NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

Drought Early Warning for the Missouri Basin

National, state, tribal and local partners work together toward resilience

The Little Missouri River flows through Theodore Roosevelt National Park in North Dakota.

Table of contents

Citation

B. Perry, K. Bogan, D. Kluck, C. McNutt, M. Svoboda. 2015. Drought Early Warning for the Missouri Basin, Report from 2014 National Integrated Drought Information System workshops.

Dear Reader,

On behalf of the National Oceanic and Atmospheric Administration (NOAA), the National Drought Mitigation Center (NDMC) at the University of Nebraska at Lincoln, and the National Integrated Drought Information System (NIDIS), we are pleased to share "Drought Early Warning for the Missouri River Basin." This report documents the development of the regional Drought Early Warning System (DEWS) for the Missouri River Basin from 2012 to present.

The process for building the DEWS is a reflection of the rich partnerships in the Missouri Basin, as well as the knowledge and experience these partnerships have accumulated over the last several decades. Some of the groups included in the DEWS development process were the Western Governors Association (WGA), the Missouri River Basin Interagency Roundtable, the Missouri River Association of States and Tribes, and research and monitoring groups like NOAA's High Plains Regional Climate Center (HPRCC), the U.S. Department of the Interior's North Central Climate Science Center (NCCSC), and the Western Water Assessment, a NOAA Regional Integrated Sciences and Assessment (RISA) team.

While the Nebraska City meeting is the foundation of the DEWS in the Missouri River Basin, this report also captures efforts prior to the February 2014 meeting. One particular effort was the series of meetings held with the Missouri River Basin Tribes on monitoring and drought risk management. Tribes in the Plains are located in some of the most highly variable climatic locations in the country and their perspective was important to include in this process.

The report concludes with activities initiated following the DEWS kickoff meeting in 2014 in Nebraska City. They are organized under three themes: 1) Developing a DEWS with the Missouri Basin States; 2) Developing a DEWS with the Tribes; and 3) Improving Observing and Monitoring Networks.

We gratefully acknowledge the organizations and the people who shared their concerns and capabilities as well as their overall support of the creation of the Missouri River Basin DEWS. Specifically, we would like to recognize those who contributed to this report: Martha Shulski and Crystal Stiles, HPRCC; Gwen White, Eastern Tallgrass Prairie & Big Rivers Landscape Conservation Cooperative; Tonya Haigh, Nicole Wall, and Tonya Bernadt, NDMC; and Laura Edwards, South Dakota State University Extension.

Chad McNutt, NIDIS
Mark Svoboda, NDMC
Doug Kluck, NOAA - NCEI
Kathy Bogan, NIDIS
Bethany Perry, NOAA

The Missouri River Basin spans nine states and dozens of tribal lands, drained by 2,540 miles of river.

Getting a start on drought early warning

Network of partners kicks off a cooperative effort to cope with drought in the Missouri River Basin

INTRODUCTION

Drought is a natural part of our environment. It is also a creeping and insidious natural hazard that has been the subject of intense and long-term litigation, the source of government instability, and the motivation for population migration and resettlement. Drought frequently affects the Missouri River Basin, including significant events in the 1930s and 1950s. These events had a substantial impact on water supplies, crops and livestock, energy, transportation of goods, and the ecosystem.

The most recent drought event in the basin occurred in 2012, following a devastating flood year in 2011 that was initiated by record snowpack in Wyoming and Montana, followed by record spring rainfall. Leading up to the drought of 2012 many were concerned that another flooding year was likely given current global climate signals (i.e. La Niña). What followed instead was a devastating drought few saw coming. These two events emphasized the need for a drought early warning system that not only could improve how we anticipate drought events but could also improve collaboration and coordination of informational networks for floods in the Missouri Basin.

The National Integrated Drought Information System (NIDIS) is an interagency federal program

What is NIDIS?

The National Integrated Drought Information System (NIDIS) is an interagency and interstate effort to establish a national drought early warning information system. NIDIS builds on existing products and service networks like the U.S. Drought Monitor and Seasonal Outlooks to provide better coordination of monitoring, forecasting, and impact assessment efforts at national, watershed, state, and local levels.

Together with its partners, NIDIS pursues the goals of:

1) leadership and networking among all sectors to plan for and cope with the impacts of drought;

2) supporting research on the science of drought;

3) creating location-specific early warning systems for drought management; and

4) developing educational resources, interactive systems, and tools to assist communities in learning about and dealing with drought.

What is a Drought Early Warning Information System (DEWS)?

Regional DEWS, developed by NIDIS, explore and demonstrate a variety of early warning and drought risk reduction strategies within a particular area. They incorporate drought monitoring and prediction information in partnership with federal, state, tribal and local agencies, organizations and other users.

Located throughout the contiguous U.S., DEWS help regions plan for and establish best practices in drought-stressed times, and share this with other regions of the country.

created by Congress in 2006 to develop a drought early warning system (DEWS) for the U.S. NIDIS is working toward its national goal by establishing a network of regional DEWS. These DEWS build on existing monitoring and forecast products as well as service networks such as the U.S. Drought Monitor (USDM) and seasonal outlooks (e.g. the National Weather Service's Climate Prediction Center 90-day seasonal outlook) in a way that provides improved communication, interpretation and coordination of monitoring, forecasting, and impact assessment efforts at national, watershed, state and local levels. Broadly stated, NIDIS' mission includes understanding and responding to societal, economic, and environmental challenges created by drought conditions, as well as sharing information to create an early warning capability for managing drought risks.

In 2014 NIDIS initiated the development of an DEWS for the Missouri River Basin (MRB) during a two-day meeting in February in Nebraska City, Nebraska. The DEWS is a consolidation of groups (e.g. state climate offices, NOAA, the High Plains Regional Climate Center, and the National Drought Mitigation Center) that have been active in the MRB over the past several years.

COMING TOGETHER IN NEBRASKA CITY: LAUNCHING A DROUGHT EARLY WARNING SYSTEM

NIDIS, together with the National Drought Mitigation Center (NDMC), Western Governors Association (WGA), U.S. Department of Agriculture (USDA), North Central Climate Science Center (NCCSC), South Dakota State University (SDSU) and the National Oceanic and Atmospheric Administration (NOAA), met on February 26-27, 2014, with more than 70 stakeholders from throughout the basin. The group discussed the region's current state of drought awareness, planning and capacity.

The meeting kicked off a process in the basin to better understand existing resources, vulnerabilities, impacts and priorities. The goal of this process was to create the Missouri River Basin Drought Early Warning System MRB DEWS. (See sidebar at left, "What is a DEWS?")

The gathering brought together a diverse group of federal, state, tribal, local partners and stakeholders from the water- and land-management communities, to discuss and understand decision makers' needs for drought, climate, weather, and water-related information, and ways to improve capacity to meet those needs across the Missouri Basin.

Four outcomes were targeted:

(1) Increased knowledge and awareness of tools and processes for decision makers

(2) Identification of gaps in knowledge and gaps in communication of information and resources;

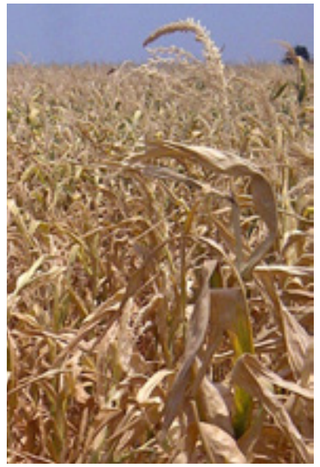
(3) Recommendations for improved drought early warning, which would include better coordinated integration, display and distribution of data and information about climate, weather, and water;

continued on page 6

Single-digit temperatures didn't deter the participants from the meeting that launched the Missouri River Basin Drought Early Warning System.

THE LAUNCH TEAM IN NEBRASKA CITY

American Planning Association
Army Corps of Engineers - Missouri River Water Management
Bureau of Indian Affairs
Bureau of Land Management
Bureau of Reclamation
Center for Research on the Changing Earth System
Colorado Climate Center, Colorado State University
Colorado Water Conservation Board
East Dakota Water Development District
Eastern Tallgrass Prairie & Big Rivers LCC
Environmental Protection Agency, Region 7
Federal Emergency Management Agency
High Plains Regional Climate Center
InterTribal Buffalo Council
Intertribal Council On Utility Policy (COUP)
Iowa Dept. of Agriculture & Land Stewardship
Kansas State University
Kansas Water Office
Local public
Mid-America Regional Council
Missouri Department of Natural Resources
Missouri River Association of States and Tribes
Montana Department of Natural Resources and Conservation
National Drought Mitigation Center
National Integrated Drought Information System (NIDIS)
National Oceanic and Atmospheric Administration (NOAA)
NOAA's National Centers for Environmental Information
NOAA's National Weather Service
National Park Service
Natural Resources Conservation Service - National Soil Survey Center
Nebraska Department of Agriculture
Nebraska Department of Health & Human Services
North Central Climate Science Center, Colorado State University
North Dakota State Water Commission
Northern Arapaho Tribe
Omaha World-Herald
Santee Sioux Nation of Nebraska
South Dakota School of Mines and Technology
South Dakota State University Extension
South Dakota State University/South Dakota State Climate Office
U.S. Department of Agriculture - Agricultural Research Service
U.S. Geological Survey - Earth Resources Observation and Science Center
U.S. Geological Survey - Nebraska Water Science Center
U.S. Geological Survey - North Central Climate Science Center
U.S. Geological Survey - South Dakota Water Science Center
University of Colorado, Boulder
University of Nebraska Medical Center
University of Nebraska Public Policy Center
Western Governors' Association
Wyoming State Engineer's Office



Drought planning and beyond: Further objectives to develop early warning

The Nebraska City meeting participants identified these areas as focal points for an effective drought early warning system, and indicated that they need further work:

- *Development of early warning information and delivery systems based on historical patterns of floods followed by droughts, such as the 2011 flood and 2012 drought.*
- *Communication of information about drought severity and impacts to states, tribes, and various sectors to increase awareness of the hazard.*
- *Consolidation of tools and information about drought as well as improved vulnerability analysis.*
- *Identification of trigger or tipping points.*
- *Improvement of monitoring of soil moisture, stream flows, and snowpack*
- *Research and communication about groundwater vulnerability.*
- *Education and outreach through trusted entities.*

continued from page 4

(4) Recommendations for future actions, collaborative research, and decision support.

Participants identified key points to consider in the development of a DEWS through discussion groups focused on specific sectors, including natural resources management; energy; water systems management; human health; and agriculture.

STRENGTHS TO BUILD UPON: The attendees identified a number of existing strengths in the basin, which could form the foundation for an effective DEWS. These included infrastructure, partnerships, and resources (such as climate webinars). In addition, participants repeatedly noted that stakeholders in the basin already possess an abundance of experience, diversity, enthusiasm and support for drought early warning. Key partners from numerous organizations with many specialties have strong relationships and a history of collaborating. Many of the basin's states, tribes and municipalities have drought plans in place, which provide templates for and feedback on effective planning.

Finally, there is an increasing interest and well-defined need for climate information designed for decision makers. Historic events such as the flooding in 2011 followed by the drought of 2012 reinforce the importance of understanding and preparing for extreme events, for decision makers as well as for the public.

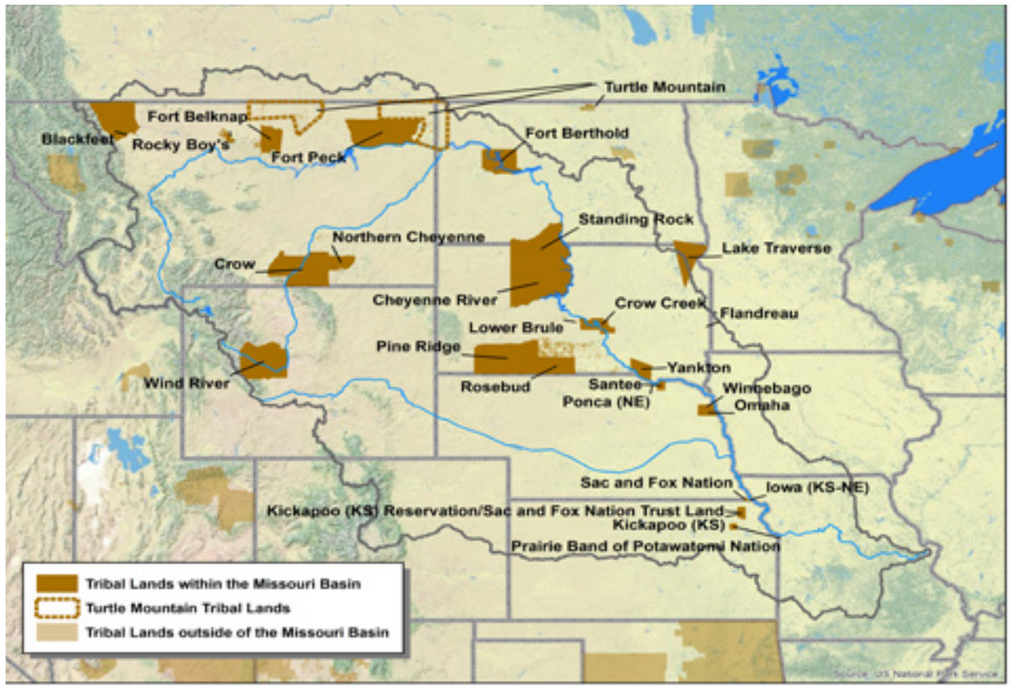
GAPS TO ADDRESS: Attendees noted several areas in need of further development and coordination. These included research; data and information; education and outreach; drought planning; funding; and policy. Many participants underscored the need for effective drought planning, specifically developing or revisiting existing drought plans. These planning efforts could focus on creating, updating, and implementing state drought plans; finding and sharing opportunities to encourage proactive management; advancing awareness of plans from the U.S. Army Corps of Engineers; balancing requirements and promoting cooperation among sectors and disciplines; and clearly defining roles of partners to integrate efforts and reduce duplication.

POTENTIAL BENEFITS OF THE DEWS: Meeting participants envisioned these outcomes from the establishment of and participation in the DEWS:

- Better planning and communication.
- Improved information services for stakeholders.
- Effective education and outreach.
- Improved resiliency and sustainability.
- The ability to leverage existing resources and collaboration opportunities.

Specifically, participants supported the idea of the DEWS for its potential to organize, clarify and interpret the wide variety of data, information, and

continued on page 9



Map by Kris Lander/National Weather Service

First steps: Tribal meetings, partnerships lay foundation for DEWS in the Missouri

Tribes in the Plains are located in some of the most highly variable climatic locations in the country. The Missouri River Basin is known for intense weather and climate variability. Extreme events, such as drought, flooding, and other climate and weather phenomena, profoundly exacerbate demand on finite tribal resources.

Tribal leaders from the basin met in 2012, with the goal of building strong partnerships among federal agencies, tribes and tribal colleges to prepare for extreme events and build resilience. They addressed questions about weather extremes, emergency preparedness, forecasting and climate variability. The meeting, and those which followed, laid the groundwork for the 2014 meeting in Nebraska City that kicked off the MRB DEWS.

In 2012, representatives from the North Central Climate Science Center, InterTribal Coup, Kiksapa Consulting, NIDIS, and NOAA gathered at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado. Tribes learned about services that agencies provide, and agencies learned about appropriate ways to engage tribes and the cultural knowledge that defines them. The agenda included ways to improve understanding of the social, legal, economic, historical and environmental context in which tribal resources are managed, directly from tribal perspectives; and ways to inform tribal educators, resource managers

continued on page 8

"What tribes need is real-time data for real-time decisions."

Gary Collins, Northern Arapaho Tribe

continued from page 7

and decision makers of weather- and climate-related federal programs, information products and processes.

A three-phase project grew from the meeting:

1. Development: Planning a series of workshops for tribal resource managers at tribal colleges and universities in the Upper Missouri Basin;

2. Delivery: Contracting with local tribal college administrations for faculty and student time to host workshops, including locating facilities, organizing outreach and logistics for attendees, and engaging regional tribal resource managers and decision makers; and

3. Implementation: Establishing projects and partnerships between NOAA/NIDIS and tribal resource management programs in the Missouri River Basin.

Relationships grew through several subsequent workshops on climate and weather extremes held across the MRB in 2012 and 2013. These workshops included the Lower Brule Community College, South Dakota in July 2012; Standing Rock Reservation in October 2012; Haskell Indian Nations University in May 2013; and Wind River Reservation and the Black Feet Indian Reservation in December 2013.

The workshops fostered interest in initiating and updating drought plans, producing regular drought summary products, and building capacity at tribal colleges and universities (TCUs), starting with hosting workshops at the American Indian Higher Education Consortium (AIHEC).

In March 2014, the Tribal Colleges and Universities Climate Change Forum provided an opportunity for participants to explore how TCUs can work together with tribal communities to respond to emerging threats and challenges in a changing climate. The group discussed ways to sustain and improve the process for gathering input for the National Climate Assessment tribal chapter.

Over the course of the tribal workshop series, several potential activities came to the fore. These included:

- Examining the adequacy of federal assistance during emergencies, specifically the possible development of a tribal-federal Memo of Understanding on preparedness for drought, working with the Emergency Management Coordinator for the Standing Rock Sioux Tribe.
- Updating the Black Feet and Wind River drought plans.
- Involving tribes in the Great Plains and Midwest climate and drought webinars.
- Producing a drought summary document and testing depiction of drought on the Wind River Reservation, using the U.S. Drought Monitor.
- Developing a research program targeted at TCUs for improving resilience in tribal communities.
- Creating drought planning profiles, highlighting plans that are both successful and culturally appropriate.
- Building a network of TCUs and tribal communities, working on local climate change-related issues through AHIEC, and sharing observations and ideas for responding to emerging threats.

The tribal workshops set the stage for further cooperation among the many stakeholders of the Missouri River Basin. NIDIS saw the efforts as an opportunity to develop a basin-wide project that would grow out of participation among the diverse stakeholders from throughout its 10 states.

The work among the tribes became a springboard for the Missouri River Basin DEWS, informing the discussion at the 2014 kickoff meeting in Nebraska City.

continued from page 6

tools for specific sectors and decision makers.

MEASURING SUCCESS: The group discussed ways to measure the success of an MRB DEWS. Finding ways to assess the following were considered key, including setting metrics to evaluate. These include:

- Reduction in vulnerability and impacts.
- Improvement of resources and assistance, as indicated by the expansion of soil moisture monitoring, remote sensing, and data availability.
- Increase in drought planning, tracked by the number of states, tribes, or municipalities which adopt or update drought plans within the first two years.
- Increase in awareness of drought-related issues and impacts.
- Effectiveness of drought-related policies.
- Effectiveness of coordination within the region.

Policy changes are also an ambitious indicator of success, such as the development and approval of legislation addressing adaptation, mitigation, and sustainability. Connecting directly with state legislators and other leaders on a regular basis is a key factor in stimulating policy change.

NEXT STEPS: Participants at the Nebraska City meeting frequently noted the many enthusiastic partners who attended the meeting, representing a diverse group of stakeholders in the basin. There was a need expressed, however, to move beyond the group and enlist more sectors and organizations. They indicted that a DEWS strategic plan would be an important initial step to ensure actions, outcomes, and resources from meetings would be effectively utilized; sector-specific outcomes realized; and to clearly identify the robust number of customers, decision makers, and target audiences.

Working groups would be a mechanism to maintain momentum on ideas to fulfill the identified needs and gaps. The topics for working groups would focus on areas such as data and monitoring, vulnerability assessments, urban or regional planning, and education and outreach.

Participants stressed the importance of **outreach and education,** putting forth ideas focused on K-12 education, opportunities for professional development, and curricula on drought.

Communication would be vital for compiling and sharing success stories and best practices. Activities and materials could include regional forums, quarterly webinars, online resources, and a database of drought resources as well as potential media partners willing to engage in communication efforts.

During break-out sessions, participants recognized numerous strengths of the existing drought information providers, such as NOAA's National Weather Service and their local weather forecast offices. They identified ways to expand and developopportunities to better inform and enable decision makers, and to enhance ongoing and future drought-related activities throughout the basin. The group prioritized next steps to include:

1) Improving understanding of impacts and vulnerability to drought.

Toward the end of the session, participants at the Nebraska City meeting brainstormed ideas for further actions, writing them on sticky notes and posting them for the group to peruse.

At a glance: Next steps for the Missouri Basin DEWS

- *Promoting interchange among the interests in the basin.*
- *Engaging policy-makers.*
- *Supporting research.*
- *Developing a strategic plan.*
- *Forming working groups.*
- *Identifying financial resources.*
- *Creating and refining a presence on the NIDIS website, drought.gov, for Missouri River Basin pilot http://www.drought.gov/drought/regional-programs/mrb/missouri-river-basin-homee*
- *Exploring communication strategies, trainings, workshops, and other resources.*

THE BIG HOLE RIVER flows 153 miles into the Jefferson in southwestern Montana. The Big Hole includes habitat for native fluvial Arctic grayling, pictured below, which influences the kinds of actions around water levels that drought plans can include.

2) Partnering with states and tribes to create new or improved drought plans.

3) Continuing to support and assess ways to enhance the Midwest and Great Plains drought and flood update webinar series.

4) Assessing approaches for improved forecasts and long-term monitoring.

5) Initiating a series of regional or sub-basin meetings to understand impacts and ways to inform drought risk management.

AFTER NEBRASKA CITY: THE EARLY WARNING SYSTEM BEGINS ITS ROLLOUT

Following the Nebraska City meeting, NIDIS and its partners have conducted activities which are being consolidated into a two-year work plan that will start in 2015. The activities resulting from the kickoff meeting are organized into themes: developing a DEWS with the MRB tribes and states, and improving observation systems and monitoring networks.

1) Developing a DEWS with the Missouri River Basin states

Montana Demonstration Project

The Montana Demonstration Project is part of a larger effort by the National Drought Resilience Partnership (NDRP) to improve overall drought resilience for the U.S. The Montana Demonstration Project is partly focused on the headwaters of the Missouri River. The activities that are included here are a result of a workshop that was held in Bozeman, MT in March 2015. The workshop included participants from seven sub-watersheds of the Upper Missouri Basin: the Beaverhead, Ruby, Big Hole, Upper Gallatin, Lower Gallatin, Madison, and Jefferson River watersheds.

Several themes emerged from the meeting:

1) Recognizing work already underway in the watersheds;

2) Leveraging, integrating, and building on existing successful efforts such as watershed restoration plans (WRPs) many of the watersheds have already developed;

3) Developing and enhancing collaboration with active NGO partners, federal and state agencies, universities, and private citizen interests.

South Dakota Drought Plan Revision

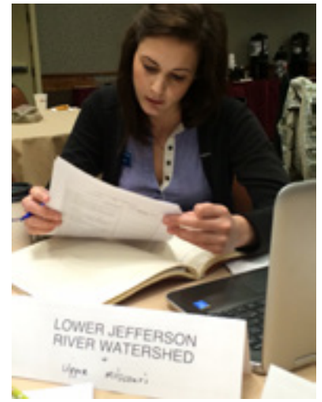
The state of South Dakota has been updating its state drought plan through a contract with AMEC Foster Wheeler. Information on initial impacts and vulnerability was gathered from various government sources and state agencies. As of June, 2015, the vulnerability assessment had been completed and was under review by members of the task force working on the update. The larger drought plan, which incorporates the vulnerability assessment, was scheduled to be completed by June 2015. Thereafter, the task force was to review the plan over the summer. It is expected to be released for public comment in autumn of 2015.

Through the Missouri River Basin DEWS, NIDIS' role in South Dakota's Drought Plan process would be to encourage local and tribal entities to develop plans that could link to the state plan. NIDIS would also use the state drought planning effort to reach out to the general public and businesses in the state to determine drought information needs. This would likely materialize in cooperation with the state Drought Task Force (DTF) through an open meeting in the fall of 2015 to encourage more participation on the drought plan and to gather additional information.

Drought Simulations with Vulnerable Communities in Kansas

Droughts and their associated impacts are common in Kansas, with serious implications for the state's communities and economy. The impacts are complex and far reaching, from both a surface and a groundwater context. The Kansas Water Office, NIDIS/NOAA and other state and regional partners are interested in aiding communities to become more aware of and resilient to such events. In the report, "A Long-term Vision for the Future of Water Supply in Kansas," under the section "Themes and Strategies to Achieve the Vision" the need for these specific services are spelled out:

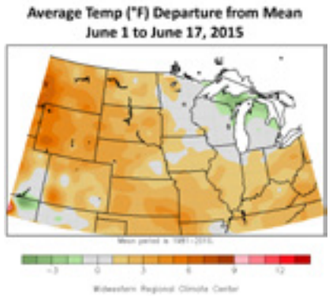
- ✦ Conduct drought simulation exercises to educate the public and identify gaps in conservation efforts.
- ✦ Incorporate drought simulation efforts into state hazard planning.
- ✦ Seek funding and support for efforts from partners such as the U.S. Department of Homeland Security (DHS), NIDIS and NOAA.



A WORKSHOP PARTICPANT studies documents during a planning exercise for the Missouri headwaters region in Bozeman, Montana, in 2015.

A SATELLITE VIEW shows flooding near Huron, South Dakota in 2010. Hazard planning often focuses on rapid-onset events like floods and fires, but just as much foresight is needed for drought response.

EARLY SPRING arrives in the Flint Hills of Kansas in 2007. The northern half of the state lies in the Missouri Basin.



WEBINAR SLIDES keep stakeholders updated on conditions and outlooks. Anyone can sign up to particpate in the webinars here: http://mrcc.isws.illinois.edu/multimedia/webinars.jsp

BISON are more resilient than cattle in adapting to the sometimes extreme climate conditions on the Great Plains. Shannon McNeeley photo

2) Activities that cut across the entire Missouri River Basin

These include improvements to observing systems and monitoring networks, as well as the following programs:

Midwest/Great Plains Early Warning Webinars (monthly)

NIDIS, NOAA, NDMC, HPRCC, regional climatologists, extension staff and media partners intend to expand the reach of the regular webinars covering current conditions and outlooks, which are publicly available. Organizers use local partner email lists and social media, extension and other state email lists and media contacts to increase awareness of the webinars, which they hope to translate into increased attendance and impact.

Identify federal funding streams and ways to leverage them for supporting drought planning

Several federal programs, such as the Federal Emergency Management Administration's (FEMA) Pre-Disaster Mitigation program and Bureau of Reclamation's (BOR) Drought Response Program, could be better utilized to support drought planning across the MRB. NIDIS and its partners intend to identify ways these programs could be used to help identify the status of state and tribal drought planning efforts.

3) Developing DEWS with the MRB tribes

A series of workshops on climate and weather extremes were held with several MRB Tribes in 2012 and 2013. These interactions led to the set of meetings and activities listed below.

Sept. 16, 2014: InterTribal Buffalo Council Drought Workshop

The Inter-Tribal Buffalo Council (ITBC) held their national meeting with the themes of climate and drought resilience. With NIDIS support, more than 20 tribes attended the meeting to discuss issues confronting them across the country, and Conservation Innovation Grants that are available for tribes to help with drought management on reservations. Attendees began the meeting with thoughts on what drought means to them, including depletion of groundwater, impacts on livestock and irrigation, increased energy cost, inability to perform rituals such as the sun dance, climate change, reduced snow melt and runoff, wildfires, and the lack of spiritual connection between women and nature.

A major theme of this meeting was determining how to restore bison herds on tribal lands, as bison have cultural significance and are more resilient and better adapted to extreme climate conditions on the Great Plains than cattle. Experts from the NDMC and the USDA discussed ranch planning resources that are available. Presenters from the NDMC also showed products that could be useful for drought decision support, such as the U.S. Drought Monitor, the Vegetation Drought Response Index (VegDRI), the Drought Impact Reporter, and the Drought Risk Atlas.

The ITBC is following up with a series of regional workshops that will include technical input from NDMC and the USDA Northern Plains Climate Hub.

A SEPTEMBER 2014 GATHERING brought together participants from 18 tribes, academic institutions and federal and state agencies in Rapid City for a two-day workshop on extreme events and drought resiliency.

Sept. 17-18, 2014: NIDIS Tribal Engagement Meeting on Climate and Extreme Weather Events

Numerous partners gathered in Rapid City, S.D., to discuss drought and climate change, drought impacts, early warning systems, and planning for extremes. Sixteen of twenty-eight tribes from the Missouri River Basin attended, as well as two tribes from Oklahoma with Missouri basin roots. The meeting also brought together academics, government representatives from the Bureau of Indian Affairs (BIA), NOAA, FEMA, USDA, National Aeronautics and Space Administration (NASA), NDMC, the HPRCC and others.

During the meeting, tribal representatives discussed current conditions as well as needs and efforts within their lands to prepare for climate extremes and drought. Representatives of various sectors also delivered information on identifying resources and opportunities to work with tribes on drought and climate resilience and planning in the basin.

Tribal representatives expressed concerns related to their resiliency to drought and extreme events, including:

- Influences of human activity (such as irrigating crops and damming rivers) potentially changing local landscapes and exacerbating climate change impacts.
- Groundwater and surface water supply and quality.
- Vulnerability of housing infrastructure to temperature extremes.
- Replacement of native species with invasive species.
- Animal disease as an impact of drought.
- Occurrence of wild land fires.

They identified the following needs:

- Increased monitoring of climate conditions, vegetation, and stream flow on reservation lands.
- Up-to-date information on climate modeling, which is used for decision making.
- Projections of the cost of future water transport.

September 2015 Tribal Engagement meeting participants

Standing Rock Sioux Tribe
Sisseton Wahpeton Sioux Tribe
Flandreau Santee Sioux Tribe
Crow Creek Sioux Tribe
Lower Brule Sioux Tribe
Rosebud Sioux Tribe
Oglala Sioux Tribe
Ponca Tribe of Nebraska
Santee Sioux Tribe
Iowa Tribe of Kansas and Nebraska
Sac and Fox Nation of Missouri in Kansas and Nebraska
Crow Tribe
Gros Ventre & Assiniboine of Ft. Belknap
Eastern Shoshone and Northern Arapaho Tribes of Wind River
Kickapoo Tribe in Kansas
Cheyenne River Sioux Tribe
Cheyenne & Arapaho
Iowa Tribe of Oklahoma
U.S. Army Corps of Engineers
Kiksapa Consulting, LLC
Montana Department of Natural Resources and Conservation
NOAA National Weather Service
Louis Berger
Syntropy Energy / RE-AMP
U.S. Department of Agriculture – Agricultural Research Service
Little Big Horn College
South Dakota State University Extension
U.S. Department of Agriculture – Natural Resources Conservation Service – Central Technology Center
U.S. Department of Agriculture – Forest Service
National Oceanic and Atmospheric Administration
National Drought Mitigation Center, University of Nebraska – Lincoln
American Indian Higher Education Consortium

continued on next page

Sept. 2015 Tribal Engagement meeting participants

continued from previous page

NOAA's Centers for Environmental Information
NOAA's Climate Program Office
NOAA's National Weather Service
Bureau of Indian Affairs
North Central Climate Science Center, Colorado State University
National Aeronautics and Space Administration
Federal Emergency Management Agency – Mitigation Division
High Plains Regional Climate Center
Wolf Mountain Environmental
South Dakota State University / South Dakota State Climate Office

- ✦Information on grants related to water, agriculture, conservation, infrastructure, and public health.
- ✦Incorporation of indigenous knowledge about climate change into scientific data collection.
- ✦Increased planning for climate extremes and climate change.
- ✦Improved communication between tribes and federal governmental institutions regarding data and information.
- ✦Incorporation of groundwater data into water management plans.
- ✦Guidance from federal governmental institutions on how to restore watersheds and the native ecology of tribal lands.

Opportunities for funding, partnerships, and collaborations were also discussed. These include:

Bureau of Indian Affairs (BIA): The BIA can perform impact assessments for a range of issues, including drought and wildlife disease. There are grants for performing vulnerability assessments and they can provide technical support and training. They have grant funding available for climate adaptation planning as it relates to forestry, wildlife, and invasive species, as well as support for travel to meetings.

Education and tribal colleges: The American Indian Higher Education Consortium (AIHEC) has problem-based learning projects on climate change for K-16 curriculum. The National Science Foundation (NSF) Tribal Colleges and Universities Program has funding for Science, Technology, Engineering, and Mathematics (STEM) projects. A representative from Little Bighorn College suggested that tribal colleges should develop Geographic Information Systems/Global Positioning Systems (GIS/GPS) curricula. Several participants stressed the importance of involving youth and students at tribal colleges in the issues discussed at the workshop.

Federal Emergency Management Agency (FEMA): Funding opportunities exist through its all-hazards pre-disaster mitigation program, as well as its hazard mitigation grant program that is available after a presidentially-declared disaster. FEMA is looking at integrating drought planning into multi-hazard mitigation planning.

National Oceanic and Atmospheric Administration (NOAA): It was suggested that relationships should be strengthened between tribes and their National Weather Service local Weather Forecast Offices (WFOs).

U.S. Geological Survey (USGS): The USGS supports tribes indirectly under some of its projects, but does not have specific funding.

High Plains Regional Climate Center (HPRCC): Dr. Martha Shulski, the HPRCC director, suggested having a workshop that focuses on all aspects of monitoring for tribal lands, including the Automated Weather Data Network (AWDN); Community Collaborative Rain, Hail, and Snow Network (CoCoRaHS); stream gauges, impacts, ecology, and land management.

Natural Resources Conservation Service (NRCS): Several tribal representatives asked for help from this agency on the removal of invasive species and restoration of native ecology.

Next steps included exploring opportunities to strengthen monitoring capabilities throughout tribal lands, investigating partnerships with tribal colleges and universities (TCUs) to build capacity for climate and drought planning efforts within a specific tribe, and continuing outreach to the tribes in the basin through several mechanisms, including directly to tribal councils.

Nov. 21, 2014: Kansas Tribes Meeting

More than 35 individuals met in Kansas City at the National Weather Service Training Center to better understand drought and climate impacts on tribal lands; build partnerships to facilitate water management, drought early warning, and responses to extreme events; identify resources and points of contact for planning, natural resources, and environmental offices; and engage and leverage TCUs.

The meeting included discussion of these issues and focused on several key topics: availability of data and monitoring; vulnerability and cultural resources; and prediction and early warning in the context of drought and climate extremes impacts.

Outcomes and next steps include:

- ✦Exploring tribally specific early warning systems for drought, including climate/drought summaries, education, and building capacity on monitoring of climatological and cultural aspects.
- ✦Familiarizing and educating on drought aspects of monitoring and climate data holdings.
- ✦Leveraging agencies for resources on planning and building resilience.
- ✦Assessing vulnerability of cultural and water resources.
- ✦Conducting tribal adaptation training.

Wind River Indian Reservation

Through previous engagement work two projects were developed in cooperation with the Wind River Indian Reservation (WRIR) Office of the Tribal Water Engineer. These will involve two coordinated activities:

1) The creation of a drought/climate summary that could eventually lead to a vehicle that improves technical capacity and collection of impact information for the U.S. Drought Monitor; and

2) The development of a WRIR drought management plan. The activity is in progress and being led by the HPRCC and NDMC.

The drought management plan will be part of a project being funded by the North Central Climate Science Center, the WRIR's "Vulnerability to the Impacts of Drought and the Development of Decision Tools to Support Drought Preparedness." The purpose of this project is to conduct an assessment of key climatological, social and ecological vulnerabilities, risks, and response capacities of the WRIR to inform the development of the management plan.

NIDIS' role will be to facilitate the development of the plan using the vulnerability assessment work as an organizing activity.

Kansas Tribes meeting participants

James Rattling Leaf, Meeting Facilitator
Kickapoo Tribe in Kansas
Sac and Fox Nation of Missouri in Kansas and Nebraska
Prairie Band Potawatomi Nation
Iowa Tribe of Kansas and Nebraska
National Oceanic and Atmospheric Administration (NOAA)
National Integrated Drought Information System (NIDIS)
National Drought Mitigation Center (NDMC)
High Plains Regional Climate Center (HPRCC)
Haskell Indian Nations University
Federal Emergency Management Agency (FEMA) – Region 7
Environmental Protection Agency (EPA) – Region 7
Kansas Water Office
United States Army Corps of Engineers (USACE)
United States Department of Agriculture (USDA)
Kansas Climate Office
University of Kansas
National Climatic Data Center


NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE
National Drought Mitigation Center
NIDIS