Last Developments and Perspectives of the X-TRACK Regional Altimeter Products

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Sea level variation is one of the major threat for coastal zones. Improving its observation is essential to better understand and predict the behavior of the coastal ocean. Altimetry provides unique long term observational dataset to characterize how sea level variability evolves from the open ocean to the coastal ocean. The X-TRACK processing chain has been developped in order to recover as more as possible altimetry data in the coastal zones. Now, X-TRACK is a multi-mission product covering all the coastal ocean, produced by the CTOH and freely distributed by the AVISO+ service. It has been decided to inject the L2 ALES product in the X-TRACK post-processing algorithm, using the best possible set of altimetry corrections, in order to combine the different efforts that have been done to advance the capabilities of satellite altimetry near coastlines, in a high resolution product (20Hz ~ 300m) which will be available for the research community.

NEW

- **Alongtrack SLA → J3 until June 2018**
- **New along-track tidal constants release 10.6096/CTOH_X-TRACK_Tidal_2018_01**
- **New 20Hz X-TRACK/ALES product available**

X-TRACK Products

1hz alongtrack SLA are available all along the coast for different altimetric missions (Topex, Jason-1&2&3, Geosat, ERS2, Envisat and SARAL/ALTIKA). **SLA is computed on a reference track using up to 25 years of data to build a precise Mean Sea Surface Height**. SLA files hold alongtrack SLA data together with MSSH, MDT, FES2012 tide, Dynamic Atmospheric Corrections and distance to coast parameters. Users can both retrieve filtered and non-filtered data.

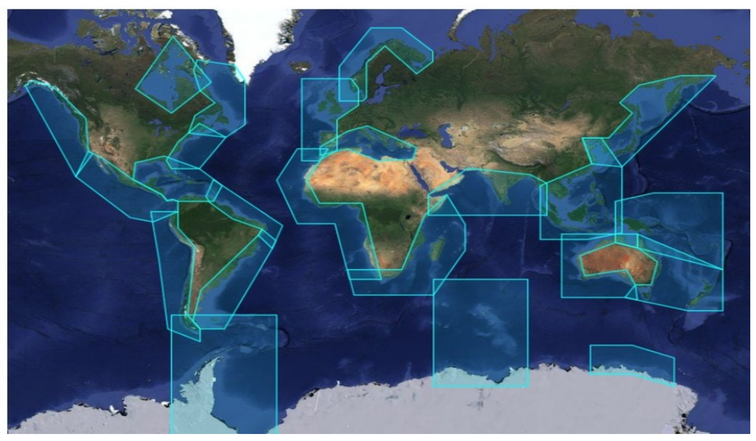


Figure 1: Definition of the regional polygons in release 2016, covering now all the coastal areas.

Period of available data

Missions	Start	End
TP+J1+J2+J3	1993/02/28	**2018/07/09**
TPinterleaved + J1interleaved	2002/09/21	2012/03/03
GFO	2002/10/01	2010/09/14
Envisat	2000/01/08	2008/09/08
SARAL	2013/03/03	2016/04/07

Along-track tidal constants (amplitude, phase lags and associated estimation errors for 73 constituents) derived from the X-TRACK T/P and Jason are also available every 6-7 km along the satellite ground tracks. They have been computed with the X-TRACK 1hz SLA for the whole TP, Jason1&2 period, and for the TP/J1 interleaved combined mission. **The release 2015 is replaced by the release 2018.**

More details of the products and the different corrections could be find in **[1]**.

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 have been made in coastal altimetry during the past decade. X-TRACK 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 retrieve more coastal altimeter waveforms than the standard processing, and then significantly more reliable 20-Hz SLA data **[2]**.

In the context of the bridging phase of the ESA's climate change initiative sea-level project (SL_cci) and acknowledging user needs we have strated to compute an X-TRACK L3 multi-mission product combining the better spatial resolution provided by high-rate data, the post-processing strategy of X-TRACK (adapted to 20Hz data), the advantage of the ALES retracker, refined geophysical corrections and dedicated studies on the impact of correction and processing on resulting sea level trends [3].

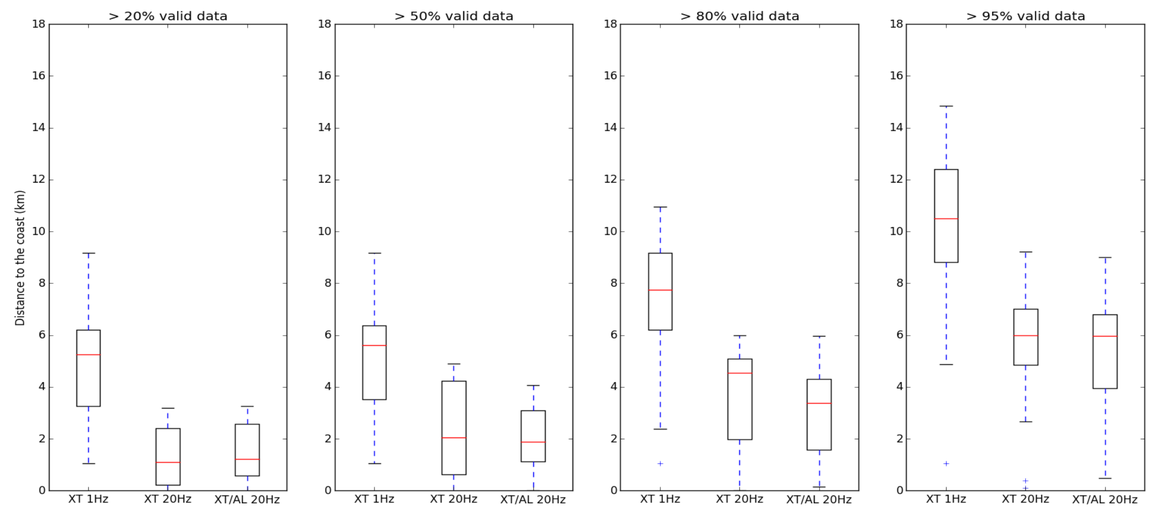


Figure 3: Distance to the coast of tht first point available with more than 20/50/80/95 % of valid data for J2 X-TRACK 1Hz product, X-TRACK 20 Hz product and the combined XTRACK/ALES 20Hz product in the Western African coastal zone.

Despite they have a much higher noise level than the classical 1-Hz data, once filtered, the high resolution allow to recover more information on coastal sea level variations. X-TRACK hight rate process extend the number of valid SLA several kilometers shoreward along the ground track. The **combined high rate X-TRACK/ALES** product increases the number of useful near shore sea level data available; as an example, for Jason-2 we obtain **80% of valid sea level data** at a distance of **3.4 km** in average for the Western African Coast, instead of **4.5 km** for the **X-TRACK 20Hz** alone and **7.6 km** for the **X-TRACK's 1Hz** version.

Sea level change are far from being geographically uniform (CMEMS trend give from -1 to 1.5 mm/yr for the Western African zone). The Sea level change generally increases from the open to the coastal ocean areas (from -0.5 to 0.75 mm/yr for the track 9). Are high rate coastal altimetry products able to study the sea level trend in the coastal zone closer to the coast ?

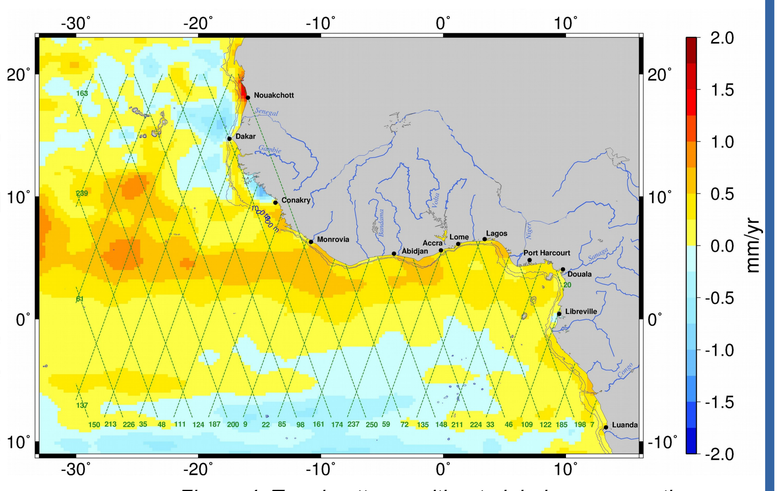
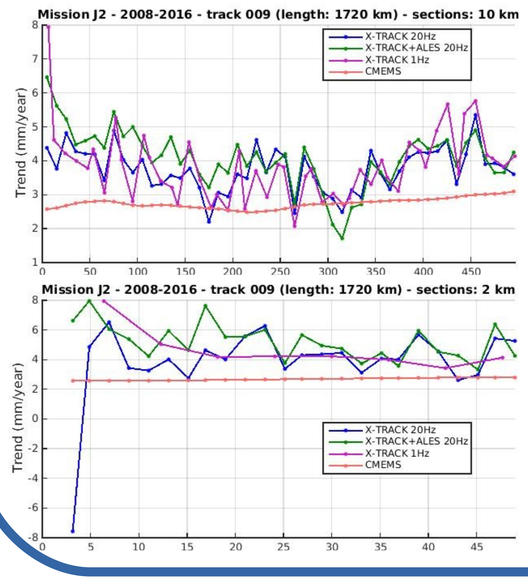


Figure 4: Trend patterns without global mean over the period1993-2017 from CMEMS L4 SLA

Figure 5: SL Trend as a function of the distance to the coast



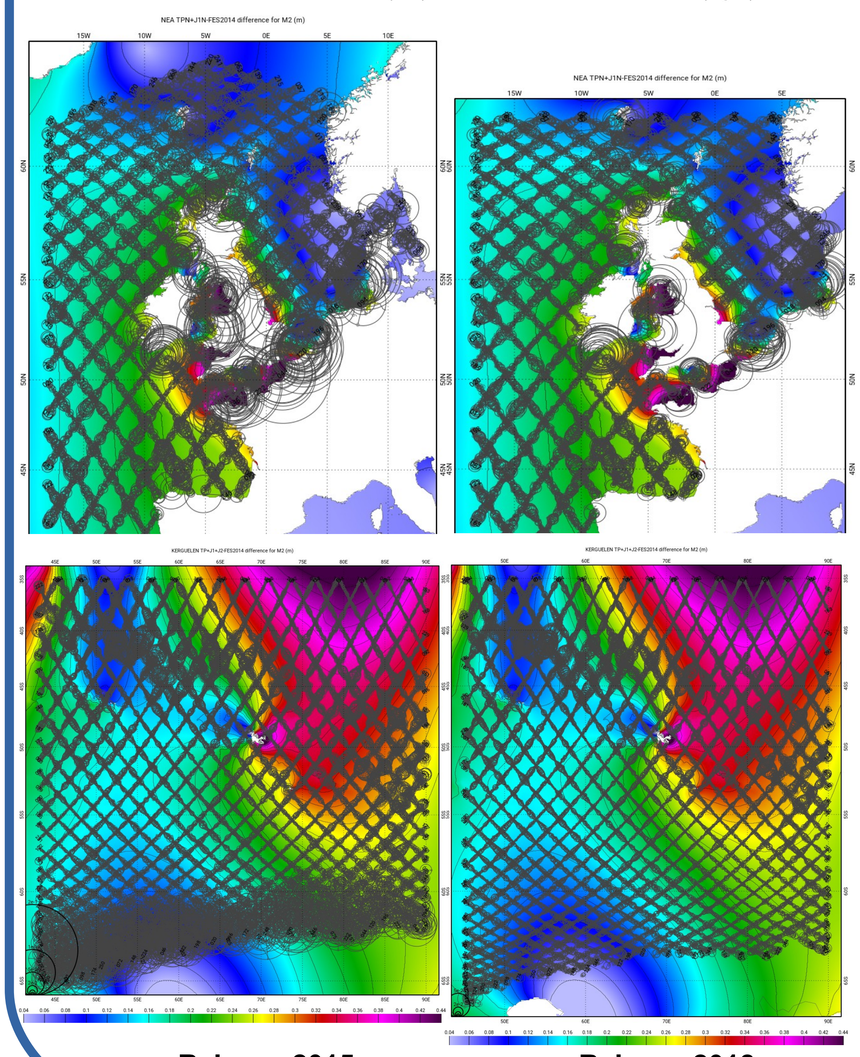
The presence of a bias between CMEMS product and X-TRACK products is due to differences in the selected treatment and will be resolve soon. The trend computed from te gridded SLA product CMEMS miss the coastal signal because his resolution is too low to capture it.

The different along-track products have comparable trend (computed for the Jason 2 period), except close to the coast where different products give different estimations of the local sea level trend with sometimes opposite sign. The combined high rate X-TRACK/ALES remains robust and coherent in space closest to the coast.

New along-track tidal constants Products

The last improvement of the coastal altimetry SLA data has led the CTOH to produce new regional along-track tidal constant product based on the X-TRACK software, available in 2019 on the operatoinal AVISO+ web portal.

Figure 2: Vector differences between FES2014 global tidal model and the X-TRACK tidal constants for M2. The background color map shows the amplitude of the M2 tidal component from the model (in m) – example of the North East Atlantic for TPN+J1N (up) and Kerguelen region for TP+J1+J2 (down) for the X-TRACK tidal constants version 2015 (left) and the new version 2018 (right)



Release 2015 **Release 2018**

As example, figure 2 shows the results of the harmonic analysis performed on X-TRACK SLA data for the M2 empirical tidal constituent in two coastal areas. The RMS of the along-track amplitude differences derived from altimetry and from the FES2014 global tidal model.

Results :

- Good agreements between the model and X-TRACK tidal constants over the open ocean.
- Larger differences are observed in coastal regions (may be due to erroneous altimeter data or to model errors).
- The new tidal constant product has better results expetially in the coastal zone.
- For the Kerguelen zone we note a strong improvement in the south part (sea ice coverage)

Data access
AVISO+ portail or CTOH website
https://www.aviso.altimetry.fr
http://ctoh.legos.obs-mip.fr/products/

Acknowledgments
We gratefully acknowledge financial support from CNES and ESA (bridging phase of the SL_cci project)

References
[1] Birol et al (2017). Coastal application from nadir altimetry: example of the Xtrack 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] Niño et al. Impact of Geophysical Corrections on Altimetry Sea Level Estimations Near the Coast (**OSTST talk on 27/09/18**)

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