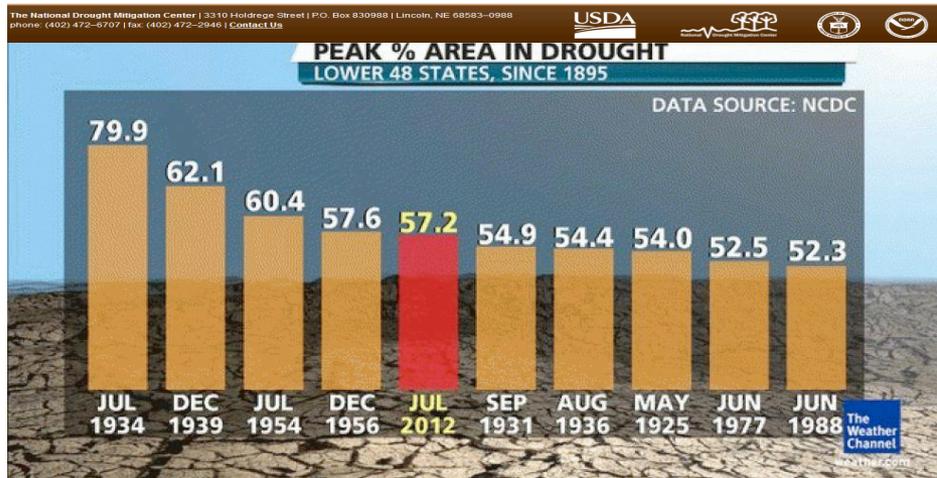
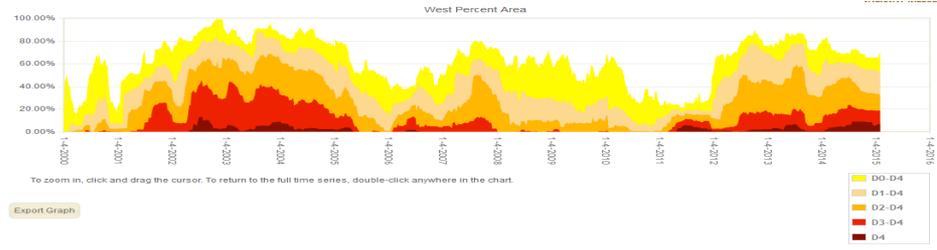
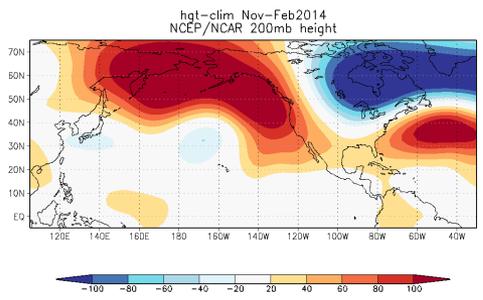




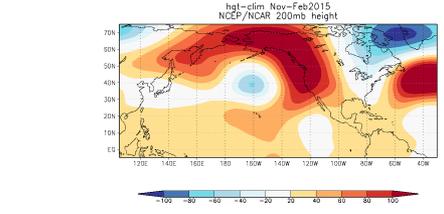
# Drought: The Weather-Climate continuum and Adaptation deficits



November 2013-February 2014



November 2014 -February 2015



Atmospheric chemistry



Ice sheets

Marine Ecosystems

Ocean surface upper full

## Early warning....resource allocation.... Infrastructure Design



Fronts, convective Cyclones systems

Blocking

MJO

NAO

ENSO

QBO

PDO

AMO



# RESILIENCE MEANS **BOUNCING BACK**

Forward?



*“Communities across the country are becoming more vulnerable to severe events. The question of our time is not IF the next big event(s) will happen, but WHEN, and WHAT blow it will deliver to our society and economy. --Equip our communities with information, products, services, and tools that allow them to become more resilient.”*

*Kathryn D. Sullivan, NOAA Administrator April 2014*

# Three major tasks under NIDIS

(Public Law 109-430, 2006; 113-086, 2014)

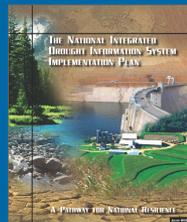
***“Enable the Nation to move from a reactive to a more proactive approach to managing drought risks and impacts”***

## **(I) Provide effective drought early warning systems**

(a) collect and integrate key indicators of drought severity and impacts; and (b) produce timely information that reflect local, regional, and State differences;

## **(II) Coordinate and integrate as practicable, Federal research *and monitoring* in support of a drought early warning system**-including research relating to the role of extreme weather events and climate variability in drought.

## **(III) Build upon existing forecasting and assessment programs and partnerships**



Public Law 109-430  
109th Congress

An Act

Dec. 20, 2006  
[H.R. 5136]

To establish a National Integrated Drought Information System within the National Oceanic and Atmospheric Administration to improve drought monitoring and forecasting capabilities.

*Be it enacted by the United States*

National Integrated Drought Information System Act of 2006.  
15 USC 311 note.  
15 USC 313d note.

**SECTION 1. SHORT TITLE.**

This Act may be cited as the "National Integrated Drought Information System Act of 2006."

**SEC. 2. DEFINITIONS.**

In this Act—

PUBLIC LAW 113-86—MAR. 6, 2014

128 STAT. 1015

Public Law 113-86  
113th Congress

An Act

To reauthorize the National Integrated Drought Information System.

Mar. 6, 2014  
[H.R. 2431]

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,*

**SECTION 1. SHORT TITLE.**

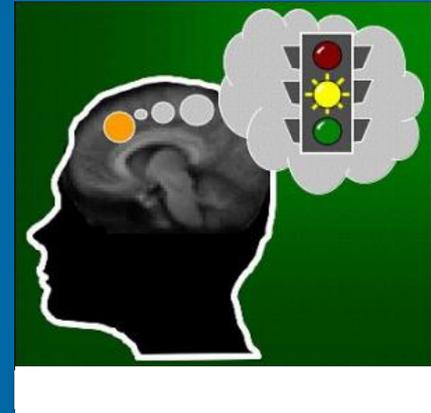
This Act may be cited as the "National Integrated Drought Information System Reauthorization Act of 2014".

**SEC. 2. NIDIS PROGRAM AMENDMENTS.**

National Integrated Drought Information System Reauthorization Act of 2014.  
15 USC 311 note.

# What is an early warning system?

The development and delivery of a forecast, projection.... AND .....



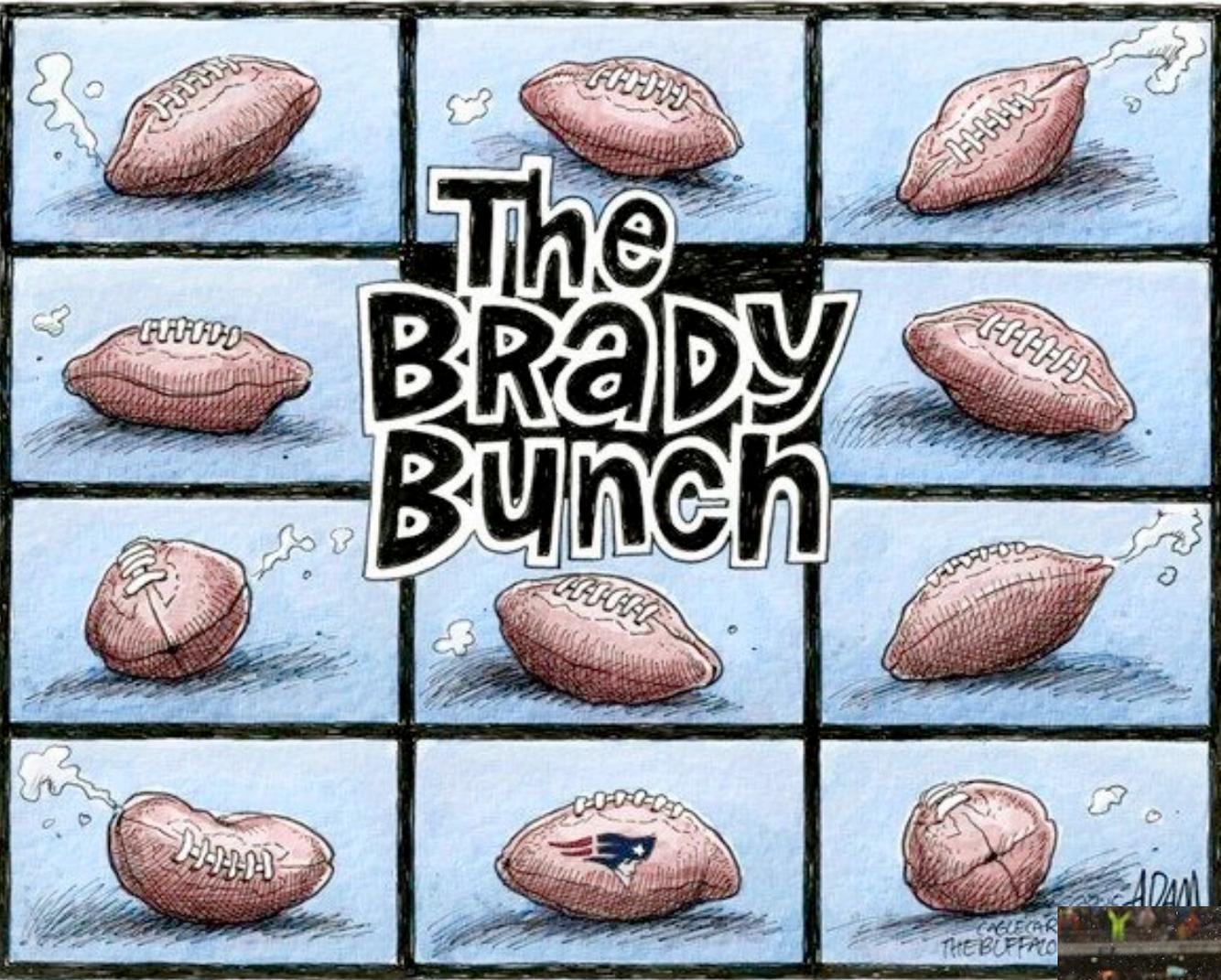
The systematic collection and analysis of relevant information about and coming from areas of impending risk that:

- (a) Inform the development of strategic responses to anticipate risks and opportunities and their evolution; and
- (b) Communicate options to critical actors for the purposes of decision-making and response

An “investment” not an “expenditure”



# The BRADY BUNCH



# NIDIS Partnerships

(Federal, States, Tribes, Private)

**Monitoring & Forecasting**

**Drought and Flood Impacts Assessments and Scenarios**

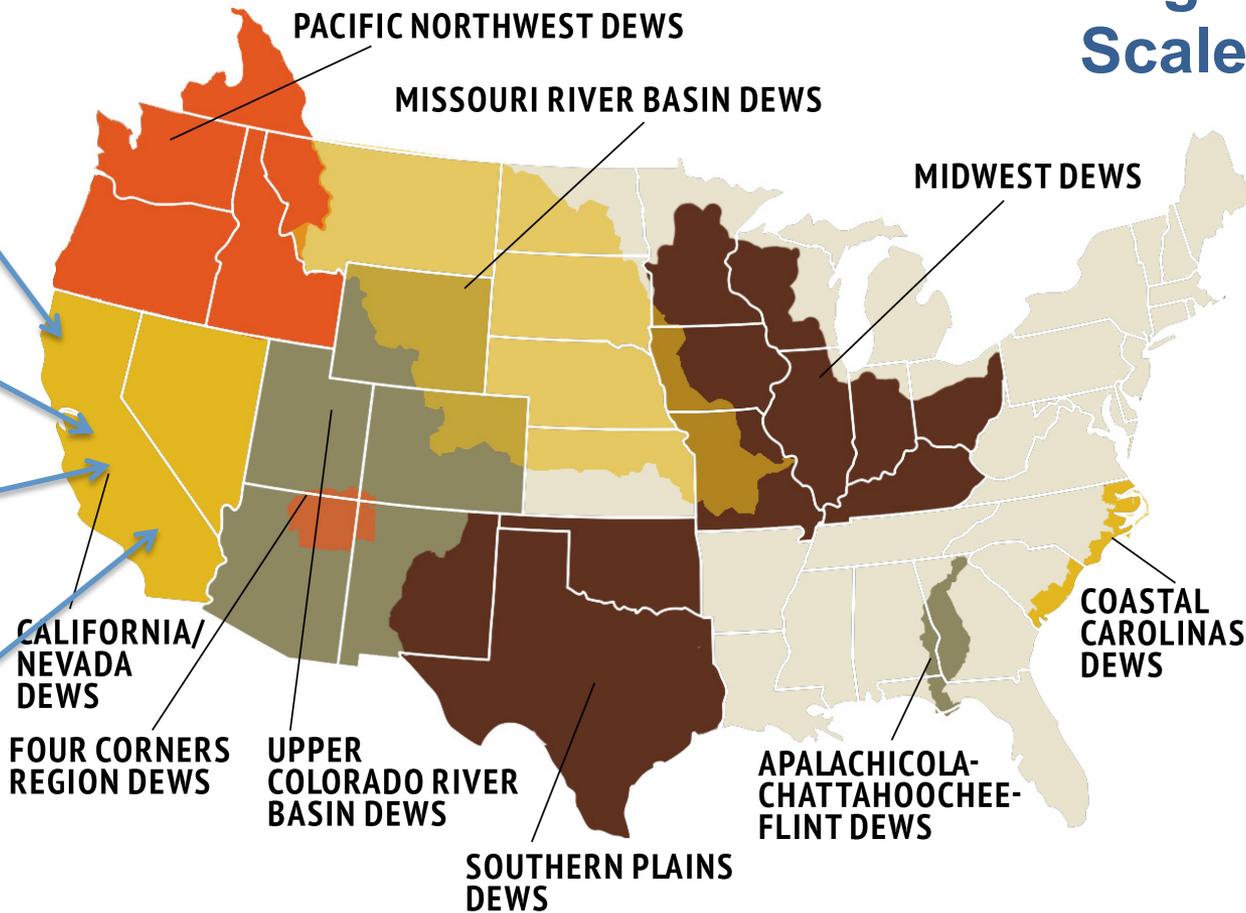
**Drought Early Warning Information Systems**

**Communication and Outreach**

**Engaging Preparedness & Adaptation**

# NIDIS Drought Early Warning Systems

## Regional Scale



**Governance Attributes: Agility, Alignment, Adaptability**

**Network coordination, Integrated Information (monitoring, forecasting, risk assessment), Drought risk management (capacity, communication (e.g. outlook forums) and planning)**

# An Interpretation of the Origins of the 2012 Central Great Plains Drought



## Assessment Report

### NOAA Drought Task Force Narrative Team

Lead: Martin Hoerling  
Co-Leads: Siegfried Schubert & Kingtse Mo

20 March 2013

## ASSESSMENT REPORT Causes and Predictability of the 2011-14 California Drought



RICHARD SEAGER  
Lamont-Doherty Earth Observatory of Columbia University

MARTIN HOERLING  
NOAA Earth System Research Laboratory

SIEGFRIED SCHUBERT  
HAILAN WANG  
NASA Goddard Space Flight Center

BRADFELD LYON  
International Research Institute for Climate and Society

ARUN KUMAR  
NOAA Climate Prediction Center

JENNIFER NAKAMURA  
NAOMI HENDERSON  
Lamont-Doherty Earth Observatory of Columbia University



NOAA Drought Task Force 2016

## Research to Advance National Drought Monitoring and Prediction Capabilities



February 2016

# National Drought Forum

*Summary Report and Priority Actions*

# 2012

## SPECIAL REPORT

JUNE 2015



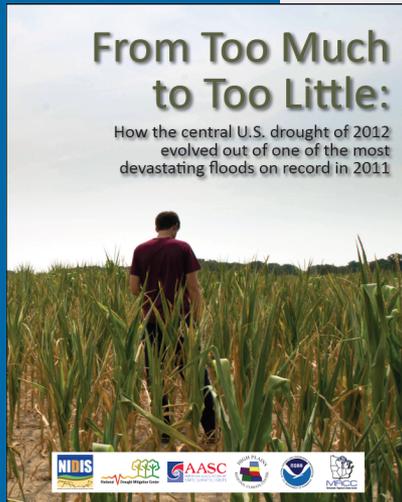
## WESTERN GOVERNORS' ASSOCIATION

[westgov.org/drought-forum](http://westgov.org/drought-forum)



# From Too Much to Too Little:

How the central U.S. drought of 2012  
evolved out of one of the most  
devastating floods on record in 2011



2010-12: First time U.S. corn yield fell  
three years in a row since 1928-30 (USDA)

## “Climate Extreme Drought To Extreme Flood: Weather Whiplash Hits The Midwest”

Weather Underground Climate Guest Contributor Apr 19, 2013

NIDIS Reauthorization P.L. 113-086, 2014

*“include research relating to the role of extreme weather  
events and climate variability in drought”*



**Memorandum of Understanding  
Between the Western Governors' Association  
and the National Oceanic and Atmospheric Administration**

**Collaboration on Drought, Flooding, and Wildfire Preparedness:  
Sharing Information and Building Resilience in Planning for Extreme Events**

*June 9, 2014  
Colorado Springs, Colorado*



WESTERN  
GOVERNORS'  
ASSOCIATION

Drought  
Information  
System Act of  
2006.  
15 USC 311 note.  
15 USC 313d  
note.

**SECTION 1. S.**  
**This Ac**  
**Information**  
**SEC. 2. DEFIN**

PUBLIC LAW 113-86—MAR. 6, 2014

128 STAT. 1015

**MOU Between DOC and USDA**



**MEMORANDUM OF UNDERSTANDING  
BETWEEN THE  
U.S. Department of Commerce  
AND THE  
U.S. Department of Agriculture**

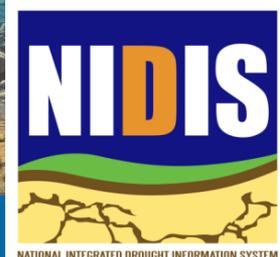
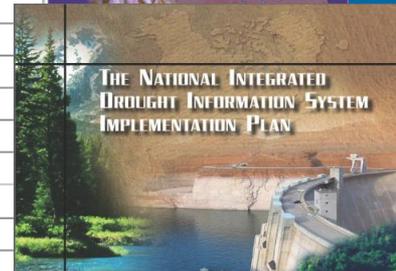
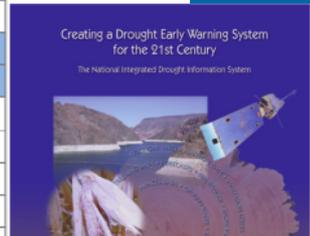
This Act may be cited as the “National Integrated Drought  
Information System Reauthorization Act of 2014”.

**SEC. 2. NIDIS PROGRAM AMENDMENTS.**

Information  
System  
Reauthorization  
Act of 2014.  
15 USC 311 note.

**Table 1. NIDIS Implementation Milestones (FY 2007-2012, by year)<sup>19</sup>**

Activity	Milestone	07	08	09	10	11	12	13
1	Initial portal operational capability at drought.gov	█	█					
1	Advanced portal mapping capability with GIS tools		█	█				
1	Populate drought.gov website (portal, plans, reports, agency links)		█	█				
1	Operational portal communities and collaborations		█	█	█			
1	Enhance data management and distribution		█	█	█			
1	Portal extension to hemispheric and global domains		█	█	█	█		
2	Drought forecast regionalization studies		█	█	█	█		
2	Enhance soil moisture and temperature measurements		█	█	█	█	█	
2	Forecast verification and calibration to measurements					█	█	█
3	Coordinate with CPO Program Managers/agencies on interdisciplinary research goals	█						
3	Inventory drought-related service (federal/state/private)	█	█					
3	Assess national status of drought early warning	█	█					
3	Inventory drought-related research (federal/state/private)		█	█				
3	Coordinate drought preparedness plans		█	█				
3	Planning for adaptation			█	█	█		
3	Institutionalize "Drought Coordinator" network			█	█	█		
3	Enhanced regional impacts research						█	█
3	Implement adaptive management strategies						█	█
4	Pilot study scoping and selection	█	█					
4	NPIT workshops: Define criteria and assess partner interest and capacity for pilots		█					
4	First Workshop: Assessment of Drought Early Warning System Status in the United States		█					
4	Pilot study implementation			█	█			
4	Initial early warning prototypes				█	█		
4	Pilot study assessment and follow-on work				█	█	█	
5	Establish NIDIS Program Office, governance structure, and final Program Implementation Team	█	█					
5	Establish regional sub-team leads within NPIT	█	█					
5	Establish initial agency/state rotational assignment to NIDIS Program	█	█					
5	Establish NIDIS Interdisciplinary Research Coordination Board	█	█					
5	Extend NIDIS to National Governors' Association and Inter-basin Watershed Commission	█	█					
5	Operational workshops to assess national drought monitoring and forecasting gaps	█	█	█	█	█	█	



Shift 18-24 mths to the right-  
delay in funding

↑ ↑ ↑ ↑  
PL109-430    \$\$  
Reauth  
Hearing



Weather and Climate Extremes 3 (2014) 14–21

Contents lists available at ScienceDirect

Weather and Climate Extremes

journal homepage: [www.elsevier.com/locate/wace](http://www.elsevier.com/locate/wace)



# Information systems under changing weather and climate extremes



Information systems in a changing climate: Early warnings and drought risk management

Roger S. Pulwarty<sup>a,\*</sup>, Mannava V.K. Sivakumar<sup>b</sup>

Managing drought risk in a changing climate: The role of national drought policy

Donald A. Wilhite<sup>a,\*</sup>, Mannava V.K. Sivakumar<sup>b</sup>, Roger Pulwarty<sup>c</sup>



## Crisis Management

### Investments

Costly + costs of inaction  
Repeat past mistakes

### Post-impact

e.g. Drought relief

Treats the symptoms of  
vulnerability, i.e., impacts  
Can reward poor resource  
management

Increases vulnerability, reliance on  
external relief (government &  
donors etc.)

## Risk Management

### Investment

- Short-term—EWS, networks
- Long-term—institutional capacity, structural adjustments

### Pre-impact

- Mitigation, risk reduction
- Test system brittleness

Promotes improved  
stewardship of natural  
resources

- Identifies and Reduces vulnerability, builds self-reliance



LONG-TERM DROUGHT  
RESILIENCE  
FEDERAL ACTION PLAN  
OF THE  
NATIONAL DROUGHT  
RESILIENCE PARTNERSHIP

MARCH 2016



# Drought-Resilience Goals

**Goal 1:** Data Collection and Integration  
–key data platforms, modeling and prediction

**Goal 2:** Communicating Drought Risk to Critical Infrastructure

**Goal 3:** Drought Planning and Capacity Building

**Goal 4:** Coordination of Federal Drought Activity

**Goal 5:** Market-Based Approaches for Infrastructure and Efficiency

**Goal 6:** Innovative Water Use, Efficiency, and Technology

# From Risk to Resilience: Research-based Integrated Information Systems



**Monitoring, Observations, and Forecasting**

**Impacts and Scenarios**



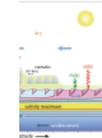
**Communication and Outreach**

**Planning and Preparedness**

## Science for Resilience

Program Office's research programs and expertise help the nation understand, anticipate and respond to climate-related changes in water resources and water-related hazards.

### 1 Skill

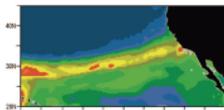


understanding  
rate system to  
lity—and  
rd floods.

#### URCES

- and Monitoring
- Predictability
- ions, & Projections
- el Ensemble

### Better Understanding



NOAA aims to improve understanding of the role precipitation events and land surface conditions have on amplifying or reducing drought and flood impacts.

#### LINKS AND RESOURCES

- Report: [Origins of the 2012 Great Plains Drought: \*Origins of the 2012 Great Plains Drought\*](#)
- SARP Case Studies: [Water Resource Strategies and Information Needs in Response to Extreme Weather and Climate Events: \*Water Resource Strategies and Information Needs in Response to Extreme Weather and Climate Events\*](#)
- Pacific Northwest RISAs: [powerinc.org/projects](#)

### Communication Tools



NOAA is developing timely, accessible communication tools to inform preparedness and adaptation

#### LINKS AND RESOURCES

- U.S. Drought Monitor: [droughtmonitor.unl.edu](#)
- Managing Drought Risk on the Ranch: [BarchiDrought](#)
- Colorado Floods: Western Water Assessment: [http://ColoradoFloods](#)
- Climate and Water Resources Data in the Klamath Basin: [http://KlamathClimate](#)
- SEC's Climate of the Southeast United States: [http://SEC2014Report](#)

### Coordination



multiple  
regions to inform  
management from  
watersheds to the nation's coasts.

#### LINKS AND RESOURCES

- Floodplains by Design: [www.floodplainsbydesign.org/sectorships](#)
- Regional Integrated Sciences and Assessment (RISA): [http://RISA](#)
- Weekly Colorado Drought Assessment Webinars: [http://ColoradoDroughtWebinars](#)
- Drought Impacts Reporter: [droughtreporter.usd.edu/](#)
- NDIS portal: [www.ndis.gov](#)

### Crafting an Integrated Information System



To make the best decisions, stakeholders need access to more than just one piece of the puzzle. Integrated Information Systems are designed to evolve over time, offer opportunities for diverse participation, and integrate what we learn through practice.

- Overcoming impediments
  - Do this for a long time

# From Information to Behavior Change



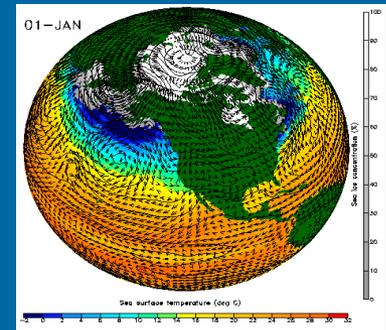
Sometimes I think the collaborative process would work better without you

# Are we better off? NIDIS goals

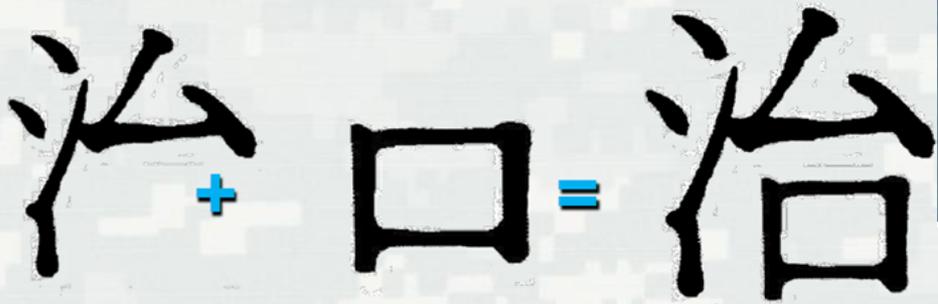
- The number of states, communities, and institutions with improved capacity to inform risk management and reduce exposure to climatic risks (compared to previous droughts)
- The number of staff in or working with those institutions trained to develop and communicate local drought information and help reduce impacts
- The number of research-based projects that conduct and update drought impacts and user needs assessments in drought-sensitive parts of the US and communicate the results to the public

# ***Challenge: Sustaining networks across Research, Observations, Services and Decisionmaking within regions and countries***

- ensure that priorities, smart practices, responses are identified, supported, secured

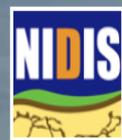


# Ancient Chinese Characters:



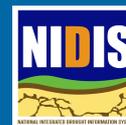
River + Dike = Political Order

1



NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM  
**MIDWEST DROUGHT EARLY  
WARNING SYSTEM**

Thank you!



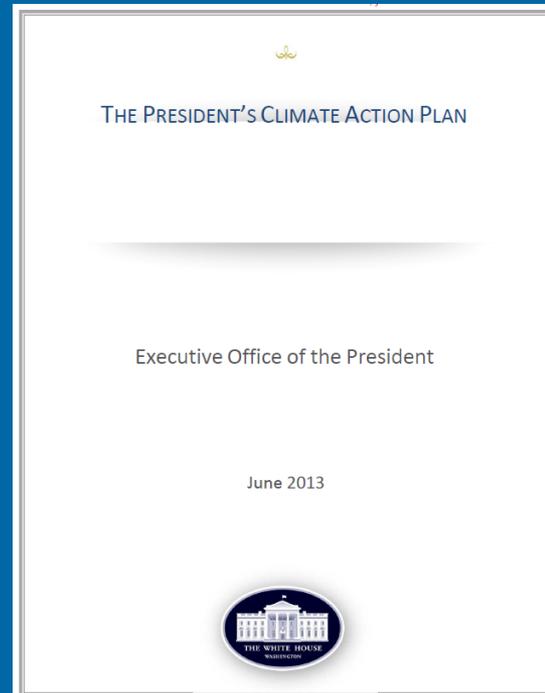
<http://go.funpic.hu>



Preparedness  
& Adaptation

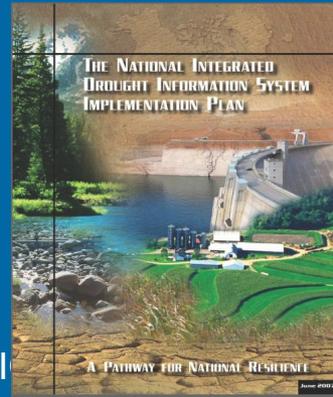
“Today, I signed the National Integrated Drought Information System Reauthorization Act into law. ***To complement the National Integrated Drought Information System, as part of my Climate Action Plan, federal agencies have also formed a National Drought Resilience Partnership to help communities better prepare for droughts in the long term, and prevent the worst impacts on families and businesses”***

***March 6, 2014. President Obama***



# Knowing more....and.....making better, not just “any” decisions

- The quality of information that has value, and is available and accessible to decision-makers at all levels
- Governance structures that facilitate better capacity development and decision-making coordination in practice



## • **“Risk”** .....

- *“A measure of the probability and severity of adverse effects”* Lowrance, (1976)
- *“What can be done in what time frames, what are the tradeoffs, and what are the impacts of current decisions on future options/consequences”* Haimes (1991)
- *The effect of uncertainty on objectives* ISO 31000 (2009)
- ***“ability-to-sleep-at-night test”***