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On the altimetric performance of the Sentinel-3 SAR-mode altimeter over the ocean: a numerical study

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The Delay Doppler Altimeter (DDA) concept – also known as SAR altimetry - was first proposed by R.K. Raney (1998), and promises improved altimetric precision and better along-track resolution than conventional pulse-limited altimeters. The Sentinel-3 Surface Topography Mission altimeter will have the capability to operate in SAR mode over the ocean, and will aim to achieve high-resolution high-accuracy altimetric mapping of the ocean in regions of high mesoscale variability and in coastal areas.

Delay-Doppler altimeters have high pulse-repetition frequency to ensure pulse-to-pulse coherence, leading to a potential along-track resolution around 300 meters, improved signal-to-noise ratio and enhanced altimeter ranging performance. With noise statistics and the shape of SAR altimeter waveforms over the ocean so markedly different from those of pulse-limited altimeters, a new waveform model and retracking methodology is required to retrieve geophysical information from SAR altimeters over the ocean. In this paper, we present results on the expected performance of a Sentinel-3 type Delay-Doppler altimeter over the ocean as obtained during the ESA SAMOSA project "Development of SAR Altimetry Studies and Applications over Ocean, Coastal zones and Inland waters".

In this paper, we present a comparative assessment of the range retrieval capabilities of conventional low-rate mode altimeters (LRM) and SAR altimeters over ocean. The study is based on numerical simulations of L1B LRM and SAR waveforms from the Cryosat Mission Performance Simulator (CRYMPS) obtained over explicit 3D realisations of ocean surfaces with different sea state conditions. LRM and SAR waveforms are obtained over a range of significant wave height conditions, averaged then retracked with an appropriate theoretical retracker. In the case of LRM, this consists of the NOCS implementation of a conventional Brown ocean altimeter waveform retracker. The SAR-altimeter L1B waveforms were retracked using a prototype SAR altimeter retracker developed at NOCS, and based on the recent theoretical DDA waveform model by Martin-Puig et al. (2009). The altimetric precision on the retrieved range is estimated for both LRM and SAR data over same ocean surfaces for a range of significant wave height, and compared with earlier results by Jensen & Raney (1998), who reported a two-fold improvement in altimetry precision with SAR altimetry.