North Dakota Climate Bulletin

Autumn 2014

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In This Issue

NDSCO

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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 autumn was the 43rd coldest on record in ND and it was the 29th driest statewide since 1895. An early frost on September 12 in western ND ended the growing season in many areas. However, an unusually warm and dry October allowed for excellent field work and a productive harvest. Ninety-nine percent of winter wheat emerged by mid-November. However, lack of snow cover generates conditions for freeze damage and even crop loss. The most notable event was the peak gust of 93.1 mph recorded with the NDAWN station in Greenbush, MN on September 19. It was the record high velocity recorded with an NDAWN station. While ENSO neutral conditions and only an El Niño watch conditions impede our climate outlook skills, will local composites give us enough tools to talk about hydrologic and climate outlook? More on the seasonal outlooks and tools we use can be found later in this issue. It will also contain graphical displays of statewide temperature, precipitation and the other weather highlights

This bulletin can be accessed at http://www.ndsu.edu/ndsco/. This website hosts other great resources for climate and weather information.

Adnan Akyüz, Ph.D.
North Dakota State Climatologist

Enchanted Highway, ND. By Akyüz

Weather Highlights

Seasonal Summary:

by Daryl Ritchison

September 2014

The state average precipitation was 1.20 inches which is below the 1981-2010 normal of 1.71 inches. September 2014 state average precipitation ranked as the 50th driest in the last 120 years with a maximum of 4.68 inches in 1941 and a minimum of 0.20 inches in 2012.

The National Weather Service (NWS) reported record rainfall of 1.13 inches in Jamestown on the 4th, and a record rainfall of 0.89 inches in Williston on the 30th. A complete list of record events can be found in the "Storms and Record Events" section later in this bulletin.

The US Drought Monitor September 30, 2014 report had no drought conditions reported for North Dakota. (http://droughtmonitor.unl.edu/)

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 0% very short, 5% short, 84% adequate, and 10% surplus with a subsoil moisture reported as 0% very short, 5% short, 85% adequate, and 10% surplus. (Weekly Weather and Crop Bulletin Vol. 101, No. 39).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for September had 18 reports of high wind, 35 hail reports, and 2 reported tornadoes. The first tornado tracked for a mile in NW Skandia Township in Barnes County on September 3. The second one tracked intermittently arounf SW of Kindred, in Cass County on the same day approximately 30 minutes after the first tornado.

The top five September daily maximum wind speeds recorded from NDAWN were Greenbush, MN with 93.1 mph (side swiped by a tornado), Hofflund with 56.9 mph, Perley, MN with 54.0 mph, Humboldt, MN with 52.6 mph and Turtle Lake with 49.4 mph. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The state average air temperature was 57.7 °F which is above the 1981-2010 normal of 56.9 °F. September 2014 state average air temperature was the 43rd warmest in the past 120 years with a maximum of 63.5 °F in 1897 and a minimum of 45.5 °F in 1965.

NDAWN's highest recorded daily air temperature for September was 97.6 °F at Williston on the 25th. The lowest recorded daily air temperature was 25.5 °F at Bowman, on the 12th. An early hard freeze on September 12 brought the growing season to an end in many locations in the western parts of the state.

The National Weather Service (NWS) reported numerous record high temperatures with the very warm temperatures across North Dakota in late September. A complete list of record events can be found in the "Storms and Record Events" section later in this bulletin.

October 2014

The state average precipitation was 0.53 inches which is below the 1981-2010 normal state average of 1.46 inches. October 2014 state average precipitation ranked the 25th driest in the past 120 years with a maximum of 4.61 inches in 1982 and a minimum of 0.09 inches in 1952.

The US Drought Monitor October 28, 2014 reported 6% of North Dakota in Abnormally Dry Conditions (D0) with no areas in Moderate or above drought conditions. (http://droughtmonitor.unl.edu/).

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 1% very short, 12% short, 81% adequate, and 6% surplus with a subsoil moisture reported as 1% very short, 8% short, 83% adequate, and 8% surplus. (Weekly Weather and Crop Bulletin Vol. 101, No. 43).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for October had 0 reports of high wind, 0 hail reports, and 0 reported tornadoes.

The top five October daily maximum wind speeds recorded from NDAWN were 48.7 mph on the 16th at Linton, 44.7 mph on the 3rd at Crary, 44.7 mph on the 2nd at Turtle Lake, 44.4 mph on the 16th at Mott and 44.4 mph on the 16th at Wishek. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The state average air temperature was 46.4 °F which is above the 1981-2010 normal of 43.4 °F. October 2014 state average air temperature ranked the 27th warmest in the past 120 years with a maximum of 54.8 °F in 1963 and a minimum of 32.6 °F in 1925.

The National Weather Service (NWS) reported that Williston, Bismarck and Fargo all broke or tied one record high during the month. A complete list of record events can be found in the "Storms and Record Events" section later in this bulletin.

NDAWN's highest recorded daily air temperature for April was 82.7 °F at Linton on the 21st. The lowest recorded daily air temperature was 5.8 °F at Langdon on the 31st.

November 2014

The state average precipitation was 0.49 inches which is below the 1981-2010 normal of 0.68 inches. November 2014 state average precipitation ranked as the 64th driest with 120 years of records with a maximum of 2.33 inches in 2000 and a minimum of 0.03 inches in 1939.

The US Drought Monitor December 2, 2014 report had 55% of North Dakota in Abnormally Dry conditions (D0) and 1.5% of the state (a part of Richland County) in Moderate Drought (D1) conditions (http://droughtmonitor.unl.edu/).

The USDA, National Agricultural Statistics Service, North Dakota Field Office reported a topsoil moisture of 1% very short, 17% short, 76% adequate, and 6% surplus with a subsoil moisture reported as 1% very short, 9% short, 83% adequate, and 7% surplus. (Weekly Weather and Crop Bulletin Vol. 101, No. 35).

According to the preliminary reports of the National Weather Service's Storm Prediction Center (SPC), severe weather reports for November had 0 reports of high wind, 0 hail reports, and 0 reported tornadoes.

The top five November daily maximum wind speeds recorded from NDAWN were from Oakes on the 7th with 48.0 mph, Crary on the 7th with 47.6 mph, McHenry on the 7th with 47.6 mph, Linton on the 23rd with 47.2 mph and Baker on the 7th with 46.8 mph. NDAWN wind speeds are measured at a height of 10 feet (3 m).

The state average air temperature was 20.7 °F which is below the 1981-2010 average of 27.3 °F. That would place November 2014 state average as the 18th coldest in the past 120 years with a maximum of 37.3 °F in 1999 and a minimum of 6.1 °F in 1896.

NDAWN's highest recorded daily air temperature for November was 65.0 °F at Linton on the 2th. The lowest recorded daily air temperature was -26.2 °F at Mohall, on the 26th.

Autumn 2014

Using analysis from the National Climatic Data Center (NCDC), the average North Dakota precipitation for the autumn season (September 1 through November 30) was 2.22 inches which is 1.63 inches below average. That would rank the autumn of 2014 as the 29th driest autumn since such records began in 1895. The autumn was dry statewide with the exception of the extreme northwestern portion of North Dakota.

The dry conditions came at an opportune time, during the fall harvest, which allowed for a nearly perfect harvest season which benefited farmers greatly after a less than perfect growing season. Although the eastern one-half of North Dakota finished November with Abnormally Dry conditions according to the Drought Monitor, the Palmer Drought Severity Index still lists all of western North Dakota in Extremely Moist conditions and the southeastern part of the state in an Unusual Moist Spell. The lack of top soil moisture will likely lessen the threat of major flooding in the spring of 2015 unless extremely wet conditions prevail over the next few months.

The North Dakota autumn 2014 average temperature was 41.6 degrees, which is 1.0 degrees below average. That would rank as the 43th coldest autumn of record and the coldest September through November period since 2006.

Season in Graphics

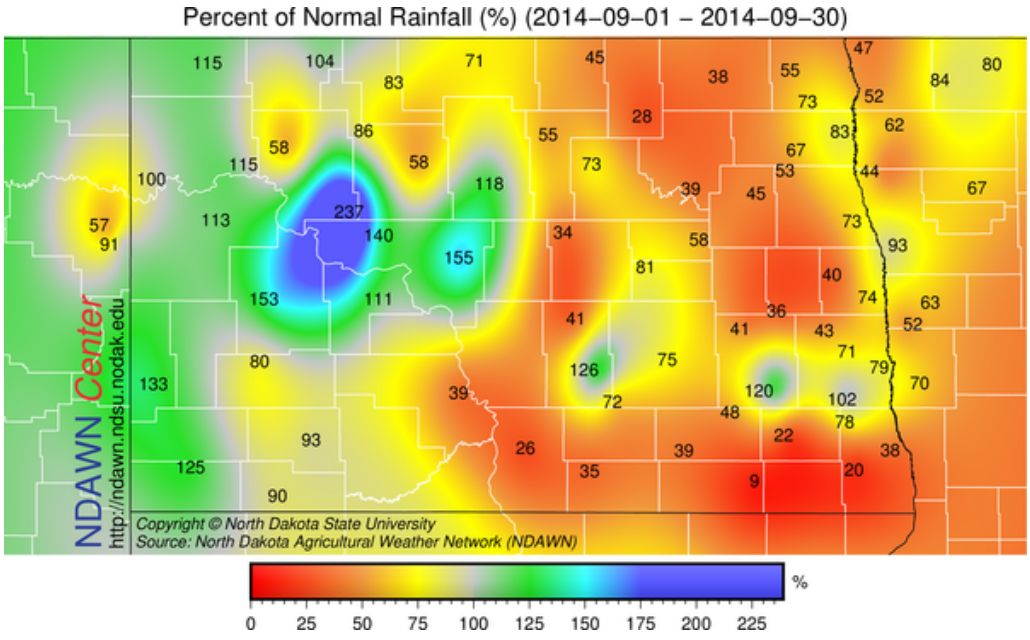
Autumn 2014 Weather in North Dakota:

September 2014

Total Precipitation percent of mean (1981-2010)

Precipitation Percent of Normal

(Data from North Dakota Agricultural Weather Network (NDAWN))

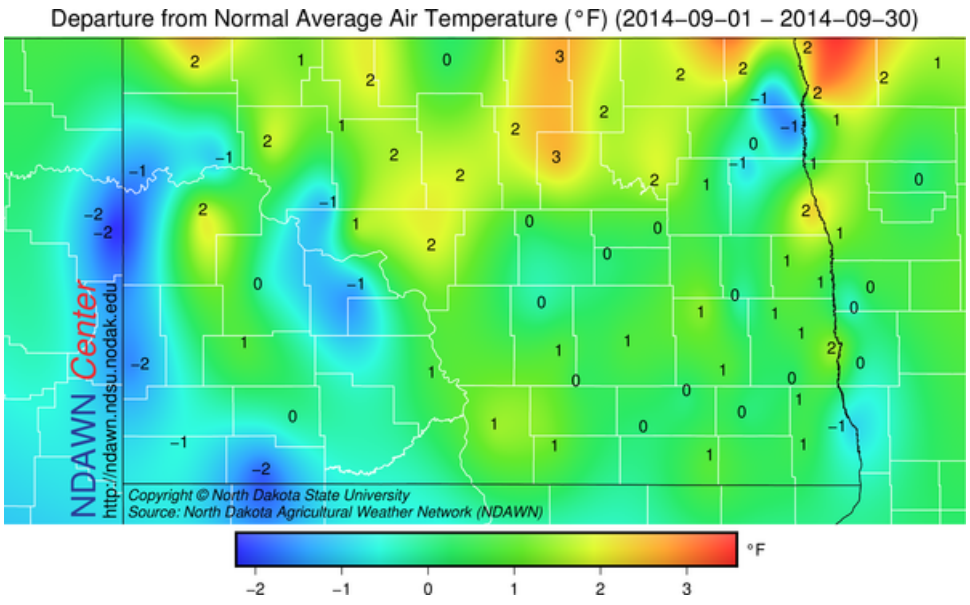


North Dakota State Climate Office

Average Temperature (°F) Deviation from Mean (1981-2010)

Departure From Normal Monthly
Average Air Temperature in degrees F

(Data from North Dakota Agricultural Weather Network (NDAWN))



North Dakota State Climate Office

Season in Graphics

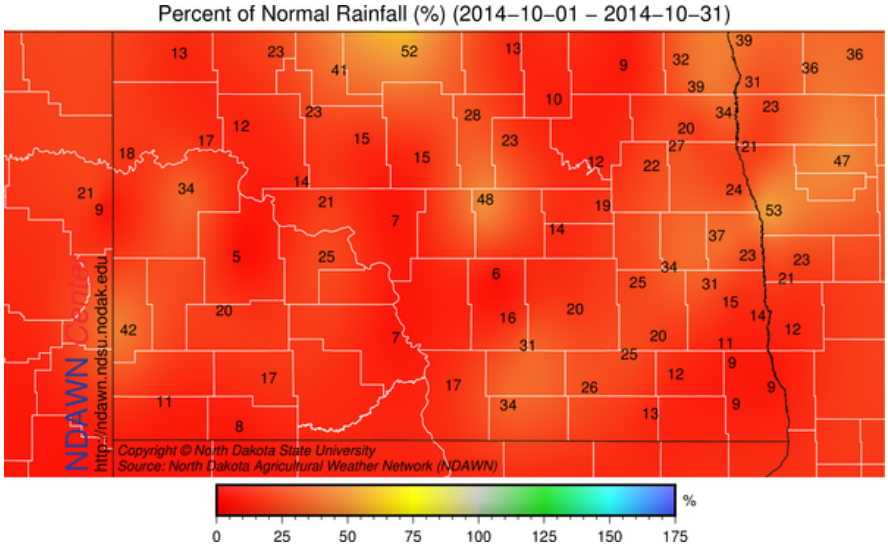
October 2014

Autumn 2014 Weather in North Dakota:

Total Precipitation percent of mean (1981-2010)

Precipitation Percent of Normal

(Data from North Dakota Agricultural Weather Network (NDAWN))

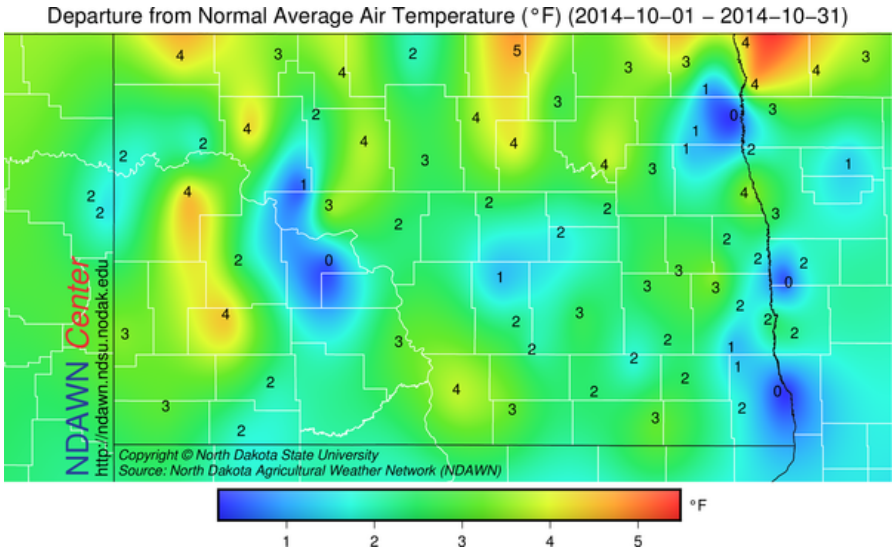


North Dakota State Climate Office

Average Temperature (°F) Deviation from Mean (1981-2010)

Departure From Normal Monthly
Average Air Temperature in degrees F

(Data from North Dakota Agricultural Weather Network (NDAWN))



North Dakota State Climate Office

Season in Graphics

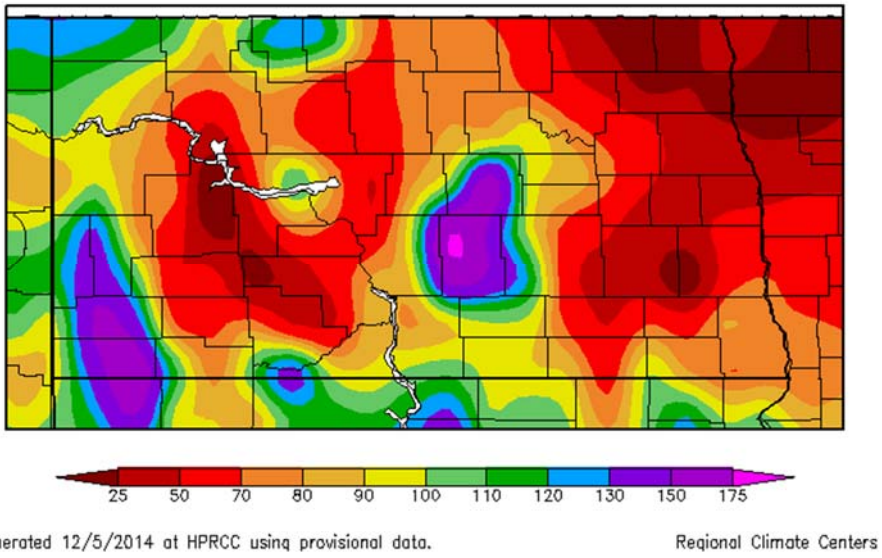
Autumn 2014 Weather in North Dakota:

November 2014

Total Precipitation percent of mean (1981-2010)

Precipitation Percent of Normal

(Data from High Plains Regional Climate Center (HPRCC))

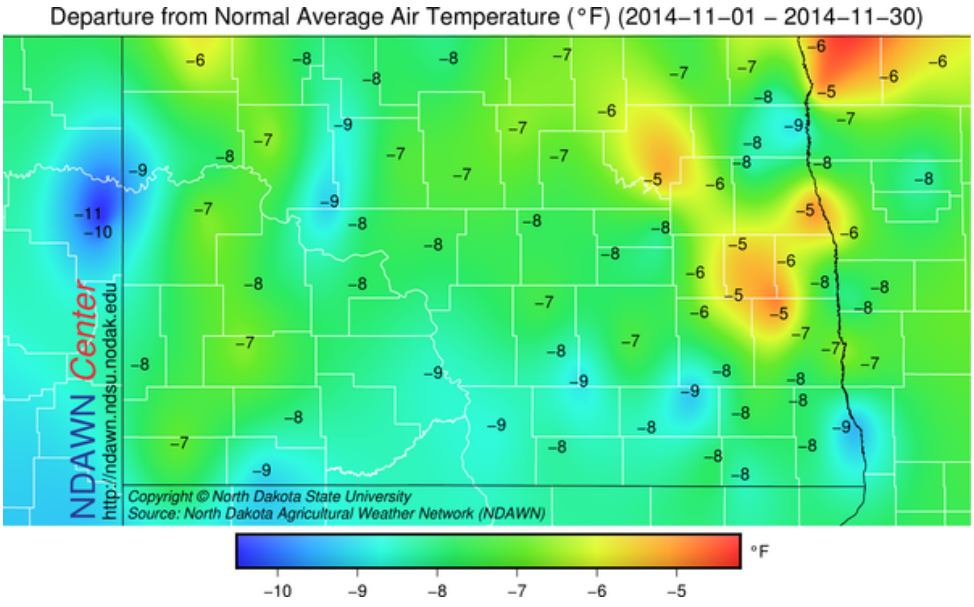


North Dakota State Climate Office

Average Temperature (°F) Deviation from Mean (1981-2010)

Departure From Normal Monthly
Average Air Temperature in degrees F

(Data from North Dakota Agricultural Weather Network (NDAWN))



North Dakota State Climate Office

Season in Graphics

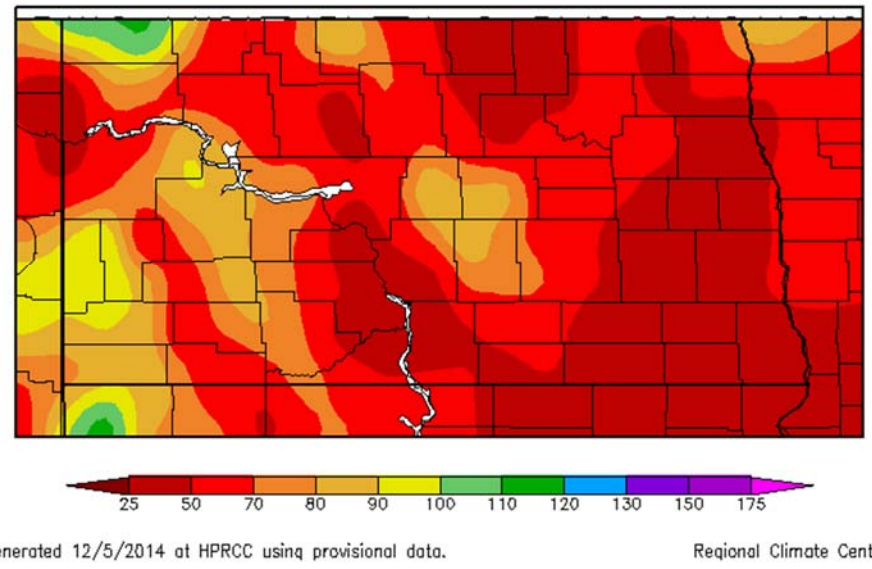
Autumn 2014 Weather in North Dakota:

Autumn 2014

Total Precipitation percent of mean (1981-2010)

Precipitation Percent of Normal

(Data from High Plains Regional Climate Center (HPRCC))

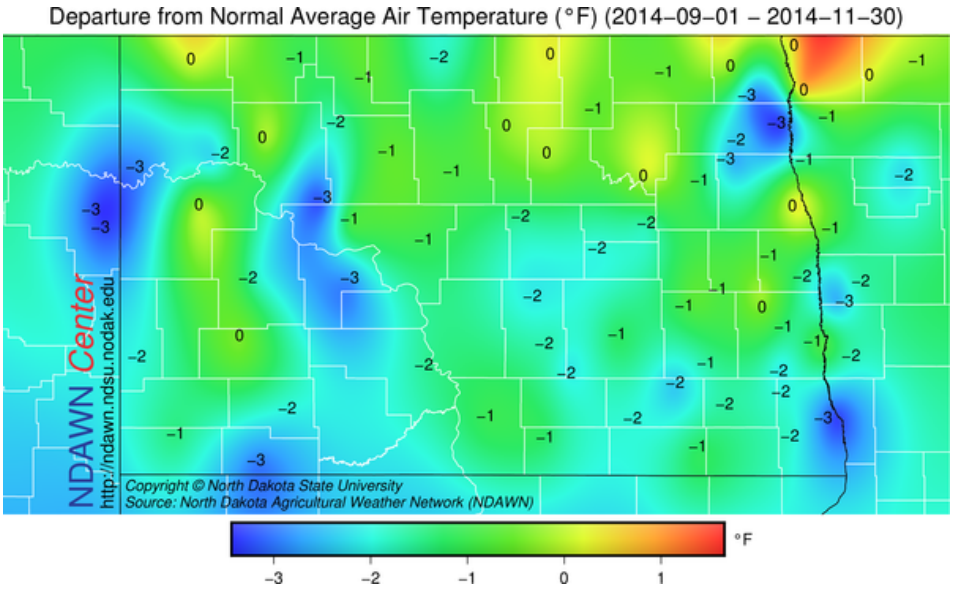


North Dakota State Climate Office

Average Temperature (°F) Deviation from Mean (1981-2010)

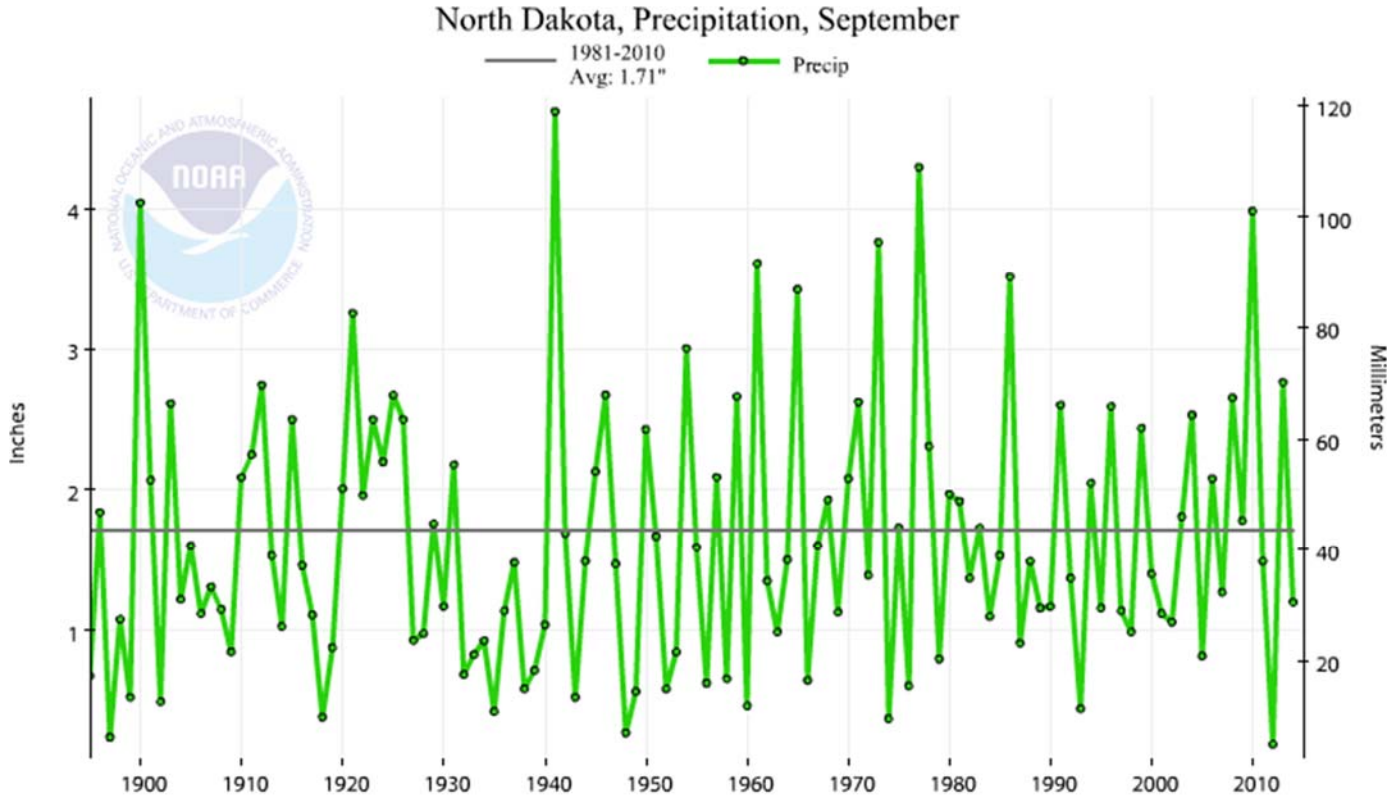
Departure From Normal Monthly
Average Air Temperature in degrees F

(Data from North Dakota Agricultural Weather Network (NDAWN))



North Dakota State Climate Office

Historical September Precipitation for North Dakota

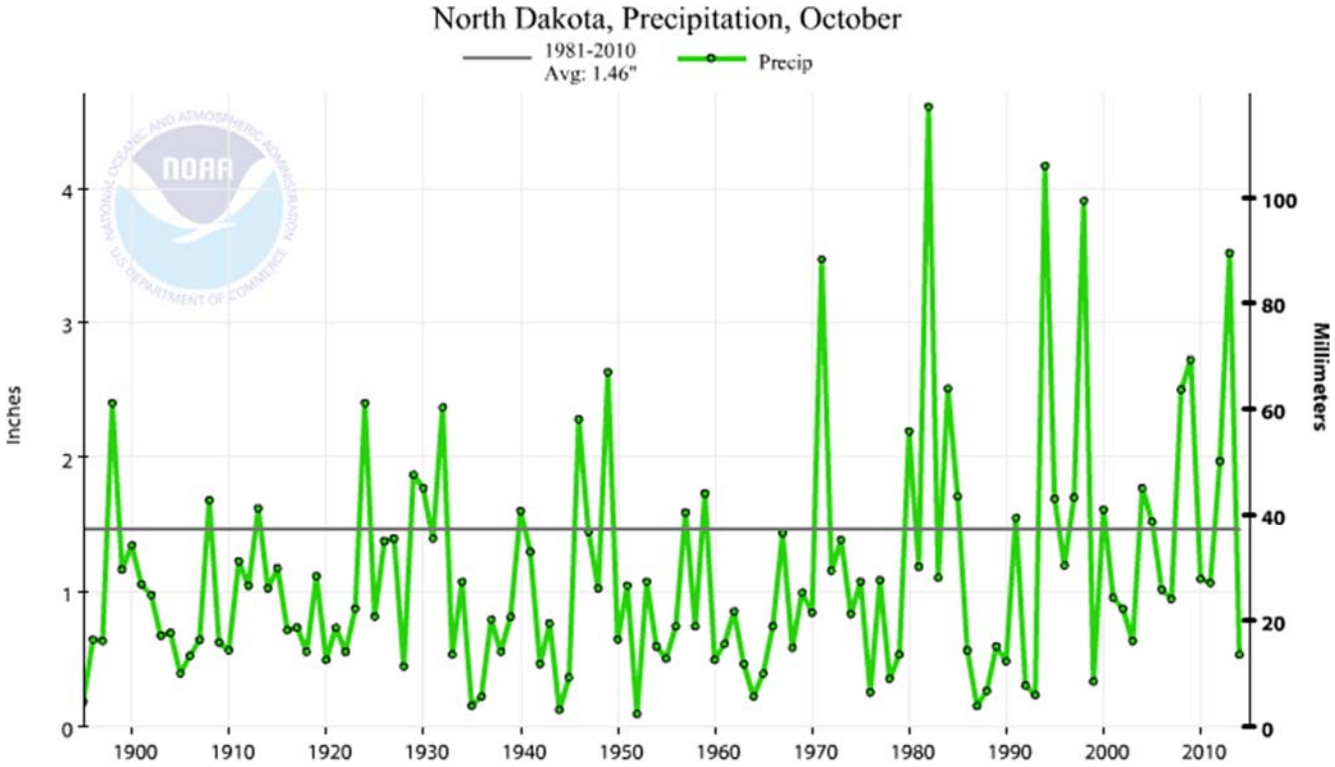


September Precipitation Statistics

2014 Amount: **1.20 inches**
Maximum: 4.68 inches in 1941
State Normal: 1.71" (1981-2010)

Monthly Ranking: 50th driest in 120 years
Minimum: 0.20 inches in 2012
Years in Record: 120

Historical October Precipitation for North Dakota

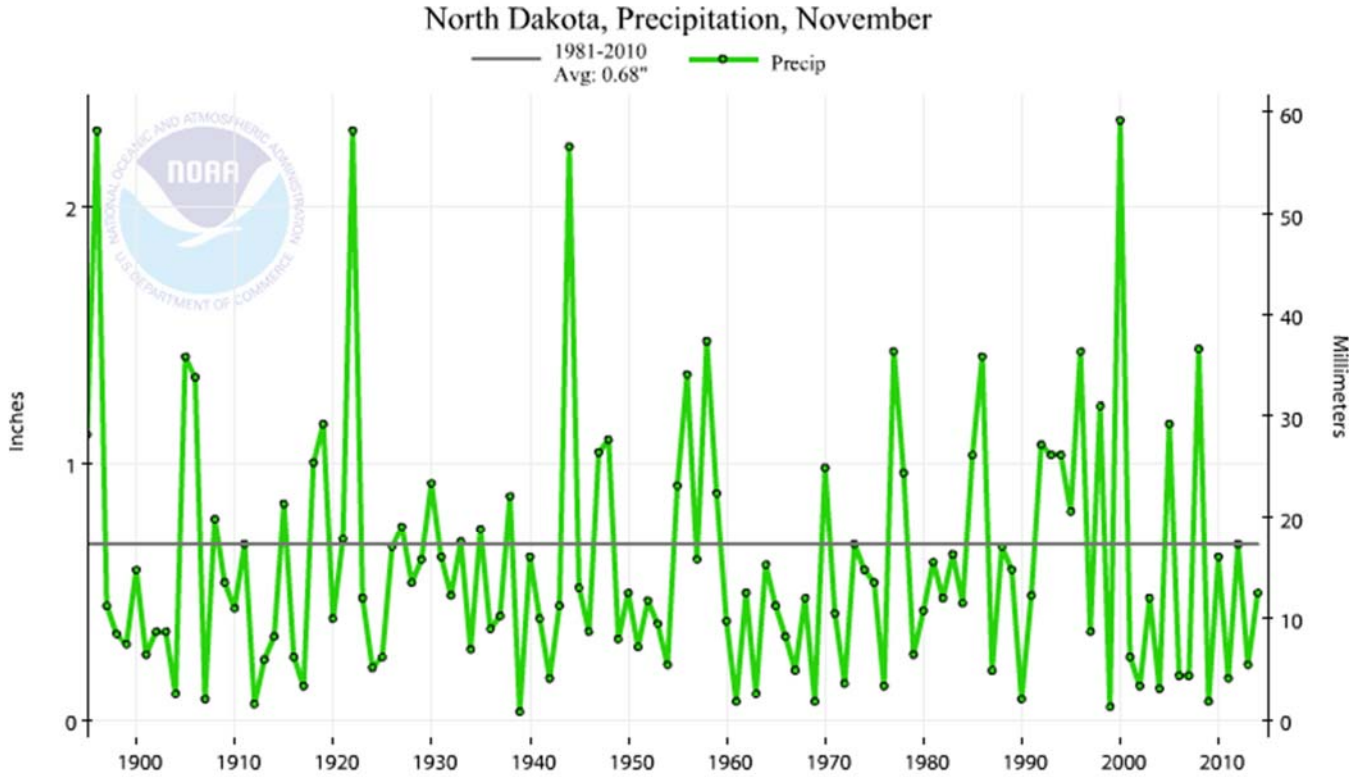


October Precipitation Statistics

2014 Amount: **0.53 inches**
Maximum: 4.61 inches in 1982
State Normal: 1.46” (1981-2010)

Monthly Ranking: 25th driest in 120 years
Minimum: 0.09 inches in 1952
Years in Record: 120

Historical November Precipitation for North Dakota

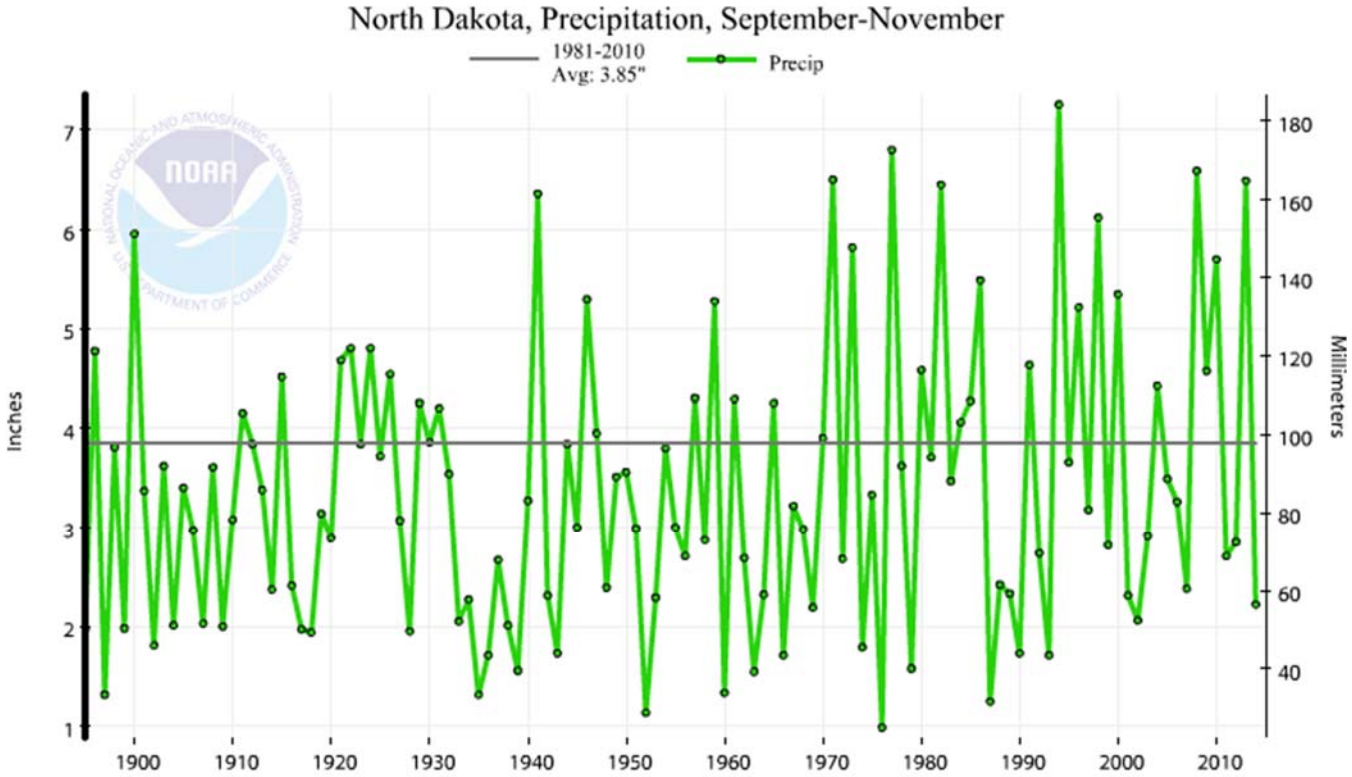


November Precipitation Statistics

2014 Amount: 0.49 inches
Maximum: 2.33 inches in 2000
State Normal: 0.68” (1981-2010)

Monthly Ranking: 64th driest in 120 years
Minimum: 0.03 inches in 1939
Years in Record: 120

Historical Autumn Precipitation for North Dakota

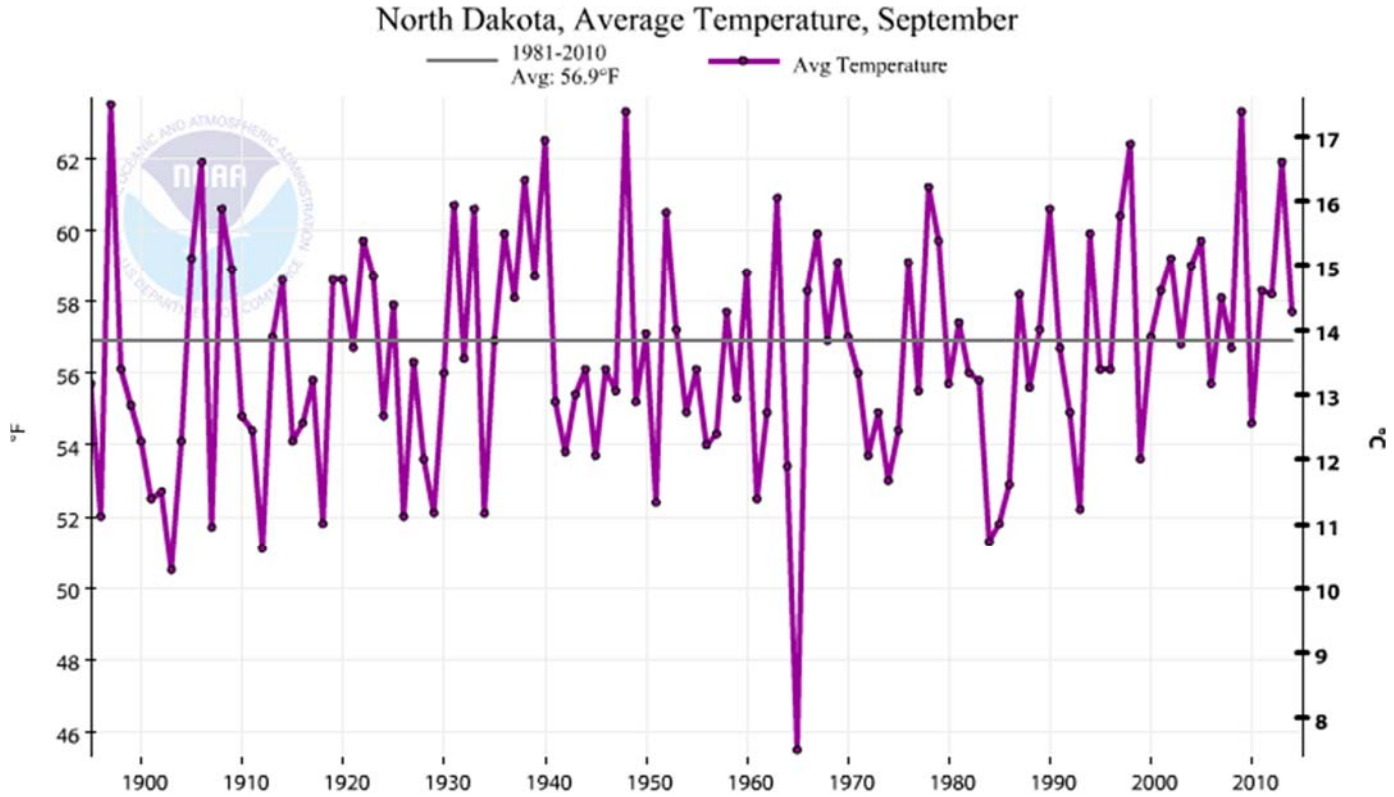


Autumn Precipitation Statistics

2014 Amount: 2.22 inches
Maximum: 7.25 inches in 1994
State Normal: 3.85” (1981-2010)

Monthly Ranking: 29th driest in 120 years
Minimum: 0.99 inches in 1976
Years in Record: 120

Historical September Temperature for North Dakota

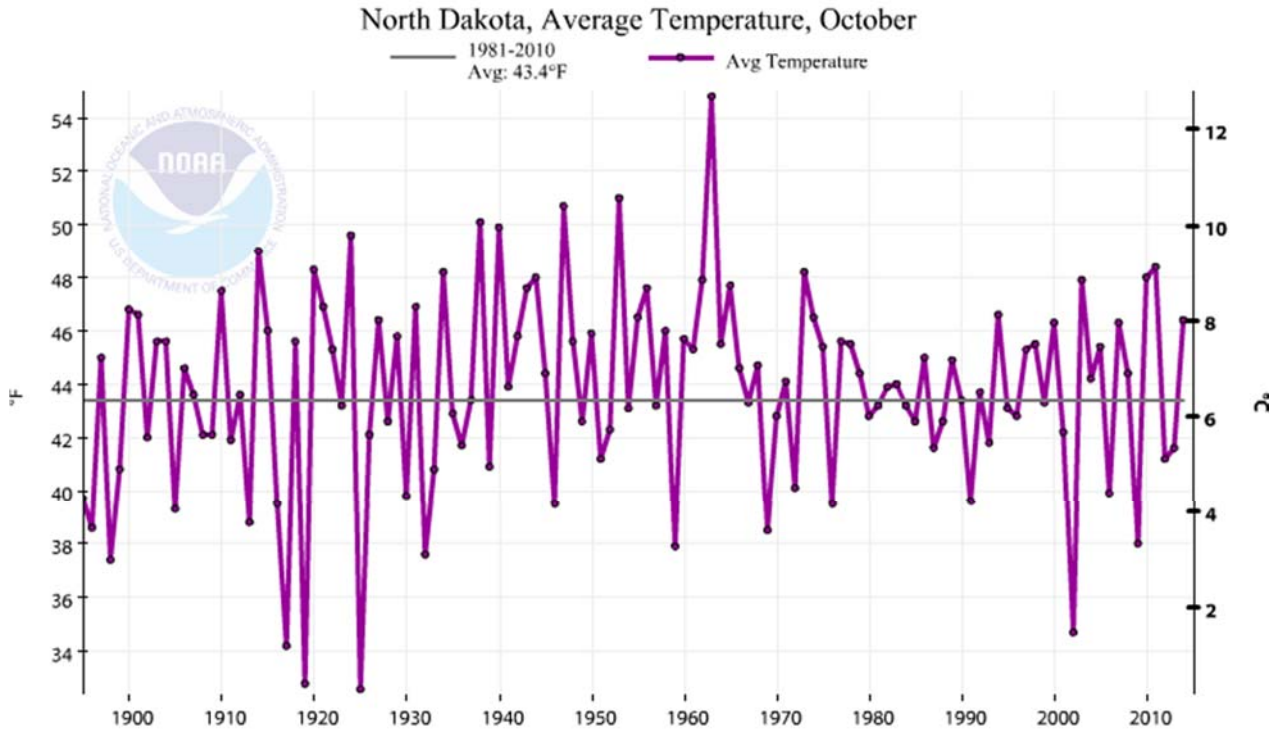


September Temperature Statistics

2014 Average: **57.7** °F
Maximum: 63.5 °F in 1897
State Normal: 56.9 °F (1981-2010)

Monthly Ranking: 43rd warmest in 120 years
Minimum: 45.5 °F in 1965
Years in Record: 120

Historical October Temperature for North Dakota

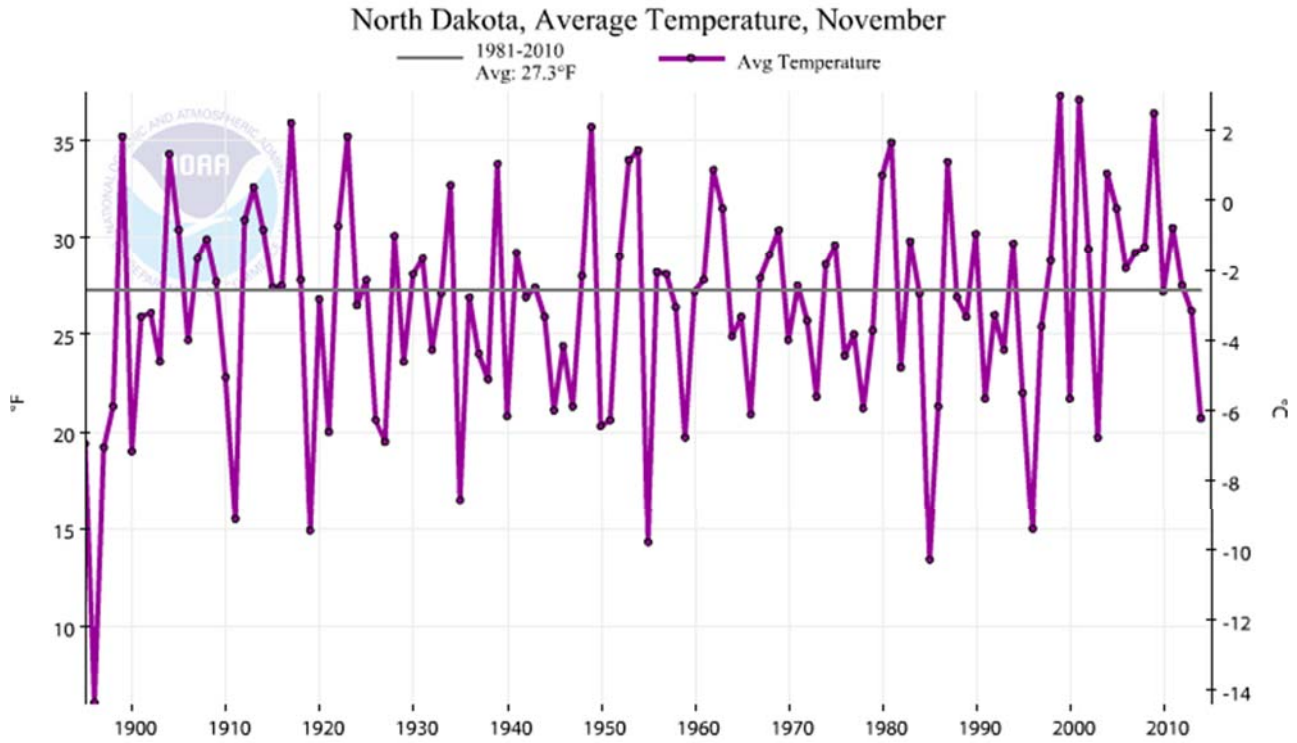


October Temperature Statistics

2014 Average: **46.4** °F
Maximum: 54.8 °F in 1963
State Normal: 43.4 °F (1981-2010)

Monthly Ranking: 27th warmest in 120 years
Minimum: 32.6 °F in 1925
Years in Record: 120

Historical November Temperature for North Dakota

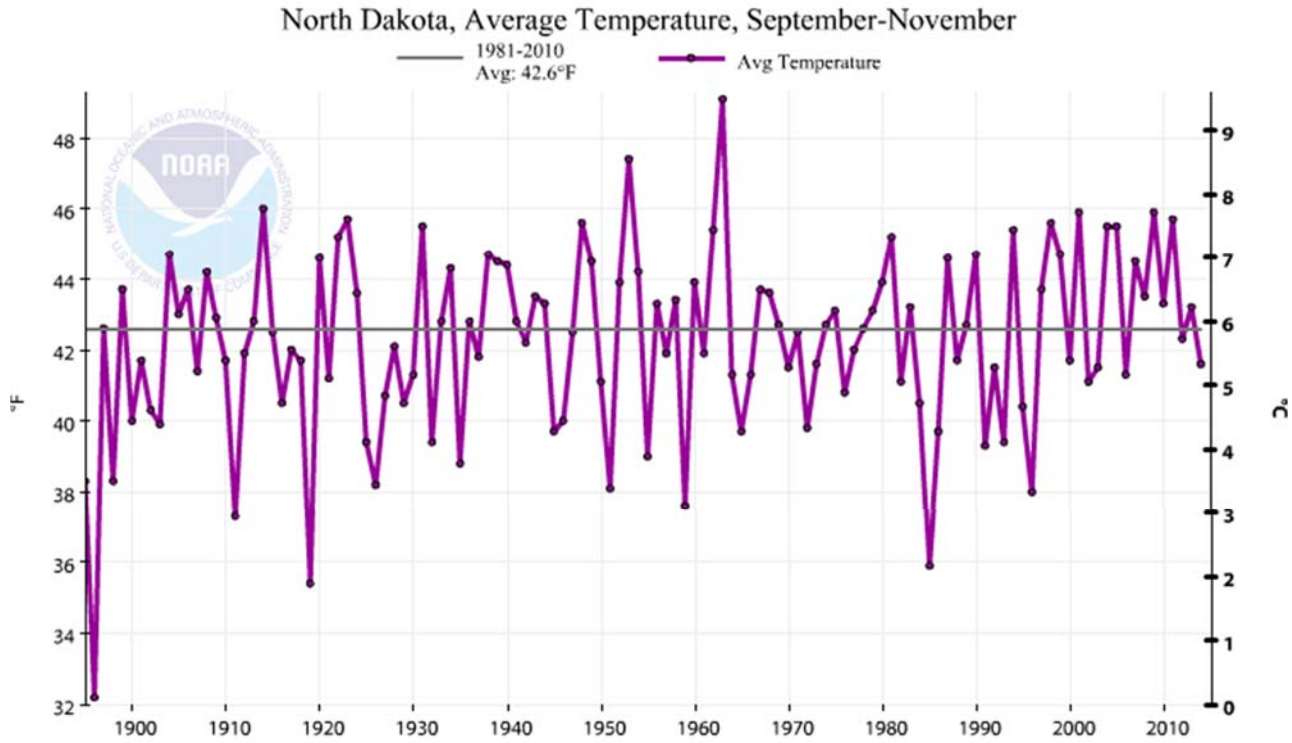


November Temperature Statistics

2014 Average: **20.7 °F**
Maximum: 37.3 °F in 1999
State Normal: 27.3 °F (1981-2010)

Monthly Ranking: 18th coolest in 120 years
Minimum: 6.1 °F in 1896
Years in Record: 120

Historical Autumn Temperature for North Dakota



Autumn Temperature Statistics

2014 Average: **41.6 °F**
Maximum: 49.1 °F in 1999
State Normal: 42.6 °F (1981-2010)

Monthly Ranking: 43th coolest in 120 years
Minimum: 32.2 °F in 1896
Years in Record: 120

Storms & Record Events

State Tornado, Hail, and Wind Reports for Autumn 2014

by D. Ritchison

North Dakota 3 Month Total	Wind	Hail	Tornado
	18	35	2

Reports by Month			
Month	**Wind**	**Hail**	**Tornado**
Total September	18	35	2
Total October	0	0	0
Total November	0	0	0

North Dakota Record Event Reports for Autumn 2014

Date	Location	Type of Record	Previous Record
September 4	Jamestown	Rainfall of 1.13 inches	0.67 inches set in 1926
September 25	Grand Forks	High Maximum 86 degrees	Tied with 86 degrees set in 1974
September 25	Williston	High Maximum 97 degrees	89 degrees set in 2011
September 25	Dickinson	High Maximum 91 degrees	89 degrees set in 1990
September 25	Bismarck	High Maximum 93 degrees	92 degrees set in 1902
September 25	Minot	High Maximum 93 degrees	Tied with 93 degrees 1938
September 26	Grand Forks (UND)	High Minimum 61 degrees	57 degrees set in 2013
September 26	Grand Forks	High Minimum 61 degrees	58 degrees set in 1950
September 26	Williston	High Maximum 94 degrees	92 degrees set in 1983
September 26	Minot	High Maximum 92 degrees	91 degrees set in 1963
September 27	Fargo	High Minimum 64 degrees	61 degrees set in 1987
September 27	Grand Forks (UND)	High Minimum 61 degrees	56 degrees set in 1914
September 27	Grand Forks	High Minimum 61 degrees	55 degrees set in 1997
September 30	Williston	Rainfall of 0.89 inches	0.41 inches in 1926
October 19	Williston	High Maximum78 degrees	Tied with 78 degrees in 1901
October 23	Bismarck	High Maximum 77 degrees	76 degrees set in 1998
October 24	Fargo	High Maximum 78 degrees	Tied with 78 degrees in 1989
November 14	Williston	Low Minimum -15 degrees	-13 degrees set in 1940
November 15	Grand Forks	Low Minimum -1 degrees	Tied with -1 degree set in 2002
November 15	Williston	Low Minimum -15 degrees	Tied with -15 degrees set in 1959
November 26	Jamestown	Low Minimum -25 degrees	-19 degrees set in 1996
November 27	Williston	Rainfall of 0.18 inches	Tied 0.18 inches from 1944
November 27	Minot	Low Minimum -18 degrees	-17 degrees set in 1985
November 27	Jamestown	Low Minimum -28 degrees	-13 degrees set in 1985

Seasonal Outlook

Winter 2014-15 Climate Outlooks

by . M. Ewens[1]

After several cold and snowy winter seasons in the Red River Valley, folks are seeing a change in the pattern. This change is due in large part to events in the Pacific Ocean, as well as changes in the Polar Regions. In the Pacific, a multi-year fluctuation known as the *Pacific Decadal Oscillation* has gone from its cold phase to its warm phase. Simultaneously the Equatorial Pacific has shown signs of the first El Niño since the 2009/2010 winter.

Several ocean & atmosphere indicators are currently close to or exceeding El Niño thresholds. Not only tropical Pacific Ocean temperatures, which have now exceeded El Niño levels for three months, but also the Southern Oscillation Index, which has remained at or near El Niño levels for three months. However, other indicators such as tropical cloud cover, trade winds and rainfall patterns, have remained near average or temporarily approached Niño thresholds. This suggests that typical El Niño ocean–atmosphere interaction may not be fully locked in. But what does that mean for the Red River Valley?

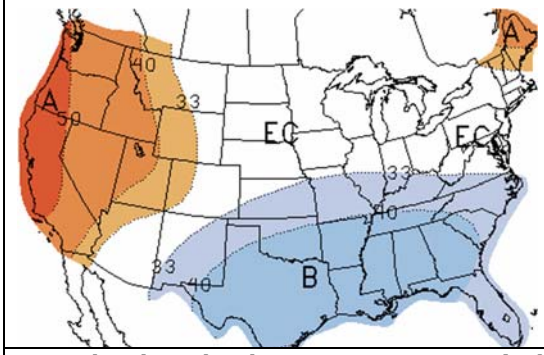
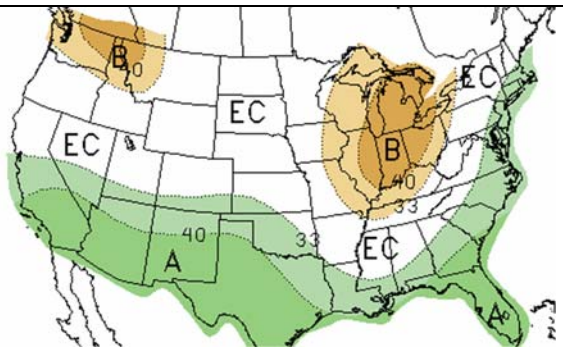
With some exceptions El Niño winters tend towards warmer temperatures, with fewer blizzards and infrequent cold snaps. Other atmospheric events, such as the Arctic Oscillation and North Atlantic Oscillation can enhance of weaken El Niño impacts. As this developing El Niño has not fully impacted the global atmosphere and is forecast to remain weak, the usual El Niño affects will either be subdued, or there could be more variability in both the weather and climate.

Based on the latest atmospheric and forecast signals, the remainder of December 2014 is expected to remain generally warmer and drier than normal. Based on historical and computer simulations, January will trends towards colder with a bit more snow. Then February will again turn milder and drier to finish out the 3 months of meteorological winter.

The images below represent the Climate Prediction Center outlooks for temperature (left) and precipitation (right). These images represent the average climate anticipated during the December 2014 – February 2015 period. Areas shaded in red (blue) are expected to have warmer (colder) than median temperatures during the 3 month period. Areas shaded in green (brown) on the right image represents are expected to be wetter (drier) than normal. The “EC” shown on the map represents a non-forecast, so the user is directed to expect mean climatological variations the next 3 months.

The latest outlook from the Climate Prediction Center (CPC) for the next three months can be seen below. The CPC is forecasting equal chances of above, below or normal precipitation a slightly higher than average chance of below normal temperatures. You can find their current and future outlooks at http://www.cpc.ncep.noaa.gov/products/predictions/90day.

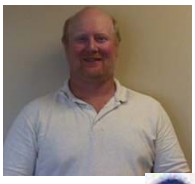
[1] The corresponding author: Mark Ewens is retired from the NOAA’s National Weather Service. He is currently a Consulting Climate Forecaster. E-Mail: Mark Ewens <slapm7@msn.com>

	
December through FebruaryTemperature Outlook	December through February Precipitation Outlook

Also, the North Dakota State Climate Office has links to the National Weather Service's local 3-month temperature outlooks for the upcoming year. Those forecasts can be found at: http://www.ndsu.edu/ndsco/outlook/L3MTO.html . The readers will also find the following National Weather Service office web sites very useful for shorter term weather forecasts:

Eastern North Dakota: http://www.crh.noaa.gov/fgf/
Western North Dakota: http://www.crh.noaa.gov/bis/

Hydro-Talk



Hydrologic Outlook in Missouri Basin

by A. Schlag[2]

Inevitably, someone at this point in the year turns our conversation on the upcoming Christmas and New Year's holiday season into a question and answer session on "what's spring going to bring". The truth is, we rarely have much in the way of a solid idea on how spring is going to unfold as it is so far into the future when it comes to forecasting exact weather and hydrologic conditions for a given day, or week. Note: most weather models only go out 10 days into the future.

Nonetheless, there are a few nuggets of useful information already in place at this time of year, so let's go over those and what reasonable impacts they tend to have on the spring flood season.

First and foremost, are there any known climate drivers in place? Currently, the answer to that is no, there are no strong climate drivers in place that have a substantial effect on winter and spring in the Northern Great Plains. However, there is a 65% probability for the onset of El Niño during the 2014-2015 winter and early spring season. If an El Niño does materialize and last into spring, the expectation tends to be for a warmer winter season with an early entry into spring with a somewhat normal to perhaps drier than normal winter and spring. This suggests a lower spring flow volume than what we have become accustomed to over the past few years and perhaps a slightly increased risk of ice problems as ice may become mobilized sooner, rather than later. Overall, this should be a positive for those tired of the spring high water events of 2009, 2010, and 2011.

Soil moisture, most of the state received well below normal precipitation during late summer and early fall. This allowed fairly high soil moisture levels to fall back into the normal range during a pretty darn nice fall. Perhaps the only large exception to this would be the southwest corner of the state, roughly south of Highway 200 and west of Highway 49 where soil moisture levels are still somewhat elevated. Frost depth, despite the unusually cool November is not remarkable and December has not been cold enough thus far to change that. Similarly, what little snow the region has been holding on the ground, is likely to disappear over the coming days. This suggests it would take something of a very extreme end to December for the region to head into 2015 with much of a snowpack, much less one that is well above normal.

At this early point in winter, what we have available to us suggests 2015 should (note, I said SHOULD) be unremarkable with respect to widespread flood problems. We remain far enough away from the normal spring melt and flood season to rule out wide spread problems, but there is good reason to be optimistic.

In March we'll have a much better idea of the weather and threats across the state as we enter the customary beginning of the spring melt season. Until then, enjoy the pleasant December!

[2] The corresponding author: Allen Schlag is the Service Hydrologist at the NOAA's National Weather Service, Weather Forecast Office in Bismarck, ND. E-Mail: Allen.Schlag@noaa.gov

Science Bits

Dynamic Models and Local Composite Outlooks

by Mark Ewens[3]

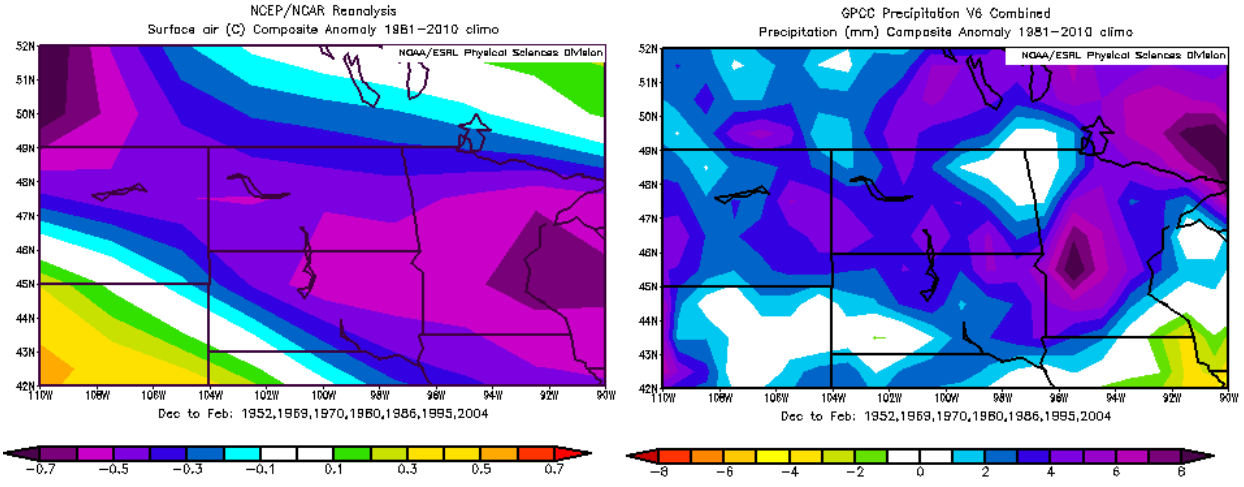
There are several sets of tools, procedures and models that are used to help predict the longer term climate. These include analog, canonical and statistical tools as well as advanced dynamic climate/weather models.

Analogs, also called composites, are an average that is calculated according to specific criteria. For example, one might want a composite for the rainfall at a given location for all years when an El Nino is occurring. *Canonical* tools are statistical methods that finds patterns of predictors (variables used to make the prediction) and predictands (variables to be predicted) that maximize the correlation between them. Lastly, *dynamic climate/weather models* work similar to the computer models used in everyday weather forecasting. However, instead of forecasting the 'weather' out to several days (or in some cases 2 weeks) these models make less specific predictions out to several months. The Unites States, Canada and the European Centers for Climate Prediction all run various climate models. Thse models are then compared in an ensemble method to present the most likely scenario for the future.

Below are examples of the local composite analog predictions for the December 2014 to February 2015 'winter' and the dynamic Multi Member Ensemble computer models.

Local Composite Outlooks

Using climate signals (the phase of El Nino, the Artic Oscillation and others) the years that these signals have overlapped in the past are used to predict the climate of the future. This is the analog or composite technique. Based on the average climate signals for September – November 2014, the years 1951/52, 1968/69, 1969/70, 1979/80, 1985/86, 1994/95 and 2003/04 represent those years most similar to this year. On average, those years saw warm and dry weather in December, colder and wetter weather in January them milder but still wetter in February. Taken as an average the composite weather is shown below.



It is important to remember that this is not a true outlook, but a tool that represents what happened in previous winters when the fall seasons climate signals were aligned a certain way. These suggest the by the end of February when we tally the numbers, the 3 month average temperatures (left panel) will be

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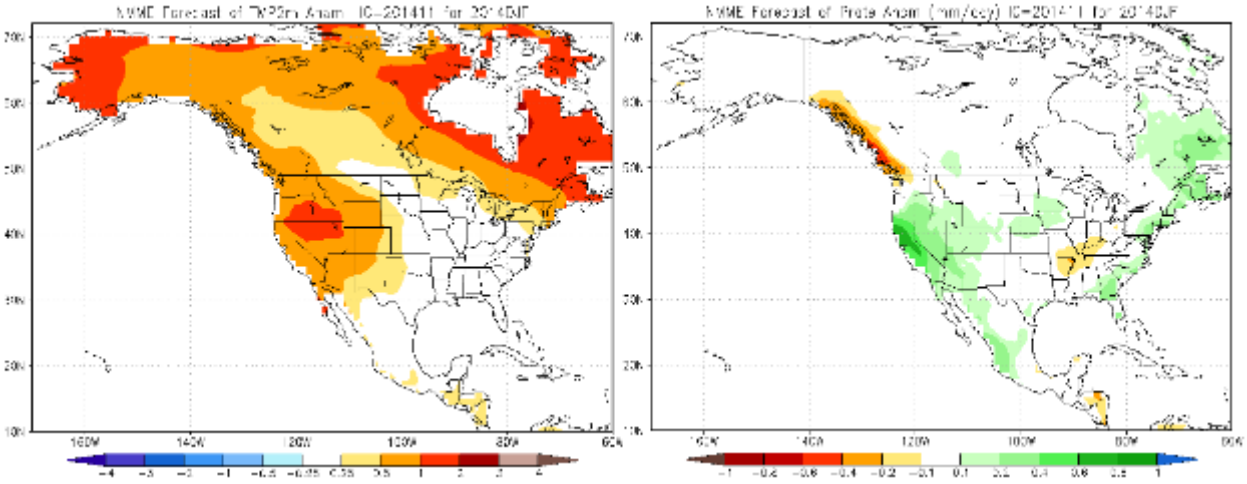
0.3C to 0.7C (0.17°F to 0.39°F) below the long term average. Precipitation (right panel) in the Red River Valley, will be 1 to 4 mm (0.04”to 0.16”) above normal.

Dynamic Models

The Ensemble Dynamic Models from the Climate Prediction center suggest a slightly different outcome. Based on the various tools presented, the Multi-Member Ensemble shows a “normal” temperature pattern for the northern plains, perhaps biased slightly to the warm side of normal. Precipitation looks somewhat similar to the composite prediction in that the highest amounts would fall south of the Red River Valley Region.



Putting it all together, the Climate Prediction Center makes the best scientific based outlook for the entire United States, Alaska and Hawaii. The science of climate forecasting and modeling will continue to improve as our understanding of the many varied and complex interactions improve.

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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