

Towards a unified land-sea vertical datum for an archipelagic country: a proposal for Indonesia

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Abstract

Indonesia has already defined the national geoid model, known as INAGEOID2020, as the vertical reference system. However, in practice, some local vertical datum, such as tidal datum, are still being used, especially in marine activities. Land elevations are linked to INAGEOID2020, while marine depths are referenced to chart datums established at individual tide gauges. This separation creates challenges in integrating terrestrial and marine data, particularly for coastal hazard assessment, offshore engineering, and hydrographic surveying. The problem is more significant in an archipelagic country such as Indonesia, where more than 17,000 islands are associated with geographically separated tide-gauge datums. A unified land-sea vertical datum is therefore needed to provide a continuous reference across the coastal zone. Three approaches are proposed, ranging from the use of mean sea level and tidal models to more advanced hydrodynamics and harmonic modelling. For initial implementation, the first approach is considered the most practical because it requires relatively established datasets and modelling capabilities. The framework integrates INAGEOID2020, mean sea surface topography, and a regional Lowest High Water Spring model constrained by more than 200 Indonesia tide gauges. The approach also recognizes key challenges, particularly limited gravity observations and uncertainties in geoid and sea surface topography models in shallow coastal areas. In the longer term, the framework is expected to support a continuous ellipsoid-based vertical reference connecting land and sea.

Keywords: Vertical datum unification, INAGEOID2020, chart datum, Indonesia