Along-track Level-2+ (L2P) SLA Sentinel-3A Product Handbook

Nomenclature: SALP-MU-P-EA-23014-CLS

Issue: 1 rev 6

Date: October 2017

Chronology Issues:			
Issue:	Date:	Validated by	Reason for change:
1.0	2016/05/20		Creation of the document
1.1	2016/09/10		EUMETSAT inputs taken into account
1.2	2016/12/08		EUMETSAT inputs taken into account
1.3	2017/01/16		Start period of L2P STC products added
1.4	2017/05/19		Taking into account RID remarks from SRR1
1.5	2017/06/27	F. Montagner (EUMETSAT)	Taking into account RID remarks from SRR2/ORR
1.6	2017/10/30		Taking into account the Spring Reprocessing

List of Acronyms:

ATBD	Algorithm Theoretical Baseline Document
ATP	Along Track Product
Aviso+	Archiving, Validation and Interpretation of Satellite Oceanographic data
CLS	Collecte, Localisation, Satellites
CMA	Centre Multimissions Altimetriques
Cnes	Centre National d'Etudes Spatiales
ECMWF	European Centre for Medium-range Weather Forecasting
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
GDR	Geophysical Data Record(s)
GOT	Global Ocean Tides
IB	Inverse Barometer
IGDR	Interim Geophysical Data Record(s)
LRM	Low Resolution Mode
LWE	Large Wavelength Error
L2P	Level-2+ product: global 1 Hz along-track data (sea level anomaly, its components and validity flag) over marine surfaces based on Level-2 products
MSS	Mean Sea Surface
MWR	Microwave Radiometer
Nasa	National Aeronautics and Space Administration
NRT	Near Real Time
NTC	Non Time Critical
OER	Orbit Error Reduction
OSDR	Operational Sensor Data Records
POE	Precise Orbit Ephemeris
RD	Reference Document
SAR	Synthetic Aperture Radar
Ssalto	Segment Sol multimissions d'ALTimétrie, d'Orbitographie et de localisation précise.
SLA	Sea Level Anomaly
SSB	Sea State Bias
SSH	Sea Surface Height
STC	Short Time Critical
TAI	IAT – International Atomic Time
T/P	Topex/Poseidon
UTC	Universal Time Coordinated

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Applicable documents / reference documents

RD 1: Sentinel-3 Marin Altimetry L2P/L3 Service: Product Format Specification.
Reference: SALP-BC-S3_COP-OP-16778-CN v1.0

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Contents

1. Introduction

The purpose of this document is to describe products generated by the 1Hz monomission along-track altimeter data processing segment for Sentinel-3A, named along-track L2P SLA products.

The generation of those products is part of the EUMETSAT Sentinel-3 Marine Altimetry L2P/L3 Service. The dissemination of those products is part of the Cnes AVISO-SALP (Service d'Altimétrie et Localisation Précise).

After a description of the input data, a short overview of the processing steps is presented. Then complete information about user products is provided, giving nomenclature, format description, and software routines.

2. Overview

2.1. Altimetry principle

The altimeter measures the **'Altimeter Range'** which is the distance between the center of mass of satellite to the surface of the Earth (figure 1). This allows computing the **'Sea Surface Height'** which is the height of the sea surface above the reference ellipsoid. The **'Satellite Altitude'** refers to the distance of the center of mass of the satellite above a reference point. The reference point will usually be either on the reference ellipsoid or the center of the Earth.

'Sea Surface Height' = 'Satellite Altitude' - 'Altimeter Range' - 'Corrections'

The **'Corrections'** due to environmental conditions need to be applied in order to retrieve the correct **'Sea Surface Height'**. They are listed in Table 2 and depend on the timeliness of the product.

Moreover another variable is often used in altimetry:

'Sea Level Anomaly'= 'Sea Surface Height' - 'Mean Sea Surface'

The **'Mean Sea Surface'** is the mean of the sea surface height relative to ellipsoid over 20 years. It is computed on a regular grid and combines the data of all satellites.

The **Reference ellipsoid** used for Sentinel-3A Along-track L2P product is the first-order definition of the non-spherical shape of Earth with (same as for TOPEX/Poseidon, Jason-1/2/3 series):

- equatorial radius of 6378.1363 kilometers
- flattening coefficient of 1/298.257

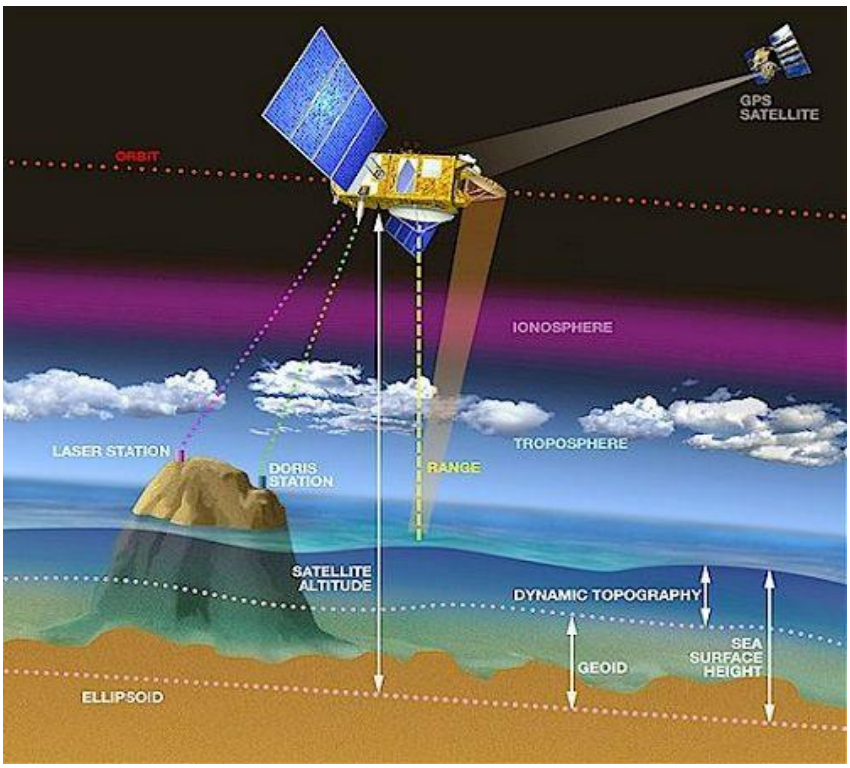

Figure 1. Altimetry principle

2.1.1. Orbits, Passes and Repeat cycle

'Orbit' is one revolution around the Earth by the satellite.

A satellite **'Pass' or 'Track'** is half a revolution of the Earth by the satellite from one extreme latitude to the opposite extreme latitude. Passes with odd numbers correspond to ascending orbits, from minimum to maximum latitude; passes with even numbers correspond to descending orbits, from maximum to minimum latitude.

'Repeat Cycle' is the time period that elapses until the satellite flies over the same location again. Every "pass file" of a given cycle (identified by its track number) flies over the same path as the pass file of every other cycle in the same repeat-cycle phase, and covers oceans basins continuously.

The inclination of Sentinel-3A is 98.65 deg.

The passes are numbered from 1 to 770 representing a full repeat cycle of the Sentinel-3A ground track for the repetitive orbit; for Sentinel-3A, a repeat cycle is 27 days.

2.2. Sentinel-3 operating mode

In the Sentinel-3 SRAL mission, there are two main modes of operation:

- High Resolution Mode, also known as Synthetic Aperture Radar mode (SAR)
- Low Resolution Mode (LRM)

The SRAL mission will normally be operated at High Resolution Mode (commonly called SAR mode). Low Resolution Mode (LRM) will be a back-up mode only.

SAR mode is designed to achieve high along-track resolution over relatively flat surfaces. This property can be exploited to increase the number of independent measurements over a given area and is a prerequisite for sea-ice thickness measurements, coastal waters, ice sheet margins, land and inland waters. The scientific justification of High Resolution Mode 100% coverage over the Earth is also applicable to open ocean surfaces because studies have shown that the best performance of this mode is over open ocean surfaces where topography is homogeneous (areas at least as large as the antenna footprint).

The detailed information can be found in the Sentinel-3 User Handbook:

https://sentinel.esa.int/documents/247904/685236/Sentinel-3_User_Handbook

Note that compared to LRM (on current altimetry missions such as SARAL/AltiKa, Envisat, Jason-1/2/3, ERS-1/2), the antenna footprint is reduced with the SAR technology and the noise on the measurement is reduced.

3. Data Processing

3.1. Overview

The processing steps of the system are overviewed on Figure 2. The L2P products are delivered in Near-Real-Time (NRT), Short Time Critical (STC), Non Time Critical (NTC). The objective is:

- To provide operational applications with directly useable continuous and high quality altimeter data.
- To provide user friendly altimeter database where users can directly access to valid sea level height content without additional processing.
- In Non Time Critical, it is to maintain a consistent and user friendly altimeter database using the state-of-the-art recommendations from altimetry community before the complete reprocessing of L2 products.

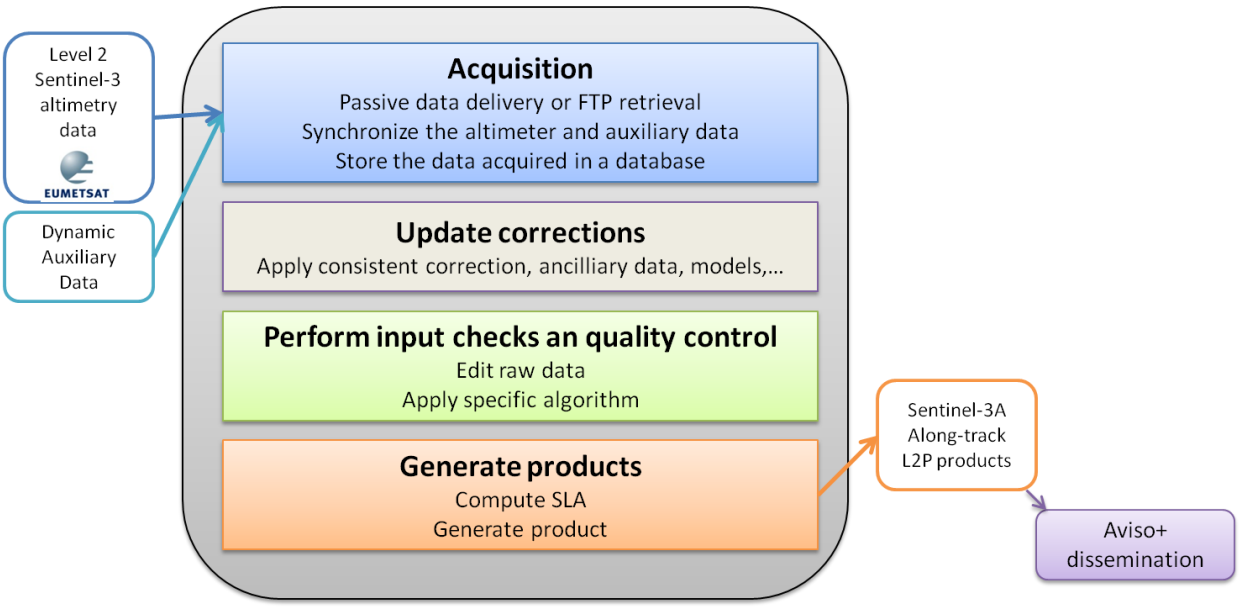

Figure 2. Processing steps of the system

The L2P products are along-track products that contain time, sea level anomaly, information of validity of the data and all corrections which were necessary to compute the sea level anomaly (range, orbital altitude, environmental and geophysical corrections). These products contain only marine surfaces. They have a homogenized format and content for all altimeter missions. Note that the variable inter_mission_bias can be different between L2P NRT/STC and L2P NTC data. L2P products are the input data for the L3 production. Note that the sea level anomaly considered in Sentinel-3 L2P products is always based on Synthetic Aperture Radar (or if not available on Low Resolution Mode) data, but never on Pseudo LRM data.

3.2. Input Data

3.2.1. Level-2 altimeter data

In order to produce Sentinel-3A Along-track L2P products, the system **uses Level-2 Water** instrumental measurements (containing Ocean data). Indeed there are different data products associated with the three levels of processing of altimeter data:

- Level-0 (L0) is the raw telemetered data
- Level-1 (L1) is the Level-0 data corrected for instrumental effects
- Level-2 (L2) is the Level-1 data corrected for geophysical effects

Level-2 and level-1 products are available to users via ftp or EUMETCast dissemination. Level-0 products are not available to users and are considered only as inputs to Level-1 processing.

There are different levels of data latency related to the Level-2 availability of the auxiliary or ancillary data as detailed in Table 1:

Altimetry product	Source	Availability	Orbit
Near Real Time (NRT) Sentinel-3A	EUMETSAT	3 hours	Fast delivery orbit
Short Time Critical (STC) Sentinel-3A	EUMETSAT	48 hours	Intermediate orbit
Non Time Critical (NTC) Sentinel-3A	EUMETSAT	30 days	Precise Orbit Determination

Table 1. Sentinel-3A timeliness Input data overview.

3.2.1.1. Dynamic and static auxiliary data

In order to compute the Sea Level Anomaly, various corrections are needed, some of them replace the ones from the L2 input product such as the Mean Sea Surface, the tidal model, ... The complete description of all the corrections used in the L2P products is given in table 2.

3.2.2. Applying altimetric corrections

Altimetric measurements need to be corrected for instrumental errors, environmental perturbations (wet tropospheric, dry tropospheric and ionospheric effects), the ocean sea state influence (sea state bias), the tide influence (ocean tide, earth tide and pole tide) and atmospheric pressure (combined atmospheric correction : high frequency fluctuations of the sea surface topography and inverted barometer height correction). The detail of these corrections applied is given in table 2. This table corresponds to the current available L2P standard 02_00 (global attribute “product_version” in the L2P files) for NRT, STC and NTC products. Note that the product_version may in the future develop differently between L2P NRT/STC and L2P NTC products.

Note that in Non-Time Critical (NTC) delivery, the products may be delivered in two versions:

- the reference version containing the corrections consistent with the Sentinel-3A products delivered in the frame of the Copernicus Marine Service project. This version will be reprocessed roughly every 3 years.
- an updated version with corrections more up-to-date. This version will be reprocessed more often.

	Sentinel-3A		
Timeliness	**NRT**	**STC**	**NTC**
Orbit	Navigator (GNSS for baseline and DORIS for backup)*	MOE*	POE*
Dry troposphere	Model computed from ECMWF Gaussian grids		
Wet troposphere	From Sentinel-3A MicroWave Radiometer		
Ionosphere	Filtered dual-frequency altimeter range measurements [Guibbaud et al., 2015]		
Sea State Bias	Non parametric SSB [Tran et al., 2012]		
Ocean tide and loading tide	FES2014 [Carrère et al., 2015]		
Solid Earth tide	Elastic response to tidal potential [Cartwright and Tayler, 1971], [Cartwright and Edden, 1973]		
Pole tide	[Wahr, 1985]		[Desai, 2015]
Dynamic atmospheric correction	MOG2D High frequencies forced with **predicted** ECMWF pressure and wind field [Carrere and Lyard, 2003; operational version used, current version is 3.2.0] + inverse barometer Low frequencies	MOG2D High frequencies forced with **analysed+predicted** ECMWF pressure and wind field [Carrere and Lyard, 2003; operational version used, current version is 3.2.0] + inverse barometer Low frequencies	MOG2D High frequencies forced with **analysed** ECMWF pressure and wind field [Carrere and Lyard, 2003; operational version used, current version is 3.2.0] + inverse barometer Low frequencies
Mean Sea Surface used	CNES_CLS15 (with reference period of 20 year)		

(*) The **Reference ellipsoid** for Sentinel-3A L2P products has been changed in order to take into account the first-order definition of the non-spherical shape of Earth with (same as for TOPEX/Poseidon, Jason-1/2/3 series): equatorial radius of 6378.1363 kilometers and flattening coefficient of 1/298.257

Table 2. Sentinel-3A Reference corrections overview (in pink same standards as L2 products, in green standards updated in L2P products)

Note that other corrections could be applied if needed, such as a datation bias correction. Note that this algorithm is not yet used.

3.2.3. Selecting valid data

The processing starts with quality control and validation of altimetric data and geophysical corrections in order to select valid ocean data. Note the following values of the editing criteria are not yet tuned for Sentinel-3A and will be adjusted later.

Editing criteria are used to select valid measurements over ocean. The editing process is divided into 3 parts as described below:

1/ Editing by flags:

A first step is to select the points where the editing thresholds will be applied. The points where:

- the ice flag is 0 (Ocean) or 5 (not evaluated),
- and the surface_type flag is 0 (Open Sea or Semi-enclosed sea) or 1 (enclosed sea or lake)
- only for NRT : the orbit source has to be ROE

are taken into account.

2/ Editing with parameters thresholds:

The editing criteria are defined as minimum and maximum thresholds for altimeter, radiometer and geophysical parameters (Table 3). They are expected to remain constant throughout the mission, so that monitoring the number of edited measurements allows an observation of data quality. Measurements are edited if at least one of the parameters does not lie within those thresholds.

Parameters	Minumum value	Maximum value
Sea Surface Height	-130m	100m
Sea Level Anomaly	-2m for NRT/STC, -7m for NTC	2m for NRT/STC, 7m for NTC
Standard deviation on the range	0	0.12 + 0.02*SWH m if instrument mode is SAR, 0.2m otherwise
Nb measurements of range	10	DV
Dry troposphere correction	-2.5m	-1.9m
Dynamical Atmospheric correction	-2m	2m
Wet troposphere correction	-0.5m	-0.001m
Sea State Bias	-0.5m	0.00m
Standard deviation of backscatter coefficient	0	0.7 dB if instrument mode is SAR, 1dB otherwise
Oceanic tide	-5m	5m
Earth tide	-1m	1m
Pole tide	-15m	15m
Altimeter wind speed	0m/s	30m/s
Backscattering coefficient	5dB	28dB
Significant wave height	0m	15m
Filtered ionosphere correction	-0.4m	0.04m

Table 3. Editing thresholds for each parameter for NTC, NRT and STC timeliness

3/ Editing by statistical validation on the track for NRT/STC data:

A final editing is used in order eliminate the tracks where orbit error can be very high:

For a track with a minimum of 200 points where:

- the bathymetry <-1000m,
- the oceanic variability <0.1m,
- the distance to the coast >10km,
- the latitude is <66°.

Then the track is eliminated if one of these criteria is true:

- the mean of Sea Level Anomaly of all the points >0.15m,
- the standard deviation of the Sea Level Anomaly of all the points > 0.2m.

4/ Iterative editing of sea level anomaly for NTC data:

Data are edited with a median filter, taking into account the ocean variability.

$|R| > 3 [\sigma(R) + \sigma (MSLA)]$

Where :

R= SLA – SLA low pass filtered at 500 km

σ (MSLA) is the standard deviation of a mean ocean variability.

3.3. Product Generation

The **'Sea Level Anomalies'** as described in section 2.1 are computed with the corrections given in Table3.

In order to allow the user to compute himself its own **'Sea Surface Height'** depending on his needs, the corrections used to compute the **'Sea Level Anomalies'** are present in the output product (see Table 6 for details about the names of variables). This allows computing the raw **'Sea Surface Height'**

Each product will contain one file per pass. The files are zipped (*.gz). The files will be delivered in cycles folders for L2P NTC products. The following table gives the frequency of delivery and the number of files delivered.

L2P altimetry output product	Frequency	Number of files delivered
Near Real Time (NRT) Sentinel-3A	Several times a day	28 passes net per day (as soon as a L2 file is available, it is produced into a L2P pass file and delivered to ftp. Only the most complete L2P pass file for each pass is kept, the less complete L2P files are removed from ftp)
Short Time Critical (STC) Sentinel-3A	Several times per day	28 passes net per day (note that generally two L2P STC files (a first very short, later the complete file) are produced for even passes, as the pass splitting in high northern latitudes is slightly different between L2 and L2P data, but only the more complete L2P pass file will be kept on ftp)
Non Time Critical (NTC) Sentinel-3A	Once per cycle (every 27 days)	770

Table 4. Number of Sentinel-3A files delivered for each timeliness

4. Product Presentation

4.1. Temporal availability

Mission	Begin date	End date	Characteristics
NRT Sentinel-3A	13-12-2016 (cycle 12)	Ongoing	27-day cycles
STC Sentinel-3A	12-01-2017 (cycle 13, pass 241)	Ongoing	27-day cycles
NTC Setninel-3A	15-06-2016 (cycle 5, pass 374)	Ongoing	27-day cycles

Table 5. Temporal availability of LP2 Sentinel-3A products.

4.2. Nomenclature

This is the generic model of L2P filename is:

global_sla_l2p_<data_type>_<mission>_<cycle>_<pass>_<begin_date>_ <end_date>_<production_date>.nc

The L2P products name components are:

- The type of data (NRT/STC/NTC): <data_type>
- The mission (s3a/s3b): <mission>
- The cycle/pass considered: <cycle>_<pass>
- The begin and end dates of the data: <begin_date>_<end_date>
- The production date: <production_date>

This is a filename example:

global_sla_l2p _nrt_s3a_C0006_P0407_20160713T031500_20160713T035759_20160902T175905.nc

In case of L2P reprocessing activities, the GLOBAL_SLA_L2P_NTC product twill be available in two versions :

- The reference product
- The reprocessed product

The nomenclature of these two products is the same, but a global attribute containing the version number within the L2P product allows distinguishing them. Furthermore the files will be available in distinct directories.

5. Data Format

This chapter presents the data storage format and convention used for S3 L2P products. All products are distributed in NetCDF with norm CF.

NetCDF (Network Common Data Form) is an open source, generic and multi-platform format developed by Unidata. An exhaustive presentation of NetCDF and additional conventions is available on the following web site:

http://www.unidata.ucar.edu/packages/netcdf/index.html.

All basic NetCDF conventions are applied to files.

Additionally the files are based on the attribute data tags defined by the Cooperative Ocean/Atmopshere Reasearch Data Service (COARDS) and Climate 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 made available by UNIDATA (http://www.unidata.ucar.edu/software/netcdf):

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

5.1. L2P Format

5.1.1. Dimensions

1 Dimension is defined:

- **time:** number of data in current file, sampled at 1Hz.

5.1.2. Data Handling Variables

You will find hereafter the definitions of the variables defined in the product:

Name of variable	Type	Content	Unit	Timeliness
time	double	Time of measurements	seconds since 2000-01-01 00:00:00 UTC	all
latitude	int	Latitude value of measurements	degrees_north	all
longitude	int	Longitude value of measurements	degrees_east	all
range	int	Range	meters	all
altitude	int	Altitude of the satellite	meters	all
wet_tropospheric_correction	short	Wet tropospheric correction	meters	all
wet_tropospheric_correction_mode	short			all
ionospheric_correction	int	Ionospheric correction	meters	all
sea_state_bias	short	Sea state bias	meters	all
solid_earth_tide	short	Solid Earth tide height	meters	all
pole_tide	short	Pole tide height	meters	all
dry_tropospheric_correction_model	short	Dry tropospheric correction	meters	all
dynamic_atmospheric_correction	short	Combined atmospheric correction	meters	all
ocean_tide_height	int	Ocean tide height	meters	all
mean_sea_surface	int	Mean sea surface height	meters	all
inter_mission_bias	int	Bias to have consistent time series since TOPEX/Poseidon	meters	all
sea_level_anomaly	int	Sea Level Anomaly relative to MSS	meters	all
validation_flag	byte	Flag indicating if Sea Level Anomaly is valid (validation_flag=0) or not (validation_flag=1)	none	all

Table 6. Overview of data handling variables in L2P NetCDF file.

The mapping between variables of L2 products and variables of L2P products is available in Table 7.

5.1.2.1. Attributes

Additional attributes may be available in L2P files. They are providing information about the type of product or the processing and parameter used.

5.1.2.2. Example of L2P file

netcdf {

dimensions:

time = 1522 ;

variables:

double time(time) ;

time:units = "seconds since 2000-01-01 00:00:00.0" ;

time:long_name = "time (sec. since 2000-01-01)" ;

time:standard_name = "time" ;

time:calendar = "gregorian" ;

int latitude(time) ;

latitude:scale_factor = 1.e-06 ;

latitude:comments = "Positive latitude is North latitude, negative latitude is South latitude." ;

latitude:long_name = "latitude" ;

latitude:standard_name = "latitude" ;

latitude:units = "degrees_north" ;

int longitude(time) ;

longitude:scale_factor = 1.e-06 ;

longitude:comments = "East longitude relative to Greenwich meridian" ;

longitude:long_name = "longitude" ;

longitude:standard_name = "longitude" ;

longitude:units = "degrees_east" ;

int range(time) ;

range:_FillValue = 2147483647 ;

range:comment = "All instrumental corrections included, i.e. distance antenna-COG, USO drift correction, internal path correction, Doppler correction, modeled instrumental errors corrections and system bias." ;

range:scale_factor = 0.0001 ;

range:coordinates = "longitude latitude" ;

range:add_offset = 700000. ;

range:long_name = "corrected 1 Hz altimeter range in main altimeter frequency band" ;

range:standard_name = "altimeter_range" ;

range:units = "m" ;

short wet_tropospheric_correction(time) ;

wet_tropospheric_correction:_FillValue = 32767s ;

wet_tropospheric_correction:comment = "A wet tropospheric correction must be added (negative value) to the instrument range to correct this range measurement for wet tropospheric range delays of the radar pulse . This correction is computed from the data of the onboard radiometer." ;

wet_tropospheric_correction:scale_factor = 0.0001 ;

wet_tropospheric_correction:coordinates = "longitude latitude" ;

wet_tropospheric_correction:long_name = "radiometer wet tropospheric correction" ;

wet_tropospheric_correction:standard_name = "altimeter_range_correction_due_to_wet_troposphere" ;

wet_tropospheric_correction:units = "m" ;

short wet_tropospheric_correction_model(time) ;

wet_tropospheric_correction_model:_FillValue = 32767s ;

wet_tropospheric_correction_model:comment = "Computed at the altimeter time-tag from the interpolation of 2 meteorological fields that surround the altimeter time-tag. A wet tropospheric correction must be added (negative value) to the instrument range to correct this range measurement for wet tropospheric range delays of the radar pulse." ;

wet_tropospheric_correction_model:scale_factor = 0.0001 ;

wet_tropospheric_correction_model:source = "European Center for Medium Range Weather Forecasting" ;

wet_tropospheric_correction_model:coordinates = "longitude latitude" ;

wet_tropospheric_correction_model:long_name = "operational ECMWF model wet tropospheric correction" ;

wet_tropospheric_correction_model:standard_name = "altimeter_range_correction_due_to_wet_troposphere" ;

wet_tropospheric_correction_model:units = "m" ;

wet_tropospheric_correction_model:institution = "ECMWF" ;

short dry_tropospheric_correction_model(time) ;

dry_tropospheric_correction_model:_FillValue = 32767s ;

dry_tropospheric_correction_model:comment = "Computed at the altimeter time-tag from the interpolation of 2 meteorological fields that surround the altimeter time-tag. A dry tropospheric correction must be added (negative value) to the instrument range to correct this range measurement for dry tropospheric range delays of the radar pulse." ;

dry_tropospheric_correction_model:scale_factor = 0.0001 ;

dry_tropospheric_correction_model:source = "European Center for Medium Range Weather Forecasting" ;

dry_tropospheric_correction_model:coordinates = "longitude latitude" ;

dry_tropospheric_correction_model:long_name = "operational ECMWF model dry tropospheric correction" ;

dry_tropospheric_correction_model:standard_name = "altimeter_range_correction_due_to_dry_troposphere" ;

dry_tropospheric_correction_model:units = "m" ;

dry_tropospheric_correction_model:institution = "ECMWF" ;

short dynamic_atmospheric_correction(time) ;

dynamic_atmospheric_correction:_FillValue = 32767s ;

dynamic_atmospheric_correction:comment = "MOG2D high resolution forced with operational ECMWF pressure and wind fields plus inverse barometer. This correction is computed by adding the high frequency fluctuations of the sea surface topography and the inverted barometer height correction computed from rectangular grids." ;

dynamic_atmospheric_correction:scale_factor = 0.0001 ;

dynamic_atmospheric_correction:coordinates = "longitude latitude" ;

dynamic_atmospheric_correction:long_name = "dynamic atmospheric correction" ;

dynamic_atmospheric_correction:units = "m" ;

dynamic_atmospheric_correction:institution = "LEGOS/CNES" ;

int ocean_tide_height(time) ;

ocean_tide_height:_FillValue = 2147483647 ;

ocean_tide_height:comment = "Includes the corresponding loading tide and equilibrium long-period ocean tide height." ;

ocean_tide_height:scale_factor = 0.0001 ;

ocean_tide_height:source = "FES2014" ;

ocean_tide_height:coordinates = "longitude latitude" ;

ocean_tide_height:long_name = "FES model geocentric ocean tide height" ;

ocean_tide_height:standard_name = "sea_surface_height_amplitude_due_to_geocentric_ocean_tide" ;

ocean_tide_height:units = "m" ;

ocean_tide_height:institution = "LEGOS/CNES" ;

short solid_earth_tide(time) ;

solid_earth_tide:_FillValue = 32767s ;

solid_earth_tide:comment = "Calculated using Cartwright and Tayler tables and consisting of the second and third degree constituents. The permanent tide (zero frequency) is not included." ;

solid_earth_tide:scale_factor = 0.0001 ;

solid_earth_tide:source = "Cartwright and Edden [1973] Corrected tables of tidal harmonics - J. Geophys. J. R. Astr. Soc., 33, 253-264." ;

solid_earth_tide:coordinates = "longitude latitude" ;

solid_earth_tide:long_name = "solid earth tide height" ;

solid_earth_tide:standard_name = "sea_surface_height_amplitude_due_to_earth_tide" ;

solid_earth_tide:units = "m" ;

solid_earth_tide:institution = "National Institute of Oceanography (UK)" ;

short pole_tide(time) ;

pole_tide:_FillValue = 32767s ;

pole_tide:scale_factor = 0.0001 ;

pole_tide:source = "Wahr [1985] Deformation of the Earth induced by polar motion - J. Geophys. Res. (Solid Earth), 90, 9363-9368." ;

pole_tide:coordinates = "longitude latitude" ;

pole_tide:long_name = "geocentric pole tide height" ;

pole_tide:standard_name = "sea_surface_height_amplitude_due_to_pole_tide" ;

pole_tide:units = "m" ;

pole_tide:institution = "IERS" ;

short sea_state_bias(time) ;

sea_state_bias:_FillValue = 32767s ;

sea_state_bias:comment = "A sea state bias correction must be added (negative value) to the instrument range to correct this range measurement for sea state delays of the radar pulse." ;

sea_state_bias:scale_factor = 0.0001 ;

sea_state_bias:source = "Empirical solution fitted on Jason-2 GDR_C data" ;

sea_state_bias:coordinates = "longitude latitude" ;

sea_state_bias:long_name = "sea surface height bias due to sea surface roughness on main altimeter frequency band" ;

sea_state_bias:standard_name = "sea_surface_height_bias_due_to_sea_surface_roughness" ;

sea_state_bias:units = "m" ;

sea_state_bias:institution = "CNES" ;

short ionospheric_correction(time) ;

ionospheric_correction:_FillValue = 32767s ;

ionospheric_correction:scale_factor = 0.0001 ;

ionospheric_correction:coordinates = "longitude latitude" ;

ionospheric_correction:long_name = "altimeter filtered ionospheric correction on main altimeter frequency band" ;

ionospheric_correction:standard_name = "altimeter_range_correction_due_to_ionosphere" ;

ionospheric_correction:units = "m" ;

int mean_sea_surface(time) ;

mean_sea_surface:_FillValue = 2147483647 ;

mean_sea_surface:comment = "referenced to 20 year period" ;

mean_sea_surface:scale_factor = 0.0001 ;

mean_sea_surface:source = "MSS_CNES_CLS-2015" ;

mean_sea_surface:coordinates = "longitude latitude" ;

mean_sea_surface:long_name = "mean sea surface height above reference ellipsoid" ;

mean_sea_surface:units = "m" ;

mean_sea_surface:institution = "CLS/CNES" ;

int inter_mission_bias(time) ;

inter_mission_bias:_FillValue = 2147483647 ;

inter_mission_bias:units = "m" ;

inter_mission_bias:long_name = "bias to have consistent time series since TOPEX/Poseidon" ;

inter_mission_bias:scale_factor = 0.0001 ;

inter_mission_bias:coordinates = "longitude latitude" ;

short sea_level_anomaly(time) ;

sea_level_anomaly:_FillValue = 32767s ;

sea_level_anomaly:quality_flag = "validation_flag" ;

sea_level_anomaly:comment = "altitude of satellite (altitude) - Ku band corrected ocean altimeter range (range) - altimeter ionospheric correction on Ku band (ionospheric_correction) - model dry tropospheric correction (dry_tropospheric_correction_model) - radiometer wet tropospheric correction (wet_tropospheric_correction) - sea state bias correction in Ku band (sea_state_bias) - solid earth tide height (solid_earth_tide) - geocentric ocean tide height (ocean_tide_height) - geocentric pole tide height (pole_tide) - dynamic atmospheric correction (dynamic_atmospheric_correction) - mean sea surface (mean_sea_surface) - inter mission bias (inter_mission_bias)" ;

sea_level_anomaly:scale_factor = 0.0001 ;

sea_level_anomaly:coordinates = "longitude latitude" ;

sea_level_anomaly:long_name = "sea level anomaly" ;

sea_level_anomaly:standard_name = "sea_surface_height_above_sea_level" ;

sea_level_anomaly:units = "m" ;

int altitude(time) ;

altitude:_FillValue = 2147483647 ;

altitude:comment = "Altitude of satellite above the reference ellipsoid (TOPEX)." ;

altitude:scale_factor = 0.0001 ;

altitude:coordinates = "longitude latitude" ;

altitude:add_offset = 700000. ;

altitude:long_name = "1Hz altitude of satellite" ;

altitude:standard_name = "height_above_reference_ellipsoid" ;

altitude:units = "m" ;

byte validation_flag(time) ;

validation_flag:_FillValue = 127b ;

validation_flag:flag_meanings = "valid_data_over_ocean rejected_data" ;

validation_flag:long_name = "validation flag" ;

validation_flag:flag_values = 0b, 1b ;

validation_flag:coordinates = "longitude latitude" ;

// global attributes:

:Conventions = "CF-1.6" ;

:cycle_number = 9 ;

:pass_number = 644 ;

:absolute_pass_number = 6804 ;

:first_meas_time = "2016-10-10 11:01:51" ;

:last_meas_time = "2016-10-10 11:19:03" ;

:creator_email = "aviso@altimetry.fr" ;

:product_version = "01_01" ;

:cdm_data_type = "swath" ;

:references = "http://aviso.altimetry.fr" ;

:Metadata_Conventions = "Unidata Dataset Discovery v1.0" ;

:institution = "CLS,CNES,EUMETSAT" ;

:creator_name = "AVISO" ;

:title = "NRT Sentinel-3A Global Ocean Along track Sea Level Anomalies L2P products" ;

:standard_name_vocabulary = "http://cf-pcmdi.llnl.gov/documents/cf-standard-names/standard-name-table/25/cf-standard-name-table.html" ;

:summary = "The Near Real Time Level-2P sea surface height above mean sea surface products for Sentinel-3A mission." ;

:project = "EUMETSAT Sentinel-3 L2P/L3 marine altimetry service" ;

:platform = "Sentinel-3A" ;

:contact = "aviso@altimetry.fr" ;

:source = "Sentinel-3A measurements" ;

:based_on = "Sentinel-3A NRT" ;

:creator_url = "http://aviso.altimetry.fr" ;

:processing_level = "L2P" ;

:equator_time = "2016-10-10T11:04:43.307000" ;

:equator_longitude = 343.81 ;

:creation_date = "2016-10-28T15:23:13" ;

:software_version = "L2P(0.2.0-develop@6658b6f)_OCTANT(11.16.0)" ;

5.2. Mapping between L2 and L2P variables

Hereafter the mapping between variables of L2 and L2P products is listed (in the case that L2P product contain the same content as L2 products):

Name of L2P variable	Name of L2 variable	Comment
time	time_01	
latitude	lat_01	
longitude	lon_01	
range	range_ocean_01_ku	
altitude	alt_01	note that in L2P products this field includes the conversion from S3A to TOPEX reference ellipsoid (see remark in table 2)
wet_tropospheric_correction	rad_wet_tropo_cor_01_ku	
wet_tropospheric_correction_mode	mod_wet_tropo_cor_zero_altitude_01	
ionospheric_correction		L2P products contain filtered ionosphere correction based on L2 variable iono_cor_alt_01_ku
sea_state_bias	sea_state_bias_01_ku	
solid_earth_tide	solid_earth_tide_01	
pole_tide	pole_tide_01	note that for L2P NTC products the pole tide is updated (not read in L2 products)
dry_tropospheric_correction_model	model_dry_tropo_cor_zero_altitude_01	
dynamic_atmospheric_correction	inv_bar_cor_01 + hf_fluct_cor_01	note that for L2P NRT product the DAC correction is updated (not read in L2 products)
ocean_tide_height		ocean tide height is updated in L2P products
mean_sea_surface		mean sea surface is updated in L2P products
inter_mission_bias		
sea_level_anomaly		
validation_flag		

Table 7. Mapping between variables in L2 and L2P files

6. Products accessibility

The Sentinel-3A L2P products are available via **authenticated** servers.

- On authenticated **Aviso+ FTP (online products)**:
  - You first need to register via the Aviso+ web portal and sign the License Agreement: http://www.aviso.altimetry.fr/en/en/data/data-access/registration-form.html.

  A login /Password will be provided via email with all the necessary information to access the products.
  - The products can be downloaded on the Aviso+ authenticated FTP: ftp://ftp.aviso.altimetry.fr/

  The following acknowledgement must be cited when using the products:

  "The Sentinel-3A L2P products are processed on behalf of EUMETSAT and distributed by AVISO+".

- On the authenticated **Aviso+ CNES Data Center (archived products)**:

  Register and download on https://aviso-data-center.cnes.fr/

7. News, updates and reprocessing

7.1. Operational news

To be kept informed about events occurring on the satellites and on the potential services interruption, see the [Duacs] operational news on the Aviso+ website:

http://www.aviso.altimetry.fr/en/data/operational-news/index.html.

7.2. Updates and reprocessing

November 2017: a new NTC L2P S3A version (02_00) is available on the ftp server. It takes into account the "spring 2017 reprocessed" version of input NTC L2 products fully detailed in the following document:

http://www.eumetsat.int/website/wcm/idc/idcplg?IdcService=GET_FILE&dDocName=PDF_S3A_TN_STM_REPRO&RevisionSelectionMethod=LatestReleased&Rendition=Web

An Aviso+ web page is dedicated to updates and reprocessing of monomission products such as L2P products:
http://www.aviso.altimetry.fr/en/data/product-information/updates-and-reprocessing/monomission-data-updates.html

8. Contacts

For more information, please contact:

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Fax: (+33) (0) 561 393 782
E-mail: aviso@altimetry.fr
On Internet: http://www.aviso.altimetry.fr/

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