

# STRATEGY ON VOLCANIC AND EARTHQUAKE HAZARD MITIGATION IN INDONESIA

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GEOLOGICAL HAZARD MITIGATION

*The 1st Wokshop of Asia-Pasific Region Global Earthquakes and Volcanic Eruption Risk Managemen  
Tsukuba, JAPAN  
February 22-26, 2012*

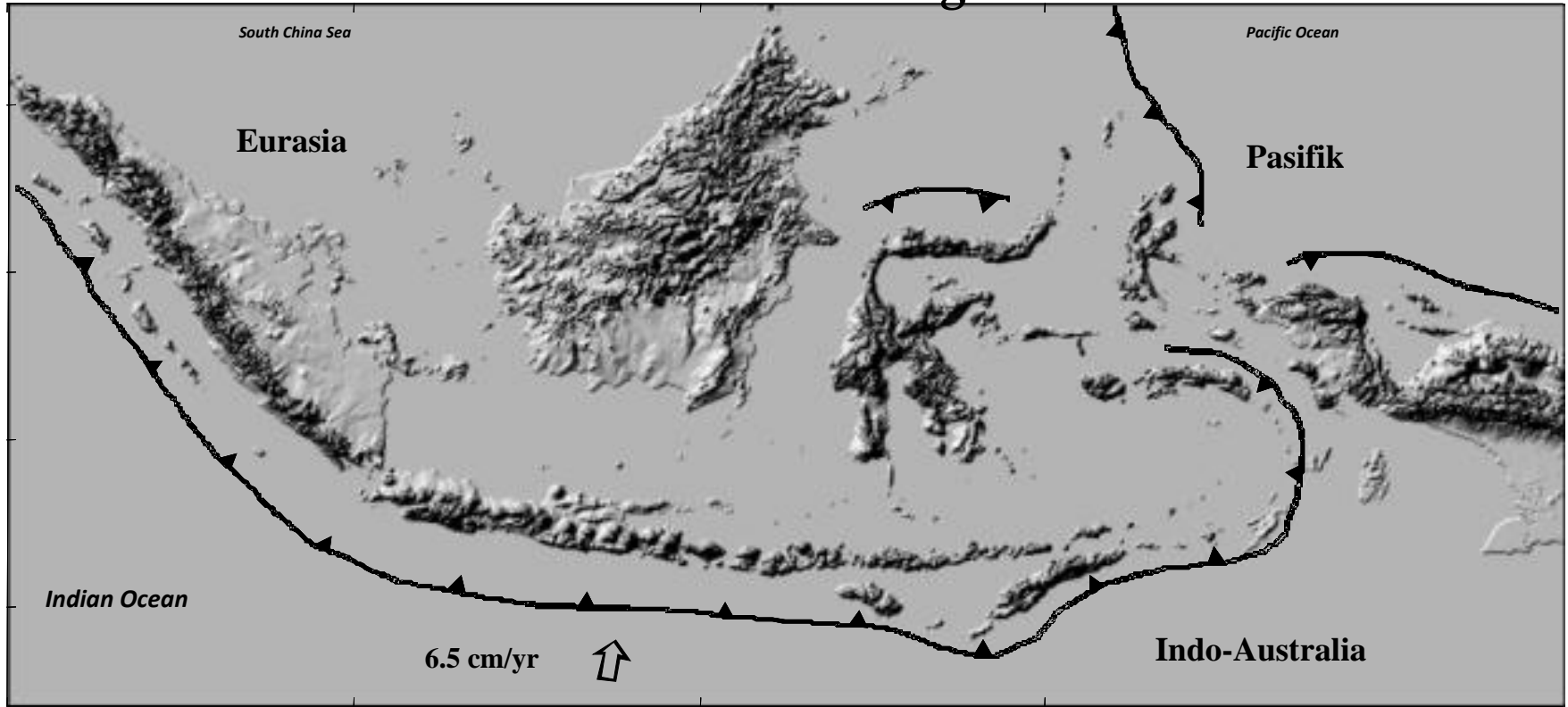


# Outline

- Introduction
- Volcanic Hazard Mitigation Strategy
- Earthquake Hazard Mitigation Strategy
- Summary

# Introduction

## Tektonic Setting



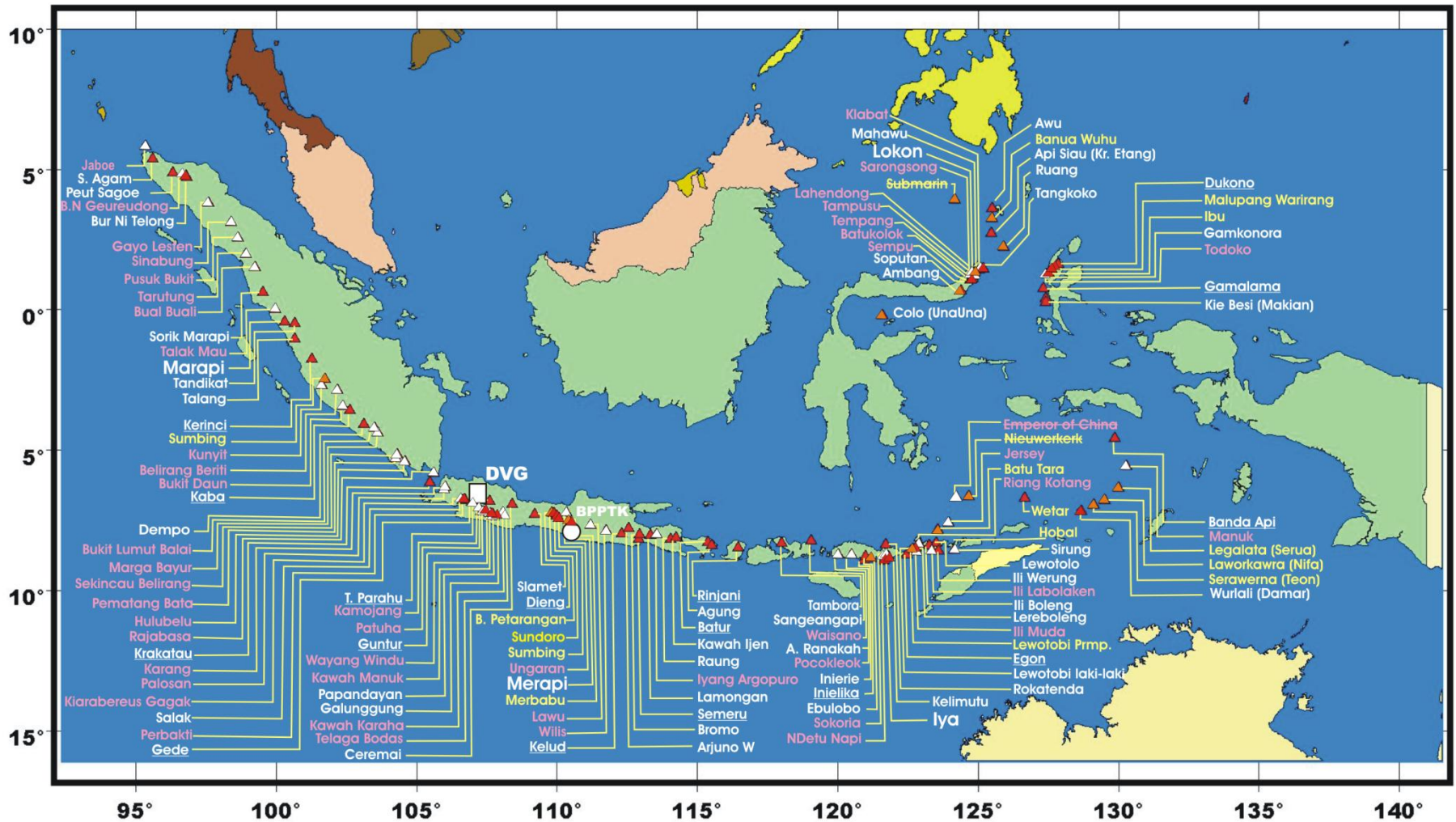
### Positive Impact:

Fertile soil  
Minerals, oil and gas

### Negative Impact:

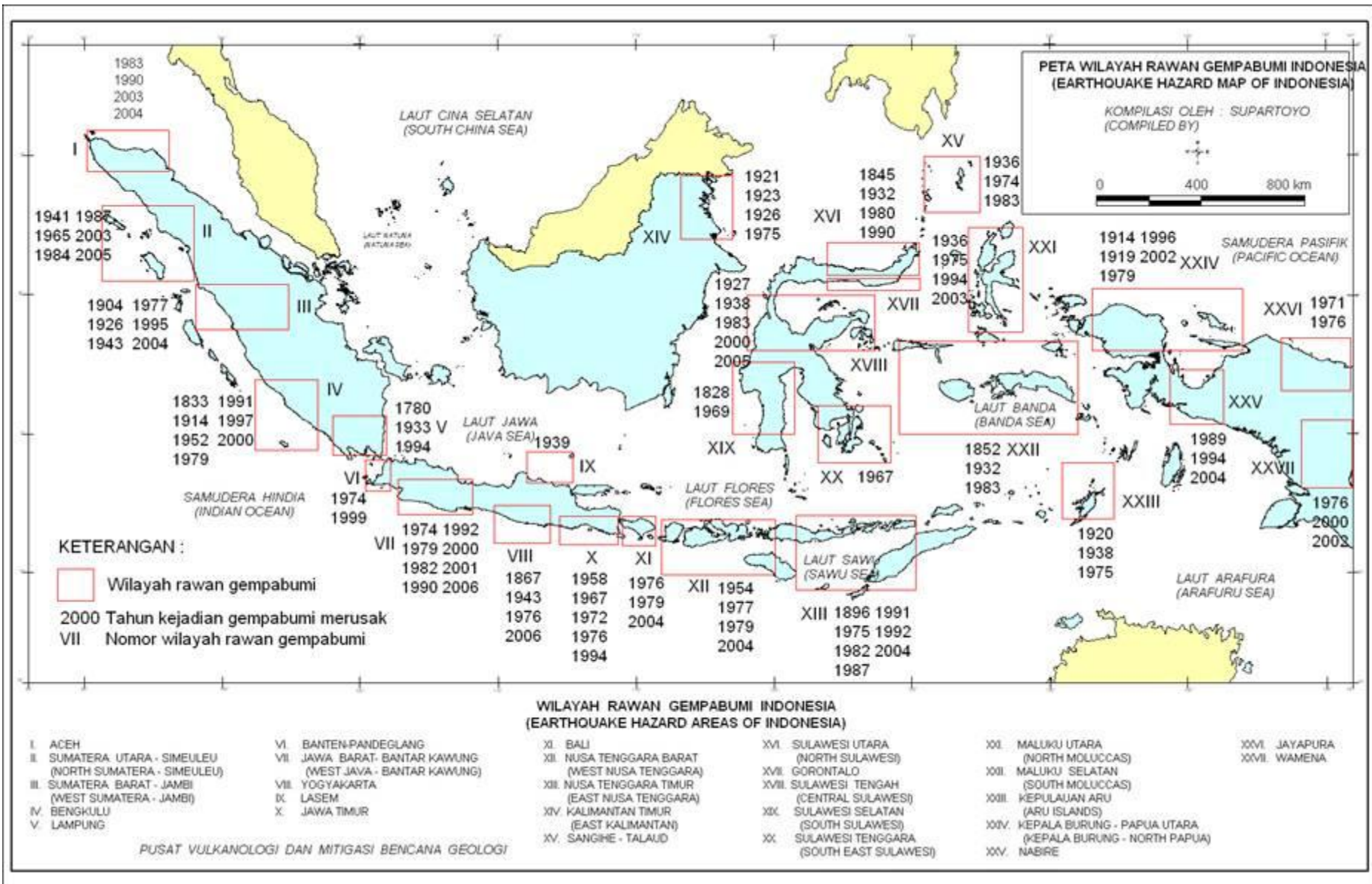
Prone to geological hazard such as volcanic eruption, landslide, earthquake and tsunami

# Distribution of Active Volcanoes in Indonesia



▲ Gunungapi Type-A dilengkapi Pos Pengamatan    ▲ Gunungapi Type-A tanpa Pos Pengamatan    ▲ Gunungapi Type-B dan Type-C

# Earthquake Prone Regions in Indonesia

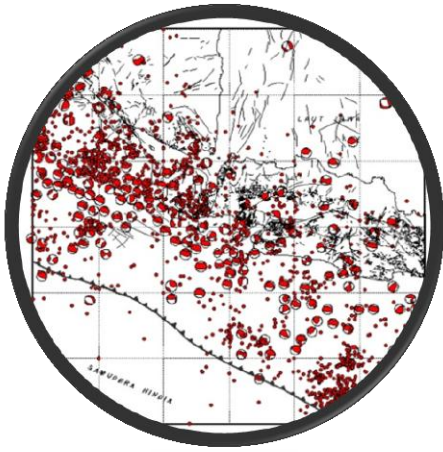


Center for Volcanology and Geological Hazard Mitigation (CVGHM), Geological Agency, Ministry of Energy and Mineral Resources is an institution which has a responsible to mitigate geological hazard in Indonesia

- CVGHM 's task:

- To mitigate volcanic, landslide, earthquake and tsunami hazards
- To deliver technical recommendation to local government and educate people living in hazard zone in order to anticipate the threat of volcanic eruption, landslide, earthquake and tsunami.

**Goal:** To minimize the loss of lives and properties due to geological hazards.



## RECENT CONDITIONS

- Many residences and vital/strategic buildings are still located in volcanic and earthquake hazards zones.
- The people and local government request fast and accurate geological hazard information.
- Lack of information about the threat of volcanic eruption and potential earthquake hazards.
- Lack of awareness of the people and local government to areas prone to volcanic eruption and earthquake.



**Pyroclastic Flows**



**Pyroclastic Falls**



**Lava Dome Collapse**



**Volcanic Gasses**

## **VOLCANIC HAZARD MITIGATION STRATEGY**



# ERUPTION OF SOME VOLCANOES IN INDONESIA



About 5 million Indonesian reside and temporary living in due to social matter and economical activity in volcanic hazard zone.

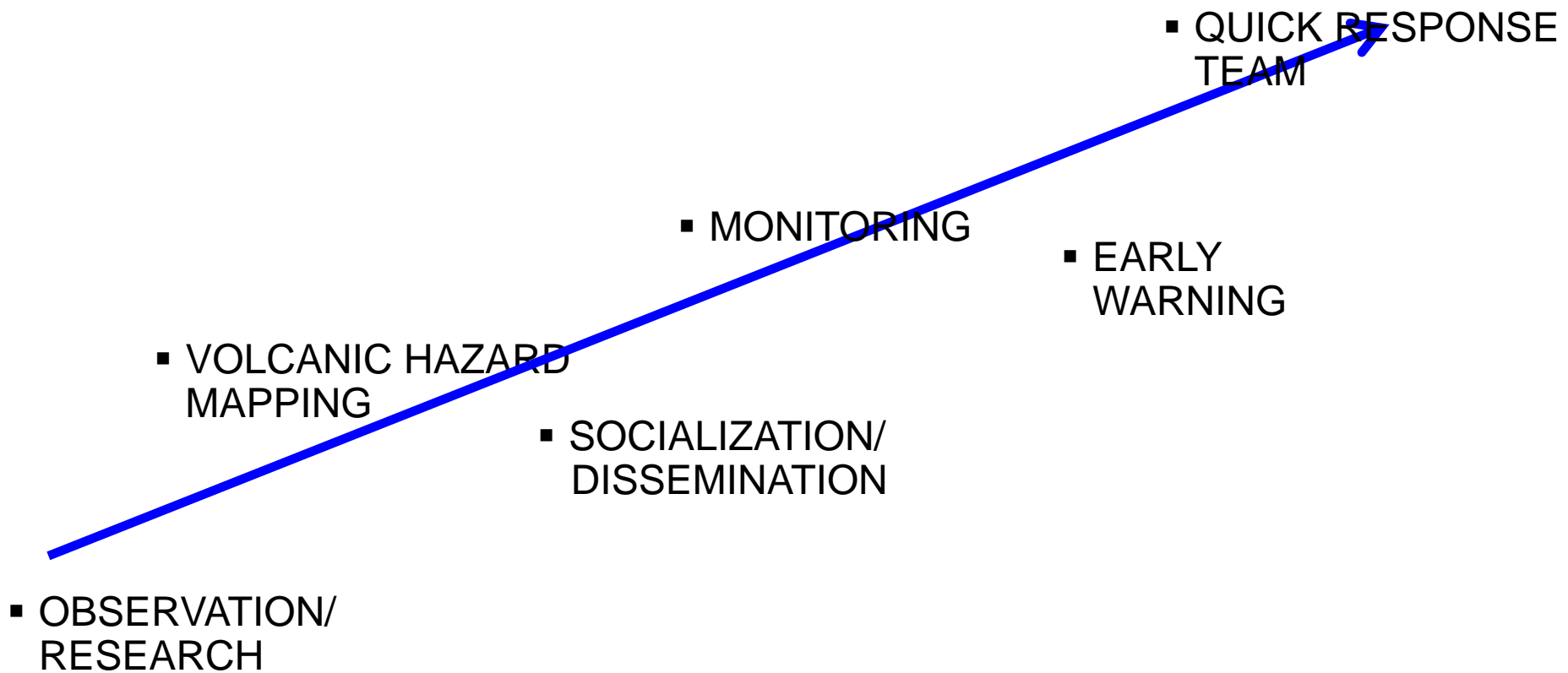
Kelud eruption in November 2007, there were 15,000 people evacuated.

Sinabung eruption in August 2010, about 16,000 refugees.

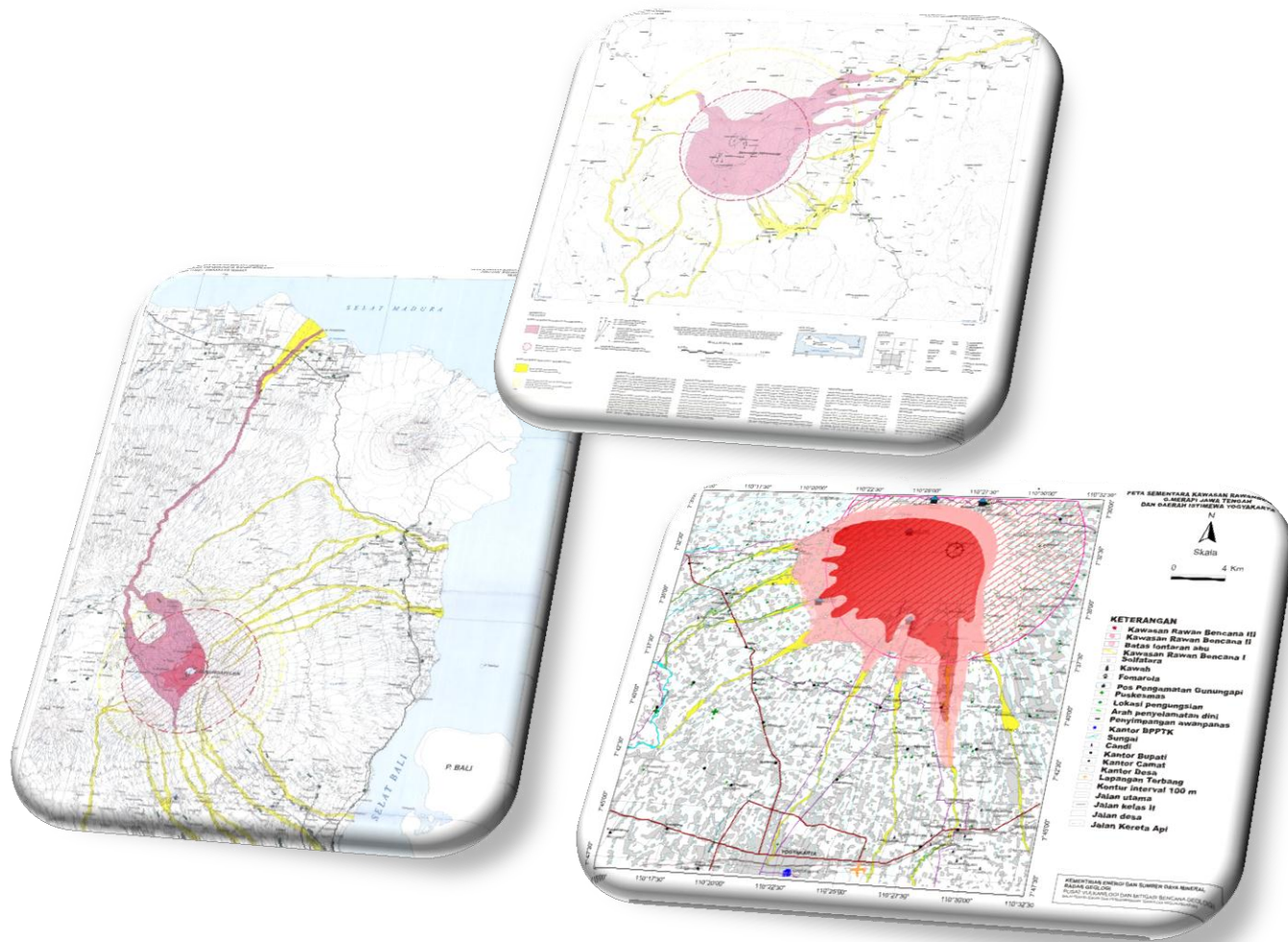
In case of Merapi eruption in 2010, there were about 1 million refugees due to eruption, but 416,000 were taken care by the government.

Lokon eruption in July 14, 2011, there were 6000 people evacuated

# STRATEGY ON VOLCANIC HAZARD MITIGATION



# PROVIDING VOLCANIC HAZARD MAP



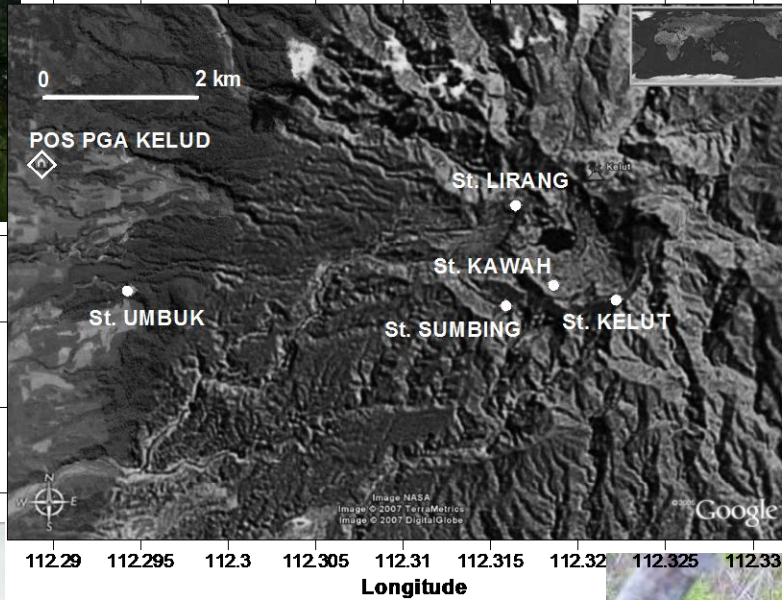
# VOLCANO MONITORING

## Volcano Observatory

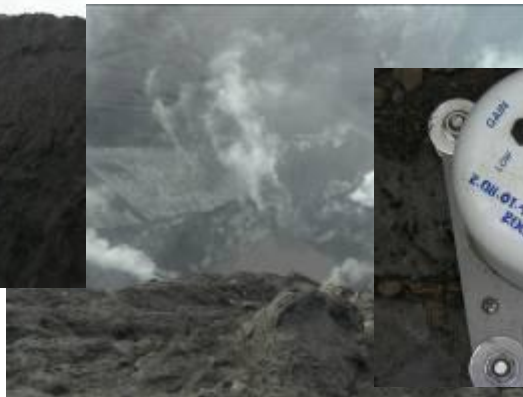


Latitude  
-7.95  
-7.955  
-7.96  
-7.965  
-7.97

## Measurement of lava dome temperature

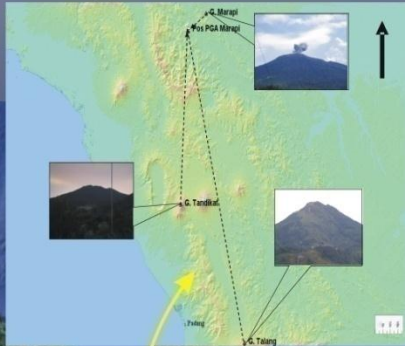


## Seismic and deformation monitoring



# REGIONAL CENTER SISTEM PEMANTAUAN GUNUNGAPI DI INDONESIA

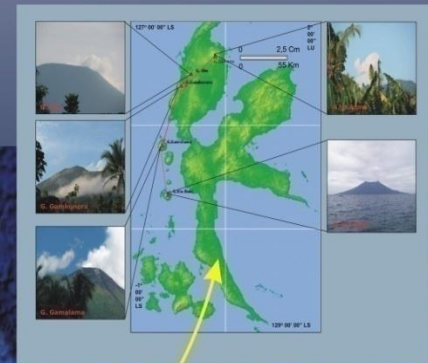
RC Marapi  
Bukittinggi - Sumatera Barat



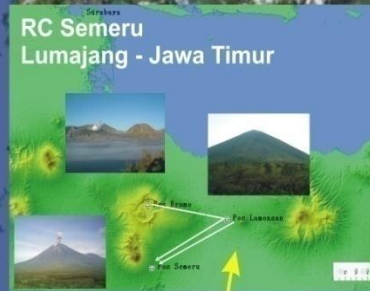
RC Lokon  
Tomohon - Sulawesi Utara



RC Gamalama  
Ternate - Maluku Utara



RC Semeru  
Lumajang - Jawa Timur



RC Batur  
Batur - Bali



Regional Center di Wilayah Nusa Tenggara Timur

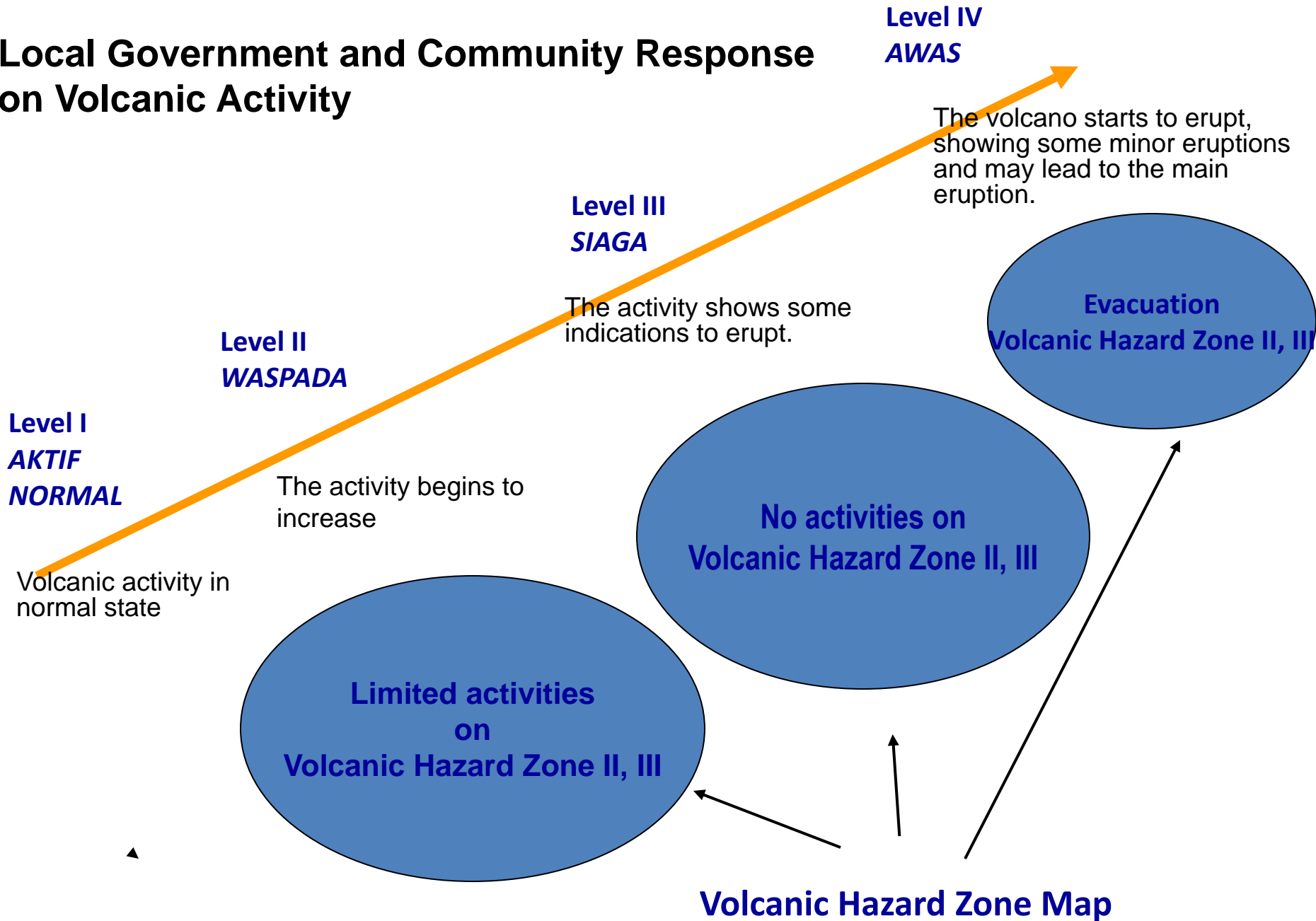


RC Guntur  
Garut - Jawa Barat

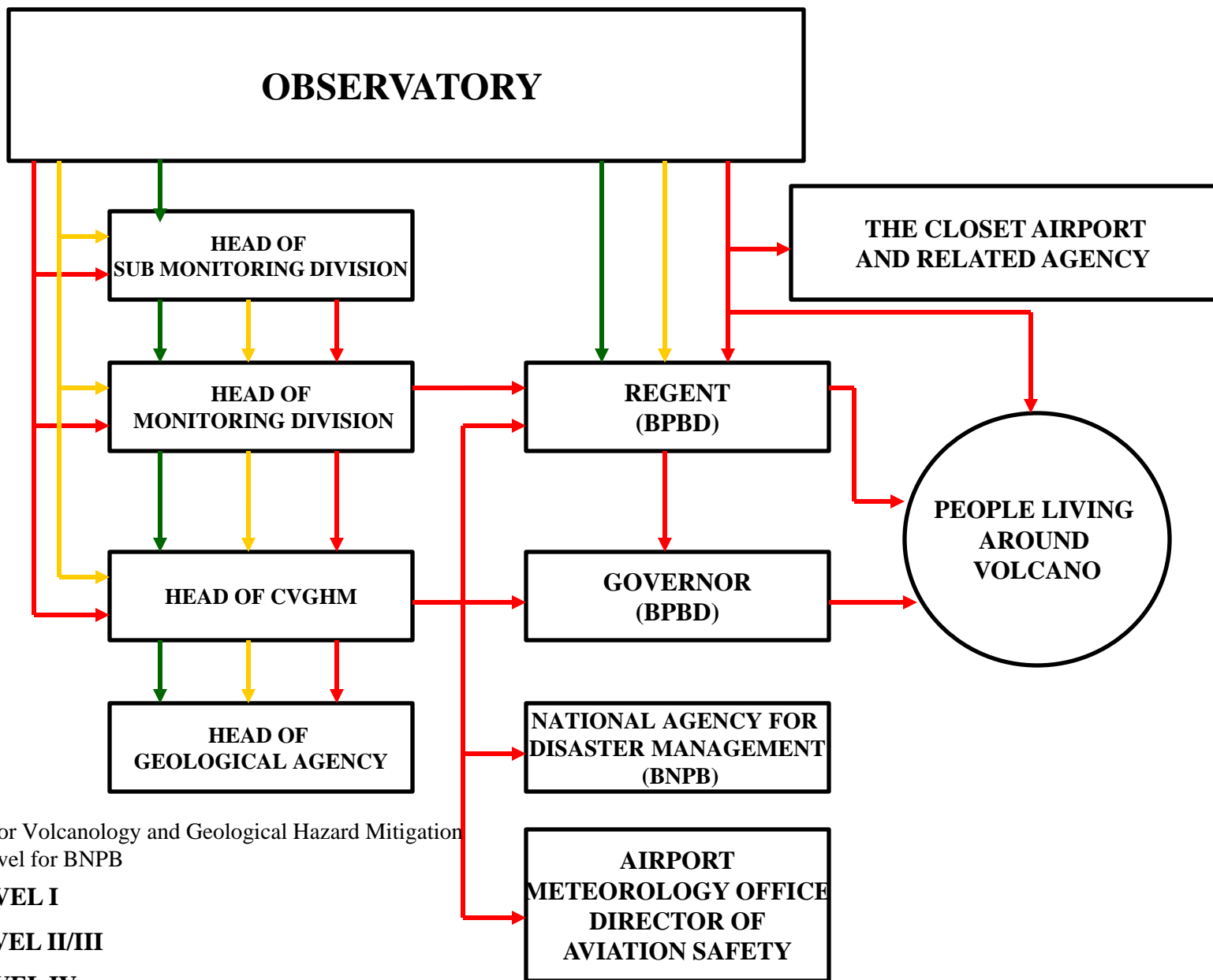


# EARLY WARNING

## Local Government and Community Response on Volcanic Activity



# FLOW CHART OF VOLCANO ACTIVITY DISSEMINATION







# SOCIALIZATION



# **AFTER ERUPTION**

- 1. To monitor the volcano continuously**
- 2. Evaluation and make a decision to downgrade level of activity**
- 3. To anticipate the occurrence of lahar, especially when the rainy season begins**
- 4. To disseminate information concerning the activity of the volcano.**



## EARTHQUAKE HAZARD MITIGATION STRATEGY

Lokasi		Tanggal	Magnituda*
1	Chili	1960 05 22	9.5
2	Prince William Sound, Alaska	1964 03 28	9.2
3	<b>Pantai Barat Sumatera Bagian Utara</b>	<b>2004 12 26</b>	<b>9.1</b>
4	Kamchatka	1952 11 04	9
5	Maule, Chili	2010 02 27	8.8
6	Pantai Ekuador	1906 01 31	8.8
7	Kepulauan Rat, Alaska	1965 02 04	8.7
8	<b>Sumatera Utara, Indonesia</b>	<b>2005 03 28</b>	<b>8.6</b>
9	Assam – Tibet	1950 08 15	8.6
10	Kepulauan Andrean, Alaska	1957 03 09	8.6
11	<b>Sumatra Barat, Indonesia</b>	<b>2007 09 12</b>	<b>8.5</b>
12	<b>Laut Banda, Indonesia</b>	<b>1938 02 01</b>	<b>8.5</b>
13	Kamchatka	1923 02 03	8.5
14	Perbatasan Chili-Argentina	1922 11 11	8.5
15	Kepulauan Kuril	1963 10 13	8.5

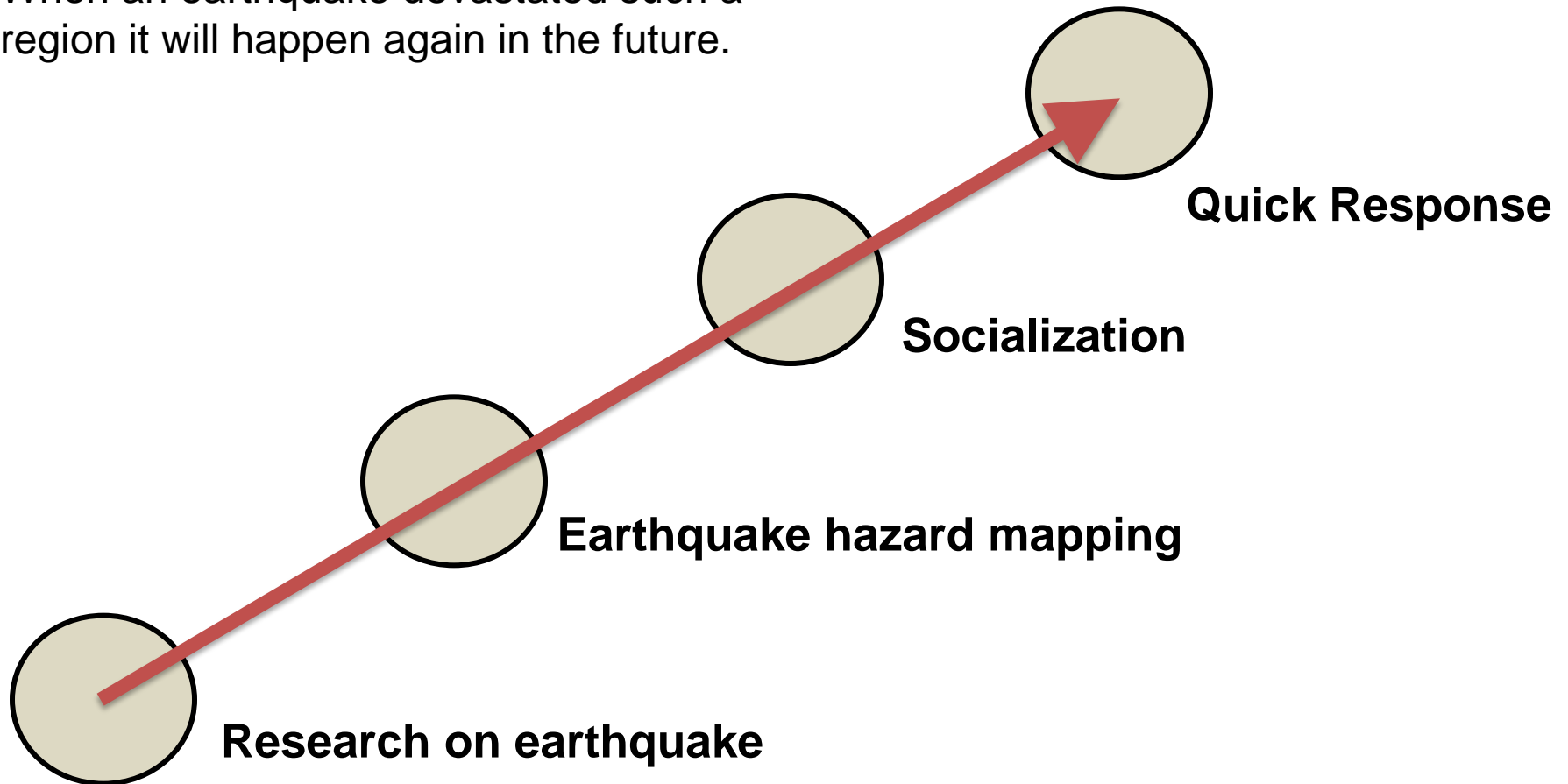
**15 world's largest earthquakes since 1900**  
**(sources:USGS)**

# Several Destructive Earthquakes in Indonesia

Date	Region	M	Victim
25/10/2010	Mentawai , West Sumatra (tsunami)	7.7	504
30/9/2009	Padang, West Sumatra	7.5	1,117
2/9/2009	West Java	7.3	81
12/9/2007	Bengkulu, Sumatra	8.4	14
26/5/2006	Yogyakarta	6.3	5,749
28/3/2005	Nias, North Sumatra (tsunami)	8.6	1,313
06/02/2004	Nabire, Papua	7	33
26/12/2004	Aceh, Sumatera (tsunami)	9.1	227,898
04/06/2000	Bengkulu, Sumatra	7.3	99
29/11/1998	Mangole & Taliabu, Maluku	8.3	34
17/02/1996	Biak, Papua (tsunami)	8.2	108

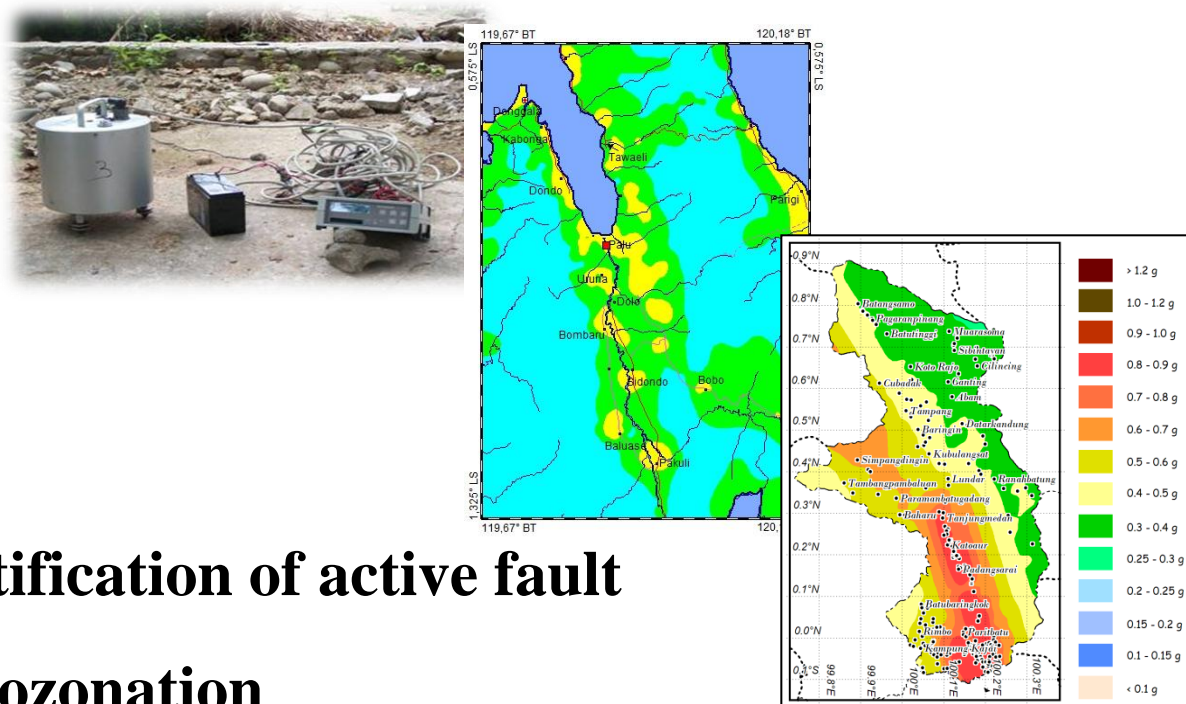
# STRATEGY ON EARTHQUAKE HAZARD MITIGATION

When an earthquake devastated such a region it will happen again in the future.



**Mitigation Strategy:** identification of an earthquake vulnerability level and prepare communities to anticipate disaster

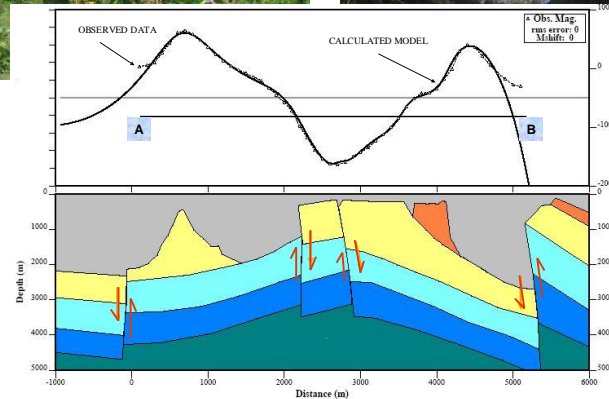
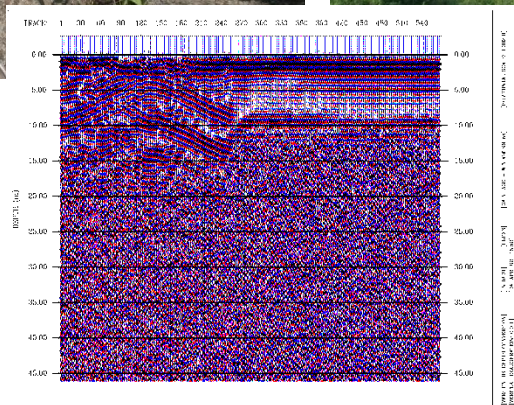
# 1) RESEARCH ON EARTHQUAKES



- Identification of active fault
- Microzonation
- PSHA (*Probabilistic Seismic Hazard Assessments*).

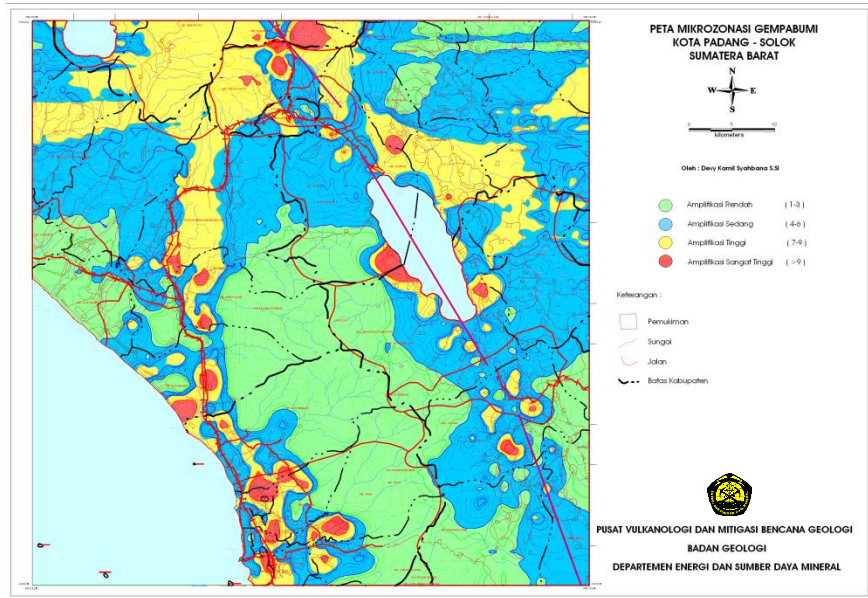
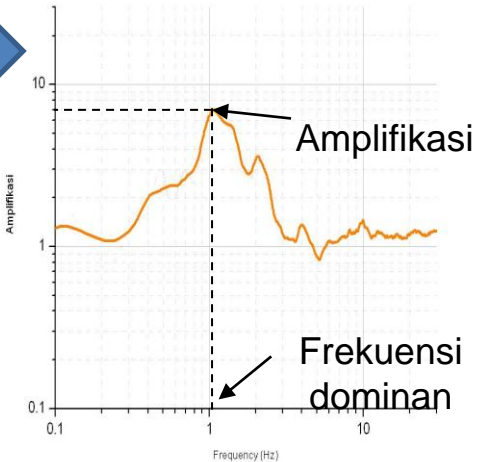
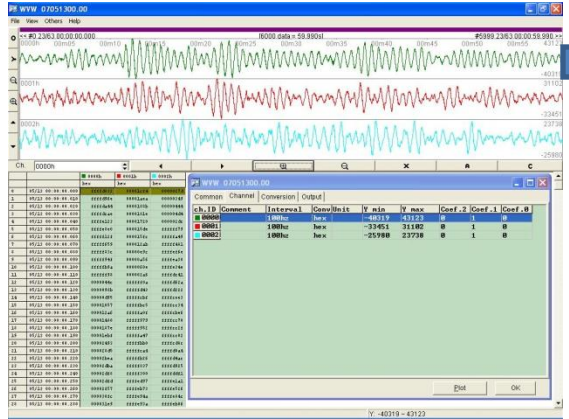
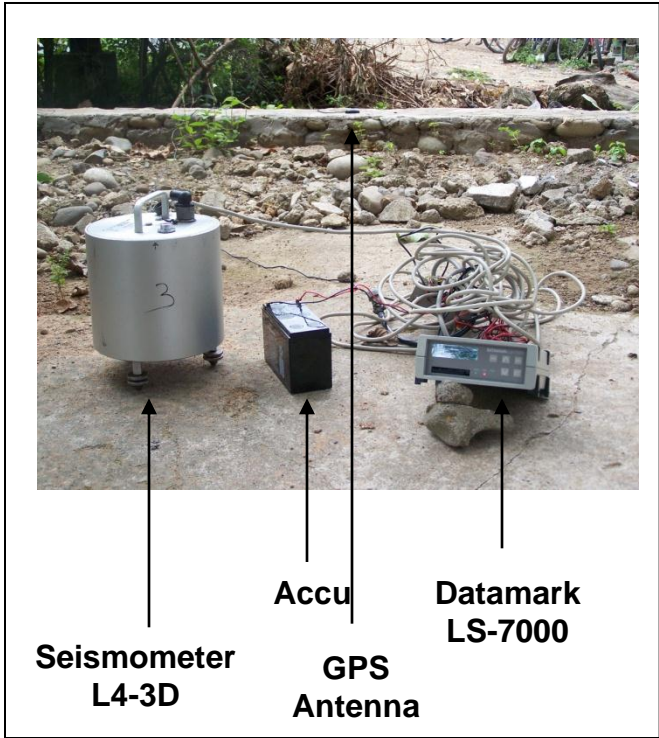
- **Identification of active fault**

- Paleo-seismology
- Geophysics Methods (Gravity, Geomagnet, GPR)
- Seismic Monitoring
- Deformation (GPS)

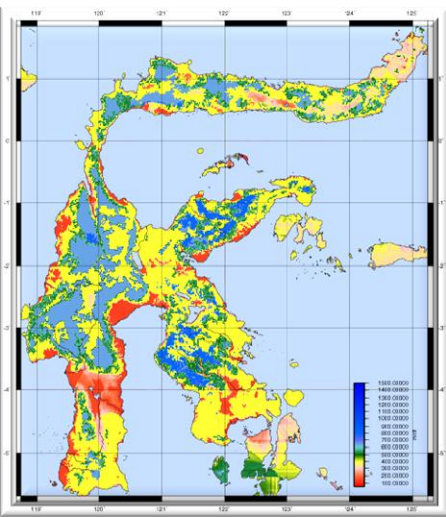




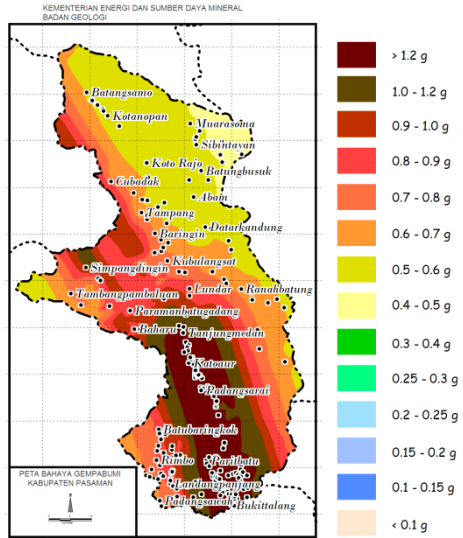
# •Microzonation



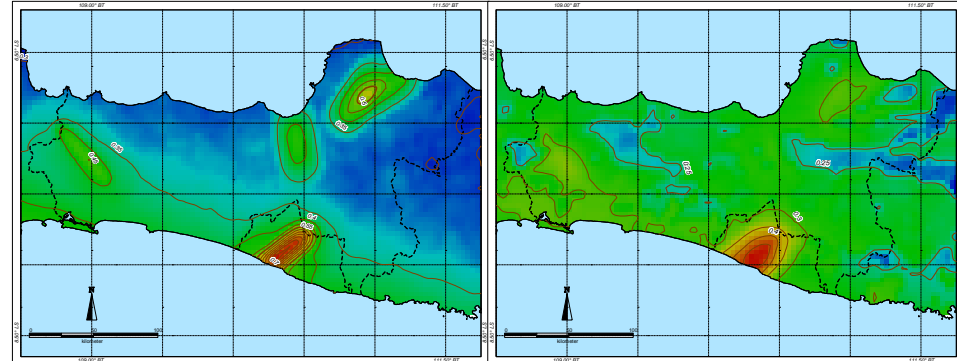
•PSHA (*Probabilistic Seismic Hazard Assessment*)



Sulawesi PSHA

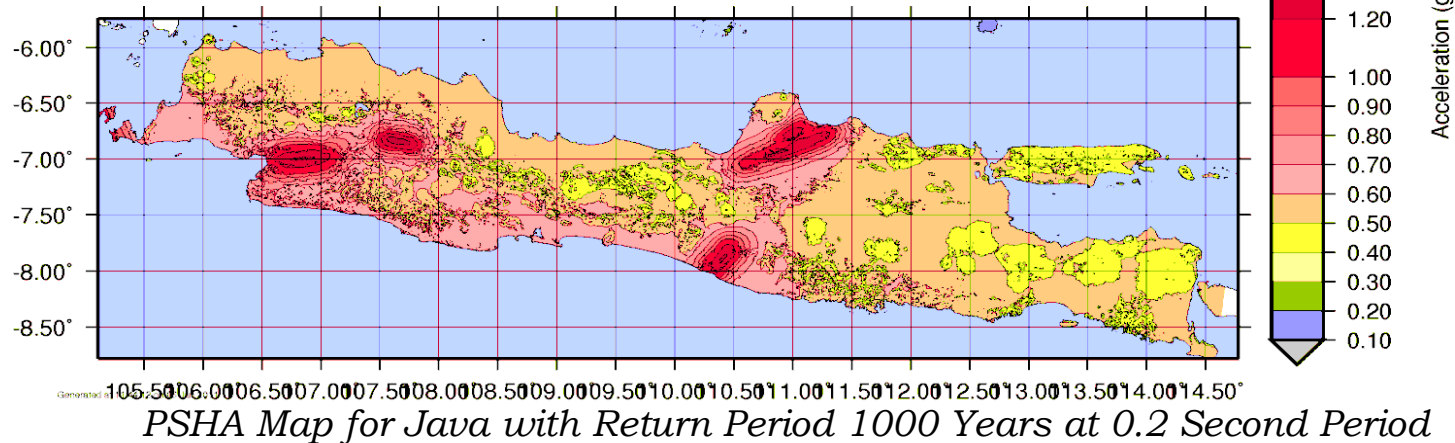


Peta PSHA Kab. Pasaman



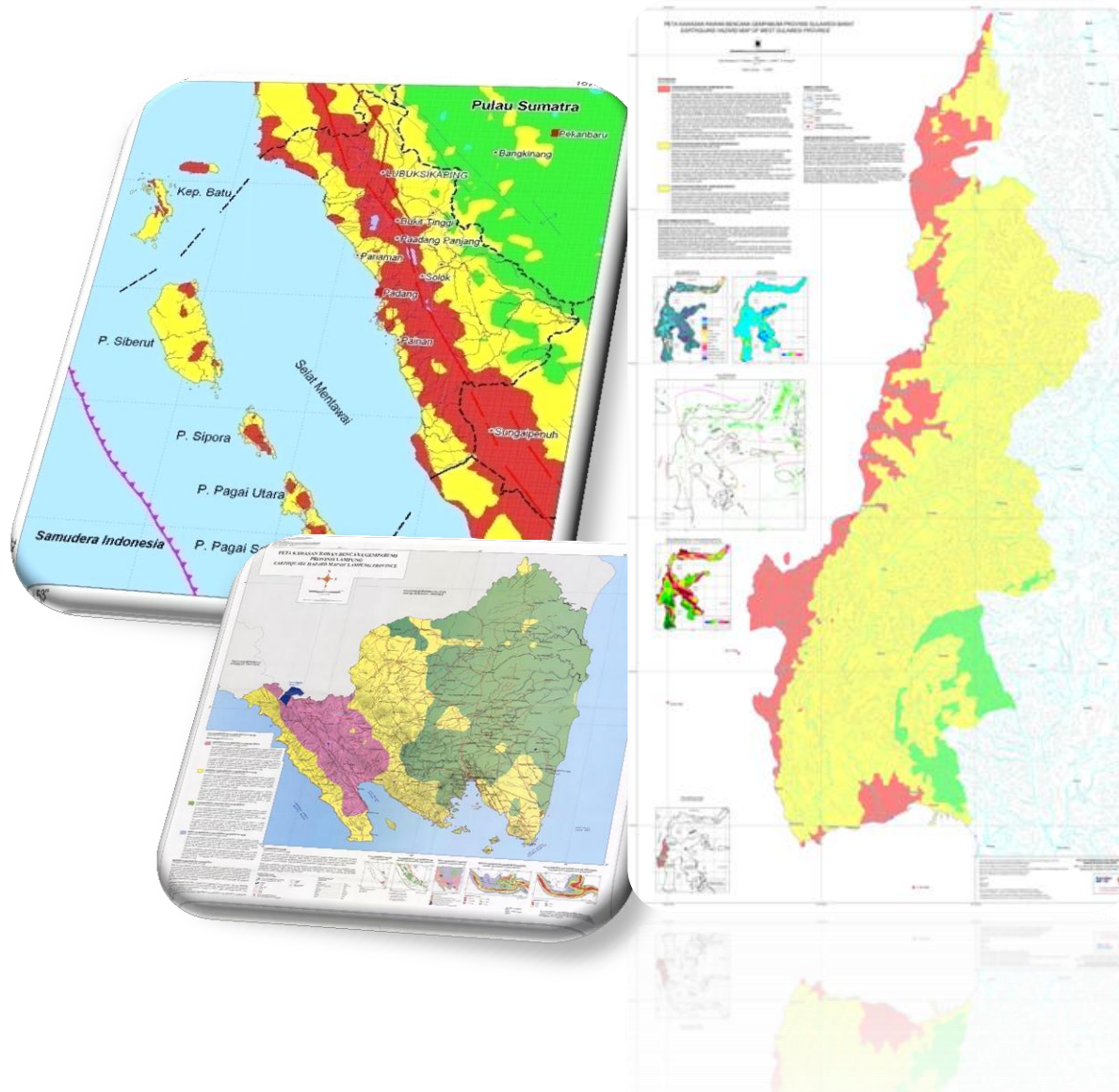
PSHA Maps for Central Java

Whole\_Java\_PSHA\_Java\_soilTrue\_1000yr\_0pt2s

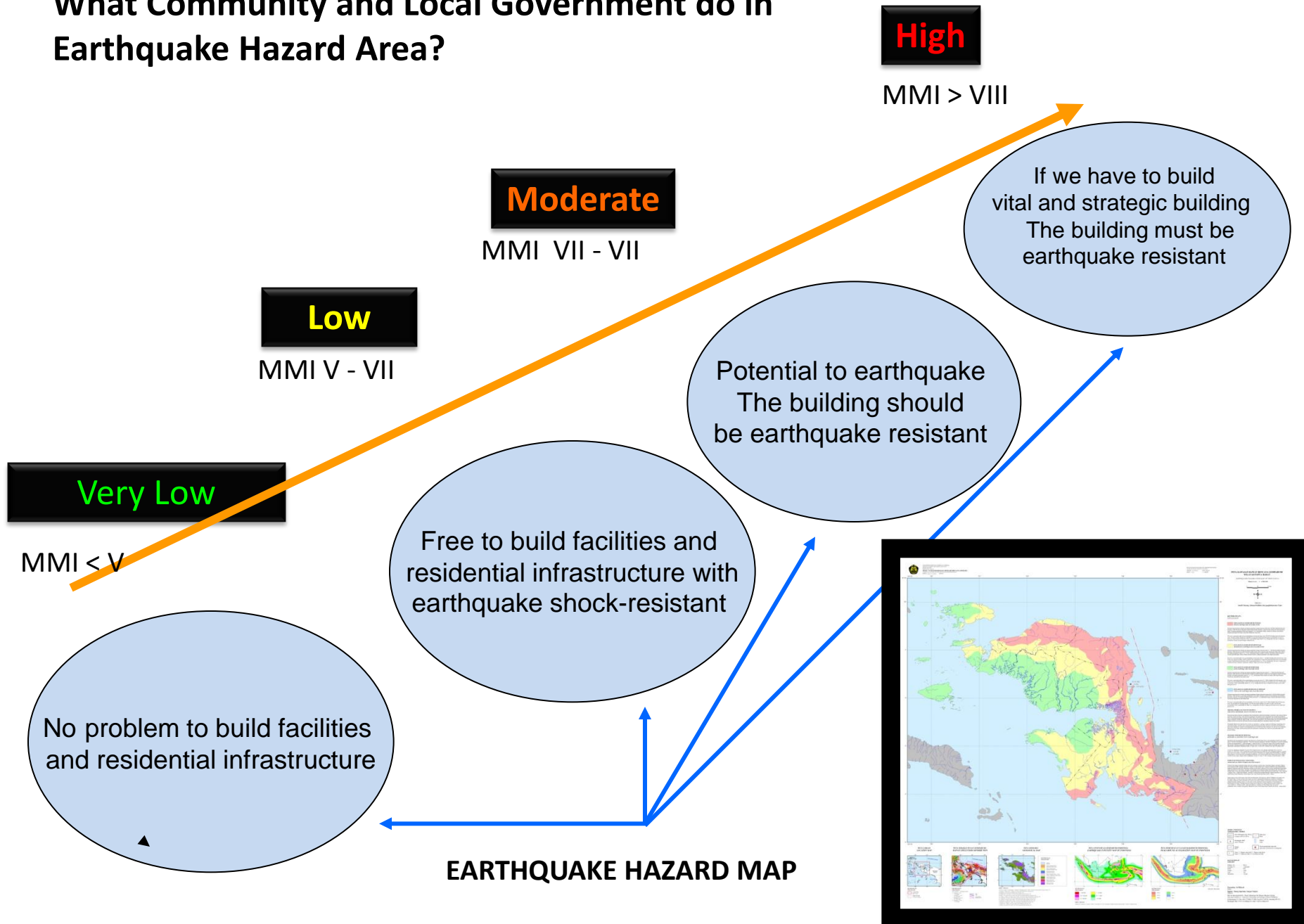


PSHA Map for Java with Return Period 1000 Years at 0.2 Second Period

## 2) PROVIDING EARTHQUAKE HAZARD MAP



# What Community and Local Government do in Earthquake Hazard Area?



### 3) SOCIALIZATION

The purpose of socialization is to increase knowledge and awareness of the people living around the prone area to earthquakes.

Coordination with the local governments and related agencies is carried out to improve the effectiveness of the earthquake hazard mitigation



## 4) QUICK RESPONSE



- Mapping of damages caused by earthquakes
- Aftershocks monitoring

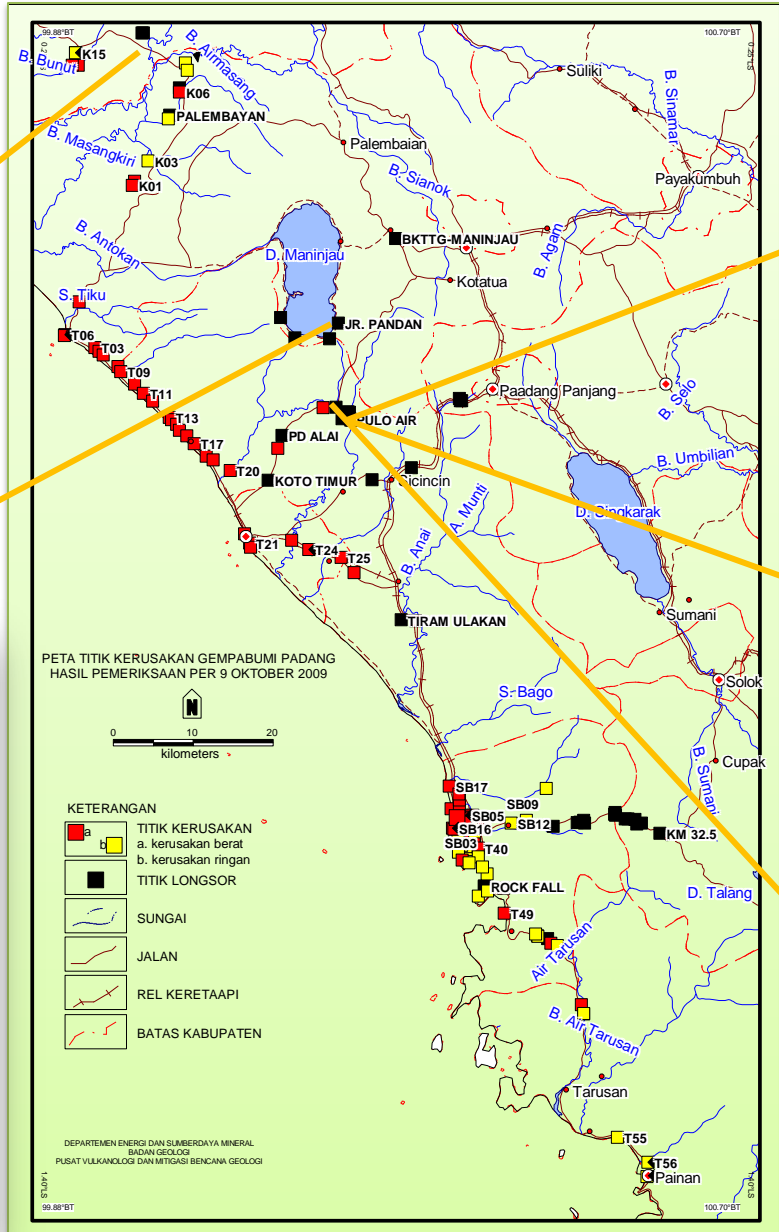
# Padang Earthquake, September 30, 2009



Palembayan, Agam



Tanjungsani, Agam



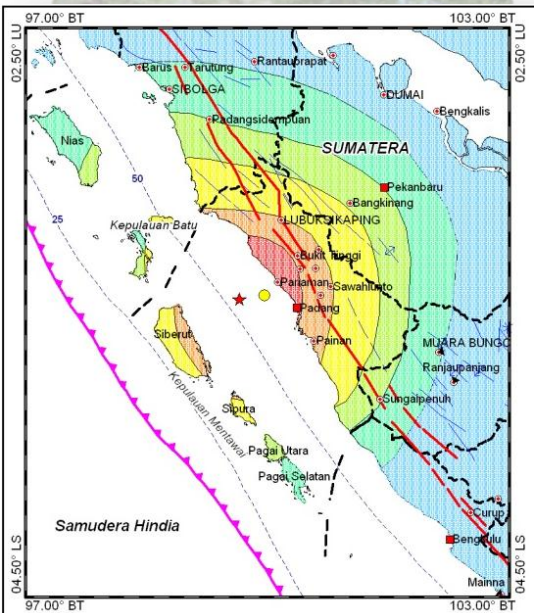
Pulo Koto



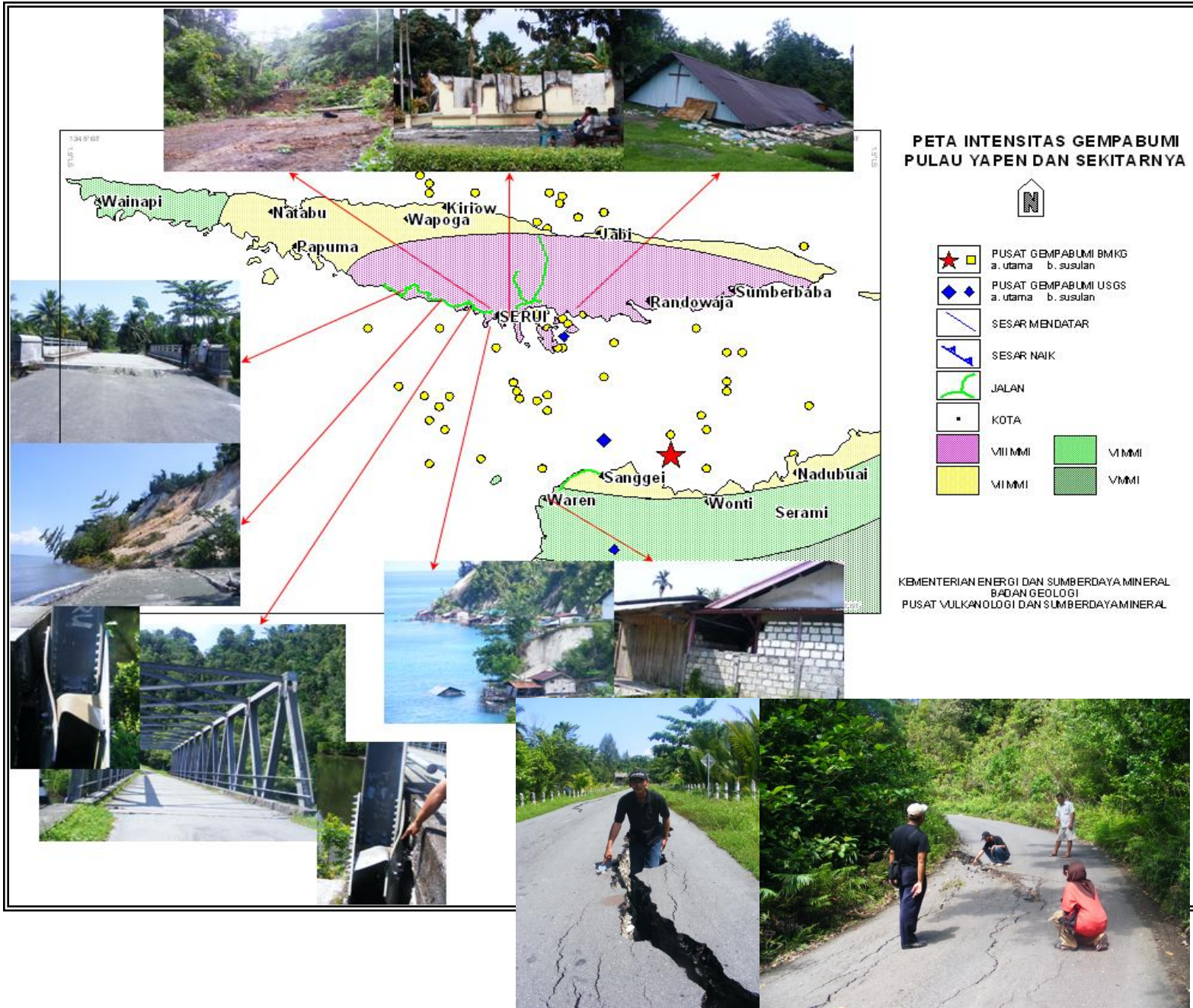
Pulo Koto



Cumanak

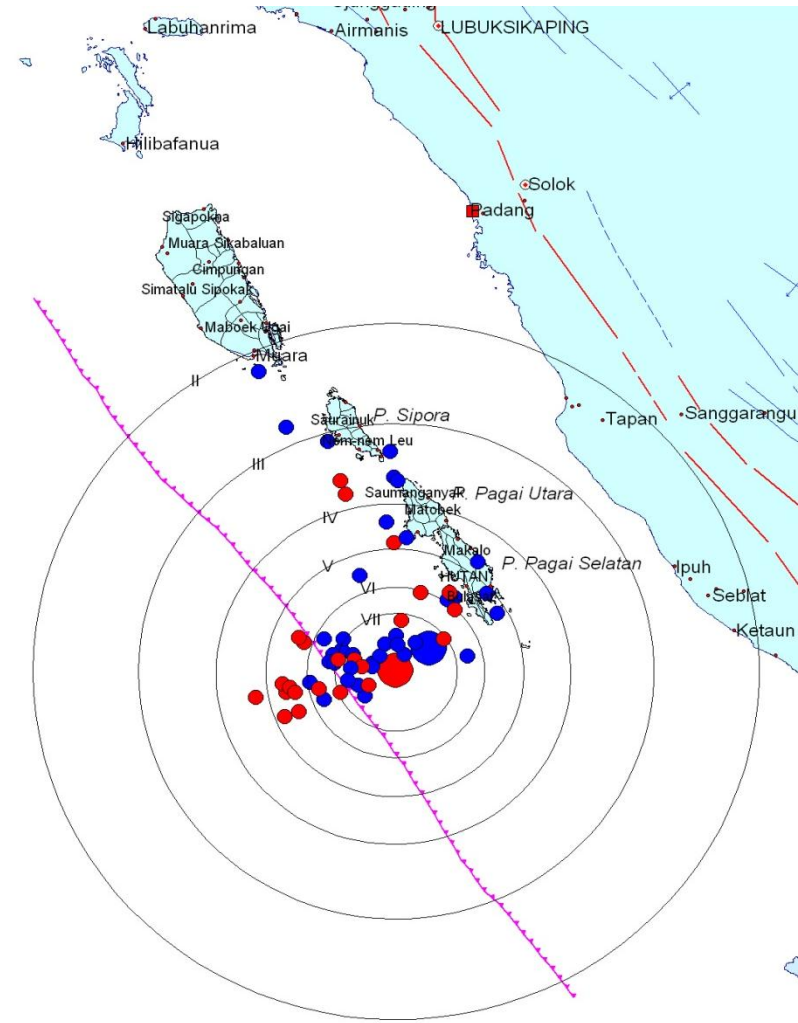
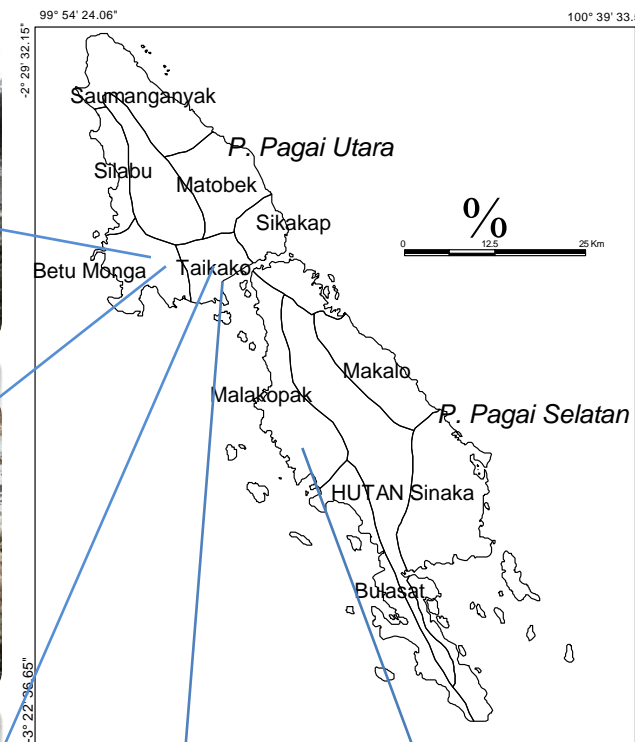


# Biak Earthquake on June, 16, 2010





# Tsunami Mentawai October 25, 2010 triggered by earthquake 7.7 Mw / 7.2 S



quick response team

## SUMMARY

- The government of Indonesia awares about the disaster and the impact owing to volcanic eruption and earthquake. As a consequence the Law No. 24/2007 concerning Disaster Management is established. It has change the paradigm of hazard mitigation by focusing on pre-disaster phase efforts such as: intensive volcano monitoring, providing hazard maps on volcano and earthquake and socialization.
- Region prone to volcanic eruption and earthquakes hazard does not mean not worthy to live in, but in the spatial planning it should refer to volcanic and earthquake hazard maps as well as risk analysis.



THANK YOU