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Improving coastal altimetry results using the Spatio Temporal Altimetry Retracking for SAR (STARS)

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Accurate knowledge of sea level change, especially close to the coast, is of major importance in order to analyze and understand drivers of local sea level change and to plan coastal protection measures. Satellite altimetry provides a continuous global record of sea level rise since about 1993. In recent years, the delay doppler altimetry (DDA), also called SAR altimetry, provides improved results compared to conventional altimetry (CA) by utilizing the Doppler effect along the satellite's groundtrack.

The altimeter emits a radar pulse from the satellite to the Earth's surface and measure the power reflected over time from the radar footprint forming a so called "waveform". From the shift, shape and amplitude of this waveform it is possible to estimate sea surface height (SSH), significant waveheight (SWH) and backscatter which is related to wind speed. Due to influences from land surfaces within the radar footprint standard methods of retrieving those estimates tend to become increasingly uncertain or even fail when the satellite groundtrack approaches the coastline. In order to still derive meaningful geophysical parameters it is necessary to reprocess or "retrack" those waveforms with specialized algorithms resulting in improved estimates.

Here, we present a novel retracker which adapts the Spatio Temporal Altimetry Retracker (STARv1.0) processing scheme for CA to DDA. Generally, the STAR algorithm consists of three steps: (1) Partitioning of the total return waveform into individual sub-waveforms, (2) retracking of each individual sub-waveform resulting in a point-cloud of potential estimates of SSH, SWH and backscatter and (3) selection of final estimates at each 20Hz measurement position. For the application to DDA the three parameter Brown model used in CA-STAR is replaced by the Signal model Involving Numerical Convolution for SAR (SINCS) model, already implemented in the Technical University Darmstadt – University Bonn SAR-Reduced SAR (TUDaBo SAR-RDSAR) processing scheme.

The combination of the updated STARv2.5 processing scheme with the SINCS model (STARS) allows to retrieve high quality sea level estimates for contemporary DDA altimeter missions. We will provide validation results for Cryosat-2 and Sentinel-3 data in the North Sea region for the time period 2016-2019. Our preliminary results suggest that we are able to derive significantly

improved results for SSH, SWH and backscatter from STARS compared to existing state of the art approaches for DDA. While originally developed for coastal regions, the STAR processing scheme also leads to improved open ocean results.