Courtesy of NOAA

If you're on a boat when a tsunami is coming, consider heading offshore into deeper water instead of running for the hills

BY BAYLOR FOX-KEMPER

# Tsunami spells trouble

The giant wave called a tsunami is created when an undersea earthquake, a landslide, a volcanic eruption, or even a meteor strike causes a large change in the ocean floor. This change disturbs the equilibrium of the water above it, and the resulting wave spreads outward in much the same way as ripples spread outward from a stone dropped in a pond.

Sailors cruising in areas that are prone to either earthquakes or volcanic activity should be aware of the possibility of a tsunami. For example, Alaska and Chile have large seismic areas offshore, and Hawaii and Japan have undersea volcanic activity.

Almost every year a tsunami hits a coastal region somewhere in the world, resulting in damage and even death. Tsunamis, like the earthquakes that often cause them, can occur at any time of year and vary in strength depending on distance from the source. Even a relatively weak tsunami can wreak havoc on coastal property and, of course, boats.

Because they form at the ocean bottom, tsunamis have very long wavelengths, and the water that moves with the wave extends all the way down to the ocean floor. In contrast, an ordinary wind-driven wave has a much shorter wavelength, and its subsurface motion extends a relatively short distance below the surface (see figure).

The enormous energy hidden below the surface will start to have an effect when a tsunami wave enters shallower waters. Because the energy contained in the wave has less space to fill in shoal water, the displaced water at the surface grows dramatically. A tsunami in the open ocean will raise the water surface just a few feet, but it may raise the water level 30 or 40 feet when it strikes a coastline. Even a mild tsunami can raise the sea level along a coast by 10 feet. And the change, which is rapid, can come at any stage of a tide, boosting a high tide even higher and (before the wave hits) making a low tide even lower. These phenomena help explain the name tsunami, which means "harbor wave" in Japanese.

The speed of a tsunami is also related to the depth to which its motion extends. A tsunami can move quickly—up to several hundred miles an hour in the open ocean. In June 2001, for example, an earthquake in Peru caused a tsunami that struck a portion of the Alaskan coastline just 16 hours later. Fortunately, the impact of a tsunami strike is reduced by the distance it has to travel.

If you know that a tsunami is approaching your area, prepare for its arrival as you would for an extreme tide or hurricane surge. Don't be lulled into thinking that a tsunami will be small because the local tides are small; the two are completely unrelated. If there is time to do so, consider heading offshore to deep water, where the tsunami wave will be minimal.

A warning system monitors earthquakes capable of generating tsunamis, and sophisticated wave-monitoring systems are also being developed. The University of Washington maintains a tsunami Web site with more information and links to warning systems: www.geophys.washington.edu/tsunami.

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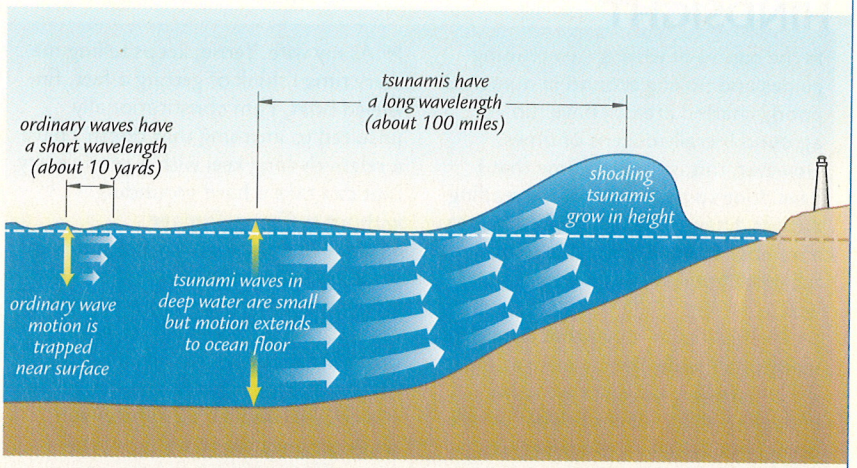
**Above: Tsunami damage at Kodiak, Alaska, following an earthquake**

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**In contrast to a conventional ocean wave, which has a small wavelength and extends just below the water surface, a tsunami has a large wavelength and moves all the water below it to the ocean floor. In the open ocean a tsunami will raise the water surface only slightly. But when the wave enters shallow water, its height will increase dramatically; damage may be caused ashore or in a harbor**