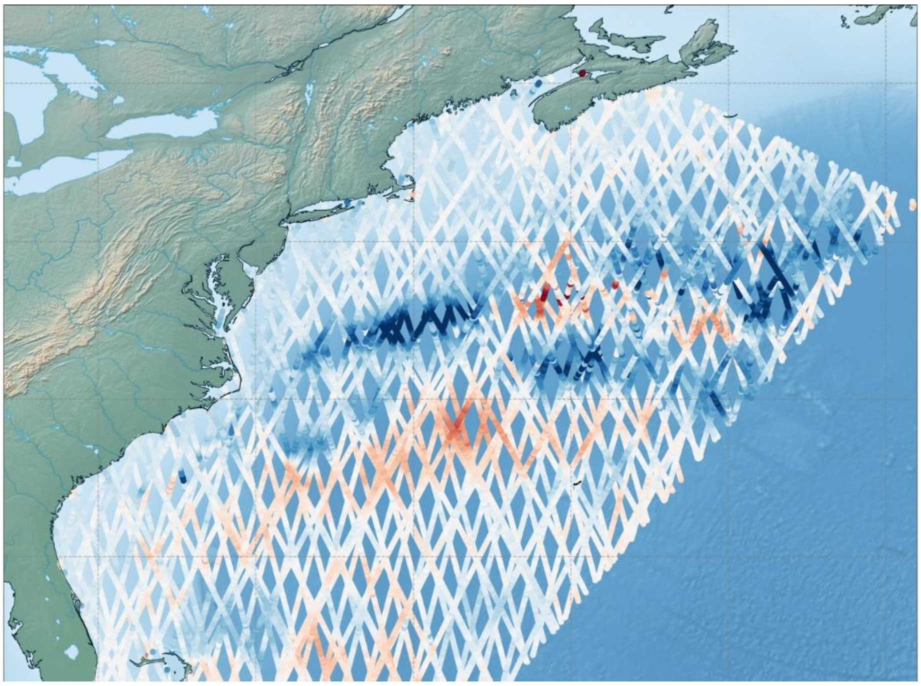
Along-Track Sea Level Anomalies regional products (X-TRACK-L2P) User Handbook



Nomenclature: SALP-MU-P-EA-23577-CLS

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Chronology Issues:			
Issue:	Date:	Validated by	Reason for change:
1.0	July 2022		First issue for XTRACK-L2P version 2022 (v2.0)
1.1	June 2023		Temporal extension, 3 new coastal zones and code improvement (v2.1)
1.2	September 2023		Addition of AZORES area
2.0	April 2025		Temporal extension, addition of 2 new missions, addition of 2 new coastal zones and code improvement (v2.2)

List of Acronyms

Aviso+	Archiving, Validation and Interpretation of Satellite Oceanographic data
CLS	Collecte, Localisation, Satellites
CNES	Centre National d'Etudes Spatiales
CTOH	Centre de Topographie des Océans et de l'Hydrosphère
SLA	Sea Level Anomaly
DAC	Dynamical atmospheric correction
L2P	Level-2+ product

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1 Introduction

Using along-track Level-2+ (L2P) data provided by CNES and the X-TRACK processing software developed at LEGOS, the CTOH has computed a coastal-oriented regional product of along-track sea level anomaly (SLA) for the following altimeter missions: Topex/Poseidon, Topex/Poseidon interleaved, Jason-1, Jason-1 interleaved, Jason-2, Jason-2 interleaved, Jason-3, Jason-3 interleaved, Sentinel-6A, Geosat Follow on (GFO), SARAL/Altika, Envisat, ERS-1, ERS2, HaiYang-2A, HaiYang-2B, Sentinel-3B and Sentinel-3A. This product, called X-TRACK-L2P, provides the SLA time series created by *combining* altimeter data that follow the same orbit. In the Jason orbit : Topex/Poseidon, Jason-1, Jason-2, Jason-3 and Sentinel-6A missions. In the Jason-interleaved orbit: Topex/Poseidon, Jason-1, Jason-2 and Jason-3. In the ERS orbit: ERS and Envisat, and Saral. The Sentinel-3A, Sentinel-3B, HaiYang-2A, Haiyang-2B and GFO are single missions since they do not share orbit paths with any other missions.

Publications should include the following statement in the Acknowledgments:
"Altimetry data used in this study were developed, validated, and distributed by the CTOH/LEGOS and CNES, France".
X-TRACK products are identified by a DOI. Please use it when citing X-TRACK.
For the last version v2.2 the DOI is 10.24400/527896/A01-2022.020.

1.1 Data Policy and conditions of use

The X-TRACK-L2P along-track SLA product is available free of charge for scientific studies or non-profit projects only. The latest specification of the conditions of use is found in the License Agreement.

Commercial use not in line with the License Agreement may be possible, but is subject to prior agreement of the licence holder. In this case, please contact aviso@altimetry.fr)

Please, subscribe to get access by filling the registration form on:

https://www.aviso.altimetry.fr/en/data/data-access/registration-form.html

2 Processing

The X-TRACK processing chain (described in *Birol et al., 2017*) is applied to AVISO L2P data (the L2P product handbook is available on the AVISO website). Starting from the along-track L2P products, 1-Hz altimetry range and corrections are combined and projected onto reference tracks, allowing the computation of coastal Sea Level Anomaly time series with a spatial spacing of ~6-7 km between points. The X-TRACK processing is performed on a regional basis, and for each region there is one file per track, containing for each 1-Hz altimetry point, the SLA and other parameters associated, described in the following section.

2.1 Product content

The product is available on most of the coastal ocean, divided in a number of different regions (see Figure 1). It consists in 1-Hz along-track SLA time series reprocessed on a regional basis with the X-TRACK software. Is is provided in NetCDF format and includes (see Table 5):

- the SLA time series along a nominal ground-track,
- an along-track MSSH profile which is consistent with the SLA (same period of the SLA time series),
- the altimetry corrections applied to the SLA (dac, dry, iono, ocean tide, pole tide, solid tide, ssb and wet)
- auxiliary parameters from altimetry (sigma0 and swh)
- the inter-mission bias applied to the SLA
- the distance to nearest coast from GSHHS *(Wessel et al., 1996*),
- the mean dynamic topography hybrid CNES_CLS22_cmems2020 *(Jousset et al., 2022) distributed by AVISO+*

Note that all the altimetry corrections are already applied to the SLA but provided in separate fields for information.

$$\begin{aligned} SLA = {} & Altitude\ of\ satellite - Altimeter\ range - Ionospheric\ correction - Model\ dry\ tropospheric\ correction \\ & - Wet\ tropospheric\ correction - Sea\ state\ bias\ correction - Solid\ earth\ tide\ height \\ & - Geocentric\ ocean\ tide - Geocentric\ pole\ tide\ height - Dynamic\ atmospheric\ correction \\ & - XTRACK\ mean\ sea\ surface - Global\ Mean\ Sea\ level\ Bias. \end{aligned}$$

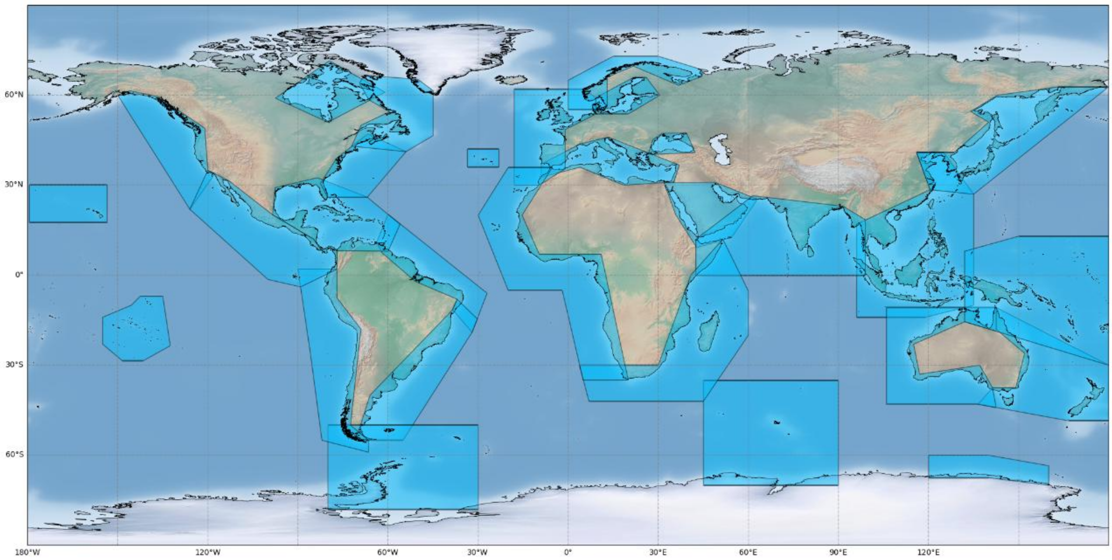

Figure 1: Map of the regions provided for X-TRACK Coastal products

2.2 Processing method

The processing starts from the altimetry orbit, range and corrections provided in the L2P products for each altimeter mission. The information concerning the corrections of the L2P product are recalled in Table 1, Table 2 and Table 3 (more details can be found in the dedicated L2P handbook (AVISO+, 2020 and AVISO+, 2022).

Details on the X-TRACK data processing can be found in *Birol et al.* (2017). Altimetric measurements having been designed for the open ocean, their quality can drop significantly when approaching the coast. The general concept of the processing method is to keep as much data as possible, using as a starting point the selection of valid ocean data with a precise land mask. A dedicated editing strategy is then used, which includes two steps.:

(1) The first step is to impose editing criteria, both on the altimeter measurements and on the corrective terms, that are designed to be more restrictive than the standard ones (AVISO, 1996). These criteria are thresholds that have been chosen after several tests for each parameter, in order to ensure that all outliers are totally removed (indeed, one of the reasons found for the unrealistic large variability often observed in altimeter data near continental shelves is the presence of many outliers in the corrective terms). For doing so, the behavior of all the corrective terms is analyzed along the track taking into account their individual characteristics. Each corrective term is edited in a different way. Abrupt changes are assumed to be associated with erroneous data, and outliers are removed. More details can be found in *Birol et al.* (2017).

A wrong or out-of-bounds altimeter correction usually implies the systematic rejection of the altimetry measurement at that point. The choice made in the X-TRACK strategy is, as far as the altimetry range is considered as correct, to compute the SLA by using interpolated corrections when one corrective term is missing.

(2) In a second step, all corrective terms are recomputed using interpolation/extrapolation, based on the valid data for each correction.
Once the corrected sea surface heights (SSHs) are computed, they are projected onto fixed points along the nominal ground track of the altimeter satellite and converted into SLAs (Sea Level Anomalies) by subtracting a precise mean sea surface height. The latter is computed at the fixed nominal points, by inversion of all the available SSH measurements along the repeated ground tracks of the altimeter mission considered. This procedure is important since it was found that, in coastal areas where the topographic gradients are large, using inaccurate mean sea surface led to significant errors in SLAs (*Vignudelli et al.*, 2005).

This 2-step strategy allows the recovery of many altimetry measurements that are flagged in standard products because of a faulty correction.

Corrections	T/P	Jason-1	Jason-2	Jason-3	Sentinel-6A
Ionosphere	Filtered dual-frequency altimeter range measurements	Filtered dual-frequency altimeter range measurements (Guibbaud 2015)	Filtered dual-frequency altimeter range measurements from SSB C-Band (Guibbaud 2015)	Filtered dual-frequency altimeter range from L2 GDRF (Nencioli 2022)	Filtered dual-frequency altimeter range from L2 LRM
Dry troposphere	From ERA5 1-hour model				
Wet troposphere	TMR GDRF radiometer reproc	JMR radiometer	AMR radiometer GDRF		AMR Radiometer reproc
Sea state bias	2D Topex GDRF	2D Non parametric (Tran et al., 2015)	2D Non parametric (Tran et al., 2019)		Non parametric from [N. Tran 2020] J3 GDRF
Solid tides	Elastic response to tidal potential (Cartwright and Tyler, 1971 ; Cartwright and Edden, 1973)				
Pole tides	Desai et al 2015 + Mean Pole Location (Ries et al. 2017)				
Ocean tide	FES 2022 (Carrere et al. 2024)				
Atmospheric correction	TUGO High frequencies forced with analysed ERA 5 and ECMWF from S6A onwards pressure and wind field + inverse barometer Low frequences				

Table 1: List of corrections used for missions following the Topex/Jason orbit

Corrections	ERS-1	ERS-2	ENVISAT	SARAL
Ionosphere	Reaper NIC09 model (Scharroo and Smith, 2010)	GIM (Ijima et al., 1999)	Filtered from L2 and after cycle 65 GIM corrected for 8mm bias	GIM (Ijima et al., 1999)
Dry troposphere	From ERA5 1-hour model			
Wet troposphere	GPD+ (Fernandes et al, 2015)		MWR radiometer reprocessed	Neural Network (5 entries) v4
Sea state bias	BM3 (Gaspar and Ogor, 1994)	Non parametric (Mertz et al., 2005)	Non parametric (Tran et al., 2017)	Non parametric (Tran et al., 2018)
Solid tides	Elastic response to tidal potential (Cartwright and Tyler, 1971 ; Cartwright and Edden, 1973)			
Pole tides	Desai et al 2015 + Mean Pole Location (Ries et al. 2017)			
Ocean tide	FES22 (Carrere et al. 2023)			
Atmospheric correction	TUGO High frequencies forced with analysed ERA 5 and ECMWF from S6A onwards, pressure and wind field + inverse barometer Low frequences			

Table 2: List of corrections used for missions following the ERS orbit

Corrections	GFO	HY-2A	HY-2B		S3B
Ionosphere	GIM (Ijima et al., 1999)				
Dry troposphere					
Wet troposphere	GFO radiometer and ECMWF model	ECMWF model	ECMWF model + radiometre (cycle > 42)	GPD+	
Sea state bias	Non parametric (Tran and Labroue 2010)		L2 product	Non parametric (Tran 2012)	
Solid tides					
Pole tides					
Ocean tide	FES22 (Carrere et al. 2023)				
Atmospheric correction	TUGO High frequencies forced with pressure and wind field from analysed ERA5 model and from ECMWF model from S6A onwards + inverse barometer Low frequencies				

Table 3: List of corrections used for missions having their own orbit

3 X-TRACK Coastal along-track SLA Products

3.1 Temporal availability

Table 4 indicates for each satellite mission and/or regional product the first and last dates available (and the corresponding cycle number).

Mission	Start	End
T/P + Jason-1 + Jason-2 + Jason-3 + Sentinel-6A	1993/02/28 (cycle 17 of T/P)	**2024/11/04 (cycle 146 of Sentinel-6A)**
ERS-1 + ERS-2 + ENVISAT + SARAL	1992/10/23 (cycle 89 of ERS-1)	2016/04/16 (cycle 32 of SARAL)
GFO	2000/01/08 (cycle 37)	2008/09/08 (cycle 222)
T/P interleaved+Jason-1 interleaved + Jason-2 interleaved + Jason-3 interleaved	2002/09/20 (cycle 369 of T/P)	2024/10/07 (cycle 390 of Jason-3)
HY-2A	2014/04/12 (cycle 67)	2016/03/15 (cycle 117)
HY-2B	2020/01/20 (cycle 33)	2022/06/20 (cycle 95)
S3A	**2016/06/01 (cycle 5)**	**2024/12/01 (cycle 119)**
S3B	**2018/12/16 (cycle 20)**	**2024/11/14 (cycle 99)**

Table 4: Temporal availability of each time series

3.2 List of variables

Name of variable	Signification	Unit
lon	Longitude	Degrees East
lat	Latitude	Degrees North
mssh	XTRACK Mean Sea Surface	meters
cycle	Cycle number	-
time	Time of measurement	days since 1950-1-1
sla	XTRACK Sea Level	meters
tide	Global FES22 geocentric tide correction	meters
dac	Global Dynamic Atmospheric Corrections	meters
dist_to_coast_gshhs	Distance to nearest GSHHS 1.3 coastline	meters
wet	Wet tropospheric correction	meters
dry	Dry tropospheric correction	meters
iono	Ionospheric correction	meters
ssb	Sea State Bias	meters
pole_tide	Pole tide correction	meters
solid_tide	Solid Earth tide correction	meters
sigma0_ku	Backscatter coefficient	dB
swh	Significant Wave Height	m
bias	Global Mean Sea level Bias	m
mdt_cnes_cls22	Mean Dynamic Topography MDT_hybridCNES-CLS22_cmems2020	m

Table 5: List of variables in the NetCDF files

3.3 Nomenclature of files

The nomenclature used for these products is:

ctoh.sla.ref.<MISSION>.<ZONE>.<TRACK_NUMBER>.nc.lzma

(note that lzma is the name of a compression algorithm)

MISSION	ERS1+ERS2+ENV+SRL GFO HY2A HY2B S3A S3B TP+J1+J2+J3+S6A TPN+J1N+J2N+J3N	European Remote-Sensing Satellite 1, 2 + Envisat + Saral/Altika Geosat Follow-On HaiYang-2A HaiYang-2B Sentinel-3A Sentinel-3A Topex/Poseidon + Jason-1 + Jason-2 + Jason-3 + Sentinel-6A Topex/Poseidon New orbit + Jason-1 New Orbit + Jason-2 New Orbit + Jason-3 New Orbit
ZONE	adelie amazon arabia asa azores baltic bsea chinasea drake eaustralia **frpolynesia** gom gulfstream **hawaii** hudson humboldt kerguelen labrador medsea nea nindian norway nwa nwp sea wafrica waustralia wla wtp	Adelie-Mertz Amazon Red Sea and Persian Gulf' Atlantic South America Azores Archipelago Baltic Sea Black Sea China Sea Drake passage East Australia **French Polynesia** Gulf of Mexico Caribbean Sea Gulf Stream **Hawaiian Archipelago** Hudson Bay Humboldt current Kerguelen Islands Labrador Sea Mediterranean Sea North East Atlantic North Indian Ocean Norway North West America North West Pacific South and East Africa West Africa West Australia West Latin America - California West Tropical Pacific
TRACK_NUMBER	XXXX	Pass number (depends on the satellite orbit)

Table 6: NetCDF files naming convention

4 Data format

This chapter presents the data storage format used for X-TRACK Coastal along-track SLA products.

4.1 NetCDF

The products are stored using the NetCDF format.

NetCDF (network Common Data Form) is an interface for array-oriented data access and a library that provides an implementation of the interface. The netCDF library also defines a machine-independent format for representing scientific data. Together, the interface, library, and format support the creation, access, and sharing of scientific data. The netCDF software was developed at the Unidata Program Center in Boulder, Colorado. The netCDF libraries define a machine-independent format for representing scientific data. Please see Unidata NetCDF pages for more information, and to retreive NetCDF software package on:

https://www.unidata.ucar.edu/software/netcdf/

NetCDF data is:

- Self-Describing. A netCDF file includes information about the data it contains.
- Architecture-independent. A netCDF file is represented in a form that can be accessed by computers with different ways of storing integers, characters, and floating-point numbers.
- Direct-access. A small subset of a large dataset may be accessed efficiently, without first reading through all the preceding data.
- Appendable. Data can be appended to a netCDF dataset along one dimension without copying the dataset or redefining its structure. The structure of a netCDF dataset can be changed, though this sometimes causes the dataset to be copied.
- Sharable. One writer and multiple readers may simultaneously access the same netCDF file.

The products are stored in **NetCDF** defined by the Cooperative Ocean/Atmosphere Research Data Service (COARDS) and Climate and Forecast (CF) metadata conventions.

The CF convention generalises and extends the COARDS convention but relaxes the COARDS constraints on dimension and order and specifies methods for reducing the size of datasets. A wide range of software is available to write or read NetCDF/CF files. API are made available by UNIDATA http://www.unidata.ucar.edu/software/netcdf :

- C/C++/Fortran
- Java
- MATLAB, Objective-C, Perl, Python, R, Ruby, Tcl/Tk

In addition to these conventions, the files are using a common structure and semantic as shown in the example below:

```
netcdf ctoh.sla.ref.TP+J1+J2+J3.medsea.007 {
dimensions:
	points_numbers = 117 ;
	cycles_numbers = 1073 ;
```

```
variables:
	double bias(points_numbers, cycles_numbers) ;
		bias:_FillValue = NaN ;
		bias:units = "m" ;
		bias:long_name = "Global Mean Sea level Bias" ;
		bias:short_name = "bias" ;
	int64 cycle(cycles_numbers) ;
		cycle:units = "count" ;
		cycle:long_name = "cycle" ;
	int cycles_numbers(cycles_numbers) ;
		cycles_numbers:units = "count" ;
		cycles_numbers:long_name = "cycle numbers" ;
	double dac(points_numbers, cycles_numbers) ;
		dac:_FillValue = NaN ;
		dac:units = "m" ;
		dac:long_name = "Global Dynamic Atmospheric Corrections" ;
		dac:short_name = "DAC" ;
		dac:source = "TUGO HF forced with analysed ERA5 pressure and wind field + IB LF up to Fev 2016 and MOG2D HF forced with ECMWF pressure and wind + IB LF after Fev 2016" ;
	double dist_to_coast_gshhs(points_numbers) ;
		dist_to_coast_gshhs:units = "m" ;
		dist_to_coast_gshhs:long_name = "Distance to nearest coastline" ;
		dist_to_coast_gshhs:scale_factor = -0.01 ;
		dist_to_coast_gshhs:comment = "Distance to nearest GSHHS 1.3 coastline" ;
	double dry(points_numbers, cycles_numbers) ;
		dry:_FillValue = NaN ;
		dry:units = "m" ;
		dry:short_name = "dry" ;
		dry:long_name = "Dry tropospheric correction" ;
		dry:source = "From ERA5 1-hour model" ;
	double iono(points_numbers, cycles_numbers) ;
		iono:_FillValue = NaN ;
		iono:units = "m" ;
		iono:short_name = "iono" ;
		iono:long_name = "Ionospheric correction" ;
		iono:source = "Filtered dual-frequency altimeter range measurements" ;
	double lat(points_numbers) ;
		lat:units = "degrees_north" ;
		lat:long_name = "Latitude" ;
		lat:short_name = "Lat" ;
	double lon(points_numbers) ;
		lon:units = "degrees_east" ;
		lon:long_name = "Longitude" ;
		lon:short_name = "Lon" ;
	int mdt_cnes_cls22(points_numbers) ;
		mdt_cnes_cls22:_FillValue = -2147483647 ;
		mdt_cnes_cls22:long_name = "Mean dynamic topography" ;
		mdt_cnes_cls22:scale_factor = 1.e-06 ;
		mdt_cnes_cls22:units = "m" ;
		mdt_cnes_cls22:product_version = "1.0" ;
		mdt_cnes_cls22:summary = "Global Mean Dynamic Topography calculated from the combination of altimetry, gravimetry (including GOCE and GRACE) and in-situ data. The reference time-period is 1993-2012." ;
		mdt_cnes_cls22:short_name = "mdt_cnes_cls22" ;
```

```
            mdt_cnes_cls22:source = "Mean Dynamic Topography HYBRID_MDT_CNES_CLS22_CMEMS2020; https://www.aviso.altimetry.fr" ;
        double mssh(points_numbers) ;
            mssh:units = "m" ;
            mssh:short_name = "MSSH" ;
            mssh:mssh_period = "Cycles from 17 to 1048 are used for the mssh computation" ;
            mssh:comment = "X-TRACK Mean Sea Surface calculated by inversion of the corrected Sea Surface Heights" ;
            mssh:long_name = "Mean Sea Surface" ;
        double ocean_tide(points_numbers, cycles_numbers) ;
            ocean_tide:_FillValue = NaN ;
            ocean_tide:units = "m" ;
            ocean_tide:short_name = "OCEAN_TIDE" ;
            ocean_tide:long_name = "Global FES14 tide correction" ;
            ocean_tide:comment = "Geocentric ocean tide, includes the corresponding loading tide and equilibrium long-period ocean tide height" ;
            ocean_tide:source = "FES2014 b" ;
        int points_numbers(points_numbers) ;
            points_numbers:units = "count" ;
            points_numbers:long_name = "along-track point numbers" ;
        double pole_tide(points_numbers, cycles_numbers) ;
            pole_tide:_FillValue = NaN ;
            pole_tide:units = "m" ;
            pole_tide:long_name = "Pole tide" ;
            pole_tide:short_name = "pole_tide" ;
            pole_tide:source = "Desai et al 2015 + Mean Pole Location" ;
        double sigma0_ku(points_numbers, cycles_numbers) ;
            sigma0_ku:_FillValue = NaN ;
            sigma0_ku:units = "dB" ;
            sigma0_ku:long_name = "Backscatter coefficeient" ;
            sigma0_ku:short_name = "sigma0_ku" ;
        double sla(points_numbers, cycles_numbers) ;
            sla:_FillValue = NaN ;
            sla:units = "m" ;
            sla:short_name = "SLA" ;
            sla:coordinates = "lon lat" ;
            sla:comment = "sla = altitude of satellite - altimeter range - altimeter ionospheric correction - model dry tropospheric correction - wet tropospheric correction - sea state bias correction - solid earth tide height - geocentric ocean tide - geocentric pole tide height - Dynamic atmospheric correction - X-TRACK mean sea surface - Global Mean Sea level Bias." ;
            sla:long_name = "X-TRACK/L2P Sea Level Anomalies" ;
        double solid_tide(points_numbers, cycles_numbers) ;
            solid_tide:_FillValue = NaN ;
            solid_tide:units = "m" ;
            solid_tide:source = "Elastic response to tidal potential (Cartwright and Tyler, 1971 ; Cartwright and Edden, 1973)" ;
            solid_tide:long_name = "Solid Earth tide correction" ;
            solid_tide:short_name = "solid tide" ;
        double ssb(points_numbers, cycles_numbers) ;
            ssb:_FillValue = NaN ;
            ssb:units = "m" ;
            ssb:short_name = "ssb" ;
            ssb:long_name = "Sea State Bias" ;
            ssb:source = "Empirical non parametric estimates; Tran et al. 2010 for TP; Tran et al. 2015 for J1; Tran et al. 2012 for J2 and J3" ;
```

```
	double swh(points_numbers, cycles_numbers) ;
		swh:_FillValue = NaN ;
		swh:units = "m" ;
		swh:long_name = "Significant Wave Height" ;
		swh:short_name = "swh" ;
	double time(points_numbers, cycles_numbers) ;
		time:_FillValue = NaN ;
		time:units = "days since 1950-1-1" ;
		time:calendar = "julian" ;
		time:long_name = "Time of measurement" ;
		time:short_name = "Time" ;
	double wet(points_numbers, cycles_numbers) ;
		wet:_FillValue = NaN ;
		wet:units = "m" ;
		wet:short_name = "wet" ;
		wet:source = "GPD+ for TP; Radiometer for J1 J2 and J3" ;
		wet:long_name = "Wet tropospheric correction" ;

// global attributes:
		:title = "1 Hz X-TRACK-L2P Sea Level Anomalies" ;
		:institution = "CTOH/LEGOS, Toulouse Univ., CNRS, IRD, CNES, UPS, France" ;
		:version = "Version v2.1" ;
		:pass_number = "007" ;
		:summary = "This dataset contains alongtrack sea level anomaly time series at 1Hz computed from the L2P products with the X-TRACK post-processing algorithm" ;
		:Conventions = "CF Version CF-1.6" ;
		:history = "Generated by X-TRACK v.2.7.12" ;
		:doi = "10.24400/527896/A01-2022.020" ;
}
```

5 Accessibility of the products

5.1 Aviso+ registration

Please fill the online form on

https://www.aviso.altimetry.fr/en/data/data-access/registration-form.html

and select the product “Coastal X-TRACK SLA”.

Aviso+ will send you your own access (login/password) by e-mail as soon as possible.

The access will be available on your dedicated products page on

https://www.aviso.altimetry.fr/no_cache/en/my-aviso-plus.html

5.2 Folders on the ftp server

Access restrictions are applied on folders. Your account gives you an access to a given list of altimetry data. Thus, the folders you're not subscribed to are empty.

6 Contact

For more information, please contact:

Aviso+ User Services
CLS
11 rue Hermès
Parc Technologique du canal
F-31520 Ramonville Cedex
France
E-mail: aviso@altimetry.fr
On Internet: https://www.aviso.altimetry.fr/

The user service is also interested in user feedbacks; questions, comments, proposals, requests are much welcome.

7 Bibliography

AVISO+ (1996): AVISO user handbook: Merged TOPEX/Poseidon products, Tech. Rep. AVINT-02-101-CN, ed. 3.0, 198pp, Toulouse, France.

AVISO+ (2020): Along-track Level-2+ (L2P) SLA. Product Handbook for missions Jason-3, OSTM/Jason-2, Jason-1, SARAL/AltiKa, Crysoat-2, HaiYang-2A, ERS-1, ERS-2, ENVISAT, Geosat Follow On, TOPEX/Poseidon. SALP-MU-P-EA-23150-CLS. https://www.aviso.altimetry.fr/fileadmin/documents/data/tools/hdbk_L2P_all_missions_except_S3.pdf

AVISO+ (2022): Along-track Level-2+ (L2P) Sea Level Anomaly. Sentinel-3/ Jason-CS-Sentinel-6 Product Handbook. SALP-MU-P-EA-23014-CLS https://www.aviso.altimetry.fr/fileadmin/documents/data/tools/hdbk_L2P_S3_S6.pdf

Birol F., N. Fuller, F. Lyard, M. Cancet, F. Niño, C. Delebecque, S. Fleury, F. Toublanc, A. Melet and M. Saraceno, F. Léger, (2017). Coastal applications from nadir altimetry: example of the X-TRACK regional products. *Advances in Space Research*, 10.1016/j.asr.2016.11.005.

Carrère L., Lyard, F., Cancet, M., Allain, D. J., Fauchet, E., Dabat, M.-L., Tchilibou, M., Ferrari, R., and Faugère, Y.: The new FES2022 Tidal atlas. Presented at the 2023 SWOT Science Team meeting (Toulouse). Available online (last access: 19 April 2024): https://doi.org/10.24400/527896/a032022.3287, 2023.Cartwright, D. E., A. C. Edden, 1973, "Corrected tables of tidal harmonics," Geophys. J. R. Astr. Soc., 33, 253-264.

Desai, S., Wahr, J. & Beckley, B. Revisiting the pole tide for and from satellite altimetry. J Geod 89, 1233–1243 (2015). https://doi.org/10.1007/s00190-015-0848-7.

Fernandes, M.J.C., Lázaro, M., Ablain, Pires, N., 2015. Improved wet path delays for all ESA and reference altimetric missions, Remote Sensing of Environment, Volume 169, November 2015, Pages 50-74, ISSN 0034-4257, http://dx.doi.org/10.1016/j.rse.2015.07.023.

Gaspar P., F. Ogor, P.Y. Le Traon, and O.Z. Zanife (1994) : Estimating the sea state bias of the TOPEX and POSEIDON altimeters from crossover differences, J.Geophys. Res., 99(C12), 24,981– 24,994.

Guibbaud, M., A. Ollivier and M. Ablain, A new approach for dual-frequency ionospheric correction filtering, ENVISAT Altimetry Quality Working Group (QWG), 2015 available in the Section 8.5 of the 2012 Envisat annual activity report: http://www.aviso.altimetry.fr/fileadmin/documents/calval/validation_report/EN/annual_report_en_2012.pdf

Iijima, B. A., Harris, I. L., Ho, C. M., Lindqwiste, U. J., Mannucci, A. J., Pi, X., Reyes, M. J., Sparks, L. C., and Wilson, B. D.: Automated daily process for global ionospheric total electron content maps and satellite ocean altimeter ionospheric calibration based on Global Positioning System data, J. Atmos. Sol.-Terr. Phy., 61, 16, 1205–1218, 1999.

Jousset S., Mulet S., Wilkin J., Greiner E., Dibarboure G. and Picot N.: "New global Mean Dynamic Topography CNES-CLS-22 combining drifters, hydrological profiles and High Frequency radar data", OSTST 2022, https://doi.org/10.24400/527896/a03-2022.3292 .

Mertz F., F. Mercier, S. Labroue, N. Tran, J. Dorandeu,2005: ERS-2 OPR data quality assessment; Long-term monitoring –particular investigation. CLS.DOS.NT-06.001

Nencioli, F., Roinard, H., Bignalet-Cazalet, F., Dibarboure, G., and Picot, N.: Advantages and drawbacks of the filtered solution for dual-frequency ionospheric correction from altimetry. OSTST meeting, https://doi.org/10.24400/527896/a03-2022.3439, 2022.

Ries J. C. and S. Desai: Conventional model update for rotational deformation. In Fall AGU Meeting, New Orleans, LA, 2017

Scharroo, R., and W. H. F. Smith (2010), A global positioning system–based climatology for the total electron content in the ionosphere, J.Geophys. Res., 115, A10318, doi:10.1029/2009JA014719.

Tran N., S. Labroue, S. Philipps, E. Bronner & N. Picot (2010) Overview and Update of the Sea State Bias Corrections for the Jason-2, Jason-1 and TOPEX Missions, Marine Geodesy, 33:sup1, 348-362, DOI: 10.1080/01490419.2010.487788

Tran, N, S. Philipps, J. C. Poisson, S. Urien, E. Bronner, N. Picot. « Impact of GDR-D standards on SSB corrections ». OSTST, Venice, 2012.

Tran N., 2015: "Envisat Phase F -SSB", Technical Report CLS-DOS-NT-15-031

Tran N : "Envisat ESL Phase-F: Tuning activities for Envisat reprocessing baseline v3.0 (Wind, SSB, Rain and Ice)", Technical report CLS-SPA-17-0069, 1rev0-09/05/2017.

Tran N : "Cryosat-2 ESL: Tuning activities: wind speed and SSB ", Technical report CLS-SPA-18-0007, 1rev0-26/01/2018.

Tran N., D. Vandemark, E.D. Zaron, P. Thibaut, G. Dibarboure, and N. Picot , 2019: "Assessing the effects of sea-state related errors on the precision of high-rate Jason-3 altimeter sea level data", Advances in Space Research / special issue " 25 Years of Progress in Radar Altimetry", doi:10.1016/j.asr.2019.11.034

Vignudelli, S., P. Cipollini, L. Roblou, F. Lyard, G. P. Gasparini, G. Manzella, M. Astraldi (2005): Improved satellite altimetry in coastal systems: Case study of the Corsica Channel (Mediterranean Sea). Geophys. Res. Let., 32, L07608, doi:1029/2005GL22602.

Wessel, P., and W. H. F. Smith, A Global Self-consistent, Hierarchical, High-resolution Shoreline Database, J. Geophys. Res., 101, 8741-8743, 1996