

A seamless transition between LRM and SAR altimetry:

3 years dataset assessment of Cryosat-2 SARM

M. Raynal, S. Labroue, T. Moreau, L. Amarouche, F. Boy, N. Picot

Background & Goals

As part of the Sentinel-3 project, the "Centre National d'Etudes Spatiales" (CNES) has developed a Cryosat-2 Processing Prototype (CPP) (Boy et al 2012, 2013). This process or starts from Cryosat-2 level-0 telemetry files and generate Sea Level Anomaly (SLA) measures for each record in LRM or SAR mode.

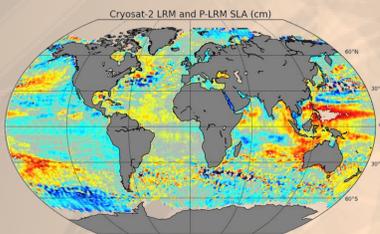
The present study shows some results obtained on a longer time series with a three year CPP SAR data record. This data set represents a major achievement in the understanding of the SAR mode altimetry (Raynal et al in prep). Data quality has been assessed through different metrics that are presented here. We analyse more deeply the main features to check the reliability and the improvements of the SAR processing (noise reduction, increased along track spatial resolution, check of the dependencies that may induce geographically correlated errors, continuity with LRM processing...).

All these efforts will result in achieving a seamless transition between LRM and SAR altimetry techniques and fulfilling the operational needs for assimilating sea level in operational forecast models. On the other hand, the Sentinel-3 SAR mode observations of sea level shall provide for the first time at global scale a data record with an improved accuracy, paving the way for high resolution altimetry and for a better observation of small scale ocean dynamics.

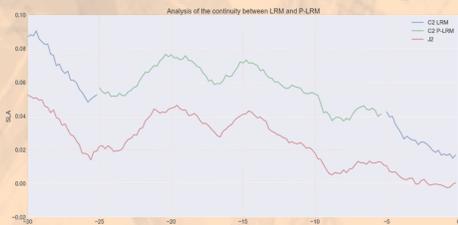
Step # 1: P-LRM validation using mono and multi missions LRM metrics

Along track analysis of the SLA

Over SAR mode area, the CPP is able to provide SAR and Pseudo-Low Resolution Mode (P-LRM) measurements. The P-LRM measurements are built on LRM "look like" echoes when the altimeter functions in SAR mode.



Perfect agreement between LRM and P-LRM SLA over the Open Ocean. SLA structures appear overlapped through SARM and LRM areas.

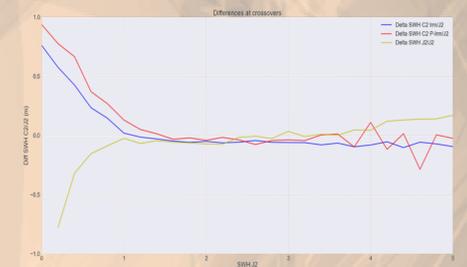
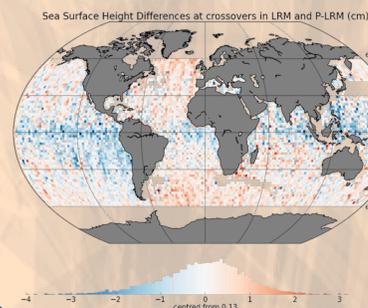


Analysis of continuity as function of the latitude around the equatorial Pacific SARM box shows differences lower than 1cm

Crossover analysis

- The very low differences of SSH at J2/C2 crossovers traduces the excellent performances of both Cryosat-2 altimeter modes.

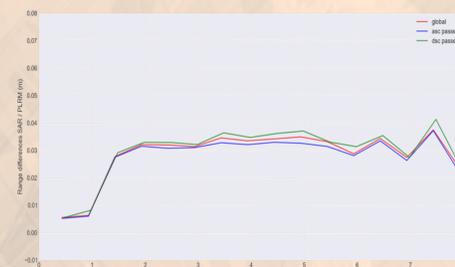
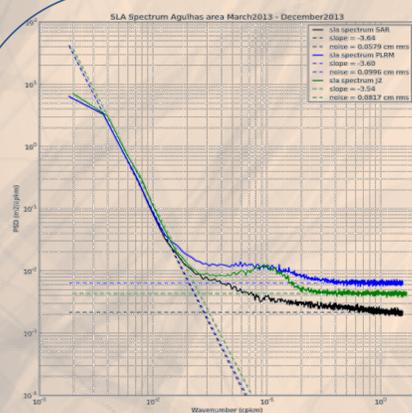
- Differences of SWH at 3h crossovers are lower than 5 cm for J2 SWH higher than 1m → good and similar performances in LRM and P-LRM



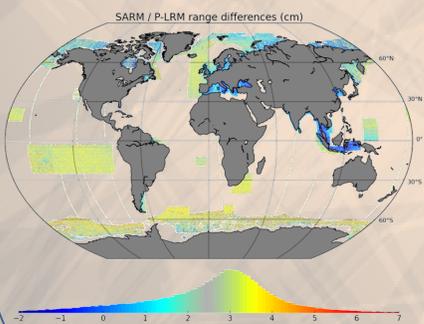
Step # 2: SARM validation using co-located P-LRM measurements

Range assessment

Due to the 300 m footprint in the along-track direction, SAR CPP shows improved content for SLA for scales lower than 100 km. There is no increase of the SLA energy between 10 and 50 km.



SAR / P-LRM range differences exhibits a constant 3 cm bias for most of the waves. Different behavior is observed for low SWH (below 1 m).

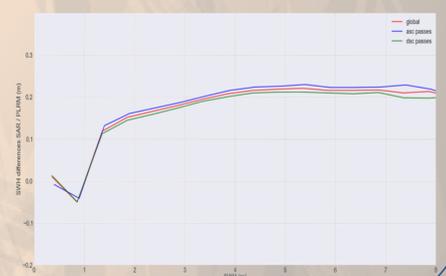
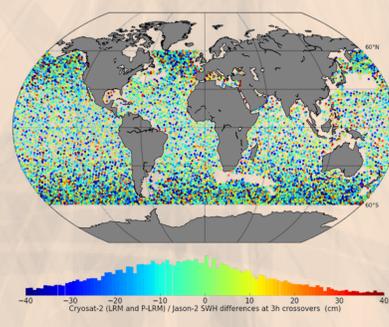
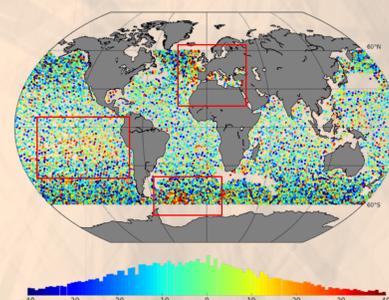


SWH assessment

- Very low dependency of SWH difference as function of P-LRM SWH ~ 1.5 %

- Compared versus Jason-2 SWH at 3h crossovers, SAR SWH appear tenth centimeter higher than Jason-2 SWH

- Different behavior is observed for low SWH



Conclusions

All the lessons learned with the extensive use of Cryosat-2 data will benefit to the ocean validation activities conducted in the frame of the Sentinel-3 mission. All these efforts will result in achieving a seamless transition between LRM and SAR altimetry techniques and fulfilling the operational needs for assimilating sea level in operational forecast models, especially for the Marine Copernicus Service.

On the other hand, the Sentinel-3 SAR mode observations of sea level shall provide for the first time at global scale a data record with an improved accuracy, paving the way for high resolution altimetry and for a better observation of small scale ocean dynamics.