The Great Lakes Operation Forecasting System (GLOFS) computer model uses an unstructured grid (i.e., triangular shapes of adaptable size) to better model physical processes in coastal areas, including the Straits of Mackinac.

Predicting Currents in the Straits of Mackinac

The Straits of Mackinac is the connecting waterway between Lakes Michigan and Huron of the Great Lakes—largest freshwater lake system by surface area on the planet. Due to the unique flow of the Straits, the two lakes are considered to be one (Lake Michigan-Huron), forming the largest lake in the world by surface area and the fourth largest by volume. Not only do the waters in this area support an important fishery and recreational economy, the Straits are also a crucial waterway for commercial shipping of iron ore, coal, cement, limestone, grain and oil.

NOAA research informs decisions

To understand the dynamic water exchange between Lake Michigan and Lake Huron, scientists at NOAA’s Great Lakes Environmental Research Laboratory (GLERL) have developed a 3D computer model that simulates currents in the Straits of Mackinac. Using the model, they have been able to show that these unique and fast moving currents would cause materials in the water to disperse far more quickly than in other locations in the Great Lakes.

Predictions of currents, as well as water levels, temperature, and other physical characteristics of the Straits, provide information in support of navigation, search and rescue, beach management, recreational use, and tracking contaminant transport. NOAA GLERL subject matter experts work with state governments, private companies, and federal organizations, such as the U.S. Coast Guard, to inform management and decision-making efforts.

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Advancing our predictions of water movement

The Great Lakes Operations Forecasting System (GLOFS) includes a hydrodynamic (the forces in, or the motion of, water) model of Lake Michigan-Huron aimed at providing improved predictions of water levels, water currents and water temperatures for the commercial, recreation, and emergency response communities.

Models of physical variables such as currents, temperature, ice cover, and water levels provide the public and decision makers with real-time information to aid in the usage and management of the Great Lakes. This knowledge is critically important given the role that physical conditions, such as current oscillation, play in water quality and the transport of contaminants in the Straits. For more on GLOFS, visit: www.tidesandcurrents.noaa.gov/ofsglofs.html.

Understanding complex water flow patterns

The currents in the Straits of Mackinac are complex, variable, and can be extraordinarily fast. Overall, water flows from Lake Michigan to Lake Huron. However, research indicates that it also oscillates (moves back and forth) and changes direction on an average of once every 1.5 days. These exchanges, caused by wind, are often very fast and can move about 80,000 cubic meters of water per second (more than the volume of 32 Olympic swimming pools), which can cause currents of up to 1 meter per second.

Simulating particle trajectory

NOAA GLERL researchers conduct particle trajectory simulations in the Straits. These modeled scenarios illustrate the uniqueness of this oscillating flow and how it affects the potential transport of a substance (e.g. oil, sediment, or nutrients). Visual simulations (see image on the right) show that the water flow patterns in the Straits can transport particles to northern Lake Michigan (west of the Straits) and to the southern shore of Lake Huron (east of the Straits). This demonstrates the complex physical conditions in the Straits and the importance of ongoing research to improve models that provide information for management and decision-making efforts.

For more information, visit: www.glerl.noaa.gov/res/straits