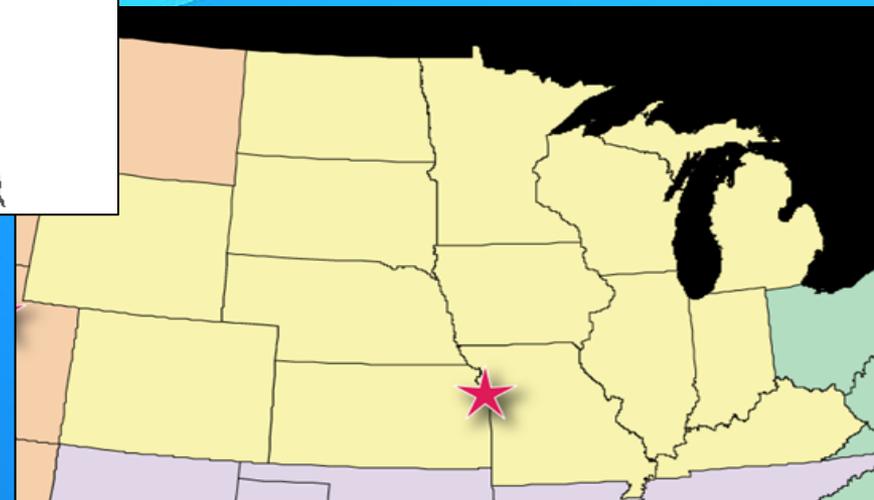
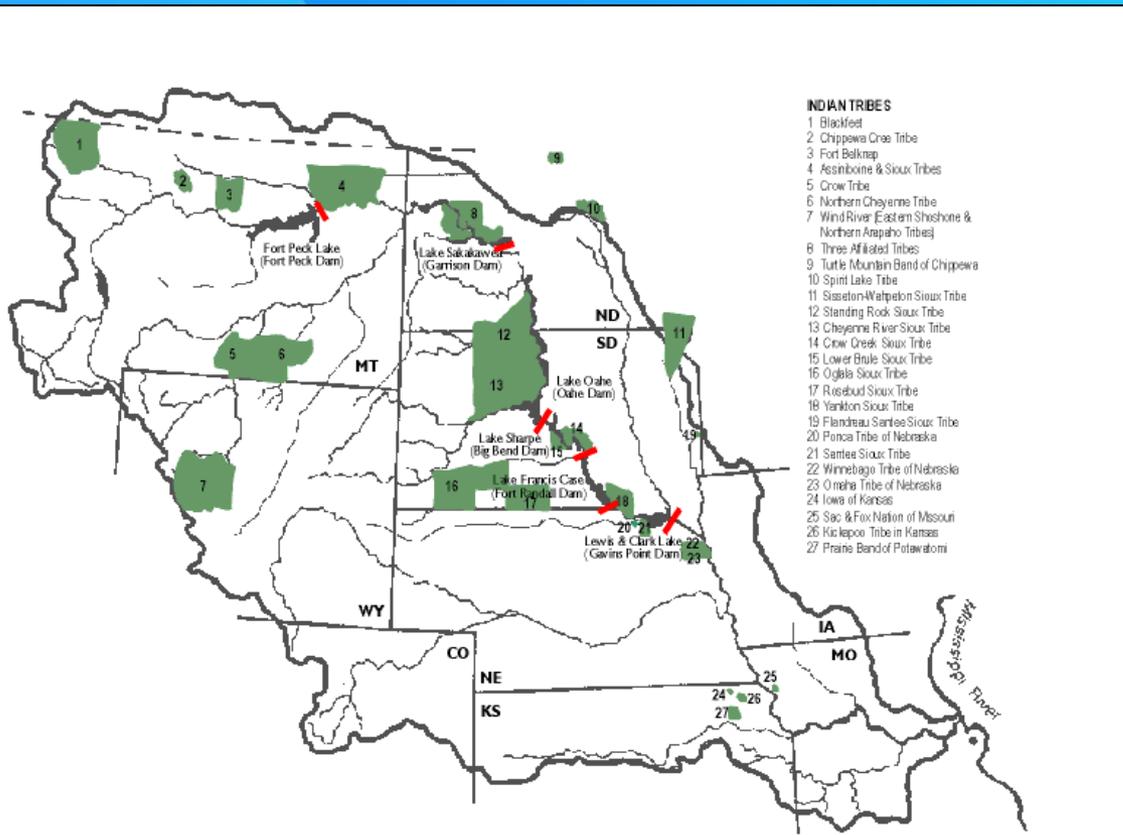


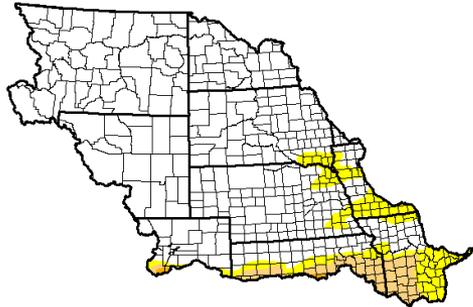
# Climate Early Warning Services for the Missouri Basin



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	

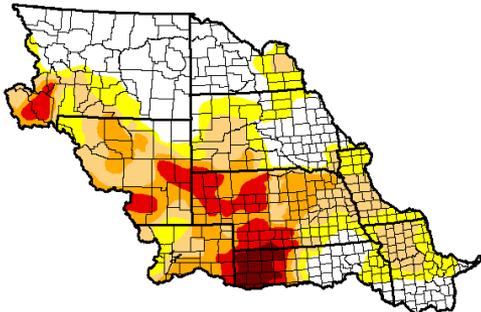
**Intensity:**  
■ D0 Abnormally Dry ■ D3 Extreme Drought  
■ D1 Moderate Drought ■ D4 Exceptional Drought  
■ D2 Severe Drought

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 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 ■ D3 Extreme Drought  
■ D1 Moderate Drought ■ D4 Exceptional Drought  
■ D2 Severe Drought

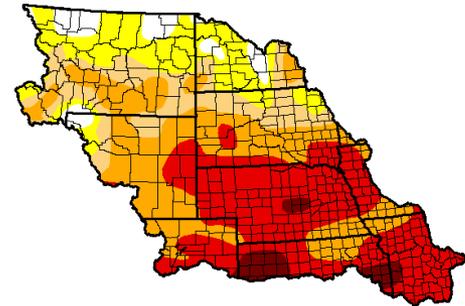
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

**Author:**  
Brian Fuchs  
National Drought Mitigation Center



<http://droughtmonitor.unl.edu/>

## U.S. Drought Monitor Missouri 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 1/2/2012	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	

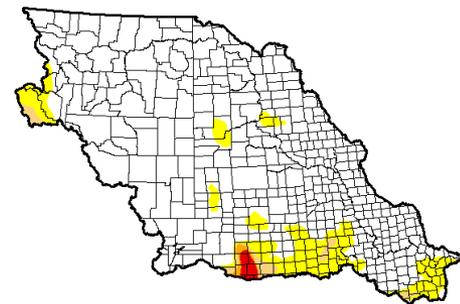
**Intensity:**  
■ D0 Abnormally Dry ■ D3 Extreme Drought  
■ D1 Moderate Drought ■ D4 Exceptional Drought  
■ D2 Severe Drought

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

**Author:**  
Mark Sroboda  
National Drought Mitigation Center



## 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 1/21/2014	63.00	37.00	16.73	6.98	1.41	0.00	
Start of Water Year 7/9/2013	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 ■ D3 Extreme Drought  
■ D1 Moderate Drought ■ D4 Exceptional Drought  
■ D2 Severe 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...



**Midwest and Great Plains  
Drought and Climate Webinar**  
September 19, 2013

**“Central Region Agricultural Update”**

**Brad Rippey**  
**USDA Meteorologist**  
**Washington, D.C.**

Photo by B. Rippey  
Saline Co., Nebraska  
April 18, 2013



**Missouri River Basin  
Climate Outlook**  
1 May 2014

Dr. Dennis Today  
State Climatologist  
South Dakota State Univ.  
dennis.today@sdsstate.edu  
605-688-5141



AMERICAN ASSOCIATION OF STATE CLIMATE OFFICERS

MISSOURI RIVER BASIN WATER MANAGEMENT DIVISION

BUILDING STRONG

# 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 (3<sup>rd</sup> 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.**

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



AP Photo Seth Perlman



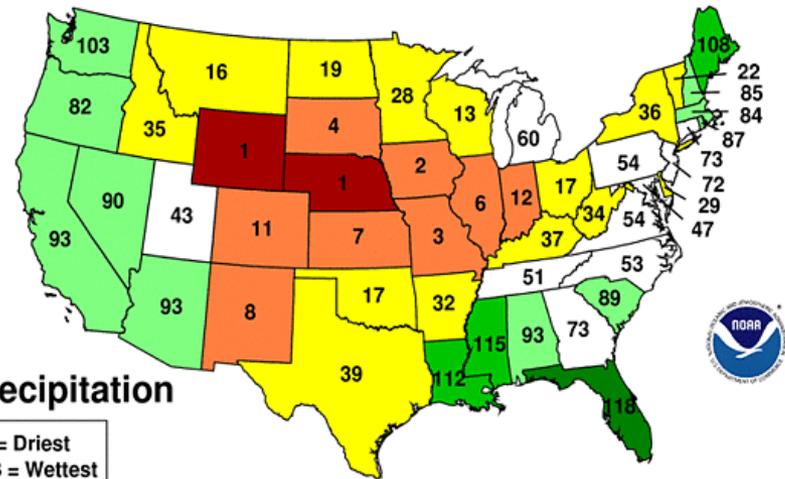
Forbes.com

# 2012

## 50-80 billion in damage

### June-August 2012 Statewide Ranks

National Climatic Data Center/NESDIS/NOAA



# 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>

## An Interpretation of the Origins of the 2012 Central Great Plains Drought



### Assessment Report

NOAA Drought Task Force  
Narrative Team

Lead: Martin Hoerling

Co-Leads: Siegfried Schubert & Kingtse Mo

20 March 2013

## Explaining Climate Extremes

An Assessment of the 2011 Missouri River Basin Flood

In early 2011, the Missouri River Basin experienced devastating flooding, which caused significant property loss and threatened thousands of lives. January-May was the wettest recorded in the region since 1895, and the annual runoff above Sioux City, Iowa surpassed the previous record.

Researchers from the National Oceanic and Atmospheric Administration (NOAA) pursued a scientific study on the meteorological causes for the flood event with hopes to better understand its causes and assess its predictability. An assessment report has been completed, following peer review, and below are highlighted the major scientific findings.



The Missouri River Basin, the Missouri River, and the main U.S. Army Corps of Engineers reservoir, the Upper (Lower) Basin is the region generally located in a west east line above (below) Gavins Point near Sioux City Iowa. (Image courtesy Missouri Department of Natural Resources)

### Major Findings

The factors immediately responsible for flooding were found to be a sequence of events that included:

- Pre-existing wet conditions - a particularly cold and wet 2010-2011 winter that led to unusually high snow pack, and
- Record-setting rains in late spring

The late spring rains were almost certainly the most critical in the meteorological sequence for understanding the historical proportion of Missouri Basin flooding.

The wintertime cold and wet conditions were shown to be consistent with those occurring in the upper Missouri basin during La Niña events, and in this sense NOAA's La Niña Advisory issued on 5 August 2010 provided early warning for these types of winter conditions. However, La Niña in general, and the particular ocean conditions in 2011 specifically, were found not to materially alter the risks for a wet spring in the upper Missouri Basin.

The report suggests that neither the NOAA La Niña Alert Status nor subsequent exact

**61** million acre-feet (maf) of runoff above Sioux City, Iowa beat the prior record by 12 maf

knowledge of the details of the ocean conditions could have forewarned of extreme heavy spring rains.

The analyses in the report indicate that the record-setting amount of water from the Upper Missouri Basin could not have been anticipated before the heavy spring rains set in, and it could almost certainly not have been anticipated at long seasonal (3-9 month) lead times.

### Conclusions

The report found that the record flooding was consistent with the physical response of basin runoff to a sequence of naturally occurring climate conditions, the majority of which resulted from random atmospheric variations, which could not have been predicted with current scientific knowledge. Due to the unusual sequence of extreme weather events, a flood of this magnitude

# Quarterly Regional Climate Summary & Outlook

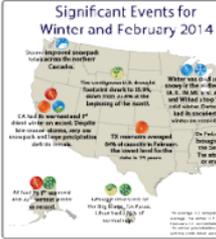
## Quarterly Climate Impacts and Outlook

### Midwest Region

Mar/Jun 2014

#### National - Significant Events for December 2013-February 2014

#### Highlights for the Midwest



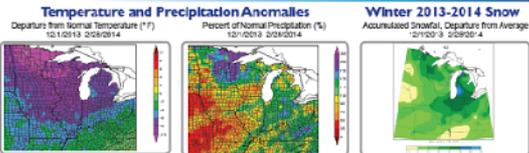
Much of the Midwest experienced the most severe winter in 30 years. Based on preliminary data this was the eighth coldest winter on record for the region. Snowfall ranked in the top five for Illinois, Indiana, Michigan, Minnesota, and Wisconsin.

The coldest winter temperatures for Benton, Minnesota was -59°F with 32 of 91 days recording a minimum temperature at -30°F or colder, a Minnesota state record. There were seven days with minimums at -40°F and lower.

Snowfall in Detroit, Michigan as of the end of February totaled 79.2 inches, the second highest on record. Average snowfall for this period is 55.9 inches. Detroit measured a record 38.8 inches in January. Chicago had a total of 67.4 inches of snow during the winter, the third highest on record.

A storm on January 5-6 led to blizzard warnings in some locations and winter storm warnings over a broad swath of the Midwest. Snowfall amounts ranged from more than a foot in some parts of Indiana and Michigan and more than 6 inches in most of Missouri, Illinois, Indiana, northwest Ohio, and southern Michigan.

#### Regional - Climate Overview for December 2013-February 2014



Temperatures were much below normal across the entire region during the winter except for the two-thirds of the Ohio River. It was 6°F to 10°F below normal from northern Missouri, Illinois, and Indiana north to the Canadian border. December temperatures ranged from near normal in the southeast quarter of the region to 15°F below normal across northern Minnesota and Wisconsin. In January the entire region was colder than normal with departures of 8°F to -12°F from northern Indiana northeast through eastern Minnesota. February temperatures ranged from 6°F to 25°F below normal.

The winter season was dry across the western portion of the region with less than 50 percent of normal precipitation. It was generally near to above normal in the eastern half of the region, but much above normal across northeastern Minnesota and northwestern Wisconsin. Excessive precipitation was much above normal across northern Minnesota and Wisconsin. The southern and eastern sides averaged 4.0°F to 6.0°F below normal while portions of Wyoming and Colorado were near normal and up to 6.0°F above normal. For some parts of the region, this was the coldest winter in 30-50 years.

A strong ridge through portions was present over the United States this winter, which resulted in cold, stormy weather in the east and dry, warm conditions in the west. Situated in the middle, the Missouri Basin states had both above and below-normal temperatures. The northern and eastern sides averaged 4.0°F to 6.0°F below normal while portions of Wyoming and Colorado were near normal and up to 6.0°F above normal. For some parts of the region, this was the coldest winter in 30-50 years.

## Midwest

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

## Quarterly Climate Impacts and Outlook

### Missouri River Basin

March 2014

#### National - Significant Events for December 2013 - February 2014

#### Significant Events for Winter and February 2014



#### Highlights for the Basin

Although the coldest winters in recent memory, only a few states broke into the top 30 rankings. North Dakota had its fifth coldest and its coldest December on record. Measurable snow and Wyoming topped their 7th and 8th coldest winters on record, respectively.

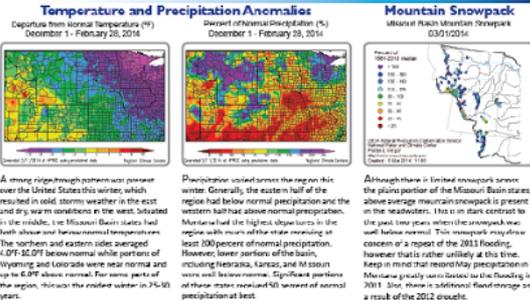
The largest temperature departures in the region were confined to western North Dakota and northeastern South Dakota where temperatures were up to 10°F below normal. Grand Forks, ND had its 3rd coldest winter on record with an average temperature of 6.4°F. Aberdeen, SD had its 7th coldest winter with an average temperature of 7.3°F.

This winter was particularly windy across the region. In January, Rapid City, SD had an average wind speed of 17.6 mph which was the highest January since records began in 1979.

Although the maximum snow amounts recorded were the winter months, many locations had well above the winter. One example is from the popular ski destination of Breckenridge, CO which had its 3rd snowiest winter on record with 131.6 inches.

The average U.S. temperature during February was 32.2°F, 1.4°F below normal. The winter U.S. temperature was 34.3°F, 3.0°F above average. February U.S. precipitation was 4.1 inches, 0.6 in below average. The winter precipitation total was 3.0 inches, 1.0 inches below average, and the sixth driest on record.

#### Regional - Climate Overview for December 2013 - February 2014



A strong ridge through portions was present over the United States this winter, which resulted in cold, stormy weather in the east and dry, warm conditions in the west. Situated in the middle, the Missouri Basin states had both above and below-normal temperatures. The northern and eastern sides averaged 4.0°F to 6.0°F below normal while portions of Wyoming and Colorado were near normal and up to 6.0°F above normal. For some parts of the region, this was the coldest winter in 30-50 years.

Precipitation conditions across the region this winter. Generally, the eastern half of the region had below normal precipitation and the western half had above normal precipitation. Mountain had the highest departures in the region with many of the states recording at least 100 percent of normal precipitation. However, lower portions of the basin, including Nebraska, Kansas, and Missouri were well below normal. Significant portions of those states received 50 percent of normal precipitation at best.

Although there is limited snowpack across the entire portion of the Missouri Basin states, above average mountain snowpack is present in the westwaters. This is in stark contrast to the past few years where the snowpack was well below normal. This snowpack may draw concern of a repeat of the 2013 flooding, however that is rather unlikely at this time. Keep in mind that record May precipitation in Missouri greatly contributed to the flooding in 2013. Also, there is additional flood storage as a result of the 2012 drought.

## Missouri Basin

## Quarterly Climate Impacts and Outlook

### Great Lakes Region

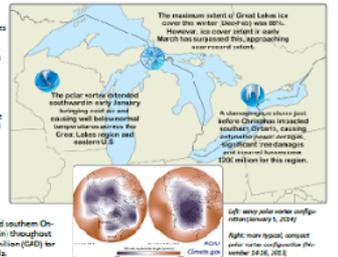
March 2014

#### Great Lakes Significant Events - for December 2013 - February 2014

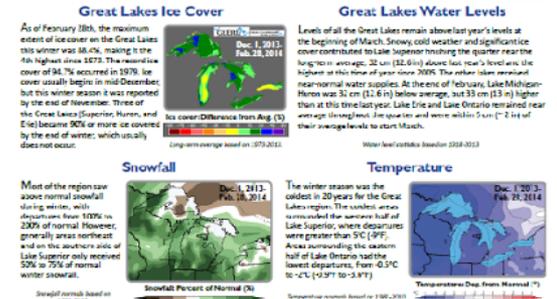
While 2013-2014 was unusually cold for the Great Lakes basin, especially when compared to recent years. An early start in early January blanketed the Great Lakes region and sent subfreezing temperatures as far south as Texas. These freezing temperatures were the result of a southward dip of the polar vortex. The polar vortex is a permanent feature of the atmospheric circulation at the poles, but in early January 2014 the polar vortex weakened, allowing it to dip south as far as the middle latitudes (see bottom right graphic). This surge of cold air in the polar vortex occurred on a number of other occasions this winter as well. Since the polar vortex is permanent in the atmosphere, there will always be a chance for this cold volatility.

A season of unusually cold weather in the Great Lakes basin is not a sign that the customary long trend of rising temperatures has reversed. In fact, while Canada and the eastern U.S. face at times this winter, many locations including Alaska and Europe, were experiencing unseasonably warm temperatures.

On December 26th-28th, a storming storm affected southern Ontario with ice buildup ranging from 15-30 cm (6-12 in.) throughout the region. Total ice amounts are estimated at 5000 million (CUB) for this region, according to the Insurance Bureau of Canada.



#### Regional Climate Overview - for December 2013 - February 2014



**Great Lakes Ice Cover**

As of February 18th, the maximum extent of ice cover on the Great Lakes this winter was 38.2%, matching the 4th highest since 1873. The maximum ice cover of 44.7% occurred in 1979. Ice cover usually begins in mid-December but this winter season it was reported by the end of November. Three of the Great Lakes (Superior, Huron, and Erie) became 50% or more ice covered by the end of winter, which usually does not occur.

**Great Lakes Water Levels**

Levels of all the Great Lakes remain above last year's levels at the beginning of March. Snowy, cold weather and significant ice cover contributed to Lake Superior missing the quarter record low average, 36.4 m (119.4 ft) above last year's level and the highest of this time of year since 2005. The polar ice remained near-normal water supplies. At the end of February, Lake Michigan-Buron was 31 cm (12.1 in) below average, but 33 cm (13.1 in) higher than at this time last year. Lake Erie and Lake Ontario returned near average throughout the quarter and were within 2 cm (.78 in) of their average levels to start March.

**Snowfall**

Most of the region saw above normal snowfall during winter, with accumulations near 100% to 200% of normal. However, generally areas northeast and on the southern side of Lake Superior only received 50% to 75% of normal winter snowfall.

**Temperature**

The winter season was the coldest in 20 years for the Great Lakes region. The coldest areas surrounded the western half of Lake Superior, where departures were greater than 9°C (16°F). Areas surrounding the eastern half of Lake Ontario had the lowest departures. Four 0.3°C to -1°C (-0.9°F to -3.9°F).

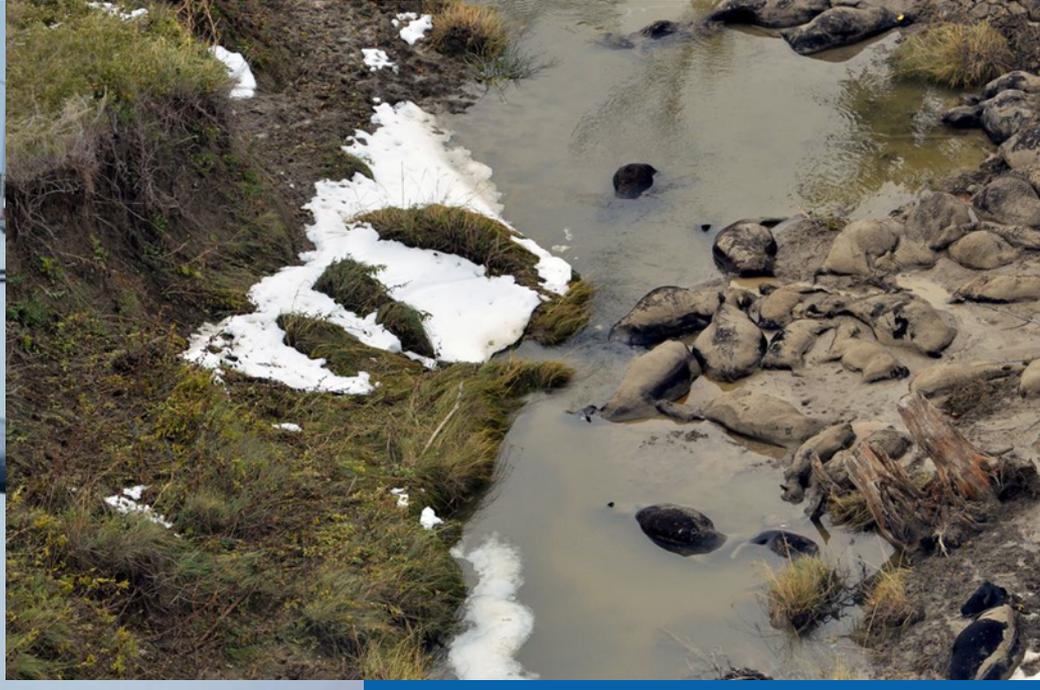
## Great Lakes

# 2013 - Drought Continues South



# 2013

- Front Range Flood
- High Plain Blizzard



# 2014

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

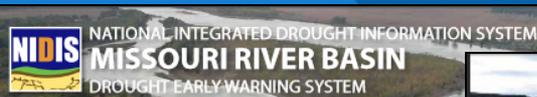


# Hail

- Near Blair, NE
- 100's of millions \$



# 2014 - National Integrated Drought Information System – Missouri Basin



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). Key sponsors of the Nebraska meeting were NIDIS, 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).

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., IDEWS help regions plan for and establish best practices in drought-stressed times, and transfer information to under-served regions of the country. Key sponsors of the Nebraska meeting were NIDIS, 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).



## 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, 1989-89, 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, wildlife, 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 livestock production, which can, in combination with market processes, increase food prices.

Many aspects of human activity affect vulnerability to flood and drought, including land and water use patterns, population shifts and agricultural practices. Warming climate adds urgency to the need against drought in the basin, because heat contributes to drought. More frequent extreme weather such as the heavy precipitation that led to flooding 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 1850 to mid 1890s. On September 23, 1877 the Nez Perce crossed the Missouri here in their flight to Canada. PHOTO BY J. H. WILSON FOR THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



### Participants at the workshop

- |   |   |
|---|---|
| American Planning Association                             | Administrative (NIDIS)  |
| Army Corps - Missouri River Water Management              | National Park Service   |
| Bureau of Indian Affairs                                  | National Resources Conservation Service - National Soil Survey Center   |
| Bureau of Land Management                                 | National Weather Service  |
| Bureau of Reclamation                                     | Nebraska Department of Agriculture                                      |
| Center for Research on the Changing Earth System          | Nebraska Department of Health & Human Services                          |
| Colorado Climate Center, Colorado State University        | North Central Climate Science Center, Colorado State University         |
| Colorado Water Conservation Board                         | North Dakota State Water Commission                                     |
| East Dakota Water Development Board                       | Northern Arapahoe Tribe   |
| Eastern Tribes Plains & Big Rivers ITC                    | Oreaha Medicine and   |
| Environmental Protection Agency Region 7                  | Science, State Relations of Nebraska                                    |
| Federal Emergency Management Agency                       | South Dakota School of Mines and Technology                             |
| Federal Emergency Management Agency                       | South Dakota State University Extension                                 |
| High Plains Regional Climate Center                       | South Dakota State University-South Dakota State Research Center        |
| Intertribal Council on Tribal Policy (ITCP)               | U.S. Department of Agriculture - Agricultural Research Service          |
| Iowa Dept. of Agriculture-Soil and Stewardship            | U.S. Geological Survey - Earth Resources Observation and Science Center |
| Kansas State University                                   | U.S. Geological Survey - Nebraska Water Science Center                  |
| Kansas Water Office                                       | U.S. Geological Survey - North Central Climate Science Center           |
| Local public  | U.S. Geological Survey - South Dakota State Research Center             |
| Mid-America Regional Council                              | University of Colorado Boulder  |
| Missouri Department of Natural Resources                  | University of Colorado Health Center                                    |
| Missouri Department of Natural Resources and Conservation | University of Missouri Medical Center                                   |
| National Drought Mitigation Center                        | University of Missouri Public Policy Center                             |
| National Inland and Drought Information System (NIDIS)    | Western Governors Association   |
| National Oceanic and Atmospheric                          | Working State Engineer's Office   |

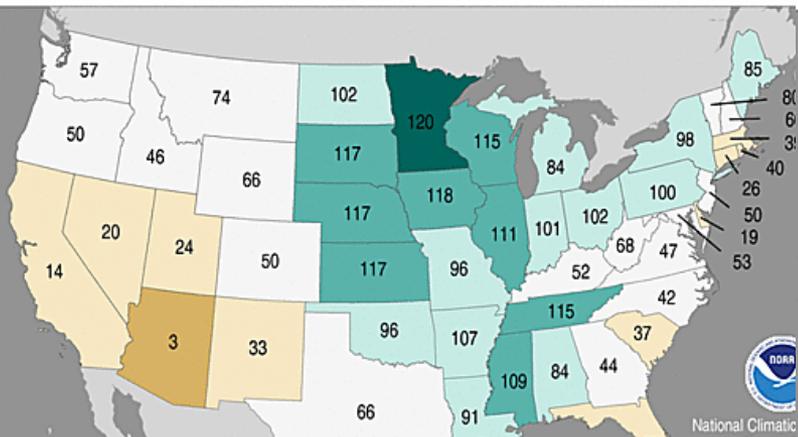
- Drought Early Warning System (DEWS)
- Informing Planning
  - Wind River Reservation
  - States
  - Federal Agencies
- Enhancing Monitoring
  - Drought/flood
- Tribally focused drought meeting
- Regional Web Portal

# Monitoring 2014 so far

## Statewide Precipitation Ranks

June 2014

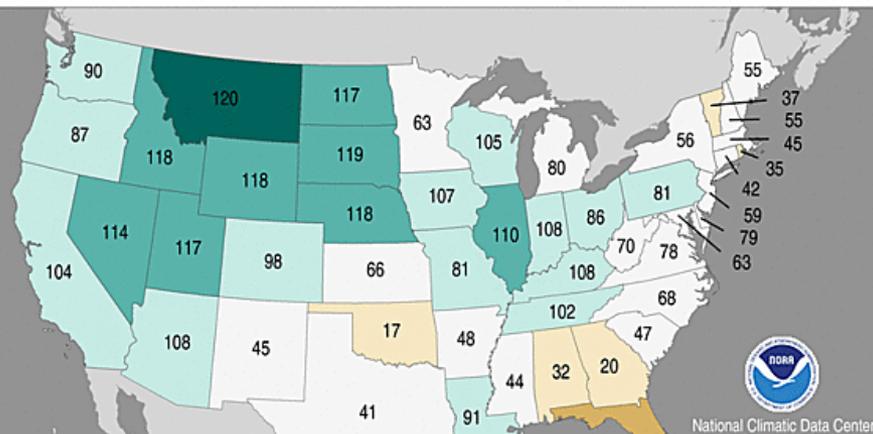
Period: 1895-2014



## Statewide Precipitation Ranks

August 2014

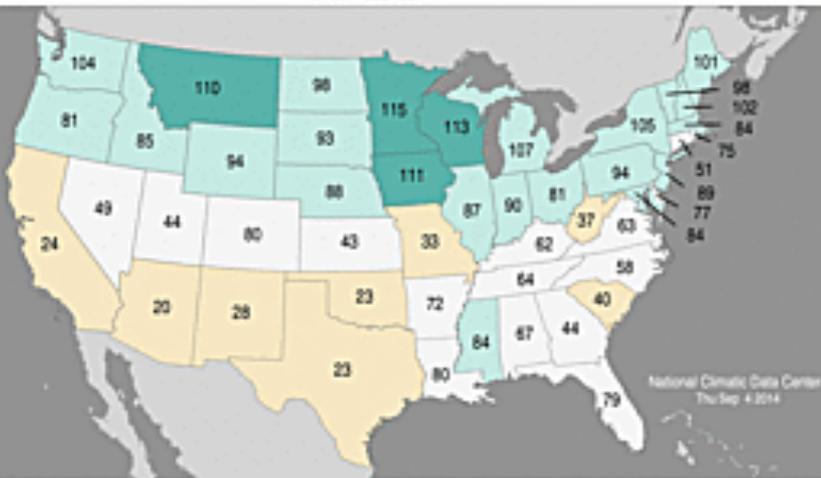
Period: 1895-2014



## Statewide Precipitation Ranks

January-August 2014

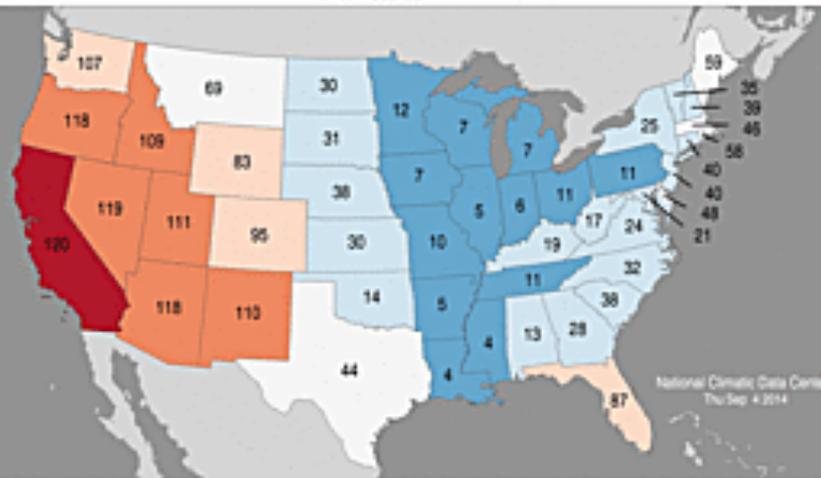
Period: 1895-2014



## Statewide Average Temperature Ranks

January-August 2014

Period: 1895-2014

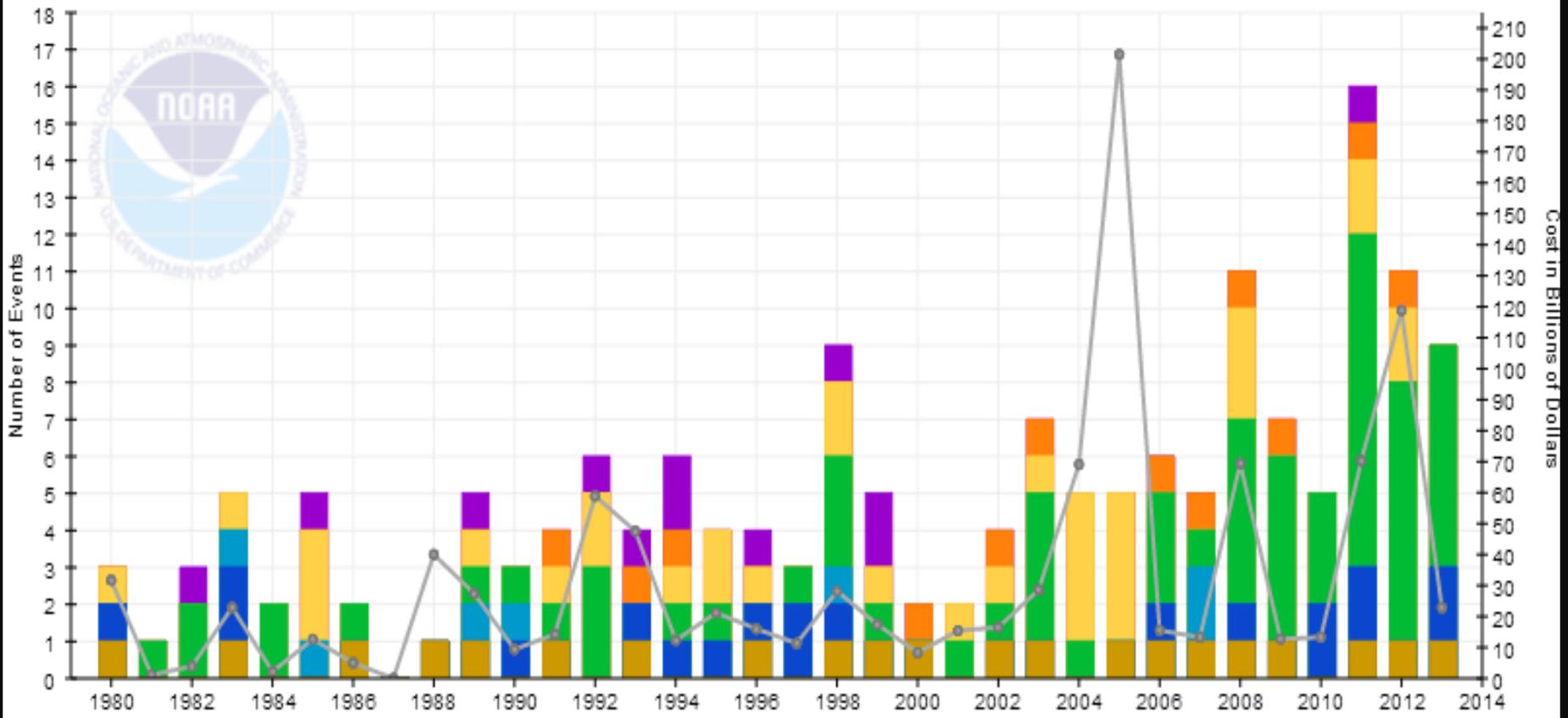




# 1980 – 2013 Billion Dollar Disasters by Type

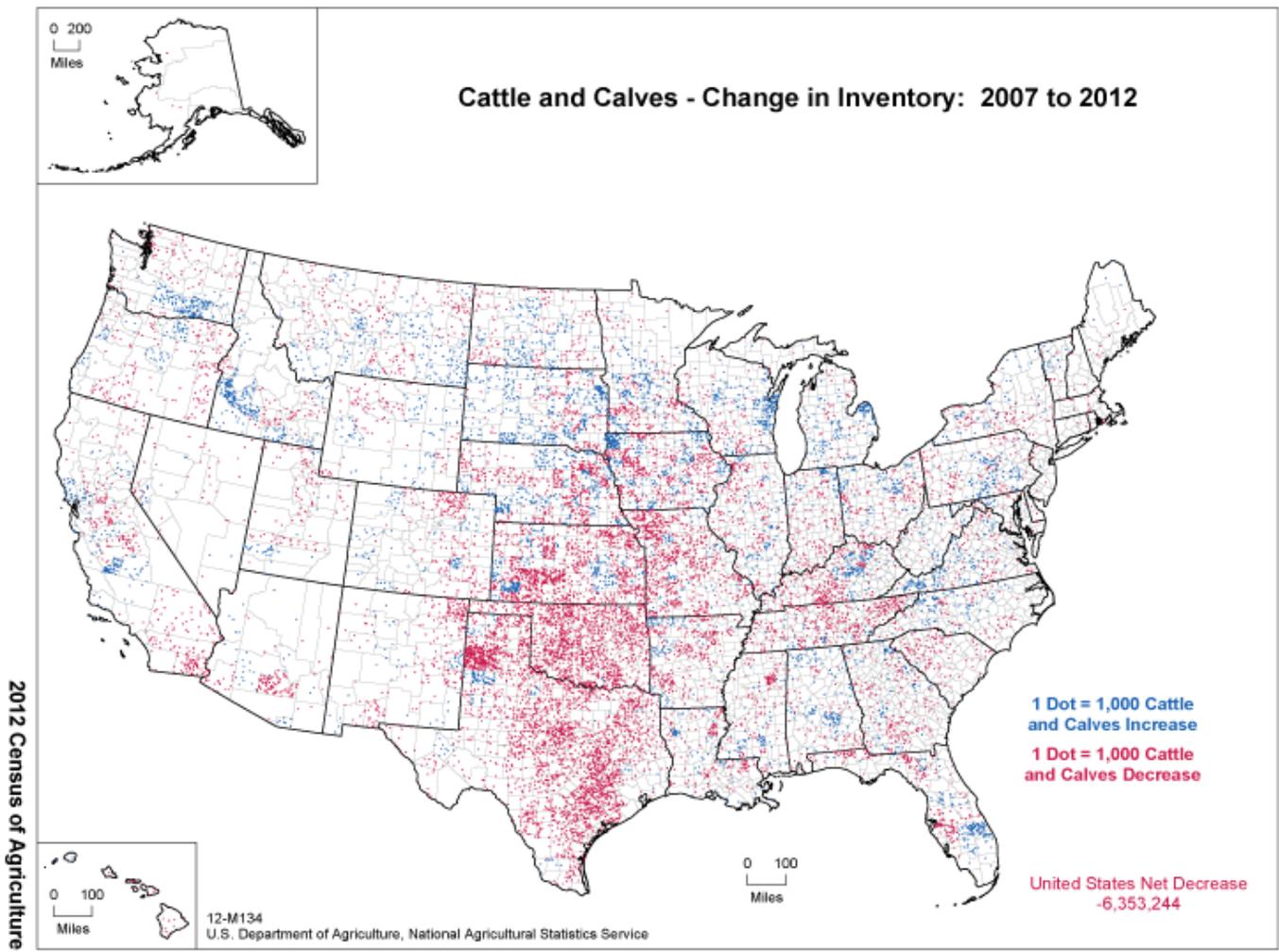
## Billion-Dollar Disaster Event Types by Year (CPI-Adjusted)

- Winter Storm
- Wildfire
- Tropical Cyclone
- Severe Storm
- Freeze
- Flooding
- Drought
- Cost



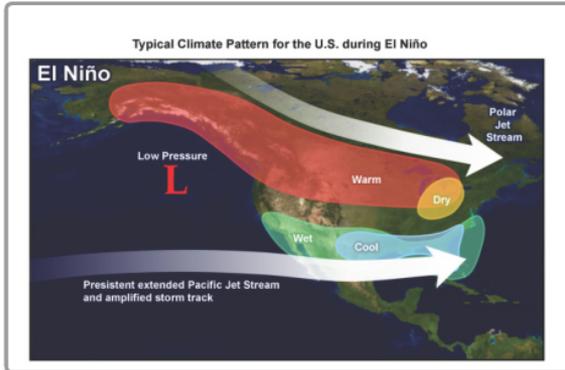


# Where have all the cattle come from?



# 2014 – El Niño?

## 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

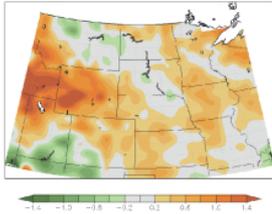
El Niño is a particular pattern in the Pacific Ocean that affects weather downstream to the United States. It has its most notable impacts in the winter, when wind patterns in the atmosphere are strongest. When El Niño is present, it provides some predictable effects to weather patterns. While no two 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

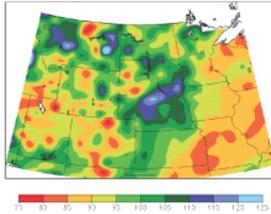
Departure from Average Temperature (°F) in Winter During Past El Niños

Departure from Mean Temperature (°F) for Dec to Feb for El Niño Winters between 1950 and 2010



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

Percent of Mean Precipitation (%) for Dec to Feb for El Niño Winters between 1950 and 2010



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.

### El Niño Likely

Highest Potential for Weak to Moderate El Niño

Chance for El Niño Development and Potential Intensity, Winter 2014-15

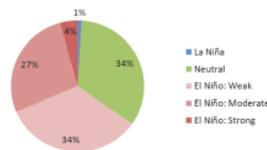
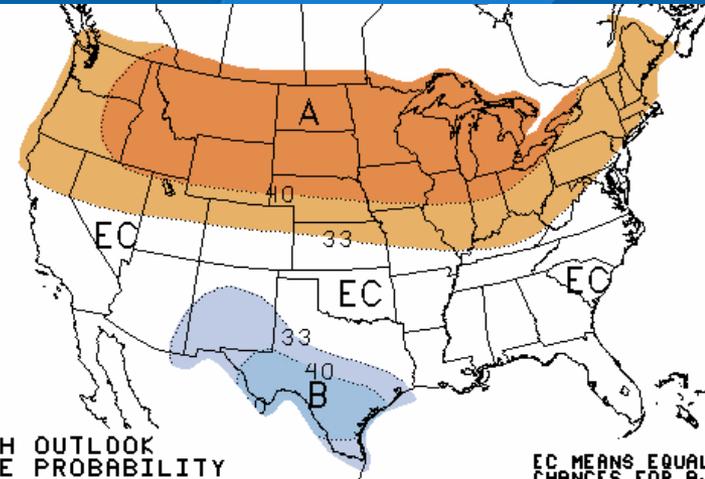


Chart based on summaries and forecast model data from the NOAA/NWS Climate Prediction Center and the International Research Institute for Climate and Society.

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.



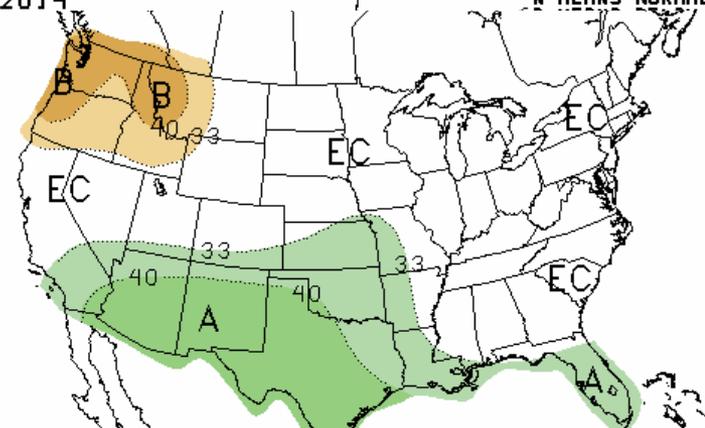
THREE-MONTH OUTLOOK  
TEMPERATURE PROBABILITY  
2.5 MONTH LEAD  
VALID NDJ 2014



EC MEANS EQUAL CHANCES FOR A, N MEANS NORMAL B MEANS BELOW



THREE-MONTH OUTLOOK  
PRECIPITATION PROBABILITY  
2.5 MONTH LEAD  
VALID NDJ 2014  
MADE 21 AUG 2014

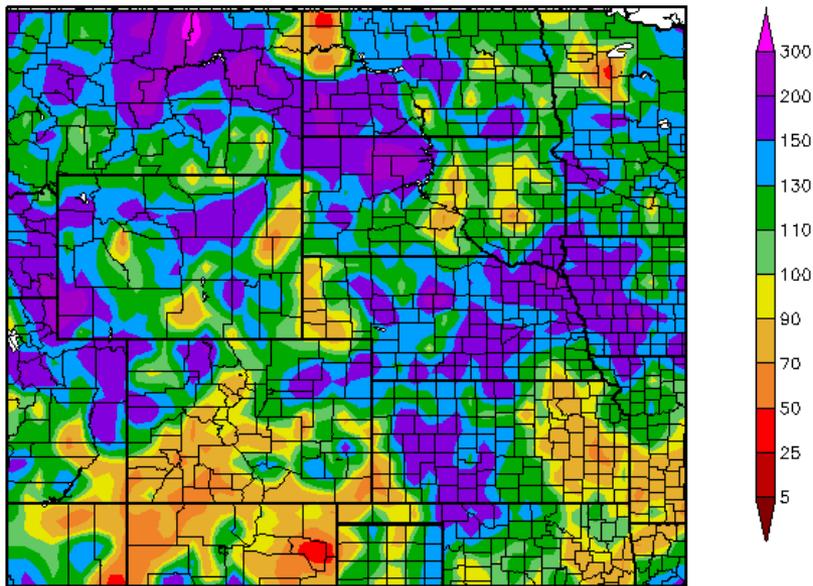


EC MEANS EQUAL CHANCES FOR A, N MEANS NORMAL B MEANS BELOW

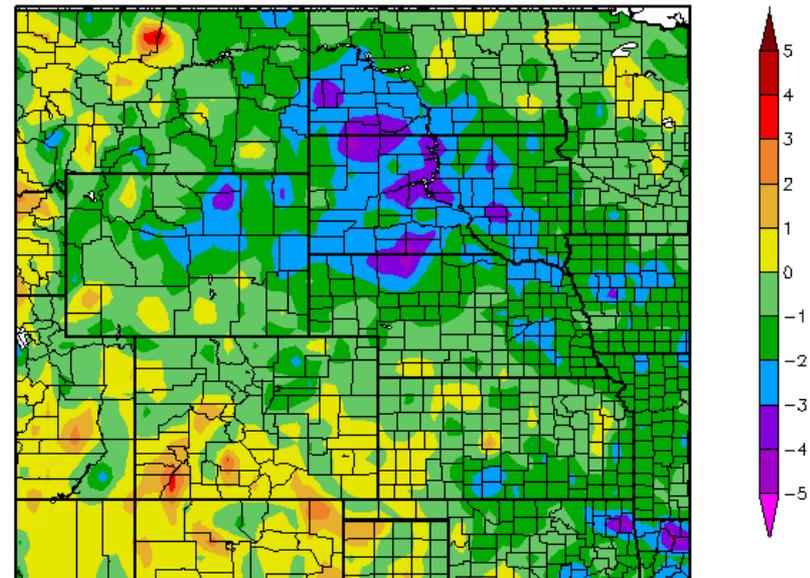


# Summer of 2014

Percent of Normal Precipitation (%)  
6/1/2014 - 8/31/2014



Departure from Normal Temperature (F)  
6/1/2014 - 8/31/2014



Generated 9/11/2014 at HPRCC using provisional data.

Regional Climate Centers

Generated 9/11/2014 at HPRCC using provisional data.

Regional Climate Centers

# Thank You

- [Climate.gov](https://climate.gov)
- [Drought.gov](https://drought.gov)
- [Weather.gov](https://weather.gov)



# 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

