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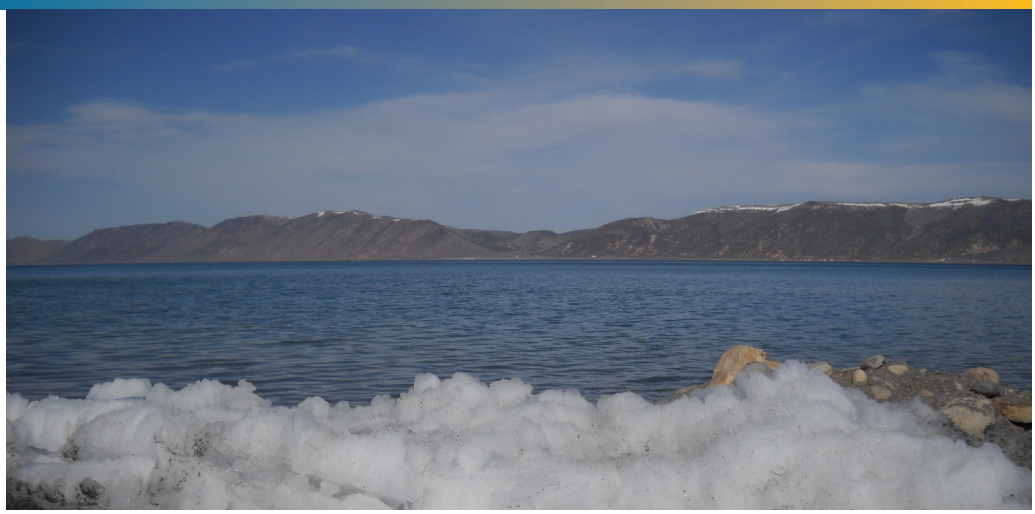

Climate Prediction Applications Science Workshop 2013 - Utah - Photo by Natalie Umphlett
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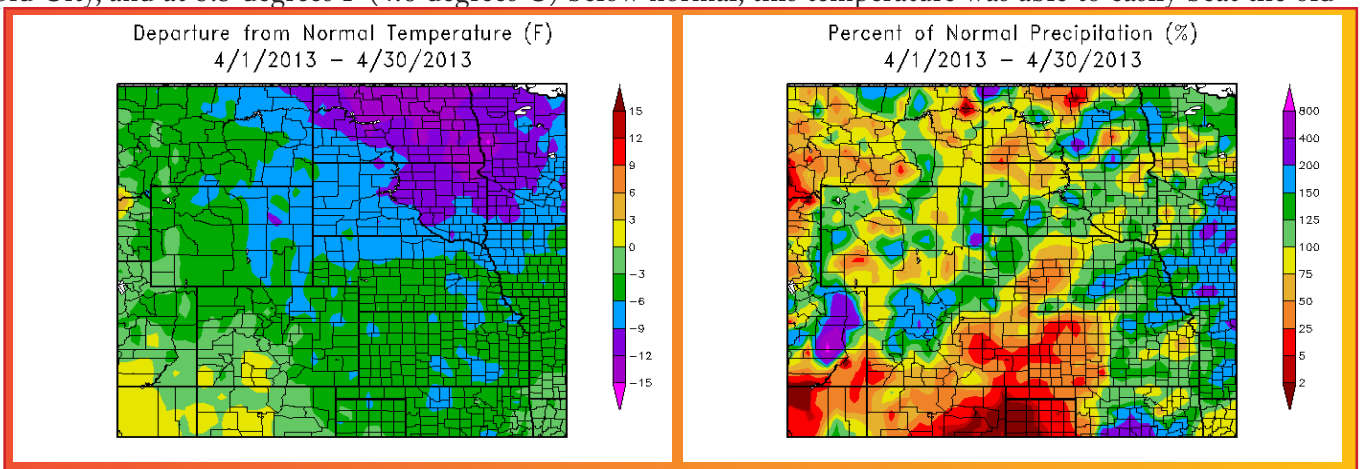
April 2013 Climate Summary

Region Breakdown

The cooler conditions of March continued into April across the High Plains Region. Average temperatures were well below normal for the majority of the Region and in stark contrast to last year when many locations were in the top ten warmest on record. A rough southwest to northeast temperature gradient was apparent with average temperatures which were near normal across southwest portions of Colorado and Wyoming and up to 15.0 degrees F (8.3 degrees C) below normal in North Dakota and northeastern South Dakota.

Even with a late month warm-up, these cooler conditions caused locations in each state to be ranked in the top ten coolest Aprils on record. These cooler conditions were also accompanied by wintry weather and some locations ranked in both the top ten coolest and snowiest Aprils on record. Aberdeen, South Dakota had its coolest and 2nd snowiest April on record. The average temperature in Aberdeen was 34.9 degrees F (1.6 degrees C) which was 9.5 degrees F (5.3 degrees C) below normal (period of record 1893-2013). The old record occurred in 1950 with an average temperature of 36.0 degrees F (2.2 degrees C). More records occurred in Rapid City, South Dakota which had both the coolest and snowiest April. The average temperature was only 36.7 degrees F (2.6 degrees C) in Rapid City, and at 8.3 degrees F (4.6 degrees C) below normal, this temperature was able to easily beat the old



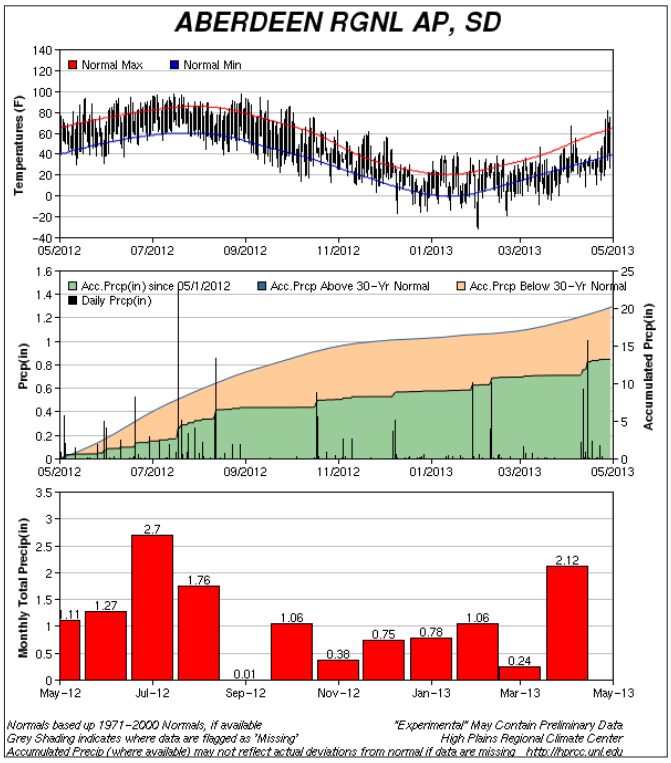
Departure from 1981-2010 Normal Average Temperature (left) and Percent of Normal Precipitation (right) for April 2013 in the High Plains Region. Maps produced by High Plains Regional Climate Center. Available at: http://hprcc.unl.edu/maps/current

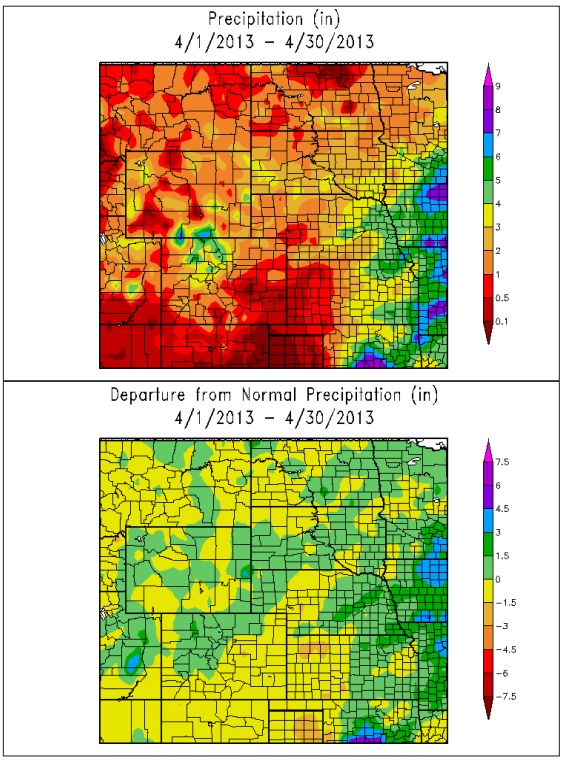
record of 38.0 degrees F (3.3 degrees C) also set in 1950 (period of record 1942-2013).

Precipitation Summary

The High Plains Region experienced a wide range of weather conditions this April including rain, snow, sleet, freezing rain, thunderstorms (including thundersnow and thundersleet), hail, high winds, dust storms, and tornadoes. This active pattern was welcomed as it brought many chances for precipitation to the drought-stricken areas and widespread improvements were made in regards to the drought. By the end of the month, April precipitation totals were quite varied, however, and most locations were within about 25 percent of normal precipitation. Areas which received at least 150 percent of normal precipitation included eastern Nebraska, northeastern Kansas, central North Dakota, central Colorado, and pockets of Wyoming and South Dakota. Meanwhile, northern and southwestern North Dakota, west-central Nebraska, western Kansas, and eastern Colorado received less than 50 percent of normal precipitation.

For some locations, even ones that came short of normal, this was the most precipitation received in the past year. For instance, North Platte, Nebraska only had 1.27 inches (32 mm) of liquid equivalent precipitation this month which was 56 percent of normal. However, this was the most precipitation since April of last year. Unfortunately, North Platte was still 13.00 inches (330 mm) below normal for that 12-month period. Even with increases in precipitation, drought impacts were still being realized. According to the USDA, the winter wheat crops in Colorado and Kansas were struggling due to the prolonged dryness with much of the crop rating in the poor to very poor categories (54 percent in Colorado and 39 percent in Kansas). Also, in Colorado, the combination of drought and strong winds contributed to a dust storm that closed I-25 and covered farmland with sand and dirt. While dust storms are not necessarily uncommon in Colorado, this dust storm had quite an impact on local farmers in Lincoln County, located in the east-central part of the state. According to *9News* in Denver, a dust storm on April 14th blew sand and dirt on more than 100,000 acres of land. Some places had an estimated 6-8 inches of sand and dirt covering the fields. Local ranchers indicated that it may take years to rebuild the soil.





Above: Maximum, minimum, and normal temperatures, accumulated precipitation, and monthly total precipitation for Aberdeen, SD over the past year (top left). Total precipitation (inches) (left) and Departure from Normal Precipitation (inches) (right) for April 2013 in the High Plains Region. These maps are produced by HPRCC and can be found on the Current Climate Summary Maps page at: http://hprcc.unl.edu/maps/current.

The High Plains Regional Climate Center is one of the Regional Climate Centers, and is involved in the Applied Climate Information System (ACIS) development and management effort. Data found throughout this publication were derived using products built on the ACIS framework.

ACIS
Applied Climate Information System - Regional Climate Centers

Precipitation Summary Continued

While drought impacts were still an issue in many parts, other areas of the Region made significant improvements. There were stations in each state which ranked in the top 10 snowiest Aprils on record as many storm systems affected the Region. Bismarck, North Dakota blasted through records this month as an historic snowstorm dumped 17.3 inches (44 cm) of snow on April 14th. This snow total went down as the new record 1-day snowfall for not just April, but for any calendar day of the year. Ultimately, with 21.8 inches (55 cm), Bismarck set a new monthly snowfall total beating the old record of 18.7 inches (47 cm) set in 1984 (period of record 1886-2013). Rapid City, South Dakota also had its snowiest April on record with 43.4 inches (110 cm). This snowfall total crushed the old record of 30.6 inches (78 cm) set back in 1970 (period of record 1942-2013). Remarkably, both Bismarck and Rapid City had set their new April snowfall records by the middle of the month. For more snowfall rankings, please see the table below.

Above: April 9-10 ice storm in Sioux Falls, SD. Over a half inch of ice was reported in the hardest hit areas of southeastern South Dakota. Image courtesy Vicki and Doug Carlson.

The abundance of snow improved the snowpack situation in the Rockies significantly, which had previously been lagging. By the end of the month, the Colorado statewide snowpack was 80 percent of average, which was up from last month's 75 percent. Conditions improved greatly in Wyoming, with the month ending at 98 percent of average, up considerably from last month's 82 percent of average. Many communities along the northern part of the Front Range racked up hefty snow totals this month. Boulder, Colorado had its snowiest April on record with 47.6 inches (121 cm) and beat the old record by over 3.0 inches (8 cm). The old record of 44.0 inches (112 cm) was set in 1957 (period of record 1893-2013).

April 2013 Snowfall Rankings - Highlights

Monthly Rankings
Snowfall in inches

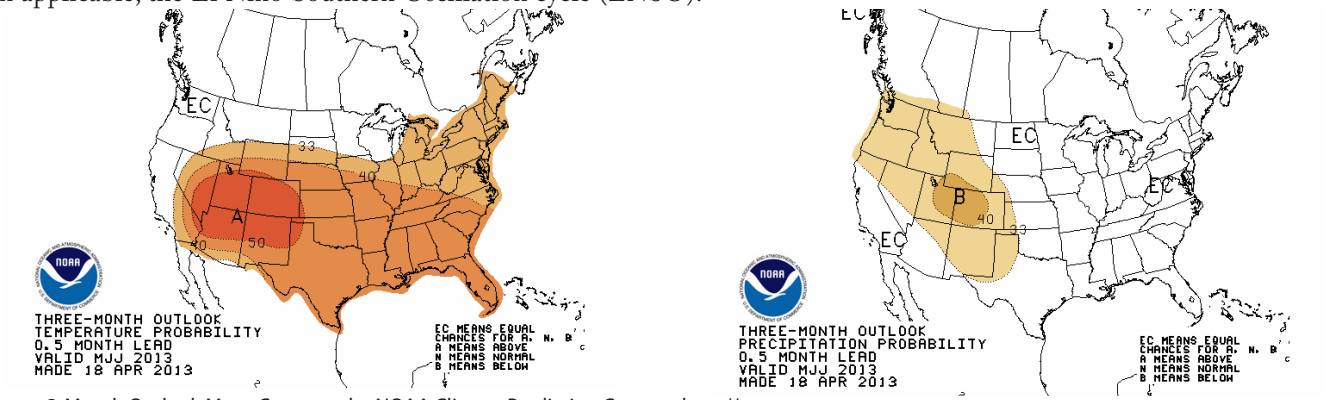
Snowiest April

Location	Snowfall / Rank	Record or Previous Record / Year	Period of Record
Denver, CO	20.4 / 10th snowiest	33.8 / 1933	1882-2013
Grand Junction, CO	4.6 / 7th snowiest	14.3 / 1975	1893-2013
Goodland, KS	12.7 / 5th snowiest	23.0 / 1944	1895-2013
Grand Island, NE	6.9 / 9th snowiest	12.0 / 1913	1895-2013
Norfolk, NE	6.6 / 7th snowiest	13.2 / 1984	1893-2013
Scottsbluff, NE	18.4 / 6th snowiest	29.7 / 1927	1893-2013
Valentine, NE	14.2 / 4th snowiest	30.4 / 1995*	1889-2013
Bismarck, ND	21.8 / snowiest	18.7 / 1984	1886-2013
Fargo, ND	16.7 / 4th snowiest	17.4 / 1904	1885-2013
Aberdeen, SD	21.8 / 2nd snowiest	24.4 / 1970	1893-2013
Huron, SD	19.7 / 3rd snowiest	25.8 / 1935	1893-2013
Rapid City, SD	43.4 / snowiest	30.6 / 1970	1942-2013
Sioux Falls, SD	14.8 / 3rd snowiest	18.4 / 1983	1893-2013
Casper, WY	39.0 / 2nd snowiest	56.3 / 1973	1939-2013
Cheyenne, WY	37.6 / 4th snowiest	46.5 / 1905	1883-2013
Lander, WY	43.3 / 6th snowiest	70.4 / 1999	1891-2013

All Data are Preliminary and Subject to Change.
* indicates multiple records, latest date is listed
Source: National Weather Service Cooperative Observation Network Data

Climate Outlook

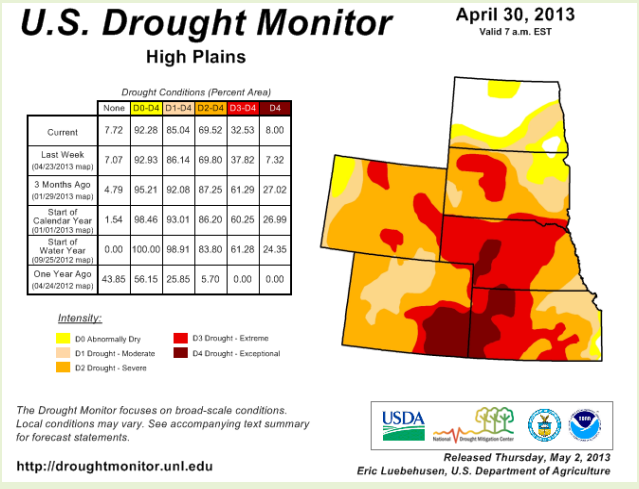
At the end of April, ENSO-neutral conditions were still present and likely to continue into summer. For the next three months, the temperature outlook indicates a higher probability of above normal temperatures for most of the High Plains Region including Colorado, Kansas, Nebraska, the majority of Wyoming, and the southern half of South Dakota. Meanwhile, the precipitation outlook indicates a higher probability of below normal precipitation for Colorado, western Kansas, western Nebraska, and all but northeast corner of Wyoming. Equal chances of above, near, or below normal temperatures and precipitation exist for the rest of the High Plains Region. In addition, no part of the country has a higher probability for below normal temperatures or above normal precipitation. The seasonal outlooks combine the effects of long-term trends, soil moisture, and when applicable, the El Niño Southern Oscillation cycle (ENSO).

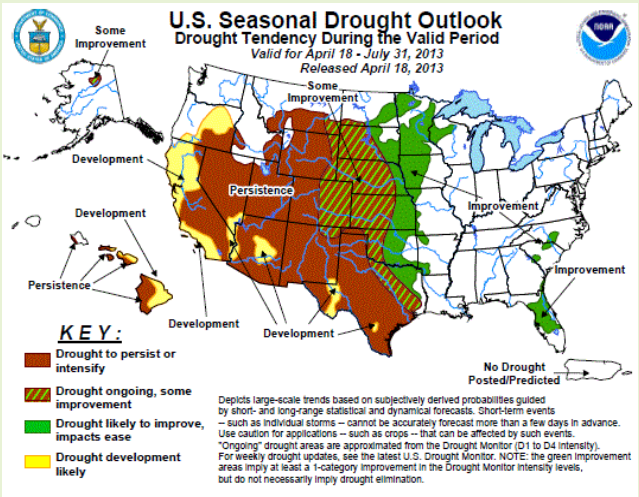


Above: 3-Month Outlook Maps Courtesy the NOAA Climate Prediction Center - http://www.cpc.ncep.noaa.gov
(left) The Three-Month Temperature Probability Outlook, (right) The Three-Month Precipitation Probability Outlook

Drought Watch

There were significant changes to the U.S. Drought Monitor over the past month as the combination of cool and wet conditions allowed for many improvements to be made. At the end of April, approximately 85 percent of the Region was in moderate (D1) to exceptional (D4) drought - down from 91 percent at the end of last month. All D4 conditions in South Dakota and Wyoming were erased leaving D3 or severe drought conditions (D2) in its place. Overall, Nebraska had the largest improvements and went from 76 percent in D4 to only 8 percent. Extreme drought conditions were also trimmed back in South Dakota, Wyoming, eastern Nebraska, and northern Colorado. Unfortunately, conditions worsened slightly in southeastern Colorado and western Kansas where D4 expanded. Kansas now has the largest percentage of D4 coverage at just under 20 percent. According to the U.S. Seasonal Drought Outlook released April 18th, drought conditions were expected to improve in North Dakota, South Dakota, Nebraska, Kansas, and eastern portions of Colorado and Wyoming. Drought was expected to persist elsewhere through July 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	52.8	29.2	41.0	-6.0	82	04/29	4	04/10	0.84	-0.81	51
Alamosa San Luis Airport	59.9	22.6	41.3	-0.5	77	04/29	6	04/19	0.33	-0.26	56
Colorado Springs Municipal Airport	56.5	28.8	42.7	-3.8	79	04/29	8	04/10	0.33	-1.09	23
Grand Junction Walker Field Airport	62.1	35.5	48.8	-2.9	81	04/30+	20	04/10	1.19	0.28	131
Pueblo Memorial Airport	62.9	30.5	46.7	-3.9	88	04/29	14	04/11+	0.30	-1.10	21

Kansas	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Concordia Municipal Airport	59.8	36.3	48.0	-5.1	84	04/29	25	04/24+	3.48	1.03	142
Dodge City Regional Airport	63.6	34.7	49.1	-4.8	91	04/30	16	04/11	0.88	-0.94	48
Goodland Renner Field	58.8	29.4	44.1	-5.1	87	04/28	13	04/10	0.79	-0.80	50
Topeka Municipal Airport	62.2	39.0	50.6	-4.5	88	04/29	27	04/02	3.12	-0.41	88
Wichita Mid-Continent Airport	61.9	40.7	51.3	-4.8	86	04/29	25	04/24	3.47	0.88	134

Nebraska	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Chadron Municipal Airport	52.4	25.0	38.7	-6.1	81	04/05	0	04/11	1.06	-0.92	54
Grand Island Airport	58.2	33.9	46.0	-4.6	86	04/28	23	04/01	3.83	1.30	151
Lincoln Municipal Airport	58.8	33.4	46.1	-5.5	84	04/29	18	04/02	4.02	1.31	148
Norfolk Karl Stefan Airfield	56.0	32.0	44.0	-5.6	86	04/28	20	04/02+	3.84	1.19	145
North Platte Regional Airport	57.6	28.3	43.0	-4.6	87	04/28	14	04/24	1.27	-1.00	56
Omaha Eppley Airport	58.7	35.9	47.3	-4.4	85	04/29	20	04/01	5.33	2.37	180
Valentine Miller Field	52.5	28.0	40.2	-6.5	84	04/29	12	04/23	1.86	-0.36	84

North Dakota	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Bismark Municipal Airport	45.4	23.7	34.5	-9.3	81	04/27	12	04/23	1.81	0.55	144
Fargo International Airport	41.7	25.9	33.8	-10.4	73	04/27	11	04/01	2.11	0.75	155
Grand Forks International Airport	39.5	24.6	32.0	-10.0	70	04/27	8	04/01	1.61	0.60	159
Theodore Roosevelt Airport	45.5	22.8	34.1	-8.2	78	04/27	6	04/09	0.63	-0.84	43
Williston International Airport	44.8	24.2	34.5	-8.9	77	04/27	12	04/09	0.83	-0.17	83

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.

April 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	45.4	24.3	34.9	-9.5	82	04/27	9	04/13	2.12	0.27	115
Huron Regional Airport	48.7	26.5	37.6	-8.9	82	04/27	8	04/23	2.82	0.51	122
Pierre Regional Airport	49.2	26.0	37.6	-9.4	83	04/27	14	04/02	2.88	1.07	159
Rapid City Regional Airport	48.4	25.0	36.7	-8.3	79	04/27	11	04/11+	3.03	1.23	168
Sioux Falls Joe Foss Field Airport	49.5	29.1	39.3	-7.1	85	04/28	15	04/02	3.13	0.12	104

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	49.2	23.4	36.3	-6.4	74	04/27	4	04/18+	2.54	1.25	197
Cheyenne Municipal Airport	47.4	24.0	35.7	-7.1	73	04/28	5	04/10	2.88	1.10	162
Lander Hunt Field Airport	50.5	25.7	38.1	-5.8	74	04/27	5	04/10	3.14	1.27	168
Laramie Regional Airport	44.9	19.5	32.2	-5.7	69	04/28	-5	04/10	0.71	-0.36	66
Rawlins Municipal Airport	47.8	22.7	35.2	-4.9	72	04/28	-7	04/18	0.56	-0.49	53
Sheridan County Airport	50.7	24.7	37.7	-5.9	76	04/27	-2	04/23	2.27	0.67	142

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April 2013 Temperature Rankings - Highlights

Monthly Rankings Temperature in degrees F			
Coolest April			
Location	**Temperature / Rank**	**Record or Previous Record / Year**	**Period of Record**
Denver, CO	41.7 / 6th coolest	38.8 / 1920	1872-2013
Concordia, KS	48.0 / 7th coolest	44.9 / 1983	1885-2013
Goodland, KS	44.1 / 10th coolest	41.5 / 1918	1895-2013
Wichita, KS	51.3 / 7th coolest	48.0 / 1983	1888-2013
Lincoln, NE	46.1 / 9th coolest	43.5 / 1907	1887-2013
North Platte, NE	43.0 / 8th coolest	40.5 / 1920	1874-2013
Scottsbluff, NE	41.2 / 5th coolest	35.0 / 1898	1893-2013
Bismarck, ND	34.5 / 3rd coolest	33.6 / 1950	1874-2013
Fargo, ND	33.8 / 5th coolest	33.0 / 1907*	1881-2013
Grand Forks, ND	32.0 / 2nd coolest	29.7 / 1950	1893-2013
Williston, ND	34.5 / 4th coolest	32.4 / 1920	1894-2013
Aberdeen, SD	34.9 / coolest	36.0 / 1950	1893-2013
Rapid City, SD	36.7 / coolest	38.0 / 1950	1942-2013
Sioux Falls, SD	39.3 / 2nd coolest	37.8 / 1950	1893-2013
Casper, WY	36.3 / 4th coolest	34.9 / 1997*	1939-2013
Cheyenne, WY	35.7 / 6th coolest	31.5 / 1920	1872-2013
Sheridan, WY	37.7 / 6th coolest	36.4 / 1920	1907-2013

All Data are Preliminary and Subject to Change.
* indicates multiple records, latest date is listed
Source: National Weather Service Cooperative Observation Network Data

State Spotlight - Kansas

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

Cold Weather Continues

At the time of the year when temperatures begin to increase, April 2013 proved unseasonably cold. In fact, the state-wide average temperature ranked as the 4th coldest since 1895. Departures from average were similar to those in March. Average temperatures ranged from 1.2 degrees cooler than normal in the Southwestern Division to 5.6 degrees cooler than average in the South Central Division. State-wide average temperatures were 4.9 degrees below normal. In contrast, during 2012 the state-wide average temperature was 5.1 degrees above normal. This year, as with temperatures, the precipitation was also below normal. State-wide, the average precipitation was 2.26 inches, which is just 75% of normal. As percent of normal, the Northeast Division ranked the highest at 118 percent. That was 3.82 inches, much of which came in the form of heavy rain on the 18th. Snow continued to be a feature of the precipitation this month. Goodland Renner Field had the highest daily snowfall from a National Weather Service (NWS) site with 8.3 inches on the 23rd. Goodland 10.3 WNW and Goodland 12.1NW, in Sherman, had the greatest 24 snowfall total from a Community Collaborative Rain Hail and Snow (CoCoRaHS) site with 8 inches, also on the 23rd. One hundred and twenty-five daily snowfall records were set in April, with 2 records tied. Heaviest precipitation totals fell in the eastern portion of the state where more of the moisture came as rain. The highest 24 hour precipitation total from a NWS site was 3.00 inches at Walnut 3S, Crawford County, on the 18th. On that same date, Seneca 0.5N, Nemaha County, set the record for the CoCoRaHS network with 3.16 inches. April ended as the 55th driest April of 119 years.

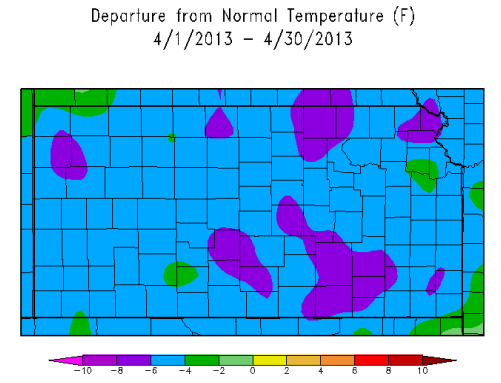

Figure 1. April 2013 departure from average temperatures across Kansas (High Plains Regional Climate Center)

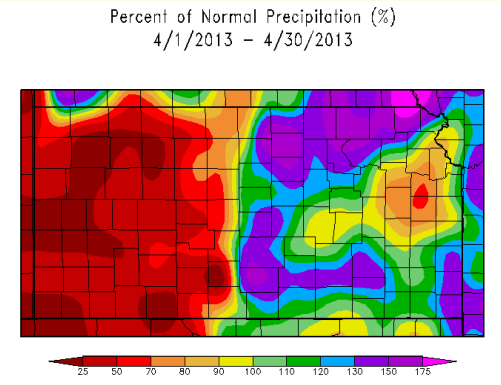

Figure 2. April 2013 percent of normal precipitation across Kansas (High Plains Regional Climate Center)

State-wide temperatures averaged 47.4F, which is 4.9 degrees below normal. The Southwest Division had the coldest average at 42.2F, or 1.2 degrees below normal. The North Central Division had the biggest departure from normal, with an average of 47.0F. This was 5.8 degrees below normal. Ashland (Clark County) reported the warmest temperature for the month with 95F on the 30th. The coldest reading for the month was reported as 12F at St. Francis (Cheyenne County) on the 10th.

Changes in the Drought Monitor have been mixed. In the Eastern divisions, with normal to above normal precipitation and cooler than average temperatures there has been improvement. A small portion of East Central KS is actually near normal. Extreme and Exceptional drought expanded in Southwestern KS, where moisture was very limited. The latest Drought Outlook indicated some drought conditions are expected to improve. Strongest signal for continued improvement is in the eastern third of the state. In the western division, there may be some improvement, but impacts are expected to continue. The El Niño/Southern Oscillation (ENSO) is expected to remain neutral, which reduces the skill in the forecast. The jet stream is expected to shift northward. For May chances are equally likely for precipitation to be above or below state-wide. In contrast to the May temperature outlook issued in mid-April, the latest temperature outlook calls for cooler than normal temperatures state-wide. This does not indicate how much cooler conditions might be, and does not exclude the possibility of significant warm weather in the period. Note that in April, temperatures went from a high of 95F to a low of 22F in 48 hours.

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:

Percent of normal precipitation totals were above normal in the central, southeast, and eastern regions and below normal elsewhere based on the High Plains Regional Climate Center (HPRCC) analysis (Figure 1). HPRCC total precipitation amounts were ~0.5 inches in the below normal regions and greater than 1.5 inches in the areas with above normal precipitation. Most of the precipitation that fell in April was in the form of snow. April ranked 4th snowiest month in Fargo with 16.7 inches and the snowiest month in Bismarck with 21.8 inches. 17.3 inches of snow fell in Bismarck on April 14th which broke the record for a daily snowfall for any day in Bismarck. The greatest amount of the April snow fell during the storm event from the 14th through the 15th. The highest amounts fell in the south central regions with totals reaching 15 to over 20 inches. The southeast received about 8 to 10 inches during that storm. The U.S. Drought Monitor April 23rd report listed 49.04% of the state as having anywhere from Abnormally Dry (D0) through Severe Drought (D2). Severe Drought (D2) was only reported for 1.84% of the state with 50.96% of the state having no drought conditions.

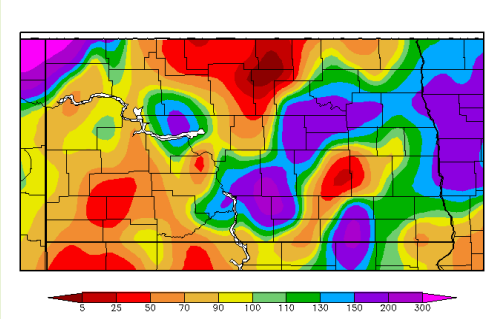

Figure 1. Percent of Normal Precipitation in April 2013 for North Dakota (High Plains Regional Climate Center)

Temperature:

NDAWN April average air temperatures ranged from ~24 °F in the north to ~35 °F in the southwest. Departure from normal average air temperatures ranged from -16 °F to -7 °F (Figure 2). The daily average temperatures were primarily far below normal throughout the state for the first 24 days of April breaking several low temperature records from the 18th through the 23rd. According to the National Climatic Data Center (NCDC), April was the 3rd coldest average temperature at Bismarck with 34.5 °F and it was the 5th coldest average temperature at Fargo with 33.8 °F. Fargo also broke the latest first 50 °F day in the recorded history. It happened on April 26th when the thermometer reached the 50 °F threshold for the first time in 2013. The previous record was set 133 years ago on April 17, 1881. After the 24th, average daily air temperatures were above normal across the state for most of the remaining days. The two-day (26th-27th) average maximum temperature at Bismarck ranked 6th warmest with 78.0 °F.

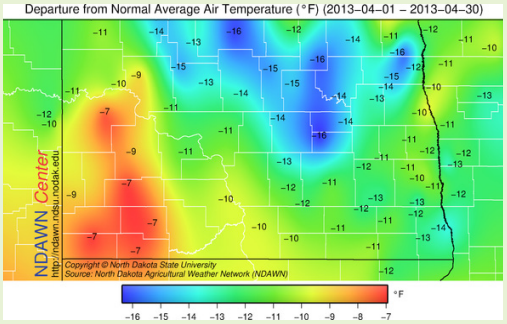

Figure 2. Temperature Departure from Normal in April 2013 for North Dakota (North Dakota State Climate Office)

For more information about the North Dakota State Climate Office: http://www.ndsu.edu/ndsco
For more information on the North Dakota Agricultural Network: http://www.ndawn.ndsu.nodak.edu
The North Dakota Agricultural Network is a part of the Automated Weather Data Network (AWDN).

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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