X-TRACK/ALES REGIONAL ALTIMETER PRODUCT FOR COASTAL APPLICATION: TOWARD A NEW MULTI-MISSION ALTIMETRY PRODUCT AT HIGH RESOLUTION

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Sea level variation is one of the major threats for coastal zones. Improving the number and quality of observational data is essential to better understand and predict the behavior of the coastal ocean. Satellite altimetry provides unique long-term observational datasets to characterize how sea level variability evolves from the open ocean to the coastal ocean. The X-TRACK processing chain has been developed in order to recover as much altimetry data as possible in the coastal zones. X-TRACK is a multi-mission product covering all the coastal oceans, produced by the CTOH and freely distributed by the AVISO+ service. Recently, the L2 ALES retracker product has been included in the X-TRACK processing algorithm, as well as the best altimetry corrections available, thus merging the most recent advances in coastal altimetry into a high resolution product (20Hz ~ 350m) made available for the research community.

Acknowledgments

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A new version of X-TRACK SLA multi-mission product at 20Hz, based on ALES retracker

We aim to take advantage of the large progress that has been made in coastal altimetry during the past decade. X-TRACK [1] is now a mature L3 1-Hz multi-mission product and its editing ant post-processing strategy allows to obtain more accurate data closer to the coast. The ALES retracker is able to analyze more coastal altimeter waveforms than the standard processing, and then to retrieve significantly more reliable 20-Hz SLA data [2].

In the context of the ESA's climate change initiative sea-level projects (bridging phase in 2018-2019 and CCI extension in 2019-2022) and acknowledging user needs we are now producing an L3 multi-mission product for different altimetry missions combining the better spatial resolution provided by high-rate data, the better quality of ALES retracker products, the post-processing strategy of X-TRACK (adapted to 20Hz data), and refined geophysical corrections. After a demonstration phase concerning the LRM altimetry missions, SAR altimetry will also be processed in order to obtain a multi-mission product.

X-TRACK/ALES: a new coastal product at high rate

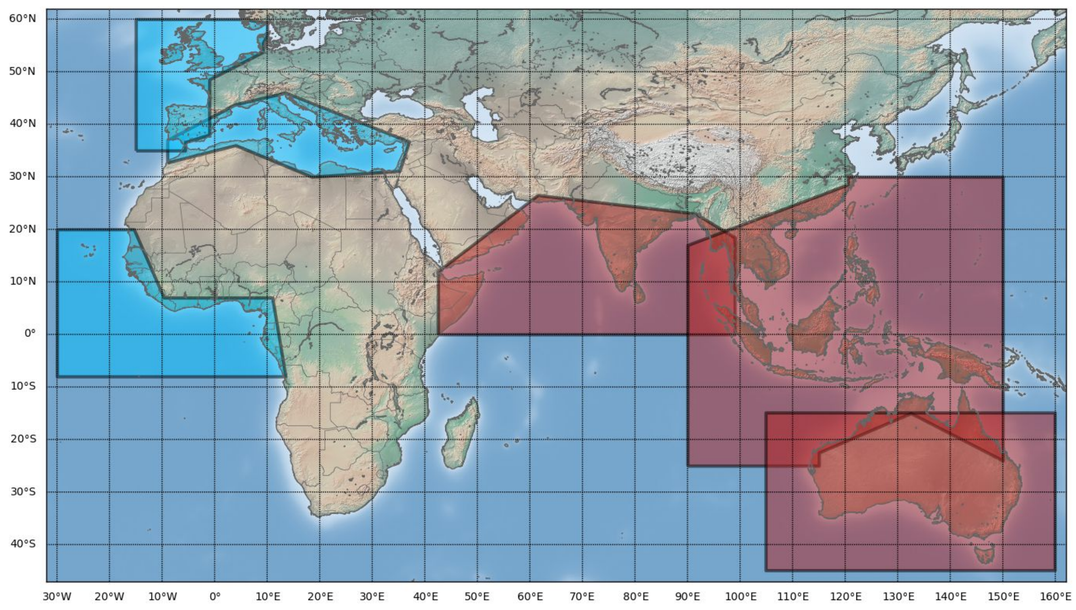

Figure 1: Map of the X-TRACK/ALES zones, bridging phase in blue and CCI+ in red.

The X-TRACK processing system has been designed to provide along-track SLA time series at 1-Hz for different LRM missions (Envisat, Jason-1,2,3, SARAL/AltiKa, ...).

	Bridging phase zones	CCI+ zones
J1+J2	Septembre 2019	February 2020
J1+J2+J3	February 2020	February 2020
Envisat	June 2020	June 2020
Saral/ALTIKA	June 2020	June 2020

Tab 1 : Schedule of data availability

It has been recently adapted to the processing of 20-Hz measurements. By merging X-TRACK and ALES altimetry processing tools, we computed along-track sea surface height time series for Jason-1 and Jason-2 missions. X-TRACK software reprocesses in delayed time corrections and parameters from the geophysical data records provided by space agencies (GDR products) and combines them with the ALES data (range, sigma0 and sea state bias) to compute the sea surface height (SSH), after a robust editing of the measurements and corrections.

Corrections/param.	Source
Range/sigma0	ALES
Ionosphere	Dual-frequency altimeter range measurements
Dry Troposphere	ECMWF model
Wet Troposphere	GPD+
Sea State Bias	SSB ALES
Solid Tides	Ttide potential model
Pole Tides	Wahr, 1985
Loading Effect	FES 2014
Atmospheric Correction	MOG2D dynamic atmospheric corr., includes the ocean dynamic response to wind and pressure forcing
Ocean Tide	FES 2014

Tab 2 : Corrections and parameters used to compute X-TRACK/ALES product

Combination of multi-mission altimetry data: Exemple of Jason-1 and Jason-2 time series

Jason-1 and Jason-2 have been connected to Jason-2's cycle 21 by subtracting the following regional bias Jason-2 SLA

Region	Bias (cm)
MEDSEA	-5,899
NEA	-5.692
WAFRICA	-5.436

Tab 3 : Regional bias between Jason1&2

X-TRACK/ALES along the coasts of Med. Sea

X-TRACK/ALES 20 Hz product is already available over the **15-year period of Jason-1&2** for 3 study coastal areas (**Mediterranean Sea**, **North East Atlantic** and **West Africa**). Despite having a much higher noise level than the classical 1-Hz data, 20-Hz measurements allow to recover more informations on coastal sea level variations. The combination of ALES and X-TRACK high-rate processing extends significantly the number of valid SLA computation several kilometers shoreward along the ground track.

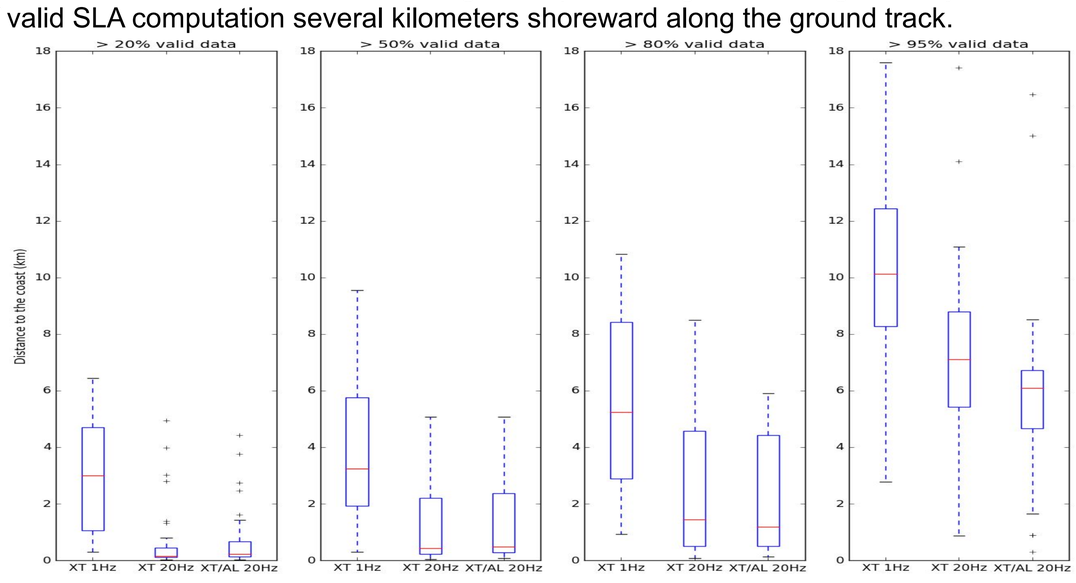

Figure 2: Distance to the coast of the first point available with more than 20/50/80/95 % of valid data for J2 X-TRACK 1Hz product, X-TRACK 20 Hz product and the combined XTRACK/ALES 20Hz product in the Mediterranean zone.

For example, for Jason-2, the **combined high rate X-TRACK/ALES** product obtains **80% of valid sea level data** at a distance of **1.2 km** in average for the Mediterranean Sea region, instead of **1.4 km** for the **X-TRACK 20Hz** alone and **5.2 km** for the **X-TRACK 1Hz** version.

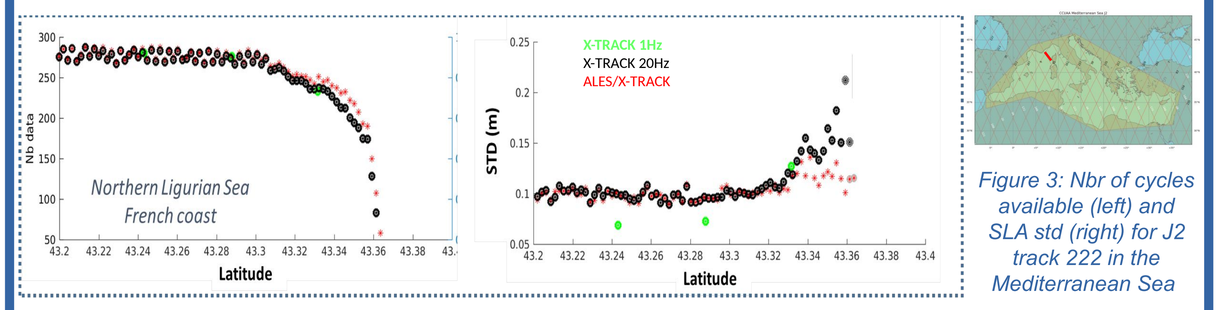

Figure 3: Nbr of cycles available (left) and SLA std (right) for J2 track 222 in the Mediterranean Sea

Compared to X-TRACK 20Hz based on the MLE4 retracker, X-TRACK/ALES product shows a more coherent and realistic variability in coastal SLA.

Scientific application: long-term coastal sea level changes in the Mediterranean Sea

This work is done in the framework of the SL_cci project (ESA funding). The main objective is to estimate the interannual and long-term evolution of sea level in the 3 study areas, as close to the shoreline as possible, and understand the principal factors that are at its origin. Below are shown preliminary results for the Mediterranean Sea. The results obtained in the different regions will be compared in the framework of the CCI+ project. Preliminary results for Western Africa could be find in [3].

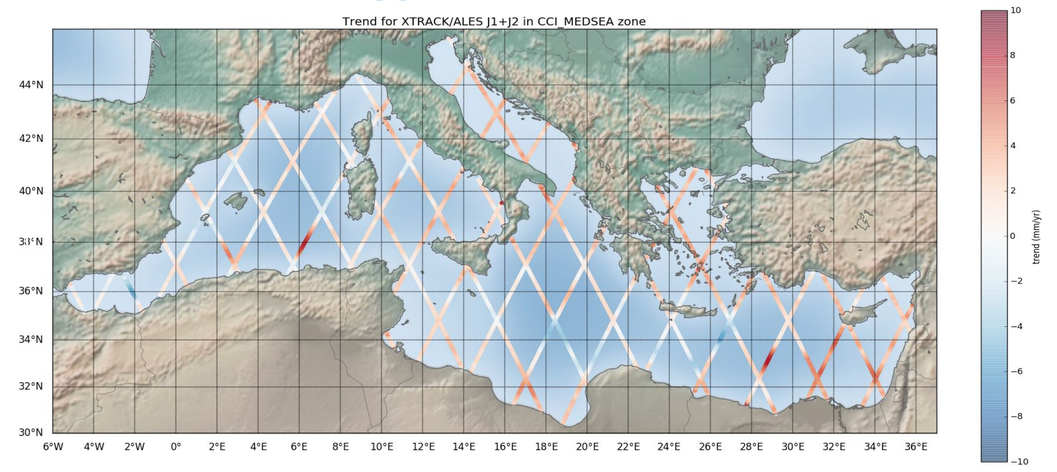

Figure 4: Example of regional trend computed with the J1and J2 combined mission X-TRACK/ALES HF product in the Mediterranean Sea.

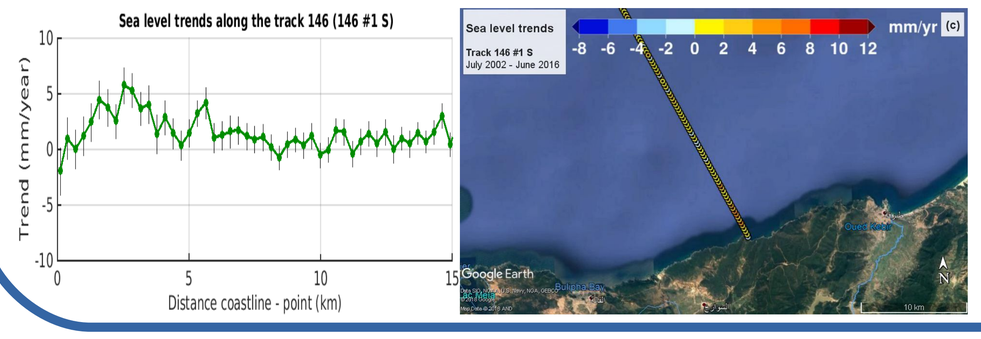

Figure 5: Coastal Sea Level trend computed with the J1and J2 combined mission X-TRACK/ALES HF for thetrack 146 in the Mediterranean Sea.

References

[1] Birol et al (2017). Coastal application from nadir altimetry: example of the X-TRACK regional product. *Advances in Space Research.*
[2] Passaro et al (2014). ALES: A multi-mission adaptive subwaveform retracker for coastal and open ocean altimetry, *Remote Sensing of Environment.*
[3] Marti et al (2019). Altimetry-based sea level trends along the coasts of Western Africa. *Advances in Space Research.*