North Dakota Climate Bulletin

Summer 2013

Volume: 7 No: 3

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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 drier summer. Temperature-wise, this summer was the 44th warmest statewide since 1895. Precipitation-wise, it was the 54th driest summer statewide since 1895.

Late-spring snow pack, extensive snow cover and slow melting associated with wet spring helped soil moisture to recharge. This reduced the agricultural impact of the subsequent drought in central and eastern portions of the state.

There were 125-wind, 110-hail, and 13-tornado events reported this summer (near-average summer tornado-wise). The storm and daily record weather events are listed on pages 15.

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

Glen Ullin (ND) Storm: August 29, 2013. Photo by Brad Oslund

Weather Highlights

Seasonal Summary:

by B. A. Mullins

June 2013

The state average precipitation was 3.88 inches which is above the 1981-2010 normal of 3.38 inches. June 2013 state average precipitation ranked 39th wettest in the last 119 years with a maximum of 7.21 inches in 2005 and a minimum of 1.14 inches in 1974.

North Dakota experienced its 58th wettest June based on the preliminary state rankings. However, the spatial distribution of the monthly total precipitation was highly variable. The North Dakota Agricultural Weather Network recorded percent of normal precipitation totals ranged from nearly 250% between Dickey and Sargent counties and nearly 20% in Foster County. June total precipitation amounts ranged from 9.24" in Valley City to 0.8" in Carrington. Heavy rainfall caused interstate 94 to close in Valley City which made travel hazardous. The persistent rainfall in drought stricken areas in south central and south eastern parts of the state ended the 2-yr long drought spell. Drought Monitor of June 26th report listed no areas in ND under any drought conditions. The persistent rainfall event halted field work in much of the state. Based on the USDA's State Agricultural Statistics Service there were only on average of 15.2 suitable days for field work in ND.

The National Weather Service (NWS) recorded breaking three precipitation records in June. Grand Forks Airport on the 4th had a record 1.49 inches of rain. Minot also on the 4th had a record 1.70 inches. Fargo on the 25th had a record 2.56 inches. A list of records can be viewed in the "Storms and Record Events" section later in this bulletin.

The US Drought Monitor July 2, 2013 report had no drought conditions in 99.68% of the state.

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 0% very short, 6% short, 69% adequate, and 25% surplus with a subsoil moisture reported as 0% very short, 4% short, 76% adequate, and 20% surplus (Weekly Weather and Crop Bulletin Vol. 100, No. 27).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), there were 51 reported hail events, 40 reported high winds, and 8 reported tornadoes in June.

The top five June daily maximum wind speeds recorded from NDAWN were 64.4 mph at Linton on the 22nd, 63.4 mph at Galesburg on the 25th, 58.4 mph at Cavalier on the 27th, 55.8 mph at Crosby on the 14th and 53.7 mph at Crosby on the 20th. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The state average air temperature was 63.2 °F which is below the 1981-2010 normal of 63.37 °F. June 2013 state average air temperature ranked 48th warmest in the past 119 years with a maximum of 74.2 °F in 1988 and a minimum of 56.2 °F in 1915.

North Dakota experienced its 60th warmest June since 1895 based on the preliminary state rankings. June average air temperatures ranged from a maximum of 57.5 °F in Fargo to a minimum of 52.2 °F in Foxholm (near Minot). Based on the NDAWN Network, departure from normal average air temperatures ranged from 3 °F in the north to -2 °F in the west. A high pressure system in southern MN, associated with a warm front and southerly flow, pushed the mercury above 90 degree- mark in some of the eastern North Dakota locations.

The National Weather Service (NWS) reported breaking no temperature records in June. A list of the records can be viewed in the "Storms and Record Events" section later in this bulletin.

NDAWN's highest recorded daily air temperature for June was 95.5 °F at Kennedy, MN on the 19th. The lowest recorded daily air temperature was 33.9 °F at Tappen on the 2nd.

July 2013

The state average precipitation was 2.28 inches which is below the 1981-2010 normal state average of 2.88 inches. July 2013 state average precipitation ranked the 55th driest in the past 119 years with a maximum of 7.88 inches in 1993 and a minimum of 0.62 inches in 1936.

The North Dakota Agricultural Weather Network recorded precipitation totals were generally below normal in the east and west central edge with near normal and above elsewhere. There were many scattered thunderstorms throughout the month. The greatest NDAWN total precipitation amount was 5.62 inches at Minot which is 220% above normal. The Storm Prediction Center (SPC) reported one tornado on the 9th in Morton County. The SPC reported two tornadoes spotted on the 21st in McHenry and Ramsey County along with a significant amount of hail in several Counties. Some locations in the southwest reported baseball sized hail. The end of July was cool and dry. The dry conditions have stressed crops in many areas. The U.S. Drought Monitor June 30th report listed 16.55% of the state as being Abnormally Dry (D0) and included McIntosh, Logan, Kidder, Stutsman, Eddy, Foster and Griggs Counties.

The National Weather Service (NWS) reported breaking one rainfall record on the 5th at Dickinson with 0.82 inches. The previous record was 0.79 inches set in 1964. See the "Storms and Record Events" section later in this publication for details on event records.

The US Drought Monitor August 6, 2013 report had no drought conditions listed for 76.18% of the state. Abnormally dry (D0) conditions were reported for 20.15% of the state in the southeast. Stutsman County was reported as having moderate (D1) drought conditions.

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 7% very short, 32% short, 56% adequate, and 5% surplus with a subsoil moisture reported as 5% very short, 27% short, 63% adequate, and 5% surplus (Weekly Weather and Crop Bulletin Vol. 100, No. 32).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), there were 51 wind reports, 46 hail reports and 3 reported tornadoes in July.

The top five July daily maximum wind speeds recorded from NDAWN were 69.1 mph on the 8th at Dunn, 62.7 mph on the 8th at Hazen, 61.2 mph on the 29th at Mott, 54.8 mph on the 12th at Mavie, MN, and 53.7 mph on the 5th at Berthold. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The state average air temperature was 68.1 °F which is below the 1981-2010 normal of 69.01 °F. July 2013 state average air temperature ranked the 49th coolest in the past 119 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 ~65 °F in the north to ~72 °F in the southeast. Departure from normal average air temperatures ranged from 1 °F to -4 °F. The daily average air temperatures were primarily above normal until the 19th after which a cold air mass settled in causing the daily average air temperatures to fall below normal for the remainder of the month. Average air temperatures were 5 to 20 °F below normal on the 27th and 28th. The National Weather Service reported new minimum average air temperature records set on the 27th at Jamestown and Bismarck with 42 °F and 39 °F, respectively. Grand Forks Airport and Jamestown set new minimum average air temperatures on the 28th with 42 °F and 41 °F, respectively.

The National Weather Service (NWS) reported breaking several minimum temperature records on the 27th and 28th. See the "Storms and Record Events" section later in this publication for a complete list on event records.

NDAWN's highest recorded daily air temperature for July was 98.4 °F at Sidney, MT on the 11th. The lowest recorded daily air temperature was 34.5 °F at Hazen on the 27th.

August 2013

The state average precipitation was 1.69 inches which is less than the 1981-2010 normal of 2.10 inches. August 2013 state average precipitation ranked 43rd driest in the past 119 years with a maximum of 5.02 inches in 1900 and a minimum of 0.72 inches in 1961.

The North Dakota Agricultural Weather Network recorded precipitation totals of below normal in the eastern half of the state and parts of the north central regions. The first six days of August had scattered showers with the more widely spread rainfall on the 6th. The National Weather Service reported record rainfall at Dickinson and Minot on the 6th with 0.64 inches and 0.83 inches respectively along with two tornadoes spotted in Richland County. A long dry spell followed during which most of the rainfall was in the west. On the 29th a wide spread rain event covered most of the northern half, central, and eastern parts of the state. Scattered showers continued on the 30th in the central region and 31st primarily in the northeast. The National Weather Service storm report recorded a tornado in Morton County on the 30th and in Pembina County on the 31st. Over the summer, drought conditions gradually worsened for the eastern part of the state. The US Drought Monitor at the end of June reported no drought conditions for 99.68% of the state. Abnormally dry (D0) conditions began to develop for 20.15% of the state at the end of July with Stutsman County increased to moderate (D1) conditions. The US Drought Monitor August 27th report has 44.35% of the state, the western half, with no drought or dry conditions. The northeast was reported as Abnormally Dry (D0) and the southeast was reported with Moderate (D1) drought conditions that surrounded Stutsman County whose drought condition was elevated to Severe (D2).

The National Weather Service (NWS) reported breaking two precipitation records on August 6th. Dickinson reported 0.64 inches of rainfall and Minot 0.83 inches breaking previous records of 0.49 inches set in 1999 and 0.68 inches set in 2011, respectively. See the "Storms and Record Events" section later in this publication for a complete list on event records.

The US Drought Monitor September 3, 2013 report had 45.97% of the state as abnormally dry (D0) to severe drought (D2). The drought area was in the southeast. Severe drought was reported in Stutsman County (http://droughtmonitor.unl.edu/).

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 16% very short, 35% short, 46% adequate, and 3% surplus with a subsoil moisture reported as 11% very short, 35% short, 51% adequate, and 3% surplus (Weekly Weather and Crop Bulletin Vol. 100, No. 36).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for August had 34 reports of high wind, 13 hail reports, and 2 reports of tornadoes.

The top five August daily maximum wind speeds recorded from NDAWN included Hazen on the 29th with 68.0 mph, Sidney, MT, on the 5th with 57.3 mph, Kennedy, MN, on the 31st with 53.0 mph, Crosby on the 26th with 52.3 mph and St. Thomas on the 31st with 52.3 mph. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The state average air temperature was 68.4 °F which is above the 1981-2010 normal of 67.52 °F. August 2013 state average air temperature ranked the 34th warmest in the past 119 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 in the north to ~72 °F in the south. Departure from normal average air temperatures ranged from 3 °F to -2 °F. Daily average air temperatures can be summarized as the first half being below normal and the second half above normal. The average air temperature of the first half of the month were 4 to 10 °F below normal with the second half being 5 to 9 °F above normal.

The National Weather Service (NWS) reported breaking one temperature record on the 20th at Bismarck with 102 °F breaking the previous record of 100 °F set in 1976. See the "Storms and Record Events" section later in this publication for a complete list on August event records.

NDAWN's highest recorded daily air temperature for August was 102.02 °F at Streeter on the 20th. The lowest recorded daily air temperature was 36.9 °F at Ada, MN on the 13th.

Season in Graphics

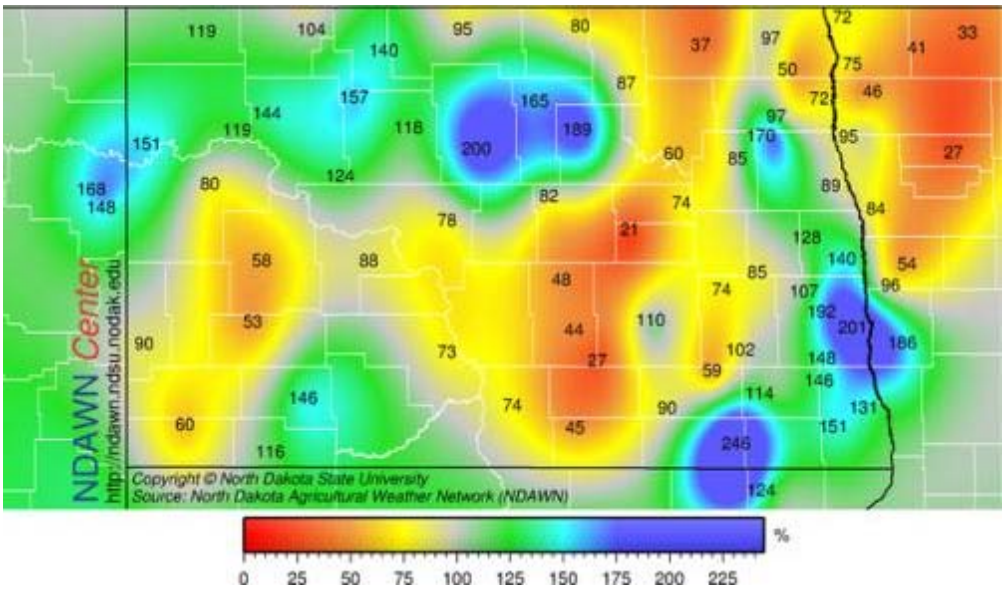
Summer 2013 Weather in North Dakota:

June 2013

Total Precipitation percent of mean (1981-2010)

Precipitation Percent of Normal

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

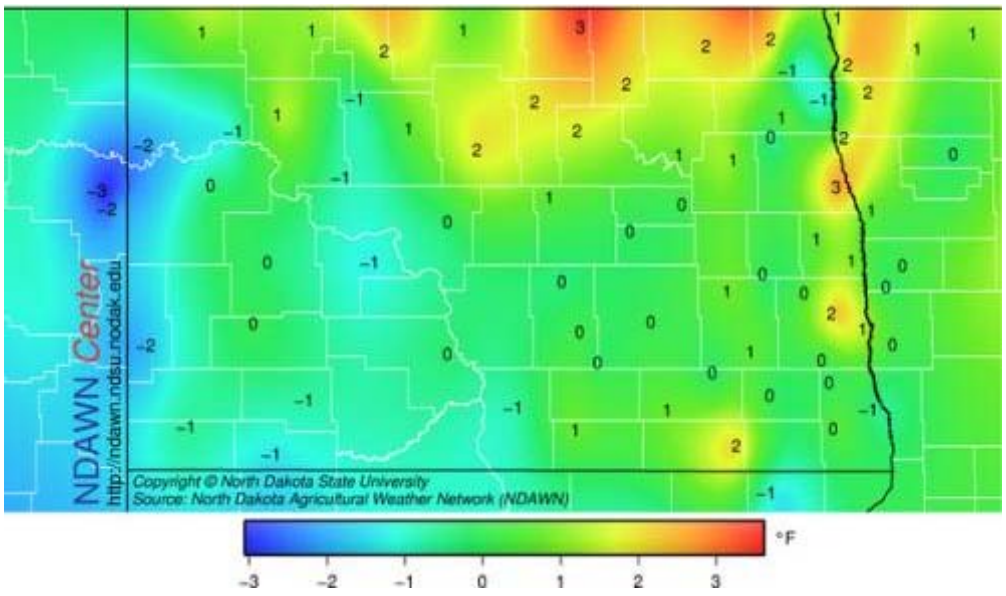


North Dakota State Climate Office

Average Temperature (°F) Deviation from Mean (1981-2010)

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

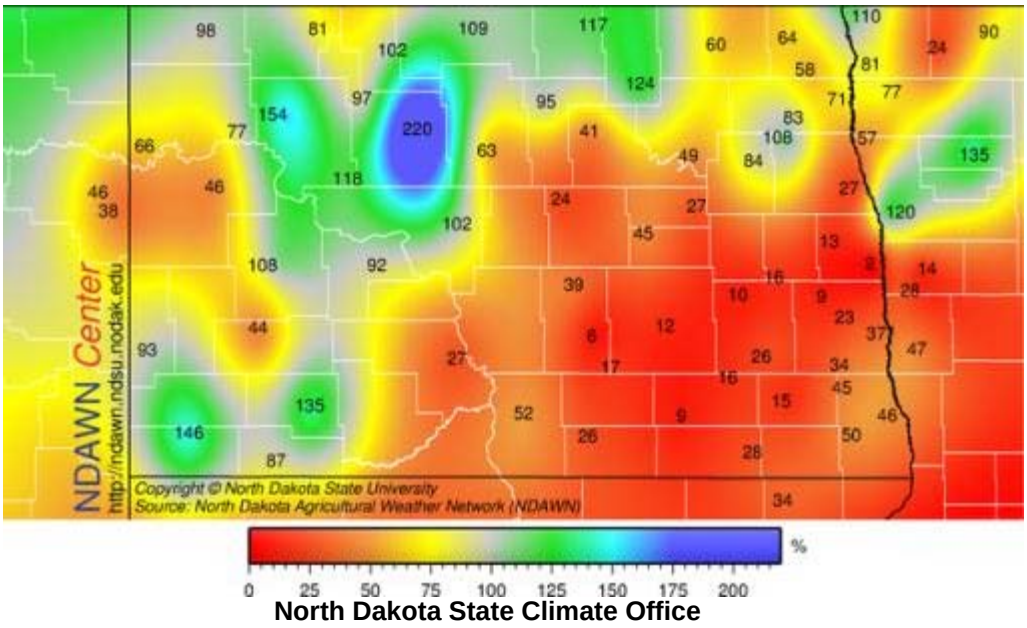
Summer 2013 Weather in North Dakota:

July 2013

Total Precipitation percent of mean (1981-2010)

Precipitation Percent of Normal

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

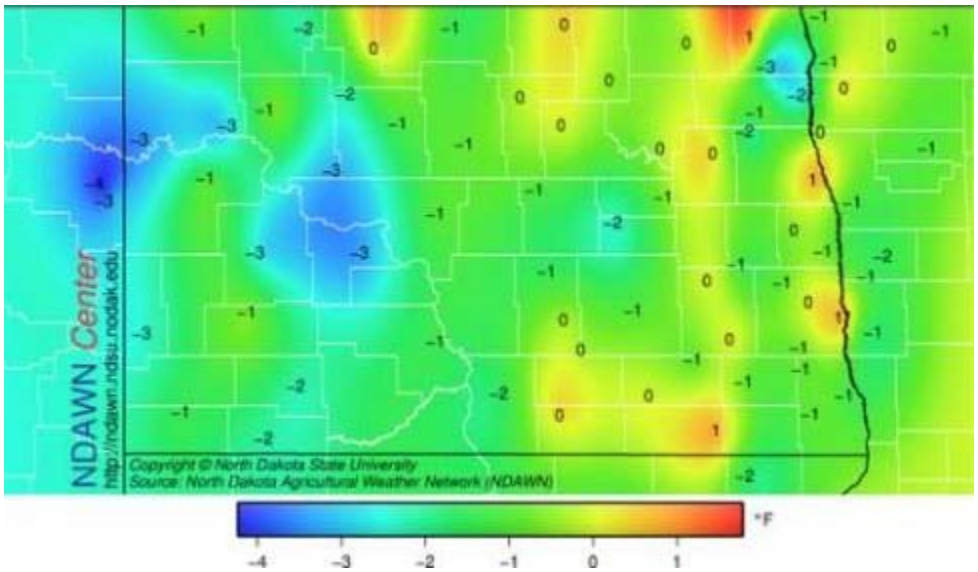


North Dakota State Climate Office

Average Temperature (°F) Deviation from Mean (1981-2010)

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

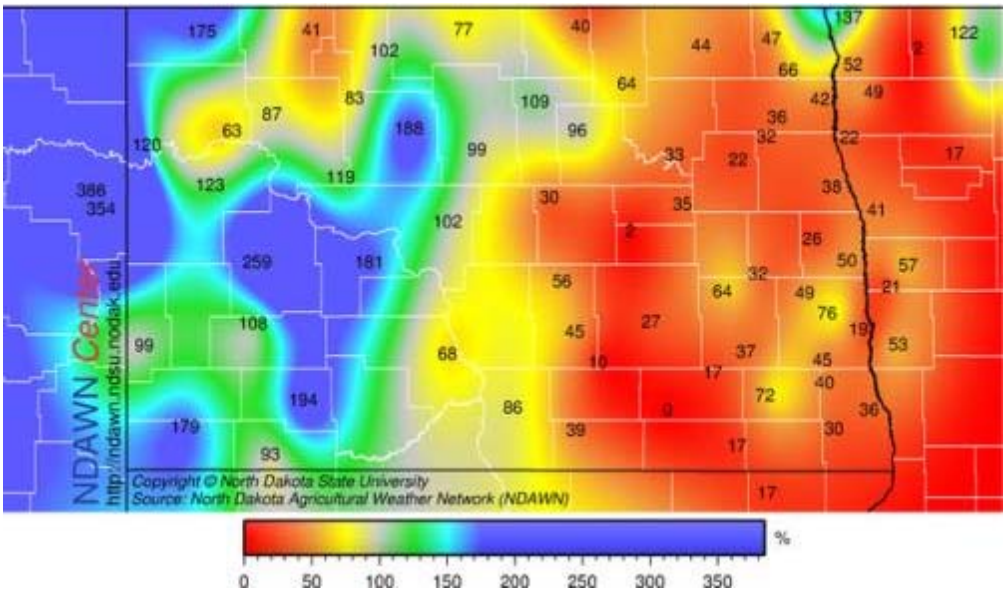
Summer 2013 Weather in North Dakota:

August 2013

Total Precipitation percent of mean (1981-2010)

Precipitation Percent of Normal

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

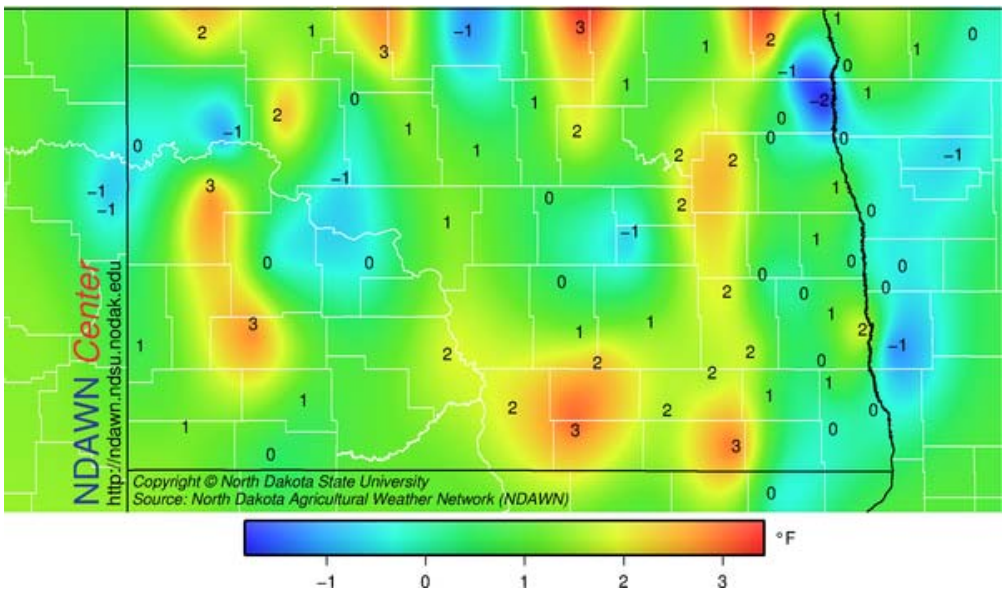


North Dakota State Climate Office

Average Temperature (°F) Deviation from Mean (1981-2010)

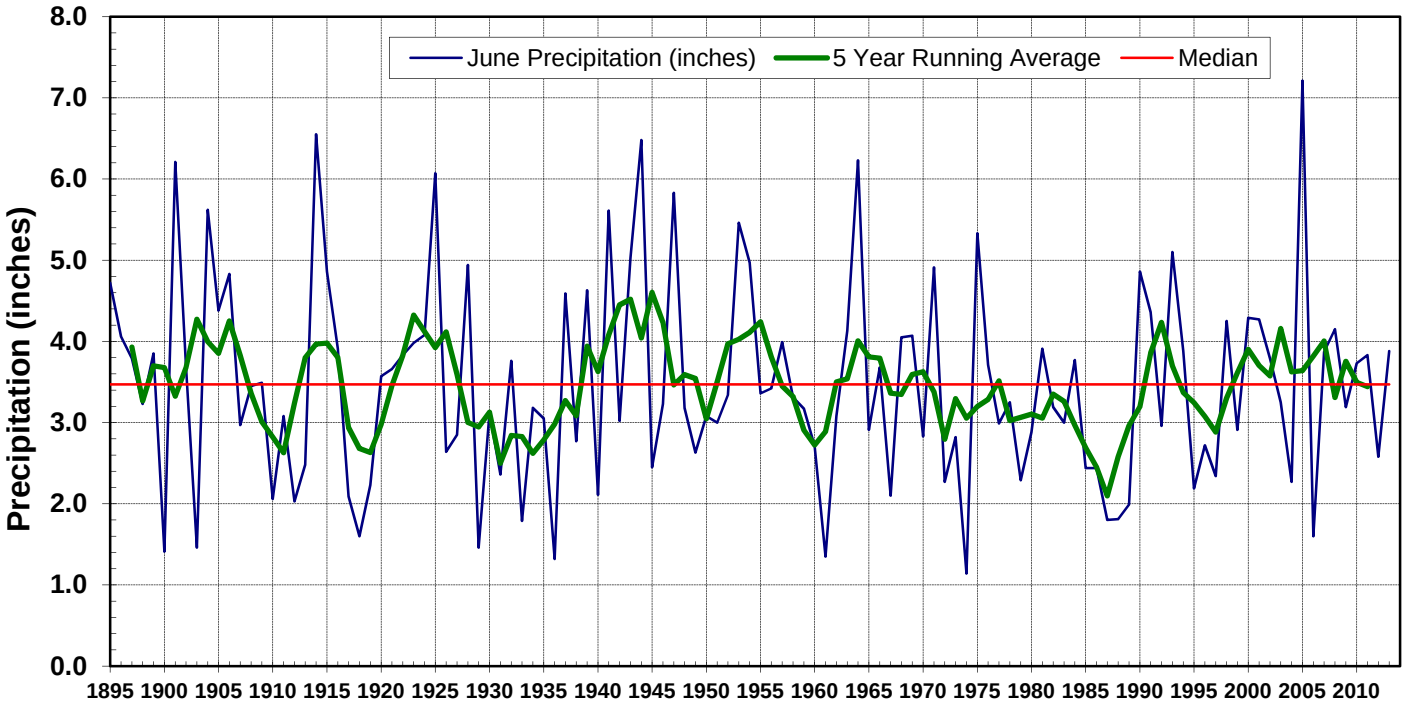
Departure From Normal Monthly
Average Air Temperature in degrees F

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



North Dakota State Climate Office

Historical June Precipitation for North Dakota

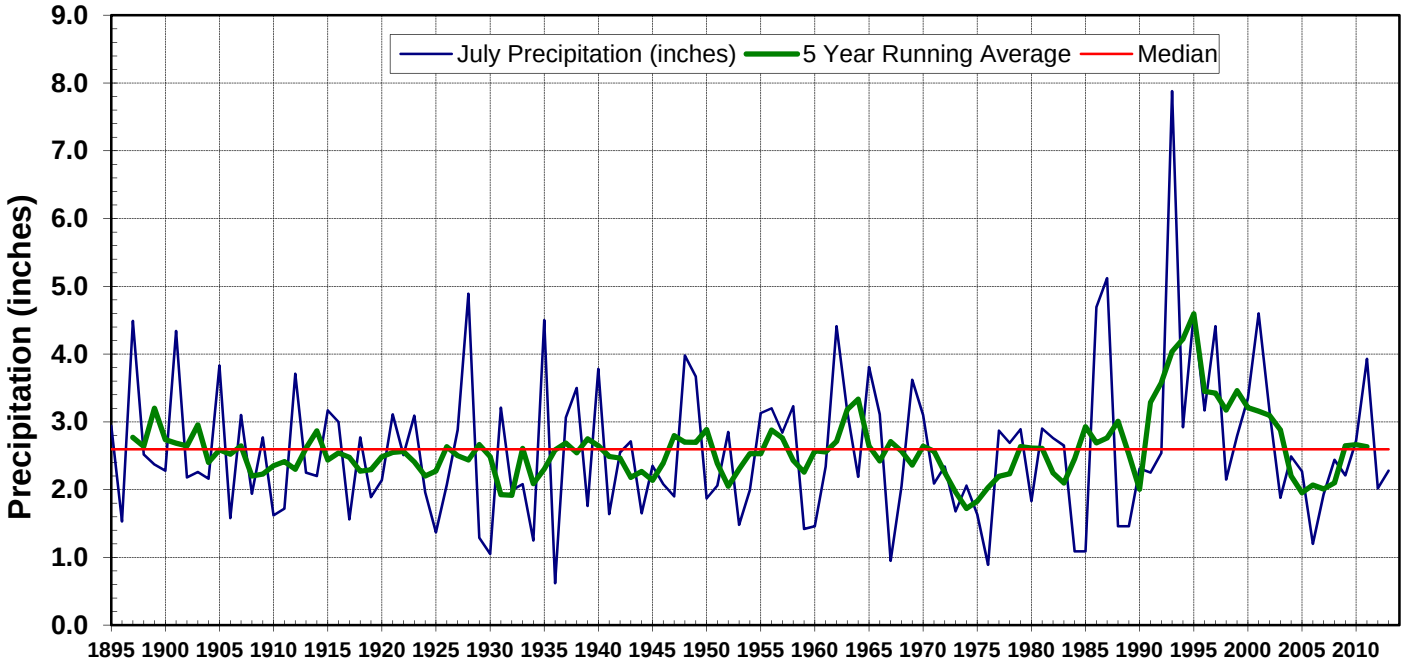


June Precipitation Statistics

2013 Amount: 3.88 inches
Maximum: 7.21 inches in 2005
State Normal: 3.38" (1981-2010)

Monthly Ranking: 39th wettest in 119 years
Minimum: 1.14 inches in 1974
Years in Record: 119

Historical July Precipitation for North Dakota

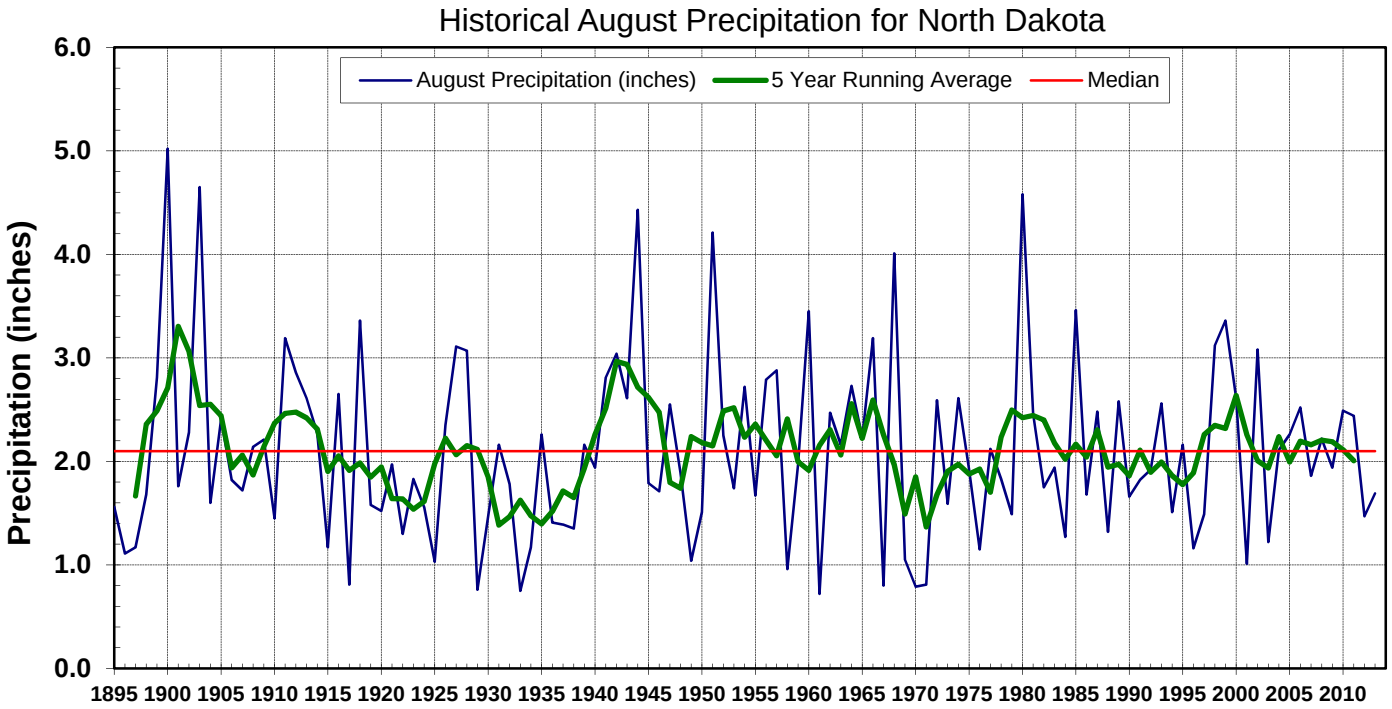


July Precipitation Statistics

2013 Amount: 2.28 inches
Maximum: 7.88 inches in 1993
State Normal: 2.88" (1981-2010)

Monthly Ranking: 55th Driest in 119 years
Minimum: 0.62 inches in 1936
Years in Record: 119

Historical August Precipitation for North Dakota

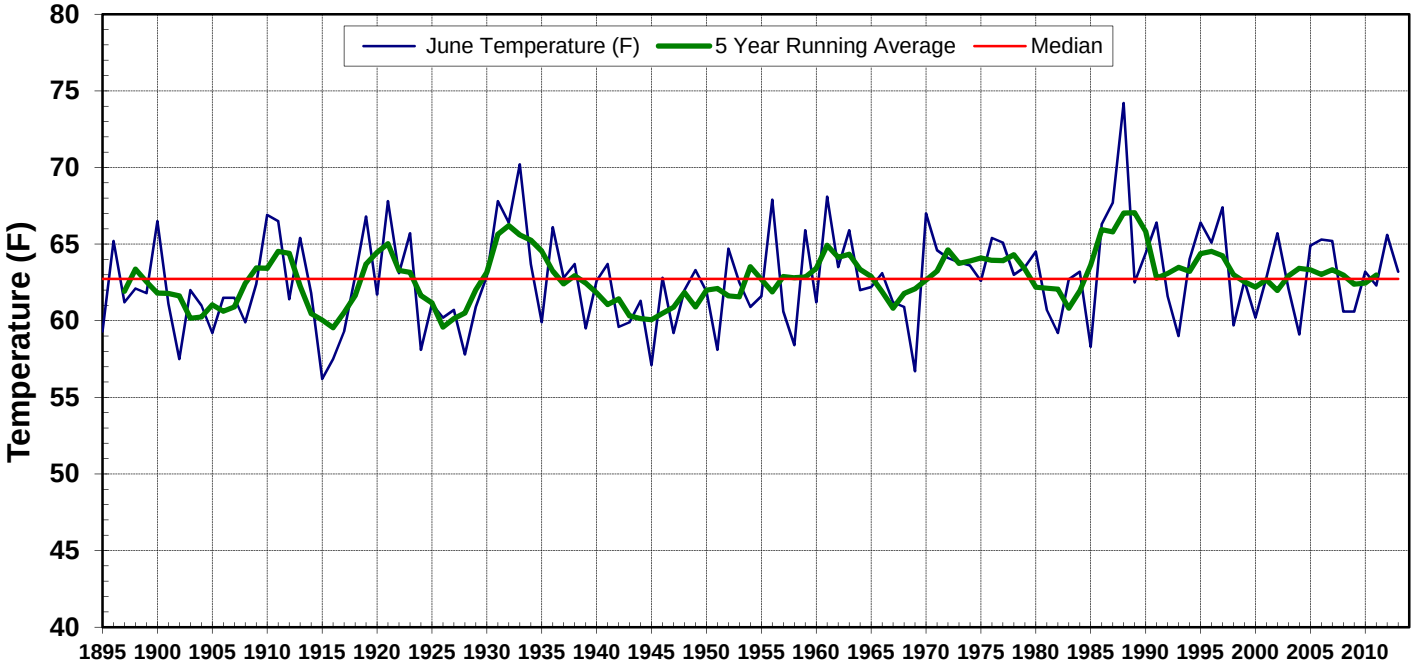


August Precipitation Statistics

2013 Amount: 1.69 inches
Maximum: 5.02 inches in 1900
State Normal: 2.10” (1981-2010)

Monthly Ranking: 43rd driest in 119 years
Minimum: 0.72 inches in 1961
Years in Record: 119

Historical June Temperature for North Dakota

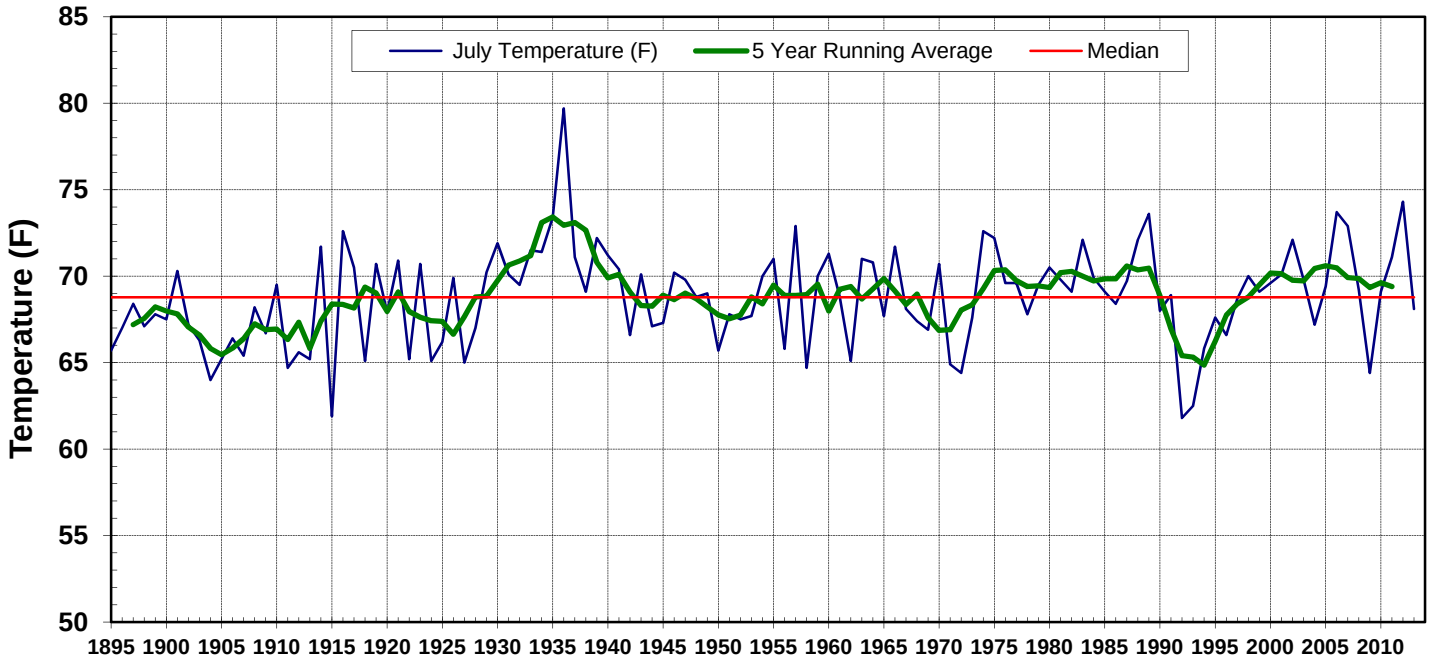


June Temperature Statistics

2013 Average: 63.2 °F
Maximum: 74.2 °F in 1988
State Normal: 63.37 °F (1981-2010)

Monthly Ranking: 48th warmest in 119 years
Minimum: 56.2 °F in 1915
Years in Record: 119

Historical July Temperature for North Dakota

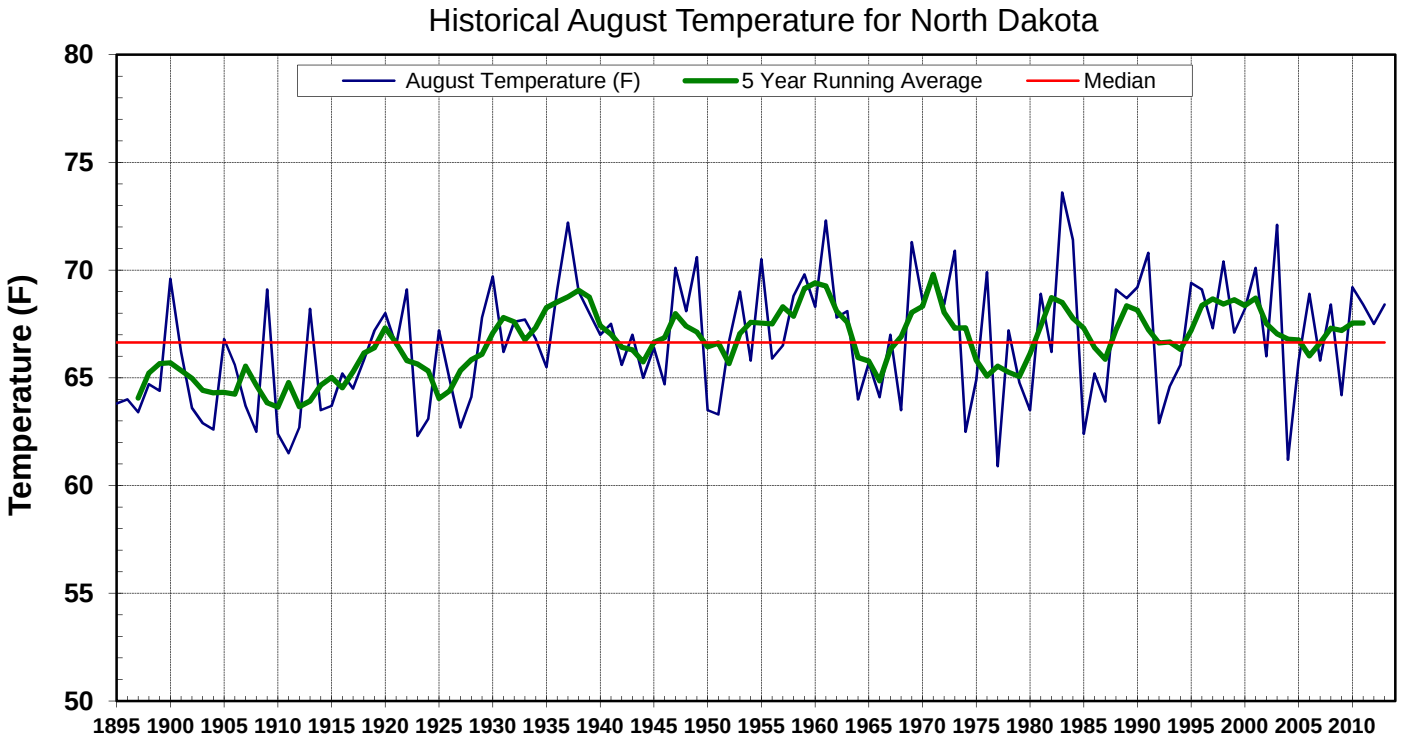


July Temperature Statistics

2013 Average: 68.1 °F
Maximum: 79.7 °F in 1936
State Normal: 69.01 °F (1981-2010)

Monthly Ranking: 49th coolest in 119 years
Minimum: 61.8 °F in 1992
Years in Record: 119

Historical August Temperature for North Dakota



August Temperature Statistics

2013 Average: 68.4 °F
Maximum: 73.6 °F in 1983
State Normal: 67.52 °F (1981-2010)

Monthly Ranking: 34th warmest in 119 years
Minimum: 60.9 °F in 1977
Years in Record: 119

Storms & Record Events

State Tornado, Hail, and Wind Reports for Summer 2013 by B. A. Mullins

North Dakota 3 Month Total	Wind	Hail	Tornado
	125	110	13

Reports by Month			
Month	Wind	Hail	Tornado
Total June	40	51	8
Total July	51	46	3
Total August	34	13	2

North Dakota Record Event Reports for Select Cities: Summer 2013

Date	Location	Type of Record	Previous Record
06/04/13	Grand Forks Airport	1.49 inches of rainfall	1.27 inches in 1958
06/04/13	Minot	1.70 inches of rainfall	1.62 inches in 1953
06/25/13	Fargo	2.56 inches of rainfall	0.99 inches in 1969
07/05/13	Dickinson	0.82 inches of rainfall	0.79 inches in 1964
07/27/13	Grand Forks	45 °F low temperature	Ties 1971
07/27/13	Jamestown	42 °F low temperature	44 °F set in 1904
07/27/13	Bismarck	39 °F low temperature	43 °F set in 1994
07/27/13	Dickinson	40 °F low temperature	Ties 1971
07/28/13	Grand Forks Airport	42 °F low temperature	44 °F set in 1981
07/28/13	Fargo	44 °F low temperature	Ties 1973
07/28/13	Jamestown	41 °F low temperature	42 °F set in 1934
08/06/13	Dickinson	0.64 inches of rainfall	0.49 inches in 1999
08/06/13	Minot	0.83 inches of rainfall	0.68 inches in 2011
08/08/13	Grand Forks Airport	43 °F low temperature	Ties 1994
08/20/13	Bismarck	102 °F high temperature	100 °F set in 1976
08/25/13	Grand Forks NWS	96 °F high temperature	Ties 1953
08/25/13	Grand Forks Airport	97 °F high temperature	Ties 1953

Seasonal Outlook

Fall 2013 Climate Outlooks

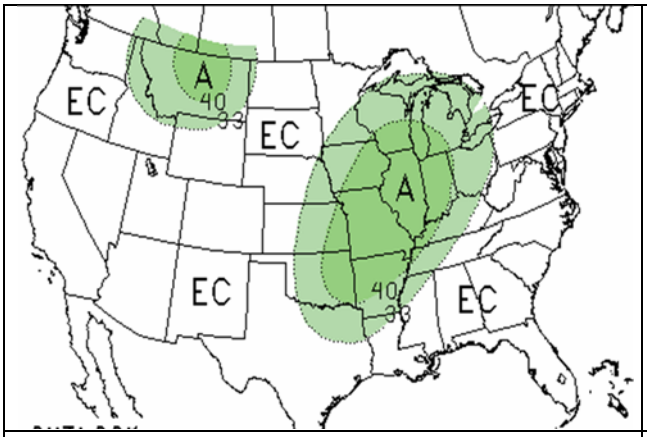
by D. Ritchison[1]

The next three months will take this area from summer heat to winter chill. Autumns can be very short in this part of the world, but in recent years, the transition to winter has been more kind. In the past 15 years, most of the falls have recorded above average temperatures and in some years well above average. In fact, the last noticeably cool autumn was back in 2002. There have certainly been cold periods during some of these years, but overall September through November has generally recorded above average temperatures so far this century.

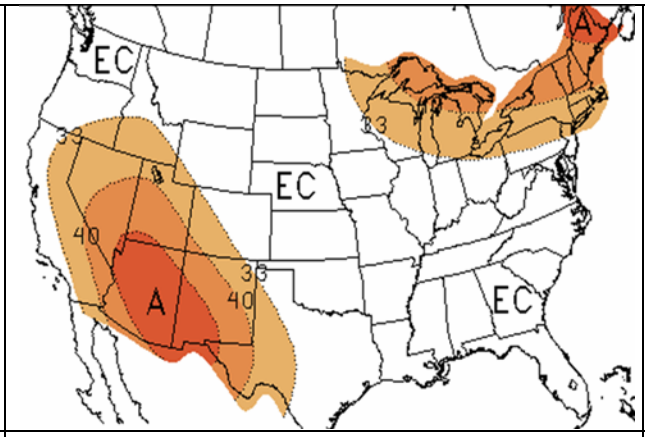
Although recent autumns have been warm, precipitation has been highly variable, with some years being dry, others, very wet. Precipitation is always the most difficult to forecast in the long term as one or two storms can be the difference between being wet or in a drought.

On that note, will our recent trend of warmer than average autumns continue? My suspicion is to some degree no. After a warm September, October and November look to be trending colder than average, meaning the three months, as a whole will average near or below normal. Many parts of the state are experiencing drought conditions once again. If the season progresses as expected, many parts of the area may experience only near average precipitation, with the possible exception of the northern counties that look to be in a slightly more favorable location for higher precipitation amounts in the coming weeks.

The latest summer outlook from the Climate Prediction Center (CPC) for the next three months can be seen below. The CPC is forecasting equal chances of above, below or normal temperatures and precipitation for this area that seems to follow my ideas. You can find their current and future outlooks at http://www.cpc.ncep.noaa.gov/products/predictions/90day.



September through November Precipitation Outlook



September through November Temperature Outlook

Also, the North Dakota State Climate Office has links to the National Weather Service's local 3-month temperature outlooks for the upcoming year. Those forecasts can be found at: http://www.ndsu.edu/ndsco/outlook/L3MTO.html. The readers will also 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/

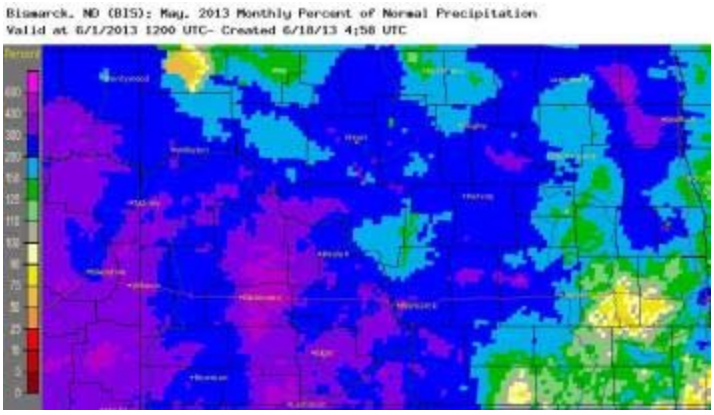
[1] The corresponding author: Daryl Ritchison is a broadcast meteorologist working at WDAY-TV Fargo, ND.
E-Mail: daryl@ritchison.com

Hydro-Talk

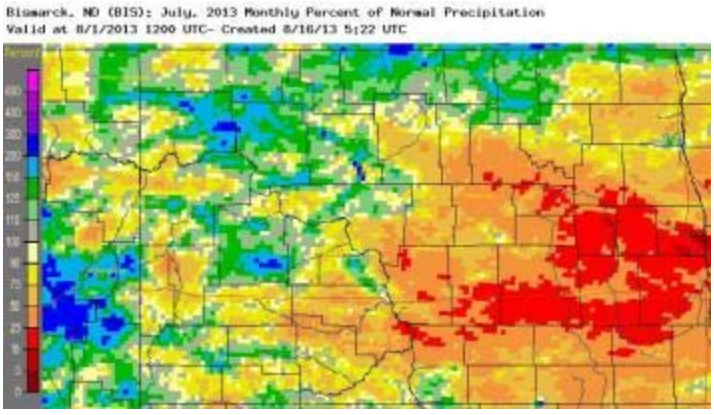
Floods, Droughts and Trends

by A. Schlag[2]

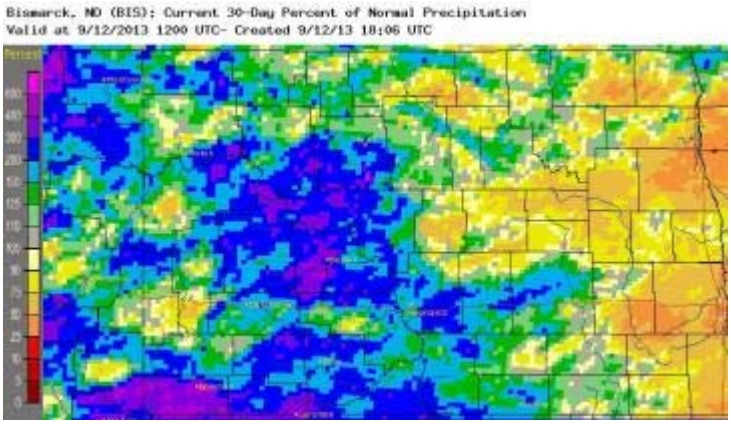
The past 6 months have been quite the roller coaster ride for those interested in all things related to hydrology. This spring once again saw fairly significant runoff in the Red, James, and Souris River basins. Albeit, much of this spring's flooding was significantly mitigated by a very slow melt on top of dry and warm soils in the Red River Valley and James River basin. April's rainfall across the Souris was much lower than normal and also helped minimize spring flooding.



Fast forward to May (shown in the upper-right) and a very different pattern emerges where the southwestern corner of the state becomes unusually wet and a prolonged dry period begins in the southeast.



Unlike the more common small grains out west which depend heavily on late May through early July rains, late June through August is the make or break time for row crops in the east when it comes to yield and quality. Regrettably, July (as shown in the middle-right) was much like June and August where orange and red represent much below normal rain across a large area.



Finally, as one follows the progression of images on the right, the very last one shows a notable improvement in rainfall over the past 30 days.

Using the statistical breakdown for these critical months, we can determine how often this type of precipitation pattern affects North Dakota.

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

While North Dakota has a known change in annual precipitation where the east is generally wetter than the west, I will use NWS data for the Bismarck area as a proxy for the state.

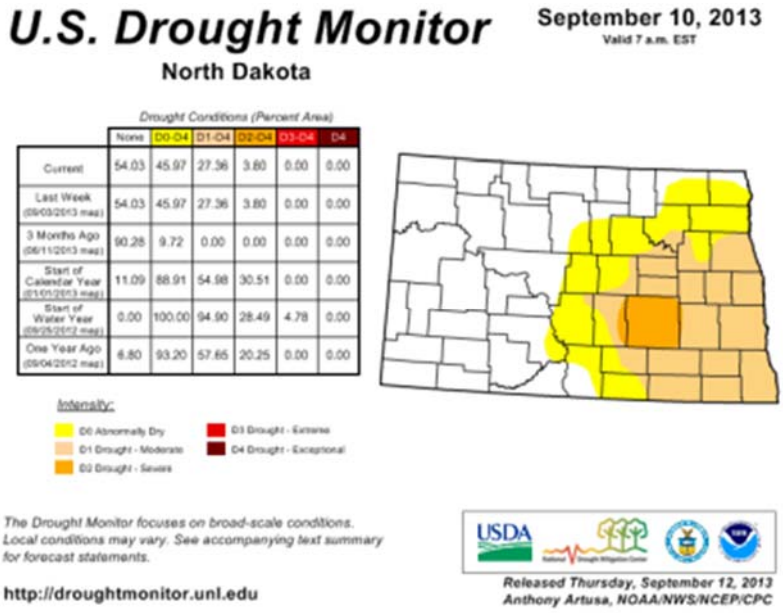
Precipitation Statistics for Bismarck Area (1874 to Present) as inches of water.

Month	Average	Median (50th Percentile)	10th Percentile	25th Percentile	75th Percentile
May	2.30	2.02	0.76	1.13	3.04
June	3.23	2.92	1.23	2.02	4.15
July	2.35	2.09	0.80	1.30	3.14
August	1.89	1.58	0.43	0.87	2.59

One of the interesting things we can glean from the above table is that the median is universally lower than the average by over a quarter inch of rain. This tells us that over half of the time, we are below the much used "normal" we all hear about. Statistically speaking this is easy to explain; while it is impossible to receive a negative amount of rain on the lower end of observed values, the upper end is theoretically unlimited and that skews the average (mean) to be universally higher than the median. Thus a few remarkably wet years exerts a stronger effect on the average than a similar number of years with near zero rainfall during a given month.

All the above brings us to what we already know, North Dakota is climatologically defined as a land of extremes, and the above helps us understand how we can go from flooding to having widespread drought (as shown below) over the course of just a few months.

A key thing to note, though, is that the drought has thus far been short-term with impacts primarily centered on agriculture. No water shortages, abnormally low streamflow, or water availability related restrictions are in place. The only water restrictions put in place thus far are related to water treatment plant capacity being exceeded as the dry weather encourages more lawn watering.



North Dakota is a wonderful place to live for those of us who would grow bored with the same weather every day. For those who grow weary of constant change, might I suggest a long vacation to Hawaii?

Science Bits

Impact of End of Season Drought on Corn 2013

by Joel Ransom[3]

The end of the growing season for corn is fast approaching. At this point, it appears likely that we will make it to the end of September without a hard killing frost. Moreover, current climate predictions seem to indicate that October and November will be warmer than normal. This is great news for the drying of the corn crop prior to harvest. Though we started the season with concerns about corn not reaching maturity before the first killing frost, for much of the state our concerns are now focused on the lack of moisture determining the end of the effective cropping season. The impacts of drought on a corn crop are more gradual than that of a hard frost (temperatures below 28°F). Drought stress begins by reducing photosynthesis as the stoma close and leaves begin to curl. As this stress continues, the lower leaves begin to die and ultimately the entire plant can be killed. During this process, stored carbohydrates and other nutrients are moved from the lower leaves and the stem into the developing kernels. When stored and newly synthesized carbohydrates are not sufficient to support the development of all the kernels in the cob, the uppermost kernels stop growing (see Figure 1). Depending on their stage of development, these kernels may be so small that they will be blown out the back of the combine. Those large enough to not be lost during combining, will be smaller than normal and have low test weight.

Figure 1. Prolonged drought stress during grain filling arrests the development of the uppermost kernels of corn.

About half of the crop is now in the dent stage. Generally when a crop gets to this stage, we are not overly concerned about the impact of drought stress on yield. However, this year, since the drought stress started well before this stage of development, continued stress has the potential to dramatically impact yield. In fact, 40% of the total kernel weight is yet to be added to kernels in the dent stage. Therefore, even the kernels at the lower end of the cob will likely fail to fully fill and will have low test weight at harvest. The recent rain brought relief from severe drought stress in much of the state, but for many farms it came too late to have much

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of an impact on the corn crop. Crops with few or no green leaves will not benefit from these recent rains.

In addition to its impact on yield, drought stress affects stalk quality. Severely stressed crops will be prone to lodging (see Figure 2). Additionally, ear drop can become more problematic in some hybrids after severe drought. Plan to harvest your most severely stressed fields first, and probably sooner than you would normally plan to, in order to minimize losses associated with downed plants or dropped ears.

Figure 2. Stalk quality is compromised with drought stress during grain filling (lodged corn plants near Fargo).

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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