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Evidence of Kendeng thrust activity from geodetic observation

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Introduction

Name : Irwan Meilano
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Nagoya University, Japan

acknowledgement



AUSTRALIA-INDONESIA
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Related publication

Velocity Field from Twenty-Two Years of Combined GPS Daily Coordinate Time Series Analysis

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Susilo et al., 2016

 **AGU** PUBLICATIONS

Geophysical Research Letters

RESEARCH LETTER

10.1002/2016GL067941

Key Points:

- The Sunda-Banda back-arc thrust system is a large active plate boundary that extends over 2000 km
- Strain is transferred from Java subduction to the back-arc thrusts via a left-lateral strike slip
- Geodetic strain across the Sunda-Banda back-arc thrusts emphasize a high seismic and tsunami hazard

Crustal strain partitioning and the associated earthquake hazard in the eastern Sunda-Banda Arc

A. Koulali¹, S. Susilo², S. McClusky¹, I. Meilano³, P. Cummins¹, P. Tregoning¹, G. Lister¹, J. Efendi², and M. A. Syafi'i²

¹Research School of Earth Sciences, Australian National University, Canberra, Australian Capital Territory, Australia,

²Bandan Informasi Geospasial, Cibinong, Indonesia, ³Institute of Technology Bandung, Bandung, Indonesia

Abstract We use Global Positioning System (GPS) measurements of surface deformation to show that the convergence between the Australian Plate and Sunda Block in eastern Indonesia is partitioned

Koulali et al., 2016

Content

- Introduction
- Tectonic of Java from Geodetic observation
- Geodetic evidence of Kendeng thrust

2014

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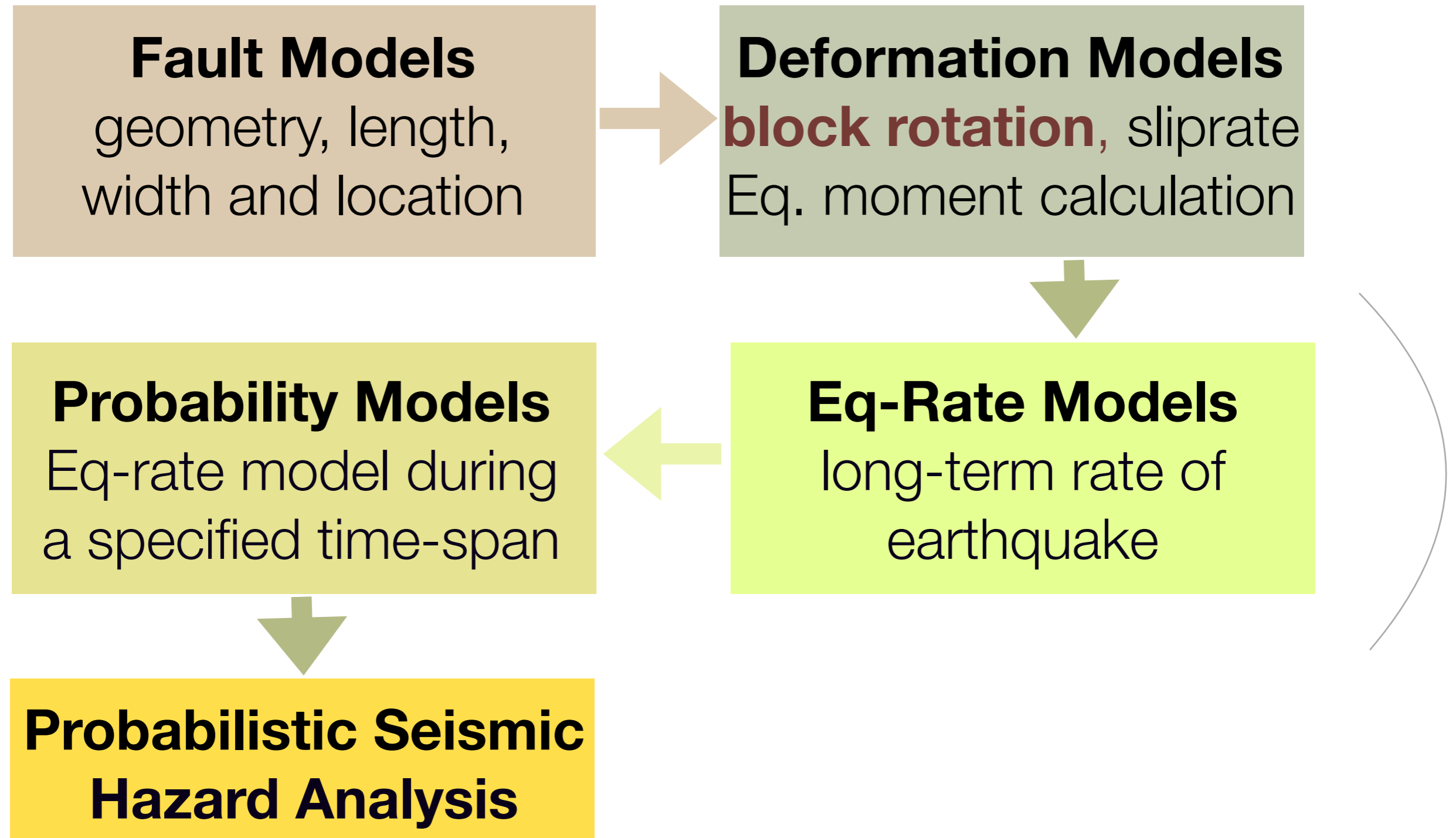


MULTIPLIERS OF PROSPERITY

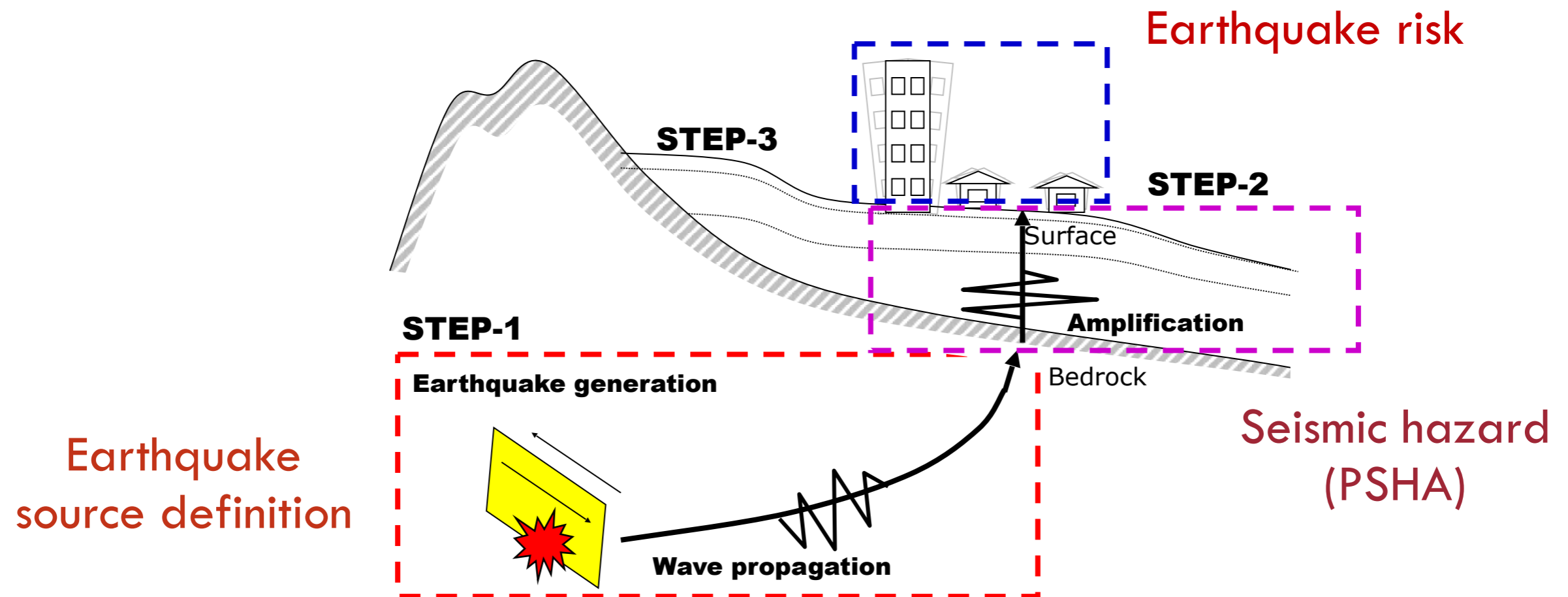
Succeeding in business in the slums of India



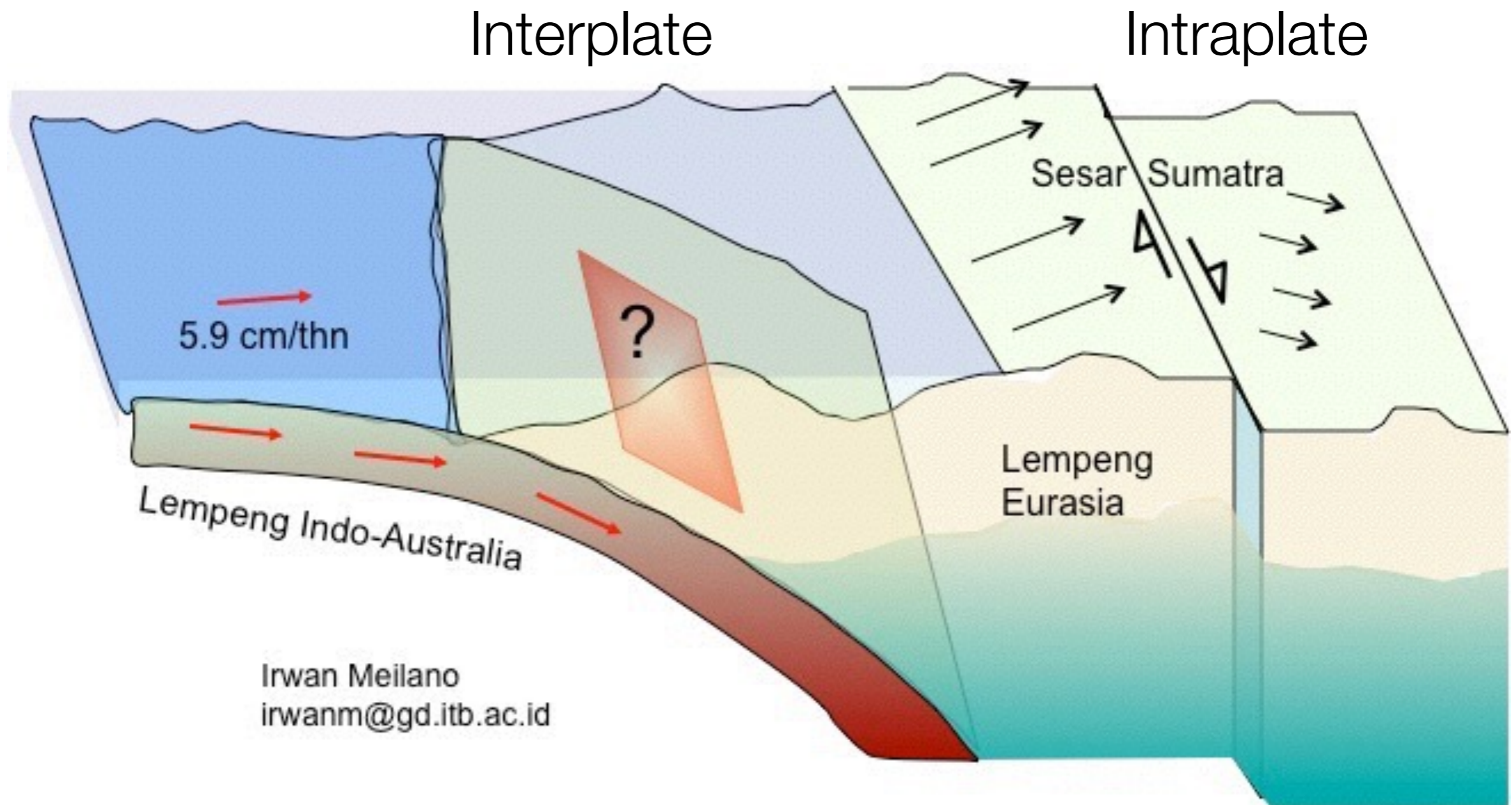
Lesson to be learned



Earthquake Sources in Probabilistic Seismic Hazard



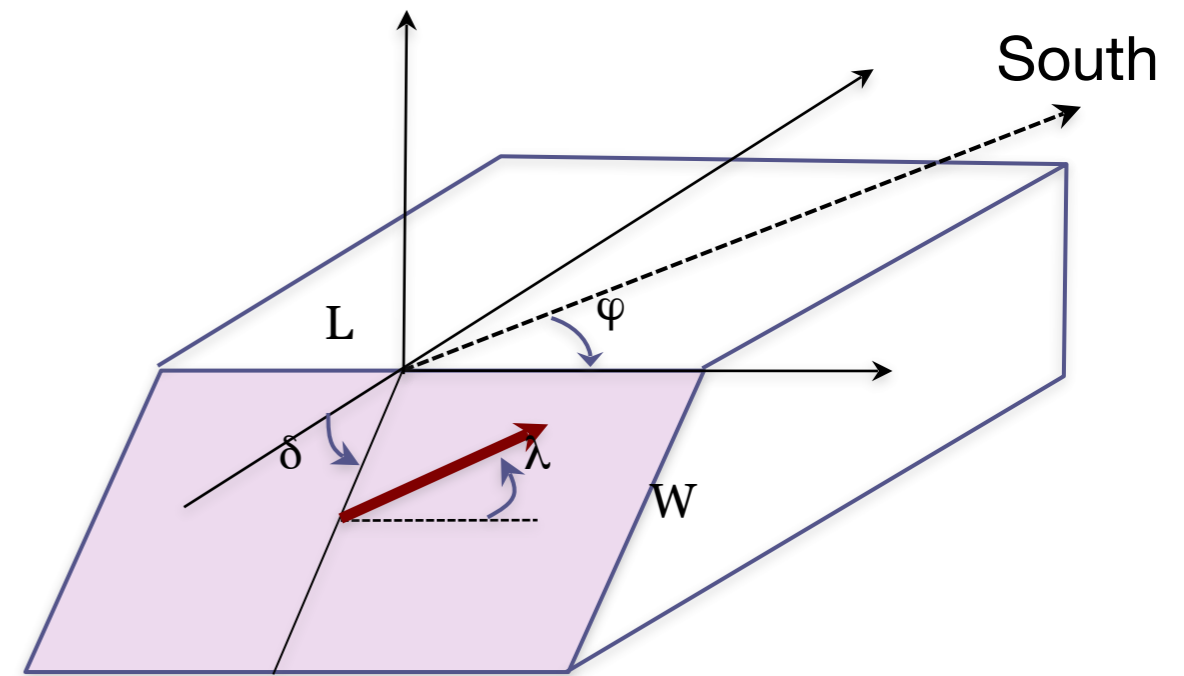
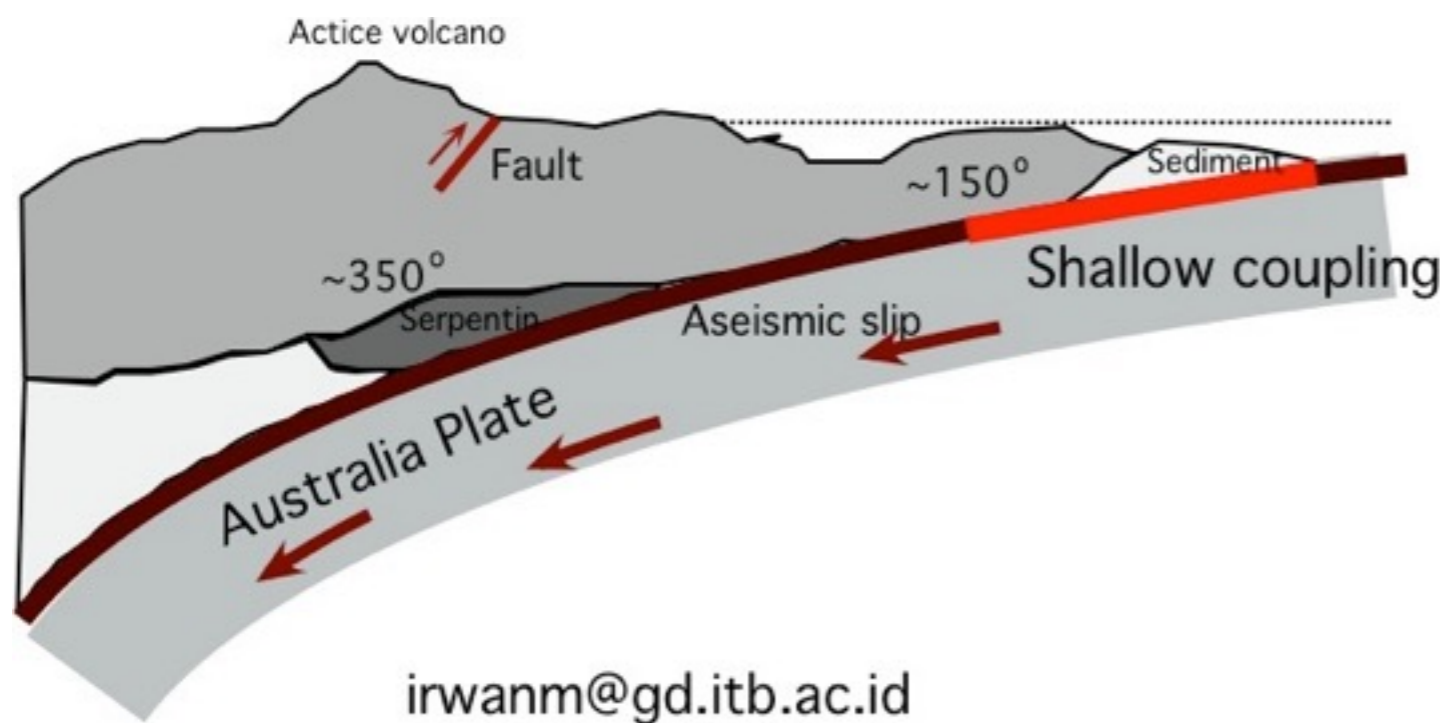
Earthquake sources



USGS, 2013

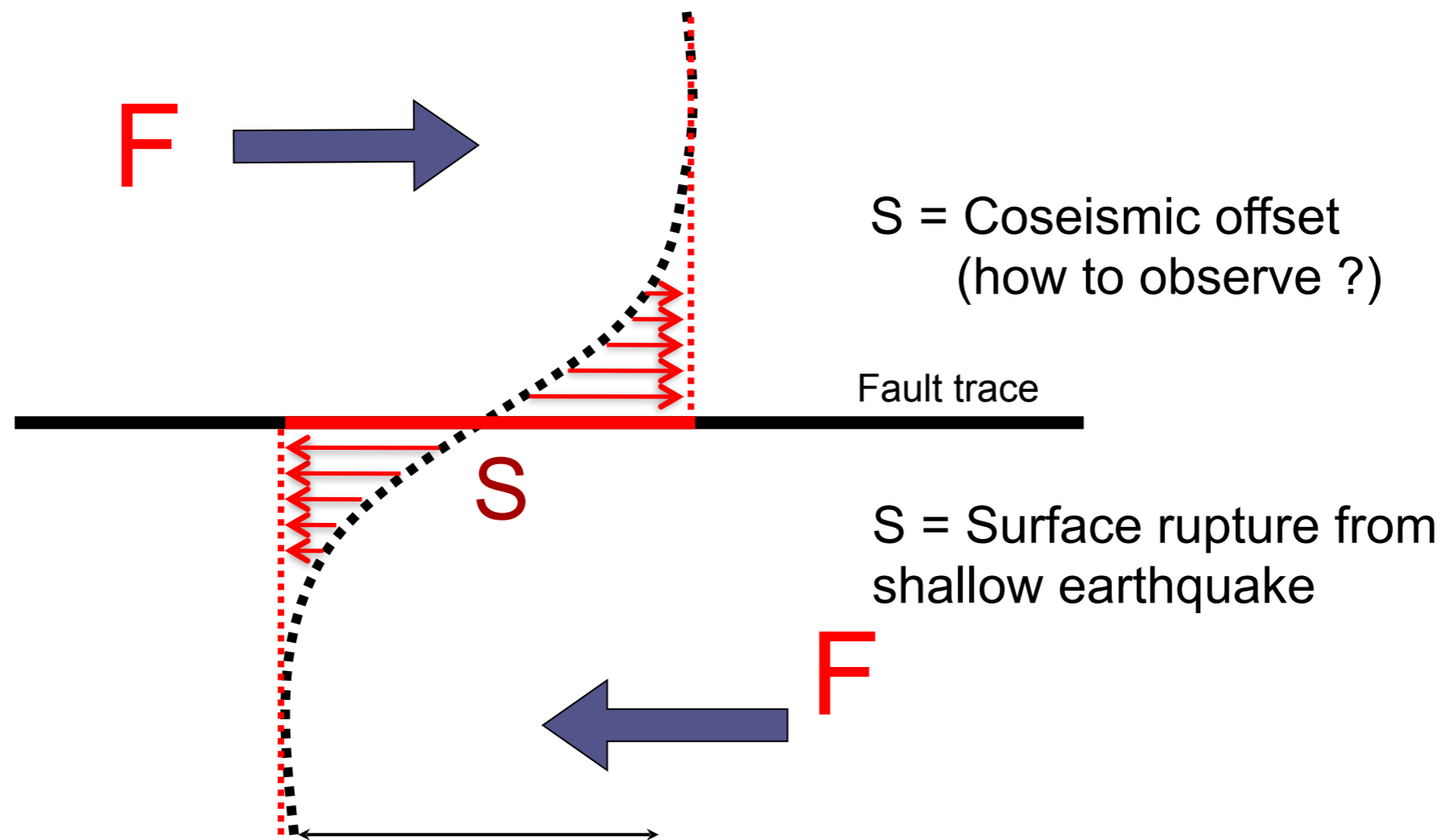
Displacement model (subduction source)

Elastic dislocation model (Okada, 1985)

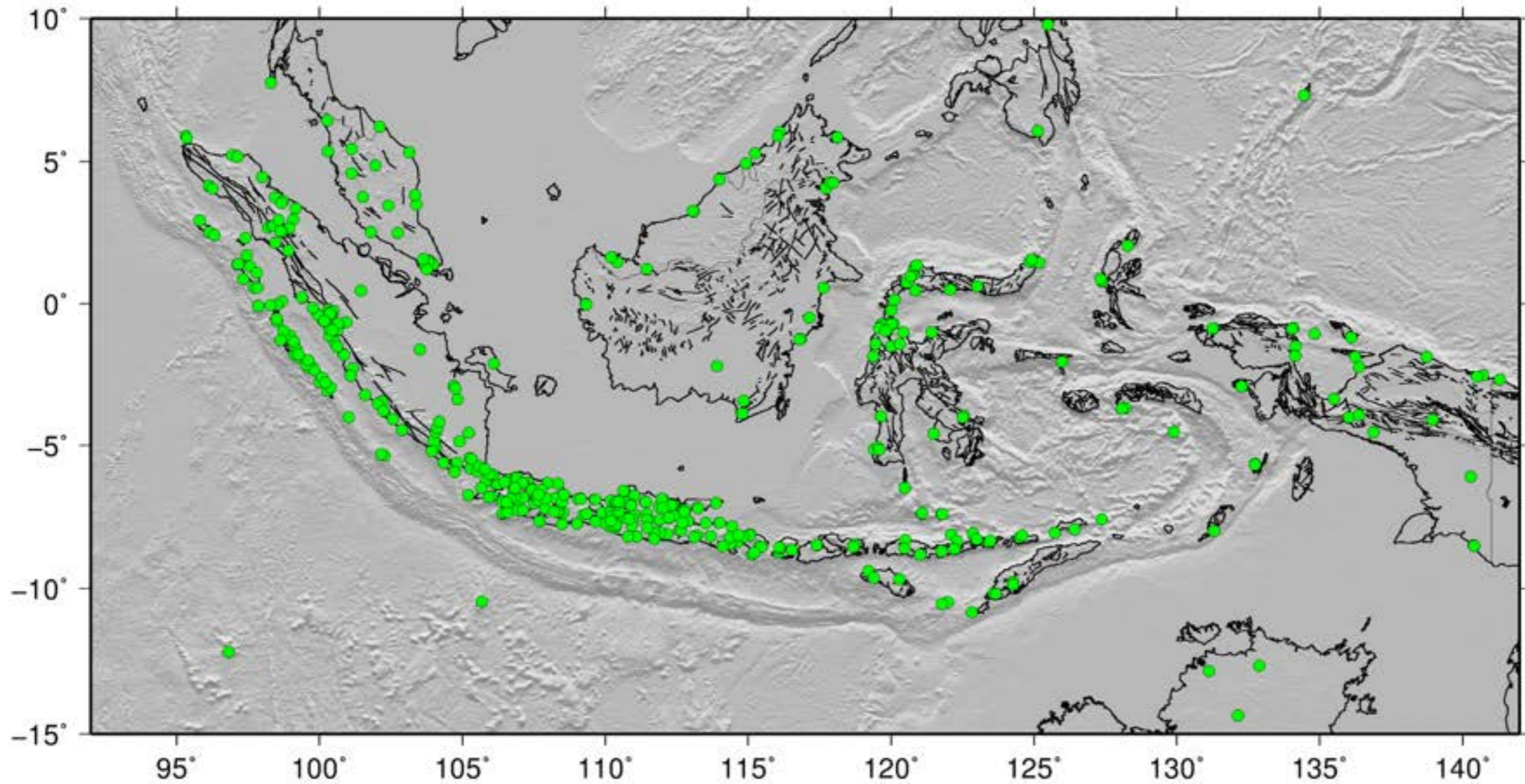


North-dipping fault, width 100km

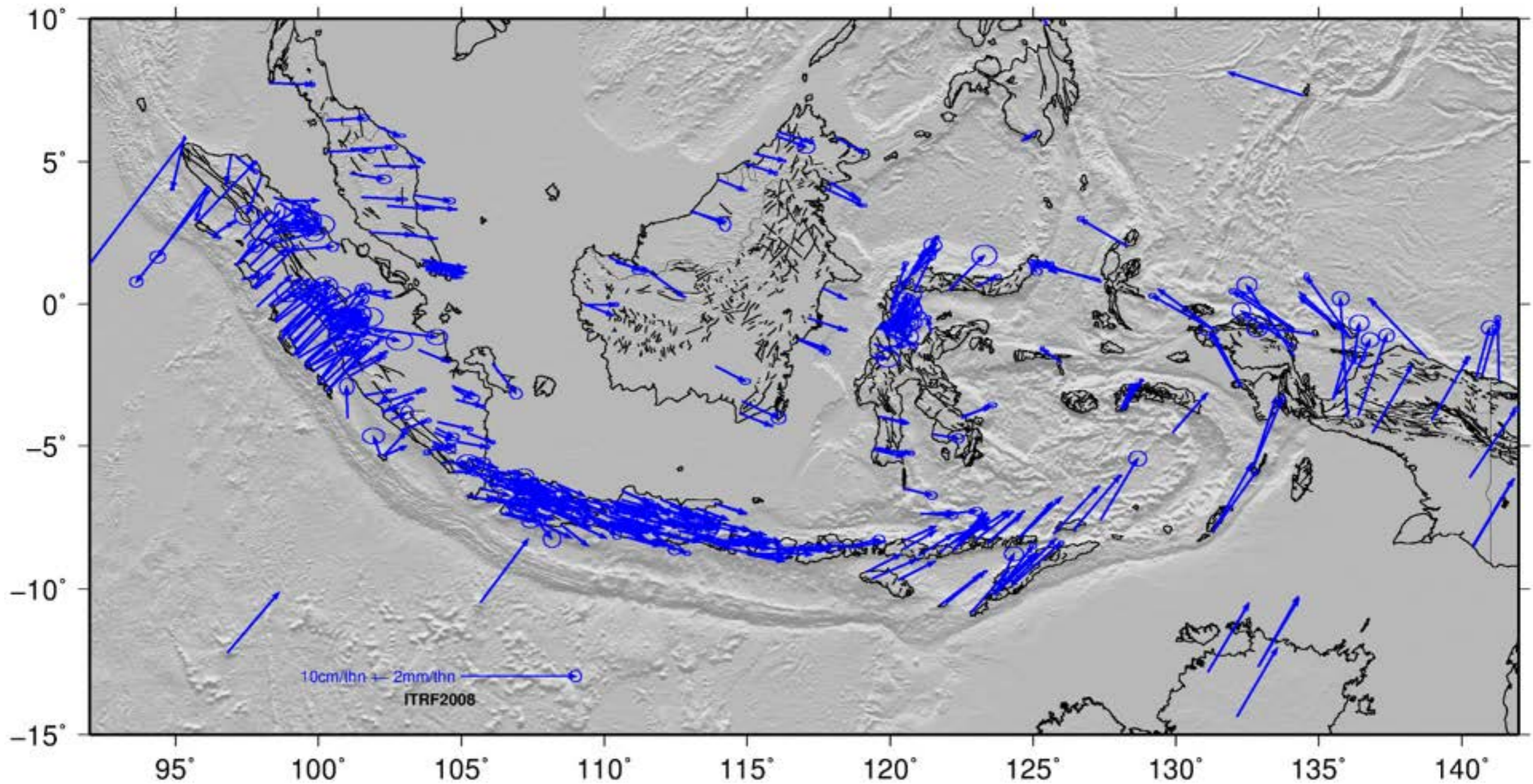
Displacement model (fault source)



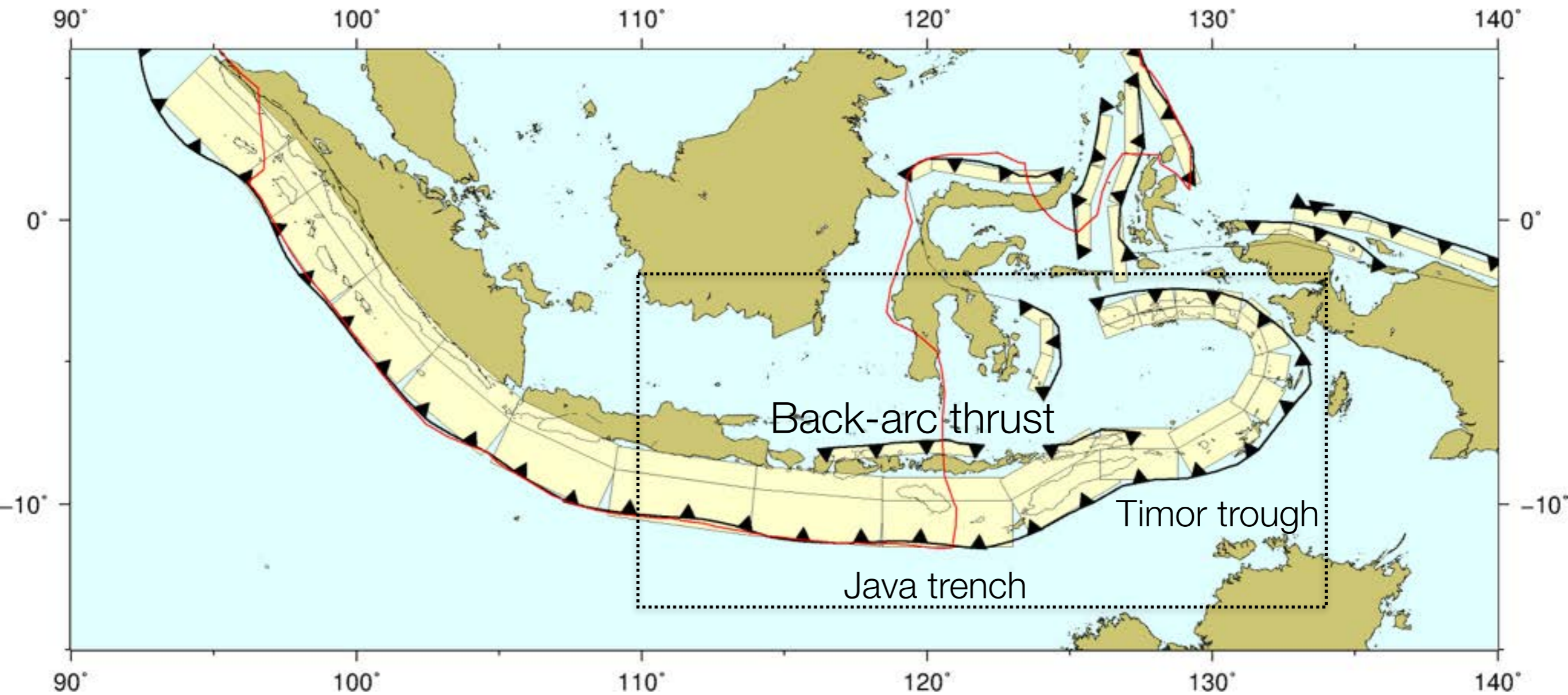
A new available geodetic observation data (2010-2015)



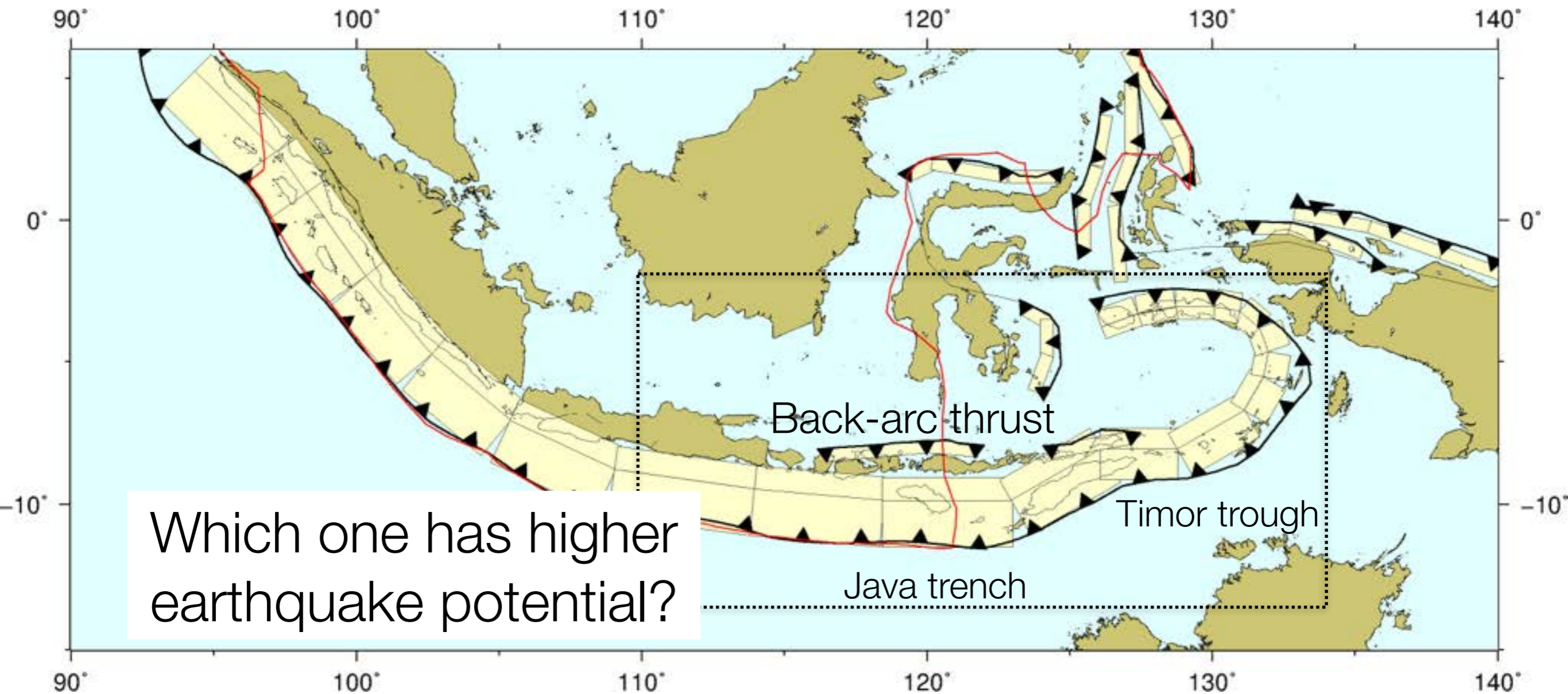
A new available : geodetic displacement rate (2010-2015)

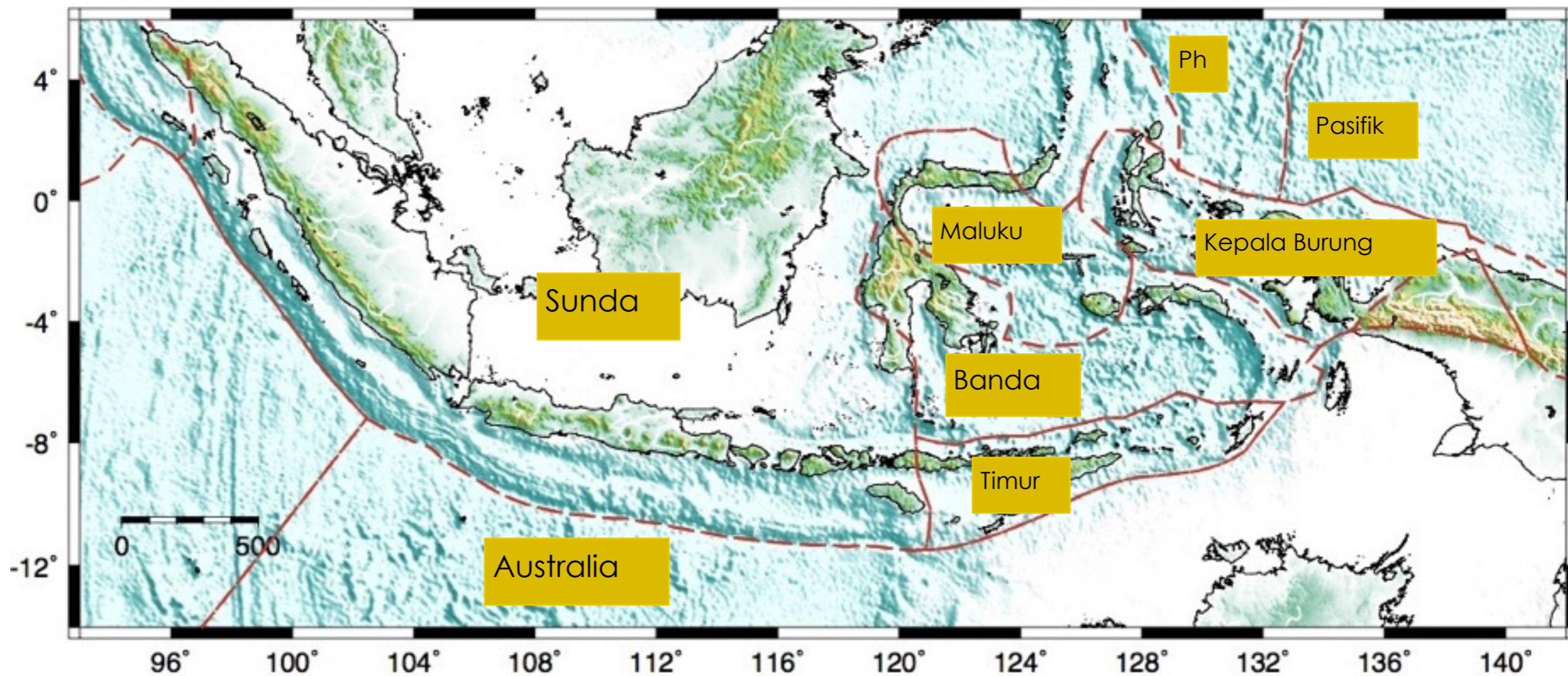


Earthquake source models of Indonesia

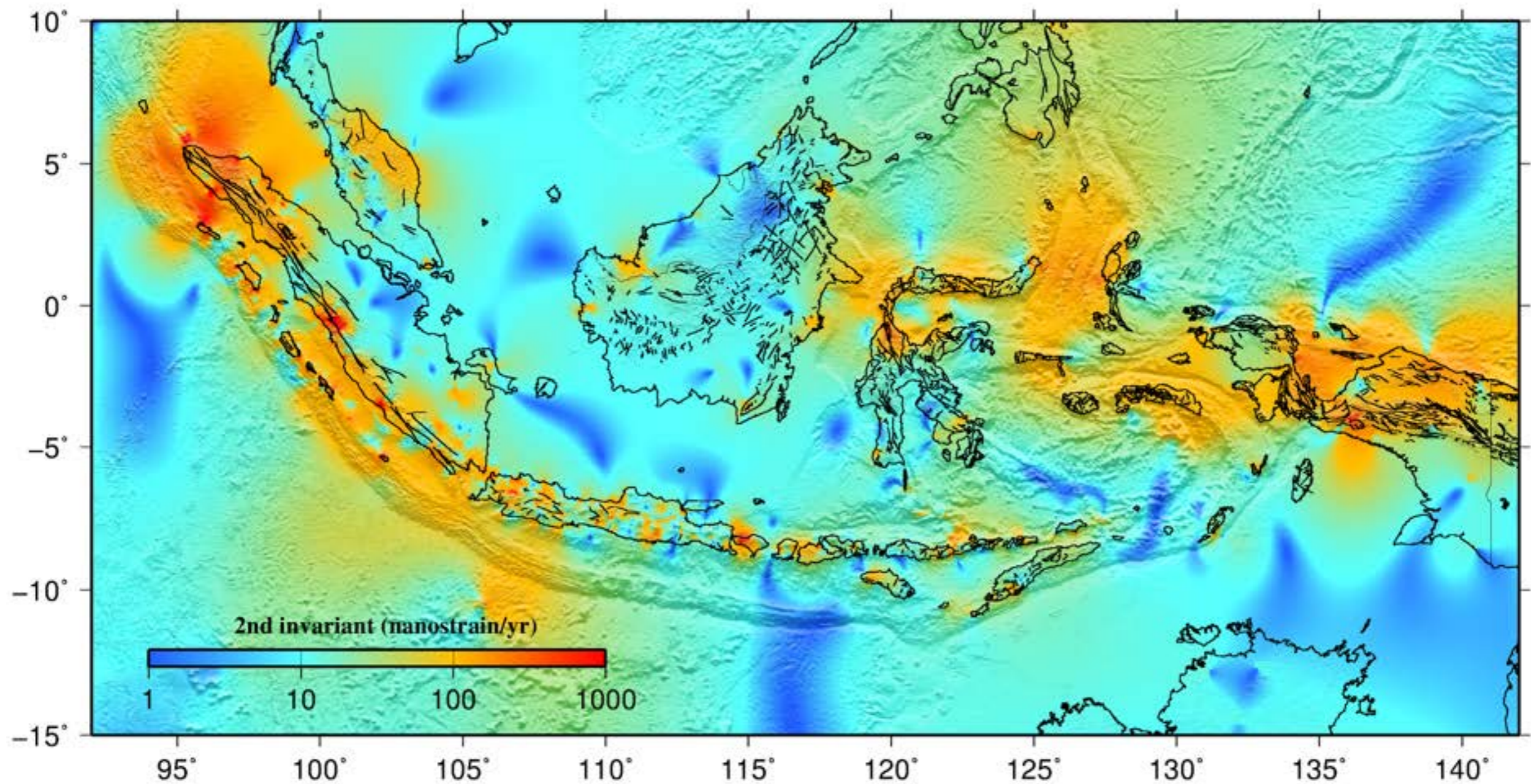


Earthquake source models of Indonesia

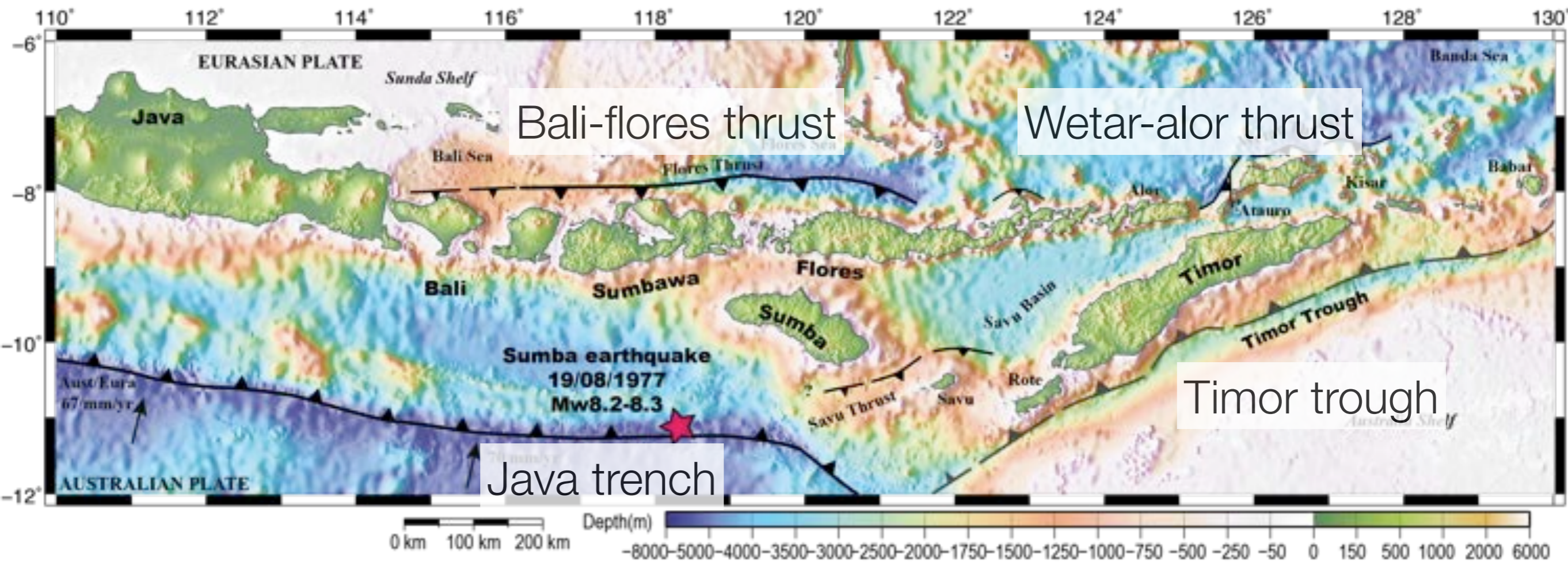




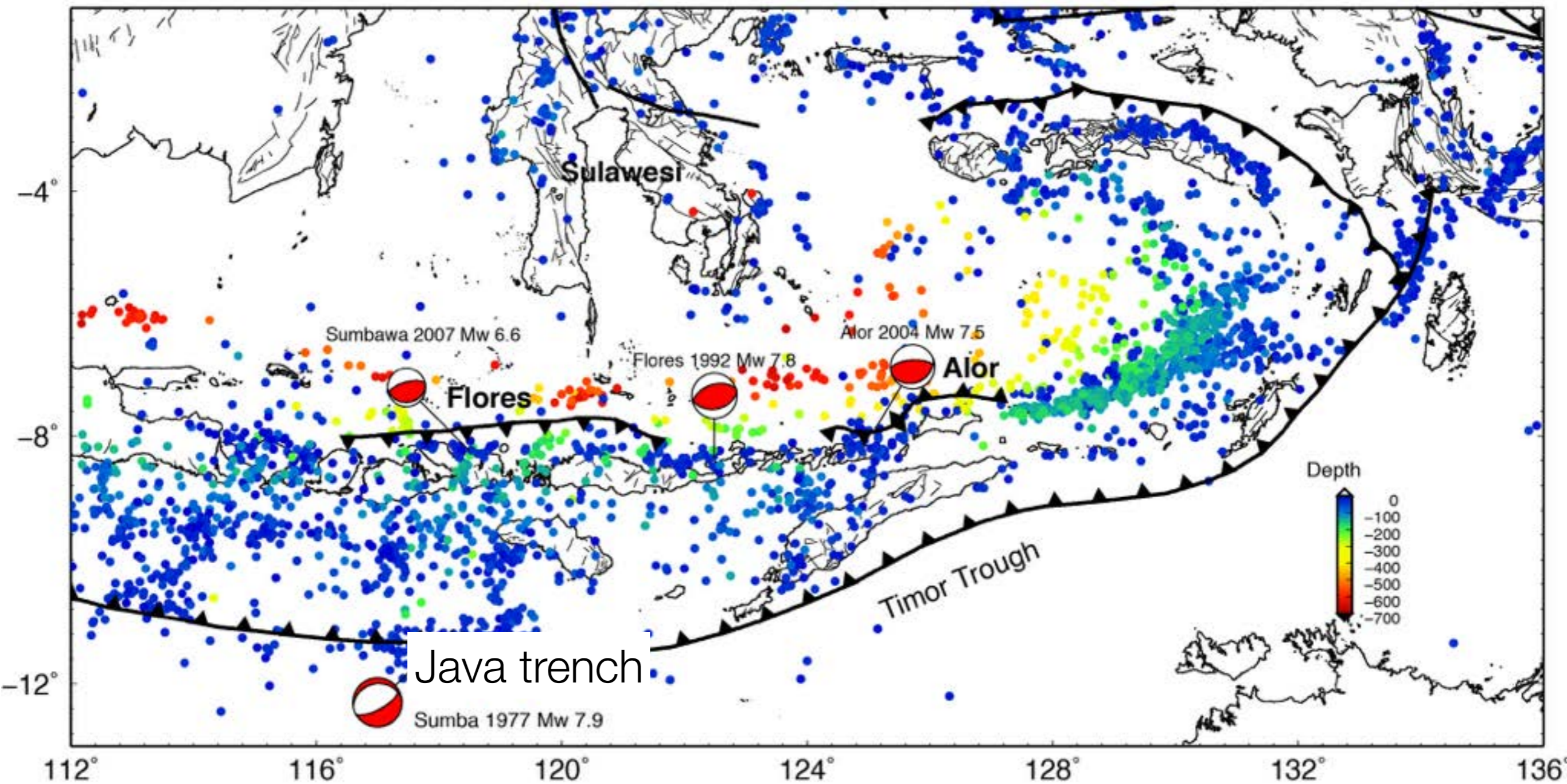
A new available : geodetic strain-rate (2010-2015)



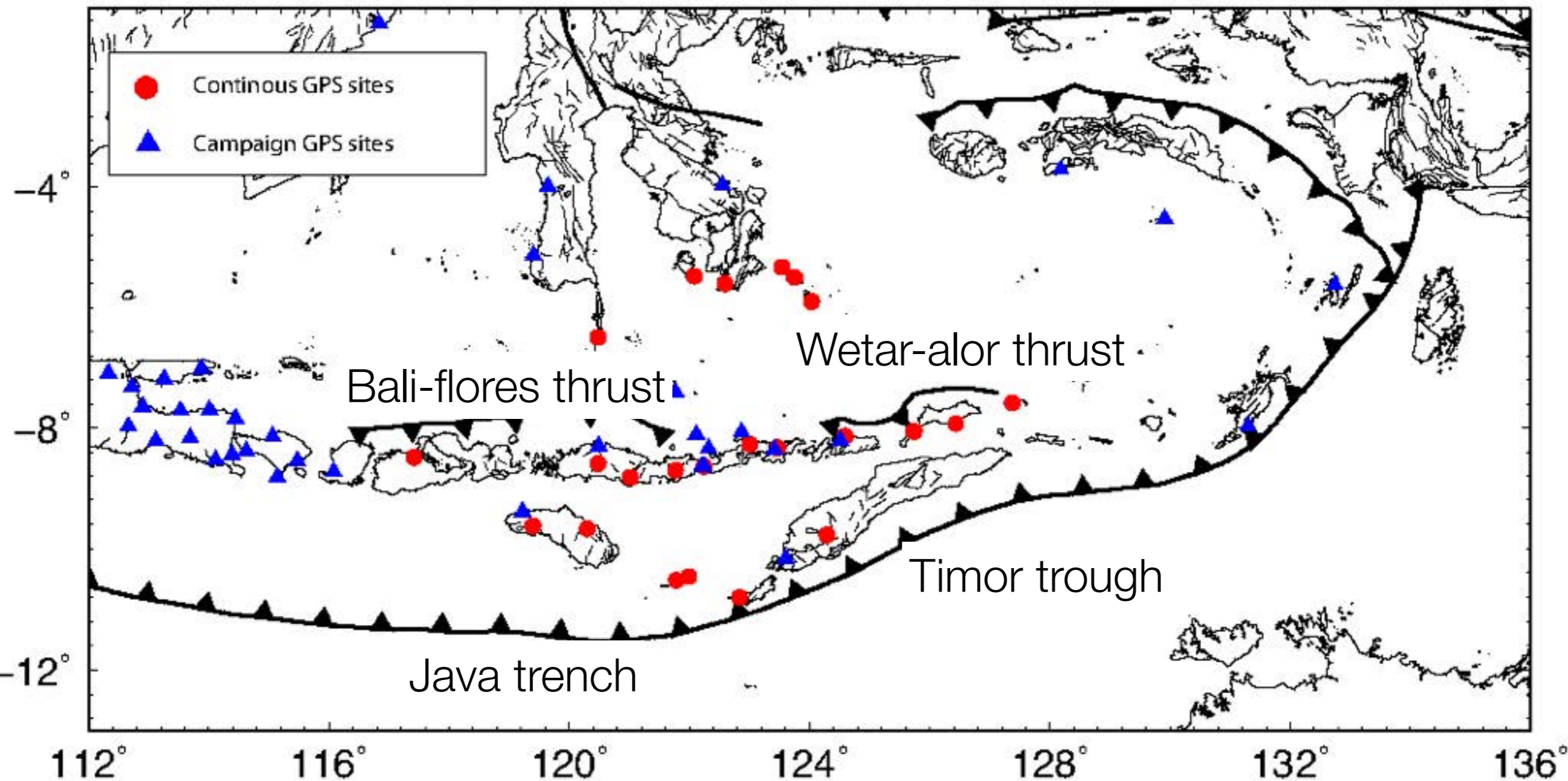
Tectonics of eastern Indonesia



Tectonics of eastern Indonesia



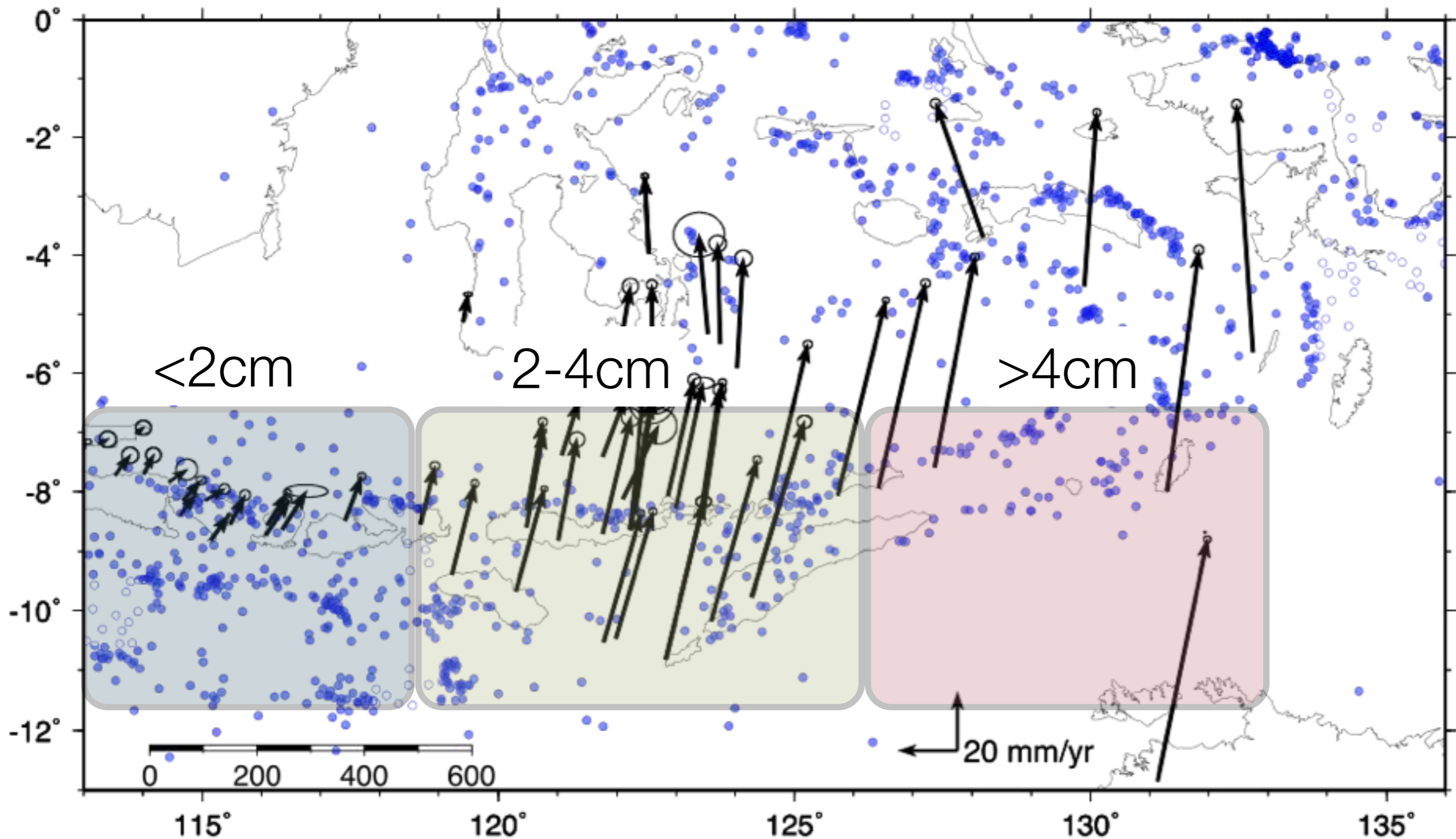
Tectonics of Eastern Indonesia



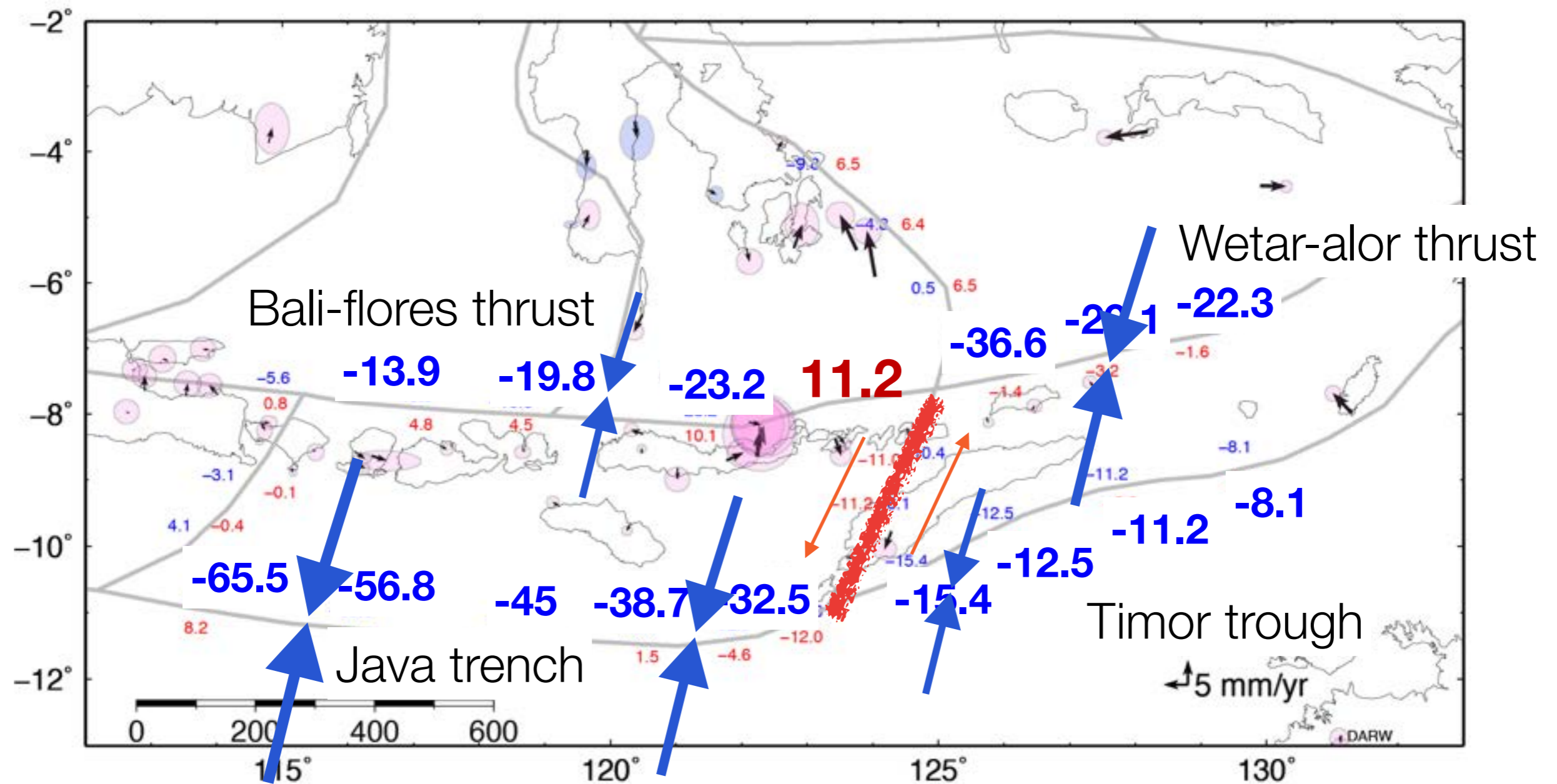
GPS observation more than 3 years



GPS velocity at Eastern Indonesia



Eastern Indonesia



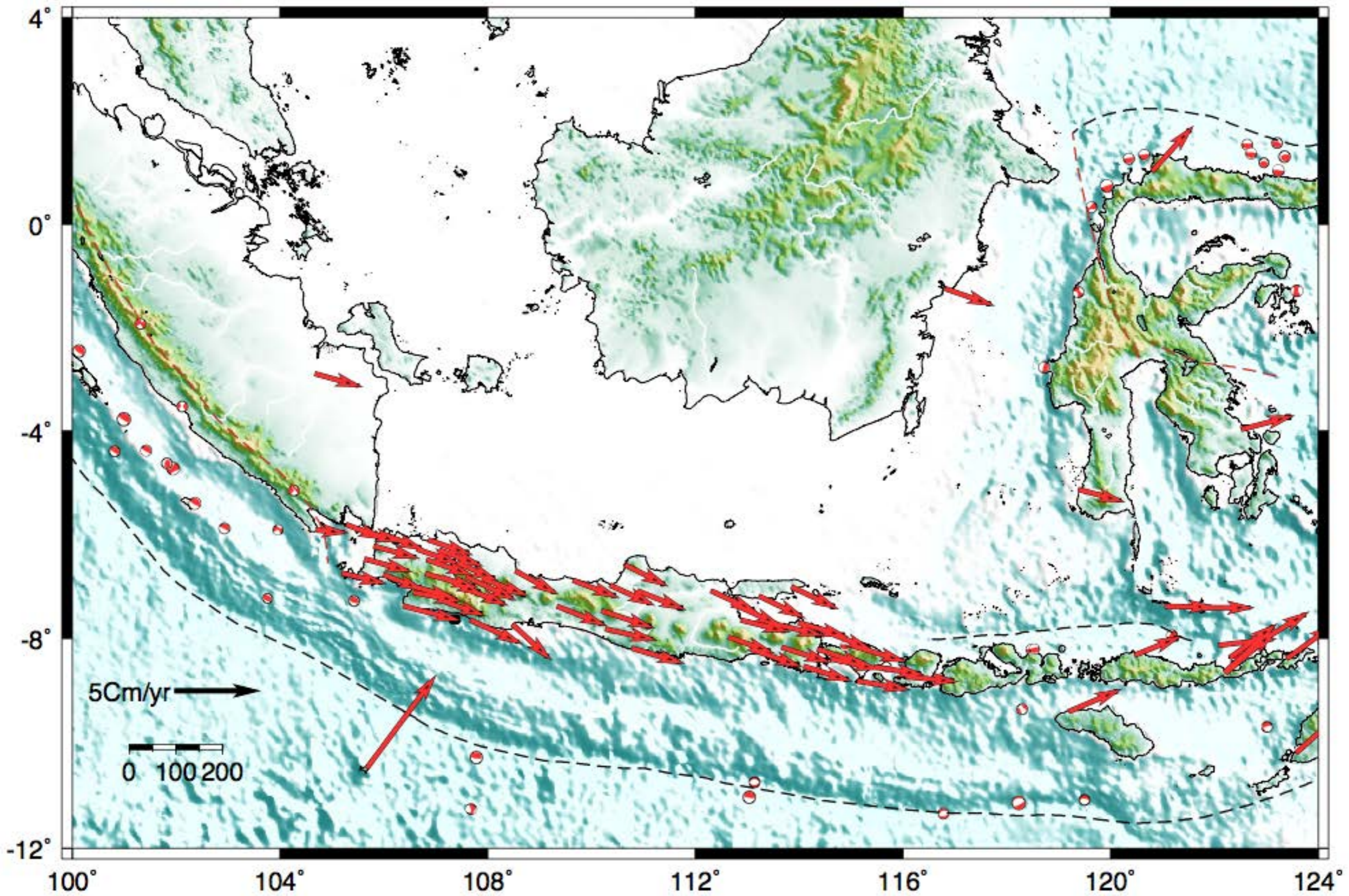
Long-term slip rates (excluding strain accumulation)

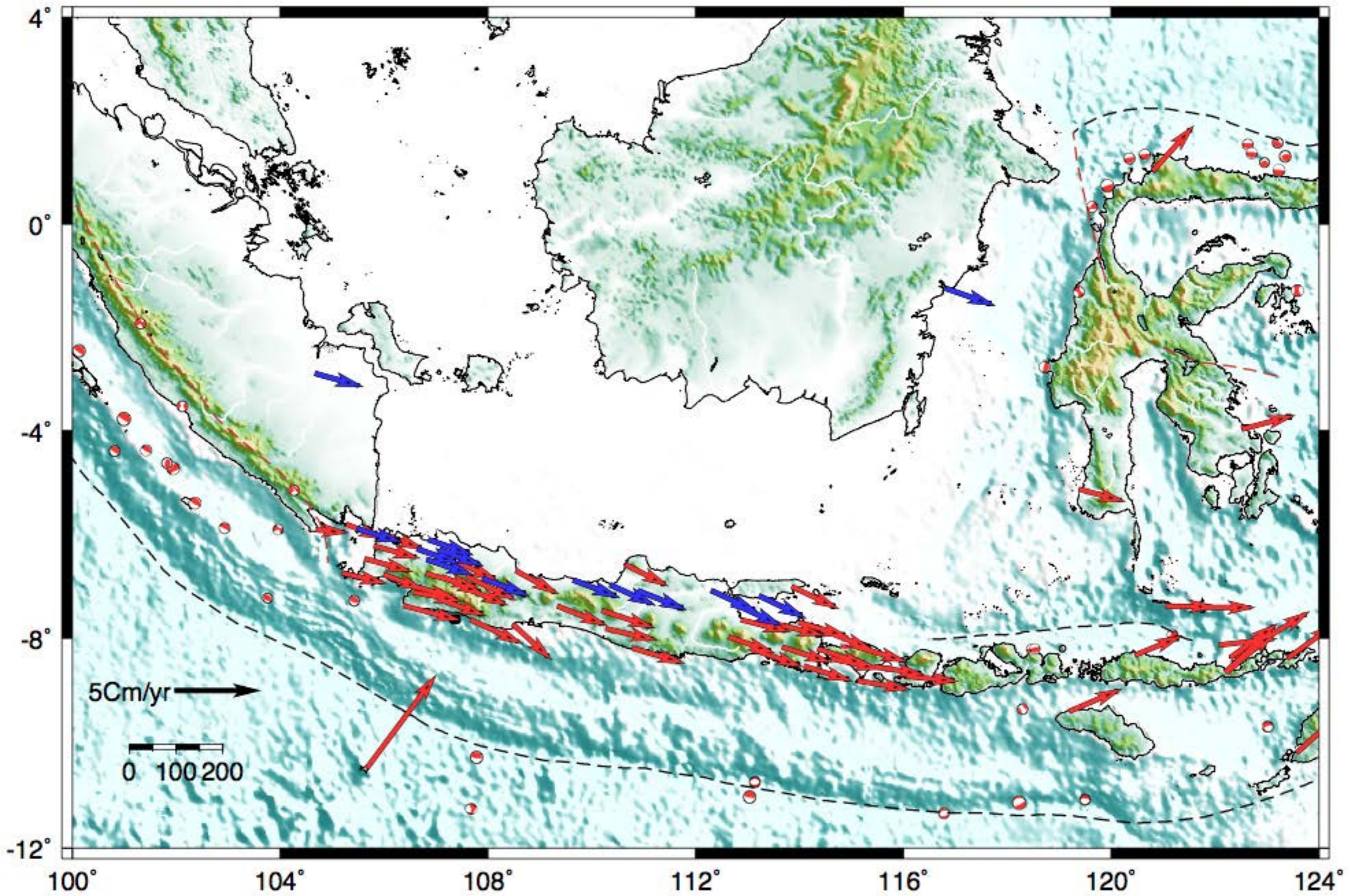
Blue numbers – fault normal motion, divergence (pos) or convergence (neg)

Red numbers – fault parallel motion, right-lateral (pos) or left-lateral (neg)

Research Question

Can we see any evidence of strain/stress accumulation in the Eastern of Java ?

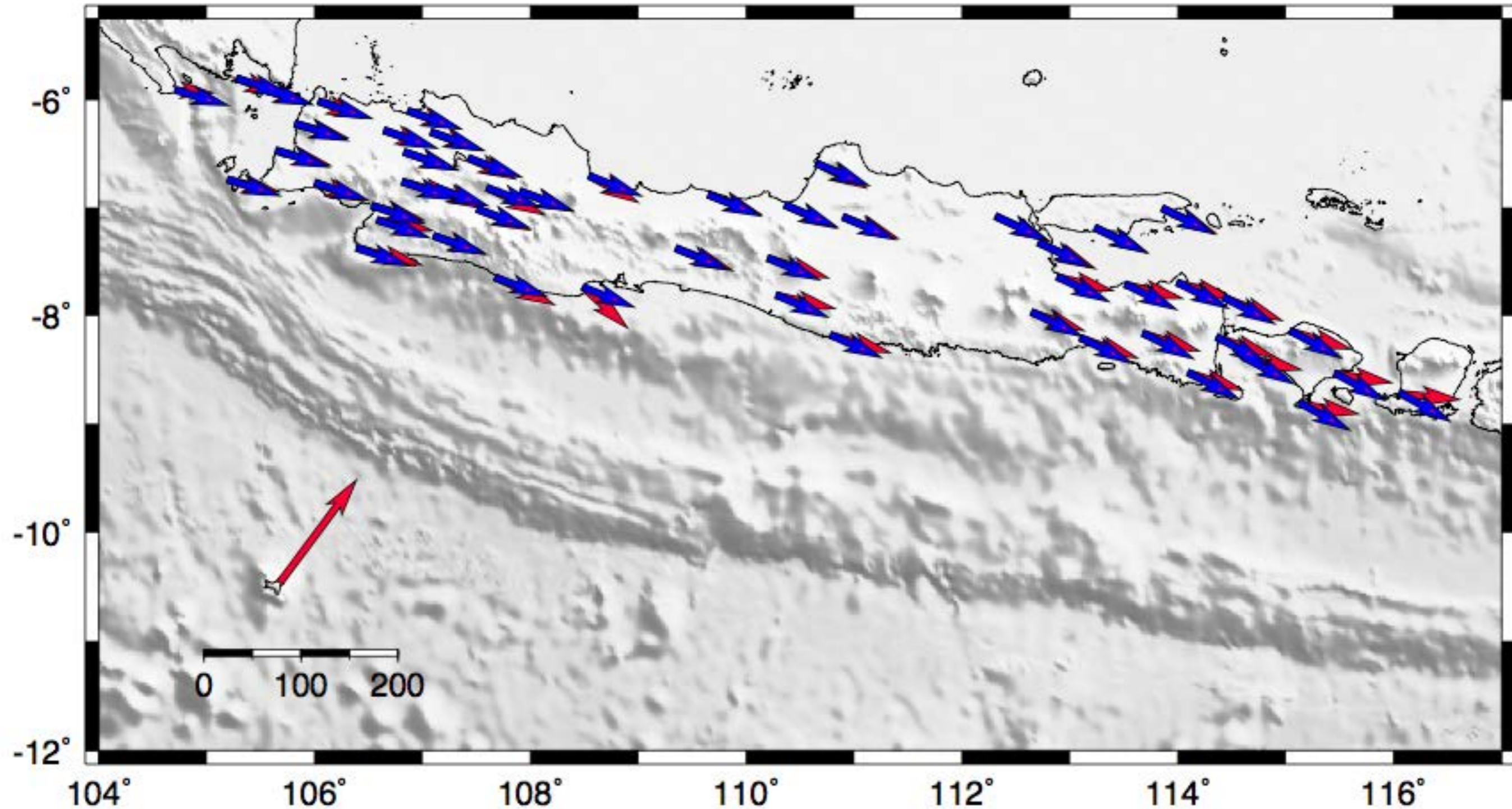




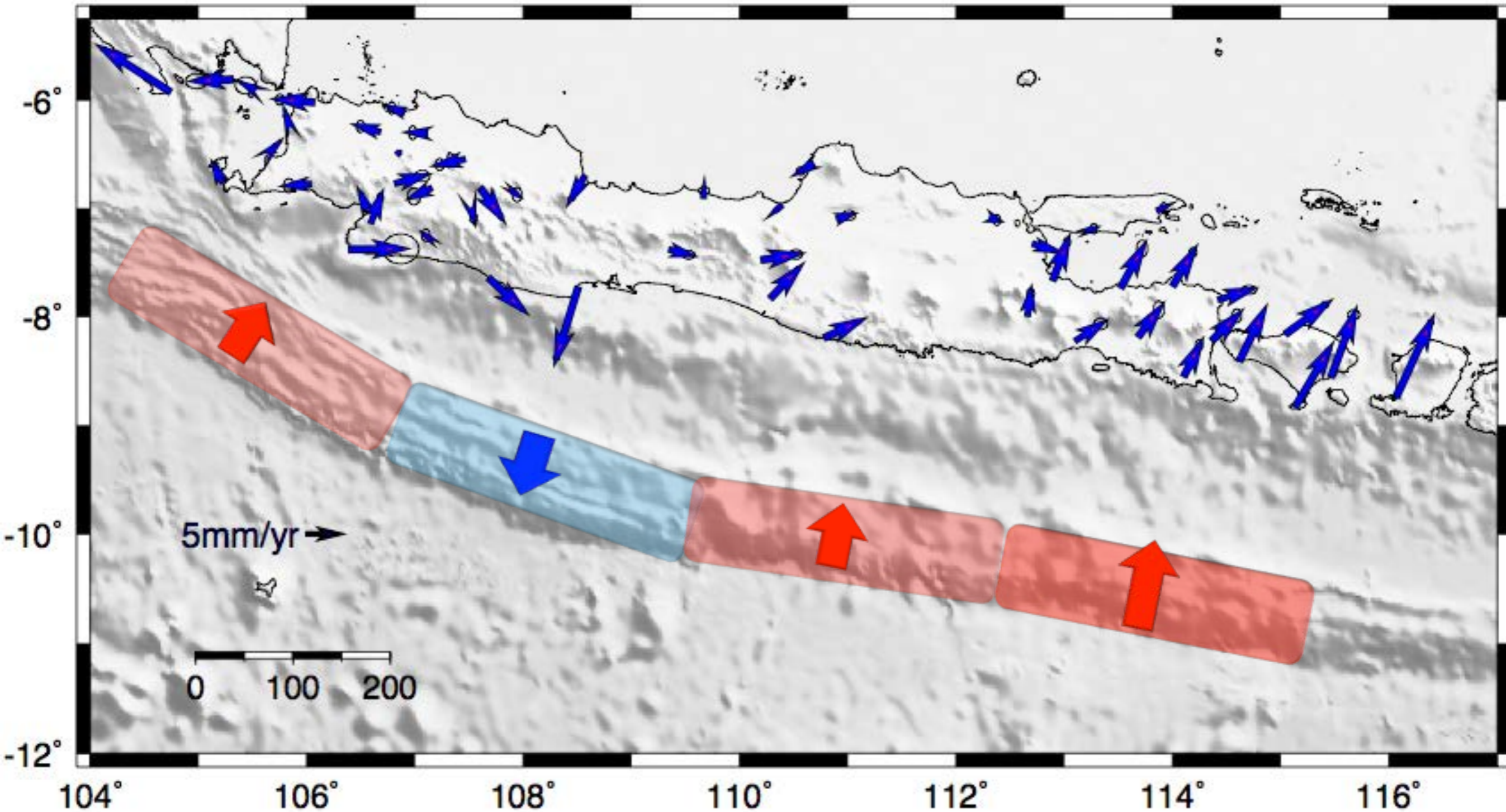
Parameter of rigid body rotation (Sunda)

Block	Reference	Latitude	Longitude	Rotation Rate deg/Ma
Sunda-ITRF00	Block et al., 2003	49.4	-95.9	0.32
Sunda-ITRF00	Bird., 2003	55.442	-72.955	1.103
Sunda-ITRF08	this study	41.021	-88.038	0.4

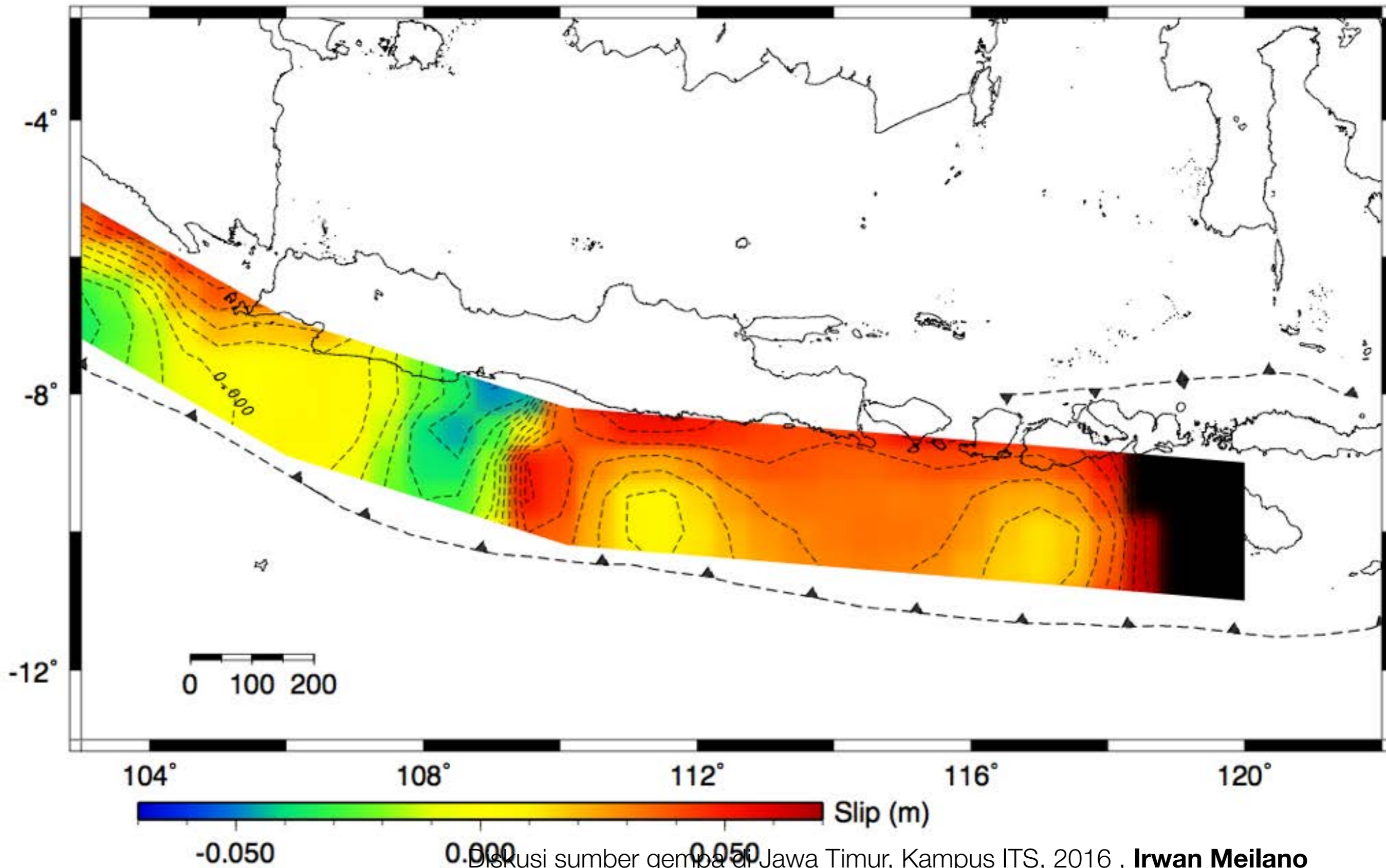
Displacement velocity 2010-2012 (wrt ITRF08)



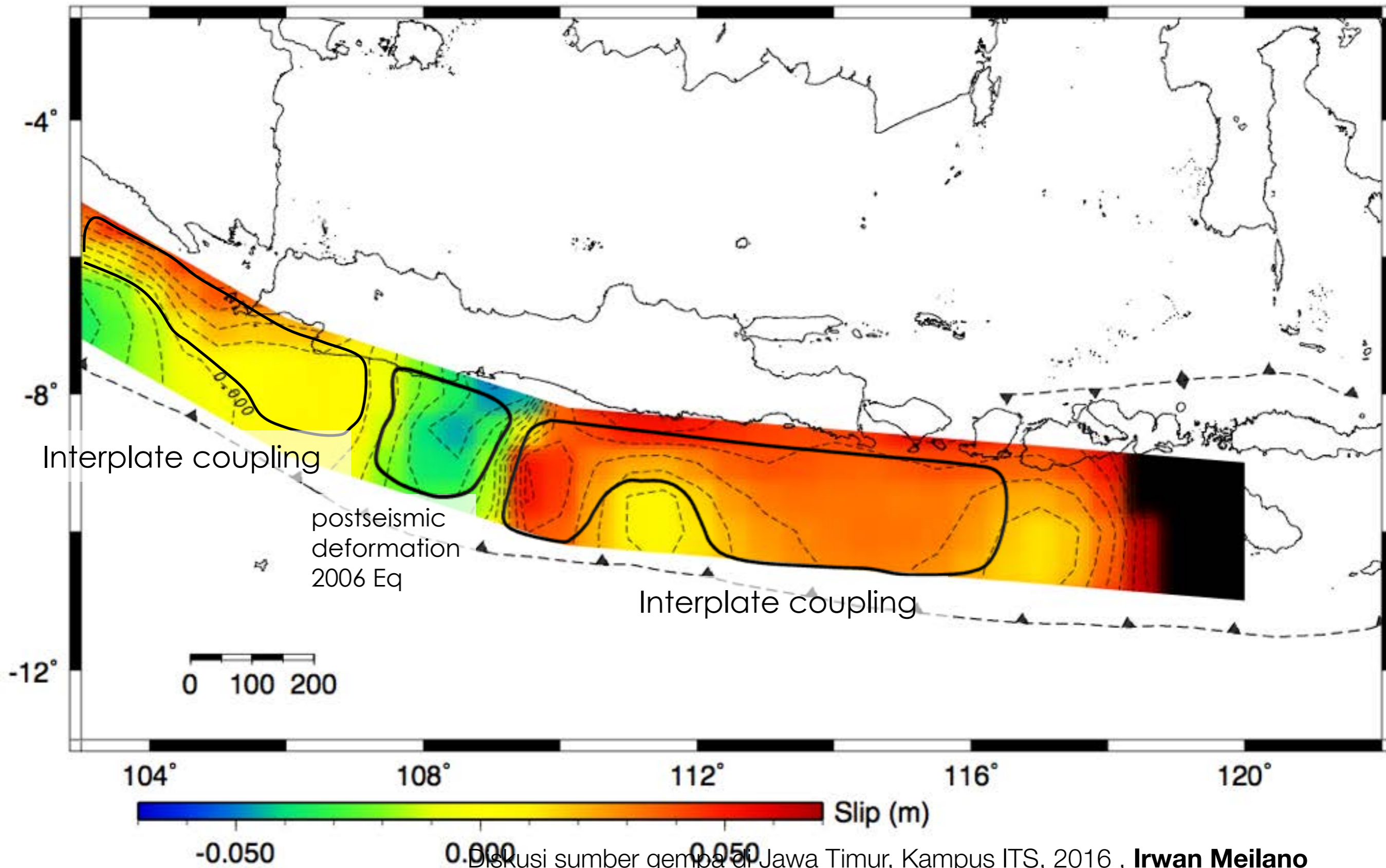
Displacement velocity 2010-2012



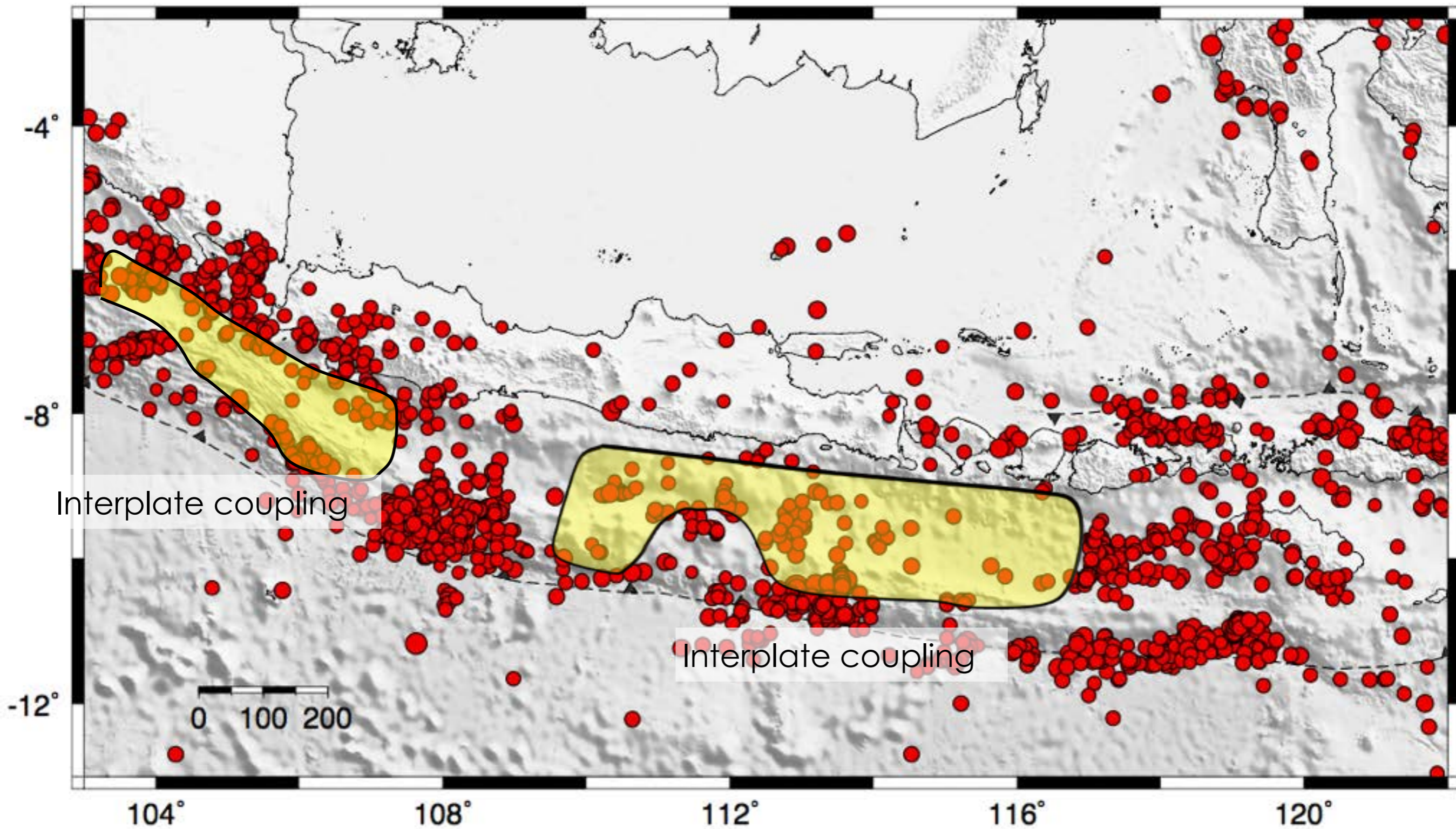
Distribution of interplate coupling



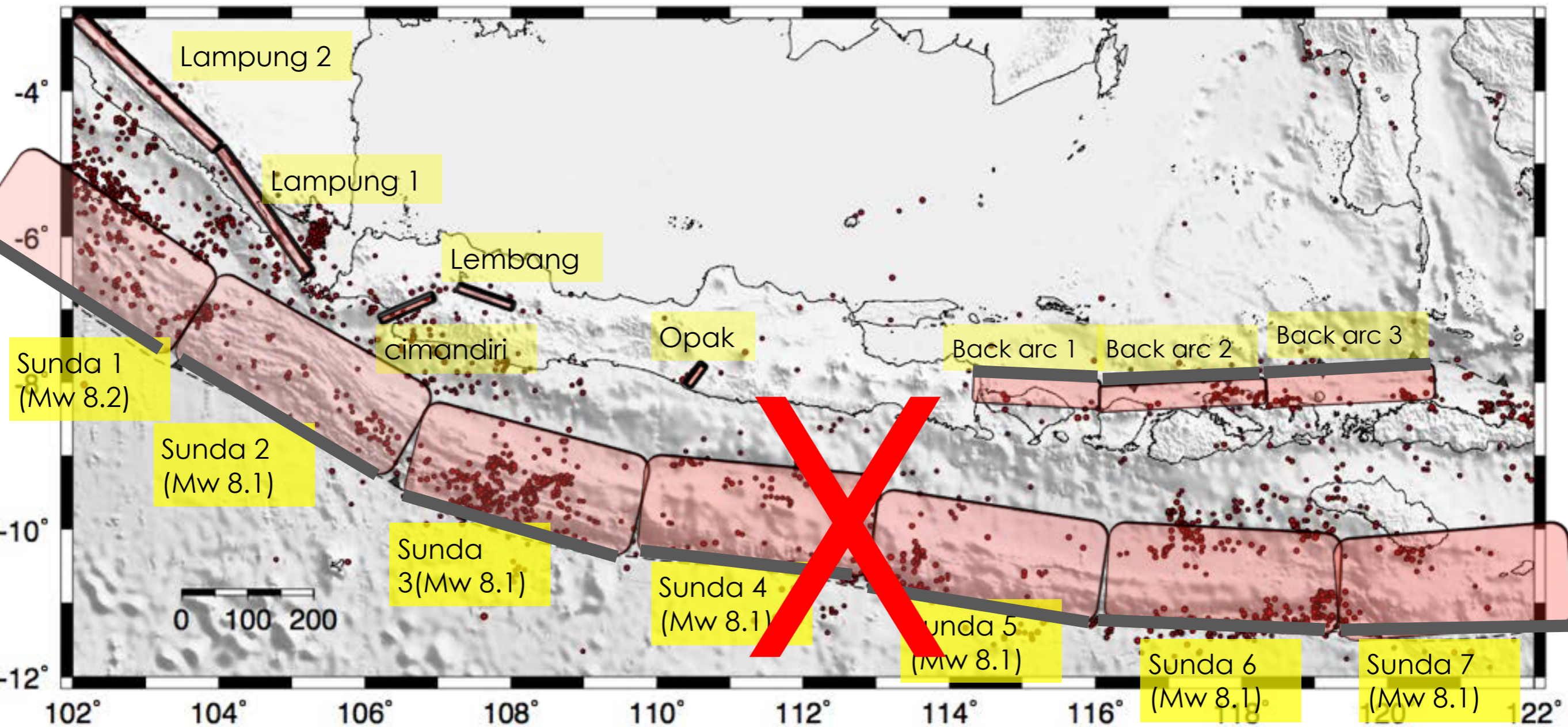
Distribution of interplate coupling



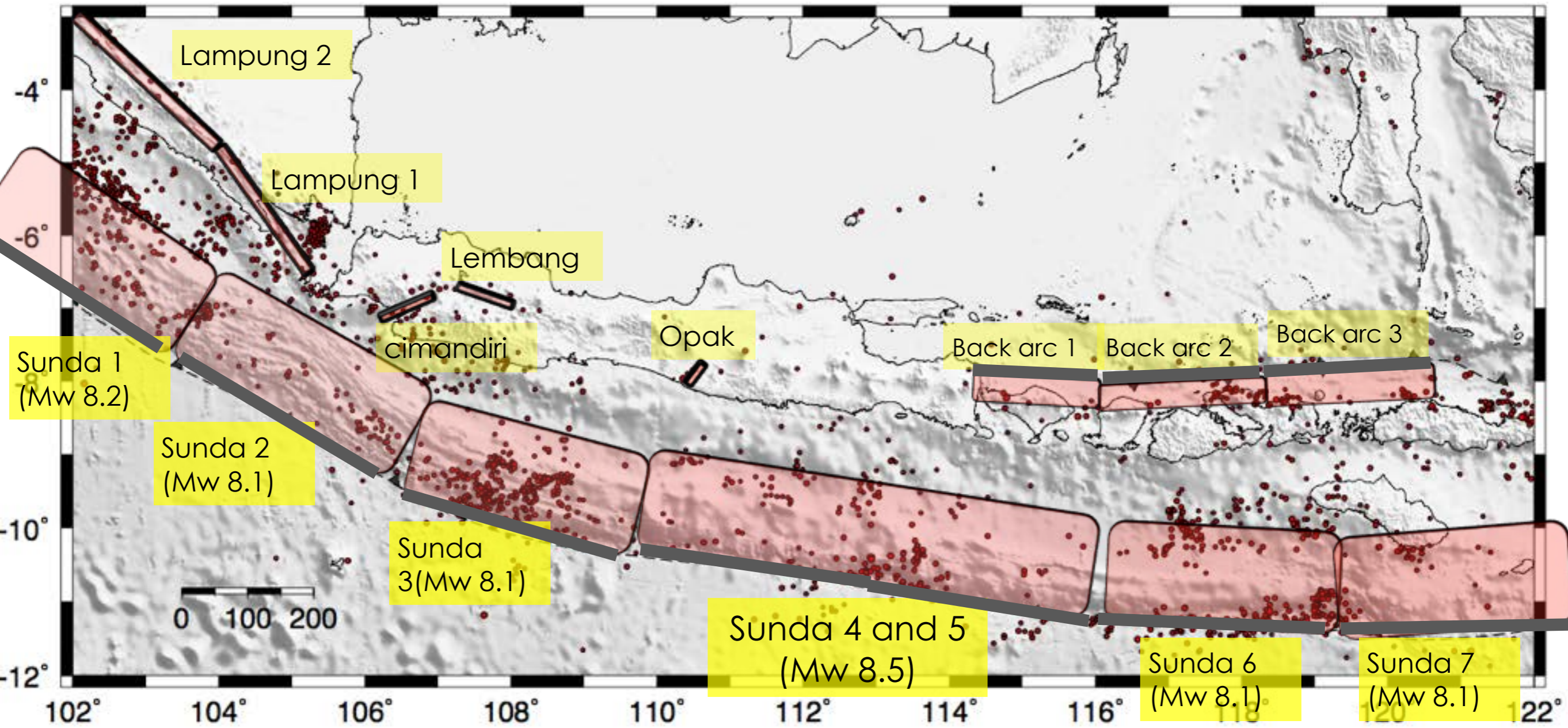
Distribution of interplate coupling



Implication to seismic hazard

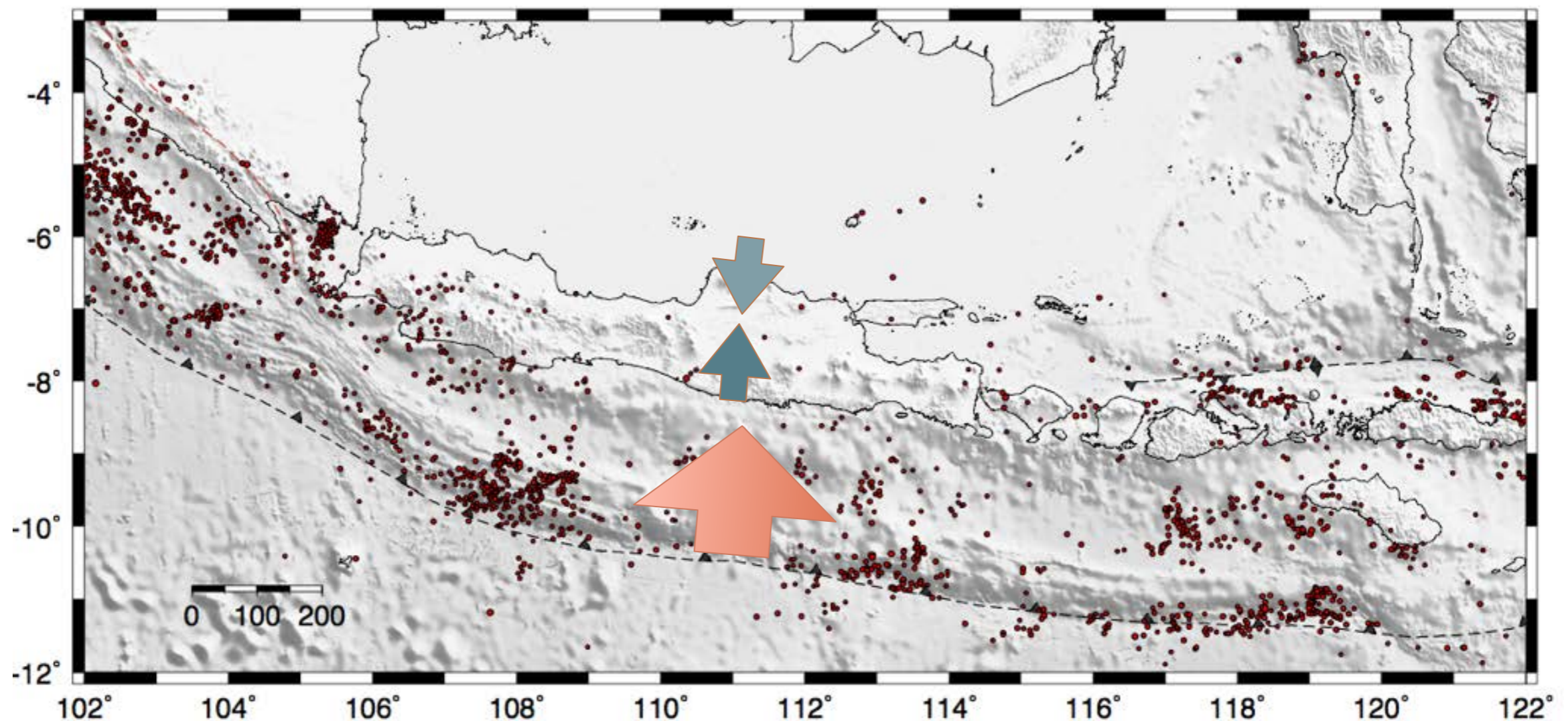


Implication to seismic hazard

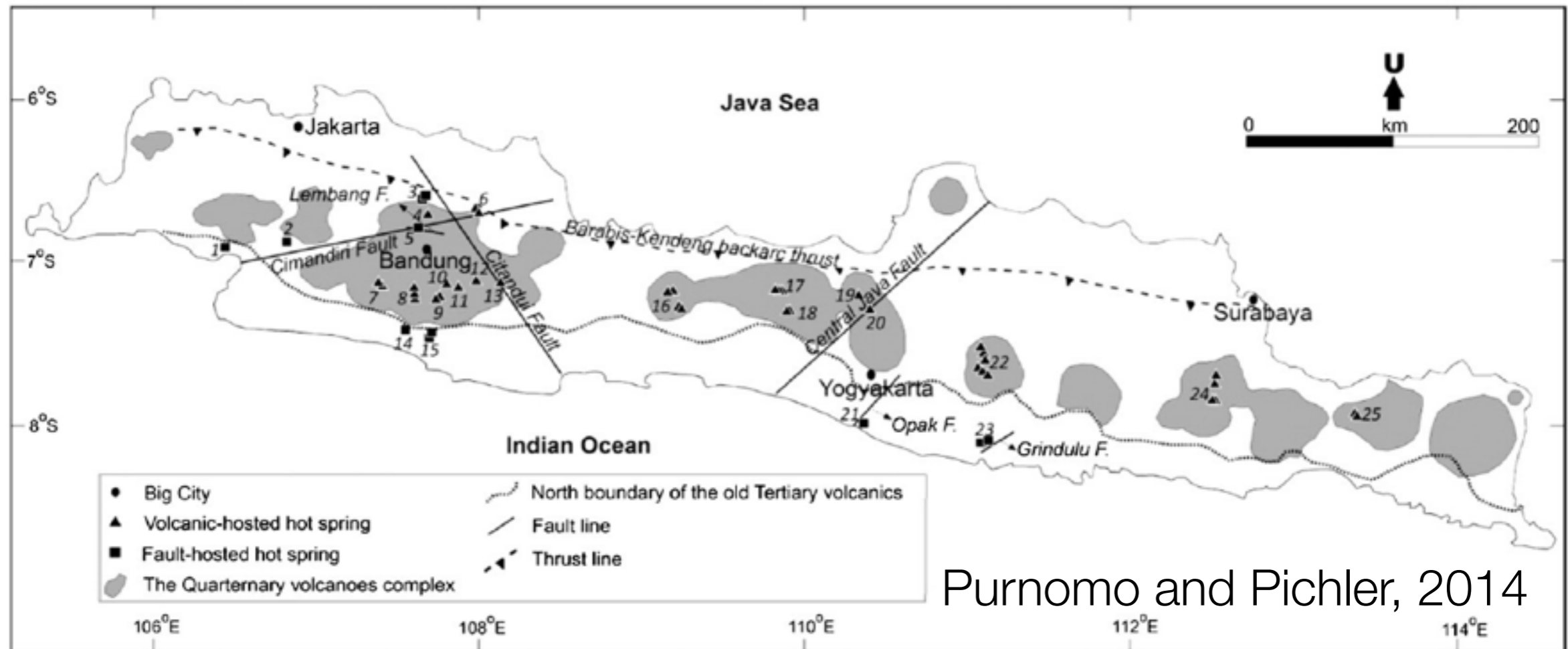


Research Question

Can we see any evidence of strain/stress accumulation in the Eastern of Java ?

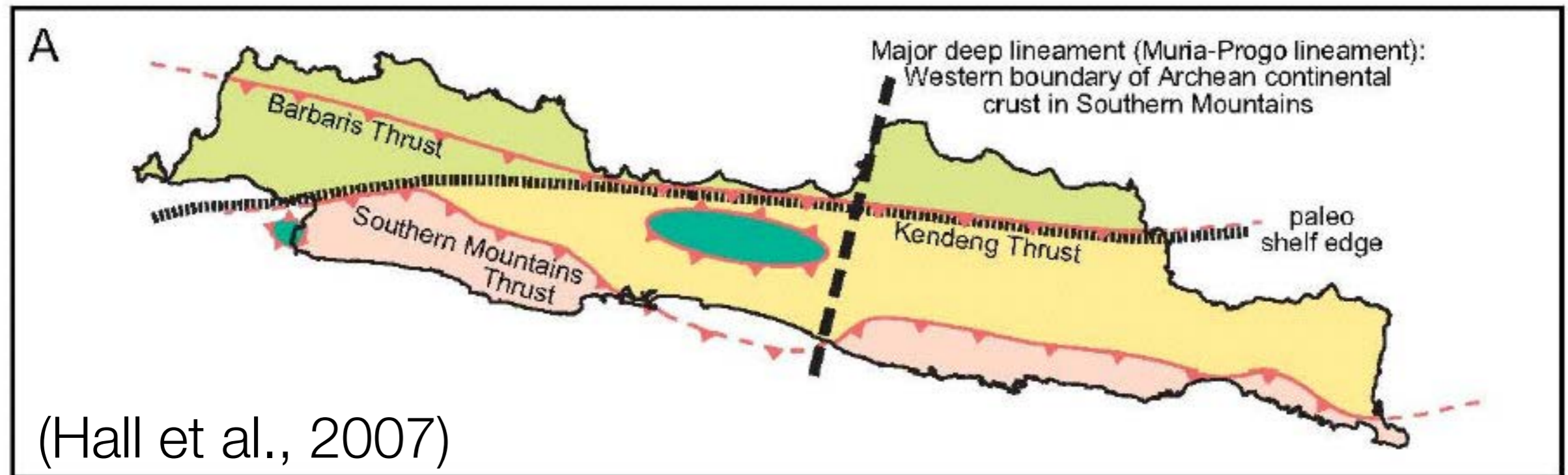


Baribis Kendeng Thrust



- Baribis-Kendeng Thrust: developed in the Late Neogene, since the cessation of and during oceanward migration of the tertiary subduction zone the south (Simandjuntak, 1995)
- To the east the thrust extends through Bali-Sumbawa straits to the Flores sea

Baribis Kendeng Thrust

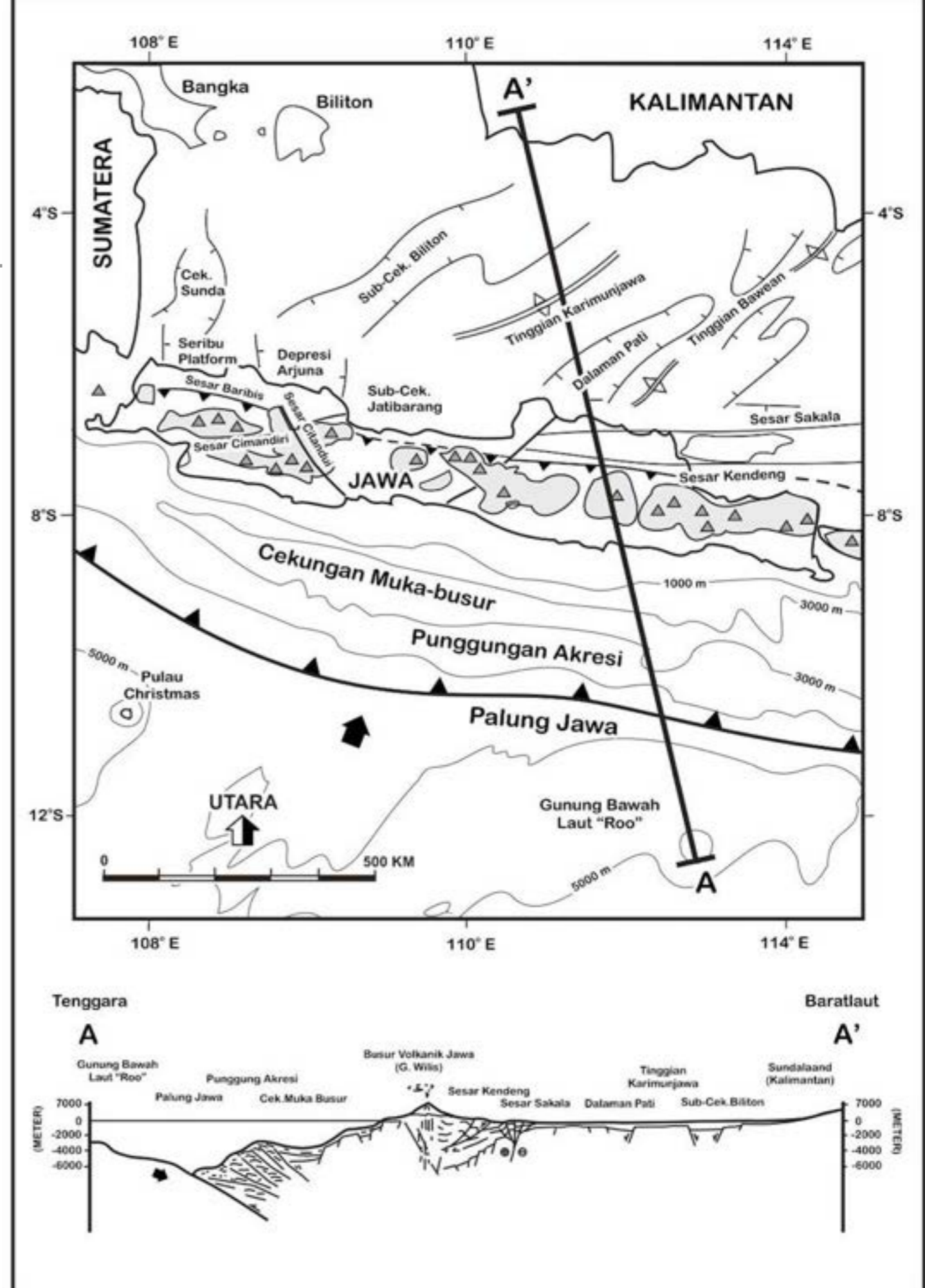


The northward thrusting in north Java is part of contractional deformation of a large wedge north of the trench, with compression between the trench and a backstop. (Hamilton, 2007)

The thrusting is Early Miocene or younger, but at present we cannot be certain of its exact age, nor if there was more than one episode of thrusting. (Hamilton, 2007)

Kendeng Thrust

- Back thrust initiated and caused the development of the Sunda orogeny, giving rise to the formation of the fold and thrust belt which was coupled with Late Neogene plutonic intrusion, causing the uplift of mountain ranges in southern Java.



Kendeng Thrust

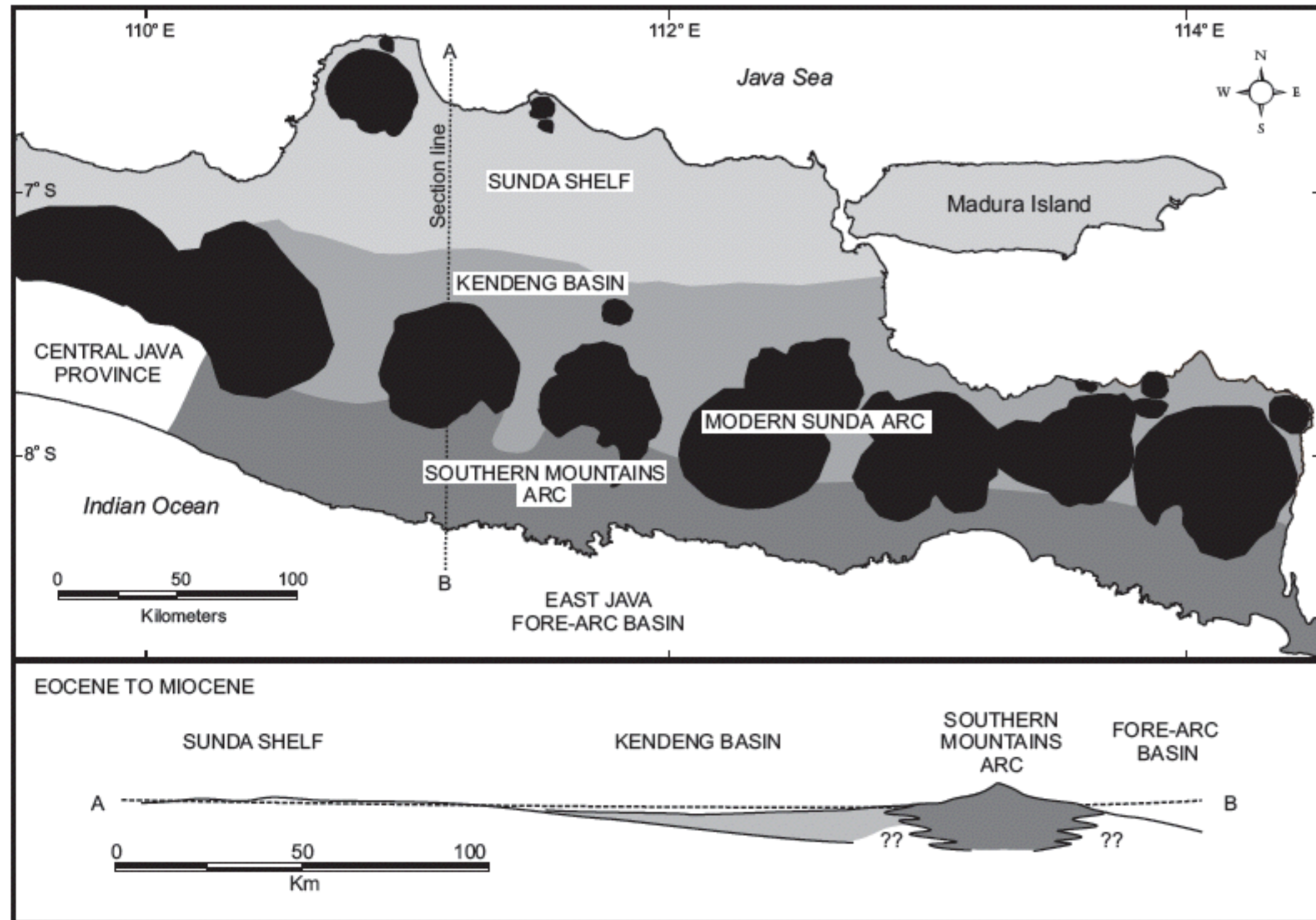


Figure 3. Structure of East Java in map-and-sketch Eocene to Miocene profile, showing the three structural provinces—Southern Mountains Arc, Kendeng Basin, and the edge of the Sunda Shelf—and the modern Sunda Arc building on top.

Smyth et al., 2008

Kendeng Thrust

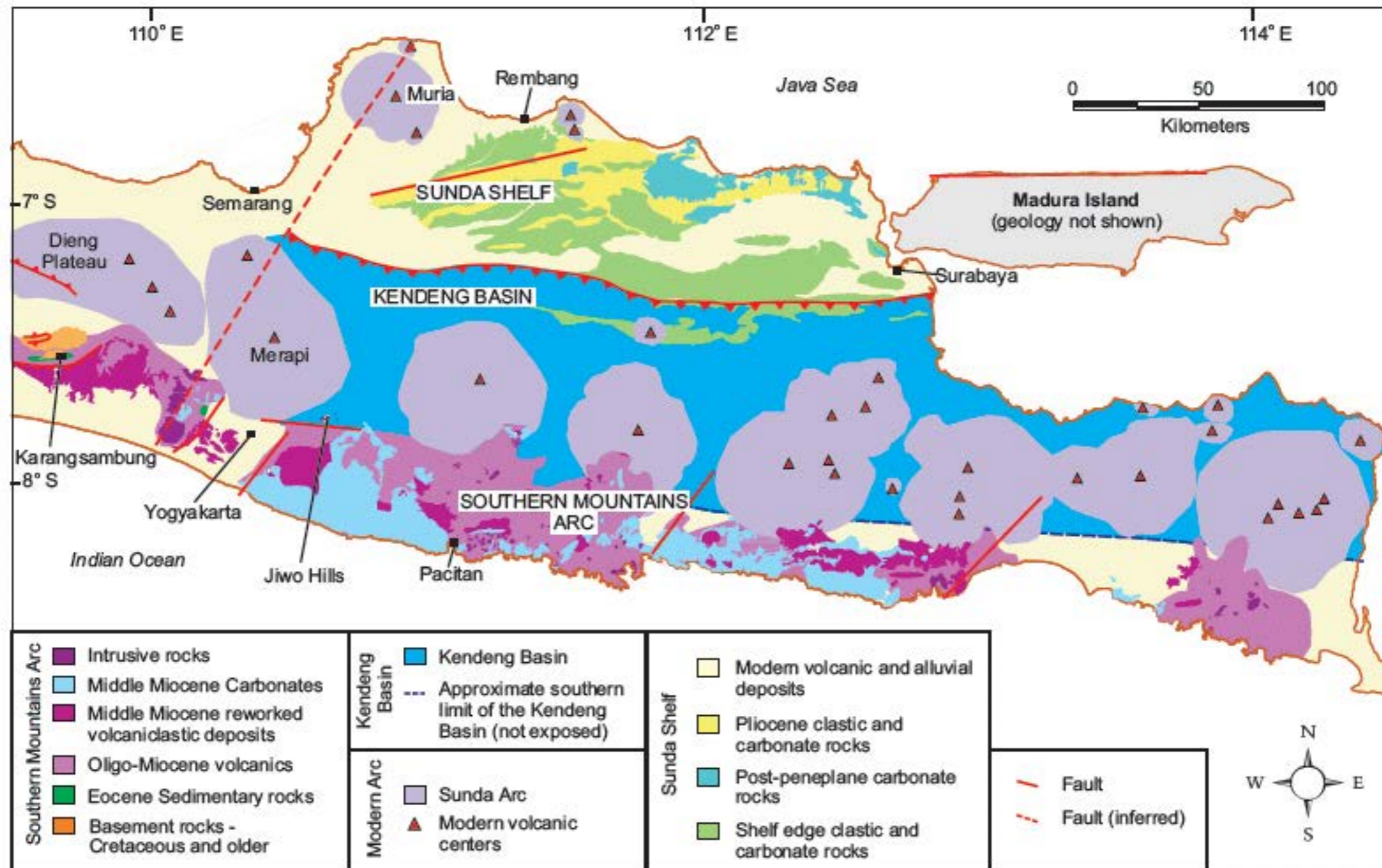


Figure 4. Simplified geological map of East Java, showing the main geological provinces and stratigraphic units.

Smyth et al., 2008

Kendeng Thrust

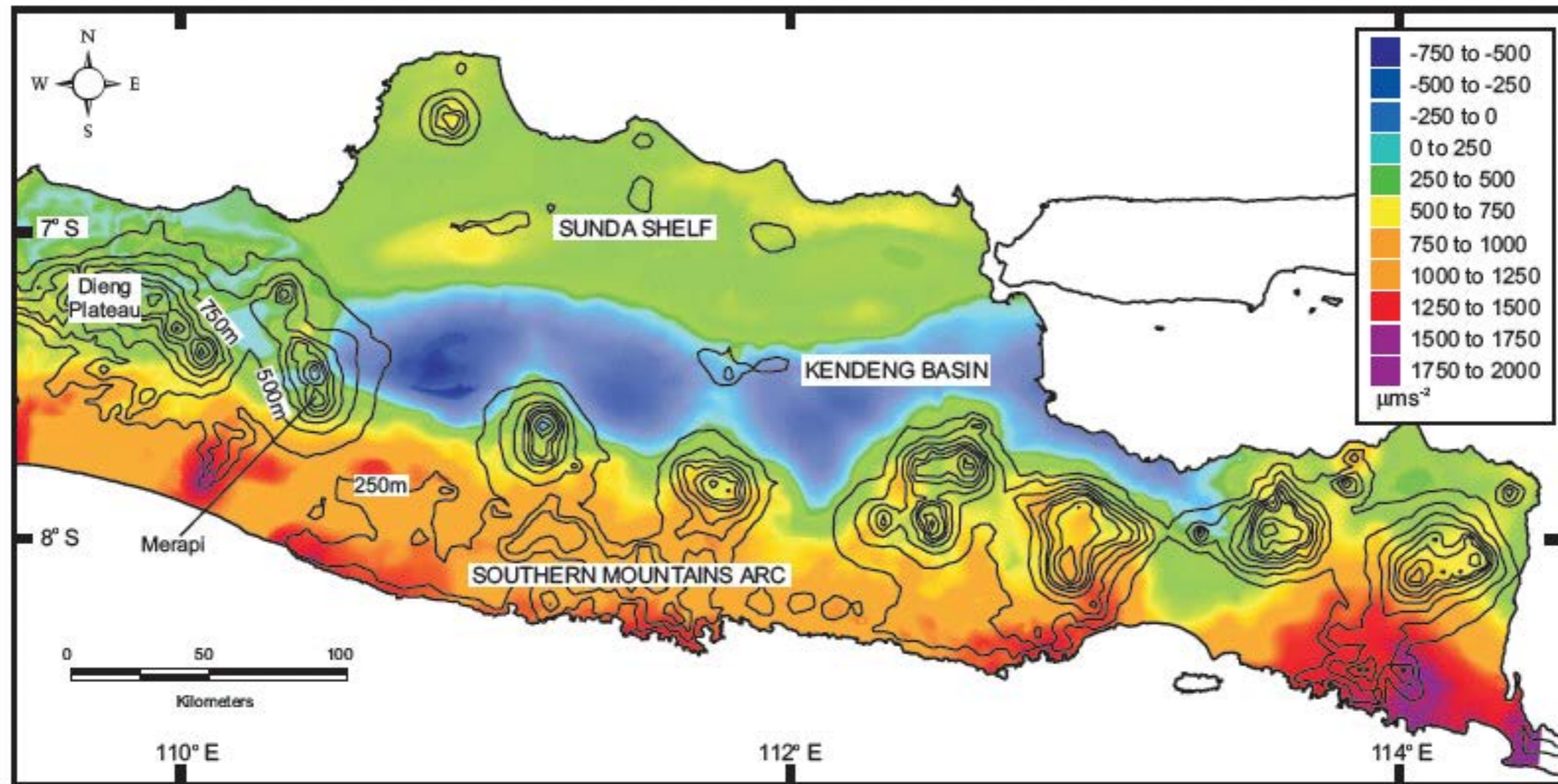
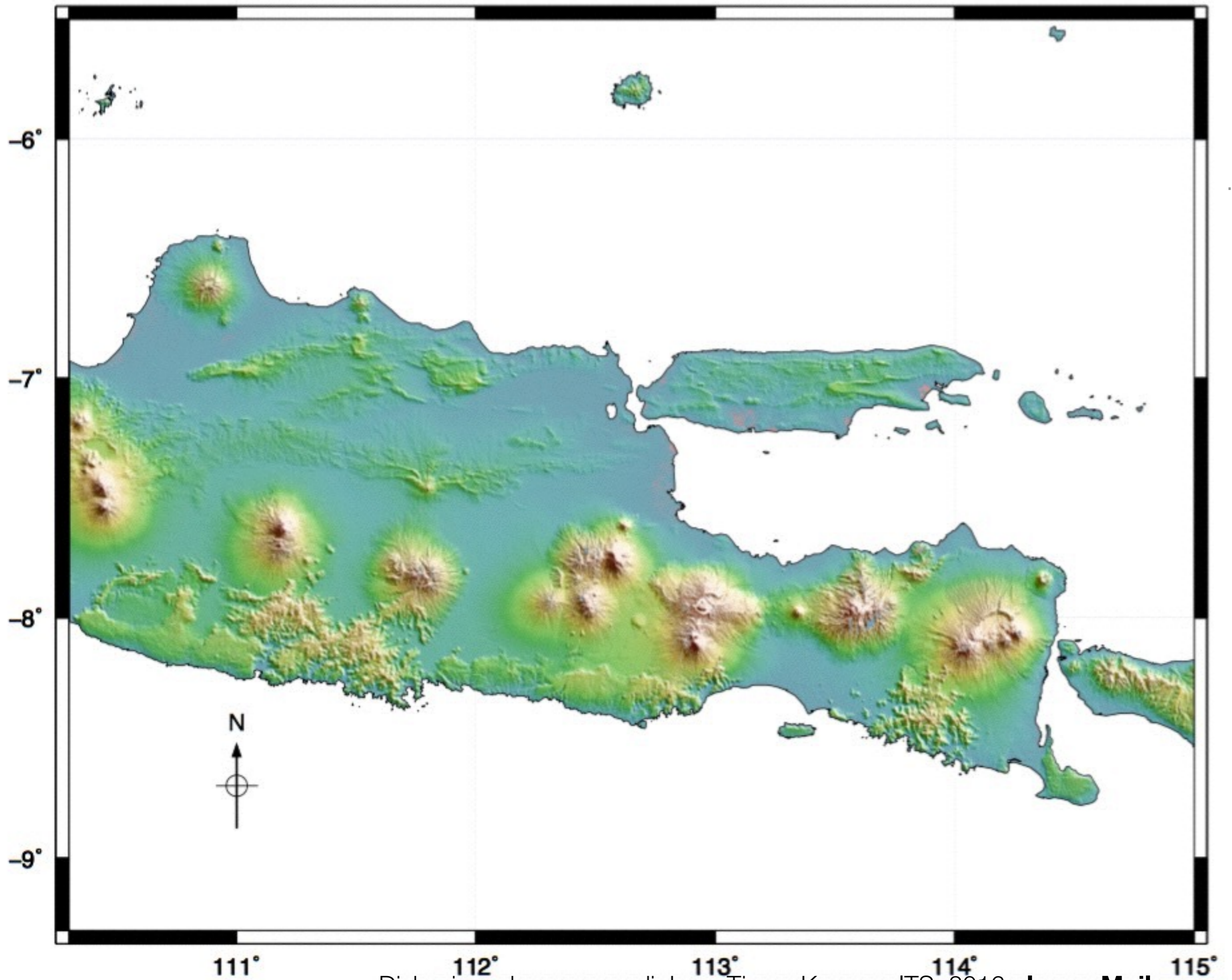
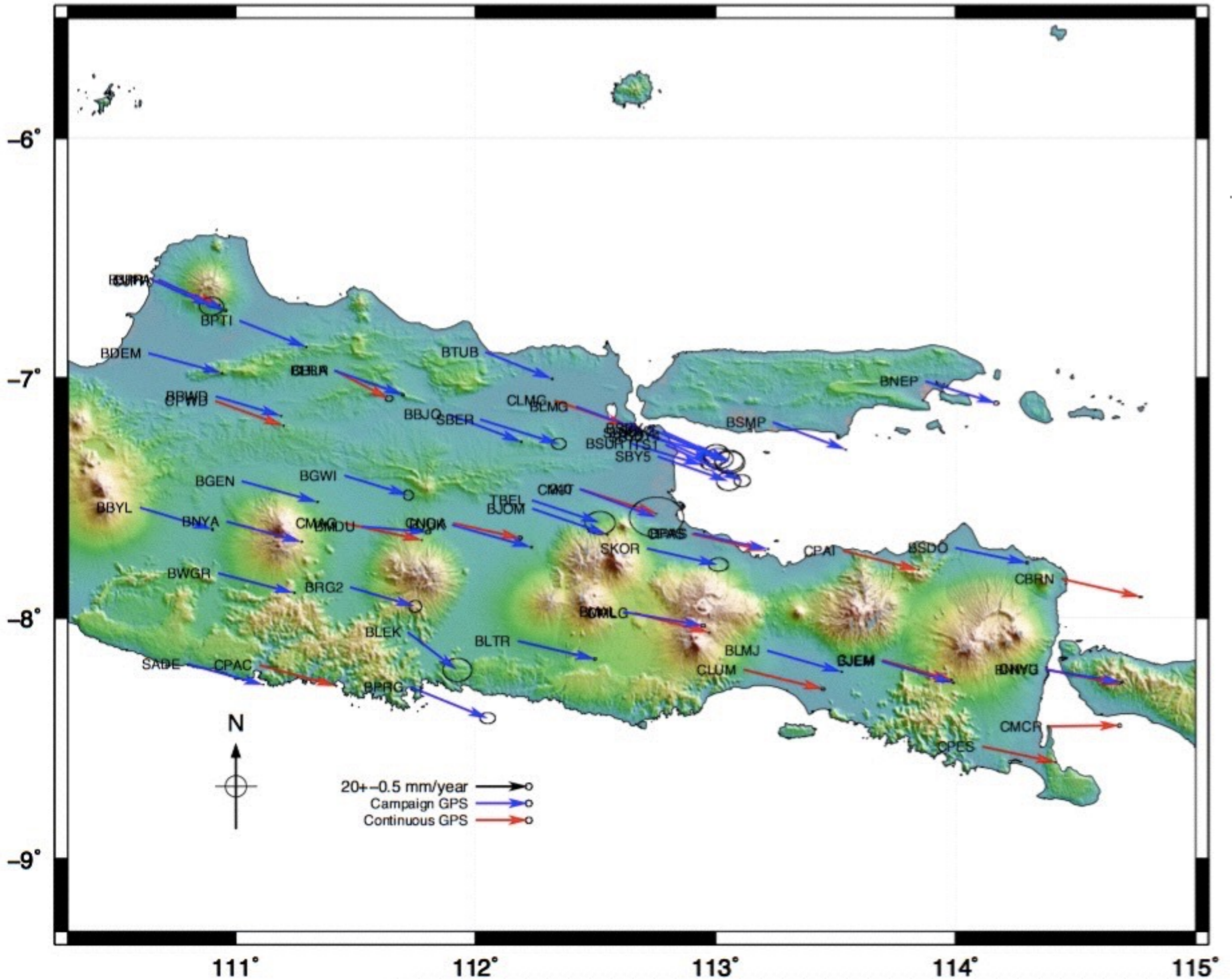
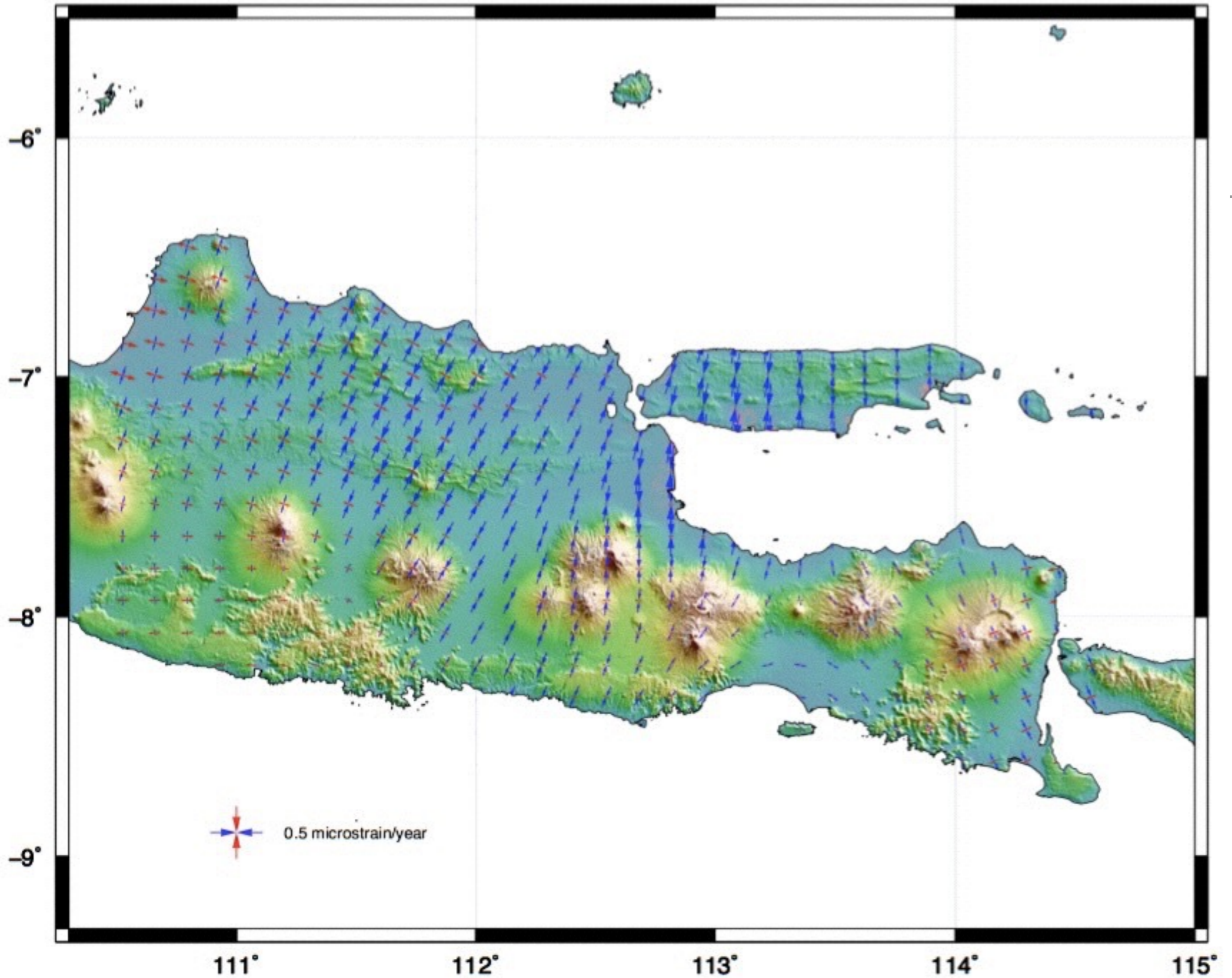


Figure 5. Bouguer gravity anomaly map of East Java. The map also shows topographic contours at 250 m intervals.

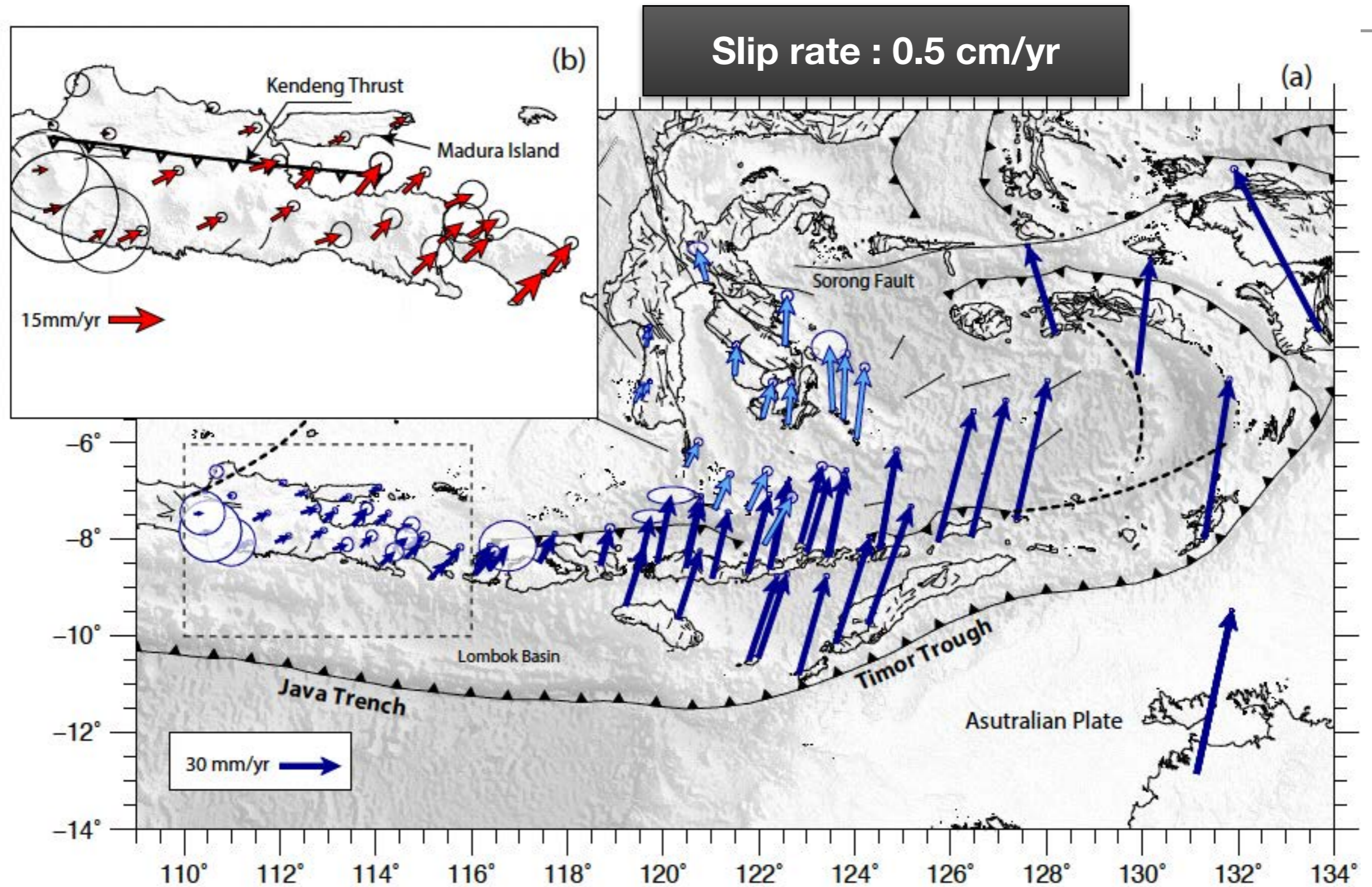
Smyth et al., 2008



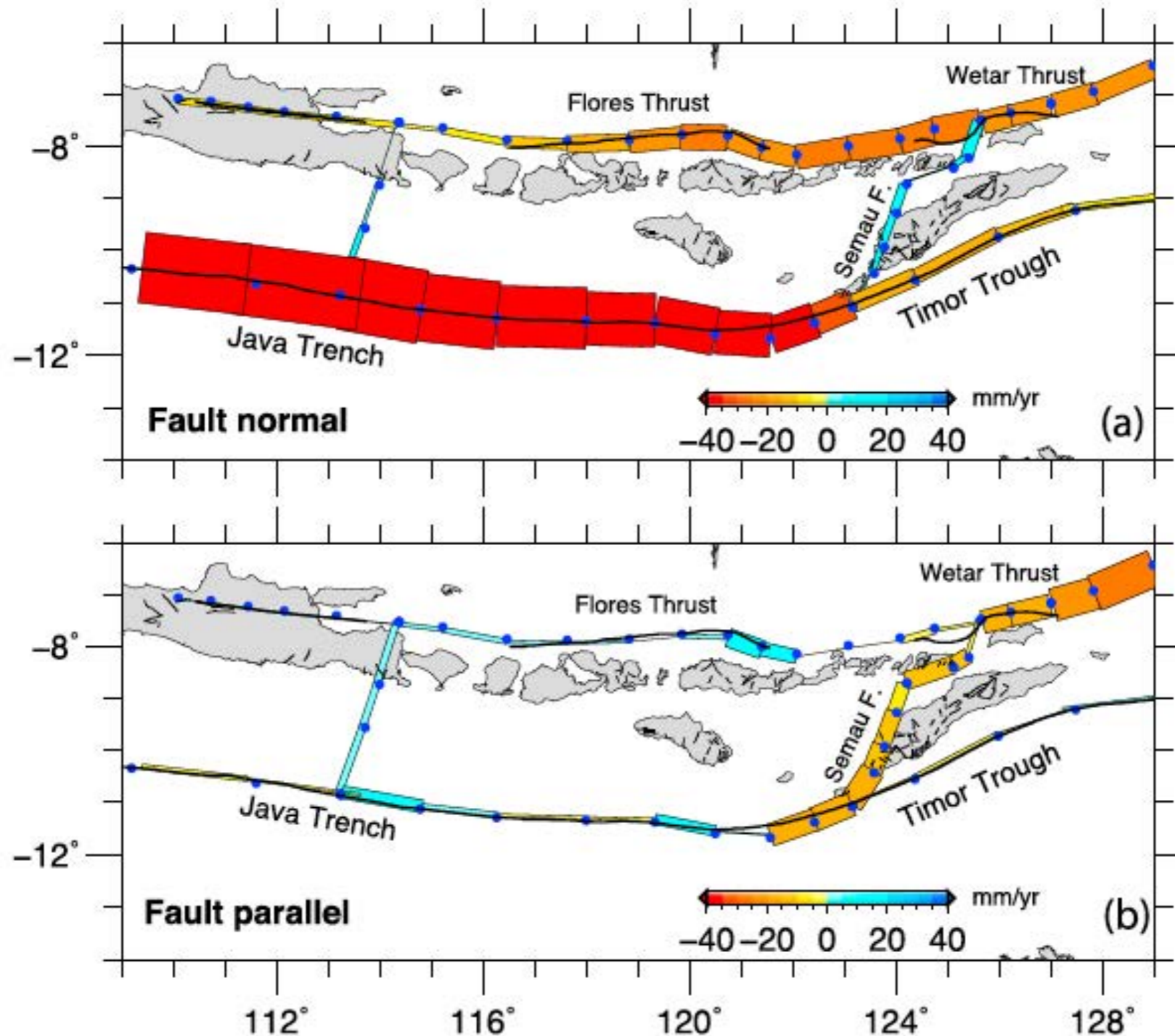




Fault in Java : Kendeng Fault Zone



Fault in Java : Kendeng Fault Zone



Conclusion

- Our results draw a new kinematic framework for active deformation in the eastern Sunda-Banda Arc, highlighting the need to reconsider the level of seismic hazard there.
- The Kendeng thrust passes through the southern outskirts of Surabaya, Indonesia's second largest city with a population of over 2.5 million, and traverses a 300 km length of East Java.

Unsolved Question !

Collaborative research is needed

- Is Kendeng fault form a single-long fault or segmented into smaller segment ?
- How big is the maximum magnitude of the earthquake ?
- Where is the western edge of the Kendeng fault ?
- What is the hazard implication of Kendeng fault ?