CryoSat-2: From SAR to LRM (FBR) for quantitative precision comparison over identical sea state

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The use of Synthetic Aperture Radar (SAR) techniques in conventional altimetry—i.e., Delay Doppler Altimetry (DDA)—was first introduced by R.K. Raney in 1998 [1]. This technique provides an improved solution for water surface altimetry observations due to two major innovations: the addition of along track processing for increased resolution, and multi-look processing for improved SNR. Cryosat-2 (scheduled for launch 2010) will be the first satellite to operate a SAR altimetry mode. Although its main focus will be the cryosphere, this instrument will also be sporadically operative over water surfaces, thus provide an opportunity to test and refine the improved capabilities of DDA. Moreover, the work presented here is of interest to the ESA's Sentinel-3 mission. This mission will be devoted to the provision of operational oceanographic services within Global Monitoring for the Environment and Security (GMES), and will include a DDA altimeter on board.

SAMOSA, an ESA funded project, has studied along the last two years the potentialities of advanced DDA over water surfaces. Its extension aims to better quantify the improvement of DDA over conventional altimetry for the characterization of water surfaces.

Cryosat-2´s altimeter (SIRAL) has three operating modes: the Low Resolution Mode (LRM), the SAR mode and the inSAR mode. The first two are of interest for the work to be done. In LRM the altimeter performs as a conventional pulse limited altimeter (PRF of 1970 Hz); in SAR mode the pulses are transmitted in bursts (64 pulses per burst). In the last, correlation between echoes is desired [1], thus the PRF within a burst is higher than in LRM (PRF of 17.8 KHz). After transmission the altimeter waits for the returns, and transmits the next burst (burst repetition frequency of 85.7 Hz). The previous acquisition modes will provide different data products: level 1 or full bit rate data (FBR), level 1b or multi-looked waveform data, and level 2 for evaluation or geophysical products. This paper is only addressing FBR data for LRM and SAR mode. In LRM the FBR data corresponds to echoes incoherently multi-looked on-board the satellite at a rate of ~ 20Hz, while in SAR mode FBR corresponds to individual complex echoes (I and Q), telemetered before the IFFT block [2]. Given that CryoSat-2 operational modes are exclusive, one task within SAMOSA extension aims to reduce SAR FBR data such that it emulates LRM FBR data allowing for the quantitative comparison of the measurement precision over identical sea state.

In working to this aim, three methodologies were implemented in the SAMOSA contract, the results achieved and detailed discussions with JHU/APL identified a revised approach (to be implemented in the SAMOSA extension), which should allow the team to meet the task goal. The different approaches will be presented in this paper.

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