



# 2019 Annual Climate Summary



Flooded road near Surprise, Nebraska. Photo courtesy Melissa Bartels, Nebraska Extension. <http://hprcc.unl.edu>

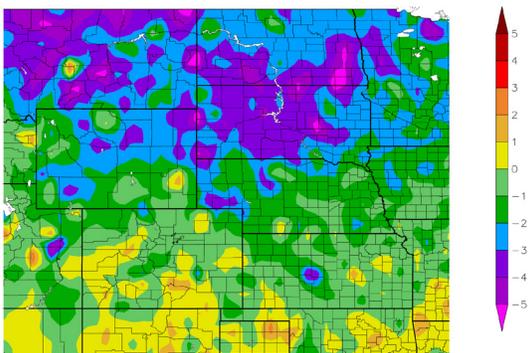
## Historic Flooding Impacts the High Plains Region

2019 will be remembered as an historic year for flooding in the High Plains region. Starting with the mid-March “bomb cyclone” event, portions of the mainstem of the Missouri River were in flood stage for most of the year. Numerous heavy precipitation events throughout the spring, summer, and autumn contributed to the long-term flooding. Even in autumn, which is usually a quiet time of the year in terms of river flooding, heavy precipitation and saturated soils caused streamflows to be much above normal to high across portions of the Missouri River and the Souris-Red-Rainy Basins. In September, runoff from the James, Vermillion, and Big Sioux Rivers in eastern South Dakota was 16 times higher than average. Some locations recorded their highest streamflow on record during this time, beating records which had all previously occurred in the spring or summer months. Ultimately, according to the Missouri Basin River Forecast Center, 6 locations set new records for the longest stretch of time above flood stage, including Nebraska City, NE (270 days), Brownville, NE (271 days), Rulo, NE (272 days), St. Joseph, MO (268 days), Napoleon, MO (271 days), and Waverly, MO (272 days). At the end of the year, the region was not completely flood-free, as some locations along the James River in South Dakota were still above flood stage.

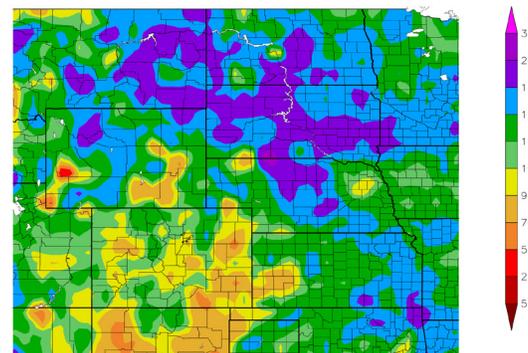
The prolonged, extremely wet conditions resulted in a wide range of impacts over the course of the year. At the beginning and end of the growing season, many producers found it difficult or impossible to get into the fields due to muddy conditions. The excessive moisture also increased the demand for propane for crop drying needs in autumn. Meanwhile, flooding damaged or destroyed numerous bridges, roads, and levees in many areas. Wet conditions were even a factor in a collapse in the Goshen/Gering-Fort Laramie irrigation canal, which provides irrigation to over 100,000 acres of crops in Nebraska and Wyoming. These events have had a significant economic impact in the region, with losses in excess of \$3 billion. As the impacts of 2019’s conditions continue to be realized, this figure will surely rise.

### Temperature and Precipitation Overview

Departure from Normal Temperature (F)  
1/1/2019 – 12/31/2019



Percent of Normal Precipitation (%)  
1/1/2019 – 12/31/2019



Above: Departure from 1981-2010 normal temperature (left) and percent of normal precipitation (right) for 2019 in the High Plains region. Maps produced by the High Plains Regional Climate Center and are available at: <http://hprcc.unl.edu/maps/current>.

## Precipitation

It was an extremely wet year for much of the High Plains region, especially across portions of central North Dakota, southern South Dakota, central Nebraska, and eastern Kansas. Over 75 locations had their wettest year on record, which resulted in widespread flooding that significantly impacted sectors such as agriculture, energy, infrastructure, and transportation. Although no area of the region was consistently dry, precipitation deficits during the latter half of the year caused some areas of Colorado, Kansas, and Wyoming to end the year below normal.

Rocky Mountain snowpack was near normal for most of the 2018-19 season (July-June). Upper Missouri Basin snowpack peaked in April at just above normal above Fort Peck Reservoir and between Fort Peck and Garrison Reservoirs. Plains snowpack, however, was quite high during the 2018-19 snow season, with many locations ranking in the top 10 snowiest seasons on record. This snowpack contributed to the devastating flooding that occurred in the spring.

Interestingly, all six states in the High Plains region had locations that ranked in the top 10 snowiest seasons on record, including: Lincoln, NE (snowiest), Mobridge, SD (snowiest), Redbird, WY (2nd snowiest), Concordia, KS (3rd snowiest), Alamosa, CO (4th snowiest), and Grand Forks, ND (5th snowiest). Several early-season snows kicked off the 2019-20 snowpack season, with many locations in the region having their top 10 snowiest autumn on record. Mountain snowpack was largely near to above normal in Colorado and Wyoming at the time of this writing.

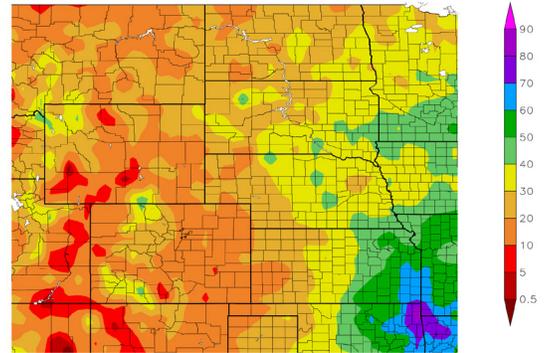
Although the extreme rain, snow, and flooding was the big story this year, it is worth mentioning that 2019 was the busiest severe weather season since 2011, with just over 4,000 tornado, high wind, and large hail reports in the High Plains region, according to the Storm Prediction Center. Several noteworthy events occurred this year, from record-breaking hail in Colorado in August (see page 4 for more details) to three EF-3 tornadoes touching down in Sioux Falls, South Dakota in September. On June 15th, a rare anticyclonic tornado touched down briefly in eastern South Dakota, near the town of Estelline, causing minimal damage. According to the Aberdeen National Weather Service Weather Forecast Office, only 1 percent of tornadoes in the Northern Hemisphere are anticyclonic (rotating in a clockwise direction).

The following locations had notable precipitation records during 2019:

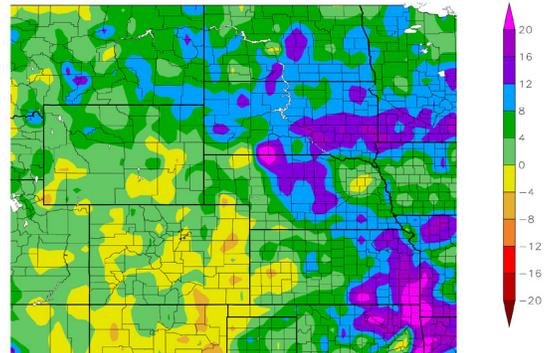
- Cheyenne, Wyoming: 4th highest (tie) 1-day total snowfall of 14.0 inches (36 cm) for any month, March 13 (period of record 1883-2020)
- Kearney 4 NE, Nebraska: Highest 1-day total precipitation of 5.04 inches (128 mm) for the month of July; 2nd highest 1-day total precipitation in any month, July 9 (period of record 1894-2020)
- Grand Forks, North Dakota: Highest 1-day total precipitation of 3.81 inches (97 mm) for the month of September; 6th highest 1-day total precipitation in any month, September 20 (period of record 1893-2020)
- Boulder, Colorado: 3rd highest 1-day total snowfall of 20.7 inches (53 cm) in any month, November 26 (period of record 1893-2020)

### Regional Precipitation

Precipitation (in)  
1/1/2019 - 12/31/2019



Departure from Normal Precipitation (in)  
1/1/2019 - 12/31/2019



Above: Total precipitation in inches (top) and departure from normal precipitation in inches (bottom) for 2019. These maps are produced by HPRCC and can be found on the Current Climate Summary Maps page at: <http://hprcc.unl.edu/maps/current>.

## Temperatures

For the second year in a row, average annual temperatures were below normal across portions of the north-central U.S. This included much of the High Plains region, where temperatures were generally 2.0–6.0 degrees F (1.1–3.3 degrees C) below normal in North Dakota, South Dakota, and portions of Wyoming and Nebraska. Temperatures were within 2.0 degrees F (1.1 degrees C) of normal elsewhere in the region. 2019 started off on the warm side. But, at the end of January, a bitterly cold airmass brought some of the lowest temperatures in years to the region. Much-below-normal temperatures were in place through a large part of the spring, with temperatures moderating over the summer. Autumn was characterized by extreme temperature swings, with September ranking in the top 10 warmest and October ranking in the top 10 coldest for many states in the region. The year ended on a relatively warm note.

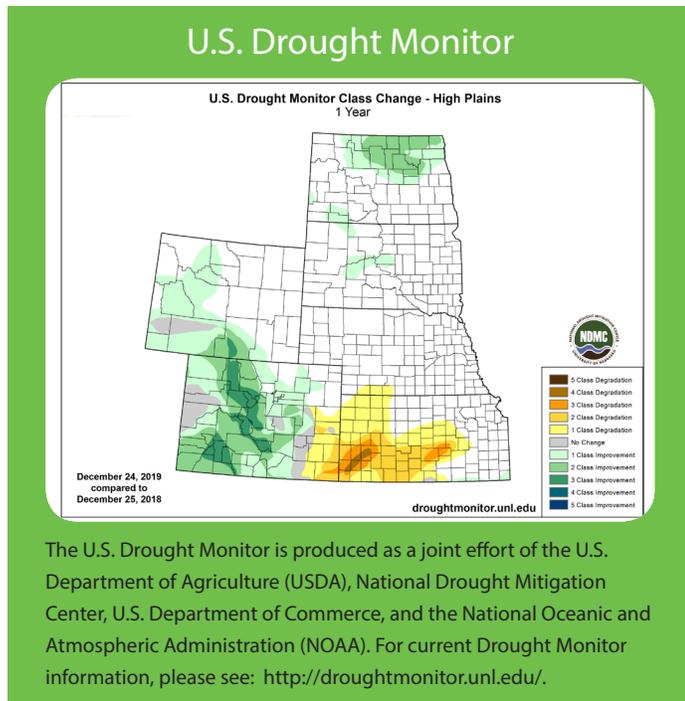
The following locations had notable temperature records during 2019:

- North Platte, Nebraska: Lowest March temperature on record at -25.0 degrees F (-31.7 degrees C), March 4 (period of record 1874–2020)
- John Martin Dam, Colorado: Highest all-time temperature for the state of Colorado at 115.0 degrees F (46.1 degrees C), July 20 (period of record 1941–2020)
- Pueblo, Colorado: Highest September temperature on record at 102.0 degrees F (38.9 degrees C), September 2 and 5 (period of record 1888–2020)
- Denver, Colorado: Latest 100.0 degrees F (37.8 degrees C) day on record, September 2 (period of record 1872–2020)
- Casper, Wyoming: Lowest October temperature on record at -9.0 degrees F (-22.8 degrees C), October 29 and 30 (period of record 1939–2020)
- Daniel Fish Hatchery, Wyoming: Lowest October temperature on record for the state of Wyoming at -34.0 degrees F (-36.7 degrees C), October 30 (period of record 1989–2020)

## Drought Conditions

According to the U.S. Drought Monitor, there were many changes in drought conditions in the High Plains region over the course of the year. At the beginning of 2019, 18 percent of the High Plains region was experiencing moderate to exceptional drought (D1–D4), with most of Colorado, southern Wyoming, and northern North Dakota being im-

acted. At the time, Colorado was the hardest hit state in the region, with 66 percent of the state in D1–D4, of which 11 percent was D4. Ample snow and heavy rainfall caused drought conditions to improve, however. In fact, for the first time since June 2009, the High Plains region was free of drought (as of the May 28th U.S. Drought Monitor map). This was only the second time in the history of the U.S. Drought Monitor that the High Plains region was completely free of drought. This drought-free status did not last long, though, as drought redeveloped and expanded across northern North Dakota in early June. This was the third summer in a row that portions of northern North Dakota had experienced drought. As these conditions improved in the late summer and early fall, drought developed and expanded across southern Kansas and southern and western Colorado. Ultimately, 2019 ended with 12 percent of the region in D1–D4, down 6 percent from the start of the year.



Due to the extremely wet conditions this year, individual states in the region experienced long stretches without drought. This was the first time in the history of the U.S. Drought Monitor that Nebraska and South Dakota were drought-free for an entire calendar year.

### Noteworthy Events

**Back-to-Back Wet Years:** It was a wet year for much of the High Plains, with several locations in Kansas, Nebraska, North Dakota, and South Dakota having their wettest or near-wettest year on record. For some, this was a continuation of wet conditions. In Sioux Falls, SD, 2018 and 2019 now rank as the top two wettest years on record. This prolonged wetness led to historic flooding and, ultimately, it was the 2nd highest runoff ever recorded in the Upper Missouri Basin, according to the U.S. Army Corps of Engineers. 2011 and 2018 rank as highest and 3rd highest, respectively.

**Historic Flooding in NE, IA, and SD:** In mid-March, historic flooding occurred along the Platte and Missouri Rivers and their tributaries, which was due to a combination of frozen soils, ice jams, heavy rainfall, and rapid snowmelt. This flooding was triggered by a “bomb cyclone” that set numerous precipitation, snowfall, wind gust, and pressure records across the region. Preliminary estimates indicate that damage from the flooding exceeds \$3 billion.

**October Blizzard Impacts in ND and SD:** A large storm system brought heavy rain, snow, and blizzard conditions to the Dakotas in mid-October. Due to the timing of the storm, there were numerous impacts, including widespread tree damage, power outages, flooding, and unharvested crops. In North Dakota, a statewide flood emergency was declared due to the flooding caused by rain and snowmelt.

**Drought Development in CO and KS:** Although much of the region was impacted by extremely wet conditions this year, drought conditions developed and expanded during the fall across southern Kansas and western and southern Colorado where precipitation deficits mounted. Dry conditions in Kansas have caused winter wheat emergence and development to lag.

**Unfavorable Conditions for Growing Season:** Cool, wet weather throughout the growing season created unfavorable conditions for planting, harvesting, and overall crop development this year. In the spring, planting and emergence were significantly delayed due to cool, wet conditions. Millions of acres were not planted, particularly in South Dakota. Once planted, crops were slow to mature as these conditions continued into the summer. Although the fall started warm, harvest conditions were largely problematic, especially in northern areas where fields were either covered in snow, muddy, or completely inundated.

**New Statewide Records for CO:** Two new records were set for the state of Colorado this year - one for maximum temperature (July 20th, 115.0 degrees F/46.1 degrees C, John Martin Dam) and one for hail (August 13th, 4.83 inches/12 cm in diameter, Bethune). It is rare for multiple statewide records to be set in one year. For more information, see: <https://www.ncdc.noaa.gov/extremes/scec/>.



**Top photo:** Flooding at the Nebraska State Fair in Grand Island, NE. Photo courtesy NWS Hastings.

**Second photo:** Record-breaking hailstone, which fell near Bethune, CO. Photo courtesy Becky Bolinger, Colorado Climate Center.

**Third photo:** Winter wheat emerging in Hutchinson, KS. Photo courtesy Romulo Lollato, Kansas State University.

**Bottom photo:** Mature soybeans covered in snow near Aberdeen, SD. Photo courtesy Laura Edwards, South Dakota State Climate Office.

## Station Summaries: By the Numbers

Colorado	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Akron Washington County Airport	62.1*	35.6*	48.9*	-0.7*	99	09/05+	-13	02/07	15.54*	-1.20*	93*
Alamosa San Luis Airport	58.6	23.0	40.8	-0.7	88	09/03+	-26	12/31+	7.81	0.50	107
Colorado Springs Municipal Airport	63.8	35.7	49.7	0.8	97	07/19+	0	01/01	11.75	-4.79	71
Denver International Airport	63.3*	36.0	49.6*	-0.8*	101	07/19	-11	02/07	15.51	1.21	108
Grand Junction Walker Field Airport	65.7	39.5	52.6	0.0	102	07/22	-4	01/02	8.56	-0.86	91
Pueblo Memorial Airport	69.6*	36.5	53.1*	1.2*	105	07/19	-6	10/30+	13.13	0.56	104

Kansas	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Concordia Municipal Airport	64.3	43.8	54.1	0.3	102	07/17	-5	03/04	34.80*	6.91*	125*
Dodge City Regional Airport	67.9	42.3	55.1	-0.2	105	07/31+	-1	03/04	22.89	1.29	106
Goodland Renner Field	64.3	37.1	50.7	-0.6	105	07/19	-10	03/04	22.78	3.12	116
Topeka Municipal Airport	65.5	44.6	55.0	0.0	98	07/20+	-3	01/30	48.75	12.29	134
Wichita Mid-Continent Airport	68.0	46.4	57.2	0.3	104	08/20	2	03/05	42.10	9.46	129

Nebraska	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Chadron Municipal Airport	58.5	31.9	45.2	-2.0	100	09/02	-21	03/03	18.99	0.94	105
Grand Island Airport	60.6	39.5	50.1	-0.7	100	06/29	-11	02/25	39.71	13.05	149
Lincoln Municipal Airport	61.8	40.1	50.9	-0.6	99	07/19+	-9	03/04+	36.11	7.16	125
Norfolk Karl Stefan Airfield	58.2	37.3*	47.8*	-1.4*	96	06/29	-14	01/30	27.08	-0.33	99
North Platte Regional Airport	61.7	34.7	48.2	-0.5	102	07/18	-25	03/04	28.91	8.68	143
Omaha Eppley Airport	60.5	42.0	51.2	0.2	98	06/29	-14	01/30	39.91	9.29	130
Valentine Miller Field	59.6	34.2	46.9	-1.0	104	06/29	-17	03/03+	30.34	10.32	152

North Dakota	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Bismarck Municipal Airport	50.6	30.3	40.4	-2.4	94	08/06	-33	01/30	29.58	11.73	166
Fargo International Airport	48.6	30.1	39.3	-3.0	96	06/07	-33	01/30	31.24	8.66	138
Grand Forks International Airport	47.2	26.9	37.1	-2.7	96	06/07	-35	01/30	28.11	7.30	135
Theodore Roosevelt Airport	50.5	28.6	39.6	-2.9	94	09/16+	-28	02/08	17.25*	1.48*	109*
Williston International Airport	50.8*	28.1*	39.4*	-2.1*	96	08/03	-43	02/08	20.51*	6.14*	143*

All data are preliminary and subject to change. + indicates multiple dates, latest date listed. \* indicates some missing data for the period. Data are retrieved through the Applied Climate Information System (ACIS) and are available online through the CLIMOD system. For more information please contact us: <http://www.hprcc.unl.edu/contact.php>.

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South Dakota	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Aberdeen Regional Airport	51.2	30.4	40.8	-2.1	96	07/15	-37	01/30	30.35	8.63	140
Huron Regional Airport	52.4	33.6	43.0	-2.9	99	06/29	-30	01/30	37.30	14.40	163
Pierre Regional Airport	53.6*	33.2*	43.5*	-3.8*	100	06/29	-20	01/30	30.96	10.95	155
Rapid City Regional Airport	54.7	31.2	43.0	-4.0	92	09/02+	-19	02/07	28.43*	12.14*	175*
Sioux Falls Joe Foss Field Airport	54.8	35.8	45.3	-0.4	96	07/19+	-25	01/30	39.54	13.16	150

Wyoming	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Casper Natrona County International AP	57.2	30.0	43.6	-1.7	98	09/02+	-23	02/07	14.46	1.94	115
Cheyenne Municipal Airport	58.4	33.2	45.8	-0.5	95	09/02+	-16	03/04	18.03	2.09	113
Lander Hunt Field Airport	55.2	29.6	42.4	-2.6	95	09/02+	-17	01/02	16.92	4.26	134
Laramie Regional Airport	54.2*	26.6	40.3*	-0.6*	91	07/19	-22	03/04	8.34*	-2.58*	76*
Rawlins Municipal Airport	54.3*	29.2*	41.7*	-0.7*	93	09/02+	-20	10/30	7.62	-1.63	82
Sheridan County Airport	56.7	29.6	43.1	-2.0	99	09/04	-18	01/01	18.01	3.85	127

## 2019 Highlights

### Annual Rankings

Temperature in degrees F / Precipitation in inches

Warmest / Coolest	Temperature / Ranking	Record / Year	Period of Record
Rapid City, SD	43.0 / COOLEST	43.4 / 1996	1942-2020
Casper, WY	43.6 / 5th coolest	42.5 / 1985	1939-2020
Dickinson, ND	39.6 / 6th coolest	36.8 / 1950	1948-2020
Wettest / Driest	Precipitation / Ranking	Record / Year	Period of Record
Flandreau, SD	43.09 / WETTEST	39.47 / 2010	1893-2020
Grand Forks, ND	28.11 / WETTEST	27.89 / 1944	1893-2020
Huron, SD	37.30 / WETTEST	31.71 / 1962	1881-2020
Mobridge, SD	29.51 / WETTEST	26.86 / 1915	1911-2020
Ottawa, KS	64.61 / WETTEST	61.24 / 1951	1895-2020
Rapid City, SD	28.43 / WETTEST	27.70 / 1946	1942-2020
Ravenna, NE	43.73 / WETTEST	39.60 / 2008	1893-2020
Sioux Falls, SD	39.54 / WETTEST	39.17 / 2018	1893-2020
Sisseton, SD	34.92 / WETTEST	32.30 / 1993	1931-2020
Bismarck, ND	29.58 / 2nd wettest	30.92 / 1876	1874-2020
Mission 14 S, SD	32.03 / 2nd wettest	35.21 / 1977	1951-2020
Pierre, SD	30.96 / 2nd wettest	31.85 / 1997	1893-2020
Valentine, NE	30.34 / 2nd wettest	32.68 / 1977	1889-2020
Grand Island, NE	39.71 / 3rd wettest	45.50 / 1905	1895-2020
Lawrence, KS	56.91 / 3rd wettest	61.67 / 1993	1857-2020

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# About the High Plains Regional Climate Center

The High Plains Regional Climate Center (HPRCC) is one of six NOAA Regional Climate Centers (RCCs) that has been providing timely climate data and information to the public for cost effective decision-making since 1987. The HPRCC primarily serves the six-state region of Colorado, Kansas, Nebraska, North Dakota, South Dakota, and Wyoming, but has also served people from all across the country and even throughout the world. HPRCC operates under a three-tiered structure of climate services and works closely with other organizations on the local, regional, and national levels. HPRCC staff engage with a wide range of stakeholders including K-20 education, the public, media, private industry, research, and state/tribal/federal entities, among others.

Much of the data and products found throughout this publication were built on the Applied Climate Information System (ACIS) framework. ACIS was designed to manage the complex flow of information from climate data collectors to the end users of climate data information. The main purpose of ACIS is to alleviate the burden of climate information management for people who use climate information to make management decisions.

HPRCC is involved in the ongoing development and management of ACIS. In the spring of 2014, the RCCs released a new website for ACIS. This new and improved website not only contains descriptions of ACIS and the sources of data found within, but also features real-world examples of how RCCs and external groups are using ACIS for their particular climate data needs. In addition to these examples, there is extensive documentation and tutorials on how ACIS can be used and accessed by external clients using Web Services. For more information see: <http://rcc-acis.org>.



## Additional Summary Information for the High Plains

### Missouri River Basin Quarterly Climate Impacts and Outlook

For more information:  
<https://www.drought.gov/drought/dews/missouri-river-basin/reports-assessments-and-outlooks>

### Midwest and Great Plains Monthly Climate and Drought Webinar

To sign up for future webinars:  
<https://www.drought.gov/drought/calendar/webinars>

For an archive:  
[www.hprcc.unl.edu/webinars.php](http://www.hprcc.unl.edu/webinars.php)

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