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"Geospatial Information for a Smarter Life and Environmental Resilience"

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Determination of Marine Gravity Anomalies in the sea of the Truong Sa Archipelago Using Satellite Altimeter Data

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Presentation structure

1. The method of determining the marine gravity anomalies from the satellite altimeter data

2. The results of determining the gravity anomalies in the sea of the TruongSa Archipelago from the Cryosat-2 data

1. The method of determining the marine gravity anomalies from the satellite altimeter data

1.1. How altimetry works

$$h = c\frac{\Delta t}{2} \quad (1)$$

$$SSH = H - h - h_{cor} \quad (2)$$

h_{cor} – Corrections
H – Satellite height above ellipsoid

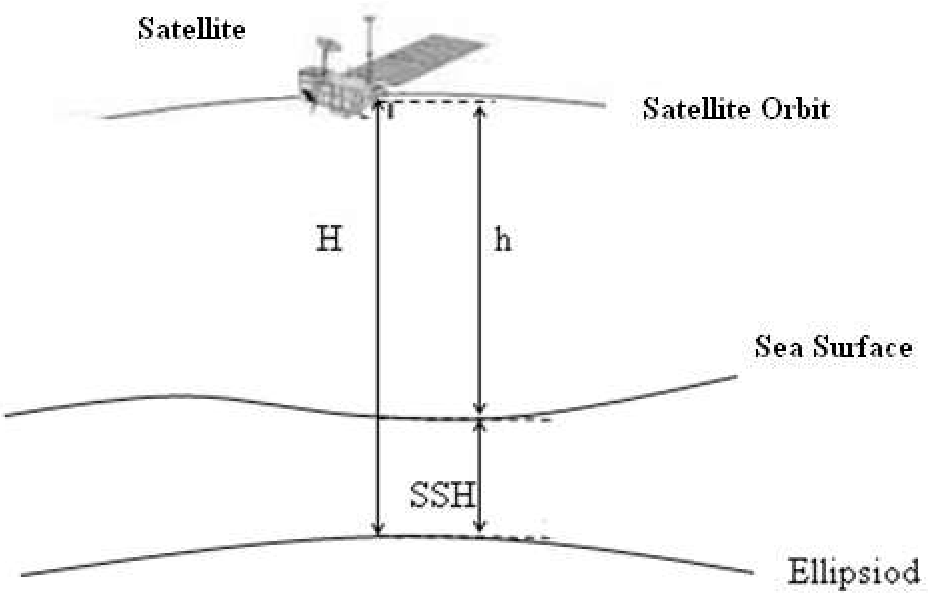


Fig. 1. Principle of altimetry

The components of sea surface height

$$SSH = N_{EGM} + \Delta N + h_{MDT} + h_t \qquad (3)$$

N_{EGM} – the long-wavelength geoid height

$\Delta \mathrm{N}$ – the residual geoid height

h_{MDT} – the mean dynamic topography

h_{t} - the time-varying sea surface topography

$$SSH = N_{EGM} + \Delta N + h_{MDT} + h_t \qquad (3)$$

For determination gravity anomaly from sea surface height, We need to remove

- the long-wavelength geoid height
- the mean dynamic topography
- the time-varying sea surface topography

and use **the residual geoid height**

to determine **residual gravity anomalies Δg_{res}**

Sea Surface Height (*SSH)*

↓

Using “remove – restore” technique to remove N_{EGM}

↓

Using the global mean dynamic topography to remove h_{MDT}

↓

Using the crossover adjustment method to remove the time-varying sea surface topography (h_t)

↓

Determination of residual gravity anomalies (Δg_{res}) using least-squares collocation

↓

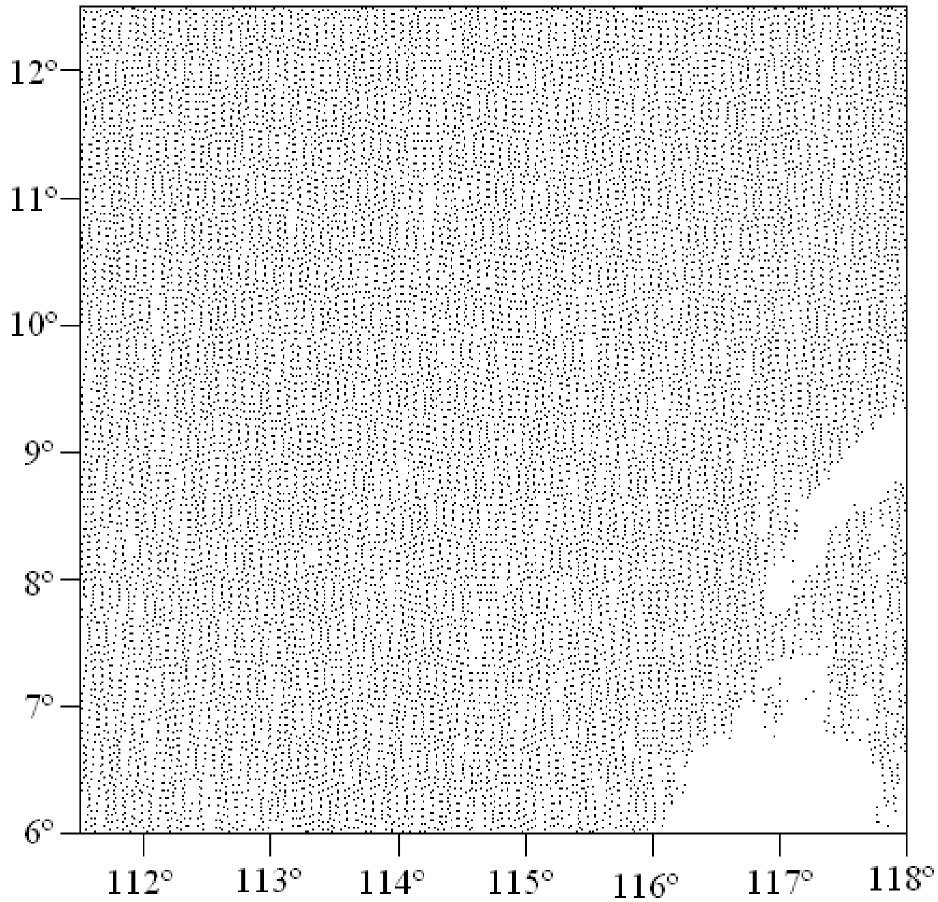
Using “remove – restore” technique to restore Δg_{EGM}:

$$\Delta g = \Delta g_{EGM} + \Delta g_{res}$$

Fig. 2. The flowchart of the determination of marine gravity anomalies from the satellite altimeter data

2. The results of determining the gravity anomalies in the sea of the TruongSa's Archipelago from the Cryosat-2 data

- study area (latitude: from 6°30' to 12°00'; longitude: from 112°00' to 117°30') (≈ 366.000 km^2)
- Cryosat-2 satellite altimeter data
  - 52 cycles, 72.483 observations
  - observed from 04 - October, 2012 to 15 - September, 2016
- global Geopotential model (EGM2008)
- The global mean dynamic topography (DTU13MDT)



- The distribution of cryosat-2 satellite altimeter data is shown in Figure 3 with a spatial resolution of 3' x 3'.

Fig. 3. Distribution of measurement points

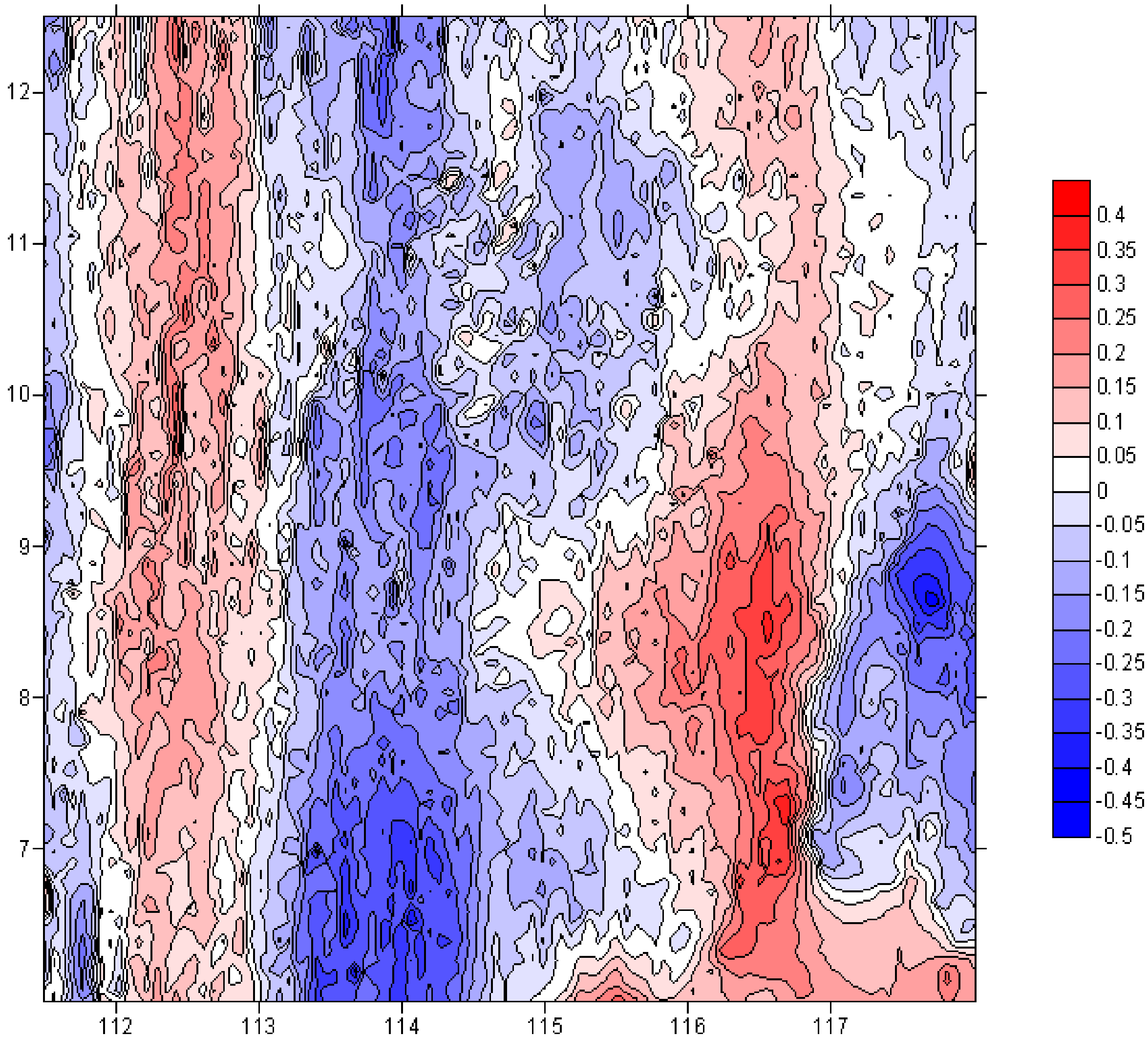


Fig. 4. The residual geoid heights (ΔN)

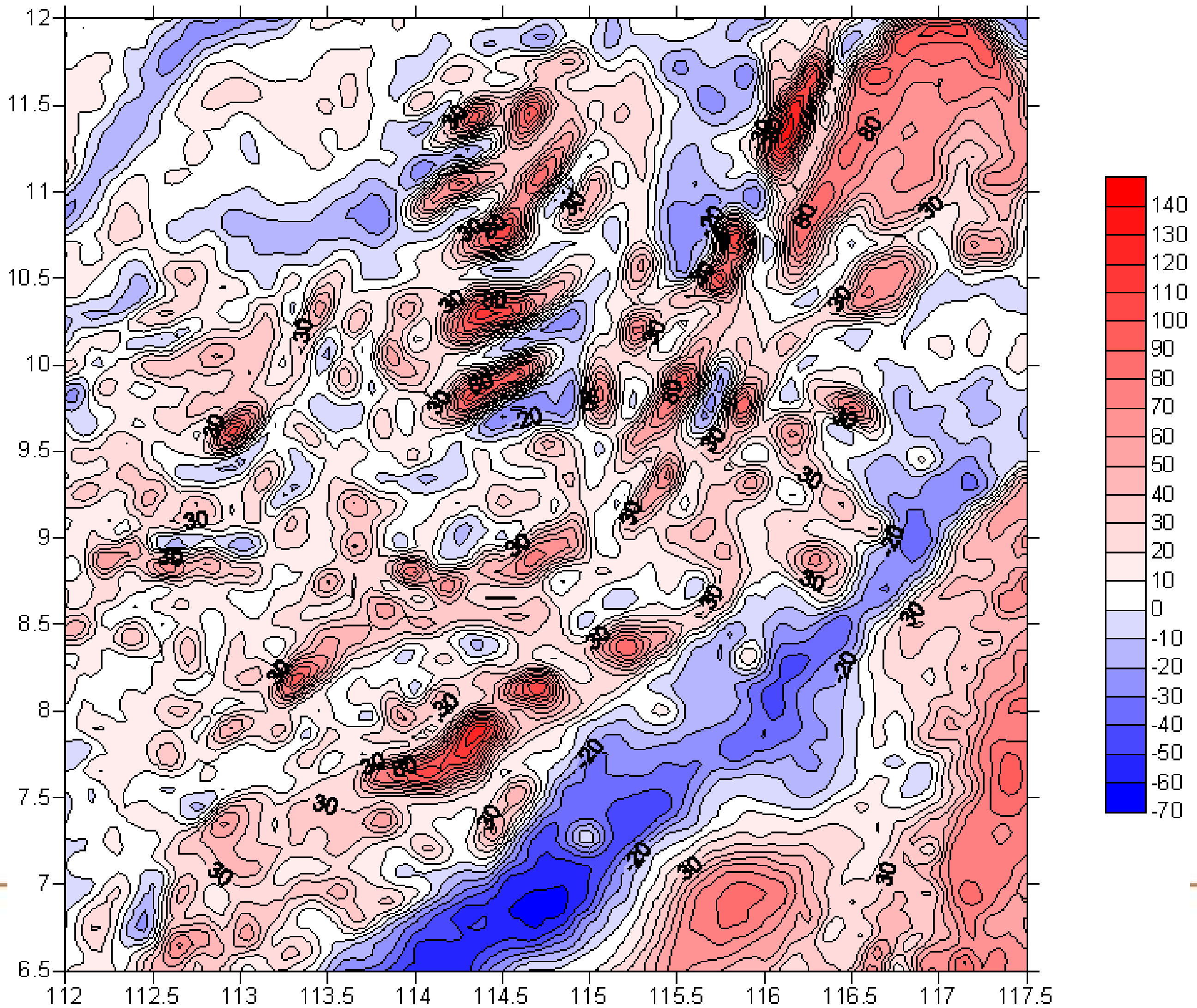
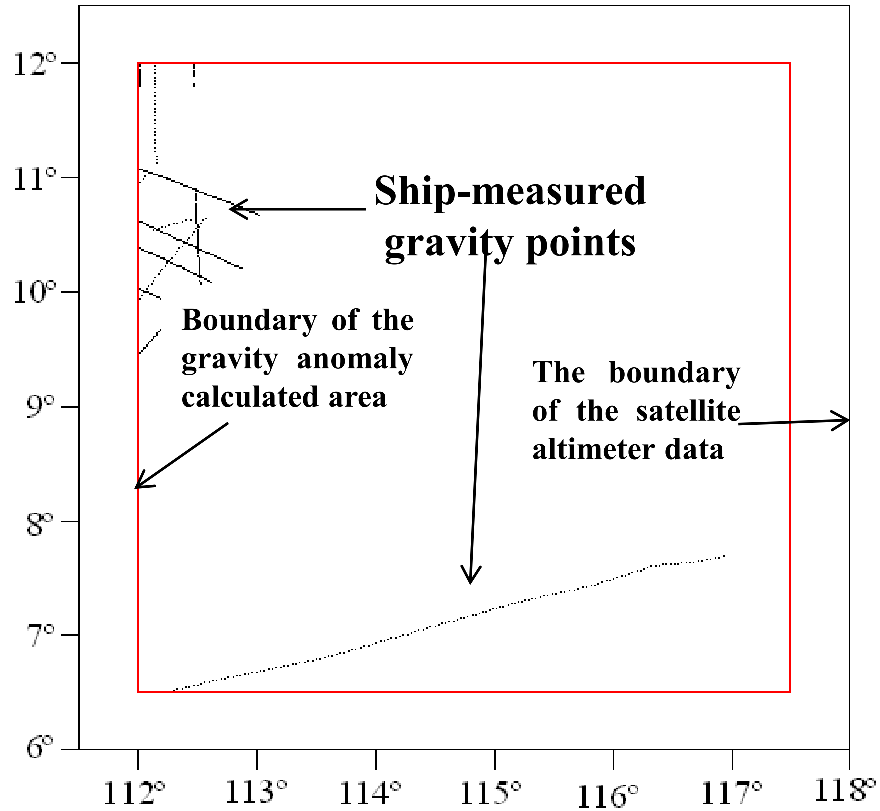


Fig. 5. The marine gravity anomalies determined from Cryosat-2 altimeter data

Accuracy assessment of the results by comparing with a ship-measured gravity points

We compared the results with the gravity of 625 points measured on a ship



The comparison statistics are as follows:

- **The maximum deviation: +1.30 mGal**
- **The minimum deviation: -1.82 mGal**
- **The average deviation: +0.03 mGal**
- **The Standard deviation: ±0.67 mGal**

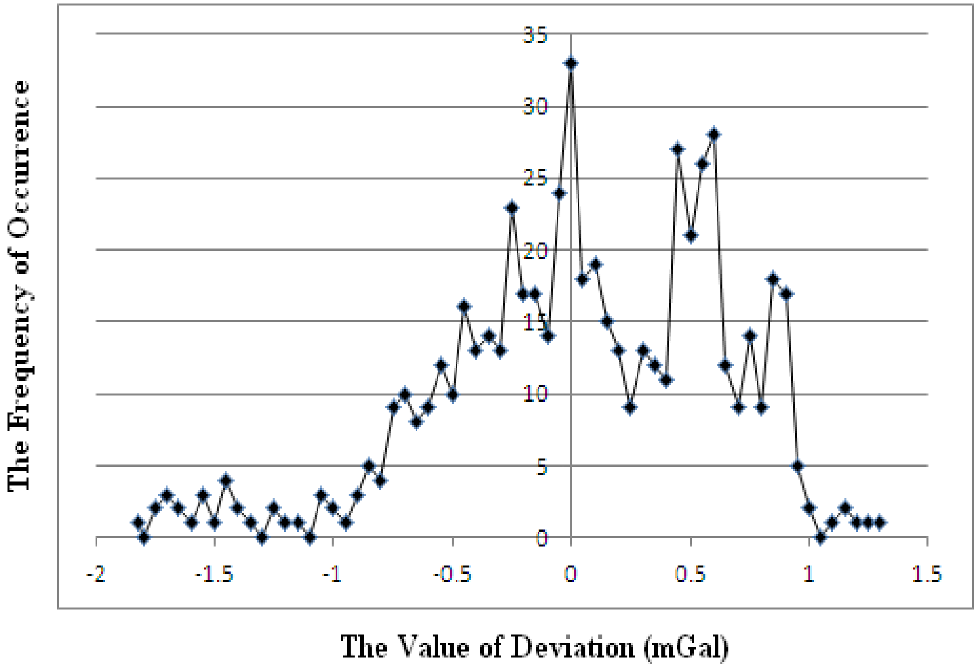


Fig. 7. The frequency of occurrence of the deviation

- The comparison shows that the satellite-derived gravity anomalies **match well** with the ship-measured gravity with very small deviations.

CONCLUSION

- The marine gravity anomalies can be determined from the satellite altimeter data under the process as shown in this paper.

- The satellite-derived gravity anomalies on the sea of the Truong Sa's Archipelago match well with the ship-measured gravity.

Thank you for your attention!