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Defining a retracking manifold within a radargram stack to improve satellite altimetric water level over coastal seas: A feasibility study

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Single-waveform retracking for satellite altimetry applications over coastal zones has reached its limits, obtaining decimeter-level accuracy. The existing retracking methods find a retracker offset in a waveform by analyzing the variation in backscattered power along the bin coordinate. This makes the retracking procedure strongly dependent on noise in backscattered power. Moreover, the success of such methods is only guaranteed for certain waveform types requiring cumbersome pre-processing steps including waveform classification.

With the launch of the operational Sentinel-3 series of the European Copernicus programme, the algorithms to obtain highly precise water level estimates over inland waters and coastal seas need to become more robust, efficient and fit for automated use. Therefore, the main objective of this study is to demonstrate the potential of developing a next-level retracking algorithm and, consequently, improve altimetric water level determination over coastal regions. To this end, neighboring waveforms are collected into a (single-pass) radargram and, then, such radargrams are stacked over time. These so-called (multi-pass) radargram stacks contain, unlike single waveforms, the full information on spatio-temporal variation of backscattered power over water surfaces.

The radargram stack eases the recognition of patterns like retracking gate, shoreline, tides, etc. Instead of a retracking gate as a point in the 1D waveform, in a 3D radargram stack a surface referred to as retracking manifold is to be determined.

The potential of our new approach will be demonstrated using Sentinel 3B data, pass number 655, over the Cuxhaven tide gauge station at the Wadden Sea.

The idea of waveform retracking by analyzing its spatio-temporal behavior in a 3D data structure opens new pathways for achieving robust and more accurate water level estimates from operational missions, e.g. Sentinel 3, and from future missions, e.g. SWOT, over inland waters and coastal seas.