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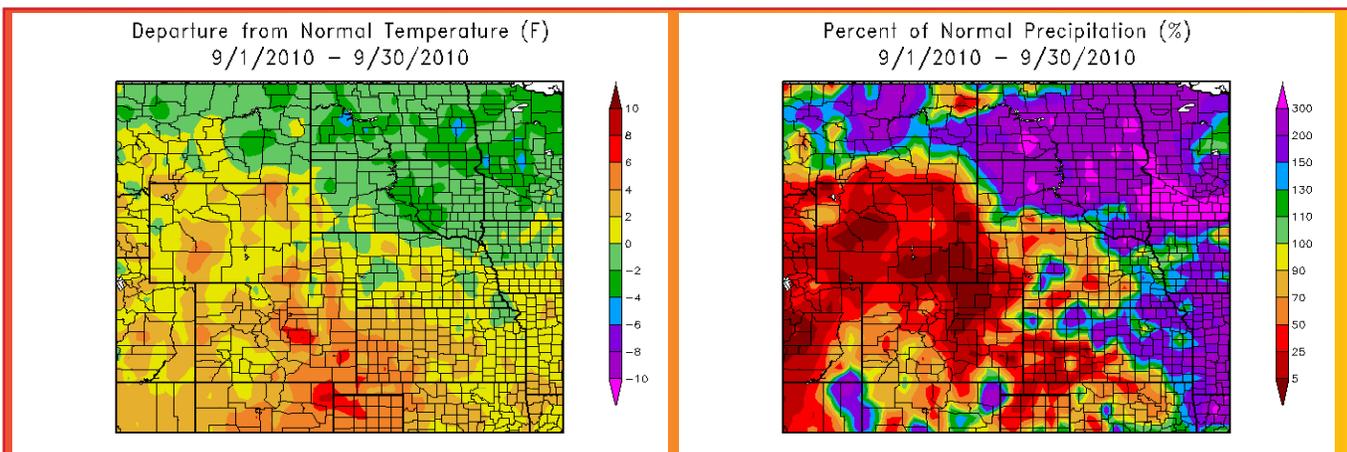
Rocky Mountain National Park - Photo by Bill Sorensen
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September 2010 Climate Summary

Region Breakdown

September 2010 was cool and wet in the northern portion of the High Plains Region and the southern and western portions of the Region were warm and dry. Overall, the wet conditions slowed the harvest of row crops; however areas planting winter wheat welcomed the rain.

Average temperatures for the month ranged from 2-6 degrees F (1.1-3.3 degrees C) below normal for most of the Dakotas, were near normal in Nebraska, and generally ranged from 4-6 degrees F (2.2-3.3 degrees C) above normal in much of Colorado, Kansas, and Wyoming. Central Colorado was particularly warm this month. High average temperatures, which were up to 9.0 degrees F (5.0 degrees C) above normal, allowed many locations to break into the top 10 warmest Septembers on record. Colorado Springs, Colorado recorded its warmest September on record with an average temperature of 67.0 degrees F (19.4 degrees C) which was 7.2 degrees F (4.0 degrees C) above normal (period of record 1894-2010). This broke the old record of 66.6 degrees F (19.2 degrees C) recorded in 1931.



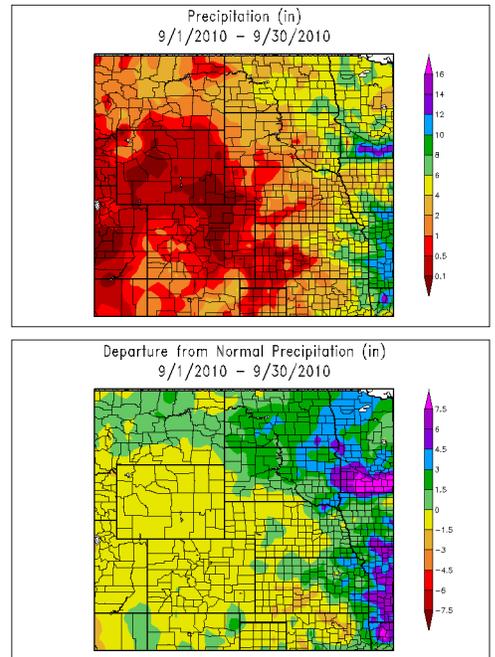
Departure from 1971-2000 Normal Average Temperature (left) and Percent of Normal Precipitation (right) for September 2010 in the High Plains Region. Maps produced by High Plains Regional Climate Center. Available at: <http://hprcc.unl.edu/maps/current>

Precipitation Summary

Above normal precipitation was mainly confined to the northern and eastern parts of the High Plains Region this month. Much of North Dakota, northern and eastern South Dakota, southeastern Nebraska, and eastern Kansas received at least 150 percent of normal precipitation. The southeastern corner of South Dakota has been extremely wet this year and this month's wet spot was Brookings 2 NE, South Dakota. Brookings 2 NE received 8.43 inches (214 mm) of precipitation, or 340 percent of normal precipitation, which broke the old September record of 7.67 inches (195 mm) received in 1986 (period of record 1893-2010). The total precipitation received at Brookings 2 NE this year now totals 36.80 inches (935 mm) which sets a new record for the entire year! The previous record was in 2005 with 33.12 inches (841 mm) of precipitation.

Severe weather was still a concern in some areas as hail damage to crops was reported in Nebraska, North Dakota, and Wyoming (source: National Agricultural Statistics Service). One storm in eastern Nebraska caused extensive damage on September 13th. The storm produced baseball sized hail and winds from 80-90 miles per hour (129-145 kilometers per hour). A University of Nebraska research facility near Mead, Nebraska sustained an estimated \$1.5 million in damage as crops were flattened, buildings were damaged, and vehicles were totaled.

Other areas of the Region received little to no precipitation this month. The majority of Wyoming, northern and central Colorado, southwestern Kansas, and the panhandle of Nebraska all received precipitation which was only 50 percent of normal or less. Some locations even received less than 5 percent of normal precipitation. This month's dry spot was Boysen Dam, Wyoming which received no precipitation this month and set the record for driest September (period of record 1948-2010). The old record was 0.02 inches (0.5 mm) received in 1956.



Above: Total precipitation (inches) (top) and Departure from Normal Precipitation (inches) (bottom) for September 2010 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>.

September 2010 Records - Highlights

Monthly Records			
Precipitation in inches, Temperature in degrees F			
Wettest	New Record	Old Record	Period of Record
Brookings 2 NE, SD	8.43	7.67/1986	1893-2010
Flandreau, SD	10.40	9.52/1986	1893-2010
Forman, ND	6.22	5.68/1988	1893-2010
Valley City 3 NNW, ND	6.69	5.82/1941	1893-2010
Driest	New Record	Old Record	Period of Record
Boysen Dam, WY	0.00	0.02/1956	1948-2010
Lander, WY	0.00	tied/1932*	1891-2010
Sybillie Research Unit, WY	0.00	tied/1977	1964-2010
Warmest	New Record	Old Record	Period of Record
Buena Vista 2 S, CO	59.5	tied/1948	1905-2010
Cabin Creek, CO	52.5	52.1/1977	1968-2010
Colorado Springs, CO	67.0	66.6/1931	1894-2010

All Data are Preliminary and Subject to Change.

* indicates multiple records, latest year is listed

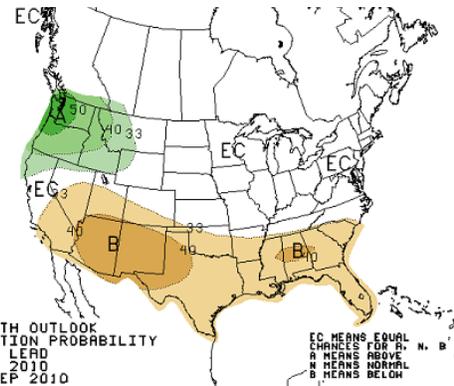
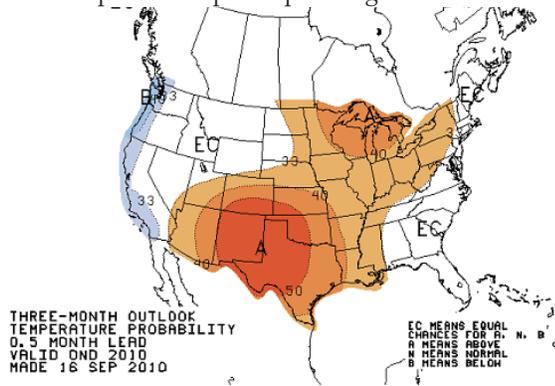
Source: National Weather Service Cooperative Observation Network Data

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.



Climate Outlook

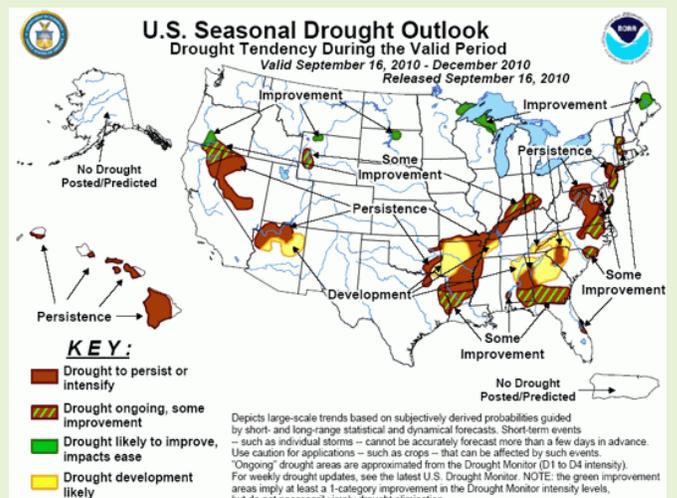
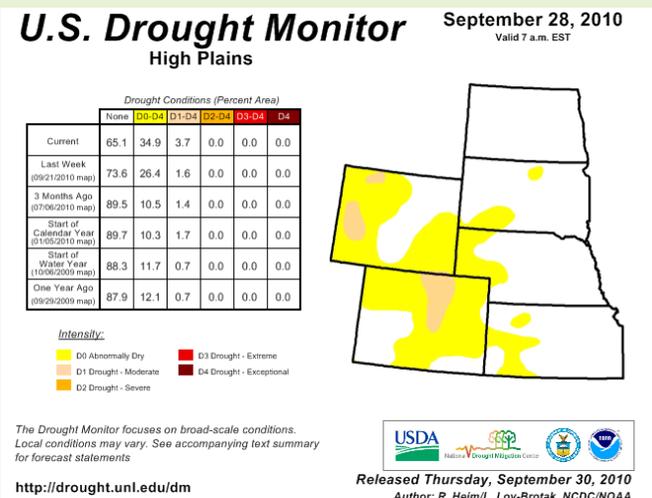
La Niña conditions were present across the equatorial Pacific this month and are likely to continue through early 2011. Like the last 3-month outlook, the temperature outlook indicates a higher probability of above normal temperatures for Colorado, Kansas, the majority of Nebraska, the eastern halves of the Dakotas, and the far southeastern corner of Wyoming. Equal chances of above, near, or below normal temperatures are predicted elsewhere in the Region. The precipitation outlook indicates a higher probability of above normal precipitation for northwestern Wyoming. Meanwhile, the western and southern portions of Colorado have a higher probability of below normal precipitation. Equal chances of above, near, or below normal precipitation are predicted elsewhere in the Region. The seasonal outlooks combine the effects of long-term trends, soil moisture, and when applicable, the El Niño Southern Oscillation cycle (ENSO). More information about these forecasts can be found here: <http://www.cpc.ncep.noaa.gov/>.



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

Above normal precipitation this month eliminated abnormally dry conditions (D0) in North Dakota, southeastern Nebraska, and northeastern Kansas, and changed the moderate drought conditions (D1) in South Dakota to D0. However, dry conditions allowed D0 to spread from western Colorado into eastern Colorado, eastern Wyoming, the panhandle of Nebraska, western Kansas, and southwestern South Dakota. In addition, an area of D1 had developed in central Colorado and extreme southern Wyoming where precipitation deficits were impacting soil moisture along with fall and winter crop decisions. According to the U.S. Seasonal Drought Outlook released September 16th, the drought conditions in western Wyoming and north central South Dakota were expected to improve through December 2010.



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://www.ndmc.unl.edu/dm/monitor.html>
 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
Alamosa San Luis Airport	79.6	36.6	58.1	3.6	85	9/29	29	9/12	0.73	-0.16	82
Akron Washington County Airport	83.4	51.2	67.3	4.2	96	9/20+	42	9/18	0.07	-0.85	8
Colorado Springs Municipal Airport	83.2	50.7	67.0	7.2	91	9/05	43	9/24	0.09	-1.14	7
Grand Junction Walker Field Airport	85.5	53.0	69.2	3.8	94	9/19+	45	9/11+	0.55	-0.36	60
Pueblo Memorial Airport	88.7	48.5	68.6	3.8	97	9/05	38	9/07	0.04	-0.80	5

Kansas	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Concordia Municipal Airport	81.4	56.5	68.9	0.9	93	9/06	44	9/26	3.32	0.82	133
Dodge City Regional Airport	88.5	56.7	72.6	3.3	102	9/05	40	9/26	1.45	-0.25	85
Goodland Renner Field	84.1	50.3	67.2	3.2	101	9/05	40	9/03	1.64	0.52	146
Topeka Municipal Airport	81.8	58.8	70.3	2.2	94	9/06	42	9/27	4.66	0.95	126
Wichita Mid-Continent Airport	86.3	62.2	74.2	3.4	97	9/15+	45	9/27	3.11	0.15	105

Nebraska	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Chadron Municipal Airport	81.8	42.9	62.4	0.7	96	9/20+	34	9/07	0.00	-1.44	0
Grand Island Airport	79.6	51.9	65.8	1.3	92	9/22	41	9/26	1.66	-0.77	68
Lincoln Municipal Airport	79.0	53.7	66.3	0.3	92	9/12	42	9/27	3.73	0.81	128
Omaha Eppley Airfield	77.9	56.1	66.9	1.5	90	9/20+	46	9/27	2.42	-0.75	76
Norfolk Karl Stefan Airport	76.9	50.5	63.7	0.3	91	9/20	41	9/26+	2.79	0.54	124
North Platte Regional Airport	79.3	45.8	62.5	0.1	98	9/05	34	9/30+	1.29	-0.03	98
Valentine Miller Field	78.1	46.3	62.2	0.7	99	9/20	35	9/30	0.89	-0.72	55

North Dakota	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	% Norm
Bismark Municipal Airport	67.9	44.6	56.2	-1.5	84	9/28	33	9/17	3.60	1.99	224
Fargo International Airport	66.2	46.6	56.4	-1.6	75	9/27+	34	9/18	5.82	3.64	267
Grand Forks International Airport	65.2	45.6	55.4	-1.6	79	9/01	35	9/18	5.28	3.32	269
Theodore Roosevelt Airport	66.9	42.6	54.6	-2.6	86	9/28	31	9/18+	2.98	1.36	184
Williston International Airport	67.1	43.8	55.5	-0.6	88	9/28+	23	9/18	1.41	0.06	104

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>.

September 2010 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	69.5	46.2	57.9	-1.9	80	9/12	37	9/16	4.08	2.27	225
Huron Regional Airport	71.4	49.0	60.2	-0.8	89	9/20	40	9/30+	3.50	1.70	194
Pierre Regional Airport	73.2	47.8	60.5	-2.7	87	9/01	40	9/18	2.89	1.34	186
Rapid City Regional Airport	76.1	43.9	60.0	-0.6	92	9/09	36	9/18	1.51	0.41	137
Sioux Falls Joe Foss Field Airport	70.6	49.3	59.9	-1.0	87	9/20	40	9/18	4.46	1.88	173

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	79.8	40.1	60.0	2.4	92	9/28+	28	9/07	0.28	-0.70	29
Cheyenne Municipal Airport	78.2	44.8	61.5	4.9	89	9/28	36	9/07+	0.01	-1.42	1
Lander Hunt Field Airport	79.2	45.0	62.1	3.4	90	9/19+	36	9/06	0.00	-1.14	0
Laramie Regional Airport	75.4	38.5	57.0	4.1	86	9/19	27	9/03	0.06	-0.93	6
Rawlins Municipal Airport	76.9	38.5	57.7	0.8	86	9/19	25	9/07	0.00	-0.82	0
Sheridan County Airport	76.8	40.5	58.6	1.5	93	9/26	32	9/07	0.25	-1.13	18

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State Spotlight - North Dakota

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



Precipitation:

The North Dakota Agricultural Weather Network (NDAWN) September precipitation ranged from 0.72 to 9.33 inches. NDAWN's percent of normal precipitation ranged from about 50% to 400% (Figure 1. North Dakota State Climate Office). The lower rainfall totals fell in Williams and McKenzie Counties which had 50% to 100% of normal rainfall. Bottineau, Renville, and northern McHenry and Pierce Counties along with parts of Foster County had approximately 100% to 140% of normal rainfall. The greatest majority of the remaining parts of the state had greater than 200% of normal. The eastern part of the state, especially the Red River Valley (RRV) had the greatest amounts of rainfall resulting in 200% to 300% of normal. The late September rains saturated soils in the RRV which could contribute to spring flooding. The NDAWN Oakes station recorded a total of 9.33 inches of rain which is 413% of normal. Most of the first 10 days of September had showers for many parts of the state followed by a relatively dry stretch with scattered light showers from the 12th through the 21st. Rain fell state wide on the 23rd with the greatest amounts falling in the eastern half of the state. The September 23rd storm system hit parts of southern Minnesota with greater than 10 inches of rain in 24 hours. The heavy rain flooded the towns of Truman, Pine Island and Owatonna causing flooded roads and many home evacuations.

Temperature:

NDAWN's September average air temperatures ranged from 51°F to 57°F. NDAWN departure from normal temperatures ranged from 1°F to -3°F (Figure 2. North Dakota State Climate Office). The eastern central and eastern part of the state had departures from normal of -2°F to -3°F with 1°F to -1°F elsewhere. The first half of the month, the daily average air temperatures held steady at below normal with a few slightly above normal days with a rough range of 10°F to -10°F, depending on location. Morning temperatures dipped below the killing freeze of 28°F on the 18th in the northwestern parts of the state. From the 21st through the 24th temperatures continued to be below normal but then rebounded state wide to above normal for the rest of the month.

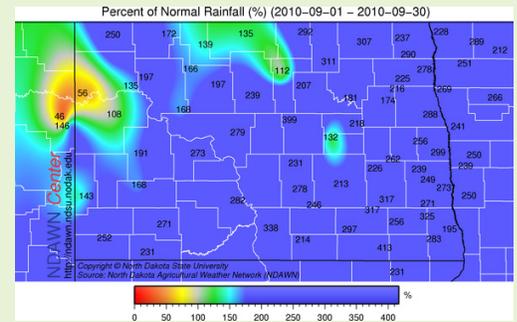


Figure 1. Percent of Normal Precipitation in September 2010 for North Dakota (North Dakota State Climate Office)

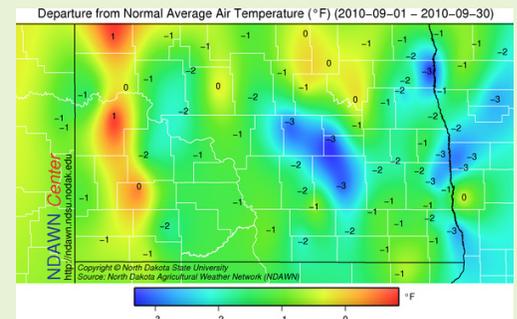


Figure 2. Temperature Departure from Normal in September 2010 for North Dakota (North Dakota State Climate Office)

State Spotlight - South Dakota

Dennis Todey - State Climatologist
South Dakota State Climate Office, South Dakota State University



Synopsis

Heavy rainfalls dominated the eastern part of the state causing flooding on the Big Sioux River and delaying the start of fall harvest while western parts of the state continued to receive below average precipitation.

Temperatures

Average temperatures in September ranged from the mid 50s F along the North Dakota border to the lower 60s F along the Nebraska border. These temperatures were generally 1-2 F below average. Northeast South Dakota was slightly cooler. The Black Hills area was 2-4 F above average.

Despite temperatures being fairly cool overall, there was little frost during the month. A few locations did experience frost on a couple occasions as conditions held off throughout the month. The average to ahead of average crop development left little crop area susceptible to freeze damage. Most row crops were ready for harvesting or very close by the end of the month. Only wet field conditions were limiting the start of harvest activity. Horticultural crops were still at risk.

Precipitation and Drought

Precipitation for the month varied greatly across the state. The east was again the wettest with a few counties in the east central recording in excess of 7" for the month. The COOP station, Astoria 4S reported 12.14" of precipitation for the month. This is a short period of record station but still well ahead of average for the area. Much of the northern and eastern parts of the state recorded precipitation totals that were 200-300% of average or more. A CoCoRaHS reporter in the same area had received over 14" for the month.

In contrast to the wet east, the far southwest (south of I-90 and west of the Missouri River) continued their dry run during the month with totals less than an inch and specifically less than 0.5" in Fall River County in the far southwest corner of the state.

Two stations, Brookings 2NE and Lemmon passed previous state records during the month. These records were set in 2005 and 1982 respectively. The excessively heavy September rains brought several other stations across the east close to annual records, also.

The wetter month allowed for some reduction in the D-area of north central SD. Late in the month the D1 was removed and D0 area reduced to only the area east of Mobridge that was running the longest term deficits. The dry area of the southwest saw an increase in D0 coverage.

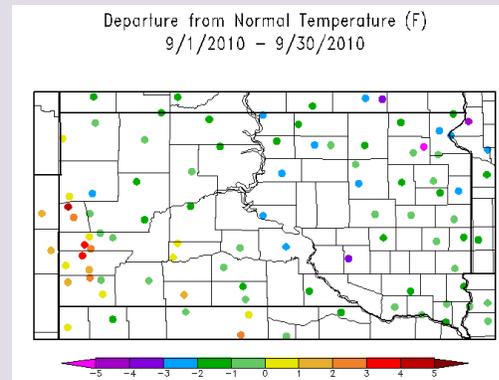


Figure 1. Departure from Normal Temperature in September 2010 for South Dakota (High Plains Regional Climate Center)

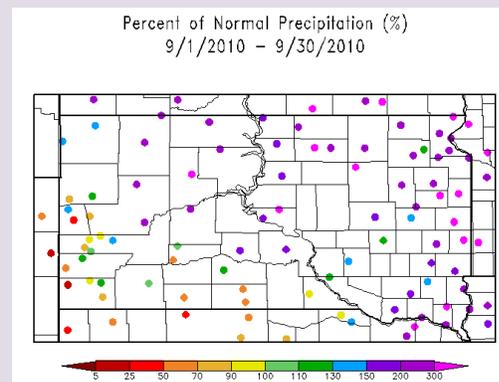


Figure 2. Percent of Normal Precipitation in September 2010 for South Dakota (High Plains Regional Climate Center)

State Spotlight - South Dakota

Dennis Today - State Climatologist
South Dakota State Climate Office, South Dakota State University



Agricultural Impacts

Most crop areas were past the potential period for frost damage and were in drydown prior to harvest. The southwest area dryness has occurred during a low impact time of year with the main potential impact being winter wheat planting and emergence. Other dry areas had already impacted crop yields and had little additional consideration. The wetness in the east flooded lowland areas along the Big Sioux River and inundated lower areas in fields.

Severe Weather Impacts

The flooding from heavy rains during the month damaged county and township roads and bridges in the southeast part of the state. These rains were heavy and fell on already wet grounds and full river systems. The Big Sioux River was pushed to near record flows near Dell Rapids. The USGS did document a record flow on Flandreau Creek breaking the previous record from 1984. Peak flows such as this are extremely uncommon in the fall.

Flooding in Brookings and Renner required evacuations of homes. The excessive run-off into sewage systems caused the City of Sioux Falls to discharge sewage directly into the Big Sioux River.

Preliminary reports from South Dakota Emergency Management indicate \$4.1 million in damages to publicly owned structures in Beadle, Brule, Clay, Fall River, Hand, Jerauld, Lincoln, Miner, Minnehaha, Sanborn, Turner, and Union Counties.

Other severe weather was quite limited, with 2 tornado, 46 hail and 9 wind reports statewide. One storm system in the Vermillion area damaged a Wal Mart with near 4" hail.

State Spotlight - Wyoming

Steve Gray - State Climatologist

Wyoming State Climate Office, University of Wyoming



September 2010 was characterized by marked dryness across the state of Wyoming. Precipitation totals at most observing stations ranked in the lowest 10th percentile for the month, and multiple stations received only a trace to no measurable rainfall at all. In terms of percentages of historical averages for the month, most of the state received 25% or less. Located in the southeastern corner of the state, Cheyenne—the state capitol and home to the largest human population (population 57,000)—recorded measurable precipitation on only one occasion. The resulting 0.1” total for the month ranked as the third driest in 120+ years of observations, with only extreme years such as 1879 (0.0” for the month) rivaling this lack of rainfall. This is even more remarkable when one considers that of the 36 CoCoRaHS (<http://www.cocorahs.org/state.aspx?state=wy>) observers in or around Cheyenne, only two reported totals of greater than 0.1” for the entire month. Likewise, nearby Laramie received only 0.06” and Casper, our second largest municipality (population 55,000), only 0.28”.

Moving west and into some of the less populated areas of the state, the story was much the same. Typical of southwestern Wyoming, Rock Springs experienced the 7th driest September on record. Worland, an agricultural and energy-production hub in north-central Wyoming, saw its 9th driest September. Even stations in the normally wet northwest corner of the state were noticeably dry. The Lake Yellowstone station in Yellowstone National Park, for example, measured only 0.34” for the month.

While not as extreme as the dryness experienced in September, conditions were generally warmer-than-average across the state. Departures ranged from 1 to 2.5° F above average, with a few scattered locations reporting > 4° F warmer. Of particular note are the numerous maximum daily temperature records that were set on both September 26th and 28th. Locations across the state broke record highs on these dates, while September 17-18 also brought record warmth to many stations.

In spite of these low precipitation totals and warm temperatures, drought remained a minor concern in most of Wyoming. September marks the beginning of what is often a dry fall season, and year-to-year variability in precipitation is notoriously high for this month. Moreover, this short-term dryness was often offset by very wet conditions in the late spring and early summer. Reservoir storage—the primary source of agricultural and municipal water in most of the state—also remained favorable. Parts of Sublette and Park Counties were classified as being in moderate drought during September (http://www.drought.unl.edu/dm/DM_west.htm), but this relates primarily to a lack of snowfall during the previous winter.

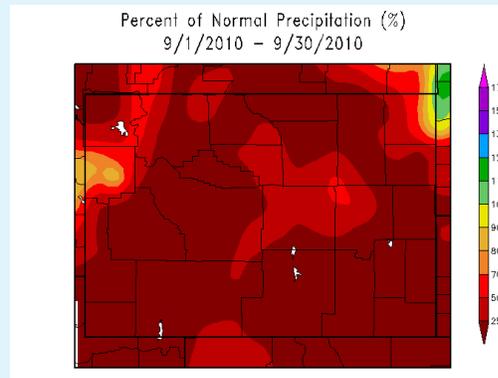


Figure 1. Map showing September 2010 precipitation as a percentage of historical averages (vs. 1971-2000 normal period) for Wyoming. Courtesy HPRCC.

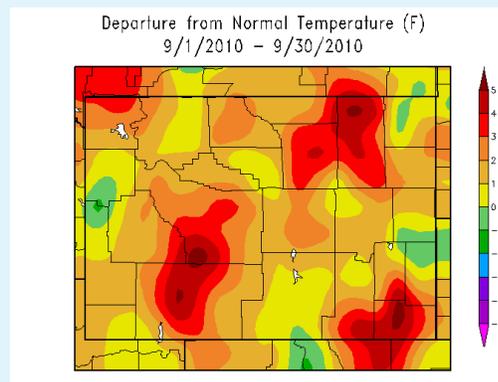


Figure 2. Map showing mean September 2010 temperatures from historical averages (vs. 1971-2000 normal period) for Wyoming. Courtesy HPRCC.

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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