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Improved satellite observations in coastal areas from altimetry and SAR

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The coastal environment is under constant pressure by natural forces and anthropogenic activities and is very sensitive to climate change. Observations of many physical and biological parameters are critical for its monitoring and management. Satellite observations constitute an efficient way to observe the global coastal environment, but ocean satellite observations have often been designed and optimised for the open ocean: algorithms and processing techniques need to be revisited and adapted for application in the coastal zone.

A case in point is that of satellite altimetry, which over the oceans is regarded as one of the most successful remote sensing techniques, as it has allowed an unprecedented mapping of the ocean surface dynamics at the large- and meso-scale. With the improvements in orbit models, radar processing, atmospheric and geophysical effect corrections that have emerged over the years, altimetry gives today also a very accurate estimation of the rate of sea level rise and its geographical variability. However, altimetric data in the near-land strip (0 to 50 km from the coastline) are often flagged as bad and left unused, essentially owing to 1) difficulties with the corrections; and/or 2) the modification of the radar returns due to the presence of land in the footprint, which makes the fitting of the altimetric echoes with a waveform model (the so-called “retracking”) problematic. Techniques to recover meaningful estimates of the altimeter-derived parameters (height, significant wave height and wind) in the coastal zone have been developed and lead to a number of new applications, which will be presented here.

The new observation from coastal altimetry are highly synergistic with Synthetic Aperture Radar (SAR). SAR imagers measure the backscattered signal from the ocean surface at spatial resolution better than 100m. This backscattered signal gives knowledge on the sea surface roughness, which is related to wind and waves. The very high resolution enabled by this instrument makes it very promising for coastal application, but interpretation depends of information from numerical weather models that often lack accuracy and resolution in the coastal zone. A new technique, measuring the Doppler shift of the backscattered signal, permits to sense the motion of the ocean surface. Together with the water displacement associated with ocean currents, the SAR measurements are also affected by a Wind-wave induced Artefact Surface Velocity (WASV) caused by the velocity of Bragg scatterers and the orbital velocity of ocean surface gravity waves which can be of the order of 1m/s. By using the additional SAR Doppler information, it is possible either to improve wind retrieval by loosing the prior information on wind from numerical weather model, or to retrieve the surface current if the wind is well known. We will discuss how this information can be compared with the height and wind retrieval from coastal altimetry in the framework of the H2020 CEASELESS project.