



North Dakota Climate Bulletin

Summer 2015

Volume: 9 No: 3

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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, College of Agriculture, Food Systems and Natural Resources, North Dakota State University in Fargo, North Dakota.

This summer was the 33rd warmest and 47th driest on record statewide since 1895.

The state average summer temperatures increased a mere 0.14 °F per decade during the last 121 years while the state average precipitation only increased 0.02 inches per decade on the average during that period. However, the annual temperature and the precipitation patterns were anything but normal. Rather, they were marked with a great amplitude of annual fluctuations. State average total precipitation ranged from a maximum of 15.54 inches in 1993 to a minimum of 3.32 inches in 1929. Even though the summer was drier than average, no areas in ND experienced drought thanks to unusually wet conditions in May. Weather highlights in each month as well as graphical displays of statewide temperature and precipitation, plus seasonal hydrologic and climate outlooks can be found later in this bulletin.

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



Cirrus vertebratus by Akyüz



Weather Highlights



Seasonal Summary:

by Daryl Ritchison

June 2015 Summary and Statistics

After a cool and wet May, June finished near normal for precipitation and slightly above normal for temperatures. The most significant weather event of the month occurred during the afternoon and evening hours of June 27. At least 19 tornadoes were reported that afternoon and evening in eastern North Dakota into far western Minnesota. Fortunately, no structural damage was reported as most of the tornadoes were brief and remained in open areas away any buildings.

The state average precipitation was 3.65 inches which is above the 1981-2010 normal of 3.35 inches. June 2015 state average precipitation ranked tied for the 49th wettest in the last 121 years with a maximum of 7.01 inches in 2005 and a minimum of 1.11 inches in 1974.

The US Drought Monitor June 30, 2015 reported 9% of North Dakota in D0 (abnormally dry) conditions which was confined to portions of western North Dakota.
(<http://droughtmonitor.unl.edu/>)

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 3% short to very short, and 20% surplus with a subsoil moisture reported as 0% short to very short and 15% surplus. (Weekly Weather and Crop Bulletin Vol. 102, No. 26).

The state average air temperature was 65.1 °F which is above the 1981-2010 normal of 63.3 °F. June 2015 state average air temperature ranked 29th warmest in the past 121 years with a maximum of 74.1 °F in 1988 and a minimum of 56.8 °F in 1915.

NDAWN's highest recorded daily air temperature for June was 96.3 °F at Wyndmere on June 9. The lowest recorded daily air temperature was 38.4 °F at Bottineau, ND, on June 4.

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for June had 40 reports of high wind, 86 hail reports, and 32 reported tornadoes.

The top five June daily maximum wind speeds recorded from NDAWN were 63.6 mph at Mandan on June 19. Other locations within the Bismarck Mandan metro recorded higher wind speeds that day with significant wind damage occurring. Warren with 62.7 mph on June 7, Brorson with 58.1 mph on June 19, Pillsbury with 55.5 mph on June 21 and Sidney, MT with 55.3 mph on June 19. NDAWN wind speeds are measured at a height of 10 feet (3 m).

July 2015 Summary and Statistics

July 2015, like the previous month of June, finished with near average temperatures and precipitation. Although the temperatures were uniformly close to the 30 year average for the month, during the summer months precipitation is rarely evenly distributed. Although as a whole the state finished near average for rainfall, as a general rule, much of the northern part of the state and especially the northeastern corner recorded above average rainfall whereas the southern one-third of North Dakota was quite dry with many locations receiving less than 50% normal rainfall.

The state average precipitation was 2.66 inches which is below the 1981-2010 normal state average of 2.87 inches. June 2015 state average precipitation ranked the 51st wettest in the past 121 years with a maximum of 7.97 inches in 1993 and a minimum of 0.64 inches in 1936.

The US Drought Monitor July 28, 2015 reported 13% of North Dakota in D0 (abnormally dry) conditions. Abnormally dry conditions were found in the northwestern and southeastern corners of North Dakota. (<http://droughtmonitor.unl.edu/>)

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 11% short to very short and 14% surplus with a subsoil moisture reported as 7% short to very short and 11% surplus. (Weekly Weather and Crop Bulletin Vol. 102, No. 30).

The state average air temperature was 69.9 °F which is above the 1981-2010 normal of 69.1 °F. July 2015 state average air temperature ranked the 49th warmest in the past 121 years with a maximum of 80.1 °F in 1936 and a minimum of 61.8 °F in 1992.

NDAWN's highest recorded daily air temperature for July was 97.7 °F at Bowman on July 26. The lowest recorded daily air temperature was 37.5 °F at Ada on the July 7.

According to the preliminary reports from the Storm Prediction Center (SPC), severe weather reports for July had 65 reports of high wind, 64 hail reports, and 2 reported tornadoes.

The top five July daily maximum wind speeds recorded from NDAWN were 71.9 mph at Turtle Lake on July 28, 62.3 mph at Hofflund on July 28, 60.6 mph at Pekin on July 23, 59.2 mph gust was reported at Berthold and McHenry on July 28. NDAWN wind speeds are measured at a height of 10 feet (3 m).

August 2015 Summary and Statistics

Although much of the state recorded below average rainfall during the month, there were two locations that recorded well above average rainfall, one in the northern Red River Valley and the other in the southwestern part of the state. The heavier rain in those two locations were associated with stagnant deformation (“wraparound”) bands of rain from separate mid-latitude cyclones. The heaviest rain from a single event occurred at the Grafton NDAWN site where 7.14 inches was recorded during the overnight hours of August 22-23. Temperatures, like the first two months of the summer season were close to the 30 year average.

The state average precipitation was 1.46 inches which is below the 1981-2010 normal of 2.09 inches. August 2015 state average precipitation ranked 29th driest in the past 121 years with a maximum of 4.74 inches in 1900 and a minimum of 0.73 inches in 1929.

The US Drought Monitor September 1, 2015 reported 8% of North Dakota in D0 (abnormally dry) conditions which was all confined to the northwestern corner of the state. (<http://droughtmonitor.unl.edu/>)

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 35% short to very short and 4% surplus with a subsoil moisture reported as 31% short or very short and 3% surplus. (Weekly Weather and Crop Bulletin Vol. 102, No. 35).

The state average air temperature was 67.9 °F which is slightly above the 1981-2010 average of 67.6 °F. August 2015 state average air temperature ranked the 49th warmest in the past 121 years with a maximum of 73.8 °F in 1983 and a minimum of 61.2 °F in 1977.

NDAWN’s highest recorded daily air temperature for August was 103.9 degrees at Watford City on August 12 and at Williston on August 14. Several triple digit maximums were recorded during the month which were the first 100° or higher maximums since 2013. The lowest recorded daily air temperature was 33.4 °F at Hettinger, ND, on August 24. The Hettinger airport recorded a low of 31° that morning for the first freezing temperature of the season in North Dakota.

According to the preliminary reports of the National Weather Service’s Storm Prediction Center (SPC), severe weather reports for May had 6 reports of high wind, 15 hail reports, and 0 reported tornadoes.

The top five May daily maximum wind speeds recorded from NDAWN were from Robinson on August 22 at 57.6 mph, Leonard on August 15 with 56.9 mph, Turtle Lake on August 22 with 51.4 mph, Dazey on August 22 with 50.8 mph and Linton also on August 22 with 49.9 mph. NDAWN wind speeds are measured at a height of 10 feet (3 m).

Summer 2015 Summary

According to the National Centers for Environmental Information (NCEI) the climatological summer of 2015 had a statewide average temperature of 67.6 degrees. That is 0.9 degrees above the current 30-year average temperature 66.7 degrees. That would rank the season as tied for the 33rd warmest in the past 121 years.

The three month statewide average rainfall according to NCEI was 7.77 inches. That is 0.53 inches below the 30 year average of 8.30 inches. That would rank as the 47th driest since such records started to be calculated in 1895.

Although temperatures were generally uniformed around the current average and the summer could be classified in the “normal” range, rainfall in typical fashion for a continental climate varied significantly around the state. In generally, a high percentage of the state tended to recorded either near or less than 75% of normal precipitation or near or above 125% of normal with few areas around the average.

Season in Graphics

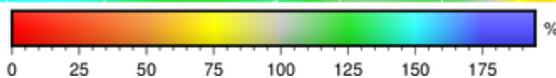
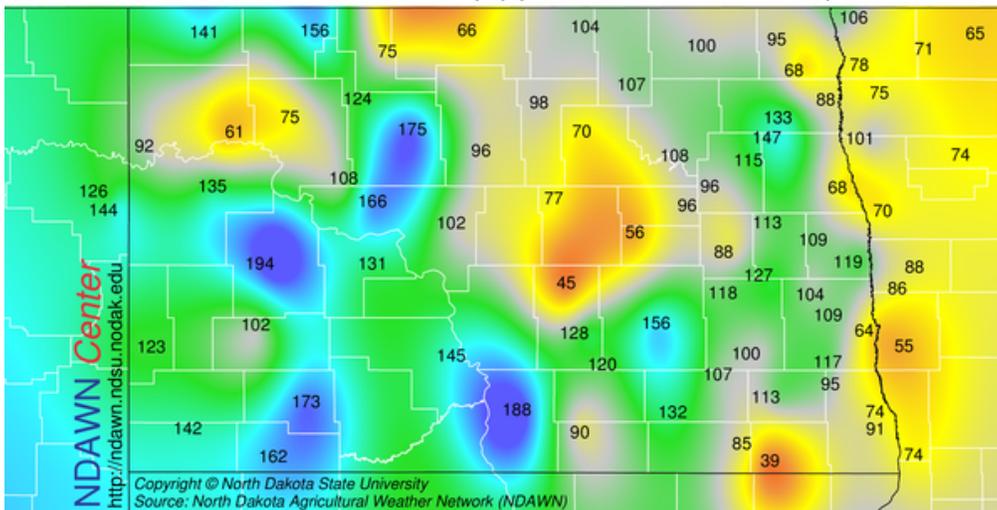
Summer 2015 Weather in North Dakota:

Total Precipitation percent of mean (1981-2010)

Precipitation Percent of Normal

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

Percent of Normal Rainfall (%) (2015-06-01 – 2015-06-30)



North Dakota State Climate Office



June 2015

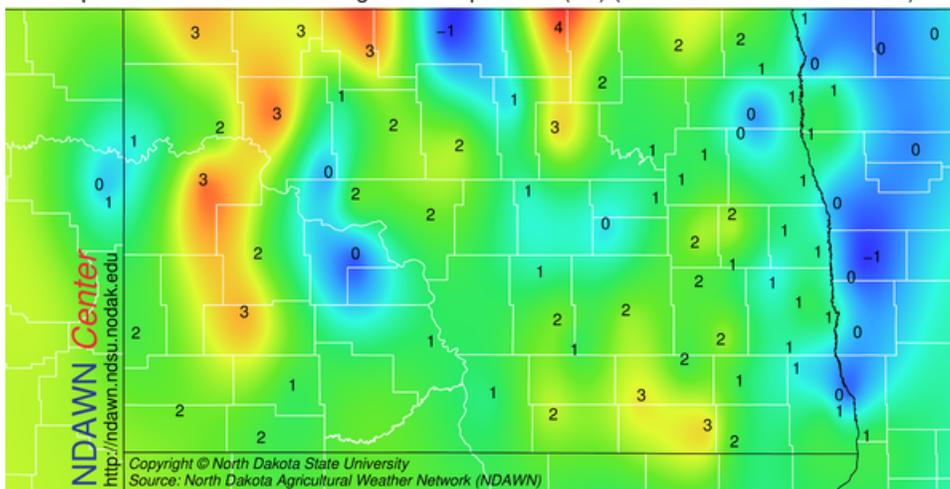
Average Temperature (°F) Deviation from Mean (1981-2010)

Departure From Normal Monthly

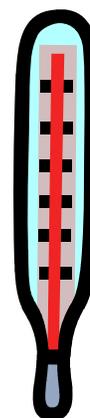
Average Air Temperature in degrees F

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

Departure from Normal Average Air Temperature (°F) (2015-06-01 – 2015-06-30)



North Dakota State Climate Office



Season in Graphics

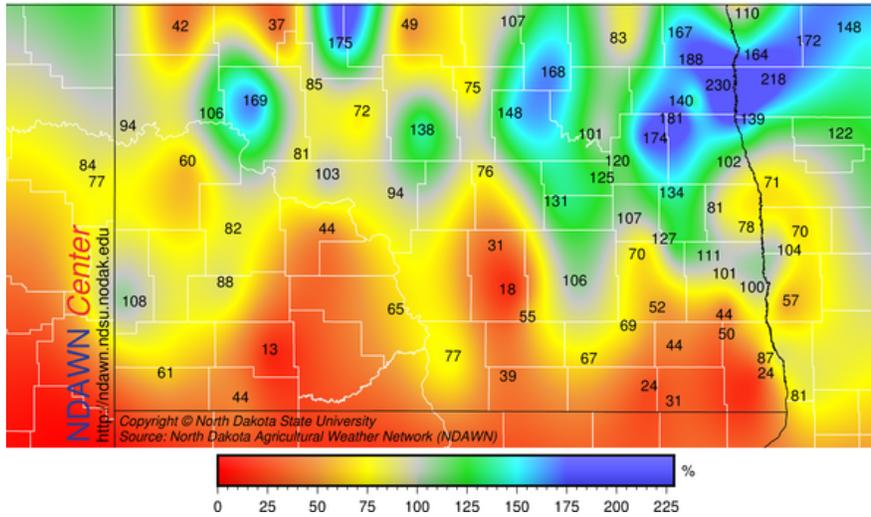
Summer 2015 Weather in North Dakota:

Total Precipitation percent of mean (1981-2010)

Precipitation Percent of Normal

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

Percent of Normal Rainfall (%) (2015-07-01 – 2015-07-31)



North Dakota State Climate Office

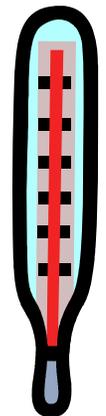
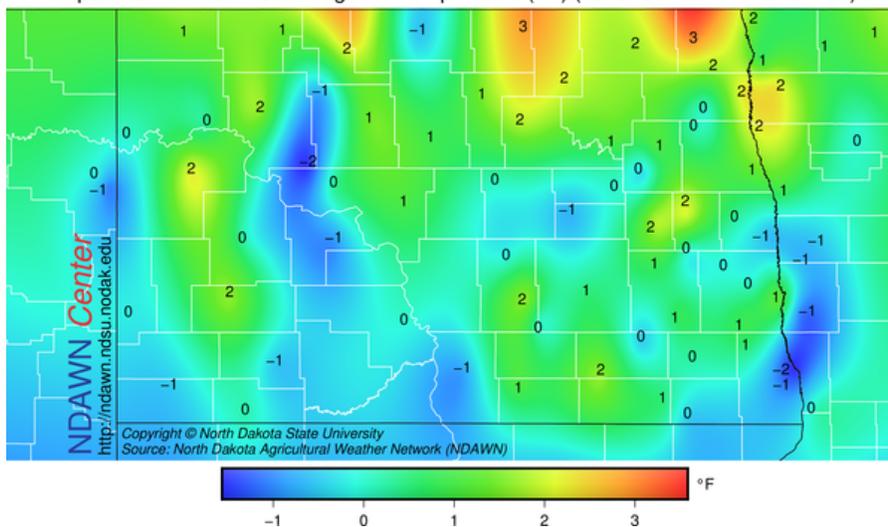
Average Temperature (°F) Deviation from Mean (1981-2010)

Departure From Normal Monthly

Average Air Temperature in degrees F

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

Departure from Normal Average Air Temperature (°F) (2015-07-01 – 2015-07-31)



North Dakota State Climate Office

July 2015

August 2015

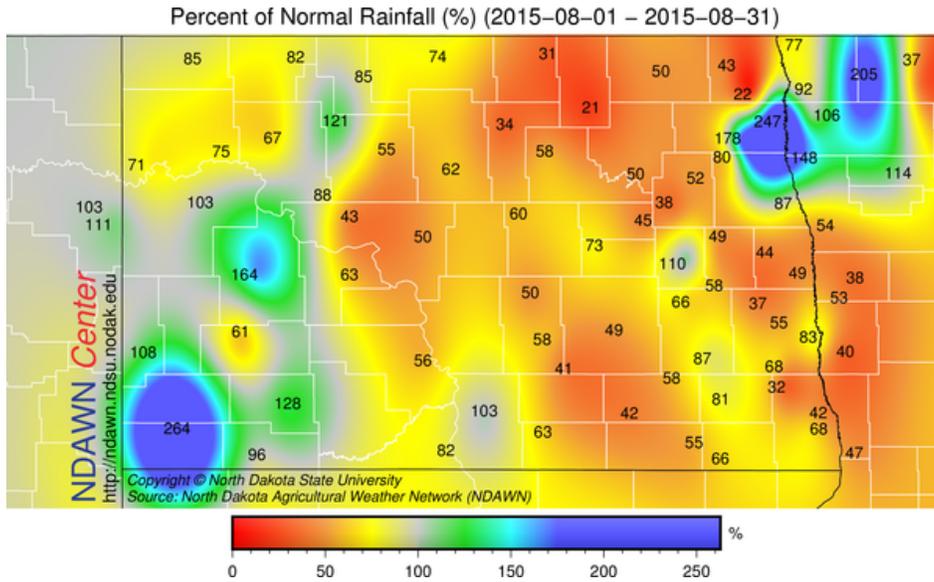
Season in Graphics

Summer 2015 Weather in North Dakota:

Total Precipitation percent of mean (1981-2010)

Precipitation Percent of Normal

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



North Dakota State Climate Office

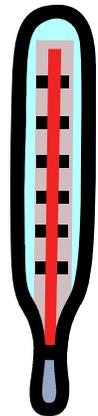
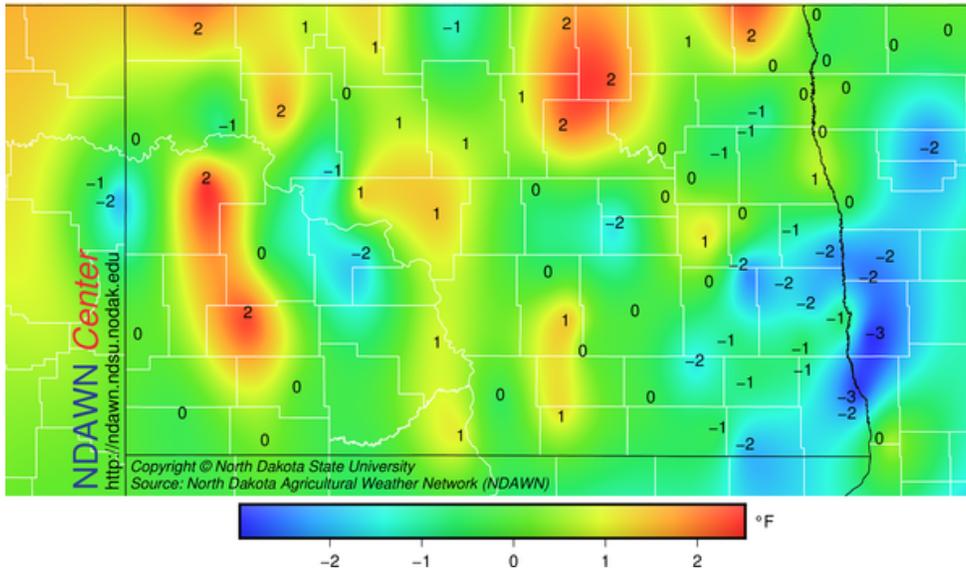
Average Temperature (°F) Deviation from Mean (1981-2010)

Departure From Normal Monthly

Average Air Temperature in degrees F

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

Departure from Normal Average Air Temperature (°F) (2015-08-01 – 2015-08-31)



North Dakota State Climate Office

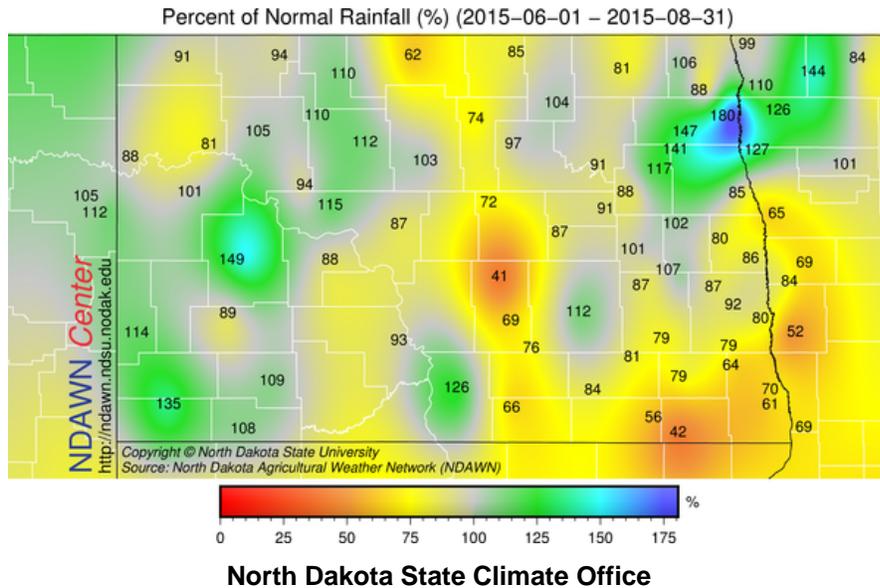
Summer 2015

Season in Graphics

Total Precipitation percent of mean (1981-2010)

Precipitation Percent of Normal

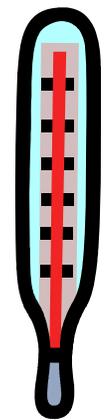
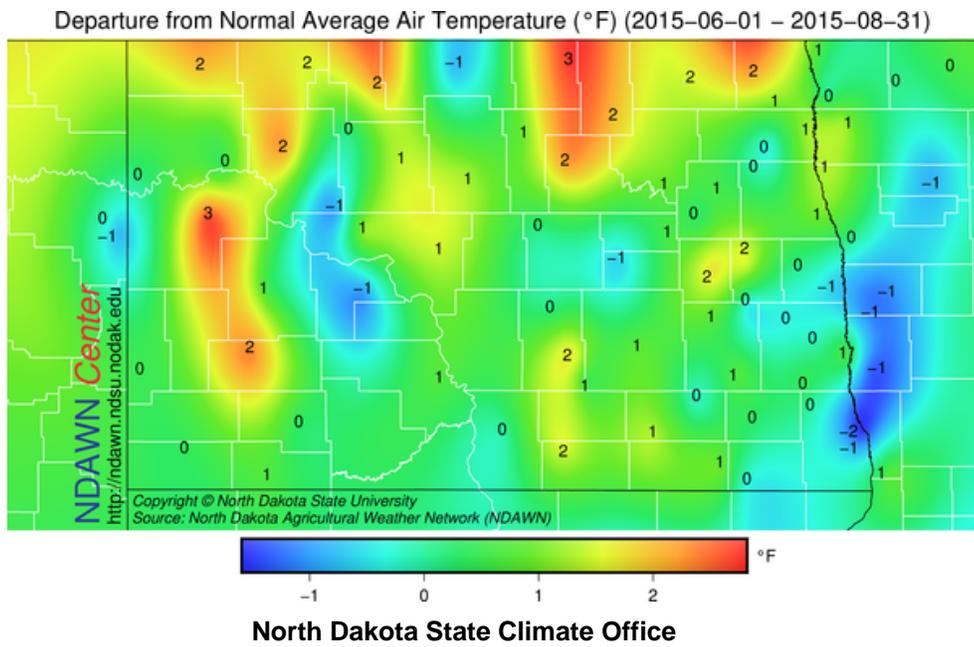
(Data from NWS Cooperative Network/HRPCC)



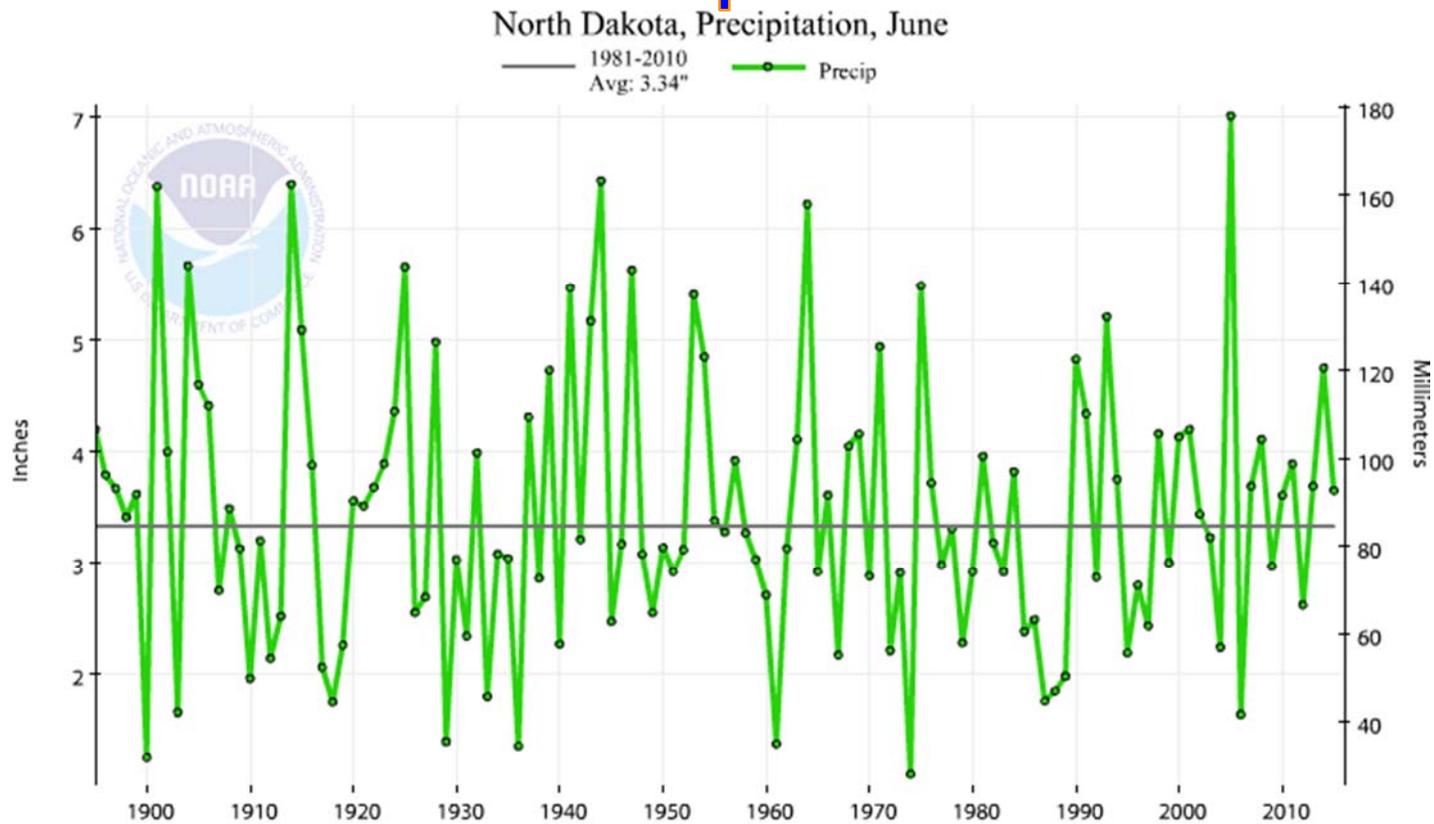
Average Temperature (°F) Deviation from Mean (1981-2010)

Departure From Normal Monthly
Average Air Temperature in degrees F

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



Historical June Precipitation for North Dakota

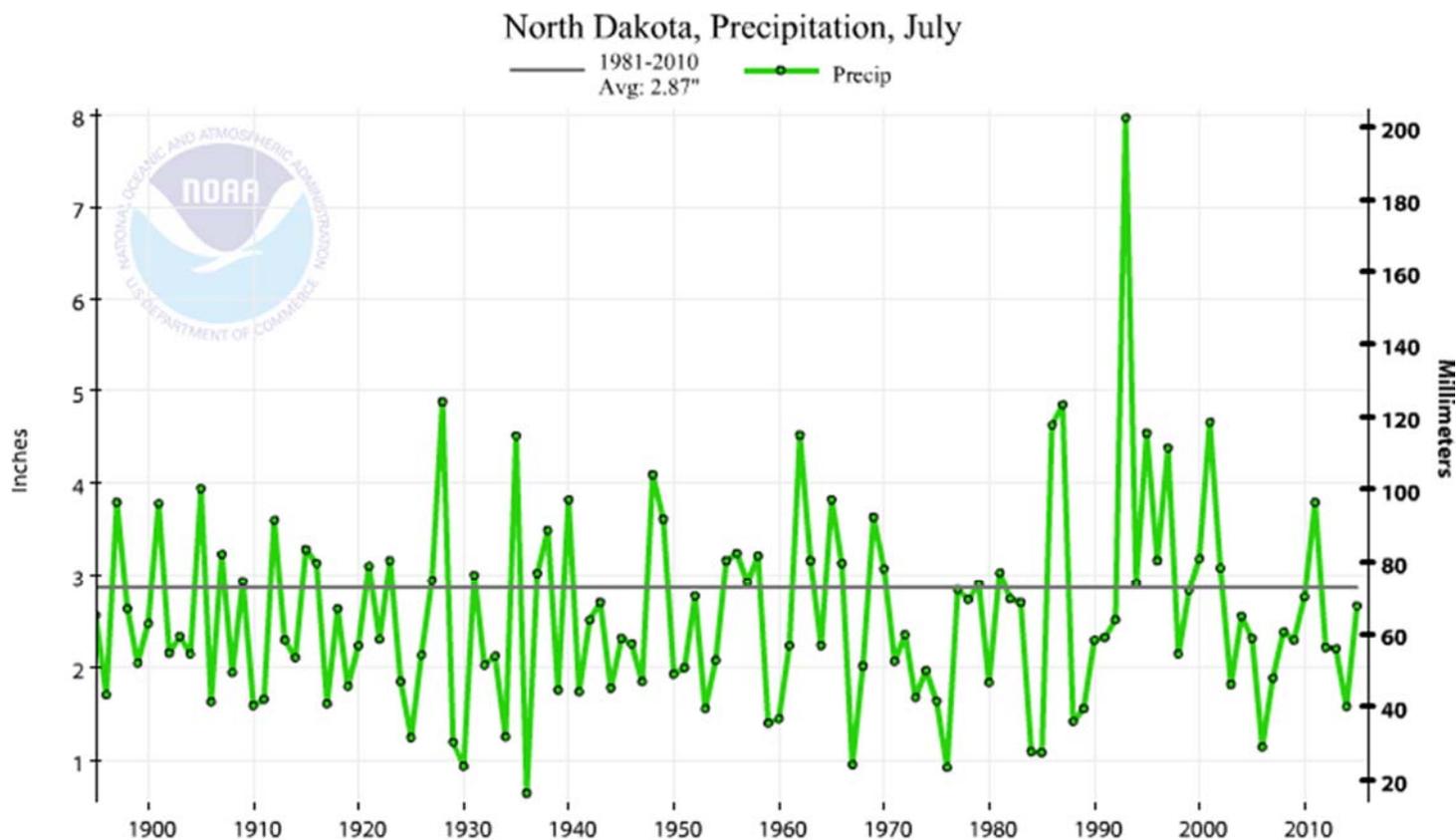


June Precipitation Statistics

2015 Amount: **3.65 inches**
Maximum: 7.01 inches in 2005
State Normal: 3.35 inches (1981-2010)

Monthly Ranking: 49th wettest
Minimum: 1.11 inches in 1974
Years in Record: 121

Historical July Precipitation for North Dakota

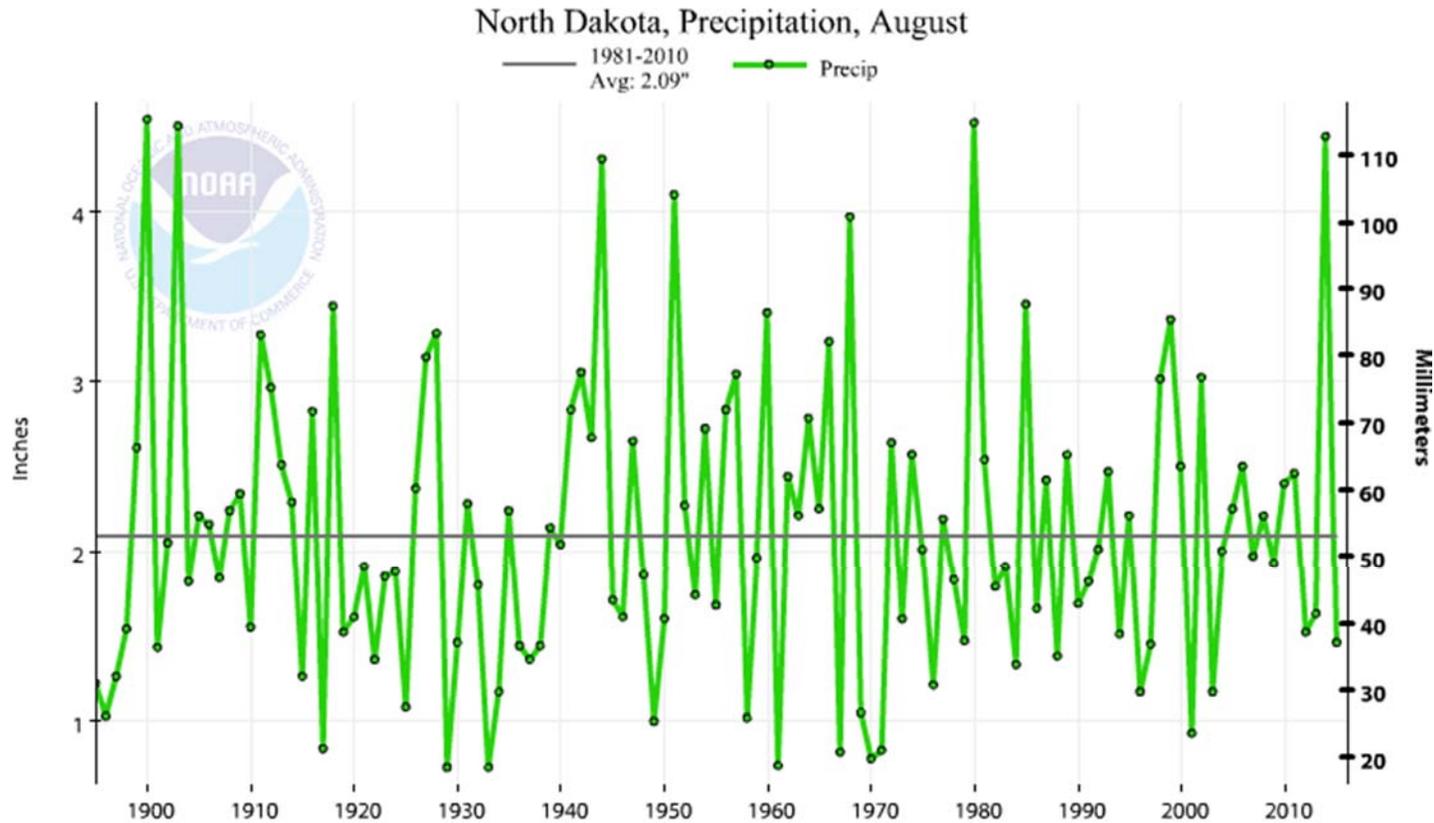


July Precipitation Statistics

2015 Amount: 2.66 inches
Maximum: 7.97 inches in 1993
State Normal: 2.87 inches (1981-2010)

Monthly Ranking: 51th wettest
Minimum: 0.64 inches in 1936
Years in Record: 121

Historical August Precipitation for North Dakota

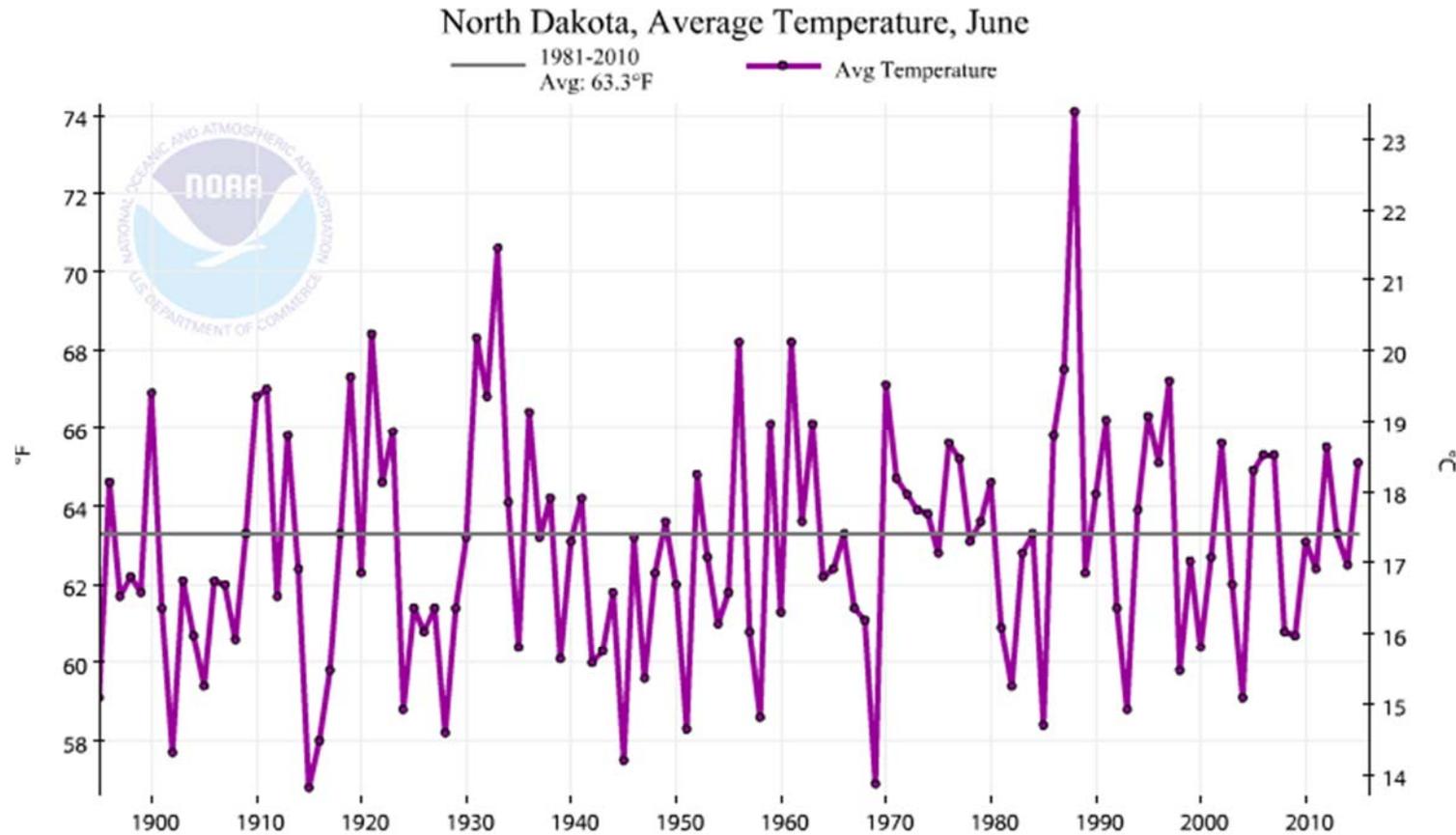


August Precipitation Statistics

2015 Amount: 1.46 **inches**
Maximum: 4.74 inches in 1900
State Normal: 2.09 inches (1981-2010)

Monthly Ranking: 29th driest
Minimum: 0.73 inches in 1929
Years in Record: 121

Historical June Temperature for North Dakota



June Temperature Statistics

2015 Average: **65.1** °F

Maximum: 74.1 °F in 1988

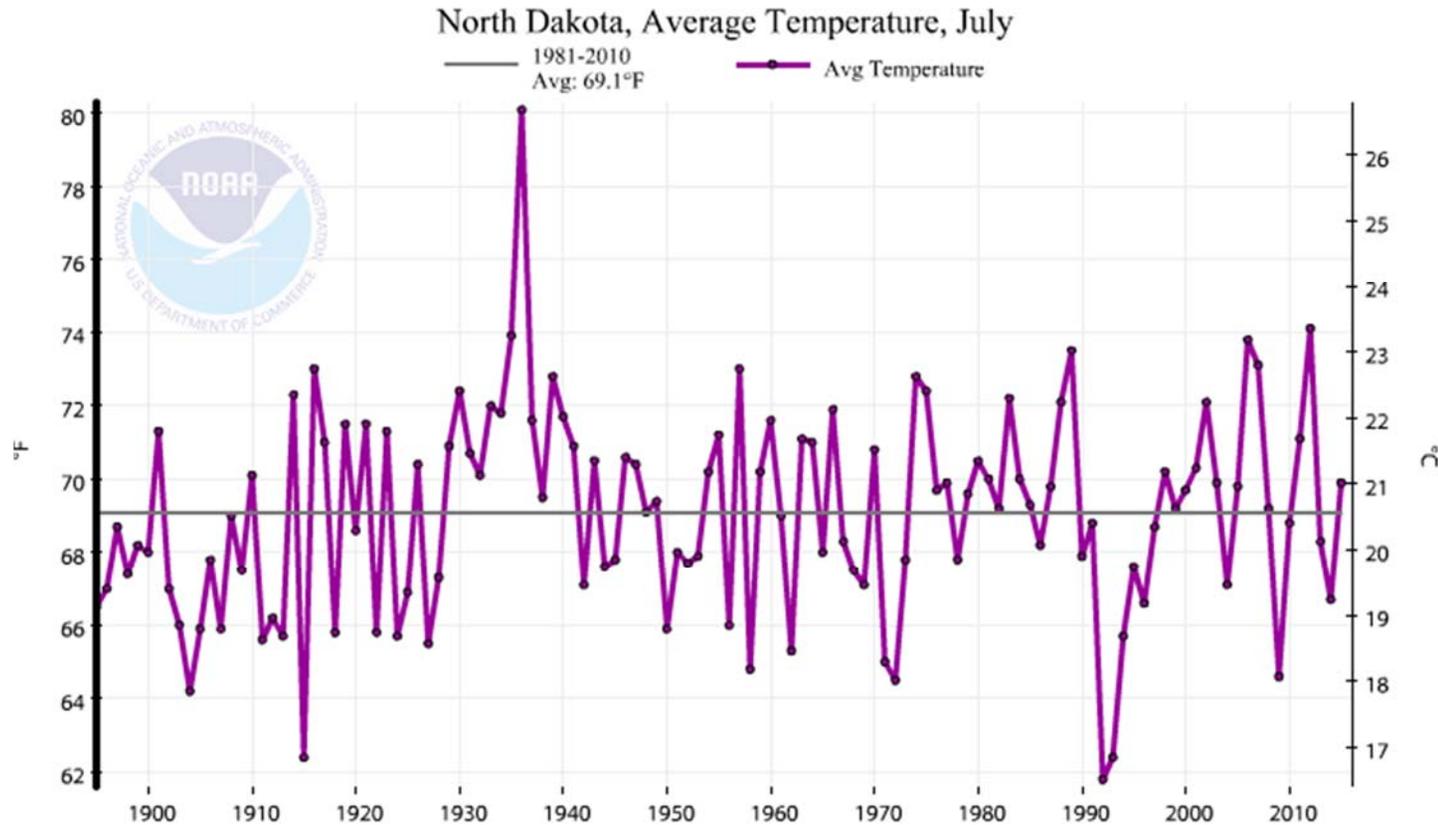
State Normal: 63.3 °F (1981-2010)

Monthly Ranking: 29th warmest

Minimum: 56.8 °F in 1915

Years in Record: 121

Historical July Temperature for North Dakota

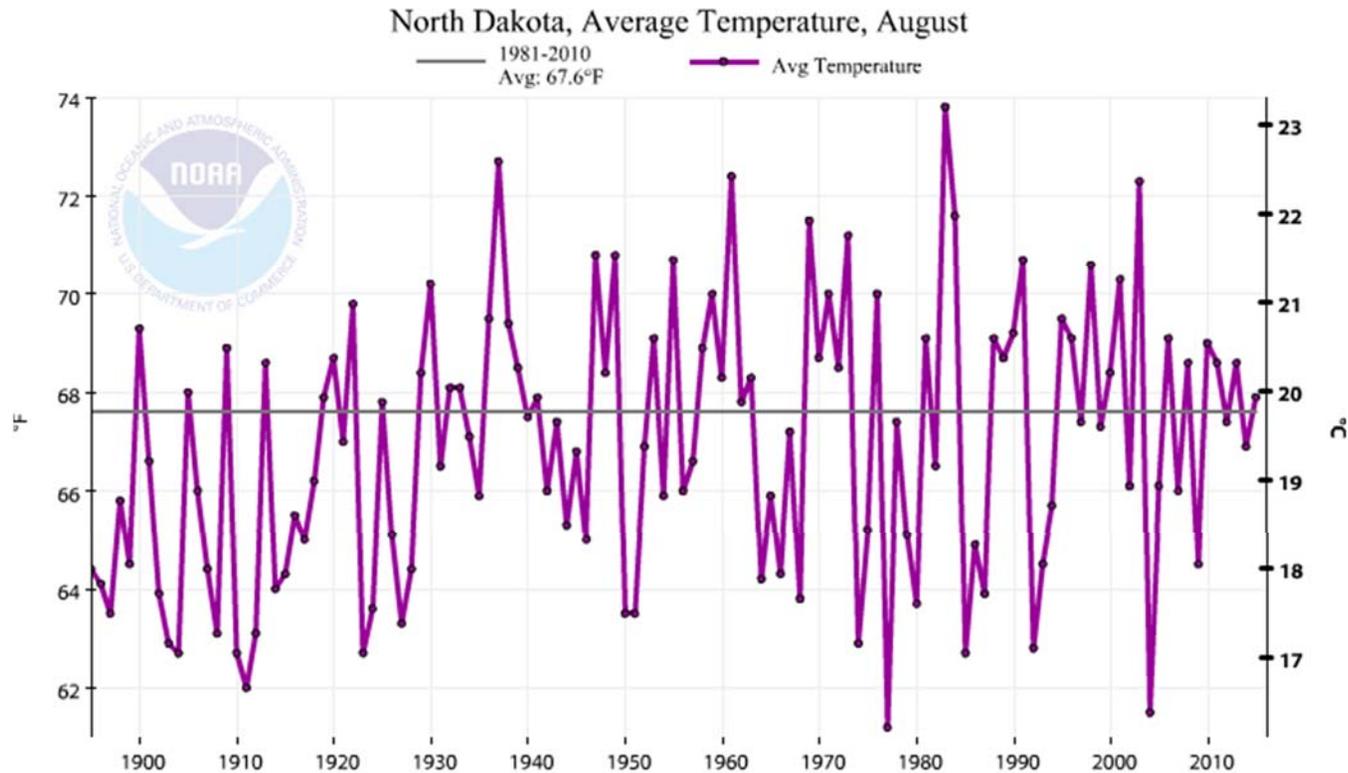


July Temperature Statistics

2015 Average: 69.9 °F
Maximum: 80.1 °F in 1936
State Normal: 69.1 °F (1981-2010)

Monthly Ranking: 49th Warmest
Minimum: 61.8 °F in 1992
Years in Record: 121

Historical August Temperature for North Dakota



August Temperature Statistics

2015 Average: **67.9 °F**
Maximum: 73.8 °F in 1983
State Normal: 67.6 °F (1981-2010)

Monthly Ranking: 49th warmest
Minimum: 61.2 °F in 1977
Years in Record: 121



Storms & Record Events



State Tornado, Hail, and Wind Reports for Summer 2015

by D. Ritchison

North Dakota 3 Month Total	Wind 111	Hail 165	Tornado 34
Reports by Month			
Month	Wind	Hail	Tornado
Total June	40	86	32
Total July	65	64	2
Total August	6	15	0

North Dakota Record Event Reports for Summer 2015

Date	Location	Type of Record	Previous Record
06/16/15	Jamestown Airport	56° F lowest maximum temperature	59° in 2000
06/16/15	Dickinson Airport	55° F lowest maximum temperature	59° in 1957
06/02/15	Williston Airport	1.53 inches of rain	0.90 inches in 2002
06/19/15	Minot Int'l Airport	1.05 inches of rain	0.79 inches in 1975
07/26/15	Dickinson Airport	1.35 inches of rain	0.76 inches in 2001
07/07/15	Fargo Airport	42° F minimum temperature	44° set in 2004
07/07/15	Grand Forks Airport	43° F minimum temperature	44° set in 2004
07/28/15	Williston Airport	64° F lowest maximum temperature	64° set in 1956
07/17/15	Dickinson Airport	69° F lowest maximum temperature	72° set in 2000
07/11/15	Bismarck Airport	69° F highest minimum temperature	Tied 69° set in 1960
08/12/15	Dickinson Airport	102° F maximum temperature	100° set in 1978
08/12/15	Williston Airport	102° F maximum temperature	101° set in 2003
08/14/15	Minot Int'l Airport	101° F maximum temperature	98° set in 1961
08/14/15	Williston Airport	104° F maximum temperature	103° set in 2003
08/15/15	Bismarck Airport	105° F maximum temperature	101° set in 2003
08/15/15	Minot Int'l Airport	100° F maximum temperature	Tied 100° set in 1971
08/12/15	Minot Int'l Airport	70° F highest minimum temperature	Tied 70° set in 2003
08/15/15	Grand Forks (UND)	73° F highest minimum temperature	72° set in 1937
08/15/15	Fargo Airport	74° F highest minimum temperature	71° set in 1972
08/15/15	Grand Forks Airport	73° F highest minimum temperature	66° set in 2014
08/15/15	Bismarck Airport	73° F highest minimum temperature	70° in 1972
08/30/15	Minot Airport	65° F highest minimum temperature	64° in 2013
08/22/15	Grand Forks (UND)	1.76 inches of rain	0.83 inches in 1992
08/22/15	Bismarck Airport	1.02 inches of rain	0.66 inches in 1991
08/22/15	Minot Airport	1.05 inches of rain	0.46 inches in 1983
08/23/15	Grand Forks (UND)	2.49 inches of rain	1.99 inches in 1932



Seasonal Outlook



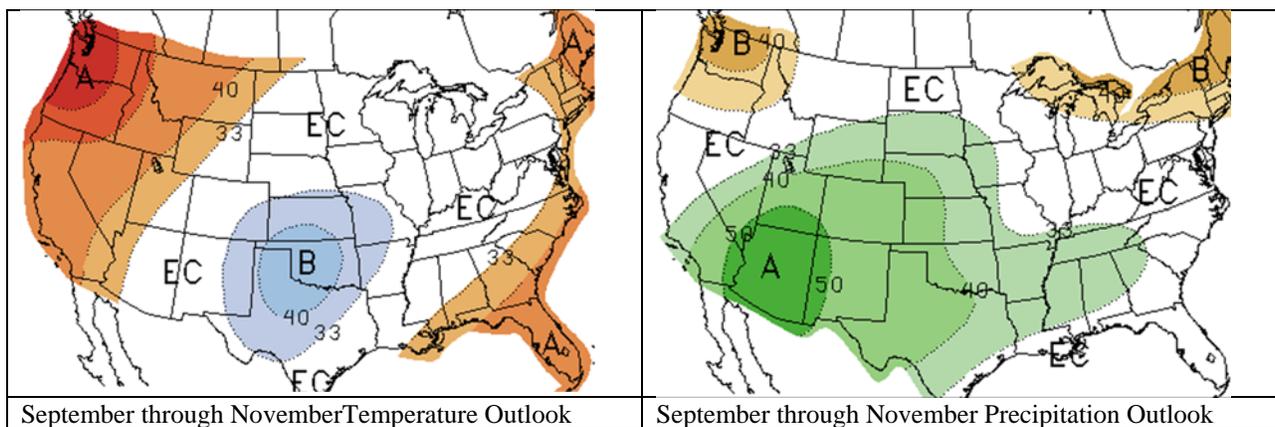
Fall 2015 Climate Outlooks by . R. Kupec¹

News and weather reports have been filled with stories of the developing strong El Niño in the southern Pacific Ocean. Some have even termed it a “super El Niño” and claim it will rival or surpass the large El Niño event of 1997. Before you start running out and stocking up on snow shovels, recalling the winter of 1997, relax. The El Niño that year impacted the winter of 1997/98, one you likely don’t remember. All of North Dakota saw a much warmer than average winter and most locations saw lower than average snowfall. But we are getting ahead of ourselves as this is a Fall Climate Outlook.

While winters tend to see above average temperatures in North Dakota during an El Niño event, autumn actually sees cooler than average temperatures. The cooling tends to be greater with stronger El Niño events. Dissecting the numbers a little further, the greatest departure from average seems to occur in October in the western portion of the state while November is further below average in the eastern half. If this year truly is analogous to the 1997 El Niño (and it appears that other ocean currents may be similar), the fall that year saw above average temperature state wide in September and October then much below average temperatures in November. The current Climate Prediction Center (CPC) outlook has an equal chance of below or above average temperatures for the fall in all of North Dakota except for the northwest corner (See the figure below).

Trying to draw any conclusions about autumn precipitation during an El Niño event is nearly impossible. There is a large degree of variability from station to station across the state. What one could infer from that, is a lack of large scale storm systems and rather smaller more localized or regional precipitation events. The one slight trend seems to be for drier Novembers across the state. The current CPC outlook agrees with this trend and gives an equal chance of above or below average precipitation through the period (See the figure below).

Summer 2015 brought a large degree of variability in temperature and precipitation to North Dakota and I would expect that trend to carry into September and October. With the strengthening El Niño, the data certainly leans towards a colder and possibly drier than average November across the state. It is interesting to note that November 1997 saw above average snowfall in the Red River Valley. So if this autumn truly is analogous to that year, the season could very well end more like winter. The next CPC outlook will be out around September 20th and is available at: <http://www.cpc.ncep.noaa.gov/products/predictions/90day>



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/data/enso/#c343262>.

¹The corresponding author: Rob Kupec is Chief Meteorologist - KVRR TV in Fargo, ND. rkupec@kvrr.com.



Hydro-Talk



North Dakota's Latest Hydrologic Status by A. Schlag²

As the region approaches autumn, summer grows distant in the rearview mirror, the best I can say about this summer is it lacked anything notable in the world of hydrology. Sure, there were minor floods and dry spells, but this is more normal for North Dakota than it is memorable. So the questions are already being asked, such as “how are we sitting with respect to soil moisture going into winter”? Well, it’s still way too early to know the answer to that, but we do have some early expectations for the coming winter.

All forecasts suggest the 2015-2016 winter will be under the effect of a strong El Niño, actually the Climate Prediction Center has issued an El Niño Advisory in order to help people prepare for the known effects of an El Niño. As the graphics to the right suggest, there is a statistically greater chance for a slightly warmer than average winter (Figure 1). Similarly, there is a greater chance of seeing a few less inches of snow than normal.

Perhaps the more interesting aspect of this isn't that we have a better than normal chance for below normal snowfall, or the slightly warmer than normal winter as shown in the statistics, it's what happens to our snow during many of the El Niño affected winters (Figure 2).

The Polar Jet Stream tends to be located farther north during an El Niño (Figure 3). This puts North Dakota a

DJF EL NINO TEMPERATURE ANOMALIES (C)
AND FREQUENCY OF OCCURRENCE (%)

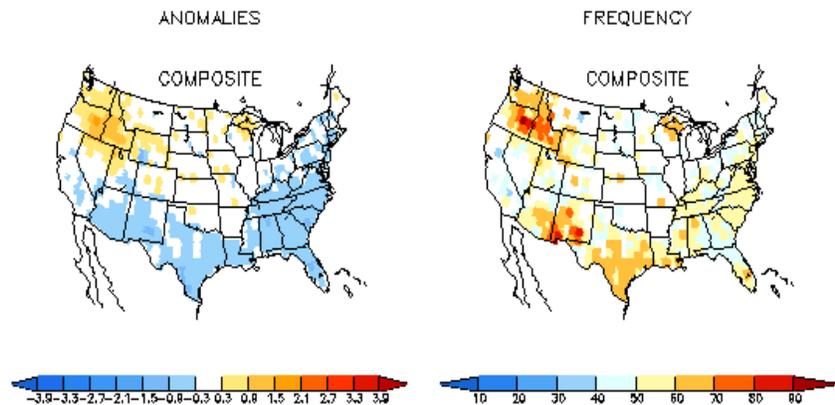


Figure 1. El Niño Winter Temperature Anomalies.

DJF EL NINO SNOW ANOMALIES (IN)
AND FREQUENCY OF OCCURRENCE (%)

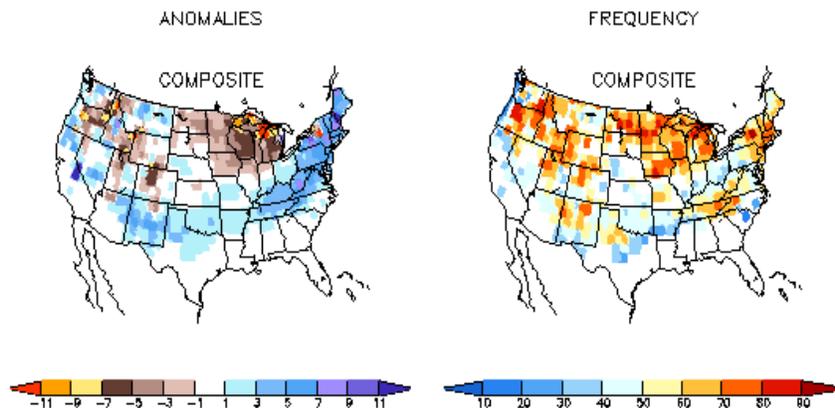


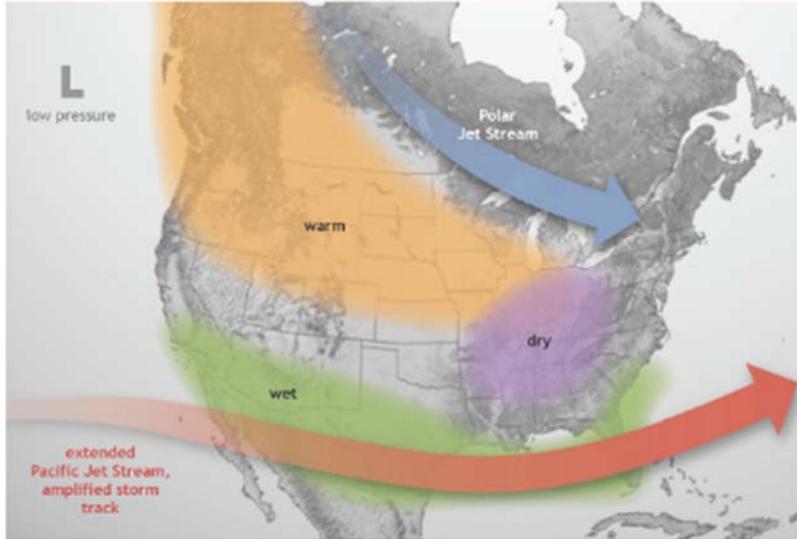
Figure 2 Figure 1. El Niño Winter Snowfall Anomalies.

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

bit more on the extreme end of its short-term perturbations, thereby reducing the number of extreme cold air outbreaks while enhancing the chances for more mild weather patterns coming up from the south.

Figures 1 and 2 used 18 El Niño years to composite: 1958, 1964, 1966, 1969, 1970, 1973, 1977, 1978, 1983, 1987, 1988, 1992, 1995, 1998, 2003, 2005, 2007, and 2010.

Wintertime El Niño pattern



So while it is clearly way too far in advance to have much for expectations for the hydrologic conditions at the end of winter; short periods of well above normal temperatures substantially increase sublimation, melting, and evaporation during the winter. Anecdotally, this greatly reduces the survival of received snow through the entire course of a winter. Less snowpack equals less snow-water equivalent available for the spring melt season.

Figure 3. Wintertime El Niño Pattern

Indeed, locally the numbers can be quite stark as shown in the final graphic where I use Minot as an

example. El Niño years when combined with the warm phase (+) of the Pacific Decadal Oscillation (PDO), which data suggests we are now in, can have a noticeable influence on temperature (Figure 4). This certainly contrasts with the subset of data where the -PDO is combined with a La Nina.

Local Temperatures - Averages and Anomalies				
Departure from normal in degrees F.				
Minot, ND	All Years	10 events	11 events	18 events
Temperatures	Average	+PDO El Niño	-PDO El Niño	-PDO La Niña
December	13.5°F	+5.4°F	+2.8°F	-2.3°F
January	6.8°F	+5.5°F	-1.6°F	-2.7°F
February	12.1°F	+9.7°F	-0.9°F	-2.3°F
March	24.1°F	+2.6°F	-2.5°F	-0.2°F
April	40.6°F	+3.6°F	+1.2°F	-1.2°F
Cool Season Avg	19.4°F	+5.4°F	+0.4°F	-1.7°F

And now the disclaimer, within the raw data used to compile these statistics, it was clear that there are years which stood out as a statistical outlier of sorts. This suggests that while El Niño does indeed have a role in determining the final outcome, there are other climate drivers that can, and do, exert a great influence as well. However, their role is less assured and more complicated.

Figure 4. Temperature Anomalies Compositied for ENSO and PDO Phases for Minot, ND.



Science Bits



A Perfect “A” for the Air Quality in ND

by Adnan Akyüz³

Based on the American Lung Association (ALA) ratings, all counties that are monitoring air quality in North Dakota shown in Table 1 received a perfect “A” grade for each county based on the number of days with an observed Air Quality Index (AQI) less than or equal to 50. All counties mentioned in Table 1 has zero days with an AQI greater than 50. See Table 2 to understand the AQI.

Table 1. ND Counties and Grade they Received Based on the ALA Grading System.

ND Counties	Grade
Billings	A
Burke	A
Burleigh	A
Cass	A
Dunn	A
McKenzie	A
Mercer	A
Oliver	A

Furthermore, the ALA ranks Bismarck and Fargo as the 10th and 19th cleanest US cities respectively for year round particle pollution in 2015. Both Bismarck and Fargo were ranked number 1 for cleanest metropolitan areas in the country based on ozone concentration and for cleanest metropolitan areas in the country based on 24-hour particle pollution.

The Environmental Protection Agency (EPA) developed an Air Quality Index (AQI) for the general public to better understand the air quality surrounding their communities. The AQI monitors ozone and particle pollution. Since the AQI is announced frequently by local broadcast meteorologists, the public has a better understanding of the magnitude and the implications of the index. For example, an index value of zero to 50 is considered excellent-to-good. The following table is provided by the EPA and indicates AQI values and their related implications.

If you are reading this from other states and looking for perfectly clean air to breathe in, you have one more reason to move to ND.

Table 2. Air Quality Index (AQI) description (Adapted from Environmental Protection Agency EPA)

Air Quality Index	Description	Color	Advisory
0-50	Good	Green	None
51-100	Moderate	Yellow	Unusually sensitive individuals should consider limiting prolonged outdoor exertion
101-150	Unhealthy for the Sensitive	Orange	Children, active adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion
151-200	Unhealthy	Red	Children, active adults, and people with respiratory disease, such as asthma, should avoid prolonged outdoor exertion; everyone else should limit prolonged outdoor exertion
201-300	Very Unhealthy	Purple	Children, active adults, and people with respiratory disease, such as asthma, should avoid outdoor exertion; everyone else should limit outdoor exertion
301-500	Hazardous	Maroon	Everyone should avoid all physical activity outdoors.

The next time when you see these Air Quality Indices or the colors that are associated with the indices on your local media, you should obey the advisory that corresponds to the respective level to avoid air pollution health risks.

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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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