



## Earthquake Hazards

# Seismic Seiches

Definition of seismic seiches and examples dating back to their first public mention in 1755.

Status -  
Active

Seismic seiches are standing waves set up on rivers, reservoirs, ponds, and lakes when seismic waves from an earthquake pass through the area. They are in direct contrast to tsunamis which are giant sea waves created by the sudden uplift of the sea floor.

The term seismic seiche was first coined by Anders Kvale in 1955 to describe oscillation of lake levels in Norway and England caused by the [Assam earthquake of August, 1950](#). But this was not the first time that seismic seiches had been observed. The first published mention was after the great earthquake of November 1755 at Lisbon, Portugal. An article in Scot's Magazine in 1755 described seiches in Scotland in Loch Lomond, Loch Long, Loch Katrine and Loch Ness. They were also seen in English harbors and ponds and were originally described in the Proceedings of the Royal Society in 1755.

Earthquake effects recorded by surface-water gages were first noticed by A.M. Piper of the U.S. Geological Survey (USGS). He reported that two of six gauges on the Mokelumne River in California showed a slight fluctuation caused by the December 20, 1932 earthquake at Lodi, California. Since then many seiches resulting from earthquakes have been recorded. Kvale made a detailed study of 29 seiches recorded in fiords and lakes in Norway and four seiches on reservoirs in England, all caused by the 1950 Assam earthquake. Frank Stermitz, a USGS scientist, reported readings from 54 stream gages that recorded seiches caused by the [Hebgen Lake, Montana, earthquake of 17 August 1959](#). These were in Montana, Wyoming, Idaho, and Alberta, Canada - the most distant seiche being 545 kilometers from the epicenter.

Seismic waves from the [Alaska earthquake of 28 March, 1964](#), were so powerful that they caused water bodies to oscillate at many places in North America. Seiches were recorded at hundreds of surface-water gaging

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stations - although they had rarely been reported following previous earthquakes. Indeed, four seiches were observed in Australia.

Some of the 1964 seiches were very large. Waves as high as 1.8 meters were reported on the Gulf Coast - probably because they were generated in resonance with the seismic surface waves.

Arthur McGarr and Robert C. Vorhis studied the continental distribution of seiches produced by the Alaska earthquake. They divided the seiches into two groups - those that occurred in Alaska itself and those that occurred outside the State.

The Alaska seiches were not wholly seismic, but were caused by landslides, submarine slides, tsunamis, and tilting - as well as by seismic surface waves. It was therefore difficult to isolate a particular mechanism for seiches produced within the epicentral region. At teleseismic distances (greater than 1000 kilometers) from the epicenter, inelastic effects are unimportant and seiches are generated solely by seismic surface waves.

After the 1964 Alaska earthquake, the southeastern part of the United States had by far the greatest density of seiches. Other high density areas included north and central New Mexico, eastern Kansas, and the region at the southern tip of Lake Michigan. The areas west of the Rockies, the Middle Atlantic States and New England experienced few or no seiches.

The 1964 distribution does not have any obvious dependence on distance or azimuth from the epicenter. But it does seem to have definite regional patterns, which reflect the influence of major geologic features:

- The density of seiches is roughly proportional to the thickness of surface sediments, for example, in the Mississippi Delta region.
- Thrust faults apparently provide a favorable environment for seiche generation. The relationship is especially clear in Georgia, near the Brevard thrust zone, in the Ouachita Mountains, and also in the Valley and Ridge province of Tennessee and Alabama.
- Seiche locations were also controlled by structural uplifts and basins - such as the Williston and Michigan basins.

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Below are publications associated with this project.

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Year Published: 1968

### Seismic seiches from the March 1964 Alaska earthquake: Chapter E in The Alaska earthquake, March 27, 1964: effects on hydrologic regimen

Seismic seiches caused by the Alaska earthquake of March 27, 1964, were recorded at more than 850 surface-water gaging stations in North America and at 4 in Australia. In the United States, including Alaska and Hawaii, 763 of 6,435 gages registered seiches. Nearly all the seismic seiches were recorded at teleseismic distance. This is the first...

McGarr, Arthur; Vorhis, Robert C.

*Attribution:* [Earthquake Science Center, Natural Hazards, Earthquake Hazards Program](#)

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