

How likely is a tsunami on Cape Ann?

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Tsunamis, Japanese for "harbor waves," can be devastating events. For example, on Dec. 26, 2004 a series of tsunamis, up to 100 feet in height, struck the coasts of 14 countries on the Indian Ocean, including Indonesia, Sri Lanka, India and Thailand. Astonishingly, almost 228,000 people lost their lives.

We on Cape Ann live on the coast of the Atlantic Ocean and could someday face the threat of a tsunami striking our shores. But just what is the likelihood of such an event? The short answer is that a moderate tsunami hitting Cape Ann is possible sometime in the next 100 years. We should, therefore, understand how tsunamis are created, and where we should look for the one that might be coming at us.

There are several events that can generate a tsunami. They include massive, underwater earthquakes, the eruption of underwater volcanoes, underwater landslides and, the least likely but the most devastating event, is an impact into the ocean by a large asteroid or comet. For each of these events, the tsunami generation mechanisms are similar. The triggering event displaces massive amounts of water, very quickly. The larger the amount of water displaced

at the epicenter of the event, the larger the tsunami created.

The 2004 tsunamis in the Indian Ocean were spawned by a major underwater earthquake of the megathrust type, about 100 miles off the west coast of Sumatra. Megathrusts are the most powerful earthquakes ever observed and occur when one tectonic plate is forced under another. This mechanism accounts for the greatest number of deadly tsunamis. In this instance it was a rupture along the fault between the Indian Plate and the Burma Plate.

During the Sumatra earthquake, a large area of the seabed had a sudden, vertical rise of up to 20 feet. This action displaced a massive amount of water, creating a huge underwater wave. In the deep water where the wave was created, it appeared on the ocean's surface as a low, broad hump that was barely noticeable. But it started to travel away from the epicenter in all directions at speeds up to 600 miles per hour. If it encountered a boat along its route, the sailors would have barely noticed the wave since it was so broad and flat on the surface of the ocean.

It became dangerous when it encountered the shallower water near the coastlines, interacted with the seabed and slowed down to 30 or 40

miles per hour. This action caused the wave to build into the 100-foot monster that rushed ashore and went far inland, causing the major destruction and loss of life along all those hundreds of miles of Indian Ocean coastline.

On Cape Ann, we are far from the edges of any major tectonic plates where megathrust earthquakes are generated. They tend to be focused around the Ring of Fire of the Pacific Ocean. We are, however, in a part of the globe that is geologically susceptible to moderate earthquakes. Such quakes could conceivably create a tsunami if they occur underwater, but it would not be of the size that did so much damage in the Indian Ocean.

The United States Geological Survey (USGS) is responsible for maintaining databases of earthquakes and using that information to understand the likelihood for such activity in the future. According to them, the Cape Ann area has had several minor quakes over the last 100 years. For example, between 1982 and 2003, there were five earthquakes generally in the same location, in the waters about 27 miles east of Rockport. Their magnitudes were low at only 2.2 to 3.6 on the Richter scale, so no significant damage was done.

In the past, however, there

was a major earthquake off the coast of Cape Ann that did indeed appear to generate a small tsunami. It happened on Nov. 18, 1755. The upheaval was more than 6.0 on the Richter scale, so the quake was "strong" in size. In fact, it was about 1,000 times more powerful than the recent quakes off our coast.

The epicenter of the 1755 quake was estimated to be 24 miles east of Rockport, roughly in the same region as the more recent temblors. Due to the relatively small amount of development along the New England coast in those days, little damage was done, and no lives were lost.

There was no tsunami reported in our area from the 1755 earthquake, but it still may have created the first recorded tsunami in U.S. history. With about the right travel time to have come from Cape Ann, a small tsunami hit the northern islands of the Lesser Antilles chain, about 2,000 miles south of us.

So, what is the probability that another significant earthquake will strike Cape Ann? USGS forecasts that Essex County, as a whole, has about a 19 percent chance for an earthquake of 5.0 or greater over the next 50 years. The probability for a 6.0 or greater, the size of the 1755 quake, drops to just 3.6 percent. Such an earthquake

could cause considerable damage.

If the quake occurred under deep water in the general area of the 1755 quake, it could conceivably create a tsunami. But that event is much less likely than the occurrence of the quake itself.

Beyond underwater, major earthquakes, another tsunami source is volcanic eruptions. Cumbre Vieja is a volcano on the island of La Palma in the Canary Islands. These islands are a possession of Spain in the Atlantic Ocean and are located about 60 miles west of Morocco. No one knows when the next eruption of that volcano will occur. It could be soon, or could be 100 years from now, but Cumbre Vieja will likely have a major eruption at some point in that time frame.

Scientists who have studied the possibilities indicate that the eruption will likely cause the rocky, western flank of the volcano to be dislodged and slide into the ocean.

Recent studies of Cumbre Vieja indicate that it is unlikely that the whole flank will go into the ocean at once. Instead it will, most probably, slide into the water in stages, over a significant period. Tsunamis could well be created as each section enters the ocean, but they will be much smaller than the feared mega-tsunami if the whole

flank went at once.

Scientists expect several, smaller "warning" eruptions to occur before the big one that starts to dislodge the flank. And we will, therefore, be alerted well beforehand to the potential of a tsunami coming at us from Cumbre Vieja.

The tsunami causing event with the lowest probability, but greatest impact in terms of the size of the wave, is an asteroid or comet striking the earth in the Atlantic Ocean. The last, large asteroid impact was about 66 million years ago.

The probability of another asteroid of that size hitting us is very, very low. But, just in case, NASA has a mission to be prepared to launch a vehicle that can destroy, or at least divert, such an asteroid, and there are plans in the works to have such a craft available.

Living on the coast of Cape Ann is one of the joys of life that we all share. A downside is the potential for a significant sized tsunami. The most likely candidate mechanism to cause a tsunami that impacts us would be a major eruption of the Cumbre Vieja volcano. It could happen sometime in the next 100 years, but we should receive plenty of warning about its potential impact. So, sleep well.

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