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Validating the Geoid Heights over Nigeria from Global Geopotential Models using ground-based GNSS/levelling Data

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Several high-resolution global geopotential models (GGMs) provide valuable information about the Earth's gravity field products such as gravity anomalies and geoid heights. However, ground-based datasets are required to assess these products quality. This contribution investigates different validation strategies using geoid heights derived from GRACE- and GOCE-based GGMs as well as combination GGMs with the corresponding 136 well-distributed ground-based Global Navigation Satellite System (GNSS)/levelling points over the country of Nigeria within longitude 3º to 14º E and latitude 4º to 14º N. One of our validation strategies is to consider the spectral consistency by applying the spectral enhancement method (SEM) between the GGMs and the ground-based geoid heights. Accordingly, we incorporate high/very-high frequencies of gravity functional, i.e. the gravity signal beyond maximum d/o of GOCE-based GGMs, using the EGM2008 and the high-resolution digital terrain model provided by the SRTM (Shuttle Radar Topography Mission). Our findings show that using the SEM strategy helped much in assessing the quality of the GGMs solutions more unbiasedly. In particular, the fits of GNSS/levelling to EGM2008 geoid heights show improvement from 0.288 m without applying the SEM compared to 0.276 m after the SEM was applied. Finally, four types of transformation models, i.e. linear, four-, five- and seven-parameter transformations, are examined to mitigate reference system offsets between the studied GGMs and the GNSS/levelling data over Nigeria. With the SEM technique and the best-fitting transformation model, we find that GGM misfits to GNSS/levelling down to about 0.26 m.

Keywords: GNSS/levelling, geoid heights, Global Geopotential Models (GGMs), transformation models, Spectral Enhancement Method (SEM).