Geophysical Research Abstracts
Vol. 20, EGU2018-17523-1, 2018
EGU General Assembly 2018

Improved Coastal Sea Level Along the North Eastern Atlantic Shelf from Sentinel-3A Delay Doppler Altimetry

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This study addresses the impact of the newly available satellite altimeter data processed with Delay Doppler methodology (DDA) on sea level and significant wave height and climate change studies in the coastal stripe within 10 Kilometres from land. Combined satellite/model/in situ data performance in coastal areas based on the advanced coupled model systems and the newly available Sentinel information is assessed.

The region selected is the North-Eastern Atlantic shelf from Lisbon to Bergen. Data cover 18 months of Sentinel-3A (from June 2016 to November 2017) and seven years of CryoSat-2 (from October 2010 to November 2017). SAR products are from the ESA GPOD processor, SARvatore, for both satellites and from the Marine Sentinel-3 product. The first have been processed with the SAMOSA+ coastal dedicated retracker. Reduced SAR altimetry (RDSAR) is from TUDaBo/TALES and STAR in-house products and from the Marine Sentinel-3 product. Model data are taken from the operation BSH model and the coupled Geestacht COAstal model SysTem GCOAST; in situ sea level, wave height and GPS data from SONEL and local organisations.

Firstly, comparison with in situ and model data shows the superiority of the SAMOSA+ algorithm on SAR data processed in conventional way (RDSAR) and other official SAR products. Data quality is investigated in terms of precision, accuracy and noise level as function of the distance to coast for different orientation of the tracks and storm surge conditions.

Secondly, we investigate the impacts of the new data quality on sea level change, mean dynamic topography and surge detection. In situ data and models agree at best with altimetric data processed with SAMOSA+. Indeed, only for SAMOSA+ sea level anomalies the correlation decreases, and the standard deviation increases, for increasing distance between station and altimeter measurements. Impacts of this result on sea level trends and vertical motion are expected for Sentinel-3, which repeat cycle duration allows the construction of time-series normal points along-track. The less noisy data near the coast improve also the coastal mean dynamic topography; the smallest standard deviation differences (6 cm) between a standard geodetic mean dynamic topography and the spatially averaged dynamic topography are found for CryoSat-2 with SAMOSA+. The other datasets have more outliers near the coast.
We conclude that Sentinel-3 with optimal SAR/SAMOSA+ dedicated processing provides reliable data for coastal sea level studies up to 2-3 Kilometers from coast. The output derived from modelling results, satellite data and in situ observations allows for a robust assessment of coastal/offshore risks and search and rescue.
This study is part of Project GB_S3CVAL (German Bight S-3 Calibration and Validation), which is included in the Sentinel-3 Validation Team (S3VT) planned analysis.