

ABSTRACT

Establishing Seamless Vertical Datums for Land and Marine use within Caribbean Territories

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Coastal regions of the Caribbean are invaluable to the economies of the island nations and as such there is a need to ensure sustainable development in this environment. Management initiatives will benefit significantly from a vertical separation model that facilitates the integration of vertical survey data acquired on land and at sea.

The difficulty in integrating datasets in the coastal zone is that vertical reference systems vary across the land-sea interface. In this regard, the development of a vertical separation model is applicable, which incorporates tidal components that vary spatially and temporally. Resource and data deficiencies, imprecise definitions of vertical datums and vertical deformation of landmasses present particular challenges to the development of such models for the Caribbean region. As an almost enclosed basin leading to variations in tide and vertical deformation of the land mass, the Gulf of Paria offers an interesting area for study.

The research examines the separations among five major vertical datums, MSL, LAT, National Land Datum, WGS 84 Ellipsoidal Datum and the Geoid. Data sources include: sea level observations, elevations from differential levelling, static GNSS surveys, sea surface heights (SSH) from satellite altimetry and GPS buoy data. A hydrodynamic model was also developed. The model was validated using independent sea level data sources. The separations between the WGS 84 ellipsoidal datum, MSL, LAT and the Geoid are now available on a 5' X 5' grid.

The research shows that the increase in MSL-LAT separation is steeper at the coastline than offshore and new larger separation values are available for the coastline. The MSL-LAT separation at Port of Spain is 0.8 metres, at Pt. Lisas it is 0.9 metres and at Cedros the separation is 1.2 metres. Sea level at Port of Spain over the last 77 years was found to have a rate of change of 2.41 millimetres per year. Results also estimate rates of vertical deformation vary from -50 to 6 millimetres per year in the study area. These findings support the need for the establishment of a new gravity based vertical datum for Trinidad and an improved local geoidal model based on dense, observed gravity data.

Keywords: Cassandra Nanlal; coastal vertical datums; vertical separation model; tides; seamless data integration; Caribbean; hydrodynamic model; Gulf of Paria; vertical deformation; satellite altimetry; tidal model; geological fault.