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To file a program discrimination complaint, a complainant should complete a Form AD-3027, USDA Program Discrimination Complaint Form, which can be obtained online, from any USDA office, by calling (866) 632-9992, or by writing a letter addressed to USDA. The letter must contain the complainant's name, address, telephone number, and a written description of the alleged discriminatory action in sufficient detail to inform the Assistant Secretary for Civil Rights (ASCR) about the nature and date of an alleged civil rights violation. The completed AD-3027 form or letter must be submitted to USDA by:

mail:
U.S. Department of Agriculture
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410; or

fax:
(833) 256-1666 or (202) 690-7442;

email:
program.intake@usda.gov.

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La información del programa puede estar disponible en otros idiomas además del inglés. Las personas con discapacidades que requieren medios de comunicación alternativos para obtener información sobre el programa (por ejemplo, Braille, letra agrandada, grabación de audio y lenguaje de señas americano) deben comunicarse con la agencia estatal o local responsable que administra el programa o con el TARGET Center del USDA al (202) 720-2600 (voz y TTY) o comunicarse con el USDA a través del Servicio Federal de Transmisión de Información al (800) 877-8339.

Para presentar una queja por discriminación en el programa, el reclamante debe completar un formulario AD-3027, Formulario de queja por discriminación del programa del USDA, que se puede obtener en línea, en cualquier oficina del USDA, llamando al (866) 632-9992, o escribiendo una carta dirigida al USDA. La carta debe contener el nombre, la dirección y el número de teléfono del reclamante, y una descripción escrita de la supuesta acción discriminatoria con suficiente detalle para informar al Subsecretario de Derechos Civiles (ASCR, por sus siglas en inglés) sobre la naturaleza y la fecha de la presunta violación de los derechos civiles. La carta o el formulario AD-3027 completado debe enviarse al USDA por medio de:

correo postal:
U.S. Department of Agriculture
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410; o

fax:
(833) 256-1666 o (202) 690-7442;

correo electrónico:
program.intake@usda.gov.

Esta institución ofrece igualdad de oportunidades.



Great Lakes Water Levels: A Wild Ride in 2020? Yes...

Mark Brederland
Michigan Sea Grant Extension

Michigan Waterways Commission
February 7, 2020

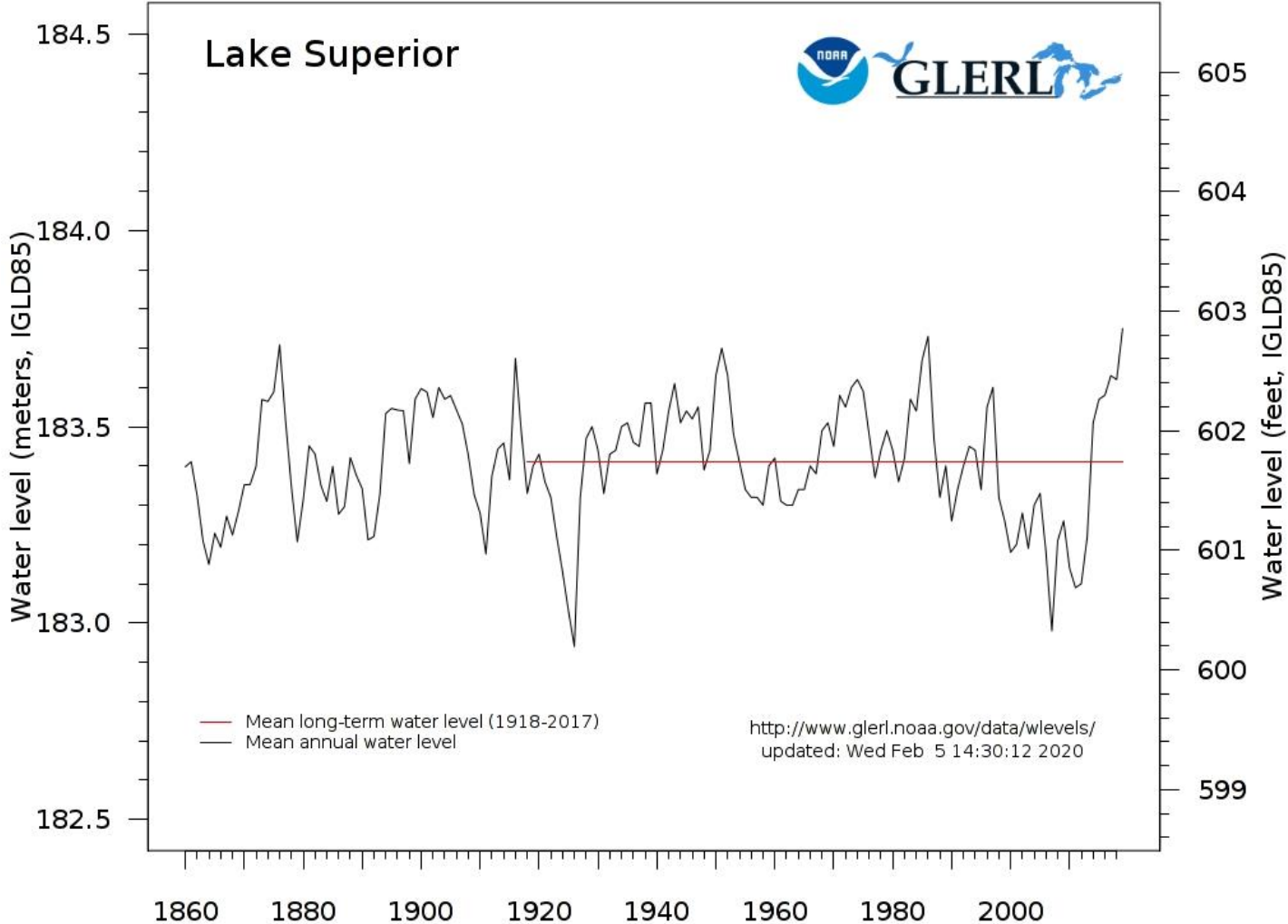
Michigan Sea Grant College Program

MISSION: Michigan Sea Grant supports research, outreach, and education to enhance sustainable use of Great Lakes resources, benefiting the environment, the quality of life, and the Michigan, Great Lakes, and national economy.

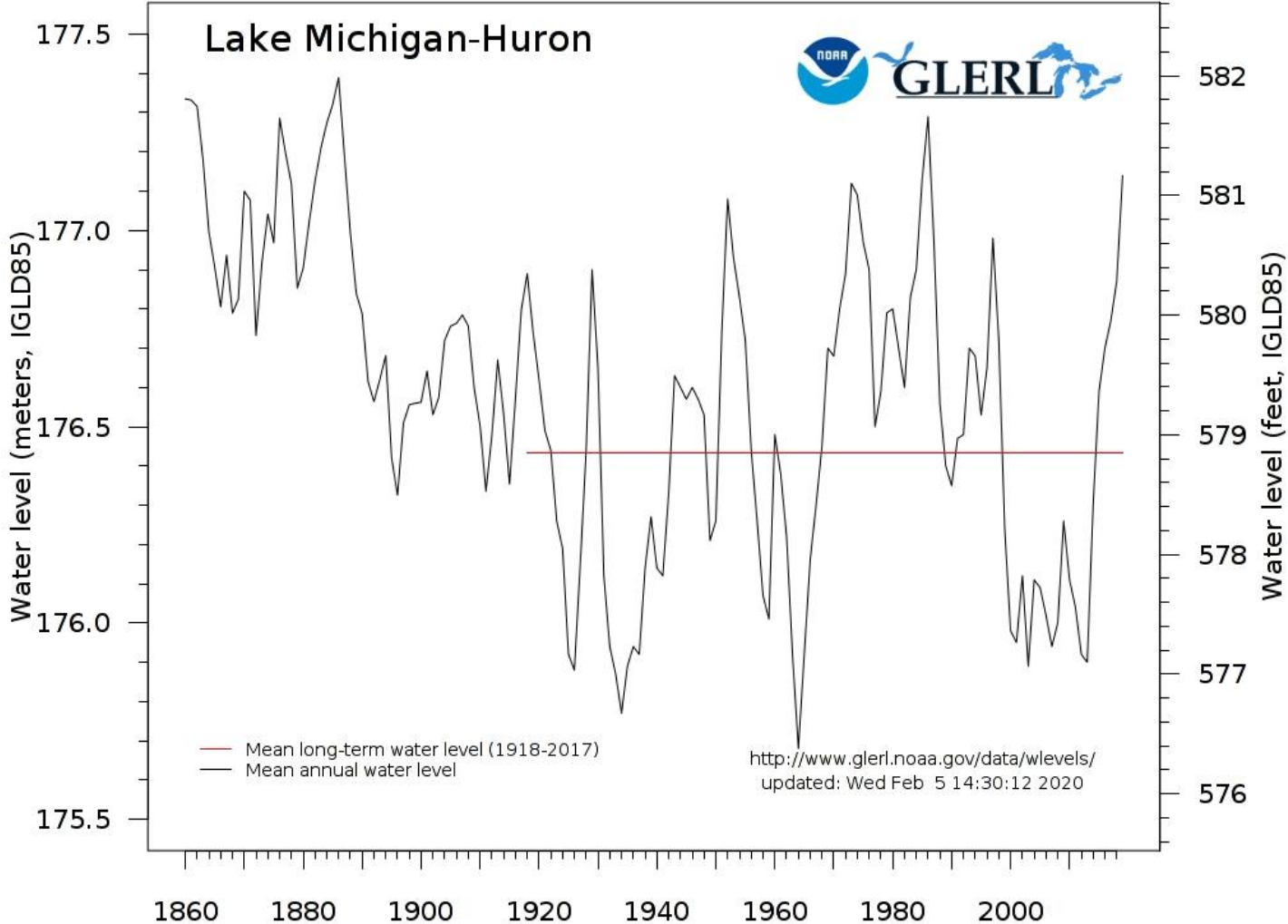
Michigan Sea Grant is a cooperative program of the University of Michigan, Michigan State University, and the National Oceanic and Atmospheric Administration



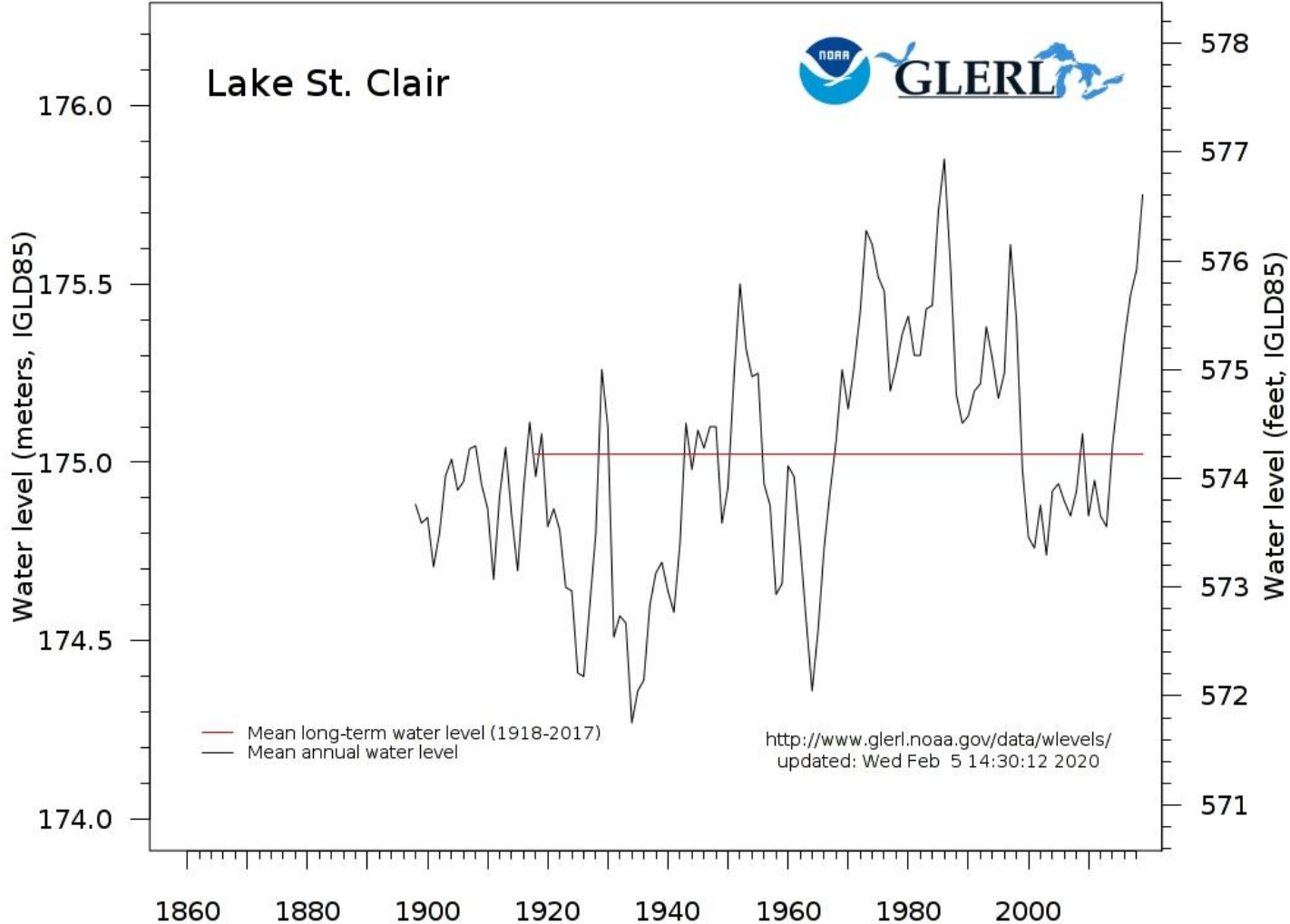
Yearly Avg



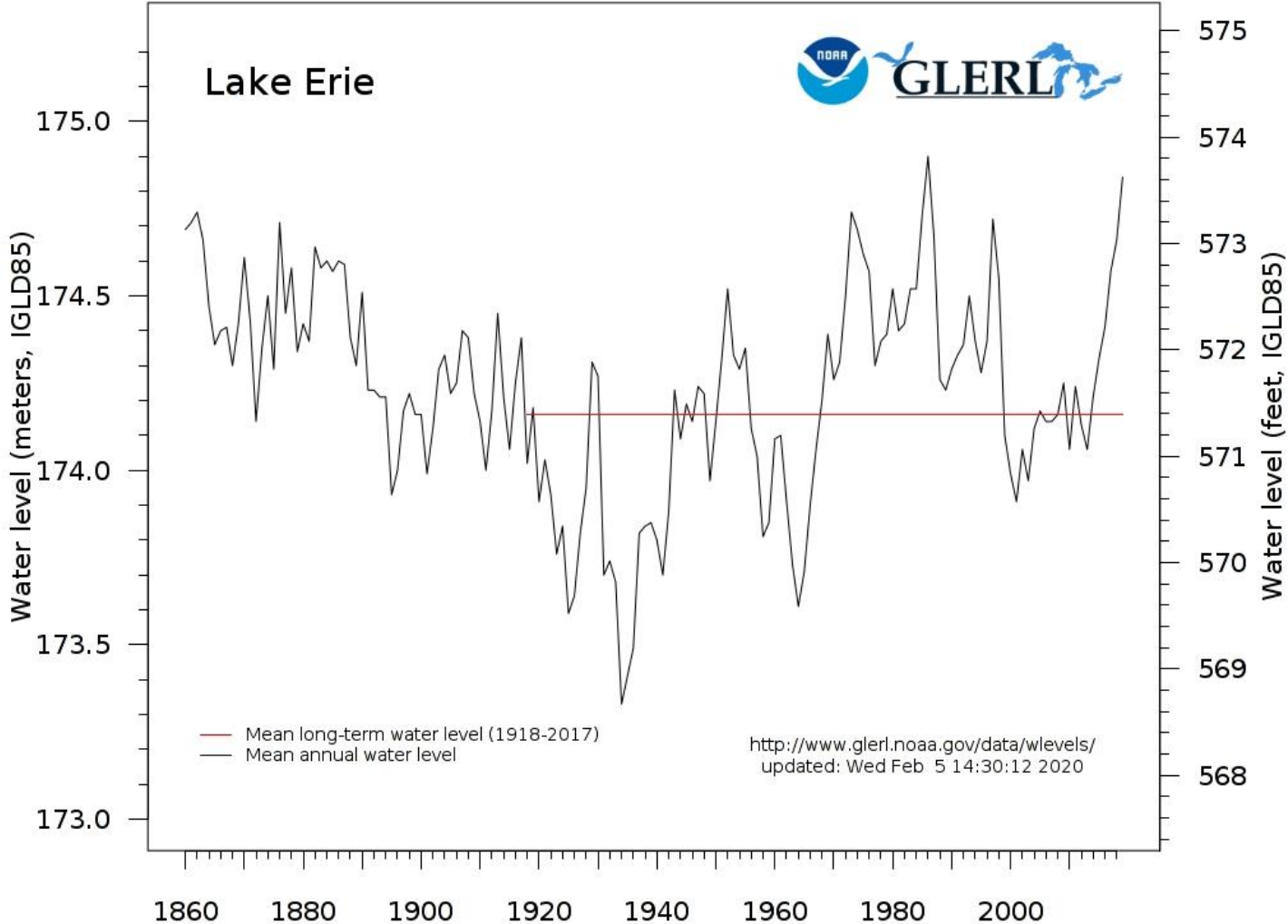
Yearly Avg.



Yearly Avg



Yearly Avg





December 2013



January 2016



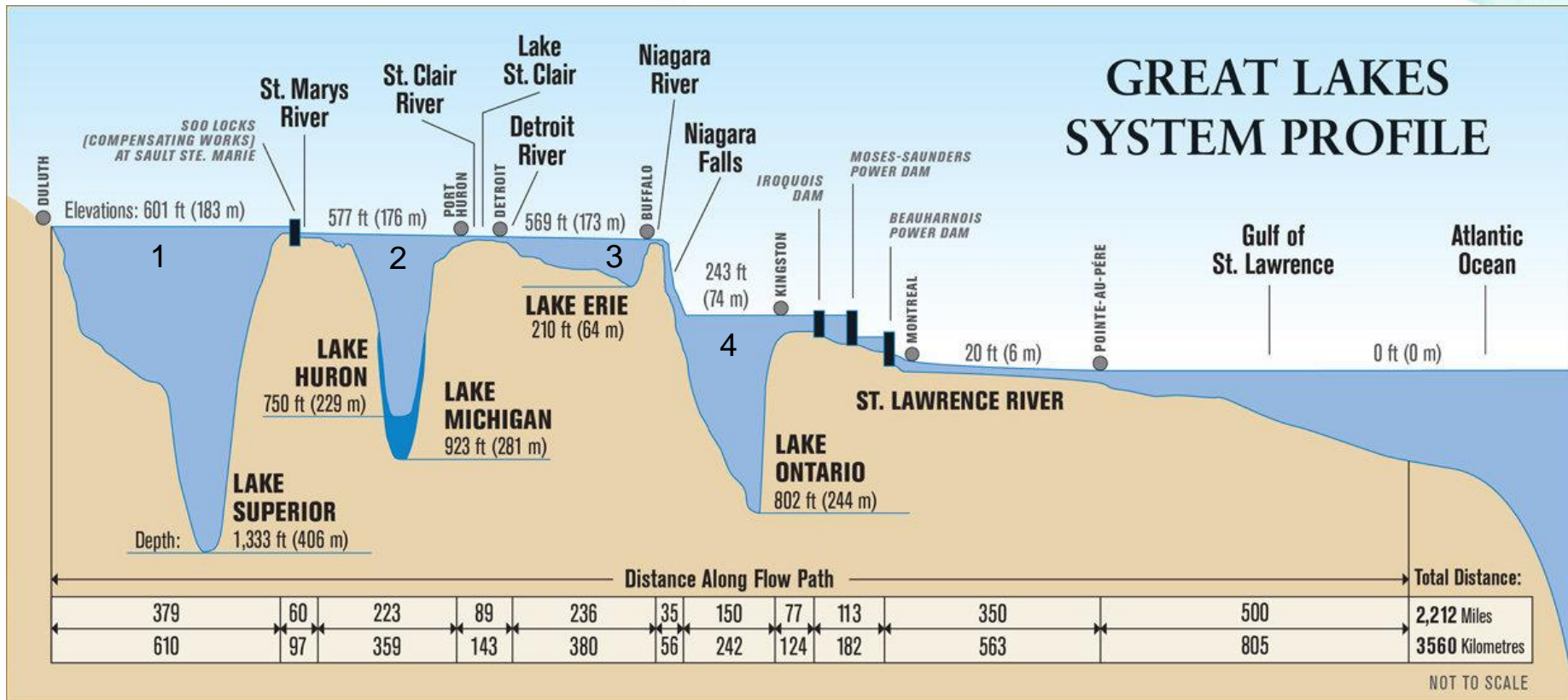
December 2019

Courtesy of
R.J. Kane



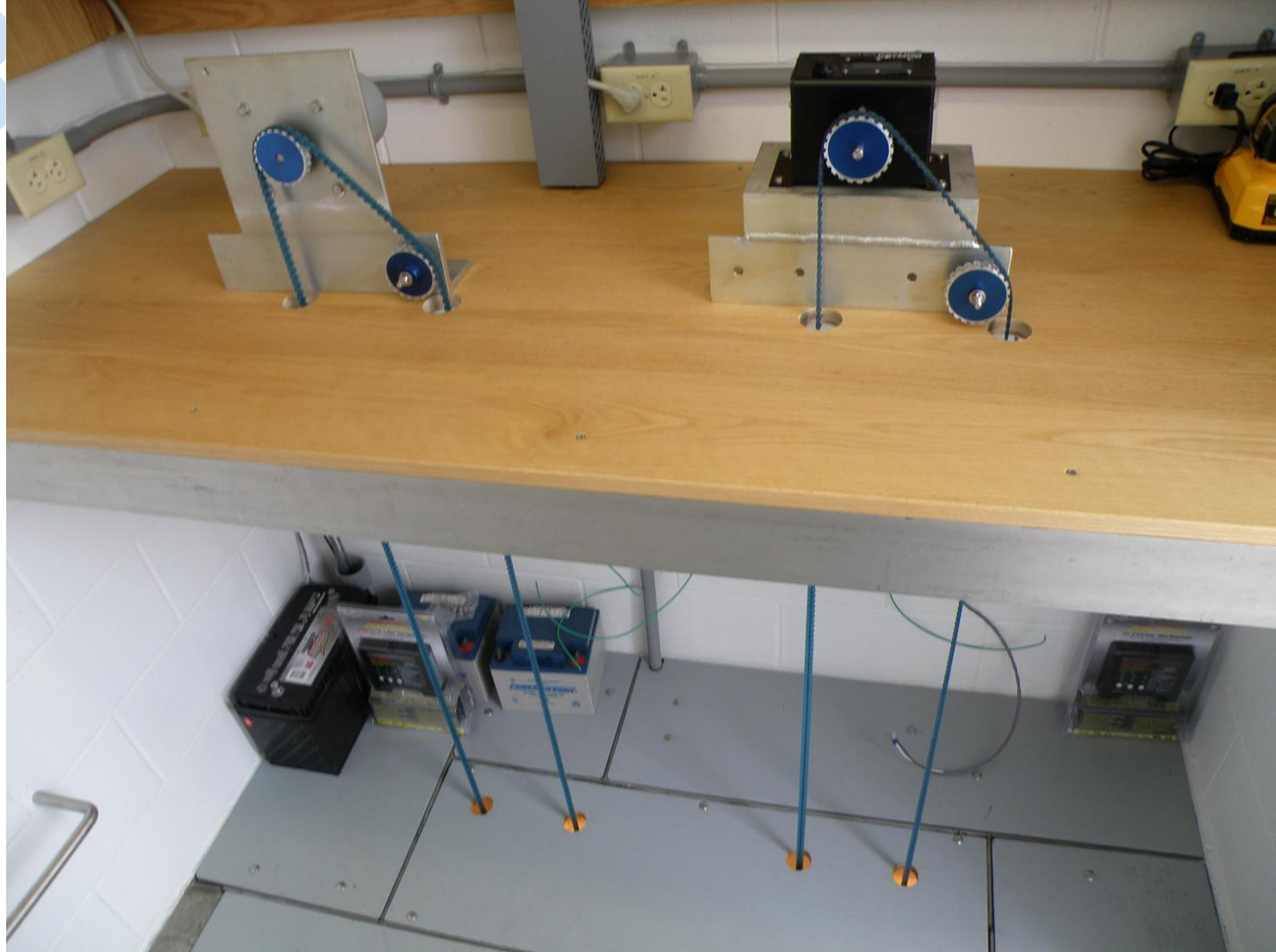
A satellite map of the Great Lakes region in North America, showing the five Great Lakes (Superior, Michigan, Huron, Erie, and Ontario) and the surrounding land and water. The text "HOMES" is written in large, white, bold, sans-serif capital letters with a blue outline, and a thick red horizontal line is drawn across it. Below "HOMES", the word "SOMHE" is written in the same style, with a blue underline under the letter "E".

~~HOMES~~
SOMHE









Budgets Within Lakes

The map below shows contributions of runoff, precipitation, and evaporation to the water budgets of each of the Great Lakes - these are their internal budgets.

RUNOFF

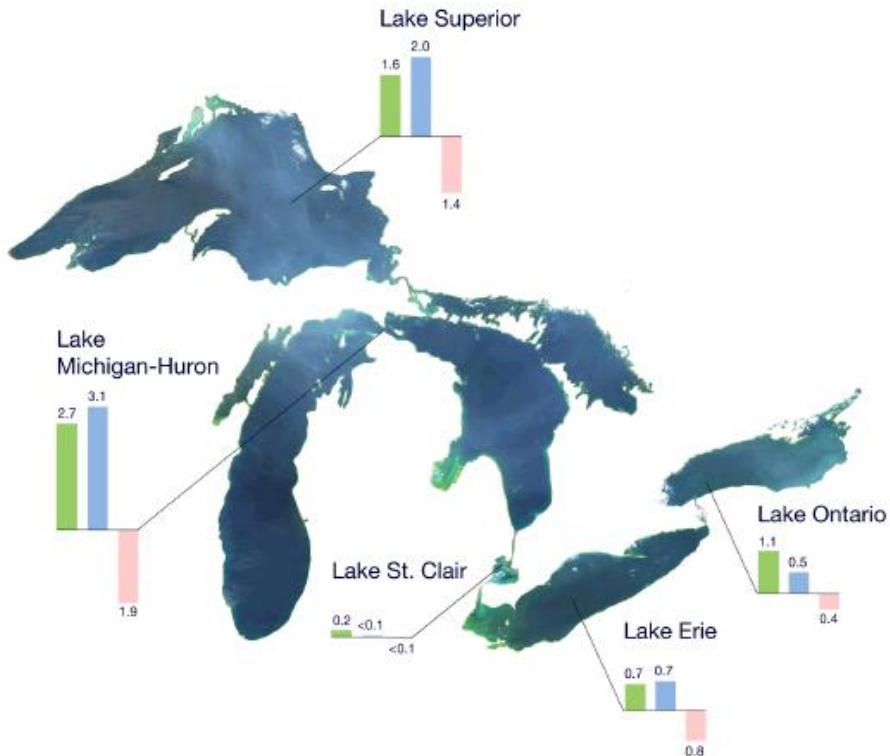
Runoff (deposit) is all of the water that runs off of land in a lake's watershed, making its way into rivers, which eventually empty into the lakes. It is impacted by precipitation over land, evaporation over land, and transpiration (the water sucked up by plants).

RAIN

Overlake Precipitation (deposit) is precipitation that falls on the lake surface.

EVAPORATION

Overlake Evaporation (withdrawal) is evaporation that occurs from the lake surface.

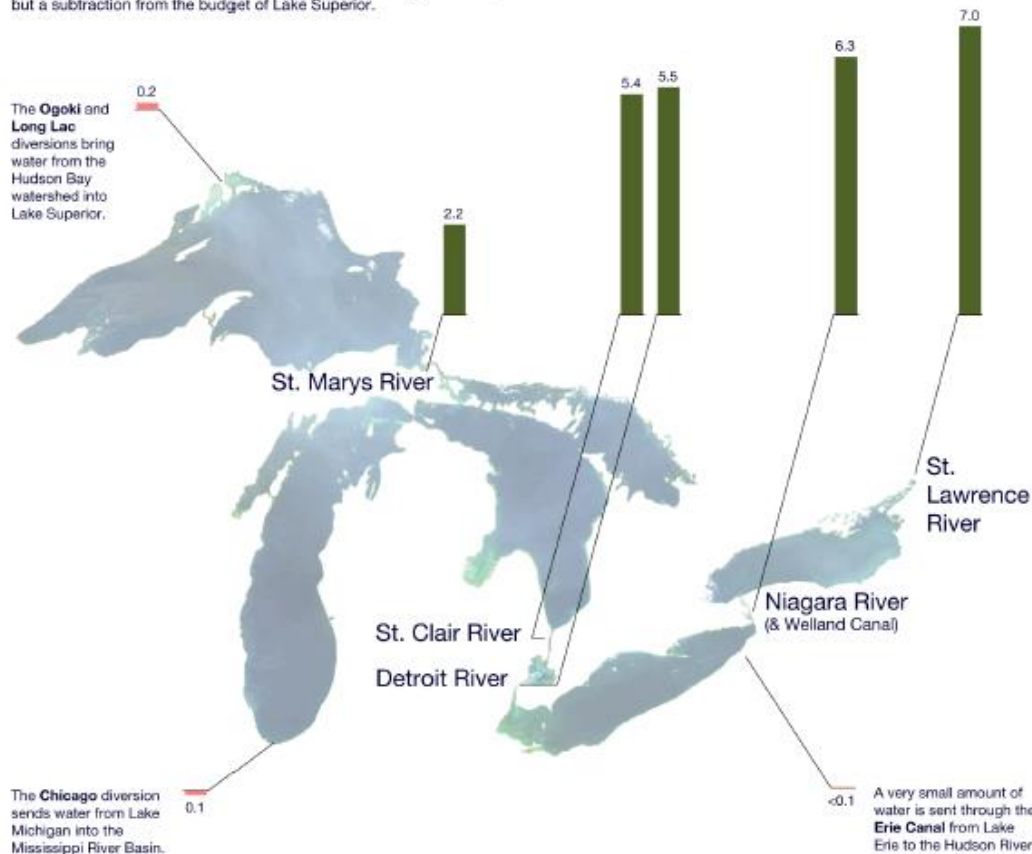


Flow Between Lakes and Diversions

The Great Lakes are a system where water flows from a beginning (Lake Superior) to an end (the St. Lawrence River and eventually the ocean). Excesses from a lake's internal budget flow to the next lake. As you move downstream, the amount of water flowing through the various connecting channels increases, as excess water is collected in each lake.

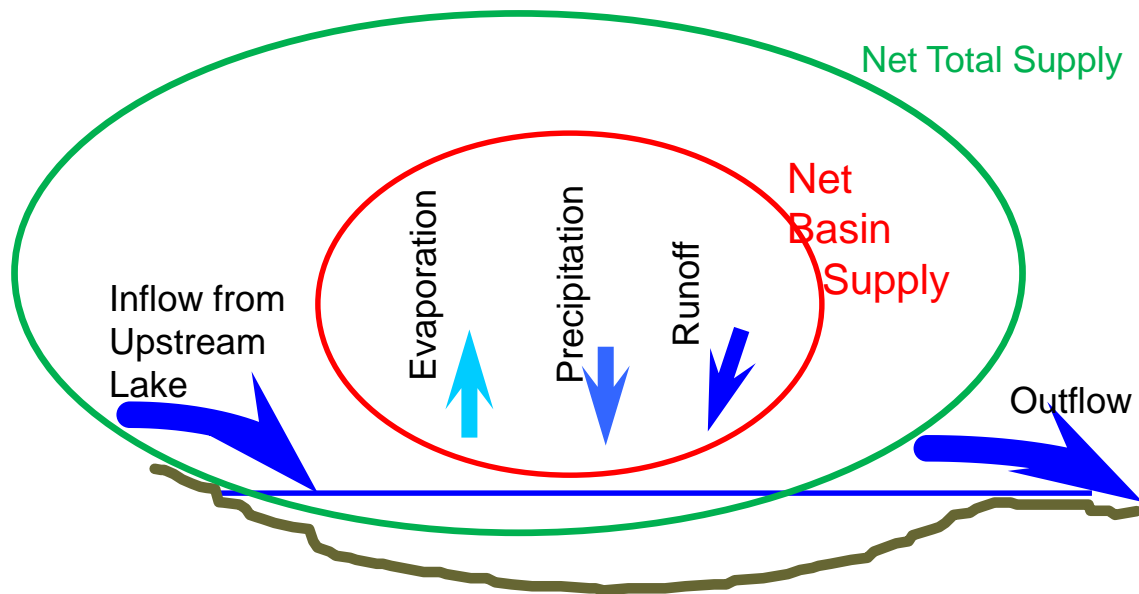
Flow Between Lakes can be a **deposit or withdrawal**. For example, the St. Marys River flows between Lake Superior and Lake Huron. Its flow is an addition to the budget of Lake Michigan-Huron, but a subtraction from the budget of Lake Superior.

Diversions can be **deposits or withdrawals**, and are negligible relative to the internal water budget of the Great Lakes.



1000s of
Cubic Meters/Second
Averaged 1950-2010
Hunter et al JGLR 2015

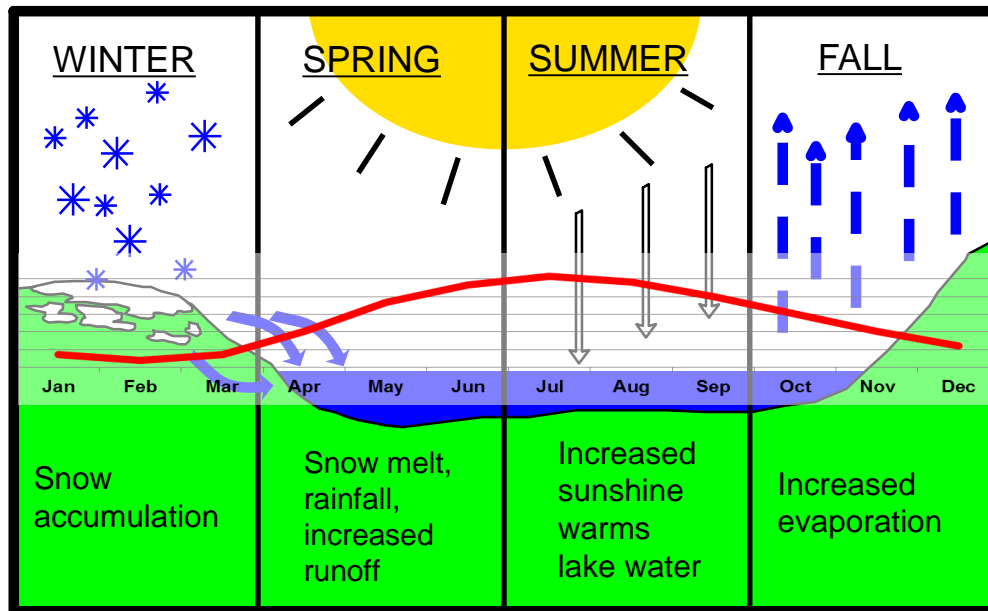
FACTORS IMPACTING WATER LEVELS



US Army Corps
of Engineers



ANNUAL WATER LEVELS AND THE HYDROLOGIC CYCLE



— Water Level



US Army Corps
of Engineers



Great Lakes Drainage Basins

Black line=cut off for what affects
Lakes Michigan/Huron



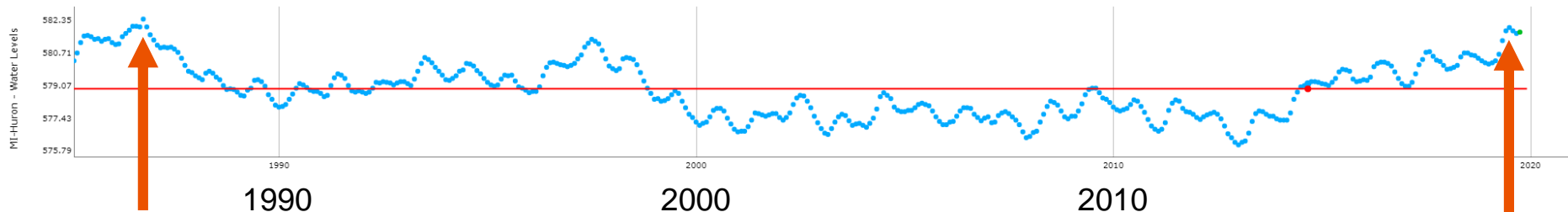
The Great Lakes Dashboard (β)

10/23/2019, 9:50:20 AM

Variable

By Basin

☐ Superior
 ☒ Michigan-Huron
 ☐ St. Clair
 ☐ Erie
 ☐ Ontario
 Water Levels

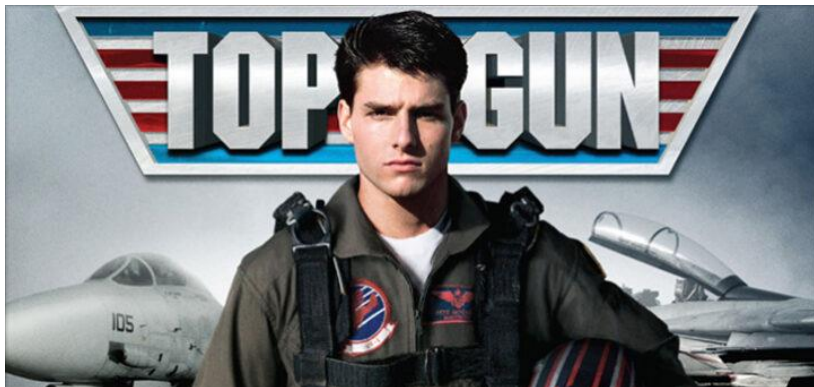


1986
October
 Monthly
 Average
582.35

2019
July
 Monthly
 Average
581.93

1986
 July
 Monthly
 Average
 581.99

1986



Great Flood of 1986

1986flood.com

- The Great Flood of 1986 in Michigan was one of the worst extreme weather events in the state's history.
- The deadly storm system covered an area 180 miles east to west and 60 miles north to south dumping torrential amounts of rain over the course of three days.
- The storm hit hardest in the Saginaw Bay and Thumb regions where 22 counties were declared federal disaster areas impacting more than 1.8 million residents.
- The rain began late Tuesday evening on Sept. 9, 1986, in west central lower Michigan and gradually moved east into the Thumb region. From September 10 -12, 1986 rainfall over central lower Michigan averaged between 8 inches and 14 inches.
- Eleven dams failed including the Hart Dam in Oceana County, which emptied out Hart Lake destroying the southbound portion of the U.S. 31 Bridge and forcing 300 people to evacuate their homes. Across the state, more than 3,600 miles of road and 30,000 homes were flooded.



New State Record 24-hour Rainfall

A new record for the state of Michigan has been set!

Amount: 12.92 inches of rain in 24 hours

When: July 20, 2019

Where: Branch Township, Mason County



National Weather Service
Grand Rapids, Michigan

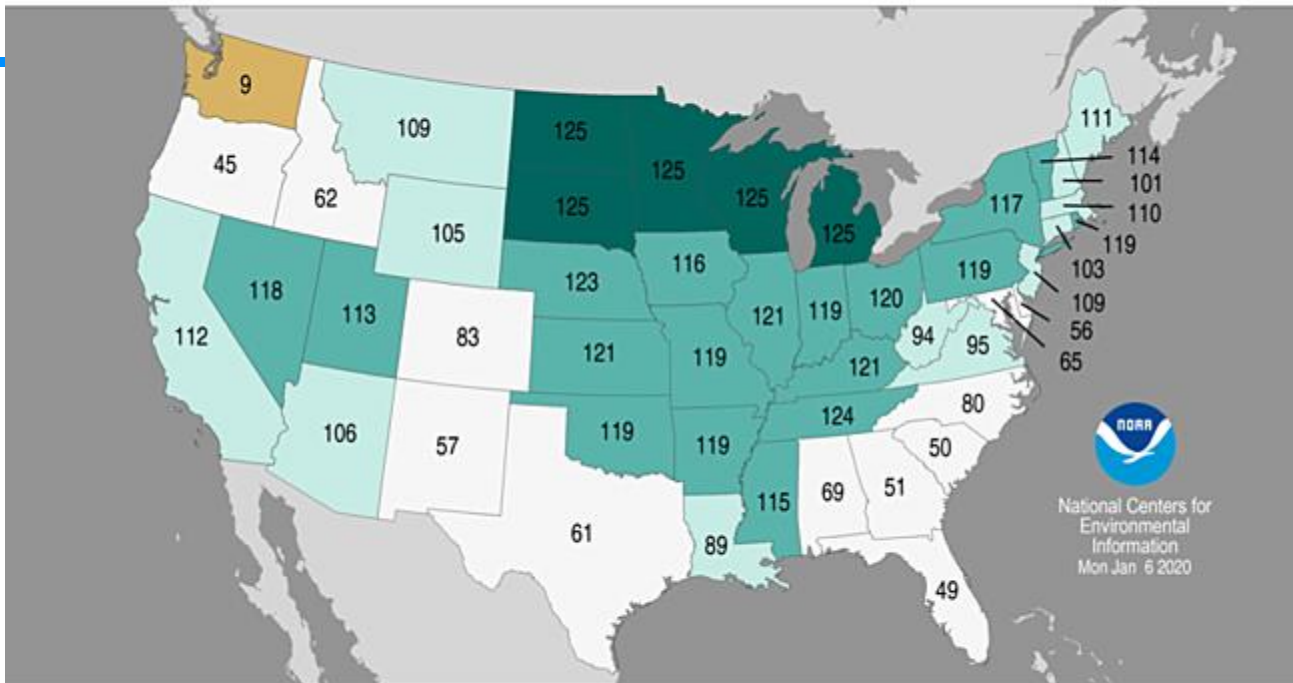
www.weather.gov/grr

Last Updated At:
9/24/2019 10:49 AM

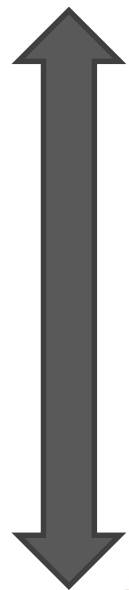
Statewide Precipitation Ranks

January–December 2019

Period: 1895–2019



Lake Michigan-Huron Variation



October, 1986: 582.35 monthly avg.

October, 2019: 581.65* monthly avg

6 Feet 4 inches!

January, 2013: 576.02 monthly avg.

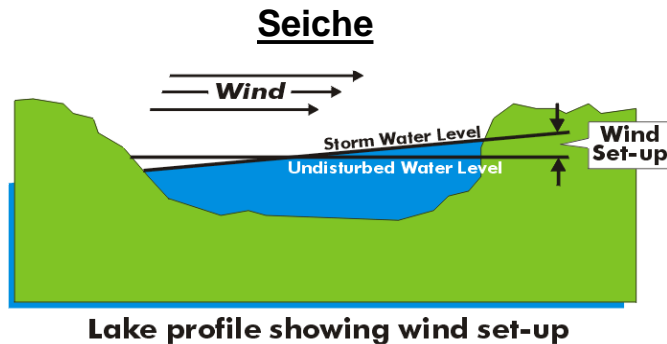
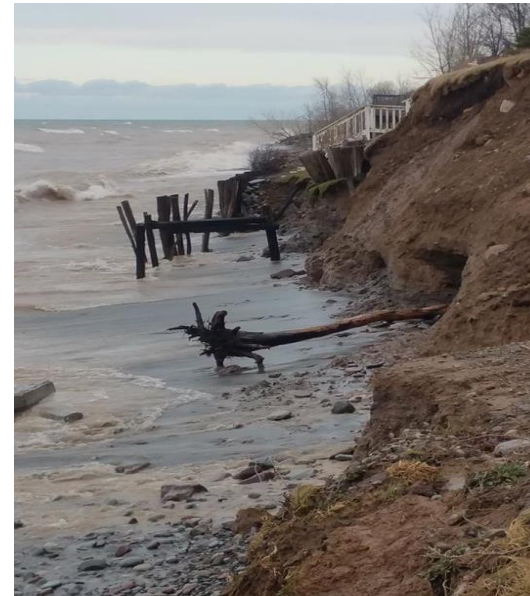
NOTES ABOUT WATER LEVELS

- Not a depth, but an elevation above sea level
- International Great Lakes Datum of 1985
- Michigan and Huron = One lake
- Lake-wide daily means → Lake-wide monthly means
- Based on still water, not influenced by meteorological forcing
- Based on a network of water level gauges
- Detroit District Corps of Engineers = keeper of official monthly water level statistics from 1918-2018
- Coordination occurs with Environment and Climate Change Canada

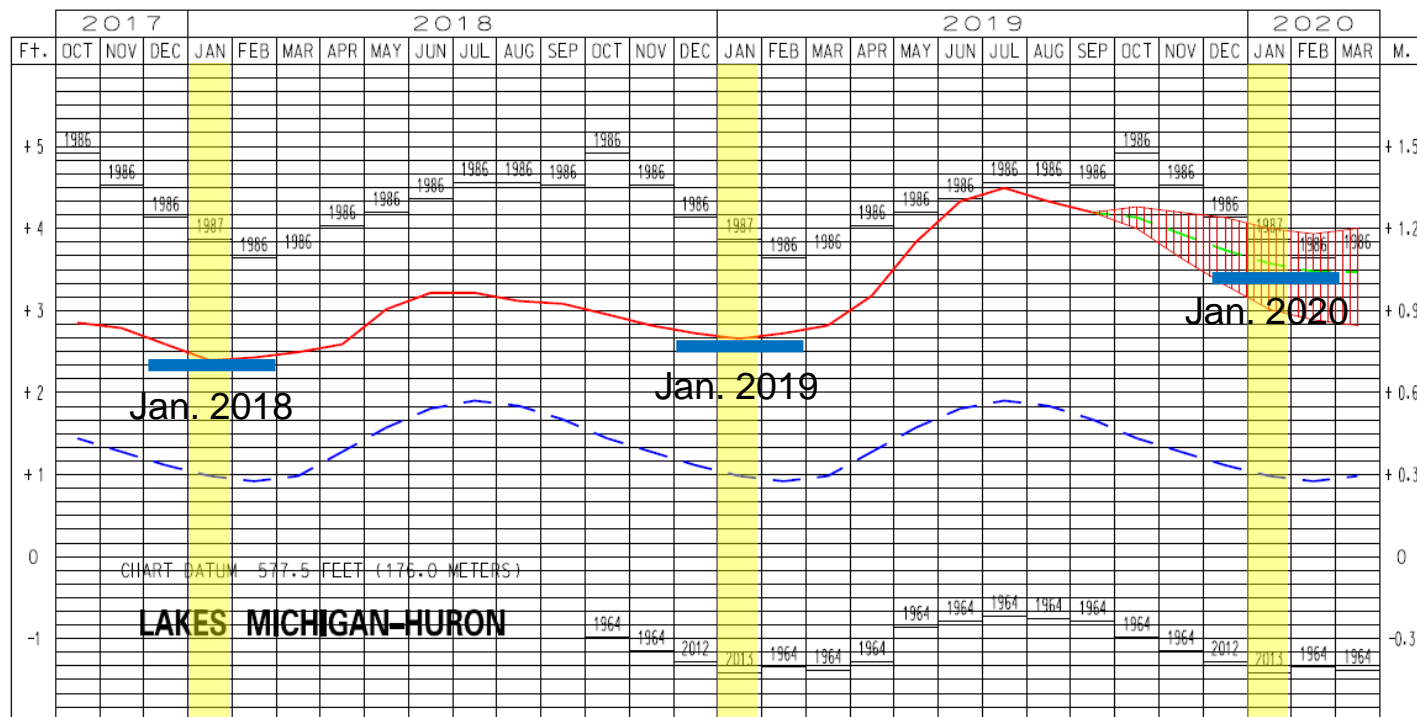
HIGH WATER LEVEL IMPACTS

27

- Shoreline erosion
 - Less beach
- Property damage
- Greater impact from seiche (wind) events
- Ice jams produce greater chance for flooding



LAKE MICHIGAN-HURON WATER LEVELS – OCTOBER 2019

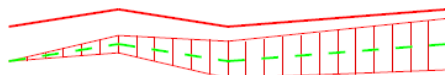


LEGEND

LAKE LEVELS

RECORDED

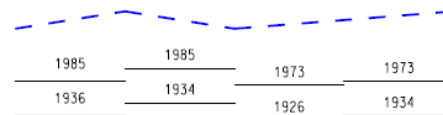
PROJECTED



AVERAGE **

MAXIMUM **

MINIMUM **



** Average, Maximum and Minimum for period 1918-2018

Simple Math on Levels

Lakes
Michigan-Huron

1/15/2019	580.08
1/15/2020	581.56
feet	1.48
Oct. 1986	582.35

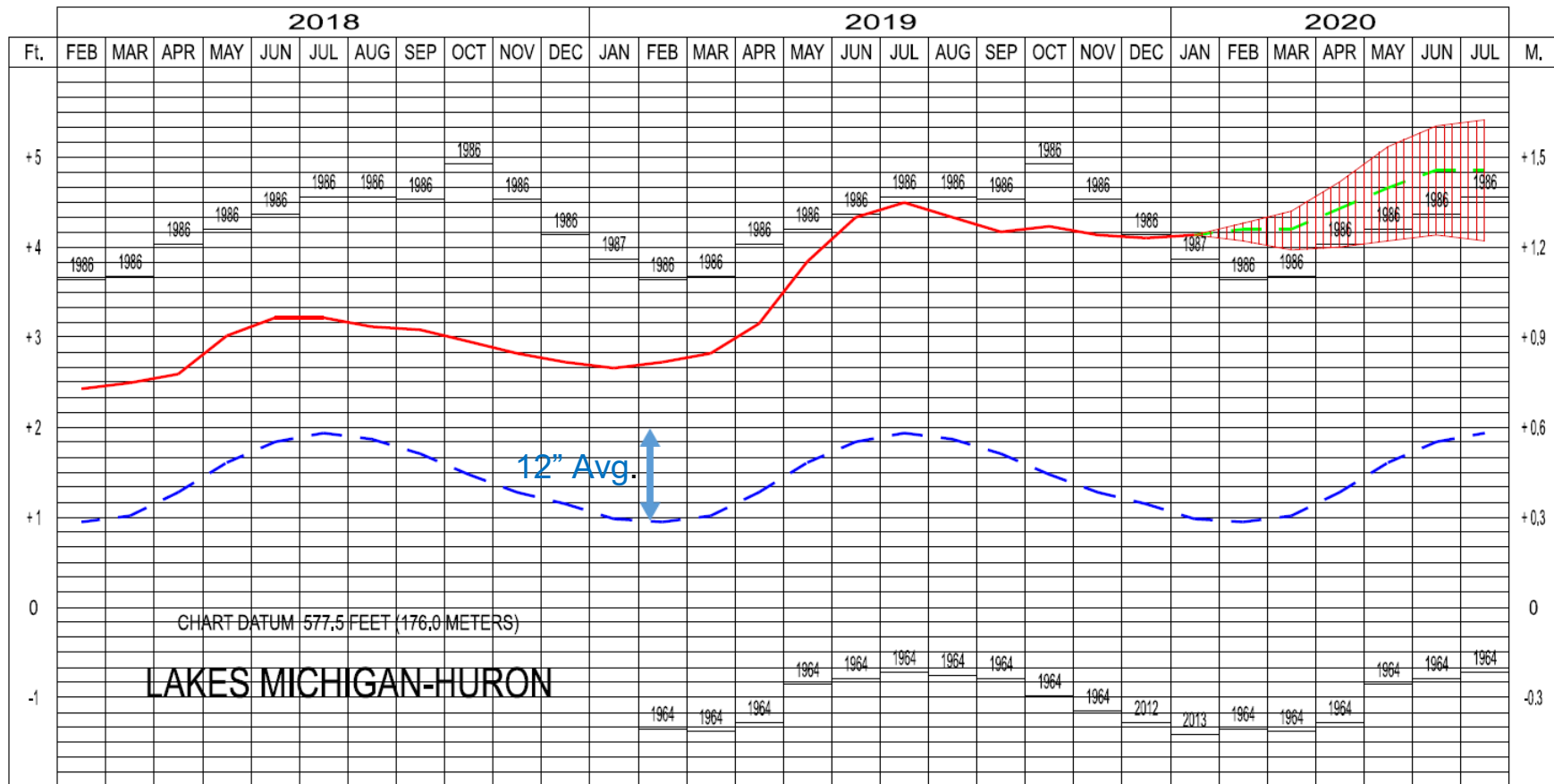
Verified Monthly Avg.

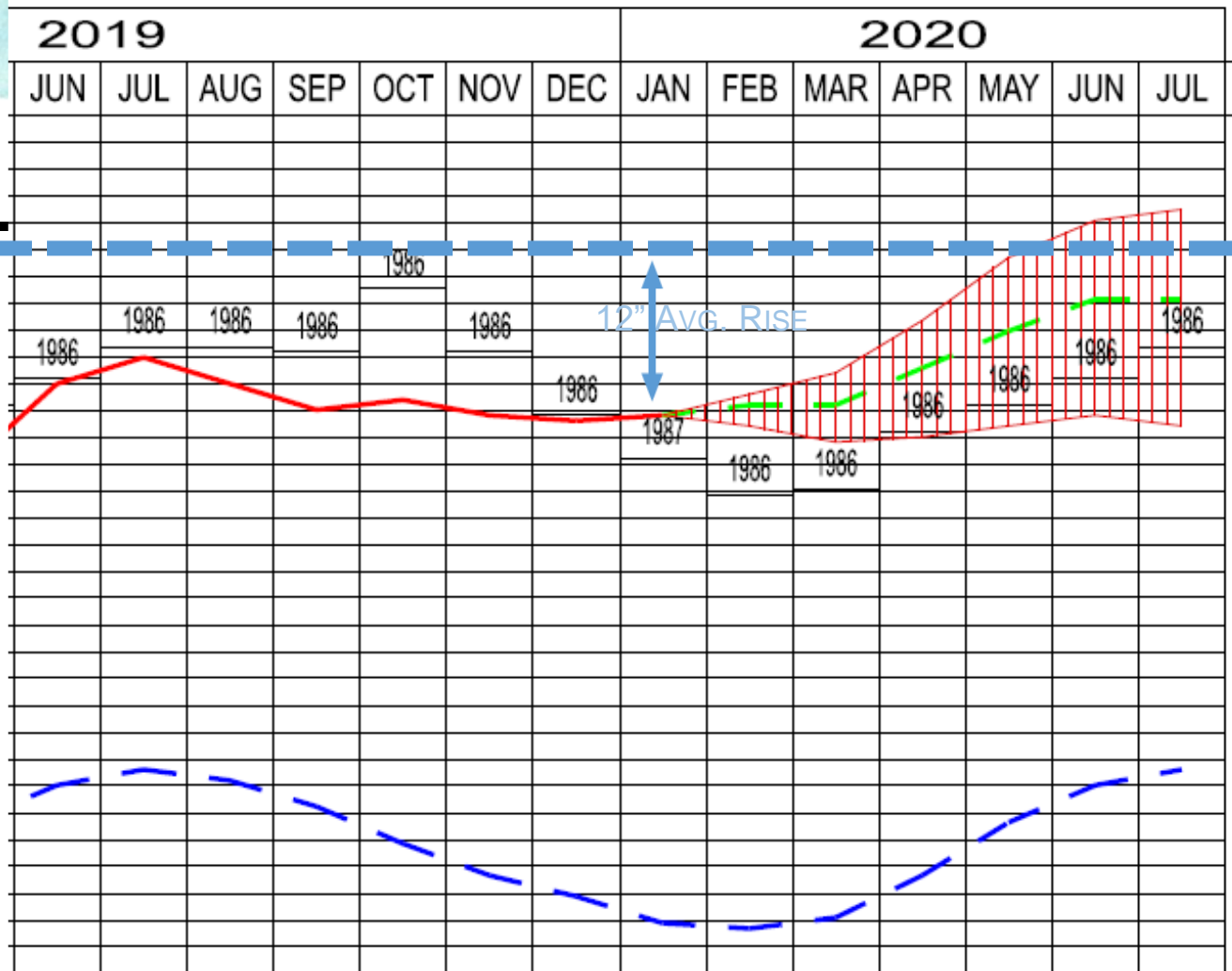
Avg. 1/1 to 1/31/20

17.76"

"Record" High
9.48 in. higher
than today

LAKES MICHIGAN-HURON WATER LEVELS - FEBRUARY 2020

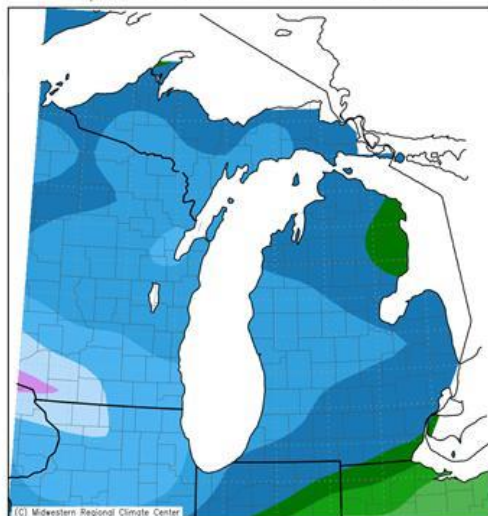




Rainfall Statistics Since September 1

Total Rainfall

Accumulated Precipitation (in)
September 1, 2019 to October 3, 2019



Midwestern Regional Climate Center
cli-MATE: MRCC Application Tools Environment
Generated at: 10/3/2019 7:55:47 PM CDT

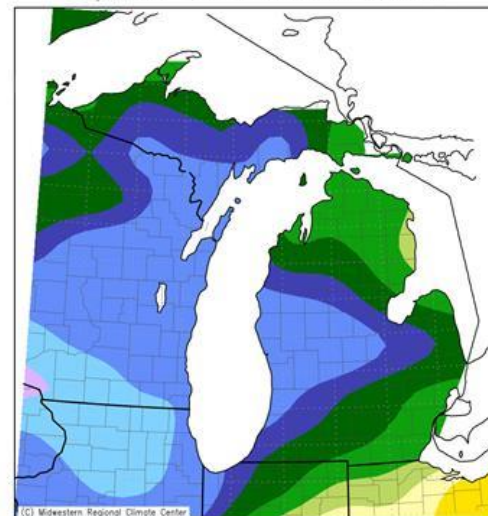
>Most of West and Central Lower Michigan has received 7.5"-10" of rain since September 1

>This equates to 200-300% of normal!

>Rivers are running well above normal, with some in flood stage

% of Normal

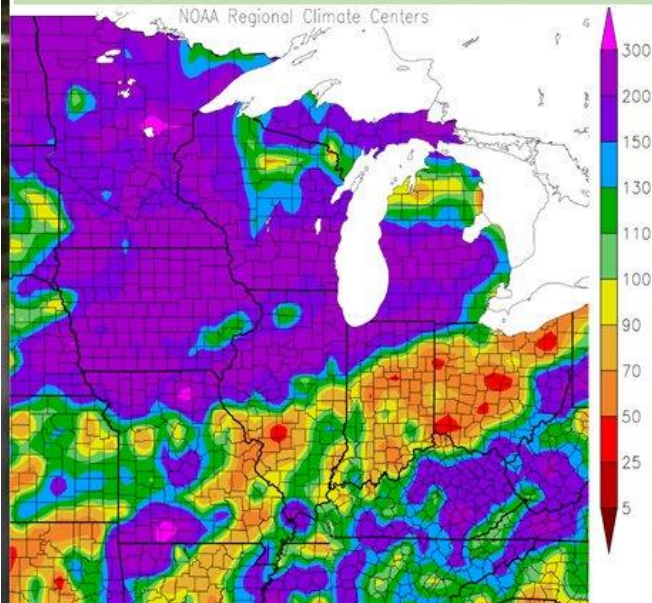
Accumulated Precipitation: Percent of Mean
September 1, 2019 to October 3, 2019



Midwestern Regional Climate Center
cli-MATE: MRCC Application Tools Environment
Generated at: 10/3/2019 8:00:39 PM CDT

It's Been A Wet October So Far...

Percent of Normal Precipitation (%)
9/27/2019– 10/26/2019



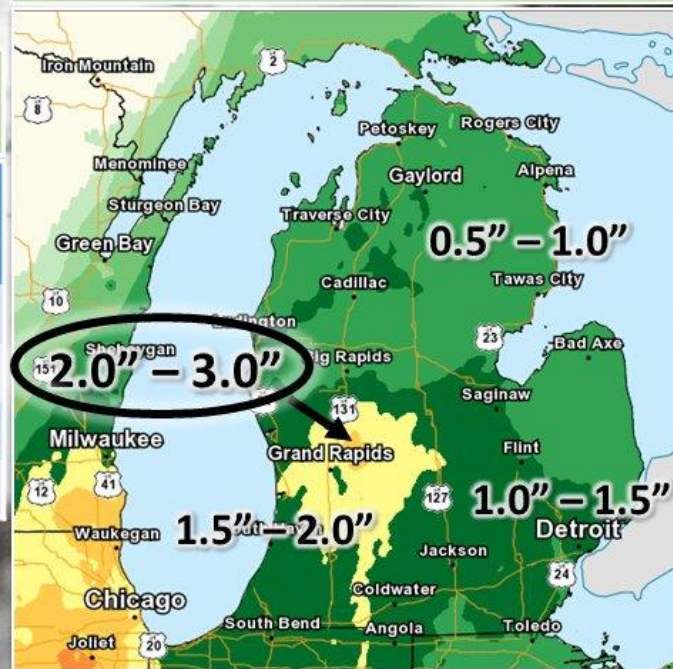
Generated 10/27/2019 at HPRCC using provisional data.

October Statistics:

Climate Normal Period: 1981 - 2010

City	October Rainfall So Far	October Normal Monthly Rainfall
GR	6.00"	2.83"
Lansing	5.65"	2.21"
Muskegon	7.13"	2.69"
Kalamazoo	3.44"	2.93"

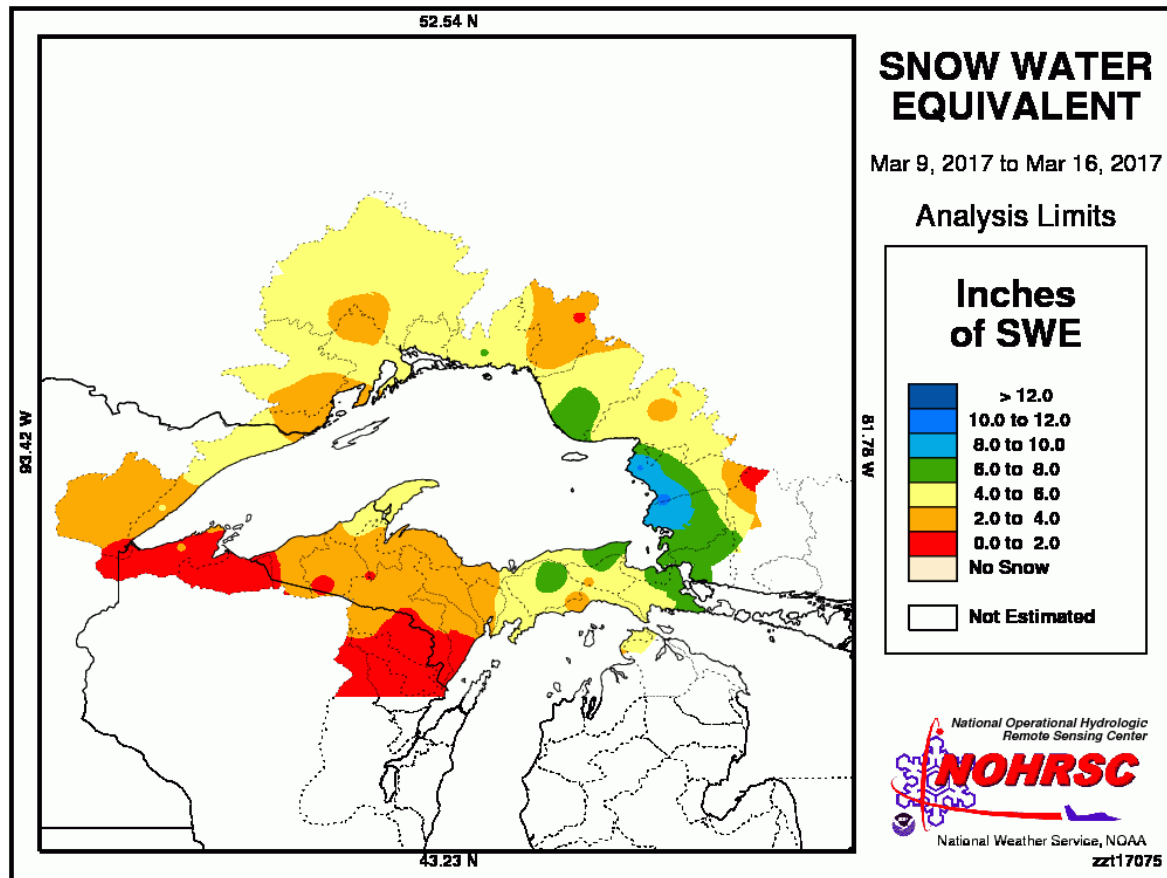
Observed Rainfall October 26 – 27, 2019



- As a whole, the entire state of Michigan is in the middle of the wettest 1 year period, 3 year period and 5 year period since records began over 120 years ago.

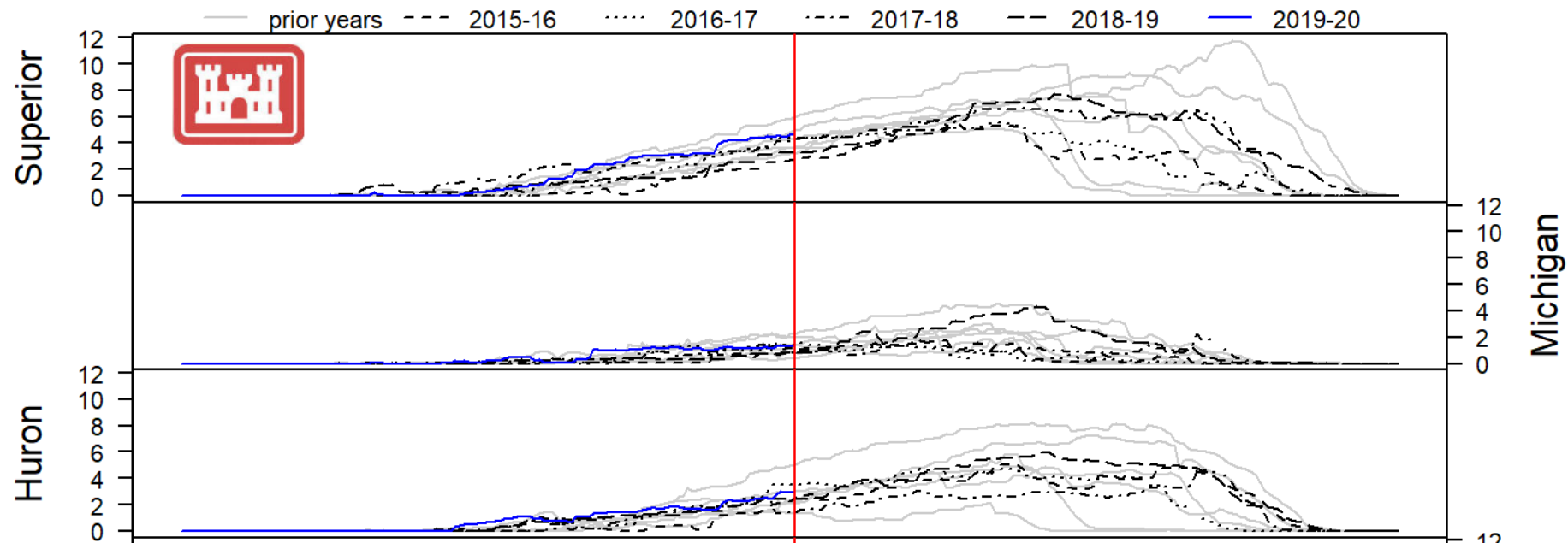
Michigan-Huron Lake Level Height “1200 Months of Record”

581.65	582.35	First Place	10/15/1986	10/15/2019
	581.99	Tied - 2nd Place	7/15/1986	
	581.99	Tied - 2nd Place	8/15/1986	
	581.96	Tied - 3rd Place	9/15/1986	
	581.96	Tied - 3rd Place	11/15/1986	
	581.92	Fourth Place	7/15/2019	
	581.79	Fifth Place	6/15/1986	
	581.77	Sixth Place	8/15/2019	
	581.76	Seventh Place	7/15/1974	
	581.61	10th? Place	9/15/2019	
1986		2019		



Lake Basin Snow Water Equivalent (inches)

Red line drawn at Jan 16



GREAT LAKES SURFACE ENVIRONMENTAL ANALYSIS (GLSEA)



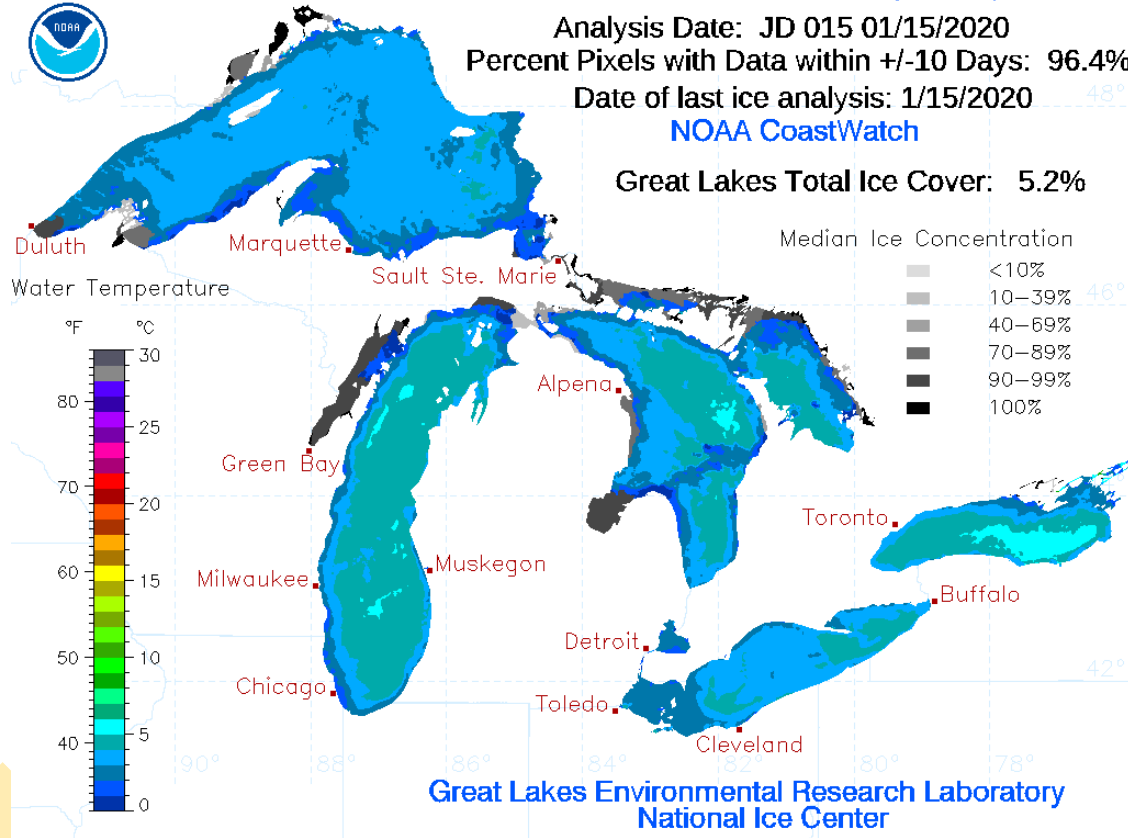
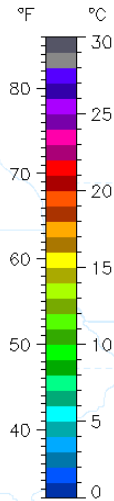
Analysis Date: JD 015 01/15/2020
Percent Pixels with Data within +/-10 Days: 96.4%
Date of last ice analysis: 1/15/2020
NOAA CoastWatch

Great Lakes Total Ice Cover: 5.2%

Median Ice Concentration

- <10%
- 10–39%
- 40–69%
- 70–89%
- 90–99%
- 100%

Water Temperature



Ice cover
1/15/2019
9.3%

Ice cover
1/15/2018
32.1%

GL Ice records
To 1972; some
GT Bay info to
Late 1800s..

Great Lakes Environmental Research Laboratory
National Ice Center

Some Impacts from High Water Levels

- Shoreline Erosion
- Increased sediment transport in the nearshore zone
- Alterations to stream and river mouths
- Damage to Roads & Coastal Infrastructure
- Flooded marinas, docks, boat launches
- Hazards to Navigation
- Increase in some coastal wetlands habitat
- Shrinking beaches / loss of beach sand
- Increased impacts when storms move through – water levels are the enabler of wave energy hitting high on the bluff



Matt Gillen
National Weather Service – Gaylord, MI

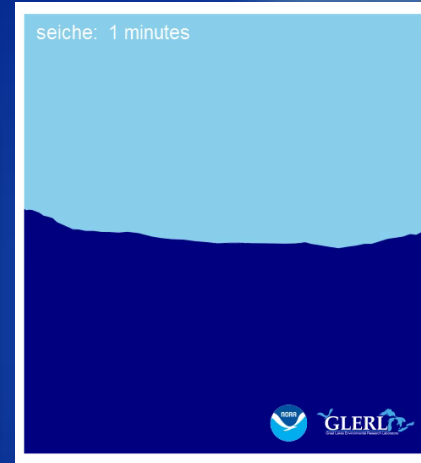
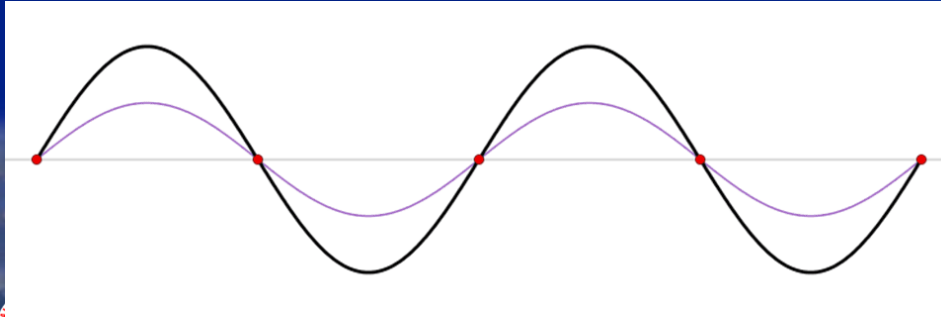
www.weather.gov/gaylord
[@NWSGaylord](https://twitter.com/NWSGaylord) [NWSGaylord](https://www.facebook.com/NWSGaylord)

Bob Dukesherer
Senior Forecaster – Marine Program Manager
NWS Grand Rapids Michigan



Seiches

- Typically caused when sustained strong winds and/or rapid changes in atmospheric pressure push water from one end of a body of water to the other. *Think Gales of November.*
 - When the wind stops, the water rebounds to the other side
 - Water can oscillate back and forth for hours or even days
- Similar to water sloshing back and forth in a bathtub
- Often difficult to tell the difference from a true seiche event & wave action, especially with high water levels
 - Damage can occur with either one



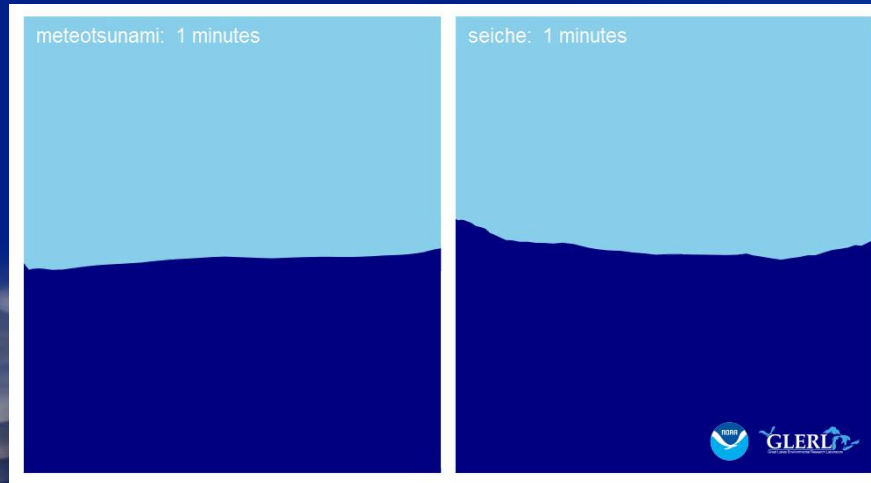
Meteotsunamis vs. Seiches Recap

Meteotsunami

- *Think severe thunderstorms*
- Short duration
- Often more damaging/chaotic than a seiche

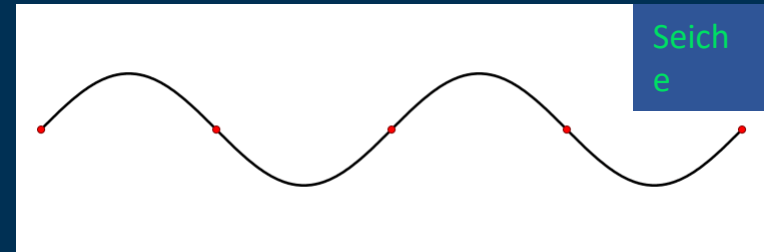
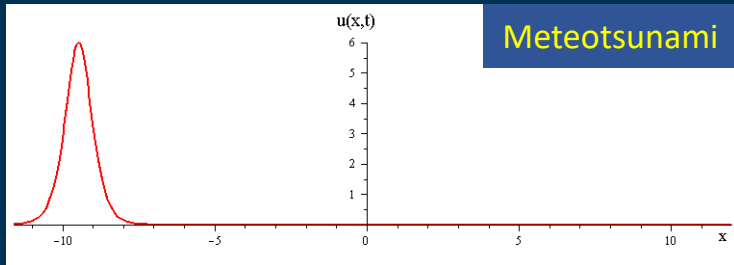
Seiche

- *Think Gales of November*
- Water pushed to one side of lake, typically from a prolonged periods of winds
 - Water oscillates back & forth
- Can last several hours/days

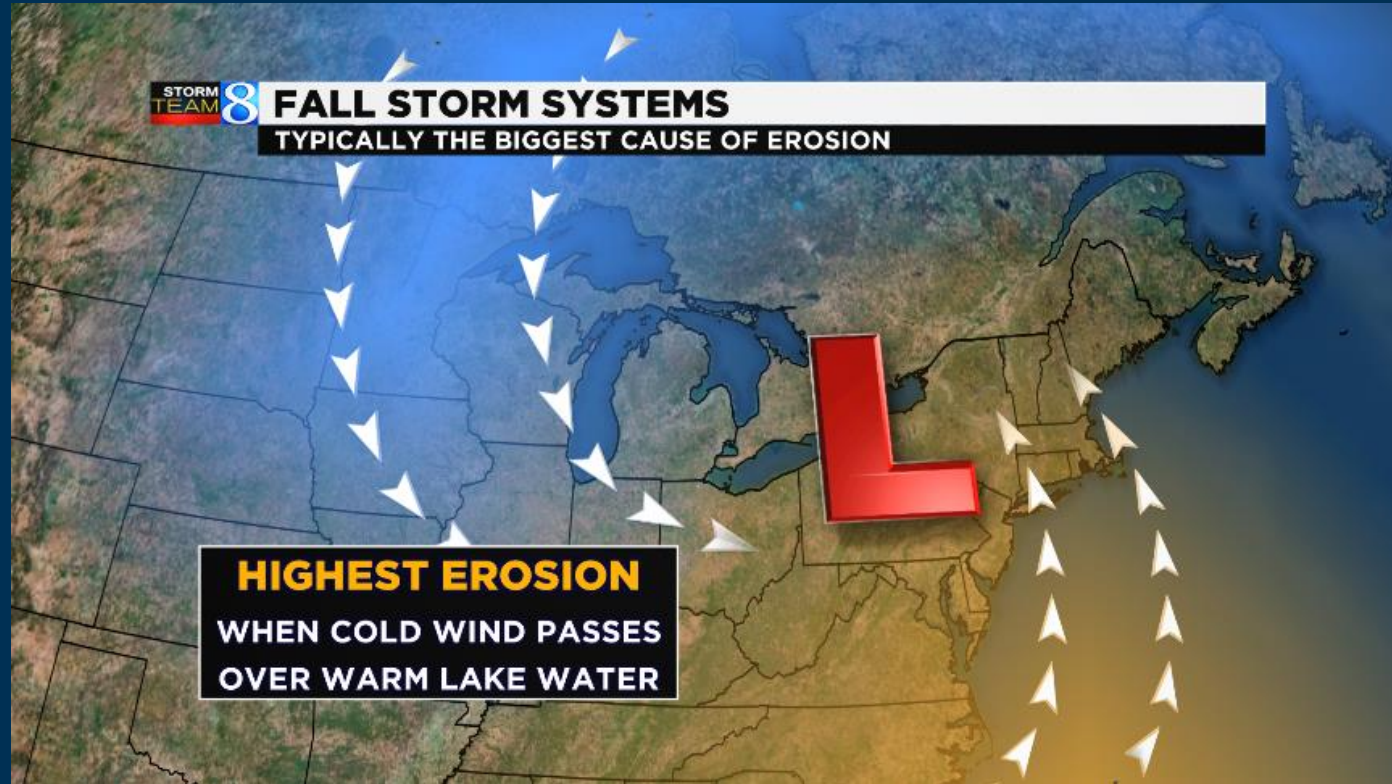


Meteotsunami vs Seiche

	Meteotsunami	Seiche	Storm Surge
<u>Definition</u>	<p>A rapid change in water level (similar to a seismic tsunami) in response to a meteorological event.</p> <p>Typically caused by the wind and atmospheric pressure changes associated with <i>fast</i> moving convective storms.</p>	<p>A standing wave oscillation (i.e. a back-and-forth sloshing) of water levels in a lake.</p> <p>Caused by a wind shift or rapid atmospheric pressure change.</p>	<p>A temporary rise in water levels lasting hours to days along a downwind coast.</p> <p>Caused by a combination of the drag of storm winds on the surface of a lake and atmospheric pressure variations.</p>



November is the windiest month on average





Lake Level Viewer United States Great Lakes

[Help](#)[Download FAQ](#)[Share](#)

Lake Michigan

Lake Level Change

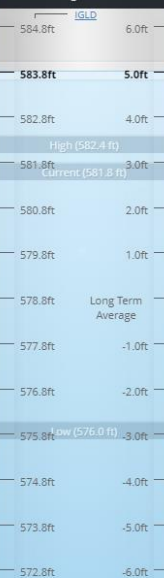
Mapping Confidence

Society

Business

Download

Lake Michigan Water Level



Records & Avg. ☒

Unit of Measure ☐ Ft ☐ M

500 m
2000 ft

MICHIGAN SEA GRANT



Opacity

Topography On

Depth-Query Off

POWERED BY
esri

Sea Grant
Michigan



Thank you / Questions???

michiganseagrant.org

Mark Breederland breederl@msu.edu

231-922-4628