Application of Water and Energy Cycle Science and Observations within the Framework of GEWEX

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GEWEX: The Past – Phase I

Phase I Objectives

• Determine the hydrological cycle and energy fluxes by means of global measurements of atmospheric and surface properties.
• Model the global hydrological cycle and its impact on the atmosphere, oceans and land surfaces.
• Develop the ability to predict the variations of global and regional hydrological processes and water resources, and their response to environmental change.
• Advance the development of observing techniques, data management, and assimilation systems for operational application to long-range weather forecasts, hydrology, and climate predictions.
GEWEX Phase I Results

Phase I Results Summarized

- 10-25 year global data sets of clouds, precipitation, water vapor, surface radiation, and aerosols--indicating no large global trends, but with evidence of regional variability.
- Implementation of the land surface and cloud parameterization upgrades suggested for most regional and global models--showing improved precipitation.
- Initial results from the GEWEX Continental-Scale Experiments--approaching closure of the regional water and energy budgets and determining the importance of recycling and diurnal processes for regional predictions.

- **GEWEX Accomplishments - Phase I**
  - To receive a copy by mail, please send an e-mail to gewex@gewex.org
GEWEX in Phase II (2003-2012/13) addresses the following principal scientific questions:

- Are the Earth's energy budget and water cycle changing?
- How do processes contribute to feedback and causes of natural variability?
- Can we predict these changes on up to seasonal to interannual scales?
- What are the impacts of these changes on water resources?
GEWEX achieves its goals through data set development and analysis, process studies and model improvement.
The Field of Use

- Regional
- Global
- Integrated / coupled
An Old Example: GLASS

- GEWEX Global Land/Atmosphere System Study (GLASS):
New GLASS Structure

• **Benchmarking land surface model evaluation:**
  set up a strategy/protocol that addresses the question how good a model (improvement) needs to be in order to be actually good enough

• **Land-atmosphere coupling (LAC),** to combine the current GLACE/LOCO coupling projects and appreciate the fact that the separation between local and global is fairly arbitrary and synthetic separation

• **Data Assimilation/Model Data Fusion (MDF),**
  a new workgroup that needs to coordinate or monitor the rapid developments in the area of land data assimilation.
GMPP

• GEWEX Model Development Panel
• Merges with the WGNE
• Stronger and broader push to parameterization and model development
# GEWEX Organization

## Radiation

**GEWEX Radiation Panel (GRP) - C. Kummerow, Chair**
- **BSRN** Baseline Surface Radiation Network (E. Dutta)
- **CIRC** Continuous Intercomparison of Radiation Codes (L. Crepon)
- **GACP** Global Aerosol Climatology Project (M. Mishchenko)
- **GCPP** Global Precipitation Climatology Project (R. Adler)
- **I3RC** Intercomparison of 3-D Radiation Codes (R. Cahalan)
- **ICRCCM** Intercomparison of Radiation Codes in Climate Models (R. Ellingson)
- **ISCCP** International Satellite Cloud Climatology Project (W. Rossow)
- **LandFlux** Land Surface Fluxes (W. Rossow)
- **SRB** Surface Radiation Budget Project (P. Sackhouse)
- **SeaFlux** Sea Surface Fluxes (C. Clayson)
- **WGCAP** Working Group for Cloud and Aerosol Profiling (T. Ackerman)
- **WGDEMA** Working Group on Data Management and Analysis (W. Rossow)
- **WGPRN** Working Group for Precipitation Radar Networks (V. Levizzani)

## Modelling and Prediction

**GEWEX Modelling and Prediction Panel (GMP) - C. Jakob, Chair**
- **GABLS** GEWEX Atmospheric Boundary Layer Study (B. Holtslag; G. Svensson)
- **GCSS** GEWEX Cloud System Study (P. Siebesma)
  - Boundary Layer Clouds (A. Lock)
  - Cirrus Cloud Systems (S. Dobbie)
  - Extra Tropical Layer Clouds (G. Tsolaki)
  - Precipitating Convective Cloud Systems (J. Petch)
  - Polar Clouds (J. Pinto)
  - GPCI - GCSS Pacific Cross-section Intercomparison (J. Teixeira)
- **GLASS** GEWEX Global Land/Atmosphere System Study (B. van den Hurk; M. Best)
  - ALMA Assistance for Land-surface Modelling Activities (T. Oki)
  - GLACE-2 Global Land/Atmospheric Coupling Experiment (R. Koster)
  - GSMP-2 Global Soil Wetness Project (P. Dirmeyer)
  - LoCo Local land-atmospheric Coupling (B. van den Hurk)

## Hydroclimate

**Coordinated Energy and Water-Cycle Observations Project (CEOP) - T. Koike, R. Stewart, Co-chairs**

### Regional Hydroclimate Projects (RHPs)
- **AMMA** African Monsoon Multidisciplinary Analysis Project (A. Gaye)
- **BALTEx** Baltic Sea Experiment (H. Isenman)
- **CPA** Climate Prediction Program for the Americas (J. Hwang)
- **LBA** Large-Scale Biosphere-Atmosphere Experiment in Amazonia (J. Maia)
- **LPB** La Plata Basin Project (H. Berbery)
- **MAHASRI** Monsoon Asian Hydro-Atmospheric Science Research and prediction Initiative (J. Matsumoto)
- **MDB** Murray-Darling Basin Water Budget Project (H. Cleugh)
- **NEEPSi** Northern Eurasia Earth Science Partnership Initiative (P. Groisman)

### Regional Studies
- High Altitude (G. Tartari)
- Cold Regions (T. Ohata)
- Semi-arid (C. Fu)

### Cross-Cutting Studies
- Water and Energy Budget Studies (K. Yang)
- Extremes (R. Stewart)
- Stable Water Isotope Working Group (D. Noone, K. Yoshimura)
- Aerosols (W. Lau)

### Modelling Studies
- Global Models (M. Bosilovich)
- Regional Models
  - Inter-Continental Transferability Study (B. Rockel)
  - Regional Modelling for Variability and Extremes (R. Aritt)
  - GEWEX Modelling and Prediction Panel (C. Jones)
- Land Surface Models (M. Rodell)
- Hydrologic Applications Project (E. Wood)

### Affiliated Global Organizations
- GPCC Global Precipitation Climatology Centre (T. Fuchs)
- GRDC Global Runoff Data Centre (U. Looser)
Data projects and centers under the GEWEX umbrella

Related information can be found at:

http://www.gewex.org
Available Global Datasets

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Global Variations in Precipitation (1979-2005) 90N-90S

Global mean = 2.6 mm/d (Ocean [ 2.8 mm/d ] Land[ 2.1 mm/d ]

Little or no linear change during period [biggest change is +2% over ocean]

Ocean and land precipitation tend to compensate
Reprocessing in an era of faster computers and more disk space

- Reprocessing is no longer limited by computer technology.

- It is hampered instead by the haphazard nature of the historic data archives. Storage media, data formats, ancillary information, lack of ancillary information, etc.

- GRP needs to be involved in data stewardship discussions to ensure that data are not only preserved, but preserved in such a way that the reprocessing of long time series can be better automated in the future.
Data Rescue Efforts:

**B1 Status - 2003**

- 17 satellites

**B1 Status - 2006**

- 22 satellites

**B1 Status - 2007**

- 29 satellites

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SeaFlux Global level comparisons - LHF
## LandFlux – Turbulent Fluxes

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<tr>
<th>Data Sets</th>
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<td>Albedo (Spectral)</td>
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<tr>
<td>Skin Temp. (Diurnal)</td>
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<td>R</td>
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<tr>
<td>Vegetation Properties (hi-res description)</td>
<td>Y</td>
<td>R</td>
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<tr>
<td>Surface Meteorology</td>
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<td>Yr</td>
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<td>Precipitation</td>
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<td>Snow Water Amount</td>
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<td>R</td>
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<tr>
<td>Flooding (Standing Water)</td>
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<td>R</td>
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<tr>
<td>Water Levels (&amp; Discharge)</td>
<td>P</td>
<td>R</td>
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<td>Soil Moisture</td>
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<td>Water Storage</td>
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<td>R</td>
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<tr>
<td>Surface Radiation</td>
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Regional Data Sets

GEWEX REGIONAL HYDROCLIMATE PROJECTS

- Climate Prediction Program for the Americas (CPPA)
- Baltic Sea Experiment (BALTEx)
- Northern Eurasia Earth Science Partnership (NEESPI)
- Monsoon Asian Hydro-Atmosphere Science Research and prediction Initiative (MAHASRI)
- Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA)
- African Monsoon Multidisciplinary Analysis (AMMA)
- La Plata Basin (LPB)
- Murray-Darling Basin (MDB)
Regional Data Sets

• The regional data sets are predominantly organized under CEOP

• Accessible through the CEOP Data and Archiving System:
  – In-situ (UCAR): http://www.eol.ucar.edu/projects/ceop/dm/
  – Model (MPI): http://www.mad.zmaw.de/projects-at-md/ceop/
Some Challenges

• Most products are research products and not operational
• Primary/Originally intended use is by other research communities
• GEWEX → WRAP → End Users
• GEWEX → HAP → NHS → End Users
• For example: Hydrological Ensemble Predictions
Hydrological Applications Project

- Basin Scale - Regional
- Process Understanding whilst Events Based:
  - Floods: forecasting, (onset, duration, intensity, extent, ...)
  - Droughts: forecasting, (onset, duration, intensity, extent, ...)
- Ensemble Predictions – address uncertainty in forecasting (HEPEX)
Implementation Strategy

CEOPI/Hydrologic Application Project
- develop and test probabilistic hydrologic forecasts procedures
- demonstrate how to produce reliable hydrologic ensemble predictions and their use for water resources
- develop and test hydrologic nowcasting and monitoring systems useful for water resources
- demonstrate the usefulness of GEWEX data products for related activities like WISE, HEPEX, PUB, (etc.)
Future HAP Activities

Seasonal Hydrologic Predictions.

HAP will continue its activity to generate a global (land) hydrologic re-forecasts (hindcasts) based on NOAA and DEMETER/EuroSIP seasonal forecasts. CSEs should identify testbed activities, and groups to evaluate the hydrologic ensemble forecasts. HAP will expand its collaboration with HEPEX.

Estimation of current hydrologic conditions (snow, soil wetness)

HAP will try to work with other GEWEX activities and weather centers to obtain real-time data that will allow for such estimation. GEWEX needs to help to facilitate this.
EXTREMES

- Floods and Drought are foci
- Extreme precipitations events
- SWAT team from CLIVAR and GEWEX side will do the ground work
Monsoons

- Two foci to be decided
- Again a small team should do the ground work
- Duration 3 years
The IWM series is a part of the WMO major quadrennial symposia and workshops series under the World Weather Research Programme (WWRP). As a WWRP activity, the IWM-4 will follow the guidance of Commission for Atmospheric Sciences (CAS) XIV (February 2006, Cape Town, South Africa) to emphasize research for the reduction of disaster risks through improved forecast of high-impact weather. IWM-4 activities will also include the Workshop on Operational Monsoon Research and Forecast sponsored by the WMO Education and Training Department.

- **The workshop will be held jointly with the Second Pan-WCRP Monsoon Workshop (PWM-2).**
- IWM-IV is organized by the Monsoon Panel of the CAS Working Group for Tropical Meteorology Research. **PWM-2 is organized by the International Monsoon Studies (IMS) Scoping Group under the Joint Scientific Committee of World Climate Research Programme (WCRP).**
- The cosponsors include China Meteorological Administration (CMA), CMA/Chinese Academy of Meteorological Sciences and East Asian Monsoon Activity Center, the WCRP/CLIVAR Asian-Australian Monsoon Panel, Chinese Academy of Sciences/Institute of Atmospheric Physics, and other agencies of the host country.
- **The deadline for abstract submission of contributed papers is June 30, 2008.** Please include “IWM4 abstract” in the subject line of the submission email and send it to Professor C. P. Chang (c/o hjchen@nps.edu).
Initially Proposed Foci

• (1) the role of the monsoons in the global circulation system in a changing climate, in relation to phenomena such as heat and water transport and desertification and with consideration of both the ascending and descending parts of global monsoon circulations.
  – Deliverable: synthesis paper(s) providing input to next IPCC assessment.

• (2) The use of cloud resolving models to improve monsoon predictions.
  – Deliverable: a statement on how applying these techniques affect predictions of monsoon onset, strength and breaks, including how cloud resolving models improve representation of phenomena such as intraseasonal oscillations and the diurnal cycle.
A Few Concluding Thoughts…

• A wealth of information and data sets have been and are being produced (model output, observations, RA…)
  – Accessibility and availability is an issue
  – Duplication and changed versions difficult to track
• GEWEX expand its focus to Monsoons and Extremes, this will be reflected in type of available data products
• GRP Data sets reprocessed and made suitable for climate and trend analysis
• CEOP to link regional and global data sets (e.g. WEBS, HAP, etc.)
Parallel Science Conferences with Joint Sessions

The Sixth International Scientific Conference on the Global Energy and Water Cycle

The Second Integrated Land Ecosystem-Atmosphere Processes Study Science Conference

Water In A Changing Climate
Progress In Land-Atmosphere Interactions and Energy/Water Cycle Research

24-28 August 2009        Melbourne, Australia

• Land in the Climate System
• Aerosol, Cloud, Precipitation, and Climate Interactions
• Future Integrated Observations and Modelling Systems
Thank You