CryoSat-2 Ocean Altimetry Assessment

Poster CLV-017

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1 Abstract

CryoSat-2 was launched on the 8th of April 2010, the primary purpose of the mission is to measure sea ice thickness, however the mission is also able to monitor land ice volume variations and ocean height changes. The primary instrument is the Siral altimeter, it comes with an unprecedented accuracy and precision capable of measuring in a low resolution mode LRM, a synthetic aperture mode SAR and an interferometric SAR mode known as SARin. Over ocean areas there are SAR calibration zones, within these zones there is an algorithm to reduce the SAR data to pseudo-LRM data (RDSAR data). In this poster we validate CryoSat-2 LRM and RDSAR measurements and the ESA ocean products: IOP and GOP and we assess the IOP and GOP products with Jason-2 and Jason-3 data whereby the Radar Altimeter Database System RADS is used. Finally we perform long term monitoring by comparing the CryoSat-2 ocean sea level data with a selected set of tide gauges. In this way we are able to evaluate the stability of the measurement system and the identification of biases and bias drifts.

2 Data

Performance of the ocean data products is assessed by so-called indirect calibration. For this we 'compare range measurements and relevant range delays (tropo, iono), wave height, backscatter and wind speed, both internally (from global overall analysis and single-satellite crossovers) and externally (from global overall analysis and dual-satellite crossovers, i.e. CryoSat-2 crossings with Jason-2 and Jason-3).

The actual work in frame of this project consisted of transferring and by that converting CryoSat-2 COP (GOP) data to the native RADS format which is in netcdf, the "SIRAL reader" software. In RADS we also have level 1b retracked CryoSat-2 data to further improve upon the (original) product and augmented it with the best available correction data. In this research we can therefore also compare the COP products with these re-tracked products.

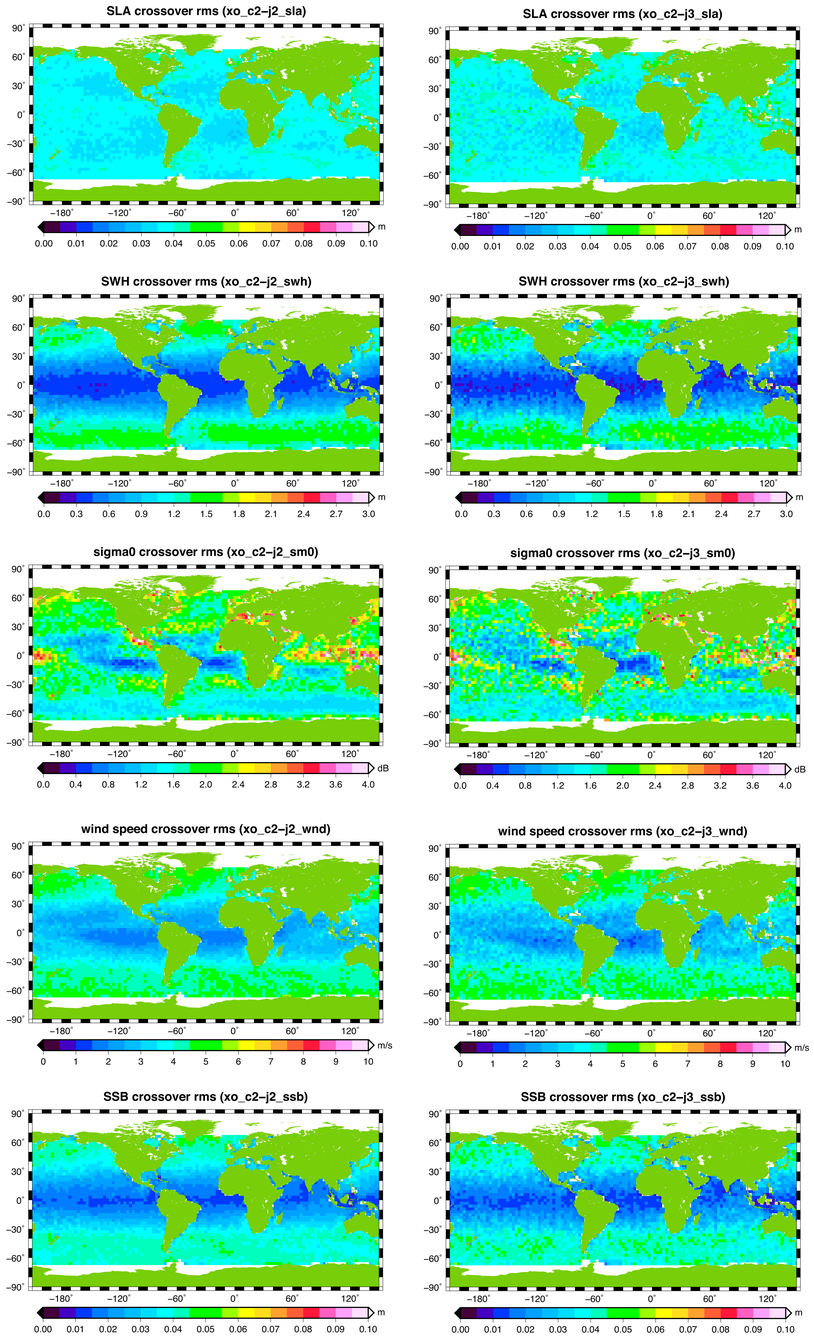
In the analyses presented in this poster we take a look at the up-to now available GOP level-2 data (status end March 2017) from November 2010 up to March 2017 (cycles 8 to 90). The RADS cycle definition for CryoSat (the same as CNES/CLS is following) we have the following sequence of revolutions: 4 * (29 + 29 + 27) + 29 = 369 days. To get approximately the same time coverage for Jason-2 for the crossover analyses, we have chosen Jason-2 cycles 85 – 303, and for Jason-3 cycles 0 - 42.

3 Statistics CryoSat-2, Jason-2 and Jason-3

	SLA [m]		SWH [m]		σ^0 [dB]		WIND [m/s]		SSB [m]	
	mean	rms	mean	rms	mean	rms	mean	rms	mean	rms
C2	0.0011	0.0482	-0.0032	1.1905	0.0142	2.1348	-0.0434	4.5110	0.0001	0.0380
J2	-0.0003	0.0342	-0.0028	1.1967	0.0010	1.6541	-0.0019	3.9161	0.0001	0.0393
J3	0.0008	0.0359	-0.0010	1.2219	0.0003	1.6995	0.0014	3.9756	0.0000	0.0402

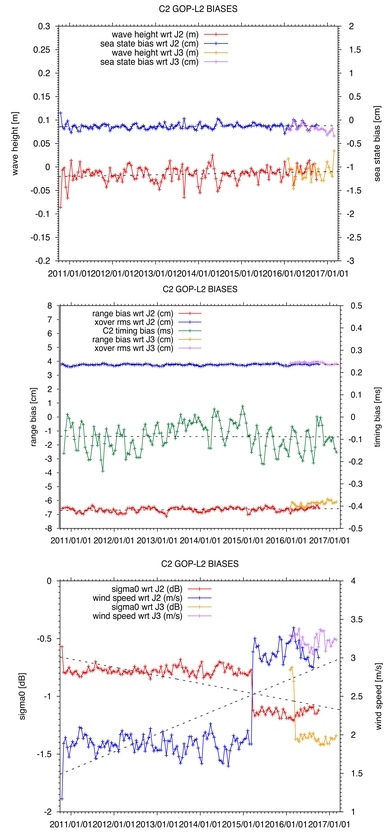
This table is based on the single satellite crossover statistics in the analysis period November 2010 to March 2017.

3 Crossover analysis



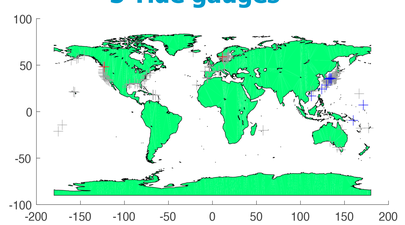
The above figures show the rms of the dual-satellite crossover differences between CryoSat-2, Jason-2 and Jason-3. The differences are presented for the sea level anomalies, the significant wave heights and backscatter coefficients, the wind speeds and the sea state bias correction between CryoSat-2 and Jason-2 and Jason-3

4 Evolution of the biases



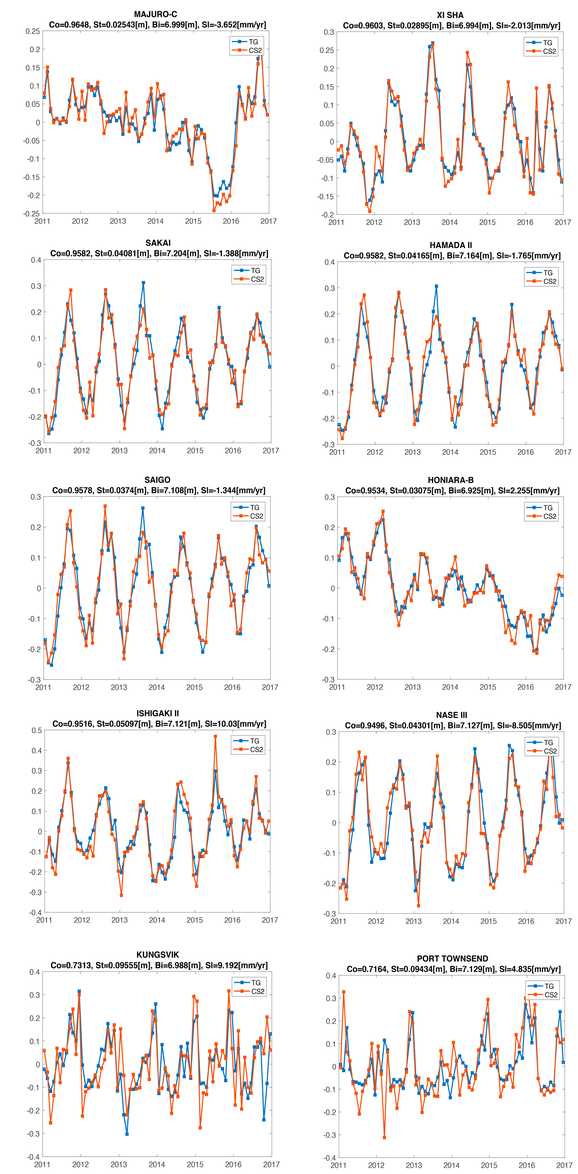
Evolution of CS2 GOP vs Jason-2 and Jason-3 differences over time. Shown are SWH, SSB, range, crossover rms', CS2 timing biases, sigma0 and wind-speed.

5 Tide gauges



TGs used in this study, the blue gauges show the best correlation, the red gauges the worst. Timeseries are shown in section 6.

6 Timeseries tide gauges vs CryoSat-2



Correspondence of sea level anomalies against sea level at 10 selected tide gauges. Out of a set of 1503 there are 150 TGs that satisfy editing criteria, the average correlation becomes R=0.84, the drift between CS2 and the TGs is -0.38 mm/yr, the rms is 5.79 cm. No land motion or GIA corrections were applied.

7 Conclusions and acknowledgments

The latest CryoSat-2 GOP/IOP product from ESA is at the quality level compatible to that of Jason-2 and Jason-3, albeit that CryoSat-2 is in a non-repeating near polar orbit. ESA-ESRIN is gratefully acknowledged for funding the project under Contract 4000112740. We thank Remko Scharroo (EUMETSAT) and Walter Smith/Eric Leuliette (NOAA) for maintenance of the RADS database, and we thank NOC-NERC for providing the TG data within the PSMSL.

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