North Dakota Climate Bulletin

Spring 2016

Volume: 10 No: 2

In This Issue

NDSCO

Editor
Adnan Akyüz, Ph.D.
North Dakota State University

Graphics
Daryl Ritchison
North Dakota State University

Contributing Writers:
Daryl Ritchison, NDSU
Allen Schlag, NOAA
Greg Gust, NOAA

North Dakota State Climate Office
www.ndsu.edu/ndsco

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 spring was the 6th warmest and 27th wettest on record statewide since 1895.

Even with a dry start in March, April showers brought between 1.5 to 3 times more rain than normal amounts across the state making April the 7th wettest on record. Statewide March temperatures were noteworthy with broken 46 highest daily low and 115 highest daily high temperature records. Daily temperatures ranged from the coldest temperature of -16° recorded on March 2 in Lake Matigoshe SP to the warmest temperature of 96° recorded on May 6 in Cavalier yielding an impressive 112° seasonal temperature range this spring. The state average spring temperatures declined 0.8°F per decade during the last 30 years which may be attributed to the increasing-trend (0.5 inches per decade) in state average spring precipitation accumulations during that period. The 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

A Gust Front (*Arcus*) in Fargo, ND by Akyüz

Weather Highlights

Seasonal Summary:

by Daryl Ritchison

March 2016 Summary and Statistics

Although there were a few exceptions, most of North Dakota recorded below average precipitation during the month. March continued the trend of the past several months with precipitation amounts being recorded on the low side of normal. March 2016 with the 10th consecutive month with above average temperatures in North Dakota. Several of those months the average temperature was well above average and March can be added to that list with most of the state recording temperatures 8° F to 12° F above normal. The average temperature for the North Dakota NDAWN (North Dakota Agricultural Weather Network) stations in February was 36.3° which is 9.6° above normal for those locations. Although temperatures were above average for much of the month, the highest temperature anomalies occurred from March 6-16 when on many days temperatures were 20° to 30° F above average.

The state average precipitation was 0.53 inches which is below the 1981-2010 normal of 0.83 inches. March 2016 state average precipitation ranked tied for the 43rd driest in the last 122 years with a maximum of 2.31 inches in 1902 and a minimum of 0.11 inches in 1930.

The US Drought Monitor March 29, 2016 reported 92% of North Dakota in D0 (abnormally dry) or D1 (moderate drought) conditions. Of that 11% was in Moderate drought which was confined to the James River Valley portion of the state. (http://droughtmonitor.unl.edu/)

The state average air temperature from data obtained from the National Centers of Environmental Information (NCEI) was 36.2 °F which is above the 1981-2010 normal of 27.5 °F. March 2016 state average air temperature ranked 3rd warmest in the past 122 years with a maximum of 40.6 °F in 2012 and a minimum of 7.0 °F in 1899.

NDAWN's highest recorded daily air temperature for March was 75.4 °F at Beach on March 12. The lowest recorded daily air temperature was -7.2 °F at Langdon, ND, on March 1.

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

April 2016 Summary and Statistics

A high percentage of the state recorded well above average rainfall during April 2016. Although there were several smaller events, most of the rain came from two systems that drop widespread moderate rain amounts, one in the middle of April and the other during the last week of the month. May 2015 was the last month with below average temperatures in North Dakota taken as a whole. Granted, several of those months would be considered average as the positive temperature anomaly was slight, yet above average nevertheless. April 2016 ended that streak with slightly below average temperatures recorded.

The state average precipitation was 2.66 inches which is well above the 1981-2010 normal state average of 1.22 inches. April 2016 state average precipitation ranked the 7th wettest in the past 122 years with a maximum of 3.71 inches in 1986 and a minimum of 0.11 inches in 1987.

The US Drought Monitor April 26, 2016 reported 28% of North Dakota in D0 (abnormally dry) conditions. That area was spread out in several different parts of North Dakota. (http://droughtmonitor.unl.edu/)

The state average air temperature was 41.9 °F which is slightly below the 1981-2010 normal of 42.4 °F. April 2016 state average air temperature ranked the 51st warmest in the past 122 years with a maximum of 50.2 °F in 1987 and a minimum of 31.2 °F in 2013.

NDAWN's highest recorded daily air temperature for April was 87.7 °F at Wyndmere on April 13. The lowest recorded daily air temperature was 6.9 °F at Plaza on the April 11.

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for April had 3 reports of high wind, 0 hail reports, and 0 reported tornadoes.

May 2016 Summary and Statistics

Very little precipitation fell across North Dakota during the first half of May but the last 10 days of the month it turned quite wet for at least some parts of the state. With the lack of moisture during the first part of the month many seeds did not germinate or emerge until the rains arrived which in some ways was a blessing because of a hard freeze right before the needed rains eventually arrived. Even though the overall precipitation for the state was near the average, most NDAWN station tended to finish either well above or well below normal for the month. May 2016 continued the overall trend for above normal temperatures that started last summer. The southern and western portions of North Dakota recorded temperatures near to a bit above average, whereas the northeastern portion of the state had temperature departures more noticeably above the current 30 year average.

The state average precipitation was 2.26 inches which is slightly below the 1981-2010 normal of 2.53 inches. May 2016 state average precipitation ranked 63rd driest in the past 122 years with a maximum of 5.96 inches in 1927 and a minimum of 0.23 inches in 1901.

The US Drought Monitor May 31, 2016 reported 13% of North Dakota in D0 (abnormally dry) conditions. That area was split between northwestern, a small part of central and southeastern North Dakota. (http://droughtmonitor.unl.edu/)

The state average air temperature was 56.4 °F which is above the 1981-2010 average of 54.1°F. May 2016 state average air temperature ranked the 24th warmest in the past 122 years with a maximum of 63.5°F in 1934 and a minimum of 44.4 °F in 1907.

NDAWN's highest recorded daily air temperature for May was 94.0 °F at Cavalier, ND on May 5. The lowest recorded daily air temperature was 21.5 °F at Pillsbury, ND, on May 14. That hard freeze damaged crops that had emerged throughout the region.

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for May had 11 reports of high wind, 6 hail reports, and 1 reported tornado.

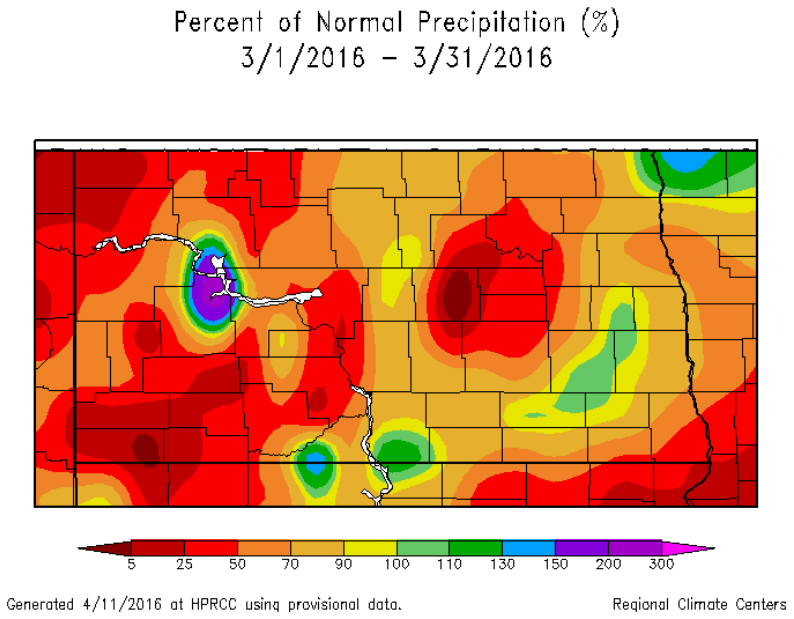
Season in Graphics

Spring 2016 Weather in North Dakota:

March 2016

Total Precipitation percent of mean (1981-2010)

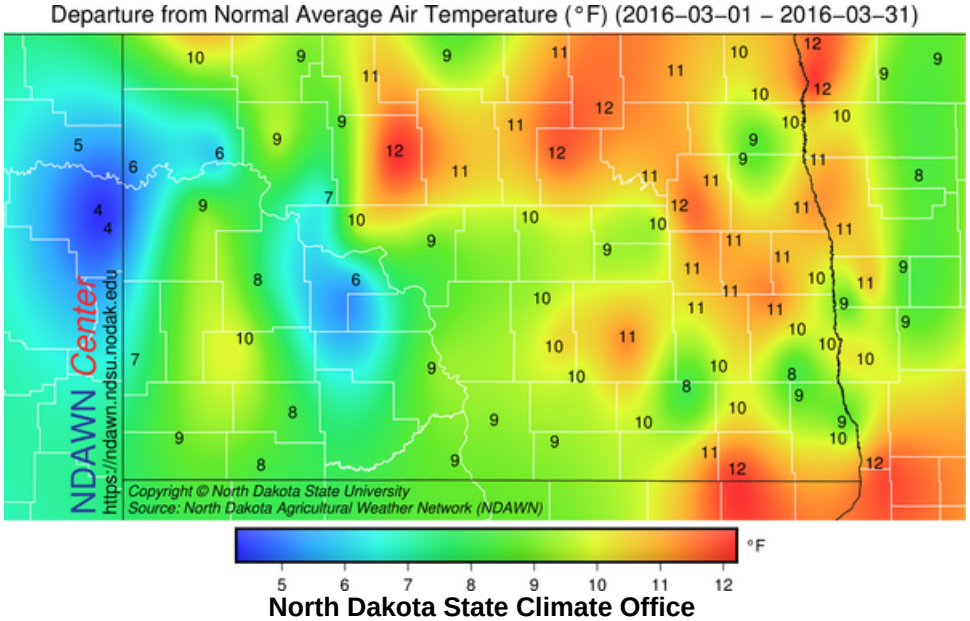
Precipitation Percent of Normal
(Data from NWS Cooperative Network/HPRCC)



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

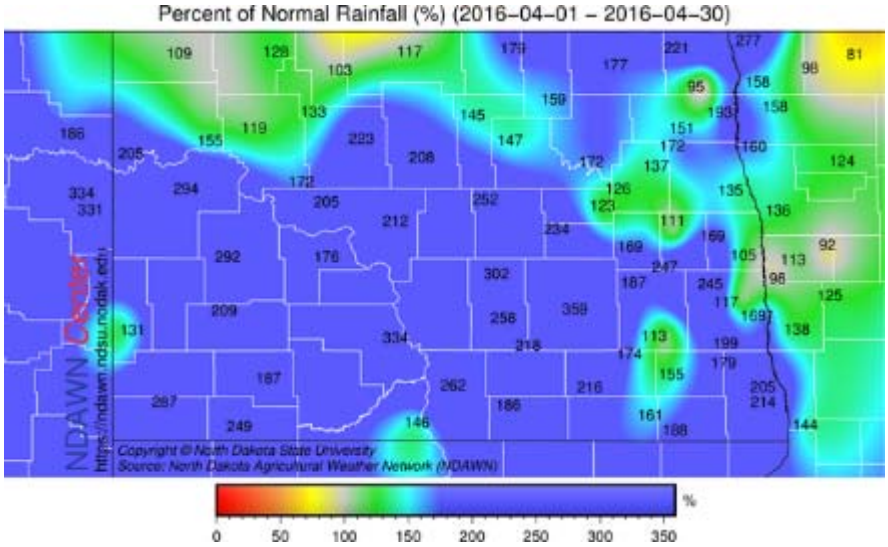
April 2016

Spring 2016 Weather in North Dakota:

Total Precipitation percent of mean (1981-2010)

Precipitation Percent of Normal

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

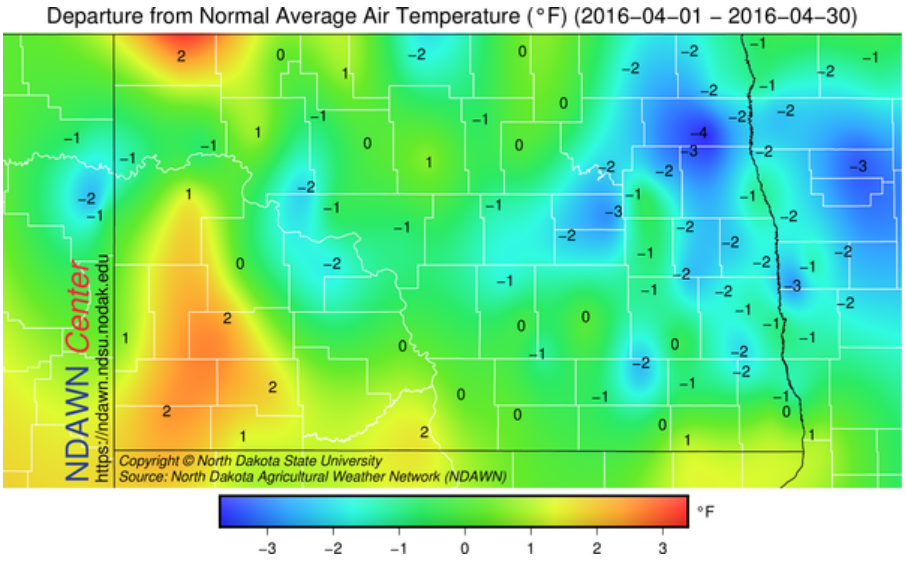


North Dakota State Climate Office

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))



North Dakota State Climate Office

Season in Graphics

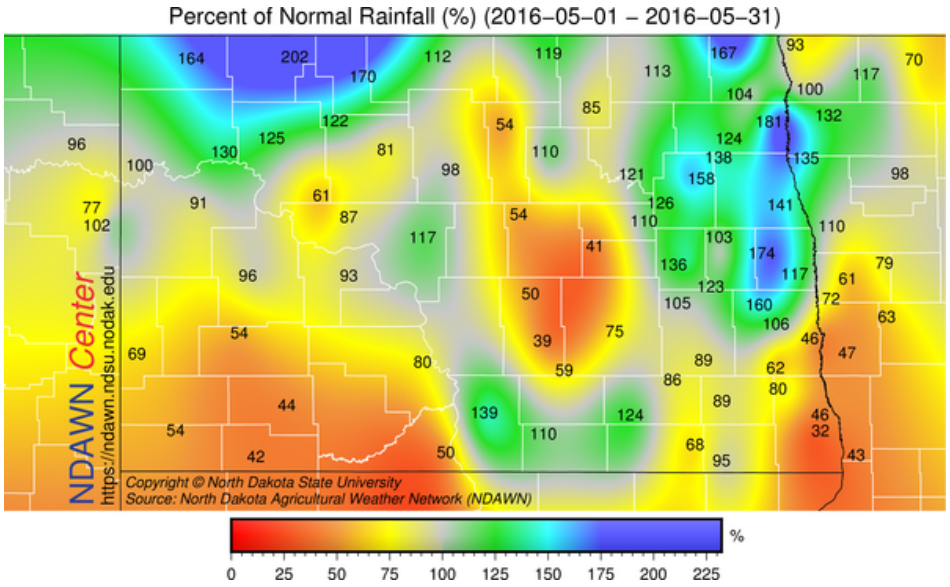
Spring 2016 Weather in North Dakota:

May 2016

Total Precipitation percent of mean (1981-2010)

Precipitation Percent of Normal

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

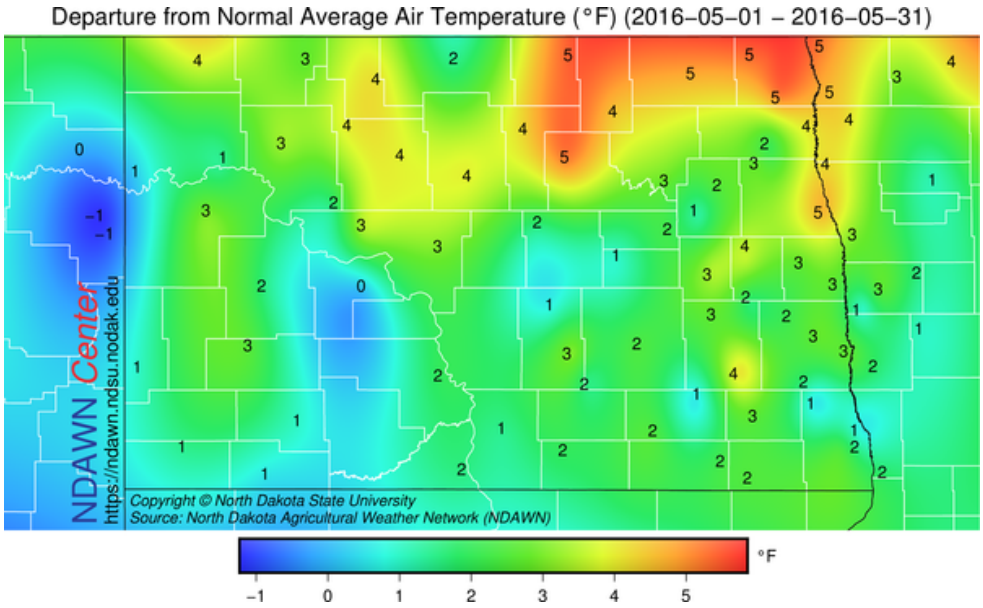


North Dakota State Climate Office

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

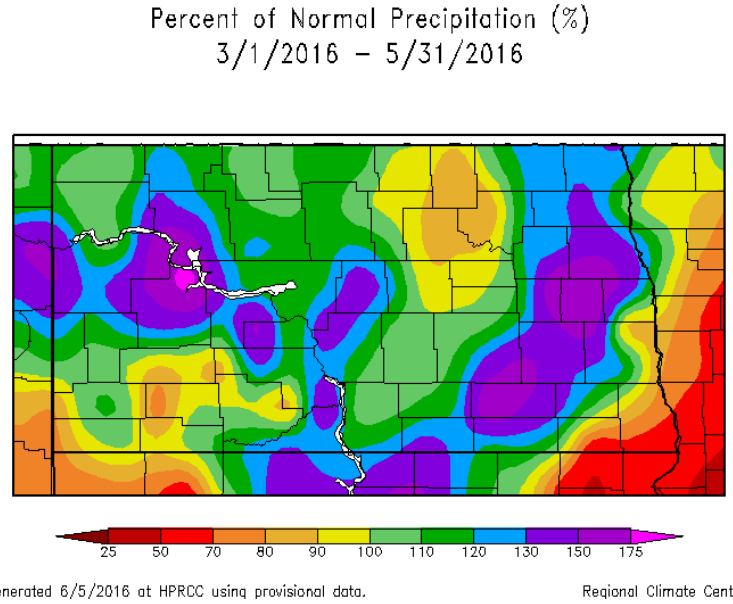
Season in Graphics

Spring 2016

Total Precipitation percent of mean (1981-2010)

Precipitation Percent of Normal

(Data from NWS Cooperative Network/HPRCC)

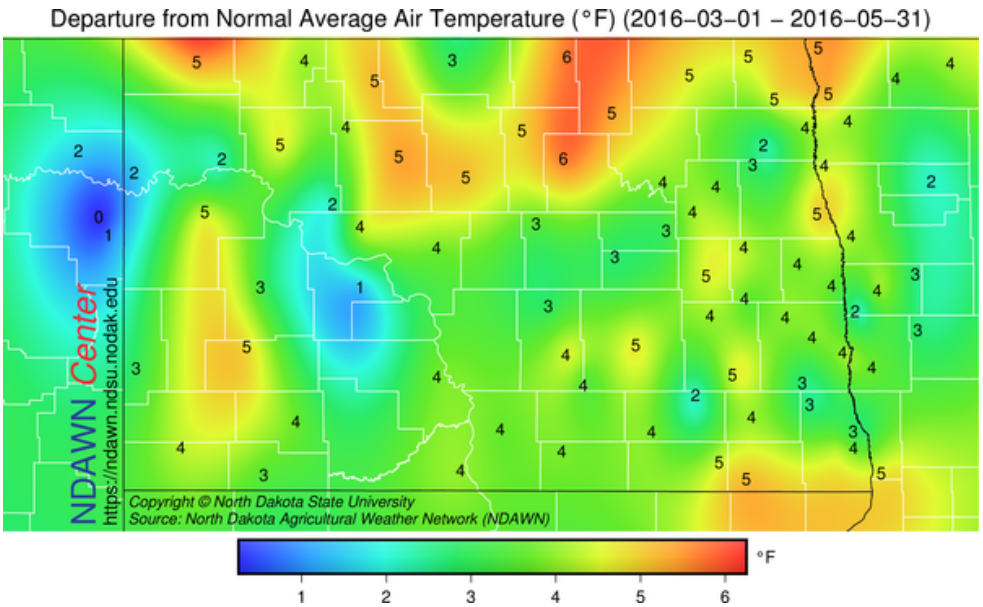


North Dakota State Climate Office

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

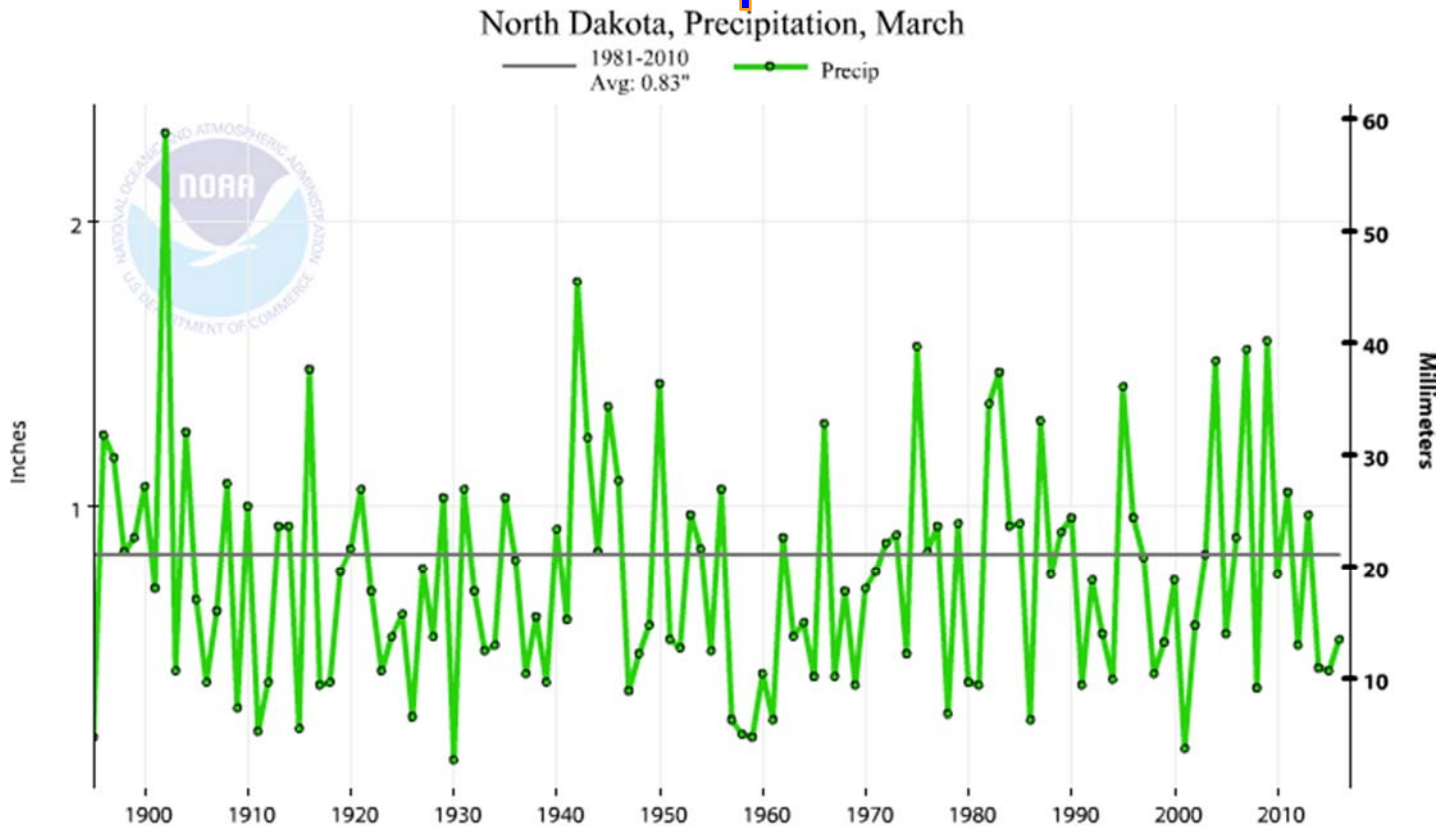
Departure From Normal Monthly Average Air Temperature in degrees F

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



North Dakota State Climate Office

Historical March Precipitation for North Dakota

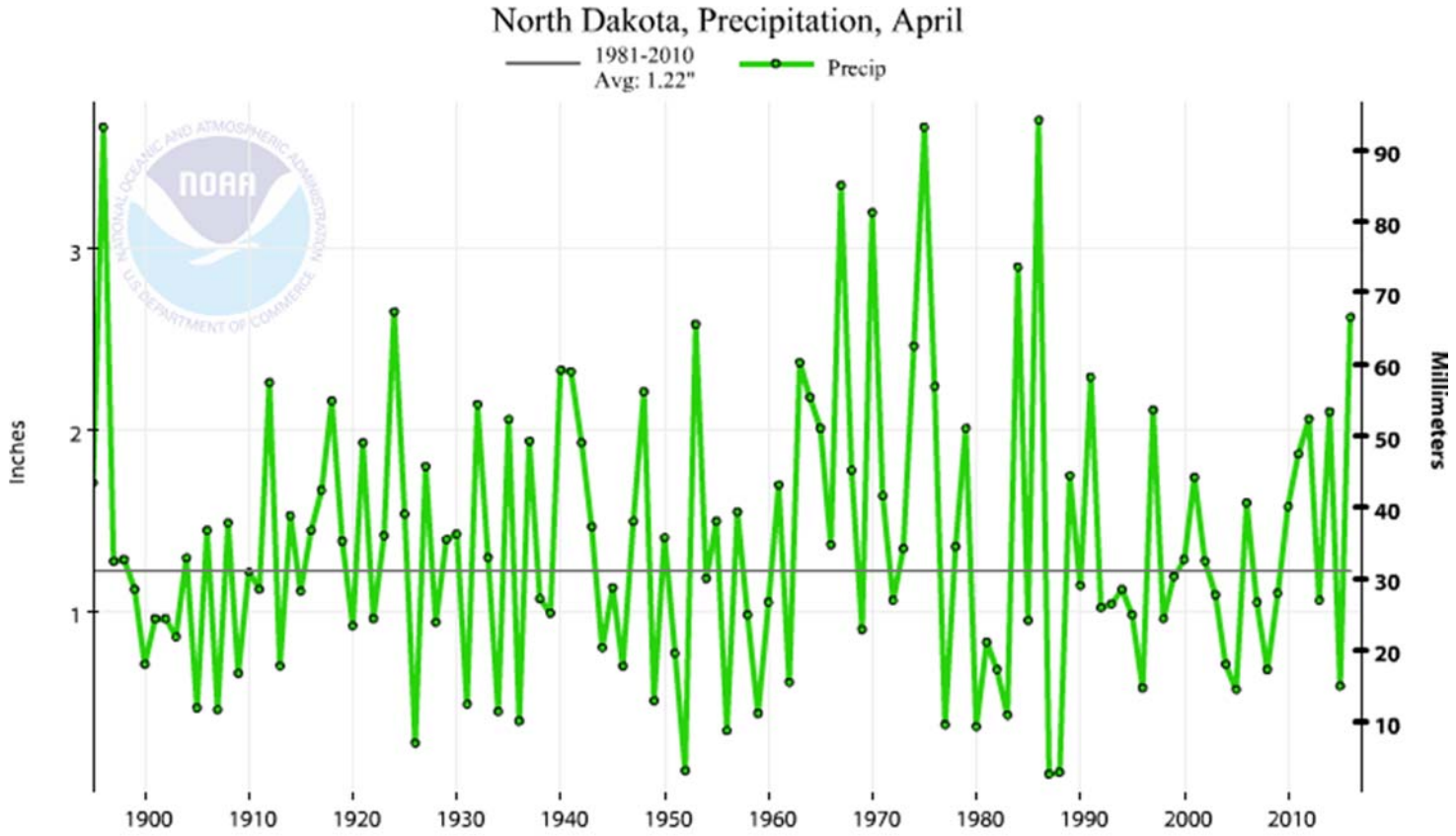


March Precipitation Statistics

2016 Amount: **0.53 inches**
Maximum: 2.31 inches in 1902
State Normal: 0.83 inches (1981-2010)

Monthly Ranking: 43st driest
Minimum: 0.11 inches in 1930
Years in Record: 122

Historical April Precipitation for North Dakota

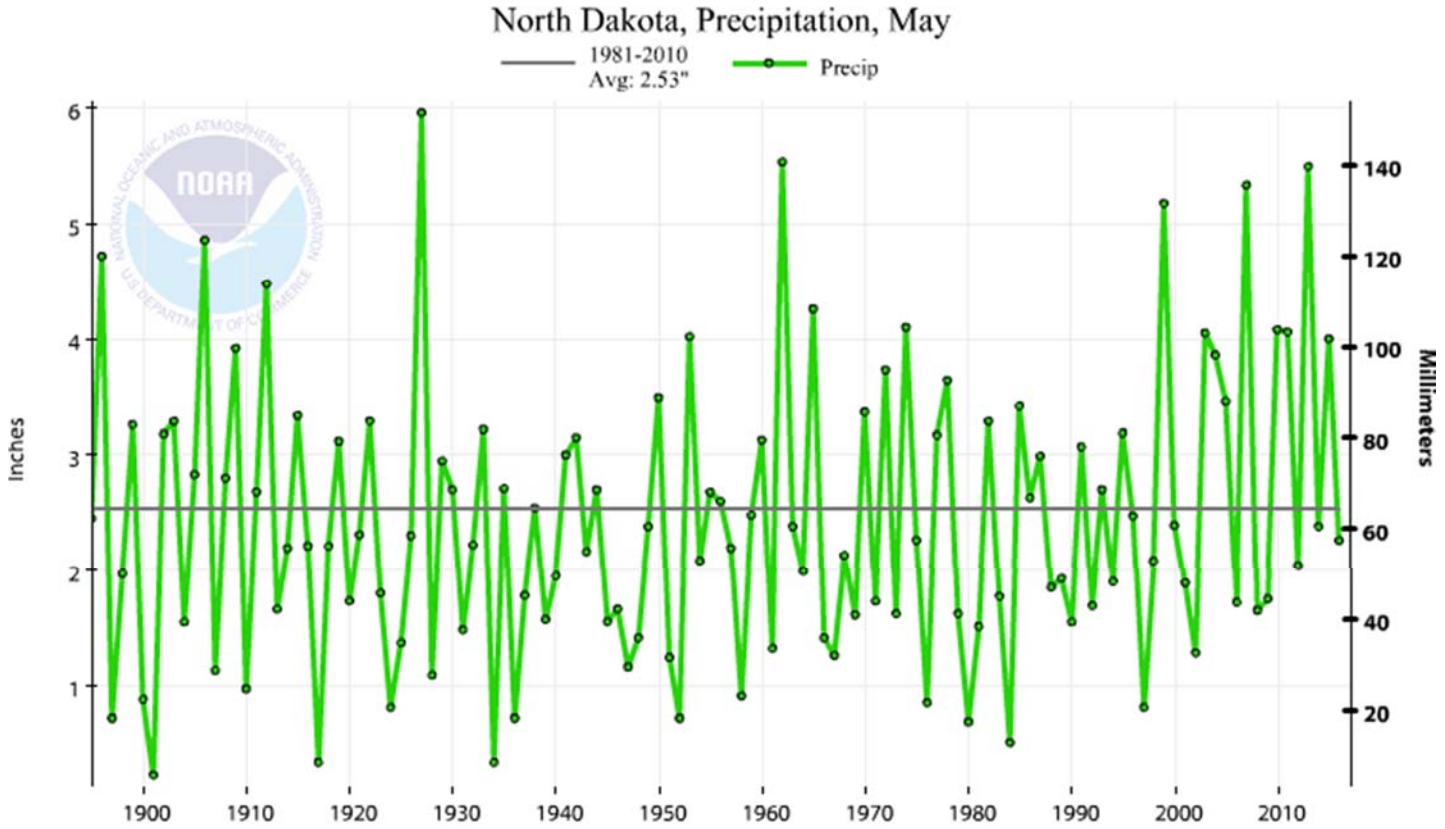


April Precipitation Statistics

2016 Amount: 2.66 inches
Maximum: 3.71 inches in 1986
State Normal: 1.22 inches (1981-2010)

Monthly Ranking: 7th wettest
Minimum: 0.11 inches in 1987
Years in Record: 122

Historical May Precipitation for North Dakota

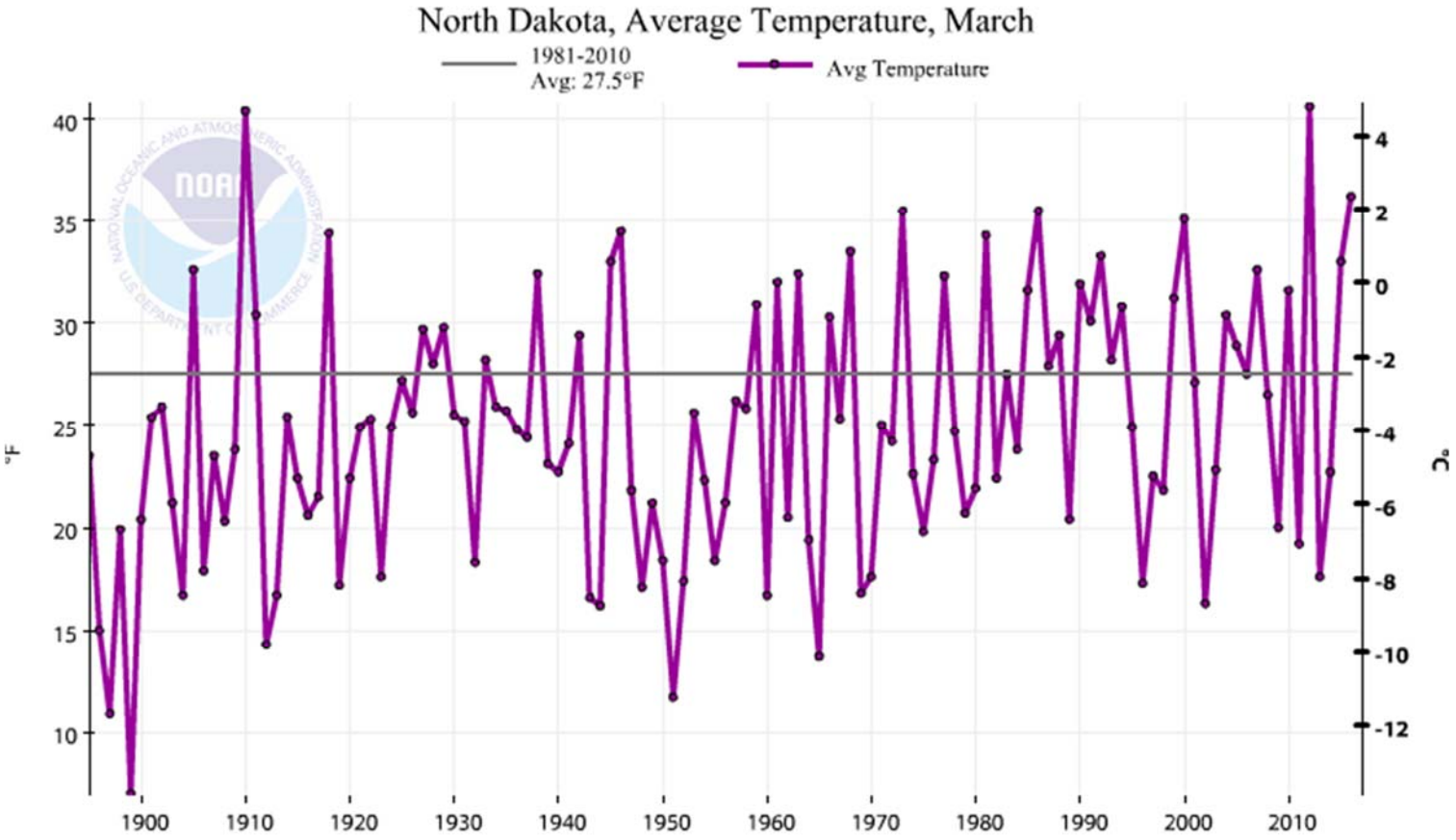


May Precipitation Statistics

2016 Amount: 2.26 inches
Maximum: 5.73 inches in 1927
State Normal: 2.53 inches (1981-2010)

Monthly Ranking: 63rd driest
Minimum: 0.23 inches in 1901
Years in Record: 122

Historical March Temperature for North Dakota

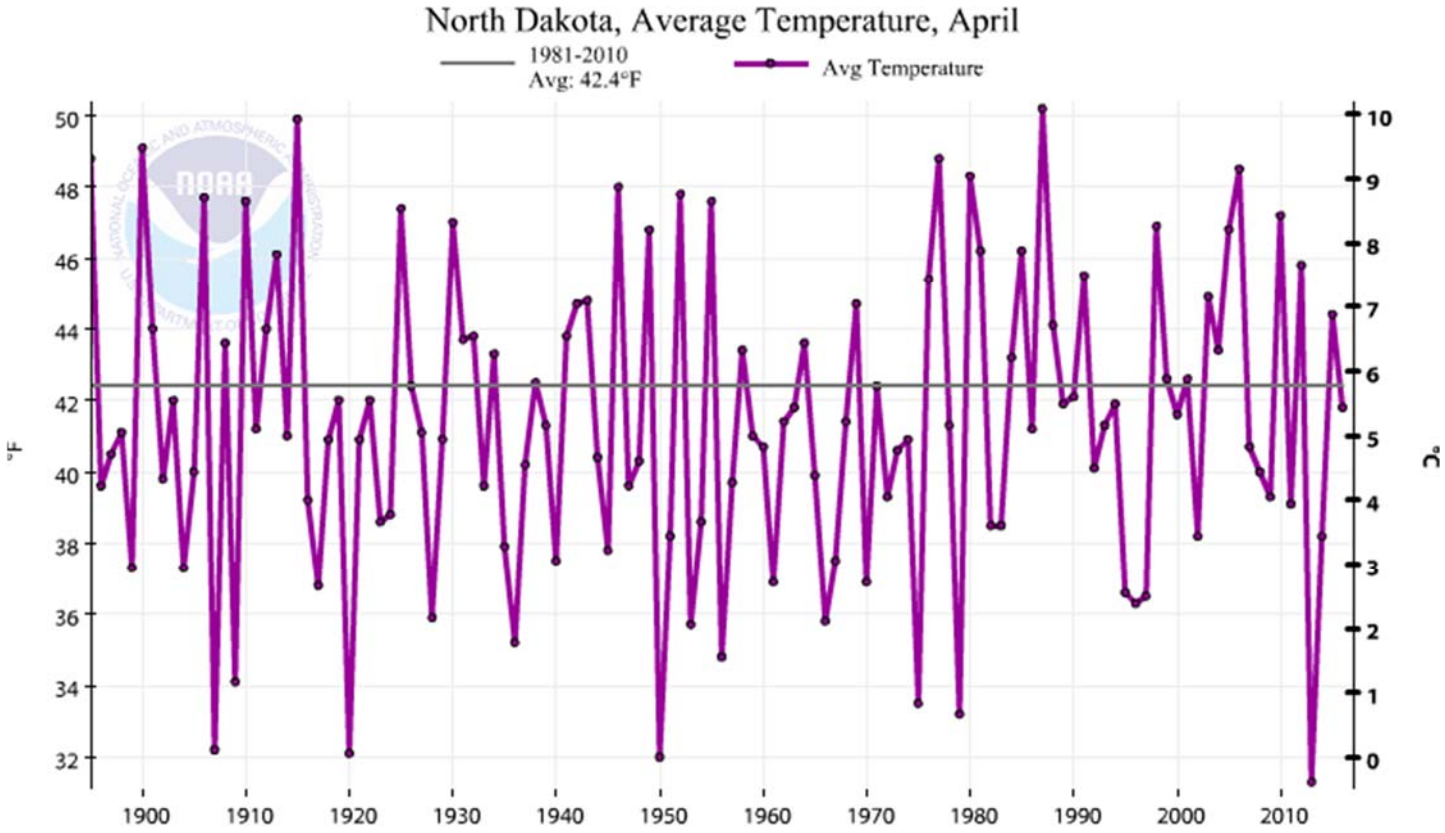


March Temperature Statistics

2016 Average: 36.2 °F
Maximum: 40.6 °F in 2012
State Normal: 27.5 °F (1981-2010)

Monthly Ranking: 3rd Warmest
Minimum: 7 °F in 1899
Years in Record: 122

Historical April Temperature for North Dakota

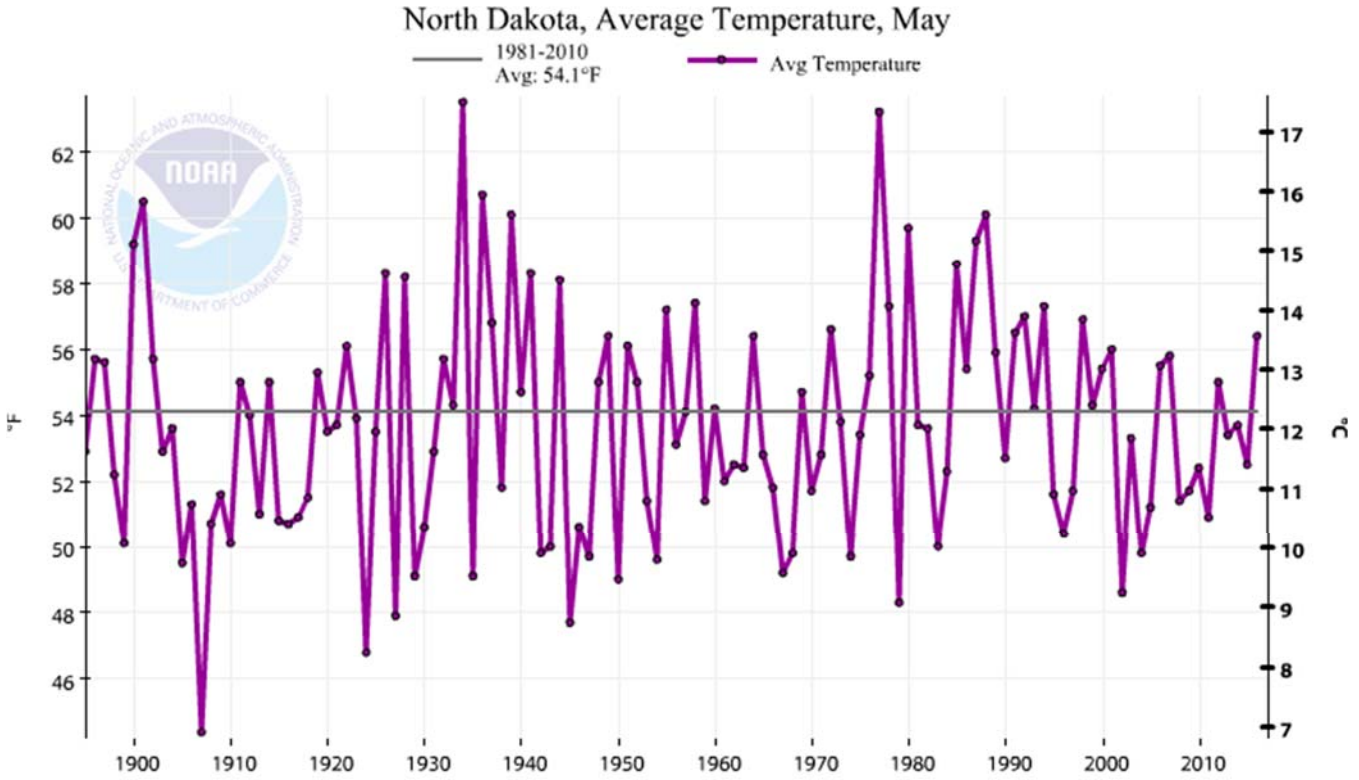


April Temperature Statistics

2016 Average: 41.9 °F
Maximum: 50.2 °F in 1987
State Normal: 42.4 °F (1981-2010)

Monthly Ranking: 51st Warmest
Minimum: 31.2 °F in 2013
Years in Record: 122

Historical May Temperature for North Dakota



May Temperature Statistics

2016 Average: 56.4 °F
Maximum: 63.5 °F in 1934
State Normal: 54.1 °F (1981-2010)

Monthly Ranking: 24th warmest
Minimum: 43.3 °F in 1907
Years in Record: 122

Storms & Record Events

State Tornado, Hail, and Wind Reports for Spring 2016

by D. Ritchison

North Dakota 3 Month Total	Wind 14	Hail 6	Tornado 1
Reports by Month			
Month	**Wind**	**Hail**	**Tornado**
Total March	0	0	0
Total April	3	0	0
Total May	11	6	1

North Dakota Record Maximum Reports for Spring 2016

Date	Location	Type of Record	Previous Record
03/11/16	Bismarck	70° F maximum temperature	69° in 2012
03/06/16	Bismarck	75° F maximum temperature	63° in 2005
03/13/16	Bismarck	72° F maximum temperature	72° in 2012
03/14/16	Bismarck	73° F maximum temperature	72° in 2015
03/12/16	Dickinson	72° F maximum temperature	71° in 2007
03/06/16	Fargo	66° F maximum temperature	63° in 2000
03/12/16	Fargo	66° F maximum temperature	63° in 2015
03/08/16	Fargo	65° F maximum temperature	62° in 2000
03/11/16	Fargo	63° F maximum temperature	59° in 2015
03/12/16	Grand Forks (AP)	64° F maximum temperature	59° in 2015
03/11/16	Grand Forks (AP)	63° F maximum temperature	56° in 2015
03/06/16	Grand Forks (AP)	60° F maximum temperature	58° in 2000
03/14/16	Grand Forks (NWS)	65° F maximum temperature	64° in 2015
03/06/16	Grand Forks (NWS)	62° F maximum temperature	59° in 2000
03/11/16	Grand Forks (NWS)	65° F maximum temperature	57° in 2012
03/15/16	Minot (Exp Station)	65° F maximum temperature	62° in 1938
03/14/16	Jamestown	67° F maximum temperature	62° in 2012
03/07/16	Jamestown	67° F maximum temperature	66° in 1898
03/07/16	Minot (Exp Statin)	69° F maximum temperature	63° in 1987
03/15/16	Minot (Exp Statin)	69° F maximum temperature	65° in 2012
03/06/16	Williston	70° F maximum temperature	69° in 1987
05/05/16	Bismarck	88° F maximum temperature	86° in 2000
05/05/16	Dickinson	86° F maximum temperature	81° in 1966
05/06/16	Fargo	86° F maximum temperature	83° in 1983
05/05/16	Grand Forks (AP)	93° F maximum temperature	85° in 2000
05/06/16	Minot (Exp Station)	89° F maximum temperature	88° in 1911
05/05/16	Williston	90° F maximum temperature	89° in 1934

Seasonal Outlook

Summer 2016 Climate Outlooks

by . R. Kupec[1]

Summertime and the living is easy; so says the line from the George Gershwin song from the 1930's. That is not the case for those trying to make a seasonal forecast for the next three months. Of all four seasons, summer provides the greatest challenge for a long range forecast. Teleconnections between the summer weather of North Dakota and the different climate drivers of North America are scant at best. This summer a fading El Niño and the promise of a developing La Niña leave us with little, if any, substantial signals with which to make an educated guess.

With the departure of El Niño, the southern Pacific is entering a neutral state with a forecast for a La Niña pattern to develop sometime in the fall. The most aggressive modeling scenarios develop the La Niña before the end of summer, while others hold it off until the middle of winter. Either scenario has little impact on our North Dakota summer weather. For nearly the entire state, neutral or La Niña weather patterns have no discernible impact on temperature or precipitation. The one exception is in northwest North Dakota where neutral conditions in the summer have a tendency towards slightly wetter than average conditions and La Niña in the summer brings slightly drier than average precipitation. Even in this area, there is no connection to temperature.

This spring the fading El Niño brought a mixed bag of precipitation amounts across the state. Many areas saw average to above average moisture but there were pockets of drier than average conditions, especially in southeastern North Dakota. Temperatures were above average to varying degrees statewide. The overall weather pattern of the spring is continuing into the early part of summer. It has been exceptionally wet across the south central U.S. and warm, west of the Rockies. At different times we have seen some of that moisture and some of the heat make its way to North Dakota and in all likelihood that pattern will continue into much of the summer. Look for slightly warmer than average temperatures state wide and near average moisture, with sporadic pockets of areas seeing more rainfall than average while other pocket may be dry. This is very typical of summer in our area, with the hit and misses nature of thunderstorms.

The current Climate Prediction Center (CPC) Summer Outlook gives much of the state a better than average chance of seeing above average temperatures for the summer. The one exception is the far southwest corner which only has an equal chance (see figure 1). The CPC has nearly the entire state with an equal chance of above or below average precipitation; again the one exception is the very far southwest corner where slightly above average precipitation chances are forecasted (see figure 2). The next 90 day outlook from the CPC should be available after June 16th at http://www.cpc.ncep.noaa.gov/products/predictions/90day.

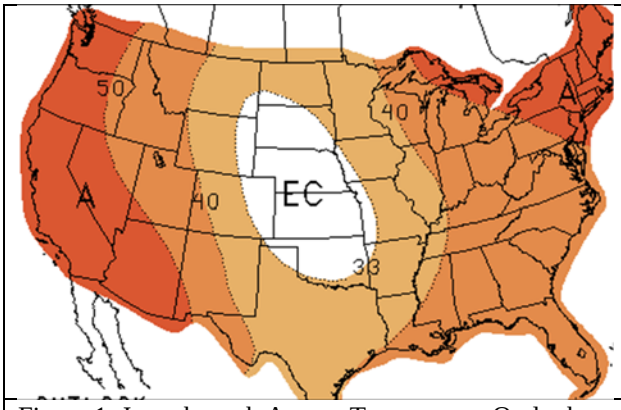


Figure 1. June through August Temperature Outlook

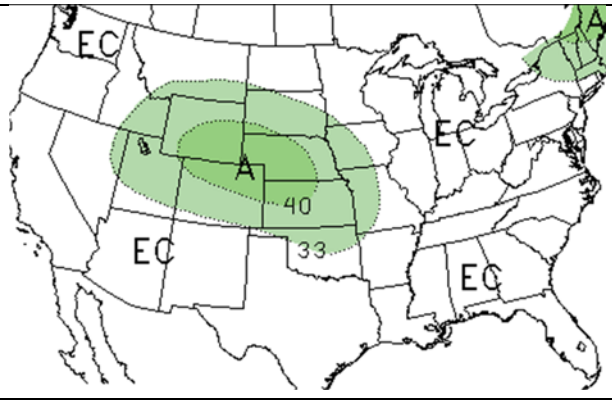


Figure 2. June through August Precipitation Outlook

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

Hydro-Talk

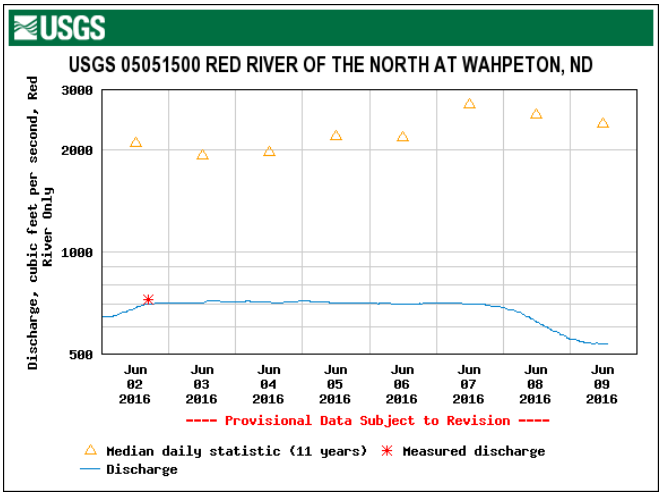
North Dakota's Latest Hydrologic Status

by A. Schlag[2]

Normal, such an interesting word. *This is how Merriam-Webster defines the word in the context most often used:*

- according with, constituting, or not deviating from a norm, rule, or principle
- conforming to a type, standard, or regular pattern
- occurring naturally <*normal immunity*>

So when looking at the above, we are often left to wonder if what we see taking place around us is "normal", or something unusual. This can be difficult here in North Dakota as our location on the continent provides us with such broadest temperature and precipitation swings in the United States. Often times, our normal is something different than what we expect, even after having lived here for many years.



For example, here's the most recent hydrograph for the Red River of the North at Wahpeton. In this graphic, the yellow triangles represent the median value over the history of this gage on this day of the year. Clearly, such a low volume of water suggests that things are not "normal". Indeed, when we look at the statistics for this location, it is well below any common metric (mean, median, 25th percentile, etc). In particular, I like to use the upper and lower ends of what constitutes one-half, or 50% of the data. In this, those lower and upper ends are represented by the 25th and 75th percentiles. Again, the Red River of the North is well below what could be considered normal by this definition.

Daily discharge, cubic feet per second: statistics for Jun 9 based on 11 years of record more

Most Recent Instantaneous Value Jun 9	Min (2012)	25th percentile	Median	Mean	75th percentile	Max (2005)
533	940	1280	2390	2430	2870	5200

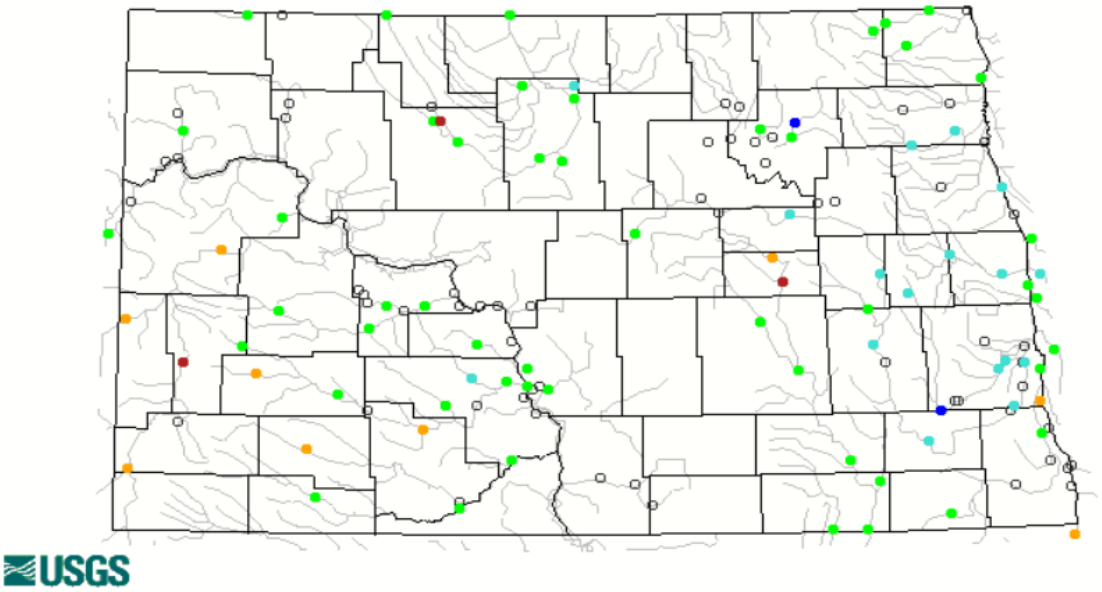
A quick glimpse of how surface waters around the state of North Dakota are doing with respect to such a definition of "normal" is available from the United States Geological Survey. You can find the following map at http://waterwatch.usgs.gov/?m=real&r=nd. It is one of the most useful tools a hydrologist has in assessing the current availability of water.

[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

Map of real-time streamflow compared to historical streamflow for the day of the year (North Dakota)

North Dakota or Water-Resources Regions

Thursday, June 09, 2016 15:30ET



USGS

Choose a data retrieval option and select a location on the map

○ List of all stations ◉ Single station ○ Nearest stations ○ Peak flow

Explanation - Percentile classes							
●	●	●	●	●	●	●	○
Low	<10 Much below normal	10-24 Below normal	25-75 Normal	76-90 Above normal	>90 Much above normal	High	Not-ranked

Based on the map above, about the only thing a person can be left with is the impression that it truly reflects North Dakota's definition of "normal" in the sense of there's a good distribution of locations that are in the yellow and red (below and much below normal) categories, and just about the same number of locations in the green and dark blue (above and much above normal) categories. And often, these streams that are well above normal are right next to a basin that is well below normal. What a great place to live if you enjoy variety!

Science Bits

Severe Summer Storm Outlook in North Dakota

by Greg Gust[3]

Storm Mongers ask: Will we have *decent* Severe Summer Storms this Year?

Well the short (and easy) answer to this is… yes! And I can say this with a high degree of confidence for a couple of reasons:

1. We're in the right "zone"
2. El Nino is only "just" out the door.

First off, we're in the right zone. Here in the Northern Plains of the U.S. we are in the climatological epicenter of summertime convective zone. Just looking at the composites of the 25-year average of tornadoes per state by month map as seen below (also online: http://www.spc.noaa.gov/wcm/permonth_by_state/) we see that in the wintertime, while we northerners are huddled with the rest of the frozen chosen, the far Southern Plains and Gulf Coast states are still quite convectively active… especially this past winter season, when El Nino was keeping those areas charged with super-abundant low level moisture transport and upper level energy via the southern branch of the Polar Jet Stream.

In the springtime, that zone of convective chaos starts climbing northward, through the Southern Plains and into the Central Plains states, as moisture transport and polar jet stream energy adjust with the northward shift of sunlight. We occasionally get some late spring severe storms (late April and May) into the Dakotas and Minnesota, especially if the winter has been mild and snow cover is slight (like this year)… but we really are quite dependent on low level moisture transport to bring in the fuel (water vapor) for those really big storms. Since we are so far north of the Gulf of Mexico, that low level moisture transport doesn't really start to kick in for us until we start to get some crop growth, especially corn fields, down in those Southern and Central Plains.

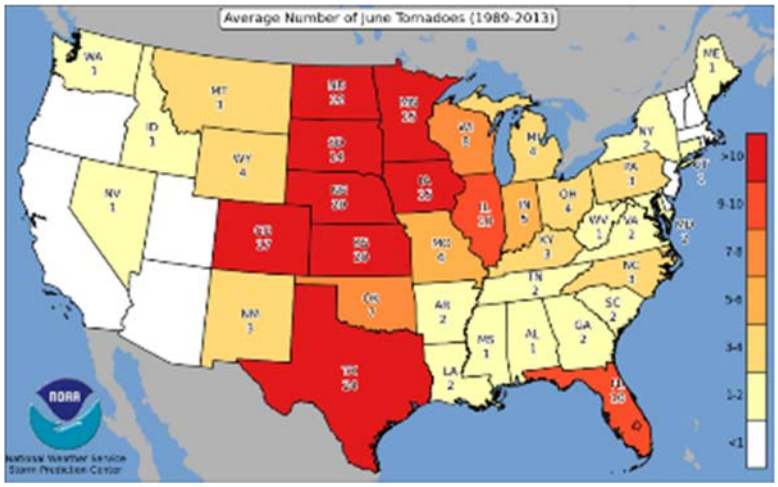


Figure 1. Average Number of June Tornadoes by States (NOAA, Storm Prediction Center)

So it's not until true summertime, June, July and August, that all our ingredients are typically in place – that would be heat (sunshine and warming temperatures), low level moisture (evaporation, transpiration, and the moisture advection), upper level energy (Polar Jet Stream), and then whatever favorable combination of storm system interactions which can generate the appropriate shear (change in wind direction and/or speed with height) that can foster really deep storm development, storm tilt, and the types of storm rotation that produce tornadoes.

During the summer months in an area like the eastern third of North Dakota (the Red River and Devils Lake Basins), we are going to have, on average, nearly one tornado per county per year. Some years we'll have only half that many tornadic storms and some years twice that many… but we will always have some really nifty, really BIG storms, somewhere in the neighborhood.

---

[3] The corresponding author: Greg Gust is the Warning Coordination Meteorologist at the NOAA's National Weather Service, Weather Forecast Office in Grand Forks, ND. E-Mail: gregory.gust@noaa.gov

Further west, into central and western North Dakota, the number of tornadoes per unit area tends to decrease – while as the threat for large hail storms tends to increase! One reason for this increased threat for large hail in the west may be due to the overall cleaner air, fewer cloud condensation nuclei (CCN), and the tendency for those fewer but larger hail stones to survive their fall through the cloud to the ground. Thus the longevity of the state's aerial hail suppression project, the North Dakota Cloud Modification Project [online: http://www.swc.nd.gov/arb/ndcmp/].

It's also possible that the higher amounts of low-level moisture and directional shear found further east in the state aid in initiating low level spin into the developing storms (generating more tornadoes), while the drier low-levels, the deeper speed shear (stronger winds aloft), and the overall fewer CCN, all conspire to help developing hailstones to grow larger and to frequently affect the west.

Second, El Nino is only recently ended. While a strong El Nino had been a major factor in our exceptionally mild and fairly snow-sparse winter and early spring seasons, NOAA/CPC scientists note that El Nino has weakened to the point where it was considered ENSO-neutral by late May. In general, ENSO phases (El Nino = warm phase, La Nina = cold phase) don't tend to have much, if any, direct impacts on our Northern Plains summer storm environment anyway. The article linked here explains some of those seasonal and global scale El Nino impacts: https://www.climate.gov/news-features/featured-images/global-impacts-el-nino-and-la-nina

Yet there can still be a residual or secondary effect which shows up on occasion… in that the typical El Nino patterns tend to provide an abundance of moisture and energy across the southern states over the winter and spring (as we've seen), and a more moist Southern Plains will tend to enhance convection into the Central Plains, and a more moist Central Plains tends to enhance convection into the Northern Plains. So if anything, a waning El Nino doesn't typically lead to a Northern Plains drought!

…While La Nina is not yet here! The NOAA Climate Prediction Center considers it likely that La Nina conditions will develop by this fall or winter. So one can wonder if that can possibly affect this current summer convective season…

Maybe… An early paper on the topic, first presented by Mark Bove at the *19th AMS Conf. on Severe Local Storms* back in 1998, is titled "Impacts of ENSO on United States Tornadic Activity". In his conclusions, Mr. Bove states that, "Tornadoes commonly develop in spring due to a large difference in the cold dry air masses pushing southward from Canada and the warm, moist air flowing north from the Gulf of Mexico. Ropelewski and Halpert (1986) note that the PNA and reverse PNA patterns associated with ENSO warm and cold events, respectively, cause changes in regional temperatures. Warm events [El Nino] tend to decrease the temperature gradient between the gulf coast and Great Plains, which is less conducive for tornadic activity. However, cold phase [La Nina] tends to increase the temperature gradient between these two areas, making an environment more conducive to tornadic development." [online: http://coaps.fsu.edu/papers/impacts_enso_tornadic_activity/].

Or Not! A paper by Mayes, et al, as presented at the *19th AMS Conf. on Climate Variability and Change* in 2007, is titled "Tornado and Severe Weather Climatology and Predictability by ENSO Phase in the North Central U.S." Mayes and company didn't quite look as far north as North Dakota, but they at least were able to validate that for the warm season in general (May-Sep), there was a signal showing a slight decrease in significant tornados and/or tornado days following on either ENSO-neutral or El Nino conditions for Central Plains locations [See image block b or c, respectively, in Figure 2]. However, the more nearby portions of their study area, in southern Minnesota, showed the opposite impacts… in that area, it was following on a La Nina that tornadoes were more prevalent! [online: http://www.weather.gov/media/arx/research/ensosvrwxclimatology.pdf].

In conclusion. As expected, the recent strong El Nino and its related North American winter and spring season impacts have diminished even before our traditional summer storm season begins, but we are still a long way from seeing any developing edges of a La Nina pattern (maybe by this coming fall or winter).

Thus our best ENSO climatology told us we should expect this mild winter to be followed by an early spring, as it has… and a move towards near normal precipitation and near normal storminess for the coming summer. But by next year…well we'll just have to wait an

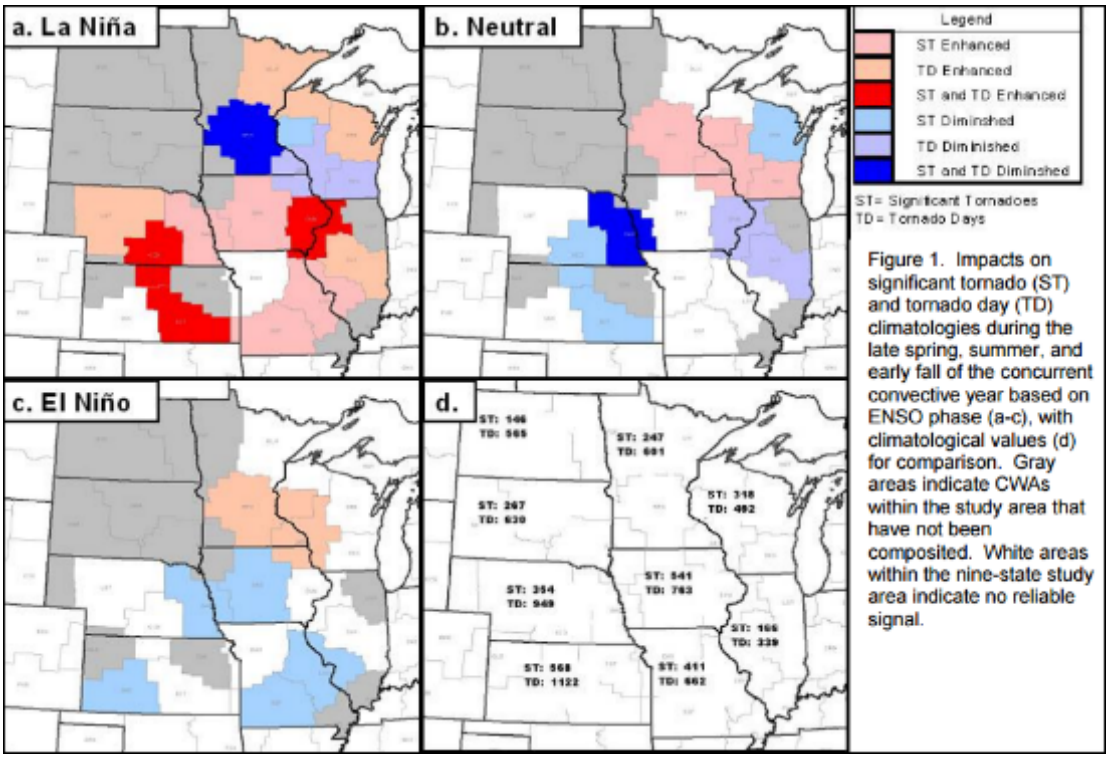


Figure 1. Impacts on significant tornado (ST) and tornado day (TD) climatologies during the late spring, summer, and early fall of the concurrent convective year based on ENSO phase (a-c), with climatological values (d) for comparison. Gray areas indicate CWAs within the study area that have not been composited. White areas within the nine-state study area indicate no reliable signal.

Figure 2. ENSO impact on Significant Tornado and Tornado Days (Mayes et al., 2007)

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.

North Dakota State Climate Office

College of Agriculture, Food Systems, and Natural Resources
North Dakota State University
231 Walster Hall, Fargo, ND 58108
Administration: 701-231-8901
Climate Services: 701-231-6577
Fax: 701-231-7861

URL: http://www.ndsu.edu/ndsco
E-mail: Adnan.Akyuz@ndsu.edu