Improving the Understanding of Tsunami Risk

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Online Tsunami Seminar

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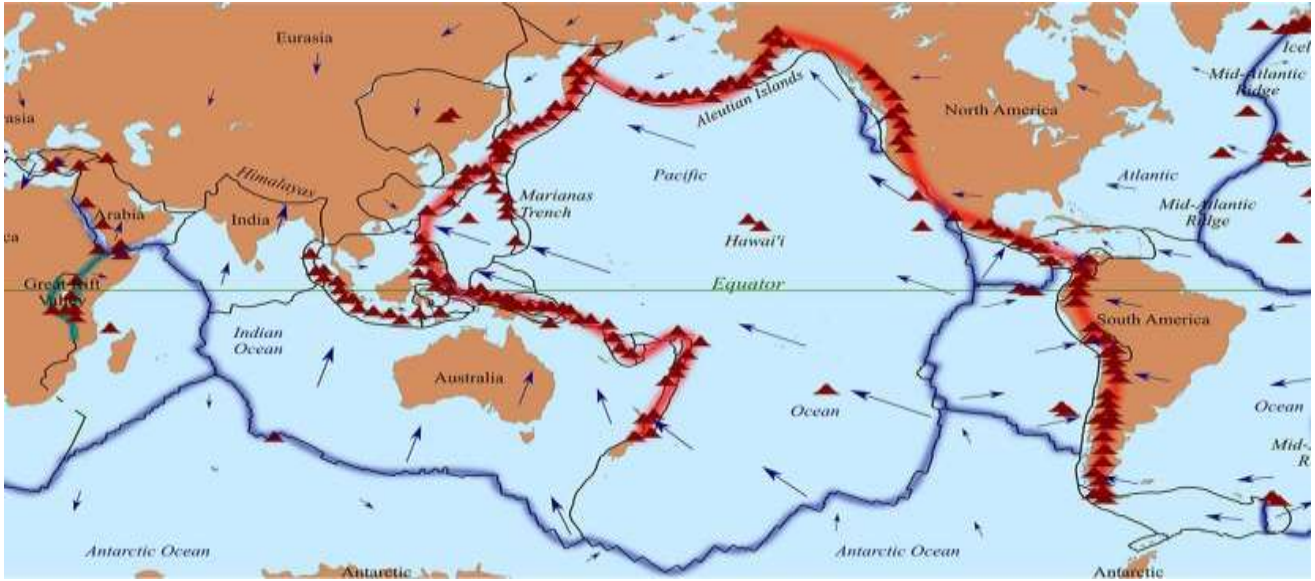
Highly Dynamic Pacific Ring-of-Fire

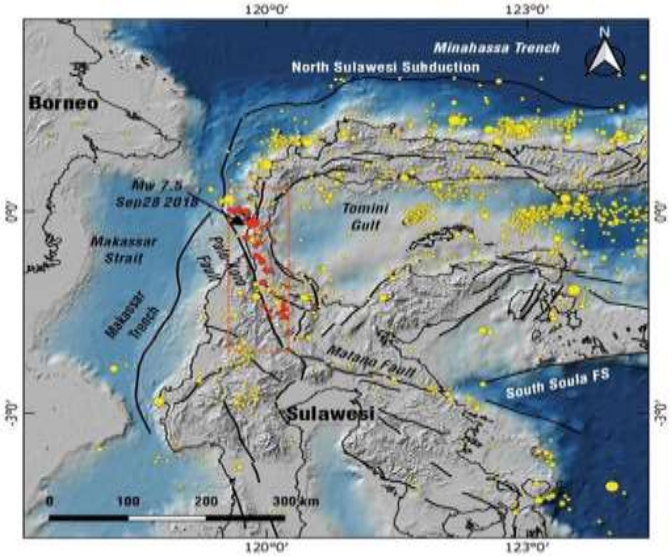


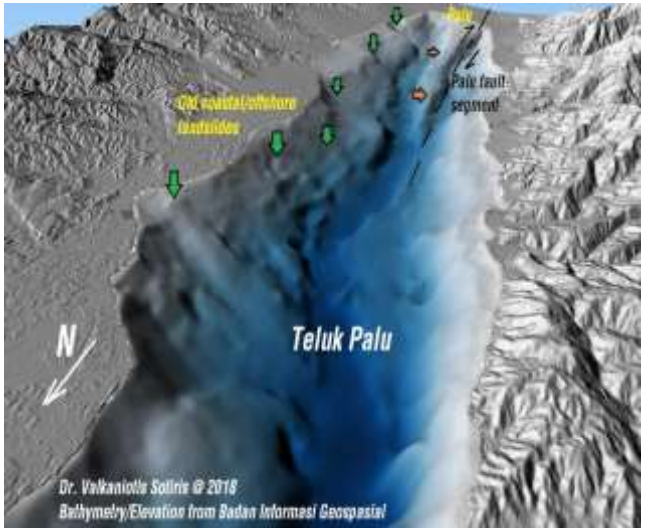
Source: Mancini (2021)

Selected Global Tsunami Events

Tsunami Event	Date	M_w	Mechanism	H-Losses	TEWS
I.O./Sumatra, INA	26 Dec '04	9.3	Subduct. Zone tectonic	200,000+	No
Sendai, JAPAN	11 Mar '11	9.0	Subduct. Zone Tectonic	20,000	Yes
Palu, Sulawesi, INA	28 Sep '18	7.5	Non-Tectonic -*Landslide*	4,340	No
Sunda Strait, INA	22 Dec '18	-	*Volcanic erupt./flank collapse*	430+	No
TONGA, S. Pacific	15 Jan '22	-	*Volcanic eruption-Explosion*	6	VEWS

Palu, SEP 2018 M7.5 Landslide-Induced Tsunami





Source: Valkaniotis et al. (2018)

Palu, SEP 2018 M7.5 Landslide-Induced Tsunami Impact


Volcanos in Indonesia
127 active volcanos
Anak Krakatoa
Last known eruption:
Since 2000
1900-2000
Before 1900
500 km
Source: Smithsonian Institute, Global Volcanism Program
© AFP

Indonesia | Anak Krakatau volcanic eruption

On 24 April 2022, Anak Krakatau erupted and the ash column reached up to 3,000 km high from the summit of the volcano. National Authorities raised the Alert Level to III (Standby Phase).

RECENT ACTIVITY

On 22 Dec 2018 a Tsunami was generated by the collapse of the Anak Krakatau Volcano, with waves propagating in all directions inside the Sunda Strait, the sea portion between the Java and Sumatra Islands. The Tsunami caused **437** fatalities.

Volcanic hazard map

Volcano

Populated places

HAZARD ZONE I

Area potentially affected by ash fall and probably hit by incandescent ejected rock fragments of lapilli sizes (r = 8 km)

HAZARD ZONE II

Area potentially affected by lava flow and possibly affected by pyroclastic flows

Area potentially affected by heavy ash fall and possibly affected by incandescent ejected rock fragments by pebble size (r = 5 km)

HAZARD ZONE III

Area frequently affected by lava flow and possibly affected by pyroclastic flow

Area frequently affected by heavy ash fall and incandescent ballistic projectiles (volcanic bomb) (r = 2 km)

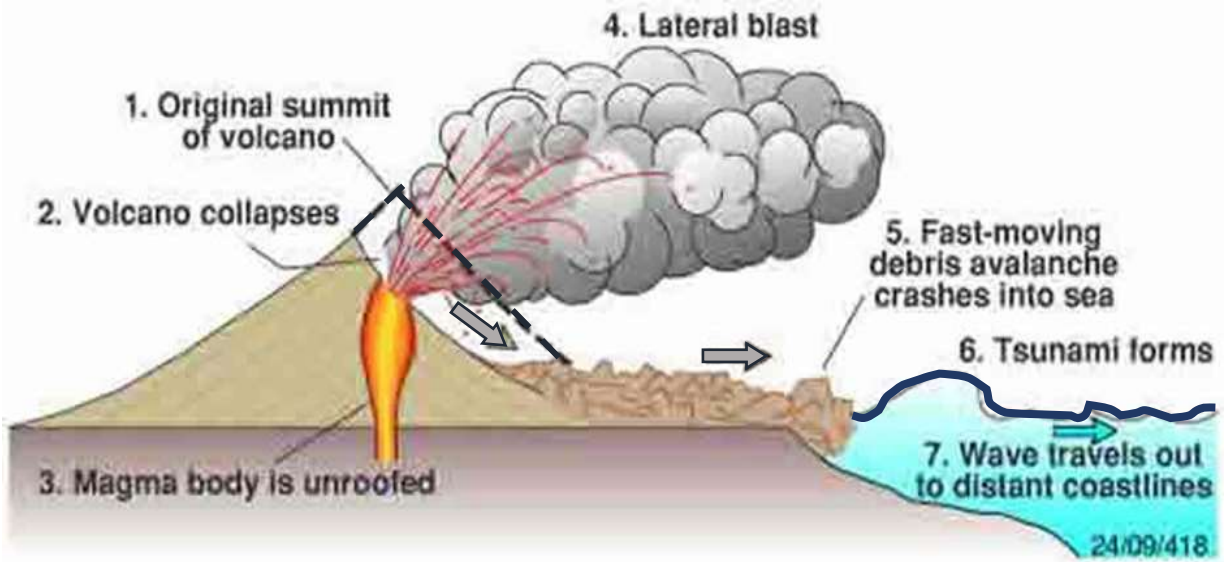
0 12.5 25 km

Early Warning System

- JRC IDSL installed
- New JRC IDSL to be installed
- Tide Gauges (BIG)
- IA Seismic Network (BMKG)

JRC IDSL: Inexpensive Device for Sea-Level Measurement
BMKG: Indonesian Agency for Meteorology, Climatology and Geophysics
BIG: Indonesian Geospatial Information Agency
[1] *With satellite communication by BMKG/BAKTI*
[2] *Connection via Telkomsel GSM link from a new tower installed on Sebesi Island*

Volcanic Eruption-Induced Tsunami



Source: Geoscience Australia

Sunda Strait DEC 2018 Volcanic Eruption-Induced Tsunami Impact

Source: Tribunnews (2019)

Tsunami Risk and its Understanding

Hazard perspective:

- Source mechanism: Tectonic, non-tectonic: Volcanic eruption, landslide
- Cascading multi hazards: fire, explosion, epidemy, etc.

Vulnerability perspective:

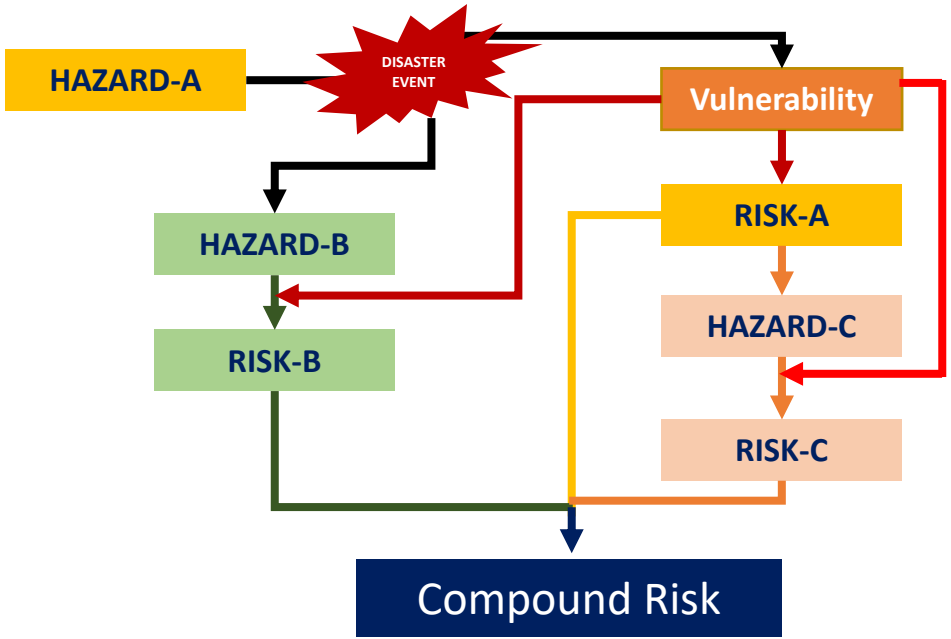
Multi hazard-specific structures and infrastructure, socio-environment

Capacity perspective:

Tsunami risk governance

Conventional Disaster Risk Perspective

Cascading/Systemic Disaster Risk Perspective



Non-tectonic Tsunami Disaster Mitigation Effort in Indonesia

Strategy	Stakeholder	Status
Structural	**Policy**: TEWS	Progress made – IDSL
Non-structural	**Policy**: Advocacy, Preparedness, Risk assessment, Regulations, Instruments, Spatial planning	Very early phase
	Community: Awareness, Education	Yet to Start

IDSL - Tsunami Early Warning System

Inexpensive Device for Sea Level Measurement

- Developed at the Joint Research Center of EC.
- Installed in Indonesia in collaboration with Ministry of Fisheries and Marine Affairs, BMKG, Geospatial Information Agency, Indonesian Tsunami Experts Association, UNESCO/IOC, etc.
- Cheap, very effective, short latency time, robust, reliable, relatively easy maintenance.

IDSL Units Installed in Indonesia

Ministry of Fisheries and Marine Affairs, Indonesia

Selected Research on Recent Non-Tectonic Tsunamis in Indonesia

Authors	Date	Location	Topic	Major Finding
Ye et al.	2020	Sunda Str.	Volcanic landslide	Flank collapse of A. Krakatau
Widiyanto et al.	2019	Palu	Post-tsunami survey	Tsunami arrived in 3-8 min.
Husrin et al.	2020	Palu	Tsunami simulation	Palu Bay hydrodynamics is important for simulation
Haridhi et al.	2022	N. Sumatra	Submarine landslide	Sumatran fault EQ could cause submarine landslides

Efforts Needed to Improve Tsunami Risk Mitigation in Indonesia

1. Comprehensive tectonic and non-tectonic source mechanism mapping
2. Installation of seismometers to monitor submarine volcanic activity
3. Installation of IDSL units in areas prone to near-field tsunamis
4. Integration of disaster risk reduction into coastal spatial planning
5. Assessment of coastal and submarine landslide dynamics
6. Strengthening the coordination for End-to-End TEWS dissemination
7. Community awareness raising for non-tectonic tsunamis
8. Drafting of regulations and SOPs for non-tectonic tsunami risk mitigation

THANK YOU