



March 2019 Climate Summary

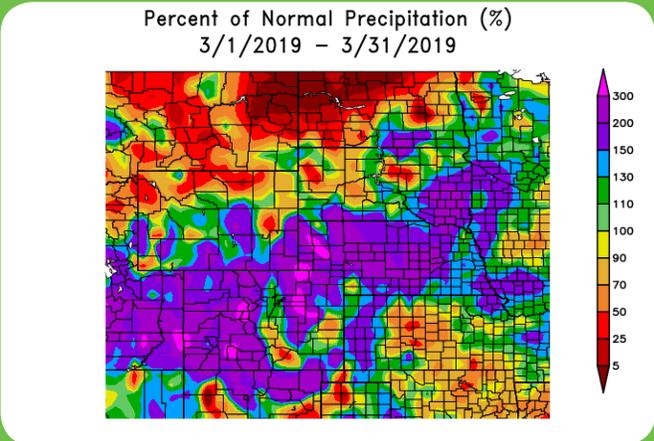
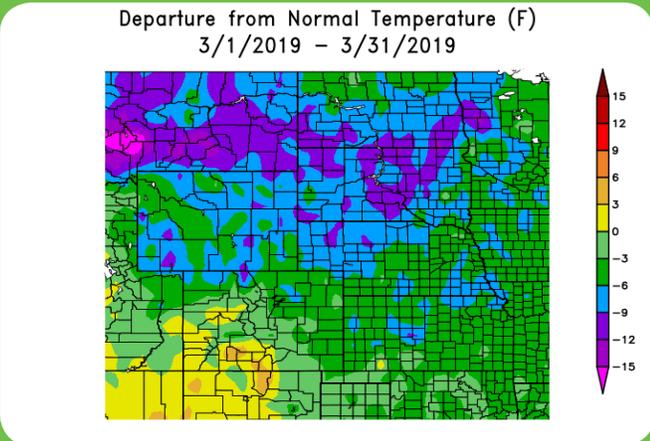


Historic Flooding Hits Eastern Nebraska

The combination of antecedent conditions and a strong storm system produced an historic flooding event in March for parts of the region, hitting eastern Nebraska especially hard. To put this event into context, soils were quite moist from wet fall conditions going into the winter season throughout eastern portions of South Dakota, Nebraska, and Kansas. Bitterly cold temperatures kept soils frozen and moisture in place during mid-late winter. Winter snowfall was plentiful in these areas, with an impressive snowpack in place by mid-March. Then, a powerful storm system and warmer temperatures brought several inches of rain to portions of eastern Nebraska, causing a rapid melting of snow and high runoff due to the frozen soils. Rainfall and snowmelt overwhelmed streams and rivers throughout the region, many of which still contained ice, causing major flooding. Multiple dams and levees were breached, prompting flash flood emergencies for several communities. Record crests occurred on the Big Blue, Elkhorn, Loup, Missouri, and Platte Rivers in Nebraska. Numerous state highways were closed and even washed out, cutting off transportation to and from several communities. Railroads and bridges were damaged from ice jams and flooding. Livestock perished, and several people died after being swept away by floodwaters. Initial damage estimates have already exceeded \$1 billion.

The growing season is quickly approaching, and producers have begun to assess the impact of harsh winter conditions on fields and planting decisions. Late planting is nearly a certainty this season due to the prolonged winter, as soils are thawing slowly and fields are muddy from excessive moisture. If wet conditions continue, the risk for crop disease will be high. Winter wheat damage has already been reported in Kansas and South Dakota. Winter wheat was damaged from exposure to extreme cold with no snow cover in Kansas, while constant melting and refreezing damaged the wheat in South Dakota. Winter conditions took a toll on livestock as well. Extreme cold and blizzard conditions hit the region just as calving season began, and cattle got stuck in muddy fields and were buried by snow.

Temperature and Precipitation Overview



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

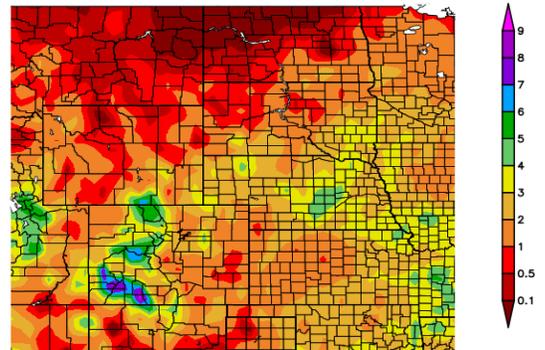
The High Plains experienced precipitation extremes across the region during March, as some areas were excessively wet while others were very dry. A large area of wetness extended from Colorado northeast through southeastern Wyoming, Nebraska, and southeastern South Dakota. This region received approximately 150-300 percent of normal precipitation, which resulted in numerous locations ranking in the top 10 for wettest March on record. Meanwhile, dryness prevailed throughout northern and western North Dakota, with these areas receiving less than 25 percent of normal precipitation. Williston, North Dakota only received 0.01 inches (0 mm) of precipitation the entire month, tying 1966 for its driest March on record (period of record 1894-2019).

Extremes in snowfall across the High Plains were evident in March as well. Several winter storms traversed the region, adding to the already impressive snowfall totals for the season. For instance, Scottsbluff, Nebraska had its snowiest March on record with 30.8 inches (78 cm), breaking its previous March snowfall record of 26.0 inches (66 cm) that was set in 1906 (period of record 1893-2019). Meanwhile, portions of western Colorado missed out on plentiful snowfall. In fact, Grand Junction did not record any snow and tied multiple years for least snowiest March on record, despite having its 2nd wettest March (period of record 1893-2019). This can be attributed to temperature, as temperatures mostly remained above freezing throughout the month so that precipitation fell as rain instead of snow.

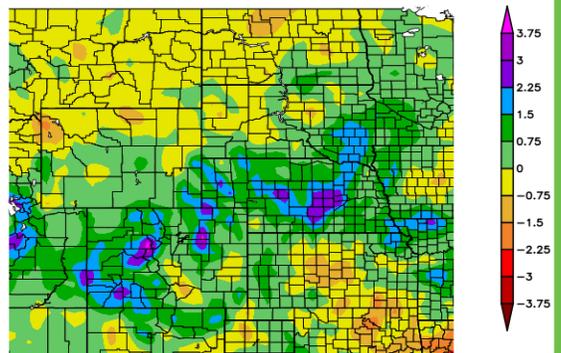
The most notable storm system to impact the region during March was a very strong mid-latitude cyclone that produced large amounts of snowfall and hurricane-force winds throughout northeastern Colorado, southeastern Wyoming, the Nebraska Panhandle, and southwestern South Dakota on the 13th. Although unofficial, this storm produced near-record-low barometric pressure in Colorado and Kansas and, according to the National Weather Service in Denver/Boulder, the storm produced the 2nd highest non-thunderstorm wind gust ever recorded in the Denver area. The storm also produced over a foot of snow in some locations, setting impressive records. The following locations ranked in the top 5 for highest 1-day total snowfall in March: Scottsbluff, NE (12.0 inches (30 cm), tied for highest); Casper, WY (13.6 inches (35 cm), 2nd highest); and Cheyenne, WY (14.0 inches (36 cm), 2nd highest).

Regional Precipitation

Precipitation (in)
3/1/2019 - 3/31/2019



Departure from Normal Precipitation (in)
3/1/2019 - 3/31/2019



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

Snowpack Update

Snowfall was plentiful throughout Colorado and Wyoming during March. As of the beginning of April, Snow Water Equivalent (SWE) was above normal in all basins in Colorado. In Wyoming, SWE was above normal in southeast basins, slightly below normal in north-central basins, and near normal elsewhere. In the Upper Missouri Basin, mountain SWE above Fort Peck Reservoir and between Fort Peck and Garrison Reservoirs decreased slightly to 97 percent of average and 93 percent of average, respectively, by the end of March. SWE was slightly above average in both reaches one month ago. Plains snowpack was impressive during the first half of March, with the majority of the region covered in snow. However, a warm-up along with rain in some areas caused snow to melt, and portions of western North Dakota, southern and eastern South Dakota, and eastern Nebraska were snow free by the end of March.

Temperatures

The cold pattern experienced throughout the region in February continued into March. With the exception of southern Colorado, temperatures were below normal for the month throughout the High Plains. Temperature departures ranged from 3.0-6.0 degrees F (1.7-3.3 degrees C) below normal in the southern part of the region to 6.0-9.0 degrees F (3.3-5.0 degrees C) below normal across the northern High Plains. These chilly conditions resulted in several locations ranking among the top 10 of coldest Marches on record: Chadron, NE (6th), Pierre, SD (10th), Laramie, WY (10th), and Rawlins, WY (10th).

The coldest temperatures of the month arrived on the 3rd and 4th for much of the region. Several locations in Nebraska, North Dakota, South Dakota, and Wyoming dipped below -20.0 degrees F (-28.9 degrees C). These temperatures were record-breaking in Nebraska. For instance, it got down to -21.0 degrees F (-29.4 degrees C) in Chadron on the 3rd, while the temperature fell to -25.0 degrees F (-31.7 degrees C) in North Platte on the 4th. These temperatures were the coldest ever recorded during any March at these two locations (Chadron period of record 1941-2019, North Platte period of record 1874-2019).

It was a long winter for the High Plains, especially in the northern part of the region where temperatures remained below freezing for long periods of time. The following locations had impressive runs for consecutive days of maximum temperatures below 32.0 degrees F (0.0 degrees C): Fargo, ND, 6th longest, 63 days from January 8-March 11, 2019 (period of record 1881-2019); and Aberdeen, SD, 6th longest, 43 days from January 28-March 11, 2019 (period of record 1893-2019).

Drought Conditions

Thanks to a continuation of wet conditions in drought-stricken areas, drought conditions improved in several locations during March. According to the U.S. Drought Monitor, the area in the High Plains experiencing abnormally dry or drought conditions (D0-D4) decreased from approximately 31 percent to 11 percent over the course of the month, while areas experiencing drought (D1-D4) decreased from 14 percent to only 2 percent. As of the end of March, severe drought (D2) and extreme drought (D3) conditions no longer existed in the region.

U.S. Drought Monitor

U.S. Drought Monitor
High Plains

March 26, 2019
(Released Thursday, Mar. 28, 2019)
Valid 8 a.m. EDT

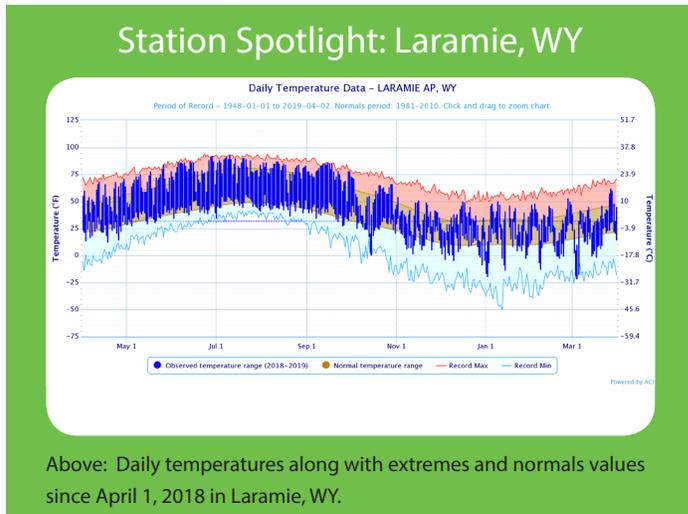
	Drought Conditions (Percent Area)				
	None	D0-D4	D1-D4	D2-D4	D3-D4
Current	89.91	11.09	1.83	0.00	0.00
Last Week <small>(04-18-2019)</small>	85.36	14.65	1.98	0.13	0.00
3 Month Ago <small>(12-25-2018)</small>	69.24	31.76	10.44	11.85	5.54
Start of Calendar Year <small>(01-01-2019)</small>	70.74	29.26	19.27	11.85	5.54
Start of Water Year <small>(08-25-2018)</small>	52.20	47.80	28.48	19.28	11.95
One Year Ago <small>(03-27-2018)</small>	37.00	63.00	41.24	21.63	7.59

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.

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U.S. Department of Agriculture

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/>.



Mountain snowpack in Colorado continued to build nicely during March, allowing for additional drought relief. The small area of D3 in the extreme southern part of the state, as well as the large area of D2 throughout southern and central Colorado were eliminated, and areas experiencing moderate drought (D1) and abnormally dry conditions (D0) were significantly reduced to include only southern areas of the state. Improvements were made in southern Wyoming and the Nebraska Panhandle as well. The major winter storm that crossed the region mid-month brought enough snowfall to alleviate drought and dryness in these areas.

The only area that experienced a degradation in drought conditions during March was north-central Wyoming. This region missed out on several storm systems during the past few months, and March precipitation was less than 50 percent of normal, prompting the expansion of D0 into this area from the west.

Climate Outlooks

According to the Climate Prediction Center, El Niño conditions are present in the Pacific and an El Niño Advisory is in effect. Weak El Niño conditions are expected to continue through spring and summer. For more information about ENSO, check out the ENSO blog here: <https://www.climate.gov/news-features/department/enso-blog>. To learn more about how El Niño may affect the Missouri Basin region, see this El Niño briefing: <https://www.drought.gov/drought/documents/el-nino-impacts-and-outlook-missouri-river-basin-october-2018>.

According to NOAA's spring flood outlook, moderate to major flooding is expected in eastern areas of the Missouri River Basin and in the Souris-Red-Rainy water resource region. In the High Plains, this includes eastern portions of the Dakotas, Nebraska, and Kansas. Western areas of the Missouri Basin have a reduced risk for flooding this spring.

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

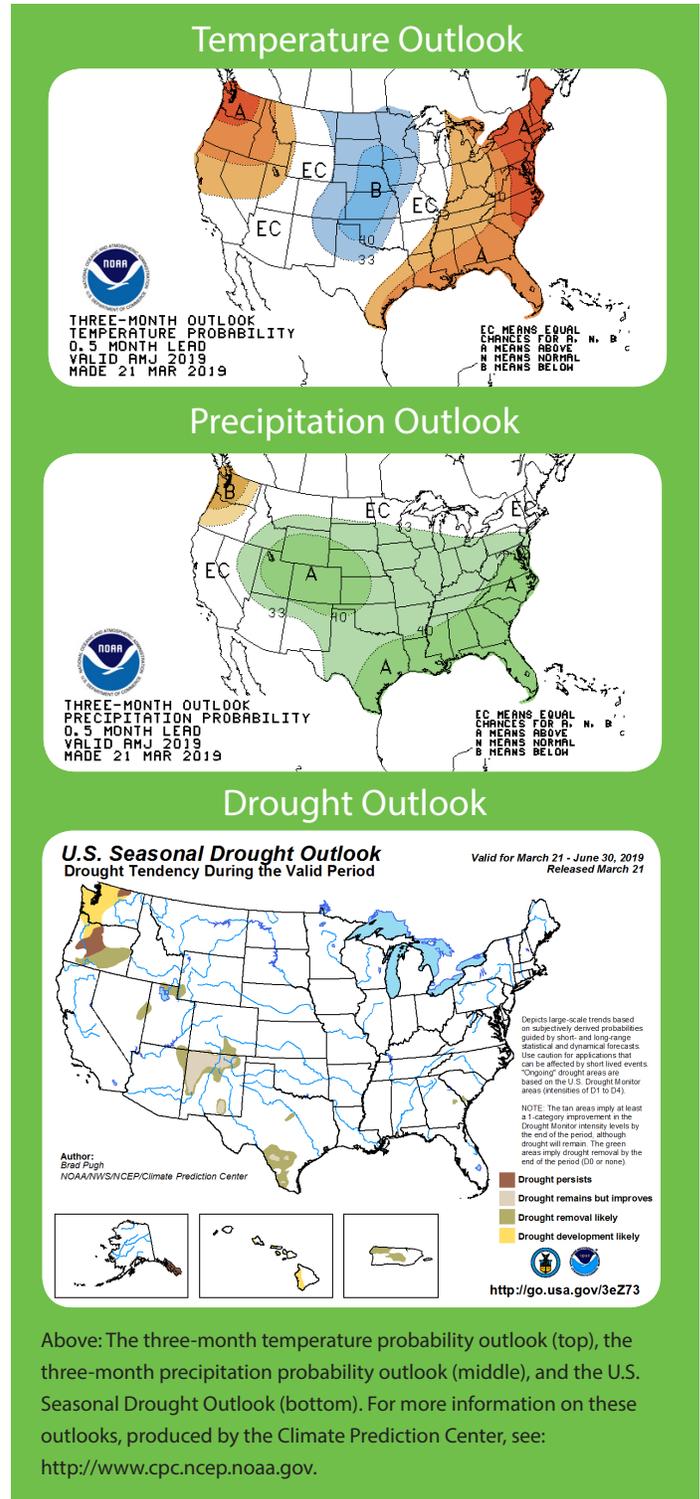
The April-June temperature outlook indicates an increased chance of above-normal temperatures for northwestern and eastern portions of the contiguous U.S. In the High Plains, this includes extreme western Wyoming. Below-normal temperatures are expected throughout the Plains, including North Dakota, South Dakota, Nebraska, Kansas, the eastern half of Colorado, and extreme eastern Wyoming. Elsewhere, there are equal chances for above-, below-, and near-normal temperatures during the April-June period.

Precipitation

The precipitation outlook for the next three months calls for a higher probability of above-normal precipitation across a large portion of the contiguous U.S., including the Interior West, the Plains, the Southeast, and the Mid-Atlantic. In the High Plains, this includes Colorado, Wyoming, Kansas, Nebraska, South Dakota, and extreme southern North Dakota. Below-normal precipitation is expected in the Pacific Northwest. Elsewhere, there are equal chances for above-, below-, and near-normal precipitation during the April-June period.

Drought

The March 21st U.S. Seasonal Drought Outlook indicates that drought is expected to persist across parts of the Pacific Northwest. Drought may improve or be removed in portions of the West and the Southern Plains. In the High Plains, this includes southern Colorado as well as south-western Wyoming. Drought development is expected in the Pacific Northwest, but drought development is not anticipated in the High Plains region through June.



Above: The three-month temperature probability outlook (top), the three-month precipitation probability outlook (middle), and the U.S. Seasonal Drought Outlook (bottom). For more information on these outlooks, produced by the Climate Prediction Center, see: <http://www.cpc.ncep.noaa.gov>.

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	46.6	22.7	34.7	-4.5	71	03/27	-11	03/04	1.27	0.40	146
Alamosa San Luis Airport	50.4	22.4	36.4	2.9	69	03/27	14	03/25	1.42	0.89	268
Colorado Springs Municipal Airport	49.4	24.4	36.9	-2.2	76	03/28	1	03/04	1.22	0.22	122
Denver International Airport	46.7	23.5	35.1	-5.3	73	03/27	-6	03/03	1.39	0.47	151
Grand Junction Walker Field Airport	53.9	33.5	43.7	-0.2	70	03/27	24	03/15	2.29	1.37	249
Pueblo Memorial Airport	56.2	26.3	41.3	-1.0	82	03/28+	2	03/05	1.35	0.42	145

Kansas	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Concordia Municipal Airport	47.5	28.2	37.8	-5.2	80	03/27	-5	03/04	2.33	0.32	116
Dodge City Regional Airport	52.1	27.7	39.9	-4.5	78	03/27	-1	03/04	1.33	-0.26	84
Goodland Renner Field	48.0	23.0	35.5	-5.0	78	03/27	-10	03/04	1.17	0.10	109
Topeka Municipal Airport	51.6	30.9	41.3	-3.5	75	03/27	0	03/04	2.72	0.23	109
Wichita Mid-Continent Airport	54.9	32.8	43.8	-2.7	75	03/28	2	03/05	2.47	-0.22	92

Nebraska	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Chadron Municipal Airport	39.7	16.5	28.1	-7.7	68	03/26	-21	03/03	1.10	-0.13	89
Grand Island Airport	43.8	24.4	34.1	-5.3	76	03/27	-10	03/04	3.67	1.87	204
Lincoln Municipal Airport	45.3	24.2	34.7	-5.4	76	03/27	-9	03/04	2.65	0.72	137
Norfolk Karl Stefan Airfield	40.9	22.4	31.6	-5.8	70	03/27	-9	03/03	2.98	1.21	168
North Platte Regional Airport	45.0	19.8	32.4	-5.6	76	03/27	-25	03/04	2.68	1.63	255
Omaha Eppley Airport	44.5	26.6	35.5	-4.0	76	03/27	-5	03/03	2.68	0.69	135
Valentine Miller Field	41.3	18.6	30.0	-6.2	72	03/26	-17	03/03	1.84	0.77	172

North Dakota	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Bismarck Municipal Airport	33.4	12.0	22.7	-7.2	57	03/27	-15	03/03	0.99	0.12	114
Fargo International Airport	28.6	10.8	19.7	-8.1	45	03/27	-20	03/03	1.58	0.28	122
Grand Forks International Airport	27.1	7.8	17.4	-7.8	46	03/27	-17	03/07	1.21	0.25	126
Theodore Roosevelt Airport	33.2	12.7	22.9	-7.1	55	03/21	-19	03/03+	T*	-0.69*	0*
Williston International Airport	35.0	12.2	23.6	-5.7	65	03/26	-19	03/03+	0.01	-0.70	1

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	30.6	11.1	20.9	-9.0	52	03/27	-20	03/03	1.33	0.17	115
Huron Regional Airport	33.7	15.8	24.7	-8.4	59	03/31	-21	03/03	2.19	0.73	150
Pierre Regional Airport	33.7	16.6	25.1	-9.3	60	03/31	-16	03/03	1.79	0.56	146
Rapid City Regional Airport	38.1*	16.8*	27.4*	-8.0*	66	03/26	-16	03/04	0.66*	-0.27*	71*
Sioux Falls Joe Foss Field Airport	38.7	20.5	29.6	-3.3	69	03/27	-17	03/03	3.64	1.88	207

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	41.4	18.2	29.8	-5.4	63	03/27+	-8	03/04+	1.74	0.92	212
Cheyenne Municipal Airport	42.4	20.2	31.3	-4.6	68	03/27	-16	03/04	2.38	1.33	227
Lander Hunt Field Airport	42.4	20.2	31.3	-4.2	66	03/27	-6	03/04	1.28	0.12	110
Laramie Regional Airport	36.8	12.3	24.5	-6.4	62	03/27	-22	03/04	0.84	0.26	145
Rawlins Municipal Airport	37.1	16.7	26.9	-5.4	58	03/27	-4	03/04	0.77	0.09	113
Sheridan County Airport	41.8	16.8	29.3	-5.9	65	03/26	-17	03/04+	0.44	-0.54	45

March 2019 Highlights

Monthly Rankings

Precipitation and snowfall in inches

Wettest / Driest	Precipitation / Ranking	Record / Year	Period of Record
Alamosa, CO	1.42 / 2nd wettest (tie, 1973)	1.62 / 1992	1906-2019
Grand Junction, CO	2.29 / 2nd wettest	2.36 / 1912	1893-2019
Scottsbluff, NE	2.61 / 4th wettest	2.99 / 1927	1893-2019
Grand Island, NE	3.67 / 5th wettest	6.63 / 1987	1895-2019
Casper, WY	1.74 / 6th wettest	2.43 / 1954	1939-2019
Cheyenne, WY	2.38 / 6th wettest	3.65 / 1990	1871-2019
North Platte, NE	2.68 / 7th wettest	4.37 / 1949	1874-2019
Chadron, NE	1.10 / 10th wettest	2.44 / 2016	1941-2019
Williston, ND	0.01 / DRIEST (tie)	0.01 / 1966	1894-2019
Snowiest / Least Snowiest	Snowfall / Ranking	Record / Year	Period of Record
Scottsbluff, NE	30.8 / SNOWIEST	26.0 / 1906	1893-2019
Casper, WY	27.4 / 5th snowiest	36.2 / 1975	1939-2019
Pierre, SD	15.9 / 6th snowiest	31.8 / 1975	1893-2019
Cheyenne, WY	23.3 / 8th snowiest	39.2 / 1990	1871-2019
Alamosa, CO	10.4 / 10th snowiest	29.2 / 1973	1906-2019
Grand Forks, ND	14.4 / 10th snowiest	29.3 / 1966	1893-2019
Grand Junction, CO	0.0 / LEAST SNOWIEST (tie)	0.0 / 1999+	1893-2019

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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:
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www.hprcc.unl.edu/webinars.php

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