

APPROACHES FOR ALIGNING HEIGHTS FROM DISPARATE MEAN SEA LEVELS FROM TIDE GAUGES IN LUZON MAINLAND, PHILIPPINES

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Abstract

This study evaluates global and local geoid models for vertical datum alignment across tide gauge stations in Luzon, Philippines. Mean sea level (MSL) observations across seven tide gauge locations were used to derive geometric geoid heights, which were compared against gravimetric geoid heights of four (4) models (EGM2008, EIGEN-6C4, XGM2019e, and PGM2018) to determine their offsets. Mean Dynamic Topography (MDT) from CNES-CLS22 satellite altimetry-based model was incorporated to construct a modelled MSL surface. Results show XGM2019e exhibited the best performance with lowest RMSE and standard deviation among global models. After MDT integration, PGM2018 gravity geoid aligned better with observed MSL, particularly at Manila. The offsets were then aligned using single-offset shifting technique to 5-parameter equation surface fit, each solved as a free solution and with selected tide gauges held fixed as the reference. Assessing the GGMs with MDT, for the case of XGM2019e, Legaspi, Port Irene, and San Fernando emerged as the most reliable tide gauge references. However, significant inconsistencies observed in Manila TGBMs highlight challenges in benchmark stability and historical datum realization. The findings emphasize the importance of continuous, high-quality tidal observations and reliable GNSS/levelling data for robust vertical datum development in archipelagic regions.