BADAN INFORMASI GEOSPASIAL

The Indonesian Geoid Model Development

Arisauna Pahlevi, Widy Putra, Bagas Triarahmadhana, Agustina Syafarianty, Raa Ina S. Muntaha – *Indonesian Geospasial Agency (BIG)*

Dudy D. Wijaya, Brian Bramanto – *Bandung Institute of Technology (ITB)*

Evolution of the Indonesian Geoid Model (IGM)

Year	Data	Accuracy
IGM 1986	Limited terrestrial gravity, GEOS-2	± 4.0m
IGM 1996	Limited terrestrial gravity, BGN, OSU91	± 1.0m
IGM 2020 **[InaGeoid 2020]**	Terrestrial gravity, Airborne, EGM2008	± 0.3m

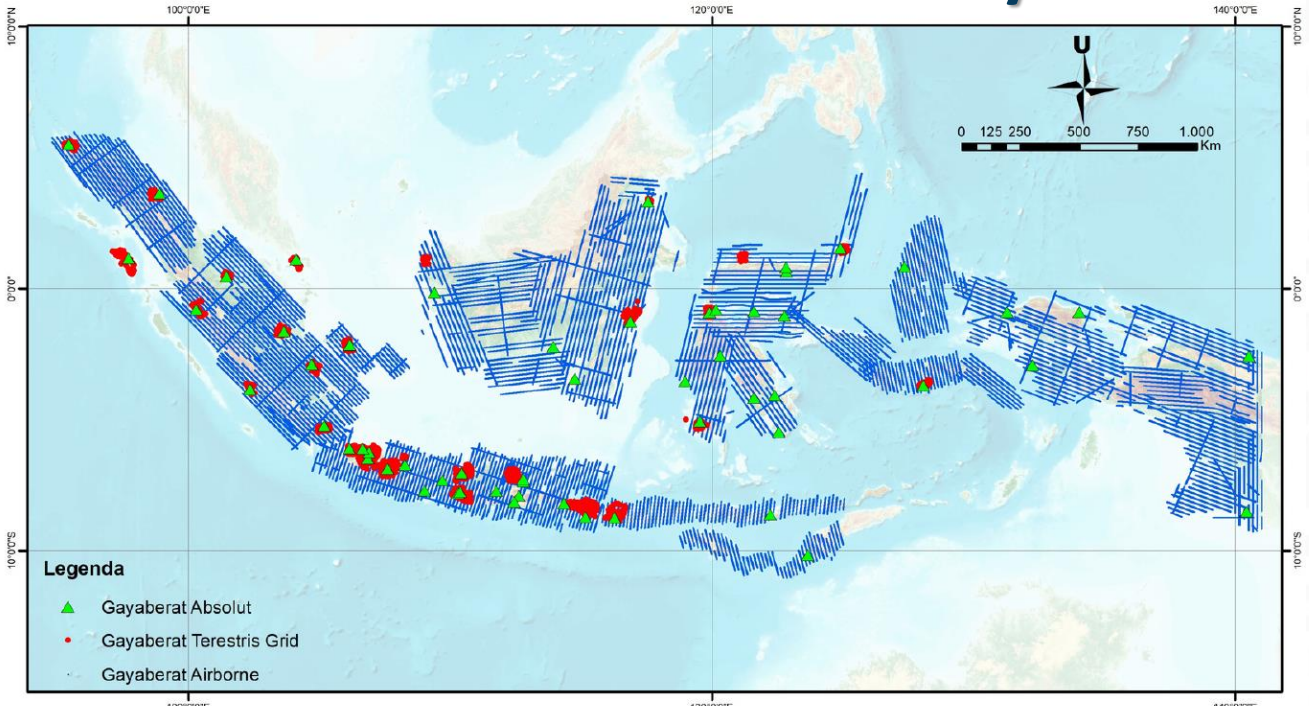
- The IGM focuses on land geoid, while marine geoid remains untouchable

BADAN INFORMASI GEOSPASIAL

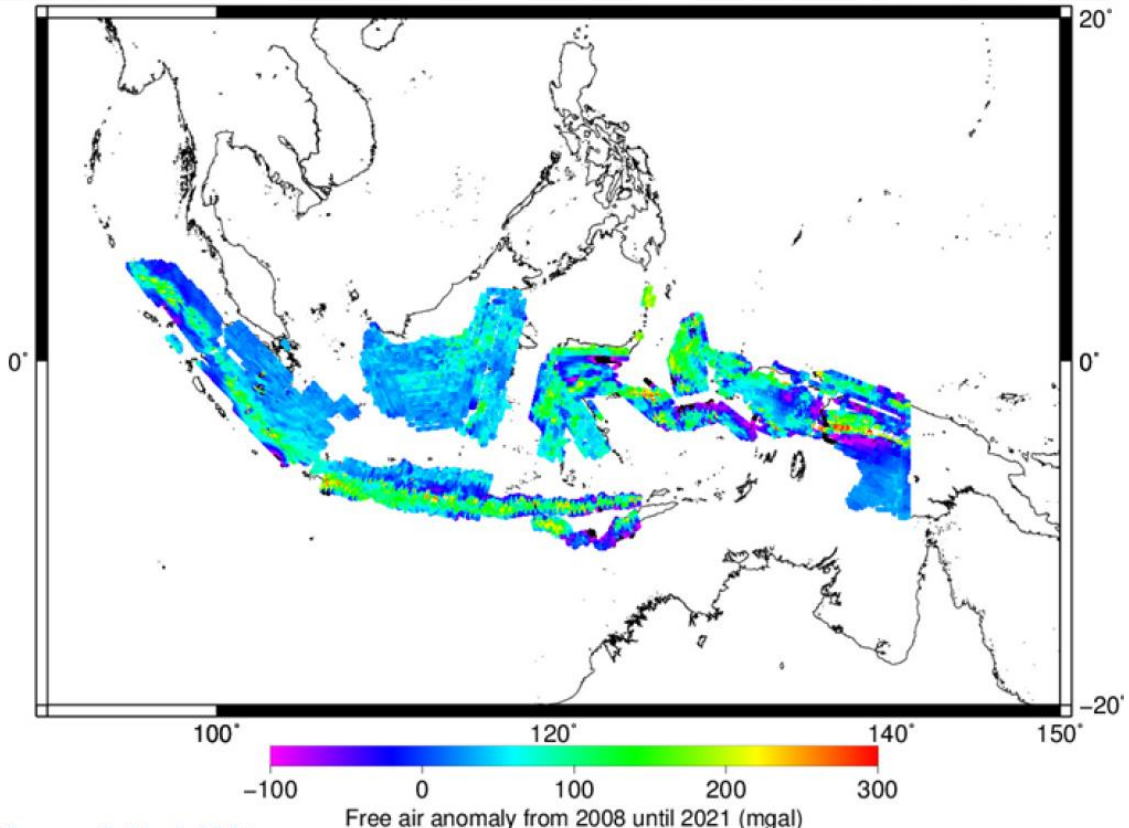
Pahlevi (2024)

InaGeoid 2020: Data & Strategy

Terrestrial & Airborne Gravity Data

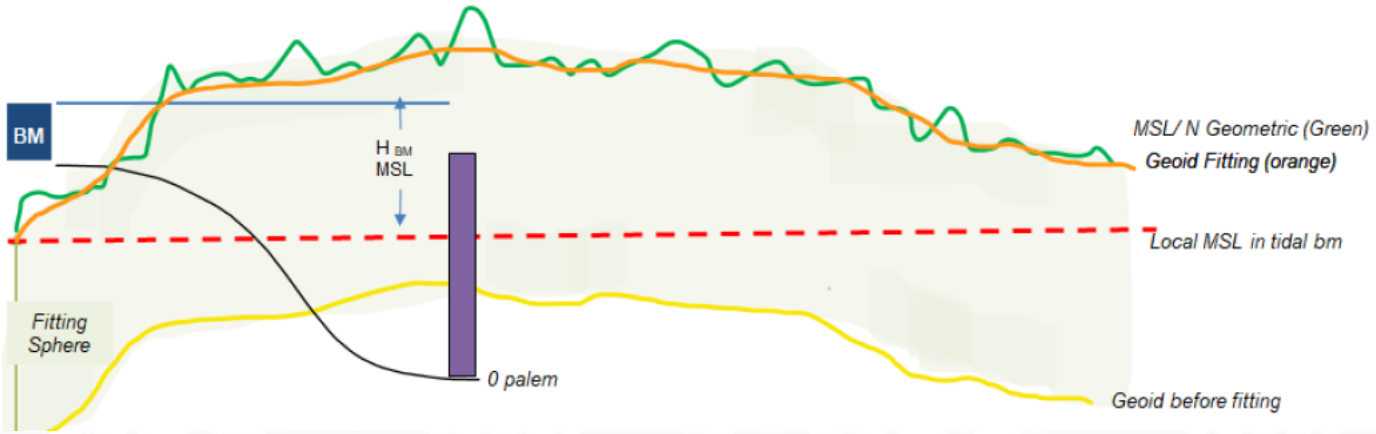


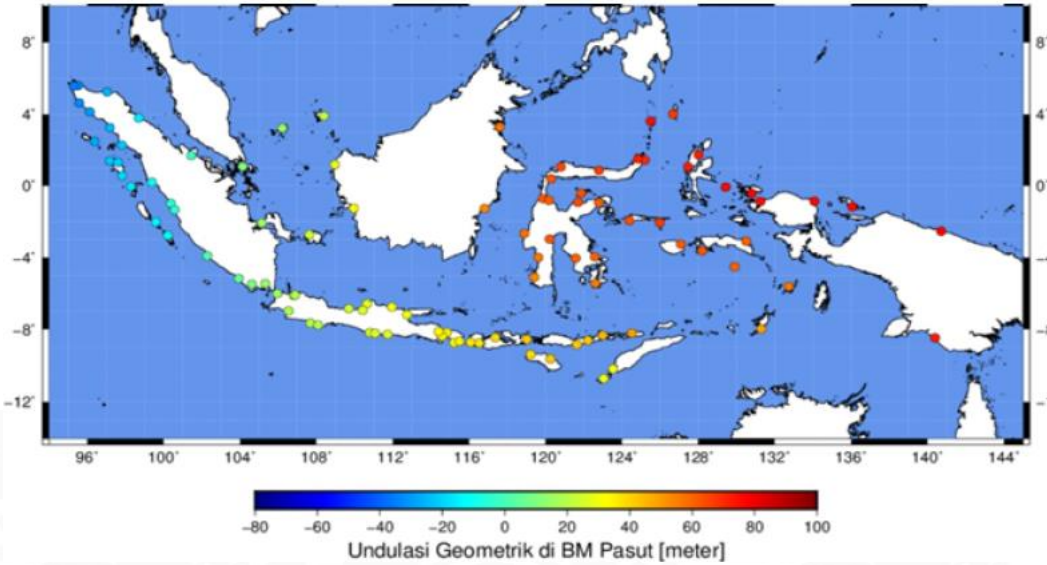
Reduced Free-Air Anomaly



Remove-Compute-Restore & Stokes' approach

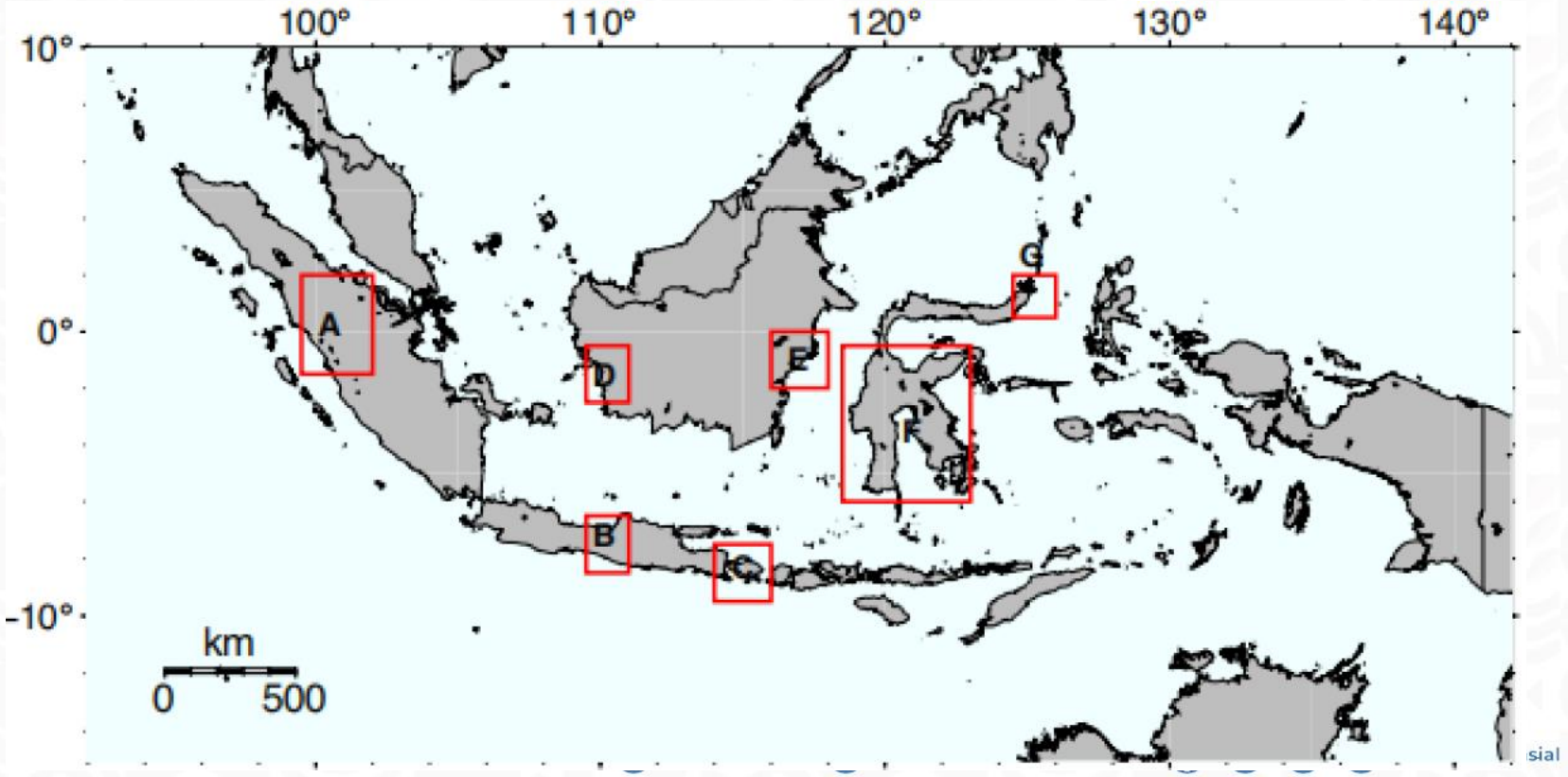
InaGeoid 2020: Geoid Fitting





Pahlevi (2024)

InaGeoid 2020: Validation by GNSS/Leveling



GNSS/Levelling Survey

- Sumatera 1 Line
- Jawa 1 Line
- Bali 1 Line
- Kalimantan 2 loops
- Sulawesi 2 loops

Pahlevi (2024)

InaGeoid 2020: Model's Accuracy

Total Accuracy: ± 0.3m

Pahlevi (2024)

Areas	Number of data	Before Fitting (m)				After Fitting (m)			
		ΔN_{min}	ΔN_{max}	ΔN_{mean}	ΔN_{stdev}	ΔN_{min}	ΔN_{max}	ΔN_{mean}	ΔN_{stdev}
Java	186	1.769	2.321	2.053	0.122	−0.243	0.301	0.008	0.118
Bali	178	1.768	2.798	2.316	0.200	−0.560	0.367	−0.106	0.167
West Kalimantan	284	1.489	1.958	1.766	0.070	−0.538	−0.001	−0.269	0.064
East Kalimantan	264	1.640	2.160	1.944	0.073	−0.196	0.206	0.020	0.059
South part of Sulawesi	53	1.380	2.655	2.015	0.272	−0.005	0.753	−0.040	0.251
North part of Sulawesi	220	1.673	2.281	1.994	0.116	−0.355	0.270	−0.034	0.121
Sumatra	21	0.881	2.222	1.610	0.293	−0.934	0.372	−0.219	0.286

Plans for Improving the InaGeoid 2020

Some considerations:

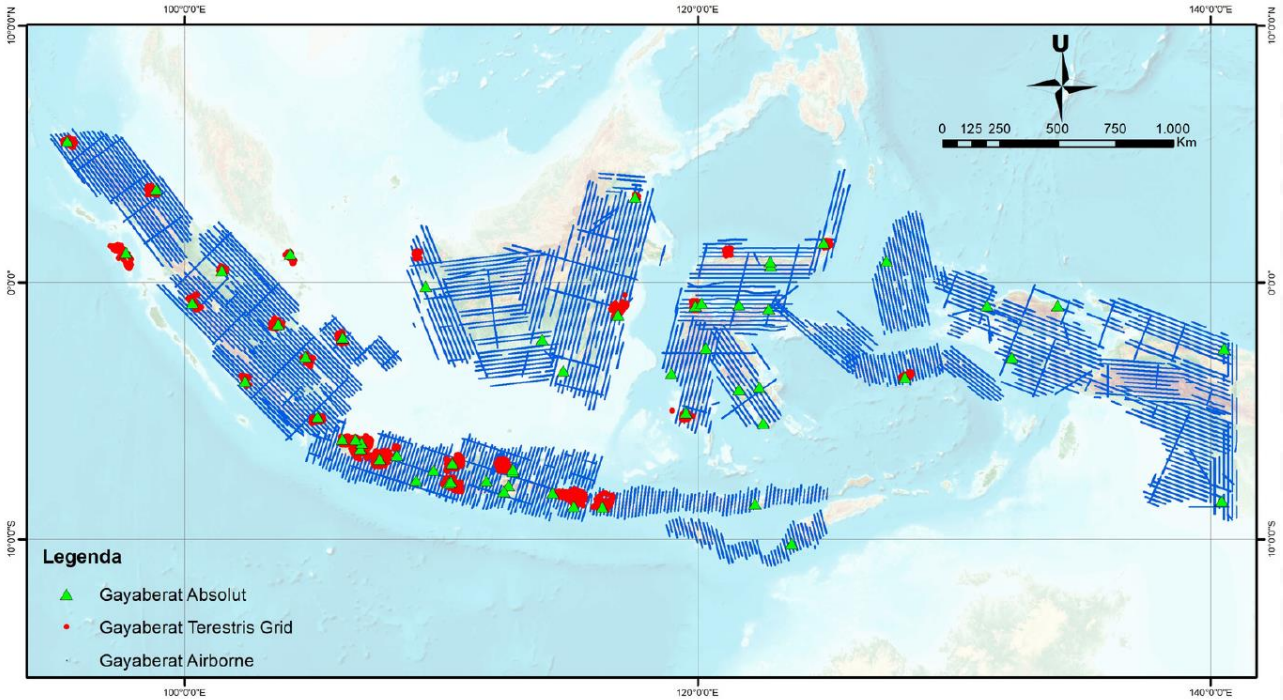
- Introducing more gravity observations (Including Ocean Altimetry)
- Homogenizaton of data processing
- Refining numerical aspects
- Densifying the GNSS/leveling observations
- ‘Connecting’ between local MSL observations

⇒

- **Accuracy goal: ± 0.1m**
- **InaGeoid 2025/2026**

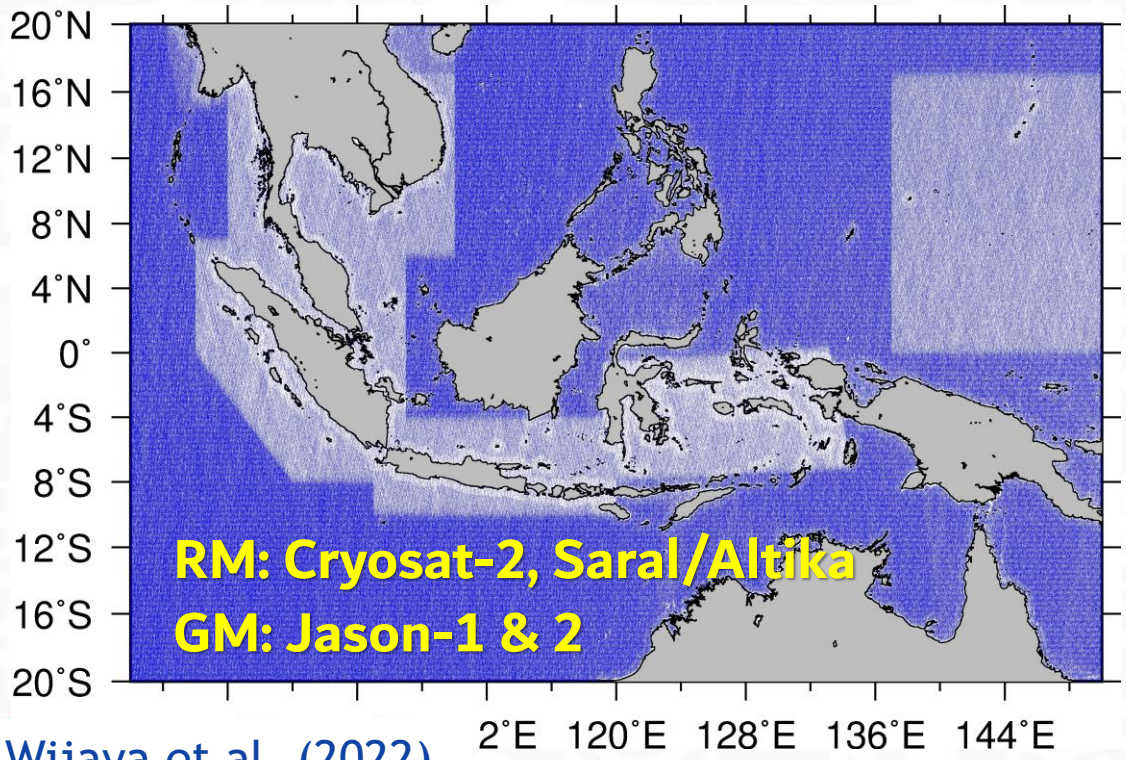
Land & Ocean Gravity Data

Terrestrial & Airborne Gravity Data



Pahlevi (2024)

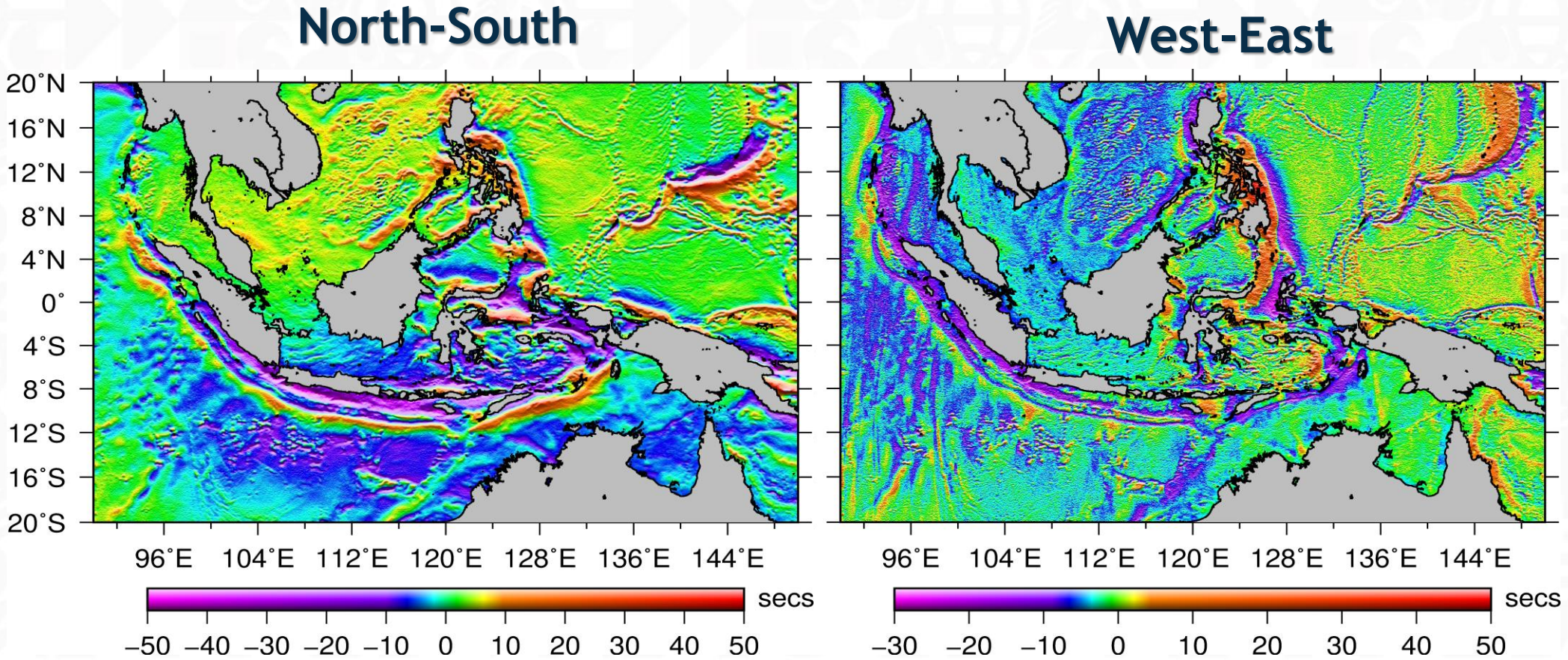
Satellite Altimetry Data



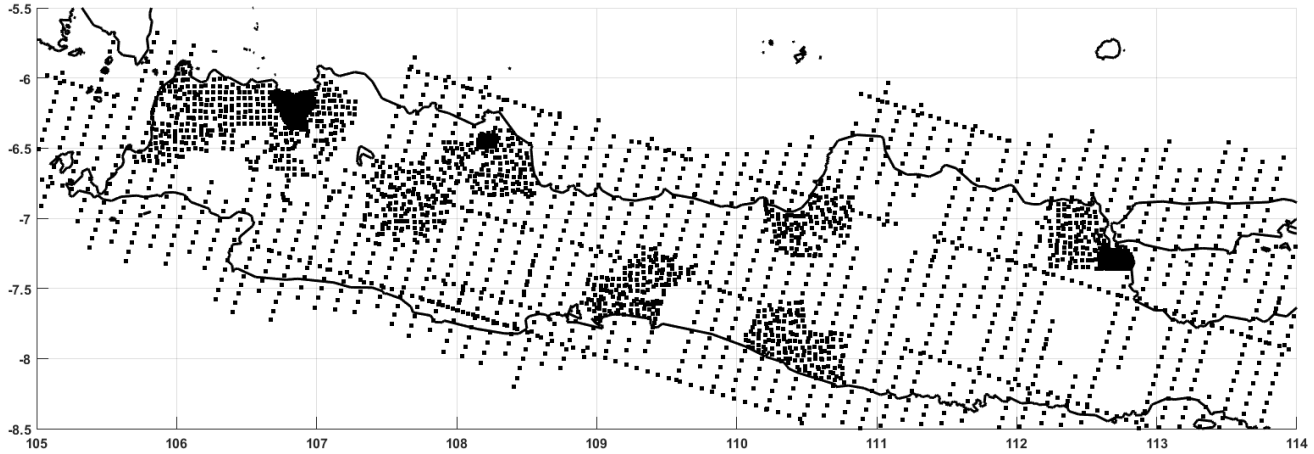
Wijaya et al. (2022)

Ocean Vertical of Deflection

Wijaya et al. (2022)



Introducing More Gravity Observations

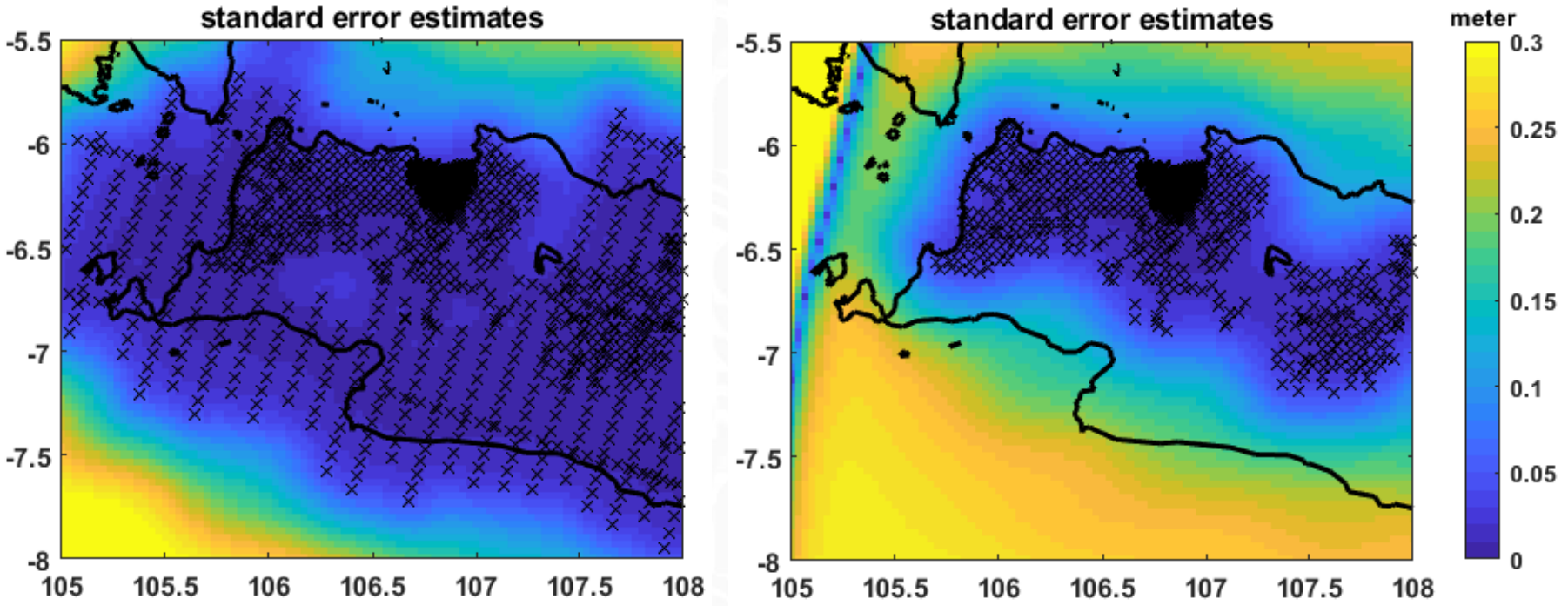


Current status:

- Airborne: 18 km line spacing
- Terrestrial: 5 km interval

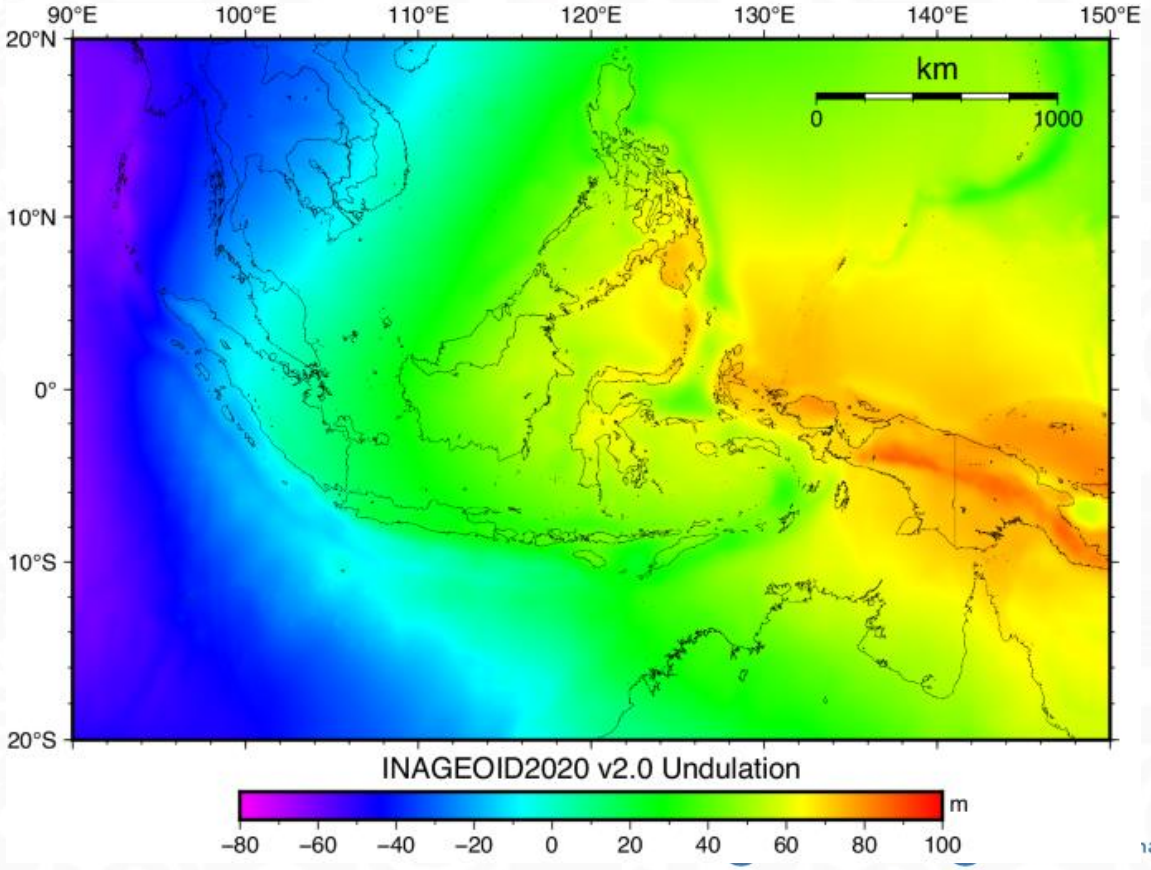
- More gravity surveys are expected to be conducted to fill the ‘gaps’

The Importance of Dense Gravity Observations



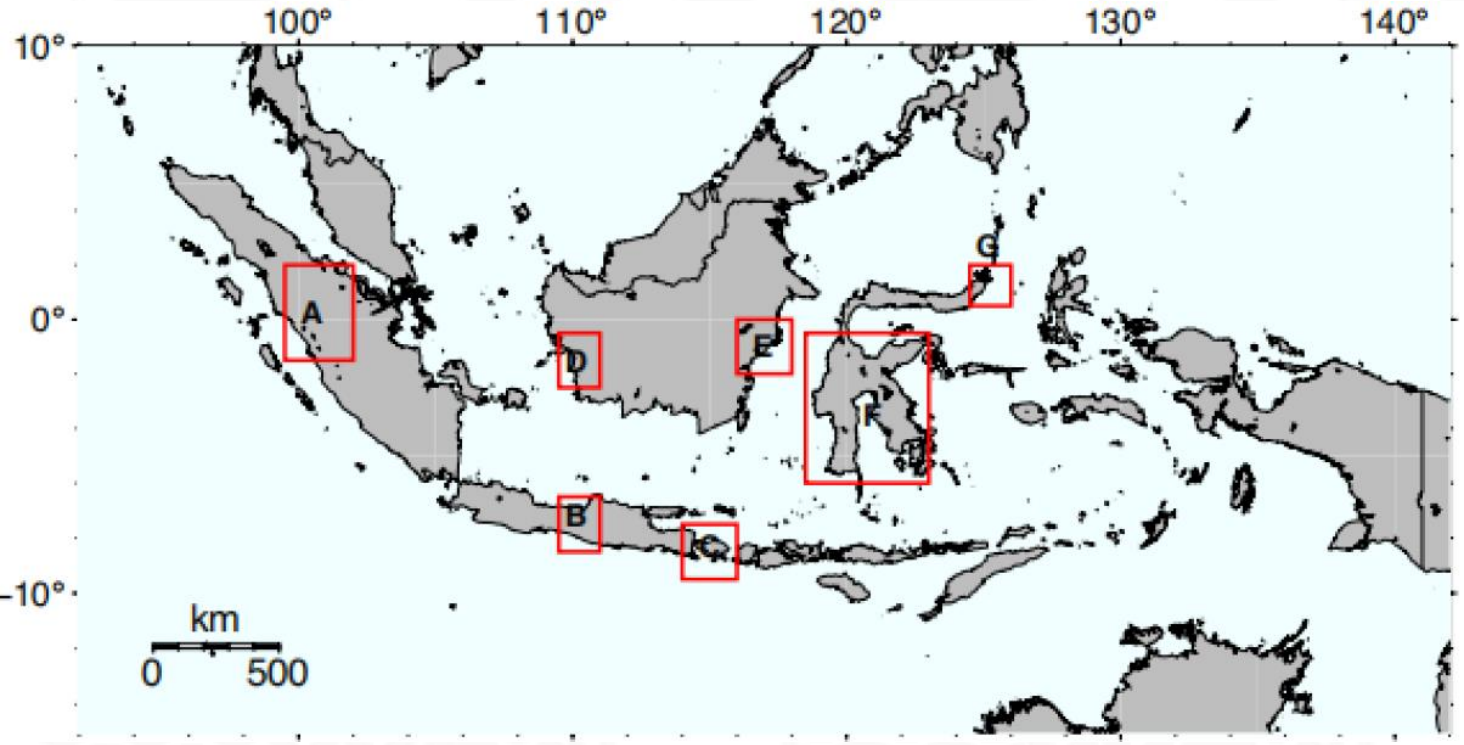
- The current formal error is better than 10 cm
- More gravity dataset is expected to enhace this.

Numerical Aspects



- The InaGEOID 2020 is still based on the basic FFT convolution method
- Refinement aspects:
  - Introducing Wong-Gore modifications
  - Least-squares collocation (to introduce uncertainty from different datasets)

Densifying the GNSS/Leveling Observations



- Most GNSS/leveling observations is only available on profile-based observation
- Evaluation can only be made island-based!
  - Each GNSS/leveling is based on local sea level observations!

'Connecting' betwen Local Sea Level Observations

- Determining the method to unify the references (in this case related to the validation of the gravimetric geoid model), still requires further study
- One possible method that can be proposed for study:
  - Hydrodynamic leveling (https://link.springer.com/article/10.1007/s00190-018-1133-3)
  - Using MDT model to connect the observations
  - Etc…

… Thank you very much …
… Hatur nuhun pisan …