The Geoid Model in Brazil Using Three Different Methodologies

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Gravity data coverage in a grid of 5' is quite complete in São Paulo state and surroundings due to recent efforts for surveying. This is a result of FAPESP (Foundation of the State of São Paulo) Thematic Project that aims to carry out the establishment of a geoid model, a height system and the study of the possible vertical crust movement. The project involves several laboratories of Brazilian universities. These efforts resulted in a geoid model called GEOIDSP, limited by 19ºS and 26ºS in latitude and 44ºW and 54ºW in longitude, which has been derived using three methodologies: the modified Stokes integral through Fast Fourier Transform (FFT) and Numerical Integration (NI), and the Least Square Collocation (LSC). The Canadian package SHGeo has been used to derive the Helmert's gravity anomalies for the FFT and the NI computations. EGM08 model has been selected as a reference field restricted to degree and order 150. For the LSC the software GRAVSOFT has been used to generate the Residual Terrain Correction. For the present study, a suitable gridded topography with a size of 3" x 3" (approximately 90 m x 90 m) from SAM3s_v2 has been used. This model consists of SRTM3 with the substitution of EGM96, previously used, by EIGEN-GL04C in order to derive the orthometric height. The gaps were substituted by digitising maps and DTM2002 topographic model. Over the ocean, DTU10 with resolution of 1' x 1' has been used. A comparison involving the three techniques was performed to verify the geoid model behavior and consistency. The models have been validated over 170 GPS observations on Bench Marks of the spirit leveling network. The height anomaly derived from GOCE geopotential global models (direct solution, time-wise solution and space-wise solution), EIGEN-6C, EIGEN-6S, GOCO02S, GOCO01S, EGM2008 and the geoidal height derived from MAPGEO$_2$010 (official geoid model of Brazil) have also been checked against these GPS points. Moreover, the geopotential models have been evaluated in terms of gravity anomaly degree variances and error degree variances. The error degree variances can reflect different philosophies regarding the weighting of terrestrial and altimetry data. The mean free air gravity anomalies in a grid of 5' obtained from point gravity data have been used to evaluate these geopotential models. In terms of RMS difference, GEOIDSP presented more consistency with GPS points than the other models.