



## Present-day vertical land movement in San Fernando (La Union) and Currimao (Ilocos Norte), northwest Luzon, Philippines

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The northwestern coast of Luzon Island is located within the forearc region of the Manila Trench where emergent coral reef platforms have been reported; and an uplift rate of 0.5 m/kyr has been estimated for the past 7,000 years in San Fernando and Currimao. This study examined the present-day vertical land movement (VLM) in both sites using tide gauge records and retracked Jason satellite altimeter missions. Both the tide gauge and satellite data were corrected for tides using the T\_Tide algorithm and the difference between the tide gauge sea level (TGSL) and sea surface heights (SSH) from the satellite were calculated. The influence of VLM was inferred from the differences between the TGSL and SSH, then validated using available GNSS data.

Hourly TGSL for San Fernando is available from 2002 to 2018 with a completeness index (CI) of 37%. The satellite products used were the 20 Hz MLE4 and 1Hz ALES retracked Jason satellite series downloaded from AVISO+ and OpenADB, respectively. The MLE4 product indicates subsidence with a rate of  $0.43 \pm 0.10$  mm/yr, while ALES indicates uplift at  $1.93 \pm 0.42$  mm/yr. GNSS observations at the San Fernando TG benchmark (TGBM) from 2017 to 2019 shows subsidence at  $0.74 \pm 0.40$  mm/yr, which agrees well with the VLM estimate from the difference between TGSL and MLE4 SSH.

Currimao TG station has a CI of 90% from 2008 to 2016. Satellite products used were the 20 Hz MLE4 and 20 Hz ALES retracked Jason-2 downloaded from AVISO+, and both indicate uplift with a rate of  $7.30 \pm 0.17$  and  $6.24 \pm 0.25$  mm/yr, respectively. The present-day uplift agrees with the geological records, however, there are no GNSS data at the TGBM to validate the present-day vertical motion.

The differences between the present-day vertical motion of San Fernando and Currimao may indicate the influence of other fault systems associated with the Philippine Fault or segmentation of the forearc. Subsidence in San Fernando could imply stress accumulation in the area and the observed uplift in the geological records are cumulative co-seismic vertical displacements.