North Dakota Climate Bulletin

Fall 2010

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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.

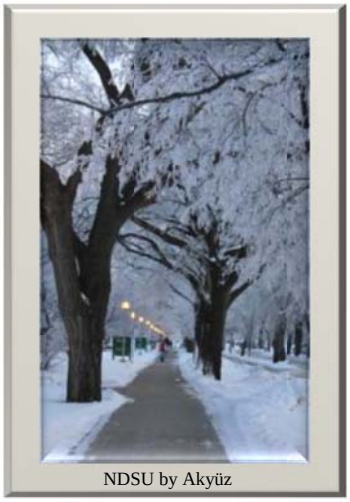
Compared historically, North Dakota had a warmer and wetter fall following a warmer and wetter summer. Temperature-wise, this fall was the 42nd warmest since 1895. Precipitation-wise, it was the 9th wettest fall since 1895. Even though September was cooler than normal, warmer than normal temperatures in October and November pushed crop harvest significantly ahead of both last year and the average.

Unusually wet fall in the eastern North Dakota yielded major floods in the Red River Valley more often than not. We dedicated this quarter's Science Bits section to discuss in detail Red River Spring Flood Sensitivity to previous fall precipitation.

The North Dakota total precipitation amounts as a percentage of the normal and average temperature departure from normal are shown on pages 6 through 8 (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



NDSU by Akyüz

Weather Highlights

Seasonal Summary: by B. A. Mullins

September 2010

The state average precipitation was 3.92 inches which is above the 1971-2000 normal of 1.74 inches. September 2010 state average precipitation ranked 4th wettest in the last 116 years with a maximum of 5.00 inches in 1900 and a minimum of 0.28 inches in 1897.

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%. 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.

The National Weather Service (NWS) reported breaking several rainfall records on the 6th. The record rainfalls reported on the 6th include Fargo with 1.99 inches, Minot with 1.64 inches, Bismarck with 2.12 inches, and Dickinson with 0.80 inches. The NWS also reported record rainfalls on the 23rd at Fargo with 1.60 inches, Grand Forks AP with 1.79 inches and Grand Forks NWS with 1.85 inches.

The US Drought Monitor September 28, 2010 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, 3% short, 76% adequate, and 21% surplus with a subsoil moisture reported as 0% very short, 6% short, 76% adequate, and 18% surplus (Weekly Weather and Crop Bulletin Vol. 97, No. 39).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for September had 4 reports of high wind, 12 hail reports, and 0 reported tornadoes.

The top five September daily maximum wind speeds recorded from NDAWN were Sidney MT on the 9th with 49.0 mph, Rolla on the 9th with 48.3 mph, Hazen on the 9th with 47.6 mph, Linton

on the 9th with 45.1 mph, and Linton on the 2nd with 44.7 mph. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The state average air temperature was 54.1 °F which is below the 1971-2000 normal of 56.14 °F. September 2010 state average air temperature ranked 29th coolest in the past 116 years with a maximum of 63.4 °F in 1897 and a minimum of 45.2 °F in 1965.

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. The eastern central and eastern part of the state had departures from normal of -2 °F to -3 °F with 1 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.

The National Weather Service (NWS) reported breaking one temperature record in September. A record low temperature of 23 °F was reported on the 23rd at Williston which broke the previous record of 28 °F set in 1901.

NDAWN's highest recorded daily air temperature for September was 89.0 °F at Beach on the 26th. The lowest recorded daily air temperature was 24.5 °F at Crosby on the 18th.

October 2010

The state average precipitation was 1.27 inches which is below the 1971-2000 normal state average of 1.41 inches. October 2010 state average precipitation ranked the 39th wettest in the past 116 years with a maximum of 4.71 inches in 1982 and a minimum of 0.10 inches in 1952.

October's percent of normal precipitation ranged from roughly 25% to 200%. The first 24 days of October were primarily dry with above normal temperatures. Beginning on the 25th, a major storm system started to develop in the Midwest. By the 26th, the storm was producing winds similar to a tropical storm. Peak wind speeds in North Dakota ranged from in the 50's to 60's mph (measured at 33 feet). The National Weather Service (NWS) reported record breaking low pressure in Minnesota and Wisconsin. Fargo at 28.58 inches of Mercury came within 3 hundredths of the previous record of 28.55 inches of Mercury set on March 15, 1920. The two day rain total, 26th to 27th, in eastern North Dakota was 2 to 3 inches. The two day snow total for northeastern ND was 2 to 6 inches, north central ND was 8 to 13 inches, and central to western ND ranged from 2 to 8 inches. The remaining days of October were dry with mild temperatures.

The National Weather Service (NWS) reported breaking precipitation records during the major storm system that started on the 25th. On the 25th Williston and Jamestown recorded record precipitation of 0.66 inches and 0.54 inches, respectfully. Williston also recorded a record snowfall on the 25th of 2.1 inches. Fargo, Grand Forks airport, and Grand Forks NWS recorded a record rainfall on the 26th of 1.21 inches, 1.40 inches, and 1.33 inches, respectfully. Minot reported a record rainfall on the 27th of 0.33 inches. Bismarck and Williston reported a record snowfall on the 27th of 3.2 inches and 2 inches, respectfully.

The US Drought Monitor October 9, 2010 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, 10% short, 76% adequate, and 14% surplus with a subsoil moisture reported as 0% very short, 7% short, 79% adequate, and 14% surplus (Weekly Weather and Crop Bulletin Vol. 97, No. 45).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for October had 1 report of high wind, 1 hail report, and 0 reported tornadoes.

The top five October daily maximum wind speeds recorded from NDAWN were Linton on the 26th with 63.7 mph, McHenry on the 26th with 57.6 mph, Streeter on the 26th with 56.6 mph, Hazen on the 27th with 55.5 mph, and Dazey on the 26th with 55.1 mph. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The state average air temperature was 47.9 °F which is above the 1971-2000 normal of 43.6 °F. October 2010 state average air temperature ranked the 11th warmest in the past 116 years with a maximum of 54.8 °F in 1963 and a minimum of 32.5 °F in 1925.

The North Dakota Agricultural Weather Network (NDAWN) October average air temperatures ranged from 45 °F to 50 °F. NDAWN departure from normal temperatures ranged from 2 °F to 6 °F. Temperatures were above normal across the state with the warmer temperatures falling in the southwest and eastern part of the state. Most of the month had above normal or near normal temperatures. A few days at the beginning of the month had 10 °F or more above normal temperatures. According to the USDA, NASS North Dakota Field Office, the warm, dry days helped producers make excellent harvest progress. The warmer weather did however delay sugarbeet harvest.

The National Weather Service (NWS) did not report any record temperatures in October.

NDAWN's highest recorded daily air temperature for October was 89 °F at Wyndmere on the 8th. The lowest recorded daily air temperature was 8 °F at Brorson MT on the 28th.

November 2010

The state average precipitation was 0.84 inches which is above the 1971-2000 normal of 0.73 inches. November 2010 state average precipitation ranked 32nd wettest in the past 116 years with a maximum of 2.51 inches in 2000 and a minimum of 0.02 inches in 1939.

November's percent of normal precipitation ranged from roughly 25% to 300% of normal. Most of the eastern part of the state and parts of the west central and southwestern part of the state had below normal precipitation. Most of the highest amounts fell along the western edge and north central regions. Precipitation amounts ranged from about 0.15 inches to 2.5 inches. Warm, dry weather stretched from the 1st through the 9th of November across the state. Light snow fell from the 10th through the 11th in western ND. The following days from the 12th through the 16th were relatively dry with scattered pockets of light snow. Western ND had snowfall on the 17th and 18th. On the 19th, snow fell across the upper northern part of the state and the 20th had snowfall in the southwest corner. A major storm system from the 21st through the 26th brought snowfall across the state with blowing snow and some areas receiving freezing drizzle. The storm system caused hazardous travel for many on the Thanksgiving holiday. Fargo was caught in a small band of heavy snow and received a record 12.6 inches on the 22nd. Following the 26th was a

quiet two days but another state wide snowstorm on the 29th and 30th caused snow and blowing snow with wind gusts of 40 mph.

The National Weather Service (NWS) reported breaking two precipitation records in November. Williston reported a record precipitation on the 20th of 0.38 inches breaking the previous record of 0.31 inches set in 1938. Fargo recorded a record 12.6 inches of snow on the 22nd breaking the previous record of 6.1 inches set in 1985.

The US Drought Monitor December 7, 2010 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, 8% short, 80% adequate, and 12% surplus with a subsoil moisture reported as 0% very short, 7% short, 81% adequate, and 12% surplus (Weekly Weather and Crop Bulletin Vol. 97, No. 47).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), there were no severe weather reports for November.

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

The state average air temperature was 27.3 °F which is above the 1971-2000 normal of 26.08 °F. November 2010 state average air temperature ranked the 58th coolest in the past 116 years with a maximum of 37.4 °F in 2001 and a minimum of 7.30 °F in 1896.

The North Dakota Agricultural Weather Network (NDAWN) November average air temperatures ranged from 24 °F to 30 °F. NDAWN departure from normal temperatures ranged from -2 °F to 3 °F. The eastern half of the state had above normal average temperatures and the western half had normal to slightly below normal average air temperatures. State wide above normal daily average air temperatures were enjoyed from the 1st through the 9th of November. Average temperatures then hovered at near normal from the 10th through the 18th. From the 20th through the 25th average air temperatures for most were 10 to 20 °F below normal. The 26th through the 30th had below normal or near normal average air temperatures for most areas.

The National Weather Service (NWS) reported breaking three temperature records in November. Bismarck had a record high temperature of 73 °F on the 6th breaking the previous record of 72 °F set in 2009. Grand Forks Airport and Fargo Airport had record high temperatures on the 9th of 61 °F and 66 °F, respectively, breaking the previous records of 57 °F set in 1954 and 65 °F set in 1937, respectively.

NDAWN's highest recorded daily air temperature for November was 77 °F at Hazen on the 6th. The lowest recorded daily air temperature was 6 °F at Bottineau on the 29th.

Season in Graphics

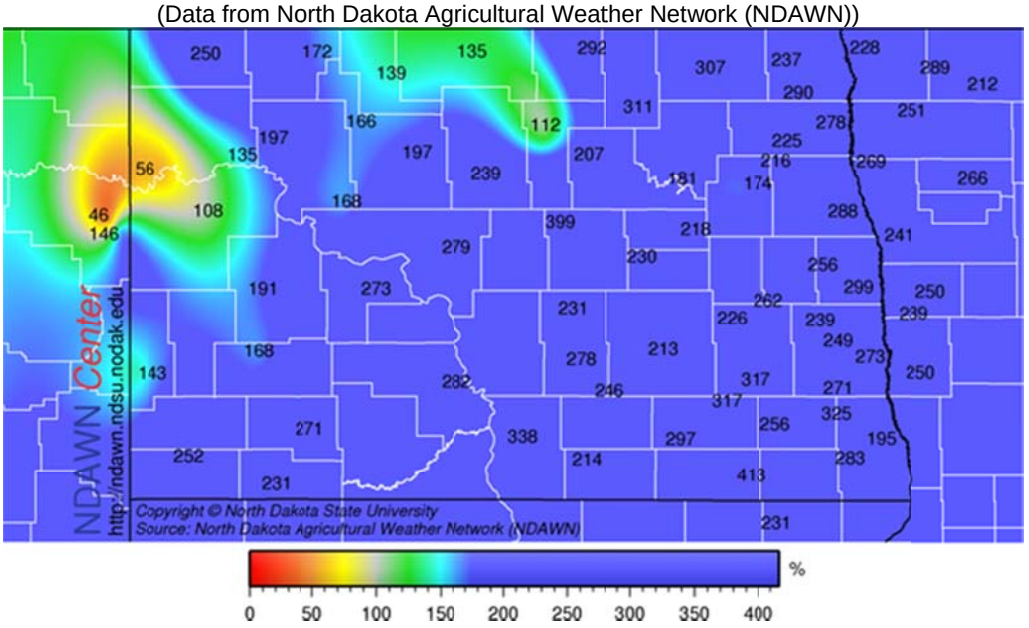
Fall 2010 Weather in North Dakota:

September 2010

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

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

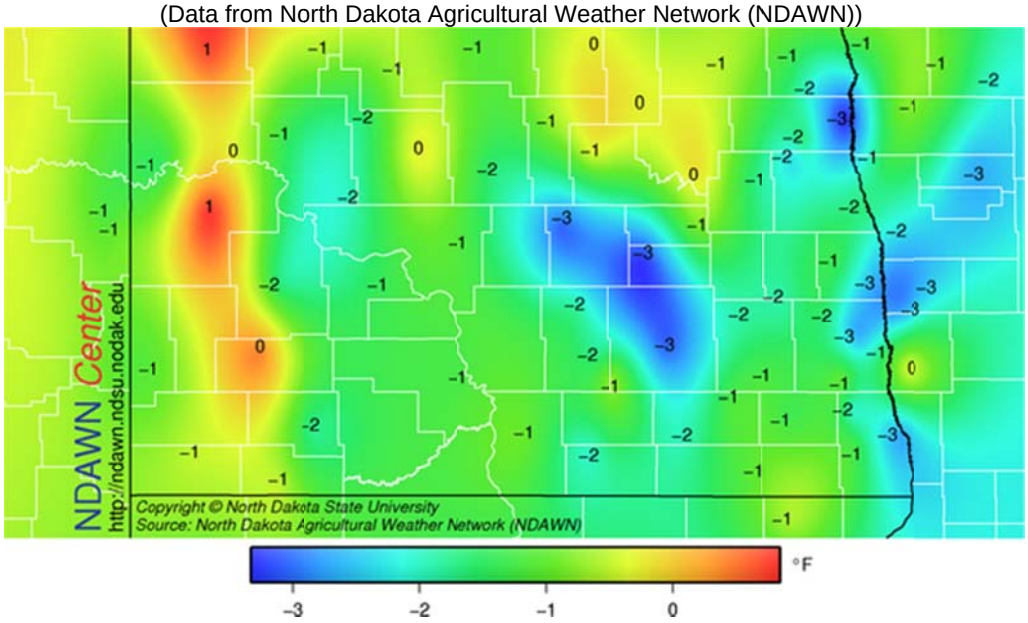


North Dakota State Climate Office

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

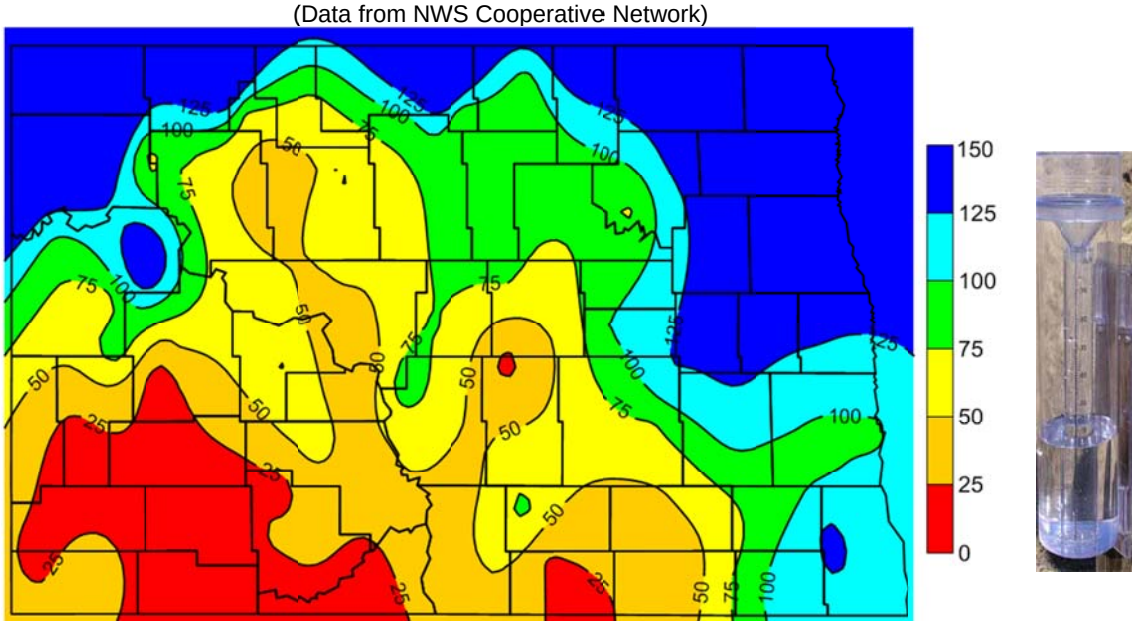
October 2010

Fall 2010 Weather in North Dakota:

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

(Data from NWS Cooperative Network)

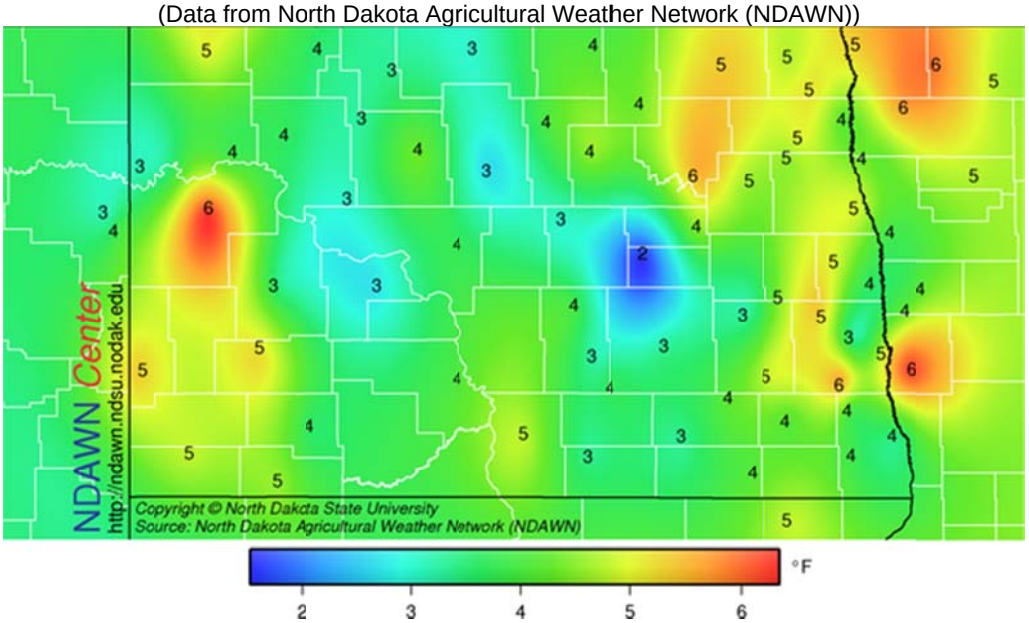


North Dakota State Climate Office

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

Season in Graphics

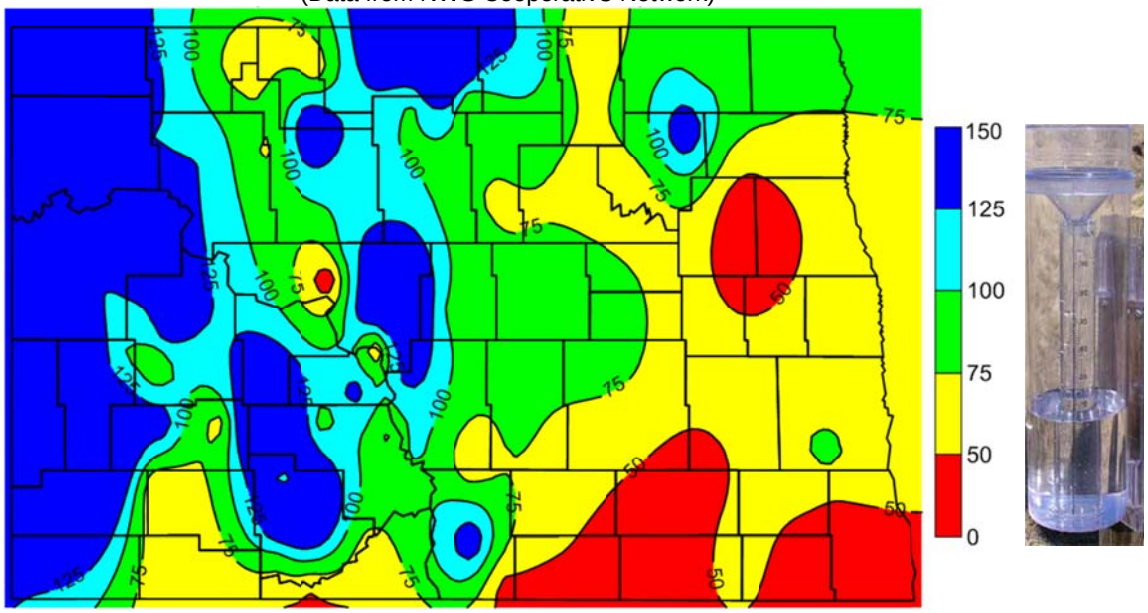
Fall 2010 Weather in North Dakota:

November 2010

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

(Data from NWS Cooperative Network)



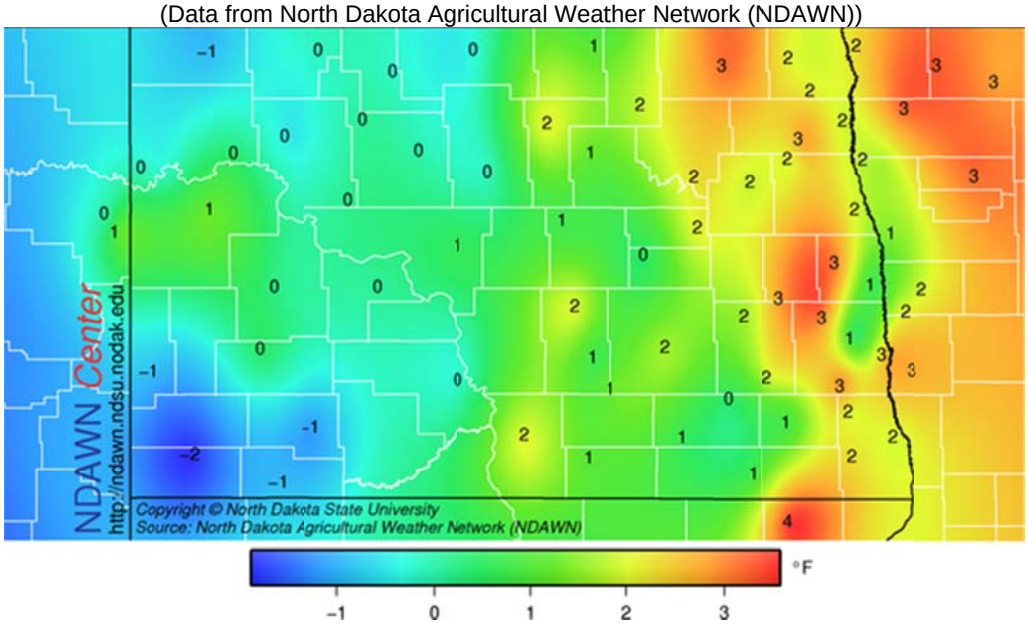
North Dakota State Climate Office

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

Departure From Normal Monthly

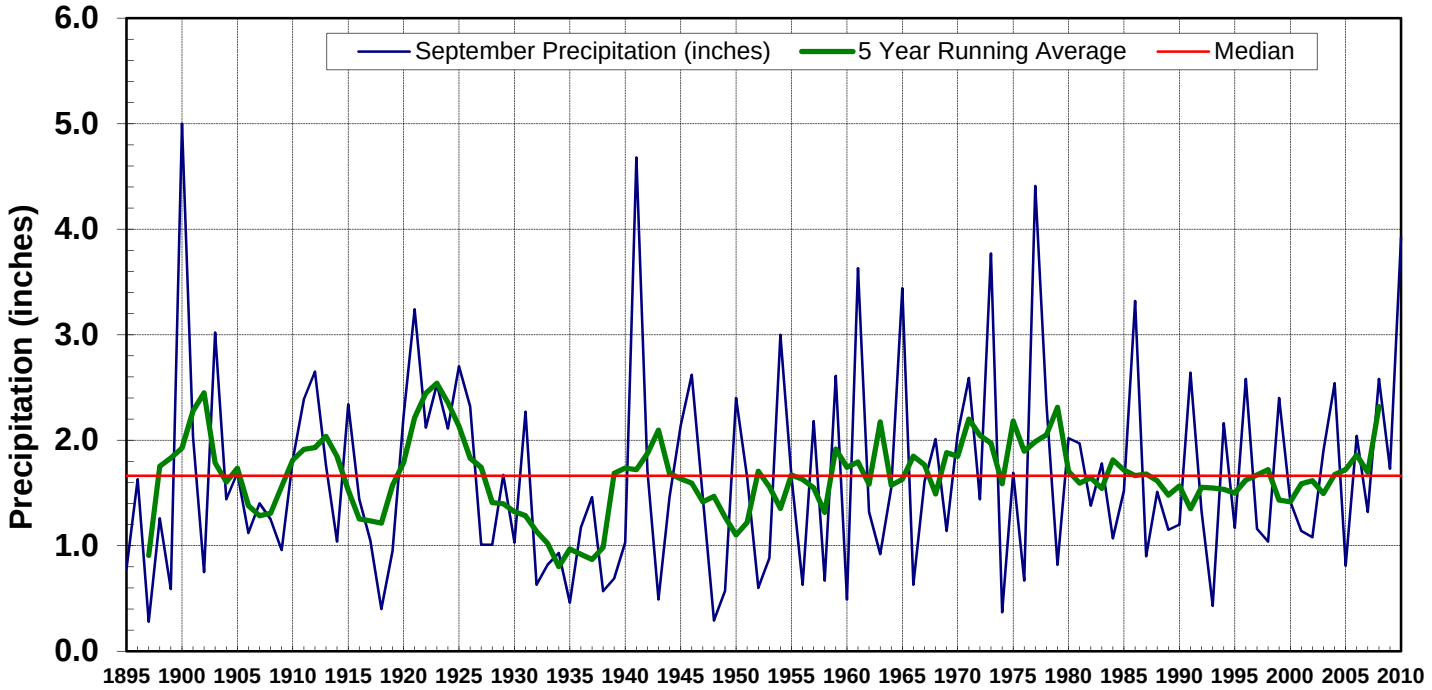
Average Air Temperature in degrees F

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



North Dakota State Climate Office

Historical September Precipitation for North Dakota

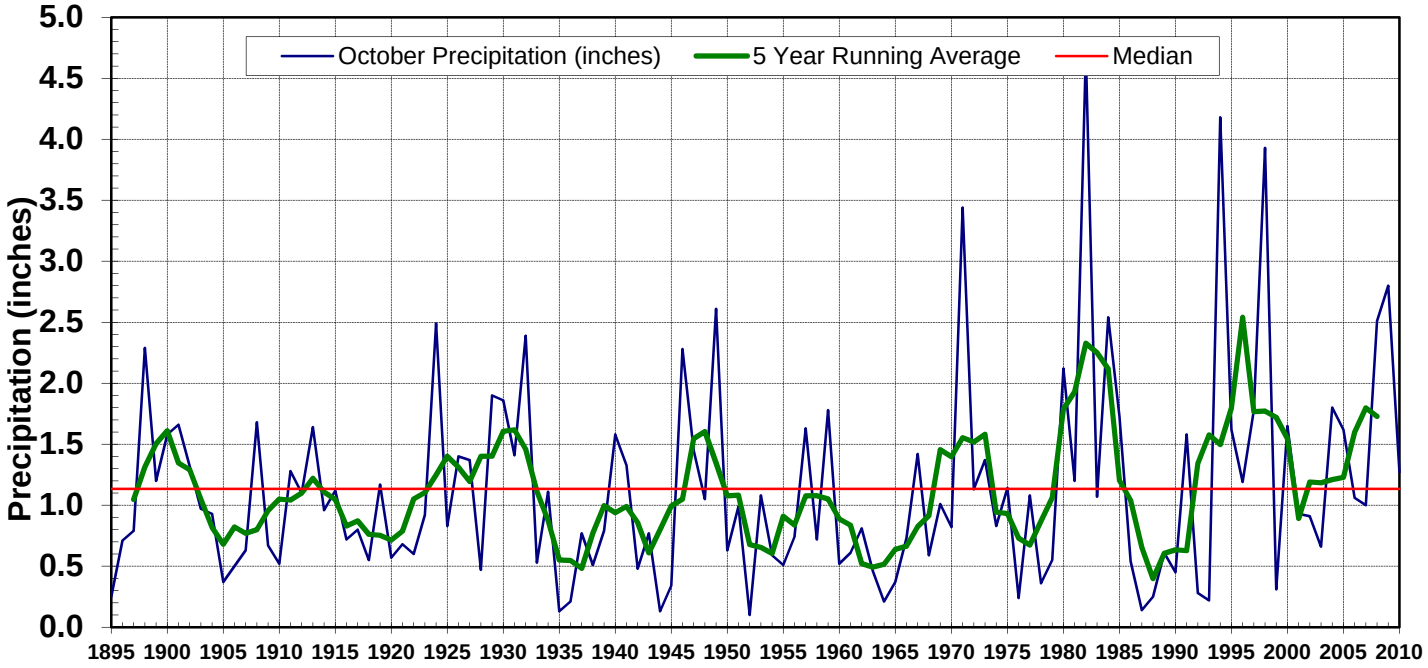


September Precipitation Statistics

2010 Amount: **3.92 inches**
Maximum: 5.00 inches in 1900
State Normal: 1.74" (1971-2000)

Monthly Ranking: 4th Wettest in 116 years
Minimum: 0.28 inches in 1897
Years in Record: 116

Historical October Precipitation for North Dakota

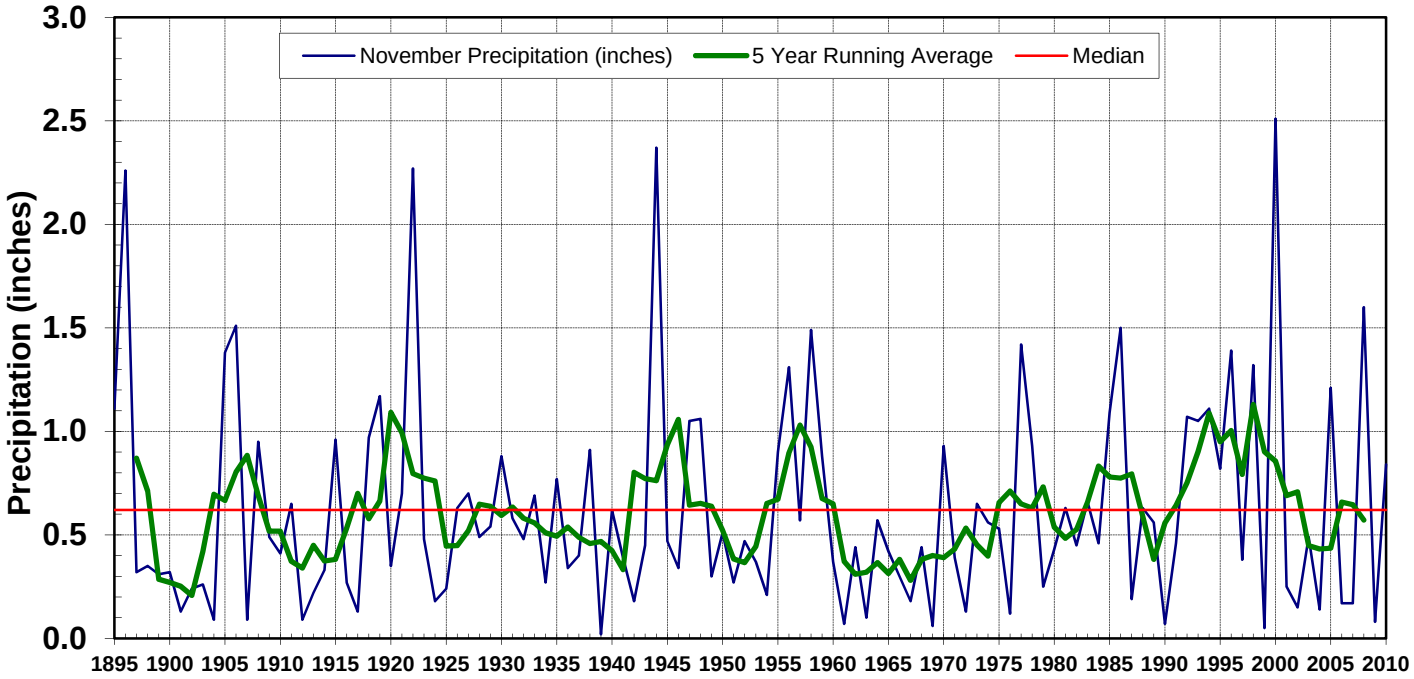


October Precipitation Statistics

2010 Amount: 1.27 inches
Maximum: 4.71 inches in 1982
State Normal: 1.41" (1971-2000)

Monthly Ranking: 39th wettest in 116 years
Minimum: 0.10 inches in 1952
Years in Record: 116

Historical November Precipitation for North Dakota

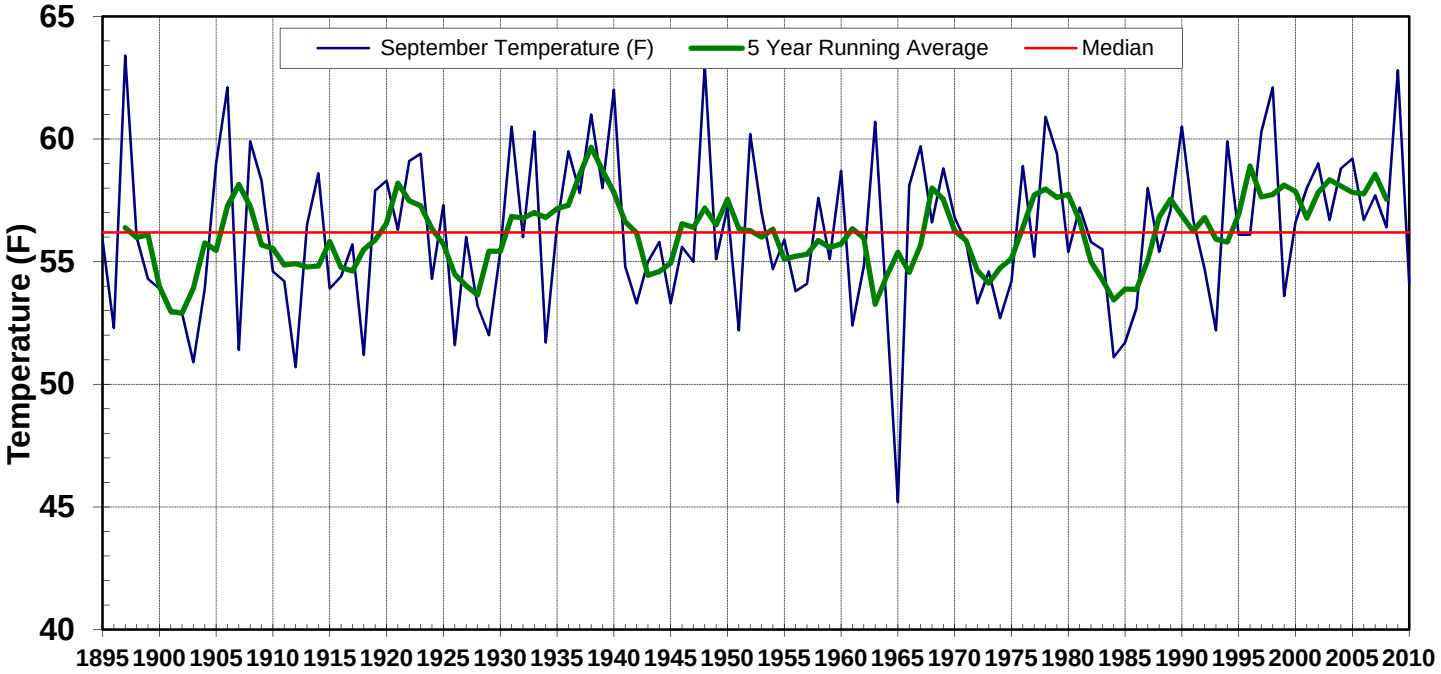


November Precipitation Statistics

2010 Amount: 0.84 **inches**
Maximum: 2.51 inches in 2000
State Normal: 0.73" (1971-2000)

Monthly Ranking: 32nd wettest in 116 years
Minimum: 0.02 inches in 1939
Years in Record: 116

Historical September Temperature for North Dakota

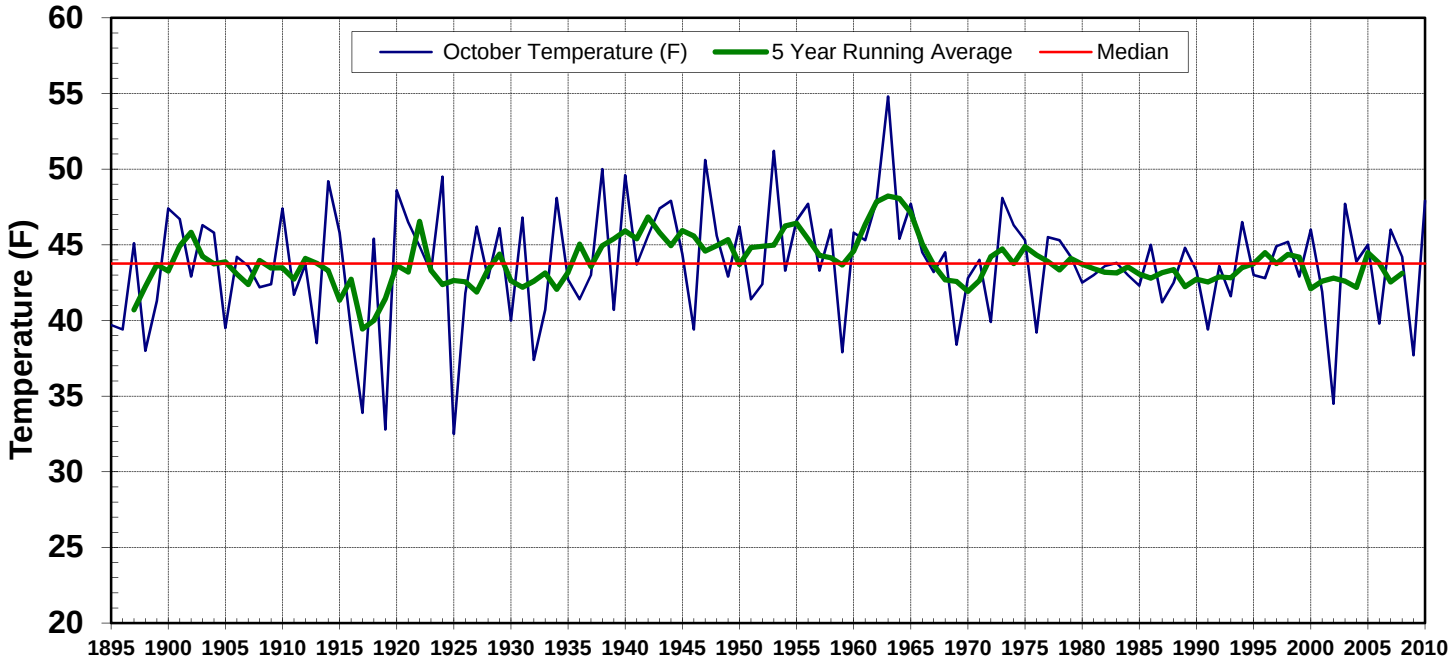


September Temperature Statistics

2010 Average: **54.1** °F
Maximum: 63.4 °F in 1897
State Normal: 56.14 °F (1971-2000)

Monthly Ranking: 29th Coolest in 116 years
Minimum: 45.2 ° F in 1965
Years in Record: 116

Historical October Temperature for North Dakota

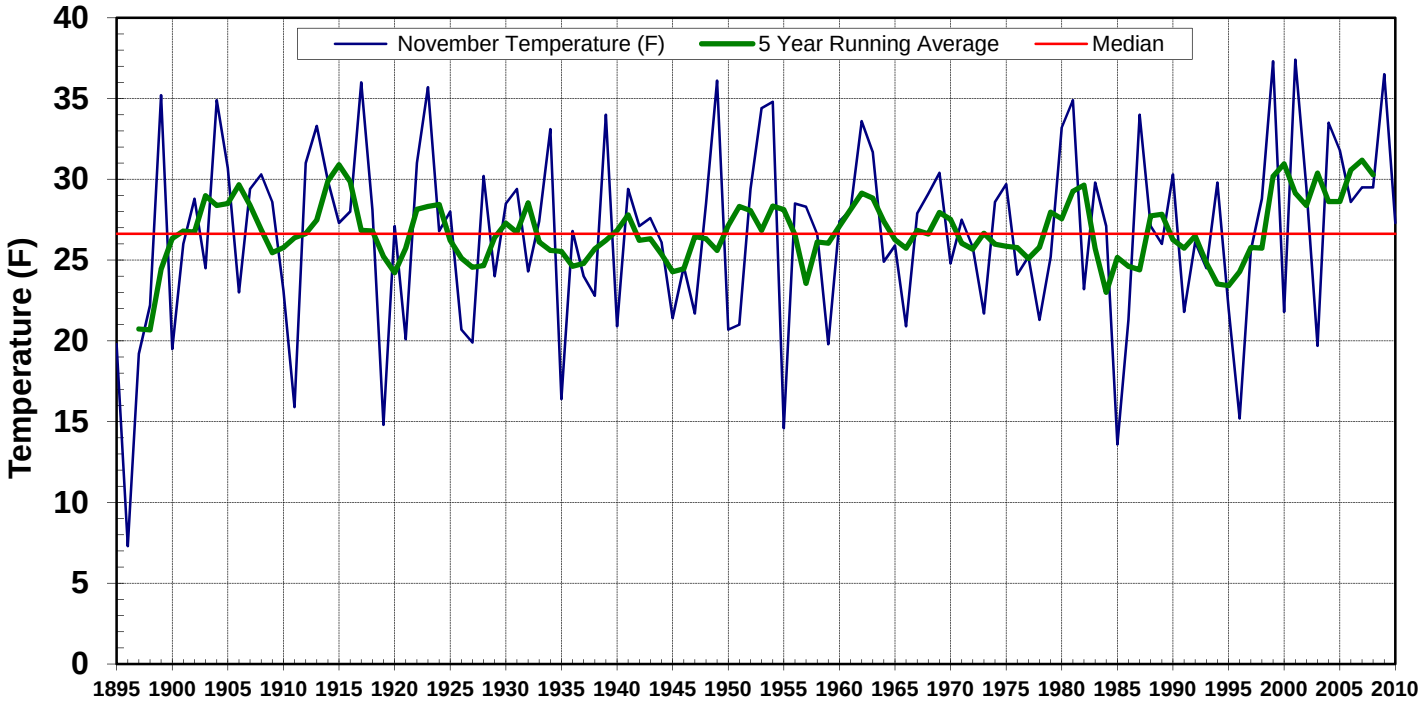


October Temperature Statistics

2010 Average: 47.9 °F
Maximum: 54.8 °F in 1963
State Normal: 43.6 °F (1971-2000)

Monthly Ranking: 11th Warmest in 116 years
Minimum: 32.5 °F in 1925
Years in Record: 116

Historical November Temperature for North Dakota



November Temperature Statistics

2010 Average: **27.3 °F**
Maximum: 37.4 °F in 2001
State Normal: 26.08 °F (1971-2000)

Monthly Ranking: 58th Coolest in 116 years
Minimum: 7.3 °F in 1896
Years in Record: 116

Storms & Record Events

State Tornado, Hail, and Wind Reports for Fall 2010

by B. A. Mullins

North Dakota 3 Month Total	Wind	Hail	Tornado
	5	13	0

Reports by Month			
Month	Wind	Hail	Tornado
Total September	4	12	0
Total October	1	1	0
Total November	0	0	0

North Dakota Record Event Reports for Fall 2010

Date	Location	Type of Record	Previous Record
09/06/10	Fargo	Rainfall of 1.99 inches	1.04 inches set in 1937
09/06/10	Minot	Rainfall of 1.64 inches	0.66 inches set in 2000
09/06/10	Bismarck	Rainfall of 2.12 inches	1.32 inches set in 1981
09/06/10	Dickinson	Rainfall of 0.80 inches	0.33 inches set in 2001
09/23/10	Williston	Low temperature of 23 °F	28 °F set in 1901
09/23/10	Fargo	Rainfall of 1.60 inches	1.07 inches set in 1920
09/23/10	Grand Forks airport	Rainfall of 1.79 inches	1.22 inches set in 1981
09/23/10	Grand Forks NWS	Rainfall of 1.85 inches	1.19 inches set in 1981
10/25/10	Williston	Rainfall of 0.66 inches	0.33 inches set in 1897
10/25/10	Jamestown	Rainfall of 0.54 inches	0.41 inches set in 1956
10/26/10	Williston	Snowfall of 2.1 inches	0.90 inches set in 1976
10/26/10	Fargo	Rainfall of 1.21 inches	0.84 inches set in 1996
10/26/10	Grand Forks airport	Rainfall of 1.40 inches	1.11 inches set in 1996
10/26/10	Grand Forks NWS	Rainfall of 1.33 inches	0.83 inches set in 1996
10/27/10	Bismarck	Snowfall of 3.2 inches	2.4 inches set in 1933
10/27/10	Minot	Precipitation of 0.33 inches	Ties previous record set in 1984
10/27/10	Williston	Snowfall of 2.0 inches	1.5 inches set in 1946
11/06/10	Bismarck	Maximum temperature of 73 °F	72 °F set in 2009
11/09/10	Grand Forks airport	Maximum temperature of 61 °F	57 °F set in 1954
11/09/10	Fargo	Maximum temperature of 66 °F	65 °F set in 1937
11/20/10	Williston	Precipitation of 0.38 inches	0.31 inches set in 1938
11/22/10	Fargo	Snowfall of 12.6 inches	6.1 inches set in 1985

Seasonal Outlook

Winter Climate Outlooks

by D. Ritchison[1]

Perhaps because North Dakota's climate has more cold days than warm days the interest in winter outlooks seem to garner the most attention. The winter of 2010-11 is expected to follow the trend of recent years with colder than average temperatures dominating much of the season. Plus, current projections would also suggest above average precipitation for much of the state as well.

Many of you have likely heard that La Niña conditions are currently occurring in the Pacific Ocean. A La Niña is the cold water equivalent to El Niño and is part of a recurring atmospheric oscillating pressure pattern between the western and eastern portions of the equatorial Pacific Ocean. A La Niña often leads to colder than average temperatures for this part of North America as it influences the upper level wind flow in such a way that arctic air frequently moves into the northern plains.

Although La Niña conditions are a good tool in forecasting probable winter conditions, it is only one of many factors in a complex array of atmospheric and oceanic interactions that influence weather patterns across the northern hemisphere. Unfortunately, several of these other factors also suggest a higher probability for colder than average temps for this entire region.

One of those other factors is a phenomenon referred to as the Arctic Oscillation (AO). The AO is a climate pattern characterized by winds circulating counterclockwise around the arctic. When the AO is in its positive phase, a ring of stronger winds circulating around the North Pole tends to keep the coldest air in the higher latitudes. In the negative phase of the AO, this belt of winds becomes weaker allowing arctic air to more readily move southward bringing bitterly cold air to the state. Although accurate forecasts of what state the AO will be in is difficult beyond a few weeks, recent weather patterns hint that the AO will, like last winter, be frequently in the negative phase.

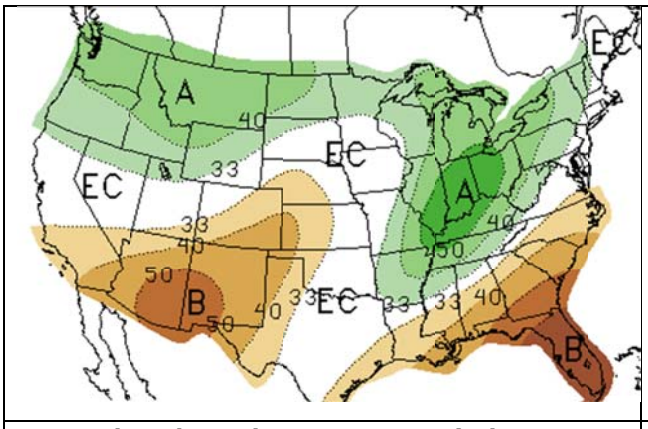
Other factors leaning toward cold conditions are the above average early snow cover across the Northern Hemisphere, a continued quiet Sun, active volcanic activity and the current state of oceanic temperatures around the globe. Forecasting long-term temperatures, albeit imperfect, is easier than precipitation. In our relatively dry climate, one or two storms missing or hitting us often make the difference between average and very wet conditions over the course of any three-month period. Using the past as our guide, the odds favor the winter to finish at least near average and more likely above average for precipitation during the December through February time frame for most parts of the state.

The latest winter outlook from the Climate Prediction Center (CPC) is predicting an greater probability of a cooler and wetter than average January-through-March period (See the figure below).

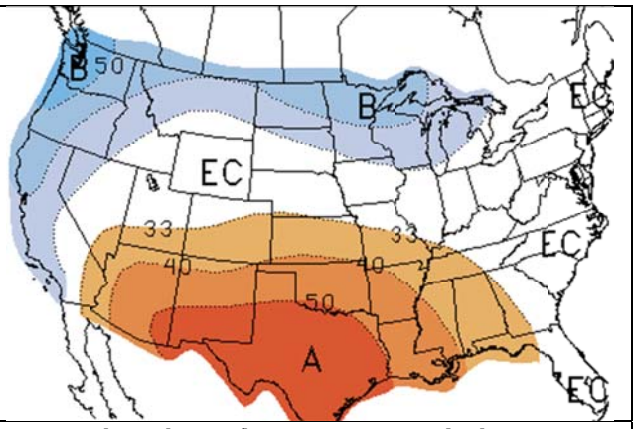
The North Dakota State climate Office has links to the National Weather Service's local 3-month temperature outlooks for the next 12-month period (updated monthly). Those outlooks can be found at:
http://www.ndsu.edu/ndsco/outlook/L3MTO.html

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/

[1] The corresponding author: Daryl Ritchison is a broadcast meteorologist working at WDAY-TV Fargo, ND.
E-Mail: daryl@ritchison.com



January through March Precipitation Outlook



January through March Temperature Outlook

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/

Climate impact on North Dakota Hydrology

by A. Schlag[2]

Flooding in a given place depends on more than just 1 factor; however, the basic premise is that if flooding is largely a function of precipitation, and precipitation is generally a function of climate, then to some degree flooding must also be a function of climate. I matched a set of river gage data and precipitation data. Minot, along with several other locations, can be used. First and foremost, the thing that jumps out is just how "noisy" precipitation and river data appears. For example, in Fig. 1 the raw precipitation and maximum recorded river stage for a year are plotted for the Minot location.

As shown in Fig. 1, distinguishable trends seem apparent in raw data for river stages, but are not so obvious in the precipitation data. The noise can be reduced by having 10 precipitation gauges, but since we do not have 10 gauges, the next best solution to describing the mean areal precipitation is to look at it in longer terms. In this case, we used a 10-yr moving average of the single rain gauge and plotted it in Fig. 2 against the 10-yr moving average for **the maximum river stage to reveal any correlations.**

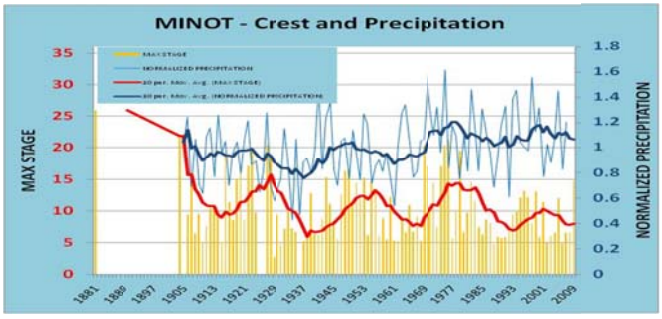


Figure 1. Raw data for Souris River and precipitation at Minot, ND.

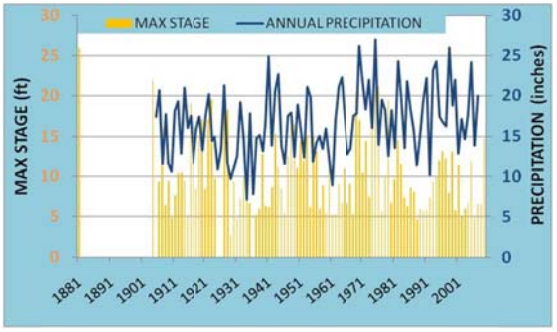


Figure 2. River and precipitation data with a 1-yr moving average.

In Fig. 2, the precipitation data were first normalized by dividing each year by the historical mean of 16.68 inches. This provides a fairly quick tool for identifying extended periods of above or below average precipitation as years with values for precipitation above 1 are wetter than "normal" and years below 1 are drier than normal. After making these adjustments to the data, a very distinct 25 year cycle appears in the trend lines. This cyclical trend also appeared at every location studied across the entire state and suggested a large-scale climate forcing mechanism. Of note here, the Minot graph clearly shows the effect of adding the Rafferty and Alameda dams in Canada and Lake Darling in North Dakota on overall flooding. The last peak in maximum stage on the river is much smaller than the previous cycles would have led one to expect.

Now that we have established a cyclical nature to precipitation and flooding in North Dakota, it follows that if we identify the forcing mechanism for this cycle we may be able to use this knowledge to predict spring flood risk months before they occur. We identified this as a function of ENSO (El Niño Southern Oscillation) and PDO (Pacific Decadal Oscillation) cycles being in phase, or as the case may be, out of phase. The PDO is a temperature oscillation of the surface waters off the coast of Alaska, just as ENSO is

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a temperature oscillation of the surface waters in the Equatorial Pacific. Outside of the neutral years for PDO and ENSO, there are four distinct possibilities to consider: +PDO or –PDO and La Niña or El Niño. The number of years with +PDO and La Niña is too small of a sample set to consider, leaving only three common combinations to be described, as shown in Table 1.

Table 1 shows a defined trend towards warm winters during El Niño events combined with a +PDO and cool winters with La Niña and –PDO combinations. The slightly cooler averages tend to delay the spring melt, while the warmer winters allow for earlier spring melts and less overall time to accumulate snow (water) on the ground. The cooler springs are inherently more susceptible to higher runoff events because of the increased time allowed in the spring for moisture to accumulate and an increased risk of experiencing a sudden warming. Combine this with normal to above normal spring rains and runoff can more easily lead to flooding. Not only are temperatures strongly affected by the PDO and ENSO combinations, but so are the precipitation patterns.

Table 1. PDO and ENSO conditions. (All temperatures and temperature anomalies are in degrees Fahrenheit)

Minot, ND	Average	Temp Anomaly	Temp Anomaly	Temp Anomaly
	All Years	+PDO & El Niño (10 events)	-PDO & El Niño (11 events)	-PDO & La Niña (18 events)
December	13.5	+5.4	+2.8	-2.3
January	6.8	+5.5	+1.6	-2.7
February	12.1	+9.7	-0.9	-2.3
March	24.1	+2.6	-2.5	-0.2
April	40.6	+3.6	+1.2	-1.2
Cool Season Avg	19.4	+5.4	+0.4	-1.7

Figure 3, displays the same general pattern as noted at every other location. A –PDO and La Niña year has statistically much higher precipitation than the El Niño years, which leads to more water available in the snowpack for the spring melt.

In keeping with higher precipitation one would expect to see higher streamflow.

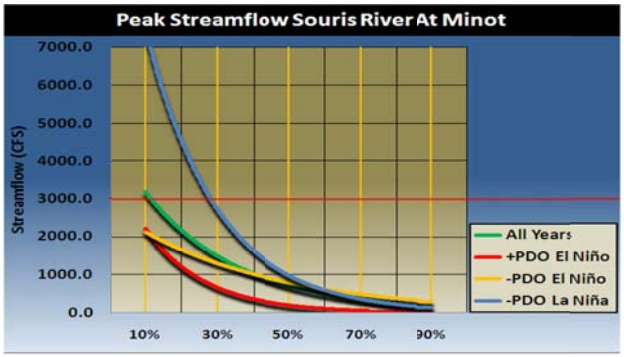

Figure 3. Precipitation probability during respective ENSO and PDO combinations.

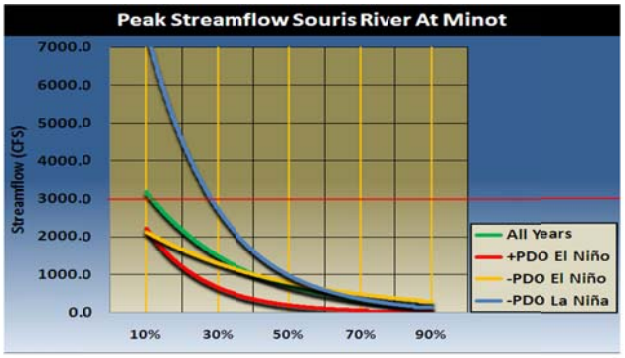

Figure 4. Peak streamflow during the respective ENSO and PDO combinations.

Indeed, this is true as Fig. 4 shows that –PDO and La Niña years strongly favor higher streamflow on the Souris River at Minot.

This continues to be a work in progress as we perpetually evaluate our understanding of how this information can be used to better our preparedness for spring runoff. But at this point in time, we already know the expectation is for a continued –PDO and La Niña winter, which may extend through spring.

Science Bits

Red River Flood Sensitivity to Fall Precipitation:

by F. A. Akyüz[3]

As fall precipitation rises in the Red River Valley, so does the concern for river flooding the following spring. Fargo received 8.46" of total precipitation during the period from September 1 through November 30, 2010. It is the 10th wettest fall in the130 years of recorded history since 1881. While the magnitude of the spring flood is a function of more variables than just the fall precipitation, it has historically been a good indicator of the category of the flood especially when followed by a wet winter. For example, the following table lists the 15 wettest falls in recorded history in Fargo, ND. It also includes winter snowfall the following winter as well as the peak Red River stage the following spring based on the USGS gauge at Fargo.

Fall Precipitation Ranking*	Year	Fall Precipitation (in)	Following Seasonal Snowfall Total Departure from Normal (in)**	Following Spring Red River Peak Stage in Fargo (Historic Ranking of the Stage Magnitude)
1	2008	10.67	+33.1	40.84 (Highest River Stage)
2	1977	10.25	+3.2	34.41 (11th Highest River Stage)
3	2000	9.73	+5.9	36.69 (8th Highest River Stage)
4	1971	9.55	+7.1	25.36 (26th Highest River Stage)
5	1903	9.5	+31.0	21.3 (36th Highest River Stage)
6	1982	9.28	-23.4	15.99 (Not ranked)
7	1998	8.92	+2.0	20.81 (38th Highest River Stage)
8	1881	8.91	Missing	37.8 (4th Highest River Stage)
9	1957	8.59	-37.3	10.9 (Not ranked)
10	2010	8.46	Current Year	Current Year
11	1896	8.34	+3.5	39.1 (3rd Highest River Stage)
12	2004	8.28	-17.8	28.18 (23rd Highest River Stage)
13	1984	8.17	-18.4	20.08 (44th Highest River Stage)
14	1996	7.97	+70.4	39.57 (2nd Highest River Stage)
15	2009	7.91	0.0	36.99 (7th Highest River Stage)

*1 indicates the wettest and 15 indicates the 15th wettest fall in recorded history since 1881.
**1971-2000 average (normal) seasonal snowfall for Fargo is 46.6 inches. As positive/negative numbers indicate above normal, negative numbers indicate below normal seasonal snowfall totals.

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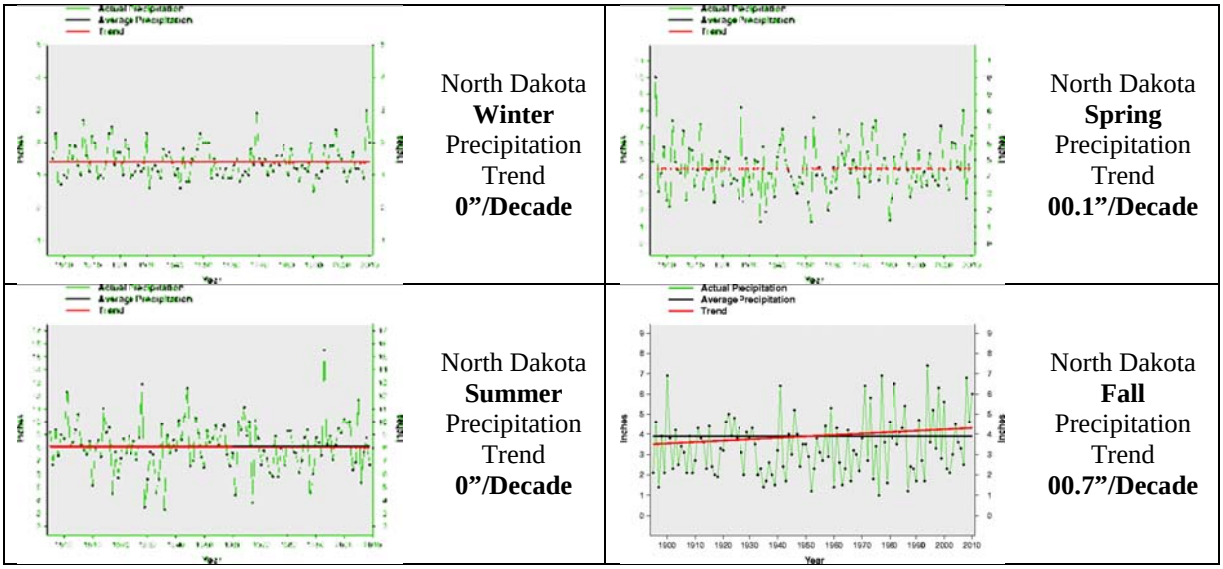
Wet conditions before freeze-up usually limit the amount of infiltration in the Red River Valley soils the following spring. It results in greater runoff into the river system increasing the flood potential. The soil moisture conditions were very much similar to those observed prior to freeze-up the previous year (2009). Surplus moisture in the topsoil was reported along the Red River Valley from Richland County to Walsh County and into the Devils Lake area.

To better emphasize the flood sensitivity to fall precipitation in the Red River, perhaps the following 4-panel graph would be helpful. It shows the seasonal precipitation variation (individual dots) and trend (solid red line). It shows that fall precipitation increased in time on the average by 0.07" per decade while the other seasons showed no significant increase in precipitation. In fact, fall is the season that explains the increasing flood frequency in time the most.



North Dakota **Winter** Precipitation Trend **0"/Decade**

North Dakota **Spring** Precipitation Trend **00.1"/Decade**

North Dakota **Summer** Precipitation Trend **0"/Decade**

North Dakota **Fall** Precipitation Trend **00.7"/Decade**

The Table on the previous page shows that:

- 7 out of the 15 wettest falls were followed by major floods in the Red River in Fargo.
- Even though 1982 and 1957 were the 6th and 9th wettest falls, they were not followed by any flood category. Incidentally, 1982 and 1957 were followed by a very dry winter season with 50% and 2% of normal seasonal snowfall totals respectively.
- 13 out of the 15 wettest fall seasons were followed by major floods when coupled with normal and wetter than normal snow seasons.

The outlook is indicating another wet winter. As of December 15, Fargo has already received 13.1" above the normal snowfall that Fargo receives on the average. When determining long term climate outlook it is much harder to follow a weather pattern from an initial condition to project what the conditions are going to be sometime in the far future. Instead we use teleconnection--a linkage between weather in North Dakota and phenomena elsewhere, such as ENSO (El Niño Sothern Oscillation), AO (Arctic Oscillation), and solar activities. Please read the Seasonal Outlook section of this bulletin to see how the current La Niña, Negative AO, and solar activities will impact our winter weather. All indicators are suggesting above normal precipitation for eastern North Dakota.

Fargo experienced four 2-consecutive major floods in recorded history including the floods of 2009 and 2010. However, Fargo has never experienced 3 consecutive floods. Furthermore, there are 3 previous ENSO conditions that are the most similar to the current ENSO period: 1973, 1970, and 1998. None of these years were followed by a major flood in Fargo. Even further, 1998 was the 7th wettest fall in the recorded history.

In conclusion, neither are any 2 historic events similar, nor do 2 similar events yield the same result. Climate models only explain the events that took place in the past, but the projections are only useful when limitations are known. Even though there is a greater chance (based on historic outcome) of having another major flood next spring in Fargo, it is still not 100% certain nor can it be quantified. Before making any decisions, we have to weigh the difference between the consequences of reacting this early before the flood if a major flood did not occur, and the consequences of not reacting if a major flood did occur.

CONTACTING THE NORTH DAKOTA STATE CLIMATE OFFICE

Please contact us if you have any inquiries, comments, or would like to know how to contribute to this quarterly bulletin.

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