

North Dakota Climate Bulletin

Summer 2009

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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 colder and a dryer summer following another cooler and dry summer. Temperature-wise, this summer was the 12th coldest since 1895. Precipitation-wise, it was the 24th driest summer since 1895. Cool temperatures raised some concern among most growers as to necessary heat units may not be accumulated for crops to mature by the end of the growing season this fall. Based on the ND Agricultural Weather Network compared to 30-yr average, 300 to 500 less growing degree units are accumulated across the state for corn by the end of August. The Community Collaborative Rain Hail and Snow Network (CoCoRaHS) currently has 92 observers representing 26 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

June 2009

The State average precipitation was 2.71 inches which is below the 1971-2000 normal of 3.19 inches. June 2009 state average precipitation ranked 31st driest in the last 115 years with a maximum of 7.21 inches in 2005 and a minimum of 1.14 inches 1974.

Daily precipitation was primarily below normal across the State from the 1st through the 13th. On June 6th, measureable snow of up to 3 inches fell in the west. Dickinson had the first measureable June snow since 1951. The second half of June had periodic daily rain events. The National Weather Service (NWS) reported breaking rainfall records at Bismarck on the 15th and 16th, plus Grand Forks on the 26th and 27th. The North Dakota Agricultural Weather Network (NDAWN) total June rainfall ranged from 7.64 inches at Mandan to 0.65 inches at Dazey. The percent of normal June total rainfall was above normal in the southwest, south central, and far northeast corner with a general range of 110% to 300% plus. Areas with below normal precipitation included the northwest corner, north central, and southeast with a general range of 25% to 70%.

The US Drought Monitor July 7, 2009 report classified central, east central, and northwestern North Dakota as “abnormally dry”. The remaining parts of the State had no drought conditions listed.

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 0% very short, 13% short, 74% adequate, and 13% surplus with a subsoil moisture reported as 1% very short, 10% short, 72% adequate, and 17% surplus (Weekly Weather and Crop Bulletin Vol. 96, No. 27)

The NWS record rainfall at Bismarck on the 15th of 3.19 inches, plus the record rainfall on the 16th of 2.60 inches was a record 24 hour maximum rainfall of 5.77 inches. Bismarck June total rainfall of 7.94 inches was the 4th highest on record with the highest record being 9.90 inches in 1914. The NWS recorded record rainfall at Grand Forks airport on the 26th was 1.71 inches and on the 27th was 1.27 inches.

According to the preliminary reports of the National Weather Service’s Storm Prediction Center (SPC), severe weather reports for June had 24 reported high wind events, 51 reports of hail, and 17 reported tornadoes. The SPC severe weather reports for the 18th reported high wind, hail and one tornado in the southeast corner of the State. On the 24th, the western part of the State had several reports of hail and three reported tornados in Stark and Hettinger County. On the 26th the SPC recorded several hail, high wind, and tornadoes stretching from the southwest corner to the northeast corner of the State.

The top five June daily rainfall totals measured from NDAWN were 4.41 inches at Eldred MN on the 26th, 4.35 inches at Robinson on the 15th, 3.93 inches at Mandan on the 15th, 3.63 inches at Oakes on the 16th, and 3.11 inches at Forest River on the 26th.

The top five June daily maximum wind speeds recorded from the North Dakota Agricultural Weather Network (NDAWN) were 74.5 mph on the 30th at Sidney MT, 60.1 mph on the 26th at Mandan, 58.7 mph on the 4th at Langdon, 58.4 mph on the 27th at McHenry, and 54.8 mph on the 26th at Warren MN. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The State average air temperature was 60.6°F which is below the 1971-2000 normal of 63.7°F. June 2009 state average air temperature ranked 26th coolest in the past 115 years with a maximum of 74.2°F in 1988 and a minimum of 56.2 °F in 1915.

Most daily temperatures were below normal across the State from the 1st through the 13th. The NWS reported breaking several low minimum and maximum air temperatures during the first half of June. Fargo set a new June record with five straight days with high temperatures in the 50's. The second half of June had average daily air temperatures hovering near normal. Monthly average air temperatures ranged from the high 50's in the west to the low 60's in the east. June average air temperature departure from normal was below normal across the State. The monthly departure from normal temperatures ranged from roughly -5°F in the southwest to -1°F in the east.

The National Weather Service (NWS) recorded breaking several daily low temperature and low maximum temperature records in the first half of June. Williston tied a record low temperature on the 2nd of 30°F. On the 5th, Grand Forks tied the record low of 34°F and Williston tied the record low of 33°F. On the 6th, a record low maximum temperature was set at Grand Forks airport with 54°F, Williston with 50°F, and Bismarck with 47°F. And again on the 7th a record low maximum temperature was set at Bismarck and tied at Williston with 50°F. Bismarck had a record low temperature of 35°F on the 9th. Grand Forks airport tied the record low temperature of 40°F on the 10th.

NDAWN's highest recorded daily air temperature for June was 95.7°F at Brorson, MT on the 25th. The lowest recorded daily air temperature was 26.0°F at Cavalier on the 6th.

July 2009

The State average precipitation was 2.35 inches which was below the 1971-2000 normal state average of 2.75 inches. July 2009 state average precipitation ranked the 57th driest in the past 115 years with a maximum of 7.88 inches in 1993 and a minimum of 0.62 inches in 1936.

Most of the July precipitation fell in the first half of the month. The North Dakota Agricultural Weather Network (NDAWN) total July rainfall ranged from 4.59 inches at the northwestern Hofflund station to 0.40 inches at the eastern located Galesburg station. The percent of normal July total rainfall was generally above normal in a stretch from the northwest to south central area with a range from roughly 100% to 200%. The north central, southwest corner, and eastern regions had below normal precipitation with the eastern region having the lowest amounts with 50% or less percent of normal precipitation. A major storm event occurred on the 8th in the western part of the State. The National Weather Service (NWS) Storm Prediction Center reported tornadoes on the 8th in Golden Valley, Burke, Billings, Stark, and Renville Counties. A tornado touched down in Dickinson on the evening of the 8th. The tornado was classified an EF3 with winds speeds of 150 mph and a path length of nearly 2 miles long and one tenth of a mile wide. The NWS also recorded record rainfall on the 8th at Dickinson of 0.71 inches which broke the previous record of 0.66 inches set in 2002.

Statewide drought conditions worsened compared to previous months. The US Drought Monitor July 28, 2009 report elevated conditions from abnormally dry to moderate drought in east central portions of the State occupying southwestern Barnes and Nelson Counties, southeastern Eddy, eastern Foster, Northeastern Stutsman, northern Barnes, western Steele and entire Griggs counties. The state was drought free prior to the end of July since February 2009. Currently, agricultural impacts are negligible.

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 2% very short, 28% short, 67% adequate, and 3% surplus with a subsoil moisture reported as 0% very short, 17% short, 76% adequate, and 7% surplus (Weekly Weather and Crop Bulletin Vol. 96, No. 31).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for July had 23 reported high wind events, 30 reports of hail, and 11 reported tornadoes. As mentioned earlier, the SPC reported a major storm with several tornadoes, high winds, and hail passed through western North Dakota on the 8th. The western part of the State had another storm event on the 11th in which the SPC reported high winds at Emmons, Mercer, Mountrail, Divide and McLean Counties, plus hail at Grant, Burke, and Stark Counties, including one tornado that briefly touched down in Stark County. On the 19th, the SPC reported hail in McLean, Pierce, McHenry, Benson, Towner, Cavalier, Cass, Trail, and Dunn Counties.

The top five July daily rainfall totals measured from North Dakota Agricultural Weather Network (NDAWN) were Wahpeton with 2.50 inches on the 14th, Dunn with 2.02 inches on the 8th, Dickinson with 1.79 inches on the 8th, Hofflund with 1.79 inches on the 8th and Watford City with 1.68 inches on the 7th.

The top five July daily maximum wind speeds recorded from NDAWN were Leonard with 54.1 mph on the 20th, Rolla with 50.1 mph on the 9th, Dickinson with 48.7 mph on the 8th, Britton SD and Linton both with 48.0 mph and both on the 14th. NDAWN wind speeds are measured at a height of 10 feet (3 m) versus the NWS which measure wind speed at a height of 33 ft (10 m).

The State average air temperature was 64.3°F which is below the 1971-2000 normal of 68.7°F. July 2009 state average air temperature ranked 5th coolest in the past 115 years with a maximum of 79.7°F in 1936 and a minimum of 61.8°F in 1992.

July's cooler than normal temperatures slowed the maturity of grains and the development of row crops. The departure from normal monthly average air temperatures were below normal across the state and ranged from roughly 3 to 6 degrees below normal. The average monthly air temperatures recorded from NDAWN ranged from 62°F to 68°F with the cooler temperatures in the north and warmest temperatures in the southeast corner and central western edge. The NWS reported breaking the low maximum daily temperature at the Grand Forks Airport with 69°F on the 16th. The NWS also recorded a record low daily temperature at Williston of 42°F on the 17th. The monthly average air temperature for July at Bismarck was 66.9°F which ranked the 11th coolest of records going back to 1875. Similarly, the monthly average air temperature for July at Fargo was 66.5°F which ranked 12th coolest of records going back to 1881.

The National Weather Service (NWS) reported breaking the low maximum temperature record at Grand Forks Airport on the 15th with 67°F and the 16th with 69°F. The NWS reported breaking the record low temperature at Williston on the 17th with 42°F.

NDAWN's highest recorded daily air temperature for July was 96.3°F at Sidney, MT on the 25th. The lowest recorded daily air temperature was 36.0°F at Bottineau on the 11th.

August 2009

The State average precipitation was 1.65 inches which is below the 1971-2000 normal state average of 2.10 inches. August 2009 state average precipitation ranked the 38th driest in the past 115 years with a maximum of 5.02 inches in 1900 and a minimum of 0.72 inches in 1961.

In general, August was a cool, dry and uneventful month. In North Dakota, the majority of the rain fell from the 6th through the 9th, the 14th through the 16th, the 19th to the 20th, and finally on the 24th. The North Dakota Agricultural Weather Network (NDAWN) total August rainfall ranged from 4.93 inches at Perley MN to 0.26 inches at Hazen. The majority of the State had below normal precipitation with the central region receiving less than 50% of normal. The driest regions had less than 25% of normal precipitation and included parts of McLean, Oliver, Morton, Burleigh, and Sheridan Counties. The areas of the State that received above normal precipitation included the northwest and southeast corners with primarily 130 to 200% of normal.

The National Weather Service (NWS) reported breaking one precipitation record on August 15th at Jamestown with a record rainfall of 0.7 inches. The 0.7 inches broke the previous record of 0.47 inches set in 1977.

The US Drought Monitor updated on September 1 reported a strip of abnormally dry conditions from the north central region extending to the southeast corner. Abnormally dry conditions were also reported in the far northwest and a small area in the southwest. An area of moderate drought conditions was reported in parts of Nelson, Eddy, Foster, Griggs, Steele, Stutsman, and Barnes Counties.

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 2% very short, 28% short, 68% adequate, and 2% surplus with a subsoil moisture reported as 1% very short, 24% short, 72% adequate, and 3% surplus (Weekly Weather and Crop Bulletin Vol. 96, No. 35).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for August had 10 reported high wind events, 16 reports of hail, and 0 reported tornadoes. The SPC had reports of hail on the 13th in McKenzie, Mountrail, Wells and McHenry Counties, plus high winds reported in Sheridan, Wells, and Pierce Counties. On the 14th, SPC reported hail in Wells, Benson, Ramsey, and Grand Forks Counties, plus high winds in Wells, Dickey, and Sargent Counties. On the 23rd, SPC had reports of hail in Williams, Mountrail, and Towner Counties, plus high winds reported in McKenzie and Mountrail.

The top five August daily rainfall totals measured from North Dakota Agricultural Weather Network (NDAWN) were Perley MN on the 16th with 2.23 inches, Greenbush MN on the 15th with 2.19 inches, Britton SD on the 7th with 2.12 inches, Wahpeton on the 16th with 1.73 inches, and Lisbon on the 8th with 1.60 inches.

The top five August daily maximum wind speeds recorded from NDAWN were Watford City on the 24th with 50.8 mph, Beach on the 14th with 49.3 mph, Bowman on the 24th with 48.0 mph, Beach on the 19th with 45.8 mph, and Watford City on the 14th with 45.8 mph. NDAWN wind

speeds are measured at a height of 10 feet (3 m) versus the NWS which measure wind speed at a height of 33 ft (10 m).

The State average air temperature was 64.6°F which is below the 1971-2000 normal of 67.2°F. August 2009 state average air temperature ranked the 32nd coolest in the past 115 years with a maximum of 73.6°F in 1983 and a minimum of 60.9°F in 1977.

Throughout the month of August, most of the daily average air temperatures were below normal or near normal. The daily average air temperatures were above normal around the 11th through the 14th. Below normal monthly average air temperatures continued across the State. 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. In 2009, February through August had below normal monthly air temperatures across the State. The August departures generally ranged from 1°F to 4°F below normal. The northeast corner of the state had between 1 and 2°F below normal. The northwest, central, and southeast were 2 to 3°F below normal. The southwest was 3 to 4°F below normal. The average air temperatures ranged from 62°F in the north and 67°F in the southern part of the State.

The National Weather Service (NWS) reported breaking the record low temperatures at Dickinson on the 4th with 41°F, at Williston on the 4th with 40°F, and at Grand Forks Airport (AP) on the 30th with 38°F. A record high temperature was set at Minot on the 12th with 100°F. A record high minimum temperature was set on the 15th at Grand Forks AP with 68°F. A record low maximum temperature was set on the 17th at Grand Forks with 65°F.

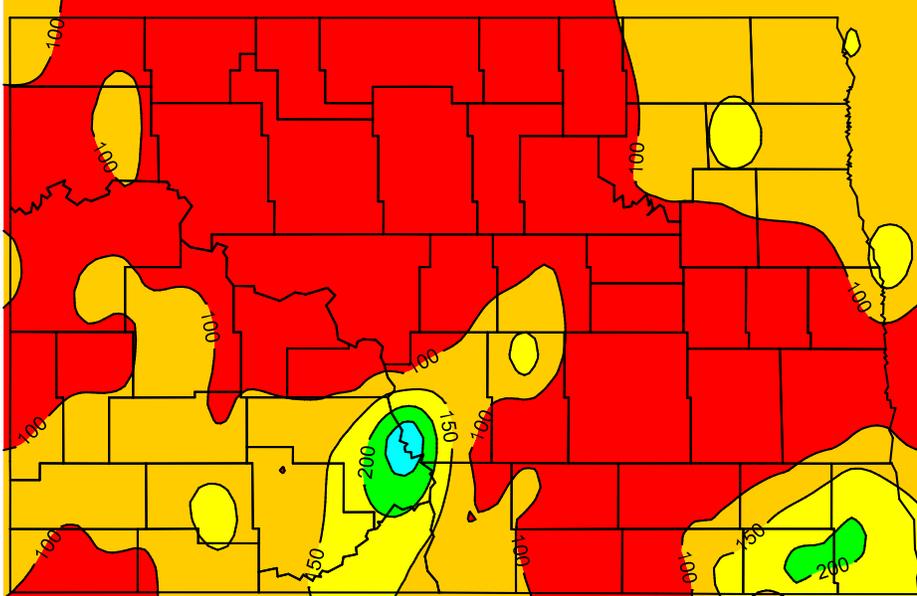
NDAWN's highest recorded daily air temperature for August was 103.4°F at Cavalier on the 12th. The lowest recorded daily air temperature was 33.9°F on the 30th at Roseau MN.

Summer 2009 Weather in North Dakota:

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

(Data from NWS Cooperative Network)



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

Departure From Normal Monthly

Average Air Temperature in degrees F

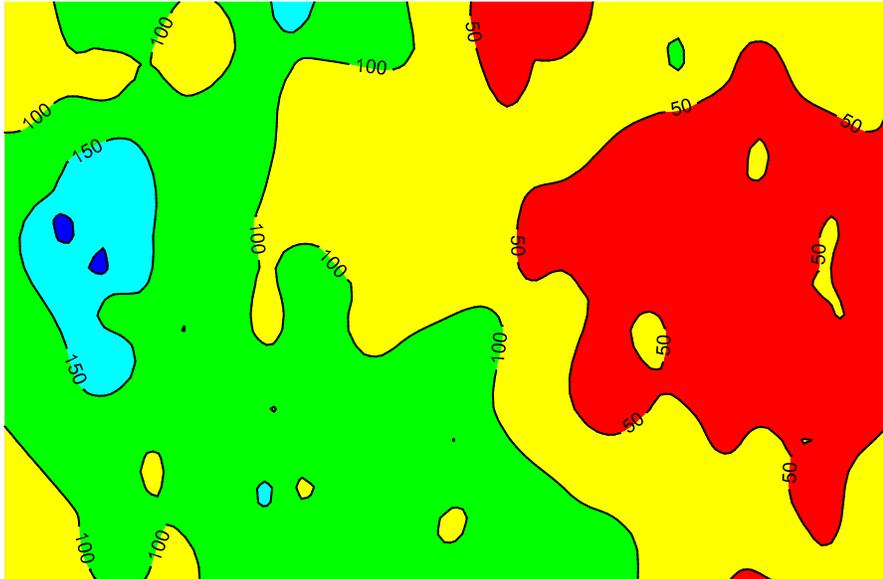
(Data from North Dakota Agricultural Weather Network (NDAWN))

Summer 2009 Weather in North Dakota:

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

(Data from NWS Cooperative Network)



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

Departure From Normal Monthly

Average Air Temperature in degrees F

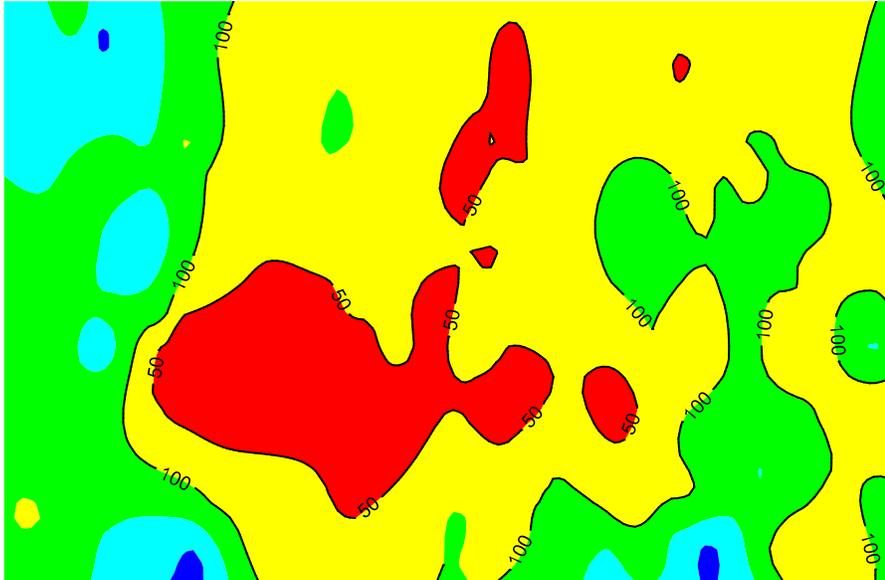
(Data from North Dakota Agricultural Weather Network (NDAWN))

Summer 2009 Weather in North Dakota:

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

(Data from NWS Cooperative Network)



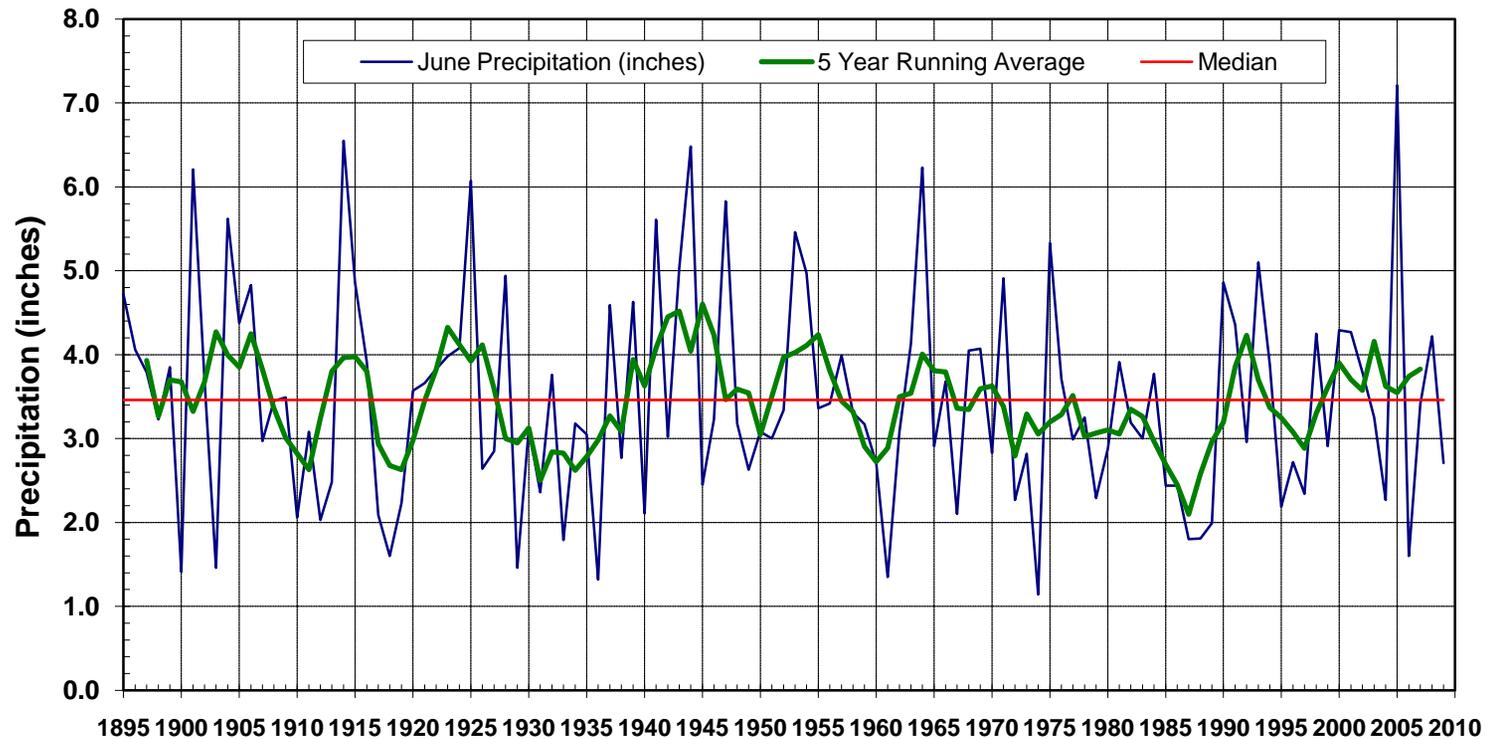
Average Temperature (°F) Deviation from Mean (1971-2000)

Departure From Normal Monthly

Average Air Temperature in degrees F

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

Historical June Precipitation for North Dakota

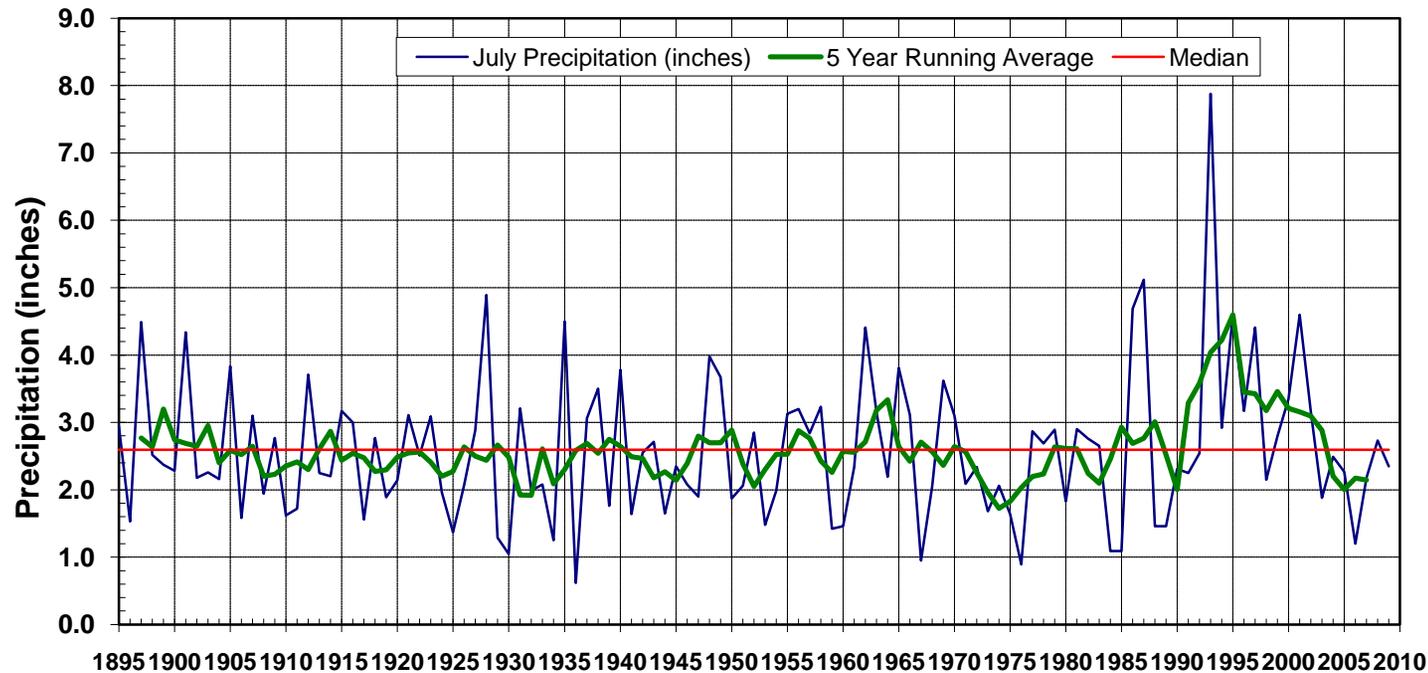


June Precipitation Statistics

2009 Amount: **2.71 inches**
Maximum: 7.21 inches in 2005
State Normal: 3.19" (1971-2000)

Monthly Ranking: 31st Driest in 115 years
Minimum: 1.14 inches in 1974
Years in Record: 115

Historical July Precipitation for North Dakota

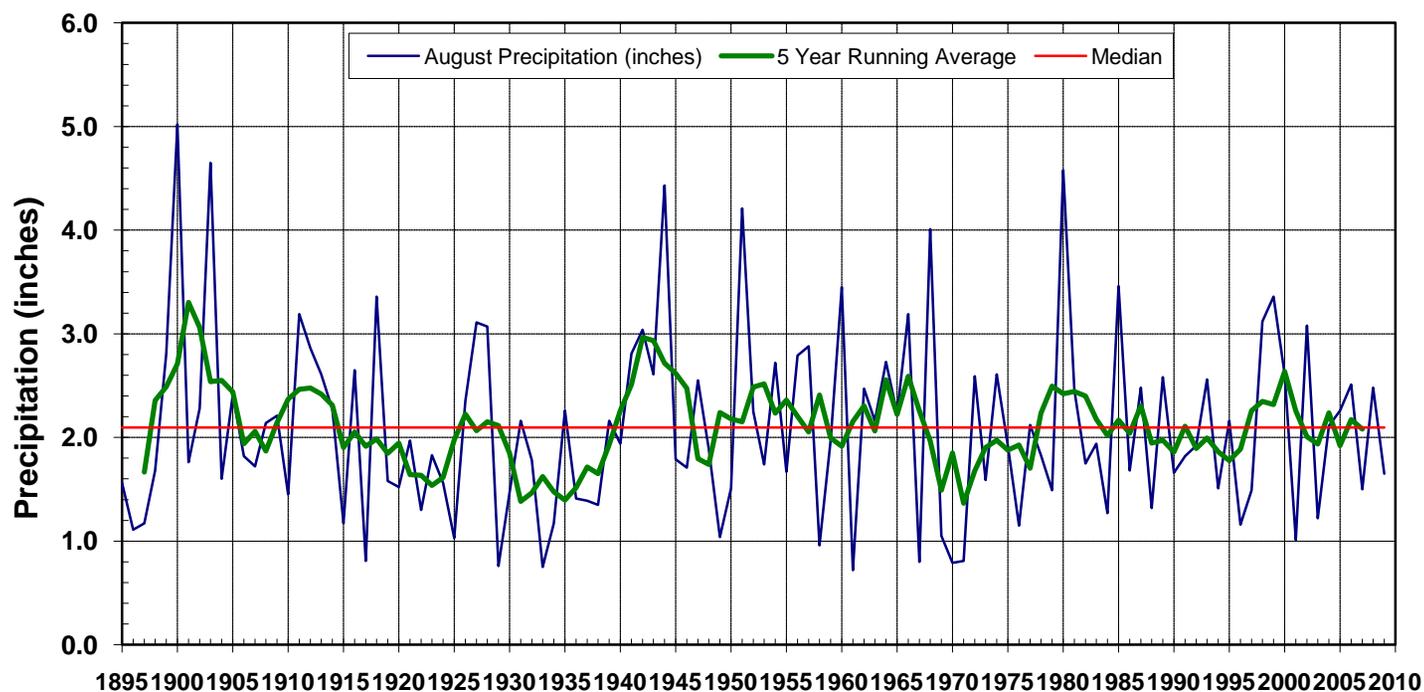


July Precipitation Statistics

2009 Amount: 2.35 inches
Maximum: 7.88 inches in 1993
State Normal: 2.75" (1971-2000)

Monthly Ranking: 57th Driest in 115 years
Minimum: 0.62 inches in 1936
Years in Record: 115

Historical August Precipitation for North Dakota

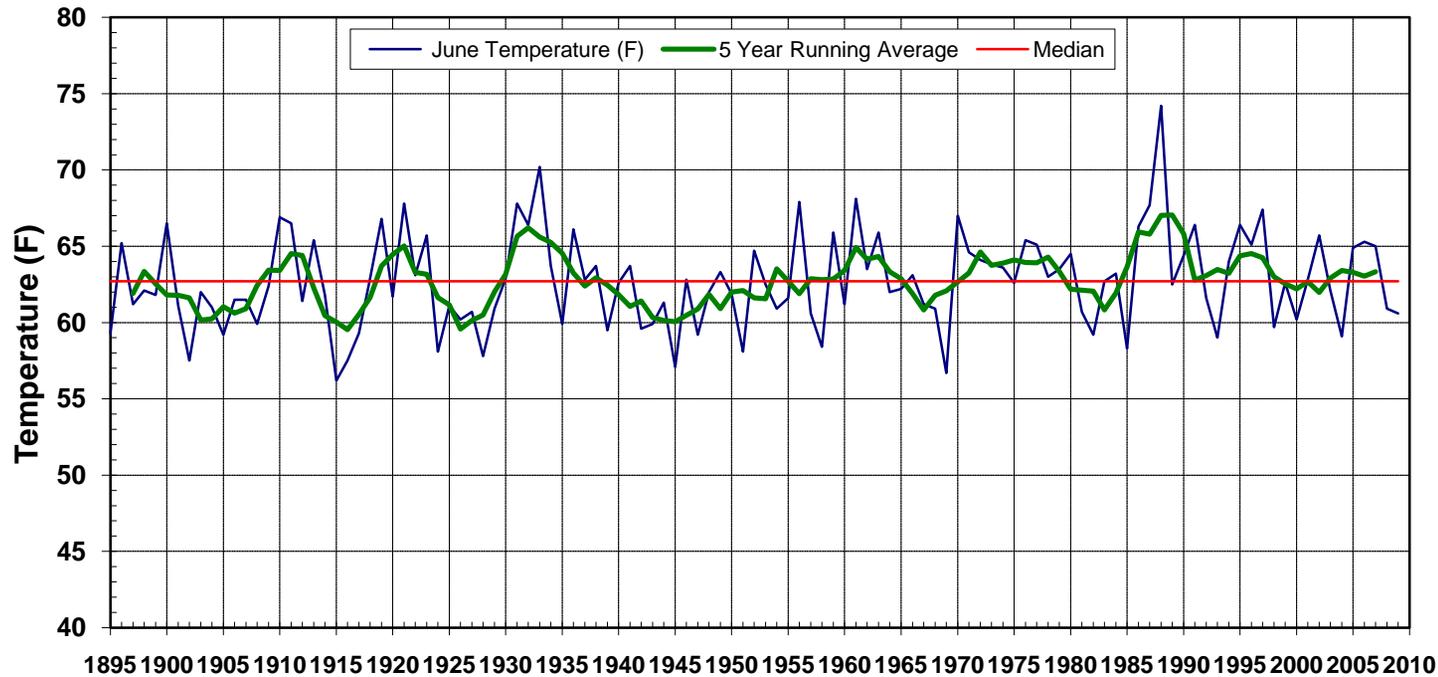


August Precipitation Statistics

2009 Amount: 1.65 **inches**
Maximum: 5.02 inches in 1900
State Normal: 2.10" (1971-2000)

Monthly Ranking: 38th Driest in 115 years
Minimum: 0.72 inches in 1961
Years in Record: 115

Historical June Temperature for North Dakota

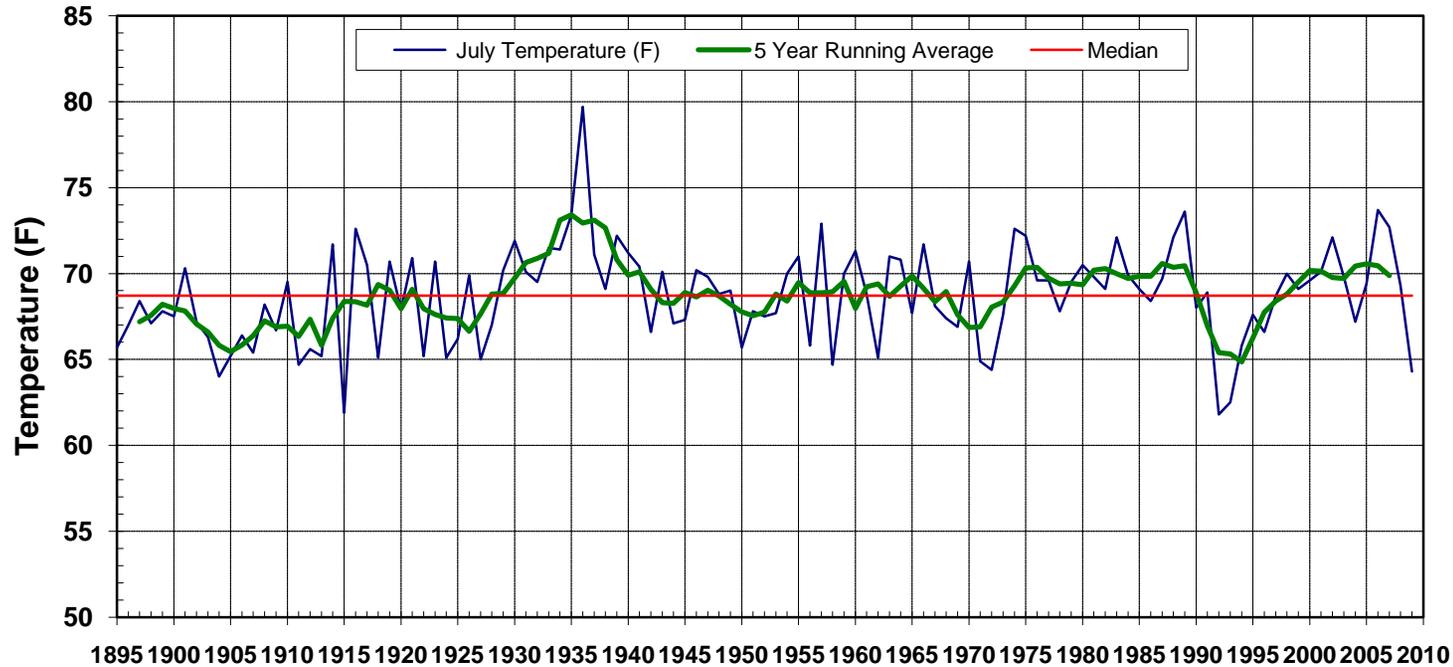


June Temperature Statistics

2009 Average: **60.6°F**
Maximum: 74.2°F in 1988
State Normal: 63.7°F (1971-2000)

Monthly Ranking: 26th Coolest in 115 years
Minimum: 56.2° F in 1915
Years in Record: 115

Historical July Temperature for North Dakota



July Temperature Statistics

2009 Average: 64.3°F

Maximum: 79.7°F in 1936

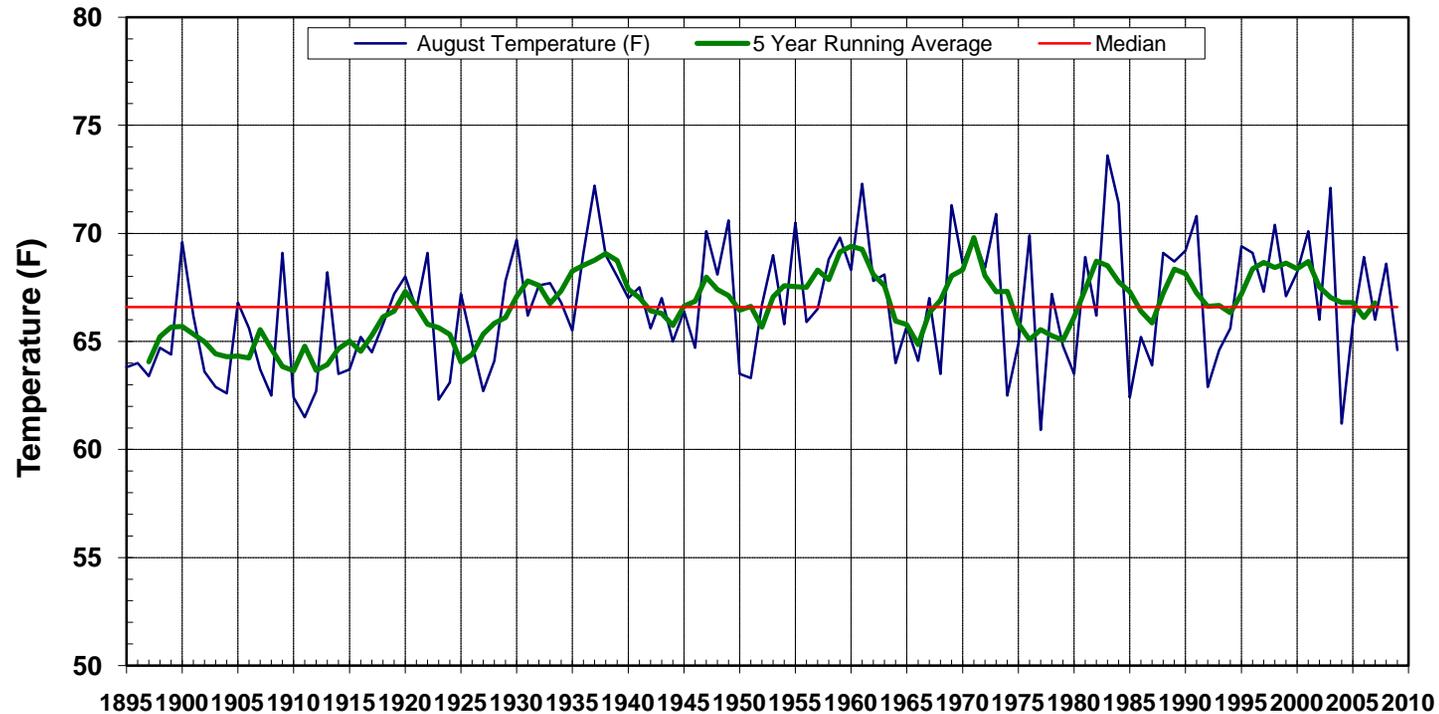
State Normal: 68.7°F (1971-2000)

Monthly Ranking: 5th Coolest in 115 years

Minimum: 61.8°F in 1992

Years in Record: 115

Historical August Temperature for North Dakota



August Temperature Statistics

2009 Average: **64.6°F**
Maximum: 73.6°F in 1983
State Normal: 67.2°F (1971-2000)

Monthly Ranking: 32nd Coolest in 115 years
Minimum: 60.9°F in 1977
Years in Record: 115



Storms & Record Events



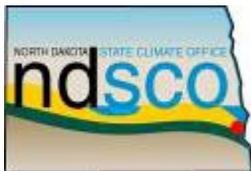
State Tornado, Hail, and Wind Reports for Summer 2009 by B. A. Mullins

North Dakota 3 Month Total	Wind	Hail	Tornado
	57	97	28

Reports by Month			
Month	Wind	Hail	Tornado
Total June	24	51	17
Total July	23	30	11
Total August	10	16	0

North Dakota Record Event Reports for Summer 2009

Date	Location	Type of Record	Previous Record
06/02/09	Williston	Low temperature of 30°F	Ties record in 2000
06/05/09	Grand Forks	Low temperature of 34°F	Ties record in 1945
06/05/09	Williston	Low temperature of 33°F	Ties record in 1907
06/06/09	Grand Forks AP	Low maximum temperature of 54°F	57°F set in 1992
06/06/09	Williston	Low maximum temperature of 50°F	Ties record in 1916
06/06/09	Bismarck	Low maximum temperature of 47°F	50°F set in 1915
06/07/09	Bismarck	Low maximum temperature of 50°F	52°F set in 1945
06/07/09	Williston	Low maximum temperature of 50°F	Ties record in 1924
06/09/09	Bismarck	Low temperature of 35°F	Ties record in 1877
06/10/09	Grand Forks AP	Low temperature of 40°F	Ties record in 1969, 1952, and 1947
06/15/09	Bismarck	Rainfall of 3.19 inches	3.07 inches set in 1953
06/16/09	Bismarck	Rainfall of 2.60 inches	1.42 inches set in 1934
06/15-16/09	Bismarck	24 hour rainfall of 5.77 inches	5.27 inches set on July 15-16 in 1993
06/26/09	Grand Forks AP	Rainfall of 1.71 inches	1.14 inches set in 1965
06/27/09	Grand Forks AP	Rainfall of 1.27 inches	1.20 inches set in 1914
07/08/09	Dickinson	Rainfall of 0.71 inches	0.66 inches set in 2002
07/15/09	Grand Forks AP	Low maximum temperature of 67°F	Ties record in 1962
07/16/09	Grand Forks AP	Low maximum temperature of 69°F	70°F set in 1998
07/17/09	Williston	Low temperature of 42°F	44°F set in 1907
08/04/09	Dickinson	Low temperature of 41°F	Ties record in 1974
08/04/09	Williston	Low temperature of 40°F	42°F set in 1978
08/12/09	Minot	High temperature of 100°F.	Ties record in 1978.
08/15/09	Jamestown	Rainfall of 0.70 inches.	0.47 inches set in 1977.
08/15/09	Grand Forks AP	High minimum temperature of 68°F.	66°F set in 2003.
08/17/09	Grand Forks AP	Low maximum temperature of 65°F.	66°F set in 2002, 1980, 1975, 1956, 1950.
08/30/09	Grand Forks AP	Low temperature of 38°F.	Ties record in 1982.



Seasonal Outlook



Fall Climate Outlooks

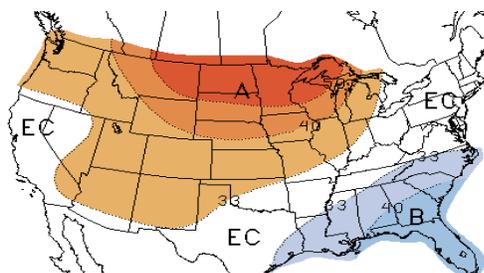
by M. Ewens¹

After an unusually cold and relatively dry summer, indeed a nearly 9 month string of below normal weather, area residents are looking for a change in the overall pattern. Based on conditions developing in the equatorial Pacific, the northern plains may well get that much needed break. An El Niño developed this summer, and is forecast to remain in place during the upcoming winter season.

El Niño, like its cousin La Niña, represents a change in the water temperatures across the Pacific Ocean from the Ecuador coast to the Australian and New Guinea areas in the west Pacific. During an El Niño the waters across the Pacific Ocean from the west coast of South America into the western Pacific are warmer than normal. This abnormally high temperature usually develops in the summer and lasts much of the following year. The opposite is true during La Niña events.

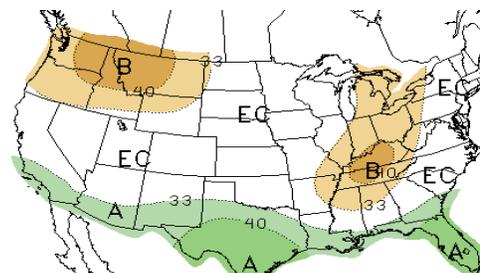
The past two winters have been dominated by a persistent La Niña, which has resulted in colder and snowier than normal weather across a large part of North America. The switch to El Niño all but guarantees the upcoming winter will be warmer than normal. Typically, the warmest weather occurs during the December and January time frame, with February often turning towards normal weather conditions. Snowfall is close to, or a little below average, in most El Niño winters.

At this time, the Climate Prediction Center (CPC) is expecting the winter months of December 2009 through February 2010 to, on balance, have warmer than normal temperatures over the three month period. Despite the overall warmth expected this winter, brief cold snaps are likely, but they should not be very severe or last for more than a few days. Normal winter precipitation is 40 to 50 inches across the region in a 'normal' winter.



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

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



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

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



Hydro-Talk



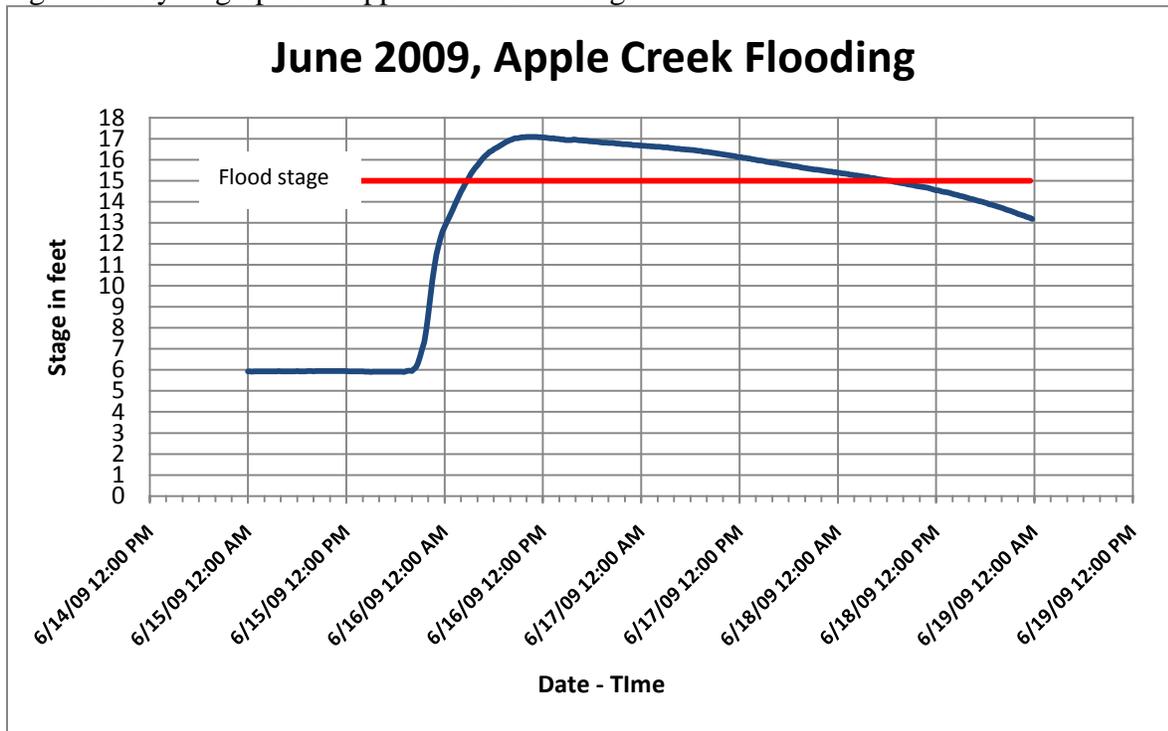
Summer 2009...the quiet time

by A. Schlag²

After such a busy spring, most river watchers were hoping for a bit more of a calm summer season. We almost got it too. Well, except for the near perpetual high water on the James River created by releases from Jamestown and Pipestem dams and there was of course also the Williston gage on the Missouri River which remained above flood stage until July 12th. One should also include the near permanent nature of flooding as Devils Lake reclaims its old shoreline, but none of these were surprises nor were they particularly threatening. The damage from the James River had already been done, there were no reported damages associated near Williston despite an eventual crest of 22.09 ft, or 2.09 ft above flood stage and Devils Lake is a very slow moving train wreck.

A nearly stationary thunderstorm on June 15th that dropped seven to ten inches of rain in the upper Apple Creek watershed east of Bismarck. Some media outlets even reported amounts over 12 inches! This storm system created a flash flooding on a large scale. Figure 1 below shows the hydrograph for the Menoken gage on Apple Creek where the very rapid rise at the gage site truly reflects flash flooding.

Figure 1. Hydrograph for Apple Creek Flooding.



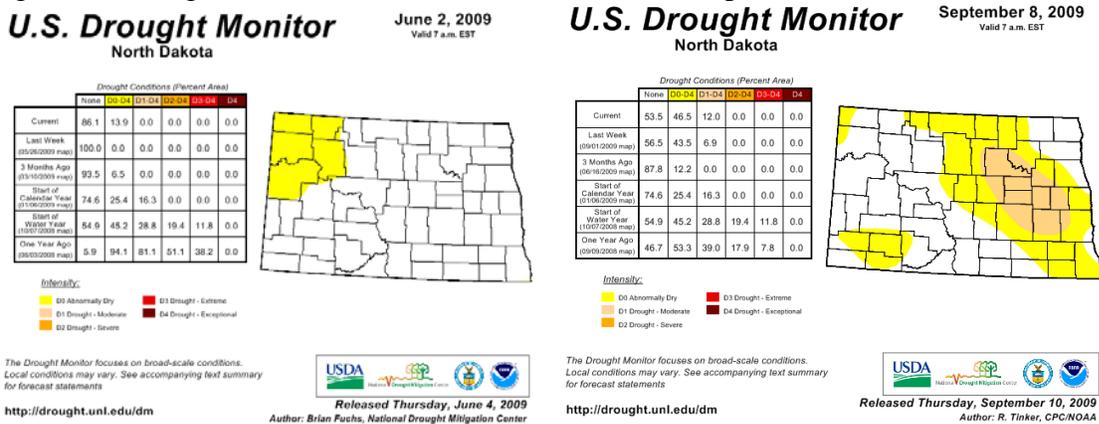
The pre-storm stage of just under six feet rapidly rose in just a few hours to reach flood stage and within 12 hours water had reached 17 ft. This rivaled the flood event of this spring and if the preliminary data hold, this will be the highest water mark for a non-spring runoff event on Apple

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Creek since stage records have been kept in October of 2000 and likely fall within the top 5 or 6 discharge peaks of all time which date back to March of 1905. Regrettably there were a number of homes again flooded that were already in various stages of repair after the 2009 spring flooding.

The current status of North Dakota's lakes and rivers are generally pretty good with most sites at or slightly above seasonal norms. Similarly, most reservoirs are in generally good shape with water held in storage and the James River basin dams are once again back into normal operating levels after having spent the majority of the summer evacuating their flood storage pools. This doesn't mean though that there aren't some areas which couldn't have used a little more precipitation over the summer. Figure 2 reflects the drought status of North Dakota on June 2nd and September 8th of 2009, respectively.

Figure 2. Drought status for North Dakota in June and September, 2009.



As seen in figure 2, very little of the state was classified as abnormally dry at the beginning of the summer and this pattern migrated eastward and became more severe as summer progressed. One should note though that this is generally an improvement over the past few years and there were some areas which received substantial precipitation. For example, Bismarck had received 18.72 inches of precipitation through August and that puts it well ahead of its annual average of 16.84 inches of precipitation.

This has also been a very cool summer with Bismarck recording an average temperature of 66.9 degrees Fahrenheit, about 3.5 degrees below normal. This also has an effect on the hydrologic conditions as the cooler temperatures lower the potential evapotranspiration rates and preserves moisture in the lakes as well as in the soil.

Looking ahead towards what the upcoming fall and winter will bring us is clearly something that has everyone's attention after last winter. Analysis of historical data for the El Nino Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO) suggests that while September and October should be slightly cooler than normal, the upcoming winter months will be normal to slightly warmer in average temperatures and normal to dryer with respect to precipitation. Well, at least that's what the historical data show but I for one believe it is wise to always be prepared for the statistical outlier when it comes to the weather and hydrologic conditions!

The Bismarck National Weather Service Forecast Office: www.weather.gov/bis
 The Grand Forks National Weather Service Forecast Office: www.weather.gov/fgf



Science Bits



Prospects for Late Maturing Corn by J.K. Ransom³

As we all know too well, 2009 has been a cool summer and the crops in North Dakota show it. The small grains responded favorably to the weather and have produced record yields in most of the state. Corn on the other hand still has a long way to go, and is way behind schedule, even with the above average temperatures we were blessed with this past week. Based on the USDA-NASS report for the week ending September 13th, the corn crop in ND was only 23% dented compared to 70% for the average of 2004-2008. Perhaps of an even greater concern, however, is that the corn crop is substantially behind last year when 52% of the corn crop was dented. Most everyone can remember vividly the state of the corn crop at harvest last year!

The intent of this article is to provide some background about corn development and field dry-down so that we might have a better perspective of how the corn crop might finish this year. Of course any prediction is dependent upon weather and predicting weather is not my strength. Nevertheless, past weather data can provide us a glimpse of what may be in store this fall.

Where are we at now with corn development?

We are currently running about 200-250 growing degree days (GDDs) behind normal and about 75-150 GDDs behind last year. At this time of the year that probably translates into about 10-15 calendar days behind normal. As of September 13th, assuming a 1 May planting date, we had accumulated 1977 GDDs in Fargo and only 1699 in Carrington. Based on the approximate GDD requirement from planting to black layer (see Table 1), in Fargo we need an additional 288 and 323 GDDs for 86 and 93 RM hybrids, respectively. Assuming an October 1st killing frost, it looks unlikely that a full season hybrid will be able to reach physiological maturity (or black layer) this year. The scenario is much more disconcerting when we calculate the GDDs needs in Carrington. Table 2 summarizes the approximate number of calendar days required for corn in different stages to reach maturity. Though these data were developed using long season hybrids (i.e. 105 RM) in the Corn Belt, they probably still apply to our hybrids in ND as our weather is substantially cooler in the fall than Iowa and Illinois, slowing down the process. Our own research last year found that it took 66 days for an 85 day hybrid to reach maturity from silking. It might be interesting for you to add 66 days to your silking date this year to see how close this year will be to last year for reaching maturity (30% moisture).

Table 1. Approximate GDD requirements of corn hybrids of differing maturities to reach key growth stages.

RM of Hybrid	GDD to pollination	GDD to black layer	GDD pollination to black layer
79	1095	2040	945
86	1175	2265	1090
91	1200	2300	1100
95	1245	2410	1165

Table 2. Approximate number of calendar days for corn in different stages to reach maturity (Adapted from the National Corn Handbook, 1986).

Stage	Calendar days to maturity
Silk	55-65
Blister	52
Late milk/ Early dough	39
Early dent	25
Fully dented	12

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What kind of losses might we anticipate this year?

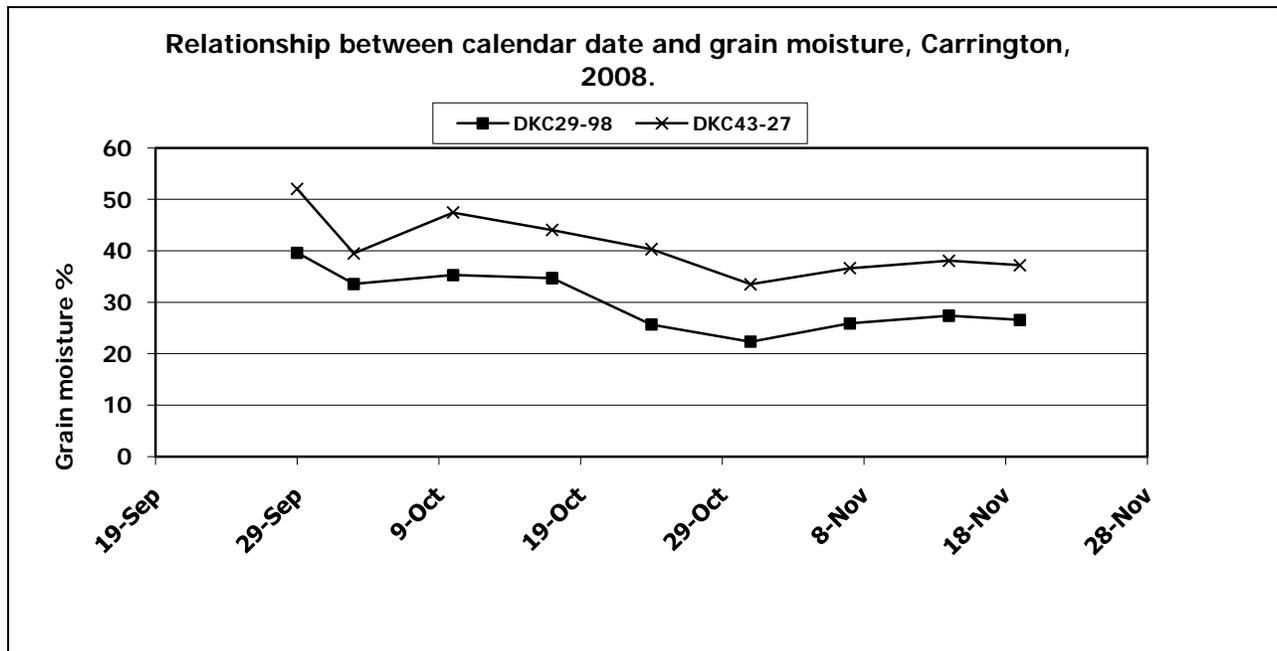
First of all, the cool summer weather does not necessarily mean that we will have poor yields. In fact, we had record corn yields last year, even though the season was unusually cool. Generally the corn crop looks good this year, so there is reason to believe that we could have another high yield crop. The unknown is how soon the season will end. Table 3 describes the type of yield loss that can be expected from a killing frost occurring at various stages before maturity. Obviously, the closer we get to maturity the less the loss and the greater the test weight. Late dent seems to be a threshold where the losses will not be excessive and where test weight approach the level that the grain will not be discounted.

Table 3. Effect of time of killing frost on yield and test weight of corn (adapted from Hicks, 2004).

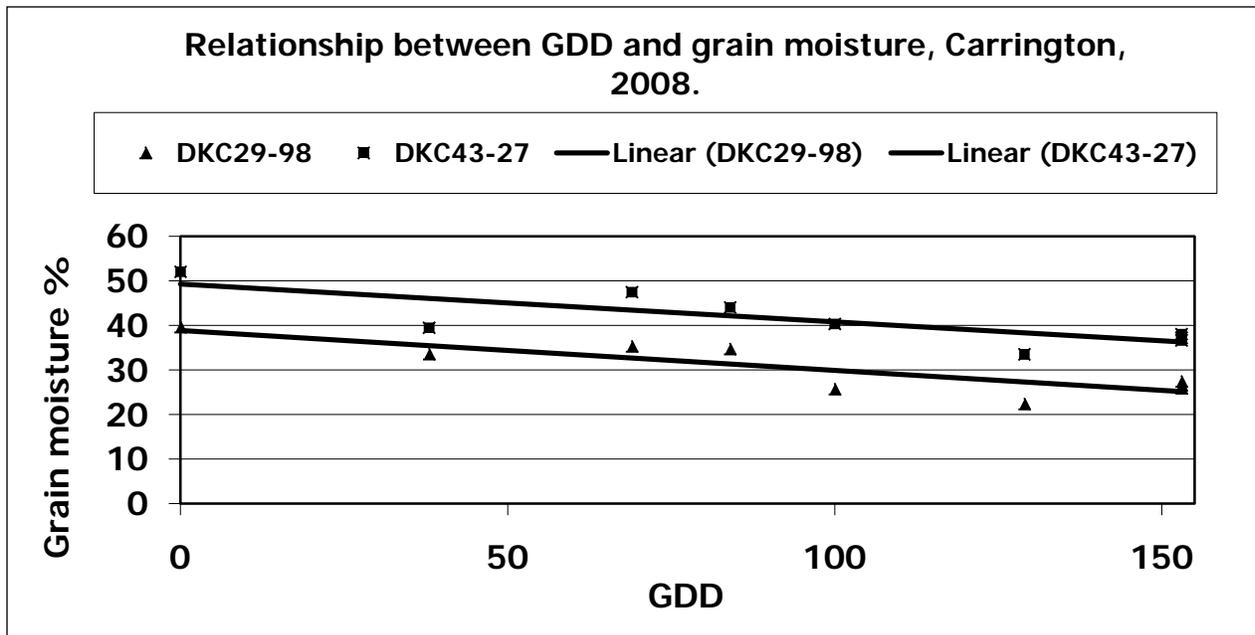
Stage	Yield Loss (%)	Test Weight (lbs/bu)
Soft dough	55	35-40
Early Dent	32	47
Dent	27	50
Late Dent	15	53
Half Milk Line	8	55

What about in field dry down?

Reaching maturity is only half of the story. The other half is that the grain must dry sufficiently to allow for harvest and to minimize drying costs. The rate of field dry down is largely regulated by temperature, the moisture content of the kernel (drier kernels have a slower rate of dry down than wet ones) and to a lesser extent relative humidity. Typically, because of cool temperatures, the rate of drying is exceeding slow after the third week of October. So in reality, our hope is that the grain will reach black layer (~30%) and dry to 20% or less before the first of November. We have been measuring the rate of dry down for the past two years (see Figure 1 for data from Carrington). Last year we found a loss of about 0.25% moisture per day for the period September 29th to November 20th. The decline in moisture loss is notable after the end of October because cool weather and a few rainfall events.

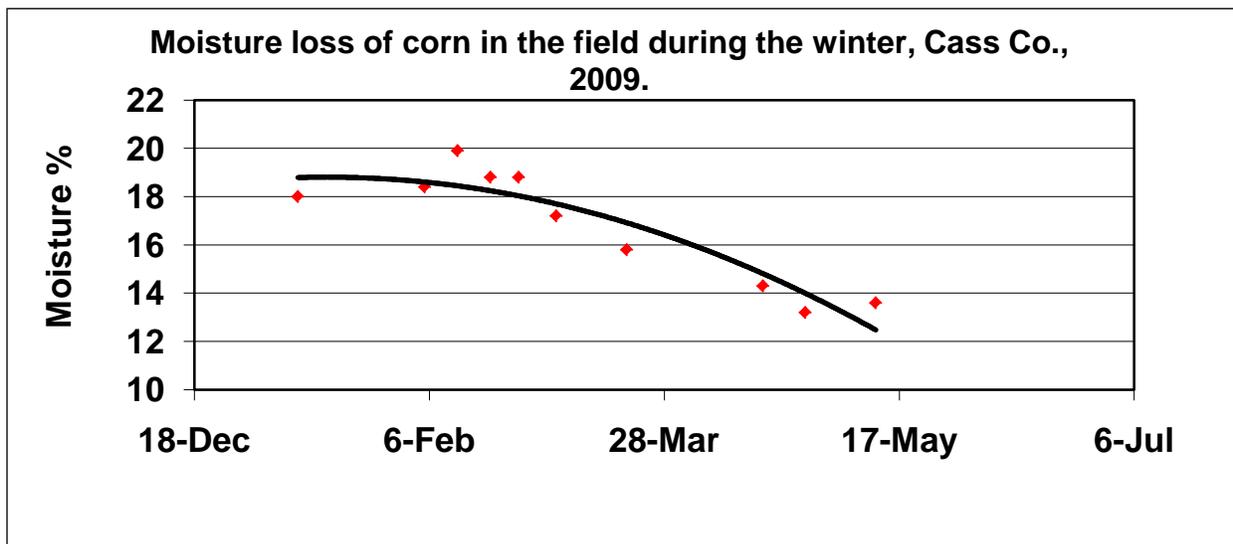


The relationship between GDDs and dry down is more predictive than the relationship between calendar days and dry down. Last year, we found that 1% moisture loss required 11 GDDs (Figure 2). We also found that GDD accumulations more or less ceased by the end of October last year, reinforcing the notion that most of in-field drying is finished in the fall by the beginning of November.



What about letting corn dry over the winter?

As many farmers learned this past year, leaving corn over the winter in the field can be a viable option. Even with all of the snow we received, most reports indicated that corn dried down to very manageable levels and that field losses were tolerable. I think that field losses were tempered last year because we went into the winter with very good stalk strength. We had minimal stress to deplete stalk reserves prior to the killing frost. We will probably have good stalk strength again this fall since we have not seen significant stress in most fields; rains have been timely and temperatures moderate. We collected data on field dry down during the winter last year in one field in Cass County (Figure 3). As you can note, most of the serious drying occurred after the third week of February when temperatures started to warm, and were at about 16% moisture by mid-March.



Conclusion

As you can note in the above paragraphs, I am reluctant to predict how the corn crop will end this year. Obviously the crop is late and the likelihood of a frost before maturity is quite high. I think we have a reasonable chance of escaping huge yield losses, however, if we are able to move into October without a killing frost. The crop may even dry enough for some serious harvesting in early November if October and November weather is not abnormally cold.

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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