

Indonesian permanent GNSS stations network: the current status



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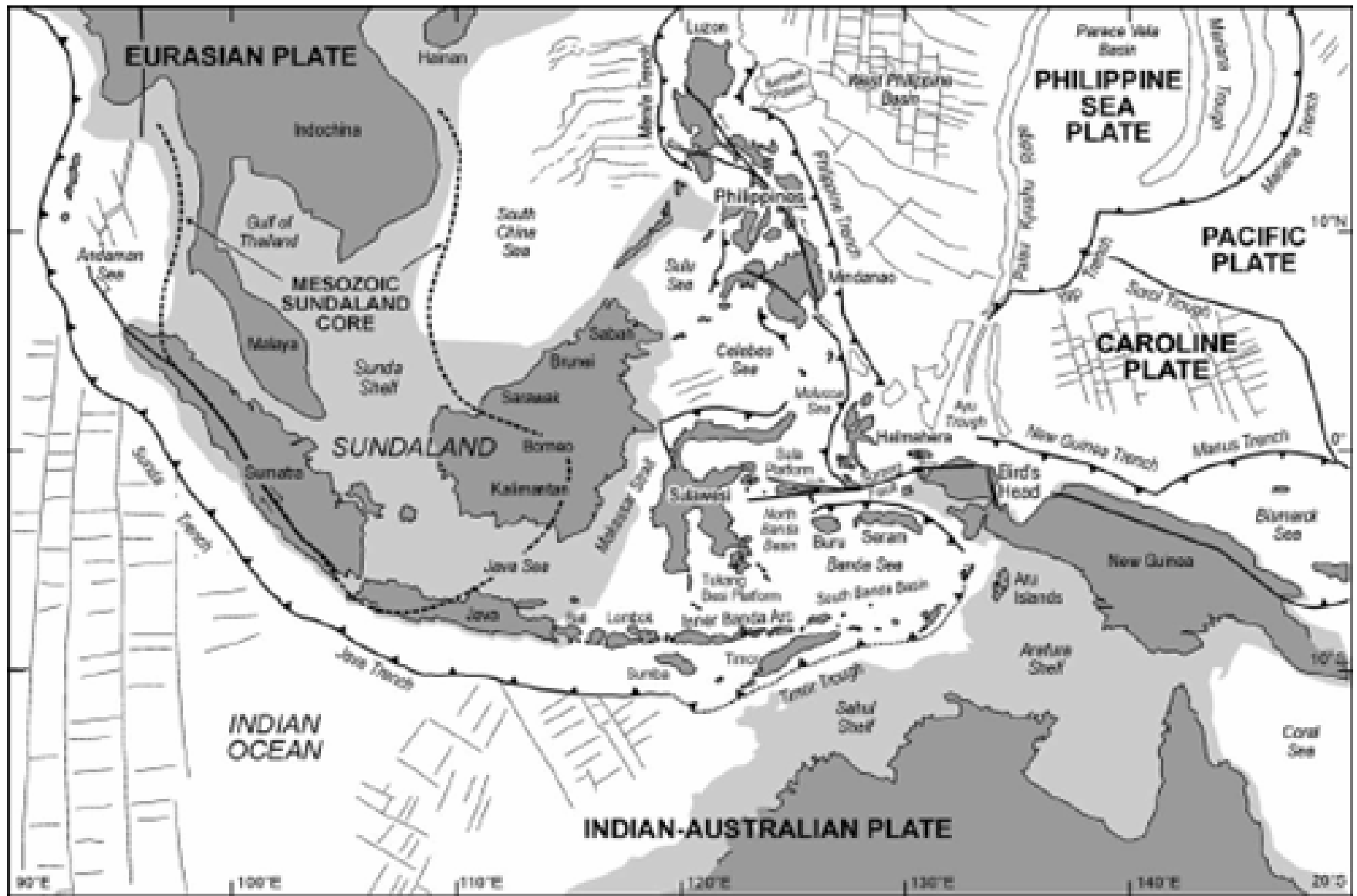
National Coordinating Agency for Surveys and Mapping

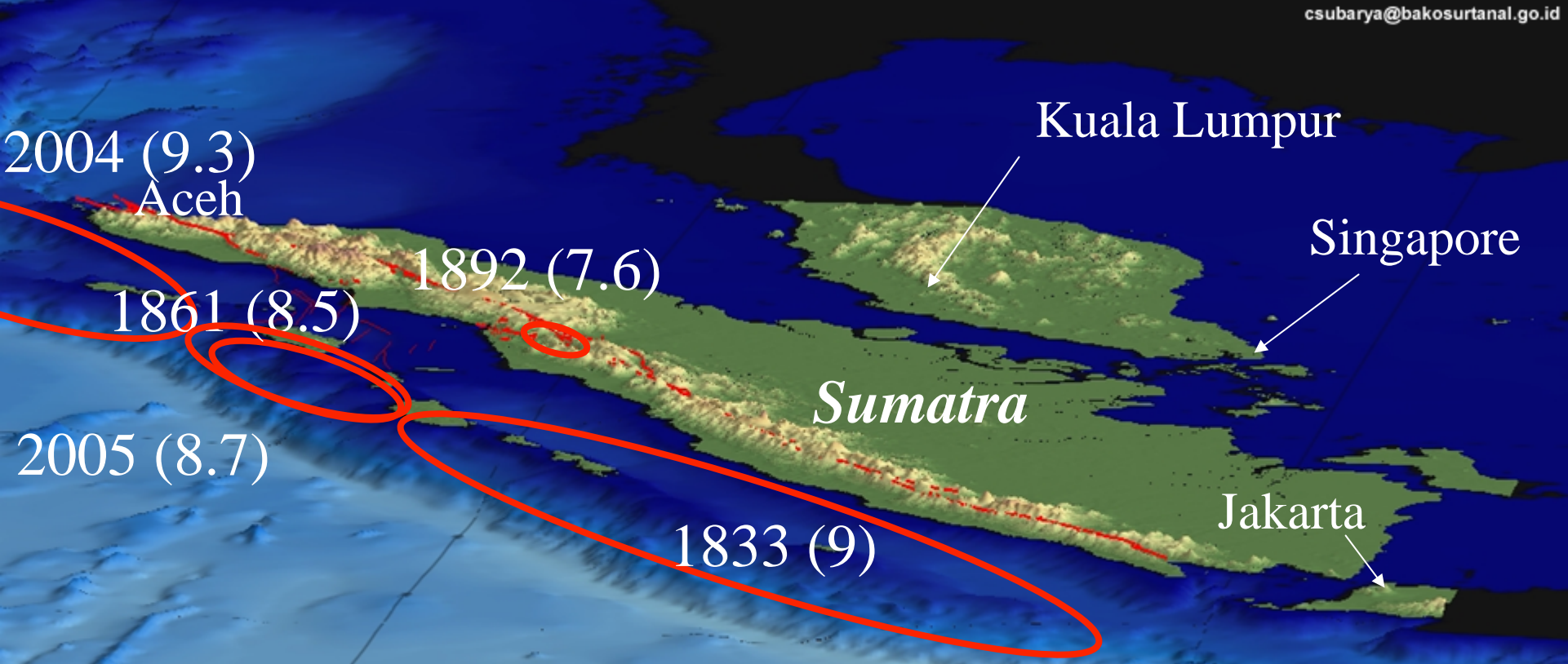
OBJECTIVES

- ***To maintain national geodetic reference frame in active seismic zones for survey and mapping purposes,***
- ***Crustal deformation monitoring for geological hazard mitigation,***
- ***Sea level change monitoring with continuous GPS and Tide Gauge stations collocation,***
- ***GPS Meteorology to determine PW in the troposphere and TEC in the ionosphere,***
- ***GPS for safety navigation.***

Geological Setting in Indonesia Region

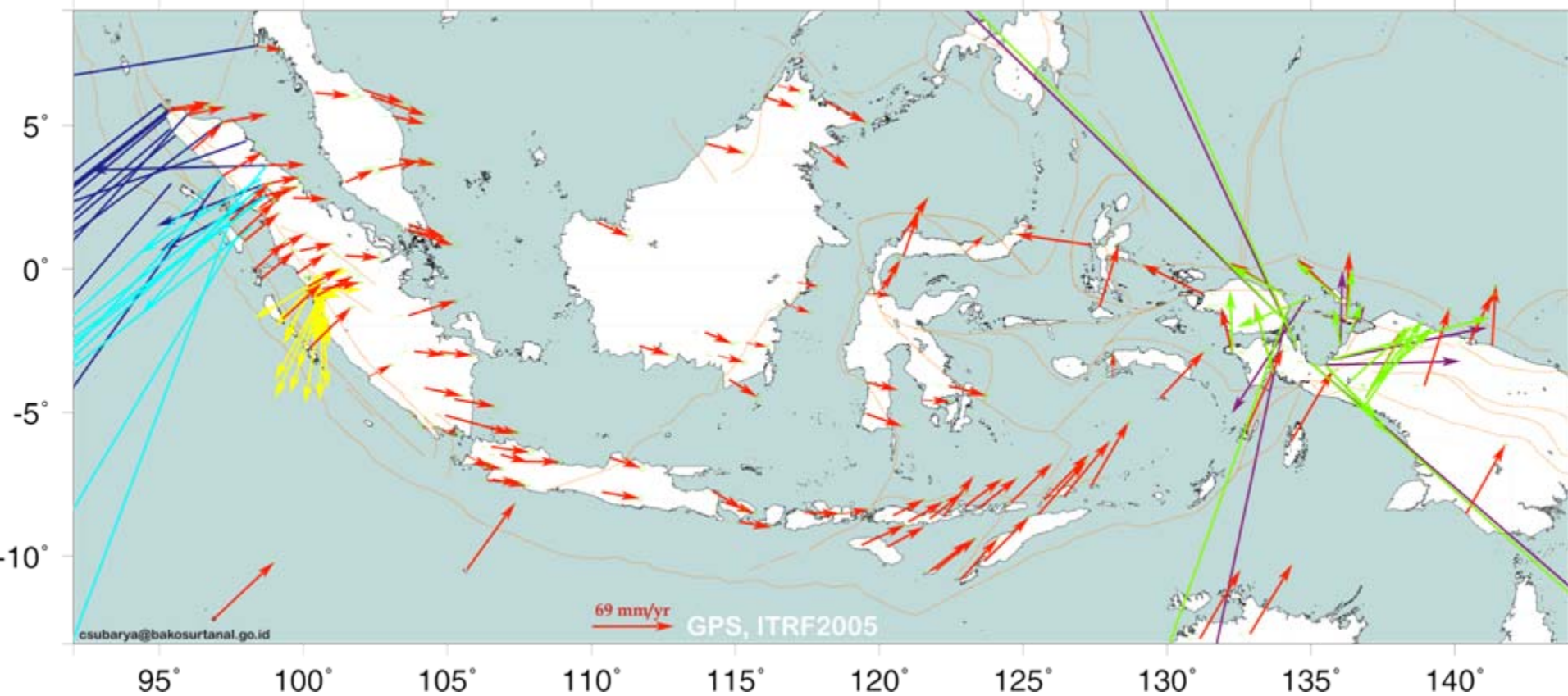
(Source: Robert Hall, 2002)





GPS DATA ANALYSIS
GAMIT ver.10.35 - GLOBK

***The Velocities Field in Indonesia during Inter-seismic and Co-seismic
from GPS measurements 1992-2009***

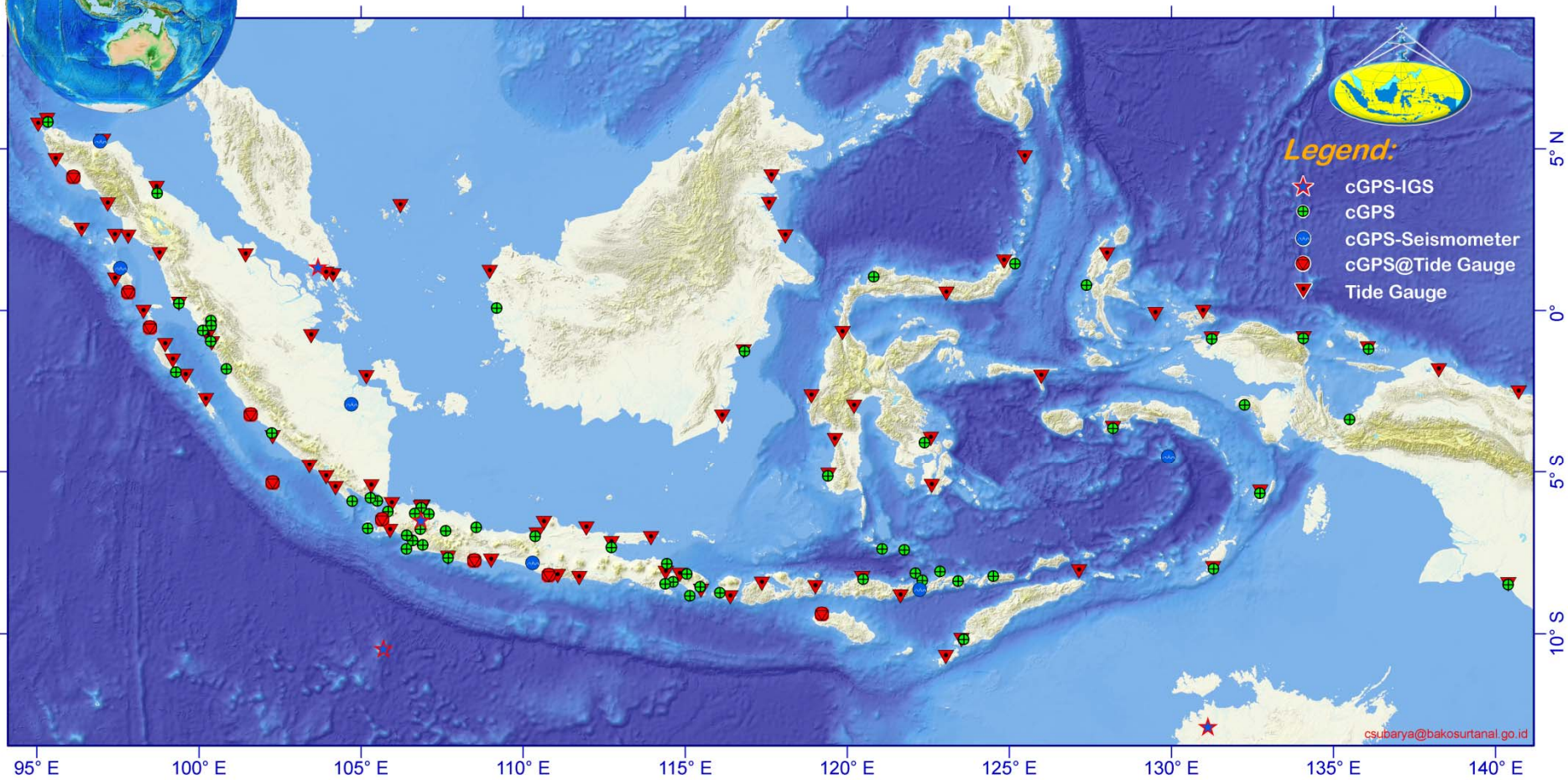


Indonesia Tsunami Early Warning System (InaTEWS)

- ***Earthquakes monitoring: Seismograph and accelerograph***
- ***Crustal deformation monitoring: continuous GPS (cGPS)***
- ***Sea level monitoring: Tide Gauges and Buoy***



GEODETIC INFRASTRUCTURE AND MONITORING SYSTEM

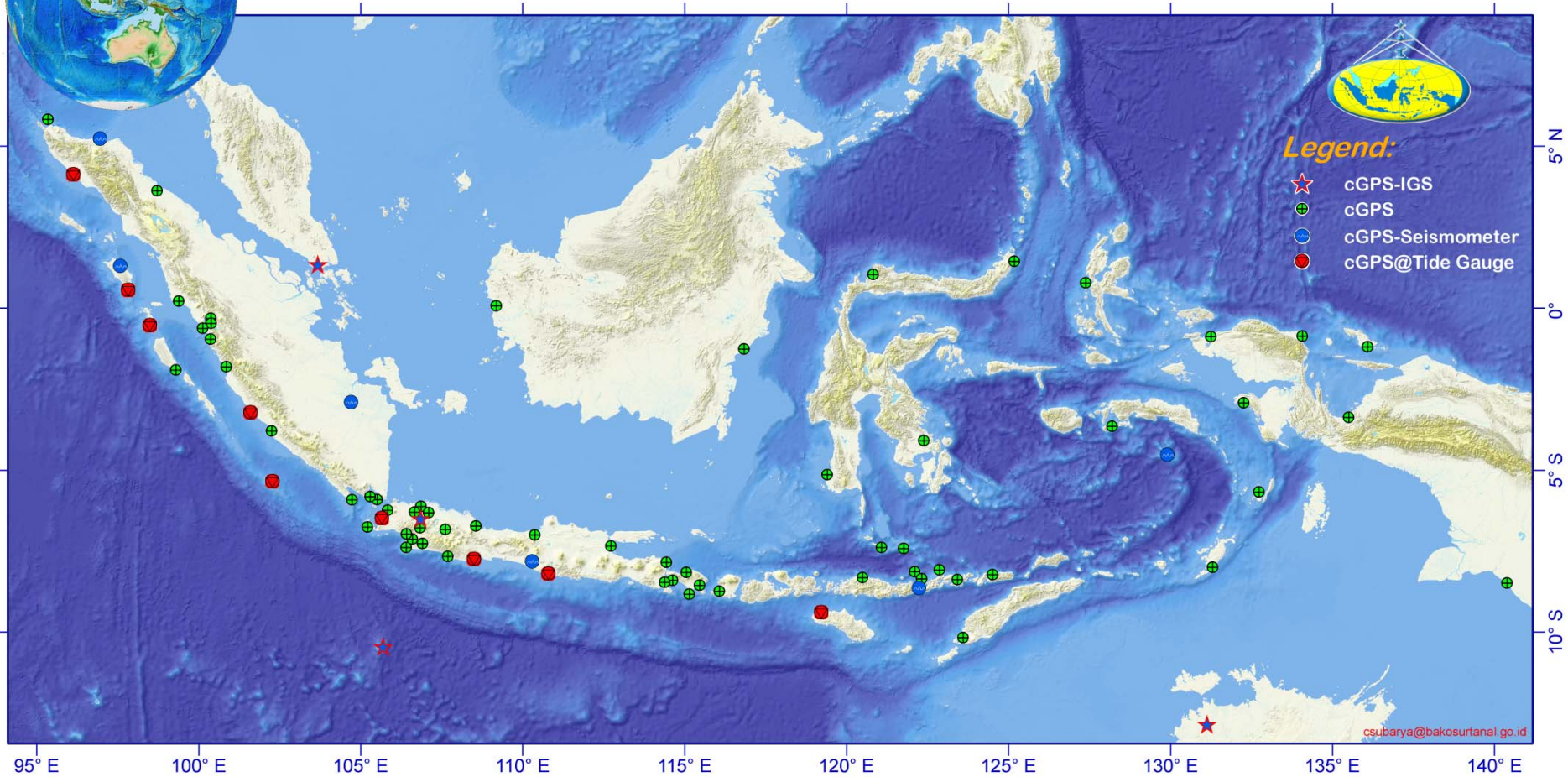


Legend:

- ★ cGPS-IGS
- ⊕ cGPS
- ⊕ cGPS-Seismometer
- cGPS@Tide Gauge
- ▼ Tide Gauge

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GEODETIC INFRASTRUCTURE AND MONITORING SYSTEM ***(continuous Global Positioning System = cGPS)***

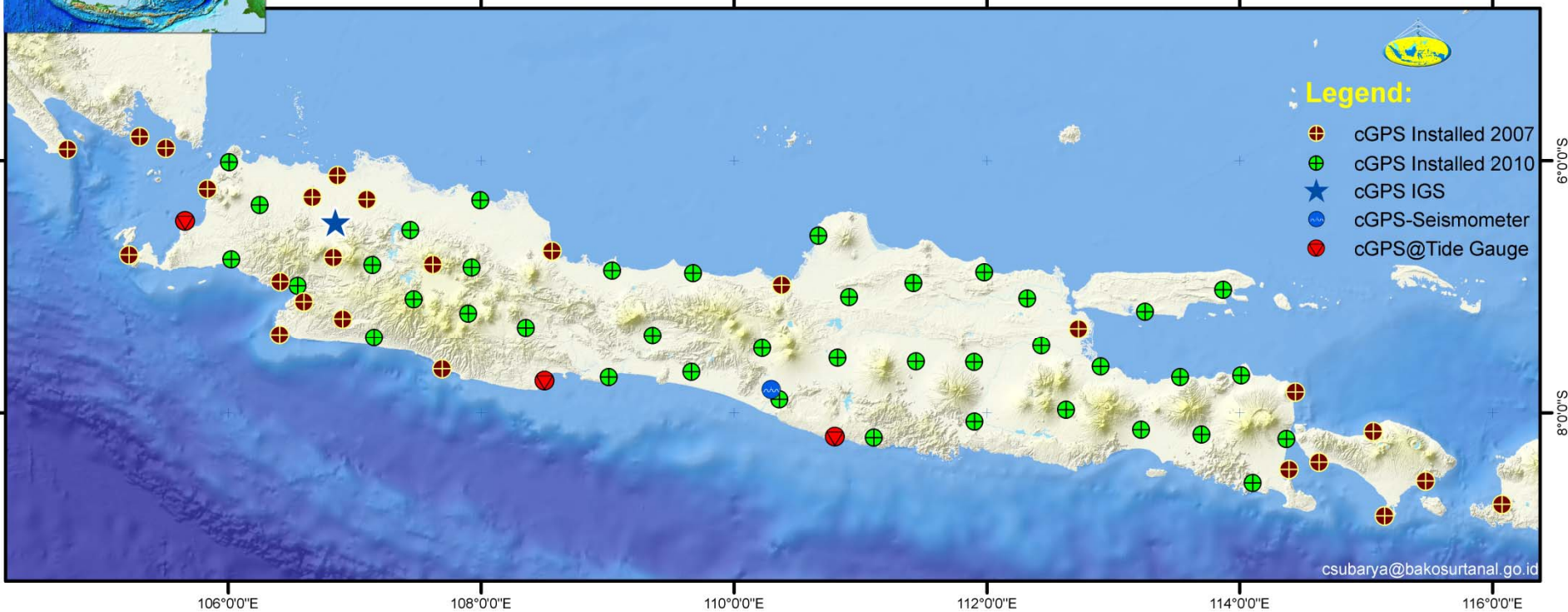


Legend:

-  cGPS-IGS
-  cGPS
-  cGPS-Seismometer
-  cGPS@Tide Gauge

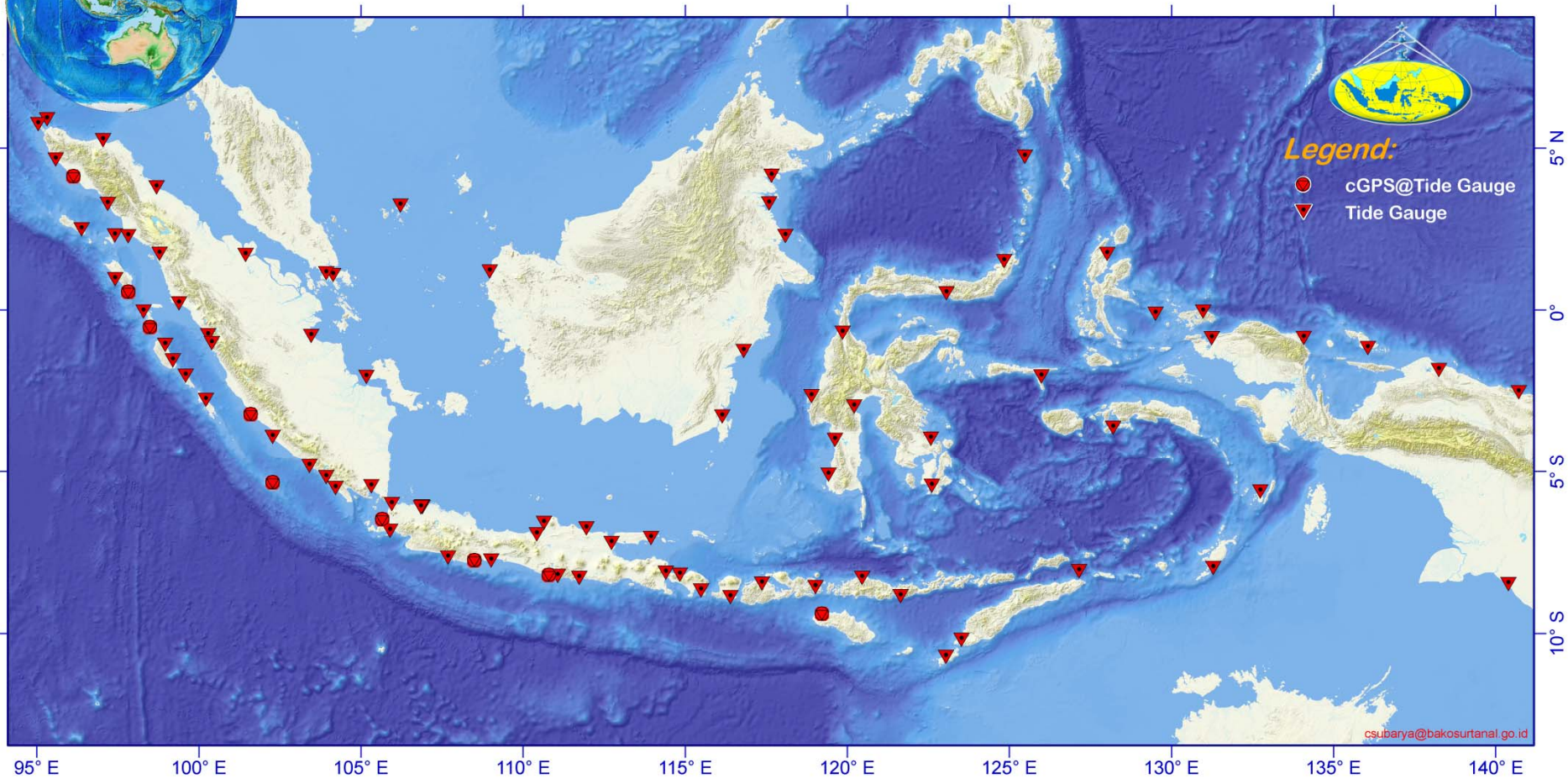
csubarya@bakosurtanal.go.id

GEODETIC INFRASTRUCTURE (continuous GPS)



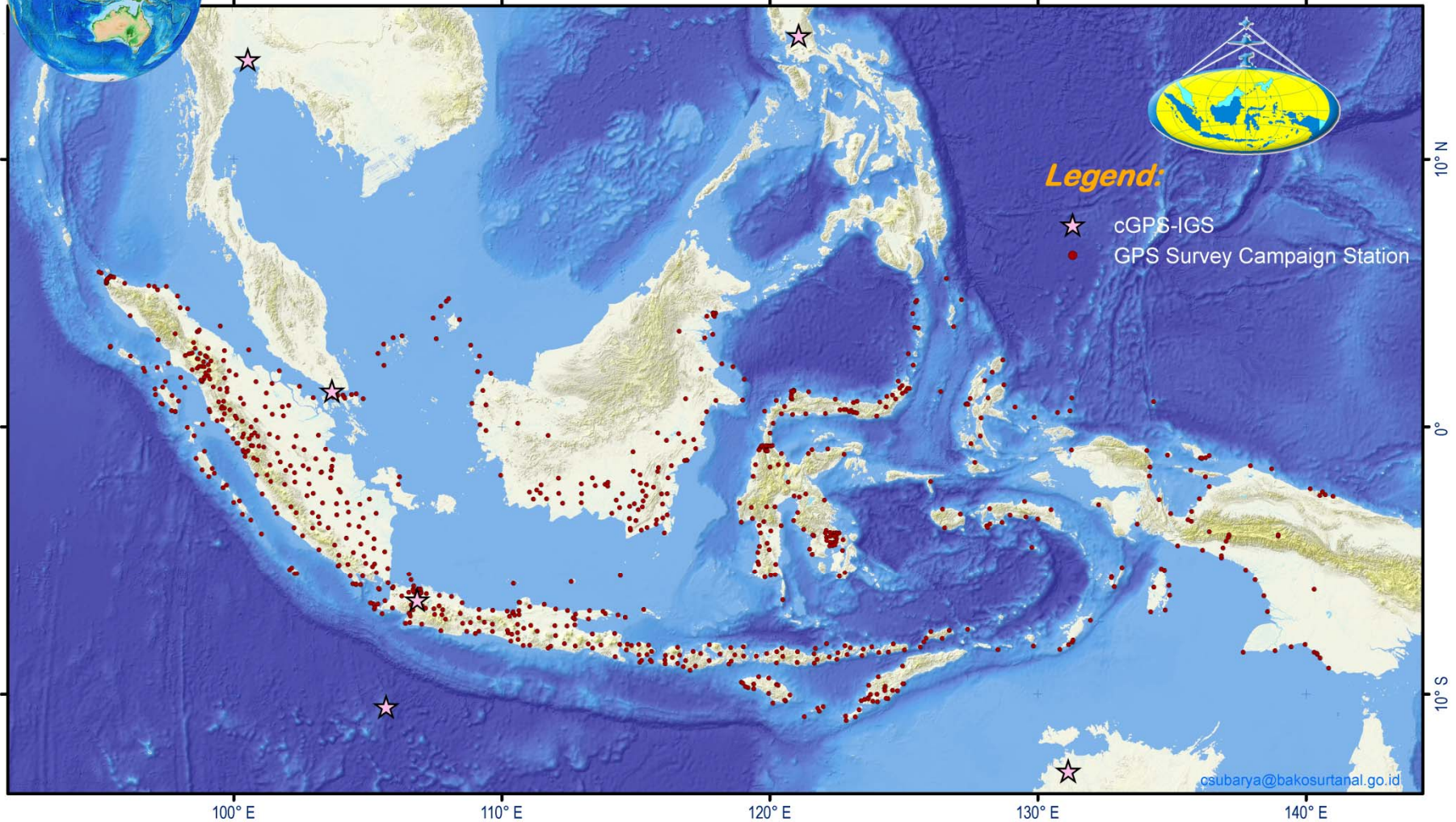


GEODETIC INFRASTRUCTURE AND MONITORING SYSTEM (Tide Gauges)



MONITORING SYSTEM

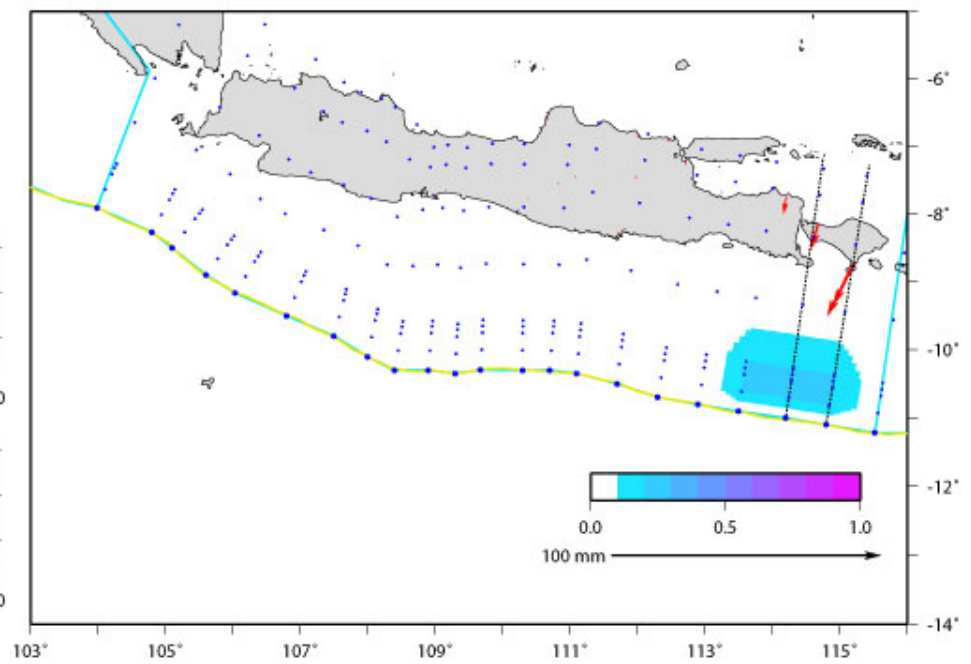
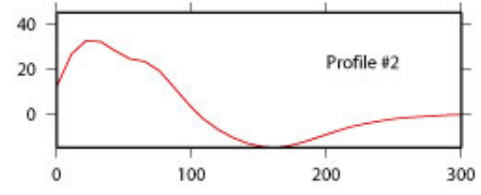
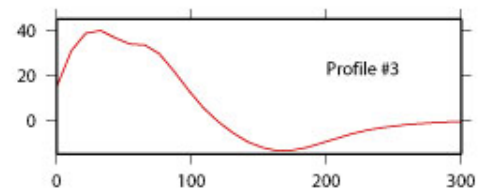
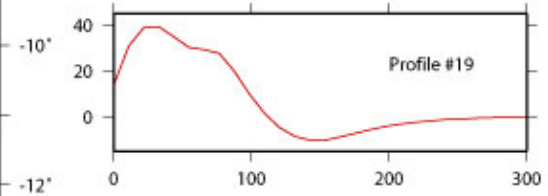
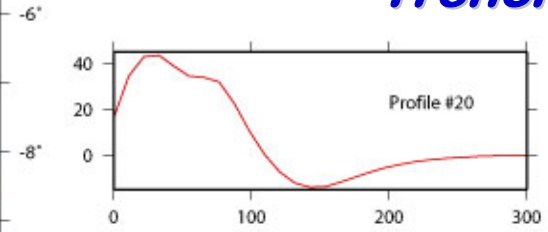
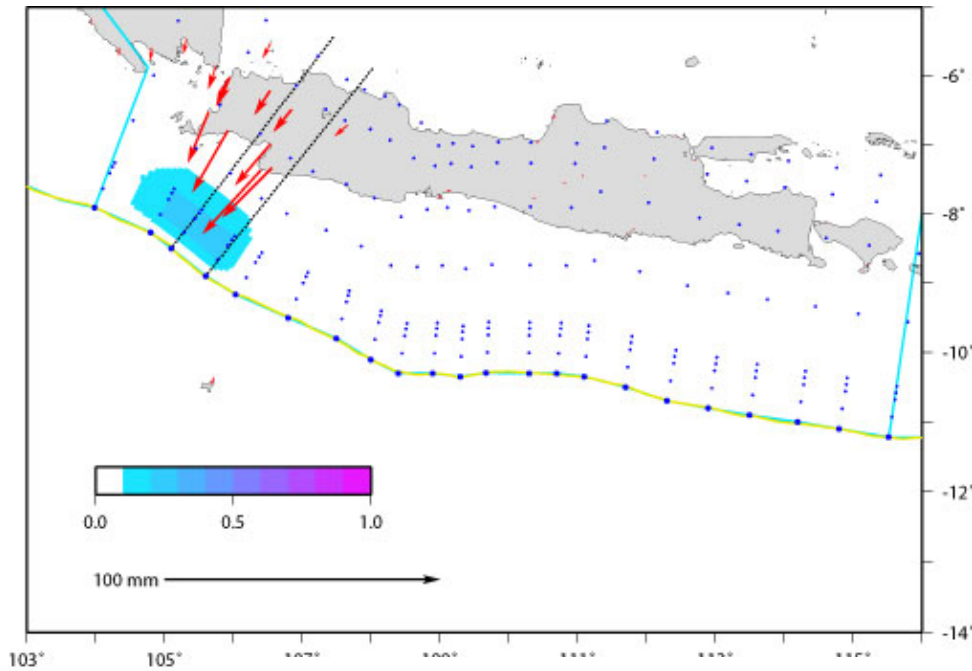
(GPS SURVEY CAMPAIGN FOR CRUSTAL DEFORMATION AND GEODETIC REFERENCE FRAME)

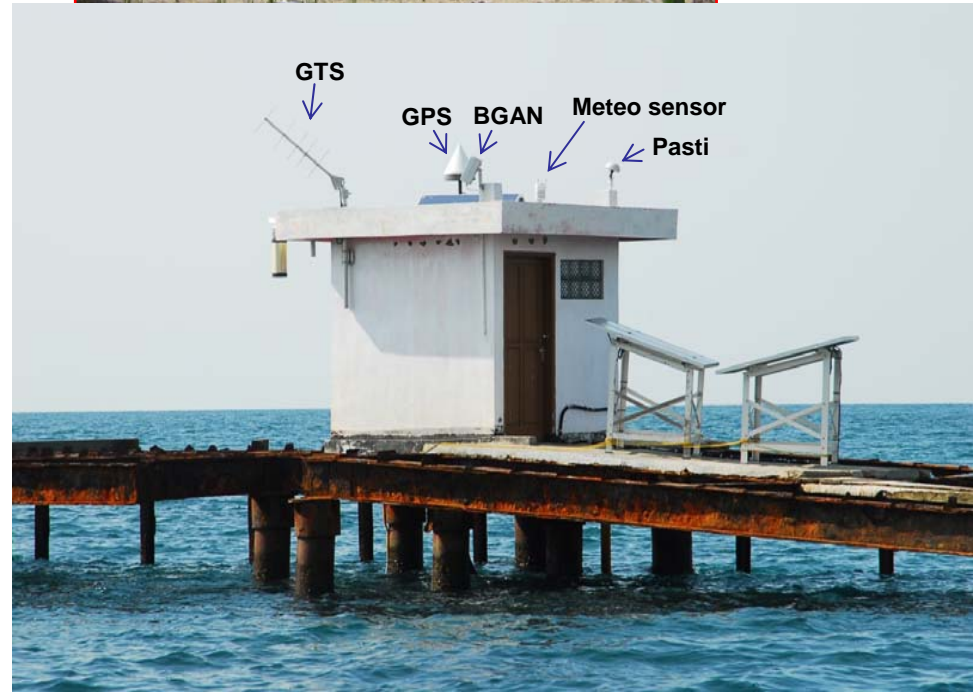


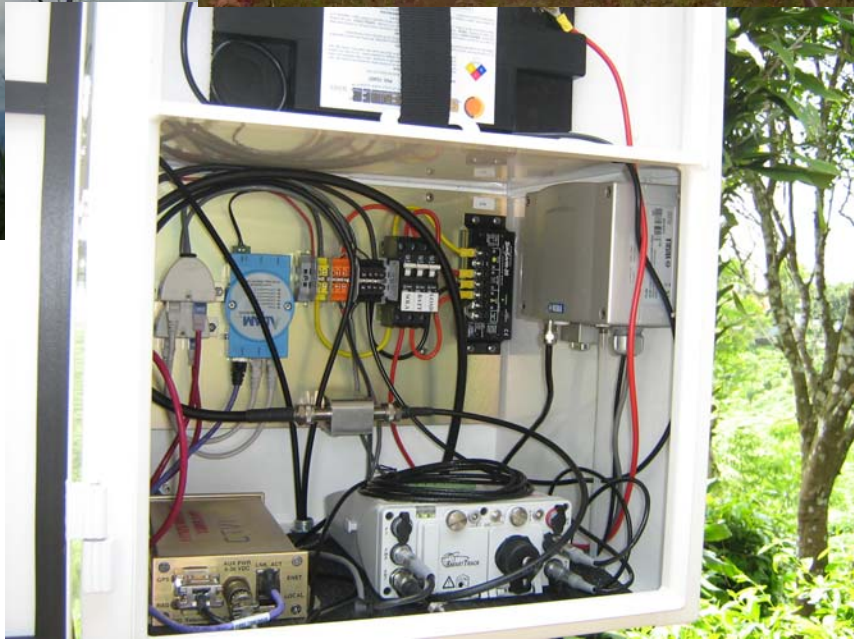
Legend:

- ☆ cGPS-IGS
- GPS Survey Campaign Station

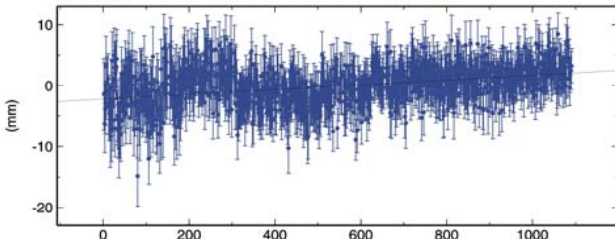
Scenario Earthquakes on Java Trench



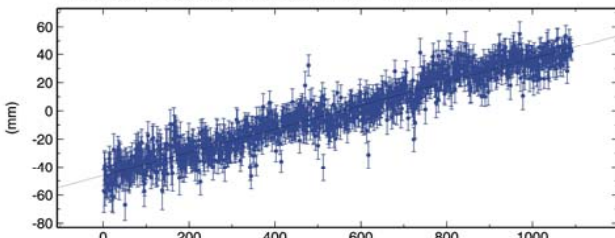




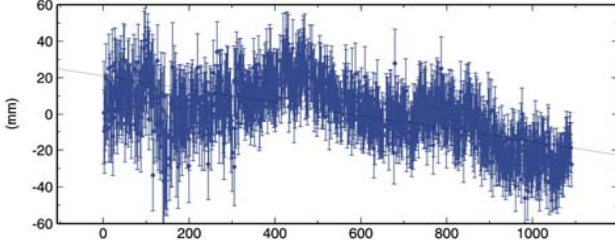
SAMP North Offset 403155.921 m
rate(mm/yr)= 1.44 ± 0.14 nrms= 0.77 wrms= 2.8 mm # 1009



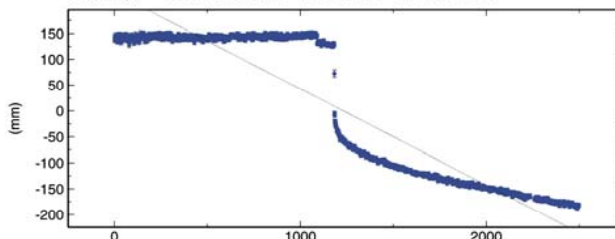
SAMP East Offset 10966935.953 m
rate(mm/yr)= 30.39 ± 0.32 nrms= 0.91 wrms= 7.7 mm # 1009



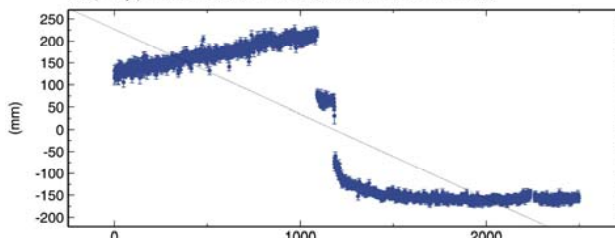
SAMP Up Offset 2.033 m
rate(mm/yr)= -13.35 ± 0.59 nrms= 0.80 wrms= 12.2 mm # 1009



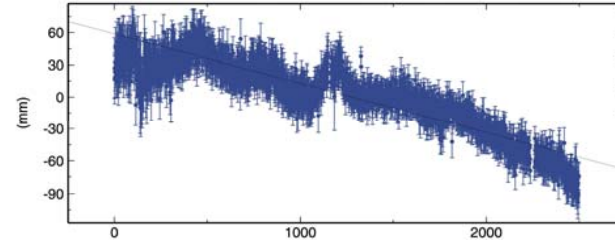
SAMP North Offset 403155.921 m
rate(mm/yr)= -67.79 ± 0.04 nrms= 17.09 wrms= 53.2 mm # 2276



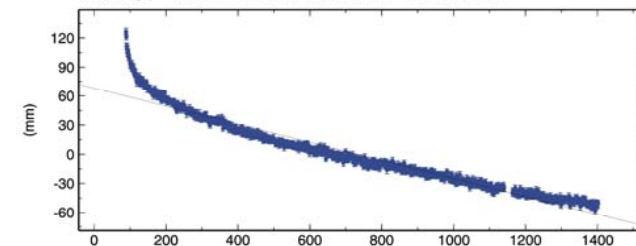
SAMP East Offset 10966935.953 m
rate(mm/yr)= -70.21 ± 0.08 nrms= 11.76 wrms= 81.0 mm # 2276



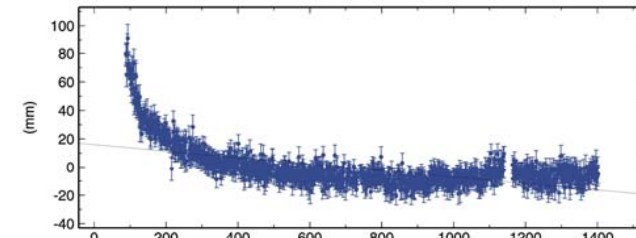
SAMP Up Offset 2.033 m
rate(mm/yr)= -16.88 ± 0.15 nrms= 1.04 wrms= 13.2 mm # 2276



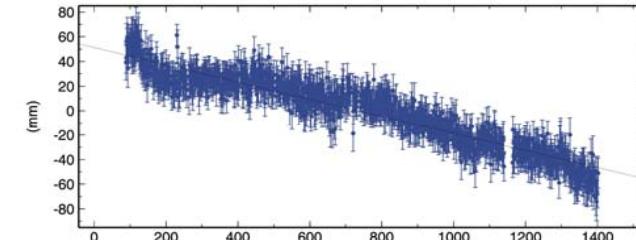
SAMP North Offset 403155.775 m
rate(mm/yr)= -34.05 ± 0.08 nrms= 2.88 wrms= 8.0 mm # 1186



SAMP East Offset 10966935.766 m
rate(mm/yr)= -8.45 ± 0.17 nrms= 1.74 wrms= 10.5 mm # 1186



SAMP Up Offset 2.022 m
rate(mm/yr)= -25.54 ± 0.32 nrms= 0.80 wrms= 9.0 mm # 1186



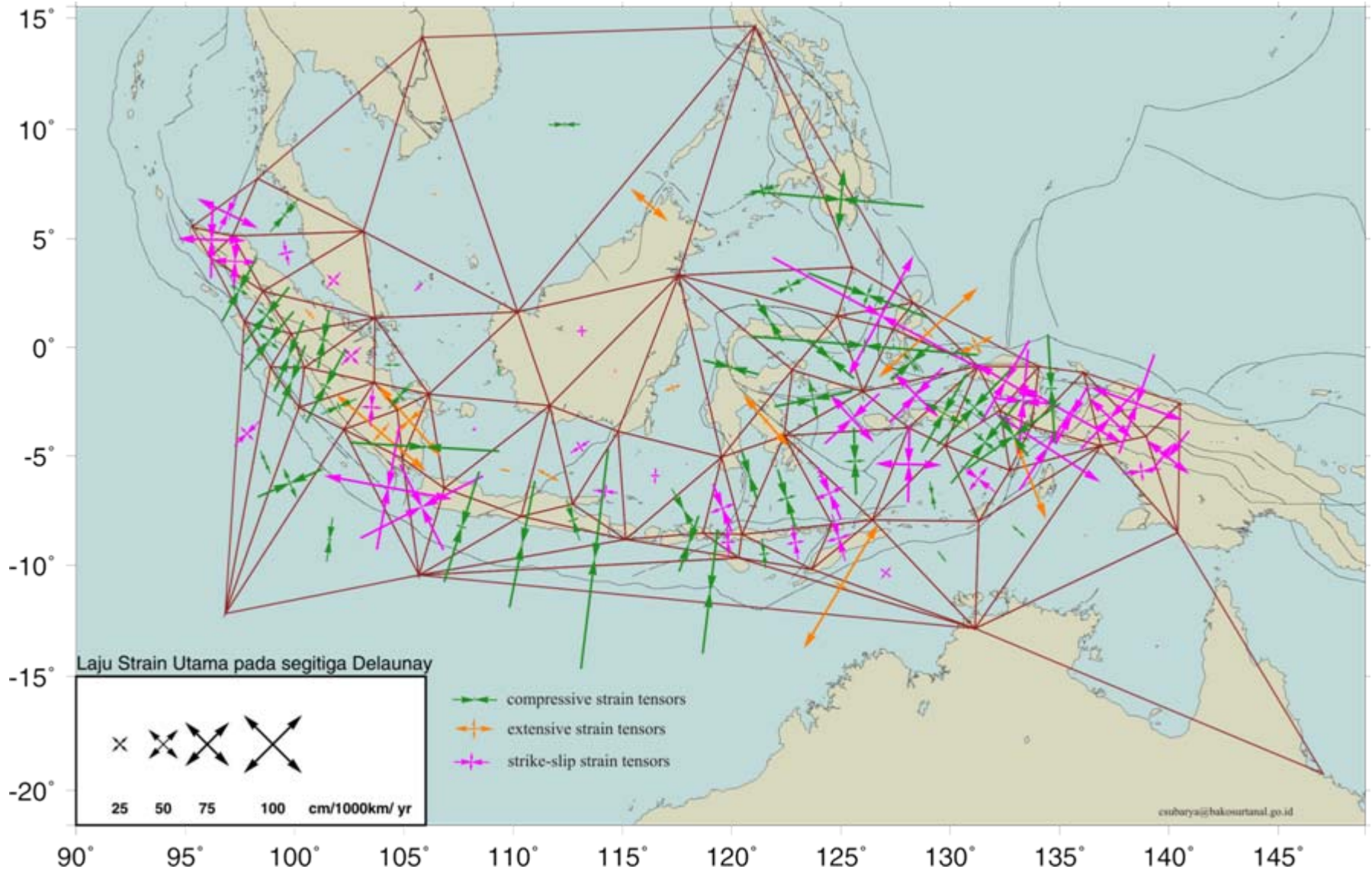
inter-seismic

co-seismic

post-seismic

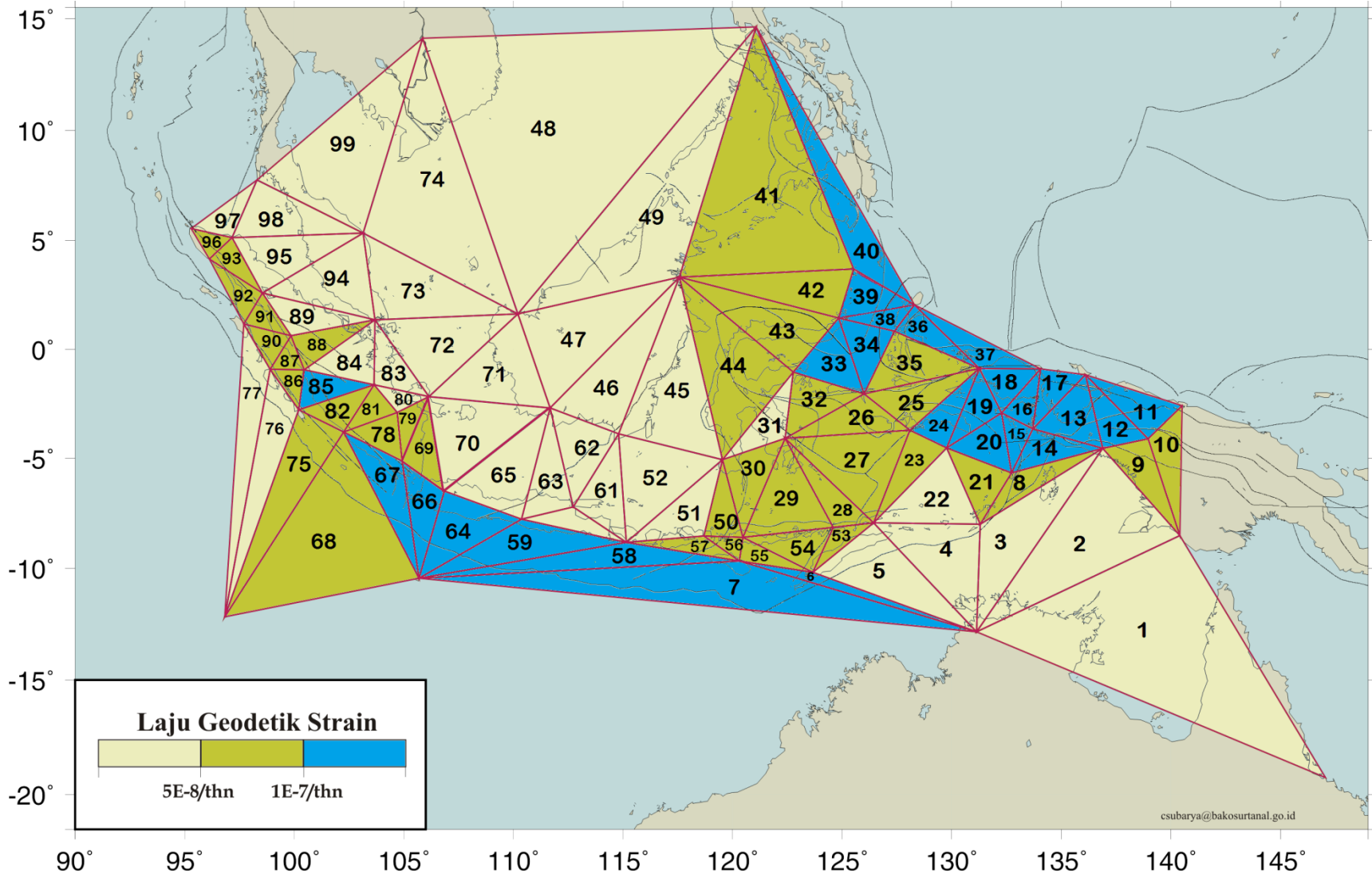
GEODETIC STRAIN

Laju regangan geodetik utama pada 99 segitiga pada periode tahun 1992–2002 sebelum berbagai peristiwa gempa kuat di wilayah Indonesia dan sekitarnya



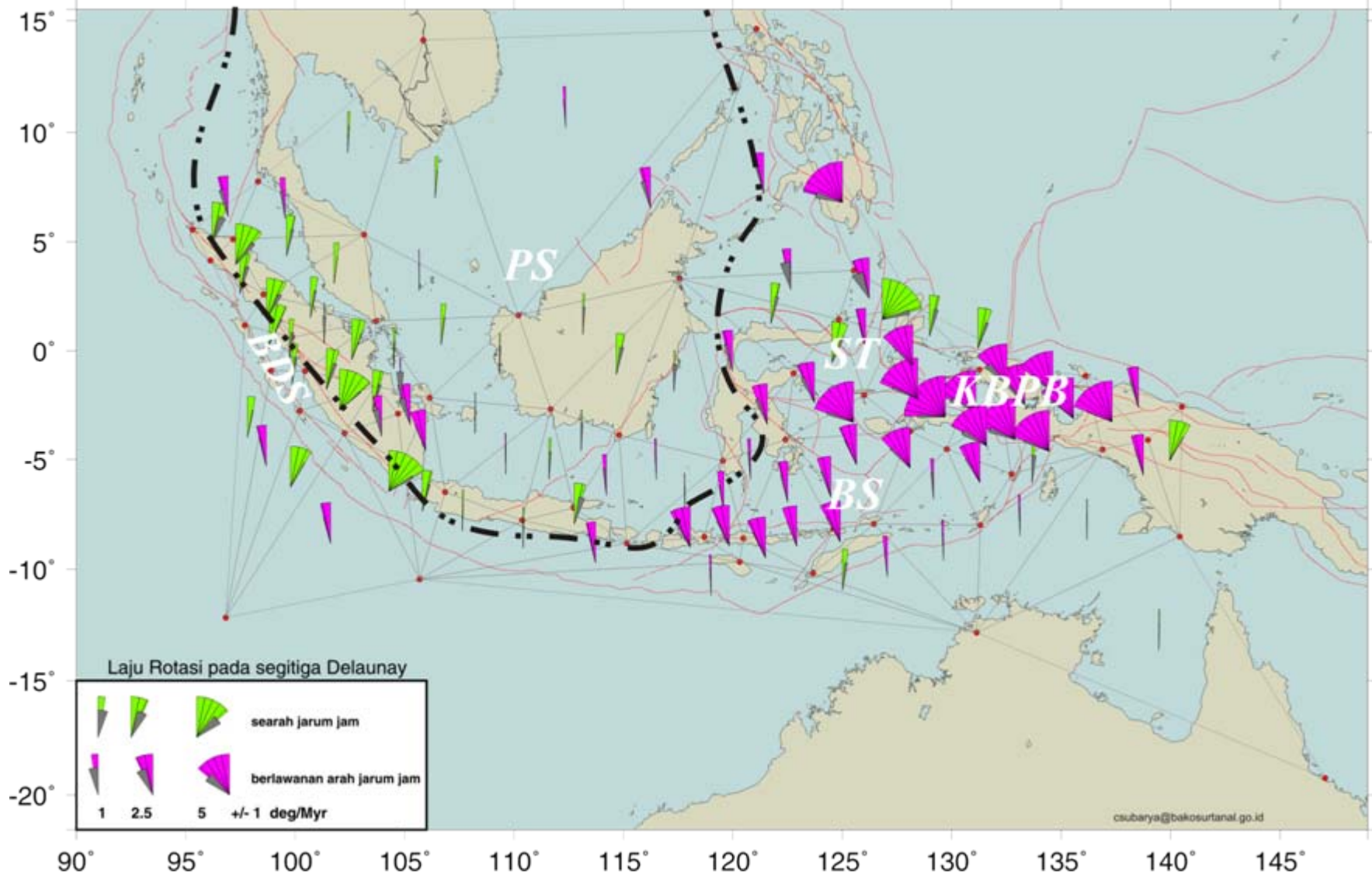
GEODETIC STRAIN

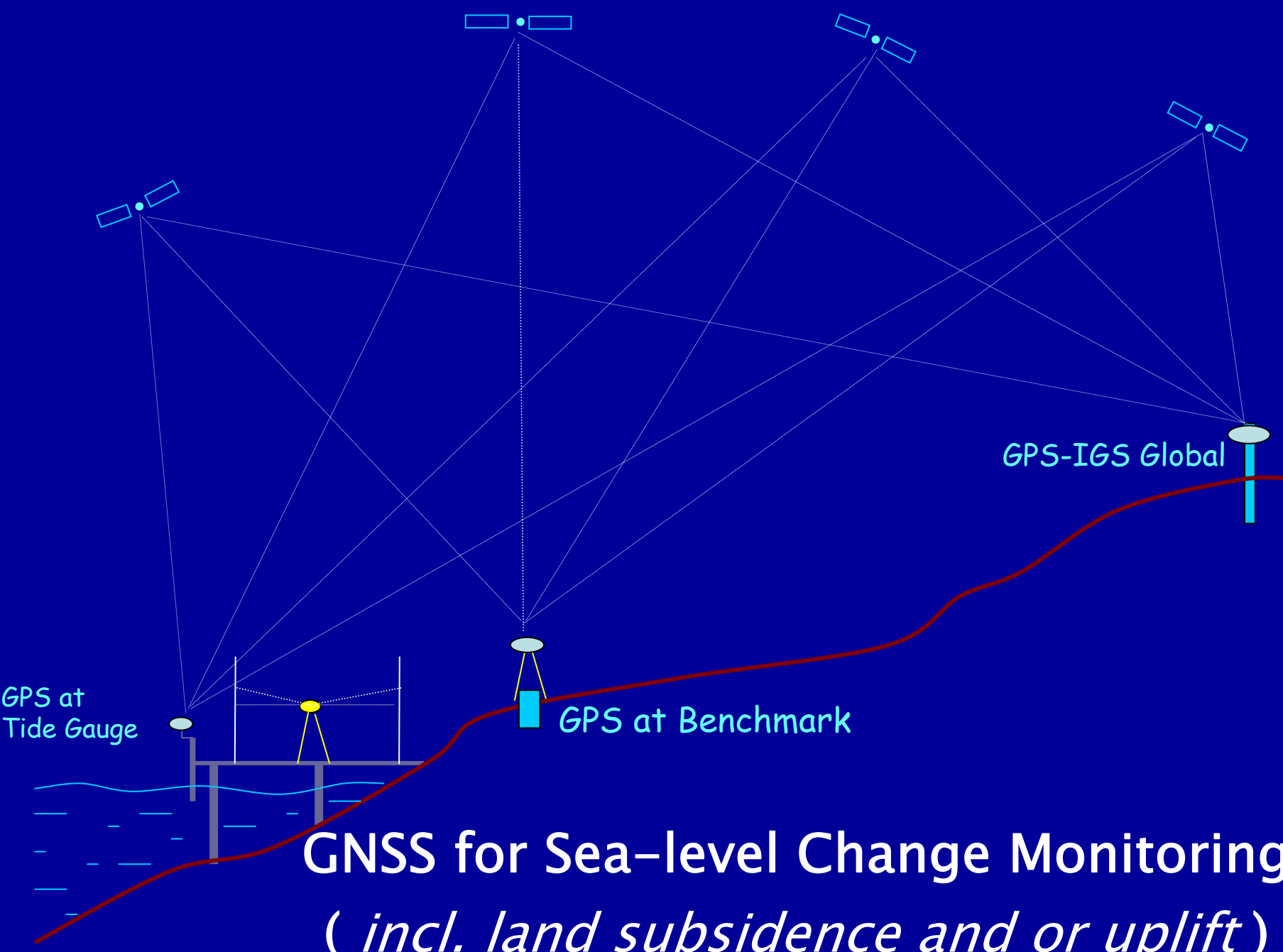
Laju regangan geodetik utama pada 99 segitiga pada periode tahun 1992–2002, warna krem < 5×10^{-8} /thn, warna kuning-hijau $> 5 \times 10^{-8}$ /thn, dan warna biru $\geq 10^{-7}$ /thn



GEODETIC STRAIN

Laju rotasi regangan geodetik utama di tiap 99 segitiga pada periode tahun 1992-2002 sebelum berbagai peristiwa gempa kuat di wilayah Indonesia dan sekitarnya





GNSS for Sea-level Change Monitoring
(*incl. land subsidence and or uplift*)

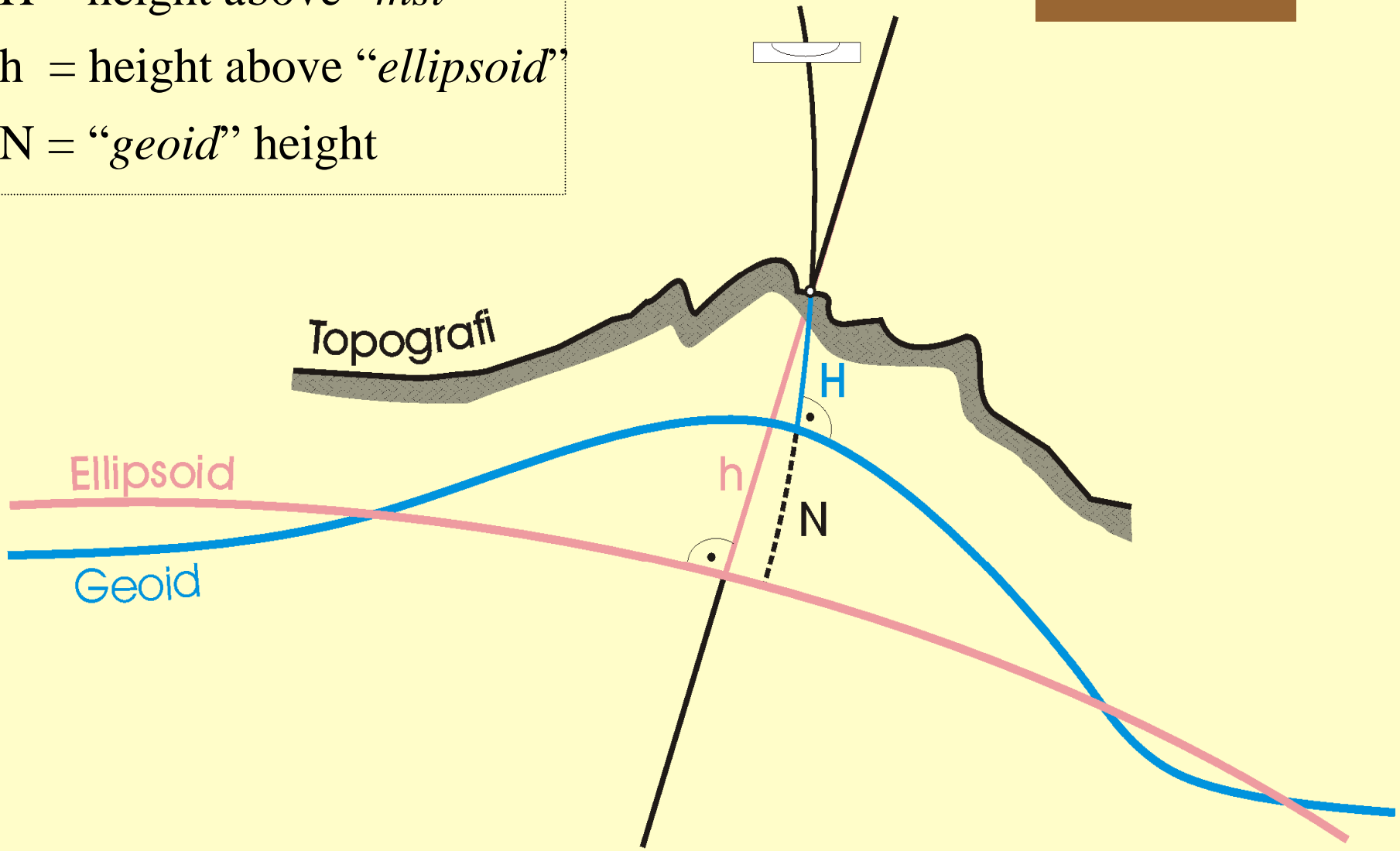
RELATIONSHIP OF REFERENCE COORDINATE SYSTEM WITH RESPECT TO EARTH SURFACE

H = height above “*msl*”

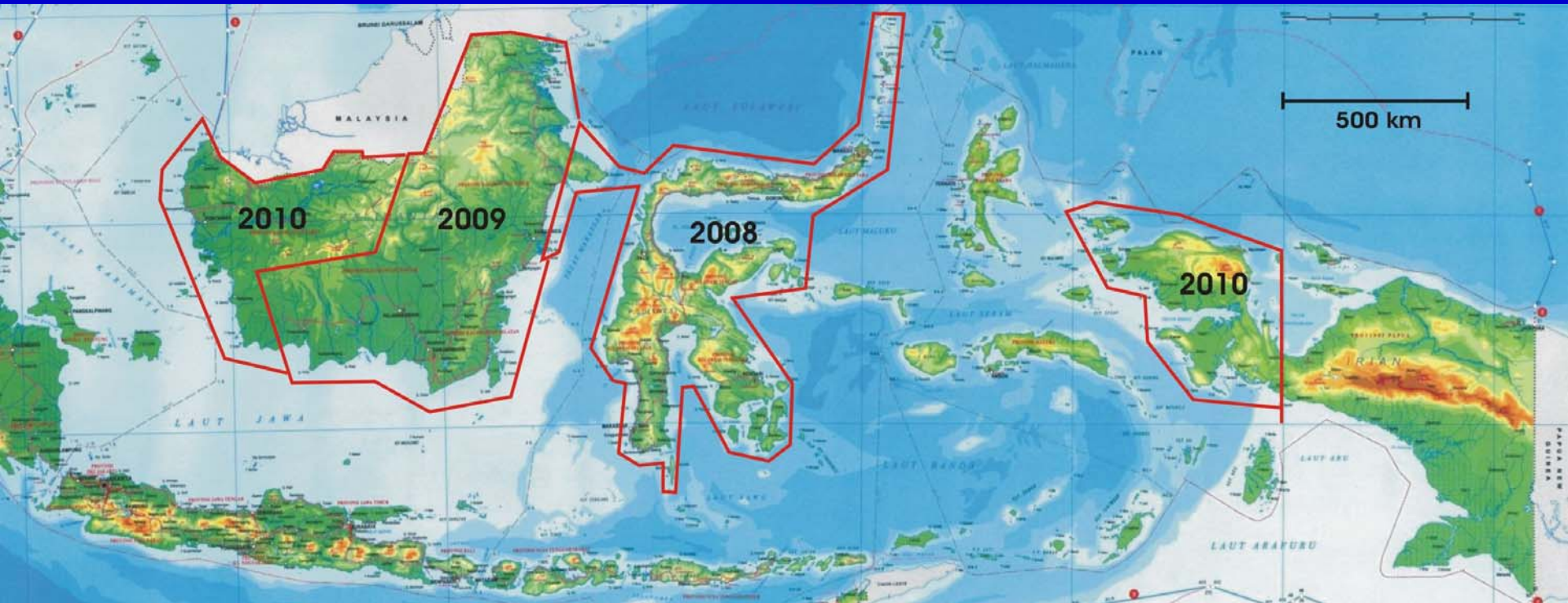
h = height above “*ellipsoid*”

N = “*geoid*” height

$$H = h - N$$



Geoid Mapping Activities by “Airborne Gravity”



CONCLUDING REMARKS

***A developing of Indonesian permanent GNSS
stations network is ongoing***

GPS = Great Places to Smoke

