



# **INDONESIAN NEWS**

## **AUGUST-OCTOBER 2018**

**Dr. Susan Bliss**

**VOLCANIC ERUPTIONS  
EARTHQUAKES  
TSUNAMI  
LIQUEFACTION  
UNDERSEA LANDSLIDES  
ABOVE GROUND LANDSLIDES**

*A ship stranded on the shore after an earthquake and tsunami hit Wani, Donggala, Central Sulawesi, Indonesia  
October 1, 2018*

*Antara Foto/Muhammad Adimaja/ via REUTERS*

*<http://morungexpress.com/indonesia-earthquake-tsunami-toll-reaches-164>*

## CURRICULUM: GEOGRAPHY AND SCIENCE

### VISUAL LITERACY: PHOTOGRAPHS, DIAGRAMS, GRAPHS, VIDEOS, SATELLITE, INFOGRAPHICS

Indonesia is located on the **Ring of Fire** and on **several tectonic plates**:

- **Continental plates:** **Eurasian Plate** (Sunda Plate) and **Australian Plate** (Sahul Shelf)
- **Oceanic plates:** **Philippine Sea Plate** and **Pacific Plate**

Because of Indonesia's location the country contains more active volcanoes than any other country, and is at risk from multiple **geomorphic hazards** such as **earthquakes**, **earthquake generated tsunamis**, **liquefaction** and **landslides**. Following the 2004 Indian Ocean Tsunami the Indonesian government enacted a law on disaster management and in 2008 created the **National Disaster Management Agency (BNPB)**. Additionally, the new 2015-2019 development plan outlines the country's disaster management policy, which aims to reduce risk, increase the resilience of national and local governments, and support communities facing disasters.

<https://www.gfdr.org/indonesia>; [https://en.wikipedia.org/wiki/Geology\\_of\\_Indonesia](https://en.wikipedia.org/wiki/Geology_of_Indonesia)

#### CONTENT

- Landscapes and landforms
- Geomorphic processes
- Geomorphic hazards-causes, impacts and responses

#### GENERAL CAPABILITIES

- Literacy
- Numeracy
- Information and Communications Technology
- Critical and Creative Thinking
- Personal and Social Capability
- Civics and Citizenship
- Work and Enterprise

#### KEY INQUIRY QUESTIONS

- How do geomorphic processes produce landforms in Indonesia, over time?
- Where are the geomorphic hazards located in Indonesia?
- What are the spiritual, cultural and economic values of volcanoes in Indonesia?
- How can the volatile volcanic and earthquake prone landscapes be managed sustainably?
- What were the impacts of the present volcanic eruptions, earthquakes, tsunamis, liquefaction and landslides on Indonesian people?
- What are the different perspectives of people, organisations and governments on the management of volcanic eruptions, earthquakes, tsunamis, liquefaction and landslides in Indonesia?

#### THINK, PUZZLE, EXPLORE

- **Place:** How do geomorphic processes produce different landforms across Indonesia?
- **Space:** What is the spatial distribution of volcanoes across Indonesia?
- **Sustainability** How can technology contribute to sustainable landscapes, by preventing and/or responding to these geomorphic disasters?
- **Change:** How do these geomorphic hazards change landscapes and their settlements?

#### INQUIRY PROCESS

- **Plan an investigation** into the causes, impacts and responses to recent geomorphic hazards in Indonesia
- **Identify** geomorphic process resulting in the recent hazards in Indonesia
- **Collect and record** relevant geographical data using primary and/or secondary sources
- **Represent data and information** using maps, satellite imagery, diagrams, graphs and photographs
- **Conclude** by presenting an oral report supported by an audio-visual display
- **Reflect** on the management of these hazards, and whether the responses were effective

#### JOURNALIST FOR A DAY

Imagine you are a journalist reporting on one of the recent geomorphic disasters affecting Indonesia. Include:

- What was it?
- Where and when did it occur?
- Why did it occur?
- What were its impacts on people and the environment?
- What were the responses local, national and global?
- Were the responses effective? If not, suggest sustainable management strategies.

Photograph: <https://www.channelnewsasia.com/news/asia/un-warns-pacific-ring-of-fire-is-active-as-volcanoes-erupt-9891808>



## WHAT ARE GEOMORPHIC HAZARDS?

Geomorphic hazards originate from the lithosphere. The hazards include:

- volcanic eruptions
- earthquakes
- earthquake or undersea landslide generated tsunamis
- mass movements-landslides, avalanches and liquefaction

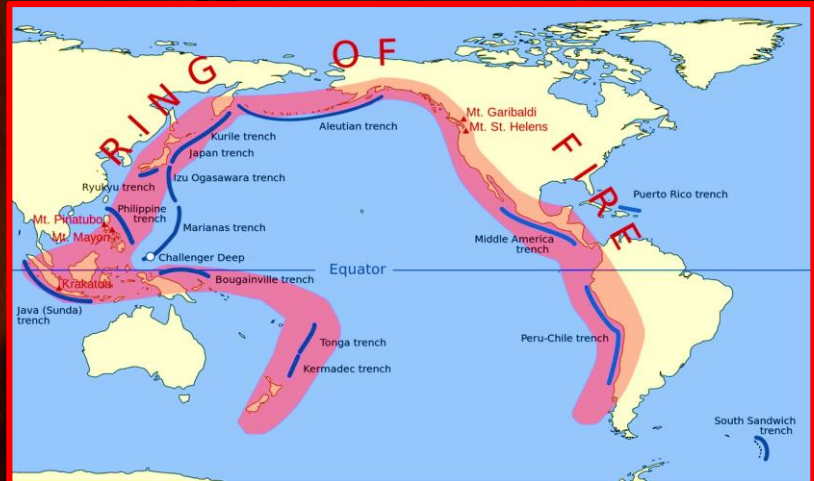
## WHERE WERE RECENT RUMBLING VOLCANOES LOCATED IN ASIA?

**Mount Agung** in **Bali** experienced recent eruptions that affected the tourist industry.

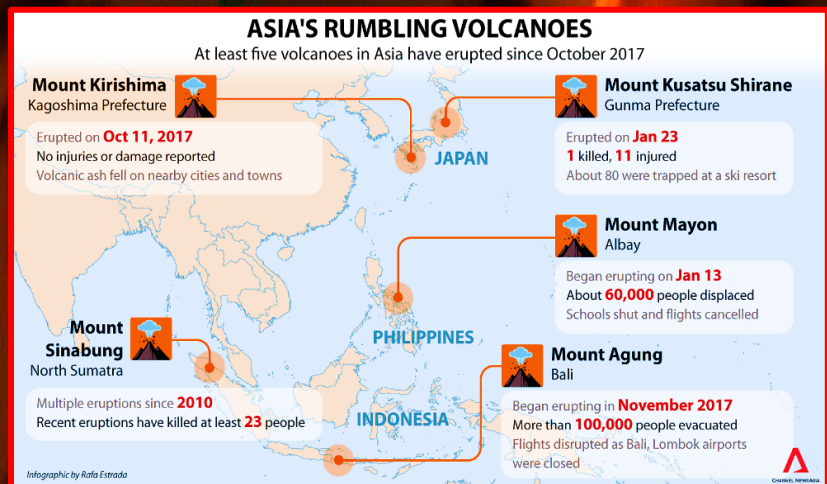
<https://www.channelnewsasia.com/news/asia/un-warns-pacific-ring-of-fire-is-active-as-volcanoes-erupt-9891808>

<https://www.livescience.com/43220-subduction-zone-definition.html>

What is the Ring of Fire?



What are the connections between Asia's rumbling volcanoes and the location of the Ring of Fire?



ICT

YouTube

- Plate tectonics <https://www.youtube.com/watch?v=ryrXAGY1dmE>
- The Pacific Ring Of Fire Discovery History Travel full documentary <https://www.youtube.com/watch?v=RzS3ZWQmKYw>
- Top 5 Volcano Eruptions Caught on Camera <https://www.youtube.com/watch?v=VBTAcACmcgo&list=PL5IEdW-FLmxMXoAxAxRKRL0vn4U2sVJJJ4K>

WWW

- UN warns Pacific Ring of Fire is 'active' as volcanoes erupt across Asia Read more at <https://www.channelnewsasia.com/news/asia/un-warns-pacific-ring-of-fire-is-active-as-volcanoes-erupt-9891808>
- Ring of Fire <https://www.nationalgeographic.org/encyclopedia/ring-of-fire/>
- UGS Ring of Fire <https://pubs.usgs.gov/gip/dynamic/fire.html>
- Indonesia Quake-Tsunami - Sulawesi sits on the Biggest Fault on Earth in the Deadly 'Ring of Fire' <https://www.youtube.com/watch?v=BSwpI1z-9hg>

Background: <https://news.abs-cbn.com/overseas/10/04/18/indonesias-mount-soputan-erupts-on-tsunami-hit-island>

## WHAT WERE THE RECENT GEOMORPHIC DISASTERS IN INDONESIA?

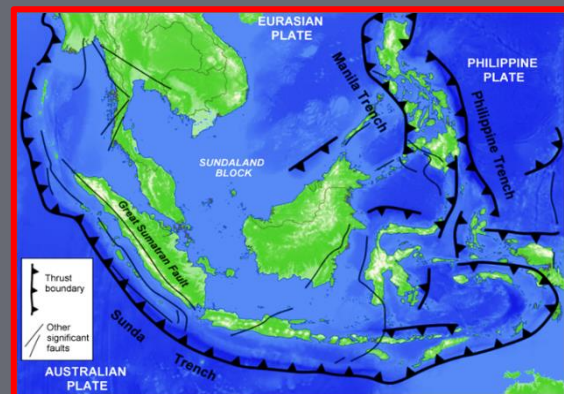
Date	Region	Mag.	Fatalities	Injuries	Comments
2018-09-28	Sulawesi	7.5 M <sub>w</sub>	1,558+	2,549	Major tsunami (local, up to 7m).
2018-08-19	Lombok	6.9 M <sub>w</sub>	14	24	Fatalities also in Sumbawa.
2018-08-19	Lombok	6.3 M <sub>w</sub>	2	3	Aftershock.
2018-08-09	Lombok	5.9 M <sub>w</sub>	6	24	Aftershock.
2018-08-05	Lombok	6.9 M <sub>w</sub>	513	1,353	Widespread damage.
2018-07-29	Lombok	6.4 M <sub>w</sub>	20	401	Foreshock.
2018-07-21	Sumatra	5.2 M <sub>w</sub>	1	2	
2018-04-18	Java	4.5 M <sub>w</sub>	3	21	Buildings damaged locally in Kalibening District.
2018-01-23	Java	6.0 M <sub>w</sub>	2	41	

## WHAT IS THE ZONE OF CONVERGENCE?

Indonesia is located on the **Zone of Convergence**. This is where several tectonic plates meet:

- **Continental plates:** Eurasian Plate (Sunda Plate) and Australian Plate (Sahul Shelf)
- **Oceanic plates:** Philippine Sea Plate and Pacific Plate. Where the tectonic plates converge it is called the **plate boundary**. These plates can either collide or as the case in Indonesia one plate is pushed underneath the other plate. This is referred to as **subduction**

[http://www.weather.gov.sg/learn\\_earthquakes/](http://www.weather.gov.sg/learn_earthquakes/)

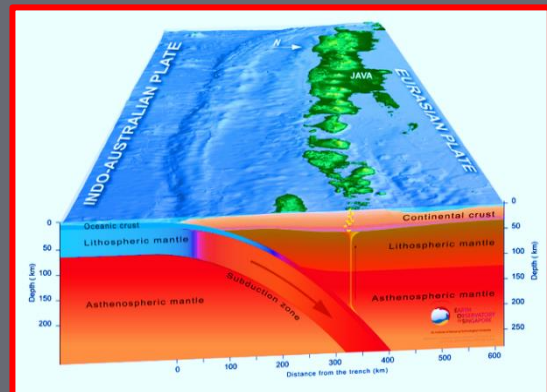


## WHAT ARE THE IMPACTS OF PLATES CONVERGING ON INDONESIA?

Block-diagram shows a cross-section of the **subduction zone** beneath the islands of Java, Bali, Lombok and Sumbawa in Indonesia. The Indo-Australian tectonic plate (on the left) dives under (subduction zone) the Eurasian plate (on the right).

Main features associated with subduction zones.

- Oceanic Trenches formed at subduction zones.
- Volcanic arcs formed parallel to subduction zones
- Earthquakes occur along the subduction zone.



<https://earthobservatory.sg/resources/illustrations/subduction-zone-beneath-java-bali-and-lombok-islands-indonesia>

### YouTube:

- Tectonic Plates and Subduction <https://www.youtube.com/watch?v=KDrDLAzYhGo>
- Plate Tectonics: Seafloor Spreading, Subduction and Megathrust Earthquakes <https://www.youtube.com/watch?v=f-nIb8JkFrg>
- When Earth Erupts- Subduction Zone <https://www.youtube.com/watch?v=NbDqJy28hBw>
- Volcano erupts on Sulawesi, the Indonesian island previously hit by a tsunami <https://www.youtube.com/watch?v=XO4hOCVA5dQ>

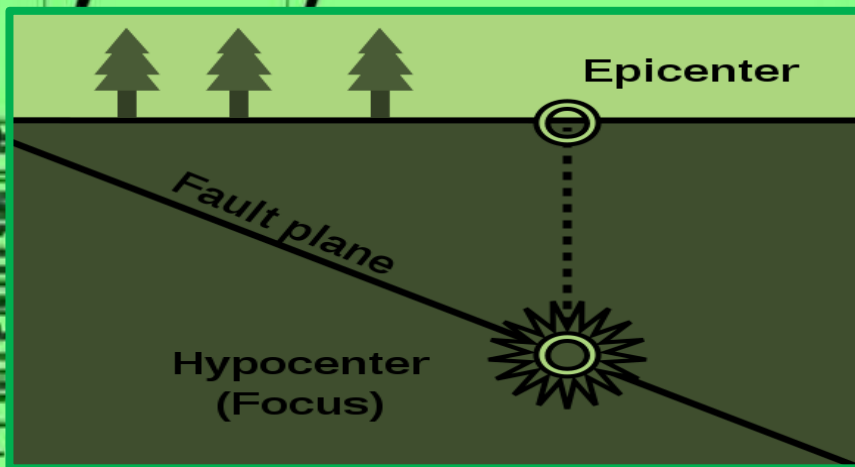
List of natural disasters in Indonesia [https://en.wikipedia.org/wiki/List\\_of\\_natural\\_disasters\\_in\\_Indonesia](https://en.wikipedia.org/wiki/List_of_natural_disasters_in_Indonesia)

Natural disasters in Indonesia <https://factsofindonesia.com/disaster-in-indonesia>

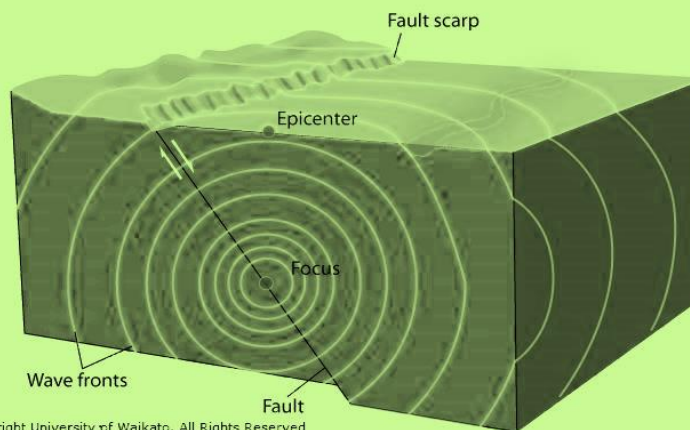


## EARTHQUAKES: WHAT ARE THE GEOMORPHIC PROCESSES?

- **EPICENTRE:** Point on the Earth's surface directly above a **HYPOCENTRE**.
- **HYPOCENTRE** or **FOCUS:** Point where an earthquake or an underground movement originates.
- **SEISMIC WAVES:** When an earthquake occurs **shock waves of energy**, called **SEISMIC WAVES**, are released from the earthquake focus.
- **SEISMOGRAPHS:** Shock waves of energy that travels through the Earth is recorded on seismographs. These waves shake the Earth, and turn soft deposits such as sand into jelly, called **LIQUEFACTION**



### Seismic Waves Radiate from the Focus of an Earthquake



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[https://en.wikipedia.org/wiki/Epicenter#/media/File:Epicenter\\_Diagram.svg](https://en.wikipedia.org/wiki/Epicenter#/media/File:Epicenter_Diagram.svg)  
<https://www.sciencelearn.org.nz/resources/340-seismic-waves>

#### You/tube:

- Earthquake Waves <https://www.youtube.com/watch?v=HwY1ICqWGEA>
  - What Is Earthquake | Seismic Waves | P and S Waves  
[https://www.youtube.com/watch?v=uA\\_OLKIQpYA](https://www.youtube.com/watch?v=uA_OLKIQpYA)
- Background <https://sciencing.com/scales-used-measure-earthquakes-7238883.html>

## LOMBOK INDONESIA

### WHAT WERE THE MAGNITUDES OF LOMBOK EARTHQUAKES 2018?

From 1901-2017 Indonesia experienced over 150 earthquakes with magnitude of over 7 on the **Richter scale**. From July-August 2018 Lombok, a small island east of Bali, experienced a sequence of earthquakes and aftershocks.

The **2018 Lombok earthquakes** refer to the following **5 thrust type earthquakes**, with epicentres north of Rinjani volcano that caused significant damage and deaths:

- July 2018 Lombok earthquake ( $M_w$  and  $M_L$ : 6.4, a foreshock). In the aftermath of the earthquake, blackouts occurred throughout Lombok and telecommunications went down
- **\*5 August 2018 Lombok earthquake ( $M_w$ : 6.9,  $M_L$ : 7.0, the main shock)-CASE STUDY**
- 9 August 2018 ( $M_L$ : 5.9 aftershock, 6 deaths)
- 18 August 2018 23:10pm local time Lombok earthquakes ( $M_w$ : 6.4 aftershock, 2 dead)
- 19 August 2018 Lombok earthquake ( $M_w$  6.9 new earthquake, different fault.)

[https://en.wikipedia.org/wiki/2018\\_Lombok\\_earthquake](https://en.wikipedia.org/wiki/2018_Lombok_earthquake)

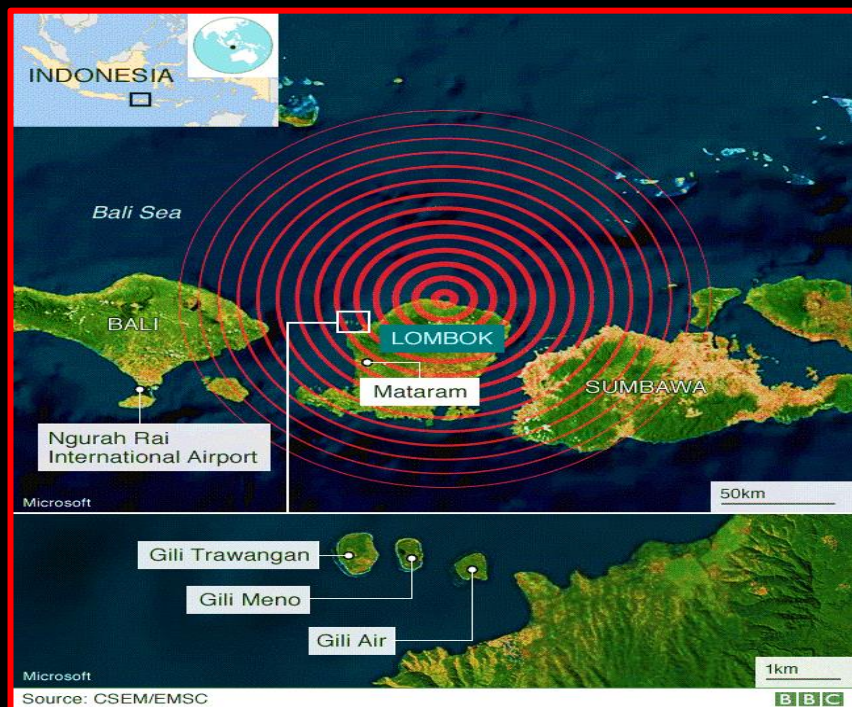
### WHAT IS MEANT BY THE EARTHQUAKE MAGNITUDE SCALE?

Magnitude	Earthquake Effects	Global: Estimated Number Each Year
2.5 or less	Usually not felt, but recorded by seismograph.	900,000
2.5 to 5.4	Often felt, but only causes minor damage.	30,000
5.5 to 6.0	Slight damage to buildings and other structures.	500
6.1 to 6.9	May cause a lot of damage in very populated areas.	100
7.0 to 7.9	Major earthquake. Serious damage.	20
8.0 or greater	Great earthquake. Can totally destroy communities near the epicentre	One every 5 to 10 years

### WHAT OCCURRED ON LOMBOK ON 5 AUGUST 2018?

The **5 August 2018 earthquake** was the largest and strongest that had hit Lombok in recorded history. The largest city in Lombok, Mataram, recorded a maximum intensity of **VIII (Severe)**. There was also strong shaking of neighbouring islands, such as Bali.

By 18 August, there had been 664 aftershocks, most of which were below  $M_w$  5.9 magnitude



<https://www.bbc.com/news/world-asia-45076800>



## WHAT WERE THE IMPACTS OF LOMBOK EARTHQUAKE?

- Ground shifted
- Widespread damage
- Thousands of homes damaged-lack of construction regulations and poor knowledge concerning earthquake resistant buildings
- Lost electrical power
- Widespread looting
- Disrupted transport
- Refugees-makeshift camps to accommodate people displaced by damages
- Lack of clean water-government drilled wells for groundwater
- The provincial capital Mataram recorded 20,343 displaced people, with West and East Lombok regencies recording 91,372 and 76,506 refugees respectively. The hardest-hit part of North Lombok reported 198,846 people in refugee camps - from a population of about 215,000

[https://en.wikipedia.org/wiki/5\\_August\\_2018\\_Lombok\\_earthquake](https://en.wikipedia.org/wiki/5_August_2018_Lombok_earthquake)



People waiting to be evacuated on a beach on the Indonesian island of Gili Trawangan, a day after a magnitude-6.9 earthquake struck the area.  
Melissa Delport/Agence France-Presse — Getty Images  
<https://www.nytimes.com/2018/08/10/world/asia/indonesia-lombok-earthquake-tourism.html>

Tourists walk past damaged buildings following an earthquake on the island of Lombok, Indonesia.  
Antara Foto/Reuters  
<https://www.nytimes.com/2018/08/08/travel/lombok-indonesia-earthquake-tourism.html>



Background <https://sciencing.com/scales-used-measure-earthquakes-7238883.html>



## WHAT WERE THE RESPONSES TO LOMBOK EARTHQUAKE?

- By 7 August, 4,636 local and foreign tourists had been evacuated to the ports of Bangsal, Lembar and Bena
  - Regional governments sent aid
  - Temporary schools opened in Lombok in response to the Indonesian Child Protection Commission
  - Benefit concerts, charity runs and fundraising held across the country.
  - During opening ceremony of 2018 Asian Games, a moment of silence held for victims of the earthquake
  - Indonesian National Armed Forces deployed a hospital ship, and aircraft carried medical supplies, aid and troops to impacted areas.
  - Indonesian National Lines (Pelni) provided free ferry services for humanitarian purposes
  - Indonesia Red Cross dispatched medical personnel, 26 tonnes of aid consisting of 2,000 tarpaulins, 2,000 blankets and 2,000 mattresses.
  - Pertamina sent LPG and gasoline.
  - Indonesian state-owned postal service announced that logistic or aids would be fee-free until 31 August.
- [https://en.wikipedia.org/wiki/5\\_August\\_2018\\_Lombok\\_earthquake#cite\\_note-130](https://en.wikipedia.org/wiki/5_August_2018_Lombok_earthquake#cite_note-130)

## WHAT WERE THE IMPACTS OF LOMBOK EARTHQUAKE 6 WEEKS LATER?

**Lombok: Six weeks after a devastating earthquake flattened parts of the Indonesian island of Lombok, 2277 families affected - or just 1%- have received money promised to rebuild their homes. There are estimated 400,000 people now described as refugees on the island because they have lost their homes**  
<https://www.smh.com.au/world/asia/i-just-want-to-get-my-baby-to-a-proper-home-lombok-reels-from-quake-20180919-p504to.html>



Hanan holds baby Akila, his wife Reniatun is behind him, in their makeshift home:

<https://www.smh.com.au/world/asia/i-just-want-to-get-my-baby-to-a-proper-home-lombok-reels-from-quake-20180919-p504to.html>

## VIDEOS

- Residents run in panic after fresh 6.3 magnitude quake jolts Indonesia's Lombok  
<https://www.theguardian.com/world/video/2018/aug/19/aftermath-earthquake-lombok-indonesia>. US
- Hundreds of tourists in Lombok evacuated after quake  
<https://www.theguardian.com/world/video/2018/aug/06/hundreds-of-tourists-in-lombok-evacuated-after-quake->
- Climbers flee Mount Rinjani in Lombok, Indonesia after earthquake  
<https://www.theguardian.com/world/video/2018/jul/30/climbers-flee-mount-rinjani-lombok-indonesia-earthquake>
- Lombok <https://www.nytimes.com/video/world/asia/100000006041829/indonesia-earthquake-lombok.html?module=inline>

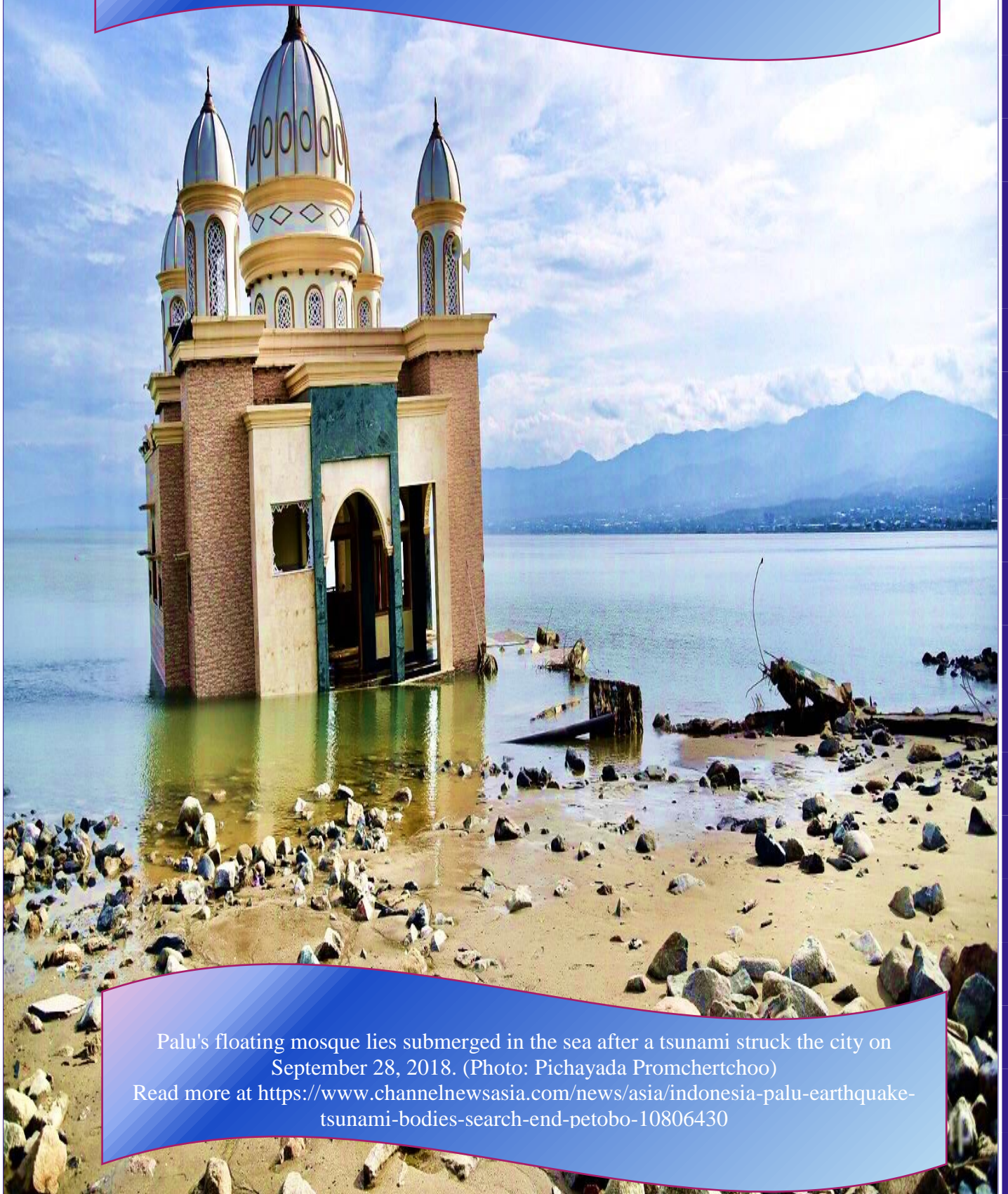
## ICT

- Map with seismicity in July 2018  
[http://earthjay.com/earthquakes/20180728\\_indonesia/20180728\\_indonesia\\_interpretation.pdf](http://earthjay.com/earthquakes/20180728_indonesia/20180728_indonesia_interpretation.pdf)
  - Map showing historic seismicity around Lombok  
[http://earthjay.com/earthquakes/20180728\\_indonesia/20180728\\_indonesia\\_interpretation\\_19182018\\_EQGTE\\_60.pdf](http://earthjay.com/earthquakes/20180728_indonesia/20180728_indonesia_interpretation_19182018_EQGTE_60.pdf)
- Background <https://sciencing.com/scales-used-measure-earthquakes-7238883.html>



## **SULAWESI: MULTIPLE GEOMORPHIC DISASTERS**

**EARTHQUAKE, TSUNAMI, LIQUEFACTION,  
UNDERSEA LANDSLIDES AND GROUND LANDSLIDES**



Palu's floating mosque lies submerged in the sea after a tsunami struck the city on September 28, 2018. (Photo: Pichayada Promchertchoo)  
Read more at <https://www.channelnewsasia.com/news/asia/indonesia-palu-earthquake-tsunami-bodies-search-end-petobo-10806430>



## WHAT OCCURRED IN SULAWESI ON 25 SEPTMBER 2018?

On 28 September 2018 a massive 7.5 magnitude earthquake (as well as before and after shocks) occurred on the Indonesian island of Sulawesi. The quake triggered a tsunami, reaching 6 metres in height. As the tsunami approached the coast it was reported to be travelling at 400km/h. It also triggered landslides as well as liquefaction, adversely affecting the towns of Palu and Donggala in Sulawesi. **Large earthquakes are not uncommon in Palu, Sulawesi** with 15 events over magnitude 6.5 occurring in the past 100 years. Several of these large earthquakes have generated tsunamis, such as:

- In 1927, an earthquake and tsunami caused about 50 deaths and damaged buildings in Palu.
- In 1968 an earthquake with magnitude 7.8 near Donggala generated a tsunami that killed more than 200 people.

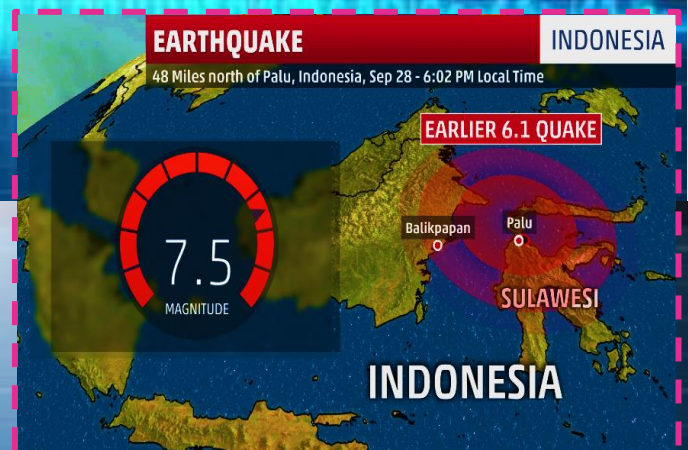
Despite this history, many people in Palu were not aware of the risk of a tsunami following the earthquake.

<https://www.f3nws.com/news/large-earthquake-strikes-indonesia-s-sulawesi-island-damage-reported-the-weather-channel->

## SULAWESI EARTHQUAKE: WHEN? WHAT? IMPACTS?

Table: [https://en.wikipedia.org/wiki/2018\\_Sulawesi\\_earthquake\\_and\\_tsunami](https://en.wikipedia.org/wiki/2018_Sulawesi_earthquake_and_tsunami)

UTC time	2018-09-28 10:02:44
Local date	28 September 2018
Local time	18:02:44 WITA (Indonesia Central Standard Time)
Magnitude	M <sub>w</sub> 7.5
Depth	10.0 km
Epicentre	0.178°S 119.840°E Coordinates: 0.178°S 119.840°E
Fault	Palu-Koro fault
Type	Strike-slip
Max. intensity	IX (Violent)
Tsunami	Yes (highest 7 m in Donggala Regency and 15 m in Wani)
Landslides	Yes
Foreshocks	M <sub>w</sub> 6.1, M5.4, M5.0
Aftershocks	Five M≥5.5 The mainshock was followed by a series of aftershocks, with 14 of M≥5.0 in the first 24 hours. Since then, a total of 150 aftershocks have struck the region
Casualties	<ul style="list-style-type: none"> <li>• 2,010 dead</li> <li>• 10,679 injured</li> <li>• 5,000+ missing<sup>[3]</sup></li> <li>• 70,821 evacuated<sup>[4]</sup></li> </ul>



**ICT OVERVIEW:** <https://www.f3nws.com/news/large-earthquake-strikes-indonesia-s-sulawesi-island-damage-reported-the-weather-channel-13d210a8da3>

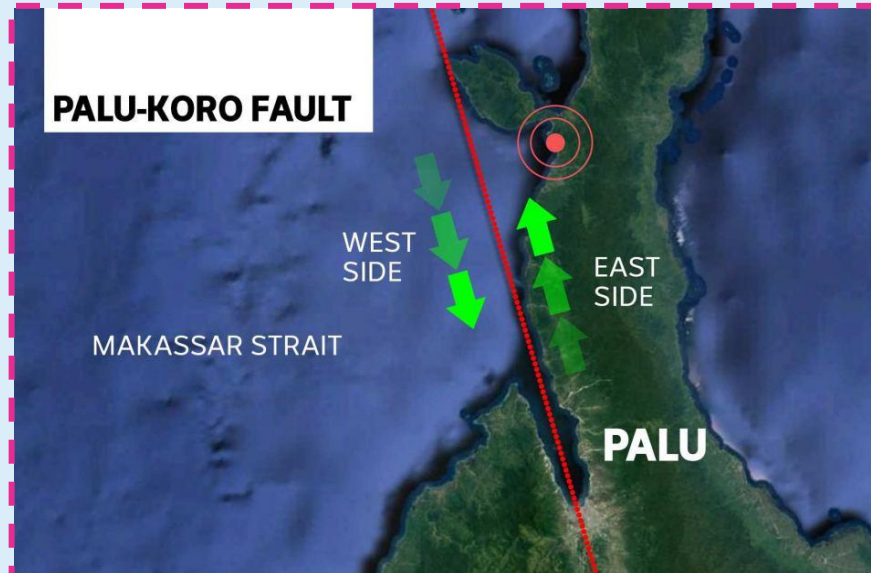
Background <https://corporatenepal.com/2016/11/6655/>



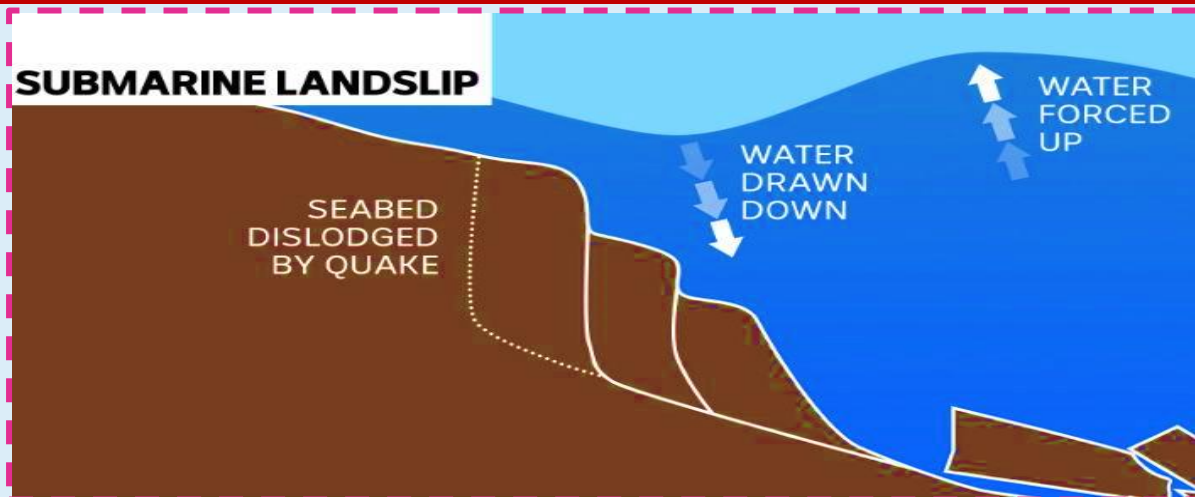
## SULAWESI: WHAT WERE THE DIFFERENT GEOMORPHIC PROCESSES? PERSPECTIVES

**Diagram:** Experts declare that the earthquake at Palu was caused by the Palu-Koro fault line, running through Sulawesi. The fault usually shifts by 30 to 40 millimetres a year, with the western side heading south while the eastern edge moves north.

<http://www.abc.net.au/news/2018-10-03/why-the-indonesia-quake-and-tsunami-were-so-destructive/10330420>



### DID AN UNDERWATER LANDSLIDE CAUSE DESTRUCTION IN SULAWESI?



*"Based on historical data and tsunami modelling, this earthquake was not capable of generating a tsunami affecting the Indian Ocean region," said the Meteorological, Climatological and Geophysical Agency of Indonesia.*

<https://www.f3nws.com/news/large-earthquake-strikes-indonesia-s-sulawesi-island-damage-reported-the-weather-channel-13d210a8da3>

According to Phil Cummins from the ANU's School of Earth Sciences, it remains something of a mystery how a **strike-slip fault** triggered a tsunami. A **thrust quake** is more likely to trigger a tsunami, he said, because its vertical motion pushes a column of seawater upwards, setting a wave in motion.

Experts the ABC talked to, agree that the **earthquake was likely caused an underwater landslide**. Palu's steep mountains continue underwater to great depths, so one or more of their slopes could have been damaged by the quake, displacing so much water it caused the tsunami. What happens when this occurs is a section of the seabed is dislodged and slips downwards, drawing water down where it originated, and forcing it up where it lands. "Either of those result in wave motion," Professor Cummins said.

<http://www.abc.net.au/news/2018-10-03/why-the-indonesia-quake-and-tsunami-were-so-destructive/10330420>

#### ICT:

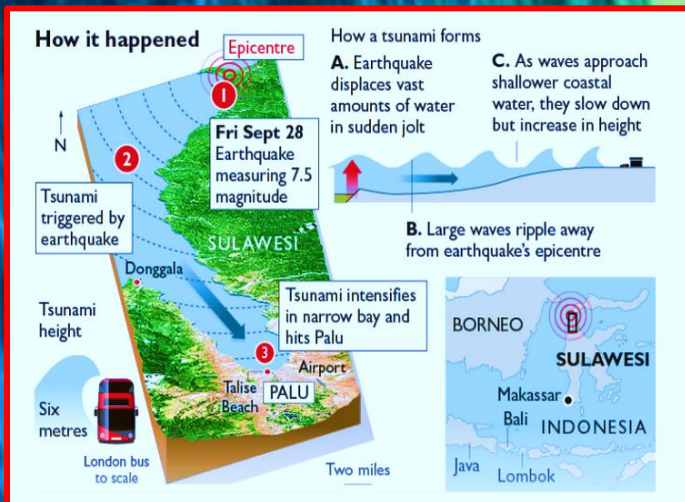
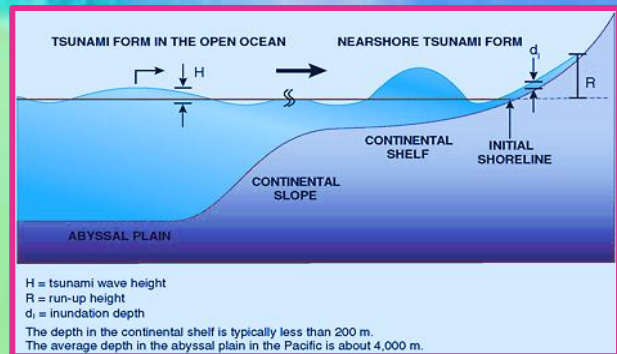
**The large displacement of land beneath the sea created the tsunami.**

<http://www.abc.net.au/news/2018-10-03/submarine-landslip-graphic/10330468>

## SULAWESI: WHAT IS THE EARTHQUAKE-TSUNAMI CONNECTION?

A **cross section** of the ocean as a tsunami wave travels towards the shoreline. Sea level is represented as a black horizontal line.

<http://temblor.net/earthquake-insights/tsunami-in-sulawesi-indonesia-triggered-by-earthquake-landslides-or-both-7825/>



<https://www.thetimes.co.uk/article/thousands-feared-dead-as-tsunami-flattens-town-9v0kd9855>



Photos from a video posted to social media show the waves generated by the earthquake.

<https://www.straitstimes.com/asia/se-asia/tsunami-hits-small-sulawesi-city-after-major-quake-casualties-unknown>

Background: <https://www.livescience.com/6470-ocean-depth-volume-revealed.html>



## SULAWESI TSUNAMI: WHAT? WHERE? WHY? FUTURE? LITERACY

Indonesia's tsunami warning system, completed in 2008, consists of seismographic sensors, buoys, tidal gauges and GPS. None of these measures were able to adequately predict the scale of the recent Sulawesi tsunami, which reached heights of 6 metres in the city of Palu, south of the earthquake's epicentre.

### WHAT CAUSED THE EARTHQUAKE GENERATED TSUNAMI?

It is not clear whether the tsunami was caused by **movement on the fault from the earthquake, or from submarine landslides** in Palu Bay caused by the shaking from the earthquake.

The **sides of the Palu Bay are steep and unstable**, and **submarine landslides** have occurred there in the past.

If the tsunami was generated by a **submarine landslide** within the Palu Bay, **tsunami sensors at the mouth of the bay would not have sensed the tsunami wave before it struck the shore in Palu**

### WHY IS AWARENESS RAISING ESSENTIAL TO REDUCE ADVERSE IMPACTS OF NATURAL DISASTERS?

The need to **raise awareness of the risk** becomes more challenging when large tsunamis occur infrequently, as in Palu.

Many residents would not have been born when the last tsunami impacted on the town in 1968. Ongoing **awareness and education programmes** are the most important part of a tsunami warning system in coastal areas at risk of tsunami.

### WHY IS TIMING CRUCIAL?

The Indonesian Tsunami Warning System issued a warning only minutes after the earthquake, but officials were unable to contact officers in the Palu area.

The warning was also cancelled 34 minutes later, just after the third tsunami wave hit Palu.

**Timing** is crucial. Official tsunami warnings require analysis of data, and take time to prepare and disseminate. This time is crucial for people near the earthquake epicentre and where the tsunami may strike within minutes of the earthquake. Those living in such areas need to be aware of the need to evacuate without waiting for official warnings.

Relying on the earthquake as a natural warning of a potential tsunami.

### WHY WAS THE ADVANCED WARNING SYSTEM NOT EFFECTIVE?

- The tsunami warning system developed after the devastating 2004 Boxing Day tsunami, did not reach most of the people living in Palu.
- The tsunami early warning systems are most useful for areas several hundred kilometres from the tsunami source. In regions like **Palu the earthquake and tsunami source were very close -the tsunami struck the shore within 20 minutes of the earthquake.**
- The **advanced warning system currently was only in the prototype stage**
- Most of Indonesia's deep ocean tsunametre buoys, specially designed to detect tsunamis in the open ocean, have **not been working since 2012**. They had not been maintained or had been vandalised.

### WHAT WERE THE ISSUES SURROUNDING COMMUNICATIONS?

High tech tsunami warning systems are able to send out warnings through phone **networks** and other communications channels, and reach the community through text messages and tsunami sirens on beaches.

But in areas where a devastating earthquake has occurred, this infrastructure is often too damaged to operate and the warning messages can't get through.

In Palu, the earthquake destroyed the **local mobile phone network and no information was able to get in or out of the area.**

<http://theconversation.com/would-a-better-tsunami-warning-system-have-saved-lives-in-sulawesi-104223>

[https://www.wwf.or.id/berita\\_fakta/pengadaan/?61843/Alat-Sistem-Deteksi-Dini-Bencana-Kebakaran-Lahan-Gambut-EWS#](https://www.wwf.or.id/berita_fakta/pengadaan/?61843/Alat-Sistem-Deteksi-Dini-Bencana-Kebakaran-Lahan-Gambut-EWS#)

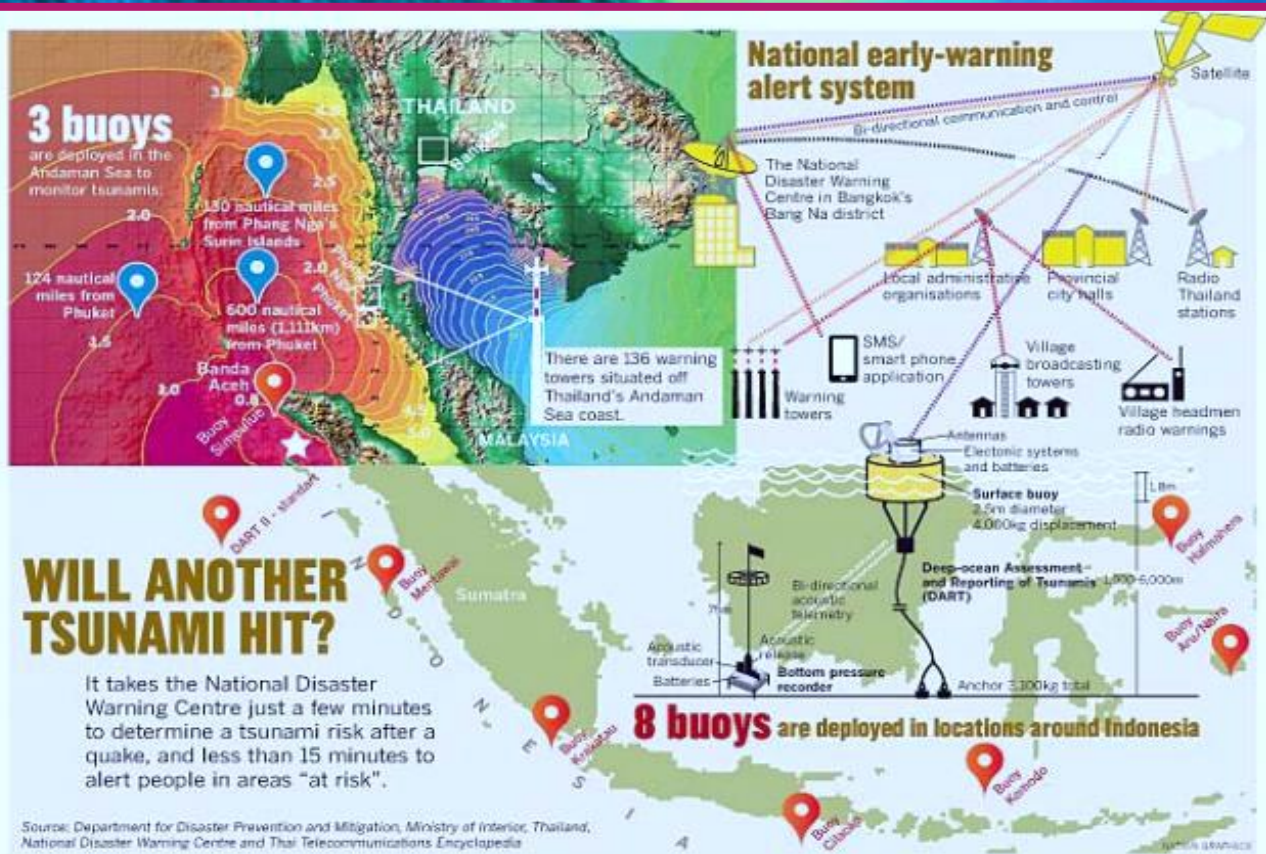
Graphic: S. Bliss

Background: <https://www.livescience.com/6470-ocean-depth-volume-revealed.html>



## SULAWESI: WHAT IS THE TSUNAMI WARNING SYSTEM? VISUAL LITERACY: INFOGRAPHIC

DART: Sensors failed to detect huge waves <http://www.coastaldigest.com/world/indonesia-tsunami-sensors-failed-detect-huge-waves-official>

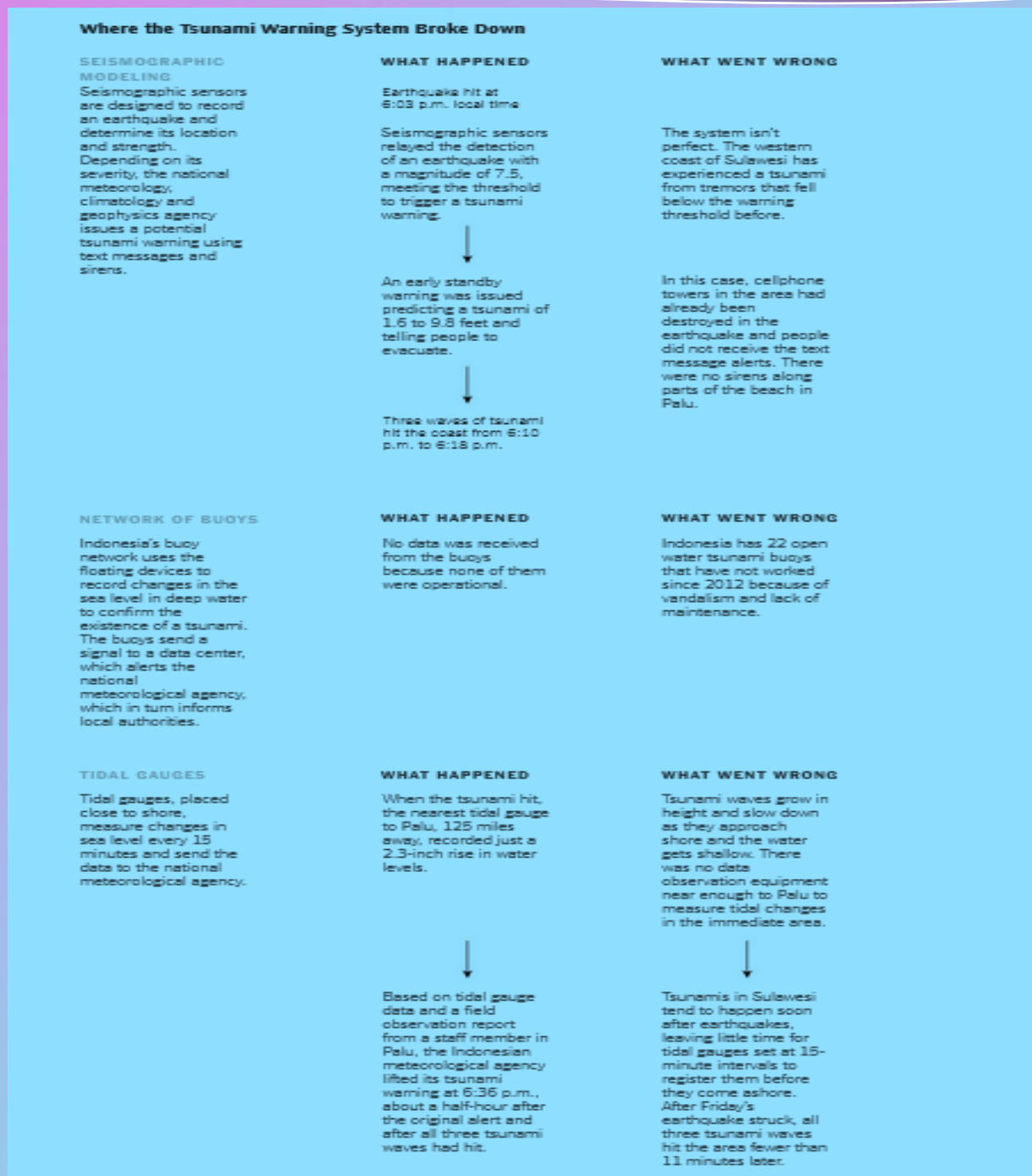


Infographic: <http://www.nationmultimedia.com/national/Tsunami-warning-system-finally-ready-after-8-years-30196748.html>

Background: <https://www.livescience.com/6470-ocean-depth-volume-revealed.html>



## SULAWESI: WHAT WENT WRONG WITH TSUNAMI WARNING SYSTEM? SUMMARY TABLE



### SUMMARY CHART

<https://www.nytimes.com/interactive/2018/10/02/world/asia/indonesia-tsunami-early-warning-system.html>

- What went wrong with Indonesia's tsunami early warning system  
<https://www.nytimes.com/interactive/2018/10/02/world/asia/indonesia-tsunami-early-warning-system.html>
- Reviewing Indonesia's tsunami early warning strategy: Reflections from Sulawesi Island  
<https://theconversation.com/reviewing-indonesias-tsunami-early-warning-strategy-reflections-from-sulawesi-island-104257>
- Indonesia tsunami early detection buoys haven't worked for six years due to 'lack of funding'  
<http://www.abc.net.au/news/2018-10-01/indonesia-tsunami-early-detection-buoys-broken-for-six-years/10324200>

## SULAWESI: DID THE SHAPE OF PALU'S BAY MAKE THE DISASTER WORSE?

*Palu – a city in Sulawesi located in a **narrow bay** – was hit by waves as high as six metres. The surging water brought buildings down and caused widespread destruction. Hundreds of people had gathered for a beachfront festival and it was a scene of horror as waves powered over the beach – sweeping up everything in their path.* <http://www.ienews.com/wordpress/indonesia-earthquake-and-tsunami-how-warning-system-failed-the-victims/>

*A factor that probably contributed to the size of the tsunami was the **shape of Palu Bay**.*

***Computer models** of tsunami waves show that as waves travel south towards the city of Palu, the wave heights increase. This is probably caused because the depth of the bay gets shallower to the south. We know that as tsunami approach shallower water from deeper water, wave heights get larger.*

*<http://temblor.net/earthquake-insights/tsunami-in-sulawesi-indonesia-triggered-by-earthquake-landslides-or-both-7825/>*



### ICT

- Scientists said the tsunami that ravaged the city of Palu was outsized compared to the earthquake that spawned it, but factors - including a long, narrow bay - conspired to create monster waves. <https://www.channelnewsasia.com/news/asia/indonesia-quake-tsunami-sulawesi-survivors-search-10780352>
- The shape of Palu's bay likely intensified the effect of the wave. <http://www.abc.net.au/news/2018-10-03/palu-august-17/10330528>
- Indonesia tsunami worsened by shape of Palu bay <https://www.channelnewsasia.com/news/asia/indonesia-tsunami-worsened-by-shape-of-palu-bay-scientists-10780178>; [https://www.channelnewsasia.com/news/asia/perfect-storm-of-factors-behind-indonesian-quake-tsunami-10778026?cid=h3\\_referral\\_inarticlelinks\\_24082018\\_cna](https://www.channelnewsasia.com/news/asia/perfect-storm-of-factors-behind-indonesian-quake-tsunami-10778026?cid=h3_referral_inarticlelinks_24082018_cna); <https://www.channelnewsasia.com/news/asia/perfect-storm-of-factors-behind-indonesian-quake-tsunami-10778026>

A ship was stranded after an earthquake and tsunami hit Donggala, Indonesia, near the mouth of Palu Bay on the island of Sulawesi. Antara Foto/Reuters

<https://www.nytimes.com/interactive/2018/10/02/world/asia/indonesia-tsunami-early-warning-system.html>





## SULAWESI: WHAT IS LIQUEFACTION? WHEN, WHERE AND WHY DOES IT OCCUR?

SOIL TURNED INTO A LIQUID/GROUND OPENED UP AND SWALLOWED PEOPLE

*Aside from the immediate dangers of huge shaking and potential tsunamis, **liquefaction is one of the biggest causes of death and destruction during a seismic event.** Survivors of the enormous 7.5-magnitude earthquake and tsunami in Sulawesi, have given harrowing testimony of how the ground beneath their feet seemed to churn and suddenly rise up—swallowing everything in its path. In some cases, the ground swelled up several metres, sweeping away entire houses and communities and flipping hefty vehicles onto their roofs.*

<https://phys.org/news/2018-10-liquefaction-terra-firma-mush.html#jCp>

### WHAT IS LIQUEFACTION?

Strength and stiffness of soil is reduced by the shaking earthquake

### IS LIQUEFACTION A COMMON PHENOMENON?

Yes, it is common phenomenon with earthquakes across the world. In 2011 it caused major destruction in Christchurch, New Zealand. In 1964 Japan experienced a 7.5-magnitude earthquake that unleashed a huge tsunami. It also triggered massive liquefaction of soil in low-lying areas, destroying the foundations of four-storey apartment blocks and causing them to tilt.

### WHERE DOES LIQUEFACTION GENERALLY OCCUR?

Mainly in low, flat areas near the ocean, where groundwater levels are high. The city of Palu was built on a flat plain formed from loose sediment (e.g. sandy soil). Also soil was saturated from the tsunami

### WHAT ARE THE CONNECTIONS BETWEEN EARTHQUAKES AND LIQUEFACTION?

Quakes exacerbate liquefaction, by shaking the soil so violently that it forces its particles to become looser. Groundwater or tsunami then fills the gaps between soil particles. When the soil is saturated with water the ground behaves like a liquid, and starts to move and flow to lower levels like rivers. Mud bubbles appear on the surface from under the ground, and buried infrastructure such as sewers lift to the surface.

### WHAT DID LIQUEFACTION CAUSE IN SULAWESI?

Mud and sludge rose out of the ground, toppling houses and trees and destroying building foundations and roads

Buildings slid across the land like they were moving on water.

Significant impact on people's lives by destroying their homes and lifelines, such as electricity, gas and water, and infrastructures buried underground.

About 1,700 houses in one neighbourhood were swallowed up by liquefaction

<http://www.abc.net.au/news/2018-10-03/why-the-indonesia-quake-and-tsunami-were-so-destructive/10330420>

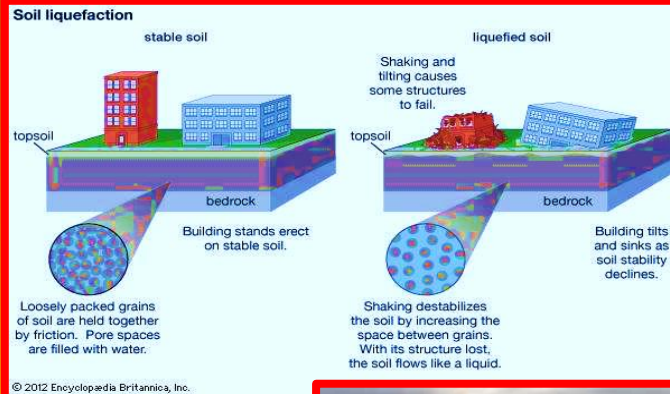
<https://phys.org/news/2018-10-liquefaction-terra-firma-mush.html#jCp>

Background: An aerial view of Petobo sub-district following an earthquake in Palu, Central Sulawesi, Indonesia, on Oct 2, 2018. PHOTO: REUTERS/ANTARA FOTO <https://www.straitstimes.com/asia/se-asia/the-ground-opened-up-and-swallowed-people>



## SULAWESI: LIQUEFACTION HOW? WHERE? WHEN?

**Diagram** of liquefaction process <https://www.britannica.com/science/soil-liquefaction>



Oct. 5, 2018, a family scavenges for salvageable items from the ruins of their house at Petobo neighbourhood which was wiped out by liquefaction caused by a massive earthquake in Palu, <https://phys.org/news/2018-10-indonesia-expert-quake-govt-areas.html#jCp>



An aerial view of liquefaction, or shifting ground, on Oct 1, 2018, following an earthquake in Palu, Central Sulawesi, Indonesia.

PHOTO: REUTERS

<https://www.straitstimes.com/asia/se-asia/sulawesi-quake-when-earthquakes-liquefy-soil-devastation-can-follow>

**YouTube:** The Sulawesi quake turned rice paddies into deadly quicksand  
<https://www.youtube.com/watch?v=ErFP51JFUX8>



## SULAWESI: LIQUEFACTION WHAT ARE THE CHANGES TO THE LANDSCAPE

Satellite: Before and after aerial photographs of liquefaction at Palu's 'sunken village' of Petobo  
More at this website <http://www.abc.net.au/news/2018-10-02/satellite-images-before-and-after-indonesia-tsunami/10328562>

### BEFORE



Petobo on August 17 (DigitalGlobe, via AP)

Petobo on October 1 (DigitalGlobe, via AP)

### AFTER



Petobo on August 17 (DigitalGlobe, via AP)

Petobo on October 1 (DigitalGlobe, via AP)



## SULAWESI: WHERE WERE THE LANDSLIDES AFTER EARTHQUAKE AND AFTER SHOCKS? WHY DID THEY OCCUR?

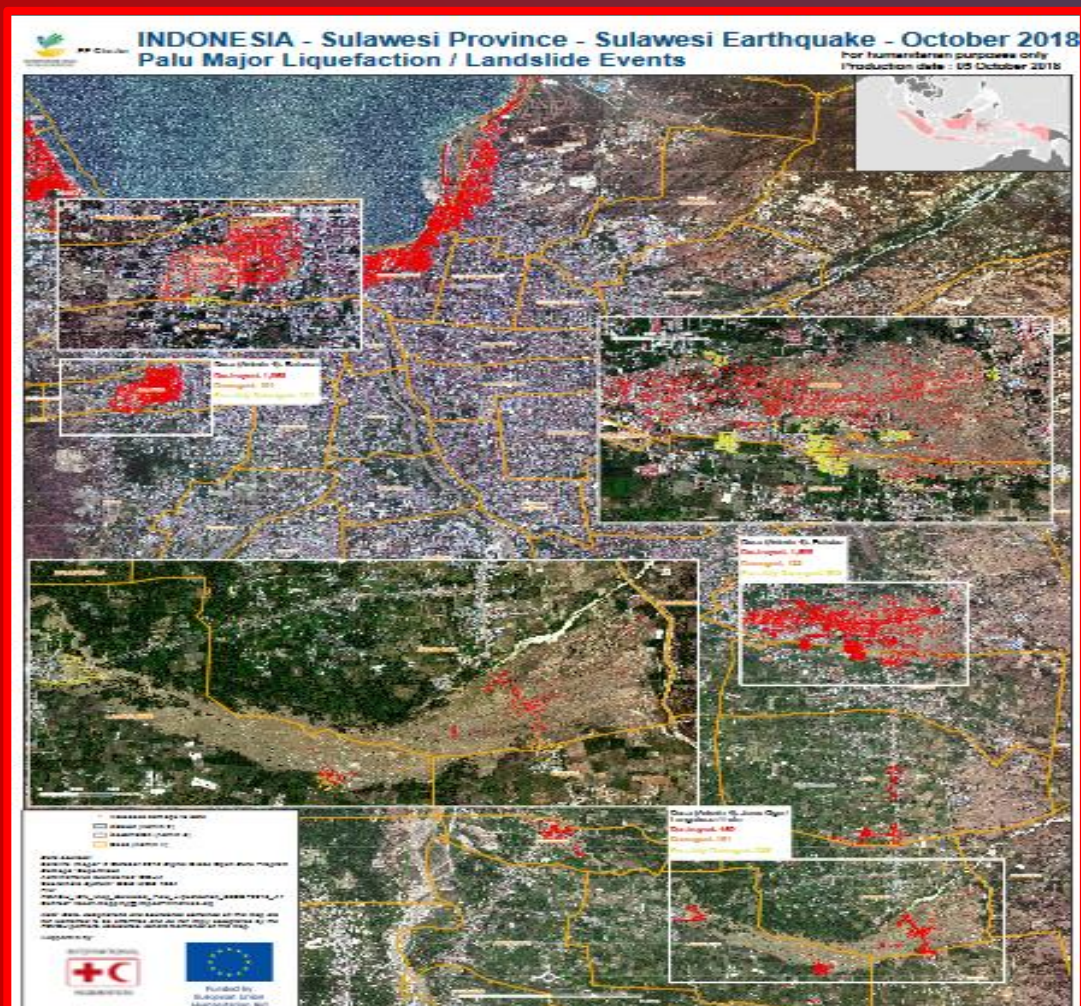


The Tinggede landslide on the outskirts of Palu. Image via Planet Labs

This is a very large slide –the head scarp is about 1 km across, and the slide is over 3 km in length. This is a flow type slide (rather than a lateral spread), with many houses being involved.

This landslide in Palu appeared to be shallow slides on comparatively low angle slopes-close to the fault trace.

<https://blogs.agu.org/landslideblog/2018/10/02/palu-sulawesi-earthquake-2/>



Satellite images showing liquefaction and landslides

[https://reliefweb.int/sites/reliefweb.int/files/resources/reach\\_idn\\_map\\_sulawesi\\_palu\\_liquefaction\\_05oct2018\\_a1\\_v4\\_0.pdf](https://reliefweb.int/sites/reliefweb.int/files/resources/reach_idn_map_sulawesi_palu_liquefaction_05oct2018_a1_v4_0.pdf)



## SULAWESI: ACTIVITIES

1. Indonesia is historically vulnerable to numerous earthquakes. Explain this statement.
2. Describe the location, hypocentre and epicentre of the 7.5 magnitude earthquake in Sulawesi.
3. What does the word magnitude mean? How serious is a 7.5 magnitude earthquake?  
Richter scale [https://simple.wikipedia.org/wiki/Richter\\_scale](https://simple.wikipedia.org/wiki/Richter_scale)
4. **Table:** What is meant by the words-‘before shocks’ and ‘after shocks’ and what were their magnitudes?
5. If large earthquakes are common in Palu, why were the responses deficient by governments and communities?
6. **Diagram:** Explain the location of the Palu-Koro Fault and its past movements.
7. What type of fault triggered the earthquake?
8. **Diagram:** How can an earthquake cause an undersea/submarine landslide that could result in a tsunami?
9. **Diagram:** Describe how earthquakes generate tsunamis.
10. **Literacy diagram:** Explain why the advanced tsunami warning system or tide gauges were ineffective. Include:
  - Indonesia’s deep ocean tsunametre buoys were not working
  - Lack of community awareness education
  - Inadequate timing to prepare and disseminate information
  - Broken networks
11. The Sulawesi tragedy has highlighted what critics say is a patchy early-warning system to detect tsunamis in the seismically-active Southeast Asian archipelago. Could a better tsunami warning system have saved lives in Indonesia? Suggest changes <https://www.channelnewsasia.com/news/asia/indonesia-quake-tsunami-palu-sulawesi-early-warning-system-10780966>
12. **Infographic:**
  - How long does it take the National Disaster Warning Centre to determine a tsunami risk and how many minutes to alert people in areas of risk?
  - How many tsunami buoys are deployed in locations around Indonesia
  - How many buoys are deployed in the Andaman Sea?
  - What does DART mean?
  - Why are smart phones important technology to save lives and property in a geophysical disaster?
13. **Summary chart**
  - What is the purpose of seismographic sensors?
  - How are buoys connected to data centres?
  - What are tidal gauges?
  - List three things that went wrong during the Sulawesi earthquake
  - Would a better tsunami warning system saved lived and infrastructure?
14. **Satellite imagery:** Explain how Palu’s Bay’s shape had a major impact on the natural disaster  
Palu's unique geography will not have helped, they said - the tsunami likely intensified as it raced down the narrow bay on which the city sits. "Geographical factors (the narrow bay, shallow water) seemed to have played major roles," said Taro Arikawa, a professor at Chuo University in Tokyo.  
Read more at <https://www.channelnewsasia.com/news/asia/perfect-storm-of-factors-behind-indonesian-quake-tsunami-10778026>
15. Complete the **table** on liquefaction

What is liquefaction?	Where does liquefaction occur?	What were the processes involved from earthquake to liquefaction?	What were the impacts of liquefaction in Sulawesi?
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16. Complete the **table** on landslides

What are landslides?	What are the connections between landslides and earthquakes?	What impacts did the landslides in Sulawesi have on people, settlements and infrastructure?
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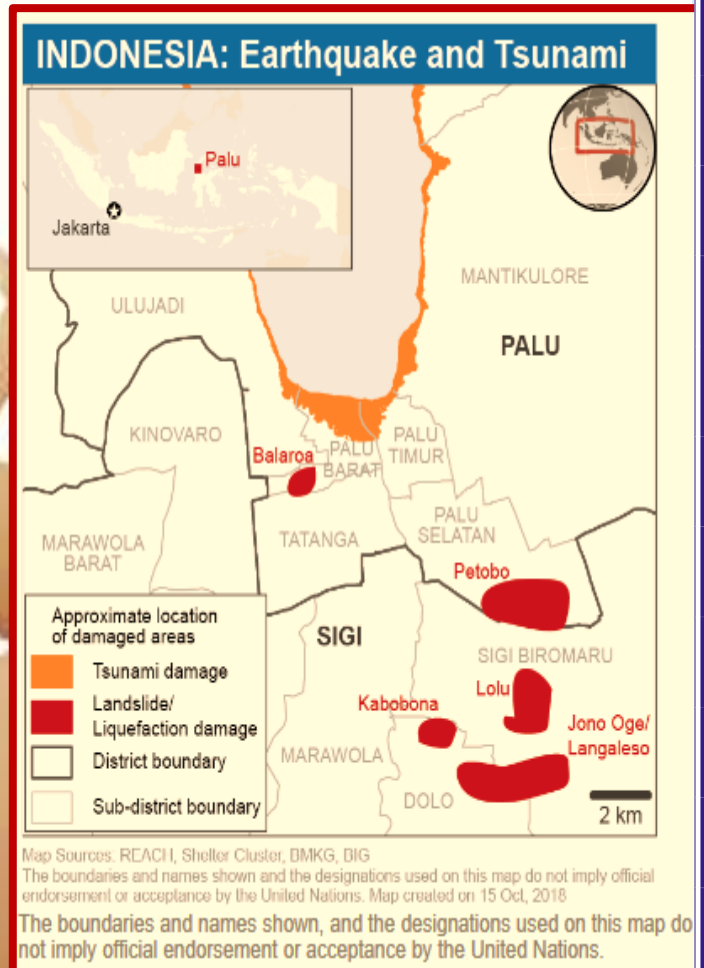
Background: <https://ubisafe.org/explore/cracking-clipart-earthquake/>



## SULAWESI: WHAT WERE THE IMPACTS OF THE DISASTER?

### 16 October, 2018

- Following the earthquake and tsunami on 28 September, and resulting liquefaction and landslides, 2,096 people are known to have died, 10,679 people have been injured, as of 16 October.
- Search and rescue operations were stopped on 12 October. According to Indonesia's national disaster management agency (BNPB), at least 680 people are still missing.
- Around 79,000 people are internally displaced. At least 15,000 houses have been destroyed, with no prospect of return.
- The government-led response is underway, with NGOs, the Red Cross and the UN supporting efforts in line with Government priorities.
- The emergency response period has been extended by the Government for a further two weeks until 26 October.
- The HCT's Response Plan, requesting US\$ 50.5 million to provide assistance to 191,000 people, is funded at 23 per cent.
- The United Nations' Central Emergency Response Fund (CERF) has committed US\$15 million to the response.



**2,096**

People dead (BNPB)

**680**

People missing (BNPB)

**79,000**

Internally displaced (BNPB)

**11,000**

People injured (BNPB)

**68,000**

Houses damaged (BNPB)

**191,000**

Targeted by HCT Response Plan

[https://reliefweb.int/sites/reliefweb.int/files/resources/HCT%20Sitrep\\_16102018\\_FINAL.pdf](https://reliefweb.int/sites/reliefweb.int/files/resources/HCT%20Sitrep_16102018_FINAL.pdf)

Background: <https://ubisafe.org/explore/cracking-clipart-earthquake/>



## SULAWESI: WHAT WERE THE PROBLEMS AND RESPONSES TO THE DISASTER OVER TIME?

Adapted source: <https://www.internetgeography.net/topics/2018-sulawesi-indonesia-earthquake-and-tsunami-case-study/>

### IMMEDIATE PROBLEMS AND RESPONSE

- Thousands displaced, died, missing and injured. Search, rescue and retrieval efforts undertaken
- Loss of homes and infrastructure.
- Main highway cut by landslide and a large bridge washed away by tsunami.
- Landslides cut off communications networks and collapsed bridges made it hard for aid workers and rescuers to reach affected areas.
- Due to damaged hospitals people received medical treatment in the open.
- At least 70,000 people gathered in evacuation sites across the island.
- Strong aftershocks hit the island the day after the earthquake.

### SHORT TERM PROBLEMS AND RESPONSES

- Thousands of survivors streamed out of Palu to nearby cities.
- 700 army and police officers dispatched to disaster zone.
- Aid from Indonesian Red Cross (PMI), National Search and Rescue Agency (BASARNAS), Indonesian National Armed Forces (TNI), and local government agencies.
- Public health warnings issued. In response, Government's priority to supply clean water, sanitation and hygiene.
- Immediate repair of infrastructure and public services (airport, road, electricity, water and fuel supply).
- Removing dangerous, damaged structures to reduce risk of further damage or injury.
- Public kitchens established in six displaced sites, and supplementary foods provided to young children and pregnant women.
- Queues for fuel eliminated
- Electricity returned to Palu.
- Authorities requested that people who left Palu to return, and restart economic activities.
- Telecommunications restored
- Roads in Palu functional and access to outlying areas improved.
- Aid flown in by the Indonesian military, and other foreign militaries.
- Short supplies led to looting of shops and supply trucks.
- Hospitals remain overstretched-short staffed and lack of supplies. A floating hospital is run by the Indonesian navy
- Getting vital supplies to affected areas is challenging, with the limited number of flights able to land at Palu's small airport, leaving aid workers facing gruelling overland journeys.

### LONGER TERM PROBLEMS AND RESPONSE

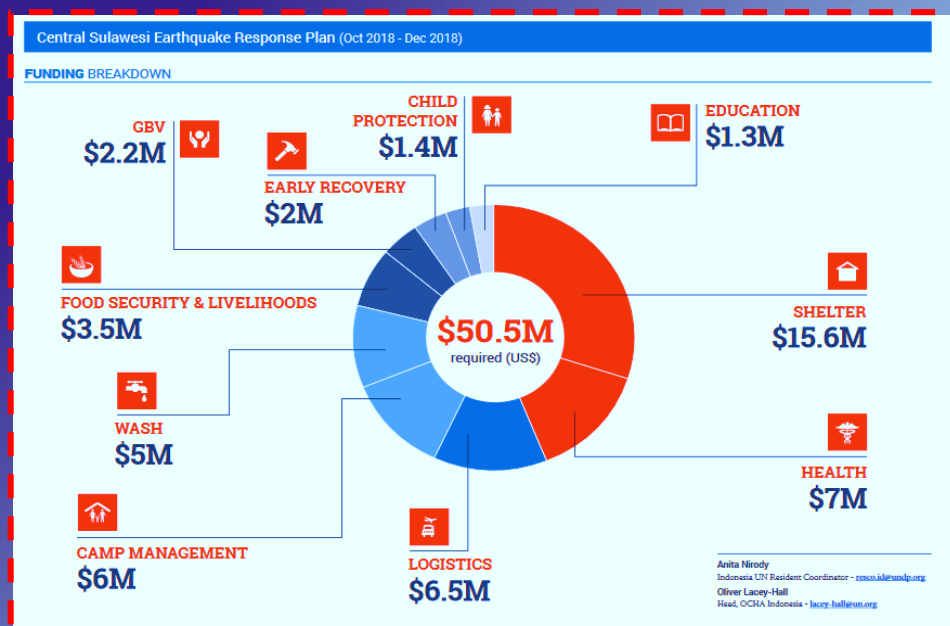
- At first, Indonesia reluctant to accept outside assistance, but as the scale of the disaster became clear, the government agreed to allow in foreign aid.
- Oxfam sent water treatment units and purification kits to Palu, and Swiss aid teams provided drinking water and emergency shelter.
- **Central Sulawesi Earthquake Response Plan** (Oct-Dec 2018)
  - 1.5 million people affected
  - 191,000 people targeted
  - requiring \$50.5 million for immediate relief
- Government articulates how the humanitarian community working in the country will provide targeted, technical assistance and relief items.
- Future funding required to rebuild city and housing for more than 80,000 displaced people.
- Petobo and Balaroa, to be closed and designated as mass graves.
- National Board for Disaster Management said debris will be cleared and sites turned into parks and monuments.

## SULAWESI: WHAT IS THE SULAWESI EARTHQUAKE RESPONSE PLAN?

The **Central Sulawesi Earthquake Response Plan (Oct 2018 - Dec 2018)** has been developed in consultation with the Government. It covers an initial period of three months. After one month, the plan will be reviewed and revised in light of new assessments and prioritisation of needs.

The **National Disaster Management Agency (BNPB)** and the **Regional Disaster Management Agency (BPBD)** are coordinating the disaster response under the leadership of the Coordinating Minister for Political and Security Affairs.

<https://reliefweb.int/sites/reliefweb.int/files/resources/SULAWESI%20RP%20051018%20FINAL.PDF>



<https://reliefweb.int/sites/reliefweb.int/files/resources/SULAWESI%20RP%20051018%20FINAL.PDF>

### STRATEGIC OBJECTIVES

The Central Sulawesi Earthquake Response Plan articulates the support planned by the Humanitarian Country Team to meet targeted needs in complement to the Government-led response. This support seeks to:



Deliver **immediate, life-saving assistance** to those in the most urgent need in line with national priorities and in support of the Government response;



Provide **humanitarian logistics capacity** to augment Government efforts to ensure people in need can access humanitarian assistance;



Ensure that conditions of **safety and dignity** are restored for the most vulnerable people and that they are able to access urgently-needed assistance.

<https://reliefweb.int/sites/reliefweb.int/files/resources/SULAWESI%20RP%20051018%20FINAL.PDF>



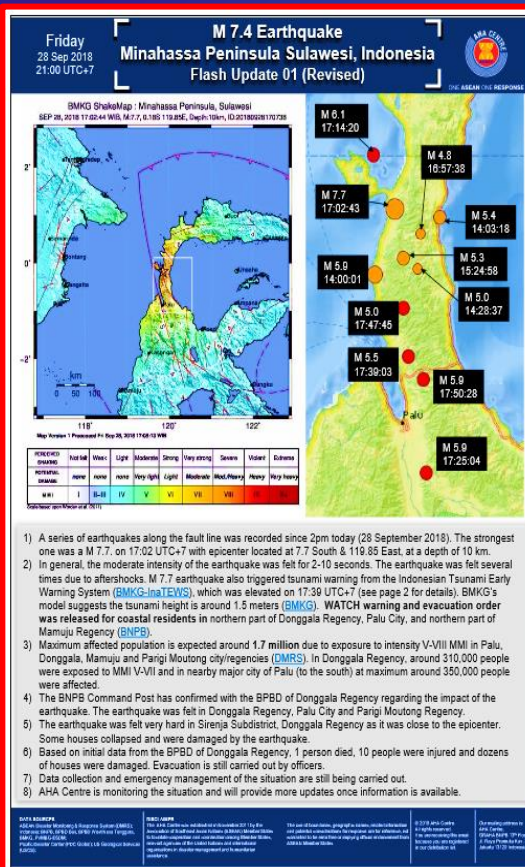
## SULAWESI: WHAT IS THE ROLE OF THE ‘ONE ASEAN, ONE RESPONSE’ PLAN?

The **ONE ASEAN, ONE RESPONSE** performs **Risk Identification, Early Warning and Monitoring**. Through these activities, the **AHA Centre** aims to reduce loss of life and damage to property from natural disasters through the identification of hazards and risks prior to impacts and by increasing warning time. The AHA Centre works with the **National Disaster Management Organisations (NDMOs)** of ten ASEAN Member States in monitoring and sharing information about hazards and disasters in the region. Additionally, the AHA Centre monitors **Earth observation (EO)** as well as early warning releases by hydro-meteorological and geological agencies of ASEAN Member States. <https://ahacentre.org/disaster-monitoring/>

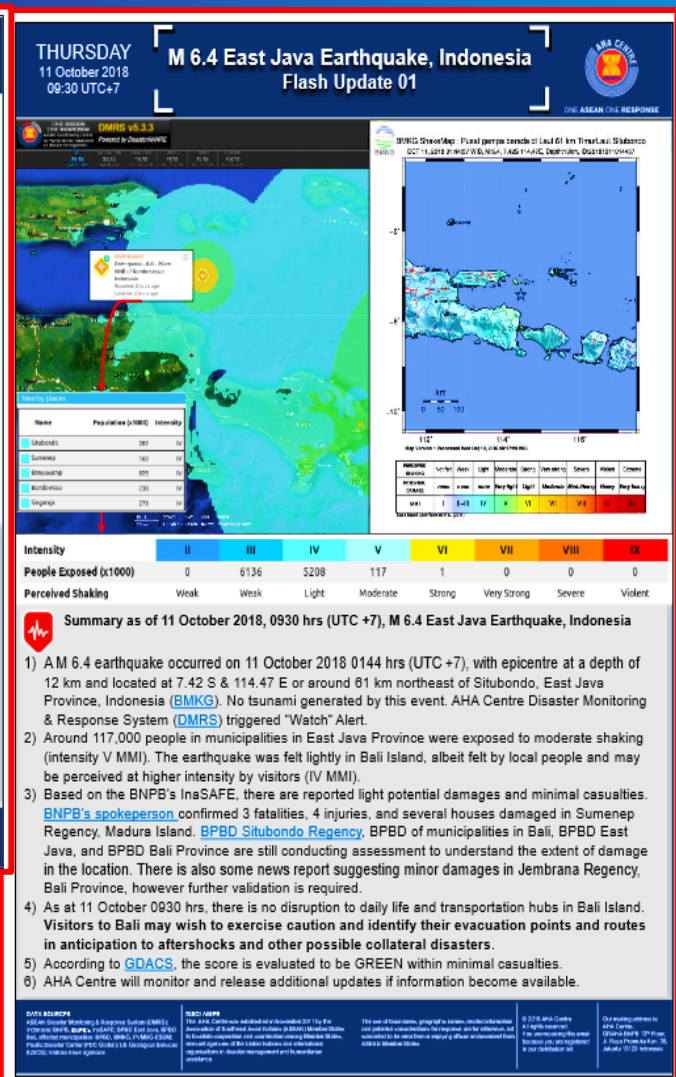
**Earth observation (EO)** is the gathering of information about the physical, chemical, and biological systems of the planet via remote-sensing technologies, supplemented by Earth-surveying techniques, which encompasses the collection, analysis, and presentation of data. Earth observation is used to monitor and assess the status of and changes such as geomorphic movements. [https://en.wikipedia.org/wiki/Earth\\_observation](https://en.wikipedia.org/wiki/Earth_observation)

**ICT: FLASH UPDATES-FIND THE LATEST!**  
<https://ahacentre.org/flash-updates/>

**ICT: FLASH UPDATES-FIND THE LATEST!**  
<https://ahacentre.org/flash-updates/>



<https://ahacentre.org/flash-update/flash-update-no-01-m-6-4-earthquake-east-java-bali-earthquake-11-oct-2018/>  
<https://ahacentre.org/flash-update/flash-update-no-01-m-7-4-earthquake-minahassa-peninsula-sulawesi-indonesia-28-sep-2018/>



## SULAWESI: HOW IS ASEAN (AHA CENTRE) REGULATING THE MANAGEMENT OF INTERNATIONAL AID?

The Indonesian Government requested the **ASEAN Coordinating Centre for Humanitarian Assistance** on disaster management (**AHA Centre**) to serve as the conduit for offers of international assistance. It aims to regulate foreign volunteers and foreign NGOs

### Regulations for International NGOs aim to provide assistance in Central Sulawesi

1. Foreign NGOs are not allowed to go directly to the field. All activities must be conducted in partnership with local partners.
2. Foreign citizens who are working with foreign NGOs are not allowed to conduct any activity on the sites affected by disasters.
3. Foreign NGOs who already procured/prepared relief items in Indonesia need to register their assistance with the relevant ministries/agencies & mandated to work with local partners in distributing the aid.
4. If the respective NGOs have not registered their assistance with the relevant ministries/agencies, they are asked to register with BNPB for the distribution to the affected population on the field.
5. Foreign NGOs wishing to provide aid can do so through the Indonesian Red Cross (PM) or PMI's - with the guidance of the related ministries/agencies or local partners.
6. Foreign NGOs who have deployed its foreign personnel are advised to recall their personnel immediately.
7. A monitoring of foreign volunteers is required.
8. The delivery of relief items are being coordinated temporarily by BNPB through Balikpapan.

National Disaster  
Management Authority



**BNPB**

[https://reliefweb.int/sites/reliefweb.int/files/resources/AHA-Situation\\_Update-no10-Sulawesi%20EQ-rev.pdf](https://reliefweb.int/sites/reliefweb.int/files/resources/AHA-Situation_Update-no10-Sulawesi%20EQ-rev.pdf)

The Indonesian Government selectively accepts Foreign Aid for Central Sulawesi

<http://www.en.netralnews.com/news/currentnews/read/24609/govt.selectively.accepts.foreign.aid.for.central.sulawesi>



Examples:

- Health assistance is only received in terms of medical devices minus medical personnel.
- Medicines are not accepted due to regulatory considerations and not necessarily in accordance with the conditions in Indonesia.
- All administration and licensing must go through the Ministry of Foreign Affairs



## SULAWESI: MANAGEMENT OF DISASTER OCHA: WHO DOES WHAT, WHERE AND WHEN (4W) (AS OF 16 OCT 2018)?

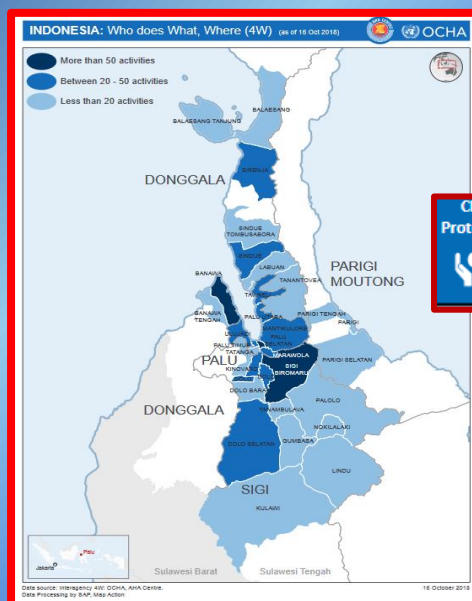


Photograph: <https://www.unocha.org/asia-and-pacific-roap/indonesia>

### OCHA: The United Nations Office for the Coordination of Humanitarian Affairs

- OCHA stated that over the past decade, most Asian countries have established **national disaster management authorities and systems** that are capable of effectively managing disaster responses. Nationally-led disaster management includes the 'whole of society', including the government, military, private sector, civil society, and most crucially, the affected communities.  
<https://www.unocha.org/asia-and-pacific-roap/asia-disaster-guide>
- OCHA stated that "the Government of Indonesia is experienced and well-equipped in managing natural disasters, but sometimes, as with all other countries, outside help is also needed". "Given the scale and complexity of this emergency in Sulawesi, UN agencies and humanitarian organisations are working closely with government counterparts to provide life-saving assistance."
- OCHA has "allocated money to the Sulawesi disaster from the **Central Emergency Response Fund (CERF)** to allow UN agencies and humanitarian organisations to rapidly scale up support to the Indonesian Government-led response in the areas of logistics, shelter, safe water and sanitation, health care, camp coordination and camp management, emergency livelihoods and protection services  
<https://www.unocha.org/story/indonesia-cerf-allocates-us15m-bolster-relief-assistance-people-affected-earthquake-and>

### OCHA: ORGANISED MANAGEMENT OF SULAWESI DISASTER



OCHA allocates activities to organisations such as UNICEF (e.g. nine listed below) they will implement in different areas in the disaster affected areas in Sulawesi, aimed to avoid overlap and wasted resources

#### ACTIVITIES

Child Protection	Early Recovery	Education	Food Security	GBV	Health	Nutrition	Shelter	WASH

[https://reliefweb.int/sites/reliefweb.int/files/resources/IDN\\_4W\\_%20Final%20Product\\_181016.pdf](https://reliefweb.int/sites/reliefweb.int/files/resources/IDN_4W_%20Final%20Product_181016.pdf)



## HOW CAN TECHNOLOGY SUPPORT DISASTER MANAGEMENT?

Geomorphic hazards frequently evolve into disasters. While little can be done to block huge tsunami waves caused by undersea earthquakes or stop volcanic explosions, the **United Nations Office for Disaster Risk Reduction (DRR)** aims to reduce deaths and damage to properties and livelihoods.

There are four main disaster management strategies—*preventing, preparing, responding and recovering*. The DRR focuses on **preventing and preparing** before the disaster, rather than responding and recovering after the disaster. Improvements in preparing for geomorphic disasters includes education, early warning systems and evacuation procedures.

### PREPARING:

- Identify the hazard and organise community awareness campaigns.
- Build seawalls to reduce impacts of tsunamis, and revegetate slopes to stop landslides.
- Earth Observation (EO) technologies warn of impending disasters e.g. data buoys in oceans, land-based monitoring stations and environmental satellites

### RESPONDING:

**Aims to be quick and effective**

- United Nations organisations – World Food Programme (WFP). World Health Organisation (WHO)
- Non-government organisations-World Vision, Oxfam, Doctors without Borders
- Governments and individuals
- Digital technologies-crises mapping
- Emergency services e.g. fire, police, ambulance and defence

**PREPARING  
FOR  
DISASTERS**

**RESPONDING  
TO DISASTERS**

**PREVENTING  
DISASTERS**

**RECOVERING  
FROM  
DISASTERS**

### PREVENTING:

**Potential risks and actions taken before the disaster.**

The UN International Day for Disaster Reduction (IDDR) promotes disaster prevention since \$1 spent on preventative disaster results in an \$8 reduction in costs of damages from disasters

### RECOVERING:

**Affected community is fully functional.**

Roads, shelter, food, water, hospitals and schools restored.

The Natural Disaster Relief and Recovery Arrangements (NDRRA) are administered by the Australian Government.



## SULAWESI: WHERE DO WE GO NOW?



Aid distribution and recovery operations in Palu following quake and tsunami. People get water from a tank at a temporary shelter in Palu, Central Sulawesi, Indonesia, on Monday, Oct. 8, 2018. Images  
<https://www.gettyimages.com.au/detail/news-photo/people-get-water-from-a-tank-at-a-temporary-shelter-in-palu-news-photo/1047746666>

### MOVING FORWARD

Organisations such as the **Global Facility for Disaster Reduction and Recovery (GFDRR)** reports that the Indonesian government “spends US\$300m to US\$500m annually on post-disaster reconstruction” and “costs during major disaster years reach 0.3% of national GDP and as high as 45% of GDP at the provincial level”. **Budgets clearly need to increase**, but these funds should also be **used to do things differently** – for example, by focusing more on **people’s awareness** in a way **that engages better and more proactively with communities and their existing cultures**. As disasters happen at a local level, **local government** should take a central role. Existing socialisation programmes are not working and even if everyone on the beachfront in Palu city had the BMKG app on their phone, would they have known exactly what to do to keep themselves and others safe?

<https://theconversation.com/sulawesi-tsunami-how-social-media-and-a-lullaby-can-save-lives-in-future-disasters-104703>

### HOW SOCIAL MEDIA CAN SAVE LIVES IN THE FUTURE

The Indonesian Agency for **Meteorology, Climatology and Geophysics (BMKG)** has a **phone app** that sends quick alerts about seismic activity and potential tsunamis to those using it. The subsequent distressing impact in Palu shows that such warnings can be useless if people are not aware of, fail to trust or understand them, or are ill-prepared to know what to do in the event of one. The subsequent distressing impact in Palu shows that such warnings can be useless if people are not aware of, fail to trust or understand them, or are ill-prepared to know what to do in the event of one.

<https://theconversation.com/sulawesi-tsunami-how-social-media-and-a-lullaby-can-save-lives-in-future-disasters-104703>

#### Activity:

- What is the cost of natural disasters to Indonesian governments? How can these costs be reduced?
- Technology, such as the phone app can reduce the adverse impacts of geomorphic disasters? Explain its use and why it failed in Sulawesi?
- What is meant by the phrase ‘things need to be done differently?’

## SULAWESI: ACTIVITIES

- 1 Indonesia sits along the Pacific "Ring of Fire", the world's most tectonically active region, and its 260 million people are vulnerable to earthquakes, tsunamis, volcanic eruptions, liquefaction and landslides. The country is beset by geomorphic problems. In pairs outline these problems as an **oral report supported by maps, graphs, diagrams and photographs.**

- 2 In groups design a **mind map** illustrating 'the heroes?' involved in the Sulawesi multiple geomorphic disasters.

- 3 **Perspectives:** Are they survivors or looters?

Residents in the earthquake and tsunami-ravaged city of Palu in Sulawesi have turned to looting due to a shortage of necessities such as food, water and petrol.

A crisis brings out the survivor in people. To call them "Looters" is a gross misrepresentation of the desperation.

Refer to the internet for the different perspectives on this issue. Explain your opinion.



<https://www.abc.net.au/radio/programs/am/sulawesi-children-at-risk-of-abuse-slavery-plan-international/10331952>

<https://www.channelnewsasia.com/news/commentary/palu-sulawesi-earthquake-tsunami-scale-destruction-impact-10810962>

<http://www.thejakartapost.com/news/2018/10/02/government-to-only-accept-non-cash-foreign-aid-for-c-sulawesi.html>

- 4 **Future:** For those people who escaped the disasters the hardest part is yet to come. Explain this statement

<https://www.abc.net.au/news/2018-09-30/indonesia-tsunami-survivors-recount-harrowing-stories/10322262>. Outline the harrowing stories of survival and loss

- 5 **Diagram:** In groups explain the reasons for the Funding Request



<https://reliefweb.int/sites/reliefweb.int/files/resources/SULAWESI%20RP%20051018%20FINAL.PDF>  
\*HCT-Humanitarian Country Team



## SULAWESI: ACTIVITIES

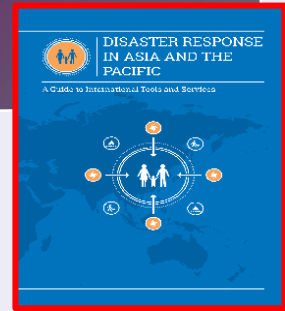
6. **UNICEF Children:** Reports that children make up more than 33% of the population of Central Sulawesi, and 43% of the children live in poverty. Explain why Sulawesi children are at risk of exploitation, abuse and slavery  
<http://www.scoop.co.nz/stories/WO1810/S00022/sulawesi-children-at-risk-warns-save-the-children.htm>  
<https://www.abc.net.au/radio/programs/am/sulawesi-children-at-risk-of-abuse-slavery-plan-international/10331952>  
<https://www.voanews.com/a/thousands-of-children-sulawesi-indonesia-at-risk-of-exploitation/4597998.html>  
<https://www.bordermail.com.au/story/5690554/indonesian-children-at-risk-of-trafficking/?cs=9676>
7. **Diseases:** Authorities announced mass burial to avoid the spread of disease. Discuss why there were fears of spreading diseases after the Sulawesi quake and suggest strategies to reduce the spread.  
<https://coconuts.co/bali/news/fears-spreading-diseases-rise-bodies-recovered-sulawesi-quake-tsunami/>  
<https://www.firstpost.com/world/indonesia-earthquake-authorities-announce-mass-burial-to-avoid-spread-of-disease-toll-could-reach-thousands-5290091.html>  
<https://www.express.co.uk/news/world/1026760/indonesia-earthquake-tsunami-volcano-eruption-disease-fears-mass-grave-sulawesi-palu>  
<https://www.doctorswithoutborders.org/what-we-do/news-stories/story/indonesia-msf-responds-earthquake-and-tsunami-sulawesi>



Mass graves dug and filled to prevent spread of disease. Djakarta Post  
<https://www.wowshack.com/23-facts-about-north-sulawesi-earthquake-despair-heroism-how-to->

8. **Literacy:** Read the **notes and article** on the 7.4 earthquake and tsunami that struck Sulawesi, Indonesia.
  - What were the major physical and social impacts of the earthquake?
  - What were the initial assistance responses?
  - Where were the greatest impacts of this multiple geomorphic disaster?
  - How can satellite imagery help direct humanitarian needs in a disaster?
  - What was the response by the government of Indonesia to the geomorphic disaster?
  - What was the ASEAN Emergency Response?
  - What was the response by other governments e.g. Australia and non -government organisations?

## SULAWESI: ACTIVITIES



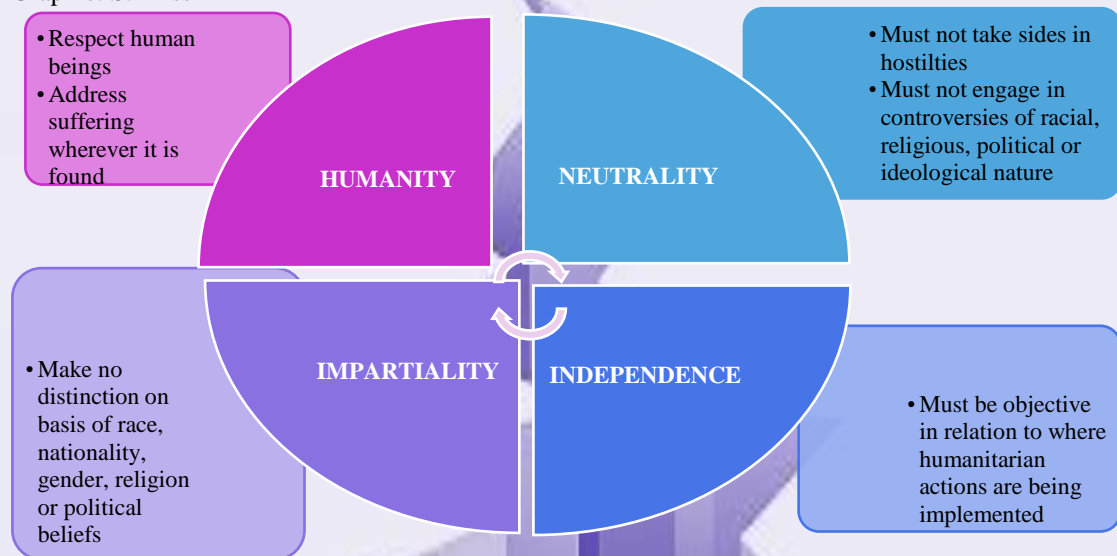
9. **Literacy:** In pairs refer to the **graphics** below and the document '*Disaster Response in Asia and the Pacific*', designed to help disaster managers in Asia to effectively mobilise international and regional tools and services during a disaster response <https://www.unocha.org/asia-and-pacific-roap/asia-disaster-guide>.

- **Diagram:** Explain the **Humanitarian Approach** to disaster management.
- **ICT:** Refer to the internet. What is the meaning to the following **acronyms** that refer to international organisations that provided humanitarian support in the recent geomorphic disaster in Sulawesi-UNICEF, UNHCR, UNDP, WHO, WFP and IOM

### DISASTER MANAGEMENT: COMMITMENT TO HUMANITARIAN PRINCIPLES

<https://www.unocha.org/asia-and-pacific-roap/asia-disaster-guide>

Graphic: S. Bliss



10. **Technology:** *The World Disasters Report* focuses on the spread of technologies to prevent and respond to geomorphic disasters. Mobile phones, crowdsourcing, crises mapping, digital data collection, improved seismic networks and tsunami early warning systems led to a decrease in loss of lives over the last 10 years. Geo-referencing of maps shows the location of the worst affected areas and the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) network of volunteers enables governments and aid organisations to respond quickly with shelter, food and water. In the future, technology aims to eliminate earthquake damage to buildings such as: building on top of a cushion of air; sensors on buildings to detect seismic activity; and shock absorbers to reduce the magnitude of vibrations.

#### EARTHQUAKES

- seismometers and seismographs
- earthquake early warning systems
- emergency earthquake alert

#### VOLCANOES

- seismometers and seismographs
- videos, infrared cameras, satellite imagers, webcams

#### TSUNAMIS

- deep-ocean tsunami detection buoys
- NOAA's DART-real-time monitoring system

- Explain how technology is able to reduce the number of deaths and damaged buildings before, during and after a geomorphic disaster.
- Describe what is meant by preventing and preparing for a geomorphic disaster.
- Research the advantages of the ESRI Global Disaster Resilience App (e.g. evacuation routes and safe shelter locations) aimed to reduce adverse impacts of geomorphic disasters.
- Design an electronic poster for International Day for Natural Disaster Reduction (IDDR) focussing on Indonesia.



## SULAWESI: ACTIVITIES



### TRIGGERED

#### EARTHQUAKE, BEFORE AND AFTER SHOCKS

Palu-Koru fault suddenly slipped, a short distance offshore and only 10km below the surface. This generated the 7.5 magnitude earthquake.

Undersea landslide

Tsunami-6 metres high travelling 250mph

Liquefaction

Landslides on land

### I M P A C T S

#### PEOPLE: DEATH, INJURY, MISSING DESTRUCTION: SHELTER, INFRASTRUCTURE

#### IMPACTS MAGNIFIED BECAUSE OF:

Poor tsunami warning technology-detection buoys off the coast of Sulawesi had not been operational since 2012  
Destroyed communication networks.  
Thick layers of sediment on which Palu lies (not bedrock) allowed the sediment to move like a liquid  
Palu's long narrow bay accentuated the impacts of a tsunami  
Landslides, broken communications networks and collapsed bridges made it difficult for aid workers and rescuers  
Poorly constructed homes and infrastructure  
Hospitals damaged-people received medical treatment in the open  
Lack of preparedness by Indonesian authorities  
Many residents had little awareness about risks from tsunamis and liquefaction

11. In groups discuss the causes, impacts and responses to the Sulawesi geomorphic disaster in 2018. Explain why the impacts of the disaster were magnified, and how improved technology and education could reduce these adverse impacts in the future. Present response as a photo story using ICT.

Photograph: Woman rescued: Rescuers worked to save people trapped in flood waters and rubble. AP: Arimacs Wilander <http://www.abc.net.au/news/2018-10-01/woman-rescued-from-flood-waters/10325386>



## SULAWESI: ACTIVITIES



Aid distribution and recovery operations in Palu following quake and tsunami. Women perform afternoon pray in the front of Raya Mosque in Palu, Central Sulawesi, Indonesia, on Monday, Oct. 8, 2018:

Putu Sayoga/Bloomberg via Getty Images <https://www.gettyimages.com.au/detail/news-photo/women-perform-afternoon-pray-in-the-front-of-ray-mosque-in-news-photo/1047746672>

### ICT

#### Webpages

- Sulawesi: Despair fills Indonesia's buried village of Petoba <https://www.channelnewsasia.com/news/asia/indonesia-palu-earthquake-tsunami-bodies-search-end-petoba-10806430>
- Lombok earthquake: 'Resilient' communities in flattened villages desperate for new homes ahead of rainy season <https://www.standard.co.uk/news/world/lombok-earthquake-resilient-communities-in-flattened-villages-desperate-for-new-homes-ahead-of-rainy-a3929281.html>
- Lombok: Indonesian island hit by multiple earthquakes-can tourism recover? <https://www.nytimes.com/2018/08/08/travel/lombok-indonesia-earthquake-tourism.html>
- Lombok: Indonesian islands were shaken in quake-tourists' confidence was, too.
- <https://www.nytimes.com/2018/08/10/world/asia/indonesia-lombok-earthquake-tourism.html>

#### Satellite images: before and after Sulawesi

- Before and after satellite images and photographs at <https://www.nytimes.com/interactive/2018/10/01/world/asia/map-tsunami-indonesia.html>
- Satellite images show the destruction in Indonesia as the death toll from the massive earthquake and tsunami that hit the island of Sulawesi <https://economictimes.indiatimes.com/news/international/world-news/indonesia-before-after-satellite-images-show-destruction-of-earthquake-tsunami/videoshow/66037649.cms>
- <http://www.abc.net.au/news/2018-10-02/satellite-images-before-and-after-indonesia-tsunami/10328562>

#### You Tube

- Convergent Margin—Subduction to Tsunami (Educational) [https://www.youtube.com/watch?v=Wt\\_jJUnTFhg](https://www.youtube.com/watch?v=Wt_jJUnTFhg)
- How tsunamis work <https://www.youtube.com/watch?v=Wx9vPv-T51I>
- The devastation in Indonesia's quake-hit Sulawesi <https://www.youtube.com/watch?v=sweHFt1RM3w>