NATIONAL WEATHER SERVICE
GREEN BAY

PACKERLAND WEATHER NEWS

Winter 2020/2021
Volume 18

LAKE MICHIGAN WATER LEVELS REMAIN NEAR RECORD HIGHS

BY: MIKE CELLITTI

In December 2012 and January 2013, the Lake Michigan-Huron basin (Lake Michigan and Lake Huron are treated as one lake from a hydrologic perspective) observed record low water levels, making it the 14th consecutive year of below normal water levels. These record low water levels garnered national attention raising concerns for the shipping industry, climate impacts, and the long-term future of the Great Lakes water levels. Since this minimum in water levels 6 years ago, Lake Michigan-Huron has been on the rise, culminating in record high water levels for much of this year (Figure 1). In fact, Lake Michigan-Huron set monthly mean record high water levels from January to August, peaking in July at greater than 3 inches above the previous record.

The water level on the Great Lakes can fluctuate on a monthly, seasonal, and annual basis depending upon a variety of factors including the amount of precipitation, evaporation, and rainfall induced runoff. Precipitation and runoff typically peak in late spring and summer as a result of snowmelt and thunderstorm activity. Although it is difficult to measure, evaporation occurs the most when cold air flows over the relatively warm waters of the Great Lakes during the fall and winter months.

The record high water levels of Lake Michigan-Huron are largely a result of well above normal precipitation across the basin over the past 5 years. Looking back ending in September 2020, the Great Lakes basin has recorded the wettest 4-year and 5-year period on record dating back to 1895. The 2010s were the wettest

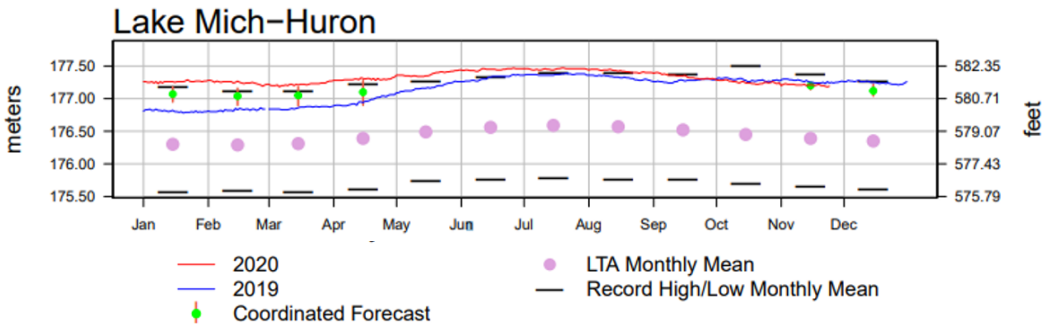


Figure 1: Comparison of 2019 and 2020 Lake Michigan-Huron water levels. (Courtesy of US Army Corps of Engineers)

Inside this issue:

East River Flooding

See how the NWS is working with multiple agencies and the University of Wisconsin to increase forecast lead times to help decision makers and the public prepare for flooding.

decade on record for northeast Wisconsin and it was the 2nd wettest 2-year and 3-year period on record as well. In Wisconsin, annual totals have been above normal for the last 6 out of the last 7 years; ergo, the city of Green Bay broke annual precipitation records in 2018 and 2019.

Although not quite as large of a factor as precipitation, ice cover has also contributed to the record high water levels on Lake Michigan-Huron. Ice cover tends to reduce evaporation during the winter months when water levels typically fall. Over the past seven years, four of those years have recorded above normal ice cover. The 93.3 percent ice cover in 2014 was the highest annual maximum ice coverage since 1979.

The northeast Wisconsin shoreline has observed its fair share of impacts from the record setting water levels. The western shore of the Bay of Green Bay from Marinette to Oconto to the city of Green Bay has been hit particularly hard over the past year from numerous episodes of lakeshore flooding. On April 29, a strong spring storm pushed a storm surge of 2.6 feet into the mouth of the Fox River in Green Bay, which resulted in the 2nd highest water level on record since the early 1970s at the water level gauge at the mouth of the Fox River. This resulted in flooding on the East and Fox Rivers, road closures from Oconto to Suamico to downtown Green Bay, water damage to structures near the shoreline, flooding of parking lots and parks, and widespread shoreline erosion. Looking ahead, Lake Michigan-Huron water levels are expected to fall early next year, which is a normal occurrence during the fall and winter seasons. However, the latest forecast calls for water levels to remain well above the long-term average through next March, and only about 3 to 4 inches below the record water levels for January, February, and March of 2021 (Figure 2). Unfortunately, impacts from the high water levels on Lake Michigan-Huron do not appear to be going away any time soon.

A special thank you to the Army Corps of Engineers Detroit District for the water level data and forecasts.

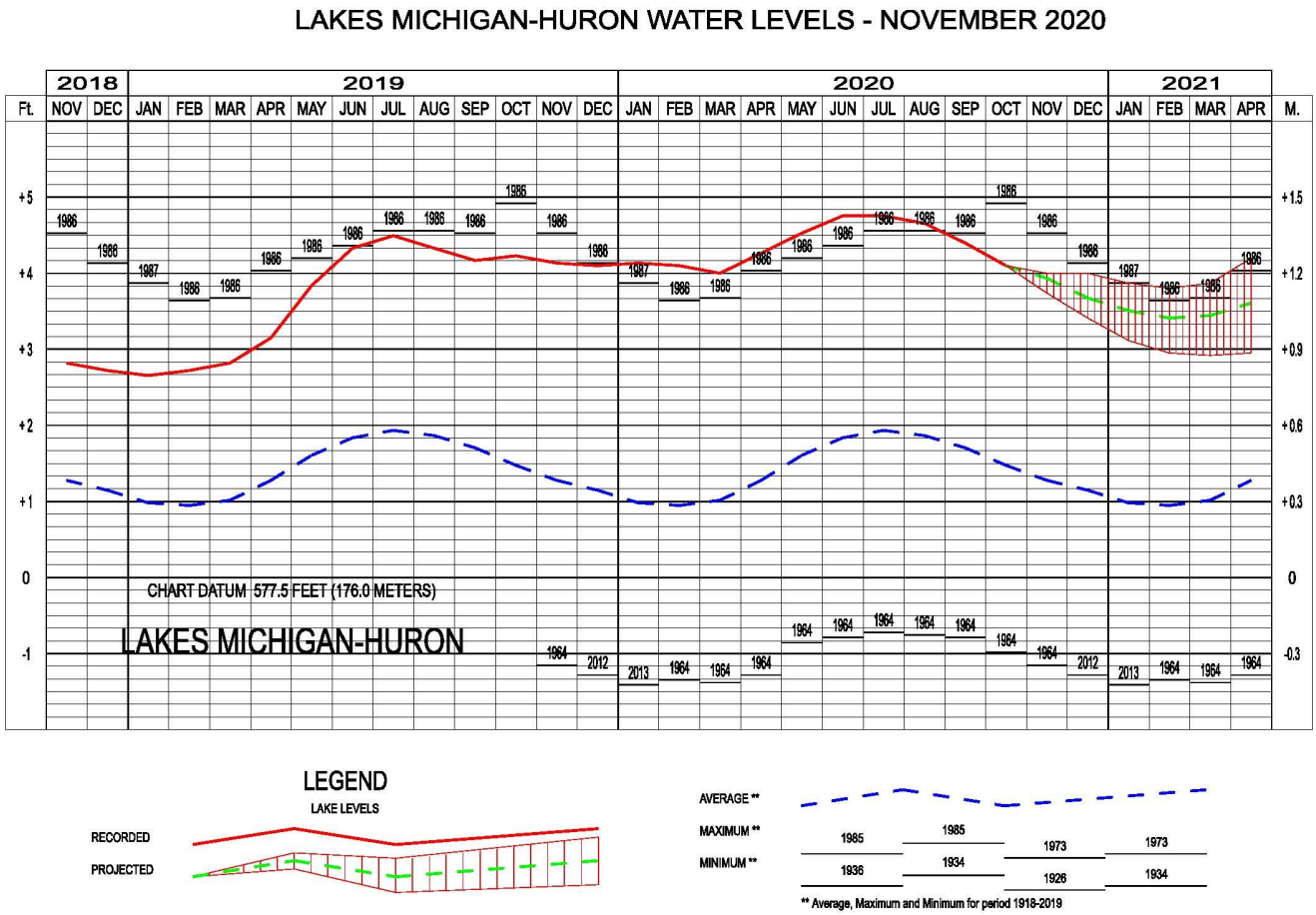


Figure 2: Recorded and projected water levels for Lake Michigan-Huron as of October 2020. (Courtesy of US Army Corps of Engineers)

EAST RIVER WATERSHED RESILIENCY PROJECT

BY: KEITH COOLEY & GENE BRUSKY

Flooding along the East River has become a fairly common occurrence over the past few years due to near record high water levels on the Great Lakes. While some of the flooding has been more of a nuisance, such as flooding along area trails, some events have been very impactful, resulting in flooding of homes, roadways, and evacuations. Most recently, two events which caused significant flooding along the East River and resulted in residential flooding, road closures, and evacuations were in March 2019 (as a result of rain, snowmelt, and ice jamming) and earlier this year in April 2020 (as a result of strong northeast winds and associated storm surge from the Bay).

The East River has a history of flooding that is well documented as far back as the mid 1900s. Although mitigation plans have been enacted along the river to limit the overall impact to area residents, flooding concerns remain. With that in mind, the National Weather Service (NWS) in Green Bay and the North Central River Forecast Center (NCRFC) in Chanhassen, Minnesota, have partnered with multiple agencies across Wisconsin to develop a river level forecast for the East River. In support of forecast development, the NWS has reviewed historical archives to determine the typical patterns and weather phenomena that result in the most impactful flooding events along the East River.

Figure 1. Staff gauge just south of Hoffman Road Bridge.

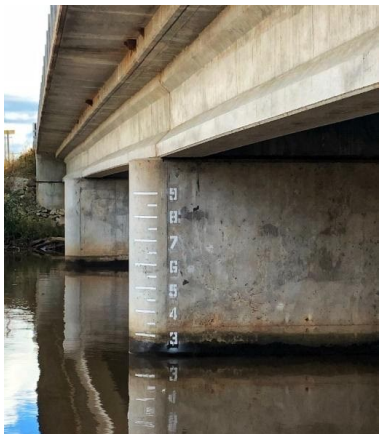


Figure 2: Gauge on Hoffman Road Bridge.

Over the past several years, there were only two river gauge observations along the East River, one located near Greenleaf, and the other 15 miles downstream near the mouth of Green Bay. The lack of observations made it very difficult to calibrate river forecast models to any appreciable accuracy. Thus, the NWS in Green Bay has worked with local partners to install two additional river gauge observations along the East River near the Hoffman Road Bridge (Figures 1 & 2). Although observations have to be taken manually and will have low temporal resolution, the readings will contribute to improving river forecast models. In addition, an East River hydraulic modeling effort is underway, in collaboration with the University of Wisconsin, Sea Grant, and the Department of Civil and Environmental Engineering. In mid-October 2020, several temporary sensors were deployed (Figures 3 & 4) to monitor water levels and the complex streamflow associated with the East River watershed. This data will be utilized to calibrate a high resolution model used to predict flooding in the most vulnerable areas and help to better understand how factors, like storms, lake levels, and land use, drive the worst flooding.

These efforts are ongoing and will hopefully provide useful information that will be recognized through increased forecast lead time of significant flooding threats. This will allow decision-makers and residents along the East River to prepare well in advance of any evacuations or general flooding concerns.

Figure 3: Map of sensor locations.

Figure 4: Surveyor unit measures the bathymetry and discharge.

2020-21 WINTER FORECAST: LA NIÑA CONDITIONS EXPECTED

BY: ROY ECKBERG

Thousands of miles away from Wisconsin, temperature anomalies across the equatorial Pacific Ocean (Figure 1) can have a big impact on winter conditions across the Upper Midwest. Scientists monitor the water temperature anomalies across the Niño 3.4 region for a multitude of reasons including to create a winter forecast for the United States. For an El Niño to occur, water temperature anomalies of +0.5°C or greater must occur for five consecutive months. For a La Niña to occur, water temperature anomalies of -0.5°C or greater must also occur for five consecutive months.

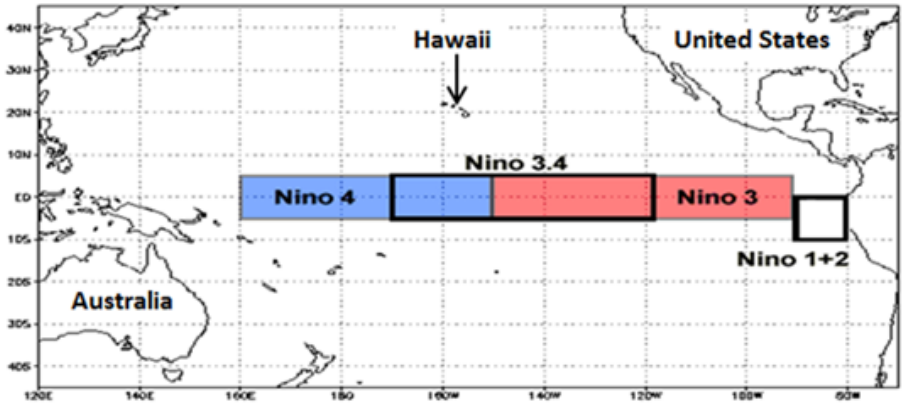


Figure 1: Niño regions for monitoring water temperature anomalies.

The temperature anomalies in the equatorial Pacific Ocean can have a major impact on the location and magnitude of the jet streams (Figure 2). During an El Niño winter, the subtropical jet stream is stronger than normal, while the polar jet is weaker. This pattern usually leads to fewer intrusions of arctic air into the western Great Lakes and a greater likelihood of above normal temperatures during the winter months. When La Niña conditions occur, a ridge of high pressure dominates the western United States. The polar jet stream moves north towards Alaska, and then dives southeast towards the Mid-Atlantic states. This pattern usually leads to more Arctic intrusions into the western Great Lakes region, resulting in an increased chance for below normal temperatures during the winter months.

A La Niña Advisory remains in effect this winter. Moderate to strong La Nina conditions will gradually weaken as we head into spring.

A local study was conducted at the National Weather Service in Green Bay, which looked at 22 La Niña winters since 1950. Average temperatures for 11 of the 22 winters (50%) were below normal, while 8 winters (37%) were above normal, and 3 winters (13%) were near normal. Of the 8 winters that ended above normal, the average was anywhere from 2 to 7 degrees above normal. The study found that there is a slightly better chance of below normal temperatures than above normal temperatures during La Niña winters. Although La Niña plays an import role in winter temperatures across Wisconsin, the pressure patterns near the Arctic Circle (called the Arctic Oscillation) can also significantly impact temperatures. When the Arctic Oscillation is in a positive phase, there are usually less arctic intrusions into the northern United States. In the negative phase, colder than normal conditions are more likely to occur. Unfortunately, the forecast of the Arctic Oscillation only goes out for several weeks, thus it can't be factored into the upcoming winter temperature and

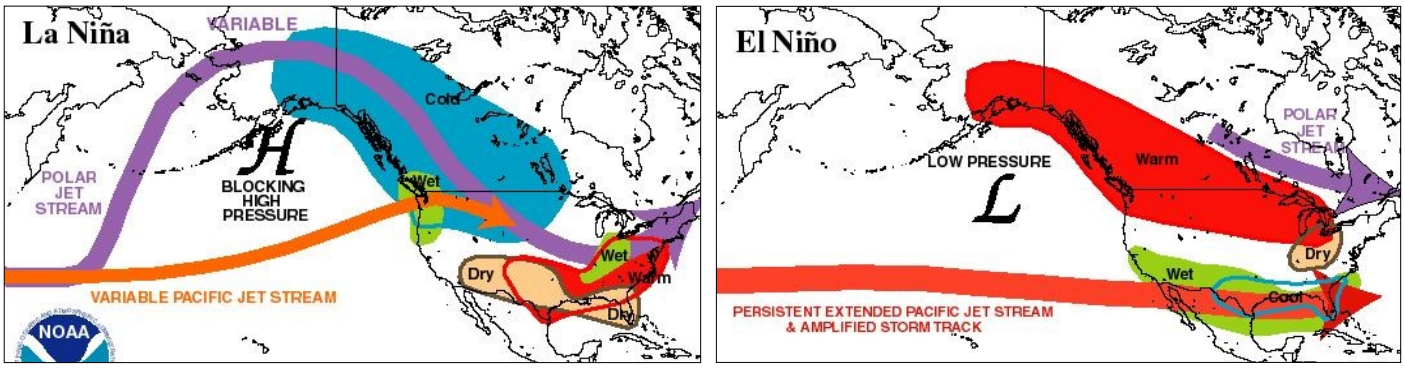


Figure 2: Typical jet stream patterns during El Niño and La Niña winters.

precipitation forecasts.

As for precipitation during a La Niña winter, there is a 77% chance of near or above normal precipitation. According to past events, there is a 68% chance of above normal snowfall for the entire season (Oct-May), while there is only a 32% chance of near or below normal snowfall. Although above normal snow is more likely to occur this winter, it should be noted that La Niña winters can be highly variable in the seasonal snowfall amounts. Some of our snowiest winters occurred during a La Niña winter: 3rd snowiest (2010-11), 4th snowiest (2008-09), 5th snowiest (2007-08), and 8th snowiest (1995-96). Five other winters also made the top 40 snowiest winters on record at Green Bay. However, when the jet stream pattern sets up south of the state, most of Wisconsin sees reduced seasonal snow totals. There have been 6 winters that made the top 40 least snowiest winters on record.

The climate models are indicating a nearly equal chance of above, below, or near normal temperatures (Figure 3). This is not surprising given the high variability in past events at Green Bay. Above normal precipitation, including snowfall, is likely this winter (Figure 4). Previous La Niña winters would support the wetter and snowier forecast. Will have to wait and see what mother nature brings this winter.

For more climate information, visit:

https://www.cpc.ncep.noaa.gov/

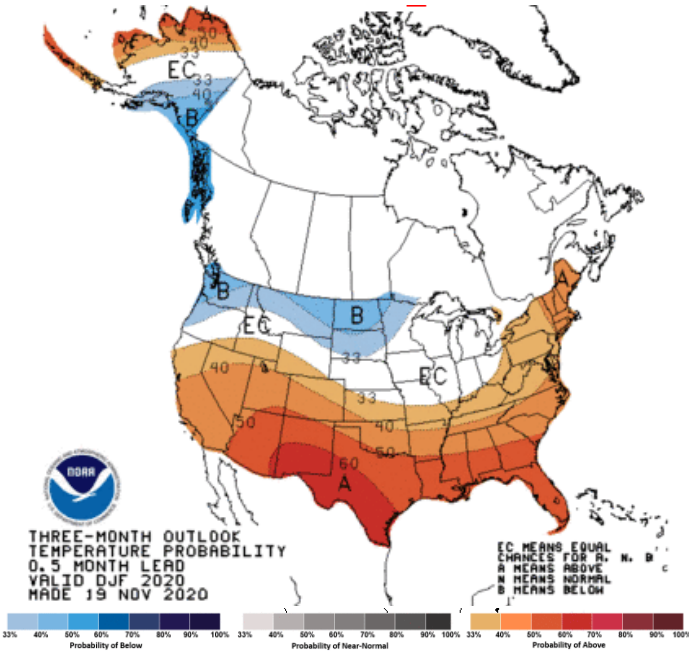


Figure 3: CPC Winter (Dec-Feb) Temperature Forecast.

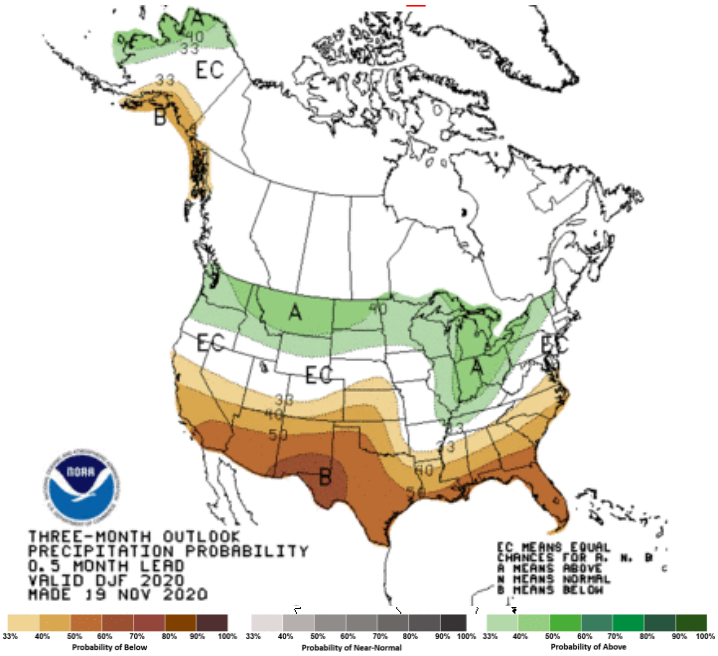


Figure 4: CPC Winter (Dec-Feb) Precipitation Forecast.

*Remember to visit **www.weather.gov/grb** for the latest watches, warnings, statements, and forecasts.*

BROWN COUNTY EMERGENCY MANAGEMENT RECOGNIZED AS WRN AMBASSADOR OF EXCELLENCE FOR NORTHEAST WISCONSIN

BY: REBECCA HYKIN & PHIL KURIMSKI

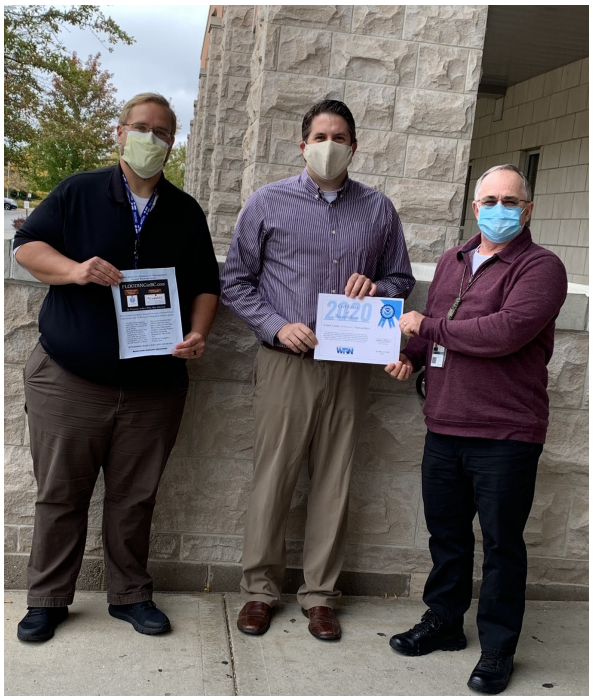
Each year local National Weather Service (NWS) forecast offices honor one Weather-Ready Nation Ambassador for their exemplary efforts helping to build a Weather-Ready Nation (WRN). Over the last year, Brown County Emergency Management (BCEM) has made excellent efforts as a WRN Ambassador and was recognized as this year's WRN Ambassador of Excellence for northeast Wisconsin.

BCEM routinely promoted weather safety and preparedness through their social media channels and CodeRED notifications, sending emails, texts, or calls to citizens when flooding threatens their neighborhood. Officials from BCEM also organized several community events with representatives from several organizations, including the NWS, promoting safety and preparedness messages about lakeshore flooding and erosion due to record high lake levels on the bay of Green Bay. BCEM continued their safety and preparedness efforts by creating a special one-stop-shop website (floodinginbc.com) dedicated to flooding resources for the community. BCEM's outstanding work has helped ensure the public is ready, responsive, and resilient for these unusual events, in addition to other extreme weather and water events.

If your organization or business is committed to weather safety, willing to help spread the word, and inspire others to take action, the NWS wants to recognize your work! Join the thousands of WRN Ambassadors across the nation and help build a Weather-Ready Nation.

For more information, visit:

https://www.weather.gov/wrn/



Left to right: Lauri Maki (Brown County Emergency Manager Director), Kurt Kotenberg (Weather Coordination Meteorologist - NWS Green Bay), Sam Martin (Brown County Emergency Management Coordinator)

Certificate of Recognition and StormReady sign given to the Brown County Emergency Management

KOTENBERG JOINS NWS GREEN BAY AS WARNING COORDINATION METEOROLOGIST

BY: LINDA SKOWRONSKI

Kurt Kotenberg joined the staff at the National Weather Service in Green Bay as the Warning Coordination Meteorologist on August 30. He succeeds Jeff Last who retired last year.

Kotenberg began his career with the National Weather Service as a Meteorologist Intern at the Midland, Texas office. He then accepted a promotion as a Meteorologist at the Des Moines, Iowa office. As the Warning Coordination Meteorologist in Green Bay, he will serve as the primary liaison between the weather forecast office, our core partners in state and local agencies, as well as tribal nations, to ensure the office Impact-Based Decision Support Services meet the needs of our citizens throughout northeast and north-central Wisconsin. As a former member of broadcast media, Kotenberg highly values building partnerships with the media and Emergency Managers, as well as all members of the public.

Kotenberg earned his Bachelor's Degree and Master's Degree in Atmospheric Sciences from the University of Wisconsin-Milwaukee. In addition, he earned an MBA Degree from Iowa State University.

Kurt, his wife Erin, and their two children are happy to be back in their home state of Wisconsin.

Welcome to Green Bay Kurt!

SEVERE WEATHER SPOTTER RESOURCES

BY: PHIL KURIMSKI

Storm spotters are volunteers who help their community and the National Weather Service (NWS) by keeping an "eye on the sky" during severe and hazardous weather. Spotters contact their local office by phone, amateur radio, or the internet to keep forecasters updated with the latest weather information from their location. Anyone over the age of 15 can become a spotter. In 2020, NWS Green Bay offered several online spotter classes, as well as a pre-recorded version.

If you would like to become a severe weather spotter for northeast or north-central Wisconsin, you must either attend training presented by NWS Green Bay or complete the online courses through COMET or the NWS. To remain a spotter in good standing, you must either attend a refresher course or retake the online courses every 2-4 years.

For more information about the Severe Weather Spotter program please visit:

www.weather.gov/grb/skywarn

This page offers resources, training, and Frequently Asked Questions about the storm spotter program. Bookmark this page and stay tuned to our Facebook and Twitter accounts for information regarding training for the spring of 2021.

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SKYWARN

THANK YOU COOP/UCOOP/COCORAHS OBSERVERS!

BY: SCOTT CULTICE & SCOTT BERSCHBACK

Happy Winter!

We wanted to personally thank each of you for your dedicated rain and snow measuring efforts through the years!

Your dedicated, timely, and accurate measurements allow us to provide better service to our partners and the public and, in some cases, immediate life-saving action. In addition, the observations provide important data for research and advancements in forecast and warning services.

As we look ahead to the new winter season, you can find many helpful reminders on measuring snow/ice and water equivalent online:

Slide Shows:

www.cocorahs.org/Content.aspx?page=training_slideshows

Videos:

www.youtube.com/user/cocorahs

Have a safe winter! If you have any questions, please send us an e-mail or give us a call.

Thanks again!

COOP AWARDS

50 Year Institutional Award

Daryl Rutkowski - City of Eagle River WWTP

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WINTER WEATHER WORD SEARCH

WINTER SAFETY VEHICLE KIT ITEMS

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