BADAN INFORMASI GEOSPASIAL

Roles of Geospatial Information for Disaster Risk Reduction Management in Indonesia

(Case Study: Palu-Donggala Earthquake 28 September 2018)

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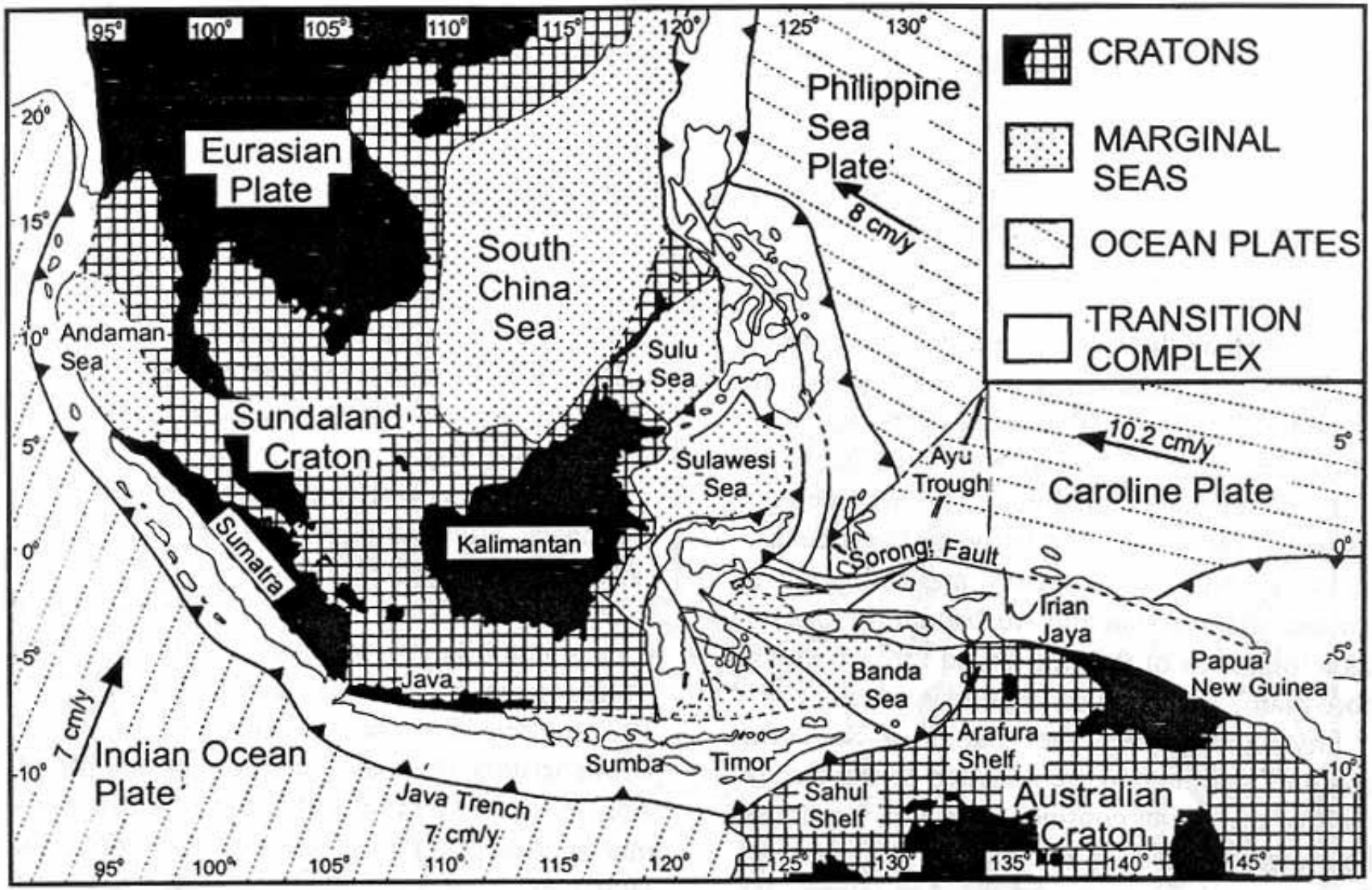
Geospatial Information Agency of Indonesia (BIG)

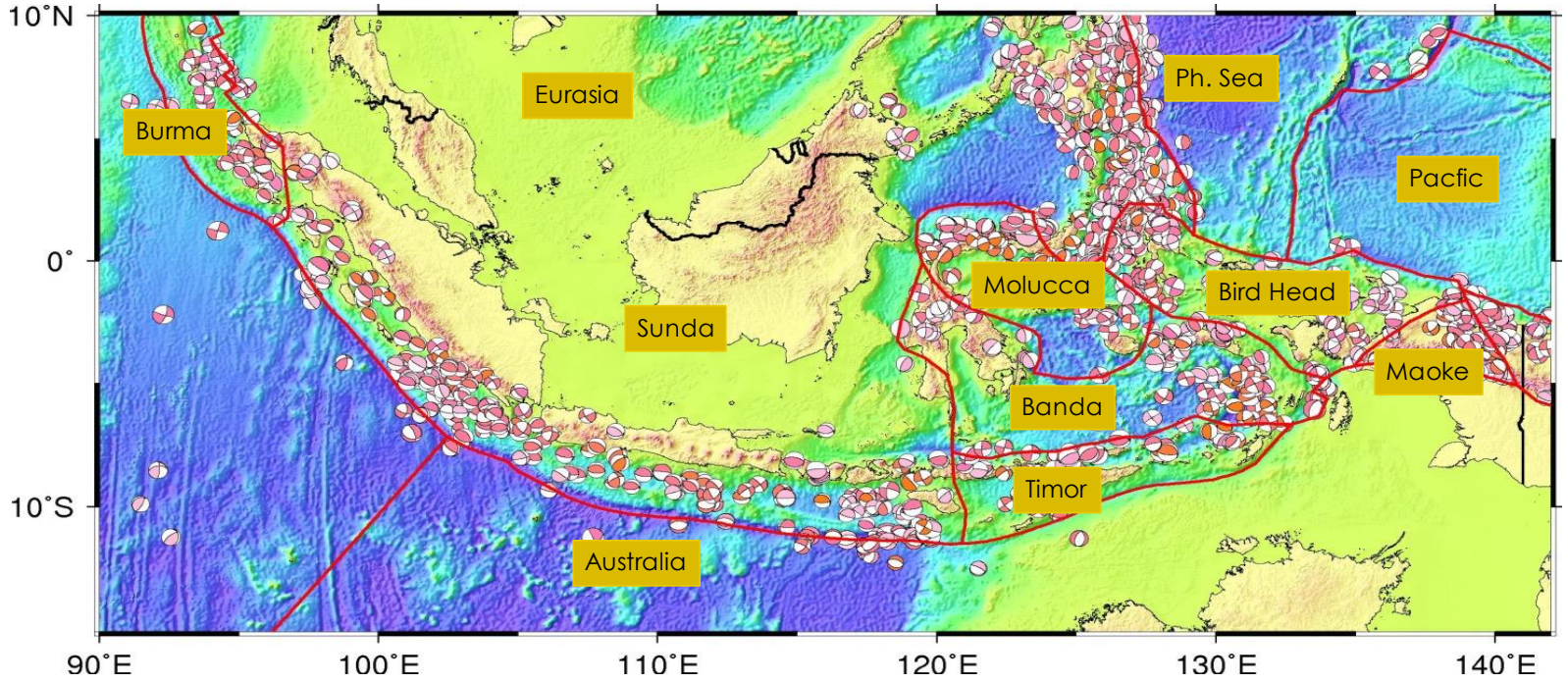
Presented at the United Nations
World Geospatial Information Congress (UNWGIC)
Deqing, Zhejiang Province, China
19-21 November 2018

General Tectonic Settings of Indonesia

from *Simandjuntak and Barber* (1996)

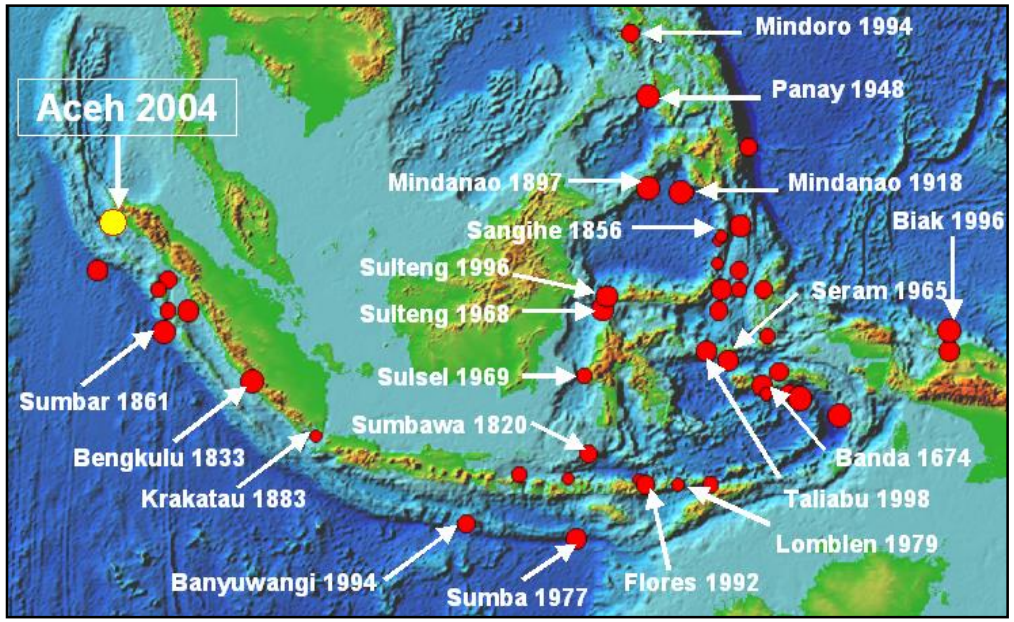
INDONESIA
is an archipelago with tectonically active settings, and therefore prone towards many natural hazards.

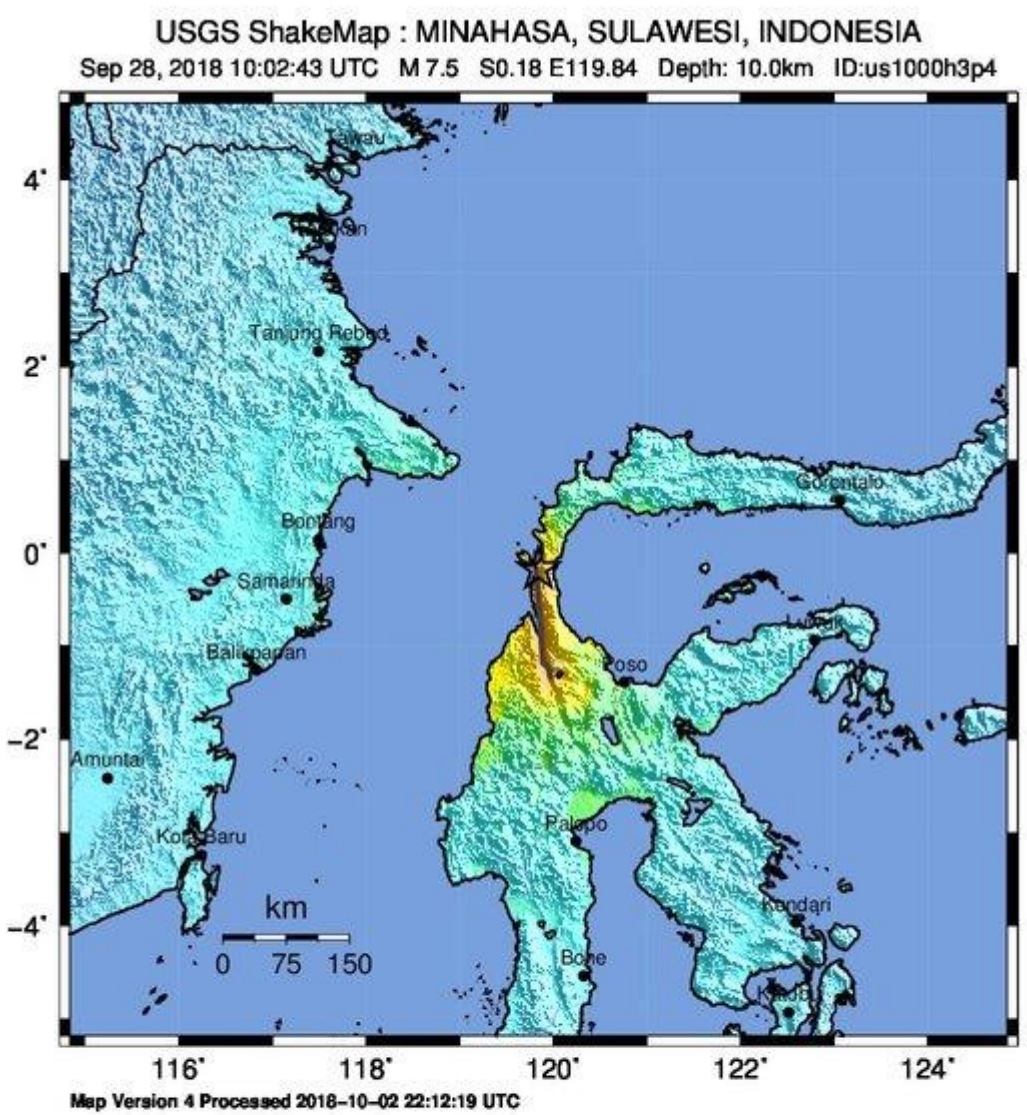




INDONESIA
is prone to several natural disasters:

- *Earthquakes*
- *Tsunami*
- *Volcano Eruption*
- *Flooding*
- *Landslide*
- *Land subsidence*
- *Drought*
- *Flooding*
- *Forest fire*
- *Windstorm*

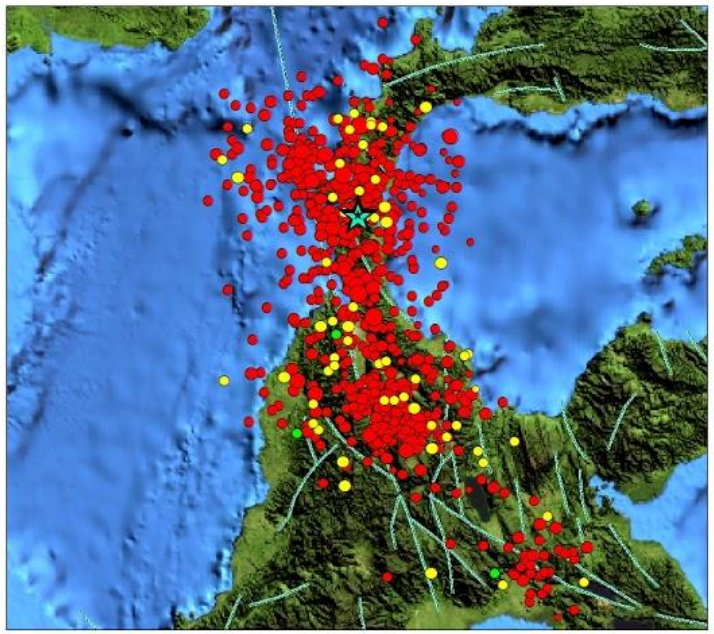




PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
PEAK VEL.(cm/s)	*<0.02*	*0.1*	*1.4*	*4.7*	*9.6*	*20*	*41*	*86*	*>178*
INSTRUMENTAL INTENSITY	I	II–III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Worden et al. (2012)

Earthquake aftershocks: 770 events
(28 Sept - 27 Oct. 2018)



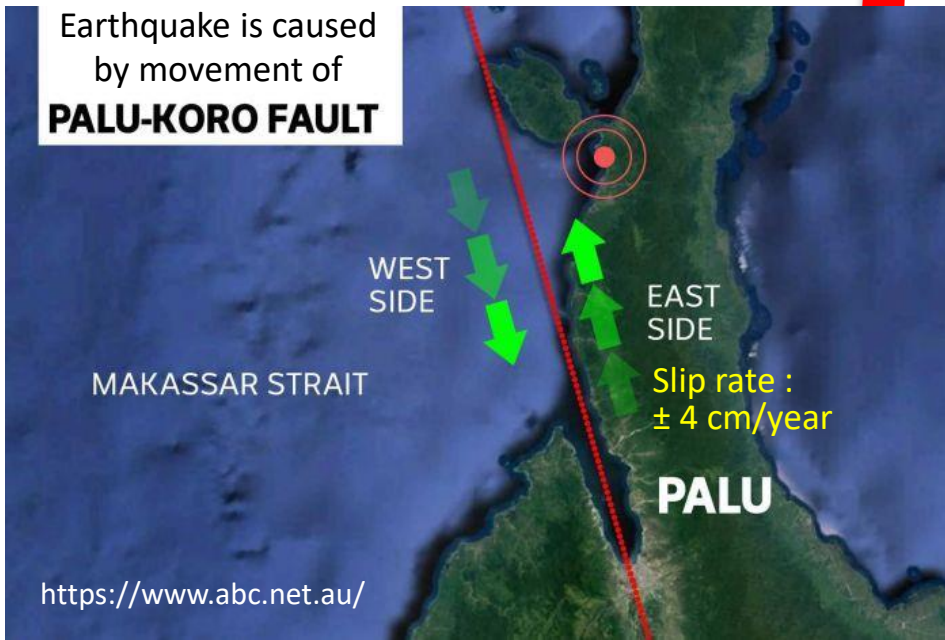
BMKG
BADAN METEOROLOGI KLIMATOLOGI & GEOFISIKA
BALAI BESAR METEOROLOGI KLIMATOLOGI & GEOFISIKA
WILAYAH IV MAKASSAR

LEGENDA
Subduksi
Mainshock (M 7.4)
Aftershock (770 event)
Magnitudo :
M > 7.0 SR
6.0 < M < 6.9 SR
5.0 < M < 5.9 SR
4.0 < M < 4.9 SR
3.0 < M < 3.9 SR
M < 3.0 SR
Kedalaman :
h < 60 Km
60 < h < 300 Km
h > 300 Km

BADAN INFORMASI GEOSPASIAL

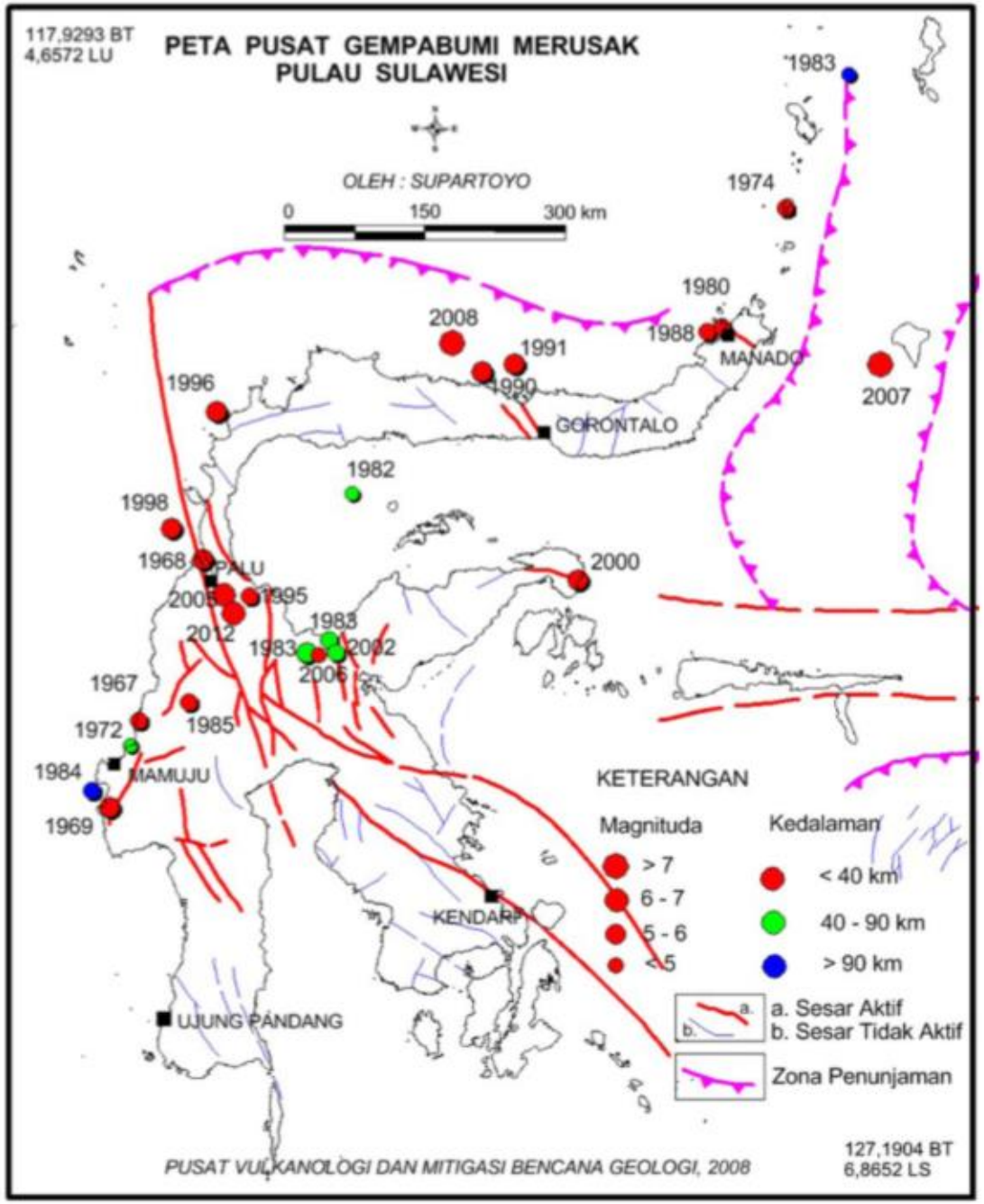
Palu-Donggala Earthquake Mw 7.4

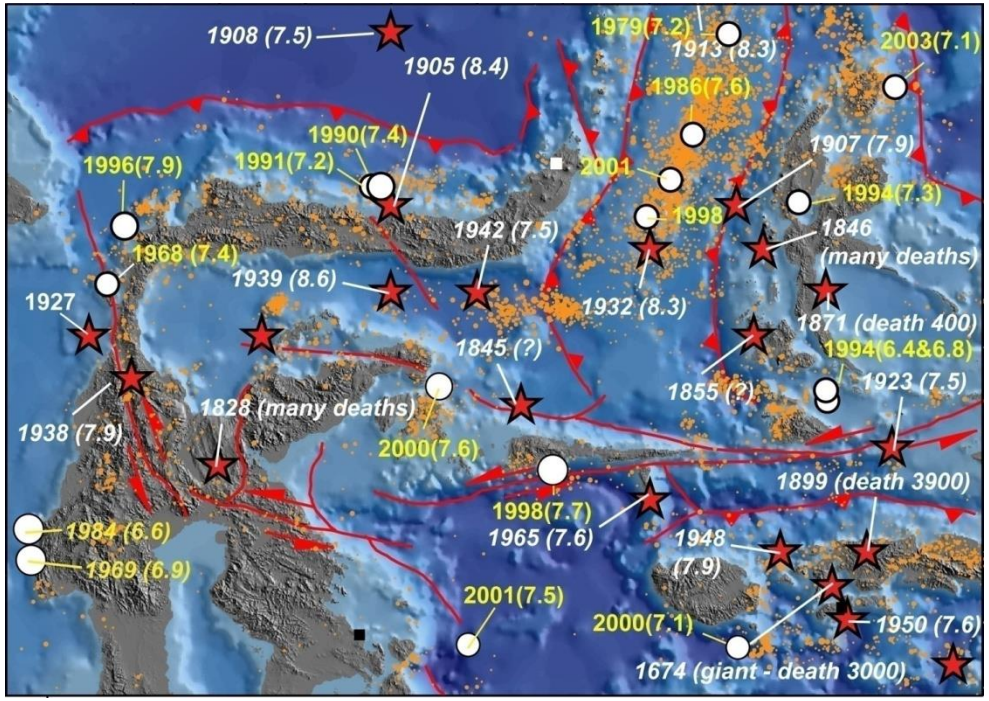
Friday
28 Sept. 2008
18:02 WITA



Several Previous Recorded Earthquakes and Tsunamis in Palu-Donggala Region

- ✓ 1927 (6.3 Mw, Tsunami →15 m)
- ✓ 1930 (Earthquake, Tsunami →2 m)
- ✓ 1938 (7.9 SR, Tsunami →10 m)
- ✓ 1968 (7.4 Mw, Tsunami →10 m).
- ✓ 1996 (7.7 Mw, Tsunami →4 m)
- ✓ 2005 (6.2 Mw), 2012 (6.2 Mw)





https://act.id/news/detail/ekspedisi-palu-koro-1-mencari-jejak-patahan-besar-di-atas-pulau-sulawesi

Disaster of 28 September 2018

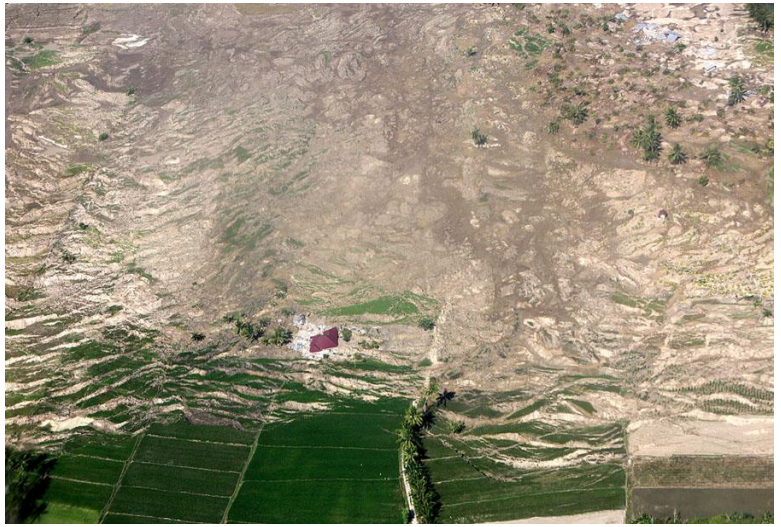
Palu-Donggala-Sigi-Parigi Moutong

Central Sulawesi, Indonesia

Damaged Houses > 68,000

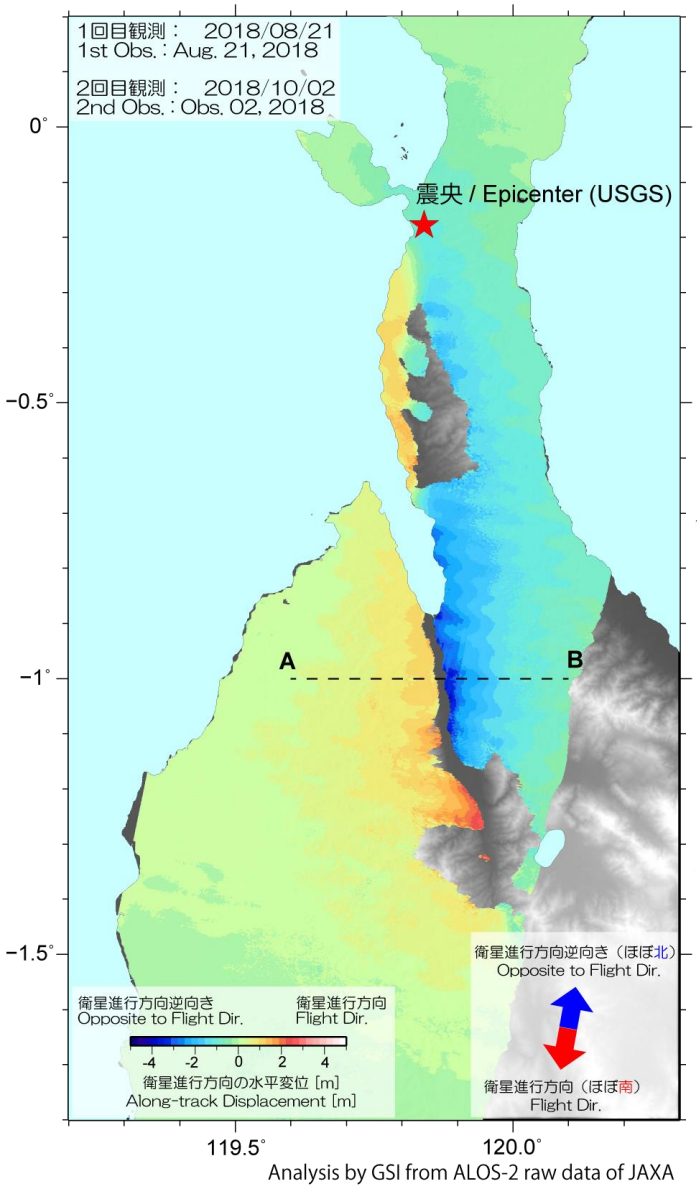
- ✓ Earthquake
- ✓ Liquefaction
- ✓ Tsunami
- ✓ Landslide

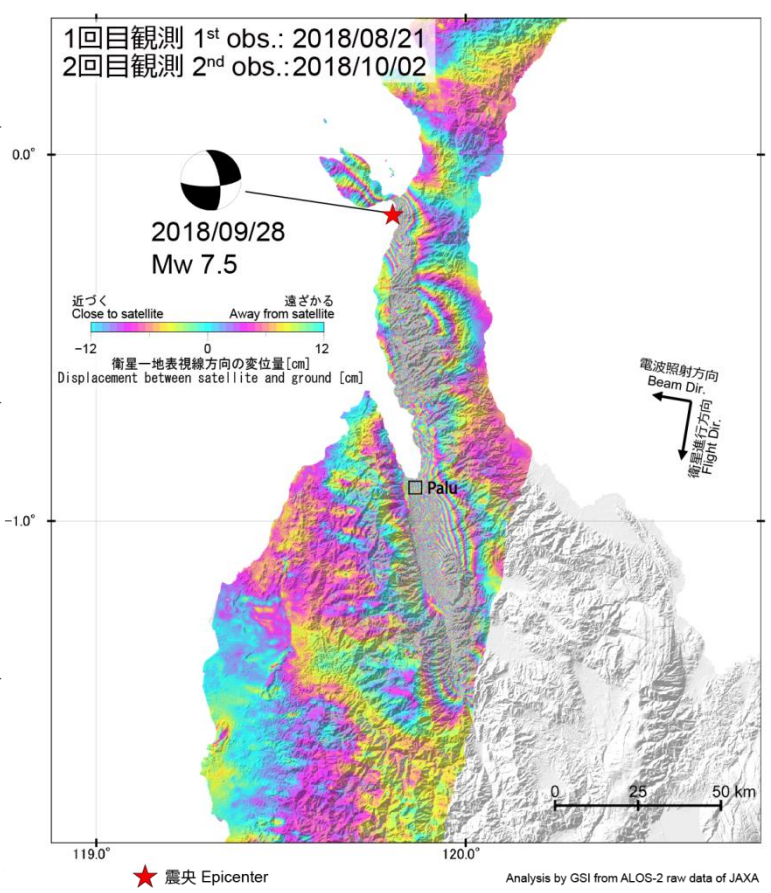
Victim (Peoples):
Dead > 2100
Missing > 1300
Injured > 4400
Displaced > 173.000



Photos from https://www.theatlantic.com/photo/2018/10/photos-from-indonesias-devastating-earthquake-and-tsunami/572068/

2018 Palu-Donggala Earthquake
Ground Displacements and Surface Ruptures



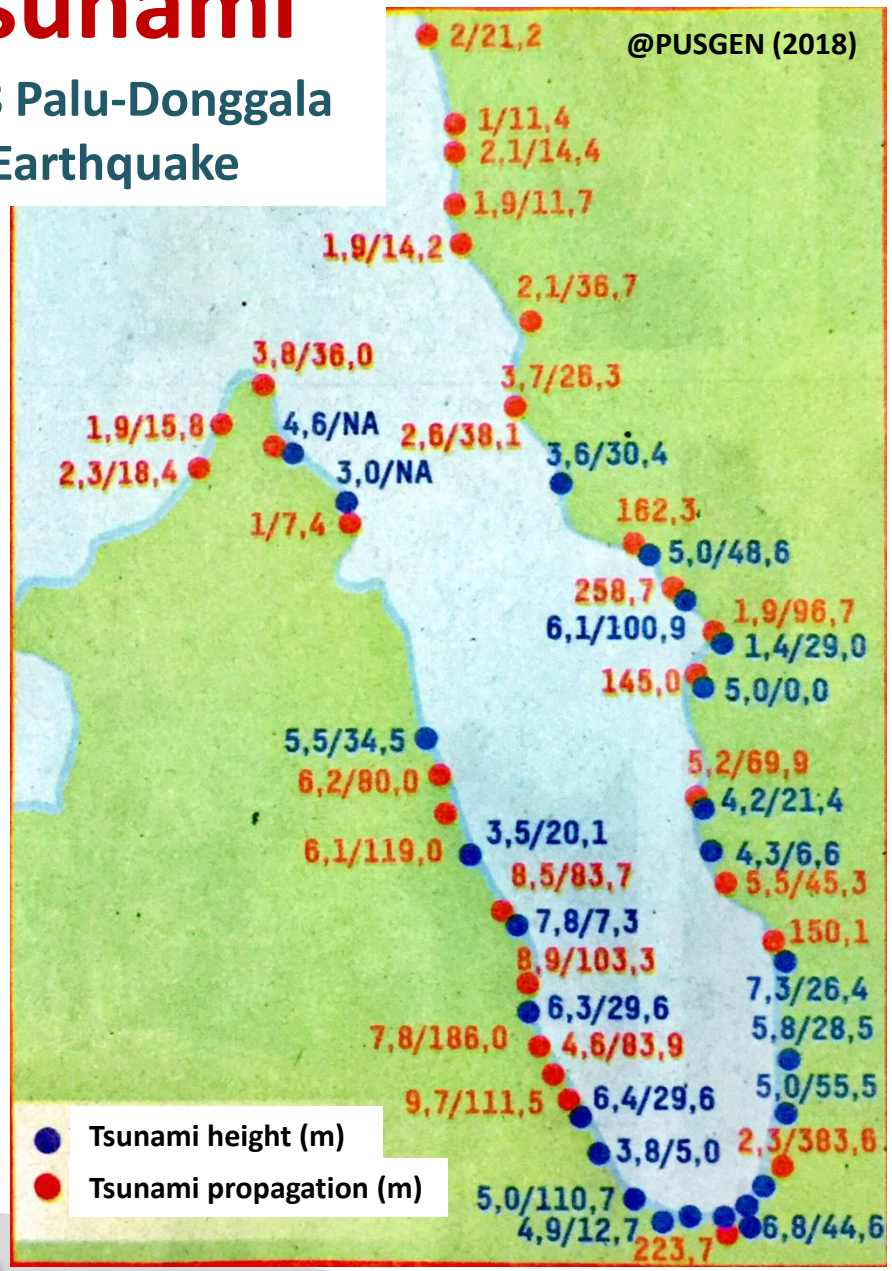


Ref: http://www.gsi.go.jp/cais/topic181005-index-e.html

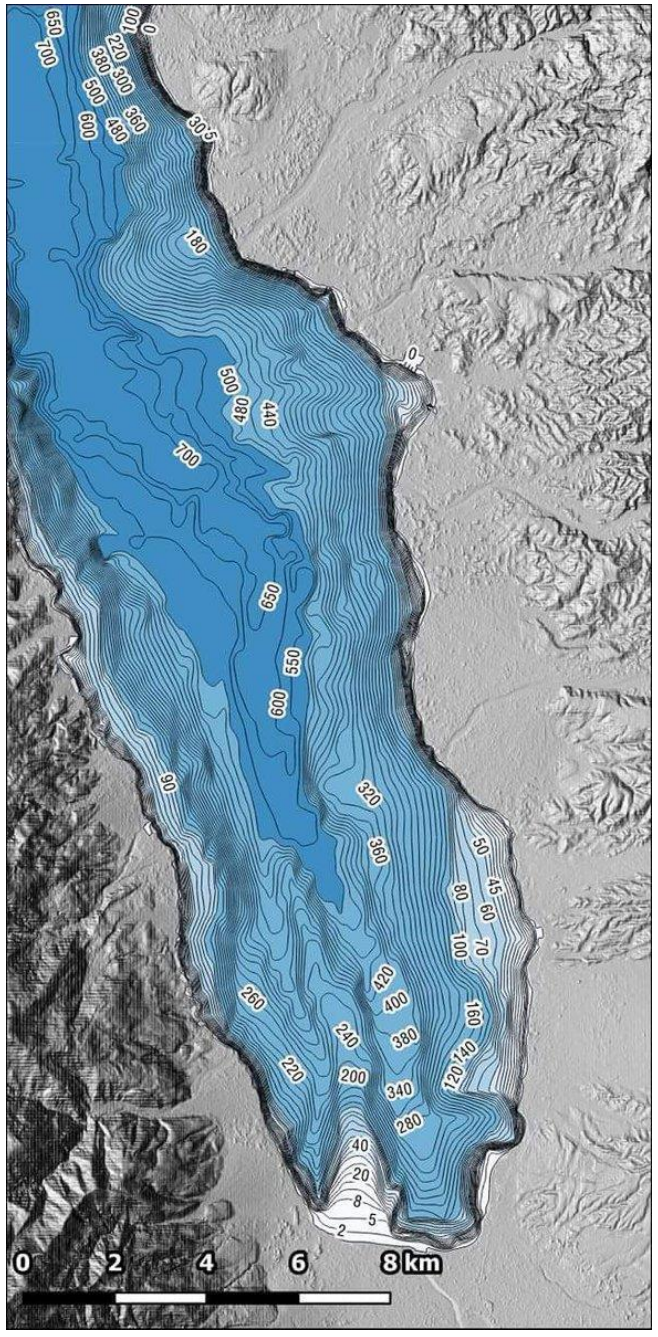
Ground displacements up to about 5.8 m (lateral) and 3.5 m (vertical) was reported. Surface rupture is estimated about 70 km (on land) and 80 km (under the sea)

Tsunami

2018 Palu-Donggala Earthquake



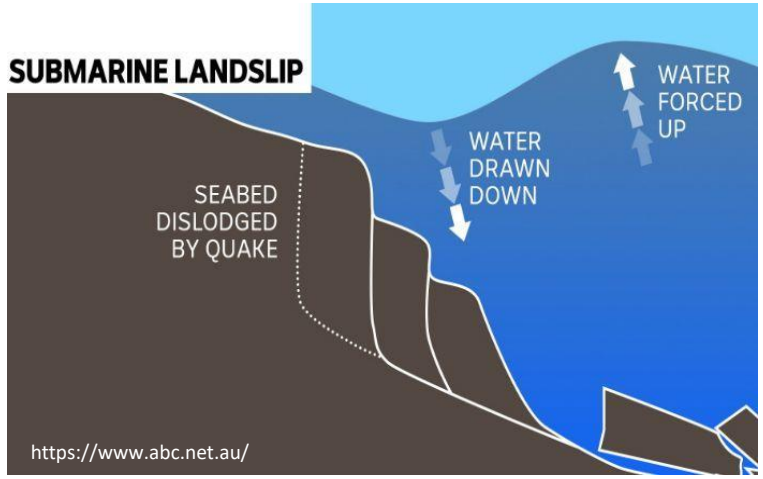
HU Kompas, 15 Nov. 2018



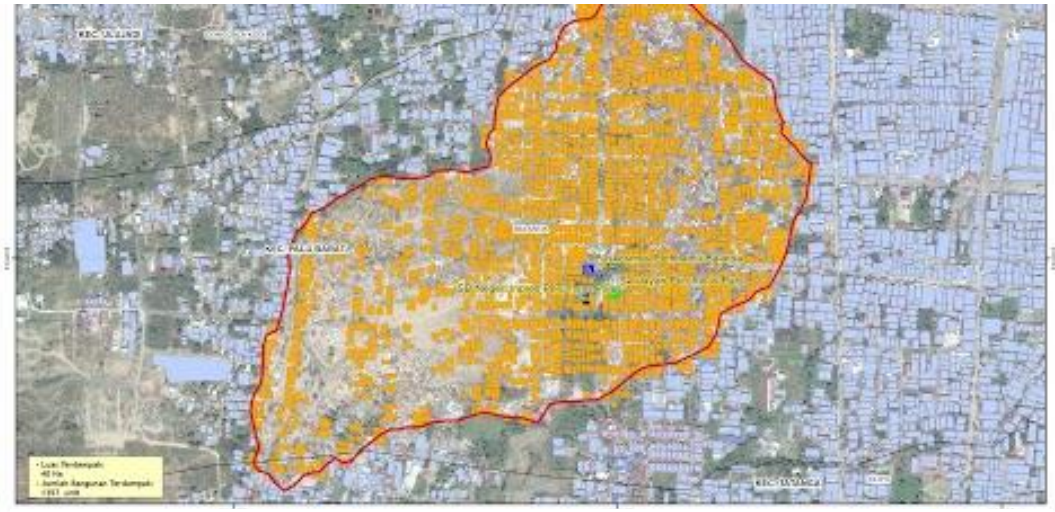
Bathymetry of Palu bay,
based on the National DEM of BIG
freely available from the following site:
http://tides.big.go.id/DEMNAS/

HYPOTHESIS:

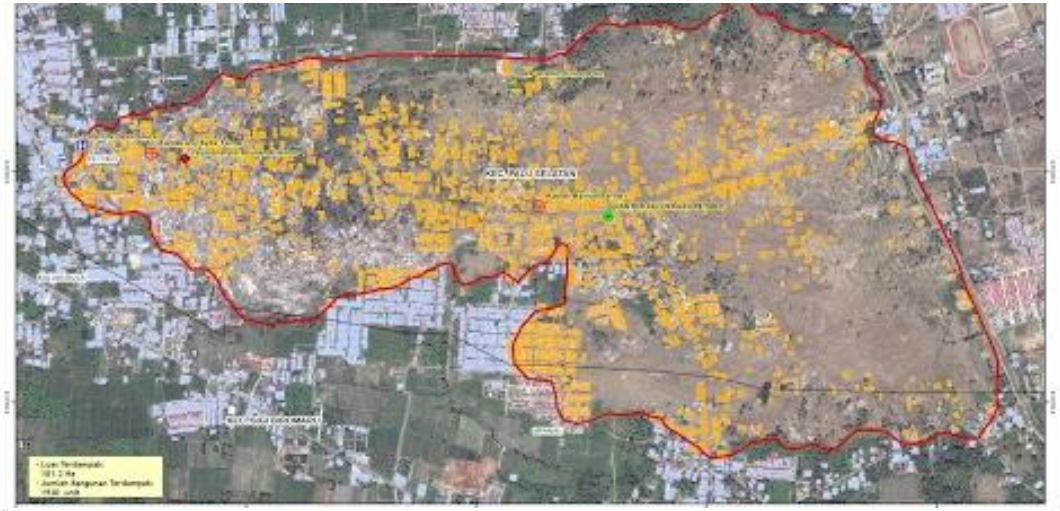
the killer tsunami was most likely generated by an underwater landslide occurring inside Palu bay (*Muhari et al.*, 2018)



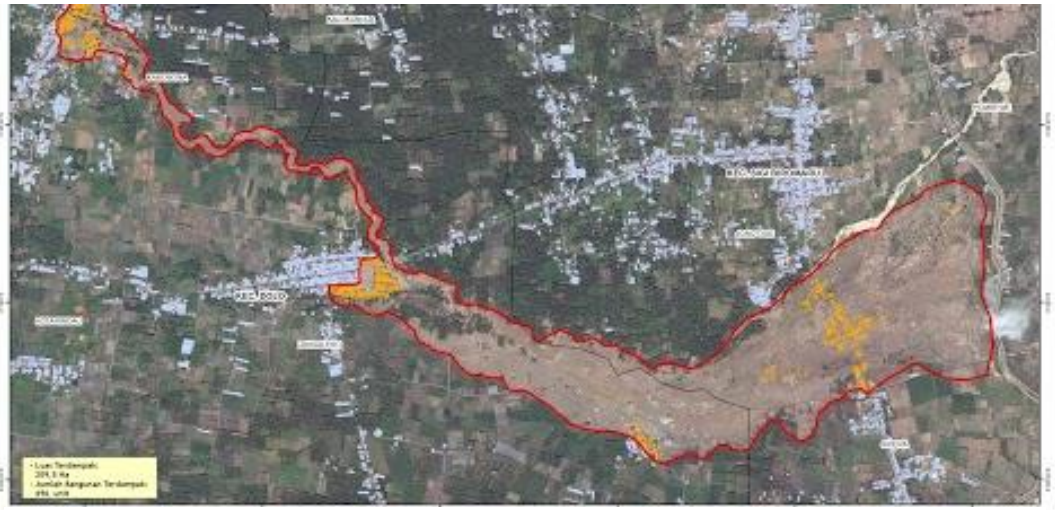
2018 Palu-Donggala Earthquake: Liquefaction (+Landslide)



Balaroa area
affected 40 hectares and 1357 houses/buildings

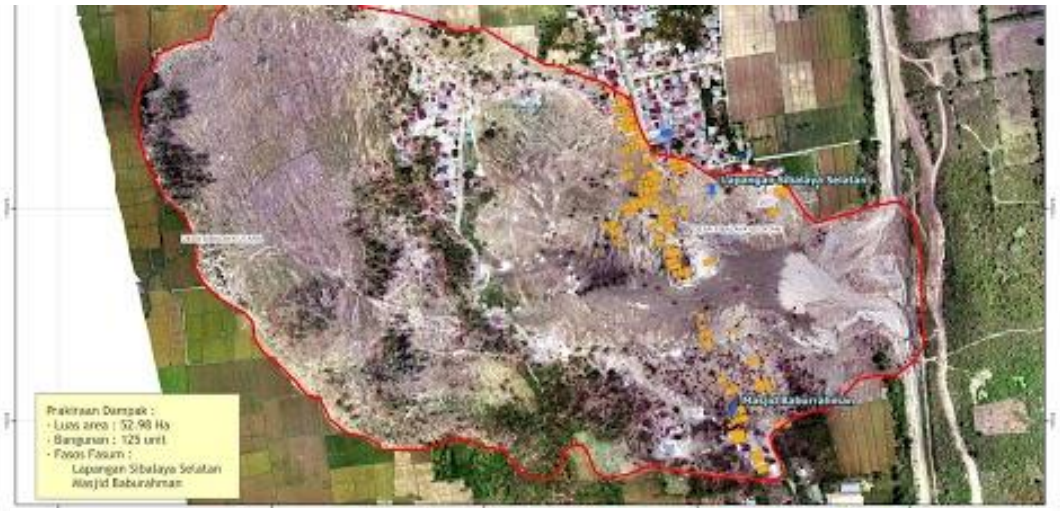


Petobo area
affected 40 hectares and 1742 houses/buildings



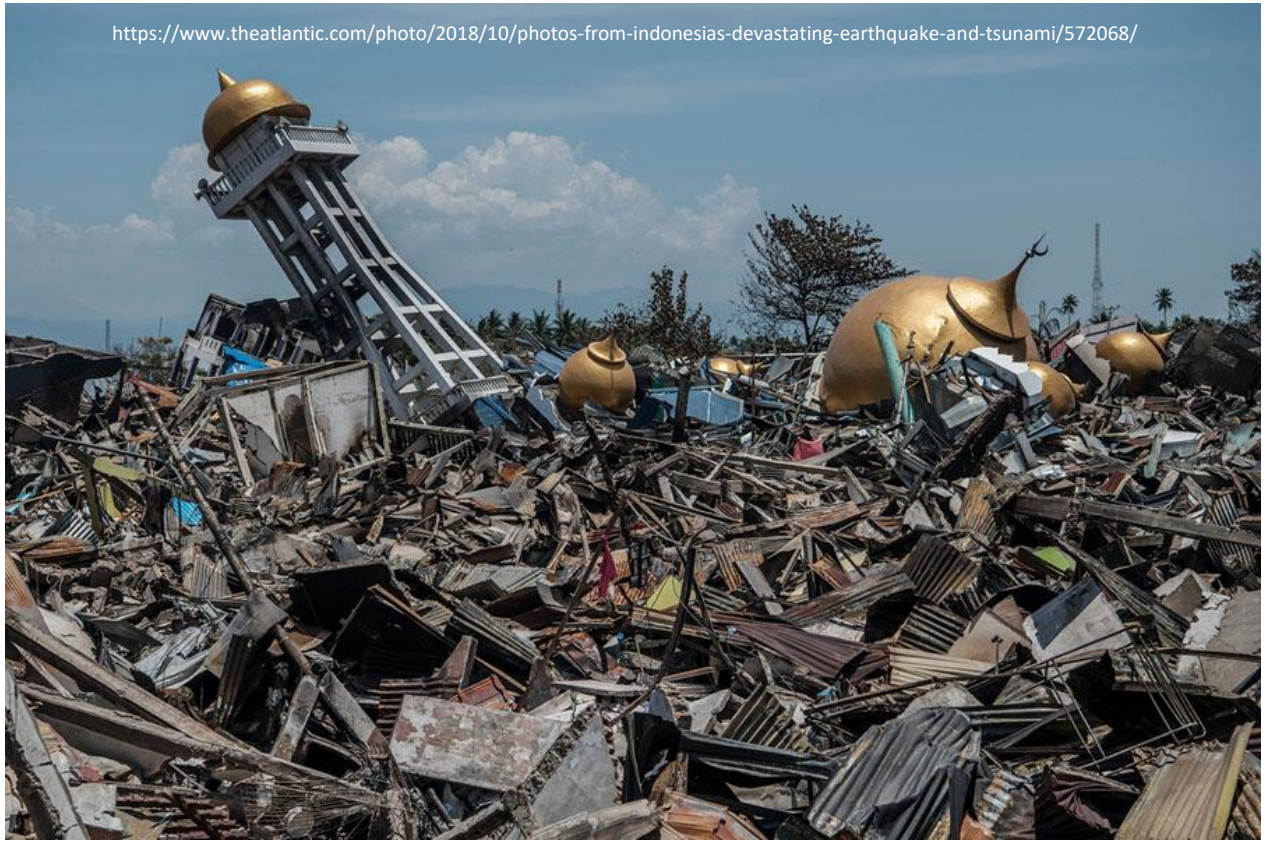
Jono Oge area
affected 210 hectares and 496 houses/buildings

Ref: https://bnpb.go.id/



Sibalaya area
affected 53 hectares and 125 houses/buildings

Disaster Risk Reduction Management



Rubble and debris lie around the ruins of a mosque following an earthquake, on October 2, 2018, in Palu, Indonesia

A broad range of activities designed to (ADPC, 2009):

- **Prevent the loss of lives.**
- **Minimize human suffering.**
- **Inform the public and authorities of risk.**
- **Minimize property damage and economic loss.**
- **Speed up the recovery process.**

Disaster Risk Reduction (DRR) Management

from ADPC (2009)

Geospatial Information will have important roles for several activities of ***Disaster Risk Reduction Management***

Geospatial Information for Disaster Risk Reduction Management (Indonesian Case)

Geospatial Information

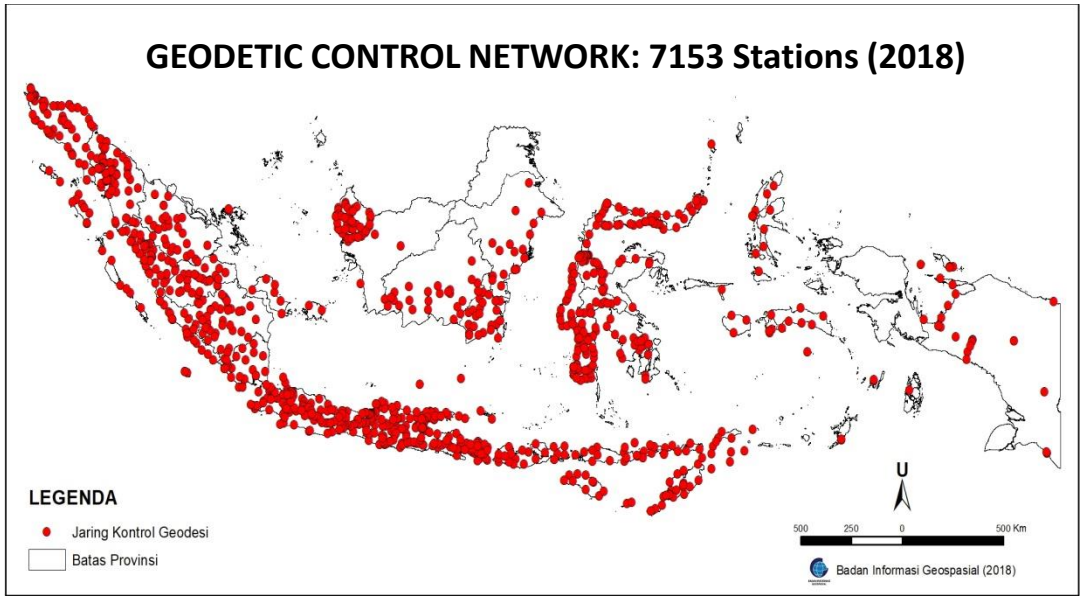
- **Geospatial Reference Frames**
  - *CORS, Tide Gauges, Geodetic Network, Geoid*
- **Base Maps**
  - *Topographic Map (RBI), Coastal Area Map (LPI), and Marine Area Map (LLN)*
- **Integrated and Synchronized Thematic Maps**
  - *One Map Policy (OMP)*

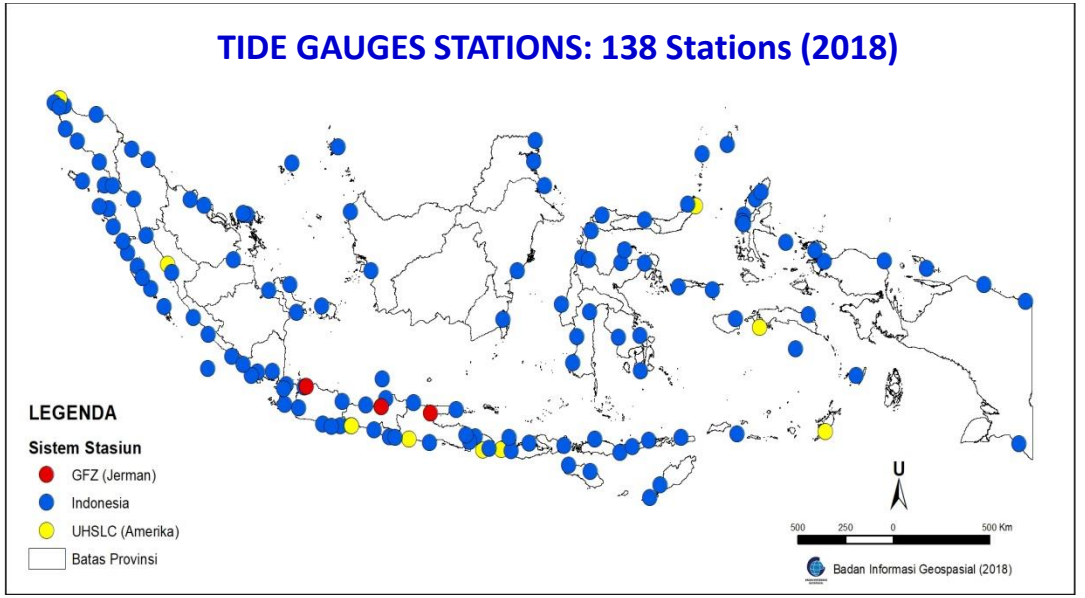
→ **National Geospatial Information Network**

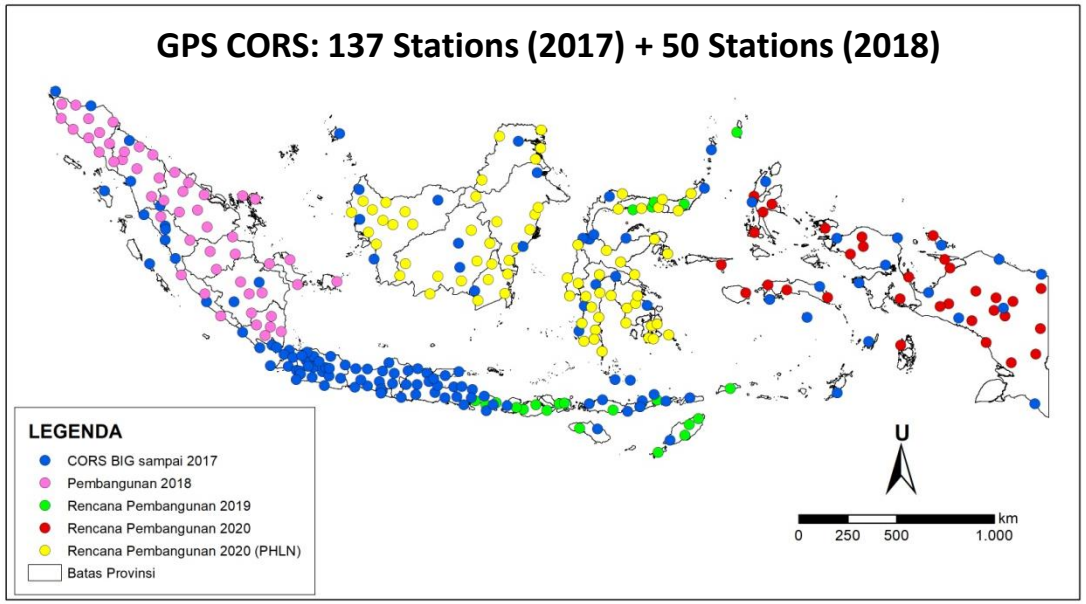
InaGeoportal

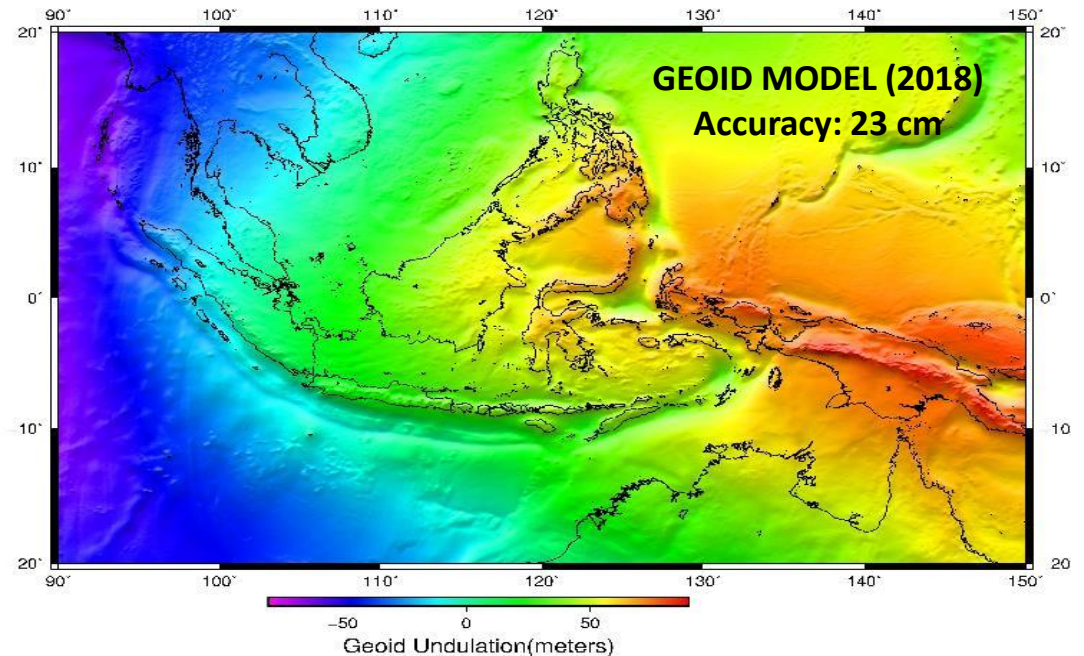
→ **Disaster Risk Reduction Management**

Geospatial Reference Frames of Indonesia





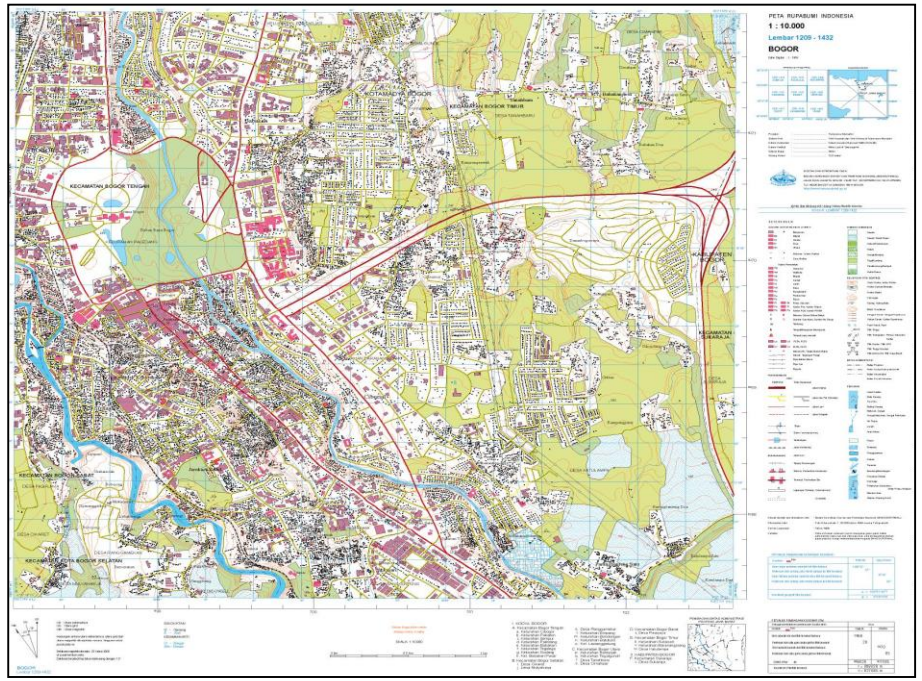




Basemaps of Indonesia

- Topographic Map
- Coastal Area Map
- Marine Area Map

Scales of
1:1000 to 1:1.000.000

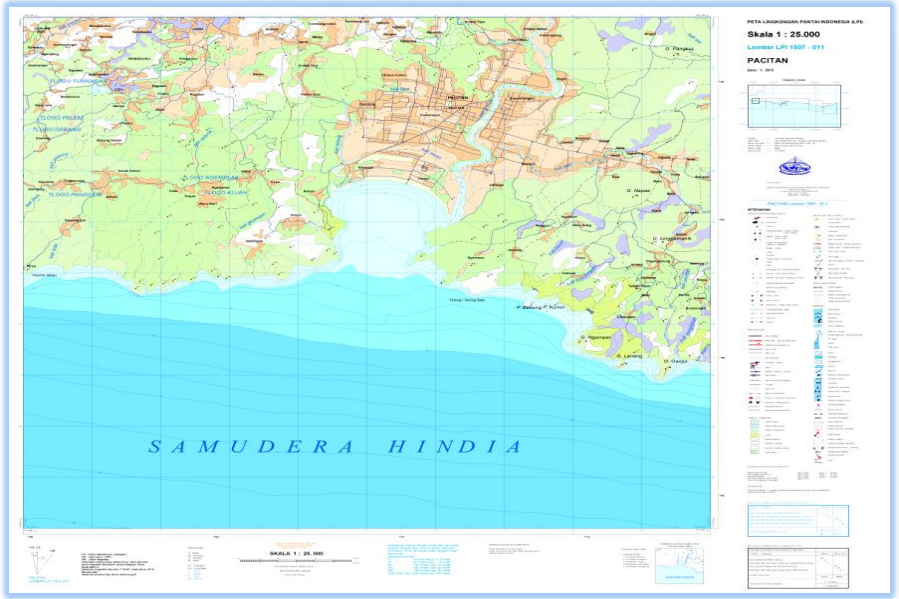


Topographic Map

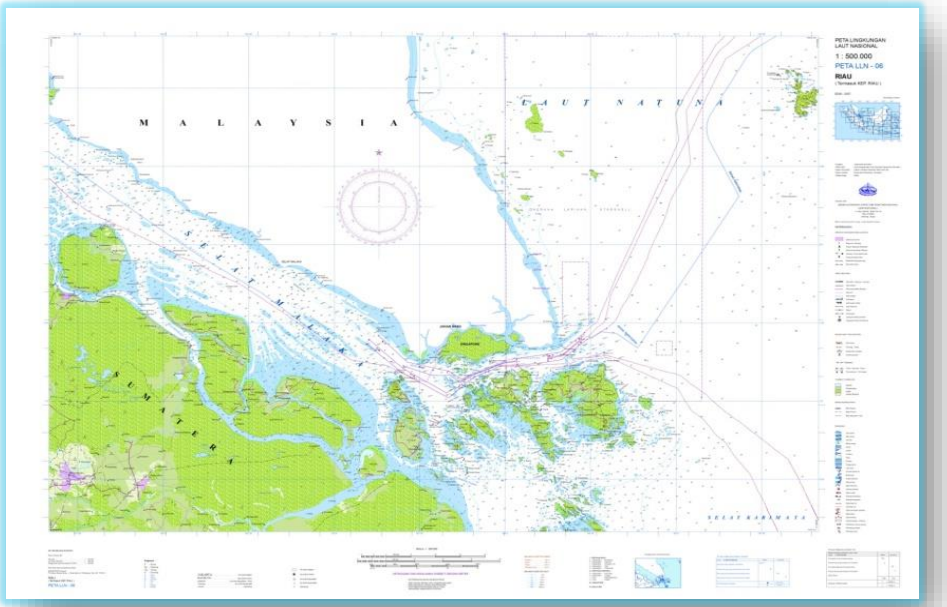
Topographic layers:

1. Coastline
2. Hipsography
3. Hidrography
4. Topographic names
5. Administrative boundary
6. Transportation and utility
7. Building and public facility
8. Land cover

Coastal Area Map



Marine Area Map



ONE MAP POLICY

PRESIDENTIAL REGULATION
NO. 9 YEAR 2016

Regarding the acceleration of implementation of One Map Policy on 1:50.000 scale map accuracy

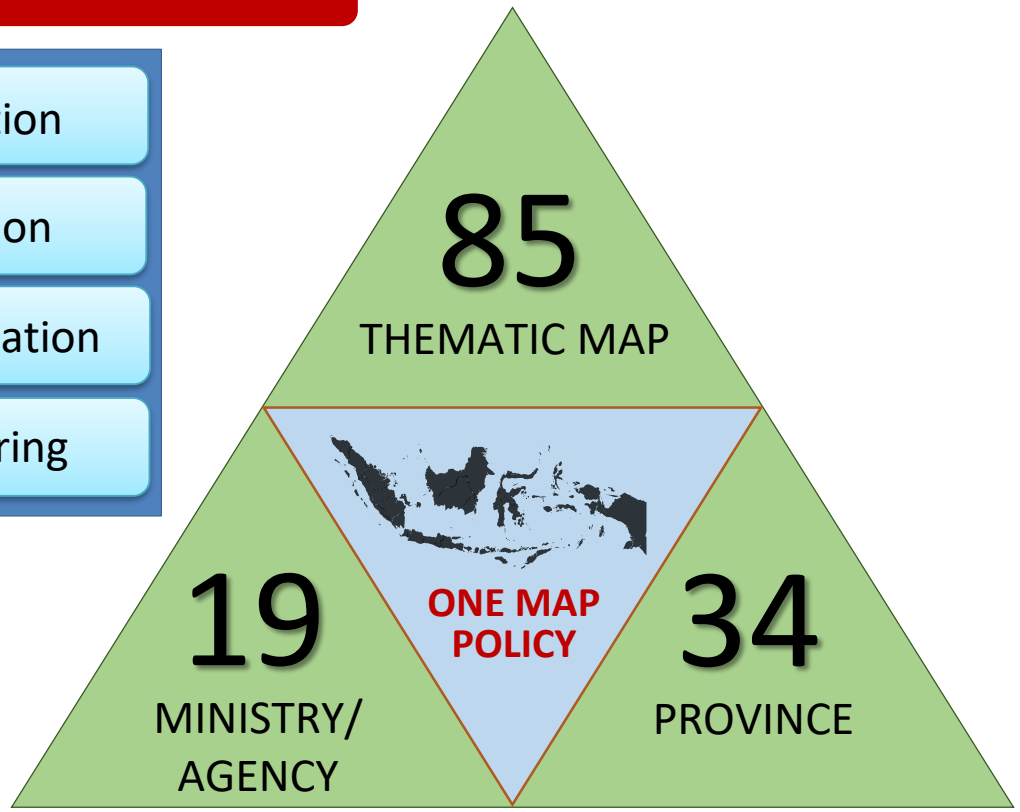
Issued on 4 February 2016

ONE MAP POLICY GOALS

1 GEOREFERENCE
STANDARD
DATA BASE
GEO-PORTAL

ONE MAP POLICY MAIN PROGRAM

- Compilation
- Integration
- Synchronization
- Data Sharing



ONE MAP POLICY UTILITY

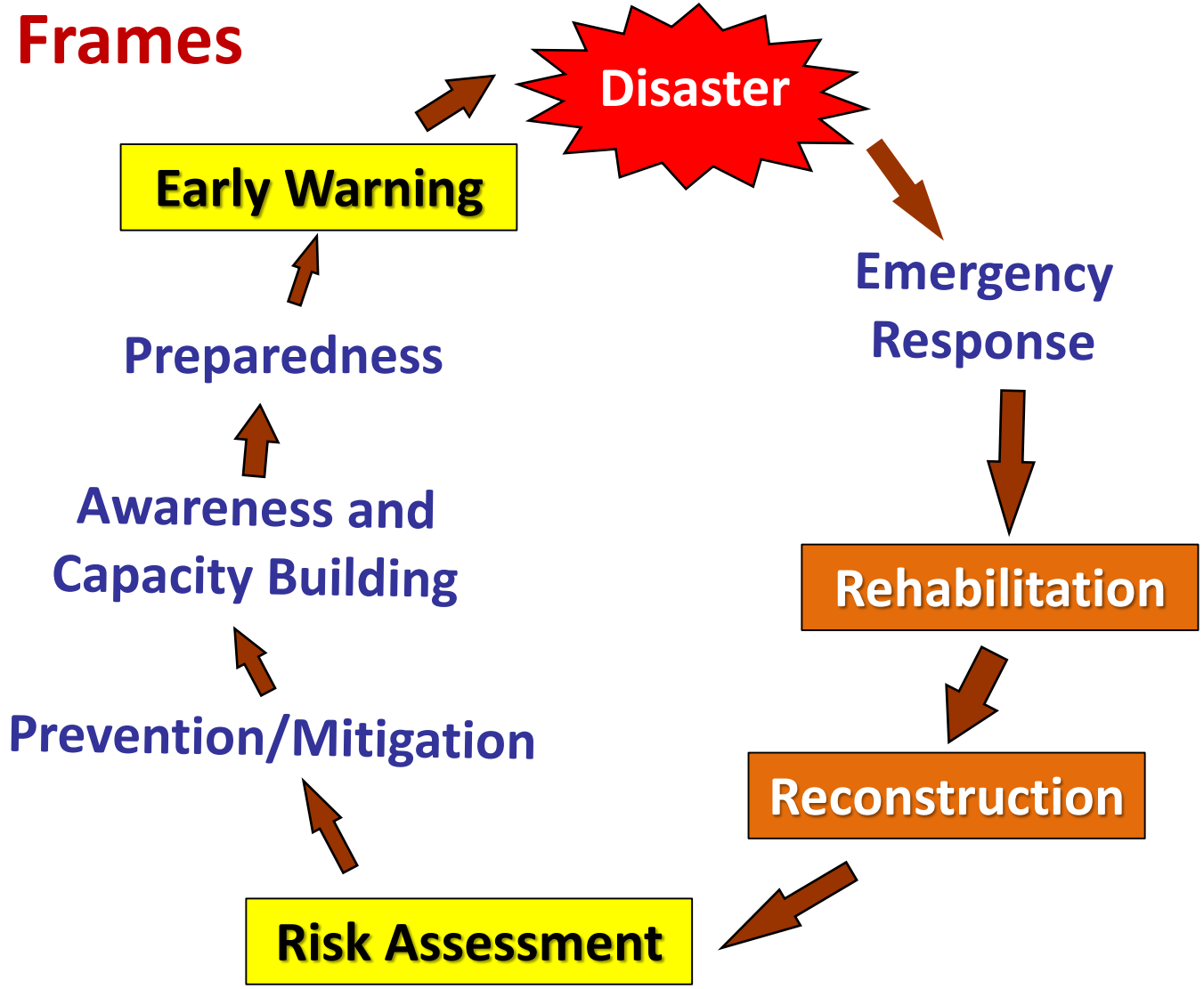
As Reference for Improving the quality of :

- Spatial Planning
- National Resources Management
- Sustainable Development
- Disaster Risk Reduction Management
- Policy and Decision Making

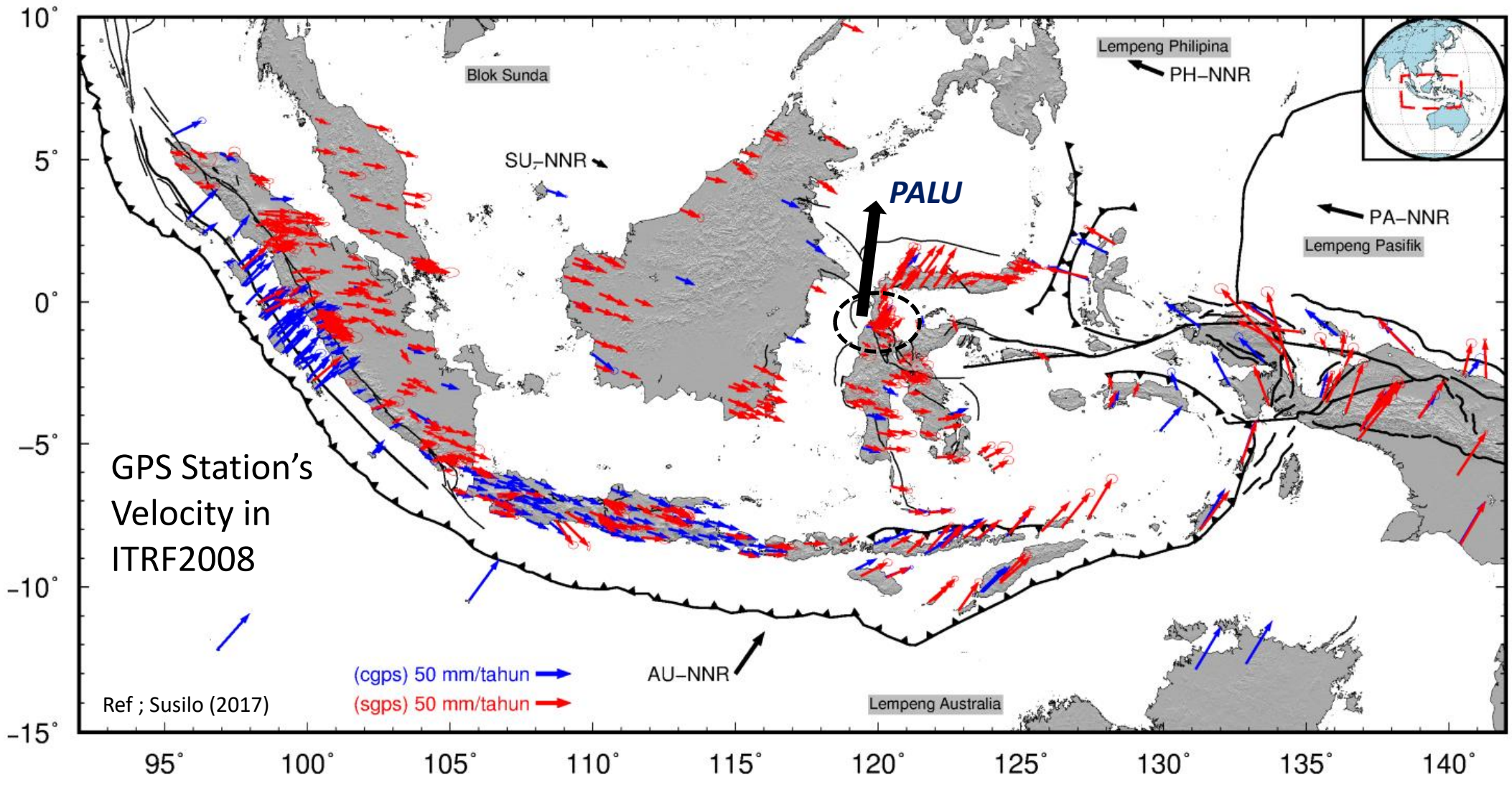
Roles of Data and Information from Geodetic Reference Frames

- ***GPS and Levelling Networks***
- ***GPS CORS Stations***
- ***Tide Gauge Stations***

Data and Information from the Geodetic Reference Frames are mainly important for ***Risk Assessment, Early Warning, Rehabilation and Reconstruction*** *stages*



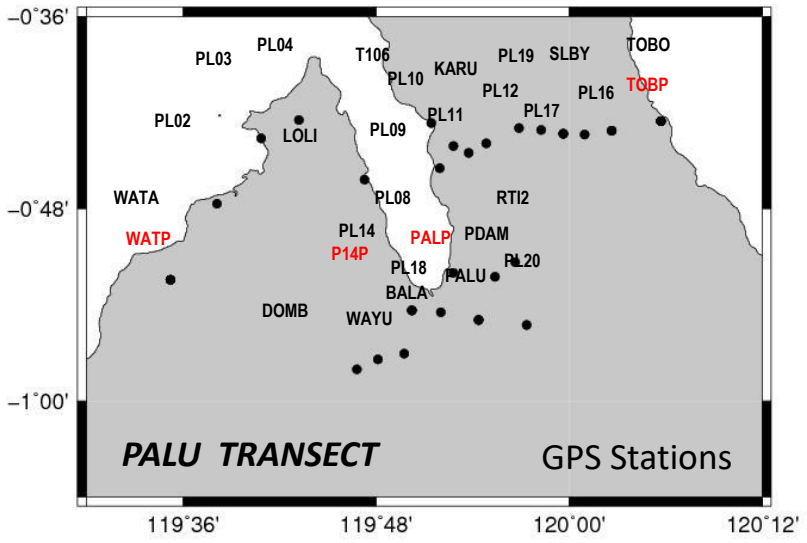
Risk Assessment: Based on GPS (CORS+Episodic) Data

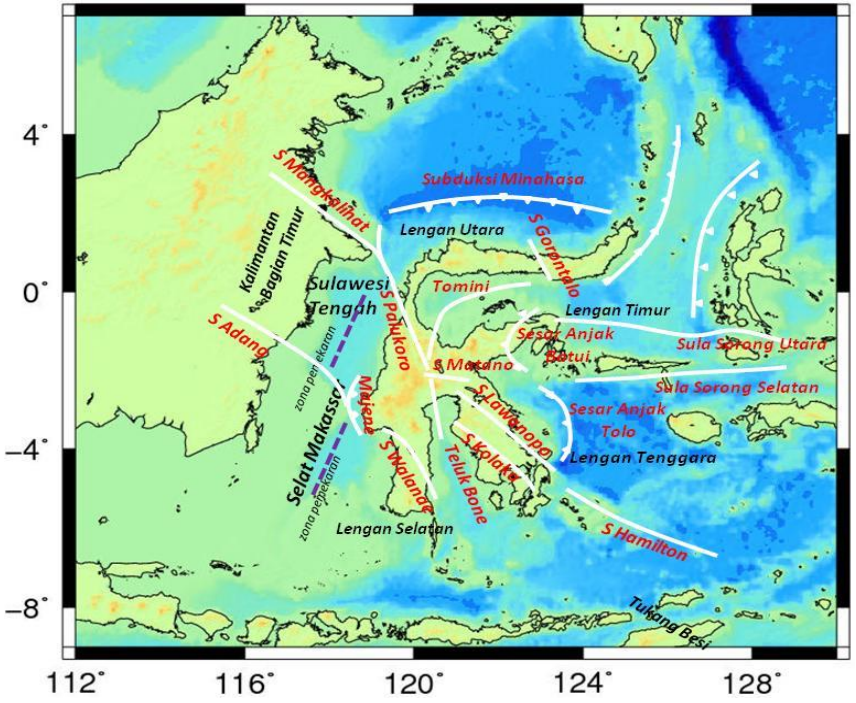


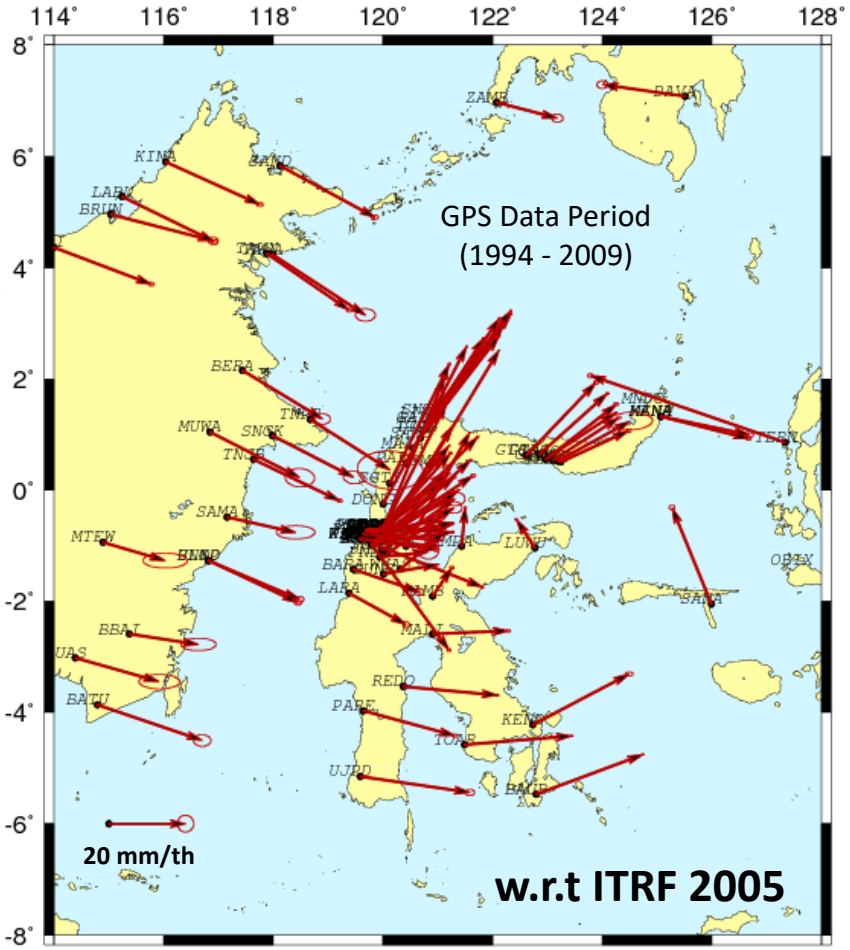
Risk Assessment:

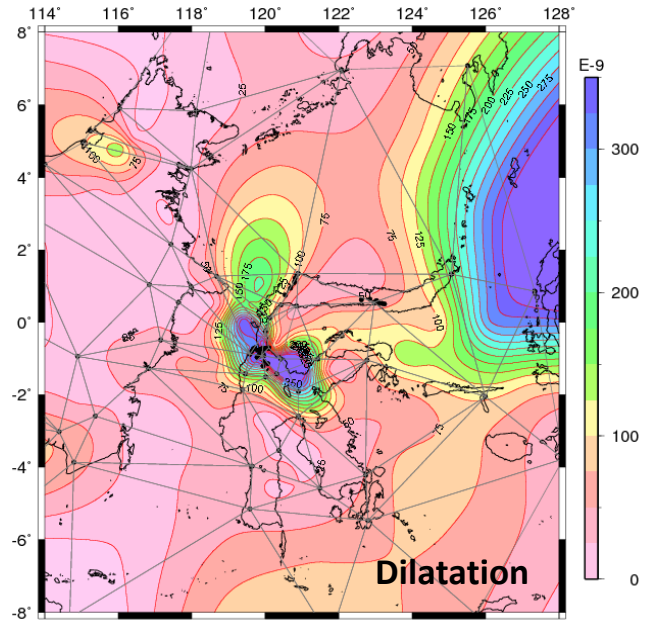
Based on GPS CORS and GPS Episodic Data

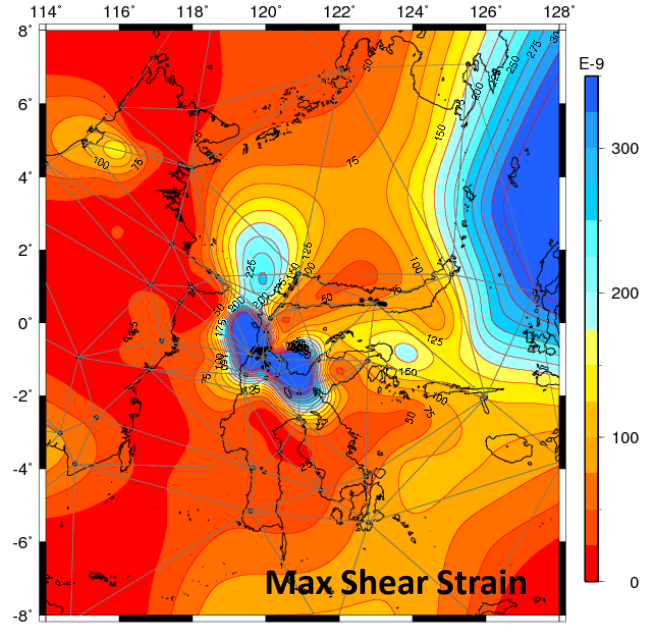
(Dina A. Sarsito, 2010)



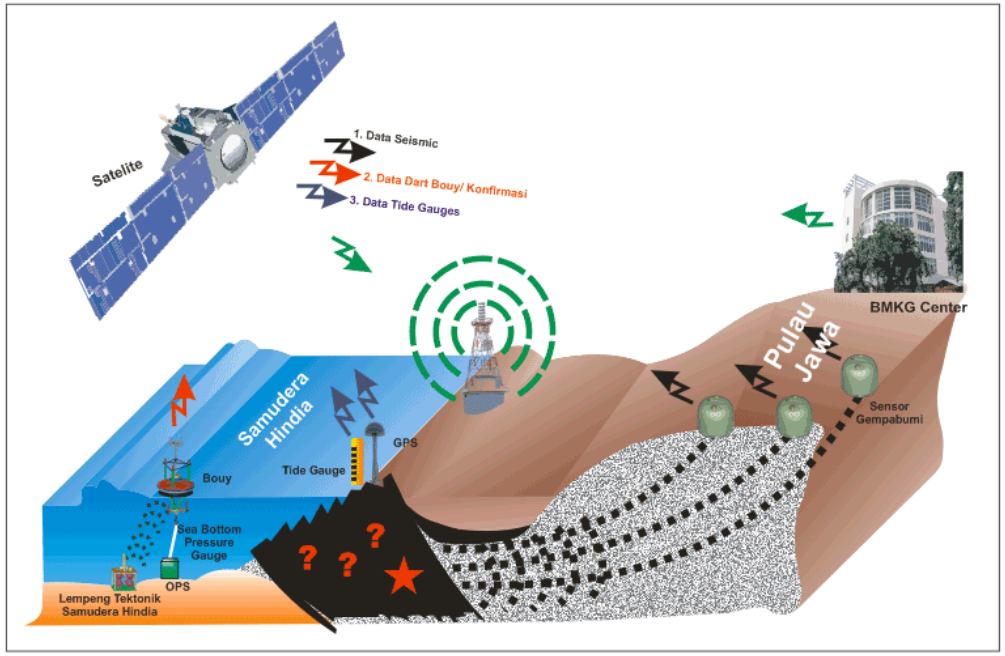




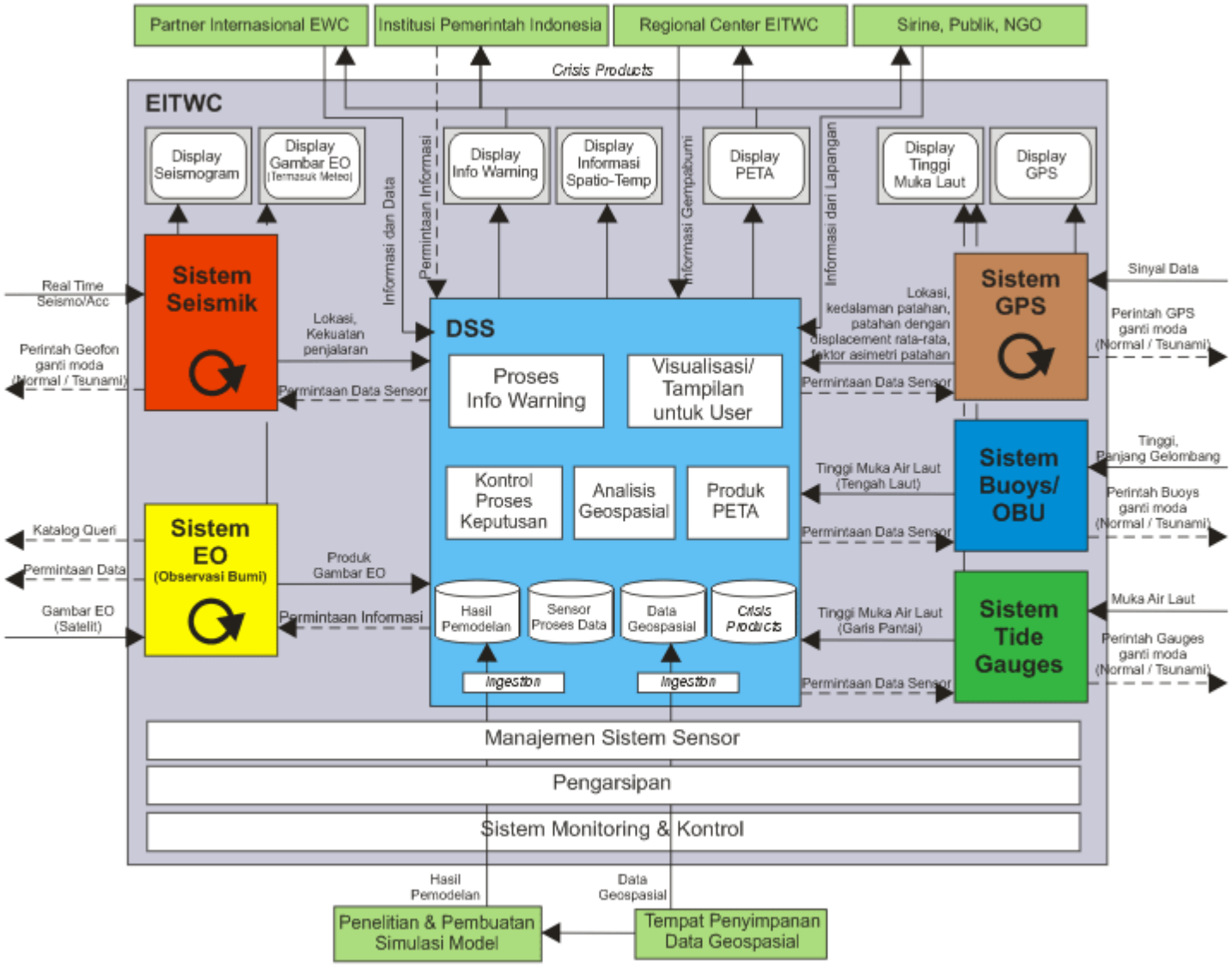




Indonesian Tsunami Early Warning System (InaTEWS)



https://inatews.bmkg.go.id/new/



Contributions of BIG:

1. **GPS CORS:**
   http://inacors.big.go.id/
2. **Tide Gauges:**
   http://tides.big.go.id/pasut

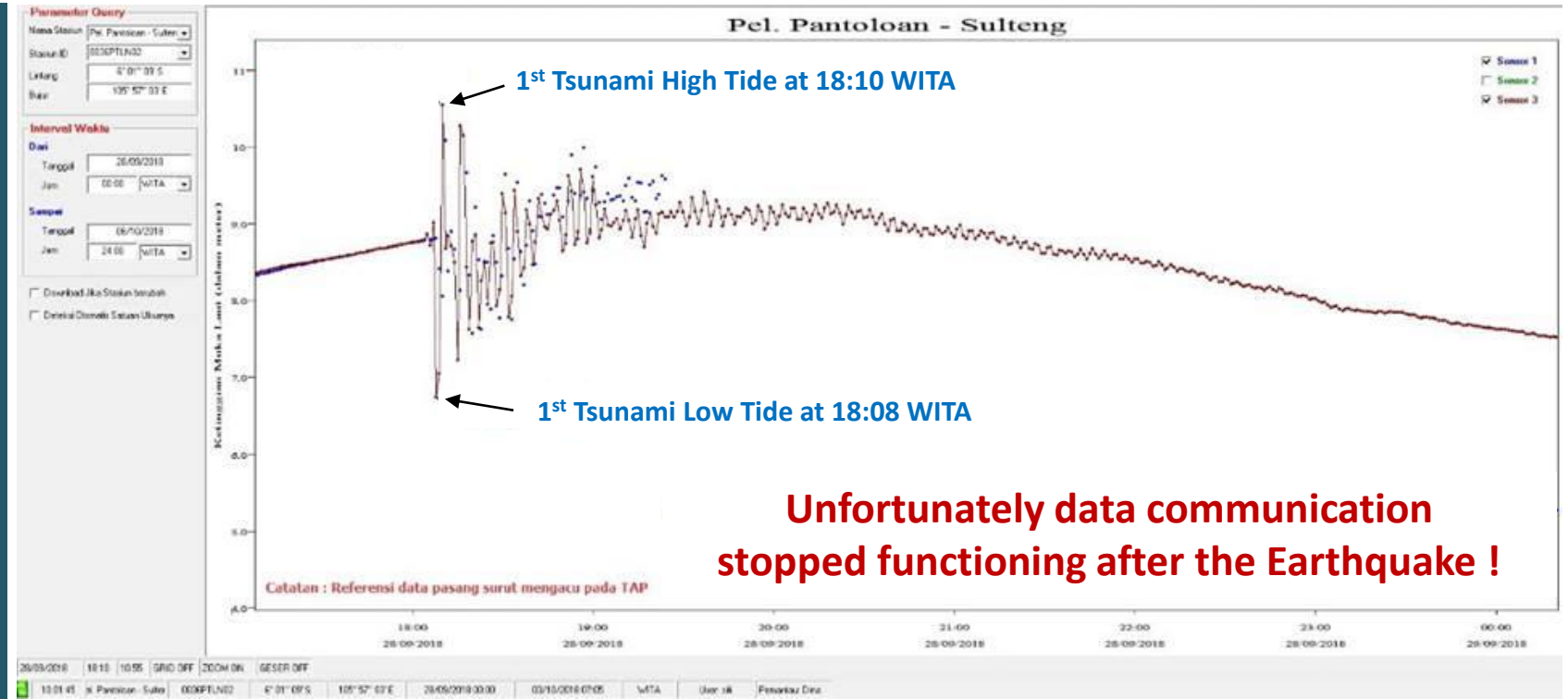
Tsunami Early Warning

Tide Gauge Station

Pantoloan

Friday, 28 Sept. 2018

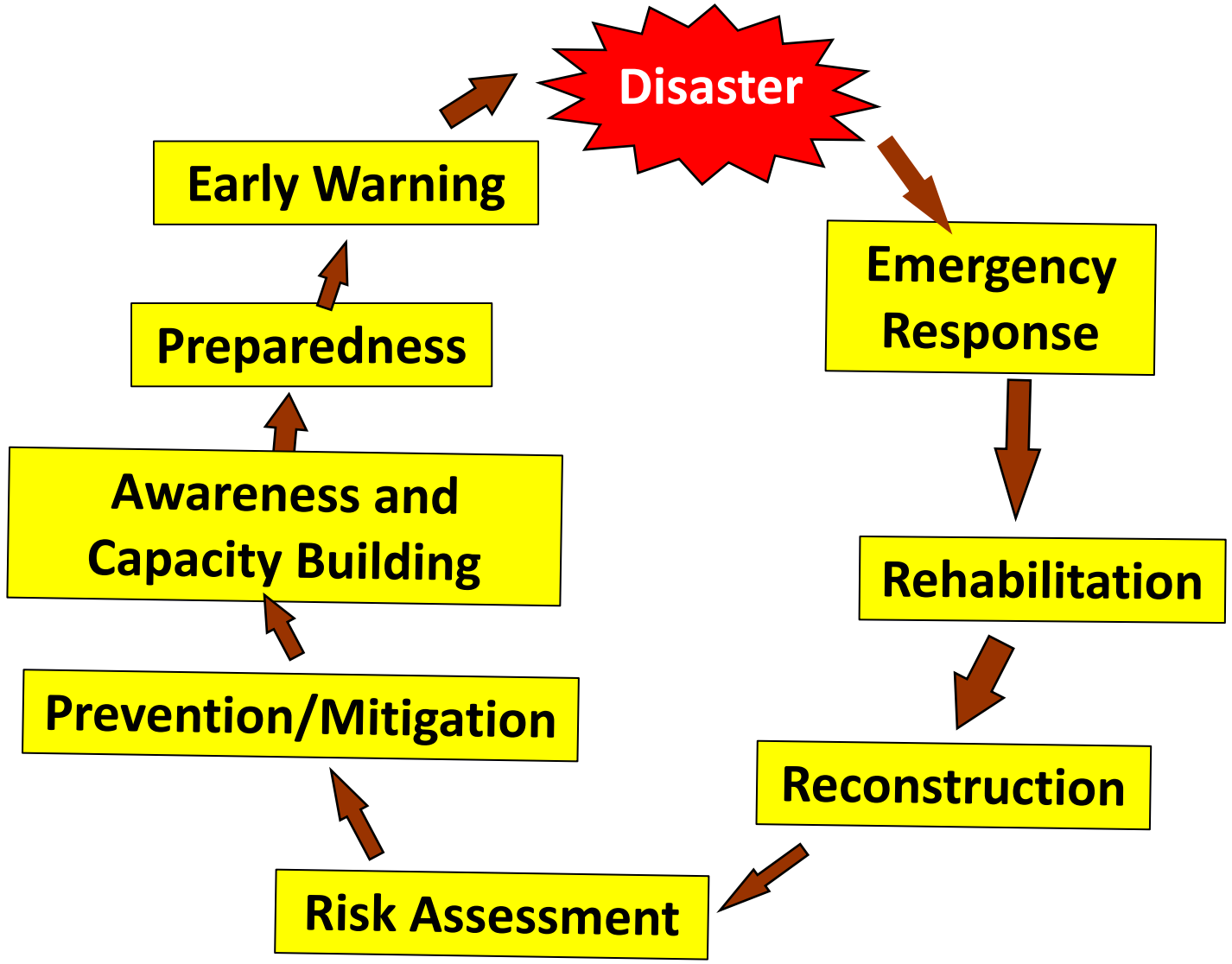
Earthquake:
28 September 2018
18:02:44 WITA



Unfortunately data communication stopped functioning after the Earthquake !

Roles of Base and Thematic Maps

- *Topographic Map*
- *Various Thematic Maps*
- *DEM, Aerial Photos, and Satellite Images*

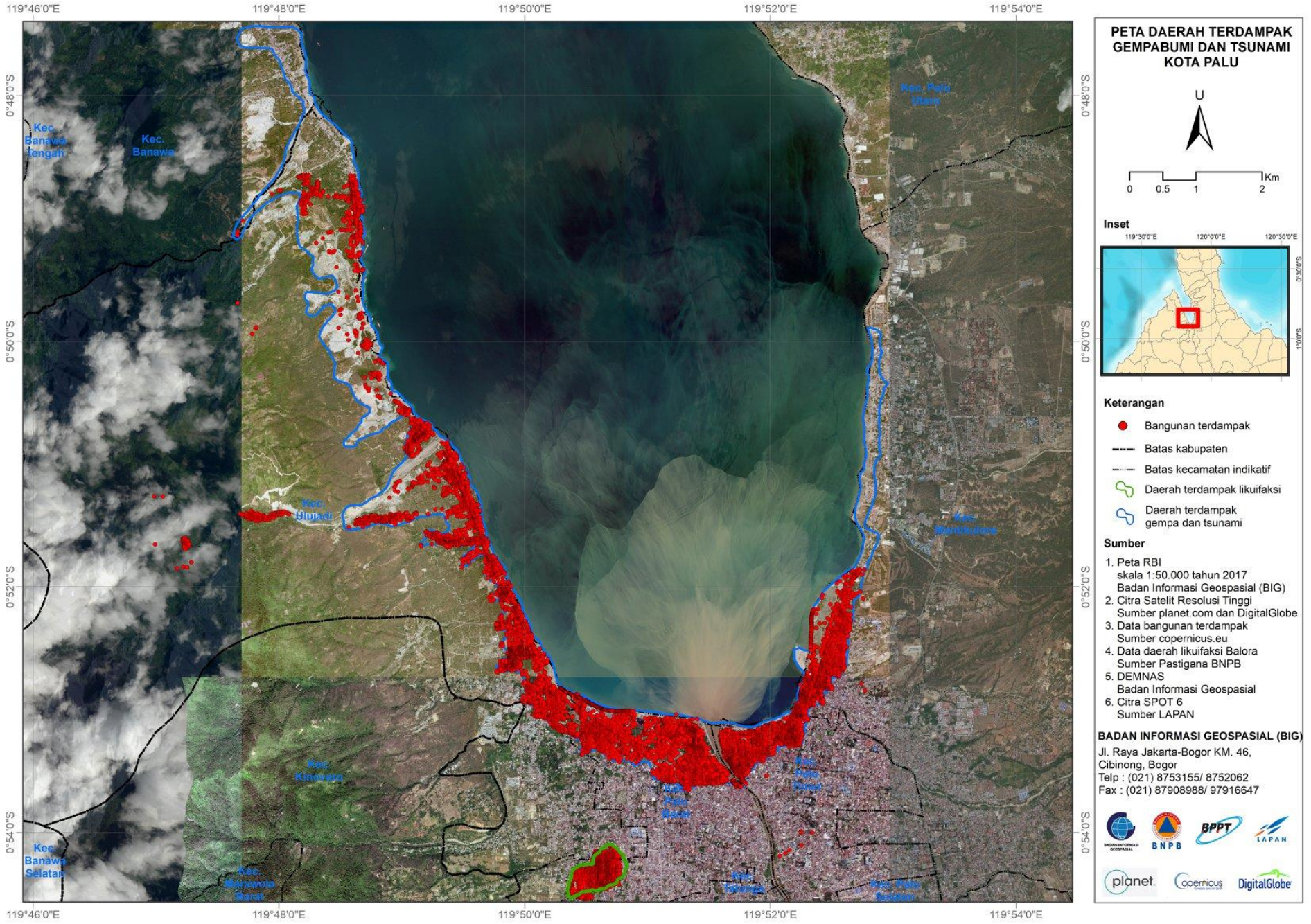


Base and Thematic Maps will play important roles for all stages of Disaster Risk Reduction.

Post-Event Rapid Assessment Mapping

of affected houses/buildings

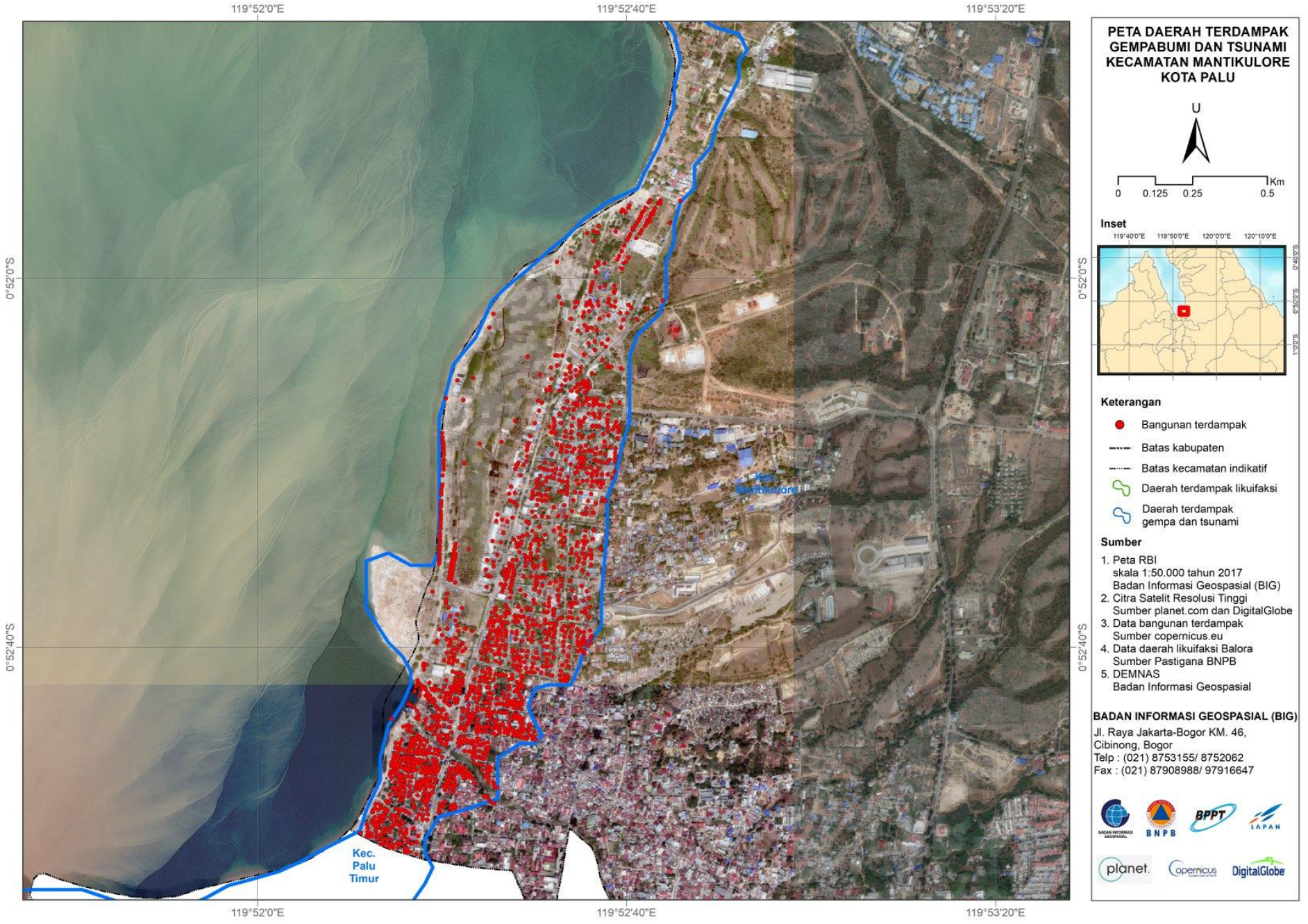
Based on Topographic Map, National DEM, Satellite Images, and Ground Survey



Post-Event Rapid Assessment Mapping

of affected houses/buildings

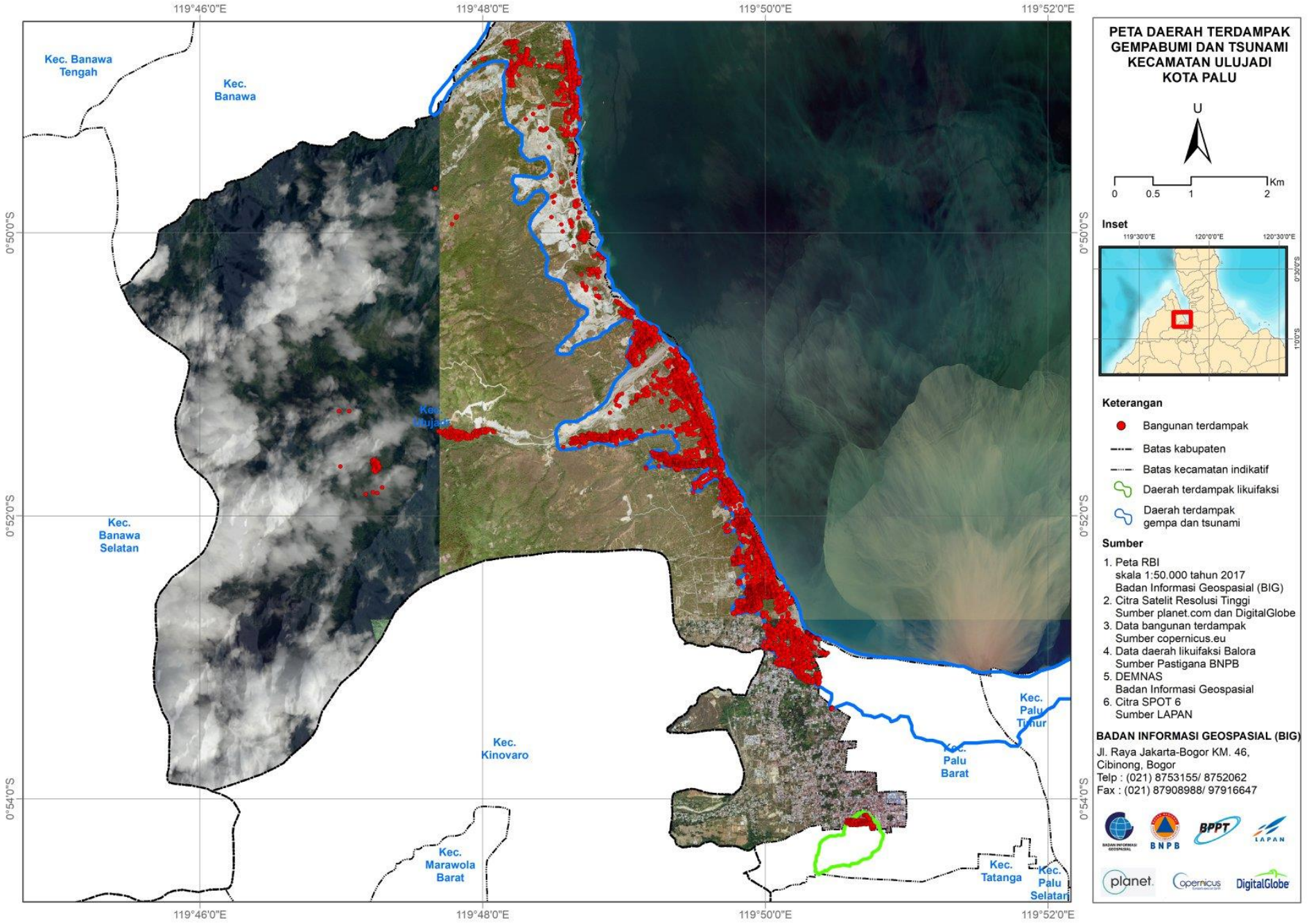
Based on Topographic Map, National DEM, Satellite Images, and Ground Survey



Post-Event Rapid Assessment Mapping

of affected houses/buildings

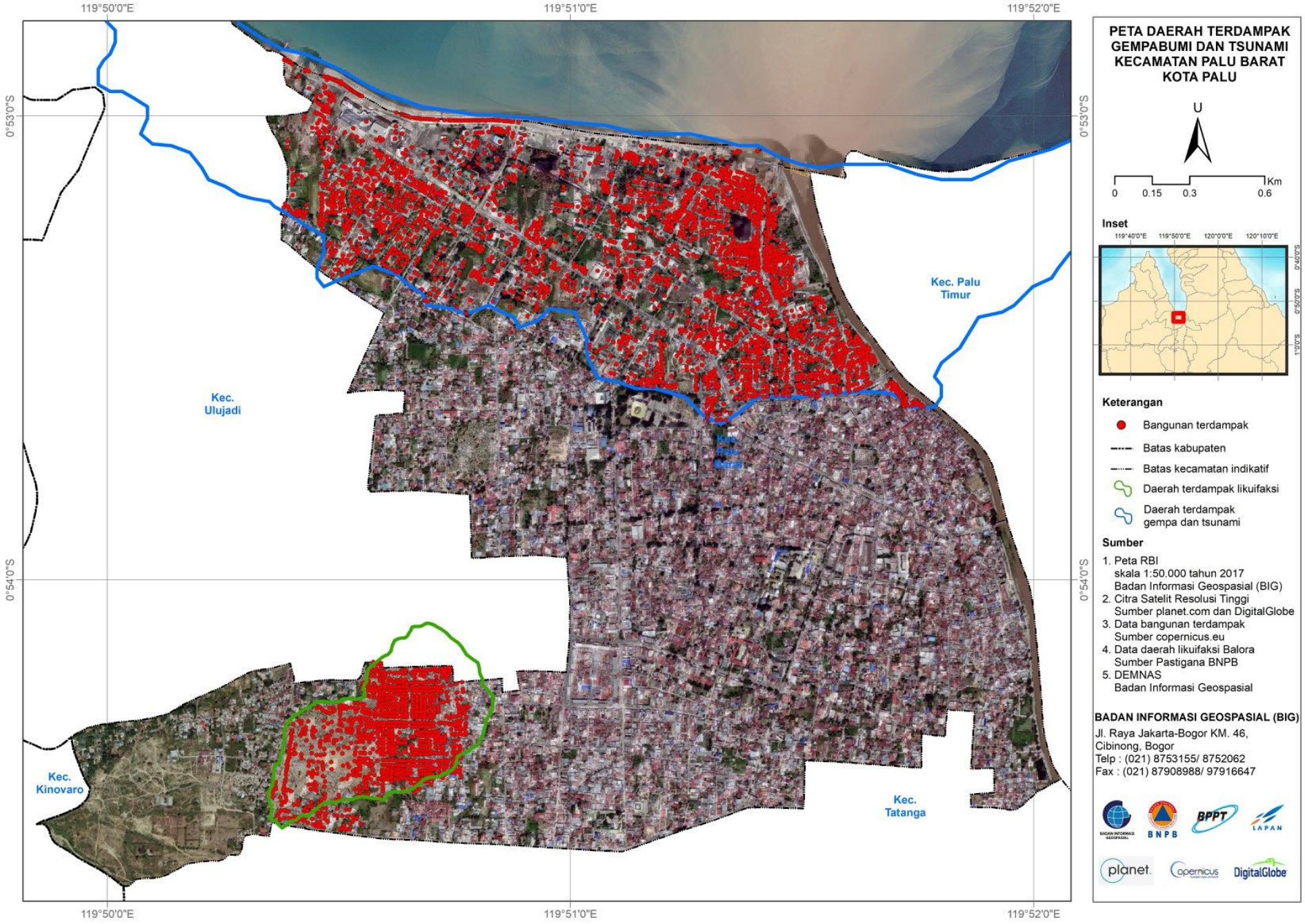
Based on Topographic Map, National DEM, Satellite Images, and Ground Survey



Post-Event Rapid Assessment Mapping

of affected houses/buildings

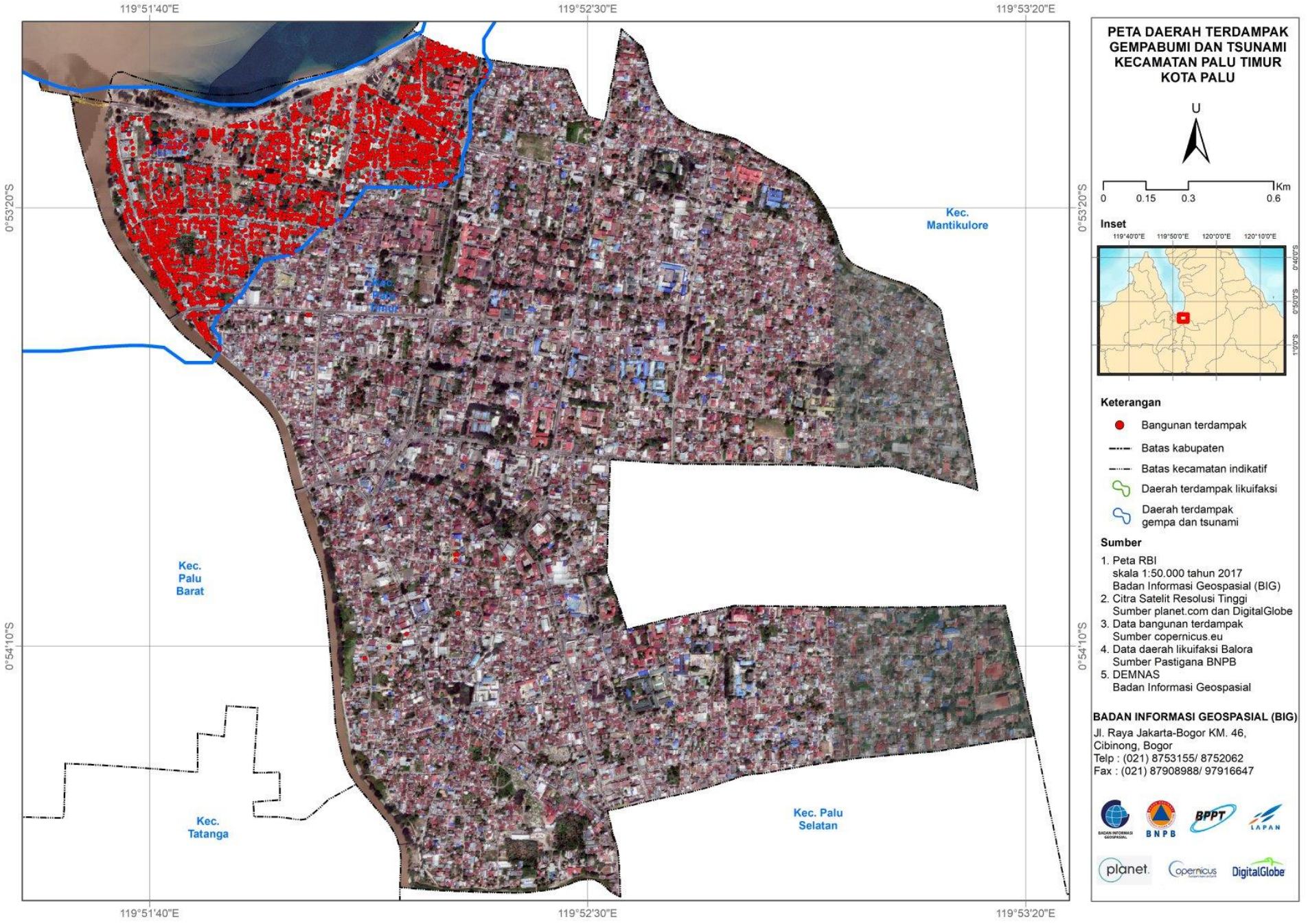
Based on Topographic Map, National DEM, Satellite Images, and Ground Survey



Post-Event Rapid Assessment Mapping

of affected houses/buildings

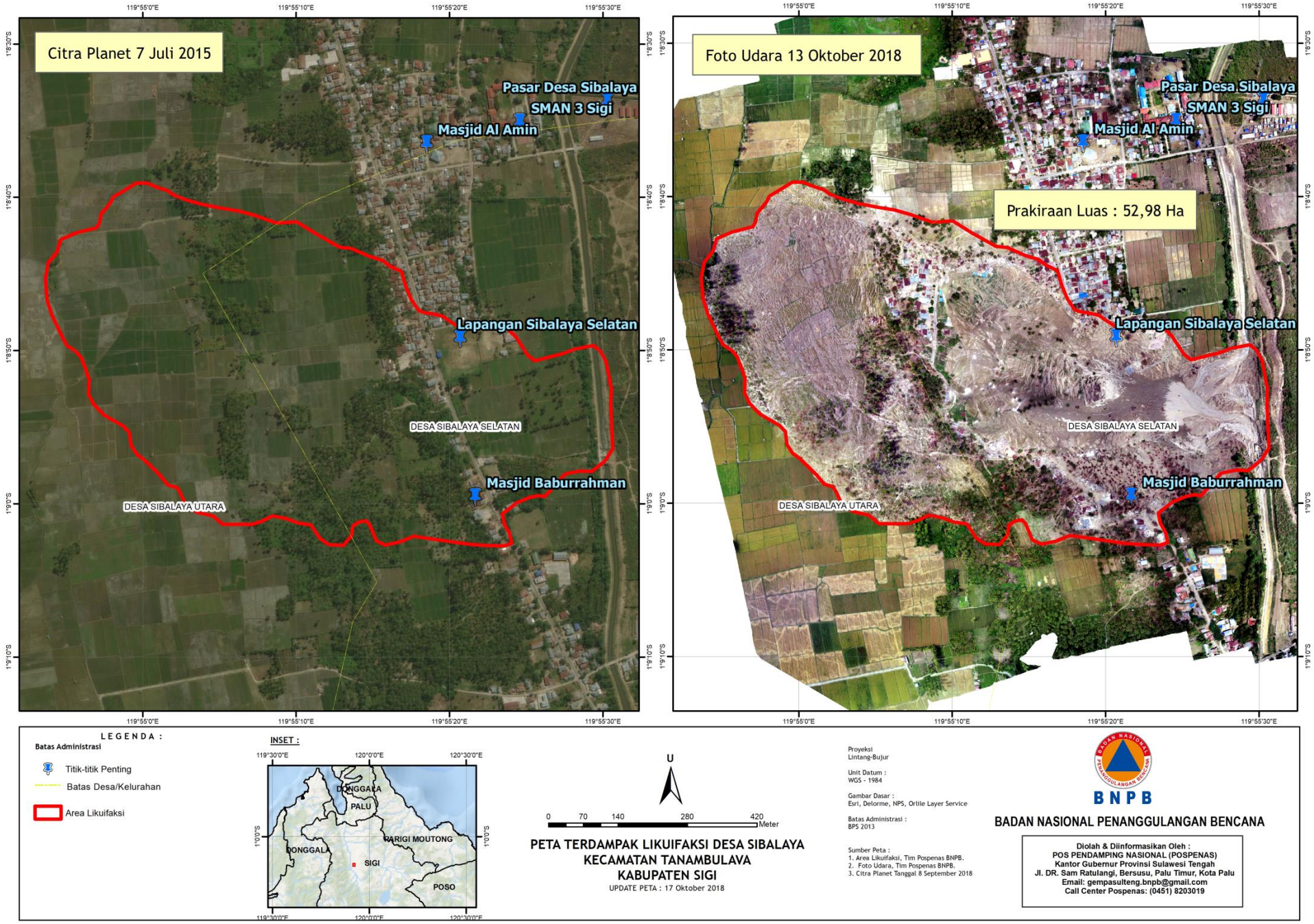
Based on Topographic Map, National DEM, Satellite Images, and Ground Survey



Post-Event Rapid Assessment Mapping

of Liquefaction area of Sibalaya

Based on
Arial Photos and
Satellite Images



Estimated Loss and Damage

Disaster of 28 Sept. 2018

Palu-Donggala-Sigi-Parigi Moutong

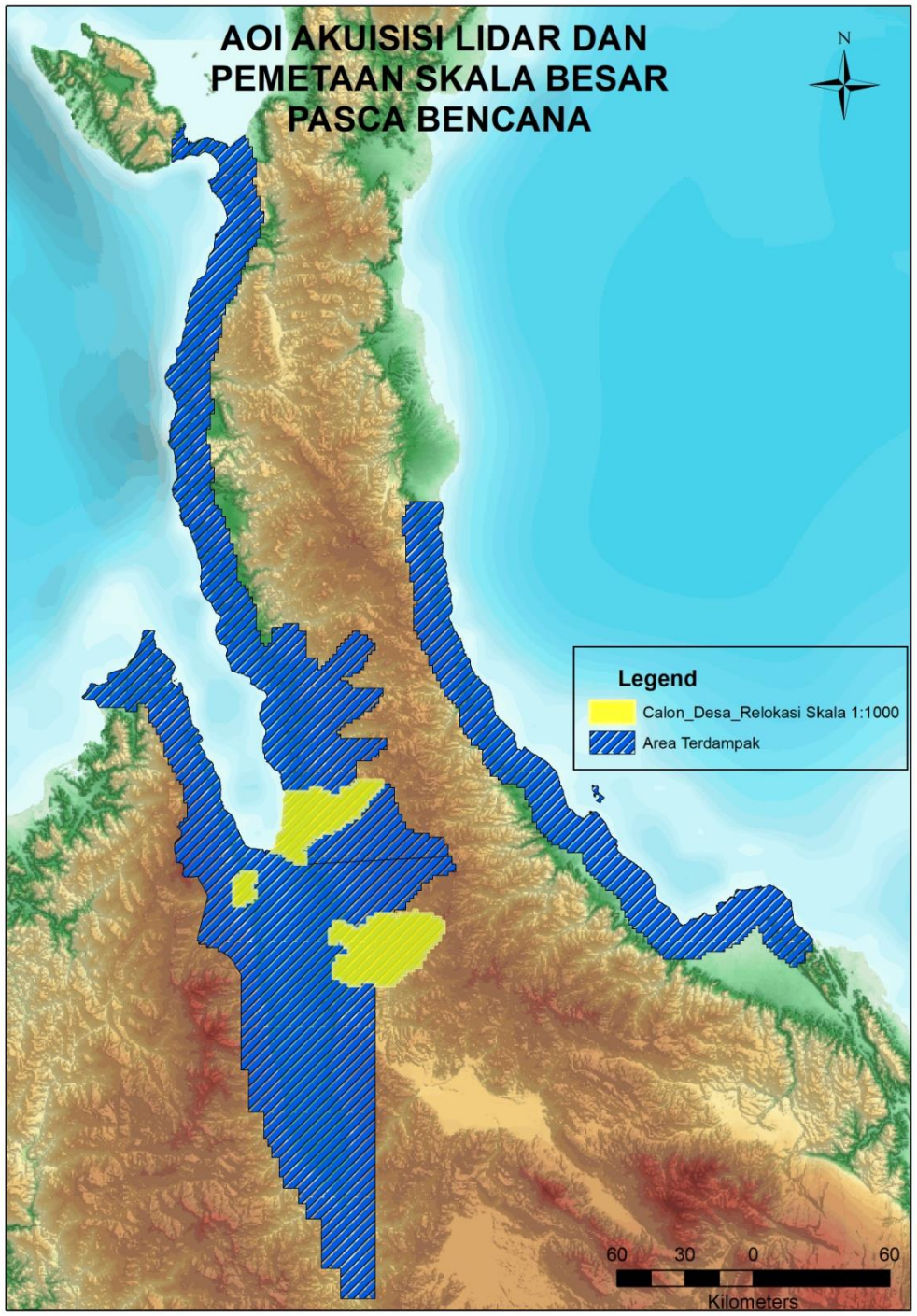
Estimated Loss and Damage (in Trillion Rupiah)	
AREA	**VALUE**
Palu	8,3
Sigi	6,9
Donggala	2,7
Parigi Moutong	0,6
TOTAL	**18,5**

Estimated Loss and Damage (in Trillion Rupiah)	
SECTOR	**VALUE**
Settlement	9,4
Infrastructure	1,1
Economic	4,2
Social	3,4
Cross	0,4
TOTAL	**18,5**

The estimated loss and damage due to the disaster, according to BNPB, is about 18,5 Trillion IDR or about 1,26 Billion USD.

Also there will be tremendous **intangible loss and damage** due to **death of many victims**, **social network destruction**, **environmental destruction**, etc.

Ref: https://www.cnnindonesia.com/nasional/20181028193229-20-342094/bnpb-kerugian-akibat-gempa-palu-capai-rp184-triliun



Rehabilitation and Reconstruction (RR) Programs

- New Spatial Planning.
- New Housing Development.
- Relocation of Affected Inhabitants.
- RR of Roads and Infrastructures.
- RR of Drainage and Sewerage System.
- RR of Irrigation System.
- RR of Dam and Reservoir, etc.

Require Basemaps of 1:1000 and 1:5000 Scales

Mapping based on Digital Photogrammetry and LIDAR is conducted by BIG; just started and need to be completed by end of January 2019

Cost for RR Programs is estimated by BNPB to be about 12,6 Trillion IDR or about 865 Million USD.

Geospatial Data Sharing

Geospatial Data related to Palu and Donggala of Palu-Donggala Earthquake is housed in InaGEOPORTAL: http://tanahair.indonesia.go.id and can be freely downloaded by public

https://cloud.big.go.id/index.php/s/sxb9TEStoDYT276

Closing Remarks

Priorities in Disaster Risk Reduction Management
(Margareta Wahlström, 2016)

1: Understanding disaster risk.
2: Strengthening disaster risk governance to manage disaster risk.
3: Investing in disaster risk reduction for resilience.
4: Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction.

Geospatial Data and Information are important and needed at every stage of Disaster Risk Reduction Management.

Participatory mapping is very helpful !

Lessons from Palu-Donggala Disaster, the following are necessary:

- ✓ Hazard-based Spatial Planning
- ✓ Earthquake-resistance Building Codes
- ✓ Public Education and Awareness
- ✓ Reliable Early Warning System
- ✓ Rapid Geospatial Data Sharing
- ✓ Mapping of Liquefaction prone Areas
- ✓ Disaster-related Insurance and Compensation


THANK YOU
6.490°S 106.849°E