



BADAN INFORMASI
GEOSPASIAL

XXV FIG CONGRESS, “Engaging the Challenges, Enhancing the Relevance”, 16 – 21 June 2014, Malaysia

Coastal Gravity Anomalies from Retracked Geosat/GM : A Case Study in Bali, Indonesia

Presented By,
Dyah Pangastuti
Arisauna M.Pahlevi



BADAN INFORMASI
GEOSPASIAL

XXV FIG CONGRESS, “Engaging the Challenges, Enhancing the Relevance”, 16 – 21 June 2014, Malaysia

BACKGROUND

- inspired by paper of Hwang et al., 2012, Yang et., al 2006, and Deng and Featherstone., 2006
- Indonesia develop Indonesian Geospatial Reference System (SRGI 2013). Geoid is vertical datum in SRGI 2013
- Indonesian archipelago consists of an estimated total of 13.466 islands (BIG, 2013).
- Indonesian Geoid need land and marine gravity data
- Lack of marine gravity data (limitation of shipborne and airborne survey)
- Solution : use altimetry for marine gravity
- Handicapped of altimetry: Near coastal, altimeter waveform may be corrupted. Retracking altimetry can improve waveform and gravity data



BADAN INFORMASI
GEOSPASIAL

XXV FIG CONGRESS, “Engaging the Challenges, Enhancing the Relevance”, 16 – 21 June 2014, Malaysia

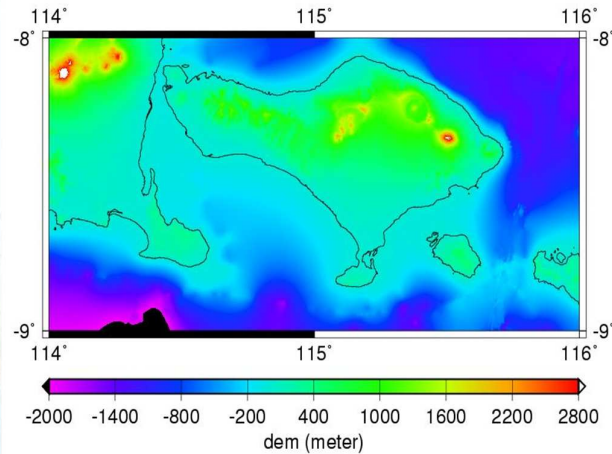


Figure 1. Data Elevation Model of Bali Inland and Waters Around Bali From SRTM 3'' Resolution

- Waters around Bali, Indonesia is classified as shallow water (300-800 m)
- Bali island near with Java Island and Lombok Island. Altimeter signal should be corrupted in that area.



BADAN INFORMASI
GEOSPASIAL

XXV FIG CONGRESS, “Engaging the Challenges, Enhancing the Relevance”, 16 – 21 June 2014, Malaysia

OBJECTIVE

- Retracking SSH in waters around Bali
- Get gravity data from SSH
- Improve gravity data from altimetry



BADAN INFORMASI
GEOSPASIAL

XXV FIG CONGRESS, “Engaging the Challenges, Enhancing the Relevance”, 16 – 21 June 2014, Malaysia

SUBWAVE THRESHOLD METHOD

- Subwave threshold retracker derive the leading edge to reduce the error in the estimated arrival time of the pulse in four steps (Hwang et al., 2012):
 - a. Obtain an accurate reference leading edge from the Brown Model
 - b. The subwaveform correlation is used to derive the optimal subwaveform
 - c. the leading edge is determined after analysing the optimal subwaveform
 - d. the retracking correction is derived from the leading edge with the threshold retracking. Compute retracking gate

The Result : SSH after Retrack



BADAN INFORMASI
GEOSPASIAL

XXV FIG CONGRESS, “Engaging the Challenges, Enhancing the Relevance”, 16 – 21 June 2014, Malaysia

IMPROVED GRAVITY ANOMALY FROM RETRACKTED SSH

- We use Geosat/GM altimeter at waters around Bali
- The SSH retracked of Geosat/GM used to derive along track geoid gradient observed, e .

$$e_{\text{res}} = e - e_{\text{long}}$$

$$e_{\text{res}} = \text{geoid residual, } e_{\text{long}} = \text{geoid global, egm 2008}$$

- We use Least Square Collocation to compute g_{res}
- $G = g_{\text{res}} + g_{\text{long}}$



BADAN INFORMASI
GEOSPASIAL

XXV FIG CONGRESS, "Engaging the Challenges, Enhancing the Relevance", 16 – 21 June 2014, Malaysia

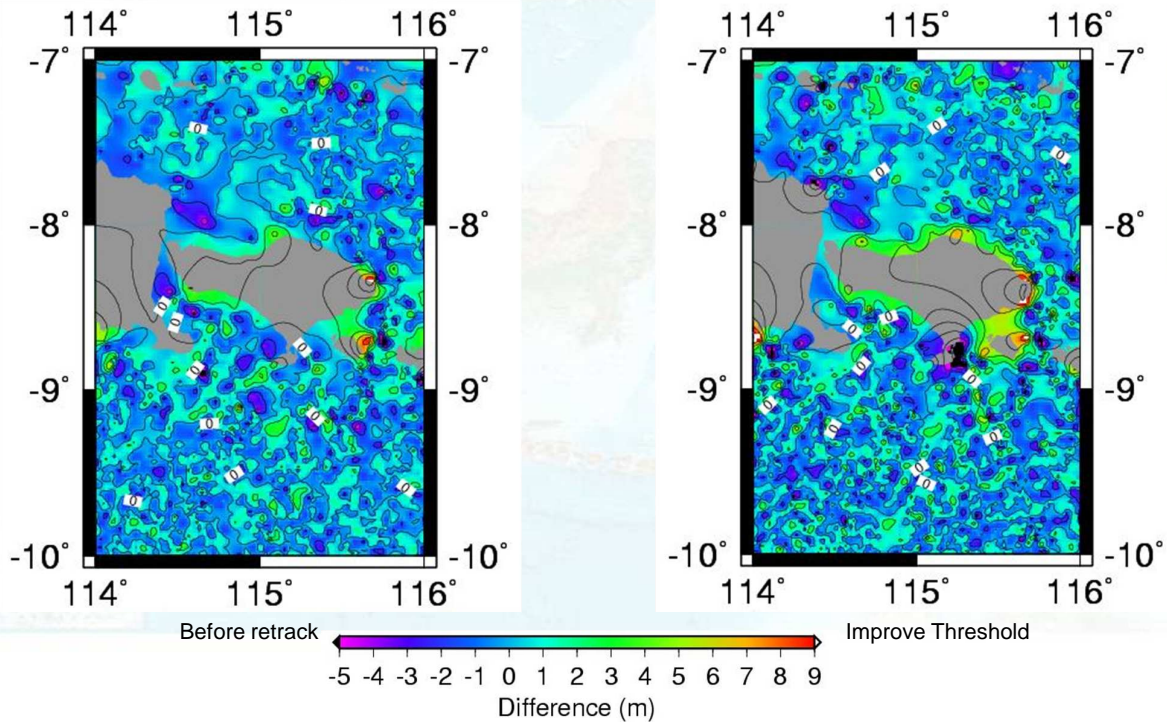


Figure 2. Residual SSHgradien Before Retracking (left) and Improve Threshold Retracker (right)



BADAN INFORMASI
GEOSPASIAL

XXV FIG CONGRESS, "Engaging the Challenges, Enhancing the Relevance", 16 – 21 June 2014, Malaysia

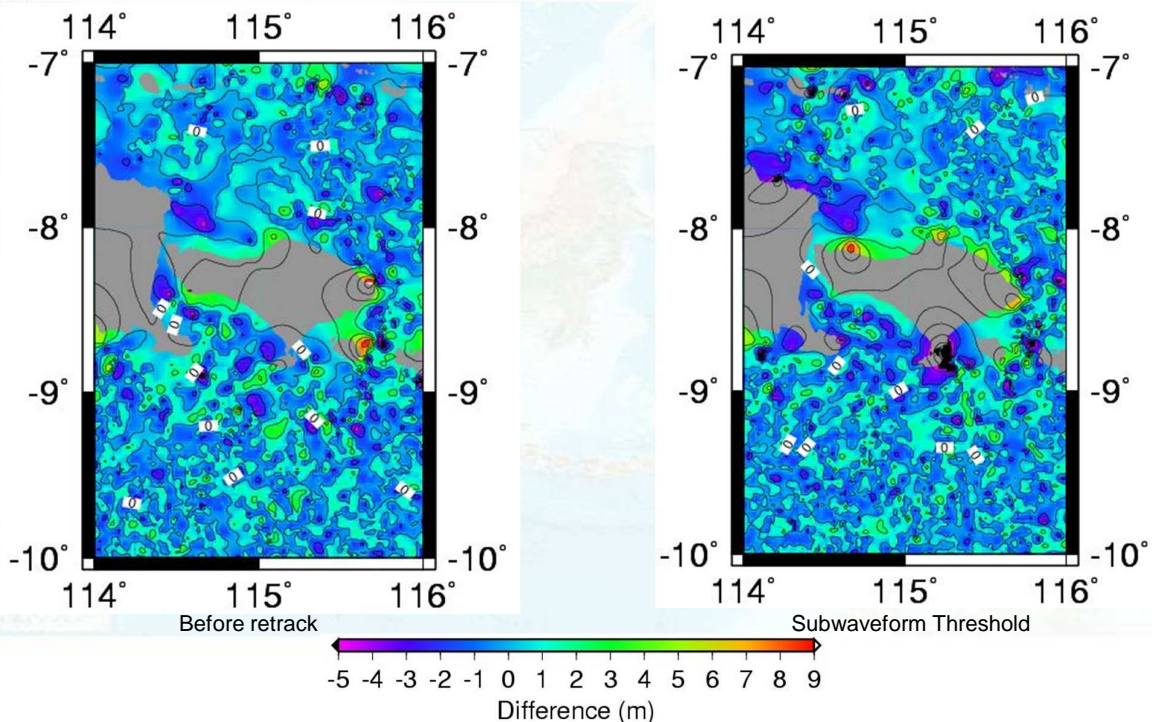


Figure 3. Residual SSHgradien Before Retracking (left) and Subwaveform Threshold Retracker (right)



BADAN INFORMASI
GEOSPASIAL

XXV FIG CONGRESS, "Engaging the Challenges, Enhancing the Relevance", 16 – 21 June 2014, Malaysia

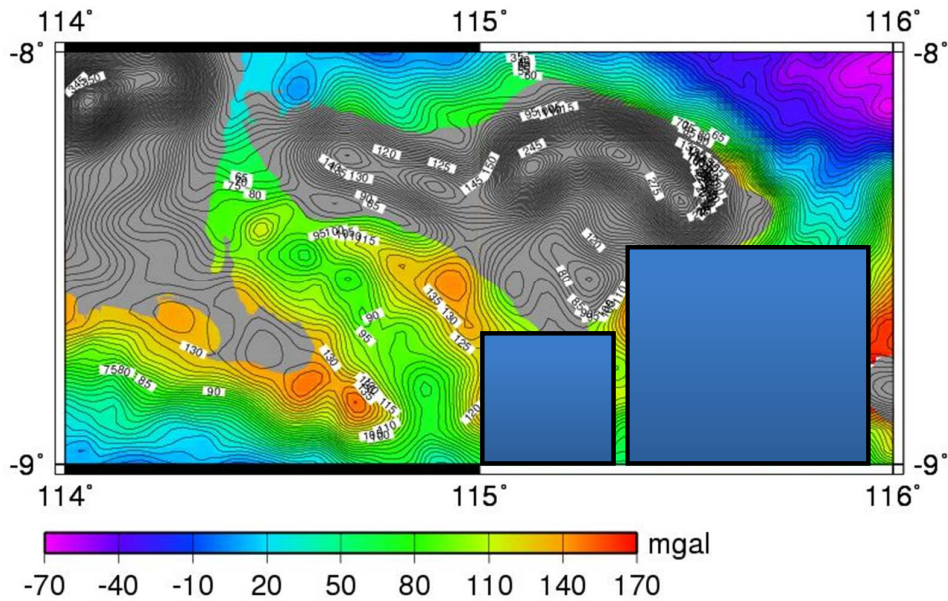


Figure 4. Contours of Gravity Anomalies Using raw SSH



BADAN INFORMASI
GEOSPASIAL

XXV FIG CONGRESS, "Engaging the Challenges, Enhancing the Relevance", 16 – 21 June 2014, Malaysia

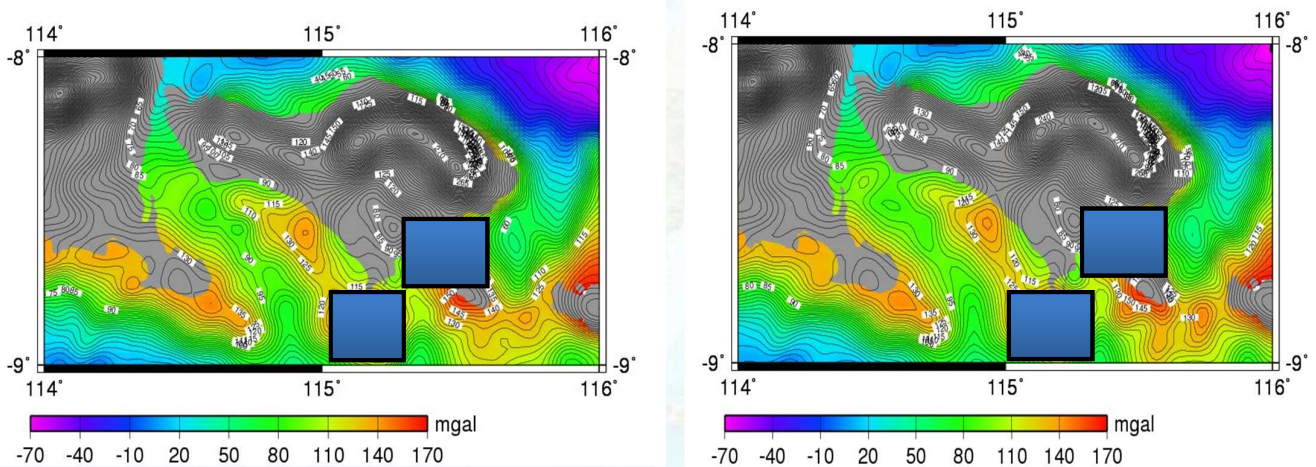


Figure 5. Contours of Gravity Anomalies Retracted SSH (Improve Threshold Retracker (left) and Subwaveform threshold retracker (right))



BADAN INFORMASI
GEOSPASIAL

XXV FIG CONGRESS, “Engaging the Challenges, Enhancing the Relevance”, 16 – 21 June 2014, Malaysia

- anomaly gravities derived from raw SSH has rough contours
- anomaly gravities from retrackted SSH has smooth contours.
- at a location northeast of Bali island (at marine area nearby Penida and Lombok Island), some gravity artifacts are dissapeared after retracted.
- Also at a location north of Bali island



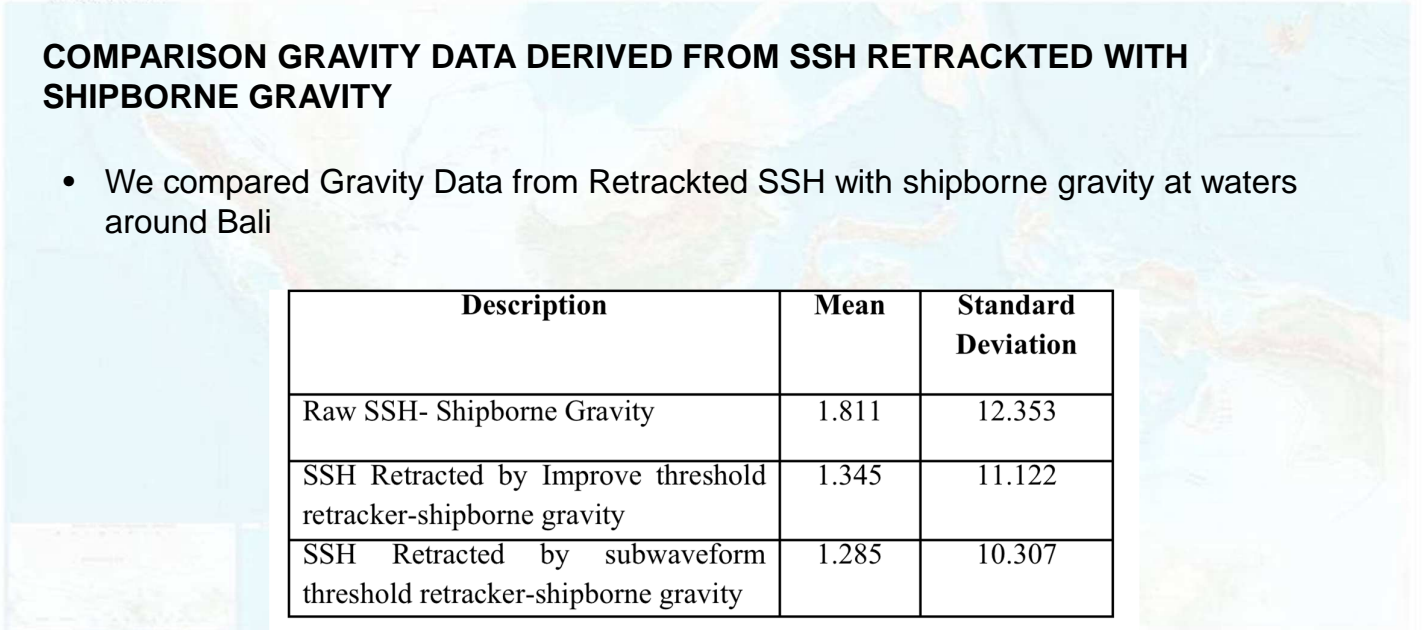
BADAN INFORMASI
GEOSPASIAL

XXV FIG CONGRESS, “Engaging the Challenges, Enhancing the Relevance”, 16 – 21 June 2014, Malaysia

COMPARISON GRAVITY DATA DERIVED FROM SSH RETRACKTED WITH SHIPBORNE GRAVITY

- We compared Gravity Data from Retracked SSH with shipborne gravity at waters around Bali

Description	Mean	Standard Deviation
Raw SSH- Shipborne Gravity	1.811	12.353
SSH Retracted by Improve threshold retracker-shipborne gravity	1.345	11.122
SSH Retracted by subwaveform threshold retracker-shipborne gravity	1.285	10.307





BADAN INFORMASI
GEOSPASIAL

XXV FIG CONGRESS, "Engaging the Challenges, Enhancing the Relevance", 16 – 21 June 2014, Malaysia

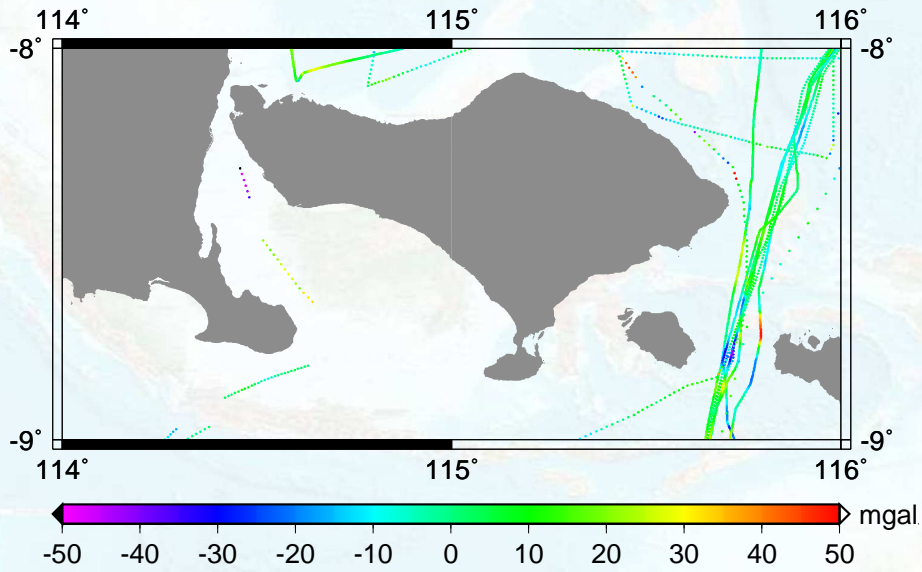


Figure 6. Distributions of Difference Between Gravity Anomalies Derived by Altimeter and Shipborne Gravity Before Retracking



BADAN INFORMASI
GEOSPASIAL

XXV FIG CONGRESS, "Engaging the Challenges, Enhancing the Relevance", 16 – 21 June 2014, Malaysia

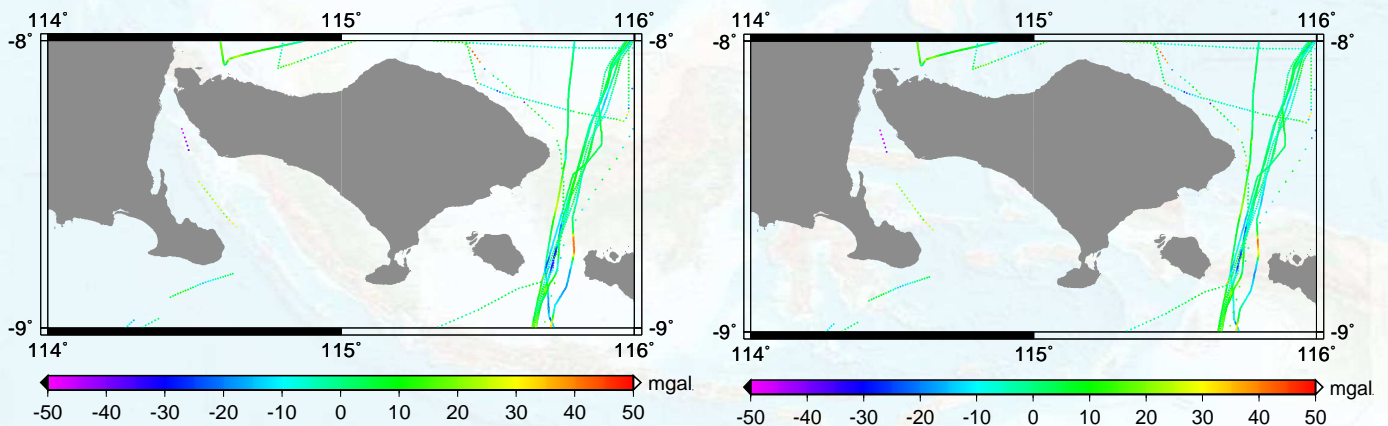


Figure 7. Distributions of Difference Between Gravity Anomalies Derived by Altimeter and Shipborne Gravity , a. Improve threshold Retracker, b. Subwaveform Threshold Retracker



BADAN INFORMASI
GEOSPASIAL

XXV FIG CONGRESS, “Engaging the Challenges, Enhancing the Relevance”, 16 – 21 June 2014, Malaysia

CONCLUSION

- Shallow water around Bali made altimeter subwaveform corrupted.
- Altimeter retracked can improve gravity anomaly in waters around Bali. Subwaveform threshold improved 29%, improve threshold retracker improved 25%
- Subwaveform threshold retracker is outperform than improve threshold retracker