



North Dakota Climate Bulletin

Summer 2008

Volume: 2 No: 3

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NDSCO

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From the State Climatologist



The 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 wet and a warm summer following a dry and a cold spring. Extreme to severe drought ruled the western 1/2 of the state during the summer. Regionally, western North Dakota was very warm and dry while eastern half was very wet and cool. Temperature-wise, the summer of 2008 was the 49th warmest since 1895. Precipitation-wise, it was the 25th wettest summer since 1895. The summer temperature trend for the period of record (1895 to present) was 0.21° F per decade indicating that this summer in ND was 2.1° F warmer than it was 100 years ago on the average. The total precipitation as percentage of the normal and average temperature departure from normal are shown on pages 4 through 12 (Season in-Graphics). The Season in-Graphics also displays 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 web site hosts other great resources for climate and weather information.

Adnan Akyüz, Ph.D.
North Dakota
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Weather Highlights



Seasonal Summary:

by B. A. Mullins

June 2008

The state average precipitation was 4.22 inches which is above the 1971-2000 normal of 3.19 inches. June 2008 state average precipitation ranked 28th wettest in the last 114 years with a maximum of 7.21" in 2005 and a minimum of 1.14" in 1974.

Welcomed rains fell across the state throughout the first half of June with daily record rainfall at several locations on June 11th. The second half of June saw more dry conditions with intermittent showers across the state. June precipitation ranged from just under 2" in the west to as high as nearly 7" in the southeast. The percent of normal precipitation ranged from 50% in the west and isolated areas in the east central region to nearly 200% in the southeast with a couple pockets of over 200%. The US Drought Monitor classified the central regions as abnormally dry with the western region as moderately dry and the far western part of the state with severe drought. The eastern part of the state did not have drought conditions. The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 8% very short, 34% short, 57% adequate, and 1% surplus with a subsoil moisture reported as 15% very short, 31% short, 54% adequate, and 1% surplus (Weekly Weather and Crop Bulletin Vol. 95, No. 28).

The National Weather Service (NWS) reported breaking five rainfall records on the 11th. Bismarck recorded 1.37" of rain breaking the previous record of 0.86" set in 1880. Jamestown recorded 2.62" breaking the previous record of 0.77" set in 2001. Minot recorded 1.88" breaking the previous record of 1.61" set in 1977. Dickinson recorded 0.65" breaking the previous record of 0.64" set in 1966. Williston recorded 0.94" breaking the previous record of 0.69" set in 2003. The top five June daily rainfall totals measured from the North Dakota Agricultural Weather Network (NDAWN) all fell on the 11th and they were 2.16" at Fargo, 2.23" at Mohall, 2.30" at Minot, 2.63" at Fingal, and 2.68" at Jamestown. The storm system on the 11th produced rainfall at all 70 of the North Dakota Agricultural Weather Network (NDAWN) stations. The smallest amounts were in the southwest corner and ranged from 0.2 to 0.5 inches. Nearly all other areas received between an inch and 2" of rain. National Weather Service's Storm Prediction Center (SPC) recorded only 7 reports of hail and 2 reports of high wind from the system. The top five June daily maximum wind speeds recorded from NDAWN was 73.4 mph on the 14th at McHenry, 68.7 mph on the 11th at Marion, 60.1 mph on the 5th at Oakes, 58.7 mph on the 14th at Carrington, and 58.0 mph on the 14th at Dazey. NDAWN wind speeds are measured at a height of 10 feet (3 m).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), June had 58 reported high wind events, 108 reports of hail, and 5 reported tornadoes. Nearly half of the high wind reports fell on the 14th when a storm system that stretched from the northwest corner down to the southeast corner produced some rain but mostly hail (11 events reported by SPC), one tornado and high winds (23 events reported by SPC). The one tornado was sighted in Barnes County. The 11 hail reports came from Ramsey, Divide, Mountrail, Ward, Cass, Burleigh, Sargent, McHenry and Barnes Counties. The 14 high winds were reported from

Divide, Mountrail, Ward, Traill, Dickey, Ransom, McHenry, McLean, Cass, Pierce, Benson, Eddy, Wells, Foster, Benson, Ramsey, Barnes, Nelson, Eddy, and Grand Forks Counties.

On the 11th, a storm system produced rainfall at all of the North Dakota Agricultural Weather Network (NDAWN) stations. The smallest amounts were in the southwest corner and ranged from 0.2 to 0.5 inches. Nearly all other areas received between an inch and 2" of rain. NDAWN stations with over two inches of rain were Jamestown at 2.68", Fingal with 2.63", Minot with 2.30", Mohall with 2.23", Fargo with 2.16", Berthold with 2.07" and Galesburg with 2.00". SPC recorded only 7 reports of hail and 2 reports of high wind from the system. The counties reporting hail were Richland, McLean, Burleigh, Sargent, Grant, and Kidder. The high winds were reported in Richland, Cass, and Barnes counties.

A storm system on the 18th produced rain in the central part of the state with some places receiving a half inch. NDAWN had one station that measured over an inch of rain at Mandan with 1.30". SPC had 2 reported tornadoes in Morton County. There were also 27 hail reports primarily from central counties including Oliver, McLean, Bottineau, McHenry, Mercer, Ward, McKenzie, Ward, Morton, Sheridan, and Sioux.

The storm system on the 23rd through the 24th brought rain to areas from the northwest down to the southeast with isolated showers in the northeast. NDAWN stations recording greater than an inch of rain across the two days were Leonard with 1.49", Jamestown with 1.40" and Tappen with 1.78". According to SPC there were 31 reports of hail from Billings, Stark, Dunn, Mercer, Morton, Sioux, Burleigh, McLean, Stutsman, Pierce, Benson, Towner, Cavalier, Wells, and Eddy Counties. There were 5 high wind reports from Dunn, Stark, Stutsman, Lamoure, and Barnes. SPC listed one tornado sighting in Benson County that touched down briefly.

The 26th storm system brought various amounts of rain to many parts of the state. NDAWN had two stations recording over an inch of rain (McHenry with 1.11" and Carrington with 1.01"). SPC listed 15 reports of hail and 3 reports of high wind. The hail was sighted in Williams, McKenzie, Mercer, Stark, McLean, Sioux, Foster, Steele, and Emmons Counties. The high winds were reported in Morton and Burleigh Counties.

The state average air temperature was 60.9 °F which is below on the 1971-2000 normal of 63.7 °F. June 2008 state average air temperature ranked 29th coolest in the past 114 years with a maximum of 74.2 °F in 1988 and a minimum of 56.2 °F in 1915.

The daily average temperatures for the first half of June were below normal across the state while the second half of June's daily temperatures were near normal. The average monthly air temperature ranged from a 66°F in the southeast to 57°F in the northwest. The monthly departure from normal average air temperatures ranged from -1 to -5. Therefore, even with an increase in temperatures in the second half of June, the monthly end result was below normal temperatures across the state.

NDAWN's highest recorded daily air temperature for June was 98°F at Sidney, MT on the 30th. The lowest recorded daily air temperature was 34.9°F at Mott on the 10th.

July 2008

The state average precipitation was 2.73 inches which was nearly equal to the 1971-2000 normal state average of 2.75 inches. July 2008 state average precipitation ranked the 67th driest in the past 114 years with a maximum of 7.88 inches in 1993 and a minimum of 0.62 inches in 1936.

Total July rainfall ranged from just under an inch, primarily in the west, to just over 5 inches, primarily in the east. The areas of the state that received above normal precipitation were the south central and east central regions. Most of the above normal precipitation was between 100 and 150% of normal with a few areas in McIntosh, Steele, and Trail counties with 150 to 300% of normal. The remainder of the state received below normal July precipitation with the lowest value of less than 50% of normal on the western edge of the state. According to the US Drought Monitor, a third of North Dakota including the northwest, north central, and southwest is under severe to extreme drought conditions (Figure 1). The majority of the remainder of the state is considered abnormally dry. The dry conditions depleted pasture land and provoked some producers to harvest small grains for hay. There were also reports of producers selling livestock because of the dry conditions. The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 17% very short, 30% short, 52% adequate, and 1% surplus with a subsoil moisture reported as 20% very short, 35% short, 44% adequate, and 1% surplus (Weekly Weather and Crop Bulletin Vol. 95, No. 32).

A record rainfall of 1.67" was recorded by the National Weather Service (NWS) at Jamestown on the 23rd breaking the previous record of 0.63" set in 1987. Also on the 30th the NWS reported a record rainfall of 0.33" at Minot which broke the previous record of 0.22" set in 1984. The top five July daily rainfall totals measured from the North Dakota Agricultural Weather Network (NDAWN) was 2.73" on the 29th at Perley MN, 2.41" on the 19th at Britton SD, 2.16" on the 31st at Oakes, 2.08" on the 28th at Mayville, and 2.04" on the 7th at Grafton. The top five July daily maximum wind speeds recorded from NDAWN was 62.3 mph on the 30th at Mandan, 59.1 mph on the 28th at Watford City, another 59.1 mph on the 27th at Mott, 57.6 mph on the 10th at Wahpeton, and another 57.6 mph on the 16th at Streeter. NDAWN wind speeds are measured at a height of 10 feet (3 m).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), throughout July there were 33 reported high wind events, 108 reports of hail, and 18 reported tornadoes. Some of these reports came from major storm systems on the 7th, 10th, 19th, 28th, and 30th. Outside of a few scattered showers, July precipitation started out quiet for the first few days. On the 7th, the eastern half of the state had rainfall amounts as high as 1 to 2 inches. NDAWN had one station with over two inches at Grafton with 2.04" of rain. Tornadoes were reported in Bottineau, Rolette, Towner, Steele, and Walsh counties. Hail was reported in Steele, Cass, Benson, Eddy, Foster, Richland, Griggs (golf ball size), Barnes, Pembina, and Trail counties.

The storm system that moved through ND on the 10th brought limited rains that fell primarily in the east. The highest totals were only between 0.5" and 1" in the southeast corner. The SPC reported sightings of tornadoes in Grant and Burleigh counties. Hail was reported in Grant, Burleigh, Richland, Mclean, Morton, Wells, Dickey, Lamoure, Emmons and Sargent Counties.

The 19th storm system dropped hail with very little rain. SPC reported one tornado in Dunn County. Dime to quarter sized hail fall in McKenzie, Mercer, Emmons, McIntosh, and Oliver counties. Golf ball sized hail was reported in Williams, Dunn and Morton Counties with baseball sized hail reported in Burleigh County.

Rain fell on the 28th in the northern half of the state with small and trace amounts in the south central region. According to SPC there was a tornado reported in Burleigh County. Hail was reported at Burleigh, Mclean, Steele, Nelson, Towner, and Trail. Golf ball sized hail was

reported in Dunn, Mercer, and McIntosh Counties. Heavy rain fell in Nelson County where NDAWN recorded 1.77” at the Michigan weather station.

The 30th had rainfall primarily in the west central, central and north central regions. Most of the daily totals were around a tenth with a few pockets of over an inch. This storm event produced very large hail. SPC had McKenzie County with 1” hail, McLean, Morton, and Mercer with quarter to tennis ball hail, Adams with golf ball hail, Stark and Grant with nickel sized hail, and Ward with quarter sized hail. Wind speeds were reported over or near 60 mph at McLean, Stark, and Mercer. It was also reported on SPC that Mercer had 12” diameter trees blown down. The heaviest rain was in Morton where NDAWN’s Mandan station recorded 1.38”.

Even though the state average air temperature was 69.3°F which is slightly above the 1971-2000 normal of 68.7°F, the majority of the state experienced below normal temperatures. July 2008 state average air temperature ranked the 61st coolest in the past 114 years with a maximum of 79.7°F in 1936 and a minimum of 61.8°F in 1992.

The average monthly air temperatures ranged from 65°F in the northeast to 70°F in the southwest. The departure from normal monthly average air temperature ranged from -4 in the northeast to 4 in the southwest. So while the southwest had above normal average air temperatures, the remainder of the state had below normal average air temperatures. The higher temperatures of the southwest skewed the state average air temperature to be 69.3°F which was slightly above normal.

NDAWN’s highest recorded daily air temperature for July was 99°F at Dickinson on the 10th. The lowest recorded daily air temperature was 40°F at Bottineau on the 3rd.

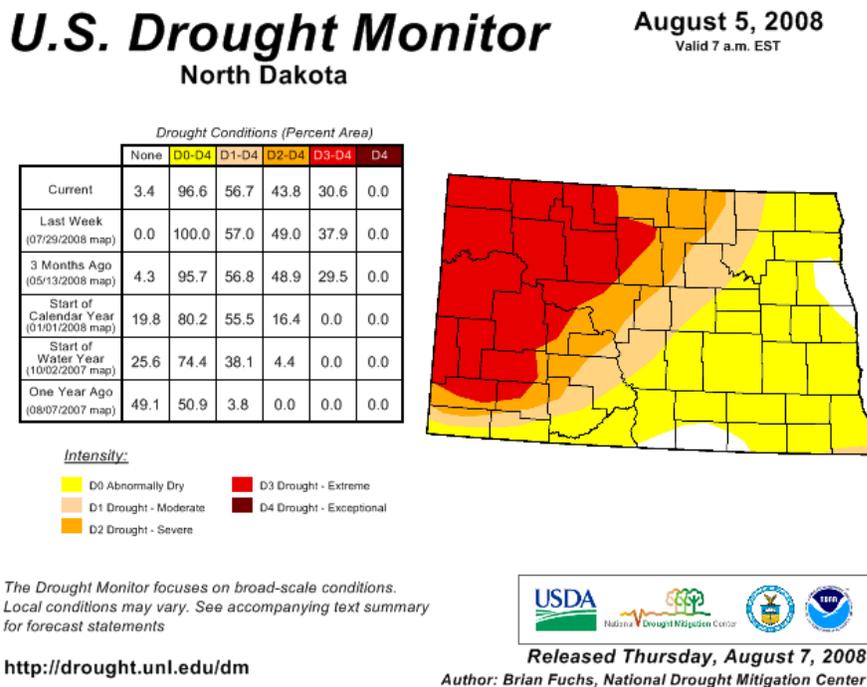


Figure 1. Drought Monitor for North Dakota (National Drought Mitigation Center)

August 2008

The state average precipitation was 2.48 inches which is above the 1971-2000 normal of 2.10 inches. August 2008 state average precipitation ranked 36th wettest in the past 114 years with a maximum of 5.02 inches in 1900 and a minimum of 0.72 inches in 1961.

The August total rainfall in the southwest was primarily between 0.5 and 1.5 inches. Most of the rainfall totals in the central, north central, northwest and northeast part of the state were wide spread falling between 2 and 7 inches. The southeast corner also varied with anywhere between 1 and 4 inches of rain. Around half or more of the state has below normal precipitation, however the state average was 2.48 inches which is above the 1971-2000 normal of 2.10 inches. The north central region had generally around 200% to 300% of normal precipitation. The US Drought Monitor classified the south-eastern 1/3rd of the state as no longer under drought conditions. McKenzie, Dunn, Golden Valley, Billings and Stark counties were classified as extreme drought. Counties surrounding the area of extreme drought along with the counties in the northwest were classified as severe drought. The remaining western counties fell in the abnormally dry to moderate drought range (Figure 1). The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 20% very short, 23% short, 56% adequate, 1% surplus with a subsoil moisture reported as 24% very short, 27% short, and 49% adequate (Weekly Weather and Crop Bulletin Vol. 95, No. 36).

A record rainfall of 3.33" was recorded by the National Weather Service (NWS) at Fargo on the 11th breaking the previous record of 2.10" set in 1963. Also on the 11th the NWS reported a record rainfall of 1.64" at Grand Forks which broke the previous record of 0.89" set in 1999. The top five August daily rainfall totals measured from the North Dakota Agricultural Weather Network (NDAWN) was 3.92" on the 11th at Wahpeton, 3.25" on the 21st at Harvey, 3.07" on the 11th at Wyndmere, 2.77" on the 11th at Sabin MN, and 2.54" on the 2nd at Rolla. The top five August daily maximum wind speeds recorded from NDAWN was 70.5 mph on the 3rd at Plaza, 53.0 mph on the 3rd at Watford City, 49.8 mph on the 21st at Dickinson, 48.7 mph on the 22nd at Watford City, and 48.0 mph on the 22nd at both Bowman and Linton. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The National Weather Service's Storm Prediction Center (SPC) preliminary August storm reports had 13 reported high wind events, 62 reports of hail, and 7 reported tornadoes. The majority of the storm reports fell on the 1st, 2nd, 11th, 14th, 21st, and the 26th. The first half of August saw more rainfall than the second half. From the 1st through the 14th, rain fell across the state with the larger amounts falling in the northern and eastern parts of the state. The 15th through the 20th was mostly dry. The 21st and 22nd had scattered showers mostly in the north, west central and central regions. The 23rd through the 25th was dry. The 26th through the 28th had rainfall in the eastern part of the state and the 29th through the 31st was dry.

The storm system of the August 1st and 2nd had rain falling in the north and eastern part of the state. SPC had 33 reports of hail with most falling in Benson, Bottineau (quarter sized), Dunn (nickel to golf ball sized), Mountrail, McLean (quarter sized), and Ward (quarter to golf ball size) counties. SPC also had 3 reports of high winds of over 70 mph on the 2nd in Mercer, Golden Valley, and Plaza counties.

The storm system of the August 11th had rain fall again in the north and eastern part of the state. NDAWN recorded over 3 inches at Wahpeton and Wyndmere, and over 2 inches at Fargo, Oakes, Ekre, Sabin MN, Warren MN, and Grand Forks weather stations. SPC reported 6 tornadoes that briefly touched down in Burleigh, McLean, McHenry, and Benson counties.

The August 14th storm system had scattered light showers scattered across the state. The highest amounts as recorded by NDAWN was 0.99” at Fargo and 0.90” at Pillsbury. SPC had 8 reports of hail in Barnes, Cass, Pembina, Ransom, and Steele counties. SPC had 1 reported tornado in Steele and 2 reports of high winds in Griggs and Walsh counties.

The August 21st storm system had light showers mostly in the northern and west central part of the state. The highest amount recorded at the Harvey NDAWN station was 3.25”. SPC had 13 reported hail events in Rolette, McHenry, Billings, Stark, Benson, Billings Oliver, McLean, Ramsey and Stark counties. There were also 3 high wind reports from Ward and Stark counties.

The storm system on the 26th had rainfall in the eastern part of the state. SPC had 4 hail reports from Barnes, Emmons, Richland and Sioux counties.

The state average air temperature was 68.6° F which is above the 1971-2000 normal of 67.2° F. August 2008 state average air temperature ranked the 33rd warmest in the past 114 years with a maximum of 73.6 °F in 1983 and a minimum of 60.9 °F in 1977.

The average monthly air temperatures ranged from 70°F in the southwest to 65°F in the northeast. Most of the state had above normal air temperatures with most of the state having 1 to 3 ° F above normal. The second half of August had record high temperatures. According to the National Weather Service (NWS) on the 19th Williston tied the record high temperature of 98°F that was set in 1992. Again on the 30th Williston tied the 1983 record high temperature of 97°F. Also on the 30th, Bismarck had a record high temperature of 100°F breaking the previous record of 97° set in 1948 and Dickinson had a record high temperature of 101°F breaking the previous record of 96° set in 1929. On the 31st Grand Forks had a record high minimum temperature of 68°F breaking the previous record of 67° set in 1953. The top five August maximum daily air temperatures recorded from NDAWN was 101.8°F on the 1st at Sidney MT, 100.8°F on the 30th at Bowman, 100.7°F on the 30th at Hazen, 100.3°F on the 30th at Mott, and 100.2°F on the 1st at Brorson MT.

The NWS reported a record low temperature at Grand Forks on the 24th of 39°F which broke the previous record of 40° set in 1942. The top five August minimum daily air temperatures recorded from NDAWN was 34.1°F on the 23rd at Bowman, 35.4°F on the 23rd at Mott, 36.4°F on the 23rd at Hettinger, 37.4°F on the 27th at Hettinger and 37.6°F on the 28th at Bottineau and 37.6°F also on the 24th at Rolla and Warren MN.

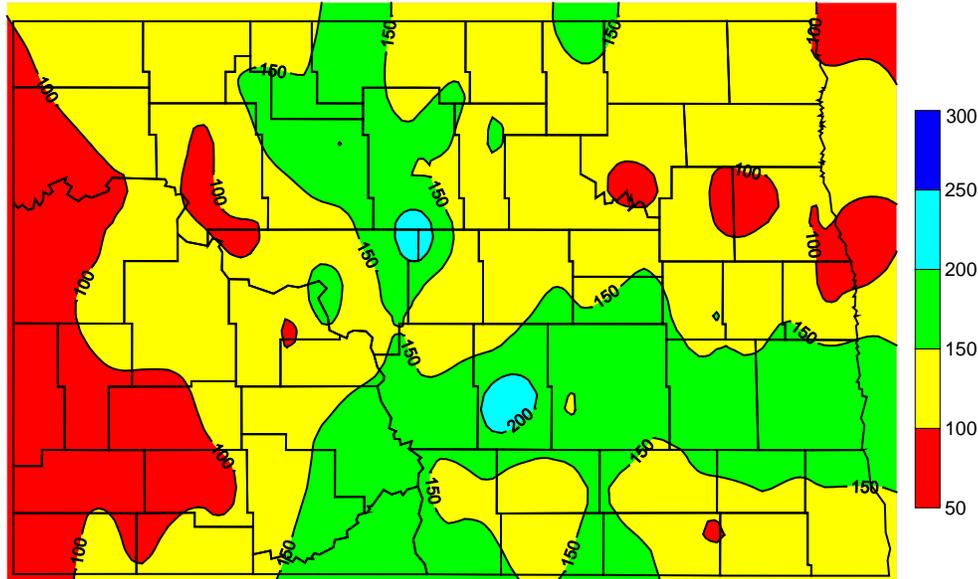
Season in Graphics

Summer 2008 Weather in North Dakota:

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

(Data from NWS Cooperative Network)



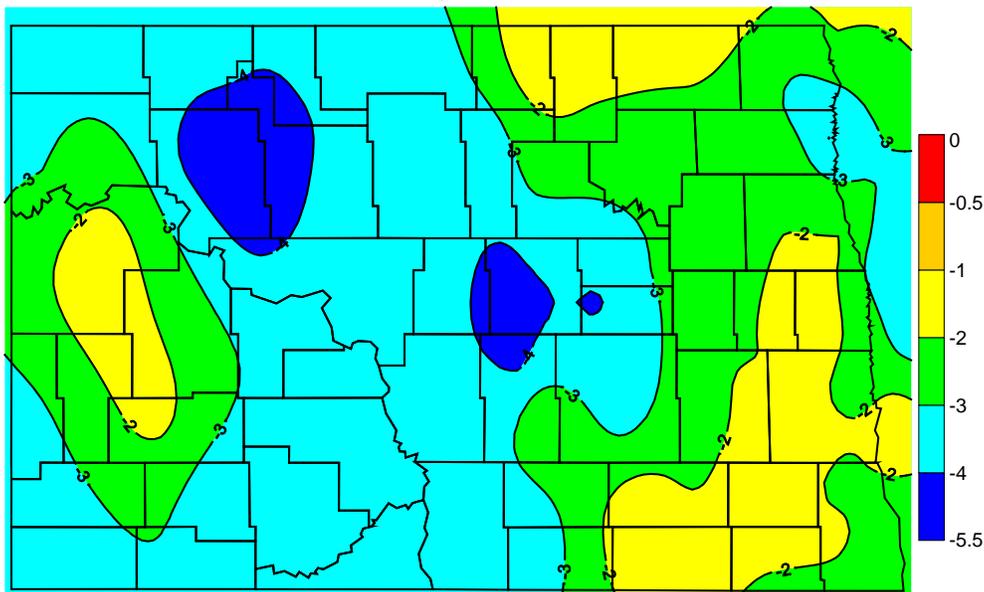
North Dakota State Climate Office

2008

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

June

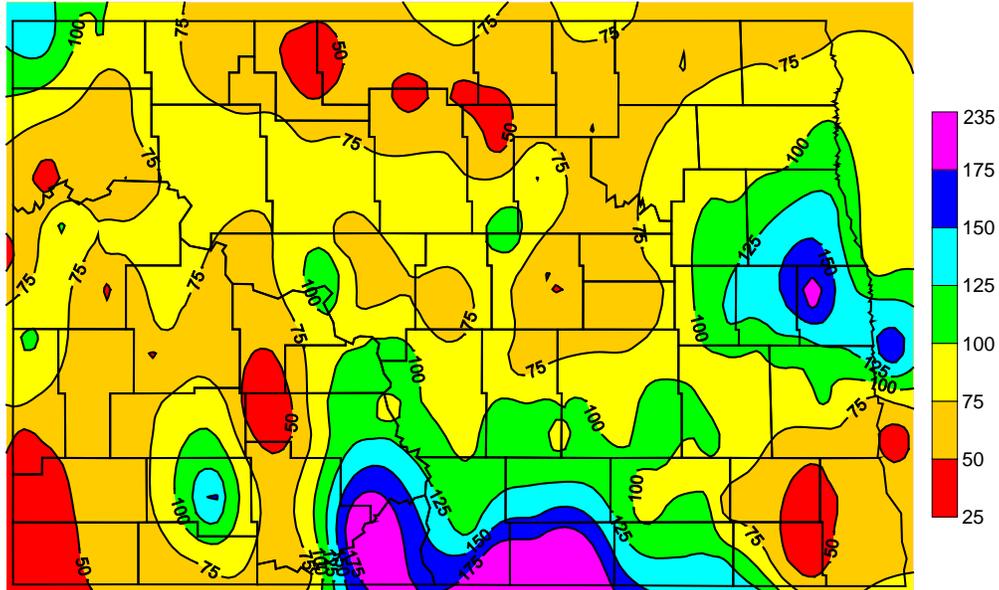
Season in Graphics

Summer 2008 Weather in North Dakota:

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

(Data from NWS Cooperative Network)

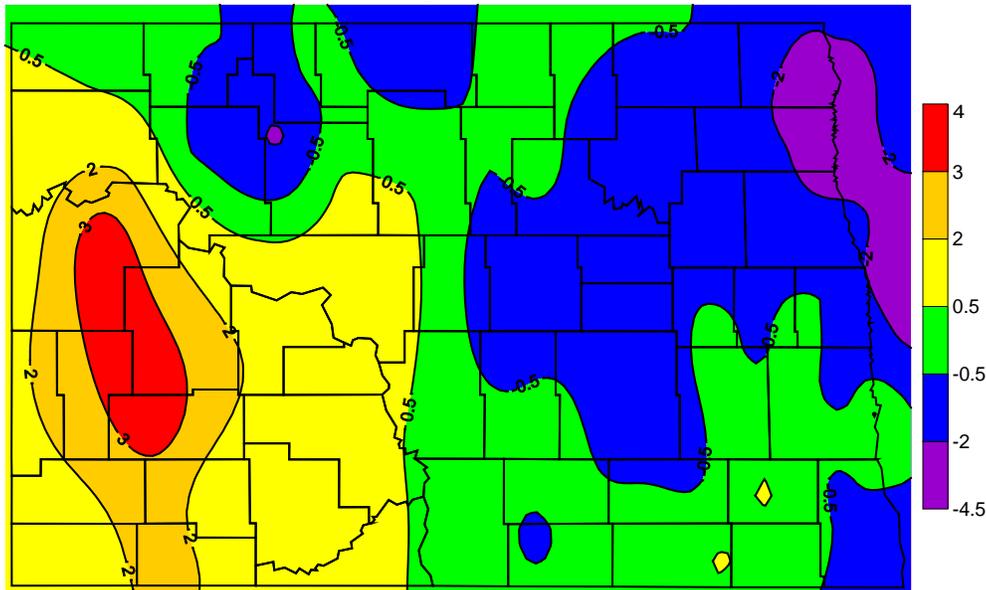


North Dakota State Climate Office

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

JULY 2008

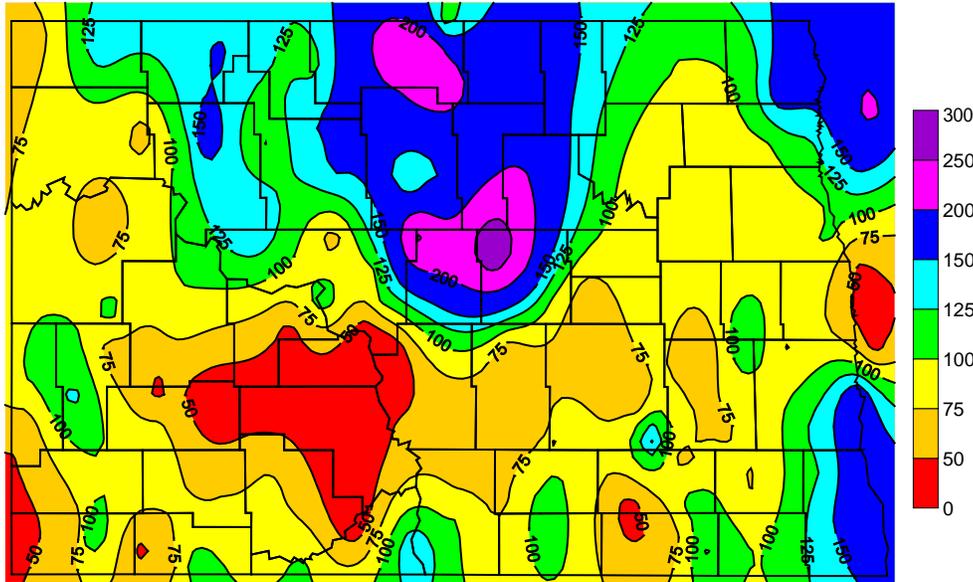
Season in Graphics

Summer 2008 Weather in North Dakota:

Total Precipitation percent of mean (1971-2000)

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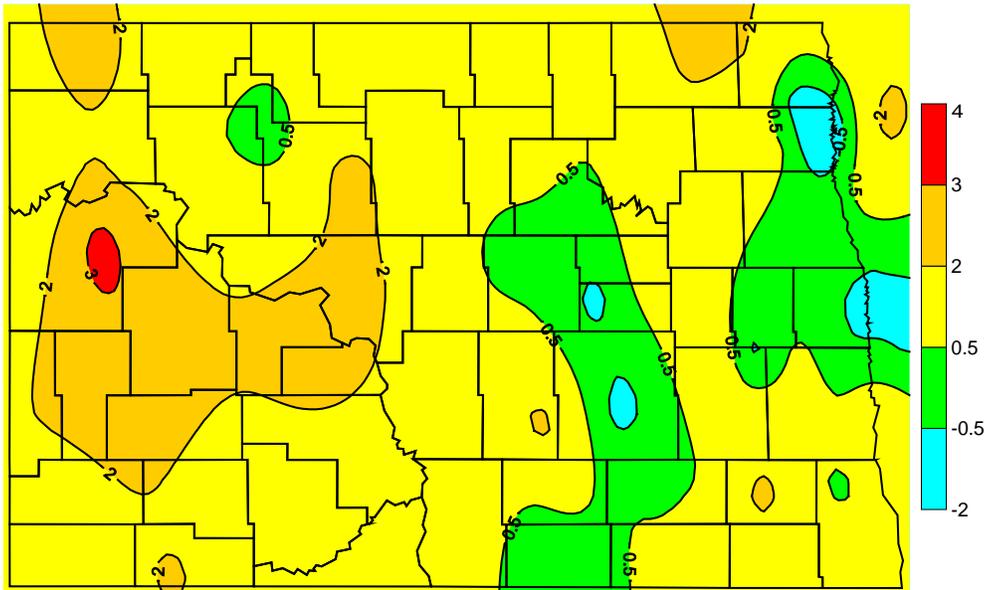


North Dakota State Climate Office

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

Departure From Normal Monthly Average Air Temperature in degrees F

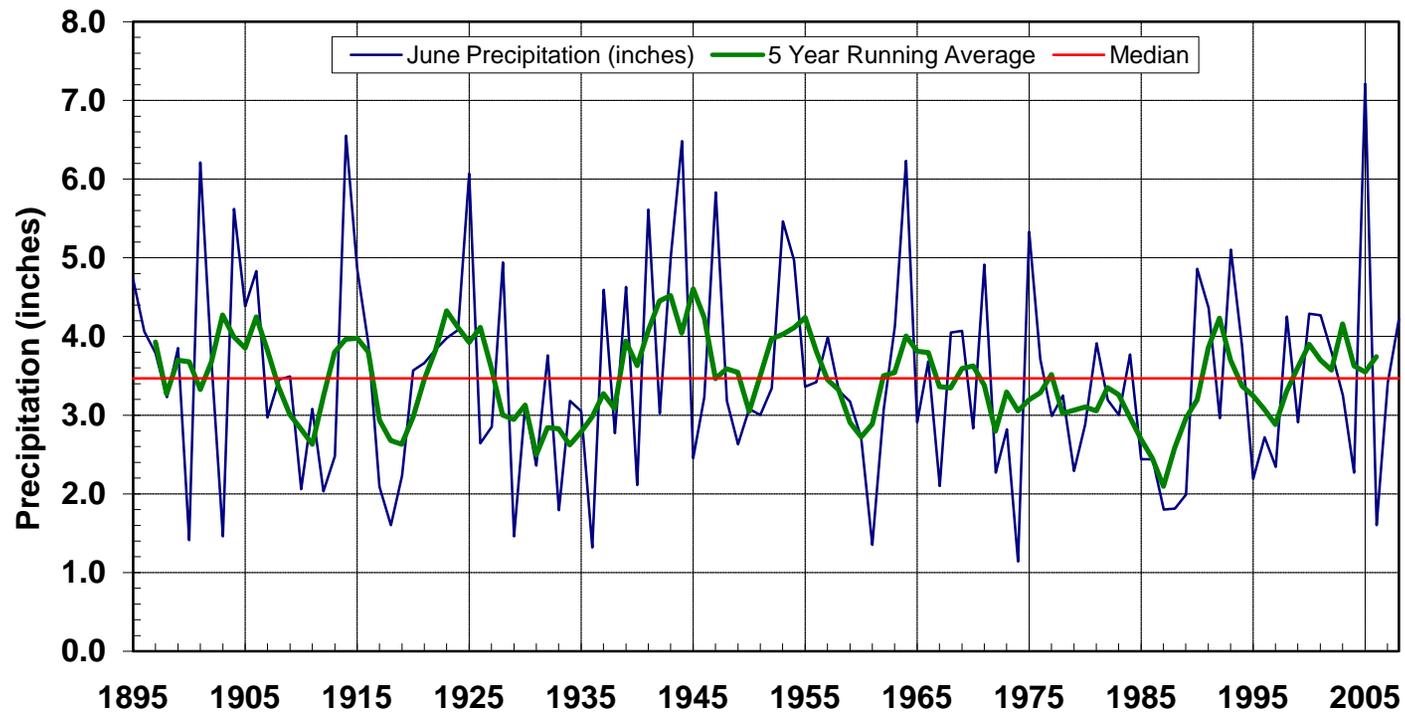
(Data from North Dakota Agricultural Weather Network (NDAWN))



North Dakota State Climate Office

August 2008

Historical June Precipitation for North Dakota

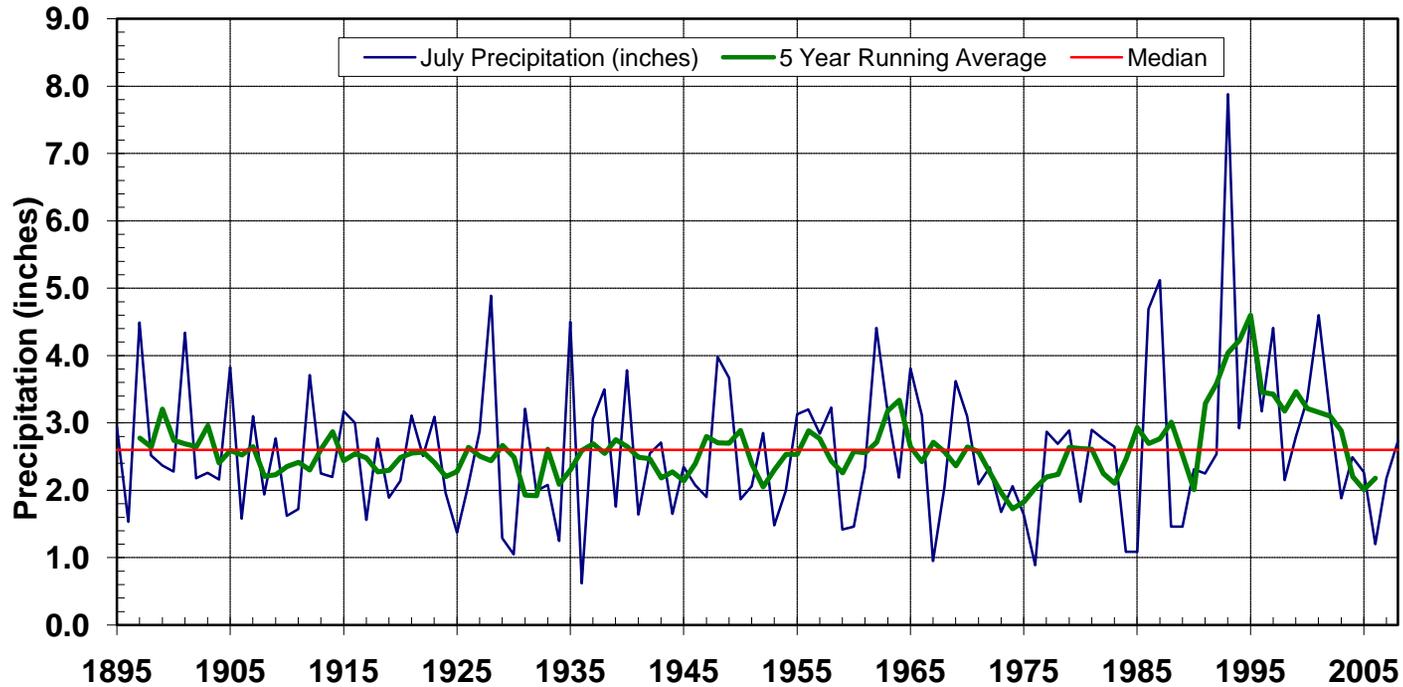


June Precipitation Statistics

2008 Amount: **4.22 inches**
Maximum: 7.21 inches in 2005
State Normal: 3.19" (1971-2000)

Monthly Ranking: 28th Wettest in 114 years
Minimum: 1.14 inches in 1974
Years in Record: 114

Historical July Precipitation for North Dakota

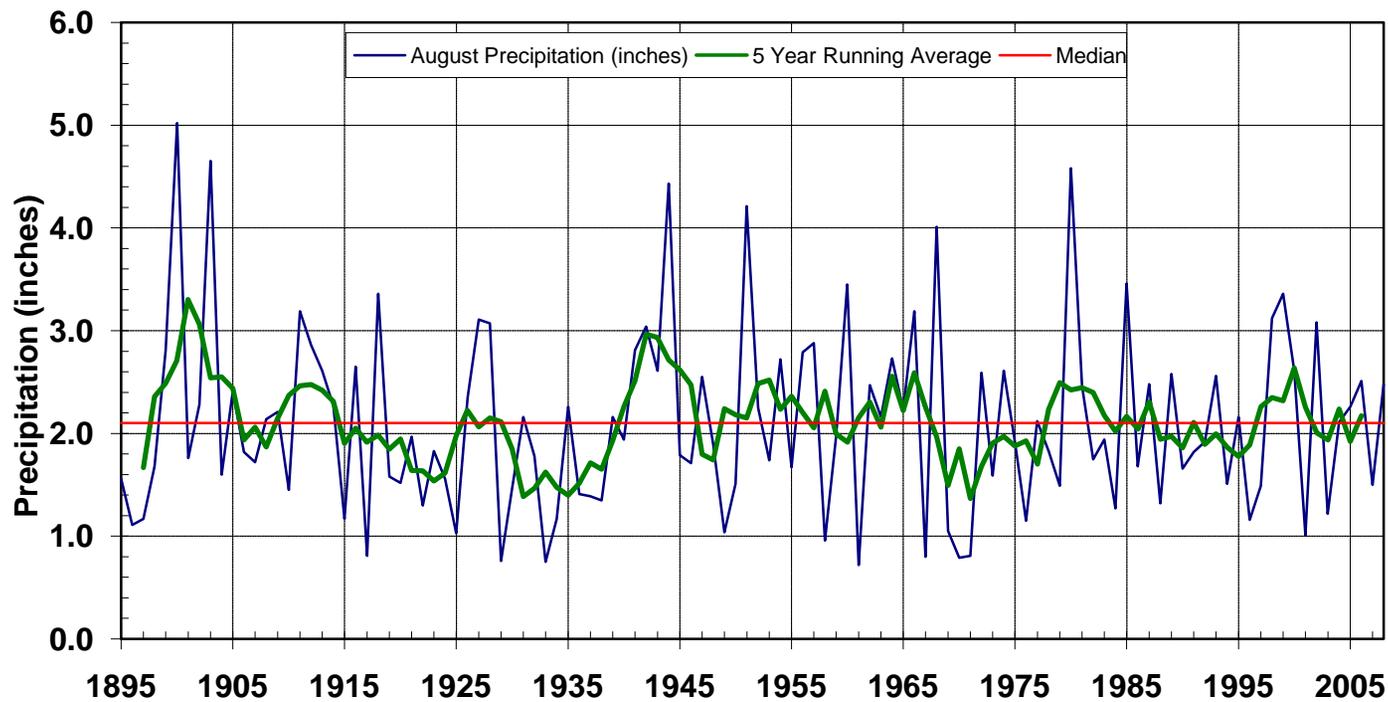


July Precipitation Statistics

2008 Amount: 2.73 inches
Maximum: 7.88 inches in 1993
State Normal: 2.75" (1971-2000)

Monthly Ranking: 67th Driest in 114 years
Minimum: 0.62 inches in 1936
Years in Record: 114

Historical August Precipitation for North Dakota

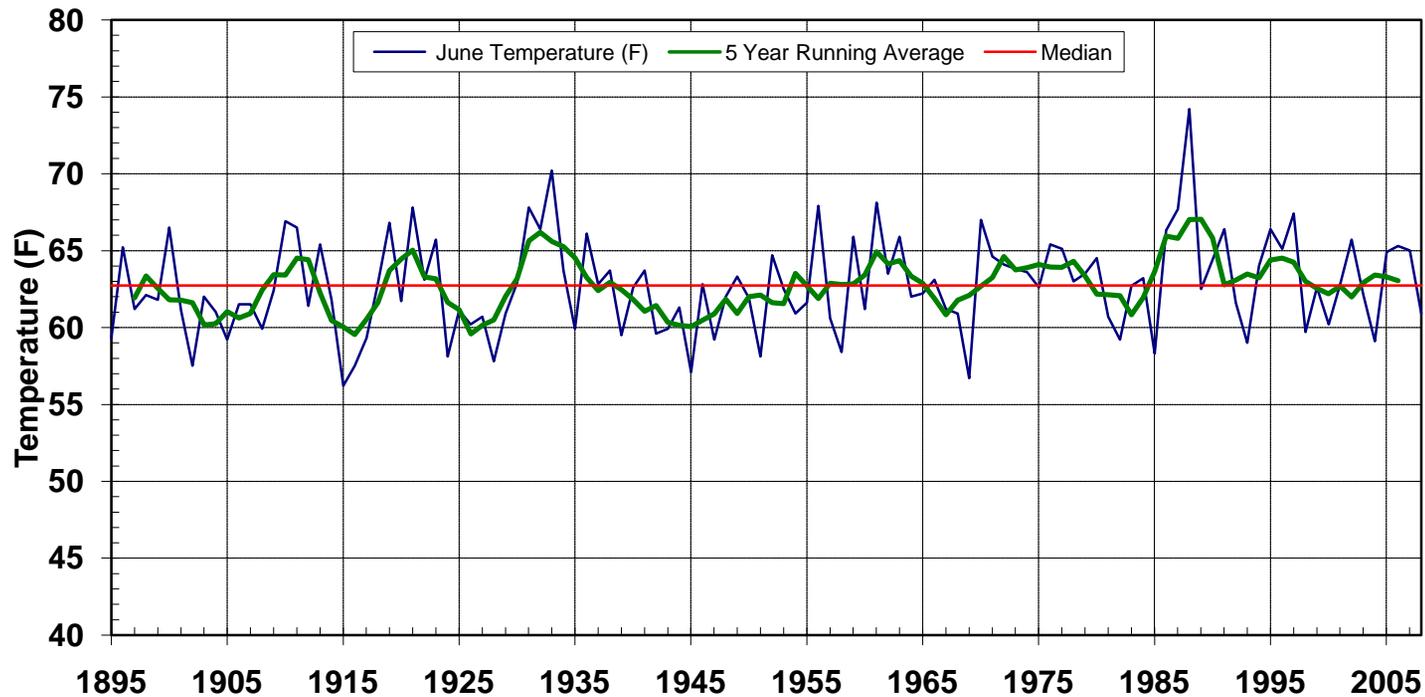


August Precipitation Statistics

2008 Amount: 2.48 **inches**
Maximum: 5.02 inches in 1900
State Normal: 2.10" (1971-2000)

Monthly Ranking: 36th Wettest in 114 years
Minimum: 0.72 inches in 1961
Years in Record: 114

Historical June Temperature for North Dakota



June Temperature Statistics

2008 Average: 60.9 °F

Maximum: 74.2° F in 1988

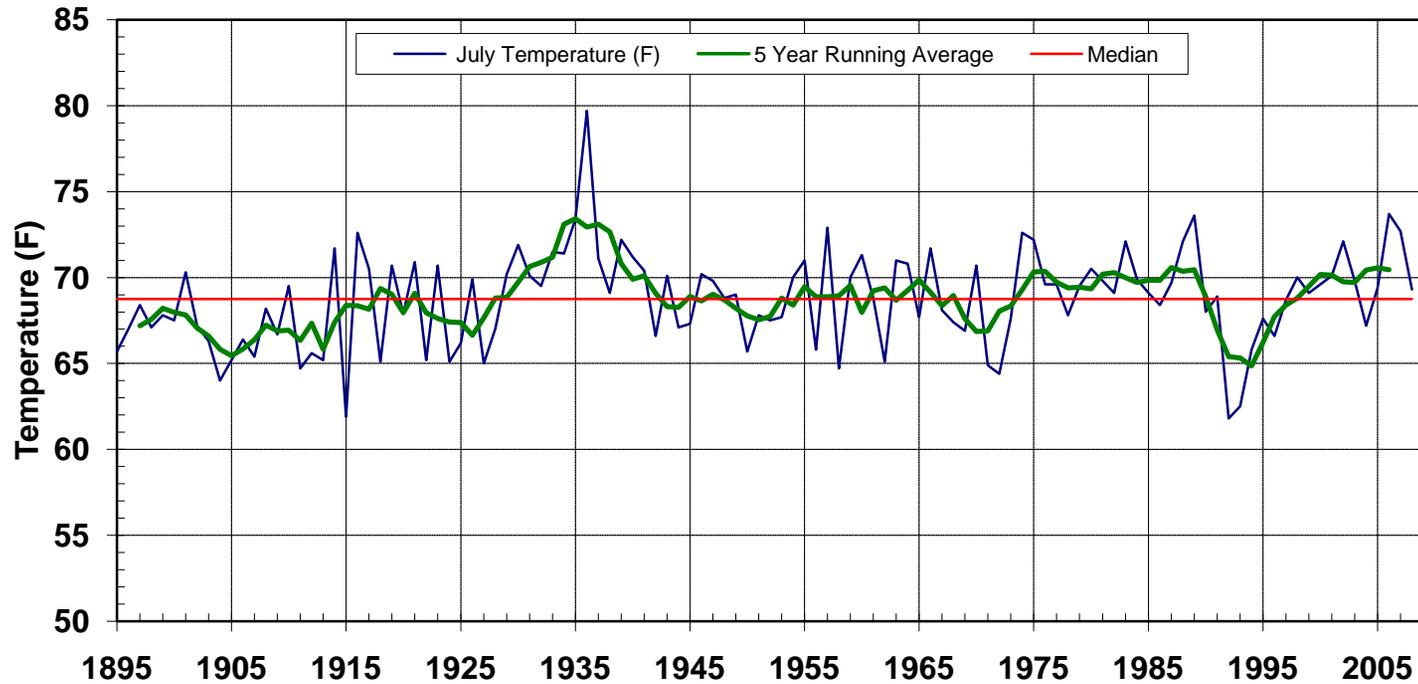
State Normal: 63.73° F (1971-2000)

Monthly Ranking: 29th Coolest in 114 years

Minimum: 56.2° F in 1915

Years in Record: 114

Historical July Temperature for North Dakota

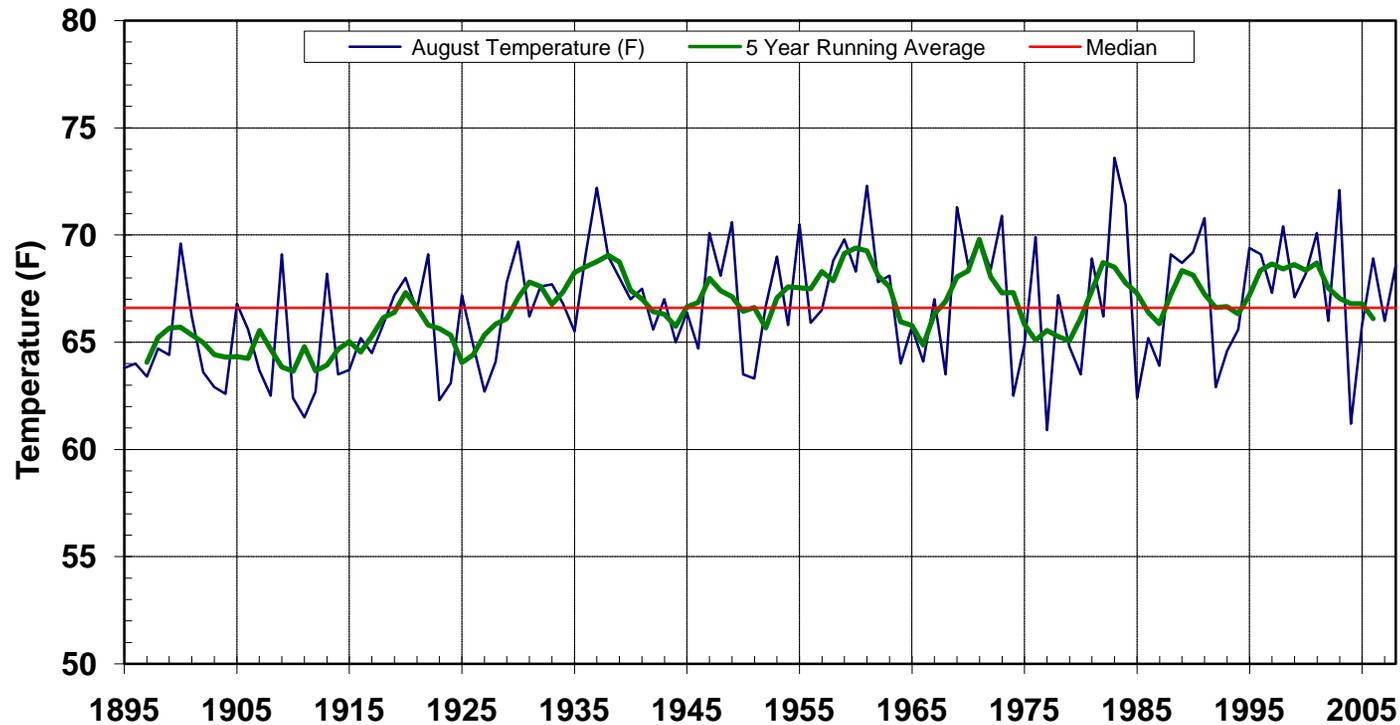


July Temperature Statistics

2008 Average: 69.3 °F
Maximum: 79.7 °F in 1936
State Normal: 68.7 °F (1971-2000)

Monthly Ranking: 61st Coolest in 114 years
Minimum: 61.8 °F in 1992
Years in Record: 114

Historical August Temperature for North Dakota



August Temperature Statistics

2008 Average: **68.6°F**

Maximum: 73.6°F in 1983

State Normal: 67.2 °F (1971-2000)

Monthly Ranking: 33rd Warmest in 114 years

Minimum: 60.9°F in 1977

Years in Record: 114



Storms & Record Events



State Tornado, Hail, and Wind Reports for Summer 2008 by B. A. Mullins

North Dakota 3 Month Total	Wind	Hail	Tornado
	104	278	30

Reports by Month			
Month	Wind	Hail	Tornado
Total June	58	108	5
Total July	33	108	18
Total August	13	62	7

North Dakota Record Event Reports for Summer 2008

Date	Location	Type of Record	Previous Record
06/11/08	Bismarck	Record rainfall of 1.37 inches.	0.86 inches set in 1880.
06/11/08	Jamestown	Record rainfall of 2.62 inches.	0.77 inches set in 2001.
06/11/08	Minot	Record rainfall of 1.88 inches.	1.61 inches set in 1977.
06/11/08	Dickinson	Record rainfall of 0.65 inches.	0.64 inches set in 1966.
06/11/08	Williston	Record rainfall of 0.94 inches.	0.69 inches set in 2003.
07/23/08	Jamestown	Record rainfall of 1.67 inches.	0.63 set in 1987.
07/30/08	Minot	Record rainfall of 0.33 inches.	0.22 set in 1984.
08/11/08	Fargo	Record rainfall of 3.33 inches.	2.10 set in 1963.
08/11/08	Grand Forks	Record rainfall of 1.64 inches.	0.89 set in 1999.
08/19/08	Williston	Record high temperature of 98°F.	It ties the previous record set in 1992.
08/24/08	Grand Forks	Record low temperature of 39°F.	40° set in 1942.
08/30/08	Williston	Record high temperature of 97°F.	It ties the previous record set in 1983.
08/30/08	Bismarck	Record high temperature of 100°F.	97° set in 1948.
08/30/08	Dickinson	Record high temperature of 101°F.	96° set in 1929.
08/31/08	Grand Forks	Record highest minimum temperature of 68°F.	67° set in 1953.



Seasonal Outlook



Fall Climate Outlooks

by M. Ewens

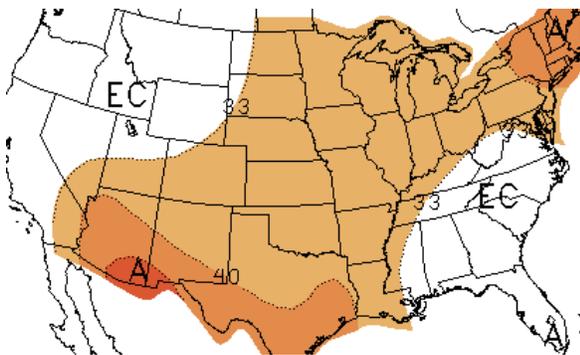
This past summer was a fairly cool summer across much of the United States, and in the northern plains in particular. While not record cold, it was consistently cold, with very few very warm days conducive to the rapid accumulation of heat units. This has led to concerns that an early frost may hurt certain crops. On the other hand, timely rains and moderate temperatures allowed for several of the small grains to grow very well.

The overall weather pattern for the upcoming fall season is forecast to create warmer weather than normal across a large part of the plains states. This outlook is based mainly on the past decades trends of warmer fall weather. Due to the lack of strong forcing from the Pacific signal, the Climate Prediction Center uses the trends of the past decade to drive the outlook. Precipitation is expected to show its normal climatic variability.

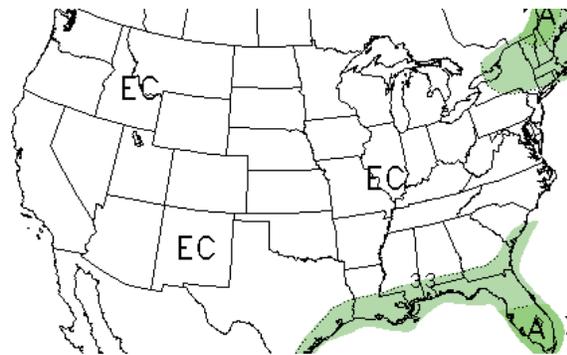
Local research agrees that the fall will probably be, on balance, warmer than average. Precipitation will probably end up being above normal, which is based heavily on the trend and persistence of the pattern we have experienced this fall. As is always the case with precipitation, significant variability from place to place is most likely.

These outlooks are available at

http://www.cpc.ncep.noaa.gov/products/OUTLOOKS_index.shtml



Fall 2008 Temperature Outlook (CPC, NOAA)



Fall 2008 Precipitation Outlook (CPC, NOAA)

North Dakota State Climate Office has links to National Weather Service's local 3-month temperature outlooks into the fall of 2009. Those outlooks can be accessed from the following web site for your 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/>



Hydro-Talk



Is Long Lake Becoming a Salt Lake?

by L. Peterson



On a clear day, satellite pictures are displaying a unique white area in south central North Dakota near Moffit (see the highlighted area in the picture below). This turns out to be an area of Long Lake that is shrinking and leaving a large salt deposit.

The direct sun is reflecting enough of this area to be visible on the satellite pictures.

This picture on the right is from MODIS 250 meter resolution on August 18, 2008.

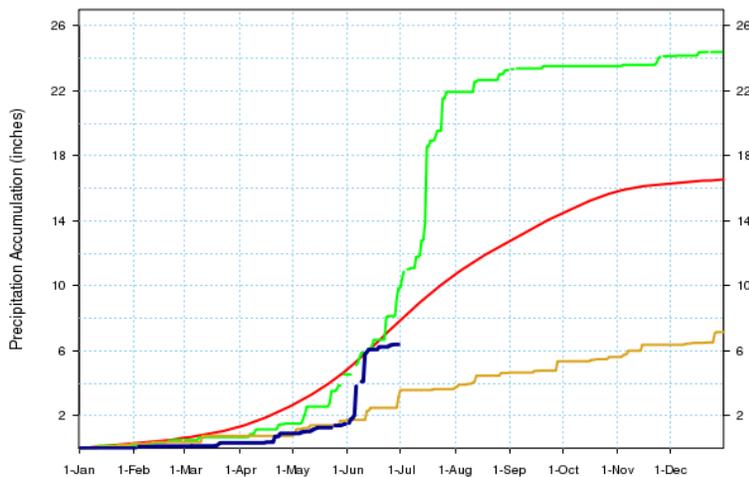
The lake levels at Long Lake, Moffit have been decreasing over the past few years due to a continual drought condition.

During the past 8 years at Moffit there have been 4 very

dry years, 2 near normal and only 2 wet years. The wettest period was 1993 when the annual total precipitation was 24.39 inches (green line in the graph below). The driest year in this period was 1988 when the total annual precipitation was 7.15 inches (tan line in the graph below). The average annual precipitation for this area is 16.53 inches. The total precipitation so far this year, January through July, is 6.39 inches which is 1.32 inches below normal (blue line in the graph below). Temporary relief from the drought conditions may occur with scattered thunderstorms but a long term moisture laden season is needed to bring significant relief.



Precipitation Summary for MOFFIT 3 SE
Jan 1 - Dec 31



Heavy dark blue line is precipitation accumulation for 2008. Smooth red line is normal. Green line is accumulation for wettest period (1993). Tan line is accumulation for driest period (1988). Period of record for wettest and driest: 1943 - 2008.

The state drought conditions as of September 9, 2008 indicate more than 15% of the state is experiencing at least severe drought conditions in the west central North Dakota. Slight improvement is expected through western counties during the next 60 days.

For updated information on the state drought conditions check the following National Drought Mitigation web site:

<http://drought.unl.edu/dm>



Science Bits



How Drought Stress Impacts Corn Development

by J. Ransom¹

Drought has been a serious concern in more than half of the state during the 2008 growing season with nearly a third of the state is under severe drought during part of the year. Corn is one of the most water efficient crops grown in North Dakota. Nevertheless, it has a high water requirement because of its high yield potential and can be significantly impacted by drought. The impact of drought on corn growth and yield varies considerably depending on its timing and severity. Research has shown that there is little impact of drought on corn growth during early vegetative stages. During late vegetative development, however, short periods of drought stress (four days of sufficient stress to cause leaves to curl) during this growth stage can reduce yields by 5-10%. During late vegetative development until just before the silk emergence, kernel numbers per cob are set, so drought stress during this period can impact the size of the cob. Drought stress during tassel emergence has the potential to reduce yields by 10 to 25%. The most sensitive period for drought stress in corn is during the period between silk emergence and the blister stage where yield losses between 40-50% can occur. Corn is most sensitive to drought during this stage because the male and female flowers are separated by a considerable distance and pollen and silks are sensitive to hot and dry conditions. When corn is severely stressed prior to flowering, silk growth is delayed and pollen shed will occur before the silks have emerged, resulting in barrenness. Silks can also dry before they are pollinated resulting in poor fertilization and missing kernels. Abortion of developing kernels is common, particularly towards the tip of the ears, with drought stress during early grain fill. Since the corn plant has the capacity to store considerable reserves in the stem, yield losses when drought stress is delayed until the dough stage usually are in the 20-30% range. These yield losses discussed above can be additive if stress occurs a more than one growth stage. Readers can refer to the Table 1 below to access tabular depiction of the drought impact on corn yield at different growth stages corresponding approximate corn time in Accumulated Growing Degree Units (AGDU).

Table 1. Yield reduction due to drought stress (4 days of accumulative visible wilting) at different growth stages for corn hybrids with 80-95 Relative Maturity (After Classen and Shaw, 1970).

Growth Stage	Approximate AGDU	Potential Yield Reduction
Late Vegetative	600-800	5-10%
Tassel Emergence	900-1000	10-25%
Silk Emergence-Pollen Shedding	950-1150	40-50%
Blister	1500-1700	30-40%
Dough	1800-2000	20-30%

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How is yield affected by late season drought stress?

During the first stage of stress, the upper leaves curl or roll towards the midrib during the hottest part of the day (see the picture on the right). If stress continues, premature leaf death begins at the bottom of the plant and proceeds upward. Leaf death is the first sign of permanent damage to the plant. With severe stress, the upper leaves roll so tightly that they appear like “onion leaves”. With less leaf area capable of photosynthesis, grain filling is slowed even while maturing at an accelerated pace.



Carbohydrates that had been stored in the stem earlier in the season are moved to the developing ear. Not surprisingly, drought stressed crops are more prone to lodging because of poor stalk health. There may be some kernel abortion in the tips of the ears, but for the most part, kernel numbers are not reduced significantly with late season drought. Yield losses will largely be due to reduced kernel size and reduction in test weight. The amount of reduction will be related to the amount of stress prior to harvest.

Reference

Classen, M.M. and Shaw, R.H., 1970. Water Deficit Effects on Corn II-Grain Components. *Agron. J.* 62, pp. 652–655.

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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