Workshop Pengurangan Resiko Bencana Kota
Surabaya Dan Jawa Timur, ITS, 19 Oktober 2017

UPDATING SESAR AKTIF INDONESIA
Focus: Surabaya dan Jawa Timur

PuSGeN

Oleh:
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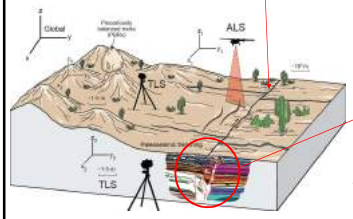
Ketua Pokja Geologi, Pusat Studi Gempa Nasional (PuSGeN)
Anggauta: Benjamien Sapiie, Ph.D, Dr. Mudrik R.Daryono, Gayatri Marliyani, Ph.D, Ma'ruf Mukti, Ph.D, Dr.Supartoyo, Dr. Astika Pumpuni, Dr.Ahmad Solihin

UPDATING SESAR AKTIF

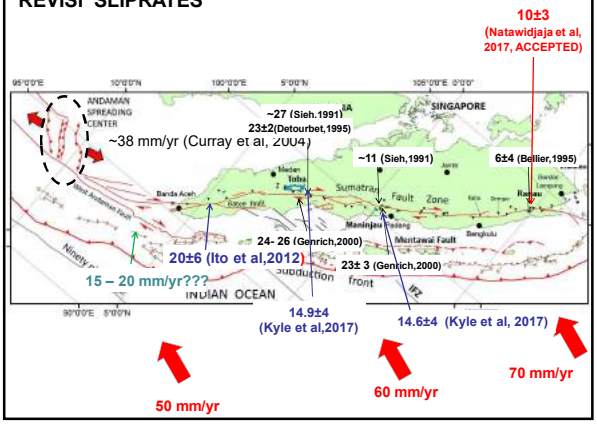
1. LOKASI YANG LEBIH AKURAT
2. UPDATING SEGMENTASI SESAR
3. **SLIPRATE** (Laju Gerak) (data primer masih < 5%)
4. **PALEO-EARTHQUAKE (data primer masih < 2%)**
5. TIPE/MEKANISME SESAR
6. PENAMBAHAN JALUR SESAR BARU

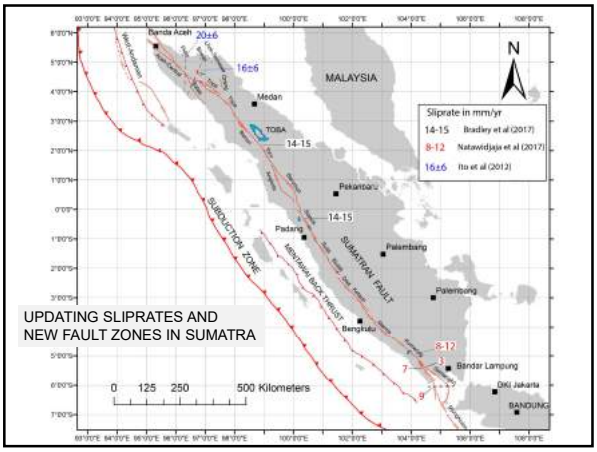


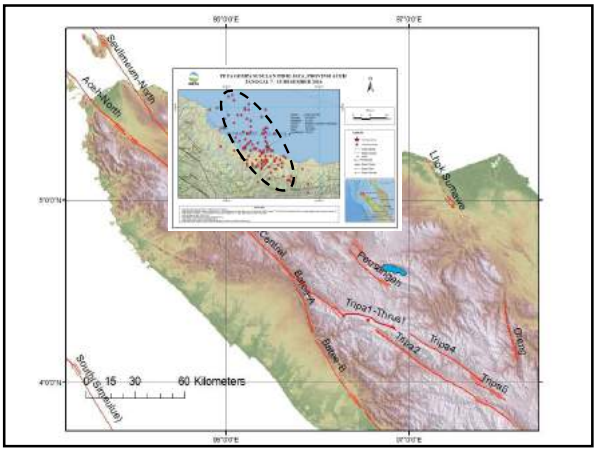
REVISI DAN PENAMBAHAN JALUR SESAR AKTIF

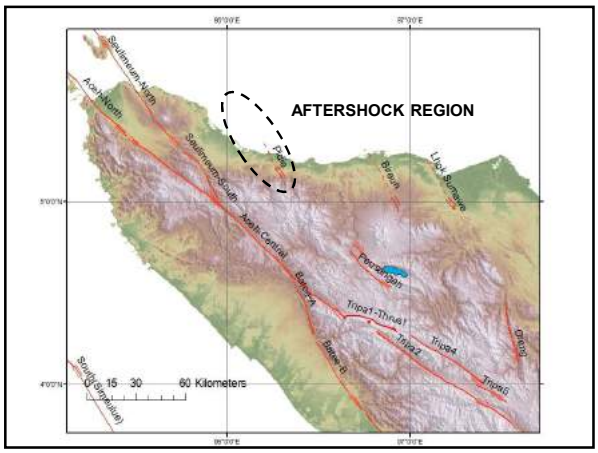
- SUMATRA: 19 → 55 segmen sesar aktif
- JAWA: 6 → 37 segmen sesar aktif
- SULAWESI: 12 →48 segmen sesar aktif
- PAPUA-MALUKU: 16 → 80
- NUSA TENGGARA – BANDA: 4 →49

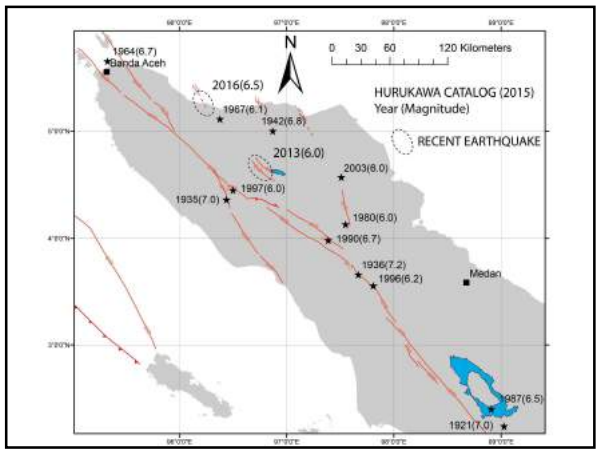
REVISI SLIPRATES

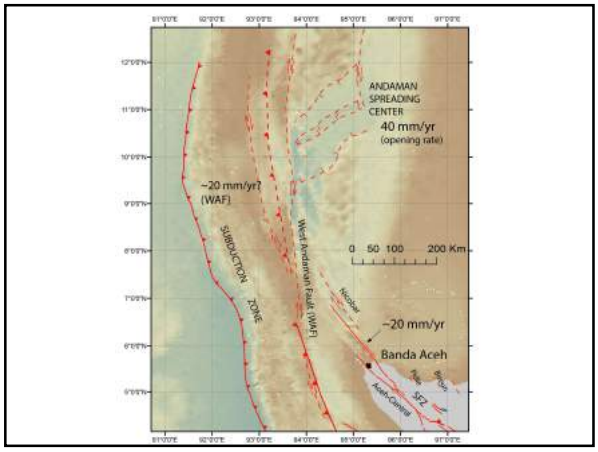


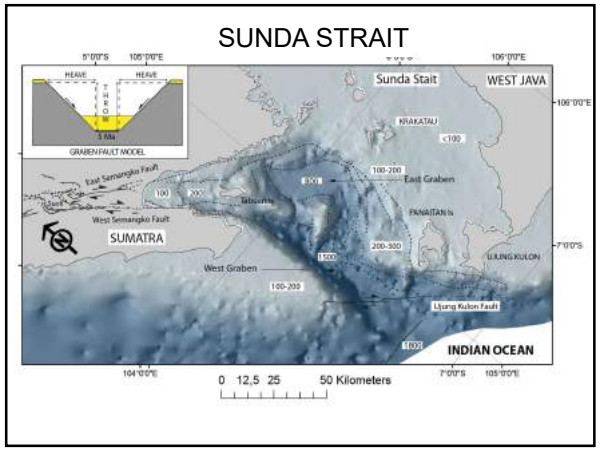


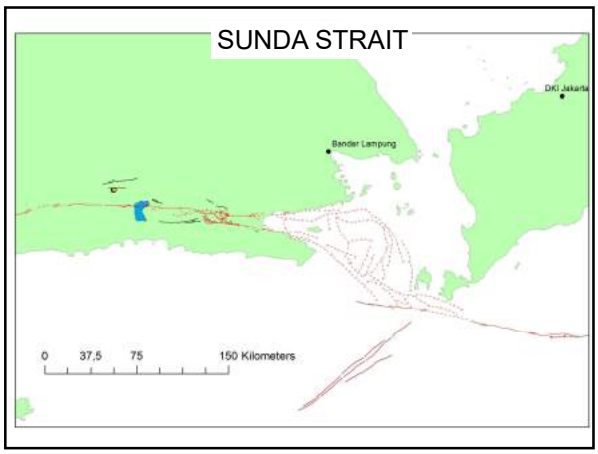


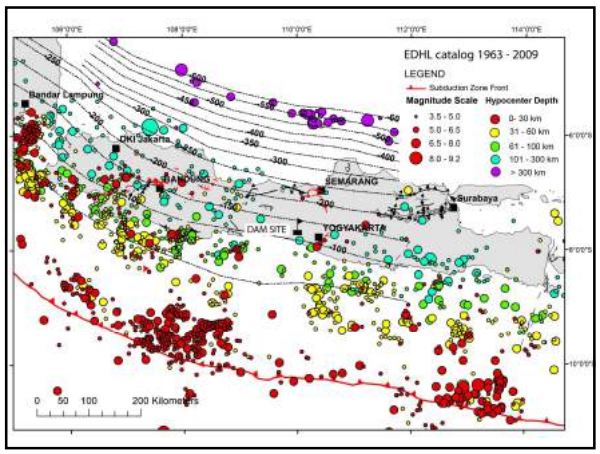

AFTERSHOCK REGION
Aceh-North
Seulimeum-Aceh
Seulimeum-South
Aceh-Central
Batee-A
Batee-B
Tripa1-Thrust
Tripa2
Tripa4
Tripa5
Peusangan
Bireuen
Lhok Sumawe
Seunagan
15 30 60 Kilometers

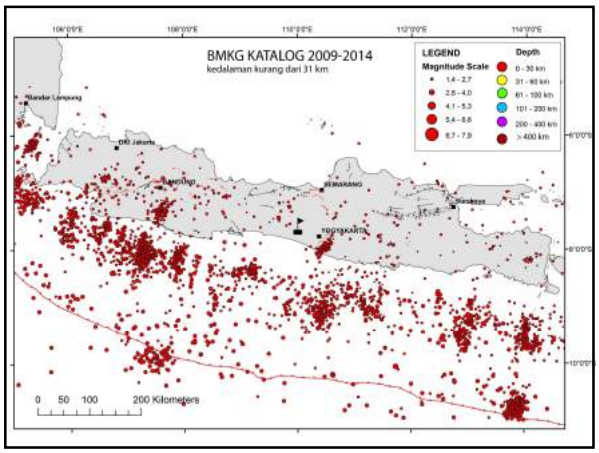

1964(6.7)
Banda Aceh
2016(6.5)
1967(6.1)
1942(6.8)
2013(6.0)
2003(6.0)
1997(6.0)
1935(7.0)
1980(6.0)
1990(6.7)
1936(7.2)
1996(6.2)
Medan
1987(6.5)
1921(7.0)
N
0 30 60 120 Kilometers
HURUKAWA CATALOG (2015)
Year (Magnitude)
RECENT EARTHQUAKE

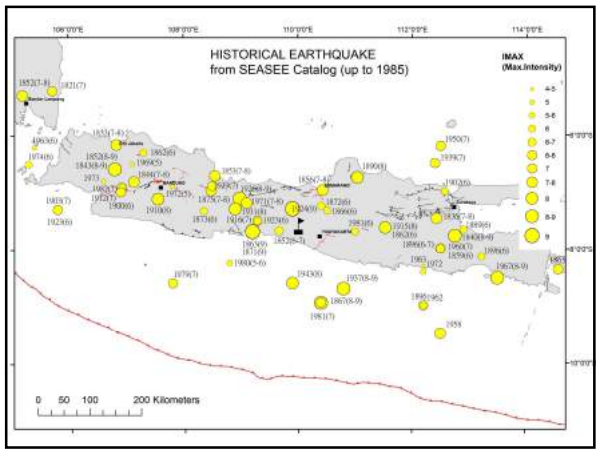

ANDAMAN
SPREADING
CENTER
40 mm/yr
(opening rate)
~20 mm/yr?
(WAF)
SUBDUCTION ZONE
West Andaman Fault (WAF)
0 50 100 200 Km
~20 mm/yr
Banda Aceh
Aceh-Central
SFZ

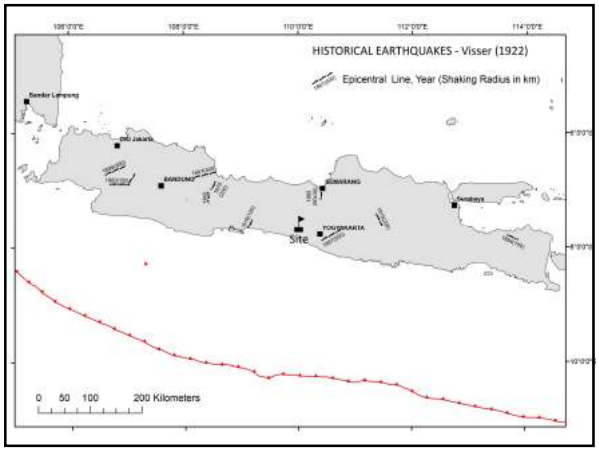

SUNDA STRAIT
Sunda Stait
WEST JAVA
KRAKATAU
East Graben
PANAITAN Is
SUMATRA
West Graben
East Semangko Fault
West Semangko Fault
Ujung Kulon Fault
UJUNG KULON
INDIAN OCEAN
GRABEN FAULT MODEL
0 12,5 25 50 Kilometers

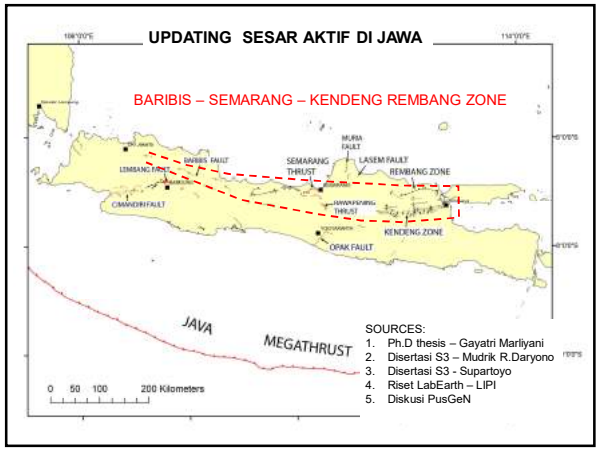

SUNDA STRAIT
DKI Jakarta
Bandar Lampung
0 37,5 75 150 Kilometers

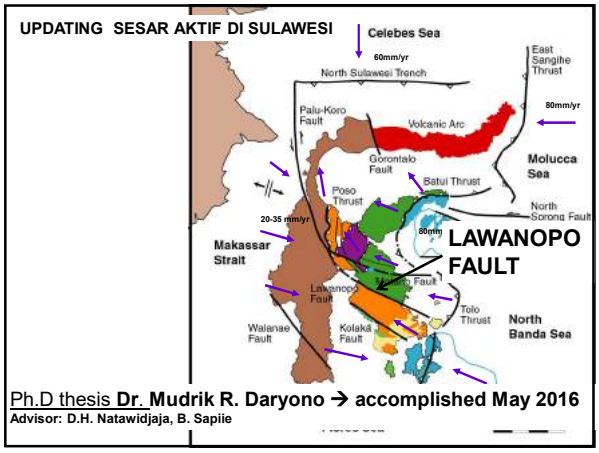

EDHL catalog 1963 - 2009
LEGEND
Subduction Zone Front
Magnitude Scale
Hypocenter Depth
Bandar Lampung
DKI Jakarta
BANDUNG
SEMARANG
Surabaya
DAM SITE
YOGYAKARTA
0 50 100 200 Kilometers

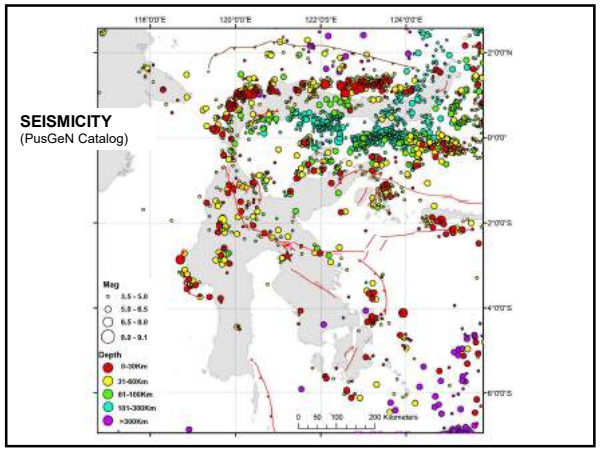

BMKG KATALOG 2009-2014
kedalaman kurang dari 31 km
LEGEND
Magnitude Scale
Depth
0 50 100 200 Kilometers

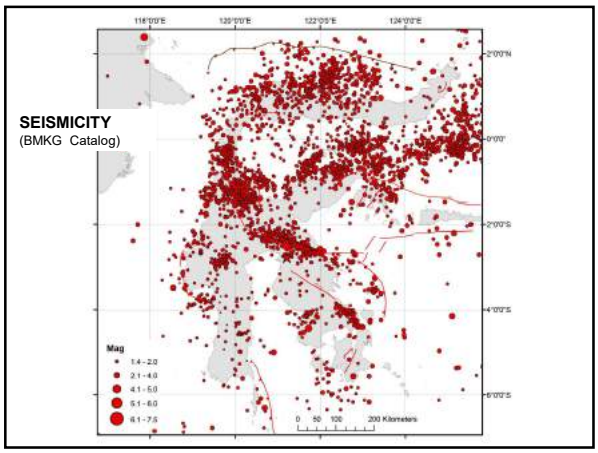

HISTORICAL EARTHQUAKE
from SEASEE Catalog (up to 1985)
IMAX
(Max.Intensity)
0 50 100 200 Kilometers

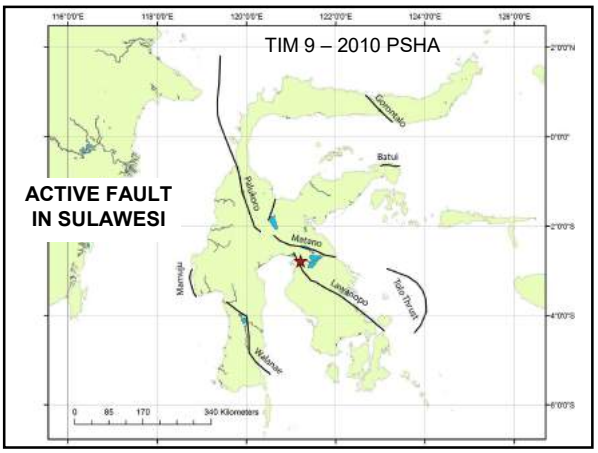

HISTORICAL EARTHQUAKES - Visser (1922)
Epicentral Line, Year (Shaking Radius in km)
Site
0 50 100 200 Kilometers

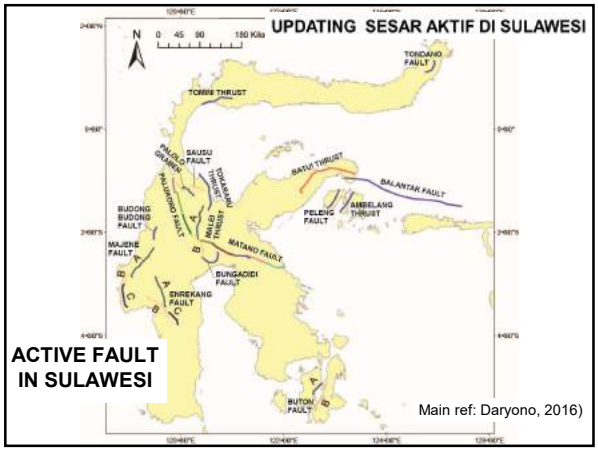

UPDATING SESAR AKTIF DI JAWA
BARIBIS – SEMARANG – KENDENG REMBANG ZONE
BARIBIS FAULT
SEMARANG THRUST
LASEM FAULT
REMBANG ZONE
CIMANDIRI FAULT
KENDENG ZONE
OPAK FAULT
JAVA MEGATHRUST
0 50 100 200 Kilometers
SOURCES:
1. Ph.D thesis – Gayatri Marliyani
2. Disertasi S3 – Mudrik R.Daryono
3. Disertasi S3 - Supartoyo
4. Riset LabEarth – LIPI
5. Diskusi PusGeN

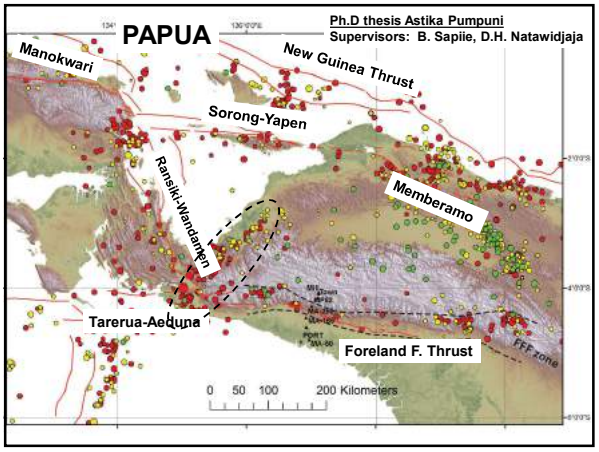

UPDATING SESAR AKTIF DI SULAWESI
Celebes Sea
60mm/yr
North Sulawesi Trench
East Sangihe Thrust
80mm/yr
Palu-Koro Fault
Volcanic Arc
Molucca Sea
Gorontalo Fault
Batui Thrust
Poso Thrust
North Sorong Fault
20-35 mm/yr
Makassar Strait
LAWANOPO FAULT
Lawanopo Fault
Tolo Thrust
North Banda Sea
Walanae Fault
Kolaka Fault
Ph.D thesis Dr. Mudrik R. Daryono → accomplished May 2016
Advisor: D.H. Natawidjaja, B. Sapiie

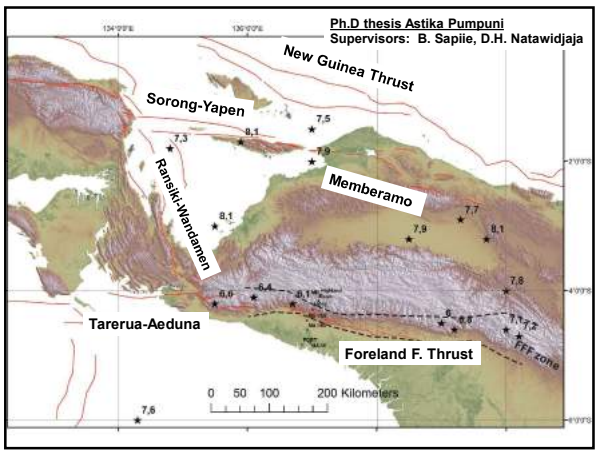

SEISMICITY
(PusGeN Catalog)
Mag
Depth

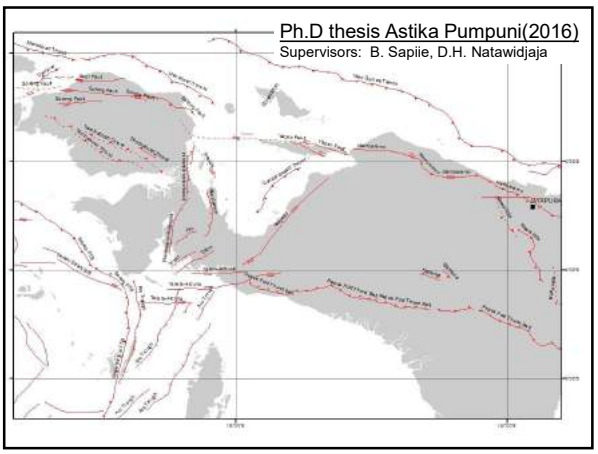

SEISMICITY
(BMKG Catalog)
Mag
1.4 - 2.0
2.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.5
0 50 100 200 Kilometers

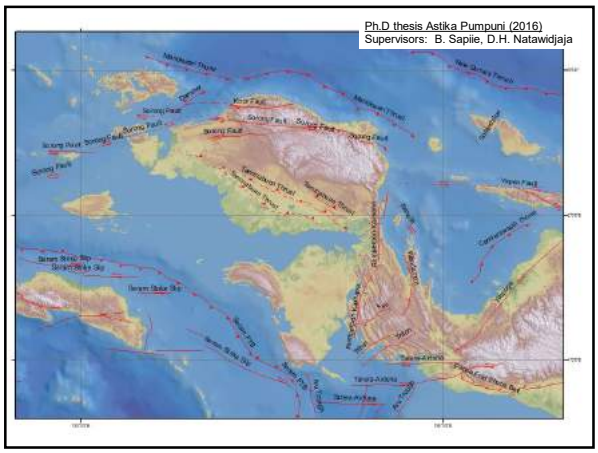

TIM 9 – 2010 PSHA
ACTIVE FAULT
IN SULAWESI
Gorontalo
Batui
Palukoro
Matano
Lansilopo
Toto thrust
Walanae
Mamuju
0 85 170 340 Kilometers

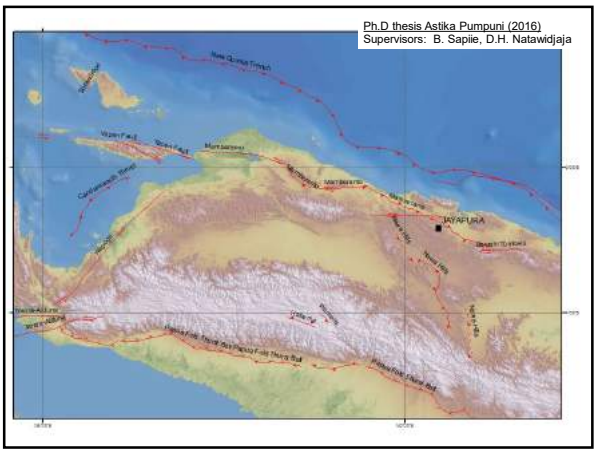

UPDATING SESAR AKTIF DI SULAWESI
ACTIVE FAULT
IN SULAWESI
Main ref: Daryono, 2016)
TONDANO FAULT
TOMINI THRUST
SAUSU FAULT
BATUI THRUST
BALANTAK FAULT
PALUKOBO FAULT
PALUKOBO GRABEN
TOKARARU THRUST
BUOLI THRUST
BUDONG BUDONG FAULT
PELENG FAULT
AMBELANG THRUST
MAJENE FAULT
MATANO FAULT
BUNGACIDI FAULT
ENREKANG FAULT
BUTON FAULT

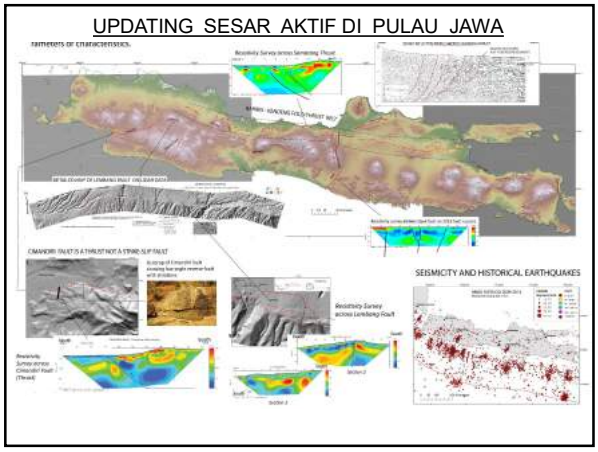

PAPUA
Ph.D thesis Astika Pumpuni
Supervisors: B. Sapiie, D.H. Natawidjaja
Manokwari
New Guinea Thrust
Sorong-Yapen
Ransiki-Wandamen
Memberamo
Tarerua-Aeduna
Foreland F. Thrust
FFF zone
0 50 100 200 Kilometers

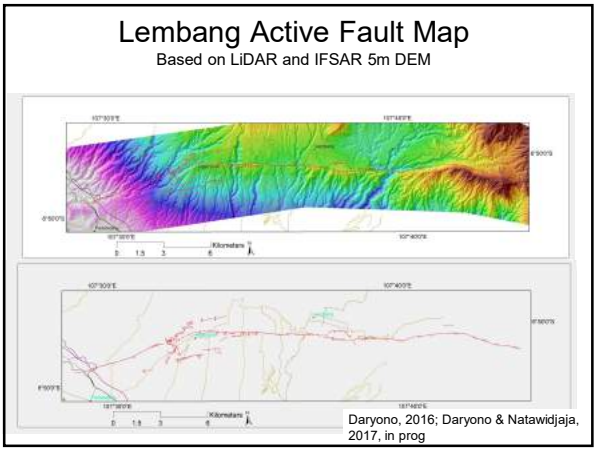

Ph.D thesis Astika Pumpuni
Supervisors: B. Sapiie, D.H. Natawidjaja
New Guinea Thrust
Sorong-Yapen
Ransiki-Wandamen
Memberamo
Tarerua-Aeduna
Foreland F. Thrust
FFF zone
0 50 100 200 Kilometers

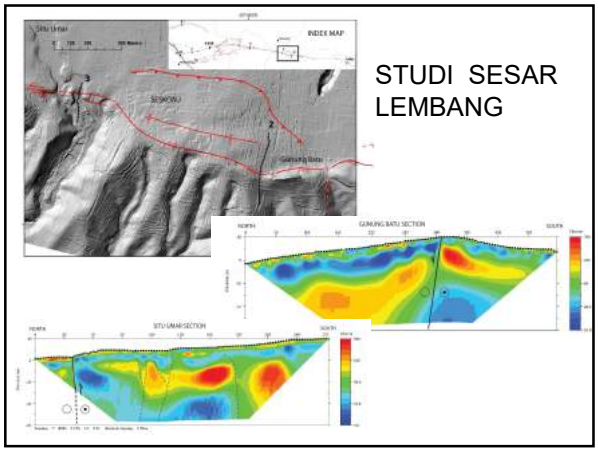

Ph.D thesis Astika Pumpuni(2016)
Supervisors: B. Sapiie, D.H. Natawidjaja

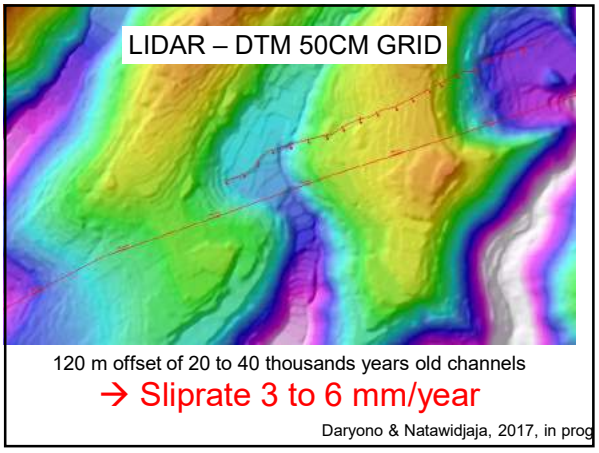

Ph.D thesis Astika Pumpuni (2016)
Supervisors: B. Sapiie, D.H. Natawidjaja

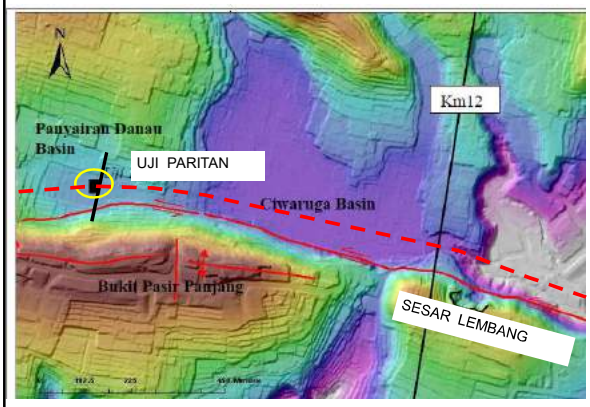

Ph.D thesis Astika Pumpuni (2016)
Supervisors: B. Sapiie, D.H. Natawidjaja


UPDATING SESAR AKTIF DI PULAU JAWA
SEISMICITY AND HISTORICAL EARTHQUAKES

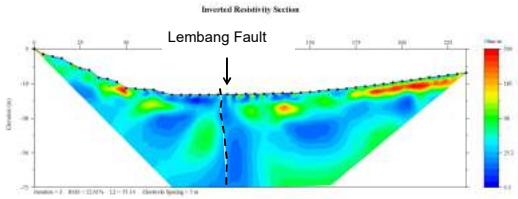

Lembang Active Fault Map
Based on LiDAR and IFSAR 5m DEM
Daryono, 2016; Daryono & Natawidjaja, 2017, in prog


STUDI SESAR LEMBANG


LIDAR – DTM 50CM GRID
120 m offset of 20 to 40 thousands years old channels
→ Sliprate 3 to 6 mm/year
Daryono & Natawidjaja, 2017, in prog

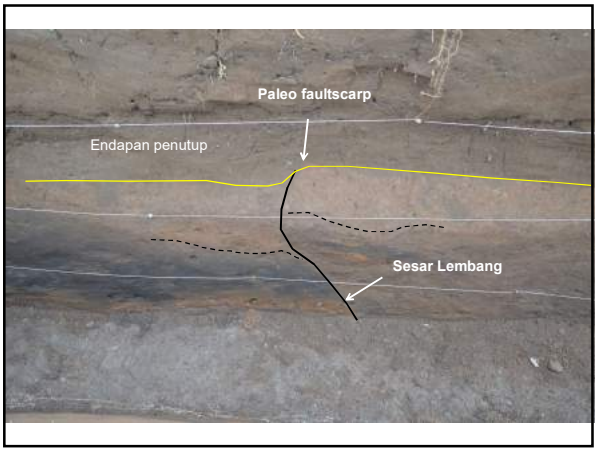


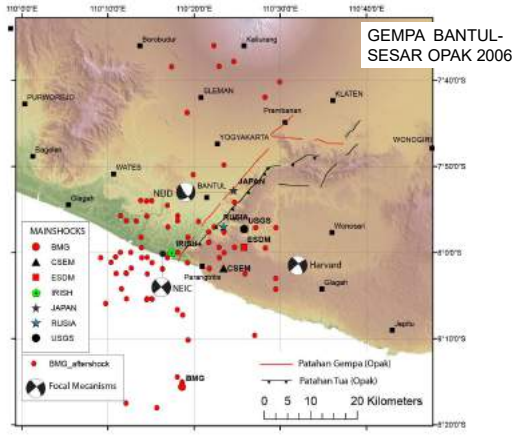
DATA LiDAr

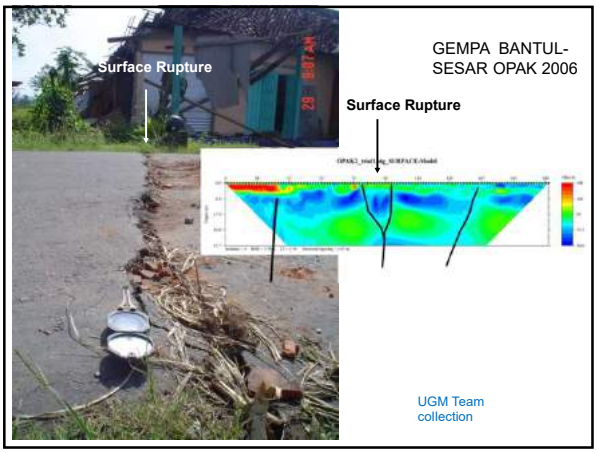


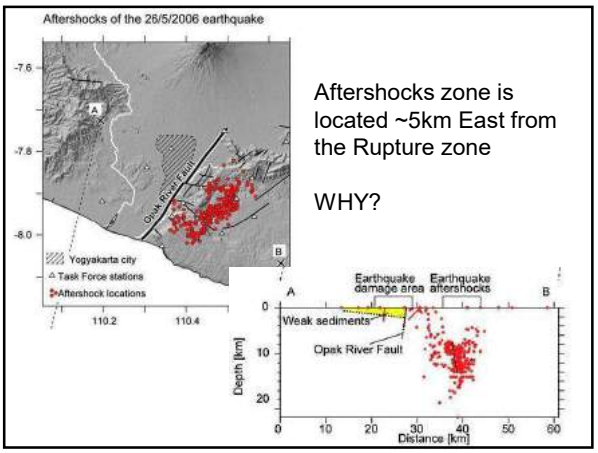
LINTASAN GEOLISTRIK 2D, 5M spacing

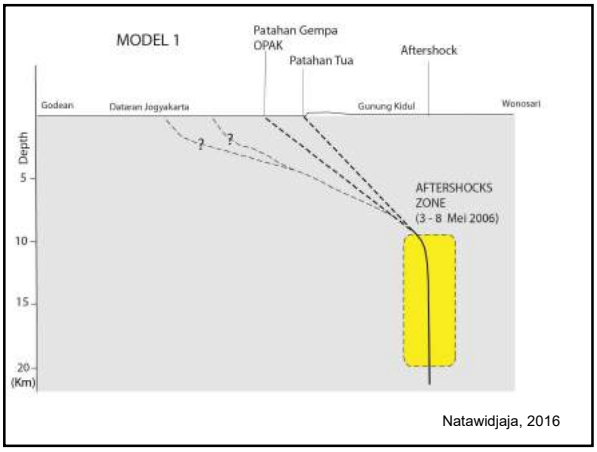
Lembang fault paleoseismologi



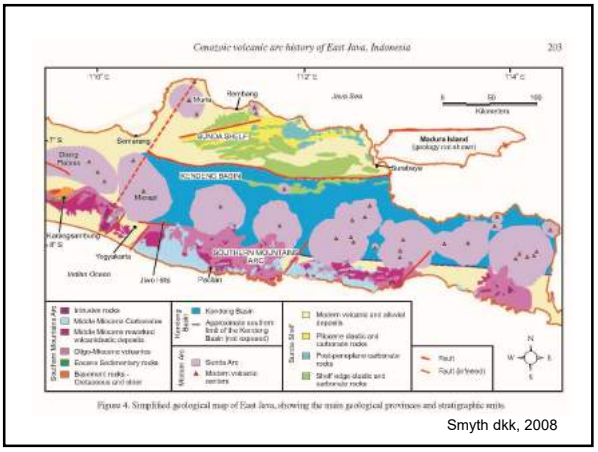




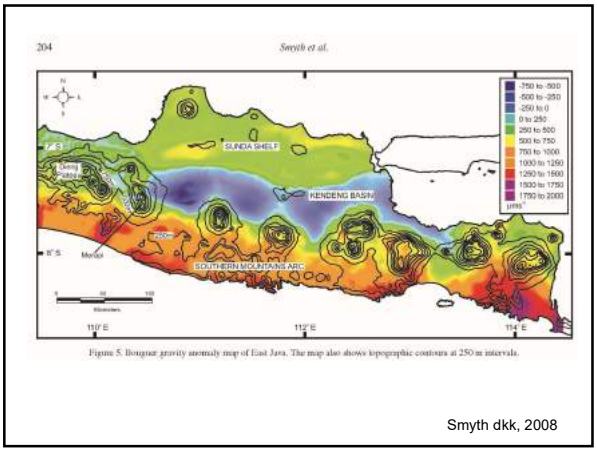




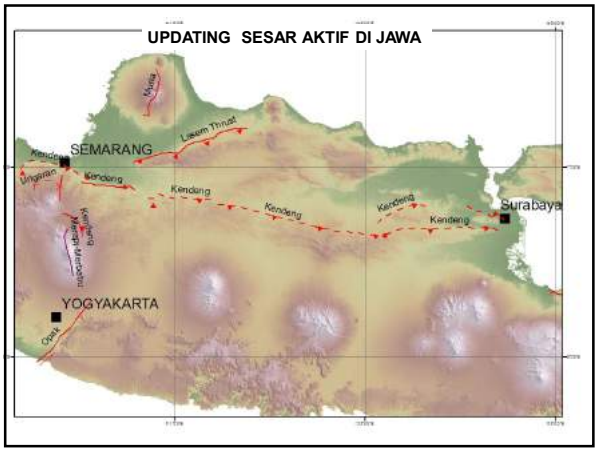
Natawidjaja, 2016

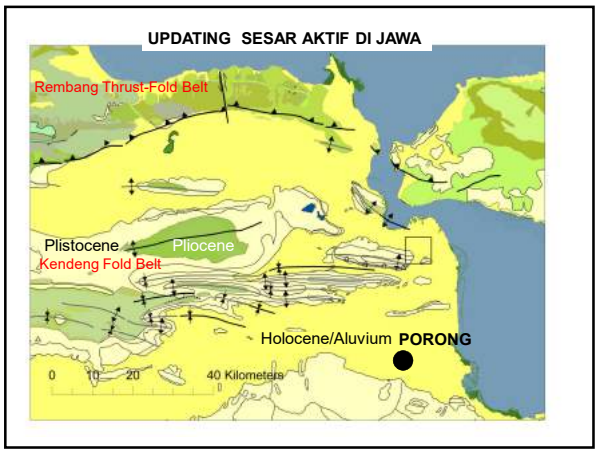


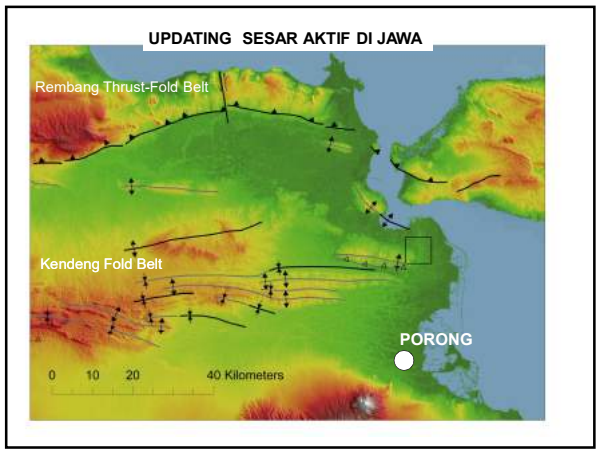
Smyth dkk, 2008

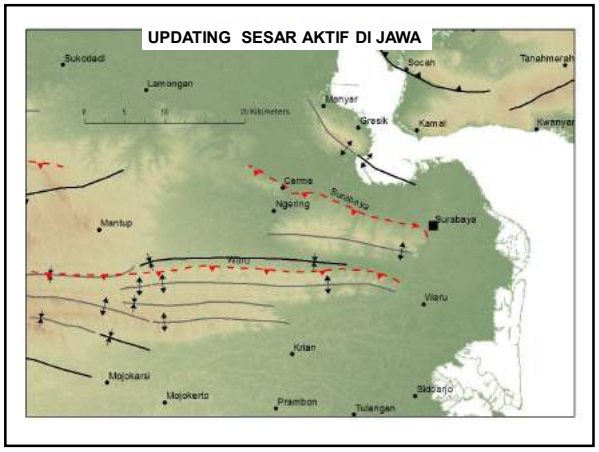


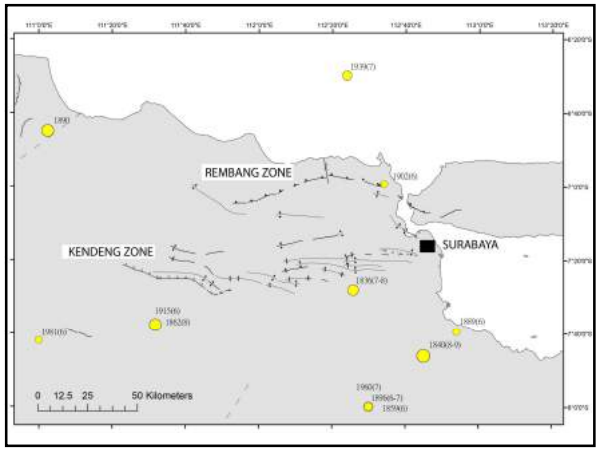
Smyth dkk, 2008

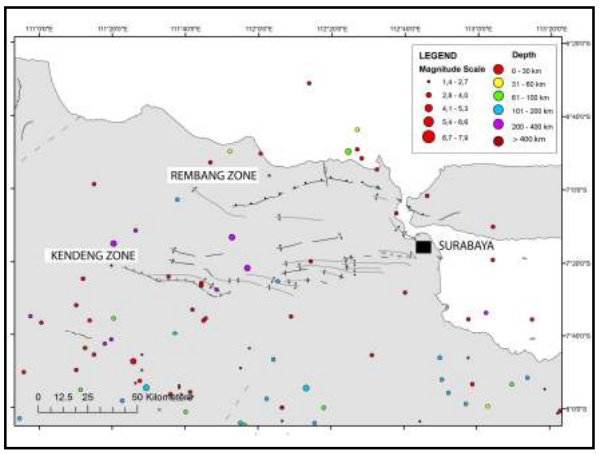


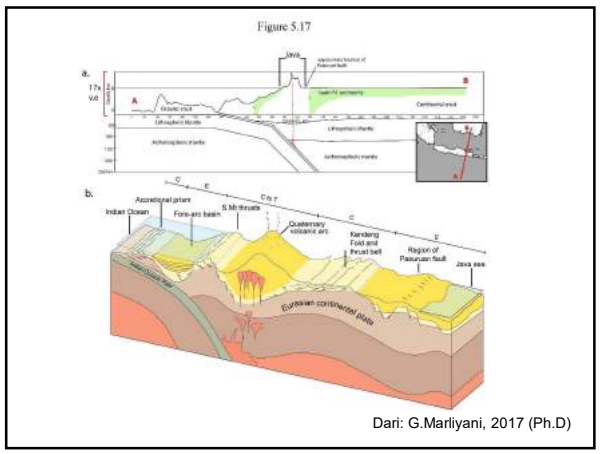






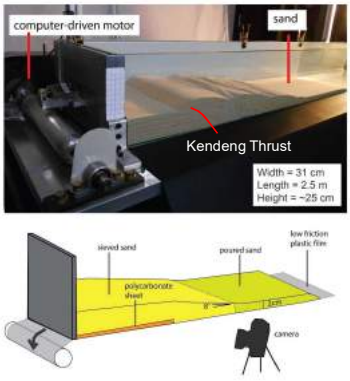






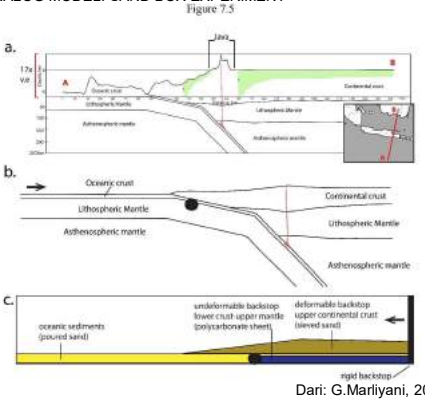
Dari: G.Marliyani, 2017 (Ph.D)

ANALOG MODEL: SAND BOX EXPERIMENT



Dari: GAYATRI .Marliyani, 2017 (Ph.D)

ANALOG MODEL: SAND BOX EXPERIMENT

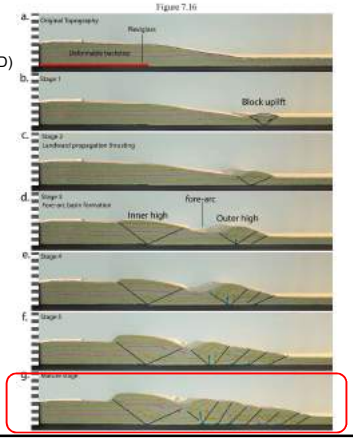


Dari: G.Marliyani, 2017 (Ph.D)

Analog MODEL
Sand Box

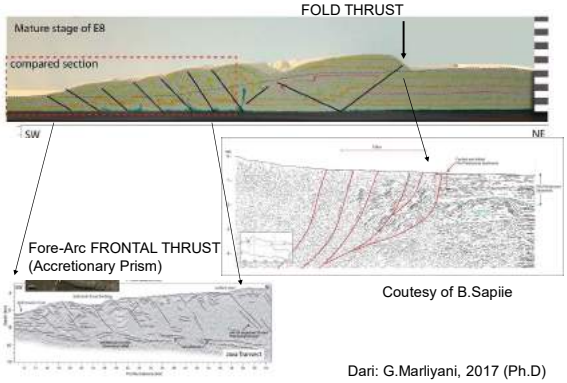
G.Marliyani, 2017 (Ph.D)

RESULTS



Analog MODEL – Sand Box

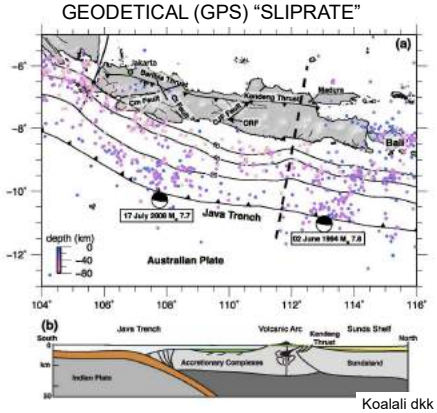
KENDENG-BARIBIS back-arc FOLD THRUST



Coutesy of B.Sapiie

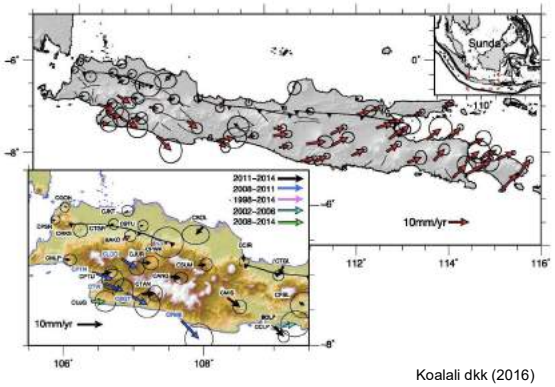
Dari: G.Marliyani, 2017 (Ph.D)

GEODETICAL (GPS) "SLIPRATE"



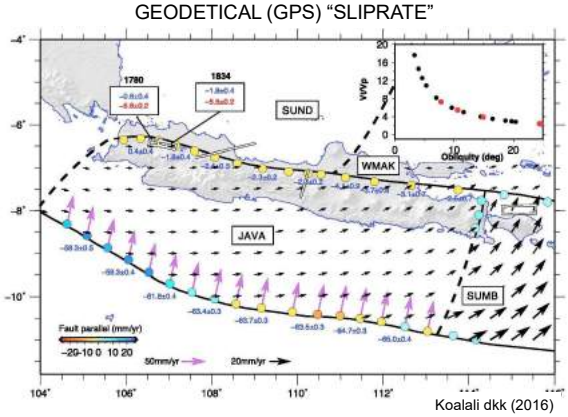
Koalali dkk (2016)

GEODETICAL (GPS) "SLIPRATE"



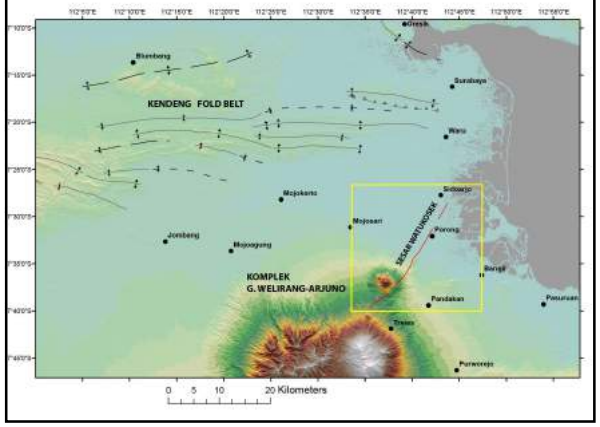
Koalali dkk (2016)

GEODETICAL (GPS) “SLIPRATE”



Koalali dkk (2016)

SESAR WATUKOSEK AKTIF?



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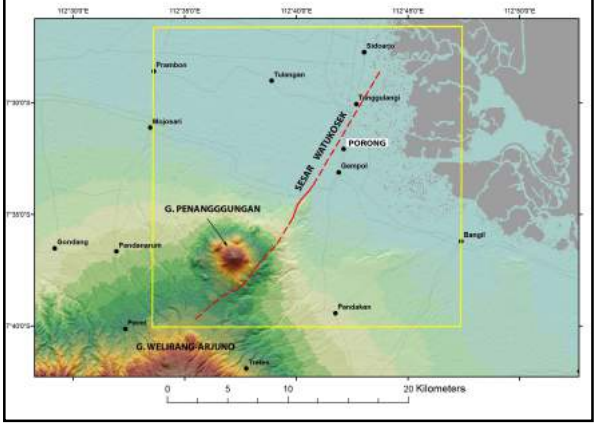
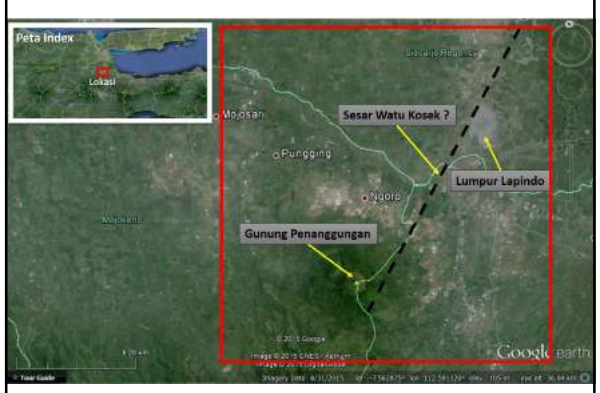
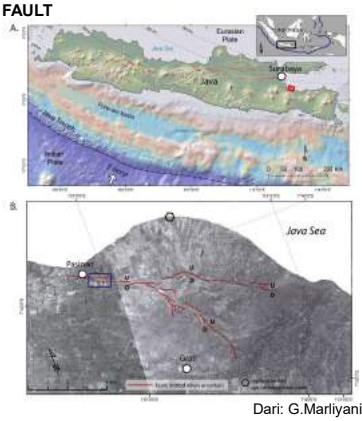


SESAR WATUKOSEK AKTIF?



PASURUAN FAULT

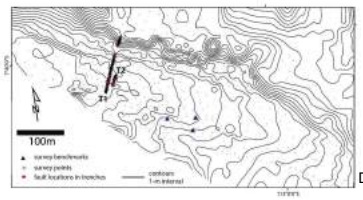


Dari: G.Marliyani, 2017 (Ph.D)

UPDATING SESAR AKTIF DI JAWA

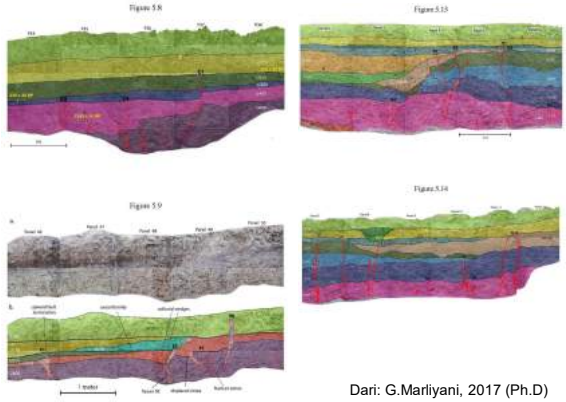
PASURUAN FAULT

Figure 5.3



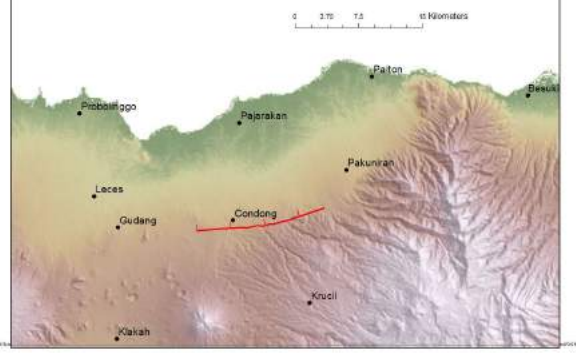
Dari: G.Marliyani, 2017 (Ph.D)

PASURUAN FAULT

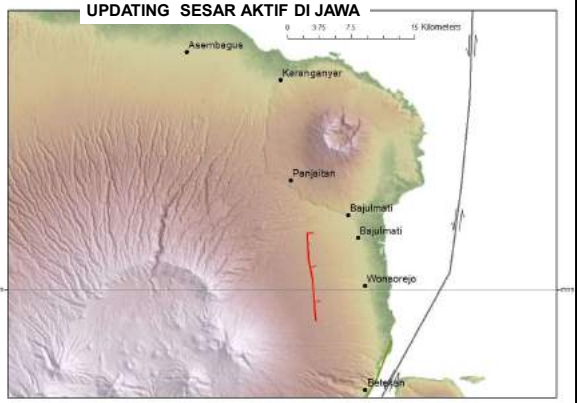


Dari: G.Marliyani, 2017 (Ph.D)

UPDATING SESAR AKTIF DI JAWA

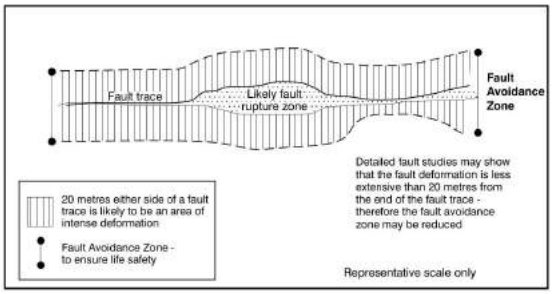


UPDATING SESAR AKTIF DI JAWA



SELAIN ZONASI SEISMIC HAZARDS (=GROUND MOTION) JUGA PERLU DIBUAT

ZONASI BAHAYA DEFORMASI SESAR AKTIF



Catatan: contohnya sudah diterapkan di USA dan New Zealand

KESIMPULAN DAN SARAN

1. Banyak revisi input data lokasi jalur-jalur sesar aktif dan karakterisasinya sesuai dengan pengetahuan yang terkini. Banyak diantaranya merupakan jalur-jalur 'sesar baru" yang belum ada di Peta versi tahun 2010; Namun masih sangat banyak jalur-jalur sesar aktif yang memerlukan pendetilan pemetaan dan penelitian lebih lanjut, baik untuk yang sudah diperkirakan lokasinya ataupun yang mungkin belum diketahui sama sekali.
2. Masih banyak parameter gempa sesar aktif, khususnya data *sliprate* (laju geser) dan data *paleoseismologi,* yang belum diketahui/diteliti. Oleh karena itu, penelitian harus dilanjutkan dengan lebih intensif dan komprehensif.
3. Pemetaan dan penelitian jalur-jalur sesar aktif harus diprioritaskan untuk wilayah perkotaan, terlebih lagi untuk bangunan-bangunan besar atau instalasi vital
4. Selain persyaratan konstruksi tahan goncangan gempa, juga harus memperhatikan lokasi jalur-jalur sesar aktif terkait dengan bahaya deformasi tanah dan likuifaksi.

KHUSUS SURABAYA - JATIM

1. Keberadaan Zona Lipatan-Sesar Kendeng dan Sesar Watukosek perlu mendapat perhatian khusus dan diteliti lebih lanjut.
2. Informasi lebih rinci yang diperlukan termasuk:
   - Pemetaan jalur patahan lebih rinci dan akurat
   - Pengukuran sliprate (tingkat keaktifan, frekuensi gempa)
   - Penentuan segmentasi sesar → maximum magnitude gempa dari masing-masing segmen sesar
3. Selain itu penambahan zona sesar aktif lain di Jawa Timur di wilayah Lengan Timur Jatim (Pasuruan – Bondowoso) juga cukup penting untuk diteliti dan ditindaki lebih lanjut.