North Dakota Climate Bulletin

Spring 2011

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NDSCO

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From the State Climatologist

The North Dakota Climate Bulletin is a digital quarterly publication of the North Dakota State Climate Office, the College of Agriculture, Food Systems and Natural Resources, North Dakota State University in Fargo, North Dakota.

Compared historically, North Dakota had a cooler and wetter spring following another cooler and wetter season. As a result, widespread flooding was common in the state. First time in recorded history 3 back-to-back major flooding in Fargo occurred. The river gauge at Fargo reached its 4th highest stage of 38.75 feet (nearly 14 feet over the major flood category marking) on April 9, 2011. Another record breaking flooding currently is in progress in Minot along the Souris River. More on the Souris River flooding is featured in the "Hydro Talk" section of this issue. Temperature-wise, this spring was the 16th coolest since 1895. Precipitation-wise, it was the 12th wettest winter since 1895. The 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.

Souris River, Minot, ND: Photo by NWS Bismarck

Adnan Akyüz, Ph.D.
North Dakota
State Climatologist

Weather Highlights

Seasonal Summary: by B. A. Mullins

March 2011

The state average precipitation was 0.99 inches which is above the 1971-2000 normal of 0.80 inches. March 2011 state average precipitation ranked 28th wettest in the last 117 years with a maximum of 2.72 inches in 1902 and a minimum of 0.09 inches in 1930.

Precipitation ranged from approximately 5% to 300% of normal precipitation. Above normal precipitation covered most of the state and fell in large portions of the central and east central regions. Precipitation totals ranged primarily from 0.15 to 2.7 inches. Persistent cold weather slowed the snow melt and delayed spring flooding into April. According to the USDA, National Agricultural Statistics Service, North Dakota Field Office the statewide average snow depth was 12.2 inches on March 27th (15.6 inches on February 28, 2011) compared to 0.6 inches at this time last year. As of March 31st, Fargo recorded its 3rd snowiest winter (since 1885), Grand Forks was 8th (since 1893), Bismarck was 8th (since 1886), Dickinson was 9th (since 1893), Minot was 4th (since 1905) and Williston was 1st (since 1894). There were two major storm events. On the 11th, snow totals ranged from approximately a Trace to 6 inches with wind gusts of over 40 mph with some areas measuring greater than 60 mph. The 22-23 storm system produced heavy, wet snow of 5 to 20 inches in the west central, central, south central, eastern, and southeastern locations.

The National Weather Service (NWS) recorded breaking daily total precipitation records on the 11th at Minot with 0.45 inches, on the 22nd at Fargo with 0.89 inches, and on the 23rd at Williston with 0.52 inches. One snowfall record was broken on the 23rd at Williston with 6.2 inches. March NWS records are listed in the Storm and Record Events section of this bulletin.

The US Drought Monitor April 12, 2011 report had no drought conditions reported in the state.

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 0% very short, 0% short, 45% adequate, and 55% surplus with a subsoil moisture reported as 0% very short, 1% short, 54% adequate, and 45% surplus (Weekly Weather and Crop Bulletin Vol. 98, No. 16).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for March had no reports of high wind events, hail, or tornadoes.

The top five March daily maximum wind speeds recorded from NDAWN all happened on the 11th. The top five were Linton with 67.7 mph, Mandan with 63.7 mph, Robinson with 63.7 mph, Wishek with 59.8 mph and Edgeley with 58.4 mph. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The state average air temperature was 18.7 °F which is below the 1971-2000 normal of 26.87°F. March 2011 state average air temperature ranked 24th coolest in the past 117 years with a maximum of 40.7°F in 1910 and a minimum of 6.9 °F in 1899.

The North Dakota Agricultural Weather Network (NDAWN) March average air temperatures ranged from 16 °F to 23 °F. NDAWN departure from normal temperatures ranged from -3 °F to -10 °F. The past 4 months had below normal average monthly air temperatures with a 12/1/10 - 3/31/11 departure from normal average temperature range of -2 to -7. The first 9 days of March were cold with average daily temperatures from 10 to nearly 30 °F below normal. There were a few days from the 14th through the 22nd where average daily temperatures hovered more near normal or even slightly above. The remainder of the month had varying temperatures across the state of near normal to 20 °F below normal.

The National Weather Service (NWS) did not report any new temperature records in March.

NDAWN's highest recorded daily air temperature for March was 55.1 °F at Hettinger on the 18th. The lowest recorded daily air temperature was -21.3 °F at Karlsruhe on the 7th.

April 2011

The state average precipitation was 1.81 inches which was above to the 1971-2000 normal state average of 1.40 inches. April 2011 state average precipitation ranked the 27th wettest in the past 117 years with a maximum of 3.86 inches in 1896 and a minimum of 0.11 inches in 1987.

Precipitation ranged from approximately 50% to 300% of normal precipitation. The heaviest amounts of above normal precipitation fell in the southwest and eastern regions. Precipitation totals ranged primarily from 0.50 to 3.0 inches. A cool wet cycle continued into April. April had two scattered snow events which were from the 15th through the 16th and from the 17th through the 19th. The heaviest snow totals of 7 and up to 9 inches fell on the 15th in the central part of the state. The Red River crested at Fargo on the 9th at 38.75 ft which was the 4th highest on record. Many roads including parts of the interstate were closed due to overland flooding for much of April especially in the Red River Valley.

The National Weather Service (NWS) reported breaking both a rainfall and snowfall record at Grand Forks NWS with 0.91 inches of rain and 7.6 inches of snow and Grand Forks AP with 0.95 inches of rain and 7.9 inches of snow on the 15th. Fargo had a record snowfall of 1.7 inches on the 18th. Williston had a record rainfall of 0.75 inches on the 29th followed by a record snowfall of 7.9 inches on the 30th. The records are listed in the Storms and Record Events section later in this bulletin.

The US Drought Monitor May 3, 2011 report had no drought conditions reported in the state.

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 0% very short, 1% short, 54% adequate, and 45% surplus with a subsoil moisture reported as 0% very short, 0% short, 58% adequate, and 42% surplus (Weekly Weather and Crop Bulletin Vol. 98, No. 19).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for April had no reports of high wind events, hail, or tornadoes.

The top five April daily maximum wind speeds recorded from NDAWN all happened on the 30th with 64.1 mph at Crosby, 60.5 mph at Bowman, 59.8 mph at Williston, 57.6 mph at Mott, and 57.3 mph at Beach. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The state average air temperature was 38.9 °F which is below the 1971-2000 normal of 41.71 °F. April 2011 state average air temperature ranked the 32nd coolest in the past 117 years with a maximum of 50.2°F in 1987 and a minimum of 31.1°F in 1907.

The North Dakota Agricultural Weather Network (NDAWN) April average air temperatures ranged from 35 °F to 43 °F. NDAWN departure from normal temperatures ranged from 1 °F to -5 °F. April is the fifth straight month of below average air temperatures for most of the state. The average of 12/01/2010 through 04/30/2011 departure from normal average air temperature range was 2 to 7 °F below normal. Average daily air temperatures hovered near normal for most of the state during the first half of the month. Average air temperatures dropped to 10 and 20 °F below normal across the state during the majority of the last half of the month. The wet and cool conditions prohibited field work. According to the USDA, National Agricultural Statistics Service, North Dakota Field Office the average starting date for field work is May 7th which is 16 days behind the five-year (2006-2010) average.

The National Weather Service (NWS) reported breaking one temperature record at Dickinson which recorded a low temperature of 11 °F on the 20th.

NDAWN's highest recorded daily air temperature for April was 73.8 °F at Stephen MN on the 29th. The lowest recorded daily air temperature was 3.5 °F at Mott on the 20th.

May 2011

The state average precipitation was 4.07 inches which is above the 1971-2000 normal of 2.31 inches. May state average precipitation ranked 12th wettest in the past 117 years with a maximum of 5.73 inches in 1927 and a minimum of 0.31 inches in 1901.

Percent of normal precipitation ranged from approximately 70% to 300%. The western half of the state had the highest amounts with 200% to 300% of normal. Much of the eastern half ranged from 70% to 150%. The North Dakota Agricultural Weather Network (NDAWN) May rainfall totals ranged from 1.60 to 7.01 inches. The greatest daily rainfall events occurred between the 8th and 10th, 19th and 22nd, and the 27th through to the 31st. According to the USDA, National Agricultural Statistics Service, North Dakota Field office the average planting date was May 7th which was 19 days later than 2010 and 16 days later than the previous five year average (2006-2010). Cool, wet conditions continued to hamper field work throughout May. Melting snow pack and heavy rains in eastern Montana and western North Dakota caused river levels to rise above the 100-year flood level. The residents of the flooded areas filled sand bags and built dikes to protect property and still some had to evacuate their homes on short notice. Ground water also became an issue as the water table rose and began seeping into basements.

The National Weather Service (NWS) reported breaking one rainfall record on May 10th at Williston with 1.27 inches. See the Storms and Record Events section later in this bulletin to view NWS spring records.

The US Drought Monitor June 7, 2011 report had no drought conditions reported in the state.

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 0% very short, 1% short, 41% adequate, and 58% surplus with a subsoil moisture reported as 0% very short, 0% short, 43% adequate, and 57% surplus (Weekly Weather and Crop Bulletin Vol. 98, No. 22).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for May had 9 reports of high wind events, 3 reports of hail, and 3 reported tornadoes.

The top five May daily maximum wind speeds recorded from NDAWN all happened on the 30th with Perley MN at 66 mph, Hillsboro at 62 mph, Eldred MN at 61 mph, Ada MN at 60 mph, and Fargo at 58 mph. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The state average air temperature was 50.6 °F which is below the 1971-2000 normal of 54.80 °F. May state average air temperature ranked the 32nd coolest in the past 117 years with a maximum of 63.10°F in 1977 and a minimum of 43.30 °F in 1907.

NDAWN May average air temperatures ranged from 49 °F to 55 °F. NDAWN departure from normal temperatures ranged from -1 °F to -5 °F. May is the sixth straight month of below average air temperatures for most of the state. Average daily air temperatures across the state hovered near 50 °F throughout most of May. According to data from the NDAWN weather station network, the first 2011 day a maximum air temperature of over 80 °F was measured in North Dakota was on the 30th in the southeastern part of the state. The hot humid temperature came on the doorstep of a large scale thunder storm that produced near hurricane force winds. The Fargo Hector International Airport measured a strongest gust of 72 mph. However, it is estimated from the damage that gusts could have been 90 to 100 mph. Straight-line winds in the Fargo-Moorhead metro area ripped up trees, knocked down power poles, and caused power outages. Some who lost power did not have it restored for over a day.

The National Weather Service (NWS) reported breaking one temperature record on May 1st at Grand Forks airport with a lowest maximum temperature of 34 °F. See the Storms and Record Events section later in this bulletin to view NWS spring records.

NDAWN's highest recorded daily air temperature for May was 88 °F at Wahpeton on the 30th. The lowest recorded daily air temperature was 17 °F at Hazen on the 2nd.

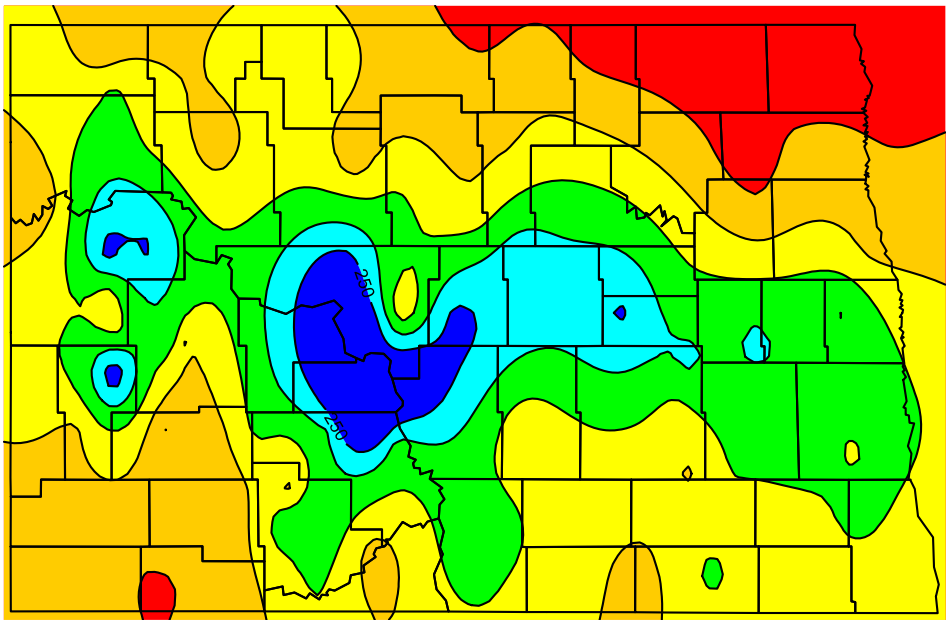
Season in Graphics

Spring 2011 Weather in North Dakota:

March 2011

Total Precipitation percent of mean (1971-2000)

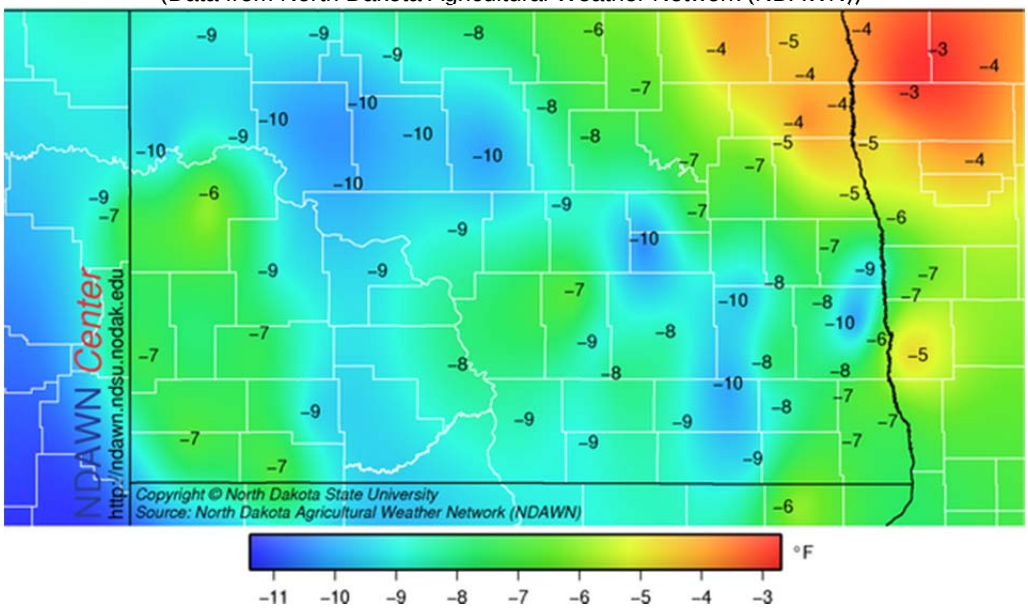
Precipitation Percent of Normal
(Data from NWS Cooperative Network)



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

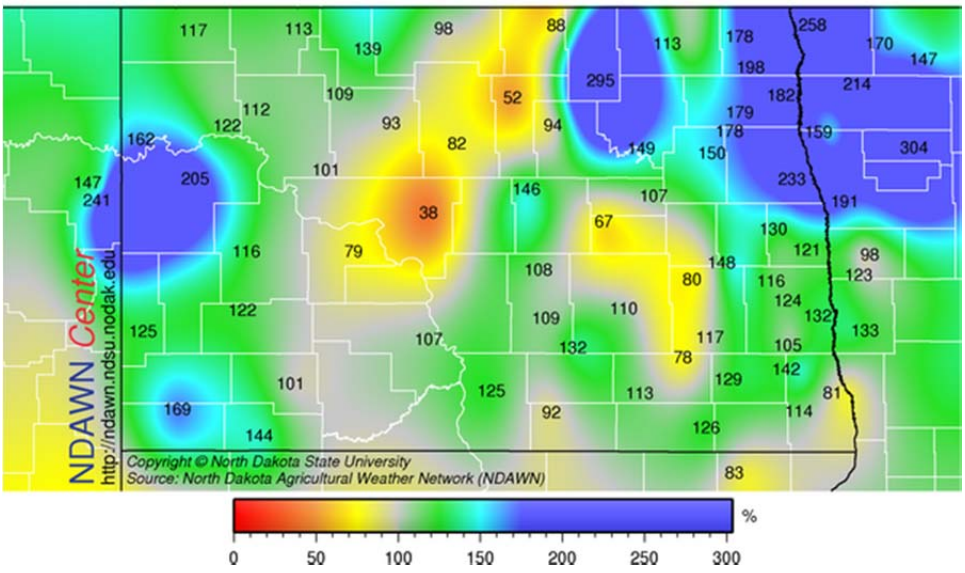
April 2011

Spring 2011 Weather in North Dakota:

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

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

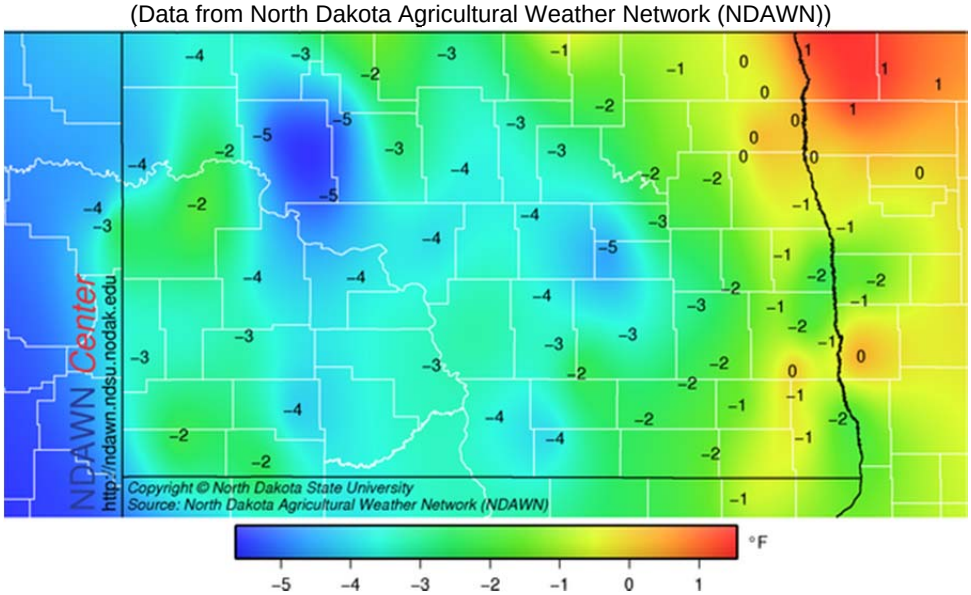


North Dakota State Climate Office

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

Departure From Normal Monthly
Average Air Temperature in degrees F

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



North Dakota State Climate Office

Season in Graphics

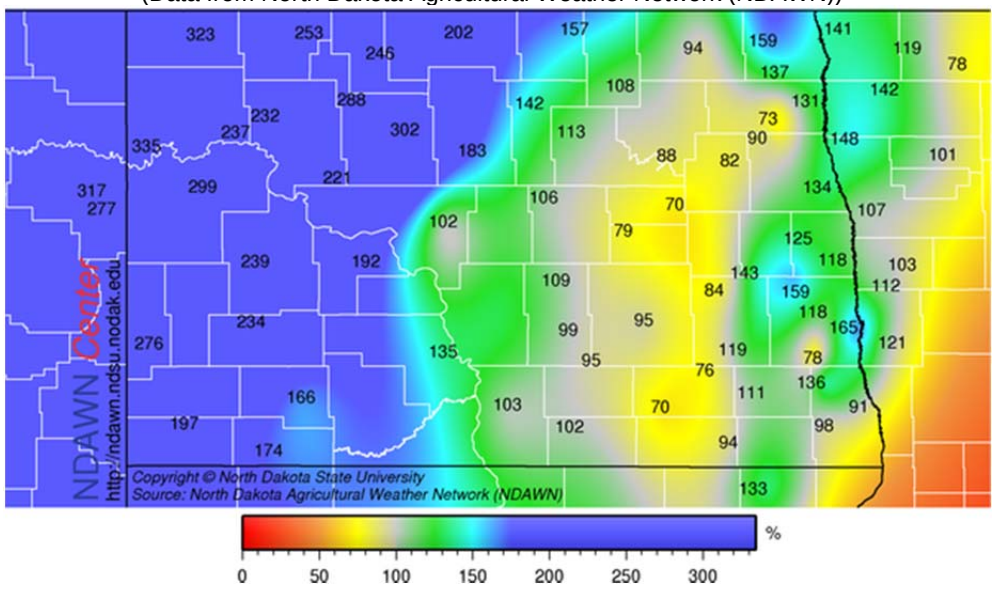
Spring 2011 Weather in North Dakota:

May 2011

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

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

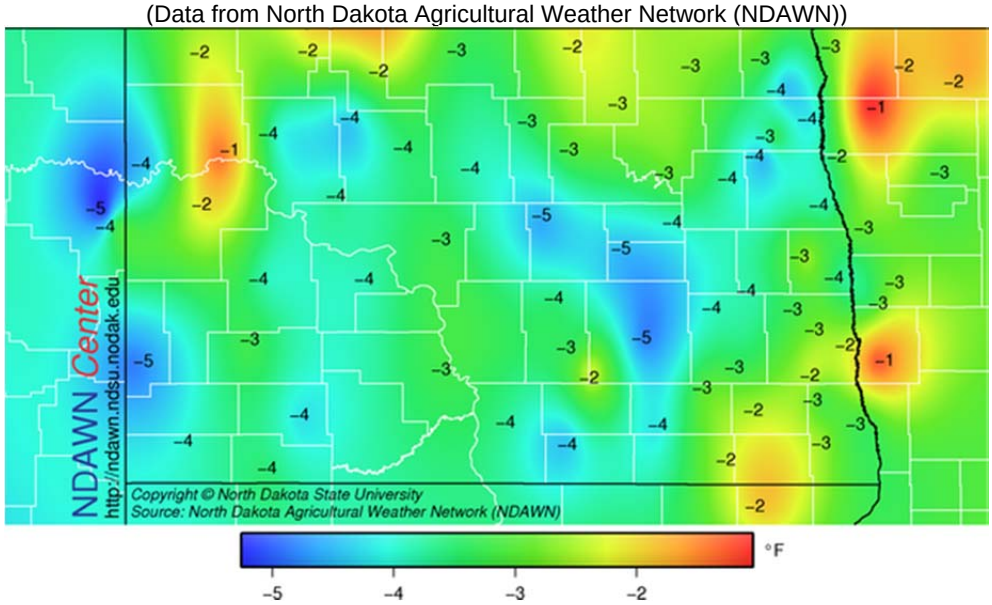


North Dakota State Climate Office

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

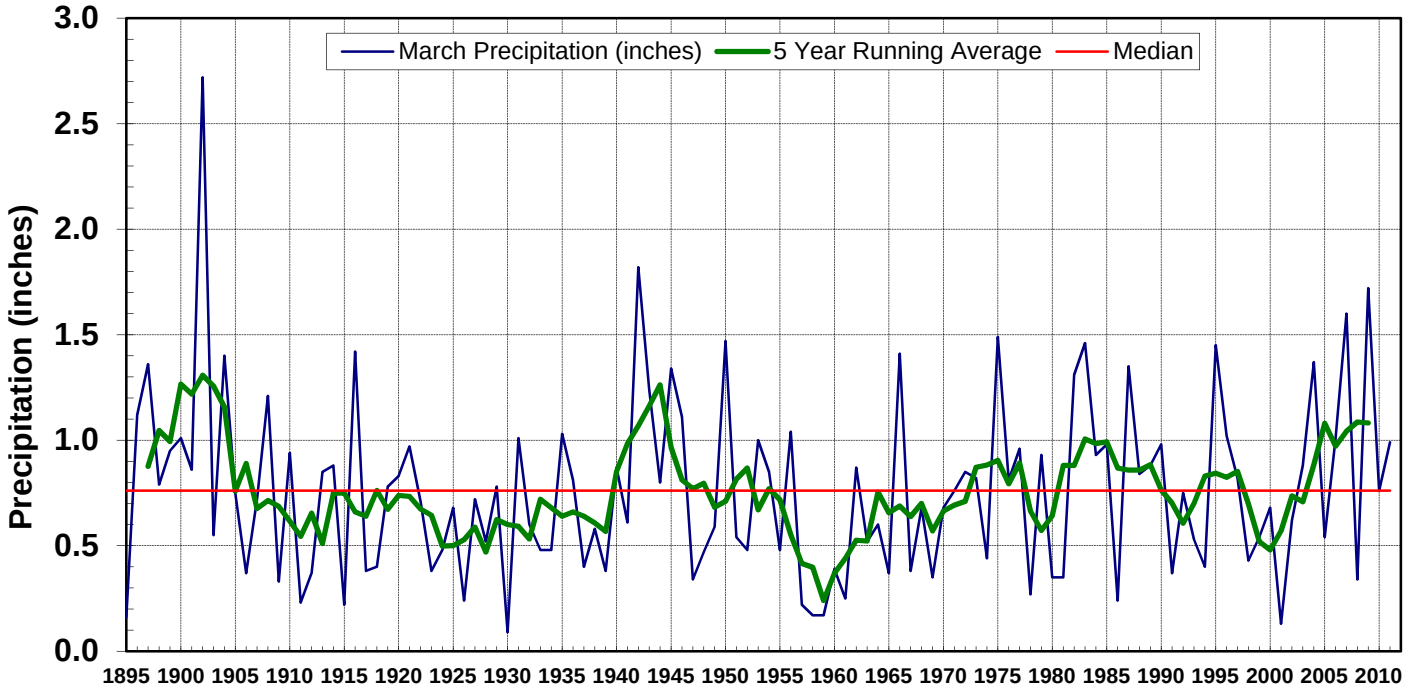
Departure From Normal Monthly
Average Air Temperature in degrees F

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



North Dakota State Climate Office

Historical March Precipitation for North Dakota

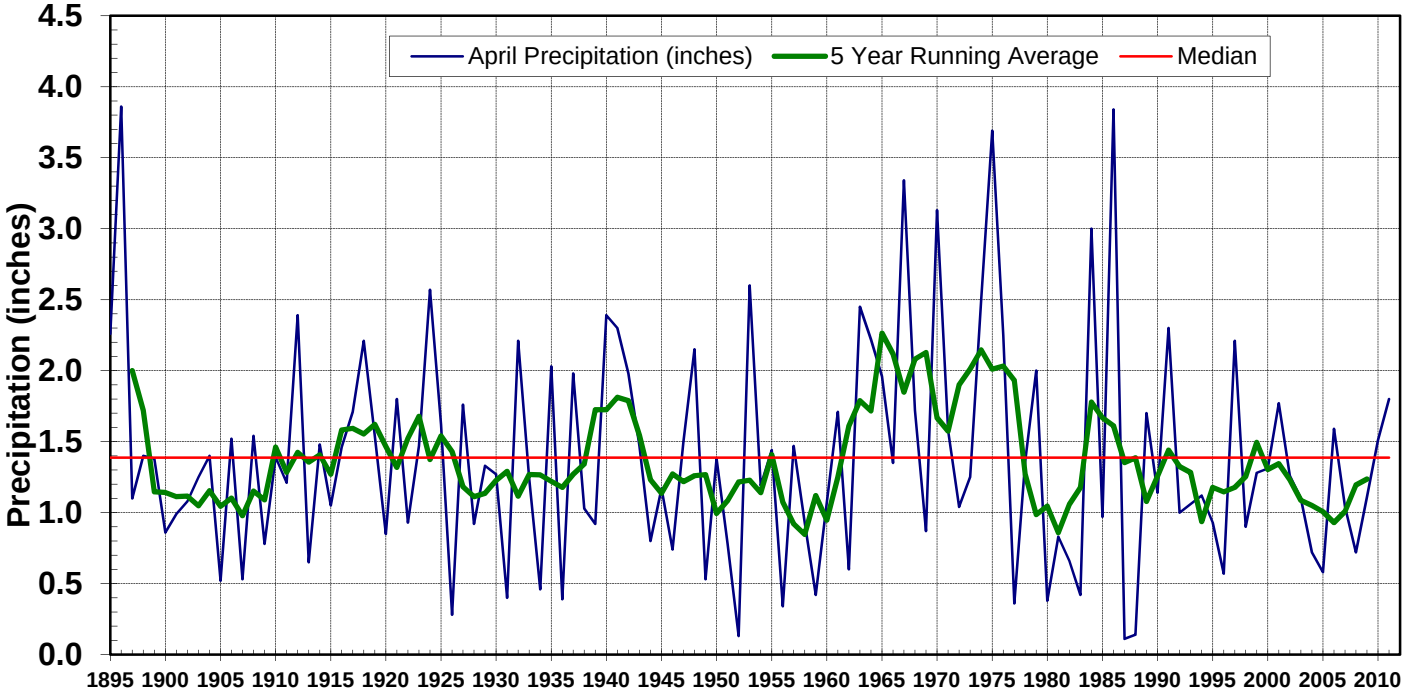


March Precipitation Statistics

2011 Amount: 0.99 inches
Maximum: 2.72 inches in 1902
State Normal: 0.80” (1971-2000)

Monthly Ranking: 28th Wettest in 117 years
Minimum: 0.09 inches in 1930
Years in Record: 117

Historical April Precipitation for North Dakota

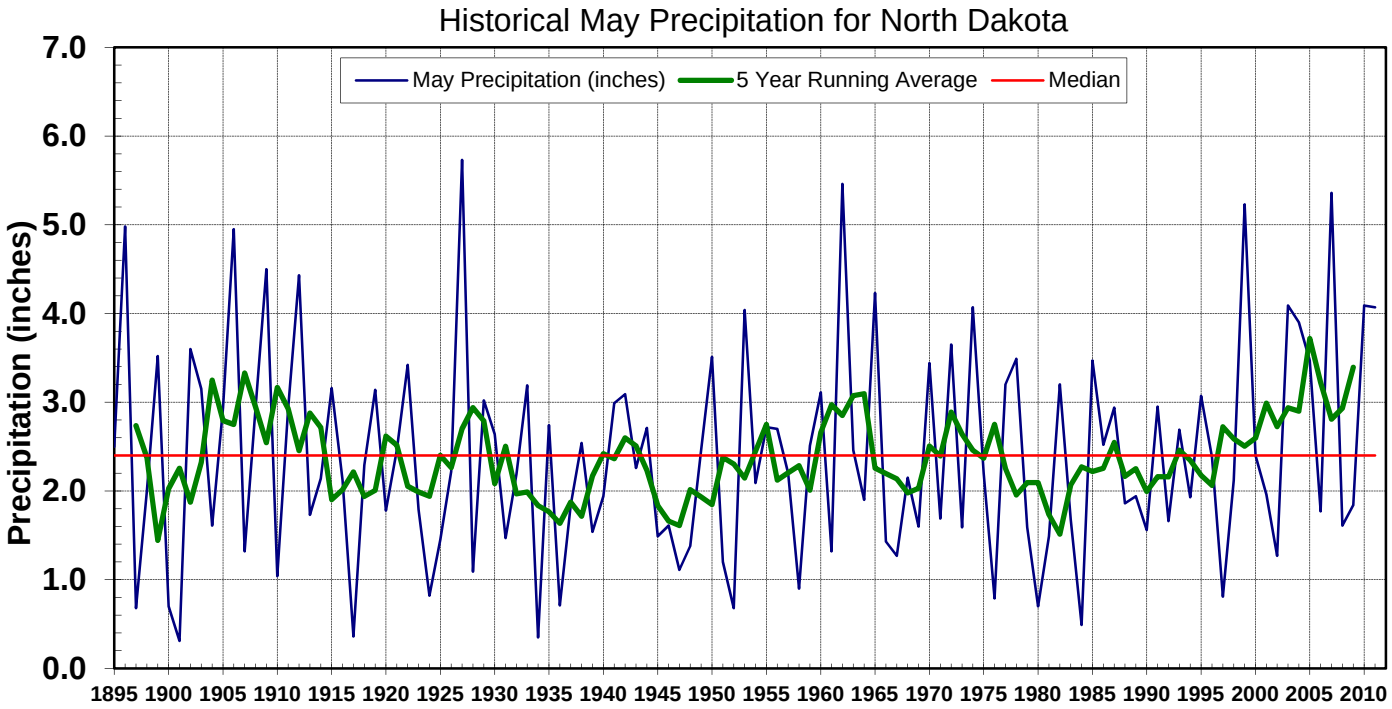


April Precipitation Statistics

2011 Amount: 1.81 inches
Maximum: 3.86 inches in 1896
State Normal: 1.40” (1971-2000)

Monthly Ranking: 27th wettest in 117 years
Minimum: 0.11 inches in 1987
Years in Record: 117

Historical May Precipitation for North Dakota

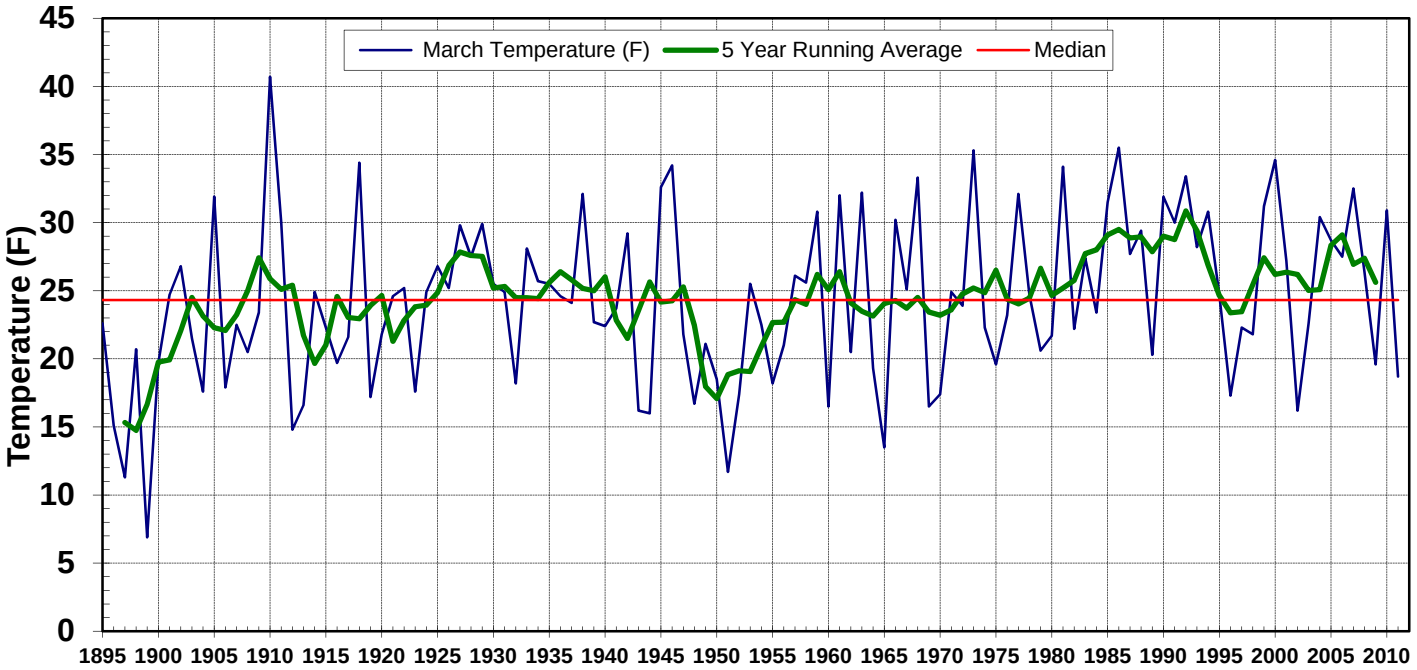


May Precipitation Statistics

2011 Amount: 4.07 inches
Maximum: 5.73 inches in 1927
State Normal: 2.31” (1971-2000)

Monthly Ranking: 12th wettest in 117 years
Minimum: 0.31 inches in 1901
Years in Record: 117

Historical March Temperature for North Dakota

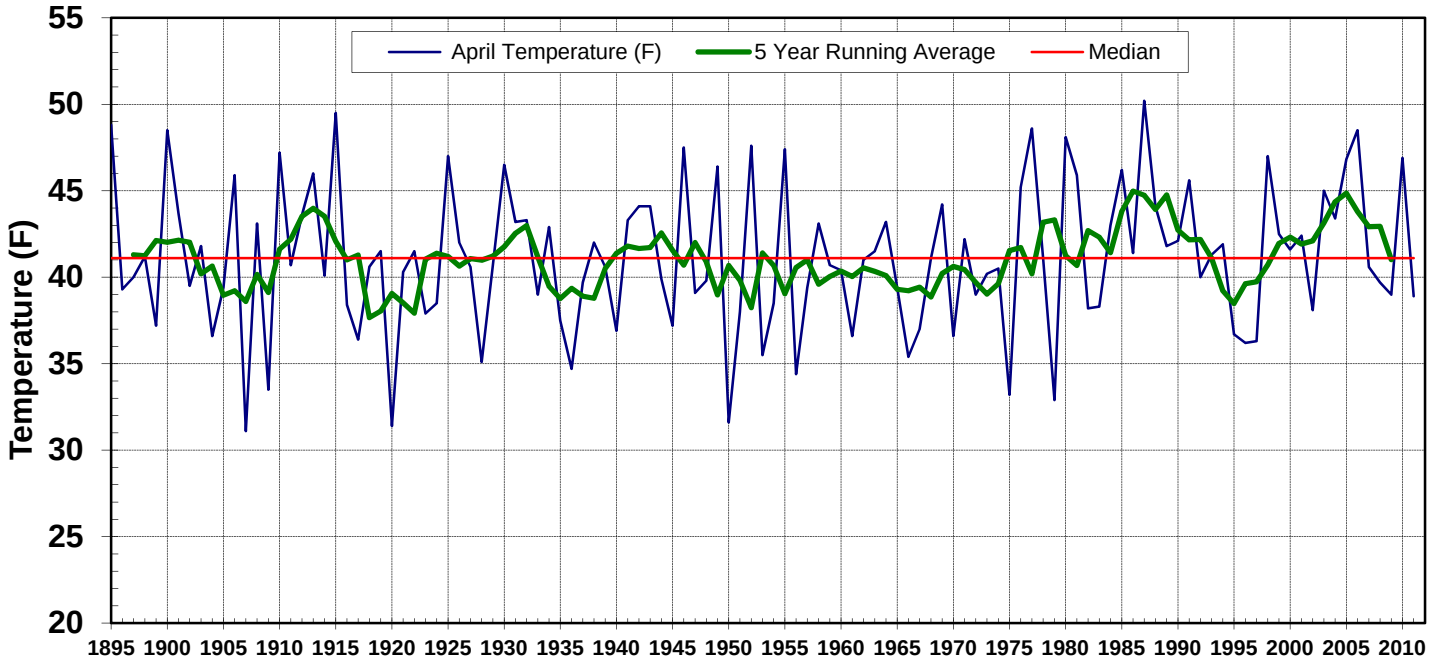


March Temperature Statistics

2011 Average: 18.7 °F
Maximum: 40.7°F in 1910
State Normal: 26.87°F (1971-2000)

Monthly Ranking: 24th Coolest in 117 years
Minimum: 6.9° F in 1899
Years in Record: 117

Historical April Temperature for North Dakota

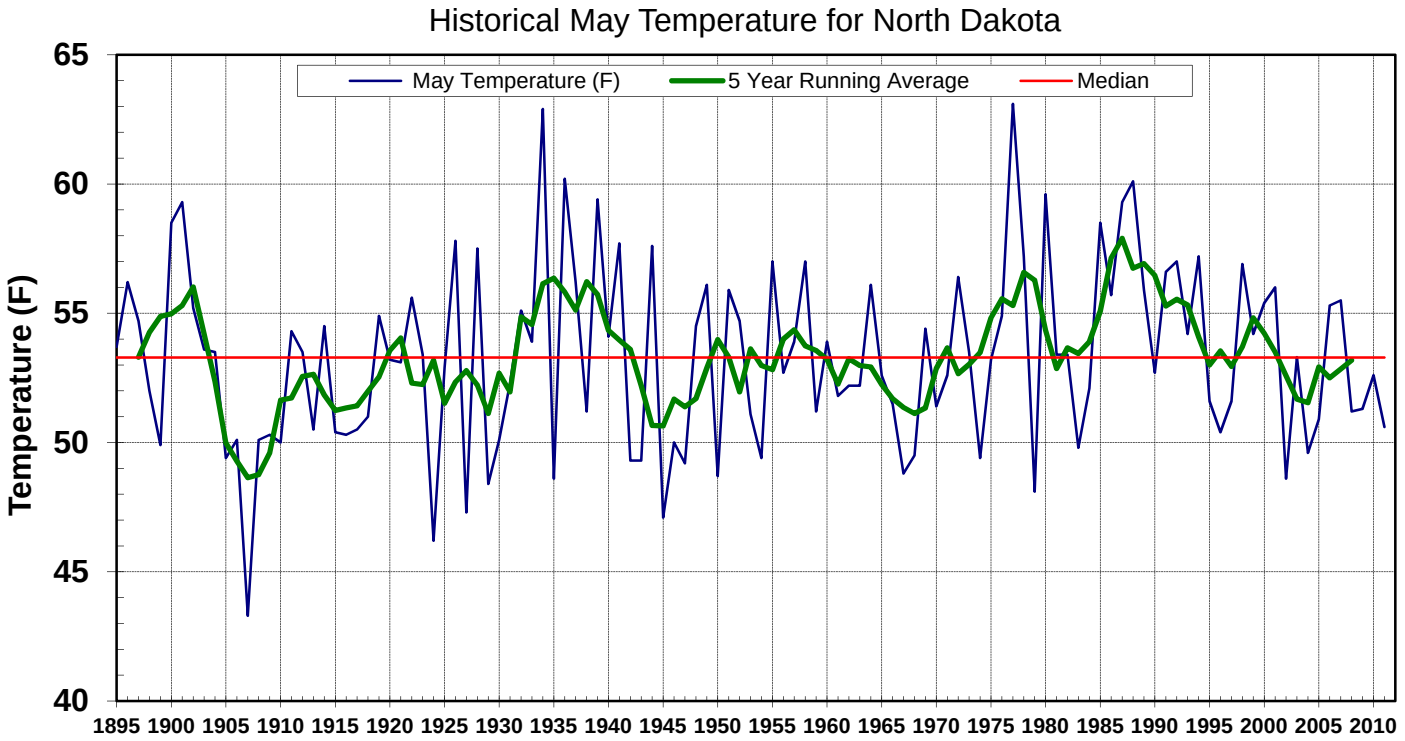


April Temperature Statistics

2011 Average: 38.9 °F
Maximum: 50.2°F in 1987
State Normal: 41.71°F (1971-2000)

Monthly Ranking: 32nd Coolest in 117 years
Minimum: 31.1°F in 1907
Years in Record: 117

Historical May Temperature for North Dakota



May Temperature Statistics

2011 Average: 50.6 °F
Maximum: 63.1°F in 1977
State Normal: 54.80°F (1971-2000)

Monthly Ranking: 32nd Coolest in 117 years
Minimum: 43.3°F in 1907
Years in Record: 117

Storms & Record Events

State Tornado, Hail, and Wind Reports for Spring 2011

by B. A. Mullins

North Dakota 3 Month Total	Wind	Hail	Tornado
	9	3	3

Reports by Month			
Month	**Wind**	**Hail**	**Tornado**
Total March	0	0	0
Total April	0	0	0
Total May	9	3	3

North Dakota Record Event Reports for Spring 2011

Date	Location	Type of Record	Previous Record
03/11/11	Minot	Precipitation of 0.45 inches	0.39 inches set in 1988
03/22/11	Fargo	Precipitation of 0.89 inches	0.86 inches set in 1894
03/23/11	Williston	Precipitation of 0.52 inches	0.35 inches set in 1975
03/23/11	Williston	Snowfall of 6.2 inches	3.0 inches set in 1975
04/15/11	Grand Forks NWS	Precipitation of 0.91 inches	0.52 inches set in 1970
04/15/11	Grand Forks NWS	Snowfall of 7.6 inches	1.0 inches set in 1973
04/15/11	Grand Forks AP	Precipitation of 0.95 inches	0.23 inches set in 1976
04/15/11	Grand Forks AP	Snowfall of 7.9 inches	0.7 inches set in 2001
04/18/11	Fargo	Snowfall of 1.7 inches	1.6 inches set in 1928
04/20/11	Dickinson	Low temperature of 11 °F	12 °F set in 1966
04/29/11	Williston	Precipitation of 0.75 inches	0.74 inches set in 1967
04/30/11	Williston	Snowfall of 7.9 inches	2.4 inches set in 1920
05/01/11	Grand Forks AP	Low maximum temperature of 34 °F	Ties previous record set in 2005
05/10/11	Williston	Precipitation of 1.27 inches	1.25 inches set in 1999
05/26/11	Grand Forks NWS	Low minimum temperature of 31 °F	Ties 1993, 1984, 1961

Seasonal Outlook

Summer Climate Outlooks

by D. Ritchison[1]

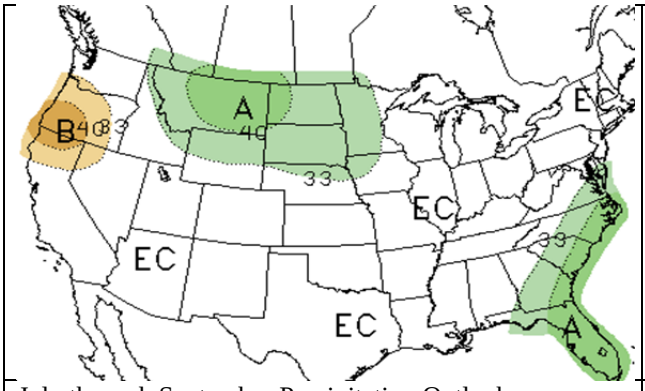
North Dakota experienced a wet spring, which was preceded by a wet winter. In fact, as a whole, the state of North Dakota has experienced seven straight wet seasons. The last season that finished either near or below average was the summer of 2009, which at the time was the 32nd driest on record.

This summer, climatologically being June through August, is also starting off very wet across most of the region. Some parts of the state recorded more rain in June than they average over the course of an entire summer. That is particularly true in portions of central and western North Dakota. The big question is will this trend continue?

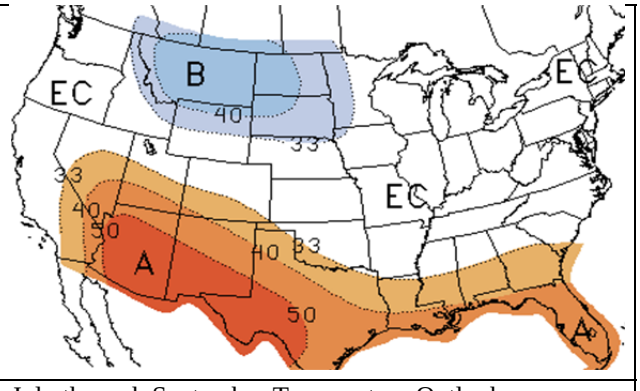
Historically, summers that follow La Niñas tend to start wet with conditions improving over the course of the summer. With June being so wet, the overall season will finish with above average precipitation for the state, but the odds do favor July and August not seeing the widespread excessive rainfall that has occurred in June with precipitation falling closer to the historical average in most areas.

With abundant rain, comes abundant cloud cover, which when combined with a saturated soil, lowers the ambient air temperature. This of course means that temperatures tend to be cooler than normal. But following the lead with my precipitation forecast, the summer temperatures should improve per the average as we progress through the summer as the soils dry and the precipitation becomes less abundant. Therefore, July and August will likely have an improvement in the overall number of heat units (growing degree days) that the crops will need to catch up after a cool start to the growing season.

The North Dakota State Climate Office has links to the National Weather Service's local 3-month temperature outlooks for the upcoming year (updated monthly). Those outlooks can be found here: http://www.ndsu.edu/ndsco/outlook/L3MTO.html. The latest CPC (Climate Prediction Center) forecasts nationally can be found at http://www.cpc.ncep.noaa.gov/products/predictions . The latest 3-month forecast through September can be seen below:



July through September Precipitation Outlook



July through September Temperature Outlook

The North Dakota State climate Office has links to the National Weather Service's local 3-month temperature outlooks for the next 12-month period (updated monthly). Those outlooks can be found at: http://www.ndsu.edu/ndsco/outlook/L3MTO.html

These outlooks are updated on the third Thursday of each month, with a final monthly outlook issued at the end of each month. These outlooks are available at http://www.cpc.ncep.noaa.gov/products/predictions/90day/

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

Devastation in Minot : Souris River Flooding

by A. Schlag[2]

This will likely be one of the sadder Hydro Talk articles I ever write. As I sit here at the keyboard, North Dakota is witnessing flooding along the Souris (Mouse) River on a scale that is nearly impossible to comprehend. We already know widespread devastation in Minot and Burlington is at hand; downstream communities of Logan, Sawyer, and Velva wait to learn if their race to build dikes high enough and fast enough will spare them the same fate.
In times such as this, the questions of "how is this possible" and "who is to blame" are tough to avoid and perhaps difficult to answer. Minot residents have looked to the National Weather Service for many years now to offer forecasts and forewarnings of such events, and in that sense we are already asking ourselves if we had done all we could to provide the community leaders and residents with as much advanced warning possible.

Since the event is still unfolding, taking a first cut at establishing the timeline of events that led up to the catastrophe at hand will be preliminary as I may gloss over details. First in line to actually create (albeit, relatively minor) flooding were the dam operators themselves. Despite having already lowered the upstream reservoirs to normal winter levels, as the area entered the middle of February, a look at the already impressive snowpack covering the Souris River basin prompted the dam operators to lower their respective water levels even more from the normal winter drawdown elevations. So on about February 16th, releases commenced from Rafferty and Alameda dams in Canada along with Lake Darling in North Dakota. At that moment, the spring flood of 2011 along the Souris River commenced and has gone non-stop (albeit with fluctuations) ever since.

Once the Souris and respective dams made it through the spring snowmelt season, the entire region entered a period of unusually wet weather. Spring rainstorms that were commonly 100+ miles wide with rain amounts of 2-5 inches seemed to routinely pass over parts of the Souris River basin with frighteningly regularity, roughly once every 4-7 days. These storms kept the rivers above flood stage and prevented the dam operators from ever fully emptying the flood control zones of the upstream dams, where 6-10 inches of rain were not uncommon reports for May rain totals. The full dams and ongoing flooding spurred daily conference calls to discuss forecasts and local conditions between state and federal agencies with city and county leaders.
As the wet weather continued into June, Minot continued to answer the weekly increases in forecast levels for the river by raising the base protection level of around 5,500 cfs in Minot to dikes capable of holding back 7,000 cfs and eventually 9,000 cfs.
However, with each passing week, hypothetical solutions to how severe of a storm needed to push the Souris River above currently available protection levels required less creativity and began to look similar to the storms we had already been seeing. And then came the storm of June 19th through June 20th with radar estimates and reports received of over 5 inches of rain in the Estevan area of Saskatchewan and 3+ inches of rain in the Long Creek watershed. The ramifications of such an event would take less than a day to begin to materialize as Boundary and Rafferty dams were quickly forced into an "inflow must equal outflow" situation due to already being near maximum pool from the most recent rains of just a few days earlier. A staggering flow of nearly 30,000 cfs from dam outflows and local runoff was headed to

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

Sherwood, the first gage on the Souris River in North Dakota. As forecasters and dam operators worked to assess the overall volume of this flow, it became clear that Lake Darling would have to immediately raise its own releases as the soon-to-be realized flow at Sherwood would fill Lake Darling in well under two days. The silence during the already daily conference call on Souris River flooding between community leaders and other state/federal agencies testified to the difficulty everyone had with grasping the magnitude of this event.
To give people a statistical grasp of just how rare this magnitude of a flood event is on the Souris, here are a few numbers.

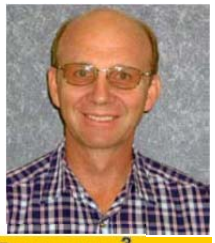
1. Previous record at Minot is approximately 1,558 ft MSL in 1881. The flood of 1969 that everyone remembers so well is actually #3 overall at a stage of 1,555.40 MSL and had a flow of 10,100 cfs. This flood is forecast to reach a stage of just under 1564 ft MSL with a flow of around 26,000 cfs.
2. USGS statistics for the Souris River at their gage just 4 miles northwest of Minot show an average flow of 158 cfs with a maximum of 1,410 cfs for this date in history based on 107 years of data.

Visually, one cannot fathom the carnage of such an event without the aid of photographs. Here are two photographs taken by a NWS employee around 8:00 AM on June 24th in the city of Minot with a river stage of around 1,555.5 ft, note the river has about another 8 ft to rise.


Photo by the National Weather Service Bismarck office (www.weather.gov/BIS)

This is indeed a sad day for North Dakota in general, and especially for those of us who have family and friends who are directly affected by this event.

Science Bits



Impacts of Flooding on Crop Development

Joel Ransom[3]

Excessive rainfall this spring following an unusually wet winter has resulted in extensive flooding in many regions of ND. Currently, even soils that are not visibly flooded, quickly become saturated after a rain because there is little evapotranspiration occurring due to low temperatures and lack of an established crop. Waterlogging (flooded/ponded/saturated soils) affects a number of biological and chemical processes in plants and soils that can impact crop growth in both the short and long term. The primary cause of waterlogging in crop plants is oxygen deprivation or anoxia as excess water itself does not react chemically with the plant. Plants need oxygen for cell division, growth and the uptake and transport of nutrients. Since oxygen diffuses through undisturbed water much more slowly than a well-drained soil, oxygen requirements rapidly exceed that which is available when soils are saturated. The rate of oxygen depletion in a saturated soil is impacted by temperature and the rate of biological activity in the soil. Faster oxygen depletion occurs when temperatures are higher and when soils are actively metabolizing organic matter. The cooler weather we are having this week will delay the adverse effects of waterlogging on any emerged crops. Generally, the oxygen level in a saturated soil reaches the point that is harmful to plant growth after about 48-96 hours. In an effort to survive, tissues growing under reduced oxygen levels use alternate metabolic pathways that produce by-products, some of which are toxic at elevated levels.

Germinating seeds/emerging seedlings are very sensitive to waterlogging as their level of metabolism is high. Crops like small grains and corn tend to be more sensitive to waterlogging when their growing point is still below the surface of the soil (before the 5-6 leaf stage). With the exception of winter wheat, all of the small grain and corn crops in the state are still in these sensitive stages (if planted at all) and can be killed if soils are saturated beyond 48 hours when soil temperatures exceed 65 degrees. Crops can differ in their tolerance to waterlogging. Although I was not able to find definitive information on the relative tolerance of crops to waterlogging, data from differing sources suggest a possible ranking of waterlogging tolerance as follows (most tolerant to most susceptible): rice, soybean, oats, wheat, corn, barley, canola, peas, dry beans and lentils. Growth stage and variety can impact this ranking. Waterlogged conditions also reduce root growth and can predispose the plant to root rots, so the ultimate effect of excess moisture may not be known until late in the season. It is common to observe plants that have experienced waterlogging to be especially sensitive to hot temperatures and to display nitrogen and phosphorus deficiencies later in the season due to restricted root development. Yield losses can occur even if these obvious visible symptoms are not observed. Waterlogging can also indirectly impact cereal growth by affecting the availability of nitrogen in the soil.

Excessive water can leach nitrate nitrogen beyond the rooting zone of the developing plant, particularly in well-drained lighter textured soils. In heavier soils, nitrate nitrogen can be lost through denitrification. The amount of loss depends on the amount of nitrate in the soil, soil temperature, and the length of time that the soil is saturated. Research conducted in other states found losses from denitrification between 1 and 5% for each day that the soil remains saturated.

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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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