GEWEX

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C. Kummerrow (GRP)
B. van den Hurk, M. Best (GLASS)
J. Petch, C Bretherton (GCSS)
B. Holtslag, G. Svensson (GABLS)

Pan-GEWEX Meeting

Seattle, Washington, 23-28 August 2010

In Memoriam
Moustafa Chahine

Summary


GEWEX
WCRP
Water
Energy
surface
climate
processes
imperatives
However
water
system
regional
future
set
cycle
core
atmospheric
particular
mission
interactions
research
Scientific
Global
land
new
Observations
radiation
timeline
statement
strong
projects
name
given
SSG
energy
hydrological
challenges
scientific
themes
components
Experiment
land-atmosphere
Panel
Modeling
services
influences
suggested
observations
Cycle
plans
Project
view
list
complete
related
project
clouds
old
indeed
January
atmosphere
activities
visioning
Cryosphere
Coordination
Land-atmosphere
approved
science
experiments
panels
also
understanding
global
human
much
encompasses
Councils
within
runoff
retain
move
modeling
fast
CLIC
evolution
imperative
hydrology
began
arguments
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including
ocean
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organizations
Delhi
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Spring
Regional
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Model
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World
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extensive
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Silver
Capacity
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International
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via
Spring

MOST IMPORTANT ACCOMPLISHMENTS by GEWEX in 2010-11

- "*GEWEX Imperatives: Plans for 2013 and Beyond*" living document: drafted, reviewed and available in response to JSC guidelines for the future. This outlines the future directions of GEWEX.
- The **GEWEX Newsletter** has been published quarterly to keep all interested parties informed about the process and activities.
- The **Pan-GEWEX meeting**: successful in late August 2010 (Seattle, Washington); provided a vibrant interactive forum for different GEWEX Panels to interact with each other and with many program managers and representatives from other parts of WCRP, GWSP, and so on.
- A major **workshop on climate extremes**: led by GEWEX on behalf of the WCRP at UNESCO in September 2010. A full report is now available and an article has appeared in *Eos*.
- Special **session on WCRP projects** at Jan 2011 AMS meeting.

Reinvigoration of GEWEX Panels

- **GRP** is focused on reprocessing the GEWEX datasets and a major workshop is planned in April at ESRIN in Frascati, Italy;
- **GMPP** no longer exists and a new framework has been set in place to organize the modeling within GEWEX and some reorganization has taken place;
- **CEOP** has been substantially revamped and is now called the GEWEX Hydroclimatology Panel (**GHP**), with new leadership and new directions.
  - A new Regional Hydroclimate Project (HYMEX) focused on the Mediterranean region is now included and
  - Plans are underway for a new RHP in North America.

GEWEX Project Organization

RADIATION

GRP GEWEX Radiation Panel (C. Kummerow; J. Schultz)

- **BSRN** **Baseline Surface Radiation Network** (E. Dutton)
- **CIRC** **Continuous Intercomparison of Radiation Codes** (L. Oreopoulos)
- **GACP** **Global Aerosol Climatology Project** (M. Mishchenko)
- **GPCP** **Global Precipitation Climatology Project** (R. Adler)
- **ISCCP** **International Satellite Cloud Climatology Project** (W. Rossow)
- **I3RC** **Intercomparison of 3-D Radiation Codes** (R. Cahalan)
- **LandFlux** **Land Surface Fluxes** (W. Rossow)
- **RAMI** **Radiation transfer Model Intercomparison** (J-L Widlowski)
- **SeaFlux** **Sea-Surface Fluxes** (C. Clayson)
- **SRB** **Surface Radiation Budget Project** (P. Stackhouse)
- **WGDMA** **Working Group on Data Management and Analysis** (W. Rossow)

Assessment Working Groups:

- **Aerosols** (S. Christopher; J. Reid)
- **Clouds** (C. Stubenrauch)
- **Radiation** (P. Stackhouse)

MODELING AND PREDICTION

GCSS/ GABLS **GEWEX Cloud System Study** (J. Petch; C. Bretherton)
GEWEX Atmospheric Boundary Layer Study (B. Holtslag; G. Svensson)

- **ACPC** **Joint GCSS/iLEAPS Project on Aerosols, Clouds, Precipitation and Climate** (B. Stevens/GCSS; A. Meinrat/iLEAPS)
- **DIME** **Data Integration for Model Evaluation** (R. Rossow)

GCSS Working Groups

- **Boundary Layer Clouds** (A. Lock)
- **Cirrus Cloud Systems** (S. Dobbie)
- **Cloud Climate Feedback**
  - -- **CFMIP-GCSS Intercomparison of LES and SCMs** (M. Zhang; C. Bretherton)
- **Cloud Microphysics** (U. Lohmann)
- **GCSS Pacific Cross-section Intercomparison** (J. Teixeira)
- **Polar Clouds** (J. Pinto; H. Morrison)
- **Precipitating Convective Cloud Systems** (J. Petch)

GLASS **Global Land/Atmosphere System Study** (B. van den Hurk; M. Best)

- **ALMA** **Assistance for Land-surface Modeling Activities**
- **GLACE-2** **Global Land/Atmospheric Coupling Experiment** (R. Koster)
- **GSWP-3** **Global Soil Wetness Project** (T. Oki)
- **LoCo** **Local land-atmospheric Coupling** (B. van den Hurk)
- **LUCID** **Land-Use and Climate, Identification of robust impact** (A. Pitman)
- **PILPS** **Project for the Intercomparison of Land-surface Parameterization Schemes** (A. Pitman)

HYDROCLIMATOLOGY

GHP GEWEX Hydroclimatology Panel (D. Lettenmaier; TBD) J. Polcher

Regional Hydroclimate Projects (RHPs)

- **AMMA** **African Monsoon Multidisciplinary Analysis Project** (T. Lebel)
- **BALTEX** **Baltic Sea Experiment** (H.J. Isemer)
- **CPPA** **Climate Prediction Program for the Americas** (J. Huang)
- **HyMeX** **HYdrological cycle in the Mediterranean Experiment** (P. Drobinski)
- **LBA** **Large-Scale Biosphere-Atmosphere Experiment in Amazonia** (J. Maia)
- **LPB** **La Plata Basin Project** (H. Berbery)
- **MAHASRI** **Monsoon Asian Hydro-Atmosphere Scientific Research and Prediction Initiative** (J. Matsumoto)
- **MDB** **Murray-Darling Basin Water Budget Project** (J. Evans)
- **NEESPI** **Northern Eurasia Earth Science Partnership Initiative** (P. Groisman)

Regional Studies

- **Cold Region** (T. Ohata)
- **High Elevation** (G. Tartari)
- **Monsoon** (J. Matsumoto; H. Berbery; W. Lau)
- **Semi-arid** (C. Fu)

Data Management

- **Reference Sites, River Basins** (S. Williams)
- **Model Output** (M. Lautenschlager)
- **Satellite Data** (T. Koike)
- **Data Integration and Dissemination** (T. Koike)
- **Central Data Integration** (T. Koike)

Cross-Cutting Studies

- **Water and Energy Budget Studies** (K. Yang)
- **Extremes** (R. Stewart)
- **Isotopes** (D. Noone; K. Yoshimura)
- **Aerosols** (W. Lau)

Modeling Studies

- **Global Models** (M. Bosilovich)
- **Regional Models**
  - - **Inter-Continental Transferability Study** (B. Rockel)
  - - **Scale Interaction Evaluation Experiment** (R. Arritt)
- **Land Surface Models** (M. Rodell)
- **Hydrologic Applications Project** (E. Wood)

Affiliated Global Organizations

- **GPCC** **Global Precipitation Climatology Centre** (U. Schneider)
- **GRDC** **Global Runoff Data Centre** (U. Looser)

GRP

- **Radiative processes** and understanding
- **Global Data sets** on radiative and turbulent fluxes
- Global In-situ **observational networks**, development and standardization (radiation, soil moisture)
- Development and improvement of **radiative transfer** codes
- **Intercomparison** studies and assessment
-http://www.gewex.org/projects-GRP.htm

CEOP ⇒ GHP

- Globally distributed extensive **regional data sets** covering water and energy cycle observations (in situ and space borne and modeling data)
- **Data management** system / GEO Prototype for Water Cycle Observations
- **Regional Climate Modeling and Process** Descriptions (Monsoons, Extremes, etc)
- **Hydrological Applications** and Forecasting (Drought monitoring, Hydrological Ensemble Predictions…)
- Coupling with Global Modeling and Global Data sets
-http://www.gewex.org/projects-CEOP.htm

GMPP ⇒, GCSS/GABLS => GASS | GLASS

- Model **Parameterization** and development from land surface process to atmospheric processes
- **Cloud process** descriptions, parameterizations and model, data sets and tools, intercomparisons
- **Atmospheric Boundary layer** studies, descriptions and intercomparison studies (diurnal cycle)
- Strong cooperation with Numerical Prediction Centers and weather forecasting “through” WGNE
- **Land surface feed back/coupling** studies
- http://www.gewex.org/gcss_gabls_panel.html
- http://www.gewex.org/glass_panel.html

Some Key Issues for GEWEX

- The new GEWEX has adopted the mission of "land-atmosphere"

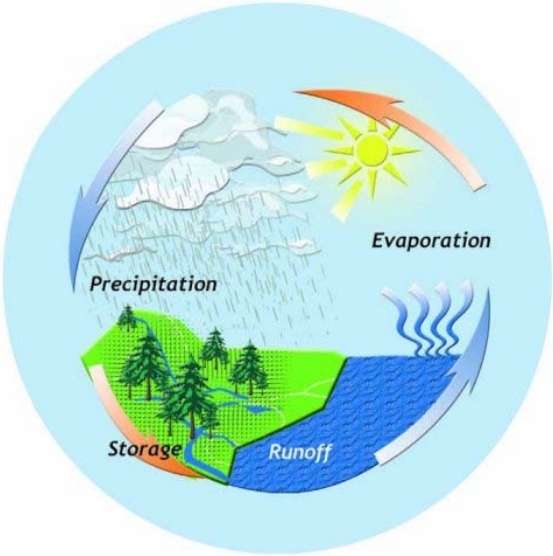
However GEWEX has also decided to be much more:

- GEWEX will continue to embrace the **global energy and water cycles**

- GEWEX also embraces activities spanning Earth system domains and other integrating themes
  - **monsoons**
  - **extremes** …

GEWEX : post 2013

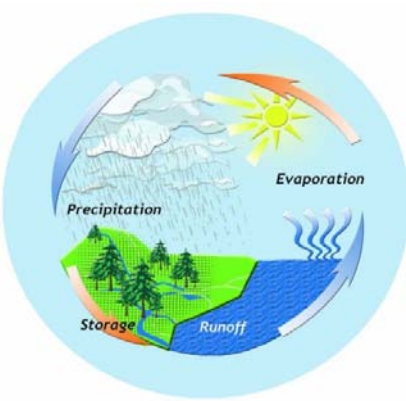
New name*:



Global and regional Energy and Water Exchanges: GEWEX

* To be approved

GEWEX: post 2013



Mission statement

To measure and predict global and regional energy and water variations, trends, and extremes (such as heat waves, floods and droughts), through improved observations and modeling of land, atmosphere and their interactions; thereby providing the scientific underpinnings of climate services.

Imperatives: Headlines

Datasets: Foster development of climate data records of atmosphere, water, land, and energy-related quantities, including metadata and uncertainty estimates.

Analysis: Describe and analyze observed variations, trends and extremes (such as heat waves, floods and droughts) in water and energy-related quantities.

Processes: Develop approaches to improve process-level understanding of energy and water cycles in support of improved land and atmosphere models.

Modeling: Improve global and regional simulations and predictions of precipitation, clouds, and land hydrology, and thus the entire climate system, through accelerated development of models of the land and atmosphere.

Applications: Attribute causes of variability, trends and extremes, and determine the predictability of energy and water cycles on global and regional bases in collaboration with the wider WCRP community.

Technology transfer: Develop diagnostic tools and methods, new observations, models, data management, and other research products for multiple uses and transition to operational applications in partnership with climate and hydro-meteorological service providers.

Capacity building: Promote and foster capacity building through training of scientists and outreach to the user community.

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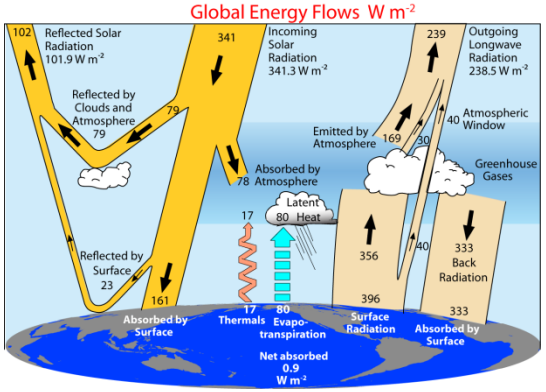
Example: Imperatives: 1

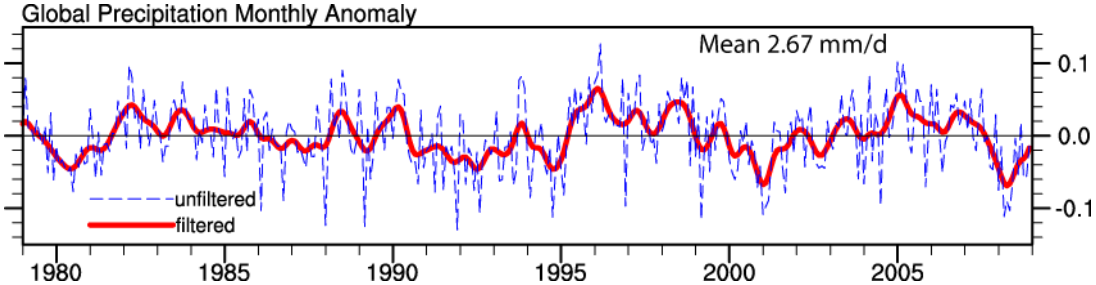
DATASETS: Foster development of climate data records of atmosphere, water, land, and energy-related quantities, including metadata and uncertainty estimates.

Lead: GRP, CEOP; **Partners:** SCOPE-CM, CEOS, WOAP

Actions:

- Reprocess GEWEX datasets, provide advice on other efforts and lead evaluations.
- Continue evaluation and refinement of sensor algorithms, influencing next generation space-born platforms and reprocessing.
- Development of appropriate calibration/validation/evaluation datasets to confront models.
- Devise robust ways of dealing with the more diverse, complex, higher spatial and temporal resolution, and much greater volumes of data.
- Build on CEOP experience in data management, archival and access.





GRP develops **climate data records** of water and energy variables, complete with metadata and error bars.

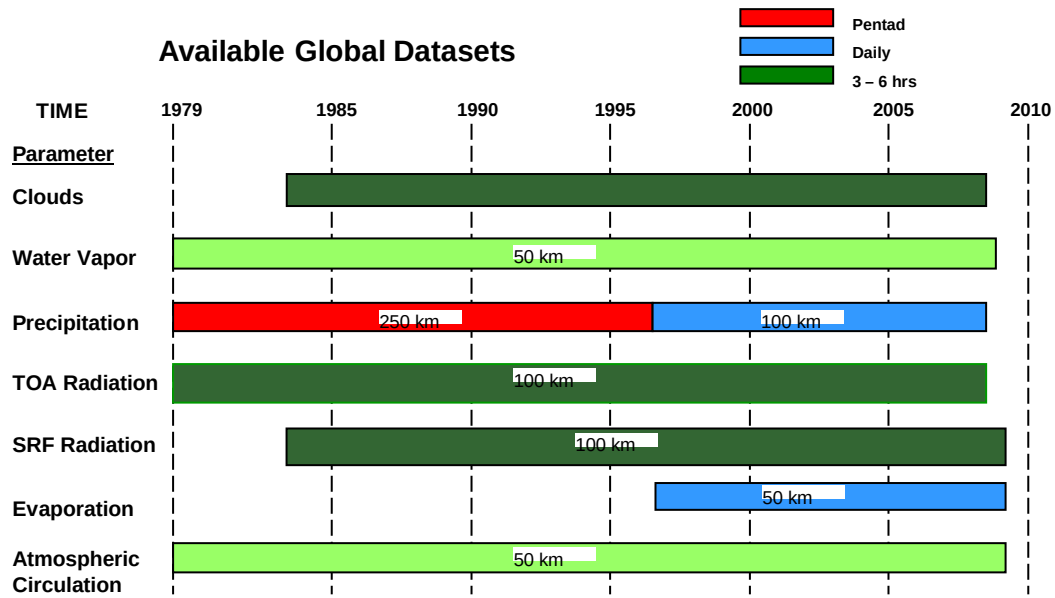
Clouds - ISCCP
- Cloud Assessment

Radiation - SRB
- Surface reference observations - BSRN
- Radiation Assessment

Aerosols - GACP
- Aerosol Assessment

Precipitation - GPCP
- Sfc gauge obs (GPCC)

Turbulent Fluxes
- SeaFlux
- LandFLux
- Soil Moisture



A GRP product is endorsed by GEWEX/GRP to conform to a high standard of production and documentation. It consists of a blend of available satellite and in-situ observations and is periodically compared and assessed against other products in an open and transparent fashion. It is openly available to everyone without restrictions.

Key Data Objective

When GRP began there were few datasets. Now there is a proliferation: a multitude of datasets that are all different, and with different strengths and weaknesses. The need to assess these, and evaluate and reprocess the data is enormous! So the objective is:

Reprocess all GRP products with common ancillary data and assumptions. Panel has learned much about reprocessing; distribution; documentation and user support. Plan to reprocess periodically (e.g. approx. every 5 years)

Publish state of the "Observed" Water and Energy budgets

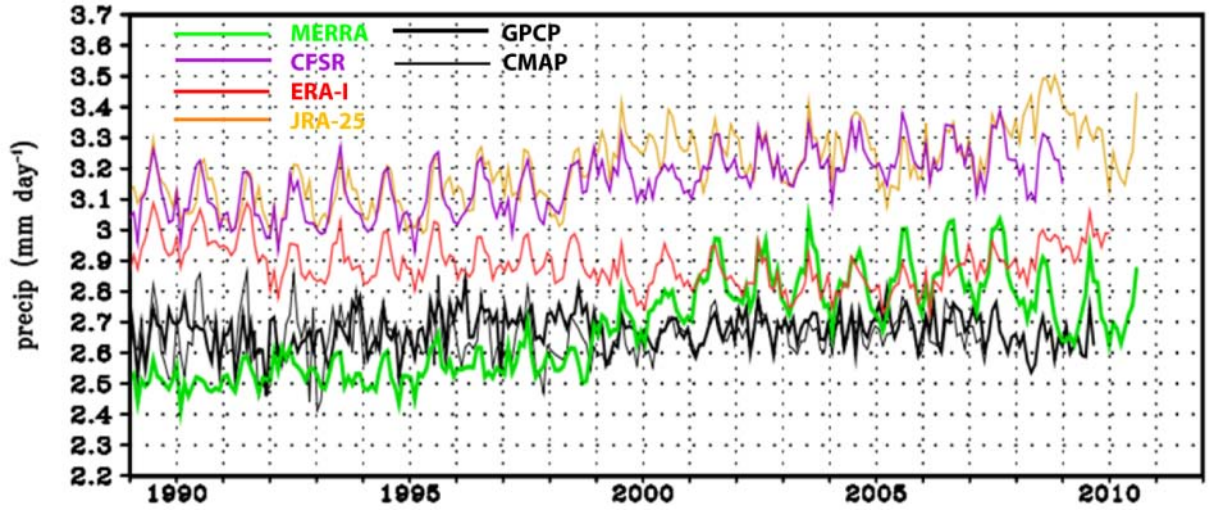
Expand accessibility to multi-variable products

Facilitate research to interpret global and regional covariance among Water & Energy variables.

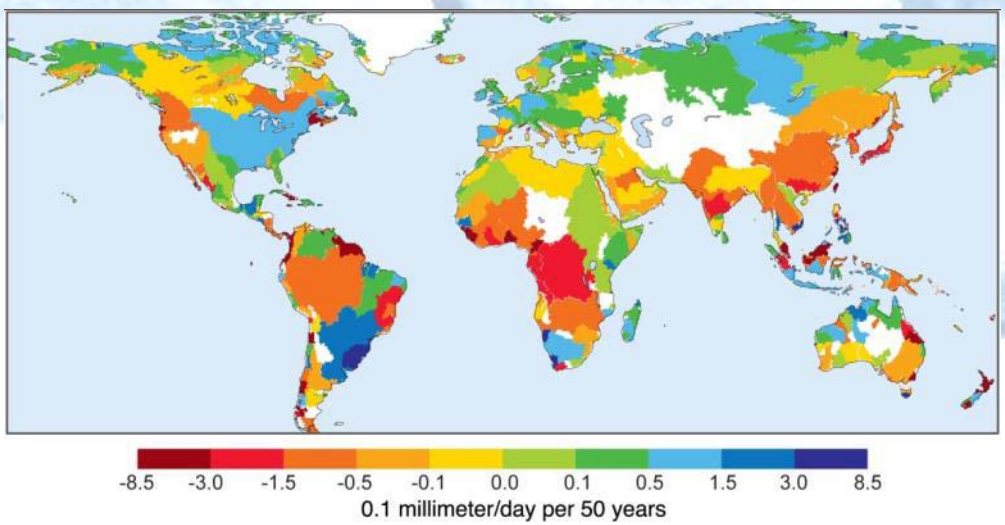
Assess all products of the same variable for strengths and weaknesses. Each agency wants to only reprocess their product.

Help move products to operations; share experience

2. *Analysis:* Describe and analyze observed variations, trends and extremes (such as heat waves, floods and droughts) in water and energy-related quantities.

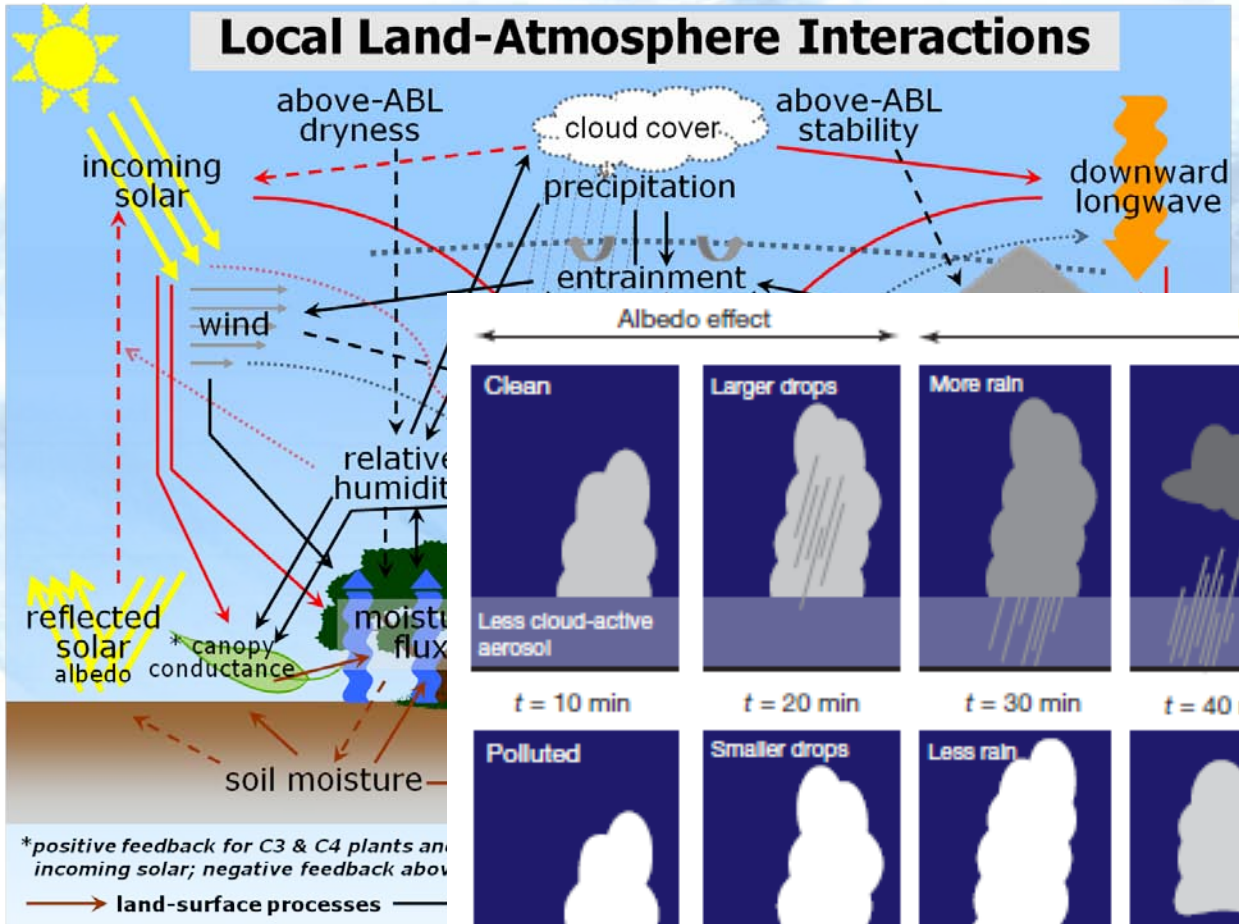


Precipitation from observations and reanalyses (courtesy D. Dee)

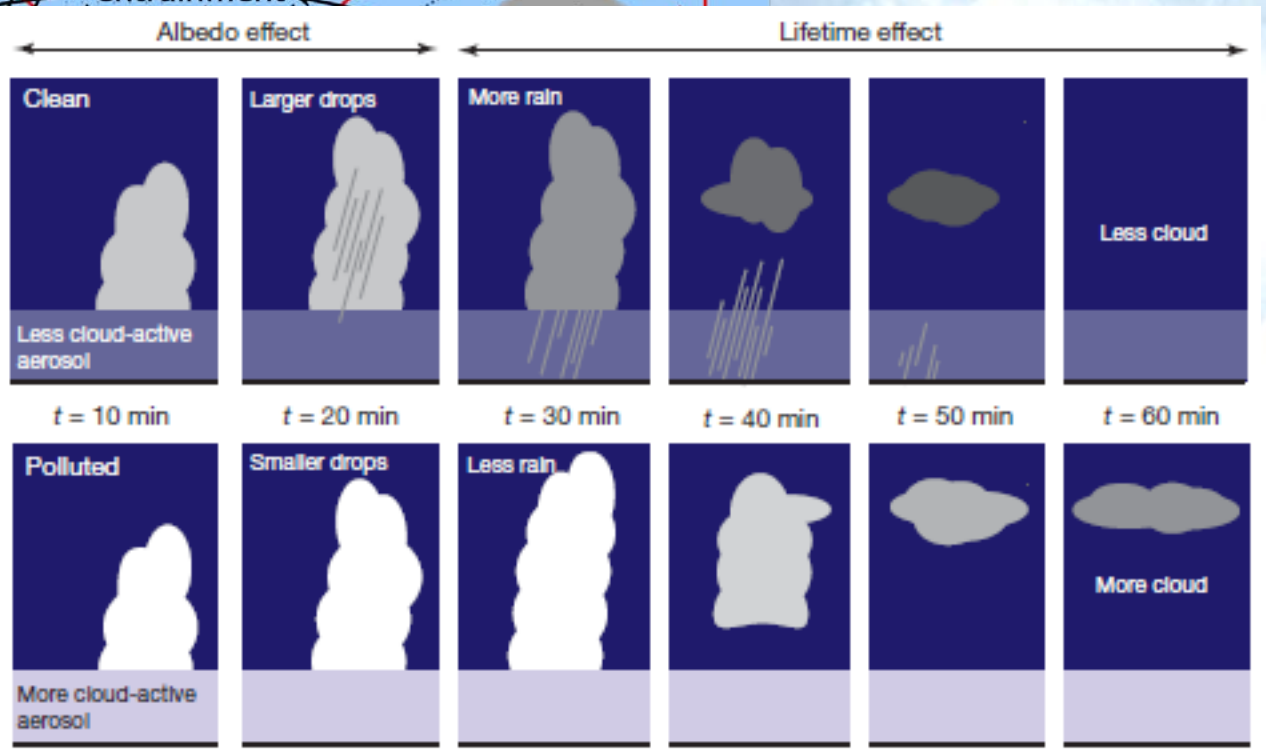


Runoff trends 1948 to 2004 (Dai et al 2009)

3. *Processes:* Develop diagnostic approaches to improve process-level understanding of energy and water cycles in support of improved land and atmosphere models.



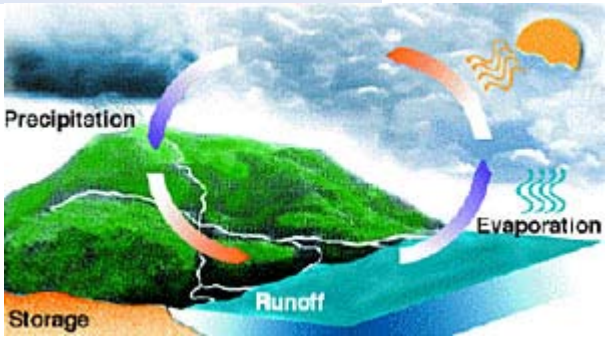
Courtesy Mike Ek, K Tr

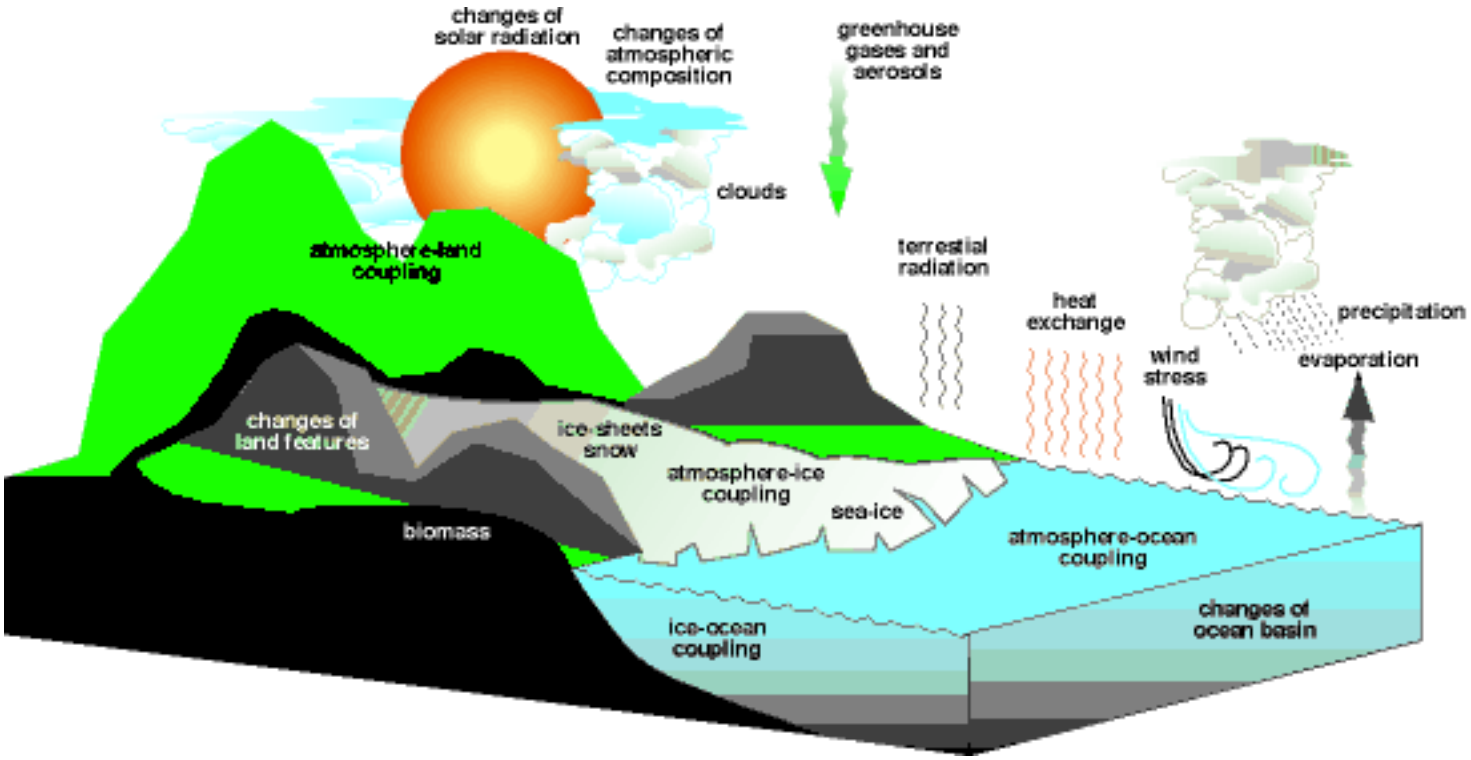


Stevens and Feingold 2009

Regional water cycles

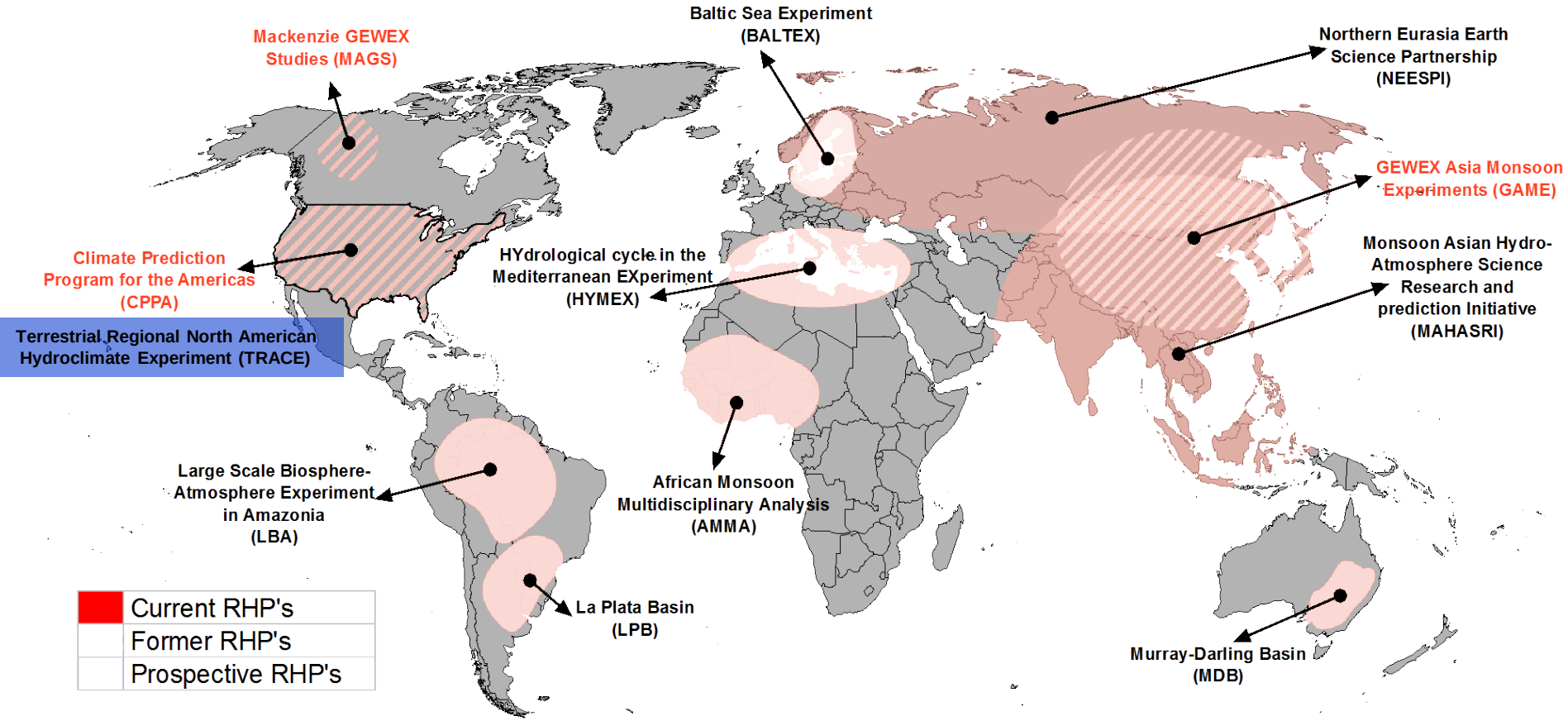
GHP: Back to basics





CEOP → GHP

GEWEX REGIONAL HYDROCLIMATE PROJECTS



Regional water cycles

CEOP → GHP

There has been considerable modeling within CEOP of 2 kinds:

1. **Regional Hydrological Project** modeling, which can range from detailed hydrologic models over catchments or river basins, to regional climate modeling such as now given by CORDEX
2. **Global and intercontinental transferability**

- The MAC: Multi-model Analysis for CEOP (Bosilovich et al 2009)

Global models in GCSS/GABLS and GLASS should enable interactions with RHPs which provide local expertise and datasets for validation etc, in context of global processes.

- How to do this remains a challenge?

Revitalizing GHP

- CEOP reference sites vs flux towers
- 10 year data set; mission creep => WOAP?
- Archive for regional projects

New Phase

- Need to reinvigorate RHPs
  - Type I (core; criteria) and type II (affiliated)
- Stronger hydrological activities: foster the next generation of hydrologically realistic land surface schemes (cf home for PILPS)

4. *Modeling:* Improve global and regional simulations and predictions of precipitation, clouds, and land hydrology, and thus the entire climate system, through accelerated development of models of the land and atmosphere.

Proposal from the last JSC meeting for a **"Modeling Council"**: "… the Modeling Council concept would allow the Projects to be better connected to the WCRP modeling efforts. "

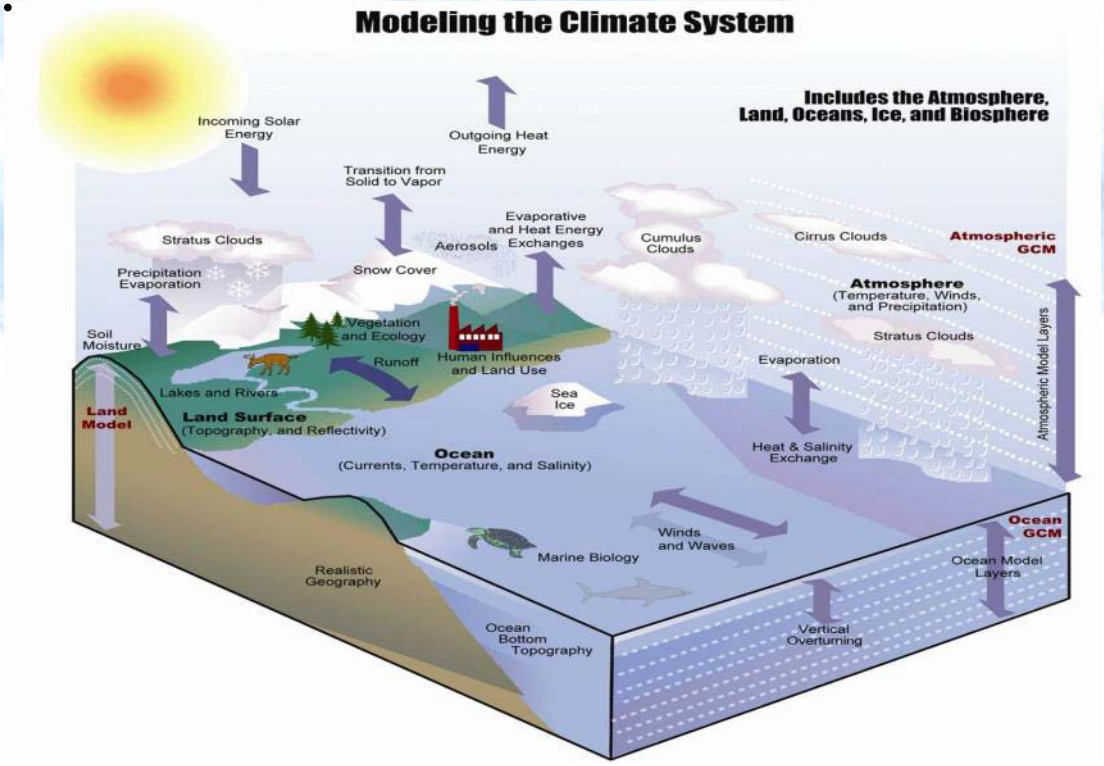
GEWEX:

GCSS

GABLS

GLASS

RHPs

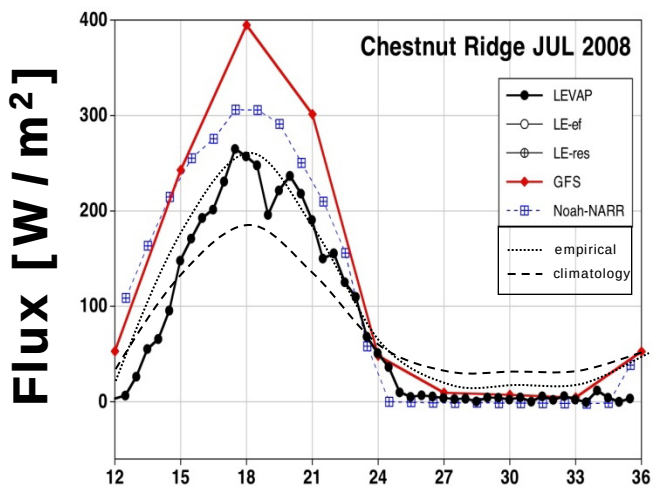


GEWEX Modeling

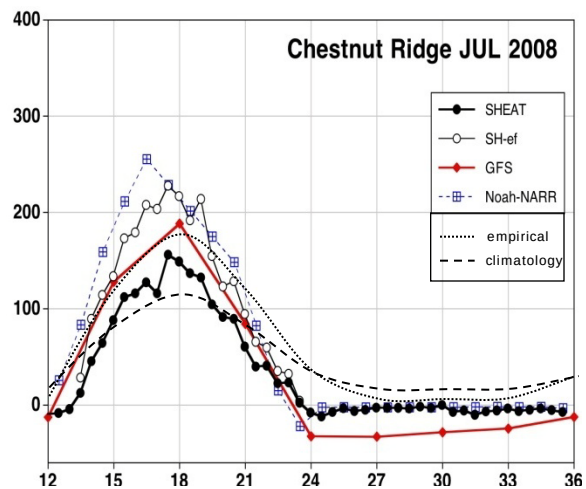
- GCSS and GABLS to be combined: GMPP removed
- Replace the GCSS working groups and their chairs by an SSC that oversees projects (about 8?)
- Projects are proposed to the SSC by any member of the community
- There will be a small set of criteria a project has to fulfill (e.g., leadership, timeline, plan)
- GABLS will be integrated into this structure and its participants will propose projects
- GLASS and GCSS/GABLS represent the SSG in WGNE
- GHP hydrological modeling is largely separate
- GHP has agreed to consider hosting CORDEX

Joint GEWEX/GLASS-GHP project: Land Surface Model Benchmarking

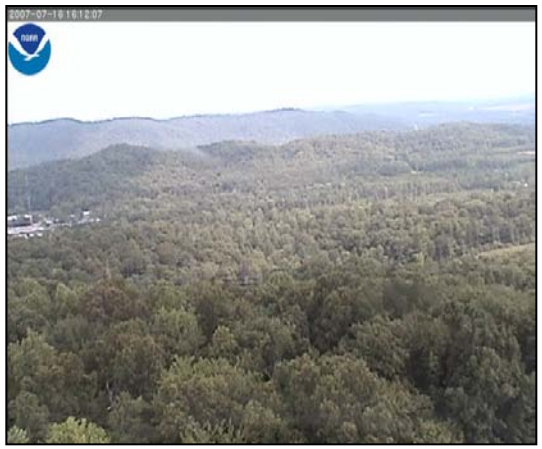
GLASS provides tools (i.e. *Protocol for the Analysis of Land Surface models*: www.pals.unsw.edu.au), and **GHP** (formerly CEOP) provides flux site data sets for different regions, seasons & variables, e.g. to evaluate ***energy***, ***water*** & ***carbon*** budget components.



Latent



Sensible



Forest tower

Monthly diurnal average surface latent and sensible heat flux
Chestnut Ridge, Tennessee, USA, July 2008

Framework for Atmospheric Model Enhancement (FAME)

- Mission: Improving the representation of physical and dynamical processes in the troposphere in models for all purposes and especially weather and climate services
- Ingredients
  - PBL (GABLS)
  - Clouds and Convection (GCSS)
  - Radiation (shared with GRP and SPARC)
  - Coupling to dynamical processes
  - Coupling to numerics

FAME

Resides within GEWEX: endorsed by SSG

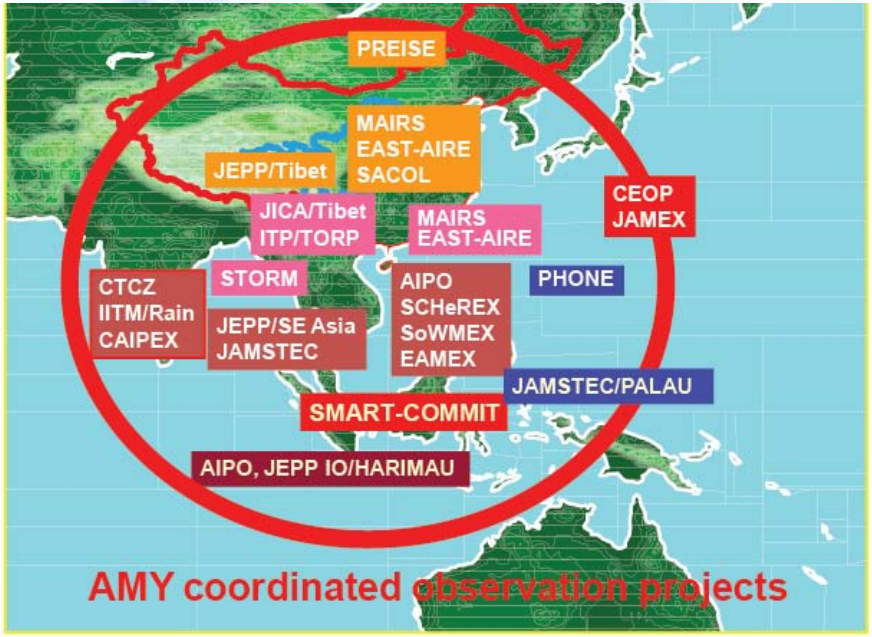
- maintains links to GLASS
- potentially good links to LAMs and RHPs
- natural focus on energy and water cycle
- deals with "fast processes"

- Will raise visibility of atmospheric model development
- Needs to integrate with regional modeling (such as CORDEX)
- Should this be broadened to replace GMPP and include RHP modeling?

5. *Applications*: Attribute causes of variability, trends and extremes, and determine the predictability of energy and water cycles on global and regional bases in collaboration with the wider WCRP community.

Pan-WCRP & WMO

Cross-cutting studies:
Monsoons
Extremes



Monsoon crosscuts

- Concern that, once again, because monsoons cut across land and ocean domains, they may not be adequately addressed in new WCRP structure
- Models do not simulate monsoons well
- How much is resolution (e.g. of topography, land-sea divide)?
- Can models simulate the floods in Pakistan, China, India in summer 2010, and in Australia in their summer 2010-11?




Extremes in models

- Evaluate and develop models wrt replication of extremes:
  - Methods for comparing model grid point values with observations.
  - Establish extreme-related measures for evaluation of models.
- Archives must include high frequency data.
  - Hourly data: pdfs
- Assess ability and utility of models wrt extremes (not good)
  - Resolution; parameterizations (e.g. convection)
  - Phenomena, confidence in physics
- Set up CMIP5 analysis projects focused on extremes
  - Derive certain mandatory statistics
- What do these mean for impacts: downscaling?
- Improvements of models (intensity, frequency of precip etc)
- Improvements in resolution

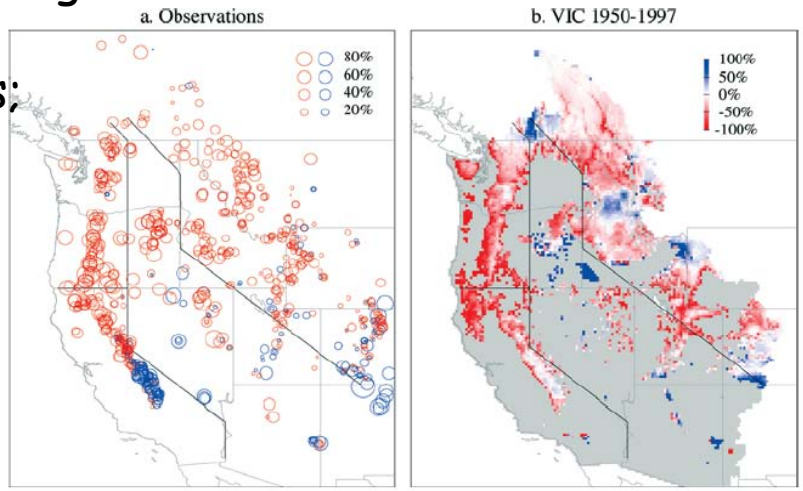
5. *Applications*: Attribute causes of variability, trends and extremes, and determine the predictability of energy and water cycles on global and regional bases in collaboration with the wider WCRP community.

- Water availability is changing: and non-stationarity is not included in planning: New methods much needed
- Issues of how to get regional information from global models:
  - CMIP5, CORDEX
- Information for hydrological modeling and water management needed.

a) Evaluate the ability of coupled land-atmosphere models to reproduce observed trends in land surface hydrological variables;

b) Evaluate coupled model predictions of hydrologic extremes for use in risk-based design (e.g., of dam spillways), and observed drought and soil moisture deficits;

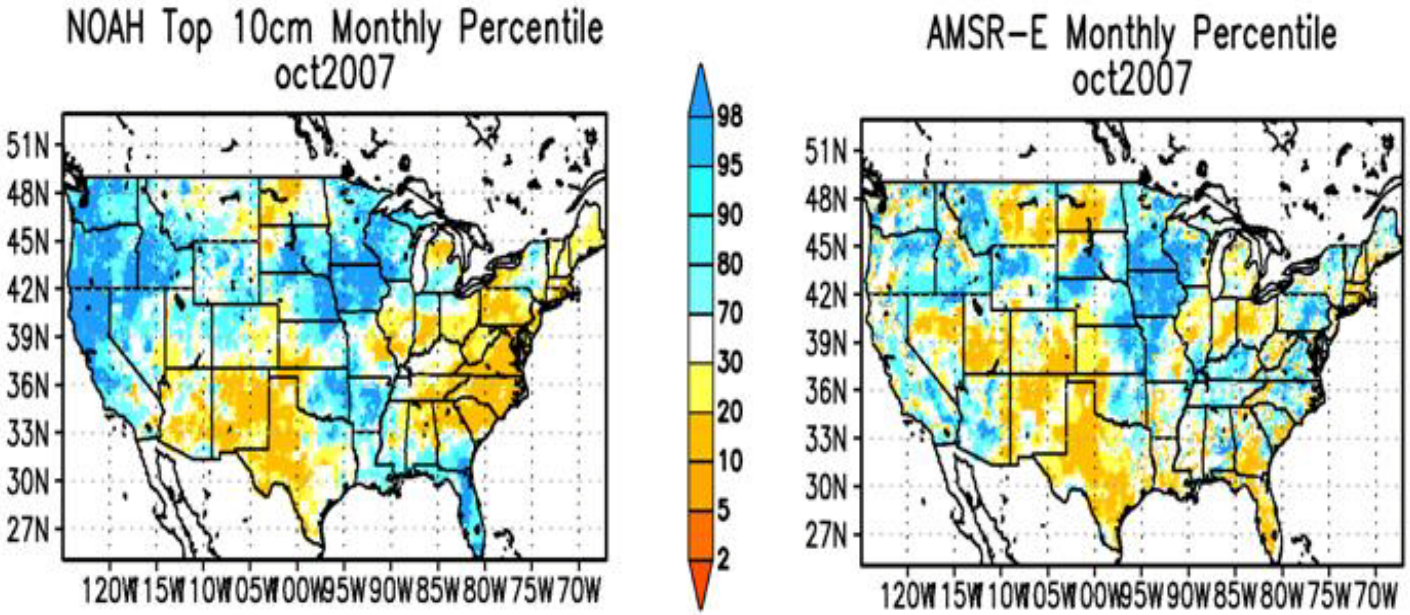
c) Evaluate the predictability of hydrologic extremes (floods and droughts) using coupled models over a range of lead times from days to months or longer.



Observed (from manual snow course data, left) and modeled trends (right) in snow water equivalent in the western U.S. (from Mote et al. 2005).

6. Technology transfer: Develop diagnostic tools and methods, new observations, models, data management, and other research products for multiple uses and transition to operational applications in partnership with climate and hydro-meteorological service providers.

GEWEX has a well established legacy of development of global datasets, satellite simulators, providing results from regional field programs with observations and products, establishing new methods of processing data and displaying results, improving models, and demonstrating the usefulness of these developments through applications focused on water and energy cycles ⇒ climate services



Estimated drought index as the percentile value of the estimated soil moisture based on a long data record for October 2007. Left: Noah Land surface model estimate; right: AMSR-E based. (From Sheffield et al. 2011)

7. Capacity Building: Promote and foster the development of capacity through training of scientists and outreach to the user community.

Education: workshops, training, summer schools; observations, data; technology use; technology transfer; interactions with users; outreach ⇒ climate services.

Participants at a recent La Plata Basin Workshop held in Itaipú Technological Park, Foz do Iguaçu, Paraná State, Brazil.

A panel discussion at the International BACC Conference, May 2006 in Gothenburg, Sweden, providing for science – stakeholder interaction and GEWEX/BALTEX outreach.

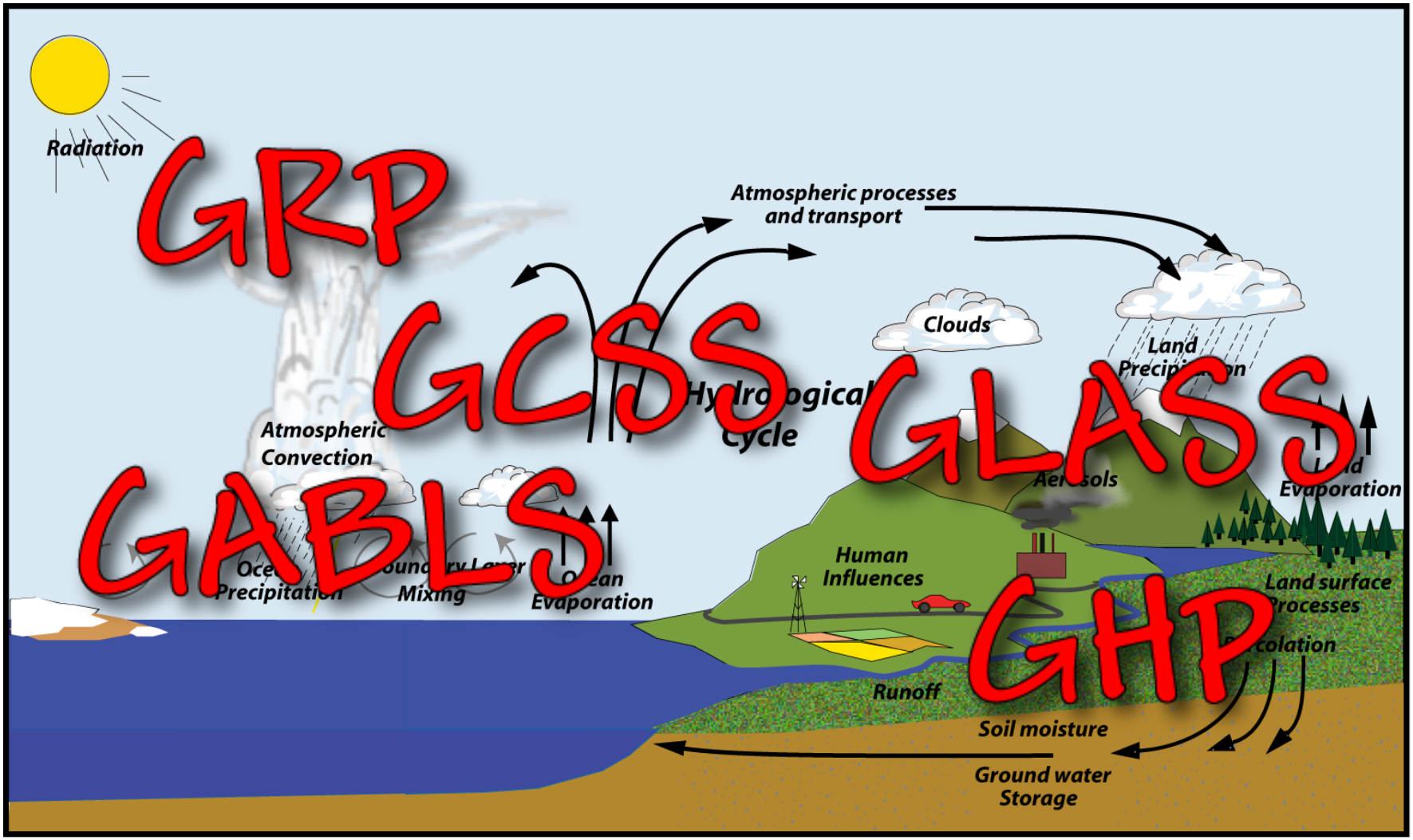
GEWEX planned meetings

- 8 April 2011: GHP Meeting at EGU, Vienna, Austria
- 6th-10th June, 2011: CFMIP/GCSS/EUCLIPSE Meeting on Cloud Processes and Climate Feedbacks, UK Met Office, Exeter
- 30 Aug - Sep 1: GRP Meeting Tokyo, Japan
- 23 Oct. 2011: GLASS Meeting in Denver, CO, USA
- 19 - 21 Oct: Proposed GHP Panel meeting, Boulder, CO, USA
- 28-30 Oct: GEWEX Exec Comm mtg; Boulder, CO, USA
- 14-18 November 2011: GEWEX SSG, Rome, Italy
- 7-10 November 201: GABLS-ECMWF, Reading, UK

Other regional meetings:

- TRACE Terrestrial Regional North American Hydro-Climate Experiment Washington DC 18-20 April
- HYMEX wkshp 16-20 May; Menorca, Spain

GEWEX


Radiation
GRP
GCSS
GLASS
GABLS
GHP
Atmospheric processes and transport
Clouds
Land
Atmospheric Convection
Hydrological Cycle
Aerosols
Evaporation
Human Influences
Land surface Processes
Precipitation
Mixing
Evaporation
Runoff
Soil moisture
Ground water Storage