Improving Conventional Altimetry SSH observability: global assessment of SSH datasets derived from innovative LRM retrackers

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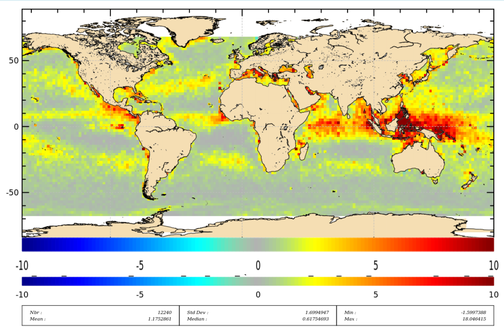
Since many years, altimetry constellation is delivering relevant measurements to monitor the ocean large scale surface topography. More recently, with our understanding of the oceanic structures, these needs have evolved toward a better characterization of the oceanic mesoscale and sub mesoscales dynamic, over open and coastal areas. To answer this problematic, many progresses were made in the instrumental design domain. Thanks to the new generation of Delay Doppler altimeters (first time onboard on Cryosat-2 mission), the instrumental noise and spectral bump error were significantly reduced. On the other hand, to continue exploiting the recent and past LRM datasets, a lot of work has been dedicated to improve the retracking methods.

This study focuses on the assessment of the **adaptive retracker** (Thibault et al., OSTST 2018). It aims at reviewing the Sea Surface Height retrieval performances. The assessment will be done with classical metrics at 1 Hz at global scales to assess the improvement compared to the existing MLE4 operational datasets. This will complement the assessment done by Smith et al (OSTST 2017) that focused on performances of several retrackers at small spatial scales.

Data validity and coverage

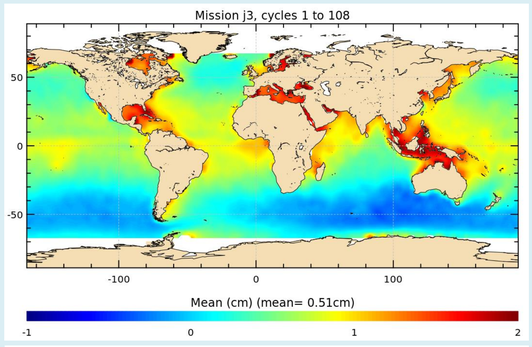
There are more valid points with adaptive retracking parameters (yellow and red areas) compared to MLE4, when following the Jason-3 handbook editing procedure.
The gain is mainly located over areas affected by rain events and/or sigma bloom where the adaptive retracker is more robust than MLE4 algorithm.

% valid SLA points (ADAPTIVE) – % valid SLA points (MLE4)

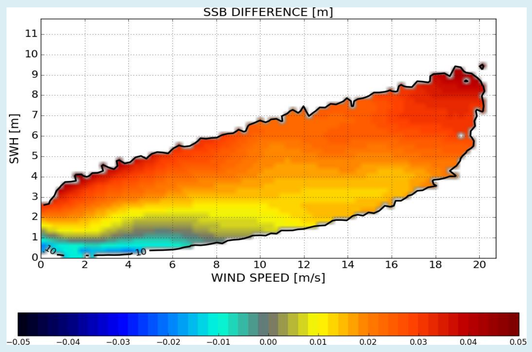


Data Sets Characteristics

The comparison is done at 1 Hz, using specific Adaptive or MLE4 data for retracked parameters and SSB correction. All other geophysical corrections are identical between both data sets. Since adaptive and MLE4 range have different dependency wrt SWH, a new SSB model was estimated for adaptive retracker. Figures show that the difference in range and thus in SSB is close to 0.3% SWH, adaptive SSB being lower compared to MLE4 solution.

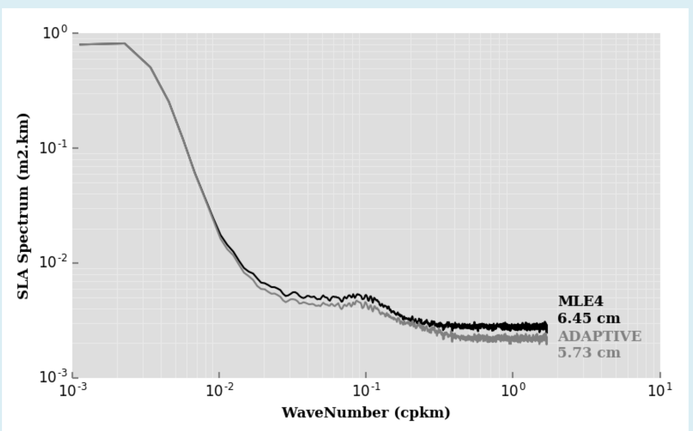


RANGE ADAPTIVE – RANGE MLE4



SSB ADAPTIVE – SSB MLE4

Impact on short spatial scales



As shown by Thibaut et al (OSTST 2018), the adaptive retracker improves the SSH short scale content by reducing the PSD energy below 60 km. The 20 Hz noise reduction is close to 10%.
Note that the energy reduction is stronger for adaptive SWH (not shown).

Conclusions

The analysis shows that the adaptive retracker improves SSH data quality compared to MLE4 algorithm.

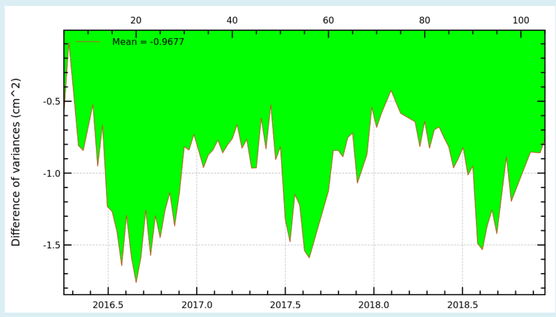
The improvement is present :

- at global scales with improved metrics at crossovers and along track SLA
- over coastal areas with more stable SLA approching the coast in the last 6km
- at shortest spatial scales thanks to the 20 Hz range noise reduction

The adaptive retracker will be included in the GDR-F Jason-3 reprocessing.

Performances of along-track SLA

variance (SLA with ADAPTIVE) – variance (SLA with MLE4)

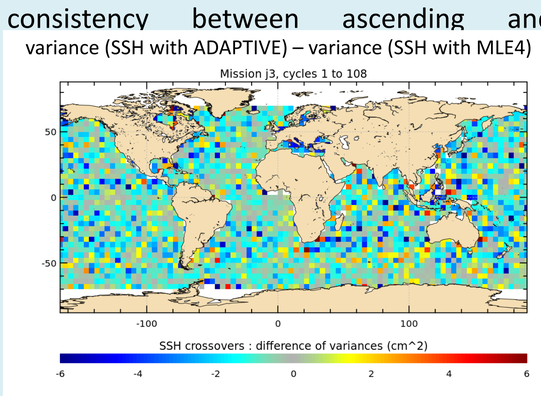


Regarding along track SLA variations, it is confirmed that the adaptive SLA improves data quality with a higher mean impact closer to 1 cm², reducing the mean SLA standard deviation to 10 cm.
The variance improvement shows annual signal while the mean map of the variance gain highlights more contrasted patterns compared to the crossovers. It shows an almost consistent improvement with variance reduction, except over some very specific regions: Malaisia, Baltic Sea, Oman Sea and East Equatorial Pacific. The main currents also exhibit variance increase that need to be further investigated to understand whereas geophysical signal is better retrieved over those high variability regions.

Performance SSH difference at crossovers

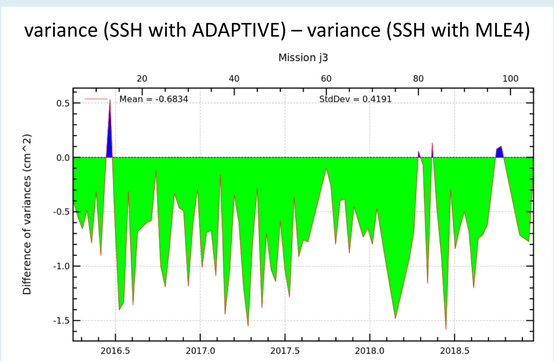
Crossover metrics show a global improvement of the adaptive derived SSH close to 0.7 cm2 in average. The variance reduction is also quite homogeneous in space, with a constant magnitude over the whole globe. Such an improvement was not expected since this metric mainly checks the consistency between ascending and

variance (SSH with ADAPTIVE) – variance (SSH with MLE4)

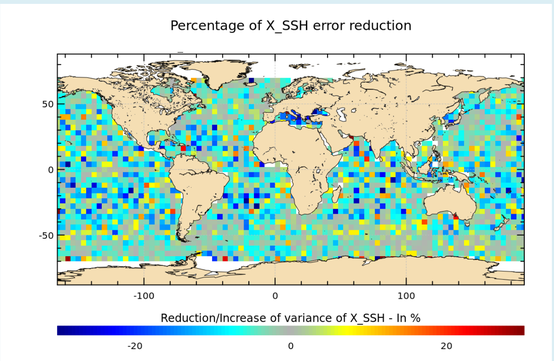


The improvement represents 5 to 10% of the signal variance over equatorial and mid latitude regions.

variance (SSH with ADAPTIVE) – variance (SSH with MLE4)



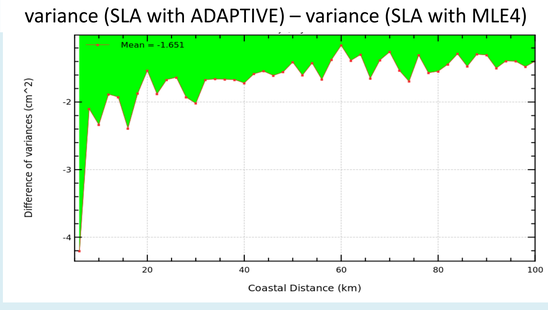
Percentage of X_SSH error reduction



Performance over coastal areas

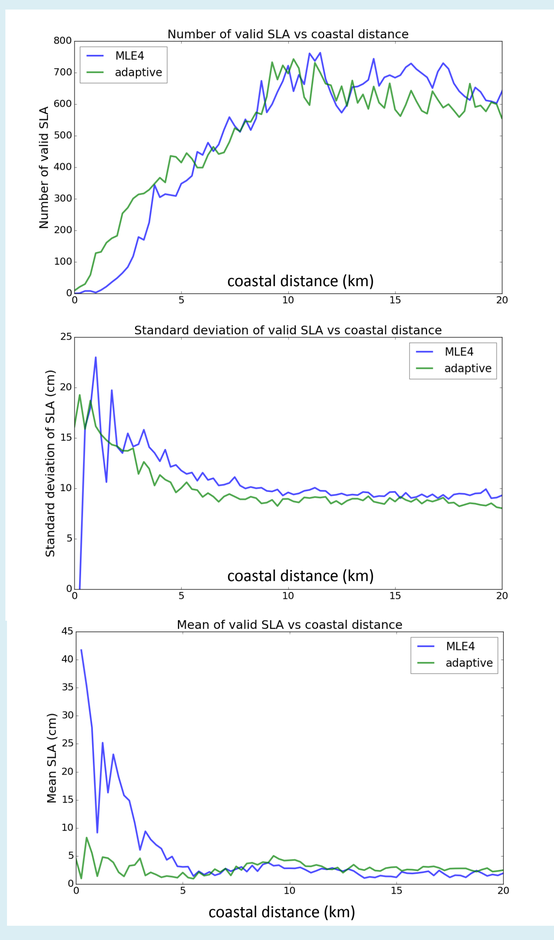
The analysis of variance gain at 1 Hz shows an increase in the improvement when approaching the coast. Adaptive retracker reduces the SLA variance in the strip 5 to 20 km.

variance (SLA with ADAPTIVE) – variance (SLA with MLE4)



The same analysis is done at 20 Hz focusing on the Mediterranean basin to assess the coastal performances at high resolution. The adaptive retracker is compared to MLE4 with same outliers detection procedure and zoom on the last 20 km confirms excellent performances with:

- Increase of the percentage of valid data in the last 6 km
- Robust mean value of SLA approaching the coast
- Variance reduction of SLA



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