The U.S. National Integrated Drought Information System

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USA
Drought: Weather-climate continuum and adaptation deficits

Fronts, convective systems
Cyclones
Blocking
MJO
NAO
ENSO
QBO
PDO
AMO

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

1 DAY
1 WEEK
1 MONTH
1 SEASON
1 YEAR
1 DECADE
100 YEARS

Ocean surface
upper
full

Atmospheric chemistry
Ice sheets

Marine Ecosystems
Multiple dimensions within “a” drought
(WMO Climatology and Agrometeorological Commissions)

Onset
- Abnormally dry (Level 0)
- Soil moisture levels are low, crop & pasture growth delayed
- Water alerts are issued

Climatological Drought event
- Meteorological indices have returned to normal
- Soil moisture is restored in cultivated land
- Pasture growth re-establishes
- Forest growth re-establishes
- Reservoirs and lakes refill
- Agricultural and Natural ecosystem productivity returns to average pre-drought conditions
- Lake and reservoir levels return to average pre-drought conditions
- Socioeconomic conditions:
  - Do they return or stabilize?
  - In some cases we hit a “new normal”

Recovery
- Level 2 – 4 drought
- Water shortages crop damage, and fires are widespread
- Fire risk high to extreme
- Socioeconomic impacts are moderate to severe and widespread

Drought Event
- Moderate (Level 1 - 2)
- Some crop & pasture damage
- Fire risk moderate - high
- Water conservation measures activated
- Socioeconomic impacts are mild to moderate

Drought footprint
- Normal precipitation level
- Drought indices threshold

Intensification
- Water alerts are issued
- Soil moisture levels are low, crop & pasture growth delayed

Persistence
- Abnormally dry (Level 0)
- Water alerts are issued
Three major tasks under NIDIS
(Public Law 109-430, 2006; Public Law 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 drought early warning

(III) Build upon existing forecasting and assessment programs and partnerships
Why has it been dry/drier than normal? Is this drought like others?

How did we get here? Status and antecedent conditions

What are the impacts and where did they occur?

What information is being provided and by whom?

How bad might it get and how long will it last?

How are we planning for this year and for longer-term risks and opportunities?
Pathways to Drought Monitoring and Predictability

Key Phenomena, variables

Ocean Temp anomalies

Global-Scale Atmospheric Changes

Regional Forcing and land feedbacks

Local Impacts, Info needs

ENSO, PDO, AMO, warm pool variability, climate change,

planetary waves, hydrological cycle, monsoons, Hadley Cell, Walker Circulation

precipitation, soil moisture, snow, low level jets, dust, vegetation, land/atmosphere contrasts, changes in weather

soil moisture, stream flow, precipitation, ground water, lakes, reservoirs
The weather-climate continuum

July 2010
8% moderate to exceptional

July 2011
28% moderate to exceptional

May 2012
35% moderate to exceptional

July 2012
64% moderate to exceptional

January 2013
58% moderate to exceptional

Area (%) of the US (including Alaska, Hawaii and Puerto Rico) categorized as D1, D2, D3 or D4 on the US Drought Monitor

The great drought
USA experienced the worst drought transforming 15 percent of its land into desert

NIDIS
NATIONAL DROUGHT INFORMATION SYSTEM
The weather-climate continuum

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8% moderate to exceptional

July 2011
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35% moderate to exceptional

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58% moderate to exceptional

Area (%) of the US (including Alaska, Hawaii and Puerto Rico) categorized as D1, D2, D3 or D4 on the US Drought Monitor

54%

28%

The great drought
USA experienced the worst drought for almost four decades, resulting in widespread crop and soil damage.
A complete explanation of these droughts must invoke not just the ocean forcing but also the particular sequence of internal atmospheric variability - weather - during the event.
US Drought Portal
drought.gov

- Improved navigation: Landing page for data, maps, tools and other products
- Access to particular kinds of data, products and tools
Network coordination
Integrated Information (monitoring, forecasting, risk assessment)
Drought risk management

System Attributes: Agility, Alignment, Adaptability

Watershed/Regional and sub-regional Scales
Example: NIDIS Colorado Basin Early Warning System
Stakeholder and Research/Applications Collaborative Network

- Colorado Division of Water Resources (CDWR)
- Colorado State Climatologist
- Colorado River Water Conservation District (CRWCD)
- Colorado Water Conservation Board (CWCB)
- USBR: Eastern Colorado Area Office, Great Plains Region, Office of Policy and Programs, Research and Development
- Denver Water Board
- Northern Colorado Water Conservancy District (NCWCD)
- Wyoming State Engineer Western Regional Climate Center
- Ranching and Farming Communities
- USDA Forest Service Region2
- Hydropower Power Administration
- Indigenous Communities: Dine, Hopi, Hualapai, Zuni

- National Center for Atmospheric Research (NCAR)
- National Drought Mitigation Center
- USDA: Natural Resources Conservation Service
- University of Colorado – Western Water Assessment, CIRES, and CADSWES
- USGS: Colorado Water Science Center, Central Region, Grand Canyon Monitoring and Research Center
- NOAA: Earth System Research Laboratory, National Centers for Environmental Prediction, National Weather Service, National Center for Environmental Information
- Colorado, Utah and Wyoming State Climatologists
Loveoick, Nevada – Humboldt River Basin
- No groundwater pumping for irrigation (too salty)
- Very little storage upstream
- Extremely sensitive to persistent hydrologic drought

Growing Season Crop Water Use (30m Pixels) – Computed using Google Earth Engine
Google hosts the entire 40yr+ Landsat archive and provides parallel cloud computing

2011 Wet
2013 Dry
2014 Drier

Only ~5% water delivery
Drought Forum

Western Governors’ Association
westgov.org/drought-forum

Drought-Ready Communities
A Guide to Community Drought Preparedness

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

MANAGING DROUGHT
IN THE SOUTHERN PLAINS

You are invited to join us in a webinar web-based webinar series to discuss drought conditions, impacts and resources available to help manage drought in the Southern Plains. Webinars will be held on the 5th Thursday of each month at 12:00 P.M. Central Time. A 30-minute break will be offered on the 5th Thursday. The content is geared toward a general audience anyone who has responsibility to manage or assist others in managing drought and its related impacts.

If you would like to join in these webinars, you need to register via the SCIPP website: http://www.ucdavis.edu/scipp or e-mail scipp@scipp.ucdavis.edu. For each webinar, you will receive an e-mail with the link to access the webinar. Each webinar will last 45-60 minutes.

Each webinar will include an overview of the current drought occurrence and outlook, summary of impacts across the region, and a topic or resource, such as La Niña or wildfire conditions. You will have an opportunity to suggest topics for following webinars. The primary focus is on the most near-term impacts from the current drought. Texas, Oklahoma, and New Mexico - but participation from surrounding states is encouraged.

The webinar series is sponsored by a partnership of the National Integrated Drought Information System (NIDIS), National Oceanic and Atmospheric Administration (NOAA), USGS, Climate Change Program, National Drought Mitigation Center, Southern Climate Impacts Planning Program, Climate Assessment for the Southeast, and the region’s State Climatologists.

Information from the webinars will be posted on a website linked through http://www.southernclimateimpact.org. A one-page summary will be produced and posted for each webinar. Please pass on this announcement to related organizations or groups that are involved in managing or monitoring drought and its related impacts.

Website Topics:
- La Niña
- Drought
- Impacts
- Water Supply
- Agriculture
- Agricultural Impacts
- Wildfires
- Drought Ready Communities

Drought Early Warning Pilot in the Apalachicola, Chattahoochee, and Flint River Basin: Evaluation of Activities and Outcomes

February 2016

NOAA Drought Task Force 2016
Research to Advance National Drought Monitoring and Prediction Capabilities
NI Drought Early Warning Pilot in the Apalachicola, Chattahoochee, and Flint River Basin: Evaluation of Activities and Outcomes
Are we better off?

NIDIS Colorado Basin Evaluation: Comparing drought-readiness before 2002 (most severe drought in the Basin) and now....
An information system informs both Preparedness & Resilience

Define demand and barriers to the flow and use of information

- Physical and social information—about and coming from places of risk
- Support knowledge sharing and options for responding to risk.

How is the NIDIS system organized and governed to achieve these goals?
NIDIS Program Office

REGIONAL (Multiple States)

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

Drought Early Warning Information Systems
NIDIS Governance: Executive Council

NATIONAL

NIDIS Implementation Team:

NIDIS Technical Working Groups

REGIONAL (Multiple States)

- Public Awareness And Education
- Engaging Preparedness Communities
- Monitoring and Forecasting
- Interdisciplinary Research and Applications

U.S. Drought Portal

WATERSHED/URBAN/LOCAL

Drought Early Warning Information Systems
<table>
<thead>
<tr>
<th>Activity</th>
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<td>Initial portal operational capability at drought.gov</td>
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<td>Advanced portal mapping capability with GIS tools</td>
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<td>Populate drought.gov website (portal, plans, reports, agency links)</td>
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<td>Operational portal communities and collaborations</td>
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<td>Enhance data management and distribution</td>
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<td>Portal extension to hemispheric and global domains</td>
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<td>Drought forecast regionalization studies</td>
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<td>Enhance soil moisture and temperature measurements</td>
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<td>Forecast verification and calibration to measurements</td>
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<td>Coordinate with CPC Program Managers/agencies on interdisciplinary research goals</td>
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<td>Assess national status of drought early warning</td>
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<td>Planning for adoption</td>
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<td>Institutionalize &quot;Drought Coordinator&quot; network</td>
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<td>Enhanced regional impacts research</td>
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<td>Implement adaptive management strategies</td>
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<td>Pilot study scoping and selection</td>
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<td>NPT workshops: Define criteria and assess partner interest and capacity for pilots</td>
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<td>First Workshop: Assessment of Drought Early Warning System Status in the United States</td>
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<td>Pilot study implementation</td>
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<td>Initial early warning prototypes</td>
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<td>Establish regional sub-team leads within NPT</td>
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<td>Establish initial agency/state rotational assignment to NIDIS Program</td>
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<td>Extend NIDIS to National Governors' Association and inter-basin Watershed Commission</td>
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<td>Operational workshops to assess national drought monitoring and forecasting gaps</td>
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## NIDIS through 2018

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<th>Long term (3-5 years)</th>
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| **Develop a fully integrated suite of regional drought early warning information systems (DEWS)** | • Continue established DEWS network for ongoing outlooks and forums on impacts and across timescales (sub-seasonal to decadal etc.).  
• Initiate additional regional and sub-regional systems  
• Evaluate effectiveness of DEWS. | Complete staging and diffusion of regional DEWS and coordinators to achieve national coverage in partnership with federal, state, regional, private and local agencies. |
| **Advance drought monitoring, forecasts, impacts assessments and reporting** | • Improve understanding and improved forecasts of physical and demand factors to inform risk assessment and management.  
• Demonstrate the effectiveness of drought risk reduction strategies | Continued drought information system as inputs into watershed, state, and local drought plans and operations. |
| **Improve regional to local capacity to educate, and communicate drought information and response** | • Initiate process for transferring capabilities to new locations (1) to assess drought impacts and (2) improving usability of products planning and response  
• Engage regional capabilities (USDA Climate Hubs, DoI CSCs) in DEWS development /implementation | Develop an integrated interagency drought information network for education, coordination, capacity building and delivery of products and services at regional to local level. |
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Information systems under Changing weather and climate extremes
Challenges:

• Multi-year droughts (two or more) are, at present, not addressed by any forecast system—clearly a gap in our capabilities.

• Impacts are not well-documented or linked to event characteristics and timescales.
Challenge:
Coordinating and sustaining regional networks across research, observations, services and decisionmaking

Science-informed Preparedness & Adaptation