NORTH DAKOTA STATE CLIMATE OFFICE ndsco

North Dakota Climate Bulletin

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In This Issue

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Graphics
NCEI, NDSCO, NDAWN, NOAA, HPRCC, MRCC, CPC, USDM

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North Dakota State Climate Office
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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 temperature was 1.3 degrees cooler than average, and it was the 50th coolest on record. Precipitationwise, it was the 37th driest spring on record since 1895 in North Dakota. Overall, 73 highest and 146 lowest daily temperature records were broken or tied. In addition, 95 highest daily precipitation records, including 53 daily snowfall records, were broken or tied. A total of 314 records, including temperature- and precipitation-related occurrences across the state, were tied or broken.

Drought conditions improved, compared with the previous season. However, by the end of the season, the western half of the state still was experiencing the drought hangover. As the atmospheric evaporative demand increases with increasing temperatures throughout the season, more precipitation is going to be needed to ameliorate the drought in western North Dakota. Is the outlook for summer promising increased chances for wetter than average conditions? The answer is in the seasonal outlook section of the bulletin.

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

Downtown Fargo. (J. Alan Paul Photography)

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, 2018) was 3.72 inches, which was 2.71 inches more than the last season (winter 2017-18) and 1.27 inches more than last spring (spring 2017) but 0.86 inch less than the 1981-2010 average spring precipitation. It also was the driest spring since 2017. This would rank spring 2018 as the 37th driest spring since such records began in 1895. Figure 1 shows the percent of normal precipitation distribution geographically. Based on historical records, the state average spring precipitation showed a positive long-term trend of 0.36 inch per century during this period of record since 1895. The highest and lowest seasonal spring average precipitation for the state ranged from the highest amount of 9.64 inches in 1896 to the lowest amount of 1.3 inches in 1934. The "Historical Spring Precipitation for North Dakota" time series on Page 5 shows a graphical depiction of these statistics.

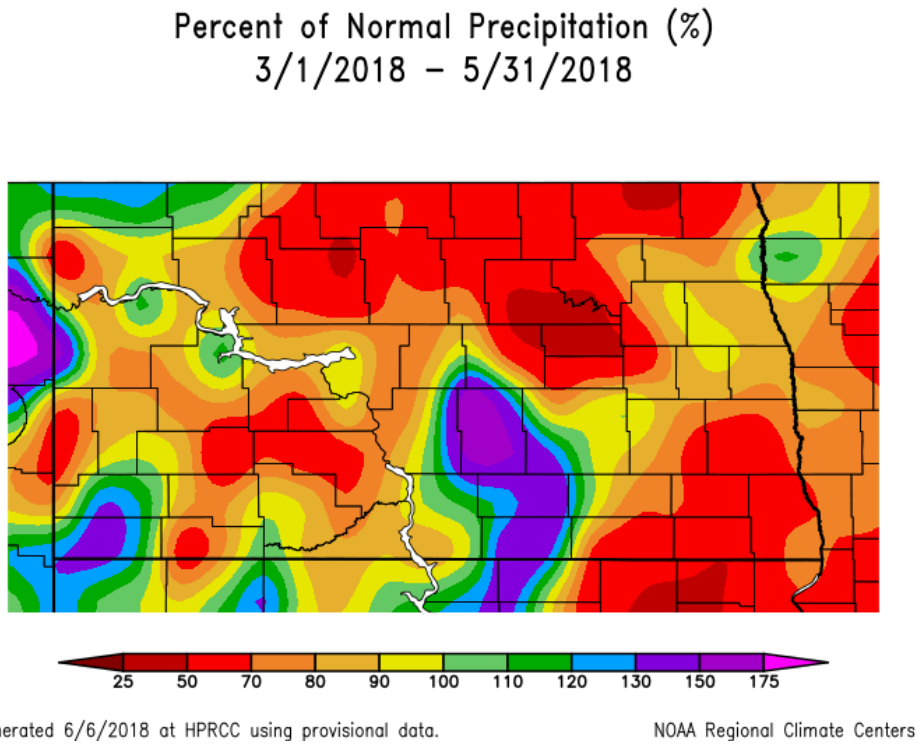


Figure 1. Precipitation percent of normal in spring 2018 for North Dakota. (HPRCC)

Temperature

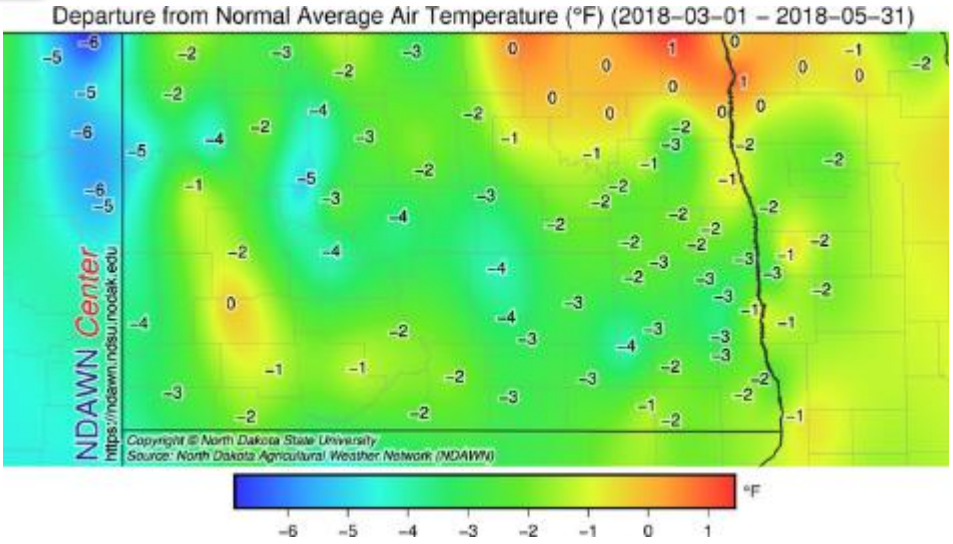


Figure 2. Temperature departure from normal in spring 2018 for North Dakota. (North Dakota Agricultural Weather Network, NDSU)

The average North Dakota temperature for the season (March 1 through May 31, 2018) was 39.3 F, which was 28.4 F warmer than the last season (winter 2017-18), 2.3 F colder than last spring (2017) and 2 F colder than the 1981-2010 average spring temperature. It also was the coldest spring since 2014. This would rank spring 2018 as the 50th coolest spring since such records began in 1895. Figure 2 shows the departure from normal temperature distribution geographically. Based on historical records, the average spring temperature showed a positive trend of 0.21 F per decade since 1895. The highest and lowest seasonal spring average temperatures for North Dakota ranged from the highest of 48.1 F in 1977 to the lowest of 31.5 F in 1899. The "Historical Spring Temperature for North Dakota" time series on Page 6 shows a graphical depiction of these statistics.

Drought: Despite the 11th wettest March, the 14th driest April and 46th driest May made the spring the 37th driest on record since 1895. By the end of the season, 51 percent of the state was experiencing drought (a 13 percent reduction in coverage, compared with the beginning of the season), 14 percent of which was in the severe category. Figure 3 below shows the drought conditions in the beginning and the end of the spring (Figure 3).

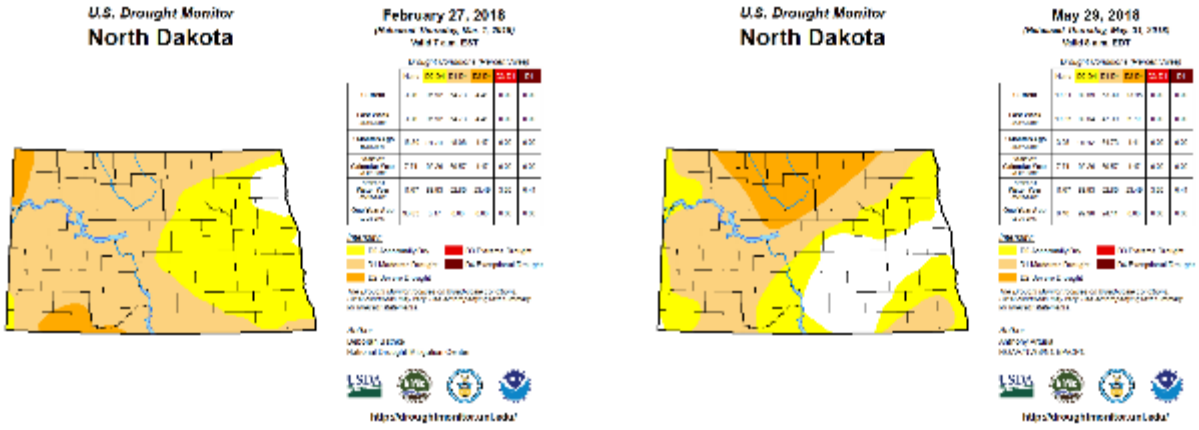


Figure 3. Drought Monitor map comparison for North Dakota in the beginning (on the left) and at the end (on the right) of spring 2018 (USDM).

Figure 4 below shows the statewide drought coverage in percentage and intensity (DO, D1, etc.) in time scale representing the state from the beginning to the end of the month, with a one-week resolution.

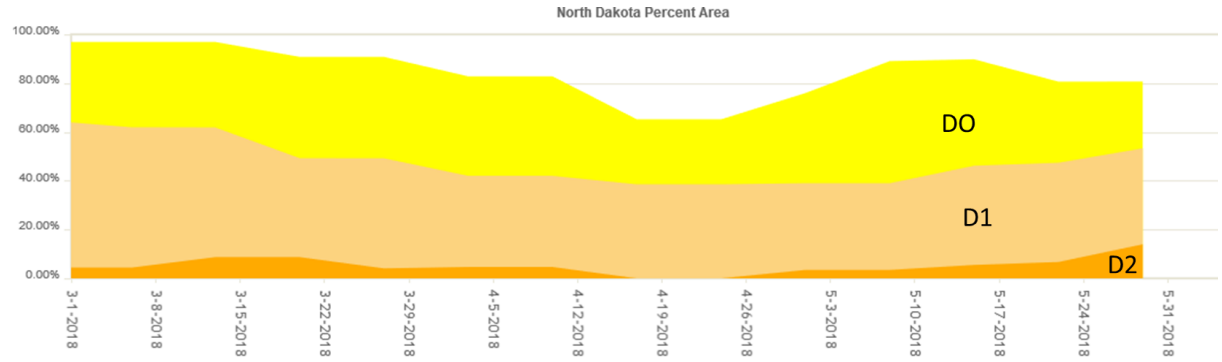


Figure 4. Statewide drought coverage (%) and intensity (Dx) in spring 2018 (USDM).

The index that takes into account intensity (D-level) and coverage (%), called the Drought Intensity and Coverage Index (DSCI), was 148 by the end of the season. That is an 18-point decrease, compared with the beginning of the season (Figure 5). The index reached its maximum value of 295 in the first week of August 2017 during the current drought; that was the second highest value on record since 2000.

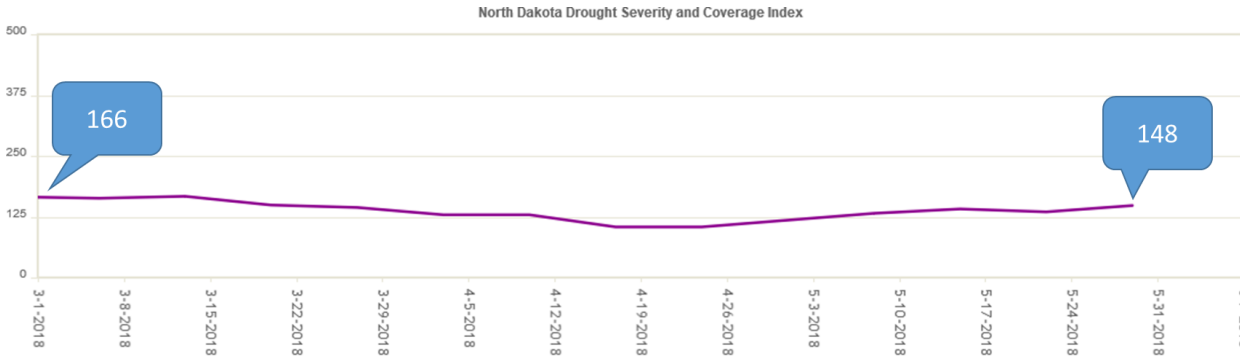
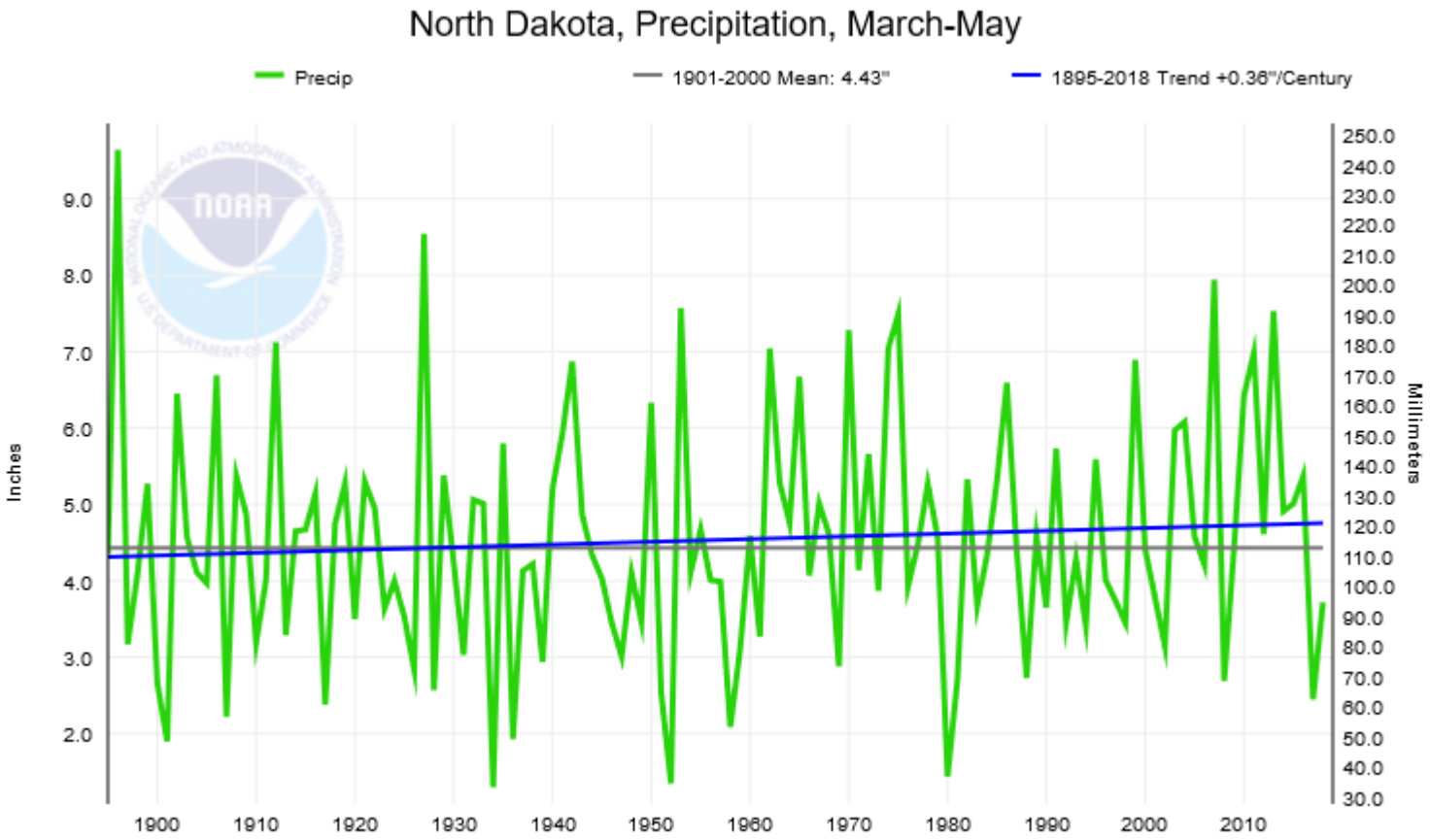


Figure 5. Statewide Drought Coverage and Intensity Index (DSCI) in spring 2018 (USDM).

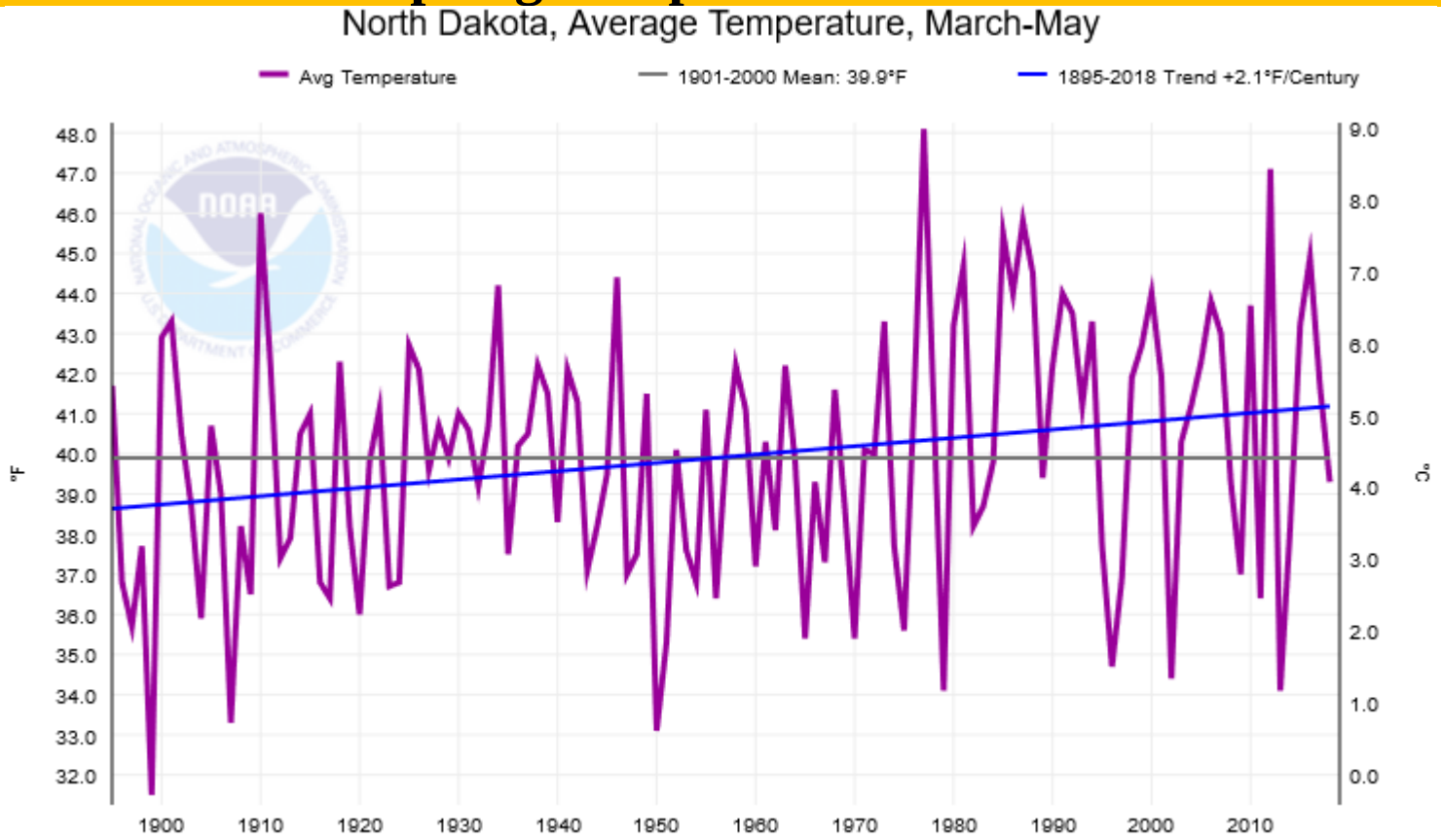
Historical Spring Precipitation for North Dakota



Record High Value: 6.64 inches in 1896
Record Low Value: 1.3 inches in 1934
Seasonal Trend: 0.36 inch per century

Spring 2018 Value: 3.72 inches
1981-2010 Average: 4.58 inches
Seasonal Ranking: 37th driest spring
Record Length: 124 years

Historical Spring Temperature for North Dakota



Record High Value: 48.1 F in 1977
Record Low Value: 31.5 F in 1899
Seasonal Trend: 0.21 F per decade

Spring 2018 Value: 40 F
1981-2010 Average: 41.3 F
Seasonal Ranking: 50th coolest spring
Record Length: 124 years

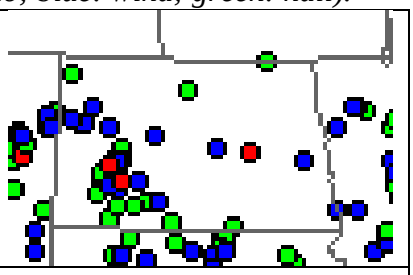
Storms and Record Events

State Tornado, Hail and Wind Events for spring 2018

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
March Total	0	0	0	**0**
April Total	0	0	0	**0**
May Total	3	18	14	**35**
Seasonal Total	**3**	**18**	**14**	**35**

The graphics below show 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).

None Reported	None Reported	
March 2018 North Dakota Storm Events	April 2018 North Dakota Storm Events	May 2018 North Dakota Storm Events

State Record Events for Spring 2018

Table 2. 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	0	29	**29**
Highest Daily Min. Temp.	2	0	42	**44**
Lowest Daily Max. Temp.	10	61	2	**73**
Lowest Daily Min. Temp.	8	65	0	**73**
Highest Daily Precipitation	37	1	4	**42**
Highest Daily Snowfall	41	12	0	**53**
Total	**98**	**139**	**77**	**314**

Seasonal Outlook

Summer 2018 Outlook

By R. Kupec[1]

Spring 2018 was a fickle season across North Dakota, with some of the coldest April temperatures on record to some of the warmest in May. The one constant: Both months were drier than average. Overall, the season ended slightly cooler and drier. The forecast presented here was correct in regard to temperature, but precipitation was expected to run a little above average. Seeing such a large shift in temperature that is not accompanied by a shift in precipitation is somewhat anomalous.

The weak La Niña conditions in the southern Pacific Ocean have come to an end as expected. We are now in a neutral phase of the La Niña/El Niño sea surface temperature regime. Most computer models suggest that this will remain into the fall. These conditions signal toward average summer temperatures across the state. Precipitation is somewhat more varied, with western and southern North Dakota seeing slightly above-average precipitation and north-central and northeastern North Dakota seeing average to below-average precipitation.

Last summer saw drought to severe drought conditions across the state with a similar neutral phase of the La Niña/El Niño. However, given the weather patterns that are appearing at the beginning of summer, I do not expect a repeat of summer 2017. Instead, look for precipitation to be near normal, with slightly warmer than average temperatures.

The current Climate Prediction Center (CPC) Summer Outlook has a similar forecast, with an equal chance of above- or below-average temperatures for the season (Figure 6a). The CPC also has an equal chance of above- or below-average precipitation (Figure 6b).

The next 90-day outlook from the CPC should be available after June 21 at www.cpc.ncep.noaa.gov/products/predictions/90day.

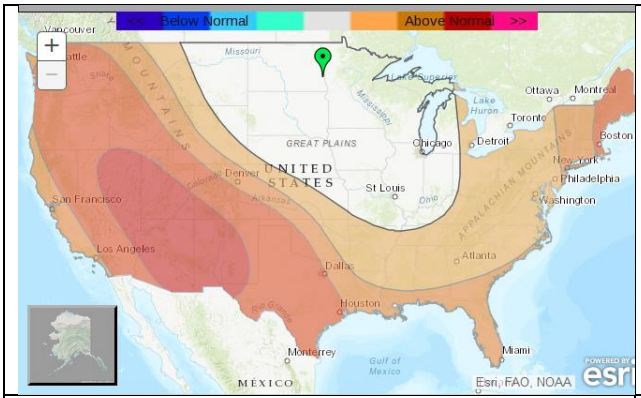


Figure 6a. June through August temperature outlook. (Climate Prediction Center, NOAA)

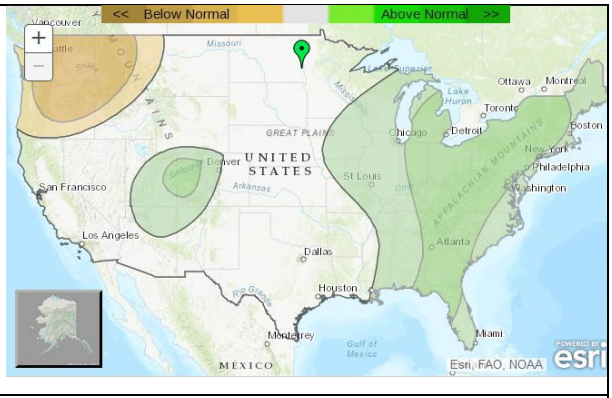


Figure 6b. June through August precipitation outlook. (Climate Prediction Center, NOAA)

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

Hydro-Talk

How Are We Farming in 2018?

By A. Schlag[2]

At the end of 2017 and thus far in 2018, we can safely say that we've been on something of a roller coaster when talking about hydrology. Highly variable and inconsistent snowpack, flooding, dry soils, hit-or-miss rainfall, the drought's hangover effect and guarded optimism are all terms we've used during the past several months to describe where North Dakota stands with regard to the conditions in the countryside.

Figure 1. U.S. Drought Monitor graphics showing the evolution of drought during the past 12 months.

The three U.S. Drought Monitor graphics in Figure 1, while different, are not necessarily the full picture of drought evolution from last June until now. In reality, we've experiences lot of ups and downs; we have had significant periods of time where precipitation has been well above normal, only to see the benefits not materialize, or be very short term in nature. Overall, though, only a small sliver of North Dakota has been above average for the full past 12 months, as shown in Figure 2 below.

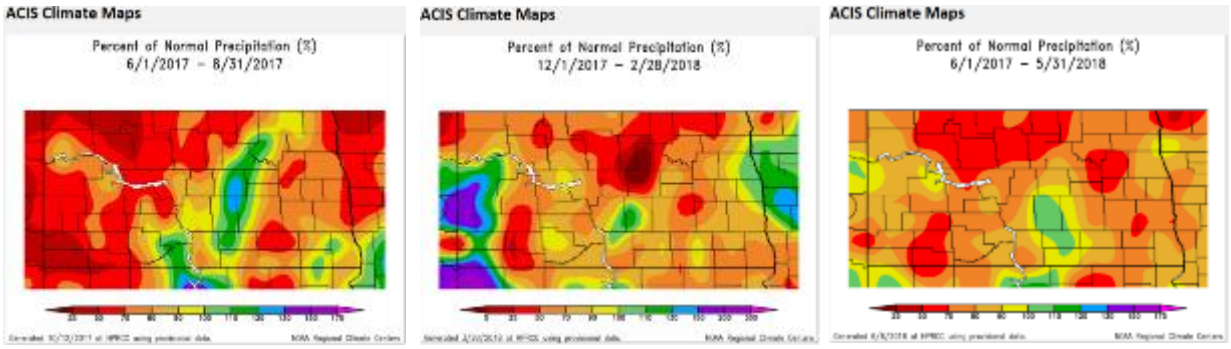


Figure 2. HPRCC depictions of percent of normal precipitation during the past 12 months.

[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

When looking at all of the above, and the countryside in general, at least a "drier than normal" designation for most of North Dakota is pretty easy to support. However, when the soil moisture models (shown in Figure 3) are taken into account, the picture can be even worse for the northern part of the state. Soil moisture deficits are greatest in the northern part of the state, and this is generally consistent with the precipitation maps.

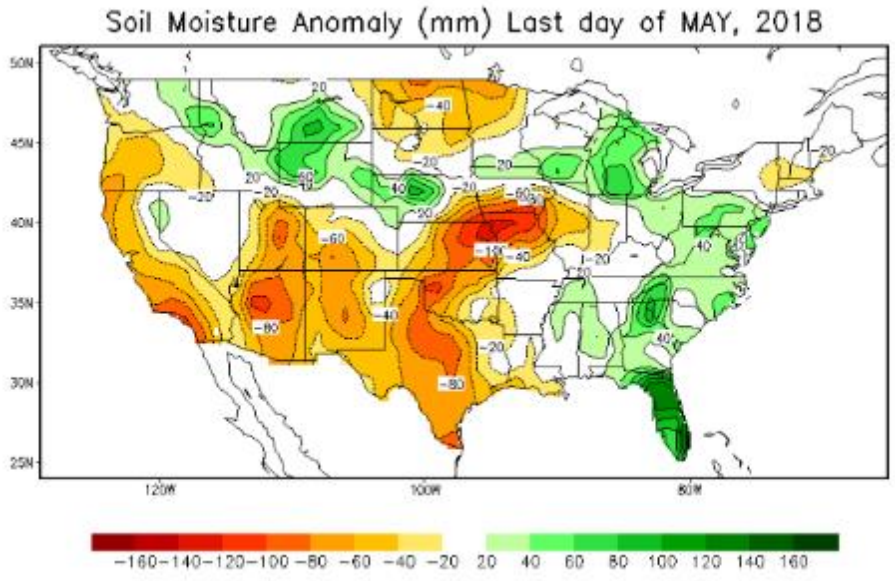


Figure 3. Climate Prediction Center soil moisture model depiction.

What is somewhat hidden in all of this is the timeliness of the rains. North Dakota has essentially two periods during the year in which moisture is allowed to reach the lower soil horizons necessary to support row crops, and even our native trees. Not surprisingly, these two times of the year are roughly late March through late April, before vegetation comes alive, and again in late September through November after vegetation has been exposed to a killing frost.

The reasons for this are quite simple. In the summer, grasses and most crops easily can consume an inch of water per week in support of their growth, and this is on top of evaporative demand. In reality, North Dakota has no extended period of the year where itis expected to receive an inch of rain per week. Our vegetation is quite dependent on moisture stored in the soil from late fall and early spring, when evaporative demand is taken into account. And, of course, soils in North Dakota receive very little infiltration during the late November to mid-March time frame because soils tend to be frozen and relatively impermeable.

This summer, we find ourselves again teetering on the brink of widespread crop and pasture stress, even with the recent widespread rains, while the fortunate received timely rains last year to help support their small grains and row crops. We have largely gone 0 for 2 in our most recent seasons of the year for adding moisture to the lower root zones. The fortunate who receive enough timely rainfall this summer to support their crops may not notice the difference, but overall, this year's crops most likely will be spotty in nature because agriculture will have to survive off of our hit-or-miss thunderstorms.

Science Bits

Climate Prediction Applications Science Workshop 2018

M.T, F.H., J.M.[3]

Figure 4. Participants of 2018 CPASW

The North Dakota State Climate Office, housed within North Dakota State University, and the National Oceanic and Atmospheric Administration's National Weather Service (NWS) co-hosted the 16th Climate Prediction Applications Science Workshop (CPASW) May 22-24, 2018. The workshop brought together a diverse group of climate researchers, information producers and users to share developments in the research and applications of climate predictions for societal decision making. The theme of the 2018 CPASW focused on impact-based decision support tools and applications for climate services.

The workshop addressed the following focus areas:

- Climate predictions and applications at local, regional and global scales relevant for agriculture, energy, public health, water supply and resources, and business solutions
- Emergency management and preparedness for weather and climate extremes, including drought, flooding, blizzards and wildfires
- Service delivery coordination and decision support for planning, resource allocation, sustainable development and environmental management needed for building resilient communities
- Best practices of observing, documenting and communicating climate information relevant for national, tribal and international collaborations

The workshop brought together 65 experts from the region, nation and world to discuss the focus areas. It provided an opportunity for sharing effective strategies for understanding decision-maker requirements, communicating risks and threats of extreme events, and the heightened

[3] Marina Timofeyeva (Marina.Timofeyeva@noaa.gov), Fiona Horsfall (fiona.horsfall@noaa.gov) and Jenna Meyers (jenna.meyers@noaa.gov): National Weather Services, National Oceanic and Atmospheric Administration

uncertainty and attribution of high impact weather. The workshop participants also discussed challenges and opportunities for climate services for North Dakota, northern Plains agriculture, energy, emergency management and extreme events.

The workshop participants discussed best practices, opportunities, tools, applications and new research in climate- and drought-based decision support services, and user and stakeholder engagement. The climate-based decision support services included examples from sectors such as agriculture, water resources and health. A special session was dedicated to research and operational capabilities of services at subseasonal to seasonal (S2S) timescales, which covers climate services from two weeks to months to seasons out to two years into the future. The 2018 CPASW provided rich discussions on developing or enhancing decision support services with examples from the U.S. and other countries, including Canada, Pacific Rim islands, Japan and Bangladesh. The workshop participants had a unique opportunity to meet with local farmers to discuss their applications of climate information in their operations in producing crops and raising livestock.

Figure 5. Participants discuss practices used by local farmers for applying climate information to their operations.

The major recommendations from all participants were:

- Co-develop climate information in collaboration with users and other producers to ensure the best response to the information needs with minimal redundancy in services
- Include interpretive services to ensure climate information and products are well-understood
- Establish and maintain partnerships with communities (for example, tribes, nongovernmental organizations)
- Provide risk management solutions for potential losses caused by weather and climate events
- Tailor climate services tools to support specific user groups
- Improve and sustain climate data quality control
- Enhance S2S climate information, including monitoring, analysis, predictions and services to end users
- Improve operational services of water and climate forecasts in real time
- Include ecological and social vulnerabilities in climate studies on adaptive management of drought

- Provide climate change guidance for longer-term drought management specifically related to trends in evaporation, evapotranspiration and soil moisture
- Improve services of climate information on longer-term time scales to support decision making; for example, orchards plan tree plantings for 25 to 30 years into the future

The workshop this year showcased more than a dozen examples of NWS operational impact-based decision support services (IDSS) provided for disruptive weather, water and climate events such as tornadoes, floods, droughts, extreme heat, coastal floods and coastal erosion. The NWS is investigating new ways of providing IDSS to include climate information. Some examples are:

- Providing climate risk information to customers using better communication methods, such as social media, targeted user engagement and online interactive tools
- Including impact information supported by science
- Working with partners to explain the NWS suite of operational climate forecasts
- Making sure partners have the most important information needed for their specific climate-informed decisions

CPASW is an annual event, and this year it celebrated its 16th year. The 2018 CPASW organizing committee expresses the most profound appreciation to Adnan Akyüz for his leadership and commitment to make this year even the most productive and beneficial for all participants.

In 2019, the workshop will be held in Charleston, S.C. For more information on past and future CPASW events, please see: www.nws.noaa.gov/om/csd/index.php?section=meetings.

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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