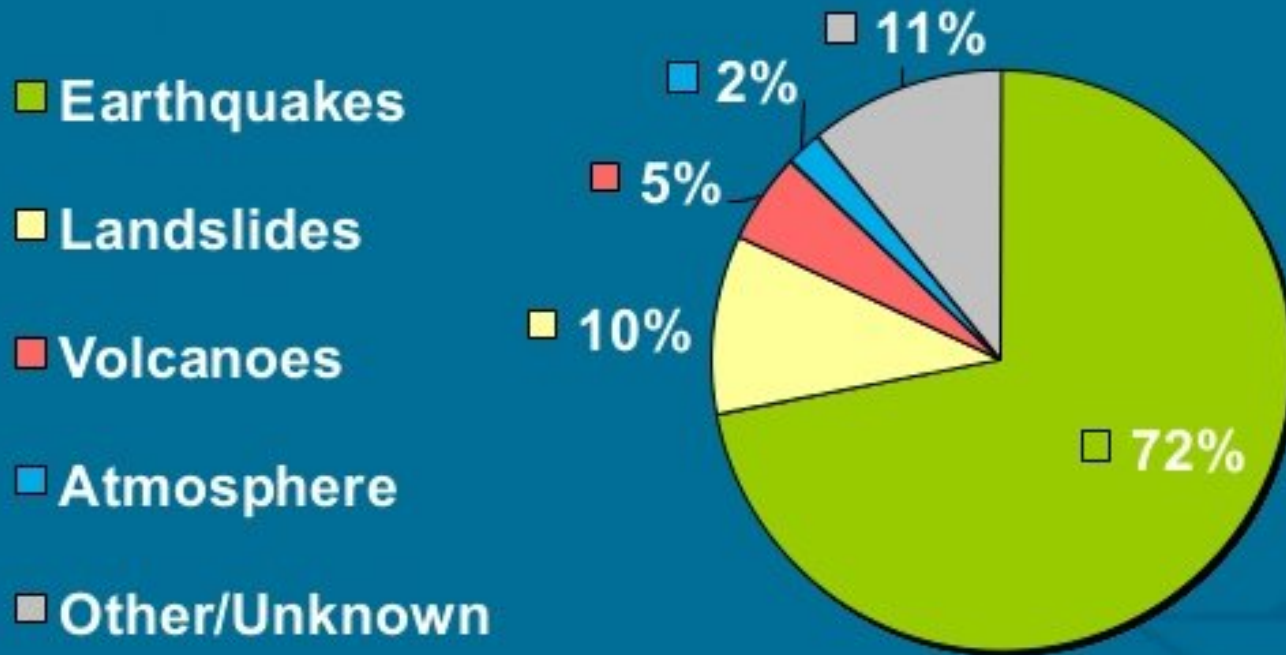


Tsunami

Tsunami

- Tsunami meaning "harbour wave" in literal translation comes from the Japanese characters for harbour (tsu) and wave (name).
- A tsunami also called seismic sea waves

What Causes Tsunamis?



Thus, the tsunami warning system relies primarily upon rapid earthquake detection and characterization.

Causes of Tsunami

- **Earthquake** -
- Tsunami can be generated when the sea floor ruptures abruptly due to tectonic earthquakes, causing vertical displacement of the overlying water.
- Most of the earthquakes which generate tsunamis occur on thrust faults.
- These earthquakes occur mainly in the areas where tectonic plates move toward each other in subduction zones.

- **Landslides -**
- Tsunamis can be generated when a landslide enters the water and displaces it.
- Such generation of Tsunami depends on the amount of rock material that displaces the water,
- the speed with which it is moving,
- and the depth it moves to

- **Volcanoes -**
- volcanoes generated Tsunamis are very infrequent, both above and below water.
- However, different types of volcanic activity can displace enough water to generate tsunamis e.g. submarine explosions, caldera formations etc.
- Like other non-seismic tsunamis, such as those generated by landslides, volcanic tsunamis usually lose energy quickly and rarely affect distant coastlines.

- **Near Earth Objects**

- It is very rare for a near earth object like an asteroid or comet to reach the earth
- its potential to generate Tsunami is still uncertain, as there are no records of a Tsunami caused by near earth objects, in recent human history.
- However, scientists are of the opinion there are two ways near earth objects could generate a tsunami.

Characteristics of Tsunami

- Tsunamis are among Earth's most infrequent hazards and most of them are small and nondestructive
- Tsunamis generally consist of a series of waves, with periods ranging from minutes to hours
- Tsunamis radiate in all directions from the point of origin and they can cover entire ocean basins.
- There is no season for tsunamis. We cannot predict where, when or how destructive the next tsunami will be

- Not all tsunamis act the same. And, an individual tsunami may impact coasts differently.
- Most tsunamis are caused by large earthquakes. Though, not all earthquakes cause tsunamis.
- Tsunamis are waves generated by the tremors and not by an earthquake itself.
- The effect of Tsunami would occur only if the epicentre of the tremor is below oceanic waters and the magnitude is sufficiently high.

- A tsunami can strike any ocean coast at any time. They pose a major threat to coastal communities.
- The speed of the wave in the ocean depends upon the depth of water. It is more in the shallow water than in the ocean deep. As a result of this, the impact of a tsunami is more near the coast and less over the ocean
- Over deep water, the tsunami has very long wavelengths (often hundreds of kilometres long) when a tsunami enters shallow water, its wave-length gets reduced and the period remains unchanged, which increases the wave height.
- Tsunamis have a small amplitude (wave height) offshore. This can range from few centimetres to over 30 m height. However, most tsunamis have less than 3 m wave height.

- Wave Height is 10-30 meters
- Wave length is 100-500 Km
- Wave Period is 5 minutes to 2 hours
- Wave Speed 800-900 Kmph

How a tsunami occurs

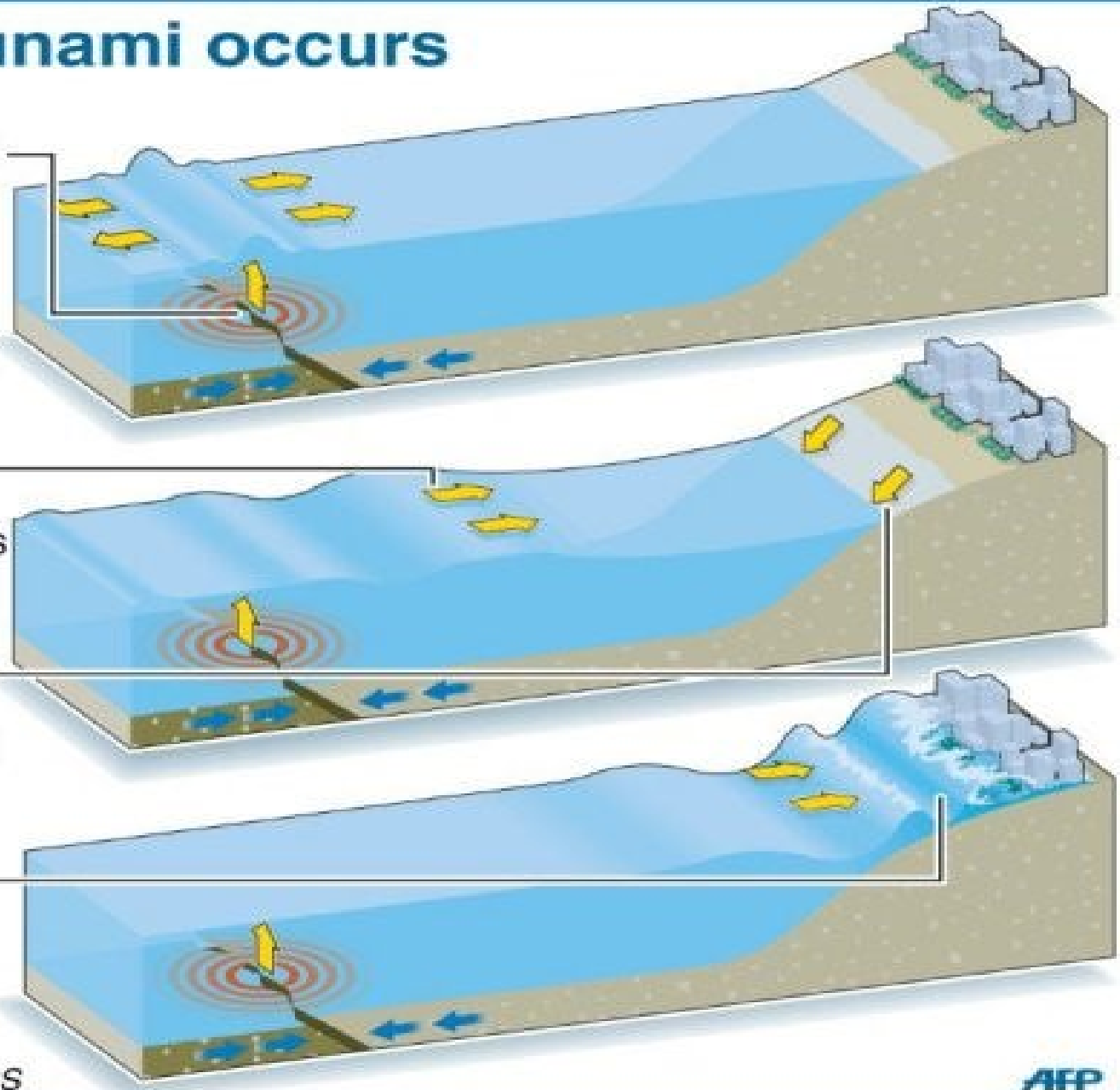
1 An earthquake rocks the ocean floor

2 Displaces volume of water, pushing it up

3 Sets off an oscillation, which develops underwater at great speed

4 Sea water is sucked back from the shore

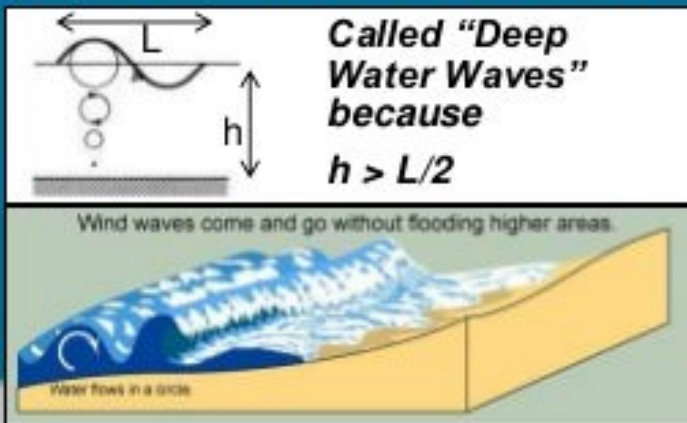
Waves get bigger as water gets shallower



Normal vs. Tsunami waves

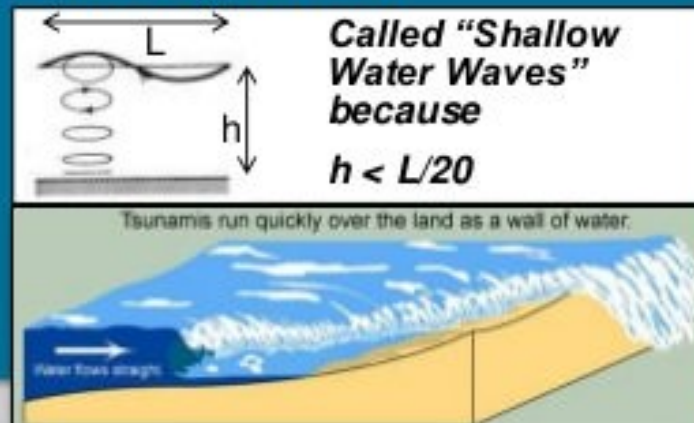
Normal Waves:

- Movement of uppermost layer of water only, motion diminishes with depth
- Caused by wind or storm surge
- Wavelength: 30-200 m, Period: 1-30 s
- Speed: 15-115 km/h
(function of wave period → dispersive)



Tsunami Waves:

- Movement of entire water column down to sea floor
- Caused by tides or tsunamis
- Wavelength: 80-500 km, Period: 5-60 m
- Speed: 50-900 km/h
(function of depth only)



Tsunami waves are not noticed by ships far out at sea

- As tsunami waves are long wavelength waves, they cannot be perceived in deep oceans.
- Their amplitude is negligible when compared with their wavelength and hence the waves go unnoticed in deep oceans.

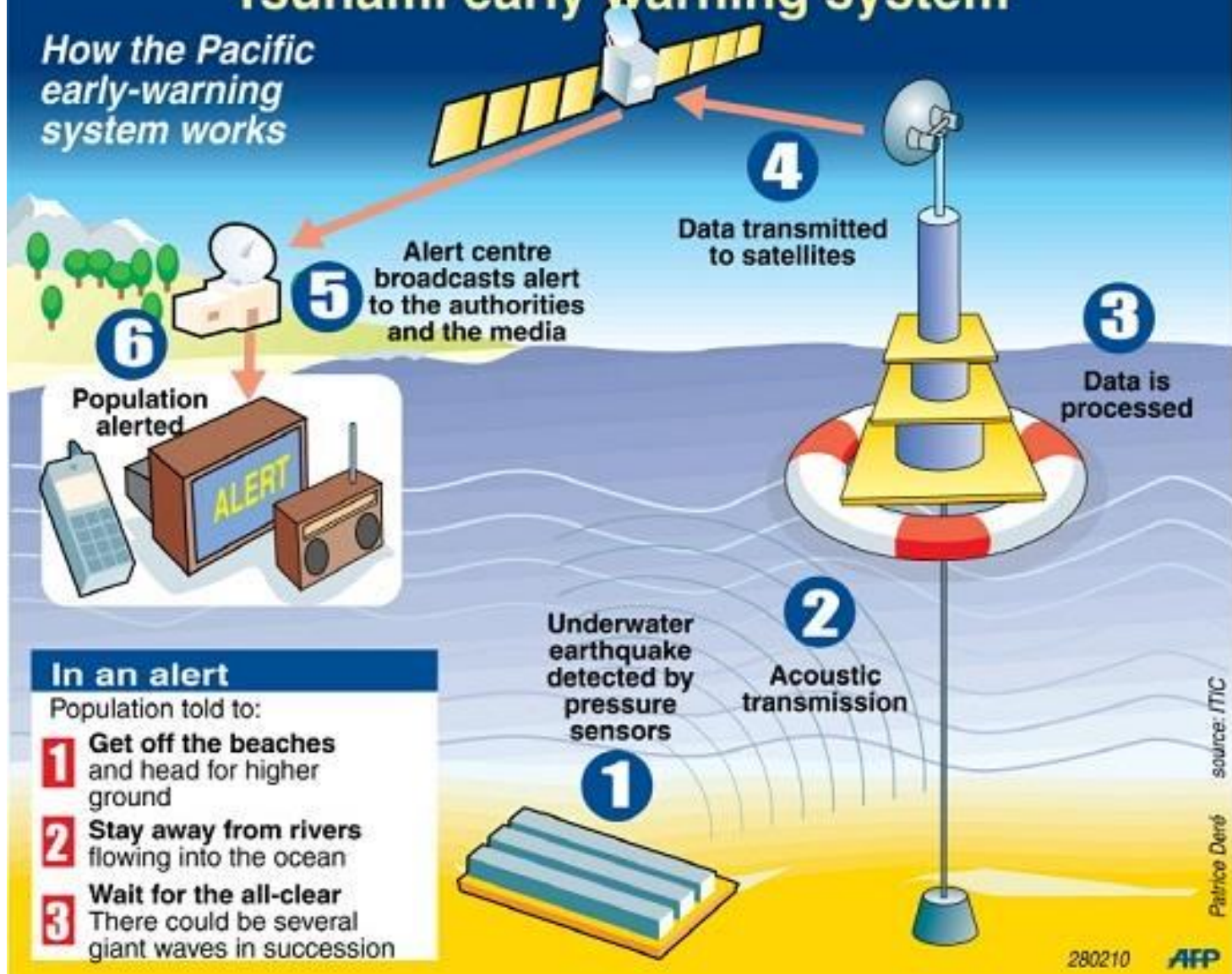
Warning Systems

- While the earthquake cannot be predicted in advance, it is possible to give a three-hour notice of a potential tsunami.
- Such early warning systems are in place across the Pacific Ocean. Post 2004, they were installed in Indian Ocean as well.
- In 1965, early warning system was started by the National Oceanic and Atmospheric Administration (NOAA).
- The member states of the NOAA include the major Pacific Rim countries

- NOAA has developed the 'Deep Ocean Assessment and Reporting of Tsunamis' (DART) gauge.
- Each gauge has a very sensitive pressure recorder on the sea floor. Data is generated whenever changes in water pressure occur.
- The data is transmitted to a surface buoy which then relays it over satellite.
- Computer systems at the Pacific Tsunami Warning Centre (PTWC) in Hawaii monitors data.
- Based on the data, warnings are issued.

Tsunami early warning system

How the Pacific early-warning system works



In an alert

Population told to:

- 1** Get off the beaches and head for higher ground
- 2** Stay away from rivers flowing into the ocean
- 3** Wait for the all-clear
There could be several giant waves in succession

Patrice Deré source: ITIC

280210

AFP

India's preparedness

- The Deep Ocean Assessment and Reporting System (DOARS) was set up in the Indian Ocean post 2014.
- The Indian government plans to set up a network with Indonesia, Myanmar and Thailand etc..
- A National Tsunami Early Warning Centre, which has the capability to detect earthquakes of more than 6 magnitude in the Indian Ocean, was inaugurated in 2007 in india