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North Dakota Climate Bulletin

Winter 2016-17 Volume: 11 No: 1

In This Issue

by
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Image Credits
NCEI, NDSCO, NDAWN, MRCC

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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 in Fargo, North Dakota.

This winter was the 31st warmest and sixth wettest (the wettest winter since 2010-11) on record since 1895 statewide in ND. Overall in the winter season, there were 26 highest daily maximum and 115 highest daily minimum temperature records either broken or tied. There were also 83 highest daily snowfall records either broken or tied. A total of 320 records were either tied or broken including temperature and precipitation related occurrences across the state. There was only one hail event this winter which became the new earliest hail event in ND. A one-inch diameter hail event was reported near Hettinger, Adams County on February 21st, 2017.

Detailed monthly climate summaries for September, October and November can be individually accessed via https://www.ndsu.edu/ndsco/resources/monthlyclimatesummary/

The bulletin will contain graphical displays of statewide seasonal temperature, precipitation, and other weather highlights.

This bulletin can be found at http://www.ndsu.edu/ndsco/, along with several other local resources for climate and weather information.

Adnan Akyüz, Ph.D.
North Dakota State Climatologist

Near Dazey, ND *by Akyüz*

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 winter season (December 1, 2016 through February 28, 2017) was 2.46 inches, which was 1.27" greater than last year, 1.04" greater than the 1981-2010 average winter precipitation and was the wettest Winter since 2010-11. This would rank winter 2016-17 as the 6th wettest winter since such records began in 1895. Figure 1 shows the percent of normal precipitation distribution geographically. Based on historical records, the state average winter precipitation showed no average long-term trend since 1895. The highest and the lowest seasonal winter average precipitation for the state ranged from the highest amount of 2.99" in 1968-69 to the lowest amount of 0.59" in 1989-90. The "Historical Winter Precipitation For North Dakota" time series on page 4 shows a graphical depiction of these statistics.

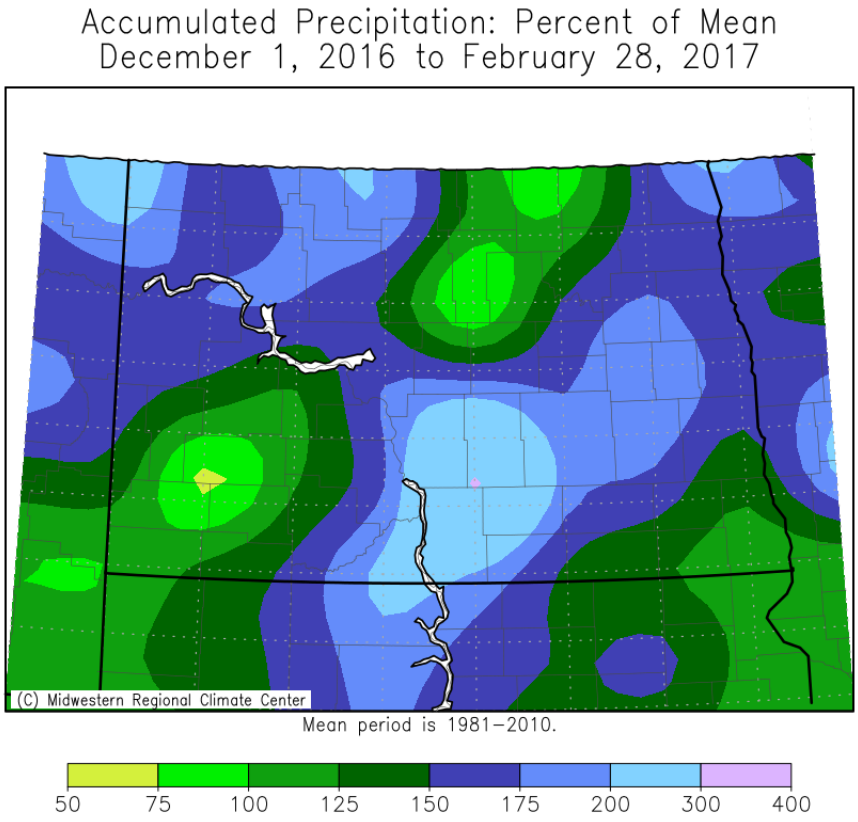


Figure 1. Precipitation % of Normal in Winter 2016-17 for North Dakota (MRCC)

Flood Potential: There are several areas of interest for high potential for a spring flood. They include the Northern Red River Valley of the North in eastern North Dakota and western Minnesota, Devils Lake Basin in the northeast central ND, and Souris River in the northwest ND. These particular locations are further discussed in the Hydro-Talk section of this bulletin.

Temperature

The average North Dakota temperature for the winter season (December 1, 2016 through February 28, 2017) was 13.9°F, which was 6.5°F colder than last year, but 0.4°F warmer than the 1981-2010 average winter temperature and the warmest winter since 2013-14. This would rank winter 2016-17 as the 31st warmest winter since such records began in 1895. Figure 2 shows the departure from normal temperature distribution geographically. Based on historical records, the state average winter temperature showed a record increasing trend of 0.47°F per decade since 1895. It is currently the steepest average temperature trend in the US during such a period. The highest and the lowest seasonal winter average temperatures for the state ranged from the highest amount of 22.2° in 1986 to the lowest amount of -3.0° in 1935-36. The "Historical Winter Temperature For North Dakota" time series on page 5 shows a graphical depiction of these statistics.

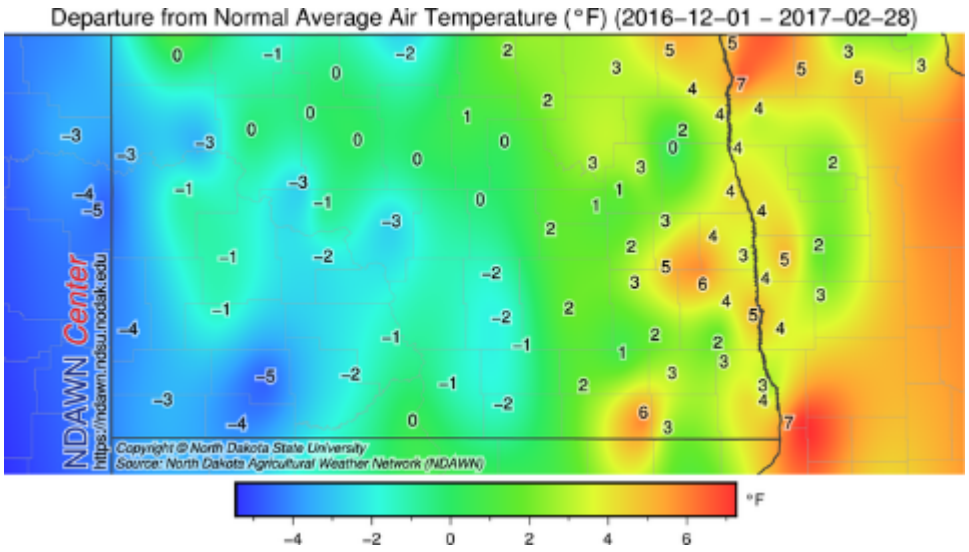
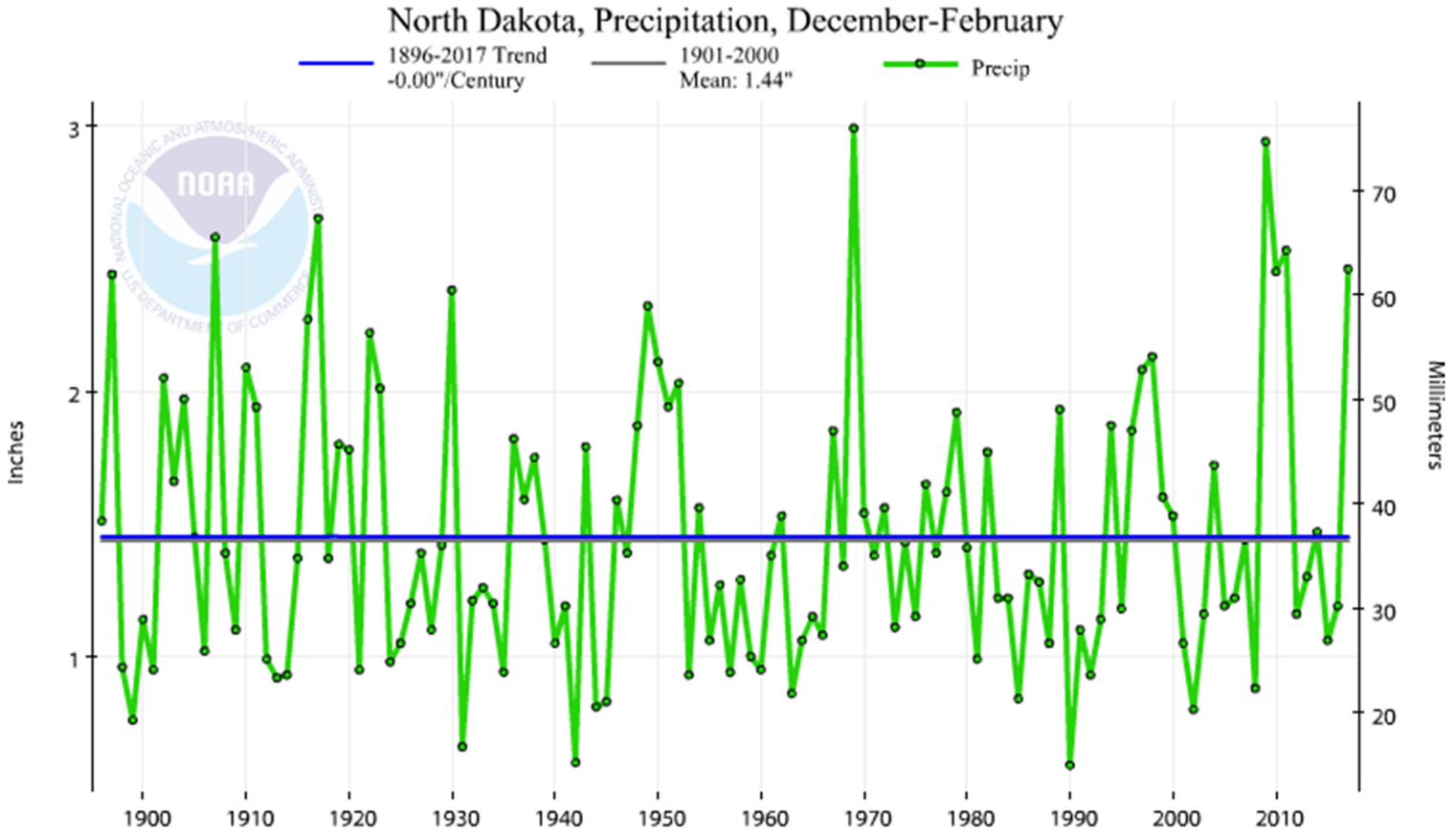


Figure 2. Temperature Departure from Normal in Winter 2016-17 for North Dakota (NDAWN)

Agricultural Impact: There were only a few counties in far southwest North Dakota where abnormally dry conditions persisted from the beginning to the end of winter season. By the end of the season, dugouts and ponds signaled stress. If additional moisture does not come in the next few weeks, conditions in these locations can degrade to moderate drought category. Back-to-back heavy snow and blizzard conditions on December 5, 6, and 7 in central and north-central parts of the state made access to feed and facilities difficult thereafter. Freezing rains in January made the matter even worse. However, early snowmelt due to the mild weather in February brought relief to livestock producers. Excessive snowfall in the northern Red River Valley heightened the potential for flooding which may cause delayed spring planting in fields along the Valley.

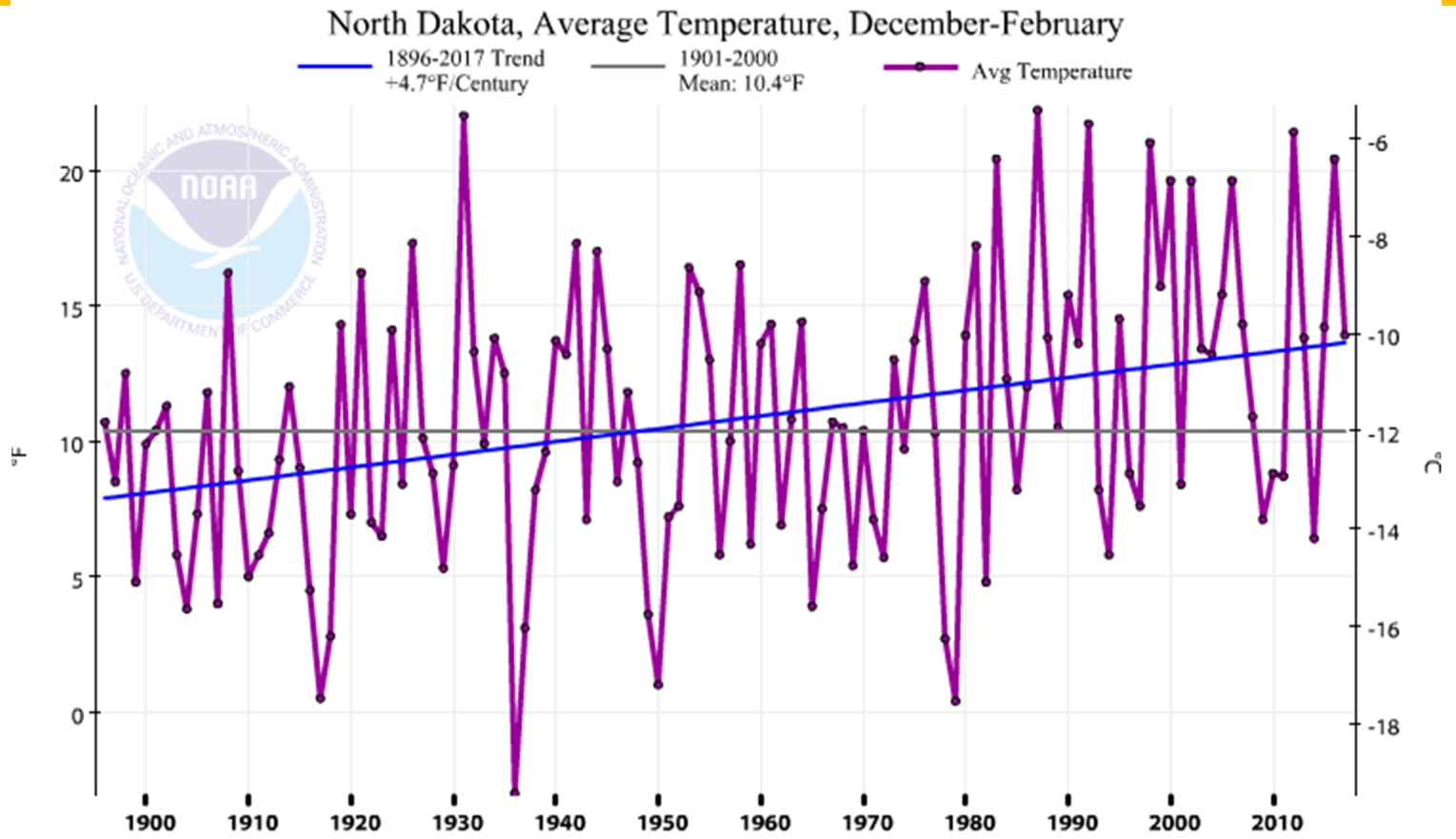
HISTORICAL WINTER PRECIPITATION FOR NORTH DAKOTA



Record High Value: 2.99” in 1968-69
Record Low Value: 0.59” in 1989-90
Seasonal Trend: 0.00” per Decade

Winter 2016-17 Value: 2.46”
1981-2010 Average: 1.42”
Seasonal Ranking: 6th Wettest Winter
Record Length: 122 years

HISTORICAL WINTER TEMPERATURE FOR NORTH DAKOTA



Record High Value: 22.2°F in 1986-87
Record Low Value: -3.0°F in 1935-36
Seasonal Trend: 0.47°F per Decade

Winter 2016-17 Value: 13.9°F
1981-2010 Average: 13.5°F
Seasonal Ranking: 31st Warmest Winter
Record Length: 122 years

Storms & Record Events

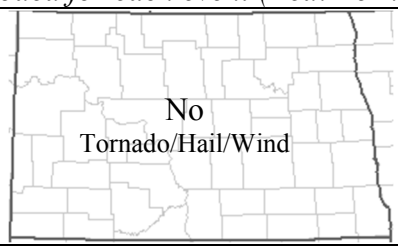
State Tornado, Hail, and Wind Events for Winter 2016-17

Table 1. Numbers in the table below represent the number of tornado, hail and wind events accumulated monthly and seasonally.

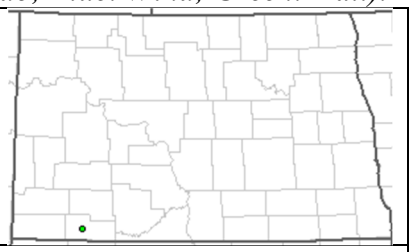
Month	Tornado	Hail	Wind	Total
December Total	0	0	0	**0**
January Total	0	0	0	**0**
February Total	0	1	0	**1**
3-Month Total	**0**	**1**	**0**	**1**

The graphics below shows the 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).

December 2016 North Dakota Storm Events



January 2017 North Dakota Storm Events.



February 2017 North Dakota Storm Events.

State Record Events for Winter 2016-17

Table 2. Numbers in the table below represent the number of select state record events (records broken or tied) accumulated monthly and seasonally.

Category	December	January	February	Seasonal Total
Highest Daily Max Temp.	0	1	25	**26**
Highest Daily Min Temp.	7	64	44	**115**
Lowest Daily Max Temp.	13	3	0	**16**
Lowest Daily Min Temp.	14	1	0	**15**
Highest Daily Precipitation	32	22	11	**65**
Highest Daily Snowfall	43	28	12	**83**
Total	**109**	**119**	**92**	**320**

Seasonal Outlook

Spring 2017 Outlook

By R. Kupec[1]

The weak La Niña in the southern Pacific over the winter has ended. It has now entered a neutral phase, with sea surface temperatures running close to average. The winter outlook had called for slightly colder than average temperatures and average to slightly below average precipitation. Most of North Dakota started winter with colder than average temperatures. The cold start was offset by warmer than average January and February temperatures, making the winter as a whole, average, to slightly warmer than average across much of the state. Nearly the entire state saw wetter than average conditions in December, with several areas seeing one of the wettest Decembers on record. Conditions did become closer to average in January and February but overall the winter had above-average precipitation for the season. The difference between the forecast and actuality is likely attributed to the weak nature of the La Niña and the unusual amount of open-ocean in the Arctic which possibly modified the placement of colder air in North America.

The neutral phase of the La Niña/El Niño sea surface temperature regime in the southern Pacific correlates with average precipitation and temperature across North Dakota. A close examination of the years when neutral conditions followed a weak La Niña does reveal a tendency towards slightly wetter and cooler spring conditions across the entire state, with a slightly higher signal in far western North Dakota. With the current trend of nearly two years of consistently above average temperatures, a safer forecast would be for roughly average spring temperatures and slightly higher than average precipitation. The current Climate Prediction Center (CPC) Spring Outlook has an equal chance of above or below average temperatures for the season (see figure 3). Though the area with the chance of above average temperatures comes nearly up to the far southeast corner of North Dakota. The CPC has nearly the entire state being in between 33 and 40 percent chance of above average precipitation; the one exception is the southeast corner which is in the Equal-Chance or EC category (see figure 4).

The next 90-day outlook from the CPC should be available after March 16th at
http://www.cpc.ncep.noaa.gov/products/predictions/90day

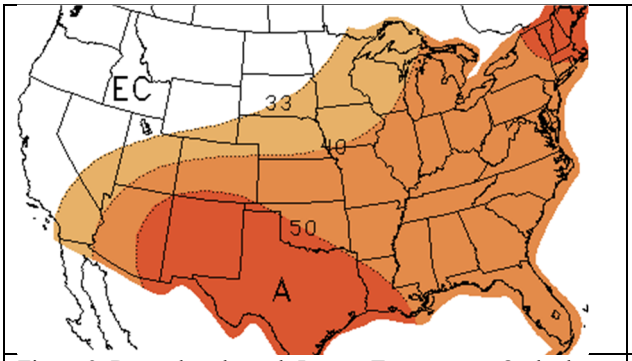


Figure 3. December through JanuaryTemperature Outlook

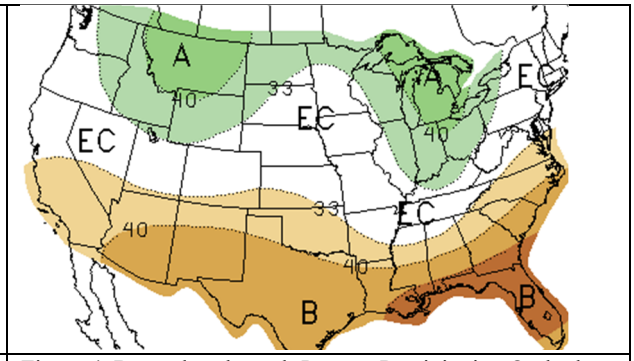


Figure 4. December through January Precipitation Outlook

[1] The corresponding author: Rob Kupec is Chief Meteorologist - KVRR TV in Fargo, ND. <rkupec@kvrr.com>

Hydro-Talk

State and Local Hydrological Overview

By A. Schlag[2]

Living in North Dakota for the vast majority of my life has always left me with an appreciation for how fast things change. Whenever someone mentions "normal" to me, I tend to chuckle as I point out that what is truly normal for North Dakota is that we simply wave at the often mentioned averages (normal) as we go from one extreme to another. The winter of 2016-2017 has thus far provided an excellent example of the swings we see that quickly take us from one extreme to the other in this state.

When looking at the Bismarck Area for the winter in Table 3, November came in at 39.6 degrees (F) and was the second warmest November since 1874 (143 years) and was 11 degrees above the mean. Contrast that with December, where the average temperature was a mere 10.5 degrees and finished in a tie for 34th coldest out of 143 years. Quite honestly, after such a pleasant November, I think most would have assumed the final ranking for December would have been even colder. January ended up being even warmer than December, and with an overall ranking of 81st coldest since 1875, there really wasn't much unusual as it was slightly warmer than the long-term mean of 9.2 degrees. In February, the winds of change hit hard around the middle of the month, and that left February with an average temperature of 22.6 degrees and left it tied for the 24th warmest (120th coldest) on record.

Table 3. Monthly Temperature and Precipitation Statistics for Bismarck Area.

Temperature Average (F)				Precipitation (inches)			
November	December	January	February	November	December	January	February
39.6	10.5	11.1	22.6	1.42	2.05	0.64	0.76

When it comes to precipitation, November's 1.42 inches of liquid equivalent resulted in the 14th wettest November on record. However, given that nearly all of that moisture came in the last 4 days of November, I would bet most people are going to be a little surprised at the overall ranking as the first 27 days were quite pleasant. Similarly, December of 2016 finished with 2.05 inches, or the wettest on record and was largely due to the Christmas blizzard.

As 2017 came in, precipitation was more limited and January ended up with a mere 0.64 inches of liquid equivalent which resulted in an overall ranking of 40th for most precipitation, or something slightly above the mean. February, with 0.76 inches of liquid equivalent, ended up tied for 21st place in the wettest February on record. At this point, a person's head may start to spin if trying to make sense of how this winter has unfolded in the record books if you just look at the numbers. In reality, if someone were to ask me on the streets what this winter has been like, I would tell them that we had a beautiful warm and dry fall that ended just after Thanksgiving where we turned to wet and cold which lasted through December. January was fairly unmemorable, but February will go into the memory of what I want all future Februaries to look like. In the end, we are still left with the question of what does it all mean with respect to remaining flood potential. This February's two week period of well above normal temperatures removed a lot of snow across the southern half of the state. While there were some notable rises in a few tributaries of the Red River along with the Elm and Maple rivers in the James River basin, this very early warm spell gently removed much of the snowpack along and below the I-94 corridor without creating

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problematic high water. Meltwater simply came so slow as to be able to nearly all infiltrate into the soil. This was a major benefit to many areas of the state and leaves us with only the snowpack depicted in the image below to discuss.

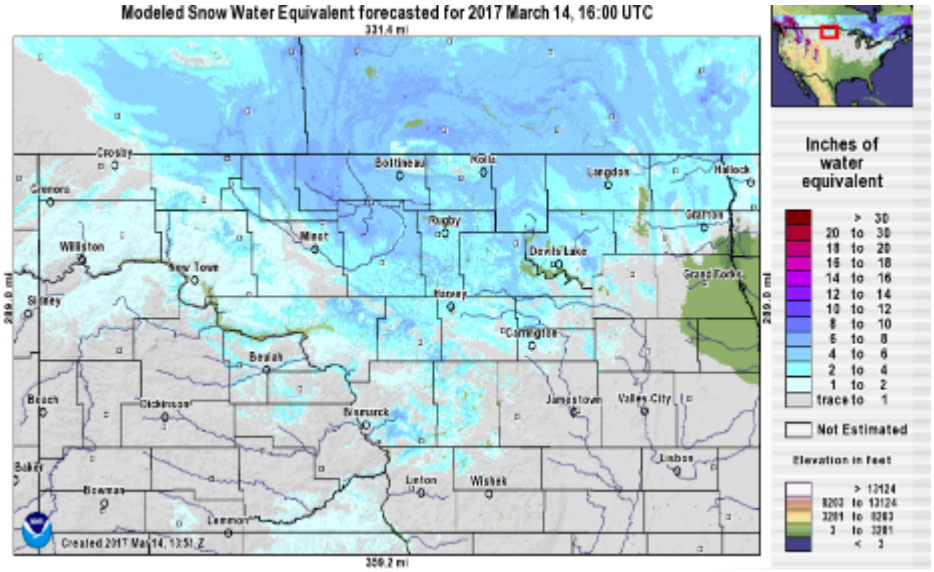


Figure 5. Estimated Snow Water Equivalent in North Dakota as of March 14, 2017 (NOHRSC, NOAA).

In the south, Apple Creek near Bismarck still has an appreciable amount of snow that could prove problematic under the right melt conditions, and especially if an early spring rain hits the area with snow still on the ground. However, this part of the state has already demonstrated that the melt in February was able to infiltrate into the ground with little problems. To the north, the Souris (Mouse) River basin north and east of Minot retains a snowpack with lots of potential for creating excess runoff. This includes Willow Creek and streams draining the Turtle Mountains. Flood control reservoirs have created extra storage in anticipation of the spring runoff event. However, in much of this area the soils are not well frozen and a protracted melt pattern should see much of this water infiltrate into the ground. To the east, the upper James River Basin still has a fair amount of snow sitting on the ground north of Carrington and again, unfrozen soils are expected to temper runoff in everything but a very short melt season. To the northeast, the Park and Pembina Rivers also have plenty of snow left to come off the countryside. Last, and certainly not least, the Devils Lake drainage basin retains a lot of water on the countryside. In fact, the Devils Lake basin has enough water across it to where it has about a one-in-five chance of returning to its modern day record elevation of 1,454.30 ft. This alone will keep hydrologists and those interested in Devils Lake transfixed as this story unfolds over the coming months.

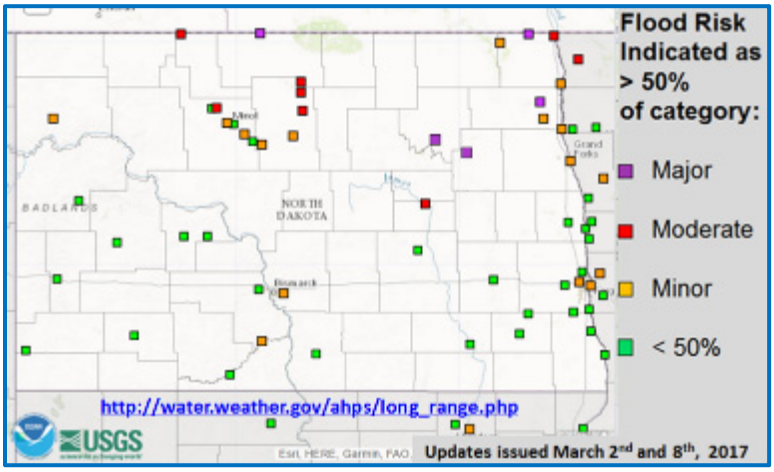
Science Bits

Spring has sprung from floods through fires to the storms.

By G. Gust[3]

As spring unfolds across these Northern Plains, it's not uncommon to have a period or two (even perhaps three) "seasons" seem to overlap. And as weather forecasters, we kind of like those special days where three or four types of really significant weather are all occurring within our area of interest.

From Spring Flood: Most often we see a slowly unfolding snowmelt flood, maybe in March and April (even May) along the Red River or the Mouse/Souris River, or even later into May and June as meltwaters move through the upper Chain of Lakes into the Devils Lake and Stump Lake system. With the Missouri River, a riverine flood can drag on even longer as those copious (this year) snows in the Northern Rockies finally start to flow.



Another scenario could be a flash flood, where an early spring downpour (usually more than an inch or two) happens over ground that is still either frozen or even snow covered. This results in a very rapid and high rate of runoff, overland flow, and local inundation within any small watershed area so affected.

In a typical year, the northern half of the state will persist with patchy snow cover and frozen ground, long after the southern half of the state is showing bare and dry ground. This year, so far, has been more the norm than the exception.

To Wildfire: During these transition weeks or months there are likely to be those periods when, just a few miles outside of the still thawing and/or flooded areas, there are tinder-dry grasslands or forest. There could be vast areas of the state where the pastureland, fields, ditch banks and scrub growth are snow free but have not yet started to "green-up". Those areas soon become prime areas for controlled (intentional) burns under closely monitored conditions, a wildfire from a careless spark or ember, a dry lightning strike from the edge of an early spring thunderstorm, or a mindless toss of a cigarette butt out of a vehicle window.

Early springs that are long and dry, such as years 2012 and 2015, when much of the state has bare snow-free ground and especially dry grassland conditions can be challenging for our firefighters across the state. Rural fire halls in each of our counties may need to control several small grass fires on any given day. In statewide drought years, Fire Fighters from numerous agencies must often coordinate their response to a handle the larger and more widespread wildfire threats.

Fire Weather Watch: typically issued a day or two ahead of expected Red Flag conditions.

Red Flag Warning: Issued the afternoon before or day of the expected conditions… very low relative humidity (30% or less) and strong wind (20 mph or greater).

Statewide information on **Burn Bans** or the daily **Fire Danger Rating** is available online at https://www.nd.gov/des/planning/fire-danger-awareness

Through Green-up: It is possible to have a relatively mild and easy going spring, with a series of lower intensity storm systems moving across the region and

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providing infrequent, widespread soaking rains. This will generally promote a more rapid thaw process and thus stimulate an early and widespread green-up of the surrounding landscape.

If these low-intensity storm systems can continue to move in a more westerly or northwesterly (jet stream level: often split jet stream) flow pattern, they can help to suppress the onset of severe thunderstorms over the state by shunting any warmer and wetter flow from the south out across the Central Plains and Ohio Valley.

It's also possible (and fairly frequent) to have an occasional deep fetch of heat and moisture move northward from the southern plains and provide both fuel and energy (instability) for strong-to-severe thunderstorms starting to occur as early as late March or early April.

To Convective Storms: Deep convective thunderstorms can produce especially nasty weather on their own. They the types we typically associate with intense updraft and downdraft within a fairly small area, with each individual storm cell on the scale of a township-size or less. They can also be an accelerant to either of the aforementioned meteorological episodes.

Convective storms which are deep (high) enough to produce large hail, intense lightning, and very heavy rain. Early spring storms tend to develop in a somewhat drier (lower dew point temperature) environment and thus have a higher cloud base, a smaller overall storm rain footprint, and a higher likelihood that hail and lightning may both eject out from the edges of the storm and outside of the rain wetted area. Problems with these types of the storm can include:

- **Dry Lightning:** Lightning that originates from the leading anvil of a low-precipitation type thunderstorm or from its edges. It strikes areas of the ground that haven't been wetted by the rain which can trigger a wildfire, especially in tinder-dry grasslands. Lightning can strike up to 10 miles ahead of the storm!
- **Dry Microburst:** An intense thunderstorm with a high cloud-base can produce rainfall which largely evaporates before hitting the ground. This can lead to a dry downdraft and outflow which spread out from the storm and can fan the flames of an existing wildfire.
- **Localized Flash Flooding:** As mentioned above, localized flash flooding can also occur if heavy rains fall on frozen ground, even while nearby dry grasslands are subject to wildfire.
- **Maybe even a Late Blizzard:** As a final note, we should all remember that our winter season doesn't typically end when a particular calendar date passes. The Northern Plains region can easily see a major snow storm or blizzard strike well into April, and occasionally into May.

New Record for Earliest Hail!
The earliest report of a tornado in the North Dakota still stands at March 26th, 2003, in northern Stutsman County. But the record for the earliest report of large (severe) hail was already shattered early in the year, with one inch diameter hail reported north of Hettinger on February 21st, 2017, in Adams County.

Record Early Tornadoes… did occur in neighboring Minnesota, with two damaging tornadoes reported on March 6th, 2017, in Freeborn and Sherburne Counties, beating out the previous record holder by some 12 days.

Regardless of how any one day may fare, a spring season in the Northern Plains will usually have something for everyone. And maybe, just maybe, there will be one day this spring when everything meteorological comes together!

Contacting the North Dakota State Climate Office

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

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