US Army Corps of Engineers Detroit District

Great Lakes Update

Volume 193: 2015 January through June Summary

The U.S. Army Corps of Engineers (USACE) monitors the water levels of each of the Great Lakes. This report provides a summary of the Great Lakes water levels and basin conditions from January through June 2015.

The primary drivers of water level changes are precipitation falling on the lake surface, runoff draining to the lake, evaporation from the lake surface, diversions into or out of the lake, and connecting channel inflows and outflows. The combined effects of the first three hydrologic factors – precipitation, runoff, and evaporation – are referred to as the Net Basin Supply (NBS) to the lake. The NBS is an important quantity for understanding the amount of water supplied to the lake. USACE uses the residual method to calculate NBS, which is equal to the water level change, minus the inflow from an upstream lake, plus the outflow, and plus any diversions out of (+) or into (-) the lake. Net Basin Supply is the most significant driver of water level change.

All water levels mentioned in this article are monthly mean surface elevations in feet referenced to the 1985 International Great Lakes Datum. The period of record used for each of the lakes includes the years 1918 to 2014 and these data have been coordinated between the United States and Canada. All 2015 water levels are considered provisional and will be officially coordinated in the spring of 2016. The water level of each lake is averaged from a network of individual water level gages around each lake. Also of note is that Lake Michigan and Lake Huron are hydraulically treated as one lake due to their connection at the Straits of Mackinac.

2015 Overview: January - June

In January 2014, the only Great Lake above its long-term average was Lake Ontario. By January 2015, however, Lake Ontario was the only lake whose water level was below its long term average. While Lake Ontario was 1 inch below its long term average January level in January 2015, Lakes Superior, Michigan-Huron, St. Clair, and Erie were 9, 8, 12, and 8 inches above their long term average January levels, respectively.

This dramatic change on the upper lakes resulted from a second consecutive year of significantly higher than average seasonal rises on those lakes. This was not the case during 2015, however, as shown in Figure 1 and Table 1. Instead, seasonal rise (through June) was slightly less than average for Lakes Superior and Michigan-Huron, but significantly higher than normal for Lakes St. Clair, Erie, and Ontario. Figure 1 shows the difference between the observed lake level change during each month compared to that calendar month's long term average lake level change. Table 1 provides the water level changes from the winter minimum level to the June level for each lake.

The notable rise on the lower lakes is largely a result of very high precipitation during the month of June (95% and 79% more precipitation than normal fell over Lakes Erie and Ontario, respectively, during June 2015). Lake Superior, on the other hand, received 91% of its long term average June precipitation. On the whole, the Great Lakes basin has transitioned from a drier than average fall and winter to a wetter than average late spring and early summer, and this has translated to a similar transition from lower than average NBS during winter to higher than average NBS in the summer.

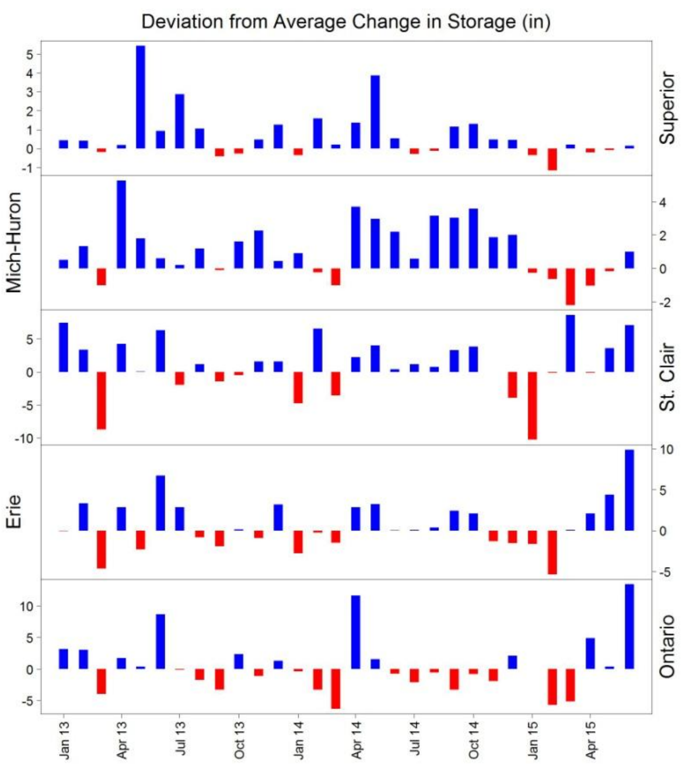


Figure 1: Change in lake level, in inches, relative to the long term average change in lake level for each month.

As of June 2015, all of the Great Lakes were above their long term average monthly mean levels, and all lakes but Ontario were above their June 2014 levels.

Lake	2013	2014	2015	LTA
Superior	14	14	8	9
Michigan-Huron	19	17	8	11
St. Clair	18	24	27	15
Erie	16	18	21	13
Ontario	28	22	24	19

Table 1. Great Lakes Water Level Changes, in inches, from winter minima to June (calculated using monthly means)

Lake Superior Summary

In June 2015, Lake Superior's water level was 1 inch higher than it was a year before, and 7 inches higher than LTA. Figure 2 shows 2013, 2014, and 2015 monthly mean water levels in comparison with the historical record and long term average monthly mean water levels.

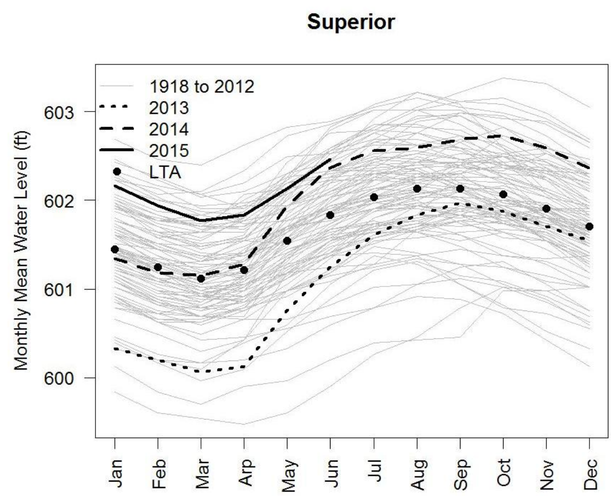


Figure 2: 2013, 2014, and 2015 Lake Superior water levels overlaid with water levels from 1918 to 2012 and the long term average (LTA) monthly mean water levels.

Figure 3 shows the deviation from long term average monthly precipitation since January 2013. The Superior basin has, for the most part, experienced less than average precipitation since December 2014, with the exception of May 2015. Unlike the lower lakes, Lake Superior did not receive exceptionally high June precipitation. For the most part, this, in combination with higher than average winter evaporation rates has resulted in slightly less-than-average NBS to Lake Superior.

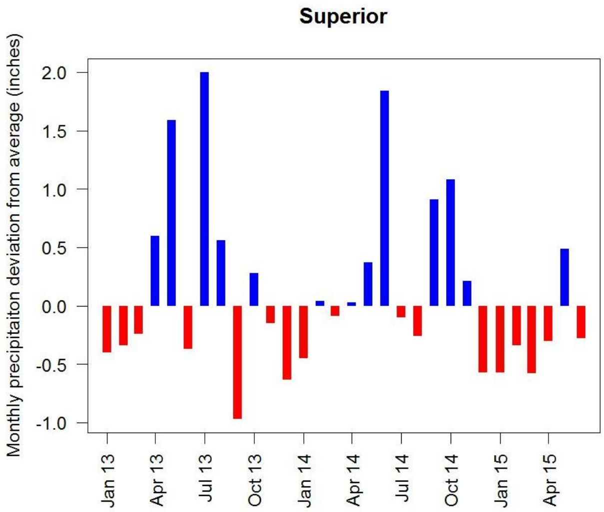


Figure 3: Deviation from long term average monthly precipitation.

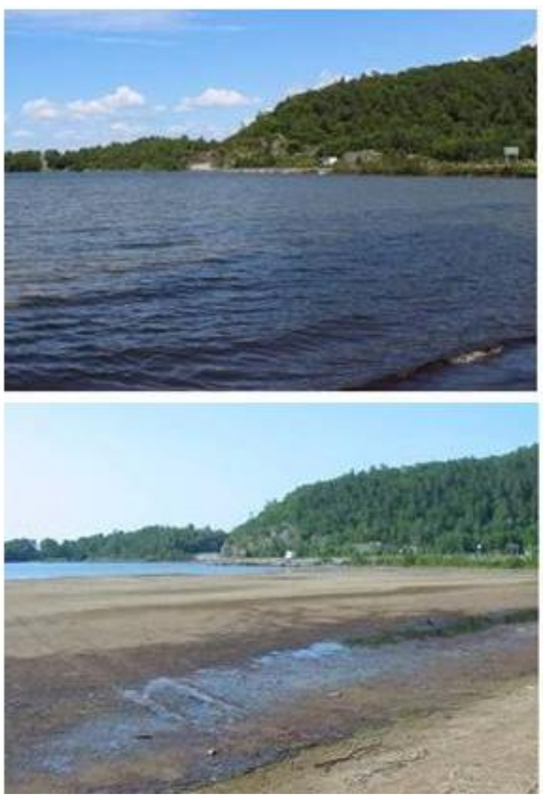


Figure 4: Impacts of higher Lake Superior water levels at Havilland Bay, Ontario (top: 2007; bottom: 2015). Credit: Lake Superior Board of Control.

Although Lake Superior levels have not reached record high values, two years of high levels following an extended period of very low water levels has resulted in noticable waterfront impacts. For example, beach area has been reduced, as in Figure 4.

The water level of Lake Superior is forecast to begin is seasonal decline between August and September. Levels are anticipated to be below last year's levels from September to January, but remain several inches above LTA levels over the next 6 months.

Lake Michigan-Huron Summary

In June 2015, Lake Michigan-Huron's water level was 12 inches higher than it was a year before, and 6 inches higher than LTA. Figure 5 shows 2013, 2014, and 2015 monthly mean water levels in comparison with the historical record and long term average monthly mean water levels.

Figure 6 shows the deviation from long term average monthly precipitation since January 2013. Greater than normal precipitation during May and June followed a 5-month period of below average precipitation. For the most part, this has resulted in less-than-average NBS to Lake Michigan-Huron, except in December and in June.

June 2015 water levels were 26 inches below record high June water levels (1986). However, two years of high levels following an extended period of very low water levels has resulted in noticable waterfront impacts, similar to those seen on Lake Superior. Figure 7 shows one location where water levels have encroached on property and eroded a sandy beach to expose rocks and pebbles.

Lake Michigan-Huron is predicted to begin its seasonal decline in August, but will remain above last year's levels until December. By January, the level is forecast to be 1 inch below last year's level. Levels will remain 7 to 8 inches above LTA over the next 6 months.

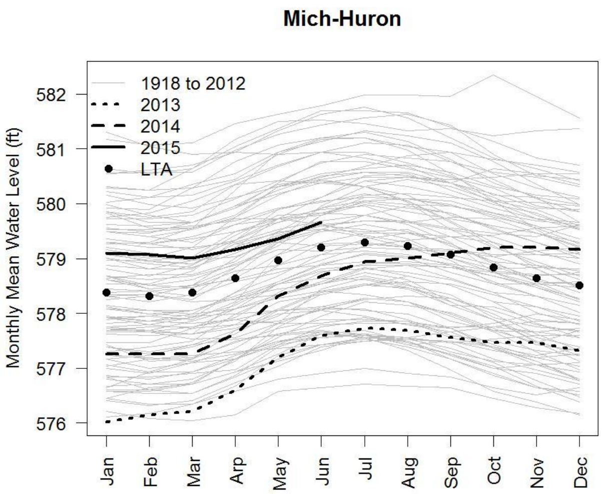


Figure 5: 2013, 2014, and 2015 Lake Michigan-Huron water levels overlaid with water levels from 1918 to 2012 and the long term average (LTA) monthly mean water levels.

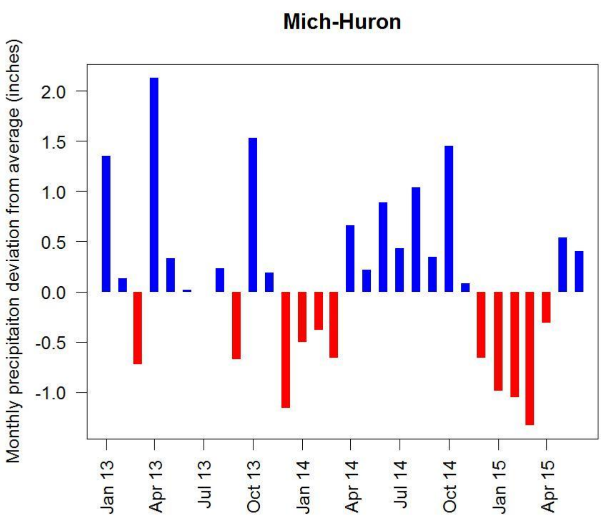


Figure 6: Deviation from long term average monthly precipitation.

Figure 7: Impacts of changes in Lake Michigan-Huron water levels at one location in Two Rivers, Wisconsin (top: December 2013; bottom: July 2015). Credit: the Sacket Family, Two Rivers, WI.

Lake St. Clair Summary

The water level of Lake St. Clair in June 2015 was 8 inches above the level of one year ago and 10 inches above the LTA. Figure 8 shows 2013, 2014, and 2015 monthly mean water levels in comparison with the historical record and long term average monthly mean water levels.

Lake St. Clair's mean water level in December 2014 was 9 inches above its LTA December level. Due to dry conditions and constriction of flow in the St. Clair River during the very cold winter months, however, the level dropped to 2 inches below LTA by February. The subsequent breakup of ice followed by very high precipitation in June then resulted in a rise of 15 inches bringing the lake to June's high level.

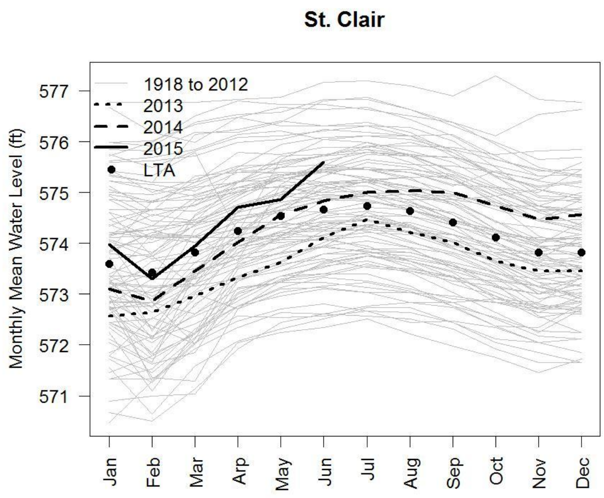


Figure 8: 2013, 2014, and 2015 Lake St. Clair water levels overlaid with water levels from 1918 to 2012 and the long term average (LTA) monthly mean water levels.

Lake St. Clair is expected to continue its seasonal decline, but is forecast to remain above last year's levels for the next 6 months. Levels are anticipated to be 9 to 13 inches above LTA levels.

Lake Erie Summary

In June 2015, Lake Erie was 7 inches above its June LTA level and 5 inches above its level in June 2014. Figure 14 shows 2013, 2014, and 2015 monthly mean water levels in comparison with the historical record and long term average monthly mean water levels.

Figure 10 shows the deviation from long term average monthly precipitation since January 2013. Greater than normal precipitation during May and nearly double the normal June precipitation followed a 7-month period of below average precipitation. This has resulted in less-than-average NBS to Lake Erie from October 2014 to March 2015 transitioning to NBS values much higher than average by June (the June NBS was more than 3.5 times its LTA June NBS). This very large NBS, combined with higher than average Detroit River flows, was responsible for a very large rise on Lake Erie.

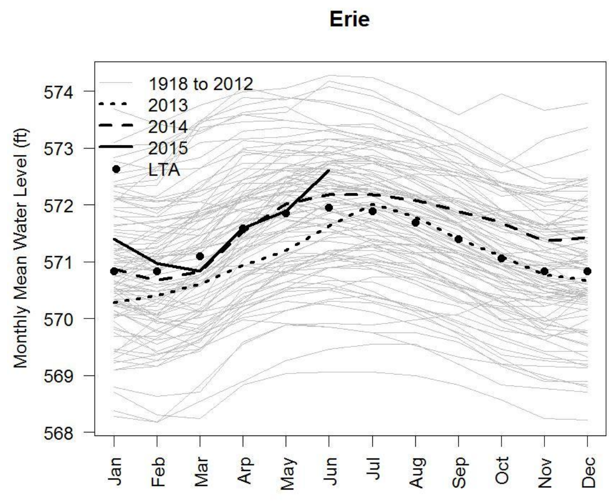


Figure 9: 2013, 2014, and 2015 Lake Erie water levels overlaid with water levels from 1918 to 2012 and the long term average (LTA) monthly mean water levels.

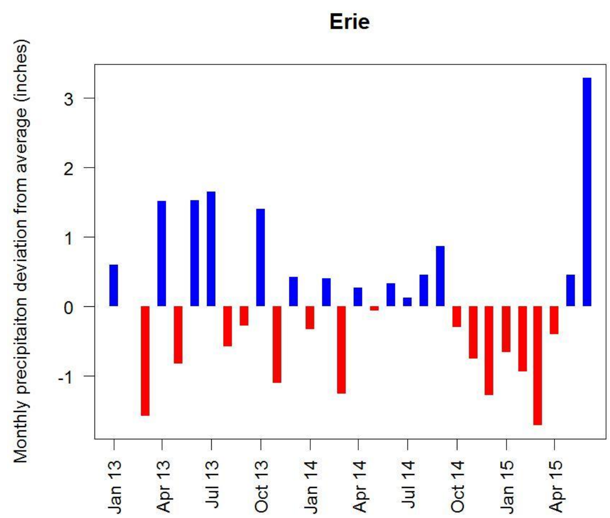


Figure 10: Deviation from long term average monthly precipitation.

The lake's seasonal rise until June was 21 inches, which is 8 inches more than the normal March to June rise. The lake began the year 7 inches above

LTA, but returned to its LTA level in March. The subsequent very wet late spring and early summer then resulted in Lake Erie returning to above average levels by June.

Lake Erie is expected to continue its seasonal decline, but remain above levels seen last year over the next 6 months. The latest 6-month forecast shows Lake Erie levels ranging from 10 to 16 inches above LTA.

Lake Ontario Summary

Despite dropping to 11 inches below LTA levels by March, Lake Ontario returned to just 2 inches below LTA by June. The water level of Lake Ontario in June 2015 was 6 inches below the level of one year ago. Figure 11 shows 2013, 2014, and 2015 monthly mean water levels in comparison with the historical record and long term average monthly mean water levels.

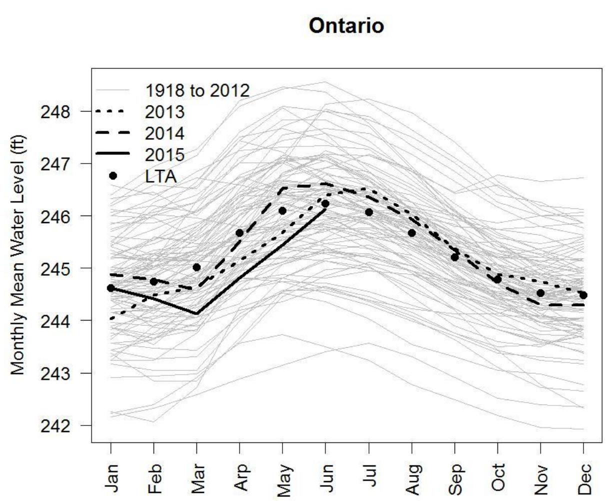


Figure 11: 2013, 2014, and 2015 Lake Ontario water levels overlaid with water levels from 1918 to 2012 and the long term average (LTA) monthly mean water levels.

The NBS to Lake Ontario was above average in April and June 2015, but below average during the remainder of the 6 month period. The June NBS was more than twice its normal June value, a result of the very large amount of June precipitation, demonstrated in Figure 12.

Lake Ontario will continue its seasonal decline, but is forecast to remain 1 to 6 inches above last year's levels over the next 6 months. The 6-month forecast predicts levels ranging from 9 inches above LTA in August to 2 inches below LTA in December.

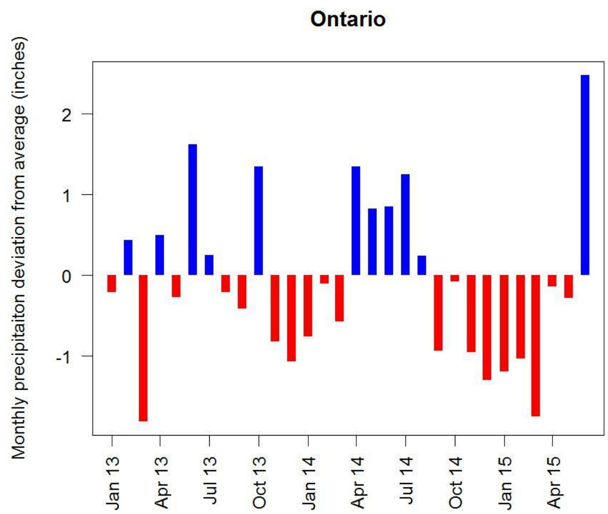


Figure 12: Deviation from long term average monthly precipitation.

2015 Winter Conditions

The winter of 2014-2015 was somewhat drier than the previous winter (see Figure 3, Figure 6, Figure 10, and Figure 12). However, despite a warmer-than-average start in December 2014, the winter of 2015 was very cold, especially during the month of February. The extremely cold February meant that although the overall precipitation was low for the winter, snow that did fall remained on the ground. Ultimately, the snow water equivalent (the amount of liquid water contained within the snowpack, SWE) was relatively high throughout the winter in the Lake Erie and Lake Ontario basins, despite low precipitation (Figure 14 shows the Lake Erie SWE alongside the monthly departure from average precipitation).

SWE has a strong impact on runoff to the lakes in the early spring months, and according to maps produced by the U.S. Geological Survey, runoff in the Lake Erie basin was at or above normal in March and April, and runoff in the Lake Ontario basin was above normal in April. The above average April runoff was likely responsible for the higher than average increase in Lake Erie and Lake Ontario lake levels during April (Figure 1).

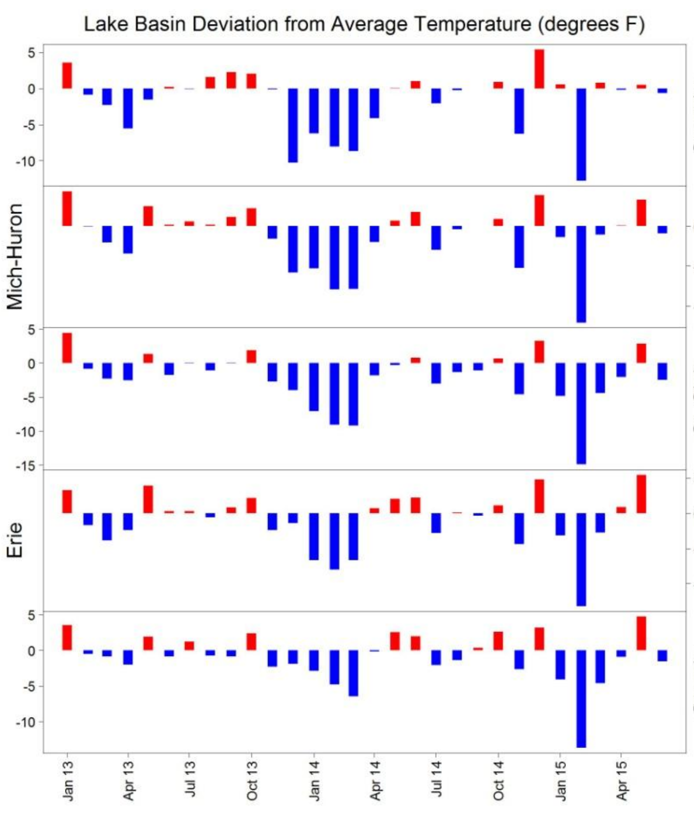


Figure 13: Preliminary monthly temperature deviation from average (overland).

2015 Spring Conditions

During May and June, much of the Great Lakes basin experienced a transition from drier than average conditions to wetter than average conditions. During June, several frontal systems passed through the Great Lakes region and stalled just north of the Ohio River. Additionally, the remnants of Tropical Storm Bill brought tropical moisture to the Erie Basin. According to preliminary precipitation estimates, the June 2015 precipitation was the highest June precipitation ever recorded for Lake Erie, and the third highest June precipitation on record for Lake Ontario.

Overlake precipitation directly contributes to the lakes' water budgets, and overland precipitation contributes indirectly through the translation of precipitation to runoff to the lakes. Throughout the month of June, many streamgages in the Lake Erie and Lake Ontario basins were recording flows at or above the 90th percentile discharge values for that time of year. The dramatic lake level rise seen on Lakes Erie and Ontario (Figure 1) was a result of this direct and indirect contribution from extremely high June precipitation. The change from dry to wet conditions is reflected in the USGS maps of monthly streamflow in Figure 15.

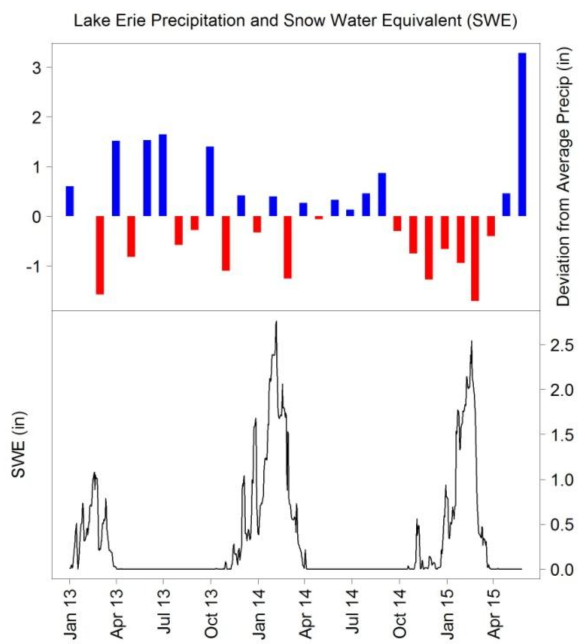
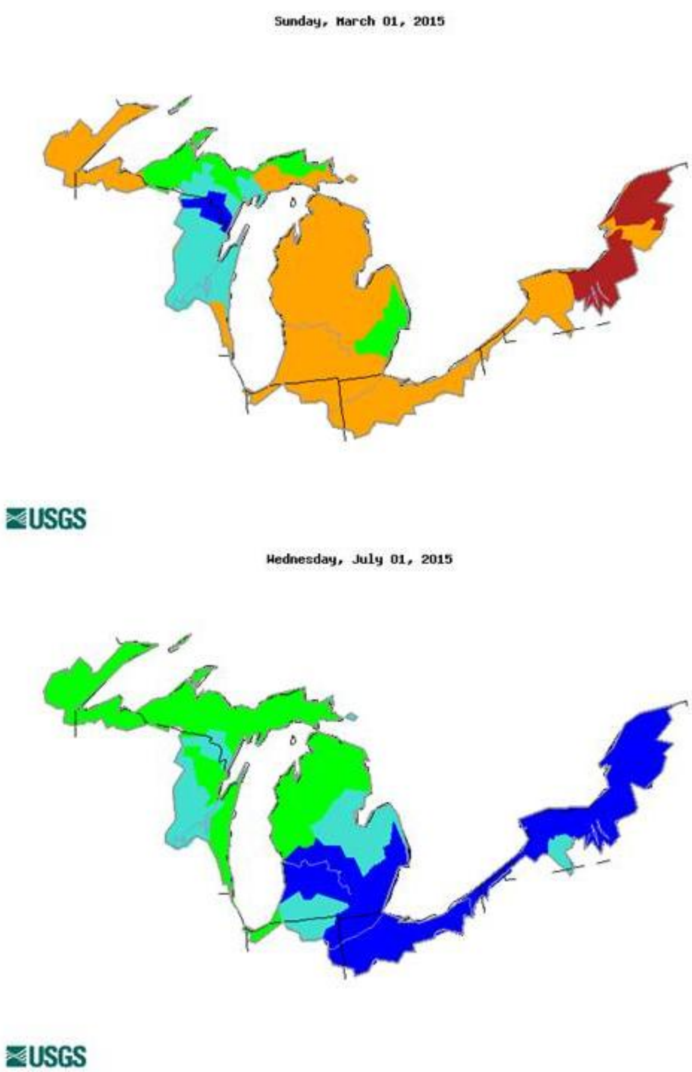


Figure 14: Top: Deviation in monthly precipitation (inches). Bottom: snow water equivalent (SWE) for Lake Erie. Deviation from monthly precipitation is estimated from preliminary monthly precipitation amounts, and SWE data are aggregated from the National Weather Service's SNOw Data Assimilation System (SNODAS).



Explanation - Percentile classes							
Low	<10 Much below normal	10-24 Below normal	25-75 Normal	76-90 Above normal	>90 Much above normal	High	No Data

Figure 15: Monthly streamflow for Great Lakes hydrologic units for February (top) and June (bottom) of 2015. Source: waterwatch.usgs.gov.

Request for Photos

The recent lake level rise has resulted in dramatic changes on shoreline properties. Images showing shoreline properties under low and high water level conditions, such as those shown in Figure 4 and Figure 7 provide valuable documentation of the impacts these lake level changes have on individuals and communities. If you have images that show impacts of lake level change, be they positive or negative, please consider sharing them with the Detroit District. To send images, please email hhpm@usace.army.mil or send hard copies to the address listed at the end of this document. Include your name, contact information, and a short description of the photos, including the location, year, and season in which they were taken. Credit will be given when using these images in publications (as in Figure 4 and Figure 7).

More Information

The Detroit District's Monthly Bulletin of Great Lakes Water Levels provides 1- to 6-month lake level forecasts and a summary of recent basin hydrological conditions. Additionally, the Detroit District issues an updated 1-month forecast each week. The bulletin and weekly forecasts can be found online at:

http://www.lre.usace.army.mil/Missions/GreatLakesInformation/GreatLakesWaterLevels/WaterLevelForecast.aspx

The Detroit District welcomes comments on all of our forecast products. Please email questions and comments to hhpm@usace.army.mil. To contact the District by phone call toll free 1-888-694-8313 and select option 1.

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