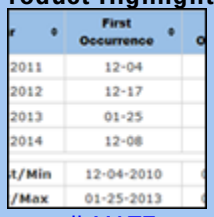
THE CLIMATE OBSERVER

A publication of the Midwestern Regional Climate Center

March 19, 2014

MRCC Product Highlight:



	First Occurrence	
2011	12-04	
2012	12-17	
2013	01-25	
2014	12-08	
t/Min	12-04-2010	
/Max	01-25-2013	

cli-MATE Seasonal Statistics

Climate Cool Tool:

US Tornado Environment Browser

Quick Links:

Temp & Precip
Growing Degree Days
Drought
CPC-Climate Prediction Ctr.
Natl. State of the Climate

MRCC Midwestern Regional Climate Center

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The Apostle Islands Ice Caves go Viral in 2014!

Bob Krumenaker, Superintendant of Apostle Islands Natl. Lakeshore, Natl. Park Service

Middle school students from Butternut, WI made their first trip to the national lakeshore to explore the ice caves. Students referred to the trip as "the best field trip ever". Photo provided by Natl Park Service.

The mainland sea caves of northern Wisconsin's Apostle Islands National Lakeshore are the national park's most popular summer kayaking destination. The Cambrian-era Devils Island Sandstone has been eroded by the relentless pounding of Lake Superior waves since water levels stabilized after the last glaciation.

In early winter, when the air is frigid but the lake surface has yet to freeze, spray from the crashing waves freezes to the rock cliffs just above the water's surface. Drips from groundwater seeps and flowing water from the land surface above the caves freezes on the cave walls and ceilings, forming a panoply of karst-like formations that look very similar to those found in underground limestone caves. Except these are made of ice and form in days and weeks, in contrast to the underground rock formations that take centuries or longer to form. The ice formations change rapidly, depending on the winter weather, and disappear in spring as quickly as they form.

Hoarfrost on icicles, forming delicate karst-like formations. Photo provided by Natl. Park Service.

Most of the year, the National Park Service (NPS) refers to these formations as the "sea caves," but in winter, they transform into the "ice caves." While other ice caves exist, there may be no other place on the planet where ice caves are so variable, so protected, and at least in some winters, so accessible.

On the Road:
IL - Chicago-area Climate Partners
FL - Association of American Geographers
DC - Various congressional offices and area climate partners
IA - U2U Conference

About the Ice Caves

Access to visit the caves depends on whether or not this portion of western Lake Superior freezes. Solid ice formation depends on more than low temperatures; this part of the Lake is very exposed and therefore vulnerable to big winds and waves, which can break up the ice very quickly. NPS staff monitor ice conditions and require that the ice pack be stable, locked in between particular geographic points, and at least 8" thick for two weeks before the ice is deemed "low risk." Only then will park staff announce that the ice caves are accessible.

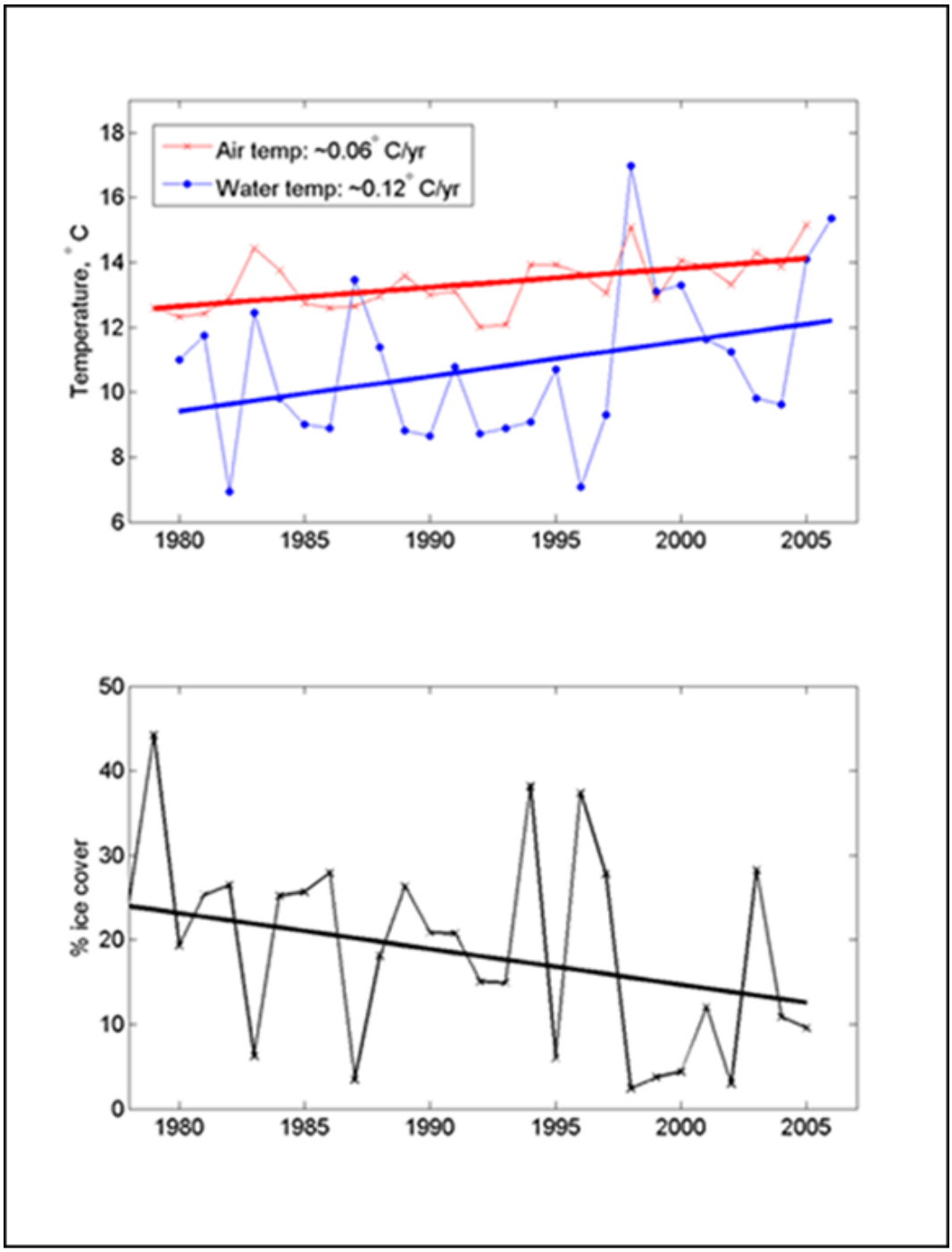
Western Lake Superior ice cover, MODIS image from 3/8/2014. Photo provided by Natl Park Service.

The route to the caves is about a 1.1 mile walk from the small NPS parking area at Meyers Beach, about 18 miles northwest of Bayfield, Wisconsin. This is very close to the northernmost point on the Wisconsin mainland as it juts out into Lake Superior. The caves then extend along the shoreline for about two miles. The first portion of the walk is on a snow-covered beach, but as the shoreline topography changes, the path goes onto the frozen surface of the lake. For many people, walking on an ice-covered Great Lake is a once-in-a-lifetime experience. Depending on the thickness of the ice, the amount of snow, winds, and the nature of the ice pack, this can be like walking on any other snow-covered route… or like walking on a sheet of glass. Sometimes the ice pack groans, and sometimes the entire surface undulates ever-so-slightly when a swell passes beneath the ice. It's definitely different, and requires keen attention to one's environment – and footwear to match the conditions.

Park ranger checking ice thickness. Photo provided by Natl Park Svc.

Prior to 2009, the caves were accessible for seasons from a few days to about six weeks in duration about two of every three winters. But surface water temperatures have been

warming rapidly on Lake Superior since 1980 (Austin and Colman, 2007) and the duration and extent of ice has also declined 79% since 1973 (Wang et al, 2012). The winters since 2009 have seen little ice formation, and climate projections for future ice conditions suggest that access across the Lake to the ice caves would be an increasingly rare experience.



Comparison of Lake Superior surface water and air temperatures since 1980 (top) and percent ice cover during the same period (bottom). By Jay Austin (University of Minnesota, Duluth).

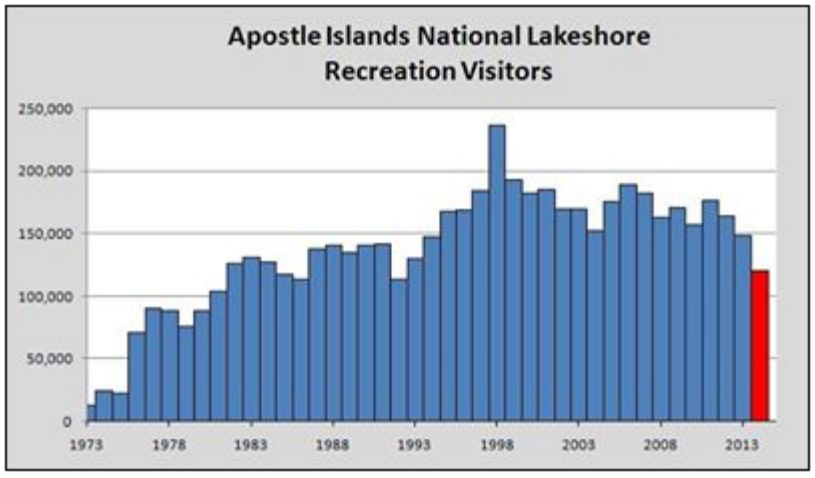
The extreme cold of this winter, however, caused much of Lake Superior to ice over early, and the ice to grow very thick. For the first time in five winters, the NPS was able to open the access to the ice caves, and the January 15th opening was about a month earlier than usual.

Attention Explosion

NPS staff knew the caves would be a popular attraction, and anticipated visitation similar to previous "good ice" years – maybe 10,000 to 12,000 people over a six-week period. Each of the first weekend days they were open, however, saw the largest daily crowds the park had ever seen -- winter or summer. The ice formations were spectacular as a result of the deep, deep cold. Thousands of people were venturing out despite extraordinarily cold conditions. In the first several weeks, steady winds from the west and southwest combined with single digit (or lower) temperatures to create wind chills in the minus 25 to minus 35 degree range most days. It was brutal! Yet the people kept coming.

Thousands of people visiting the ice caves on February 15, 2014. Photo provided by National Park Service.

Initially, media attention was local and regional, as expected. A TV crew from KBJR-TV in Duluth was one of the first, followed by Wisconsin Public Radio. Both stories were picked up by their national affiliates… ABC and National Public Radio. Soon, the CBS Evening News and NBC Nightly News sent crews to do their own stories, which were aired nationally in prime time. The Wall Street Journal even did a story. It even went international – Australia's 7 Network sent their Los Angeles based-crew and did TV spots on the most watched TV news show Down Under, and re-edited it for their Sunrise show, which is the most popular morning show in that country. Al Jazeera even sent a TV crew. The London Daily Mail covered it, and countless other media outlets literally across the globe.



Yearly visitation to the Apostle Islands National Lakeshore since 1973, showing the impact of the 2014 ice cave season (through3/10/2014). Image provided by National Park Service.

And the people kept coming. During the two weeks in January that the caves were accessible, there were over 12,000 visitors to

the caves, matching the highest previous season in its entirety. February's numbers were inconceivable – 68,000 visitors, despite a short closure due to a severe winter storm that threatened to (but did not) destabilize the ice. Temperatures remained frigid.

What accounts for the viral media attention and the huge visitor influx? I believe there are three primary elements. First, this year's polar vortex generated its own media attention, and the enthusiasm of people visiting the Apostle Islands ice caves stood out as a rare positive story about the impact of the extreme cold. Second, the media (surprisingly) picked up on the climate change theme, focusing on this being the first time the caves have been open in five years, and the likely rarity of this phenomenon in the future. In fact, both CBS and NBC chose climate change-related sound bites out of all the things they heard me say while the cameras rolled. However, there is no doubt that the biggest factor was the internet and social media, as any Google search can attest. Park staff for the first time ever began tending our Facebook page interactively, creating and feeding a positive feedback loop with thousands of fans. It has been a ton of work but also very rewarding.

Today

I write this on March 10, more than 8 weeks into the record 2014 ice cave season. It was well over 50 degrees and the ice cave season is clearly in its "end game." Over 3,000 people visited today, many in short sleeves, watching the hanging ice formations melt. Rangers urged them not to stand beneath the massive formations, as some have begun to fall. The ice pack that was at least 36" thick at one point (the length of our drill bits), is now thinning. This past Saturday, the caves saw over 14,000 visitors, and we've topped 120,000 for the season. Last year, the 21-island, 69,000-acre national park counted only 150,000 people for the entire year, and we're already over 80% of that number and rising.

Standing under hanging ice formations is NOT recommended! Photo provided by Natl Park Service.

The economic impact of the visitors to the Bayfield area has also been staggering. The Bayfield Chamber of Commerce and Visitor Bureau (www.bayfield.org) estimates that there's been a $10-12 million boost to the local economy. The NPS coincidentally just released its park-by-park national economic impact data, indicating that the Apostle Islands National Lakeshore has an estimated $24 million annual economic impact – and that was calculated for a non-ice cave year (2012)!

Challenges

There have been challenges, of course, to hosting all these visitors. The infrastructure at the trailhead has been overwhelmed. Normal capacity is 50 cars. There are two vault toilets. The NPS has brought in 18 portables. In previous ice cave years, NPS needed no staff on site Monday through Friday and would put 4-6 rangers on site on weekends for crowd management, search and rescue, and to provide interpretation of the caves. That's all the normal NPS budget can afford. As this event skyrocketed, it quickly threatened to overwhelm all available resources, and spilled outside the park with an impact on county and state police and local ambulance services. Fortunately, the community supports its national park and early commitments of funding and in-kind support from the Town of Bell, Wisconsin, the Friends of the Apostle Islands (www.friendsoftheapostleislands.org), and the Bayfield Chamber made a huge difference. The alignment of federal, state, tribal, and local agencies too numerous to mention, along with the local tourism and business communities has been remarkable. The US Coast Guard Auxiliary has provided volunteers every weekend, no matter how brutal the conditions. Finally, the NPS regional office in Omaha stepped forward and provided funding for the park to bring in rangers and others from national parks across the Midwest to provide the skilled and hearty staff to supplement and spell the Apostle Islands staff.

We don't yet know how and when this ends. Warm weather will eventually melt the ice, but that could be weeks away and a slow erosion is actually very frightening, as the ice may appear safe when it is not. Ice often breaks up quickly and dramatically, and an overnight breakup will be the best possible end, as it will be dramatic, definitive, and safe as no one will be out on it. Scariest of all would be a dramatic daytime breakup, on a weekend day, when there could be thousands of people on the ice. We hope there will be indicators ahead of time, but this is something none of the agencies are experienced with.

The public agencies are ramping up the planning for all three scenarios, preparing for the worst and hoping for the best. Here's where social media may really be our friend – we've never before had the capability of broadcasting real-time updates and we're hopeful we can get the word out when the time comes that the caves are closed – and that people will heed the warnings. We'd like to remember this as the remarkable ice cave year in the Apostle Islands National Lakeshore, when everything came together and thousands of people discovered how wonderful winter can be in one of the nation's most spectacular national parks.

Media Links

London Daily Mail | CBS Evening News | NBC Nightly News | Australia's Sunrise Show

NPS Apostle Islands National Lakeshore Mainland Sea Caves - Winter Conditions Web Site

NPS Apostle Islands National Lakeshore Facebook Site

Citations

Austin, JA and SM Colman. 2007. Lake Superior summer water temperatures are increasing more rapidly than regional air temperatures: A positive ice-albedo feedback. Geophysical Research Letters 34(6): L06604. http://www.cee.mtu.edu/~reh/papers/pubs/non_Honrath/austin07_2006GL029021.pdf

Wang, J., X. Bai, H. Hu, A.H. Clites, M.C. Colton, and B.M. Lofgren. 2012. Temporal and spatial variability of Great Lakes ice cover, 1973-2010. Journal of Climate 25(4):1318-1329 (DOI:10.1175/2011JCLI4066.1)
(2012). http://journals.ametsoc.org/doi/pdf/10.1175/2011JCLI4066.1

For more information on this article or the Apostle Islands National Lakeshore, please contact Bob Krumenaker via email at bob_krumenaker@nps.gov

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New Climate Tools Help Farmers and Advisors Make Informed Decisions

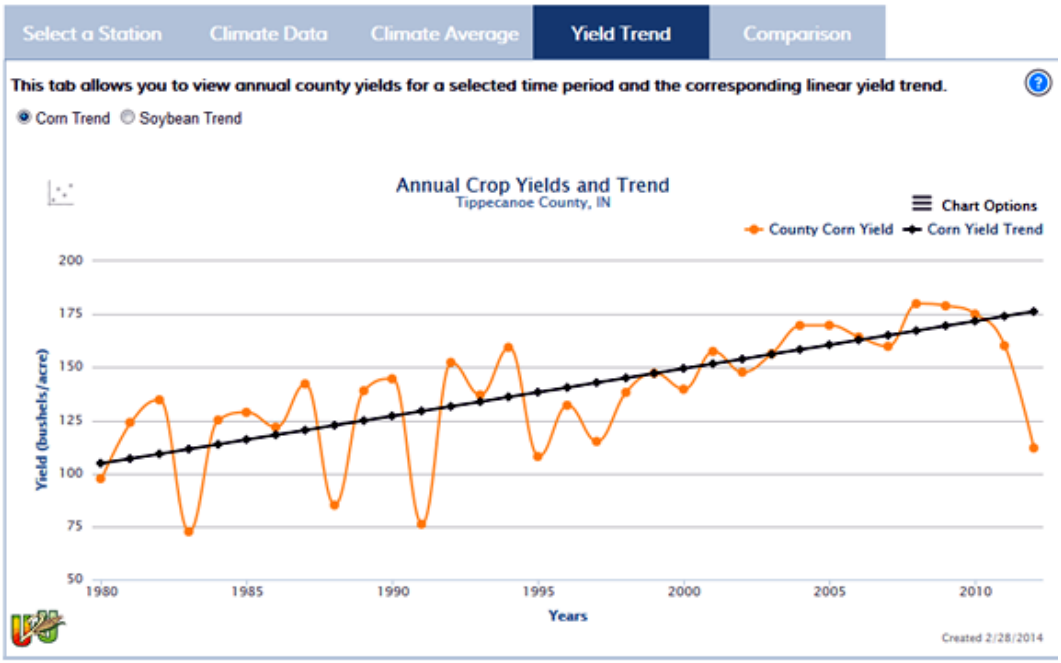
John Kriva and Melissa Widhalm, U2U Project Members

The Useful to Usable (U2U) climate initiative recently launched two new decision support tools to help farmers and agricultural advisors manage increasingly variable weather and climate conditions. Part of the U2U Decision Support Tool (U2UDST) Suite, **AgClimate View DST** and **Corn Growing Degree Day DST** provide easy to use historical climate data that can help inform purchasing, marketing and activity planning throughout the growing cycle. An integrated team of university researchers, climatologists and social scientists from across the Corn Belt collaborated on the project.

"We are excited to announce

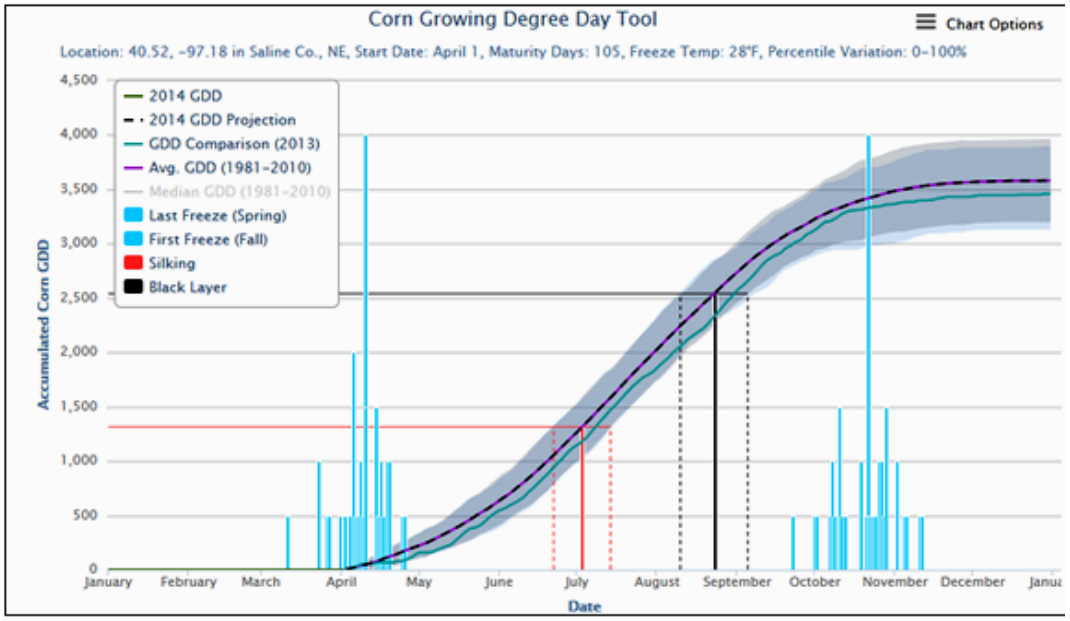
the launch of our first of several decision support tools. Our social science research on the front end helped our team of climate experts, economists and agronomists create easy to use tools that make climate data accessible and useful to the agricultural community. We'd like to think we are demystifying climate data one user at a time and hope producers will use the information to make better decisions and ultimately increase yields with minimal environmental impact," said Dr. Linda Stalker Prokopy, Associate Professor of Natural Resource Social Science at Purdue and U2U Project Director.

AgClimate View DST provides convenient access to customized historical climate and crop yield data for the U.S. Corn Belt. Users can view graphs of monthly temperature and precipitation, plot corn and soybean yield trends, and compare climate and yields over the past 30 years.



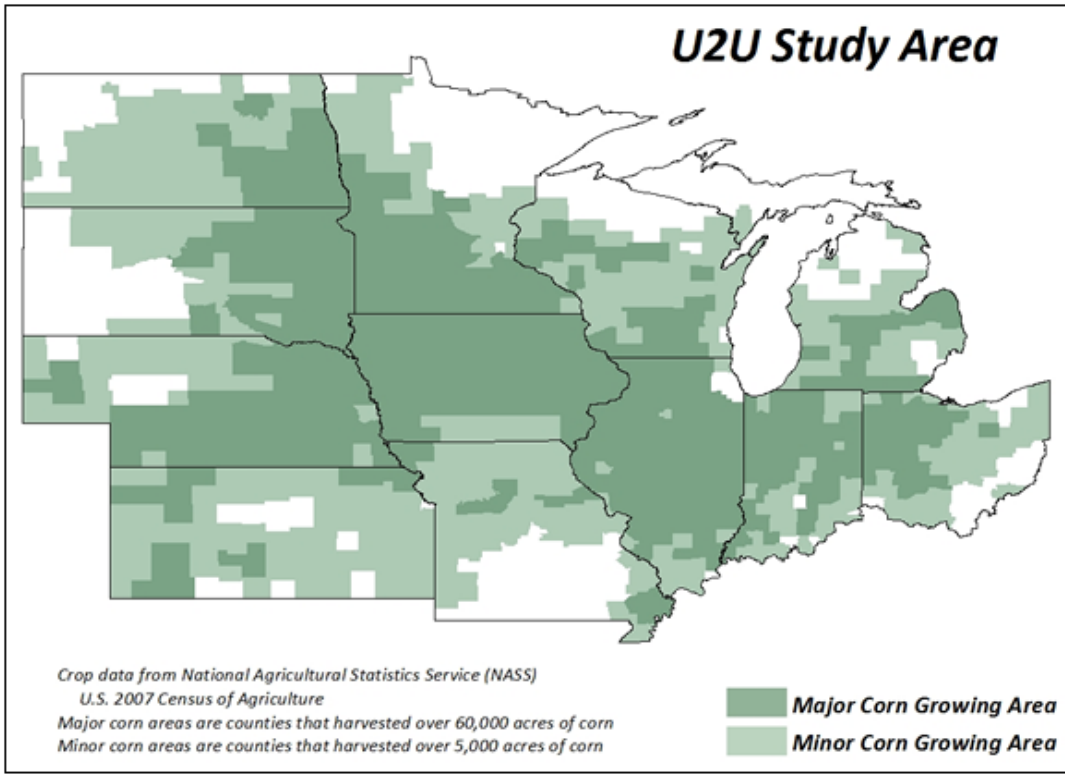
Output of AgClimate View DST of annual crop yields and trends for corn in Tippecanoe County, IN.

Corn Growing Degree Day DST allows users to track real-time and historical GDD accumulations, assess spring and fall frost risk, and guide decisions related to planting, harvest, and seed selection. This innovative tool integrates corn development stages with weather and climate data for location-specific decision support tailored specifically to agricultural production. Animations are also available for visualizing corn growing degree days throughout the selected time period.



Output from the Corn Growing Degree Day Decision Support Tool (DST) for Saline County, NE.

Both tools are designed for agricultural advisors and producers in the North Central region of the United States as well as Kentucky and Tennessee. The U2UDST Suite can be accessed via U2U's web portal.



A map of the U2U project study area.

Useful to Usable is a USDA-funded research and extension project designed to improve the resilience and profitability of U.S. farms in the Corn Belt amid a variable and changing climate. The project is comprised of a team of 50 faculty, staff, and

students from nine North Central universities with expertise in applied climatology, crop modeling, agronomy, cyber-technology, agricultural economics, and other social sciences.

U2U Project Team at a 2013 meeting.

U2U Project Partners: Purdue University, Iowa State University, Michigan State University, South Dakota State University, University of Illinois, University of Michigan, University of Missouri, University of Nebraska-Lincoln, University of Wisconsin, High Plains and Midwestern NOAA Regional Climate Centers, and the National Drought Mitigation Center.

U2U material is based upon work supported by the National Institute for Food and Agriculture, U.S. Department of Agriculture, under award number 2011-68002-30220. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the U.S. Department of Agriculture.

For more information on this article or the U2U initiative, please contact Melissa Widhalm via email at mwidhalm@purdue.edu.

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MRCC "Current Events"

Internships Available:

Do you know any students in either atmospheric science or computer science that may be interested in a summer internship? If so, the MRCC is having two paid summer internships this summer in Champaign, IL in these fields! The climatology intern (current soph. or junior in college) will assist MRCC climatologists with outreach and education activities and in responding to data and information requests in the MRCC service office. The computer science intern (undergrad or grad student) will assist MRCC scientists with the modification and development of computer programs and scripts to gain exposure to online tools development that accesses large atmospheric datasets. Applications are due March 24th!

When Climate Minds Meet

Beth Hall, MRCC Director

On March 12-13, climate scientists and partners from around the Midwest gathered in Champaign, Illinois to elevate awareness among each other of climate activities, projects, and services, as well as discuss how best to coordinate our activities throughout the region. There were forty participants from federal, state, local, non-government, and tribal organizations. While the common theme was climate, it was clear that the climate impacts and concerns varied greatly depending upon location and interest.

The meeting was organized into seven sessions: agriculture (2), Great Lakes and urban infrastructure, landscape conservation, research, education, and how to communicate climate science to the public and policy lawmakers. Each session consisted on an in-depth presentation on the topic, 2-3 brief overviews, and an extended discussion among the entire group that focused on the following key questions:

1. What is the biggest climate issue, impact, and/or challenge for your organization, region, or sector?
2. Why is it the biggest climate issue, impact, and/or challenge?
3. What resources have you been utilizing thus far to address this issue, impact and/or challenge?
4. What are the gaps that you are finding that are currently hindering you from achieving your goals?
5. How would collaboration with each other / anyone at this meeting benefit you and your climate needs?

While the findings were broad and clearly indicated the need to work together on many climate topics, a common theme included how to be prepared for climate extremes and their impacts as we move forward. From drought, to flooding, to Great Lake levels and erosion, to the various impacts on our landscape … climate has always played a large

role in our lives. This role has sometimes been negative, but has also brought positive impacts. The better prepared we are as a community to these climate impacts, the more pro-active we become as a society, rather than reactive.

Attendees of the Midwest Climate Meeting, hosted by the Midwestern Regional Climate Center.

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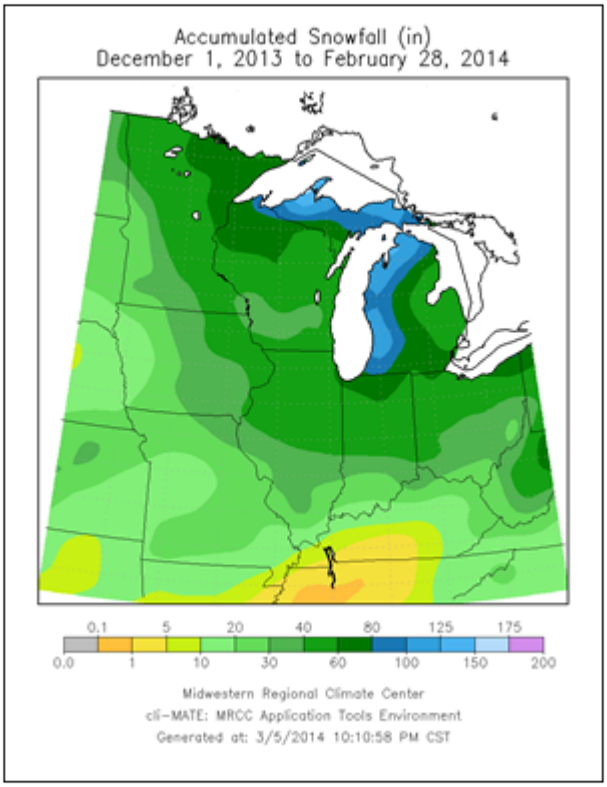
Midwest Climate at a Glance - Winter 2013/14 Overview



Much of the Midwest experienced the most severe winter in 30 years, with several blasts of arctic air and significant winter storms throughout winter. Highest seasonal snowfall totals were along Lake Michigan in western Michigan and in Upper Michigan, where season totals ranged between 80" and 175" of snow. The remainder of the region also experienced above normal snowfall, with the exception of western Iowa, southern Kentucky, and a small portion of western Minnesota.

Throughout the winter, the Midwest experienced several arctic blasts, some of which sent subfreezing temperature as far south as Florida. Extreme cold was felt in the town of Embarrass in northern Minnesota, where the mean winter temperature was only -5.5°F. In fact, Embarrass recorded 32 days with a minimum temperature -30°F or colder, a Minnesota state record.

As of March 6th, the total ice cover on the Great Lakes was 92.2%, making it the 2nd highest ice cover since 1973. The record ice cover of 94.7% occurred in 1979. In addition, for the first time since 1994, four of the Great Lakes (Superior, Michigan, Huron, and Erie) became 90% or more ice covered.

For more details, graphics, and impacts during winter 2013/14, visit the MRCC Midwest Climate Watch Overview

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MRCC Product Highlight

Seasonal Statistics
Snow Season based on 1in
CHICAGO OHARE INTL AP (IL)
USW00094846

Year	First Occurrence	Last Occurrence	Season Length	Snowfall
2010-2011	12-04	02-26	85	55.7
2011-2012	12-17	02-24	70	19
2012-2013	01-25	03-05	40	27.8
2013-2014	12-08	03-12	95	77.5
Earliest/Min	12-04-2010	02-24-2012	40	19
Latest/Max	01-25-2013	03-12-2014	95	77.5

M: Not enough data was available during the year to calculate a date
NA: No event occurred that season

Midwestern Regional Climate Center
cli-MATE: MRCC Application Tools Environment
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Wondering when the growing season began during the past 10 years or how much snowfall accumulated throughout the last snow season? The new seasonal statistics tool in the **MRCC cli-MATE** system can answer these questions and many more!

This tool will calculate the beginning date, ending date, season length and a user-chosen accumulated value for the growing, frost, or snow season for any number of years. The tool also allows you to define the season by selecting a specific threshold temperature or snowfall value. Also, by clicking on the data table headers, you can easily rank the years based the dates, season length or accumulated value. To access this tool, register for the free, online, cli-MATE system, then it choose Station Data > Seasonal > Seasonal Statistics from the menu.

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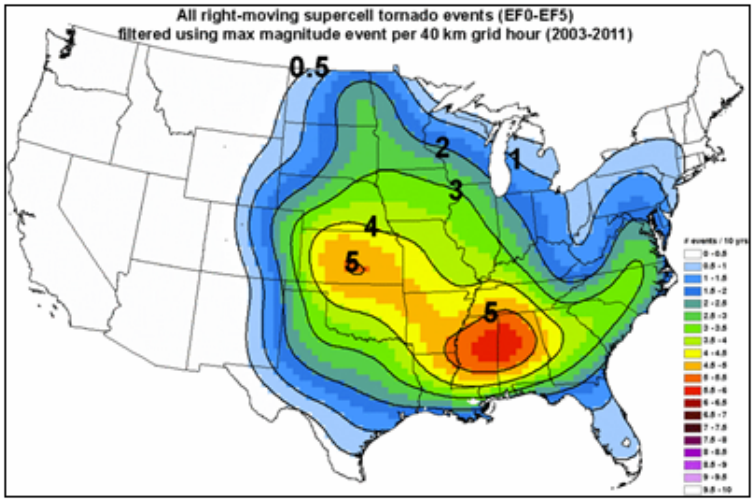
Climate Cool Tool



The **US Tornado Environment Browser** from the Storm Prediction Center (SPC) characterizes the recent US tornado history. The data cover 2003 to 2011 and are presented in various ways showing the spatial distribution, seasonal distribution, diurnal distribution, and the atmospheric conditions associated

with tornado occurrences. The information is localized for the location selected by the user. This tool provides a nice historical context for the daily monitoring of both severe weather conditions and storm reports at the SPC. The SPC link also provides access to more historical information under the storm reports section.

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MRCC On The Road

Chicago, IL (March 16-19) - Chicago Area Climate Partners

Beth Hall will be visiting Chicago-area climate partners.

Tampa, FL (April 7-12) - Association of American Geographers

Nancy Westcott will be presenting a talk on the Climate Data Modernization Project (CDMP) at the annual Association of American Geographers (AAG) meeting.

Washington, DC (April 28 - May 2) - Congress and Climate Partner visits

Beth Hall will be visiting with various congressal offices and some climate partners. If you're in that area and would like her to stop by, please email her.

Davenport, IA (May 19-21) - Useful to Usable Team Meeting

Beth Hall will be attending the annual Useful to Usable (U2U) Team Meeting, which brings project collaborators together to discuss outcomes from the previous year and strategize tasks for the upcoming year.

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Need Climate Data?
Ask about our Online Climate Data Resources (cli-MATE) or Request some data!

Can't Find a Climate Product?
Let us know!

Email us your local climate impacts! We are constantly keeping a log of how climate is impacting
our region, and our information would not be complete with YOUR help!

Have something to share as a feature article in an upcoming *The Climate Observer* issue, or interested in being contacted for an article interview? Please let us know!

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The MRCC is a partner in a national climate service program that includes the NOAA National Climatic Data Center, Regional Climate Centers, and State Climate Offices.
MRCC is based at the Illinois State Water Survey, a division of the Prairie Research Institute
at University of Illinois Urbana-Champaign.