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In This Issue

Produced by
Adnan Akyüz, Ph.D.
State Climatologist

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Contributing Writers
R. Kupec
A. Schlag
G. Gust

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

North Dakota State University

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, N.D.

The overall spring average temperature was 1.3 degrees cooler than average, which would make it the 61st coolest spring on record. Precipitation-wise, the statewide accumulation was 2.14 inches drier than average, which would make it the ninth driest spring on record. Considering the past five months, it also ranks among the sixth driest such period on record. The drier-than-average season was well-received, especially along the Red River Valley of the North, where the flood-damaged areas got a chance to dry for necessary field work. Overall, a total of 167 records, including temperature- and precipitation-related occurrences across the state, were tied or broken.

Dry conditions in the western parts of the state caused moderate drought in the middle of the season. A summary of the statewide drought sysnopsis can be found in the Hydro-Talk portion of this bulletin.

Lonely tree. (Vern Whitten Photography)

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

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, 2020) was 2.44 inches, which was 1.11 inches greater than the last season (winter 2019-20), 1.52 inches less than last spring (spring 2019) and 2.14 inches less than the 1981-2010 average spring precipitation (Table 1). This would rank the spring of 2020 as the ninth driest (118th wettest) spring since such records began in 1895.

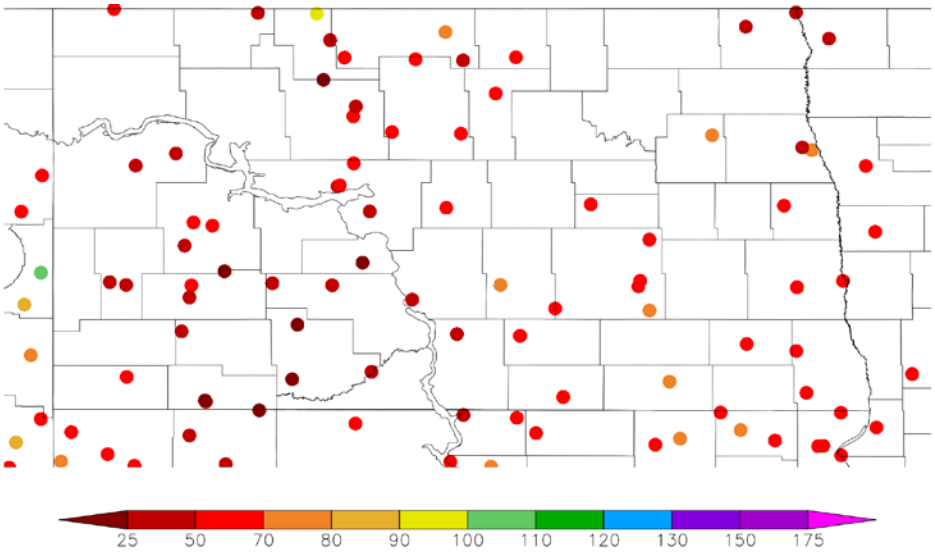


Figure 1. Precipitation percent of normal in spring 2020 for North Dakota. (High Plains Regional Climate Center, HPRCC)

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 of the season was 4.63 inches, recorded in Ellendale, Dickey County. The greatest seasonal snowfall accumulation was 19 inches, recorded in Grand Forks, Grand Forks County. Based on historical records, the state average spring precipitation showed a positive long-term trend of 0.25 inch per century during this period of record since 1895. The lowest and highest seasonal spring precipitation for the state ranged from 1.3 inches in 1934 to 9.64 inches in 1896. The “Historical Spring Precipitation for North Dakota” time series (Figure 2) shows a graphical depiction of these statistics.

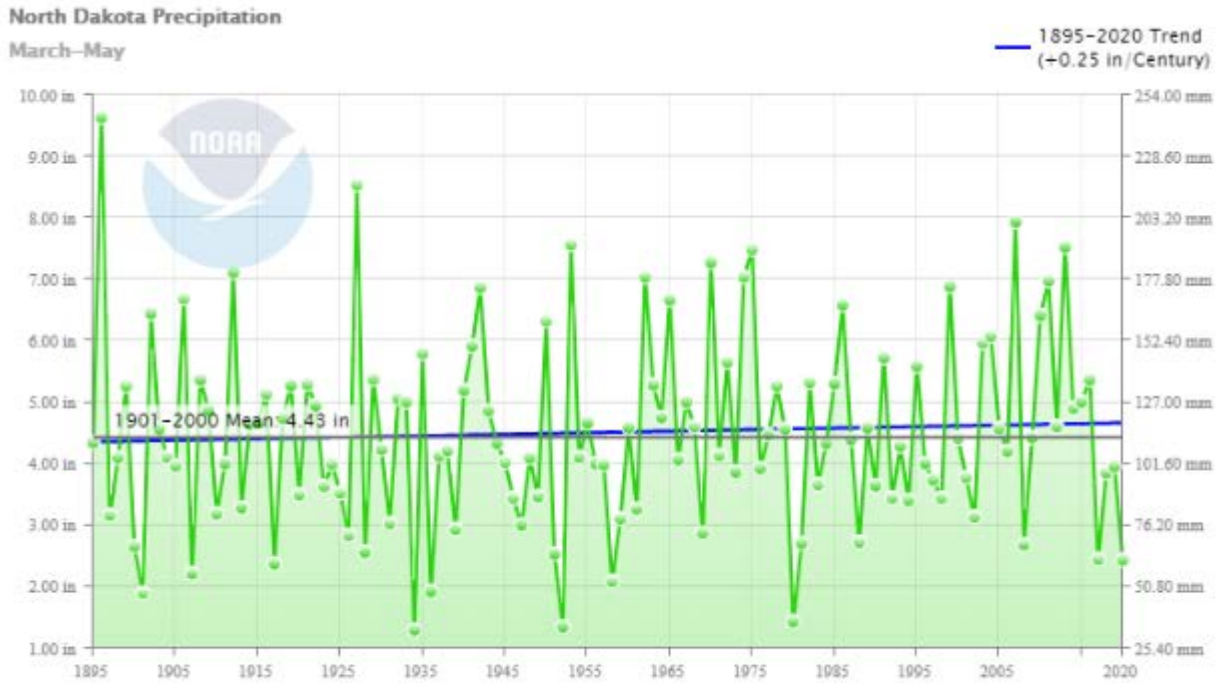


Figure 2. Historical spring precipitation time series for North Dakota.

Table 1. North Dakota Spring Precipitation Ranking Table[1].

Period	Value	Normal	Anomaly	Rank	Wettest/Driest Since	Record Year
Spring 2020	**2.44”**	**4.58”**	- 2.14”	**9th driest 118th wettest**	**Driest since 1980 Wettest since 2019**	**1.3” (1934) 9.64” (1896)**

[1] NOAA National Centers for Environmental Information, Climate at a Glance: Statewide Time Series, published December 2019. Retrieved on Dec. 11, 2019, from www.ncdc.noaa.gov/cag.

Temperature

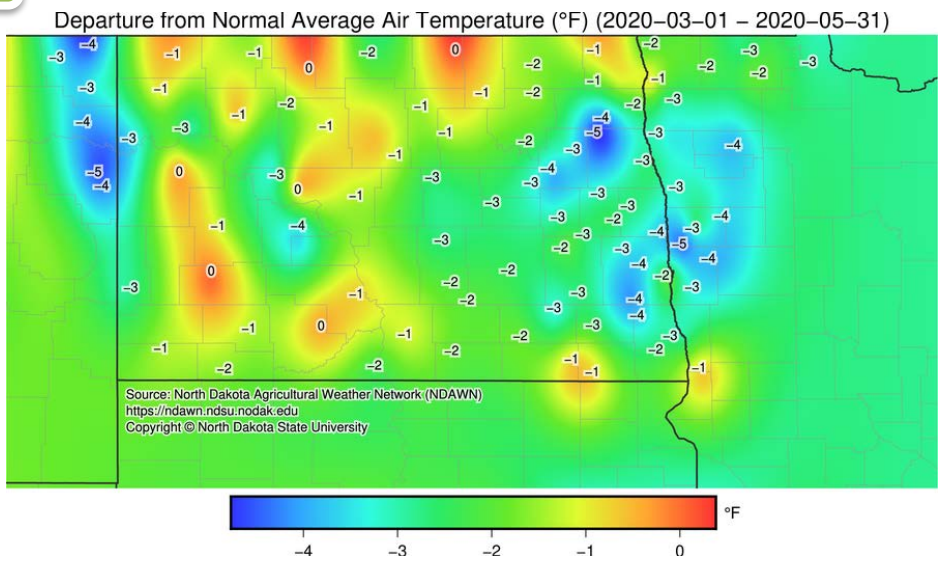


Figure 3. Temperature departure from normal in spring 2020 for North Dakota. (North Dakota Agricultural Weather Network)

The average North Dakota temperature for the season (March 1 through May 31) was 40 F, which was 24.4 degrees warmer than the last season (winter 2019-20), and 2.7 degrees warmer than last spring (2019 season). It was 1.3 degrees cooler than the 1981-2010 average spring temperature, which would rank spring 2020 as the 61st coolest (66th warmest) 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. In contrast, numbers that are equal to or greater than zero in the same figure are shaded in orange and red to depict the region with average to above-average temperatures. Based on historical records, the average spring temperature showed a positive trend of 0.2 degree per decade since 1895. The lowest and highest seasonal spring temperatures for North Dakota ranged from minus 31.5 F in the 1899 season to 48.1 F in the 1977 season. The “Historical Spring Temperature for North Dakota” time series (Figure 4) shows a graphical depiction of these statistics.

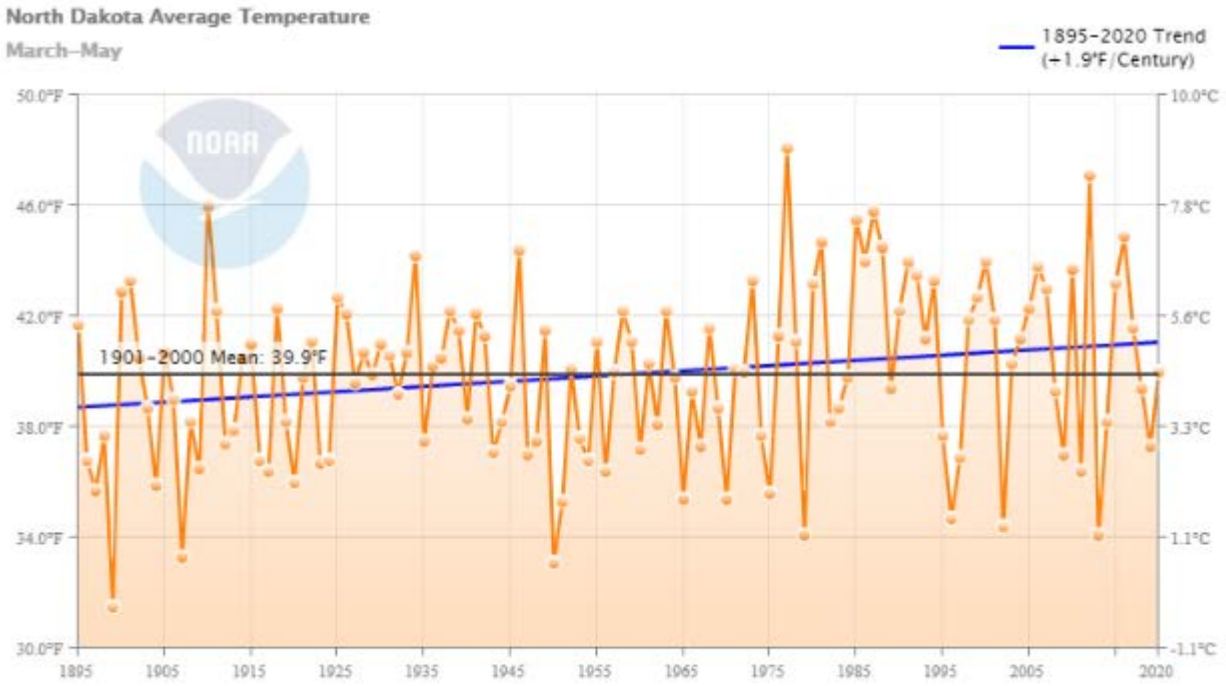


Figure 4. Historical spring temperature time series for North Dakota.

Table 2. North Dakota Spring Temperature Ranking Table[2].

Period	Value	Normal	Anomaly	Rank	Warmest/Coolest Since	Record Year
Spring 2020	40 F	41.3 F	-1.3 F	61st coolest 66th warmest	Coolest since 2019 Warmest since 2017	31.5 F (1899) 48.1 F (1977)

[2] NOAA National Centers for Environmental Information, Climate at a Glance: Statewide Time Series, published December 2019. Retrieved on Dec. 11, 2019, from www.ncdc.noaa.gov/cag.

Drought: The state had no dryness getting into spring by utilizing excessive soil moisture left over from the previous fall and winter. However, as the season progressed, precipitation was lacking in western North Dakota while major flooding was observed along the Red River Valley of the North. By the end of the season, 31% of the state was in moderate drough. Figure 5 below shows the drought conditions in the beginning and the end of spring. Figure 6 shows the drought intensity and coverage in a time scale. Both of the figures show no drought conditions spatialy and temporally.

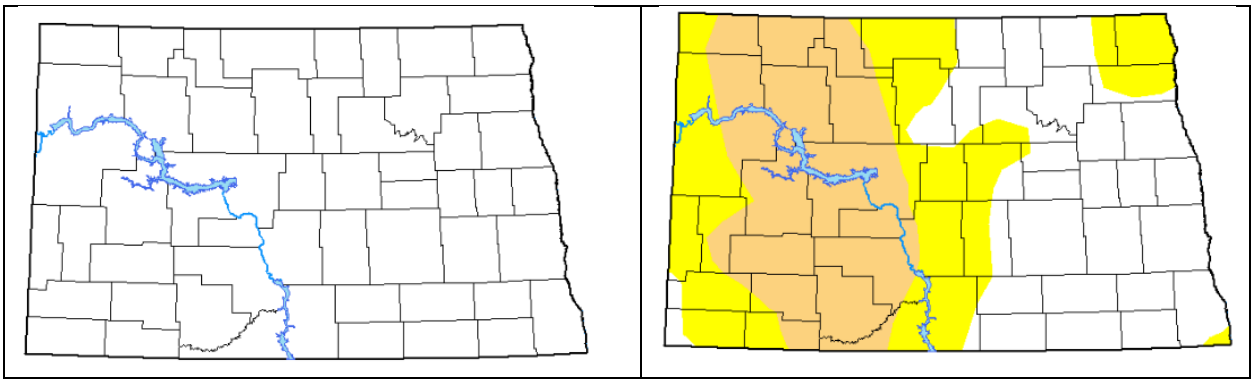


Figure 5. Drought Monitor map comparison for North Dakota in the beginning (on the left) and at the end (on the right) of spring 2020. (U.S. Drought Monitor)

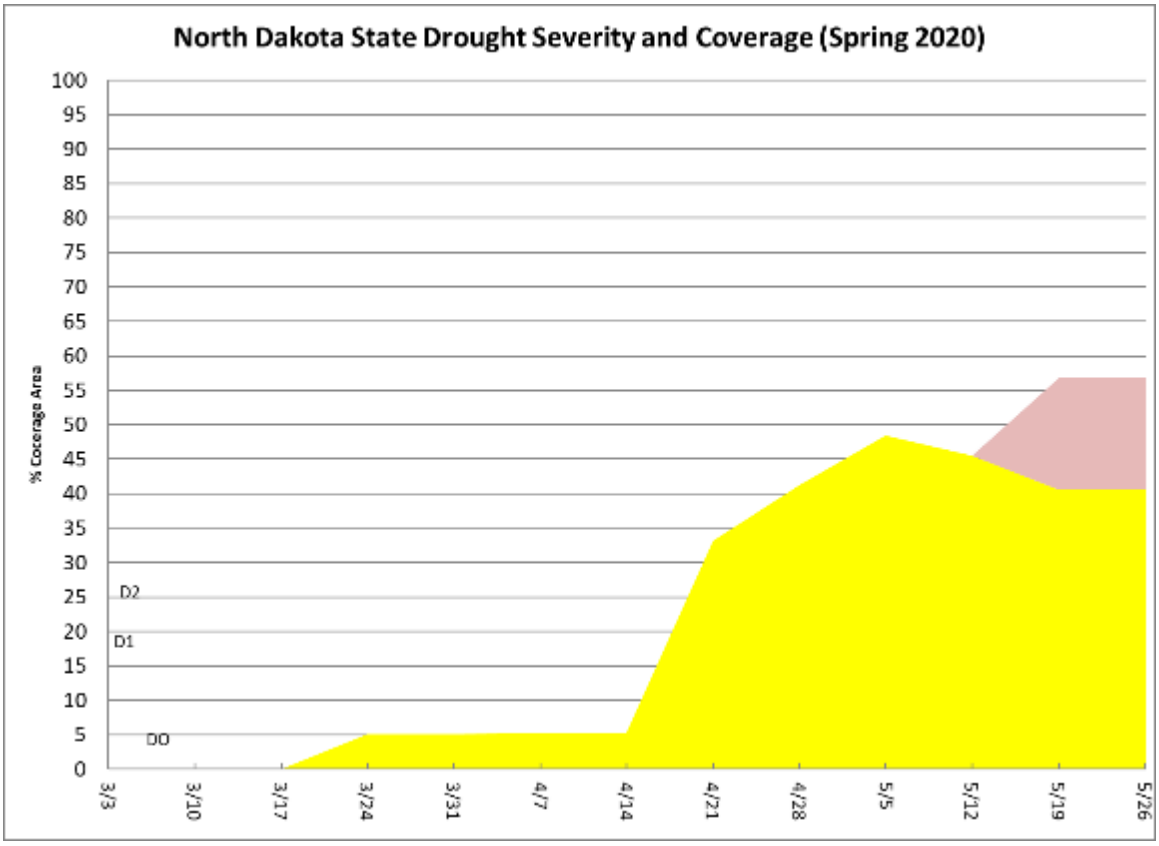


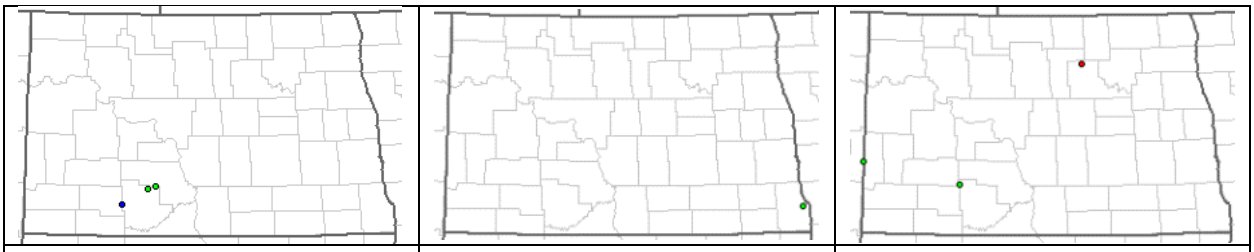
Figure 6. Statewide drought coverage in percentage and intensity (DO, D1, etc.) in a time scale representing the state from the beginning to the end of the season, with a one-week resolution in spring 2020.

Storms and Record Events

State Tornado, Hail and Wind Events for Spring 2020

Table 3. The numbers in the table below represent the number of tornados and hail and wind events accumulated monthly and seasonally.

	March	April	May	Seasonal Total
Tornado	0	0	1	**1**
Hail	2	1	2	**5**
Wind	1	0	0	**1**
Total	**3**	**1**	**3**	**7**



March
North Dakota Storm Events

April
North Dakota Storm Events

May
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 2020

Table 4. The 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.	7	0	0	**7**
Highest daily min. temp.	2	1	3	**6**
Lowest daily max. temp.	1	36	1	**38**
Lowest daily min. temp.	1	43	20	**64**
Highest daily precipitation	8	12	3	**23**
Highest daily snowfall	7	18	4	**29**
Total	**26**	**110**	**31**	**167**

Seasonal Outlook

Summer 2020 Outlook

By R. Kupec[3]

Dry and cool conditions could be found across North Dakota this spring. Across the state, most locations were 1 to 4 degrees below average for the season. The colder spots were in portions of the Red River Valley, while spring was not as cold in the western portion of the state. The diminished precipitation that began with the start of 2020 continued into the spring season. Moisture deficits of 2 to 5 inches below average were common across the state.

The spring outlook called for near-average precipitation and average to slightly above average temperatures. An unusually strong jet stream across the southern U.S. held through the spring season. Usually this jet stream would migrate north during the spring to allow moisture from the Gulf of Mexico into North Dakota. That rarely happened this spring. Now, in early June, moisture is finally streaming north, resulting in several rounds of thunderstorms with heavy rain. In the southern Pacific, the El Niño/La Niña pattern has entered a neutral phase and is showing signs of developing a weak La Niña. The northern Pacific, like last summer, remains warm. Given those factors, expect this summer to see average to slightly below average precipitation and temperatures near seasonal normals.

The current Climate Prediction Center (CPC) Summer Outlook has a similar outlook for temperatures, calling for an equal chance of above- or below-average temperatures for roughly the eastern two-thirds of the state. For the western one-third, the CPC is predicting a warmer than average summer (Figure 8a). The CPC precipitation forecast is starkly different, calling for above-average rainfall in much of the east and south-central parts of the state. It also expects drier than average conditions in areas along the Montana border (Figure 8b). The next 90-day outlook from the CPC should be available after June 18 at www.cpc.ncep.noaa.gov/products/predictions/90day.

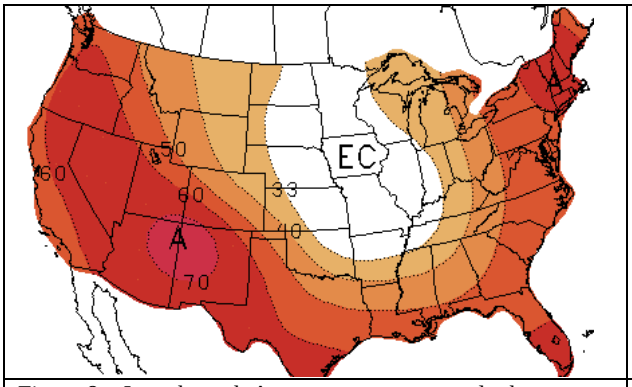


Figure 8a. June through August temperature outlook. (Climate Prediction Center, NOAA)

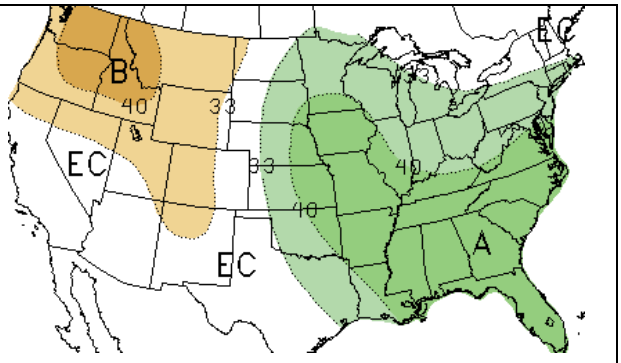


Figure 8b. June through August precipitation outlook. (Climate Prediction Center, NOAA)

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

Hydro-Talk

Another Tale of Two Halves

By A. Schlag[4]

Once again, we spent a very short time with any semblance of "normal" before we headed to another extreme. Less than three months after the wettest year on record, we started seeing the signs of drought creeping back into North Dakota, as shown in Figure 9. However, the dry second half of winter and early spring were generally appreciated by most residents and helped mask the overall precipitation deficit. By early June, the moisture deficit across the state is widely 2 to well over 3 inches, as shown in the High Plains Regional Climate Center's graphic in Figure 10. Once again, perception of this is almost as important as the actual data. For example, people living in the Prairie Pothole Region of the state are still dealing with all the high water from 2019; roads are closed and wetlands have consumed thousands of acres of crop and pasture lands. Indeed, it can be tough to convince them they are in a drought, especially as vegetation is still surviving, or maybe even thriving, due to the unusually high soil moisture we started out the growing season with in 2020.

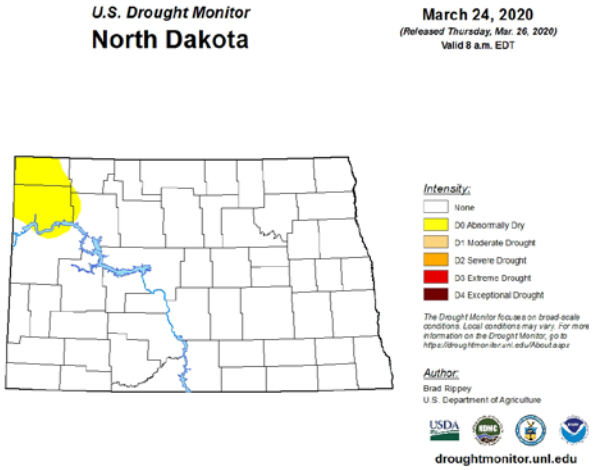


Figure 9. USDM Map of North Dakota.

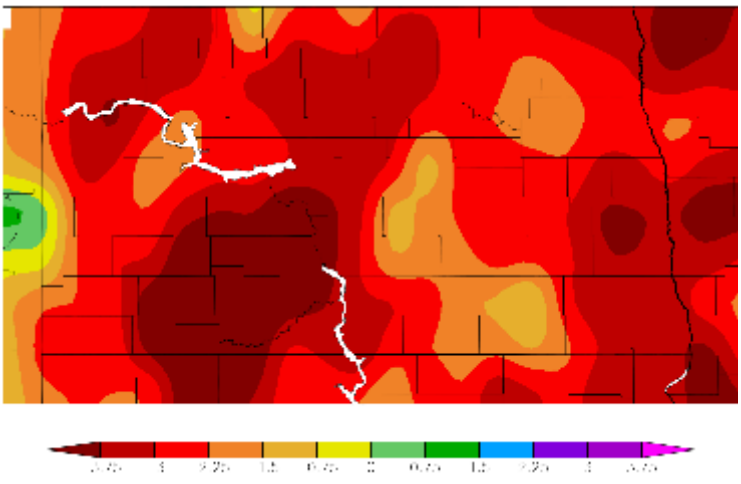


Figure 10. Jan. 1 through June 4 precipitation departure from normal. (High Plains Regional Climate Center)

As we enter June, thoughts quickly start turning to crop success and forage for livestock. This is where the perception of drought is gaining traction as crops and native cool-season grasses are stunted.

To put a little perspective on just how dry this growing season has been, Bismarck has recorded only one day in each of March, April and May with at least 0.1 inch of moisture, and none through the first four days of June.

This remarkable stretch of dry weather prompted the U.S. Drought Monitor (USDM) contributors and authors to quickly ratchet up the drought designations for North Dakota. Figure 11

[4] 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

contains the latest USDM image for North Dakota.

The depiction of drought usually tends to reflect precipitation deficits better than this snapshot in time. However, given the recent spring flood season and vast amounts of ponded water still on the countryside, impacts due to drought are slower to materialize in the Prairie Pothole Region.

One of the indicators of long-term drought tends to be surface water levels. In regard to surface waters, the USGS leads the way in data collection and analysis. One of the tools it provides is a statistical comparison of current streamflow to historical values. In that sense, the streams in North Dakota are not yet significantly below normal. In Figure 12, the vast majority of stream gauges in North Dakota are in their normal range, and there are more above normal than there are below normal.

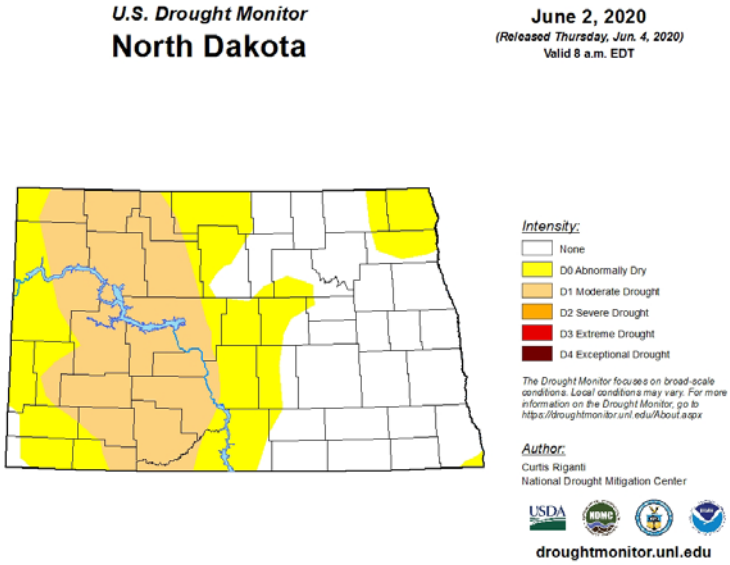


Figure 11. Latest USDM image for North Dakota.

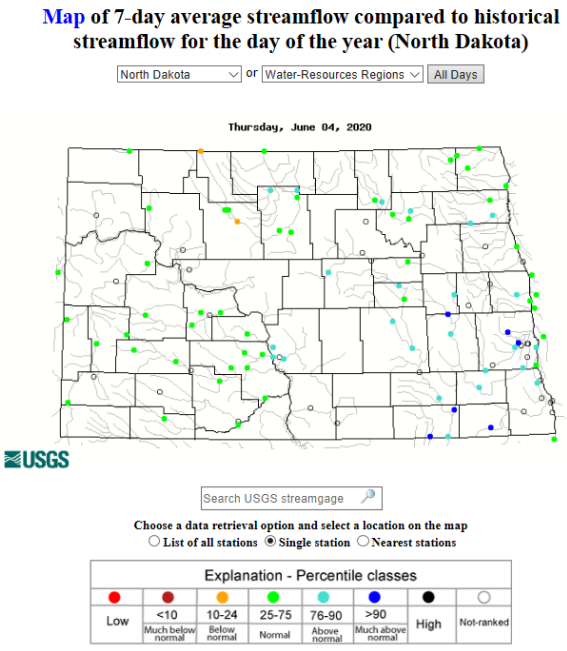


Figure 12. Latest USGS average streamflow comparison.

The big question right now is when will the drought break. As I write this on June 5, a significant risk of severe thunderstorms is in the forecast for tonight and tomorrow. Even if we avoid the severe weather and get substantial moisture, it is unlikely to mark the end of the drought. Regrettably, the Climate Prediction Center's outlooks for the summer months provide little cause for optimism at this point.

As a hydrologist who works with some of the finest meteorologists in the country, I have no answer as to what is causing the drought. On the other hand, as I look out the window of my home, the one thing I do know for sure is that this is all my fault. There's probably nothing that can bring on a drought faster than me sowing a few hundred dollars of grass seed on a recent landscaping project. The seed, which lies out of reach of my pump and considerable collection of hoses, has been waiting nearly eight weeks now for enough moisture to germinate. Sadly, this also may be the future of some late planted crops this year without a little help from Mother Nature.

Science Bits

Just a Spring Dust Devil or is it a "Gustnado"?

By G. Gust[5]

This article was prompted by the usual flurry of reports, photos and videos we see each spring (and early summer) encompassing a wide variety of smaller spinning things, any of which is a type of whirlwind, possibly a cyclone, but not necessarily a tornado.

For most definitions used here, I'll be using the Glossary of Meteorology, American Meteorology Society (AMS)[6]

Dust Devil: A well-developed dust whirl; a small but vigorous whirlwind, usually of short duration, rendered visible by dust, sand and debris picked up from the ground.

Figure 13. Dust devil on April 2017 in Flasher, N.D. (Photo courtesy of Sherry Jonson Schmidt)

Probably the most common dust whirl/dust devil in our northern Plains environment may be that little phenomena we see develop in the inside corner of a building, the edge of a garden or parking lot or along a gravel road, like this April 2017 image from Flasher, N.D. (Figure 13).

Such phenomena may be only a few feet across or a few yards high, and lasting for a few seconds as it skitters away with a flurry of dust in the spring and summer, or splash of dry leaves in the fall.

Even in the winter, a cooler cousin, perhaps a snow whirl (or snow devil?), can develop in a quiet wind situation or one that is more forced. We'll discuss this a bit more later.

And on occasion, one can see those very large dust devils form in a farm field and grow some tens to hundreds of feet across, and stretch upward some tens to hundreds of feet high, lasting several minutes or more. And as the *Glossary* states, they can become strong enough to produce some minor damage, generally EF0 or less (LTE 85 mph) on the

[5] Greg Gust is the warning coordination meteorologist at the National Weather Service, Grand Forks, N.D. Email: gregory.gust@noaa.gov

[6] *Glossary of Meteorology, AMS: http://glossary.ametsoc.org/wiki/Main_Page.*

Enhanced Fujita Scale. These are most often seen hopping across a freshly cultivated field in the spring during a warm, dry and sunny day.

The graphic below (Figure 14), courtesy of our NWS Forecast Office in Reno, Nev., nicely describes the process by which warm (usually hot and dry) air near the surface starts to rise, and while rising, begins to spin in a counter-clockwise fashion, like most all low-pressure systems in the Northern Hemisphere. The swirling air may move along slowly for a brief period of time, but it usually will start to ingest cooler air above or alongside that warm surface and mix itself out.

Gustnado: Colloquial expression for a short-lived, shallow, generally weak, vertically oriented vortex found along a gust front. Gutsnadoes are usually visualized by a rotating dust or debris cloud.

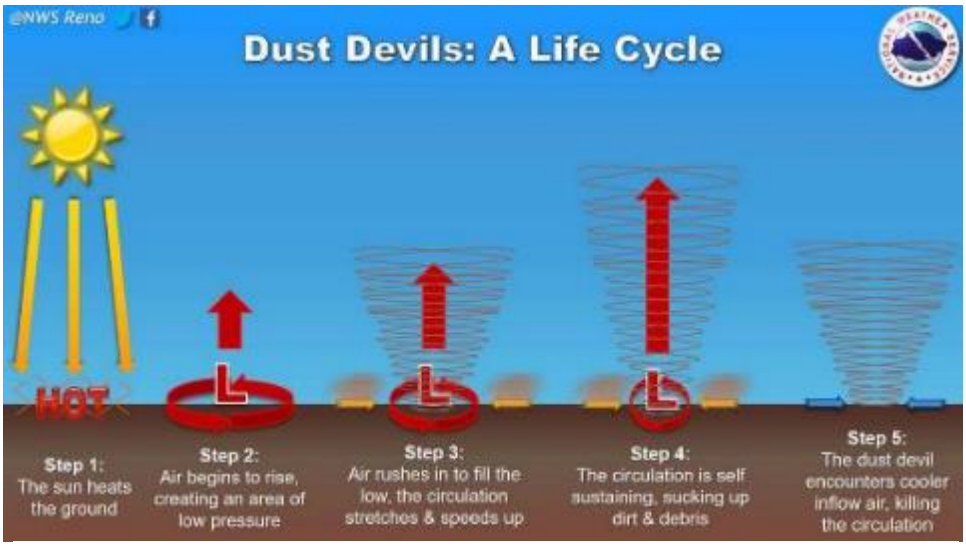


Figure 14. A lifecycle of dust devils. (Courtesy of the NWS Forecast Office in Reno, Nev.)

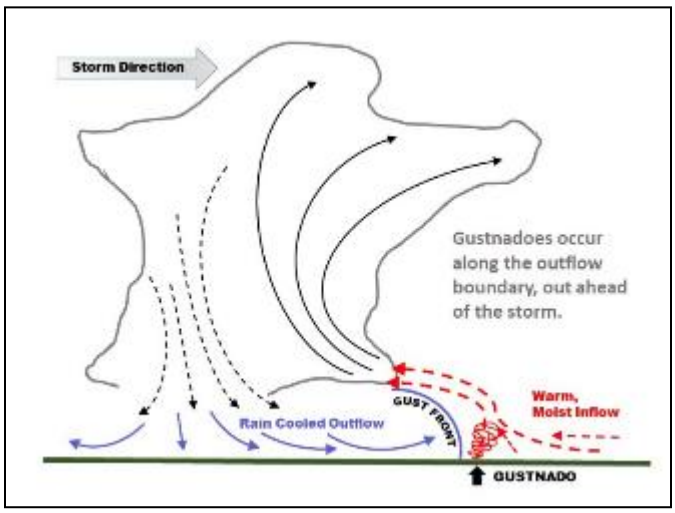


Figure 15. Location of gustnados with respect to their parent cloud.

As implied above, dust devils are usually formed in sunny and warm environments and under fairly weak wind flow regimes that help the localized warm air pockets to form apart from otherwise mixing winds regimes.

As the graphic on the left (Figure 15) illustrates, gustnadoes form on the outflow boundary out ahead of thunderstorms in the warm, often moist and very unstable air. Although they may closely resemble a dust devil, they are typically moving more rapidly. The combined rotational speed and forward speed of these "whirlwind" phenomena can approach that of a weak tornado, EF0 to EF1 (LTE 110 mph).

Figure 16. The two images taken from the same location, east of Wahpeton-Breckenridge, on different dates. (Courtesy of the Minnesota Department of Natural Resources)

The two images at the left (Figure 16) were taken from the same location, east of Wahpeton-Breckenridge, on different dates.

The upper photo was a mainly sunny and warm day in early April 2015, with one or more fairly large dust devils forming on a stubble field.

The lower photo is from mid-June 2008, with a thunderstorm squall line moving into the area and one or more gustnadoes forming.

A subtle point here is that during this June 2008 episode, the updrafts which at one point were producing gustnadoes ahead of the storm eventually coupled with the main storm and produced a bona fide tornado.

But that's fodder for a future Science Bits article, no doubt.

In summary, neither dust devils nor gustnadoes are bona fide tornadoes, but they have a similar low-level, near-surface forcing. The missing ingredient in both cases is a direct connection to the sustaining and strengthening power supplied by the convective updraft found in a robust cumuliform cloud. They are both types of a phenomena called whirlwinds, and in the Northern Hemisphere, they are usually cyclonic in their rotation. They and their larger tornado cousins are sometimes called cyclones, but that distinction is more commonly reserved for the much larger scale phenomena such as tropical and extratropical cyclones, that is, hurricanes and blizzards.

So I'll leave you to ponder whether there are snow devil or snownado relatives in this whirlwind family. You won't find either term in the *Glossary*, but if you keep your eyes open when you watch the snow blowing in between buildings or watch the eddies forming off the edge of large trucks moving down a snow-enhanced roadway, you may just become a believer!

The Glossary of Meteorology: http://glossary.ametsoc.org/wiki/Main_Page

Snownado: A Rare Winter Phenomenon. http://thescienceexplorer.com/nature/snownado-rare-winter-weather-phenomenon

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[7].

North Dakota State Climate Office

College of Agriculture, Food Systems, and Natural Resources
North Dakota State University
304 Morrill Hall, Fargo, ND 58108
Climate Services: 701-231-6577

URL: www.ndsu.edu/ndsco
Email: Adnan.Akyuz@ndsu.edu

[7] *This work is supported by the USDA National Institute of Food and Agriculture, Hatch/Multi State project ND1005365.*