North Dakota Climate Bulletin

Summer 2011

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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 summer following a cooler and wetter spring. Temperature-wise, this summer was the 39th warmest since 1895. Precipitation-wise, it was the 9th wettest summer since 1895. Although it is preliminary, 51 tornadoes hit North Dakota mostly in July. There were also 147 hail incidents and 177 excessive wind reports during this summer. CoCoRaHS network expanded into 33 counties with 169 volunteer observers.

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

Photo by Akyüz

Weather Highlights

Seasonal Summary:

by B. A. Mullins

June 2011

The state average precipitation was 4.51 inches which is above the 1971-2000 normal of 3.19 inches. June 2011 state average precipitation ranked 23rd wettest in the last 117 years with a maximum of 7.21 inches in 2005 and a minimum of 1.14 inches in 1974.

Percent of normal precipitation ranged from approximately 40% to 250%. The northwest, eastern, and southwestern corner had above normal precipitation and below normal elsewhere. The North Dakota Agricultural Weather Network (NDAWN) June rainfall totals ranged from 1.07 inches at Brorson, MT to 6.89 inches at Streeter. The first half of the month was relatively dry and warm. During the second half of the month there was a significant rain event somplace in North Dakota almost daily. Major unprecidented flooding occurred along the Souris (Mouse) river. Heavy rains in western North Dakota and neighboring Canada contributed to the flooding. Towns along the Souris river including Minot, Burlington, Sawyer, and Velva were affected. Minot being the 4th largest city in North Dakota evacuted a fourth of it's population. An estimated 11,000 people were evacuated in less than 24 hours. Many homes and business were damaged or lost. At Minot the river crested on the 25th at 1561.72 feet breaking the previous record set in 1881 of 1558 feet.

The National Weather Service (NWS) reported record rainfall on the 12th at Dickinson with 1.65 inches, on the 14th at Jamestown with 1.72 inches, on the 21st at Fargo with 1.81 inches, and on the 26th at Jamestown with 2.32 inches.

The US Drought Monitor July 12, 2011 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, 4% short, 62% adequate, and 34% surplus with a subsoil moisture reported as 0% very short, 1% short, 60% adequate, and 39% surplus (Weekly Weather and Crop Bulletin Vol. 98, No. 28).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for June had 24 reports of high wind, 27 hail reports, and 9 reported tornadoes. The majority of the events were reported on the 2nd, 12th, and 24th.

The top five June daily maximum wind speeds recorded from NDAWN were 74.5 mph at Linton on the 2nd, 61.6 mph at Tappen on the 3rd, 60.9 mph at McHenry on the 3rd, 56.2 mph at Streeter on the 3rd, and 54.1 mph at Jamestown on the 3rd. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The state average air temperature was 62.0 °F which is below the 1971-2000 normal of 63.73 °F. June 2011 state average air temperature ranked 50th coolest in the past 117 years with a maximum of 74.2 °F in 1988 and a minimum of 56.2 °F in 1915.

NDAWN June average air temperatures ranged from 60 °F to 66 °F. NDAWN departure from normal temperatures ranged from 1 °F to -2 °F. The beginning of the month had a few very warm days with above normal temperatures. The 7th through the 11th were cool and below normal for most locations. The rest of the month had fairly steady near normal temperatures. The last couple days of the month were hot with temperatures in the high 80's and 90's. The minimum temperatures in east on the 29th were in the 70's. Fargo set a new record high minimum temperature of 76 °F on the 30th.

The National Weather Service (NWS) reported a record minimum temperature of 34 °F on the 11th at Bismarck. A record high minimum temperature was set at Fargo on the 30th with 76 °F.

NDAWN's highest recorded daily air temperature for June was 98.2 °F at Dickinson on the 29th. The lowest recorded daily air temperature was 33.1°F at Bowman on the 1st.

July 2011

The state average precipitation was 3.29 inches which is below the 1971-2000 normal state average of 2.75 inches. July 2011 state average precipitation ranked the 21st wettest in the past 117 years with a maximum of 7.88 inches in 1993 and a minimum of 0.62 inches in 1936.

Percent of normal precipitation ranged from approximately 40% to 230%. Below normal precipitation fell in the northwest and southwest corners and along the northern edge with above normal precipitation falling most elsewhere. The North Dakota Agricultural Weather Network (NDAWN) July rainfall totals ranged from 1.19 inches at Crosby to 10.14 inches at Britton SD. July had scattered thundershowers throughout the month. Most of the daily rainfall events happened during the second half of the month. Minot recorded its third wettest July since 1948 with 5.58 inches. Minot's wettest July was in 1993 with 7.39 inches. Bismarck tied the 1969 record for the fourth wettest July since 1874 with 5.24 inches. Bismarck's wettest July was in 1993 with 13.75 inches.

The National Weather Service (NWS) reported record rainfall at Minot on the 8th with 1.57 inches, the 15th with 0.68 inches and the 26th with 1.11 inches. Record rainfall was also reported at Dickinson on the 22nd with 1.41 inches and at Grand Forks airport on the 23rd with 1.13 inches. NWS reported records are listed in the Storms and Record Events section later in this bulletin.

The US Drought Monitor August 2, 2011 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, 4% short, 64% adequate, and 32% surplus with a subsoil moisture reported as 0% very short, 2% short, 61% adequate, and 37% surplus (Weekly Weather and Crop Bulletin Vol. 98, No. 31).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for July had 105 reports of high wind, 79 hail reports, and 41 reported tornadoes.

The top five July daily maximum wind speeds recorded from NDAWN were Oakes on the 10th with 80.6 mph, Roseau MN on the 4th with 78.1 mph, Stephen MN on the 20th with 78.1 mph, Greenbush MN on the 20th with 74.5 mph, and Mandan on the 31st with 63.7 mph. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The state average air temperature was 70.8 °F which is above the 1971-2000 normal of 68.7 °F. July 2011 state average air temperature ranked the 26th warmest in the past 117 years with a maximum of 79.7 °F in 1936 and a minimum of 61.8 °F in 1992.

NDAWN July average air temperatures ranged from 68 °F to 76 °F. NDAWN departure from normal temperatures ranged from 0 °F to 5 °F. Average daily air temperatures were near normal on most days. July's favorable temperatures and precipitation aided crop development across the state. There was a stretch of hot and humid days from the 15th through the 19th. Maximum air temperatures across the state reached in the 80's and 90's. Minimum air temperatures on the 18th and 19th were in the upper 60's to 70's for most of the state. Fargo's July average minimum air temperature of 63.9 °F ranked 5th warmest since 1881. Grand Fork's July average minimum air temperature of 60.6 °F ranked 6th warmest since 1890.

The National Weather Service (NWS) reported record high minimum temperatures on the 16th at Fargo with 73 °F, on the 17th at Grand Forks airport with 72 °F, and on the 19th at Grand Forks airport with 75 °F. NWS reported records are listed in the Storms and Record Events section later in this bulletin.

NDAWN's highest recorded daily air temperature for July was 98.7 °F at Britton SD on the 19th. The lowest recorded daily air temperature was 45.2 °F at Hazen on the 2nd.

August 2011

The state average precipitation was 2.75 inches which is above the 1971-2000 normal of 2.10 inches. August 2011 state average precipitation ranked 23rd wettest in the past 117 years with a maximum of 5.02 inches in 1900 and a minimum of 0.72 inches in 1961.

Percent of normal precipitation ranged from approximately 25% to 300%. Below normal precipitation fell in the northern half with above normal precipitation falling in the southern region. The High Plains Regional Climate Center (HPCC) August rainfall totals ranged from approximately 0.50 inches to 6.00 inches. Scattered showers fell throughout the month. Multiple hail and high wind events were reported by the storm prediction center (SPC) on the 5th, 12th, 15th, 22nd, 27th, and the 31st. The SPC reported one tornado on the 12th in Stutsman County. Favorable weather in August assisted harvest progress.

The National Weather Service (NWS) reported breaking several precipitation records. Most of the records were set on the 6th with 1.88 inches at Grand Forks NWS, 1.16 inches at Grand Forks airport, 0.97 inches at Fargo, and 0.68 inches at Minot. See the Storms and Record Events section later in this bulletin for a complete list of NWS August rainfall records.

The US Drought Monitor August 30, 2011 reported no drought conditions present in the state.

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 1% very short, 9% short, 74% adequate, and 16% surplus with a subsoil moisture reported as 0% very short, 3% short, 73% adequate, and 24% surplus (Weekly Weather and Crop Bulletin Vol. 98, No. 35).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for August had 48 reports of high wind, 41 hail reports, and 1 reported tornadoes.

The top five August daily maximum wind speeds recorded from NDAWN were Mandan on the 15th with 74.1 mph, Turtle Lake on the 31st with 72.0 mph, Pillsbury on the 1st with 67.0 mph, Hazen on the 31st with 60.1 mph, and Galesburg on the 1st with 57.6 mph.

The state average air temperature was 68.2 °F which is above the 1971-2000 normal of 67.23 °F. August 2011 state average air temperature ranked the 39th warmest in the past 117 years with a maximum of 73.6 °F in 1983 and a minimum of 60.9 °F in 1977.

NDAWN August average air temperatures ranged from 66 °F to 71 °F. NDAWN departure from normal temperatures ranged from -1 °F to 4 °F. Most areas had above normal daily average temperatures from the 1st through the 5th. From the 6th through the 21st most days had average air temperatures below normal with some near normal. The 22nd and 23rd had a spike in air temperature with above normal average temperatures across the state. The remainder of the month had most places with above normal average air temperatures. By the end of August, Corn Growing Degree Days (GDD) ranged from 1960 in the SE to 1660 in the NW of North Dakota, based on May 24th planting. Generally, corn is 300 GDD less than the required GDD to reach maturity. Under normal conditions, the additional 300 GDD can be attained on October 12th in the NW and on October 1st in the SE of North Dakota.

The National Weather Service (NWS) reported no temperature records in August.

NDAWN's highest recorded daily air temperature for August was 98.3 °F at Oakes on the 1st. The lowest recorded daily air temperature was 41.3 °F at Humboldt on the 27th.

Season in Graphics

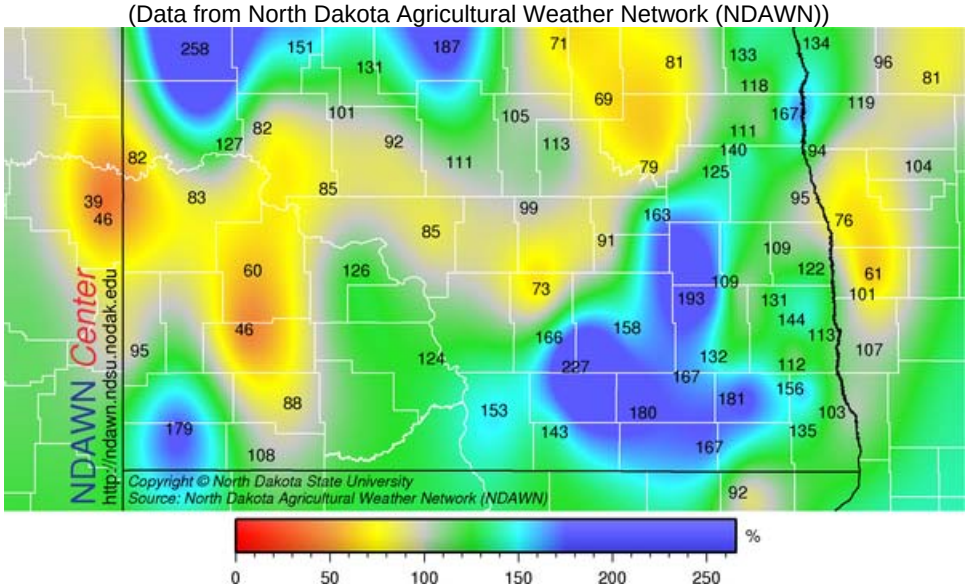
Summer 2011 Weather in North Dakota:

June 2011

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

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

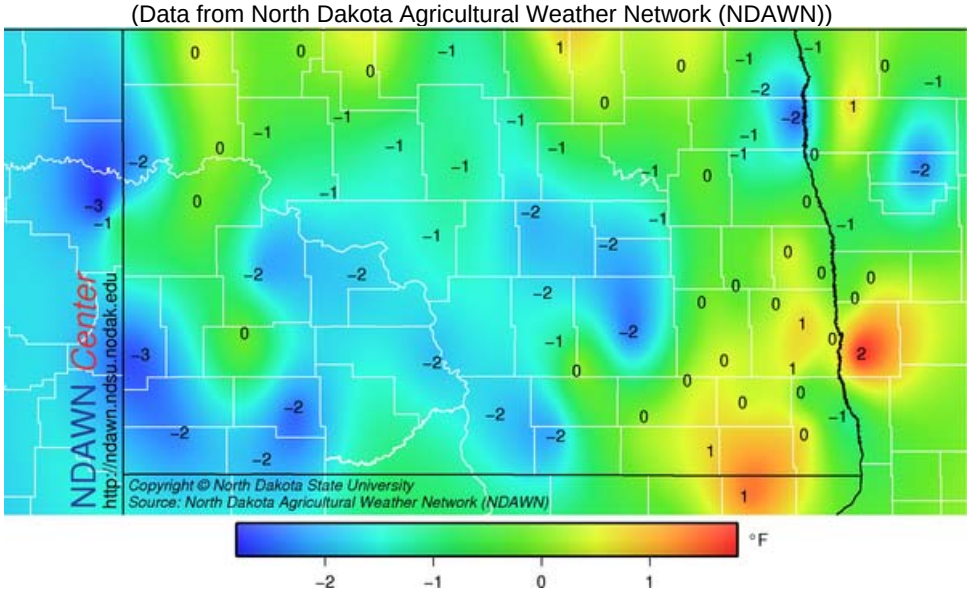


North Dakota State Climate Office

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

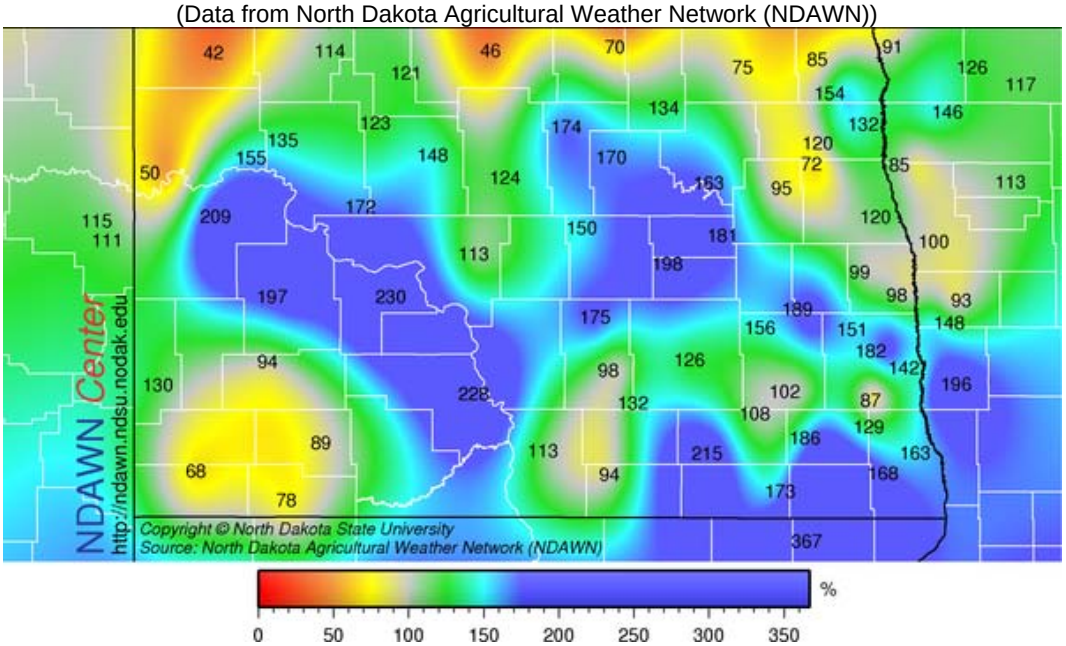
Summer 2011 Weather in North Dakota:

July 2011

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

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

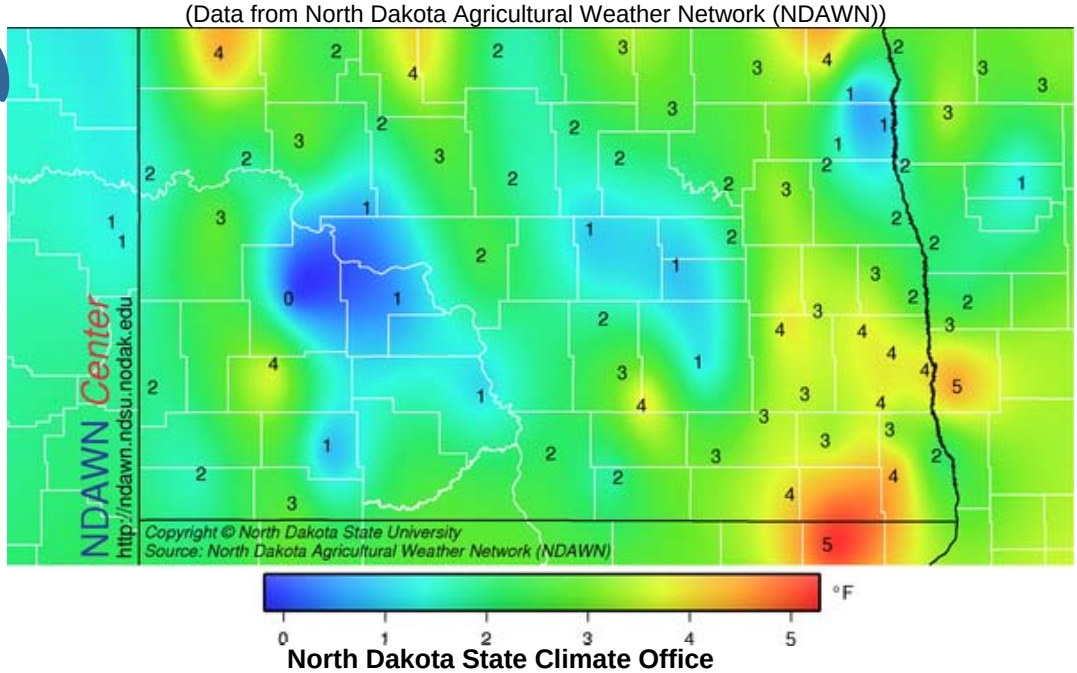


North Dakota State Climate Office

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

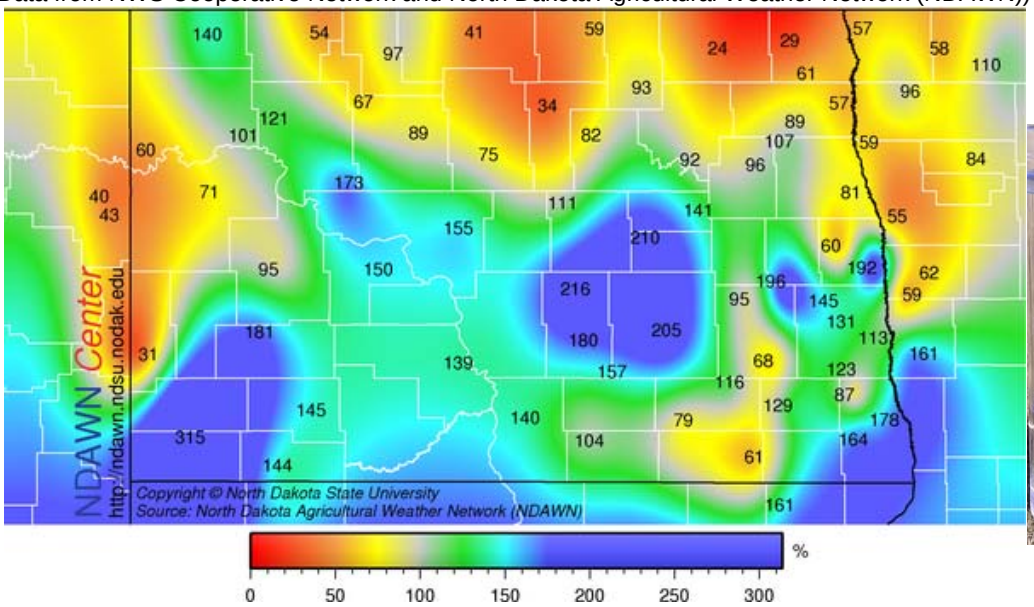
Summer 2011 Weather in North Dakota:

August 2011

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

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

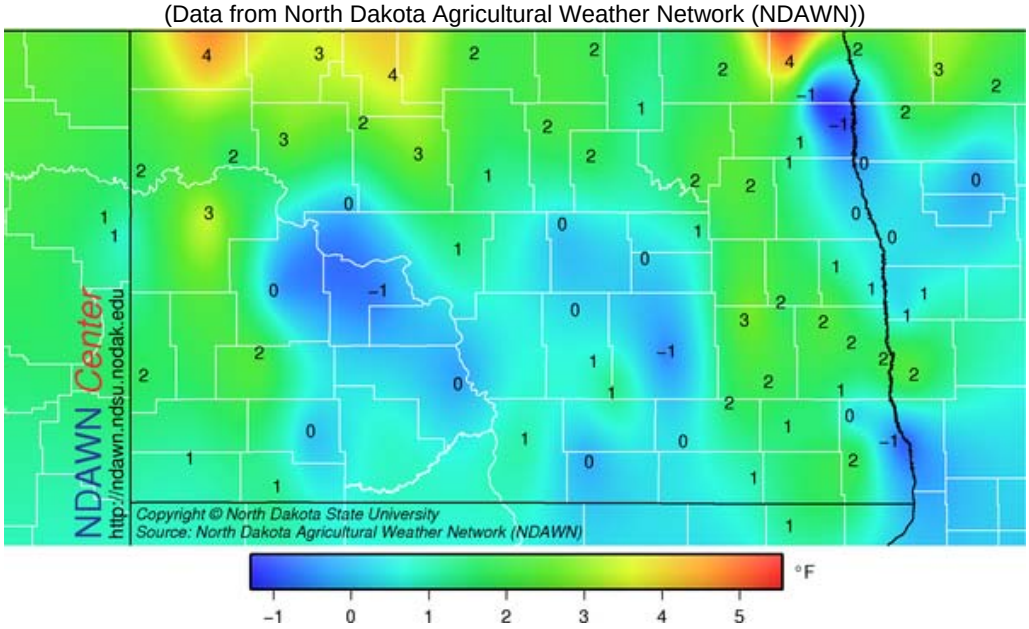


North Dakota State Climate Office

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

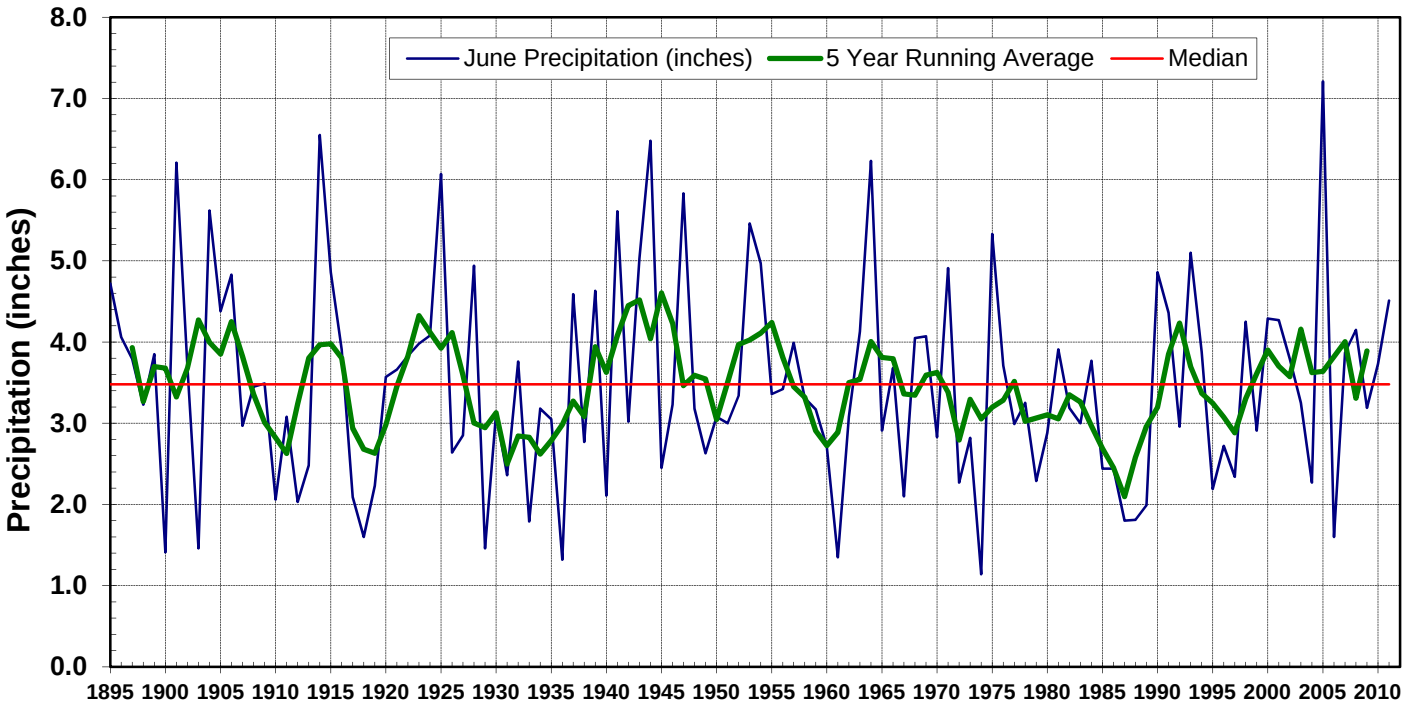
Departure From Normal Monthly
Average Air Temperature in degrees F

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



North Dakota State Climate Office

Historical June Precipitation for North Dakota

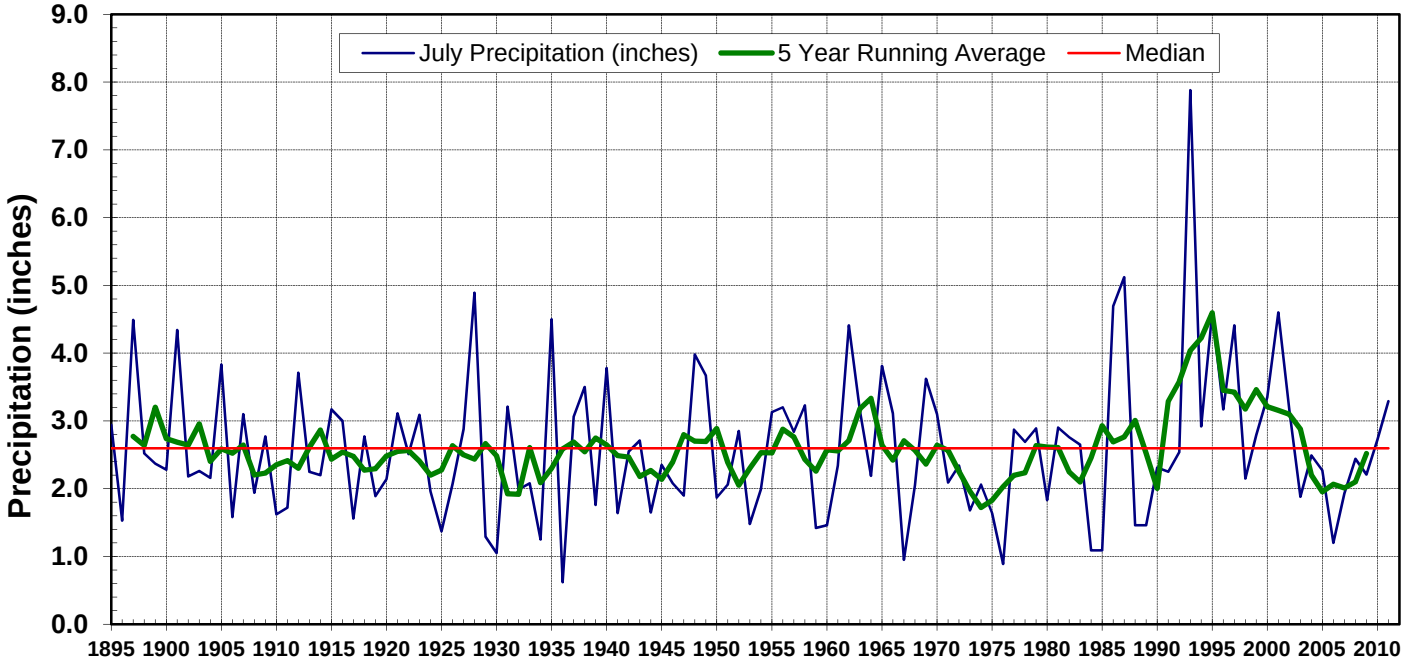


June Precipitation Statistics

2011 Amount: **4.51 inches**
Maximum: 7.21 inches in 2005
State Normal: 3.19" (1971-2000)

Monthly Ranking: 23rd Wettest in 117 years
Minimum: 1.14 inches in 1974
Years in Record: 117

Historical July Precipitation for North Dakota

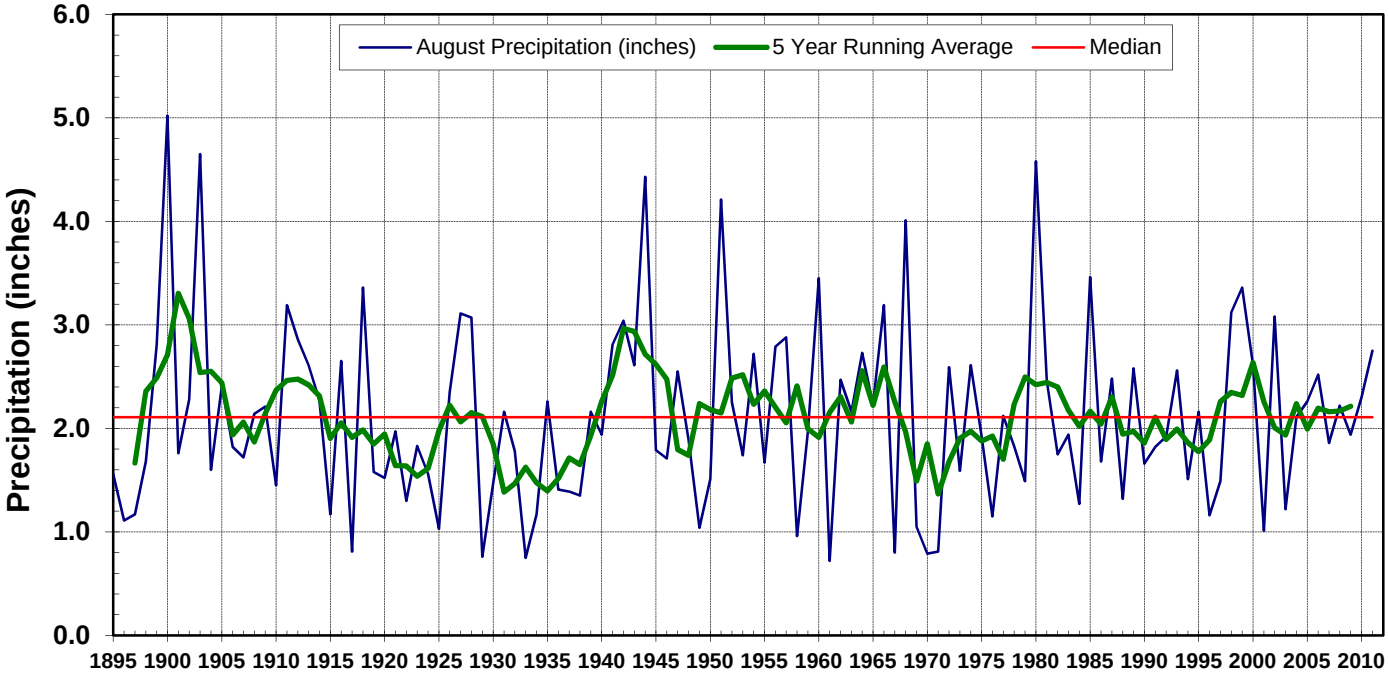


<u>July Precipitation Statistics</u>

2011 Amount: 3.29 inches
Maximum: 7.88 inches in 1993
State Normal: 2.75” (1971-2000)

Monthly Ranking: 21st wettest in 117 years
Minimum: 0.62 inches in 1936
Years in Record: 117

Historical August Precipitation for North Dakota

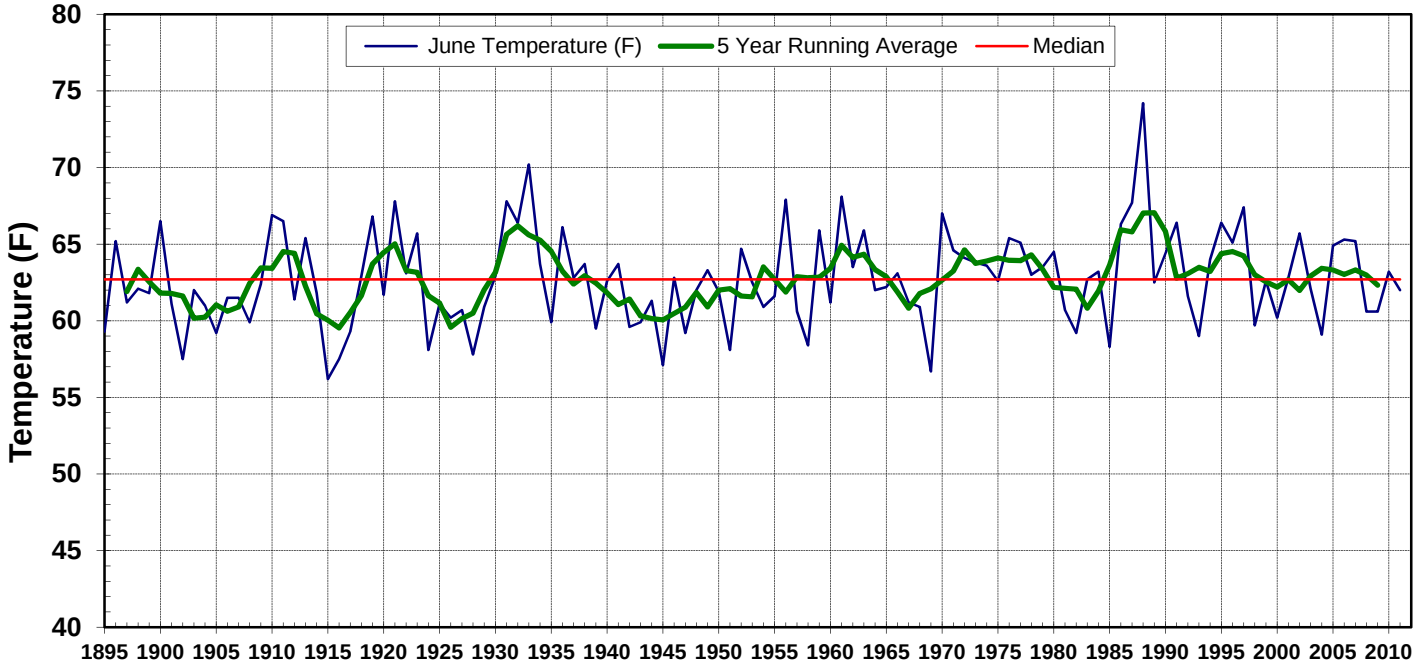


<u>August Precipitation Statistics</u>

2011 Amount: 2.75 **inches**
Maximum: 5.02 inches in 1900
State Normal: 2.10” (1971-2000)

Monthly Ranking: 23rd wettest in 117 years
Minimum: 0.72 inches in 1961
Years in Record: 117

Historical June Temperature for North Dakota

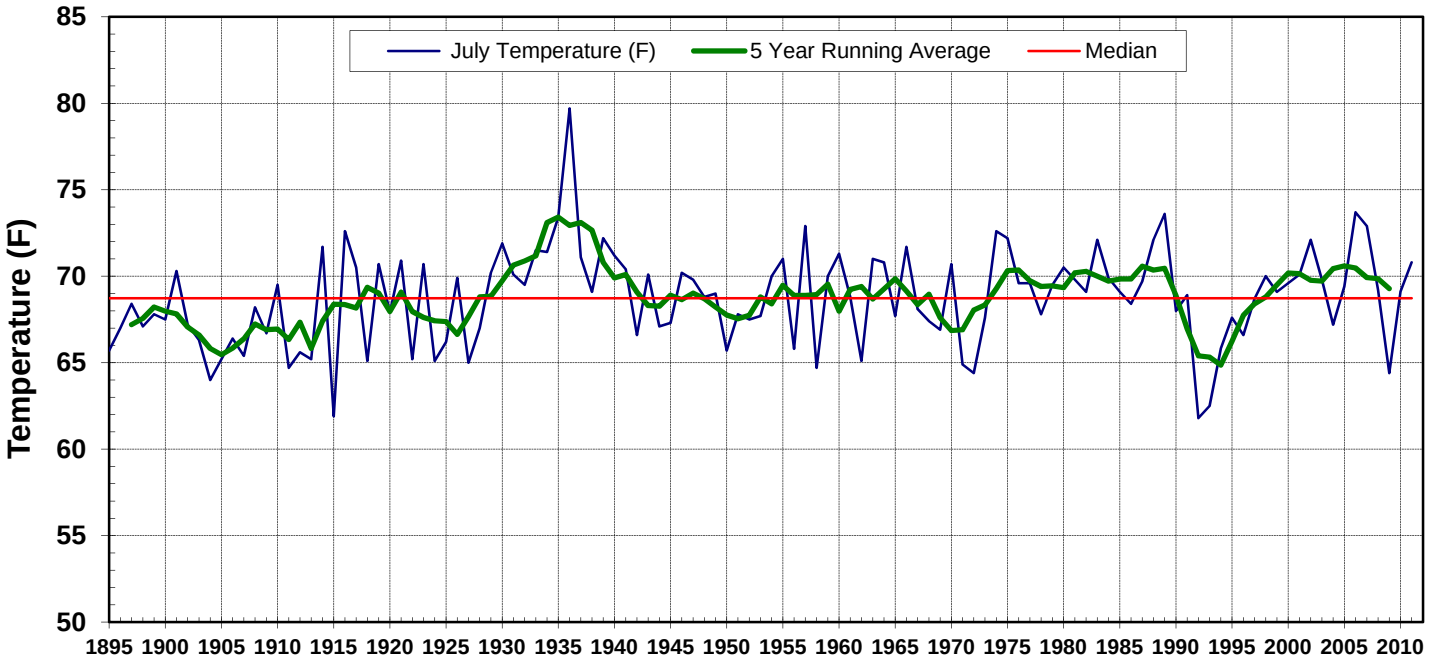


June Temperature Statistics

2011 Average: **62.0** °F
Maximum: 74.2 °F in 1988
State Normal: 63.73 °F (1971-2000)

Monthly Ranking: 50th Coolest in 117 years
Minimum: 56.2° F in 1915
Years in Record: 117

Historical July Temperature for North Dakota

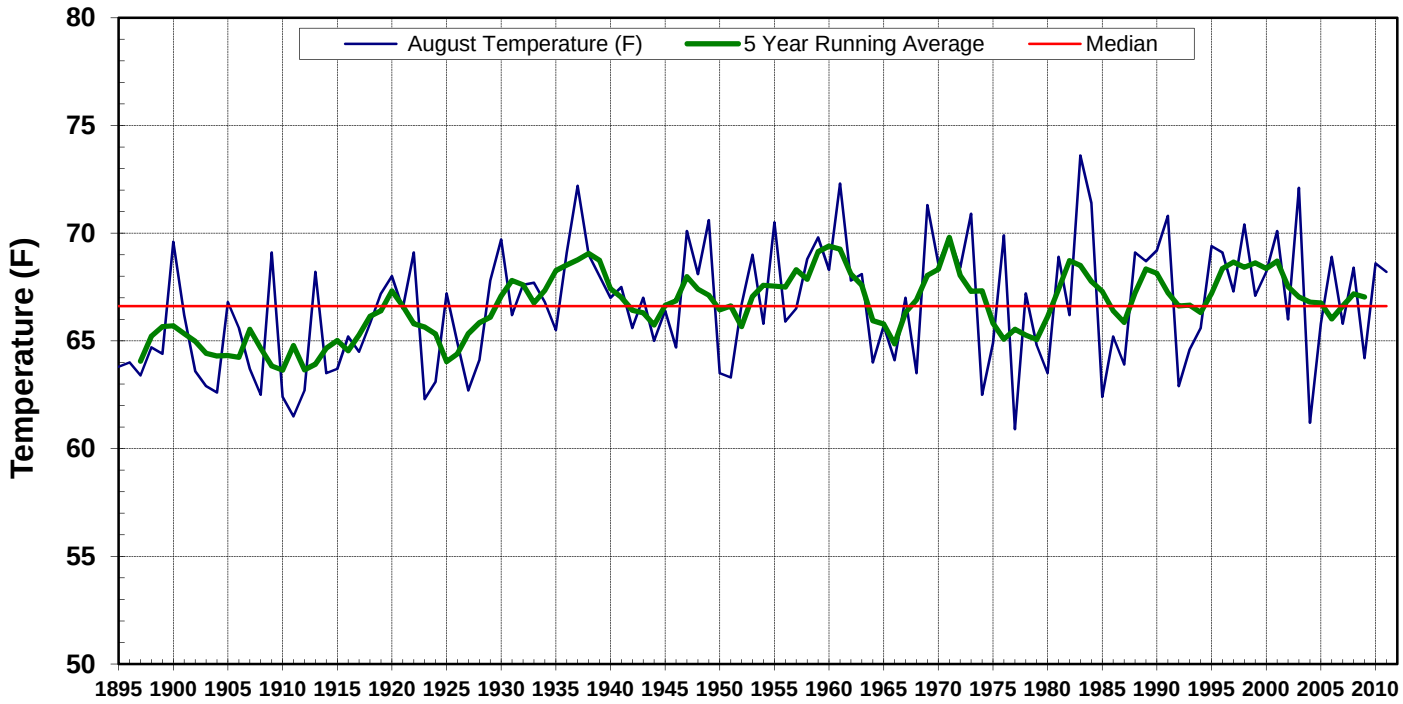


<u>July Temperature Statistics</u>

2011 Average: 70.8 °F
Maximum: 79.7 °F in 1936
State Normal: 68.7 °F (1971-2000)

Monthly Ranking: 26th Warmest in 117 years
Minimum: 61.8 °F in 1992
Years in Record: 117

Historical August Temperature for North Dakota



<u>August Temperature Statistics</u>

2011 Average: **68.2 °F**
Maximum: 73.6 °F in 1983
State Normal: 67.23 °F (1971-2000)

Monthly Ranking: 39th Warmest in 117 years
Minimum: 60.9 °F in 1977
Years in Record: 117

Storms & Record Events

State Tornado, Hail, and Wind Reports for Summer 2011 by B. A. Mullins

North Dakota 3 Month Total	Wind	Hail	Tornado
	177	147	51

Reports by Month			
Month	**Wind**	**Hail**	**Tornado**
Total June	24	27	9
Total July	105	79	41
Total August	48	41	1

North Dakota Record Event Reports for Summer 2011

Date	Location	Type of Record	Previous Record
06/11/11	Bismarck	Low temperature of 34 °F	36 °F set in 1969
06/12/11	Dickinson	Rainfall of 1.65 inches	0.64 inches set in 1981
06/14/11	Jamestown	Rainfall of 1.72 inches	1.59 inches set in 1970
06/21/11	Fargo	Rainfall of 1.81 inches	1.56 inches set in 1927
06/26/11	Jamestown	Rainfall of 2.32 inches	1.28 inches set in 1965
06/30/11	Grand Forks airport	High temperature of 96 °F	Ties 1970 record
06/30/11	Fargo	High minimum temperature of 76 °F	74 °F set in 1921
06/30/11	Grand Forks airport	High minimum temperature of 73 °F	Ties 1966 record
07/08/11	Minot	Rainfall of 1.57 inches	0.98 inches set in 1982
07/15/11	Minot	Rainfall of 0.68 inches	0.67 inches set in 2004
07/16/11	Fargo	High minimum temperature of 73 °F	Ties 1975 record
07/17/11	Grand Forks airport	High minimum temperature of 72 °F	71 °F set in 1975
07/19/11	Grand Forks airport	High minimum temperature of 75 °F	70 °F set in 1964
07/22/11	Dickinson	Rainfall of 1.41 inches	1.38 inches set in 1987
07/23/11	Grand Forks airport	Rainfall of 1.13 inches	0.47 inches set in 1986
07/26/11	Minot	Rainfall of 1.11 inches	0.56 inches set in 1963
08/01/11	Fargo	Rainfall of 2.87 inches	1.53 inches set in 1951
08/05/11	Dickinson	Rainfall of 0.86 inches	0.40 inches set in 2004
08/06/11	Grand Forks NWS	Rainfall of 1.88 inches	1.58 inches set in 1987
08/06/11	Grand Forks airport	Rainfall of 1.16 inches	0.55 inches set in 1969
08/06/11	Fargo	Rainfall of 0.97 inches	0.83 inches set in 2004
08/06/11	Minot	Rainfall of 0.68 inches	0.47 inches set in 1966
08/31/11	Minot	Rainfall of 0.92 inches	0.78 inches set in 1977

Seasonal Outlook

Fall Climate Outlooks

by D. Ritchison[1]

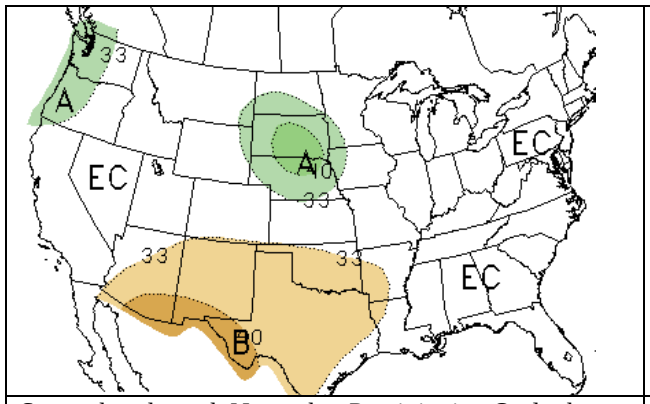
North Dakotans have experienced a number of mild autumns in recent years. In fact, many parts of the state have recorded eight straight years with autumn temperatures finishing at or above normal. This has not necessarily meant consistently mild conditions for all three months, as our climate is prone to wild fluctuations. Yet, the overall trend has been for this region to experience cool springs and mild autumns during the past two decades.

By analyzing past years with similar atmospheric and oceanic conditions to what has been occurring in 2011, the odds seem to favor this area recording yet another fall season with above average temperatures.

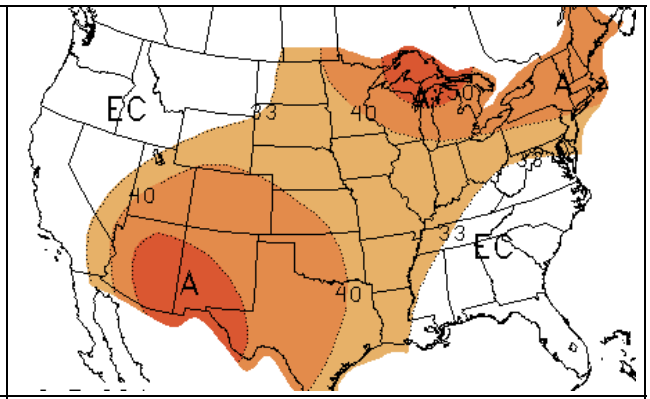
Although the past few weeks have brought some relief to the excessive precipitation that most of North Dakota has received in the past year, three weeks is not necessarily a trend. With fall harvest beginning and dry conditions also needed to lessen fears of more catastrophic flooding next spring, precipitation will continue to be forefront on everyone's mind for months to come.

Using the same techniques as the temperature forecast, would lead one to believe precipitation trends may be favorable the next three months (near average). However, our current wet phase makes it difficult to have confidence in any precipitation forecast besides a wet one.

The Climate Prediction Center's (CPC) autumn forecast for the area can be seen below.



September through November Precipitation Outlook



September through November Temperature Outlook

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/

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/

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

Hydro-Talk

Problem in James River Valley

by P. Ayd[2]

Through much of the unprecedented 2011 flood season across North Dakota, the James River basin was relatively quiet compared to the Red, Souris, Missouri and Devils Lake basins. Unfortunately, through the mid to late portions of this summer, the James River has followed the pattern of the other major basins across the state. Shown below in Fig. 1 is the 60 day precipitation total from July 1 through August 30, 2011.

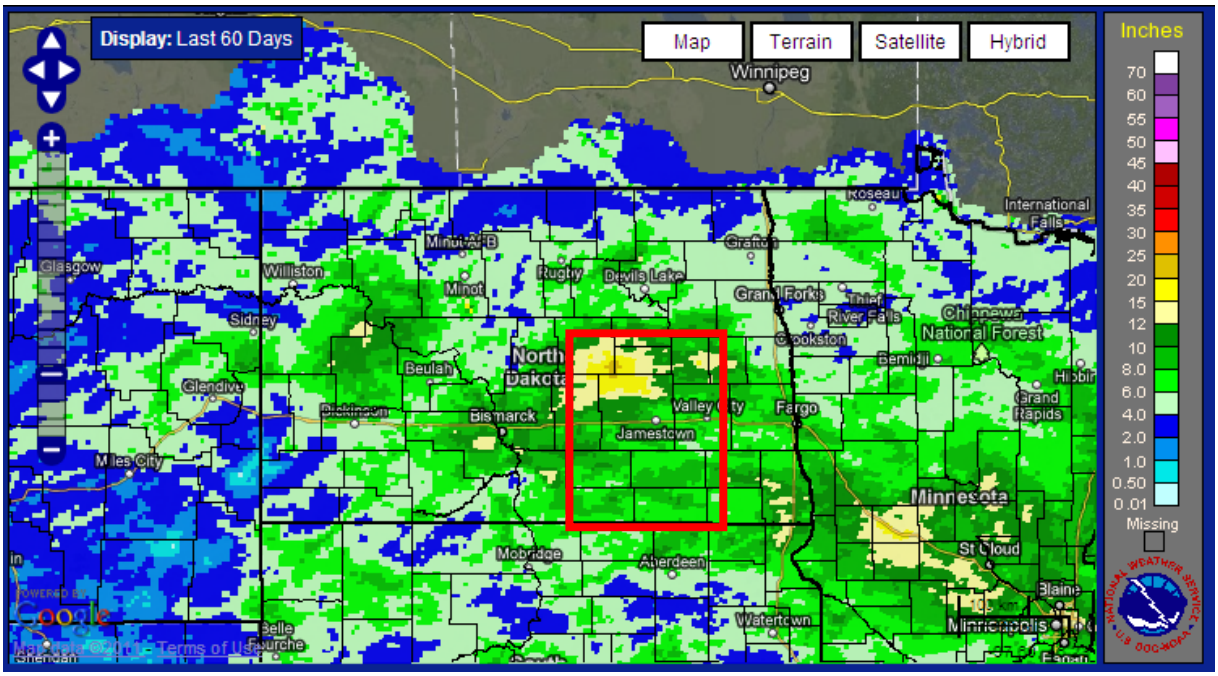


Figure 1. 60-day precipitation totals from July 1 through August 30, 2011. The red box denotes the area covered by Figure 2.

As shown in the yellow and orange shading in the above image, the drainage areas above the Pipestem and Jamestown Reservoirs during the 60-day period ranged from 12 to more than 20 inches of rainfall, falling on already wet soil conditions from the winter and spring.

For Jamestown, the average rainfall at for July and August is 5.46 inches. Runoff from the heavy rainfall this summer caused pool levels on both the Jamestown Reservoir on the James River, and the Pipestem Reservoir on the Pipestem Creek, to remain in exclusive flood control and approach peak levels for this water year from the spring snow melt at Jamestown Reservoir, and surpass the peak spring level at Pipestem Reservoir as shown in Figs. 3 and 4.

Such elevated pool levels so late in the summer necessitated an elevated release schedule of up to 2400 cubic feet per second (CFS) combined from the Jamestown and Pipestem Reservoirs in late

[2] The corresponding author: Patrick Ayd is aat the NOAA's National Weather Service, Weather Forecast Office in Bismarck, ND. E-Mail: Patrick.Ayd@noaa.gov

August, and is the high flows are expected to continue through early fall. This release schedule is required to gain additional capacity in the reservoirs for fall precipitation and to draw the reservoirs down to normal operating levels before winter freeze-up.

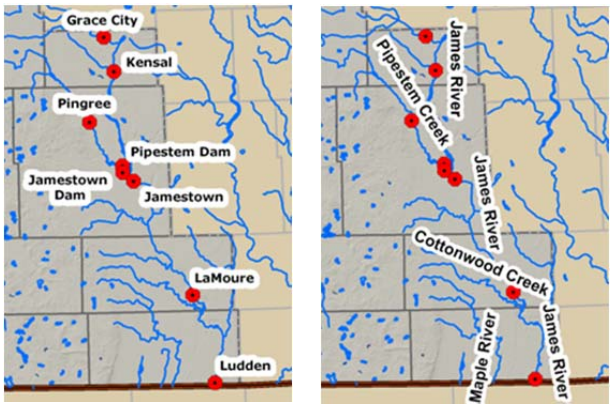


Figure 2. James River basin maps indicating all river gage names and locations.

The city of Jamestown is sensitive to such high releases, which will cause the James River at Jamestown to approach 12.8 feet (flood stage at Jamestown is 12.0 feet). Temporary flood protection was constructed in Jamestown to handle the expected river levels at peak release. That said, the city is still vulnerable to heavy rainfall events during this period of high reservoir releases. The National Weather Service in Bismarck has been working very closely with Stutsman County Emergency Management in an effort to provide at least four to six hours of advanced warning for all rain events. This partnership will provide sufficient time for dam release reductions to lower the stage at Jamestown, making room in the channel for local runoff. Without this advanced warning, it is possible that local runoff could be sufficient to overtop the temporary flood protection currently in place.

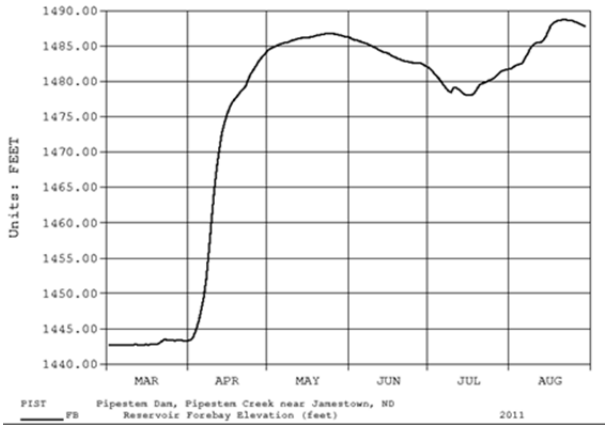


Figure 3. Jamestown Reservoir Pool Elevation March-August 2011.

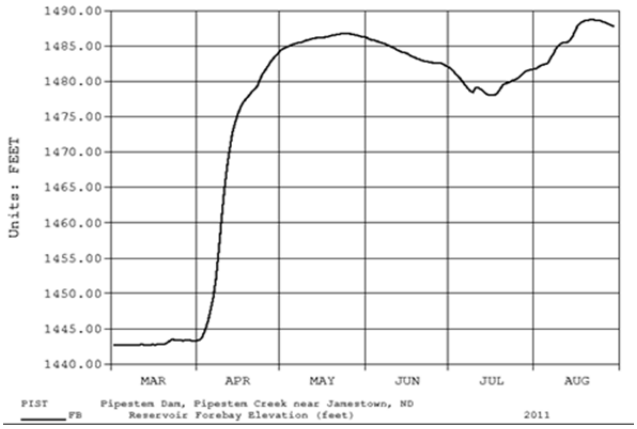


Figure 4. Pipestem Reservoir Pool Elevation March-August 2011.

Science Bits

NDAWN Economic Benefits to Regional Agriculture:

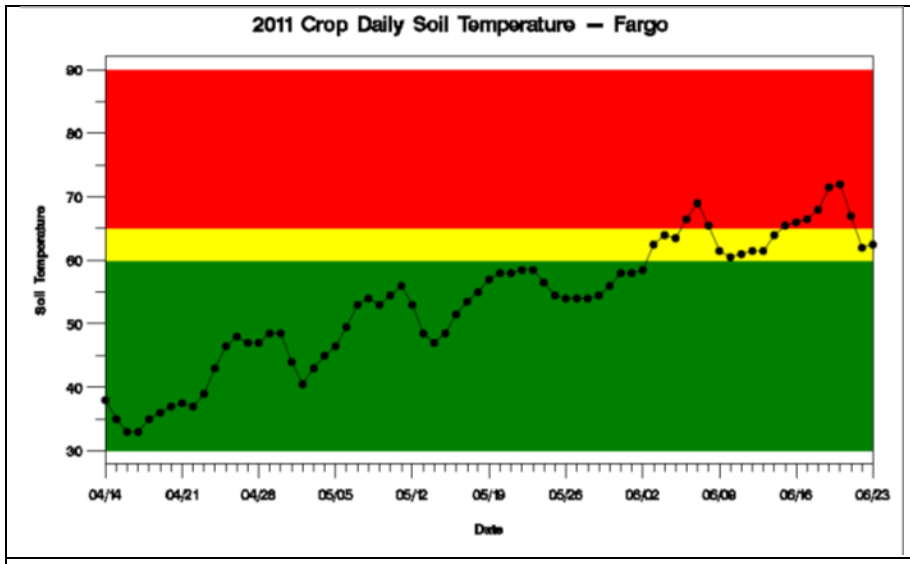
by F. A. Akyüz[3]

North Dakota Agricultural Weather Network (NDAWN) was established in 1989 by John Enz, former North Dakota State Climatologist and Emeritus Professor of Climatology, Soil Science Department at North Dakota State University. Originally, the network consisted of six automated weather stations. Today, 72 stations are operating in North Dakota and its neighboring States primary agricultural locations.

Principal benefits of the network are to provide weather information to the area growers and the crop-specific agricultural applications.

The NDAWN Center has assisted many North Dakota growers in making weather-critical decisions concerning their crops, livestock, and livelihood. The network provides weather data, which is instrumental in developing various agricultural models including but not limited to the late blight model, degree day and growth stage models for barley, corn, canola, potato, sugarbeet, sunflower, wheat and other small grains, irrigation scheduling, crop water use, sugarbeet root maggot, and insect development models.

Sugarbeet growers in the Red River Valley for example, utilize the NDAWN data for several applications that are designed to better inform the growers of the existing environmental conditions and to help target optimum timing for applications of herbicide, insecticides and fungicides.



	High Rhizoctonia Infection Risk
	Increasing Rhizoctonia Infection Risk
	No Risk of Rhizoctonia Infection

Figure 1. Pest Alert: Rhizoctonia Fungicide Application

American Crystal Sugar Company designed a new "Pest Text Alert System" that utilizes NDAWN data, applies parameters and sends a text message to growers, company staff and allied industry members. The pest alerts are designed to be an early warning system for the onset of

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pending disease and insect problems (Figure 1). The Pest alert system advises growers to apply fungicide treatment when the soil temperature is between 65 and 70°F to be the most effective.

NDAWN's Sugarbeet Root Maggot Application can also prevent insect damage through proper timing of pesticide application. Nearly $8 Million net benefit can be attributed to the use of NDAWN data by increasing control of root maggot flies, cercospora and rhizoctonia.

Minnesota and North Dakota sugarbeet factory districts issue a daily spray advisory via recorded telephone messages for producers in the district. These advisories are based on the total Daily Infection Value (DIV) that has accumulated in the past two days. If the past 2 day total DIV is less than 6, infection conditions are considered unfavorable. A two day total DIV equal to 6 is marginal, and greater than 6 means conditions are favorable for infection. (Figure 2)

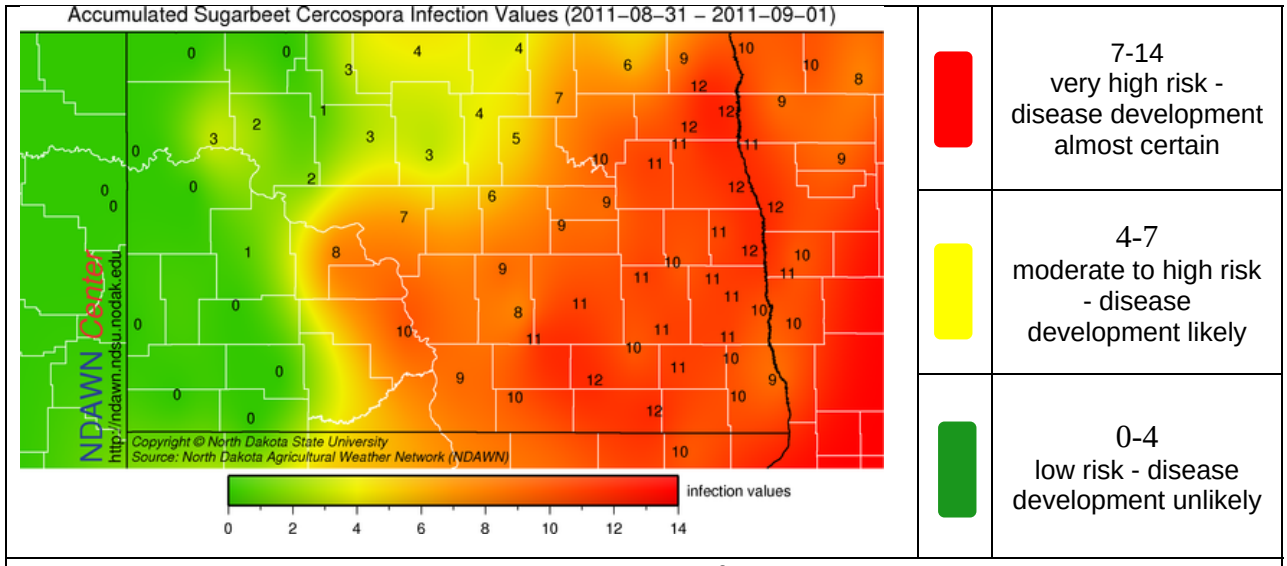

Figure 2. NDAWN Two-day Sugarbeet Cercospora Infection Values

NDAWN's Cercospora Application can reduce the amount of fungicide the sugarbeet growers use. There are between 2 and 4 applications of fungicide per growing season depending on the weather. Each application costs $9 Million to RRV sugarbeet growers. If growers can eliminate one fungicide application from their cercospora program they have the potential to save $9M annually ($20 per acre for the cost of the chemical times 450,000 acres of sugarbeet land).

With a similar agricultural application that allows the area potato growers to utilize potato late blight severity values, they can save 1 to $2M per year by avoiding one to two applications of fungicide using NDAWN data (N. Gudmestad, Plant Pathology Prof., NDSU)

NDAWN is a valuable regional resource and so far only a fraction of its potential has been realized. These data have become part of the North Dakota climatological archive and will become more valuable as the period of record grows and/or new applications are discovered by scientists in all fields. Timing of these applications is a direct economic environmental gain.

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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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