Assessing tide correction under altimetry tracks: an innovative validation methodology using USV (Unmanned Surface Vehicle) in-situ measurements

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Satellite altimetry recently reached an unprecedented level of global coverage with 7 missions flying simultaneously. While altimeters have been originally designed for open ocean and have improved our understanding of the large-scale ocean dynamic, the exploitation of coastal altimetry data remains a challenge that mobilizes a large effort in the scientific community. The future SWOT mission will solve this issue and certainly revolutionize our view of the coastal waters by mapping SSH with an unprecedented resolution.

One challenging aspect of coastal altimetry is the lack of accuracy in some geophysical corrections, which are critical to derive accurate sea-surface height anomalies (SSHA) near the coast. Especially, uncertainties in ocean tides is still an issue for the exploitation of altimetry in nearshore regions. Global tide models are usually used in most altimetry products. Despite their considerable progress in the last decade, their accuracy tends to decrease near the coast (Lyard, F. et Al., 2020).

Difficulties encountered in modelling the coastal tide are mainly due to its non-linear behaviour caused by changes in depth, shoreline interactions or varying bottom drag as it propagates onto shallower waters. The distortion of tidal propagation can thus be represented as additional tidal waves, which reflect overtides compound tides. These interactions are numerous and a great number of constituents have to be considered in order to reproduce accurately the tidal signal in shallow regions. Consequently, efforts in developing regional modelling of coastal areas are encouraged, as well as the consideration of ocean/shelf/land as a modelling continuum, for the preparation and exploitation of the future SWOT mission (Ayoub, N. et Al., 2015).

Moreover, these shallow-water waves exhibit smaller wavelengths than major astronomical ones, and there is a critical need for observations with short space and time scales to appreciate their spatial variability. While tide models are classically validated against tide-gauges confined to the coast, new opportunities are emerging with the development of kinematic GNSS systems. Chupin et Al. (2020), have demonstrated the ability of the Cyclopée system (a combination of a GNSS antenna and an acoustic altimeter) mounted on an USV to map sea surface height in motion. At a fixed point, the Cyclopée system provides similar accuracy than the best tide-gauge systems (and is therefore a way to propagate tide gauges measurements under satellites tracks).

Through a methodology based on crossover measurements; we demonstrate in this study the
potential of the USV PAMELi, developed at the University of La Rochelle, for assessing tide corrections under altimetry tracks, in the scope of future coastal altimetry applications (e.g. storm surge or wave setup). For this purpose, the Pertuis Charentais area (France) is addressed as a modelling case study with a new regional barotropic configuration based on SCHISM model (Zhang, J. et al., 2016). After being compared against coastal tide-gauges, our SCHISM model as well as other available global solutions are assessed through this methodology applied under the pass 216 of Sentinel-3A.