

Development of new hybrid geoid model for Japan, GSIGEO2000

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A new hybrid geoid model for Japan, GSIGEO2000, on a grid of 1 by 1.5 arc-minutes, is determined by combining the latest gravimetric geoid model for Japan, JGEOID2000 (Kuroishi, 2000) with PS-derived geoid undulations.

Re-analysis for the nationwide net of GPS at 816 benchmarks was performed in terms of GPS-derived ellipsoidal heights and leveled heights. Network adjustment for the GPS baseline-analysis data, processed by GAMIT software, was applied by GLOBK software with fixing 108 continuous GPS stations in the nationwide GPS array of Japan, GEONET. The resulting three-dimensional positions were given in ITRF94 (epoch 1997.0). Helmert orthometric heights were determined from leveling survey carried out in the latest period to the GPS observation of 1995.

The re-analysis yield the changes of -14 to + 22 cm in ellipsoidal height, of - 41 to + 30 cm in orthometric height, and of - 30 to + 58 cm in geoidal undulation at the data stations.

The differences between JGEOID2000 and the GPS-derived geoid undulations are calculated by a least squares collocation method (LSC) with an analytical covariance function of Tscherning and Rapp (1974) type, modeled from empirical covariance functions. In the calculation, variance of GPS/leveling geoid undulation errors is assumed to be 13 cm. The calculated differences are used as a correction model to JGEOID2000 and a hybrid geoid model,GSIGEO2000 is obtained as a result.

The RMS error of GSIGEO2000 is estimated better than 4 cm. When we use a half of GPS/leveling geoid undulation data in the correction modeling and compare the geoid model with the other half, standard error of GSIGEO2000 is evaluated at 4.5 cm. The same value is obtained in the opposite case. The new hybrid geoid model shows an improvement by factor 2 (50 % reduction) over the previous hybrid model, Japanese Geoid Model 1996 (Fukuda et al., 1997).