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Spring snowstorm north of Lander, Wyoming (photo courtesy Crystal Stiles)

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Message from the Director

By Dr. Rezaul Mahmood

Hello from – finally – not so cold Lincoln! As many of you know, so far it has been a year of historic snowfall and cold, followed by an historic flood in Nebraska. Our staff remained busy monitoring these rapidly-evolving extreme conditions with the National Weather Service in Omaha/Valley and other partners.

Despite these challenges, we remained focused and are pleased to announce that the Climate4Cities tools have been officially released (see pages 2-3)! These tools are a result of several years of collaboration among the Nebraska State Climate Office, the High Plains Regional Climate Center, the University of Nebraska Public Policy Center, the UNL Community and Regional Planning Program, and the City of Lincoln. The tools will assist city officials across the Midwest and the High Plains in planning under a changing climate.

Natalie, Warren, and Bill led a hands-on workshop for the University community on Thematic Real-time Environmental Distributed Data Services (THREDDS) (see page 5). This system is provided by Unidata and allows access to real-time and archived observational and modeled datasets in netCDF for a number of disciplines, including meteorology, oceanography, and climatology. In the meantime, Natalie and Crystal traveled throughout the region to engage and interact with our stakeholders. For instance, they attended the Northern Plains Climate Product, Service, and User Engagement Workshop in Fargo, ND, as well as the Wind River Drought Planning Workshop in Fort Washakie, WY. Other similar engagements included a successful webinar on HPRCC web tools for the Applied Climate Information System (ACIS).

I expect a busy spring season here at the HPRCC. Thanks for stopping at *The Prairie Post!*



Meet our Postdoc, Paul Flanagan



Paul joined our staff in January as a postdoctoral research associate. Paul has a Bachelor’s Degree in Meteorology from Florida State University, and he received his Master’s and Doctoral Degrees in Meteorology from the University of Oklahoma. Areas of research interest include precipitation variability, regional climatology, synoptic meteorology, and land-atmosphere interactions. Paul is particularly interested in doing research that aids in forecasting future extreme events from a precipitation perspective.

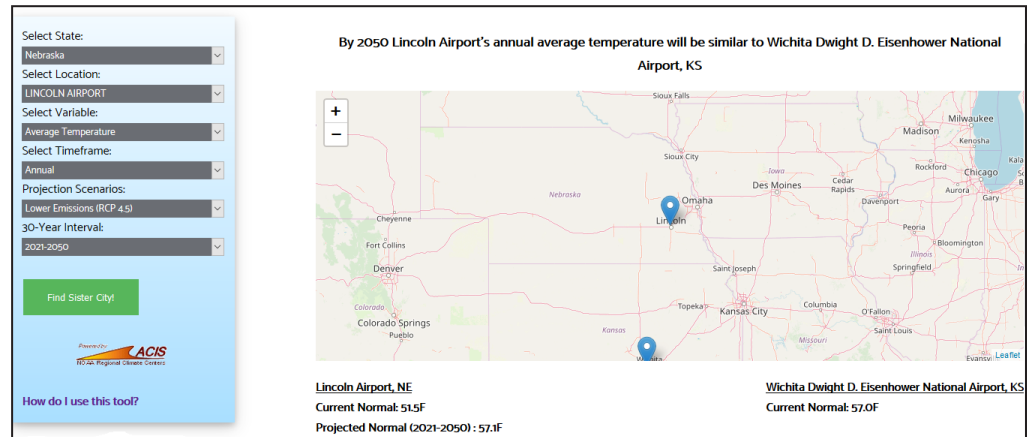
Paul grew up in Indiana and experienced all sorts of interesting weather events. He has always been fascinated by severe storms and would stay outside as long as possible to watch the storm clouds roll in. His curiosity of how storms formed ultimately led him to study it further in school. Paul enjoys storm chasing and has some good stories from his time in Oklahoma. Aside from weather, he enjoys sports (particularly football and hockey) and playing board games.



Suite of Tools, Including ‘Sister City’ Match, Brings Context to Climate Change

Planning for climate change isn't easy. The complexity of the issue itself is hard to digest, let alone translate into action items. But a new suite of tools designed by a group of University of Nebraska-Lincoln researchers gives municipal planners a clearer climate picture of what to expect and prepare for.

“Climate is not always tangible,” said Natalie Umphlett, co-lead on the project, dubbed Climate for Cities, and regional climatologist with the High Plains Regional Climate Center at the School of Natural Resources. “But our website offers tangible tools you can use and interact with to help make better decisions when planning for the future.”



Example from the Sister City tool: <https://hprcc.unl.edu/climate4cities/sister.php>.

The project, funded by the National Oceanic and Atmospheric Administration Climate Program Office Sectoral Applications Research Program, provides climate data in a variety of forms, including historical trends and future projections, for a range of climate variables. The potentially greatest display of that information comes in the form of the “sister city” tool.

The tool covers the 10 states in the Missouri River Basin, and pairs up 100s of cities of varying sizes, providing a literal look at what one's possible climate in the future looks like today. By 2055, for example, Lincoln's annual temperature could be like Wichita, Kansas, and by 2099, like Joplin, Missouri, under a scenario where efforts have curbed greenhouse gas emissions enough to reduce the current trajectory.

The web tool also opens the door to see how that sister city has handled current climate issues, such as drought, mosquitoes or excess heat.

“Many communities do not have the resources to develop climate reports and tools on their own,” Umphlett said, but this site can help change that. “This gives towns, both big and small, the chance to begin to explore their climate; no one is left behind.”

Users will also find a searchable database for planning documents from 18 municipalities, detailing current and potential issues and solutions.

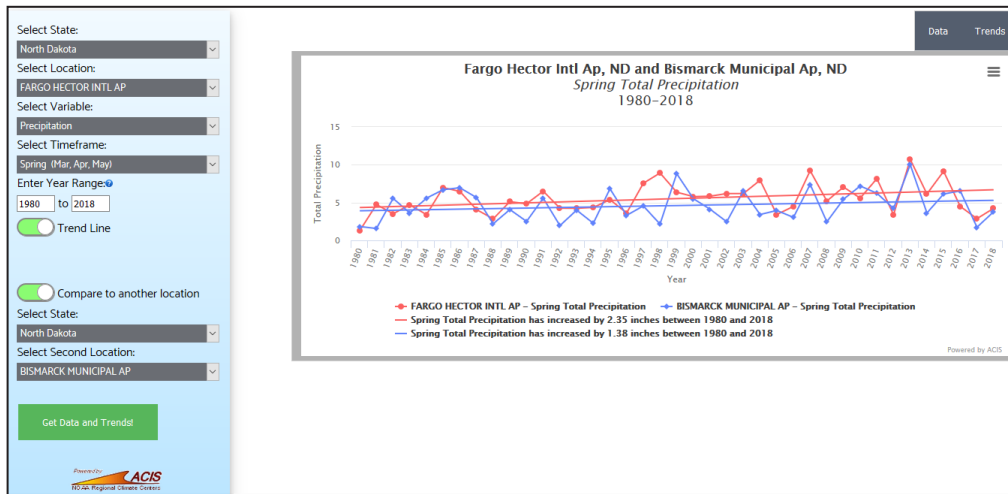
“We've catalogued all these plans by various topics. So, when you search for, say green streets or sustainable infrastructure, the results will take you to the exact page of the plan that covers the topic you are interested in,” Umphlett said. “It's beneficial to see how others have implemented policies around these topics.”

The website is the result of two years' worth of work with 11 cities in Nebraska, Iowa, Kansas and Missouri, and with university partners Martha Shulski, co-lead on the project from the Nebraska State Climate Office; Zhenghong Tang, of Community and Regional Planning; Tarik Abdel-Monem, of the University of Nebraska Public Policy Center; and the Bureau of Sociological Research, as well as Frank Uhlarik of the City of Lincoln.

The project was designed to help municipalities prepare for changes in climate, including warmer temperatures, increased rain events, and more erratic weather, all of which affect city services, utilities, industries, public health and city budgets.

(Story continues on Page 3)

(Continued from Page 2)



Example of the Historical Climate Data and Trends tool: <https://hprcc.unl.edu/climate4cities/historical.php>.

Each of those 11 cities received personalized climate reports, which describe their expected change in temperature and precipitation, as well as the implications of those changes. Lincoln's indicates the city will see more single- and multi-day heavy rain events, which could lead to more frequent flood events, soil erosion and decreased water quality, but the city also is likely to see more drought.

The researchers are cognizant that the reports represent a snapshot in time, and while the online suite won't replace the report, it can certainly

enhance its use as the climate data available will always be up-to-date, pulling the most recent numbers from the Applied Climate Information System, a management system for the complex stream of climate data maintained by NOAA Regional Climate Centers.

Early feedback has shown users expect to use the website to develop mitigation or adaptation plans and to validate decisions being made, as Lincoln plans to do.

“The climate report for Lincoln reaffirms earlier work by UNL published in ‘Understanding and Assessing Climate Change (2014)’ and forms a solid foundation for the city to ramp up mitigation and resiliency efforts,” Uhlarik said. “While we have included various mitigation goals in our 2017 ‘Lincoln Environmental Action Plan,’ we fully intend to more broadly address resiliency efforts both in our comprehensive plan updates and Utilities master plans in 2019/2020.”

That won't be the end, though, for the researchers at Nebraska. Over the next few years, they intend to continue garnering feedback to improve and refine the tools, potentially expanding the site to cover specific industries or additional states.

“This work represents stakeholder-driven research that provides cities with a suite of usable climate information to help reduce risk to local climate change impacts,” Shulski said. “We learned a great deal about municipal decision-making and climate communication, and the users are provided with synthesized and actionable planning tools.”

All steps forward in handling the complex issue.


-This story was written by Shawna Richter-Ryerson, UNL School of Natural Resources, and was published in *Nebraska Today*: <https://news.unl.edu/newsrooms/today/article/nebraska-developed-tool-suite-brings-context-to-climate-change/>.



Product Highlight: CLIMOD

The HPRCC has many tools for analyzing and visualizing climate data. CLIMOD is a web-based application that can be used to investigate the climate, retrieve and analyze data, and display climate information in useful ways. CLIMOD can be used to investigate a specific day and characterize the climate for that day historically. It can graph temperature and precipitation over a selected time period, as well as provide the data. It can even rank data for many variables over different seasons and generate a graph of the results. CLIMOD also has the ability to provide some information for multiple stations at one time.

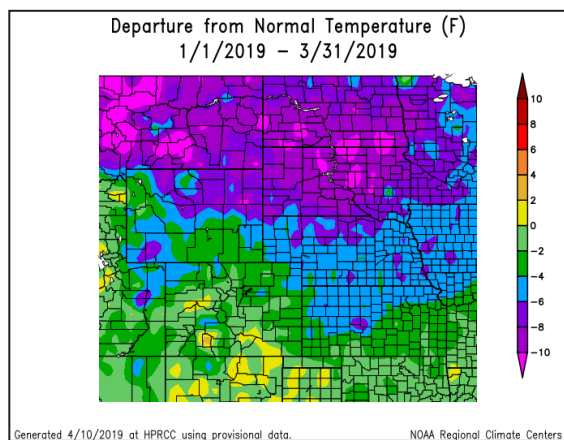
In the spring, many people are interested in when the last frost/freeze will occur, given its impact on production agriculture and urban landscapes. CLIMOD has a tool for that. The 'Frost/Freeze Summary' can be used to look at the first and last occurrence for a specified temperature for a selected station (see example at right). Years can then be ranked based on the date the temperature occurred. A table includes all the dates for each year as well as a summary including the mean date, first frost date, and last frost date. Don't let yourself be surprised by a late frost this year. Check out the tool: <http://climod.unl.edu>.



Frost/Freeze Summary for NORTH PLATTE REGIONAL AP, NE
Each section contains date and year of occurrence and number of missing values.
 Click column heading to sort ascending, click again to sort descending.

Year	Last	Missing	First	Missing	Season Length
1989	05-06 (1989)	0	09-13 (1989)	0	129
1990	05-10 (1990)	0	09-23 (1990)	0	135
1991	05-06 (1991)	0	09-18 (1991)	0	134
1992	05-29 (1992)	0	09-28 (1992)	0	121
1993	05-03 (1993)	0	09-26 (1993)	0	145
1994	05-07 (1994)	0	10-09 (1994)	0	154
1995	04-27 (1995)	0	09-21 (1995)	0	146
1996	05-01 (1996)	0	09-27 (1996)	0	148
1997	05-15 (1997)	0	10-09 (1997)	0	146
1998	06-06 (1998)	0	10-06 (1998)	0	121
1999	05-12 (1999)	0	09-13 (1999)	0	123
2000	05-19 (2000)	0	09-24 (2000)	0	127
2001	05-23 (2001)	0	09-24 (2001)	0	123
2002	05-25 (2002)	0	09-22 (2002)	0	119
2003	05-20 (2003)	0	09-19 (2003)	0	121
2004	05-14 (2004)	0	10-02 (2004)	0	140
2005	05-15 (2005)	0	09-28 (2005)	0	135
2006	05-16 (2006)	0	09-18 (2006)	0	124
2007	04-26 (2007)	0	10-08 (2007)	0	164
2008	05-14 (2008)	0	10-13 (2008)	0	151
2009	05-14 (2009)	0	09-28 (2009)	0	136
2010	05-14 (2010)	0	10-12 (2010)	0	150
2011	05-16 (2011)	0	09-30 (2011)	0	136
2012	05-14 (2012)	0	10-01 (2012)	0	139
2013	05-05 (2013)	0	10-07 (2013)	0	154
2014	05-17 (2014)	0	10-03 (2014)	0	138
2015	05-21 (2015)	0	10-16 (2015)	0	147
2016	05-17 (2016)	0	10-06 (2016)	0	141
2017	05-24 (2017)	0	10-10 (2017)	0	138
2018	04-28 (2018)	0	09-26 (2018)	0	150
2019	-	108	-	366	-
Minimum	04-26 (2007)		09-13 (1999)		119
Mean	05-13		09-29		138
Maximum	06-06 (1998)		10-16 (2015)		164

Cold, Wet Start to the Year



Beginning in the latter half of January, bitter cold gripped the High Plains through the rest of the winter and into early spring. For the January-March period, temperature departures were below normal throughout nearly the entire region, with the greatest departures ranging from 8-10°F below normal across the Dakotas. The extreme cold event that occurred January 29-30 was particularly noteworthy, as portions of the eastern Dakotas experienced air temperatures in the -40s and wind chills in the -60s. While warmer temperatures during the first half of January balanced out average temperature departures for the month, it was cold throughout the region for most of the month of February, and records were impressive. For instance, Dickinson, ND and Rapid City, SD had their coldest February on record. March was colder than normal for most of the region, but the cold was not as extreme as it was in February.

The winter season was rather snowy across the High Plains, boosting both mountain and plains snowpack. Grand Forks, ND, Fargo, ND, and Omaha, NE each had their snowiest February on record. Mountain snowpack in Colorado was well above normal, which helped relieve drought conditions across this area that had been lingering since the previous year. Mountain snowpack in Wyoming was near normal, and flooding issues are not anticipated in the Upper Missouri Basin this spring. However, wet conditions and rapid snowmelt increased flood risk across the Lower Missouri Basin for the spring, and flooding in some areas is already occurring. In March, the combination of antecedent conditions and a strong storm system produced an historic flooding event for parts of the region, hitting eastern Nebraska especially hard. Multiple dams and levees were breached and numerous state highways were closed and washed out, cutting off transportation to and from several communities. Railroads and bridges were damaged from ice jams and flooding. Livestock perished, and several people died after being swept away by floodwaters. Initial damage estimates have already exceeded \$1 billion. To learn more about climate conditions in the High Plains, check out our monthly, quarterly, and annual climate summaries here: <https://hprcc.unl.edu/climatesummaries.php>.

HPRCC Staff Conduct Workshop for Using Large Datasets



Warren instructs participants on how to work with large datasets using Unidata's THREDDS server. (Photo courtesy Natalie Umphlett)

On March 25th, Warren, Natalie, and Bill hosted a workshop for faculty, staff, and students at the University of Nebraska-Lincoln on using gridded data from the new HPRCC Thematic Real-time Environmental Distributed Data Services (THREDDS) server. The server was funded through an equipment grant from Unidata last year, and hosts gridded versions of the HPRCC Applied Climate Information System (ACIS) summary maps. The HPRCC applied for the grant in order to help fill a gap in data usability, by specifically helping researchers and students access gridded versions of HPRCC products. Before the new THREDDS server was provided by Unidata, researchers using HPRCC products had to use raw data or pre-rendered maps. The addition of netCDF data provides a new, efficient method of doing quantitative research with HPRCC products.

At the workshop, HPRCC staff provided an overview of the netCDF file format by discussing its advantages, looking at how the headers are formatted, and showing how the data are packaged. The new THREDDS

data server was introduced by first showing examples from various institutions to demonstrate the variety of datasets that are available. For example, the THREDDS data server at UCAR was shown as an example of a server that contains complex datasets. Participants were then shown how to browse the server and makes various data requests. Once the overview was complete, the hands-on portion of the workshop could begin. The Unidata Integrated Data Viewer (IDV) was used to show how applications can query a THREDDS instance. Participants were given a step-by-step walkthrough of the various IDV features, and were then able to explore the HPRCC THREDDS datasets. Panoply was also briefly demonstrated as another application that can interact with a THREDDS server. After the workshop ended, most participants indicated interest in a follow-up workshop that would be focused on using Python.

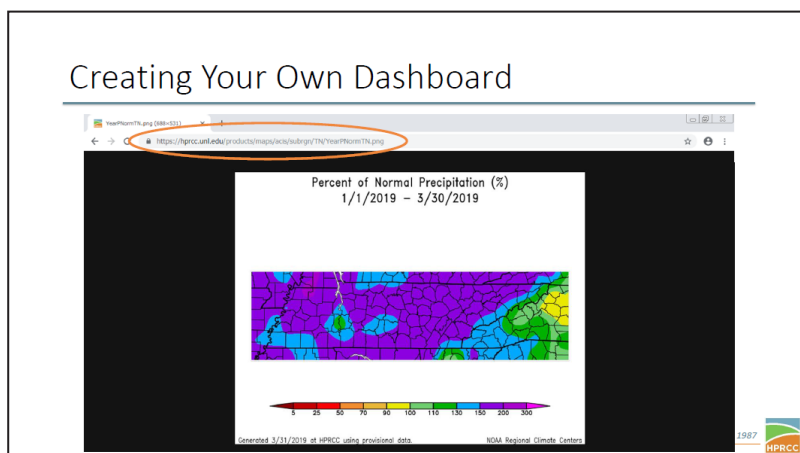
To access our ACIS products on our THREDDS server, please follow this link: <https://hprcc.unl.edu/thredds/>.

Staff Host Webinar on Incorporating HPRCC Products into Web Design

On April 4th, Natalie and Warren gave a webinar for members of the American Association of State Climatologists. The webinar covered the basics of incorporating ACIS-based data and products, such as ACIS Climate Summary Maps and ACIS GIS data, into web design.

In addition, several examples of ACIS-based tools from partners were highlighted, including:

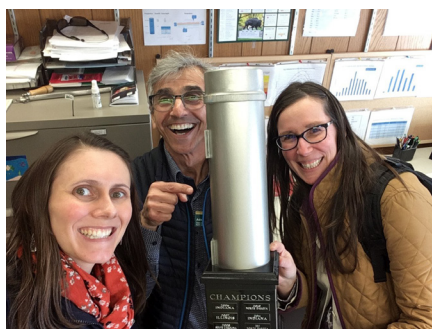
- [ACIS Daily Data Browser](#); Alaska Climate Research Center
- [Historical Monthly Station Data](#); Office of the New Jersey State Climatologist
- [Southern U.S. Drought Tool](#); Southern Climate Impacts Planning Program
- [Drought Risk Atlas](#); National Drought Mitigation Center
- [Climate Dashboard](#); South Dakota State Climate Office



Example from the webinar of incorporating ACIS tools into web design.

If you would like to learn more, check out the webinar recording here: <https://www.youtube.com/watch?v=ZPJmt4aLNyA&feature=youtu.be>.

Recent and Upcoming Travel and Activities



Natalie, Adnan Akyuz, and Dannele Peck pose with the CoCoRaHS Cup at the workshop in Fargo. (Photo courtesy Natalie Umphlett)

Nature Learning Night at Pershing Elementary, Lincoln, NE (January 24)

On January 24th, Natalie and Emily hosted a booth at Pershing Elementary for their annual Nature Learning Night. Approximately 220 people came to the event, many of whom stopped by the HPRCC's booth. We hosted a fun hands-on activity where children created clouds out of cotton balls and learned how to identify the different types of clouds we often see in Lincoln.

AASC Mesonet Workshop, Nashville, TN (February 27-28)

At the end of February, the American Association of State Climatologists (AASC) held a workshop with the goal of determining a set of operational standards for state mesonets. Jamie Lahowetz, Automated Weather Data Network (AWDN) Manager, attended this workshop in person, while Rezaul joined via teleconference. It is expected that these standards will be voted on at the AASC Annual Meeting in June.

Nebraska Climate Summit, Lincoln, NE (March 21)

Several HPRCC staff members attended the Nebraska Climate Summit, which brought together individuals from across the state who were interested in learning about climate change in Nebraska and activities that address it. The morning session was dedicated to the National Climate Assessment, while the afternoon session focused on climate intersections with agriculture, health, and municipalities. As part of the climate and municipalities session, Natalie presented on new tools that can help cities explore their current and future climate. The Summit was sponsored by the Nebraska State Climate Office, Nebraska Extension, and the Northern Plains Climate Hub.

Northern Plains Climate Product, Service, and User Engagement Workshop, Fargo, ND (March 28)

At the end of March, Natalie attended and presented at the Northern Plains Climate Product, Service, and User Engagement Workshop in Fargo, ND at North Dakota State University. The workshop brought together regional partners who produce weather/climate data and information, as well as end users of these products to discuss recent developments and current needs. The workshop was sponsored by the [Center for Regional Climate Studies](#) and [ND EPSCoR](#), and had a focus on agriculture, hydrology, and atmospheric science.

Weatherfest, Lincoln, NE (April 6)

Natalie and Emily attended the 19th annual Family Weatherfest and Science Spectacular, which was held on Innovation Campus at the University of Nebraska-Lincoln. This year, Emily created a new game where participants could learn about various types of clouds. Many kids were able to beat their parents at the game, and were challenged by trying to identify rarer clouds, such as lenticular and Kelvin-Helmholtz.

Wind River Drought Planning Workshop, Fort Washakie, WY (April 10)

Despite a looming spring snowstorm, Crystal visited the Wind River Reservation to discuss drought planning with the Eastern Shoshone and Northern Arapaho Tribes, along with several partners. Crystal also took the opportunity to visit the National Weather Service Office in Riverton to discuss needs and opportunities for collaboration.

Upcoming: National Adaptation Forum, Madison, WI (April)

In April, Crystal and Natalie will be attending this forum and participating in two panel sessions and the tools café to discuss their work with tribes and municipalities, as well as the importance of regional collaboration. Please come join us, if you are attending!

Upcoming: Spirit Lake Climate Workshop, Fort Totten, ND (May)

In May, Crystal and Natalie will be on the road again – this time to the Spirit Lake Reservation in North Dakota. They will be joined by James Rattling Leaf, with Rattling Leaf Consulting, to conduct a hands-on workshop on the use of climate data and information at the Cankdeska Cikana Community College.

Upcoming: American Association of State Climatologists (AASC) Annual Meeting, Santa Rosa, CA (June)

Several HPRCC staff members will be making their way to the 43rd annual gathering of the AASC. We look forward to catching up with our long-time partners and friends.



Emily and Natalie teach kids about clouds at Weatherfest. (Photo courtesy Ramesh Laungani)