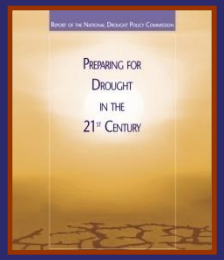
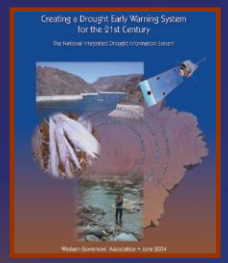
The National Integrated Drought Information System: The Colorado Basin

Roger S. Pulwarty
Director, NIDIS
National Oceanic and Atmospheric Administration
Boulder CO



"(We) contend that we can reduce this nation's vulnerability to the impacts of drought by making preparedness— especially drought planning, plan implementation, and proactive mitigation— the cornerstone of national drought policy.."— ***National Drought Policy Commission Report, May 2000***

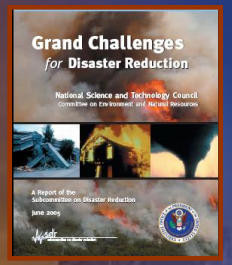


"NIDIS should improve and expand the **compilation of reliable data on the various indicators of droughts**, and it should **integrate and interpret that data with easily accessible and understandable tools, which provide timely and useful information to decision-makers and the general public.**— ***Western Governor's Association Report, June 2004***

"Characteristics of disaster-resilient communities":

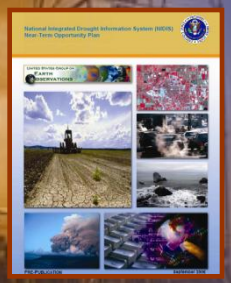
- **Relevant hazards are recognized and understood.**
- **Communities at risk know when a hazard event is imminent.**
- **Individuals at risk are safe from hazards in their homes and places of work.**
- **Communities experience minimum disruption … after a hazard event has passed."**

— National Science and Technology Council, June 2005

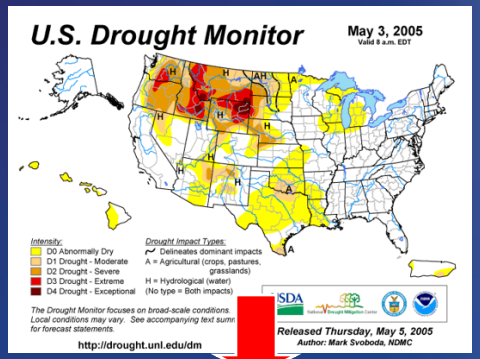


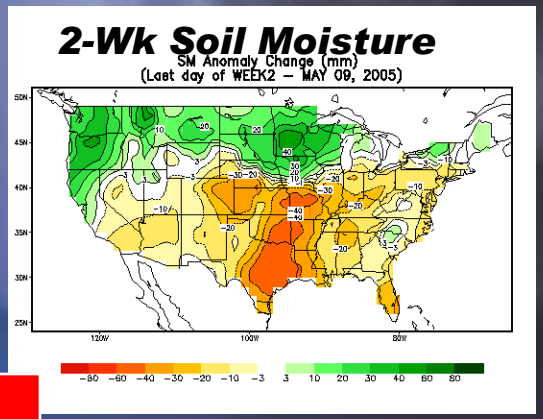
"Near-term opportunities identify observing systems or integration of components that meet high priority societal needs, and make improvements to inadequate existing systems that can be completed within 5 years and have tangible, measurable results.

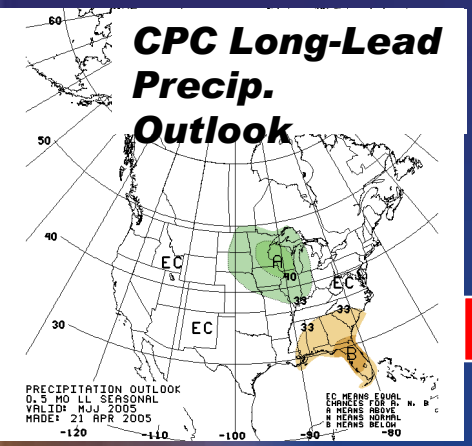
- *Improved Observations for Disaster Warnings*
- *Global Land and Sea Level Observation Systems*
- ***National Integrated Drought Information System***
- *Air Quality Assessment and Forecast System*
- *Architecture and Data Management."* ***— U.S. Group on Earth Observations, Sept. 2006***

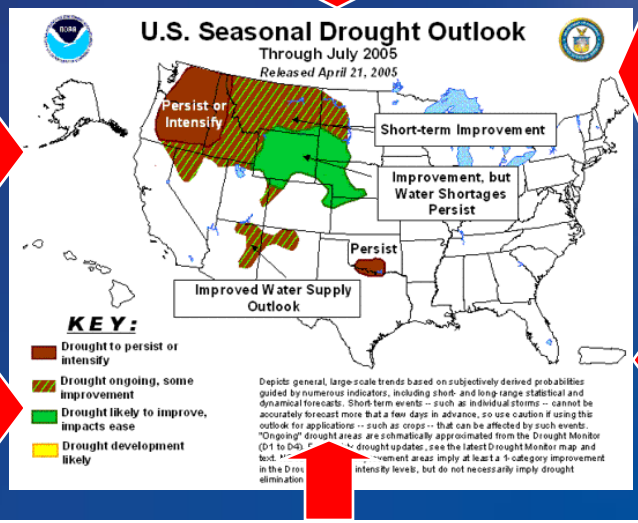


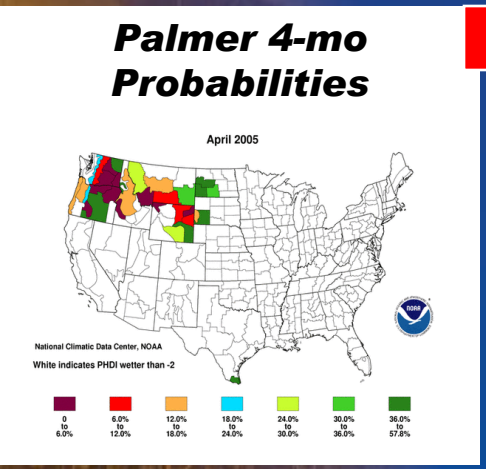
Principal Drought Outlook Inputs

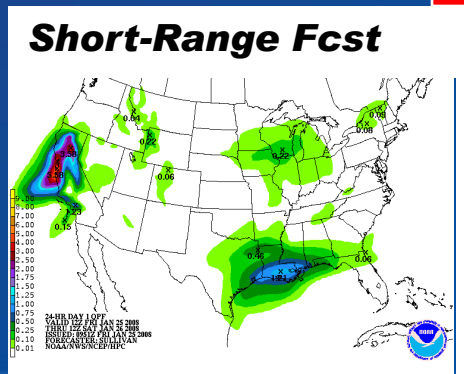


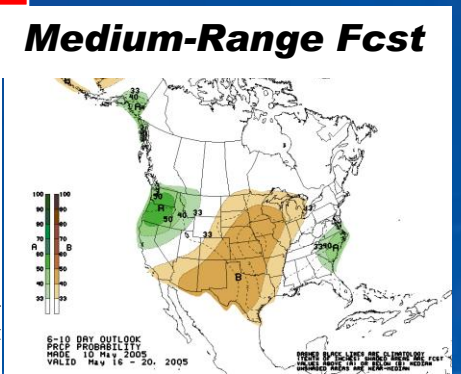


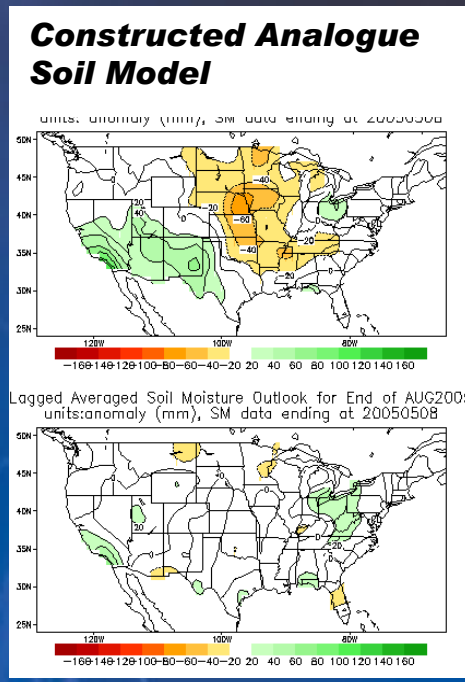




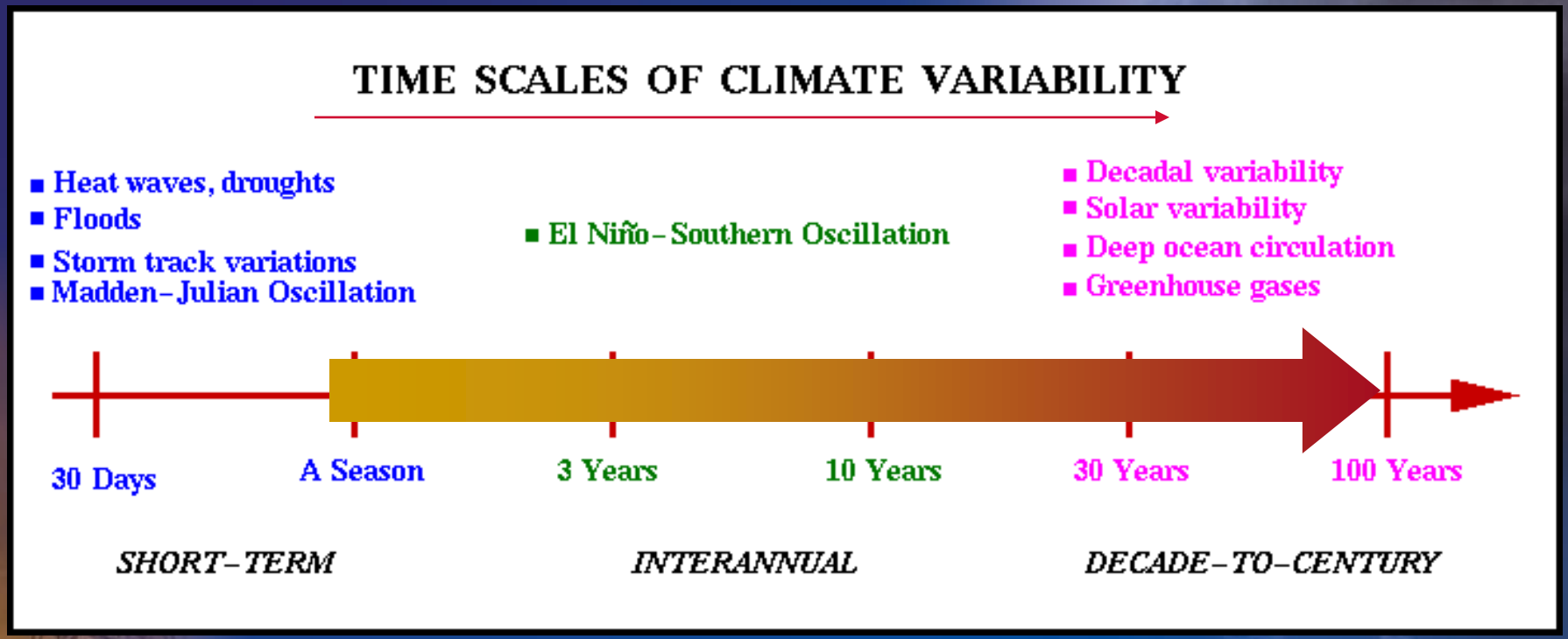






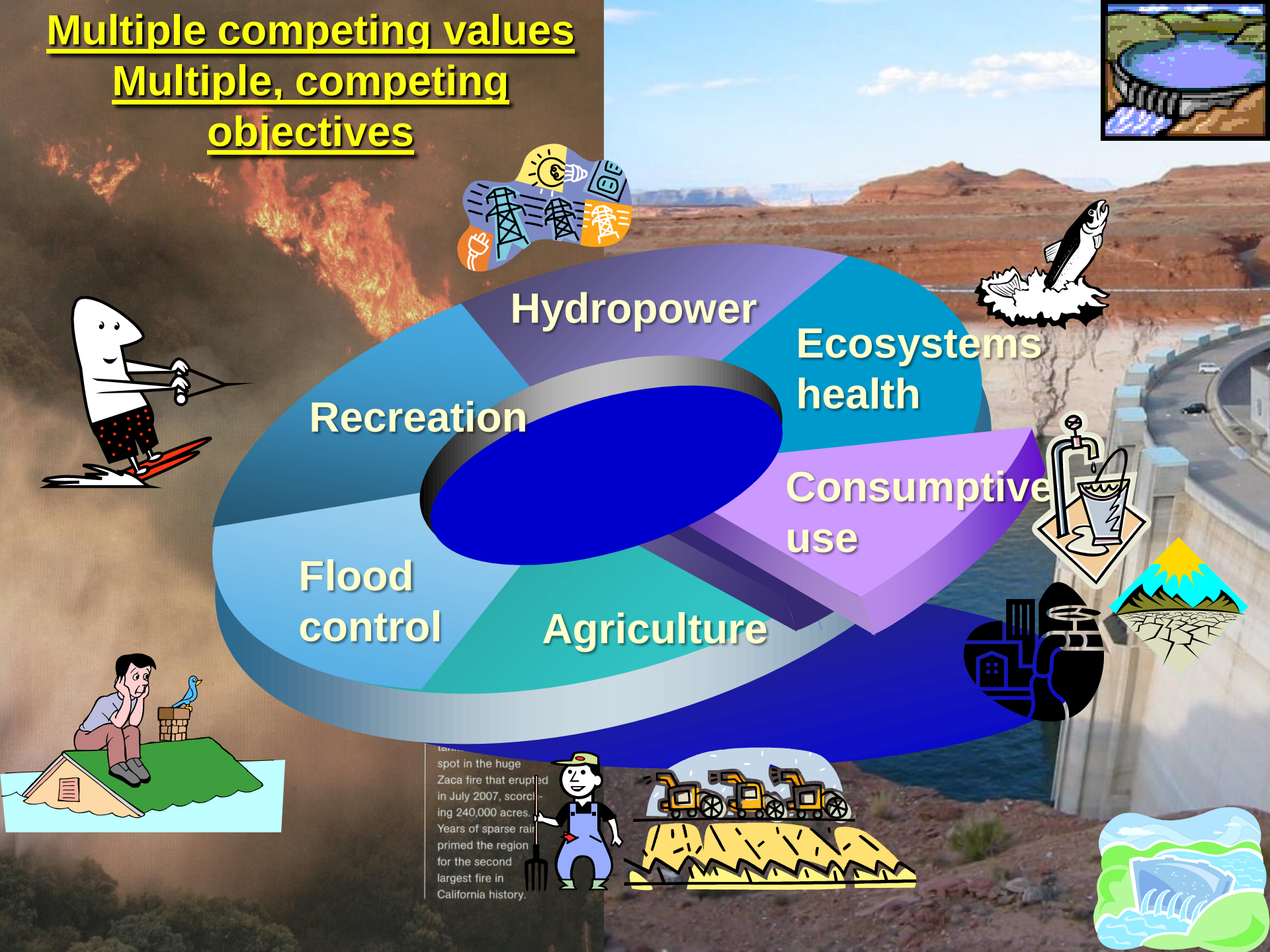


Challenge:
Diverse Temporal and Spatial Scales



Droughts span an enormous range of time and spaceescales

Multiple competing values
Multiple, competing objectives



spot in the huge Zaca fire that erupted in July 2007, scorching 240,000 acres. Years of sparse rain primed the region for the second largest fire in California history.

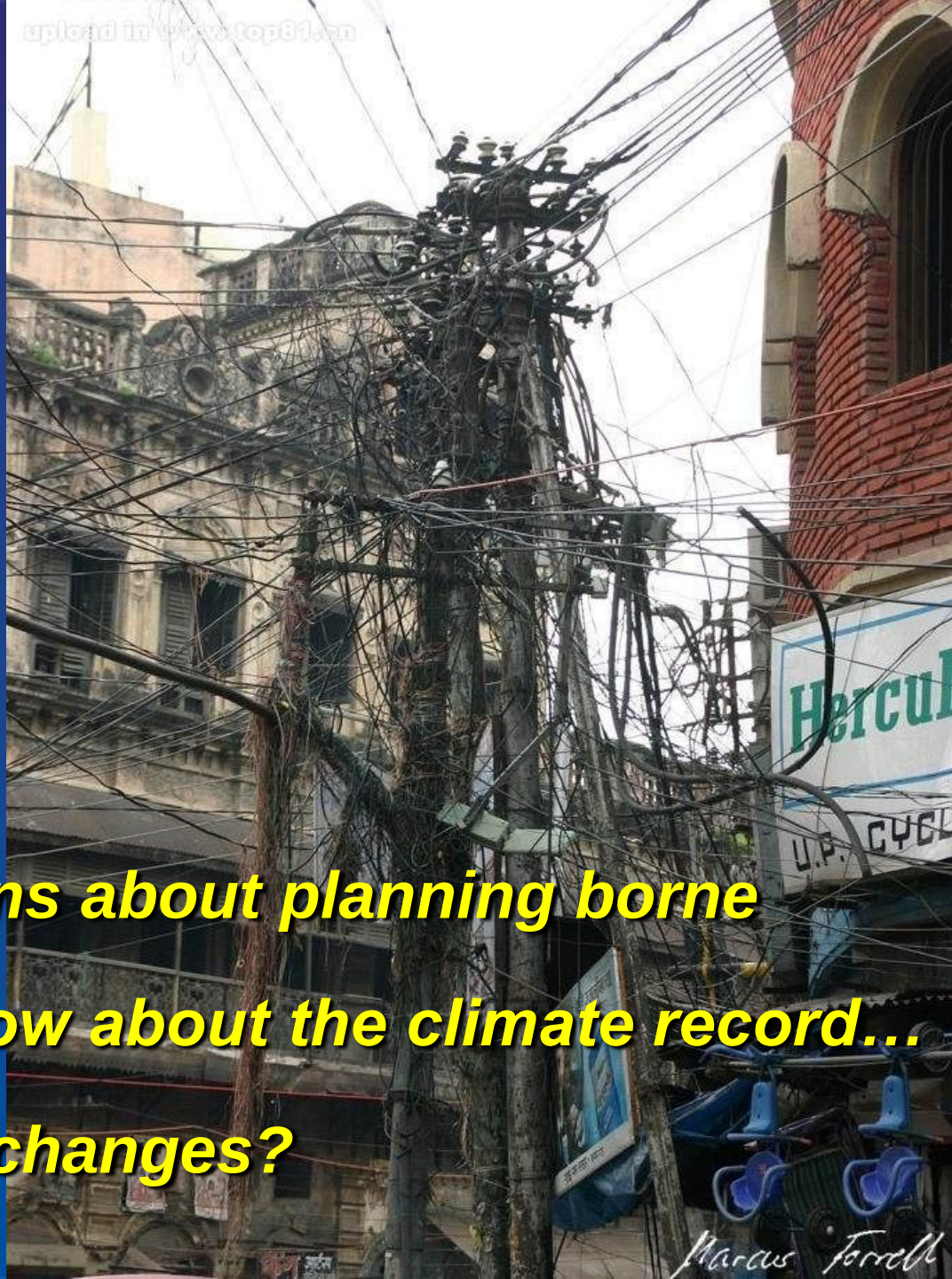
"No systematic collection and analysis of social, environmental, and economic data focused on the impacts of drought within the United States exists today"

Western Governors Association 2004

If so……..

_…….so what ?

Are the assumptions about planning borne out by what we know about the climate record… or about potential changes?



NIDIS VISION and GOALS

"A dynamic and accessible drought information system that provides users with the ability to determine the potential impacts of drought and the associated risks they bring, and the decision support tools needed to better prepare for and mitigate the effects of drought."
Public Law 109-430 (Signed by the President December 2006)

(www.drought.gov)

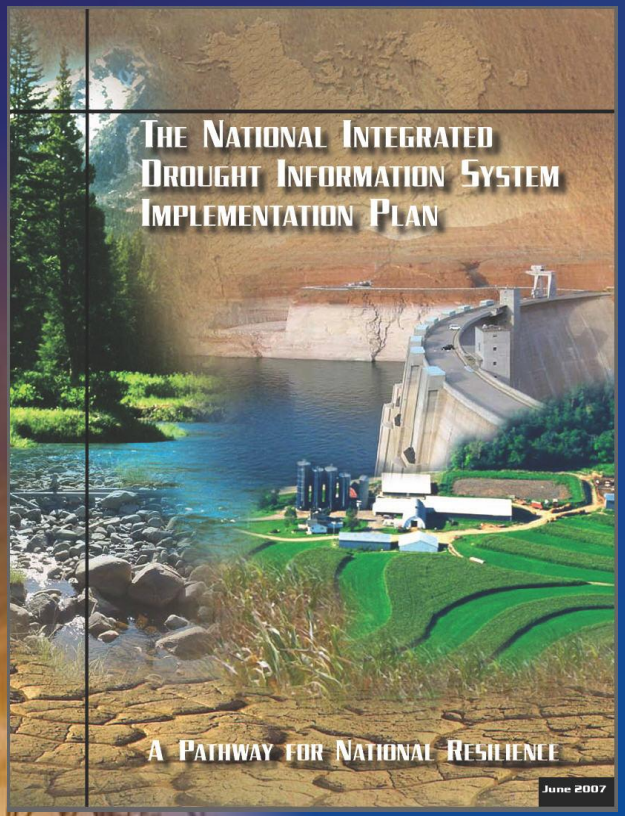
NIDIS
NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

NIDIS Objectives

Creating a drought early warning *information* system

- ***Coordinating national drought monitoring and forecasting system***
- ***Providing an interactive drought information clearinghouse and delivery system for products and services—including an internet portal and standardized products (databases, forecasts, Geographic Information Systems (GIS), maps, etc)***
- ***Designing mechanisms for improving information to support coordinated preparedness and planning***

NIDIS Implementation Team Partners (to date):



www.drought.gov

- NOAA
- Western Governors Association
- USGS
- Dept. of Interior (BoR)
- U.S. Army Corps of Engineers
- USDA (NRCS, ARS, CSREES)
- NASA
- Indigenous Waters Network
- Regional Climate Centers
- National Drought Mitigation Center
- Association of State Climatologists
- Cornell University
- New Mexico State University
- Rutgers University
- South Dakota State University
- University of Oklahoma
- University of South Carolina
- University of Washington
- The Weather Channel

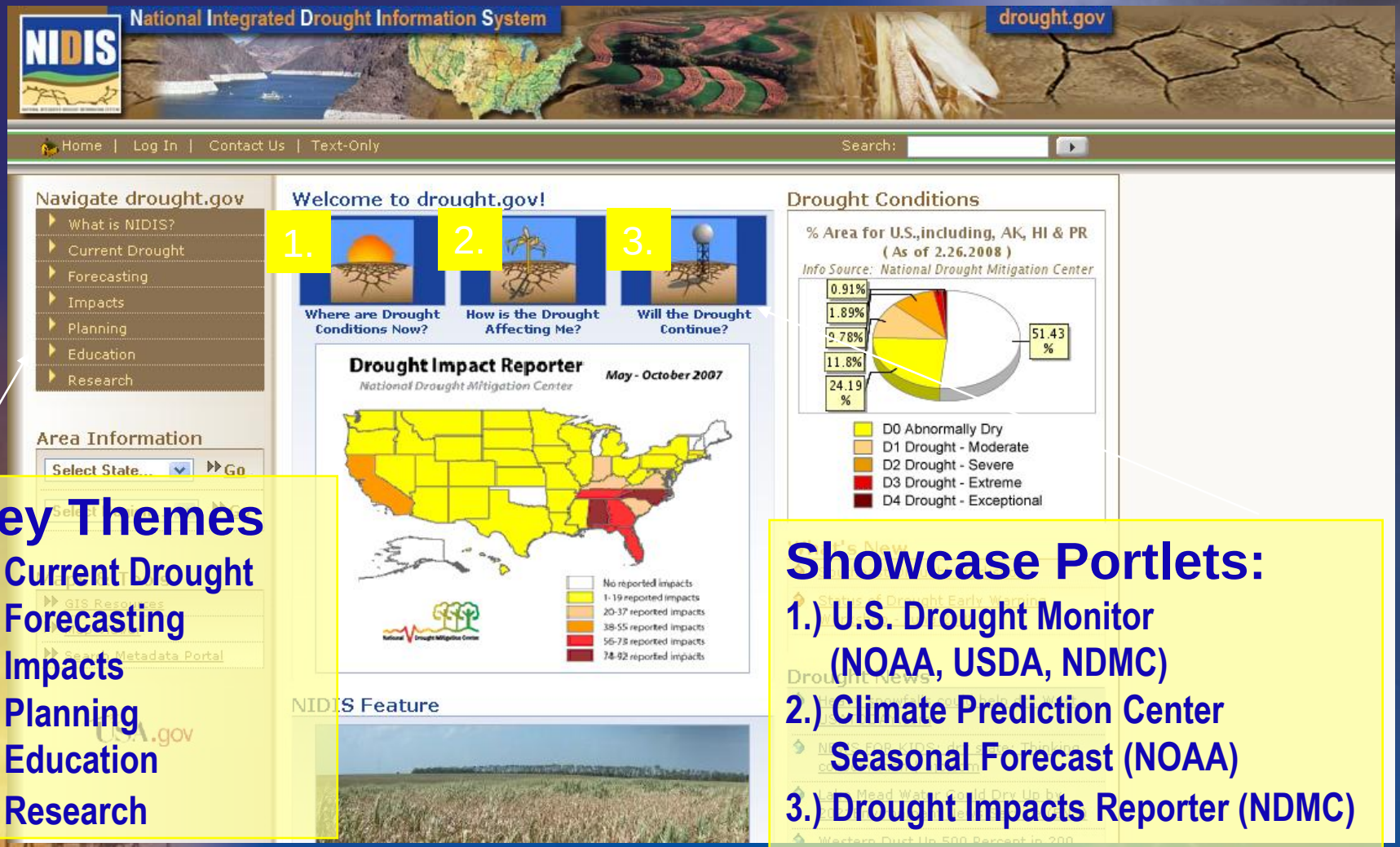
New:

- Duke Power
- U. Georgia
- Others?

Early Warning System components

- Monitoring and forecasting
- Risk assessment: Indicators and triggers
- Drought risk planning and preparedness
- Drought Portal
- Communication and Education

The U.S. Drought Portal (www.drought.gov)



Key Themes

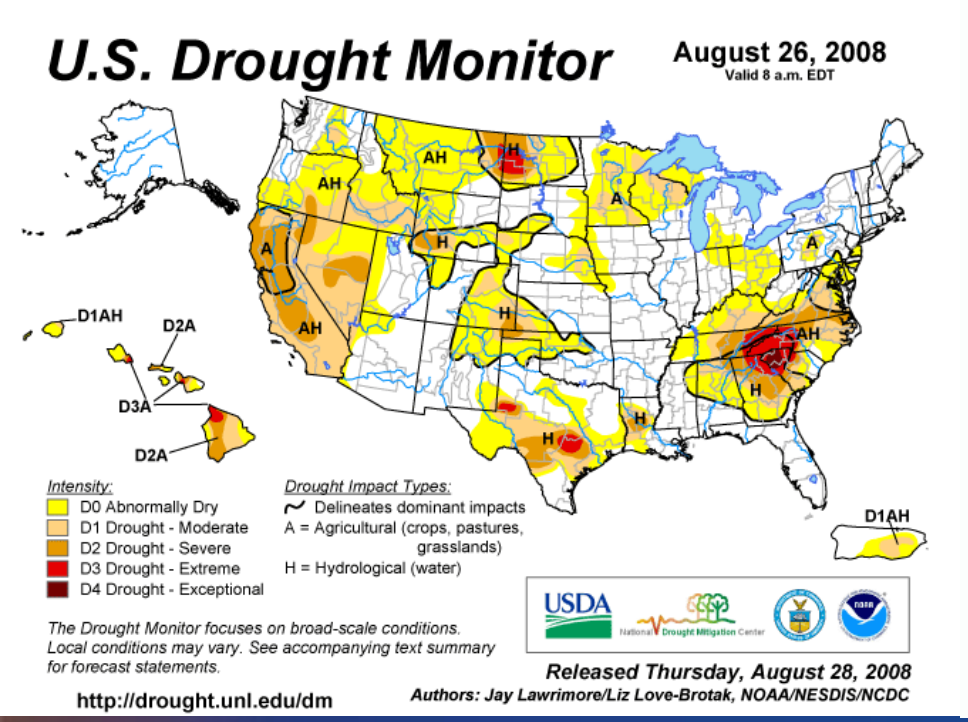
1.) Current Drought
2.) Forecasting
3.) Impacts
4.) Planning
5.) Education
6.) Research

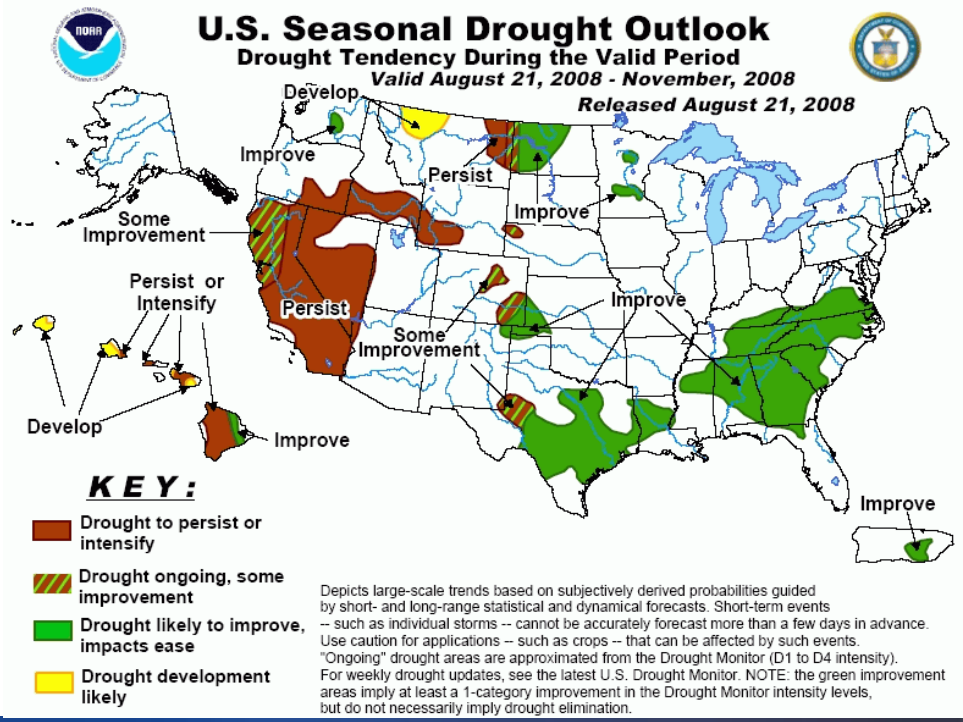
Showcase Portlets:

1.) U.S. Drought Monitor (NOAA, USDA, NDMC)
2.) Climate Prediction Center Seasonal Forecast (NOAA)
3.) Drought Impacts Reporter (NDMC)

NIDIS Knowledge and Service Assessment Workshops

- "Reconciling Projections of Future Colorado River Stream Flow", Sept 2007/November 2008
- "Remote Sensing Contributions to Drought Monitoring", February 6-7, 2008, Boulder
- "NIDIS Southeast Drought Workshop" – April 29-30, 2008, Peachtree City, Georgia
- "National Status of of Drought Early Warning Systems", June 17-19, 2008, Kansas City

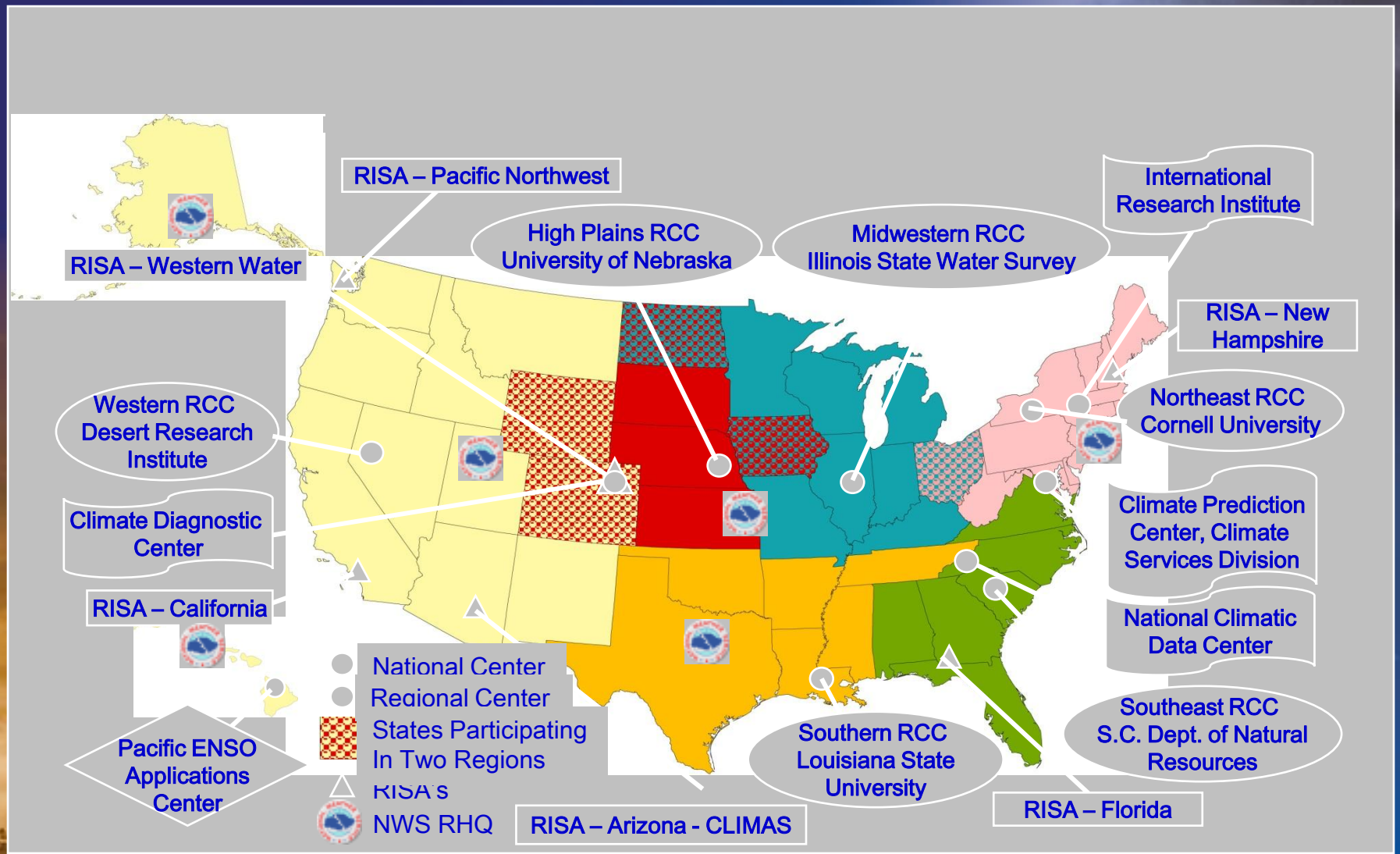




Tailoring and interpretation of national products needed for regional, watershed and local detail and usability

Upscaling of local data to create regionally specific monitors and risk assessment

NOAA & NOAA-Supported Centers



A mixed of traditional and newer approaches

In laymen's terms there are 23 flushes left…..

Atlanta Journal Constitution Oct. 2007

NIDIS Early Warning Systems Pilots – Drought-type and analysis units

Coordinated reservoir operations: Low flow shortage triggering criteria (Powell/Mead)

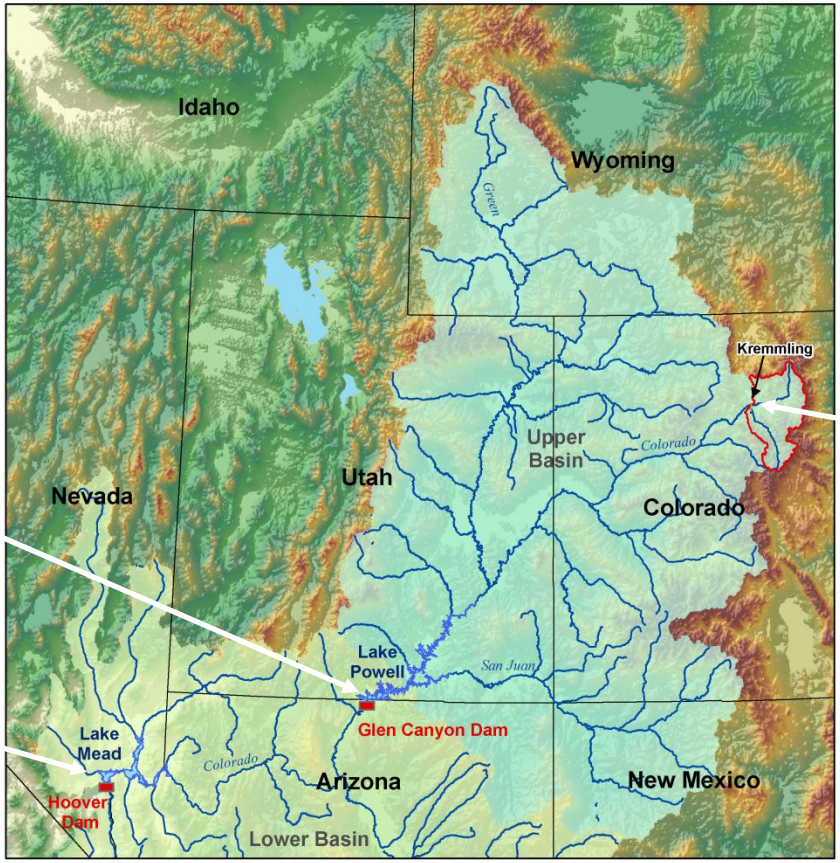
Inter- and Intra-basin transfers

Ecosystem health/services

Lake Powell

Lake Mead

Kremmling



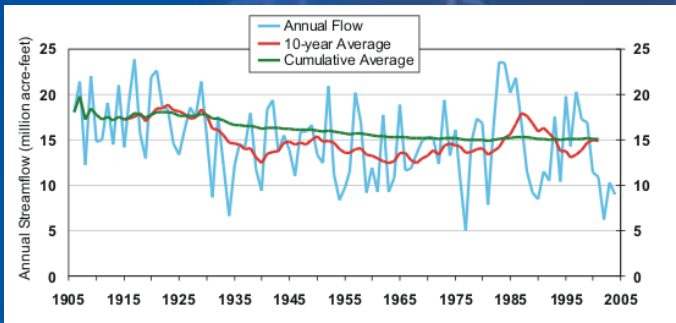
NIDIS

NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

States
Dams
Streams
Reservoirs
Upper Basin
Lower Basin

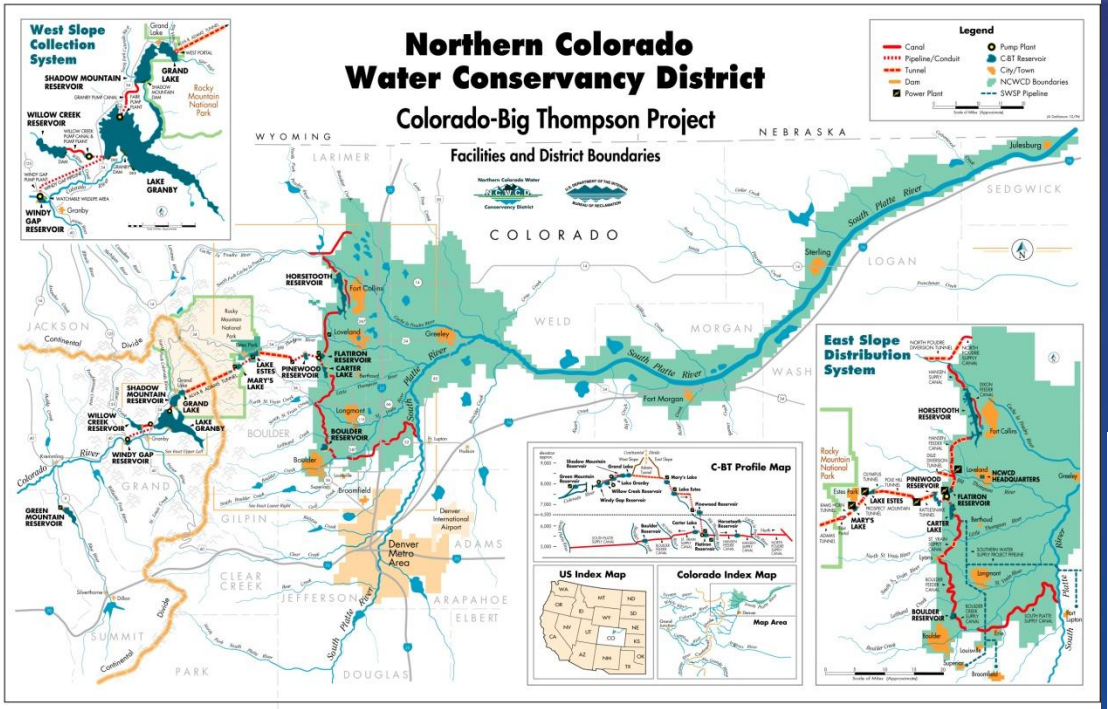
Elevation
High
Low

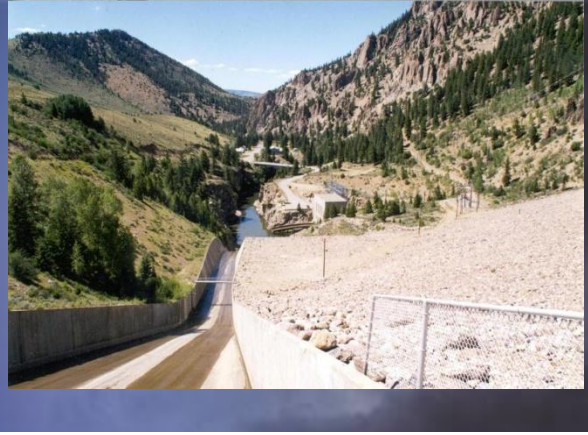
0 25 50 100 150 200
Miles



Spatial Resolution/ Time Horizon	Operational Activity	Decisions
Basin-wide over decades	Long-term Planning	Operating Criteria and Guidelines
Basin-wide over 1-2 years	Mid-term Operations	Annual Operating Plan
Sub-basin over 4-6 weeks	Short-term Scheduling	Water and Power Schedules Unit Commitment Economic Dispatch
Single project over 1-7 days	Real-time Control	Automatic Generation and Control

(T. Fulp BoR)





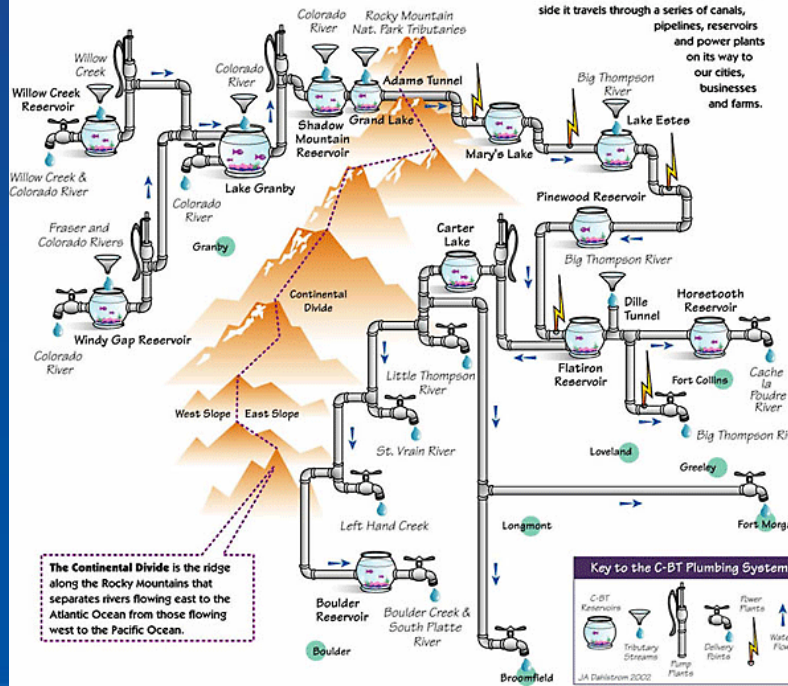
THE COLORADO-BIG THOMPSON PROJECT

Source of Water

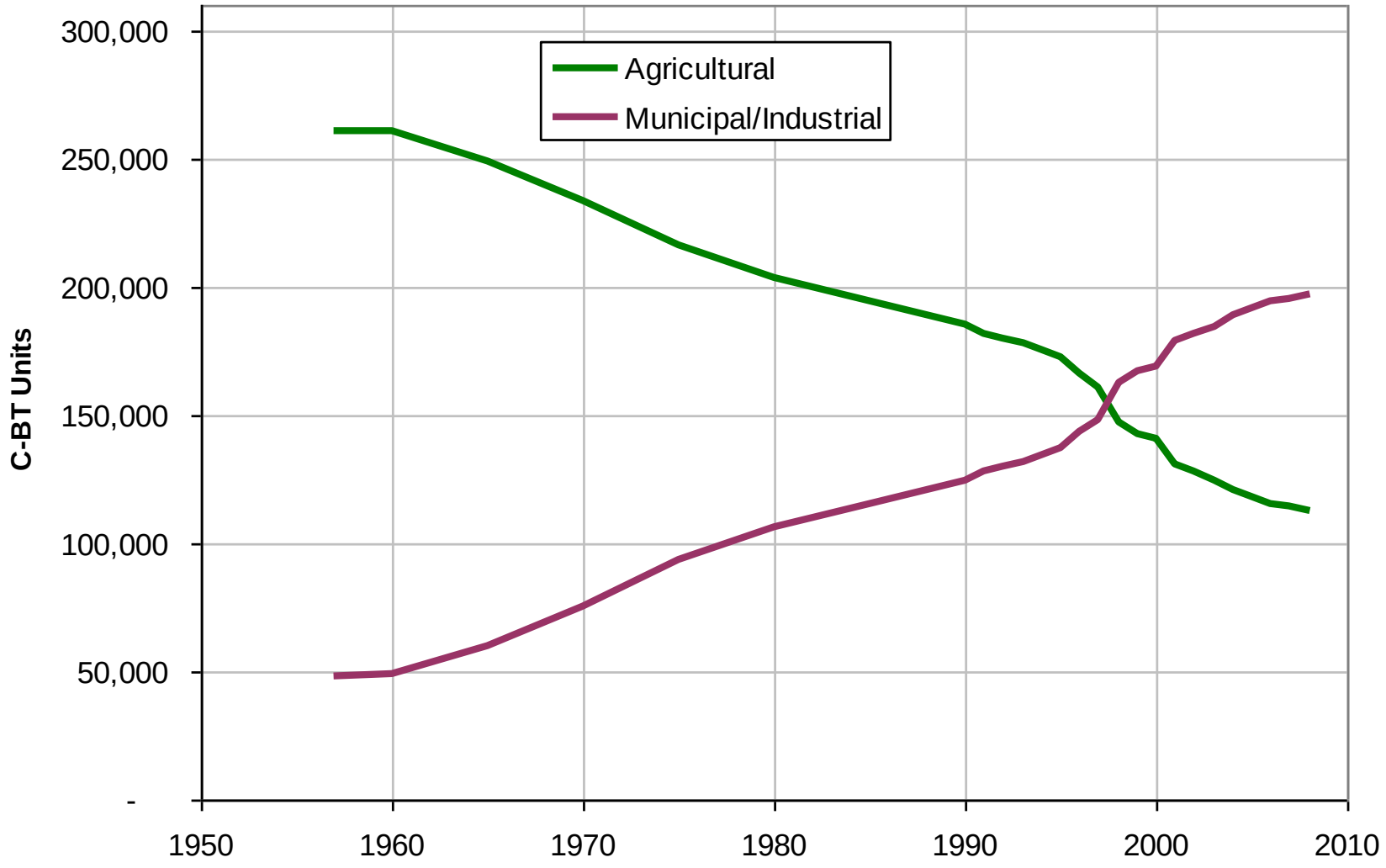
We live in a pretty dry region here in northeastern Colorado. The area receives approximately 14 inches of precipitation each year. This amount does not meet all our needs.

So what do we do? We bring water from the other side of the Continental Divide, where more than 80 percent of Colorado's rain and snow fall, through and around the beautiful Rocky Mountains to supplement what Mother Nature provides naturally. If we didn't this region would look far different and many of us would not be living here.

The Colorado-Big Thompson Project, or C-BT, was built over 50 years ago to help us water the thirsty plains of northeastern Colorado. The C-BT collects water from melting snows on the west side of the mountains, then pumps it uphill and through the 13-mile long Adams Tunnel and under Rocky Mountain National Park. Once the water reaches the east side it travels through a series of canals, pipelines, reservoirs and power plants on its way to our cities, businesses and farms.



Agricultural vs. Municipal/Industrial Ownership



NCWCB

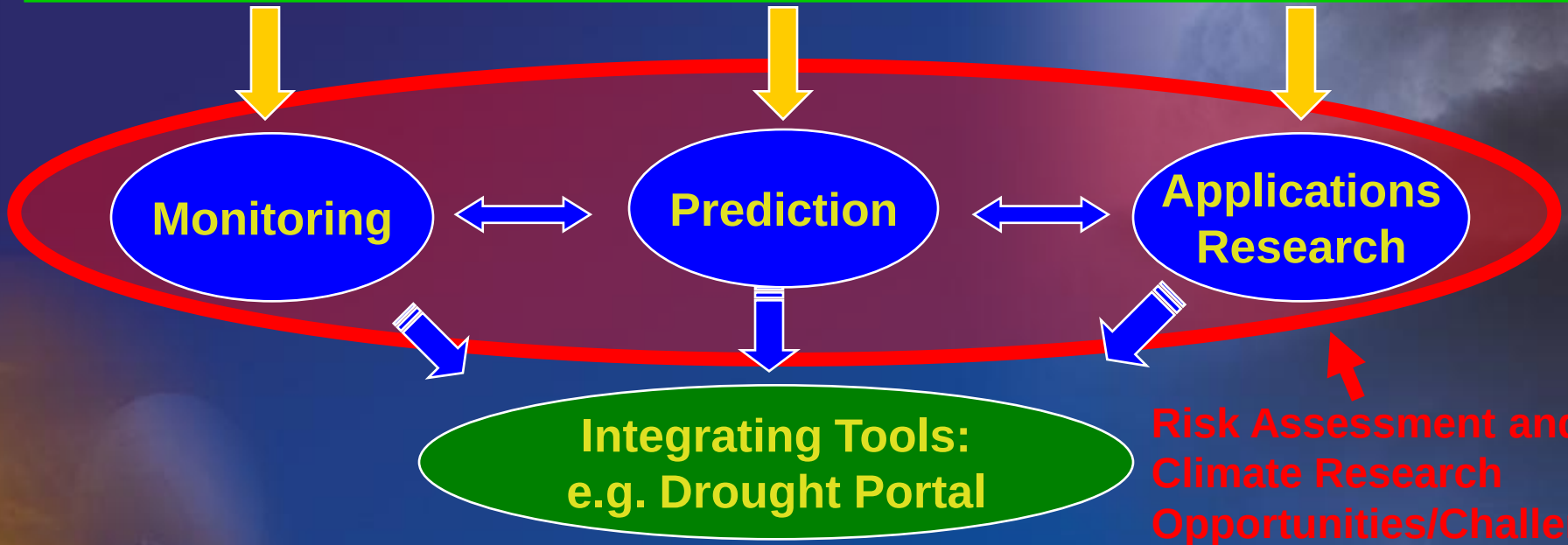
- **Assist in demand projections**
  - ***Northern Water***
  - ***Denver Water***
  - ***Grand Valley***
- **Assist USFWS in setting target flows**
  - ***Peak enhancement***
  - ***Late summer flows in 15-Mile Reach***
- **Initiate drought mitigation discussions (e.g. Shoshone call reduction)**

(BoR Eastern CO Area office)

- Drought monitor-U.S. Seasonal Drought Outlook Basin specifics
- Insufficient number of high-elevation sites collecting weather and streamflow data
- Tie global indices and signals (e.g., PDO, AMO, ENSO) to regional drought signals
- How often are droughts on the west side of the divide “in-phase” with droughts on the east side?
- NCWCD has no explicit triggers or formulas related to quota allocation
- Peak flow on May 1 and June 1
- ***Potential fate of the UCRB snowpack in early March with respect to the degree that above-average temperatures and windy conditions in March and April might decrease the April-July forecasted runoff to Lake Powell***
- ***(NCWCD)***

NIDIS Implementation

Coordinating federal, state, and local drought-related activities (*e.g.*, within watersheds and states)



Engaging preparedness communities: Indicators and management triggers

Upper Colorado River (down to Lake Mead) Pilot Meeting Boulder, CO, October 1 & 2, 2008

Assessment study of gaps in monitoring, in process understanding, and in prediction

- Gather and synthesize information from observation network operators, researchers, and forecasts/projection producers
- Identify unmet needs for drought early warning
- Provide the basis for initiatives to strengthen and enhance monitoring, understanding and prediction in support of drought early warning

Upper Colorado River Pilot

Drought early warning client organizations convened from three categories:

- Water managers from Reclamation and State governments of Utah, Wyoming, and Colorado
- Urban/local water supply managers (Denver, Salt Lake City, Northern Colorado Water Conservancy District)
- Ecosystems/environmental/recreational resource managers (Forest Service, EPA, States, NPS, USGS/BRD, NGOs)
- State and Federal climate researchers
- Explore existing mandates, decision cycles, and organizational capacities to determine a team to implement the pilot

Four main topics emerged for near-term action:

- Assessment of gaps in present monitoring and forecasting systems within the Basin
- Assimilation of existing drought-related indicators, triggers and trends into one accessible location
- Promoting interaction (existing websites, datasets) with the US Drought Portal to begin developing a Colorado Basin drought portal and information clearinghouse
- Begin efforts to develop an Upper Colorado basin-specific drought monitor (including interbasin transfer locations and ecosystem impacts)

- **Develop small, focused teams led by the meeting participants (and others) beginning the design of the pilot early warning system.**

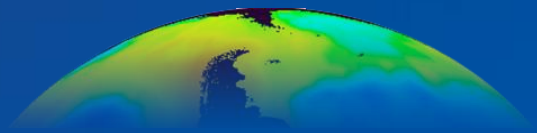
- **Teams will begin to assess the role that improved coordination and access to such information could have played on planning and managing the impacts of previous events such as 2002, 1977 and multi-year events (and then for events selected from the paleoclimatic record and for projections of future changes relevant to water managers).**

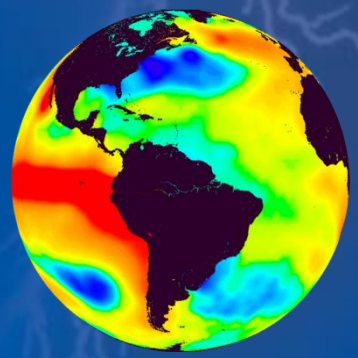
- **NIDIS Office will begin to work with the conservancies, urban, and federal entities on developing periodic discussions as key forecasting dates approach (most likely as part of existing water availability and management meetings)**

- **Year 1: Designing a Drought Early Warning Information System**
  - *What exists. Gap analysis monitoring and forecasting*
  - *Key players-Existing planning processes*
    - What partnerships and actions are needed (to improve information development, coordination and flow)

- **Year 2. Implementation of the Drought Early Warning System (across timescales from a season multi-year, longer term trends):**
  - *Improving coordination, feedback into "Colorado Basin" Drought Portal, ongoing briefings on impacts and projections across climate timescales*
  - *Years 3 and beyond : Early Warning System transferability and support*

- **The combination of the inherent uncertainty of natural variability, plus projections for a warmer climate in the 21st century, make *early warning* and *adaptation* more important than ever**
- **NIDIS offers a framework for integration and mainstreaming of vulnerability and hazard information to support adaptation strategies**



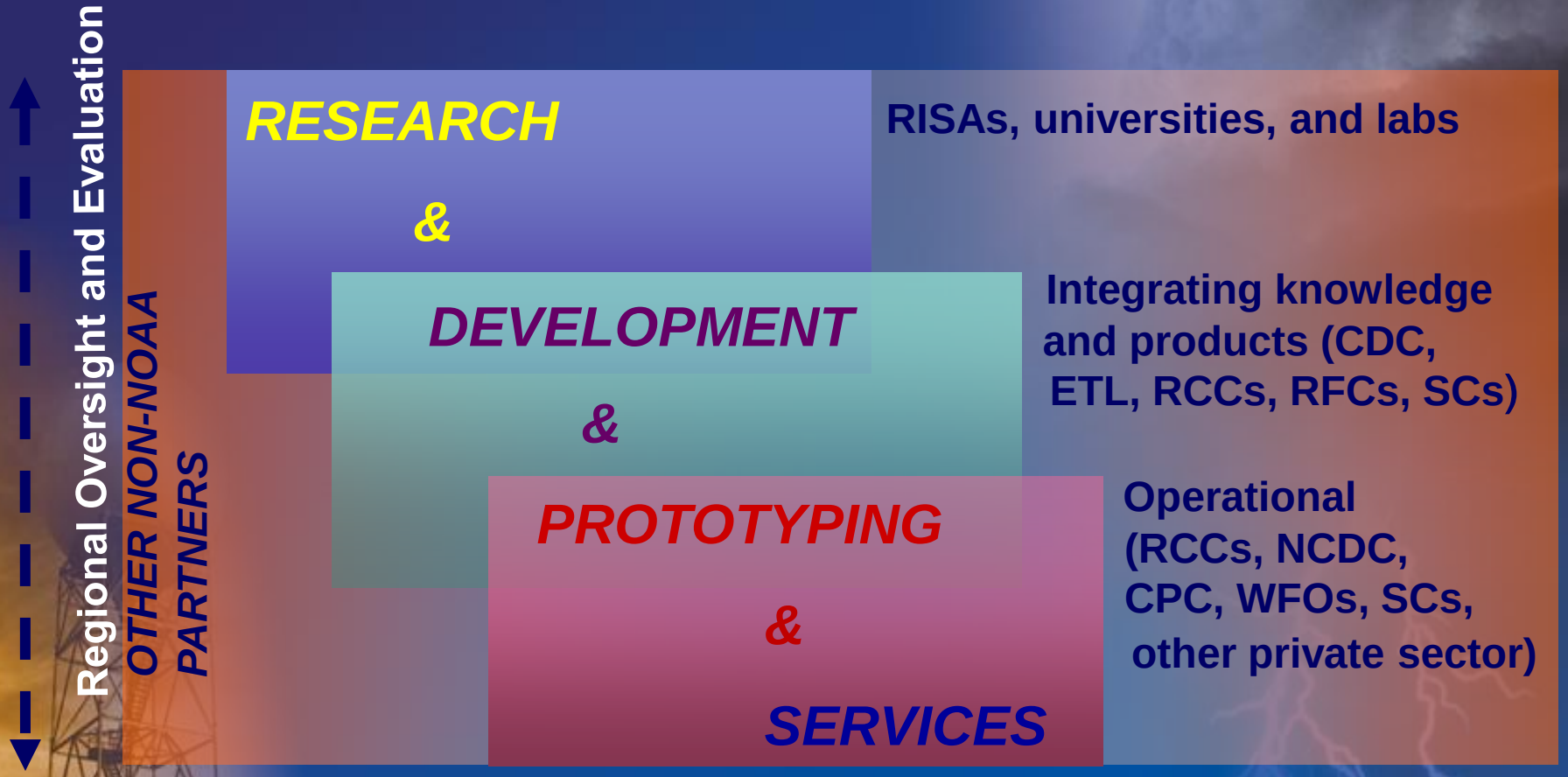


OVERCONFIDENCE

This is going to end in disaster, and you have no one to blame but yourself.


Thanks!
NIDIS
NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

National Climate Service:
Information services in support of adaptation

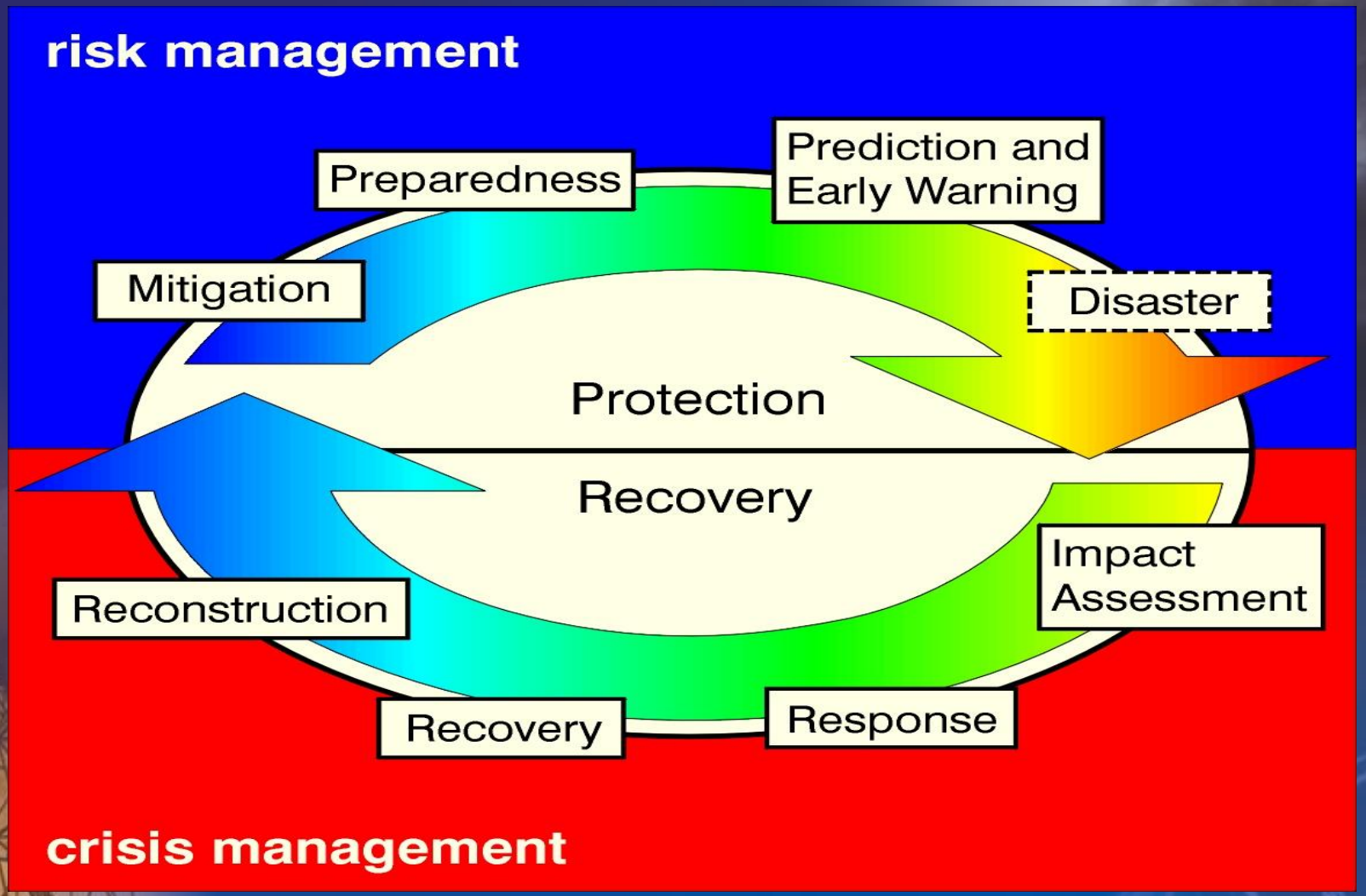


new or enhanced regional products
information delivery technology
sustained & systematic communication and feedback

Potential Opportunities/Challenges

Risk Assessments	**vulnerabilities, triggers, decision making process, adaptive capacity, mitigation pathways, building/engaging network of users/partners**
Monitoring	**current and past temperature, precipitation, snowpack, soil moisture, runoff and evapotranspiration, and vegetation health trends/variations -- at all elevations**
Process Understanding	**critical thresholds, elevation dependency of climate change, closing the hydrologic budget, role of aerosols, role of sublimation, soil moisture sources and sinks, impacts of land use changes**
Modeling, Forecasts, Projections	**Improved atmospheric/ hydrology coupling, extension of reliable predictions beyond 10 days better seasonal outlooks + 2 to 5 year timescale, hydrologic demand predictions, downscaled projections to relevant elevation & spatial scales**

The Cycle of Disaster Management



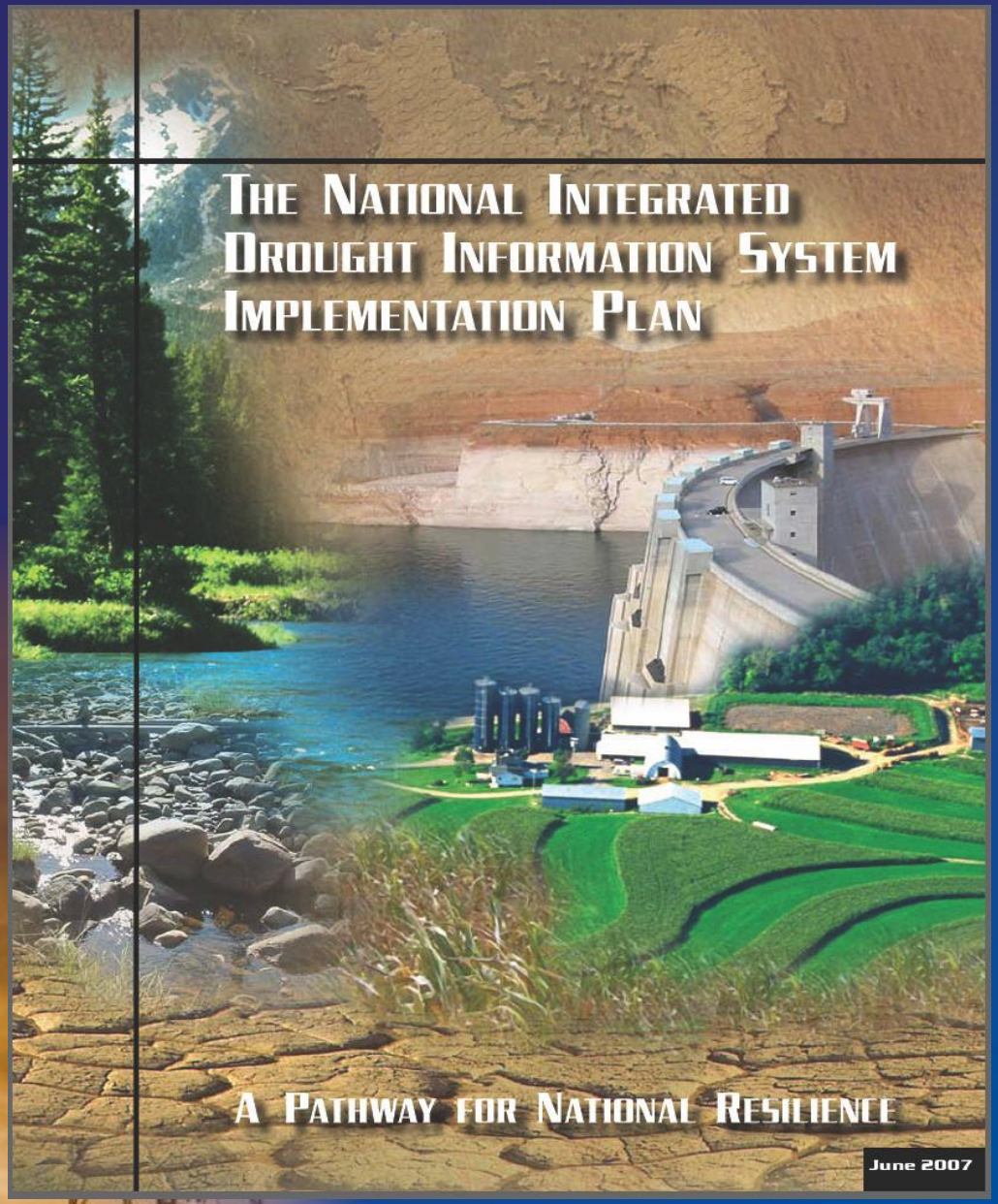
NDMC and others

Where are we?

- *Interagency and Interstate NIDIS Team and Implementation Plan (June 07)*
- *U.S. Drought Portal rollout (October 07)*

- *Identify and review NOAA (and other) cross-line activities in support of NIDIS*
  - **(NIDIS Executive Council)**
- *Satellite-based drought monitoring (Feb08), Climate projections over the Colorado Basin (Fall 07)*
- *Designing drought early warning systems for the Southeast (ACF-ACF) April 08*
- *Planning meeting: Upper Colorado Basin (down to Lake Mead)*
- *National Status of Drought Early Warning Systems (June 2008 Kansas City)*

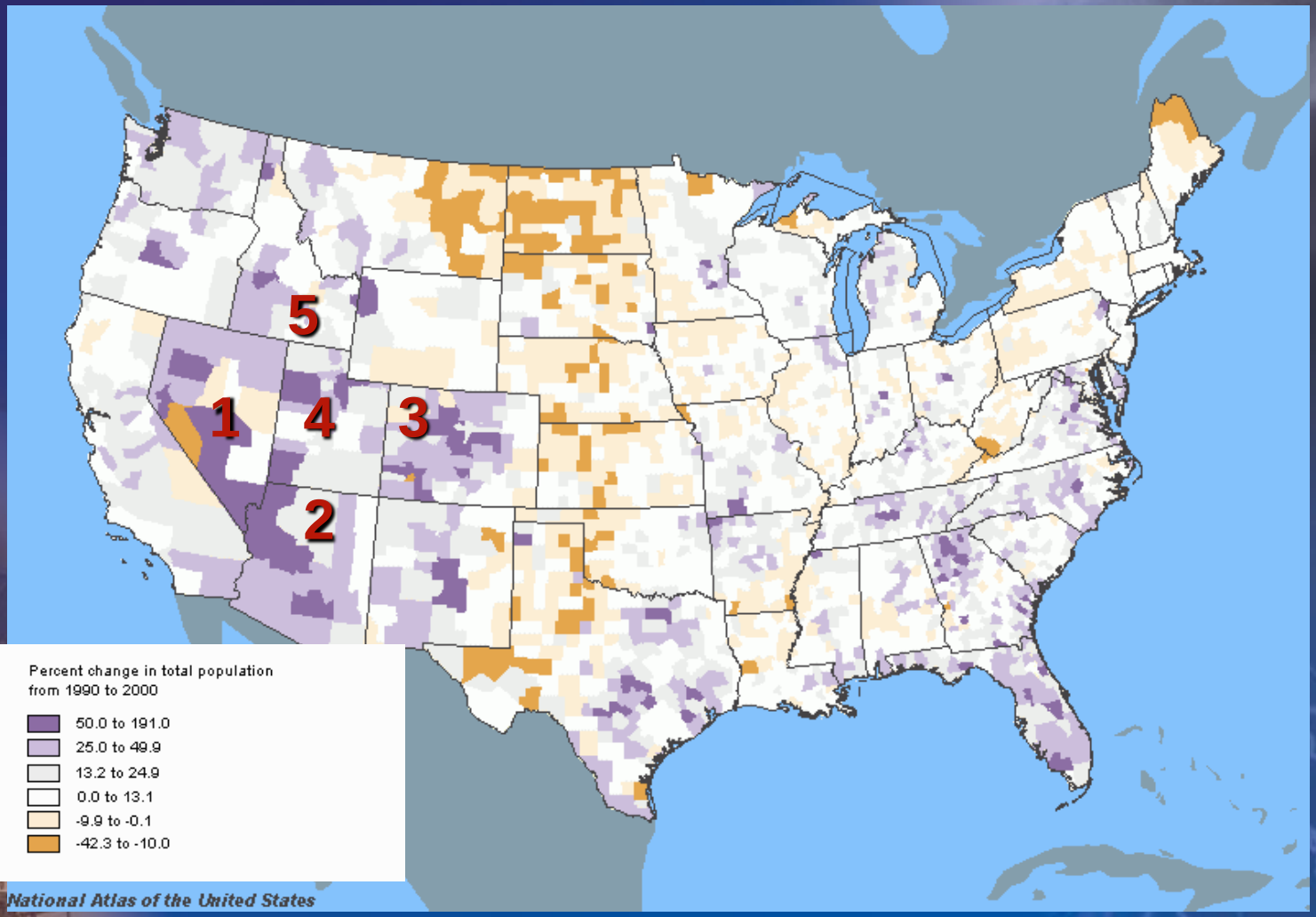
- *Upper Colorado Basin Workshop 1-2 October, 2008*



Elements

- 1. U.S. Drought Portal:
  - *Development and tailoring*
- 2. Climate Test Beds:
  - *Integrating data and forecasts*
- 3. Coping with Drought
  - *Integrated Research and applications*
  - *Engaging preparedness communities*
  - *Education and awareness*
- 4. NIDIS EWS Pilots:
  - *Early Warning System Design and Implementation*
- 5. NIDIS Program Office

Percent Change in Total Population, 1990-2000



Source: U.S. Geological Survey, *National Atlas of the United States*

Key issues

- What climate and drought-related triggers are used for management and response seasonal operations, long-term planning (watershed, industry, state, county)?

- How can we most effectively develop and coordinate information for early warning (onset, duration, demise, impacts) into drought plans?

  E.g. Exceptional Drought Operation Plan, Interim Operating Plan, Power needs etc?

- Proposed NIDIS Pilot: Partnerships to maintain a regional dialog on drought, climate and water resources

Governance Structure for NIDIS Implementation

NIDIS Executive Council

Co-chairs: Director, NOAA Climate Program Office (or designee)
Director, National Drought Mitigation Center (or designee)

NIDIS Program Office
(NPO Director)
- *Coordinate NIDIS-relevant cross-NOAA*
- *and Interagency drought-related activities*
- *Develop a national presence for NIDIS (e.g. formal links to National Governors Ass'n)*
- Participate in GEOSS / IEOS

NIDIS Program Implementation Team (NPIT)

Working-Level Partner Representatives
Coordinate and develop evaluation criteria for all NIDIS activities including pilot project selection
Chair: NPO Director

NIDIS Technical Working Groups

Federal, Regional, State, Tribal and Local Partner Leads
Embedded in national and regional, and local NIDIS Activities
Develop pilot implementation and transferability criteria
Co-Chairs selected by NPIT

National Integrated Drought Information System

Drought Early Warning System Design, Pilots, and Implementation

Governance Structure for NIDIS Implementation

NIDIS Executive Council

Co-chairs: Director, NOAA Climate Program Office (or designee)
Director, National Drought Mitigation Center (or designee)

NIDIS Program Office
(NPO Director)
- *Coordinate NIDIS-relevant cross-NOAA*
- *and Interagency drought-related activities*
- *Develop a national presence for NIDIS (e.g. formal links to National Governors Ass'n)*
- Participate in GEOSS / IEOS

NIDIS Program Implementation Team (NPIT)

Working-Level Partner Representatives
Coordinate and develop evaluation criteria for all NIDIS activities including pilot project selection
Chair: NPO Director

NIDIS Technical Working Groups

Federal, Regional, State, Tribal and Local Partner Leads
Embedded in national and regional, and local NIDIS Activities
Develop pilot implementation and transferability criteria
Co-Chairs selected by NPIT

- Public Awareness And Education
- Engaging Preparedness Communities
- Integrated Monitoring and Forecasting
- Interdisciplinary Research and Applications
- U.S. Drought Portal

National Integrated Drought Information System

Drought Early Warning System Design, Pilots, and Implementation

Roger S. Pulwarty is a climate scientist and the Director of the National Integrated Drought Information System (NIDIS, www.drought.gov) at the National Oceanic and Atmospheric Administration (NOAA) in Boulder, Colorado. His interests and publications are on climate variability and change, assessing social and environmental vulnerability, and on developing climate information and services for risk management. Dr. Pulwarty's work focuses on the Western U.S., Latin America and the Caribbean. From 1998 to 2002 he directed the Regional Integrated Sciences and Assessments (RISA) Program at NOAA. He also leads the Vulnerability and Capacity Assessments component of the World Bank/GEF-funded project on "Mainstreaming Adaptation to Climate Change in the Caribbean."

Roger is a lead author on Vulnerability, Adaptation and Impacts in the 2007 UN Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, the IPCC Technical Report on Climate and Water Resources, and on the multi-agency U.S. Climate Change Science Program Synthesis and Assessments Reports including Climate Extremes. Roger has acted in advisory capacities on climate and natural resources management to several U.S. and international agencies including the Western States Water Council, the Environmental Protection Agency, the Department of the Interior, the Governments of CARICOM (the Caribbean Economic Community), Venezuela, Chile, the Organization of American States, the UNDP, UNEP and the World Bank. He is Professor-adjunct at the University of Colorado and University of the West Indies. Roger has served on Committees of the U.S. National Academy of Sciences, has testified before the U.S. Congress on climate, water resources and adaptation most recently on "Water Supply Challenges in the 21st Century", and featured in several media communications, including the New York Times Magazine article "The Future is Drying Up" (NYT, October 2007). He is a co-recipient of the 2008 NOAA Administrator's award for outstanding achievements in integrating climate research into decision making.