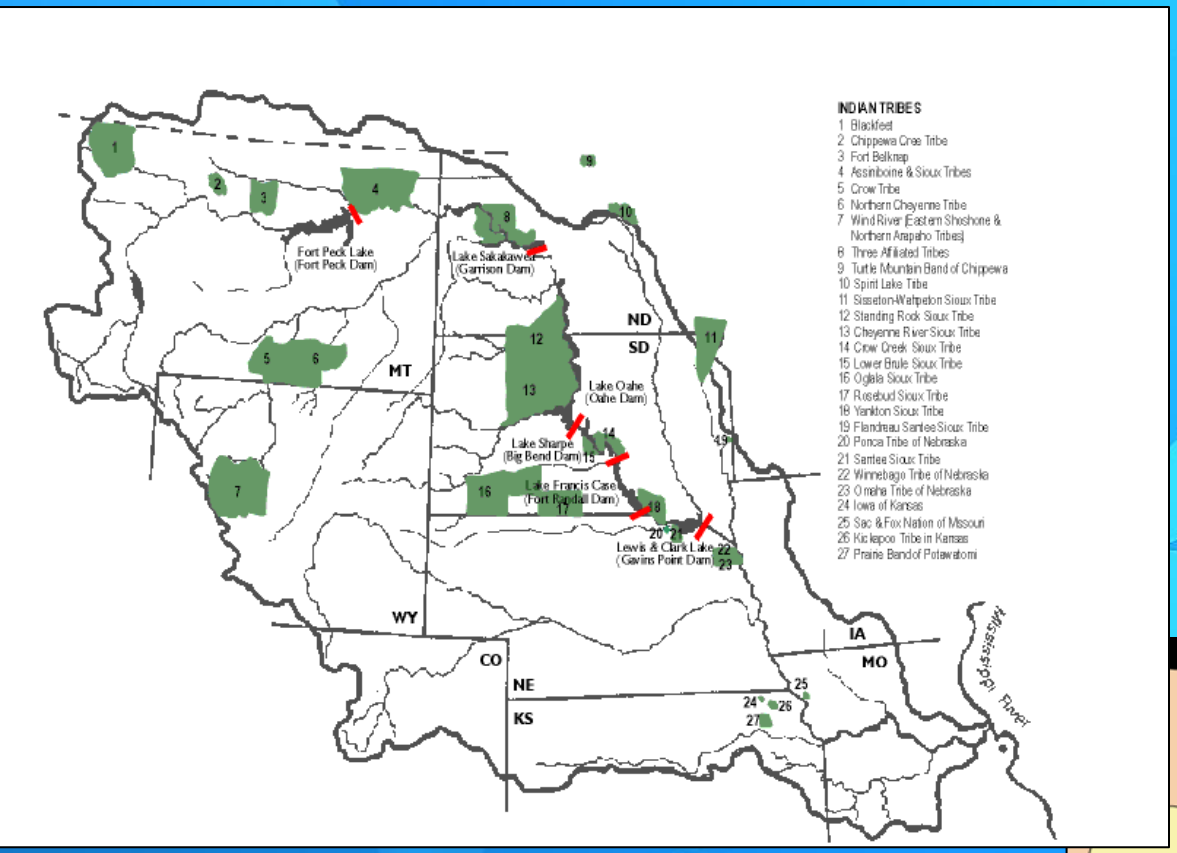
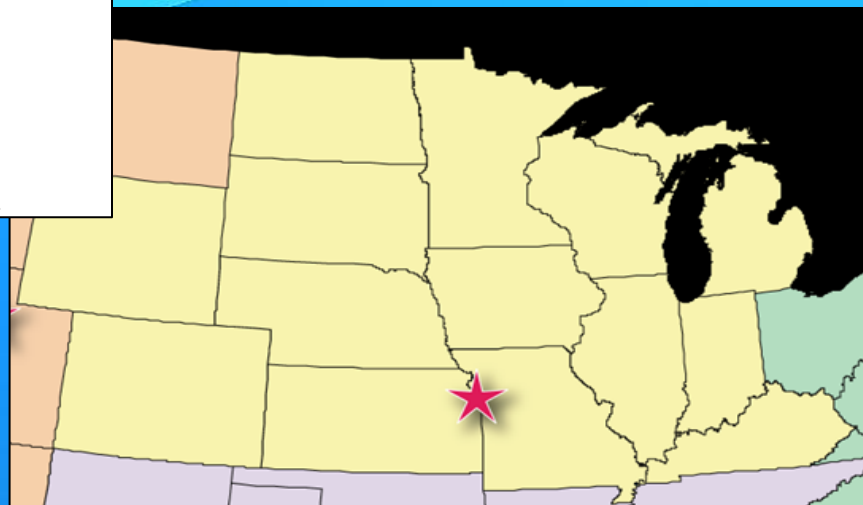
Climate Early Warning Services for the Missouri Basin



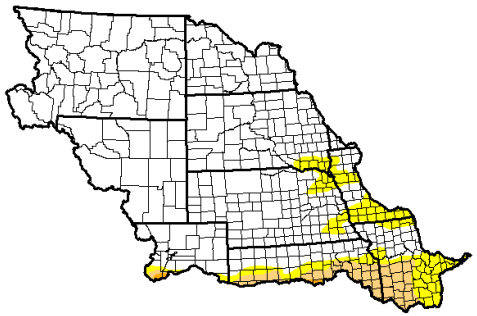


Missouri Basin Tribal Nations Drought Meeting
Doug Kluck, NOAA/NCDC
Doug.kluck@noaa.gov
Kansas City, Mo

Drought Monitor: 2011 to Now

U.S. Drought Monitor

Missouri Watershed



August 2, 2011

(Released Thursday, Aug. 4, 2011)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	86.73	13.27	4.69	0.21	0.00	0.00
Last Week 7/26/2011	93.19	6.81	1.02	0.14	0.00	0.00
3 Months Ago 5/3/2011	81.43	18.57	7.89	3.09	0.00	0.00
Start of Calendar Year 1/4/2011	74.64	25.36	7.96	0.15	0.00	0.00
Start of Water Year 9/28/2010	80.55	19.45	2.41	0.00	0.00	0.00
One Year Ago 8/3/2010	97.30	2.70	0.30	0.00	0.00	0.00

Intensity:

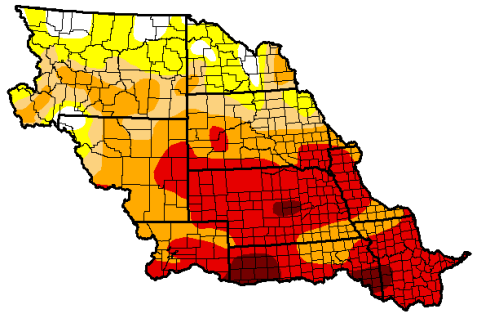
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Brad Rippey
U.S. Department of Agriculture

U.S. Drought Monitor

Missouri Watershed



August 7, 2012

(Released Thursday, Aug. 9, 2012)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	5.17	94.83	78.81	65.37	37.19	3.52
Last Week 7/31/2012	5.17	94.83	77.88	65.44	34.08	2.13
3 Months Ago 5/8/2012	70.63	29.37	4.14	0.37	0.00	0.00
Start of Calendar Year 1/3/2012	74.44	25.56	6.49	1.97	0.00	0.00
Start of Water Year 9/27/2011	71.67	28.33	4.59	0.25	0.01	0.00
One Year Ago 8/9/2011	87.64	12.36	4.00	0.12	0.00	0.00

Intensity:

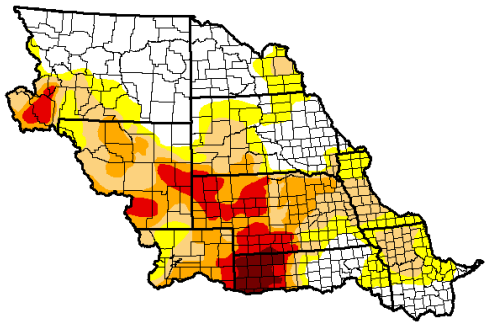
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Mark Svoboda
National Drought Mitigation Center

U.S. Drought Monitor

Missouri Watershed



August 6, 2013

(Released Thursday, Aug. 8, 2013)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	36.16	63.84	44.83	24.82	10.56	2.10
Last Week 7/30/2013	31.89	68.11	45.20	26.58	11.26	2.59
3 Months Ago 5/7/2013	23.30	76.70	65.71	47.59	21.35	3.01
Start of Calendar Year 1/1/2013	11.52	88.48	81.86	68.75	45.29	22.09
Start of Water Year 9/25/2012	2.91	97.09	91.77	73.24	46.90	18.48
One Year Ago 8/7/2012	5.17	94.83	78.81	65.37	37.19	3.52

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

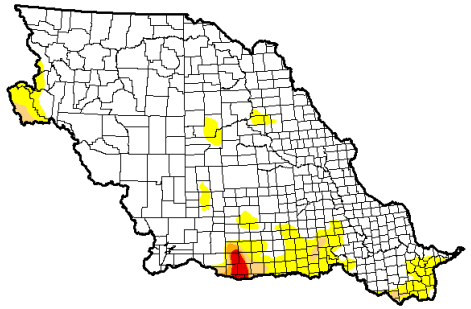
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Brian Fuchs
National Drought Mitigation Center

http://droughtmonitor.unl.edu/

U.S. Drought Monitor

Missouri (HUC 2)



September 9, 2014

(Released Thursday, Sep. 11, 2014)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	87.83	12.17	2.27	0.89	0.55	0.00
Last Week 9/2/2014	85.77	14.23	5.40	0.94	0.55	0.00
3 Months Ago 6/10/2014	73.42	26.58	14.72	3.46	1.06	0.00
Start of Calendar Year 12/31/2013	63.00	37.00	16.73	6.98	1.41	0.00
Start of Water Year 10/1/2013	45.68	54.32	33.38	13.74	1.68	0.00
One Year Ago 9/10/2013	35.03	64.97	45.84	24.45	8.52	1.34

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Brian Fuchs
National Drought Mitigation Center

http://droughtmonitor.unl.edu/

A Chronology of Recent Extremes (2011-2014)

- 2011 – Devastating and long lasting flood from Montana to Missouri

Little Big Horn College

Omaha Casino

2011 Flood Aftermath

- Levees and infrastructure in disrepair
- Much worry about next spring flood season
- Continuing La Nina means another flood, right?

Monthly Climate & Drought Webinars

- Began November 2011
- Focus where concerns are highest in “real-time”
- Provides Early Warning
- Flexible response to climate extremes
- Popular w/states, feds, tribes, private interests
- Presenters: AASC, NDMC, RCC, USDA, etc…

Webinars:

- Consistent and all in one place from many sources
- Past, present and future climate information
- Drought, Flood, Fire, Heat, Cold, Agriculture, Snow, soil moisture/temperature, precipitation, temperatures, rivers, reservoirs, etc…
- Monthly (3rd Thursday) unless it gets really bad then every other week

- Sign up here: http://drought.gov/drought/content/regional-programs/regional-drought-webinars

- Webinars are recorded: http://www.hprcc.unl.edu/webinars.php

2012 – Drought & Heat

2012 was warmest and second most extreme year on record for the contiguous U.S.

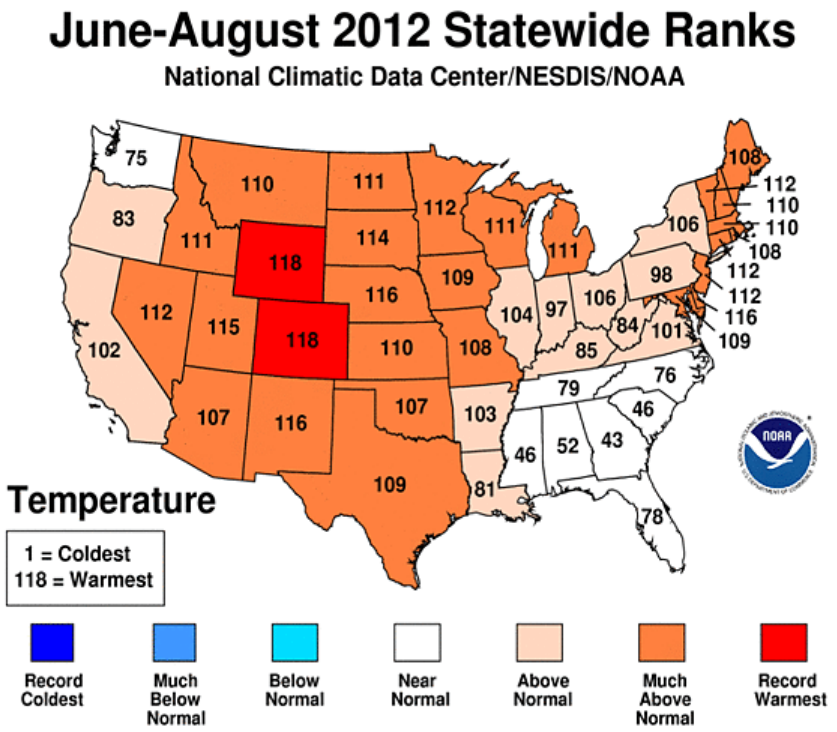
- **2nd warmest summer**
- **3.2F above average (this is huge)**
- **15th driest year**
- **61%+ Nation in drought**
- **9.2 million acres burnt (3rd highest)**

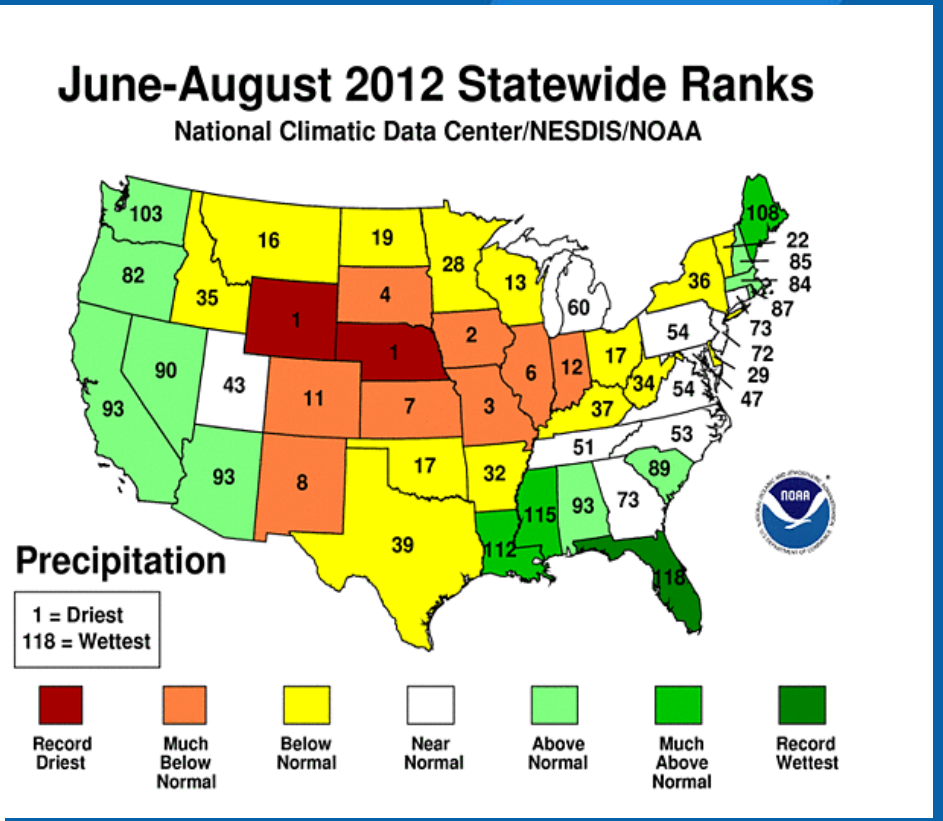
AP Photo Seth Perlman

Forbes.com

2012

50-80 billion in damage





Attribution and Assessments

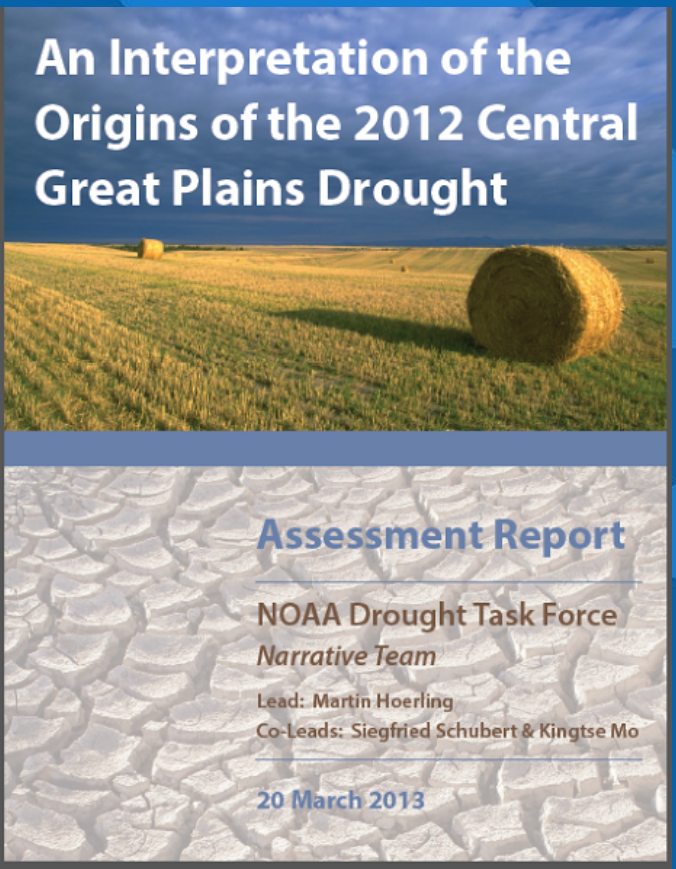
Devil's Lake Attribution

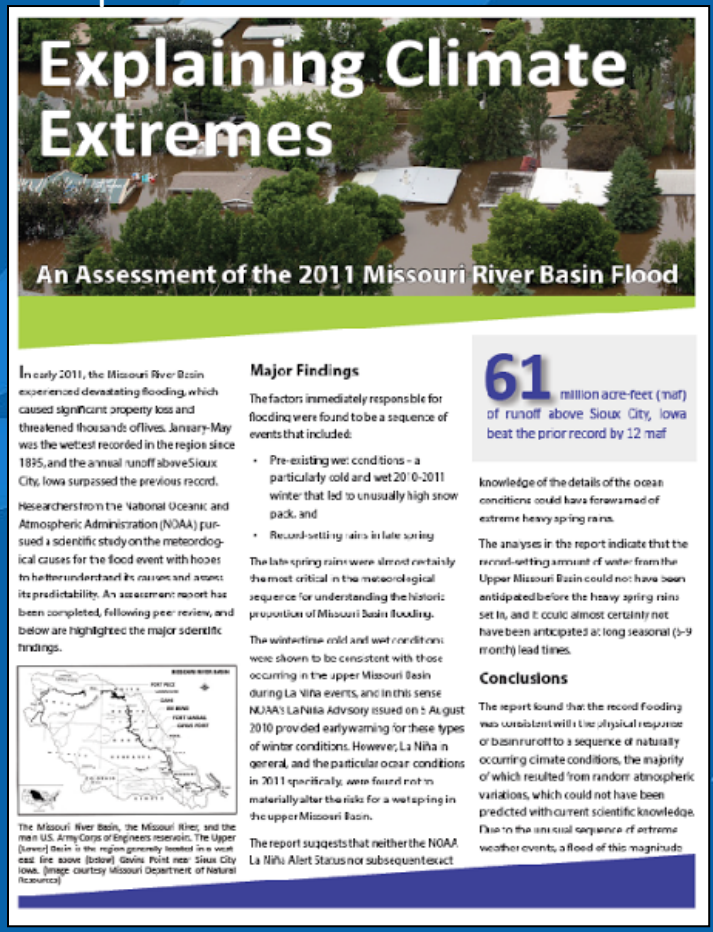
2011 Flood Attribution Study

2012 Drought Assessment (Coming Soon)

2012 Drought Attribution Study

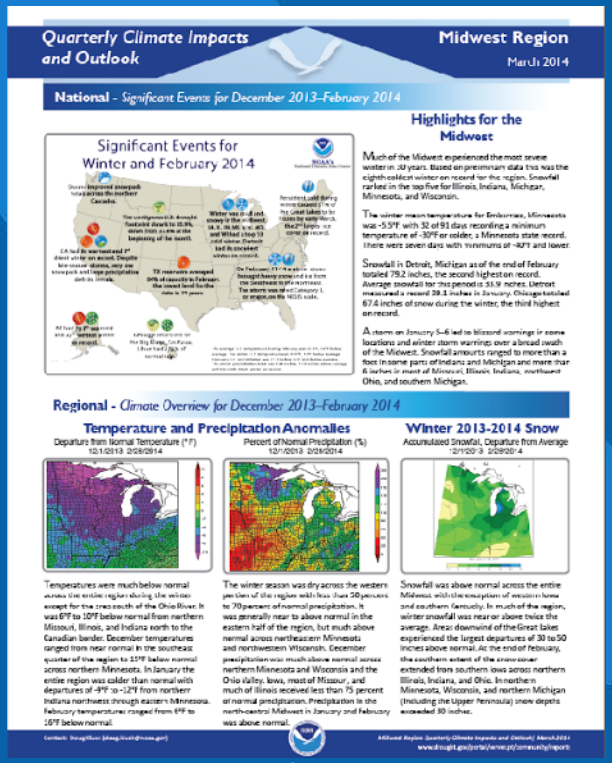
2007 April Freeze http://www1.ncdc.noaa.gov/pub/data/techrpts/tr200801/tech-report-200801.pdf



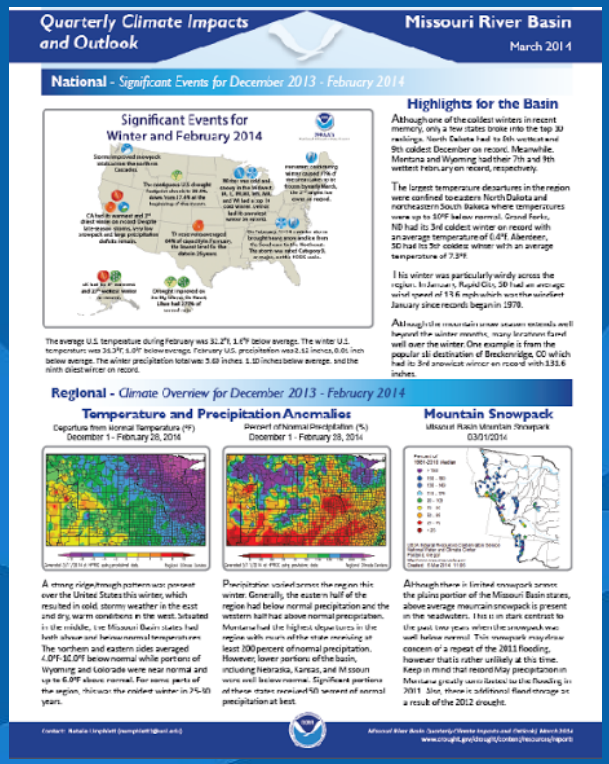


http://www.esrl.noaa.gov/psd/csi/factsheets/

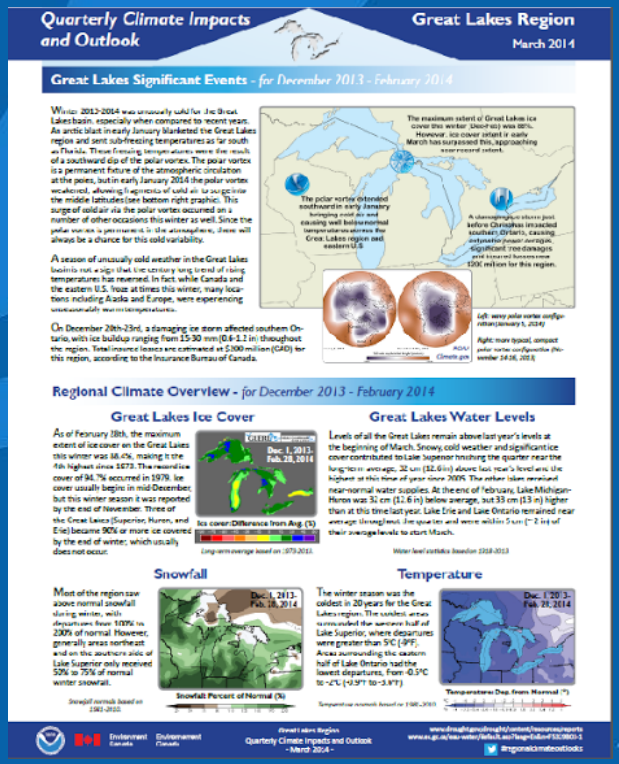
Quarterly Regional Climate Summary & Outlook



Midwest



Missouri Basin



Great Lakes

Pacific Region
Eastern Region
Western Region
Alaska Region
Rio Grande/Bravo Basin
Gulf of Maine Region
Midwest Region
Caribbean Climate

http://drought.gov/drought/content/resources/reports

2013 - Drought Continues South

2013

- Front Range Flood
- High Plain Blizzard

2014

- Flooding: South Dakota (June), Montana (August)
- Hail (Nebraska & Iowa)

Hail

- Near Blair, NE
- 100’s of millions $

2014 - National Integrated Drought Information System – Missouri Basin

NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

MISSOURI RIVER BASIN

DROUGHT EARLY WARNING SYSTEM

THE KICKOFF MEETING, FEB. 26-27 2014; NEBRASKA CITY, NEBRASKA

Teaming up for drought planning, preparedness, early warning systems

People from more than 70 federal, state, tribal, academic, regional and national institutions met in Nebraska City, Nebraska, in February 2014 to discuss the current state of drought awareness, planning and capacity across the Missouri River Basin.

The meeting was the first of a multi-year engagement process in the basin to better understand existing resources, vulnerabilities, impacts and priorities. The goal is to create a Drought Early Warning System (DEWS).

Regional DEWS (RDEWS), developed by the National Integrated Drought Information System (NIDIS), explore and demonstrate a variety of early warning and drought risk reduction strategies. 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., RDEWS help regions plan for and establish best practices in drought-stressed times, and transfer t information to under-served regions of the count

Key sponsors of the Nebraska meeting were NIDIS, the National Drought Mitigation Center (NDMC), Western Governors Association (WGA), U Department of Agriculture (USDA), North Central Climate Science Center (NCCSC), South Dakota St University (SDSU) and the National Oceanic and Atmospheric Administration (NOAA).

Vast, productive basin is vulnerable to drought and flood

The Missouri River Basin is known for intense weather and extreme climate variability, such as the stark differences between record high flows and flooding in 2011, followed by record low flows and drought in 2012. Drought is a normal part of climate throughout the Basin, causing devastating impacts during the 1930s Dust Bowl, the 1950s, 1988-89, 2000-2006, and 2012-13.

While the effects of flooding tend to be concentrated along waterways, the effects of drought spread across the landscape. Drought has direct impacts on agriculture, water supply, water quality, wildlife habitat, wildfire, landscapes, and air quality. It has physical, economic and social effects on the well-being of people, families and communities. Widespread drought disrupts farming and livesto production, which can, in combination with mark processes, increase food prices.

Many aspects of human activity affect vulnerab ity to flood and drought, including land and wate use patterns, population shifts and agricultural pr tices. Warming climate adds urgency to the need address drought in the basin, because heat contri utes to drought. More frequent extreme weather such as the heavy precipitation that led to floodin in 2011 also threatens the region's productivity.

Stakeholders at the meeting requested:

- Networks for regional drought monitoring and planning.
- Better understanding of drought as a hazard, societal vulnerability, and coping strategies.
- Education and outreach to citizens, agencies and organizations in the basin.

Gaps that came up included the need to:

- Create or revisit state drought plans.
- Develop early warning information and delivery systems based on the historical pattern of floods followed by droughts, such as the 2011 flood and 2012 drought.
- Communicate information about drought severity and impacts to states, tribes, and various sectors to increase awareness of the hazard.
- Communicate about related water use issues.
- Consolidate tools and information about drought.
- Capitalize on the strong, pre-existing foundation of connectedness in the basin while developing NIDIS as a key coordinator of drought information.
- Improve vulnerability analysis.
- Identify trigger or tipping points.
- Improve monitoring of soil moisture, stream flow and snow pack.
- Research and communicate ground water vulnerability.
- Offer education and outreach through trusted entities.

Next steps

NIDIS and its partners are in the process of identifying activities for building and enhancing a drought early warning information system in the Missouri River Basin. Next steps will include:

- Improving understanding of impacts and vulnerability to drought.
- Partnering with states and tribes to create new or improved drought plans.
- Continuing to support and assess ways to enhance the Midwest and Great Plains Drought and Flood Update Webinar series.
- Assessing approaches for improved forecasts and long-term monitoring.
- Initiating a series of regional or sub-basin meetings to understand impacts and ways to inform drought risk management.

ABOVE Cow Creek flows into the Missouri River in Montana. The steamboats dropped freight at Cow Island Landing, in the area where trees stand now, during the steamboat era of 1860 to mid 1880s. On September 23, 1877 the Nez Perce crossed the Missouri here in their flight to Canada.

MONTANA GEOGRAPHIC SOCIETY VIA WIKIMEDIA COMMONS

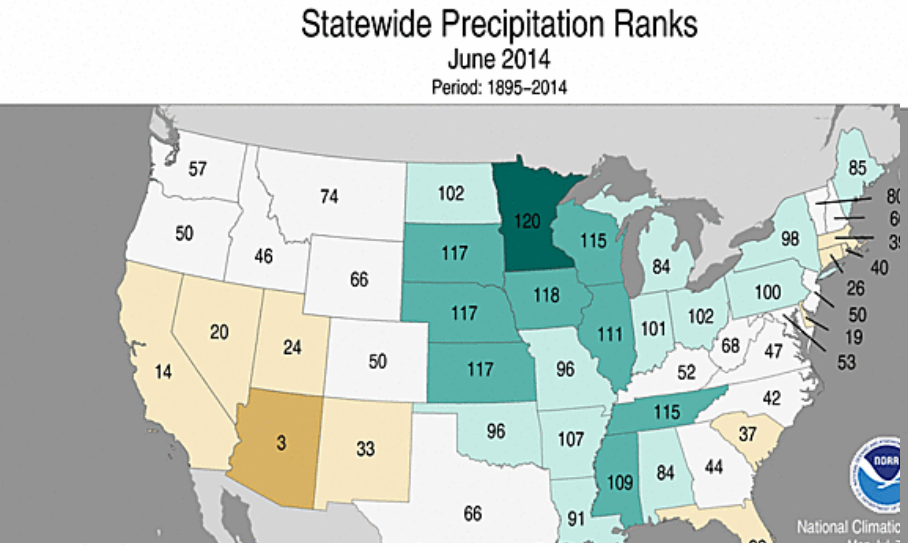
Participants at the workshop

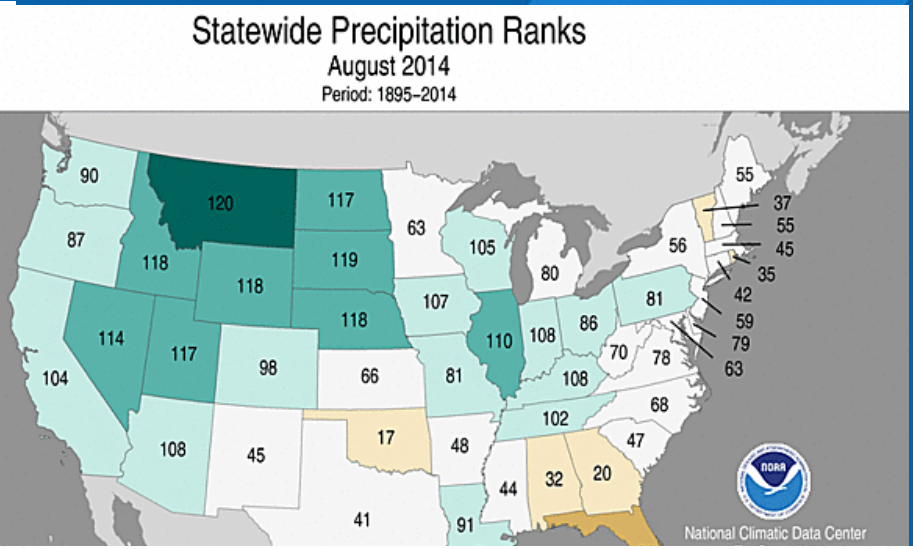
American Planning Association
Army Corps - Missouri River Water Management
Bureau of Indian Affairs
Bureau of Land Management
Bureau of Reclamation
Center for Research on the Changing Earth System
Colorado Climate Center, Colorado State University
Colorado Water Conservation Board
East Dakota Water Development 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)
National Park Service
Natural Resources Conservation Service - National Soil Survey Center
National Weather Service
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

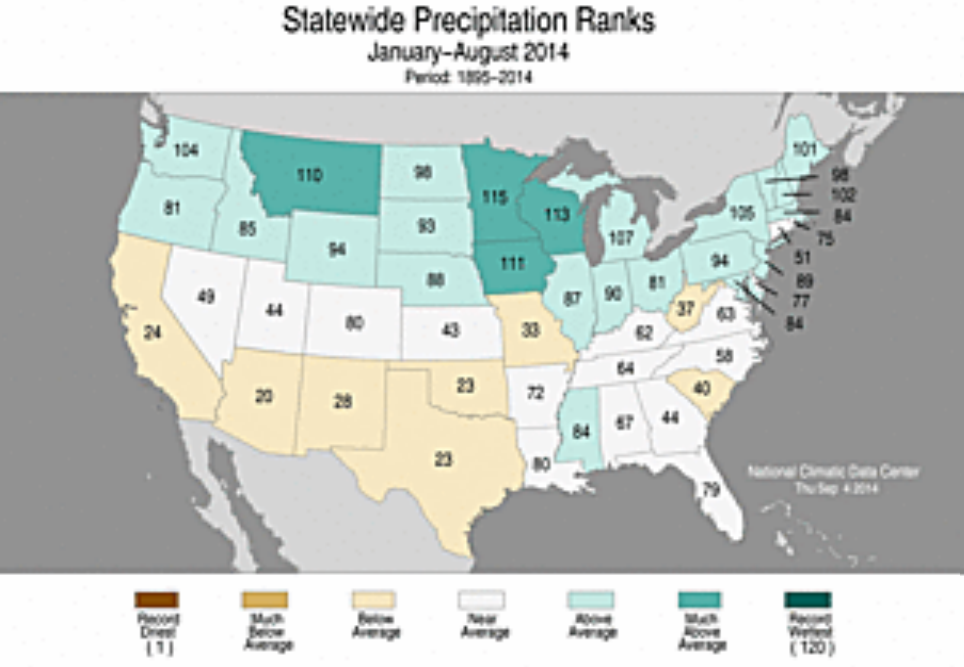
- Drought Early Warning System (DEWS)
- Informing Planning
  - Wind River Reservation
  - States
  - Federal Agencies
- Enhancing Monitoring
  - Drought/flood
- Tribally focused drought meeting
- Regional Web Portal

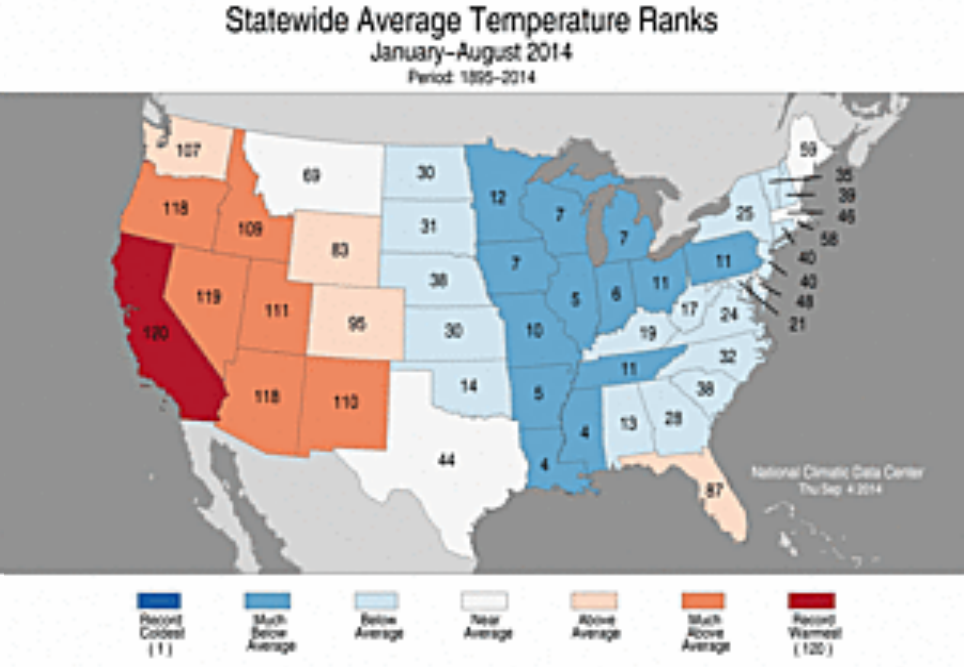
http://drought.unl.edu/Portals/0/docs/EPC/MRB%20Feb%202-14%20wkshop%202-pager.pdf

Monitoring 2014 so far



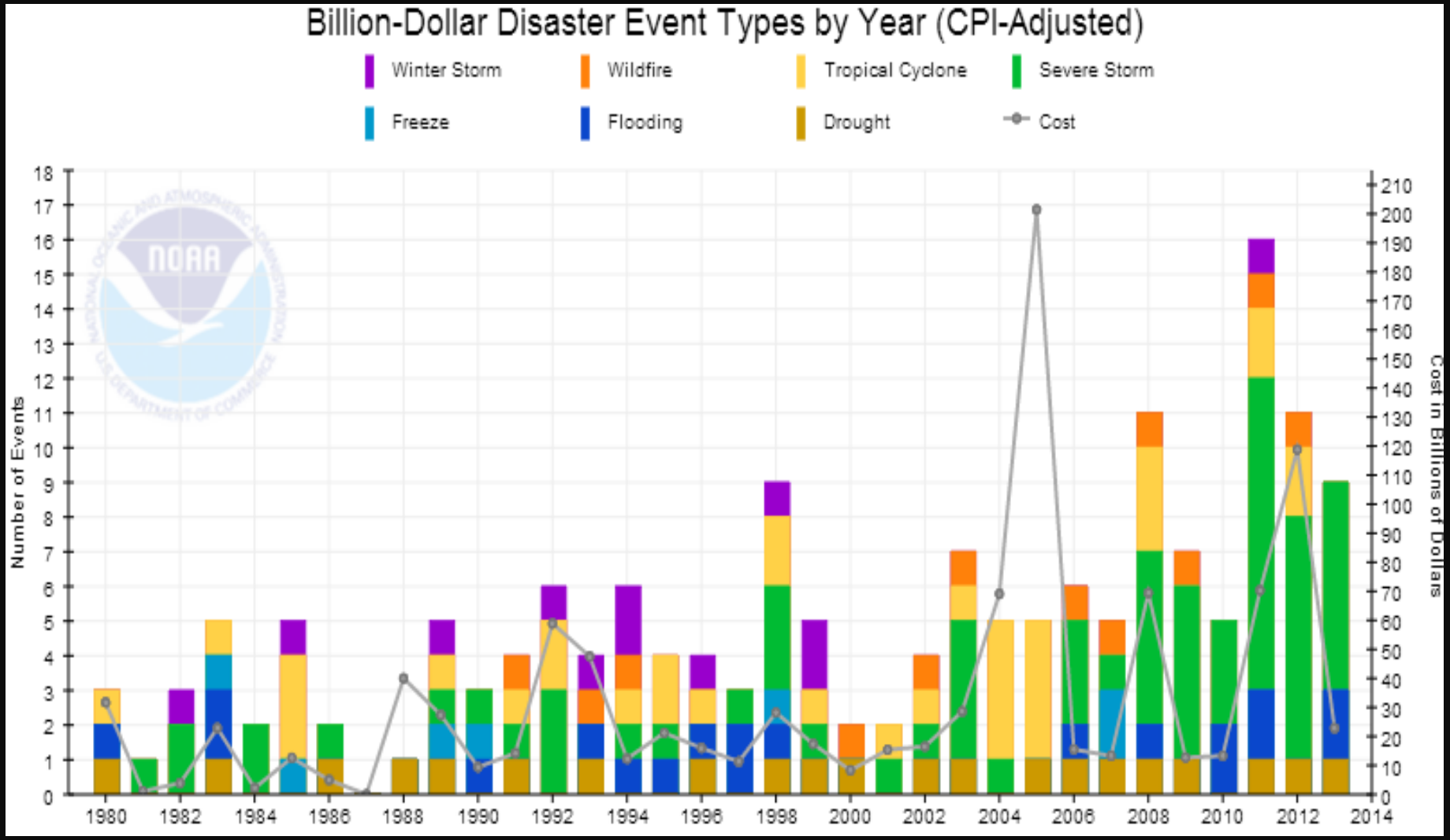




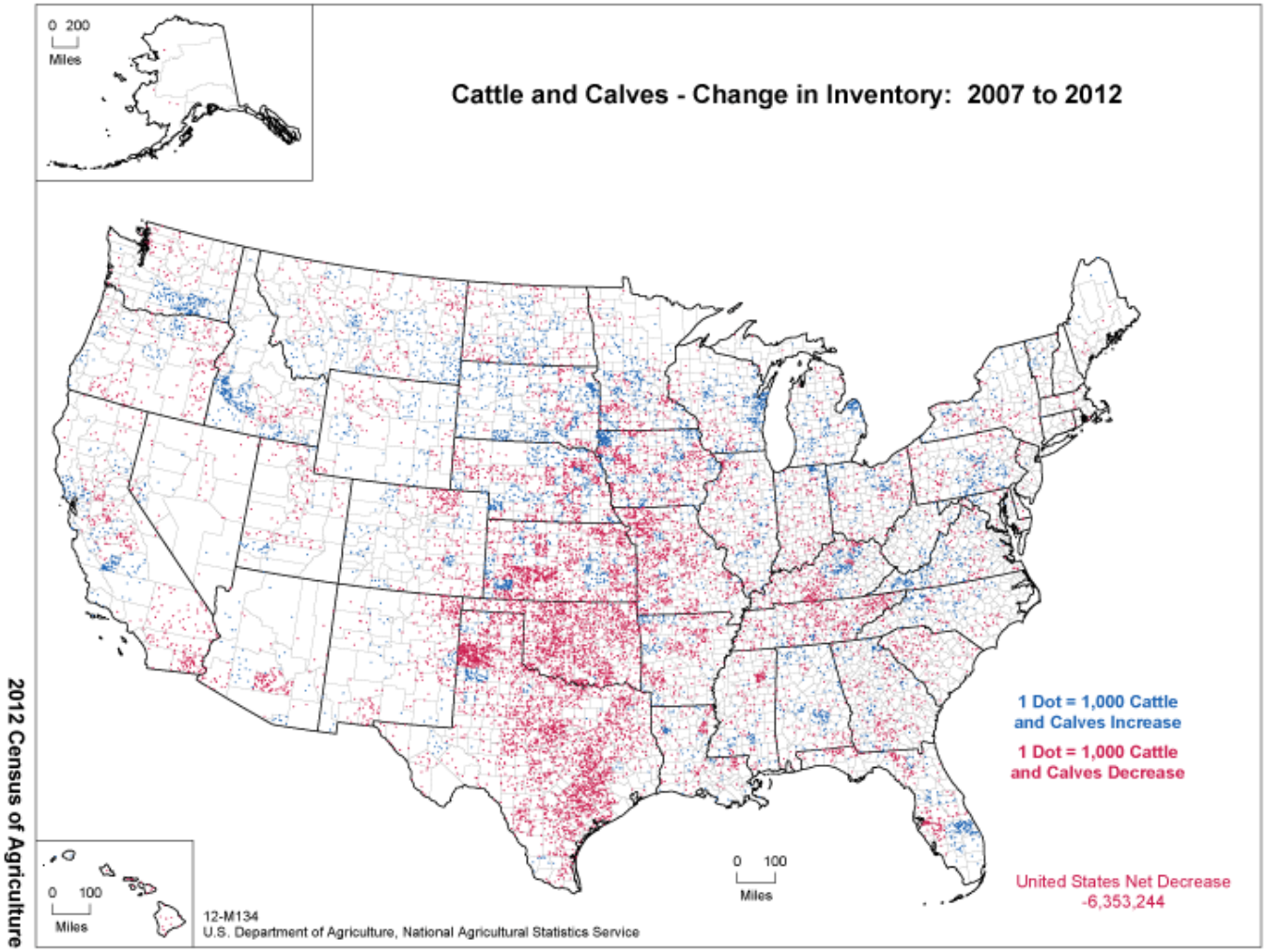


http://www.ncdc.noaa.gov/sotc/national/2014/8

1980 – 2013 Billion Disasters by Type



Where have all the cattle come from?

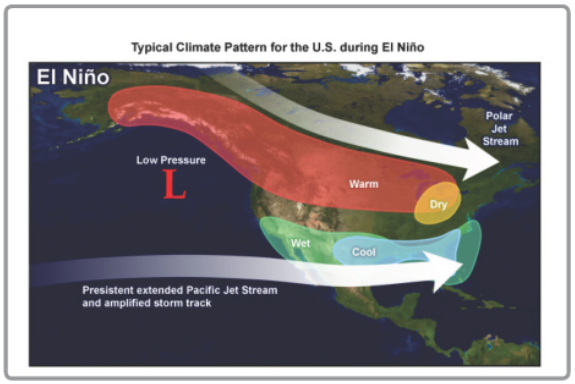


2014 – El Nino?

What does it mean for the Missouri Basin?

El Niño Impacts and Outlook — **Missouri Basin Region** — September 2014

Typical El Niño Winter Pattern



Typical El Niño jet stream patterns across the U.S. include a stronger than usual storm track across the southern U.S., leaving the northern U.S. removed from the average storm track. Image courtesy of NOAA.

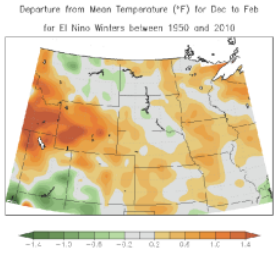
El Niño Winter Tendencies

El Niño is a particular pattern in the Pacific Ocean that affects weather downstream to the United States. It has its most notable impacts in the winter, when wind patterns in the atmosphere are strongest. When El Niño is present, it provides some predictable effects to weather patterns. While no two El Niño events are alike, the typical winter weather pattern (left) brings the polar jet stream farther north than usual, across Canada, while the Pacific jet stream remains in the southern U.S. As a result, the upper Missouri River basin can be warmer than normal, with the potential for less frequent heavy snow than usual. Confidence in these patterns is higher with stronger El Niño events.

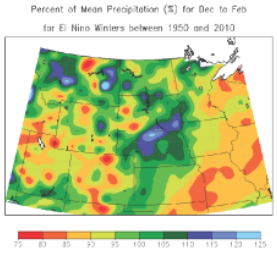
El Niño Outlook and Climate Connections

Winter Temperature and Precipitation

Departure from Average Temperature (°F) in Winter During Past El Niños



Percent of Average Precipitation (%) in Winter During Past El Niños



Departures from average temperature (left) and percent of average precipitation (right) in December through February during past El Niño years. Image courtesy of the Midwest Regional Climate Center.

The winter outlook from the NOAA/NWS Climate Prediction Center mainly is consistent with typical El Niño patterns across the central U.S., shown above, with a slightly increased chance for above-normal temperatures from the upper Missouri River basin. There also is a slightly increased chance for below-normal precipitation in Montana and Wyoming.

El Niño Likely

Highest Potential for Weak to Moderate El Niño

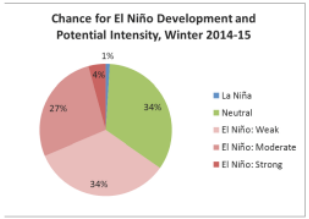
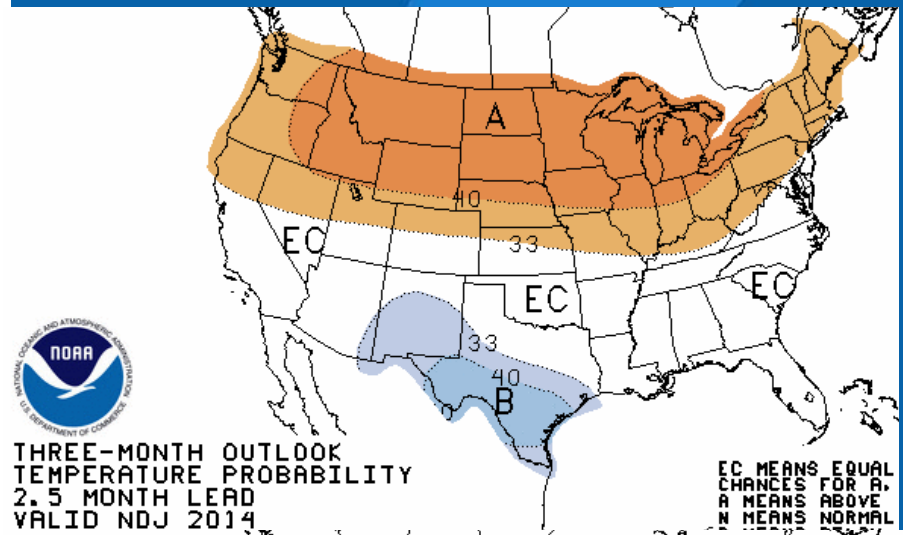
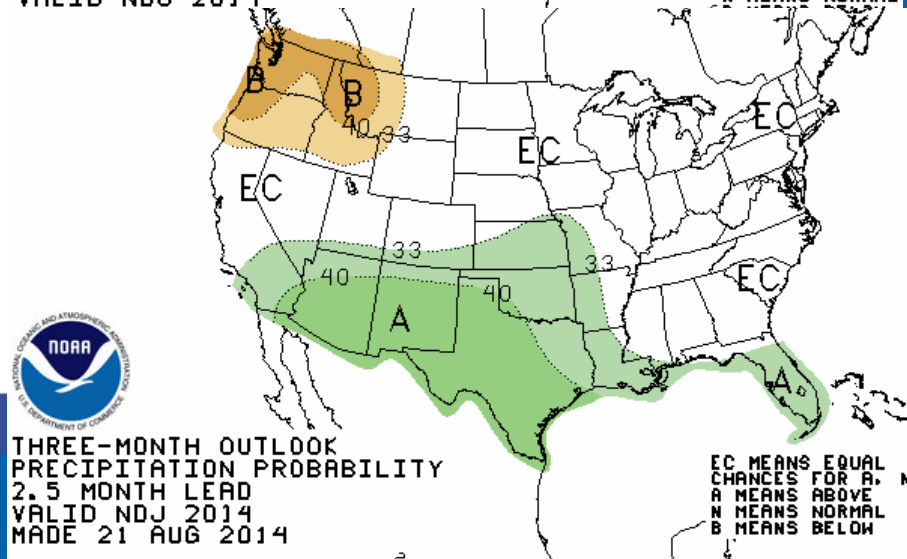


Chart based on summaries and forecast model data from the NOAA/NWS Climate Prediction Center and the International Research Institute for Climate and Society.

Odds still favor an El Niño forming by mid to late fall, with a 60-70% chance of development. There is a 30-40% chance for neutral conditions to continue through this winter, with a near-zero chance for La Niña to develop.

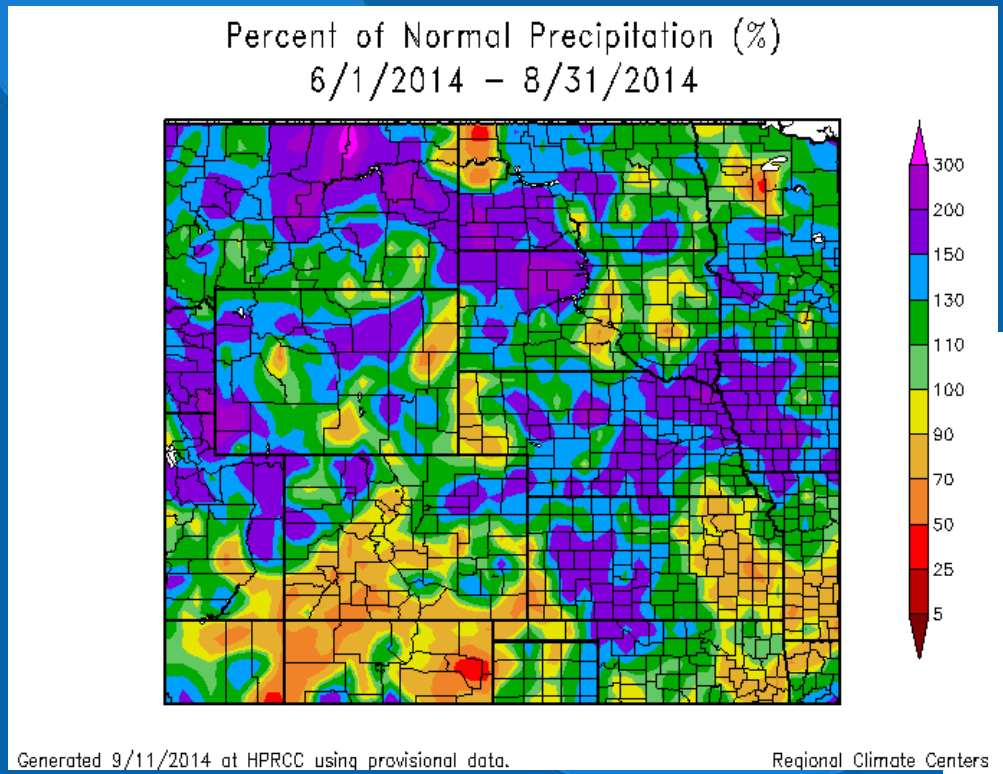
Contact: Barbara Mayes Boustead (barbara.mayes@noaa.gov)

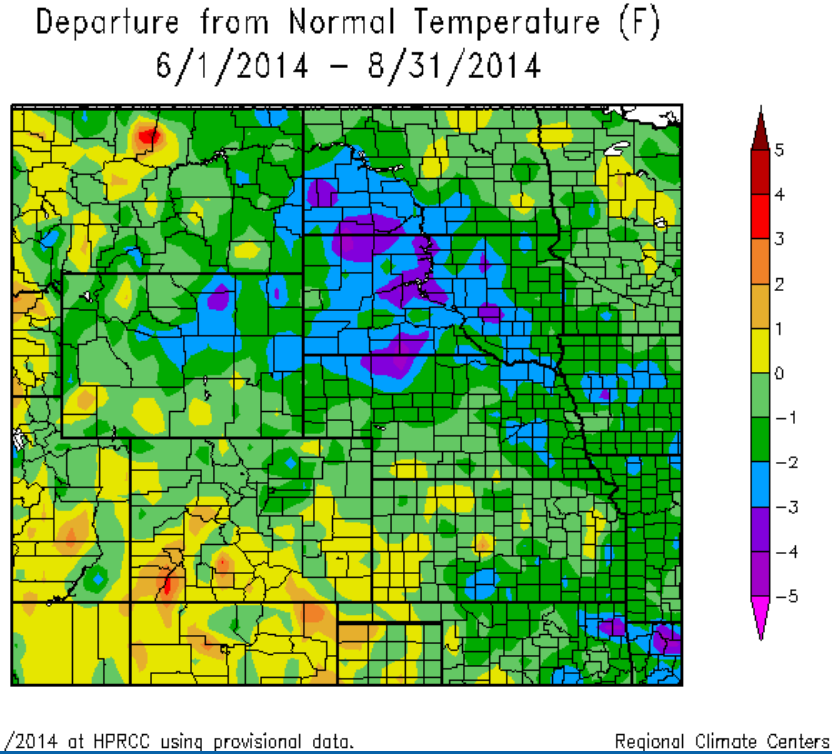




http://www.cpc.ncep.noaa.gov/

Summer of 2014





http://www.hprcc.unl.edu/maps/current/

Thank You

- Climate.gov
- Drought.gov
- Weather.gov

Doug.kluck@noaa.gov
816-994-3008/816-564-2417(c)

Extreme Weather

Some extreme weather and climate events have increased in recent decades, and new and stronger evidence confirms that some of these increases are related to human activities.

Billion Dollar Weather/Climate Disasters

1980-2012