

Water Levels of Lake Michigan

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Green Bay Port Symposium

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THE GREAT LAKES BASIN

LEGEND

- GREAT LAKES WATERSHEDS**
- Erie
 - Superior
 - Huron
 - Michigan
 - Ontario
- International Boundary
 State/Provincial Boundary
 City, State/Provincial Capital, National Capital
 River
 Canals and Diversions
- MILES: 0 50 100 150 200

Map Projection: Albers Equal Area Conic, Coordinate System: North American Datum 1983. Data Sources: Institute for Fisheries Research Great Lakes GIS, Michigan Geographic Data Library, ESRI, NOAA-GLEBS, Great Lakes Monthly Hydrologic Data, U.S. Army Corp of Engineers, Michigan Sea Grant produced this map in collaboration with the U.S. Geological Survey (USGS).



A collaborative effort of the University of Michigan and Michigan State University and its MSU Extension, Michigan Sea Grant is part of the NOAA-National Sea Grant network of 14 university-based programs.
michiganseagrant.org



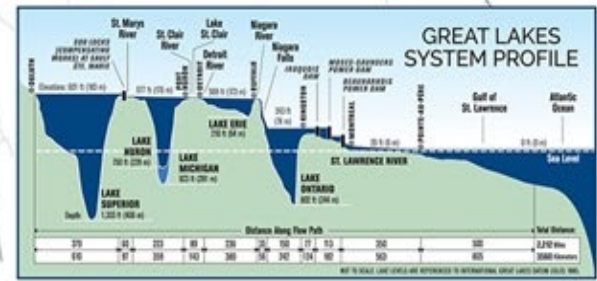
WHAT IS A WATERSHED?

A watershed is an area of land where all of the rain and melting snow drains to a single body of water, such as a creek, river, or lake.

Watersheds nest within each other. For example, watersheds from smaller creeks may combine to form a river's watershed. Multiple river watersheds feed into each Great Lake. The watersheds of the Great Lakes are collectively called the "Great Lakes Basin."

WHY DO WATERSHEDS MATTER?

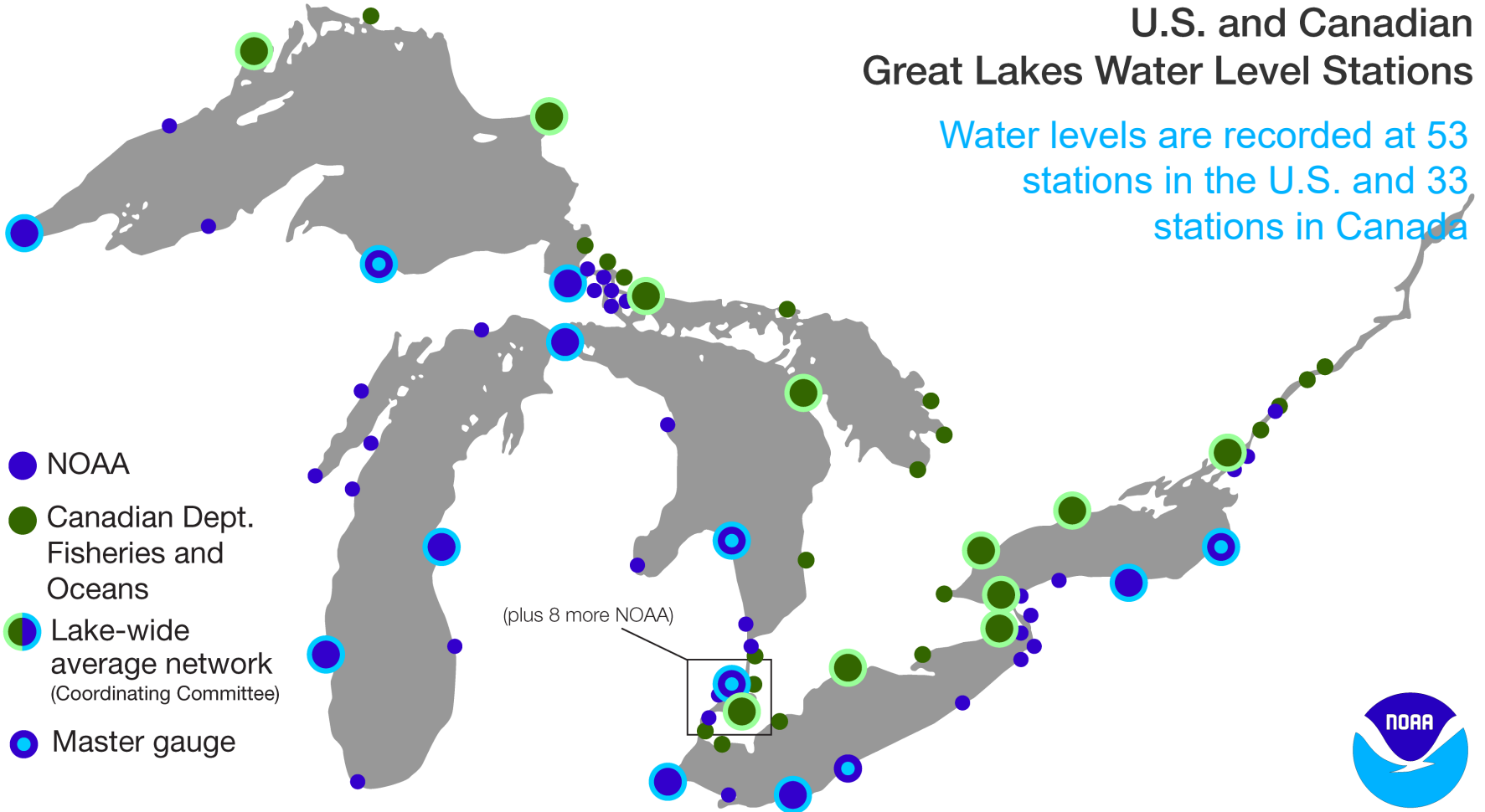
Understanding and protecting watersheds is important because actions upstream have consequences downstream. Water is only as clean as the land it flows over; a river or lake is only as healthy as the water draining into it. Healthy watersheds reduce flood risk, support crops, filter pollutants, mitigate effects of climate change, and boost human wellbeing.



Water Level Monitoring

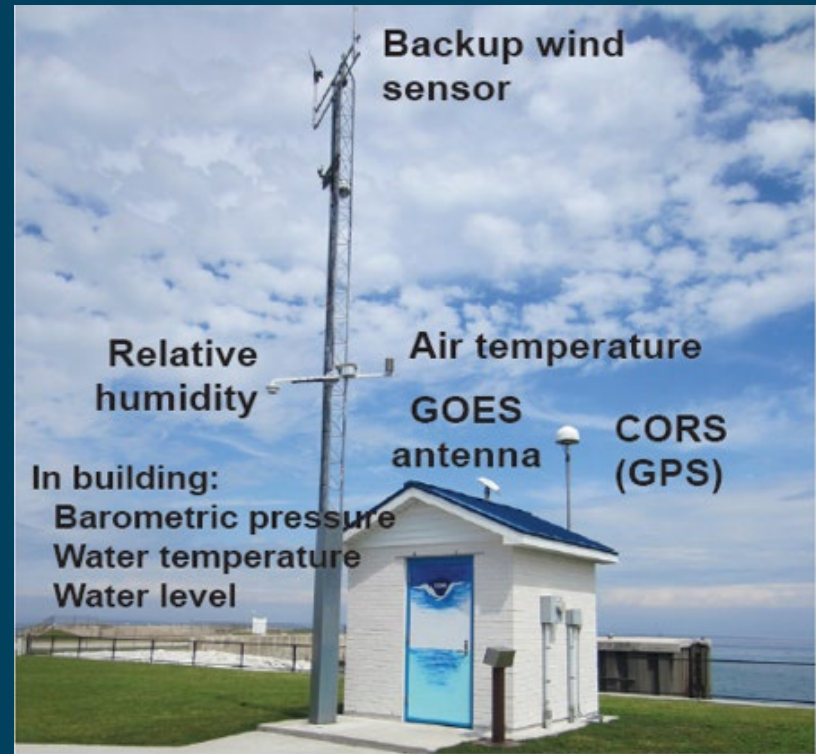
U.S. and Canadian Great Lakes Water Level Stations

Water levels are recorded at 53 stations in the U.S. and 33 stations in Canada



Water Level Monitoring

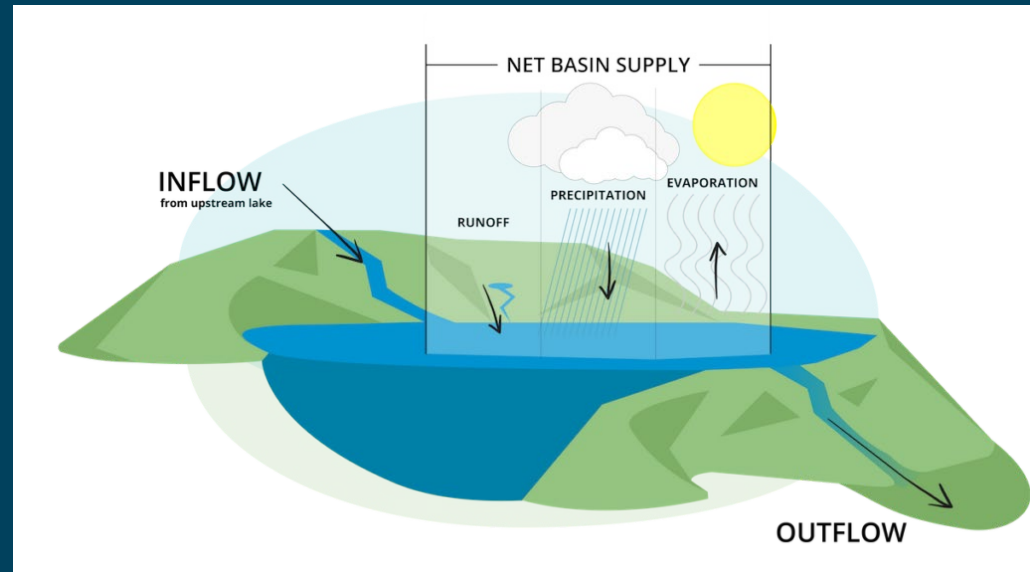
- The 53 NOAA/NOS stations record a 3 minute average water level every 6 minutes
- Daily levels are from each lake's master gauge
- Monthly lake-wide average levels are determined from a pre-determined set of approved U.S. and Canadian gauges
- Data is available starting in 1918
- Many stations also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

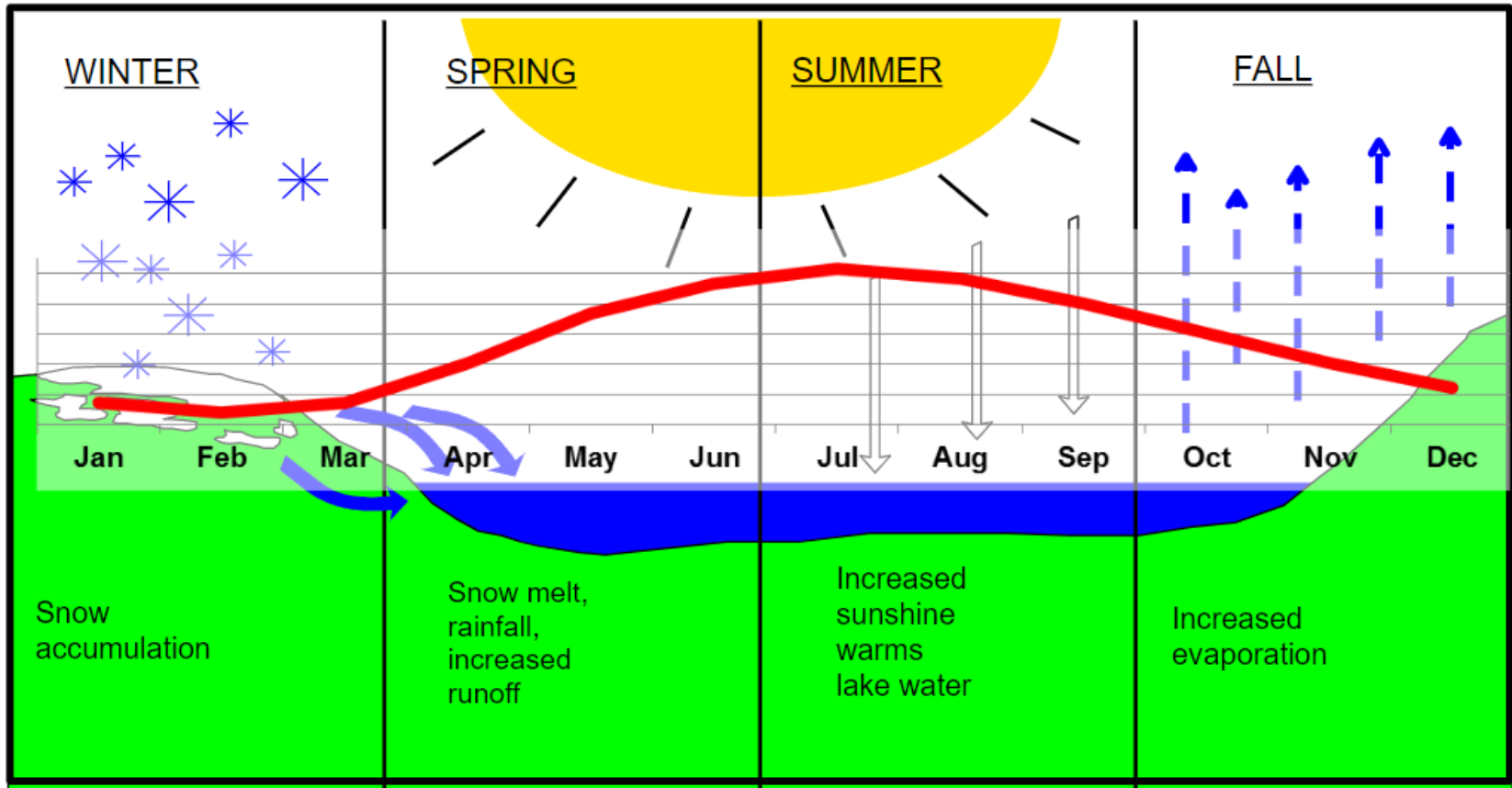
- Net basin supply is the primary driver of Great Lakes water levels
- Net basin supply = precipitation + runoff - evaporation
- Precipitation and runoff (snow melt) peaks in spring and summer (rising water levels)
- Evaporation is highest in autumn and winter when cold air flows over the relatively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



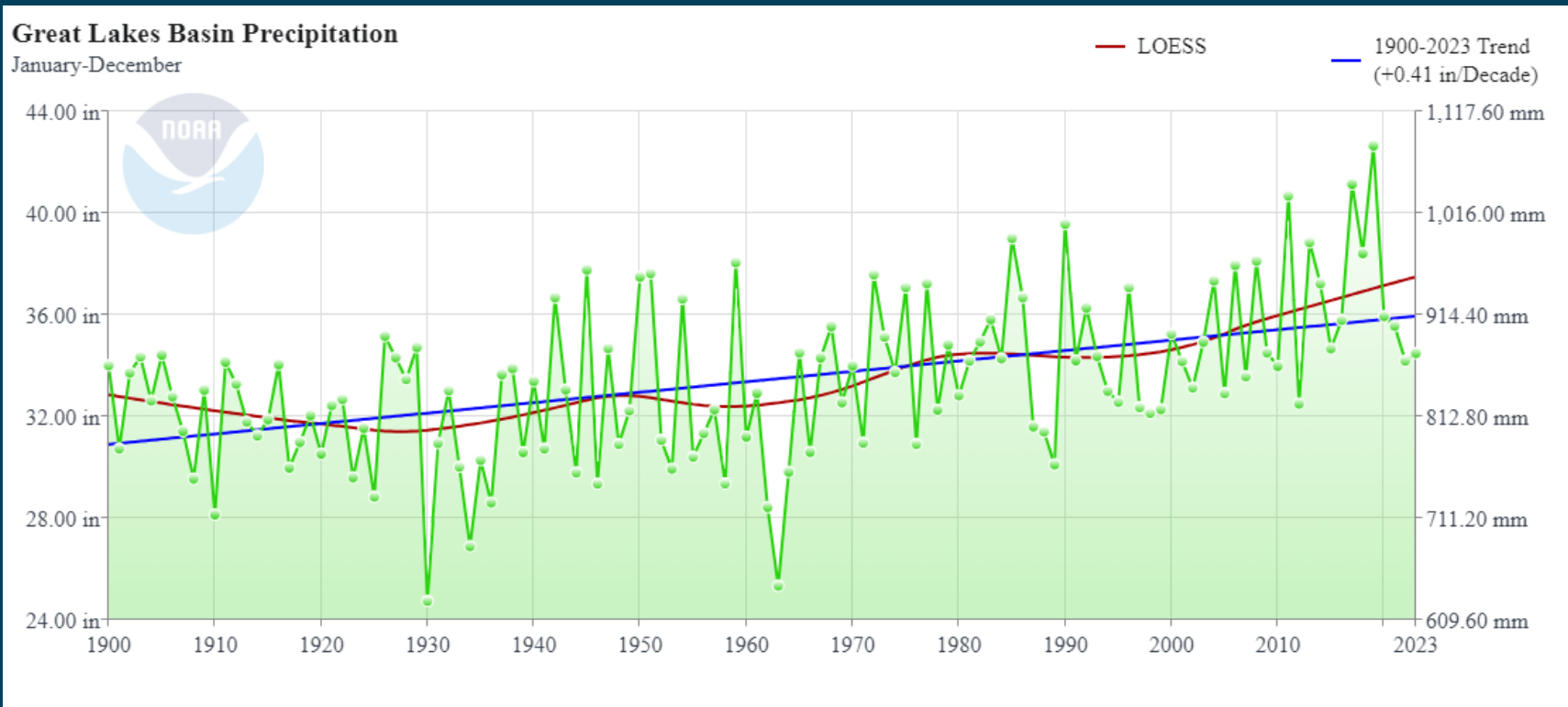
The Water Cycle



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	
<i>Ties: 1918, 1943</i>							
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	
<i>Ties: 2000</i>							
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

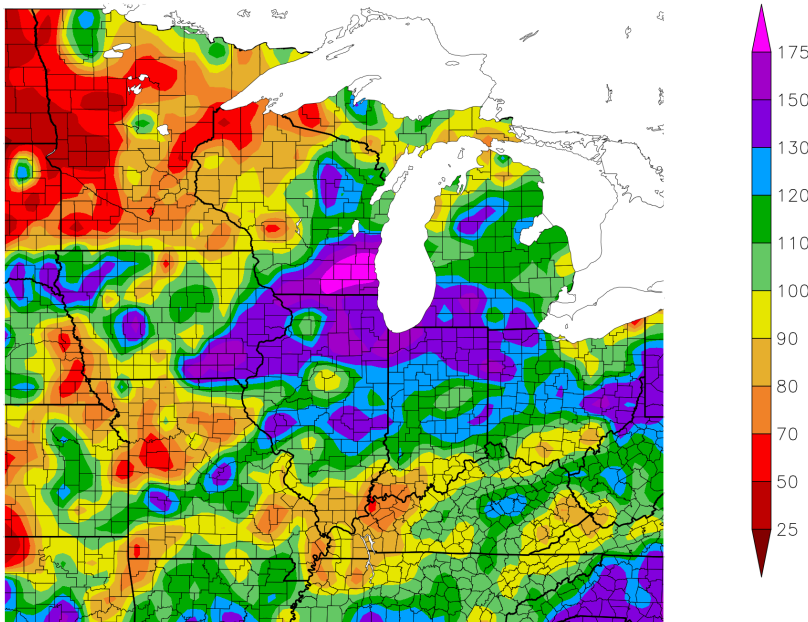
Persistent wet conditions over last 5 years

	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	
<i>Ties: 1911</i>							
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

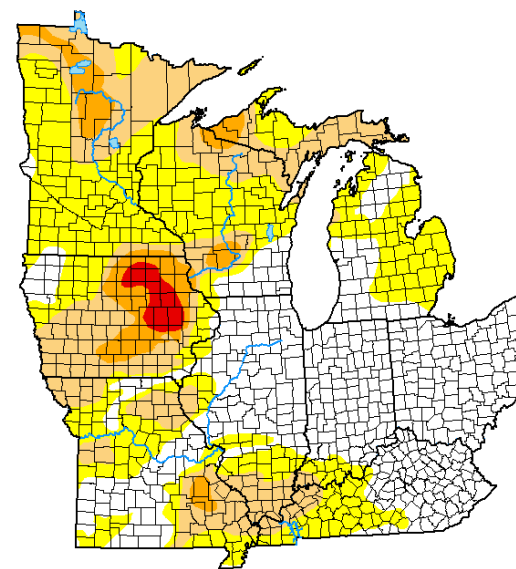
Abnormally Dry (D0) to Moderate Drought (D1) remain over parts of the northern Lake Michigan basin

Percent of Normal Precipitation (%)
1/1/2024 – 4/3/2024



U.S. Drought Monitor Midwest Climate Region

April 2, 2024
(Released Thursday, Apr. 4, 2024)
Valid 8 a.m. EDT



Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	37.95	62.05	27.97	7.12	1.30	0.00
Last Week 03-26-2024	34.90	65.10	26.56	7.29	1.36	0.00
3 Months Ago 01-02-2024	22.92	77.08	50.25	20.76	4.20	0.00
Start of Calendar Year 01-02-2024	22.92	77.08	50.25	20.76	4.20	0.00
Start of Water Year 09-26-2023	16.82	83.18	54.98	23.81	6.21	0.13
One Year Ago 04-04-2023	82.92	17.08	5.46	1.78	0.17	0.06

Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>

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CPC/NOAA

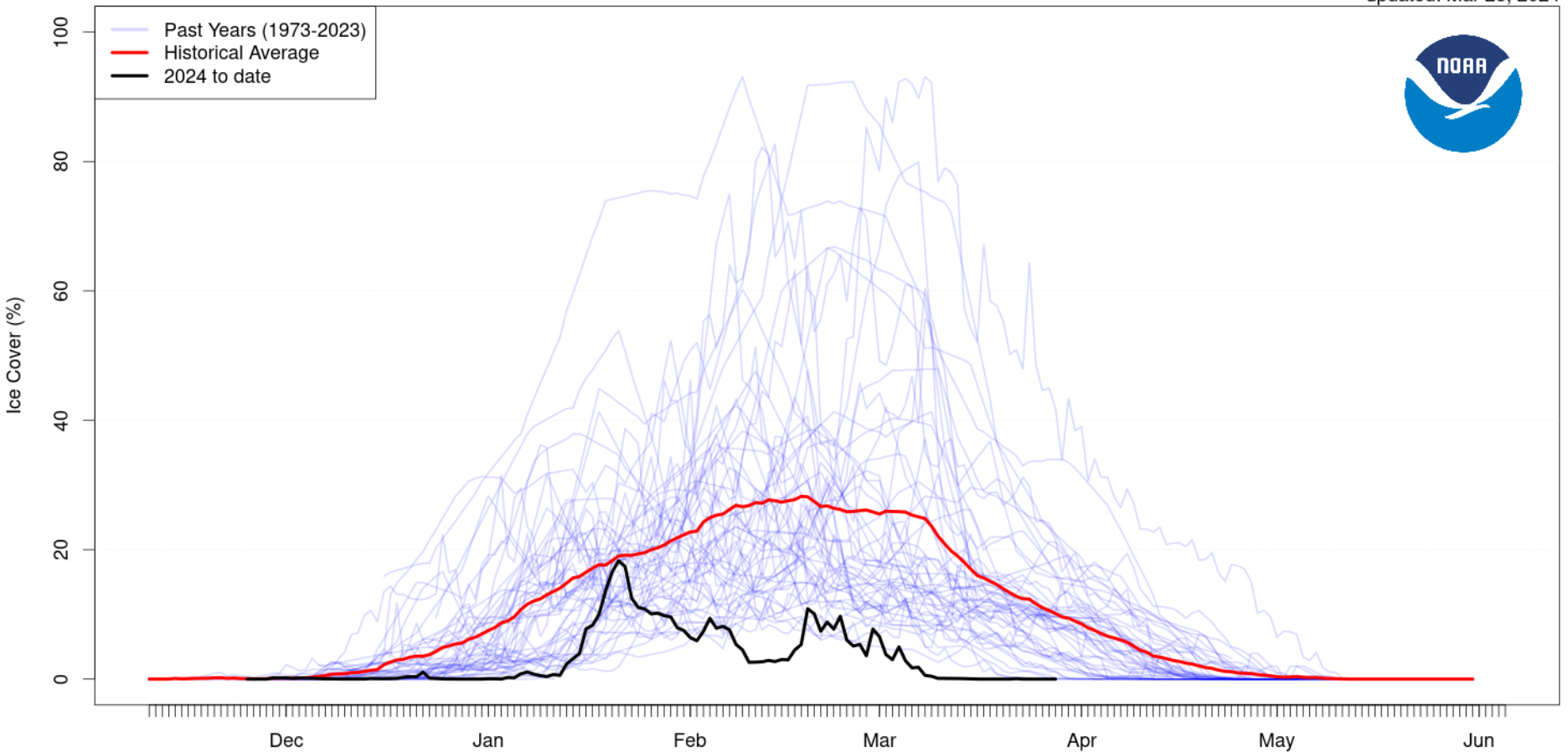


droughtmonitor.unl.edu

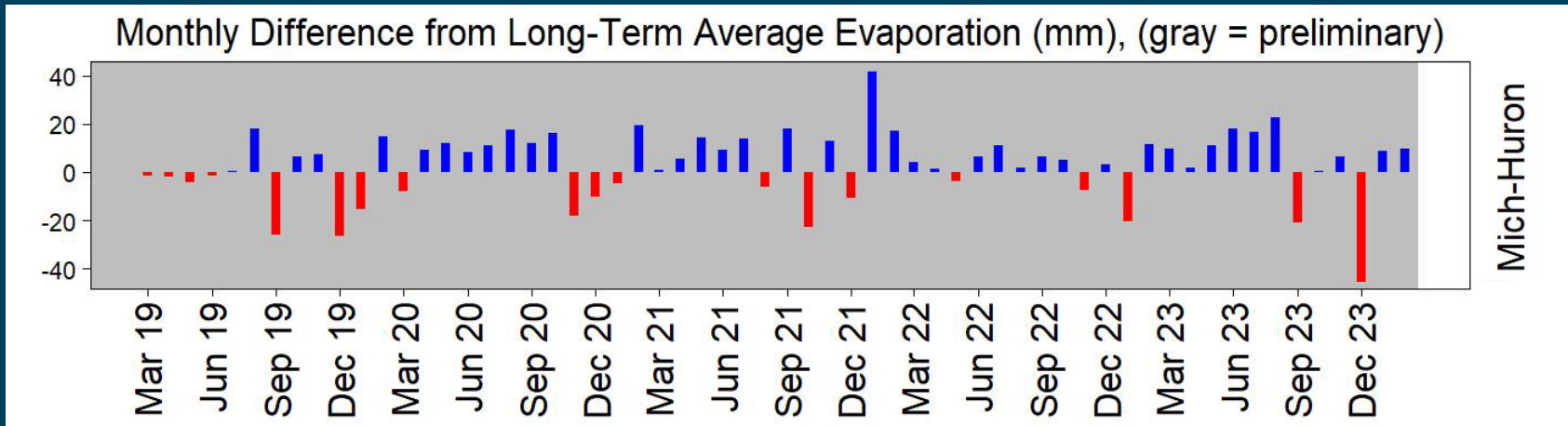
Lake Michigan Ice Coverage Winter 2023-2024

Lake Michigan Average Ice Cover

updated: Mar 28, 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.

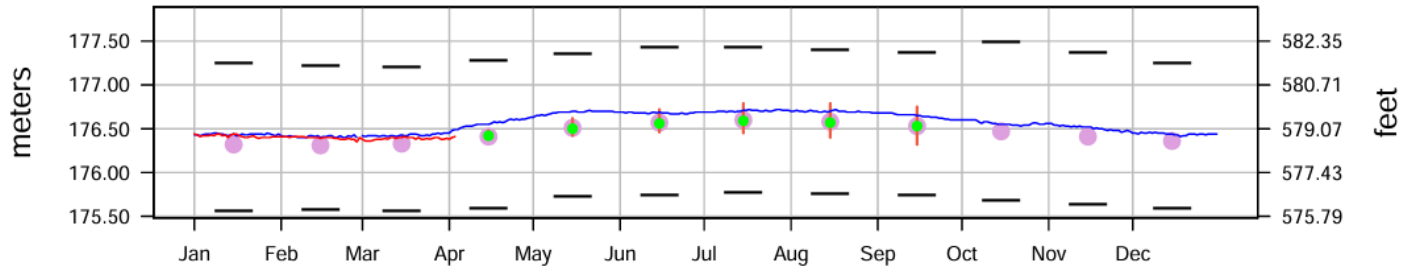
Lake Michigan-Huron Water Levels Since January 2023



Daily Great Lakes Water Levels

- 2024
- 2023
- Coordinated Forecast
- LTA Monthly Mean
- Record High/Low Monthly Mean

Lake Mich-Huron



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

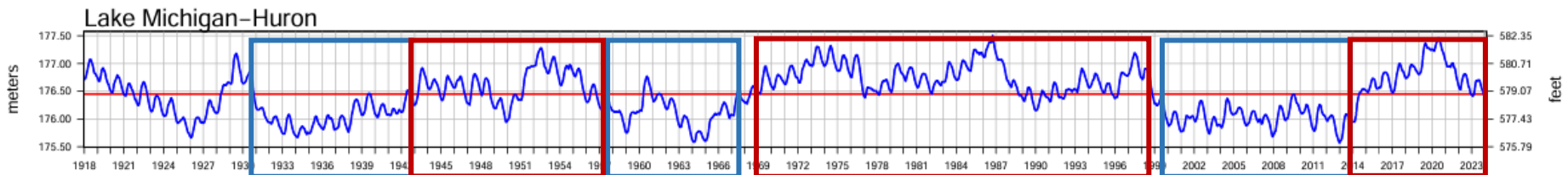
- Year to year variability in water levels, but generally long periods of higher than normal water levels and lower than normal water levels exist.



Great Lakes Water Levels (1918–2024)

— Monthly Mean Level — Long Term Average Annual

High Water Periods
Low Water Periods



NOAA ENSO Forecast Probabilities

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

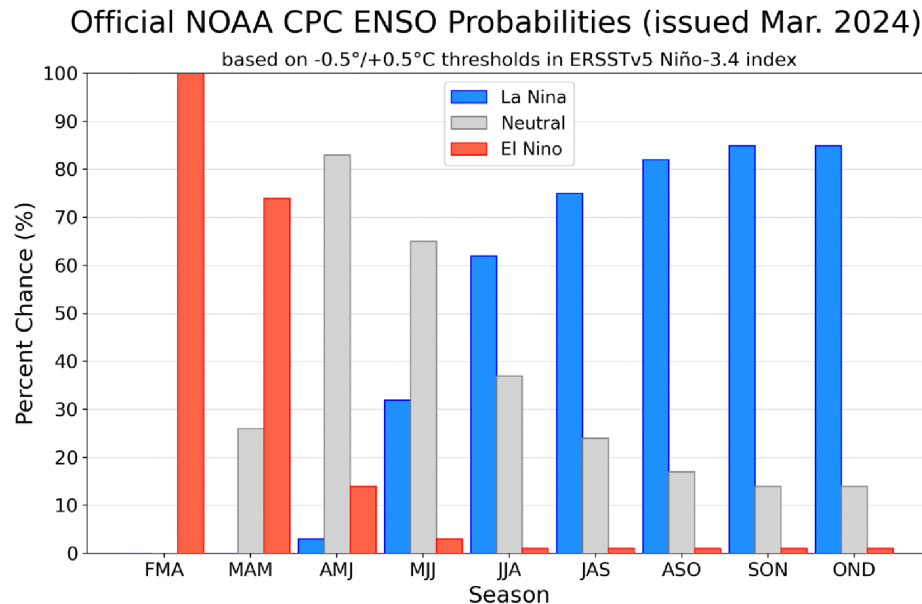
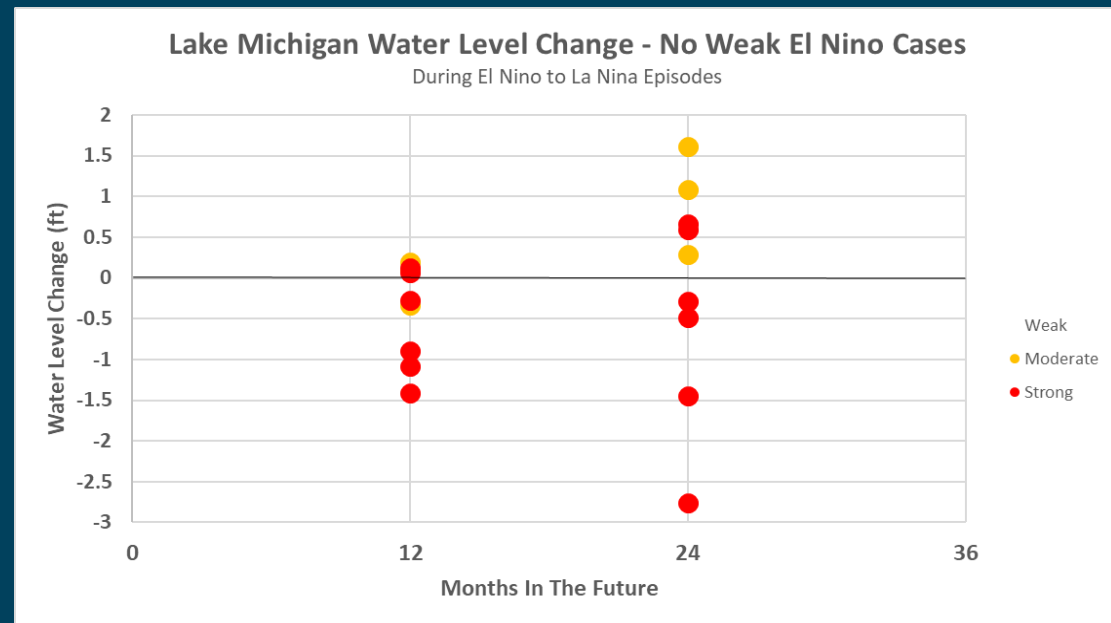


Figure 7. Official ENSO probabilities for the Niño 3.4 sea surface temperature index (5°N - 5°S , 120°W - 170°W). Figure updated 14 March 2024.

Lake Michigan-Huron Water Levels

During Past El Nino to La Nina Episodes

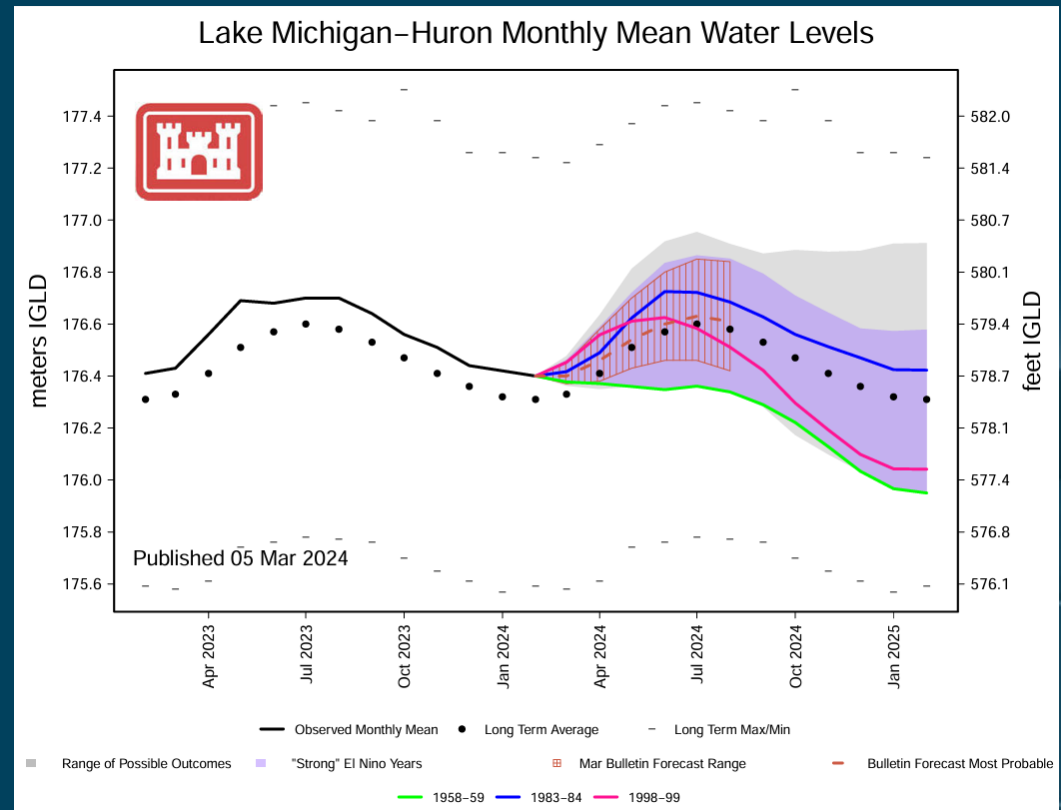
- Moderate signal for decreasing water levels over next year
- Average year over year change is about **-0.33 ft** (-0.38 ft in moderate to strong El Nino's only)
- Little to no signal 24 months into the future



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

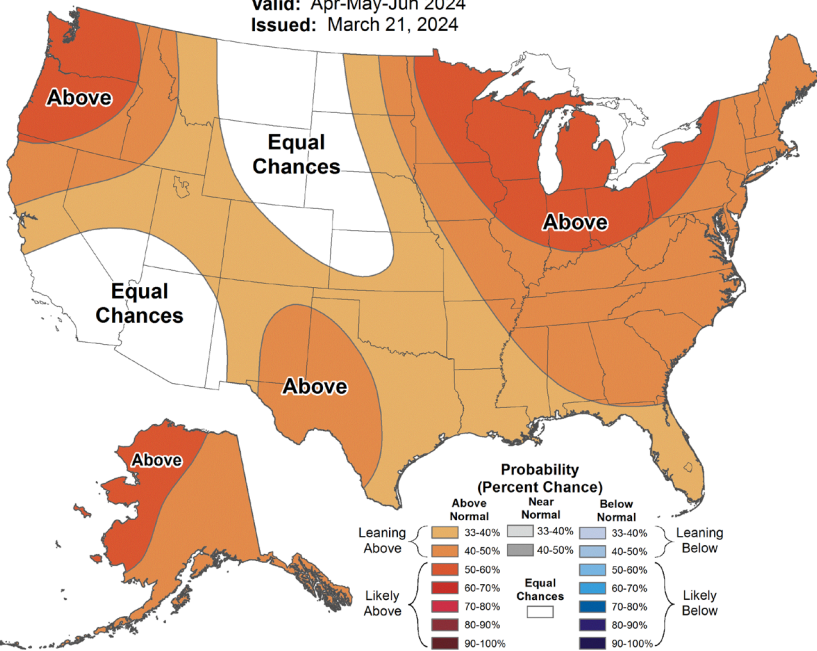
April - June



Seasonal Temperature Outlook



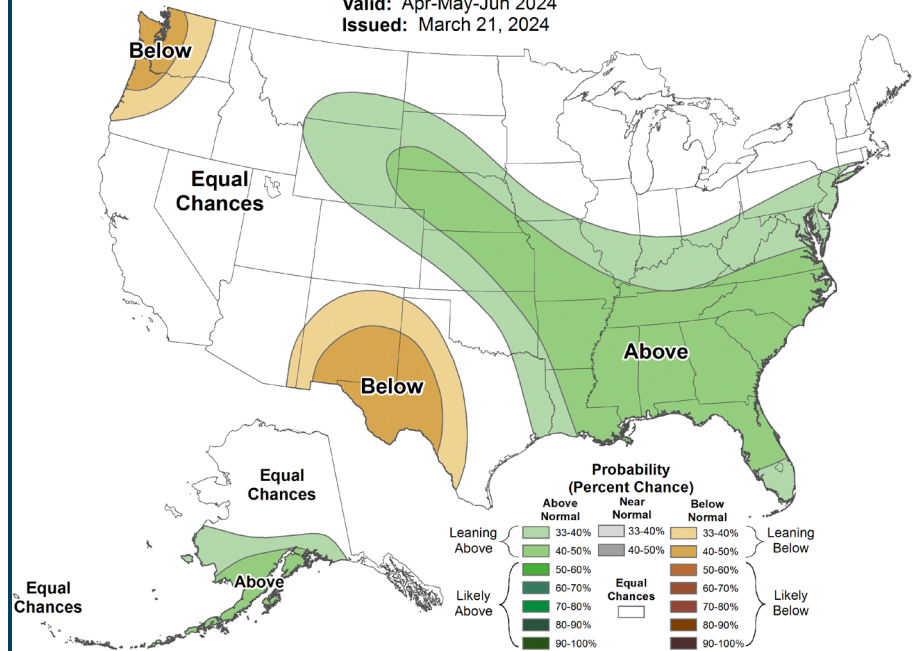
Valid: Apr-May-Jun 2024
 Issued: March 21, 2024



Seasonal Precipitation Outlook



Valid: Apr-May-Jun 2024
 Issued: March 21, 2024



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