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North Dakota Climate Bulletin

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In This Issue

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Graphics
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From the State Climatologist

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

The overall spring average temperature was 4 degrees cooler than average, which would make it the 29th coolest spring on record and the coolest spring since 2013. Precipitation-wise, the statewide accumulation was 0.61 inch drier, and it was the 42nd driest spring on record since 1895 in North Dakota. Overall, eight high and 70 low daily temperature records were broken or tied. In addition, 78 daily precipitation records were broken or tied. A total of 167 records, including temperature- and precipitation-related occurrences across the state, were tied or broken.

While the multi-year drought started in the spring of 2017, abnormally dry conditions started along the Canadian border toward the end of this spring. Major flooding occurred all along the Red River Valley, causing delays in spring planting. The spring flood summary and impacts of late planting on yield are discussed in this issue.

Detailed monthly climate summaries for March, April and May, along with several other local resources for climate and weather information, can be accessed at www.ndsu.edu/ndsco.

Adnan Akyüz, Ph.D., North Dakota State Climatologist

Red River in Fargo on April 21, 2019. (F.A. Akyüz, NDSU)

Weather Highlights

Seasonal Weather Summary: By Adnan Akyüz

Precipitation

Using analysis from the National Centers for Environmental Information (NCEI), the average North Dakota precipitation for the spring season (March 1 through May 31, 2019) was 3.97 inches, which was 1.88 inches more than the last season (winter 2018-19), 0.14 inch more than last spring (spring 2018) but 0.61 inch less than the 1981-2010 average spring precipitation (Table 1). This would rank spring 2019 as the 42nd driest spring since such records began in 1895. The numbers less than 100 in Figure 1 are shaded in yellow and red to depict the region with below-average rainfall. In contrast, the numbers that are greater than 100 in the same figure are shaded in green, blue and purple to depict the region with above-average rainfall. The greatest seasonal precipitation accumulation was 9.04 inches, recorded in Fullerton, Dickey County. The greatest seasonal snowfall accumulation was 36.4 inches, recorded in Ashley, McIntosh County. Based on historical records, the state average spring precipitation showed a positive long-term trend of 0.33 inch per century during this period of record since 1895. The highest and lowest seasonal spring average precipitation for the state ranged from 9.64 inches in 1896 to 1.3 inches in 1934. The "Historical Spring Precipitation for North Dakota" time series (Figure 2) shows a graphical depiction of these statistics.

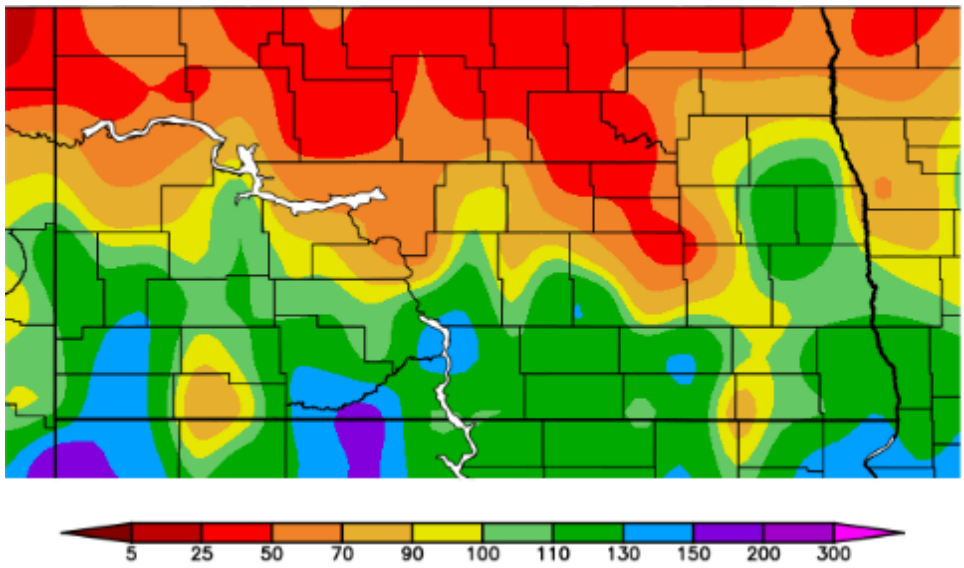
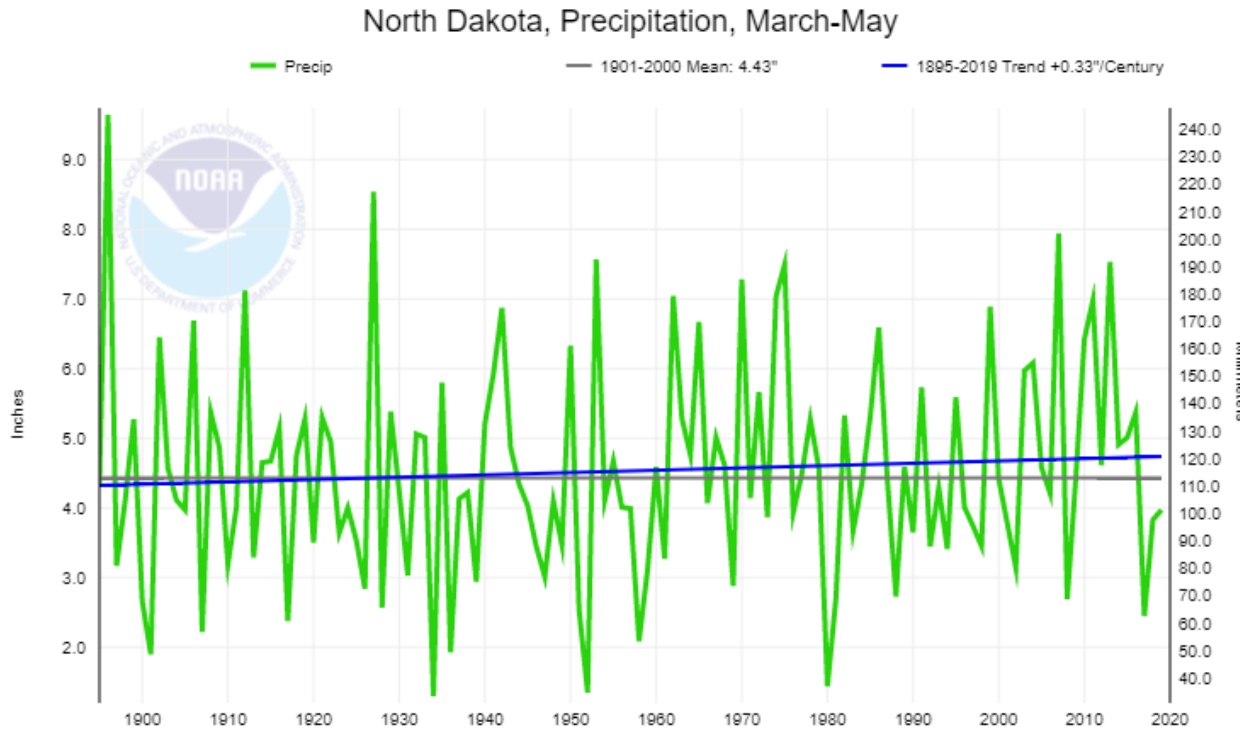


Figure 1. Precipitation percent of normal in spring 2019 for North Dakota. (High Plains Regional Climate Center)



Spring Precipitation Statistics
Record high value: 9.64 inches in 1896
Record low value: 1.3 inch in 1934
Trend: 0.33 inch per century

Spring 2019 value: 3.97 inches
1981-2010 average: 4.58 inch
Monthly ranking: 42nd driest
Record length: 125 years

Figure 2. Historical spring precipitation time series for North Dakota.

Table 1. North Dakota Spring Precipitation Ranking Table.

Period	Value	Normal	Anomaly	Rank	Wettest/Driest Since	Record Year
Spring 2019	3.97”	4.58”	-0.61	42nd driest 84th wettest	Driest since 2018 Wettest since 2016	1934 1896

Temperature

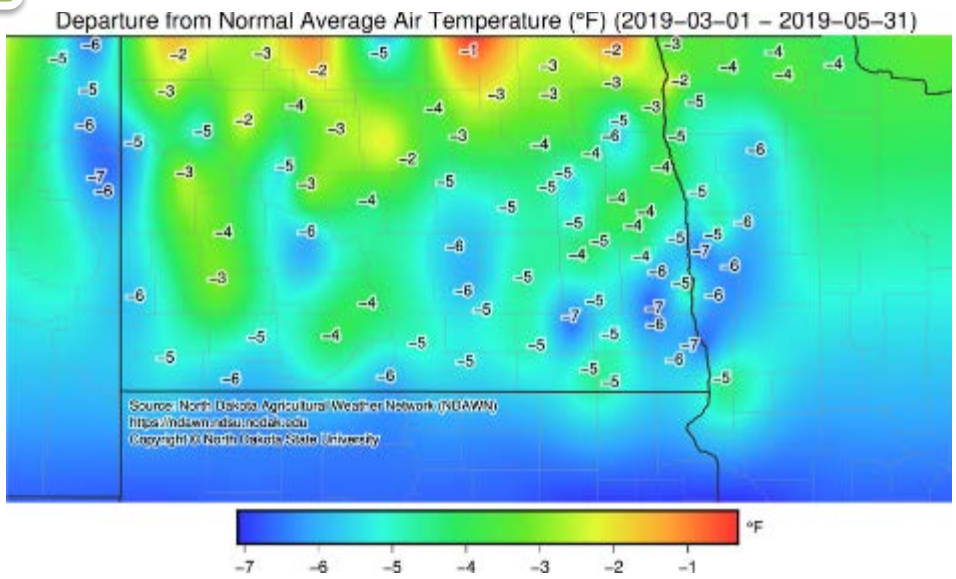
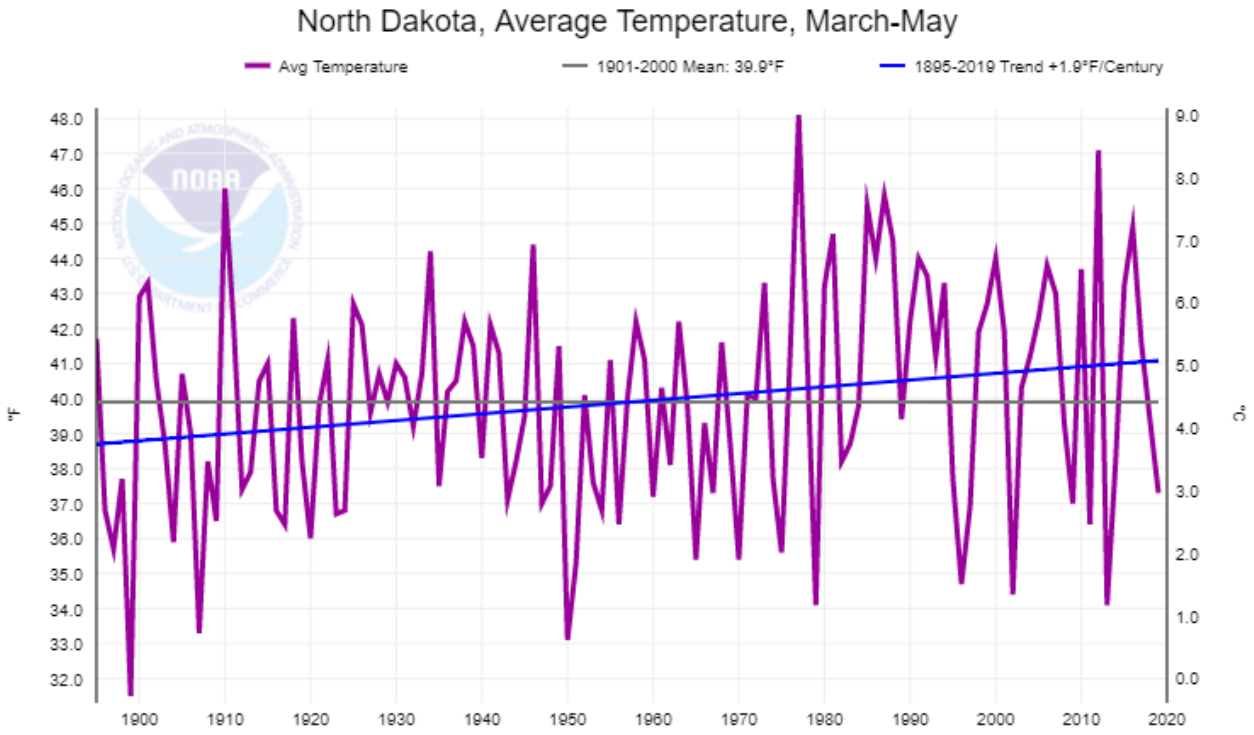


Figure 3. Temperature departure from normal in spring 2019 for North Dakota. (NDAWN)

The average North Dakota temperature for the season (March 1 through May 31, 2019) was 37.3 F, which was 9.2 F warmer than the last season (winter 2018-19), 2.1 F cooler than last spring (2018) and 4 F cooler than the 1981-2010 average spring temperature. This would rank spring 2019 as the 29th coolest spring since such records began in 1895 (Table 2). Figure 3 shows the departure from normal temperature distribution geographically. The negative numbers in Figure 3 are shaded in green and blue to depict the region with below-average temperatures. Based on historical records, the average spring temperature showed a positive trend of 0.2 F per decade since 1895. The highest and lowest seasonal spring average temperatures for North Dakota ranged from 48.1 F in 1977 to 31.5 F in 1899. The "Historical Spring Temperature for North Dakota" time series (Figure 4) shows a graphical depiction of these statistics.



Spring Temperature Statistics
Record high value: 48.1 F in 1977
Record low value: 31.5 F in 1899
Trend: 0.2 F per decade

Spring 2019 value: 37.3 F
1981-2010 average: 41.3 F
Monthly ranking: 29th coldest
Record length: 125 years

Figure 4. Historical spring temperature time series for North Dakota.

Table 2. North Dakota Spring Temperature Ranking Table.

Period	Value	Normal	Anomaly	Rank	Warmest/Coolest Since	Record Year
Spring 2019	37.3	41.3	-4	29th coolest 97th warmest	Coolest since 2013 Warmest since 2018	1899 1977

Drought: After the end of the drought of 2017-18, abnormally dry conditions appeared in the north-central parts of the state. By the end of the season, nearly one-fourth of the state was under DO, or abnormally dry, conditions based on the official Drought Monitor scale. Figure 5 below shows the drought conditions in the beginning and the end of the spring.

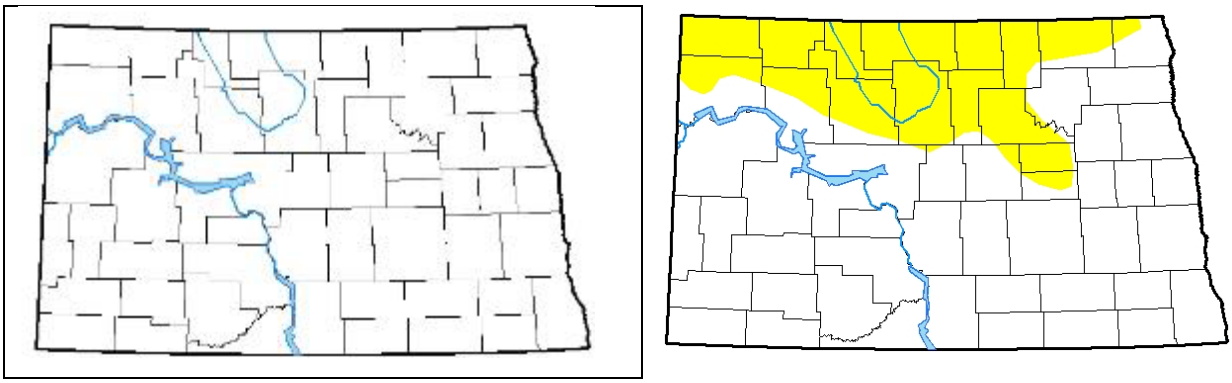


Figure 5. Drought Monitor map comparison for North Dakota in the beginning (on the left) and at the end (on the right) of spring 2019. (U.S. Drought Monitor)

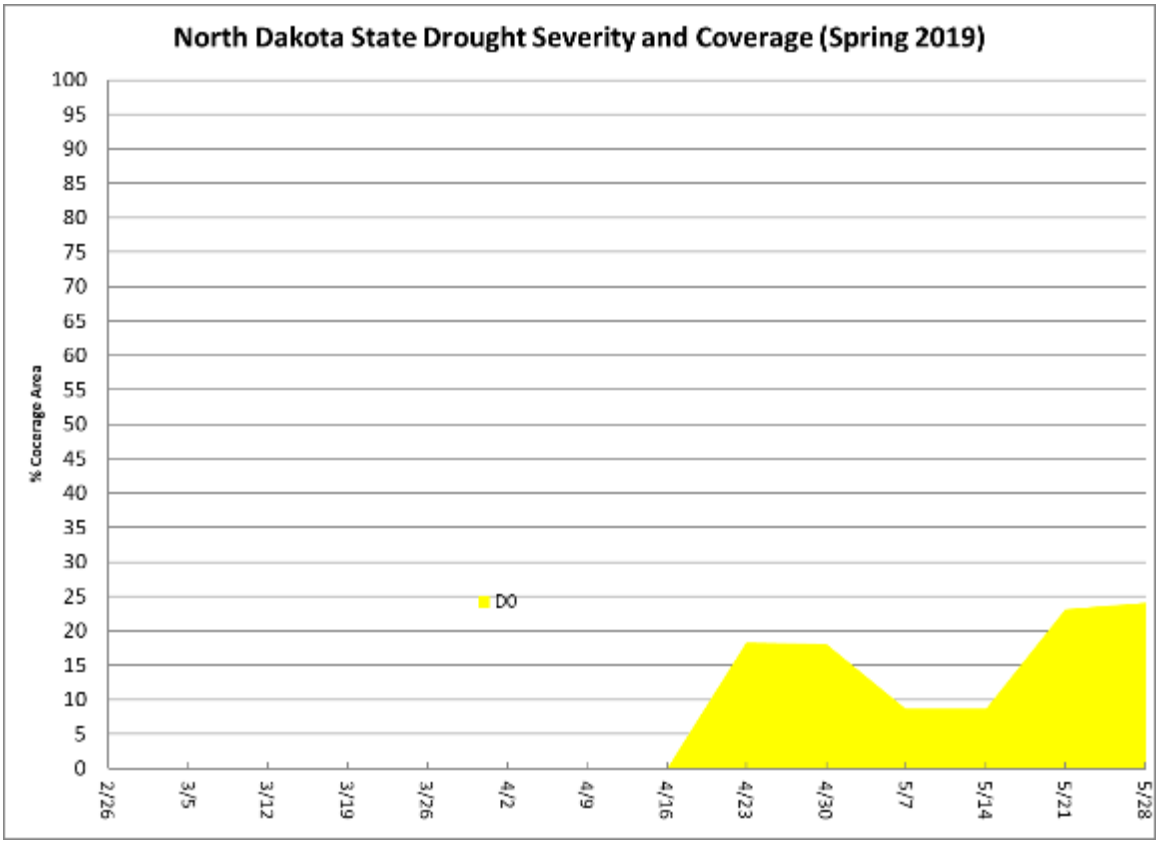


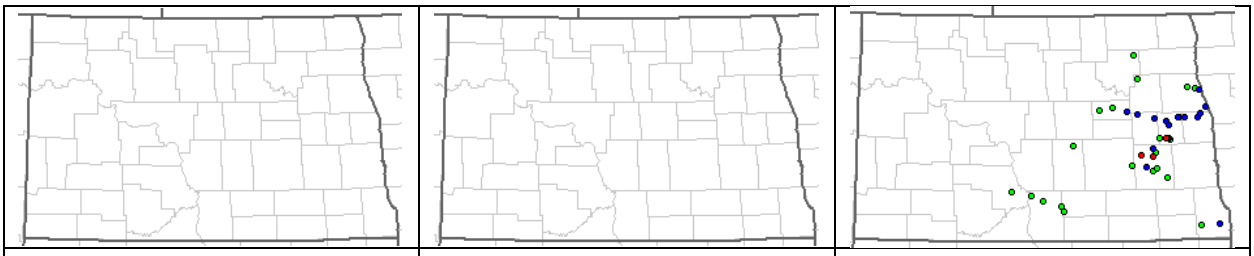
Figure 6. Statewide drought coverage in percentage and intensity (DO, D1, etc.) in a time scale representing the state from the beginning to the end of the season, with a one-week resolution.

Storms and Record Events

State Tornado, Hail and Wind Events for Spring 2019

Table 3. Numbers in the table below represent the number of tornado, hail and wind events accumulated monthly and seasonally.

Month	Tornado	Hail	Wind	Total
March total	0	0	0	**0**
April total	0	0	0	**0**
May total	**3**	**20**	**17**	**40**
Seasonal total	**3**	**20**	**17**	**40**



March 2019 North Dakota Storm Events | April 2019 North Dakota Storm Events | May 2019 North Dakota Storm Events

Figure 7. Geographical distribution of the storm events in the table above in each month. The dots are color-coded for each event (red: tornado; blue: wind; green: hail).

State Record Events for Spring 2019

Table 4. Numbers in the table below represent the number of select state record events (records broken or tied) accumulated monthly and seasonally.

Category	March	April	May	Seasonal Total
Highest daily max. temp.	0	1	2	**3**
Highest daily min. temp.	0	5	0	**5**
Lowest daily max. temp.	24	12	29	**65**
Lowest daily min. temp.	9	0	7	**16**
Highest daily precipitation	18	6	12	**36**
Highest daily snowfall	23	14	5	**42**
Total	**74**	**38**	**55**	**167**

Seasonal Outlook

Summer 2019 Outlook

By R. Kupec[1]

The spring season began as expected with temperatures below average and precipitation near or slightly below normal. April brought average to slightly above-average temperatures to western North Dakota, while the east remained a little below average. Temperatures ran about 2 to 5 degrees below average across the state in May, with below-average precipitation across the northern part of the state and near- to above-average precipitation across the south. The spring outlook had called for the season to start dry and cool, then turn warm in May, and for precipitation to increase. Much warmer weather did arrive at the end of the month, but it was too little, too late to overcome the very cold start to May. Areas from Bismarck to the southwest saw an increase in precipitation, but much of the remainder of the state ran a moisture deficit.

The weak El Niño weather pattern in the South Pacific that began in late winter continues into the summer. Typically, El Niños bring average to slightly above-average temperature to North Dakota. Precipitation also runs close to average or a little above average. Soil moisture plays a large role in influencing our summer temperatures. When the ground is wet, more energy from the sun is used in evaporating moisture from the ground, leading to slightly cooler temperatures during the day. The opposite occurs when the soil is dry. As we head into summer, most of the state is running a moisture deficit. Across the northern tier of North Dakota, this is a continuation of last summer's dry conditions.

While June has started with much warmer than average temperatures, cooler weather is expected to arrive for at least the middle of the month. Given the current soil moisture, I would expect to see near to above-average temperatures this summer. I also believe the spring pattern of near-average precipitation in the south and dry conditions across the north will continue. The current Climate Prediction Center (CPC) Spring Outlook has a slightly different forecast, giving nearly all of North Dakota below-average temperatures for the season (see Figure 8a). To our south, record flooding in the central and southern Plains means those area are very wet and likely would see cooler than average temperatures. The CPC also gives about two-thirds of the state above-average precipitation (see Figure 8b). The next 90-day outlook from the CPC should be available after June 20 at www.cpc.ncep.noaa.gov/products/predictions/90day.

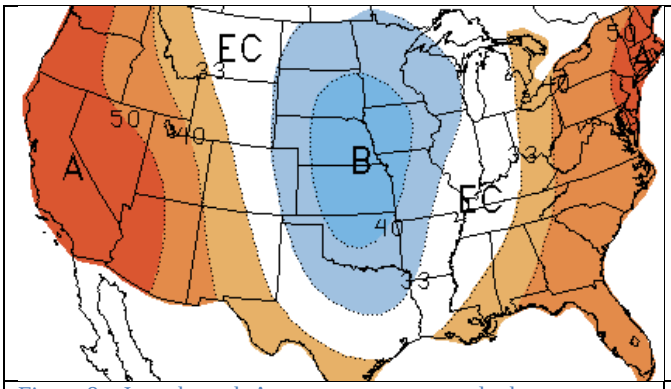


Figure 8a. June through August temperature outlook. (Climate Prediction Center, NOAA)

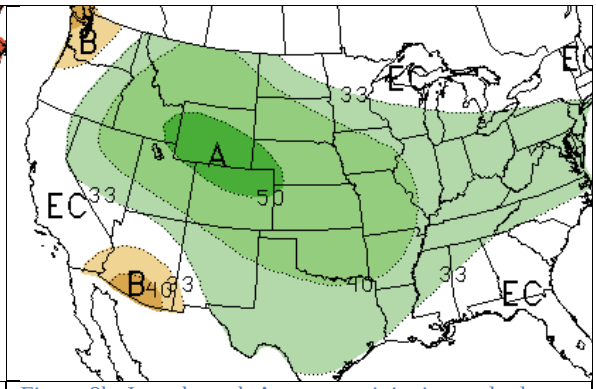


Figure 8b. June through August precipitation outlook. (Climate Prediction Center, NOAA)

[1] The corresponding author, Rob Kupec, is chief meteorologist at KVRR-TV in Fargo, N.D. Email: rkupec@kvrr.com

Hydro-Talk

2019 Spring Flood Summary

By A. Schlag[2]

It is safe to say that I am rarely surprised anymore with how each spring is unique and each spring flood season unfolds. This year was no exception. Despite compressing winter into basically just the latter half of January through early March (remember how balmy and dry December was this past winter), much of the state rolled into the spring melt season with plenty of water on the ground to cause problematic high water. The notable exception to this was the Souris River Basin. It ended the snow accumulation season very much in the normal range, and accordingly had little to no issues with the spring melt season. However, across pretty much the rest of North Dakota, there were plenty of examples of higher than desired water levels.

The first hint of problems to come were reports out in Montana that the Yellowstone River was experiencing ice jams. Sure enough, by the 22nd of March, those ice jams were affecting the Yellowstone River near Fairview, Mont., and Cartwright, N.D. In fact, the preliminary crest data of 28.04 feet would rank this as the second highest flood by just barely eclipsing the 28-foot flood of 1912, but falling well short of the 30.38-foot flood crest of 2011. However, this is as measured at the Missouri River gauge near Williston. Reports of significant damage to homes never before impacted by flooding along the Yellowstone are supported by the high water period from around March 24 through at least the early part of March 27. Eventually the ice and high water moved toward the confluence of the Yellowstone and Missouri rivers and again was captured in the data for the Missouri River near Williston, Figure 9.

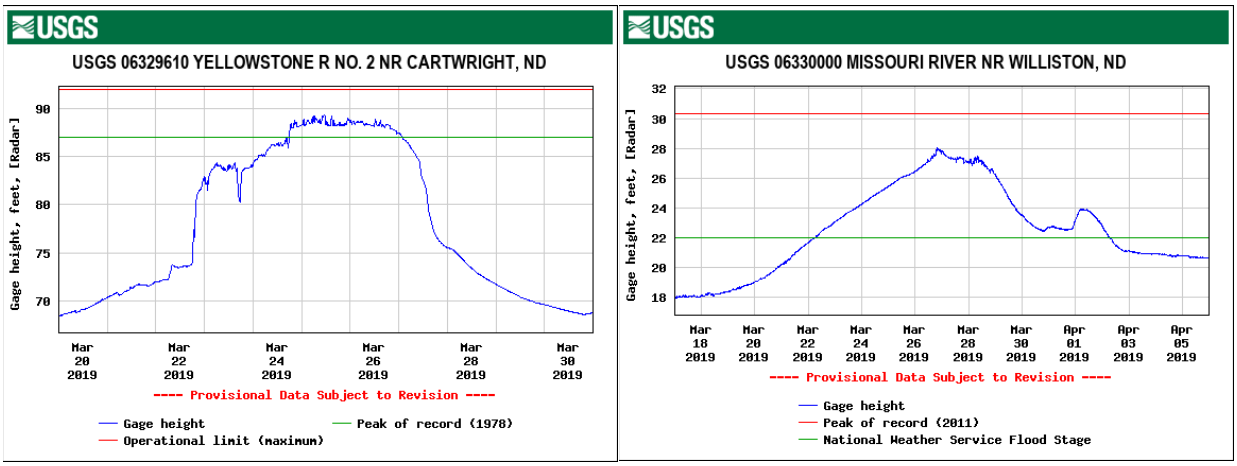


Figure 9. Hydrographs of Yellowstone River near Cartwright, N.D., (left) and Missouri River near Williston, N.D. (right).

[2] The corresponding author, Allen Schlag, is the service hydrologist at the NOAA's National Weather Service in Bismarck, N.D. Email: Allen.Schlag@noaa.gov

At nearly the same time, many rivers in southwestern North Dakota also became very active as runoff ran into fairly solid river ice. The Heart, Knife, Little Missouri, Little Muddy, Cannonball and James rivers, along with Beaver, Spring, Apple and Cedar creeks, came alive and experienced problematic high water. See Figure 10 for examples.

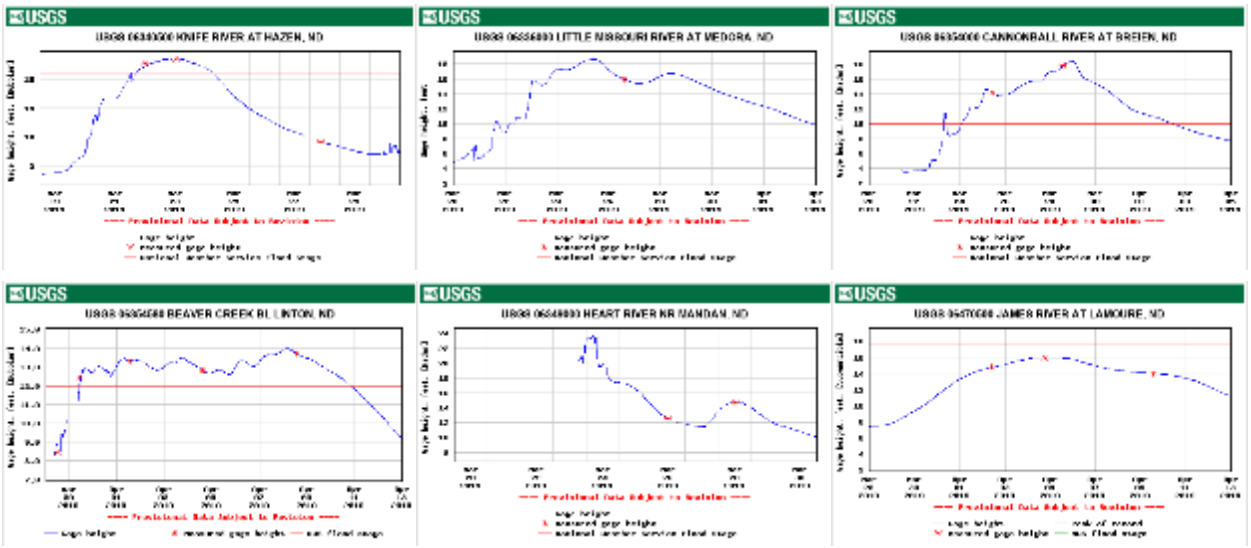


Figure 10. Hydrographs for western North Dakota streams.

Not wanting to be left out, the rivers and streams of eastern North Dakota played catchup in late March, and also strung out the high water for a lengthy flood season, Figure 11.
Like I noted earlier, each year tends to have its unique qualities during the spring flood season that affect timing, severity and duration. The one trait that each of the displayed hydrographs has is a fairly prolonged period of high water with a somewhat muted peak. This would suggest that

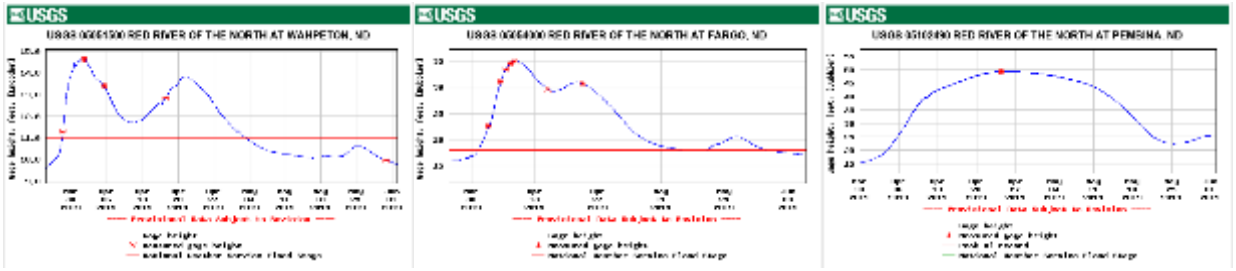


Figure 11. Select Red River of the North hydrographs.

even though some of these crests were well up into the historical rankings, a more historically normal, and sharper, single peak would have seen the crests higher than what were observed. In that sense, we appear to have had a bit of luck on our side. On a second note, damages this year don't appear to be anywhere near the same level as recent high water events of 2009, 2010 or 2011, even though the above crests rank quite high on the historical records. I find it encouraging to see that North Dakota, and its residents, are dealing with this kind of high water more effectively as we at the NWS strive to make a more Weather Ready Nation.

Science Bits

What Does Late Planting This Year Mean for Yield?

By J. Ransom[3]

Planting in North Dakota was delayed for most growers this spring due to wet and cold conditions. In fact, at the time of writing (June 7), some corn and wheat acres still had to be planted. Part of this land might not be planted because we are past the last planting date for full crop insurance coverage, and growers are eligible to take the prevent-plant option. More than half of the corn acres were planted after May 20 this year, meaning that they were planted later than is considered optimum for yield. Similarly, more than half the wheat acres were planted after the middle of May, well beyond the recommended optimum planting date. For a given location, later planting almost always means lower yields; something like 1% per day for every day beyond the optimum planting period is a reasonable rule of thumb. Nevertheless, crop yields ultimately are determined by a multitude of environmental, biological and management factors, thus predictions of yield based on planting date alone are difficult to make. In fact, when we look at the state as a whole in the past 11 years, we have found little relationship between the date when 50% of the spring wheat acreage was planted and yield at the end of the season (see following graphs). Last year is a good example of the lack of impact of date when 50% is planted and yield; 48% of spring wheat was planted after May 14 (May 5 latest), yet the state harvested the highest yield on record (49 bushels per acre). The relationship between the date when 50% of the corn was planted and statewide yield has been somewhat more predictive for corn (see Figures 12 for wheat and 13 for corn). Nevertheless, last year was the second highest yielding year for corn, even though planted acres did not reach greater than 50% until after May 21. This means even with our current delays in planting crops this spring, the potential still exists for reasonably good yields, depending, of course, on the type of weather we obtain during the remainder of the season. For corn, above-average growing degree-days for the rest of the season and the lack of moisture stress, particularly from silking to mid-grain filling, will be important determinants of yield. For wheat, cool weather during early vegetative growth that promotes larger spikes and more tillering, coupled with relatively cool weather during grain filling to ensure kernels are well filled, are the critical determinants of yield. Sadly, in some respects, weather that is good for corn likely will not be good for wheat and vice versa. For late-planted corn, one other point needs mentioning: In addition to the potential for yield reductions, producers also run the risk of having to deal with very wet corn at harvest when corn is planted very late. Air temperature and, to a lesser, extent relative humidity in October determine how quickly grain will dry in the field. Because Novembers are almost always too cold to promote much drying, one cannot count on much drying after the end of October (I know we have had exceptions to that statement). For growers who had to plant very late this year, especially if they did not switch to earlier maturing hybrids, having a plan in place for drying your corn may be wise, and consider your options for procuring propane when it is least expensive.

[3] Joel Ransom is an Extension agronomist for cereal crops at North Dakota State University. Email: joel.ransom@ndsu.edu

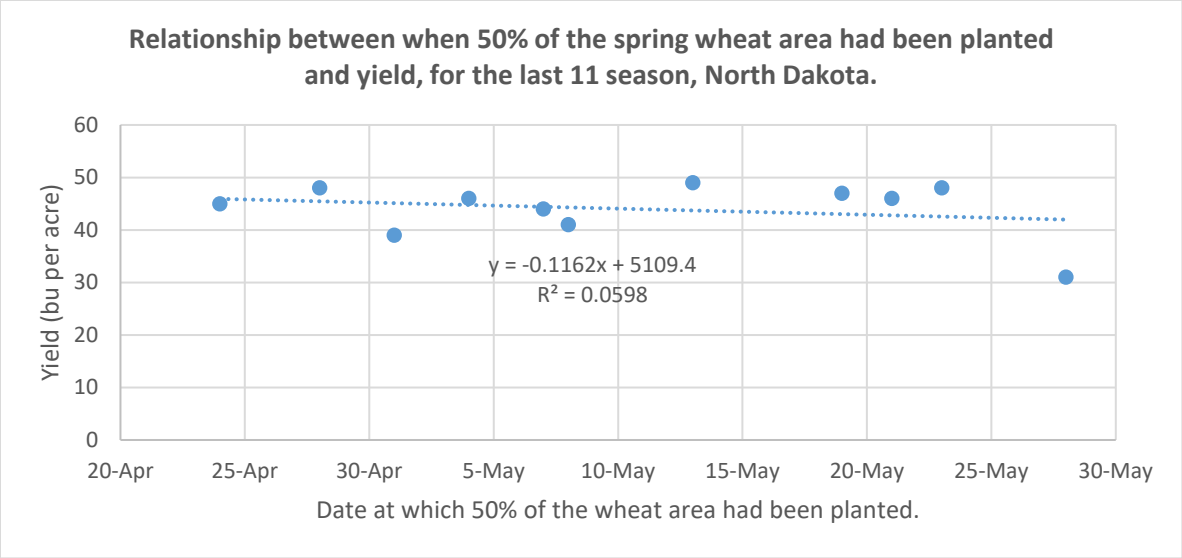


Figure 12. Relationship between when 50% of the spring wheat area had been planted and yield for the last 11 season, North Dakota.

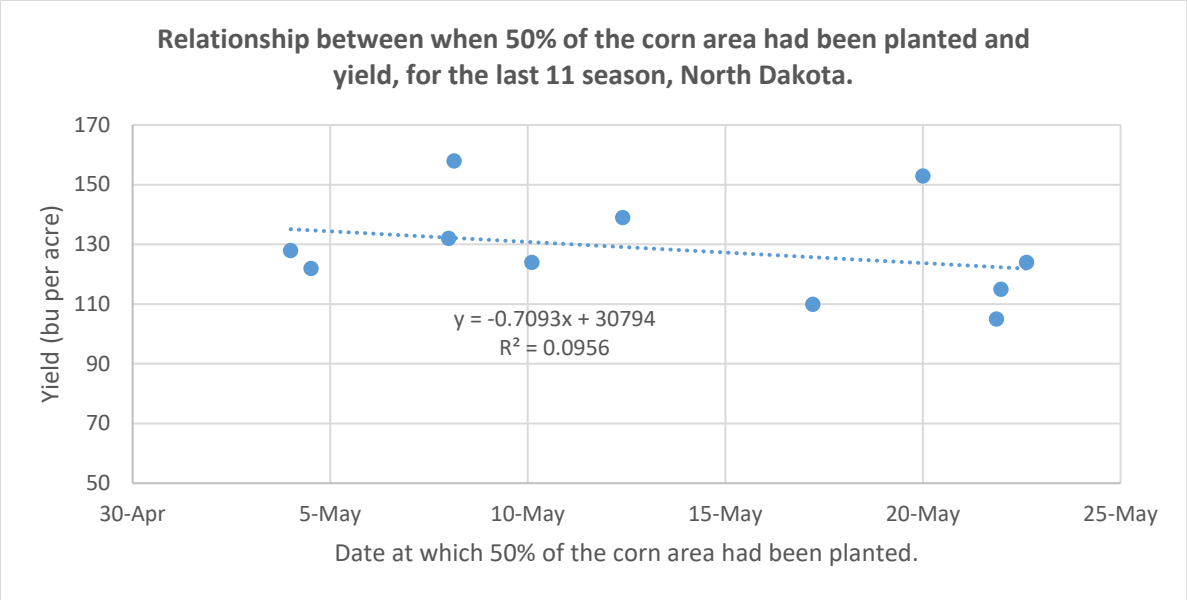


Figure 13. Relationship between when 50% of the corn area had been planted and yield for the last 11 season, North Dakota.

Contacting the North Dakota State Climate Office

Please contact us if you have any inquiries or comments, or would like to know how to contribute to this quarterly bulletin.

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