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

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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
High seismicity, shallow EQs mostly confined at the subduction zone

Susilo et al., 2016
**Tectonic Complexity of Indonesian Region (Displacement)**

Coordinate Displacements

3D coordinate displacements due to motion of tectonic blocks

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

620 cm

3D coordinate displacements due to earthquakes

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 accommodate the active tectonics of Indonesian region, and also to support One-Map Policy of the Indonesian government.
Geodetic Datums in Indonesia

1862 - 1970
Local Topocentric Datum
Static datum
Datum Genuk, Bukit Rimpah, Gunung Sahara, Serindung, Moncong Lowe, T21 Sorong

1970 - 1995
National Topocentric Datum
Static Datum
Datum ID74

1996 - 2013
National Geocentric Datum
Static Datum
DGN95

2013 - ...
National Geocentric Datum
Semi-dynamic datum SRGI2013 Deformation Model

Launched on October 11th 2013

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)
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.
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.
Previous Velocity Model for IGRS 2013

computed using GPS CORS data from 2010 to 2013

Abidin et al., 2014
Previous 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
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:
  – Latitude (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
Residual velocity model with respect to Sunda Block
Deformation (Velocity) Model has to be established for 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 accommodate 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