THE NEW GENERATION OF HIGH-RESOLUTION X-TRACK/ALES REGIONAL ALTIMETRY PRODUCT

F. Léger(1), F. Birol(1), F. Niño(1), M. Passaro(2), A. Cazenave(1), J.F. Legeais(3), C. Schwatke(2), J. Benveniste(4)

(1) LEGOS, Université de Toulouse, CNES, CNRS, IRD, UPS, Toulouse, France
(2)DGFI-TUM, Munich, Germany (3)CLS, Ramonville St-Agne, France (4)ESA-ESRIN, Frascati, Italy

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 (20 Hz ~ 350 m) made available for the research community.

Acknowledgments

We gratefully acknowledge financial support from CNRS/INSU, CNES, IRD, University of Toulouse and ESA

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 a L3 regional multi-mission product that combines the better spatial resolution provided by high-rate data (i.e. 20-Hz for Jason) and the benefit of both the ALES retracker and the post-processing strategy of X-TRACK in the coastal ocean. The best set of geophysical corrections has also been chosen. After a demonstration phase dedicated to the LRM altimetry missions, SAR altimetry will also be processed.

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

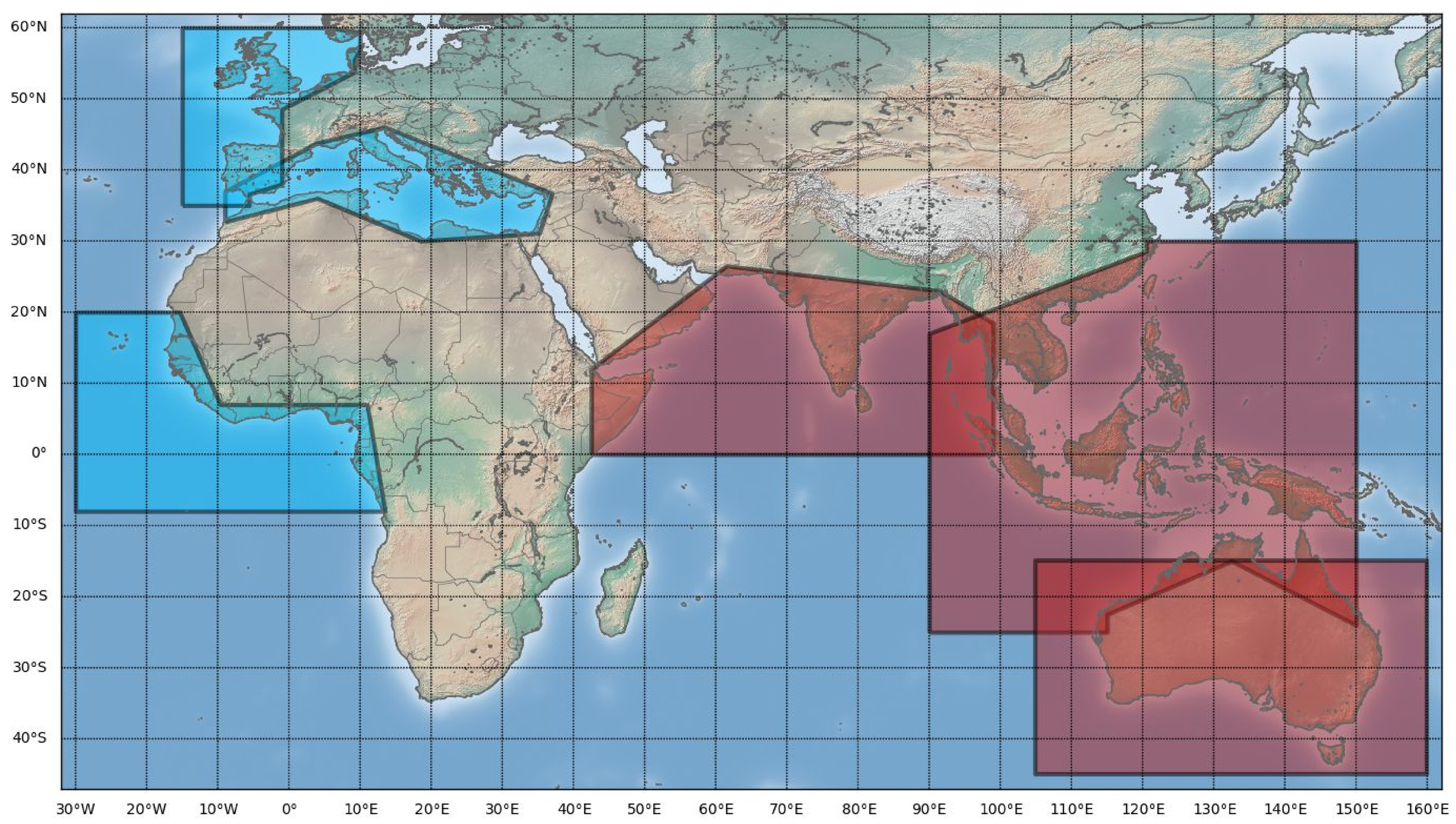

Figure 1: Map of the X-TRACK/ALES zones, bridging phase in blue and CCI+ in red.

	Bridging phase zones	CCI+ zones
J1+J2	October 2019	February 2020
J1+J2+J3	February 2020	February 2020
Envisat	June 2020	June 2020
Saral/ALTIKA	June 2020	June 2020
Sentinel3	2021	2021

Tab 1 : Planed schedule of data availability

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, ...).

It has been recently adapted to the processing of higher rate measurements. By merging X-TRACK and ALES altimetry processing tools, we computed along-track SLA time series for Jason-1 and Jason-2 missions. X-TRACK software reprocesses in delayed time corrections and parameters from the geophysical data records (GDR products) and combines them with the ALES data (range, sigma0 and sea state bias) to compute the SLA, after a robust editing of the measurements and corrections and the computation of a high rate MSSH along the altimeter tracks (by inversion of the corrected SSH data).

Corrections/param.	Source
Range/sigma0	ALES
Ionosphere	Dual-frequency altimeter range measurements filtered by X-TRACK
Dry Troposphere	ECMWF model
Wet Troposphere	GPD+ [3]
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

The combined J1+J2 X-TRACK/ALES 20 Hz SLA products will be soon available on

http://www.esa-sealevel-cci.org/products

X-TRACK/ALES: validation and performances

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**). 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.

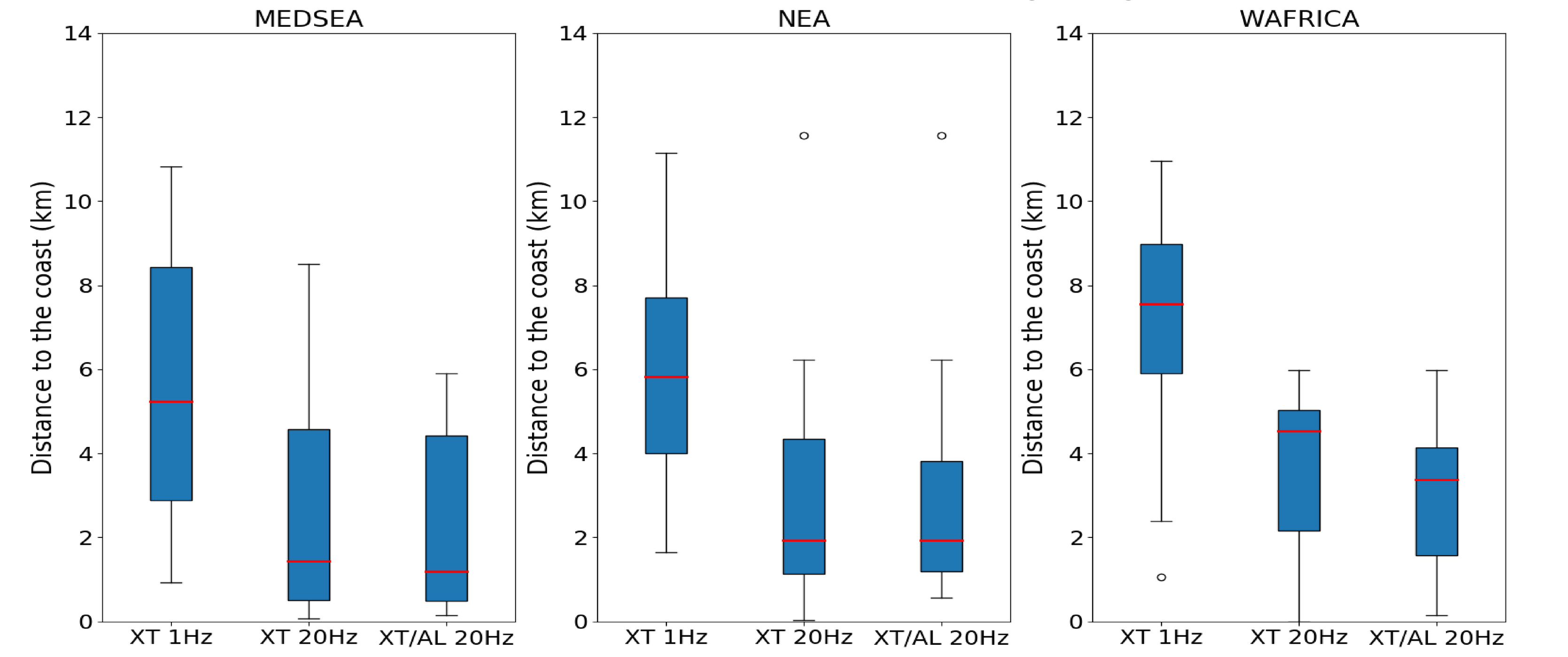

Figure 2: Distance to the coast of the first point available with more than 80 % of valid data for Jason-2. One boxplot depicts the statistics of all the tracks of the considered region.

For example, for Jason-2, the **combined high rate X-TRACK/ALES** product obtains **80% of valid sea level data** at a distance of **3.4 km** in average for the Western African Coasts, instead of **4.5 km** for the **X-TRACK 20Hz** alone and **7.6 km** for the **X-TRACK 1Hz** version. For the Mediterranean Sea, we obtain better results with **1.2 km** for **X-TRACK/ALES**, **1.4 km** for the **X-TRACK 20Hz** alone and **5.2 km** for the **X-TRACK 1Hz** version.

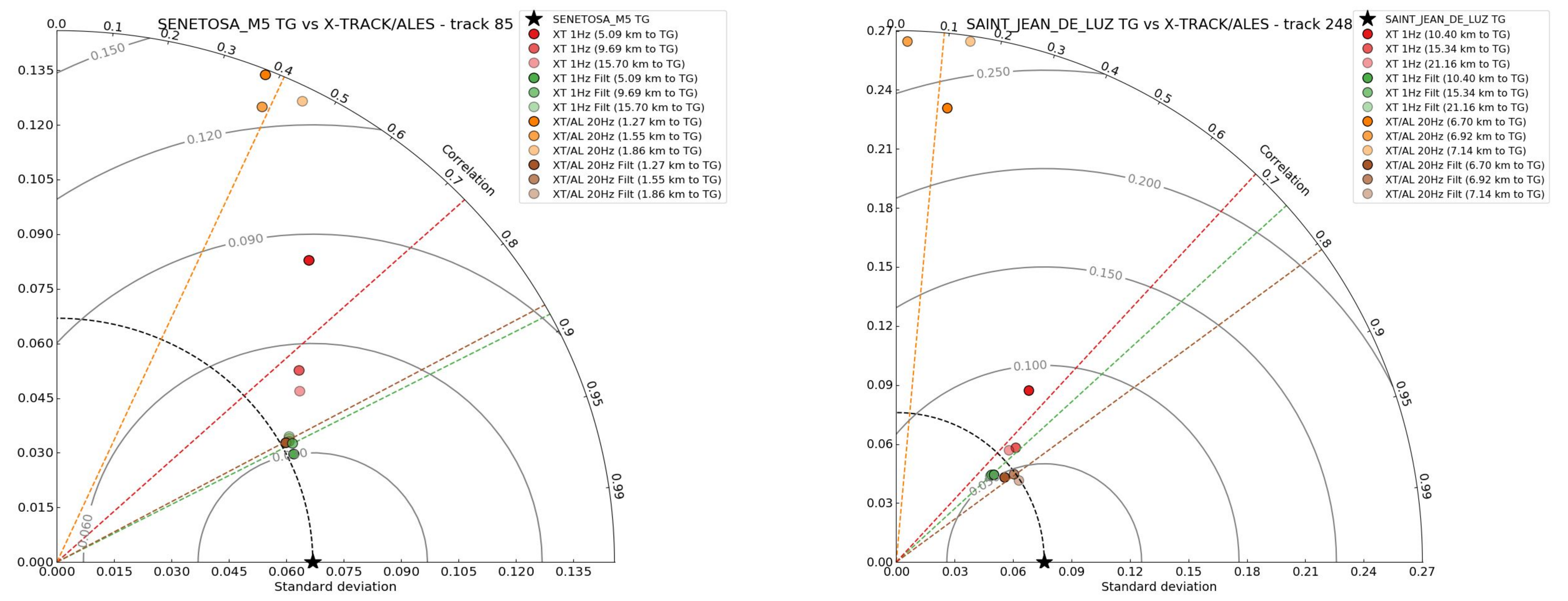

Figure 3: Normalized Taylor diagrams of Senetosa (left) and St-Jean-de-Luz (right) tide gauge stations. Nearest altimetric point for unfiltered/filtered X-TRACK 1 Hz (red/orange) and X-TRACK/ALES (green/brown) are selected.

Comparison to tide gauge station shows good agreement. Once correctly spatially filtered, the statistics (standard deviations and correlations with tide gauge) computed from the 20-Hz X-TRACK/ALES SLA are similar to those computed from X-TRACK 1-Hz data, still providing more informations on coastal sea level data [4].

X-TRACK/ALES: scientific applications

Coastal current variability

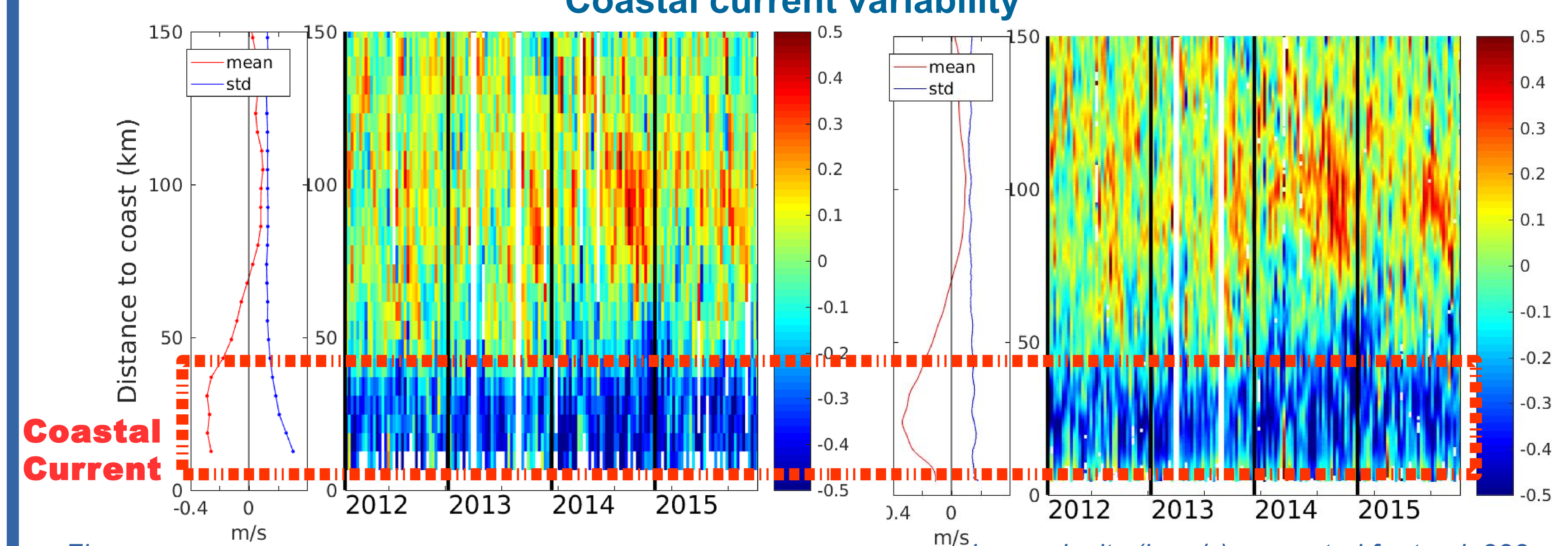

Figure 4: Time-space diagrams of monthly averaged along-track anomalous velocity (in m/s) computed for track 222 using both X-TRACK 1-Hz (left) and X-TRACK/ALES 20-Hz (right) SLA data.

20-Hz SLA data were used to compute geostrophic currents in the NW Mediterranean Sea.The signature of the variability of the Northern Current (Mediterranean Sea) is well captured, and allows to better characterize the evolution of the coastal current very close to the coast compared to the conventional 1 Hz SLA product.

Long-term coastal sea level changes

The main objective is to estimate the long-term evolution of sea level in the study areas, as close to the shoreline as possible, and understand the principal factors that are at its origin. The results obtained in the different regions will be compared in the frame of the CCI+ project. Preliminary results could be find in [4] and in the poster of Y. Gouzenes **Coastal sea level trends from retracker satellite altimetry over 2002-2016; Differences between coastal and offshore sea level rise: Senetosa site case of study**

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] Fernandez et al (2015). Improved wet path delays for all ESA and reference altimetric missions, *Remote Sensing of Environment.*
[4] Marti et al (2019). Altimetry-based sea level trends along the coasts of Western Africa. *Advances in Space Research.*

http://ctoh.legos.obs-mip.fr