



Great Lakes Significant Events - for September - November 2016

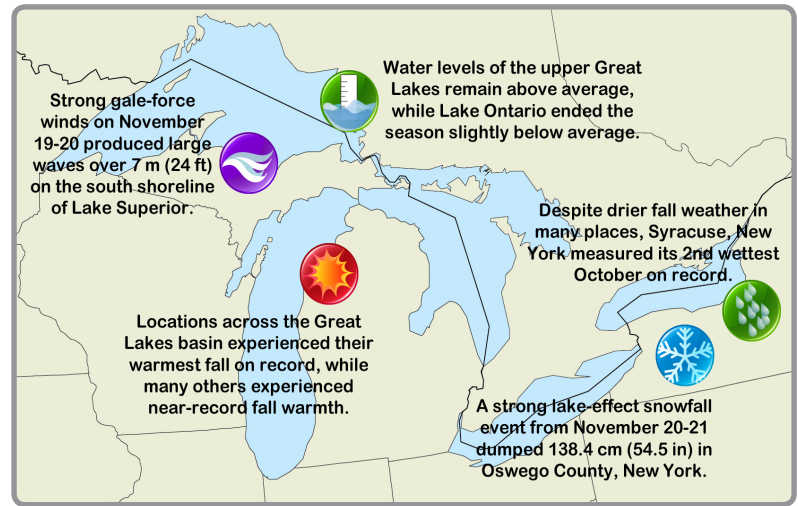
Fall 2016 was unseasonably warm across the entire Great Lakes basin. In the U.S., Michigan, Minnesota, and Wisconsin experienced their warmest fall season in 122 years of records, while it was the 2nd warmest for Illinois, Indiana, and Ohio. In Ontario, Toronto, Hamilton, Gore Bay, and Sudbury also experienced their warmest fall on record.

Despite a few noteworthy precipitation events, conditions in the Great Lakes were generally dry over the past three months, the exception being Lake Superior, where water supplies were slightly above average. This was offset by high Lake Superior outflows, and dry conditions elsewhere resulted in all lakes declining more than average during the fall.

The Windsor area in southwestern Ontario was deluged by a significant rainfall event from September 28-30. The Windsor airport reported over 110 mm (4.3 in) from the event, while volunteer rain gauge reports just north of the airport in Tecumseh measured amounts in excess of 190 mm (7.5 in).

Strong gale-force winds raced across the Great Lakes on November 19-20. Marquette, Michigan reported gusts of 80-97 km/hr (50-60 mph), resulting in very large waves of over 7 m (24 ft) on the southeastern shoreline of Lake Superior. Strong westerly winds over Lake Erie produced a storm surge event, raising the water level by 0.6 m (2 ft) on the eastern edge by Buffalo, New York and dropping the water level by 0.8 m (2.5 ft) at the western edge by Toledo, Ohio.

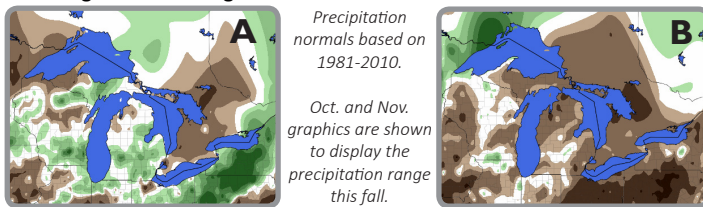
Unseasonably warm lake temperatures contributed to a significant lake-effect snowfall event in the eastern Great Lakes from November 20-21. The highest storm total of 138.4 cm (54.5 in) was recorded in Oswego County, New York, while numerous areas measured 30.5 cm (12 in) or greater. This storm was the greatest 2-day November snowfall on record in Syracuse, New York.



Regional Climate Overview - for September - November 2016

Precipitation

September precipitation ranged from 65% of average in the Lake Ontario basin to 123% of average in the Lake Erie basin, with the Great Lakes basin at 101% of average. All lakes basins saw near to above-average precipitation in October (106% overall) and near- to below-average precipitation in November (77% overall). Fall precipitation was near- to below-average for the individual basins, with the Great Lakes basin receiving 95% of average.



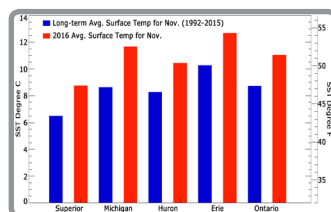
Oct. 2016 (A) and Nov. 2016 (B) Precipitation: Percent of Normal (%)

Great Lakes Water Levels

Lake	End of Nov. Water Levels			Change since September 1	
	2016	Compared to:		2016	Average
		Average	Last Year		
Superior	183.58 m (602.3 ft)	+14 cm (+5.5 in)	+1 cm (+0.4 in)	-12 cm (-4.7 in)	-10 cm (-3.9 in)
Michigan-Huron	176.56 m (579.3 ft)	+22 cm (+8.7 in)	+4 cm (+1.6 in)	-24 cm (-9.4 in)	-18 cm (-7.1 in)
Erie	174.18 m (571.5 ft)	+20 cm (+7.9 in)	-2 cm (-0.8 in)	-27 cm (-10.6 in)	-23 cm (-9.1 in)
Ontario	74.49 m (244.3 ft)	-7 cm (-2.8 in)	-4 cm (-1.6 in)	-34 cm (-13.4 in)	-29 cm (-11.4 in)

Water level statistics based on 1918-2015. Elevations are in International Great Lakes Datum of 1985.

Temperature

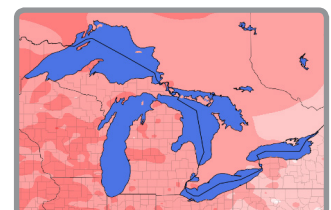


Lake Surface Temperature
Nov. 2016 surface temp (red bars) compared to the Nov. LTA (blue bars).

Air Temperature: In September and October, temperatures ranged from 0.5 to 4°C (1 to 7°F) above normal, with most areas 1 to 3°C (2 to 5°F) above normal. November temperatures ranged from 0.5°C (1°F) above normal east of Lake Ontario to more than 5°C (9°F) above normal in the western half of the Lake Superior basin. With all three months warmer than normal, fall temperatures ranged from 1 to 4°C (2 to 7°F) above normal (right).

Water Temperature: The fall season saw average water temperatures that were 1.1 to 4.6°C (2 to 8.3°F) above the long-term average (LTA). November surface temperatures were particularly warm compared to the LTA (left).

Air temperature normals based on 1981-2010. Water temperature LTA from 1992-2015.

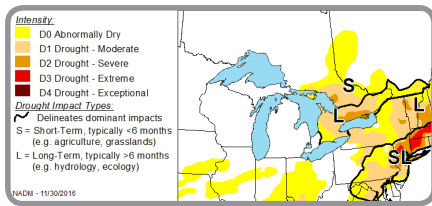


Fall 2016: Dep. from Normal
Centimeters scale: -5, -4, -3, -2, -1, -0.5, 0.5, 1, 2, 3, 4, 5

Regional Impacts - for September - November 2016

Drought

Drought conditions have slightly improved from last season in the eastern Great Lakes basin. Above-normal precipitation in October helped remove extreme drought in western and central New York. However, as of November 30, areas remain in moderate to severe drought.



North American Drought Monitor as of 11/30/16
(www.drought.gov)

Water Resources

Deficits in groundwater have been reported across the eastern Great Lakes basin. In Ontario, the Grand River Conservation Authority has been augmenting water flow with water stored in its three major reservoirs. Residents near Clarington, Ontario have reported low water levels in wells due to drought, with some reporting no running water for months. In western and central New York, several waterways and well sites had record or near-record low levels through mid-October.

Agriculture

The warm and relatively dry weather resulted in the harvest season being ahead of schedule this year in many locations across the basin. However, lower yields of corn and soybeans were reported in western New York and northern Ohio due to dry conditions. In the Niagara

region in Ontario, and along the North Shore of Lake Ontario, hay, corn, and soybean crops were negatively impacted in growth and development due to low soil moisture and surface water supplies.

Storm Impacts

The September 28-30 heavy rainfall event near Windsor, Ontario resulted in insurable loss estimates of just over \$100 million (CAD), mainly from flooded basements and other infrastructure damage. The November 19-21 lake-effect snow event resulted in more than 27,000 power outages in the Rochester, New York area, as well as highway closures and accidents.



Near Syracuse, NY on 11/21/16
(Photo: Christina Balla)

Water Quality

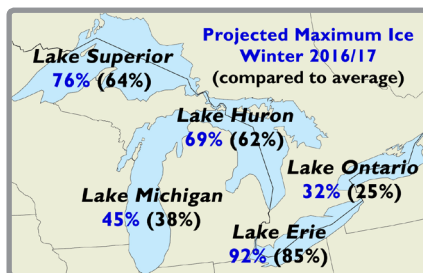
The 2016 harmful algal bloom (HAB) in Lake Erie was more mild than the blooms of 2013-2015, mainly due to drier conditions and less runoff (and therefore less phosphorus) into the lake. However, bloom biomass was more toxic than last year. Even though bloom biomass was more toxic, no drinking water advisories were issued. This indicates that bloom severity does not always equate to increased risk and highlights the ability of municipalities along Lake Erie to successfully treat incoming water.



The 2016 Lake Erie HAB (Photo: OH Sea Grant).

Regional Outlook - for January - March 2017

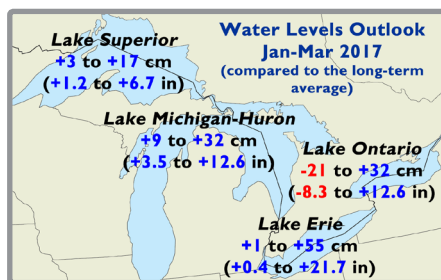
Ice Cover



Winter 2016/17 is favored to have below-normal temperatures in a majority of the Great Lakes region. Therefore, NOAA's Great Lakes Environmental Research Laboratory is forecasting maximum ice coverage of the Great Lakes to be about 64% this winter, above the long-term average of 55% (see figure for individual lakes). This forecast results from the presence of a weak La Niña, a neutral North Atlantic Oscillation, and a weak Pacific Decadal Oscillation and Atlantic Multidecadal Oscillation.

Water Levels

Great Lakes water levels are typically at their lowest during winter due to higher evaporation rates and reduced basin runoff at this time of year. Levels on lakes Superior, Michigan-Huron, and Erie are expected to remain above average, but below record highs, unless exceedingly dry or wet conditions are experienced. Lake Ontario water levels are expected to remain near average unless exceedingly dry or wet conditions are experienced.



Potential range for water levels for Jan-Mar 2017 compared to the long-term average (1918-2015).

Temperature & Precipitation

The Climate Prediction Center (CPC) predicts a greater chance for below-normal temperatures in the western U.S. Great Lakes basin and above-normal temperatures in the eastern U.S. basin for the January-March 2017 period. Environment and Climate Change Canada (ECCC) predicts above-normal temperatures for the entire Canadian basin. Above-normal precipitation is favored for a majority of the basin by both CPC and ECCC. With lake surface temperatures currently warmer than normal, this could increase the chance for lake-effect snow this winter. Also, the CPC predicts that drought conditions in the eastern basin will likely improve.

The current monthly and seasonal outlooks can be found through CPC and ECCC.

Great Lakes Region Partners

Environment and Climate Change Canada (ECCC)
www.ec.gc.ca
Agriculture and Agri-Food Canada
www.agr.gc.ca
Midwestern Regional Climate Center
mrcc.isws.illinois.edu
Northeast Regional Climate Center
www.nrcc.cornell.edu
Great Lakes Region State Climatologists
www.stateclimate.org
National Oceanic and Atmospheric Administration
www.noaa.gov
National Centers for Environmental Information
www.ncei.noaa.gov
Great Lakes Environmental Research Laboratory
www.glerl.noaa.gov
NOAA Great Lakes Sea Grant Network
www.seagrant.noaa.gov
North Central River Forecast Center
www.crh.noaa.gov/ncrfc
Ohio River Forecast Center
www.weather.gov/ohrfc
Climate Prediction Center
www.cpc.noaa.gov
Office for Coastal Management
http://coast.noaa.gov/
Great Lakes Integrated Sciences & Assessments
www.gliisa.umich.edu
US Army Corps of Engineers, Detroit District
www.lre.usace.army.mil
National Integrated Drought Information System
www.drought.gov
USDA Midwest Climate Hub
https://www.climatehubs.ocs.usda.gov/midwest

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Environment and Climate Change Canada

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Great Lakes Region
Quarterly Climate Impacts and Outlook
- December 2016 -

http://mrcc.isws.illinois.edu/pubs/pubsGreatLakes.jsp
www.ec.gc.ca/eau-water/default.asp?lang=En&n=F5329B03-1



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