Geo Factsheet

April 2005 Number 179

Tsunamis – rare but devastating

The Indian Ocean Tsunami of 2004

On 26th December 2004 a massive earthquake measuring 9.0 on the Richter scale triggered huge tsunamis that swept along the unprepared coastlines of the Indian Ocean. Whilst an accurate figure for the eventual death toll will probably never be known, it is currently estimated that about 294,000 people were killed or are missing, making it the deadliest earthquakes since 1900 *(Fig. 1)*.

Over five million people in some of the most remote and poorest parts of the world were left homeless without adequate food, water or sanitation *(Fig. 2)*. In Indonesia, closest to the epicentre of the earthquake, over 150,000 people were killed. In Sri Lanka over 30,000 died and in India over 15,000 perished. The United Nations has stated that the relief operation will be the biggest ever in the history of the world *(see Fig. 2)*.

Fig. 2 The geography of need.

Initial estimates of reconstruction costs		Impact on lives and poverty
India	$1.5bn - $2bn	• Two million people lost their jobs
Indonesia	$4.5bn - $5bn	• 410,000 housing units destroyed
Maldives	$0.3bn - $0.5bn	• Four million people will fall into poverty because of tsunami
Sri Lanka	$2.5bn - $3.5bn	• 1.7 million people internally displaced
Thailand	$1bn - $1.5bn	• 500,000 injured
Total	$9.8bn - $12.5bn	• 294,000 dead or missing
Aid pledged	**$5.5bn**	

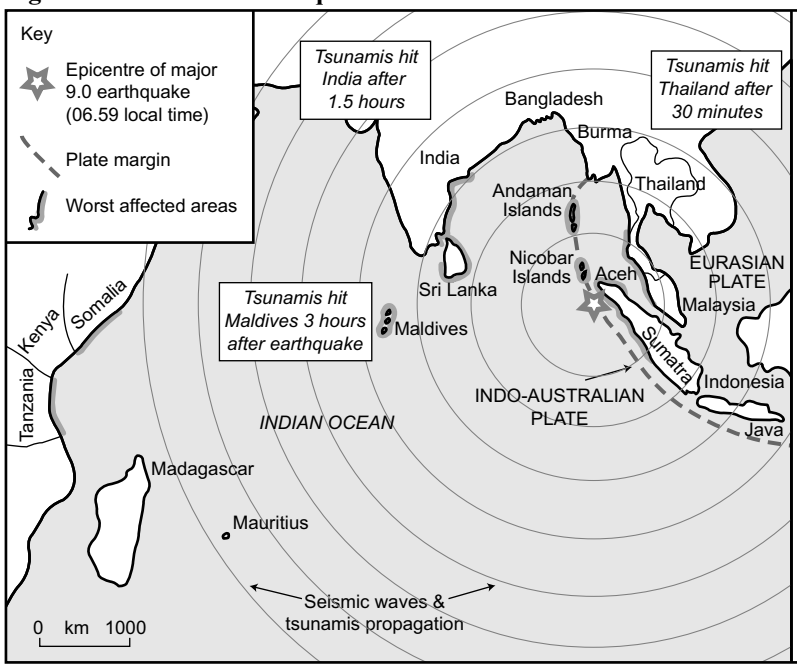
Journalists and aid workers reported beaches strewn with the bloated and decomposing bodies of local fishermen, tourists and children who had been playing on the beaches before the waves arrived. From Indonesia to Thailand, India, Sri Lanka and even Somalia in Africa the story was much the same *(see Fig. 3)*. Without warning, walls of water up to 10 metres high surged onshore sweeping away trees, buildings and cars. Despite desperate attempts to outrun the rising waters, tens of thousands of people were swept to their deaths.

Fig. 1 The top ten deadliest earthquakes (since 1900).

Location	Date	Latitude	Longitude	Deaths	Magnitude	Plate margin*	Comments
West coast of Sumatra, Indonesia	26/12/2004	3.32N	95.85E	300,000	9.0	D	Massive tsunamis along Indian Ocean coastal countries
Tangshan, China	27/07/1976	39.6N	118.0E	255,000	8.0	D	
Gansu, China,	16/12/1920	35.8N	105.7E	200,000	8.6	D	Landslides
Xining, China	22/05/1927	36.8N	102.8E	200,000	8.3	D	
Kwanto, Japan	01/09/1923	35.0N	139.5E	143,000	8.3	D	Great Tokyo fire
Ashgabat, Turkmenistan	05/10/1948	38.0N	58.3E	110,000	7.3	D	
Messina, Italy	28/12/1908	38.0N	15.5E	70 - 100,000	7.5	D	Earthquake and tsunami
Gansu, China	25/12/1932	39.7N	97.0E	70,000	7.6	D	
Peru	31/05/1970	9.2S	78.8W	66,000	7.8	D	Rock slides and floods
Quetta, Pakistan	30/05/1935	29.6N	66.5E	30 - 60,000	7.5	T	

* D (destructive); T (transform) *(Source: Various)*

Fig. 3 Indian Ocean: earthquake location and worst affected areas.



1. **Sumatra (Indonesia):** The northern province of Aceh was closest to the epicentre of the earthquake and was the worst affected area. Waves up to 12m swept 2km onshore killing at least 100,000 people. 80% of the province has been destroyed. The city of Banda Aceh was largely destroyed. Journalists described it as "stinking of death". Due to poor infrastructure and political instability, aid reached the region very slowly.
2. **Sri Lanka:** An estimated 28,000 were killed, mostly on the eastern seaboard as a series of waves swept the beaches. Potential problems with Tamil-controlled northern areas exist - including floating land mines - and may slow government aid transfers. Government quickly announced that the disaster was beyond its ability to cope.
3. **India:** The worst hit area was the remote coastline in the southern province of Tamil Nadu, which was hit by 10m high waves. 15,000 people were killed.
4. **Thailand:** Southern Thailand holiday beaches were devastated by the tsunami and the majority of the 7,000 deaths were amongst foreign tourists particularly from Scandinavia. Over 40 British people were killed. Phuket and Phang Nga were particularly badly hit.
5. **Andaman and Nicobar Islands:** Unknown numbers of people - possibly in excess of 30,000 - were killed in these remote islands close to the epicentre of the earthquake. Rescuers found areas totally destroyed. Many parts of the islands could not be reached. Survivors reported to be without food and battling crocodiles washed onshore by the tsunamis.
6. **Maldives:** Despite the inundation suffered by these low-level islands, only 67 deaths were confirmed and 68 of the 87 tourist resorts remained open.

What is a tsunami?

A tsunami (pronounced 'tsoo-nah-mee') is a single wave or, more often, a series of waves, generated by a sudden displacement of water in the ocean. The word 'tsunami' is a Japanese word literally translated as 'harbour wave', on account of the impact such waves have on coastal areas.

Unlike wind-generated waves, tsunamis are characterised by having massive wavelengths (distance between wave crests) of up to 100km. There can be as much as an hour between waves. Tsunamis travel extremely fast across the ocean. It is estimated that in the Pacific Ocean - where tsunamis are most common - they can travel up to 800km/hour, which is faster than a jet aeroplane.

One of the most remarkable characteristics of tsunamis is that they can travel many thousands of kilometres over the ocean. In 1960 an earthquake off the coast of Chile sent a tsunami 17,000km across the Pacific to Japan where 200 people lost their lives. The 2004 Indian Ocean earthquake sent tsunamis as far away as Tanzania and Somalia, over 5,000km away from the earthquake's epicentre off the coast of Sumatra.

Exam Hint: Revise topic by drawing a spider diagram with the central event - the impact of the tectonic plates - as the 'body' of the spider and the effects and lessons learned as the 'arms'.

What triggers a tsunami?

For a tsunami to be generated there needs to be a vertical displacement of a body of water in the ocean. Such an event is most commonly associated with earthquakes and volcanic eruptions, particularly along destructive plate margins where two plates are moving towards each other causing a great build up of pressure. Tsunamis can also be generated by underwater landslides, explosions and even by the impact of cosmic bodies, such as meteorites.

The Indian Ocean tsumanis were generated by a massive earthquake that measured 9.0 on the Richter scale. The earthquake – the most powerful in the world for 40 years – had its epicentre off the west coast of the Indonesian island of Sumatra.

- The cause of the earthquake was a sudden slippage along the destructive plate margin where the Indo-Australian plate is being subducted beneath the Eurasian plate *(Fig. 4A)*. Scientists believe that the upper plate - the Eurasian plate - rebounded upwards by some 15-20 metres causing the displacement of the water that triggered the tsunamis.

- As the seabed shook in response to the earthquake a massive column of water rose and split to form two tsunamis, one travelling eastwards towards the Sumatran coast and the other west and north towards Thailand, India and Sri Lanka *(Fig. 4B)*.

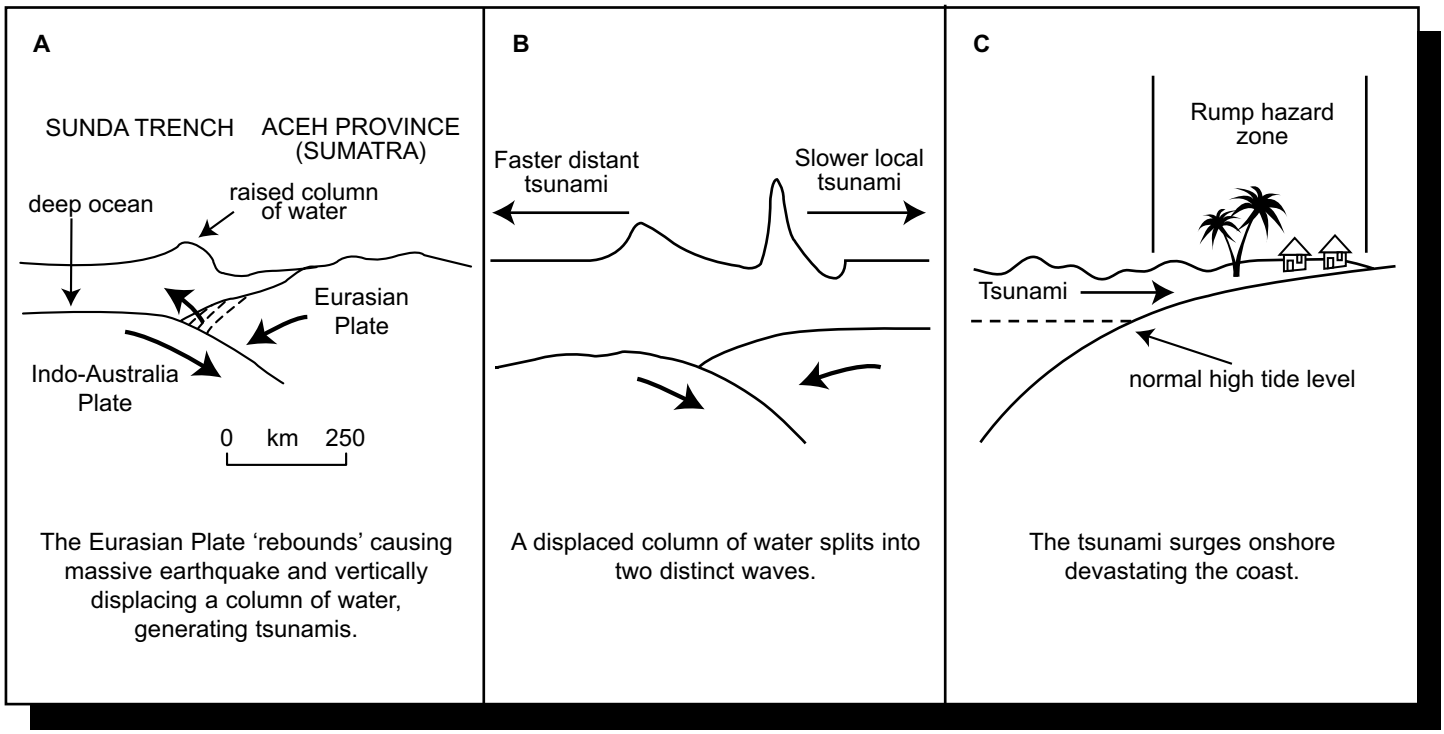
- Measuring no more than a few centimetres in open water, the tsunamis grew rapidly in height as they approached land *(Fig. 4C)*.

What happens to a tsunami as it approaches land?

As a tsunami approaches the land it behaves like an ordinary sea wave. Friction with a shallowing seabed slows the wave and causes it to rise and gain in height *(Fig. 4C)*. Variations in offshore profiles and the configuration of the coastline will have significant effects on the height of the wave as it reaches the shore. The highest tsunami often results from a narrowing of the coast. Wave refraction will also affect the orientation and height of a tsunami.

The characteristics of the tsunamis that struck the Indian Ocean coastlines on 26th December 2004 varied enormously. In some places eye-witness reports spoke of a wall of water several metres high that followed a visible draining of the sea close to the shore, in much the same way as backwash precedes an on-coming wave. Elsewhere, people simply reported a steady surge of water rather than an obvious wave. The number of waves also varied. Some places were affected by a single steady rise of water whereas other places were hit by a series of waves. In Sri Lanka the first wave left fish stranded on the beach. Many children ran down to collect the fish only to be swept to their death by a second more powerful wave. A third wave, whilst less powerful than the second, caused further death and destruction.

Fig. 4 The generation of the 2004 Indian Ocean Tsunamis.



What are the effects of a tsunami?

The waves tore apart homes and hotels leaving behind a tangle of wood, metal, and personal possessions half buried in stinking mud. Fishing vessels were swept hundreds of metres onshore to be dumped incongruously on street pavements and against main road shop fronts. Cars and buses were piled high against surviving buildings. In Sri Lanka an express train was washed off its tracks and 600 people were killed.

Then there is the human tragedy. Rivers and harbours choked with bloated bodies decomposing in the tropical sun, half-covered bodies by the roadside waiting for someone to claim them and children with terrible injuries turning gangrenous lying on hospital corridor floors with their grief-stricken parents hopelessly tending them. Truckloads of corpses being dumped into hurriedly dug holes in the ground in Indonesia and stacks of unidentified bodies burning in Hindu funeral pyres in Sri Lanka.

The immediate devastation caused by tsunamis is of an unimaginable scale. However, the challenges for the longer term are perhaps even greater. In the days and weeks after such an event diseases, such as malaria and cholera, can spread rapidly. With the lack of safe water and sanitation, water-borne diseases leading to diarrhoea often take hold leading to many deaths particularly among the very young. Lack of food and shelter are additional problems faced by people. Their homes and businesses may have been destroyed and all their possessions lost. They will also be trying to come to terms with having lost loved ones. The fishing communities will have no boats and those communities dependent upon tourists will be deserted. Economic and social problems will almost certainly have a significant and lasting impact on the survivors.

Why were the Indian Ocean tsunamis of 2004 so devastating?

The Indian Ocean tsunamis caused more deaths that any other similar event since records began *(Fig. 5)*. There are a number of factors that combined to cause such a high death toll:

- At 9.0 on the Richter scale, the earthquake itself was massively powerful, the fourth most powerful since 1900 and as powerful as all the previous five years' earthquakes throughout the world combined.

- Tsunamis are not very common in the Indian Ocean. Between 1982 and 2002, 157 tsunamis were recorded worldwide of which only 19 were outside the Pacific region. This meant that the coastal communities in countries such as Indonesia and Sri Lanka were unaware of the dangers posed by tsunamis and completely unprepared to cope.

- Most of the island chains in the Indian Ocean, such as the Maldives, are flat and low-lying. Many of the coastlines also tend to be flat or very gently sloping. Fishing villages and tourist towns were built right up against the waters' edge to make maximum use of the magnificent beaches. As a consequence, the tsunami rolled well inland bringing widespread destruction to vast swathes of the coastline and inundating entire islands.

- Much of the Indian Ocean coast is densely populated. There are thriving fishing communities and, in recent decades, tourism has flourished. Large numbers of people were at risk from the tsunamis.

- Many of the countries affected by the tsunamis, such as Indonesia and Sri Lanka, are extremely poor. They did not have the necessary emergency supplies, procedures or infrastructures to cope with a disaster on this scale and needed to rely heavily on foreign assistance.

- Unlike the Pacific Basin, there is no early warning system for the Indian Ocean. Only Thailand has a warning system and this clearly failed to function adequately. This is due to the infrequency of such events in the area – tsunamis were not thought to represent anything like the threat of typhoons, for example - together with a lack of money. Many tens of thousands of people could have been saved had such a system existed.

- Despite the lack of a recognised early warning system, agencies across the world did record the earthquake and were able to predict the generation of tsunamis. Yet, despite having several hours to respond, there were no effective warnings issued to those countries in the path of the giant waves. Bizarrely, in Kenya, officials saw on TV what was happening in India and decided to evacuate people from the beaches. This action undoubtedly saved many lives in popular tourist resorts such as Mombasa.

Fig. 5 Major tsunami disasters (1883-2004)

1883	A volcanic eruption blew up the island of Krakatoa. Waves up to 35m high swept the coasts of Java and Sumatra in Indonesia drowning over 36,000 people.
1896	The great Sanriki tsunami struck Japan without warning. A wave estimated to be more than 20m high hit a crowd gathered for a religious festival, killing more than 26,000 people.
1906	An earthquake measuring 8.8 on the Richter scale near the coast of Ecuador generated tsunami that swept the coast of South America and Japan. Approximately 1,000 people were killed.
1933	An earthquake measuring 8.5 on the Richter scale off the Japanese coast of Honshu generated 24m waves that swept the Sanriku coast killing 3,008 people, injuring 1,152 and destroying over 5,000 houses.
1952	An earthquake of magnitude 8.2 on the Richter scale off the coast of Hokkaido triggered tsunami over 4m high. 28 people were killed and 287 were injured.
1960	An earthquake measuring 9.5 on the Richter scale (the most powerful earthquake ever recorded) struck Santiago, Chile. Tsunamis with waves estimated at over 10m high killed 56 people in Hawaii, 32 in the Philippines and 138 in Japan, 16,000km away.
1964	An earthquake measuring 9.2 in Alaska triggered massive tsunamis. A total of 125 lives were lost.
1976	A tsunami triggered by an earthquake measuring 8 on the Richter scale killed more than 10,000 people in the Moro Gulf region of the Philippines.
1992	An earthquake measuring 7.8 on the Richter scale in the Flores region of Indonesia generated waves up to 25m high that ran onshore by 300 metres. The Earthquake and tsunamis killed at least 2,000 people and 90,000 structures were destroyed. It was the largest and deadliest earthquake of 1992.
1993	A powerful earthquake measuring 7.7 on the Richter scale in the Sea of Japan generated waves up to 30m high killing some 243 people on the Japanese island of Hokkaido.
1998	A magnitude 7.1 earthquake centred off the coast of Papua New Guinea generated a 15m tsunami that swept away all wooden buildings within 500m of the shore. Some 2,200 people lost their lives.
2002	An earthquake measuring 8.4 on the Richter scale centred off the coast of Peru generated tsunamis that killed 20 people.
2004	The 9.0 magnitude earthquake off the coast of Sumatra, Indonesia wiped out coastal communities around the Indian Ocean killing over 125,000 people and leaving 5 million homeless. It is the most deadly natural disaster involving tsunamis since records began.

How did the world respond to the 2004 disaster?

In the days after the disaster charity relief agencies and foreign governments started a massive recovery programme. By 31st December 2004 the UK public alone had donated £32m and the UK government had committed £50m. Globally, over £700m had been committed by the end of the year, i.e. in 7 days. In the UK (March 2005) the initial disaster fund has closed at £300 million - a record!

Plane-loads of emergency supplies - bottled water, food, medical supplies and shelter - were being flown in to the affected countries from all over the world. However, the sheer scale of the disaster combined with the remoteness of many communities, political instability in some areas and the destruction of local infrastructures meant that many thousands of people were cut off from the emergency support that they so desperately needed in the days after the disaster. As with any mega-hazard the immediate post-disaster response requires complex logistics management between governments and charities.

From March onwards the emphasis is from emergency short term support to longer term government support for rebuilding and reconstruction.

How can the tsunami hazard be reduced?

There are two approaches to reducing the tsunami hazard. One is behavioural and relates to forecasting, warning and evacuation. Such an approach also encompasses land use management, public awareness and education. The other is structural and involves the building of structures to physically withstand tsunami and protect coastlines.

1. Behavioural responses

When an earthquake happens ground shaking occurs immediately and there is little time for people to respond to the hazard. However, with a tsunami, several hours may elapse between an earthquake occurring and a stretch of coastline being hit by the waves. In theory at least, if warned, people do have time to respond to the hazard by moving to safer ground.

An international tsunamis warning centre for the Pacific Basin was established in 1949 near Honolulu, Hawaii. The Pacific Tsunami Warning Center (PTWC), managed by the US National Oceanic and Atmospheric Administration, monitors earthquakes and tracks potential tsunamis using a system of seismic and tidal stations spread across the Pacific Basin. With increased technology and, in particular, the use of satellites and computer modelling, warnings can be issued to countries threatened by tsunamis. An increased understanding of wave mechanics also enables scientists to be quite precise about the scale of any imminent waves.

If an earthquake occurs that may generate a tsunami, three levels of warning may be issued:

- **ADVISORY:** An earthquake has occurred in the Pacific basin, which might generate a tsunami. WC/ATWC and PTWC will issue hourly bulletins advising of the situation.

- **WATCH:** A tsunami was or may have been generated, but is at least two hours travel time to the area in watch status. Local officials should prepare for possible evacuation if their area is upgraded to a warning.

- **WARNING:** A tsunami was or may have been generated, which could cause damage; therefore, people in the warned area are strongly advised to evacuate.

The aim of the 'Warning' is to provide all coastal communities at risk with about one hour's notice (+/- 10 mins).

Following the disastrous 1964 'Good Friday' earthquake in Alaska, the West Coast/Alaska Tsunami Warning Center (WC/ATWC) was established to provide more localised information for California, Oregon, Washington, British Columbia, and Alaska.

In Japan, the Japanese Meteorological Agency provides local warnings for the Japanese islands. Established in 1952 the system has recently been upgraded in 1999 to make better use of computer modelling. With the aid of over 100,000 simulations relating to some 600 points around the Japanese coast, together with extremely accurate seismic measurements, the system is able to provide maximum wave height information and arrival times within five minutes of an earthquake occurring.

Public awareness and education are extremely important. There is little point in having a warning system if people do not know how to respond. In the USA the Federal Emergency Management Agency (FEMA) has issued guidelines to increase public awareness and help people to prepare themselves (see *http://www.fema.gov*). For example, people in vulnerable areas are encouraged to prepare a Family Disaster Plan, involving identifying safe evacuation routes and securing their home and possessions. People are encouraged to assemble a Disaster Supplies Kit. Detailed instructions are given on how to respond to public warnings.

Whilst warning systems may reduce deaths and injuries, they will not prevent the destruction caused by tsunami. It is therefore important that local authorities have their own plans for the immediate aftermath of a tsunami. There needs to be stores of emergency supplies including safe water (local water sources will almost certainly be polluted), food and shelter, and medicines. Consideration needs to be given to transportation, as most roads will probably be rendered impassable.

With the exception of Thailand, none of the countries affected by the 2004 Indian Ocean tsunamis had any warning system in place. This was because of the infrequency of tsunamis in this part of the world together with the lack of money available to spend on such a facility. Furthermore, it was clear from the responses of many people, that individuals had no awareness of the potential hazards represented by tsunami.

For example, in Sri Lanka, people returned to beaches after the first wave only to be swept to their deaths by a second more powerful wave. The vast majority of local authorities did not have emergency supplies or contingency plans for such a disaster. Only in India, where natural disasters are relatively commonplace, were the authorities able to respond in a relatively organised way. There is no doubt that greater individual and public awareness would have reduced the death toll massively.

2. Structural responses

It is unrealistic to protect vast stretches of coastline from tsunami. The cost of building huge seawalls along an entire coastline would be prohibitive and the impact on coastal systems would be very significant. The fact that tsunami are not particularly common in any one place also makes this a largely impractical option. However, in Japan, which is a relatively wealthy country with some high-value stretches of coastline to protect, a number of strategies have been employed to reduce the tsunami hazard *(see Case Study on page 5)*

Conclusion

The 2004 Indian Ocean tsunamis represent one of the greatest natural disasters of all time. However, tsunami will continue to be generated, particularly by underwater earthquakes, and people's lives will continue to be affected.

A tsunami warning centre for the Indian Ocean is perfectly achievable and should be established.

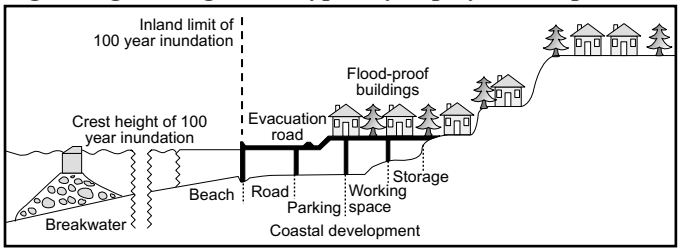
Tsunami mitigation in Japan

Tsunami mitigation measures in Japan take the form of land use management (where developments are restricted in tsunami-prone areas), a district wide warning system (via the Japanese Meteorological Agency) and, in a number of locations, the construction of tsunami seawalls.

The Sanriku coast northeast of Yokyo was hit by a damaging tsunami in 1933 *(see Fig. 5)*. In the wake of this disaster the Japanese government offered financial assistance to fishing villages to relocate on higher ground. This policy proved unsuccessful due to a shortage of land and the wishes of the fishermen to remain close to the sea. As a result the government turned its attention to the construction of onshore tsunami walls, up to 16m in height, and offshore breakwaters *(Fig. 6)*.

For example, a 10-metre high tsunami seawall was built at Taro, a small fishing village in the Sanriku district just inland of its fishing harbour. The residences and businesses situated on the seaward side of this tsunami seawall are protected from storm waves by a much lower offshore breakwater. However, with warning of an approaching tsunami, people are evacuated to the landward side of the tsunami seawall.

Fig. 6 Engineering works typically deployed in Japan.



These constructions are expensive and they do have an aesthetic impact on the coastline. There is some evidence also that offshore breakwaters interfere with tidal currents and may have a negative impact on the local fishing industry. Both onshore tsunami walls and offshore breakwaters have been constructed at Ofunato and Kamaishi. A different approach has been taken to protect the city of Ofunato, also on the east coast of Japan's Honshu Island, which was flooded and significantly damaged by the Chilean tsunami in 1960. As a result of that event, a massive offshore breakwater was built at the entrance to Ofunato Bay. This tsunami breakwater successfully protected the city from a locally generated tsunami in 1968.

Scientists predict 'mega-tsunami' could devastate east coast of USA

In 2001 scientists reported that there was the potential for a massive tsunami that could hit the east coast of America. They suggested that an eruption of the **Canary Island volcano Cumbre Vieja on La Palma** could trigger an enormous underwater landslide. Half the island (some 500 billion tonnes of rock) could slip into the ocean causing a 100m 'mega-tsunami' to hit northwest Africa and a 30-50m tsunami to reach the eastern seaboard of the USA 7-8 hours later. The scientists predicted that millions could die and that parts of cities such as New York, Miami and Boston could be inundated. The predictions were based on evidence of similar events in the geological past when parts of the USA and Australia were hit by massive waves generated by catastrophic underwater landslides. The next eruption of Cumbre Vieja is expected to be in the second half of the 21st century, although it may not necessarily trigger the landslide. For more information see:

- CNN article: *http://archives.cnn.com/2001/TECH/science/08/29/tidal.wave*
- BBC archive at *http://news.bbc.co.uk/2/hi/science/nature/3963563.stm*
- The transcript of a BBC 'Horizon' programme on mega-tsunamis at: *www.bbc.co.uk/science/horizon/2000/mega_tsunami_info.shtml*

End Note

On March 28th 2005 an 8.7 magnitude earthquake struck just off the coast of Nias Island, Indonesia. For some, as yet unexplained, reason the earthquake failed to generate the huge, destruction tsunamis of the 26th December. Scientists suggest that this may be because the latest earthquake was focused on the fault zone 30km below the seabed - three times deeper than in December - and this may have dissipated some of the energy before it reached the seabed. Despite this, it is feared that hundreds of people have been killed.

Student Internet Research

1. Use the suggested websites in the References section or conduct your own research to find out more about the 2004 Indian Ocean tsunamis.
   - Update the figures on deaths.
   - What aid has been made available for the communities affected? Try to find out about long-term reconstruction. Are there plans for establishing an Indian Ocean Tsunami Warning Centre?
   - Conduct a detailed study of one country affected by the tsunamis and illustrate your account with annotated photographs. Why did your chosen country suffer so much from the waves?
2. Find out more about tsunami protection in Japan. How do the authorities strike a balance between behavioural and structural approaches?
3. Find out about one of the other tsunami disasters listed in *Fig. 5*. There are several good reports available on the Internet describing the 1960 Chilean tsunami and the 1998 tsunami in Papua New Guinea. Identify the factors contributing to these disasters. Why did they not cause such a high death toll as the 2004 event?
4. Find out more about the role of the tsunami warning stations. How do scientists identify potential tsunami and what do they do to help people to respond appropriately to the threats posed?

References

Websites:

- For archive articles and links try the BBC (www.bbc.co.uk), Times (*www.timesonline.co.uk*) and Guardian (*www.guardian.co.uk/naturaldisasters*)
- For specific country information try the Hindu at *www.hinduonnet.com* and the Asian Tribune at *www.asiantribune.com*.
- For detailed scientific information about the earthquake, contact the National Earthquake Information Centre at *http://neic.usgs.gov*.
- Excellent information about the relief operation can be found at *www.disasterrelief.org*. Charity organisations such as Oxfam (*www.oxfam.org.uk*) and Christian Aid (*www.christianaid.org.uk*) provide updates on the relief operation and a general search will give many other options.
- For information about structural approaches to tsunami protection assess Issues in Earthquake Engineering Research visit: *www.eng.nsf.gov/nees/nrcreport/Chapter2.pdf*
- The National Tsunami Mitigation Program can be found at : *www.pmel.noaa.gov/tsunami-hazard/*
- Pacific Tsunami Warning Center: *www.prh.noaa.gov/ptwc*
- West Coast and Alaska Tsunami Warning Center: *http://wcatwc.arh.noaa.gov*
- Japanese Meteorological Agency is at: *www.jma.go.jp/JMA_HP/jma/indexe.html*
- Centre for International Disaster Information at *www.cidi.org*
- Federal Emergency Management Agency: *www.fema.gov*

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ISSN 1351-5136