

# Risk Assessment in National Priority Tourism Area

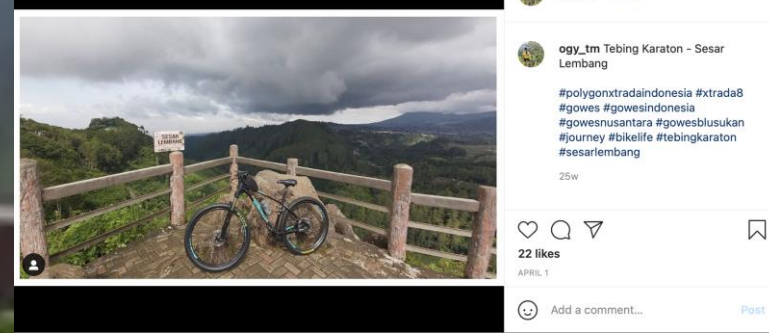
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<sup>2</sup>Badan Riset dan Inovasi Nasional (BRIN)

# Geotourism for Education in Disaster Risk Reduction

-Information board at Lembang Fault in Tebing Keraton, Bandung





# MENGENAL SESAR LEMBANG

Saat ini Anda berada di Gunung Putri, Lembang

Perhatikanlah Sesar Anda sudah bersempitan karena sudah bersempitan karena sudah bersempitan dan itu merupakan Sesar Lembang yang sudah bersempitan.



**"Saya mau cerita tentang Sesar Lembang nih, disimak ya.."**

Peta di sebelah ini adalah peta kawasan Lembang dan garis merah di peta merupakan jalur Sesar Lembang. Sesar Lembang adalah salah satu patahan aktif yang berada di Jawa Barat, dan memiliki potensi gempa di masa mendatang.

Secara morfologi, Sesar Lembang merupakan gawat yang memanjang dan membentang pada arah Barat-Timur di selatan Gt. Tangkuban Perahu sepanjang 28 Km, dimulai dari perbatasan Padalarang dengan Ngamrah, melalui Kampung Daur, The Peak, Besih, Gt. Batu, Tebing Kenyal, hingga Batu Lenceng - Gt. Manglayang. Ada kearifan lokal "Ulah ngaganggu aray nu keur tapa", jangan mengganggu ular yang sedang bertapa, karena bertangannya yang seperti ular!

Gempa merusak pernah terjadi di wilayah sesar lembang pada tahun 2003 dan 2011. Dan berdasarkan hasil penelitian, pernah terjadi gempa pada abad ke-19. Hasil penelitian mengatakan bahwa sesar lembang memiliki laju geser 2-8 mm/tahun dan dapat menghasilkan gempa hingga magnitudo 6.8. Ada 3 jenis bahaya gempa dari sesar lembang, yaitu bahaya guncangan, bahaya deformasi permukaan, dan bahaya likutan seperti patahan tanah. Sesar lembang juga dilakikan dengan legenda sanghunting. Yuk scan QR code ya untuk melihat dongengnya dan mengetahui informasi lebih banyak mengenai sesar lembang!

[Sumber penelitian: tim LIP, ITB, PVMBO, DMBO, dan PuSGeH]



You Are Here!



Sumber Peta Sesar Lembang : Pusat Penelitian Geoteknologi LIPI

"Halo sobat sesar, nama saya Esel alias Sapi Lembang"



Handled by: Organized by: Reported by:

"This project is funded by Australian Government through Australian Alumni Grant Scheme and administered by Australia Awards in Indonesia"



# Geotourism Development

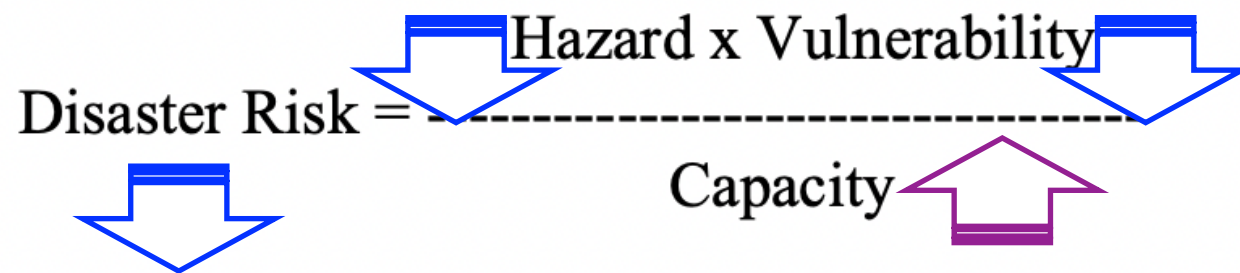
Eg. Lembang Fault, Pagarwangi Village





All disasters are fundamentally human made, a function of where and how people choose or are forced to live (Redmond, 2005)

The trigger may be a natural phenomenon such as an earthquake, but its impact is governed by the prior vulnerability of the affected community



**Hazard assessment:** determines the likelihood of experiencing any **natural or human-made hazard or threat** in the community. Assessment includes the nature and behavior of each of the hazards the community is exposed to.

**Vulnerability assessment:** identifies what **elements are at risk** and why they are at risk

**Capacities assessment:** identifies the **people's** coping **strategies**; resources available for **preparedness, mitigation** and emergency response; who has access to and control over these resources.

**People's perception of risk:** identifies the **perception of risks** of the heterogeneous groups and sectors, which make up the community; measurement of the community's disaster risks based on people's perception.

# Earthquake

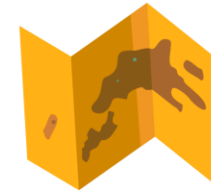
A term used to describe both sudden slip on a fault, and the resulting ground shaking and radiated seismic energy caused by the slip, or by volcanic or magmatic activity, or other sudden stress changes in the earth.

Faults are commonly considered to be active if they have moved one or more times in the last 10,000 years (USGS)

## 6 Facts on Earthquake



Suddenly



Anywhere in  
Indonesia



Cross  
generation



Impact any  
people



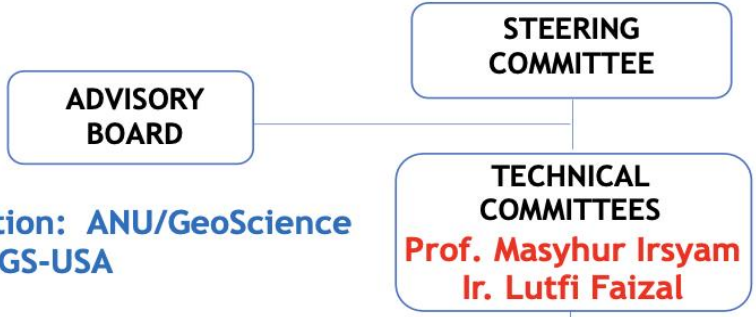
Short duration on  
damage



Without warning



# Tim Pemutakhiran Peta Sumber dan Bahaya Gempa Nasional 2017



Jumlah Anggota = 72 orang

International Collaboration: ANU/GeoScience Australia, GEM-Italy, USGS-USA



**GEOLOGY WORKING GROUP**  
Dr. D.H. Natawijaya

**GEODESY WORKING GROUP**  
Dr. Irwan Meilano

**SEISMOLOGY + INSTRUMENTATION WORKING GROUP**  
Prof. S Widiyantoro

**GMPE WORKING GROUP**  
Ariska R., MSc

**CATALOG WORKING GROUP**  
Dr. Wahyu Triyoso

**SEISMIC HAZARD WORKING GROUP**  
Dr. Sri Hidayati



**KAJIAN GEMPA PIDIE JAYA PROVINSI ACEH INDONESIA**  
7 Desember 2016 (M6.5)

Disusun oleh:  
Tim Pusat Studi Gempa Nasional  
Pusat Litbang Perumahan dan Permukiman  
Badan Penelitian dan Pengembangan  
Kementerian Pekerjaan Umum dan Perumahan Rakyat

**LAPORAN CEPAT GEMPA TASIKMALAYA PROVINSI JAWA BARAT**  
15 Desember 2017 (M6.5)

Disusun oleh:  
Tim Pusat Studi Gempa Nasional  
Pusat Litbang Perumahan dan Permukiman  
Badan Penelitian dan Pengembangan  
Kementerian Pekerjaan Umum dan Perumahan Rakyat

**KAJIAN RANGKAIAN GEMPA LOMBOK PROVINSI NUSA TENGGARA BARAT**  
29 Juli 2018 (M6.4)  
5 Agustus 2018 (M7.0)  
19 Agustus 2018 (M6.9)

Disusun oleh:  
Tim Pusat Studi Gempa Nasional  
Pusat Litbang Perumahan dan Permukiman  
Badan Penelitian dan Pengembangan  
Kementerian Pekerjaan Umum dan Perumahan Rakyat

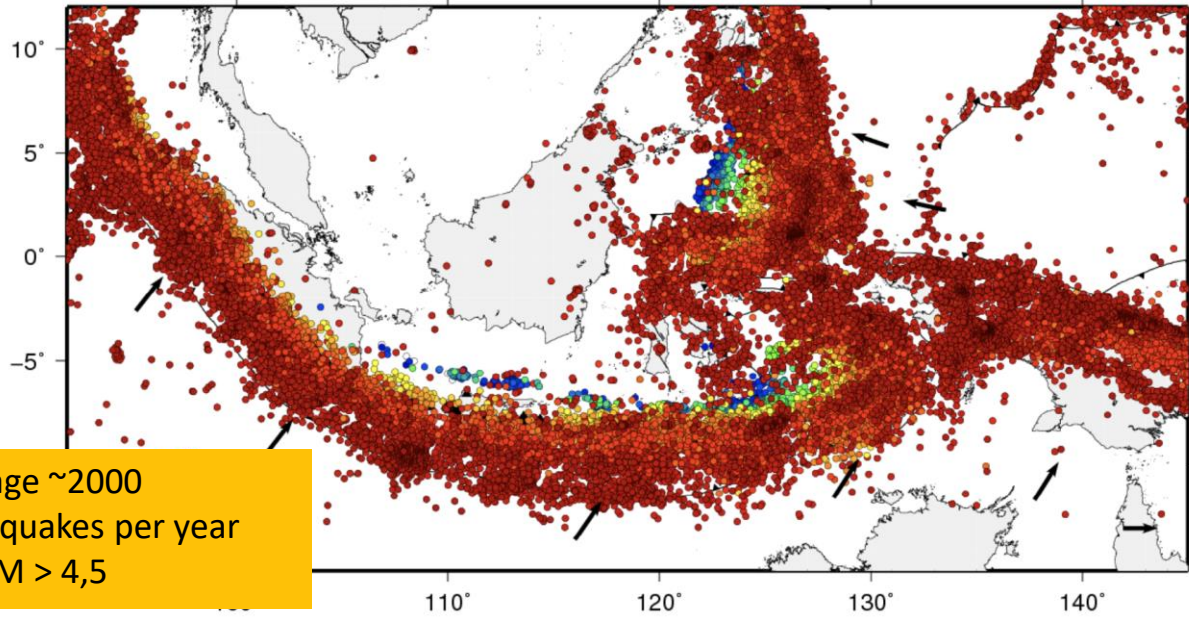
**KAJIAN GEMPA PALU PROVINSI SULAWESI TENGAH**  
28 September 2018 (M7.4)

Disusun oleh:  
Tim Pusat Studi Gempa Nasional  
Pusat Litbang Perumahan dan Permukiman  
Badan Penelitian dan Pengembangan  
Kementerian Pekerjaan Umum dan Perumahan Rakyat

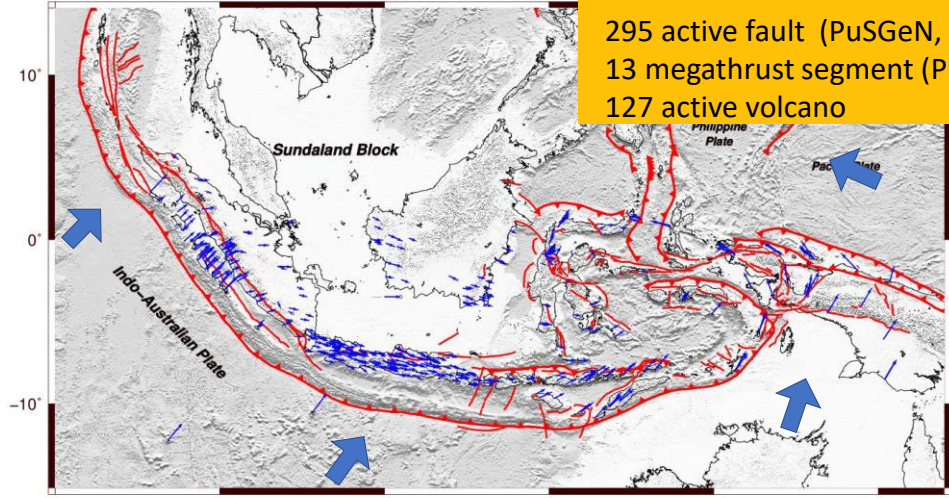




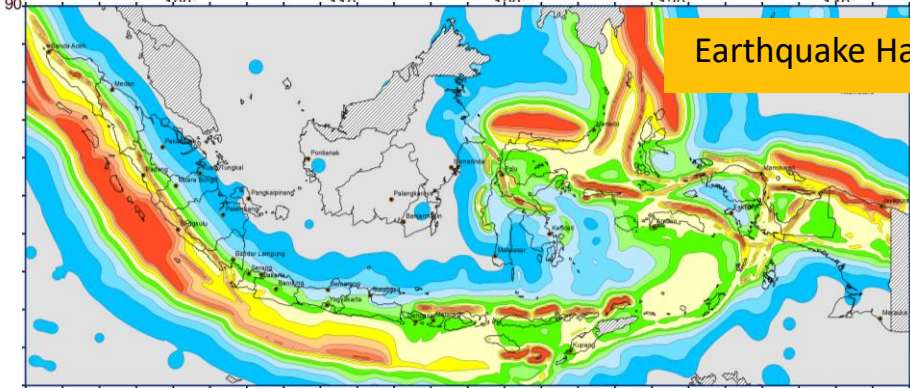
# Tectonics in Indonesia



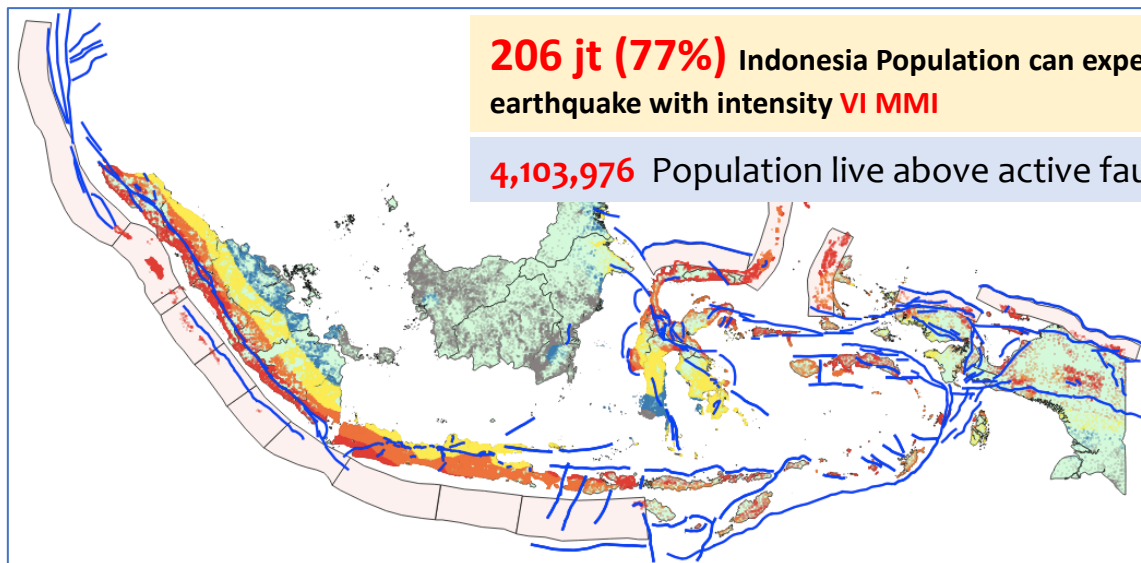
Average ~2000 earthquakes per year with M > 4,5



295 active fault (PuSGeN, 2017)  
13 megathrust segment (PuSGeN, 2017)  
127 active volcano

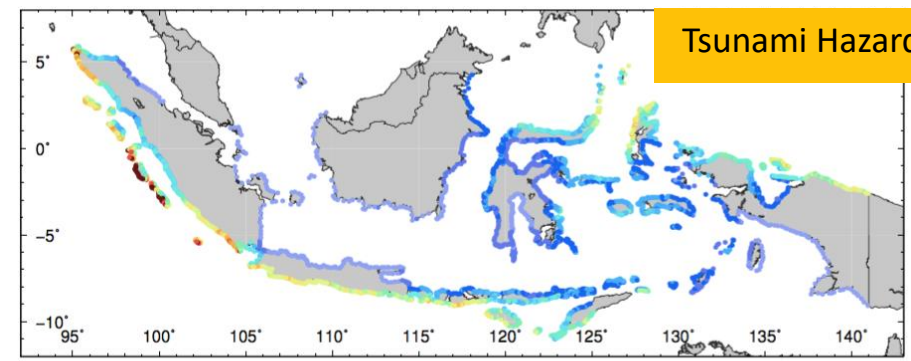


Earthquake Hazard Map

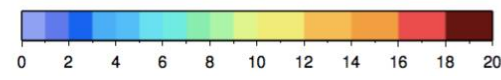


**206 jt (77%)** Indonesia Population can experience earthquake with intensity VI MMI

**4,103,976** Population live above active faults



Tsunami Hazard Map





# Earthquake Hazard

Primer Hazard :

Shaking

Surface Displacement

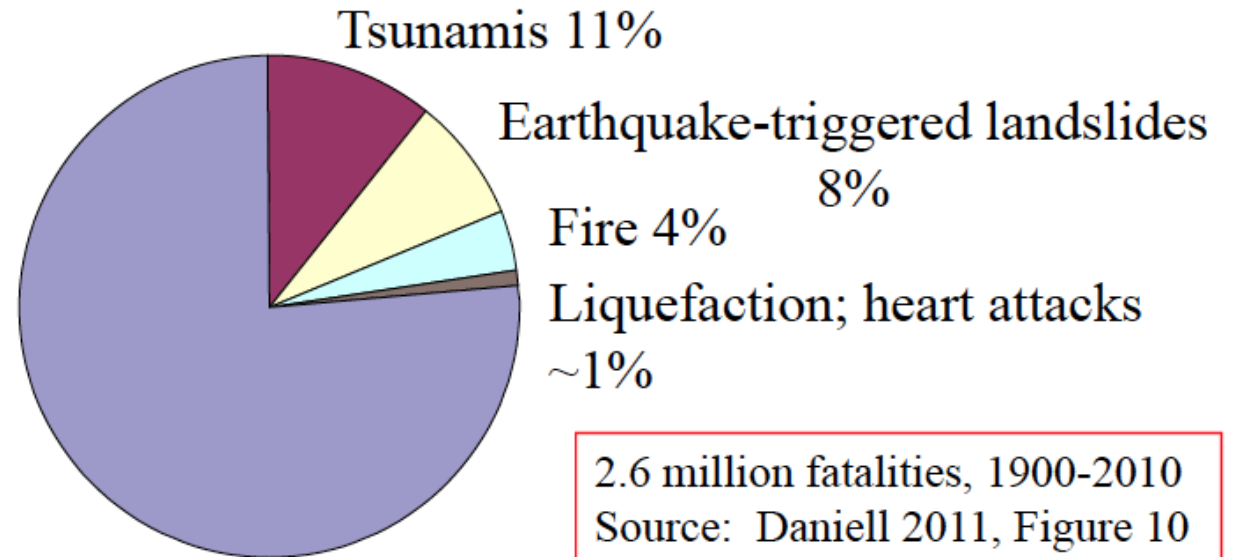
Secunder Hazard

Tsunami  
Land movement  
Landslide  
Liquefaction  
Fire  
Disease

Disturbed Life

## Source of Death at Earthquake

**People killed  
in collapsing  
buildings  
77%**





# The 21 November 2022 Mw 5.6 Cianjur Earthquake



Typical damage dominated by building damage

→ Mitigation can be done with building better on housing or retrofitting





# Illustration on Building

Weak Brick Structure at large Earthquake



Strong Brick Structure at large Earthquake (with wooden frame)



Source: Prof. Yoshiyuki Kaneda, 2018. SATREPS Turkey and Japan



# Lessons Learned from Red Zone Map based on Risk Assessment after the 2018 Palu Earthquake (M7.4)

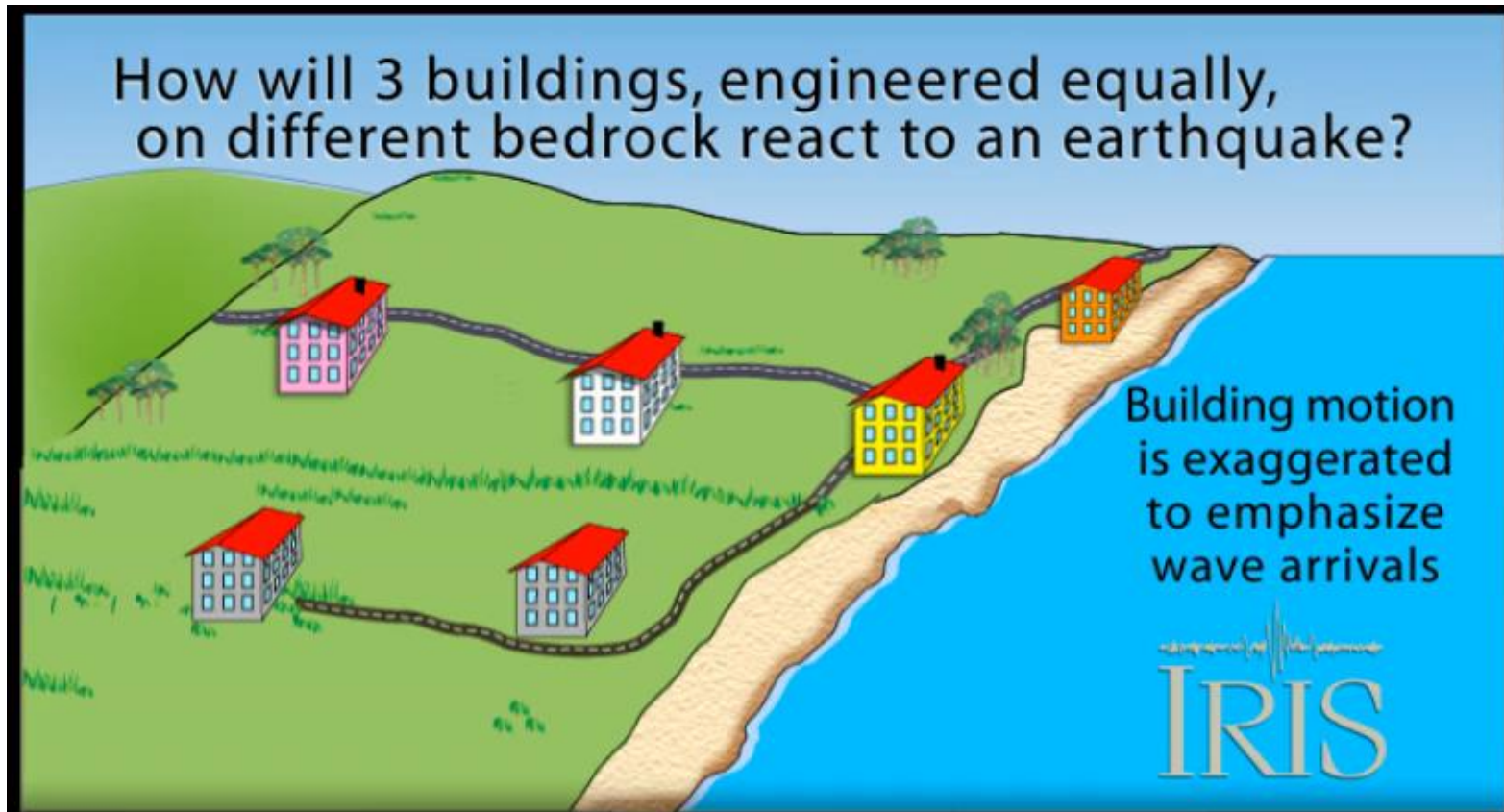
## Red Zone:

- Super-shear Earthquake,
- Strike-slip+marine landslide driven tsunami,
- Massive flow-slide liquefaction



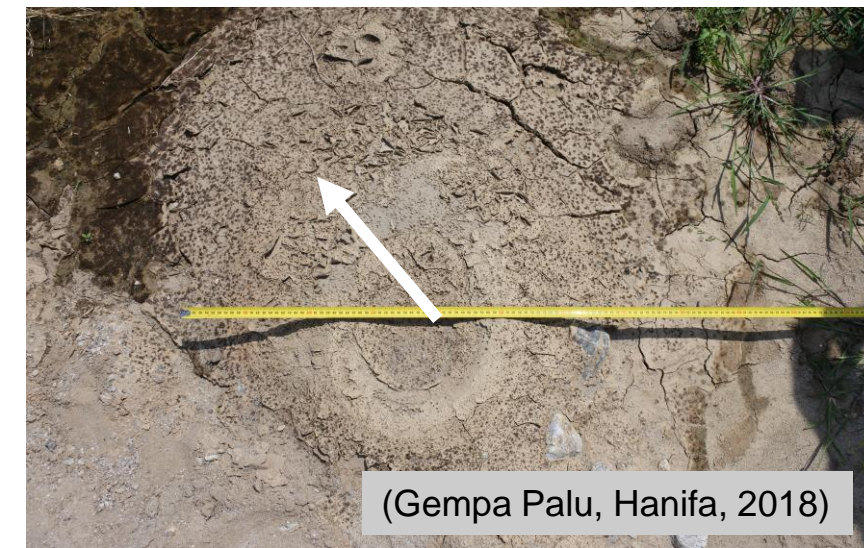


# Earthquake Secondary Impact : Liquefaction



Two variables affect damage during earthquake:

- 1) Intensity of shaking (*felt motion, not magnitude*)
- 2) Engineering





# Earthquake Secondary Impact : Landslide

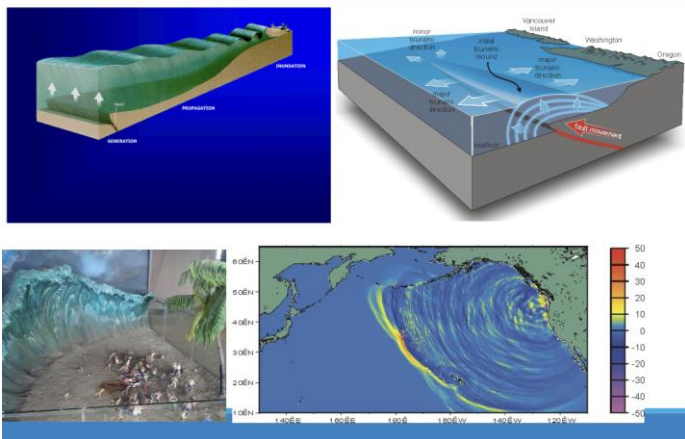


Dokumentasi PuSGeN – 2018 Lombok @Astyka Pamumpuni

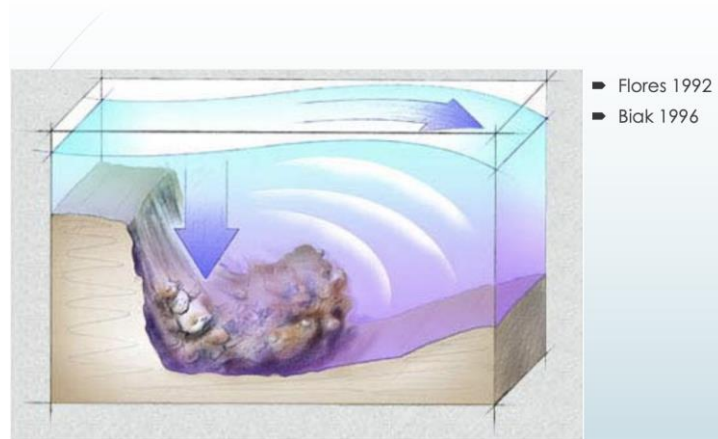


# Earthquake Secondary Impact : Tsunami

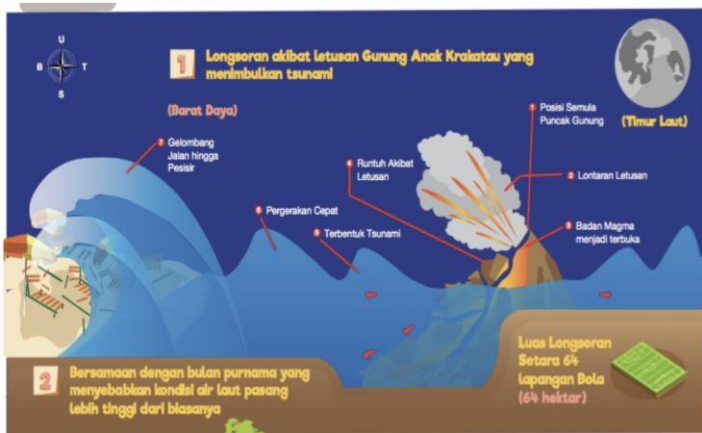
## 1. Submarine Earthquake



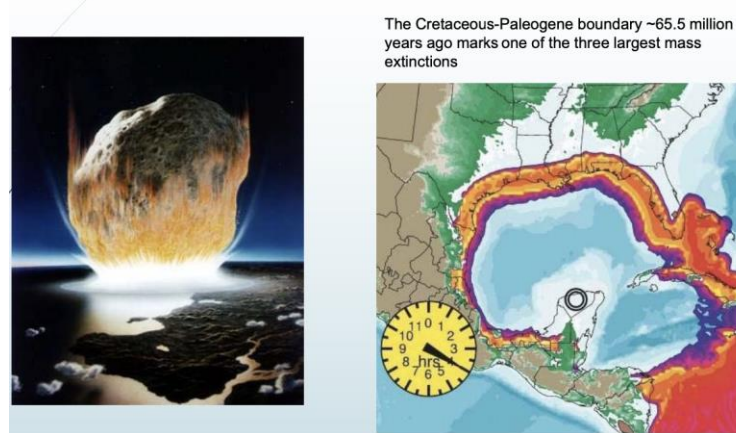
## 2. Submarine Landslide



## 3. Volcanic Landslide



## 4. Asteroid Impact



- Earthquake
- Volcanic Eruption
- Sea floor landslide
- Meteor hit sea

~ 80-90% tsunami caused by **earthquake** (Ward et al., 2011)



# Impact of the 2004 Aceh Earthquake and Tsunami

**Banda Aceh 10 Years Later  
2004-2014**

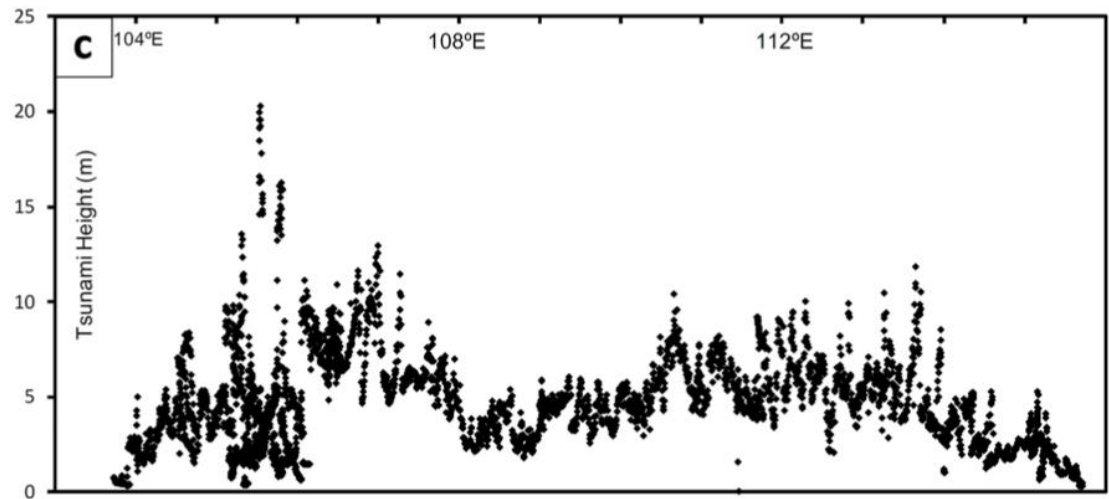
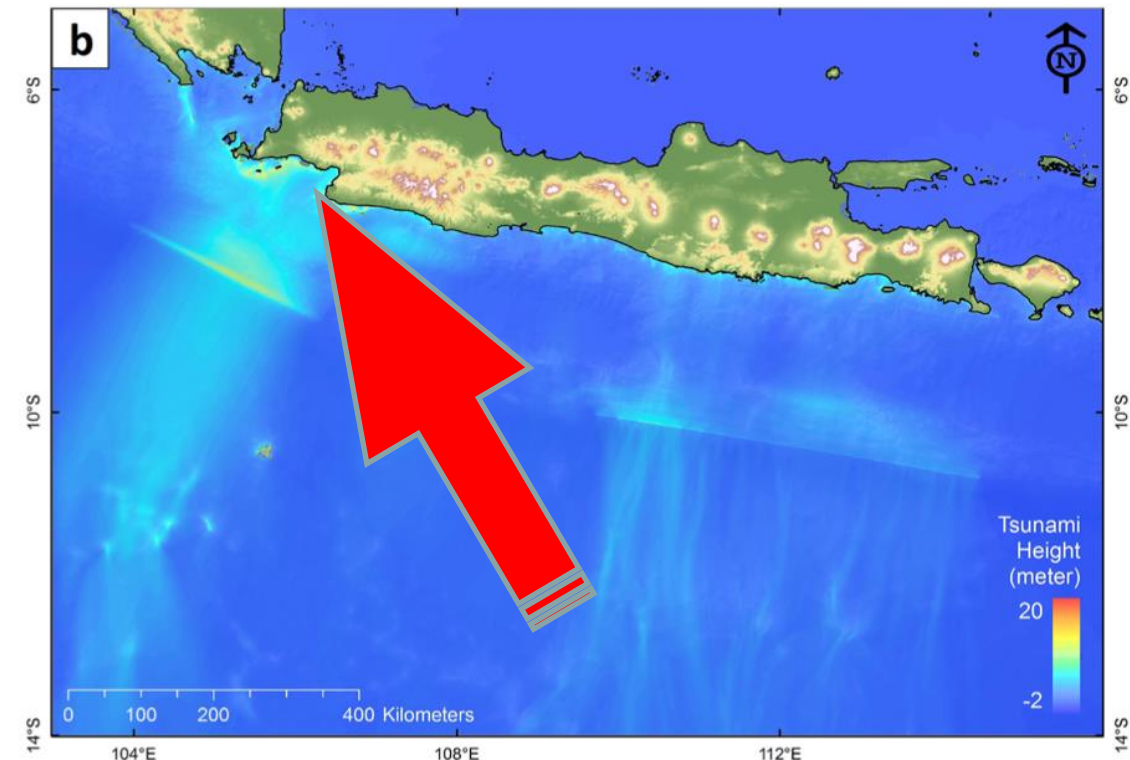
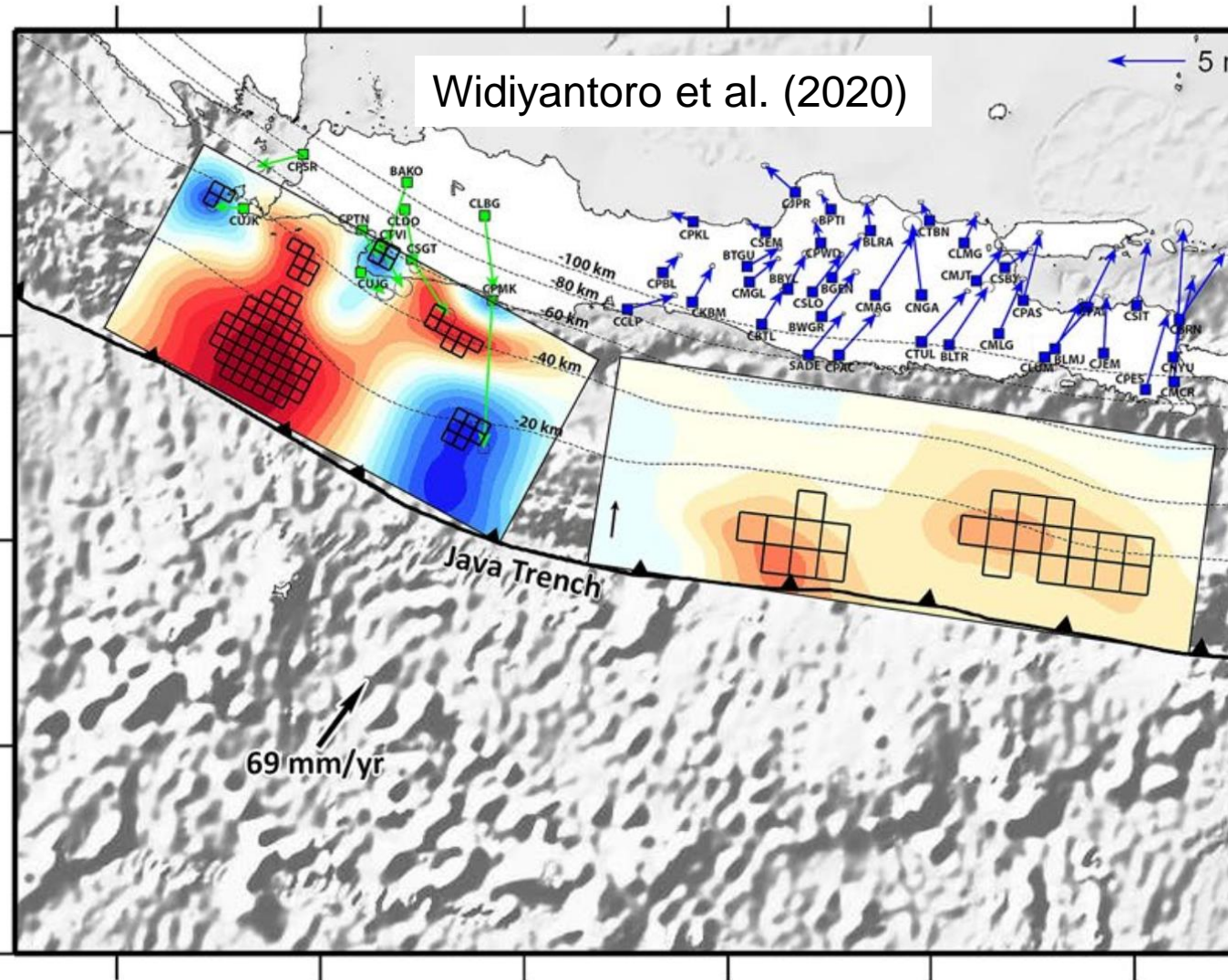


**Coastal Highway in Aceh Besar District**





# TSUNAMI ASSESMENT





# ITB COMMUNITY SERVICE @PANGGARANGAN



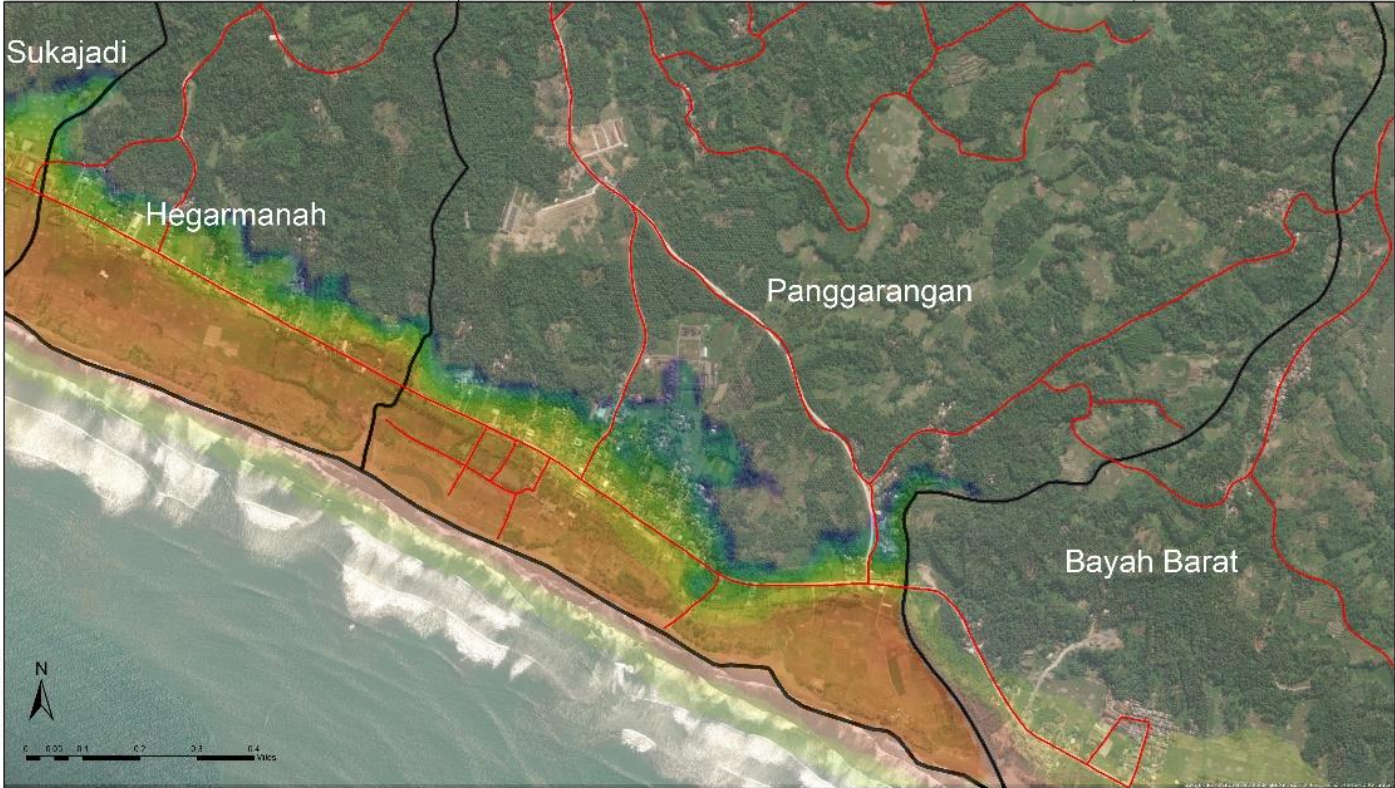


# TSUNAMI @PANGGARANGAN

PETA RENDAMAN TSUNAMI DESA PANGGARANGAN KAB. LEBAK

106°13'0"E

106°14'0"E



106°13'0"E

106°14'0"E

**LEGENDA**

- JALAN
- BATAS DESA

**POTENSI RENDAMAN TSUNAMI**

- 0-1 m
- 1-2 m
- 2-3 m
- >3 m

Potensi Rendaman Tsunami dengan Skenario Gempa Megathrust Segmen Selat Sunda M8.7  
 Warna Solid: Pemodelan tim ITB - LIPI  
 Warna Transparan: Pemodelan Tim BMKG



Sumber : (Windupranata dkk, 2021, In Preparation)



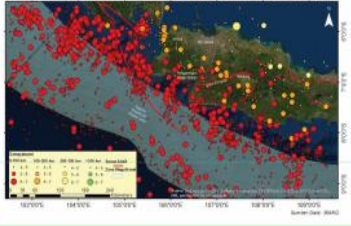


## HAYU URANG SIAGA CAAH LAUT

### Siap Siaga Tsunami

#### Sejarah Gempa di Lebak

PETA SEISMISITAS BANTEN DAN SEKITARNYA (1963-JUNI 2021)



#### Apakah Tsunami itu?

Tsunami adalah serapan bahasa Jepang. Tsu berarti pelabuhan, dan nami berarti gelombang. Jika diartikan, Kata tsunami memiliki arti ombak besar di pelabuhan. Kita sering menyebut tsunami dengan istilah "CAAH LAUT".

#### Pahami Makna Rambu berikut ini!



**Peringatan Zona Bahaya Tsunami / gempa**  
Peringatan bahwa Anda telah berada pada kawasan rawan bencana tsunami/gempa



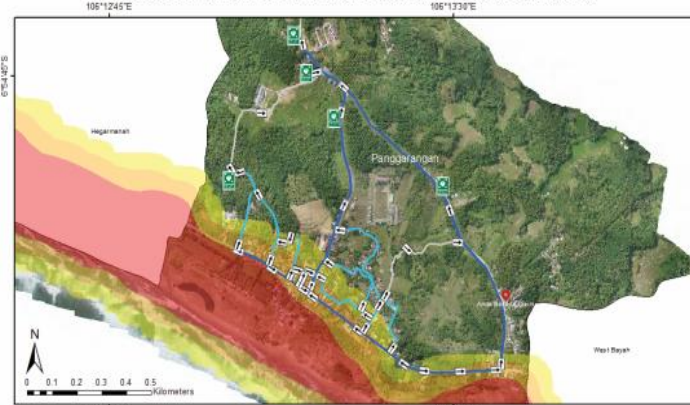
**Titik Kumpul**  
Petunjuk tempat kumpul, Mengindikasikan lokasi yang aman atau daerah yang lebih tinggi untuk evakuasi saat terjadi tsunami



**Arah Evakuasi**  
Petunjuk menuju lokasi evakuasi tsunami

Rambu di atas berdasarkan yang ada di Lebak dan SMA Perka DNPS No 70013

PETA JALUR EVAKUASI DESA PANGGARANGAN, LEBAK, BANTEN



#### Evakuasi Mandiri!

Ke tempat evakuasi terdekat jika mengalami salah satu atau lebih ciri-ciri akan terjadinya tsunami

<p>Gempabumi yang kuat atau yang berlangsung lama</p>	<p>Melihat gelombang laut yang tidak biasa (berbuih tiba-tiba surut menjalar dapat ke arah darat, bergemuruh)</p>	<p>Terdengar suara gemuruh dari arah laut, biasanya disertai angin kencang</p>
<p>Mencium yang tidak biasa seperti bau belerang yang kuat atau bau amis</p>	<p>Melihat reaksi hewan yang tidak biasa, misal berlari menjauhi pantai</p>	<p>Mendapat pemberitahuan akan ada tsunami, atau terdengar suara sirine peringatan tsunami</p>
<ul style="list-style-type: none"> <li>Tetap tenang</li> <li>Matikan semua sumber listrik dan sumber api</li> </ul>	<ul style="list-style-type: none"> <li>Bawa tas siaga jika bisa</li> <li>Tetap berada di tempat evakuasi sampai mendapat arahan dari pihak berwenang</li> </ul>	



#### Tanggap Gempa



- Waspadalah, gempabumi yang kuat atau yang berlangsung lama dapat memicu tsunami dalam waktu singkat
- Jauhi pantai dan tepi sungai, serta cari informasi apa yang akan terjadi

#### Tanggap Peringatan



- Dapatkan informasi dari peringatan dari BMKG melalui TV Nasional, radio daerah, atau pengumuman di sekitar Anda
- Jika terdengar bunyi sirine, kentongan, atau peralatan lain yang sudah disepakati, segera dievakuasi.

Peringatan BMKG memberikan STATUS ANCAMAN tsunami untuk setiap daerah

<b>AWAS</b>	Status ancaman tertinggi Warga harus evakuasi!
<b>SIAGA</b>	Status ancaman sedang, namun masih berbahaya Warga harus evakuasi!
<b>WASPADA</b>	Status ancaman rendah Warga harus menjauhi pantai dan tepi sungai!

#### Tanggap Evakuasi



- Setelah gempabumi atau menerima peringatan tsunami, segera evakuasi ke lokasi yang aman.
- Ikut jalur dan rambu evakuasi, jika ada.
- Jika lokasi aman tidak diketahui, larilah sejauh mungkin dari pantai, naiklah ke tempat tinggi.

DALAM DAERAH YANG RAWAN GEMPA, GEMPA DAPAT MENYEBABKAN TSUNAMI. CEK ANCAMAN DAN RESIKO DENGAN APLIKASI

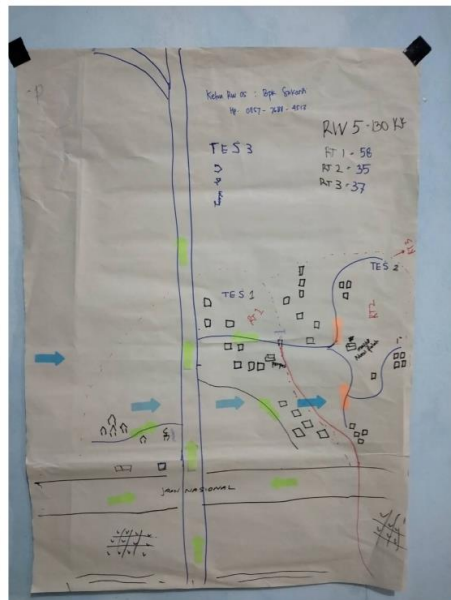
Linktree  
<https://linktr.ee/AplikasiKesiapsiagaanBencana>

BUKAN GEMPABUMI DAN TSUNAMI YANG MEMBUNUH TAPI KETIDAK TAHUAN DAN SIKAP TIDAK PEDULI KITA.

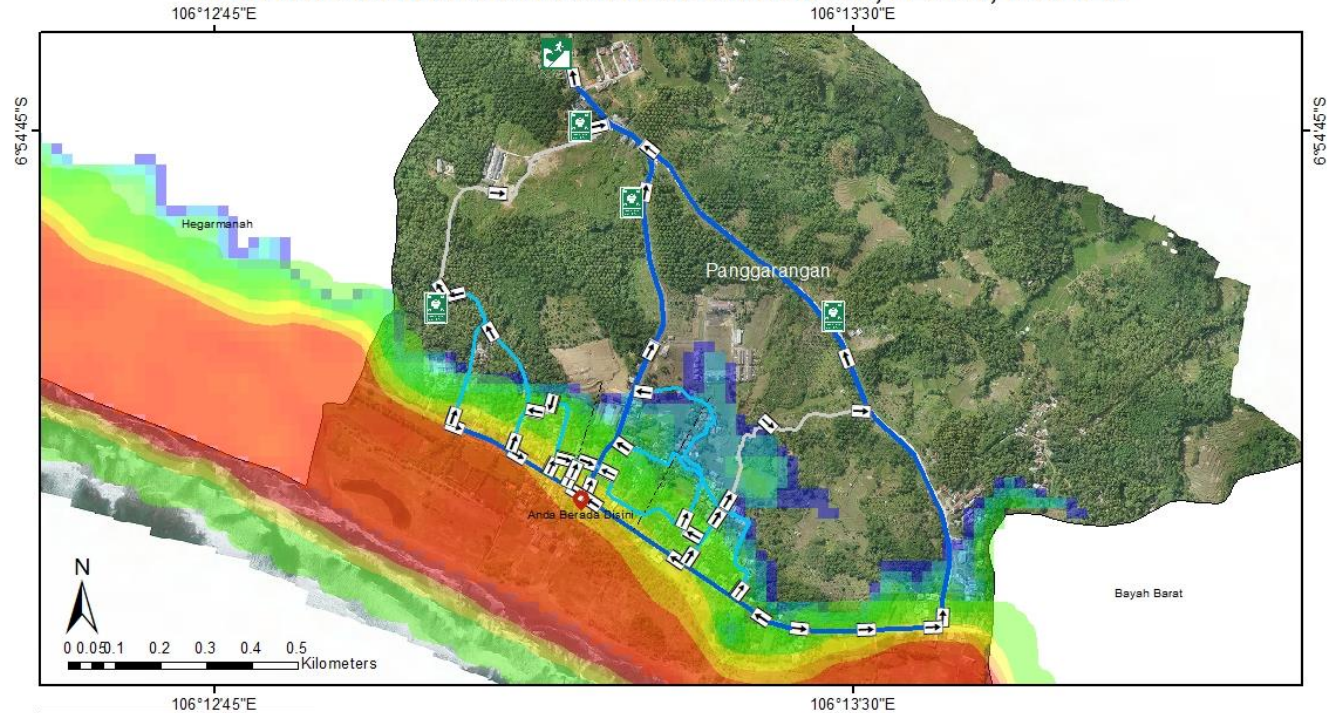




# TSUNAMI @PANGGARANGAN



## PETA JALUR EVAKUASI DESA PANGGARANGAN, LEBAK, BANTEN



**Legenda**  
**Rendaman Tsunami**

<span style="color: green;">■</span> 0-1 meter	<span style="color: orange;">■</span> 2-3 meter	Jalan Setapak
<span style="color: yellow;">■</span> 1-2 meter	<span style="color: red;">■</span> >3 meter	Jalur Motor
T.E.S	T.E.A	Jalur Mobil

Waktu tiba tsunami :  
 15 menit

Waktu menuju T.E.S  
 dengan berjalan cepat :  
 11-17 menit

Sumber data:  
 - Skenario gempa: M8.7 segmen selatan sunda (PuGeN, 2017)  
 - Pola potensi rendaman tsunami (Windupranata et al, 2020)  
 - Foto udara akuisisi Juni 2021  
 - Jalur dan tempat evakuasi partisipatif Desa Panggarangan, Juni 2021







# TSUNAMI @PANGGARANGAN





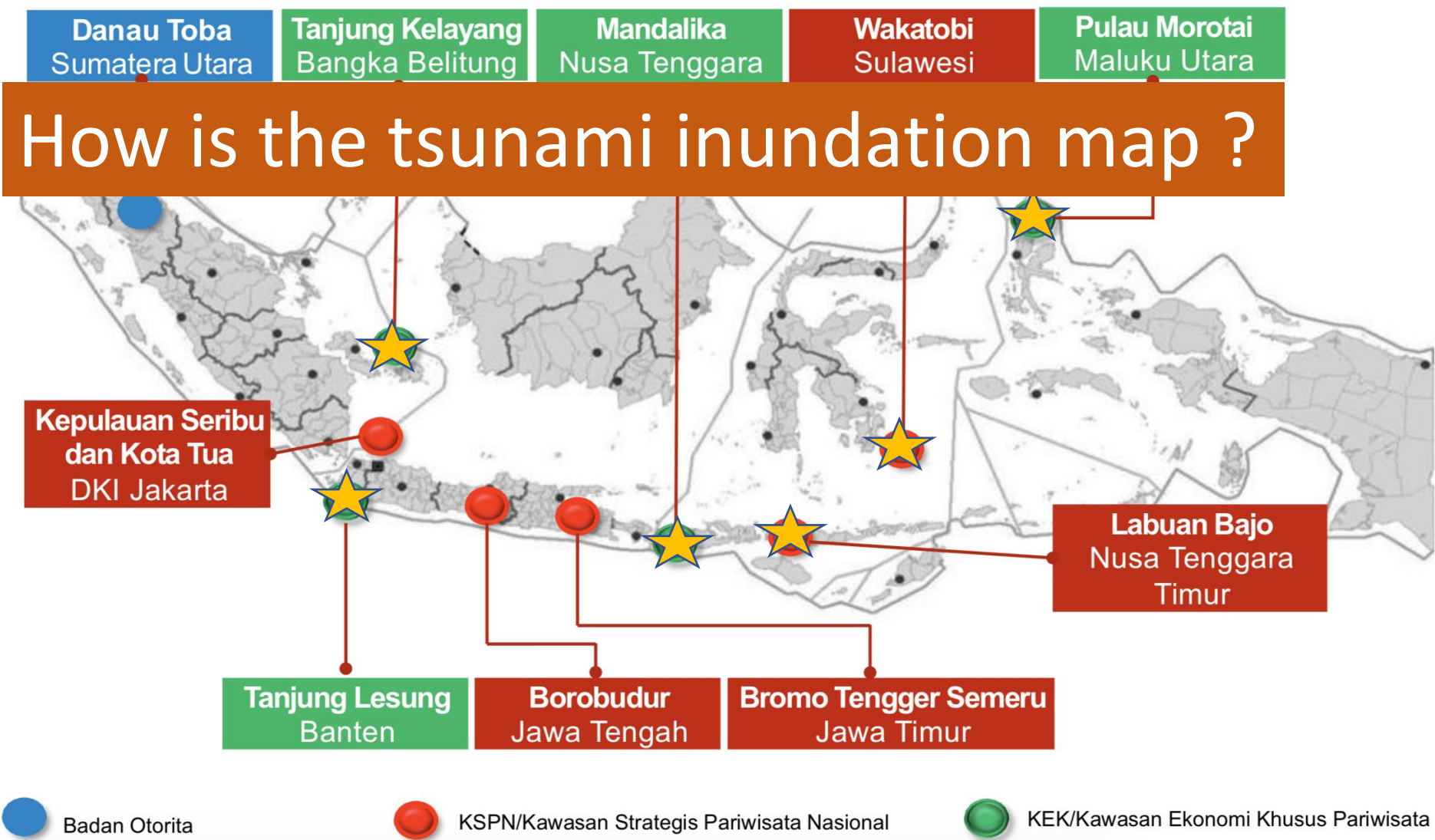
# Tsunami Ready

TSUNAMI READY INDICATORS	
<b>I</b>	<b>ASSESSMENT (ASSESS)</b>
1	<b>ASSESS-1.</b> Tsunami hazard zones are mapped and designated.
2	<b>ASSESS-2.</b> The number of people at risk in the tsunami hazard zone is estimated.
3	<b>ASSESS-3.</b> Economic, infrastructural, political, and social resources are identified.
<b>II</b>	<b>PREPAREDNESS (PREP)</b>
4	<b>PREP-1.</b> Easily understood tsunami evacuation maps are approved.
5	<b>PREP-2.</b> Tsunami information including signage is publicly displayed.
6	<b>PREP-3.</b> Outreach and public awareness and education resources are available and distributed.
7	<b>PREP-4.</b> Outreach or educational activities are held at least 3 times a year.
8	<b>PREP-5:</b> A community tsunami exercise is conducted at least every two years.
<b>III</b>	<b>RESPONSE (RESP)</b>
9	<b>RESP-1.</b> A community tsunami emergency response plan is approved.
10	<b>RESP-2.</b> The capacity to manage emergency response operations during a tsunami is in place.
11	<b>RESP-3.</b> Redundant and reliable means to timely receive 24-hour official tsunami alerts are in place.
12	<b>RESP-4.</b> Redundant and reliable means to timely disseminate 24-hour official tsunami alerts to the public are in place.





# The 10 National Priority Tourism Economic Zones



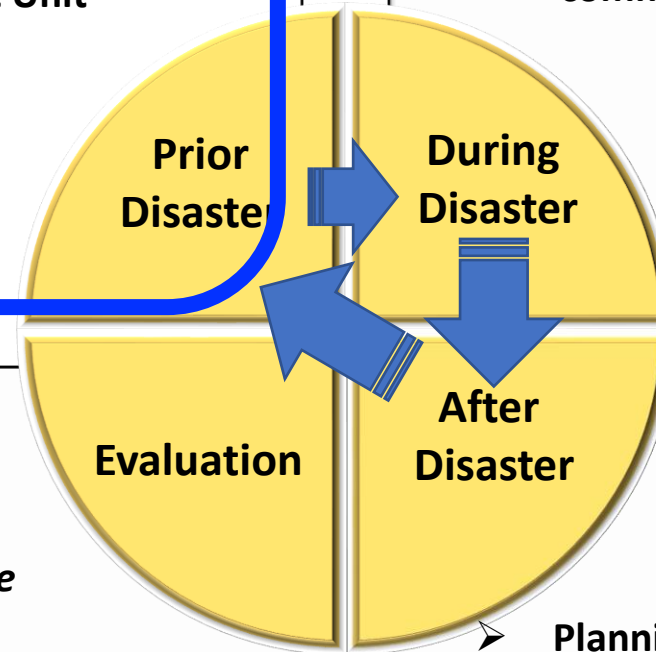


# Disaster Mitigation Flow

- Identify earthquake sources, tsunami threat level
- Conduct Risk Assessment at the Tourism Area Level
- Build Infrastructure according to minimum standards that are resistant to disasters
- Setting up disaster insurance
- Prepare for Disaster Preparedness Efforts
  - Establish a Special Disaster Management Unit
  - Develop emergency response SOPs
  - Education and Training
  - Providing Critical Facilities; Temporary Evacuation Routes & etc.

- Continue hazard source monitoring
- Carry out disaster mitigation efforts in the framework of recovery
  - *Built back better, safer, and sustainable*
- Review planning documents
- Monitor physical and non-physical recovery on a regular basis

- Command System: The Unit Head controls the operational activities of disaster management and is responsible to the Regional Head
- Implementation of emergency response SOP
  - Disseminate information via crisis control center and communications (Early Warning System)
  - Utilize disaster emergency response equipment

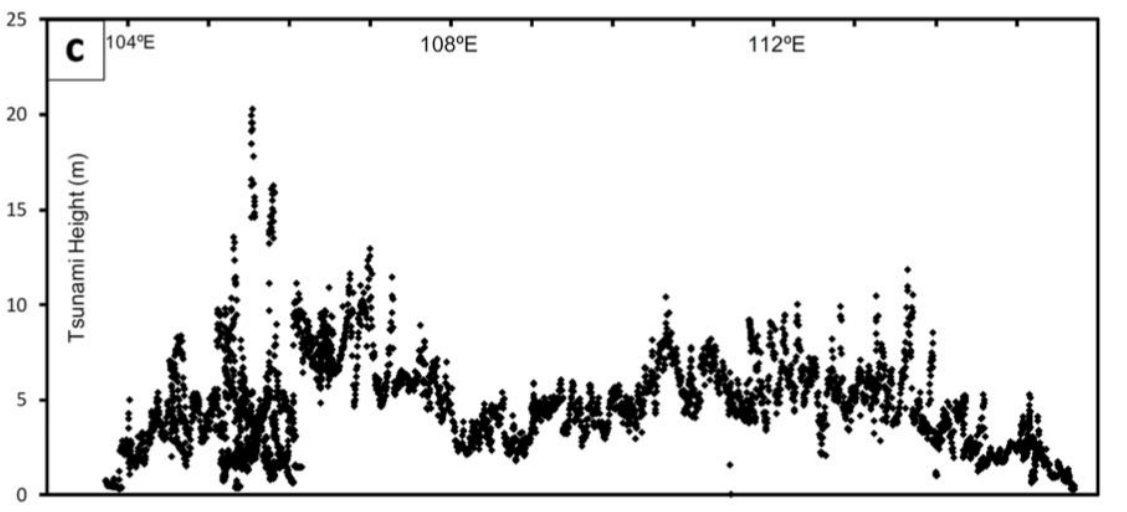
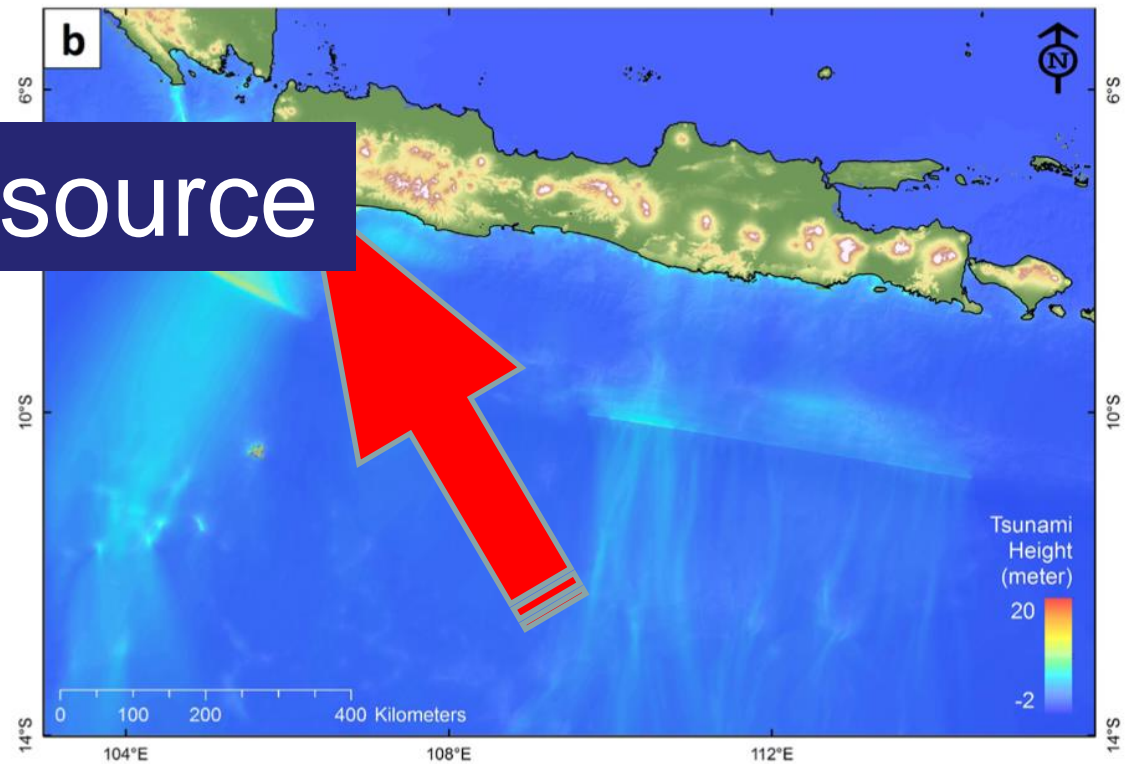
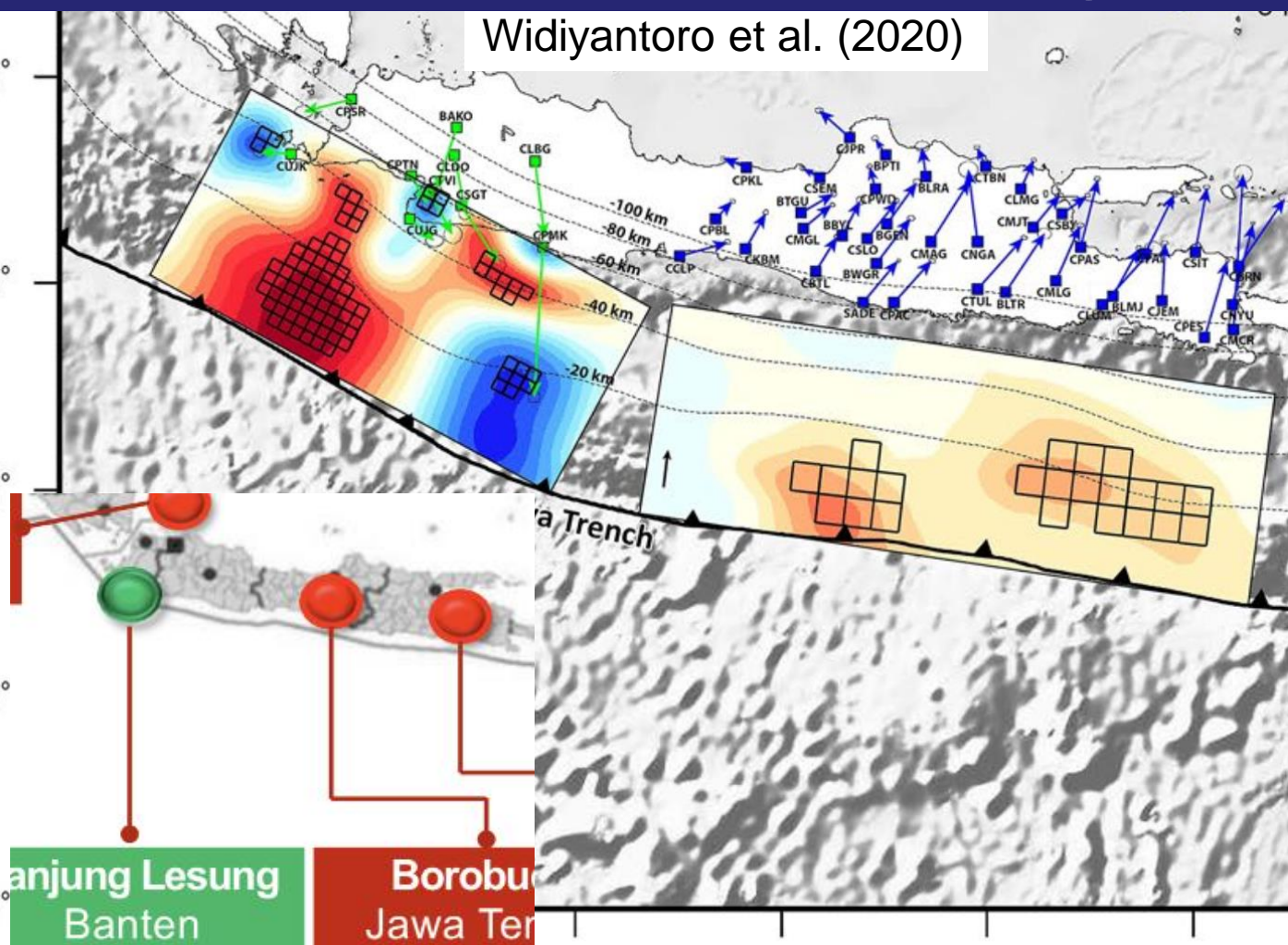


- Collecting data and assessing the impact and future disasters
  - Reviewing area facilities and infrastructure
  - Analysing hazard source
- Planning repairs and rebuilding
- Coordinating and cooperating with related parties for Rehabilitation and Reconstruction

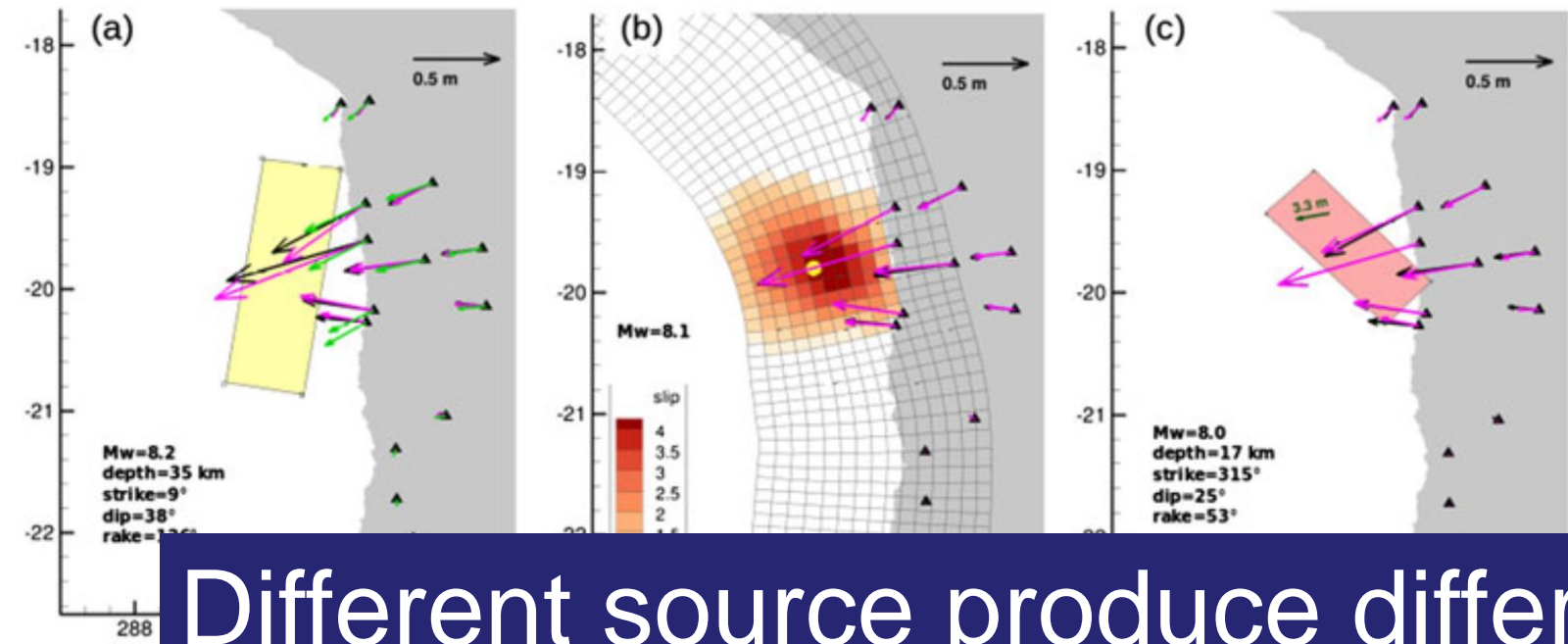


# TSUNAMI ASSESMENT

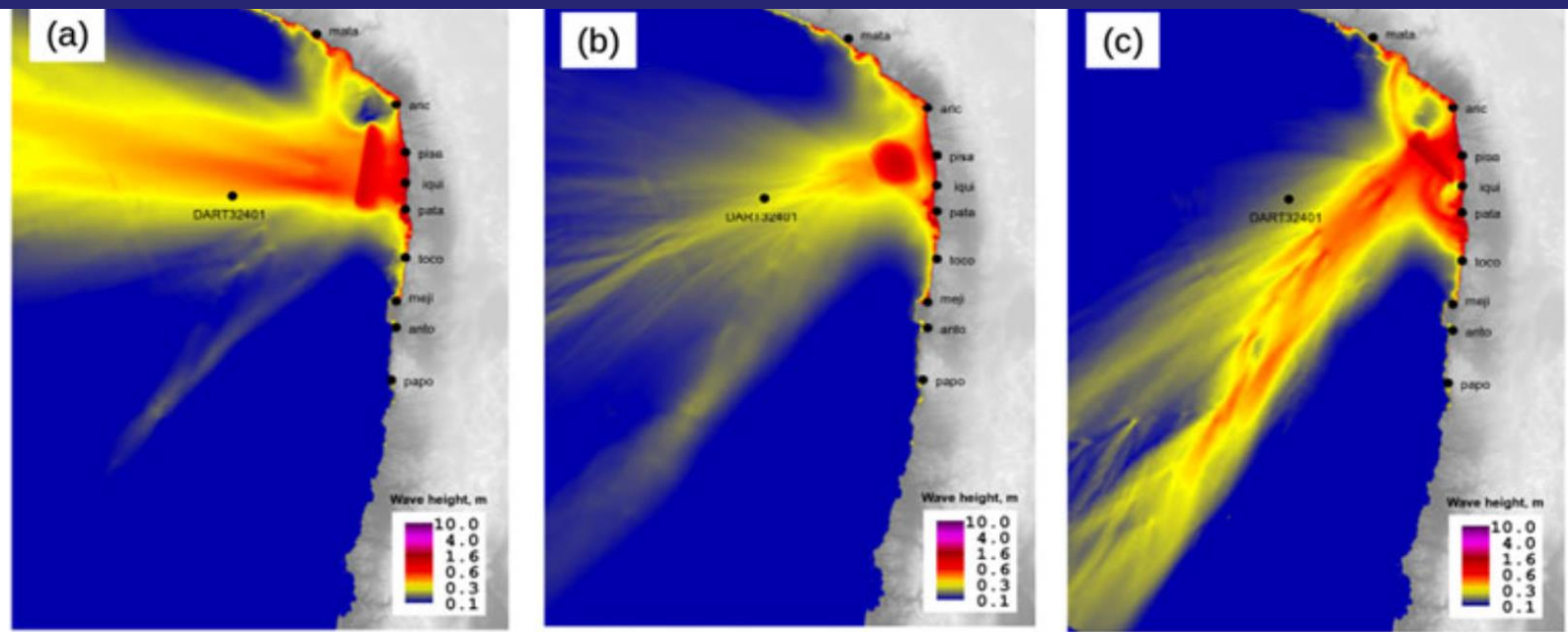
## The key is understanding the source





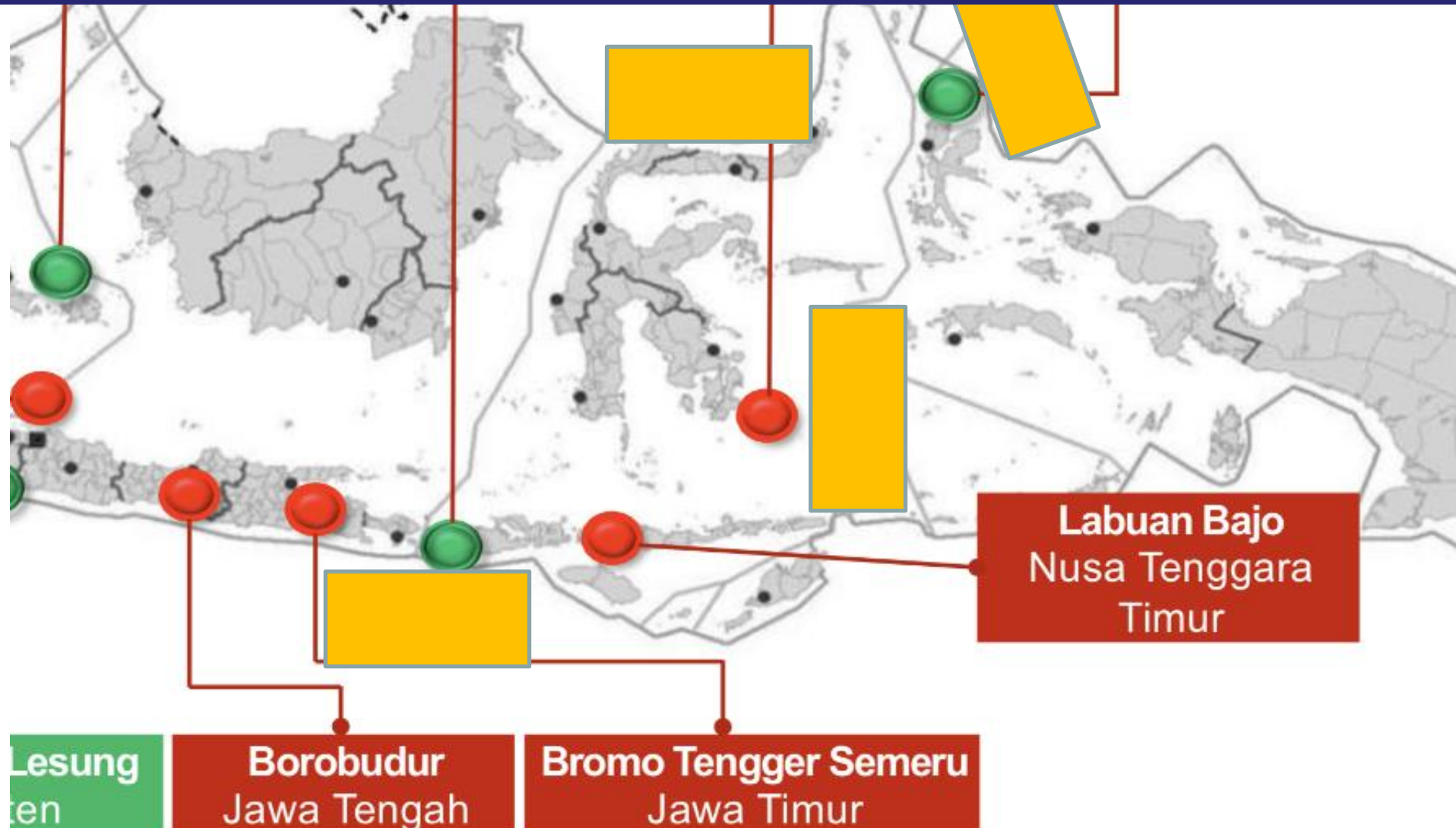


Different source produce different tsunami height





# Potential earthquake source are not known



Further investigation need to be done





THANKYOU