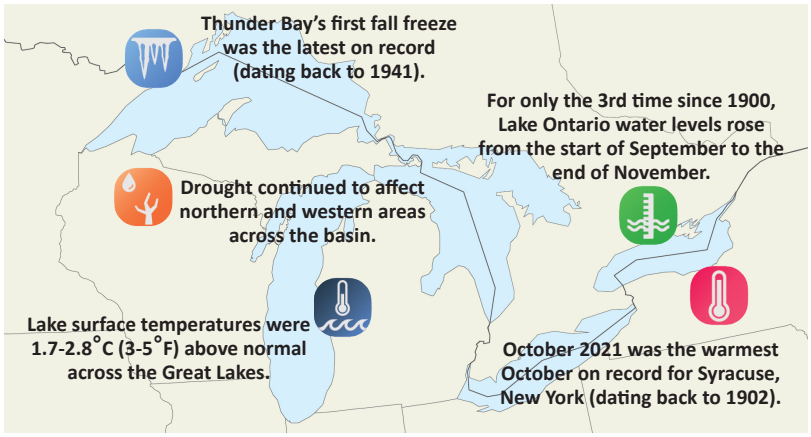
Quarterly Climate Impacts and Outlook

Great Lakes Region

December 2021

Great Lakes Significant Events – *for September - November 2021*



Above-normal temperatures dominated the region throughout the fall of 2021. October was particularly warm with record high overnight temperatures from Illinois east to New York, including Michigan and southern Ontario. The western basin saw near-record warm minimum temperatures in October.

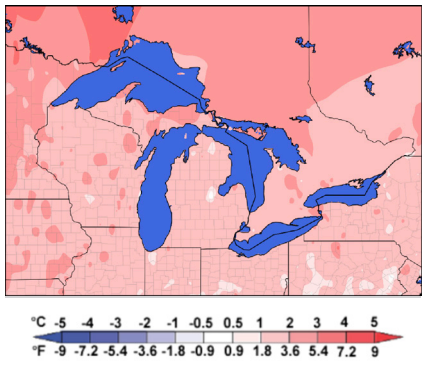
For most, the first fall freeze was 2-4 weeks later than the 1991-2020 normal, with several record late first fall freezes across the basin.

Precipitation was variable, with less moisture overall in the west than the east. Dryness in the western basin this fall continued a dry trend that has persisted in this area for over two years. Drought intensified in Wisconsin and lingered north of Chicago.

In the east, a major weather system on September 21-22 brought over 100 mm (4 inches) of rain to southern Ontario, prompting roadway flooding in London, Canada. Heavy rainfall on October 24-26 affected US locations in the basin eastward from Chicago. These storms brought 3.6-4.9 meter (12-16 foot) waves to southern Lake Michigan and led to flash flooding in western/central New York, prompting building evacuations and water rescues.

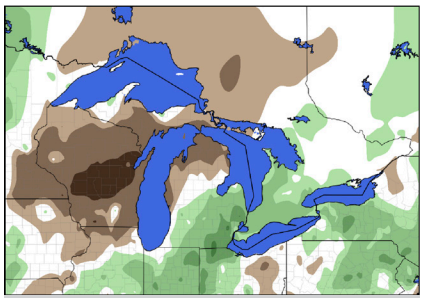
Regional Climate Overview – *for September - November 2021*

Fall 2021 Temperature Departure from Normal



°C -5 -4 -3 -2 -1 -0.5 0.5 1 2 3 4 5
°F -9 -7.2 -5.4 -3.6 -1.8 -0.9 0.9 1.8 3.6 5.4 7.2 9

Fall 2021 Precipitation Percent of Normal



25 50 75 90 110 125 150 175 200

U.S. normals based on 1991-2020.
Canadian normals based on 1981-2010.

Air Temperature and Precipitation

September and October were up to 3°C (5°F) and 5°C (9°F) warmer-than-normal, respectively. October average temperatures were the warmest on record for Ohio and among the five warmest for the other Great Lakes states. November temperatures ranged from 1°C (2°F) below-normal to 2°C (4°F) above-normal. Fall was above-normal by as much as 5°C (9°F). New York had its warmest fall. Numerous Canadian cities and all but one US state had a top ten warmest fall.

September precipitation was 103% of average across the basin, with most areas near- or above-average. All basins except Superior saw near- or above-average October precipitation, with the overall basin seeing 114% of average. Illinois had its fourth wettest October. November was drier, with the overall basin seeing 70% of average. Fall precipitation was below-average for Superior and Michigan-Huron but above-average for Erie and Ontario, with the overall basin seeing 97% of average. Wisconsin had the 11th driest fall.

Lake	End of Nov. 2021 Level Compared to:		Change in Level from beg. of Sep. to end of Nov:	
	Average for Nov.	Nov. 2020	2021 Change in Level	Average Change in Level
Sup.	-13 cm	-38 cm	-22 cm	-10 cm
Mich.-Huron	+34 cm	-45 cm	-29 cm	-18 cm
Erie	+57 cm	-7 cm	-19 cm	-22 cm
Ont.	+32 cm	+26 cm	+3 cm	-29 cm

Current Water Levels

End of November water levels were below last year's levels on all lakes, except Lake Ontario. Below-average water levels continued on Lake Superior, while other lakes remained above-average. Water levels declined on all lakes since the start of September, except Lake Ontario. There were contrasting conditions from west to east throughout the fall. The Lake Superior basin was persistently dry, while the Lake Ontario basin was much wetter.

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Regional Impacts – *for September - November 2021*



Healthy fall apples (credit: Anastasiya Romanova)



Low water levels at Booth Lake in East Troy, Wisconsin made boat launching difficult (credit: NDMC/CMOR)



An example of dulled leaf colors, modified image (credit: K. Reimer and Sylvain Deland)

Agriculture: Warm spring and summer temperatures allowed apple harvest to begin ahead of schedule this fall, but orchards noted below-normal turnout as extremely warm October temperatures deterred people's interest in apple picking. The Ontario Apple Growers estimated apple yields were down 18% compared to 2020 due to several weather-related stressors, but fruit quality was good. With drought-induced low water levels across Wisconsin and Minnesota, wild rice was difficult to harvest and eastern locations saw yield declines. Corn and soybean harvest was slower than usual in the southern portion of the basin, largely due to excess wetness during October. Warmer-than-normal soil temperatures were problematic for farmers doing early fertilizer application. Fertilizers are less effective and at high risk of loss when applied to warm soils.

Water quality: Warm water helped fuel moderately-severe harmful algal blooms (HABs) in Lake Erie. The unseasonable October warmth extended the blooms into late October whereas typically HABs resolve in mid- to late-September.

Ecosystems: Fall foliage looked less vibrant this fall across southern Ontario due to the extended fall warmth, while in Michigan the onset of peak colors was delayed and peak colors stretched into November.

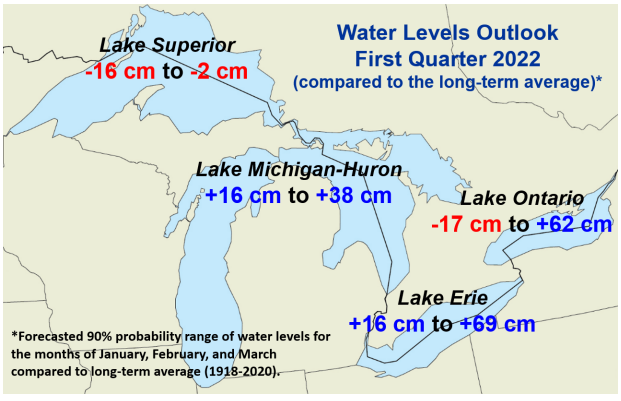
Regional Outlook – *for January - March 2022*

Air Temperature and Precipitation

Canadian and American forecasters are predicting an increased chance of above-normal temperatures in the east and equal chances of above-, near-, or below-normal temperatures in the west. Above-normal precipitation is expected for most of the basin. A La Niña Advisory is currently in effect with a 95 percent chance of persisting through March 2022.

Great Lakes Water Levels

Water levels are forecast to continue their seasonal declines before rising again in the late winter or early spring. Surface water temperatures remain high, which could lead to increased evaporation this winter and enhance water level declines on the lakes. Persistent dry conditions in the Lake Superior basin will likely keep the water levels below-average in early 2022. Lake Ontario is forecast to be above-average, but could drop below-average under drier conditions. Water levels are forecast to remain above-average on Lakes Michigan-Huron and Erie, even under drier conditions.



Partners

- Midwestern Regional Climate Center
- Environment and Climate Change Canada
- Agriculture and Agri-Food Canada
- Northeast Regional Climate Center
- Great Lakes Region State Climatologists
- NOAA
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  - GLERL
  - CoastWatch Great Lakes Node
  - Great Lakes Sea Grant Network
  - Illinois-Indiana Sea Grant
  - North Central River Forecast Center
  - Ohio River Forecast Center
  - Climate Prediction Center
  - Office for Coastal Management
- GLISA
- US Army Corps of Engineers, Detroit District
- NIDIS
- USDA Midwest Climate Hub

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