

March 29, 2021

## Geohazards - Tsunamis



**Figure 1 - The Great Wave off Kanagawa, by Katsushika Hokusai <sup>1</sup>**

I am going to finish up my discussion of geohazards (for now) with a post on tsunamis. Tsunamis can kill lots of people and smash up their property; this is not pleasant at all.

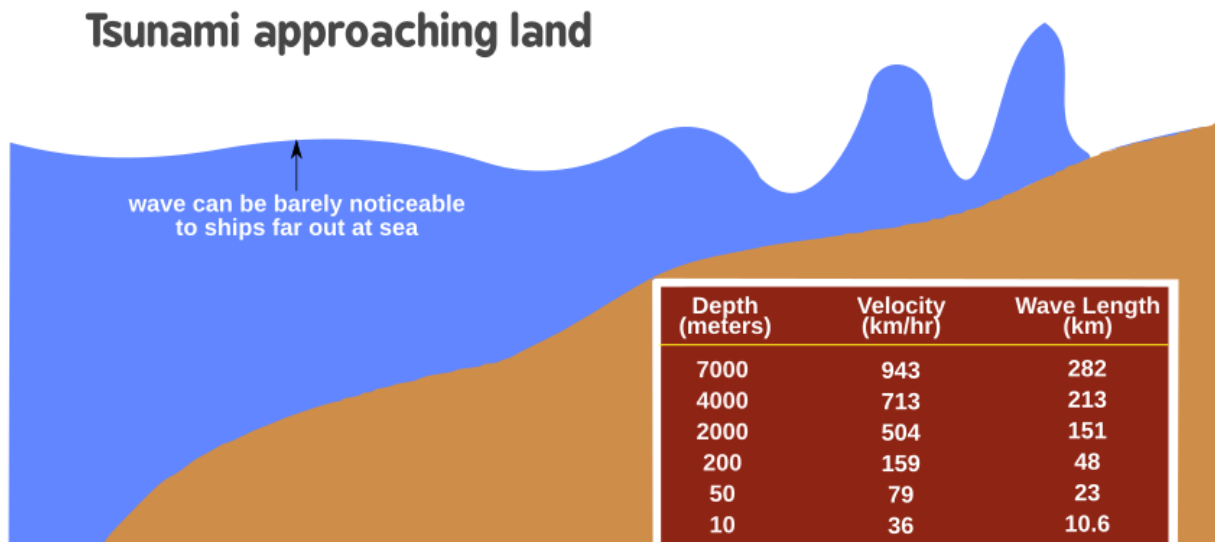
### Features of Tsunamis

The word tsunami comes from Japanese. Living on the so-called "Ring of Fire" seismic zone, the Japanese have a lot of experience with tsunamis. An older term in English was tidal wave, but this fell out of use since its confusion with tidal bores and storm tides.

To get a tsunami, something needs to displace a vast quantity of water. Volcanic explosions and the collapse of volcanic caldera under or next to the ocean can do this. Earthquakes alone can cause a tsunami but they can also trigger undersea landslides that in turn lead to a tsunami. If we really have a bad day, an extraterrestrial impactor, like an asteroid or comet, can fall into the ocean, also generating a tsunami.

The term tsunami literally translates as "harbour wave" from Japanese and this leads to an interesting feature about them. At sea, a tsunami will appear no bigger than any other swell and may not be noticeable in a rough sea. However, once the wave approaches land, for example

when it enters a harbour, the wave piles up and can become metres high. Figure 2 illustrates this process.



**Figure 2 - Tsunami approaching land <sup>2</sup>**

### **Infamous Tsunamis**

Tsunamis can be very destructive, here is a list of some most deadly tsunamis:

#### ***Indian Ocean, December 26, 2004***

Triggered by a 9.1 magnitude earthquake under the Indian Ocean, the official death toll for this tsunami was 227,898. <sup>3</sup>

#### ***Messina, Italy, December 28, 1908***

This tsunami was triggered by a magnitude 7.5 earthquake that in turn set off an undersea landslide. Estimates of the death toll range from 100,000 to 200,000 with 70,000 of those in Messina. <sup>3</sup>

#### ***Lisbon, Portugal, November 1, 1755***

This tragedy began with an earthquake magnitude of 8.5 to 9.0 under the Atlantic Ocean offshore of Lisbon, Portugal. The earthquake caused building collapses, fires and also triggered a tsunami with a 20 metre wave. This unfortunate combination of events killed about 40,000 to 50,000 in Portugal, Spain, and Morocco. <sup>3</sup>

### ***Krakatoa, Indonesia, August 1883***

The explosion of the Krakatoa volcano in August 1883 generated a tsunami 43 metres high. About 40,000 people were killed.<sup>3</sup>

### ***Fukushima, Japan, March 11, 2011***

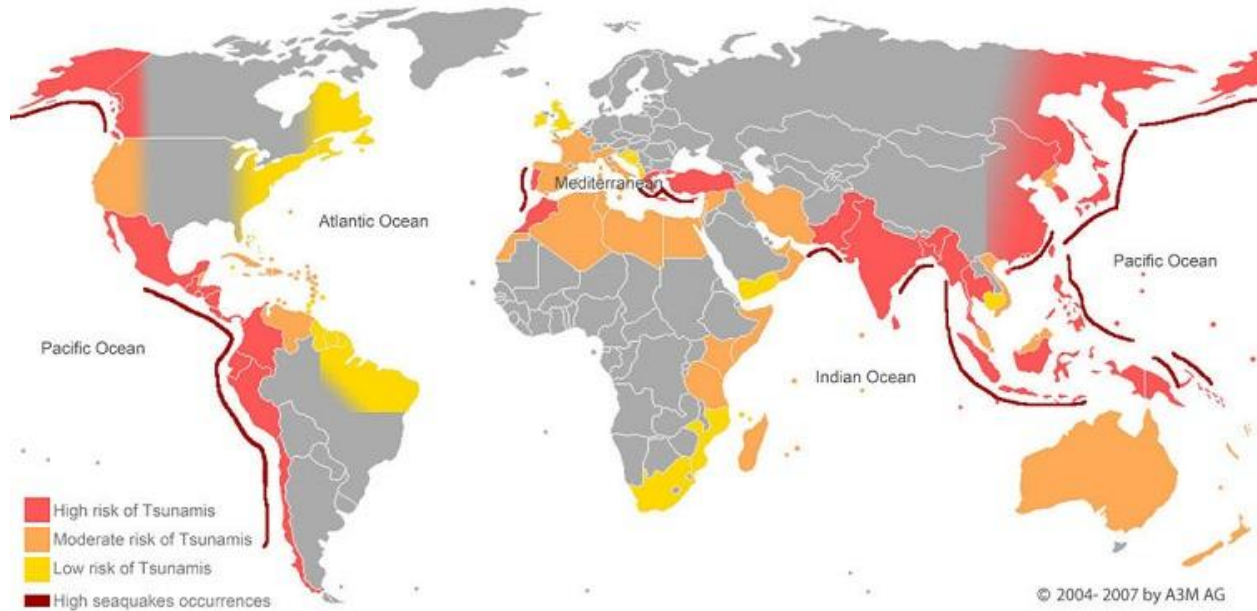
Also called the Tōhoku Earthquake, this began with a 9.0 magnitude earthquake under the Pacific Ocean offshore of Tōhoku on Honshu Island, Japan. The subsequent 40 metre high tsunami killed more than 18,000 people and destroyed approximately \$235 billion (USD) worth of property including critical portions of the Fukushima Dai-ichi Nuclear Generating Plant. The Dai-ichi Plant had a catastrophic failure leading to the release of dangerous levels of radiation both onto the surrounding land and into the Pacific Ocean.<sup>3</sup>

An interesting feature of the Fukushima tsunami is that there are many stone markers in Japan showing the maximum inland intrusion of previous tsunamis. Some of these are **uphill** from the Fukushima Dai-ichi Nuclear Plant. In some ways, the Fukushima Dai-ichi Plant was an accident waiting to happen since earthquakes and tsunami are as inevitable in Japan as are blizzards in Canada. It was a lesson that did not need to be learned again.

### **Sauve qui peut**

If you find yourself in an area where tsunami are possible, as in Figure 3, below, such as along the sea shore, keep the following in mind:

- If you feel a earthquake, prepare to seek higher ground.
- Listen on the radio for tsunami warnings, some places also send out warnings to smart phones and some places have no warning system at all
- If you see the ocean suddenly recede, this means that the tsunami is imminent. Go to higher ground immediately. Don't stick around to get photos and videos. Getting that selfie might kill you.



**Figure 3 - Tsunami Risk Map** <sup>4</sup>

## References

1. Wikimedia Commons, Mar.2015, *File:Tsunami by hokusai 19th century.jpg*, [https://commons.wikimedia.org/wiki/File:Tsunami\\_by\\_hokusai\\_19th\\_century.jpg](https://commons.wikimedia.org/wiki/File:Tsunami_by_hokusai_19th_century.jpg)
2. WPclipart, accessed March 2021, *tsunami approaching land* [https://wpclipart.com/weather/tsunami/tsunami\\_approaching\\_land.png.html](https://wpclipart.com/weather/tsunami/tsunami_approaching_land.png.html)
3. Johnson, B., Aug. 2020, *World's Worst Tsunamis*, ThoughtCo, [thoughtco.com/worlds-worst-tsunamis-3555041](https://thoughtco.com/worlds-worst-tsunamis-3555041).
4. Disaster Rally, accessed March 2021, *What to Do in Case of Tsunami Before, During, and After*, <https://disasterrally.com/what-to-do-in-case-of-tsunami/>