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Abstract Title: Delay-Doppler Processing of altimetric SAR data over open ocean: precision evaluation of different algorithms.

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During the last decade the radar altimetry has entered in its golden age as demonstrated by the different number of missions (Jason-3, CryoSat-2, SARAL/Altika, Sentinel-3a) currently operating and continuity missions planned for the near future (Sentinel-3b, Sentinel-6). The relatively new operational SAR mode in CryoSat-2 and Sentinel-3 missions, opens a new paradigm in the capabilities offered by satellite radar altimeter missions. The delay-Doppler processor (DDP), also known as SAR processor, coherently integrates a series of pulses to provide a series of Doppler beams with an improved along-track resolution (around 300 m) and focused to a specific location, which after being correctly aligned (compensating for the slant-range variation, among others) provide several looks that can be incoherently averaged. In this way, an improvement on the performance of the geophysical retrievals compared to a conventional altimetry operation is expected, whenever an optimised processing baseline is set up.

The core of this presentation explores comparatively different processing options in an isardSAT in-house Delay-Doppler chain, exploiting the high-resolution data acquired by CryoSat-2 in the SAR mode over two ocean regions (Central Pacific and Agulhas). The data set considered in the analysis has been provided under the framework of SCOOP (SAR Altimetry Coastal and Open Ocean Performance) project funded under the ESA SEOM (Scientific Exploitation of Operational Missions) Programme Element.

Different state-of-the-art processing baselines have been considered: the nominal CryoSat-2 and Sentinel-3 baselines are comparatively evaluated. Two additional settings are assessed as well: a modified version of the nominal CryoSat-2 baseline, where the artificially forced zeros at stack level are not included in the final incoherent averaging; and finally the promising ACDC (amplitude compensation and dilation compensation) algorithm is integrated and implemented at stack level.

ACDC was originally proposed by Chris Ray and isardSAT team within the Sentinel-6 Ground Prototype Processor (GPP) project. The basic idea is to perform a two-step compensation once the stacking has been performed and right after geometry corrections application: 1) along-track amplitude compensation to equalise the Doppler-dependent weighting induced by the acquisition geometry in combination with both antenna and surface radiation patterns; and 2) across-track dilation compensation to correct for the waveform widening when moving away from the central beam. In this way, a better alignment of the waveforms within the stack is obtained by focusing the spread along-track energy into a single range bin, such that an improved speckle reduction and signal-to-noise ratio (SNR) are expected. This results in a simpler and more computationally efficient analytical retracker over ACDC L1B waveforms when compared to the conventional SAR analytical retracker on L1B waveforms.

The performance of the different processing baselines is analysed in terms of the precision of retrieved geophysical parameters. A dedicated in-house L2 processor, integrating the first fully analytical SAR ocean model (*Ray et al 2015)*, has been exploited. This analytical retracker was adapted side by side with the L1B processing in order to create an L1B waveform modelling which was as accurate as possible. The objective is to gain insights into the most suitable processing options in the L1B+L2 chains, so an improvement in terms of noise estimation of different geophysical parameters can be achieved.

The flexible Delay-Doppler processor that has been implemented is based on the experience gained by isardSAT team in the development of the GPP for the future Sentinel-6 mission. In this sense, it is intended to present some very preliminary results on geophysical parameters retrieval for simulated Sentinel-6 data in the high-resolution (or SAR) mode. The specificities of the Poseidon-4 instrument on-board the Sentinel-6 satellite which has a digital architecture (exploiting the matched filter processing on-board rather than the analog de-ramping counterpart), combined with the interleaved operation mode requires a processing scheme adapted to cope with these particularities in the conventional Delay-Doppler processing.