Lake Michigan water level rise affects inland waterways

June 1 2022, by Lois Yoksoulian

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2020 marked Lake Michigan's highest water level in 120 years, experts said, and climate variance makes future water levels challenging to predict. Coastal impacts are well-documented, but the effect of lake level rise on the area's inland waterways is poorly understood. A University of Illinois Urbana-Champaign study examined how Lake Michigan's rising levels affect water quality, flood control and invasive

species management within the Chicago-area waterway system that connects the lake to Illinois, Indiana and the Mississippi River basin.

The study, led by civil and environmental engineering professor Marcelo Garcia and graduate student Dongchen Wang, focused on how lake-level rise influences the unique bidirectional flow of the Chicago-area waterway system—initiated by the engineered reversal of the Chicago River in 1900—and its connection to the Calumet-area waterway subsystem situated along the Illinois-Indiana border.

The study is published in the *Journal of Great Lakes Research*.

"The Calumet-area waterway subsystem was examined in detail for this study because it serves as the Chicago-area's only primary connection to Lake Michigan not completely controlled by hydraulic structures," Garcia said.

The researchers built complex computer models—calibrated and validated against observed field data—to reproduce the effect of past lake-level rise on the Calumet waterway subsystem's flow. To study the impact of future rises, the researchers plugged realistic increases in the Lake Michigan levels into their model.

"Our models successfully replicated the observed bidirectional flow and water levels of the Calumet subsystem," Wang said. "With that, we could look at various hydraulic scenarios. For example, when lake levels are 0.5 feet below the Calumet subsystem's normal level, the discharge in the Grand Calumet River is around zero, and water flows east toward Indiana and the Great Lakes basin. However, when we increase the lake level to 1.5 feet above normal, the flow reverses direction and drains west into Illinois toward the Mississippi basin."

The area surrounding the Calumet subsystem has a long history of heavy

industry, and streams and rivers in the area contain chemical pollutants, the researchers said. Restoration and environmental cleanup projects have left the system's channels broader and deeper after the dredging of polluted sediments. If the lake remains at a high level, the system could serve as an uncontrolled connection for invasive species to migrate between Lake Michigan and the Illinois and Mississippi rivers.

"State and federal agencies have made efforts to separate the Great Lakes basin and Mississippi River basin to control the spread of pollution and invasive species," Wang said. "However, we can now confirm that water can flow freely via the Grand Calumet River to Lake Michigan—or backward through the Chicago area waterway system toward the Mississippi River basin when the lake is at a high level—affecting an area much greater than originally understood," Wang said.

The study found that the spread of pollutants and invasive species through bidirectional water flow is not the only issue associated with Lake Michigan's era of high water levels.

"This work helps us better understand how the entire Chicago area waterway system will respond to flooding," Garcia said. "It will also better define the need for policy change related to Illinois' Lake Michigan water diversion laws. The researchers said there is still an immense amount of work needed to better characterize these initial findings and hope that the study results will motivate state and federal agencies to increase support for continued research.

More information: Dongchen Wang et al, Impact of Lake Michigan water level rise on complex bidirectional flow in the Chicago Area Waterway System (CAWS), *Journal of Great Lakes Research* (2021). DOI: 10.1016/j.jglr.2021.10.008

Provided by University of Illinois at Urbana-Champaign