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Retrieval of short scale geophysical signals and improved coastal data from SAR satellite altimetry

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The Delay Doppler/Synthetic Aperture Radar (SAR) altimeter offers a new quality of observational data in comparison to the pulse-limited low resolution mode (LRM) data collected over the past twenty years. Due to the reduced noise in the measurements an improved retrieval of the geophysical signal is expected in SAR.

The goal of this study is to characterize these improvements both in open ocean and coastal zone using standard Level 2 and Level 1 data reprocessed with improved algorithms.

We have carried out, from CryoSat-2 Level 1a Full Bit Rate (L1a FBR) data, a Delay-Doppler processing and waveform retracking tailored specifically for coastal zone by applying Hamming Window and Zero-Padding, using an extended vertical swath window in order to minimize tracker errors and a dedicated SAMOSA-based coastal retracker (named SAMOSA+). SAMOSA+ accepts mean square slope as free parameter and the epoch's first guess fitting value is decided according to the peak in correlation between 20 consecutive waveforms (in order to mitigate land off-ranging effect). Those products can be extracted from ESA-ESRIN GPOD service (named SARvatore).
In order to quantify the improvement with respect to pulse-limited altimetry, we build 20 Hz PLRM (pseudo-LRM) data from CryoSat-1 L1a FBR and retrack them with numerical convolutional Brown-based retracker. Hence, here, PLRM is used as a proxy for real pulse-limited products (LRM), since there is no direct comparison of SAR and LRM possible otherwise. The PLRM data are built and retracked by Technical University of Darmstadt (TUDa).

In the open ocean the study consists on the retrieval of short scale geophysical, as the swell signals. The selected areas are the CryoSat-2 Pacific and Atlantic Boxes in which it operated in SAR mode. In the coastal zone of the North Sea the study concentrates on the reduction of land and ships contamination by dedicated procedures including improved retracking. Effects of different options and retracking methods, e.g. Hamming/no Hamming window in SAR, adaptive retracking and the two-pass retracking method in PLRM are analysed within an in-situ validation in the German Bight and a cross-validation of the altimeter data results.

Finally, the improved climate-quality sea level signal derived from the CryoSat-2 mission in 2010-2015 is compared to the signal derived from the ESA Climate Change Initiative Sea Level Project (SLCCI) dataset. The objective is to verify the ability of SAR altimetry to measure accurately in coastal zone the sea level annual cycle and the sea level trend. The work is a preparation to GB_S3CVAL activities, as part of the Sentinel-3 Validation Team (SSVT). It also has relevance to the algorithm selection of the upcoming Sentinel-6/Jason-CS mission.