



September 2015 Climate Summary

Sunrise with rain shaft - Photo by Martha Shulski

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Record-Setting Warmth

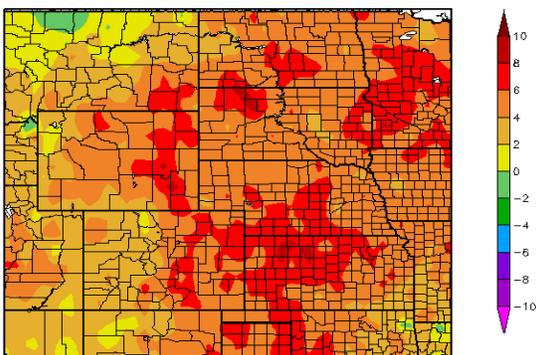
September was a record-setting month for much of the High Plains region and beyond. The jet stream stayed well to the north of the region in Canada, which allowed for unseasonably warm temperatures. The month started off extremely warm with temperatures soaring above 100 degrees F (37.8 degrees C) in central and western portions of Kansas, Nebraska, South Dakota, and North Dakota. Daily average temperature departures ranged from 10.0-20.0 degrees F (5.6-11.1 degrees C) above normal for several days. Although there was a dip in the middle of the month, temperatures rebounded and this resulted in an overall very warm month for the region.

Across the U.S., temperature departures of 3.0-6.0 degrees F (1.7-3.3 degrees C) were common for parts of the Southwest, the Plains, the Midwest, and the Northeast. Embedded areas of the Plains, upper Midwest, and Northeast had average temperature departures in excess of 6.0 degrees F (3.3 degrees C) above normal. The only areas to have average temperatures which were below normal were the Pacific Northwest and portions of the southeastern U.S. Precipitation was variable across the country with much of the western and south-central U.S. receiving, at best, 25 percent of normal precipitation. This translated into deficits of at least 1.50 inches (38 mm) for a large area encompassing Texas through Alabama and portions of Oklahoma, Kansas, and Missouri. Meanwhile, precipitation totals of at least 150 percent of normal occurred for some areas of the East Coast, southern portions of California and Arizona, a few pockets of the central U.S., and an area stretching from northern Utah through Montana.

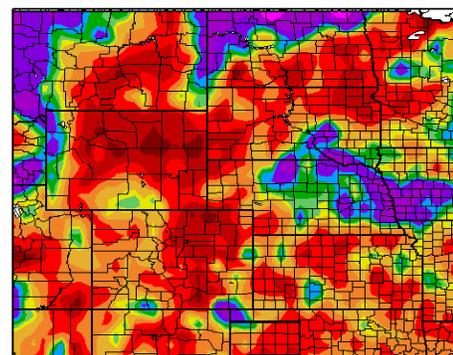
Overall, the generally warm and dry conditions were good for producers as these helped progress the maturity of late planted crops, aided in the dry down process, and allowed for fall harvesting and/or planting activities to begin. According to the United States Department of Agriculture (USDA), record corn and soybean yields are expected in both Nebraska and South Dakota, while record hard spring wheat yields are forecast for North Dakota.

Temperature and Precipitation Overview

Departure from Normal Temperature (F)
9/1/2015 - 9/30/2015



Percent of Normal Precipitation (%)
9/1/2015 - 9/30/2015



Above: Departure from 1981-2010 normal temperature (left) and percent of normal precipitation (right) for September 2015 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 a fairly dry month across the High Plains region, with large areas receiving little to no precipitation. Large portions of Wyoming, eastern Colorado, western and northern South Dakota, and southern and eastern North Dakota all received less than 50 percent of normal precipitation. For the majority of the dry areas, this translated into a deficit of less than an inch (25 mm); however, in areas of northeastern South Dakota and southwestern Kansas, deficits were in excess of 2.00 inches (51 mm). The exceptions to the dryness included western Wyoming, western and northern North Dakota, and an area stretching from north-central Nebraska/south-central South Dakota to the east into eastern Nebraska and western Iowa. These areas received at least 150 percent of normal precipitation.

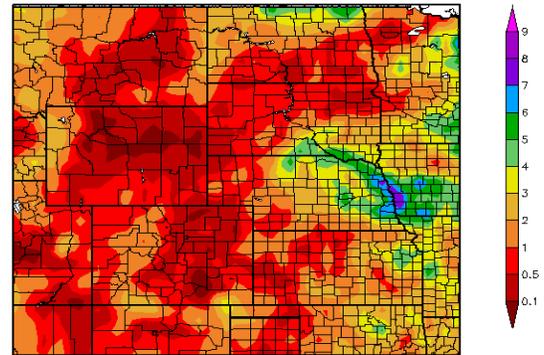
The wide range in precipitation totals led to extremes on both ends of the spectrum and many locations ranked in either the top 10 driest or the top 10 wettest Septembers on record. Some dry examples included Casper, WY (7th driest), Boulder, CO (9th driest), and Rapid City, SD (10th driest). Meanwhile, wet locations included Omaha, NE (3rd wettest) and Topeka, KS (10th wettest).

Pueblo, Colorado was one of the drier locations this month and only received 0.03 inches (1 mm) of precipitation. This amount ranked as the 6th driest September on record and was a mere 4 percent of normal. Although a paltry amount, this could not beat the record of a Trace that is shared with the Septembers of 1892, 1916, and 1956 (period of record 1888-2015). Interestingly, Pueblo went from one extreme to the other as it just had its 6th wettest August last month.

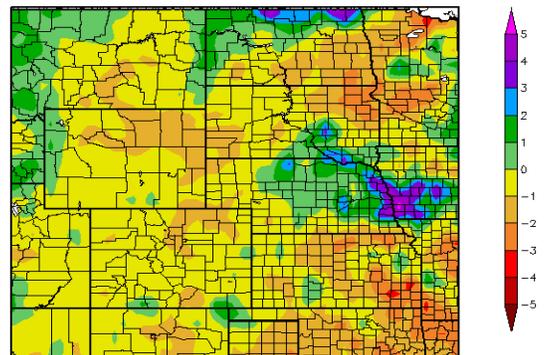
On the wet side, Omaha, Nebraska had an impressive month with 9.31 inches (236 mm) of precipitation, which was 6.63 inches (168 mm) above normal, or 347 percent of normal. Much of the precipitation fell in a two day period, the 23rd and 24th, when storms brought heavy rain that caused street flooding, power outages, and even some school closings. On the 23rd, 5.74 inches (146 mm) fell, setting a new daily record, and on the 24th, 1.48 inches (38 mm) fell. The 2-day total came to 7.22 inches (183 mm), which set a new 2-day rainfall record for September in Omaha. The old record of 7.20 inches (183 mm) set on September 7-8, 1965 was narrowly beat (period of record 1871-2015). This was the second wet month in a row for Omaha, which, like Pueblo, also had its 6th wettest August last month.

Regional Precipitation

Precipitation (in)
9/1/2015 – 9/30/2015



Departure from Normal Precipitation (in)
9/1/2015 – 9/30/2015



Above: Total precipitation in inches (top) and departure from normal precipitation in inches (bottom) for September 2015. These maps are produced by HPRCC and can be found on the Current Climate Summary Maps page at: <http://hprcc.unl.edu/maps/current>.

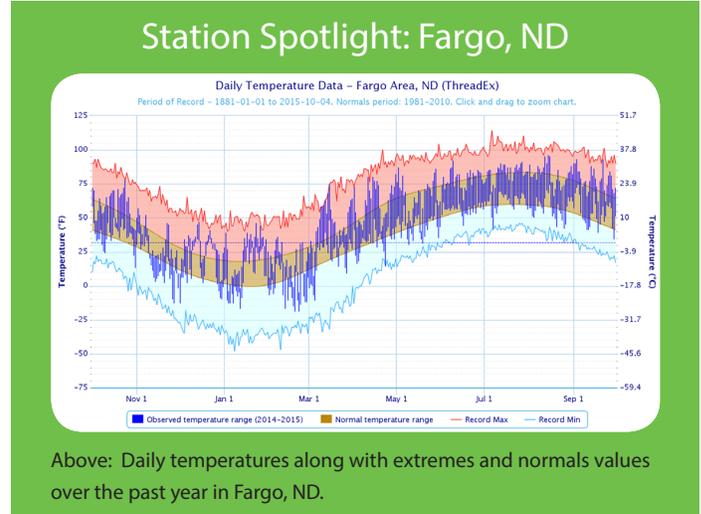
Streamflow Update

Just like much of the summer, streamflows across the High Plains region were largely near normal this month, according to data from the United States Geological Survey (USGS). There were some exceptions as monthly average streamflows were much above normal in two main areas of the region - the Black Hills and eastern Nebraska/western Iowa. Meanwhile, flows were much below average in southwestern Nebraska along the Republican River and in central Kansas along the Solomon and Smoky Hill Rivers.

For more detailed information on streamflow and to access up-to-date maps and data at individual stream gauges, please visit the USGS WaterWatch website: <http://waterwatch.usgs.gov/index.php>.

Temperatures

It was an extremely warm month for the High Plains region with average temperatures generally in excess of 4.0 degrees F (2.2 degrees C) above normal. The largest departures occurred across eastern Colorado, much of western and central Kansas, southern and central Nebraska, eastern Wyoming, and pockets of the Dakotas where temperature departures were 6.0-8.0 degrees F (3.3-4.4 degrees C) above normal. These higher than normal temperatures caused numerous locations in every state of the region to be ranked in the top 10 warmest Septembers on record and some new records were also set. For instance, Denver, CO, Fargo, ND, Lead, SD, and Cheyenne, WY all had their warmest September on record. Meanwhile, a sampling of locations ranking in the top 10 warmest included Casper, WY (2nd), Goodland, KS (3rd), Omaha, NE (4th), Bismarck, ND (5th), Boulder, CO (6th), and Sioux Falls, SD (7th). A detailed look at these rankings may be found on page 6.

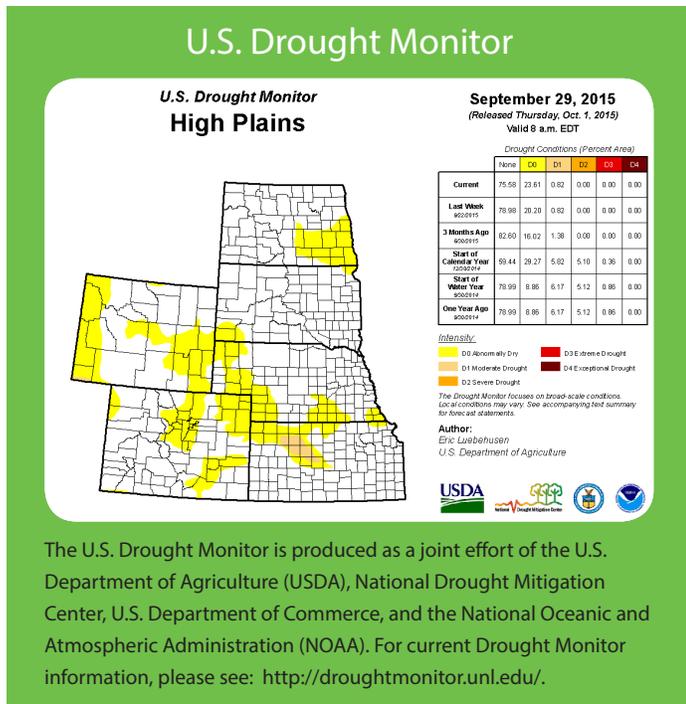


For western areas of the region, this warmth was not isolated to September as above normal temperatures have been experienced much of the year in places like Pueblo, Colorado and Cheyenne, Wyoming. For instance, at the end of the month, Cheyenne's year-to-date average temperature was 51.8 degrees F (11.0 degrees C). This was 2.2 degrees F (1.2 degrees C) above normal and ranked as the 2nd warmest January 1-September 30 on record (period of record 1872-2015). Similarly, Pueblo had its 7th warmest January 1-September 30 with an average temperature of 58.3 degrees F (14.6 degrees C), which was 2.6 degrees F (1.4 degrees C) above normal (period of record 1888-2015).

Drought Conditions

The drier conditions across the High Plains region this month led to some changes in the U.S. Drought Monitor. While not a major change, the total area in drought (D1-D4) in the region did increase to just under one percent. At the end of the month, two areas of moderate drought conditions (D1) were present - one in the far southwest corner of Wyoming and the other in northwestern Kansas.

The small area of drought in Wyoming has persisted for several months; however, the drought area in Kansas developed over the past month due to warm and dry conditions. At the end of last month, Kansas was drought free for the first time since 2010. Unfortunately, this drought free period did not last long.



Elsewhere, abnormally dry conditions (D0) developed or expanded in portions of all the states in the High Plains region. This included central and eastern Colorado, eastern Wyoming, western and southern Nebraska, southwestern South Dakota, and eastern North Dakota. While D0 does not indicate drought, it does show areas that should be monitored for possible development. D0 now encompasses almost 25 percent of the region.

Taking a look to the west shows that extreme drought conditions (D3) improved slightly in northwestern Montana, while moderate (D1) and severe (D2) drought conditions expanded slightly. Outlooks still indicate increased chances for a warmer and drier winter, so conditions should continue to be monitored in the coming months.

Climate Outlooks

According to the Climate Prediction Center, El Niño conditions continued this month and should continue through the end of winter. This El Niño is expected to peak as a strong event later this fall, and then slowly weaken through the winter and spring. If you are looking for more information about El Niño and its impacts there are many resources available. One way to get up-to-date information is to check out the ENSO blog here: <https://www.climate.gov/news-features/department/8443/all>. A special report on El Niño in the Missouri River Basin states is also available here: <http://www.drought.gov/media/pgfiles/ENSO-MOBasin-2015-Final.pdf>.

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

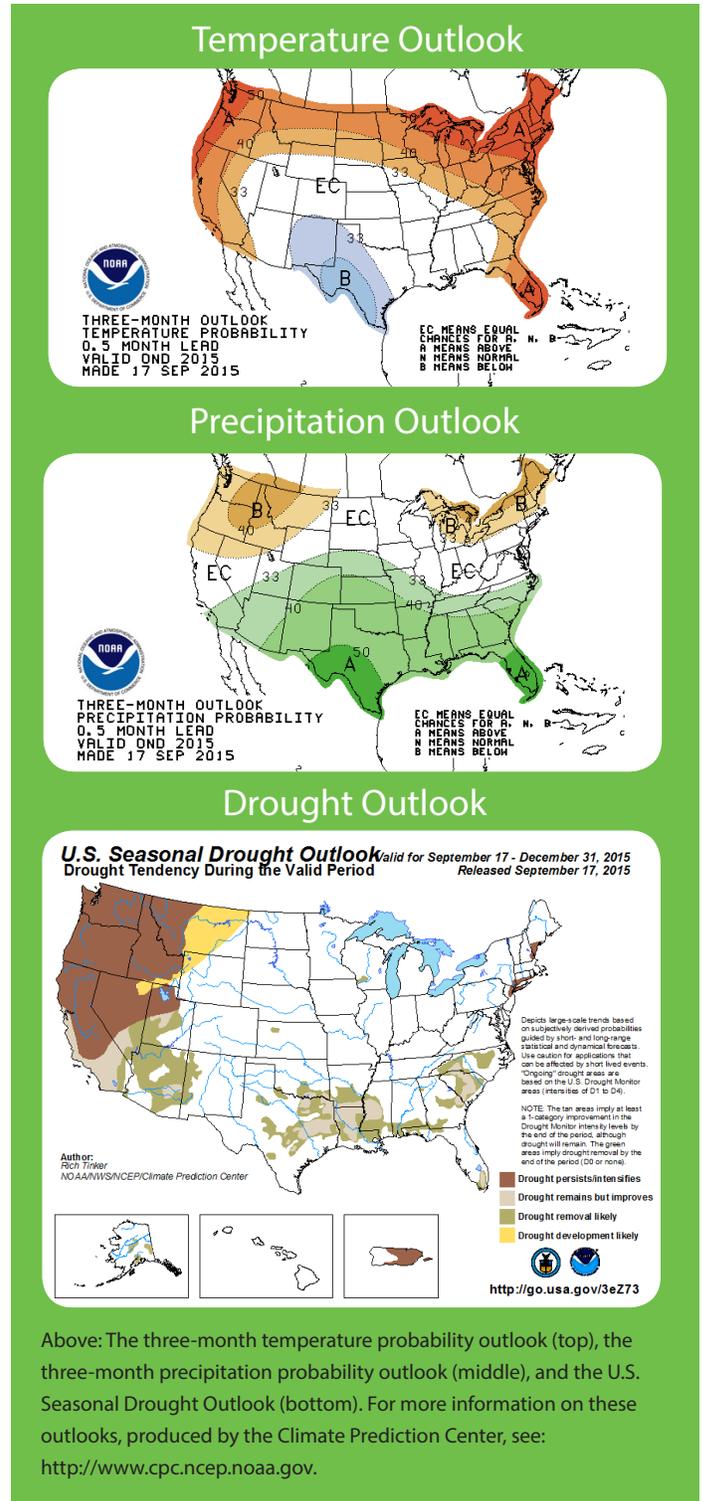
The temperature outlook for the next three months shows a higher probability of above-normal temperatures along the East and West Coasts, as well as the northern tier of the U.S. The only area with a higher probability of below-normal temperatures is an area encompassing New Mexico and most of western and central Texas. For the High Plains region, above-normal temperatures are favored for North Dakota, the majority of South Dakota, and northern Wyoming. Other areas of the region, and the contiguous U.S., have equal chances for above, below, or near normal temperatures.

Precipitation

The precipitation outlook through December indicates a higher probability for above-normal precipitation across much of the Desert Southwest, Great Plains, and Southeast. A large portion of the High Plains region is included with above-normal precipitation being favored in Colorado, Kansas, Nebraska, and southeastern Wyoming. Similar to the past couple of months, below-normal precipitation is favored for parts of the northwestern U.S., Great Lakes, and Northeast. In the High Plains region, this includes the northwestern corner of Wyoming. The remainder of the contiguous U.S. has equal chances for above, below, or near normal precipitation.

Drought

The September 17th U.S. Seasonal Drought Outlook shows that drought development is likely over the next three months across much of central and eastern Montana, along with northwestern Wyoming, and portions of Nevada, Utah, and Idaho. Drought conditions are expected to persist across the majority of the West; however, portions of California could see some welcome improvements. The small areas of drought in New England are also expected to persist. Improvements or removal of drought is likely across other areas of the Desert Southwest, as well as areas of the southern and southeastern U.S.



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	85.3	54.3	69.8	6.8	94	09/14+	43	09/19	0.10	-1.06	9
Alamosa San Luis Airport	78.5	38.3	58.4	3.4	83	09/13+	31	09/27+	0.78	-0.13	86
Colorado Springs Municipal Airport	82.4	52.3	67.3	6.4	89	09/14+	42	09/19	0.32	-0.87	27
Denver International Airport	85.2	53.5	69.4	6.0	92	09/02	44	09/19	0.11	-0.85	11
Grand Junction Walker Field Airport	83.6	54.2	68.9	2.8	90	09/12	46	09/20+	0.79	-0.40	66
Pueblo Memorial Airport	89.3	54.6	72.0	7.3	98	09/13	47	09/21+	0.03	-0.74	4

Kansas	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Concordia Municipal Airport	85.8	62.3	74.1	6.1	100	09/06	45	09/30	1.21	-1.70	42
Dodge City Regional Airport	87.6	60.7	74.2	5.0	100	09/07+	43	09/19	1.01	-0.66	60
Goodland Renner Field	86.8	55.3	71.0	6.4	98	09/03	35	09/19	1.03	-0.19	84
Topeka Municipal Airport	83.7	63.0	73.3	5.0	96	09/06	49	09/12	7.43	3.77	203
Wichita Mid-Continent Airport	87.9	65.1	76.5	5.5	102	09/07	53	09/12	2.13	-1.01	68

Nebraska	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Chadron Municipal Airport	84.2	48.4	66.3	5.3	99	09/02	34	09/19	0.41	-1.32	24
Grand Island Airport	82.2	59.1	70.7	5.6	96	09/03+	47	09/30	3.33	1.10	149
Lincoln Municipal Airport	82.6	60.3	71.5	5.5	98	09/06	45	09/30	4.93	1.91	163
Norfolk Karl Stefan Airfield	80.4	57.5	68.9	5.1	91	09/05+	39	09/12	2.88	0.19	107
North Platte Regional Airport	83.2	54.3	68.7	6.4	98	09/02	33	09/19	1.25	-0.16	89
Omaha Eppley Airport	82.0	61.2	71.6	5.9	98	09/06	45	09/12	9.31	6.63	347
Valentine Miller Field	82.1	52.7	67.4	5.1	102	09/02	35	09/19	4.80	3.16	293

North Dakota	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Bismark Municipal Airport	80.2	48.5	64.4	5.9	101	09/03	31	09/11	0.37	-1.22	23
Fargo International Airport	78.0	53.2	65.6	6.5	93	09/21+	34	09/29	1.23	-1.34	48
Grand Forks International Airport	75.5	49.3	62.4	5.5	93	09/03	29	09/29	0.84	-1.21	41
Theodore Roosevelt Airport	78.6	47.3	63.0	5.8	98	09/02	36	09/11	0.30	-1.17	20
Williston International Airport	75.9	45.7	60.8	4.1	100	09/02	31	09/29+	2.22	1.16	209

All data are preliminary and subject to change. + indicates multiple dates, latest date listed.

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 2015 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	78.9	51.3	65.1	6.2	93	09/03	33	09/19	0.37	-1.82	17
Huron Regional Airport	79.0	54.5	66.8	5.1	92	09/03	37	09/19+	2.16	-0.30	88
Pierre Regional Airport	80.8	52.9	66.9	4.0	100	09/03	37	09/19	1.18	-0.69	63
Rapid City Regional Airport	80.3	49.3	64.8	4.0	97	09/02	41	09/19	0.25	-1.04	19
Sioux Falls Joe Foss Field Airport	77.2	57.0	67.1	5.8	87	09/16+	39	09/12	3.24	0.47	117

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	82.3	46.4	64.4	6.5	91	09/26+	34	09/08	0.19	-0.89	18
Cheyenne Municipal Airport	80.1	49.8	64.9	6.7	89	09/02	38	09/19	0.14	-1.34	9
Lander Hunt Field Airport	81.5	49.1	65.3	6.7	91	09/02+	35	09/18	0.17	-0.88	16
Laramie Regional Airport	75.6	40.9	58.3	5.0	83	09/26	32	09/19	0.34	-0.77	31
Rawlins Municipal Airport	77.0	43.6	60.3	4.9	84	09/02	33	09/19	0.86	-0.11	89
Sheridan County Airport	83.1	45.0	64.0	6.1	98	09/02	35	09/17	0.27	-1.16	19

September 2015 Highlights

Monthly Rankings

Precipitation in inches / Temperature in degrees F

Wettest / Driest	Precipitation / Ranking	Record / Year	Period of Record
Boulder, CO	0.14 / 9th driest	Trace / 1944+	1893-2015
Pueblo, CO	0.03 / 6th driest	Trace / 1956+	1888-2015
Topeka, KS	7.43 / 10th wettest	12.71 / 1973	1887-2015
Omaha, NE	9.31 / 3rd wettest	13.75 / 1965	1871-2015
Valentine, NE	4.80 / 2nd wettest	5.91 / 1973	1889-2015
Rapid City, SD	0.25 / 10th driest	0.03 / 1975	1942-2015
Casper, WY	0.19 / 7th driest	0.07 / 1956	1939-2015
Warmest / Coolest	Temperature / Ranking	Record / Year	Period of Record
Pueblo, CO	72.0 / WARMEST	71.0 / 1931	1888-2015
Goodland, KS	71.0 / 3rd warmest	72.7 / 1931	1895-2015
Omaha, NE	71.6 / 4th warmest	75.3 / 1897	1871-2015
Fargo, ND	65.6 / WARMEST	tie / 1897	1881-2015
Sioux Falls, SD	67.1 / 7th warmest	69.9 / 1908	1893-2015
Cheyenne, WY	64.9 / WARMEST	63.9 / 1998	1872-2015

All data are preliminary and subject to change. + indicates multiple dates, latest date listed.

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For more information please contact us: <http://www.hprcc.unl.edu/contact.php>.

North Dakota Monthly Climate Summary



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

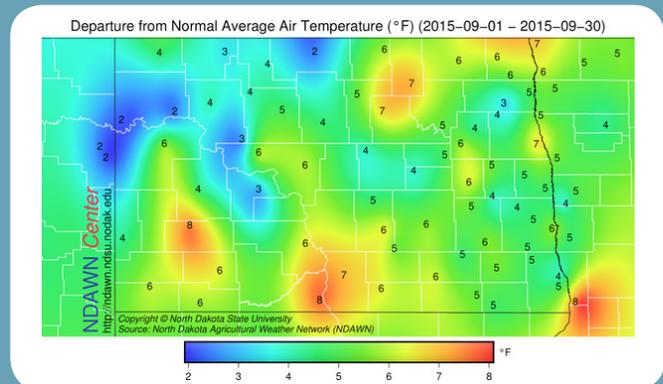
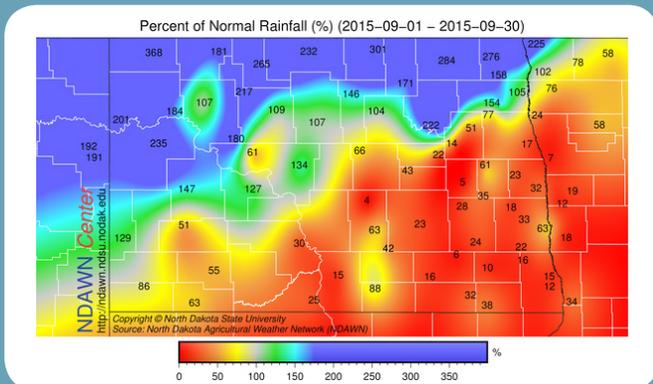
Precipitation:

Very few locations in North Dakota recorded near average precipitation during the month of September (Figure 1). The state was divided in two from the southwest to the northeast corner with the northern and western portion of the state recording well above average precipitation with the southern and eastern portion of the state being quite dry. The North Dakota Agricultural Weather Network (NDAWN) statewide average rainfall was 1.88 inches which is 0.28 inches below the average for those stations. Almost all of the excessive rainfall during the month occurred during the September 4-6, 2015 period when two heavy rain systems moved across northern North Dakota. The Crosby and Crary NDAWN stations both recorded over 4 inches of rain and several other stations measured near or over 2 inches of rain during that period.

Temperature:

September was a very mild month across much of North Dakota (Figure 2). With the exception of the northwestern part of the state, the monthly average temperature was mostly in the 4° to 8° above normal range. The NDAWN average statewide temperature was 62.4° which is 5.1 degrees above normal for those stations. Using the Fargo Airport data that city tied 1897 for the warmest September on record. The Grand Forks (UND) data tied for the 4th warmest September on record and the Bismarck Airport data came in as the 5th warmest. It was the warmest September since 2009 for most of the North Dakota reporting stations.

Temperature and Precipitation Overview



Above: Percent of normal precipitation (left, figure 1, produced by NDAWN) and departure from normal average temperature (right, figure 2, produced by NDAWN) for September 2015 in North Dakota.

Kansas Climate Summary

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Warm and Dry

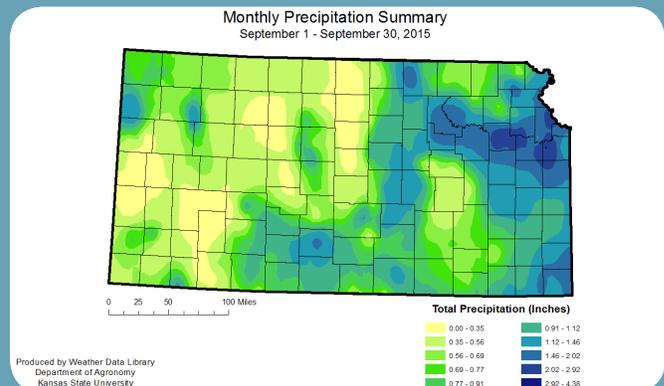
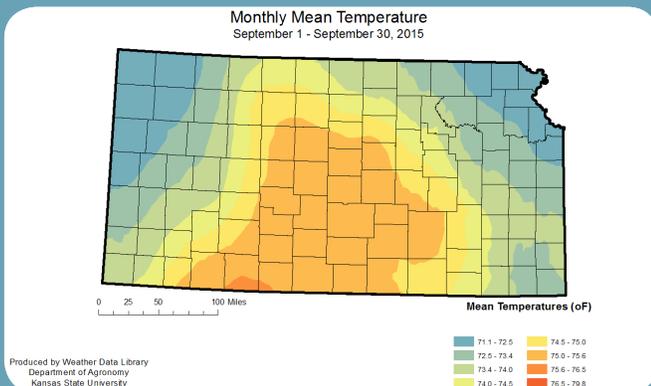
The outlooks for September were a disappointment, as the cooler and wetter than average conditions failed to materialize. September was drier than normal in most of the state. State-wide average precipitation was 1.58 inches or 53 percent of normal. The North Central Division of the state saw the lowest percent of normal precipitation at 39 percent or an average of 1.04 inches. The West Central Division wasn't far ahead with 42 percent of normal or an average of 0.71 inches. The East Central Division was closest to normal with an average of 2.85 inches or 75 percent of normal. This ranks as the 25th driest September on record, placing it in the lower third of the 121 year distribution. The greatest monthly precipitation totals reported were 7.70 inches at Lecompton, Douglas County (NWS) and 8.02 inches at Topeka 4.6 ESE, Jefferson County, (CoCoRaHS). Still, 16 daily precipitation records were set in September. Lecompton's record of 4.36 inches, reported on the 8th, also set a new record for the station in September. The previous record was 4.14 inches set on September 9, 1989.

Temperatures were warmer than normal across the state. The state-wide average temperature was 73.8F, 5.7 degrees warmer than normal for the month. There were 10 new record daily high temperatures set during the month, and 16 records tied. None of the records were new daily highs for the month. In contrast, there were no record cold high temperatures. On the low temperature side, the same trend prevailed with 34 new record warm minimum temperatures and 25 records tied. The 75F at Toronto Lake, reported on the 8th, tied for a record warm minimum temperature in September. There was 1 new record daily cold minimum temperature for the month, but no new monthly record lows set. The South Central and Southeast divisions were the closest to normal, with the South Central division averaging 4.9F warmer than normal and the Southeast Division averaging 3.9F warmer than normal. The Northwest Division was the warmest averaging 72.1F, or 6.9 degrees warmer than normal. The warmest reading was 107F and was recorded on the 7th at Hays, Ellis County (NWS). The coolest reading for the state was 33F at Brewster, Thomas County (NWS) on the 19th. The warmer-than-average temperatures allowed late-planted spring crops such as corn and soybeans to progress rapidly in development. Concerns now are for the dry conditions, with winter planted crops needing moisture for establishment before winter.

Severe weather was higher in September, despite the dry conditions. Preliminary data indicates there were 5 tornadoes reported. There were 63 hail reports and 64 damaging wind reports.

Drought conditions deteriorated, which was not unexpected, given the lower than average precipitation. Moderate drought conditions returned, and the area of abnormally dry conditions expanded. The moderate drought ranges from Northwest KS through parts of Central KS. Thirty seven counties in western Kansas remain in drought watch status according to the latest advisory from the Kansas Water Office. A return to normal or above normal precipitation is needed to sustain improvements. Some long-term hydrological deficits are in place affecting some water supplies and reservoirs. The drought outlook is for improving conditions, but the precipitation outlook for October is neutral.

Temperature and Precipitation Overview



Above: September 2015 monthly mean temperatures (left) and total precipitation (right) in Kansas. Maps produced by Weather Data Library, Department of Agronomy, Kansas State University.

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:
www.drought.gov/drought/content/resources/reports

Midwest and Great Plains Monthly Climate and Drought Webinar

To sign up for future webinars:
<http://www.drought.gov/drought/content/regional-programs/regional-drought-webinars>

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www.hprcc.unl.edu/webinars.php

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