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Earthquakes and Tsunamis

By Sam Vaknin

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Tsunamis

Tsunami – a seismic sea wave – means in Japanese "harbor-wave". It is also misleadingly called "tidal wave". It is an ocean wave caused by an earthquake of magnitude 6.5 on the Richter scale (or greater) that occurs less than 50 kilometers beneath the seafloor. Tsunamis can also be caused by volcanic eruptions and by landslides.

Tsunami waves are followed by three to five oscillations of the continental shelf waters. These convulsions may last up to a week. If the initial wave reaches the shore at its trough phase, the water recede and expose the seafloor. This happened in Lisbon Port on November 1, 1755. A few minutes later, the displaced waters return with energetic vengeance.

In the ocean, tsunami waves are merely 0.5–2 meters high with a wavelength of up to 200 kilometers. Consequently, they are virtually impalpable though they move at speeds of up to 700 kilometers per hour. As the waves near the shoreline, friction with the shallow bottom reduces their velocity, shortens their wavelength, increases their amplitude and their height.

The tsunami wave that swept across the coasts of Indonesia, Sri Lanka, Thailand, India, and Africa on December 26, 2004 was 10–12 meters high. It traveled almost 6000 kilometers. It killed almost 150,000 people. An earthquake in the fjord-like Lituya Bay, Alaska, on July 9, 1958, generated a tsunami wave 524 meters (1719 feet) high, moving at a speed of 160 kilometers per hour. Luckily, the area was largely uninhabited.

Other notable tsunamis:

In 1703 at Awa, Japan with more than 100,000 people dead.

On April 24, 1771, a tsunami caused by an underwater earthquake struck the Japanese island of Ishigaki (in the Ryuku chain). It was 85 meters high. It was so powerful that it hurled a 750 ton piece of

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coral to a distance of 2.5 kilometers inland.

Again in Japan, 27,000 people drowned in 1896, in a giant tsunami.

In the wake of the underwater volcanic eruptions that obliterated the island of Krakatau (Krakatoa) on August 26–27, 1883, a wave 35 meters high swept across the East Indies killing in excess of 36,000 people.

Triggered by a submarine landslide, a tsunami at least 375 meters high struck the island of Lanai in Hawaii about 105,000 years ago.

The 1960 earthquake in Chile created tsunami waves that traveled more than 10,000 kilometers to Hilo,

Hawaii. The 12 meters high water wall killed 61 people and destroyed many buildings.

The Seismic Sea Wave Warning System (SSWWS), based in Honolulu, is an early warning system covering the entire, tsunami-prone, Pacific Ocean.

Earthquakes

Little known facts about temblors:

The epicenter of an earthquake is not the same as its hypocenter (focus, point of origin within a fault–line). The epicenter is the point on the surface of the Earth directly above the focus. Dangerous, shallow–focus quakes originate 0–70 kilometers below the surface. Less damaging deep–focus tremors occur between 70–700 kilometers down. Subduction zone earthquakes (like the one that gave rise to the lethal tsunami on December 26, 2004) occur when one tectonic plate moves under another (subducts). There are interplate and intraplate quakes, which take place along plate boundaries or within the fracturing crust of a single plate, respectively.

Earthquakes are not rare at all – several hundred earthquakes occur every day. There are about 1 million of them annually – of which 50,000 can be felt without the aid of instruments. Tremors of the magnitude of Kobe in 1995 (which caused an estimated damage of \$100 billion) are measured 20 times in an average year.

The Encyclopedia Britannica (2005 edition) describes a "swarm" of such events thus:

"In the Matsushiro region of Japan, for instance, there occurred between August 1965 and 1967 a series of hundreds of thousands of earthquakes, some sufficiently strong (up to local magnitude 5) to cause property damage but no casualties. The maximum frequency was 6,780 small earthquakes on April 17, 1966."

The Pacific ocean is the unhappy recipient of well over 80 percent of all the energy released by earthquakes worldwide. Japan alone suffers from 1500 tremors annually (of which two thirds are greater than 3.5 in magnitude). Fault lines abound and new ones are discovered frequently. One fault

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line runs under 125th street in Manhattan, New–York.

Still, in the last 5 centuries, all earthquakes combined killed less than one tenth the victims of World War II – and this includes the 240,000 who died in the 1976 Tang–Shan, China event.

Earthquakes are composites of:

I. Primary (or compression) and secondary (or shearing) body waves (that travel in the rocks under the surface of the Earth at speeds of up to 7 kilometers per second and frequencies of between 20 Hertz and one vibration per 54 minutes)

and

II. Two types of surface waves, named after British physicist Lord Rayleigh and British geophysicist A. E. H. Love (with frequencies of 1–0.005 Hertz).

Some earthquakes are caused by human activities (such as the filling of water reservoirs behind dams,

injecting water into deep wells, and underground nuclear tests). More than 600 tremors were recorded in the decade following the filling of Lake Mead behind Hoover Dam on the Nevada–Arizona state border.

Some earthquakes produce low–pitch sounds and light effects (flashes, streamers, and balls). Water in lakes and reservoirs oscillate causing flooding (a phenomenon called seiche). Seiches were observed in Scotland and Sweden following the Lisbon quake of 1755. Similarly, the Alaskan tremor in 1964 produced seiches in Texas and throughout the southwestern parts of the United States.

Measuring the magnitude of earthquakes is more a fine art than an exact science.

Charles Richter developed his eponymous logarithmic scale in 1935. It measures the amplitude (the height) of seismic surface waves. Each unit represents a tenfold increase in the energy released by the tremor. An earthquake of magnitude 9 is, therefore, 1000 stronger than a tremor of magnitude 6. The Kobe earthquake measured 6.8 on the Richter scale, the San Francisco tremor of 1906 was 8.3 (as was the earthquake in the Mississippi Valley in 1811), and both the Alaskan quake of 1964 and the South Asian underwater temblor of 2004 were around 9 (9.2 in Alaska to be precise)

The Richter scale is used mainly by the media. Professional seismologists use the Moment Magnitude Scale (MMS) which takes into account the properties of the area and the amount of slippage (displacement). It captures the total energy of the tremor. The Kobe earthquake measured 7 on the MMS, the San Francisco tremor of 1906 was 7.6, and the Alaskan quake of 1964 was 9.

Then there is the still–used 12–grade Modified Mercalli Scale (adapted in 1931 by American seismologists H. O. Wood and Frank Neumann from the original Mercalli scale, proposed in 1902 Italian seismologist Giuseppe Mercalli). It measures the impact that an earthquake has on the natural and man–made environment to gauge its magnitude. The Europeans have a similar 12–grade scale,

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called MSK.

Seaquakes are earthquakes that start on land and then travel into the sea at the speed of sound (about 1.5 kilometers per second).

Quakes occur even on the moon which has no plates, volcanic activities, or ocean trenches. The five seismograph stations of the Passive Seismic Experiment set up between 1969 and 1977 as part of the United States Apollo Program detected up to 3,000 moonquakes every year. Mars, on the other hand, seems not to have quakes at all!

Some notable earthquakes in history:

Lisbon, November 1, 1755, 09:40 AM (All Saints Day)

Property damage: 12,000 houses, fire raged for 6 days

Casualties: 60,000 dead

Felt as far as: Algiers (1100 kilometers to the east)

Side effects: tsunami 20 meters high (at Cadiz) to 6 meters high (at Lisbon). Traveled to Martinique (6100 kilometers) in 10 hours and rose to 4 meters when it struck the shore.

New Madrid, Missouri, USA – December 16, 1811, January 23 and February 7, 1812

Felt as far as: Louisville, Kentucky (300 kilometers away); Cincinnati, Ohio (600 km. away); Canada; Gulf Coast.

Side effects: 1874 aftershocks; The tremor affected 100,000 square kilometers. An area of 240X60 kilometers sank by 1–3 meters and was flooded as a nearby river rushed in.

San Francisco, April 18, 1906, 05:12 AM

Property damage: Fire destroyed the business district of San Francisco. Cities along the fault (e.g., San Jose, Salinas, and Santa Rosa) obliterated.

Casualties: 700 dead

Felt as far as: Los Angeles in the south and Coos Bay, Oregon, to the north

Side effects: At least a 430 kilometers fault slippage (break).

Tokyo-Yokohama, September 1, 1923

Property damage: Fifty four percent of brick buildings and one tenth of other, reinforced, structures

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collapsed. Hundreds of thousands of houses crumbled or burned.

Casualties: 140,000 dead

Felt as far as: Los Angeles in the south and Coos Bay, Oregon, to the north

Side effects: Twelve-meter high tsunami crashed against Atami on the Sagami Gulf, destroyed 155 houses and killed 60 people.

Chile, 1960

Property damage: Pegged at millions of US dollars.

Casualties: 5700 killed and 3000 injured.

Felt as far as: Los Angeles in the south and Coos Bay, Oregon, to the north

Side effects: Seismic sea waves (tsunamis) struck Hawaii, Japan, and the Pacific coast of the United States.

Alaska, March 27, 1964

Casualties: 131 dead

Side effects: Felt over an area of 1,300,000 square kilometers and tilted an area of more than 120,000 square kilometers. Land was thrust up by as much as 25 meters and sank by up to 2.5 meters. Numerous tsunamis affected locales as far as Crescent City, California. The fault extended for 1000

kilometers and there were tens of thousands of aftershocks.

Tang-shan, China, July 28, 1976

Property damage: Entire city razed to the ground.

Casualties: 240,000 killed and half a million injured.

Mexico, September 19, 1985, 07:18 AM

Property damage: Most buildings in Mexico City – 400 kilometers from the epicenter – damaged extensively.

Casualties: 10,000 killed.

Felt as far as: Los Angeles in the south and Coos Bay, Oregon, to the north

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Side effects: Seismic sea waves (tsunamis) struck Hawaii, Japan, and the Pacific coast of the United States.

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Disaster Decision – Do You Need Insurance?

By Jakob Jelling

The expenses involved with owning a home can be overwhelming at times – routine maintenance, repairs, seasonal preparations, improvements. Not to mention taxes, fees, and all those monthly bills. Some homeowners, in trying to reduce their expenses, wonder if they really need disaster insurance.

Disaster insurance is typically defined as additional homeowner's insurance to cover events like hurricanes, tornadoes, earthquakes, and floods. Home insurance policies typically cover hurricanes and tornadoes (review your policy to be certain in covers damage from such events). But often damage from floods and earthquakes isn't covered. This extra insurance, if desired, must be purchased in addition to your standard homeowner policy, and it can be expensive, depending on where you live.

Because disaster insurance can be expensive, it's a type of coverage some homeowners opt not to buy. But in some cases they are required to buy. For example, mortgaged homes in the US that are located in designated flood hazard areas are required to buy flood insurance through the US National Flood Insurance Program. Of course, once those mortgages are paid, there is no longer a requirement to buy such insurance. But homeowners in those areas should carefully consider whether they really want to take the risk that their home and everything in it could be swept away, leaving them with nothing but an empty lot. Homeowners that aren't in designated flood hazard areas should still know that floods can cause plumbing problems, like sewer and septic backups. These often aren't covered in a standard homeowner's policy, and they may want to consider an endorsement for coverage.

In the US, many tend to think that only the area along the west coast is subject to earthquakes. This isn't true however, and 39 US states have some potential for earthquakes. Coverage for seismic events can be very expensive in California and other western states, but homeowners in other states should evaluate the cost vs. the earthquake risk for the area where they live.

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