CEOP really means …

- “Bring people together” to address BIG WATER CYCLE issues

- As part of its strategy through
  time (period)
  cross-cuts/focal points … (project)

- By
  keeping the focus
  learning as we go and moving forward

CROSS-CUTS AND FOCAL POINTS

- Several in CEOP

- Most familiar with Extremes …

- Some of the greatest impacts of our climate are linked with extreme events.

- Such events include a diversity of phenomena including drought, heavy precipitation, and floods as well as, in some instances, combinations of these.

- Such events are a critical part of the climate system and Earth's water and energy cycle and there is increasing concern that such events have been increasing and will increase in the future.

- There are still many scientific issues to be addressed in relation to the initiation, continuation and cessation of such extremes.

- This hampers the reliable prediction of extremes and this in turn reduces society's ability to plan for and respond to extremes.

WHO IS INTERESTED IN EXTREMES?

- Individuals
- National studies
- WMO
- WCRP and components:

  GEWEX, CLIVAR, CliC …
- GEWEX and components

  CEOP, Radiation Panel, Modelling Panel
- GEO, UNESCO, WWRP, UNEP, GWSP
- …

IN CEOP ... WIDE INTEREST

Regional Projects:

- *drought:* CPPA, DRI, LPB, MDB ...
- *heavy precipitation/flooding:* CPPA, DRI, LPB, BALTEX, MAHASRI, NEESPI ...

Other Components:

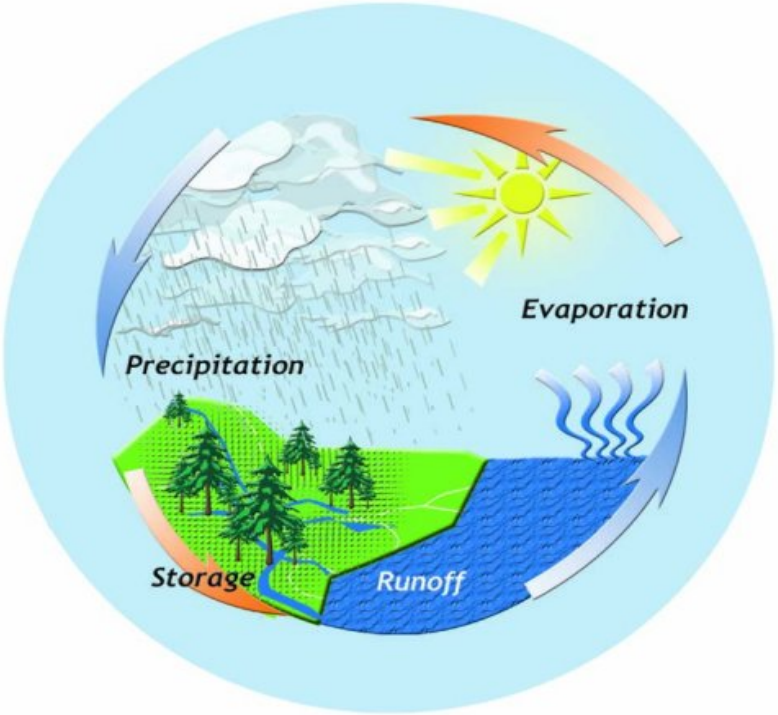
- WEBS, aerosols, isotopes
- high elevation, semi-arid …
- Modelling studies
- GPCP, GPCC, GRDC
- Data management

EXTREMES WITHIN GEWEX/CEOP

Objectives ...

- To better document, understand and simulate the occurrence, evolution, structure and role of hydrometeorological extremes within the climate system

- To contribute to their better prediction at various time scales and to addressing societal concerns



Global Energy and Water cycle Experiment

FOCUS

- Extremes of Interest

  Drought
  Heavy precipitation
  Floods
  Low Flows
  ...

- And, in some instances

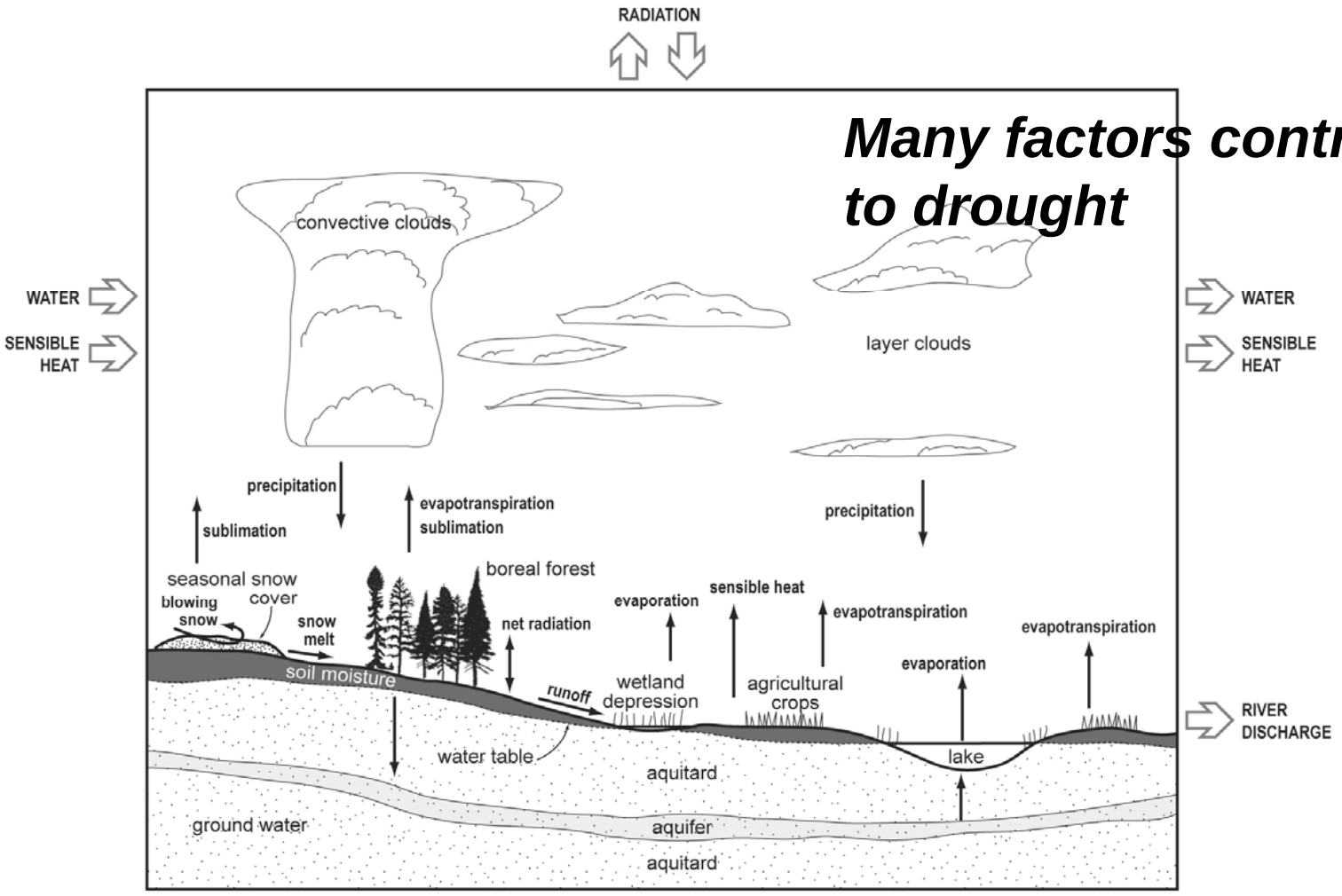
  Inter-meshing of these extremes

SUB-ISSUES

- How we define extremes?
- What datasets are available to assess the presence and characteristics of extremes?
- How do extremes develop, evolve and end within the climate system?
- What is the role of these extremes within the climate system?
- Have extremes changed in occurrence and character and why or why not?
- How can this progress be used to improve predictions and to better assess extremes in a changing climate?
- How can we contribute to ensuring that society can best cope with extremes?

WHAT FACTORS LEAD TO THESE CONDITIONS?

WATER AND ENERGY CYCLING



Many factors contribute to drought

DROUGHT AND HEAVY PRECIPITATION/FLOODING

Drought/low flows: Sustained lack of precipitation.

Many reasons for this:

- Large scales, storm tracks ...
- WV, T, vertical profiles including precipitation, aerosols ...
- Dry surface, vegetation, snow/ice, topography ...

Heavy, sustained precipitation/flooding:

Many reasons for this:

- Large scales, storm tracks ...
- WV, T, vertical profiles, precipitation systems, aerosols ...
- Wet surface, snow/ice, vegetation, topography ...

WCRP LEVEL

- Extremes: a cross-cut

- GEWEX-CLIVAR SWAT Team

  develop a joint effort

  CEOP effort a major contributor

IN SUMMARY

CRITICAL CROSS-CUTS/FOCAL POINTS ARE BEING ADDRESSED BY CEOP
often in partnership with other groups

THIS MEETING WILL MOVE SUCH EFFORTS ALONG … through

PRESENTATIONS, BREAK-OUTS, AND PLENARY DISCUSSIONS

WE LOOK FORWARD TO YOUR PARTICIPATION

IMPACTS OF EXTREMES

And many others

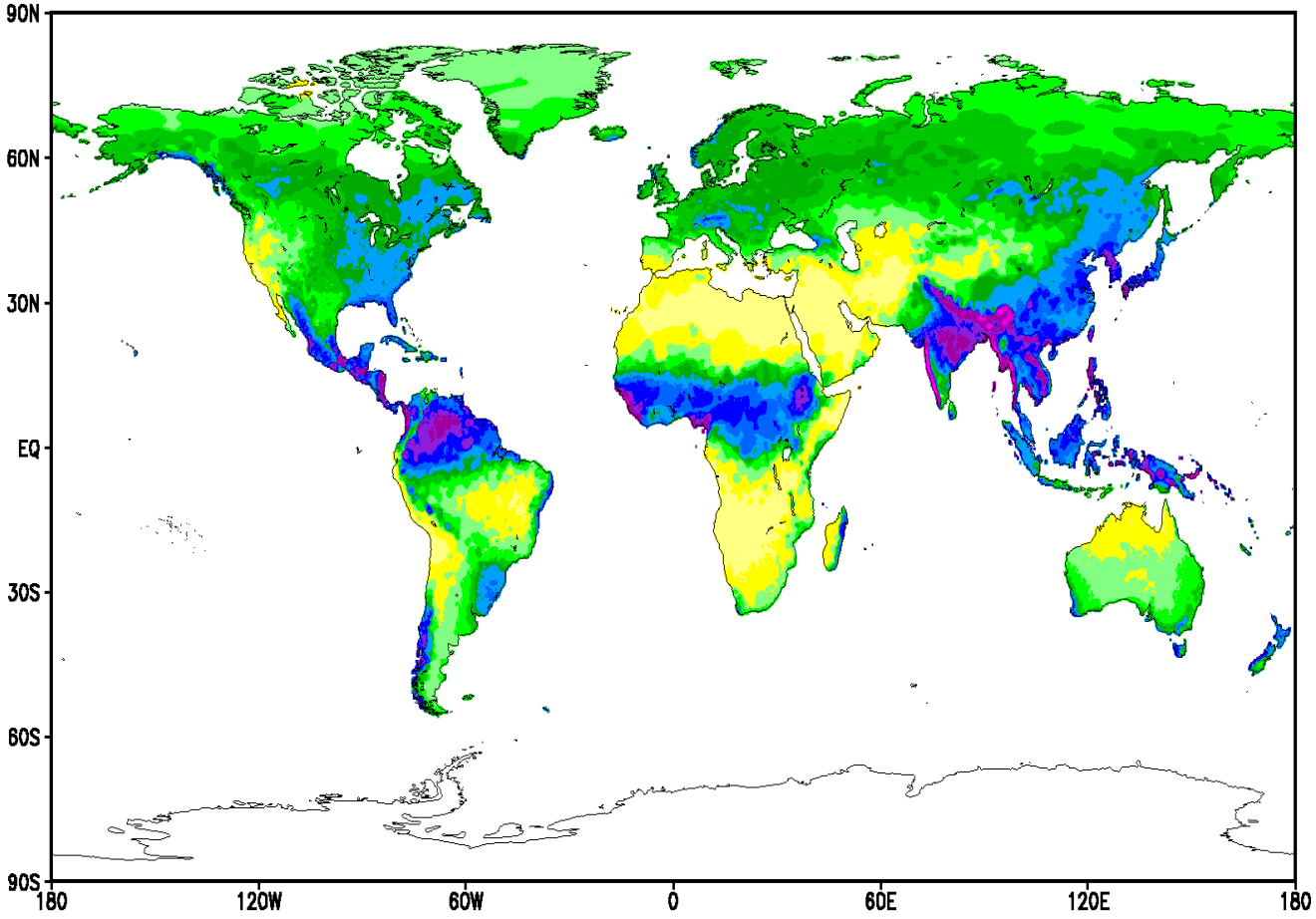
- DAY 2 .....

EXTREMES WITHIN CEOP:

Ronald Stewart
University of Manitoba

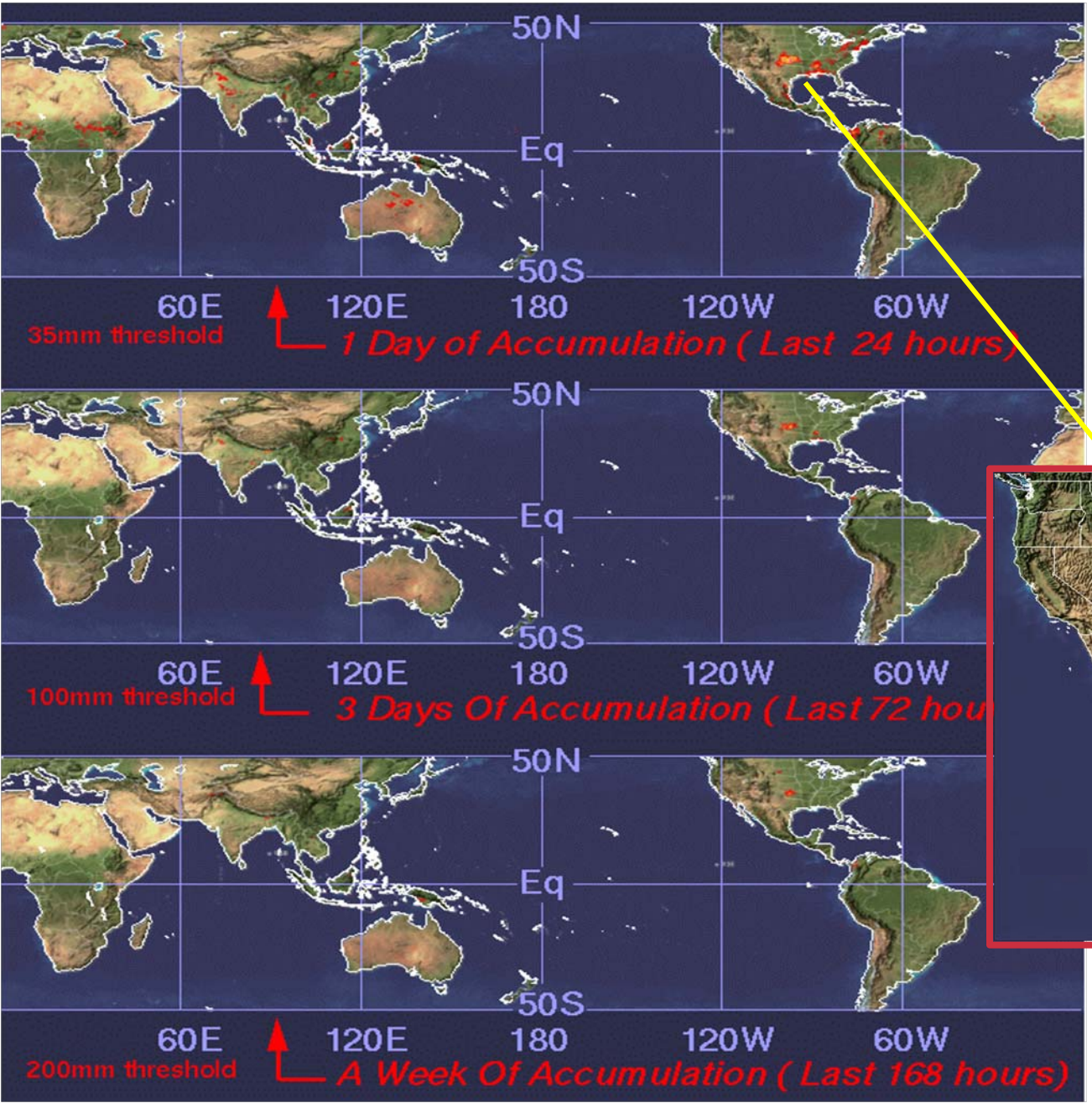
*** Global Energy and Water cycle Experiment**

JULY 10-YEAR PRECIPITATION

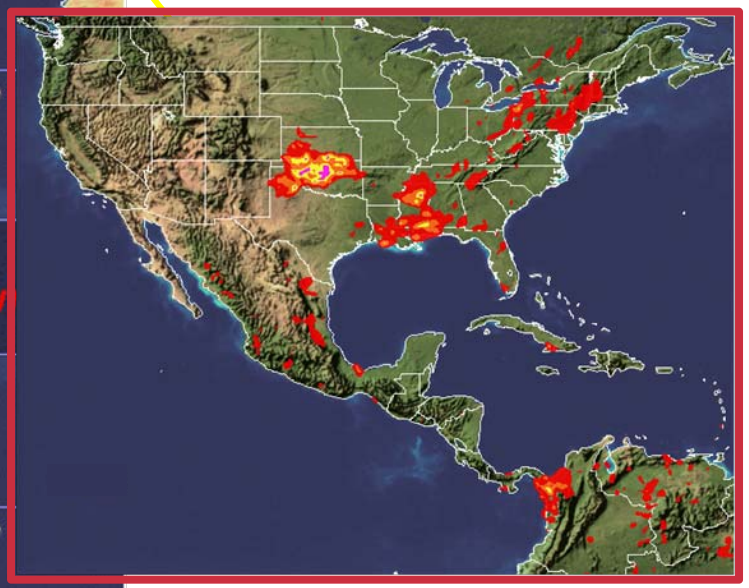


EXTREME RAINFALL EVENTS

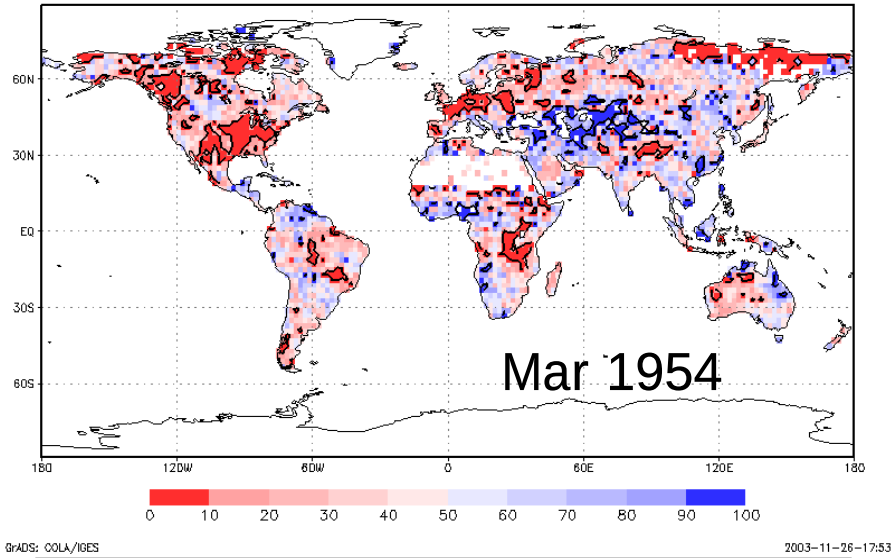
Contour thresholds:
35, 100, 200 mm

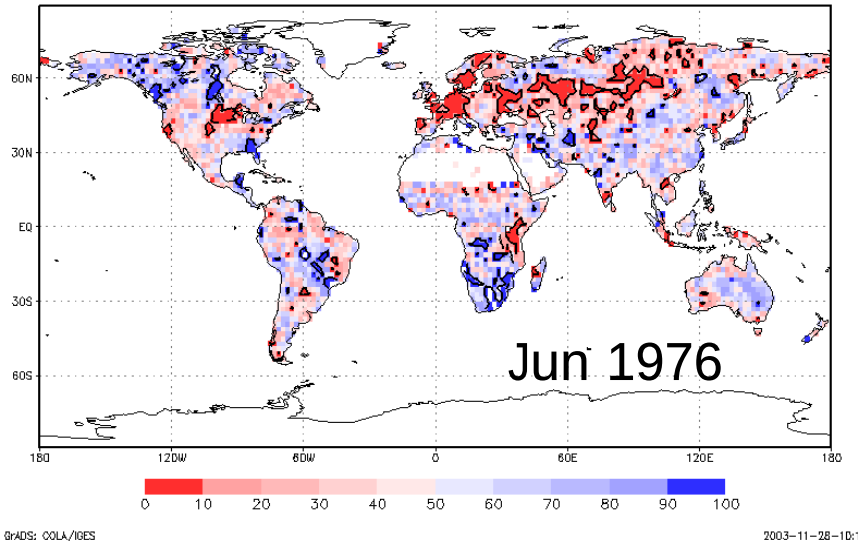


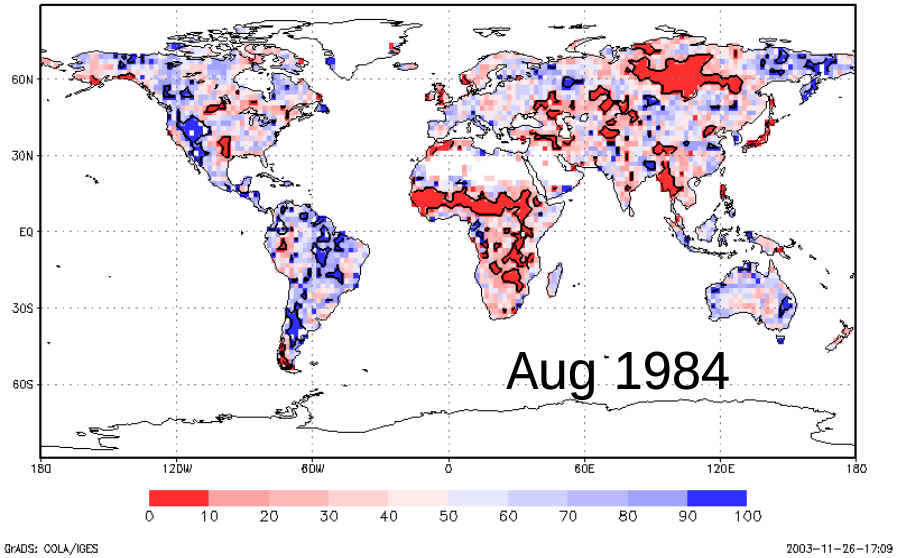
20 June 2007 06 UTC

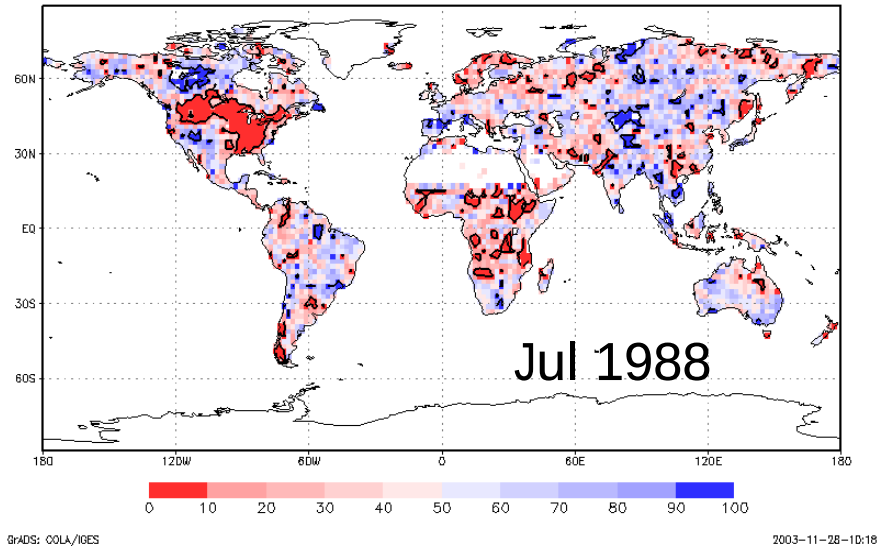


DROUGHT OCCURENCE





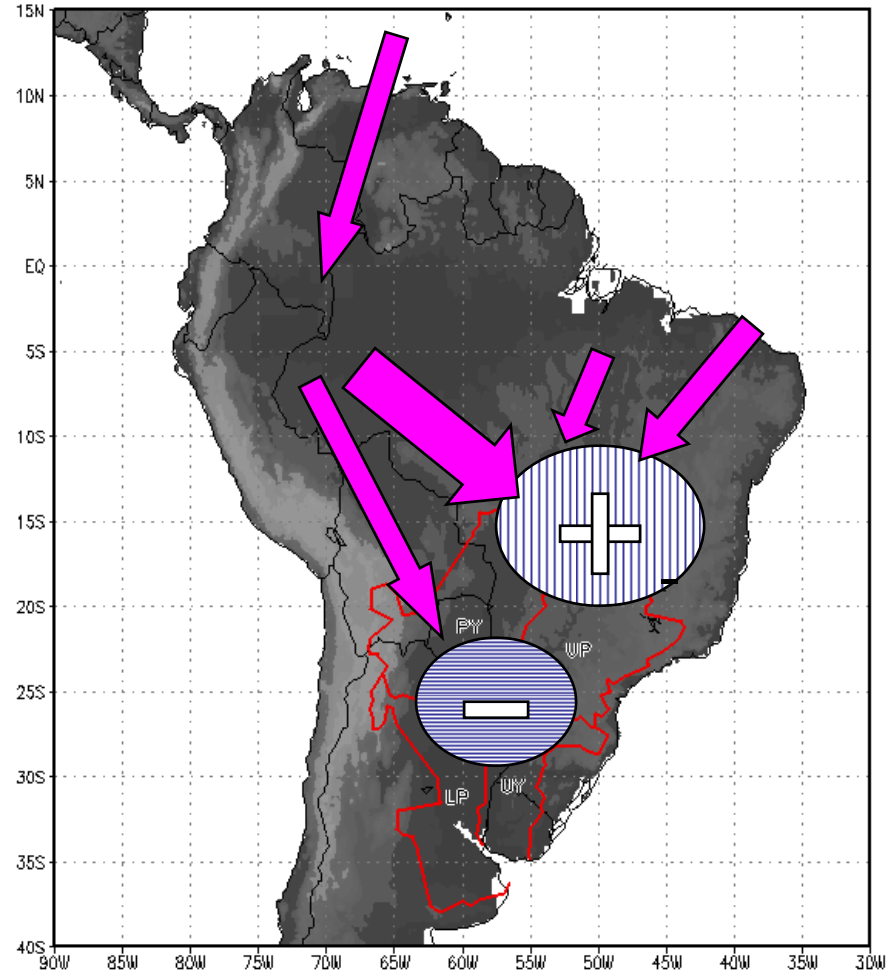


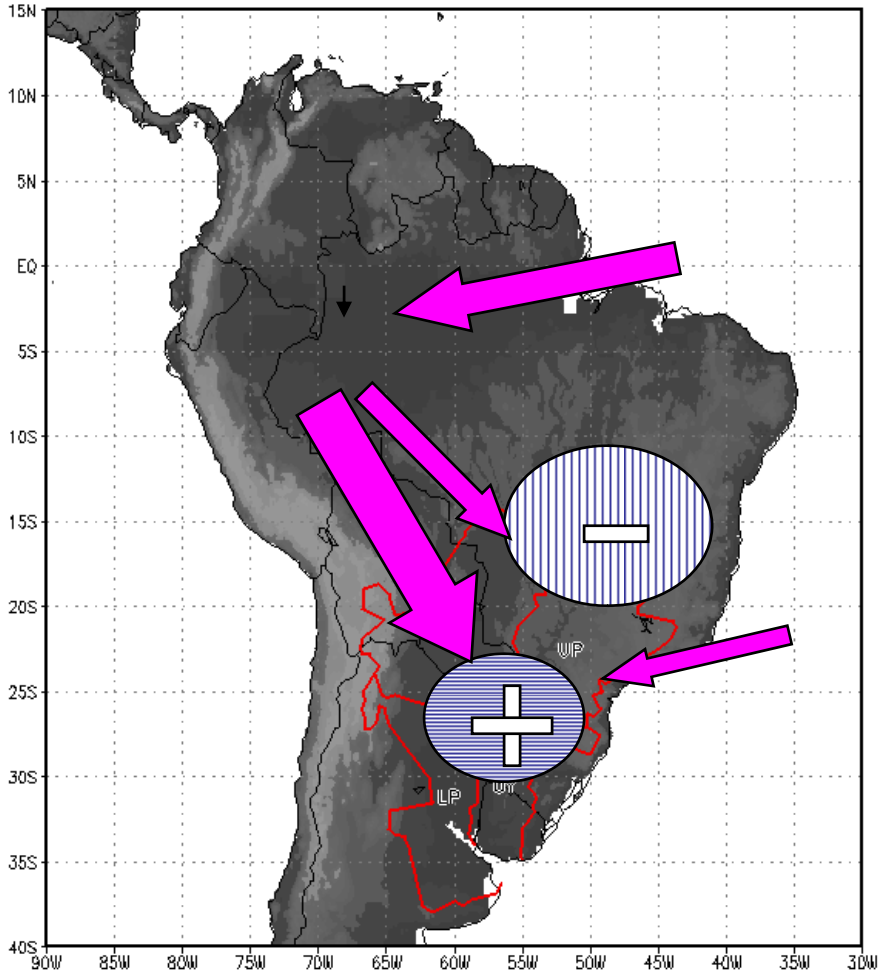


Dry Wet

Dry Wet

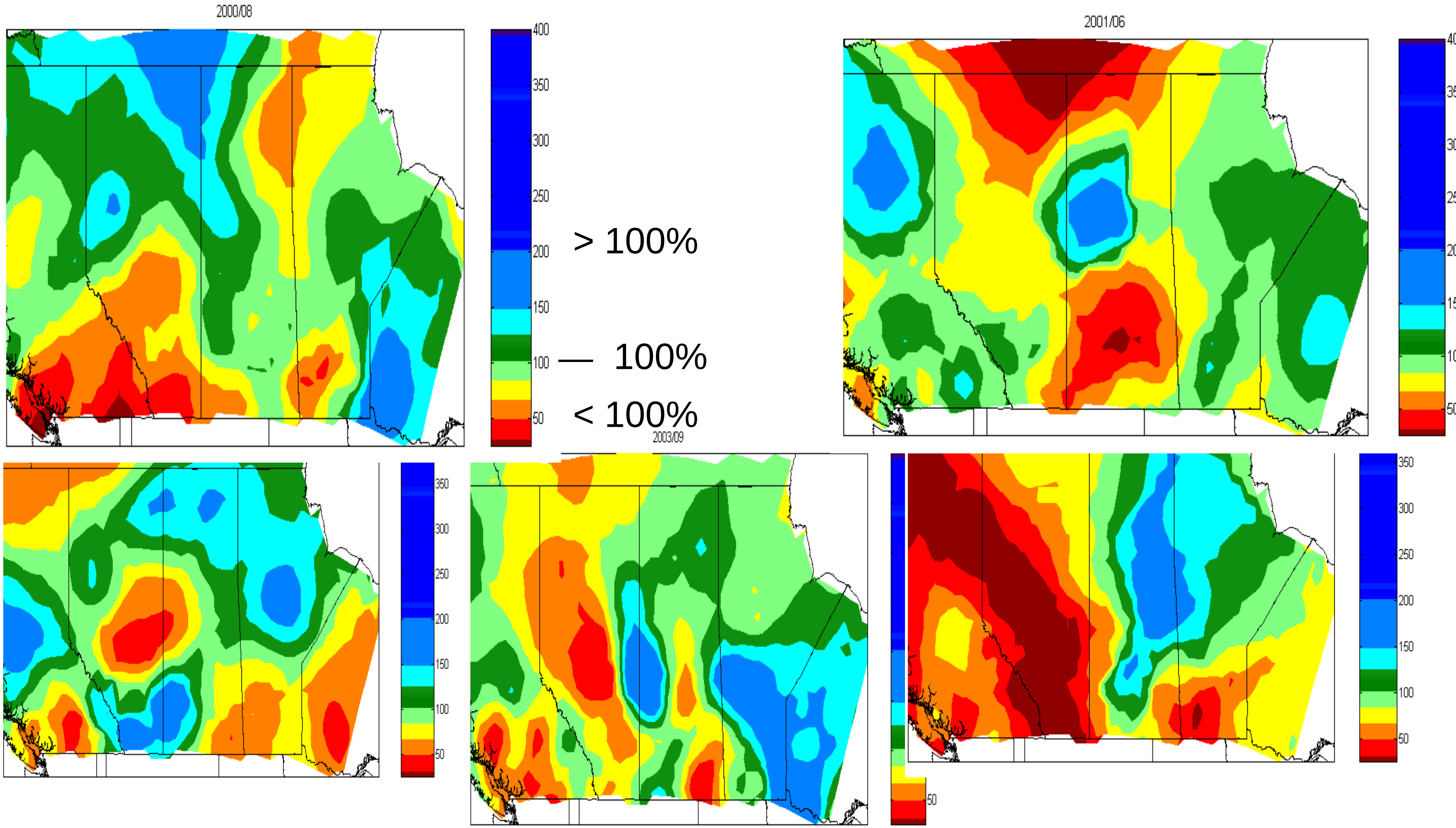
FLOW FIELDS AND PRECIPITATION ANOMALIES





MONTHLY-SCALE PRECIPITATION GRADIENTS

During 1999-2005 Drought

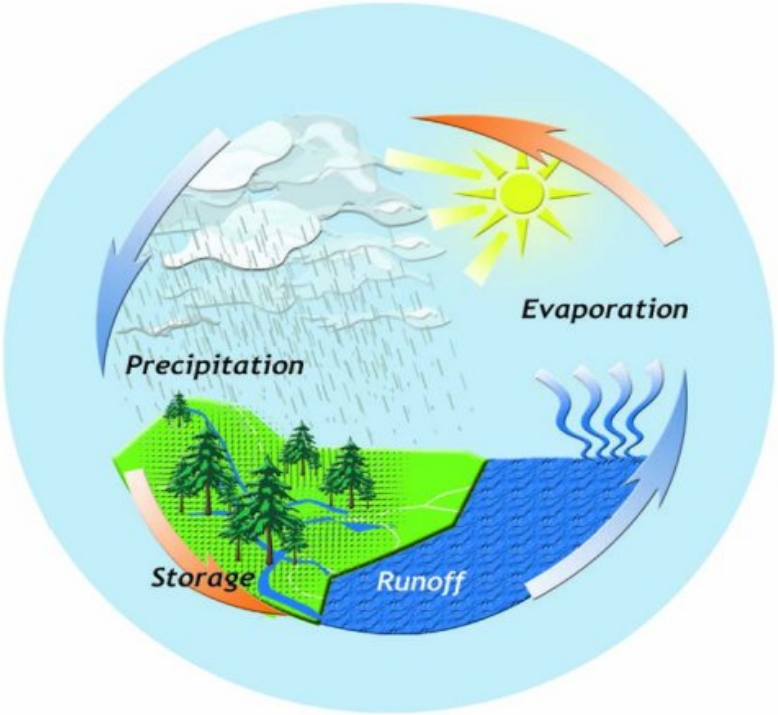


EXTREMES WITHIN GEWEX/CEOP

Objectives ...

- To better document, understand and simulate the occurrence, evolution, structure and role of hydrometeorological extremes within the climate system

- To contribute to their better prediction at various time scales and to addressing societal concerns



Global Energy and Water cycle Experiment

SPECIFIC ACTIVITIES

Associated Types of activities include:

- Definitions
- Datasets (global, regional)
- Processes governing occurrence/chains-of-events
- Model simulations
- Prediction assessment/improvement
- Trends (physically-based/statistical)
- Societal Interactions

MAY 2008 WORKSHOP
Vancouver

In general, the objective of this workshop is to:

Move the Extremes Effort ahead

Specific sub-objectives include:

- Update our progress
- Identify challenges and opportunities
- Enhance collaborations and cohesion
- Consider future activities

A BRIEF SUMMARY

Some of the issues addressed at the workshop include:

- Datasets, definitions and processes
- Statistical and physically based analyses
- Modelling capabilities
- Relation to climate change issues

DEFINITIONS

This is an on-going issue. Specific considerations include:

- There can be many interpretations as to what constitutes an extreme.
- Variables include frequency, magnitude, duration, spatial extent, and deviation from local means or climatology.
- A key issue is assessing when an extreme is an independent event versus being part of a sequence of events.
- It should be recognized that extremes can furthermore be interconnected.
- The impacts affect more than just people: for example, ecosystems can be affected.
- Tails of distributions are difficult to measure/quantify.

SCIENTIFIC ISSUES

There are numerous scientific issues that need to be addressed in connection with extremes. A few examples include:

- There is still not a fundamental understanding of the means through which all extremes develop and evolve.
- The character of drought can last for weeks or years and can be continuously dry or interspersed with heavy precipitation.
- There is a lack of understanding of the means through which extremes can be inter-related.
- The role played by extremes in the climate system needs to be better understood.

Datasets, Case Studies, Processes

- we do not have access to a comprehensive inventory of the case studies, process studies, and statistical analyses of extremes.
- Many of the areas where important extremes occur are outside areas studied by RHPs.
- The temporal and spatial scales of extremes can also vary greatly over a region and between regions and, furthermore, different extremes are important for specific conditions.

IDEAS FOR ACTION

- Develop an inventory of extreme events and extreme event studies.
- Organize a review of what is currently available, including their formats and consistencies
- Include an updated review of web material consisting of extreme event occurrences such as damages and photographs (more qualitative), and quantitative information.
- Encourage RHPs to be opportunistic in identifying and studying droughts in their areas.
- Encourage twinning studies in which RHP extremes are examined in conjunction with similar events in other parts of the world.
- Develop a review article on Extremes for use by stakeholders.

Continued …

- Document one good case study on a continental basis (e.g., the recent North American drought)
- Choose a particular time period—for example 2002—as a global case study for Extremes
- Encourage HEPEX to utilize a British Columbia (BC) flooding case as part of its international effort.
- Incorporate the “Hugh van den Dool” extreme event catalogue (heat waves, floods, droughts) on a global basis from 1948 to present into the Extremes information base.
- Develop land data assimilation products for areas where extremes case studies are being carried out.
- Assess to what extent the same mechanisms are responsible for ‘ordinary’ precipitation as opposed to ‘extreme’ precipitation.
- Inform the impacts/forecast community (e.g., BC Hydro) of what data are required for an accurate case study (so they can archive)

STATISTICAL AND PHYSICALLY BASED ANALYSES

- The historical nature of extremes must be understood and put into a risk-based framework for decision makers.

STATISTICAL AND PHYSICALLY BASED ANALYSES

The conduct of statistical studies of extremes is limited because:

- There is no single objective universal definition of extremes. However, a wide range of definitions is used in studies.
- Statistical analysis may not reflect the true trends in extremes. Land use changes, soil moisture effects, and vegetation changes may for example alter the nature of extremes.
- Many national data sets are not available for the public.
- Many data sets are not sufficiently homogeneous and the metadata are incomplete.
- There are problems in instrument differences. We need consistent techniques including a physically based approach.
- Nations do not freely share the data needed to do these studies.
- The quality of data from some nations is suspect. Standards need to be developed and applied for observations of extremes.

IDEAS FOR ACTION

- Establish national offices for coordinating data and information related to extremes (beyond GEWEX).
- Develop a small set of definitions of drought which could be supported by WCRP and the World Meteorological Organization (WMO). This could work with the *Expert Team on Climate Change Detection and Indices* (ETCCDI) as appropriate.
- Develop a task to create a data base for extreme events from data sets contributed by GEO countries. The datasets could include station data as well as satellite, model, and other products. The task should include the all nations in GEO.
- Agree on the complete data needed to characterize extremes.
- Develop standardized precipitation data sets that include wind effects.
- Develop procedures and agreements whereby researchers could work with GPCC so as to obtain access to the full GPCC data archives.
- Assess Global Precipitation Climatology Project (GPCP) satellite-based products within Extreme events such as light and heavy precipitation.
- Develop an inventory of data sources, data types, and metadata.
- Launch a study using standard definitions and techniques in different regions of the world.
- Develop a listing of ‘chains-of-events’ associated with Extremes events.
- Undertake studies of the frequency distributions of extremes using satellite data and radar products.
- Include data set developers (for GPCC and GPCP, for example) in trend and related studies since they are familiar with the data issues such as inhomogeneities.
- Assess the need for data rescue efforts for vulnerable data records in many countries.
- Develop stronger links with the ensemble forecasting community to investigate the ‘tails’ of distributions.

MODEL FRAMEWORK

- A seamless, integrated, omni-temporal scale unified modeling framework needs to be developed. Models within this framework should provide predictions of extremes and their impacts.

SIMULATIONS AND PREDICTIONS

- Fully reliable and accurate predictions of extreme wet periods, floods, droughts, and the impacts of each of these extremes are required. In particular, the parameterization of soil moisture processes and the improved initialization of soil moisture conditions in the models can make a major impact.

- *Current status of activities:*
- Both models and forecasters are biased toward the mean conditions.
- Evaluations of seasonal predictions exist but should be more widely publicized.
- Outputs must be provided with sufficient time resolution to allow extremes to be seen without being “smoothed out of existence.”
- We do not communicate the level of confidence in predictions of extreme events well.
- It is difficult to characterize the performance of models in predicting extremes because the model likely has been changed since the last time an extreme event occurred and now performs differently.
- The lack of interaction between the research and operations communities prevents the results of research from being used effectively in the operational environment.
- It is difficult to make local populations concerned about global trends and global results.
-

- *Ideas for actions:*
- Undertake comparative analyses of extremes in reanalysis data and long-term forecasts and actual extremes inferred from data. It is key to find areas where large differences exist.
- Assess the feasibility of using high-resolution models for downscaling during extremes.
- Give forecasters incentives to provide documentation on the areas where they would like to see models improved.

FUTURE OCCURRENCE

- It is anticipated that climate change will lead to increases in the frequency and intensity of extreme events such as droughts and floods. The significance of these increases and their consequences for society need to be understood as a part of a strategy for adapting to Extremes.
-

- *What can be produced:*
- Many products can be created about future extremes using models and comparing the model-projected frequencies and intensities with today's frequencies and intensities. There is still uncertainty associated with this approach, however, because the ability of a climate model to reproduce extreme events smaller than a certain size may be limited.
- There are concerns about the level of uncertainty with projections of extremes.
- At the national level there is growing interest in providing analyses of extremes that focus on the impacts of these extremes in order to inform adaptation activities.
- Analyses of recent trends in extremes are needed to determine if climate models are successfully reproducing what is being observed in nature.
- Statistical studies must be produced which will be the basis for downscaling model outputs to assess extremes.

- *Current status of activities:*
- While some studies are being carried out, the number is much less than needed because of a lack of access to data sets of sufficient length.
- The public is attributing every change in Extremes to “climate change” when some of the change may be due to other factors (i.e., poor water and land management practices). The role of human actions in extreme events needs to be more effectively documented.

- *Ideas for actions:*
- Launch a collaborative study between CEOP and the Global Water System Project (GWSP) to examine the effects of human activities on floods and droughts and vice versa. This would address, for example, the impact of land use changes on floods.
-

- The GEWEX/CEOP Extremes workshop was an important step in CEOP and WCRP Extremes efforts. It allowed for an overview of the current situation and associated issues and led to a number of suggested actions for the future.

- The next step will be further prioritizing these ideas and addressing them in a logical, do-able manner. In terms of the functioning of the Extremes effort itself, this can be best accomplished through:

- Continuation of e-mail distribution lists, teleconferences, and a special web site
- Development of smaller groups that can focus on particular issues
- Annual workshops that, to the extent possible, are held with other meetings

Now … This Session

- Elements of strategy

- Hans von Storch (definitions, data, trends)
- Hugo Berbery (issues, data ….)
- Tobias Fuchs (data, trends)

- Discussion

Session Discussion

- Issues include:
- Where are we in terms of our objectives?
- What issues/challenges do we face?
- What opportunities are there?
- What specifically do we need to do?