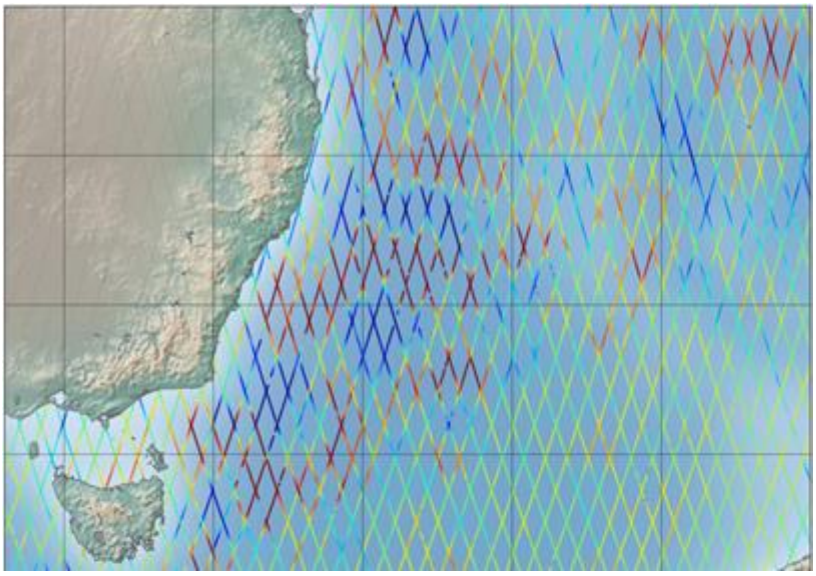
CTOH Along-Track Sea Level Anomalies regional products (X-TRACK) User Handbook.



SALP-MU-P-EA-23211-CLS

Issue 1 rev 4 – 29/09/2021

Open/Public

CHRONOLOGY ISSUES

Issue/ Version	Date	Object/Objet	Written by/ Rédigé par	Checked by / Vérifié par	Approved by/ Approuvé par
1.0	2018/04/05	Creation of the document from the CTOH existing handbook			
1.1	2018/07/24	Cosmetic correction			
1.2	2020/01/20	Update of the serie TP+J1+J2+J3 until 2019/05/22			
1.3	2021/01/15	Update of the serie TP+J1+J2+J3 until 2020/06/02			
1.4	2021/09/29	Only raw SLA are delivered			

LIST OF CONTENTS/SOMMAIRE

1 Introduction

The CTOH computes and distributes regional along-track sea level anomaly (SLA) products for the following altimeter missions: Topex/Poseidon, Jason-1, Jason-1 interleaved, Topex/Poseidon interleaved, Jason-2, Jason-3, Geosat Follow on (GFO), SARAL/Altika and Envisat. Long time series of SLA combining altimeter data from T/P, Jason-1, Jason-2 and Jason-3 are then produced.

Publications should include the following statement in the Acknowledgments:
"Altimetry data used in this study were developed, validated, and distributed by the CTOH/LEGOS, France".
X-TRACK products are now identified by a DOI. Please use it when citing X-TRACK.
For the last version the DOI is 10.6096/CTOH_X-TRACK_2017_02.

1.1 Data Policy and conditions of use

The X-TRACK Coastal along-track SLA products are available free of charge for scientific studies or non-profit projects only.

Commercial use not in line with the License Agreement is subject to separate agreement and licence (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

Using the GDR (Geophysical Data Record) data and additional altimetry corrections available in the CTOH database (see Processing method for details), SLA projected onto reference tracks with a spatial interval of about 6-7 km between points (1 second) are computed using the X-TRACK software (*Birol et al., 2017*), developed at LEGOS. The processing is done on a regional basis and for each region, raw SLA are available.

2.1 Product content

The product available in a number of different regions (see Figure 1) consists in 1-Hz along-track SLA time series reprocessed on a regional basis with the X-TRACK software. One version exists: the raw SLA letting the user applying himself the desired filtering. The files are provided in NetCDF format and include:

- the SLA data along a nominal ground-track,
- an along-track MSSH profile which is consistent with the SLA (same period of data),
- the geophysical corrections (the tidal and DAC corrections are already applied on SLA but are provided in separate fields for information),
- the distance to nearest coast from GSHHS (Wessel et al., 1996),
- the distance to nearest coast from P.Stumpf (Stumpf and Potemra, 2012) and
- the mean dynamic topography CNES_CLS_09 (Rio et al., 2011) or CNES_CLS18 (Mulet et al., 2019, see Table 3).

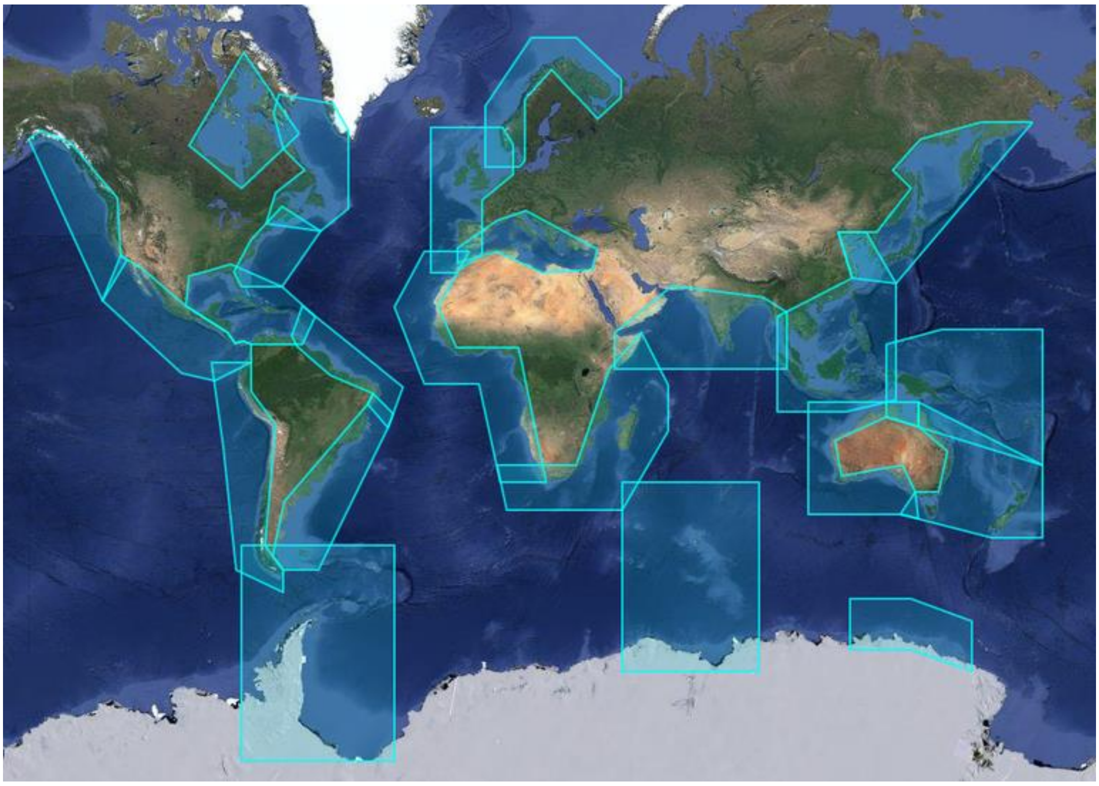


Figure 1: Map of the regions provided for X-TRACK Coastal products

2.2 Processing method

Processing first includes parameters from the GDR products for each altimeter mission plus additional state-of-the-art corrections distributed by the CTOH. Details on selected corrections are given in the table 2.

Details on the new data processing can be found in *Birol et al.* (2017). The historical processing (before 2016) is described in *Vignudelli et al*. (2005), *Roblou et al.* (2011) and *Durand et al*. (2008, see appendix). It is summarized below.

Since altimetry observations degrade in accuracy near the coast, the processing starts by the selection of valid ocean data. Then, a precise land mask and a dedicated editing strategy are used. The latter includes two steps. 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).

To solve this problem, 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. Outliers are removed. More details can be found in *Birol et al*. (2017).

Since the editing process lead to the rejection of all altimeter measurements for which at least one correction is selected as wrong, this strategy rejects much more data than the classical ones, even if the altimeter measurement is meaningful. However, in many circumstances, data analysis indicates that an accurate interpolated correction would allow us to recover valid altimeter observations. Thus, in a second step, all corrective terms are recomputed using interpolation/extrapolation, based on the valid data for each correction. This method therefore allows recovery of a lot more good measurements that are flagged in the standard product because of a deficient correction.

Once the corrected sea surface heights (SSHs) are computed, they are then 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).

Corrections	T/P	Jason-1	Jason-2	Jason-3	Envisat	GFO	Saral/Altika
Ionosphere	From dual frequency altimeter range measurements + GCP (GDR Correction)	From dual-frequency altimeter range measurements			From the GIM model *(Ijima et al., 1999)*		
Dry troposphere	From ECMWF model				From NCEP	From ECMWF	
Wet troposphere	From radiometer + GCP correction of Radiometer drift effects + GCP correction of yaw effects	From radiometer correction			From model	From radiometer	
Sea state bias	From non parametric empirical model *(Gaspar et al., 1994)*	From non parametric empirical model *(Tran et al., 2011)*	From non parametric empirical model (*Labroue et al., 2004*)		Calculated as 4.5% of the Significant Wave Height	From non parametric empirical model *(Gaspar et al., 1994)*	From non parametric empirical model (*Labroue et al., 2004*)
Solid tides	From tide potential model *(Schureman 1958)*						
Pole tides	From Wahr, 1985						
Loading effect	From FES1999 *(Lefèvre et al., 2002)*						
Atmospheric correction (DAC)	From TUGOm 2D global models for periods smaller than 20 days (*Carrere and Lyard* 2003) + Inverted barometer for periods greater than 20 days, derived from ECMWF pressure.						
Ocean tide	From FES 2012 (*Carrère et al., 2012)*						

Table 1: list of corrections used for each mission

Tidal correction

FES2012 tidal models (from *Carrere et al*. 2012) is used to compute this correction for all missions and over every region. Tidal corrections are delivered also in a separate field in case users would want to use another tidal correction.
Further details on tidal spectra:
The tidal spectrum implemented for the tidal correction based on the FES2012 model solutions includes astronomic constituents M2, S2, N2, K2, K1, 01, Q1, 2N2, P1, Mf, Mm, Mtm and MSqm. Semi-diurnal

constituents Mu2, Nu2, L2, T2, lambda2, KJ2 and R2, diurnal constituents OO1, J1, Phi1, Pi1, Psi1, Ro1, Sigma1, Theta1, 2Q1, Ki1 and long-period constituents. MSm, MSf, Mqm, MStm are added using admittances function. Finally, non linear constituent M4, long-period constituent Ssa and radiational S1 constituents are also included.

Dynamic Atmospheric Correction (DAC)

The DAC is computed as the combination of high-frequency elevations from the global Mog2D/T-UGOm 2D model (*Carrere and Lyard* 2003) simulations plus low-frequency elevations from inverted barometer law (using ECMWF atmospheric pressure products). DAC corrections are delivered also in a separate field in case users would want to use another tidal correction.

3 X-TRACK Coastal along-track SLA Products

3.1 Temporal availability

Table 1 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	1993/02/28 (cycle 17 of T/P)	2020/06/02 (cycle 158 of Jason-3)
Envisat-v2.1	2002/10/01 (cycle 10)	2010/09/14 (cycle 92)
GFO	2000/01/08 (cycle 37)	2008/09/08 (cycle 222)
T/P interleaved+Jason-1 interleaved	2002/09/21 (cycle 369 of T/P)	2012/02/02 (cycle 372 of Jason-1)
SARAL/Altika	2013/03/04 (cycle 1)	2016/04/07 (cycle 32)

Table 2: 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	-
point		
time	Time of measurement	days since 1950-1-1
sla	XTRACK Sea Level	meters
tide	Global FES12 tide correction	meters
dac	Global Dynamic Atmospheric Corrections	meters
dist_to_coast_gshhs	Distance to nearest GSHHS 1.3 coastline	meters
dist_to_coast_stumpf	Original grid provided by Richard P. Stumpf from NOAA National Ocean Service. Computed with GMT using the World Vector Shoreline (WVS) and decimated to the intermediate resolution: http://gmt.soest.hawaii.edu/gmt/doc/gmt/html/GMT_Docs/node222.html . It includes all the islands.	km
mdt_cnes_cls_09	MDT CNES-CLS09 V1.1 except for the series TP+J1+J2+J3	meters
mdt_cnes_cls18	MDT CNES_CLS18 only for the series TP+J1+J2+J3 https://www.aviso.altimetry.fr/data/products/auxiliary-products/mdt.html	meters

Table 3: list of variables in the files

4 Nomenclature of files

The nomenclature used for these products is:

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

(note that lzma is a compression algorithm)

MISSION	GFO RA2 SRL TP+J1+J2+J3 TPN+J1N	Geodat Follow On Envisat Saral/AltiKa TOPEX/Poseidon+ Jason-1 + OSTM/Jason-2+Jason-3 TOPEX/Poseidon New Orbit+ Jason-1 New Orbit
ZONE	ADELIE AMAZON ASA CHINASEA DRAKE EAUSTRALIA GOM GULFSTREAM HUDSON HUMBOLDT KERGUELEN LABRADOR MEDSEA NEA NINDIAN NORWAY NWA NWP SEA WAFRICA WAUSTRALIA WLA WTP	Adelie-Mertz Amazon Atlantic South America China Sea Drake passage East Australia Gulf of Mexico Caribbean Sea Gulf Stream 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	Number of pass (depending on the satellite)

Table 4: nomenclature of files

5 Data format

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

5.1 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

5.2 Example of file

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

```
netcdf ctoh.sla.ref.RA2.adelie.0937 {
dimensions:
    nbcycles = 83 ;
```

```
        nbpoints = 93 ;
variables:
        float lon(nbpoints) ;
                lon:units = "degrees_east" ;
                lon:unit_long = "Degrees East" ;
                lon:long_name = "Longitude" ;
                lon:short_name = "Lon" ;
                lon:_FillValue = 99.9999f ;
                lon:lon_min = 129.f ;
                lon:lon_max = 135.f ;
                lon:missing_value = 99.9999f ;
                lon:scale_factor = 1.f ;
                lon:add_offset = 0.f ;
        float lat(nbpoints) ;
                lat:units = "degrees_north" ;
                lat:unit_long = "Degrees North" ;
                lat:long_name = "Latitude" ;
                lat:short_name = "Lat" ;
                lat:_FillValue = 99.9999f ;
                lat:lat_min = -66.f ;
                lat:lat_max = -60.f ;
                lat:missing_value = 99.9999f ;
                lat:scale_factor = 1.f ;
                lat:add_offset = 0.f ;
        float mssh(nbpoints) ;
                mssh:units = "m" ;
                mssh:unit_long = "Meter" ;
                mssh:long_name = "XTRACK Mean Sea Surface" ;
                mssh:short_name = "MSSH" ;
                mssh:_FillValue = 99.9999f ;
                mssh:missing_value = 99.9999f ;
                mssh:scale_factor = 1.f ;
                mssh:add_offset = 0.f ;
        int cycle(nbcycles) ;
                cycle:long_name = "Cycle number" ;
                cycle:cyc_min = 10 ;
                cycle:cyc_max = 92 ;
        int point(nbpoints) ;
        double time(nbpoints, nbcycles) ;
                time:units = "days since 1950-1-1" ;
                time:calendar = "julian" ;
                time:long_name = "Time of measurement" ;
                time:short_name = "Time" ;
                time:_FillValue = 99.9999 ;
                time:missing_value = 99.9999 ;
        float sla(nbpoints, nbcycles) ;
                sla:units = "m" ;
                sla:unit_long = "Meter" ;
                sla:long_name = "XTRACK Sea Level " ;
                sla:short_name = "SLA" ;
                sla:_FillValue = 99.9999f ;
                sla:missing_value = 99.9999f ;
                sla:scale_factor = 1.f ;
                sla:add_offset = 0.f ;
                sla:comment = "All corrections applied including tide, wind and pressure effects" ;
        float tide(nbpoints, nbcycles) ;
                tide:units = "m" ;
                tide:unit_long = "Meter" ;
                tide:long_name = "Global FES12 tide correction" ;
```

```
            tide:short_name = "Tide" ;
            tide:_FillValue = 99.9999f ;
            tide:missing_value = 99.9999f ;
            tide:scale_factor = 1.f ;
            tide:add_offset = 0.f ;
      float dac(nbpoints, nbcycles) ;
            dac:units = "m" ;
            dac:unit_long = "Meter" ;
            dac:long_name = "Global Dynamic Atmospheric Corrections" ;
            dac:short_name = "DAC" ;
            dac:_FillValue = 99.9999f ;
            dac:missing_value = 99.9999f ;
            dac:scale_factor = 1.f ;
            dac:add_offset = 0.f ;
      int dist_to_coast_gshhs(nbpoints) ;
            dist_to_coast_gshhs:_FillValue = -2147483648 ;
            dist_to_coast_gshhs:scale_factor = -0.01f ;
            dist_to_coast_gshhs:add_offset = 0.f ;
            dist_to_coast_gshhs:comment = "Distance to nearest GSHHS 1.3 coastline in cm" ;
            dist_to_coast_gshhs:units = "m" ;
            dist_to_coast_gshhs:actual_range = -269448768., 251344672. ;
            dist_to_coast_gshhs:description = "Geodesic distances on WGS-84" ;
            dist_to_coast_gshhs:long_name = "Distance to nearest coastline" ;
            dist_to_coast_gshhs:GMT_version = "4.5.9_r9889 [64-bit]" ;
            dist_to_coast_gshhs:ctoh_edit_date = "2017-07-11 00:57" ;
      double dist_to_coast_stumpf(nbpoints) ;
            dist_to_coast_stumpf:original_file = "dist2coast.signed.txt" ;
            dist_to_coast_stumpf:reference = "http://oceancolor.gsfc.nasa.gov/DOCS/DistFromCoast/" ;
            dist_to_coast_stumpf:contact = "ctoh_products@legos.obs-mip.fr" ;
            dist_to_coast_stumpf:long_name = "dist_to_coast_stumpf" ;
            dist_to_coast_stumpf:comment = "Original grid provided by  Richard P. Stumpf from NOAA National Ocean Service.
Computed with GMT using the World Vector Shoreline (WVS) and decimated to the intermediate resolution:
http://gmt.soest.hawaii.edu/gmt/doc/gmt/html/GMT_Docs/node222.html. It includes all the islands." ;
            dist_to_coast_stumpf:units = "km" ;
            dist_to_coast_stumpf:ctoh_edit_date = "2017-07-11 00:57" ;
      double mdt_cnes_cls_09(nbpoints) ;
            mdt_cnes_cls_09:_FillValue = 1.84467440737096e+19 ;
            mdt_cnes_cls_09:comment = "MDT CNES-CLS09 V1.1" ;
            mdt_cnes_cls_09:CreatedOn = "11-MAR-2010 16:50:55:000000" ;
            mdt_cnes_cls_09:CreatedBy = "rio@px-124.cls.fr" ;
            mdt_cnes_cls_09:units = "m" ;
            mdt_cnes_cls_09:FileType = "GRID_DOTS" ;
            mdt_cnes_cls_09:OriginalName = "MDT_CNES-CLS09_v1.1.nc" ;
            mdt_cnes_cls_09:long_name = "Mean Dynamic Topography" ;
            mdt_cnes_cls_09:ctoh_edit_date = "2017-07-11 00:57" ;

// global attributes:
            :title = "CTOH Along track Sea Level Anomalies" ;
            :institution = "CTOH/LEGOS, Toulouse Univ., CNRS, IRD, CNES, UPS, France" ;
            :Conventions = "CF-1.6" ;
            :history = "creation: 2017/07/11" ;
            :contact = "ctoh_products@legos.obs-mip.fr  http://ctoh.legos.obs-mip.fr" ;
            :source = "Version X-TRACK: 1.02 - Version mercurial: hgf253ee15e44d" ;
            :doi = "10.6096/CTOH_X-TRACK_2017_02" ;
            :reference = "Birol, F. et al. âCoastal Applications from Nadir Altimetry: Example of the X-TRACK Regional Products.â
Advances in Space Research 59, no. 4 (February 2017): 936â53. doi:10.1016/j.asr.2016.11.005." ;
            :NCO = "4.0.9" ;
```

6 Accessibility of the products

6.1 Aviso+ registration

Please fill the online form on

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

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

6.2 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.

7 Contacts

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.

BIBLIOGRAPHY

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

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.

Brown, S. 2010. A Novel Near-Land Radiometer Wet Path-Delay Retrieval Algorithm: Application to the Jason-2/OSTM Advanced Microwave Radiometer. IEEE Transactions on Geoscience and Remote Sensing, Vol. 48. No. 4.

Carrere, L., and F. Lyard (2003): Modeling the barotropic response of the global ocean to atmospheric wind and pressure forcing-Comparisons with observations. Geophys. Res. Lett., 30(6), 1275, doi:10.1029/2002GL016473.

Carrere L., F. Lyard, M. Cancet, A. Guillot, L. Roblou, FES2012: A new global tidal model taking taking advantage of nearly 20 years of altimetry, Proceedings of meeting "20 Years of Altimetry", Venice 2012.

Durand F., D. Shankar, F. Birol, S.S.C. Shenoi (2008): Estimating boundary currents from satellite altimetry: A case study for the east coast of India. Journal of Oceanogr, 64, 831-845.

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.

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.

Labroue S. (2004) : RA-2 Ocean and MWR measurement long term monitoring. Final report for WP3. task 2. SSB estimation for RA-2 altimeter. Technical Note, CLS-DOS-NT-04-284.

Labroue S., P. Gaspar, J. Dorandeu, O.Z. Zanife, F. Mertz, P. Vincent and D. Cochet (2004) : Non parametrics estimates of the sea state bias for Jason-1 radar altimeter. Marine Geodesy 27 (3-4), 453-481.

Lefevre F., F. Lyard, C. Le Provost and E.J.O. Schrama (2002) : FES99: A Global Tide Finite Element Solution assimilating Tide Gauge and Altimetric Information, Journal of Atmospheric and Oceanic Technology, 19, 1345-1356.

Lyard F., F. Lefevre, T. L etellier, O. F rancis (2006) : Modelling the global ocean tides: modern insights from FES2004, Ocean Dynamics, xxx. 10.1007/s10236-006-0086-x.

Maraldi C. , B. G. Alton-Fenzi , F. Lyard , C. E. Testut , R. Coleman (2007) : Barotropic tides of the Southern Indian Ocean and the Amery Ice Shelf cavity. Geophys. Res. Let. , 34, XX. 10.1029/2007GL030900.

Mulet S., Rio M.-H., Etienne H., Dibarboure G., Picot N., "The new CNES-CLS18 Mean Dynamic Topography", OceanPredict'19

Pairaud I.L., F. Lyard, F. Auclair, T. Letellier, P. Marsalaix (2008), Dynamics of the semidiurnal and quarter-diurnal internal tides in the Bay of Biscay. Part1: Barotropic tides, Continental Shelf Research, 28, 1294-1315.

Ray R.D. (2011): High precision comparisons of bottom-pressure altimetric tides, OSTST meeting - San Diego, October 2011 (oral presentation).

Rio, M. H., S. Guinehut, and G. Larnicol (2011), New CNES-CLS09 global mean dynamic topography computed from the combination of GRACE data, altimetry, and in situ measurements, J. Geophys. Res., 116, C07018, doi:10.1029/2010JC006505.

Roblou L., J. Lamouroux, J. Bouffard, F. Lyard, M. Le Henaff, A. Lombard, P. Marsalaix, P. De Mey and F. Birol (2011) : Post-processing altimiter data toward coastal applications and integration into coastal models. Chapter 9 in S. Vignudelli, A.G. Kostianoy, P. Cipollini, J. Benveniste (eds.), Coastal Altimetry, Springer Berlin Heidelberg. Stammer D., C. Wunsch C, R.M. Ponte (2000) : De-aliasing of global high frequency barotropic motions in altimeter observations. Geophys Res Lett 27(8):1175–1178

Stumpf, Richard and Potemra, Jim. NASA Goddard Space Flight Center (GSFC) Ocean Color Group. http://www.pacioos.hawaii.edu/metadata/dist2coast_1deg_land.html

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.

Wahr J. M. (1985) : Deformation induced by polar motion, J. Geophys. Res., 90(B11), 9363– 9368.
Wessel, P., and W. H. F. Smith, A Global Self-consistent, Hierarchical, High-resolution Shoreline Database, J. Geophys. Res., 101, 8741-8743, 1996