



2016 Annual Climate Summary



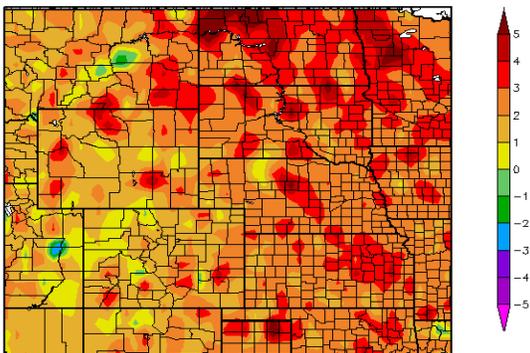
Record Warmth

The major highlight of the year was the record warmth that occurred throughout most of the High Plains, particularly in the Dakotas. Temperature departures ranging from approximately 2.0-4.0 degrees F (1.1-2.2 degrees C) above normal were experienced across most of the region, resulting in quite a few records for top 10 warmest year. A strong El Niño contributed to above-normal temperatures during the winter across the northern Plains. Warmer temperatures during winter and early spring caused mountain snowpack to suffer in Wyoming. While the summer was only slightly warmer than normal, the region experienced much-above-normal temperatures in June due to the occurrence of several heat waves. The warmth of the fall was particularly impressive, as it set several records around the region. Higher temperatures caused precipitation to fall more as rain instead of snow, which brought about a slow start to the snowpack season in the Rockies. However, the warmth extended the growing season by delaying the first fall freeze in many locations, and it also aided with harvest. The greatest below-normal temperature departures came at the end of the year, as several Arctic air masses moved through the region in December and brought some of the coldest temperatures of the year.

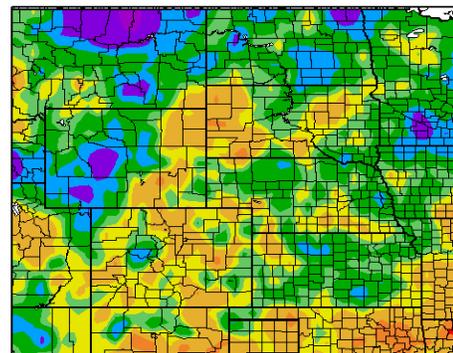
Precipitation varied from season to season, but most locations ended the year either slightly below or slightly above normal. However, wet conditions were somewhat more prominent, as there were several top 10 records for wettest year. Flood events were partially responsible for wetness in places such as Wichita, Kansas and Lander, Wyoming. Excessive wetness caused delays in spring planting and the emergence of various crop diseases in South Dakota, Nebraska, and Kansas. It was drier in Colorado and an area including western South Dakota and northeastern Wyoming, but the dryness was not record-breaking. While drought was a problem in a few locations throughout the year, it did not cause major impacts region-wide in 2016. In fact, conditions were favorable enough that corn, soybean, and sugar beet production were projected to hit record highs in 2016 in the U.S.

Temperature and Precipitation Overview

Departure from Normal Temperature (F)
1/1/2016 – 12/31/2016



Percent of Normal Precipitation (%)
1/1/2016 – 12/31/2016



Above: Departure from 1981-2010 normal temperature (left) and percent of normal precipitation (right) for 2016 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

Overall, precipitation was near normal in the region for 2016. Most places received 70-130 percent of normal precipitation. Wetter locations included western and central Wyoming and pockets of North Dakota. Localized excessive wetness also occurred in south-central Kansas. Locations with notable top 5 records for wettest year included Wichita, Kansas (2nd wettest); Lander, Wyoming (3rd wettest); and Bismarck, North Dakota (4th wettest). While precipitation varied across the region during most months, April was especially remarkable due to widespread wetness. Much of the High Plains received 200-400 percent of normal precipitation during the month, and many locations had a top 5 wettest April on record.

On the dry side, there were particular areas that experienced below-normal precipitation for the year, and certain months were rather dry across the region, but the dryness was not record-breaking. The most widespread dryness occurred in June and was accompanied by above-normal temperatures, which caused topsoil to dry out and crops to become stressed. One region that was affected by conditions in June was an area encompassing the Black Hills of South Dakota and northeastern Wyoming. Warm temperatures and lack of precipitation caused drought to develop and persist throughout the summer and fall.

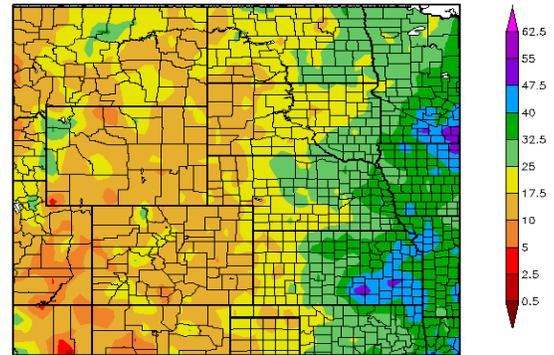
Snowpack peaked about two weeks earlier than normal and was slightly below average in the Missouri River Basin during the 2016 season. While snowpack fared well in Colorado, the first half of the season was disappointing in Wyoming. The Bighorn Mountains suffered the most, and the low snowpack caused drought to develop over the winter. However, snowpack did recover in Wyoming due to a wetter March and April. The early mountain snowmelt and dry conditions during the summer produced below-normal streamflows in the Upper Basin. Meanwhile, storm systems tracking across the Lower Basin resulted in high streamflows there. The disparity in streamflow between the Upper and Lower Basins did have a positive impact: the U.S. Army Corps of Engineers did not have to increase releases to meet downstream targets during the summer, which was helpful because it was a low runoff year in the Missouri River Basin. The 2017 snowpack season got off to a slow start in the Rockies, but ample snowfall in December allowed it to recover to near-normal ranges.

The following locations had notable precipitation records during 2016:

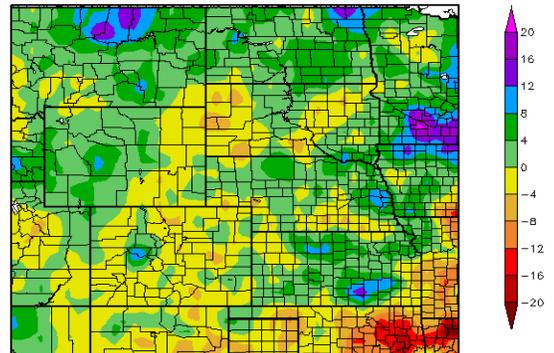
- Grand Island, Nebraska: 2nd highest 1-day snowfall total of 17.0 inches (43 cm), February 2 (period of record 1895-2017)
- Lander, Wyoming: 3rd highest 1-day precipitation total of 3.35 inches (85 mm), May 7 (period of record 1891-2017)
- Wichita, Kansas: 3rd highest 2-day precipitation total of 8.85 inches (225 mm), September 8-9 (period of record 1888-2017)
- Pueblo, Colorado: tied for 4th longest streak of no measurable precipitation (defined as less than 0.01 inches), 63 days ending November 16 (period of record 1888-2017)

Regional Precipitation

Precipitation (in)
1/1/2016 - 12/31/2016



Departure from Normal Precipitation (in)
1/1/2016 - 12/31/2016



Above: Total precipitation in inches (top) and departure from normal precipitation in inches (bottom) for 2016. 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

It was a very warm year across the region with widespread temperature departures of 2.0-4.0 degrees F (1.1-2.2 degrees C) above normal. The warmth was most impressive in North Dakota, as departures exceeding 4.0 degrees F (2.2 degrees C) above normal occurred in several locations. For example, Minot was an astounding 5.0 degrees F (2.8 degrees C) above normal for the year. The widespread warmth caused numerous locations in all six states of the High Plains region to be ranked in the top 10 warmest years on record and several locations in North Dakota experienced their warmest year on record, including Bismarck, Fargo, Grand Forks, and Minot.

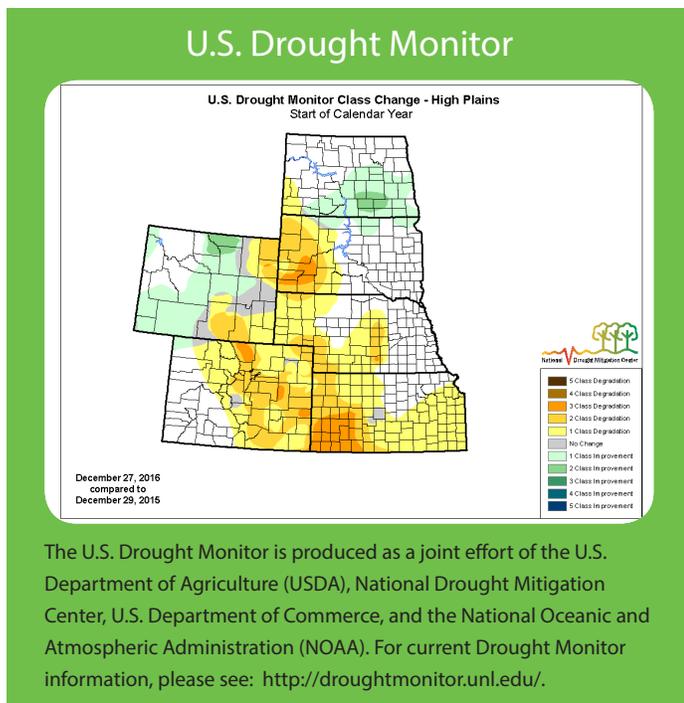
Average monthly temperatures were especially impressive in March, June, October, and November. Average temperatures were largely influenced by warmer minimum temperatures more so than maximum temperatures. The El Niño that was present during the first part of 2016 was partially responsible for above-normal winter temperatures experienced in the northern Plains. It is worth noting that while 2016 was warm on the whole, December was quite cold for the region. Several Arctic outbreaks, including one that brought the coldest temperatures of the year to many locations, created departures of 6.0-8.0 degrees F (3.3-4.4 degrees C) below normal across the western Dakotas and northern Wyoming.

The following locations had notable temperature records during 2016:

- Bismarck, North Dakota: earliest 70.0 degrees F+ (21.1 degrees C) temperature on record, February 27 (period of record 1875-2017)
- Casper, Wyoming: earliest 100.0 degrees F (37.8 degrees C) temperature on record, June 21 (period of record 1939-2017)
- Colorado Springs, Colorado: earliest 100.0 degrees F+ (37.8 degrees C) temperature on record and tied for highest temperature on record of 101.0 degrees F (38.3 degrees C), June 21 (period of record 1894-2017)
- Dodge City, Kansas: latest 100.0 degrees F+ (37.8 degrees C) temperature on record, October 17 (period of record 1874-2017)
- Manhattan, Kansas: latest first fall freeze on record, November 12 (period of record 1893-2017)

Drought Conditions

For the most part, drought was not a major widespread issue in the High Plains during 2016. While there were some areas where drought persisted throughout the year, most places received enough relief to avoid prolonged, intense drought. In fact, in August the U.S. Department of Agriculture forecasted record-high corn and soybean production in 2016 due to favorable weather and field conditions. The December 27, 2016 release of the U.S. Drought Monitor indicated that nearly half of the region was experiencing drought or abnormal dryness. Much of this depiction was due to a warm and dry fall experienced by much of the region, causing many areas to begin winter with depleted soil moisture.



Three distinct areas that were impacted by drought during 2016 included the Bighorn Mountains of northern Wyoming, the Black Hills region of South Dakota extending westward into northeastern Wyoming, and an area encompassing eastern Colorado and western Kansas. An abysmal snowpack season was largely to blame for drought in the Bighorn Mountains, which persisted until September when wet conditions prevailed. The drought in the Black Hills developed rapidly in June due to warm, dry conditions and was ongoing at the end of the year. This area was impacted by wildfires, low productivity of rangeland, reductions in livestock, hay losses, and water quality/quantity issues. A warm and dry fall caused drought to develop in eastern Colorado and western Kansas. Blowing dust, dry soils, and a delay in the emergence of winter wheat were reported in these areas.

Noteworthy Events

Severe Weather on the Plains: During May 7-10, severe weather that included tornadoes, high winds, and large hail impacted Colorado, Nebraska, and Kansas. For example, a nearly stationary severe thunderstorm produced hail up to 4.25 inches (11 cm) in diameter and damaged homes and vehicles in Lincoln, Nebraska. This storm system also impacted parts of the Midwest. Damage was costly, as it made the Billion-Dollar Weather and Climate Disasters list for 2016.

Black Hills Drought: Drought began to develop during late spring in the Black Hills region of South Dakota extending westward into northeastern Wyoming. Warm, dry conditions in June exacerbated the drought, and it continued to intensify throughout the summer. Despite some relief during the late summer, warm and dry fall conditions caused the drought to re-intensify. This area was impacted by wildfires, low productivity of rangeland, reductions in livestock, hay losses, and water quality/quantity issues.

Flooding in South-Central Kansas: A moist atmosphere combined with several upper-level disturbances to produce training storms and flooding in south-central Kansas from September 7-10. Rainfall rates of 3.00-5.00 inches (76-127 mm) per hour were reported, which resulted in flooding that led to numerous roads being closed, stranded vehicles, and water rescues. Several rivers and streams swelled out of their banks, and a record-high crest occurred on the Ninnescah River near Belle Plaine. Over a foot of rain fell in the city of Clearwater.

Cottonwood Fire: Persistent drought and especially warm weather in October created ideal conditions for a fire to spread rapidly near Cottonwood, South Dakota. The fire burned 41,360 acres of private, state, and national grass-land property, and hay and cattle were lost as well. This fire ended up becoming the largest October wildfire and 5th largest wildfire on record in South Dakota's history.

Record Crop Yields: Ideal weather and field conditions led to an excellent year for several crops. Record-high yields are projected for corn, soybeans, and sugar beets. Above-normal temperatures, a long growing season, the lack of widespread drought, and timely rainfall were all contributing factors.

Christmas Storm: A large storm system tracked across the region on December 25-26 bringing a variety of weather conditions, including snow, freezing rain, high winds, and thunderstorms. Blizzard conditions occurred in western and central North Dakota, and to the south and east, freezing rain impacted southeastern North Dakota and northern South Dakota. The ice storm caused a power outage that affected thousands of people. In the southern part of the region, this same storm system brought thunderstorms, hurricane-force winds, and tornadoes to southern Nebraska and northern Kansas.



Top photo: Damage from the hailstorm in May in Lincoln, NE. Photo courtesy Kristin Stref via AP.

Second photo: September flooding in Greenwood County, KS. Photo courtesy Greenwood County (KS) EM.

Third photo: Cottonwood Fire burning on October 17th in SD. Photo courtesy South Dakota Division of Wildland Fire.

Bottom photo: Ice accumulation from the Christmas Storm along Highway 12 near Summit, SD. Photo courtesy Ryan Lueck.

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	65.4*	38.1*	51.8*	2.2	98	07/10	-12	12/17	17.95	1.21	107
Alamosa San Luis Airport	61.4	24.6	43.0	1.5	93	06/19	-26	01/11	9.17	1.86	125
Colorado Springs Municipal Airport	66.1	37.9	52.0	3.1	101	06/21	-14	12/17	14.35	-2.19	87
Denver International Airport	66.7	38.0	52.3	1.9	102	07/10	-15	12/17	11.85	-2.45	83
Grand Junction Walker Field Airport	66.4	40.4	53.4	0.8	104	06/21	-1	02/03	8.83	-0.59	94
Pueblo Memorial Airport	72.7	38.7	55.7	3.8	105	07/10	-19	12/18	11.91	-0.66	95

Kansas	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Concordia Municipal Airport	68.0	45.2	56.6	2.8	102	06/15	-12	12/18	30.02	2.13	108
Dodge City Regional Airport	70.9	43.7	57.3	2.0	101	10/17	-16	12/18	23.40	1.80	108
Goodland Renner Field	68.7	38.6	53.6	2.3	104	07/22	-15	12/17	17.38	-2.28	88
Topeka Municipal Airport	69.3	46.9	58.1	3.1	103	06/22	-9	12/18	43.23	6.77	119
Wichita Mid-Continent Airport	72.1	48.7	60.4	3.5	105	07/23	-10	12/18	50.60	17.96	155

Nebraska	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Chadron Municipal Airport	65.8	34.4	50.1	2.9	108	07/20	-26	12/18	13.57	-4.48	75
Grand Island Airport	65.2	41.7	53.4	2.7	101	06/21	-15	12/18	24.23	-2.43	91
Lincoln Municipal Airport	66.7	43.3	55.0	3.5	101	06/15	-12	12/18	28.90	-0.05	100
Norfolk Karl Stefan Airfield	62.8	40.1	51.5	2.3	95	06/17	-24	12/18	31.43	4.02	115
North Platte Regional Airport	66.3	36.8	51.6	2.9	98	07/21	-17	12/17	23.05	2.82	114
Omaha Eppley Airport	65.4	44.7	55.0	4.0	99	08/11	-11	12/18	34.64	4.02	113
Valentine Miller Field	64.2	36.5	50.4	2.5	102	07/20	-31	12/18	26.58	6.56	133

North Dakota	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Bismarck Municipal Airport	58.8	34.2	46.5	3.7	97	07/20	-31	12/17	23.48	5.63	132
Fargo International Airport	56.5	36.8	46.7	4.5	92	07/22	-23	01/17	23.53	0.95	104
Grand Forks International Airport	54.5	34.2	44.4	4.6	93	05/05	-24	12/18	26.72	5.91	128
Theodore Roosevelt Airport	56.8*	31.9*	44.3*	1.8	98	07/20	-25	12/17	16.71	0.94	106
Williston International Airport	57.6*	33.7*	45.6*	4.1	99	08/22	-24	12/17	15.55	1.18	108

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	59.6	35.5	47.6	4.7	100	06/09	-37	12/18	20.59	-1.13	95
Huron Regional Airport	60.4	37.2	48.8	2.9	99	07/22	-31	12/18	19.52	-3.38	85
Pierre Regional Airport	61.9	37.5	49.7	2.4	109	07/20	-21	12/18	21.01*	1.00	105
Rapid City Regional Airport	62.9	35.1	49.1	2.1	103	06/11	-23	12/17	13.26	-3.03	81
Sioux Falls Joe Foss Field Airport	59.5	38.9	49.2	3.6	98	06/11	-27	12/18	32.23	5.85	122

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	61.0	32.3	46.7	1.4	100	06/21	-33	12/08	15.57	3.05	124
Cheyenne Municipal Airport	61.4	35.7	48.6	2.3	96	07/09	-16	12/08	14.71	-1.23	92
Lander Hunt Field Airport	59.8	33.5	46.6	1.6	97	07/21	-21	12/17	21.29	8.63	168
Laramie Regional Airport	56.7	28.6	42.6	1.7	91	06/21	-23	12/08	11.65	0.73	107
Rawlins Municipal Airport	57.6	31.1	44.4	2.0	96	06/21	-18	12/08	7.95	-1.30	86
Sheridan County Airport	62.7	33.3	47.9	2.8	104	06/21	-25	12/17	16.95	2.79	120

2016 Highlights

Annual Rankings

Temperature in degrees F / Precipitation in inches

Warmest / Coolest	Temperature / Ranking	Record / Year	Period of Record
Bismarck, ND	46.5 / WARMEST	46.3 / 1931	1875-2017
Fargo, ND	46.7 / WARMEST	46.3 / 2012+	1881-2017
Grand Forks, ND	44.4 / WARMEST	43.9 / 1987	1894-2017
Aberdeen, SD	47.6 / 2nd warmest	48.1 / 1987	1897-2017
Cheyenne, WY	48.6 / 2nd warmest	49.0 / 2012	1873-2017
Wichita, KS	60.4 / 2nd warmest	61.4 / 2012	1889-2017
Colorado Springs, CO	52.0 / 3rd warmest	52.9 / 2012	1895-2017
Pueblo, CO	55.7 / 3rd warmest (tie, 1954)	56.5 / 1981+	1889-2017
Grand Island, NE	53.4 / 3rd warmest	56.0 / 1934	1896-2017
Lincoln, NE	55.0 / 4th warmest (tie, 1939+)	55.6 / 1934+	1887-2017
Omaha, NE	55.0 / 4th warmest (tie, 1934)	55.9 / 1931	1871-2017
Valentine, NE	50.4 / 4th warmest	52.0 / 2012	1890-2017
Wettest / Driest	Precipitation / Ranking	Record / Year	Period of Record
Wichita, KS	50.60 / 2nd wettest	53.82 / 2008	1888-2017
Lander, WY	21.29 / 3rd wettest	21.89 / 1957	1891-2017
Grand Forks, ND	26.72 / 4th wettest	29.11 / 1944	1893-2017
Bismarck, ND	23.48 / 8th wettest	30.92 / 1876	1874-2017
Valentine, NE	26.58 / 9th wettest	32.68 / 1977	1889-2017
Casper, WY	15.57 / 10th wettest	20.48 / 1982	1939-2017

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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

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