



September 2019 Climate Summary

Black-eyed Susans in Lincoln, NE. Photo courtesy Natalie Umphlett.
<http://hprcc.unl.edu>

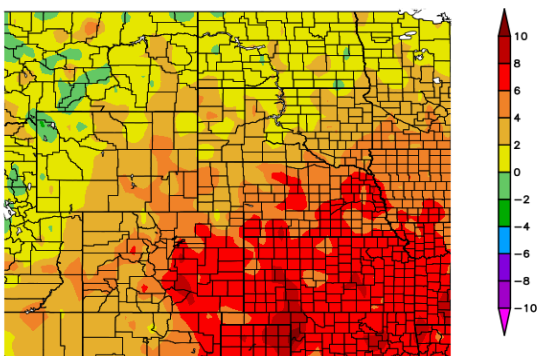
Warm Temperatures Dominate the Region

In a break from recent months, average temperatures across the High Plains region were, overall, above normal for September. Temperature departures ranged from just above normal in northern areas of the region to nearly 10.0 degrees F (5.6 degrees C) above normal in parts of Kansas. As such, many areas experienced their top 5 warmest Septembers on record, including Lincoln, Nebraska; Cheyenne, Wyoming; and Dodge City, Kansas. Precipitation, however, was not uniform across the region, with above-normal precipitation generally to the north and below-normal precipitation to the south. The Dakotas were particularly wet, with widespread precipitation totals in excess of 200 percent of normal. Consequently, several locations ranked in the top 5 wettest Septembers on record. Two locations in North Dakota, Williston and Grand Forks, experienced noteworthy records. Not only did both locations set new records for wettest September, both observed their highest single-day precipitation total for the entire month. Williston's monthly total of 8.09 inches (205 mm) was 7.03 inches (179 mm) above normal, which is a whopping 763 percent of normal. This absolutely crushed the old record of 3.74 inches (95 mm) set back in 1959 (period of record 1894-2019). 2.32 inches (59 mm) of the monthly total fell on the 7th, which was a new record for the day and the month. Meanwhile, Grand Forks' new monthly record of 8.14 inches (207 mm) was 397 percent of normal (1893-2019). 3.81 inches (97 mm) of this total fell on the 20th, which also set a new record for the day and the month. This is particularly impressive, given that Grand Forks' normal for the month is 2.05 inches (52 mm).

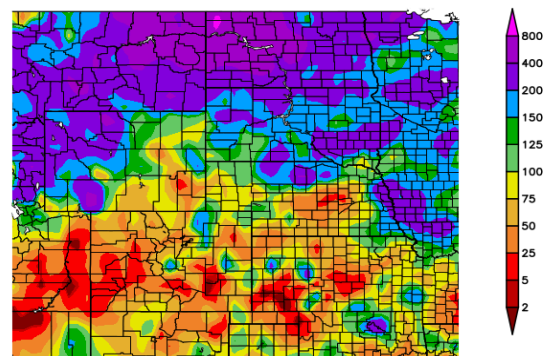
Crops continued to progress through the month, but were still far behind previous years. Concerns at this time include the timing of the first freeze (some have already experienced this) and the wetness. Heavy rainfall across northern areas this month has led to muddy or inundated fields, which will be very slow to dry as the season progresses. It is possible that some areas of the region will need to wait until soils freeze in order to complete harvest.

Temperature and Precipitation Overview

Departure from Normal Temperature (F)
9/1/2019 - 9/30/2019



Percent of Normal Precipitation (%)
9/1/2019 - 9/30/2019



Above: Departure from 1981-2010 normal temperature (left) and percent of normal precipitation (right) for September 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

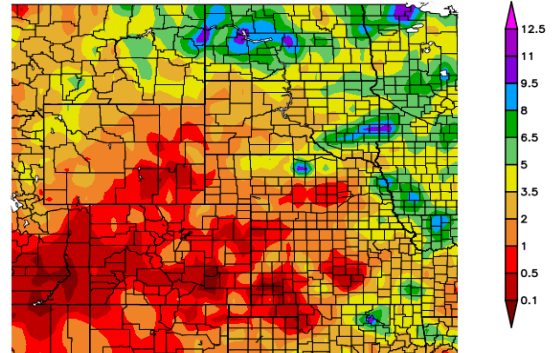
Heavy precipitation continued to impact portions of the High Plains region this month, with areas of North Dakota, South Dakota, northwestern Wyoming, and northern and eastern Nebraska receiving precipitation in excess of 200 percent of normal. A large area of western North Dakota had the largest departures with several locations receiving 400-800 percent of normal precipitation. This resulted in many locations in the Dakotas ranking in the top 10 wettest Septembers on record, including Williston, ND (wettest); Grand Forks, ND (wettest); Bismarck, ND (2nd wettest); Sisseton, SD (2nd wettest); Aberdeen, SD (5th wettest); and Rapid City, SD (9th wettest).

Throughout the month of September, several rounds of showers and thunderstorms affected northern areas of the region. Some of these storm systems brought severe weather, which is not necessarily uncommon in the fall. During the overnight hours of the 10th leading into the morning hours of the 11th, a large complex of severe thunderstorms developed over far northern Nebraska and eastern South Dakota. These storms moved slowly, dumping heavy rain over some of the same areas that have experienced flooding off and on much of the year. These storms also produced three EF-2 tornadoes in Sioux Falls, South Dakota. Widespread straight-line wind damage was also reported in the Sioux Falls area from these storms. Due to the slow movement of the thunderstorm complex, heavy rain was widespread. For instance, in Hutchinson County, which is located to the southwest of Sioux Falls, 5.54 inches (141 mm) of rain fell at the Emery 10.8 S CoCoRaHS station. Heavy rain returned to the area later in the day, and ultimately, two-day rainfall totals of 5.00-10.00 inches (127-254 mm) were reported, with some higher amounts in isolated areas. In addition to flash flooding, record crests on the Big Sioux River and James River were observed in the days following this heavy precipitation event. Fields, buildings, and many roads were inundated, including portions of I-90, which was closed in eastern South Dakota for a period of time. Some evacuations and water rescues also occurred.

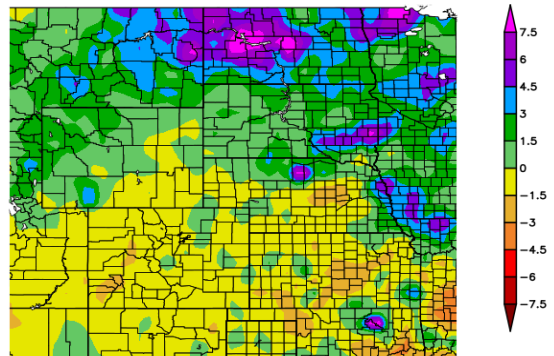
Further south, drier conditions prevailed across the remainder of the region. This was a welcome break from the heavy rain and flooding that has impacted so many in recent months. However, in some areas, such as western Wyoming, western and central Colorado, and southwestern Kansas, abnormally dry and moderate drought conditions have expanded or developed. Persistently drier than normal conditions over the last three months has been a key factor in the recent expansion of moderate drought.

Regional Precipitation

Precipitation (in)
9/1/2019 – 9/30/2019



Departure from Normal Precipitation (in)
9/1/2019 – 9/30/2019



Above: Total precipitation in inches (top) and departure from normal precipitation in inches (bottom) for September 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>.

Streamflow Update

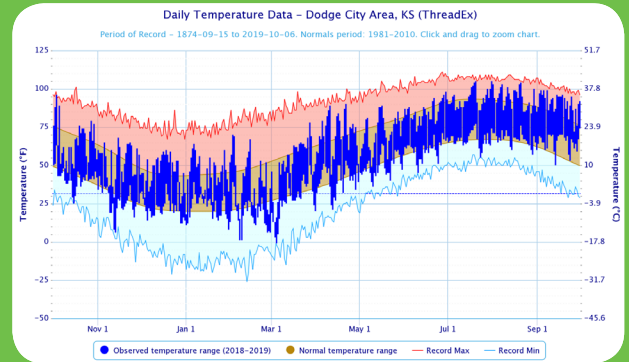
The 2019 runoff season is on track to be one of the highest on record. As of October 1, 2019, the U.S. Army Corps of Engineers' 2019 runoff forecast for the upper Basin (above Sioux City, Iowa) was 61.0 million acre-feet (MAF), which is 241% of average. If realized, this would tie 2011 as the highest upper Basin runoff since records began 121 years ago. This updated runoff forecast is higher than previous forecasts, as heavy rain and wet soils contributed to record-breaking runoff in September. According to the U.S. Army Corps of Engineers' weekly report, September runoff for the upper Basin was over four times higher than average and twice the previous record. Outside of the upper Missouri River Basin, much above normal and record high streamflows were present across other areas of the region, including Kansas, Nebraska, and portions of the Red River of the North in North Dakota.

Temperatures

In contrast to previous months, temperatures across the High Plains region were, overall, above normal this month. The greatest temperature departures occurred across Kansas, eastern Colorado, and much of Nebraska, with widespread departures of 6.0-8.0 degrees F (3.3-4.4 degrees C) above normal. Some isolated areas even had departures up to 10.0 degrees F (5.6 degrees C) above normal. This caused many locations to rank in the top 5 warmest Septembers on record, including Colorado Springs, Colorado (warmest); Dodge City, Kansas (warmest); Cheyenne, Wyoming (2nd warmest); and Lincoln, Nebraska (3rd warmest). Meanwhile, average temperatures were near normal across much of North Dakota, north-central South Dakota, and western Wyoming.

The month started off on the hot side across Colorado and Wyoming. Record-breaking maximum temperatures were widespread during the first two days of the month, with many locations experiencing their warmest September temperature on record. A few locations even topped 100 degrees F (37.8 degrees C), which is extremely rare for this late in the year. For example, Pueblo, Colorado tied for its warmest September temperature on record on the 1st (101 degrees F/38.3 degrees C) only to have a new record set the very next day with 102 degrees F (38.9 degrees C) (period of record 1888-2019). This record of 102 degrees F (38.9 degrees C) was then tied only a few days later on the 5th! Denver, Colorado also hit 100 degrees F (37.8 degrees C) on the 2nd, which was the latest 100 degrees F (37.8 degrees C) day on record (period of record 1872-2019). This was a full two weeks after the previous record, which was set on August 16, 2002.

Station Spotlight: Dodge City, KS



Above: Daily temperatures along with extremes and normals values since October 1, 2018 in Dodge City, KS.

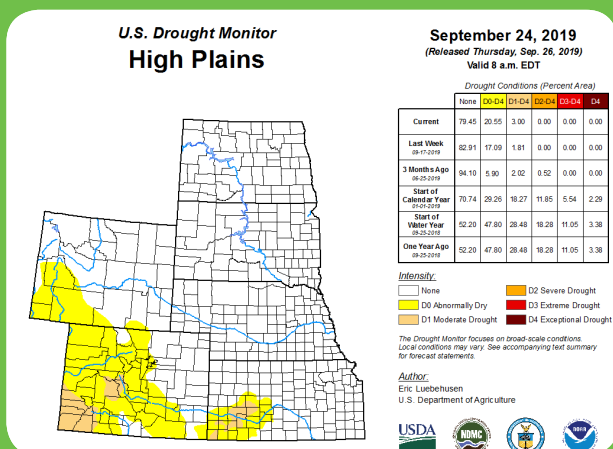
Drought Conditions

Slight changes in drought conditions occurred this month, with both improvements and degradations. According to the U.S. Drought Monitor, the area experiencing drought or abnormally dry conditions (D0-D4) in the High Plains region increased over the past month, from approximately 12 percent to 21 percent. This included improvements to drought conditions in north-central North Dakota, and the development, or expansion, of drought conditions in portions of western Colorado and southwestern Kansas.

Multiple rounds of showers and thunderstorms impacted the High Plains region this month, especially across northern areas. This rainfall was beneficial for portions of north-central North Dakota and north-east Nebraska, where drought and abnormally dry conditions were eliminated by the middle of the month.

Other areas of the region, however, were much drier. For instance, abnormally dry conditions (D0) expanded in parts of Colorado and Wyoming. Moderate drought (D1) expanded in southwestern Colorado and a small pocket of D1 also developed just northeast of this area. Meanwhile, across Kansas, D0 expanded over the southwestern portion of the state, with a slight expansion of D1 as well. Consistently below-normal precipitation over the past three months in portions of Colorado and Kansas has been a key factor to the recent D1 expansion.

U.S. Drought Monitor



The U.S. Drought Monitor is produced as a joint effort of the U.S. Department of Agriculture (USDA), National Drought Mitigation Center, U.S. Department of Commerce, and the National Oceanic and Atmospheric Administration (NOAA). For current Drought Monitor information, please see: <http://droughtmonitor.unl.edu/>.

Climate Outlooks

According to the Climate Prediction Center, ENSO-neutral conditions are present in the Pacific. These conditions are likely to continue through the fall and may continue into spring 2020. For more information about ENSO, check out the ENSO blog here: <https://www.climate.gov/news-features/department/enso-blog>

According to the National Weather Service's long-range flood outlook, minor to moderate flooding is forecast to continue in eastern areas of the Missouri River Basin through November. In the High Plains, this includes eastern portions of South Dakota, Nebraska, and Kansas, particularly along the James, Missouri, and Marais Des Cygnes Rivers. Normal wildland fire potential is expected for the entire High Plains region in September, with normal conditions expected to continue in the High Plains through October.

The seasonal temperature and precipitation outlooks below combine the effects of long-term trends, soil moisture, and when applicable, the El Niño Southern Oscillation cycle (ENSO). To learn more about these outlooks, please see: <http://www.cpc.ncep.noaa.gov>.

Temperature

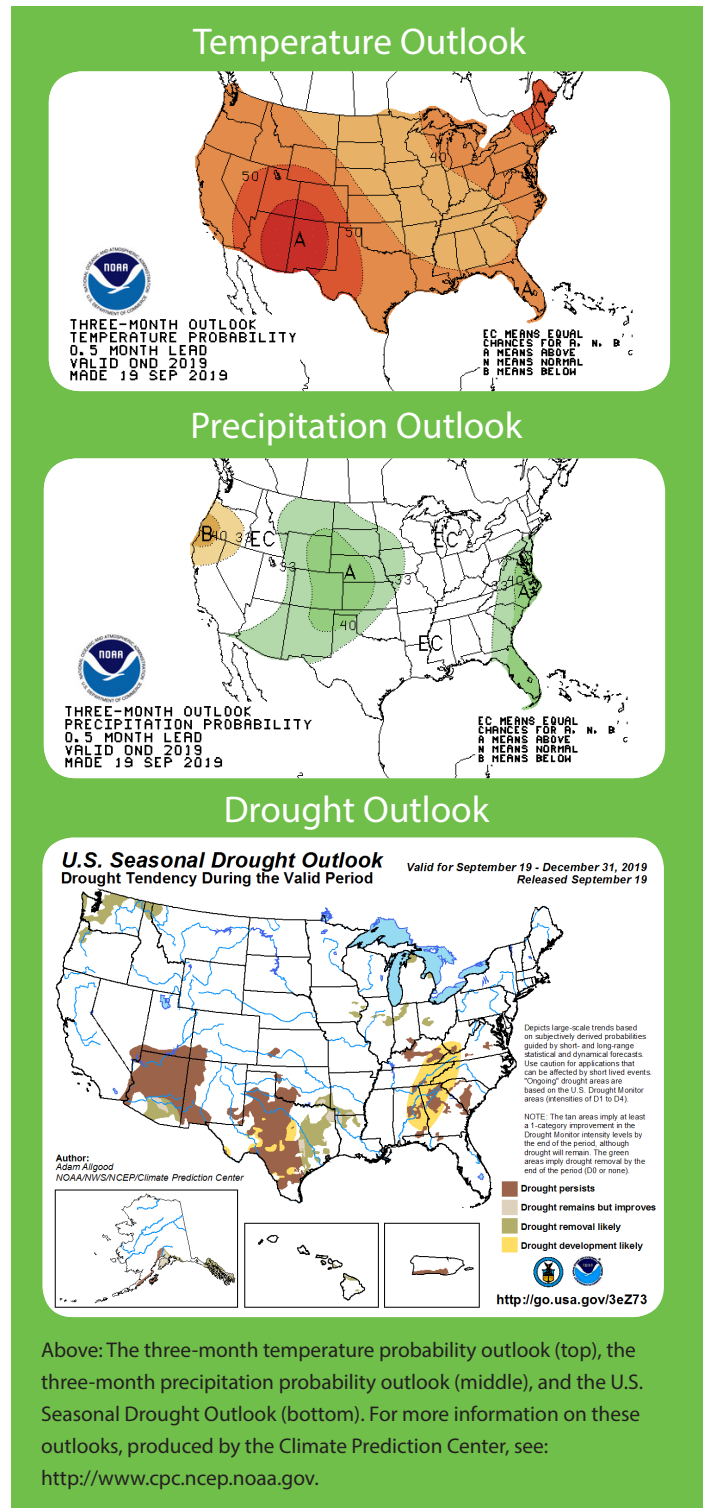
The October-December temperature outlook indicates an increased chance of above-normal temperatures for all of the contiguous U.S., which includes the entire High Plains region. There are no areas that have an increased chance of below-normal temperatures in the contiguous U.S. during the next few months.

Precipitation

The precipitation outlook for the next three months calls for a higher probability of above-normal precipitation across portions of the Interior West, the Southwest, and the Central and Northern Plains, as well as along the East Coast. This includes nearly all of the High Plains region with the only exceptions being far southeast Kansas and northeast North Dakota. Meanwhile, there is an increased chance for below-normal precipitation in portions of the West and Pacific Northwest. Elsewhere, there are equal chances for above, below, and near-normal precipitation during the October-December period.

Drought

The September 19th U.S. Seasonal Drought Outlook indicates that drought is expected to persist across parts of the Southwest, Southern Plains, and Southeast. Drought may improve or be removed in small areas of the Southwest, Midwest, Pacific Northwest, and South. Further development of drought is likely for portions of the southern and southeastern U.S. Through the end of December, for the High Plains region, drought conditions are expected to persist in portions of southwestern Colorado and southwestern Kansas. Drought development, however, is not expected at this time.



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	83.8	54.1	69.0	6.0	99	09/05+	44	09/22	0.61	-0.55	53
Alamosa San Luis Airport	77.2	40.0	58.6	3.6	88	09/03	26	09/22	0.73	-0.18	80
Colorado Springs Municipal Airport	84.0	53.3	68.7	7.8	96	09/02	43	09/22	0.32	-0.87	27
Denver International Airport	85.5	53.2	69.3	5.9	100	09/02	40	09/22	0.41	-0.55	43
Grand Junction Walker Field Airport	84.8	53.6	69.2	3.1	100	09/01	39	09/22	0.26	-0.93	22
Pueblo Memorial Airport	90.3	55.2	72.8	8.1	102	09/05+	45	09/22	0.51	-0.26	66

Kansas	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Concordia Municipal Airport	87.6	66.2	76.9	8.9	98	09/15	52	09/13	2.18	-0.73	75
Dodge City Regional Airport	90.8	65.2	78.0	8.8	99	09/07+	50	09/13	0.21	-1.46	13
Goodland Renner Field	84.6	57.0	70.8	6.2	96	09/05+	46	09/22+	0.65	-0.57	53
Topeka Municipal Airport	86.5	66.0	76.2	7.9	94	09/15+	52	09/26	2.50	-1.16	68
Wichita Mid-Continent Airport	88.7	68.7	78.7	7.7	95	09/07	55	09/23	0.98	-2.16	31

Nebraska	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Chadron Municipal Airport	80.4	49.3	64.9	3.9	100	09/02	36	09/23	1.97	0.24	114
Grand Island Airport	83.5	60.9	72.2	7.1	95	09/30	46	09/26	1.37	-0.86	61
Lincoln Municipal Airport	85.1	62.4	73.7	7.7	94	09/17+	48	09/26	3.40	0.38	113
Norfolk Karl Stefan Airfield	81.6	58.7	70.1	6.3	94	09/30	46	09/23	1.51	-1.18	56
North Platte Regional Airport	84.1	55.3	69.7	7.4	96	09/05	43	09/23	0.96	-0.45	68
Omaha Eppley Airport	83.3	63.9	73.6	7.9	92	09/16+	50	09/28	5.95	3.27	222
Valentine Miller Field	82.1	53.4	67.8	5.5	95	09/15	39	09/23	2.69	1.05	164

North Dakota	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Bismarck Municipal Airport	70.7	50.2	60.4	1.9	88	09/16	36	09/28	5.74	4.15	361
Fargo International Airport	70.0	51.8	60.9	1.8	88	09/20+	33	09/28	4.47	1.90	174
Grand Forks International Airport	68.8	49.8	59.3	2.4	90	09/20	40	09/30+	8.14	6.09	397
Theodore Roosevelt Airport	70.4	47.1	58.8	1.6	94	09/16	32	09/28	5.62	4.15	382
Williston International Airport	69.3	47.8	58.5	1.8	91	09/15	39	09/30	8.09	7.03	763

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>.

September 2019 Climate Summary

South Dakota	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Aberdeen Regional Airport	74.2	51.6	62.9	4.0	90	09/05	34	09/28	4.74	2.55	216
Huron Regional Airport	75.8	55.7	65.8	4.1	89	09/17	40	09/28	3.26	0.80	133
Pierre Regional Airport	76.4	53.0	64.7	1.8	90	09/17+	42	09/23	3.27	1.40	175
Rapid City Regional Airport	75.3	48.3	61.8	1.0	92	09/02	38	09/25	2.69	1.40	209
Sioux Falls Joe Foss Field Airport	77.2	57.6	67.4	6.1	88	09/17+	42	09/28	4.50	1.73	162

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	78.1	44.8	61.5	3.6	98	09/02	35	09/26	1.41	0.33	131
Cheyenne Municipal Airport	79.3	48.6	64.0	5.8	95	09/02	39	09/22	0.51	-0.97	34
Lander Hunt Field Airport	75.0	45.7	60.3	1.7	95	09/02	34	09/22	1.48	0.43	141
Laramie Regional Airport	75.2	42.0	58.6	5.3	90	09/02	31	09/22	1.00	-0.11	90
Rawlins Municipal Airport	75.3*	43.2*	59.4*	4.0*	93	09/02	29	09/18	0.59*	-0.38*	61*
Sheridan County Airport	74.7	45.4	60.1	2.2	99	09/04	36	09/30+	1.88	0.45	131

September 2019 Highlights

Monthly Rankings

Precipitation in inches - Temperature in Degrees F

Wettest	Precipitation / Ranking	Record / Year	Period of Record
Grand Forks, ND	8.14 / WETTEST	6.77 / 1912	1893-2019
Williston, ND	8.09 / WETTEST	3.74 / 1959	1894-2019
Bismarck, ND	5.74 / 2nd wettest	6.93 / 1977	1874-2019
Sisseton, SD	6.31 / 2nd wettest	6.65 / 2004	1931-2019
Dickinson, ND	5.62 / 2nd wettest	6.25 / 1977	1948-2019
Aberdeen, SD	4.74 / 5th wettest	6.00 / 1921	1893-2019
Mobridge, SD	3.63 / 6th wettest	4.65 / 1977	1911-2019
Pierre, SD	3.27 / 8th wettest	6.95 / 1996	1933-2019
Rapid City, SD	2.69 / 9th wettest	3.94 / 1946	1942-2019
Fargo, ND	4.47 / 10th wettest	6.50 / 1999	1881-2019

Warmest	Temperature / Ranking	Record / Year	Period of Record
Dodge City, KS	78.0 / WARMEST	77.8 / 1931	1874-2019
McCook, NE	72.7 / WARMEST	72.5 / 2015	1896-2019
Colorado Springs, CO	68.7 / WARMEST	67.3 / 2015	1894-2019
Pueblo, CO	72.8 / WARMEST	72.0 / 2015	1888-2019
Norfolk, NE	70.1 / 2nd warmest	70.5 / 1931	1893-2019
Wichita, KS	78.7 / 2nd warmest	79.4 / 1931	1888-2019
Cheyenne, WY	64.0 / 2nd warmest	64.7 / 2015	1872-2019

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North Dakota Climate Summary

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For more information: www.ndsu.edu/ndsco or www.ndawn.ndsu.nodak.edu

Precipitation:

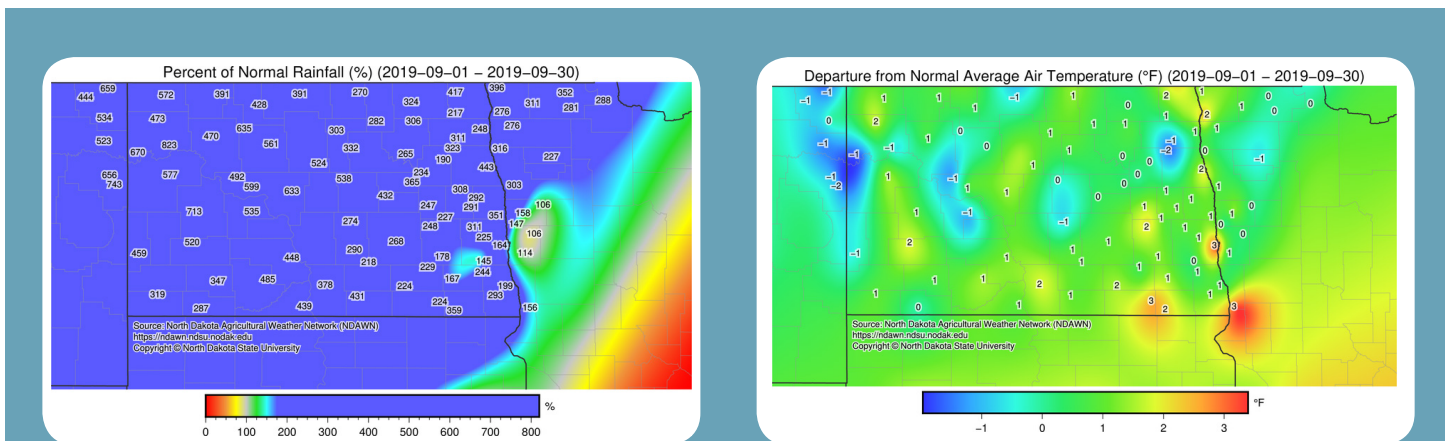
Based on the National Centers for Environmental Information (NCEI), the statewide average September precipitation was 5.69 inches, which was 2.76 inches more than last month, 4.06 inches more than in September 2018 and 3.98 inches more than the 1981-2010 average, making it the wettest September in the 125-year period of record. It was also 1.01 inches greater than the previous record that was set in 1941 (Table 1). The numbers less than 100 in Figure 1 below are shaded in yellow, orange and red to depict the region with below-average rainfall. In contrast, the numbers that are greater than 100 in the same figure are shaded in green, blue and purple to depict the region with above-average rainfall in September. The greatest monthly precipitation accumulation was 10.58 inches, recorded in Sykeston, Wells County. The greatest 24-hour precipitation was 5.7 inches, recorded also in Sykeston, Wells County, on Sept. 20. Based on historical records, statewide September precipitation showed a positive long-term trend of 0.42 inch per century since 1895. The highest and lowest September precipitation for the state ranged from 5.69 inches in 2019 to 0.2 inch in 2012 (Figure 2).

Temperature:

The official state average September temperature was 58.8 F, which is 7 degrees cooler than last month but 3.8 degrees warmer than in September 2018. The average September temperature was 1.9 degrees warmer than the 1981-2010 average, which made it the 30th warmest September in the 125-year period of record. It was the warmest September since 2015 (Table 2). The negative numbers in Figure 3 are shaded in green and blue to depict the region with cooler-than-average temperatures in September. In contrast, the positive numbers in the same figure are shaded in red and orange to depict the region with warmer-than-average temperatures in September. The state's highest and lowest daily temperatures ranged from 94 F on Sept. 16 in Dickinson, Stark County, to 26 F on Sept. 28 in Hettinger, Adams County, and Foxholm, Ward County, on Sept. 14. Based on the historical records, the state average September temperature showed a slight positive long-term trend of 0.2 degree per decade since 1895. The highest and lowest monthly state September average temperatures ranged from 63.5 F in 1897 to 45.5 F in 1965 (Figure 4).

Drought and other notable impacts:

Across the observation network of weather stations with at least 30 years of history, 65 daily high- and 10 daily low-temperature records were set or tied. A total of 100 highest daily precipitation-related records were set or tied.



Above: Percent of normal precipitation (left, figure 1) and departure from normal average temperature (right, figure 2) for September 2019 in North Dakota. Both figures produced by NDAWN.

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>

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