High water levels in Lake Huron 2020.

Beach erosion from Lake Michigan storm 1985.

The Future of Great Lakes Water Level Forecasting

Developing a Next Generation Prediction System for Great Lakes Water Levels to Inform Lake Management Decisions

The Bipartisan Infrastructure Law (BIL) is a transformational opportunity to make an impact against the climate crisis across the country, improve resilience, strengthen aging infrastructure, and invest in communities. A $904 million investment in NOAA's climate data and services will result in critical climate information in the hands of decision-makers. With BIL funding, researchers at the NOAA Great Lakes Environmental Research Laboratory (GLERL) and the University of Michigan Cooperative Institute for Great Lakes Research (CIGLR) are developing a next generation prediction system for determining baseline and extreme water levels in the Great Lakes. The forecast will be developed collaboratively with Great Lakes water managers, and will transition from research at GLERL to sustained operations at a federal partner agency.

Quick facts:

- The Great Lakes is a shared resource between the US and Canada. Successful forecast development and its transition from research to operations will be ensured by leveraging existing federal and binational partnerships that have evolved over more than 100 years of shared water management.

- This project aims to advance the modeling behind current seasonal water level forecasts by extending outlooks beyond 6 months and incorporating state-of-the-art operational products and data science.

- The next generation forecast framework will inform a decision support tool(s) (DST) designed to guide management decisions and coastal resilience planning in the Great Lakes.

- The improved water level forecast will have the potential to inform adaptive management of Great Lakes outflows and prepare commercial shipping, coastal residents, recreational users, and other stakeholders for potential hazards due to fluctuating lake levels.

- This 5-year project began in October 2022 and will be completed in September 2027.

Technological advancements pave the way for advanced prediction

Great Lakes water resource managers have a critical need for flood risk predictions on a subseasonal to annual time scale (1-12 months). This requires accurate predictions of how environmental factors will influence water supply and water level changes. Existing 6-month forecasts of water levels are valuable communication tools that reach stakeholders on both sides of the U.S.-Canada border via mailing lists, web content, binational technical committees, and interagency coordination. The use of these forecasts for decision making has been limited, however, due to historically large uncertainties. Recent advancements in atmospheric modeling, application of machine learning, and continental scale hydrological modeling have paved the way for improvements to forecasts. Ultimately, these developments increase confidence in water level forecasts, provide critical information to decision makers, and support efforts to strengthen coastal resiliency.

NOAA's development of a next generation prediction system for Great Lakes water levels

- **Hydrological, Statistical, and Climate Modeling**: Researchers are advancing Great Lakes water cycle prediction by incorporating output from state-of-the-art hydrological and atmospheric models with artificial intelligence and machine learning techniques. These efforts will advance forecast technologies and produce optimized forecasts for target users and locations.

- **Stakeholder Engagement**: CIGLR and GLERL researchers are co-developing the forecast framework and decision support tool(s) with stakeholders, including federal partners who produce and communicate forecasts, to ensure that the resulting products both (1) augment or advance existing forecast operations and decision support products, and (2) address requirements for water management decisions and coastal resilience planning.

- **Social Science**: This project will survey decision-makers in the Great Lakes region (from the local to national level) about barriers and drivers of coastal risk management decision-making.

Who will benefit:

- *Great Lakes water managers* including the International Joint Commission, U.S. Army Corps of Engineers, and Environment and Climate Change Canada.

- *Great Lakes governing bodies* including Indigenous Nations, binational governing organizations, U.S. federal agencies, U.S. state, county and municipal governments, and Canadian government agencies.

- *Decision makers* such as adaptation professionals, emergency managers, public health and human service professionals, developers, land use and municipal planners, engineers, water and natural resource managers, realtors and insurers, coastal and floodplain managers, policy makers, and transportation and navigation professionals.

- *Economic sectors* including agriculture, fisheries, energy, navigation, manufacturing, shipping and transport, real estate and property, tourism, and recreation.

- *Great Lakes residents* such as coastal communities, property owners, and recreators.