An update on NOAA’s National Integrated Drought Information System

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The National Integrated Drought Information System - An Update

Roger S. Pulwarty and the NIDIS Implementation Team

Chief, Climate and Societal Impacts Division and Director, NIDIS
NOAA
Three tasks under the NIDIS Act
Public Law 109-430, 2006

(I) Provide an effective drought early warning system:
   (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 in support of a drought early warning system

(III) Build upon existing forecasting and assessment programs and partnerships
Event to event.......issue attention cycle

- Preparedness
- Mitigation
- Prevention
- Response
- Recovery
- Development

Focusing event(s) and cumulative Impacts

Mitigation
Prevention
Recovery
Response

Event

Preparation

Learn lessons for...
NIDIS Components

1. NIDIS Office
2. U.S. Drought Portal
3. Climate Test Beds/Drought Integrating data and forecasts
4. Coping with Drought-Grants-Impacts assessment and decision support research
5. Regional Drought Early Warning Information Systems Design, Prototyping, Implementation
Support cross-RISA efforts to explore testing drought-focused tools + one new drought-focused RISA

Coping with Drought Research

Identify *socio-economic effects of drought and *data and info needs of resource managers and policy/decision makers

Transition drought information products to operations for decision making in resource management
Reconciling Projections of Future Colorado River Stream Flow
Evaluation of Fire Forecast Products to Enhance U.S. Drought Preparedness and Response
D. Ferguson (Univ. of AZ, CLIMAS); T. Brown (DRI, WRCC, CAP); P. Duffy (Neptune and Company, Inc., ACCAP); G. Owen (Univ. of AZ, CLIMAS); S. Trainor (Univ. of AK, ACCAP)
• Develop drought decision support portal for the Republican River Basin (Knutson)

• Identify/evaluate water transfer arrangements to facilitate use of climate information in planning (Colby)

• Develop hydroclimatic reconstructions for water resources management (Mantua)

• Develop climate training workshops targeting Extension Agents/Farm Bureaus (Shafer)
Paleoclimatic Information for Drought Planning and Decision Making
C. Woodhouse, University of Arizona, Tucson, AZ; and J. J. Lukas, M. Mauzy, and J. Jones

http://www.ncdc.noaa.gov/paleo
A Climate Information System to Enhance Drought Preparedness by Underserved Farmers in the Southeastern U.S.

Roncoli, C. University of Georgia Research Foundation Inc., G. Hoogenboom, C. Furman, P. Knox, J. Paz, University of Georgia, H. Gray, Federation of Southern Cooperatives/Land Assistance Fund
Bridging the Gap Between Research and Stakeholders: A Tale of Three Tools
M. Svoboda, NDMC, Lincoln, NE; and C. Knutson and M. J. Hayes

- Drought Impacts Reporter
- Republican River Basin Water and Drought Portal
- Developing Drought Ready Communities

http://droughtreporter.unl.edu/
• Transition the Drought Impact Reporter into an operational system (Hayes)

• Operationalize the SECC AgroClimate Tool for extension services for drought management (Ingram)

• Enhance decision-makers’ monitoring tools by transitioning a new drought index (Garfin)

• Link NOAA climate forecasts to dynamic vegetation models to produce seasonal predictions for fire management (Brown)
National Level: NIDIS Knowledge Assessments (selected);
What do we know? What do we need to know?

- Drought, Climate change and Early Warning on Western Tribal Lands April 2011-Four Corners Region

- WGA/WSWC Workshops on developing constituencies for NIDIS (April 2010, September 2010-Washington DC, 2011)

- NIDIS Executive Council Meeting Hall of the States Washington DC Sept. 2010

- Engaging Communities in Preparedness June 2011 Chicago
USGS 1331- Climate Change and Water Resources Management: A Federal Perspective 2009

Centers for Disease Control When Every Drop Counts: Protecting Public Health During Drought Conditions—A Guide for Public Health Professionals 2010

NIDIS Products and Services in the Colorado Basin to date

• Assessment of watershed-based drought indicators and management triggers in the Upper Basin-linkages
• Improved linkages between climate and streamflow modeling during drought
• Spatial analysis of water demand during drought
• Low flow impacts database for 164 NWS forecast points
• UCRB Community Colorado Basin-specific Drought Portal
• Weekly Drought and Water Outlook webinars/early warning discussions with resource managers in the UCRB
• Engaging underserved communities
Revision of the Plans to meet drought requirements of the State Natural Hazard Mitigation Plan, as well as FEMA and EMAP

NIDIS role

- Development of indices that incorporate current surface water conditions and a forecast component
- Assessment of trigger points and responses
- Weekly Early Warning Webinars (coordinated with River Forecast Center briefings)
Recent Landscape changes
Mandatory water conservation

NIDIS California Drought Early Warning Information System Pilot(s)

Klamath Basin

Russian River

Central Valley

San Diego/Southern CA
Regional Drought Early Warning Systems

Highlighted-first round prototypes; Non-highlighted-second round Regional DEWS
The prototype phase for regional drought early warning information systems allows for:

- Information-integration, diffusion, use, evaluation

- Existing barriers to cross-agency collaboration to be addressed or least be made explicit

- Innovations and new information to be introduced and tested, and

- The benefits of participation in design, implementation and maintenance to be clarified

Mature prototypes becomes the regional system.
Approaches:

- Identifying appropriate partners, stakeholder representatives
- Setting goals/priorities, and involving partners in problem definition
- Using professionals from relevant agencies etc. to build common ground
- Producing collectively authored gaps assessments and agreement on the way forward
- Building long term collaborative partnerships
- Tradeoffs-Decision quality vs decision acceptability

Lessons become more likely to be successfully transferred within or to other as yet underserved regions.
1. Cross-RISA collaborations to transfer tools, knowledge, products.

2. Geographically supported efforts (SE, SW, Great Plains, Pacific NW and Chesapeake Bay watershed)
   - Characterize climate related risk perception by institutions faced with making decisions in a changing climate (time scales)
   - Assess the components and types of risk analysis that are needed for planning for a changing climate
   - Assess impacts including indirect or secondary economic impacts, develop socioeconomic baselines and/or tools for generating drought risk scenarios
   - Understand how a jurisdiction plans to respond to water demand in the face of drought (how are decisions made to allocate water given competing needs)
   - Characterize the readiness of institutions that are dealing with drought to utilize climate information

3. Transition products links to the US Drought Portal.

Coping With Drought FY11
NIDIS-Transferability

- FEWSNet
- GEO Water Resources
- Mediterranean/Iberian Peninsula
- Australia (MDB/Colorado)
- India NIDIS
- Caribbean Basin
- US-Canada PNW
- GIDIS-
“We would cite the National Integrated Drought Information System (NIDIS) as one example of how federal agencies can work together and with states …...it demonstrates key elements of how….to deliver actionable information to end users and decisionmakers”

Western Governors letter to CEQ-Response to CEQ Adaptation Interim Report  May 21, 2010

NIDIS is an important example of what a climate service should do  (T. Busalacchi, Climate Working Group Chair, Sept., 2010)

NIDIS is an organizational model for developing and coordinating ongoing climate assessments  K. Jacobs NCA  November, 2011

NIDIS offers a valuable model for interagency early warning systems design  …Subcommittee on Disaster Reduction (June 2, 2011)
Drought and Water Resources: (Federal, States, Tribes, Urban, other)

Monitoring & Forecasting

Drought and Flood Impacts Assessments and Scenarios

Early Warning Information in support of Adaptation

Communication and Outreach

Engaging Preparedness & Adaptation
THANK YOU!
BACKUP SLIDES
Coordinate existing federal, state, and local drought-related data and decision support activities (e.g., within watersheds and states)

Integrating Tools e.g. Drought Monitor/Portal

Identifying and transferring indicators, decision support tools and innovative strategies for drought risk assessment, communication and preparedness

Monitoring

Prediction

Applications Research

Proactive Planning

Impact Mitigation

Improved Adaptation
Landscape changes-
Drought Early Warning on Tribal Lands
in the Four-Corners Region

(Nature, 2009)
## Risk Profiles

<table>
<thead>
<tr>
<th>Vulnerable Sector/activity/group</th>
<th>Magnitude</th>
<th>Rates of Change</th>
<th>Persistence and reversibility</th>
<th>Likelihood and confidence</th>
<th>Distribution</th>
<th>Potential for Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic sectors (Water, Ag, Tourism etc.) Communities at risk Bounded ecosystems such as coastal, mountain are already stressed</td>
<td>Situation of existing Levels of vulnerability for different magnitudes of change, especially thresholds, relative to temperature, precipitation or the other critical parameters that create the vulnerability</td>
<td>Critical rates/steeper response curves that affect vulnerability</td>
<td>Likelihood that the vulnerable sector will be affected by an irreversible impact and whether it is likely to persist</td>
<td>Overall confidence and likelihood, but state confidence also with any specific figures or points</td>
<td>Distribution of impacts – both physically and socially within countries (not in a simple developed/developing dichotomy)</td>
<td>Capacity for adaptation. Is adaptive capacity sufficient to delay or prevent adverse impacts and at what cost</td>
</tr>
</tbody>
</table>

WGII & Leggett and Pulwarty
Visit the Global Assessment Report 2011 online:
www.preventionweb.net/gar
Year 2 Actions

Prototyping/gaming: Given better data and information coordination, would responses have been improved for past events? Assess:

1. Value of improved information using past conditions
2. Responses for projections/ scenarios (seasons, decadal, change)
3. Develop EWS Fora
4. Feedback on priorities (e.g. data gaps) to Executive Council
Adaptation: Crisis, learning and redesign

What has led to “action”? 

1. Focusing events—extremes, legal decisions etc.
2. Leadership at different levels and the public are engaged:

3. **Supported framework for collaboration between research and management-integrated**, scenarios, scenarios/gaming, communication, embedding information into practice, evaluation

4. Existing social basis or even pressure for collaboration
Climate drivers of drought-a continuum

- Heat Waves
- Storm Track Variations
- Madden-Julian Oscillation
- El Niño-Southern Oscillation
- Decadal Variability
- Solar Variability
- Deep Ocean Circulation
- Greenhouse Gases

- SHORT-TERM
  - 30 DAYS
  - 1 SEASON

- INTERANNUAL
  - 3 YEARS
  - 10 YEARS

- DECADE-TO-CENTURY
  - 30 YEARS
  - 100 YEARS
Native Nations in SW are major land managers

- 6 million acres/ 242kha of land
- held in trust by the US for American Indian tribes and Alaska Natives
- Reservations and tribal lands are >25% of land in AZ
- Confronting same climate trends, need same info, but context is different
  - cultural ties to landscape
  - federal trust relationship
  - widely variable capacity
Assessing progress for each element of planning and implementation

(i) Knowledge development and management

(ii) Products and delivery

(iii) Capacity and coordination

Priorities for early adaptation action, including land use planning, building design, emergency planning, local infrastructure provision and green space management

Timeliness of action
- depends on regional/local circumstances-surprises
- cost-effectiveness of adaptation measures
- implementation monitoring and evaluation
CUAHSI HIS Custom Drought Index Server

Data Products and Services
- Web Map Based Display of Index
- WaterOneFlow Web Service(s) for inputs and outputs
- GIS Data Services
  - WMS, WFS, WCS
  - Digital Watershed
  - Drought Index Results

CUAHSI
D. Tarboton
J. Horsburgh
Utah State University

Data Processing and Index Calculation
The “Services” Challenge

- Identify user requirements
- Conduct research
- Develop applications and capacity
- Integrate knowledge and products
- Deliver information
- Data quality control

MONITORING/FORECASTS & DEVELOPMENT (Assessments, int.products) & PROTOTYPING (Scenarios, Applications)

Relative status of information
STATIC...............................EMERGENT/DYNAMIC
Through conversations before and during workshops, the team identified the most important and most uncertain climate drivers that will affect conditions over the next 40 years. These were combined in the following matrix. (Also note that temperature increase was a 'given' so it applies in all scenarios.)

**Shrubland**
- Ecosystem becomes more susceptible to annual grass invaders. Fate of pines and other trees uncertain. Soil erosion increases. Faunal composition changes.
- Flash floods entering caves more often
- Native grassland replaced by shrubland and exotic annuals
- Ponderosa pine communities more susceptible to catastrophic fires due to decreasing summer precipitation

**Novel Ecosystem**
- Climate changes quickly to something like southern SW U.S. and species migration limited. Water table drops; streams go from perennial to intermittent or gone. Soil erosion increases. Many fauna may not be sustainable.
- Period of frequent, intense fire followed by decrease in fire because of lack of fuel
- Tough decisions regarding above-ground mission

**Mixed-grass Prairie**
- Changes seen as part of normal variability
- Other management issues dominate
- Streams more intermittent, trees dry out
- Increased evaporation decreases plant productivity somewhat; ecosystem change occurs, but more slowly and/or to lesser degree than in other scenarios.

**Shortgrass Prairie**
- Extreme heat events – camp fire bans
- Decreased water availability
- Park culls half of the bison herd – limits on carrying capacity
- Forest is more restricted by moisture than currently. Megafauna capacity decreases because forage production is lower. Water table drops; spring and stream flow decreases or ceases, depending on location.
Challenges

- Develop strategic responses to crises: foreseeable, impending, actual; and
- Provide implementable options to critical actors for decision-making

A systemic view would involve assessing:

- Impediments to the flow of knowledge among existing network components
- Policies and practices that can give rise to failures of the component parts working as a system
- Opportunities for and constraints to learning and institutional innovation
III. Conduct Planning Evaluations

System Analysis, Evaluate Study Questions (related to Resource Management Objectives)
Principal Elements of Drought Risk Reduction Framework

SUMMARY

Policy & Governance
- Political commitment and responsibilities

Risk & Early Warning
- Vulnerability analysis, impact assessment, and communication

Mitigation & Preparedness
- Application of effective and affordable practices

Awareness & Education
- A well-informed public and participatory process

Local reality
- Community participation
- Political commitment
- Sustainable livelihoods
Drought Preparedness for Tribes in the Four Corners Region Workshop

April 8-9, 2010, Flagstaff, Arizona

Tribal perspectives on critical issues

Local Knowledge & Drought: How do we incorporate local knowledge?

What are current vulnerabilities and impacts tied to drought and climate change?

Critical drought-related information needs on tribal lands in Four Corners region

Improved monitoring emerged as the highest priority near-term need
Drought and Water Resources Services

Mission: Implement a dynamic, accessible, authoritative drought information system

<table>
<thead>
<tr>
<th>NOAA Produces:</th>
<th>With Our Partners:</th>
<th>Used By:</th>
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<tbody>
<tr>
<td><strong>Monitoring and Forecasting</strong></td>
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<td>USDA, National Drought Mitigation Center</td>
<td>USDA, state and local governments</td>
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<td>U.S. Soil Moisture Monitoring</td>
<td>DOE, USDA (NRCS)</td>
<td>USDA, agricultural producers</td>
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<td>USGS, NASA</td>
<td>USAID (FEWS NET)</td>
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<td>Ensemble Water Supply Forecasts</td>
<td>USDA</td>
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<td>Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation</td>
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<td>Colorado Water Conservation Board, University of Colorado, Western Water Assessment RISA</td>
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<td>Colorado water planners, State Climatologists</td>
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<td>Managing Threatened and Endangered Salmon in Low Water Conditions</td>
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Connecting geospatial and temporal water resources data

Digital Watershed

NHDPlus

NOAA NCDC and ASOS

David Maidment, U Texas

USGS NWIS Streamflow

NRCS Snotel
Upper CO Basin Water Demand Spatial Analysis

Drought vulnerability GIS database that represents relationships among water users and their respective sources of water supply

NIDIS/NCAR
Projects

Portal development sponsored by USGS Climate Effects Network and NIDIS

Publications

People
Progress has been impressive... with more tools on the way!
The development phase of regional drought early warning information systems:

Information-integration, diffusion, use, evaluation

- Allows for existing barriers to cross-agency collaboration to be addressed
- Innovations and new information to be introduced and tested, and
- The benefits of participation in design, implementation and maintenance to be clarified

Mature prototypes becomes the regional system. Lessons become more likely to be successfully transferred within or to other as yet underserved regions.
- Identifying appropriate partners, stakeholder representatives

- Setting goals/priorities, and involving partners in problem definition

- Using professionals from relevant agencies etc. to build common ground

- Producing collectively authored information gaps assessments
- and agreement on the way forward

- Building longer term collaborative partnerships

- Tradeoffs - Decision quality vs decision acceptability
Risk information-governance

Ensure political authority and policy coherence

Decentralize step-by-step and incrementally

Develop a culture of partnership
Transitions from applications to adaptation:
Social-structural and spatial-temporal, resource management
Limits of co-production

Social-ecological
Path dependence
Organizational boundaries
Joint monitoring and joint fact-finding
Adaptive institutions display robustness through:

Levels of alertness - monitoring the external world for early warning signs that key assumptions are likely to verify/fail, and a commitment to rigorous monitoring of performance;

Agility - the ability to react to early warning signs of problems or opportunities; flow of knowledge across components, and to adjust strategies and tactics rapidly to meet changes in the environment; and

Alignment - the ability to align the whole organization (and partners) to its mission-policies and practices that give rise to failures/successes

Tested through appraisal of past and ongoing practices for major focusing events.
International Association of Public Participation