Determination of Indonesian gravity fields from combination of surface gravity, satellite altimeter and digital terrain model data

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We have tried to determine the gravity field of Indonesia from combination of satellite altimeter, surface gravity and digital terrain model data. Over the ocean, we employed the satellite altimeter data ship-borne gravity data. While over the land, due to restriction of the data which only available in certain islands, we tried to derive a simulation gravity data using a digital terrain model (GTOPO30) and EGM96. We test the reliability of the simulated data by compared it with observed data. Further on determination of the geoid, show that an indirect solution, first the altimeter data was converted to the gravity anomaly, earn better results compared to a direct solution.

The gravity and geoid of Indonesian island, due to problems especially on an unavailability of the data, is neither accurate and nor comprehensively determined. Therefore, in this study we tried to combine all available data; satellite altimeter, surface gravity data and topography data, to derived reliable Indonesian gravity and geoid.

Over the ocean area we mainly employed satellite altimeter. In case of our study area, shallow and coastal areas, the data tends to be noisy and fragmentary. Its could be mainly due to tidal factor. Thus, we tried to utilized several tide models and than asses the accuracy of the altimeter data by comparing it with in-situ data. Moreover, we also utilized all the available ship-borne gravity data to solve the fragmentary data especially over the coastal area and improve the accuracy of the derived gravity field.

Over the land area, the distribution of gravity data is a very sparse, at present, the data are available only in several main islands. To overcome the unavailability of the data, we tried to use simulated gravity data calculated from a digital terrain model (GTOPO30). To evaluate the reliability of the simulated data, we prepare two data sets; simulated data only (case A) and a combination of simulated and observed land gravity data (case B) in some islands where the coverage of land gravity data is relatively good and made some test comparisons.

Last fall meeting of Japanese geodetic association, we presented the comparison results between the simulated data and the observed data, and also result from case A and case B around Jawa island. This time, we have tried to make more comparison results over some other islands, in this case Sumatra and Sulawesi island. A result of the point-to-point comparison over Sumatra island between simulated and observed data show the mean differences values of 3 mgal with STD of 26 mgal in topography range from 1 to 500 m. While the topography area stand from 500 to 4000 m, the mean increase to 15 mgal with STD of 32 mgal. The comparison between two-solution of case A and case B shows a mean difference around –6 mgal with STD differences of 30 mgal. Compared with the results obtained over the Jawa island, the difference values increased by about 2-3 mgal. Such condition could be due to more sparse observation data available around Sumatra Island. In here the inclusion of the land gravity data, even the simulated data, substantially improved the accuracy of the gravity field around 2~3 mgal specially around coastal area. Further we have tried to determine the geoid of the region using several data combination. It show that an indirectly solution on the geoid determination, first the altimeter data was converted to the gravity anomaly, earn better results compared to a direct solution. This results could be due to an avoiding of the problems on determination the relative weigh between two kind of data types and the direct influence of the residual sea surface topography inherent in the altimeter data.