An earthquake in Japan caused large waves in Norwegian fjords

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Early on a winter morning a few years ago, many residents of western Norway who lived or worked along the shores of the nation's fjords were startled to see the calm morning waters suddenly begin to rise and fall. Starting at around 7:15 local time and continuing for nearly 3 hours, waves up to 1.5 meters (about 5 feet) high coursed through the previously still fjord waters.

The scene was captured by security cameras and by people with cell phones, reported to local media, and investigated by a local newspaper. Drawing on this footage, and using a computational model and observations from a nearby seismic station, Bondevik et al. identify the cause of the waves—the powerful magnitude 9.0 Tohoku earthquake that hit off the coast of Japan half an hour earlier.

In closed or semi-enclosed bodies of water, seismic waves can trigger standing waves known as "seiches." Seiching had not been recorded in Norway's fjords since 1950. Scientists have traditionally thought that seiching is caused by seismic surface waves, but the authors find that the fjord seiching was initiated before the surface waves had arrived.

Using seismic observations and a model for local fjord behavior, they find that in this case the seiching was triggered by S waves, which travel through Earth's body, and later was amplified by Love waves, which travel on Earth's surface. There are a lot of open questions surrounding the connection between earthquakes and seiching, but the authors' research supports the idea that not all earthquakes will cause seiching in

all enclosed bodies of water. The occurrence of the Japanese earthquake?induced seiches depended on the period and orientation of the seismic waves aligning with the natural frequency and orientation of the body of water.

More information: Norwegian seiches from the giant 2011 Tohoku earthquake, *Geophysical Research Letters*, DOI: 10.1002/grl.50639, 2013 http://onlinelibrary.wiley.com/doi/10.1002/grl.50639/abstract

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