

Ministry of Research and Technology
Government of Indonesia

INDONESIAN TSUNAMI WARNING SYSTEMS (Ina-TEWS)

presented at
DIPECHO National Consultative Meeting INDONESIA
17 – 18 December 2007, Jakarta

by
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Presented at: Road Disaster Risk Reduction
November, December 14, 2007

OUTLINE

1. INTRODUCTION
2. LESSON LEARNED from Tsunami and Earthquake Disaster
3. CURRENT STATUS OF INDONESIA TSUNAMI EARLY WARNING SYSTEMS (INA-TEWS)
4. END-TO-END TSUNAMI SIMULATION IN PADANG CITY ON 26 DECEMBER 2005
5. END-TO-END TSUNAMI SIMULATION IN DENPASAR CITY, BALI ON 26 DECEMBER 2006
6. SCENARIO OF TSUNAMI SIMULATION BANTEN ON 26 DECEMBER 2007.
7. PLAN FOR THE LAUNCHING OF INA-TEWS

1. INTRODUCTION

Tectonic Setting and Seismicity of Indonesia

The Indonesian region → very complicated plates convergence (subduction, collision, back arc) and spreading (back arc and opening faults)

Moving relatively to each other

- the **Indo-Australian plate** → moving northward
- the **Philippine sea plate** → moving northward
- the **Sarawak plate** → moving east-southeastward (near Ayu) and west-northward (near Yap trench)

Every year about **460** earthquakes ($M > 4.0$)

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Earthquake and Tsunami History

EARTHQUAKE WITH $M \geq 7.0$ RS IN INDONESIA, 1900 - 2004

- A. TOTAL : 212
- B. IN THE SEA : 182 (86 %)
- C. SHALLOW IN THE SEA : 153 (72 %)
- D. GENERATED TSUNAMI : 86 (40 %)

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Tsunami Impact on Cities in Indonesia

1. Banda Aceh	6. Jogjakarta	10. Makassar
2. Medan	7. Denpasar	11. Manado
3. Padang	8. Mataran	12. Ambon
4. Bengkulu	9. Kupang	13. Jayapura
5. Lampung		

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2. Lesson Learned from Tsunami and Earthquake Disaster

Tsunami Banda Aceh : Sunday, 26 December 2004
Tsunami Pangandaran : Monday, 17 July 2006

Aceh Tsunami : a brief reminder

- 132,000 confirmed dead
- 37,000 missing
- 272,000 sheltered
- 1.8 million homes and buildings destroyed
- 8 ports and 4 fuel depots damaged
- 85% of the water and 92% of the sanitation system broke down
- 120 km of roads and 18 main bridges demolished
- total losses amount to US\$ 4.6 billion, which represents 22.2% of National GDP and 87% of Aceh's GDP

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the causes

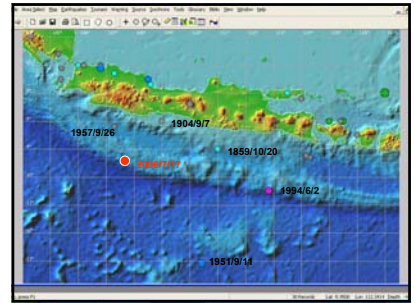
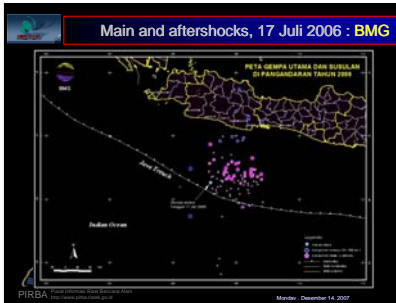
Catastrophic earthquake

- Scale 9 with shallow epicenter offshore
- Very strong ground shaking for 4 minutes felt in many areas
- People moved out of their houses out of fear

Followed by a tsunami

- Wave height ranging from 4 – 35 m
- Most people have never seen such calamity in their lives
- Did not know what to do – chaotic
- No warning was issued

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Victims of earthquake and tsunami

Why did it take so many lives ?

Lokasi	Meninggal (jiwa)	Luka (jiwa)	Hilang (jiwa)	Mengungsi (jiwa)
Camp	413	279	13	4.190
Pemukimannya	63	103	-	1.200
Carang	2	-	-	-
Kabang	157	0	20	300
Luhur	10	24	8	304
Banyuwangi	2	-	-	-
Gunung Kidul	3	-	-	-
Tempat	3	-	-	-
TOTAL	650	529	33	6.737

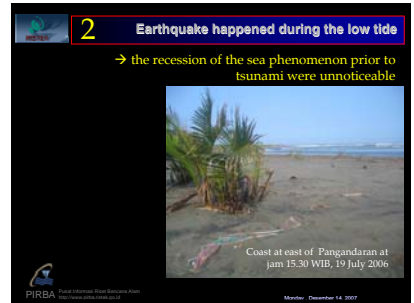
Warga Negara	Meninggal (jiwa)	Luka (jiwa)	Hilang (jiwa)
Belanda	1	2	-
Perancis	-	1	-
Austria	-	1	-
Selandia Baru	1	-	-
Pakistan	1	-	-
Saudi Arabia	2	3	-
Perancis	-	2	1
Total	5	9	1

1 Many people did not feel the earthquake

Tiga jenis gempa bumi

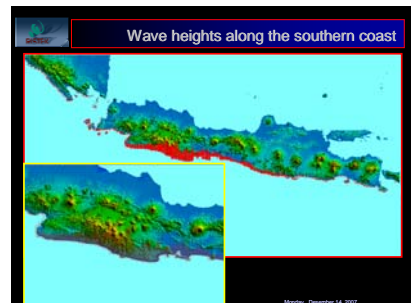
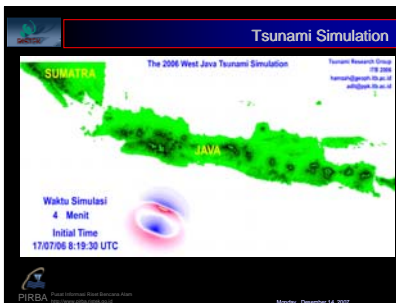
Type	Running velocity	Seismic wave radiation	Tsunami
Earthquake	High (2-3km/s)	High	Generated
Tsunami earthquake (ex. 1960)	A little slower (1-2km/s)	Medium	Generated
Slow slip	Very slow	None	None

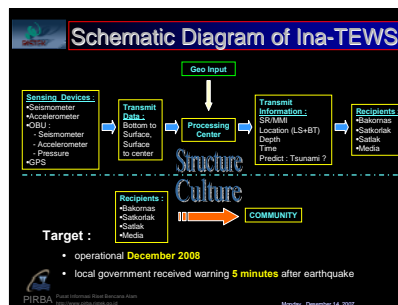
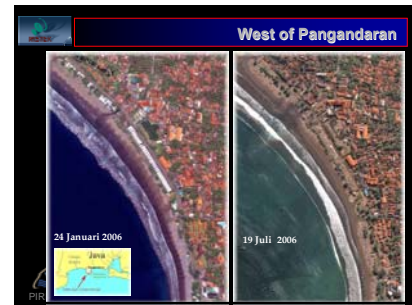
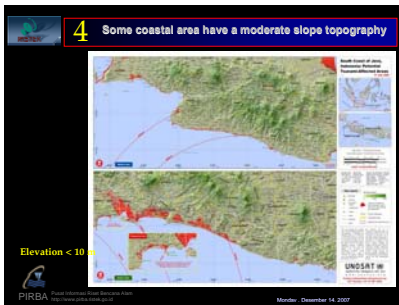
- What is "tsunami-earthquake"?
 - Earthquake that generates higher tsunami than expected from seismic analysis.
 - Earthquake that causes greater or smaller but only tsunami effects (ex. 1896 Sanriku tsunami).
 - Implication: Earthquakes that released energy in specific ways do not fully generated by seismic waves.



3 Generated tsunami waves were relatively high

Location	Longitude	Latitude	Inundation height
Pamungpeuk	107°41'26.6E	7°40'05.9S	5.20m
Sindangkerta	108°03'36.7E	7°45'52.8S	3.74m
	108°24'09.9E	7°48'56.0S	3.67m
	108°28'32.1E	7°49'10.2S	5.9m
Bakakara	108°29'51.3E	7°44'48.6S	2.12m
Daba Hu	108°52'39.4E	7°43'31.9S	5.34m
Daba Laut	108°36'43.3E	7°41'01.9S	7.67m
Pangandaran	108°39'06.0E	7°41'37.6S	4.69m
Widara Payung	109°16'51.8E	7°41'53.3S	6.70m



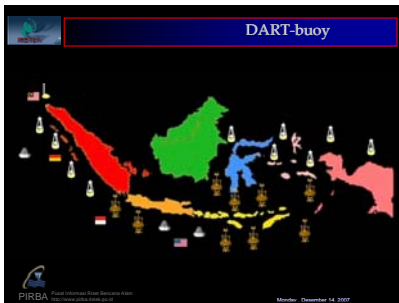
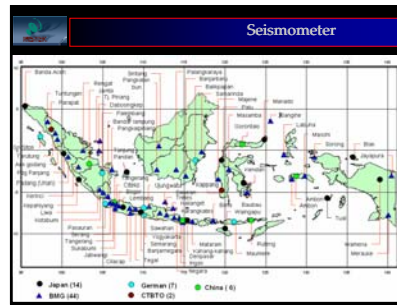


- Roles of National and Local Government**
- Structure Component → National Government**
 - Installation of sensing devices
 - Data analysis and processing to produce warning
 - Warning dissemination to interface institutions (Local Government, Related Institutions and Media)
 - Culture Component → Local Government**
 - Disseminate warning to affected community
 - Ensure that community act properly
 - Increase community preparedness
- PIRBA Pusat Informasi Tsunami Nasional
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Structure Component

- Seismometer : **67 / 160** units
- Accelerometer : **51 / 500** units
- Sea surface monitoring
 - DART-Buoy : **1 / 22** units
 - Tide gauge : **9 / 80** units
- Crustal Movement Monitoring (GPS) : **13 / 40** units
- Tsunami Database: **2 / 14** regions

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Tsunami Modeling

16 of 109 tsunamis have been simulated

- The 1797 West Sumatran Tsunami
- The 1818 Bali Tsunami
- The 1820 Bima Tsunami
- The 1833 Bengkulu Tsunami
- The 1883 Krakatau Volc. Tsunami
- The 1935 North Sumatra Tsunami
- The 1960 Mendau Tsunami
- The 1992 Flores Tsunami
- The 1994 East Java Tsunami
- The 1996 Yeh Tzu Tsunami
- The 1996 Blak Tsunami
- The 1998 RHO Tsunami
- The 2000 Banggai Tsunami
- The 2004 Aceh Tsunami
- The 2005 Nias Tsunami
- The 2006 Pangdaran Tsunami

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Culture Component : Community Preparedness

Roles of Local Government

1. Ensure security of the sensing devices
2. Develop risk maps and rescue scenario
3. Determine evacuation place
4. Construct signboards
5. Develop crisis center / command center
6. **Conduct tsunami drill regularly**
7. Develop siren systems
8. Determine / construct escape building / tsunami shelter
9. Develop spatial plans which taking into account disaster risk reduction
10. Develop school curricula on disaster risk reduction

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1. Ensure security of sensing devices

Seismometer Accelerometer Tide-gauge

DART-Buoy

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2. Develop risk maps

Example: Bali

Location	Wave Height (meter)	Travel time (minutes)
Jimbaran	7.9	42
Bandara	6.0	40
Kuta	5.7	44
Nusa Dua	5.8	28
Sanur	5.5	35

Courtesy: Hamzah Latief, et. al., 2006, Tsunami Research Group - ITB

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3. Determine evacuation place

TEMPAT EVAKUASI

PETA SEBARAN JALUR EVAKUASI

SEKTOR 7

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4. Construct signboards

Example in Bali

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5. Develop crisis center

Example: Crisis Center in Jakarta

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6. Conduct Tsunami Drill Regularly

Padang, 26 Desember 2005

Bali, 26 Desember 2006

26 December 2007: Bantén

2008 : Eastern Indonesia

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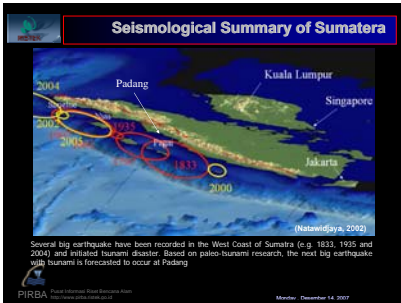
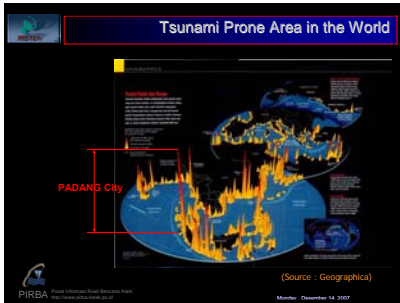
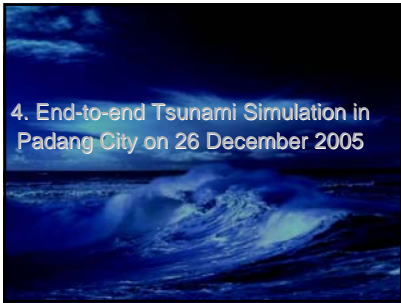
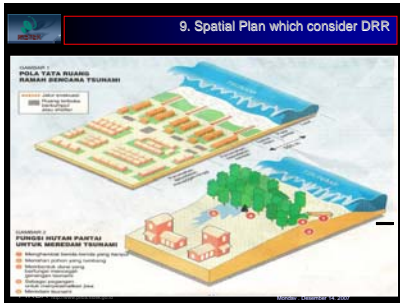
7. Develop Siren Network

Future Indonesian Siren Network

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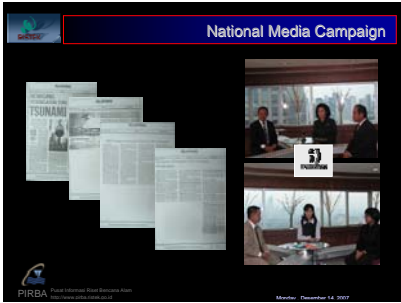
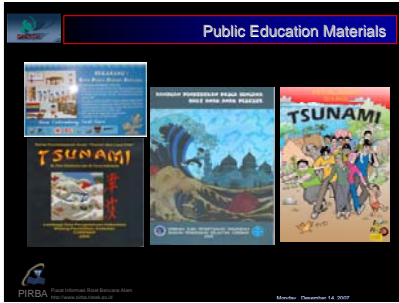
8. Construct Escape Building

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Statistics of Padang City

Geographical Position	: 0°54' - 1° 08' S
Area	: 694,96 km ²
Inhabitants	: 901,488 people
Coast length	: +/- 84 km
Number of surrounding rivers	: 21
Altitude	: 0 - 10 m (60%)



Local Media Campaign

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Distributed Materials and Previous Exercise

Hazard Map Evacuation Routes Learning media

Earthquake and tsunami drill

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Increasing Awareness for Government Officers

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Workshop for Developing Evacuation Map

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TOT for Local Officers, Students, NGO and Public

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TOT for Local Officers, Students, NGO and Public

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Elevation of Padang City

0-5 mdpl	: Zona Bahaya Tsunami
5 - 10 mdpl	: Zona Waspada Tsunami
10 - 25 mdpl	: Zona Aman Tsunami
25 - 100 mdpl	: Zona Relokasi
> 100 mdpl	: Zona Relokasi

Safe Area: > 5 mdpl
Mdpl: Meter diatas permukaan laut

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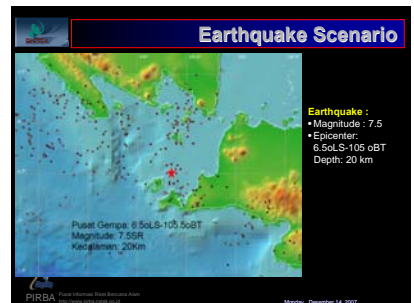
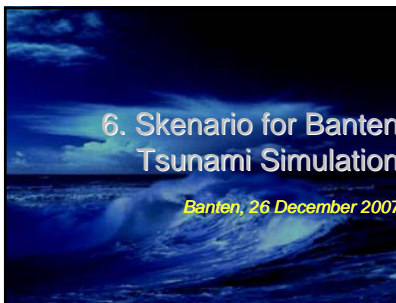
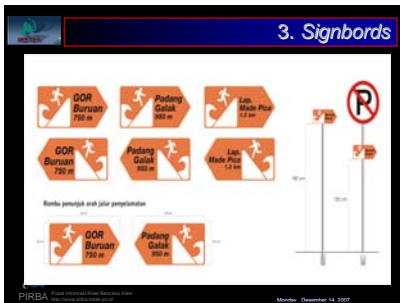
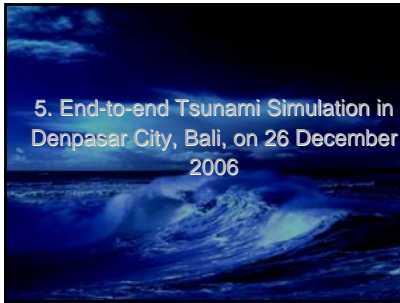
Evacuation Map and Sign Boards

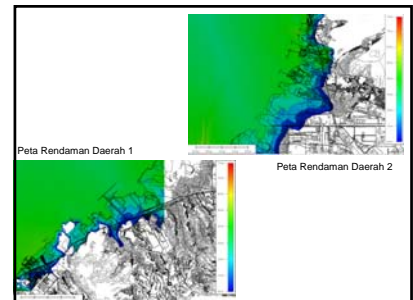
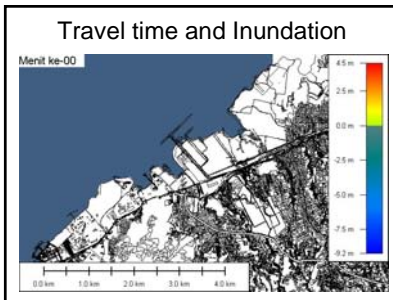
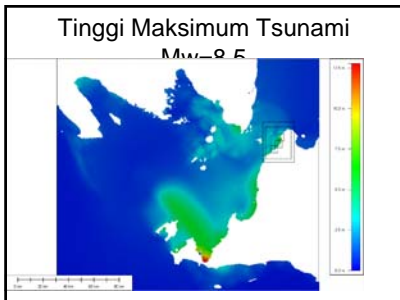
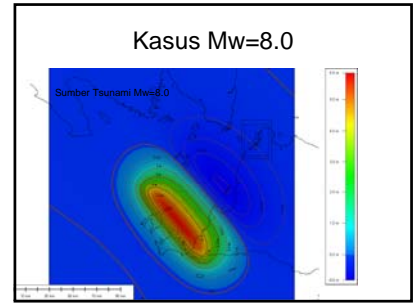
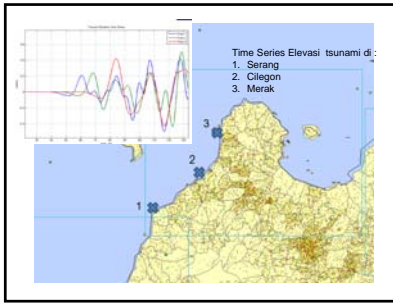
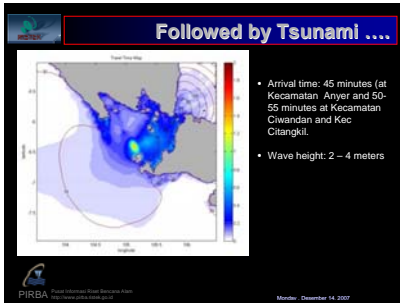
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Dokumentasi LUP
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Evacuation Routes and Escape Building

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Acronym	1. Jan 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31	2. Jan 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31	3. Feb 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31
The Launching of Ina-TEWS	Yes	Yes	Yes
ICTW	Yes	Yes	Yes
ACDR 2008	Yes	Yes	Yes
Others	Yes	Yes	Yes

ICTW = International Conference on Tsunami Warning
 ACDR = Asian Conference on Disaster Reduction
 Venue : Westin Hotel, Nusa Dua – Bali
 Inaugurated by President of Indonesia

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