

INTEGRATION OF MULTI-SOURCE GRAVITY ANOMALIES FOR SEAMLESS GEODETIC VERTICAL DATUM DEVELOPMENT IN MALAYSIA

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Abstract

Developing a seamless geodetic vertical datum for Malaysia requires gravity information that can represent land, coastal, and marine areas consistently. This remains challenging because terrestrial, airborne, satellite altimetry, and satellite gravity datasets differ in their spatial coverage, resolution, accuracy, and spectral characteristics. This study presents a multi-source gravity integration framework to improve the consistency of gravity field modelling across Malaysia. The datasets are first harmonised, quality controlled, and screened for outliers before integration. Terrestrial gravity observations are cross-validated, resulting in 8,712 quality-controlled gravity anomaly observations across Peninsular Malaysia, Sabah, and Sarawak. Marine gravity anomalies are derived from multi-mission satellite altimetry using the Remove–Compute–Restore approach and two-dimensional Fast Fourier Transform processing, while airborne gravity data help strengthen spatial coverage across land and marine regions. The different gravity datasets are then integrated using three-dimensional Least Squares Collocation to form a unified gravity anomaly field for subsequent geoid determination through the Least Squares Modification of Stokes with Additive Corrections. This approach helps overcome the uneven distribution of terrestrial gravity observations, particularly in areas where data coverage is sparse, while making use of the complementary strengths of each gravity source. The integrated gravity field therefore provides a more consistent basis for seamless geoid modelling and supports the development of a modernised national vertical reference system for Malaysia.

Keywords: multi-source gravity integration; terrestrial gravity; airborne gravity; satellite altimetry; Least Squares Collocation; geoid modelling; vertical datum; Malaysia