

2004 indian ocean earthquake and destructive tsunami waves



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The term tsunami comes from the Japanese language meaning harbour (“tsu”) and wave (“nami”). Although in Japanese tsunami is used for both the singular and plural, in English tsunamis is well-established as the plural. The term was created by fishermen who returned to port to find the area surrounding the harbour devastated, although they had not been aware of any wave in the open water. A tsunami is not a sub-surface event in the deep ocean; it simply has a much smaller amplitude (wave heights) offshore, and a very long wavelength (often hundreds of kilometres long), which is why they generally pass unnoticed at sea, forming only a passing “hump” in the ocean.

Tsunamis have been historically referred to as tidal waves because as they approach land they take on the characteristics of a violent onrushing tide rather than the sort of cresting waves that are formed by wind action upon the ocean (with which people are more familiar). However, since they are not actually related to tides the term is considered misleading and its usage is discouraged by oceanographers. CAUSES- EXPLANATION THROUGH

DIAGRAM [pic] Schema of a tsunami A tsunami can be generated by any disturbance that rapidly displaces a large mass of water, such as an earthquake, volcanic eruption, landslide or meteorite impact. However, the most common cause is an undersea earthquake. An earthquake which is too small to create a tsunami by itself may trigger an undersea landslide quite capable of generating a tsunami.

Tsunamis can be generated when the sea floor abruptly deforms and vertically displaces the overlying water. Such large vertical movements of the earth’s crust can occur at plate boundaries. Subduction earthquakes are <https://assignbuster.com/2004-indian-ocean-earthquake-and-destructive-tsunami-waves/>

particularly effective in generating tsunamis, and occur where denser oceanic plates slip under continental plates in a process known as subduction. Sub-marine landslides; which are sometimes triggered by large earthquakes; as well as collapses of volcanic edifices, may also disturb the overlying water column as sediment and rocks slide downslope and are redistributed across the sea floor.

Similarly, a violent submarine volcanic eruption can uplift the water column and generate a tsunami. Waves are formed as the displaced water mass moves under the influence of gravity to regain its equilibrium and radiates across the ocean like ripples on a pond. (3) Volcanic Eruption - Although relatively infrequent, violent volcanic eruptions represent also impulsive disturbances, which can displace a great volume of water and generate extremely destructive tsunami waves in the immediate source area .

Volcanic disturbances can generate waves by the sudden displacement of water caused by a volcanic explosion, by a volcano's slope failure, or more likely by a phreatomagmatic explosion and collapse and/or engulfment of the volcanic magmatic chambers . The majority of tsunamis that occur in the Pacific Ocean happen around the " Ring of Fire" Area surrounding the Hawaiian Islands . The periphery has also been dubbed the ' Ring of Fire' because of the extraordinarily high number of active volcanoes and seismic activity located in the region .

Since 1819, over 40 tsunamis have struck the Hawaiian Islands . One of the largest and most destructive tsunamis ever recorded was generated in August 26, 1883 after the explosion and collapse of the volcano of Krakatoa (Krakatau), in Indonesia. This explosion generated waves that reached 135
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feet, destroyed coastal towns and villages along the Sunda Strait in both the islands of Java and Sumatra, killing 36, 417 people . (4) Extraterrestrial Collision - Tsunamis caused by extraterrestrial collision (i.

e. asteroids, meteors) are an extremely rare occurrence. Although no meteor/asteroid induced tsunami have been recorded in recent history, scientists realize that if these celestial bodies should strike the ocean, a large volume of water would undoubtedly be displaced to cause a tsunami.

Characteristics [pic][pic] There is a common misconception that tsunamis behave like wind-driven waves or swells (with air behind them, as in this celebrated 19th century woodcut by Hokusai). In fact, a tsunami is better understood as a new and suddenly higher sea level, which manifests as a shelf or shelves of water. The leading edge of a tsunami superficially resembles a breaking wave but behaves differently: the rapid rise in sea level, combined with the weight and pressure of the ocean behind it, has far greater force.

[pic] Although often referred to as "tidal waves", a tsunami does not look like the popular impression of "a normal wave only much bigger". Instead it looks rather like an endlessly onrushing tide which forces its way around and through any obstacle. Most of the damage is caused by the huge mass of water behind the initial wave front, as the height of the sea keeps rising fast and floods powerfully into the coastal area. The sheer weight of water is enough to pulverise objects in its path, often reducing buildings to their foundations and scouring exposed ground to the bedrock. Large objects such as ships and boulders can be carried several miles inland before the tsunami subsides.

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Tsunamis act very differently from typical surf swells; they are phenomena which move the entire depth of the ocean (often several kilometres deep) rather than just the surface, so they contain immense energy, propagate at high speeds and can travel great transoceanic distances with little overall energy loss. A tsunami can cause damage thousands of kilometres from its origin, so there may be several hours between its creation and its impact on a coast, arriving long after the seismic wave generated by the originating event arrives. Although the total or overall loss of energy is small, the total energy is spread over a larger and larger circumference as the wave travels, so the energy per linear meter in the wave decreases as the inverse power of the distance from the source. This is the two-dimensional equivalent of the inverse square law in three dimensions.

A single tsunami event may involve a series of waves of varying heights; the set of waves is called a train. In open water, tsunamis have extremely long periods (the time for the next wave top to pass a point after the previous one), from minutes to hours, and long wavelengths of up to several hundred kilometres. This is very different from typical wind-generated swells on the ocean, which might have a period of about 10 seconds and a wavelength of 150 metres. The actual height of a tsunami wave in open water is often less than one metre. This is often practically unnoticeable to people on ships.

The energy of a tsunami passes through the entire water column to the sea bed, unlike surface waves, which typically reach only down to a depth of 10 m or so. The wave travels across the ocean at speeds from 500 to 1,000 km/h. As the wave approaches land, the sea shallows and the wave no

longer travel as quickly, so it begins to 'pile-up'; the wave-front becomes
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steeper and taller, and there is less distance between crests. While a person at the surface of deep water would probably not even notice the tsunami, the wave can increase to a height of 30 m or more as it approaches the coastline and compresses. The steepening process is analogous to the cracking of a tapered whip. As a wave goes down the whip from handle to tip, the same energy is deposited in less and less material, which then moves more violently as it receives this energy.

A wave becomes a 'shallow-water wave' when the ratio between the water depth and its wavelength gets very small, and since a tsunami has an extremely large wavelength (hundreds of kilometres), tsunamis act as a shallow-water wave even in deep oceanic water. Shallow-water waves move at a speed that is equal to the square root of the product of the acceleration of gravity (9.8 m/s^2) and the water depth. For example, in the Pacific Ocean, where the typical water depth is about 4000 m, a tsunami travels at about 200 m/s (720 km/h or 450 mi/h) with little energy loss, even over long distances.

At a water depth of 40 m, the speed would be 20 m/s (about 72 km/h or 45 mi/h), which is much slower than the speed in the open ocean but the wave would still be difficult to outrun. Tsunamis propagate outward from their source, so coasts in the "shadow" of affected land masses are usually fairly safe. However, tsunami waves can diffract around land masses (as shown in this Indian Ocean tsunami animation as the waves reach southern Sri Lanka and India). They also need not be symmetrical; tsunami waves may be much stronger in one direction than another, depending on the nature of the source and the surrounding geography.

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Local geographic peculiarities can lead to seiche or standing waves forming, which can amplify the onshore damage. For instance, the tsunami that hit Hawaii on April 1, 1946 had a fifteen-minute interval between wave fronts. The natural resonant period of Hilo Bay is about thirty minutes. That meant that every second wave was in phase with the motion of Hilo Bay, creating a seiche in the bay. As a result, Hilo suffered worse damage than any other place in Hawaii, with the tsunami/seiche reaching a height of 14 m and killing 159 inhabitants.

Warnings and prevention [pic] Tsunamis cannot be prevented or precisely predicted, but there are some warning signs of an impending tsunami, and there are many systems being developed and in use to reduce the damage from tsunamis. In instances where the leading edge of the tsunami wave is its trough, the sea will recede from the coast half of the wave's period before the wave's arrival. If the slope is shallow, this recession can exceed many hundreds of metres. People unaware of the danger may remain at the shore due to curiosity, or for collecting fish from the exposed sea bed. [pic]

WARNING Tsunami warning signs on seawall in Kamakura, Japan, 2004.

In the Muromachi period, a tsunami struck Kamakura, destroying the wooden building that housed the colossal statue of Amida Buddha at Kotokuin. Since that time, the statue has been outdoors. In instances where the leading edge of the tsunami is its first peak, succeeding waves can lead to further flooding. Again, being educated about a tsunami is important, to realise that when the water level drops the first time, the danger is not yet over. In a low-lying coastal area, a strong earthquake is a major warning sign that a tsunami may be produced.

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Regions with a high risk of tsunamis may use tsunami warning systems to detect tsunamis and warn the general population before the wave reaches land. In some communities on the west coast of the United States, which is prone to Pacific Ocean tsunamis, warning signs advise people where to run in the event of an incoming tsunami. Computer models can roughly predict tsunami arrival and impact based on information about the event that triggered it and the shape of the seafloor (bathymetry) and coastal land (topography).) One of early warnings comes from nearby animals. Many animals sense danger and flee to higher ground before the water arrives. The Lisbon quake is the first documented case of such a phenomenon in Europe.

The phenomenon was also noted in Sri Lanka in the 2004 Indian Ocean earthquake. Some scientists speculate that animals may have an ability to sense subsonic Rayleigh waves from an earthquake minutes or hours before a tsunami strikes shore (Kenneally, While it is not possible to prevent a tsunami, in some particularly tsunami-prone countries some measures have been taken to reduce the damage caused on shore. Japan has implemented an extensive programme of building tsunami walls of up to 4.5m (13.5 ft) high in front of populated coastal areas. Other localities have built floodgates and channels to redirect the water from incoming tsunamis. However, their effectiveness has been questioned, as tsunamis are often higher than the barriers.

For instance, the tsunami which hit the island of Hokkaido on July 12, 1993 created waves as much as 30m (100 ft) tall - as high as a 10-story building.

The port town of Aomori was completely surrounded by a tsunami wall, but <https://assignbuster.com/2004-indian-ocean-earthquake-and-destructive-tsunami-waves/>

the waves washed right over the wall and destroyed all the wood-framed structures in the area. The wall may have succeeded in slowing down and moderating the height of the tsunami but it did not prevent major destruction and loss of life. Environmental Consequences Precious coral reefs and mangrove areas would have been crushed by the huge tsunami waves that have devastated southern Asia, an environmental and economic setback that could take years to reverse. The reefs around Sri Lanka and Phuket have been severely damaged due to them having to bear the brunt of the forceful walls of water. When the waves get close to shore, their height is amplified and they release all their energy, decimating everything in their paths.

The atolls of the alluring Maldives and the southern Thai islands (including Mangrove areas that act as nursery habitats to fish and shrimp) were also destroyed by the strong waves. According to scientists, reef-forming coral grows only about 0.5 cm, or 1/5 inch a year, thus for the seaside resorts on the numerous affected islands to regain their previous splendor could take several years to a decade. The worst marine damage was likely to have been concentrated 100m to 1km from shore.

Fortunately, large sea mammals such as whales and dolphins probably suffered little impact. According to Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO), dolphins can feel disturbances happening in the water and would have most likely headed for deep water where they would be safe. Also, they mostly inhabit the areas far offshore, where the tsunami has the least damaging capacity. Damage to Fishing Industry For the many indigenous fishermen and for the fishing industry as a whole, the tsunami spells more than just a natural disaster. These fishermen, <https://assignbuster.com/2004-indian-ocean-earthquake-and-destructive-tsunami-waves/>

most of whom have no other skills, can no longer depend on fishing as a means of survival for the time being.

The fish stock has been depleted, as would the fishermen's money. Also, the many of the fishermen's families would have lost their sole breadwinners, together with the fishing boats and equipment, adding on to their already heightening problems. The tsunamis that affected the coast of Thailand, Indonesia and the Maldives has destroyed much of the marine biology there, also damaging the ecosystem severely. Even if the fish had detected the incoming tsunami, they would most probably still have gotten caught up in it, due to its immense energy. Any fish trying to swim away from it would also have ended up on the shores, after being swept ashore. Also, the arrival of a tsunami is marked by a huge receding wave, which would have left fish flopping on the seabed.

Millions of fish were swept ashore by the huge waves, and many more will continue to die, being unable to survive in the severely damaged habitat left in the wake of the tsunami. The marine ecosystem is hence likely to have been affected badly, with the predators up the food chain, such as dolphins and sharks, dying out due to the lack of food. Many species will not be able to adapt to the sudden change in their lifestyle and will inevitably die.

Damage to Infrastructure Under-Secretary-General for Humanitarian Affairs

Jan Egeland said that relief supplies could be moved to tsunami-hit regions in Sri Lanka and the Maldives, but ninety percent of the problem remains in Indonesian archipelago. He estimated that there are currently over 1.8 million people in tsunami-stricken countries in need of food aid around 1

million in Indonesia, and around 700, 000 in Sri Lanka, with the remainder in the Maldives and Somalia.

ABC News has reported that heavy rains and fresh floods had disrupted relief efforts in Asia's tsunami-hit countries villages as the United Nations refugee agency started a 400 ton airlift as part of a \$2 billion relief operation to save the millions who had survived but were struggling to survive. Tropical rainstorms in Aceh province of Indonesia and flooding along Sri Lanka's low-lying coast also hampered aid deliveries. [pic] Immense Devastation, Banda Aceh Source: DigitalGlobe The damage to human and animal life was also tremendous, leaving an estimated 150, 000 people dead in Indonesia alone. The latest total death toll is expected to be over 225, 000, one of the largest dealt by a tsunami in history.

When the sheer force of a incoming tsunami obliterates everything in its path, it also clears away roads and railways, hampering rescue efforts. In addition, the torrential water deluging entire hectares prevent helicopters from landing. Normal rescue launches and boats would also be unable to withstand the impact of the tsunami, and could be sunk or smashed into pieces by the walls of water. Not to mention that most of the affected villages were situated in isolated or secluded areas (e. . islands of the Maldives) and are extremely hard to get to.

The huge mass of water also broke sewage and water pipes, contaminating water and food sources. Subsequently, diseases such as cholera, typhoid, dysentery and dengue then become more rampant. The rotting corpses left behind by the tsunami also helped to spread diseases to the survivors.

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Crops, settlements, trees, birds, fishes, wildlife, properties were severely destroyed, with power and communications disrupted, adding on to the daunting task of rescue work.

People clung on to trees for their dear life; some were rescued, but some were also swept away, right in front of their relatives and family members.

The emotional and mental trauma would remain in all those affected for years, even if they had escaped a watery grave.

Damage to Tourism
Skipping to the damage to the economy, the tsunamis of South-East Asia have dealt a heavy blow to the tourism industry in the region. The huge losses of life suffered by Thailand and the Maldives, which were once extremely popular tourist destinations, only proved that safety measures in the above countries had been taken lightly and were inadequate.

Potential tourists would have lost a sense of security in visiting these countries, thus leading to a loss of tourism revenue. People would also refrain from visiting the countries for fear of being affected by similar incidences due to this lack of protection. Furthermore, few people would want to visit a site ravaged by the forces of nature, where countless died, for the time being, either out of respect for the dead or due to its pure eeriness itself. The governments of the affected countries would hence lose massive amounts of money which could have been otherwise used for improving the general standard of living of the people.

The impact of the tsunami on the Maldives and Phuket is expected to set the growth rate back for at least two years. It would take half to two years to rebuild the devastated stretches of beaches, which were once tourist

havens, and probably even longer to attract back the tourists. Almost all the countries situated around the Bay of Bengal were affected by the tsunami waves in the morning hours of 26 December 2004 (between 0900 - 1030 hrs IST). The killer waves were triggered by an earthquake measuring 8.9 on the Richter scale that had an epicenter near the west coast of Sumatra in Indonesia.

The first recorded tsunami in India dates back to 31 December 1881. An earthquake of magnitude 7.5 on the Richter scale, with its epicenter believed to have been under the sea off the coast of Car Nicobar Island, caused the tsunami. The last recorded tsunami in India occurred on 26 June 1941, caused by an earthquake with magnitude exceeding 8.5. This caused extensive damage to the Andaman Islands.

There are no other well-documented records of Tsunami in India. It was all quiet on the waterfront on the Sunday morning after Christmas in 2004 at Kanyakumari, the famous Marina Beach in Chennai and elsewhere on the Kerala coast and Andaman Nicobar Islands. There was the excitement of a holiday with an offbeat mood with swarms of people on the sea front: children playing cricket and men and women on their morning work at the Marina. Elsewhere, fishermen were putting out to sea for the day's catch. Then all on a sudden, a curious thing happened. The holidaymakers at Kanyakumari were awestruck when the sea receded from the shores.

In the present tsunami, India was the third country severely battered after Indonesia and Sri Lanka. In India the State severely affected by tsunami

Of about 700 people trapped at the Vivekananda Rock Memorial off Kanyakumari, 650 were rescued. In Chennai, people playing on the Marina beach and those who taking a Sunday morning stroll were washed away, in addition to the fisherfolk who lived along the shore and those out at sea. The death toll at Velankanni in Nagapattinam district is currently 1, 500. Most of these people were visiting the Basilica of the Virgin Mary for Christmas, while others were residents of the town. The nuclear power station at Kalpakkam was shut down after sea water rushed into a pump station. No radiation leak or damage to the reactor was reported. An estimated 30, 000 people are homeless in the Union territory of Pondicherry.

The current official toll is 560. The affected districts are Pondicherry (107 dead), Karaikal (453 dead). Karaikal is the most devastated area from the Pondichery Union territory. Where massive destruction and loss of casualties accure.

This mishap occur because of uncover stone block. Mostly fisherfolk are affected due to location and distance between sea and their basti (village). Fishing peoples are just preparing for venturing into sea and within fraction of seconds every thing wash away and their boats are damaged they lost every thing in terms of life and property. More than 453 people are died so far and still some are missing . Kerala The current official toll is 168.

The affected districts are Kollam (131 dead), Alappuzha (32 dead), Ernakulam (5 dead). The tsunami that hit the Kerala coast on December 26, 2004 , were three to five metres high , according to the National Institute

of Disaster Management,(NIDM) which functions under the ministry of home affairs. The Tidal upsurge had affected | | 250 kilometers of the kerala costline and entered between one or two kilometers inland pounded 187 villeges affecting 24. 70 lakh persons in the state . As many as 6, 280 dwelling | | units were destroyed. As many as 84, 773 persons wee evacuated from the costal areas and accomedated in 142 Relief Camaps opened in Kollam, Alappuzha and Ernakulam Districts.

| | | According to NIDM, 131 Lives were lost in Kollam, 32 in Alappuzha and five in Ernakulam, taking the official death tole to 168. High wave swept the cost along a 40-Km stretch , from | | Sakthikulangare in the south to Thrikunnapuzha in the north. This stretch has two narrow strips of land sand wiced between the sea and back water. | | | | Andhra Pradesh | | | | The current official toll is 105.

The affected districts are Krishna (35 dead), Prakasam (35 dead), Nellore (20 dead), Guntur (4 dead), West Godavari (8 dead) and East Godavari (3 | | dead). | | | | Andaman and Nicobar : | | | | The Andaman and Nicobar Islands comprise 572 islands (all land masses in both low and high tides) out of which 38 are inhabited, both by people from the mainland and indigenious | | tribes. The islands lie just north of the earthquake epicentre, and the tsunami reached a height of 15 m in the southern Nicobar Islands. The official death toll is 812, and about | | 7, 000 are still missing. The unofficial death toll (including those missing and presumed dead) is estimated to be about 7, 000. | | | | The Great Nicobar and Car Nicobar islands were the worst hit among all the islands because of their proximity to the quake and relative flatness.

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Aftershocks continue to rock the | | area. One fifth of the population of the Nicobar Islands is said to be dead, injured or missing. Chowra Island has lost two thirds of its population of 1, 500. Entire islands have | | been washed away, and the island of Trinket has been split in two. Communications have not been restored with the Nancowry group of islands, some of which have been completely | | submerged, with the total number of the population still out of contact exceeding 7, 000. | | | | Among the casualties in Car Nicobar, 100 Indian Air Force personnel and their family members were washed away when the wave hit their air base, which was reported to have been | | severely damaged.

The St. Thomas Cathedral (also known as the John Richardson church after John Richardson, a missionary and member of parliament) was washed away. The church, | | established in 1930 was one of the oldest and prominent churches in the region. A cricket stadium named after John Richardson and a statue dedicated to him were also washed away. | | | | The majority of the population of Andaman Islands is made up of people from the mainland, mostly from West Bengal and Tamil Nadu.

The natives of Andaman and Nicobar Islands are | | endangered tribal groups, such as such as the Jarawa, the Sentinelese, the Shompen, the Onge and the Andamanese. They are regarded as anthropologically significant as they are some | | of the world's most primitive tribes and considered the world's only link to ancient civilisation. Most of these tribes have maintained their aboriginal lifestyle for centuries, and| | government policy has been to not interfere with them unless absolutely essential. | | | | It is reported that most of the native islanders survived the tsunami because they live on <https://assignbuster.com/2004-indian-ocean-earthquake-and-destructive-tsunami-waves/>

higher ground or far from the coast. The Onge (with a 2001 census population of 96), Jarawa (240), Sentinelese (39) and Andamanese (43) have been reached by survey teams and are confirmed to be safe although the number of dead is unknown.

The Sentinelese live on a reserved island and are hostile to outsiders which is making it difficult for Indian officials to visit the island. They have shot arrows at helicopters sent to check on them. In the Nicobar Islands, the Nicobarese, a Mongoloid tribe (2001 population of 28, 653), have lost about 656 lives with 3, 000 still missing. Surveys are being conducted on the Shompen (2001 census count of 398) located on Great Nicobar island. India's only active volcano, Barren 1, located at Barren Island 135 kilometres (80 miles) northeast of the capital Port Blair, erupted because of increased seismic activity on 30 December 2004.

People have been evacuated since then and there have been no reports of any casualties. ———— “Tsunami Ready” signs in Ocean Shores and Grays Harbor, Washington [pic] Tsunami wall at Tsu-shi, Japan