Panel Discussion – Coordinating Federal Climate Services for Drought & Water

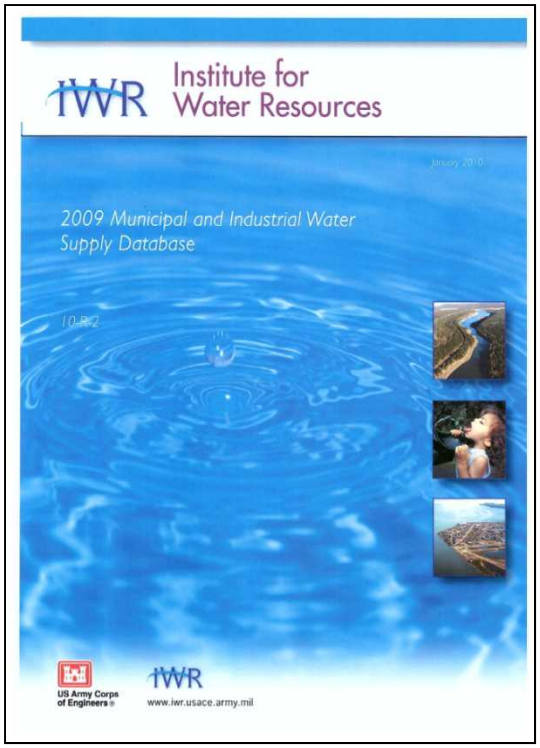
Western Governors' Association-Western States Water Council Drought and Climate Workshop
Washington, DC

Bob Pietrowsky
Director, Institute for Water Resources
US Army Corps of Engineers

15 September 2010

US Army Corps of Engineers
BUILDING STRONG®

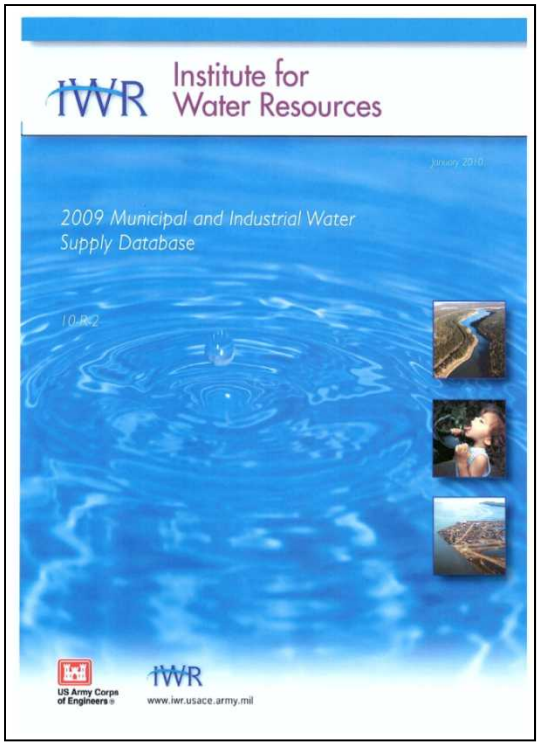
Corps Water Supply Projects



National Level Report

http://www.corpsresults.us/watersupply/wsfastfacts.cfm

Corps Water Supply Projects

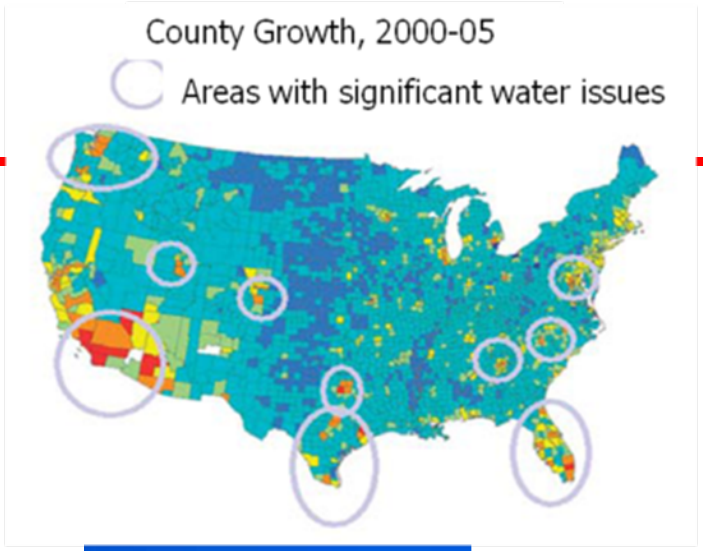


National Level Report

Of the ~ 380 major reservoir projects operated by Corps:

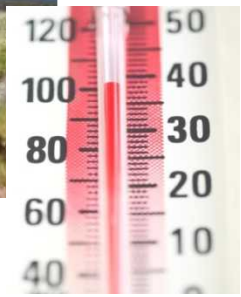
- **133 reservoirs contain Public (Municipal & Industrial) Water Supply Storage**
  - **These 133 reservoirs contain 11.1 million acre feet of M&I storage, with yield of ~ 5,400 MDG, and**
  - **Are located in 26 States and in 22 of the Corps 38 Civil Works Districts – with ~ 60% of the reservoirs & ~ 87% of the storage located in the Western States**
- **Via agreements thru Reclamation, 37 reservoirs in the West provide either specific or joint storage for Irrigation totaling ~ 56 million acre-feet**
- **Over last twenty years 97 reallocation agreements executed, and a recent National Portfolio Assessment for Reallocation has identified 53 potential reallocations for M& I water supply**

Water Resources Challenges



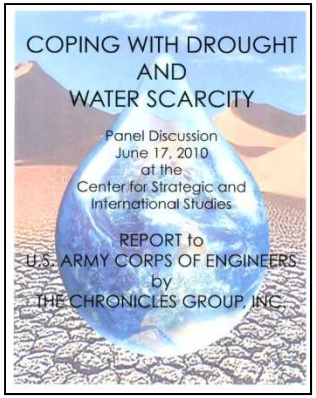
Demographic shifts – U.S.

- U.S. population to reach 400 million by 2050
- Population more urbanized, concentrated in coastal areas and areas already experiencing scarcity of fresh water



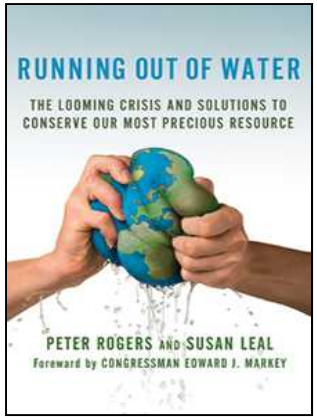
Adaptation to Climate Change

- Need means to anticipate & adapt to climate change impacts to the frequency, intensity & spatial occurrence of extreme events
- Observed changes in snowmelt, floods & droughts are likely to progress over time, potentially affecting all aspects of water resources management

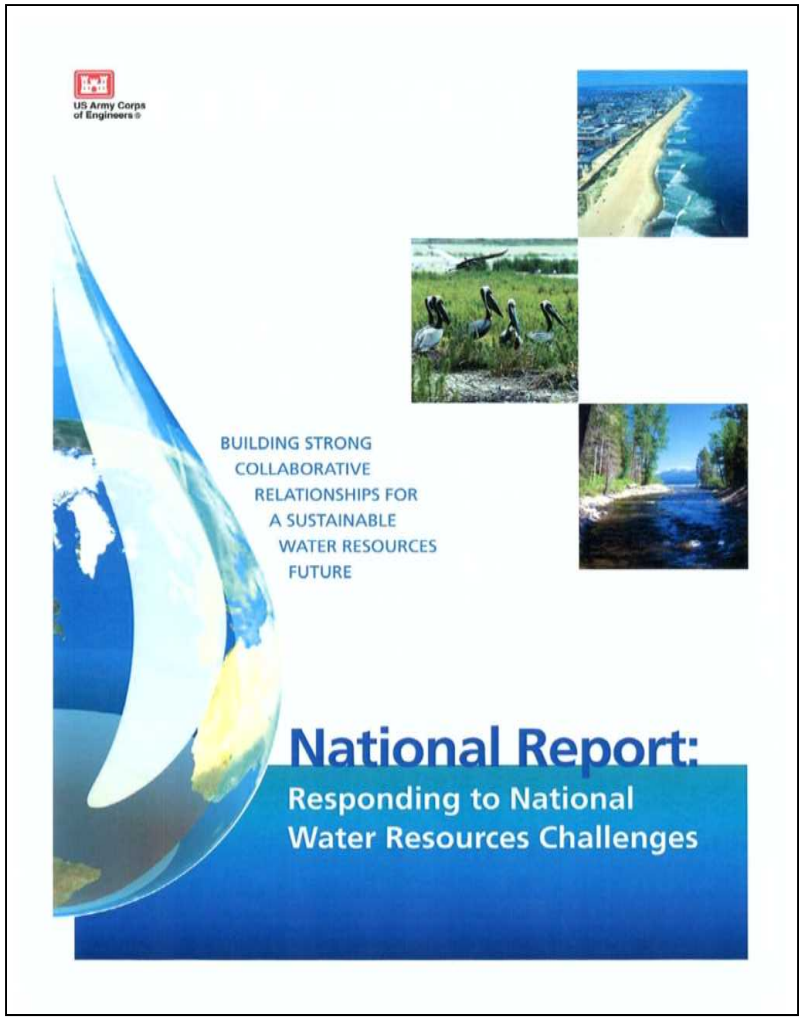


Aging Infrastructure

- Much of U.S. 20th Century infrastructure is approaching or exceeding original design lives
- Failure poses risk to populations, economy



Emphasis on Intergovernmental Collaboration



1) **Integrated Water Resources Management**
   - Focus on Sustainable Solutions Using Watershed Perspective/Approach

2) **Governance & Management**
   - Federal Interagency Partnerships

3) **Continue Dialogue**
   - Increase awareness & national emphasis in support of State water priorities

4) **Collaboration**
   - Management of water as a collaborative endeavor focused on shared responsibilities

5) **Water Resources Investment Strategies**
   - Innovative Financing

6) **Managing Extreme Events**
   - Adaptation to Climate Change

7) **Knowledge & Technology Transfer**
   - Integrated Water Information & Services

8) **State Water Resources Leadership**
   - Recognize Primacy of State Role

9) **Communications and Education**
   - Active & Continuous Engagement w/Public

USGS Circular 1331

- Collaboration between four US water resources agencies:
  - USACE, U.S. Geological Survey, Bureau of Reclamation, National Oceanic and Atmospheric Administration

US Army Corps of Engineers®

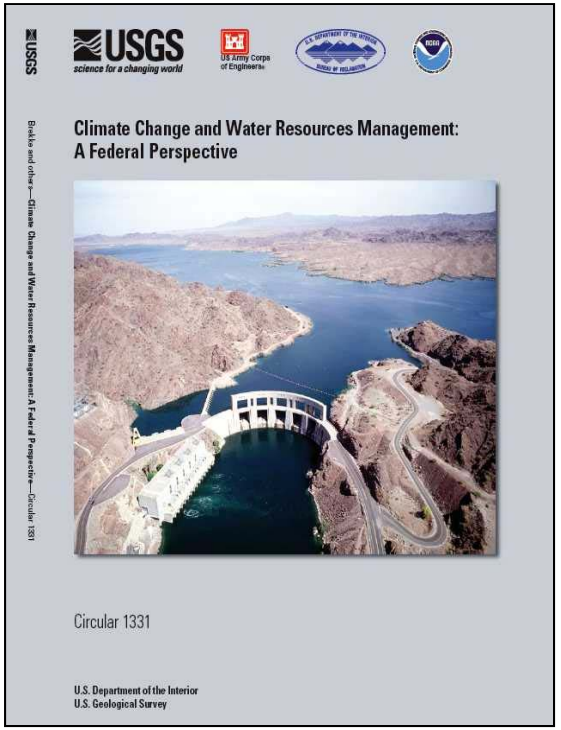
U.S. DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION

USGS science for a changing world

NOAA

- Purpose:
  - To evaluate practices of federal agencies to incorporate climate change considerations into activities related to Nation's water resources
  - Provide foundation for future policies

- Report released as USGS Circular 1331 February 2009



http://pubs.usgs.gov/circ/1331/

The Future Will Not Look Like the Past

POLICYFORUM

CLIMATE CHANGE

Stationarity Is Dead: Whither Water Management?

Climate change undermines a basic assumption that historically has facilitated management of water supplies, demands, and risks.

P. C. D. Milly,* Julio Betancourt,† Malin Falkenmark,‡ Robert M. Hirsch,§ Zbigniew W. Kundzewicz,‖ Dennis P. Lettenmaier,¶ Ronald J. Stouffer#

Systems for management of water throughout the developed world have been designed and operated under the assumption of stationarity. Stationarity—the idea that natural systems fluctuate within an unchanging envelope of variability—is a foundational concept that permeates training and practice in water-resource engineering. It implies that any variable (e.g., annual streamflow or annual flood peak) has a time-invariant (or 1-year-periodic) probability density function (pdf), whose properties can be estimated from the instrument record. Under stationarity, pdf estimation errors are acknowledged, but have been assumed to be reducible by additional observations, more efficient estimation, or regional or paleohydrologic data. The pdf's, in turn, are used to evaluate and manage risks to water supplies, waterworks, and floodplains; annual global investment in water infrastructure exceeds US$500 billion (*1*).

The stationarity assumption has long been compromised by human disturbances in river basins. Flood risk, water supply, and water quality are affected by water infrastructure, channel modifications, drainage works, and land-cover and land-use change. Two other (sometimes indistinguishable) challenges to stationarity have been externally forced, natural climate changes and low-frequency, internal variability (e.g., the Atlantic multidecadal oscillation) enhanced by the slow dynamics of the oceans and ice sheets (*2*, *3*). Planners have tools to adjust their analyses for known human disturbances within river basins, and justifiably or not, they generally have considered natural change and variability to be sufficiently small to allow stationarity-based de-

An uncertain future challenges water planners.

In view of the magnitude and ubiquity of the hydroclimatic change apparently now under way, however, we assert that stationarity is dead and should no longer serve as a central, default assumption in water-resource risk assessment and planning. Finding a suitable successor is crucial for human adaptation to changing climate.

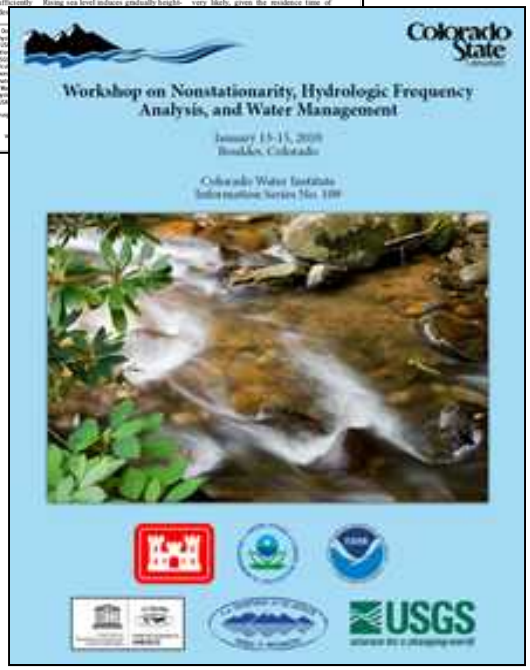
How did stationarity die? Stationarity is dead because substantial anthropogenic change of Earth's climate is altering the means and extremes of precipitation, evaporation, and rates of discharge of rivers (*4*, *5*) (see figure, above). Warming augments atmospheric humidity and water transport. This increases precipitation, and possibly flood risk, where prevailing atmospheric water-vapor fluxes converge (*6*). Rising sea level induces gradually height-

that has emerged from climate models (see figure, p. 574).

Why now? That anthropogenic climate change affects the water cycle (*9*) and water supply (*10*) is not a new finding. Nevertheless, sensible objections to discarding stationarity have been raised. For a time, hydroclimate had not demonstrably exited the envelope of natural variability and/or the effective range of optimally operated infrastructure (*11*, *12*). Accounting for the substantial uncertainties of climatic parameters estimated from short records (*13*) effectively hedged against small climate changes. Additionally, climate projections were not considered credible (*12*, *14*).

Recent developments have led us to the opinion that the time has come to move beyond the wait-and-see approach. Projections of runoff changes are bolstered by the recently demonstrated retrodictive skill of climate models. The global pattern of observed annual streamflow trends is unlikely to have arisen from unforced variability and is consistent with modeled response to climate forcing (*15*). Paleohydrologic studies suggest that small changes in mean climate might produce large changes in extremes (*16*), although attempts to detect a recent change in global flood frequency have been equivocal (*17*, *18*). Projected changes in runoff during the multidecade lifetime of major water infrastructure projects began now are large enough to push hydroclimate beyond the range of historical behaviors (*19*). Some regions have little infrastructure to buffer the impacts of change.

Stationarity cannot be revived. Even with aggressive mitigation, continued warming is very likely, given the residence time of



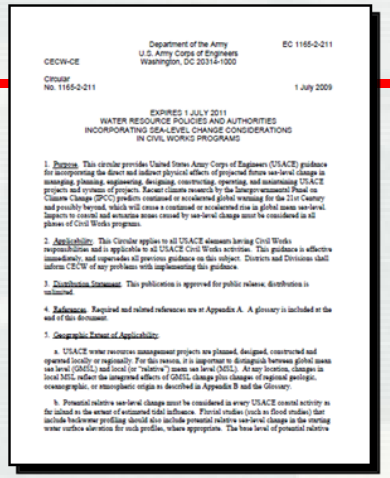
- Addressing user needs: Nonstationarity & Hydrologic workshop: 13-15 Jan 2010
- The risk associated with extreme events has been based on relatively short-term hydrologic records – in some cases potentially affecting the reliability of critical infrastructure during floods and droughts.
- Planning and operations need to be re-assessed & verified given nonstationary conditions.
- Best Practices - analytical techniques integrating climate change into statistical evaluation of designs & operations are needed as basis for consistent policies on assurance of reliability. Products thus far:
  - Proceedings (summer 2010)
  - Special issue JAWRA (16 papers)

Federal Interagency Working Group

- Climate Change and Water Working Group (C-CAWWG)
  - Purpose: A federal interagency workgroup providing scientific collaborations in support of water management as climate changes – originally with western focus.
  - Action: Developing and implementing a multi-agency research and knowledge transfer agenda that spans the hydrologic cycle and is driven by water management, portfolio reallocation and planning decisions.

Responses to Climate Change Program – FY 2010

Develop and begin implementing nationally consistent, practical, and cost-effective approaches that reduce vulnerabilities to water infrastructure resulting from climate change and variability.


Department of the Army
U.S. Army Corps of Engineers
Washington, DC 20314-1000

CECW-CE

Circular
No. 1165-2-211

EC 1165-2-211

1 July 2009

EXPIRES 1 JULY 2011

WATER RESOURCE POLICIES AND AUTHORITIES
INCORPORATING SEA-LEVEL CHANGE CONSIDERATIONS
IN CIVIL WORKS PROGRAMS

1. Purpose. This circular provides United States Army Corps of Engineers (USACE) guidance for incorporating the direct and indirect physical effects of projected future sea-level change in managing, planning, engineering, designing, constructing, operating, and maintaining USACE projects and systems of projects. Recent climate research by the Intergovernmental Panel on Climate Change (IPCC) predicts continued or accelerated global warming for the 21st Century and possibly beyond, which will cause a continued or accelerated rise in global mean sea-level. Impacts to coastal and estuarine areas caused by sea-level change must be considered in all phases of Civil Works programs.

2. Applicability. This Circular applies to all USACE elements having Civil Works responsibilities and is applicable to all USACE Civil Works activities. This guidance is effective immediately, and supersedes all previous guidance on this subject. Districts and Divisions shall inform CECW of any problems with implementing this guidance.

3. Distribution Statement. This publication is approved for public release; distribution is unlimited.

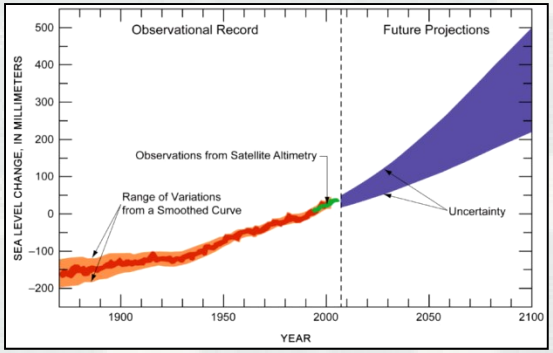
4. References. Required and related references are at Appendix A. A glossary is included at the end of this document.

5. Geographic Extent of Applicability.

a. USACE water resources management projects are planned, designed, constructed and operated locally or regionally. For this reason, it is important to distinguish between global mean sea level (GMSL) and local (or "relative") mean sea level (MSL). At any location, changes in local MSL reflect the integrated effects of GMSL change plus changes of regional geologic, oceanographic, or atmospheric origin as described in Appendix B and the Glossary.

b. Potential relative sea-level change must be considered in every USACE coastal activity as far inland as the extent of estuarine tidal influence. Fluvial studies (such as flood studies) that include backwater profiling should also include potential relative sea-level change in the starting water surface elevation for such profiles, where appropriate. The base level of potential relative

Vulnerability assessments to evaluate the potential impacts of climate change on existing USACE projects.



Pilot studies to test adaptation strategies such as:

NIDIS Pilot Study: Southeast U.S. Apalachicola-Chattahoochee-Flint Basin

New Sea Level Change Guidance: Multiple scenario approach

Program designed as intergovernmental collaboration w/other Federal agencies, other levels of government, academia, and stakeholders.

Global Change Sustainability Program – FY 2011

Implementation of strategies to ensure the sustainability and performance of USACE projects and systems to reduce vulnerabilities to observed and future (both predicted and unexpected) global changes.

Update drought contingency plans.

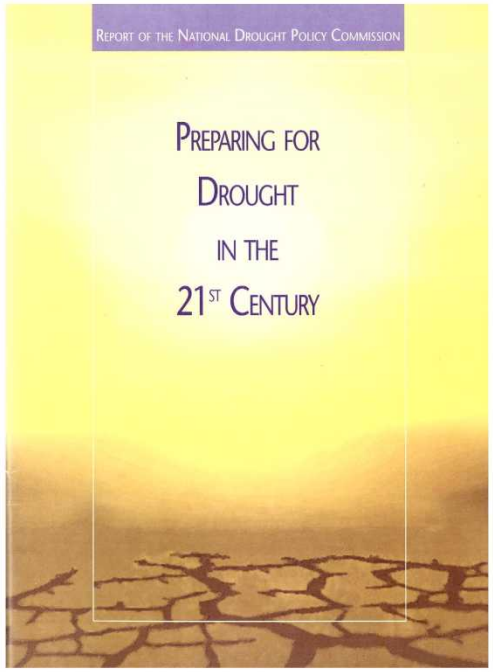
Develop greenhouse gas emissions reduction strategies.
Evaluate carbon sequestration potential of USACE projects and systems.

Evaluate reservoir reallocation or re-operation for contemporary needs.

Sustainable Rivers Program demonstration projects with The Nature Conservancy.

Global Change Sustainability: Update of Drought Contingency Plans

- Top priority in FY11 program
- In 1981, USACE published ER 1110-2-1941, Drought Contingency Plans (DCP)
  - Policy & guidance for preparation of DCP in the context of water control management
  - DCP intended to respond to public needs with respect to drought, including:
    - ID potential modifications to project regulation to increase capability to respond to a drought (given existing authorities and other constraints)
    - Plan on a regional, basin-wide and project basis
    - Coordinate with appropriate stakeholders during droughts
    - ID long-term opportunities to modify project storage allocations
  - DCP for each Corps project or system of projects having controlled reservoir storage
  - Interdisciplinary and intergovernmental teams to:
    - Assess existing USACE DCP's
    - Review and update existing methods and policies to support updated DCP
    - Strategy to update DCP's – transparent process in collaboration w/agencies, sponsors & States
    - Prioritize needs
    - Multi-year effort to update DCP's



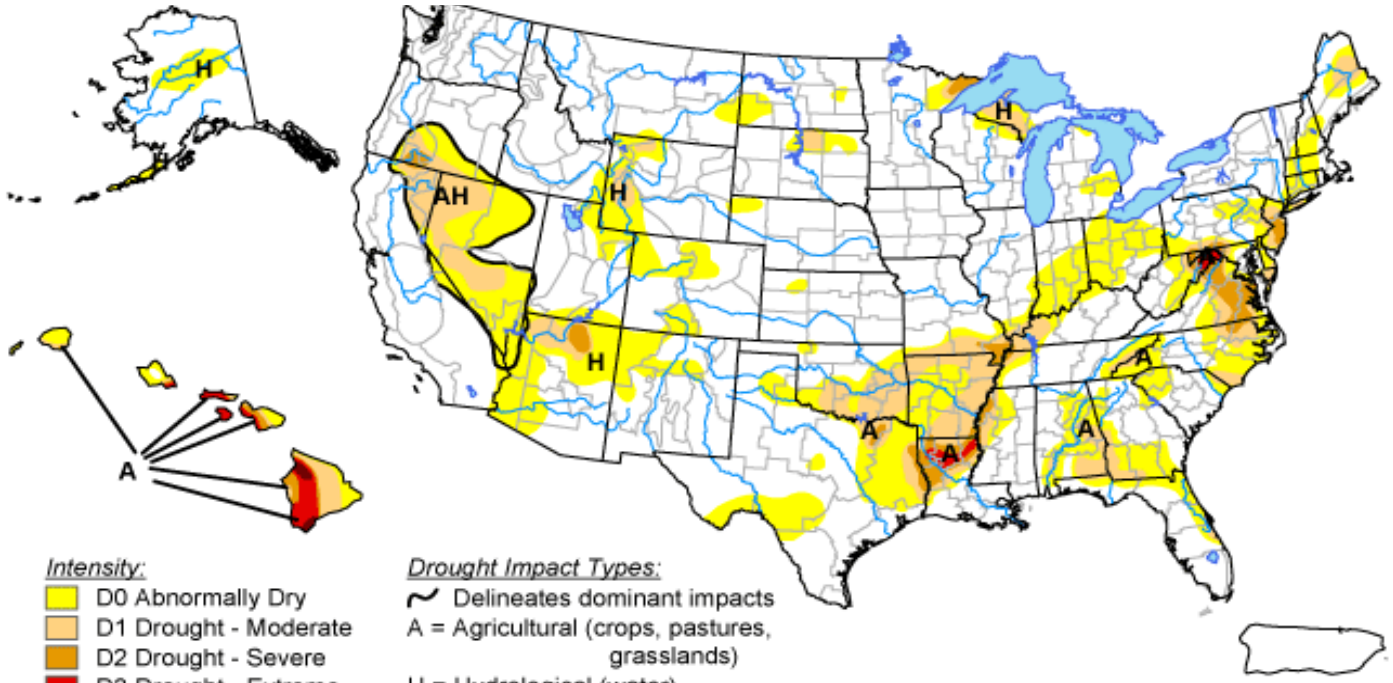
National Drought Policy Commission Report – 1998

- **Favor preparedness over insurance, insurance over relief, and incentives over regulation.**
- **Coordinate the delivery of federal services through cooperation and collaboration with nonfederal entities.**

✓ Recommended a shift from an emphasis on drought relief.

✓ Encouraged a forward-looking stance on preparedness—especially focused on drought planning, drought contingency plan implementation, and proactive mitigation as the cornerstone of national drought policy.

Thank You!


H
AH
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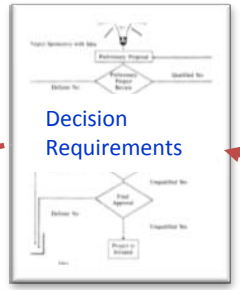
Intensity:
D0 Abnormally Dry
D1 Drought - Moderate
D2 Drought - Severe
D3 Drought - Extreme
D4 Drought - Exceptional
Drought Impact Types:
Delineates dominant impacts
A = Agricultural (crops, pastures, grasslands)
H = Hydrological (water)
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
http://drought.unl.edu/dm
USDA
National Drought Mitigation Center
Released Thursday, September 9, 2010
Author: Matthew Rosencrans, NOAA/NWS/NCEP/CPC

Backup/Background Slides

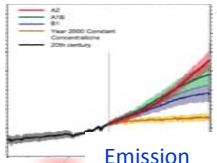
Approach to Adaptation

- Collaborative
- Comprehensive
- Consider scales
- Capacity-building

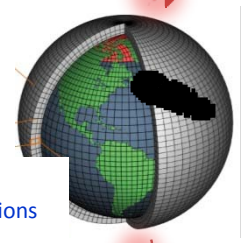
Assessing a Portfolio of Approaches for Producing Climate Change Information to Support Adaptation Decisions



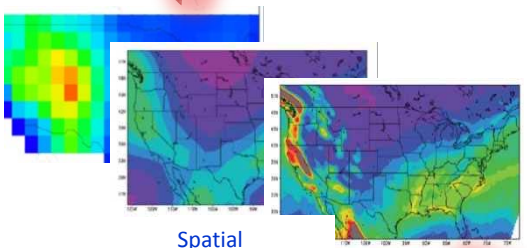
Decision Requirements



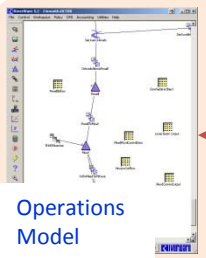
Emission Scenarios



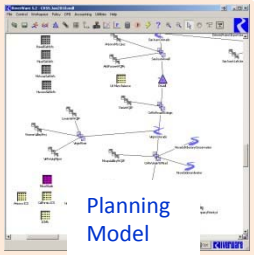
Climate Simulations



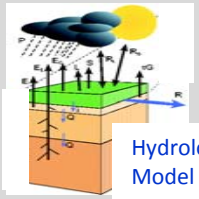
Spatial Downscaling



Operations Model

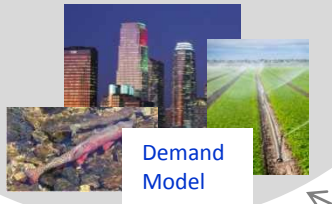


Planning Model



Hydrologic Model

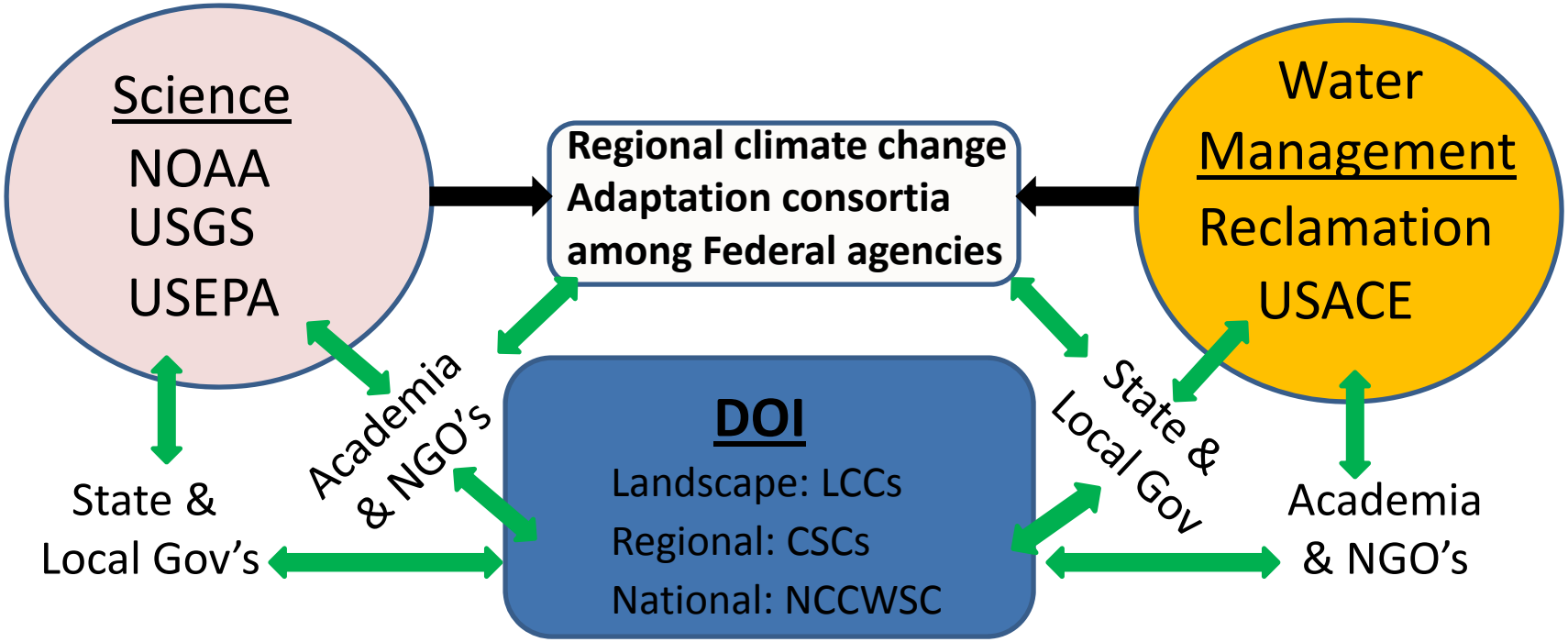
Land Cover Change



Demand Model

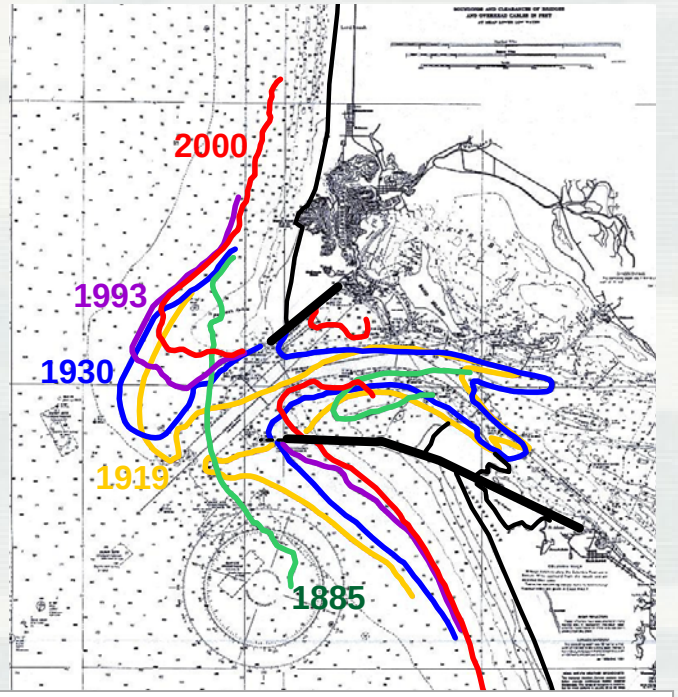
Societal Changes

Essential Collaboration between Science and Water Management (Interagency Work)



Coastal

- Update existing sea-level change guidance (2009)
- Update coastal vulnerability index (2010-2011)
- Develop guidance on sea-level change impacts, response, and adaptation (2010-2011)
- Perform comprehensive evaluation of projects with respect to sea-level changes (2011-2014)



Next Steps: Vulnerability Assessments

- Build on existing tools:
  - USGS Coastal Vulnerability Index (CVI)
  - US Forest Service Fire Management System
  - EPA Regional Vulnerability Assessment Tool
  - Visualize in Watershed Investment Decision Tool
- Build on existing data:
  - Program for Climate Model Diagnostics and Intercomparison (PCMDI) archive of GCM and downscaled date
- Consider where climate is changing fastest or is most severe

FY10-11 Pilot: NIDIS

- Title: **NIDIS Pilot Study: Southeast U.S. Apalachicola-Chattahoochee-Flint Pilot Study** (Pilot 20%, depends on other agency schedules)
- Phase: Planning and O&M
- USACE Lead: James Hathorn (SAM)
- Background: More frequent and severe droughts are possible with climate change. Water managers will need tools to better assess and communicate drought conditions in order to better implement adaptive measures.
- Central Question: "What information is needed for monitoring and assessing drought for water management decision making? How should this information be communicated to stakeholders?"
- Approach: This pilot would leverage a National Integrated Drought Information System (NIDIS) project in its beginning phases. The NOAA-led interagency effort will develop a drought information system for "better informed and more timely drought-related decisions, leading to reduced impacts and costs." The objective of USACE participation in this NIDIS pilot study is to develop tools to meet a SAM-identified need to assist the district and stakeholders in the basin to agree on current drought conditions, prior to developing and evaluating adaptation alternatives.
- This pilot concentrates on flexible framework step 2 (Understand how climate is changing) and step 6 (Build awareness and capacity).
- RCC POC: Dr. Rolf Olsen

Other FY10 Adaptation Pilot Questions

- How do we incorporate climate change considerations into reservoir operating policies that will be robust and adaptive to potential climate changes?
- At what point will back bay flooding in certain portions of the beach decrease benefits to the point that beach renourishment is unjustified in those locations?
- Changing climate and acceleration of sea level rise will increase area of sensitive resources (coral reef) over time – how do we account for the changing baseline over time, and how does this natural process impact project life-cycle?
- How do we incorporate multiple scenarios into the planning process?
- What information is needed for monitoring and assessing drought for water management decision making? How should this information be communicated to stakeholders?”
- How will changing climate affect reservoir sedimentation?