Water Levels of Lake Michigan

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Green Bay Port Symposium

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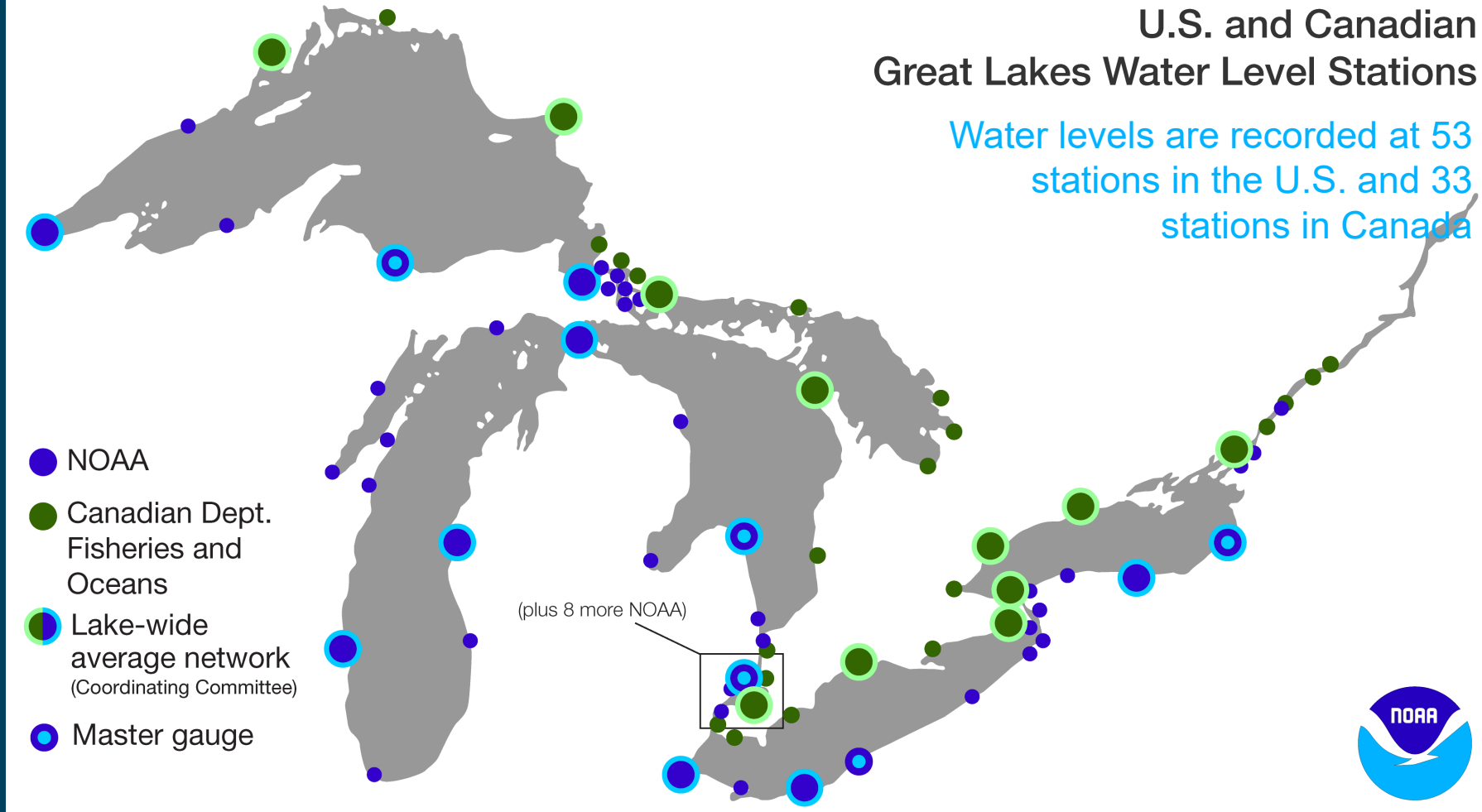
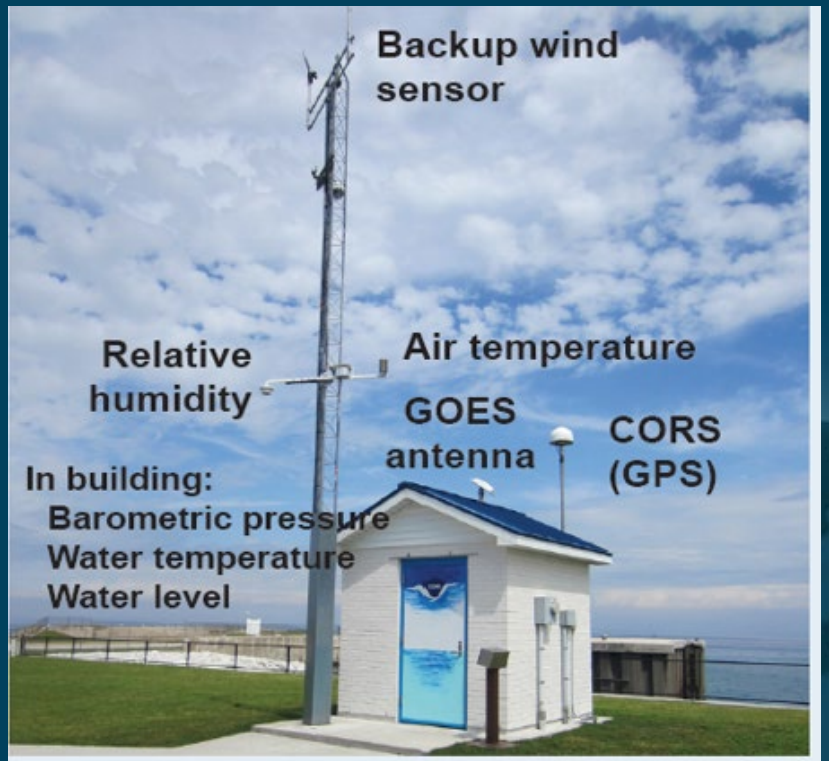
THE GREAT LAKES BASIN

Water Level Monitoring



Water Level Monitoring

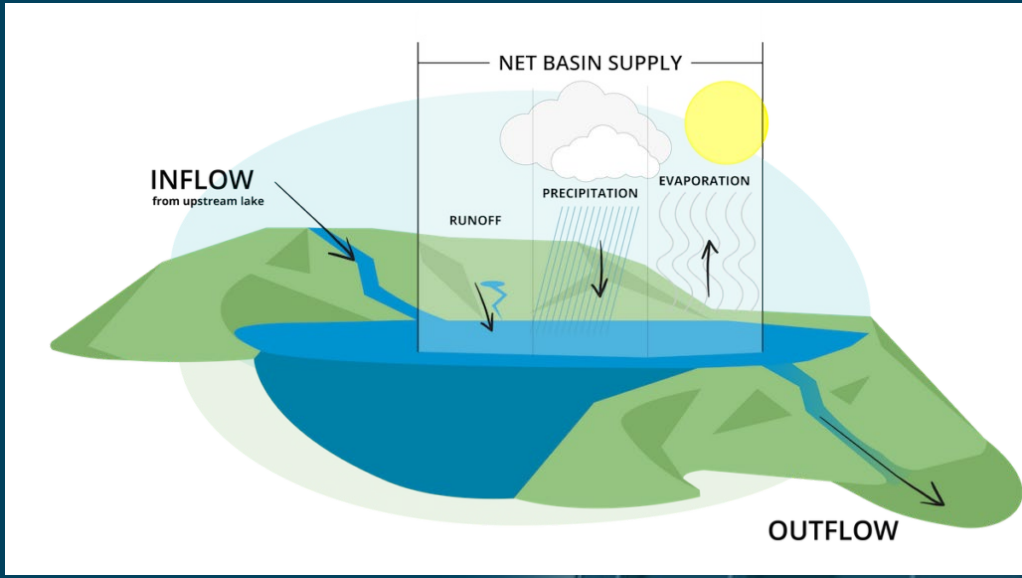
- The 53 NOAA/NOS stations record a 3 minute average water level every 6 minutes
- Daily levels are from each lake's master gauge
- Monthly lake-wide average levels are determined from a pre-determined set of approved U.S. and Canadian gauges
- Data is available starting in 1918
- Many stations also record wind, relative humidity, air & water temperature, barometric pressure



NOAA/NOS/CO-OPS water level station at Mackinaw City, MI. Many stations are equipped with meteorological sensors similar to this one.

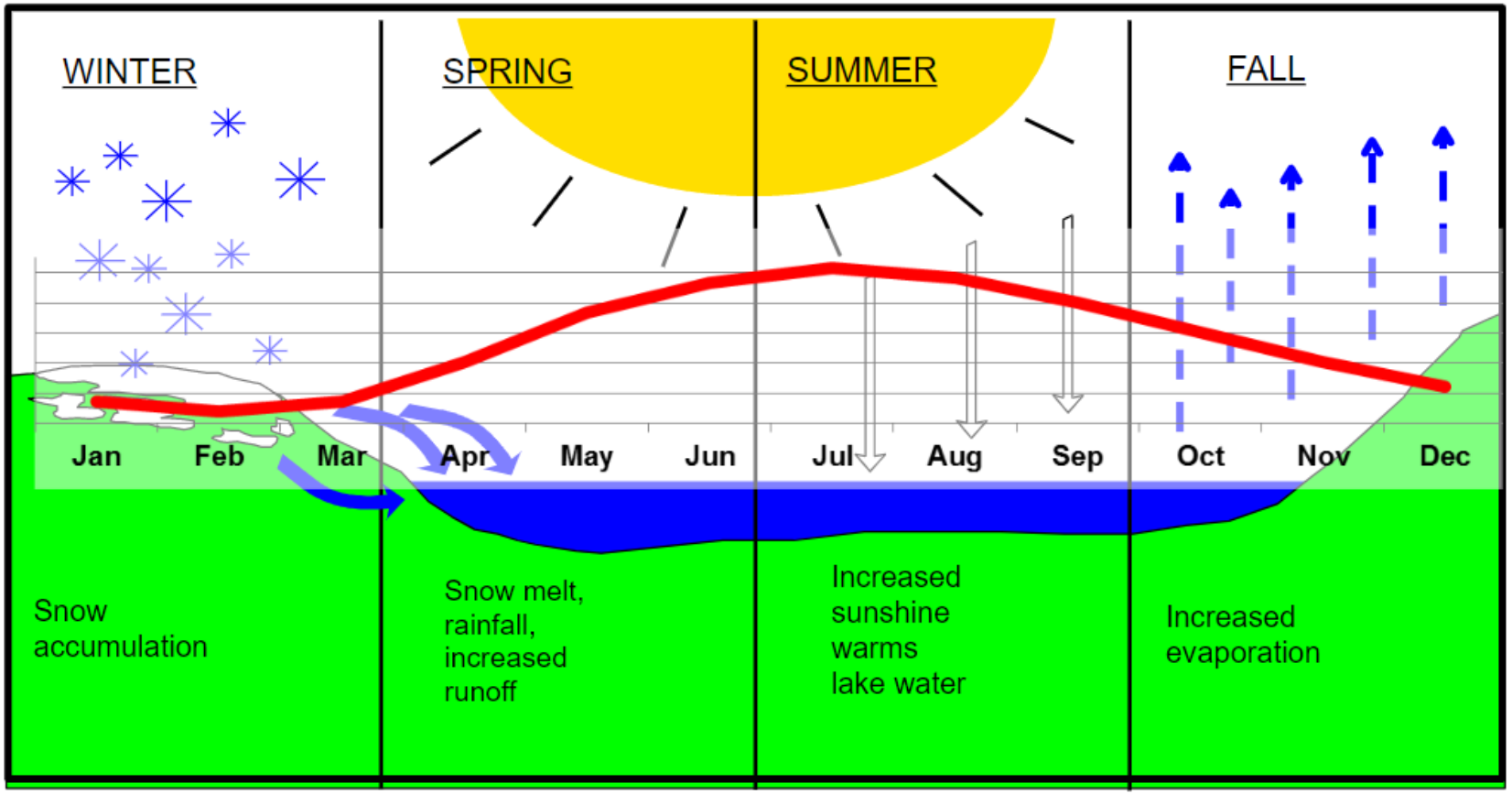
The Water Cycle

- Net basin supply is the primary driver of Great Lakes water levels
- Net basin supply = precipitation + runoff - evaporation
- Precipitation and runoff (snow melt) peaks in spring and summer (rising water levels)
- Evaporation is highest in autumn and winter when cold air flows over the relatively warm waters of the Lakes (falling water levels)
- Ice cover reduces evaporation



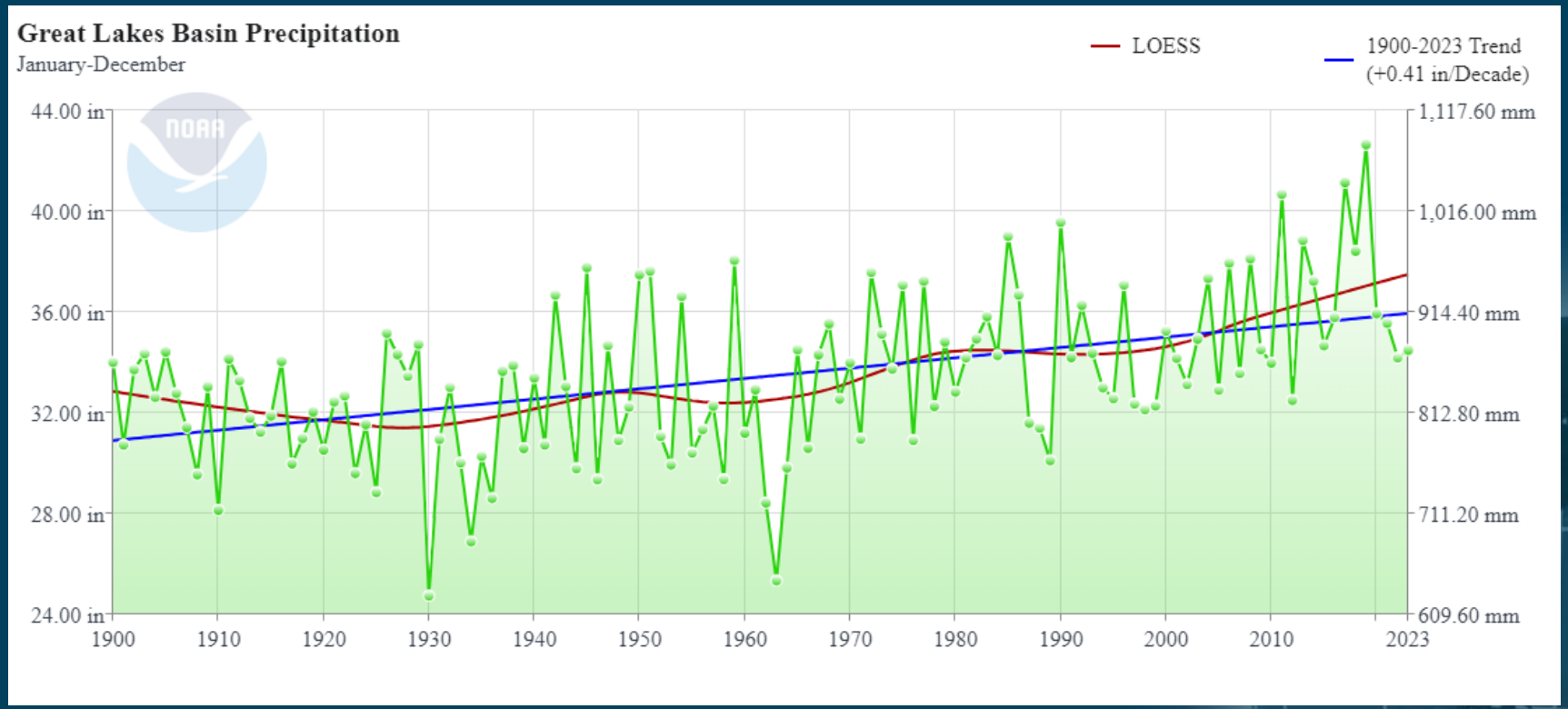
The Water Cycle

ANNUAL WATER LEVELS AND THE HYDROLOGIC CYCLE



Long Term Precipitation Trends

Great Lakes Basin



An increasing trend in precipitation is observed long-term

Annual Precipitation over Wisconsin

Relatively dry conditions over last 3 years

Record Driest	Bottom 1/10	Bottom 1/3	Normal	Top 1/3	Top 1/10	Record Wettest

Period	Value	1901-2000 Mean	Anomaly	Rank (1895-2024)	Driest/Wettest Since	Record
Jan–Dec 2023 **12-Month**	30.13" (765.30mm)	31.29" (794.77mm)	-1.16" (-29.46mm)	50th Driest	Driest since: 2021	1910
				80th Wettest	Wettest since: 2022	2019
Jan–Dec 2022 **12-Month**	32.28" (819.91mm)	31.29" (794.77mm)	0.99" (25.15mm)	67th Driest	Driest since: 2021	1910
				63rd Wettest	Wettest since: 2020	2019
Jan–Dec 2021 **12-Month**	29.90" (759.46mm)	31.29" (794.77mm)	-1.39" (-35.31mm)	45th Driest	Driest since: 2012	1910
				85th Wettest	Wettest since: 2020	2019
	Ties: 1918, 1943					
Jan–Dec 2020 **12-Month**	34.19" (868.43mm)	31.29" (794.77mm)	2.90" (73.66mm)	93rd Driest	Driest since: 2012	1910
				37th Wettest	Wettest since: 2019	2019
	Ties: 2000					
Jan–Dec 2019 **12-Month**	44.55" (1,131.57mm)	31.29" (794.77mm)	13.26" (336.80mm)	129th Driest	Driest since: 2018	1910
				1st Wettest	Wettest to Date	2019

Annual Precipitation over Michigan

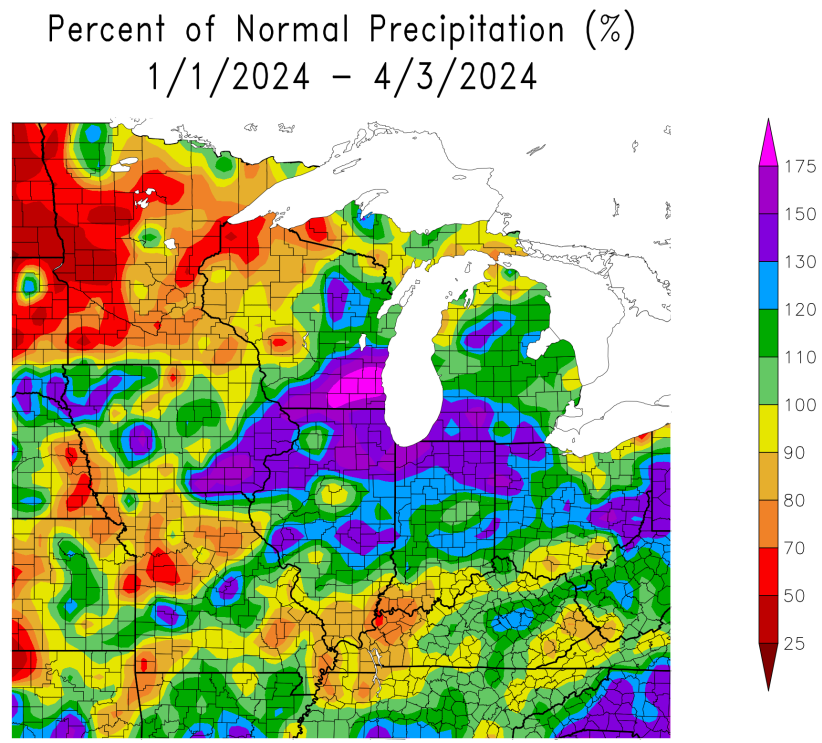
Persistent wet conditions over last 5 years

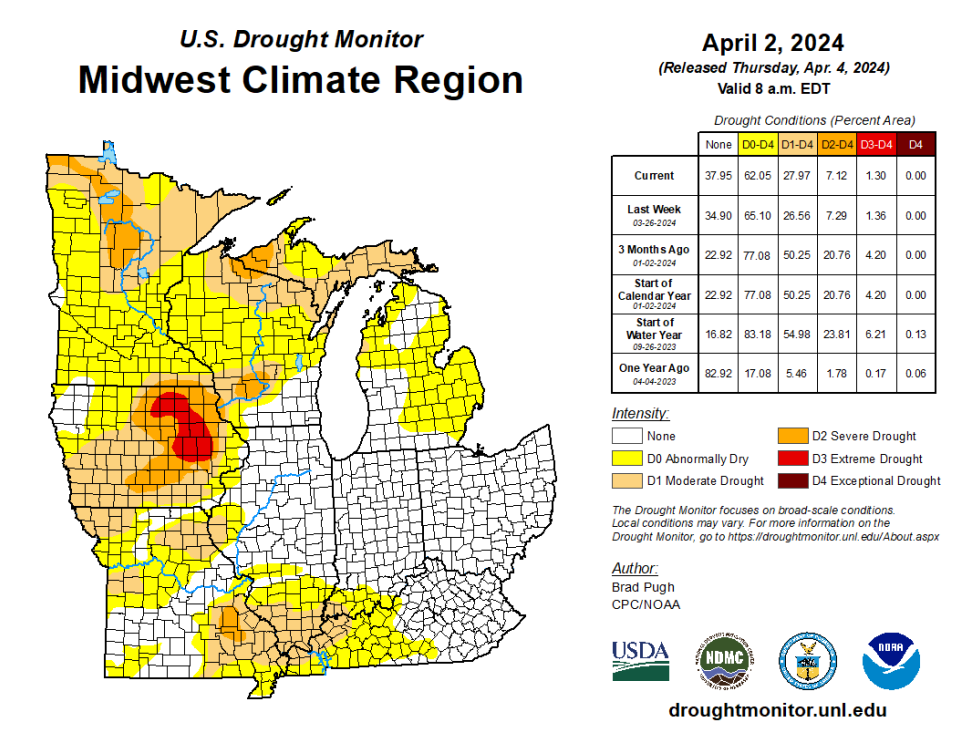
Record Driest	Bottom 1/10	Bottom 1/3	Normal	Top 1/3	Top 1/10	Record Wettest

Period	Value	1901-2000 Mean	Anomaly	Rank (1895-2024)	Driest/Wettest Since	Record
Jan–Dec 2023 **12-Month**	33.41" (848.61mm)	31.13" (790.70mm)	2.28" (57.91mm)	97th Driest	Driest since: 2022	1930
				33rd Wettest	Wettest since: 2020	2019
Jan–Dec 2022 **12-Month**	32.62" (828.55mm)	31.13" (790.70mm)	1.49" (37.85mm)	86th Driest	Driest since: 2015	1930
				44th Wettest	Wettest since: 2021	2019
Jan–Dec 2021 **12-Month**	32.88" (835.15mm)	31.13" (790.70mm)	1.75" (44.45mm)	92nd Driest	Driest since: 2015	1930
				38th Wettest	Wettest since: 2020	2019
	Ties: 1911					
Jan–Dec 2020 **12-Month**	35.31" (896.87mm)	31.13" (790.70mm)	4.18" (106.17mm)	112th Driest	Driest since: 2015	1930
				18th Wettest	Wettest since: 2019	2019
Jan–Dec 2019 **12-Month**	41.83" (1,062.48mm)	31.13" (790.70mm)	10.70" (271.78mm)	129th Driest	Driest since: 2018	1930
				1st Wettest	Wettest to Date	2019

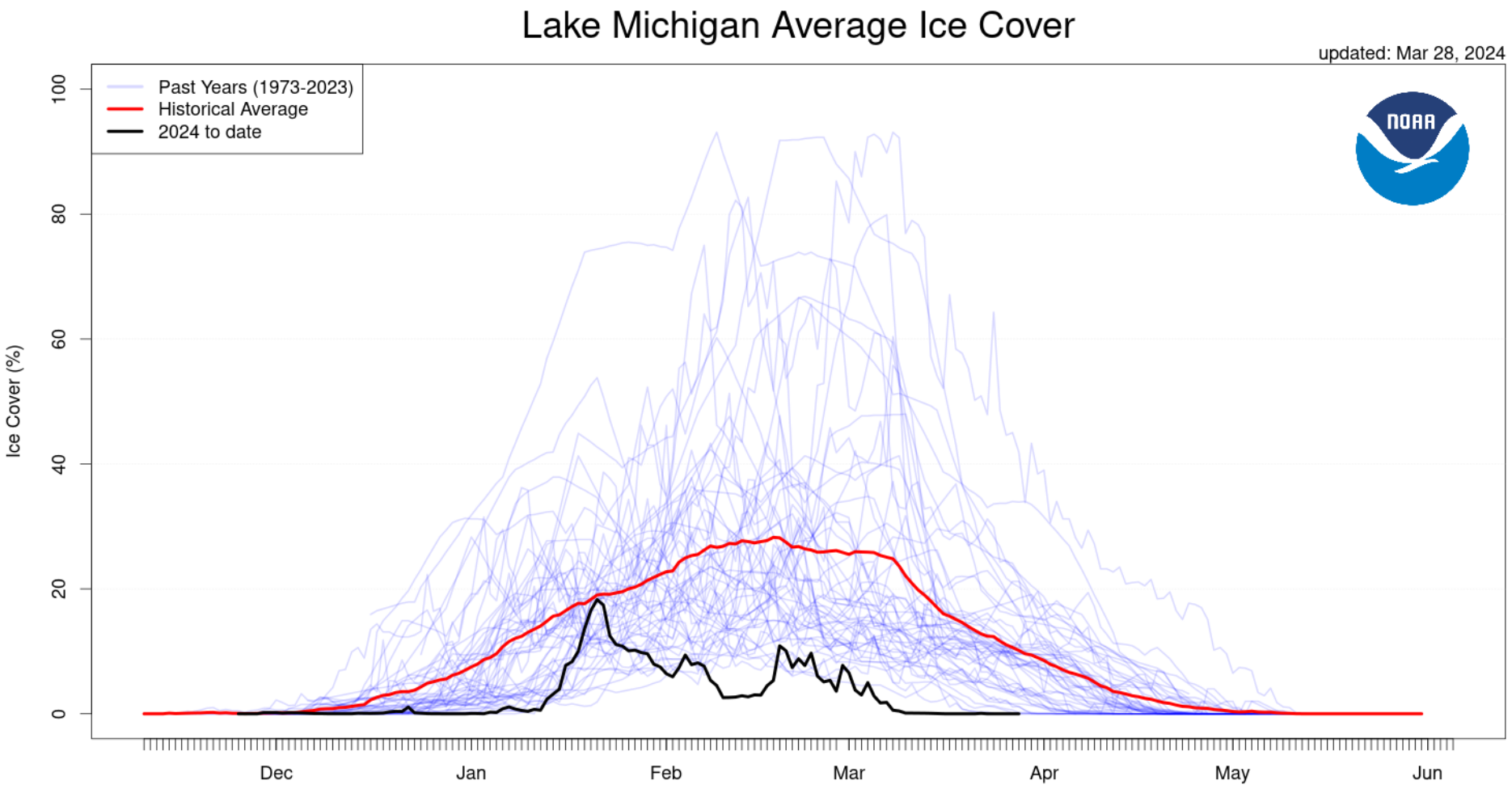
Drought Improving over Wisconsin

Abnormally Dry (D0) to Moderate Drought (D1) remain over parts of the northern Lake Michigan basin

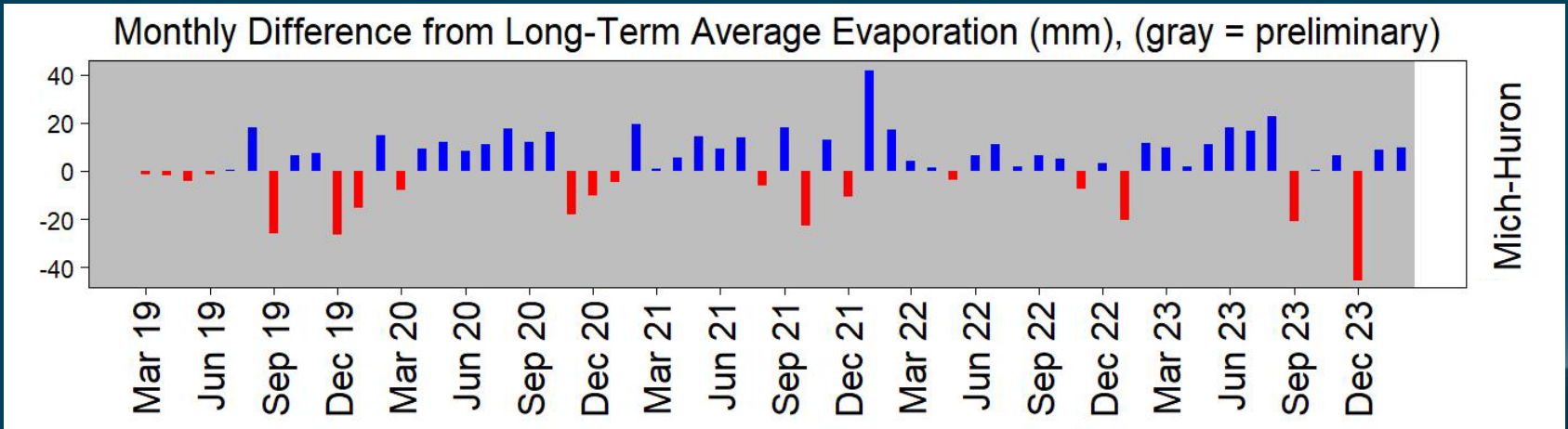




Lake Michigan Ice Coverage
Winter 2023-2024

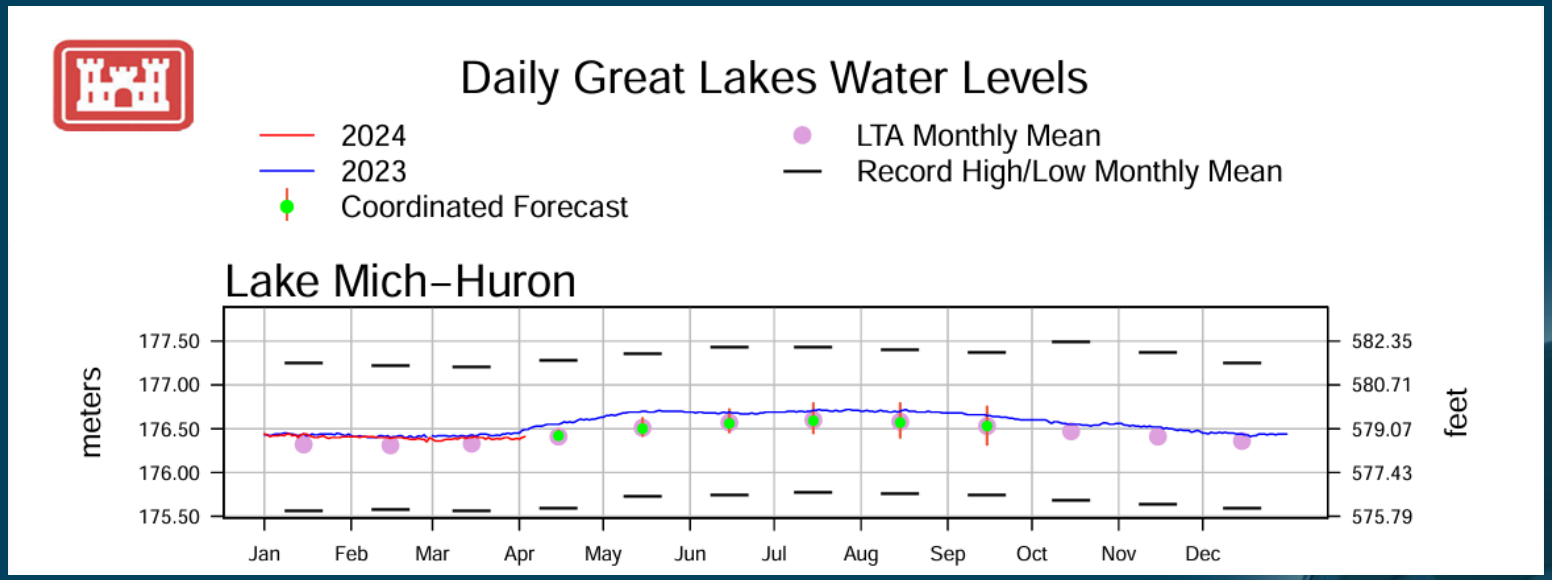


Lake Michigan-Huron Evaporation
Last 5 Years



- Low ice cover supported potentially higher evaporation than normal this year
- However, the very warm temperatures led to well below normal evaporation in December. Thus, the impacts on evaporation from a lack of low ice cover was lessened.

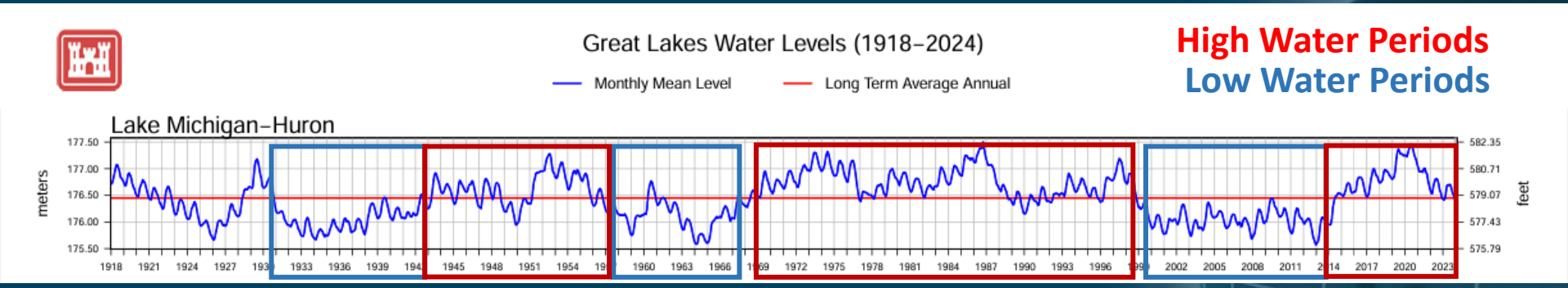
Lake Michigan-Huron Water Levels
Since January 2023



Water Level Difference From	Amount
1 year ago (April 5)	4” below
Long Term Monthly Average of April	0” above
Highest Monthly Average of Record for April	35” below

Great Lakes Water Levels
Past 100 Years of Historical Record

- Year to year variability in water levels, but generally long periods of higher than normal water levels and lower than normal water levels exist.



NOAA ENSO Forecast Probabilities

- Strong El Nino is forecast to transition to a La Nina by next autumn

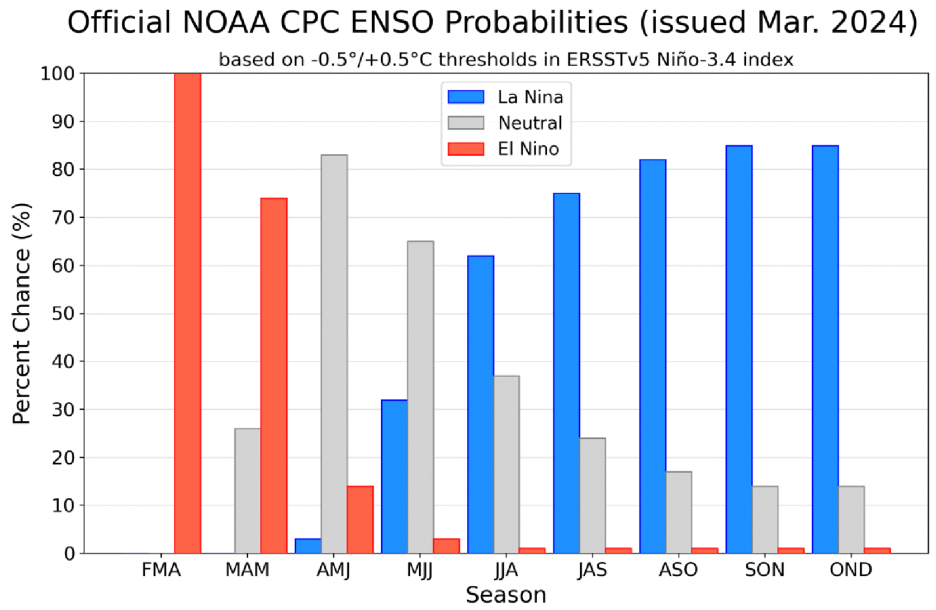
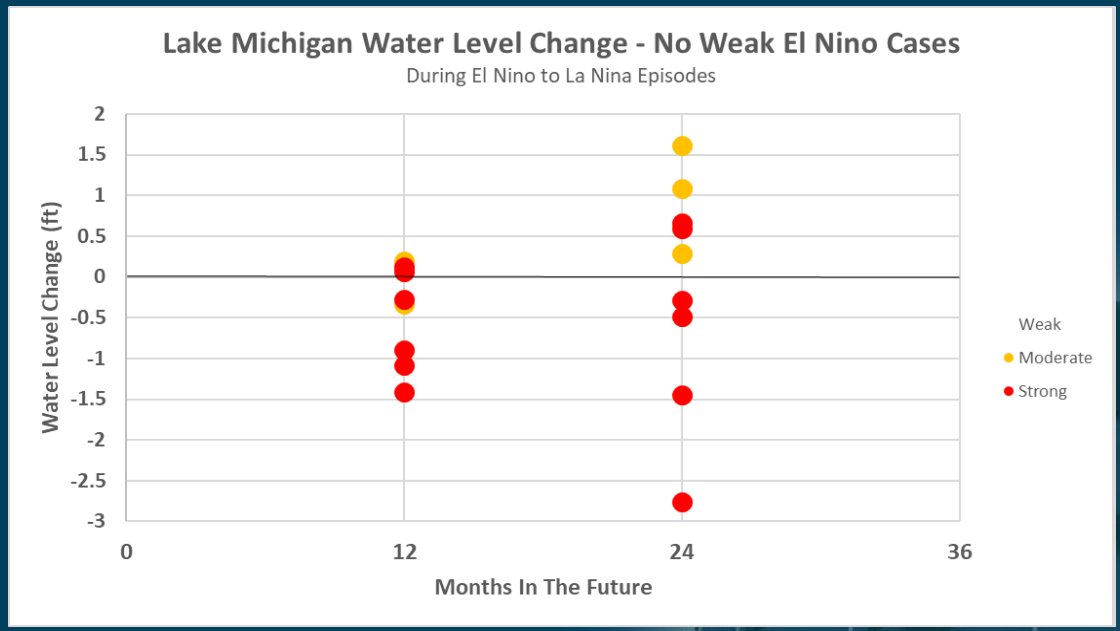


Figure 7. Official ENSO probabilities for the Niño 3.4 sea surface temperature index (5°N-5°S, 120°W-170°W). Figure updated 14 March 2024.

Lake Michigan-Huron Water Levels

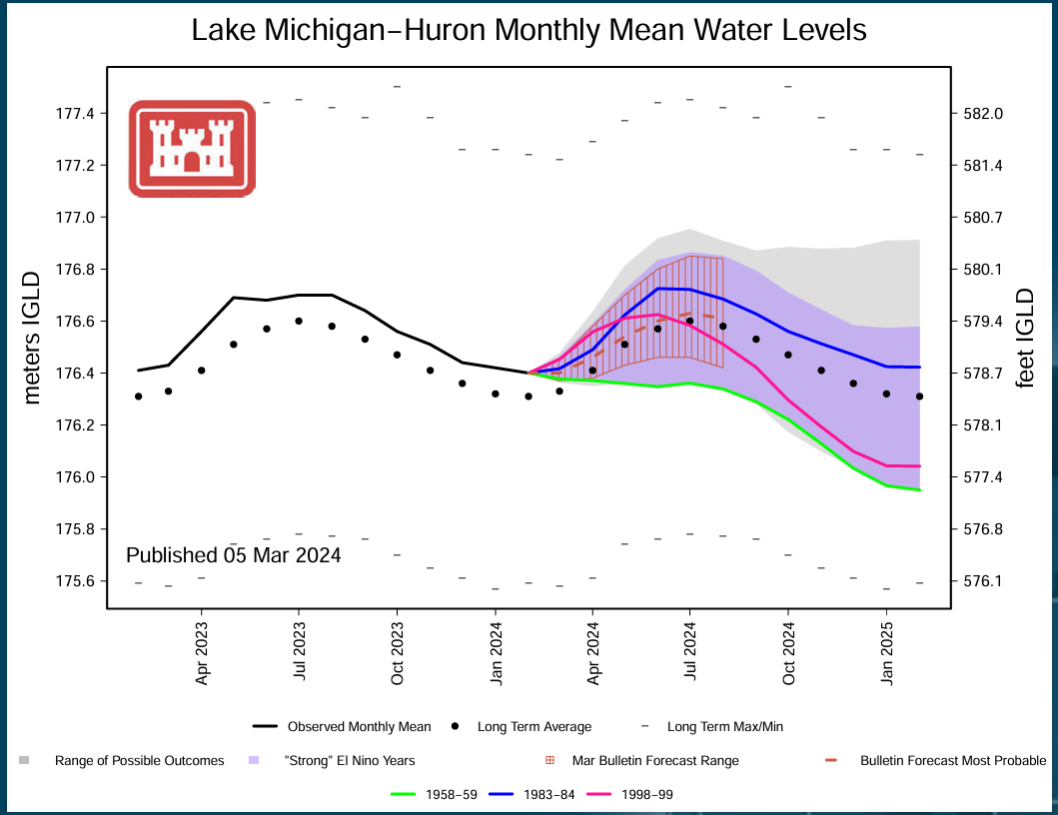
During Past El Nino to La Nina Episdoes

- Moderate signal for decreasing water levels over next year
- Average year over year change is about **-0.33 ft** (-0.38 ft in moderate to strong El Nino's only)
- Little to no signal 24 months into the future



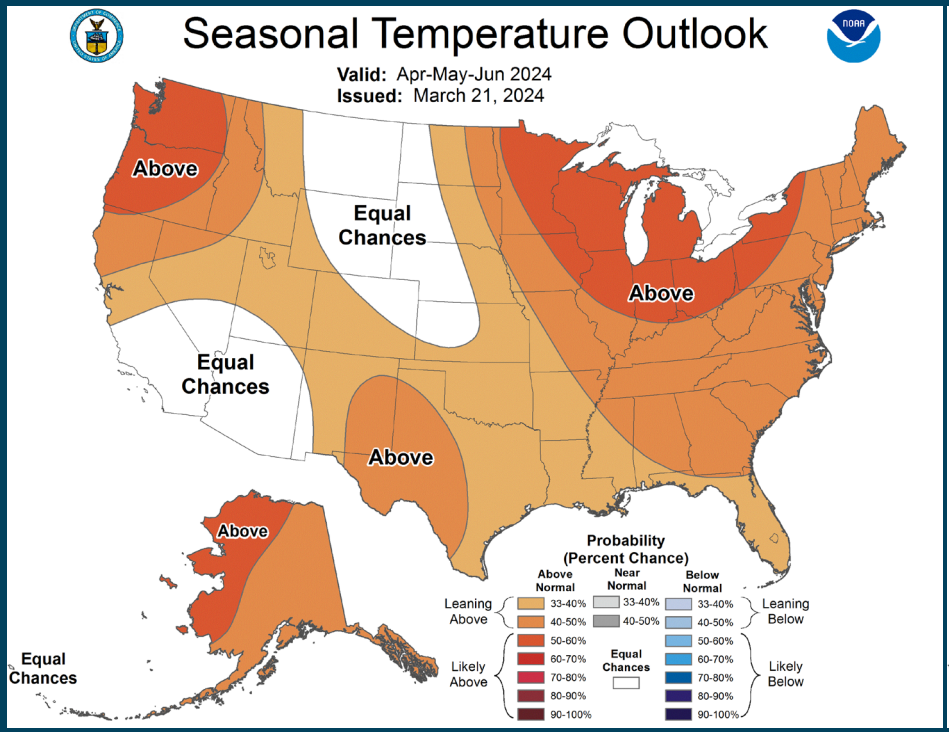
Lake Michigan-Huron Water Levels
6 Month Forecast

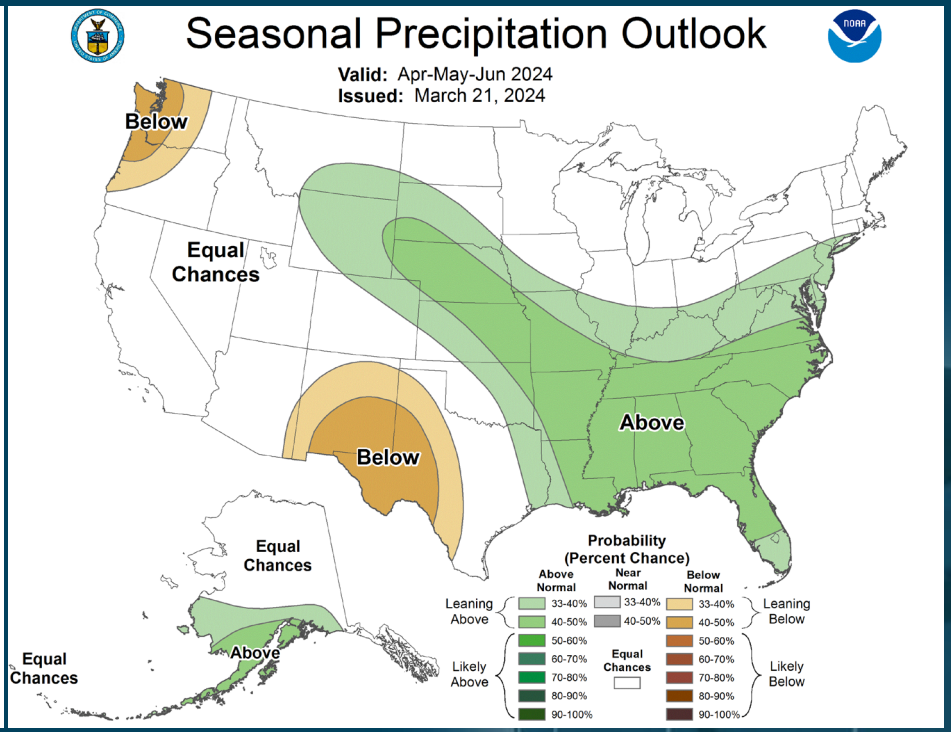
- Official forecast calls for water levels to remain near to slightly above the long term average through the summer
- Past data suggests a moderate signal for falling water levels 1 year from now
- Antecedent conditions argue for falling water levels over next 12 months



Temperature / Precip Outlook

April - June





Lake Michigan-Huron Water Level Forecast Summary

- El-Nino to La Nina global weather pattern expected to have some influence on Lake Michigan-Huron water levels over the next 12 months
- Historical data suggests there is precedent for water levels to remain near current levels or decrease over the next 12 months
- With a moderate drought and lack of runoff from spring snow melt, conditions are favorable for falling year-over-year water levels later this year