An Assessment of Decadal Drought Information Needs of Stakeholders and Policymakers in the Missouri River Basin for Decision Support

Part II: Water, Fisheries and Wildlife, Electric Power, and Agriculture Sectors in the Northern Missouri River Basin

Vikram M. Mehta[1], **Cody L. Knutson**[2], **J. Rolf Olsen**[3], **Nicole A. Wall**[2], **Tonya K. Bernadt**[2], **Michael J. Hayes**[2] and **Norman J. Rosenberg**[1]

1 Center for Research on the Changing Earth System (CRCES), Maryland
2 National Drought Mitigation Center (NDMC), University of Nebraska – Lincoln, Nebraska
3 US Army Corps of Engineers (USACE) – Institute for Water Resources (IWR), Virginia

The UL Bend on Fort Peck Lake, Montana, during the 2007 drought.
Courtesy Larry and Shane Hoyer, Department of Energy, Western Area Power Administration, Fort Peck.

A Report Provided to
the NOAA-Climate Program Office-Sectoral Applications Research Program
Under Grant NA080AR431067

The Center for Research on the Changing Earth System CRCES

National Drought Mitigation Center

US Army Corps of Engineers

Summary

The Missouri River Basin (the Basin hereafter) is the largest river basin in the U.S. The Basin produces approximately 46% of wheat, 22% of grain corn, and 34% of cattle in the United States; and is thus a major "bread basket" not only of the U.S., but also of the world. Three decadal climate variability (DCV) phenomena -- the Pacific Decadal oscillation, the tropical Atlantic sea-surface temperature (SST) gradient oscillation, and the west Pacific Warm Pool SST variability -- significantly impact the hydro-meteorology of the Basin. Records available from 1950 to 2000 show that decadal droughts and wet periods in the Basin are correlated with various combinations of these three DCV phenomena in their respective positive and negative phases.

We have undertaken a project, titled "*An Assessment of Decadal Drought Information Needs of Stakeholders and Policymakers in the Missouri River Basin for Decision Support"* and funded by the NOAA-Climate Program Office-Sectoral Applications Research Program. The objectives of the project are to (1) conduct workshops involving stakeholders and policymakers in the Basin; (2) develop retrospective drought and wet period scenarios using statistical modeling of DCV indices and their associations with hydro-meteorological variables in the Basin; and (3) develop sectoral impact evaluations through use of the Hydrologic Unit Model of the United States (HUMUS) and the Erosion Productivity Impact Calculator (EPIC) driven by the retrospective scenarios. The ffirst workshop in this project was held in Kansas City, Missouri on April 27-28, 2009. __ Approximately 25 stakeholders attended the Kansas City workshop. Approximately 40 stakeholders and policy-makers from the northern Missouri River Basin participated in the second workshop held in Helena, Montana on June 24-25, 2009. The purpose of this workshop was threefold: (1) to show that climatic events on the decadal scale have major effects in the Basin, including major droughts and wet periods; (2) to gather information about the effects of droughts in the 1980s and the most recent drought period during the 2000s decade; as well as the prolonged wet period of the 1990s; and (3) to explore the potential for developing future decadal climate outlooks and potential management options that would be useful in preparing for and coping with droughts and wet periods.

This Report describes major conclusions, potential barriers to using decadal climate outlooks, and recommendations from the second workshop in Helena, Montana.

Table of Contents

1. Introduction

The Missouri River Basin (the Basin hereafter) covers more than 500,000 square miles and a part or all of 10 states (Montana, Wyoming, Colorado, North Dakota, South Dakota, Minnesota, Iowa, Nebraska, Kansas, and Missouri), numerous Native American reservations, and parts of the Canadian provinces of Alberta and Saskatchewan. People living in the Basin depend on the Missouri River for drinking water, irrigation and industrial needs, hydro-electricity, recreation, navigation, and fish and wildlife habitat. The Basin contains some of the country's most sparsely-populated agrarian counties as well as a number of large metropolitan areas such as Omaha and Kansas City on the Missouri River and Denver at the foothills of the Rocky Mountains. Grain crops for food and feed contribute a large portion of the Basin's agricultural income. About 117 million acres are in cropland in the aforementioned states. Of that total, about 12 million acres are irrigated. The Basin produces approximately 46% of wheat, 22% of grain corn, and 34% of cattle in the U. S.; and is thus a major "bread basket" not only of the U.S. but also of the world. Of the 18 Major Water Resource Regions of the U.S., shown in Figure 1, freshwater withdrawals for irrigation are greatest in California, the Pacific Northwest and the Basin.

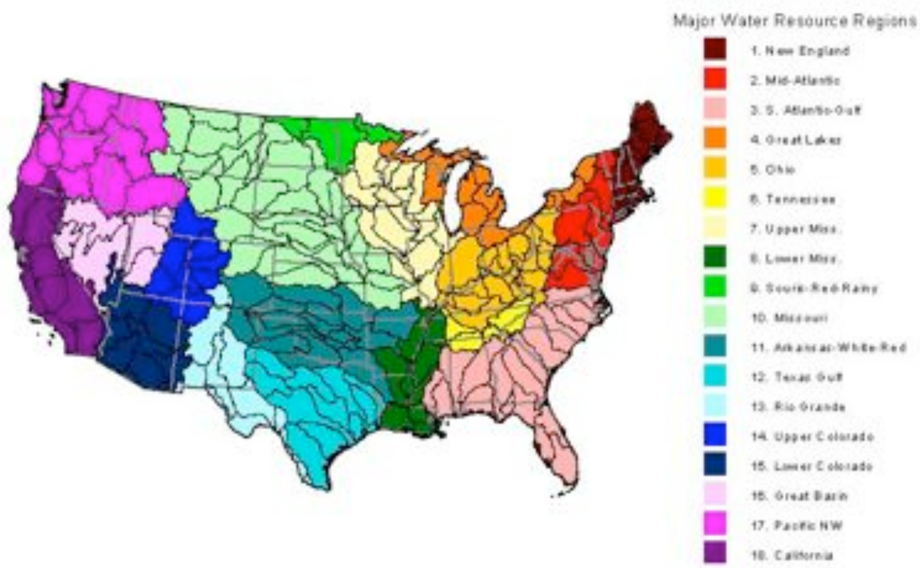

Figure 1: The 18 MWRRs of the Conterminous USA showing, as well, the ("4-digit") Hydrologic Unit Areas as Defined by the US Geological Survey.

The vulnerability of the Basin changes, of course, with precipitation variability forced by large-scale climate variability, especially at interannual and decadal timescales. These explain 60-70% of the total variance of annual-average precipitation. For example, during a major multiyear-to-decadal (hereafter referred to as decadal) drought, such as that in the late 1980s and the drought of 2000-01 to 2008, inflows in the Basin were insufficient to fully support reservoir-based recreation and Missouri River navigation. Conversely, too much water in the Basin reservoir system during above-average precipitation years of the 1990s resulted in greater than normal water releases from the reservoirs, which threatened farms and homes in the Basin's floodplains. Decadal-scale droughts in the Basin deplete the stored water leading to the tensions over competing water uses between upstream and downstream states.

In a project titled "*An Assessment of Decadal Drought Information Needs of Stakeholders and Policymakers in the Missouri River Basin for Decision Support*", funded by the NOAA-Climate Program Office-Sectoral Applications Research Program, we are conducting workshops involving stakeholders and policymakers in the Basin; developing retrospective drought and flood scenarios using statistical modeling of DCV indices and their associations with hydro-meteorological variables in the Basin; and developing sectoral impact evaluations through use of the Hydrologic Unit Model of the United States (HUMUS) and the Erosion Productivity Impact Calculator (EPIC) driven by the retrospective scenarios. Retrospective scenarios of hydro-meteorological variables, crop yields, and water flows are being compared with records of actual hydro-meteorological variables, crop yields, and streamflow; and observations and model results are a part of the DCV-related drought information provided to users in workshops. The second workshop in this project was held in Helena, Montana on June 24-25, 2009 and this is a Report based on workshop proceedings. Further details of this project and its predecessor project are given in Appendix 1.

The purposes of this second workshop (the first of the series was held in Kansas City, MO on April 27-28 2009) were threefold: (1) to show that climatic events on the decadal scale have major effects in the MRB, including major droughts and wet periods; (2) to gather information about the effects of droughts in the 1980s and the most recent drought period during the 2000s; as well as the prolonged wet period of the 1990s; and (3) to explore the potential for developing future decadal climate outlooks and potential management options that would be useful in preparing for and coping with droughts and wet periods.

Approximately 40 stakeholders and policymakers representing a variety of sectors in the northern part of the Basin participated in the Workshop. Workshop participants and their affiliations are listed in Appendix 2.

2. Stakeholder Interaction Techniques

The project team used a variety of techniques to interact with stakeholders. Initial information about the project was provided via a quarterly newsletter initiated as part of this project.--*The Missouri Basin Climateer* , A web site (www.DecVar.org/MRB_project.php) was also set up to provide information to workshop participants and others, The site is to be maintained after the project ends., A preliminary description of the workshop's purposes and a list of questions to consider were provided to the participants a few days prior to the event. The importance of this project to Montana and NOAA was evidenced by the participation of the Lieut. Governor of Montana (Fig. 2) and the Chief of the Climate Assessment Division of the NOAA Climate Office (Fig. 3) in this Workshop.

Project team members delivered a series of presentations during the Workshop and sufficient time was alloted for interactions with participants. Most of the interaction took place in the form of small-group discussions that utilized a public participation "sticky" wall, where a variety of lists could be generated such as those related to impacts during historical wet and drought periods in the basin.

Figure 2: Honorable John Bohlinger, Lt. Governor of Montana, explaining the importance of the project to Workshop participants.

Other techniques such as polling the audience with "clickers" (hand-held audience response units) were used to gather feedback and stimulate discussions. Sessions also offered facilitated discussions by topics related to the use of DCV information (as shown in Figure 4) using a "World Café" technique. In this approach, the group is broken into sub-groups and placed at tables. They are then asked to address one question per table. After a discussion, each group then moves to the next table to answer the next question. This allows each group to discuss a range of questions relatively quickly. At the end of the session, each table reporter presented the major discussion points of the topics to the entire group. At the end of the workshop, participants were also asked to respond to a final questionnaire about the workshop content and offer suggestions for improvement.

3. Information Provided to Stakeholders

In the main presentation by the project team, stakeholders were introduced to various definitions of DCV and then to the three major DCV phenomena – the PDO, the TAG, and the WPWP variability. Spatial patterns and time histories of these phenomena were shown and major hypotheses for their causes were briefly described. Statistical associations between each of the DCV phenomena and hydro-meteorological variables such as rainfall and surface air temperature were used to show how each contributes to hydro-meteorological variability in the Basin at decadal timescales. Rainfall and temperature patterns associated with two recent, multiyear to decadal timescale hydrological events – droughts in the 1980s and a prolonged wet period in the 1990s –reconstructed from the aforementioned statistical associations-- were shown to workshop participants.

The Erosion Productivity Impacts Calculator (EPIC) model was used to simulate crop yields in the Basin under idealized but realistic hydro-meteorological scenarios characteristic of the three DCV phenomena.

Figure 3: Dr. Dan Walker, Chief, Climate Assessment Division, NOAA Climate Office, explaining NOAA's interest in interactions with stakeholders and policymakers.

The crops modeled were corn, winter and spring wheat, and soybean. The results of these experiments with EPIC were also shown to workshop participants.

The aforementioned information imparted to participants was discussed in several sessions. Participant recollections of these events were elicited. The question of future evolution of the DCV phenomena and their possible impacts on the Basin was discussed. The project team initiated this series of discussions by reviewing the current status of efforts to produce decadal climate outlooks by several major climate modeling groups around the world. The difficulties of producing such outlooks were also described and discussed.

4. Workshop Results

4.1 Participant Recollections

4.1.1 The 1980s Drought

According to stakeholder recollections, the 1980s drought reduced crop production due to water shortages, causing a financial crisis for farms and resulting in an increase in farm consolidation. Lacking earlier planning for prolonged droughts caused the implementation of ad hoc disaster relief programs s were implemented to alleviate drought impacts. The decadal drought also stimulated increased investments in center-pivot sprinkler irrigation systems and an increased interest in conservation tillage methods including no-till farming.

Low-flow conditions in MRB rivers caused population declines in sauger (*Sander canadensis*; a food fish typical of rivers), waterfowl and mule deer and increases in spruce bud infestation.

The extreme and prolonged dryness also damaged and weakened urban lawns. Municipal water use was restricted in many localities. In addition, wide-spread fires occurred in the Yellowstone National Park and elsewhere.

4.1.2 The 1990s Wet Period

Major consequences of the 1990s wet period, included wide-spread floods in the MRB and "100-year"floods in the Yellowstone River. River banks were eroded with resultant changes in river habitats. Stakeholder feedback also suggested that increased precipitation beginning in the early 1990s encouraged complacency about groundwater tables and water management, until water tables in wells actually began to drop in delayed response to the 1980s drought.

Although the 1990s was a wet period overall, occasional late precipitation in some parts of the MRB during planting seasons delayed or impeded planting with resultant crop losses. Overall, however, the generally greater precipitation increased yield of dryland crops in the Basin. The number of cattle also increased due to generally increased availability of forage and feed. The increased availability of water and feed stimulated population growth in water fowl and 'big game' animals.

Figure 4: Small groups of stakeholders and policymakers discussing their decadal climate information needs.

4.1.3. The Droughts in the 2000s

During the prolonged drought in the first decade of the 21st century, water levels declined in rivers, lakes, and reservoirs, increasing conflicts between reservoir and river entities such as the Corps of Engineers, river management groups, irrigators, etc.. The Fort Peck hydro-electric plant, fed by the highest dam on the Missouri River in Montana, ran well below maximum capacity. Low water levels in rivers also resulted in less water available for municipal and power generation pump sites.

As in the prior drought, stakeholders discussed how the prolonged 2000-2008 drought resulted in low crop and forage yields, decreased cattle numbers, increased investments in center-pivot irrigation systems and increased no-till farming.

Low water levels in the upper Missouri River also reportedly resulted in a lack of paddlefish spawn upstream of Fort Peck and a decline in other recovering fish populations. The low-flow conditions on many streams also closed the streams for fishing. There were several waterfowl die-offs in rivers, streams, and marshes due to the generally dry conditions.

The drought also caused an increase in forest fire activity, with severe fire seasons in 2000, 2003, and 2007. The fires, along with other damage, caused smoky skies and wildlife deaths.

The drought also resulted in substantial impacts on the MRB economy and individual/family health. Stakeholders noted that adverse impacts of the drought on the region's economy led to increased instances of substance abuse and family discord.

4.2 Usefulness of Decadal Climate Outlooks

Workshop participants were presented observations on climate and impacts from the 1980s and the 2000s drought periods as if they were 100% accurate climate forecasts with multiyear to a decade lead times. They were asked to describe how they would have used these decadal climate outlooks (DCO) had they been available just before the onset of the 1980s and the 2000s drought periods. The ensuing discussions resulted in reasonably specific ideas about how DCOs could be used in decision making.

It was generally agreed that the most recent decadal drought had stimulated a more proactive and scientific view of drought planning. Such planning would involve customized management of water, agriculture, and energy supplies; and improved disaster assistance, cost management, capital investments, agricultural commodity management, and cash flow management. Public expectations from governments and utilities can also be better managed with reliable DCOs.

Workshop participants felt that DCOs can assist with large-scale water management in a variety of ways through proactive rather than reactive management of river flows and reservoirs. For example, if DCOs can be applied to stream flow models to predict reservoir inflow, then changes in sectoral (agricultural, industrial, municipal, ecosystem and fisheries) requirements for water can be predicted. It was felt that DCOs over 10-20 years may not be actionable, except for reservoir and other water infrastructure construction, but knowledge of expected inflows over 5-10 years in the future may be useful because irrigation and fisheries water rights are based on 10-year forecasts. Reliable DCOs can also enable trade-offs among agricultural, wildlife, and recreational uses of water including tourism.

DCOs can also assist in crop management issues such as which crop to plant and when to plant; whether or not to purchase crop insurance and the level of coverage needed; whether to use a crop rotation, a continuous single crop, or let ground lie fallow at times; and whether to invest in irrigation. A change of business plan may follow from a DCO that indicates that drought may become the norm in decade ahead.

Reliable DCOs can facilitate planning for disaster services such as emergency water supply and fire fighting. DCOs, if the public is confident in them, can help generate support for the funding of emergency planning, drought monitoring, and advisory services;

4.3 Potential Barriers to Using Decadal Climate Outlooks

Workshop participants were also asked to identify potential barriers to the use of DCOs. The unknown reliability, accuracy, and spatial and temporal resolutions of DCOs would be the major barriers to their adoption and use. It was also felt that a lack of clarity as to the relationship of DCV phenomena and climate change, would also be a barrier to the use of DCOs. Current controversies regarding global warming confuse the general public and make it difficult for an understanding of the distinction between natural climate variability and anthropogenic climate change.

Other barriers to the use of DCOs can be social, political, and cultural resistance to change; and a lack of financial means to act on the DCOs. Legal barriers such as water rights; public resistance to government funding for infrastructure change and inflexible farm benefit programs may pose obstacles to the adoption and use of DCOs. The public may also feel that there are more important factors in resource management than climate . Finally, it was also felt that incorrect or deliberate scientific misinformation and “acts of nature” that do not seem to match the predicted trend (e.g., a heavy rainfall event during a long-term drought) can also lessen the credibility of climate scientists.

4.4 Specific Recommendations for Providing Decadal Climate Outlooks

The Workshop participants recommended that:

1. The existing Missouri River Basin Website, developed for this project, should be enhanced with links to relevant sites; and user-friendly DCV information needed by stakeholders such as probabilities of occurrence, user-definable preferences (including resolutions), GIS capabilities, and explanations of data and information in terms that a broad range of stakeholders can understand. The information should be in watershed scales pertaining to streams and rivers in the MRB and it should be downloadable in presentation formats developed in collaboration with users.

2. Credibility of DCOs should be established in 'hind-casting' studies using historic climatic data. Also, limitations of DCOs should be clearly conveyed to potential users.

3. DCOs should deal not only with DCVs but with ENSO and other relevant climate phenomena as well.

4. Precipitation and temperature patterns are distinctly different to the east and to the west of the Continental Divide in Montana, for example. DCOs should have sufficient spatial resolution to be distinguish these differences

5. DCOs should include information on soil moisture conditions and be able to project stored water in reservoirs, potential for stream bank erosion, and potential for flooding due to ice jams.

6. Climate scientists and climate information should be readily accessible to stakeholders and policymakers when decisions need to be made. Communications between climate scientists and decision makers need to be improved; differences between scenarios and forecasts must be made clear to users of climate information.

7. Climate scientists should select a few promising economic sectors (e.g. agriculture, municipal water, ecosystem management) and work with decision makers in those sectors to convey the usefulness of DCV information to their general user communities. Climate scientists should attend user community meetings and conferences as often as possible.

8. Current status of the various DCV phenomena and their possible impacts should be posted on the MRB website. Subscribers should be alerted to the availability of newly posted outlooks and significant developments.

9. Existing user networks and extension agents should be engaged to channel climate information, and there should be more coverage of climate-related matters on TV and other local and regional news media.

5. Next Steps

As the next steps in this process of interactions with users, it was recommended by the workshop participants that experimental, decadal climate and impacts information for the MRB should be provided to users; and the network of stakeholders and policymakers in the MRB should be further developed via the newsletter "*Missouri Basin Climateer*", the already-existing web site, and through e-mail. The participants also expressed a keen interest in assessing the usefulness of experimental DCOs.

Appendix 1: Projects on Impacts of Decadal Climate Variability on Water and Agriculture in the Missouri River Basin

SARP I

In our previous project funded by NOAA-Climate Program Office-SARP, referred to as SARP I here, we used century-long precipitation time series over the basin and found that interannual El Niño-Southern Oscillation (ENSO) variability explains less than 20% and that decadal (>7 years) timescale variability explains approximately 40-50% of the total variance in precipitation. The interannual and decadal precipitation variability thus accounts for 60-70% of the total precipitation variance in the basin. These precipitation (and snow accumulation and stream discharge) estimates are also reflected in the percentage area of the basin under severe to extreme drought conditions. As shown in Figure 2, the fraction of the basin experiencing severe to extreme drought in the 20th century has ranged from 20% to 60% or more at interannual to decadal timescales. From 2000-01 to 2008 much of the basin experienced such a drought.

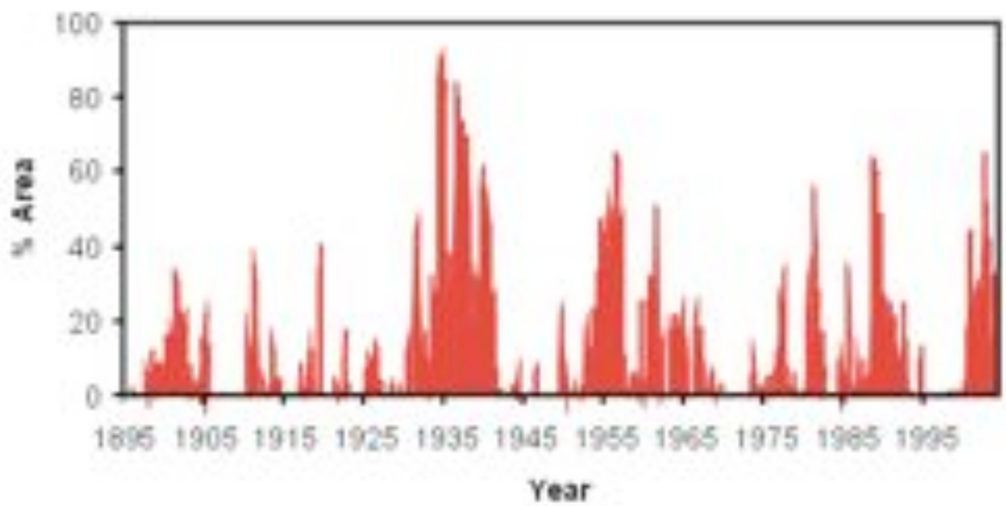

Figure A1: Percent of total Missouri River Basin area experiencing severe to extreme drought between January 1895 and March 2004. Based on data provided by the National Climatic Data Center, NOAA; Copyright 2004 National Drought Mitigation Center.

The climate of the continents is sensitive to what happens over the oceans. Unusual warming and cooling of vast oceanic areas creates such phenomena as the Pacific Decadal oscillation (PDO), the tropical Atlantic sea-surface temperature (SST) gradient (TAG for brevity) oscillation, and the west Pacific Warm Pool (WPWP). In SARP I we found that these three decadal climate variability (DCV) phenomena significantly impact the hydro-meteorology of the Missouri River Basin. Records available from 1950 to 2000 show that decadal droughts and wet periods in the Basin are correlated with various combinations of these three DCV phenomena in their positive and negative phases.

In December 2006, a representative cross-section of Nebraska stakeholders and policymakers was interviewed by the project researchers to gather information about perceived needs for climate information. Discussions were held with over 30 local and regional water managers, policymakers, farmers, and researchers in Nebraska and western Iowa. Some of the major organizations represented in this study were Central Nebraska Public Power and Irrigation District, Bureau of Reclamation, Army Corps of Engineers, Nebraska Farm Bureau, Tri-Basin Natural Resource District, National Park Service, and various departments and centers within the University of Nebraska–Lincoln system. Very positive and articulate responses to our questions by the various stakeholders, policymakers, and academic researchers with whom we met led to the following major conclusions: (1) impacts of persistent decadal hydro-meteorological anomalies are qualitatively different compared to impacts of year-to-year anomalies; (2) agriculture, water resources for municipalities, power plants, and navigation in the MRB are much more vulnerable to decadal drought events than to year-to-year events; (3) there is an evident need for decadal drought outlooks; (4) any particular DCV-related drought or flood event can have differing sectoral and economic impacts in the various geographical portions of the MRB (e.g., recreation in Montana and the Dakotas, irrigation in Nebraska and Kansas, and navigation in the downstream States); (5) municipalities and industry, particularly power generation, are sensitive to drought and flood-related changes in water supply everywhere in the MRB; (6) farms along the Missouri River are much more vulnerable to persistent floods than to persistent droughts; (7) while crops are, of course, sensitive to changes in weather associated with year-to-year hydro-meteorological anomalies, modern crop breeding is increasing their resilience to short-term climate variations; (8) research must be extended to consideration of: the role of groundwater in the total impacts of droughts and floods on water availability; the very important impacts on unmanaged ecosystems; , and land-use changes in response to the Conservation Reserve Program and the introduction of biomass cropping in the region; and (9) a much more detailed study, with questions focused on individual groups and a wider range of economic sectors, is needed for the entire MRB.

The research undertaken in SARP II (the current program) has been guided by the findings listed above.

SARP II

The primary purpose of the SARP II project is to broaden our understanding of drought information needs that were gathered in the earlier phase. This was done by soliciting, evaluating, and documenting stakeholder knowledge of DCV phenomena across the entire basin. In order to achieve this purpose, we are undertaking systematic assessments of the DCV-related perceptions and drought information needs of various types of stakeholders (such as local/regional water managers, farmers and cattle ranchers and feeders, researchers, local/regional business people, and policymakers) in the basin for decision support by means of a series of workshops, surveys, and web-based communication methods.

To help demonstrate the relationships between DCV and associated impacts in the basin, we also developed retrospective scenarios for three DCV-related hydrologic events in the basin; the multiyear-to-decadal drought event in the mid-to-late 1980s and the recent drought (2000-01 to 2008) and the multiyear-to-decadal wet period event in the 1990s; and are assessing their possible impacts on hydro-meteorology, water and crop yields, and regional economy. This work is essential to: (a) help provide credibility of the DCV-societal impacts relationships to stakeholders, (b) be useful in fostering discussions on the effects of DCV, and (c) provide a starting point for discussion on the information needed to better understand and effectively adapt to and cope with DCV-related droughts and excessive wetness. Interconnected components of this project are shown in Figure A2.

SCENARIOS OF DCV AND DROUGHTS/ FLOODS INFORMATION

IMPACTS OF DROUGHTS/FLOODS ON WATER AND CROPS

ASSESSMENT OF USERS' DCV-RELATED INFORMATION NEEDS FOR DECISION SUPPORT

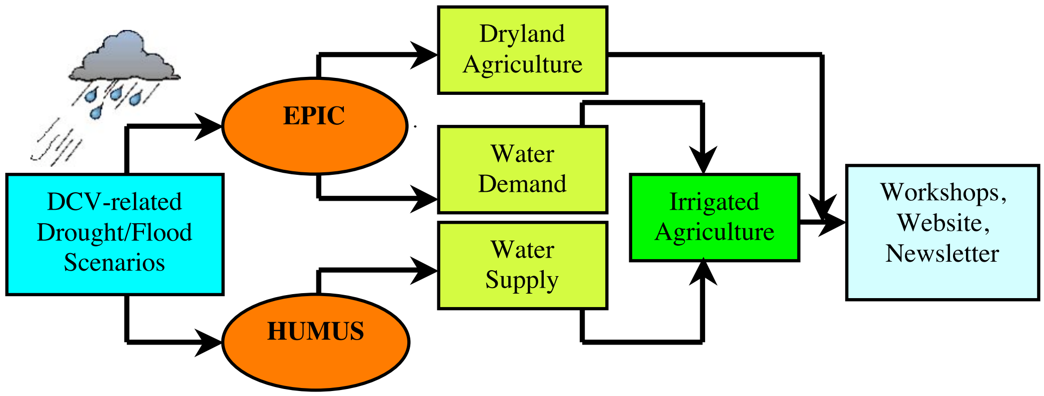

Figure A2: From scenarios of DCV-related droughts/floods to assessment of users' drought information needs.

Appendix 2: List of Participants in the Helena Workshop

Name	Occupation Title	Organization
Hon. John Bohlinger	Lt. Governor, Montana	Office of the Lt. Governor
Dustin R. de Yong	Associate Policy Advisor / Executive Assistant	Office of the Lt. Governor
Jeff Tiberi	Director	Montana Association of Conservation Districts
Ron de Yong	Director	Montana Department of Agriculture
Lola Raska	Executive Vice President	Montana Grain Growers Association
Curt Diehl	Member, Board of Directors	Montana Grain Growers Association
Walt Bales	County Executive Director	USDA Farm Services Agency
Jay VanVoast	Director	Montana State University Extension Service
Dick Iversen	Ag Producer	
Buzz Mattelin	Ag Producer	
Boone Whitmer	Ag Producer	
Allan Rollo	Watershed Coordinator	Sun River Watershed Group
Brian MacDonald	Water Resources Program Coordinator	Blackfoot Challenge Watershed
Donald Potts	State Climatologist	University of Montana
Dave Bernhardt	Science and Operations Officer	National Weather Service
Bill Martin	Science and Operations Manager	National Weather Service
Bob Nester	Incident Meteorologist	National Weather Service
Ken Mesch	Director	MT Disaster & Emergency Services
Lance Elias	Resource Coordinator	PPL Montana
Kerry Berg	Policy Analyst	Northwest Power and Conservation Council
Laura Ziemer	Director	Trout Unlimited
Ken McDonald	Wildlife Division Administrator	Montana Fish, Wildlife and Parks
Andy Brummond	Water Resource Specialist	Montana Fish, Wildlife & Parks
Danielle Blank	Senior Outreach Coordinator	National Parks Conservation Association
Bryan Henry	Fire Meteorologist	Northern Rockies Coordination Center
Raymond Nelson	Direct Protection Fire Coordinator	Montana Dept. of Natural Resources and Conservation
Greg Archie	Fire Management Program	Montana DNRC Forestry Division

Randy Perez	Coordinator	Fort Belknap Water Resources Department
Deb Madison	Environmental Programs Manager	Fort Peck Assiniboine and Sioux Tribes
Jesse Aber	Water Resources Planner	Montana DNRC Water Resources Division
Mary Sexton	Director	Montana DNRC Water Resources Division
Tom Patton	Hydrogeologist	Montana Bureau of Mines and Geology
John Kilpatrick	Director	USGS Montana Water Science Center
Wayne Berkas	Hydrologist	USGS Montana Water Science Center
Robert E. Gresswell	Research Biologist	USGS – NoROCK
Katherine J. Chase	Hydrologist	USGS Montana Water Science Center
David Brandon	Chief - Hydrology and Climate Services Division	NWS Western Region Headquarters
Tim Felchle	Chief of Reservoir Operations	Bureau of Reclamation
Kyle Blasch	Assistant Director	USGS Montana Water Science Center
Chris Hunter	Administrator	Montana Fish, Wildlife, and Parks
Karen Nelson	Toxicologist	US Fish and Wildlife Service
Lenny Dubenstein	Manager	Bureau of Reclamation
Mark Reller	Constituent Account Executive	Bonneville Power Administration