North Dakota Climate Bulletin

Winter 2010-2011

Volume: 5 No: 1

In This Issue

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 cooler and wetter winter following a warmer and wetter fall. Temperature-wise, this fall was the 41st coolest since 1895. Precipitation-wise, it was the 11th wettest winter since 1895. Even though February was dryer than normal, overall winter precipitation was still above normal.

Unusually wet fall in the eastern North Dakota followed by another wet season increased chance for major flooding in most places in the Red River Valley. The chance of a major flooding in Wahpeton, Fargo, and Grand Forks is greater than 98%. Statewide ranking during the 6-month period from September through February was 4th wettest 6-month period in the history.

The North Dakota total precipitation amounts as a percentage of the normal and average temperature departure from normal are shown on pages 6 through 8 (Season in-Graphics) followed by the time series of monthly total precipitation and average temperature of North Dakota for respective months of the season.

This bulletin can be accessed at http://www.ndsu.edu/ndsco/. This website hosts other great resources for climate and weather information.

Adnan Akyüz, Ph.D.
North Dakota
State Climatologist

NDSU by Akyüz

Weather Highlights

Seasonal Summary: by B. A. Mullins

December 2010

The state average precipitation was 1.06 inches which is above the 1971-2000 normal of 0.44 inches. December 2010 state average precipitation ranked 6th wettest in the last 116 years with a maximum of 1.29" in 2008 and a minimum of 0.06" in 1944.

The northwest, eastern, and central regions had above normal precipitation with many areas of greater than 200% in December. The central and southeast areas had greater than 300% of normal. The southwest corner of the state had below normal precipitation. Precipitation totals ranged from about 0.15 inches in the southwest to 2.5 inches in the central region. In summary, December was wet and cold for most of the state with several wide spread storm systems. The National Weather Service (NWS) reported breaking several liquid precipitation, snowfall, and at least one snow depth record in December. Williston had a record 35.3 inches of snow in December and a record snow depth set on the 21st of 23.0 inches. The first wide spread storm event was on the 3rd and 4th in which precipitation records were broken at Dickinson, Bismarck, Minot and Williston. The second wide spread system was on the 10th and 11th during which a record 14.3 inches of snow was recorded at Williston on the 11th. A light snow fell for most on the 13th. The 15th through the 17th had yet another wide spread storm system with only a few days before the next bout of snow fell on the 20th and 21st. The 24th again had light snow for most. The month closed with a final storm system on the 30th and 31st that brought high winds, freezing drizzle, and snow. White out conditions and snow drifts closed many roads and interstates in the east and southeastern parts of the state on the 31st.

The National Weather Service (NWS) recorded breaking several snowfall and precipitation records throughout the month of December. Most of the records fell on the 3rd, 10th, 20th, and 31st. A summary of these records can be viewed in the "Storms and Record Events" section later in this bulletin.

The US Drought Monitor January 4, 2011 report had no drought conditions reported in the state.

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported an average snow depth of 18.3 inches on January 2. Road conditions were rated 67% open, 25% difficult, 8% closed with 45% drifted, 23% icy, and 32% dry. (Weekly Weather and Crop Bulletin Vol. 98, No. 1).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), there were no severe weather reports of wind, hail or tornadoes in December.

The top five December daily maximum wind speeds recorded from NDAWN were 59.8 mph at Watford City on the 27th, 50.5 mph at Robinson on the 31st, 50.1 mph at Streeter on the 31st, 47.2 mph at Linton on the 31st, and 47.2 mph at Wishek on the 31st. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The state average air temperature was 9.8 °F which is below the 1971-2000 normal of 13.0 °F. December 2010 state average air temperature ranked 38th coolest in the past 116 years with a maximum of 25.6 °F in 1939 and a minimum of -2.5 °F in 1983.

The North Dakota Agricultural Weather Network (NDAWN) December average air temperatures ranged from 6 °F to 15 °F. NDAWN departure from normal temperatures ranged from 0 °F to -5 °F. Several days of cold arctic air brought the monthly average air temperatures down to below normal across the state. The 1st through the 19th had most days with below normal average air temperatures. The 11th through the 13th temperatures dipped farther to -10 to -20°F below normal for most. From the 20th through the 30th temperatures rebounded to near normal with a few above normal days. More arctic air moved in on the last day of December bringing temperatures down again to -9 to -17 °F below normal in the central and eastern region.

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

NDAWN's highest recorded daily air temperature for December was 41.9 °F at Sidney MT on the 9th. The lowest recorded daily air temperature was -30.1 °F at Roseau MN on the 13th.

January 2011

The state average precipitation was 0.84 inches which is above the 1971-2000 normal state average of 0.50 inches. January 2011 state average precipitation ranked the 13th wettest in the past 117 years with a maximum of 1.35 inches in 1916 and a minimum of 0.07 inches in 1973.

Precipitation ranged from roughly 25% to 300% percent of normal. Above normal precipitation fell primarily in the south central, southwestern, and northeastern regions with below normal precipitation falling elsewhere. Precipitation totals ranged mostly from 0.3 to 1.2 inches across the state with greater than an inch falling in the southwest corner. The National Weather Service released its 2011 spring flood predictions in which many locations across North Dakota were rated as greater and far greater than normal of reaching and exceeding flood stage. Factors that contributed to the spring flood concerns include the wet fall soil conditions, above normal snowfall, and a persisting La Nina pattern in conjunction with a negative Arctic Oscillation. The USDA, National Agricultural Statistics Service, North Dakota Field Office reported the average statewide snow depth was 24.3 inches on January 30th compared with 13.3 inches this time last year.

The National Weather Service (NWS) reported breaking a few precipitation and snowfall records in January. On the 9th Dickinson and Williston had record precipitation of 0.21 inches and 0.29 inches, respectively. Williston also had a record snowfall on the 9th of 5.0 inches. On the 10th, Fargo had a record precipitation of 0.25 inches. On the 14th, the Grand Forks Airport had a record precipitation of 0.23 inches and a record snowfall of 3.5 inches. And on the 30th, Bismarck had a record snowfall of 4.5 inches. See the "Storms and Record Events" section later in this publication for details on January precipitation records.

The US Drought Monitor February 1, 2011 report had no drought conditions reported in the state.

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported an average snow depth of 24.3 inches on January 30. Road conditions were rated 56% open, 33% difficult, 11% closed with 53% drifted, 29% icy, and 18% dry. (Weekly Weather and Crop Bulletin Vol. 98, No. 5).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), there were no severe weather reports of wind, hail or tornadoes in January.

The top five January daily maximum wind speeds recorded from NDAWN all happened on the 28th with 50.8 mph at Berthold, 48.0 mph at McHenry, 47.6 mph at Robinson, 46.5 mph at Edgeley, and 44.7 mph at Dazey. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The state average air temperature was 5.9 °F which is below the 1971-2000 normal of 7.9 °F. January 2011 state average air temperature ranked the 50th coolest in the past 117 years with a maximum of 25.9°F in 2006 and a minimum of -10.7°F in 1950.

The North Dakota Agricultural Weather Network (NDAWN) January average air temperatures ranged from 1 °F to 14 °F. NDAWN departure from normal temperatures ranged from 3 °F to -6 °F. Most of the state had near normal or slightly below normal average temperatures. Areas with -4 °F or less departure from normal temperatures were the southwest corner, the eastern edge, and the southeast. Most of the daily average air temperatures in January were below normal. There were a couple of days in the first few days of January that were above normal and a stretch from around the 24th through the 28th that were above normal. Otherwise, most days were near normal or below. Days with far colder than normal temperatures fell around the 10th to the 12th primarily in the west, 18th to the 22nd primarily in the east, and the last three days which took a sharp downward turn to the upper teens and 20 °F below normal for most of the state and 30 °F below normal in the southwest.

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

NDAWN's highest recorded daily air temperature for January was 46.8 °F at Sidney MT on the 27th. The lowest recorded daily air temperature was -39.6 °F at Roseau MN on the 21st.

February 2011

The state average precipitation was 0.34 inches which is below the 1971-2000 normal of 0.45 inches. February 2011 state average precipitation ranked 46th driest in the past 117 years with a maximum of 1.83 inches in 1998 and a minimum of 0.06 inches in 1934.

Precipitation ranged from roughly 5% to 200% of normal precipitation. Above normal precipitation fell primarily in the south central region and the western and southeastern edge. The majority of the state had 5% to 70% of normal precipitation. Precipitation totals ranged mostly from 0.01 to 0.7 inches. While it was the 6th driest February for Fargo, most of the state received roughly 0.05 to 0.1 inches of precipitation. According to the USDA, National Agricultural Statistics Service, North Dakota Field Office the statewide average snow depth was 15.6 inches on February 28 compared to 17.1 inches at this time last year. The mid-February thaw reduced the snow depth. However, the National Weather Service reported that the moisture content in the snowpack in parts of the southern Red River Valley is higher than it was in 2009 when Fargo hit a record high crest. Spring flood preparations started in the Fargo-Moorhead area as sandbag operations went into full swing. The city of Fargo filled 1.5 million sand bags to date which is 50% of the total sandbags planned to be filled. The North Dakota National Guard began training exercises to prepare for the potential flood fight in the eastern part of the state.

The National Weather Service (NWS) reported breaking two snowfall records in February. Williston on the 17th had a record snowfall of 2.9 inches which broke the previous record of 2.8

inches set in 1950. Fargo had a record snowfall of 6.7 inches on the 21st which broke the previous record of 2.4 inches set in 1945.

The US Drought Monitor March 1, 2011 report had no drought conditions reported in the state.

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported an average snow depth of 15.6 inches on February 27. Road conditions were rated 66% open, 24% difficult, 10% closed with 40% drifted, 20% icy, and 40% dry. (Weekly Weather and Crop Bulletin Vol. 98, No. 9).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), there were no severe weather reports of wind, hail or tornadoes in February.

The top five February daily maximum wind speeds recorded from NDAWN all happened on the 13th with 55.1 mph at Berthold, 54.4 mph at Watford City, 54.1 mph at Edgeley, 53.3 mph at Turtle Lake, and 53.0 mph at Bowbells. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The state average air temperature was 9.5 °F which is below the 1971-2000 normal of 15.4 °F. February 2011 state average air temperature ranked the 48th coolest in the past 117 years with a maximum of 29.7 °F in 1954 and a minimum of -14.1 °F in 1936.

The North Dakota Agricultural Weather Network (NDAWN) February average air temperatures ranged from 5 °F to 13 °F. NDAWN departure from normal temperatures ranged from -1 °F to -10 °F. Average air temperatures were below normal across the state and would have dipped even further below normal if not for the 10 days of above normal temperatures. Average air temperatures were near or above 25 °F across North Dakota from the 3rd through the 5th, and from the 11th through the 17th. The above normal temperature melted some of the snow depth. The remaining days in February were cold with 10 °F to 25 °F below normal average air temperatures for most of the state.

The National Weather Service (NWS) reported breaking one temperature record in February. Bismarck had a record high minimum temperature of 34 °F on the 13th which broke the previous record of 32 °F set in 2006.

NDAWN's highest recorded daily air temperature for February was 54.9 °F at Hettinger on the 16th. The lowest recorded daily air temperature was -31.1 °F at Britton SD on the 8th.

Season in Graphics

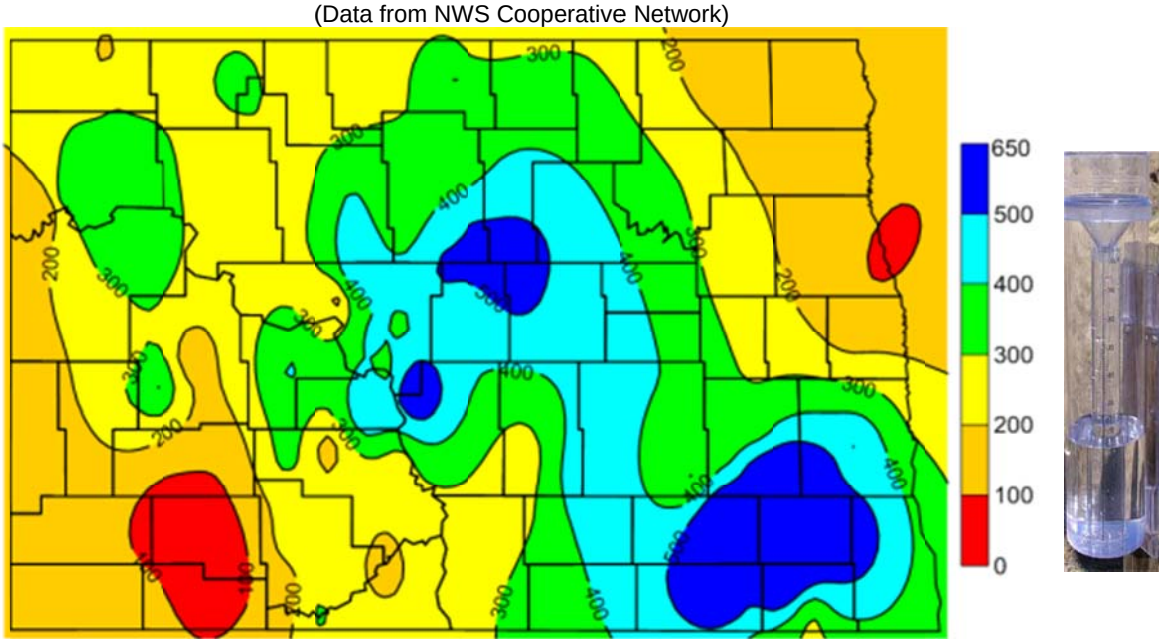
Winter 2010-2011 Weather in North Dakota:

December 2010

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

(Data from NWS Cooperative Network)

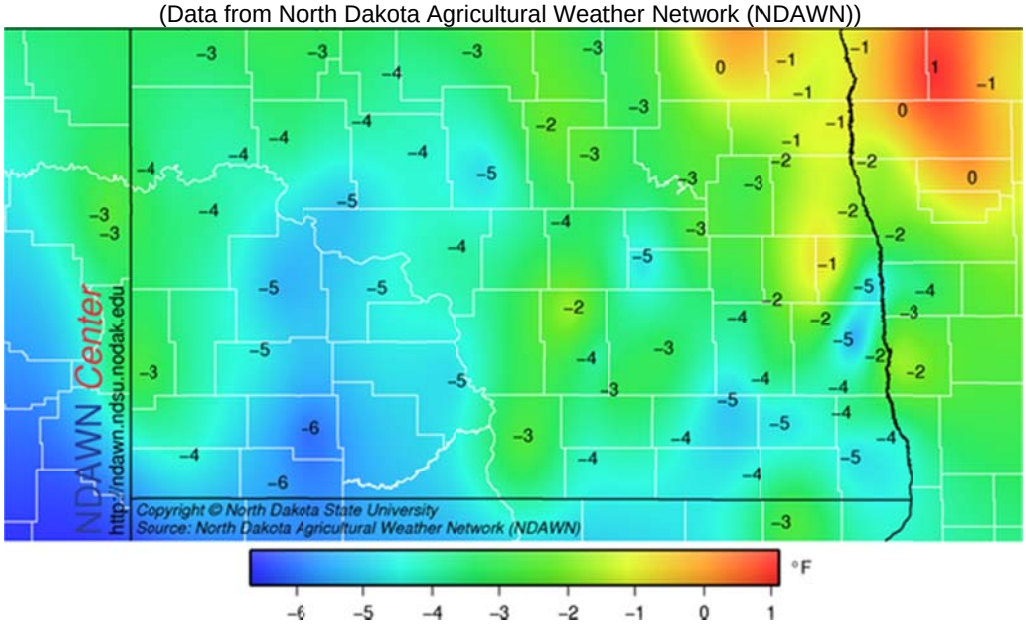


North Dakota State Climate Office

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

Departure From Normal Monthly
Average Air Temperature in degrees F

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



North Dakota State Climate Office

Season in Graphics

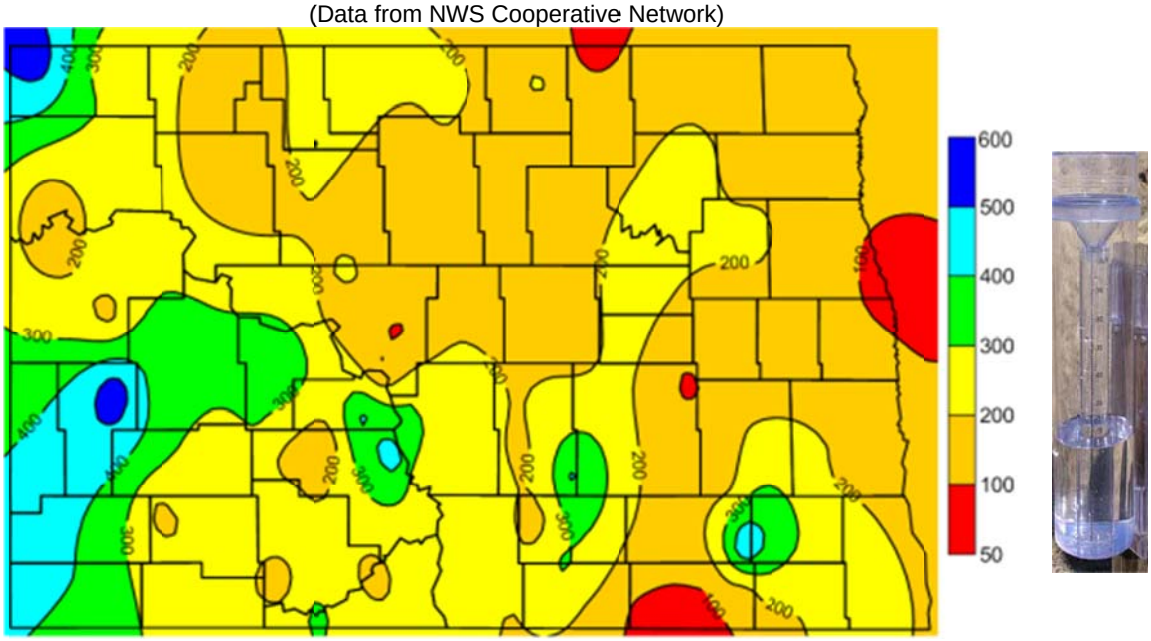
January 2011

Winter 2010-2011 Weather in North Dakota:

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

(Data from NWS Cooperative Network)

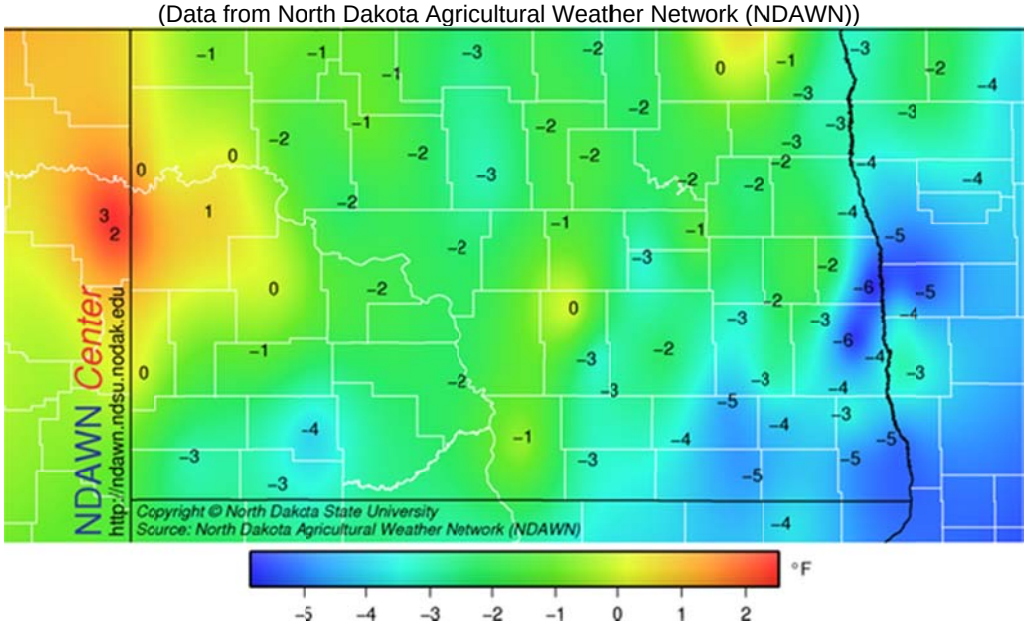


North Dakota State Climate Office

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

Departure From Normal Monthly
Average Air Temperature in degrees F

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



North Dakota State Climate Office

Season in Graphics

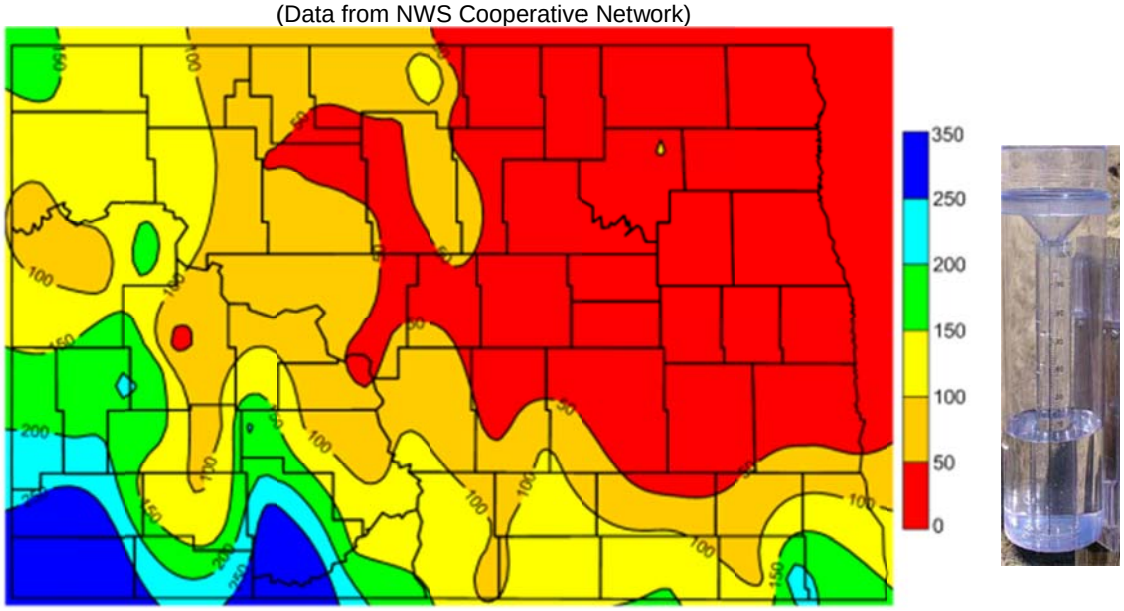
February 2011

Winter 2010-2011 Weather in North Dakota:

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

(Data from NWS Cooperative Network)



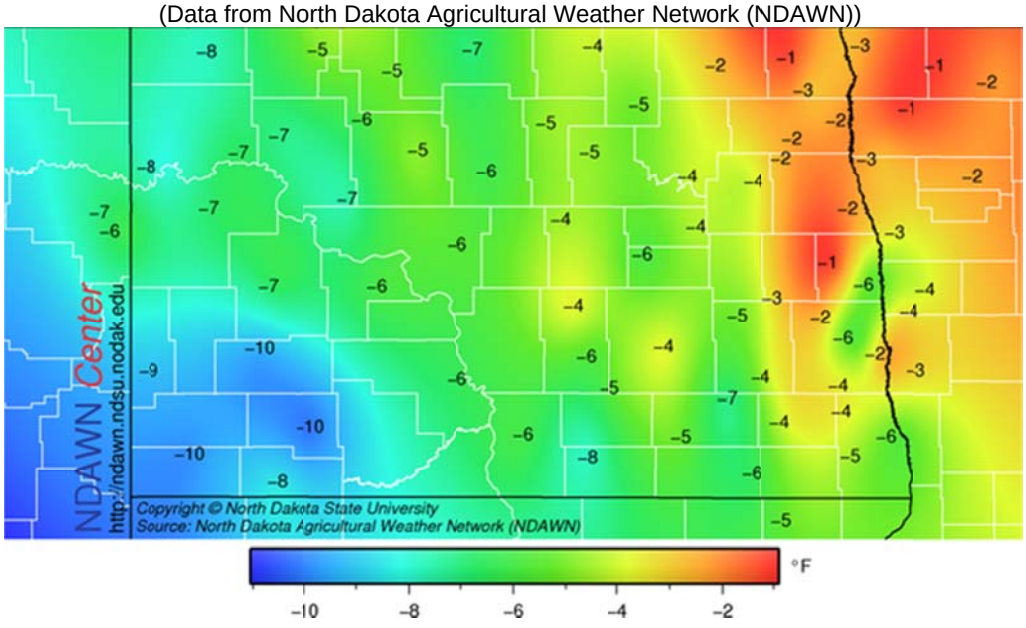
North Dakota State Climate Office

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

Departure From Normal Monthly

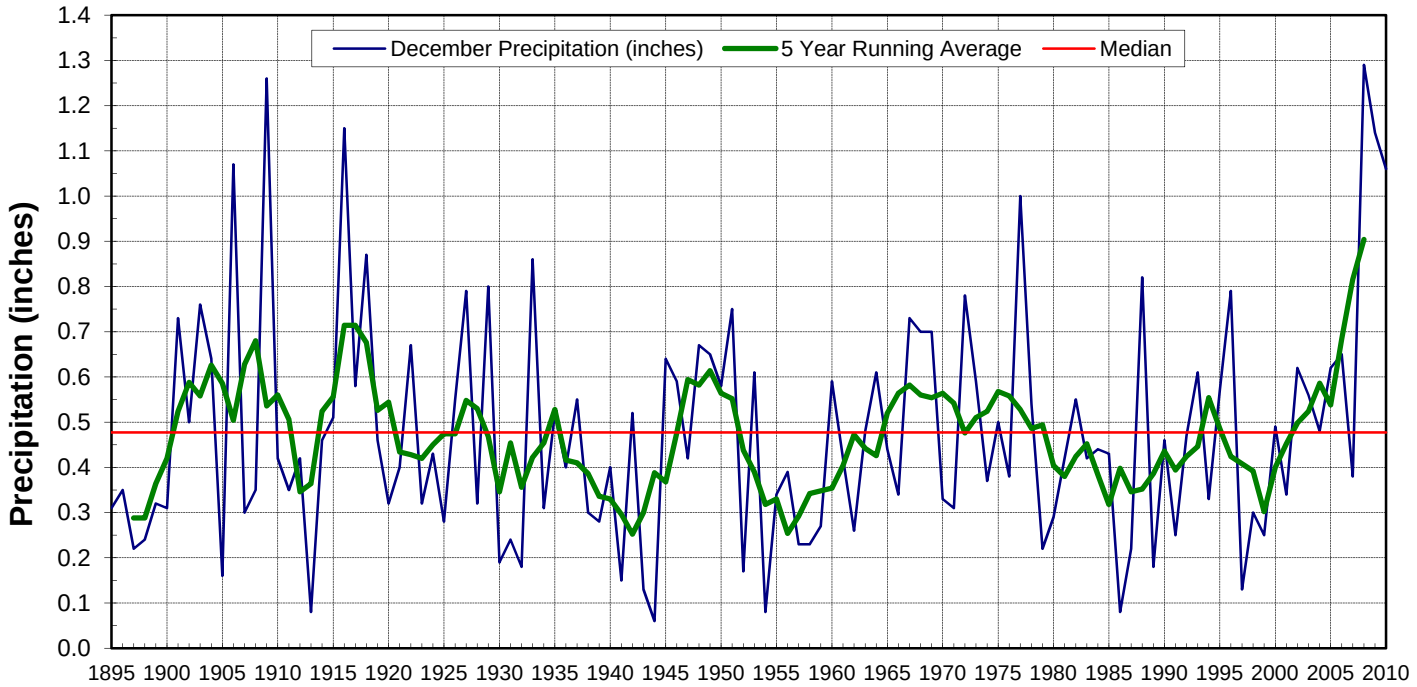
Average Air Temperature in degrees F

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



North Dakota State Climate Office

Historical December Precipitation for North Dakota

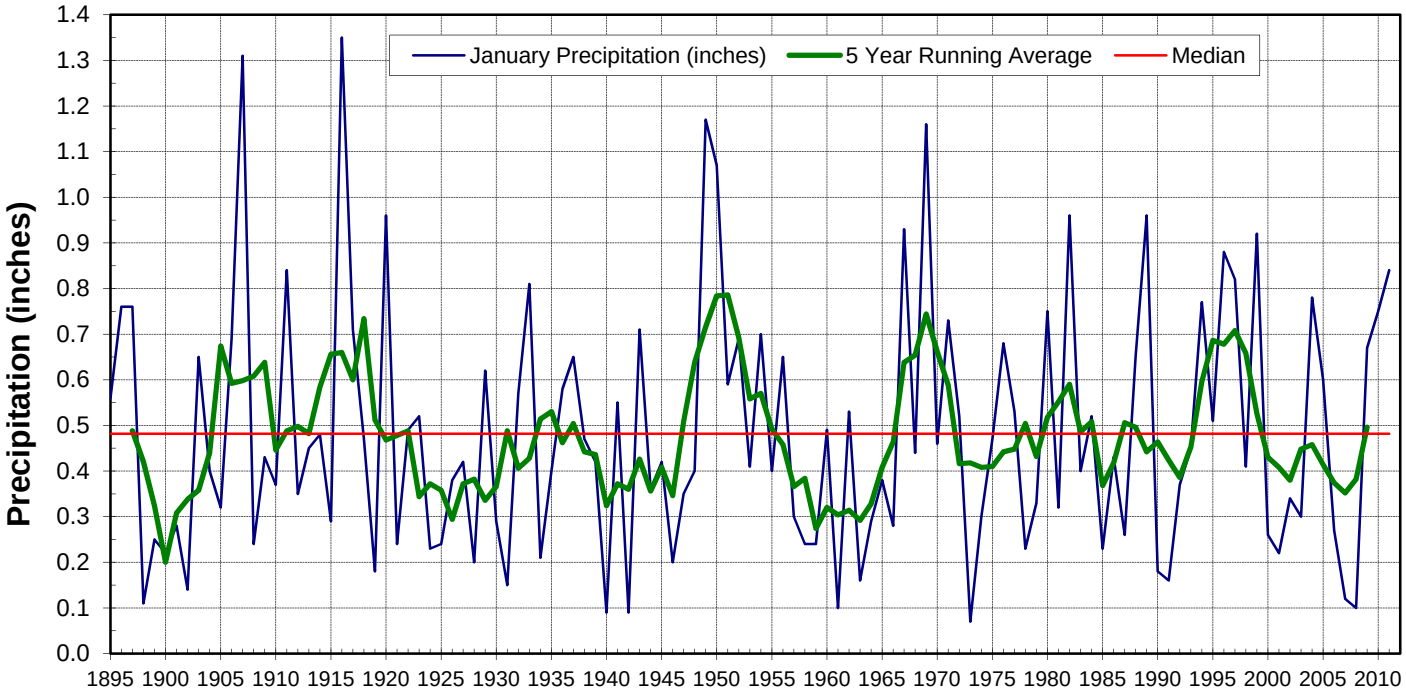


December Precipitation Statistics

2010 Amount: **1.06 inches**
Maximum: 1.29 inches in 2008
State Normal: 0.44” (1971-2000)

Monthly Ranking: 6th Wettest in 116 years
Minimum: 0.06 inches in 1944
Years in Record: 116

Historical January Precipitation for North Dakota

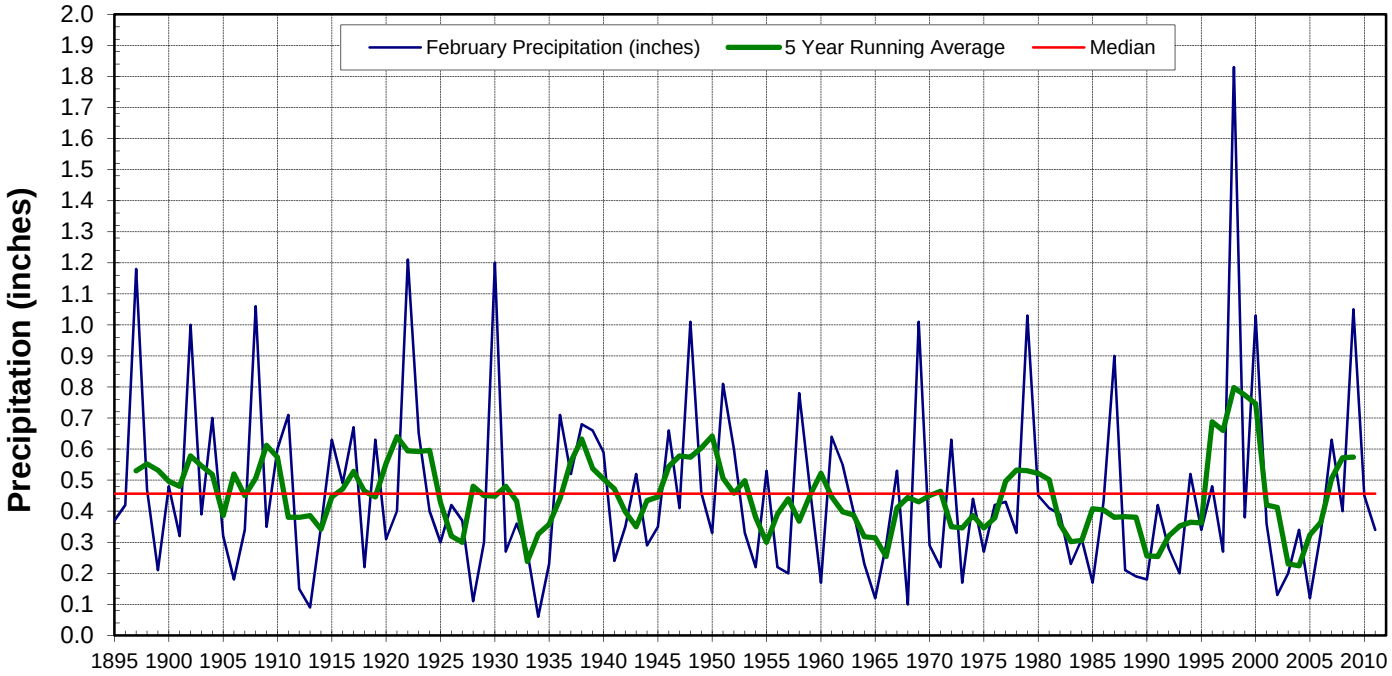


January Precipitation Statistics

2011 Amount: 0.84 inches
Maximum: 1.35 inches in 1916
State Normal: 0.50” (1971-2000)

Monthly Ranking: 13th Wettest in 117 years
Minimum: 0.07 inches in 1973
Years in Record: 117

Historical February Precipitation for North Dakota

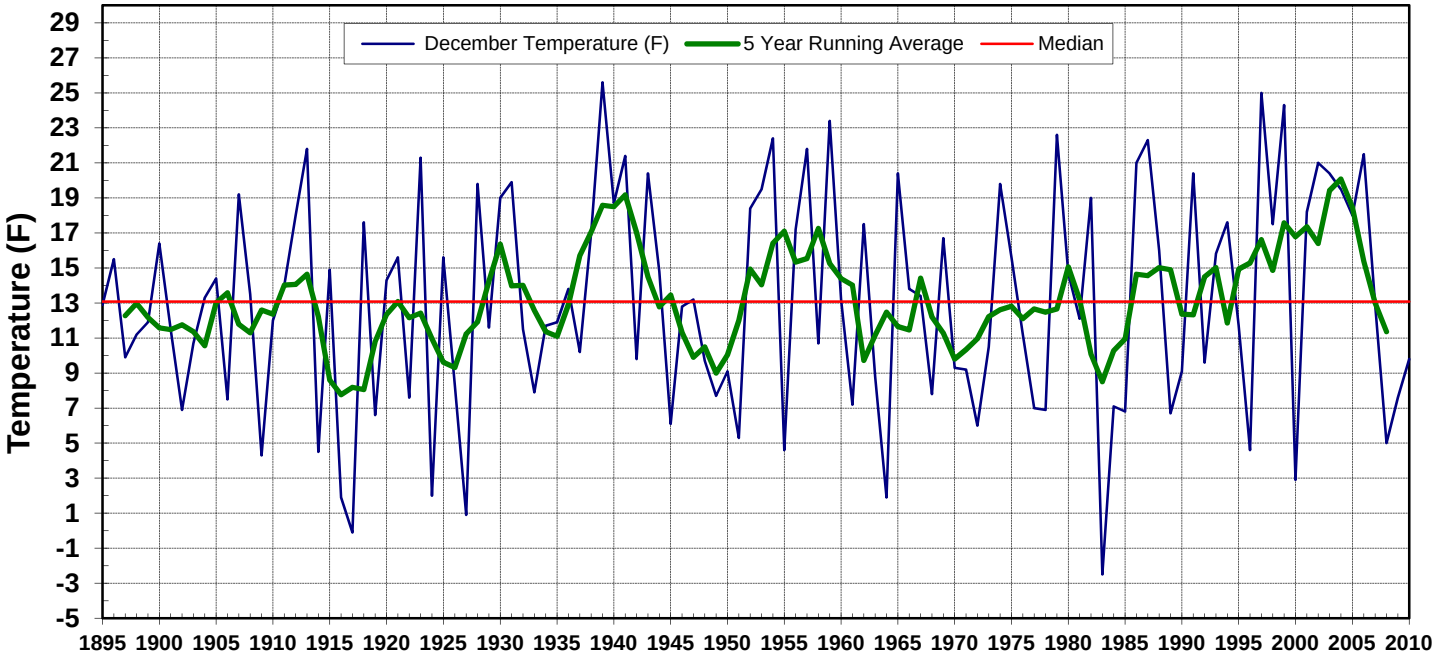


February Precipitation Statistics

2011 Amount: 0.34 **inches**
Maximum: 1.83 inches in 1998
State Normal: 0.45" (1971-2000)

Monthly Ranking: 46th Driest in 117 years
Minimum: 0.06 inches in 1934
Years in Record: 117

Historical December Temperature for North Dakota

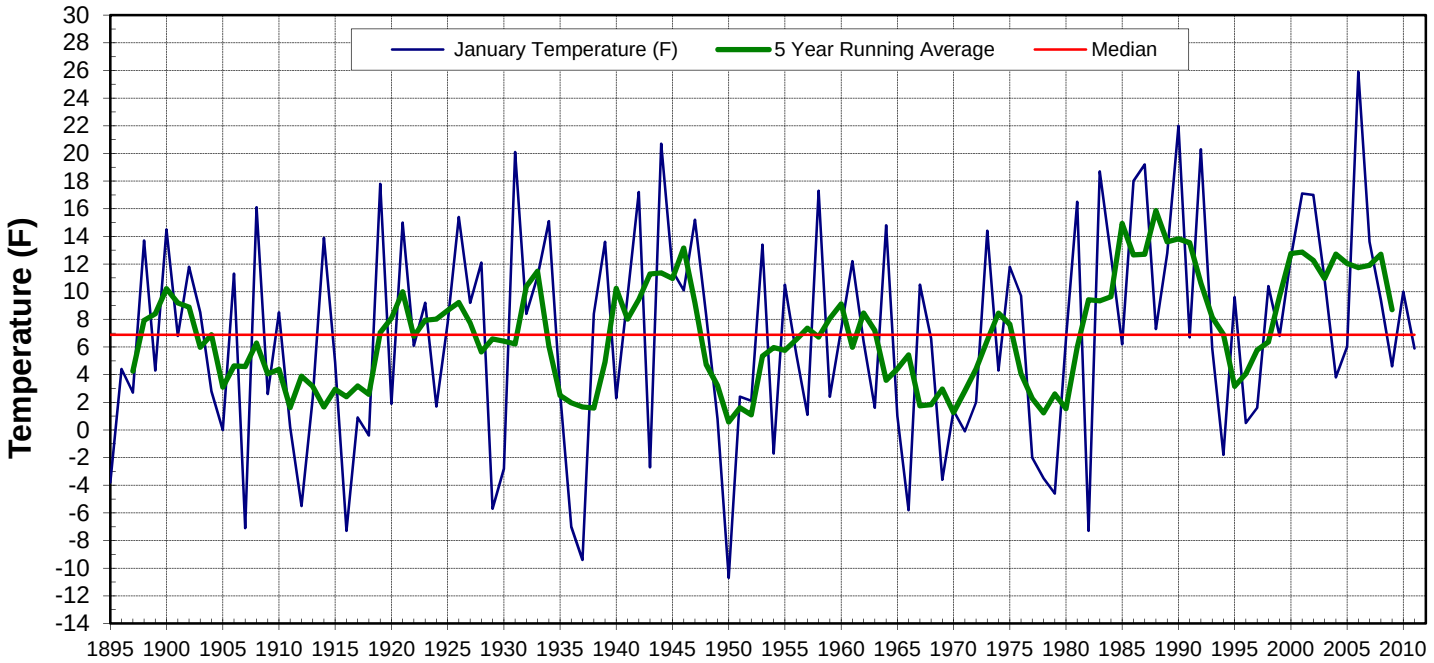


December Temperature Statistics

2010 Average: **9.8** °F
Maximum: 25.6 °F in 1939
State Normal: 13.0 °F (1971-2000)

Monthly Ranking: 38th Coolest in 116 years
Minimum: -2.5 ° F in 1983
Years in Record: 116

Historical January Temperature for North Dakota

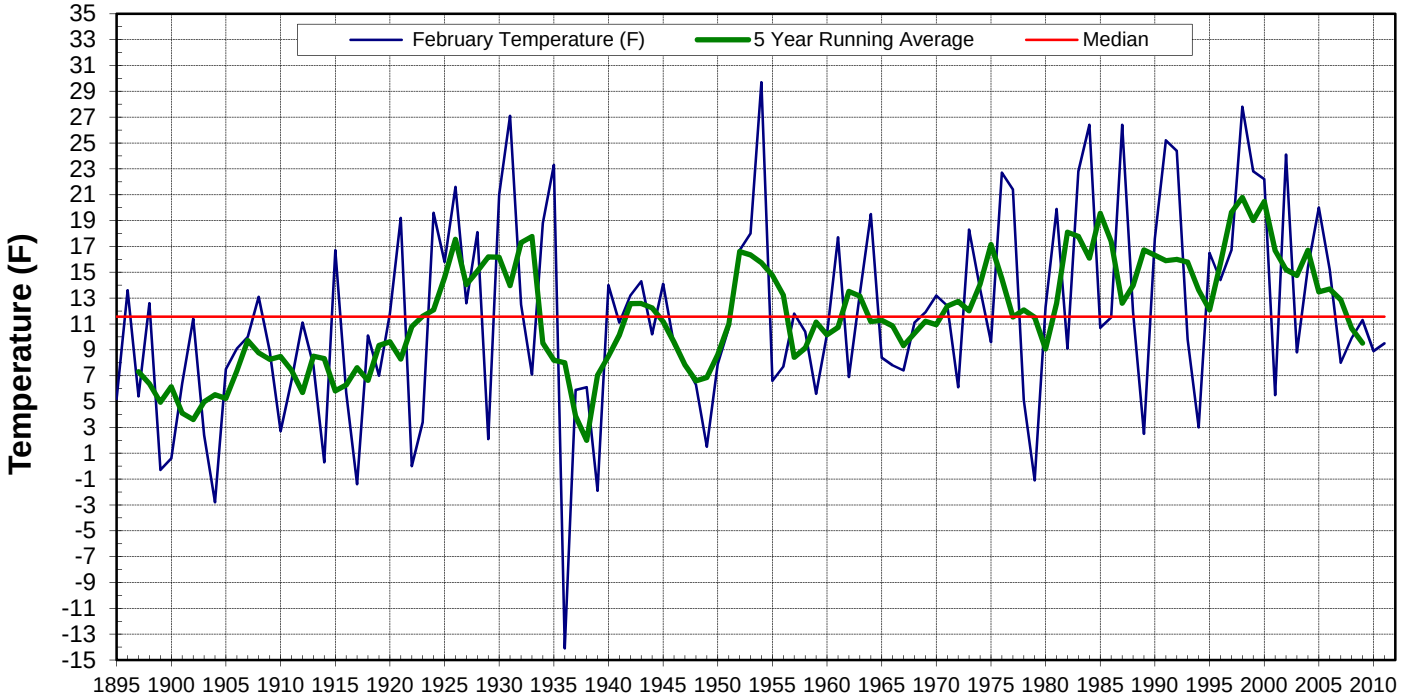


January Temperature Statistics

2011 Average: 5.9 °F
Maximum: 25.9 °F in 2006
State Normal: 7.9 °F (1971-2000)

Monthly Ranking: 50th Coolest in 117 years
Minimum: -10.7 °F in 1950
Years in Record: 117

Historical February Temperature for North Dakota



February Temperature Statistics

2011 Average: **9.5 °F**
Maximum: 29.7 °F in 1954
State Normal: 15.4 °F (1971-2000)

Monthly Ranking: 48th Coolest in 117 years
Minimum: -14.1 °F in 1936
Years in Record: 117

Storms & Record Events

State Tornado, Hail, and Wind Reports for Winter 2010-2011 by B. A. Mullins

North Dakota 3 Month Total	Wind	Hail	Tornado
	0	0	0

Reports by Month			
Month	Wind	Hail	Tornado
Total December	0	0	0
Total January	0	0	0
Total February	0	0	0

North Dakota Record Event Reports for Winter 2010-2011

Date	Location	Type of Record	Previous Record
12/02/10	Williston	Rainfall of 0.20 inches	0.19 inches set in 1994
12/03/10	Williston	Snowfall of 4 inches	3.9 inches set in 1994
12/03/10	Dickinson	Precipitation of 0.12 inches	0.05 inches set in 1977
12/03/10	Bismarck	Precipitation of 0.45 inches	0.34 inches set in 1903
12/03/10	Bismarck	Snowfall of 5.6 inches	3.4 inches set in 1903
12/03/10	Minot	Precipitation of 0.15 inches	0.13 inches set in 1994
12/10/10	Williston	Rainfall of 0.72 inches	0.36 inches set in 1929
12/10/10	Williston	Snowfall of 14.3 inches	5.2 inches set in 1929
12/15/10	Jamestown	Precipitation of 0.36 inches	0.21 inches set in 2003
12/20/10	Bismarck	Precipitation of 0.39 inches	0.25 inches set in 1967
12/20/10	Bismarck	Snowfall of 4.8 inches	3.8 inches set in 1967
12/20/10	Williston	Precipitation of 0.58 inches	0.27 inches set in 1967
12/20/10	Grand Forks	Precipitation of 0.41 inches	0.36 inches set in 1967
12/20/10	Fargo	Snowfall of 5.5 inches	5.4 inches set in 1967
12/20/10	Williston	Snowfall of 10.2 inches	2.7 inches set in 1967
12/21/10	Williston	Snow Depth of 23.0 inches	19.6 inches set on 12/3/1896
12/29/10	Williston	Snowfall of 6.8 inches	4.2 inches set in 1972
12/31/10	Grand Forks Airport	Snowfall of 4.6 inches	2.6 inches set in 1966
12/31/10	Grand Forks NWS	Snowfall of 4.6 inches	4.5 inches set in 2004
12/2010	Williston	Snowfall of 35.3 inches	32.0 inches set in 2008
01/09/11	Dickinson	Precipitation of 0.21 inches	0.15 inches set in 1983
01/09/11	Williston	Precipitation of 0.29 inches	0.25 inches set in 1916
01/09/11	Williston	Snowfall of 5.0 inches	1.7 inches set in 1916
01/10/11	Fargo	Precipitation of 0.25 inches	Ties previous record set in 1929
01/14/11	Grand Forks AP	Precipitation of 0.23 inches	0.21 inches set in 1956
01/14/11	Grand Forks AP	Snowfall of 3.5 inches	2.1 inches set in 1974
01/30/11	Bismarck	Snowfall of 4.5 inches	3.4 inches set in 1896
02/13/11	Bismarck	High minimum temperature of 34 °F	32 °F set in 2006
02/17/11	Williston	Snowfall of 2.9 inches	2.8 inches set in 1950
02/21/11	Fargo	Snowfall of 6.7 inches	2.4 inches set in 1945
02/26/11	Dickinson	Low temperature of -24 °F	Ties previous record set in 1962

Seasonal Outlook

Spring Climate Outlooks

by D. Ritchison[1]

It was a cold and wet winter across most of North Dakota. This was not totally unexpected, as our state often has experienced such conditions during our cold season when a La Niña is present in the Pacific Ocean. Those colder than average temperatures in the Pacific Ocean have probably been a key player in weather events around the world. From the flooding rains in Australia, to abnormally dry conditions in the wheat belt in China, to the cold and snowy conditions across the lower 48 states, these events could all be partially attributed to the colder than average oceanic temperatures in the equatorial Pacific.

Granted, it is over simplifying the complexity of atmospheric motions by pinpointing just one phenomenon to describe worldwide events, yet, the moderate La Niña currently in place has historically been present when similar events have occurred around the globe. Each year is unique, but looking at similar atmospheric and oceanic conditions in the past can bring some clues as to what may occur in the future.

Historically, when a La Niña is present, North Dakota tends to have a cooler than average spring with the coldest anomalies from average occurring during the first half of the season. Granted, a warm March is always colder than a cool May, but if the past is our guide, the departures from average will likely be higher earlier in the season then they will be as we progress into May.

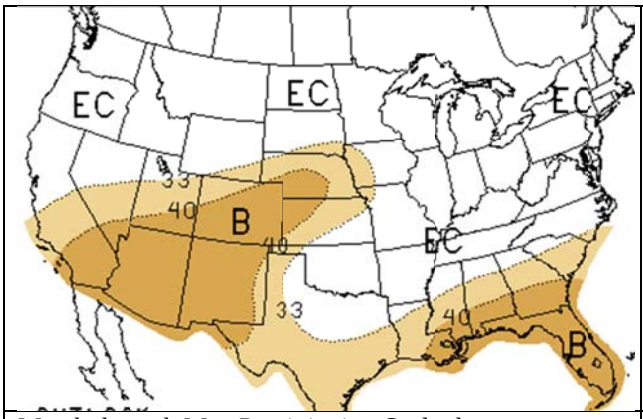
Precipitation trends during a La Niña spring statistically are more favorable for wetter than normal conditions. Like temperatures, the anomalies tend to be higher during the early part of the season. Although a thunderstorm at the wrong time in May will slow down fieldwork, for instance in a small area, the larger scale heavier precipitation events are more likely in March and April.

As a reminder, the North Dakota State Climate Office has links to the National Weather Service's local 3-month temperature outlooks for the upcoming year. Those outlooks can be found here: http://www.ndsu.edu/ndsco/outlook/L3MTO.html

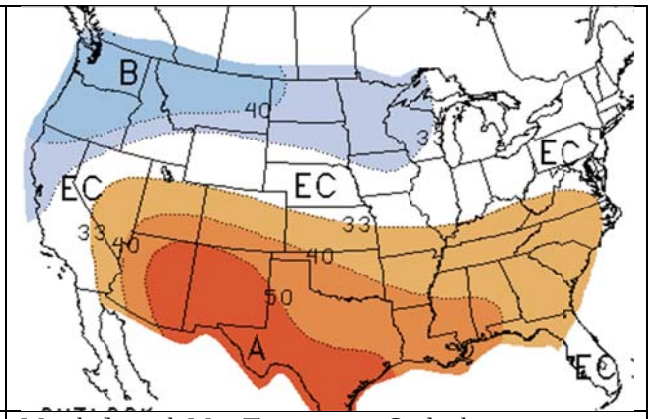
The latest spring outlook from the Climate Prediction Center (the graphics below) is giving equal chances for the spring season to be either average, above average or below average for precipitation, differing from my take, and they are forecasting temperatures to have a higher than normal likelihood of finishing below average, which is similar to my thoughts above. These outlooks are updated on the third Thursday of each month, with a final monthly outlook issued at the end of each month. These outlooks are available at http://www.cpc.ncep.noaa.gov/products/predictions/90day

One thing that is almost certain in our transitional seasons of spring and autumn in North Dakota is that we will likely see wild swings in our weather patterns during the next three months. The outlooks try to give an overall average of those extremes and at the moment that odds seem to favor cool and moist conditions in most areas when compared to the long-term averages.

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



March through May Precipitation Outlook



March through May Temperature Outlook

Also the readers will find the following National Weather Service office web sites very useful for shorter term weather forecasts:

Eastern North Dakota: http://www.crh.noaa.gov/fgf/
Western North Dakota: http://www.crh.noaa.gov/bis/

Hydro-Talk

Cooler than Normal March is what the Doctors Ordered

by A. Schlag[2]

It doesn't take a lifelong resident of North Dakota to recognize that we are now entering another spring with a significantly enhanced risk of flooding. Quite simply, enough water is already present to produce widespread flooding and there really are very few substantive differences between the current snowpack and that of the spring 2009, or that observed in 2010. However, those flood seasons unfolded vastly different from each other. It would appear that March is again going to be the key to understanding the severity of flooding in 2011. For numerical analysis of the probability of flooding, I would ask that you visit the National Weather Service Advanced Hydrologic Prediction Service web site (http://water.weather.gov/ahps/) where all river (and some lakes) gauges in the US are accessible for the past, current and future river/lake stage information. In this brief discussion, I will only be writing on the qualitative aspects of flood expectations in the Souris, Missouri, and James River basins. The Red River Valley and Devils Lake Basin have distinctly different hydrologic characteristics from western and central North Dakota.

Unlike the winter of 2009, we have received a relatively large number of reports talking about a lack of significant frost depth. We had also received a number of reports concerning minimal frost depth in the spring of 2010 and that greatly reduced the flood severity in western and central North Dakota. Importantly, this lack of frost was combined in many areas with a very gradual rise in temperatures into the snow melting temperatures of 30s and 40s. When these two conditions were in the same watershed, flooding was basically a non-story. Conversely, when one of these two conditions is not met, the local rivers and streams were still a problem.

So, where does that leave us with our prognostications for spring flooding in 2011? The current lack of frost does provide reason for cautious optimism that the hydrologic model output can be "wrong" (one should note that the hydrologic models are not "wrong" as they produce probability tables showing the risk of reaching certain stages. There is always a legitimate chance in any probability table that the lower probability events will occur.) with all the doom and gloom probabilities. Similarly, we continue to maintain a cooler than normal temperature across the state, and that's perfectly OK by me. This observed cooler than normal pattern 9 days into March has kept our daytime highs below the mid-30s with nighttime lows below freezing. Quite honestly, the last thing I want right now is for March to strive for an overall "normal" temperature. In order for March to end up with an average daytime high near "normal", the second half of the month would have to be well above the daily normal, perhaps in the upper 40s and mid-50s. At this point getting March a "normal" temperature rating would be a recipe for widespread flooding. So I hope everyone understands why I am now holding out hope that the end of March is colder than normal, something in the 35 degree range would be great. Cooler than normal March is exactly what the doctors ordered, because it is what we need to avoid catastrophic floods.

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Science Bits

Perfect Weather:

by F. A. Akyüz[3]

Now that we are almost certain (98% chance based on the NWS flood outlook) that we will have a major flood in the Red River of the North in Fargo, the question becomes, what would be the perfect weather to tone down the magnitude of the flood to more tolerable levels.

The major flood stage of the Red River in Fargo is 30 feet. The river exceeded this threshold 15 times in recorded history since 1882. The table on the right shows the major floods and their occurrence dates in Fargo. There are 4 back-to-back major flood events: 1965-66, 1978-79, 2006-07, and 2009-10. During the last 10 years, there have been 5 major floods. Four of the last five years produced major floods. Most ten-year olds can remember the last 5 years of their lives. Therefore, major floods are common part of our lives in their minds as this is all they saw and heard every year during spring melt. Topography and the synchrony of spring thaw make the Red River Valley one of the most flood prone regions in the country. The valley gently slopes to the North. A simple analogy would be pouring a bucket of water on a flat table to explain to our ten-year olds how a slope impacts flood frequency. Explaining synchrony is a little tougher one. Perhaps using a few match box cars can help explain how synchrony of spring thaw works against us every year. First, line up all your match box cars northward but make sure the slowest car (combine, tractor or a construction vehicle such as a grader) is in the front of the line, while faster cars (monster trucks and race cars) are in the back of the line. Assume for a minute that they all are waiting at a stop sign for the lights to turn green (waiting for spring to arrive). Once the green lights turn on, the faster cars in the back of the line want to go fast, but they cannot, because they must wait for the slower traffic to clear the road before they pursue their northerly journey. Similarly, snow and ice melt much faster in the south. Late melt in the north causes natural ice jams every year, making it difficult for the water to navigate northward every year.

Historic Major Floods (Fargo, ND)

Year	Date	Peak River Stage (ft)
1882	11-Apr	37.8
1897	7-Apr	39.1
1965	15-Apr	30.5
1966	22-Mar	30.16
1969	15-Apr	37.34
1975	4-Jul	33.26
1978	2-Apr	34.41
1979	19-Apr	34.93
1989	9-Apr	35.39
1997	17-Apr	39.57
2001	14-Apr	36.69
2006	5-Apr	37.13
2007	8-Jun	30.84
2009	28-Mar	40.84
2010	21-Mar	36.99

The conditions above are the static conditions that exist every year. Now, let's talk about dynamic conditions that change year after year: the weather. North Dakota, especially the eastern half, has been experiencing wetter than normal conditions since 1993. Historically the area underwent a series of wet and dry periods. Unfortunately, there is no easy answer to whether or how long the wet period will last or if flood magnitude will decrease in time. All correlations can

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only explain the past and may not be extrapolated into the future. However, history can tell us about the river's behavior when certain conditions are repeated. For example;

- 5 out of the 10 wettest falls were associated with major flooding the following spring. Two of these events were followed by moderate floods and one was followed by a regular flood. It is the most reliable early warning system for major floods in our region.
- 4 out of the 5 wettest falls that were associated with major floods were followed by wet winters. It is a reconciliation of the early warning system.
- All 4 events mentioned above were associated with rapid warm up or significant precipitation during (or just prior to) melting. This is a good indicator that a major flood will occur. In fact all major floods were associated with some significant amount of precipitation just before the peak stage.

September Through February Precipitation			
Ranking	Amount (in)	Year	Peak River Stage (ft)
1	14.31	2009	40.84 (The Highest)
2	12.19	2010	36.99 (7th Highest)
3	12.15	1897	39.1 (3rd Highest)
4	12.00	1904	21.3
5	11.62	1997	39.57 (2nd Highest)
6	11.61	1972	25.36
7	11.36	2001	36.69 (8th Highest)
8	11.34	1978	34.41 (11th Highest)
9	11.25	1882	37.8 (4th Highest)
10	**11.19**	**2011**	**?**

When compared previous September through February conditions (Table to the left) to our 2010-2011 season, only 2 events out of 10 did not end up with major flooding: 1904 (peak stage of 21.3' on April 20), and 1972 (peak stage of 25.36' on March 24). The spring of 1904 spring was unseasonably cold until April 20. In 1972, March precipitation was 0.43" below normal.

Since we cannot change the prior conditions, at this point we can all wish for the conditions to tone down the magnitude of the flood to more tolerable levels--the perfect weather. To accomplish this would be:

- Dry for the remainder of March and April
- Gradual warming (slightly above freezing daytime temperatures and slightly below freezing nighttime temperatures)
- Windy days during melting: Wind will help in two ways.
    1. It will enhance evaporation
    2. Evaporation will lower the temperature. If the air temperature is around 32°F, evaporative cooling can lower the temperature back to freezing which in turn will slow down water movement into the river's main stem.

We may be 98% certain that we would get a major flood, but its magnitude depends on two remaining variables: the rate of warm up, and significant precipitation during melting.

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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