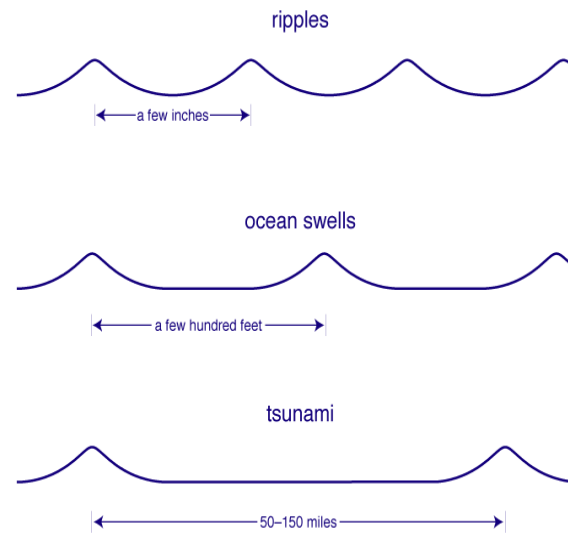


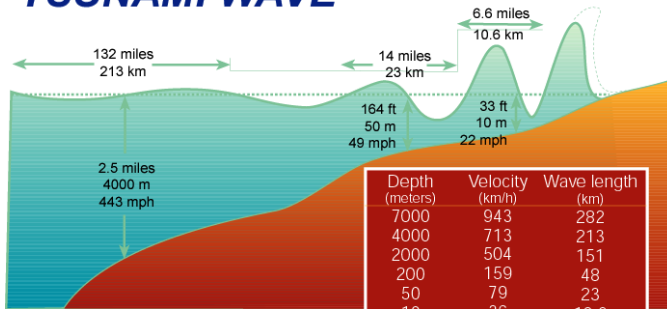
## What is a Tsunami?

- A Japanese word meaning *Harbor Wave*.
- It is a very long period wave
  - 50-250 miles crest to crest
  - 15-75 minutes crest to crest
- Most are earthquake generated
- Speed greater than 500 mph in deep water
- Height is a few inches to 4 feet in deep water
- Most damage is near the earthquake epicenter
- A tsunami wave is classified as a seismic sea wave and not a wind-generated wave; these waves differ

## Different wave types: ripples, ocean swells, tsunamis



## TSUNAMI WAVE



**As it enters shallow water, tsunami wave speed slows and its height increases, creating destructive, life-threatening waves.**

Depth (miles)	Velocity (mph)	Wavelength (miles)
4.4	586	175
2.5	443	132
1.2	313	94
635 ft	99	30
164 ft	49	14
33 ft	22	6.6

## Definitions

**Local Tsunami**—A tsunami that is generated within 60 miles of a location; wave arrival time < 30 min.

**Regional Tsunami**—A tsunami generated between 61 and 1500 mi from a location; wave arrival time 1-3 hr.

**Distant Tsunami (Tele-Tsunami)**—A tsunami generated more than 1500 miles from a location; wave arrival time is more than 3 hours away.

**Destructive Tsunami**—A tsunami that causes impacts/destruction; generally a tsunami wave of 3 ft or more above high tide.

**Non-Destructive Tsunami**—A tsunami that does not cause major impacts/destruction; generally a tsunami wave below 2 ft at high tide.

## Generation Mechanisms

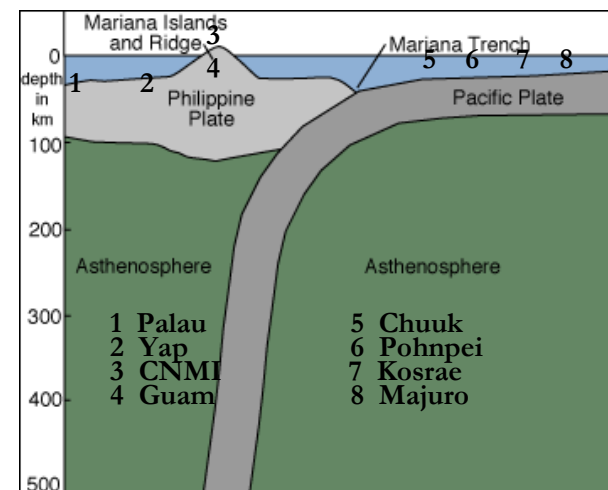
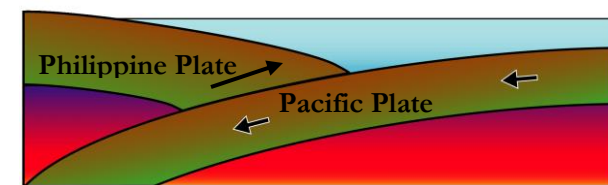
Underwater earthquakes located less than 60 mi (100 km) below the ocean floor.

Very large underwater landslides (~ a mile across)

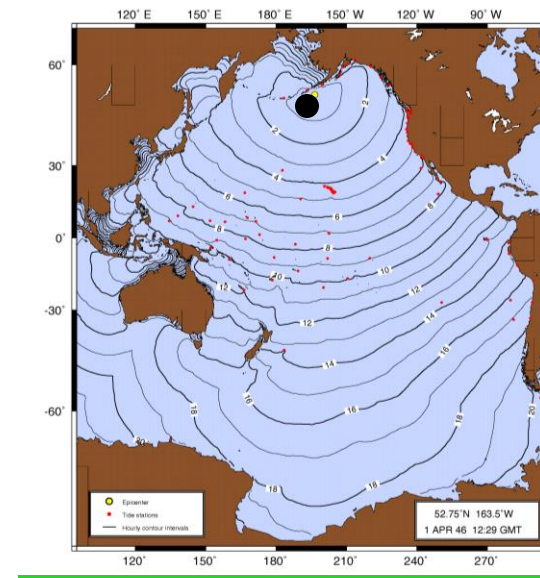
Underwater volcanoes

Meteorites

Anything that rapidly displaces a large volume of water in the ocean or a large body of water. The most common sources of undersea earthquakes are subduction zones where tectonic plates collide, destroying the earth's crust



A tsunami generated near southern Alaska would reach all of Micronesia in 7-9 hours



## “Domestic” Tsunami Products

Bulletins, Watches, Advisories and Warnings are issued by the Pacific Tsunami Warning Center in HI

**Tsunami Bulletin** —A statement that indicates an event, usually an earthquake, has occurred, and indicates whether or not a destructive tsunami could have been generated.

**Tsunami Watch**—A message issued when a potentially destructive tsunami is within 6 hours of a specific location.

**Tsunami Advisory**—A message issued when a tsunami is within 3 hours of a specific location and is expected to be less than 3 feet. Could cause strong currents.

**Tsunami Warning**—A message issued when a potentially destructive tsunami is within 3 hours of a specific location and is expected to produce a wave 3 feet or greater.



Pacific Tsunami Warning Center (PTWC), Pearl Harbor, Hawaii (Located on the third/top floor)

## Warning Process

An Information, Watch, Advisory or Warning Bulletin is sent to the Emergency Management Offices, and also to the Guam Weather Forecast Office (WFO), where it sets off an alarm. WFO Guam then contacts the appropriate Homeland Security Emergency Management Office HS/OCD or HSEM to make sure it received the information.

**For an Info Bulletin:** The disaster office monitors the situation to see if a destructive tsunami was generated.

**For a Watch (destructive tsunami may arrive within 6 hours):** The EMO notifies key Government personnel to get ready to respond and may issue a statement telling people to listen for further instructions.

**For an Advisory (strong currents may arrive within 3 hours):** The Governor(s) or his/her designated representative will direct people to get out of the water and off the beaches. Response instructions will be disseminated as appropriate.

**For a Warning (destructive tsunami may arrive within 3 hours):** The Governor(s) or his/her designated representative will direct an island-wide or selected coastal evacuation. Response instructions will be disseminated as appropriate.

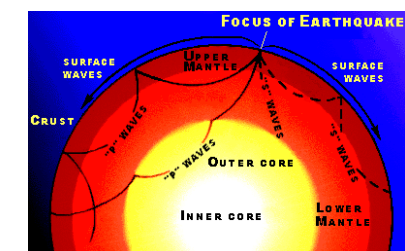
**These warning processes pertain to regional and distant tsunamis. For local tsunamis, there is no time for a watch, advisory or warning. If the ground shakes violently, duck, cover and hold on, then immediately get away from shore after the earthquake stops. If possible, go up 50 feet of elevation and 100 feet inland. In hotels, follow directions of the staff.**

## Destructive Tsunami Characteristics

Tsunami warnings are based on waves that travel through the earth.

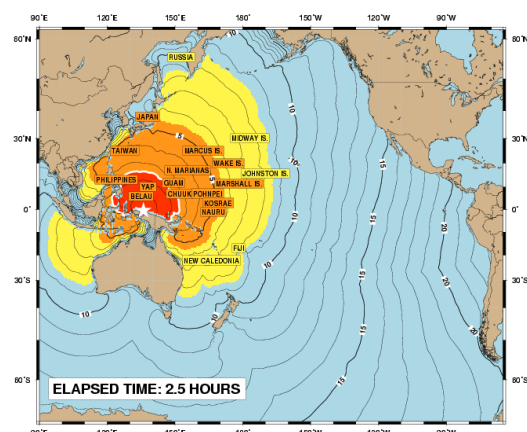
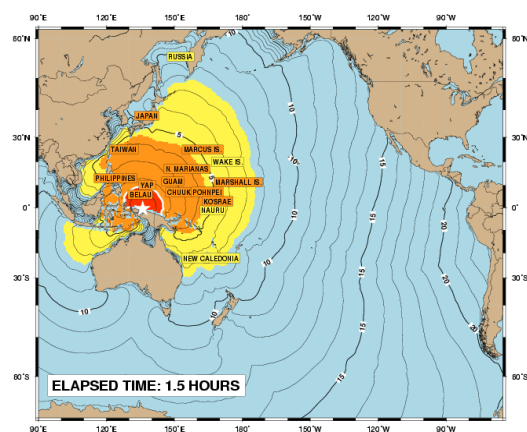
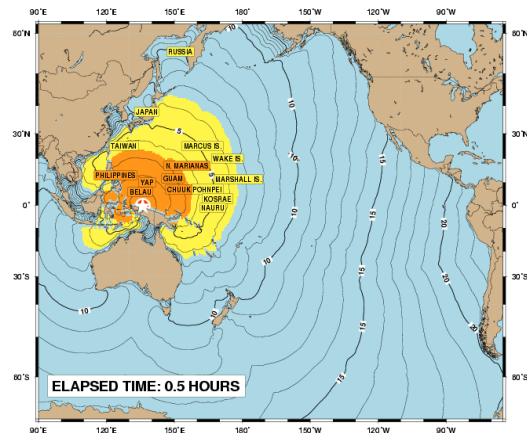
**For local tsunamis (within 60 mi/100 km):** An earthquake of at least magnitude 7.5 on the Richter Scale is usually needed.

**For regional or distant tsunamis (greater than 60 mi/100 km):** An earthquake of at least 7.9 on the Richter Scale is usually needed.



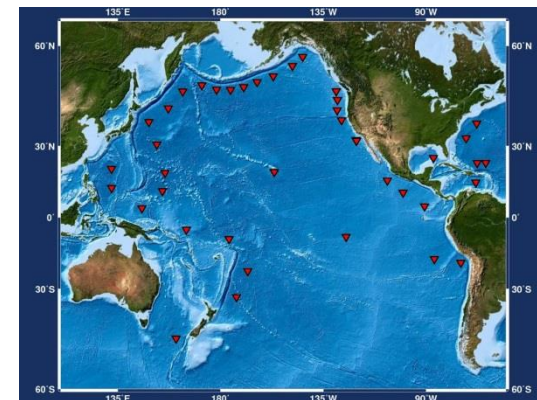
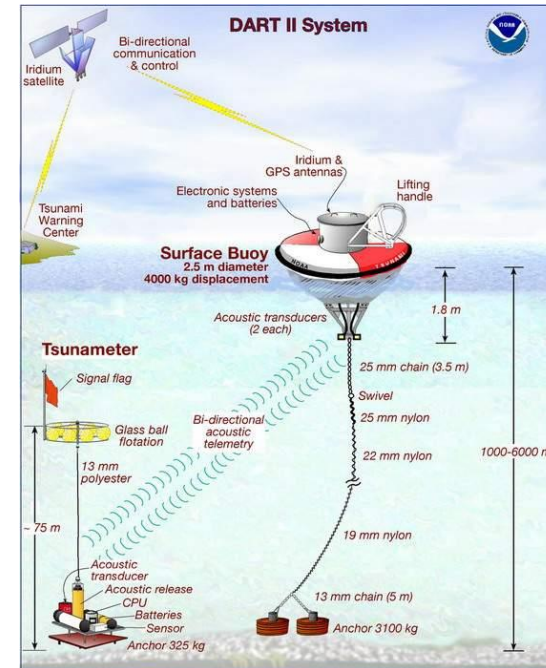


A tsunami generated near Papua New Guinea would require a warning for most of Micronesia (orange area) and a watch for the remainder (yellow area) within 0.5 hour of wave formation. Within 1.5 hours, virtually all of Micronesia would be in a warning. The tsunami (red with white star) would already have arrived at Palau, Yap, Guam, the CNMI and Chuuk. In 2.5 hours, the tsunami would have arrived at all of the Micronesian islands.



## Detecting Tsunamis

Two primary sensors are used to detect tsunamis—**Deep Ocean Real-Time Tsunami monitoring buoys (DART buoys)** and tidal gauges.



Dart Buoy locations (above); tide gauges (below).



## Tsunami Watches, Advisories and Warnings

Set by the **Pacific Tsunami Warning Center (PTWC)**

**Tsunami Information Bulletin- 1)** A destructive tsunami may have been generated, wait for further guidance; or, **2)** no destructive tsunami was generated from a recent earthquake

**Watch:** A potentially destructive tsunami is possible within 6 hours; prepare to respond.

**Advisory:** A non-destructive tsunami with strong currents and < 3 feet flooding possible within 3 hours.

**Warning:** A potentially destructive tsunami is possible w/i 3 hours; move inland to higher ground or a safe zone.

**Tsunami Cancellation-no destructive tsunami is expected; strong currents may occur near coast**

**All Clear- Only given by local authorities.**

## Dissemination of Tsunami Watches and Warnings

It takes the PTWC about 10 minutes to detect an earthquake and generate a Bulletin, Watch, Advisory or Warning for the Western North Pacific Islands.

### What to do during a local tsunami

1. After strong shaking or a rapid change in sea level, get away from the coast line; don't try to save property; save people.
2. If possible, go up 50 feet and inland 100 feet.
3. Follow emergency instructions as soon as they are available.
4. Wait for the "all clear" signal from emergency mgrs; several (3 or 4) tsunami waves can occur. If no one gives the "all clear", check with Emergency Mgmt.
5. Assess damages, especially to food and drinking water sources, and critical infrastructure.

### What to do during a regional or distant tsunami

1. Listen to directions from emergency mgmt. leaders.
2. If a watch is set for your location, get ready to respond. You can gather important papers and valuables, and plan escape while you are waiting.
3. If a warning is set for your location, follow directions 2 through 6 above.

### Historical Micronesian Tsunamis Over 3 Feet Guam: 1849, 1892, 1952, 1993; Tinian: 1994

### Tsunami Tracking and Education

<http://www.prh.noaa.gov/ptwc/>

<http://ioc3.unesco.org/itic/>

## Tsunamis in the Marianas: Are You Prepared?

Reading this will help!



Tsunami wave crossing the Maldives west of India during the December 26, 2004 Indian Ocean Tsunami.



**NATIONAL WEATHER SERVICE  
FORECAST OFFICE GUAM  
3232 HUENEME ROAD  
BARRIGADA, GUAM 96913**

**National Oceanic and Atmospheric Administration  
U.S. Department of Commerce**

Website: [weather.gov/gum](http://weather.gov/gum)  
Phone number: (671) 472-0900

(Updated 7 September 2015)

Extracted primarily from: Training materials used in seminars conducted by Mr. Charles "Chip" Guard across Micronesia. Many materials were provided by the Pacific Tsunami Warning Center (PTWC), Pearl Harbor, Hawaii and the International Tsunami Information Center (ITIC), Pearl Harbor, Hawaii.