

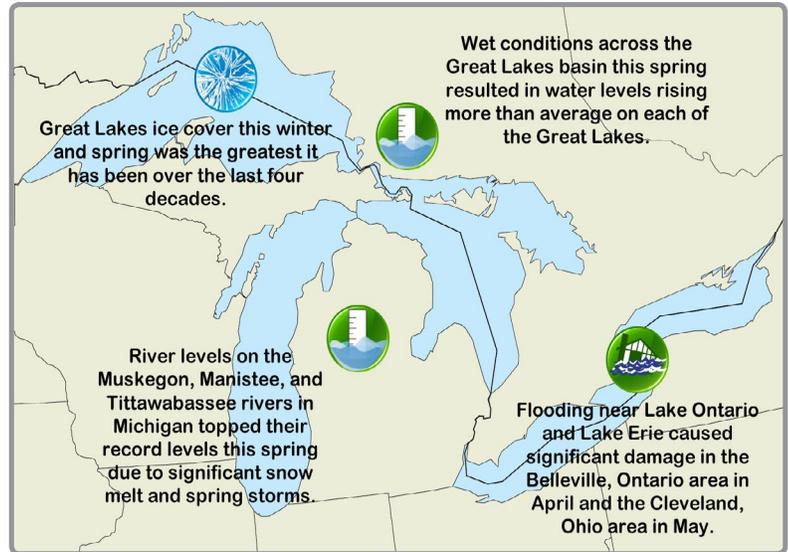


Great Lakes Significant Events - for March - May 2014

Following an unusually cold winter in the Great Lakes region, Spring 2014 was also cooler than normal, with this spring coming in as the 5th coldest on record since 1948 over the Great Lakes. Great Lakes ice cover reached its maximum extent of 92.5% on March 4, making it the second greatest amount of ice cover since record keeping began in 1973.

Wet conditions across the Great Lakes basin this spring resulted in water levels rising more than average on each of the Great Lakes. After more than a decade of low water levels, Lake Superior has risen to above-average levels not seen since 1997. Lake Michigan-Huron, while still below average, began June with the highest levels since 2009 for this time of year.

Several cities across the Great Lakes basin experienced record snowfall and/or cold this winter and spring. Detroit, Michigan and neighbouring Windsor, Ontario received 241 cm (94.9 in) and 248.8 cm (98 in) of snow, respectively. This broke the previous snowfall season record for Detroit set back in 1880-81 and ranked 3rd for Windsor. Numerous Ontario locations including Sault Ste. Marie, Kitchener/Waterloo, and Ottawa set new records for coldest mean temperature for March.

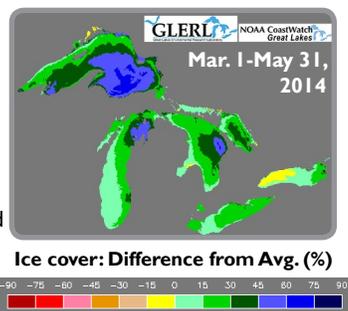


Severe flooding occurred along the Moira River in eastern Ontario in mid-April as a result of significant snow melt and rainfall (86.5 mm (3.4 in)) that fell from April 4-15, causing infrastructure and property damage in and around Belleville, Ontario. In mid-May, flash flooding occurred in the Cleveland, Ohio area, after severe thunderstorms produced torrential rainfall, measuring more than 100 mm (4 in) in some areas. A major interstate around Cleveland was closed due to high water, and several people were reported to be trapped in homes and vehicles.

Regional Climate Overview - for March - May 2014

Great Lakes Ice Cover

The maximum extent of ice cover on the Great Lakes this winter and spring was 92.5%, the 2nd greatest since 1973 (record is 94.7% in 1979). All lakes but Ontario became 90% or more ice covered, which has not occurred since 1994. Ice cover in late May on Lake Superior (1.9% on May 31) has occurred only 3 other times during the 40 year period of record.



Long-term average based on 1973-2013.

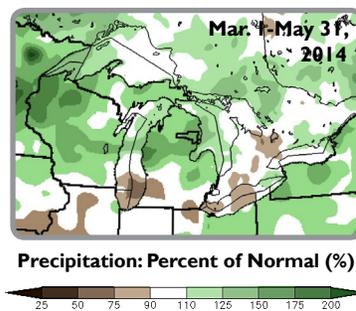
Great Lakes Water Levels

Levels on all of the Great Lakes are above last year's water levels at the beginning of June. Wet, cold weather contributed to Lake Superior finishing the quarter 14 cm (5.5 in) above the long-term average, 32 cm (12.6 in) above last year's level. The other lakes all received higher than normal water supplies in April and May including Lake Ontario, which set a new record for greatest increase in water levels during April. At the beginning of June, Lake Michigan-Huron remained 17 cm (6.7 in) below average, but 32 cm (12.6 in) higher than this time last year. Lake Erie finished the quarter 8 cm (3.1 in) above average while Lake Ontario was 13 cm (5.1 in) above average.

Water level statistics based on 1918-2013.

Precipitation & Snowfall

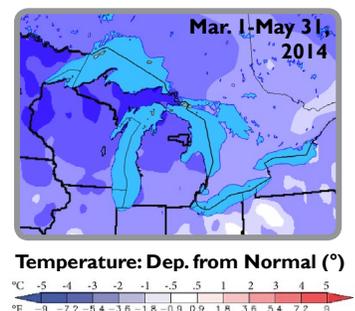
The Great Lakes basin saw 96% of its average precipitation for this quarter. However, while March was dry at 47% of average, April and May were wet seeing 122% and 110% of average, respectively. Each of the lake basins were at least 90% of normal, except Erie at 80%. Spring snowfall was above normal, with the heaviest accumulations along western Lake Superior and Lake Erie, and southern Lake Michigan.



Map: precip normals based on 1981-2010.
Text: precip normals based on 1900-2010.

Temperature

Spring 2014 was the 5th coldest since 1948 over the Great Lakes, with temperatures 1° to 4°C (2° to 7°F) below normal. March was 2nd coldest, with temperatures 3° to 7°C (5° to 12°F) below normal, while April was the 8th coldest. May temperatures ranged from 2°C (4°F) above normal in the eastern parts of the basin to 2°C (4°F) below normal in western parts. Regionally, spring was unusually cold, but globally, March was 4th warmest and April tied for record warmest.



Temperature normals based on 1981-2010.

Regional Impacts - for March - May 2014

Great Lakes Shipping



The U.S. Coast Guard ice breaker Mackinaw; Photo: U.S. Coast Guard (via Flickr)

The extensive ice cover caused delays in getting U.S./Canadian shipping lines open for the spring. On March 25, the Soo Locks on the St. Marys River opened, marking the start of the shipping season, but some companies waited until April to allow for the ice to melt. To combat the extensive ice cover, the U.S. and Canadian Coast Guards did nearly three times as much ice breaking this winter

in the Great Lakes than normal. In fact, 10,597 hours (nwi.com) of ice breaking were needed. Ice breaking operations were completed on May 16, 3 weeks later than last year. Ice breakers were requested for several ships that were trying to get salt to critical areas for snow removal.

Ship traffic in April and May were 35% and 19% lower (respectively) when compared to 2012, which was a low ice year (NOAAPORT).

Industry

The largest steel mill in the U.S., located in Gary, Indiana, had to temporarily close in early April as it was waiting on its shipment of iron ore, which was delayed due to extensive ice cover on the Great Lakes. The Lakes Carriers Association says that the ice cover this season dramatically slowed coal shipments in April. Loadings totaled only 995,000 tons, a decrease of nearly 55% compared to last year.

Agriculture

Below normal temperatures over the winter and well into the spring delayed the spring snowmelt and field operations across the Great Lakes region. In Ontario, field operations were delayed by up to two weeks but by late May, warmer temperatures resulted in improved conditions for agriculture operations and the delays were reduced. In Michigan, flooded fields caused issues for farmers and delayed planting as well. At the end of May, some crops in Michigan were past the optimal planting window, leaving farmers concerned about crop maturity this fall.

Infrastructure

With record snowfall across the region, municipalities had to deal with increased operational and infrastructure costs.

Ann Arbor, Michigan had to use over \$3 million from its cash reserves to address "severe winter operational expenses and infrastructure damage" (mlive.com).

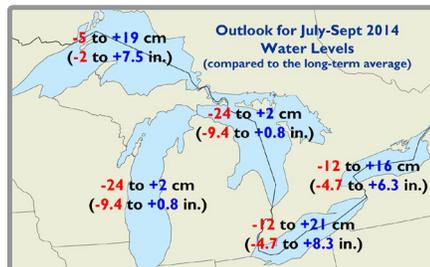
Ice shoves (strong winds pushing ice ashore) caused property damage across areas of the Great Lakes this spring, including along Lake Superior in Michigan (Marquette and the Keweenaw Peninsula) and along Lake Winnebago in Oshkosh, Wisconsin. Also, a concrete seawall cracked and crumbled under the force of strong waves on Lake Ontario in late April.



Ice shove in Menominee, MI on 4/13/14; Photo: weather.com contributor mike5501

Regional Outlook - for July - September 2014

Lake Level Outlook



Outlook from the US Army Corps of Engineers and Environment Canada (July-September 2014)

Current projections for July through September indicate that levels on Lake Superior and Lake Erie are expected to remain 5-10 cm (2-4 in) above average unless exceedingly wet or dry water supply conditions are experienced. While Lake Michigan-Huron is most likely to remain below average, a very wet summer could bring it to average levels. Lake Ontario is expected to fall a few centimeters below average unless above-average water supplies are received.

Temperature & Precipitation Outlook

NOAA's Climate Prediction Center and Environment Canada are predicting a greater chance for below-normal temperatures for July through September across western portions of their respective Great Lakes basins, with equal chances elsewhere. The outlook for below-normal temperatures is partially a result of the lingering effects of the extensive ice cover and below-normal temperature of the Great Lakes, particularly Lake Superior.

For precipitation, the Climate Prediction Center and Environment Canada are both forecasting equal chances for above-, below-, or near-normal precipitation in their respective basins for July through September.

Harmful Algal Bloom Outlook



Lake Erie algal bloom on 9/20/13; Ohio Sea Grant

Should the Lake Erie basin receive above average precipitation and associated runoff next quarter, this could lead to a larger than average harmful blue-green algae bloom in

Lake Erie this summer. Longer storm seasons and more severe storms are a contributing factor to excessive amounts of phosphorus entering the lake, mostly attributed to urban and agricultural runoff, which feeds the algal blooms. It is too soon to tell if the 2011 algal bloom will approach the size of the 2011 bloom, the largest in Lake Erie's history.

Great Lakes Region Partners

Environment Canada

www.ec.gc.ca

Agriculture and Agri-Food Canada

www.agr.gc.ca

Midwestern Regional Climate Center

www.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 Operational Hydrologic Remote Sensing Center

www.nohrsc.nws.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/nrcf

Climate Prediction Center

www.cpc.noaa.gov

Great Lakes Integrated Sciences & Assessments

www.gllisa.umich.edu

US Army Corps of Engineers, Detroit District

www.lre.usace.army.mil

National Integrated Drought Information System

www.drought.gov

Great Lakes Water Level Dashboard

www.glerl.noaa.gov/data/now/wlevels/dbd/

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