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Local Vertical Datum improvement using Sentinel-3 SAR and Cryosat-2 SAR/SARin altimetry data

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Satellite altimetry offers unprecedented information for global sea level monitoring in both space and time domain. Its development emerged from the inadequate information at both the open sea and coastal areas without established tide gauges (TGs) along with the increased need to observe sea level rise mainly due to climate change. Nevertheless, monitoring coastal zones with available TGs is also required, since they provide a much longer sea level record and have been used in the past to define and establish the zero-level point of most of the available vertical reference systems. The established levelling benchmarks at TGs, which realize a national local vertical datum (LVD), are influenced from both horizontal and vertical movements, the magnitude of which can be considered significant for the final estimation of the sea level height and the definition of a LVD. Sentinel-3 and Cryosat-2 Synthetic Aperture Radar (SAR) altimeter mode was designed in order to both improve the spatial resolution in the along- and cross-track direction in open sea and reduce the observation gap as close as possible to the coast. The additional data arising from the measurements close to the coast are also useful for the improvement in Local Vertical Offsets (LVOs) estimation. The latter refers to the determination of offsets between various LVDs and/or with respect to an International Height Reference System (IHRS). The exploitation of SAR altimetry can be achieved by extending the marine observations to the coast through proper prediction methods. Given the above, ocean leveling can be used as a determination method of the LVOs in order to unify the different LVDs with respect to a global one. This study focuses on the definition of appropriate steps to estimate ellipsoidal heights at the coast exploiting altimetry data. For this purpose, the geomorphological characteristics of each area of interest and the size of the data collection radius around each control point are taken into account. The area of Greece was selected as a suitable study region to investigate the contribution of SAR data to Wo determination and conclude on the correlation between coastline characteristics, island presence and prediction accuracy. Additionally, interferometric SAR (SARin) data of Cryosat-2 were also used for the same reason, as the corresponding mode was operated in this area. The results acquired are validated against an external LVO estimation resulted from GOCE/GRACE Global Geopotential Models referring to 83 islands in Greece. Conclusions on the achievable accuracy for stations on the islands are drawn based on mono- and multi-mission SAR/SARin data.