On the Development of Deformation Model for the Indonesian Geospatial Reference System (IGRS) 2013

Susilo SUSILO[1,2], Hasanuddin Z. ABIDIN[2], Irwan MEILANO[2],
K. PRIJATNA[2], B. SAPIIE[2], A.B. WIJANARTO[1], J. EFENDI[1]

1) Geospatial Information Agency of Indonesia (BIG), Jln. Jakarta-Bogor Km. 46, Cibinong, Indonesia

2) Geodesy Research Group, Institute of Technology Bandung (ITB), Jln.Ganesha 10 Bandung, Indonesia

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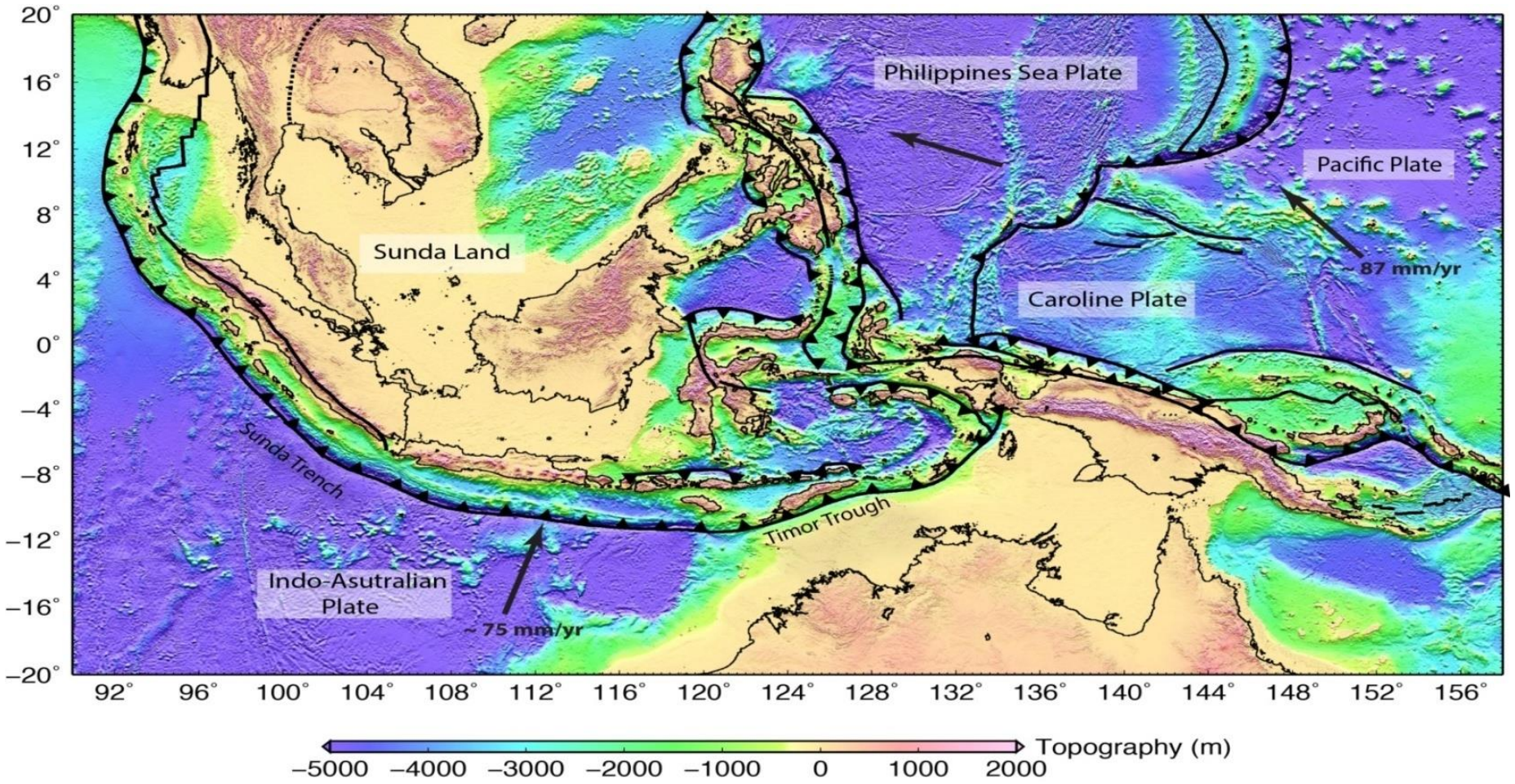
CHRISTCHURCH, NEW ZEALAND
2–6 May 2016
Recovery from disaster

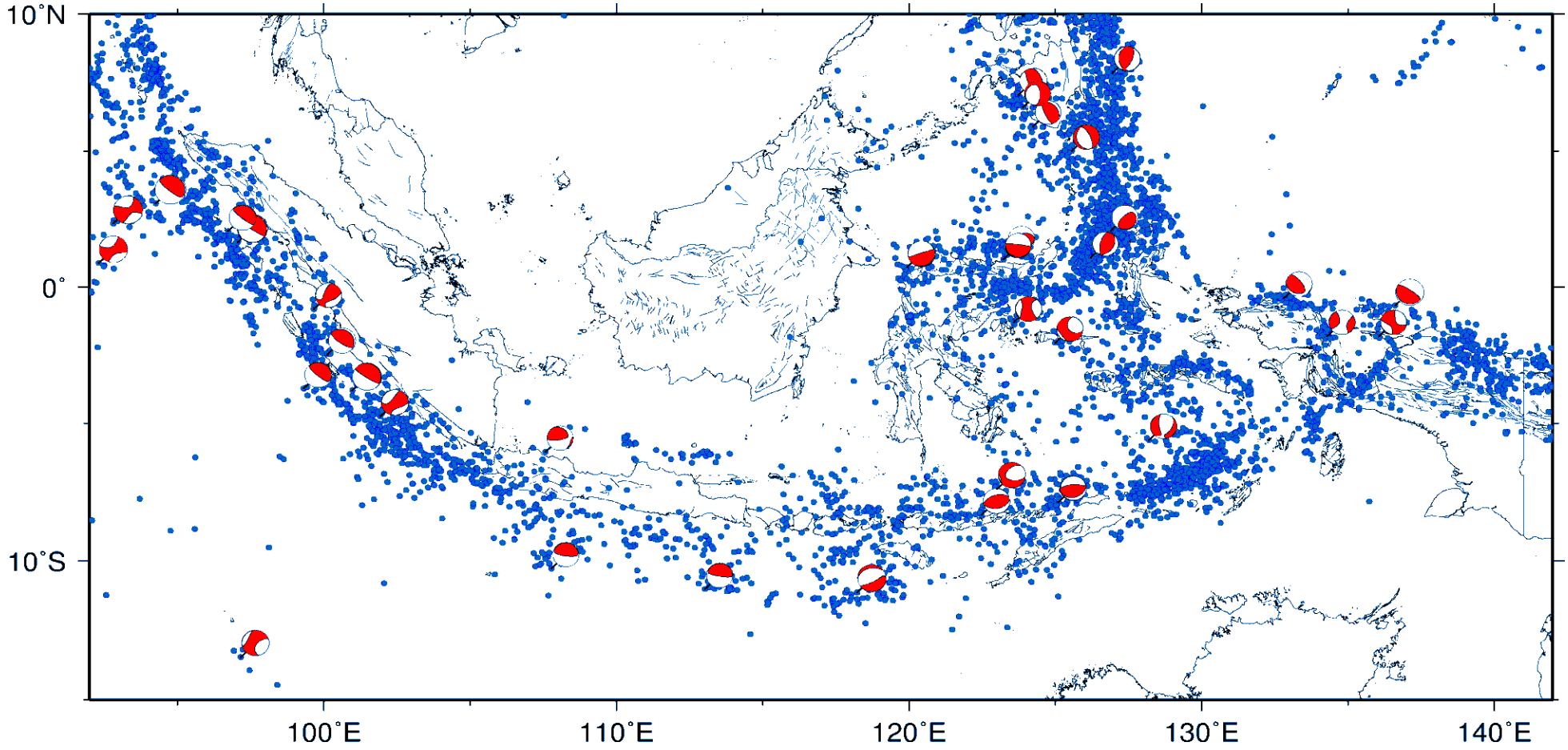
Regional Tectonic of Indonesia



Intersection of 3 major plates, wide range of tectonic environments, including island arc volcanism, subduction zones, and arc-continent collision

Susilo et al., 2016

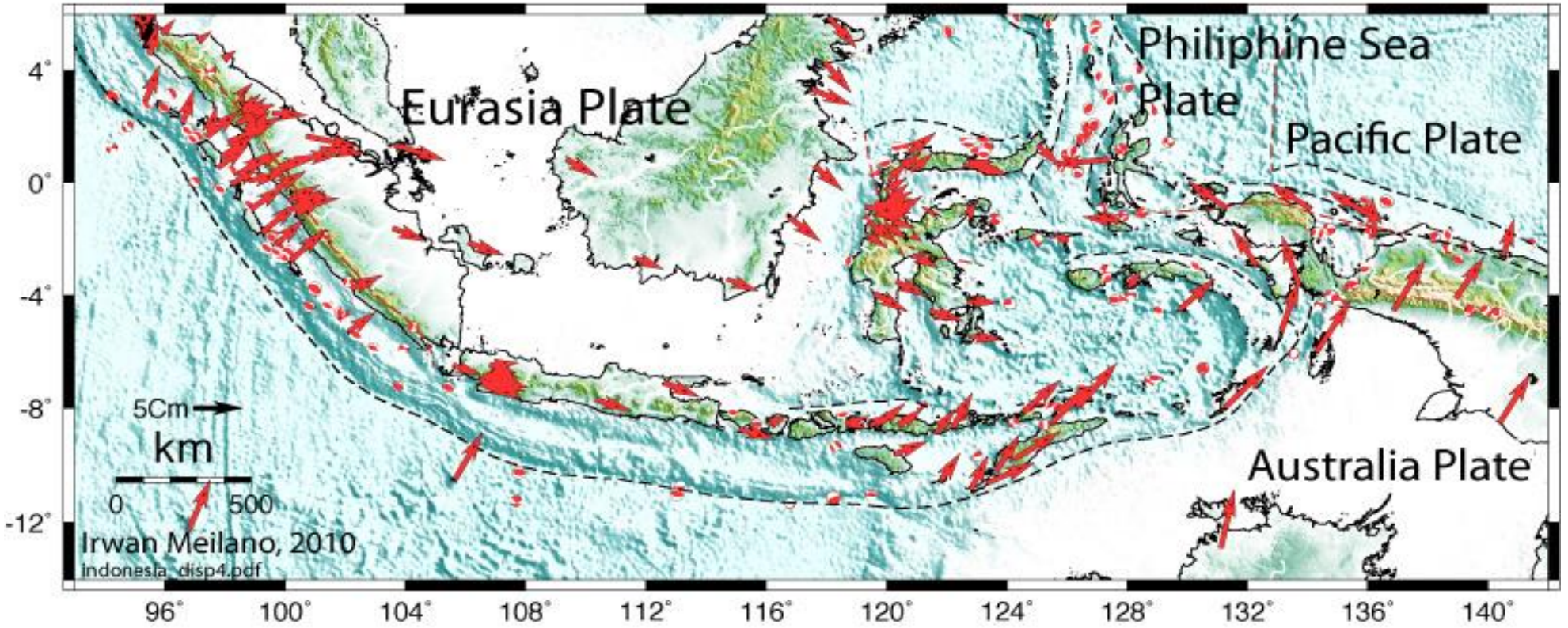
Tectonic Complexity of Indonesian Region (Seismicity)



High seismicity, shallow EQs mostly confined at the subduction zone

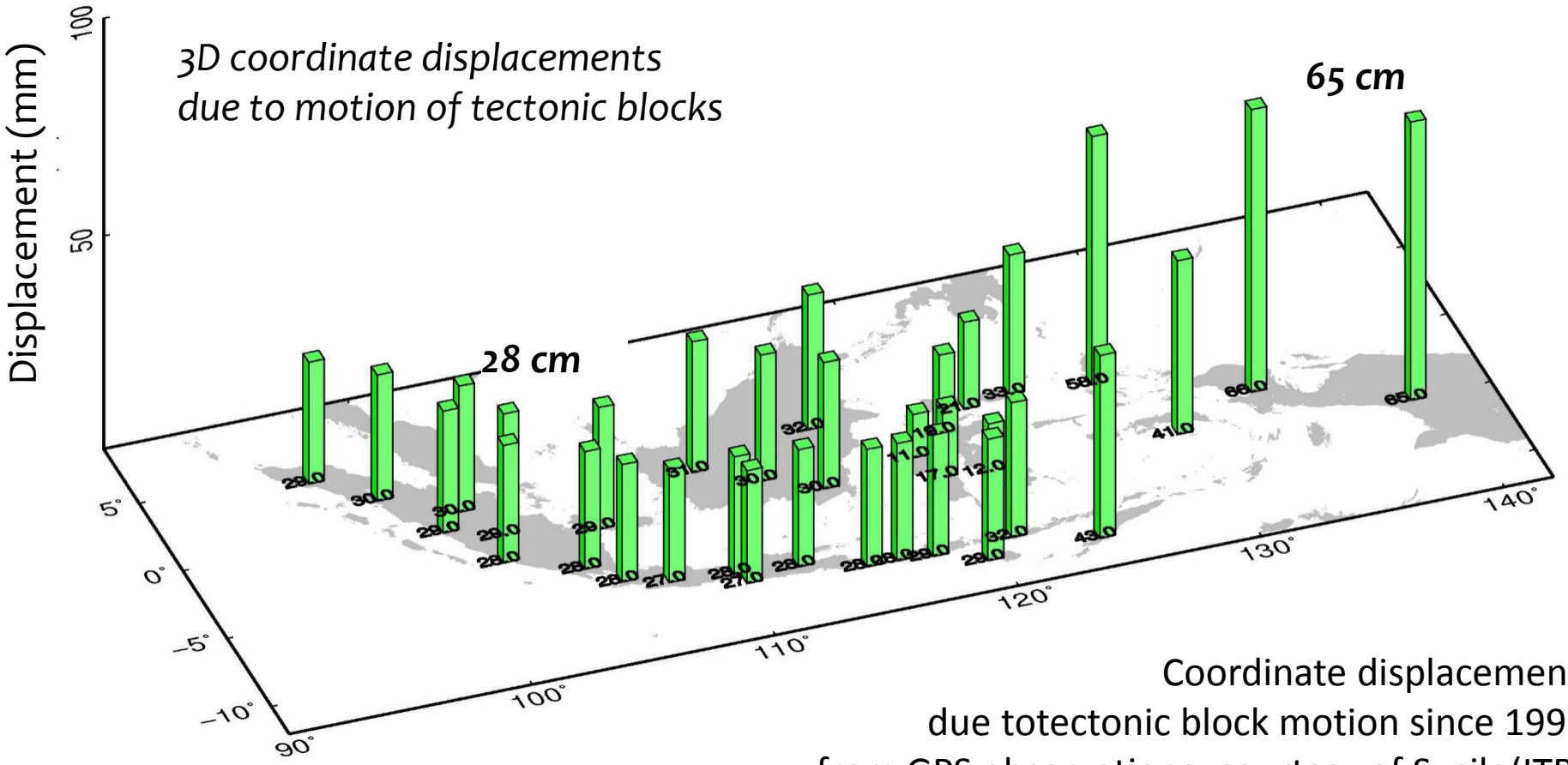
Susilo et al., 2016

Tectonic Complexity of Indonesian Region (Displacement)



Data : Stevent et.al.,[1999/2000], Nugroho et.al., [2000]. Bock,et.al., [2003] Socquet et.al., [2006], Subarya et.al.,[2007]. Abidin et al., [2007], Meilano et al., [2012]

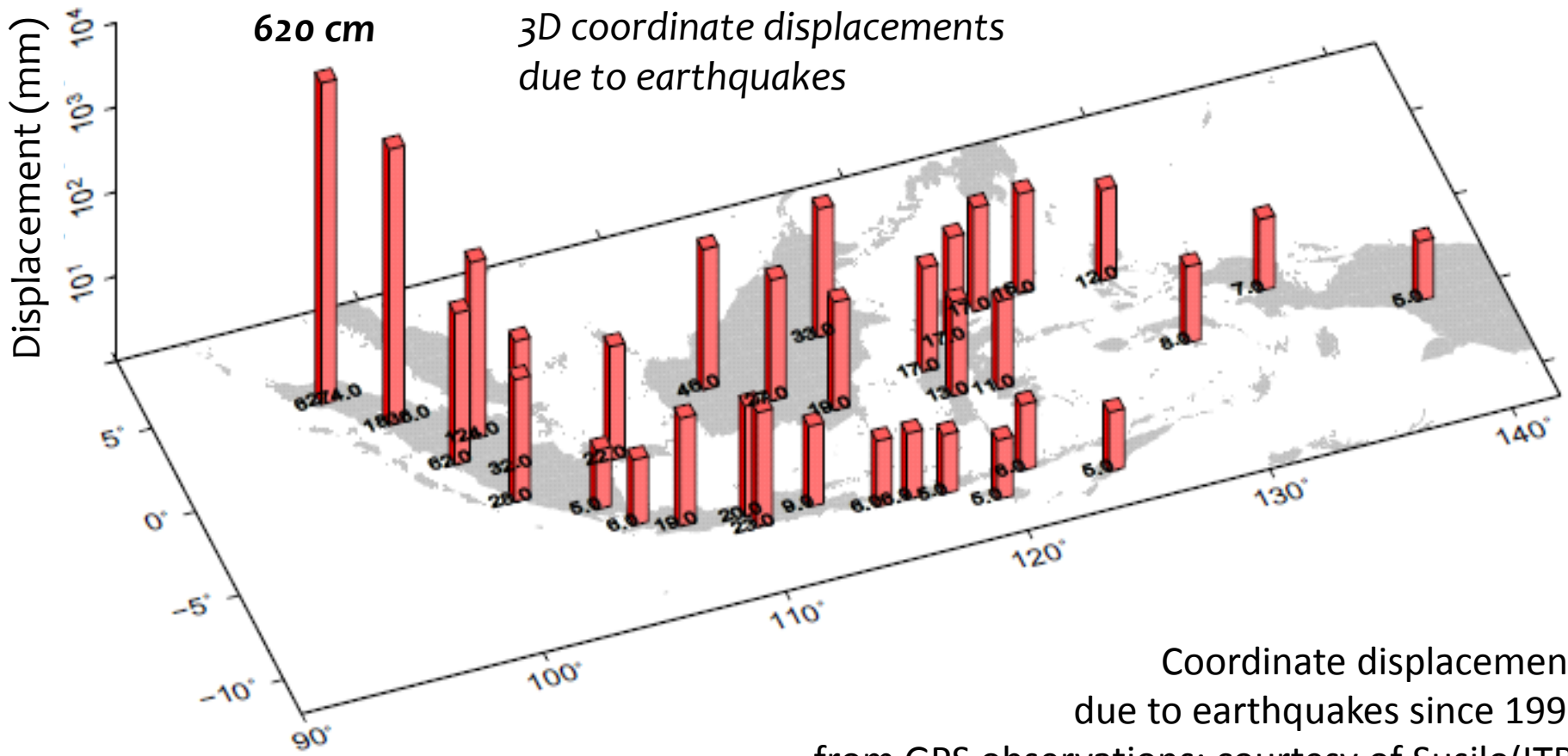
Coordinate Displacements



Coordinate displacements
due totectonic block motion since 1996,
from GPS observations; courtesy of Susilo(ITB).

courtesy of Irwan Meilano (ITB)

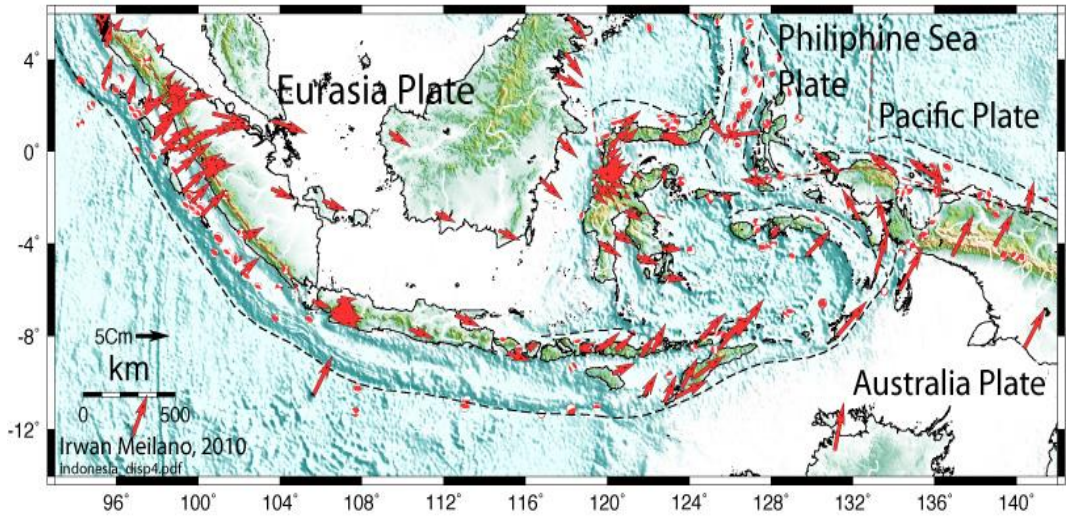
Coordinate Displacements

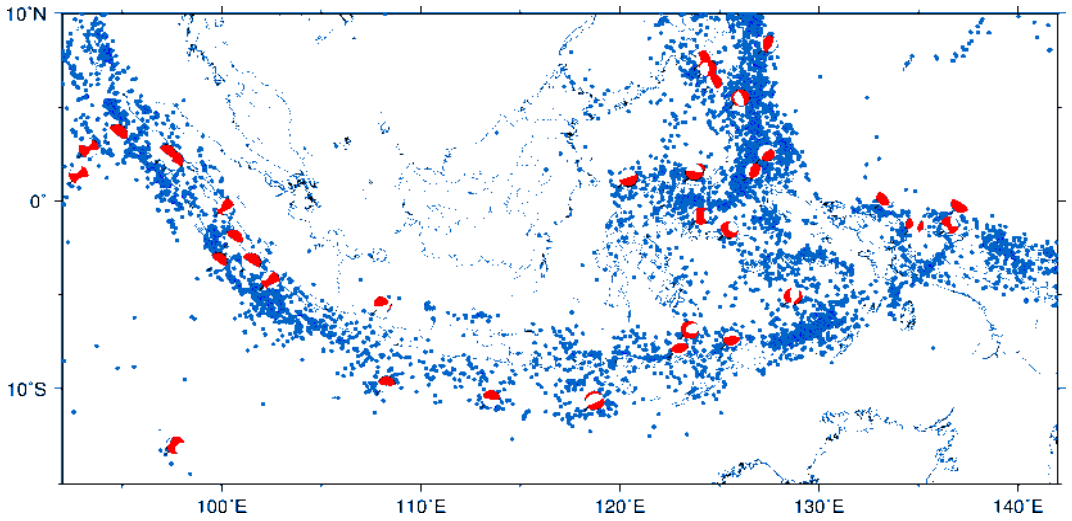


Coordinate displacements
due to earthquakes since 1996,
from GPS observations; courtesy of Susilo(ITB).

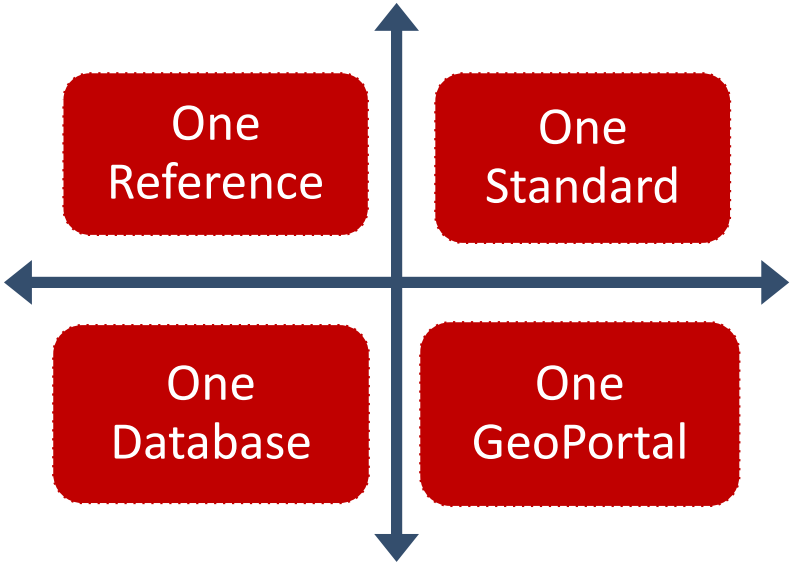
courtesy of Irwan Meilano (ITB)

The Need for a more dynamic New Datum





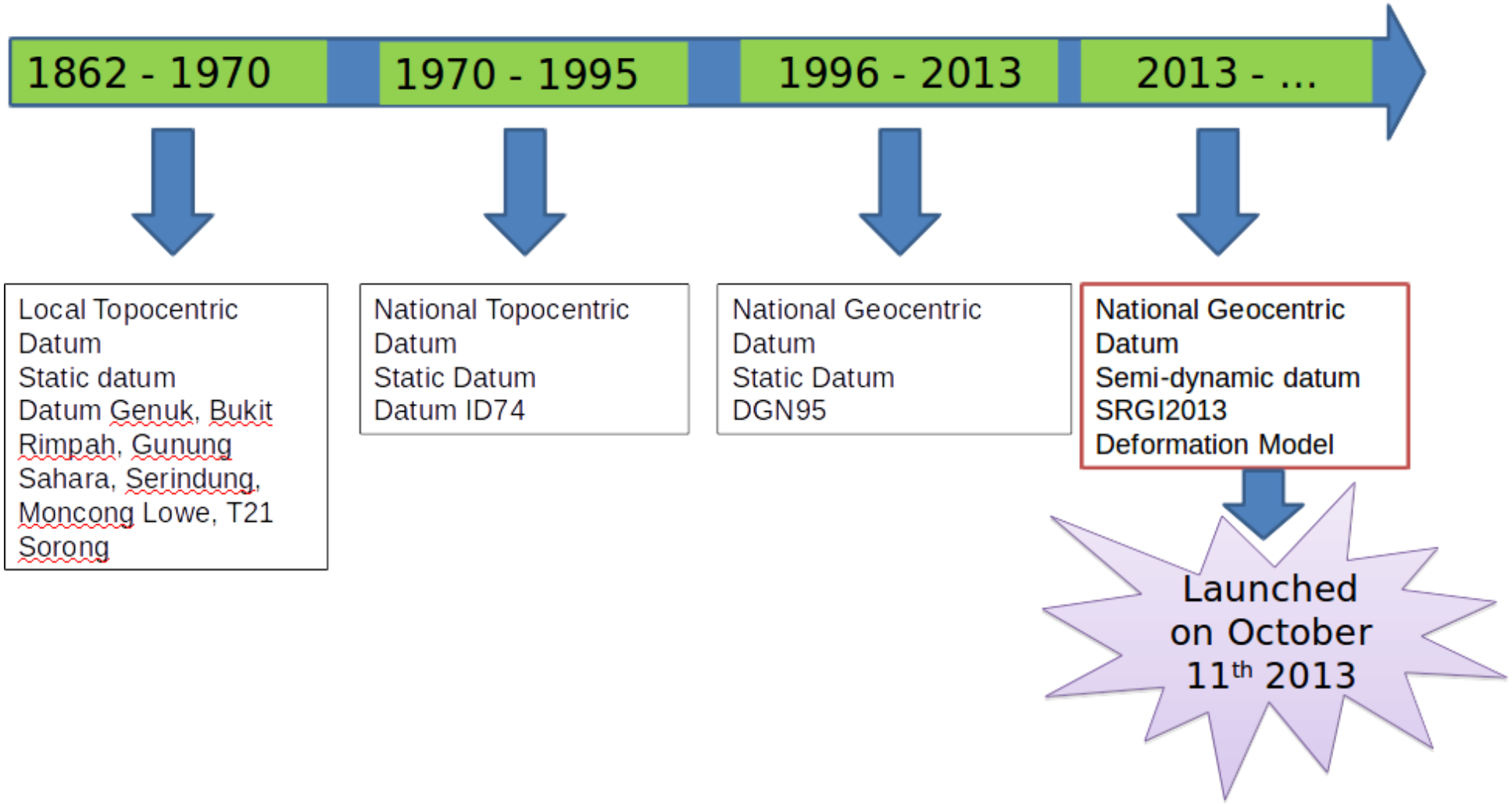
A new Geodetic Datum is required to accomodate the active tectonics of Indonesian region, and also to support One-Map Policy of the Indonesian government.



ONE-MAP POLICY

Abidin et al., 2016

Geodetic Datums in Indonesia



Susilo et al., 2016

Geodetic Datums in Indonesia

1. **Dutch Colonial Time: LOCAL TOPOCENTRIC DATUM**
   (Several, Static Datum)
2. **ID 1974 : NATIONAL TOPOCENTRIC DATUM**
   (Padang Datum , Static Datum)
3. **DGN 1995 : NATIONAL GEOCENTRIC DATUM**
   (Static Datum)
4. **SRGI 2013 : NATIONAL GEOCENTRIC DATUM**
   (Semi-Dynamic Datum)

INDONESIAN GEOSPATIAL REFERENCE SYSTEM, IGRS 2013 (Geodetic Reference System)

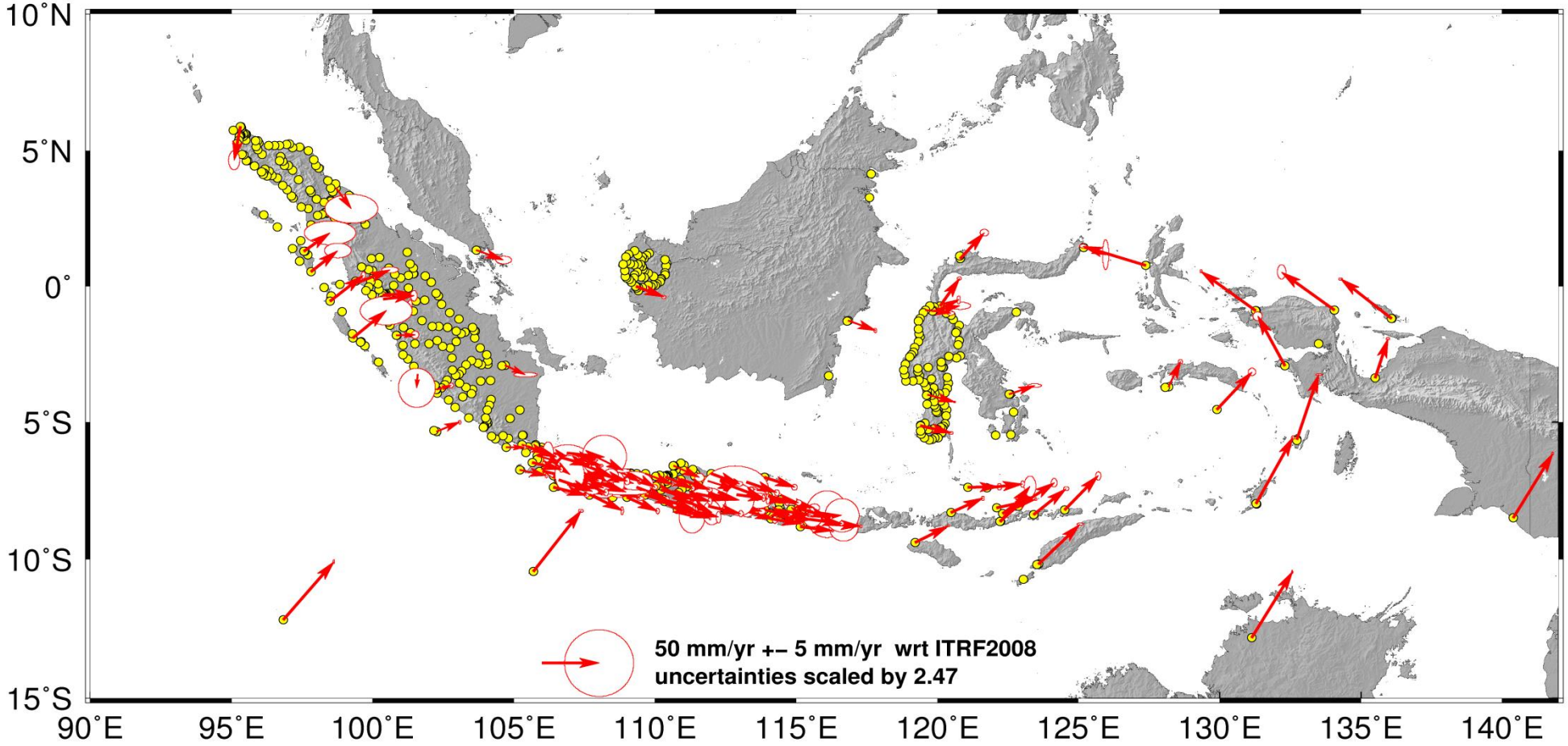
- **Launched: 11 October 2013**
- **Semi-Dynamic datum.**
- **Connected to the global ITRF2008 reference frame.**
- **Reference epoch: 1 January 2012**
- **Reference Ellipsoid: WGS 1984 (a = 6378137.0 m; 1/f = 298,257223563).**
- **If a new version of the ITRF reference frame becomes available, then the IGRS reference frame will also be updated accordingly.**
- **A velocity model, which incorporates tectonic motion and earthquake related deformation, is used to transform coordinates at an observation epoch to or from this reference epoch.**

INDONESIAN GEOSPATIAL REFERENCE SYSTEM, IGRS 2013 (Vertical Reference System)

- **Vertical datum is Geoid.**
- **The Geoid is derived from the gravity surveys which was tied to National Gravity Control Network (NGCN).**
- **NGCN has to be connected to the IGSN71 or its new version.**
- **In case there is no official Geoid yet, the vertical datum is MSL derived from 18.6 years tide observation or at least from 1 year observation.**

Pevious Velocity Model for IGRS 2013

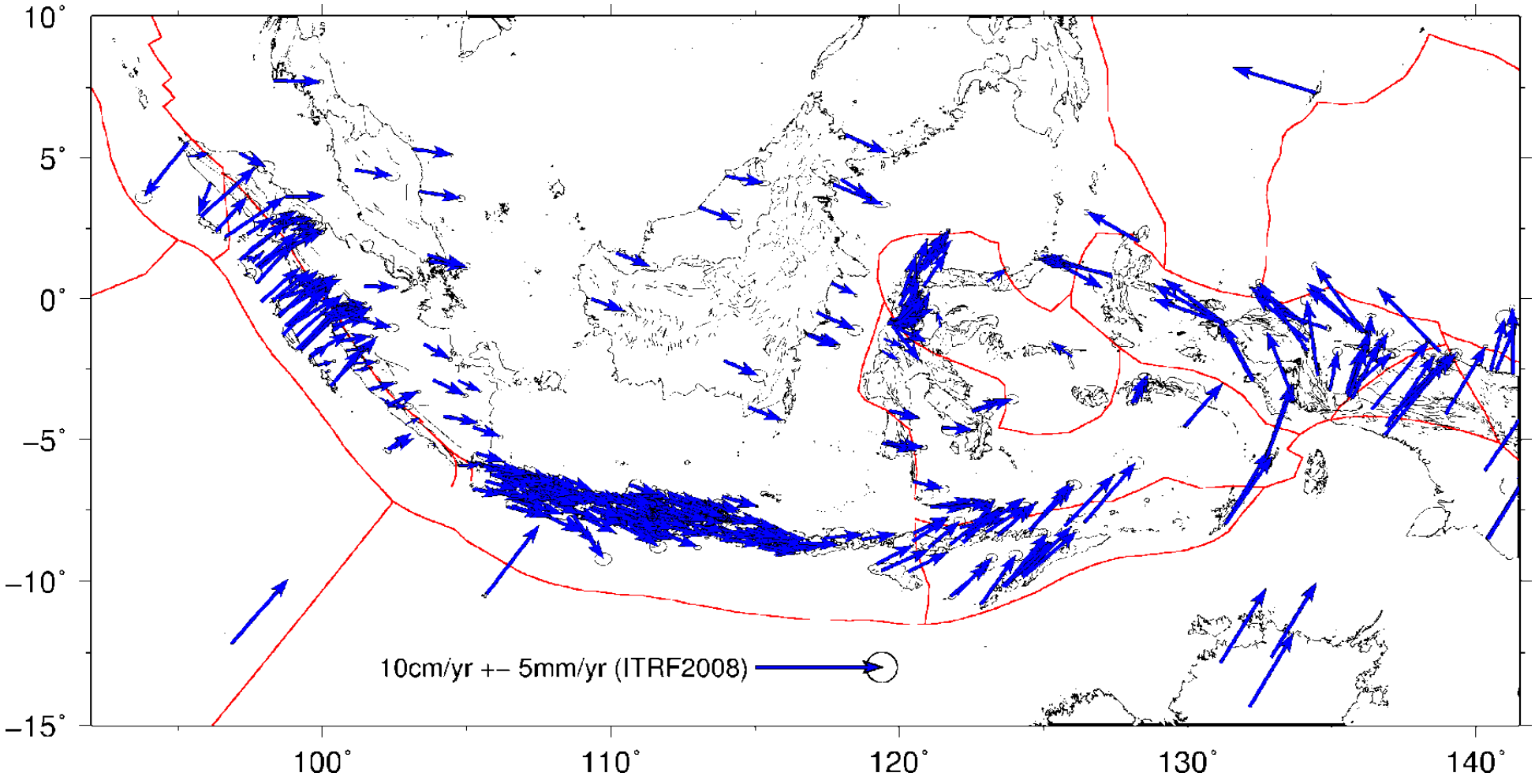
computed using GPS CORS data from 2010 to 2013



Abidin et al., 2014

Pevious Velocity Model for IGRS 2013

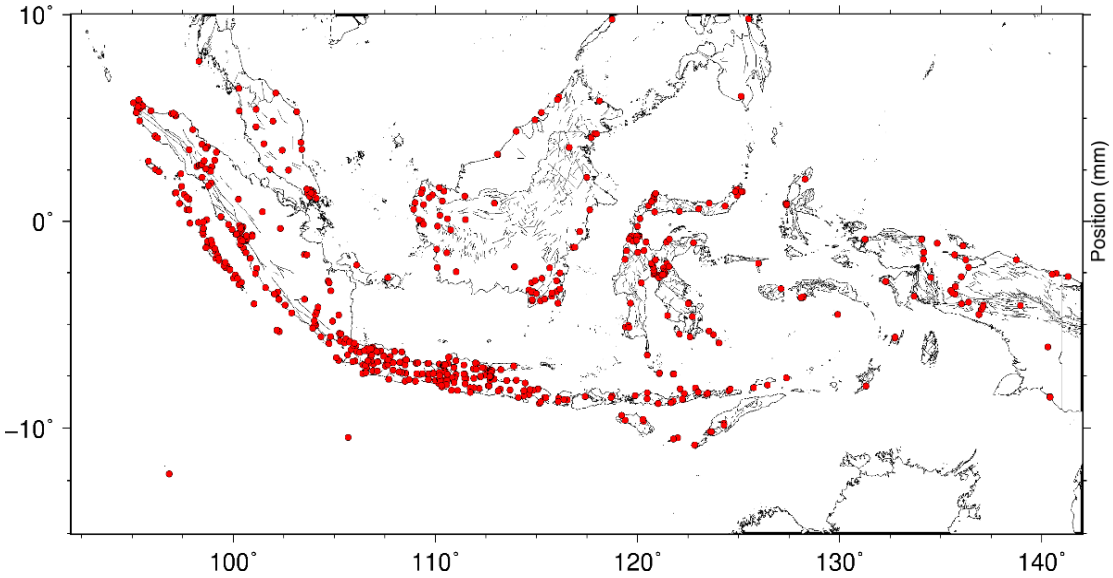
computed using GPS CORS and sGPS data from 1996 to 2013

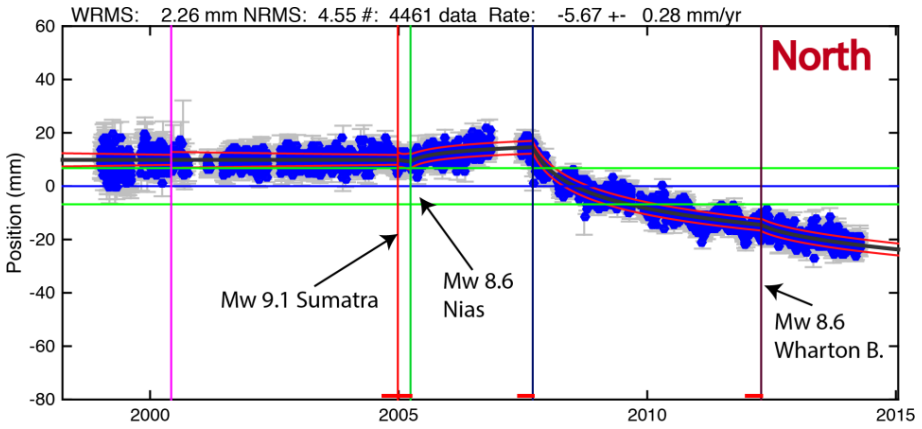


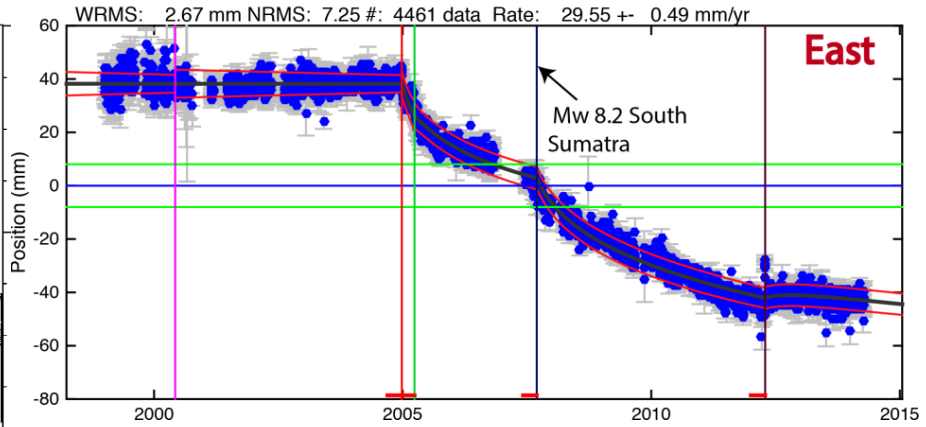
Susilo et al., 2015

New Velocity Model for IGRS 2013

- Computed using **GPS CORS** and **sGPS data** from **1993 to 2015**
- Including estimation of the **co-sesimic** and **post-seismic** due to **2012 April 12 EQ**
- **Denser** GPS station distribution in Borneo Island





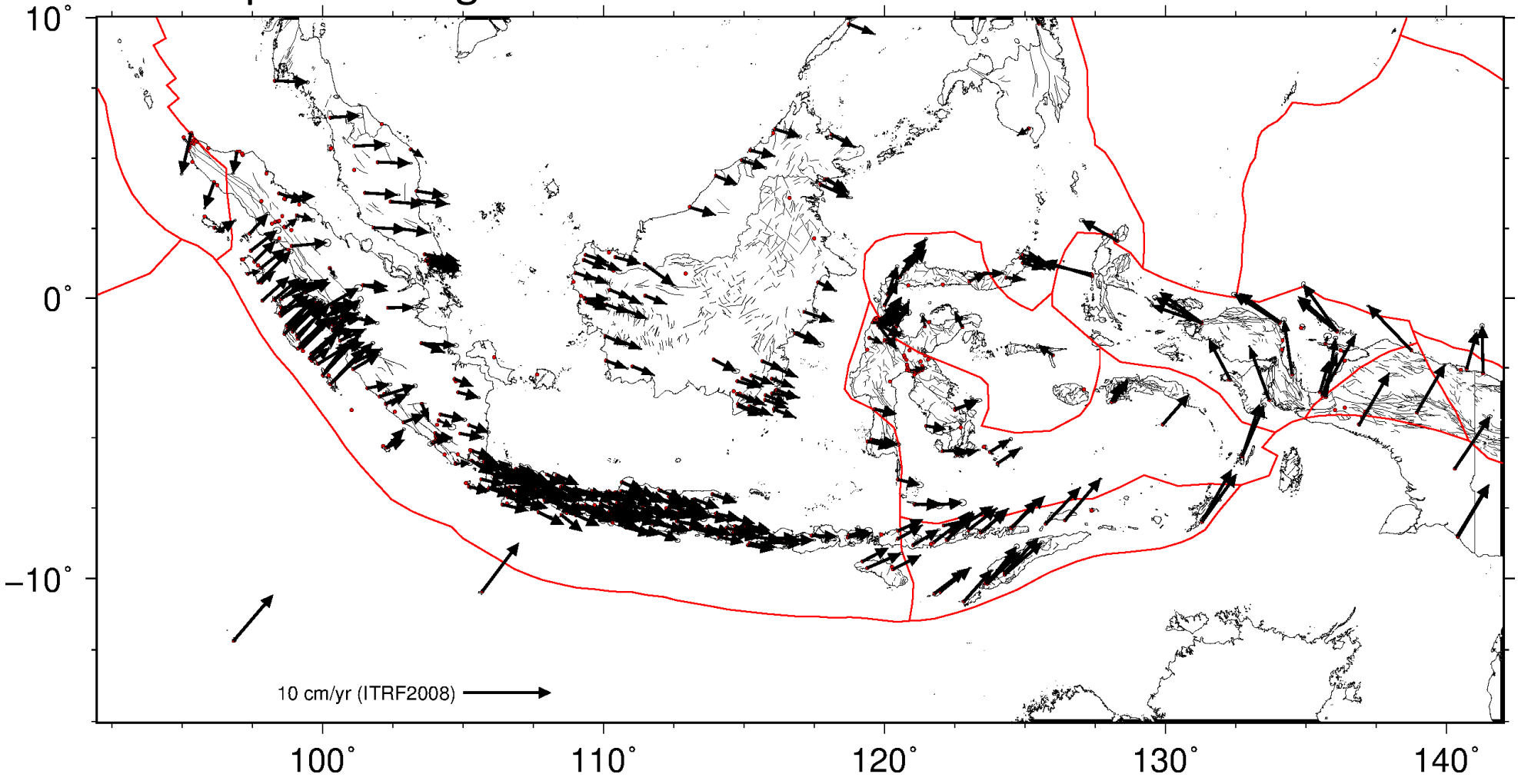


Post-seismic deformation in the NTUS position time series

Susilo et al., 2016

New Velocity Model for IGRS 2013

computed using GPS CORS and sGPS data from 1993 to 2015



Susilo et al., 2016

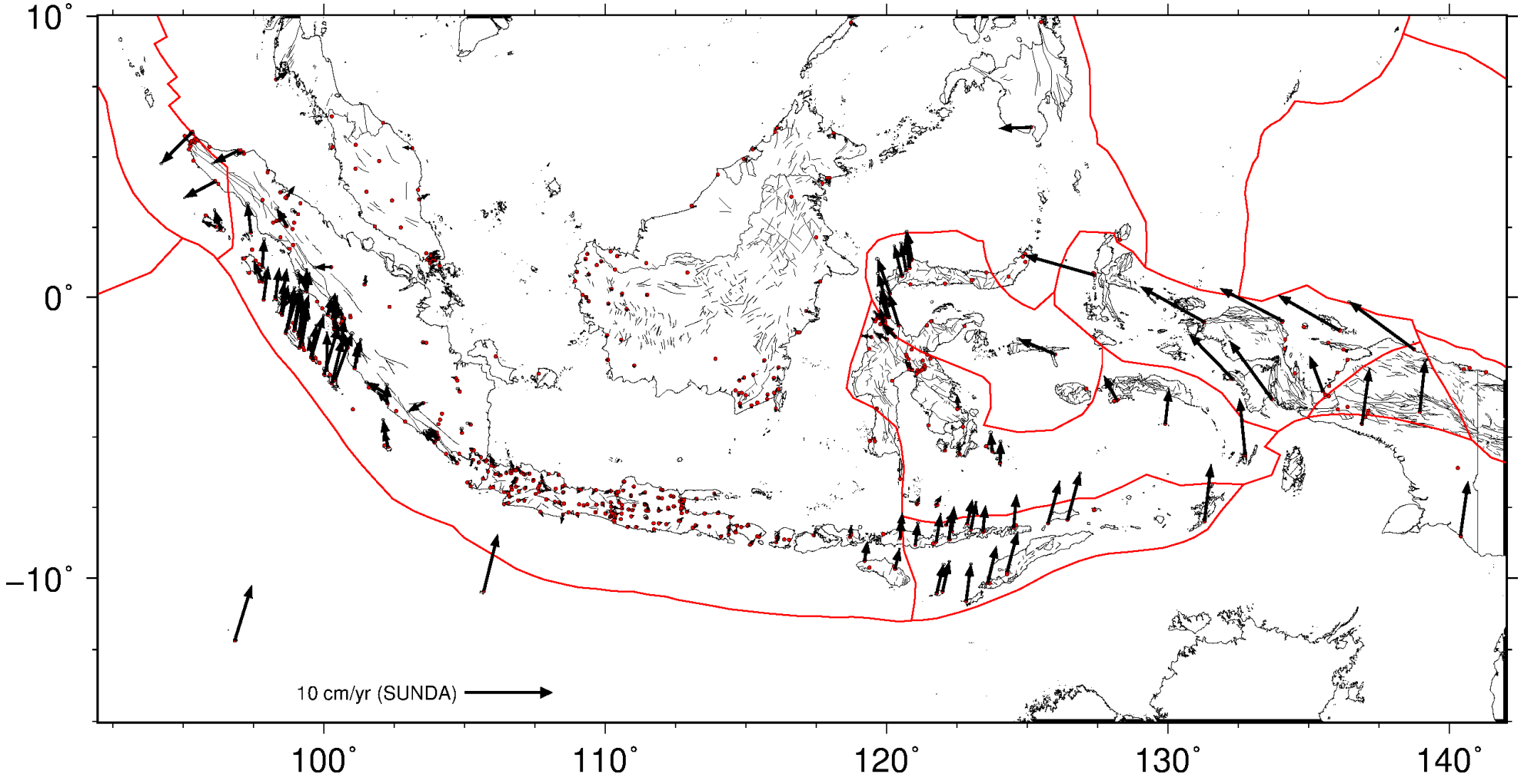
Sunda Block Reference Frame

- SUNDA block euler pole:
  - Latitute (deg) : 64.446
  - Longitude (deg) : 157.953
  - Rate (deg/Myr) : 0.247
  - Semi major (deg): 0.50
  - Semi minor (deg): 0.03
  - Azimuth (deg): 67.4
  - Rate Unc. (deg/Myr): 0.0003

- wrms for NE component: 1.17 & 0.79 mm/yr

Susilo et al., 2016

Residual velocity model with respect to Sunda Block



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Closing Remarks (1)

Deformation (Velocity) Model has to be established for $t_{obs} \longleftrightarrow t_{ref}$ coordinate transformation of IGRS 2013 :

- ***The model coverage : all over Indonesia.***
- ***Indonesian area cannot be represented only by a single velocity model.***
- ***Updating time for each model ?***
- ***How to accomodate the deformation related earthquakes ?***

Closing Remarks (2)

- Updated velocity model using GPS data from 1993-2015 shows more dense velocity and improved the velocity model for IGRS2013.
- More detail characteristics of the local deformation in Indonesian region is necessary for updating the velocity model of IGRS 2013.
- By the new definition of ITRF2014, the update of IGRS 2013 will be initiated.

Thank You Very Much