-scale data in predicting streamflow. *Predicting Ungauged Streamflow in the Mackenzie Valley: Today's Techniques & Tomorrow's Solutions,* Canadian Water Resources Journal Special Issue.
- WRAP paper presentation at CEOP special session at AGU (Montreal, May 2004).

Water Resource "Indicators" and GEWEX / WRAP

- Possible contributions identified through discussion with WWAP and participation in MTM IV Conference:
  - Monitor global trends
  - Assess regional impacts of global observations
  - Develop and use indices
  - Identify and predict impacts of climate variability (El Nino)
  - Extend short-term climate records
  - Provide model (GLDAS) outputs in areas where only sparse data exist.
  - Develop links between water cycle and other biogeochemical cycles.
- Continuing discussion with WWAP concerning a GEWEX-specific contributing project.
- Potential for links to CEOP.

Recent Workshops

- *Transferring Hydrological Data Across Spatial and Temporal Scales*
  - Workshop W6 at IAHS Scientific Assembly (Foz do Iguaçu, Brazil, 4-9 April 05)
  - Goal was to review suitability of available "downscaling" methods for hydrological analysis / modeling and water resource decision-making in mesoscale basins.
  - Convened by WRAP in collaboration with GEWEX WG, PUB, ICCLAS, ICRS, ICSI.
  - Follow-up to earlier WRAP workshops that identified the need to specify predictive uncertainty and downscale data for water resource applications.
  - Incorporated a special paper set and discussion on HEPEX
  - 14 oral papers and 10 posters presented
  - IAHS report and summary submitted
  - A special presentation by the WRAP Chair titled *LDAS and LIS: A collaborative opportunity for GEWEX and IAHS-PUB?*
    - Reviewed concept of LDAS and potential for application of LIS data products in hydrological modeling
    - LIS/LDAS interest: Validation of LIS/LDAS products capability to reproduce key elements of the hydrologic cycle
    - PUB interest: Evaluation of the capacity of LIS/LDAS products to provide initial conditions / state variables and forcing variables in ungauged areas

        - Uncertainty as a common interest
        - Discussion points
            - Convergence/integration of climatological and hydrological approaches to the water cycle
            - Relevance to PUB goals and level of interest
            - Leadership and coordination
            - GLASS annual workshop as possible venue to consider science questions and experimental design
            - Assessment of progress in Perugia (IAHS VIIth)
- *Applicability of Climate Research and Information for Water Resource Management in Semi-Arid and Arid Regions*
    - A joint WCRP-UNESCO Invited Workshop in Cairo, Egypt, 18-21 April 2005
    - Co-chairs: Lawrence Martz (Chair, WRAP) and Mohamed Abdulrazzak (Director, UNESCO Cairo Office)
    - Structured around stakeholder and expert presentations and dialogue.
    - Objectives:
        - Bring together operational hydrology and water management stakeholders from the arid/semi-arid regions of north Africa and the Middle East with hydro-climate scientists
        - Articulate regional water issues and examine current state of knowledge about climate system relevant to water management in arid/semi-arid regions
        - Identify gaps in understanding, data and regional capacity
        - Provide feedback to WCRP and its several programs
    - Major needs identified
        - Increase awareness of the significance of climate change and variability in water resource planning and management across the region.
        - Improve sharing of hydroclimatological data across various national and intra-national jurisdictions.
        - Access and develop tools to bring global and regional data into a form suitable to support decision-making.
        - Apply climate forecasts and data products to specific water management and planning issues.
        - Improve the interface between regional institutions and the international community to enhance the regional capacity to address issues related to the interaction of water and climate
    - Priority for action
        - Formation of a regional network of professional and academic scientists
        - Use existing institutional capacity within the region with UNESCO to take lead role
        - The initial tasks of the network would be to:
            - Inventory expertise within the region
            - Inventory hydroclimatological observation sites across the region
            - Examine the feasibility of developing a reference site under the CEOP program
            - Develop a proposal for a demonstration project that applies GEWEX/CLIVAR data products or models to the solution of a specific water management issue.

Hydrological Ensemble Prediction Experiment (HEPEX)

- Objective is to demonstrate use of hydrological ensemble forecasts to support water resource decision-making that has important consequences for economy and public health & safety
- Initiated at the lead of John Schaake
- Supported by GEWEX-WRAP, WMO-Hydrology, IAHS-PUB
- WRAP role in coordination and promoting CSE participation.
- GAPP and MAGS participation confirmed
- A formal statement of the nature of the relationship between GEWEX/WRAP and HEPEX is needed and a pragmatic implementation of this (steering committee membership etc.) is required

CSE demonstration projects

- WRAP is promoting the development of CSE based demonstration projects
- MAGS example
    - *Science meets Society* workshops with stakeholders in 2003, 2004 and 2005 and *Mackenzie Basin Climate: Linking Traditional Knowledge and Science* workshop series with aboriginal communities in July 2005.

- Demonstration projects on (1) Streamflow forecasts for NWT Power Corporation, (2) Lightning and forest fire prediction for Canadian Forest Service, (3) Ice breakup and flood forecasting for Town of Hay River, (4) Data and models for wildlife habitat and distribution study, (5) Short-term snow forecasting with Prairie Aviation & Arctic Weather Centre and (6) Community participation in Great Bear Lake thermodynamics study

WRAP 2005/06 Plans and Issues

- A GEWEX-WRAP Workshop on Mountains as Water Sources is being planned
  - Co-organized by Lawrence Martz and Lai-Yung (Ruby) Leung
  - Strong hydro-climate linkage
  - Objective: To articulate major issues and develop a project proposal
  - Summer 2006, Vancouver Island, Canada??
- Regional hydro-climate network for Middle East
  - UNESCO to take lead (perhaps through G-WADI)
  - Demonstration project on hydrological or water resource application merging regional skills and data with WCRP expertise, data sets and models.
  - Potential for a regional CEOP site should be considered
- PUB-GEWEX partnership
  - Pursue the option of a collaborative project with an LIS/LDAS focus.
  - Project leadership from both PUB and GEWEX needs to be identified.
- GWSP linkage
  - Digital water atlas – GEWEX can provide access to global data sets through data management
  - WEBS can make a significant contribution to the GWSP goal of improving estimates of world water balance – Roads to lead.
- HEPEX linkage
  - GEWEX-specific contributions need to be identified and a formal statement of the relationship of this project to GEWEX needs to be articulated
- Ongoing proposals to develop a Predictability activity within GHP need to be brought to a conclusion. In part, a decision is needs as to whether this is to be a stand-alone working group within GHP or should be incorporated into the WRAP working group.

Succession planning

- The WRAP working group is scheduled to wrap up 2006.
- If there is a single over-riding message that arises from the WRAP dialogue with the water resource management community, it is that the model and data products generated through GEWEX and related WCRP global projects need to be rescaled temporally and spatially to be widely useful for water management applications. Rescaled results must also have appropriate bounds or uncertainty measures associated with them. In essence, the hydrologic science community was identified as an essential filter between the global hydroclimatological community and the water management community. It is recommended that:
  - The WRAP initiative be re-focused and re-organized around hydrological science and operational hydrological services.
  - The role of CSEs remains central to the initiative but with some flexibility reflecting the level of participation.
  - That the leadership of the new initiative be heavily drawn from participants in demonstration projects.
  - The current WRAP committee provides a synthesis of activities and recommendations for future action to GHP-2006.

3.2.4 Transferability Working Group (TWG)

The TWG seeks answers to questions such as:

- How portable are our regional climate models?
- How much does “tuning” limit the general applicability to a range of climatic regions?
- Can we recover some of the generality of “first-principles” models by examining their behavior on a wide range of climates?

The overall objective of the TWG is to understand the physical processes underpinning the global energy budget, the global water cycle, and their predictability through systematic intercomparisons of regional

climate simulations on several continents and through comparison of these simulated climates with coordinated continental-scale observations and analyses. Transferability experiments are carried out by use of ensembles of regional climate models on multiple domains with all modeling parameters kept fixed during model transfer among domains.

Past year activities:
The TWG hosted a meeting at European Geophysical Union Meeting in Vienna (April 2005) that generated discussion on scientific aspects of transferability and raised awareness of transferability among European colleagues.

- Analysis of model output from CEOP1 (July – September 2001) is proceeding by testing TWG Hypothesis Box plots of diurnal cycles of 3-hourly mean values of surface sensible and latent heat fluxes for CSE reference sites and nearest model grid points allow evaluation of model distributions, including extremes and "outliers", for model native and non-native grids.
- A TWG website (http://rcmlab.agron.iastate.edu/twg/) was created that describes the TWG mission and strategy and serves as a platform for disseminating analysis products for TWG Experiment 1. A 1-page brochure with information and contacts on transferability has been created for dissemination at conferences and workshops.
- R. Arritt discussed transferability at the Pan-WCRP Monsoon Workshop in Irvine, CA in June and created new interest in participation in ICTS. Since then, numerous modeling groups have expressed interest in simulating the CEOP on all seven domains.
- Colin Jones, Université du Québec à Montréal, has joined the TWG team as a liaison to the GEWEX Global Model and Prediction Panel (GMPP) and also as a participant in ICTS.
- E. Takle discussed transferability and CSE activities with Indian colleagues at the Indo-US Joint Workshop on High Performance Computing for Regional Weather and Climate (http://www.mmm.ucar.edu/events/indo_us/agenda.html) (30 June – 2 July 2005) in Boulder, CO, USA. Verbal invitation was received to visit India in February for ongoing discussions in connection with transferability intercomparisons.

New Directions (longer term vision):
Preliminary studies of surface fluxes confirm that systematic evaluation of specific model results compared to enhanced observations across several domains is a valuable tool for exposing model weaknesses. The long-term vision is that follow-on studies that include soil moisture, boundary-layer properties, and cloud characteristics will clarify specific ways in which models – both regional and global – can improve accuracy of simulation of the water and energy cycles. Specifically, use of regional models under transferability intercomparisons will enable more systematic development of parameterizations for high-resolution modelling, both global and regional.

Next Year Foreseen Activities:
Further analysis of surface latent and sensible heat will continue, with first analysis paper to be submitted summer 2006. This will be followed by studies relating soil moisture to boundary-layer properties, and intensity and diurnal phasing of precipitation (see specific hypotheses). Discussions at GHP-11, stimulated by a report on GCSS by Christian Jacob, resulted in a commitment by TWG to conduct a Pacific Cloud Transect Study. This study will compare global model and regional model (ideally some RCMs having enhanced vertical resolution) simulations of clouds along a transect that spans a Pacific Ocean region from the tropics through mid-latitudes for which extensive cloud measurements are available for a June-August period.

Key Results:

- Three model teams have submitted data to the ICTS archive
- Five model teams have submitted at least some data for the TWG Hypothesis 1 intercomparison
- Three more modelling groups have indicated strong interest in joining the ICTS simulations and participating in the TWG Hypothesis 1 intercomparison
- An article on ICTS with some analysis has been submitted to the CEOP Newsletter

Preliminary results from the study of sensible and latent heat fluxes suggest:

- There is evidence from both sensible and latent heat flux that there is a "home domain advantage" for regional climate models
- Most models do well in determining the time of peak daytime sensible and latent heat flux, even though the observation sites have different peak times.

- Variability of latent heat seems overestimated for the warmer climate site and underestimated for the cooler climate site
- Variability of sensible heat seems overestimated for the cooler climate site and underestimated for the warmer climate site.

Issues and Recommendations:
- TWG should actively seek ways to work closely with global modelling groups (e.g., GMPP) and cloud study groups (e.g., GCSS) to provide a means of exploring regional processes with enhanced resolution (compared to global models).
- TWG should continue its plan for hypothesis-driven studies of water and energy cycle processes
- TWG should actively seek participation by more modelling teams for participation in ICTS and TWG intercomparisons.

Summary:
TWG has initiated an ambitious plan for rigorous evaluation of model capabilities for simulating water and energy cycle processes across a wide range of climates. Preliminary results reveal enhanced model accuracy on native domains. TWG seeks active engagement with other GEWEX studies and working groups to exploit enhanced resolution studies as complements to global simulations and field observations.

3.2.5 Worldwide Integrated Study of Extremes (WISE)

Extremes have always been a concern of GHP. At its first meeting in 1995, one of GHP's overall scientific issues was given as: *What feedback mechanisms affect the water cycle and how do these influence wet and dry periods?* A concerted effort to examine this issue was officially started in 2005 after several years of preliminary discussions. It is expected that the exact nature of the objective will evolve somewhat as the effort proceeds. The effort is initially focusing on ***droughts and extended wet periods***.

The objective is *to better understand the occurrence, evolution and role of extremes within the climate system.*

There are several sub-issues associated with this objective including:
- How do we best define extremes for our purposes?
- What extremes have occurred in the past?
- How do extremes develop, evolve and end within the climate system?
- Have extremes changed in occurrence and character and why or why not?
- Given our progress, how can we contribute to assessing whether extremes may change in the future?

The effort is just beginning and systematic activities are being started. These include:
- Web site: A web site (accessible through the GHP web site) has been developed at UCAR which summarizes our plans and also lists numerous other web sites that contain information on extremes and hazards.
- GEWEX Newsletter: A short write-up of this extremes activity was prepared for the May 2005 issue of the Newsletter.
- CEOP Phase II science plan: A section of this science plan has been prepared on one element of our overall WISE strategy, extremes during the CEOP time period.

In addition, a very successful WISE breakout session was held in conjunction with the GHP 2005 meeting. This breakout session led to the identification of a set of specific activities that will be initiated within WISE. These have been referred to through this update (definitions, data base, case studies, trends, CEOP).

The first WISE conference call was held on October 24 with 10 participants. This call was organized around the specific activities within WISE in order to move them forward. It is expected that other calls will take place on time scales of order a month or so.

New Directions
One of the most critical aspects of the water and energy cycle is the occurrence of extremes. From a global perspective, extremes develop and evolve on a continual basis, and they lead to enormous

impacts when and where they occur. Second, one of the most critical concerns of a changing climate is also in connection with extremes. To what extent will the types, distributions, and impacts of extremes change in a world with an altered climate?

We envision WISE addressing both of these issues associated with extremes. WISE will systematically address extremes within the present climate system and this solid foundation will allow us to contribute significantly to assessing to what extent they may change in the future. This will be carried out through several activities. This includes the potential development of new GHP-focused measures of extremes such as droughts and extended wet periods, the development of a GHP-focused data set of extremes, the conduct and analysis of several 'case studies' of GHP-focused extremes, and a probable examination of trends of extremes (in the past and probably in the future as well). It also includes participating within CEOP to study extremes during the 'same time period' around the world. It may also include 'case studies' of extremes within climate scenarios.

We envision several milestones of progress that follow from these activities. These include assessments and potential modification of definitions of extremes, compilation of datasets, summary articles on the results of case studies of extremes (which might include ones within future scenarios), synthesis articles on extremes during CEOP, another on trends, and another on (but later) all WISE activities. Our vision also includes a possible expansion of WISE to include all elements of GEWEX and perhaps WCRP. For now, we have started within GHP in order to establish a solid foundation.

Next Year's Activities
This is really the first year of the effort. The focus will be in starting the implementation of our longer-term plan. This includes improving our definitions of extremes and starting our database of extremes. There are numerous definitions available and we will assess these and decide if they are satisfactory for our needs. In parallel, we will begin to pull together our own dataset of extremes. There is a great deal of information now on extremes but this needs to be pulled together in a more consistent manner.

We will begin our first extremes case study. Following the success of other GEWEX efforts such as GCSS, we intend on collectively studying several extremes to assess our collective understanding, documentation and modelling capability. Our modelling capability includes assessments of the prediction of the extremes. Building on WEBS, our first one will be utilize WEBS calculations carried out in relation to MAGS. The focal point will be the drought over the Canadian Prairies in 2001-02.

By the end of the year (or earlier), we expect to have made a decision as to whether we will initiate an effort to examine trends in extremes. A key aspect of this decision is assessing our needs and establishing whether these are being satisfied through other activities. We will also work within CEOP as one element of our strategy. We are examining several extremes within the CEOP time frame and this will continue and this will include the usage of CEOP data.

Issues and Recommendations
As highlighted above, key issues we are addressing include determining the extent to which we need to initiate our own efforts or whether we learn more on what others have already done. It would be desirable if WISE could extend past its GHP roots to include all aspects of GEWEX (and perhaps WCRP). Extremes such as droughts and extended wet periods are a huge issue for which all groups can and should contribute. Through a wider base, the scope of WISE could also be expanded to consider other extremes in the climate system.

Summary
A concerted effort to address extremes has begun within GEWEX. This effort builds upon past work within GHP and its CSEs and other working groups and it also utilizes opportunities such as CEOP. A multi-point strategy has been developed, a group of researchers has been brought together, and preliminary activities have been initiated. Outcomes of this effort are directly relevant to Phase II.

3.2.6 Stable Water Isotope Intercomparison Group (SWING)

Since more than four decades the isotopic composition of water stored in various archives (e.g. ice cores, ground water) has been used to study changes in the hydrological cycle on timescales from glacial-interglacial to short term variations. However, the interpretation of isotopic variations in terms of climate change is often handicapped by an observational lack of other relevant climate parameters

(e.g. temperature, relative humidity, precipitation) both in space and time. Modelling the isotopic composition of water within the hydrological cycle of general circulation models (GCM) may help to overcome this deficit on available climate data. Isotope GCMs simulate the 18O/16O (and/or 2H/1H) relation as an independent quantity within a closed "model world" where all other relevant climate parameters are known, too. This enables an improved analysis of (simulated) isotope variability in terms of climate change. Modelling of stable water isotopes also offers the potential to improve our understanding of current-day tropospheric and stratospheric water vapor and cloud processes.

Aims and Objectives of SWING

The Stable Water Isotope Intercomparison Group (SWING) is a working group of the GEWEX Hydrometeorology Panel (GHP). Its general purpose is an international inter-comparison of current state-of-the-art general circulation models with stable water isotope (H218O, HDO) built into the hydrological cycle (so called Isotope GCMs) and related observational isotope data. The SWING project serves as a platform exploring the following topics:

- Enable an overview about ongoing isotope GCM modelling capabilities
- Serve as a platform for common isotope simulation experiments of the various research group (model-model-intercomparison)
- Identify the most important need of new observational isotope data in space, time and the various aggregate forms of water (model-data-intercomparison)
- Strengthen the linkage between the modelling community and the key contributors of observational water isotope data
- Serve as an interface to other isotope model intercomparison studies, e.g. IPILS (Isotopes in Project for Intercomparison of Land-surface Parameterization Schemes)

SWING Activities in 2004/2005

The SWING project has been officially launched at a first workshop, hosted by the IAEA, Vienna, in February 2004. The project efforts of phase I of this initiative can be summarized as follows (main contributors are given in brackets):

- SWING presentation at the 10th GHP meeting, Montevideo, Uruguay, September 2004 (J. Roads)
- Presentation of first results of the SWING project (by M. Werner) at
  - The AGU Fall Meeting, San Francisco, USA, December 2004
  - The General Assembly of the EGU, Vienna, Austria, 2005
  - The 5th International GEWEX Scientific Conference, Costa Mesa, USA, 2005.
- Performing and analyze first common SWING simulations under present-day boundary conditions using 3 different state-of-the-art Isotope GCMs: GISS, ECHAM4 and MUGCM (G. Schmidt, J. Brown, M. Werner)
  - A climatology control run with prescribed SST from HadISST data set, mean of period 1980-1999, other boundary conditions set to 1980's value.
  - A 134-years simulation with varying SST from the HadISST data set, period 1870-2003, increasing CO2 and other greenhouse gases.
- Collection of model output of present-day control simulations of the different isotope GCMs in a common SWING database, available to the public (K. Sickel, M. Werner)

Future SWING Activities:

The main SWING activity in the near-time future will be a sum-up of all Phase I results, the in-depth evaluation of the new GCM model results and the scientific discussion about key focus of the envisaged Phase II of the SWING project.

SWING web site: http://www.bgc-jena.mpg.de/projects/SWING

3.3 GHP AFFILIATE PROJECTS

3.3.1 Coordinated Enhanced Observing Period (CEOP)

Overview

Objective(s):

To understand and model the influence of continental hydroclimate processes on the predictability of global atmospheric circulation and changes in water resources, with a particular focus on the heat source and sink regions that drive and modify the climate system and anomalies.

The key science objectives of CEOP are associated with its Water and Energy Simulation and Predictability (WESP) and Monsoon Systems Studies activities. These include respectively: (1) To use enhanced observations to diagnose, simulate and predict water and energy fluxes and reservoirs over land on diurnal to annual temporal scales as well as apply these predictions for water resource applications; and (2) To document the seasonal march of the monsoon systems, assess their driving mechanisms, and investigate their possible physical connections.

Status: past year activities
During this reporting period, CEOP has made progress in the establishment two sets of unique functional components to: (1) integrate observations based on coordination among field science groups, space agencies, and numerical weather prediction centers in the local, regional and global scales; and (2) to exchange and disseminate observational data and information including data management that encompasses functions such as Quality Assessment/Quality Control, access to data, and archiving of data, data integration and visualization, and information fusion. In this context, one of the key achievements of CEOP, in this reporting period, has been to greatly refine the establishment of an integrated observation system by combining different types of observations, in-situ and satellite. In addition, the numerical weather prediction model outputs are merged with the observed data to provide spatially and temporally continuous coverage in a complementary way. The coordinated enhanced observation and model output generation were carried out during the first Enhanced Observing Period (EOP-1) [July-September 2001], and the EOP-3 [October 2002-September 2003] and the EOP-4 [October 2003-December 2004].

In-situ Data Issues - Key agreements were reinitiated to maintain the provision of in-situ data from 35 selected globally distributed "reference" stations mainly involved in the GEWEX Hydrometeorological Panel (GHP) Continental Scale Experiments (CSEs). These Reference Sites provide enhanced observations of sub-surface (soil profiles), surface (standard meteorological and radiation), near surface (flux tower), atmospheric profiles (rawinsonde and profiler), and ancillary data sets (radar, special observations) in a common format. Collection of the data from the CEOP Reference sites for the initial CEOP period has shown that adherence by the sites to a consistent format is especially important to ensure an efficient continuation of the CEOP dataset development and delivery process. The CEOP Reference Site Data Management Internet page is at: http://www.joss.ucar.edu/ghp/ceopdm/. Data are deposited at this site through the CEOP Central Data Archive (CDA) at NCAR.

Satellite Observations - Almost all components of the water cycle among atmosphere, land and ocean can be observed by currently available satellite sensors. CEOP has taken the essential step of integrating the satellite products for generating new data sets of the overall water cycle. The work associated with satellite data set development and integration that was undertaken by CEOP during this reporting period has progressed as planned. Dataset documentation and background information has been made available at the following Internet page: http://monsoon.t.u-tokyo.ac.jp/camp-i/doc/sat_info/index.htm. A contribution by JAXA in coordination with the University of Tokyo has been established that applies to an on-going effort to provide CEOP satellite datasets for integration with the CEOP in-situ and model output data. The data set consists of the main water cycle parameters necessary to accomplish CEOP scientific goals; these data are geo-coded (i.e. re-sampled to a regular LAT/LON Grid). They are generated at three scales, 250km rectangular, monsoon regional and global scales, associated with product levels 1b, 2 and 3. The processing levels have also been defined to ensure a clear understanding of the nomenclature and reduce ambiguity in the statement of requirements. The Levels of processing have been established to be:
[Level-1b] - Radiance product with full resolution at reference sites.
[Level-2] - Geophysical product at the same resolution at reference sites and monsoon regions.
[Level-3] - Statistical geophysical product in space and/or time at reference sites, monsoon regions and global. (example: Monthly mean rain rate at reference sites, etc.)

They consist of an image element and a metadata part element that is compliant with the ISO-19115 standard.

NWP Model Outputs - The basis of the NWP model output component of CEOP, which was established through a letter, which was sent in September 2001, to NWP and data assimilation centers worldwide, was expanded and extended during this reporting period. The initial letter requested that the NWP centers archive specific model output data for CEOP during the CEOP EOP-3, -4 time period from 1 October 2001 through 30 September 2004 (later extended through 31 December 2004 to match the

extension of EOP-4). The letter also requested both analysis/assimilation and forecast model products from both global and regional NWP suites, and from both operational and reanalysis systems. A new letter, sent in 2005, asked that this work be extended through the end of CEOP Phase 2. The response to the request from WCRP and CEOP for this extension to the support of the CEOP model output component was a special success for the start of CEOP Phase 2 implementation. All nine operational NWP and two data assimilation centers that are currently contributing to this component of CEOP are, therefore, expected to continue to do so at least at the current level of commitment through 2010. To assist with the organization of this activity, a CEOP Model Output Management Document was drafted as a guide for the participating centers to use in setting up their processes for meeting their commitments to CEOP.

The Max-Planck-Institute for Meteorology with the ICSU World Data Center for Climate (WDCC) in Hamburg, Germany, which earlier undertook to serve the CEOP model output archive center, has also agreed to continue in this capacity through CEOP Phase 2. Results up to this point in the CEOP model output generation effort make it clear that the transfer aspect of the data handling effort has been progressing well. Data from all 11 Centers (NCEP, UKMO, NASA-GMAO, NASA-GLDAS, JMA, BMRC, ECMWF, NCMRWF, ECPC, CPTEC-INPE, and CMC) participating in CEOP has been received at the data archive center and has either been placed into the database at the Hamburg facility, or is in the process of being entered into the database. The gateway to the CEOP Model database can be found at: http://cera-www.dkrz.de/CERA/cera2browser_CEOP/index.html.

CEOP Data Integration Activities -The total amount of the CEOP Phase 1 data is estimated to be around 300 Terabytes. As originally produced by the various sources the data was in a wide variety of formats and structures and CEOP began addressing possible solutions to this important issue. In response to this situation there was recognition of need for data management systems for the collection, sharing and provision of data from which users can obtain precisely the data they need, whenever they want it and in formats familiar to the science community. It is essential to transform observation data into scientifically and socially relevant information through the systematic collection and integration of data, merging of essential related information, and building of systems for sharing this knowledge on an international basis.

During this reporting period the University of Tokyo, the Japan Aerospace Exploration Agency (JAXA) and the Committee on Earth Observation Satellites (CEOS) have, therefore, begun working together to create a distributed "data mining" system for the CEOP data archive. CEOS membership encompasses the world's government agencies responsible for civil Earth Observation (EO) satellite programs. Within CEOS, the Working Group on Information Systems and Services (WGISS) is responsible for systems and services that manage and supply the data and information from participating agencies' missions. The purpose of the Distributed Data Integration System, known as the WGISS Test Facility for CEOP (WTF-CEOP), is to support development of data services associated with data integration. WTF-CEOP provides metadata and documentation about CEOP data and supports browse and review of the data, including various data integration functions and services. In addition, CEOP scientists are invited to submit requests for specialized processing of CEOP data to support their research. The system is based on Distributed Oceanographic Data System (DODS) server technology (now know as OPeNDAP). WTF-CEOP uses Live Access Server (LAS) software to provide menus to select the data variable, location, time range, etc. After menu selections are complete and the data type has been chosen, LAS will access the data via the DODS server at the appropriate data archive center. The Ferret client software then performs data processing functions such as data plots, on screen display of the data values, and downloading the data in ascii, spreadsheet and NetCDF formats. The LAS software was designed so that it was possible to add other analysis software.

In addition to the Distributed System a Centralized Data Integration System has been developed at the University of Tokyo that utilizes the centralized CEOP data archive sited at the Institute of Industrial Sciences, the University of Tokyo and allows handling of significantly larger amounts of heterogeneous observation data. The browse and analysis interface is performed by dedicated clients, which provide the users with menus, integrated access to the data, and analysis tools. The connection between the clients and the server is based on HTTP. Users can access all types of data through a single interface and can view the retrieved data as graphic charts or bitmap images, depending on their dimensionality. Some analysis operations such as average, difference, correlation and visualization can be applied to single or multiple data types through the interface. Prototypes of both the Centralized Data Integration System and

the Distributed Data Integration System were opened to the CEOP community on 1 June 2005. They are accessible along with more information about what services they provide, at the websites: http://jaxa.ceos.org/wtf_ceop/ and http://monsoon.t.u-tokyo.ac.jp/ceop-dc/ceop-dc_top.htm for Distributed and Centralized Systems, respectively.

New directions

During its deliberations at the Fourth CEOP International Implementation and Planning Meeting (March 2005) the CEOP Advisory and Oversight Committee (AOC) and the CEOP Science Steering Committee (SSC) endorsed a number of CEOP goals and objectives for the future including:

i. A CEOP Phase II plan and schedule (as presented at the meeting) that proceeds in two stages that run from 1 January 2005 to 31 December 2010 extending existing data and observation processes and adding greater emphasis on the research and analysis components of CEOP, providing for CEOP to meet its commitments to CEOS/IGOS-P Water Theme, WCRP/COPES and GEOSS.
ii. Selection of the diurnal cycle as a unifying scientific theme in CEOP Phase 2.
iii. Phase 2 plans to continue select a small set of hydrological reference sites, from the existing CEOP reference sites that will have dual roles as validation sites for the land-surface parameterizations in coupled land-atmosphere-ocean models, essentially at a point or small area scale and as "tie points" or ground truth reference sites for remote sensing products.
iv. Phase 2 plans to exploit progress in WESP on the recycling of moisture associated with local evaporation in affecting regional water budgets as a means for CEOP to contribute towards, what may be, a larger goal associated with examining some inter-connectivity between land areas including the middle and higher latitudes, and in general towards better understanding some of the means through which land plays a role in the larger climate system.
v. Phase 2 plans to entrain a team of researchers embarking on a Worldwide Integrated Study of Extremes (WISE) that focuses in a collective manner on extremes during the CEOP period as an extension of the work currently under way in CEOP WESP.
vi. CEOP Phase 2 plans to undertake a joint initiative with the WCRP Climate and Cryosphere CEOP/CliC project and the International Polar Year (IPY) initiative that will exploit a number of CEOP reference sites in regions where snow occurs to provide the required data to begin and complete this project in Part 2 of CEOP Phase 2 (2007-2010).
vii. Phase 2 plans to exploit CEOP reference sites located in semi-arid regions to produce data that can be applied using capabilities now existing in WESP to better understand variations in water and energy budgets in such regions.
viii. Plans to augment and formalize the CEOP international coordination function to provide more consistent collaboration with national and international funding agencies and relevant research groups related to organizing and managing CEOP.

Future: Next year foreseen activities

Data from the carefully selected CEOP reference stations will continue to be delivered to the CEOP Central Data Archive (CDA) at UCAR/JOSS. The CEOP sites will continue to be closely with the existing network of observing sites involved in the GEWEX CSEs distributed around the world. As planned, model products will be received from the major National and Multi-National Numerical Weather Prediction Centers around the globe and a CEOP model products archive and distribution center operated by the Max Planck Institute (MPI) will continue handling the data. Also, during the next reporting period the CEOP Satellite Data Integration Center at the University of Tokyo (UT) will receive and store satellite data. Datasets from ESA will be added to the current database in 2006.

The network that links the CEOP reference site, model and satellite data archives developed with joint JAXA and NASA support will continue to evolve in 2006. Because of a NASA funded proposal that was accepted in 2005 the Committee on Earth Observation Satellites (CEOS), Working Group on Information Systems and Services (WGISS), will continue to develop the CEOP WGISS Test Facility for the purpose of integrating the CEOP data centers and making the data available to the broader user community. The collection, archive and distribution of coordinated, quality checked, in-situ, satellite and model datasets are expected to lead to success in meeting CEOP science goals. With these new datasets and integration/visualization tools, CEOP WESP will examine the vertical structure in the atmosphere and the impact of land processes on closing and simulating vertically integrated water and energy budgets with observations and analyses at global scales.

In the CEOP Inter-monsoon Study (CIMS), a hierarchy of models including general circulation models (GCM), regional climate models (RCM) and cloud resolving models (CRM) will be examined to run numerical experiments that target simulation of fundamental physical processes and lead to identification of basic errors and biases in model physics.

Because of the funding, by NASA of a specific CEOP related proposal in 2005, the CEOP Model Output Working Group plans to apply CEOP datasets/tools to specifically focus on the ability of current global data assimilation systems, individually and in ensemble, to reproduce all of the components of the water and energy cycles (precipitation, evaporation, transports, water and energy content, and radiation). They will investigate processes related to the diurnal cycle and seasonal progression (e.g. monsoons).

CEOP will increase its interaction with elements of WCRP and other international organizations and efforts that are focused on the measurement, understanding and modeling of water and energy cycles within the climate system. This includes holding a second joint Implementation and Planning meeting with the Integrated Global Water Cycle Observations (IGWCO) theme within the framework of the International Global Observing Strategy Partnership (IGOS-P) in 2006. Since the *ad hoc* Group on Earth Observations (GEO), has prepared a 10-year Implementation Plan for a comprehensive, coordinated, and sustained Global Earth Observation System of Systems (GEOSS), in 2006 CEOP will attempt to undertake a number of activities that are related closely to work that is being defined in GEOSS so that CEOP can also be viewed as an example of a coordinated activity in support of GEOSS.

Key results

There has been a great deal of discussion and work on using CEOP data for science applications particularly in three areas where specific examples can be provided:

i. The CEOP initiative on focusing model "validation" against the reference site data has a web page (http://monsoon.t.u-tokyo.ac.jp/ceop/model/telecon/) where some of the initial work in this area was presented for reference by the contributors to the model output component of CEOP. Several of the outcomes from these studies have already been published in CEOP Newsletters and presented at International meetings such as the AGU spring and fall meetings last year.
ii. On a broader scale there is work that is just now getting started which includes multiple models run alone and in ensembles. This effort is being spearheaded by CEOP Working Group Chairs/Co-Chairs. The results have already shown the ability of several current global data assimilation systems, individually and in ensemble, to reproduce all of the components of the water and energy cycles (precipitation, evaporation, transports, water and energy content, and radiation). The analysis data has been collected in conjunction with CEOP. An article in the CEOP Newsletter has shown the results and has increased international involvement so that the effort is now being expanded into a CEOP wide approach to model improvement.
iii. On the science objectives CEOP has now had four workshops on Monsoon Systems studies. Several articles have been published in the CEOP Newsletter on the application of CEOP data to improved understanding of monsoon characteristics.
iv. From the WESP group an interesting science effort is under way called the CEOP Inter-CSE Transferability Study (ICTS). The home page for that is at: http://w3.gkss.de/ICTS/index.html. In the ICTS, regional atmospheric climate models (RCM) from different CSEs are being transferred from their “home” CSE to other CSEs involved in GEWEX. The models are being initialized and forced at their boundaries by several state of the art Global Circulation Models (GCMs). At http://www.joss.ucar.edu/ghp/ceopdm/model/ model.html one can find a list of global analyses data and associated data centres. For evaluation CEOP data from the CEOP reference site data archive and the CEOP satellite data archive are being considered. Main emphasis is on the energy and water cycle components.
v. CEOP has submitted a preproposal on a CEOP Polar Observations Project to be undertaken in Part 2 of CEOP Phase 2 that will be undertaken jointly with CliC and IPY 2007-2008. Help and inputs will be sought on data sites in the higher latitudes to form the basis for meeting the science objectives.
vi. A new thrust will be related to Extremes that has begun and which will be expanded in the coming year.

Issues and Recommendations

i. EOP continue data collection at all reference sites; production of model products at all contributing NWP centers; and exploitation of all relevant operational and experimental satellite instrument data in a coordinated manner.
ii. CEOP continue its relationship with data archive Centers at UCAR, MPI and JAXA/UT.

iii. CEOP constitute and maintain a CEOP Implementation Planning Task Team (IPTT) to provide a CEOP Phase 2 Implementation/Science Plan that builds on and extends the work undertaken during Phase 1, and emphasizes the unique aspects of those efforts including: life-cycle data management for large volumes of data using state-of-the-art storage technology, utilization of advanced database technology that enables multi-layered visualization of various types of data, new value-added products resulting from the blending of information in diverse and large volumetric observation data sets and implementation of international information sharing capabilities through an Internet-based service.
iv. A final draft of a CEOP Phase 2 Implementation/Science Plan be provided for review by the GEWEX SSG and that it be published as part of the WCRP Report Series following final review at the end of the CEOP 2006 International Implementation and Planning Meeting.
v. CEOP incorporate work on extreme/teleconnections; aerosols and water cycle; and watershed hydrology as science issues and extend/enhance data collection and analyses into cold and semi-arid regions as part of Phase 2.
vi. CEOP take steps to obtain relevant ocean data particularly in ocean areas near existing reference sites where data may be more easily obtained through agreements which are already in place.

Contributions to COPES

CEOP is being viewed as an example of coordinated global observational activity in support of the WCRP COPES. CEOP will contribute to COPES by applying the techniques it has developed as a successful activity that has stimulated and leveraged the development and integration of coordinated observing networks that exist for collection of climate related parameters, that include instruments on satellites and at land based reference sites and, which can be coordinated with model output.

CEOP has already been identified as a potential major contributor to COPES and GEOSS because it is currently playing a valuable role by increasing the focus on the important topic of water resources applications. The infrastructure that has evolved in CEOP over its initial observation period is a very positive contribution to the overall context of water and energy cycle research in climate studies. The key developments within CEOP that must be sustained and expanded upon as contributions to COPES, IGOS-P Water Theme and GEOSS have already been cited to include:

i. Cooperation, Coordination and exploitation of data from GEWEX Continental Scale Experiments on a broad global scale;
ii. International participation by a number of weather prediction and modeling centers interested in seasonal to interannual time periods;
iii. Involvement of space agencies through broad international groups e.g. CEOS and IGOS-P;
iv. Advancement of an active data integration process with real and valuable tools for visualization of satellite, *in-situ* and model data and products;
v. A timely emphasis on water cycle research;
vi. An evolving notion of the characterization and implementation of an international climate observations reference network with prototypical land and water observations available to a broad set of users; and
vii. Initial Implementation of actual Long-term archive quality datasets.

In so far as CEOP will be contributing to GEOSS, then the targets for implementation of GEOSS that CEOP will assist with can be viewed as contributions to COPES as it develops in concert with GEOSS. CEOP Phase 2 planning is, therefore, remaining consistent with the both the COPES and GEOSS framework.

Summary

CEOP made important progress towards the realization of its long-term guiding scientific goal: *"To understand and model the influence of continental hydroclimate processes on the predictability of global atmospheric circulation and changes in water resources, with a particular focus on the heat source and sink regions that drive and modify the climate system and anomalies."* The scientific objective for the WESP working group is to *use enhanced observations to diagnose, simulate and predict water and energy fluxes and reservoirs over land on diurnal to annual temporal scales as well as apply these predictions for water resource applications.* The CEOP Monsoon Studies Working Group aims to achieve another CEOP science objective: *to document the seasonal march of the monsoon systems, assess their driving mechanisms, and investigate their possible physical connections*. CIMS has been undertaking *to assess, validate and improve the capabilities of climate models in simulating physical processes in monsoon regions around the world.* CIMS and WESP are demonstrating the utility of CEOP data for *better understanding of the regional and global water cycle and for model physics improvement.*

The CEOP Data Management, Satellite Data Integration and Model Output Development and Management Working groups are attaining the CEOP goal *to provide a database of common measurements from both in-situ and satellite remote sensing measurements, as well as matching model output that includes Model Output Location Time Series (MOLTS) data along with four-dimensional data analyses (4DDA; including global/regional reanalyzes) for a specified period.* By setting these goals CEOP is responding to the challenges and priorities that relate to variations in the earth's water and energy budgets and the cycling rate of the hydrological cycle as posed by the International Panel on Climate Change (IPCC) and will contribute to the development of WCRP COPES and the GEO, GEOSS.

CEOP website: http://www.ceop.net/

3.3.2 International Satellite Land Surface Climatology Project (ISLSCP)

The ISLSCP Initiative II data collection is now complete and can be accessed at http://islscp2.sesda.com. The ISLSCP Initiative II data collection contains 50 global time series spanning the ten-year period 1986 to 1995 (selected data sets span even longer periods) considered by members of the GEWEX community as required to support investigations of the global carbon, water and energy cycle. Over the course of 3 years, the data were acquired from investigator teams within a number of U.S. and international agencies, universities and institutions, quality checked, some reprocessed to correct problems, then co-registered to equal-angle grids of one degree, one-half and one-quarter degree resolution, a common land-water mask applied, gaps filled and reformatted into a common ASCII format. Each data set has been uniformly documented. Both data and documentation has undergone two peer reviews for quality and ease of use. Overview and user guidance documentation are not yet complete, but will be furnished with the final DVD product.

Initiative II was begun in 1999 with core funding from NASA's Hydrology Program, and later augmented by NASA'S Terrestrial Ecology Program. Its completion and evaluation was made possible through core funding in 2002 from NASA's Earth Science Information Partners Program. However, ISLSCP Initiative II would not have been possible without the unswerving support of the international Global Water and Energy Cycle Experiment (GEWEX) community. Community members met twice yearly to first define the type and nature of the required data sets, and identify potential data providers. A smaller ISLSCP science working group consisting of data providers and data users met monthly by telephone to discuss the numerous problems that arose and guide the development. Providers worked regularly with the ISLSCP staff and science working group to guide data development and documentation, which were evaluated, iterated and frequently modified to correct problems.

The ISLSCP Initiative II beta collection is complete. 50 sets of 4 DVD's have been distributed for evaluation. The entire collection is available on line. The final product will be published on DVDs. Over the next six months GEWEX invites an even broader participation in the use and evaluation of the on-line collection, which will bring to the broader community's attention this important data collection, provide some good science and a thorough evaluation across the entire collection and its user interface. A science and evaluation workshop was held present and discuss the results on May 4th, 5th and 6th of 2005 at the University of Maryland, Baltimore County near Greenbelt, Md. A Journal of Geophysical Research special section is being organized to publish the science results. The Initiative II collection will be augmented in the months following the workshop with findings from the workshop. For more information contact: fghall@ltpmail.gsfc.nasa.gov.

ISLSCPNEXT

The ISLSCP follow-on global data initiative as it was originally proposed by ISLSCP to NASA for funding, is a crosscutting GEWEX task that should be taken on by a broader set GEWEX groups. There are two other options for ISLSCP follow-on, ISLSCPNEXT. (1) Consider taking on an international construction involving algorithm intercomparison and dissemination of long-term land satellite climatology data sets (long-term observational land records) making sure the land surface satellite data (e.g. AVHRR-MODIS-NPP) provide as seamless a bridge as possible between the past and future, or (2) Focus on developing integrated, multidisciplinary data sets needed to compute long-term climatologies of surface-atmosphere fluxes (land paramaters, radiation, water, carbon). This would be an important contribution to a broader GEWEX global data initiative, but would concentrate on "land centric" products. In both cases, ISLSCP will seek a direct link to emerging IGOS – P initiative.

LANDFLUX and ISLSCPNEXT
The GHP chair, on behalf of GEWEX SSG, is leading a working group on LANDFLUX, which will over the next few months formulate a plan to estimate global land fluxes in a combined approach using the entire domain of GEWEX observational and modeling products. ISLSCP will participate in this working group.

3.3.3 Global Runoff Data Centre (GRDC)

Objectives:
GRDC overall objective is to serve – on a long term basis – as a **facilitator** between providers and users of **river discharge data** in support of the water and climate related programmes and projects of the United Nations (UN), their specialized agencies and the **scientific research community**, including WCRP and GEWEX. Facilitation includes:

- Worldwide **acquisition**, storage and dissemination of historical and near-real-time river discharge data, usually provided directly by National Hydrological Services but also indirectly via scientific projects such as CSE.
- Operation and further development of the GRDC database, improvement of integration with external databases, contribution to the development as well as application and propagation of **international standards** for metadata, discharge data and data structures.
- Preparation and maintenance of applied **global data products** and discharge-related geo-information, partly in collaboration with specialized external institutions.
- Application of **mathematical models** in various scales for estimation of water balances, water availability and coupling with climate models.
- **Collaboration** with and consulting of international organizations, other world data centres as well as foreign institutions in the fields of hydrology, water resources as well as data management and data acquisition. This includes active participation in a number of national and international working groups, steering committees and panels.
- **Publication** of the GRDC Report Series, operation and maintenance of a comprehensive GRDC web site.

Status
Past year activities:

- Mid 2005, the GRDC database holds discharge data of worldwide 7242 stations in 154 countries featuring around 265000 station-years of monthly and daily values with an average time-series length of 37 years. Throughout the 1½-year, data of 3782 stations from 53 countries have been **updated**.
- GRDC has succeeded in accommodating an action item on the Essential Climate Variables (ECV) "river discharge" in the **GCOS Implementation Plan for the Global Observing Systems for Climate** (GCOS-IP) published by GCOS in Oct 2004 and appreciated and encouraged by UNFCC Decision 5/CP.10 in Dec 2004.
  In preparation to this action item GRDC has defined a GCOS baseline river discharge network of around 400 stations called **Global Terrestrial Network for River Discharge** (GTN-R, http://gtn-r.bafg.de). The action item calls upon the Parties to timely contribute regular updates to GRDC, thus improving access to near real-time river discharge data for selected gauging stations around the world, capturing the majority of the freshwater flux into the oceans. This will eventually allow coming up with a **measurement-based time series of fluxes to the oceans** and thus improve the corresponding GRDC product.
  Based on an initial draft by GRDC, in April 2005 the GCOS secretariat send out a data request and support letter signed by the WMO Secretary General to The Permanent Representative with WMO and The Hydrological Adviser with WMO of 82 countries which feature tentative GTN-R stations concerning the *"Institutionalized regular provision of daily river discharge data for selected rivers and gauging stations of the GTN-R"* together with a country-tailored information package. Since then around 20 countries have replied positively and GRDC received a number of datasets, a highlight being the first provision of discharge data from China since the existence of the GRDC.
- In view of GRDC's limited staff capacity GRDC aims at outsourcing research activity based on GRDC data and has introduced the practice of establishing collaboration contracts with researchers working with significant amounts of GRDC data. This includes especially the publication of their research in the GRDC Report Series (see below) in order to demonstrate its application (currently there are ten ongoing projects). Thus demonstrating GRDC data application serves several purposes: connecting people, documentation of research on global river discharge, increasing awareness and acceptance of data providers and GRDC sponsors to contribute data and funds.

New directions:
Through its active data acquisition the GRDC provides a direct, short-term oriented service supporting Global Change research. Another important, long-term oriented aspect of GRDC activities is to elevate GRDC's visibility by linking it to higher-level activities and stressing the need for the improvement of data exchange through fostering automation. GRDC consequently contributes to the development and application of international standards, such as the so-called WMO Core Metadata Profiles of ISO 19115. Furthermore, GRDC aims at getting involved and becoming part of international activities such as GCOS-IP and GEOSS. Besides getting recognition as the depository for the ECV "river discharge" GRDC takes here a role in stressing the often neglected central importance of "technical data integration" besides all the science related problems.

Future:
- GRDC has recently submitted an offer for a near real time river discharge data acquisition scheme to the EC-Joint Research Centre (JRC) as a service contribution to the European Flood Alert System (EFAS). The task will be the development and operation of an information infrastructure for the automated collection, quality control and redistribution of real-time or near real-time river water level and discharge data from European transboundary river basins located in 25 EU-, 4 EU-candidate and some of 15 non-EU-countries. The project is planned for 2006 - 2008 (3 years) and is currently under review. If successful it will boost GRDC's capacity to hire 2 additional staff for 3 years. It perfectly would fit to GRDC's GTN-R initiative in the framework of the GCOS-IP and provide cross-sponsoring.
- GRDC started to develop service specifications of a project to migrate an existing ISO 19100 compatible metadata management system (being developed in the framework the North and Baltic Sea Coastal Information System) and provide its interface via the GRDC web site. GRDC's host, BfG has agreed to finance the adaptation of the existing software to the WMO core Metadata Profile of the ISO 19115 standard. A call for tender is scheduled for 2006.

Key results
- Discharge database updated (50% of all stations in 30% of all countries)
- Research cooperation contracts continued
- Action item on near real-time river discharge data provision accommodated in GCOS-IP
- Definition of Global Terrestrial Network for River Discharge (GTN-R, http://gtn-r.bafg.de)
- Source of funding identified (not yet secured) for development of software infrastructure required for near real-time river discharge collection
- Roadmap for implementation of a ISO compatible GRDC metadata management system developed

Issues and Recommendations
With regard to GRDC's role in GEWEX and CSEs, it was desirable to have the commitment of each participating group to support GRDC in data acquisition. Project-related contacts with the National Hydrological Services (NHS) and other national institutions should aim to include:
- general promotion of GRDC's mission and encouragement of NHS to release their data to GRDC
- securing that, especially when project money is being spend for data acquisition from NHS or other institutions, a constituent part of any agreement or contract is the free and unrestricted release of data to international data centres including the GRDC.
- using GRDC as a data depository for discharge data, thus ensuring that the legacy of discharge data collected in the scope of their projects is perpetuated behind the project' s life span and synergic use of the same data can be made by follow up projects.
- GRDC database and products are ready to be used by GEWEX projects

Summary
The GRDC maintains a database of global river discharge in support of Global Change research. GRDC products and services are extending and improving. GRDC connected to international data collection and harmonization efforts (GCOS-IP and GEOSS) and in this context launched and got recognition for GTN-R which will provide near real time data collection and distribution services. In this regard GRDC has a realistic chance of increasing its operational capacity by 50% through a 3-year EC-funded project for a European contribution to GTN-R. GRDC also started the implementation of an ISO compatible metadata management system.

GRDC website: http://grdc.bafg.de

3.3.4 Global Precipitation Climatology Centre (GPCC)

Special GPCC Focuses and Major Achievements in 2005

Global 50-Year Precipitation Climatology
The GPCC published a first version of a 50-Year Precipitation Climatology (Beck, Grieser and Rudolf, 2005; Schönwiese et al., 2005). This data set was developed by the project VASClimO (Variability Analysis of Surface Climate Observations) within DEKLIM, the German Research Climate Programme 2001-2006, and includes gridded precipitation data fields (0.5° lat/lon) for the 600 individual months of the period January 1951 to December 2000. The analysis is based on mostly complete time-series from 9,343 stations, which have been selected out of the totally 50,000 stations after quality control and test for homogeneity. The period has been defined as an optimum of spatial coverage and length and completeness of the time-series. The data set, as well as global maps of the statistical features are available via the Website of GPCC under the VASClimO Project pages.

The first version is based on the pooled gauge data collections of CRU, FAO, GHCN and GPCC. The WMO distributed a circular letter in July 2004, requesting data submission to the GPCC by all Members. By the meantime many countries followed this call and an update of the climatology is planned after the additional data will be processed.

Arctic Precipitation Climatology
The GPCC finished a second project in support of the Arctic Climate System Study, funded by the German Polar Research Programme (Rudolf and Mächel, 2005). The major result is a significant enlargement of the Arctic climate database and a new precipitation climatology covering the Arctic hydrological catchment on the EASE grid. However, the spatial density of the now available snow depth data is still to poor for a gridded snow data set. Some very first balance studies on snow melt, precipitation and river runoff have been started.

GPCC Operational Product Generation
The quasi-operational monitoring and analysis of land-surface precipitation proceeded successfully. The related activities (data acquisition, reprocessing and quality-control) request the major part of the capacity of the GPCC.

The development of the operational estimation of the systematic gauge measuring error for the individual months based on daily synoptic data succeeded: the prototype is ready and the method will be operational by end of the year and replace the current climatic mean approach. The major deficiency will be the lack of information about the currently used instruments and related correction techniques. Therefore, the new error estimate will be more reliable for area of Europe and Northern Asia (and for those countries using similar gauges) than for other continents.

Documentation and publication
The DWD installed a Quality Management System and got the certificate to fulfil ISO 9001: 2000.

Selected GPCC publications are listed under item 3. The basics of the Monitoring product are described by Rudolf and Schneider (2005).

A set of gridded precipitation data sets specified for different applications
Requirements being addressed to a gridded precipitation data set are timely availability, high spatial resolution, high accuracy on the individual grid cell, long time-series, and homogeneity. All of these required features cannot be fulfilled by one single gridded data set. Therefore, the GPCC provides four data sets respectively products, which differ in the subset of observed gauge data used (with respect of data availability until product generation) and the quality control methods and analysis techniques. Each of the products is optimized for a specific type of application.

The GPCC First Guess of the Monthly Precipitation
The First Guess of the monthly precipitation anomaly is based on interpolated precipitation anomalies at about 4,500 stations. The data sources are synoptic data received via GTS for the considered month, and the mean monthly precipitation (“climatological normals”) from those stations where available. About 1500 synoptic stations only supply short time-series. A fully automatic quality control (QC) is been applied on the synoptic data. The field of monthly total precipitation is calculated from about 6,000 stations, and it is

automatically forwarded to the FAO and NOAA for application with drought monitoring. The First Guess is available within 5 days after end of the observation month.

The Monthly Precipitation GPCC Monitoring Product as the Early Quantitative Information
The Monitoring Product of monthly precipitation for global climate monitoring is based on SYNOP (after high level QC) and monthly CLIMAT reports from totally 7,000 stations and is available within about 2 months after observation month. The operational analysis started in 1996 and is going on to near-present. An Interim Version of the Monitoring Product covering the period 1986-1995 has been derived from similar input data in 1994/1995 after GPCC's development phase. The Monitoring Product supplies the in-situ component to the satellite-gauge combinations of GPCP and of CMAP.

The GPCC Full Data Reanalysis of Monthly Precipitation
The Full Data Reanalysis is based on all available observations. It includes monthly data from about 10,000 to more than 40,000 stations, i.e. the merged gauge data set of the global collections of CRU, FAO, NCDC (GHCN) and all national data sets delivered to the GPCC as well as the reprocessed real-time data. From this, the gridded data set is of much higher regional accuracy. Therefore, application of this particular gridded data set is recommended for hydrometeorological studies and verification studies. It is less recommended for analysis of temporal evolution, because the data coverage varies from month to month. The current product is Version 3 covering the period from 1951 to 2004. New versions will be supplied after significant growth in the database.

The new GPCC 50 Year Climatology
The 50 Year Precipitation Climatology supplies gridded time-series for studies on climate variability, e.g., analysis of long-term trends. For this gridded data only (mostly) complete data time-series were used after quality control and homogeneity tests. The first version is based on time-series of 9,343 stations covering the period 1951-2000 (Beck, Grieser and Rudolf, 2005).

The GPCC Gridded Precipitation Normal Climatology
The Gridded Precipitation Normal Climatology provides gridded mean monthly precipitation for the period 1961-1990. The current version is based on data from about 28,000 stations. The sources are data of the WMO Global Climatological Normal collection, the long-term mean data delivered by the countries to the GPCC or mean values calculated from data time-series at the GPCC.

Users are recommended to consider the background of the different products and select the product being most suitable for the application. Error-related meta information (e.g., number of stations used on the grid) is also available as gridded data sets and should be taken into account.

All gridded data sets are calculated on a monthly basis with a spatial resolution of 0.5° latitude and longitude. With regard to the spatial coverage by the input data, it is recommended to use the results averaged on 1° or 2.5° grid boxes, as provided by the GPCC. Averaging land-surface precipitation should include the land proportion on the grid as a weighting factor. Else, the area mean being derived from 2.5° would differ from those being derived from a smaller grid resolution. For more information see GPCC Website.

3.3.5 International Association of Hydrological Sciences (IAHS) WMO Working Group on GEWEX

The objectives of the IAHS/WMO Working Group on GEWEX are:
- Promote the development and application of hydrological science to the aims of GEWEX.
- Provide for discussion, comparison, and publication of research results and the requirements for future research through the organization of workshops, symposia at special sessions at the IUGG General Assemblies and IAHS Scientific Assemblies and stand alone workshops.

IAHS Scientific Assembly, Foz do Iguaçu, Brazil 2-9 April 2005. Seven symposia and eight workshops were held in conjunction with a major theme based on PUB. 459 registrants from 56 countries ensured a successful Assembly and good scientific discussion. Of the seven Symposia the GEWEX relevant S6 on Regional Hydrological Impacts of Climate Variability and Change with Emphasis on Less Developed Countries resulted in two pre-published IAHS Red Books. The eight workshops included MOPEX-5 and the IAHS/WMO Working Group on GEWEX and WRAP sponsored Workshop on

Transferring Hydrological Data Across Spatial and Temporal Scales to which was added presentations on HEPEX (refer the Appendix C6 WRAP report).

MOPEX-5 Workshop, Foz do Iguaçu. The fifth Model Parameter Estimation Experiment (MOPEX) Workshop was a follow-on from the MOPEX-4 Workshop organised by CEMAGREF held in Paris in July 2004 and utilised the US MOPEX data sets of 348 basins and the seven years of data for 65 basins in the south of France used in MOPEX-4. Thirteen papers and one poster were presented from France, US, Canada, China and Denmark. These dealt with issues such as local and global optimising, transferability of soil-based algorithms, comparisons of high and low resolution land surface characteristics, lumped and distributed parameters, different time steps and calibrated and uncalibrated parameters. A full report of the Workshop including the active discussion session and the presentations is available on the new MOPEX webpage: www.seas.ucla.edu/~thogue/MOPEX. Based on the papers from the 4th and 5th MOPEX Workshops an IAHS Red Book dealing with the current parameter estimation issues is being prepared. This will also include a CD of the MOPEX database. Sixteen papers from the MOPEX-3 Workshop held as part of the IUGG in Sapporo in July 2003 are in the final stage of publishing as a Special MOPEX Issue of the Journal of Hydrology.

IAHS PUB. The IAHS Assembly's S7 Prediction in Ungauged Basins (PUB) was the main event over five days and demonstrated the considerable enthusiasm, particularly amongst younger scientists, for this 10-year project. Publication of several Red Books is planned. PUB Working Groups aim to identify common hydrological objectives with its members to evaluate a range of methodologies for achieving a common objective. Compatible output is required to enable testing and intercomparison of methodologies. Working Groups are self-organising with their activities constrained by common objectives and predictions are made with the associated uncertainty quantified. The approach taken is based on the successful experience of PILPS and AMIP. By April in Brazil, 23 Working Groups had been established. Most relevant to GEWEX thus far are: MOPEX, HEPEX, orographic precipitation, model uncertainty, downscaling, top down modelling, and remote sensing and data assimilation. A PUB web site exists (link through www.iahs.info). Links have been established with the UNESCO IHP, HELP and WMO CHy. A new streamlined SSG for the Second PUB Biennium has been created under the Chairmanship of Jeff Mc Donnell and is based on the leaders of the main PUB themes of:

Theme 1. Basin inter-comparison and classification
Theme 2. Conceptualization of process heterogeneity
Theme 3. Uncertainty analyses and model diagnostics
Theme 4. Develop and use of new data collection approaches
Theme 5. New hydrological theory
Theme 6. New model approaches
Theme 7. National Working Groups and PUB Tech Transfer

In summary PUB is keen to link to and work with GEWEX to meet our many common aims.

IAHS/WMO Working Group on GEWEX was established to provide links to the hydrological scientific community and, through WMO, the operational hydrological services. The Working Group held its 12th meeting in Foz do Iguaçu. Issues discussed included WRAP input to COPES, use of GSWP products of model field output in PUB giving climatology and a basis for basin classification, THORPEX and HEPEX, use of the GEWEX data base in the GWSP global digital water atlas and PUB involvement in the GEWEX GLASS Panel using the new Land Information System (LIS) research at NASA and the 1 km resolution data products at a 1 hour time step. Working with GWSP, **t**here is scope for assistance in an Indicator Workshop and joint data products and activity and links to PUB. IAHS could help with case studies. Prior to the meeting the Director of WMO's, HWR Dept., Avinash Tyagi, advised a more formal structure for WCP-Water is being established with UNESCO and a review is underway to take a broader view of its links with the climate programme. Indicator basins are to be established to examine trends. Following the discussions with the Chairman GEWEX SSG and Project Office Director, WCRP and HWRD in Geneva last October a review needs to be similarly completed on HWRD-GEWEX/WCRP links. Avinash Tyagi agreed to advise the outcome of these reviews for discussion at the GHP and WRAP meetings in September 2005. In the light of these, consideration will be given to the holding of a joint expert meeting with the objective of identifying the cross-cutting issues and implementation of activities of joint interest to WMO, GEWEX and IAHS. A report of the meeting can be found on the IAHS web site at: www.iahs.info.

HEPEX (The Hydrological Ensemble Prediction Experiment) aims to bring the international hydrological and meteorological communities together to demonstrate how to produce reliable hydrological ensemble forecasts that can be used with confidence by the emergency management and water resources sectors to make decisions that have important consequences for the economy, for public health and safety. The main scientific theme of HEPEX will be how hydrologic forecast uncertainty can reliably be quantified at each step of the forecast process and then communicated to, and applied by the end users. The recent well attended AGU and EGU HEPEX Workshops have shown the developing interest in the project. The second HEPEX Workshop was hosted by NCAR in Boulder, Colorado, 19-21 July 2005 and was followed by a meeting on 22rd to finalise the HEPEX planning, structure, Steering Group and User Group and the development of the Implementation Plan. Around 55 participants from 10 countries, primarily from North America, saw the presentation of 32 papers. Extensive discussion periods and Working Groups on Test beds, Datsets and Models, and Users developed material for HEPEX planning. There was considerable interest and enthusiasm for this project with an initial nine test beds proposed and actively supported focused subject areas established with links to several already developed projects. It is hoped to establish close links with THORPEX and WMO's hydrology risk management and Short-/long-term Hydrological Forecasting System activities. The Workshop presentations and minutes of the meeting are on the new HEPEX web site: http://hydis8.eng.uci.edu/hepex/

CEOP and IAHS is assisting in establishing hydrological reference basins associated with the CEOP flux towers with data for basins close to the two Australian sites currently being prepared. Discussions were held with the CEOP Data Manager in July to facilitate this activity.

Future:

- Continue attempts to involve and cooperate with WMO's HWRD and CHy on GEWEX related activities of common interest and to cooperate with WCP-Water
- Promote the expansion of HEPEX, particularly the involvement of countries outside of the Americas and Europe (current participants) and of WMO's hydrology risk management and short-/long-term hydrological forecasting system activities
- Preparation of an IAHS Red Book on MOPEX based on Workshops held in 2004 and 2005
- Promote cooperation with IAHS PUB, particularly with GLASS and the use of global Land Information Systems
- Assist CEOP in establishing hydrological reference basins
- Maintain links with GWSP and facilitate the use of GEWEX products
- Work with IAHS ICLASS, ICWRS, ICRS and IAMAS ICCL on the preparation and pre-publication of papers for the 2007 IUGG General Assembly in Perugia, Italy, Symposium on the Quantification and Reduction of Predictive Uncertainty for Sustainable Water Resources Management

3.4 RELEVANT GLOBAL PROJECTS

3.4.1 iPILPS

The introduction of the isotopes of oxygen, hydrogen and carbon to land schemes holds great promise for the future: oxygen and hydrogen isotopes combine to form various isotopologues of water which trace and differentiate hydrologic processes in ways that cannot be revealed by gross water measurements while oxygen and carbon isotopes can reveal subtleties of the biospheric system which cannot be detected with mass budgets alone. iPILPS adds this new dimension to model land code testing and comparisons.

iPILPS recognizes the importance of isotopes to the representation of energy, water and material budgets at the continental surface. In initiating an isotope-based intercomparison, the PILPS (http://www.pilps.mq.edu.au) community is moving to apply the rigour of carefully specified experiments and homogeneous analysis and interpretation to this new aspect of land-surface scheme (LSS) simulation. The scientific hypotheses to be tackled in iPILPS include that:

- The ability of LSSs to reproduce isotopic components of the water and mass (carbon initially) budgets is directly related to their ability to reproduce gross water and mass budgets;
- Isotopic fluxes between the atmosphere and the land-surface depend more strongly on the land-surface parameterization than on the computed atmospheric conditions; and
- It is possible to generate 'adequately correct' isotopic pools and fluxes without adding complexity to the LSSs beyond a 'bucket' hydrology and a simple stomatal resistance term.

We believe that isotopes offer a novel and unique tool with which to test and improve LSSs. For example, as transpiration does not fractionate while evaporation does, the stable water isotopes differentiate plant-effected vaporization from non-plant processes.

It is anticipated that many of the early 1990s' lessons learned with gross fluxes will be revisited for isotope fluxes including: conservation, initialization, spin-up impact and group means' outperforming of individual LSSs (e.g. http://www-pcmdi.llnl.gov/amip/ and http://grads.iges.org/gswp2/).

Simulation Progress and New Observations
The goals of iPILPS are to (i) offer a framework for intercomparison of isotope-enabled land surface schemes (ILSS) and (ii) encourage improvement of these schemes by evaluation against high quality (isotope) observations (http://ipilps.ansto.gov.au). Three sites covering a range of climatologies have been selected to link iPILPS to three GEWEX Continental Scale Experiments (CSEs): BALTEX, LBA and the MDBMBP:

1. Mid-latitude (deciduous) grass/woods, nominally at Munich 48°N 11°E,
2. Tropical (evergreen) rainforest, nominally at Manaus 3°S 60°W, and
3. Mid-latitude eucalypt (evergreen) forest, nominally at Tumbarumba 35°S 148°E.

Under the IAEA's new Moisture Isotopes in the Biosphere and Atmosphere (MIBA, http://www-naweb.iaea.org/napc/ih/MIBA_web/MIBA.htm) Australia is adding detailed isotope observations to the Tumbarumba Oz Flux site (www.dar.csiro.au/lai/ozflux) in the Murray Darling Basin. Preliminary field observations including the use of the Fourier Transform Infra-Red spectrometry (FTIR from the University of Wollongong) will be discussed at a workshop at CSIRO in October.

In the context of the MDB CSE (http://www.bom.gov.au/bmrc/csr/gewex/), the four years' forcing data provided from the isotope-enabled atmospheric model, REMO (REgionales MOdel: Max Planck Institute for Meteorology http://lgge.obs.ujf-grenoble.fr/~sturm/REMOiso/PhD_index.htm) are being analysed basin-wide.

First Results from the April Workshop
At our first workshop (18th to 22nd, April 2005 which is the basis for a special edition of *Global and Planetary Change*) the most hotly debated topic was a methodology for determining "plausibility" of stable water isotope simulations. Papers from the workshop describe isotope observations from the Tumbarumba wet sclerophyll forest (dominant species *Eucalyptus delegatensis*) and compare the off-line simulations of two stable water isotopologues ($^{1}H_{2}{}^{18}O$ and $^{1}H^{2}H^{16}O$) with forcing from an isotopically enabled regional model for three iPILPS locations: an evergreen tropical forest, a eucalypt forest and a mixed deciduous woodland. They report on the experimental framework, the quality control undertaken on the simulation results and the method of intercomparisons employed. The partioning of available energy and water is found to be a function of the models' complexity, in agreement with previous PILPS' results. However, ILSS-simulated isotopic equilibrium seems to be independent of the total water and energy budget with respect to both equilibration time and state.

The empirically-based Craig-Gordon parameterization is found to give adequately realistic isotopic simulations when incorporated in a wide range of land-surface codes, although true validation of isotopic simulations at the land surface must await more, and much more complete, observational campaigns. We are very keen to access high quality observations of isotopic data in vapour, precipitation, soil and plant water, especially those with diurnal timescale resolution, for future iPILPS' simulation evaluations.

3.4.2 Hydrological Ensemble Prediction Experiment (HEPEX)

Users of hydrologic predictions need reliable, quantitative forecast information, including estimates of uncertainty, for lead times ranging from less than an hour during flash flooding events to more than a year for long-term water management. The Hydrologic Ensemble Prediction EXperiment (HEPEX) is an international effort that brings together hydrological and meteorological communities to develop advanced probabilistic hydrologic forecast techniques that use new weather and climate ensemble forecasts. HEPEX will demonstrate how to produce reliable hydrological ensemble predictions that can be used with confidence to make decisions that have important consequences for the economy, environment, public health and safety.

The key science issue for HEPEX is reliable quantification of hydrologic forecast uncertainty. HEPEX plans to address the following key questions: (1) What are the adaptations required for meteorological ensemble systems to be coupled with hydrological ensemble systems? (2) How should the existing hydrological ensemble prediction systems be modified to account for all sources of uncertainty within a forecast? and (3) What is the best way for the user community to take advantage of ensemble forecasts?

HEPEX is a global project affiliated with GEWEX that helps GEWEX meet its water resource applications objectives. Also, it is an important GEWEX contribution to the over-arching WCRP Coordinated Observation and Prediction of the Earth System (COPES) initiative. HEPEX will rely on the International Association of Hydrological Sciences (IAHS) Predictions for Ungauged Basins (PUB) initiative for contributions of new science and data sets, and expects PUB to participate in its test bed projects.

Participation in HEPEX is open to anyone wishing to contribute to its objectives. HEPEX activities include test bed projects, development of supporting data sets, development of components of a Community Hydrologic Prediction System (CHPS), and sponsorship of workshops and special sessions at scientific meetings. HEPEX test bed projects will be used to develop CHPS components and to meet the HEPEX demonstration goal. CHPS is expected to have an open systems architecture that will easily accommodate new forecast components and greatly accelerate infusion of new hydrologic science into hydrologic forecast operations. HEPEX invites potential forecast users to participate in HEPEX activities and the "Users Forum," which helps oversee activities to assure user needs are being addressed.

HEPEX builds upon two international planning workshops: the first was hosted by the European Center for Medium-Range Weather Forecasts, March 8–10, 2004, where the HEPEX science agenda was established and the second one was held at the National Center for Atmospheric Research, July 19–21, 2005, where several test bed projects were initiated.

HEPEX will interact with GEWEX by demonstrating how to use improved climate forecast products that GEWEX will help to produce. This could include developing a seamless approach to the application of weather and climate forecasts through collaboration with The Observing System Research and Predictability Experiment (THORPEX) Interactive Grand Global Ensemble (TIGGE) Project. TIGGE is expected to provide an ensemble of 2-week forecast inputs that can be used for hydrologic ensemble prediction.

Biases in weather and climate forecasts must be removed and the forecasts must be downscaled for hydrologic application. This requires an archive of forecasts and corresponding observations that can be used to estimate parameters of the hydrologic ensemble preprocessor. The archive of ensemble forecasts from the National Weather Service Global Forecast System for the period 1979 to the present is an important initial global source of meteorological ensemble forecasts to study this issue. A measure of the potential importance of the ensemble precipitation forecasts is the correlation between the ensemble mean and the corresponding observation. The high correlation for 14-day total precipitation for most of the United States, and the eastern/midwestern United States and the mountainous west in particular, demonstrates their potential for improving hydrological predictions. For more information see the HEPEX website at http://hydis8.eng.uci.edu/hepex.

3.4.3 North Eurasia Earth Science Partnership Initiative (NEESPI)

The Northern Eurasia Earth Science Partnership Initiative, NEESPI, is an interdisciplinary program of internationally-supported Earth systems and science research that addresses large-scale and long-term manifestations of climate and environmental change. Over the past few years it has secured funding for more than thirty-five new research projects through U.S., Russian, Chinese, Finnish, Hungarian, European Union, and NATO Programs. The currently funded projects bring together more than 250 senior scientists from more than 150 institutions of 29 countries. Furthermore, these numbers are expected to substantially increase in the near future.

As outlined in the NEESPI science plan, NEESPI addresses the question: How do Northern Eurasia's terrestrial ecosystems dynamics interact with and alter the biosphere, atmosphere, hydrosphere, and cryosphere of the Earth? NEESPI's area of study covers approximately 20% of the global land area addresses regional water and energy budget questions by focusing on questions such as, "What is the relative importance of the major drivers and feedback mechanisms that control the variability and changes of the surface energy and water cycles at local, regional, and continental scales?" and "What are

the details of surface energy and water cycle dynamics in Northern Eurasia, and how do they improve our understanding of how this region interacts with global cycles?" NEESPI is particularly concerned with the processes that directly feed back to the global Earth system. It also addresses processes of major societal importance including those of pivotal importance to the region's population such as extreme weather events, water supply, thaw of permafrost, desertification, and impacts on agriculture and air and water quality.

Major deficiencies in surface energy and water cycle knowledge and observing systems are being addressed by using modern tools of environmental monitoring, integrating results from historical data sets, present observational systems, and process studies into a unified knowledge base, and developing an interactive suite of the land surface models that can account for major land surface process dynamics in Northern Eurasia and interactively feed back to regional and global climate, environmental, and economic models.

The above science agenda addresses the GEWEX objectives in areas such as the development and testing of data sets, studies of processes governing land-atmosphere interactions and applications. These studies focus on high latitudes of the continent (tundra and boreal forest zones), the forest and forest steppe zones, and processes important for energy and water budgets of dry regions of the interior part of Eurasia. Given NEESPI's many contributions to GEWEX objectives it is recommended that NEESPI and GEWEX, through its hydrometeorological panel, develop a closer working relationship. NEESPI believes that both its interests and GEWEX interests would be best served by welcoming NEESPI into the GEWEX program as a Continental Scale Experiment (CSE).

ACTIONS

A. GENERAL

A.1. The WMP lacks a regional modeler. GHP, CEOP and GMPP will work with IGPO to identify and nominate a GEWEX regional modeler to WMP. (ACTION: Koike, Roads, IGPO)

A.2. Develop a proposal for a GHP/GEWEX session for the 2nd Global Change Conference, November 2006, Beijing, China. (ACTION: Roads, IGPO)

A.3. Add milestones for GEWEX contributions to GWSP to the GEWEX Phase II roadmap. (ACTION: IGPO)

A.4. Provide GHP recommendations for the GEWEX Phase II roadmap milestones by November 10. These updates will include milestones on transferability, etc. (ACTION: Roads, others)

A.5. Submit CSE and global project reports by October 31, 2005 (using the report template provided by P. van Oevelen). (ACTION: All CSE, working groups and global project leaders)

A.6. Develop succession plans for GHP working group project leadership. (ACTION: All WG Chairs)

B. WORKING GROUP ISSUES

B.1. By November 1, 2005, complete and forward to the GHP chair (and IGPO), the working group science plans. (ACTION: all WG Chairs). The unique nature of DMWG will be taken into account in its science plan. (ACTION: Williams)

B.2. Implement a WEBS web site on a priority basis. (ACTION: Roads)

B.3. Prepare a WRAP synthesis paper “by when?” (ACTION: Martz)

B.4. Develop plans for a follow-on activity to WRAP along the lines of a hydrological application project. (ACTION: Martz/Roads/IGPO)

B.5. Hold discussions to determine whether SWING should be part of GHP or GMPP (GLASS). (ACTION: Werner/Roads/new GLASS Chair)

B.6. Submit a summary of TWG activities for the upcoming WMP meeting. (ACTION: Tackle)

B.7. Present a report for presentation at the next GHP on the future of the WMO Information System (FWIS) and its representation. (ACTION: Steve Williams)

C. CSE SPECIFIC

C.1. Provide a final summary report on GCIP at the next GHP meeting which can be used as a template by the other CSEs for their final reports. The report will include a list of achievements, legacies and outlook; a bibliography of relevant research; and discussion of legacy data sets, including where these will be permanently archived. (ACTION: Huang/Williams/Lawford)

C.2. Provide a MDB implementation plan to John Roads and IGPO by December 1, 2005 for review at the January 2006 GEWEX SSG meeting. (ACTION: Gibson/Seed)

C.3. Provide a draft LPB implementation plan to John Roads and IGPO by December 1, 2005 for review at the January 2006 GEWEX SSG meeting. The document will be finalized by the next GHP meeting. (ACTION: Berbery)

C.4. Present a final MAGS synthesis report at the next GHP meeting. (ACTION: Martz)

C.5. Present a BALTEX Phase I synthesis report at the next GHP meeting. (ACTION: Isemer)

C.6. Prepare a support letter for BALTEX (letter proposal from WMO) to request that national services deliver basic data required for WCRP research, free of charge. (ACTION: Isemer, Sommeria; STATUS: due to current EU policy, BALTEX has withdrawn its request)

C.7. Present a synthesis report on GAME accomplishments at the next GHP meeting. (ACTION: Matsumoto, Yasunari)

C.8. Comments on the GAME follow-on project (MAHASRI) should be provided to Jun Matsumoto by October 15, 2005. (ACTION: All GHP members). Submit a proposal for the GAME follow-on project (MAHASRI) in November for GHP review before the January 2006 GEWEX SSG Meeting. (ACTION: Matsumoto/Roads)

C.9. Present a synthesis report for LBA Phase I at the next GHP meeting. (ACTION: Marengo)

C.10. Prepare a letter to the BARCA experiment to encourage hydrometeorological studies in the campaign (include data). (ACTION: Marengo/IGPO/ Roads)

C.11. Submit a LBA Phase II science and implementation plan at the next GHP meeting for review. (ACTION: Marengo)

D. GLOBAL PROJECTS

D.1. Advise HEPEX on how to become a GHP global project. (ACTION: Roads, Sorooshian, IGPO)

D.2. Provide support as needed for the CliC/NEESPI MOU. (ACTION: Roads, IGPO)

D.3. Provide GHP guidance (with special input from BALTEX and MAHASRI) to NEESPI on how to become a CSE. (ACTION: Roads, Isemer, Matsumoto, IGPO)

D.4. Present a proposal to the GEWEX SSG on how CEOP envisions GEWEX oversight of CEOP science and data observations. In addition, present a proposal for new CEOP initiatives, such as the arid region study and how these studies fit within the original goal of CEOP to build a 2-year comprehensive database. (ACTION: Koike, Roads, Sorooshian, IGPO)

E. WRAP

E. 1. Organize a special session on WRAP at the spring 2006 AGU meeting. This session should result in a publication of some type. (ACTION: Martz, IGPO)

E.2. Develop plans for a GEWEX/WRAP/IGWCO workshop on mountain hydrometeorology to meet the needs of GEWEX, WRAP and IGWCO for mountain initiatives. (ACTION: Martz, Leung, IGPO)

F. WISE

F.1. Develop a definition for WISE extremes and use this to develop a database of extremes, beginning in 1990. (ACTION: Stewart)

F.2. Organize scientific sessions on extremes at scientific meetings, as opportunities present themselves. (ACTION: Stewart)

G. TWG

G.1. TWG will participate in joint activities as part of the Pacific Cloud Transect Study. (ACTION: Tackle, Jones)

H. MISCELLANEOUS

H.1. Provide information on long-term data archival requirements at the World Data Centres. (ACTION: Williams, Sommeria)

H.2. Prepare a special *GEWEX News* issue in 2006 on GHP that includes results from Phase I for LBA, BALTEX, GCIP, CEOP and results from GAME, MAGS and WRAP. (ACTION: John Roads, IGPO)

H.3. Provide information on potential NEPAD support and contacts for AMMA to Jan Polcher. (ACTION: IGPO)

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AGENDA

GLOBAL ENERGY AND WATER CYCLE EXPERIMENT
World Climate Research Programme

11th GHP Meeting
PROVISIONAL AGENDA
WITH TOPICS AND CONTRIBUTORS
Melbourne, Australia, 26-28 SEPTEMBER 2005

Objective: To review progress, to re-focus on our objectives, and to re-chart our future.

Monday September 26

08:00-08:30	**Registration**	
08:30-10:30	**OPENING**	
	Welcome, Local Logistics	J. Roads, A. Seed
	WCRP Developments	G. Sommeria
	GEWEX Project Office	R. Lawford
	European GEWEX Project Office	P. Van Oevelen
	GHP Summary	J. Roads
10:30-11:00	**BREAK**	
1100-1230	**Agency Overviews**	
	NASA NEWS	R. Lawford, J. Roads
	NOAA	J. Huang
	ESA	P. Van Oevelen
12:30-13:30	**LUNCH**	
13:30-15:30	**CSE Overviews**	
	LPB	H. Berbery
	LBA	J. Marengo (via telecon)
	GAPP	J. Huang
	MAGS	L. Martz
15:30-16:00	**BREAK**	
16:00-18:00	**CSE Overviews**	
	BALTEX	H. Isemer
	GAME	J. Matsumoto
	MDB	A. Seed
	AMMA	J. Polcher (via telecon)
18:00-20:00	**Reception**	

Tuesday September 27

08:30-10:30	**GHP Working Group Summaries**	
	Data Management	S. Williams
	WEBS	J. Roads
	WRAP	L. Martz
	Stable Water Isotope Intercomparisons	M. Werner
10:30-11:00	**BREAK**	

AGENDA

11:00-12:30 **GHP Working Group Summaries**

Extremes	R. Stewart
Transferability	E. Takle
ICTS	B. Rockel

12:30-13:30 **LUNCH**

13:30-14:30 **Other Regional Modeling Efforts**

Modeling for GAME	T. Satomura
RCMs	C. Jones

14:30-15:30 **Global Projects**

GEWEX SSG	S. Sorooshian
CEOP	T. Koike

15:30-16:00 **BREAK**

16:00-17:30 **Global Projects Continued**

ISLSCP	R. Lawford
IAHS	A. Hall
HEPEX	J. Schaake

Wednesday September 28

08:30-10:30 **Relevant Global Projects**

GWSP	J. Marengo
PUBS	B. Croke
IPILPS	J. Gibson
GLDAS	J. Roads

10:30-1100 **BREAK**

11:00-12:00 **Relevant Global Projects**

GCSS	C. Jakob
NEESPI	R. Lawford

12:00-14:00 **LUNCH**

1400-15:30 Parallel Working Group Meetings

TWG	E. Takle, B. Rockel, C. Jones, others
(Others)	

15:30-16:00 **BREAK**

16:00-17:00 **Plenary**

Thursday September 29

Continuation of ad hoc working group meetings

10:30-1100 **BREAK**

12:00 **GHP tour**