Lake Erie Coastal Events

How Climate Change is affecting their frequency
Why Lake Erie is prone to them
How are they forecast and warned for

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Outline

- Climate Changes
- Coastal Issues
- Forecast and Warning Products

Climate Changes - What's Already Occurring

- Temperature
  - Winter – warmer and fewer cold days and nights
  - Summer – hotter and more frequent hot days/nights and heat waves

- Precipitation:
  - Extreme rainfall events in the Great Lakes have increased over the last century and these trends are expected to continue.

What about regional temperatures changes?

(Buffalo Airport Climate Normals)

MAX		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
	1981-2010	31.2	33.3	42.0	55.0	66.5	75.3	79.9	78.4	71.1	59.0	47.6	36.1	**56.4**
	1991-2020	32.1	33.3	41.8	54.7	67.4	75.6	80.2	79.0	72.3	59.6	47.8	37.2	**56.8**
		0.9	**0.0**	**-0.2**	**-0.3**	**0.9**	**0.3**	**0.3**	**0.6**	**1.2**	**0.6**	**0.2**	**1.1**	**0.4**
MIN		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
	1981-2010	18.5	19.2	26.0	36.8	47.4	57.3	62.3	60.8	53.4	42.7	33.9	24.1	**40.3**
	1991-2020	19.0	19.5	26.4	36.5	48.3	58.1	63.1	61.7	54.5	43.9	34.2	25.6	**40.9**
		0.5	**0.3**	**0.4**	**-0.3**	**0.9**	**0.8**	**0.8**	**0.9**	**1.1**	**1.2**	**0.3**	**1.5**	**0.6**
Mean		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
	1981-2010	24.9	26.3	34.0	45.9	56.9	66.3	71.1	69.6	62.2	50.8	40.7	30.1	**48.3**
	1991-2020	25.5	26.4	34.1	45.6	57.9	66.9	71.7	70.4	63.4	51.7	41.0	31.4	**48.8**
		0.6	**0.1**	**0.1**	**-0.3**	**1.0**	**0.6**	**0.6**	**0.8**	**1.2**	**0.9**	**0.3**	**1.3**	**0.5**

Positive Change **Negative Change** **No Change**

What about regional precipitation changes?

(Buffalo Airport Climate Normals)

Precipitation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Annual**
1981-2010	3.18	2.49	2.87	3.01	3.46	3.66	3.23	3.26	3.90	3.52	4.01	3.89	**40.48**
1991-2020	3.35	2.49	2.89	3.37	3.37	3.37	3.23	3.23	4.10	4.03	3.50	3.75	**40.68**
	0.17	**0.00**	**0.02**	**0.36**	**-0.09**	**-0.29**	**0.00**	**-0.03**	**0.20**	**0.51**	**-0.51**	**-0.14**	**0.20**

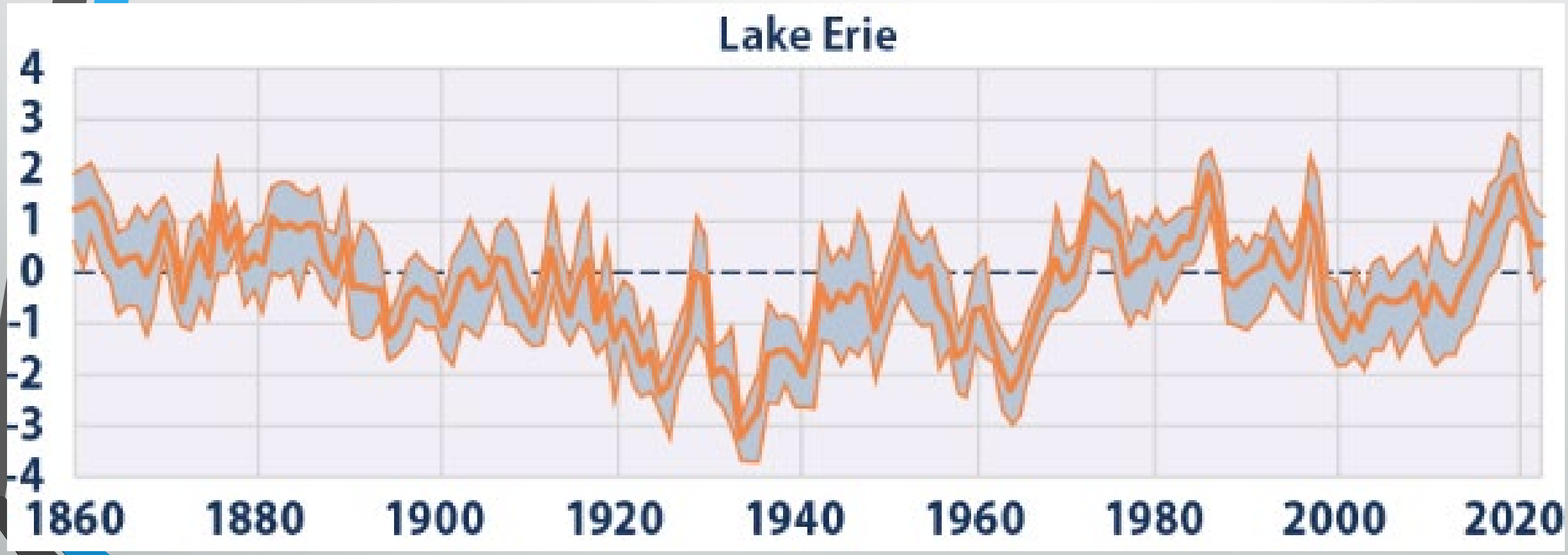
Snow	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Annual**
1981-2010	25.3	17.3	12.9	2.7	0.3	0.0	0.0	0.0	0.0	0.9	7.9	27.4	**94.7**
1991-2020	26.7	18.1	14.1	2.5	0.0	0.0	0.0	0.0	0.0	0.9	7.8	25.3	**95.4**
	1.4	**0.8**	**1.2**	**-0.2**	**-0.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**-0.1**	**-2.1**	**0.7**

Increase

Decrease

No Change

Lake Erie Water Levels



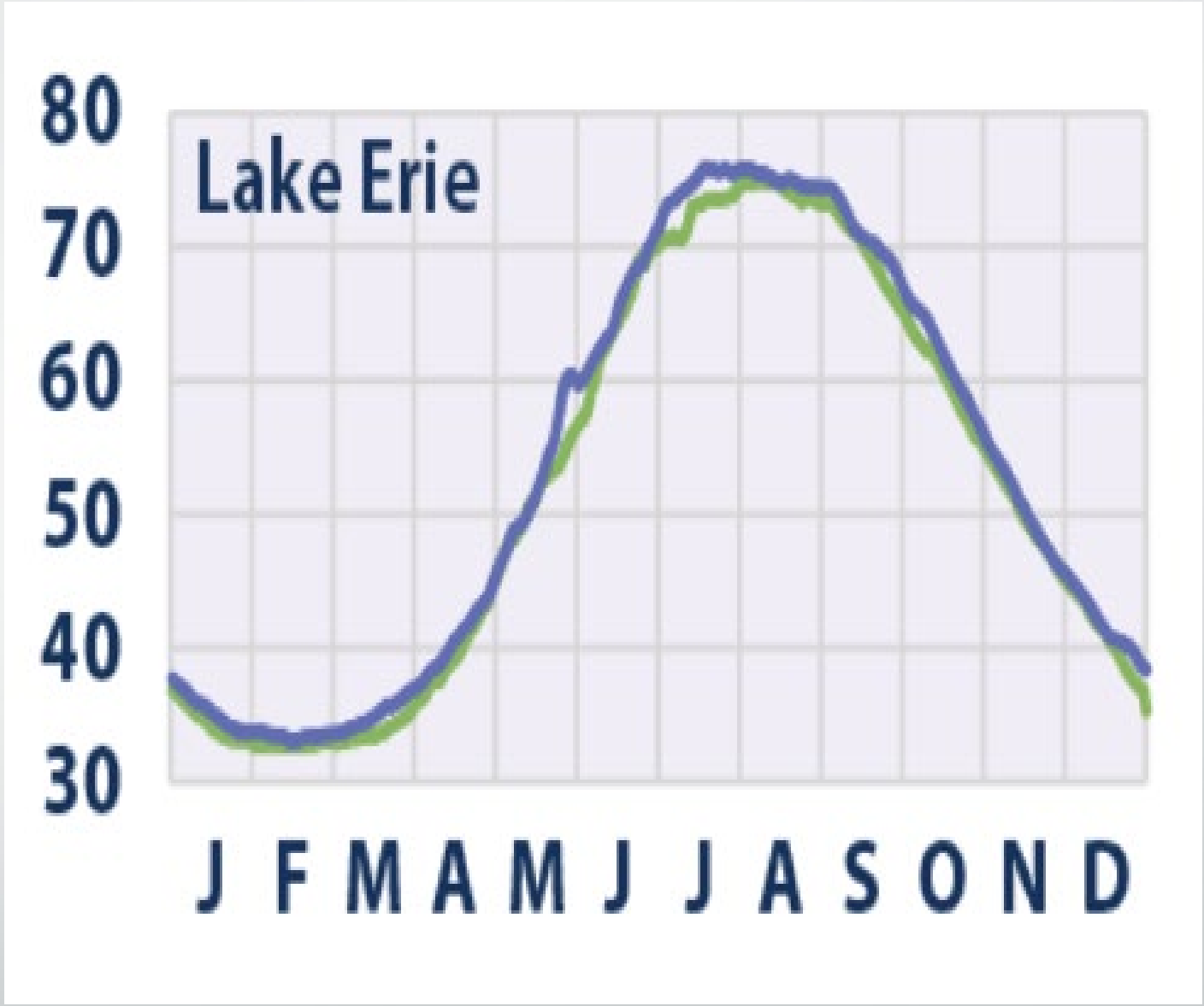
EPA, Climate Change Indicators, Surface Temperatures of the Great Lakes, https://www.epa.gov/climate-indicators/great-lakes 08/04/2024

Water Level Balancing Act

1. Evaporation
2. Outflow into Lake Ontario

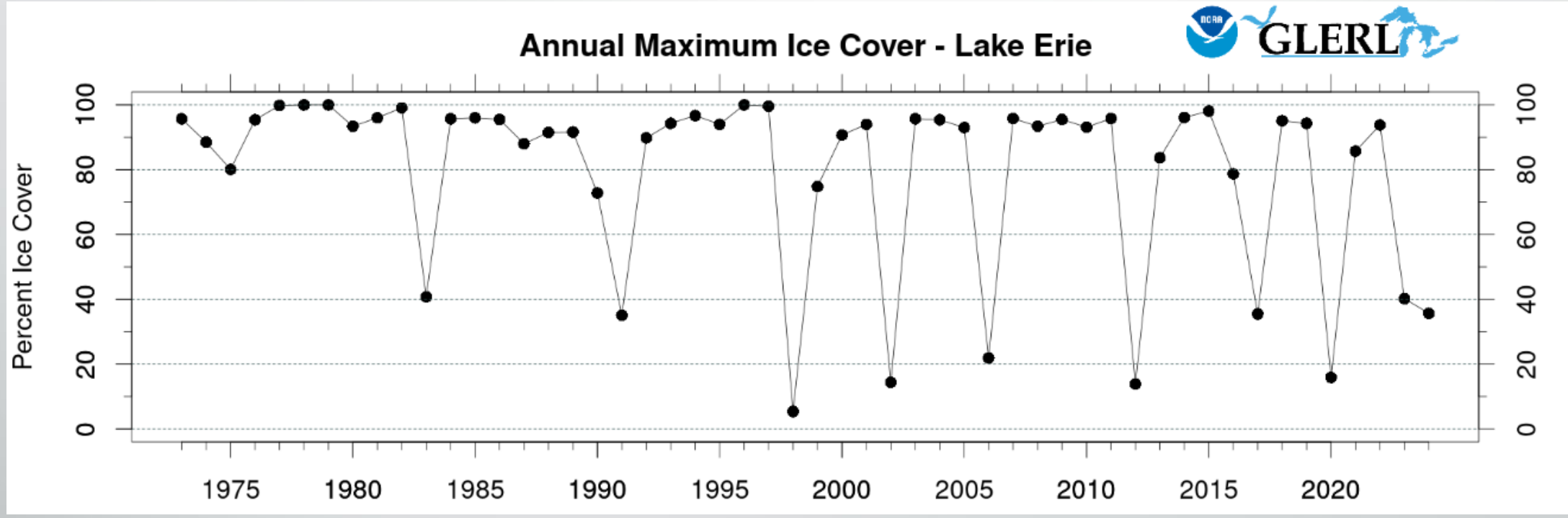
1. Inflow from Detroit River
2. Precipitation on Lake
3. Runoff into Lake

Lake Erie Water Temperatures



EPA, Climate Change Indicators, Surface Temperatures of the Great Lakes, https://www.epa.gov/climate-indicators/great-lakes 08/04/2024

Lake Erie Ice Cover



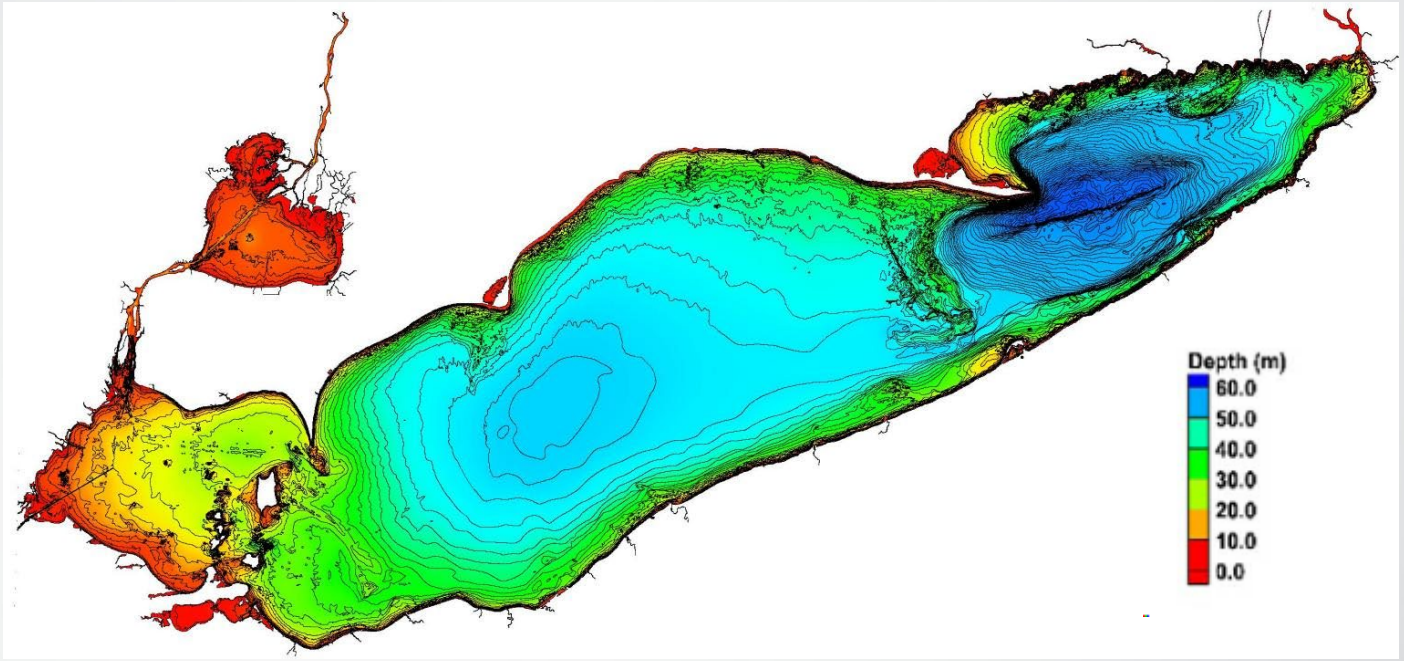
NOAA, GLERL, Historical Ice Cover, https://www.glerl.noaa.gov/data/ice/#historical 08/04/2024

Regional Climate Changes in the Great Lakes and Northeast: Summary

- More heat waves
- More frequent severe flooding
- Increase in amount of lake effect snow events
- Decline in air quality
- Crop, livestock, forest and floodplain management practices must adapt

Seiches

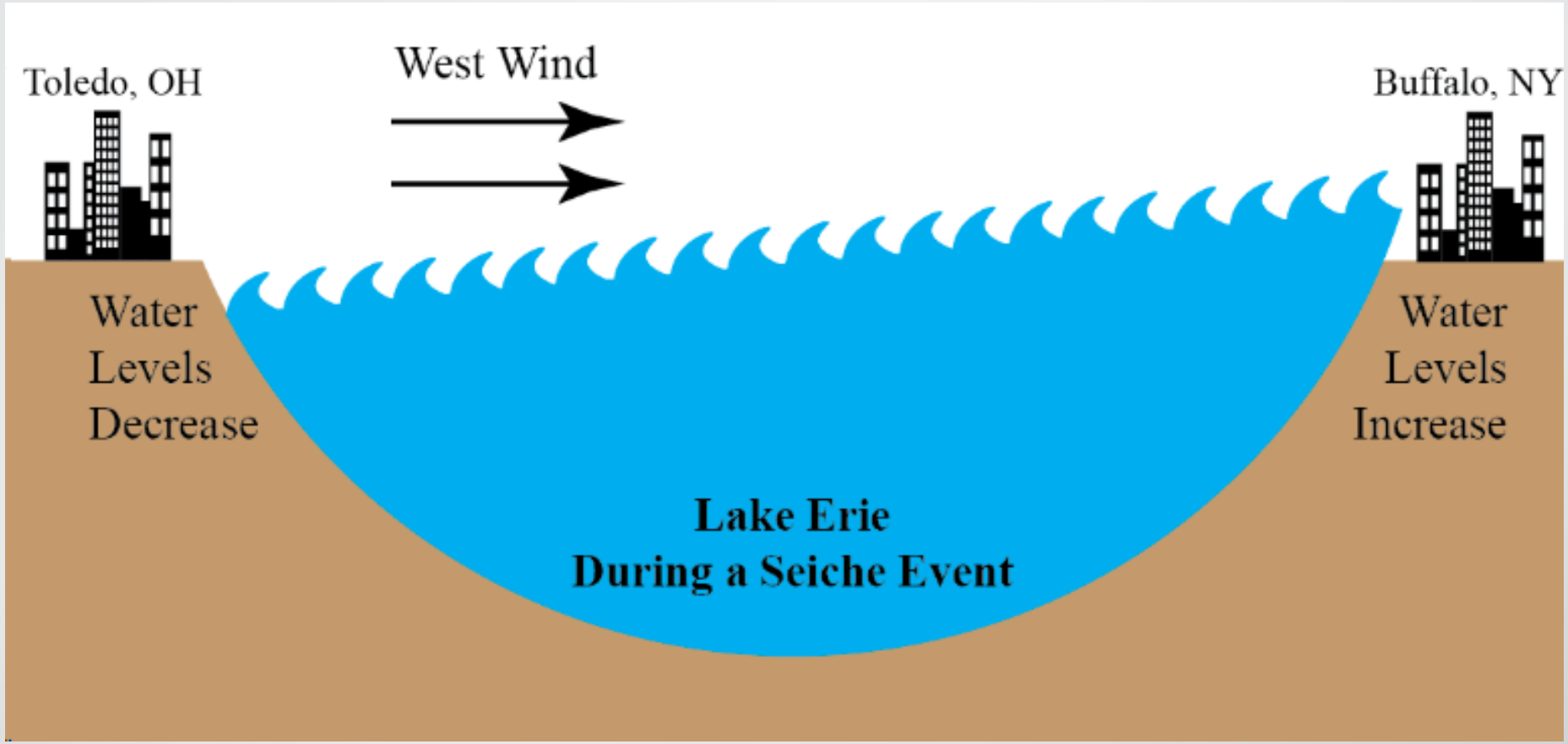
Lake Erie



- Shallowest of all the Great Lakes
- Maximum depth 210 feet in the eastern basin
- Longest Fetch ~240 miles

SeaGrant, Seiche Induced Erosion in Lake Erie, https://storymaps.arcgis.com/stories/5963dcd910b74537852c734e69f9b62a 08/04/2024

Lake Erie

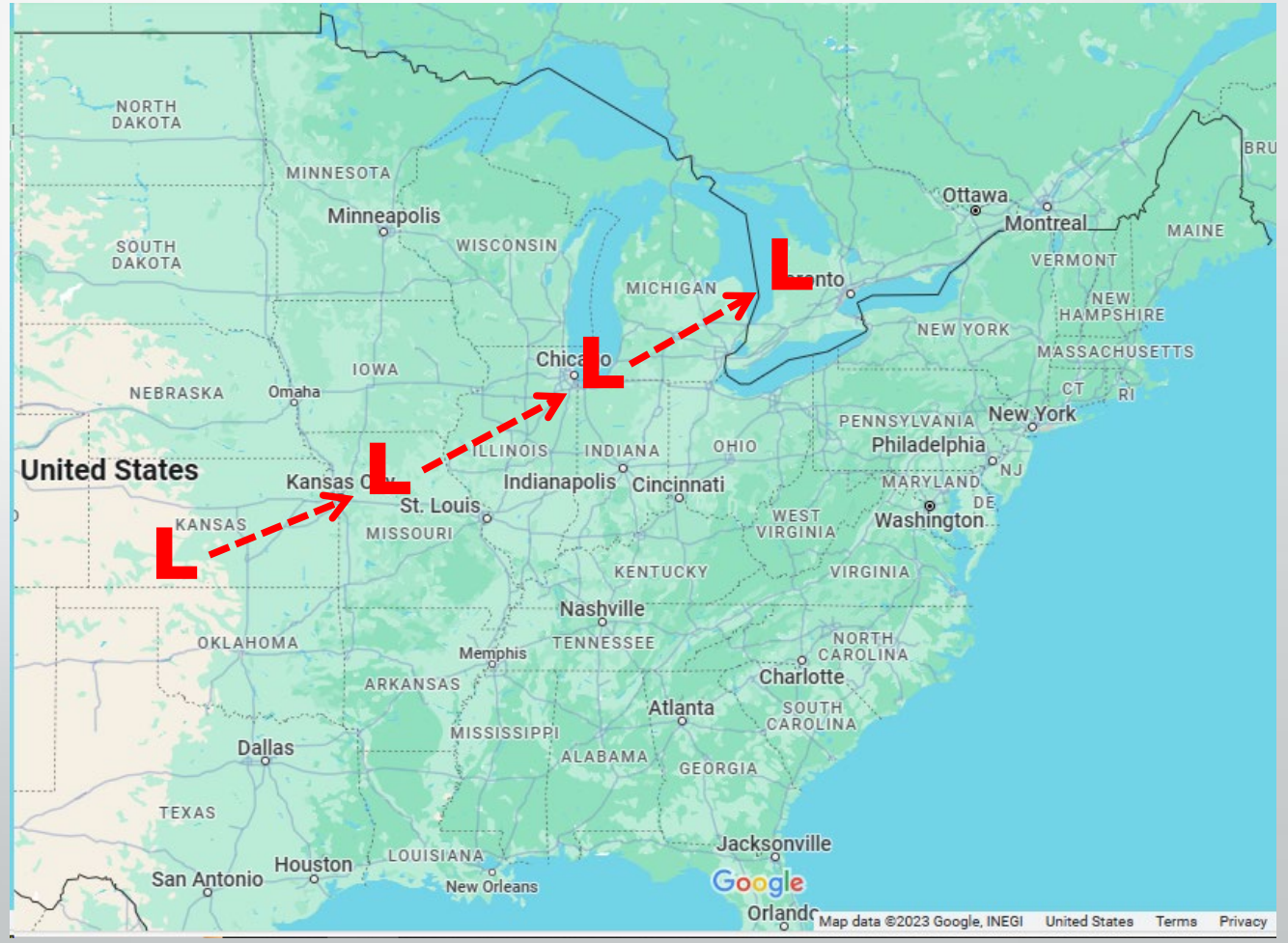


- Increase in water level is a function of the fetch, the time the strong winds persist, and the pre-seiche water levels

SeaGrant, Seiche Induced Erosion in Lake Erie, https://storymaps.arcgis.com/stories/5963dcd910b74537852c734e69f9b62a 08/04/2024

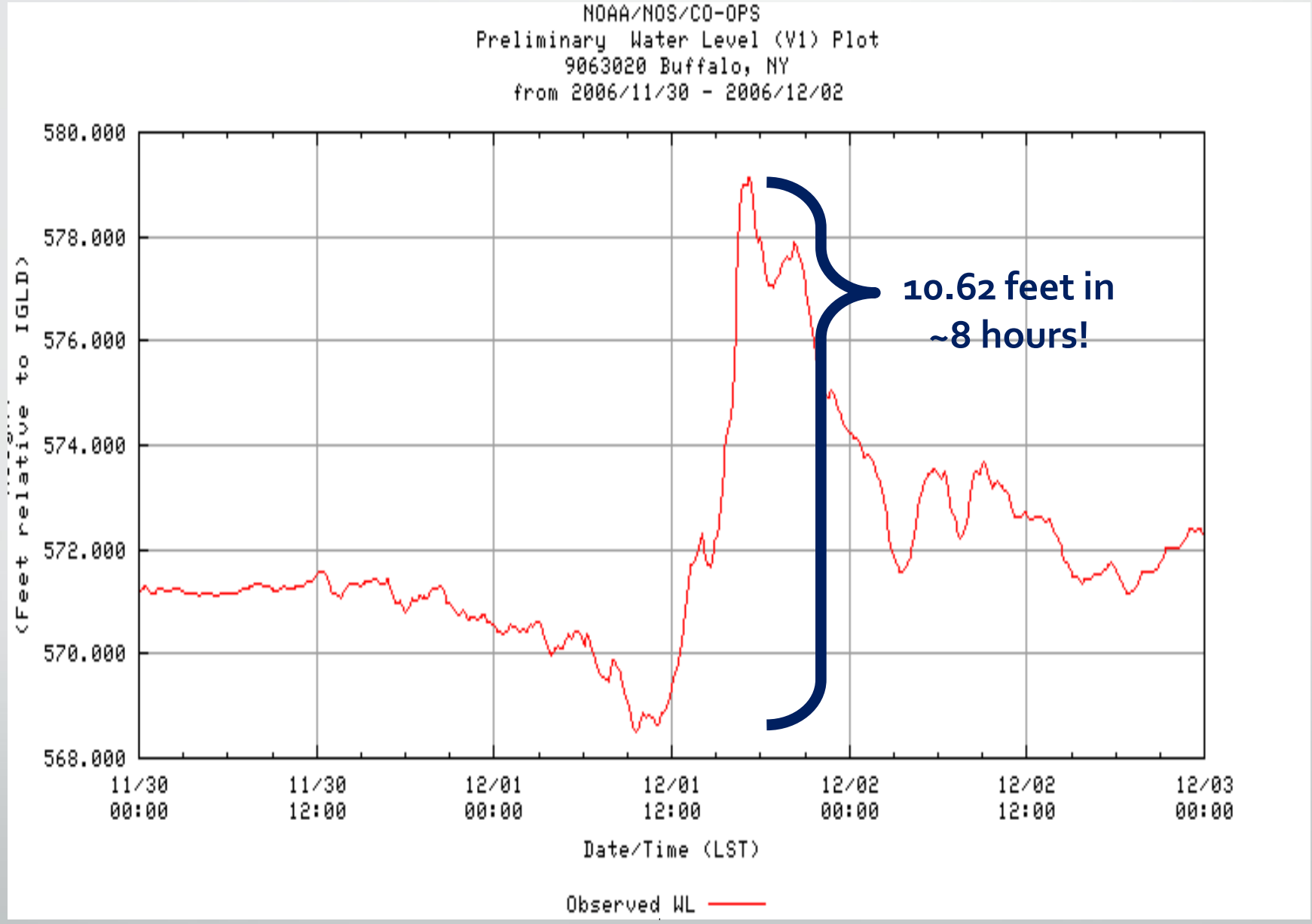
Typical Great Lakes Cutter

- As the system approaches winds become south/southeast
- Winds become very strong as the low passes by just to our north and west
- A cold front associated with the low brings a sharp shift in wind direction to the west



Buffalo NY

Put In Bay OH


NOAA/NOS/CO-OPS
Preliminary Water Level (V1) Plot
9063020 Buffalo, NY
from 2006/11/30 - 2006/12/02
580.000
578.000
576.000
574.000
572.000
570.000
568.000
(Feet relative to IGLD)
11/30 00:00
11/30 12:00
12/01 00:00
12/01 12:00
12/02 00:00
12/02 12:00
12/03 00:00
Date/Time (LST)
Observed WL
10.62 feet in ~8 hours!

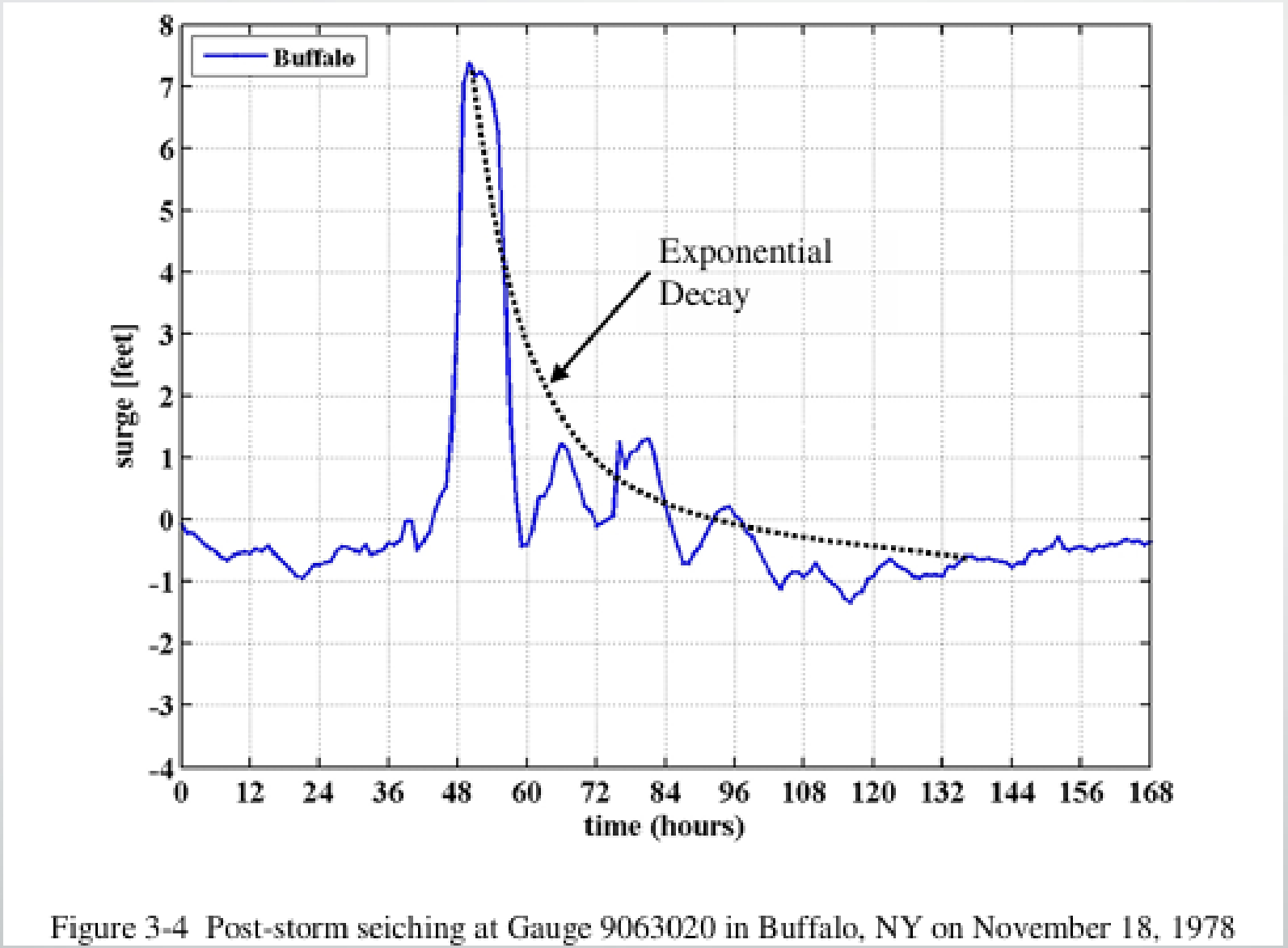


Figure 3-4 Post-storm seiching at Gauge 9063020 in Buffalo, NY on November 18, 1978

https://chs.erdc.dren.mil/Library/CHS_Studies/FEMA_RiskMAP_GreatLakesStudy/Publications/Lake_Erie_Final_Rampp_Report.pdf

Buffalo NOS observing site - Dec 2006

Ice shove

What we know about ice shoves

- Documented in North America since the early 1800s
- Most common in springtime

- Ice shoves happen when the ice has started to thaw and has cracks
- Strong onshore winds occurring
- A gentle sloping shoreline provides less resistance

February 23, 2019
Two Ice Shoves Occurred

Fort Erie, Ontario

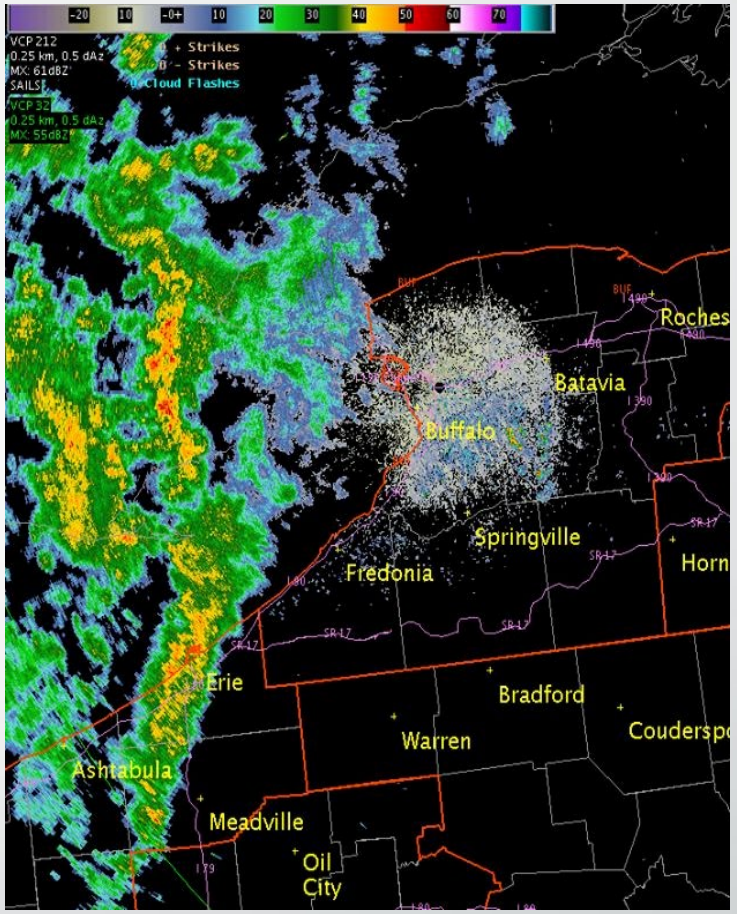
Photo Credit: The Weather Network

Hamburg, New York

Photo Credit: Sean Crotty

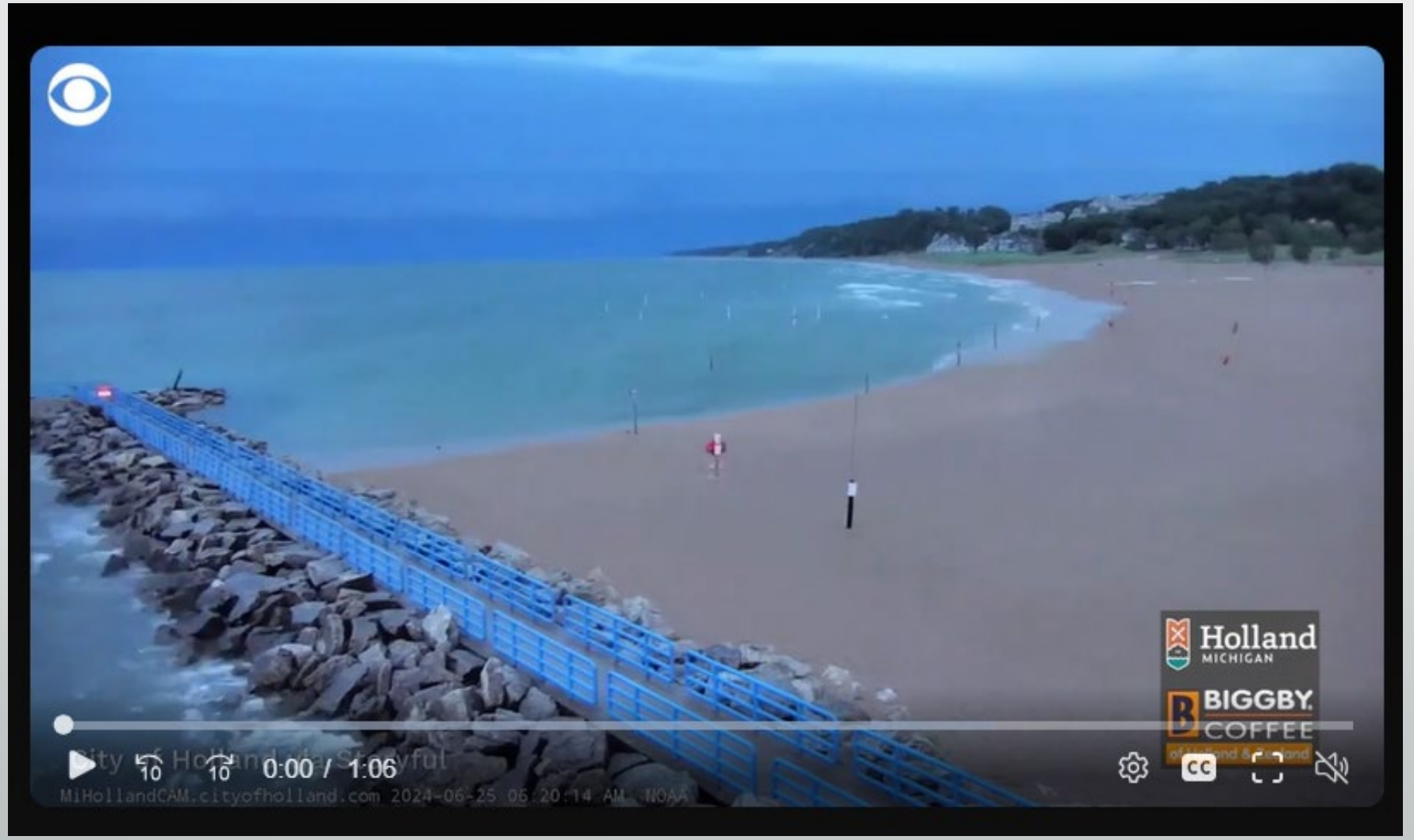
Meteotsunami

Meteotsunami



- Caused by fast moving weather systems
- Waves develop in the lakes
- As the waves approaches the shore it increases in height and intensity

Watch a meteotsunami strike a Lake Michigan shoreline (msn.com)

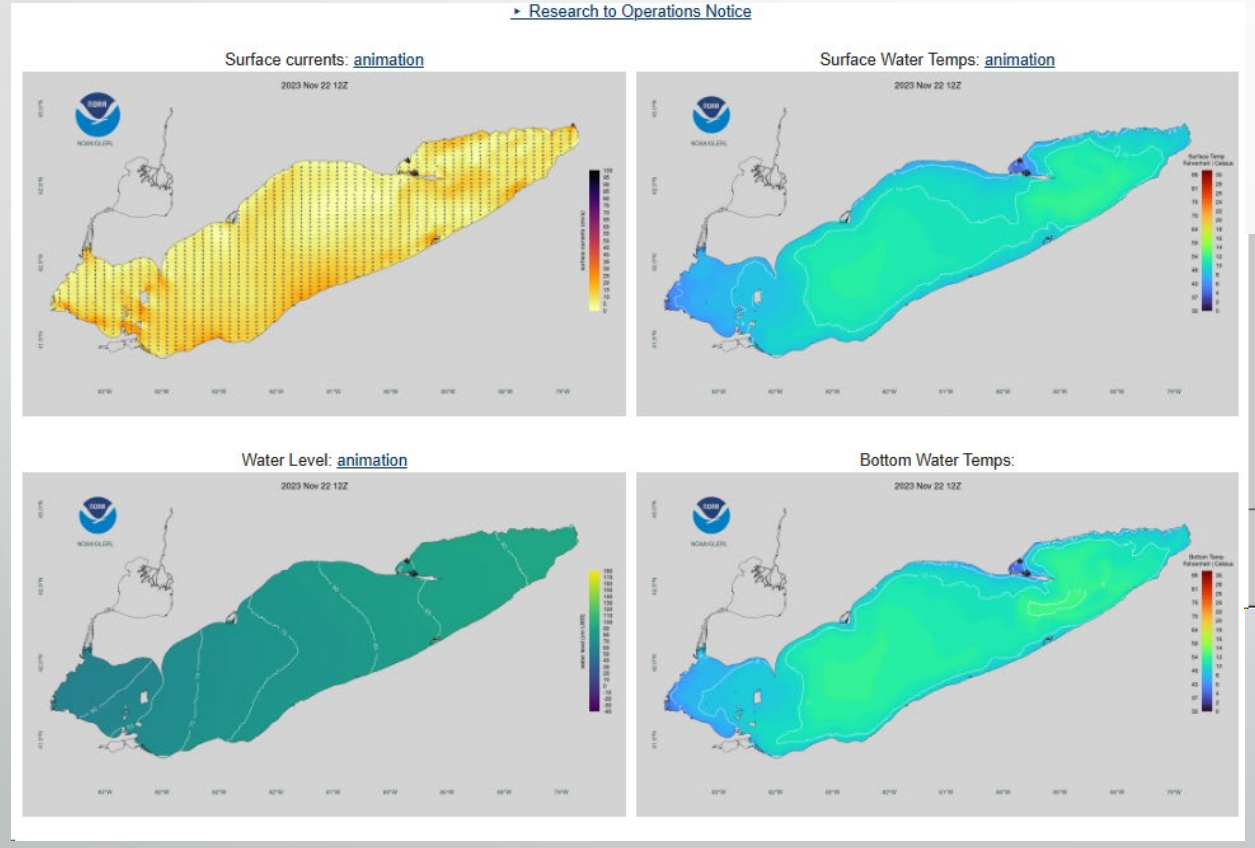


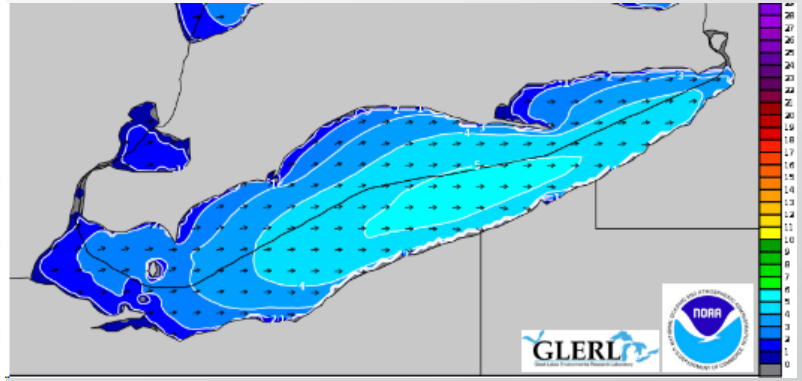
National Weather Service

Forecasting
Products for the Lake Shores

Forecasting

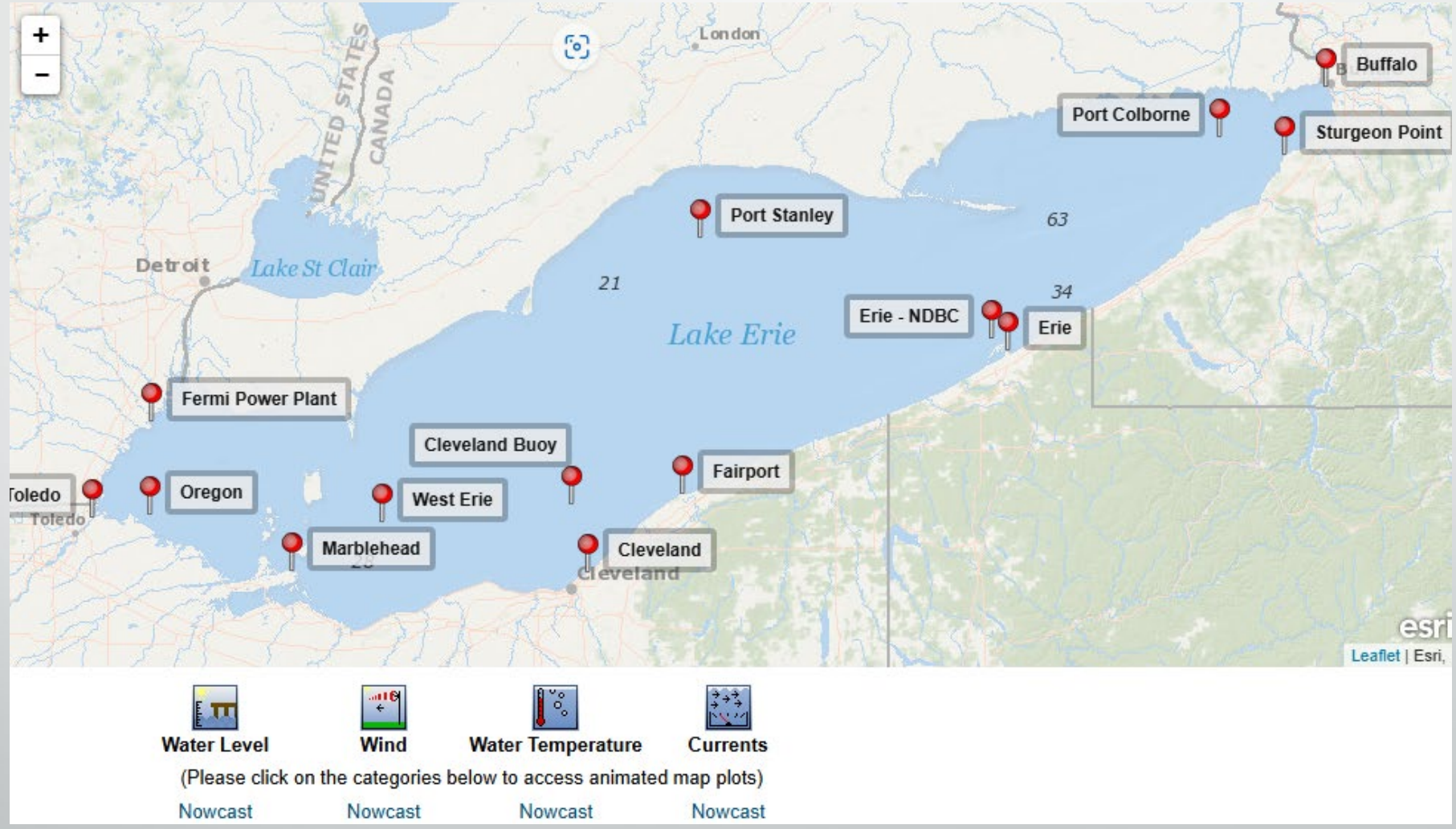
- Computer models are run several times per day and provide information on currents, water temperatures, water level fluctuations, ice and waves out five to six days
- Forecasters use the model guidance and their expertise to make official forecasts





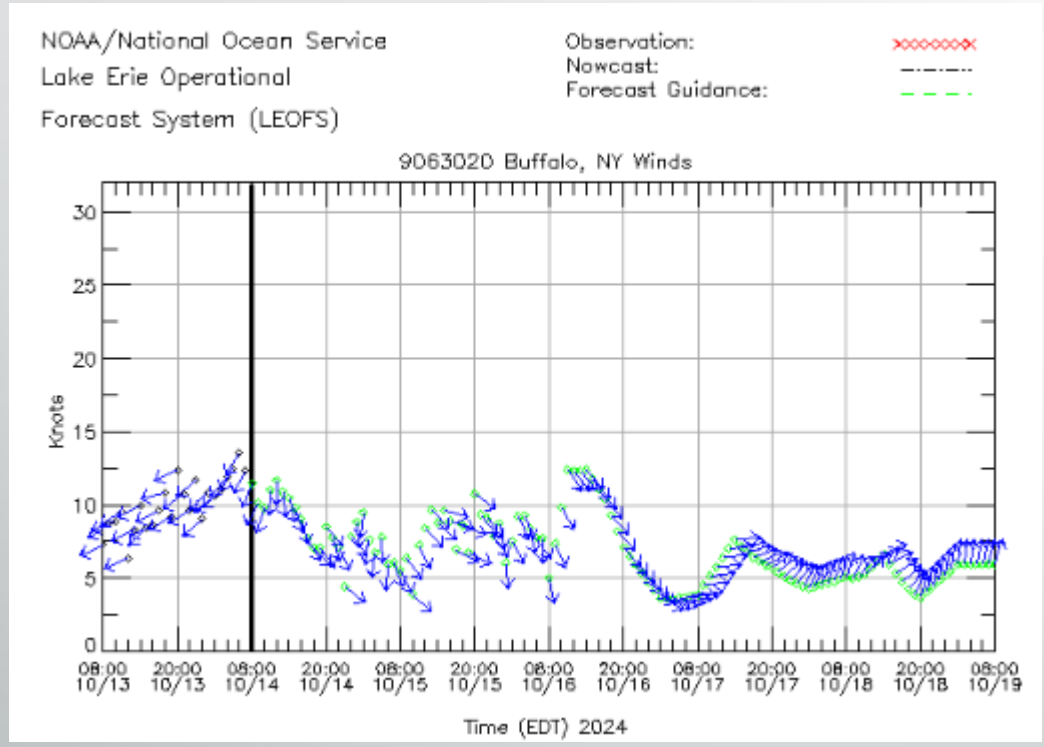
https://www.glerl.noaa.gov/emf/waves/WW3
https://www.glerl.noaa.gov/res/glcfs/ncast.php?lake=eri

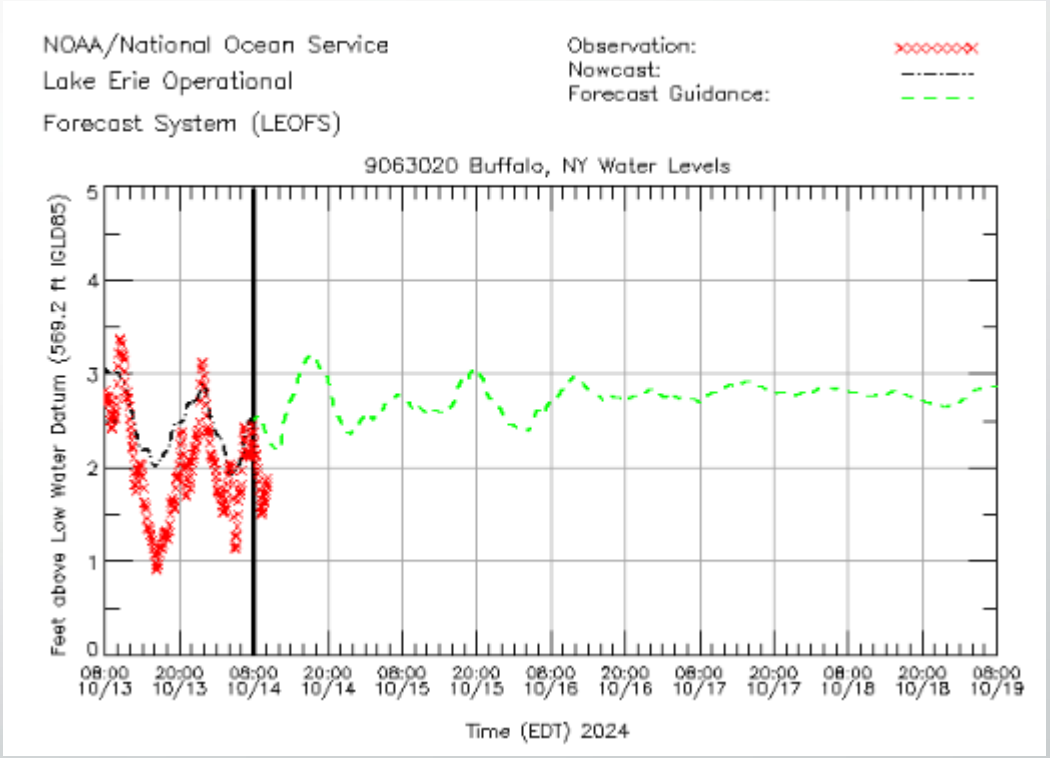
Lake Erie Operational Forecast System (LEOFS)



https://tidesandcurrents.noaa.gov/ofs/leofs/leofs.html

Lake Erie Operational Forecast System (LEOFS)





https://tidesandcurrents.noaa.gov/ofs/leofs/leofs.html

NWS Products

- Lakeshore Flood Watch:
  - 50% or greater forecaster confidence of meeting or exceeding Warning criteria at least 12 hours in advance of the onset of lakeshore flooding
- Lakeshore Flood Warning:
  - For Buffalo to Ripley when Lake Erie water level is expected to reach or exceed 8 feet
    - Upper Niagara River included if water level is expected to reach or exceed 9 feet
- Lakeshore Flood Advisory
  - For levels of 6 to 8 feet forecast when Gale Warnings are in Effect

Impacts

- At 8 feet:
  - Minor flooding and splash-over along the immediate Lake Erie shoreline
  - Route 5 in Hamburg may be impacted

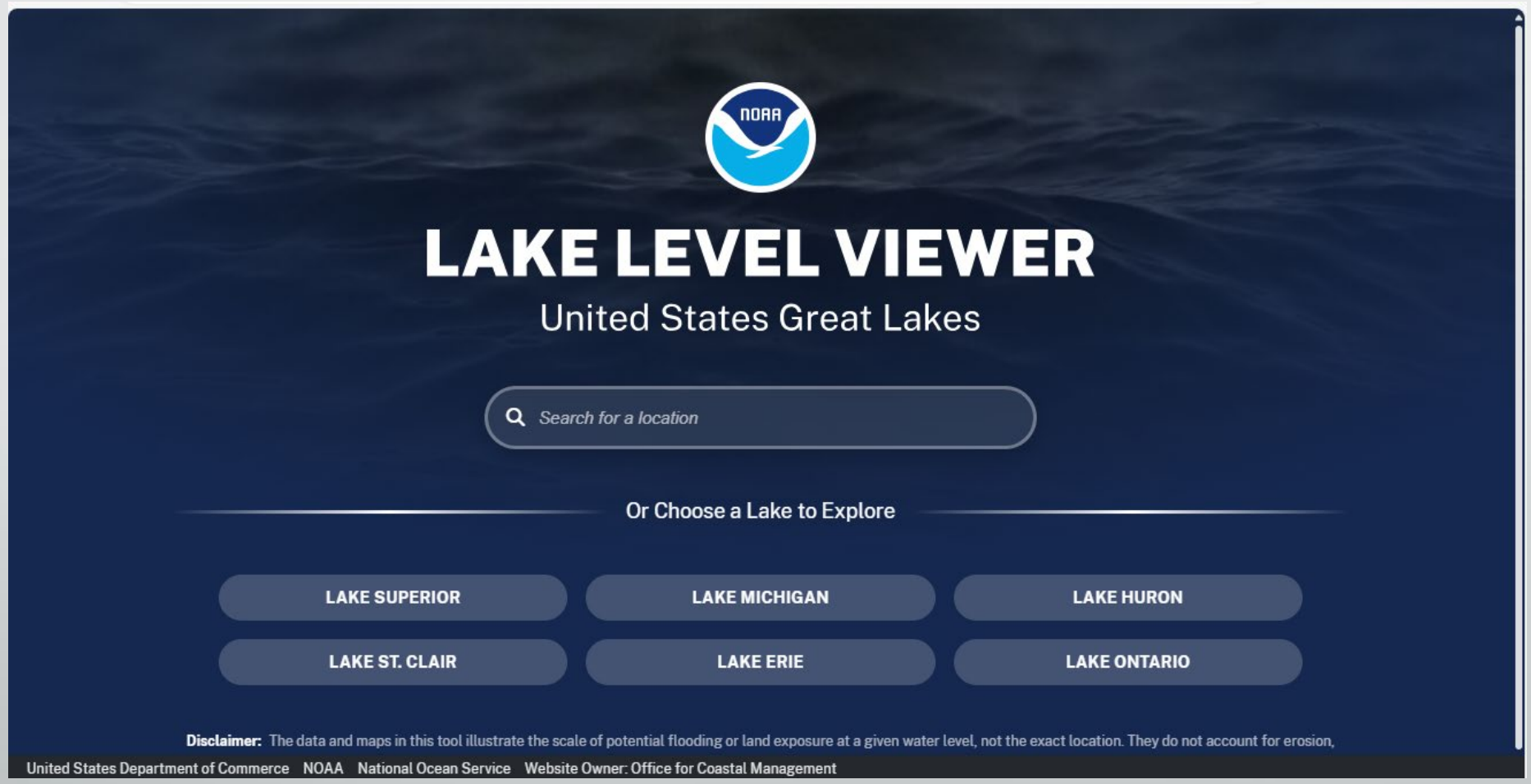
- At 9 feet:
  - Flooding begins at Canalside
  - Minor flooding at Sunset Beach
  - Possible flooding on Lakefront Blvd, Dunkirk City Pier and Crooked Brook Dr and Route 5 Hamburg
  - Minor flooding begins on Cayuga Island

Impacts

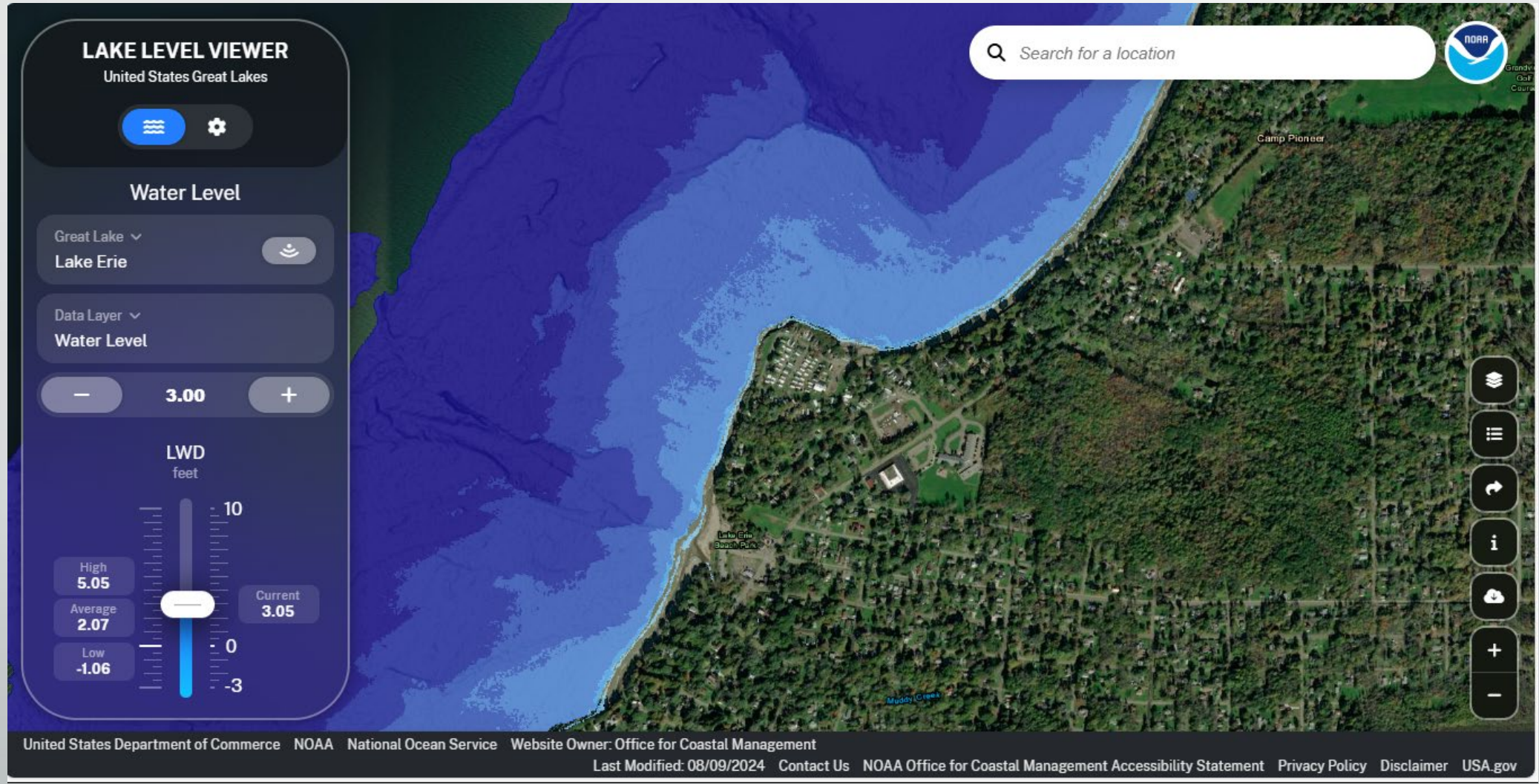
- At 10 feet:
  - Flooding at Canalside, Sunset Beach, Hoover Beach, Ralph Wilson Park
  - Flooding Buffalo starts on Niagara and Tonawanda Streets and the mouth of Buffalo River
  - Dunkirk lakewall impacted
  - Flooding at North Grand Island Bridge at I-190 ramps, LaSalle Expressway and Niagara Parkway
  - Flooding on Colony, Bronson, and East River Roads on Grand Island

- At 11 feet:
  - Flooding in Buffalo First Ward, Riverworks, Hamburg St and Buffalo River
  - Widespread flooding at Hoover Beach, South Grand Island and Dunkirk
  - Flooding at Van Buren Point and Silver creek; lakewalls also impacted
  - Flooding on Old Lakeshore Rd in Evans

NOAA's Lake Level Viewer
https://coast.noaa.gov/llv



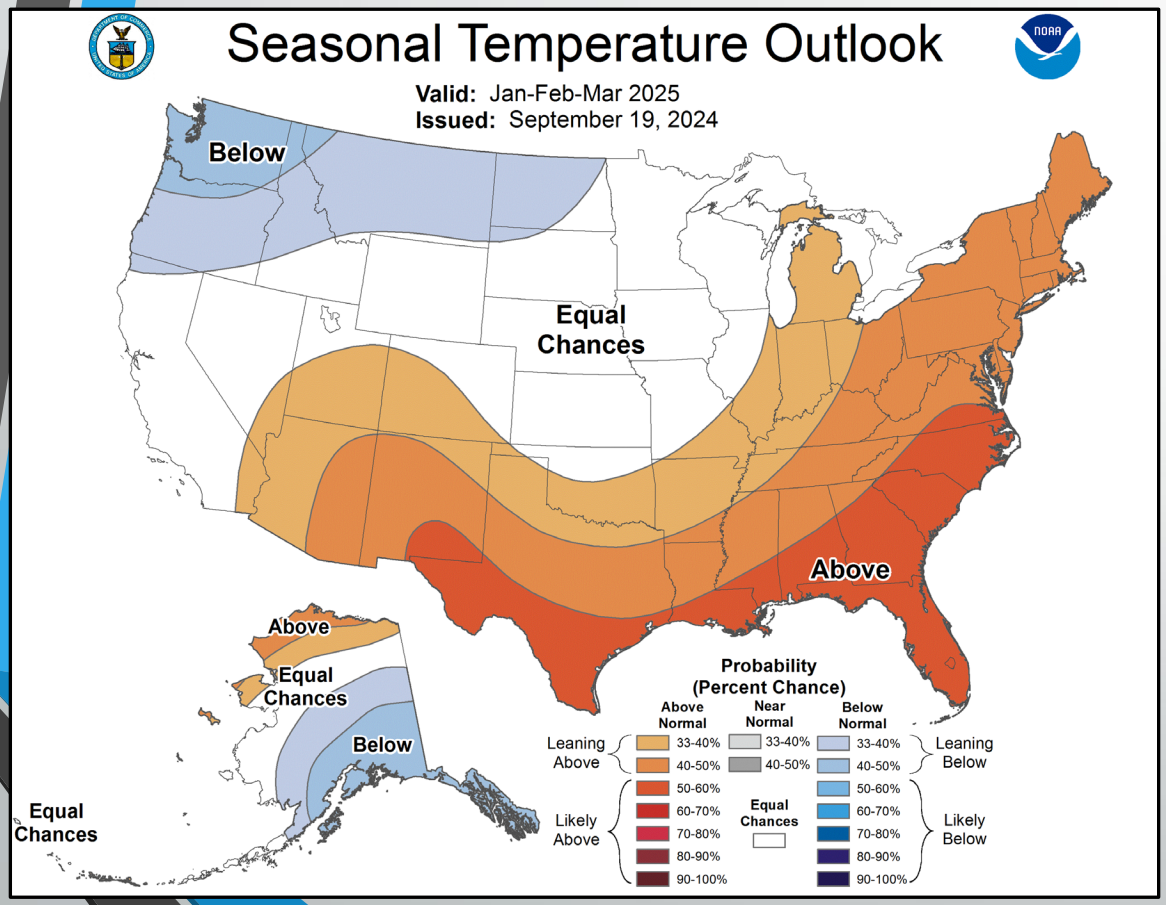
NOAA's Lake Level Viewer – Lake Erie

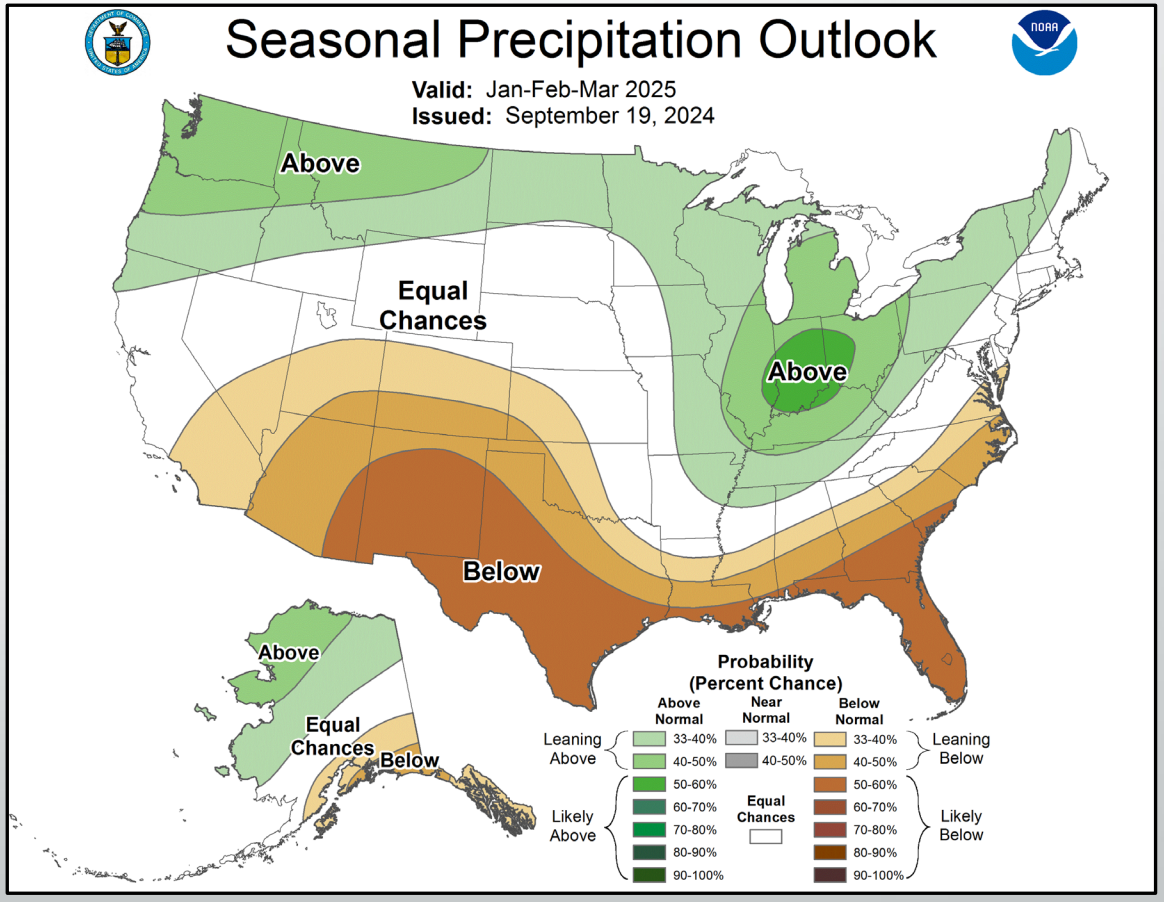


https://bit.ly/3Ub2hdz

Outlook for the 2024-25 Winter

La Niña is favored to emerge through November and is expected to persist through March 2025





https://www.cpc.ncep.noaa.gov/products/predictions/long_range/seasonal.php *10/14/2024*

Questions?

- https://www.facebook.com/watch/?v=3892991207426757