Reduction of the Sea Surface Height spectral hump using a new Retracker decorrelating ocean estimated parameters (DCORE)

L. Amarouche, L. Zawadzki, A. Vernier, G. Dibarboure, S. Labroue, M. Raynal, J. Poisson

CONTEXT

- Sea Surface Height spectra of LRM mode are impacted by a "hump" that degrades the observation of ocean scales smaller than 100 km (see the paper of Dibarboure et al. “Investigating short wavelength correlated errors on 1 low-resolution mode altimetry” submitted to JAOT and accepted in 2014)
- This hump is due to inhomogeneities of the ocean surface affecting the shape of the altimeter waveform
- In the frame of Sentinel-3 Marine Collaborative Ground Segment Project funded by French Government and with the support of CNES, a new retracker has been developed to mitigate these effects: DCORE for parameters DeCOrrelation REtracker.
- This retracking significantly reduces the spectral hump but also the noise on the estimated parameters.
- This presentation provides a description of the DCORE retracker and the main analysis results

CONTENT

DCORE Methodology

- IceNew is a Retracker developed in the frame of CNES R&D Studies in 2007
- IceNew was initialy developed for ice surfaces and was based on the decorrelation of sigma0 and mispointing
- It was applied to inland water waveforms and showed significant improvements (See the poster of Amarouche et al. "Imrovement of Inland Water Areas Altimeter Height Estimation Using New Retracking Techniques" presented at OSTST of Venice 2012).
- Application to J2 in the frame of CNES SLOOP project => Improvement of sigma0 estimation over ocean in case of blooms and rain
- Application to AltiKa in the frame of CNES PEACHI project => The results on sigma0 confirmed for Ka band (several presentations in AltiKa meetings by J. Poisson)
- Improvements of sigma0 estimation were unfortunately less significant for the range and SWH
- DCORE is then developed to improve the range and SWH estimation.
- DCORE is using a modified waveform analytical model that mitigates the impact of the trailing edge deformations on the range and SWH

DCORE Methodology

$$S(t) = \frac{A\sigma_0}{2}\left[1 + erf\left(\frac{t - \tau - \frac{4c}{\Gamma h}\sigma_c{}^2}{\sqrt{2}\sigma_c}\right)\right]\exp\left[-\frac{4c}{\Gamma h}\left(t - \tau - \frac{2c}{\Gamma h}\sigma_c{}^2\right)\right] + N_t$$

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Only this part is used for SWH estimation

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- MLE4 ponderated
- True PTR used
- Analysis window reduced

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Towards the Jason-3 waveform processing: assessment of the numerical retracking performances
Franзois Boy et al.

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SWH and Gamma are smoothed and then injested in a second pass MLE2 to estimate epoch and sigma0

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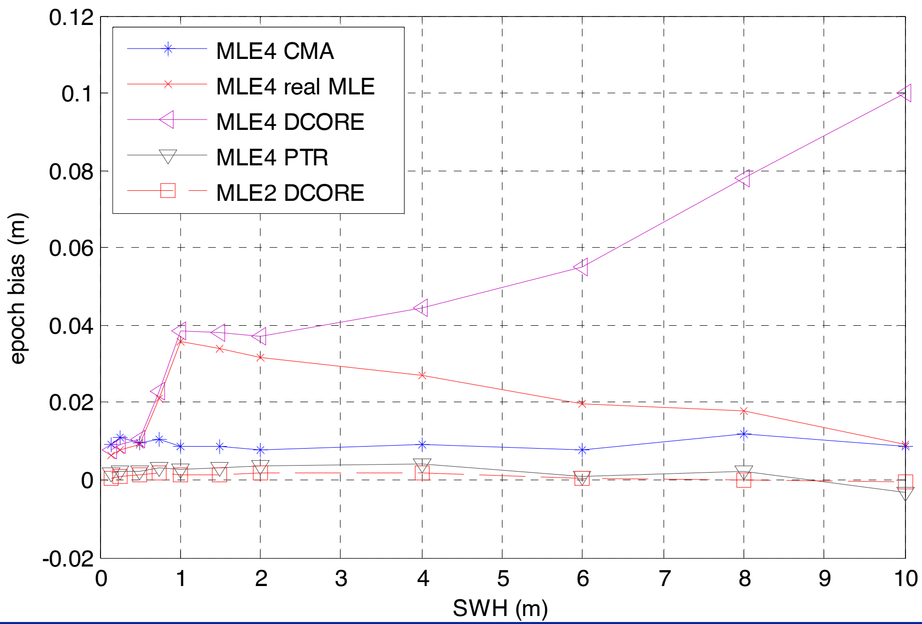
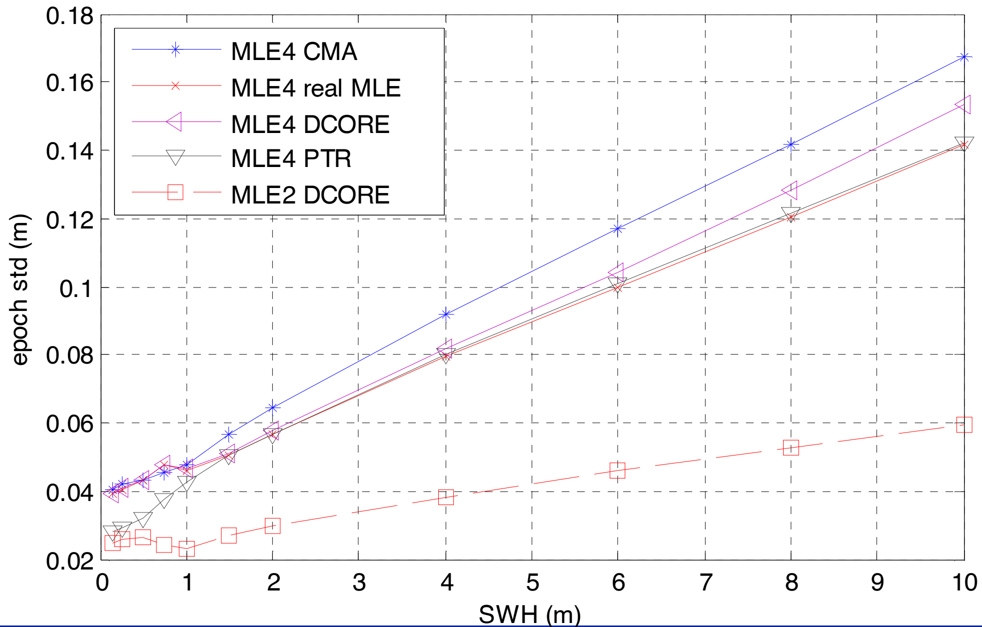
Analysis on simulated data

Example of results (bias and noise versus SWH) for epoch for the different configurations tested to tune the algorithm.

Configurations to be compared: MLE4 CMA (MLE4 Standard) and MLE2 DCORE (second pass of DCORE)

MLE4 DCORE and MLE4 PTR are both ponderated MLE with true PTR and respectively with the Brown Second Order Model and the new DCORE model.These retracking have been used as intermediate steps for DCORE development.

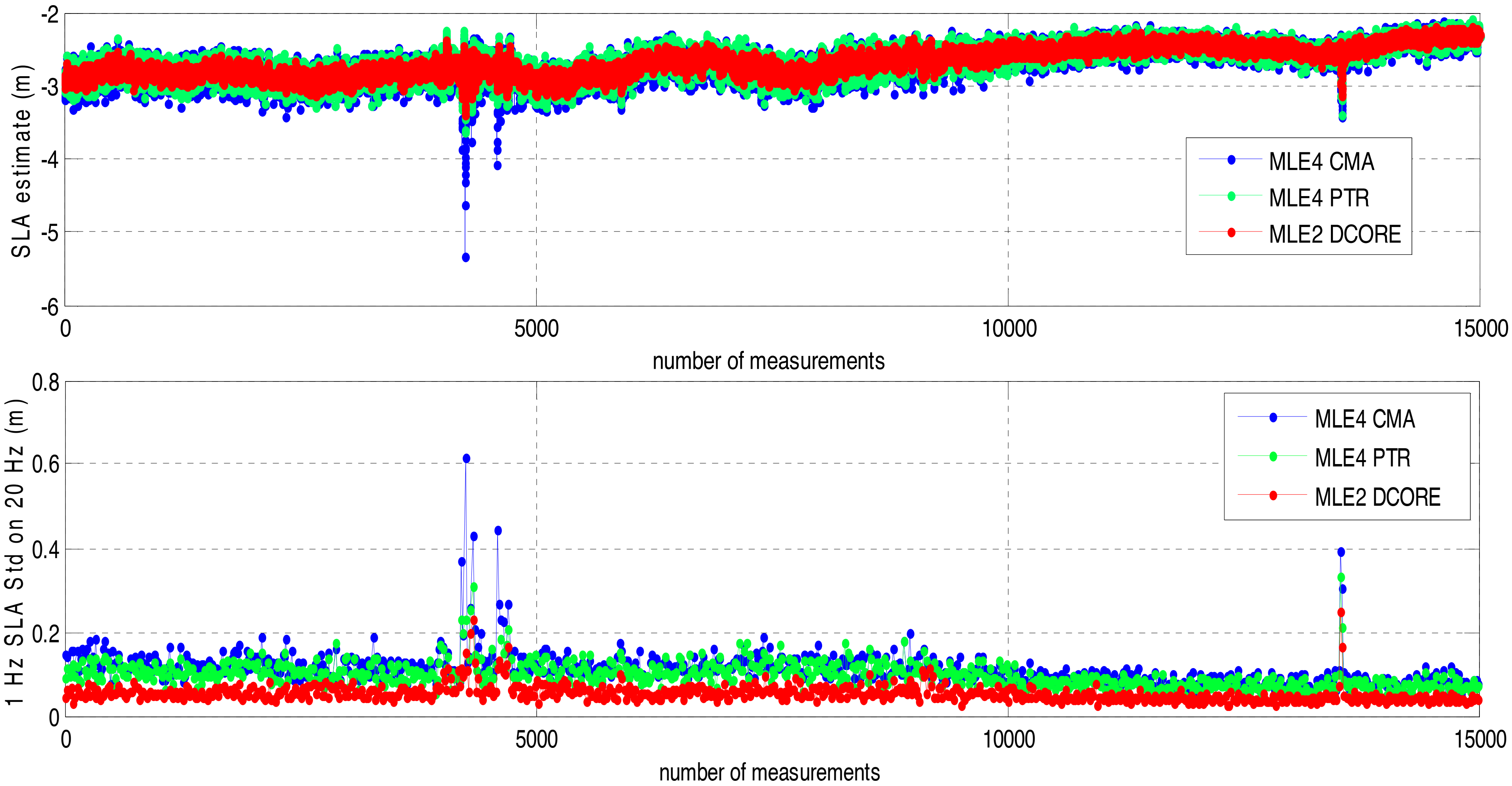




Analysis on Jason-2 real data

One pass of J2 cycle 35 (approximately 15000 20 Hz measurements)

SSH = Orbit – range – mss



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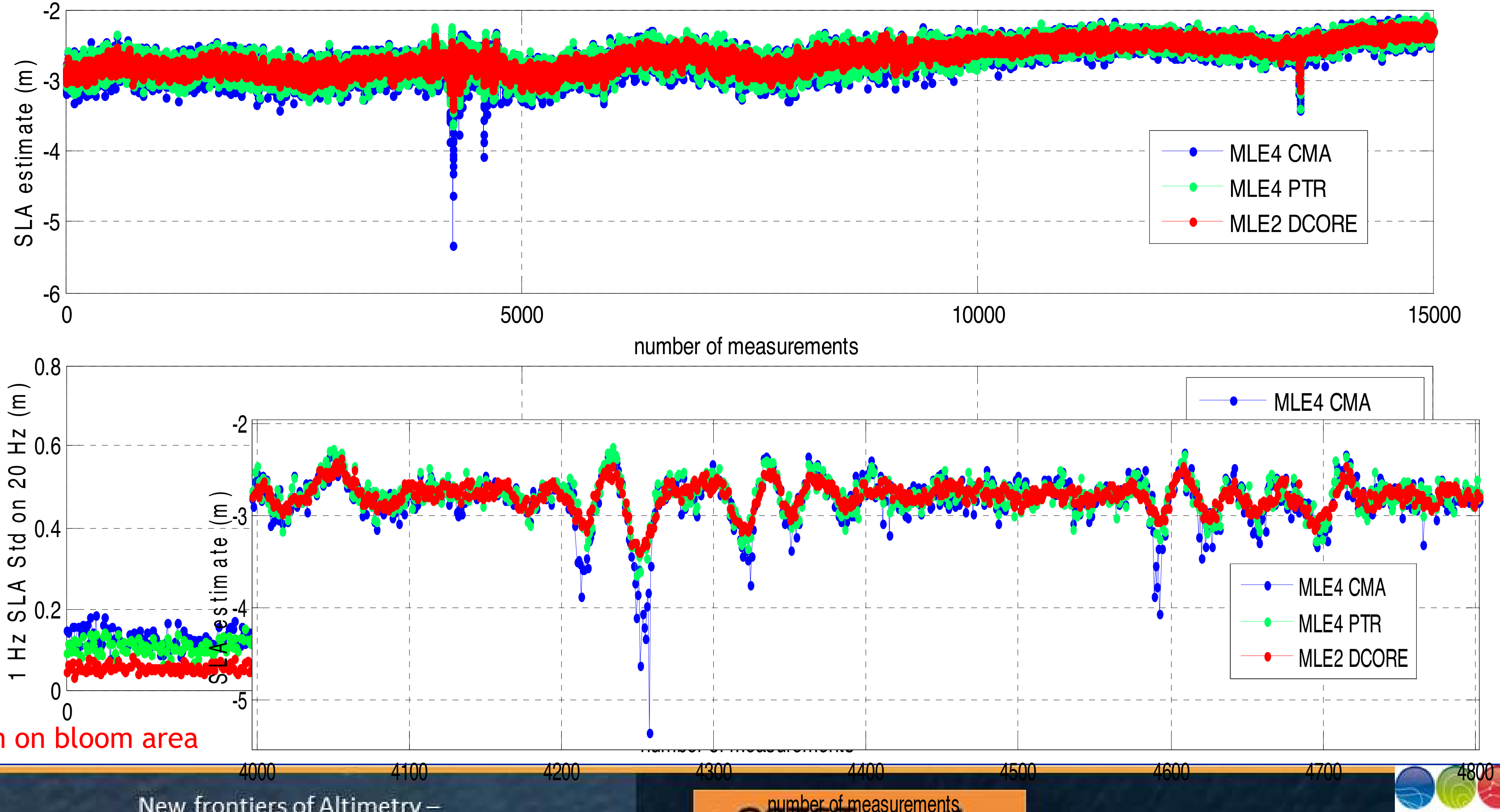
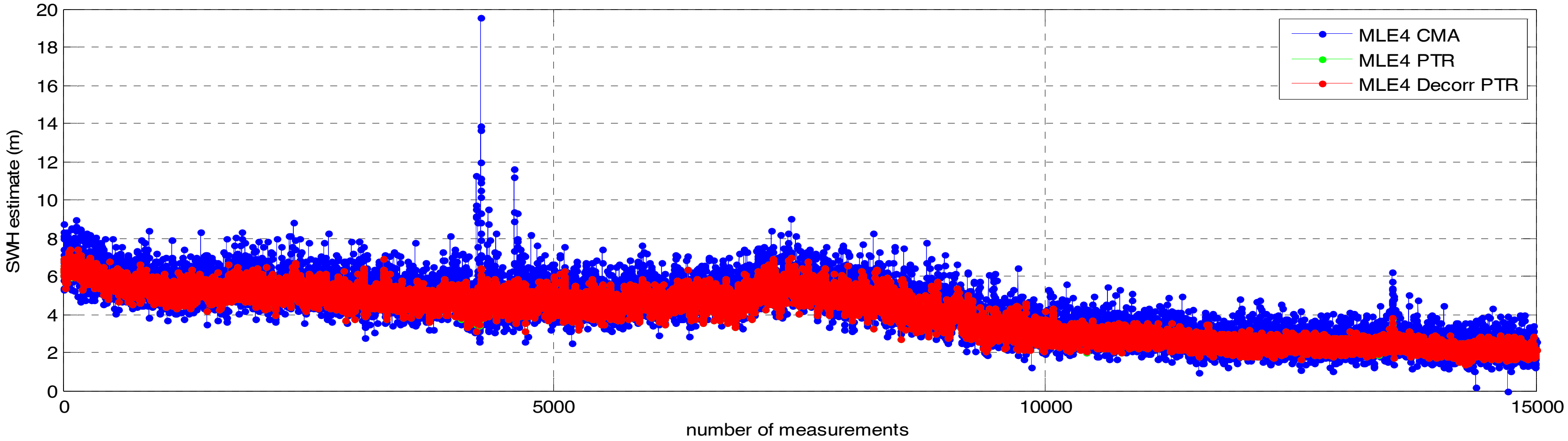
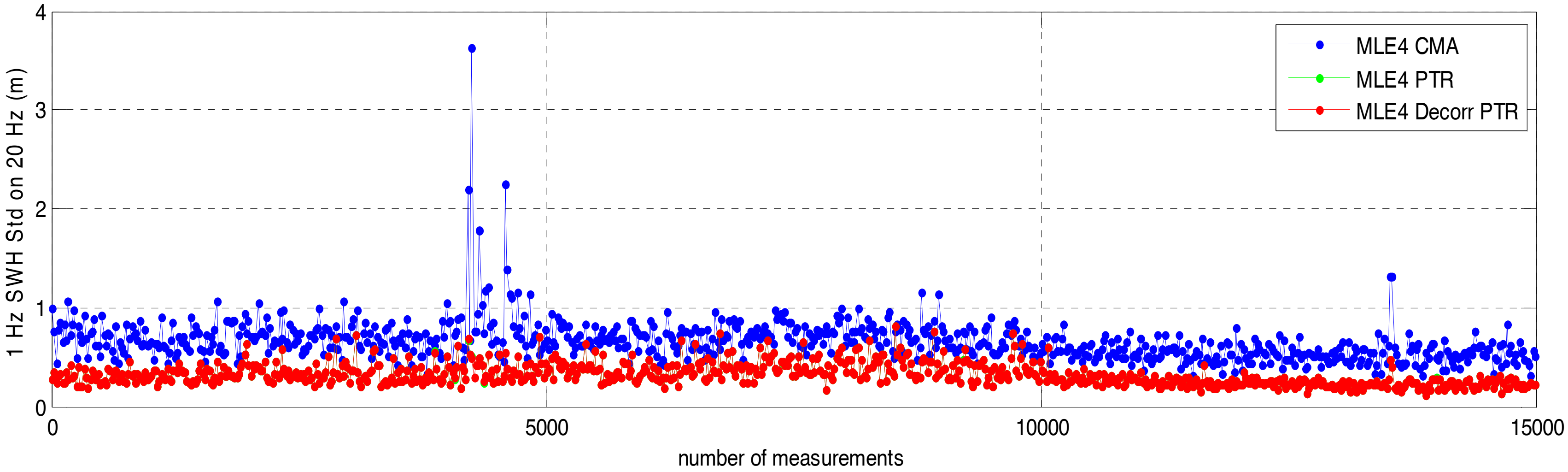


Zoom on bloom area

Analysis on Jason-2 real data

SWH estimates





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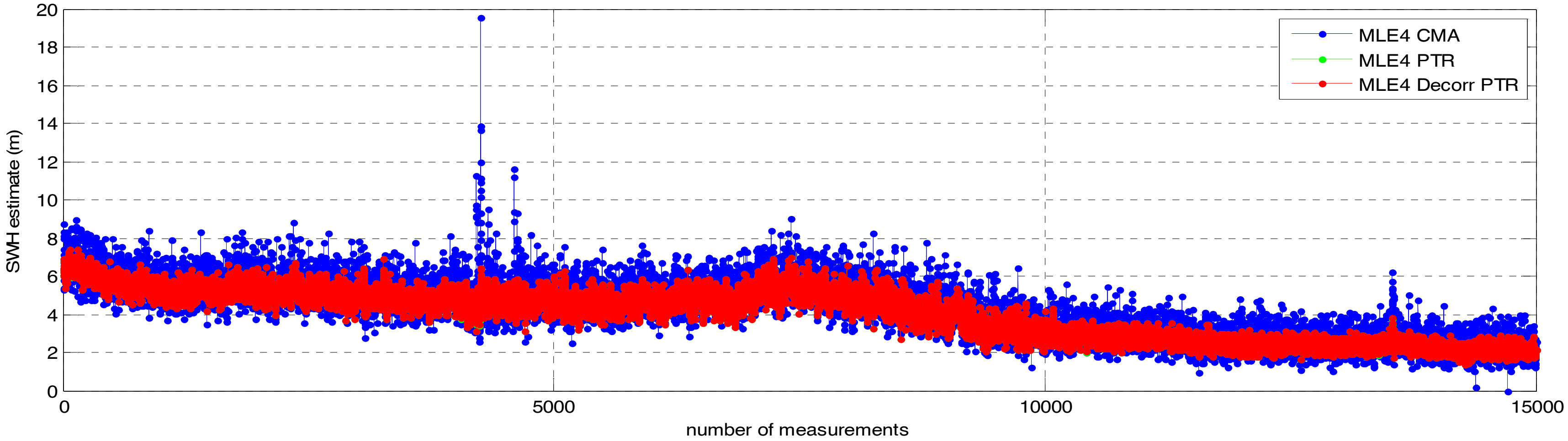
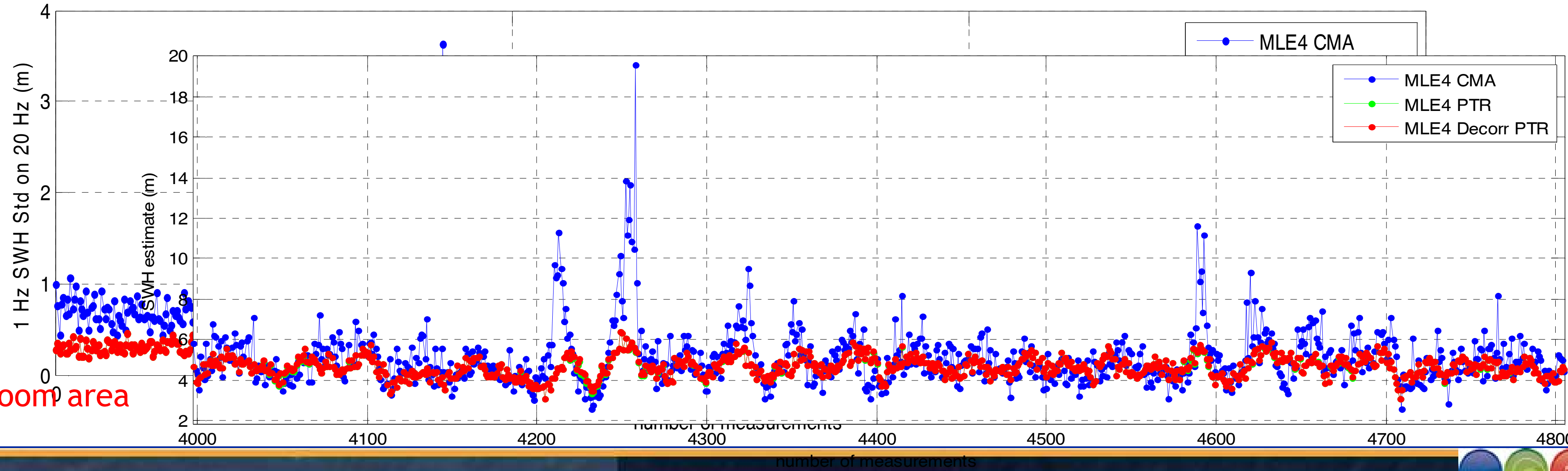


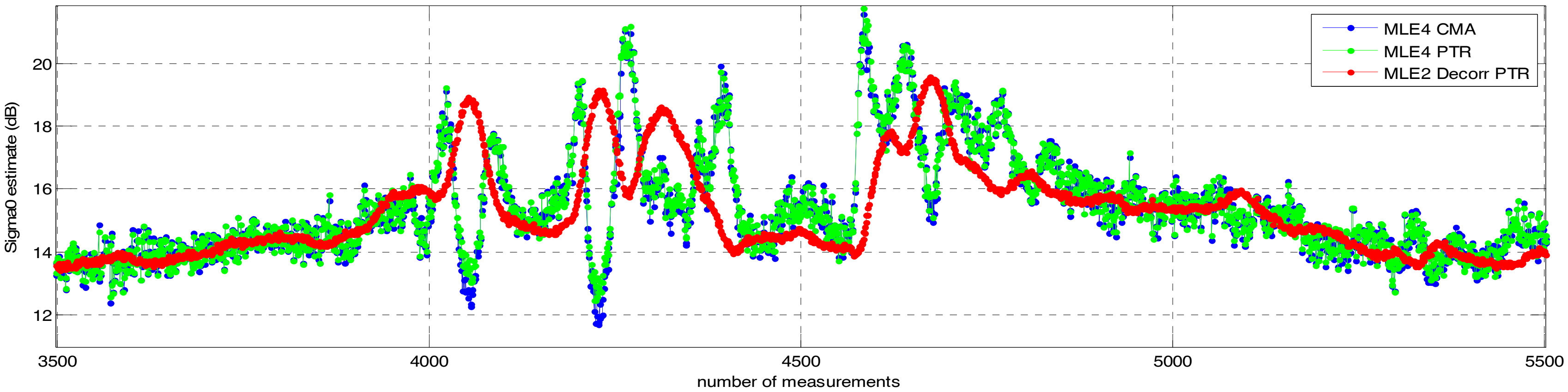


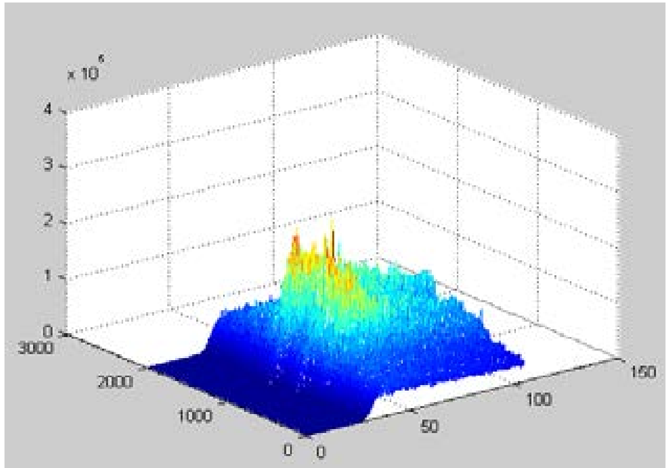
Zoom on bloom area

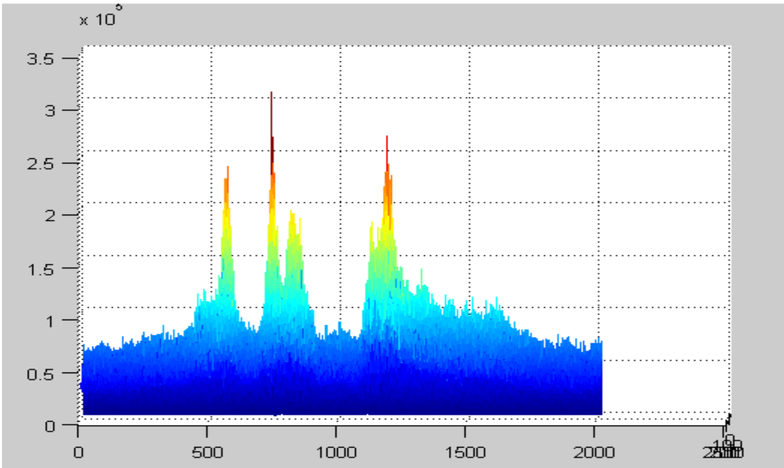
Analysis on Jason-2 real data

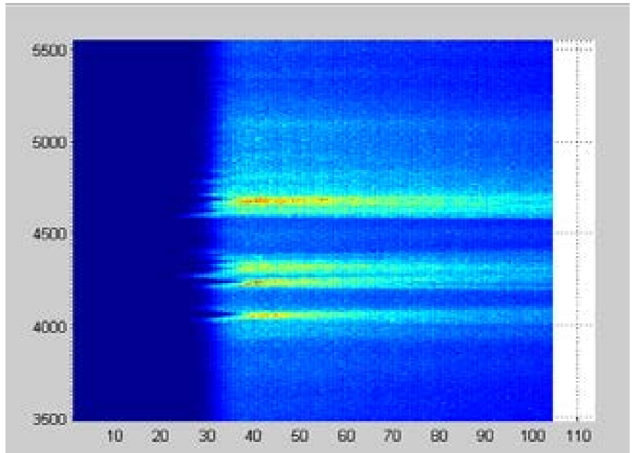
Estimations Sigma0

Zoom over a bloom area



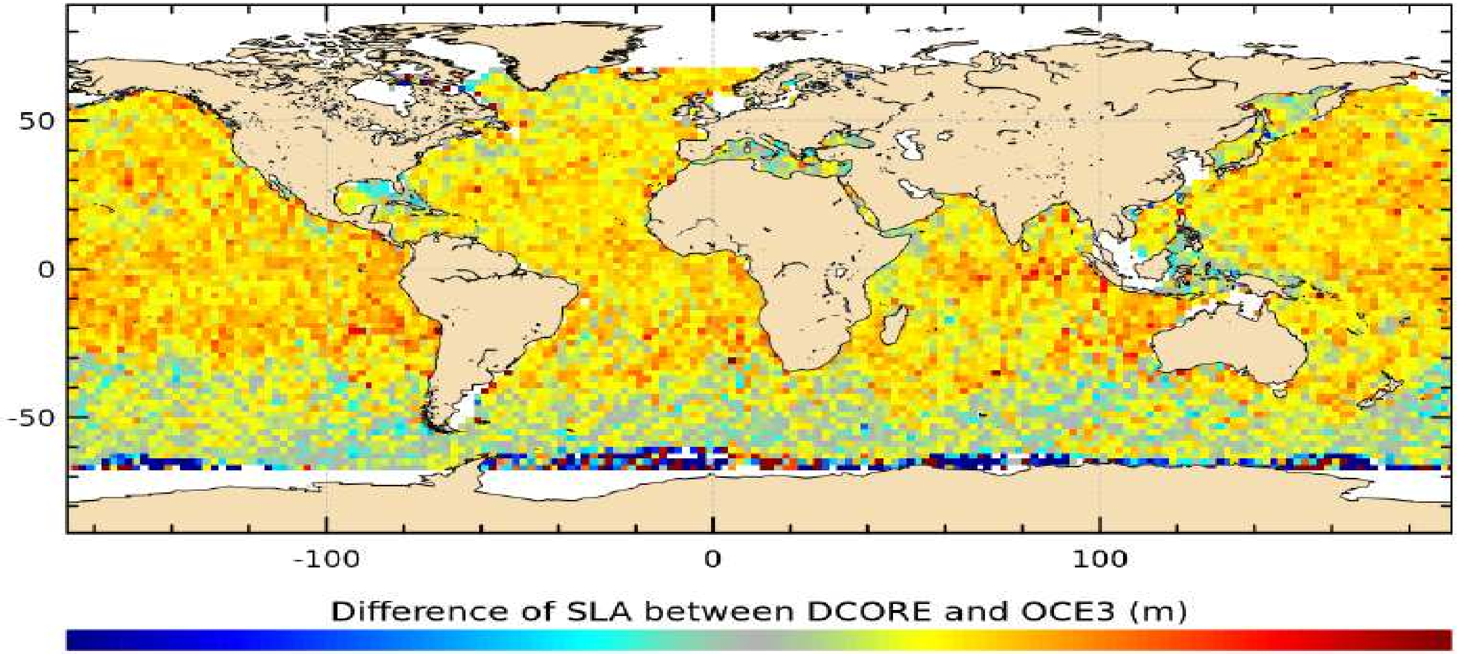






Analysis on Jason-2 real data

Cycle 35 analysis window reduced to samples 13-86



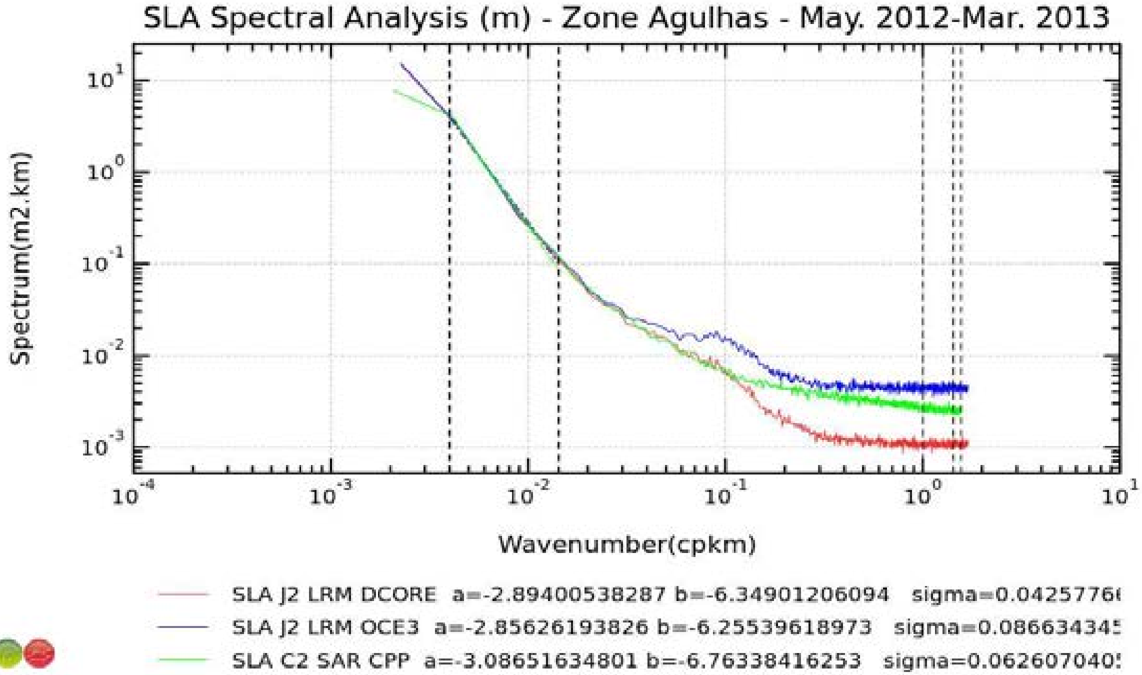
Nbr :	8726	Std Dev :	0.016504949	Min :	-0.46144723
Mean :	0.0057041217	Median :	0.006532947	Max :	0.78258218

Low range differences

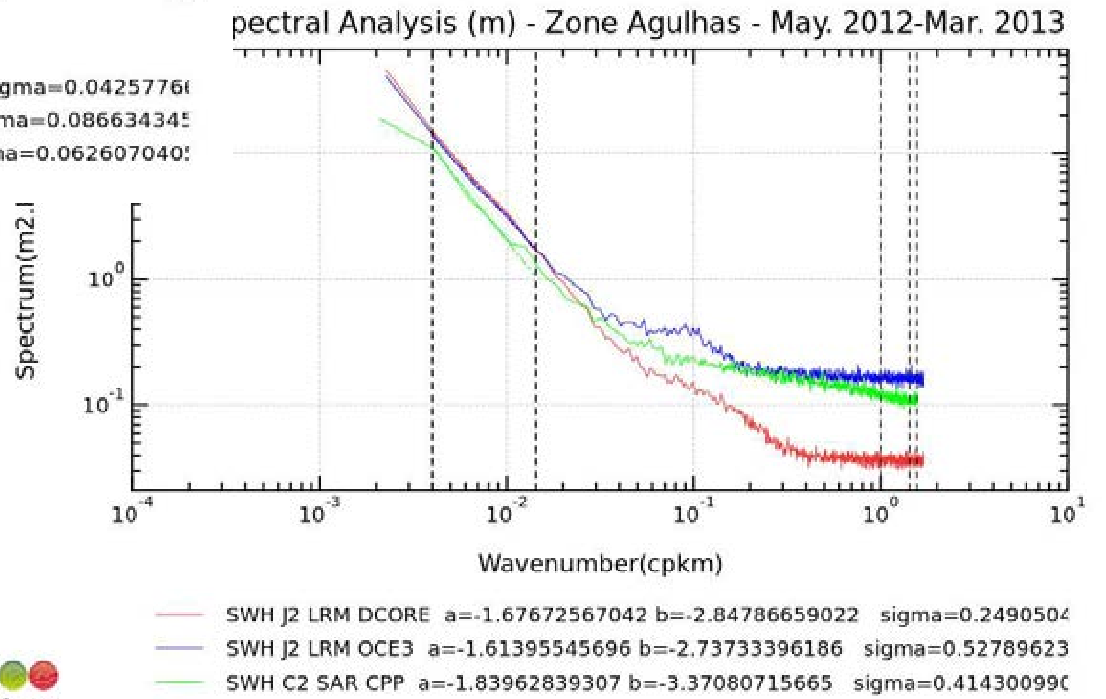
Comparison to SAR CS2 in Agulhas current area

One year of data between May 2012 and March 2013

SLA



SWH



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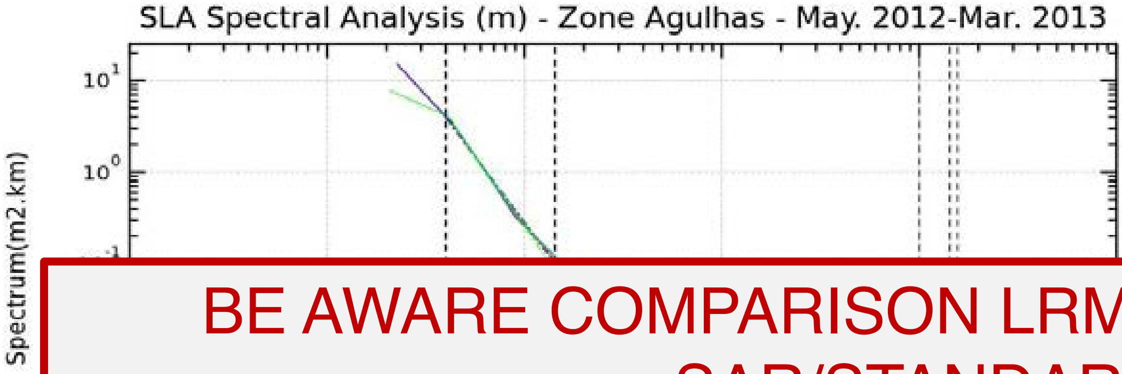
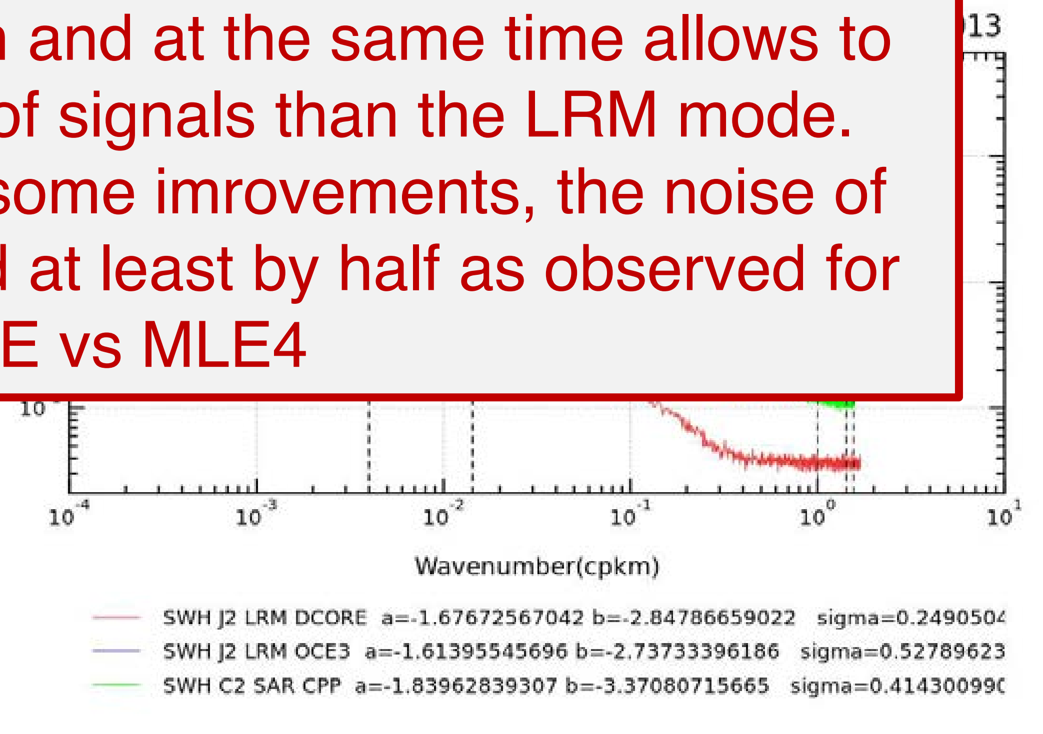


BE AWARE COMPARISON LRM/IMPROVED MLE AND SAR/STANDARD MLE

Beyond the retracking method, the SAR mode allows a higher spatial measurement resolution and at the same time allows to accumulate a higher number of signals than the LRM mode.

We can then expect that, with some imrovements, the noise of the SAR mode RTK be reduced at least by half as observed for the DCORE vs MLE4



Conclusions

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- Reduction of noise on the Retracking estimated parameters
- Imrovements are still possible when further analysis performed using a higher amount of data

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- For S3 mission, PLRM is noisier than LRM while it is the only mode available at the same time as for SAR mode = > Applying DCORE to PLRM allows SAR validation with less noisy PLRM mode to ensure continuity with the previous conventional missions
- Re-processing of previous conventional altimetry missions to have better historical data
- Methods used to improve LRM retracking can also benefit to SAR mode retrackings

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SAR mode will then benefit from these improvements on LRM : use the same methodolody, use of improved validation data…

Perspectives

Regarding validation

- Process PLRM CS2 data over the same period as CPP CNES products to compare PLRM/DCORE and SAR/CPP for the same measurements (platform mispointing has to be injested).
- Analysis of Sea State dependencies
- Further checks of the estimates for high SWH values

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- **On the RTK itself**
  - Specific analysis of low SWH values
  - CPU optimization

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❑ On the RTK itself

- Specific analysis of low SWH values
- CPU optimization

❑ Other applications

- Adaptation to AltiKa
- DCORE is very robust to reduced analysis window = >Tests on coastal areas
- Analyse DCORE on the same areas as IceNew (inland water, sea ice and ice sheet)