The Platte River, between Columbus and Schuyler, Nebraska, in June 2019. Photo courtesy Jim Hoppe.

The Historic Year of 2019

Summary

In 2019, precipitation and flooding reached historic levels in the Missouri River Basin. Starting in March with the "bomb cyclone" event, portions of the Missouri River and its tributaries were above flood stage for the majority of the year. Impacts from the heavy precipitation and subsequent flooding were widespread. Communities were evacuated. Farmland was inundated. Critical infrastructure, such as roads, bridges, and levees, were damaged or destroyed. The mental toll from these events is ongoing. Ultimately, 16 major disasters were declared across the region due to the weather and climate events of 2019. Although the calculation of losses is not finalized, the total certainly will reach into the billions of dollars.

50+
record river crests

125+
precipitation records

300+
days in flood

In this Report

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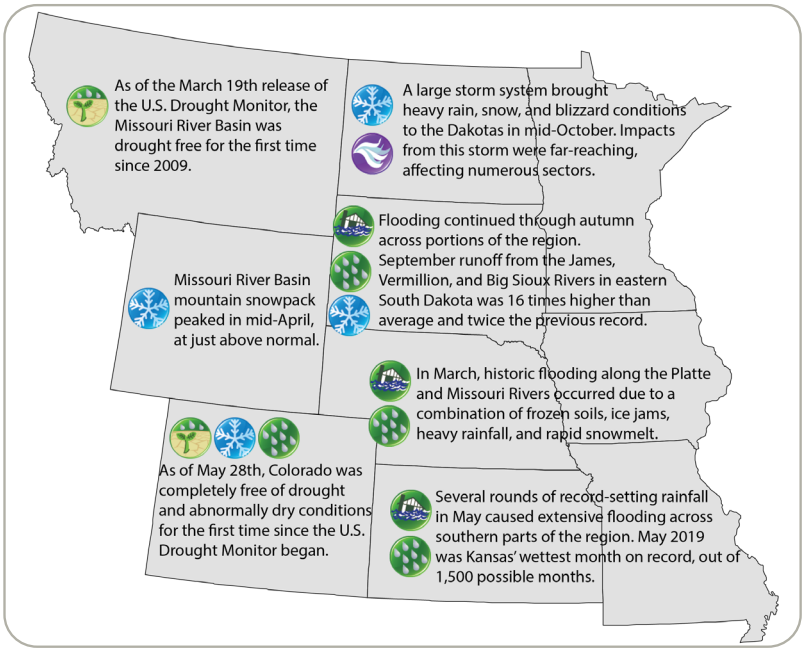
Extreme Wetness of 2019 - *A Retrospective*

Significant Events of 2019

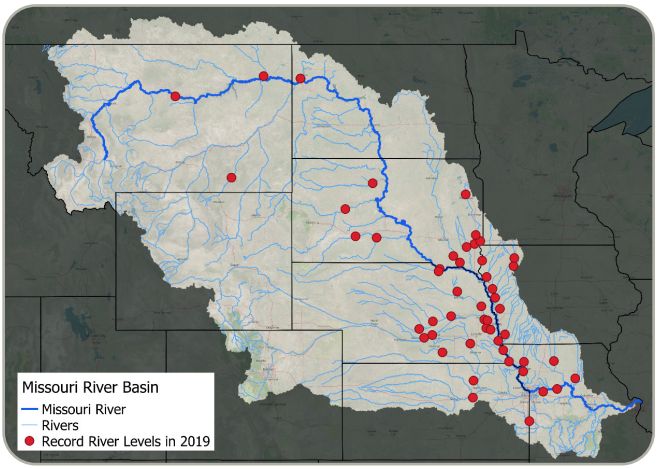
A number of events led to the severe flooding and record rainfall that occurred across the Missouri Basin in 2019. Although 2019 is the main focus of this report, conditions during the fall and early winter of 2018 were a significant contributing factor. For instance, in 125 years of data, the October-December 2018 time period was the 12th wettest on record. Precipitation during this timeframe increased soil moisture, which subsequently became locked in the frozen soils. In January 2019, a bitterly cold air mass impacted the region, causing deeply frozen ground and thick river ice in many areas. In addition to these factors, numerous storm systems repeatedly brought precipitation to the region. In fact, the winter of 2018-2019 was the second-wettest on record. All of these conditions built up to the initial record flooding that was triggered by the March "bomb cyclone" event. Precipitation afterwards was unrelenting, however. May was the fifth-wettest month ever for the Basin (out of all possible months) and heavy precipitation during the late summer and early autumn caused flooding to continue.



While research will help determine links to long-term climate trends, the short-term reasons for the heavy precipitation are relatively straightforward. Abundant moisture from the Gulf of Mexico was able to consistently stream northward into the Plains, where interactions with an active storm pattern led to many days of heavy precipitation across the region.

Extreme Wetness of 2019 - *River Levels*

Numerous Records Set Across the Basin



Preliminary record river levels. Courtesy MBRFC.

Portions of the Missouri River Basin were above flood stage for the majority of the year, starting with the mid-March "bomb cyclone" event and continuing with heavy rainfall events during the late spring, summer, and autumn. According to the U.S. Geological Survey's WaterWatch, there were approximately 75 record peaks in the Basin, with 27 of these streamgages having at least 30 years of record. Although the majority of these records occurred during the spring and early summer, it is noteworthy that some records in eastern South Dakota occurred in autumn, which is usually a very quiet time of the year for river flooding.

Ultimately, according to the U.S. Army Corps of Engineers, 2019 ranked as the second-highest runoff ever recorded in the Upper Missouri Basin at 60.9 MAF. The recent years of 2011 and 2018 rank as highest and third-highest, respectively.

Record number of consecutive days above flood stage:

- Nebraska City, NE: 270 days, ending December 8th
- Brownville, NE: 271 days, ending December 9th
- Rulo, NE: 272 days, ending December 10th
- St. Joseph, MO: 268 days, ending December 6th
- Napoleon, MO: 271 days, ending December 9th
- Waverly, MO: 272 days, ending December 10th

Select locations along the James River that continued to be above flood stage in 2020:

- Ashton, SD: 328 days (new record)
- Huron, SD: 328 days (new record)
- Forestburg, SD: 336 days (new record)
- Mitchell, SD: 343 days (new record)

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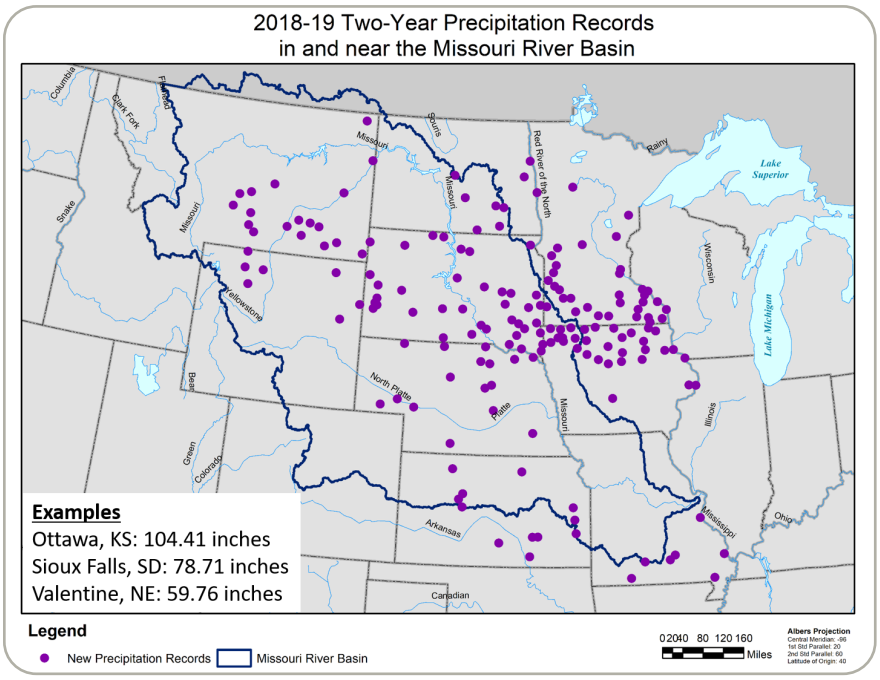
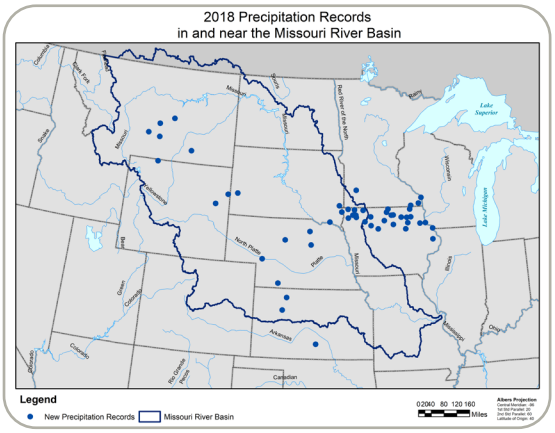
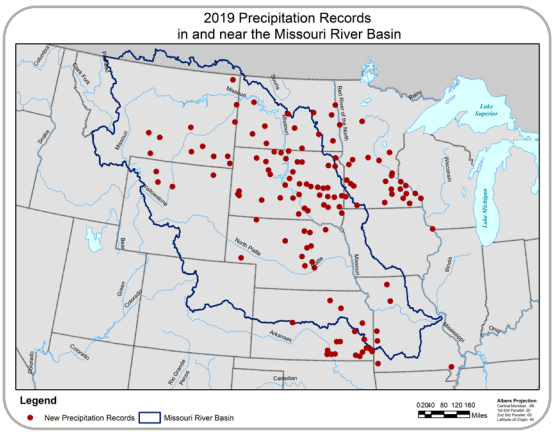
Extreme Wetness of 2019 - *Local Records*

Wet Conditions Spanned Two-Year Time Period

Numerous precipitation records were set in 2019 on daily, monthly, seasonal, and annual time scales. The maps to the right show locations that set new annual records in 2018 (top) and 2019 (bottom). The map below shows locations that set new records for a two-year period.







Extreme Wetness of 2019 - *Long-term Trends*

Putting 2019 into Context

Precipitation in the Missouri River Basin varies widely across the region and throughout the year. Situated in the mid-section of the country, the Basin encompasses much of the central and northern Great Plains, which is characterized by a pronounced east to west precipitation gradient. On an annual basis, eastern areas of the region receive nearly four to five times as much precipitation as western areas (with exceptions in the mountainous regions). Summer is generally the wettest season, while winter is the driest.

Over the past 125 years, there have been both wet and dry periods, with a number of extremes in recent years. In just the past ten years, the Basin experienced its third-driest year (2012) and its third-wettest year (2019). Multi-year time frames also show impressive records, despite recent drought in the Northern Plains. For instance, 2018-2019 was the wettest two-year time period, 2017-2019 was the wettest three-year time period, 2016-2019 was the second-wettest four-year time period, and 2015-2019 was the wettest five-year time period.

Trends indicate that Basin-wide precipitation has increased by about 8% since 1895. This is driven primarily by increases in the spring (14%) and autumn (14%). Precipitation changes are not uniform across the Basin, however, as eastern areas have experienced the greatest increases. According to the Fourth National Climate Assessment, precipitation is projected to continue to increase, particularly in the winter and spring.

For more information, please see:

NCEI, Climate at a Glance: https://www.ncdc.noaa.gov/cag/

National Climate Assessment: https://nca2018.globalchange.gov/

Top 10 Wettest Five-Year Periods

Ranking	Years	Amount
1	2015-2019	115.85"
2	2007-2011	115.49"
3	1992-1996	113.75"
4	1993-1997	112.99"
5	1991-1995	112.25"
6	1995-1999	111.52"
7	1905-1909	111.49"
8	2014-2018	111.25"
9	2013-2017	110.68"
10	1941-1945	110.66"

Data provided by NCEI, Climate at a Glance.

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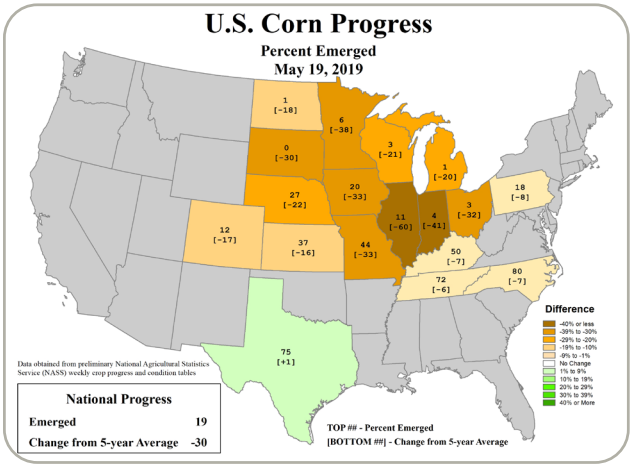
Extreme Wetness of 2019 - *Growing Season*

Extreme Wetness Significantly Impacted Growing Season



Wet conditions in the fall of 2018 increased soil moisture prior to the winter of 2018-2019. Once soils froze, the moisture was locked in until the spring thaw. The combination of wet soils and additional heavy precipitation in the spring of 2019 caused widespread planting delays because muddy fields limited accessibility. Ultimately, spring planting moved at a record slow pace for maize (corn), soybeans, small grains, and other crops. Nearly 20 million acres went unplanted, with the largest areas occurring in Illinois, Minnesota, North Dakota, Ohio, and South Dakota. South Dakota led the nation in unplanted acres (3.9 million acres).

The delayed spring planting significantly shortened the growing season. Summer temperatures were largely near normal; however, below-normal maximum temperatures hindered crop development. This resulted in slowly maturing crops, which continued the near-record delayed progress for most crops. Despite the slow development, most crops reached maturity, or were close to it, prior to the fall freeze. Crops that were still somewhat immature required additional drying and management.

Continuing the slow pattern from spring and summer, the 2019 fall harvest was also slow. This was due to a combination of wet soil conditions and slow dry-down of crops. As mentioned above, somewhat immature crops required a large amount of additional drying time, which increased energy demand, as propane is used to aid in crop dry-down. Several early-season snowstorms in parts of the Dakotas also complicated matters by damaging crops and slowing harvest even further. As of January 1, 2020, over 50% of corn was still unharvested in North Dakota.

Overall, yields were slightly below the national trend.

Sectoral Impacts - *Agriculture*

Row Crops

Cool, wet conditions throughout the growing season created widespread issues for planting, harvesting, and overall crop development. Spring planting and emergence were delayed, particularly in the Dakotas where millions of acres went unplanted. This was followed by cool conditions in the summer, which slowed maturity, and then difficult harvest conditions in the fall, which resulted in delays or crops that went altogether unharvested.

Livestock

Livestock endured extremely harsh conditions this year. In some areas, untimely blizzards, in both the spring and the fall, made activities such as calving or feeding difficult or impossible. In other areas, cattle were killed by flooding or stuck in muddy fields. During the initial flooding in March, hay donations from around the country were delivered to Nebraska. The Nebraska Army National Guard even airlifted hay to stranded cattle.

Cropland and Pastureland

Extreme wetness and flooding have caused issues for landowners. Thousands of acres of land were impacted by sediment deposition, erosion, and scouring. In some cases, the cost of remediation far exceeded the value of the land, leaving some landowners with difficult decisions. Even in areas that were not completely inundated, compaction of land due to planting and harvesting activities has also been an issue.

Above: Corn in snowy field near Aberdeen, SD, photo courtesy Laura Edwards, SDSCO (left); heifers in the cold and snow in northwestern Kansas, photo courtesy Sandy Johnson, KSU (center); flooded farmland in Iowa, photo courtesy Doug Kluck (right).

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Sectoral Impacts - *Infrastructure*

Roads, Bridges, and Rail Lines

Damage to roads and bridges caused many transportation issues across the region. For instance, I-29 in Missouri and Iowa was closed several times, causing traffic to be rerouted, and flooded roads in rural areas made it difficult for farmers to reach their fields. These long or impossible commute times impacted everyone. The railroad industry was also impacted, as shipments had to be diverted to other lines while repairs were being made.

Dams and Levees

In many areas, dams and levees could not hold back the record-breaking river levels. Three dams failed in March, including Spencer Dam on the Niobrara River in Nebraska. Numerous levees were also breached and, although repairs continue into 2020, many levees will not be repaired before spring. Damage to levees and flood infrastructure in the U.S. Army Corps of Engineers' Omaha District was estimated at $1-2 billion.

Other Structures

Homes, businesses, and government buildings were also impacted by the flooding. The flooding has prompted some towns, such as Winslow, NE, to consider relocating out of the flood plain. Offutt Air Force Base, located just south of Omaha, NE, was also inundated when a levee failed upstream. This was the third U.S. military base to be impacted by a billion-dollar disaster during the September 2018-March 2019 time period.

Above: Flooding on I-90 in SD, photo courtesy Patrick Todey (left); flooding near Surprise, NE, photo courtesy Melissa Bartels, Nebraska Extension (center); flooding along the Missouri River, near Omaha, NE, photo courtesy Dennis Todey, USDA (right).

Sectoral Impacts - *Ecosystems*

Plants

Trees throughout the Missouri River Basin were impacted by the 2019 flooding. Initial damage was caused by floodwaters that carried ice and debris; however, damage continued throughout the year as some areas were inundated for long periods of time. According to UNL Water, it can take 2-5 years for flood-damaged trees to die. Therefore, long-term impacts will continue to be realized well into the future.

Wildlife

Wildlife seem to have fared well after the initial flooding in March, according to the Nebraska Game and Parks Commission. For instance, at the time of the flooding, upland game nesting season had not started and many migratory bird species were not in the area, as conditions were still too cold. The flooding did create additional wetland habitat, however, which was most likely beneficial for these migrating species.

Recreation Closures

Heavy rains and flooding put a damper on outdoor activities, as a number of state parks and recreation areas temporarily closed in areas of Iowa, Kansas, Missouri, Nebraska, North Dakota, and South Dakota.

In addition, portions of the Big Sioux River and its tributaries in South Dakota were closed to recreation in the fall, while portions of the James River in North Dakota were under restrictions for winter recreation.

Above: Flooded road by Tuttle Creek Reservoir, KS, photo courtesy Judith O'Mara, KSU (left); deer in snow in South Dakota, photo courtesy Susan Sanders, NWS Rapid City (center); flooding at the Nebraska State Fair, photo courtesy NWS Hastings (right).

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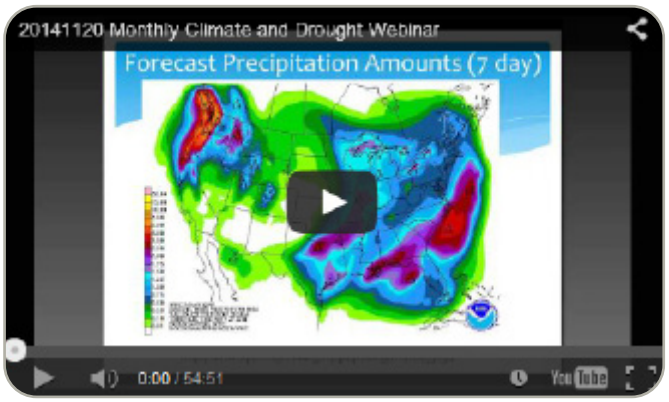
For More Information - *Resources in the Missouri Basin Region*

North Central U.S. Monthly Climate and Drought Summary and Outlook Webinar

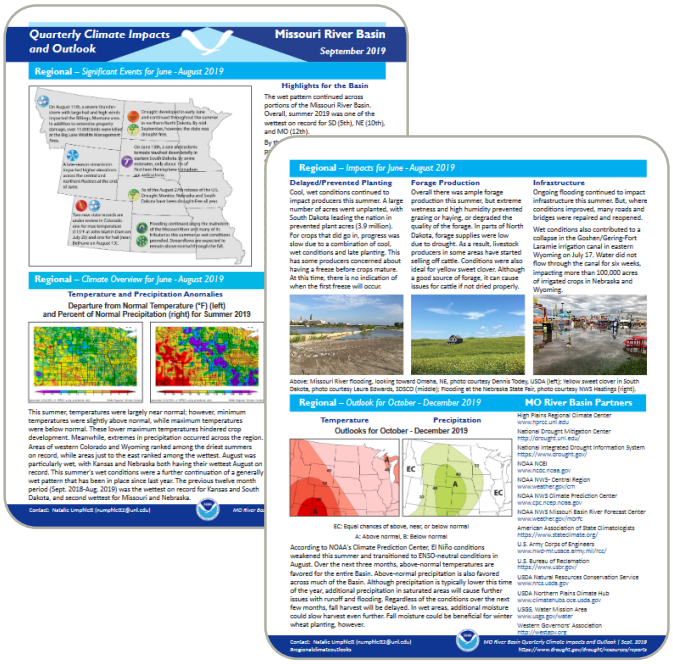


The North Central U.S. Climate and Drought Summary and Outlook webinars occur on the third Thursday of each month at 1pm Central. These webinars cover the latest climate conditions, impacts, and outlooks.

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

For an archive:
www.hprcc.unl.edu/webinars.php

Missouri River Basin Quarterly Impacts and Outlook Report



For more information:
https://hprcc.unl.edu/climatesummaries.php

For More Information - *Climate Partners in the Missouri Basin Region*

For the latest flood information:

NOAA NWS Missouri Basin River Forecast Center
www.weather.gov/mbrfc

U.S. Army Corps of Engineers
www.nwd-mr.usace.army.mil/rcc/

U.S. Bureau of Reclamation
https://www.usbr.gov/

USDA Natural Resources Conservation Service
www.wcc.nrcs.usda.gov

USGS WaterWatch
https://waterwatch.usgs.gov/

For the latest weather and climate outlooks:

NOAA National Weather Service
www.weather.gov/

NOAA NWS Climate Prediction Center
www.cpc.ncep.noaa.gov/

For climate data, information, and impacts:

High Plains Regional Climate Center
www.hprcc.unl.edu

NOAA NCEI
www.ncdc.noaa.gov

USDA Northern Plains and Midwest Climate Hubs
www.climatehubs.oce.usda.gov

Information in this report provided by:

High Plains Regional Climate Center
www.hprcc.unl.edu

National Drought Mitigation Center
http://drought.unl.edu

NOAA NCEI
www.ncdc.noaa.gov

NOAA NWS- Central Region
www.weather.gov/crh

NOAA NWS Missouri Basin River Forecast Center
www.weather.gov/mbrfc

American Association of State Climatologists
www.stateclimate.org/

U.S. Army Corps of Engineers
www.nwd-mr.usace.army.mil/rcc/

USDA Northern Plains and Midwest Climate Hubs
www.climatehubs.oce.usda.gov

USGS WaterWatch
https://waterwatch.usgs.gov/

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