INDONESIA TSUNAMI EARLY WARNING SYSTEM
“DEVELOPMENTS AND ACHIEVEMENTS”

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IOC/UNESCO Symposium: Advances in Tsunami Warning to Enhance Community Responses
Paris, France 12-14 February 2018
Indonesia Region is a Part of “Ring of Fire”, with:

- Indonesia is one of a very seismic active region in the world
- 295 active faults and 5 active subduction zone:
  1. Sunda Subduction,
  2. Banda subduction,
  3. North Sulawesi Subduction,
  4. Molucca Sea Subduction and
  5. North Papua Subduction
- 46% of Indonesia coastal length is prone to tsunami

Source: Pusgen (2017) and IABI (2013)
ACEH TSUNAMI: DECEMBER 26, 2004

Indonesia situation before Tsunami 2004

- Tsunami risk: considered low
- Very limited seismic observation to detect the earthquake
- Very limited real-time sea level observation to verify the tsunami event
- No tsunami warning system
- No national tsunami warning contact point to be informed
- Community unaware and not prepared

Interim Advisory Service:
- US/NOAA
- Pacific Tsunami Warning Centre (PTWC)
- Japan Meteorological Agency (JMA)

IMPACT

- Dec 26, 2004, 00:59 UTC
- M 9.1 Earthquake struck west coast of Northern Sumatra, Indonesia, near the city of Banda Aceh
- Megathrust Earthquake triggered along 1300 km rupture, over 12 minutes

- Loss of over 230,000 lives
- The displacement of over 1.6 million people around the Indian Ocean,
- Environmental damage
- Psychological trauma
- Estimated economic losses of $14 billion.
Inaugurated on November 11, 2008

Establishment of InaTEWS
Indonesia Tsunami Early Warning System

- The main product of InaTEWS is Earthquake Info and Tsunami Warning
- Required to disseminate Earthquake Information and Tsunami Warning within **5 minutes** after the earthquake occurred

Indonesia Tsunami Early Warning System Goal’s:

- Timely detection of earthquake event and provide tsunami warning to the responsible-institutions and people.
- Appropriate response of communities to reduce and minimize the impacts of disaster.
I naTEWS: End To End System

BMKG

SEISMIC MONITORING SYSTEM

PROCESSING SYSTEM

EARTHQUAKE PROCESSING SYSTEM
TSUNAMI PROCESSING SYSTEM

PRODUCTS

EARTHQUAKE INFORMATION
TSUNAMI WARNING

DISSEMINATION SYSTEM

MULTIMODA DISSEMINATION

INTERFACE INSTITUTION

BNPB, BPBD, KOMINFO
TNI, POLRI, MEDIA, dll.

RISK COMMUNITY IN THE COASTAL AREA

SEA MONITORING SYSTEM

TIDE GAUGES, BUOY

STAKE HOLDERS

BMKG

UPSTREAM

DOWNSTREAM
**InaTEWS Infrastructure: Monitoring System**

### Real Time Seismic Monitoring
- **170** Broad Band Seismograph
- **224** Accelerograph

### Real Time Sea Level Monitoring
- **137** Tide Gauges
- **9** Selected Beach CCTV
InaTEWS Infrastructure: Processing System

- **SEICOMP 3 - EQ Analysis**
- **Earthquake Information**
  - Origin Time
  - Magnitude
  - Depth
  - Coordinate
  - Shake Map
- **Decision Support System**
- **TSUNAMI WARNING**
  - Major Warning
  - Warning
  - Advisory
  - No Tsunami
- **TOAST** (Tsunami Observation And Simulation Terminal)
Multimode Dissemination of InaTEWS:

1. SMS (registered phone number)
2. SMS (Local Based Service-non register)
3. Social Media (twitter, facebook)
4. WhatsApp
5. DVB & WRS
6. Email
7. Website
8. Television (running text & breaking news)
9. Faximile - official
10. Radio
11. Tsunami Sirens
InaTEWS: Destructive Earthquakes and Tsunami Potential Events

Earthquake: 38 x ± 2 / year
Tsunami: 14 x > 1 / years

InaTEWS has issued 20 events, and no tsunami 6 events
DEVELOPMENTS & ACHIEVEMENTS:
TSUNAMI DATABASE & BMKG SHAKE MAP

Tsunami Scenario Database for Indonesia

- Completing Tsunami scenario database in Indonesian Region from 4,580 scenarios to 16,000 scenarios (until February 2017).
- Continuously improving the tsunami warning bulletin in Indonesia.

BMKG Shake Map:

Operating the Shake Map information, since 2016, and become one of BMKG’s product to estimate the shaking level and earthquake effect in less than 15 minutes.
DEVELOPMENTS & ACHIEVEMENTS: SOURCE MECHANISM TO SUPPORT TSUNAMI MODELLING

- Moment Tensor Inversion is started to use in estimating the source mechanism since 2012.
- The source mechanism becomes an input for tsunami simulation in order to increase the tsunami modelling accuracy (since mid. 2017)

Case Study: Tasikmalaya Earthquake (M 6.9) December 15, 2017

DSS – Without Source Mechanism “Tsunami Potential”

TOAST (new DSS) – With Source Mechanism: “Not Tsunami Potential”
## Developments & Achievements: New DSS with New S.O.P.

### DSS

**No** | **DSS (OLD)** | **TOAST (NEW DSS)**
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1 | 4,580 Tsunami Scenarios | Almost 17,000 Tsunami Scenarios
2 | Tsunami scenario only cover Sunda Trench region | Tsunami scenario cover all over Indonesia region
3 | TsunAWI is used as the basis for tsunami modeling | TsunAWI and easywave are used as tsunami modeling bases
4 | Default Tsunami modeling uses thrust fault | Possible to update modelling with Realistic source mechanism
5 | Hard to upgrade | Easy to develop and upgrade with new features
**DEVELOPMENTS & ACHIEVEMENTS: NEW NATIONAL TSUNAMI WARNING CENTER (NTWC) AREA**

- Change the NTWC area, from rectangular into polygon based on combination of tsunami travel time contour map, tectonic condition and sensor detection capability to cover 5 minutes area dissemination.

- The existing NTWC area (rectangular area) is too wide to cover tsunami source which generally located in Indonesia subduction zone.

- Tsunami travel time
- Sensor detection capability
- Tectonic condition
GAP OF ADAPTATION CAPACITY

Disaster related External Force

Global Warming

Resilience Capacity

Absorptive coping capacity
(persistence)

Adaptive Capacity
(incremental adjustment)

Transformative Capacity
(transformational responses)

Adaptation Gap

Aging People

Year

2000

2100
Local Based Service S.M.S.

Operating the LBS SMS System, since 2016, as one of innovation in dissemination

Using LBS, people in three Districts closest to epicenter will receive earthquake info & tsunami warning automatically through SMS without having to register their phone number.

Mobile Apps, Twitter, WhatsApp, Facebook as one of innovation in dissemination sys for earthquake info & tsunami warning.
Capacity building for public awareness and preparedness as the key for the success of the early warning system

Participants:
- Local DMO
- Communities
- University
- School
- Military & Police
- NGO
- Media

Objective:
- To study community understanding of earthquake information and tsunami warning
- To study the information and warning chain
- To study community evacuation plan
- To study Local Disaster Management Office (LDMO’s) and Local S.O.P.
IOWAVE16 and PACWAVE17 Exercises

Indian Ocean Tsunami Wave Exercise 16 (IOWAVE16), 7-8 September 2016

- Table Top Exercise (TTX) and Tsunami Drill in:
  1. Padang
  2. Pandeglang
  3. Jakarta
  4. Pangandaran
  5. Pacitan

Involved many stakeholders until community: 4000 people

Pacific Wave Exercise 17 (PACWAVE17), 16 February 2017

- Table Top Exercise (TTX) in:
  1. Jakarta
  2. Manado (North Sulawesi)
  3. Ternate (North Mollusca)

Involve: NTWC, LDMO, Local Government
HEAD OF BMKG IN THE PARLIAMENT MEETING REGARDING DISASTER PREPAREDNESS
DEVELOPMENTS & ACHIEVEMENTS:
TSUNAMI SERVICE PROVIDERS (TSPs)

24 Indian Ocean rim countries will receive Tsunami warning messages

Signing Partnership Agreement BMKG and Executive Secretary of IOC, for the supporting of Office Program IOTIC 2015 - 2017; 27 June 2017

ICG/IOTWMS
TSP (Tsunami Service Provider)
1. **UPSTREAM:**
   - Seismic Network and Tsunami observation Network Improvement;
   - Speed and accuracy of earthquake parameter determination;
   - Regular monitoring, TSP Comm Test, and Regional & Local exercises;

2. **DOWNSSTREAM:**
   - Community disaster literacy: “Earthquake Field School” at 23 Provinces;
   - Seismic Building Code.

3. **SERVICES:**
   - Timor Leste: installing InaSeis (processing system) and Warning Receiver System (WRS – dissemination system);
   - Oman Job Training (2014, 2018)
1. The successful operational of InaTEWS has prompted UNESCO to appoint InaTEWS as Tsunami Service Provider (TSP) for the Indian Ocean rim countries, together with India and Australia;
2. InaTEWS has many developments and achievement regarding to monitoring, processing and dissemination system as well as community capacity building;
3. The system has been proved to work well in several significant Earthquakes and tsunamis;
4. The social media and mobile apps have high potential as the fastest and broadest media in disseminating earthquake info and tsunami warning;
5. In 2015 started “the Earthquake Field School” as part of improvement level of community disaster literacy.
THANK YOU

AGENCY FOR METEOROLOGY, CLIMATOLOGY AND GEOPHYSICS

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