

GREAT LAKES WATER LEVELS

Dr. Lauren Fry

Detroit District, Corps of Engineers

Date: 9 Nov 2019



US Army Corps
of Engineers®



HIGH WATER PHOTOS FROM ACROSS THE GL



~ 5ft difference between Jan 2008 and May 2019



HIGH WATER PHOTOS FROM ACROSS THE GL



Credit





HIGH WATER PHOTOS FROM ACROSS THE GL



Credit



Credit: The Columbus Dispatch
- Tom Hawley



05.07.2019





HIGH WATER PHOTOS FROM ACROSS THE GL



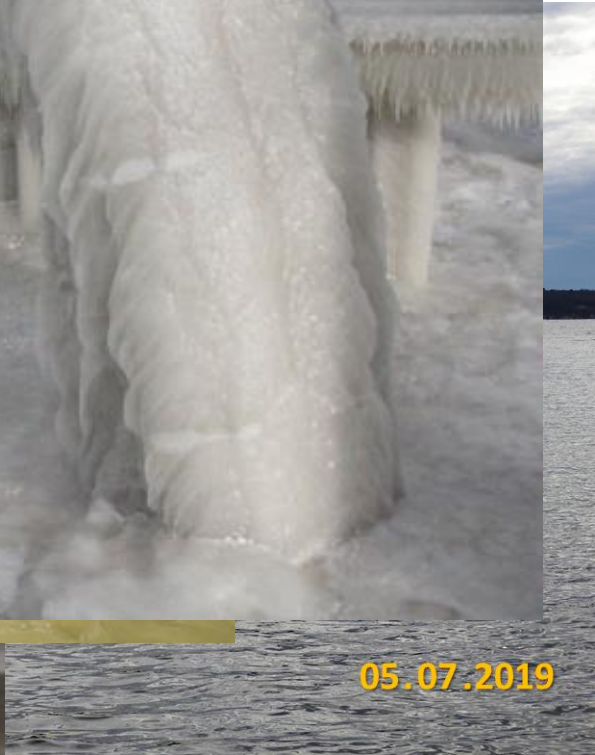
Credit



Credit: The C
- Tom Hawle



Credit: newyorkupstate.com
- Maureen Morgan Wheilan

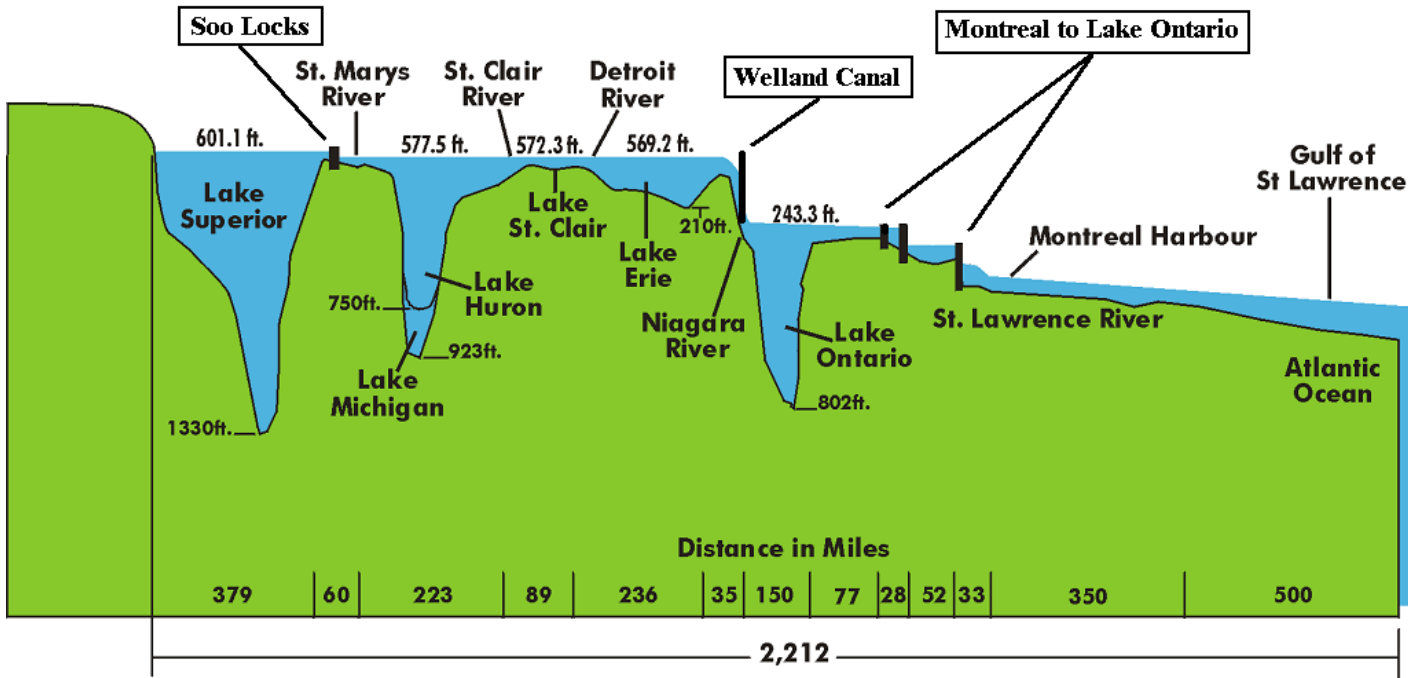


05.07.2019



The Great Lakes Basin

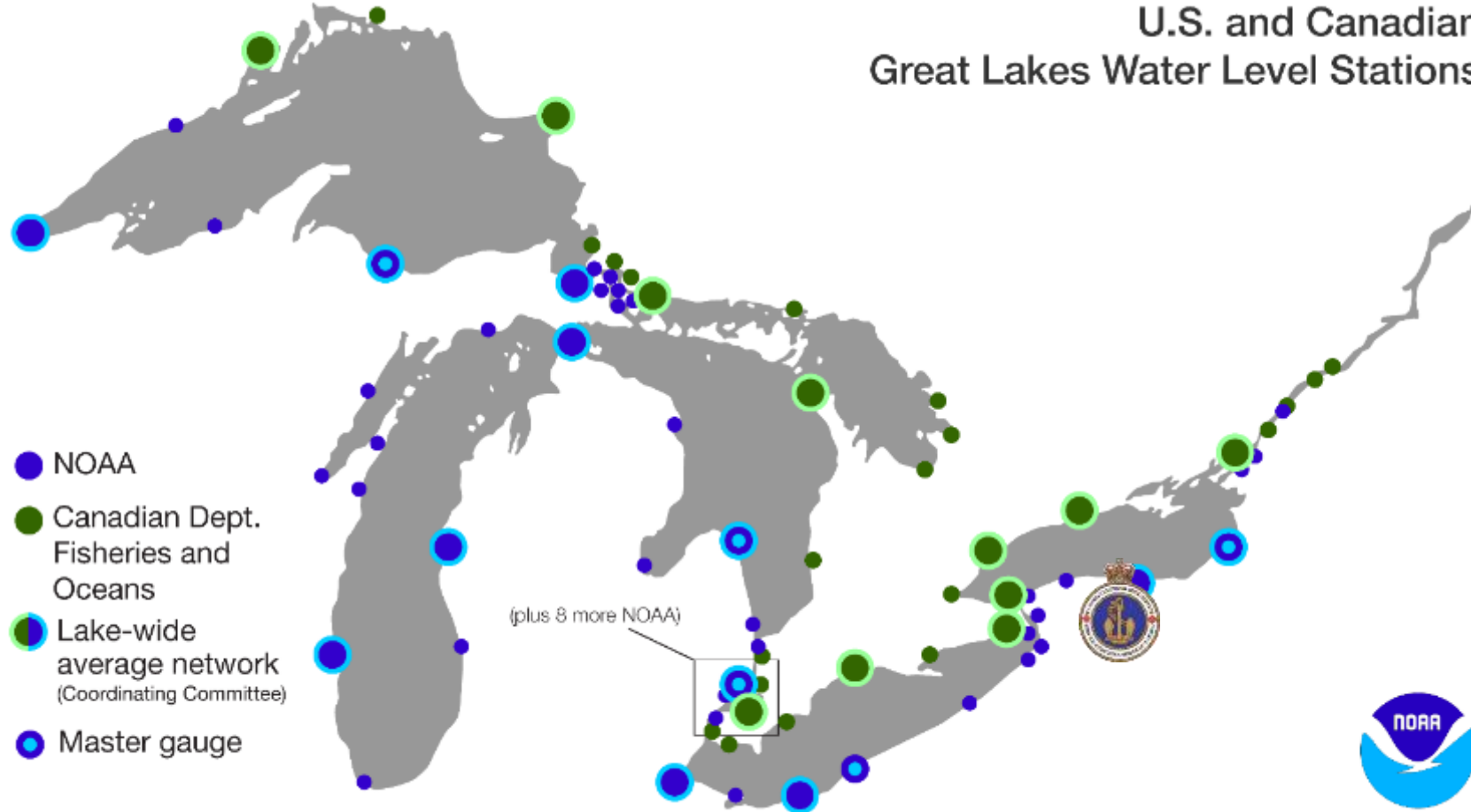
- 14,000 miles of shoreline
- 95,000 square miles of water
- 200,000 square miles of land
- 8 States & 2 Provinces





MONITORING WATER LEVELS

U.S. and Canadian Great Lakes Water Level Stations



Daily Average Water Levels Based on Lake-Wide Average Network

- **Lake Superior:** Duluth, Marquette, Pt. Iroquois, Thunder Bay, Michipicoten
- **Lakes Michigan-Huron:** Harbor Beach, Ludington, Mackinaw City, Milwaukee, Tobermory, Thessalon
- **Lake St. Clair:** St. Clair Shores, Belle River
- **Lake Erie:** Toledo, Cleveland, Port Stanley, Port Colborne
- **Lake Ontario:** Oswego, Rochester, Toronto, Kingston, Port Weller, Cobourg



- Station Info ▾
- Tides/Water Levels ▾
- Meteorological Obs.
- Phys. Oceanography

Gibraltar, MI - Station ID: 9044020

- Station Info
- Today's Tides
- Photos
- Sensor Information
- Observations
- Directions and Map
- Available Products

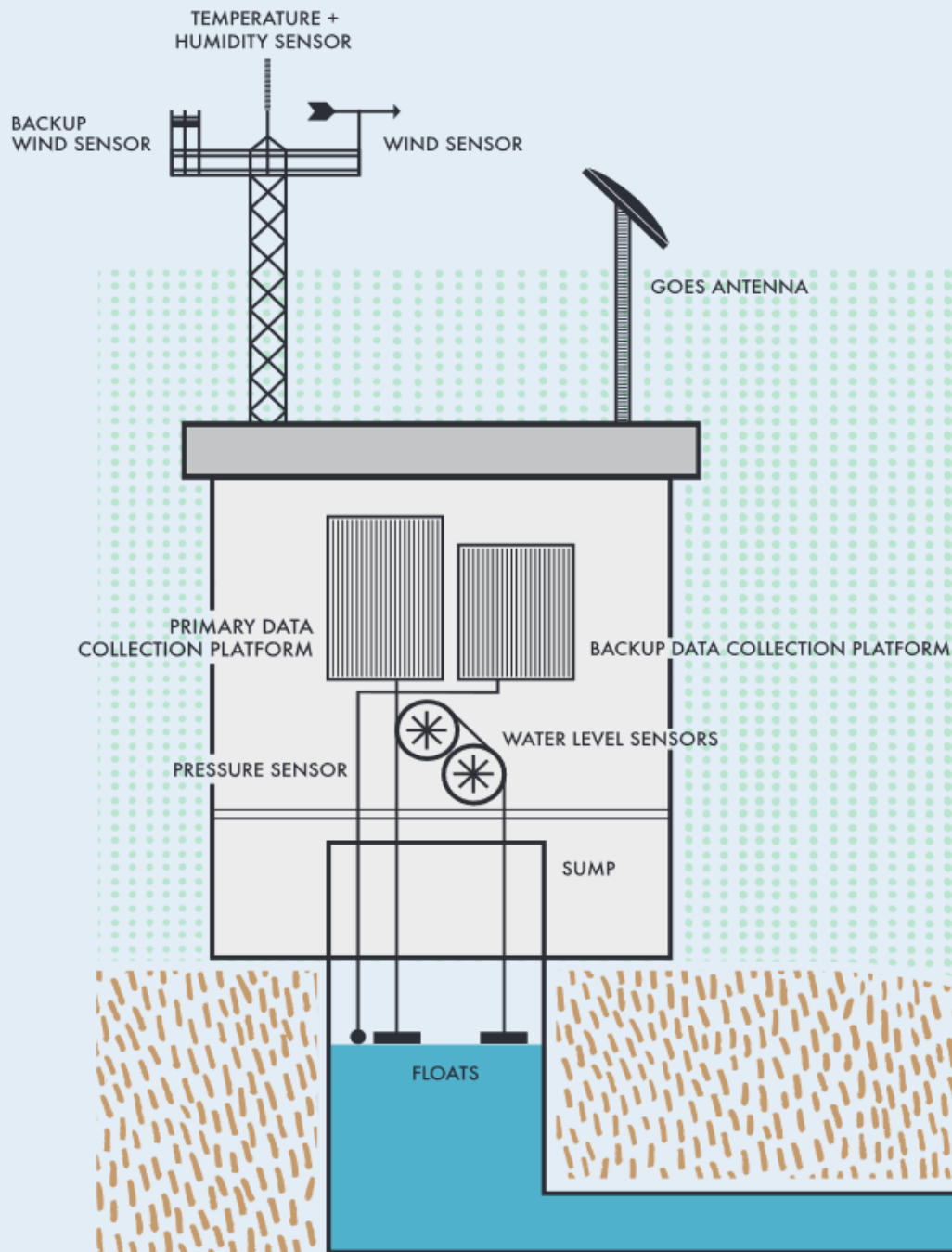
Established:	Nov 08, 1989
Time Meridian:	75° W
Present Installation:	Nov 08, 1989
Date Removed:	N/A
Water Level Max (ref MHHW):	N/A
Water Level Min (ref MLLW):	N/A
Mean Range:	N/A
Diurnal Range:	N/A
Latitude	42° 5.5' N
Longitude	83° 11.2' W
NOAA Chart#:	14853
Met Site Elevation:	N/A

Tide predictions are not available for Great Lakes stations.
The phone number for voice access to all Great Lakes stations information is: 301-713-9596



Gibraltar, MI

7 more station photos available, click to view.



This diagram shows the primary features of a Great Lakes NOAA gauging station.

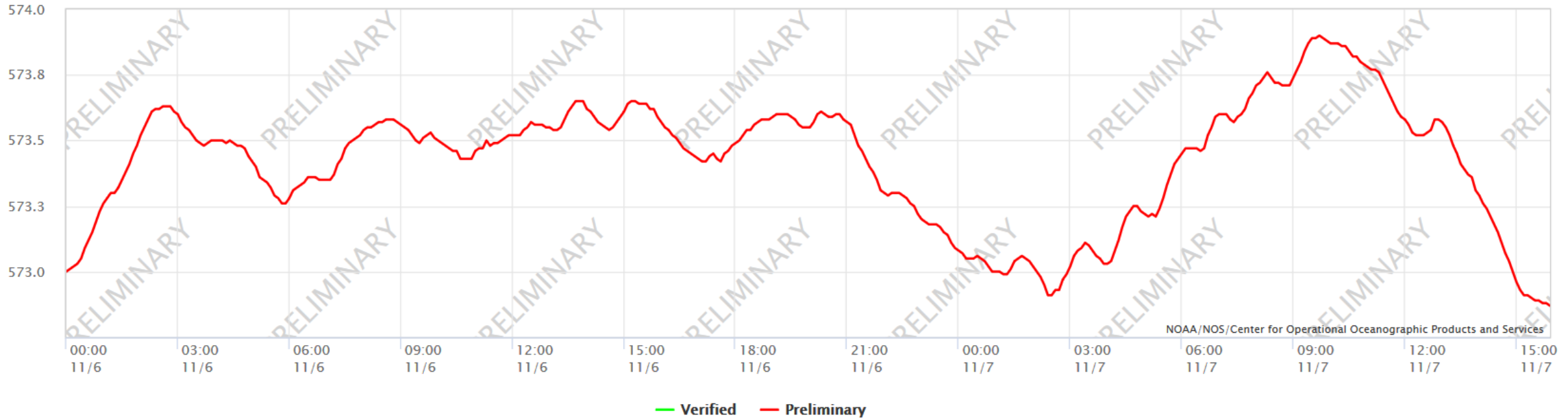
INTAKE



NOAA/NOS/CO-OPS
Observed Water Levels at 9044020, Gibraltar MI
From 2019/11/06 00:00 LST/LDT to 2019/11/07 23:59 LST/LDT

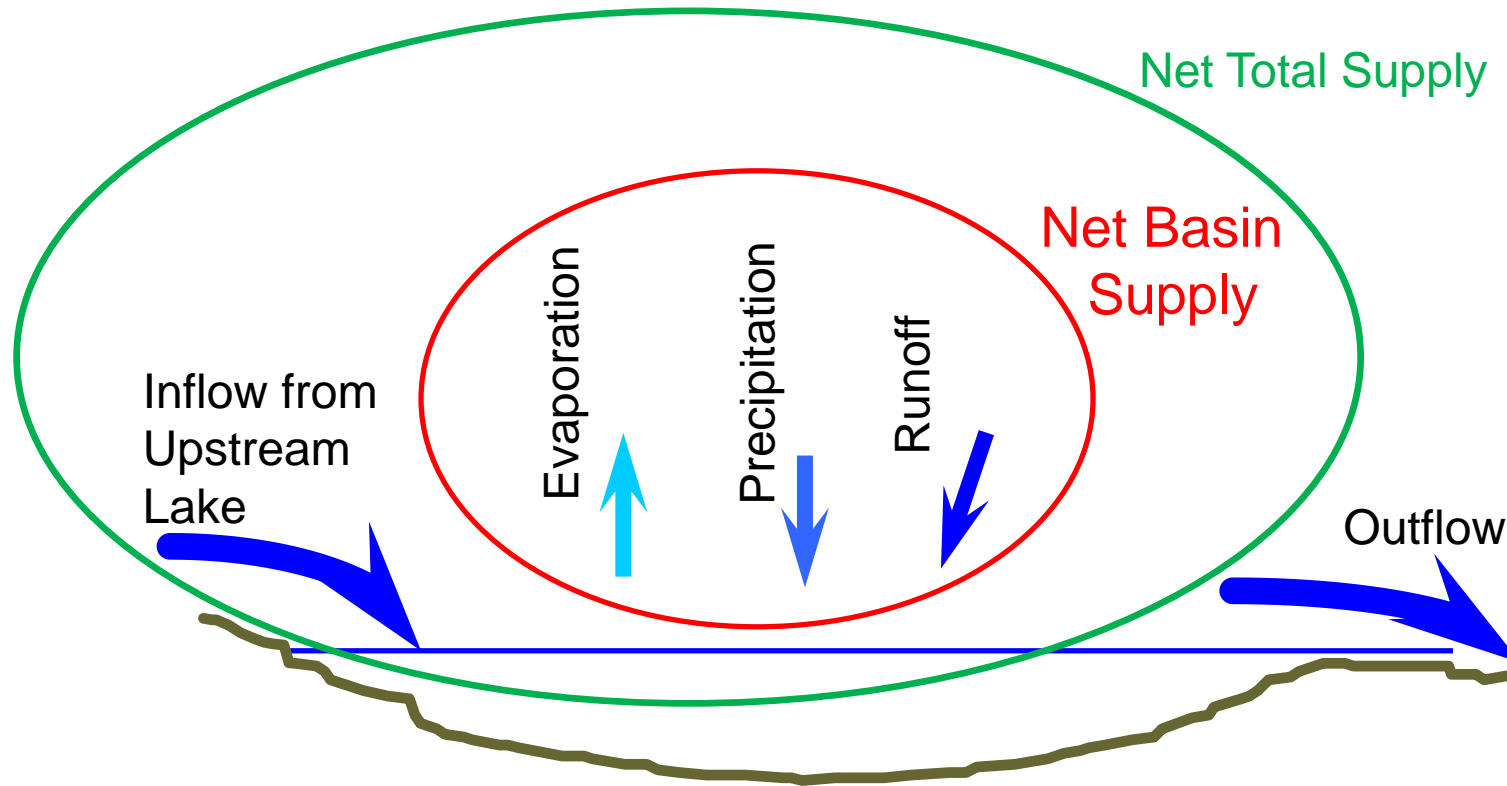


Height in feet (IGLD 1985)



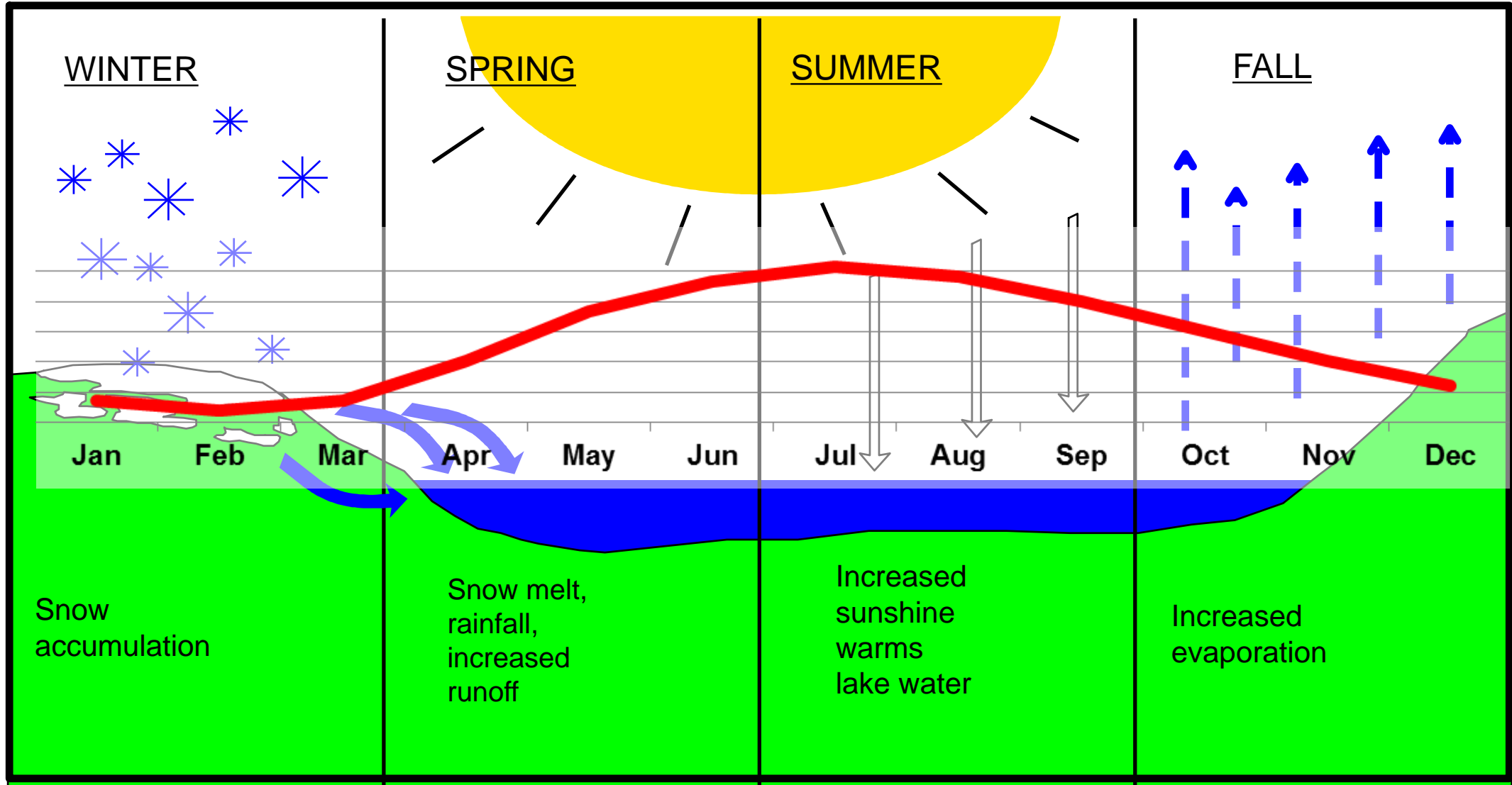


FACTORS IMPACTING WATER LEVELS





ANNUAL WATER LEVELS AND THE HYDROLOGIC CYCLE





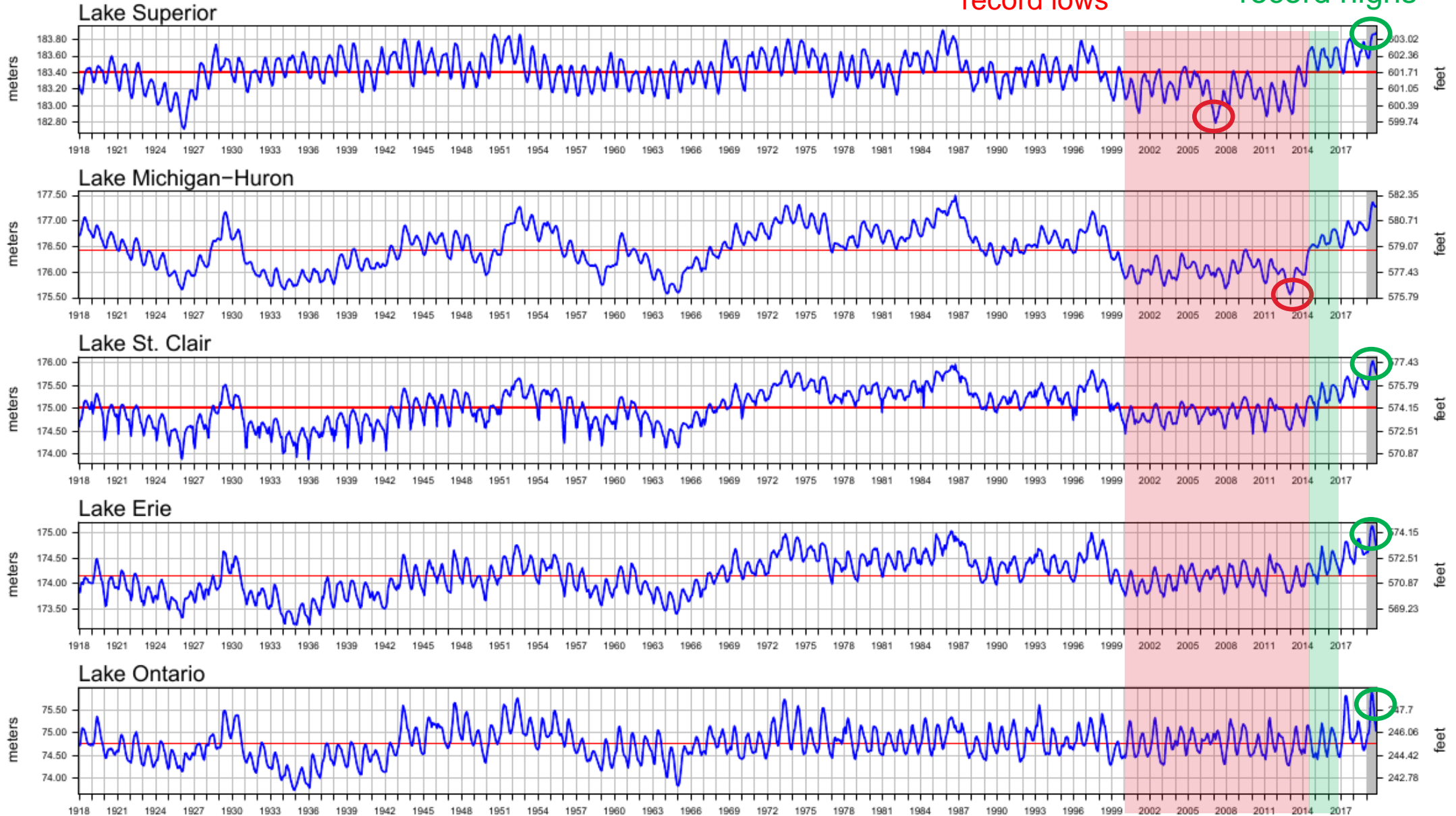
Great Lakes Water Levels (1918–2019)

Decade plus of low water with record lows

Record rise and record highs



— Monthly Mean Level — Long Term Average Annual

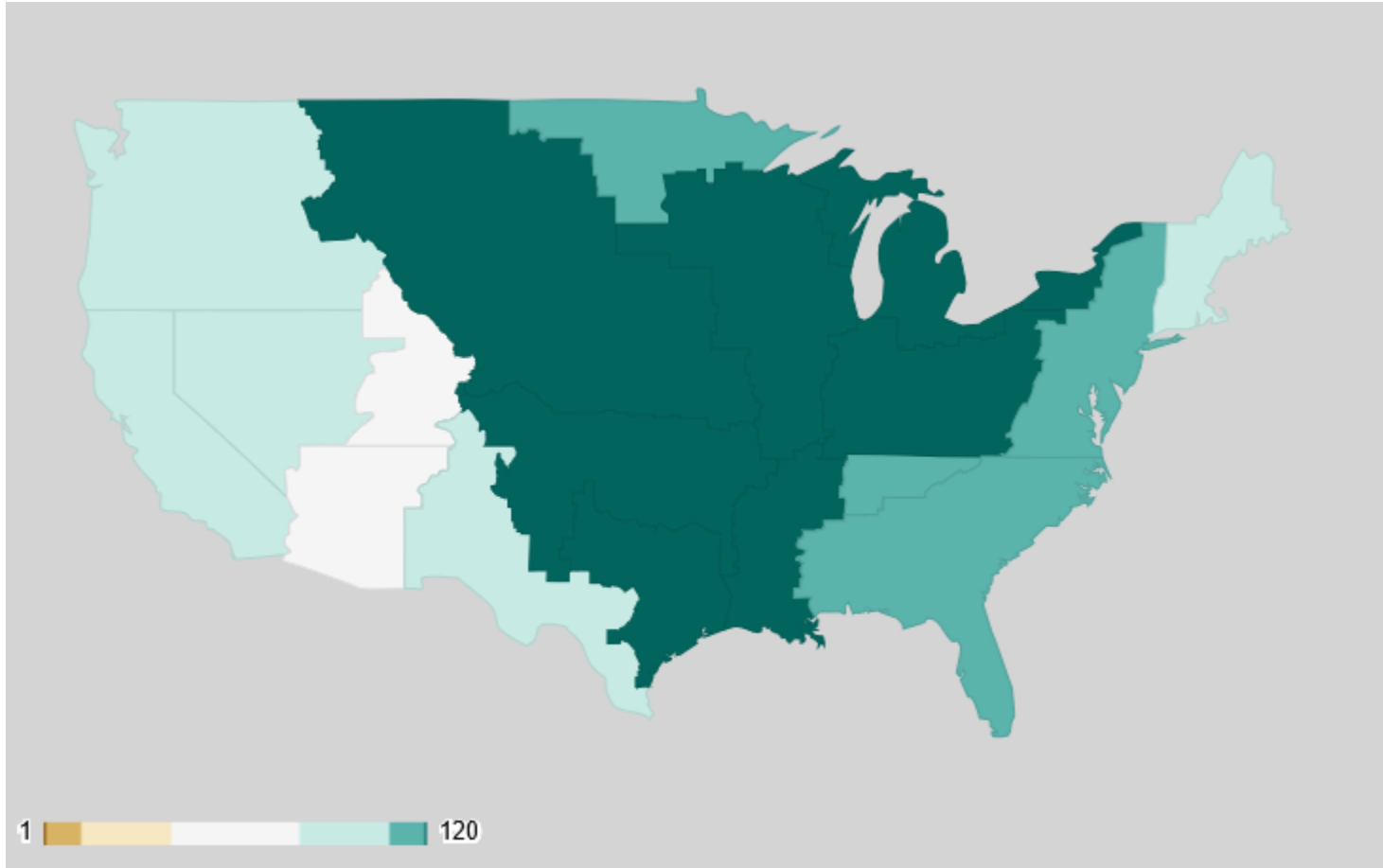


The monthly average levels are based on a network of water level gages located around the lakes. Elevations are referenced to the International Great Lakes Datum (1985).

Water levels have been coordinated through 2018. Values highlighted in gray are provisional.



60 MONTH PRECIPITATION RANKS



The 60 month period ending 31 OCT was the wettest in 120 years of record for the Great Lakes Basin

NOAA National Centers for Environmental information, Climate at a Glance: Regional Mapping, published September 2019, retrieved on September 30, 2019 from <https://www.ncdc.noaa.gov/cag/>

REGION	VALUE	RANK (120 YEARS)	1901-2000 MEAN	ANOMALY
Great Lakes Basin	190.32"	120	163.87"	26.45"

Maps/Legend Export/Data About

Dataset:
Merged CaPA and MPE

Data Type:
Departure

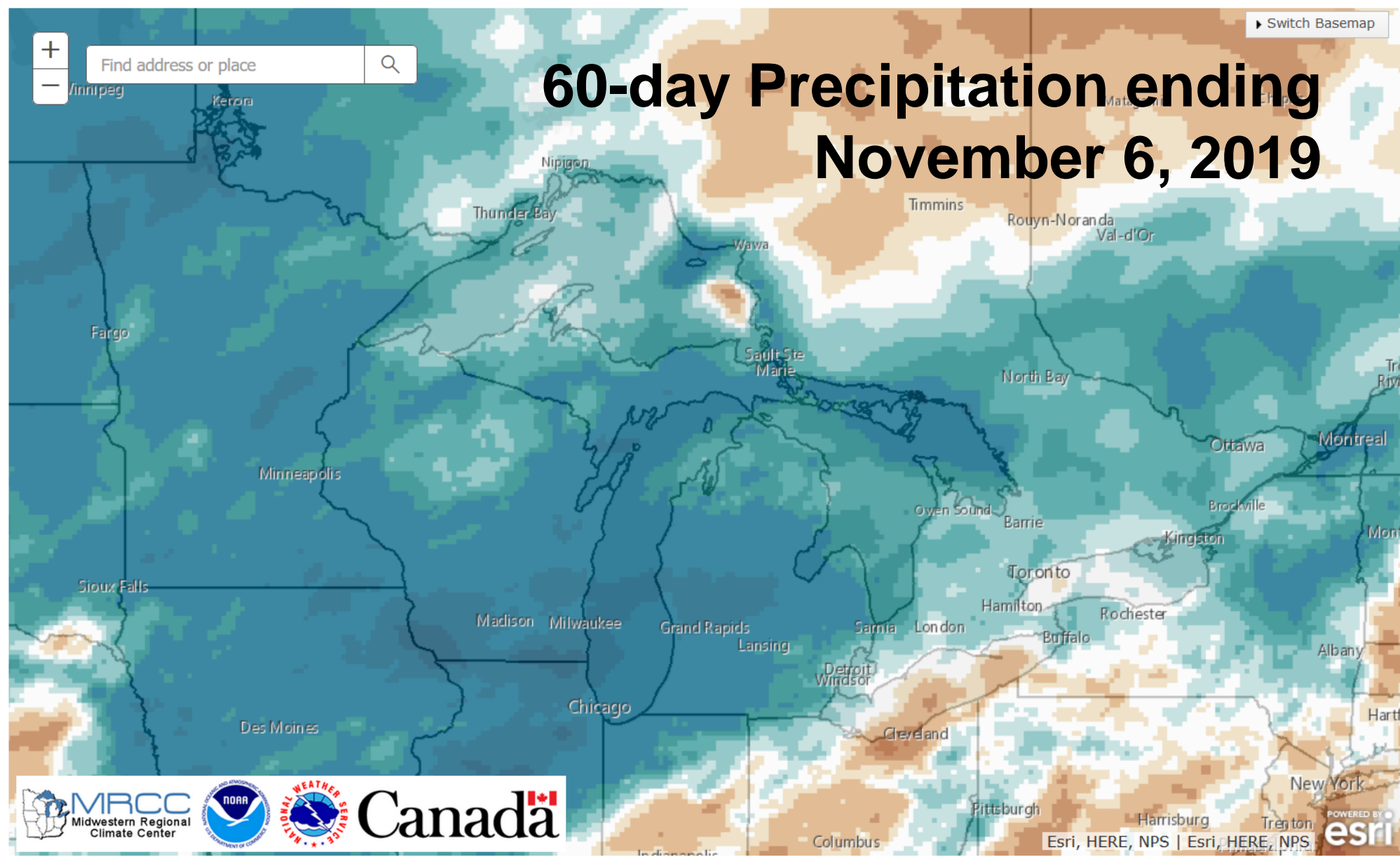
Timeframe:
60-day period;
ending at 12 UTC on:
Nov 06 2019

Legend (mm):

Merged

Merged Last 60-day Departure

- >= 300
- < 300
- < 200
- < 100
- < 75
- < 50
- < 25
- 10 to +10
- < -10
- < -25
- < -50
- < -75
- < -100
- < -200
- < -300



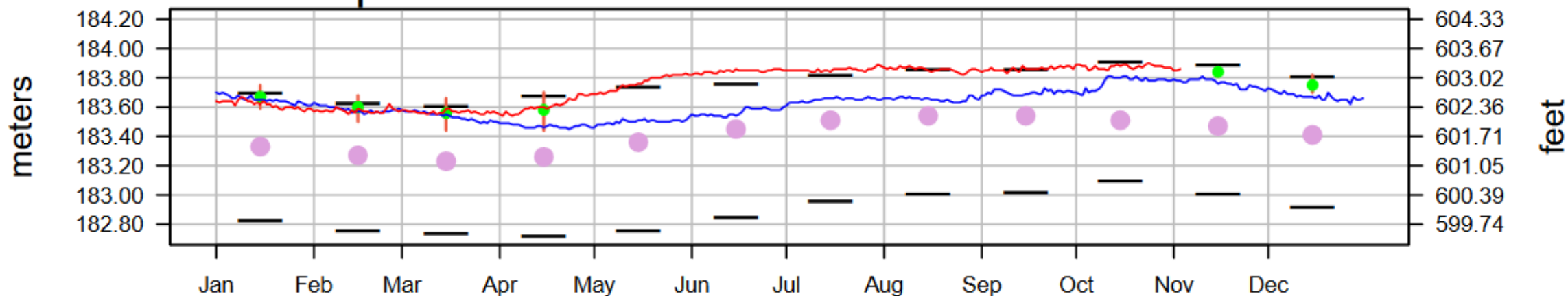
60-day Precipitation ending November 6, 2019



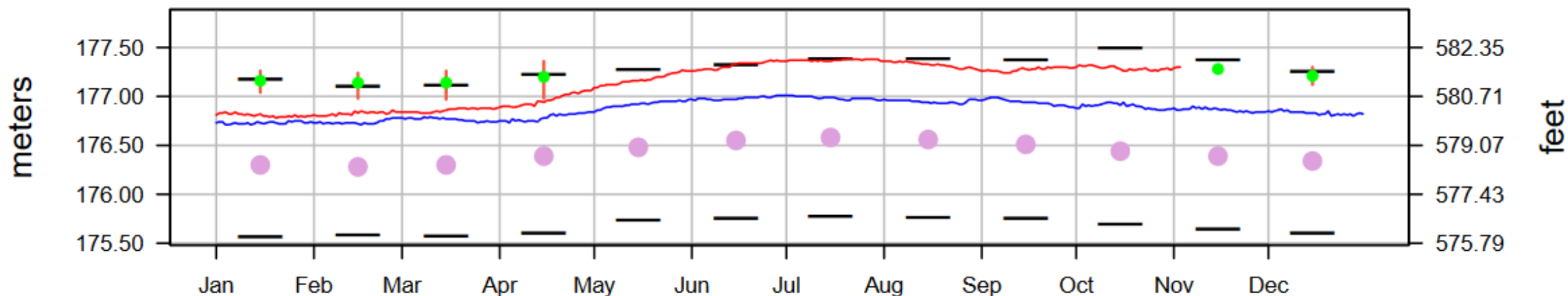
Daily Great Lakes Water Levels

- 2019
- 2018
- Coordinated Forecast
- LTA Monthly Mean
- Record High/Low Monthly Mean

Lake Superior

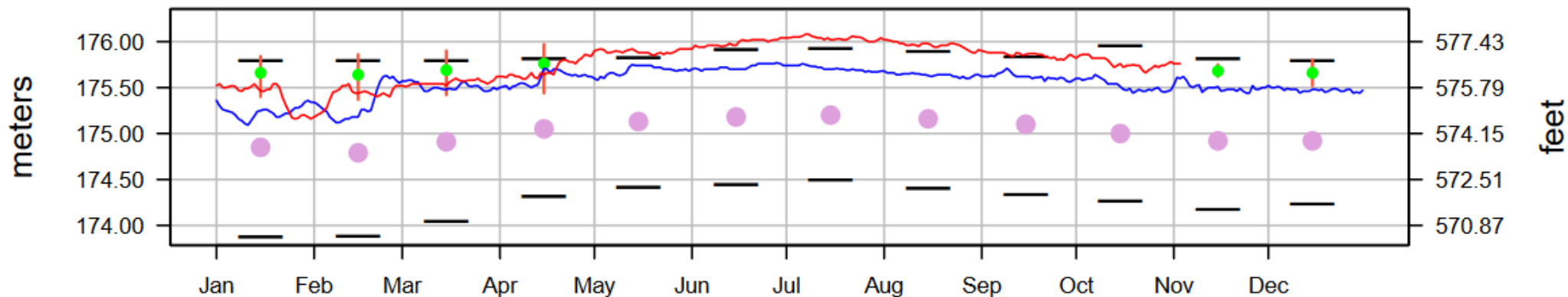


Lake Mich-Huron

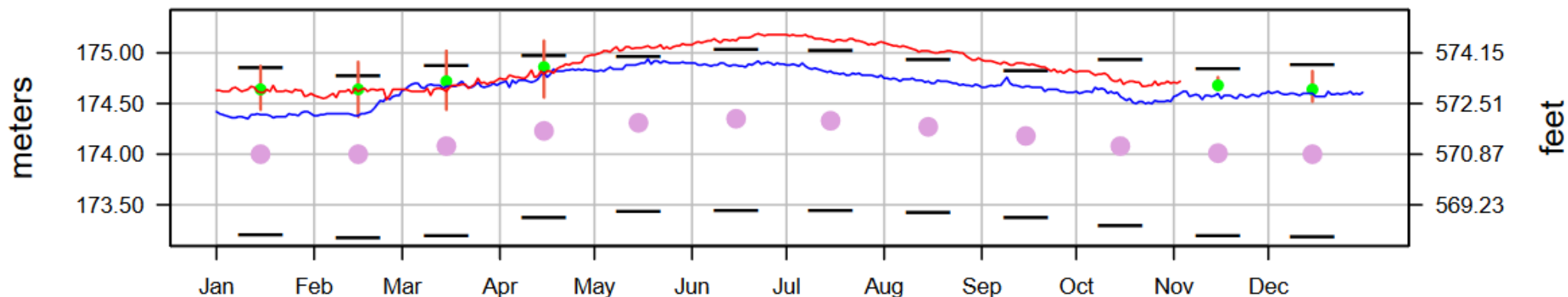




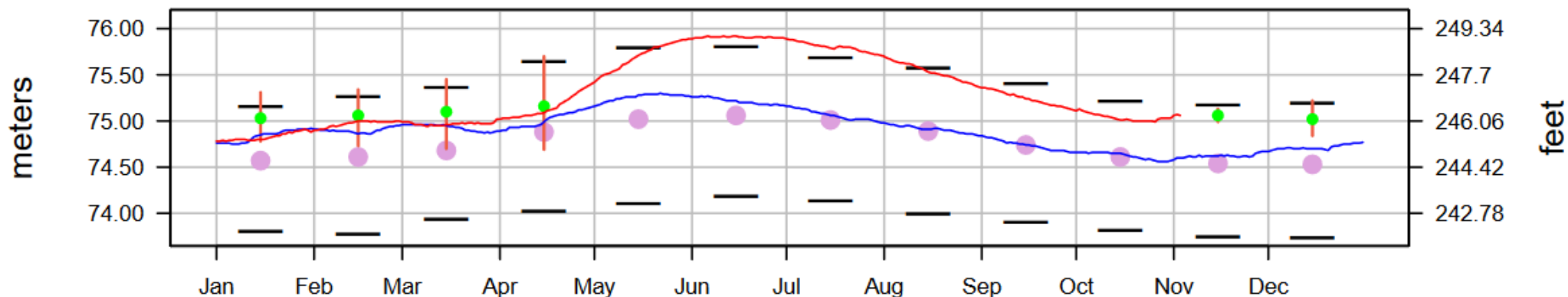
Lake St. Clair



Lake Erie



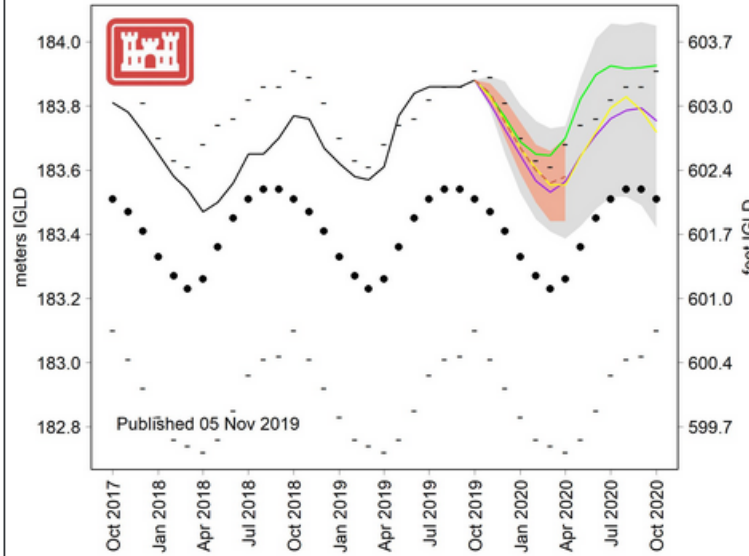
Lake Ontario



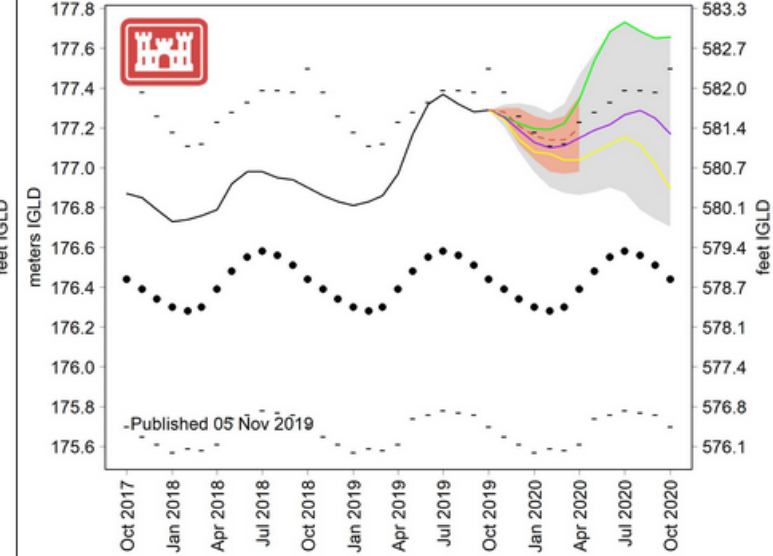


Water Level Outlooks

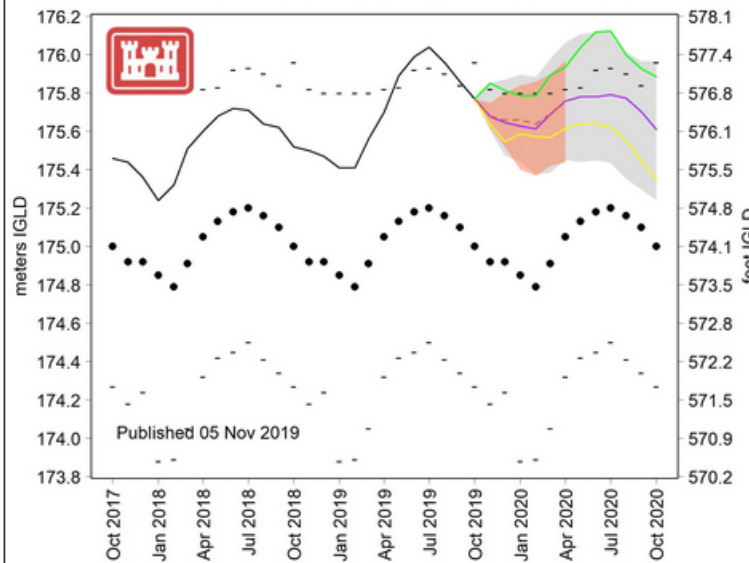
Lake Superior Monthly Mean Water Levels



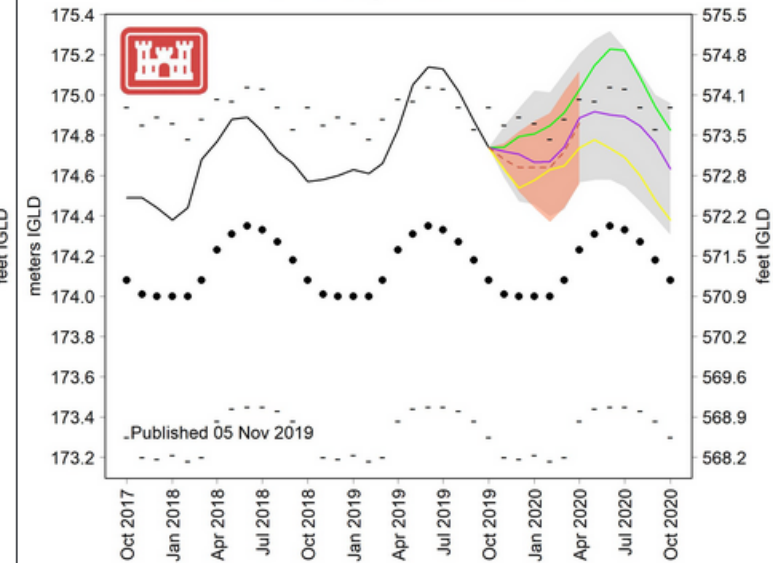
Lake Michigan-Huron Monthly Mean Water Levels



Lake St. Clair Monthly Mean Water Levels



Lake Erie Monthly Mean Water Levels



— Observed Monthly Mean • Long Term Average - Long Term Max/Min

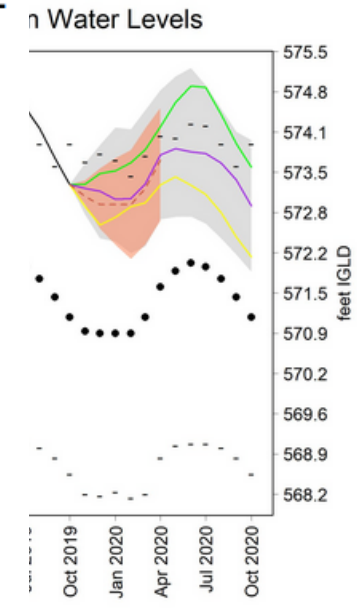
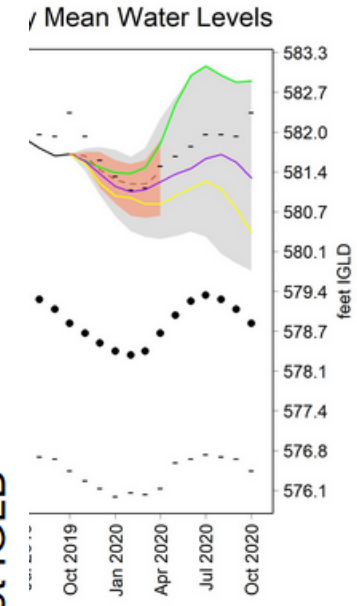
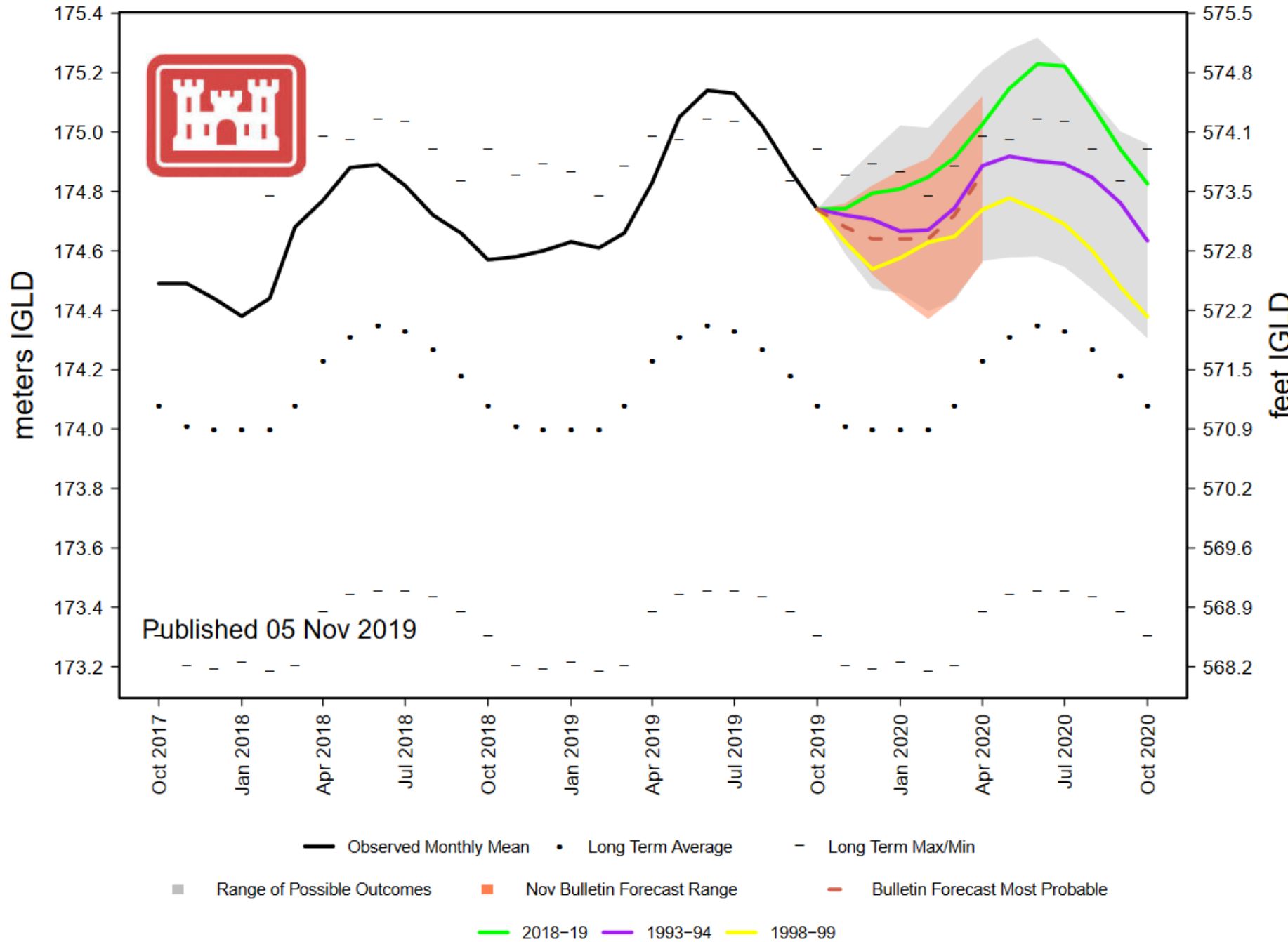
■ Range of Possible Outcomes ■ Nov Bulletin Forecast Range - Bulletin Forecast Most Probable

— 2018-19 — 1993-94 — 1998-99

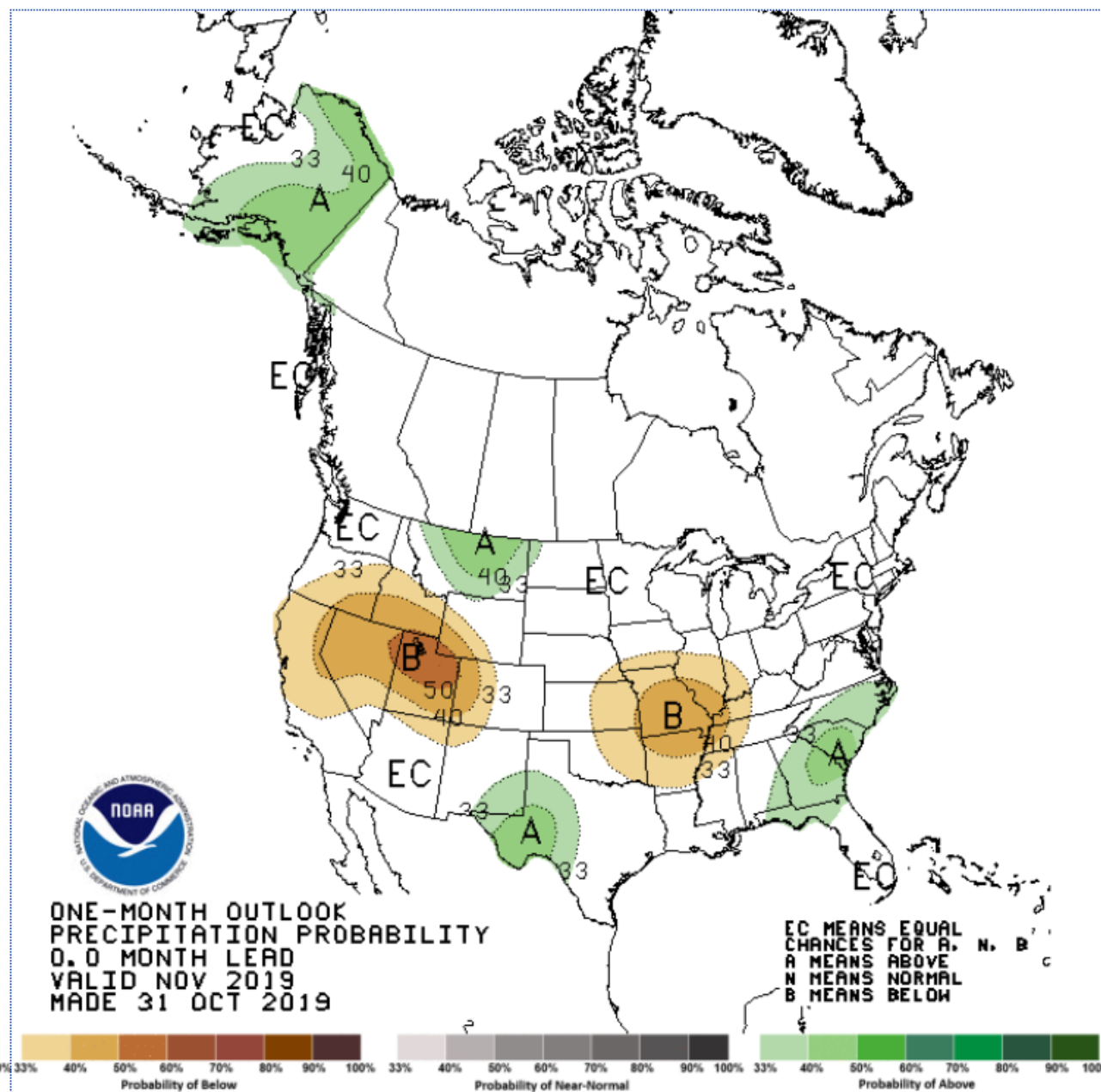
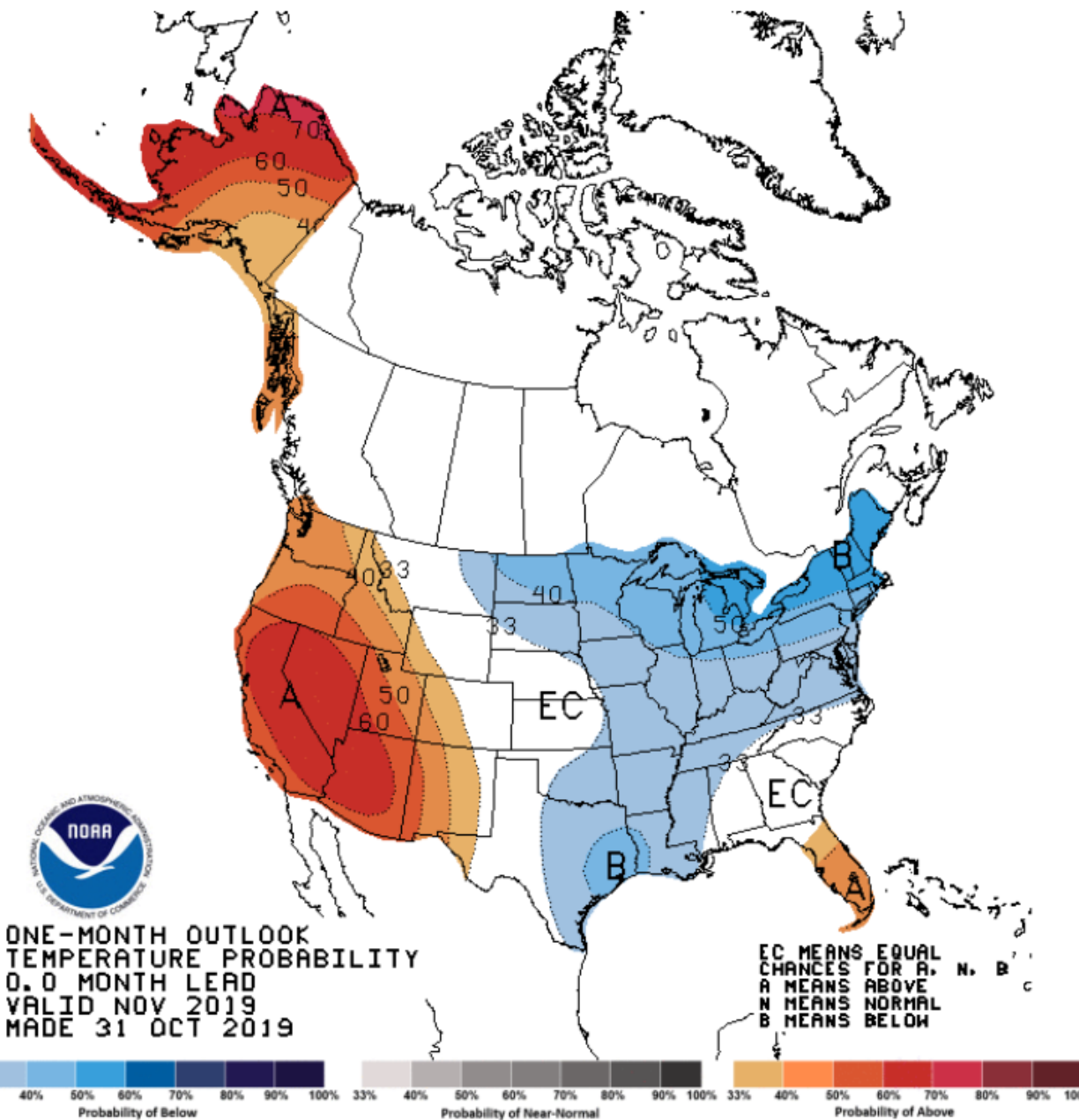


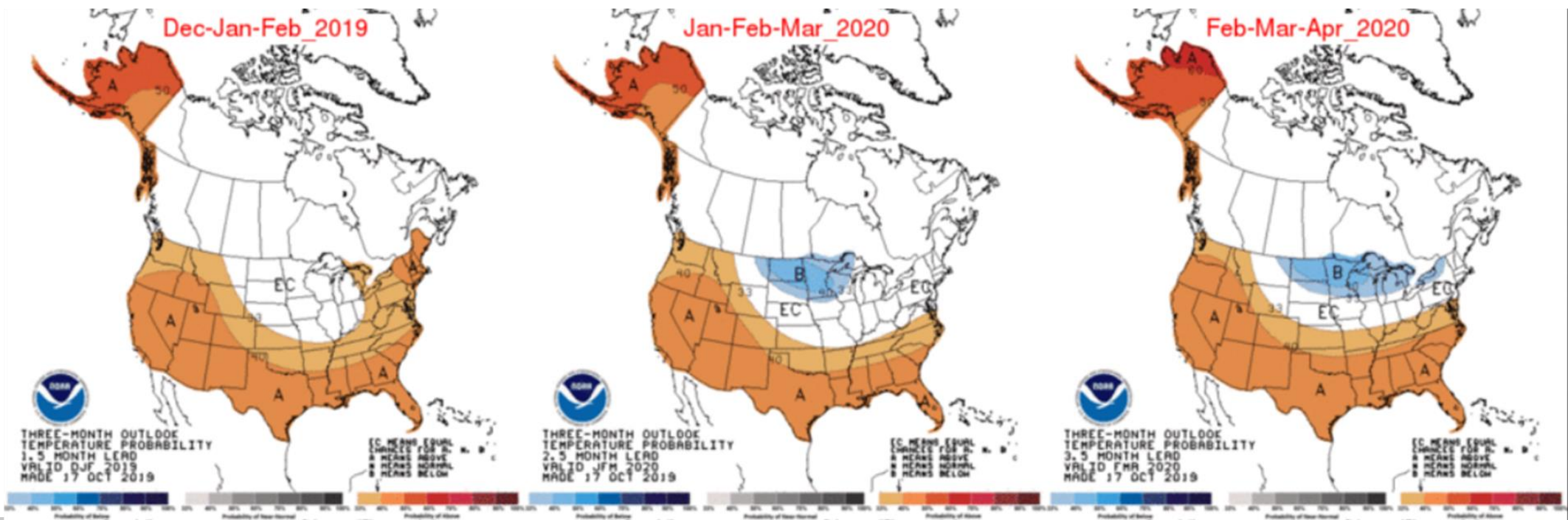
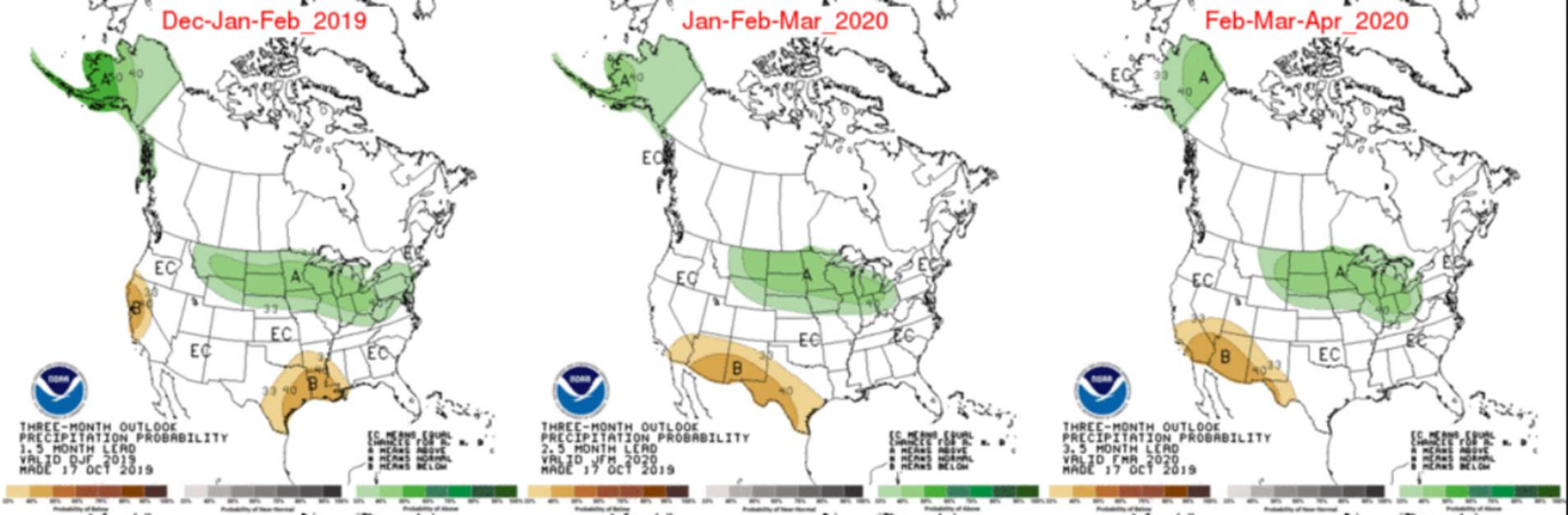
Water

Lake Erie Monthly Mean Water Levels



t Probable








HTTPS://WWW.LRE.USACE.ARMY.MIL/ABOUT/GREAT-LAKES-HIGH-WATER/




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US Army Corps of Engineers Detroit District

Great Lakes High Water

Multiple record high levels were set on the Great Lakes in 2019 resulting in increased risks from erosion and coastal flooding. The U.S. Army Corps of Engineers, Detroit District, is committed to ensuring public safety while providing technical expertise and assistance during this time of high water around the Great Lakes.



During response operations, our Emergency Management Office conducts emergency operations to save lives and protect improved properties. In the event of natural disasters such as flooding, emergency permit procedures can be activated to expedite permits to reduce further damage, and protect life and property. The Corps of Engineers has authority to provide technical and planning assistance for flood plain management planning. The Great Lakes Hydraulics and Hydrology Office forecasts and monitors water levels of the Great Lakes and the conditions that lead to water level fluctuations.



Helpful Links

- [Apply for a Permit](#)
- [Check Permit Application Status](#)
- [USACE, Detroit District, Role in Emergency Management](#)
- [International Lake Superior Board of Control](#)
- [Environment and Climate Change Canada](#)
- [Michigan Sea Grant](#)
- [NOAA - Great Lakes Environmental Research Laboratory](#)
- [Living on the Coast Booklet](#)
- [Sandbagging Instructional Video](#)

Frequently Asked Questions

- Click Question to expand Answer
- Why are water levels on the Great Lakes so high? How long is this expected to last?
 - Does the U.S. Army Corps of Engineers have control over Great Lakes water levels?
 - My shoreline is eroding, can the U.S. Army Corps of Engineers help?
 - My property is flooding, can the U.S. Army Corps of Engineers help?
 - What type of shoreline project requires a permit?



- Emergency Management Office
- Hydraulics and Hydrology Office
- Outreach Office
- Regulatory Office
- Public Affairs Office

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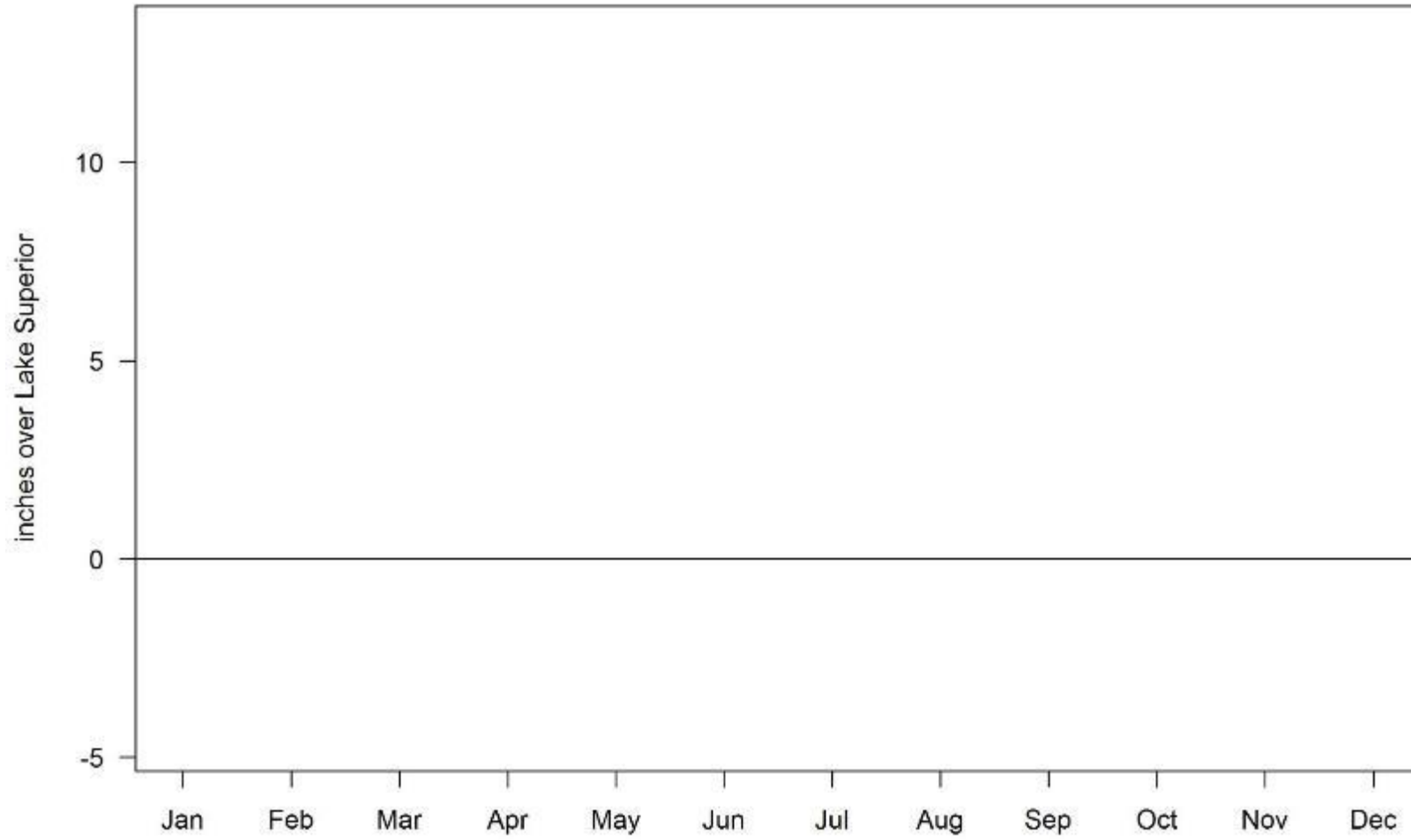
Lauren.M.Fry@usace.army.mil



EXTRA SLIDES

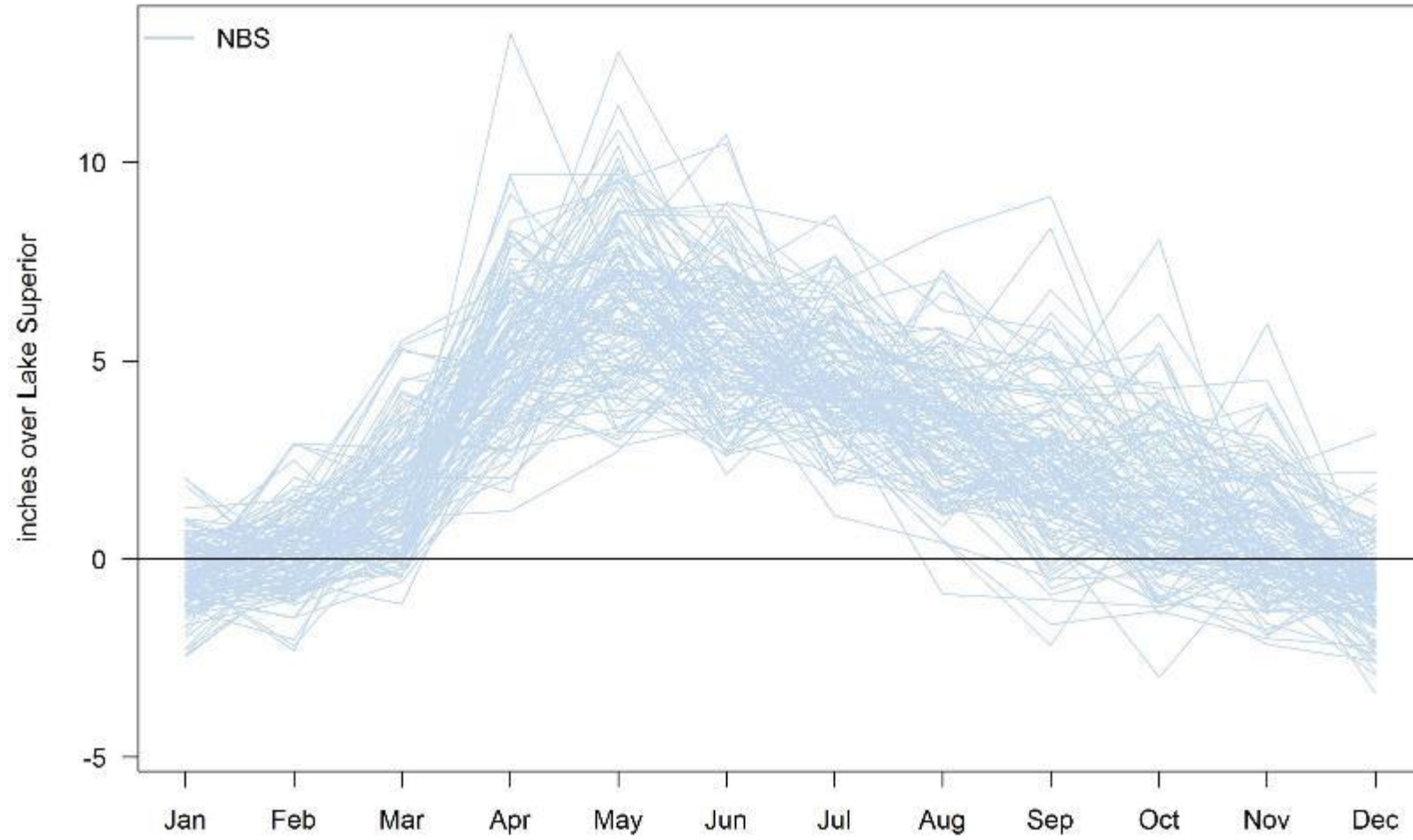


Lake Superior Inflows and Outflows



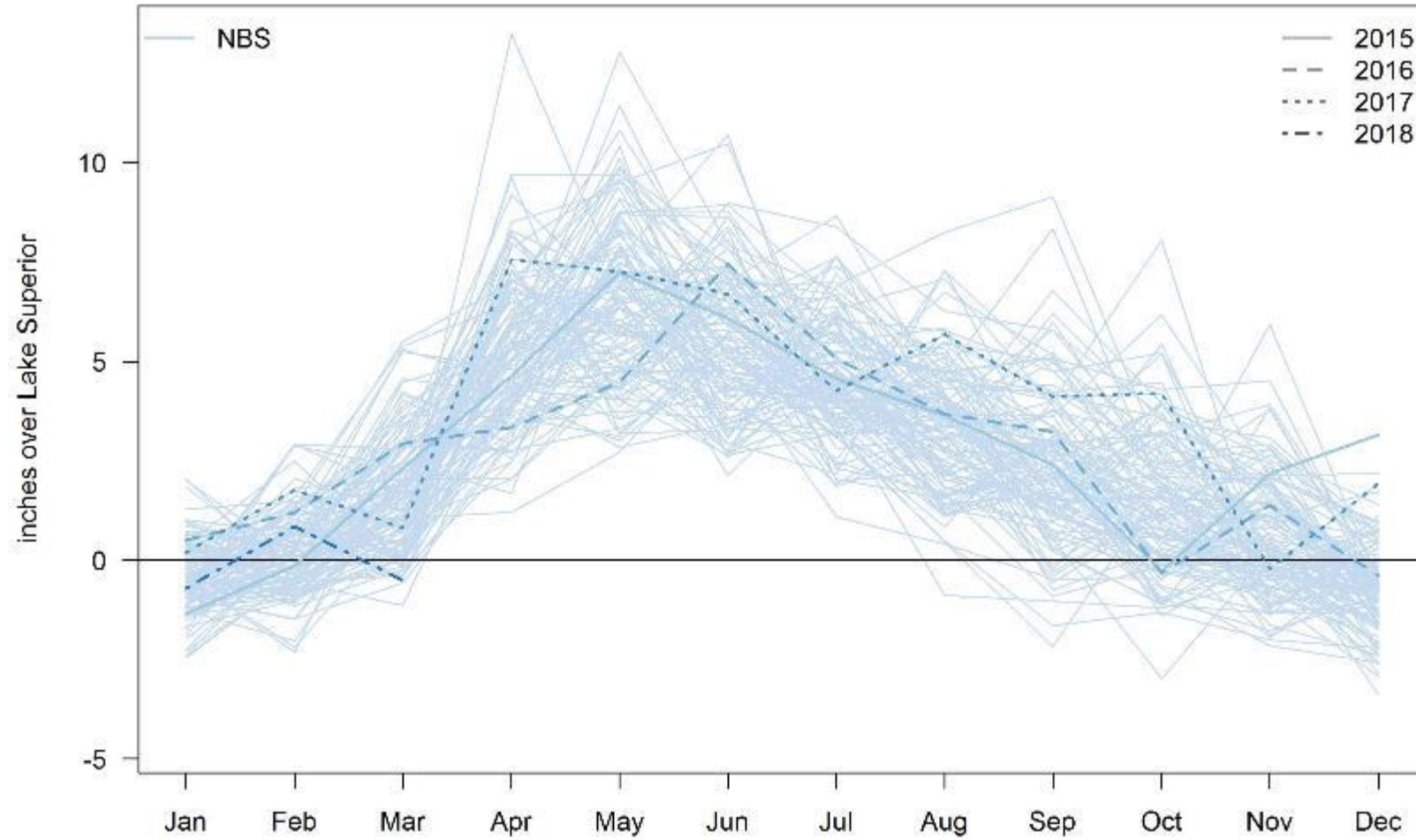


Lake Superior Inflows and Outflows



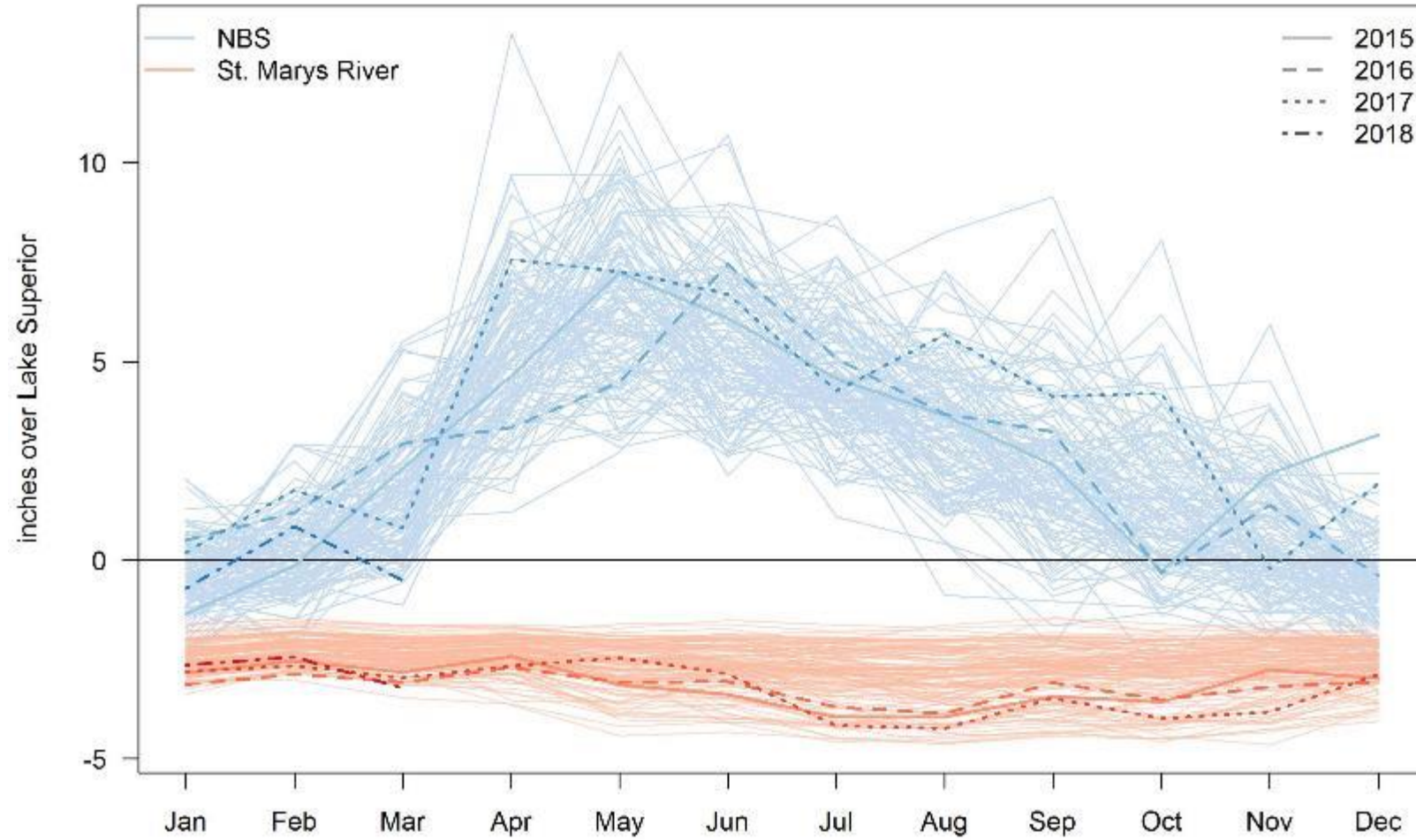


Lake Superior Inflows and Outflows



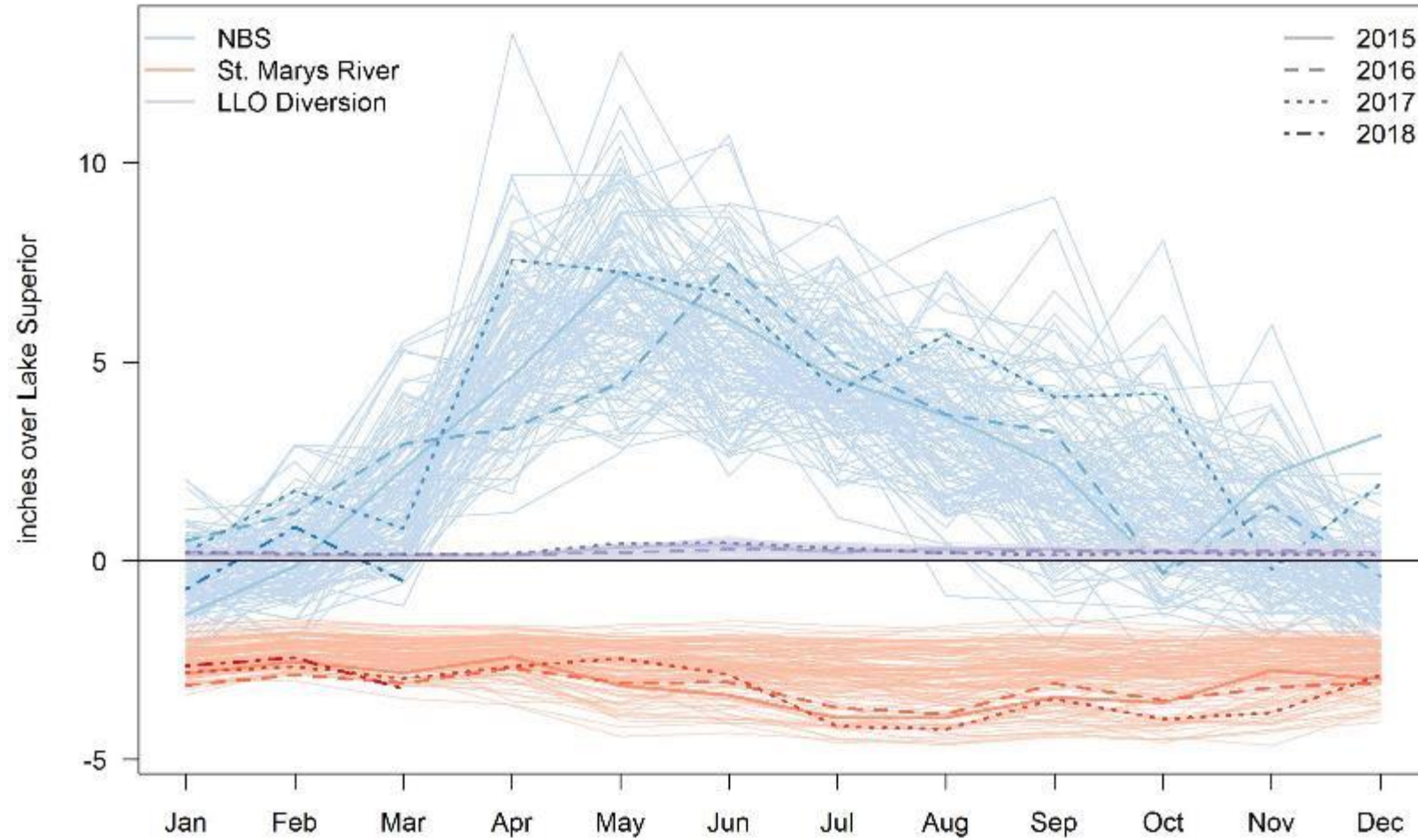


Lake Superior Inflows and Outflows





Lake Superior Inflows and Outflows



1. Start with more NATURAL FLOWS

Basis of Plan 2012 is the



* What is *pre-project* flow?

It's the flow that would have occurred prior to the canals and dam being built in the St. Marys River, which began around the year 1887

2. Apply BALANCING PRINCIPLE

To help **BALANCE** water level conditions and their impacts on **ALL** stakeholders



Flows are adjusted depending on the difference of each lake's level from seasonal target levels based on average conditions

3. Respect PHYSICAL & OPERATIONAL LIMITS

November Maximum = 3260 m³/s
(except if Superior > 183.90 m...)

3800 m³/s May to November
if Superior > 183.90 m

Winter Max = 2410 m³/s
Increased to 2690 m³/s
if Superior > 183.90 m

1700 m³/s Minimum Flow
Lake Sturgeon Every 5th June

4. Determine RAPIDS FLOW & Multi-Use ALLOCATIONS



PLAN 2012
FLOW
&
GATE
SETTING



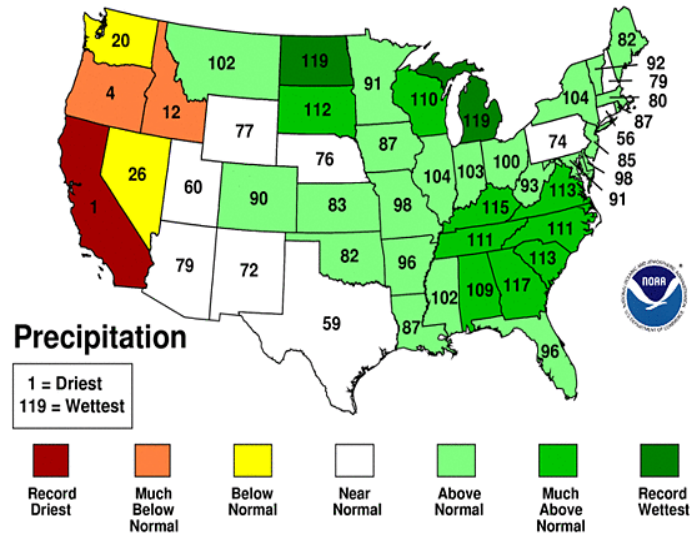
WET 2013, COLD AND SNOWY 2014

- 2013 was the wettest year on record for the state of Michigan

- 2013 was followed by a well above average wet 2014

January-December 2013 Statewide Ranks

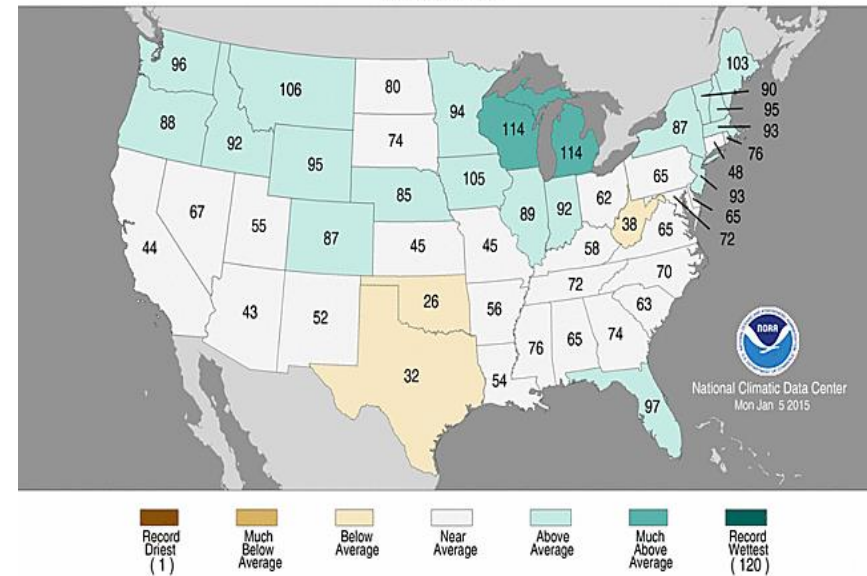
National Climatic Data Center/NESDIS/NOAA



Statewide Precipitation Ranks

January-December 2014

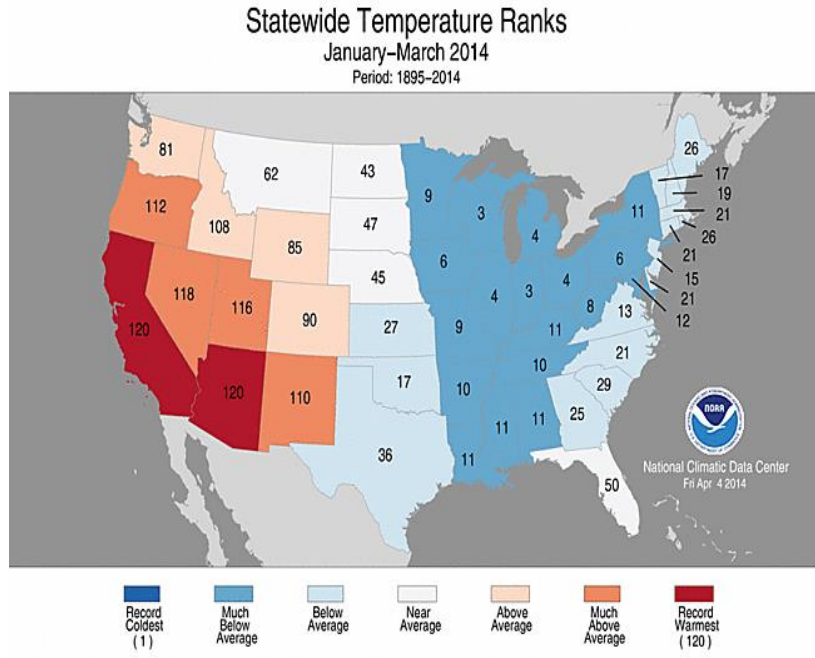
Period: 1895-2014





WET 2013, COLD AND SNOWY 2014

- Below average air temperatures during the winter of 2014



- Near record high ice cover throughout the Great Lakes in 2014

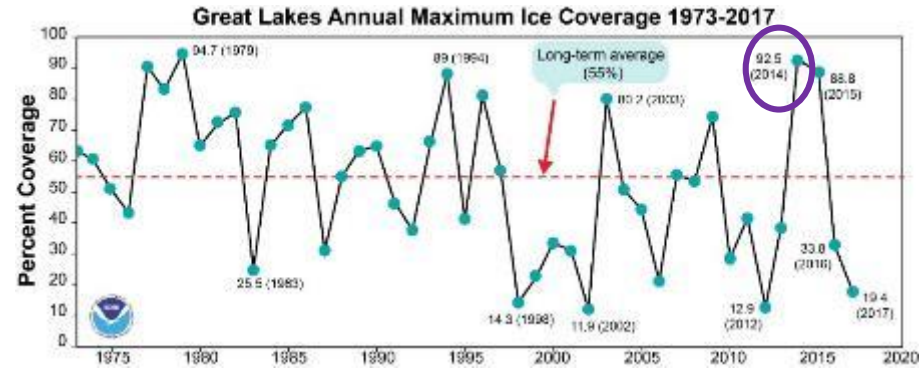


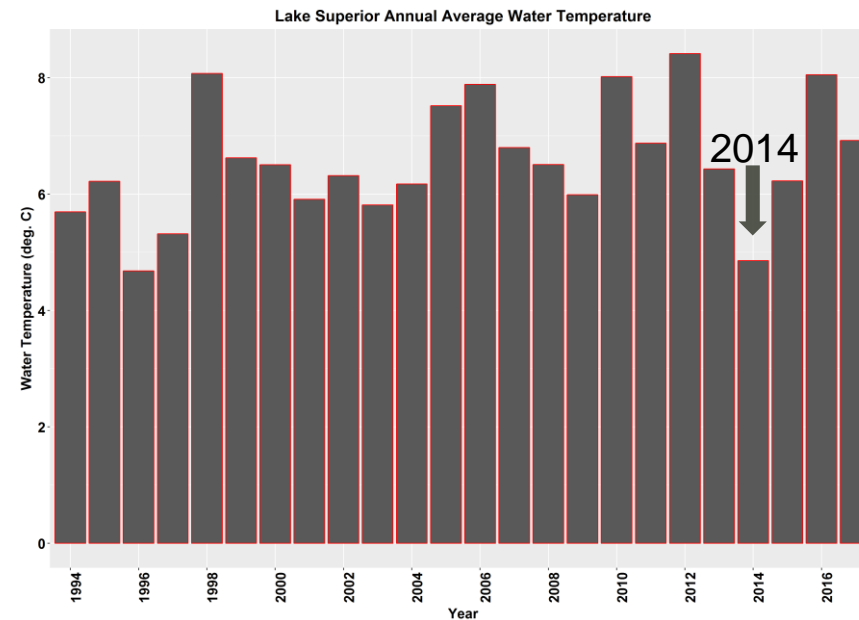
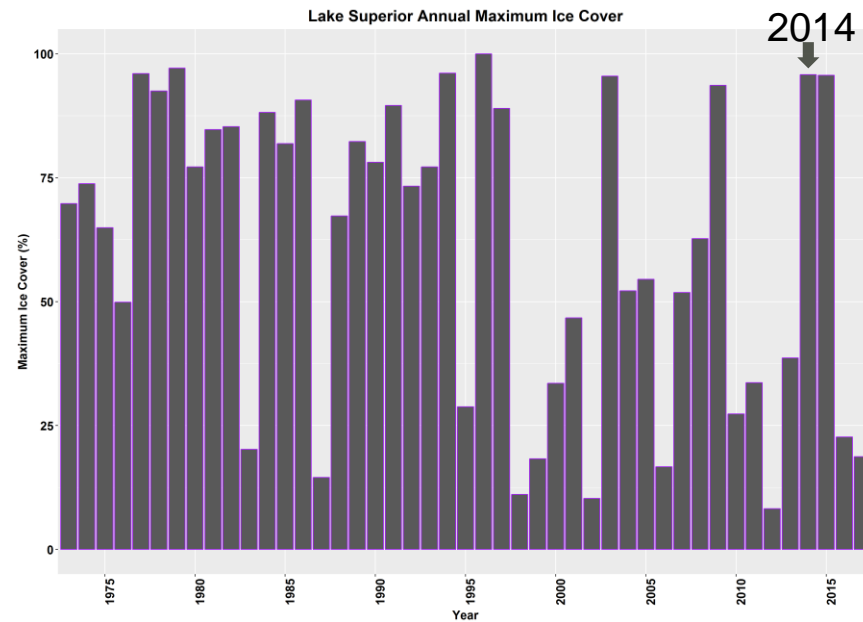
Photo credit: NASA



WET 2013, COLD AND SNOWY 2014

- High ice cover during winter of 2014 after a period of low ice cover

- Annual water temperature in 2014 low, which helped to keep evaporation rates low during the fall of 2014





FACTORS CONTRIBUTING TO RISE

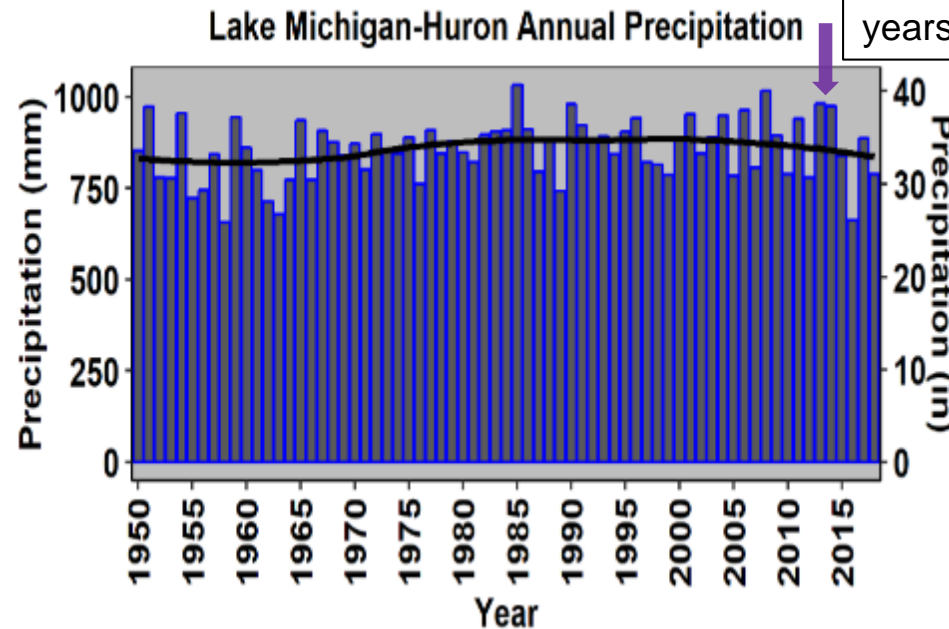


- Wet Conditions – increase in precipitation and runoff in the spring
- Large Snowpack (Snowy Winters)
- Cold winters (lower water temperatures)
 - Less Evaporation in the following Fall
- Late Ice-Out in 2013 and 2014 and high overall Ice Cover 2014



Ice Cover:
March 2014

Photo credit: NASA



2013 and 2014: Consecutive years with high precipitation

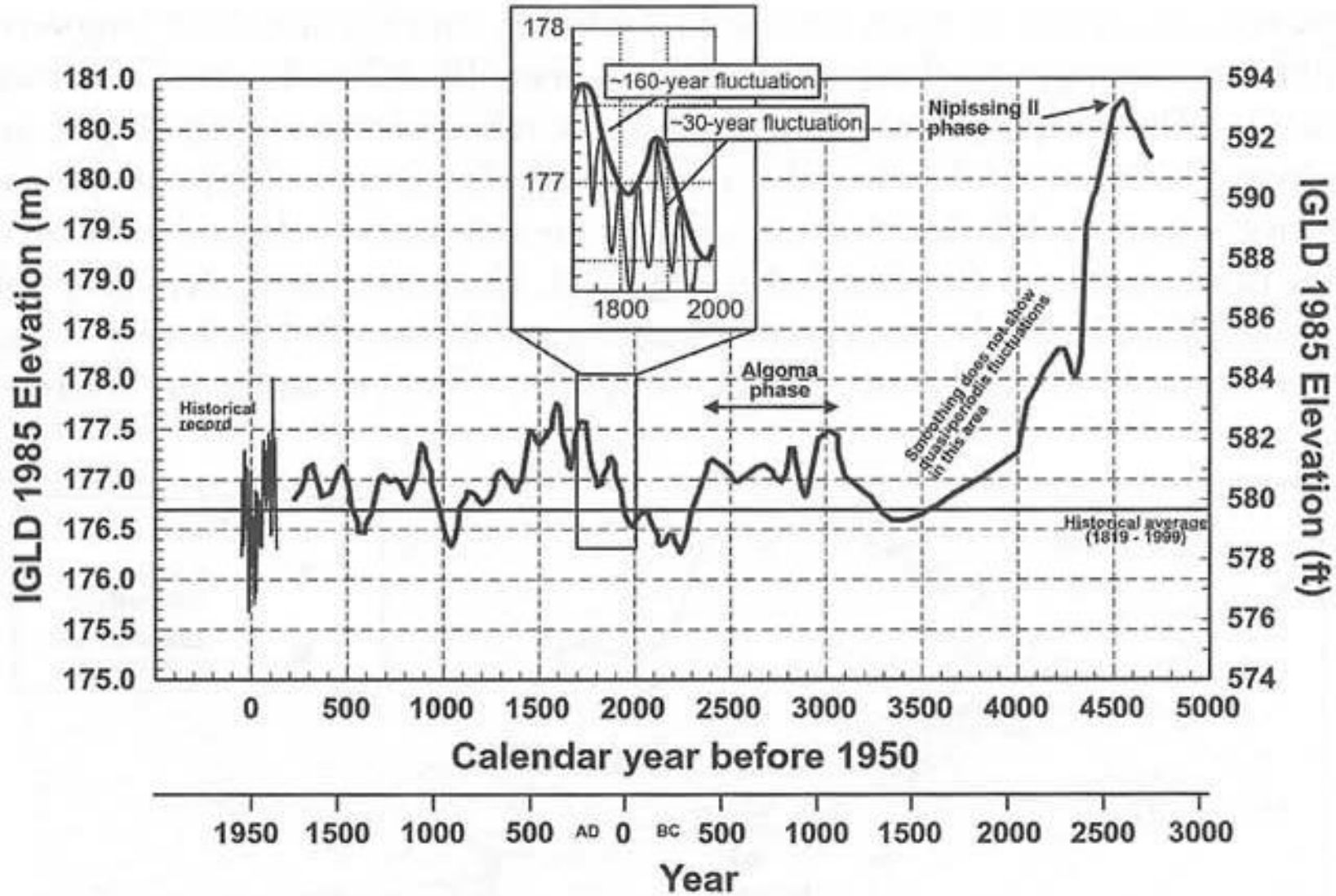


FIGURE 2. Hydrograph of late Holocene lake level in the Lake Michigan/Huron basin. Modified from Baedke and Thompson (2000).



STATUS OF CURRENT EVENT

- MI counties receiving technical assistance from USACE for 2019 lakeshore flooding:
 - Macomb
 - Monroe
 - St. Clair
 - Wayne
 - Bay
 - Ottawa
 - Muskegon
- Five counties in WI also receiving technical assistance for 2019 lakeshore flooding
- Typical technical assistance requests
 - Sandbagging technique & trainings
 - Sandbag placement



TYPES OF ASSISTANCE – TECHNICAL

Technical assistance consists of providing review and recommendations in support of state and local efforts, and helping determine feasible solutions.

Some examples include:

1. Providing experienced personnel to give guidance on flood fight techniques and emergency construction methods.
2. Providing personnel to inspect existing flood protection projects/response efforts to identify problem areas and recommend corrective measures.
3. Providing hydraulic analysis, geotechnical evaluations, topography and stream data, maps, and historic flood or storm information.
4. Providing expertise, products, and solutions in cold weather climates via a partnership with the USACE Cold Regions Research and Engineering Laboratory (CRREL).

No cost to customer



2019 TECHNICAL ASSISTANCE EFFORTS





Questions?



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LIVING ON THE COAST



<https://www.lre.usace.army.mil/Portals/69/docs/GreatLakesInfo/docs/CoastalProgram/Living%20on%20the%20Coast%20Booklet.pdf?ver=2016-06-06-105107-683>

