

# Tsunami Hazard



# What is a Tsunami?

津波

Tsu = harbor

Nami = wave

(Japanese terms)

A tsunami is a series of travelling waves most commonly generated by vertical displacements of the sea floor associated with earthquakes below or near the ocean floor that cause a huge amount of seawater to be abruptly displaced.

# Categories of Tsunamis

## Near-field/ local Tsunamis

Near-field tsunamis: tsunamis that occur within 200 km of the epicentre of an earthquake

Local tsunamis: tsunami from a nearby source for which its destructive effects are confined to coasts within less than 200 km

## Far-field Tsunamis

Far-field tsunamis: a tsunami originating from thousands of kilometres from the affected areas; usually starting as a near-field tsunami that causes extensive destruction near the source and additional casualties and destruction on shores more than 1000 km from its source

# What Cause a Tsunami?

1. Vertical movement of the seafloor related to **subduction zone earthquakes (95)**
2. Submarine **volcanic eruptions (5)**
3. Submarine **landslides (1)**
4. Extraterrestrial: **Meteor** impact

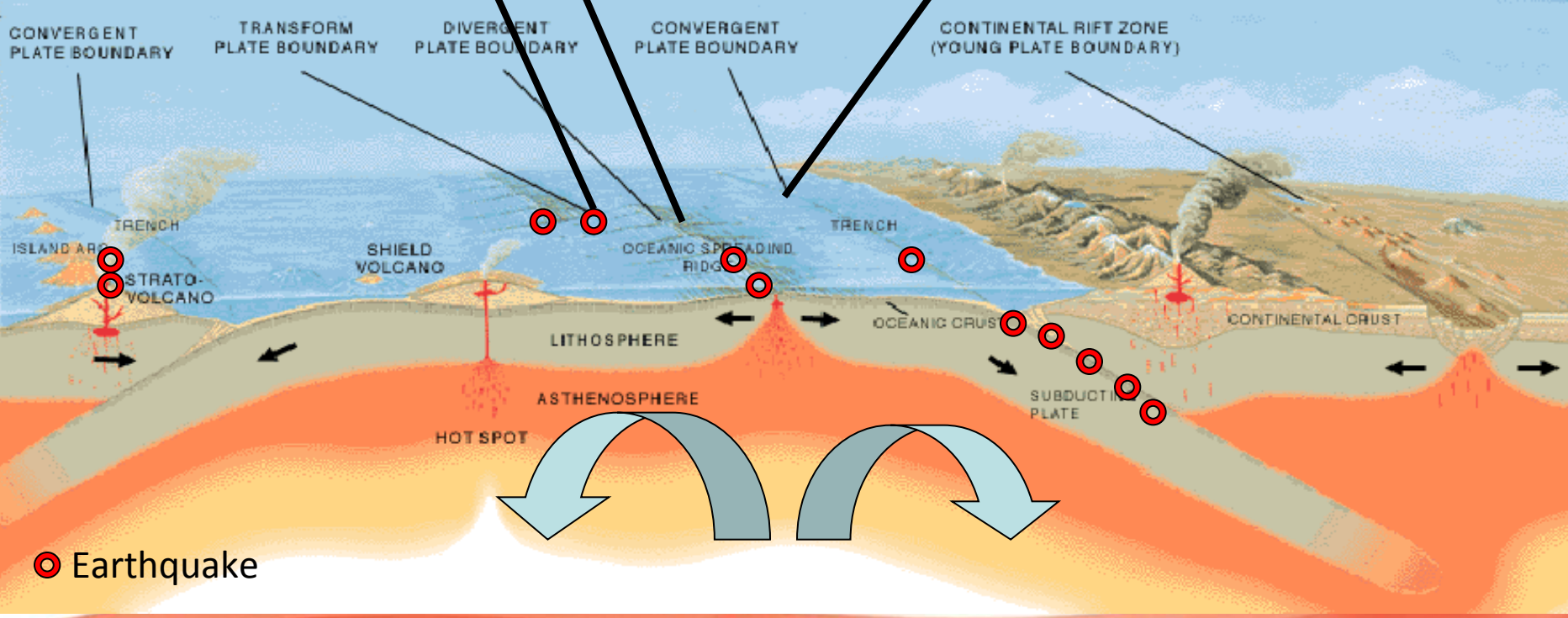
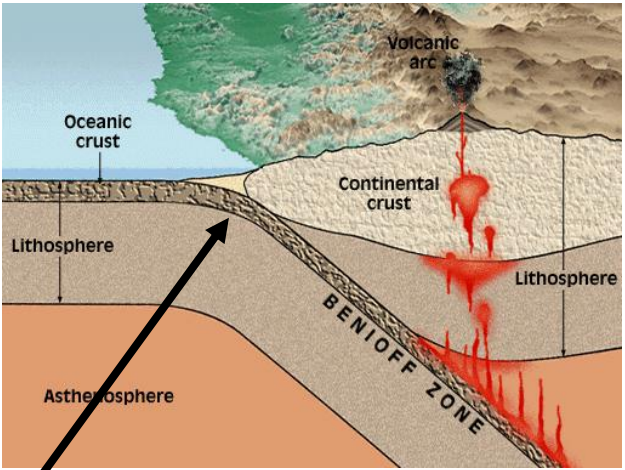
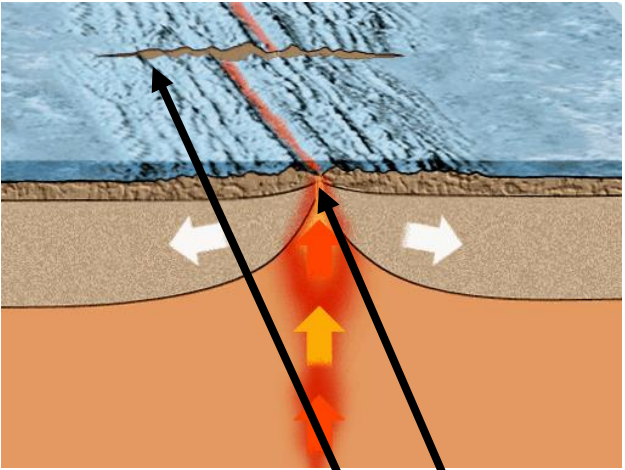
津波

(Approx. number of tsunamis for different sources since 1900 in Indonesia)

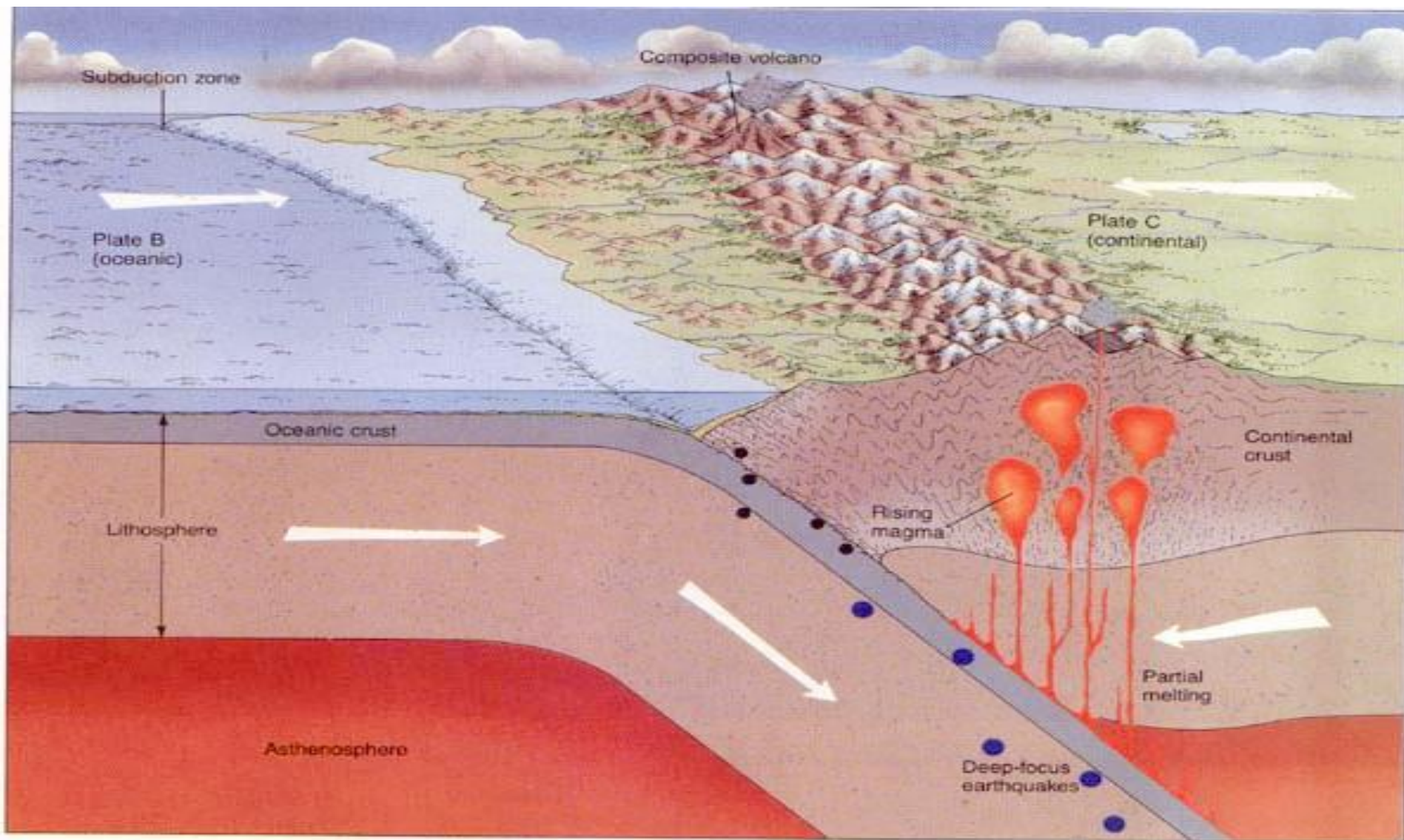
# The Tectonic Plate Movement



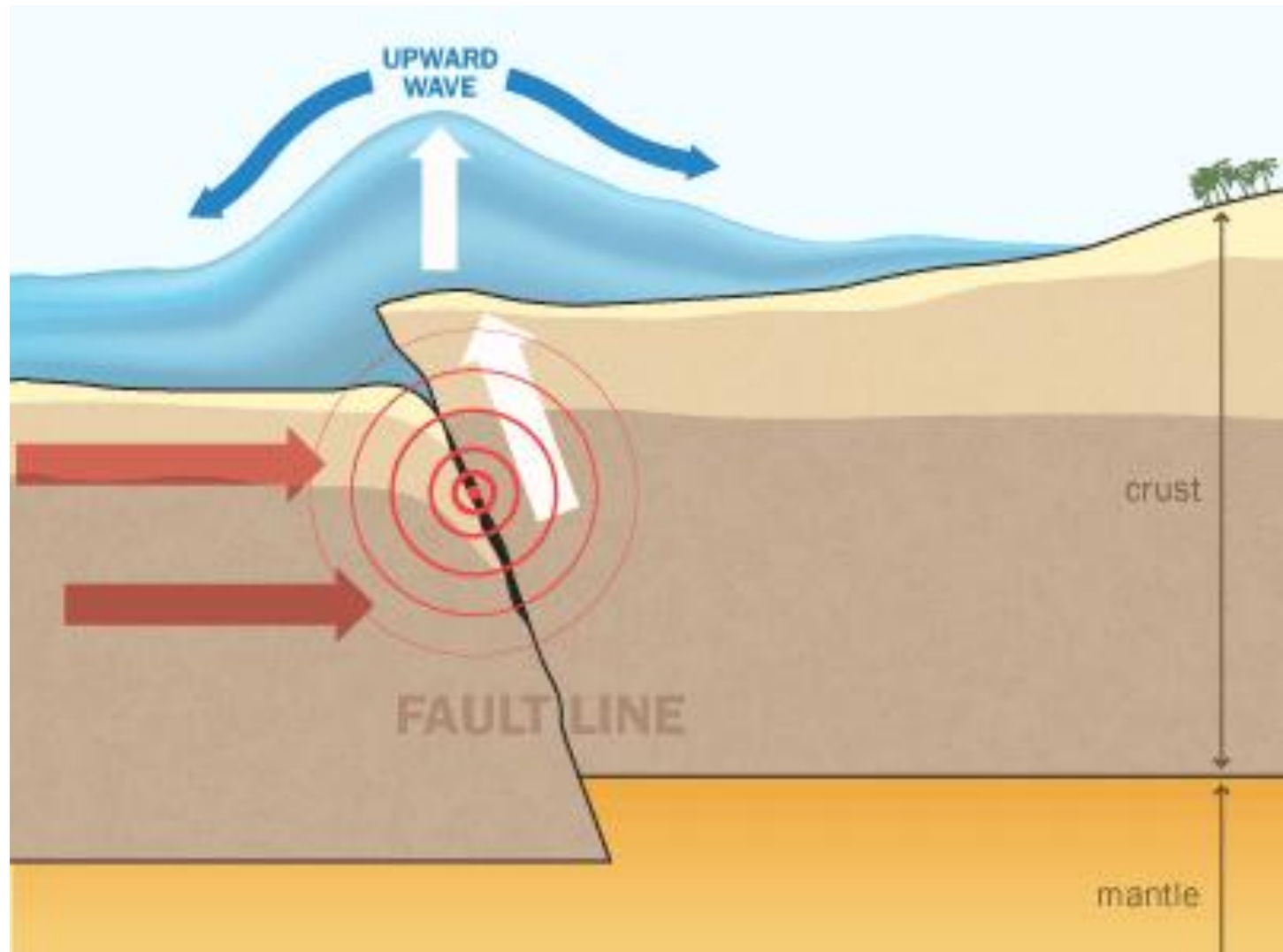
# Principles of Plate Tectonics



# Subduction Zone

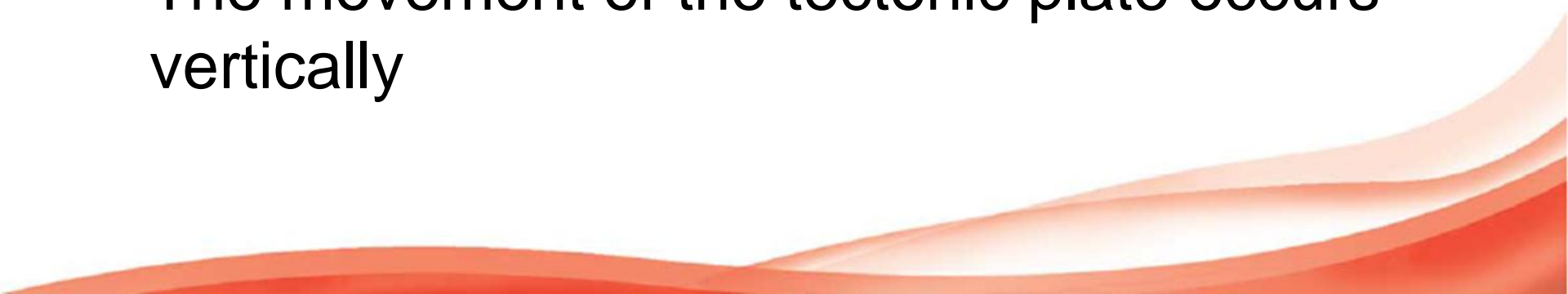


# Vertical Movement generates Tsunami

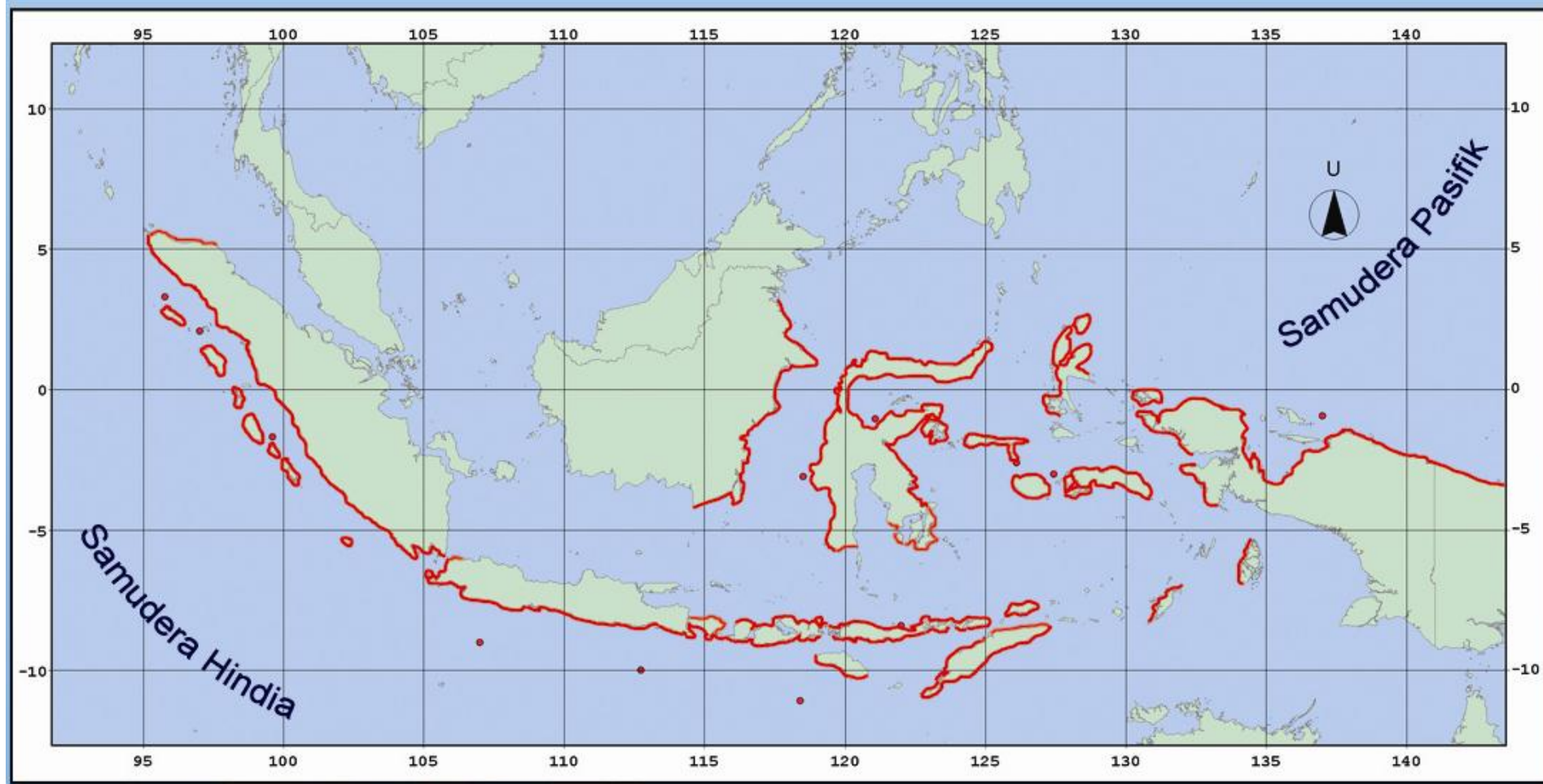




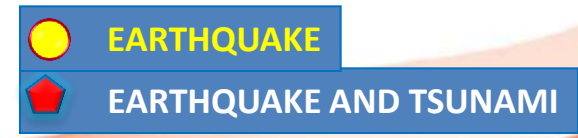
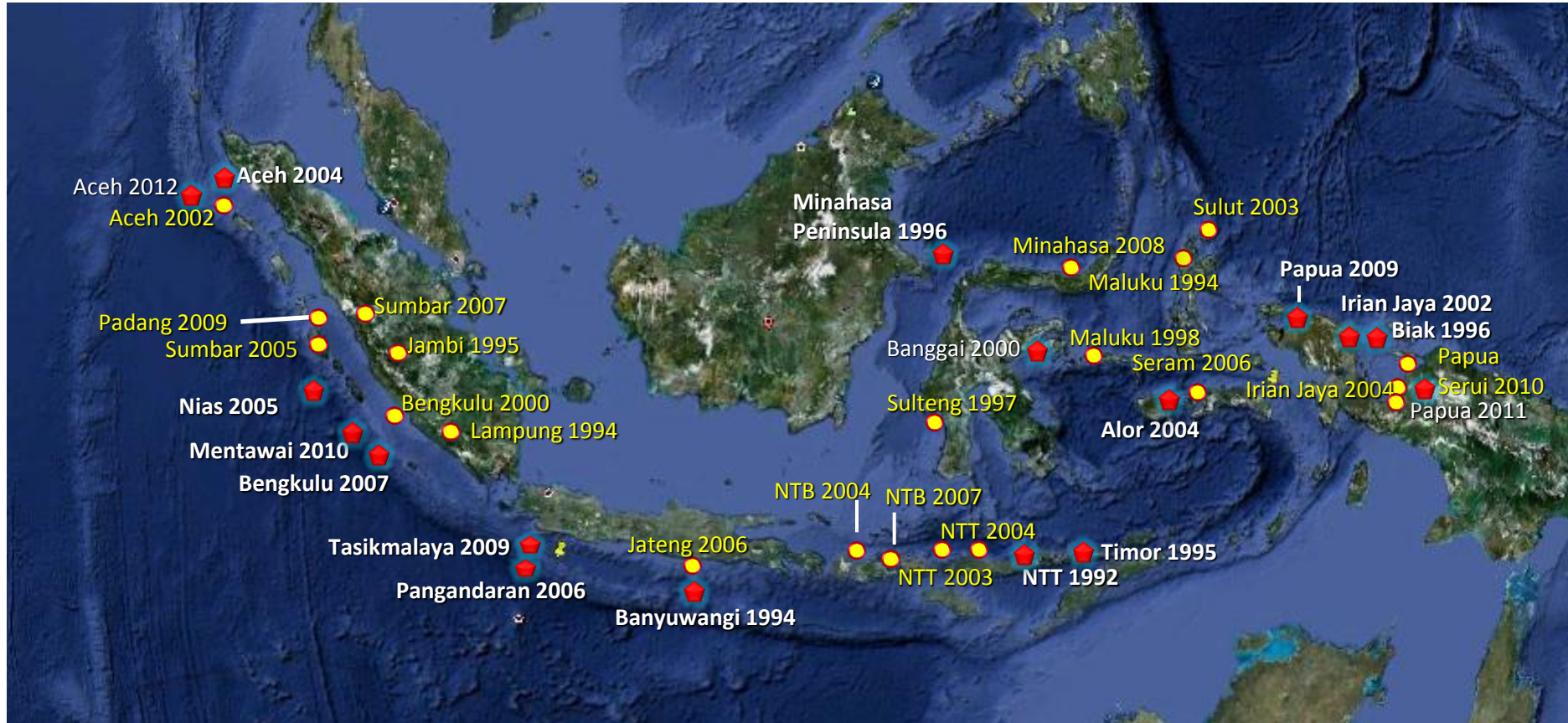
# Parameter for Tsunamigenic Earthquakes

- Located under the sea (submarine earthquake)
  - Depth of the centre of the submarine earthquake is less than 100 km
  - Magnitude 7 or more in Richter Scale
  - The movement of the tectonic plate occurs vertically
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# Tsunami Prone Areas in Indonesia

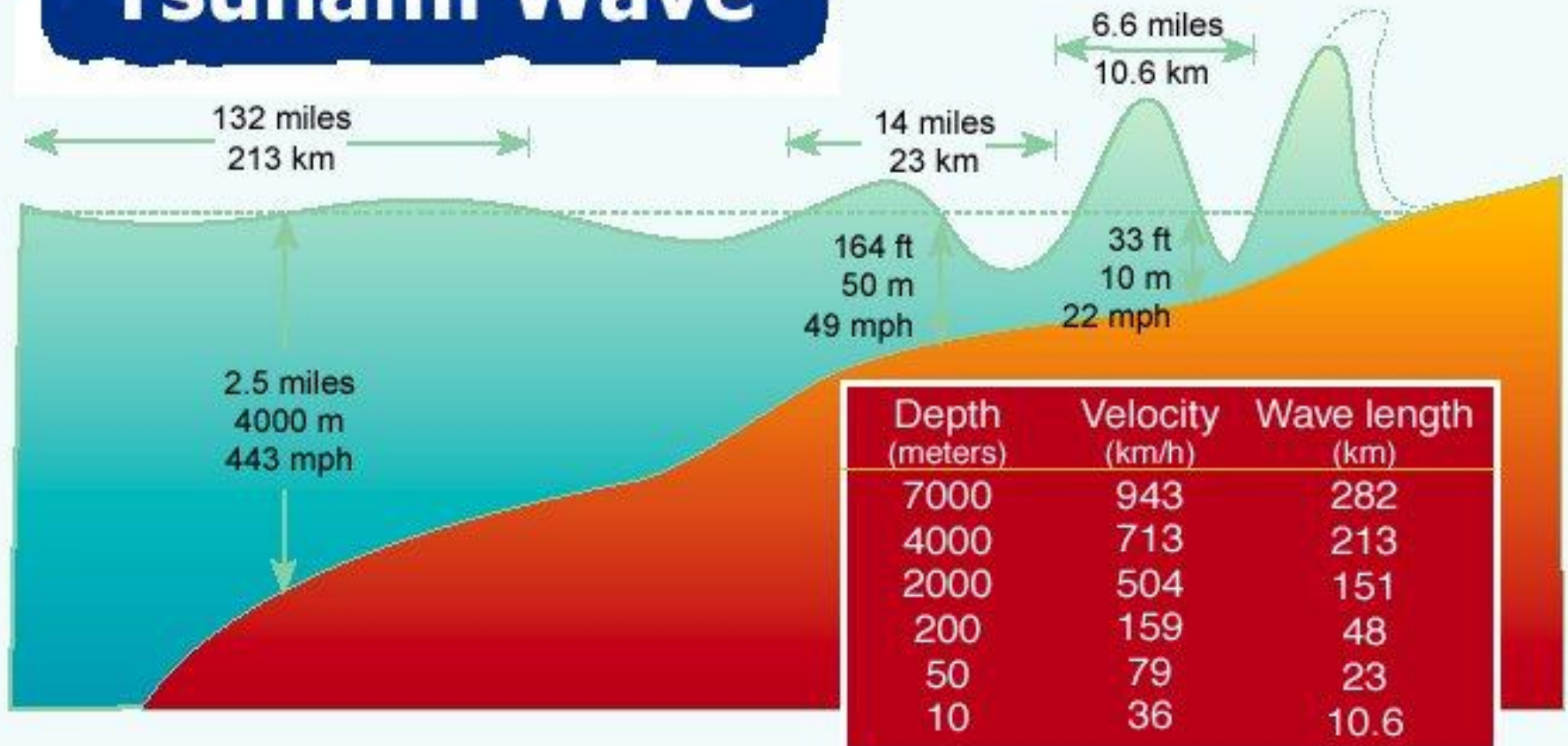


# Destructive Earthquakes and Tsunamis in Indonesia (1992 – April 2012)

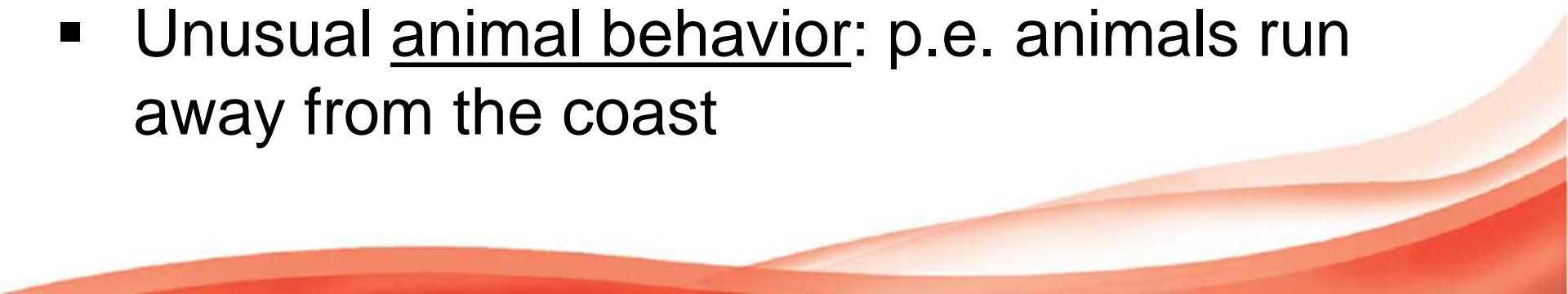


# Tsunami Characteristics

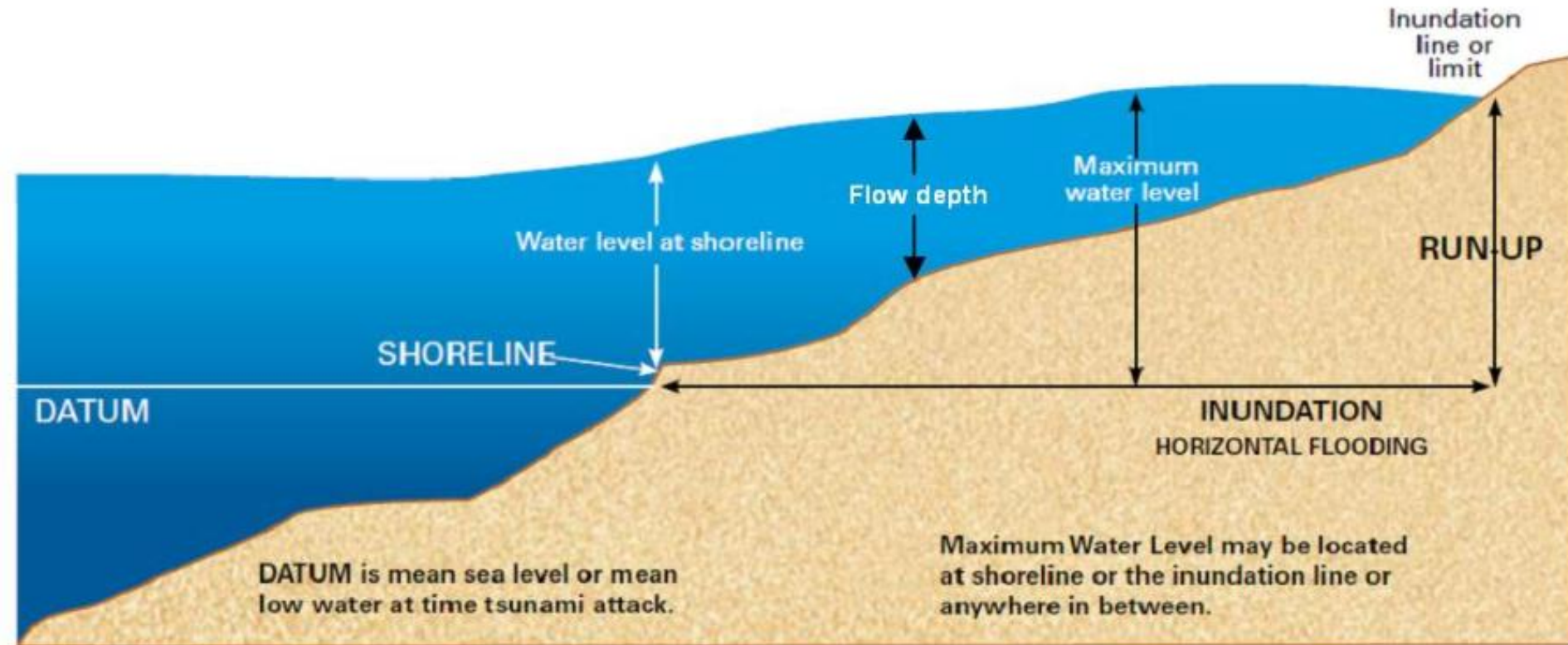
## Tsunami Wave



# Natural Warning Signs

- Ground shaking from a strong earthquake
  - Seawater withdrawal in a very quick and unusual way
  - A roaring sound that resembles the sound of an airplane or train
  - Strong winds blow from the sea to the coast
  - Unusually smells waft from the beach
  - Unusual animal behavior: p.e. animals run away from the coast
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# The Impact of Tsunamis

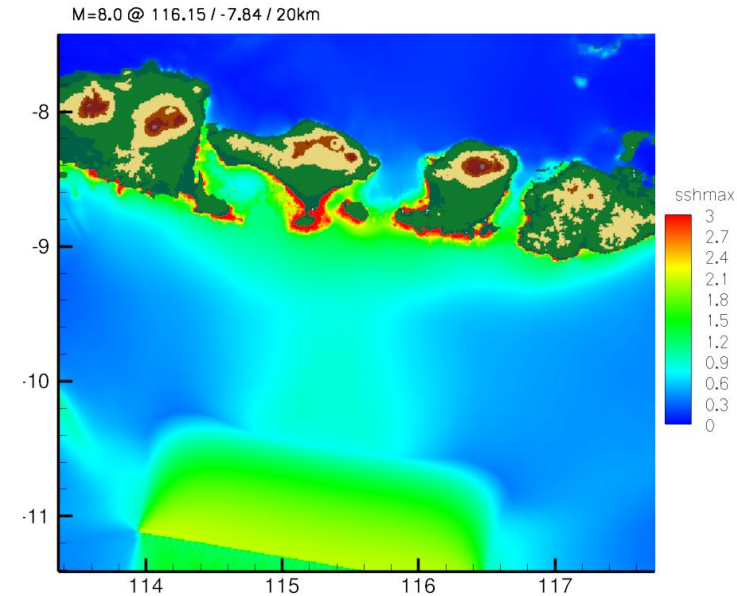


# Damages caused by Tsunamis



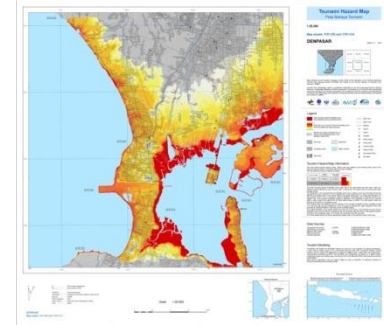
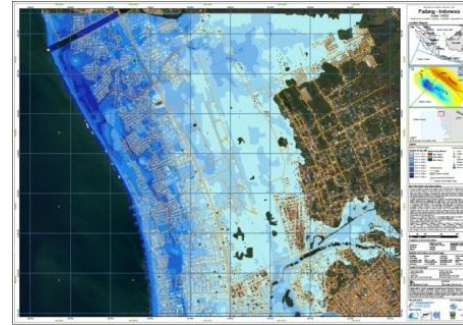
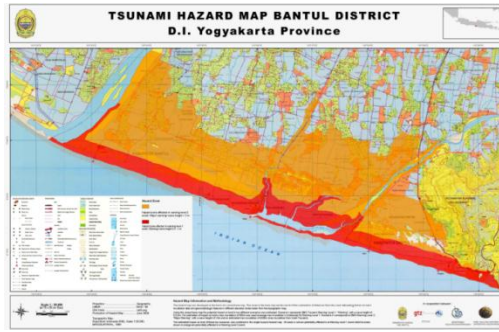
# Tsunami Hazard Assessment

- Information on source areas
- Historical events
- Paleo-tsunami studies
- Scenarios
- Estimated travel times from source areas
- Wave height at coast
- Areas inland to be affected by tsunamis (in terms of maximum inundation, flow depths, probability)



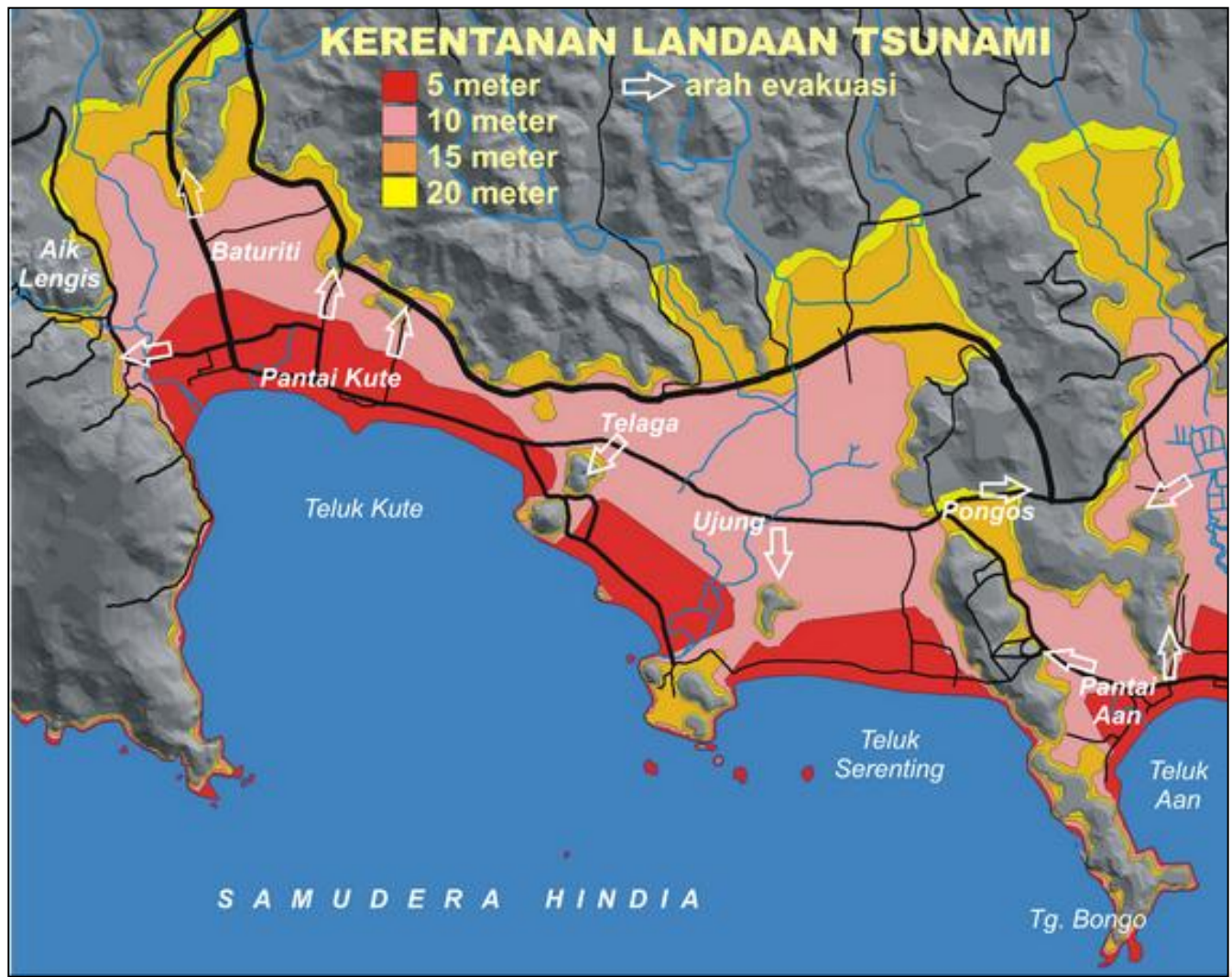


# Approaches for Hazard Mapping

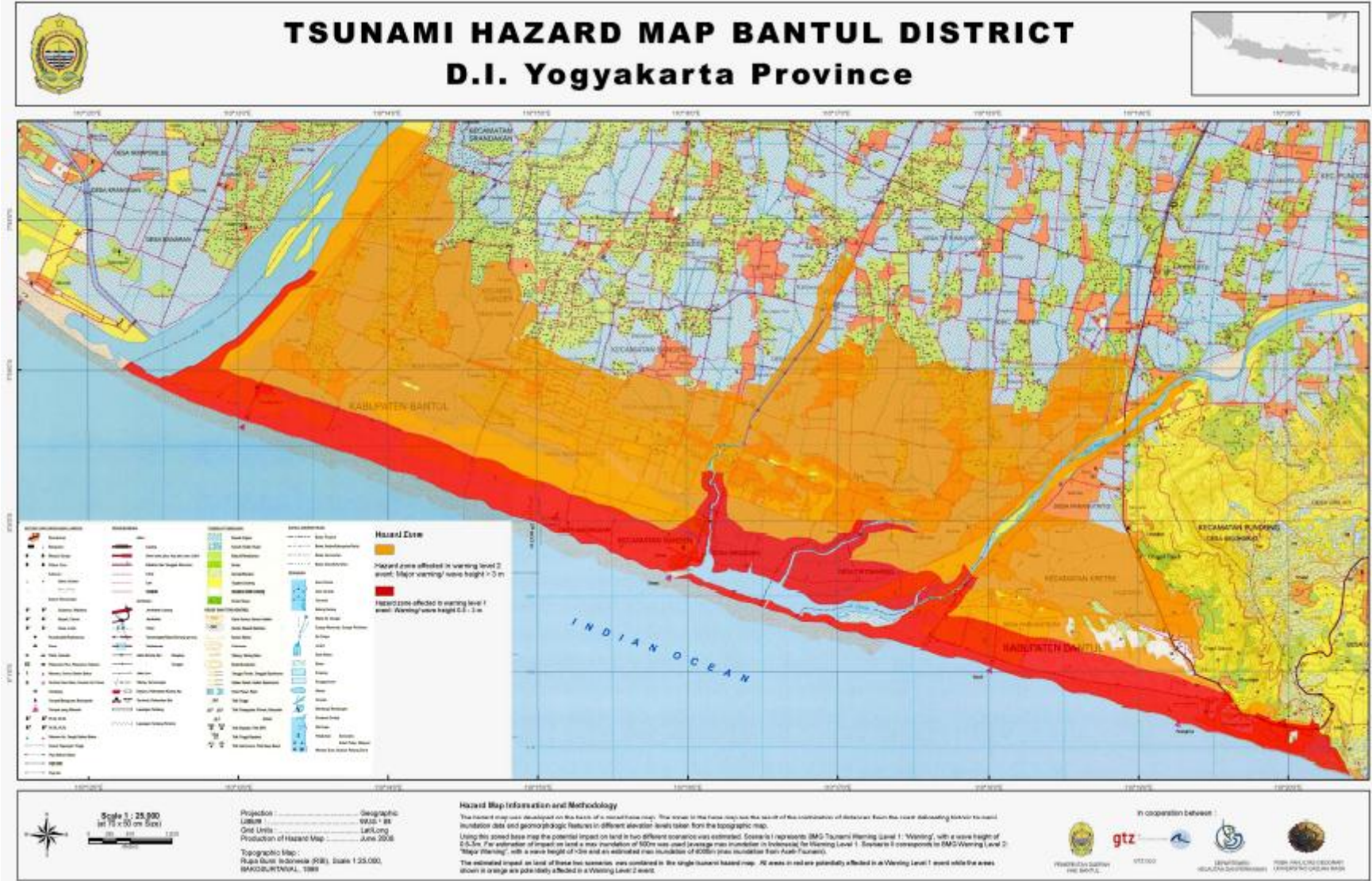


1. “Bathtub” Model - based on topography only:  
**Kuta / Lombok**
2. Based on topography but incorporating local knowledge and a rule based wave attenuation factor: **Bantul**
3. Single scenario approach - most credible or worst case: **Padang**
4. Multi-scenario approaches: **Southern Bali**

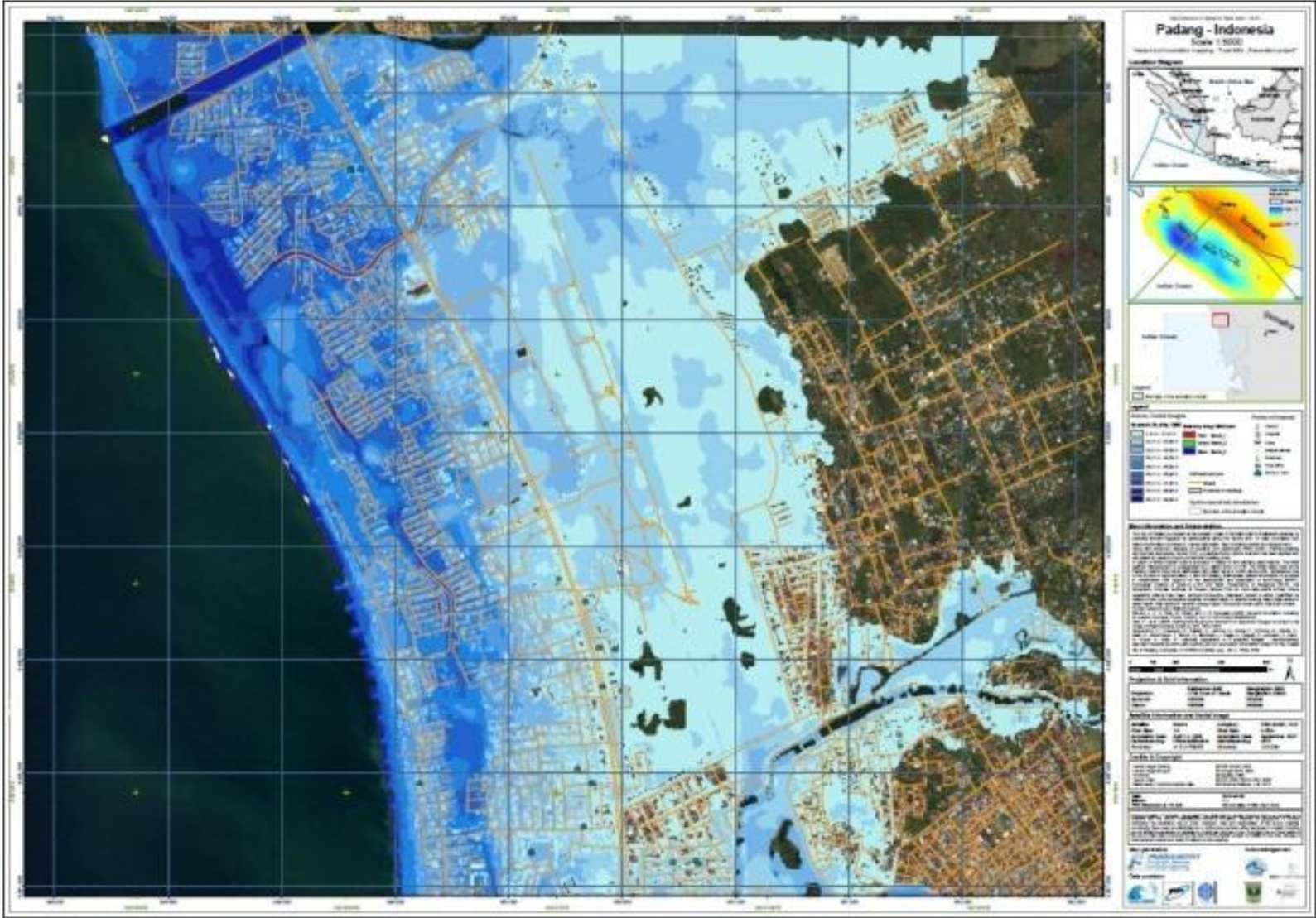
# Level 1: Tsunami Hazard Map for Kuta-Lombok



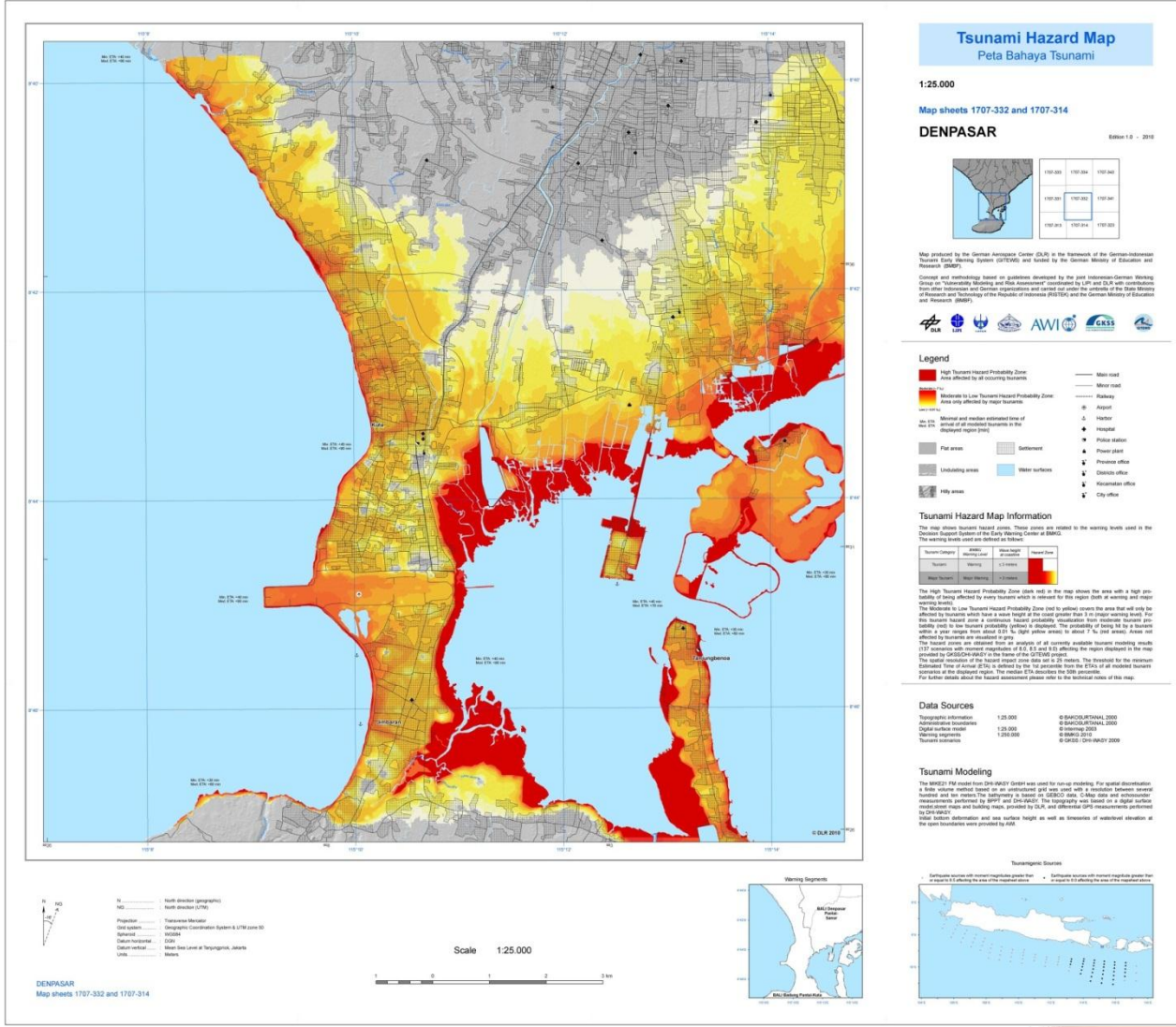
# Level 2: Tsunami Hazard Map for Bantul



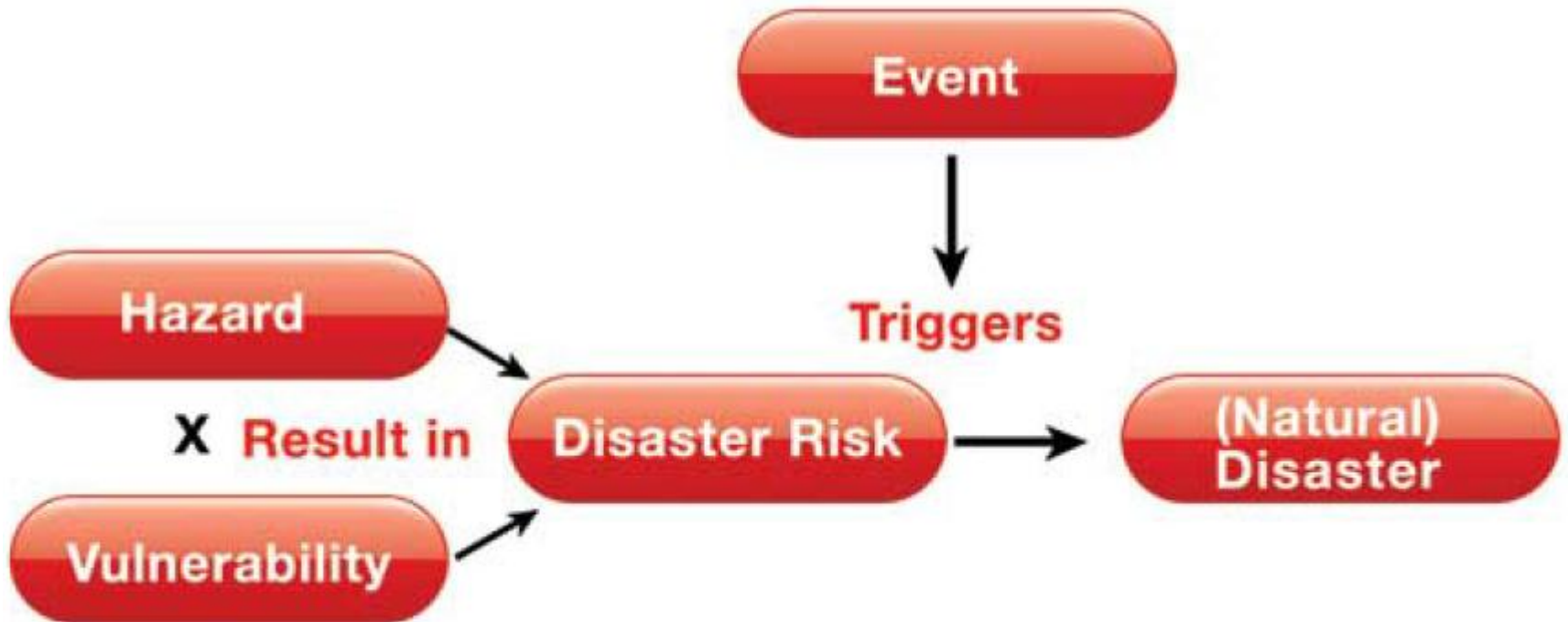
# Level 3: Tsunami Inundation Map for Padang



# Level 4: Tsunami Hazard Map for southern Bali



# Hazard & Disaster Risk



Natural hazards do not necessarily cause disasters. A disaster occurs only if a population is exposed to the natural hazard and cannot cope with its effects.

# UNISDR Terminology

**Hazard:** A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage

**Vulnerability:** The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard

**Risk:** The combination of the probability of an event and its negative consequences



**Project for Training, Education and Consulting for  
Tsunami Early Warning System (PROTECTS)  
Capacity Development in Local Communities**



[www.gitews.org/tsunami-kit](http://www.gitews.org/tsunami-kit)

