

Definition of a Physical Height System in Luzon

Arkiel G. Ventican, Dr. Rosalie Reyes, Roel Bahia

College of Engineering, Department of Geodetic Engineering, University of the Philippines
(Diliman)

Email: agventican@alumni.up.edu.ph, rbreyes3@up.edu.ph, rtbahia@up.edu.ph

Abstract:

The Philippines primarily relies on spirit leveling for vertical height information, with elevations referenced to locally established Mean Sea Level (MSL) datums. Since these tidal datums are independently established at different tide gauge stations, their reference surfaces potentially introduce systematic differences between leveling networks. This study investigates the feasibility of developing a gravity-based orthometric height system for Luzon through the integration of adjusted leveling data, gravity information, and Mean Dynamic Topography (MDT).

Four leveling line networks connecting the Legazpi tide gauge benchmark to the tide gauge benchmarks of Manila, Mariveles, San Fernando, and Currimaos were analyzed. Gravity quantities were computed at each benchmark and used to derive orthometric corrections following the Heiskanen and Moritz formulation. The results show that local Mean Sea Level datums in Luzon are not coincident, with discrepancies ranging from approximately 7.5 cm to 24.0 cm between tide gauge benchmarks. Evaluation of MDT revealed varying effects among the stations. For the San Fernando-Currimaos benchmarks, MDT removal reduced the discrepancy between independently propagated orthometric heights to approximately 0.4 cm, while larger discrepancies were observed for the Manila-Mariveles benchmarks.

These results suggest that local MDT representation significantly influences the resulting orthometric heights. Overall, the study demonstrates the feasibility of a gravity-based orthometric height workflow for Luzon and provides a foundation for the future development of a geoid-consistent vertical reference system in the Philippines.