

Analysis on the accuracy requirements of gravity and gravity gradient data for bathymetry inversion

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Abstract: Satellite altimetry developed to now has been widely used in inverting ocean topography from space. Now some new altimeter techniques have been developed, such as the SAR altimeter payloaded in CryoSat and InSAR altimeter payloaded in Tiangong number two space experiment apparatus (TG2) of China. Compared to the conventional altimeter, SAR altimeter and InSAR altimeter can provide gravity and even gravity gradient data with higher accuracy and resolution in ocean area due to the higher sampling rate. In theory, the data from these new altimetry techniques can improve accuracy of the bathymetry inversion. Before this, however, we need to know what the accuracy requirements for gravity and gravity gradient data for bathymetry inversion are.

According to the accuracy requirements of bathymetry inversion, the paper not only studies the calculation formula of the gravity and gravity gradient signals produced by the seabed terrain, but also validates the conclusions by numerical calculation. The results show that accuracy requirements for gravity and gravity gradient are different for bathymetry inversion with different resolution and accuracy. For example, if the accuracy of the bathymetry inversion is 100 meters with resolution of 1 minute, 5 minute and 10 minute, the accuracy requirements for gravity are 0.3 mgal, 3.0 mgal and 4.8 mgal respectively, and for gravity gradient, the accuracy requirements are 1.4 E, 8.3 E and 6.6 E. With the decrease of the resolution, the accuracy requirement of the gravity anomaly is gradually reduced, while the accuracy requirement of the gravity gradient is firstly decreased and then increased, which indicates that the gravity gradient is more sensitive to the shortwave signal than gravity anomaly. The theoretical study also shows that gravity gradient has a most sensitive band to the seafloor topography for specific water depths. This paper gives the relevant formula.

Finally, we show the results of the preliminary data processing for TG2 and discuss the possibility of inversion of gravity gradients from InSAR altimeter data from TG2.

Keywords: gravity, gravity gradient, bathymetry, accuracy requirements, TG2.