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Local gravity field modeling at the sea areas based on satellite altimetry data; case study: Local gravity field modeling at the Qeshm Iceland

A. Ardalan, R. Sahebi

Department of Surveying and Geomatics Engineering, University of Tehran (ardalan@ut.ac.ir)

Modeling of the gravity field of the Earth requires solution of the boundary values problem with boundary data at the whole surface of the Earth including the land and sea areas. The common practice for obtaining gravity data over the sea areas is shipborne gravimetry. Shipborne gravimetry due to the accelerations being induced by the movement of ship is inaccurate and mixed with systematic effects. On the other hand satellite altimetry gives accurate sea level observations over the major part of the sea areas of the Earth. In this work the applicability of using satellite altimetry data for modeling the gravity field at sea areas has been studied. The result of this study is a new methodology for local gravity field modeling at the sea areas based on satellite altimetry data. This new methodology is constructed based on the following algorithm:

1. Computation of Mean Sea level (MSL) from analysis of satellite altimetry observations.
2. Conversion of the MSL level to geoidal undulations, by implementing the Sea Surface Topography (SST) obtained via oceanographic studies.
3. Using inverse Bruns formula to convert the geoidal undulations into potential value at the surface of the reference ellipsoid.
4. Removal of the effect of ellipsoidal harmonic expansion to a high degree and order.
5. Removal of the effect of the masses outside the reference ellipsoid in the radius which is associated with the degree and order of ellipsoidal harmonic expan-

sion, e.g. for the case of degree/order 360/360 the radius of 55km around the computational point.

6. Upward continuation of the incremental gravity potential obtained from the removal steps to the gravity potential or gravity intensity at the point of interest by using ellipsoidal Abel-Poisson integral or its gradient.

7. Restoring the removed effect at the steps 4 and 5 at computational point of step 6.

The developed methodology is numerically tested by using the satellite altimetry data of the Topex/Poseidon to compute the gravity potential and gravity intensity at the points on the Qeshm Iceland of Iran. Besides, the method is used to derive the gravity intensity at some precise leveling benchmarks at the Bandar-Abbas near to the Qeshm Iceland. The results from the comparison have proved the accuracy of 5.2398 mGal at the precise leveling checkpoints. Considering the degradation of satellite altimetry data near the coastal area the aforementioned accuracy can be regarded at the upper band of error of our methodology for as a local gravity model at the sea areas.