WMO OMM

World Meteorological Organization

Working together in weather, climate and water

Overview of Drought Management

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Climate and Water Department

Outline

- Drought as Global Issue
- Drought Definitions
- Drought Early Warning Systems and Management
- WMO Drought Activities
- Lessons Learned

Recent Drought Events

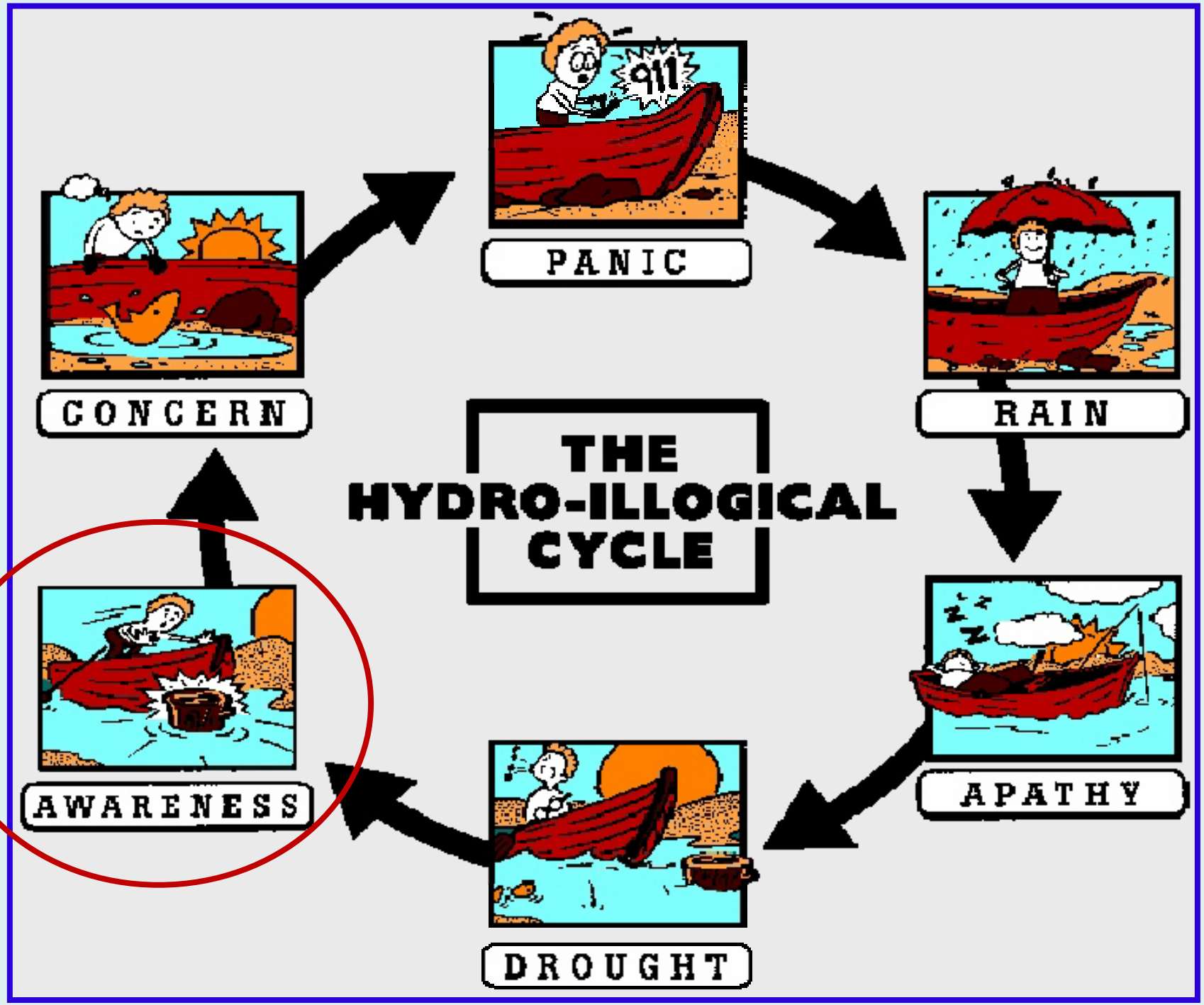
- According to the Russian Federal Service for Hydrometeorology and Environmental Monitoring, July 2010 is the warmest month ever in Moscow since start of modern meteorological records, 130 years ago.
- Temperatures exceeded long-term average by 7.8° C (previous record in July 1938 with 5.3° C above average).
- Record high temperatures varying between 35° C and 38.2° C were registered for more than 7 consecutive days end July
- Daily temperature of 38.2° C on 29 July was the highest ever in Moscow

Climate Variability or Climate Change?

Recent Drought Events

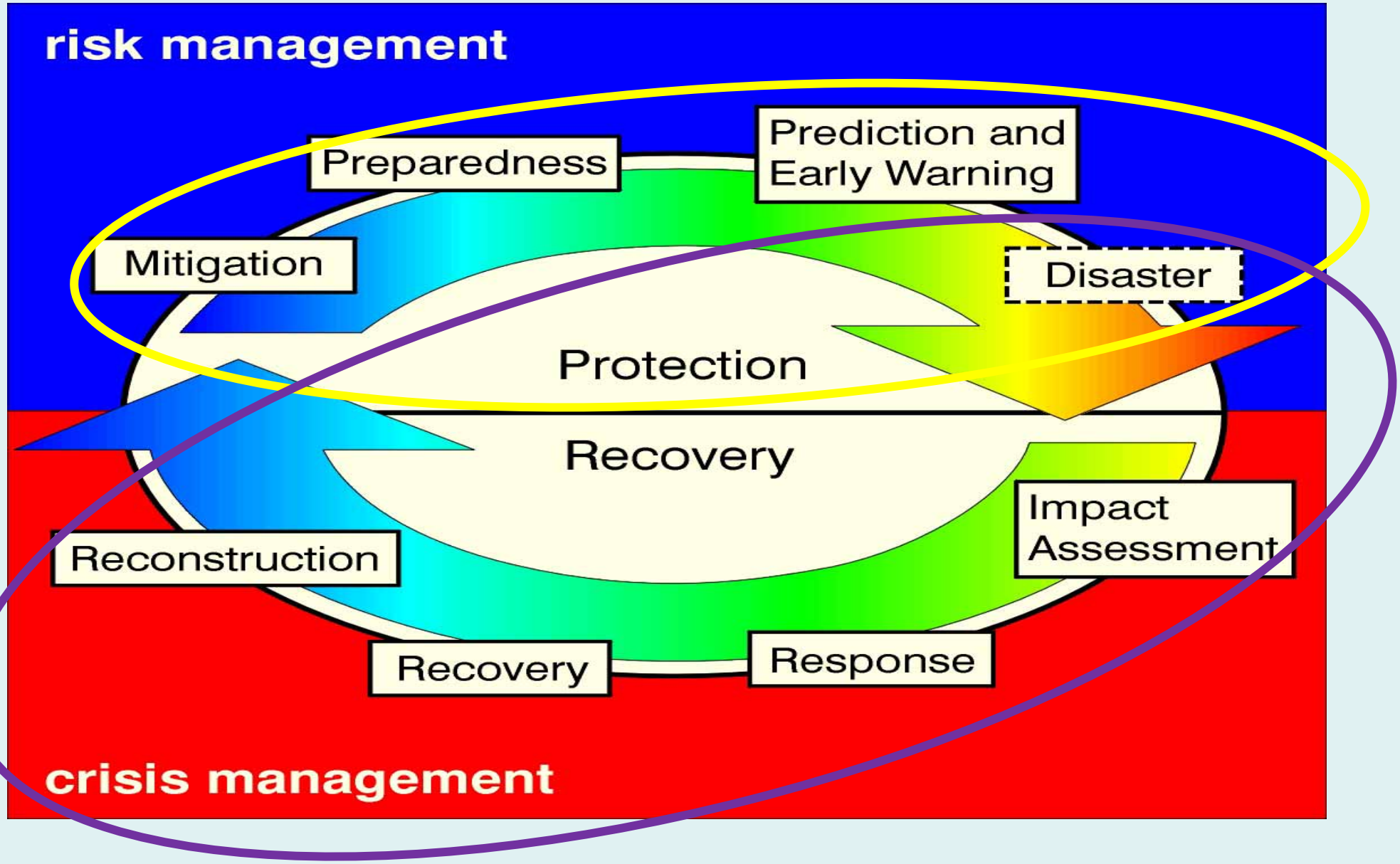
- Australia 2009 Heatwave/Drought
- "it was the hottest day on record in the midst of the longest heatwave on record with 2009 having the driest start to a year on record in a 12 year drought which has been our hottest, longest and driest on record." Bureau of Meteorology (BOM)

- BOM Drought Statement of 4 February 2009: "The combination of record heat and widespread drought during the past five to ten years over large parts of southern and eastern Australia is without historical precedent and is, at least partly, a result of climate change."



Source: Wilhite - NDMC

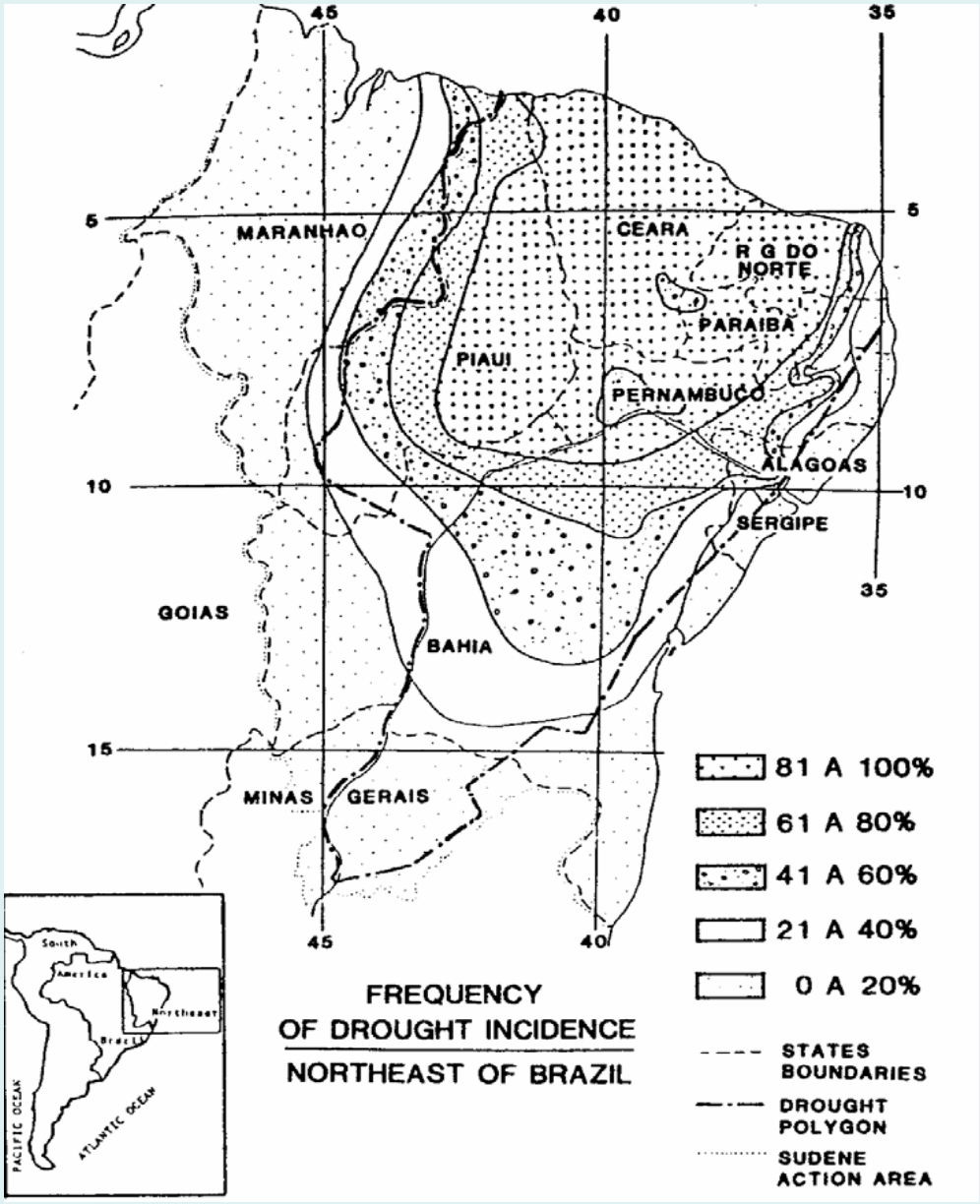
The Cycle of Disaster Management



Source: Wilhite - NDMC

Drought vs. Aridity

- Aridity is a permanent feature of climate.
- Drought is a temporary feature of climate, an aberration.



Source: Wilhite - NDMC

Drought vs. Water Scarcity

- Water scarcity = an excess of water demand over available supply.
- It can result from . . .
  - Prevailing institutional arrangements, prices
  - Overdevelopment or over allocation of the water resource
    - Indicators = mining of ground water, increasing conflicts between water use sectors, streams becoming intermittent or permanently dry, land degradation
  - Scarcity may be a social construct, i.e., product of affluence, expectations
  - Altered supply (e.g., climate change)

Source: Wilhite - NDMC

Drought: a deficiency of precipitation (**intensity**) from expected or “normal” that extends over a season or longer period of time (**duration**) . . .

Meteorological drought

and is insufficient to meet the demands of human activities and the environment (**impacts**).

Agricultural drought

Hydrological drought

Socio-economic drought

Source: Wilhite - NDMC

Comparing drought to other natural hazards–

- slow onset, “creeping phenomenon”, a non-event
- difficult to determine drought onset and end
- absence of a precise, universal definition
- impacts are nonstructural and spread over large areas
- severity and impacts best defined by multiple indices and indicators

Source: Wilhite - NDMC

Comparing drought to other natural hazards–

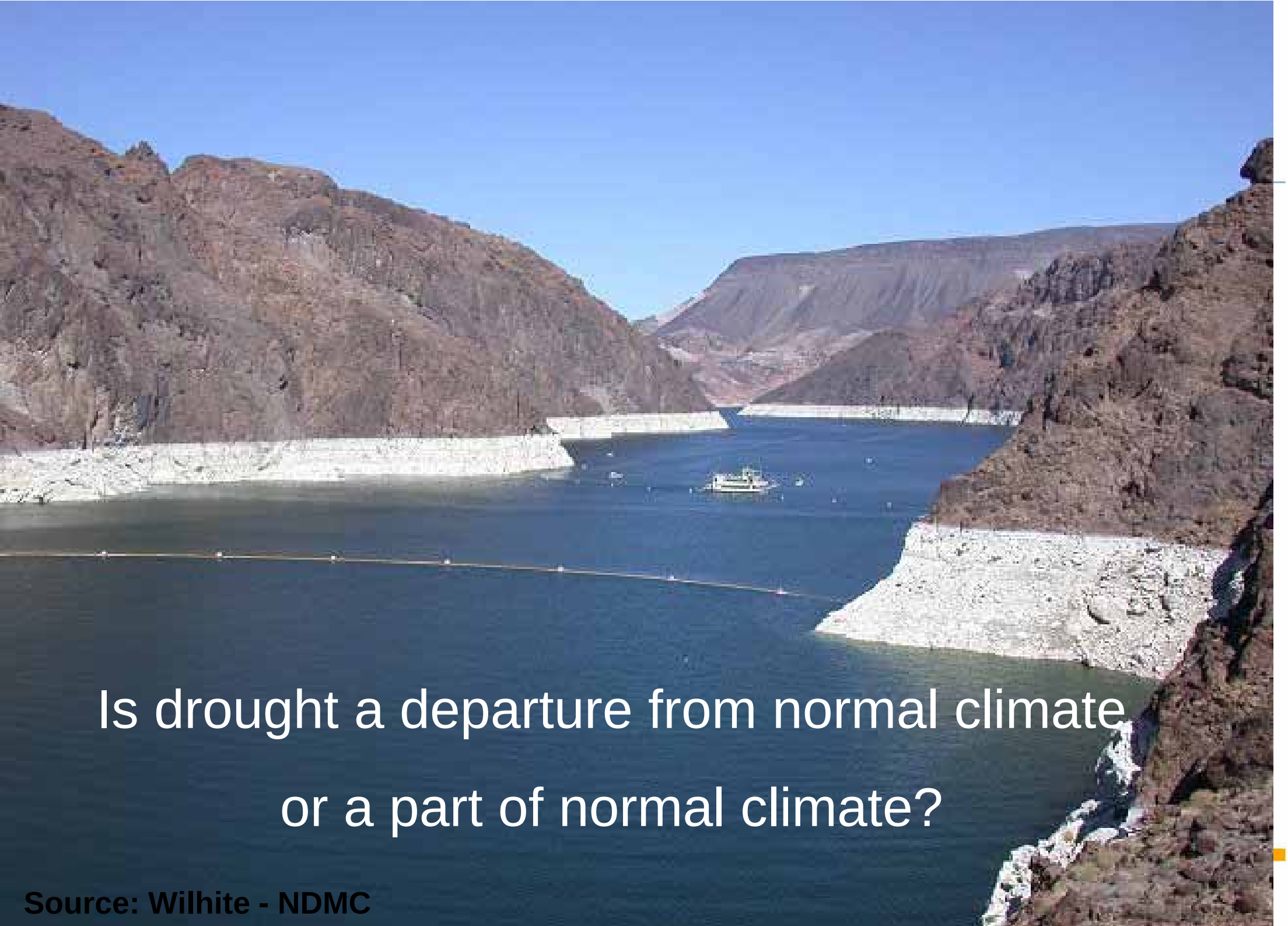
- no consistent methodology for assessing impacts or a data base for archiving impacts
- impacts are complex, affect many people, and vary on *spatial* and *temporal* timescales, multiple and migrating epicenters
- mitigation interventions are less obvious
- water shortages increase conflict—regulatory, legal authority (interstate and transboundary issues)
- **makes monitoring, early warning, impact assessment, response, mitigation, and planning difficult!**

Source: Wilhite - NDMC

Drought is a normal part of climate in most climate regimes but differs in terms of

- Causal factors
- Multiple
  - Regional in scale
  - Forcing functions not well understood
- Impacts
- Institutional structure for monitoring, mitigation, response, and planning/policy
- Societal coping capacity (vulnerability/resilience)
- Government policies (e.g., data sharing across ministries, response measures)
- Government/donor response capability

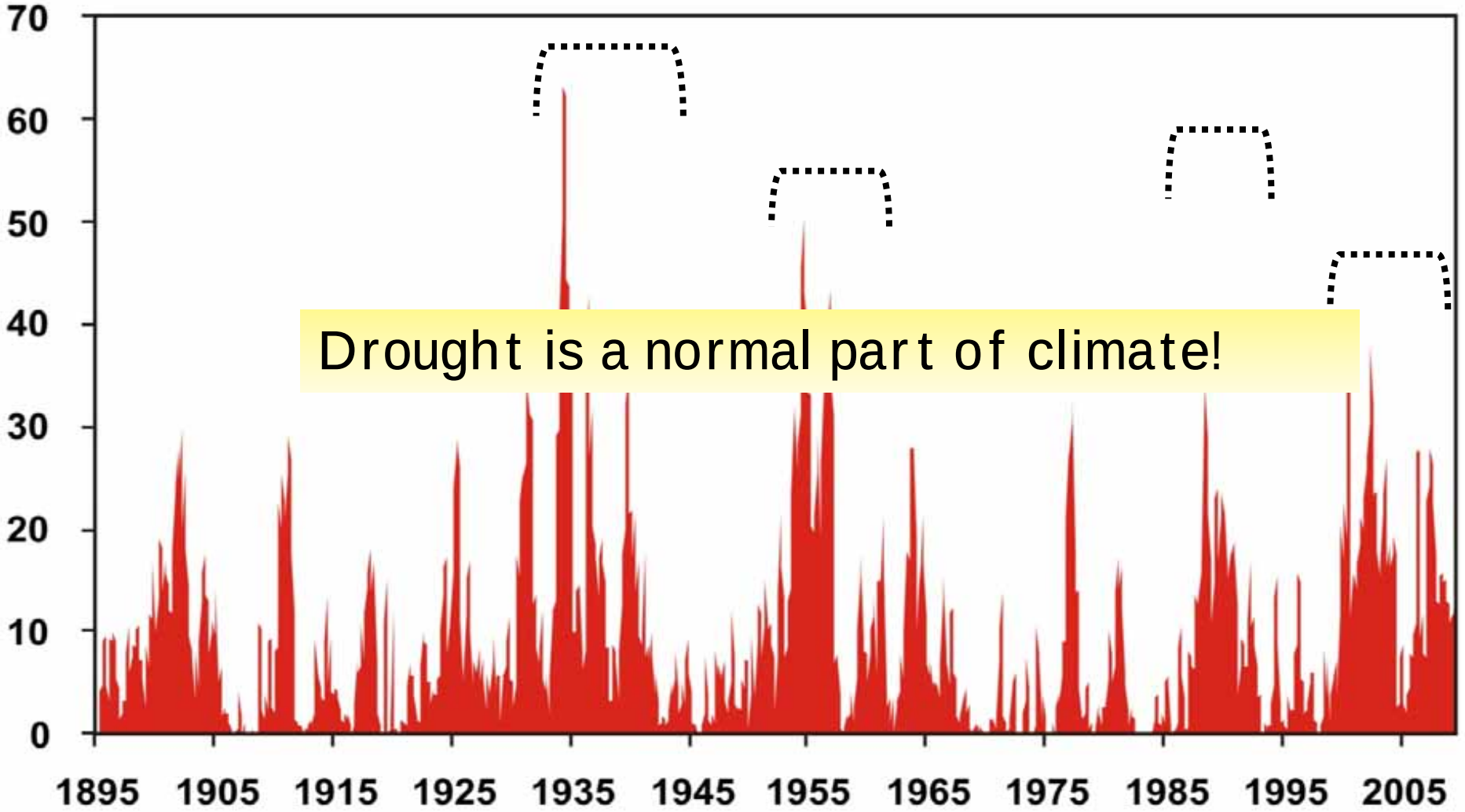
Source: Wilhite - NDMC



Source: Wilhite - NDMC

Percent Area of the United States in Severe and Extreme Drought

January 1895–August 2009



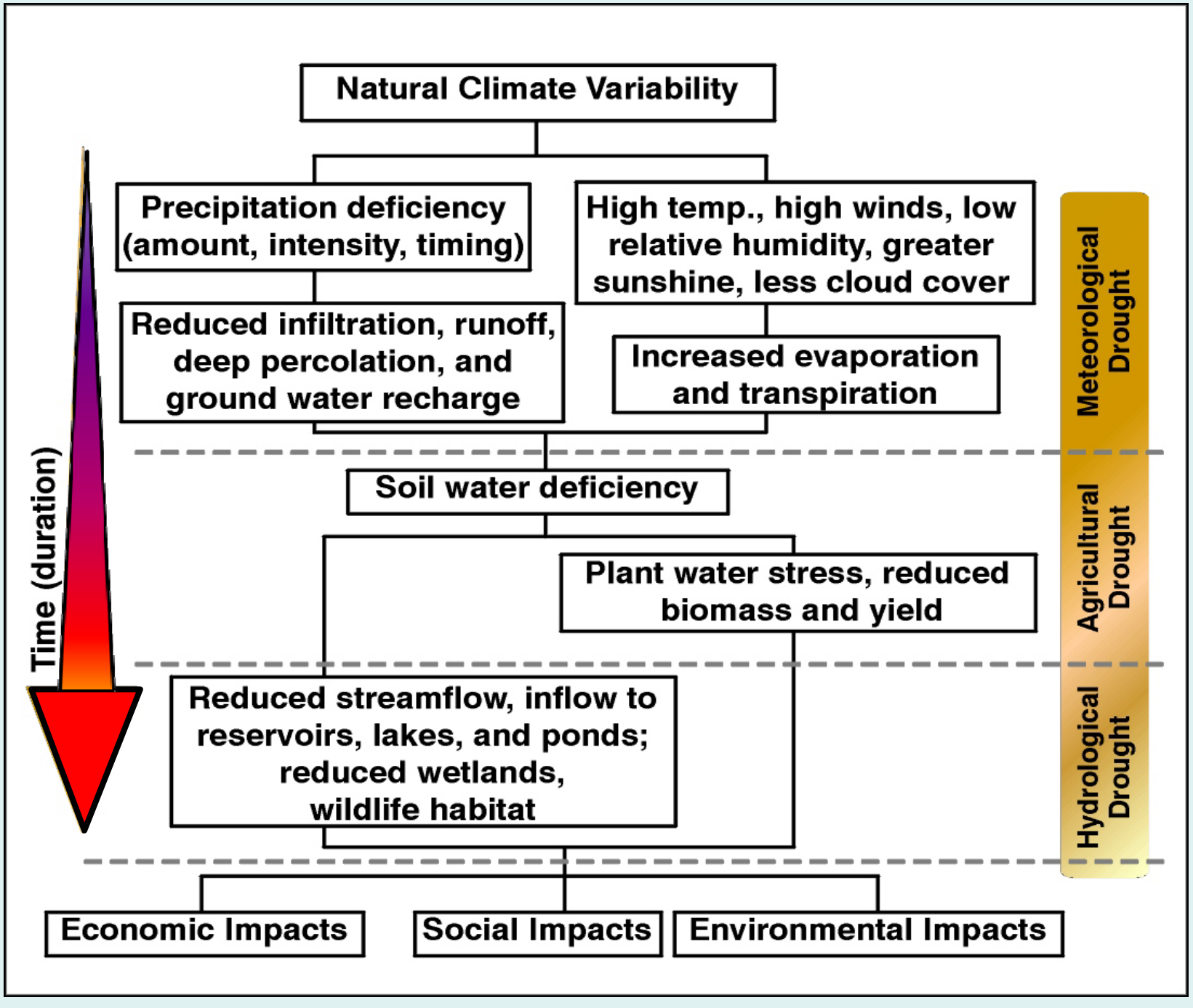
Based on data from the National Climatic Data Center/NOAA

Droughts differ in terms of:

- INTENSITY
- Duration
- Spatial Extent

Source: Wilhite - NDMC

Evolution of Drought Types

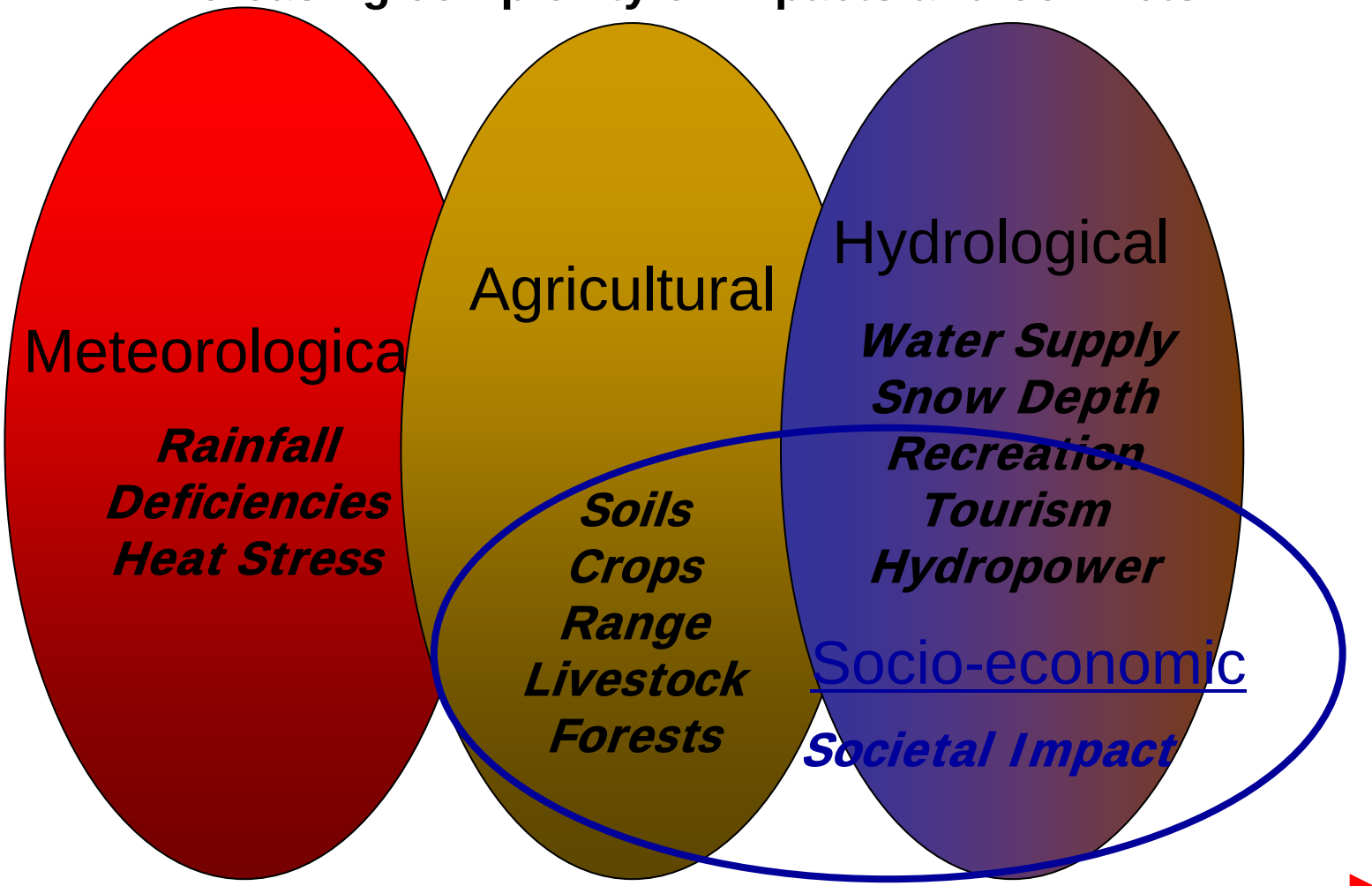


Natural and Social Dimensions of Drought

Decreasing emphasis on the natural event (precipitation deficiencies)

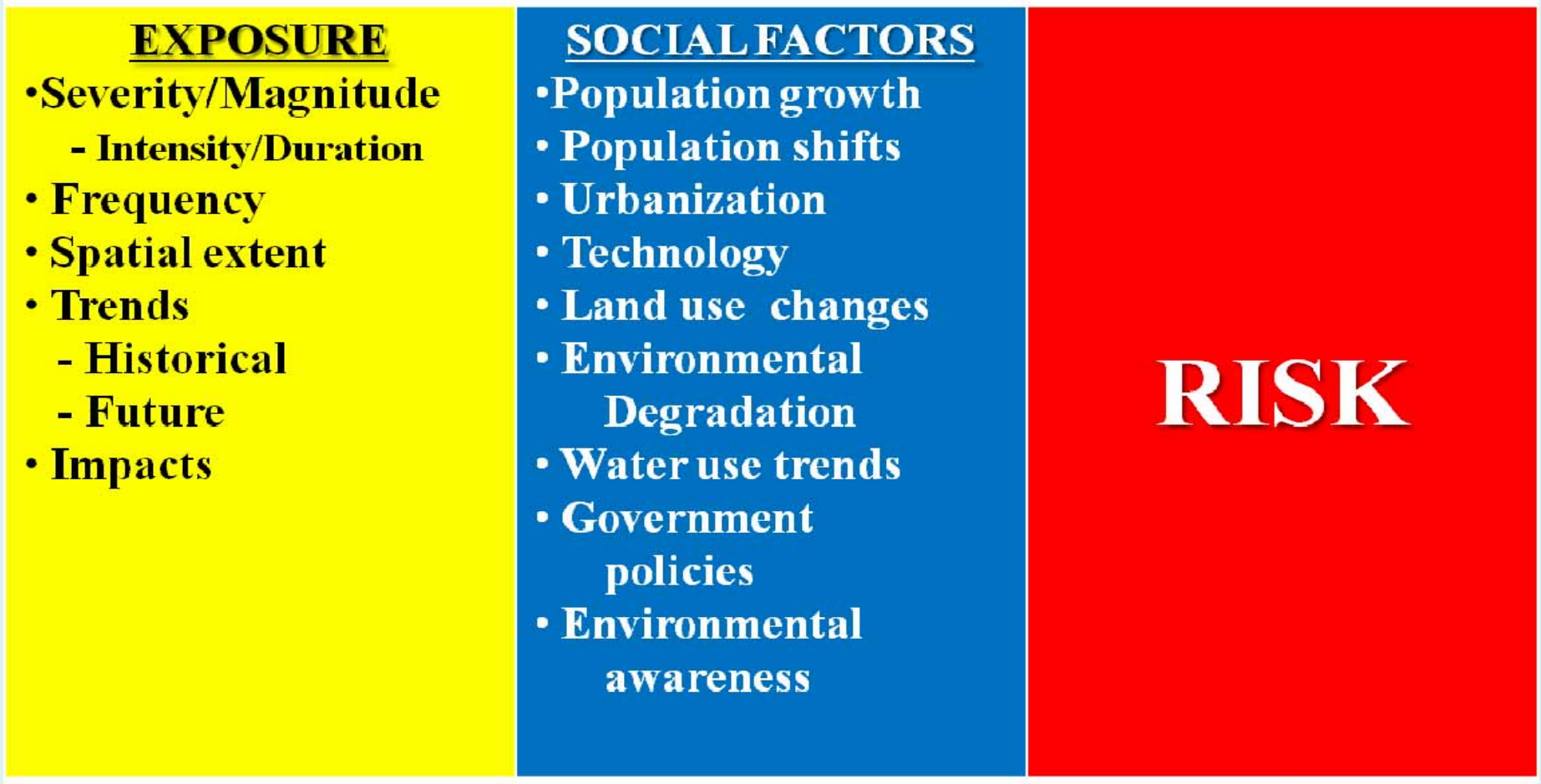
Increasing emphasis on water/natural resource management

Increasing complexity of impacts and conflicts



Time/Duration of the event

Hazard x Vulnerability = Risk



Source: Wilhite - NDMC

What is an Early Warning System for Drought ?

- **Formal UN definition: “The provision of timely and effective information, through identifying institutions, that allow individuals exposed to a hazard to take action to avoid or reduce their risk and prepare for effective response” (ISDR, 2003).**

- **Early Warning System (EWS) become practical tool for implementing timely and appropriate responses to droughts and famine via food aid and other mitigation strategies**

- **Early warning involves developing regional drought histories, monitoring current weather, using climate projections and determining possible outcomes of developing drought events, and answering questions on drought duration and severity.**

- **Effective EWSs should involve both technology and all interested parties in drought planning and response.**

Examples of Early Warning Systems

- **FAO's Global Information and Early Warning System on Food and Agriculture (GIEWS)**
- **USAID's Famine Early Warning System (FEWS)**
- **Southern African Development Community (SADC) Regional and National Early Warning System**
- **US and North American Drought Monitors**
- **Australia – National Agricultural Monitoring System (NAMS)**
  - **Australian Climate and Agricultural Monthly Update**

Australian Government

Bureau of Rural Sciences

Australian climate and agricultural monthly update

June 2010

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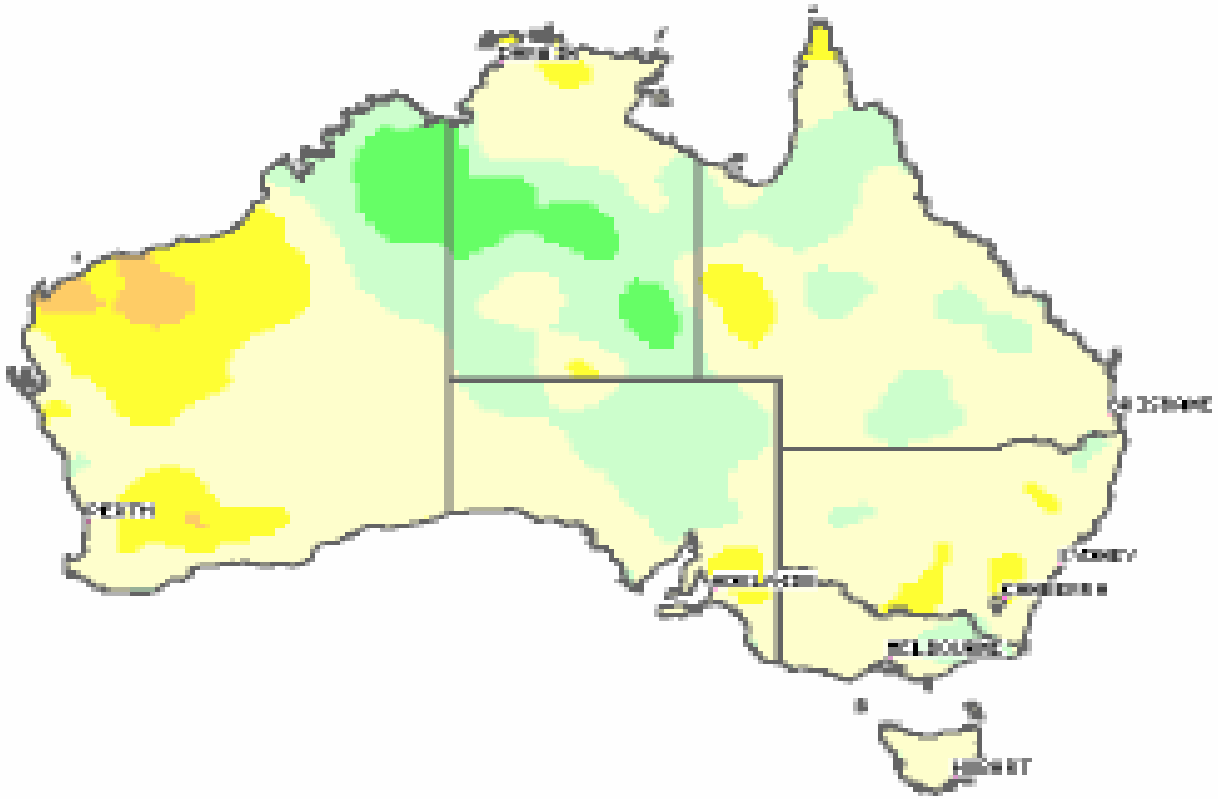
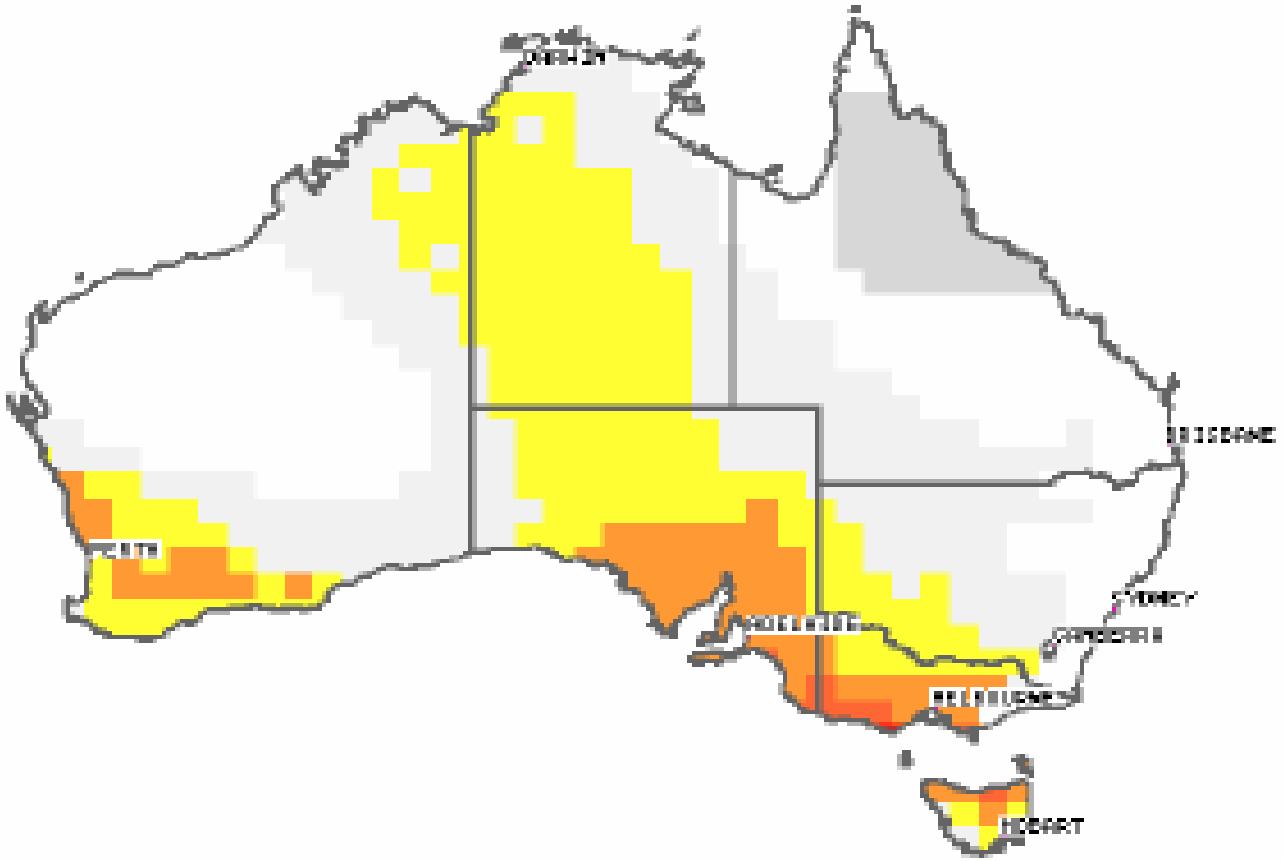


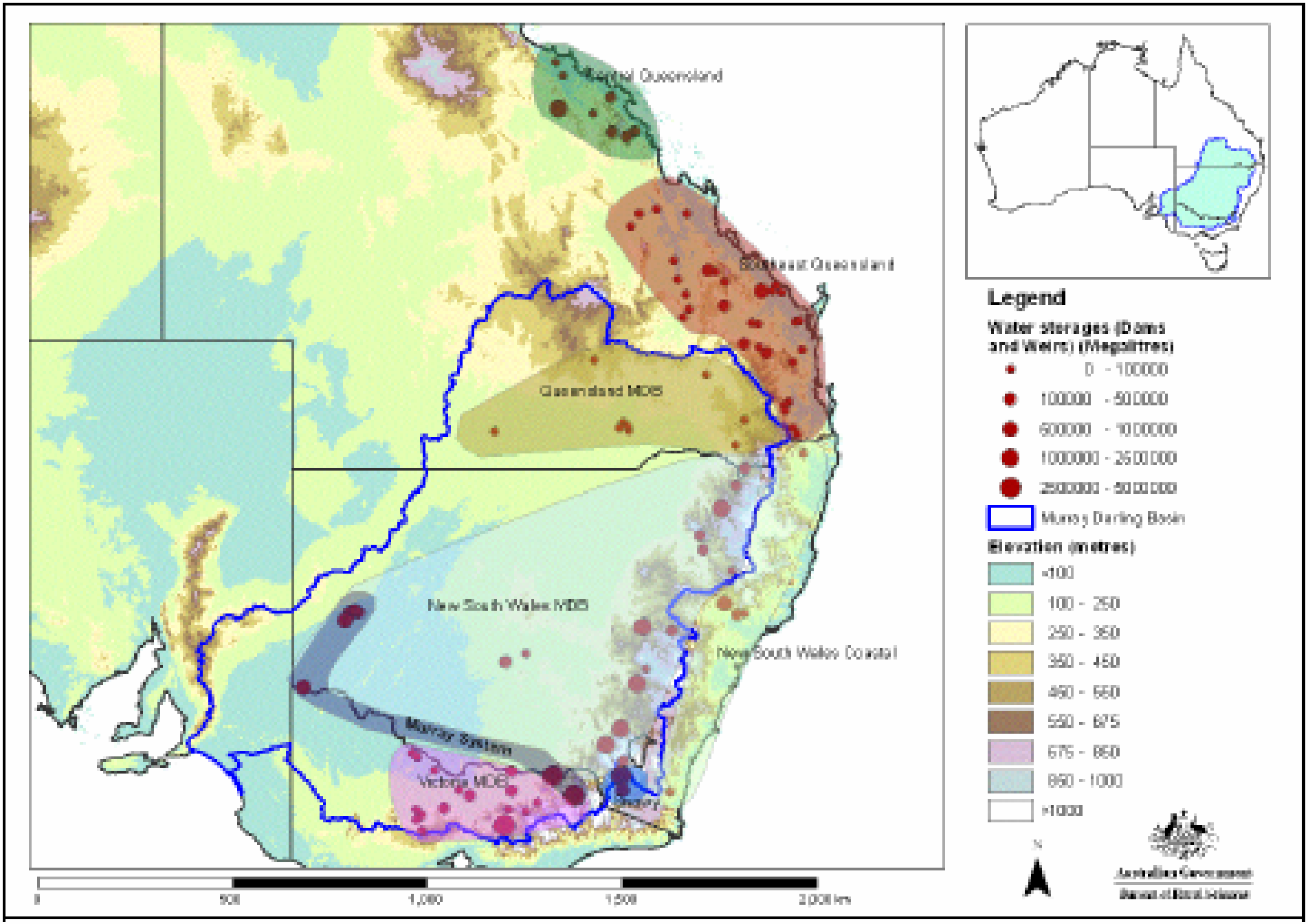
Monthly mean maximum temperature anomalies
May 2010



Chance of exceeding the median rainfall (%)

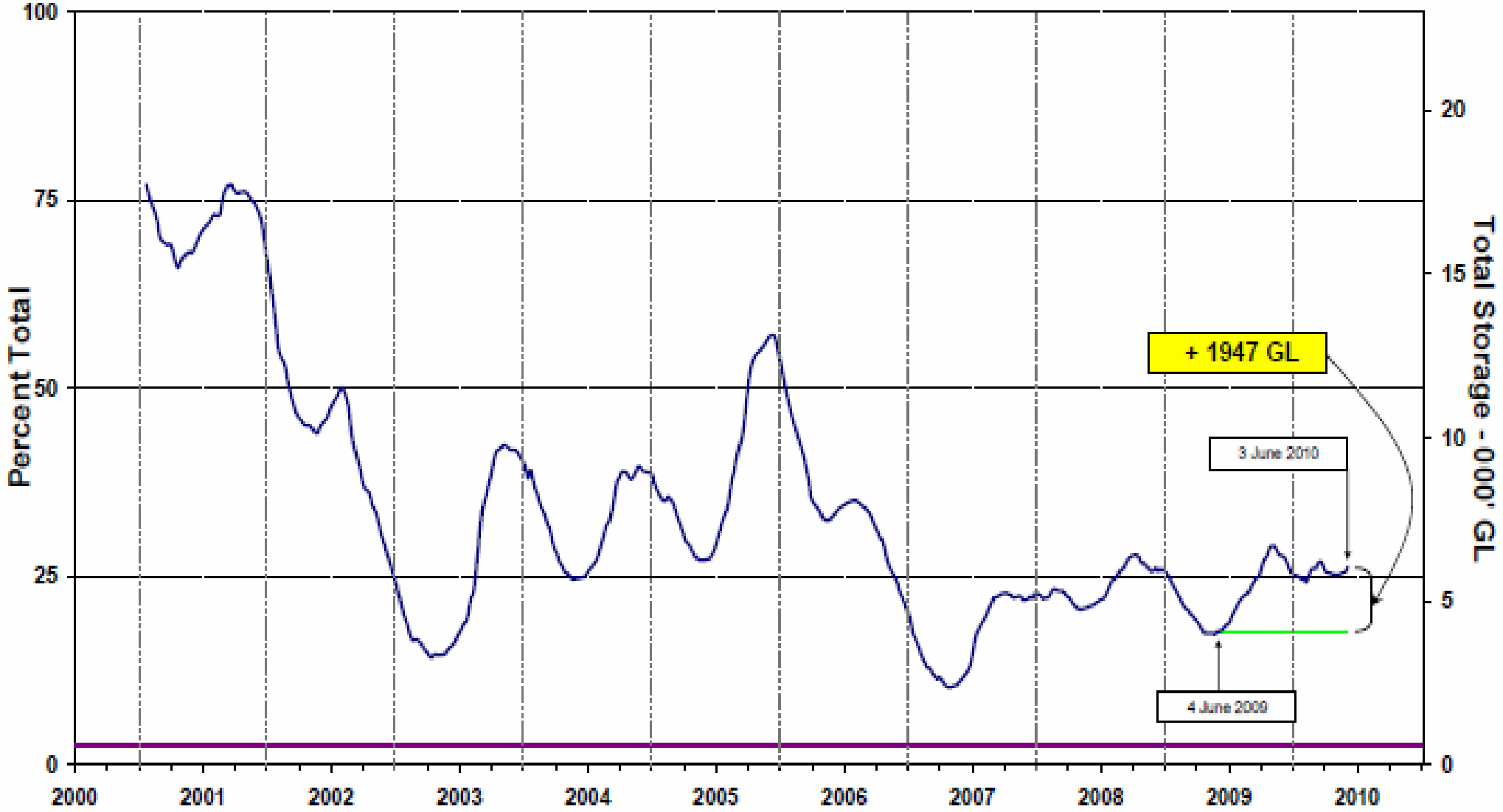
- 80–100
- 75–80
- 70–75
- 65–70
- 60–65
- 55–60
- 50–55
- 45–50
- 40–45
- 35–40
- 30–35
- 25–30
- 20–25
- 0–20

The chance of exceeding median rainfall
June to August 2010



Water storages in Queensland, New South Wales and Victoria:
The blue line indicates the extent of the Murray-Darling Basin and the shaded areas denote the coverage of the individual reporting regions.

MDB (New South Wales, Victoria and Queensland)



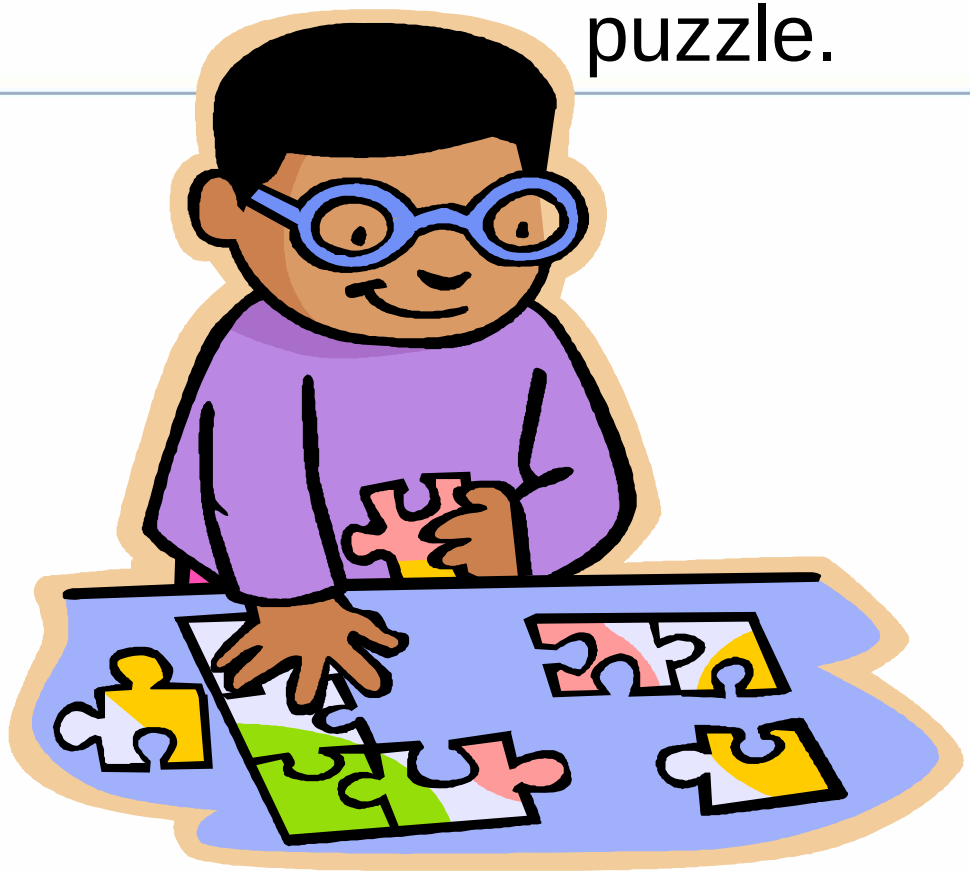
For further information on water storages, go to:

- Snowy Scheme:
  http://www.snowyhydro.com.au/lakeLevels.asp?pageID=360&parentID=6
- Queensland:
  http://www.sunwater.com.au/pdf/water/CurrentStorageSummary.pdf
- New South Wales:
  http://www.waterinfo.nsw.gov.au/
- Northern Victoria:
  http://www.g-mwater.com.au/water-resources/storage-levels/
- Murray-Darling Basin Authority:
  http://www.mdba.gov.au/

Components of a Drought Early Warning System

- Monitoring networks
  - Who is the responsible authority?
  - Multiple networks?
- Data retrieval systems
- Data quality control
- Data analysis—converting data into information
- Interaction with end users/stakeholders
  - Creating an end-to-end-to end system
- Information delivery—timely, reliable

Building an effective **drought early warning system** is like putting together the pieces of a puzzle.



Each **index or indicator** represents a valuable piece of information to assess the severity of drought and its potential impact on people and the environment. We do not see the full picture until all pieces are in place.

Source: Wilhite - NDMC

EWS is an Essential Component of Drought Management

Drought management has three major components:

- **Monitoring and early warning**
- **Risk and impact assessment**
- **Mitigation and response**

Key Indicators for Monitoring Drought

- climate data (precipitation, temperature)
- soil moisture
- stream flow
- ground water
- reservoir and lake levels
- snow pack
- short, medium, and long range forecasts
- vegetation health/stress and fire danger
- sectoral impacts

Drought impacts

- Droughts have different physical characteristics
- Society is dynamic so each drought event is superimposed onto society—impacts reflect changing vulnerabilities
- Does your country have a monitoring system for recording drought impacts?
- How do you incorporate impacts into a drought early warning system?

Drought Indices

- Percent of Normal
- Deciles
- Palmer Drought Severity Index (PDSI)
- Surface Water Supply Index (SWSI)
- Standardized Precipitation Index (SPI)
- Keetch-Byram Drought Index (KBDI)
- Vegetation Condition Index (VCI)
- And many more ……

Summary 1

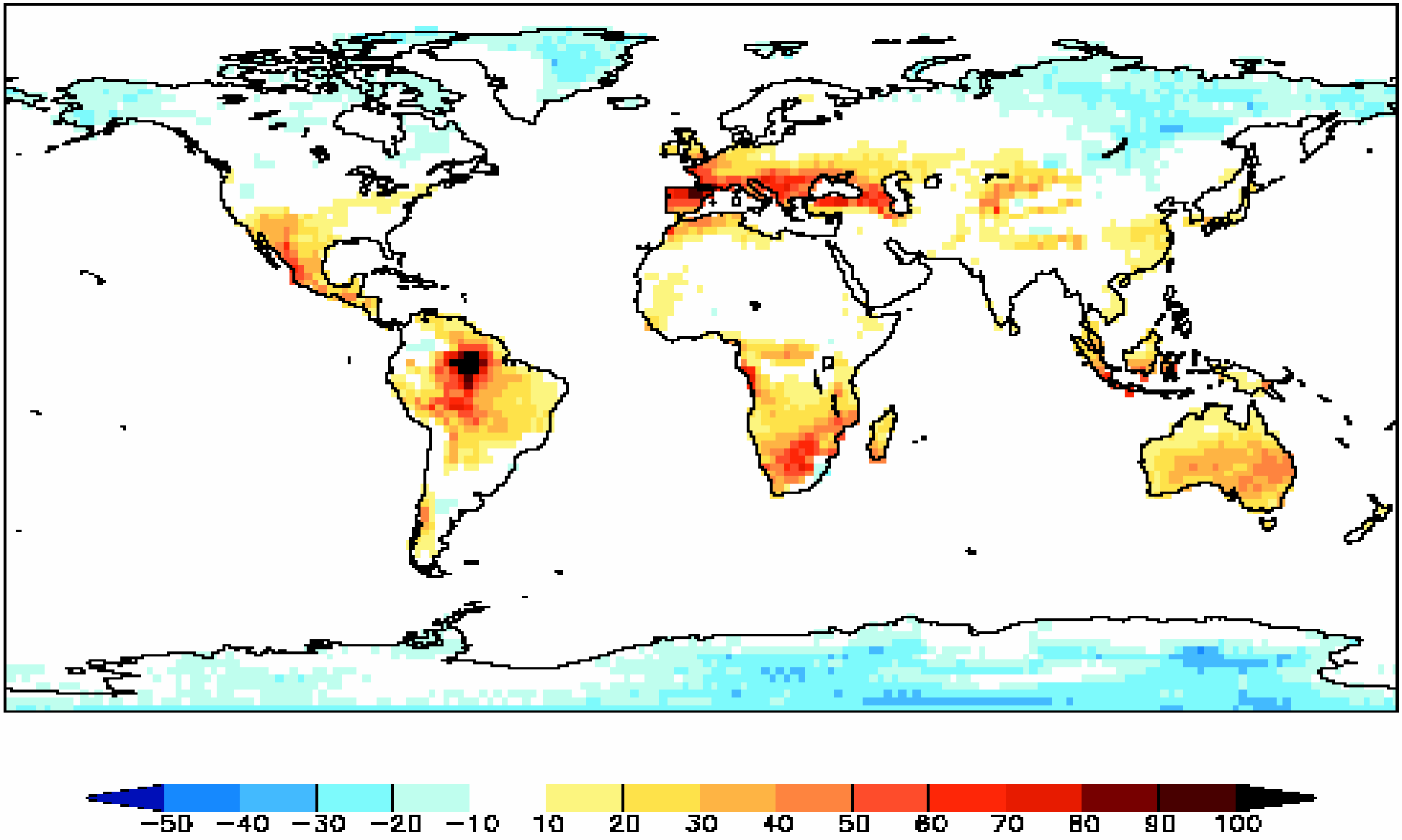
- Drought is a creeping phenomenon with no universal definition—definitions are **region** and **application** (impact) specific.
- Many indices and indicators assist in the quantitative assessment of drought severity.
- Drought impacts are a key indicator of vulnerability.

Summary 2

- Data sources are varied and require interagency cooperation to assess drought severity, impacts, and mitigation strategies (institutional barrier).
- Stakeholder involvement critical component of drought early warning & preparedness planning.
- Early warning systems foundation of effective drought mitigation/preparedness plans.

Where we're headed: Droughts

Drought projections for IPCC's A1B scenario



Percentage change in average duration of longest dry period, 30-year average for 2071-2100 compared to that for 1961-1990.

WMO and Drought

World Meteorological Organization

- Established in 1950 as a Specialized Agency of the United Nations.
- 189 Member states and territories.
- It is the UN System's Authoritative Voice on the state and behaviour of the Earth's atmosphere, its interaction with the oceans, the climate it produces and the resulting distribution of water resources.
- Climate-related initiatives: Major contributor to the establishment of the WCP, WCRP, IPCC, UNFCCC, TOGA/COARE, GCOS, GEOSS/GEO

WMO Objectives

- To produce more accurate, timely and reliable forecasts and warnings of weather, climate, water and related environmental elements;
- To improve the delivery of weather, climate, water and related environmental information and services to the public, governments and other users;
- To provide scientific and technical expertise and advice in support of policy- and decision-making and implementation of the agreed international development goals and multilateral agreements.

WMO Structure

- 10 major scientific and technical programmes,
- 8 Technical Commissions advise and guide the activities of the programmes,
- 6 Regional Associations involved in implementation

WMO Technical Commissions

- Commission for Aeronautical Meteorology (CAeM)
- Commission for Agricultural Meteorology (CAgM)
- Commission for Atmospheric Sciences (CAS)
- Commission for Basic Systems (CBS)
- Commission for Climatology (CCl)
- Commission for Hydrology (CHy)
- Commission for Instruments and Methods of Observation (CIMO)
- Joint WMO-IOC Commission for Oceanography and Marine Meteorology (JCOMM)

Commission for Agricultural Meteorology

The Commission for Agricultural Meteorology (CAgM) provides guidance in the field of agricultural meteorology by:

- studying and reviewing the available science and technology;
- proposes international standards for methods, procedures;
- provides a forum for the examination and resolution of relevant scientific and technical issues;
- promotes the training and the transfer of knowledge and methodologies, including the results of research, between WMO Members; and
- promotes international cooperation and maintains close cooperation in scientific and technical matters with other international organizations.

WMO OMM

COMMISSION FOR AGRICULTURAL METEOROLOGY

President: Byong Lee, Vice-President: Federica Rossi

Management Group (MG)

OPEN PROGRAMME AREA GROUPS (OPAGs)

OPAG 1
Agrometeorological Services for Agricultural Production

Chairperson: S. Walker (RA I)
Co-chairperson:
L.S. Rathore (RA II)

OPAG 2
Support Systems for Agrometeorological Services

Chairperson: O. Brunini (RA III)
Co-chairperson:
H. Shannon (RA IV)

OPAG 3
Climate Change/Variability and Natural Disasters In Agriculture

Chairperson: R. Stone (RA V)
Co-chairperson:
S. Orlandini (RA VI)

WMO Supports Developing Countries Through National and Regional Projects

- Modernization of NMHSs and observing networks.
- Implementation of national operational multi-hazard early warning systems.
- Strengthening of hazard analysis and hydro-meteorological risk assessment tools.
- Strengthening NMHSs cooperation with civil protection and disaster risk management agencies.
- Coordinated training and public outreach programmes.

Historical Background of DMCs

- **Established in 1989/90 by African Governments with WMO as Executing Agency.**
- **Initial funding from UNDP**
- **At the end of the UNDP funded Project in 1998 and due to the increased demand for climate information and prediction services, the Nairobi and Harare components started operating independently.**

Drought Monitoring Centres (DMCs) for Eastern and Southern Africa

- 24 participating countries

- Two operational centres in Nairobi, Kenya and Gaborone, Botswana charged with timely monitoring of drought intensity, geographical extent, duration and impact on agricultural production; and issuing early warnings

- Improved applications of meteorological and hydrological data and products

- 10-day weather advisories, decadal climatological summaries, decadal agromet conditions and impacts, decadal synoptic review and weather outlook

- Monthly drought monitoring bulletins for the sub-regions

DMCSEE

Drought Management Centre for Southeastern Europe

UNCCD

Home | Drought monitor | Links | Members section | News | Contacts

SQ BG HR MK HU RO SI TR SR **EN**

Drought Management Centre for Southeastern Europe - DMCSEE

Drought is a normal part of climate in virtually all regions of the world. South Eastern Europe is no exception; in past decades the drought-related damages have had large impact on the economy and welfare. Therefore the need to establish a Drought Center for SE Europe to alleviate the problems caused by drought in the area became evident at the end of the past century. The idea was further elaborated by International Commission on Irrigation and Drainage (ICID) and UN Convention to Combat Desertification (UNCCD). The UNCCD national focal points and national permanent representatives with the World Meteorological Organization have agreed upon the core tasks of the Drought Management Center for South Eastern Europe (DMCSEE) and the proposed project document.

The mission of the proposed DMCSEE is **to coordinate and facilitate the development, assessment, and application of drought risk management tools and policies in South-Eastern Europe with the goal of improving drought preparedness and reducing drought impacts**. Therefore DMCSEE will focus its work on monitoring and assessing drought and assessing risks and vulnerability connected to drought.

www.dmcsee.org

Founding countries:

- → Albania
- → Bosnia and Herzegovina
- → Bulgaria
- → Croatia
- → FYROM
- → Greece
- → Hungary
- → Moldova
- → Romania
- → Slovenia
- → Turkey
- → Montenegro
- → Serbia

Founding agencies:

- → WMO
- → UNCCD

WMO working on establishing Drought Management Center for Central Asia (DMCCA)

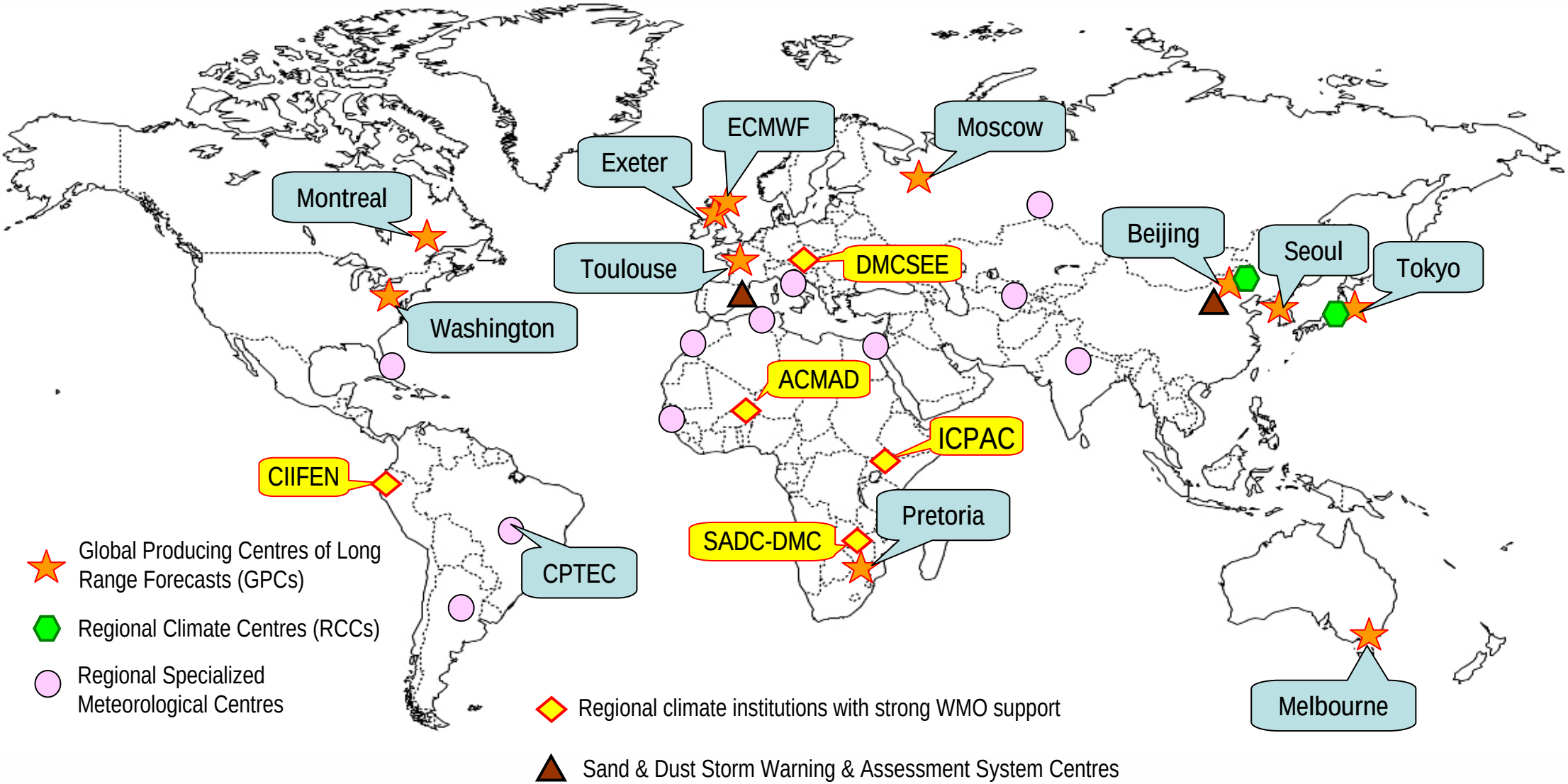
- **WMO, United Nations Convention to Combat Desertification (UNCCD) and the Organization for Security and Cooperation in Europe (OSCE) working together to establish the DMCCA.**

- **Technical Seminar on preparation towards Terms of Reference for a Regional Drought Centre in Central Asia (20-21 November, 2007, Tashkent, Uzbekistan)**

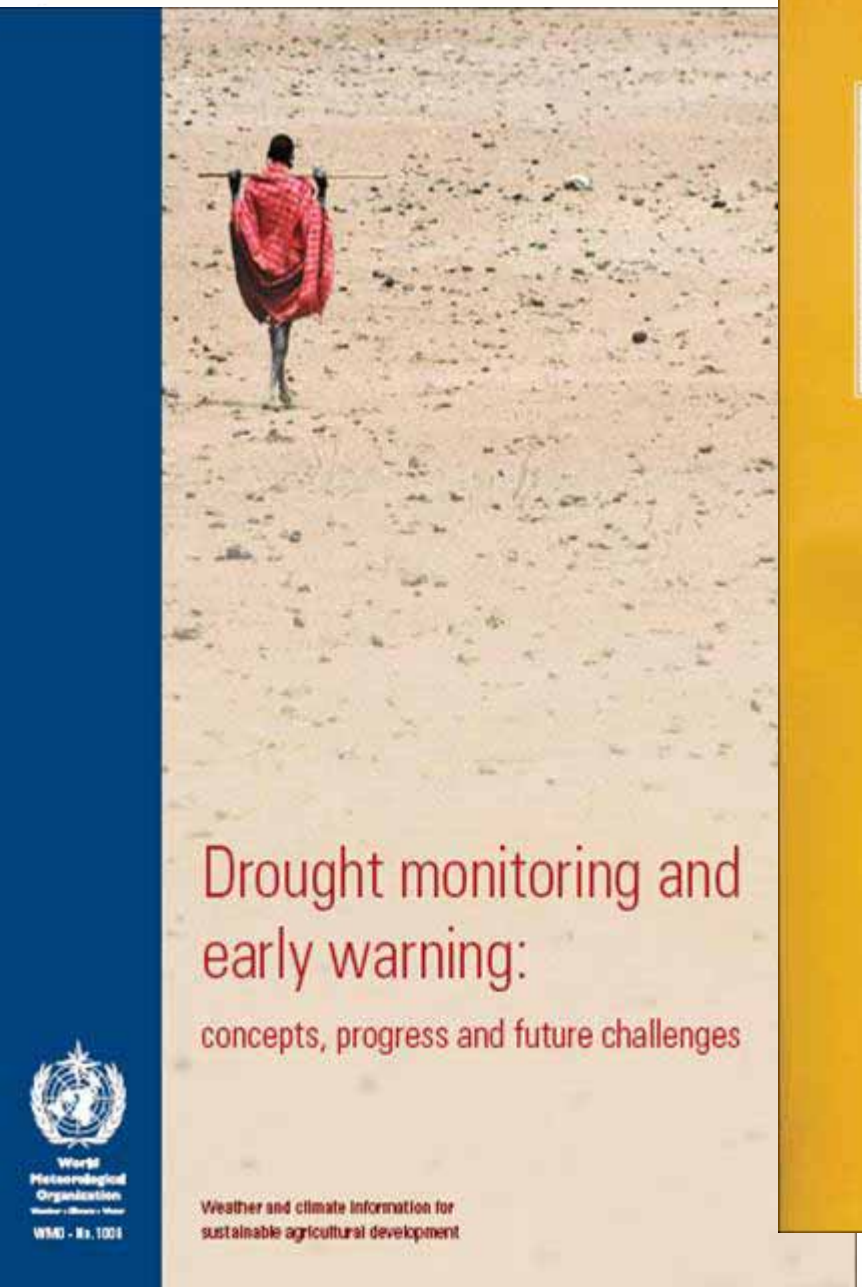
- **Second Workshop on establishing a Drought Management Centre in Central Asia (May 2008, Kyrgyzstan)**

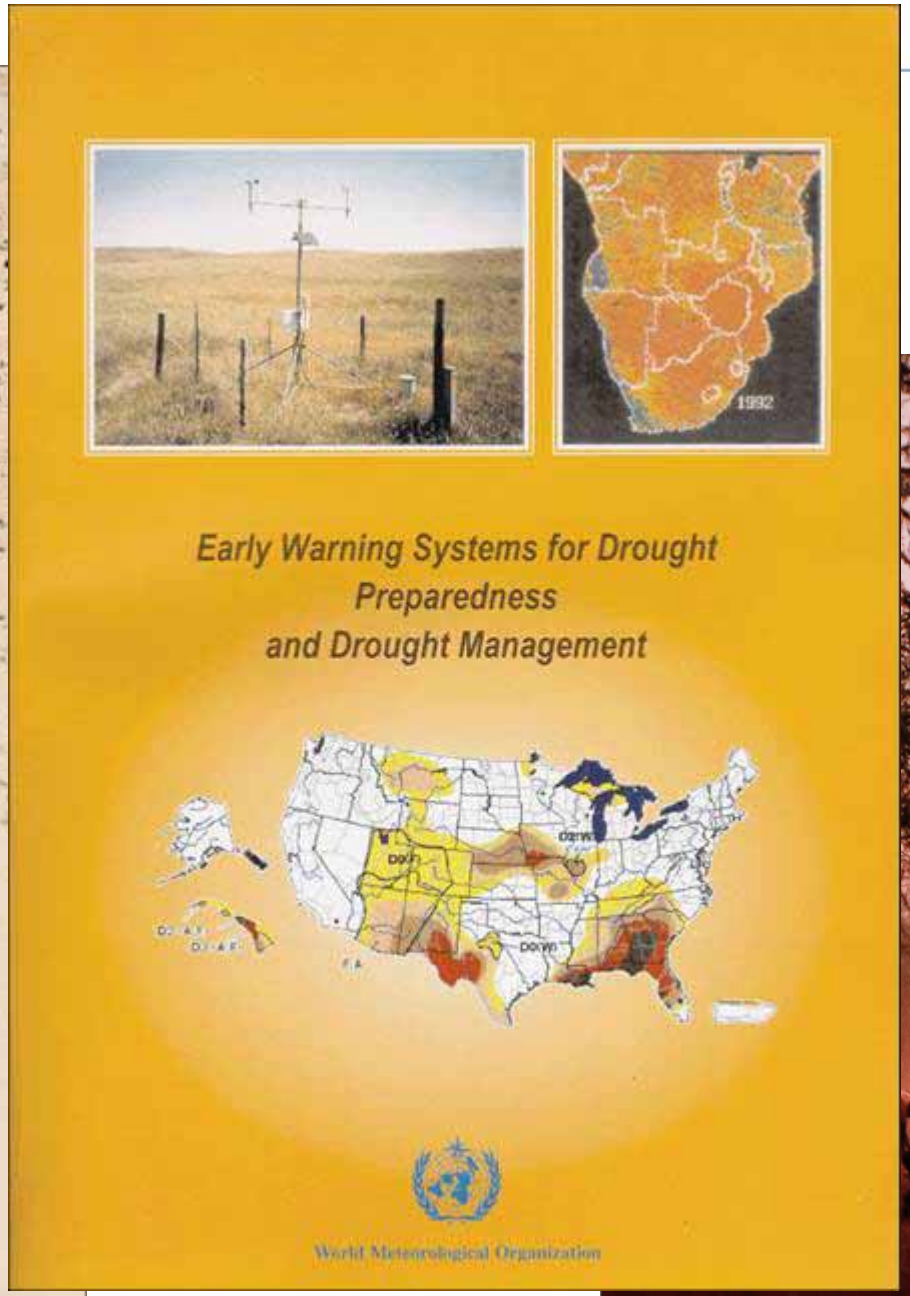
- **WMO Consultant visited the five Central Asian countries ie., Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan in November 2009 to consult with relevant organizations and institutions and prepare project proposal.**

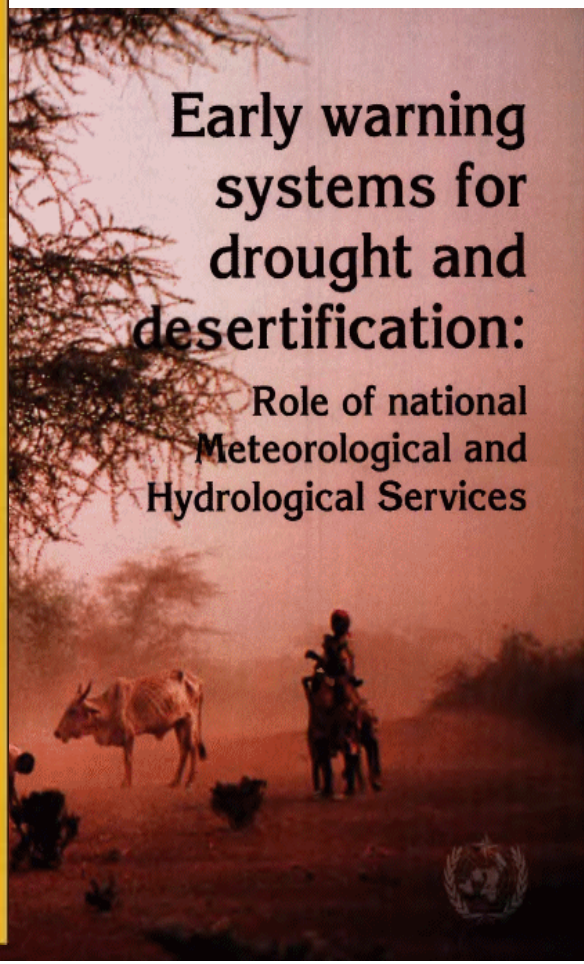
WMO network of institutions



WMO Publications







Recent WMO Drought Activities

Background

Over the years, the drought community has been asked if there is a standard drought index for the world.

Answer: Drought is a complex issue with regional differences and which indices to use is dependent on the application and what sector is being impacted (agriculture, energy, water resources, etc).

Background 2

However, the drought community can recommend certain indices for certain applications and types of drought (meteorological, agricultural, and hydrological droughts).

Background 3

WMO with other partners have organized several meetings and workshops to answer issues.

Lincoln Workshop

- **Inter-Regional Workshop on Indices and Early Warning Systems for Drought held in Lincoln, Nebraska, USA from 8 to 11 December 2009**

- **Co-Sponsors:**
  - **National Drought Mitigation Center (NDMC)**
  - **United States Department of Agriculture (USDA)**
  - **United States National Oceanic and Atmospheric Administration (NOAA)**
  - **United Nations Convention to Combat Desertification (UNCCD)**
  - **University of Nebraska-Lincoln, School of Natural Resources**
  - **World Meteorological Organization**

http://www.wmo.int/pages/prog/wcp/agm/meetings/wies09/index_en.html

Workshop Objectives

- **To review and assess drought indices currently used around the world for the three types of drought (meteorological, agricultural, and hydrological);**
- **To review and assess the strengths, weaknesses and limitations of existing drought indices and early warning systems;**
- **To develop a consensus standard index for each of the three types of drought;**
- **To develop guidelines for WMO Members in implementing and improving drought early warning systems.**

Breakout Groups

- **Mostly followed methodology from Keyantash and Dracup (2002) “The Quanification of Drought: An Evalution of Drought Indices” – Bulletin of AMS - August 2002**

Used following criteria:

- **Robustness**
- **Tractability**
- **Transparency**
- **Sophistication**
- **Extendability**
- **Dimensionality**

Meteorological Drought Outcome

- **Standardized Precipitation Index (SPI) and Percentiles were very close, but the SPI had a slightly higher score**

- **Percent of Normal Precipitation was ranked third**

- **PDSI was a distant fourth**

Recommendation: Use drought indices that are based on a sound statistical and historical perspective (SPI and Percentiles). The SPI is the recommended Meteorological drought index.

Agricultural Drought Outcome

- **No consensus (17 indices)**

Conclusions

- **Water Balance models are quite good since they take into account soil and crop growth**

- **NDVI is very useful and is comparable with hydrological balance**

- **For all indices, a temperature component is important**

Hydrological Drought Outcome

- **No consensus (6 indices)**

Recommendations

- **Examine composite indices that take into account streamflow, precipitation, reservoir levels, snowpack, groundwater levels such as:**
  - **Surface Water Supply Index (SWSI)**
  - **Aggregate Dryness Index (ADI)**
  - **Normalised ADI (NADI) (Barua and Perera 2009)**

Also suggested;

- **Streamflow drought Index (SDI) Nalbantis and Tsakiris (2009)**
- **Artificial Neural Networks (Perera et al. 2009)**

Lincoln Declaration - Recommendations

- **The National Meteorological and Hydrological Services (NMHSs) around the world are encouraged to use the SPI to characterize meteorological droughts and provide this information on their websites, in addition to the indices currently in use.**

- **A comprehensive user manual for the SPI should be developed that will provide a description of the index, the computation methods, specific examples of where it is currently being used, the strengths and limitations, mapping capabilities, and how it can be used.**

Lincoln Declaration - Recommendations

- **Two working groups with representatives from different regions and observers from UN Agencies and Research Institutions (and water resource management agencies for hydrological droughts) be established to further discuss and recommend, by the end of 2010, the most comprehensive indices to characterize agricultural and hydrological droughts.**

- **Recognizing the need to develop a framework for an integrated approach for drought monitoring to address all sectoral needs, a comprehensive study of consensus drought indicators is needed for potential global application.**

Lincoln Declaration - Recommendations

- **A simple, systematic analysis of drought impacts in different sectors should be initiated in all affected countries in order to provide useful decision-making information for policy-makers.**

- **Drought indices and early warning systems must be implemented from the beginning with the end-users in mind. To accomplish this goal, a multi-disciplinary approach incorporating user involvement is absolutely necessary.**

Current Actions

- **The recommendation to use the SPI was approved by the WMO Executive Council in June 2010. It will be sent to the WMO Congress in 2011, along with the recommendations from the other two working groups.**

- **The UN International Strategy for Disaster Risk Reduction (ISDR) is providing funding for the meetings of the working groups on agricultural (June 2010 - Spain) and hydrological (November 2010 - India) drought indices.**

- **With these recommendations, WMO will assist ISDR in finalizing the chapter on drought risks for the 2011 UN Global Assessment Report on Disaster Risk Reduction.**

Proposed Integrated Drought Management Programme

Associated Programme on Flood Management (APFM)

Joint Initiative - **www.apfm.info**

World Meteorological Organization (WMO)

Global Water Partnership (GWP)

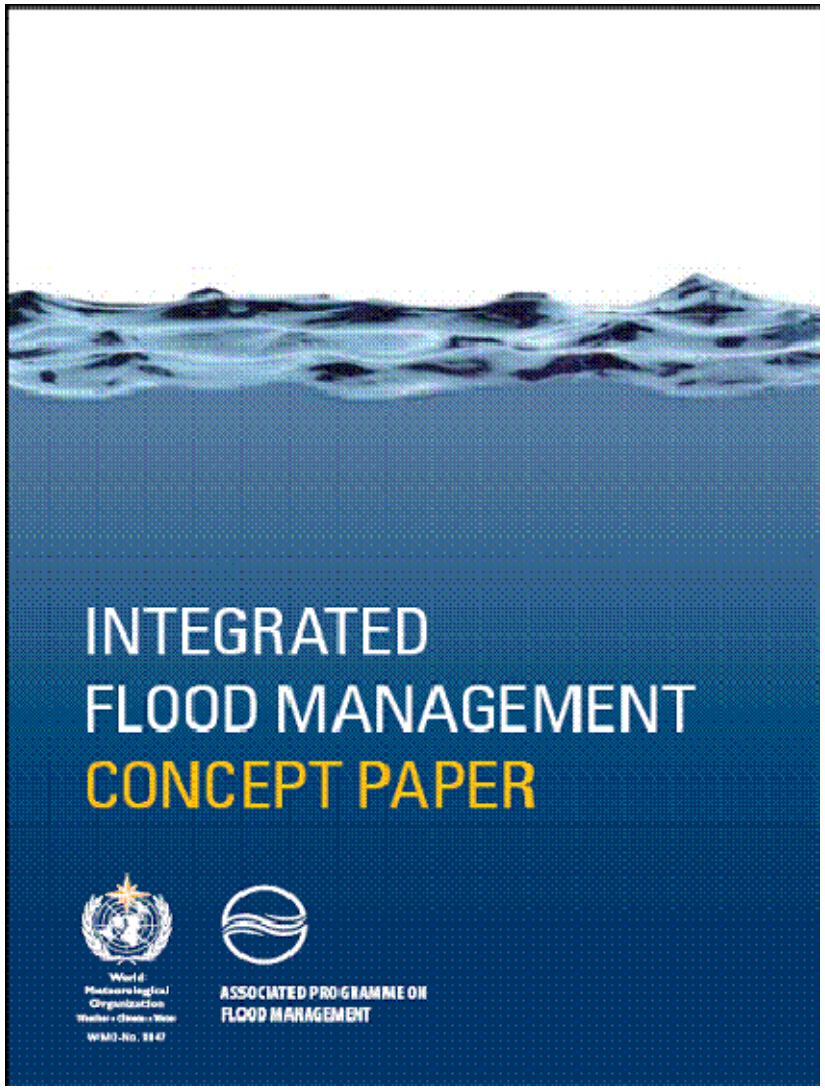
Secretariat

Technical Support Unit in WMO

- Inception Phase: 2001- 2002
- Implementation Phase I: 2002- 2006
- Implementation Phase II: 2006-2010

Trust Fund current contributors: Japan and Switzerland

Flood Management Policy Series



- Environmental Aspects
- Social Aspects and Stakeholder Involvement
- Economic Aspects
- Legal and Institution Aspects

Proposed Integrated Drought Management Programme

- **WMO** and the **Global Water Partnership** proposing **Integrated Drought Management Programme**. Similar to APFM
- **Targeting intergovernmental, governmental and non-governmental organizations** in drought monitoring, prediction, drought risk reduction and management.
- Primary beneficiaries: **governmental institutions, agencies** responsible developing **drought management policies** and/or **drought monitoring, prediction, preparedness and mitigation.**
- **Develop global co-ordination** of efforts **strengthen drought monitoring, risk identification, drought prediction** and **early warning services** and development of drought management knowledge base.

Proposed Integrated Drought Management Programme (cont)

- **The expected services to be provided are:**
  - Regional coordination of drought monitoring, prediction and early warning activities
  - Inception of pilot projects and coordination of regional projects to showcase best practices
  - Collection and dissemination of information and knowledge on good practices;
  - Guidelines, methodologies, tools and supporting documentation on **policy development and management practices and procedures**; and
  - Capacity building and advice on Integrated Drought Management.

Lessons Learned

Lessons Learned

- Don’t promise too much to quickly.
- Don’t oversell the information.
- Establish credibility slowly but surely.
- Implement new products with proper introduction.

Lessons Learned

- Be proactive in demonstrating the usefulness of your products.
- Relate the weather data to meaningful agricultural information.
- Training and education is an essential component.
- Strive to pool resources.

Final Thoughts

- What information does the user need?
- When does the user need this information?
- To answer these questions, there must be an established mechanism ....

.... between users & producers .

Thank You

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