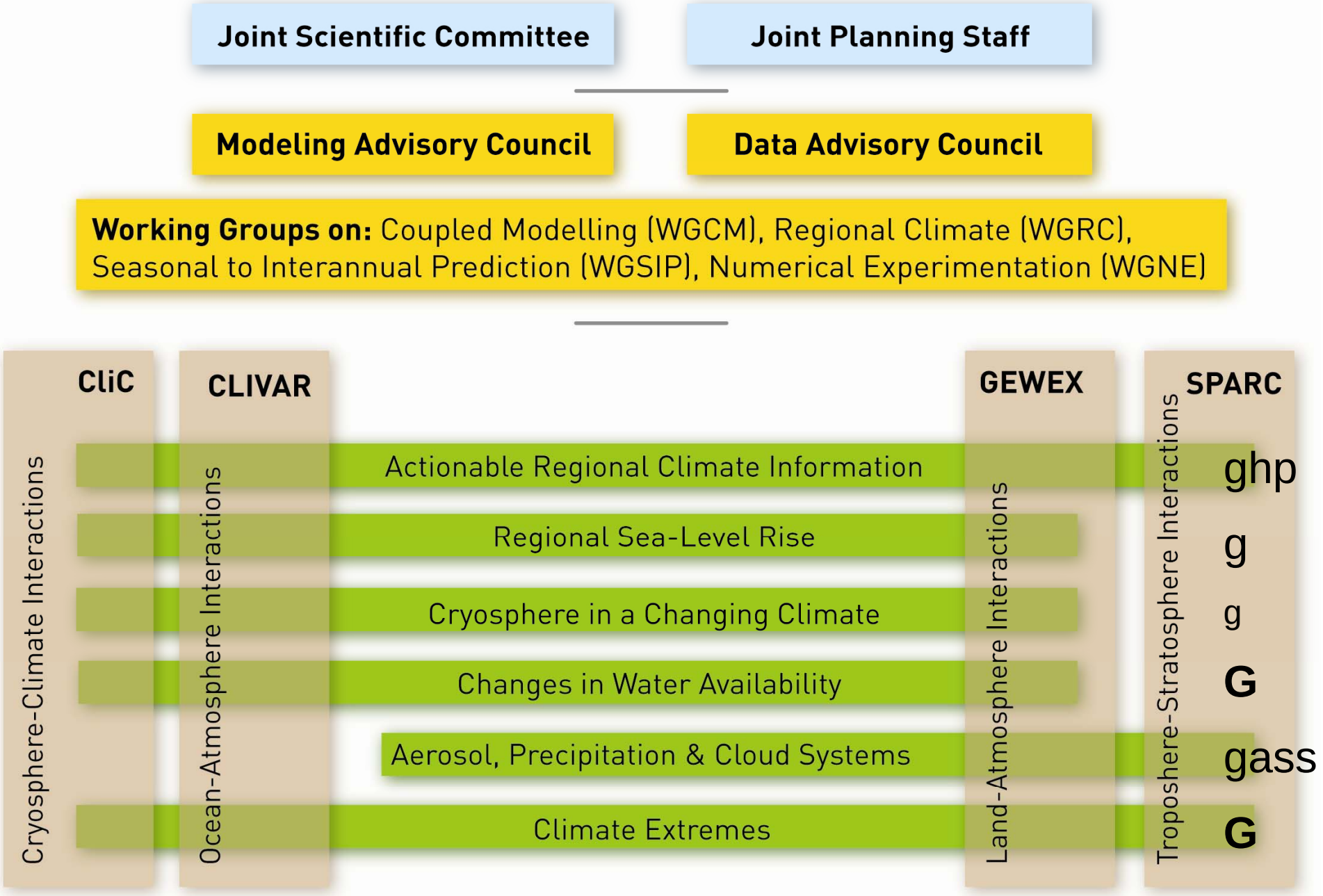
WCRP Organization

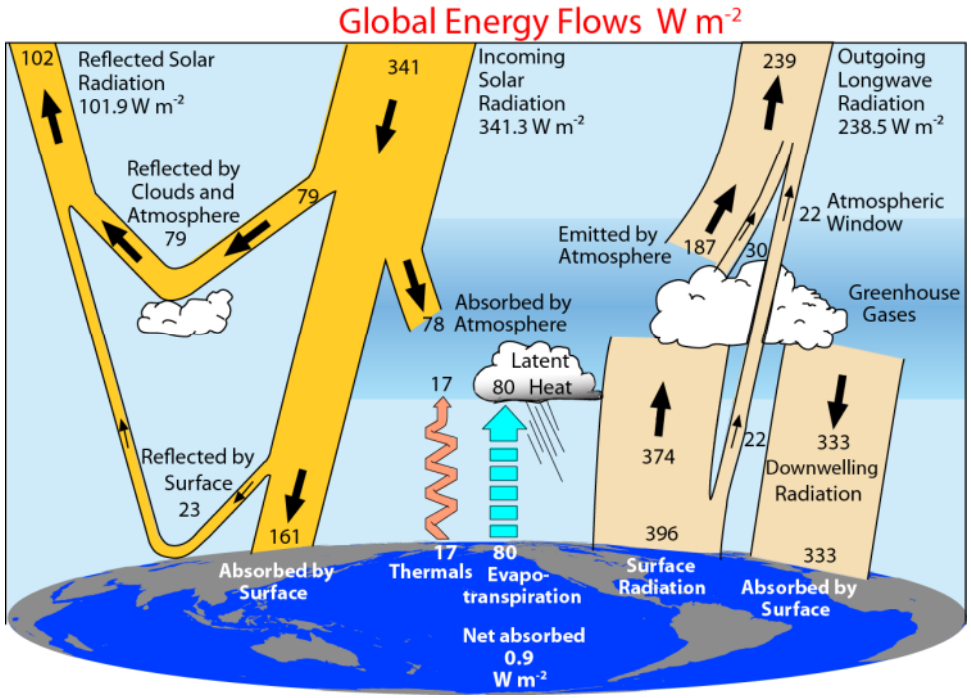



GEWEX
Global Energy and Water Exchanges
World Climate Research Programme

New name!

GEWEX Data and Assessments Panel

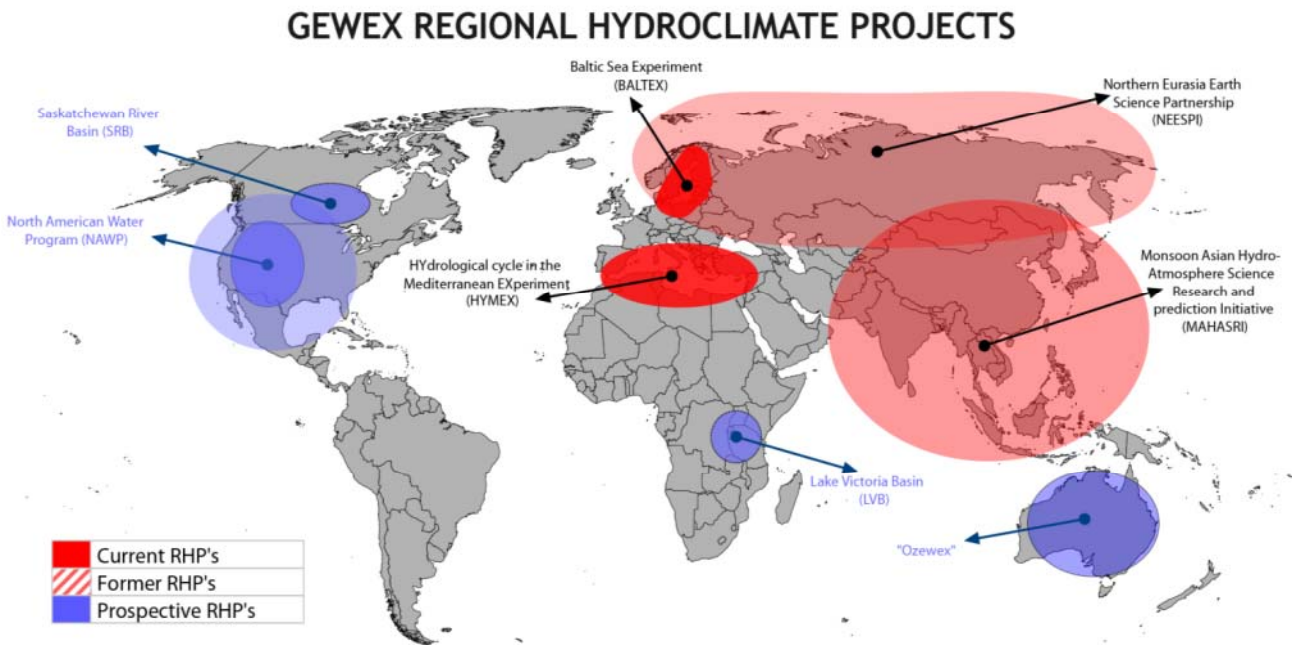
- **Radiative processes** and understanding
  - Develop and improve of **radiative transfer** codes, comparisons
- **Global Data sets**
- Global In-situ **observational networks**, development and standardization (radiation, soil moisture)
- Reprocessing of datasets
- **Assessment** and intercomparison studies
- http://www.gewex.org/GDAP.html



Global datasets
Aerosols
Clouds
Radiation
Water Vapor
Precipitation
Surface fluxes

GEWEX Hydroclimatogy Panel

- **Regional hydroclimate projects**
- Globally distributed extensive **regional data sets** : water and energy cycle observations (in situ and space borne and modeling data)
- **Global Data Centers**; data management system / GEO Prototype for Water Cycle Observations
- **Regional climate and hydrological modeling and process** Descriptions
- **Hydrological Applications** and Forecasting (Drought monitoring, Hydrological Ensemble Predictions…)
- http://www.gewex.org/projects-ghp.html

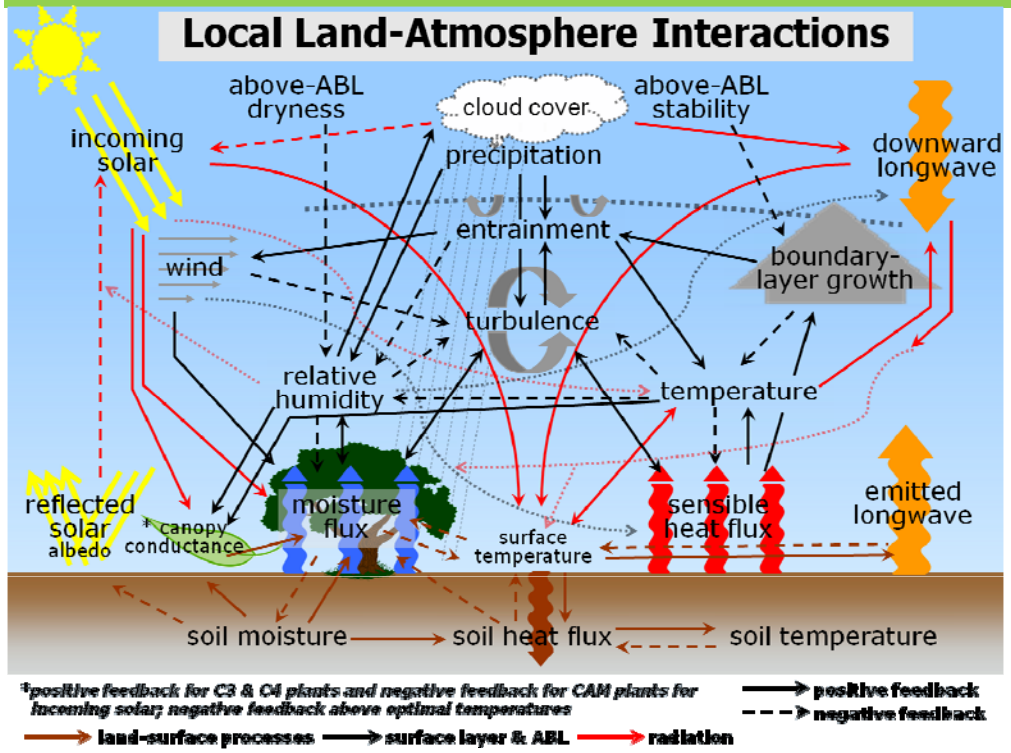


RHPs	proposed
BALTEX	SaskRB
HYMEX	NAWP
LBA	TPE
LPB	HYVIC
MAHASRI	MDB-2
MDB	BALTEX-3
AMMA	
NEESPI	

GEWEX Modeling: GLASS

Global Land Atmosphere System Study

- **Land surface modeling**
- Model **Parameterization** and development from land surface process
- **Data sets** and **tools**, intercomparisons
- **Land-atmosphere coupling**
- **Model Data Fusion**
- Strong cooperation with NWP via WGNE
- http://www.gewex.org/glass_panel.html



Projects

GLACE
LoCo
PILDAS
GSWP-3
PALS
PILPS
ALMIP2
LUCID2
GLASS-GHP links

GEWEX Science Challenges (GSQs)

- Observations and Predictions of Precipitation
- Global Water Resource Systems
- Changes in Extremes
- Water and energy cycles and processes

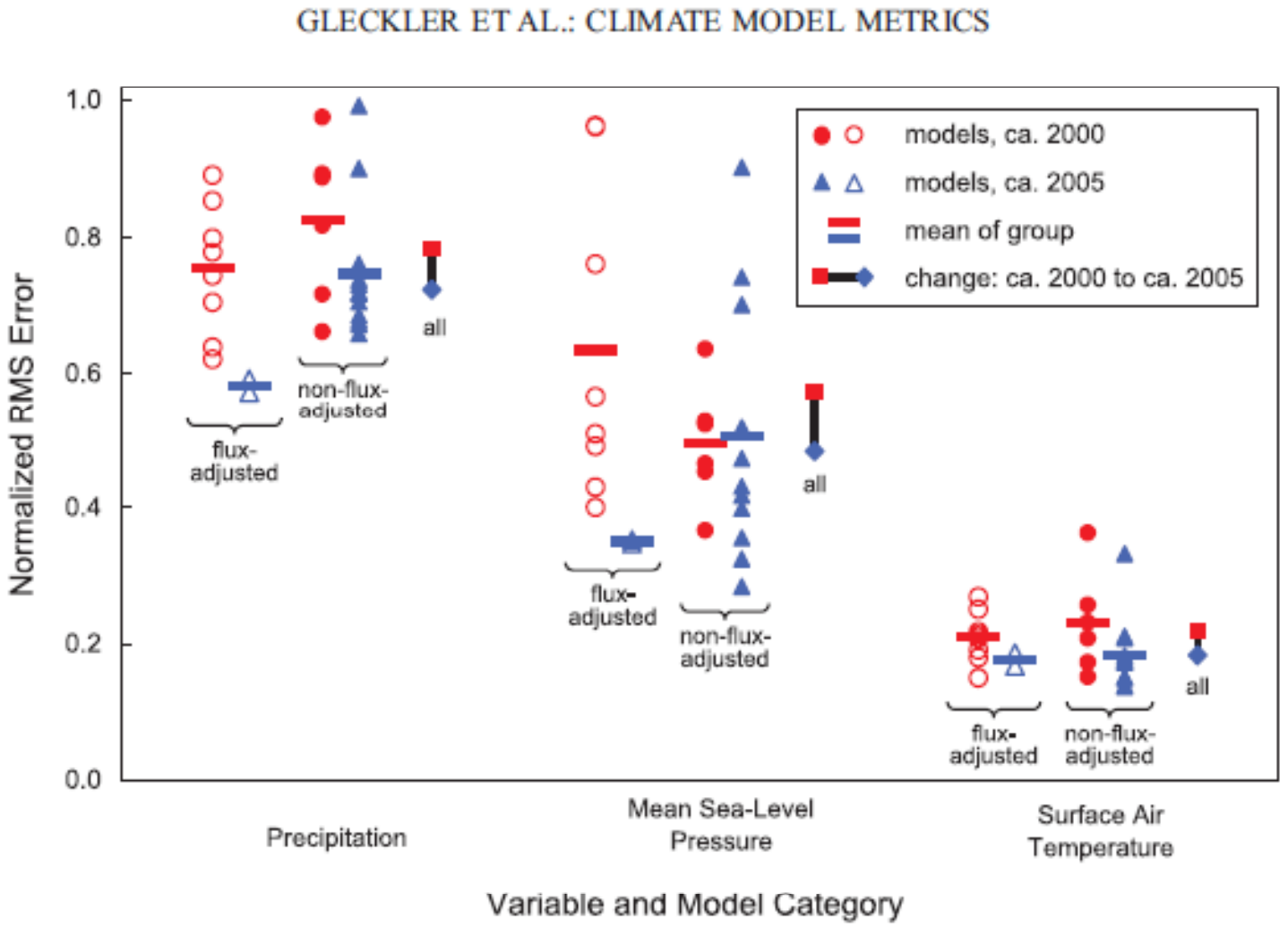
NCAR

Observations and Predictions of Precipitation- GSQ 1

- How well can precipitation be described by various observing systems, and what basic measurement deficiencies and model assumptions determine the uncertainty estimates at various space and time scales?
- How do changes in climate affect the characteristics (distribution, amount, intensity, frequency, duration, type) of precipitation – with particular emphasis on extremes of droughts and floods?
- *How do models become better and* how much confidence do we have in global and regional climate predictions of precipitation?

NCAR

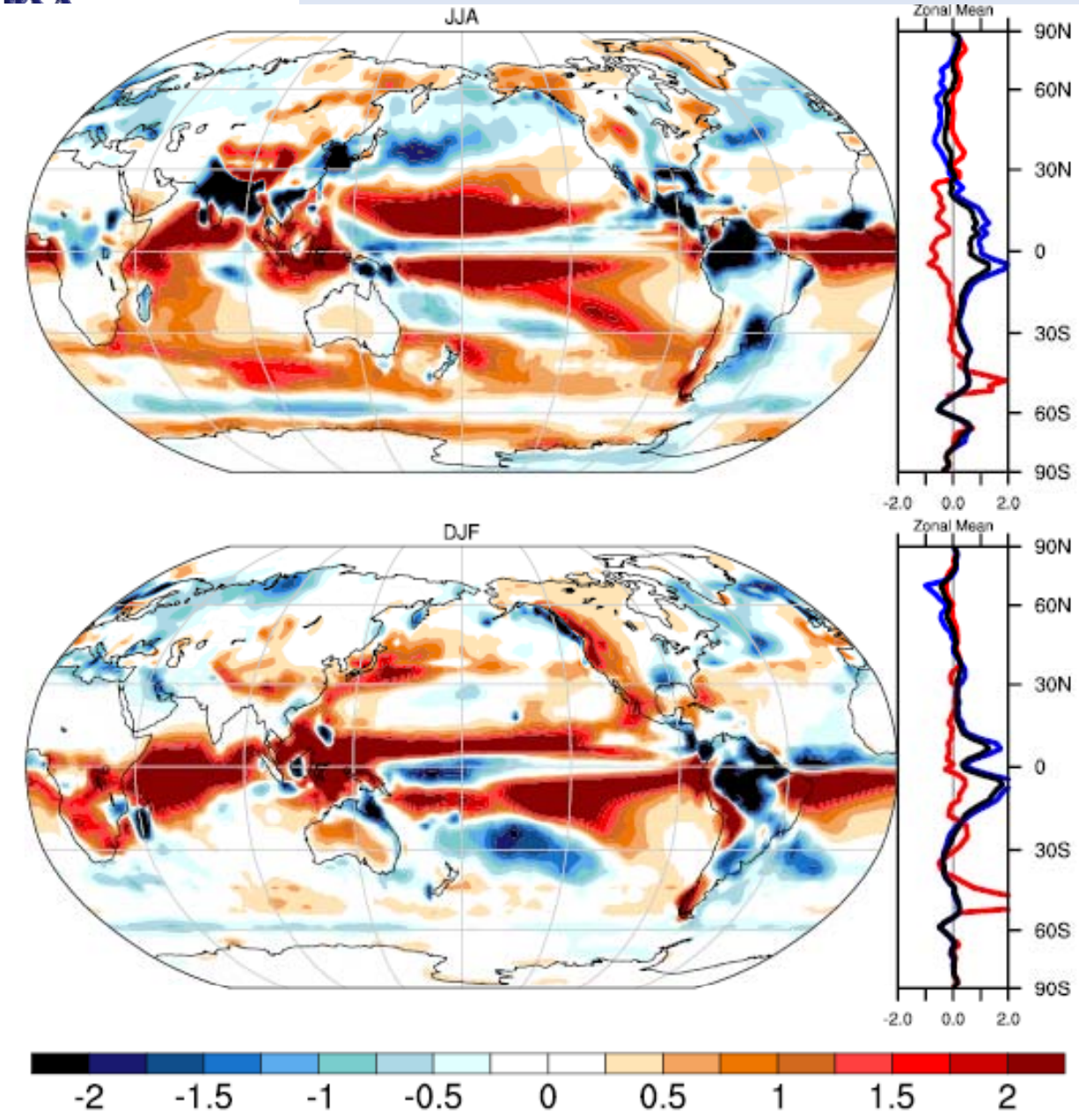
GEWEX Science Questions



Noise to signal ratio: Precip ~0.7

CMIP2 and CMIP3 model errors in simulating precipitation, mean sea level pressure and surface air temperature: Gleckler et al 2008.

Errors in CMIP5: Mean bias



The main errors are in the tropics where TRMM gives good answers, and we know the models are not correct!

Note errors over Amazonia: not enough transport of moisture onto land in monsoons!

land
ocean
total

Global Water Resource Systems -GSQ 2

- How do changes in the land surface and hydrology influence past and future changes in water availability and security?
- How do changes in climate affect terrestrial ecosystems, hydrological processes, water resources and water quality, especially water temperature?
- How can new observations lead to improvements in water management?

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Changes in Extremes -GSQ 3

- What are the short-term, mid-term and strategic requirements for the existing observing systems and datasets, and which observations are needed to accurately quantify trends in the intensity and frequency of extremes on different space/time scales?
- How can models be improved in their simulation and predictions or projections of the magnitude and frequency of extremes?
- How can the phenomena responsible for extremes be better simulated in models?
- How can we promote development of applications for improved tracking and warning systems arising from extremes?

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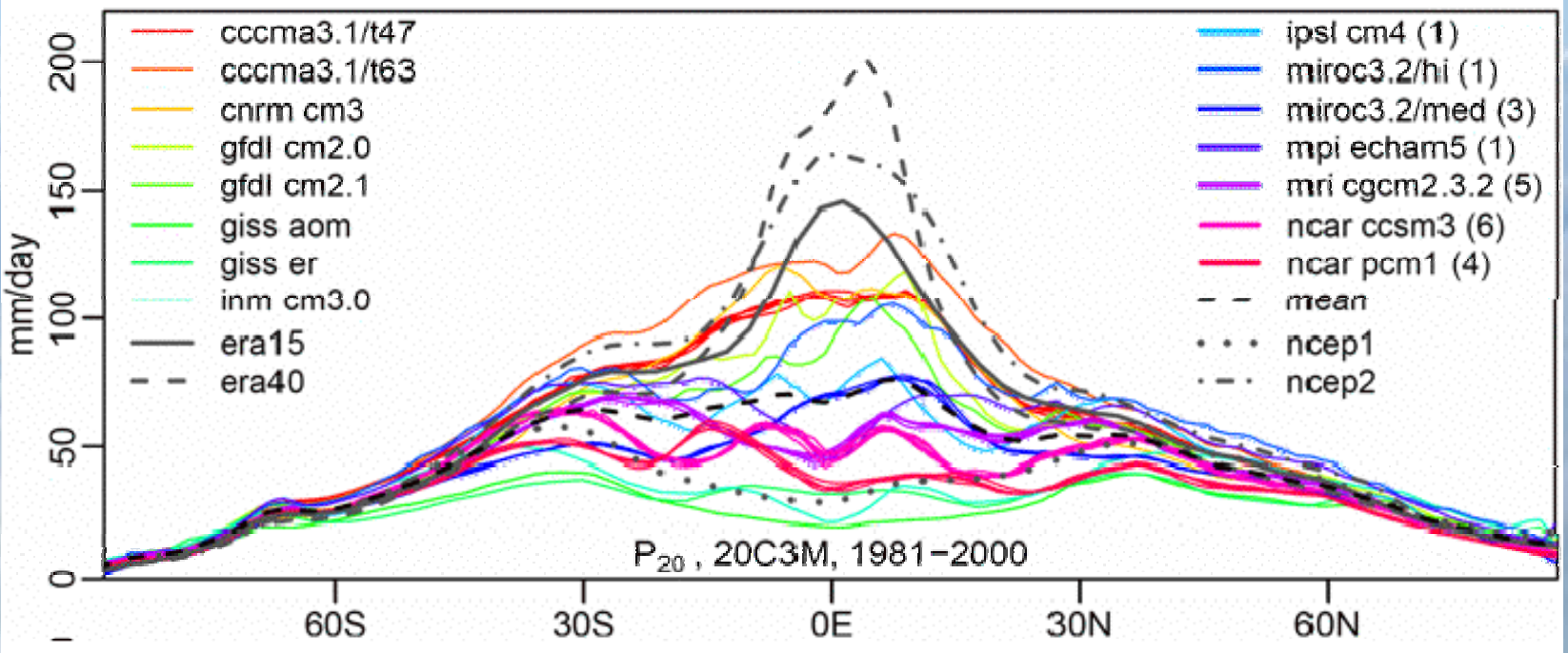
All models are wrong, some are useful!

Models are demonstrably poor at extremes

Environment Canada
Environnement Canada

20-yr 24-hr PCP extremes – current climate



Courtesy Francis Zwiers

Water and Energy Cycles -GSQ 4

- Can we balance the energy budget at the top-of-atmosphere?
- Can we balance the energy budget at the surface of the Earth?
- Can we further track the changes over time?
- Can we relate the changes in surface energy budget with atmospheric-oceanic processes and long term variability?
- Can we improve confidence in feedbacks associated with cloud-aerosol-precipitation interactions in the climate system?

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Supporting Material

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.**

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.

GEWEX: post 2013

Vision statement

Water and energy are fundamental for life on Earth. Fresh water is a major pressure point for society owing to increasing demand and vagaries of climate.

Extremes of droughts, heat waves and wild fires as well as floods, heavy rains and intense storms increasingly threaten to cause havoc as the **climate changes**. Other challenges exist on how clouds and aerosols affect energy and climate. Better observations and analysis of these phenomena, and improving our ability to model and predict them, will contribute to increasing information needed by society and decision makers for future planning.

GEWEX Science Questions:

How can we better understand and predict precipitation variability and changes?

How do changes in the land surface and hydrology influence past and future changes in water availability and security?

How does a warming world affect climate extremes, and especially droughts, floods and heat waves, and how do land area processes, in particular, contribute?

How can understanding of the effects and uncertainties of water and energy exchanges in the current and changing climate be improved and conveyed?

GEWEX Science Questions: Global water resources

How do changes in the land surface and hydrology influence past and future changes in water availability and security?

- *Address terrestrial water storage changes*
- ***Close the water budget over land***
- *Exploit new datasets, data assimilation, improved physical understanding and modeling skill across scales,*
- *Catchments to regional to global to the entire hydrological cycle including hydrogeological aspects of ground water recharge.*
- *Use of **realistic land surface** complexity with all anthropogenic effects included instead of a fictitious natural environment.*
- *Includes all aspects of **global change:** water management, land use change and urbanization; water quality and especially water temperature (affected by industrial and power plants use); later nutrients. cont…*

GEWEX Science Questions: Global water resources

How do changes in the land surface and hydrology influence past and future changes in water availability and security? Cont.

- *The **ecosystem response** to climate variability and responsive vegetation must be included.*
- *Cryospheric changes such as permafrost thawing and changes in mountain glaciers must be included.*
- *Feedbacks, tipping points, and extremes are of particular concern.*

The results should enhance the evaluation of the vulnerability of water systems, especially to extremes, which are vital for considerations of water security and can be used to increase resilience through good management and governance.

GEWEX Science Questions

How does a warming world affect climate extremes, and especially droughts, floods and heat waves, and how do land area processes, in particular, contribute?

A warming world is expected to alter the occurrence and magnitude of **extremes** from droughts to rainfall intensity, and the geographic distribution of rain and snow.

Such changes are related to an acceleration of the hydrologic cycle and circulation changes as well as to the direct impact of warmer conditions on atmospheric water vapor amounts, rainfall intensity, and snow-to-rain occurrence.

How well are models able to handle extremes and how can we improve their capability?

continued...

GEWEX Science Question 4:
water and energy cycles

How can understanding of the effects and uncertainties of water and energy exchanges in the current and changing climate be improved and conveyed?

- *improve* ***consistency*** *between net solar and infrared radiation and sensible and latent heat fluxes at the surface*
- *understand* ***cloud-aerosol-precipitation interactions*** *and their* ***feedbacks*** *on the climate system.*
- *determine* ***processes****: must be replicated in climate models.*
- *better understand* ***uncertainties*** *in* ***observations and models***

New ***satellite, in situ observations****, upgraded GEWEX* ***datasets****, global* ***reanalyses*** *of atmosphere and ocean, improved* ***modeling****, and advanced* ***diagnostics*** *play key roles.*