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Graphics

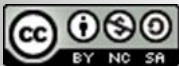
NCEI, NDSKO, NDAWN, NOAA,
CPC, USDM

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From the State Climatologist

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The overall autumnal average temperature was only 1.9 degrees cooler than average, which would make it the 30th coolest autumn on record. Precipitation-wise, the statewide accumulation was 4.92 inches wetter, and it was the wettest autumn on record since 1895. The autumn precipitation impacted the last 12-month accumulation so that the state appears to be the wettest during the past 12-month period, even though the first half was drier than average. Overall, a total of 380 records, including temperature- and precipitation-related occurrences across the state, were tied or broken.

Drought conditions were reversed into flood conditions in September, halting the harvest. Based on the Agricultural Statistics Service report at the end of the season, 30% of the corn planted was harvested, which is 61% slower than average. See more in the Hydro-Talk and drought sections in this issue.

Detailed monthly climate summaries for June, July and August, 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

*Waterlogged sugarbeet field.
(National Weather Service, Grand Forks, N.D. office)*



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 autumn season (Sept. 1 through Nov. 30, 2019) was 8.77 inches, which was 0.55 inch less than the last season (summer 2019), but 4.96 inches more than last autumn (autumn 2018) and 4.92 inches more than the 1981-2010 average autumnal precipitation (Table 1). This would rank the autumn of 2019 as the wettest autumn 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 15.41 inches, recorded in Grand Forks, Grand Forks County. The greatest seasonal snowfall accumulation was 34.9 inches, recorded at Lake Metigoshe State Park, Bottineau County. Based on historical records, the state average autumn precipitation showed a positive long-term trend of 0.94 inch per century during this period of record since 1895. The highest and lowest seasonal autumn average precipitation for the state ranged from 8.77 inches in 2019 to 0.99 inch in 1976. The “Historical Autumn Precipitation for North Dakota” time series (Figure 2) shows a graphical depiction of these statistics.

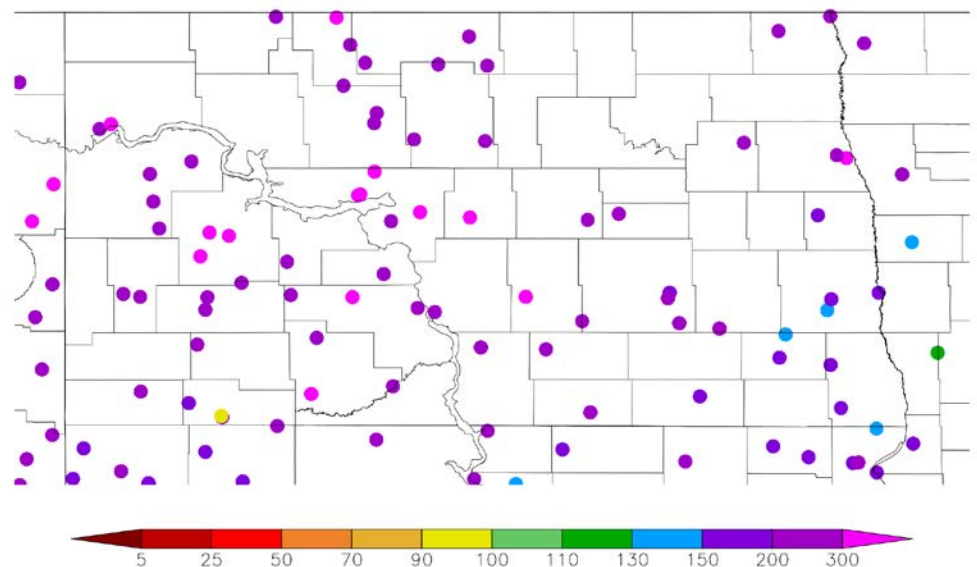


Figure 1. Precipitation percent of normal in autumn of 2019 for North Dakota. (High Plains Regional Climate Center, HPRCC)

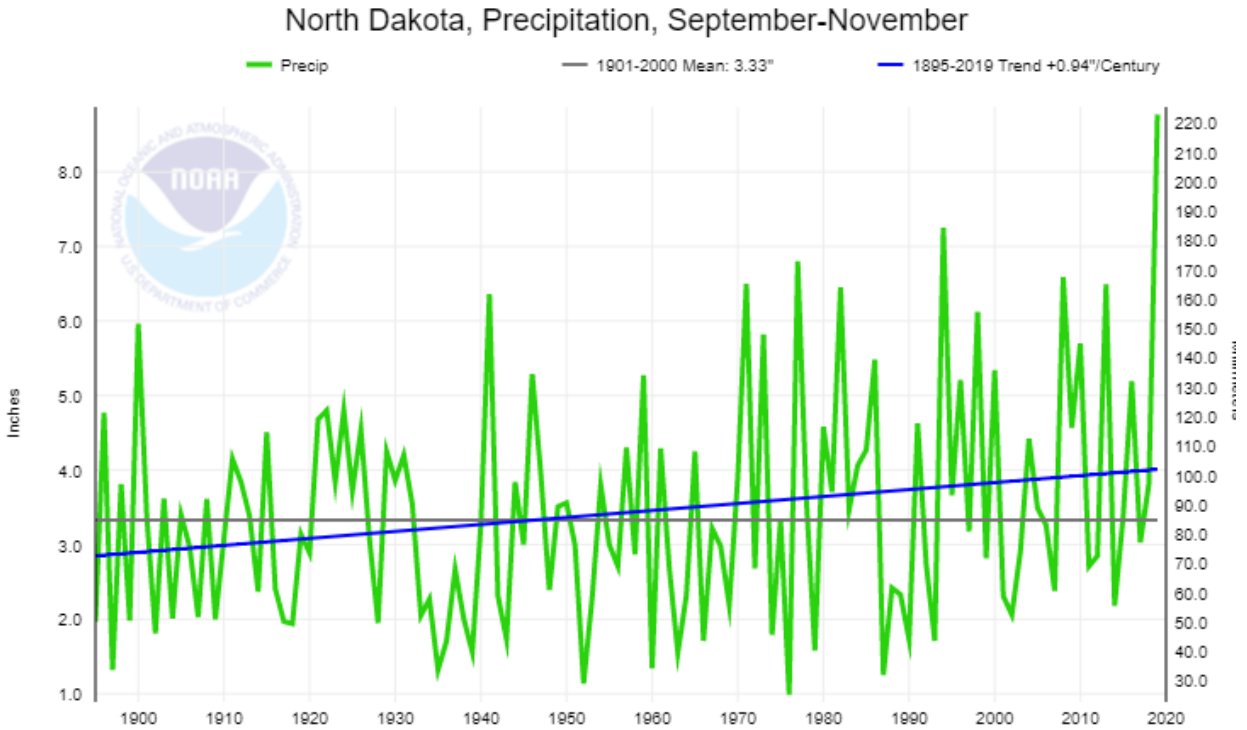


Figure 2. Historical autumn precipitation time series for North Dakota.

Table 1. North Dakota *Autumn* Precipitation Ranking Table¹.

Period	Value	Normal	Anomaly	Rank	Wettest/Driest Since	Record Year
Autumn 2019	8.77"	3.85"	+ 4.92"	125th driest 1st wettest	Driest since 2018 Wettest to date	0.99" (1976) 8.77" (2019)

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

The average North Dakota temperature for the season (Sept. 1 through Nov. 30, 2019) was 40.7 F, which was 22.6 degrees cooler than the last season (summer 2019), but 1.8 degrees warmer than last autumn (2018). It was 1.9 degrees cooler than the 1981-2010 average autumn temperature, which would rank autumn 2019 as the 30th coolest autumn or 96th warmest autumn 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 autumn temperature showed a positive trend of 0.2 degree per decade since 1895. The highest and lowest seasonal autumnal average temperatures for North Dakota ranged from 49.1 F in 1963 to 32.2 F in 1896. The “Historical Autumn Temperature for North Dakota” time series (Figure 4) shows a graphical depiction of these statistics.

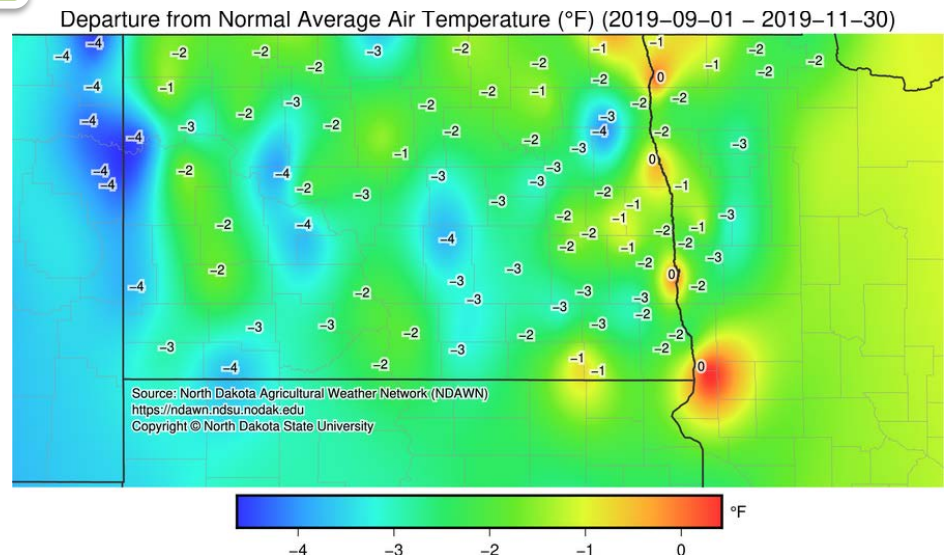


Figure 3. Temperature departure from normal in autumn of 2019 for North Dakota. (North Dakota Agricultural Weather Network)

North Dakota, Average Temperature, September-November

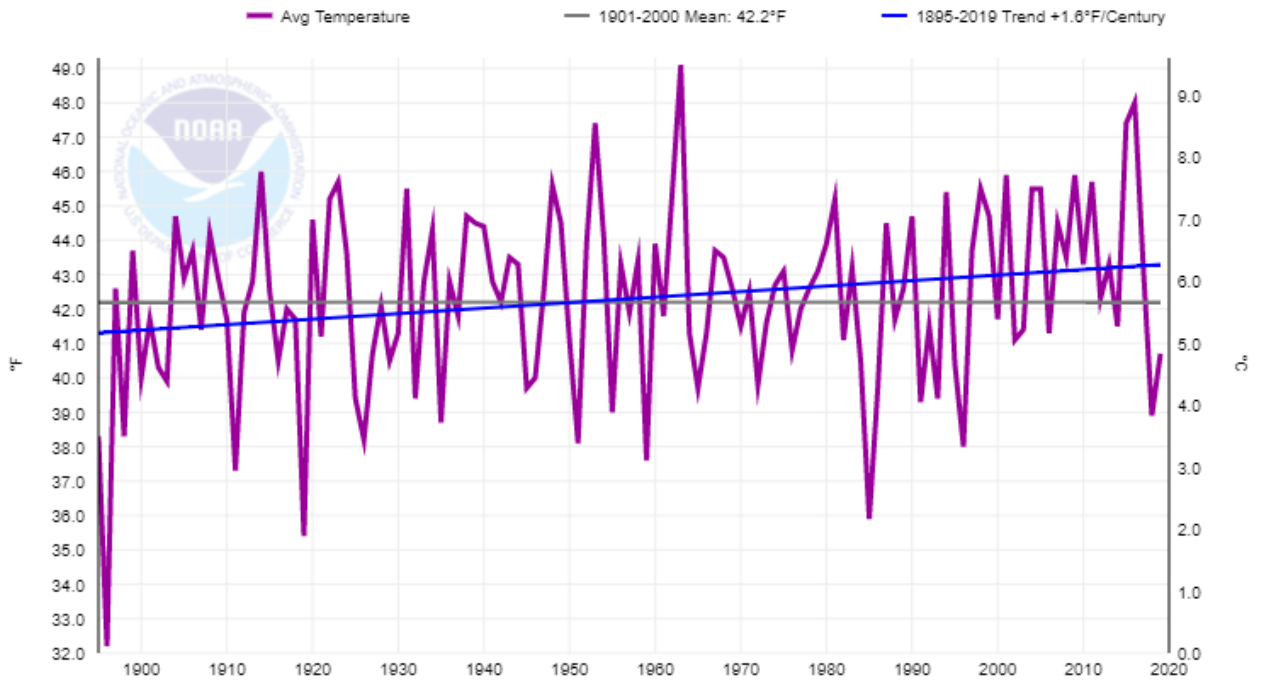


Figure 4. Historical autumnal temperature time series for North Dakota.

Table 2. North Dakota Autumn Temperature Ranking Table².

Period	Value	Normal	Anomaly	Rank	Warmest/Coollest Since	Record Year
Autumn 2019	40.7 F	42.6 F	- 1.9 F	30th coolest 96th warmest	Coollest since 2018 Warmest since 2017	32.2 F (1896) 49.1 F (1963)

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: Drought conditions persisted in the north-central parts of the state at the beginning of the season. However, September turned out to be the wettest September on record, followed by the wettest September-October period, which quickly ended the drought in these areas. In fact, the focus changed from drought to a flood situation across the state in a matter of 30 days. In response to spring flooding, a secretarial disaster designation for 47 of our 53 counties following an October precipitation event that culminated in at least \$423 million in crop damages for North Dakota producers and approximately \$6 million in infrastructure damages, the state of North Dakota is requesting a presidential disaster declaration. Figure 5 below shows the drought conditions in the beginning and the end of autumn. Figure 6 shows the drought intensity and coverage in a time scale.

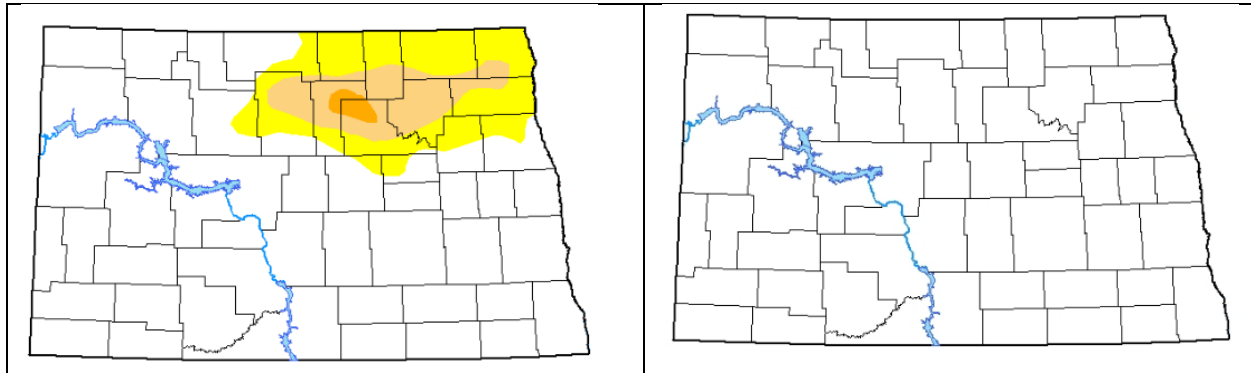


Figure 5. Drought Monitor map comparison for North Dakota in the beginning (on the left) and at the end (on the right) of autumn 2019. (U.S. Drought Monitor)

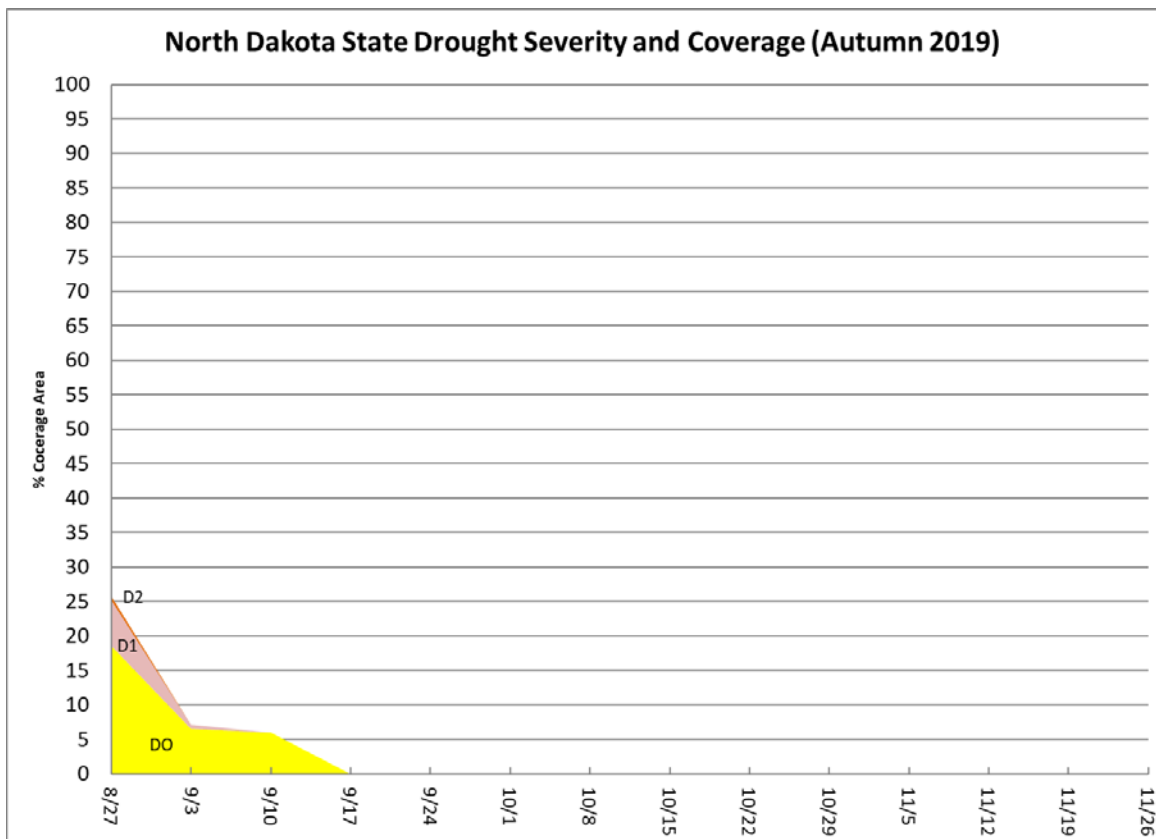


Figure 6. Statewide drought coverage in percentage and intensity (D0, D1, etc.) in a time scale representing the state from the beginning to the end of the season, with a one-week resolution.



Storms and Record Events

State Tornado, Hail and Wind Events for Autumn 2019

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

	September	October	November	Seasonal Total
Tornado	0	0	0	0
Hail	43	0	0	43
Wind	36	0	0	36
Total	79	0	0	79

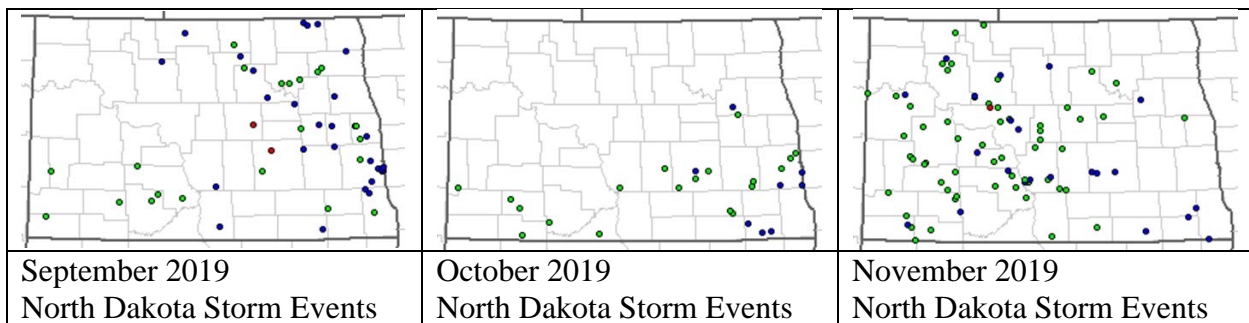


Figure 7. Geographical distribution of the storm events in the table above in each month. The dots are color-coded for each event (red: tornado; blue: wind; green: hail).

State Record Events for Autumn 2019

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	September	October	November	Seasonal Total
Highest daily max. temp.	6	0	1	7
Highest daily min. temp.	59	0	5	64
Lowest daily max. temp.	10	71	10	91
Lowest daily min. temp.	0	0	7	7
Highest daily precipitation	100	22	10	132
Highest daily snowfall	0	65	14	79
Total	175	158	47	380



Seasonal Outlook



Winter 2019-20 Outlook

By R. Kupec³

Fall 2019 was a cold and wet season. Much of North Dakota saw temperatures 2 to 4 degrees below average and precipitation ran 3 to 6 inches above average. A handful of locations saw 8-plus inches of precipitation above average, fueled by what was for many a record-setting wet September. The season also was marked by an early October snowstorm that brought heavy snow to much of the state. That snow acted like a refrigerator and helped keep October temperatures at 4 to 6 degrees below average.

The fall outlook called for a wet September followed by a drier October and November. This, for the most part, is how the season played out, but it would have been hard to predict that September would be as wet as it was. The temperature forecast was for the fall to be near average. The snow and cold of October kept the average temperature for the season lower than expected.

Winter 2018-19 started with a mild December, a cooler January, and a brutally cold and snowy February. As we head into this winter season, we are looking at conditions that are very similar to last year. In the South Pacific, the El Niño/La Niña ocean pattern is running on the warm side of neutral. This is the same pattern as last winter. Conditions in the northern Pacific and northern Atlantic also mirror last winter. Given the similarities, I would expect temperatures to be a few degrees below average and precipitation to be above average. While the seasonal averages will be close to last year, how we get to those averages likely will take a different path. December likely will not be as warm as last winter and February will not be as cold. While precipitation will run above average, it likely will be less than we saw last year.

The current Climate Prediction Center (CPC) Winter Outlook has a slightly different forecast for temperatures, giving the entire region an equal chance of above- or below-average temperatures (see Figure 8a). The CPC precipitation forecast agrees, giving above-average moisture for all of North Dakota (see Figure 8b).

The next 90-day outlook from the CPC should be available after Dec. 19 at www.cpc.ncep.noaa.gov/products/predictions/90day.

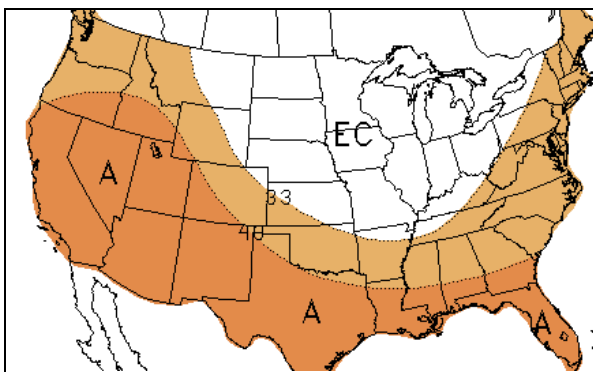


Figure 8a. December through January temperature outlook. (Climate Prediction Center, NOAA)

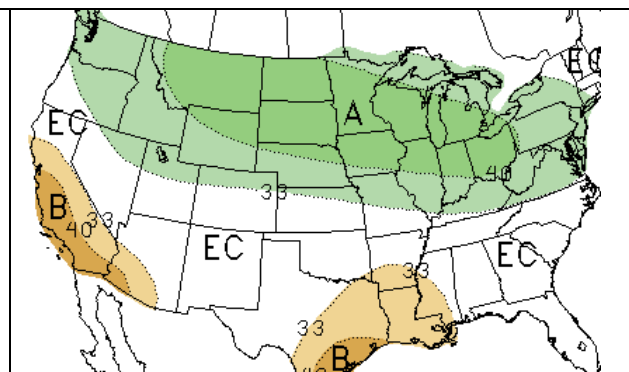


Figure 8b. December through January precipitation outlook. (Climate Prediction Center, NOAA)

³ The corresponding author, Rob Kupec, is chief meteorologist at KVRN-TV in Fargo, N.D. Email: rkupec@kvrn.com



Hydro-Talk



One for the Record Books

By A. Schlag⁴

It's fair to say that 2019 will go down in the record books, and not in a good way. Back in August, we talked about the remarkable turnaround from the dry spring to a wetter than normal July and early August. In Figure 9, the U.S. Drought Monitor (USDM) image shows the maximum areal extent and severity of drought coverage and severity experienced in North Dakota. Widespread rains in July, August and early September caused the removal of all drought designations by the middle of September. It was so wet from July through early September that the USDM removed all drought designations from North Dakota on its Sept. 17 map.

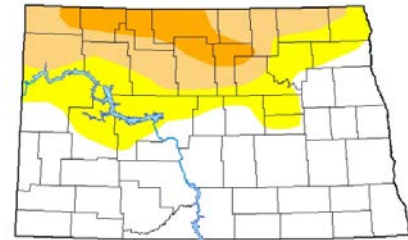


Figure 9. Maximum extent and severity of drought in North Dakota during 2019.

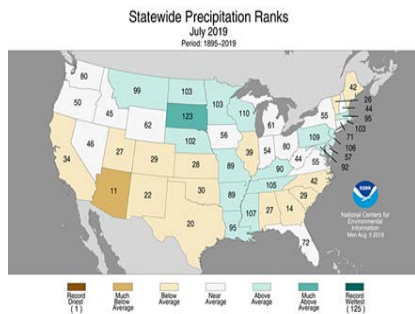


Figure 10. Statewide precipitation ranking for July.

By late July, the patterns had changed and the rains were no longer restricted to the southern half of North Dakota. The National Centers for Environmental Information (NCEI) has 125 years of data to place a given month or year into historical context. In Figure 10, NCEI ranks the rain received in North Dakota as the 103rd driest (23rd wettest) on record.

Similarly, the individual months of August, September and October all placed quite high in their respective rankings. September ended up being the wettest September on record (Figure 11).

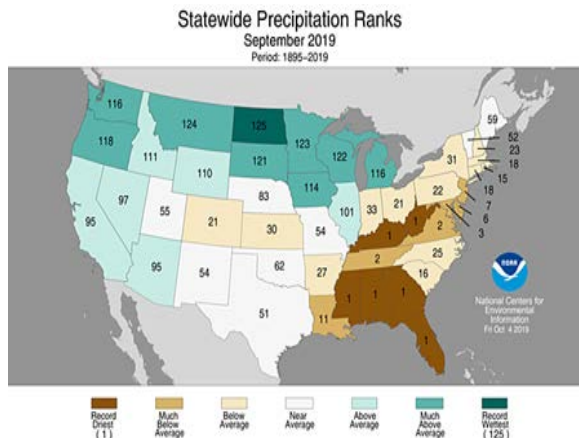


Figure 11. Statewide precipitation ranking for September.

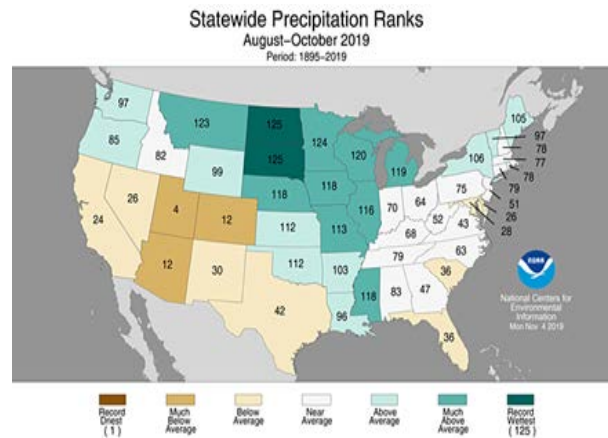


Figure 12. Statewide precipitation ranking August-October.

Not only were the individual months all very high in their rankings, but the three-month period of August-October also comes in as the wettest August through October in 125 years of data (Figure 12).

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

Even though a good share of North Dakota started the summer in a strong drought, the second half of summer and early autumn were something greater than once-in-a-generation wet.

Flooding during the latter half of summer and fall are rare for North Dakota. However, that is exactly what happened this year. See Figure 13 for just one example hydrograph that shows the gauge height of the Red River at Grand Forks. The James, Sheyenne and Red River basins were particularly hard hit even though high water also affected several Missouri River tributaries in the western part of the state.

While the Red River Basin flooding may have received more attention, the duration, severity and agricultural impacts of flooding along the James River were just as devastating. The Jamestown and Pipestem dams peaked at 31% and 43% of their respective flood storage being occupied.

As of Dec. 6, the Jamestown Dam still had 25% of its flood storage occupied, while Pipestem had fallen to 17% occupied. It is expected to take until sometime in February for both reservoirs to fall back to normal winter drawdown levels in preparation for the 2020 snowmelt season.

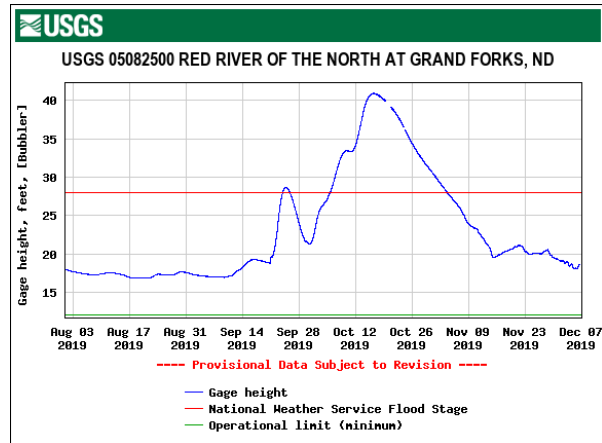


Figure 13. USGS hydrograph for Red River at Grand Forks.

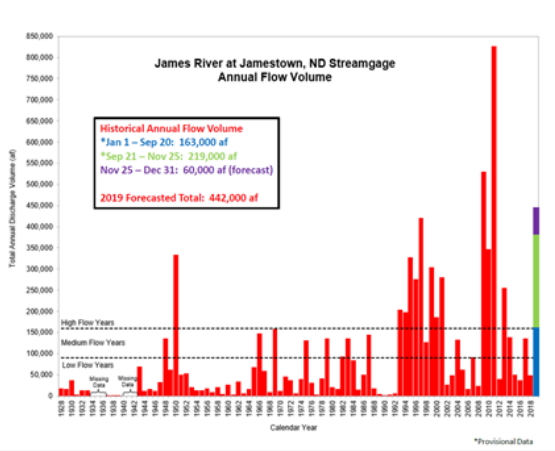


Figure 14. USACE data for James River at Jamestown through the years.

in the top five years on records going back to 1928.

While I inherently know that every flood has its own unique characteristics, I continue to find myself surprised by just how inventive Mother Nature can be up here in the northern Great Plains.

Figure 14, provided by the U.S. Army Corps of Engineers (USACE), shows just how incredible the runoff from the late September and early October rain and snow events really was in comparison with historical data. When summed up, the 219,000 acre-feet of water already passed by the Jamestown gauge, the 60,000 acre-feet expected to pass in December, about 50,000 acre-feet of excess water that will remain in storage going into 2020, up to another 40,000 acre-feet of water that is believed to be trapped in the upper basin until spring, and runoff from the September and October events eventually could exceed 350,000 acre-feet of water. To put that total into perspective, the upper James River Basin runoff attributed to the weather in September and October of 2019 easily would rank



Science Bits



Winter Weather Terminology

By G. Gust⁵

After a Record Snowy Start to Winter, Better Brush Up on Your Severe Winter Weather Vocabulary

Lest we forget, our last two Octobers have been quite brutal. One mid-October snowstorm nailed [eastern North Dakota](#) in 2018, and another nailed [eastern](#) and [central](#) North Dakota in mid-October 2019.

Snowy Records? As was mentioned in the October 2018 Climate Summary, some 35 daily snowfall records were set with the first storm. And according to the October 2019 Climate Summary,

some 65 daily snowfall records were set with this more recent

October storm. What is missed in the brief analysis is that several locations also set 24-hour snowfall records for this past October, usually in the 10- to 12-inch range. And several locations, largely across the Devils Lake, and Upper Sheyenne and Upper James River basins, reported multi-day storm total snowfall pushing 2 feet or more, falling just shy of their all-time, multi-day snowfall records - typically in the 24- to 30-inch range (Figure 15).

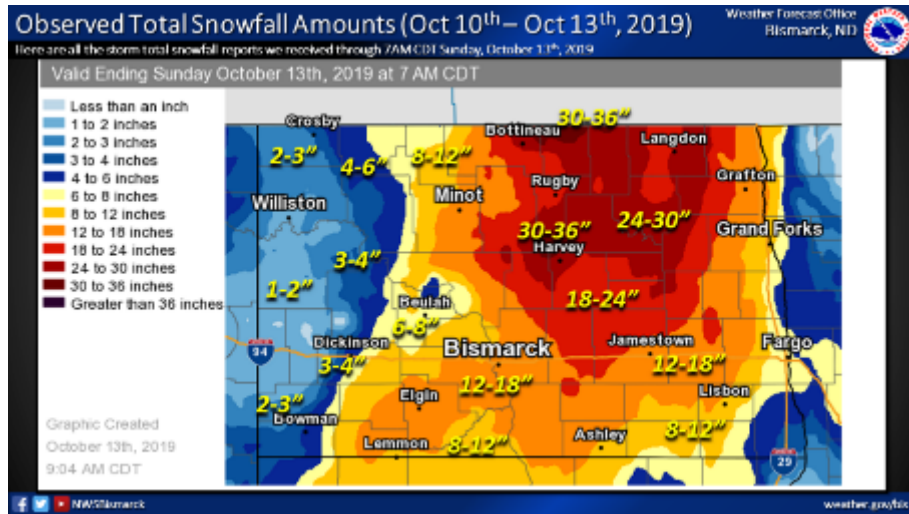


Figure 15. Observed snowfall between Oct. 3 and 10.

Caution: If you're new to winters here in the northern Plains, this is only the beginning. A winter season here usually runs from mid to late fall through early spring, averaging a solid four to five months; not just the cold-core months from December through January, but the cold-shoulders (including November and March) as well. I quite often tell my out-of-area friends that we (at least in eastern North Dakota) drive on a skating rink for five months of the year and think nothing of it! But I also admit that when an especially long and brutal winter such as 2018-19 strikes, grabbing extra frosty handfuls away from October and April, then that does get a bit trying.

Some Familiar Winter Alert Terms. Whether the rest of our usually protracted winter season continues to be extra snowy and cold or turns to the mild side, we can be guaranteed that we'll run into these winter alert terms, at least a time or three. By the way, is your [Winter Survival Kit](#) stocked and at the ready?

Winter Watches: Issued when there's an increased risk of hazardous weather, typically two to three days out, but its occurrence, location and timing still are somewhat uncertain. There are two types:

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

- A **Winter Storm Watch** is issued when conditions are favorable for a winter weather event having one or more hazards (snow, blowing snow, ice, sleet, freezing rain) to meet local criteria. For North Dakota, that would be **6+ inches** of snow in 12 hours or **8+ inches** of snow in 24 hours.
- A **Wind Chill Watch** is issued when conditions are favorable for wind chill temperatures to meet or exceed local warning criteria, which for North Dakota is **minus 40 F** or colder.

Winter Warnings: Issued when life- or property-threatening conditions are imminent, occurring or have a very high probability of occurring. We typically refer to these as our *long-fuse warnings* (such as a long fuse on a stick of dynamite) because winter storms develop and last for a much longer time period than their summer convective cousins. There are four types frequent to our area:

- A **Winter Storm Warning** is the most common warning product and is issued for significant accumulations of snow, or combinations of snow, blowing snow, ice, sleet or freezing rain, as mentioned above. An extreme winter storm may produce snowfalls of a foot or more.
- A **Blizzard Warning** is much like the tornado warning of the winter season. A blizzard is defined as sustained or frequent wind gusts of 35 mph or greater accompanied by falling and/or blowing snow, and frequently reducing visibility to less than one-fourth mile for three hours or longer. An extreme blizzard may produce winds gusting to 50 mph or greater, with widespread whiteout conditions completely shutting down travel for days.
- An **Ice Storm Warning** is issued when freezing rain is expected to accumulate as ice with a thickness of ¼ inch or more on flat horizontal surfaces. An extreme ice storm may produce an inch or more of ice, with strong winds increasing the potential for widespread power outages.
- A **Wind Chill Warning** is issued when a multicounty area is expected to reach minus 40 F or colder, for multiple hours. Extreme wind chills have dipped into the minus 60 to 80 F range or lower.

Winter Advisories: A **Winter Weather Advisory** and a **Wind Chill Advisory** are used as a lesser level of alerting for those situations of snow, blowing snow, ice and cold that are less of a threat but still can be quite an inconvenience. A typical winter weather advisory situation will necessitate extra care in driving, walking and dressing for the dangerously slippery and bitterly cold conditions.

The New Kid on the Block: a Snow Squall Warning?! A new winter product has made its appearance during the past winter season. A snow squall is more closely related to its summertime convective cousin, the squall line, and as such may constitute a true *short-fused warning* (hour or less) situation.

A **Snow Squall** situation may seem very much like a blizzard, with **visibilities dropping to one-fourth mile** or less in **heavy snow** and **sudden strong gusty winds**, but for a much smaller area and a much shorter time frame. A snow squall warning could be issued for a few counties at a time and track along with a fast-moving cold front, provided a longer-fused winter storm or blizzard warning isn't already in effect.



Figure 16. NWS Winter Safety for “Sneaky Winter Hazards”⁶.

Considered one of several “[sneaky](#)” winter hazards, snow squalls typically will form when bright midday sunshine allows for enough warming to produce convective clouds and briefly strong snow showers. In the right conditions, heavier snow and strong wind gusts can produce brief blizzardlike conditions, leading to brief but scary periods of whiteout conditions for traffic on roadways.

Enjoy this Coming Winter. Keep in mind that our winter weather can be quite beautiful and enjoyable when you are prepared for it. Do make sure you stay informed on the latest weather conditions, keep your winter survival gear at the ready, and maybe slow down a bit to enjoy some safe winter travels.

⁶ www.weather.gov/wrn/winter_safety

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 bulletin⁷.

North Dakota State Climate Office

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