North Dakota Climate Bulletin

Fall 2009

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In This Issue

NDSCO

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From the State Climatologist

The North Dakota Climate Bulletin is a digital quarterly publication of the North Dakota State Climate Office, the College of Agriculture, Food Systems and Natural Resources, North Dakota State University in Fargo, North Dakota.

Compared historically, North Dakota had a warmer and a wetter fall following the cooler and dry summer. Temperature-wise, this fall season was the 7th warmest since 1895. Precipitation-wise, it was the 22nd wettest fall since 1895. The monthly temperature rankings swung greatly from month to month with September at 3rd warmest, October at 6th coolest, and November at 3rd warmest. As of mid-December, the temperatures again have shifted to colder than normal. The wet conditions of October hampered harvest and reduced the quality of crops. Corn suffered the most with high moisture content. The Community Collaborative Rain Hail and Snow Network (CoCoRaHS) currently has approximately 100 observers representing 27 counties. The total precipitation amounts as a percentage of the normal and average temperature departure from normal are shown on pages 7 through 9 (Season in-Graphics) followed by the time series of monthly total precipitation and average temperature of North Dakota for respective months of the season. This bulletin can be accessed at http://www.ndsu.edu/ndsco/. This website hosts other great resources for climate and weather information.

Adnan Akyüz, Ph.D.
North Dakota
State Climatologist

Weather Highlights

Seasonal Summary:

by B. A. Mullins

September 2009

The State average precipitation was 1.73 inches which is nearly the same as the 1971-2000 normal of 1.74 inches. September 2009 state average precipitation ranked 72nd driest in the last 115 years with a maximum of 5.00 inches in 1900 and a minimum of 0.28 inches 1897.

The majority of the September daily rainfall fell on the 8th through the 11th and on the 21st. The North Dakota Agricultural Weather Network (NDAWN) total September rainfall ranged from 5.68 inches at Britton SD to 0.07 inches at Crosby. Areas with above normal precipitation included the central northwest and the eastern part of the State. Most of the above normal values were between 130% and 300% of normal precipitation. The above normal areas were in the north central and eastern parts of the State. The south central and southeast were below normal with the driest area in the northwest corner.

The US Drought Monitor September 29, 2009 report classified the southwest, a small part of the northwest corner, and the central eastern parts of North Dakota as “abnormally dry”. The remaining parts of the State had no drought conditions listed.

The National Weather Service (NWS) recorded breaking two rainfall records in September. The NWS recorded record rainfall on the 8th at Minot of 2.64 inches and on the 11th at Jamestown with 0.60 inches.

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 1% very short, 31% short, 66% adequate, and 2% surplus with a subsoil moisture reported as 2% very short, 27% short, 68% adequate, and 3% surplus (Weekly Weather and Crop Bulletin Vol. 96, No. 39).

According to the preliminary reports of the National Weather Service’s Storm Prediction Center (SPC), severe weather reports for September had 5 reported high wind events, 2 reports of hail, and 0 reported tornadoes. The September SPC reports are from two days. On the 7th, SPC reported hail in Bowman County. High winds on the 7th were reported in Stark, Dunn, and Morton Counties. On the 10th, SPC reported hail in McLean County. High winds on the 10th were reported in Oliver and Morton Counties.

The top five September daily rainfall totals measured from North Dakota Agricultural Weather Network (NDAWN) were 2.82 inches on the 8th at Britton SD, 2.14 inches on the 8th at Humboldt MN, 2.14 inches on the 8th at Minot, 1.89 inches on the 11th at Cavalier, and 1.86 inches on the 11th at Cando.

The top five September daily maximum wind speeds recorded from the NDAWN were 61.9 mph on the 10th at McHenry, 59.8 mph on the 27th at Galesburg, 53.7 mph on the 11th at Wishek, 51.9 mph on the 30th at Linton, and 51.5 mph on the 27th at Watford City. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The State average air temperature was 62.8°F which is well above the 1971-2000 normal of 56.1°F. September 2009 state average air temperature ranked 3rd warmest in the past 115 years with a maximum of 63.4°F in 1897 and a minimum of 45.2°F in 1965.

The monthly departure from normal air temperatures were above normal across the State with a range of 2 to 10°F. The daily average temperatures were above normal for the majority of the month and primarily ranged from approximately 60 to 80°F. Daily temperatures did drop to below normal during the last three days of September. Other than January 2009, when the southwest corner had above normal monthly average air temperatures, the last time there was State wide above normal air temperatures was November 2008.

September's monthly average temperatures were some of the warmest on record. Table 1 lists Williston's 2009 September average temperature of 64.3°F and Minot's 64.8°F ranked number one. Bismarck with 65.0°F and Fargo with 65.1°F ranked 2nd. Table 2 lists Williston's 2009 September highest maximum average temperature of 80.4°F ranked number one out of data collected since 1948. Table 3 lists Fargo's 2009 September highest minimum temperature of 53.9°F and Minot's 52.1°F ranked number one.

*Table 1. Rank of 2009 September Highest Average Temperatures (°F) for Selected Stations.**

Station	Rank	Avg Temp °F	Beginning Record
Bismarck	2	65.0	1874
Fargo	2	65.1	1881
Jamestown	4	62.9	1948
Minot	1	64.8	1948
Williston	1	64.3	1948

* Data from National Weather Service.

*Table 2. Rank of 2009 September Highest Maximum Average Temperatures (°F) for Selected Stations.**

Station	Rank	Avg Max Temp °F	Beginning Record
Bismarck	5	78.9	1874
Fargo	6	76.3	1881
Jamestown	7	75.5	1948
Minot	2	77.4	1948
Williston	1	80.4	1948

* Data from National Weather Service.

*Table 3. Rank of 2009 September Highest Minimum Average Temperatures (°F) for Selected Stations.**

Station	Rank	Avg Min Temp °F	Beginning Record
Bismarck	2	51.0	1874
Fargo	1	53.9	1881
Jamestown	2	50.3	1948
Minot	1	52.1	1948
Williston	2	48.2	1948

* Data from National Weather Service.

The National Weather Service (NWS) recorded tying one temperature record in September. The NWS recorded a record high temperature of 93°F which tied the record set in 1981.

NDAWN's highest recorded daily air temperature for September was 97.6°F at Sidney, MT on the 6th. The lowest recorded daily air temperature was 26.1°F at Greenbush MN on the 29th.

October 2009

The state average precipitation was 2.63 inches which was above the 1971-2000 normal state average of 1.41 inches. October 2009 state average precipitation ranked the 5th wettest in the past 115 years with a maximum of 4.71 inches in 1982 and a minimum of 0.10 inches in 1952.

October monthly precipitation was above normal across the state with no reported drought conditions. The southeast had the highest monthly total with 200% to 300% above normal. The northern and western parts of the state had 100% to 200% of normal precipitation. Rain fell frequently during October with the highest amounts falling on the 1st. The weekly wet conditions hampered harvest throughout the month. The quality of crops suffered under the continuing wet conditions. The second week of October had rain turn to snow across most areas of the state with the highest snow accumulations in the east and southeast. The North Dakota Agricultural Weather Network (NDAWN) total October rainfall ranged from 5.91 inches at Wahpeton to 0.67 inches at Roseau, MN.

The US Drought Monitor November 3, 2009 report had no drought conditions reported in the state.

The National Weather Service (NWS) recorded breaking several precipitation records. Record rainfall was recorded at Minot, Grand Forks NWS, Grand Forks airport, and Fargo on the 1st with 0.80 inches, 1.15 inches, 1.17 inches, and 1.98 inches, respectively. Bismarck had record snowfall on 0.6 inches on the 12th. Jamestown had record liquid precipitation of 0.34 inches on the 14th. Grand Forks airport had record snowfall on the 14th and 15th of 0.6 inches and 0.1 inches, respectively. Grand Forks airport, Dickinson, and Jamestown had record rainfall on the 20th of 0.30 inches, 0.15 inches, and 0.38 inches, respectively. The NWS records are listed under Storms and Record Events section of this publication.

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 0% very short, 9% short, 69% adequate, and 22% surplus with a subsoil moisture reported as 1% very short, 16% short, 64% adequate, and 19% surplus (Weekly Weather and Crop Bulletin Vol. 96, No. 44).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for October had no reports of high wind events, hail, or tornadoes.

The top five October daily rainfall totals measured from North Dakota Agricultural Weather Network (NDAWN) all fell on October 1st with 2.07 inches at Leonard, 2.04 inches at Prosper, 1.96 inches at Fargo, 1.91 inches at Wyndmere, and 1.90 inches at Ekre.

The top five October daily maximum wind speeds recorded from the NDAWN were 46.2 mph at Watford City on the 1st, 44.0 mph at Beach on the 1st, 43.7 mph at Berthold on the 7th, 42.9 mph at Robinson on the 7th, and 42.6 mph at Mohall on the 7th. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The October state average air temperature was 37.7°F which is below the 1971-2000 normal of 43.6°F. October 2009 state average air temperature ranked 6th coolest in the past 115 years with a maximum of 54.8°F in 1963 and a minimum of 32.5°F in 1925.

The monthly departure from normal air temperatures were below normal across the state with a range of 3°F below normal in the northeast and gradually falling to 9°F below normal in the southwest. Monthly average temperatures ranged from 41°F to 35°F. The first half of October

was cold with far below normal daily average temperatures. A killing frost occurred in the second week of October. Record low maximum temperatures were set at Bismarck on the 9th with 32°F and at Fargo on the 10th with 35°F. The second half of October continued to be cool with average temperatures at or below normal.

The National Weather Service (NWS) recorded a record low maximum temperature of 32°F at Bismarck on the 9th. NWS also recorded a record low maximum temperature of 35°F at Fargo on the 10th. Fargo tied the record low temperature of 17°F on the 13th. The NWS records are listed under Storms and Record Events section of this publication.

NDAWN's highest recorded daily air temperature for October was 79.6°F at Mandan on the 18th. The lowest recorded daily air temperature was 11.9°F at Bottineau on the 13th.

November 2009

The state average precipitation was 0.07 inches which is below the 1971-2000 normal state average of 0.73 inches. November 2009 state average precipitation ranked the 4th driest in the past 115 years with a maximum of 2.51 inches in 2000 and a minimum of 0.02 inches in 1939.

November monthly precipitation was far below normal across the state. The eastern edge of the state had less than 50% of normal precipitation. The remainder of the state had less than 25% of normal precipitation. The monthly total precipitation ranged from less than 0.5 inches along the eastern edge to less than 0.1 inches for the remainder of the state. The state average precipitation was 0.06 inches which figured to 11% of normal precipitation. At Bismarck, the total precipitation tied for the 9th driest November (data since 1874). The dry conditions were a welcomed change after a wet October. Producers were able to harvest crops and prepare fields for the 2010 growing season.

The US Drought Monitor December 1, 2009 report had no drought conditions reported in the state.

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 0% very short, 16% short, 74% adequate, and 10% surplus with a subsoil moisture reported as 1% very short, 17% short, 71% adequate, and 11% surplus (Weekly Weather and Crop Bulletin Vol. 96, No. 48).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for November had no reports of high wind events, hail, or tornadoes.

The top five November daily maximum wind speeds recorded from NDAWN all fell on the 21st with Warren MN at 42.9 mph, Dazey at 41.1 mph, Grafton at 40.4 mph, Humboldt MN at 40.4 mph and Perley MN at 40.4 mph. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The state average air temperature was 36.4°F which is above the 1971-2000 normal of 26.1°F. November 2009 state average air temperature ranked the 3rd warmest in the past 115 years with a maximum of 37.4°F in 2001 and a minimum of 7.3°F in 1896.

November brought dry conditions and warmer temperatures. The monthly departure from normal air temperatures were above normal across the state with a range of 3°F to 13°F above normal, with the greater departures of 11 to 13 in the east and the smaller departures of 8 to 11 in the

west. The monthly average temperatures ranged from 33°F to 40°F where the cooler temperatures were to the north and warmer temperatures to the south. The November average temperatures ranked 5th warmest at Bismarck (data since 1874), 3rd warmest at Williston (data since 1962), 2nd warmest at Fargo (data since 1881), and 3rd warmest at Grand Forks (data since 1893).

The National Weather Service (NWS) recorded breaking high maximum temperature records on the 6th at Dickinson with 76°F, Minot with 75°F, and Williston with 72°F. The high maximum temperature record was also broke on the 30th at the Grand Forks airport with 49°F. The high minimum temperature was broken on the 12th at Fargo with 49°F and at the Grand Forks airport with 43°F.

NDAWN's 5 highest daily air temperatures for November all fell on the 6th with 77.2°F at both Hazen and Mott, and 75.5°F at Dickinson, Karlsruhe and Hettinger. The lowest daily air temperature was 5.9°F at Bottineau on the 29th.

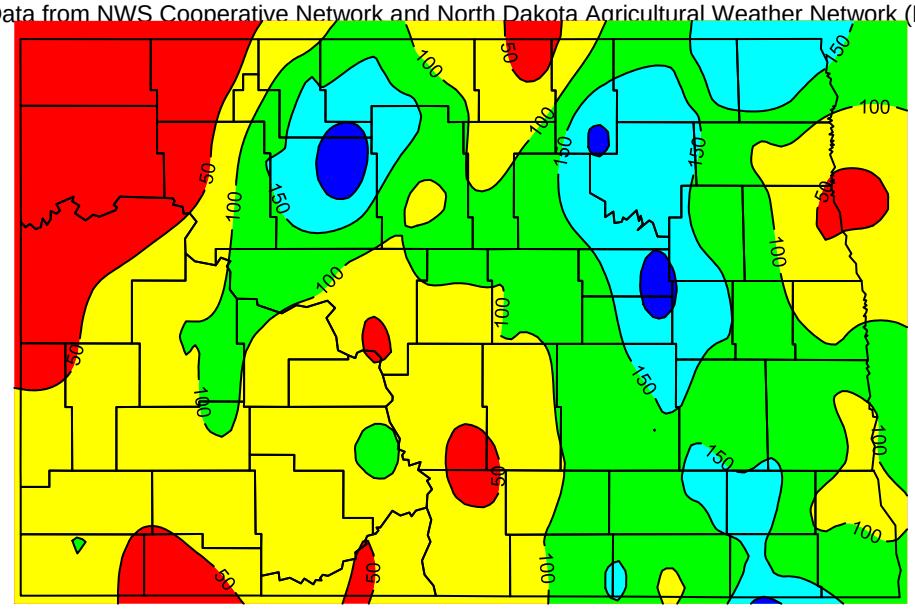
Season in Graphics

Fall 2009 Weather in North Dakota:

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

(Data from NWS Cooperative Network and North Dakota Agricultural Weather Network (NDAWN))



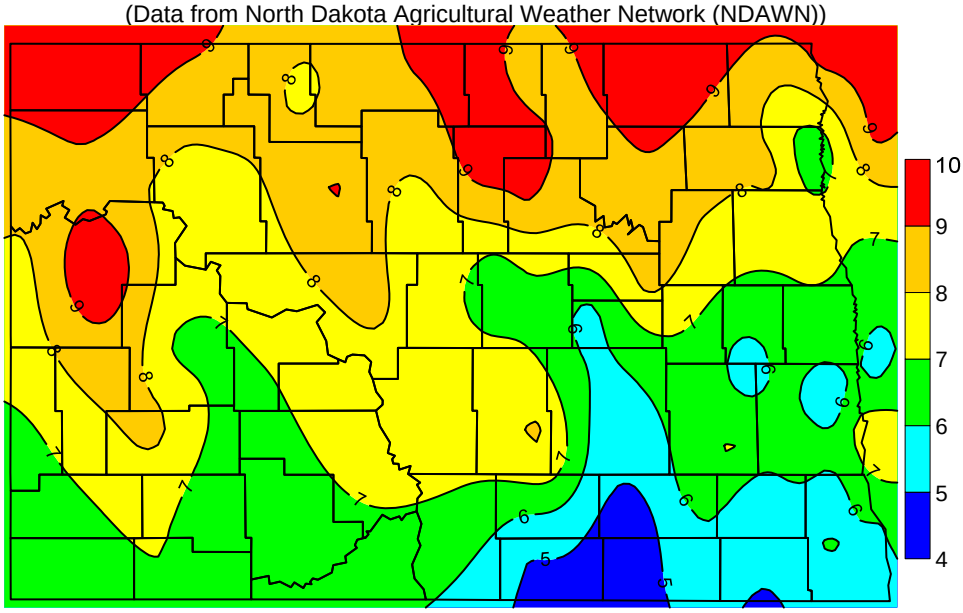
North Dakota State Climate Office

Average Temperature (°F) Deviation from Mean (1971-2000)

Departure From Normal Monthly

Average Air Temperature in degrees F

(Data from North Dakota Agricultural Weather Network (NDAWN))



North Dakota State Climate Office

September 2009

Season in Graphics

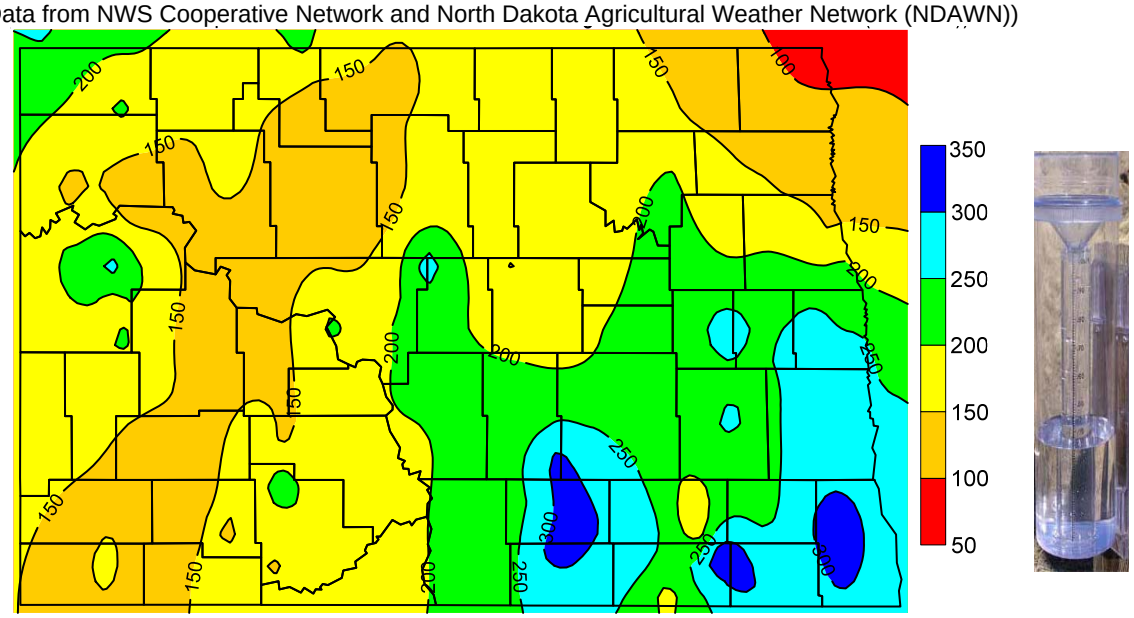
Fall 2009 Weather in North Dakota:

October 2009

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

(Data from NWS Cooperative Network and North Dakota Agricultural Weather Network (NDAWN))

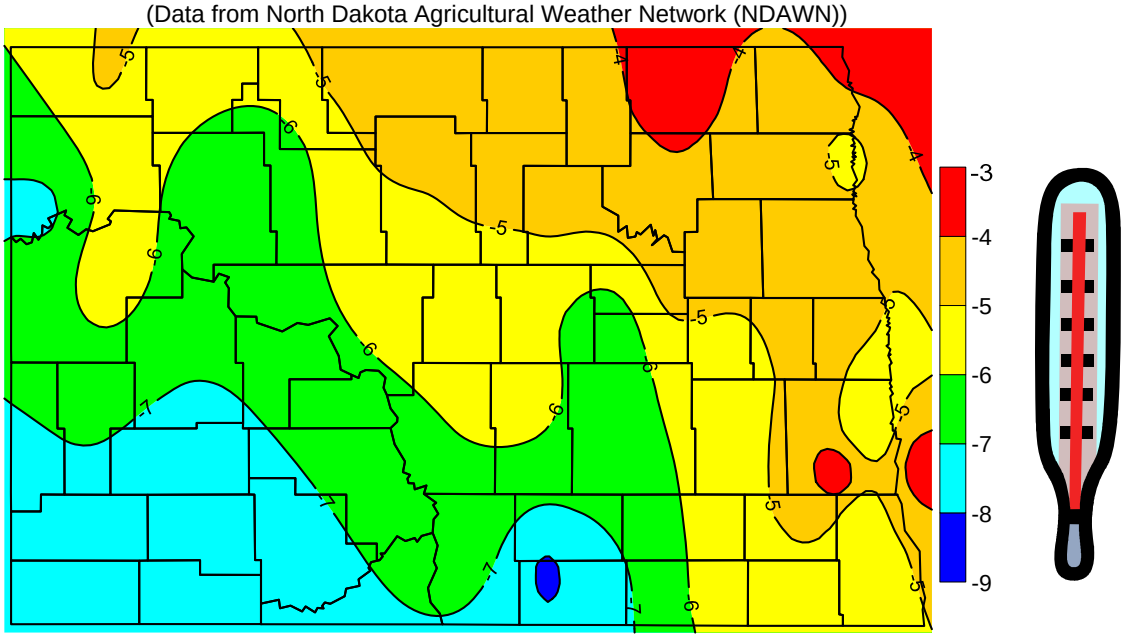


North Dakota State Climate Office

Average Temperature (°F) Deviation from Mean (1971-2000)

Departure From Normal Monthly
Average Air Temperature in degrees F

(Data from North Dakota Agricultural Weather Network (NDAWN))



North Dakota State Climate Office

Season in Graphics

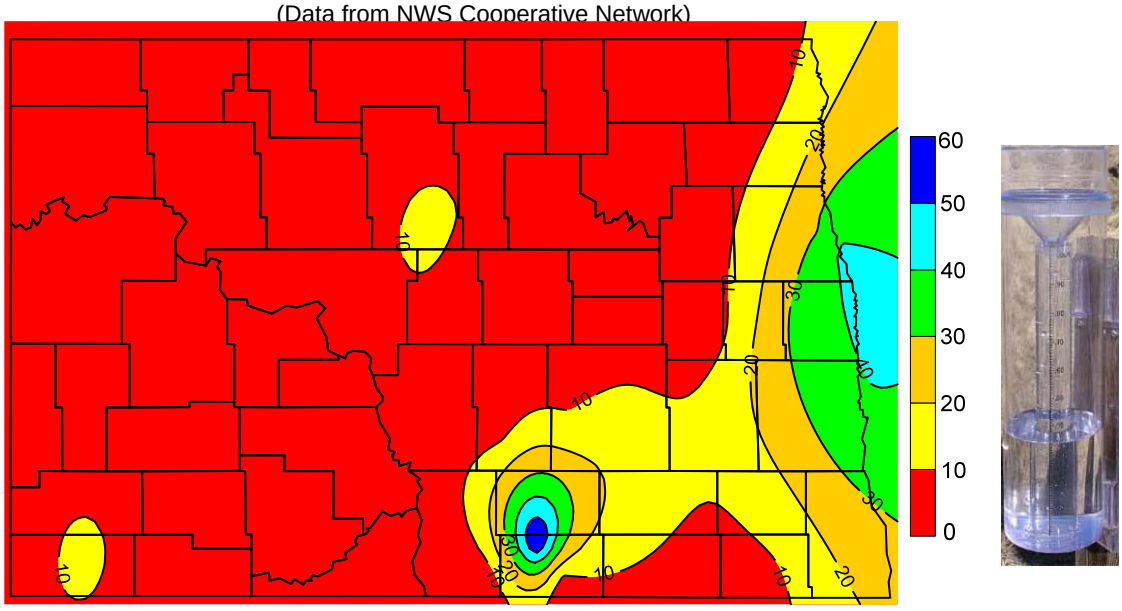
Fall 2009 Weather in North Dakota:

November 2009

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

(Data from NWS Cooperative Network)



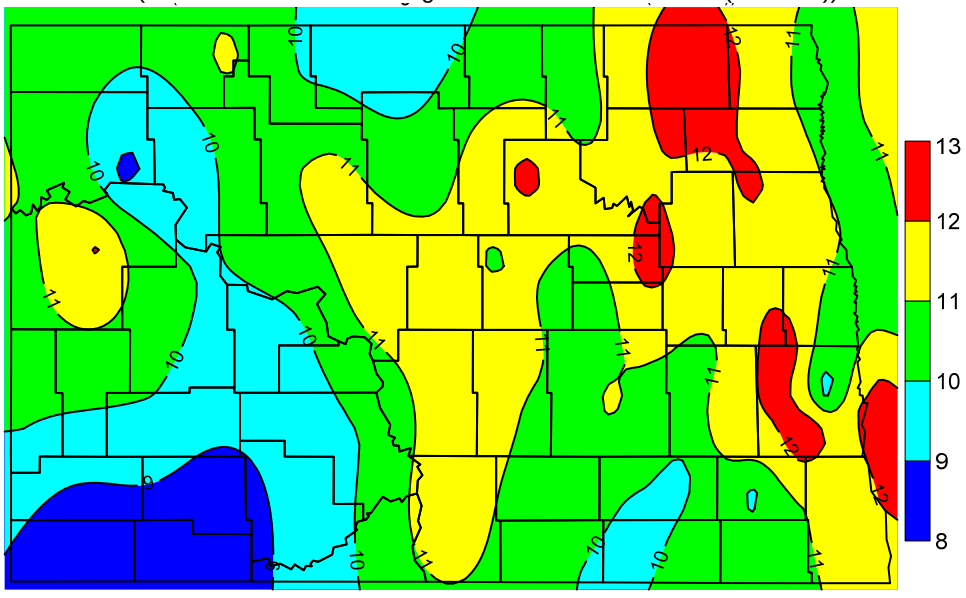
North Dakota State Climate Office

Average Temperature (°F) Deviation from Mean (1971-2000)

Departure From Normal Monthly

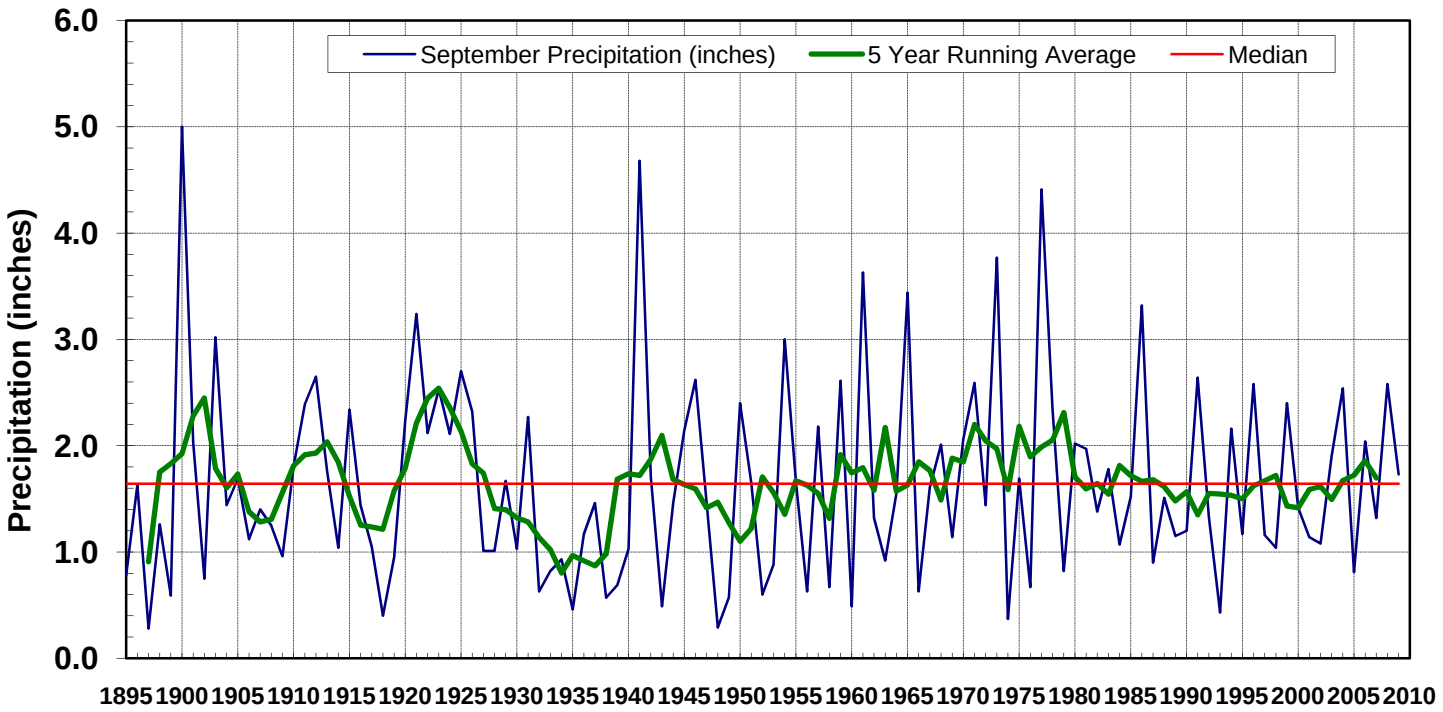
Average Air Temperature in degrees F

(Data from North Dakota Agricultural Weather Network (NDAWN))



North Dakota State Climate Office

Historical September Precipitation for North Dakota

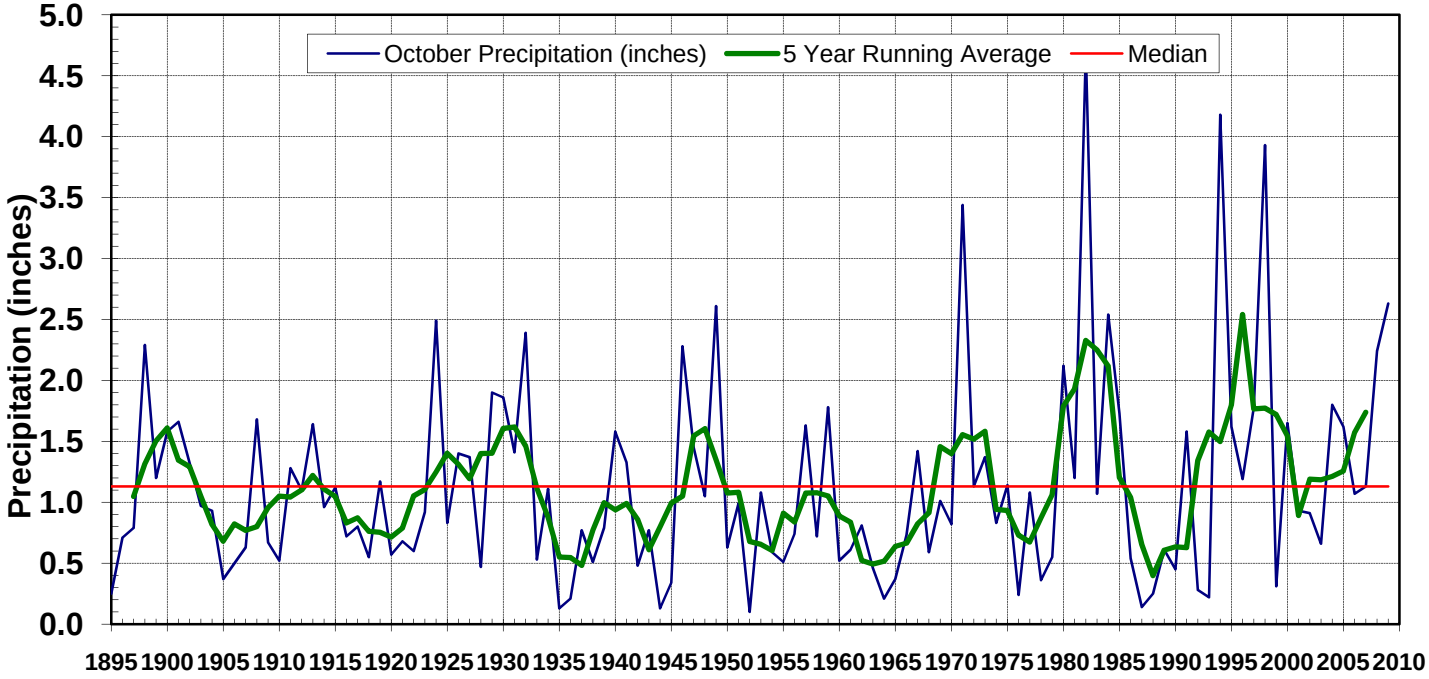


September Precipitation Statistics

2009 Amount: **1.73 inches**
Maximum: 5.00 inches in 1900
State Normal: 1.74" (1971-2000)

Monthly Ranking: 72nd Driest in 115 years
Minimum: 0.28 inches in 1897
Years in Record: 115

Historical October Precipitation for North Dakota

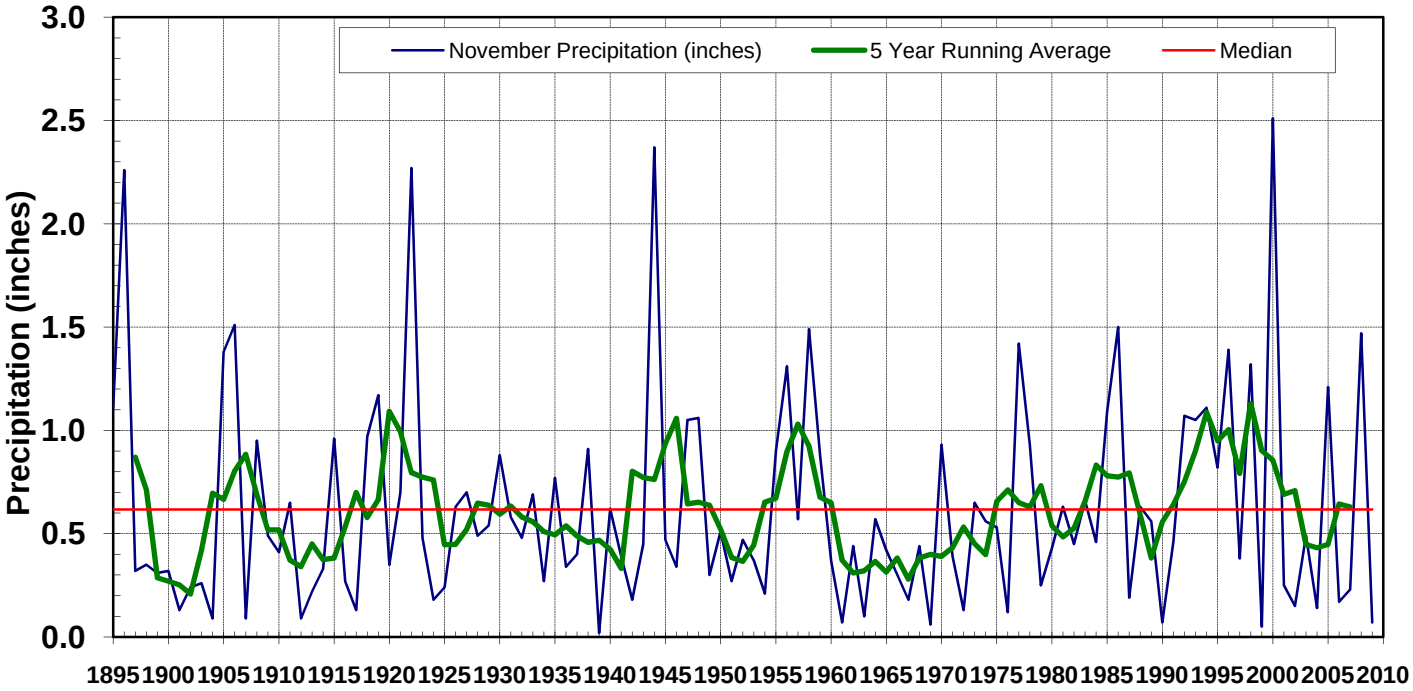


October Precipitation Statistics

2009 Amount: **2.63 inches**
Maximum: 4.71 inches in 1982
State Normal: 1.41" (1971-2000)

Monthly Ranking: 5th wettest in 115 years
Minimum: 0.10 inches in 1952
Years in Record: 115

Historical November Precipitation for North Dakota

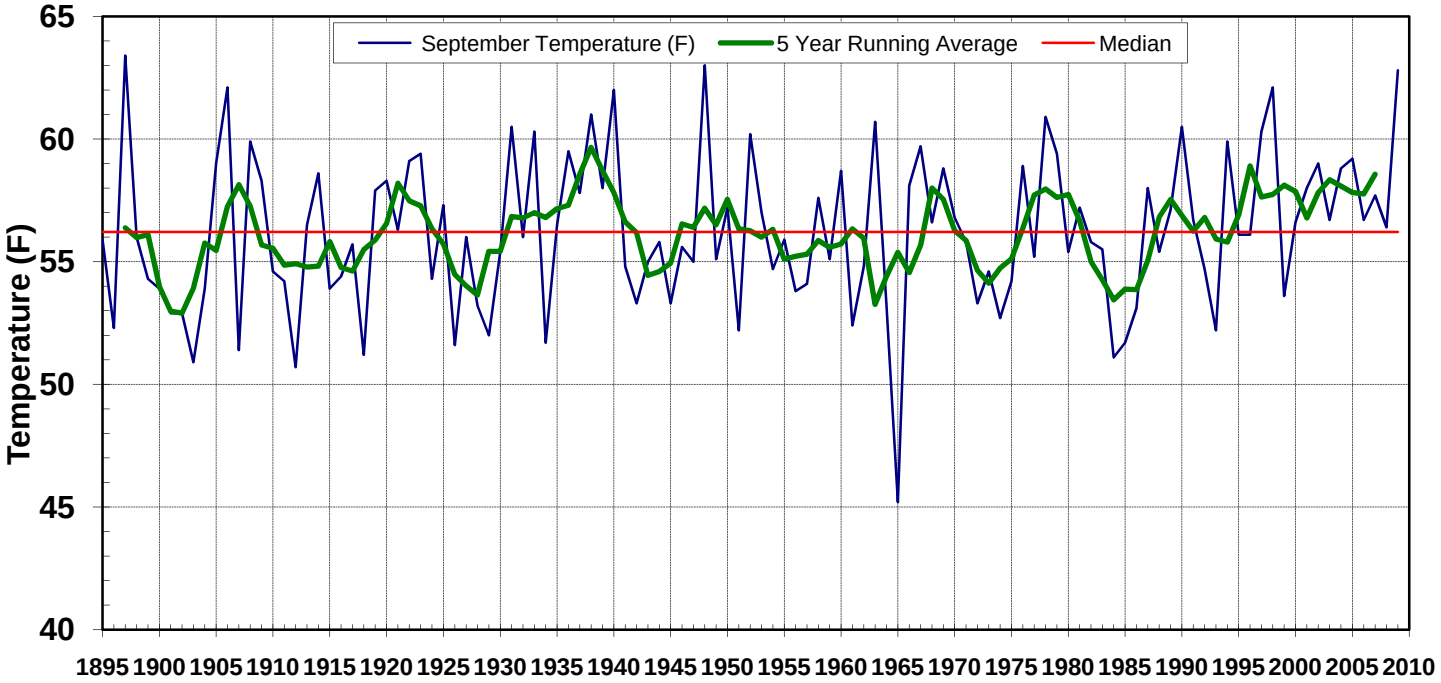


November Precipitation Statistics

2009 Amount: **0.07 inches**
Maximum: 2.51 inches in 2000
State Normal: 0.73" (1971-2000)

Monthly Ranking: 4th Driest in 115 years
Minimum: 0.02 inches in 1939
Years in Record: 115

Historical September Temperature for North Dakota

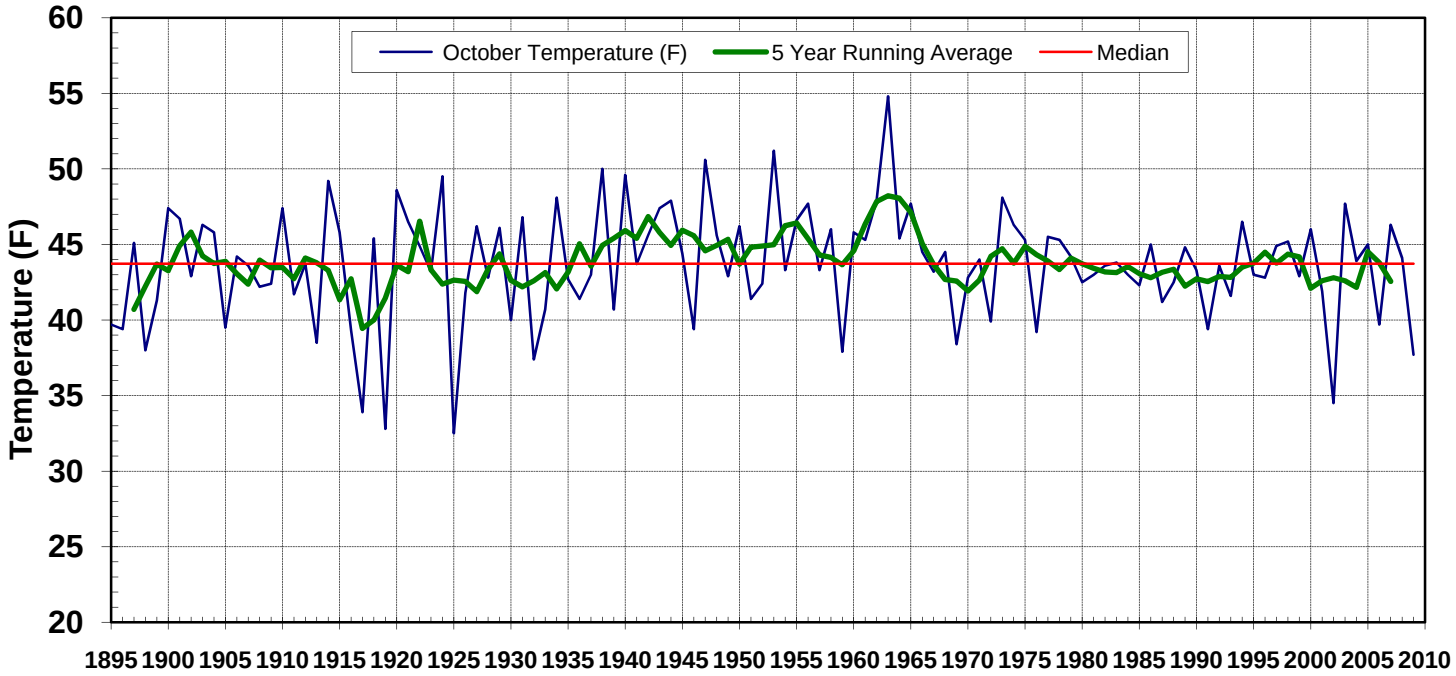


September Temperature Statistics

2009 Average: **62.8**°F
Maximum: 63.4°F in 1897
State Normal: 56.1°F (1971-2000)

Monthly Ranking: 3rd Warmest in 115 years
Minimum: 45.2° F in 1965
Years in Record: 115

Historical October Temperature for North Dakota

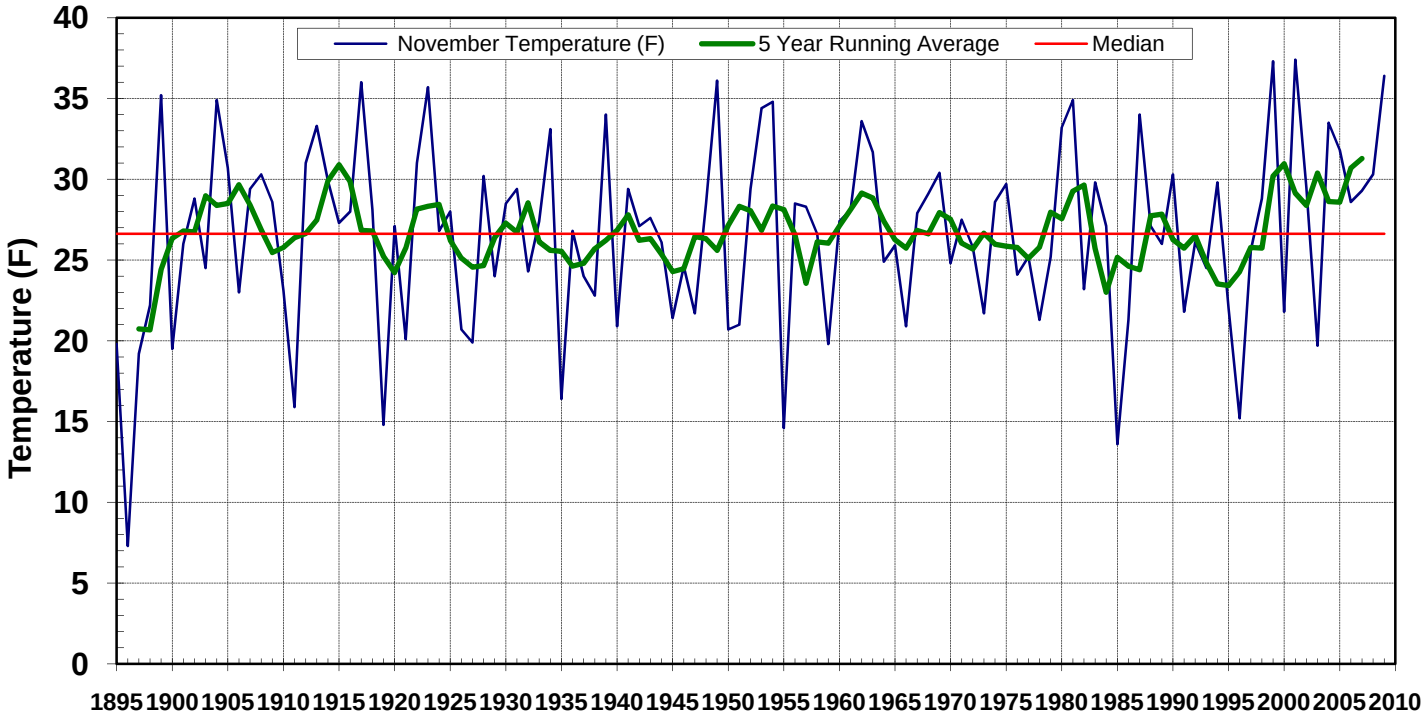


October Temperature Statistics

2009 Average: 37.7°F
Maximum: 54.8°F in 1963
State Normal: 43.6°F (1971-2000)

Monthly Ranking: 6th Coolest in 115 years
Minimum: 32.5°F in 1925
Years in Record: 115

Historical November Temperature for North Dakota



November Temperature Statistics

2009 Average: **36.4°F**
Maximum: 37.4°F in 2001
State Normal: 26.1°F (1971-2000)

Monthly Ranking: 3rd warmest in 115 years
Minimum: 7.3°F in 1896
Years in Record: 115

Storms & Record Events

State Tornado, Hail, and Wind Reports for Fall 2009

by B. A. Mullins

North Dakota 3 Month Total	Wind	Hail	Tornado
	5	2	0

Reports by Month			
Month	Wind	Hail	Tornado
Total September	5	2	0
Total October	0	0	0
Total November	0	0	0

North Dakota Record Event Reports for Fall 2009

Date	Location	Type of Record	Previous Record
09/08/09	Minot	Rainfall of 2.64 inches.	0.53 inches set in 1970.
09/11/09	Jamestown	Rainfall of 0.60 inches.	0.52 inches set in 1999.
09/19/09	Williston	High maximum temperature of 93°F.	Ties previous record set in 1981.
10/01/09	Minot	Rainfall of 0.80 inches.	0.38 inches set in 1982.
10/01/09	Grand Forks NWS	Rainfall of 1.15 inches.	0.92 inches set in 1926.
10/01/09	Fargo	Rainfall of 1.98 inches.	1.04 inches set in 1907.
10/01/09	Grand Forks AP	Rainfall of 1.17 inches.	0.60 inches set in 1983.
10/09/09	Bismarck	Low maximum temperature of 32°F.	33°F set in 1959.
10/10/09	Fargo	Low maximum temperature of 35°F.	36°F set in 1935.
10/12/09	Bismarck	Snowfall of 0.6 inches.	0.4 inches set in 1902.
10/13/09	Fargo	Low temperature of 17°F.	Ties previous record set in 1979.
10/14/09	Jamestown	Liquid precipitation of 0.34 inches.	0.15 inches set in 2004.
10/14/09	Grand Forks AP	Snowfall of 0.6 inches.	Trace set in 1975.
10/15/09	Grand Forks AP	Snowfall of 0.1 inches.	Trace set in 2004.
10/20/09	Grand Forks AP	Rainfall of 0.30 inches.	0.28 inches set in 1984.
10/20/09	Dickinson	Rainfall of 0.15 inches.	0.1 inches set in 1979.
10/20/09	Jamestown	Rainfall of 0.38 inches.	0.33 inches set in 1949.
11/06/09	Dickinson	High maximum temperature of 76°F.	72°F set in 1980.
11/06/09	Minot	High maximum temperature of 75°F.	70°F set in 1949.
11/06/09	Bismarck	High maximum temperature of 72°F.	Ties previous record set in 1954.
11/06/09	Williston	High maximum temperature of 72°F.	69°F set in 1954.
11/11/09	Fargo	High minimum temperature of 43°F.	Ties previous record set in 1964.
11/12/09	Fargo	High minimum temperature of 49°F.	45°F set in 1923.
11/12/09	Grand Forks AP	High minimum temperature of 43°F.	37°F set in 1944.
11/30/09	Grand Forks AP	High maximum temperature of 49°F.	48°F set in 1969.
11/30/09	Grand Forks NWS	High maximum temperature of 48°F.	Ties previous record set in 1969.

Seasonal Outlook

Fall Climate Outlooks

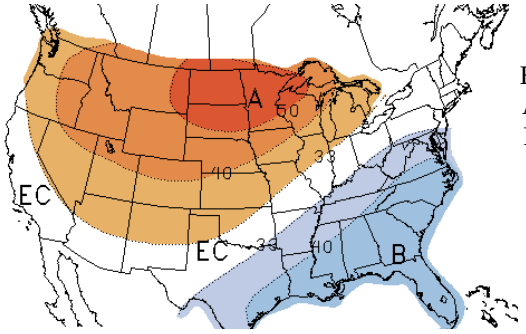
by M. Ewens[1]

During the summer and fall of 2009 a moderate El Niño developed in the equatorial Pacific Ocean. An El Niño occurs when warm water below the surface moves upward to the surface, causing a widespread, significant warming from the Argentinean coast west to the International Dateline and the Indonesian region. El Niño typically affects the climate across a large part of the northern hemisphere by displacing the jet stream south of its usual winter position, and weakens the polar jet. This in turn typically brings milder and somewhat drier weather to the northern plains.

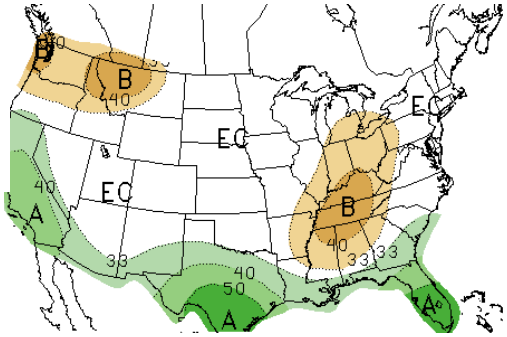
During the spring, the El Niño normally weakens, allowing weather patterns to return to a more normal state. However, the atmospheric effects can take several months to be removed from the atmosphere. In other words, the milder than normal "signal" often persists into the March and April time frame.

The official outlook for the winter month of December 2009 – February 2010 are presented below. The Climate Prediction Center (CPC) indicates there is a significant likelihood that the majority of the winter will be milder than average. However, even in an El Niño winter we can still experience heavy snows and brutal cold, but with much less frequency than normal.

These outlooks are updated on the third Thursday of each month, with a final monthly outlook issued at the end of each month.



EC: Equal Chance
A: Above Normal
B: Below Normal
N: Near Normal



3-Month Temperature Outlook (Dec-Jan-Feb)

3-Month Precipitation Outlook (Dec-Jan-Feb)

As the El Niño is forecast to continue into the spring month of March, April and May 2010 there is an increased probability of warmer and drier weather across the plains. This is indeed great news for the region, which has been abnormally wet. Should the drier than normal spring materialize this would help reduce the spring 2010 flood threat.

These outlooks are updated on the third Thursday of each month, with a final monthly outlook issued at the end of each month. These outlooks are available at http://www.cpc.ncep.noaa.gov/products/predictions/90day/

North Dakota State Climate Office has links to NWS's Local 3-Month Temperature Outlooks into 12 months ahead. Those outlooks can be accessed from the following web site for your specific location:
http://www.ndsu.nodak.edu/ndsu/ndsco/outlook/L3MTO.html

Also the readers will find the following National Weather Service office web sites very useful for shorter term weather forecasts:

Eastern North Dakota: http://www.crh.noaa.gov/fgf/
Western North Dakota: http://www.crh.noaa.gov/bis/

[1] The corresponding author: Mark Ewens is the Data Acquisition Program Manager and the Climate Services Focal Point at the NOAA's National Weather Service, Weather Forecast Office in Grand Forks, ND. E-Mail: Mark.Ewens@noaa.gov

Winter Outlook and Possible Spring Flood Impacts

by A. Schlag[2]

Winter 2009/2010 Outlook …and Possible Spring 2010 Flood Impacts for North Dakota

Given the severity of spring 2009 flooding across North Dakota, there are many people who are already contemplating what spring 2010 will bring to North Dakota with respect to flooding. This is nearly impossible to answer with any degree of certainty because no data exist on many of the factors involved in spring flooding. These factors in no specific order of importance are: 1.) available surface storage in dams, ponds or wetlands, 2.) soil moisture and temperatures at time of melt, 3.) liquid water equivalent in the snowpack at time of melt, 4.) rate of melt, 5.) extra precipitation received during the melt, and 6.) the potential for ice jams that significantly affect stream flow. However, as we exit an unusually warm and dry November throughout the western and central parts of the state, and after a cold and wet October, the question can at least be addressed qualitatively in comparison to the conditions of the past spring's flooding.

Available Surface Storage of Runoff: In regard to available surface storage of spring runoff, it is fairly safe to say that most small reservoirs, livestock dams, wetlands, and ponds are full, or nearly full, throughout the state. Spring flooding filled them to overflowing in many instances, the cool and wet summer kept them fairly full, and the October rains and snow topped them off. This sharply contrasts to this past spring where much of the state was coming out of a prolonged drought which lowered nearly all surface water bodies in the western and central part of the state. In fact, many large wetlands were dry prior to this spring and others were mere mudholes. The Devils Lake basin had been perhaps the most glaring exception to the long running drought experienced by much of the state.

Soil Moisture Conditions: With the unusually warm and dry November, much of western and central North Dakota reduced its soil moisture levels from excess to normal and in many places below normal. Conversely, the southern Red River Valley continued to retain excess soil moisture and standing water as the ground began to freeze. This frozen ground with high moisture content can produce a nearly impermeable surface when spring comes and the snowmelt is in full swing. Especially when combined with an early melt this tends to generate a very high ratio of runoff compared to infiltration. This, again, is in sharp contrast to the fall of 2008 where an early November storm thoroughly saturated much of the state just before soil temps fell below freezing. A map of current soil moisture with soil moisture values (Figure. 1) displayed as a percentile ranking is given below. As seen in the map, more extreme southern and eastern parts of North Dakota are still very wet and should not be expected to allow much infiltration next spring as the soils freeze under these conditions.

Liquid Water Equivalent in the Snowpack: The water equivalent of a snowpack that does not yet exist is impossible to measure or even reasonably estimate at this point. However, we do know that a weak to moderate El Niño pattern has formed and will affect the temperature and precipitation received in the upper Great Plains area, including North Dakota. This strongly suggests that the upcoming winter season will be different than last year's. During the summer of 2009, an El Niño began developing and has continued throughout the fall. During typical El Niño winters, temperatures for our region are 4 to 5 degrees Fahrenheit above normal, and snowfall tends to be 67% to 85% of normal. While there are other large scale climate signals that can decrease the affect of the El Niño, the winter of 2009/2010 is expected to be warmer and drier than last year.

Classic El Niño winters feature less frequent arctic air intrusions and fewer snow storms. Examples of recent El Niño winters include 2006/2007, 2002/2003, 1997/1998, 1994/1995 and 1991/1992. Below is a table with the measured snowfall in Bismarck, Minot, Dickinson, Fargo, and Grand Forks; the average of the El Niño years and the 30-year average snowfall (Table1).

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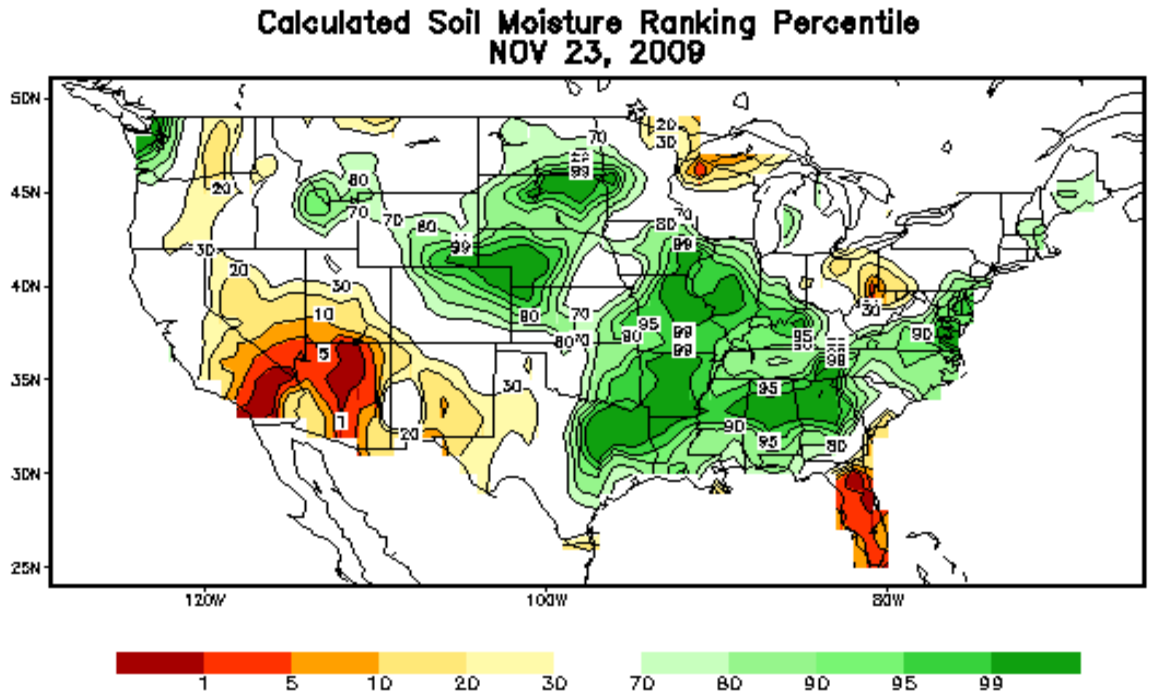

Figure 1. Calculated Soil Moisture Raking Percentile (1: Driest, 100: Wettest)

Table 1. Measured snowfall in Bismarck, Minot, Dickinson, Fargo, and Grand Forks; the average of the El Niño years and the 30-year average snowfall

	Season							
Station	1987/ 1988	1991/ 1992	1994/ 1995	1997/ 1998	2002/ 2003	2006/ 2007	Six Season Average	1971-2000 Normal
Bismarck	31.5	57.5	67.1	26.6	33.2	46.1	43.7	49.9
Minot	14.1	39.5	51.9	52.4	48.2	34.7	40.1	46.2
Dickinson	19.0	21.8	15.9	32.5	13.5	38.5	23.5	35.0
Fargo	44.5	27.5	50.3	41.1	33.4	38.3	39.1	48.7
Grand Forks	31.6	33.4	37.9	45.3	34.1	47.3	38.3	44.5

Overall, there tends to be almost 6-10 inches less snow during an El Niño winter (December through February). Typically, the snows do not build up as much as warmer and drier air can lead to more sublimation between storms. This helps prevent the snow from accumulating to average depths.

Accumulating large snowpacks tends to be more difficult during an El Niño because of warmer average temperatures, which often serve to melt snow and can lead to more sublimation. Winter season temperatures tend to be 4-5 degrees Fahrenheit warmer across the Northern Plains during an El Niño. Below is a table of the same 6 seasons, except the December through February average temperatures are compared to normal (Table 2).

Rate of Melt: Another factor that cannot be determined until just days before, or maybe even during the melt is the rate at which the melt will occur. One could and should reasonably infer that, just like nearly every other year, some areas will experience a much faster rate of melt than other areas. This factor will dictate local flooding and be especially important in deciding which areas suffer overland flooding. For example, southeastern, southwestern and south central North Dakota had a much faster rate of melt in 2009 than the northwestern and north central part of the state. As a direct result of the melt rate this past spring, some areas did not flood as severely as other areas with the same liquid water equivalence.

Table 2. December through February average temperatures, compared to normal for five locations in ND.

Station	Season 1987/ 1988	1991/ 1992	1994/ 1995	1997/ 1998	2002/ 2003	2006/ 2007	Six Season average	1971-2000 Normal
Bismarck	15.9	25.1	15.2	23.9	16.3	15.6	18.7	14.5
Minot	16.1	23.9	14.5	22.9	14.2	16.2	18.0	14.0
Dickinson	15.0	26.1	20.6	23.4	17.5	17.8	20.1	15.7
Fargo	11.9	19.9	14.6	20.9	12.5	15.0	15.8	11.2
Grand Forks	11.9	18.1	13.2	19.5	11.3	12.4	14.4	10.5

Temperatures are in degrees Fahrenheit

Extra Precipitation Received During the Melt: Not only does extra precipitation add directly to the total amount of runoff, but this is a significant factor in determining the rate of melt as it can substantially speed up the melting process of ice and snow on the countryside. It is a literal impossibility to predict this far in advance, but it can truly create flood conditions on very short notice if all the other necessary pieces of the puzzle are in place.

Ice Jams: Another factor that is mathematically impossible to predict because of its random nature are ice jams. Intuitively though, there are indicators and conditions known to increase the likelihood of ice jam related flooding. The conditions that do not change from year to year that can lead to ice jams are those related to the stream channel itself such as meandering streambeds and artificial constrictions, such as bridges, that tend to catch ice and other debris and inhibit the normal stream flow. The conditions that tend to change from year to year which do affect the potential for ice jams are ice thickness and timing of the melt from upper basin to lower basin. High river levels going into the winter freeze-up tend to be able to generate thicker sheets of ice simply because of the deeper water covering larger areas, and more ice equals greater risk. Of course, one must also have the necessary cold temperatures to freeze the ice to a greater thickness. Simply having higher water going into winter does not necessarily equate to more ice, nor does colder winters equal more ice unless the water is deep enough. Some of the ice formed last year on the western rivers in the state came despite the rivers being fairly low going into winter and the amount of ice was fairly surprising even with the cold winter. Much of the ice, especially on the Little Missouri River, can be attributed to a rather anomalous runoff from a rain event in mid-winter that pooled on top of the Little Missouri River and then froze in place on top of the existing ice sheet. This year we are heading into winter with normal to above normal water levels on many streams and this could be a slight indicator of more trouble again in the spring with ice jams than in normal years given relatively "normal" conditions.

Summary: In general the western two-thirds of North Dakota tends to be in better shape than the eastern third going into this winter simply because of the extremely moist conditions the Red River Valley had going into winter conditions. The available indicators for the rest of the state are a mixed bag with some pointing towards increased risk of flooding (lack of available surface storage) and others are pointing towards a lessened chance of flooding (El Niño, generally dry to normal soil moisture conditions). One thing that is a certainty, though, is that if we were to experience spring melt conditions similar to last year, the lack of available surface storage suggests we will not need the near record snowfall to create similar flooding next spring.

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