

Seiche Events on Lake Erie

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Seiche waves blast a shoreline structure in Buffalo, NY in April 2018. Photo by New York State Department of Environmental Conservation.

What is a Seiche and What Causes Them?

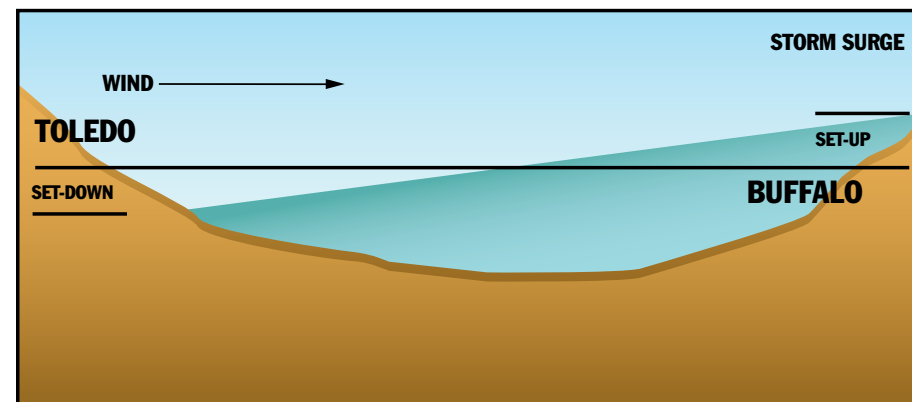
A seiche (pronounced “saysh”) is a prolonged, standing wave oscillating through a body of water such as a lake or bay. Rapid changes in atmospheric pressure or high sustained winds from one direction, push up the water level at one end of the lake, while dropping by a corresponding amount on the opposite end. As the winds decrease, water rebounds to the drawn-down area and continues to oscillate back and forth, often for multiple days [See Figure 1A page 2]. These events are often associated with periods of high winds and fast-moving thunderstorms.

Lake Erie Seiche Impacts

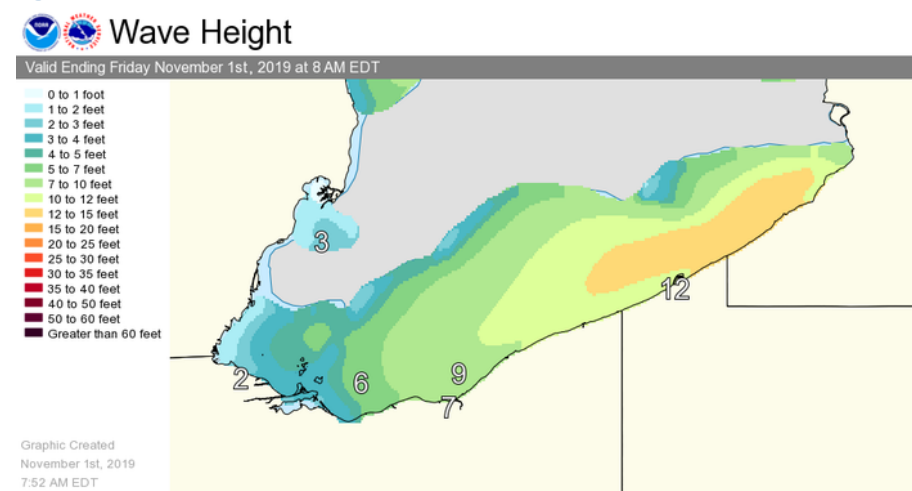
Lake Erie, the shallowest of the Great Lakes, is known for seiches due to its west-east orientation, shallow depth, and dominant wind direction. When high pressure or strong winds move along the lake’s long axis, from southwest to northeast, water accumulates along the shores of eastern Lake Erie, causing a drawdown in water on the western shore [See Figure 1B page 2]. These seiche events can cause local coastal flooding, rapid and intense erosion of the shoreline [See Figure 2 page 2], and impede recreation on the lake. When ice is present, it can pile up and cause additional damage to the shoreline. A recent study showed that over a 1-year period, seiche events were observed to be a significant source of coastline changes (erosion) near Woodlawn Beach, NY (Sogut and Farhadzadeh, 2021.)



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1A. During seiche events on Lake Erie, wind “piles up” water on the eastern shore of the lake, from Pennsylvania to Buffalo. At the same time, water levels on the eastern side near Toledo and Sandusky, Ohio, are pulled down.



1B. Wave heights associated with a seiche event on November 1, 2019 on Lake Erie. While conditions were quiet in Toledo at the western end of the lake, 12-foot waves on eastern Lake Erie caused widespread coastal erosion and flooding.

During these events, more wave energy is transferred to the lake bottom as larger waves reach the shoreline, resulting in greater movement of sediments (erosion) during these events, compared to other, calmer times of the year.

The enhanced current circulation may exacerbate the transport of sediment alongshore. Additionally, ice cover can dampen the seiche energy. However, ice coverage on Lake Erie continues to lessen as winters become warmer, and seiches could lead to more extreme flooding and erosion in the future (Farhadzadeh et al., 2018, Farhadzadeh, 2017). Further, these wave events could impact the flow and sediment transport in Lake Erie tributaries (Saharia, et al., 2021).



[Figure 2] Seiche-event shoreline damage submitted to New York Sea Grant from a property owner in Irving, NY. Waves produced by this seiche eroded the loose sediment above shale bedrock, undermining coastal structures and uprooting trees. Photo submitted through New York Sea Grant Virtual Site Visit form.

Historic Seiche Events and Today

Seiche events have been known on Lake Erie throughout history. The most destructive documented seiche in Western New York occurred in October 1844, when a 22-foot seiche breached the 14-foot-high seawall at Buffalo and drowned 78 people. In March of 1848, a seiche caused ice damming so extreme in the Niagara River that the Falls temporarily stopped flowing for almost thirty hours. Seiche events now occur every 1-2 years on Lake Erie with recent events causing localized flooding of low-lying coastal areas and intense erosion along the shoreline, affecting coastal areas from Hamburg to Van Buren Point.

Today, more frequent wind storms and intensified thunderstorms from climate change may create favorable conditions for more frequent seiches. When combined with high lake levels, long-duration wave events like seiches can lead to extensive flooding and erosion along the Lake Erie coastline in Western New York. In late fall and winter, when seiches are most common, waves from seiches can toss large slabs of ice onshore while lake spray can coat lakeside homes and roads with thick layers of ice. This issue may worsen in the future on Lake Erie as the lake becomes less likely to ice over under climate change projections.

Seiche and Rip Currents

Strong rip currents can also accompany seiches, making swimming extremely dangerous by producing abnormal currents along the shoreline and near in-water structures like piers. In 1929, a 20-foot seiche on Lake Michigan in Grand Haven, MI overswept a pier, pulling 10 people into the lake, some of whom were swept away and were drowned by strong rip currents.

Seiche Preparedness

Seiches are rare events, but you can prepare for some of the more extreme hazards that they pose:

1. Know if you're susceptible - Review local flood maps to determine if your property is in a flood zone susceptible to seiche events. For shoreline properties, determine if your property is within the beach zones where seiche waves can cause intense erosion. Contact New York Sea Grant for more information or a site consultation. FEMA flood maps are available at: www.fema.gov/flood-maps
2. Protect windows and outbuildings - Winterize your property by boarding up windows in seasonal dwellings and sheds, including boathouse doors.
3. Elevate electrical and gas utilities - By elevating utilities (gas and electric lines, gas tanks, electrical outlets) you can make your property more resilient to coastal flooding events.

4. Improve drainage - By improving drainage through the installation of drains, and weep holes in shoreline revetments (seawalls, etc.), you can lessen the flooding hazards associated with seiche events by improving the rate at which water drains from your property.

You can contact New York Sea Grant for free evaluations of shoreline erosion and flooding hazards on your property by visiting

www.nyseagrant.org/glcoastalvirtualseitevisit

Read more on seiche at:

oceanservice.noaa.gov/facts/seiche.html

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Storm Surge

Storm Surge - the abnormal rise of water caused by a storm, above predicted water levels

Seiche

Seiche – standing waves with long periods of water-level oscillations, limited to partially or fully enclosed basins and long-lasting (often four to seven hours)

Meteotsunami

Meteotsunami - progressive waves driven by air-pressure disturbances associated with fast-moving weather events (severe thunderstorms, squalls), occurring in both closed basins and the open coast, lasting no longer than a few hours

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