Quarterly Climate Impacts and Outlook

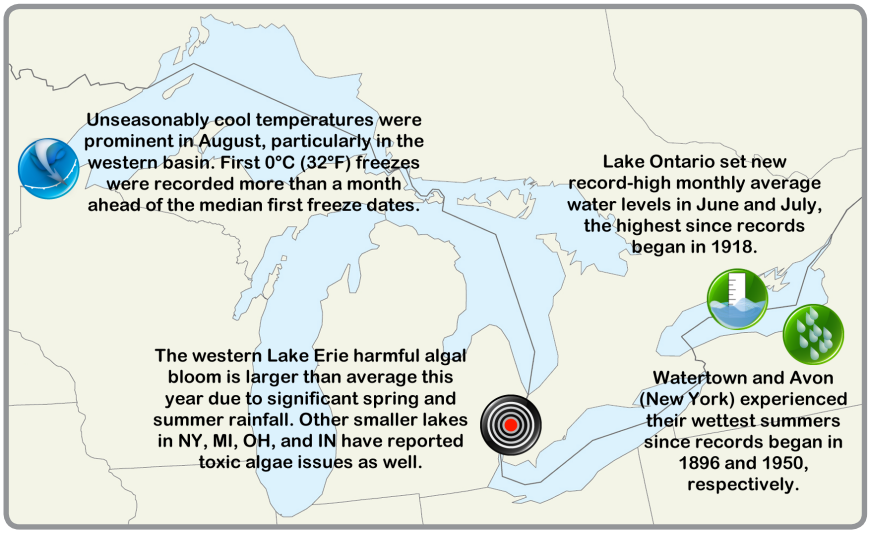
Great Lakes Region

September 2017

Great Lakes Significant Events - *for June - August 2017*

Many locations in the Great Lakes basin received above-normal precipitation this summer, with some locations receiving record-breaking precipitation. For example, Avon and Watertown (NY) experienced their wettest summer since records began in 1896 and 1950, respectively.

Bouts of heavy precipitation resulted in several flash flooding events across the basin, with notable events in all three months. One such event occurred from August 28-29, when rainfall totals of 220 to 290 mm (8.7 to 11.4 in) fell in Essex County, Ontario and resulted in significant flooding to roads and basements.

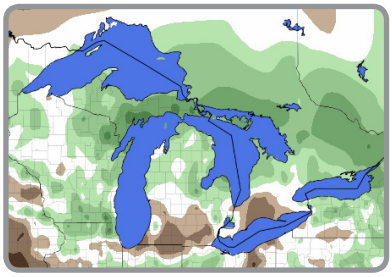


Wet conditions in the basin resulted in water levels of all the Great Lakes remaining well above average throughout the summer. Lake Ontario set new record-high monthly average water levels in June at 75.81 m (248.7 ft) and July at 75.69 m (248.3 ft), the highest since records began in 1918. Record high outflows were released from the Moses-Saunders Dam throughout the summer to provide relief to Lake Ontario shoreline interests. As a result, and despite the wet weather and continuing high inflows from Lake Erie, Lake Ontario water levels dropped 64 cm (25 in) from the start of June to the end of August, the 2nd largest drop during this three-month period on record.

On July 20, an EF2 tornado touched down in Hamburg (NY), resulting in millions of dollars in damage (estimated) at the Erie County Fairgrounds, as well as significant home damage and power outages. The last time Erie County had an EF2 or stronger tornado was in 1987.

Regional Climate Overview - *for June - August 2017*

Precipitation



June-August 2017 Precipitation: Percent of Normal (%)

25 50 75 90 110 125 150 175 200

Precipitation normals based on 1981-2010.

Summer precipitation was near or above average for all lake basins, with the overall basin receiving 110% of average. June was the wettest month this summer, with the overall basin receiving 135% of average precipitation. In July, all lake basins but Ontario saw near- or below-average precipitation, with the overall basin receiving 89% of average. The Erie and Ontario basins were slightly drier than average in August, while the Superior and Michigan-Huron basins were wetter than average. The overall basin saw 105% of average precipitation in August.

Great Lakes Water Levels

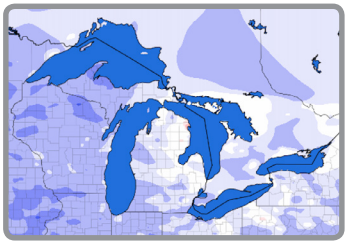
Lake	End of August 2017 Compared to:		Change since June 1st	
	Average	Last Year	2017	Average
Superior	+25 cm (+9.8 in)	+9 cm (+3.5 in)	+16 cm (+6.3 in)	+13 cm (+5.1 in)
Michigan-Huron	+44 cm (+17.3 in)	+16 cm (+6.3 in)	+11 cm (+4.3 in)	+1 cm (+0.4 in)
Erie	+48 cm (+18.9 in)	+24 cm (+9.4 in)	-17 cm (-6.7 in)	-11 cm (-4.3 in)
Ontario	+41 cm (+16.1 in)	+43 cm (+16.9 in)	-64 cm (-25.2 in)	-21 cm (-9.1 in)

Water level statistics based on 1918-2016.

Temperature

Air Temperature: Summer temperatures generally ranged from 2°C (3.6°F) below normal to near normal. The greatest temperature departures this summer were in August, when some areas were as much as 3°C (5.4°F) below normal. Portions of Minnesota and Michigan recorded 0°C (32°F) between August 24-25, which is more than a month ahead of the median first freeze dates for these areas (based on 1981-2010 normal). In July, temperatures ranged from 2°C (3.6°F) below normal to 2°C (3.6°F) above normal. June was up to 2°C (3.6°F) warmer than normal for a majority of the basin.

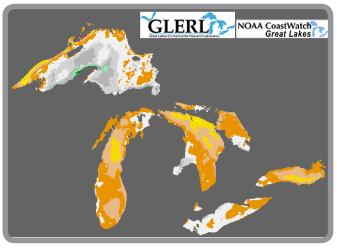
Water Temperature: Surface water temperatures on lakes Erie and Superior were cooler than the long-term average (LTA) by 0.5 to 2°C (0.9 to 3.6°F) for June through August while the other lakes were 0.5 to 1.5°C (0.9 to 2.7°F) higher than the LTA. In contrast, during the same period last year, all lakes were 1 to 3.5°C (1.8 to 6.3°F) higher than the LTA.



August 2017 Air 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



June-August 2017 Water Temperature: Departure from LTA

-4.0 -3.0 -2.0 -1.0 0 1.0 2.0 3.0 4.0

Air temperature normals based on 1981-2010.
Water temperature LTA based on 1995-2016.

Regional Impacts - *for June - August 2017*

Agriculture

Flooded farm north of Toronto in late June (Dorsey Farms).

The weather conditions this summer caused significant issues for farmers across the basin. A farm near Toronto lost hundreds of acres after a late-June heavy rainfall event, resulting in an estimated $2.5 million in damages. The wetter and cooler conditions have resulted in delayed planting and crop development, unseeded acres, reduced field access, and loss of crops due to flooded fields. As a result, reduced crop yields and quality are anticipated.

Water Quality

Several beaches and lake access points were closed temporarily at various points throughout the summer due to positive tests for harmful blue-green algae. One lake that tested positive was Cayuga Lake, which is a popular tourist destination in the Finger Lakes Region of New York.

Harmful algal bloom in western Lake Erie on 8/14/17 (NOAA GLERL).

Lake Ontario High Water Level Impacts

Lake Ontario water levels have declined during summer but still remained well above average and continued to impact communities and businesses within the Lake Ontario-St. Lawrence River system with widespread flooding and erosion issues. Tourism suffered due to extensive flooding and high water damage to shoreline communities, beaches, and parks, which negatively impacted local businesses. High water damage along the waterfront in Ogdensburg (NY) is estimated to cost $1.5 million to repair and it could be well into next year before public access is allowed. The Toronto Islands were closed to the public until July 31 due to flooding, costing the City of Toronto an estimated $8 million in revenue. While higher water levels allowed some commercial ships to carry heavier loads, the high flows this year increased velocities and cross currents in the St. Lawrence River considerably. This presented difficult conditions for mariners and required significant mitigation measures for safe navigation, all of which substantially slowed cargo shipments. The measures are provided in notices from the St. Lawrence Seaway Management Corporation.

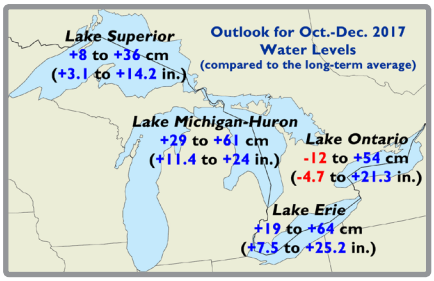
Societal

Several flash flooding events this summer caused damage and disruption to many areas in the basin. Portions of central Michigan received up to 178 mm (7 in) of rainfall from June 22-23. As a result, more than 5 million gallons of partially-treated wastewater was discharged into the Tittabawassee River and in the hardest hit counties, public and private property flood damage is estimated at over $100 million. Portions of Ohio and New York experienced flash flooding from July 13-14. The Blanchard River near Findlay (OH) had its fifth highest crest on record.

Flooding in Findlay, OH (City of Findlay, Brian Thomas).

Regional Outlook - *for October - December 2017*

Water Levels



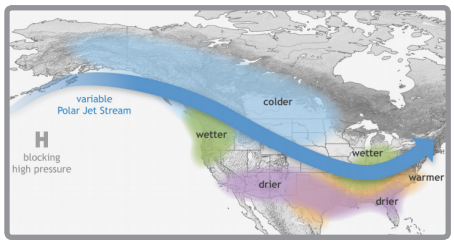
Potential range for water levels for Oct-Dec 2017 compared to the long-term average (1918-2016).

All of the Great Lakes typically begin or continue their seasonal decline at this time of the year, as lake evaporation rates are at their highest. As cold, dry air passes over a lake, it is warmed by the lake's water surface and picks up water vapor as a result. With more water leaving the basin - in the form of evaporation - than entering, water levels can continue to decline. This year, water levels are still expected to remain above average for all the Great Lakes unless exceedingly dry conditions are experienced.

Temperature & Precipitation

Outlook

The Climate Prediction Center (CPC) and Environment and Climate Change Canada (ECCC) are forecasting a greater chance for above-normal temperatures and equal chances for above-, near-, or below-normal precipitation across the Great Lakes basin for October-December. However, NOAA now says there is an increasing chance (55-60%) of La Niña during fall and winter 2017-18. For the Great Lakes basin, La Niña could mean wetter and cooler conditions in December-February. Current outlooks can be found through CPC and ECCC.



Typical impacts of La Niña on U.S. winter temperature and precipitation (NOAA Climate.gov).

Potential Impacts

Despite the outlook for warmer-than-normal temperatures in October-December, the delayed planting, unseasonably cool late-summer temperatures, and wetter soils have led to concerns that plants will not mature before the first killing frost. In Ontario, crop development was estimated to be about one week behind normal at the end of the August. The first fall 0°C (32°F) freeze typically occurs in late September and early- to mid-October across the Great Lakes basin.

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.glisa.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.oce.usda.gov/midwest

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