



CLIMATE ASSESSMENT LOOKS AT LOCAL

More than three hundred authors who are scientists by day. Twenty-nine chapters, summarized into key messages around water and agriculture and energy and people and the economy. Eight peer reviews. Countless workshops across the United States.

For two years, climatologists, including two from the University of Nebraska-Lincoln, worked on the Fourth National Climate

Assessment, an assessment of climate change across the United States, released late last month and followed by a media flurry.

“It was a process,” said Martha Shulski, director of the Nebraska State Climate Office and associate professor with the School of Natural Resources at Nebraska.

“A long process,” added Mike Hayes, also an SNR professor. “But it was an incredible, collaborative

Continued on PAGE 2

IN THIS ISSUE

3 | What does the NCA4 mean for Nebraska?

4 | Expect swings in weather through spring

5 | Keeping up-to-date with Nebraska Mesonet

Martha Shulski and Mike Hayes gathered local input on climate affects for the Fourth National Climate Assessment.



Continued from PAGE 1

effort to put this report together.”

The NCA4 Volume II examines the impacts and risks of a changing climate on the United States, with an emphasis on regions. It also looks at adaptations people and communities have made in response.

Shulski and Hayes were integral to the development of the chapter dedicated to the Northern Great Plains, which covers Montana, Nebraska, North Dakota, South Dakota and Wyoming. In addition to writing and editing chapter 22

along with 10 other scientists from the region, they also were responsible for garnering stakeholder input on impacts already being felt across the five-state area; and helping generate and develop graphics to help tell the story.

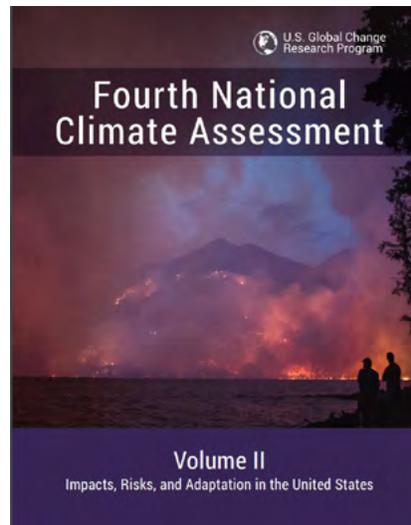
Highlighted in those efforts are Nebraska’s Platte Basin Timelapse Project and the National Drought Mitigation Center at SNR, as well as eight individuals and groups across the region who are taking steps to adapt to climate change (Figure 22.1 see here: <https://nca2018.globalchange.gov/chapter/22/>) and to build their resilience to increasing climate variability.

To do it, the authors needed to first gather input on the local issues people were experiencing.

“We wanted to answer, ‘What are the emerging issues people are dealing with? What does climate change mean for me?’” Shulski said, because “climate change is a local issue.”

After engagement sessions with stakeholders, the authors narrowed their focus to five key challenges the Great Plains Region will face:

Changes in precipitation patterns, coupled with warmer temperatures, and a potential for more extreme rainfall events will exacerbate water supply and management challenges, potentially affecting the health of people, crops, livestock, ecosystems and energy.



Key Message 1

Water
Water is the lifeblood of the Northern Great Plains, and effective water management is critical to the region’s people, crops and livestock, ecosystems, and energy industry. Even small changes in annual precipitation can have large effects downstream; when coupled with the variability from extreme events, these changes make managing these resources a challenge. Future changes in precipitation patterns, warmer temperatures, and the potential for more extreme rainfall events are very likely to exacerbate these challenges.

Key Message 2

Agriculture
Agriculture is an integral component of the economy, the history, and the culture of the Northern Great Plains. Recently, agriculture has benefited from longer growing seasons and other recent climatic changes. Some additional production and conservation benefits are expected in the next two to three decades as land managers employ innovative adaptation strategies, but rising temperatures and changes in extreme weather events are very likely to have negative impacts on parts of the region. Adaptation to extremes and to longer-term, persistent climate changes will likely require transformative changes in agricultural management, including regional shifts of agricultural practices and enterprises.

[NCA2018.GLOBALCHANGE.GOV](https://nca2018.globalchange.gov)

Access the full Fourth National Climate Assessment or just the Northern Great Plains chapter by [clicking here](#).

Rising temperatures and an anticipated increase in extreme-weather events will negatively impact agriculture in parts of the region, requiring a shift in ag management practices.

Shorter snow seasons, lower summer streamflows and higher stream temperatures will continue to negatively affect ecosystems, which in turn will negatively impact local economies dependent on those recreational or tourist opportunities.

Climate change and extreme weather events put fossil fuel and renewable energy production infrastructure at risk.

Indigenous peoples’ livelihoods,

economies, sacred waters and plants will be at high risk from a variety of climate changes, including decreased water supplies and extreme weather events.

“These are not exhaustive of the issues facing us,” Hayes said. “Other things are happening in the region, and hopefully future Climate Assessments can tackle those issues.”

But for Shulski, this is the point where the Nebraska State Climate Office, the High Plains Regional Climate Center, the Center for Advanced Land Management Information Technology, and other university and state organizations focused on climate and water and remote sensing come into play.

“This is the jumping off point,” she said. “This is where we take the report and we start a dialogue — or continue one — with stakeholders, and we dive deeper to address these issues.”

Up next is a Nebraska statewide rollout of the report planned for March 21 at Innovation Campus. Shulski, who is working with Nebraska Extension to coordinate the effort, said the rollout will be a step forward in continuing to find and build common ground from which Nebraskans can tackle climate changes issues facing the state together.

“We can land a space craft on another planet,” Shulski said. “We have the capacity to change the course of climate change.”

Pulling a (climate) thread

Three climate groups call the School of Natural Resources home, so when two climatologists play an important role in a national report, other climatologists get pulled into the action.

Natalie Umphlett with the High Plains Regional Climate Center at SNR, and Tyler Williams with Nebraska Extension, both helped execute listening sessions with Northern Great Plains stakeholders from a variety of social, economic, political and geographical backgrounds.

Doug Kluck, University of Nebraska-Lincoln alum and National Oceanic Atmospheric Administration Regional

Continued on PAGE 3

Continued from PAGE 2

Climate Services Director for the central region, acted as the federal coordinating lead for the Northern Great Plains chapter. Kluck currently serves as a member of the Earth and Atmospheric Sciences Department alumni board at Nebraska.

"I was privileged to work with Martha and Mike on the most recent National Climate Assessment as the

Coordinating Lead Author," he said via email on Monday. "Their climate experience and unique knowledge certainly strengthened the report in regards to the Northern Great Plains and especially Nebraska. The information contained in the report is essential for informing adaptation and planning in the coming years as the impacts from climate change continue affect us."

The next National Climate Assessment will be produced in 2021-22, as

is mandated by federal law. To learn more, [click here](#).

Access the report

Explore the complete National Climate Assessment [online](#) or [download the report and its related summaries](#).

To access the Northern Great Plains chapter in entirety, [click here](#).

— SHAWNA RICHTER-RYERSON, NSCO

HIGHLIGHTS FROM THE NCA4

The Nebraska State Climate Office has analyzed historical temperature and precipitation trends for the state's eight climate divisions. This was performed for the period of record, which goes back to 1895, as well as the most recent three decades. These changes are placed in the context of climate projections, made available from the recent release of the [Fourth National Climate Assessment](#).

Temperature

Nebraska's climate has warmed over the last century. On average, temperatures have increased by about 1.6 degrees Fahrenheit since 1895, which is a rate of 0.15 degrees per decade.

The rate of warming has generally increased over the past 30 years by about 0.3 degrees per decade, with the most drastic increases felt in the summer and fall. The winter months, however, are the one exception; they've seen a cooling trend, with temperatures down by about 1 degree since 1987.

Overall, the rise of minimum temperatures is out-pacing the rise in maximum temperatures by a factor of two. Lows have warmed 2.2 degrees while highs have warmed 1.1 degrees. Portions of Nebraska have experienced a slight long-term cooling trend in maxi-

mum temperatures during summer and fall. However, since 1987, the trend for summer and fall has been a warming trend of 1 degree.

Climate models project the overall warming trend will continue throughout this century. The rate of warming will accelerate in the coming decades. By mid-century average temperatures in Nebraska are expected to be 2 to 5 degrees warmer than they are now, increasing at a rate of 0.5 to 1.25 degrees per decade.

Nebraska experiences, on average, 10 to 20 days annually with a high

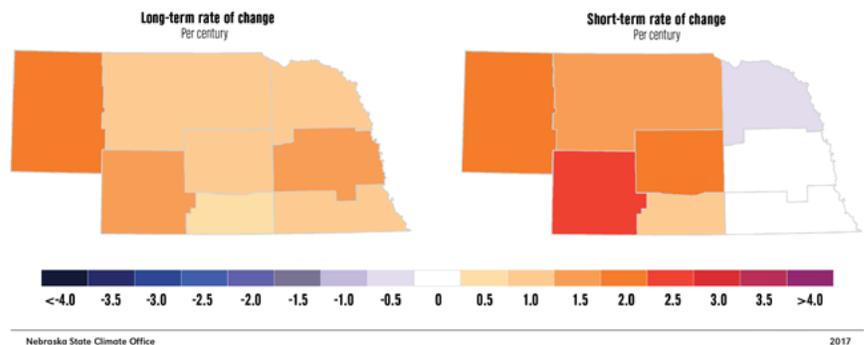
temperature greater than 95°F. By mid-century, this number will likely double, affecting plant growth and development. Conversely, the number of extreme cold days will be cut by 50 percent to 66 percent, on average.

The length of the growing season — or the number of days between last spring and first fall freeze — can be quite variable in Nebraska from year to year. On average, it is about 150 days. By mid-century, length of the growing season is expected to increase by

Continued on PAGE 4

ANNUAL AVERAGE TEMPERATURE (°F) NEBRASKA CLIMATE TRENDS

These maps show the climate trends over the long term and short term for the state's eight climate divisions based on industry-standard data from the National Centers for Environmental Information of the National Oceanic Atmospheric Administration. Long term trends use data collected between 1895 to 2016; short-term trends use data from 1986 to 2015.



Continued from PAGE 3

several weeks.

Currently, modified growing degree days (base of 50°F) accumulated per year average 3,000-4,000 units. An increase of 20 percent to 25 percent can be expected by mid-century.

Given the temperature projections and warming trend, cooling degree days are projected to be 40 percent to 60 percent more than the current average (approximately 1,000 units). Heating degree days average about 7,000 units annually in today's climate. By mid-century, projections indicate a 10 percent to 20 percent decrease.

Heating and cooling degree days are measures of heating and cooling requirements during the winter and summer, respectively, and are similar to a growing degree day unit. The base temperature is 65°F (for both heating and cooling) and are determined by accumulating the difference of the average daily temperature and 65°F.

Precipitation

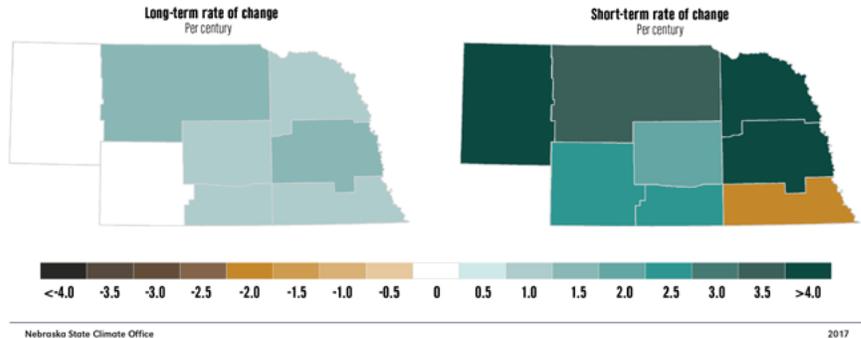
Nebraska's precipitation patterns generally can be defined by high year-to-year variability and a strong east-west gradient where annual totals decrease by 50 percent. Through the 20th century our climate generally became slightly wetter with a precipitation increase of 1.3 inches or 0.10 inch per decade. Much of this is a result of more precipitation, about 0.9 inch, during the spring.

Trends over the past 30 years are amplified with an increase of 2 inches (0.67 inch per decade) in the annual average with much of that occurring during spring (1.2 inches). Portions of Nebraska have experienced a recent drying trend during summer, fall, and winter. The strongest trends have occurred in southern Nebraska where average annual precipitation has decreased by about one inch since 1987.

The climate model projections for precipitation point to a persistence of the wetting trend for the annual average total. We can expect our historical trend to continue with an increase in

ANNUAL PRECIPITATION (IN) NEBRASKA CLIMATE TRENDS

These maps show the climate trends over the long term and short term for the state's eight climate divisions based on industry-standard data from the National Centers for Environmental Information of the National Oceanic Atmospheric Administration. Long term trends use data collected between 1895 to 2016; short-term trends use data from 1986 to 2015.



PROJECTED EFFECTS OF NEBRASKA'S CHANGING CLIMATE

EFFECT	IMPACT
LONGER GROWING SEASON	MORE EVAPORATIVE DEMAND
WARMER SUMMERS	INCREASED WATER REQUIREMENT
MORE EXTREME HOT DAYS	CROP AND LIVESTOCK STRESS
WETTER SPRING	DECREASED DAYS FOR FIELD WORK
MORE EXTREME RAIN EVENTS	INCREASED RUNOFF & SOIL EROSION
HIGHER COOLING DEGREE DAYS	SHIFTING ENERGY DEMANDS
MORE FREQUENT LARGE HAIL	INCREASED DAMAGE POTENTIAL

precipitation. There are expected to be changes, however, in when this precipitation falls. Winter and spring totals will be 15 percent to 25 percent higher than current conditions. Fall will be slightly wetter (5 percent) and summer will be 5 percent to 15 percent drier than the present climate, which will affect summer irrigation demand.

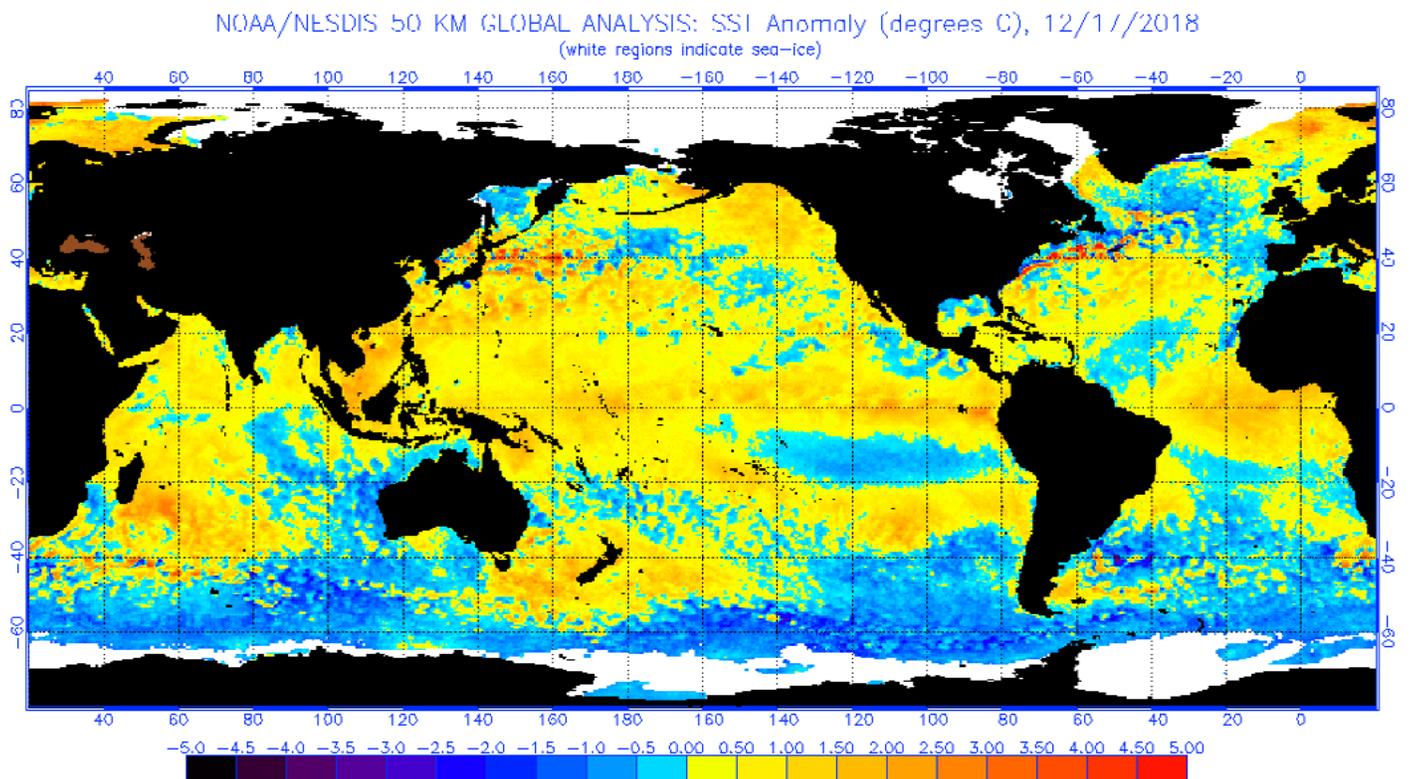
Daily rainfall greater than 1 inch is currently not very common; we record fewer than five days a year. However, we can expect a 15 percent to 35 percent increase in heavy precipitation days by mid-century. Furthermore, multi-day extreme precipitation events will increase in severity. Soil cover and structure will be critical to reduce runoff and increase the infiltration of excess precipitation.

Related to Nebraska's water resources, Rocky Mountain snowpack has seen

an overall decline in the last several decades. This trend is expected to continue with less snow water equivalence in addition to an earlier snowmelt altering the timing of peak streamflows in many Nebraska rivers.

There is inherent variability in Nebraska's climate and the potential for back-to-back flood-to-drought years. As such, reservoir and groundwater storage are expected to become even more important to mitigate enhanced risk to future precipitation variability that lies outside of the range of past experience. Sustainable water management is therefore paramount.

— MARTHA SHULSKI,
NEBRASKA STATE CLIMATOLOGIST
FOR CROPWATCH



EXPECT WEATHER SWINGS AHEAD

If our fall conditions are an indication of what is in store this winter for Nebraska, then it will likely be a very stormy winter. Thankfully, historical data indicates there is little correlation between fall and winter conditions. For most of the upper Midwest, including the eastern, central, and eastern half of the western Corn Belt, fall brought above-normal precipitation and below-normal temperatures.



AL DUTCHER
Extension ag climatologist

The forecast for the next three months includes a continued expectation that El Niño conditions will influence weather patterns across North America. Although El Niño conditions haven't met official criteria

in regards to atmospheric pressure differentials between the eastern and western Equatorial Pacific, temperature anomalies at the surface have a distinct El Niño signature.

Below the Equatorial Pacific, a large and extensive anomalous warm pool underneath of the eastern two-thirds of the Equatorial region continues to reinforce the surface temperature anomalies. The recent spike to above-normal temperatures across the Midwest developed just after the sub-surface warm pool moved 5 to 8 degrees above normal water temperatures to the surface in the eastern Equatorial Pacific.

Based upon the current evolution of the sub-surface warm pool, it appears that it will take another three to four months before the western edge of this warm pool makes it to the surface

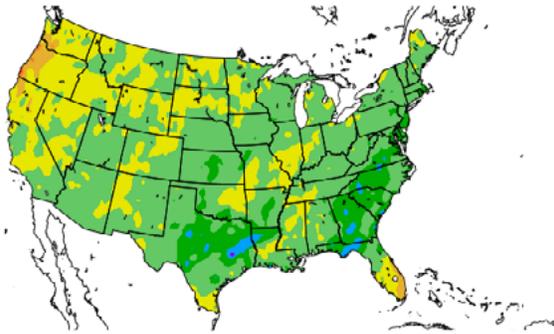
in the eastern Equatorial Pacific. Therefore, El Niño to El Niño-like conditions are likely to continue into March and possibly April.

Since this El Niño event is expected to remain weak, it is entirely possible that much of the upper Midwest will see periods that distinctly resemble El Niño conditions across the United States. However, the northern jet stream has been active the past three months, and I expect that we will see it still bring in occasional bouts of Arctic air. If this event follows past El Niño signals, the majority of Arctic intrusions will be short-lived.

For the upcoming three months (January to March), I believe that the tendency for above-normal temperatures will be strongest through mid-February, as the northern

Continued on **PAGE 5**

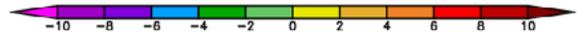
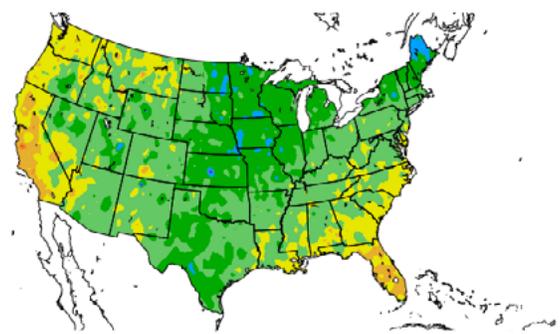
Departure from normal precipitation (in)
Sept. 1 to Dec. 17



Generated 12/18/2018 at HPRCC using provisional data.

NOAA Regional Climate Centers

Departure from normal temperature (F)
Sept. 1 to Dec. 17



Generated 12/18/2018 at HPRCC using provisional data.

NOAA Regional Climate Centers

Continued from PAGE 5

and southern jet streams battle for dominance. When the southern stream is strongest, storms will progress eastward out of the southern Rockies and impact areas south and east of Nebraska. When the northern jet stream is dominant, cold air intrusions are more likely across the eastern half of Nebraska through the mid-Atlantic region of the country.

How many moisture opportunities that we receive is always difficult to forecast during the winter, but El Niño conditions increase the odds that events will be wetter, and snow received at the surface will have a higher water content. This is because an active southern jet helps reduce the number of “Alberta Clipper” systems that develop under an active northern jet.

We have already experienced the impacts of an active southern jet this fall. Only one snow event that affected Nebraska this fall has been a classic Alberta Clipper. The remainder have originated out of the southern Rockies and have brought substantial moisture to southeast and south central Nebraska, which has helped them recover from a very dry 2019 cropping season. Snowfall has been so abundant from mid-October through the end of November that most location south of I-80 have already exceeded 50 percent of their average seasonal snowfall.

“El Niño conditions increase the odds that events will be wetter, and snow received at the surface will have a higher water content.”

— AL DUTCHER

The second half of this winter will be a difficult forecast. If the El Niño event dies rapidly, I would expect that the stormy pattern that developed this fall will return with a vengeance this spring. This would place a large portion of the Corn Belt into an enhanced risk for spring wetness and planting delays from Eastern Nebraska through the eastern Corn Belt. If the event lasts into April and May, then the heavy moisture likely will return when crops are just emerging or in their early growth stages. Finally, if this event continues through May, then we likely will experience back-to-back years of El Niño. In this case, conditions during the early Spring will likely intensify as the season progresses.

Snowpack conditions across the Rockies bear watching over the next four months. This first official snowpack releases for the season indicate a wetter than normal pattern for the southern Rockies, while the northern Rockies are

in the below normal to average range. Often, snowpack conditions below 80 percent of normal at the beginning of May have historically led to drought development immediately east of the poor snowpack conditions.

It should also be noted that the last El Niño event ushered in the beginning of a strong drought that hit eastern Montana and the western Dakota’s. Recent trends indicate that much of the northwestern U.S. has experienced below-normal moisture since the beginning of October. This trend extends east and southeast to include the western Dakota’s, and to a lesser extent, northwestern Nebraska. If this El Niño signal continues through this coming Spring, then areas downstream of Rockies where poor snowpack conditions exist will have an elevated risk for drought expansion.

Keep up with Al

Dutcher provides a weekly forecast to Market Journal, an educational outreach effort presented by the University of Nebraska-Lincoln’s Institute of Agriculture and Natural Resources, for agriculture producers. Watch the show, or just Al’s clips, on the [Market Journal website](#) or on their [YouTube channel](#).



NEBRASKA MESONET AT THE NSCO

A 10-meter tower station was installed at Leigh, Nebraska, in spring 2018.

MESONET IMPROVEMENTS AHEAD

Weather stations just kept going up, boosting the available climate data for the state of Nebraska. Data that makes a difference in keeping the climate record. Data that informs future decisions by farmers, ag producers, city managers and water management experts.

In all, Stonie Cooper and Glen Roebke, the [Nebraska Mesonet](#) crew, installed seven stations, bringing the statewide total to 68. They were:

- Leigh 1W, opened 3 April
- Oshkosh 6N, opened 18 April
- Plattsmouth 2SE, opened 18 April
- Memphis 4N, opened 20 April
- Broadwater 7N, 14 May
- Decatur 7S, opened 15 May
- Lincoln 9100 S 78th, opened 30 May
- Winslow 6E, opened 31 July

Three weather stations also were removed in 2018 due to less-than-ideal site locations, making data collected

unreliable at best. They were:

- Nemaha 4SE, closed 5 March
- Julian 4E, closed 12 April
- Angora 13N, closed 4 August

In addition to performing summer maintenance on the stations, Cooper and Roebke also tested a new experimental power paradigm at Brule 6SW and Sidney 2NW. The new power source allowed for data to be recorded and retrieved each minute of every day, so all data can be accessed nearly in real-time. It also allowed the barometer to run continuously. Considered a success, the new power paradigm will be implemented network-wide over the coming months; the Firth and IANR sites already have been converted.

Security at Nebraska Mesonet stations also was greatly enhanced in 2018 by pushing all but three stations onto a Virtual Private Network.

What's next?

The next push will be to build in sensor redundancy at each Nebraska weather station site. Nebraska Mesonet will start with precipitation gauges, in response to feedback from our user survey, collected in August and September.

"Precipitation was the No. 1 used product from the network, by far," Cooper said.

Congrats are in order

In 2017, the Nebraska Mesonet was accepted into the National Mesonet Program. This year, Nebraska Mesonet was awarded a renewal and can now expand data types it issues to the National Weather Service.

— STONIE COOPER,
MESONET MANAGER

OUR SERVICE TO NEBRASKANS

Part of our job is meeting Nebraskans and talking about what they care about. As is typical for Midwesterners, often talk includes the weather, but in our case, we talk climate: The history of weather and how that historical data informs what we know about future weather across the

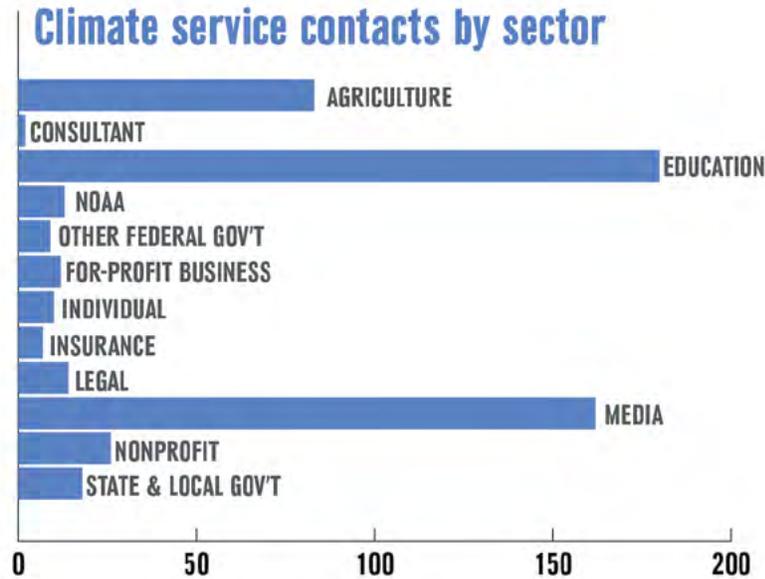
state, country and world.

This year, we've been invited to share what we know in dozens of school and university spaces. We've also shared our expertise with media outlets, businesses and ag producers. And we've answered service requests and delivered our data

to the National Oceanic and Atmospheric Administration for broader use.

Below is a snapshot of what we've done since Jan. 1, but be sure to check back on the [NSCO website](#) this coming January 2019, when we release our 2018 service totals and 2018 weather extremes.

NSCO
Jan. 1 to Dec. 14



51
TALKS

2,971
PEOPLE IN
ATTENDANCE



Martha Shulski: Nebraska State Climatologist

THE STORY OF CLIMATE IN THE PLATTE RIVER BASIN

If you live in Nebraska, odds are you've heard of the Platte River Time Lapse project, a collaboration of visual storytellers attempting to capture and share stories of a watershed that supports life and communities beyond our state's borders.

In early December, the project featured a visual and audio story of Martha Shulski, NSCO director, Nebraska state climatologist, arctic climate expert, and lover of weather since age 7.

"She grew up with a passion for weather and continues to show it in her work," the introduction to her story states. "Her goal is to help others understand how weather and climate affects them."

[Listen to the story here.](#)