Evaluation of an Influence of the Revision of Ellipsoidal height of GEONET sites on GSIGEO2000 and Improved hybrid Geoid Model

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GSI has widely expanded to the nationwide permanent GPS network called GEONET. Recently, GPS-derived ellipsoidal heights with tighter constraints to the permanent GPS-array of Japan, GEONET(the GPS Earth Observation Network of the GSI) in ITRF94 (epoch1997.0) frame was revised to correct phase offsets (errors of phase characteristic modeling in GEONET) that are caused by antenna-radome, monument-multipath effect and the modeling of antenna phase center of GEONET sites. And, the usual GEONET systems (the old GEONET) were improved to the new GEONET which were uniform to the phase characteristics of GEONET sites for each monument type.

Because it was naturally anticipated that these offsets would affect the present geoid model - a new hybrid Geoid Model for Japan, GSIGEO2000 (Kuroishi, et al., 2001), first we precisely estimated and calibrated a quantitative phase errors were observed for 108 continuous GEONET stations, which were used as the fixed points of the GPS baseline-analysis. As a result, we found that only offset for the modeling of antenna phase center of GEONET would affect GPS observation which was previously made at the GPS/Leveling points. The estimating process of GPS-derived geoid undulations was computed by the same way as that applied for a hybrid geoid model, GSIGEO2000 development. GPS/Leveling data were re-analyzed for the nationwide net of GPS at 816 benchmarks in advance in terms of leveling-derived orthometric height system, the new GPS-derived ellipsoidal heights (the ones which have corrected phase offsets of GEONET). Network adjustment for the same GPS baseline analysis data as ones used for the geoid modeling, processed by GAMIT software, was analyzed by GLOBK software with fixing 108 GEONET sites. The geoid undulation differences between the old GEONET with phase offsets and the correct old GEONET calibrated ranges from -6.9 to +2.0cm with a standard deviation of 1.7cm about a mean of -1.9cm in geoid undulation.

Next, we tried to improving a hybrid geoid model, GSIGEO2000 by fitting to the GPS-derived new geoid undulations (which were corrected for phase offsets of the old GEONET) in place of the old GEONET which weren't corrected and reviewed discrepancies between the improved geoid model and the present geoid model.

Tow grid modeling was made by using the calculation method as follows.

A) A hybrid geoid model was created by fitting the gravimetric geoid model, JGEOID2000, (Kuroishi, 2000) to the re-calculated geoid undulation data from GPS/leveling survey by least-square collocation (LSC), with being computed by the same method as that applied for a hybrid geoid model, GSIGEO2000 development.

B) An improved geoid modeling was calculated by fitting direct a hybrid geoid model, GSIGEO2000 to the geoid-difference-grid-model were gridded by spline interpolation in tension for the geoid differences between the old and the correct old GEONET which were analyzed above.

The standard deviation of the geoid undulation discrepancy between the new geoid undulation data by GPS/Leveling survey and the improved hybrid geoid model for Japan at the GPS/Leveling point is almost estimated 4.0cm both them(A and B). This is nearly similar to the one of GSIGEO2000. And comparing an improved hybrid geoid model with GSIGEO2000, we found that the difference in geoid undulations ranged from -16.0 to +5.0cm with a 2.1cm SD about a mean of -2.0cm both geoid modeling. Therefore, we concluded that there would be less influences of phase center modeling offsets in GEONET for the present geoid model, GSIGEO2000.