# GEWEX

Pan-GEWEX Meeting
Seattle, Washington, 23-28 August 2010
### Kevin Trenberth
Chair SSG

GEWEX: post 2013
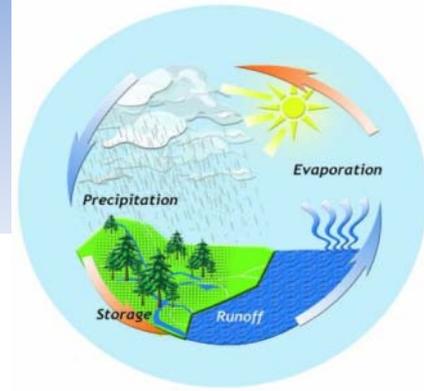
Vision statement

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 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.

The Tools

Domains

Regional

Global

Integrated / coupled

GEWEX Radiation Panel

Observational Data Sets

Theory

GEWEX Hydroclimatology Products Panel

Application Observations

GEWEX Modeling: Models and Parameterizations

GCSS/GABLS

Modeling

GLASS
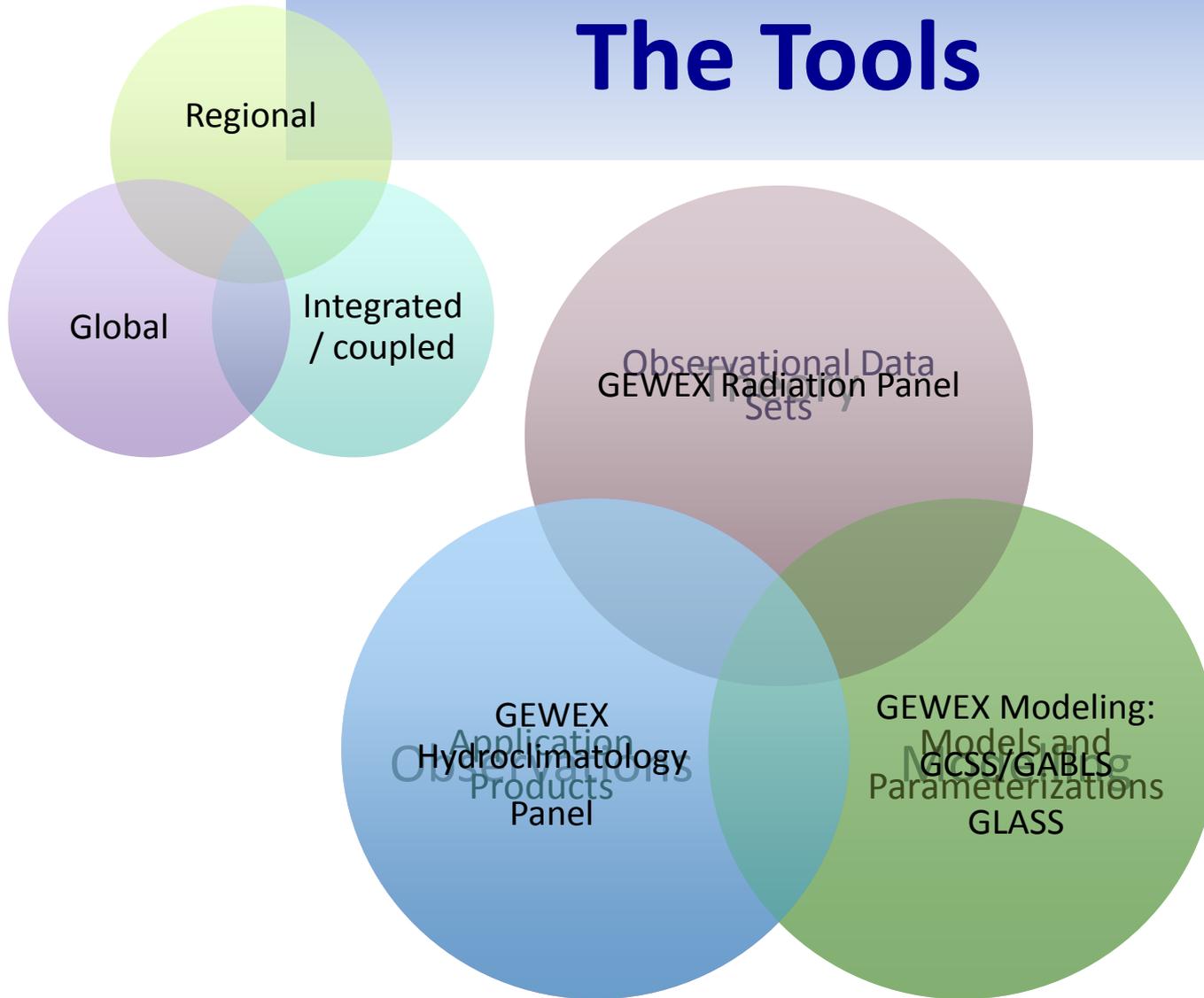
GEWEX achieves its goals through data set development and analysis, process studies and model improvement

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/   GEWEX Cloud System Study (J. Petch; C. Bretherton)
GABLS   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, GLASS

- Model **Parameterization** and development from land surface process to atmospheric processes
- **Cloud process** descriptions, parameterizations and model, data sets and tools, intercomparison studies
- **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

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- http://www.gewex.org/projects-GMPP.htm
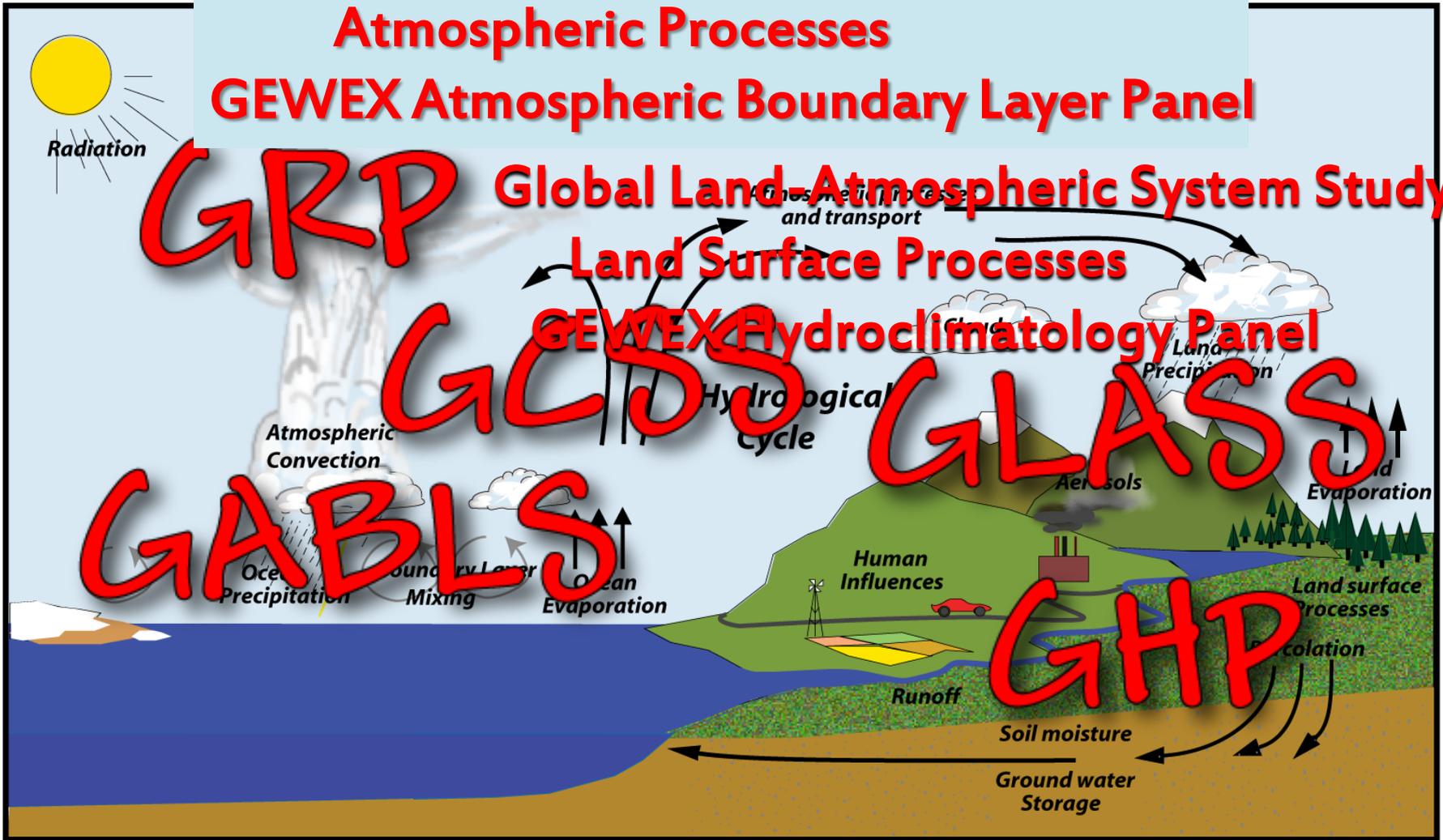
There is a new WCRP structure post 2013: how does

Main

• Core projects reta~~in~~ climate system rese~~arch~~ components:

   o Ocean-atmosphere (think ~~C~~LIVAR)
   o Land-atmosphere (think ~~G~~EWEX)
   o Cryosphere (think CliC)
   o Stratosphere-troposphere (think SPARC)

• Within each core project there is a common set of basic "themes":

   o Observations and analysis
   o Model development, evaluation and experiments
   o Processes and understanding
   o Applications and services
   o Capacity building

> Where is the atmosphere?
> Everywhere, yet nowhere!
> What are the implications
> for GEWEX?

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

Possible new name mooted:
Global and Regional Energy and Water project (GREW)
- [GEWEX grew]

or

Global and regional Energy and Water
   Exchanges: GEWEX
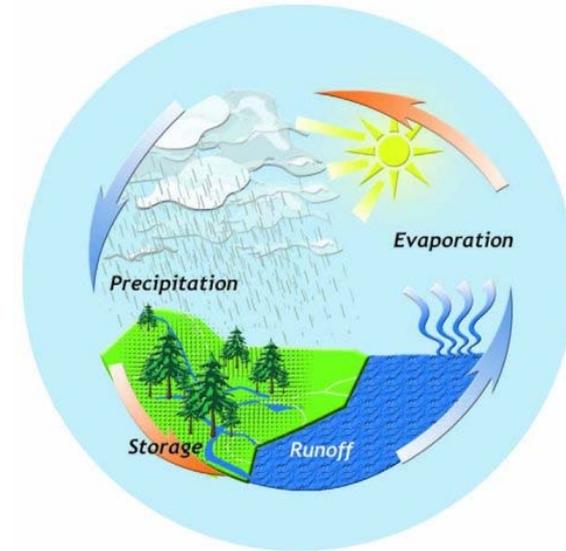
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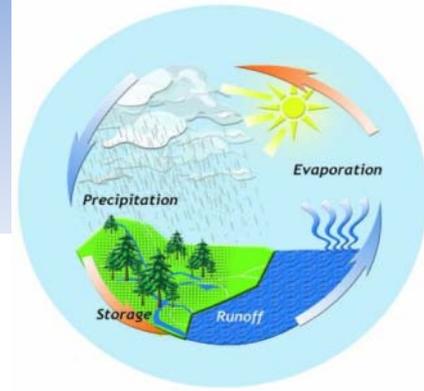
Mission statement

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.
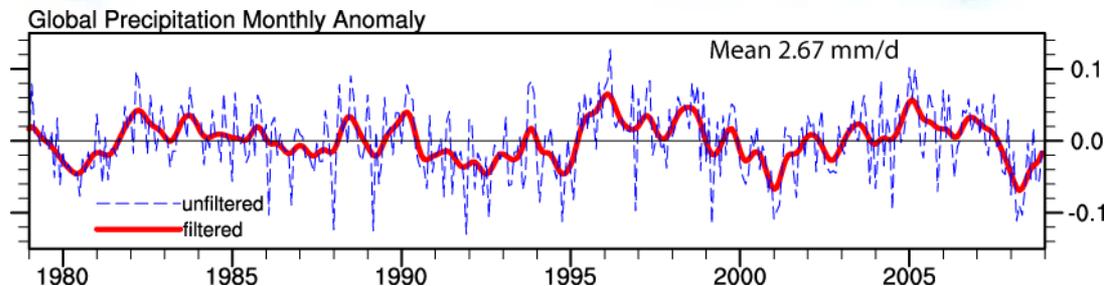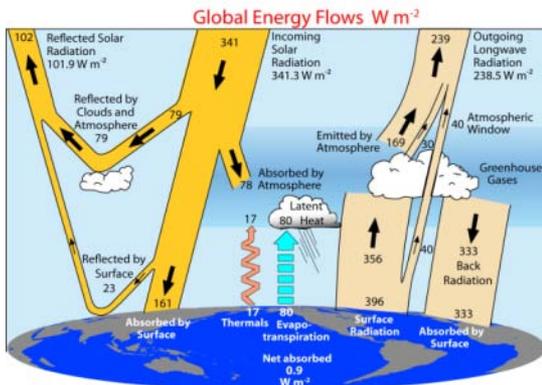
Trenberth et al 2009; 2010
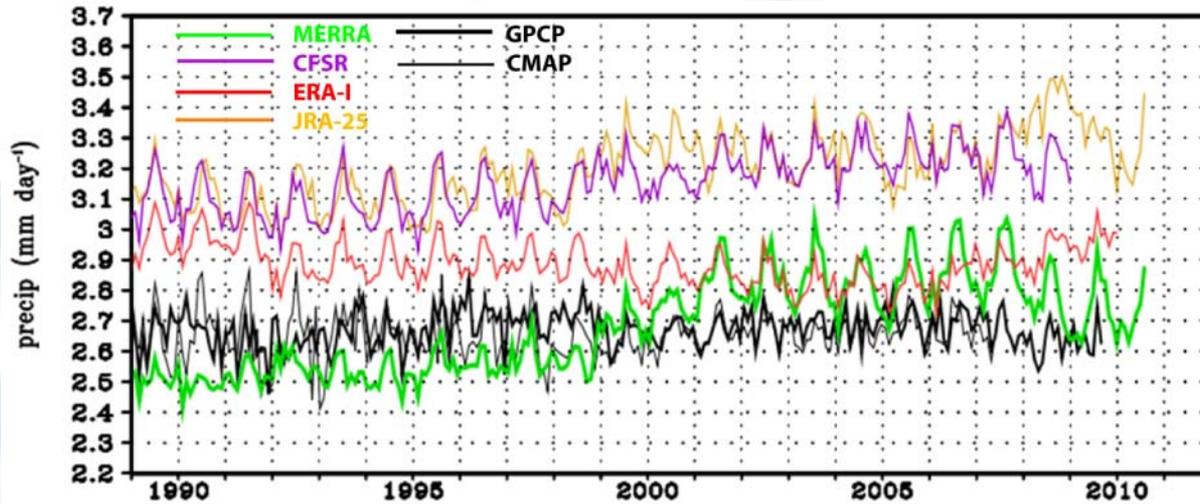
Precipitation from observations and reanalyses (courtesy D. Dee)
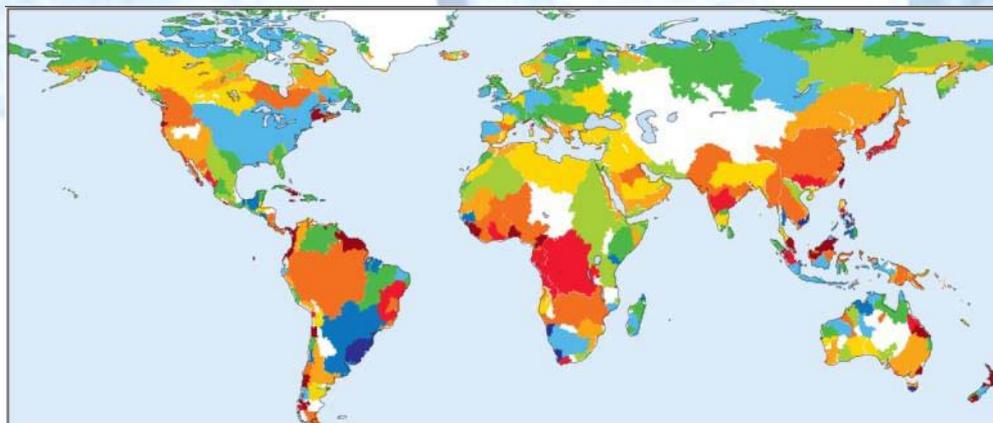
Runoff trends 1948 to 2004 (Dai et al 2009)

Local Land-Atmosphere Interactions

Courtesy Mike Ek, K Tr...

Stevens and Feingold 2009
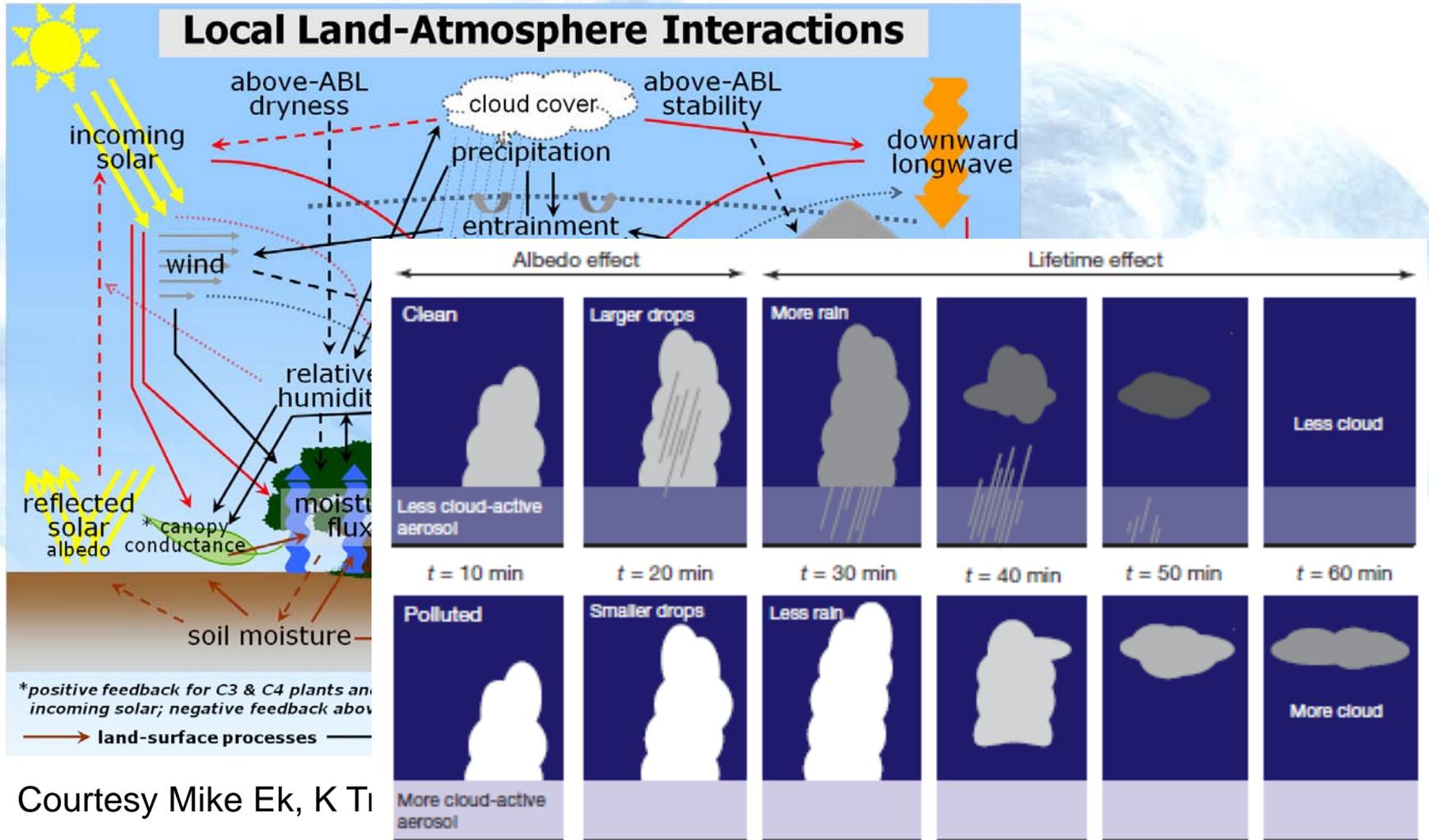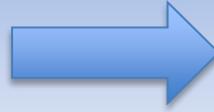
CEOP ➡ GHP

- Continental Scale Experiment (CSE) concept developed (1990s)
  - development, diagnosis, and testing of coupled land-atmosphere models
  - focus on water and energy budget closure at near-continental scale.
  - E.g. Mississippi basin well instrumented and analyzed GAPP
- Regional Hydrometeorological Projects extend this concept to other regions: MAGS, BALTEX, GAME, LBA, AMMA
- GEWEX Hydrometeorological Panel (GHP) coordinated these
- **Coordinated Enhanced Observing Period**: second phase of GEWEX 2001-2006
- Combined with GHP and evolved to **Coordinated Energy and Water Cycle Observations Project** (CEOP) in 2007-2008
- **GEWEX Hydroclimatology Panel (GHP)** in 2010

CEOP ➡ GHP

GEWEX REGIONAL HYDROCLIMATE PROJECTS

Mackenzie GEWEX Studies (MAGS)

Baltic Sea Experiment (BALTEX)

Northern Eurasia Earth Science Partnership (NEESPI)

GEWEX Asia Monsoon Experiments (GAME)

Climate Prediction Program for the Americas (CPPA)

HYdrological cycle in the Mediterranean EXperiment (HYMEX)

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)

Current RHP's
Former RHP's
Prospective RHP's

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
- 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. "

Modeling the Climate System
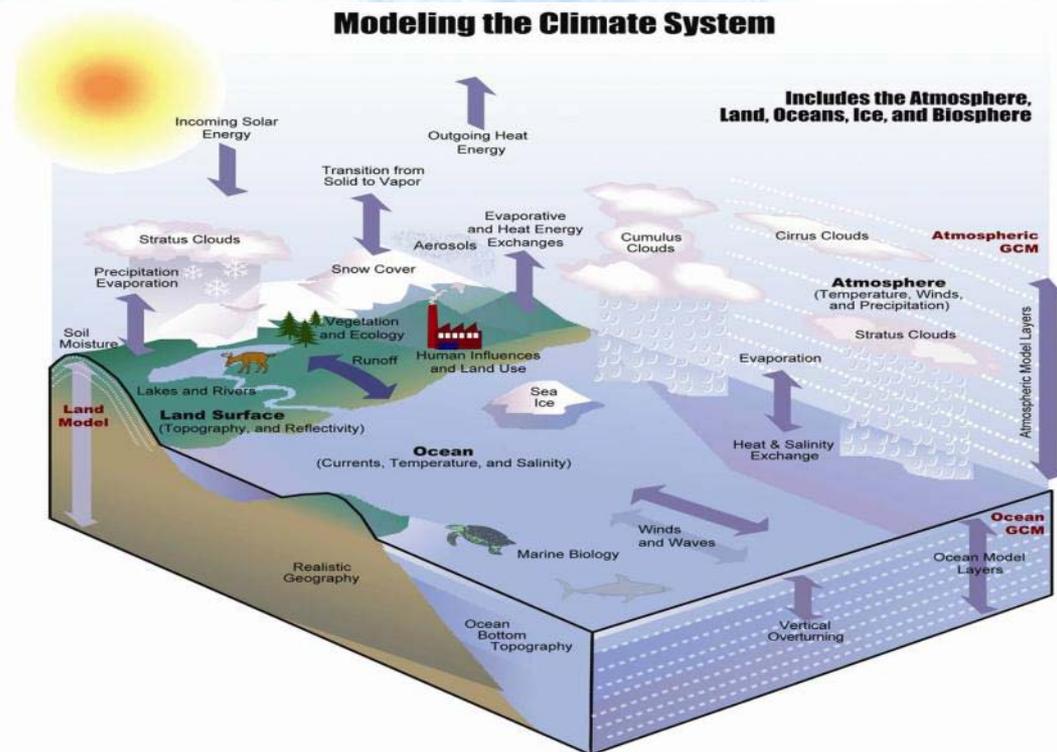
Framework for Atmospheric Model Enhancement (FAME)

* 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

Should reside within GEWEX

* GEWEX would not be anything like the same without it
* already there
* 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

FAME: post 2013

* How this develops as a working group or panel within GEWEX but interacting with all of WCRP: CLIVAR, CliC, SPARC and feeding into other modeling WGs is not yet clear.

* WG on Atmospheric Processes and model development for climate (**WGAP**)?

* Needs to integrate with regional modeling (such as CORDEX)

Pan-WCRP & WMO

Cross-cutting studies:
Monsoons
Extremes

AMY coordinated observation projects

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?

WCRP extremes workshop

Workshop on metrics and methodologies of estimation of extreme climate events: WCRP-UNESCO (GEWEX/CLIVAR/IHP)

- UNESCO, Paris: 27-30 Sept 2010
- Chair: Olga Zolina
- 132 from 32 countries
- Oral, poster, discussion sessions; 3 Breakout Groups
- Community white paper, Eos* and BAMS(?) article
- http://www.extremeworkshop.org/

Goal: To provide much improved observational datasets and model capabilities on variability and extremes, especially those that have high impacts on society and the environment; and develop a climate information system that include predictions and assessments of future changes in risk from extremes.

*21 Dec 2010 issue

Reason for focus on extremes
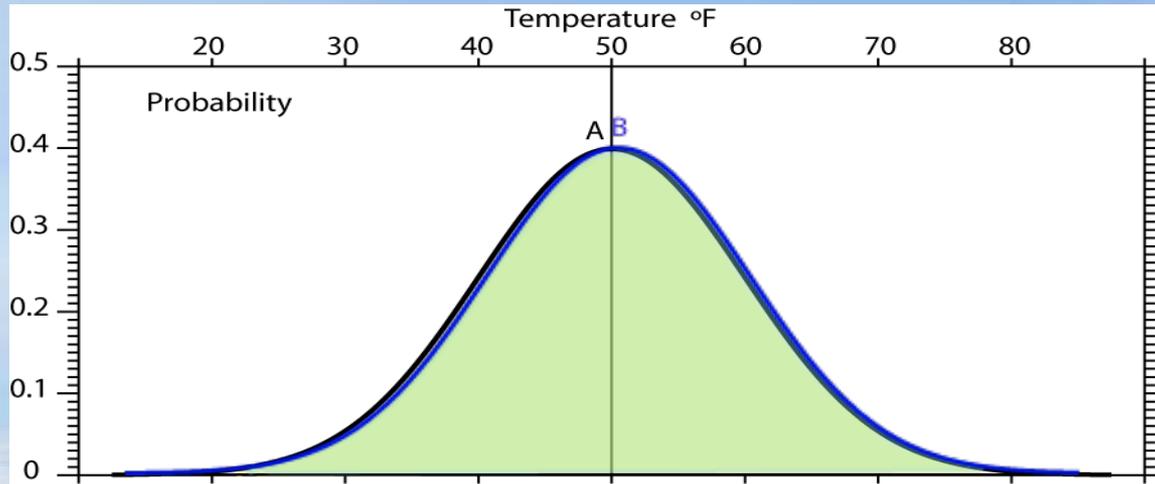
Mean A: 50° F, s.d. 10° F

Reason for focus on extremes
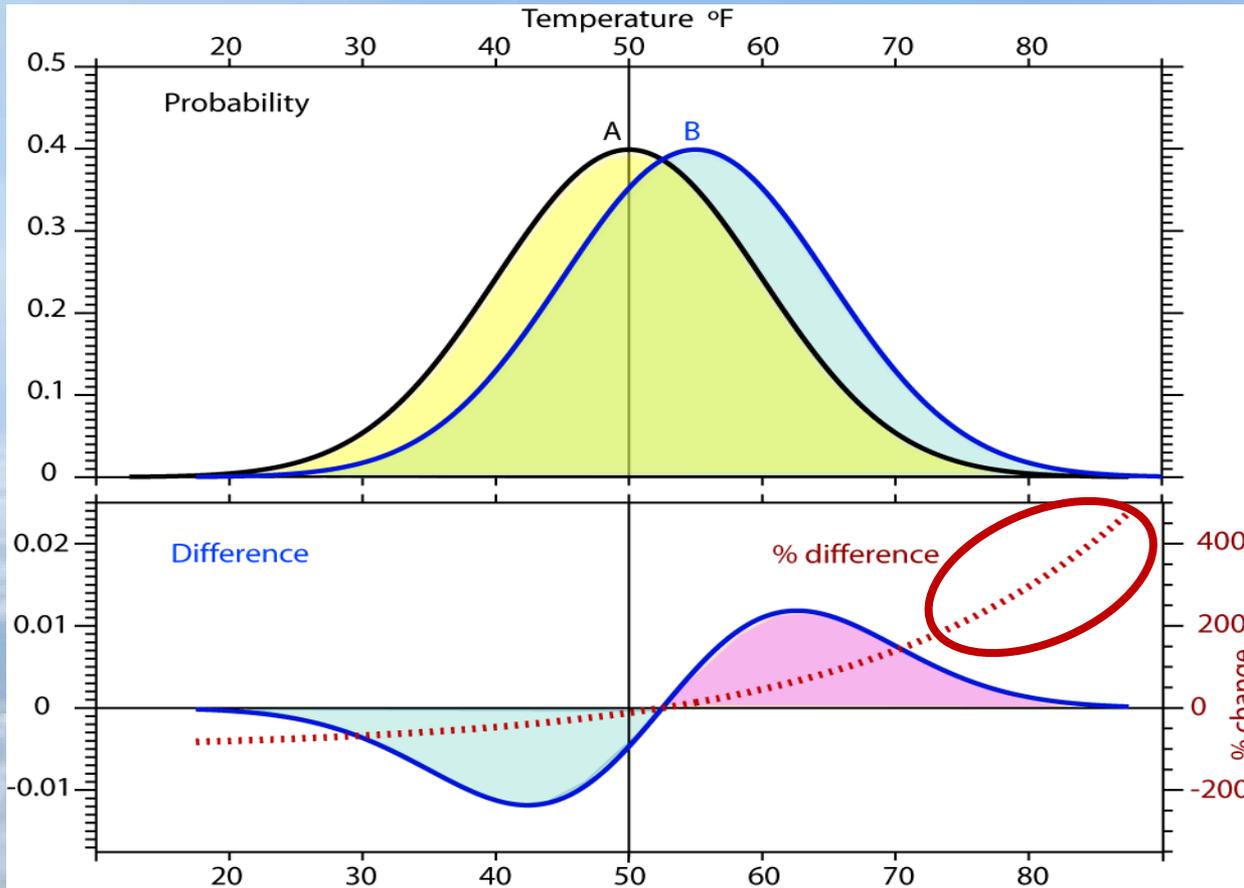
Shift in climate: from A to B

Most of time the values are the same (green).

Biggest changes in extremes: >200%

Mean A: 50° F, s.d. 10° F
Mean B: 55° F, s.d. 10° F
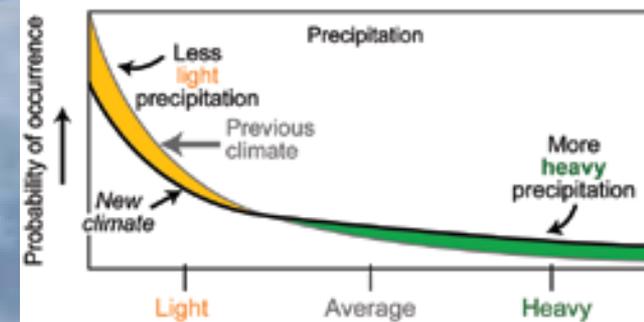
Issues for extremes in models

- Model definitions are often different from obs:
- Model grid box value may not be comparable to mean of grid box from observations
- Model results typically not available or archived.
  - Need appropriate output from models (high frequency, stats, ability to generate pdfs)
- Ability and utility of models
  - Model extremes are not well simulated.
  - Is there confidence in the physics?
- Improvements of models (intensity, frequency of precip etc)
- Improvements in resolution

Moral for extremes in models

- Provide a focus for evaluating and development of models wrt how well they replicate extremes:
  - Developing better methods for comparing model grid point values with observations. Compare apples with apples: gridded data
  - Establish extreme-related measures for evaluation of models.
- Ensure that archives of model runs include sufficient high frequency data to assess pdfs and extremes.
  - Improve model archives with hourly data
- Assess ability and utility of models wrt extremes
  - As fn of resolution
  - As fn of parameterizations (e.g. convection)
- Set up specific CMIP5 analysis projects focused on extremes
  - Derive certain mandatory statistics
- What do these mean for impacts: downscaling?

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; interactions with users; outreach.

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.