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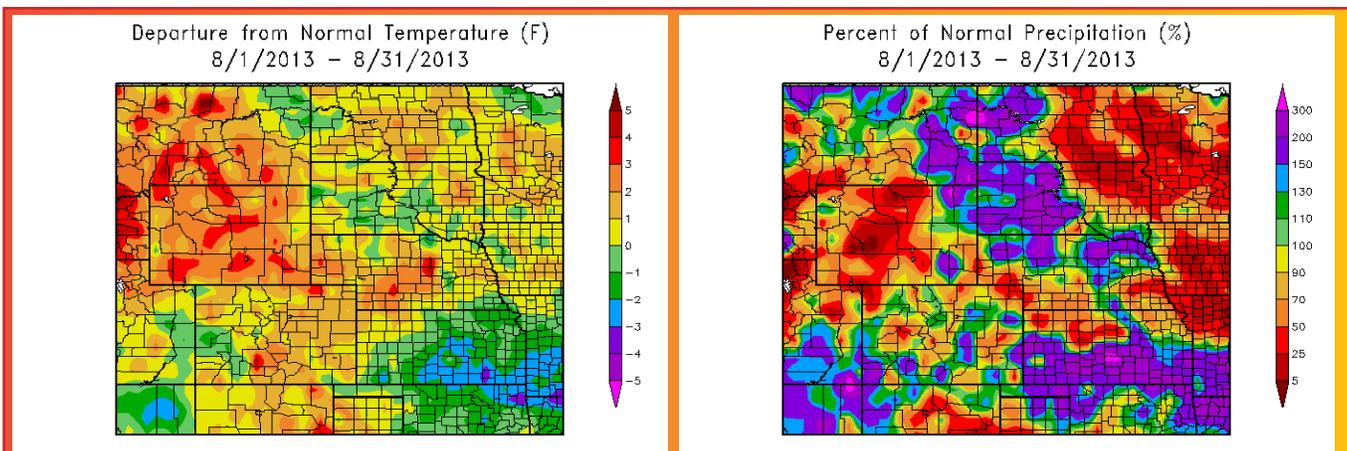
Elk in the Valentine National Wildlife Refuge near Valentine, NE - Photo by BJ Baule
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August 2013 Climate Summary

Region Breakdown

The first half of August was quite cool across the High Plains Region with temperature departures of 4.0-10.0 degrees F (2.2-5.6 degrees C) below normal in the Dakotas and 2.0-6.0 degrees F (1.1-3.3 degrees C) below normal in Nebraska and Kansas. During this time, a ridge of high pressure was off to the west, allowing cool, dry air to flow south from Canada. However, toward the end of the month, the ridge shifted to the east and southerly flow dominated bringing some of the hottest temperatures of the summer. For instance, Bismarck, North Dakota set a record high on the 20th with a temperature of 102 degrees F (38.9 degrees C). The old record of 100 degrees F (37.8 degrees C) was set in 1976 (period of record 1874-2013). With lower than normal temperatures the first half of the month and higher than normal temperatures the last half, much of the Region ended the month near normal. The exceptions included central and southeastern Kansas with monthly temperature departures of 2.0-4.0 degrees F (1.1-2.2 degrees C) below normal and most of Wyoming which had temperature departures of 2.0-4.0 degrees F (1.1-2.2 degrees C) above normal.

Temperatures have played an important role this summer as many of the impacts of dryness were staved off by cooler conditions. Unlike last year, a ridge of high pressure was just to the west of most of the Plains states which



Departure from 1981-2010 Normal Average Temperature (left) and Percent of Normal Precipitation (right) for August 2013 in the High Plains Region. Maps produced by High Plains Regional Climate Center. Available at: <http://hprcc.unl.edu/maps/current>

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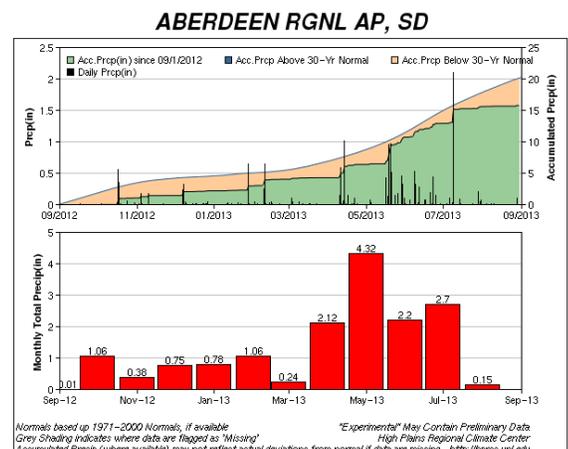
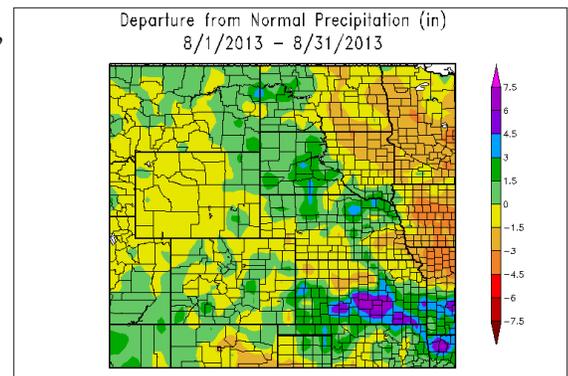
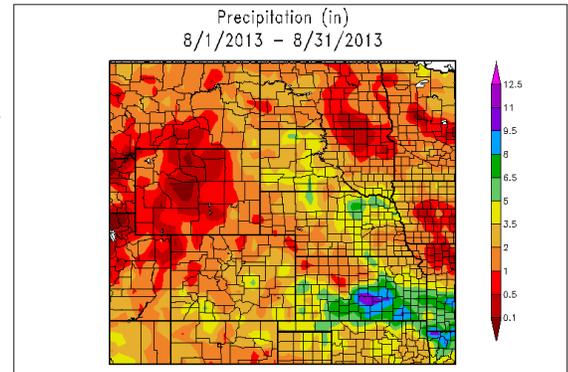
resulted in cooler, drier northerly flow for the Dakotas, Nebraska, and Kansas for much of the summer. These cooler temperatures slowed crop development - development which was already behind in many places due to either a late snowpack or wet field conditions. While crop progress was lagging, however, the cooler conditions helped with crop stress in the drier areas. By the middle of the month, there was even concern about whether or not crops would reach maturity before the first freeze of the season. But, the heat settled in for the latter half of the month and this had mixed impacts on crops. In the areas that had adequate moisture, the heat was helpful in crop development, however in the dry areas, the heat caused stress.

Precipitation Summary

Precipitation this month was hit or miss across the High Plains Region. The spotty precipitation led to both improvements and degradations in drought conditions. Areas such as southern Kansas, western portions of the Dakotas, and northern Nebraska received up to 300 percent of normal precipitation. Meanwhile, large areas of central Wyoming, eastern and central North Dakota, and northeastern South Dakota missed out and received less than 50 percent of normal precipitation. Embedded areas received little to no precipitation and ended the month with less than 5 percent of normal precipitation.

With the wide range in precipitation, there were stations which ranked in the top 10 driest or wettest Augusts on record. For instance, Aberdeen, South Dakota received only 0.34 inches (9 mm) of precipitation this month and ranked as the 4th driest on record (period of record 1893-2013). The driest August in Aberdeen occurred in 1947 when only 0.06 inches (2 mm) of precipitation fell. On the other end of the spectrum, Wichita, Kansas had its 2nd wettest August on record with 10.98 inches (279 mm) of precipitation, most of which occurred during the first half of the month. The record 11.96 inches (304 mm) in 2005 was able to hold on (period of record 1888-2013). The heavy precipitation in southern Kansas caused flooding in several communities including Wichita and Hutchinson.

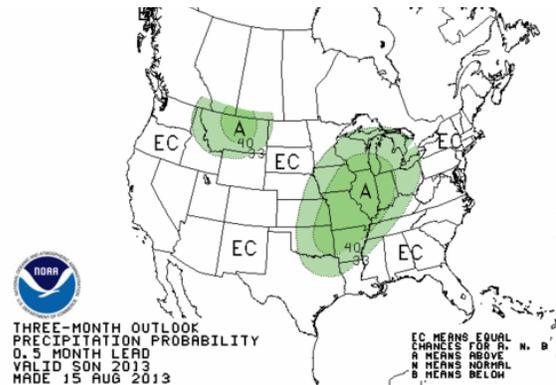
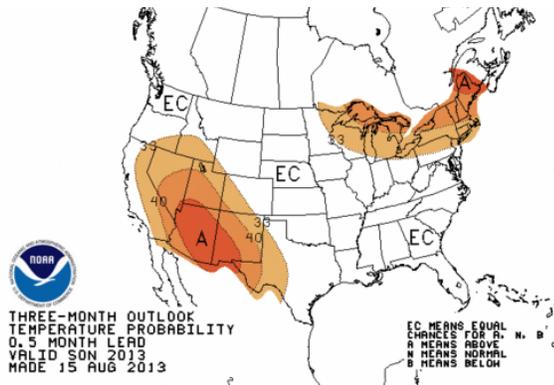
Hit or miss precipitation was the theme this summer as precipitation was quite varied across the High Plains Region. Monsoonal moisture brought much needed precipitation to Colorado in July and August which helped alleviate some long and short term drought conditions while also decreasing fire danger. Unfortunately, the rain was a double edged sword as some locations dealt with destructive flash flooding in and around recent burn scars. Southern Kansas also dealt with flooding after a dry start to the summer. For instance, while Wichita started the summer off on the dry side, this summer went down as the 3rd wettest on record with a total of 20.50 inches (521 mm). June precipitation was only 35 percent of normal, while the combined July and August precipitation was 265 percent of normal. The record of 23.61 inches (600 mm) occurred in 2005. To the north, Lincoln, Nebraska had its 6th driest summer on record with only 4.60 inches (117 mm) of precipitation. This was only 0.40 inches (10 mm) off of last year - the 4th driest summer. The 1936 record of 2.84 inches (72 mm) held (period of record 1887-2013). The Dakotas were divided with eastern areas generally below normal and western areas above normal. Meanwhile, Wyoming was dry except for the northeast corner.



Above: Total precipitation (inches) (top) and Departure from Normal Precipitation (inches) (middle) for August 2013 in the High Plains Region. Accumulated and monthly precipitation for Aberdeen, SD (bottom) over the past year. These maps are produced by HPRCC and can be found on the Current Climate Summary Maps page at: <http://hprcc.unl.edu/maps/current>.

Climate Outlook

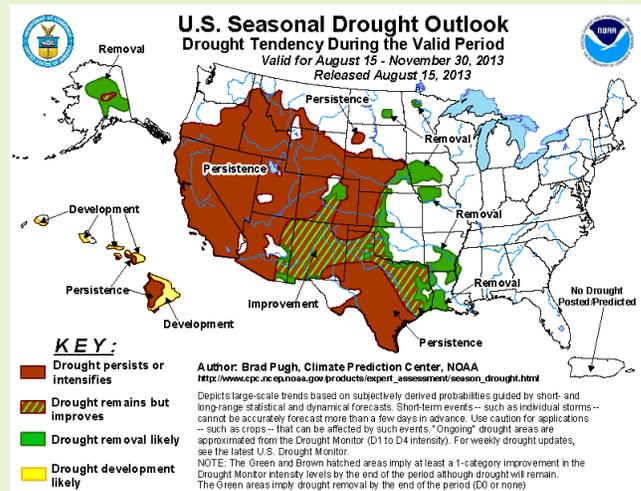
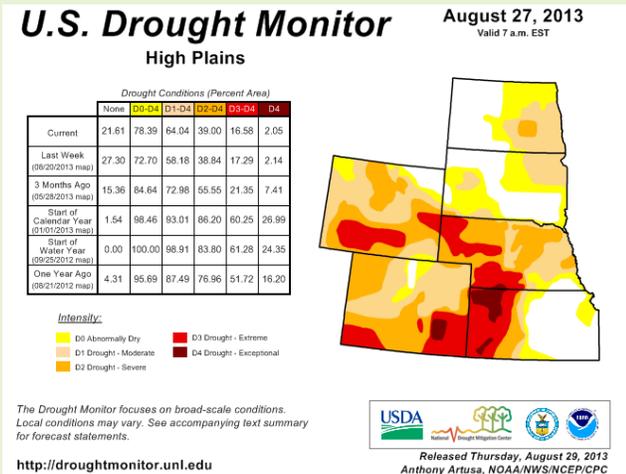
At the end of August, ENSO-neutral conditions were still present and likely to continue into the fall. For the next three months, the temperature outlook indicates a higher probability of above normal temperatures for the southwestern half of Colorado and southwest Wyoming. Equal chances of above, near, or below normal temperatures exist for the rest of the Region. Meanwhile, the precipitation outlook indicates a higher probability of above normal precipitation in two areas of the country which includes some locations in the High Plains Region: eastern Kansas, eastern Nebraska, northern Wyoming, and a sliver of western North Dakota. Equal chances of above, near, or below normal precipitation exist for the rest of the Region. The seasonal outlooks combine the effects of long-term trends, soil moisture, and when applicable, the El Niño Southern Oscillation cycle (ENSO).



Above: 3-Month Outlook Maps Courtesy the NOAA Climate Prediction Center - <http://www.cpc.ncep.noaa.gov>
 (left) The Three-Month Temperature Probability Outlook, (right) The Three-Month Precipitation Probability Outlook

Drought Watch

According to the U.S. Drought Monitor, there were numerous changes in drought conditions over the past month. Significant improvements were made in Kansas and Colorado where beneficial rains fell. The exceptional drought (D4) coverage in Kansas was reduced from 25 percent to about 9 percent, while the D4 coverage in Colorado went from 15 percent to 2 percent. Unfortunately, other areas of the Region did not fare as well. Cool conditions for the first half of the month gave way to hot and dry weather which caused drought conditions to emerge and/or deteriorate rapidly in parts of eastern North Dakota, South Dakota, and Nebraska. For instance, North Dakota started the month free of drought, but ended the month with over 30 percent of the state in at least moderate drought (D1). According to the U.S. Seasonal Drought Outlook released August 15th, drought conditions should improve in portions of eastern Nebraska, central Colorado, central Kansas, and eastern North Dakota. Drought conditions were expected to persist elsewhere through November 2013.



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). Real-time data provided through ACIS from the Regional Climate Centers are often used by the agencies involved in the U.S. Drought Monitor when determining the area and intensity of drought conditions, although the product itself is not produced by HPRCC. For current Drought Monitor information, please see: <http://droughtmonitor.unl.edu/>
 Portions of this Drought Watch are courtesy the Drought Monitor Text Discussion found on the Drought Monitor webpage.

State Summaries

Colorado	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Akron Washington County Airport	87.5	59.5	73.5	1.4	97	08/28	53	08/09	2.41	0.11	105
Alamosa San Luis Airport	80.9	47.6	64.3	1.6	88	08/21	40	08/09	2.47	1.20	194
Colorado Springs Municipal Airport	83.7	57.9	70.8	2.1	91	08/29	52	08/15+	5.72	2.38	171
Grand Junction Walker Field Airport	88.2	61.0	74.6	-0.9	97	08/19	54	08/11	1.18	0.23	124
Pueblo Memorial Airport	89.5	60.8	75.2	1.8	97	08/29	55	08/15+	3.92	1.60	169

Kansas	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Concordia Municipal Airport	85.1	65.8	75.5	-1.6	100	08/30	56	08/18+	6.58	3.44	210
Dodge City Regional Airport	88.3	65.0	76.6	-1.5	100	08/02	56	08/10	6.92	4.17	252
Goodland Renner Field	88.8	61.6	75.2	1.5	102	08/30	54	08/16+	0.94	-1.76	35
Topeka Municipal Airport	87.4	67.3	77.3	-0.1	100	08/30	56	08/18+	5.21	0.97	123
Wichita Mid-Continent Airport	87.8	68.2	78.0	-2.0	103	08/31	62	08/16+	10.98	7.27	296

Nebraska	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Chadron Municipal Airport	90.5	59.1	74.8	2.6	102	08/27	51	08/22+	1.42	-0.16	90
Grand Island Airport	85.8	66.0	75.9	1.9	97	08/27	60	08/18+	3.02	-0.10	97
Lincoln Municipal Airport	86.9	65.3	76.1	0.8	100	08/30	52	08/18	1.11	-2.38	32
Norfolk Karl Stefan Airfield	83.5	64.1	73.8	1.0	94	08/29	56	08/04	3.58	0.33	110
North Platte Regional Airport	87.6	62.0	74.8	2.7	102	08/29	54	08/09	3.51	1.22	153
Omaha Eppley Airport	87.2	66.5	76.8	2.2	99	08/30+	56	08/18	1.72	-2.10	45
Valentine Miller Field	86.4	63.3	74.9	2.1	102	08/29	57	08/07	2.01	-0.17	92

North Dakota	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Bismark Municipal Airport	85.4	56.6	71.0	1.5	102	08/20	44	08/10	1.37	-0.91	60
Fargo International Airport	83.5	58.4	70.9	1.6	96	08/20	45	08/14+	0.39	-2.17	15
Grand Forks International Airport	82.1	54.4	68.2	1.1	97	08/25+	42	08/14+	0.88	-2.00	31
Theodore Roosevelt Airport	84.1	55.7	69.9	1.5	98	08/30	48	08/01	1.67	0.13	108
Williston International Airport	83.3	55.5	69.4	0.5	86	08/26	43	08/08	2.17	0.72	150

All Data are Preliminary and Subject to Change. + indicates multiple dates, latest date listed.

Source: National Weather Service Cooperative Observation Network Data

Data are retrieved through the Applied Climate Information System (ACIS).

These data are available for the entire period of record through the CLIMOD system. For more information please see <http://hprcc.unl.edu/services>.

August 2013 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	82.7	57.1	69.9	0.9	95	08/24	46	08/14	0.34	-2.09	14
Huron Regional Airport	84.8	61.5	73.1	1.5	100	08/29	51	08/09	1.22	-1.21	50
Pierre Regional Airport	86.0	61.4	73.7	0.0	102	08/24	53	08/07	2.52	0.72	140
Rapid City Regional Airport	86.1	59.2	72.6	1.1	101	08/27	53	08/14	2.41	0.85	154
Sioux Falls Joe Foss Field Airport	81.7	61.6	71.7	1.1	93	08/27	49	08/03	3.23	0.18	106

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	89.1	54.5	71.8	2.8	97	08/17	47	08/16	0.70	-0.15	82
Cheyenne Municipal Airport	85.0	55.0	70.0	2.4	94	08/20	48	08/10+	1.19	-0.76	61
Lander Hunt Field Airport	89.1	57.3	73.2	3.6	96	08/19+	49	08/14	0.01	-0.60	2
Laramie Regional Airport	80.9	48.2	64.5	2.2	88	08/19	39	08/09	1.04	-0.19	85
Rawlins Municipal Airport	84.8	52.1	68.5	3.3	91	08/19	43	08/14	0.57	-0.19	75
Sheridan County Airport	89.7	54.9	72.3	3.3	99	08/16	48	08/12	0.05	-0.67	7

All Data are Preliminary and Subject to Change. + indicates multiple dates, latest date listed.

Source: National Weather Service Cooperative Observation Network Data

Data are retrieved through the Applied Climate Information System (ACIS).

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August 2013 Top 10 Precipitation Rankings - Highlights

Precipitation Rankings			
Precipitation in inches			
Location	Precipitation / Ranking	Record or Old Record / Year	Period of Record
Alamosa, CO	2.47 / 6th wettest	5.40 / 1993	1906-2013
Colorado Springs, CO	5.72 / 6th wettest	7.09 / 1929	1894-2013
Pueblo, CO	3.92 / 9th wettest	5.85 / 1955	1888-2013
Dodge City, KS	6.92 / 3rd wettest	7.44 / 1977	1874-2013
Salina, KS	5.00 / 10th wettest	13.75 / 1977	1948-2013
Wichita, KS	10.98 / 2nd wettest	11.96 / 2005	1888-2013
Fargo, ND	0.39 / 4th driest	0.18 / 1984	1881-2013
Grand Forks, ND	0.88 / 9th driest	0.07 / 1915	1893-2013
Aberdeen, SD	0.34 / 4th driest	0.06 / 1947	1893-2013
Lander, WY	0.01 / 5th driest	0.00 T / 1970*	1891-2013
Sheridan, WY	0.05 / 5th driest	0.00 T / 1970*	1907-2013

All Data are Preliminary and Subject to Change.

* indicates multiple records, latest year is listed, T stands for Trace amount of precipitation.

Source: National Weather Service Cooperative Observation Network Data

State Spotlight - Kansas

Mary Knapp - State Climatologist
Kansas State Climate Office, Kansas State University

Strong contrasts continue

August continued with sharp differences across the month. Temperatures started off cooler than average, before ending on a warm note. Only the Southeastern division failed to break 100, but the highest readings were all in the last two days of the month. Despite the warm end, state-wide average temperature ended 1.0 degree cooler than normal. The Northwest and North Central divisions were closest to normal, while the South Central divisions saw the biggest downward departure from average. The highest temperature was 106F, recorded at Hill City, Plainville and Wakeeney on the 31st. The coolest temperature recorded was 50F at Holton on the 18th of August. The state-wide average temperature of 76.1F was the 40th coolest since 1895. This was identical to last year's average temperature. Last year, August marked a dramatic change from the much warmer than average first half of the year. The West Central division was closest to normal this year. Their average temperature was 75.7F, which was 0.2 degrees above average. The South Central division had the greatest departure from normal. With a mean temperature of 76.8F, it was 2.4 degrees cooler than average. For individual stations, Hudson (Stafford County) was the coolest. With a mean temperature of 73.2F, it was 6.5 degrees below normal. Goodland (Sherman County) was the warmest. At 75.2F, the mean temperature was 1.5 degrees above normal.

Statewide, the average precipitation was 4.79 inches, which was 142% of normal. As percent of normal, the South Central Division ranked the highest at 250. The average was 8.53 inches, much of which came during the first week of the month. The Northwest division had the lowest percent of normal: 56. This translates to just 1.55 inches. Heaviest precipitation totals were in the South Central division. For the Community Collaborative Rain Hail and Snow Network (CoCoRaHS), the greatest total was 12.65 inches at Moundridge 3.2 SSW, Harvey County. Of the National Weather Service (NWS) stations, the greatest total was 12.62 inches at Hutchinson 4 NE, Reno County. The highest 24 hour precipitation total from a NWS site was 6.50 inches at Fredonia, Wilson County on the 5th. The greatest 24 hour total from a CoCoRaHS station was 7.30 inches at Hutchinson 1.2 N, Reno County on the 4th. With these localized heavy amounts, August ended as the 13th wettest of 119 years.

Improvements in the western divisions have been limited, as rainfall for the year continues to be well below average. Cooler than average temperatures have somewhat moderated the negative impacts, but severe to exceptional drought conditions remain throughout the region. The Seasonal Drought Outlook suggests continued improvement on the eastern edges of the drought region. The monthly Drought Outlook for September calls for continuing drought in the western third of the state. Given the fact that we are moving into the drier part of the year, even normal precipitation will have minimal impact on the long term deficits in the region. The El Niño/Southern Oscillation (ENSO) is expected to remain neutral. For September, both the temperature and precipitation outlooks are neutral. That means conditions are equally likely to be above or below normal. The mid-term outlook of 8-14 days calls for warmer than average conditions to remain through the 14th of September. Precipitation outlook calls for greater chance of above normal in the west and below normal in the east.

Severe weather was again a factor this month. Three tornadoes were reported in Northwest KS. In addition there were 49 hail reports and 72 wind damage reports. Most of these occurred in the first half of the month. With the rains following a wet end to July, widespread flooding was reported. For the 20 days stretching from July 26 to August 14, Moundridge reported 21.00 inches of rainfall. That has an average recurrence interval of 1000 years.

For more information about the Kansas State Climate Office: <http://www.ksre.ksu.edu/wdl/>

The KSU's AWDN is a part of the High Plains Automated Weather Data Network (AWDN). Data are available through KSU or HPRCC.

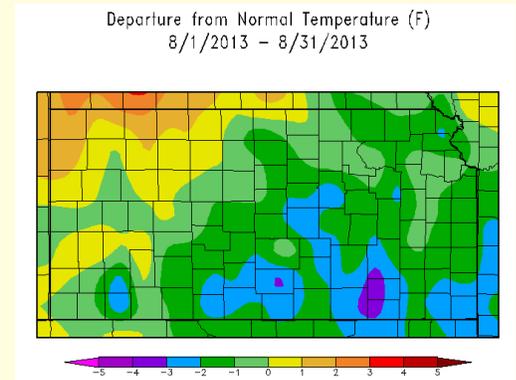


Figure 1. August 2013 departure from average temperatures across Kansas (High Plains Regional Climate Center)

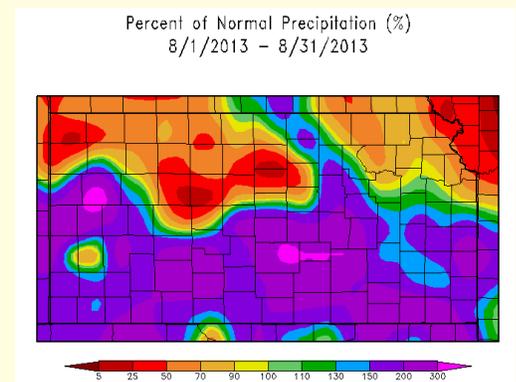


Figure 2. August 2013 percent of normal precipitation across Kansas (High Plains Regional Climate Center)

State Spotlight - North Dakota



F. Adnan Akyüz - State Climatologist, Barb Mullins - Assistant to the State Climatologist
 North Dakota State Climate Office, North Dakota State University

Precipitation:

The North Dakota Agricultural Weather Network recorded precipitation totals of below normal in the eastern half of the state and parts of the north central regions (Figure 1). The first six days of August had scattered showers with the more widely spread rainfall on the 6th. The National Weather Service reported record rainfall at Dickinson and Minot on the 6th with 0.64 inches and 0.83 inches respectively along with two tornadoes spotted in Richland County. A long dry spell followed during which most of the rainfall was in the west. On the 29th a wide spread rain event covered most of the northern half, central, and eastern parts of the state. Scattered showers continued on the 30th in the central region and 31st primarily in the northeast. The National Weather Service storm report recorded a tornado in Morton County on the 30th and in Pembina County on the 31st. Over the summer, drought conditions gradually worsened for the eastern part of the state. The US Drought Monitor at the end of June reported no drought conditions for 99.68% of the state. Abnormally dry (D0) conditions began to develop for 20.15% of the state at the end of July with Stutsman County increased to moderate (D1) conditions. The US Drought Monitor August 27th report has 44.35% of the state, the western half, with no drought or dry conditions. The northeast was reported as Abnormally Dry (D0) and the southeast was reported with Moderate (D1) drought conditions that surrounded Stutsman County whose drought condition was elevated to Severe (D2).

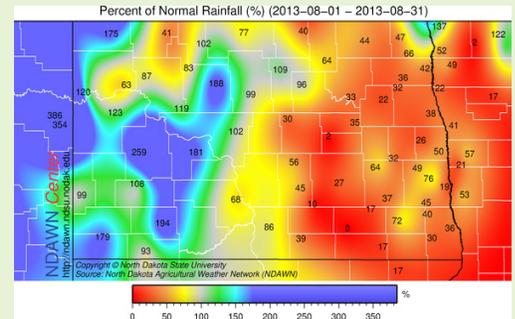


Figure 1. Percent of Normal Precipitation in August 2013 for North Dakota (North Dakota State Climate Office)

Temperature:

NDAWN August average air temperatures ranged from ~66 °F in the north to ~72 °F in the south. Departure from normal average air temperatures ranged from 3 °F to -2 °F (Figure 2). Daily average air temperatures can be summarized as the first half being below normal and the second half above normal. The average air temperature of the first half of the month were 4 to 10 °F below normal with the second half being 5 to 9 °F above normal.

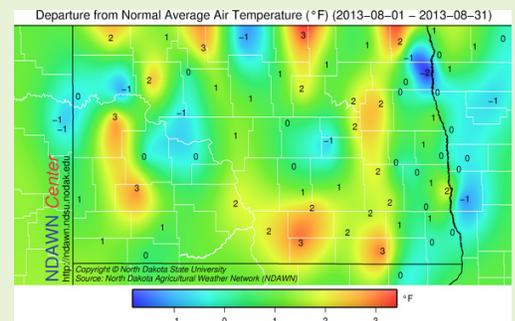


Figure 2. Temperature Departure from Normal in August 2013 for North Dakota (North Dakota State Climate Office)

About the High Plains Regional Climate Center

The High Plains Regional Climate Center (HPRCC) operates out of the University of Nebraska - Lincoln (UNL) in Lincoln, Nebraska. As one of 6 regional climate centers throughout the nation, HPRCC works closely with other organizations such as the National Climatic Data Center (NCDC), Local and Regional National Weather Service (NWS) Offices, and other climate services organizations such as the National Drought Mitigation Center (also located at UNL) to provide climate data services and specialized climate products.

For More Information Online

High Plains Regional Climate Center: <http://hprcc.unl.edu>

High Plains Regional Climate Services: <http://hprcc.unl.edu/services>

CLIMOD: <http://climod.unl.edu>

Regional Climate Centers and ACIS: <http://www.rcc-acis.org>

National Weather Service: <http://www.weather.gov>

National Climatic Data Center: <http://ncdc.noaa.gov>

University of Nebraska - Lincoln: <http://www.unl.edu>

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

Climate Prediction Center: <http://www.cpc.noaa.gov>

NOAA Storm Prediction Center: <http://www.spc.noaa.gov>



Photo of the Nebraska Sandhills by Bill Sorensen - Senior Programmer - HPRCC

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