



The physics of tsunamis

Tsunamis, commonly called tidal waves, are large sea waves or surges. These waves can carry a lot of energy from one side of the globe to the other, as shown by the South East Asian event of December 26, 2004, tsunamis can claim thousands of lives and cause extensive damage to property.

The United States Geological Survey (USGS) defines a tsunami as: «A sea wave of local or distant origin that results from large-scale sea floor displacements associated with large earthquakes, major submarine slides, or exploding volcanic islands». Many people picture large, breaking waves when they hear the word tsunami. This is usually not the case, however.

Most tsunamis make landfall as little more than a gigantic surge, as if the tide just moved in way too far, way too fast. This surging nature of tsunamis is mostly due to their extremely long wavelength, generally on the order of 100-200 km.

A tsunami can turn into a locally, large and breaking wave if the wave energy is concentrated, shortening the wavelength and increasing the amplitude.

This often happens if the wave enters a bay, fjord or similar feature.

There are several geologic events that can trigger the propagation of a tsunami.

Earthquakes: generally tectonic rebound at or near a subduction zone.

Landslides: often earthquake or volcanically triggered, can be purely submarine, or the slide could begin on land and then into the water.

Volcanic activity.

The impact of a large meteor or asteroid.

A tsunami behaves as a shallow water wave. The main differences between tsunamis and wind-generated waves are the wavelength and period of the waves. Regular ocean waves have a wavelength of about 150m, and a period of about 10s. Tsunamis, on the other hand, have wavelengths in excess of 100 km, maximum amplitude of 1.5 m and a period on the order of an hour.

(Taken from http://ffden-2.phys.uaf.edu/212_spring2005.web.dir/michael_tapp/index.htm)

EXERCISES

1 True or false?

- a. A tsunami behaves like a shallow water wave. T F
- b. The wavelength of a tsunami is generally on the order of 400-500 km. T F
- c. A tsunami is always associated with large, breaking waves. T F
- d. Regular ocean waves have a wavelength of about 150 m. T F

2 Find mistakes.

- a. A tsunami can turn into a local, small and breaking wave.
- b. A tsunami behaves as a deep water wave.
- c. Regular ocean waves have a wavelength of about 150 cm.
- d. A tsunami wave has a maximum amplitude of 1.5 km.
- e. The impact of a large meteor or asteroid cannot trigger a tsunami.

3 Match questions and answers.

QUESTIONS		ANSWERS	
A	Which geological events may trigger a tsunami?	1	The wavelength and period are the main differences.
B	What is the main difference between a tsunami and wind-generated waves?	2	The USGS definition of a tsunami is: "A sea wave of local or distant origin that results from large-scale sea floor displacements associated with large earthquakes, major submarine slides, or exploding volcanic islands".
C	What is a tsunami, according to the USGS?	3	Earthquakes, landslides and volcanic activity may all trigger a tsunami.

A

B

C