A Novel Approach of Integrating a Near-Seamless Tidal Datum and Digital Elevation Model for Maritime Boundary Delimitation

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SUMMARY

The delimitation of maritime boundary plays a significant role in preserving Malaysia's sovereignty and jurisdiction. The maritime baseline was established based on the combination of maritime basepoints, which represents the Lowest Astronomical Tide (LAT) along the coast. However, the current approach still relies on the limited number and sparse distribution of the tide gauge stations for the determination of the LAT. This study aims to develop the Peninsular Malaysia Near-Seamless Tidal Datum (PMNSTD) by integrating tide gauges, satellite altimetry, and Tide Model Driver (TMD) data. The PMNSTD was further integrated with the Digital Elevation Model (DEM) for maritime boundary delimitation. The research methodology includes data acquisitions of 12 tide gauge stations along the coast of Peninsular Malaysia, satellite altimetry data of TOPEX, Jason-1, Jason-2, and GEOSAT Follow-On (GFO) from Radar Altimeter Database System (RADS), global hydrodynamic model from Tide Model Driver (TMD), and TerraSAR-X add-on for Digital Elevation Measurement (TanDEM-X). The tide gauge, satellite altimetry, and Tide Model Driver (TMD) data encompass 23 years of tidal observation data from 1993 to 2015. For the derivation of the tidal datum, the tide gauge and satellite altimetry data were analysed using harmonic analysis approach in Unified Tidal Analysis and Prediction (UTide). Meanwhile, for the Tide Model Driver (TMD) data, the tidal datum was determined based on tidal prediction from the extracted tidal constituents. For compatibility in data integration, the derived LAT and Highest Astronomical Tide (HAT) from tide gauges, satellite altimetry, and Tide Model Driver (TMD) data were referenced to the Mean Sea Level (MSL), denoted as LAT_MSL and HAT_MSL respectively. Next, the LAT_MSL and HAT_MSL were interpolated using Inverse Distance Weighting (IDW) to develop the PMNSTD (LAT_MSL and HAT_MSL) using ArcGIS software. The statistical assessment indicated that the established PMNSTD (LAT_MSL and HAT_MSL) has a good agreement with the Department of Survey and Mapping Malaysia (DSMM) tide gauges with a Root Mean Square Error (RMSE) of ± 0.228 m for LAT_MSL and ± 0.159 m for HAT_MSL

respectively. Finally, the PMNSTD (LAT_MSL) was integrated with TanDEM-X using ArcGIS and SURFER software for the delimitation of maritime boundaries. The reliability assessment illustrated a significant improvement in the establishment of 201 proposed maritime basepoints in comparison to the current 158 maritime basepoints by the DSMM. In conclusion, the proposed approach has shown a continuous and consistent establishment of the country's maritime baseline for Peninsular Malaysia.