
THE NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

Report to Congress

January 2016

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1. Introduction

The goal of the National Integrated Drought Information System (NIDIS) is to improve the Nation's capacity to manage drought-related risks by providing the best available information and tools to assess the potential impacts of drought, and to prepare for and mitigate the effects of drought. NIDIS was authorized and established by Congress in 2006 via Public Law 109-430 to provide an effective drought early warning system for the Nation. NIDIS was reauthorized by Congress in 2014. The NIDIS Reauthorization Act (Public Law 113-086) included the requirement for a report to Congress on NIDIS, which is contained herein.

NIDIS works to improve ability of the Nation, our states and our communities to answer to following questions:

- What are the current drought conditions, and what has led to them?
- How does one drought resemble another? How is it different from past droughts?
- How long might a drought last?
- What are the impacts and where are they occurring? Where did they occur in the past?
- Where can citizens find information about drought? Are information needs being met?
- Are we prepared for a drought this year? Are we preparing for future drought risks?

Together with federal, state, tribal, local and private sector partners, NIDIS develops the leadership and partnerships needed to ensure successful implementation of a national drought information system. This system collects and integrates information on the key indicators of drought conditions, including assessments of its severity and impacts; fosters and supports a research environment that focuses on forecasting and informing risk management; provides accurate, timely, authoritative and usable information on drought conditions and associated risks to facilitate proactive decision-making; and provides a framework for increasing public awareness and education on how and why droughts occur, and how they impact human and natural systems on which communities depend.

How drought has affected the Nation since the 2006 NIDIS authorization

Drought is a global and recurring natural phenomenon. Since the creation of NIDIS in 2006, intense droughts have affected almost every sector of the national economy, costing billions of dollars in impacts.

2007-2008: Severe drought in the Southeast was particularly intense in the Apalachicola-Chattahoochee-Flint (ACF) and the Alabama-Coosa-Tallapoosa (ACT) River Basins, affecting water supplies for Atlanta and the surrounding region. Economic impacts in terms of lost jobs and lost revenue were estimated at more than \$1 billion by the Florida Department of Agriculture and Consumer Services. A subsequent drought in 2011 contributed to devastation of the oyster fishery in Apalachicola Bay.

2008-2009, 2011 and ongoing: Droughts hit California. The drought that started in 2012 is considered the state's drought of record. The U.C. Davis Center for Watershed Sciences estimated economic impacts at more than \$5 billion for 2014 and 2015 combined.

2010-2011: New Mexico, Oklahoma, and Texas began to experience one of their most extreme droughts, rivaling those of the 1950s. Impacts cut across all economic sectors, particularly affecting ranchers, who resorted to cattle herd liquidations and widespread redistribution of cattle to less affected states. 2011 was the single worst drought year ever recorded for Texas. Texas AgriLife Extension Service estimated agricultural losses for 2011 alone at \$5.2 billion.

2012: Extreme drought, following widespread flooding in 2011, evolved rapidly and devastated parts of the Great Plains and Midwest, which experienced their worst crop losses in 25 years. According to the National Oceanic and Atmospheric Administration (NOAA)'s National Centers for Environmental Information (NCEI), [impacts](#) were estimated at \$31 billion.

2015: Severe drought in the Pacific Northwest continues to affect agricultural interests and contributed to an intense wildfire season.

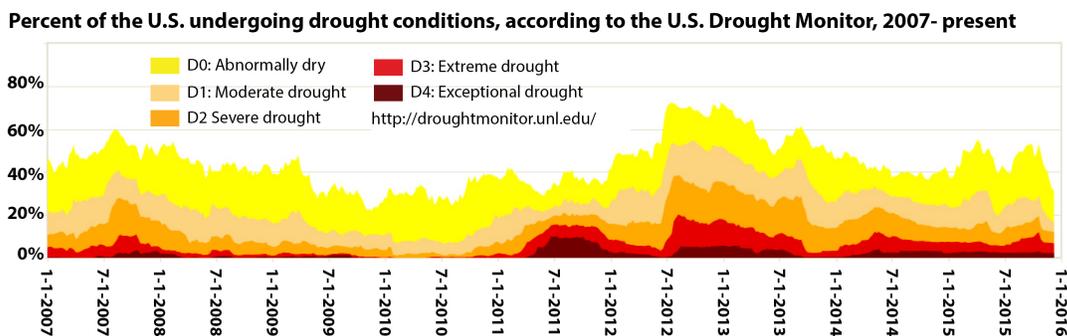


Fig. 1: How the severity of drought has fluctuated in the U.S. since 2007

While drought cannot be avoided, NIDIS provides information that allows decision makers and the public to anticipate and prepare for droughts and drought intensification, allowing proactive decision-making for reducing impacts.

NIDIS partnerships and collaboration

NIDIS works closely with agencies and organizations from federal, tribal, state, regional, local, private and nonprofit sectors, to deliver the best available data, information and resources to promote drought planning and resilience at all scales. While NIDIS is led and coordinated by the NOAA, it, by design, relies on a network of multi-agency partnerships. Examples of collaboration include:

- The U.S. Department of Agriculture's (USDA) National Resources Conservation Service (NRCS) SNOwpack TELEmetry (SNOTEL) and Soil Climate Analysis Network (SCAN) sites, providing data on snow levels/snow-water equivalents and soil moisture are essential to hydrological forecasts;

- The Water Census, led by the U.S. Geological Survey (USGS) under the Department of Interior's WATERSMART efforts, which researches water availability and usage in order to develop new water accounting tools; and
- Stream flow and reservoir level monitoring systems led by the U.S. Army Corps of Engineers and the Bureau of Reclamation.

Regionally, NIDIS shares resources and information through partnerships such as those with the Western Governors' Association (WGA), the Western States Water Council (WSWC), State Natural Resources and Water Departments, State and Regional Climate Offices, the American Association of Climatologists, and academic institutions including the National Drought Mitigation Center (NDMC) at the University of Nebraska-Lincoln.

Core NIDIS activities

Consistent with the NIDIS Act of 2006 (Public Law 109-430), NIDIS supports four core activities in its resource allocations to meet the goal of establishing an effective national drought early warning system. These are:

- 4a. Regional Drought Early Warning Information Systems (DEWS)
- 4b. Integrating Monitoring and Predictions
- 4c. Research for *Coping with Drought*
- 4d. The U.S. Drought Portal (drought.gov)

NIDIS Drought Early Warning Systems

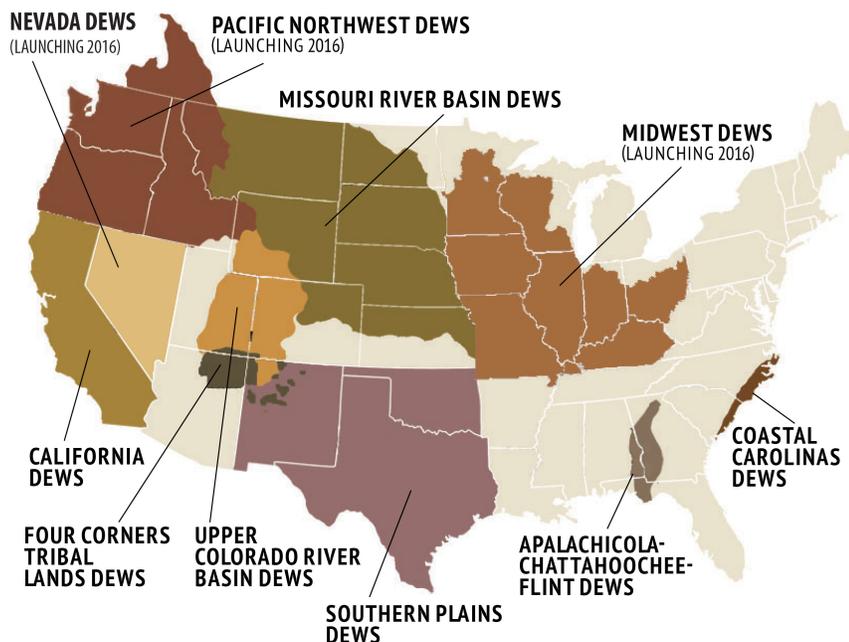


Fig. 2: NIDIS DEWS as of 2015

4a. Regional Drought Early Warning Information Systems (DEWS)

Given that drought develops and affects parts of the Nation in different ways, the [DEWS](#) provide regional mechanisms for drought early warning based on these different needs and drought types (e.g. snowpack in the West, rainfall in the Southeast). The regional DEWS facilitate ongoing assessments and scientifically based outlooks of existing and potential drought conditions and impacts. DEWS are established or under development in key drought-prone regions of the Nation (Fig. 2).

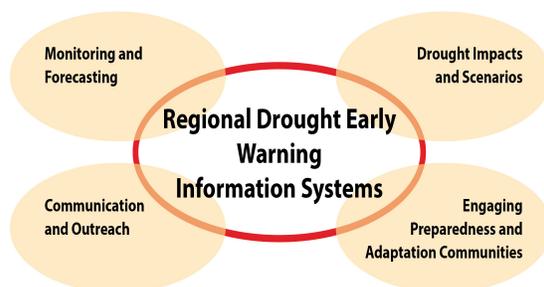


Fig. 3: Key components of NIDIS Regional Drought Early Warning Systems

The DEWS use data and information developed by the NIDIS monitoring and research components, and from other federal and state agencies, as well as universities, to develop status reports, outlooks, webinars and forums for information exchange. These efforts bring together stakeholders from all levels of government and economic sectors, interagency data providers and resource managers (such as the Department of the Interior, U.S. Army Corps of Engineers and USDA), other government agencies, water conservation districts and community members to assess the status of snowpack conditions, stream flow, reservoir levels, water demand, and provide short- and long-term forecasts, among other needs. Each DEWS integrates the key components of the framework shown in Fig. 3, and implements them according to regional needs and assets.

NIDIS has developed multi-agency Working Groups under these key components to help ensure that information needs and gaps are understood by NIDIS partners, and all relevant information and advances are brought to bear to improve the DEWS. DEWS have fostered innovative approaches for raising awareness, assessing drought risk and for informing resources management. Examples include development of:

- [A national drought risk atlas](#) that provides a wide range of decision makers with historical drought information and a web-based tool to visualize and assess their risk to drought
- [An evaporative demand drought index \(EDDI\)](#) which quantifies how much water the atmosphere is demanding or extracting from crops/vegetation and soil during drought
- [Guidance for communities to become “drought-ready”](#) and drought resilient
- [Objective, accurate, and timely assessments of fallowed acreage](#) as a measure of drought severity in California to support impact assessment and mitigation planning on farms.

- [Tabletop exercises](#) with stakeholders which simulate drought conditions to inform robust decision-making and mitigation strategies in drought planning processes

4b. Integrating monitoring and prediction

Prediction of drought onset, evolution, and recovery is critical on a variety of timescales, from days to years, so that water managers and water-dependent sectors of the economy can make efficient use of their resources. NIDIS supports drought research objectives which focus on (1) advancing the scientific understanding of the weather and climatic mechanisms that lead to drought onset, persistence and recovery; (2) improving drought prediction skill by identifying sources of drought predictability across timescales and regions to improve forecasts; (3) improving drought information systems by incorporating the latest scientific advances into metrics relevant for various societal sectors, and advanced information delivery platforms; and (4) improving coordination and delivery of information through in-person drought outlook forums and weekly webinars (e.g. Upper Colorado River Regional Drought Early Warning webinars) using networks of experts at the state and local level.

NIDIS-supported research, implemented through NOAA's Modeling Analysis Predictions and Projections (MAPP) Program within the Office of Oceanic and Atmospheric Research (OAR)'s Climate Program Office (CPO), is targeted to improving drought monitoring and prediction systems, resulting in improvements in the [U.S. Drought Monitor](#), NOAA Climate Prediction Center's (CPC) [Drought Outlooks](#) and early warning capabilities. MAPP funds collaborative research grants that involve academia, NOAA and other research laboratories. The MAPP program works extensively with the National Weather Service (NWS) through its National Centers for Environmental Prediction (NCEP) to ensure sustained transition of research results into improvements of operational capabilities for monitoring and prediction from weeks to seasons. The NCEP's [Climate Test Bed \(CTB\)](#) seeks to accelerate the transfer of research findings into NOAA's operational drought products. NCEP and MAPP are active partners in all stages of NIDIS' drought research and transition cycle.

Since 2011, research to advance the understanding, monitoring and prediction of drought in support of NIDIS has been coordinated through an interagency Drought Task Force including NASA and the USGS, established by the MAPP Program. Its goal is to achieve significant advances in understanding and in the ability to monitor and predict drought over North America. The Task Force has prepared two authoritative reports, and several subsidiary reports, on different events which have received widespread attention. The two major reports are:

- "[An Interpretation of the Origins of the 2012 Central Great Plains Drought](#)"
- "[Causes and Predictability of the 2011-14 California Drought](#)"

The Task Force has also developed a Drought Capability Assessment Protocol that includes metrics for how research has improved drought monitoring and forecasting datasets, techniques, and products. This protocol is being adopted by the broader research community.

4c. Research for *Coping with Drought*

Research through the *Coping with Drought* (CWD) initiative assesses impacts of drought on agriculture, ecosystems, and water resources and develops decision support tools for regional, state, and local use. CWD research contributes to the understanding of how communities become aware of drought threats and how they can improve preparation and planning. The projects incorporate consultation with stakeholders, and focus on information that is most useful for decision-making to reduce vulnerability; models and tools that bring this information to decision makers; and strategies for improving NIDIS' engagement with communities in preparedness. NOAA's [Sectoral Applications and Research Program \(SARP\)](#) and [Regional Integrated Sciences and Assessments \(RISA\)](#), both within CPO, administer NIDIS-supported grants under the CWD initiative, in partnership with extramural communities.

Some of the successful tools developed and prototyped through CWD include:

- Remote sensing tools to help mitigate crop losses and other drought-related damages using the Evaporative Stress Index (ESI) dataset and Geostationary Operational Environmental Satellite (GOES) thermal infrared imagery
- A customizable data app to cull climate, water, and water supply forecasts from disparate sources in the Klamath Basin working with fisherman and farmers
- A water deficit index to monitor drought conditions in Florida and Georgia, including impacts on subsurface environments
- Quantifying the role and improving forecasts of atmospheric rivers (atmospheric rivers move water vapor out of the tropics to other areas and result in high impact rainfall events) in ending or ameliorating drought severity and duration in the U.S. West. Up to 80% of droughts in the West Coast have been ended by the occurrence of just a few (5-7) of these events. Conversely, the absence of atmospheric rivers intensifies drought conditions.



Fig. 4: NOAA RISAs as of 2015. From left to right, top row: the Climate Impacts Research Consortium (CIRC) at Oregon State University; Carolinas Integrated Sciences and Assessments (CISA) at the University of South Carolina; Climate Assessment for the Southwest (CLIMAS) at the University of Arizona; California-Nevada Climate Applications Program at the University of California San Diego. Bottom row, left to right: Western Water Assessment (WWA) at the University of Colorado; Southern Climate Impacts Program (SCIPP) at the University of Oklahoma; the Southeast Climate Consortium (SECC) at the University of Florida.

Regional Integrated Sciences and Assessments (RISAs, Fig. 4) are university-based teams supported by NOAA, located in different regions across the Nation. RISAs conduct research and engagement activities to help ensure that their regions are prepared to cope with hazards and extreme events. Through RISAs, a variety of researchers and stakeholders, supported by NIDIS, work together to provide regional briefings, outreach, and in-depth workshops on understanding and communicating drought conditions, impacts and forecasts. RISA investigators assess existing information gaps, work with communities to understand vulnerabilities and impacts, and inform responses. Projects feed directly into the NIDIS DEWS through engagement and preparedness, impacts reporting and assessment, and inputs to planning and preparedness. Some examples of RISA projects supported with NIDIS CWD funds include:

- A 4-H Weather and Climate Toolkit used to train 4-H students and instructors in Florida and Georgia in conjunction with USDA Extension (Southeast Climate Consortium)
- Experimental fire risk forecasts for California that include wildfire activity, severity, and fire emissions, that may increase confidence in allowing for more prescribed burns (California Nevada Applications Program)
- A Water Data and Visualization Tool (reservoir tool) to fill gaps and inconsistencies in water resources information the Southern Plains (Southern Climate Impacts Planning Program)

The RISAs work with the NOAA NCEI/Regional Climate Centers to enhance data products and outlooks for use in NIDIS DEWS. A comprehensive list of relevant CWD research is available upon request.

4d. U.S. Drought Portal (drought.gov)

The U.S. Drought Portal provides credible, easily accessible drought data, information and resources to the public and private sectors via the internet. Drought.gov is the public face and web presence of NIDIS, integrating information on key drought indicators and data, forecasts, and assessments of drought conditions and impacts produced across the NIDIS network. Examples include the Applied Climate Information System (ACIS, Northeast Regional Climate Center), [Seasonal Drought Outlooks](#) (CPC), the High Resolution Drought Trigger Tool (University of North Carolina), the Drought Risk Atlas (NDMC) and the Evaporative Demand Drought Index (NIDIS). Drought.gov integrates drought information at a range of scales from the local to global level, packages, and presents locally or regionally specific information on each DEWS, as well as links to resources for drought planning, preparedness and education. Its archive houses reports and findings, drought assessments, quarterly climate outlooks, and other documents related to drought observations and research. Utilization of the Drought Portal has increased 155 percent since its launch in 2008.

In keeping with the Public Law directive to provide information that assists communities in being proactive, NIDIS supports the creation of regional [Quarterly Climate Impacts and Outlooks](#), posted on drought.gov. These Outlooks combine maps, projections and other monitoring and forecast products specific to a region, and highlight significant impacts, ongoing conditions or potential areas of future drought and water deficits, keeping attention on drought before, during and between events.

How NIDIS informs drought planning and response

Drought information, research, education, policy, and networking come together through NIDIS engagement with its partners and stakeholders. Over its tenure, NIDIS has commissioned several independent assessments of its services, conducted through external grants. NIDIS helps decision makers assess the risk of having too little water, and prepare for the consequences. NIDIS links farmers to information that can assist them in determining which crops to plant and when. It points foresters to the likely severity of an upcoming fire season, so they can plan ahead. It provides the historical context and current trends of a dry season to water supply managers, so they can anticipate shortfalls and respond accordingly. NIDIS works through its partner networks to inform drought early warning and risk management and planning within the DEWS, the development of and improvements to the U.S. Drought Monitor, and innovative solutions to enhancing our national climate, weather, hydrologic, and impact monitoring networks.

Benefits of the Regional Drought Early Warning Information Systems (DEWS)

The DEWS have increased the number and capacity of watershed, state, and local communities using early warning information and tools to develop and implement drought risk reduction plans. About 57 percent of the population of U.S. in some of the most critical drought-sensitive states and regions have access to a DEWS information network for planning and preparedness, with the NIDIS Drought Portal (drought.gov) creating a clearinghouse for monitoring data and information for 100 percent of the Nation.

In 2012, the NDMC surveyed NIDIS participants in the Apalachicola-Chattahoochee-Flint (ACF) River Basin, Upper Colorado River Basin (UCRB), and Southern Plains, as well as other individuals who have participated in NIDIS activities. 92 percent of respondents made drought-related decisions in some capacity. Sectors impacted included water supply/quality, agriculture, public health, recreation and tourism, natural resources, fire, and energy. Participants said they consider NIDIS a trusted and unbiased source of appropriate and useful information. They further noted that covering an entire basin or region was of benefit to people's awareness and communication, and the format of NIDIS information made it easy to share and digest. More than 80 percent of respondents said participation in NIDIS activities had increased:

- Understanding of where to find and how to use drought and water supply information;

- Ability to incorporate drought and water supply information into decisions; and
- Interest in using drought and water supply information to make decisions.

A majority of respondents said that NIDIS information improved their understanding of drought-related conditions in their region and in their jobs. An assessment of the value and relevance of the UCRB DEWS in 2014 showed that it:

- Raised awareness and understanding of drought and its impacts among users in their sectors, their regions, and jobs;
- Improved the ability of users to educate their own stakeholders about drought; and
- Produced or compiled a suite of data that effectively integrates monitoring and forecasting.

Of those who used the information in decision making or planning, about 20 percent were able to clearly estimate the financial benefit of their decisions.

The U.S. Drought Monitor (USDM)

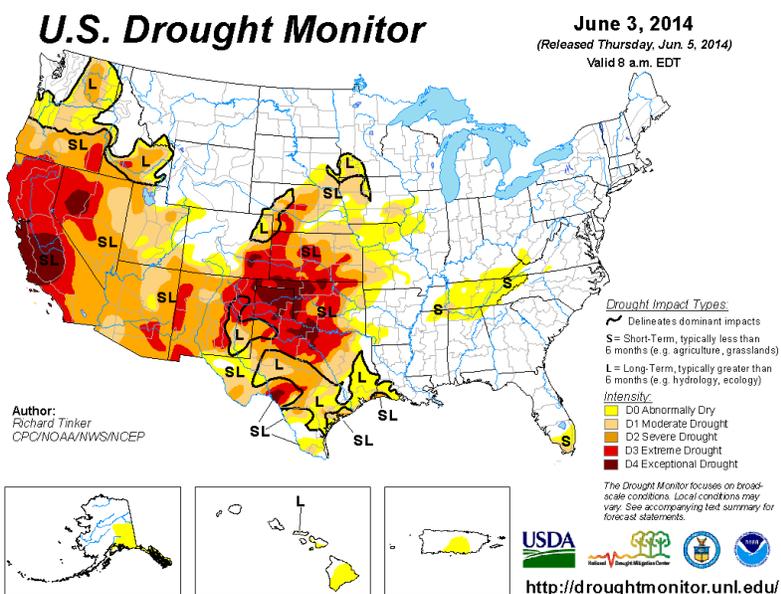


Fig.5: The U.S. Drought Monitor depiction from June 3, 2014 shows exceptional drought in California, Nevada and the Southern Plains states of Texas and Oklahoma

monitoring groups to improve the quantity and quality of monitoring data and tools going into the map. These groups provide local input and ground-truthing to the process. The state-level monitoring groups provide consolidated input from the NWS's local Weather Forecast Offices, state climate offices, and other state and federal agencies. NIDIS has supported such groups in Texas, New Mexico, Florida, Georgia, Alabama, Oregon, and Colorado.

The USDA uses the USDM to trigger disaster declarations and eligibility for low-interest loans. The Farm Service Agency uses it to help determine eligibility for their Livestock Forage

The U.S. Drought Monitor (Fig. 5) is produced jointly by NOAA, the USDA, and NDMC. It integrates multiple data sources and derivative products from local to national scales and incorporates feedback from more than 350 experts to create a weekly map reflecting drought conditions nationwide. NIDIS contributes to the USDM by supporting its authors, supporting enhancements through the integration of new data, and by facilitating the development of state-level

Program (LFP), and the Internal Revenue Service uses it for tax deferral on forced livestock sales due to drought. Tribal, state, local, and basin-level decision makers use the USDM to trigger drought responses, along with other more locally-specific indicators of drought.

Building a coordinated National Soil Moisture Monitoring Network

NIDIS is focusing on filling gaps in one of the most critical, but least understood aspects of drought monitoring: soil moisture. Soil moisture monitoring is critical for accurate prediction of drought onset and duration, wildfire and flood forecasting, prediction of crop yields and, water budgeting.

Soil moisture data are collected by many agencies and organizations in the United States using a variety of instruments and methods. These data are often distributed and represented in disparate formats, posing significant challenges for coordinated use. In recognition of these challenges, the USDA and the Department of Commerce (DOC), convened by NIDIS, signed a Memorandum of Understanding in 2012, which called for the creation of a coordinated National Soil Moisture Monitoring Network. NIDIS established a working group to assess issues of scale, observing networks, remote-sensing platforms, modeling efforts, and metadata needs in developing this capability. The group identified two steps towards a national network: First, to develop a pilot monitoring system to guide the future design of a national system; then to develop a product from existing data to demonstrate the potential usefulness of a coordinated effort.

An interagency team led by NIDIS, together with USGS, USDA/NRCS and Texas A&M University, completed the pilot project in 2015. Data and information are being integrated across many networks, including USDA's Soil Climate Analysis Network (SCAN); NOAA's Climate Reference Network (CRN), North American Soil Moisture Database and Soil Moisture Active Passive product; NASA's Soil Moisture and Ocean Salinity and North American Land Data Assimilation System (NLDAS). The result of this pilot is a reference architecture that will now inform the national monitoring network coordinated by NIDIS with USDA, USGS, NASA, NWS, NOAA's National Environmental Satellite, Data and Information Service (NESDIS) and other partners, leading to improvements in the U.S. Drought Monitor and forecast models.

Future developments and milestones

NIDIS continues to engage the expertise of drought experts, policy makers and managers across the Nation, building upon events such as the [2012 National Drought Forum](#) and the [2015 Western State Drought Coordinators and Emergency Managers Meeting](#), to share strategies and lessons learned. The following strategy is the result of long-standing consultations with relevant federal, tribal, regional, state, and local government agencies, research institutions, and the private sector. Priorities for implementation over NIDIS' next five years, identified through these processes and coordinated through NIDIS' interagency working groups, focus on two cross-cutting goals: (1) improving the prediction of the onset, duration and severity of drought

and (2) assessing and responding to regionally-specific drought impacts. Specific actions will focus on:

1. Improving the understanding and predictability of droughts across a variety of timescales. This includes the role of precipitation events and amounts needed to reduce drought duration and intensity;
2. Improving collaboration among scientists and managers to enhance the public awareness and effectiveness of observation networks, prediction, information delivery, and applied research;
3. Improving the national and regional drought information network by identifying and mapping additional existing capabilities within regions, for transfer of successful approaches to other locations;
4. Improving coordination among institutions that provide different types of drought early warning;
5. Developing impact indicators to form part of a comprehensive early warning system; and
6. Working with the private sector and others on guidance and standards for developing value-added products to support drought plans.

Improving the prediction of drought onset, length and severity

NIDIS is working with NOAA's National Weather Service, NCEP and OAR's Earth System Research Laboratory's Physical Sciences Division to assess methods for forecasting precipitation and soil moisture, surface runoff and evaporative stress. Improvements require that the forecasts extend beyond the current one-month lead. Research, monitoring and forecasting needs or improvements include:

1. Understanding the role of atmospheric rivers and other phenomena in ameliorating drought severity and duration
2. Understanding the impacts of decadal scale variations on seasonal forecast reliability
3. Improving probabilistic hydrological drought forecasts, building on previous efforts such as the National Multi-Model Ensemble and the NLDAS drought monitoring land surface models, to include additional uncertainty information and comprehensive verification
4. Working with USGS and others to improve estimates of ground water/surface water interactions during drought
5. Comprehensive assessments of the underlying predictability of surface temperature, precipitation, soil moisture, and stream flow on monthly to decadal time scales and tailoring specific products for early warning system locations
6. Evaluation of current operational drought forecasting capabilities and research toward the development of new statistical-dynamical hybrid approaches to better utilize identified sources of precipitation predictability and improve forecast skill from both operational forecast systems and official drought outlooks, and

7. Improving soil moisture estimates through integration of satellite estimates and in situ measurements of soil moisture

A major monitoring and forecasting challenge is maintaining the Nation's in situ gauge-based observation networks for meteorological, climate and hydrologic variables. A number of key measurements are either sparse or declining, which impairs our understanding of present conditions and the evaluation and implementation of model-based predictive products. One of the strengths of NIDIS is to help identify these gaps and work through its interagency and intergovernmental frameworks to support solutions. One example of this is the effort to develop a coordinated national soil moisture monitoring network, which is being led by NIDIS. The details of this effort were previously discussed on page 12.

Understanding and enhancing predictions of regionally specific drought impacts

Many states have expressed the need for guidance to develop and select useful drought-related indicators, to evaluate and improve their effectiveness. Working with FEMA, USDA, U.S. Army Corp of Engineers and others, NIDIS will develop risk assessment and decision-making tools and processes to help states, cities and communities meet their planning needs. Through its Coping with Drought initiative NIDIS will, in partnership with states and communities, develop the components of a comprehensive drought impacts reporting sub-system which will (1) focus on geographical or sectoral impacts assessment, and target more efficient and useful monitoring of developing impacts when droughts are impending or intensifying; and (2) expand drought impacts assessment via indicators tuned to specific regions, urban and rural areas.

NIDIS will continue to play a role with USDA, NASA, and the USGS, the State Department and other agencies in developing the global drought monitoring capability to provide information on drought in areas of economic and other interests to the United States.

Establishing the Drought Risk Management Research Center (DRMRC)

The NIDIS Reauthorization Act of 2014 (15 USC 311) included the direction to designate "one or more cooperative institutes to assist with NIDIS functions." In June 2015, NIDIS announced the designation of the Drought Risk Management Research Center (DRMRC) at the University of Nebraska-Lincoln. The DRMRC was established through a SARP cooperative agreement with the National Drought Mitigation Center (NDMC) through NIDIS Coping with Drought support. The Center is designed to advance NIDIS network capabilities, and draw on SARP's network of research investigators, by matching the best available research, data, and information with the needs of state and community planners. Working closely with federal, tribal, state, and university partners, the DRMRC will conduct applied research on drought risk management by:

- 1) coordinating improvements to the U.S. Drought Monitor and supporting products and tools;

- 2) integrating socio-economic information across all scales of drought preparedness and impacts;
- 3) advancing and understanding of the societal and economic benefits of regional drought early warning systems;
- 4) advancing innovations in planning for drought, including incorporating drought into state multi-hazard mitigation planning; and
- 5) developing communication tools and products across the NIDIS partner network.

NIDIS will continue to engage the expertise of Federal, state and local drought managers into its network. In July 2015, NIDIS convened the Western state drought coordinators to share strategies for drought response and awareness of drought information to support those activities. NIDIS will conduct similar activities across all drought-sensitive regions of the United States.

Conclusion: Implementing a National Integrated Drought Early Warning System

The completion of a fully operational national early warning information system is fundamental to creating a more drought resilient nation. Through its core activities, NIDIS will continue to support:

1. **Communities**, states and institutions capacity to reduce exposure to drought risks and opportunities to inform drought risk management;
2. **Staff** trained to incorporate planning and preparedness for climate-related extremes into regular implementation;
3. **Projects** that strengthen monitoring and forecasting, and that conduct and update impact assessments to meet public and private needs;
4. **Partnerships** with key programs such as the NOAA's Regional Climate Centers (RCC) that serves not only as data providers to NIDIS efforts, but convey NIDIS information to users and partners such as the USDA Climate Hubs and the DoI Climate Science Centers (CSC);
5. **Information systems** providing credible, comprehensive, and authoritative early warning of drought for an increasing percentage of the United States population.

Table 1 starting on the next page provides a summary of the near term and longer term activities and actions contributing to a fully National Drought Early Warning System called for in the 2014 NIDIS Reauthorization Public Law (113-86).

Goal	Near term (1-2 years)	Long term (3-5 years)
Develop a fully national integrated drought early warning information system	<ul style="list-style-type: none"> • 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 NIDIS systems (Northwest Midwest, Nevada) transferring lessons from existing activities. • 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 assessment methodology and reporting requirements	<ul style="list-style-type: none"> • Improve understanding and improved forecasts of physical and demand factors contributing to droughts, to inform risk assessment and management. • Demonstrate the effectiveness of drought risk reduction strategies using monitoring and prediction information, using lessons and technologies. 	Continued drought information system as inputs into watershed, state, and local drought plans and operations.
Improve regional to local capabilities to educate, develop capacity, and communicate drought information, awareness and response	<ul style="list-style-type: none"> • Initiate process for transferring capabilities to new locations at state and county levels (1) to assess regional and local drought impacts and (2) improving the usefulness of prediction products in drought planning and response • Engage recently developed regional capabilities (USDA Climate Hubs, DoI CSCs) in DEWS development and implementation 	Develop an integrated interagency drought information network for education, coordination, capacity building and delivery of products and services at regional to local level.

Table 1: Summary of near term and long term activities and actions called for in the NIDIS Reauthorization Public Law (113-86) of 2014

Drought is a complex natural hazard that will continue to affect our communities, economies, and livelihoods. Increases in drought frequency and intensity will test our existing strategies for managing drought's economic, environmental, and social impacts. The need for reliable, credible, timely, relevant, and innovative data, information, and tools to manage resources during drought continues to grow. No one agency, entity, or organization can singularly meet the need. NIDIS, with its strong interagency, intergovernmental, and private partnerships, is positioned to deliver a well-coordinated drought early warning system to the Nation, by directing resources and efforts toward reducing risk in drought sensitive sectors and regions through better awareness and understanding of the drought hazard and its links to vulnerability and opportunities for action. In creating an effective national drought early warning system, NIDIS is advancing a greater understanding of the benefits and the processes for proactive responses to drought-related risk, and supporting the development of a wide range of preparedness strategies and plans, to increase the Nation's resilience in the face of drought.

Appendix 1: Acronyms

ACF	Apalachicola-Chattahoochee-Flint River Basin
ACIS	Applied Climate Information System
ACT	Alabama-Coosa-Tallapoosa River Basin
CPC	NOAA's Climate Prediction Center
CPO	ACF
CRN	NOAA's Climate Reference Network
CSC	Department of the Interior's Climate Science Centers
CTB	Climate Test Bed
DEWS	Drought Early Warning Information System
DOC	Department of Commerce
DRMRC	Drought Risk Management Research Center
ESI	Evaporative Stress Index
GOES	Geostationary Operational Environmental Satellite
LFP	Livestock Forage Program
MAPP	NOAA's Modeling Analysis Predictions and Projections Program
NCEI	National Centers for Environmental Information
NCEP	National Centers for Environmental Prediction
NDMC	National Drought Mitigation Center
NESDIS	National Environmental Satellite, Data and Information Service
NIDIS	National Integrated Drought Information System
NLDAS	North American Land Data Assimilation System
NOAA	National Oceanic and Atmospheric Administration
NRCS	National Resources Conservation Service
NWS	National Weather Service
OAR	NOAA's Office of Oceanic and Atmospheric Research
RCC	NOAA's Regional Climate Centers
RISA	NOAA's Regional Integrated Sciences and Assessments
SARP	NOAA's Sectoral Applications and Research Program
SCAN	Soil Climate Analysis Network
SNOTEL	SNOWpack TELEmetry
UCRB	Upper Colorado River Basin
USDA	U.S. Department of Agriculture
USDM	U.S. Drought Monitor
USGS	U.S. Geological Survey
WGA	Western Governors' Association
WSWC	Western States Water Council