Estimation of Vertical Land Motion in the Western Tropical Pacific Islands from GPS, Satellite Altimetry and Tide Gauge measurements.

Kannangara K.K.D.W.S.[1*], Kusche J.[2], Karegar M.A.[2] and Uebbing B.[2]

[1] *Department of Surveying and Geodesy, Sabaragamuwa University of Sri Lanka.*
[2] *Institute of Geodesy and Geoinformation, University of Bonn, Germany.*
*waruna@geo.sab.ac.lk

The low-lying islands in the Western Tropical Pacific are vulnerable to a faster sea level variation in comparison to the global mean sea level change. Until the Satellite Altimetry technique came into operation, the primary mode of assessing the Sea Surface Heights (SSH) was limited to Tide Gauge observations. The tide gauge inferred SSH consists of absolute sea level variations and Vertical Land Motions (VLM). Therefore, VLM trends are essential for accurate sea level prediction and coastal impact assessment. In this study, the VLM rates are computed in the Western Tropical Pacific Island using the Global Positioning Satellite (GPS) time series obtained from the Nevada Geodetic Laboratory. The length of the GPS duration and the completeness of the time series recordings served as selection criteria. Vertical position time series of the selected GPS stations were post-processed to remove the outliers and offsets and adjusted for the Post-Seismic Deformation. The VLM linear rates for each station were computed using the Least Squares Estimation method by fitting the observations to a parametric model. Estimated VLM rates showed moderate land subsidence in 26 stations (~87 %) out of the 30 GPS stations considered, and the fastest subsidence rate of 9.01 mm/yr was observed in the Tafuna island, American Samoa. In another approach, the VLM rates were deduced by the difference between Altimetry (ALT) and Tide Gauge (TG) sea level records. Similar criteria as for GPS were used for the selection of the tide gauge stations. In order to maintain equal geophysical conditions in both altimetry and tide gauge observations, corrections were applied to the tide gauge records using the ocean loading tidal model. The ALT-TG rates were then calculated for three options based on the correlation of the SSH of altimetry grids around the corresponding TGs. 19 (95 %) out of 20 TGs showed moderate subsidence. The highest correlated VLM rates obtained from the ALT-TG were then compared with the co-located GPS stations within a 50 km radius. The results of 28 combinations showed a close agreement between the two methods, with a mean rate difference of 0.08 mm/yr and an RMSE of 1.68 mm/yr.

Keywords: *GPS, Satellite Altimetry, Tide Gauge, Vertical Land Motion*