SSALTO/DUACS User Handbook:

MSLA and (M)ADT Near-Real Time and Delayed Time Products

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Chronology Issues :		
Issue :	Date :	Reason for change :
2.2	2010/11/18	
2.3	2011/01/01	Modification of the commentary on the flags and of the part "Product generation"
2.4	2011/03/29	Addition of Mozambique products and temporal update of DT products
2.5	2011/04/16	Addition of daily DT products
2.6	2011/09/01	New version of SLA NetCDF files Addition of RT products
2.7	2012/01/10	**NRT**: Addition of Arctic and Europe products
2.8	2012/01/21	Cnes MOE GDR-D orbit on Envisat
2.9	2012/02/06	Addition of Cryosat-2 mission in NRT products
3.0	2012/05/25	End of Envisat mission and addition of Jason-1 on its geodetic orbit
3.1	2012/07/20	New version "D" of IGDR for Jason-2
3.2	2012/10/20	Addition of Cryosat-2 mission in DT products
3.3	2012/12/04	**NRT**: Improvement in the processing of Cryosat-2, **DT**:integration of Jason-1 geodetic mission and new version D of Jason-2
3.4	2013/01/29	**Global SLA NRT**: Integration of "OGDR on the fly" data
3.5	2013/07/01	**NRT**: Integration of Saral/AltiKa and OGDR Cryosat-2 data
3.6	2013/09/04	**NRT**: Improvement of DAC correction
4.0	2014/04/15	**NRT and DT**: DUACS 2014 version of products
4.1	2014/05/20	**NRT**: Addition of HY-2A mission
4.2	2014/11/15	**DT**: Addition of HY-2A mission
4.3	2015/05/18	**NRT and DT**: New orbit standards GDR-E (Jason-2, Cryosat-2, AltiKa)
4.4	2015/06/30	**NRT and DT**: Implementation of the Saral/AltiKa geodetic orbit
5.0	2016/08/20	New dissemination including CMEMS

List of Tables

List of Figures

List of acronyms

AL	AltiKa
ATP	Along-Track Product
ADT	Absolute Dynamic Topography
AVISO	Archiving, Validation and Interpretation of Satellite Oceanographic data
BGLO	Biais Grande Longueur d'Onde
Cal/Val	Calibration - Validation
CERSAT	Centre ERS d'Archivage et de Traitement
CORSSH	CORrected Sea Surface Height
C2	Cryosat-2
DAC	Dynamic Atmospheric Correction
DT	Delayed Time
DTU	Mean Sea Surface computed by Technical University of Danemark
DUACS	Data Unification and Altimeter Combination System
E1	ERS-1
E2	ERS-2
EN	Envisat
ENN	Envisat on its non repetitive orbit (since cycle 94)
ECMWF	European Centre for Medium-range Weather Forecasting
ENACT	ENhanced ocean data Assimilation and Climate prediction
G2	Geosat Follow On
GIM	Global Ionospheric Maps
GDR	Geophysical Data Record(s)
HY-2A	Haiyang-2A
IERS	International Earth Rotation Service
IGDR	Interim Geophysical Data Record(s)
J1	Jason-1
J1N	Jason-1 on its new orbit (since cycle 262)
J1G	Jason-1 on its geodetic orbit (since May 2012)
J2	OSTM/Jason-2
J2N	OSTM/Jason-2 on its new orbit
J3	Jason-3
JPL	Jet Propulsion Laboratory
LAS	Live Access Server
LWE	Long Wavelength Errors
MADT	Map of Absolute Dynamic Topgraphy
MDT	Mean Dynamic Topography
MOE	Medium Orbit Ephemeris
MP	Mean Profile
MSLA	Map of Sea Level Anomaly
MSS	Mean Sea Surface
NRT	Near-Real Time
OE	Orbit Error
OER	Orbit Error Reduction
Opendap	Open-source Project for a Network Data Access Protocol

PO.DAAC	Physical Oceanography Distributed Active Archive Centre
POE	Precise Orbit Ephemeris
RD	Reference Document
SAD	Static Auxiliary Data
SARAL	Satellite with ARgos and ALtika
SLA	Sea Level Anomaly
SSALTO	Ssalto multimission ground segment
SSH	Sea Surface Height
T/P	Topex/Poseidon
TPN	Topex/Poseidon on its new orbit (since cycle 369)

Contents

1. Introduction

The purpose of this document is to describe the products distributed by Aviso+:

- the along-track Absolute Dynamic Topography heights (ADT-H)
- the gridded Absolute Dynamic Topography heights (MADT-H)
- the gridded geostrophic velocities anomalies (MSLA-UV)
- the gridded absolute geostrophic velocities (MADT-UV)
- the gridded Monthly and Seasonal Means and Climatologies Sea Level Anomalies heights (MSLA-Clim)
- over Global, Mediterranean Sea, Black Sea areas.

The products are derived from the SSALTO/Duacs processing which integrates data from all altimeter missions: HY-2A, Saral/AltiKa, Cryosat-2, OSTM/Jason-2, Jason-1, Topex/Poseidon, Envisat, GFO, ERS-1&2. DUACS provides a consistent and homogeneous catalogue of products for varied applications, both for near real time applications and offline studies. Some DUACS gridded products are available free of charge. Commercial use of some gridded products is subject to separate agreement and licence (Contact aviso@altimetry.fr).

Note that the Copernicus Marine Environment Monitoring Service (CMEMS http://http://marine.copernicus.eu/) is now in charge of the processing and distribution of the Sea Level Anomalies heights along-track and gridded products (SLA-H, MSLA-H) except for Mozambique Area. Please, refer to CMEMS if you need one of those products. The Mozambique Products are still distributed by Aviso+ and a dedicated handbook is available (see http://www.aviso.altimetry.fr/en/data/product-information/aviso-user-handbooks.html. See the following table for complete information about the dissemination:

	Global	Mediterranean Sea	Black Sea	Europe	Arctic	Mozambique
SLA-H	CMEMS	CMEMS	CMEMS	CMEMS	CMEMS	Aviso+
MSLA-H	CMEMS	CMEMS	CMEMS	No	No	Aviso+
MSLA-UV	Aviso+	Aviso+	Aviso+	No	No	Aviso+
ADT-H	Aviso+	Aviso+	No	No	No	No
MADT-H	Aviso+	Aviso+	No	No	No	No
MADT-UV	Aviso+	Aviso+	No	No	No	No
MSLA-Clim	Aviso+	Aviso+	Aviso+	No	No	No

Aviso+	distributed by Aviso+
Aviso+	distributed by Aviso+ at the moment, will be distributed by CMEMS as from April 2017
CMEMS	distributed by CMEMS

Table 1: Products and Dissemination

The SLAs are used as input of the ADT-H, MADT-H, MSLA-UV, MADT-UV and MSLA-Clim products. Please refer to the CMEMS handbook for details of SLA-H and MSLA-H processing: http://marine.copernicus.eu/documents/PUM/CMEMS-SL-PUM-008-017-033.pdf.
You will find the correspondance between former Aviso+ and current CMEMS products here: http://www.aviso.altimetry.fr/en/data/product-information/updates-and-reprocessing/ssaltoduacs-product-changes-and-updates.html#c12028

1.1. Data policy and data access

All SSALTO/DUACS product users need an account on FTP, whether for Near-Real-Time or for Delayed-Time data, for along-track and gridded products.

As described in the Licence agreement,

- Duacs **along-track** (level 3 ADT-H), **gridded heights** products (level 4 MADT-H) and gridded Climatologies (MSLA-Clim) are available free of charge for all projects.

- Duacs **gridded geostrophic velocities anomalies and absolute geostrophic velocities** products (level 4+ MSLA-UV and MADT-UV) are available free of charge for scientific studies or non-profit projects only.

Commercial use of gridded products or applications not in line with the standard license agreement is subject to separate agreement and licence (Contact aviso@altimetry.fr).
Please, subscribe to get access to SSALTO/DUACS products by filling the registration form on: http://www.aviso.altimetry.fr/en/data/data-access/registration-form.html.

2. Latest operational operations

2.1. Jason-3 mission for NRT products (September 2016)

Jason-3 has been implemented in the SL-TAC system on September 2016 as the new reference mission. By succeeding TOPEX/Poseidon, Jason-1, and Jason-2, Jason-3 extends the high precision altimetry data record to support climate monitoring, operational oceanography and seasonal forecasting. Launched on January 17th 2016, Jason-3 is the result of collaboration between CNES, NASA, EUMETSAT and NOAA. Jason-3 has the same orbit than the current Jason-2 mission, Jason-2 will be moved to a new orbit in order to improve the spatial resolution of gridded products. **Note that the integration of Jason-3 in the SSALTO/Duacs system leads to the deactivation of the current Jason-2 mission. Jason-2 will be reintroduced later in the system when available in a new dataset named "j2n".**

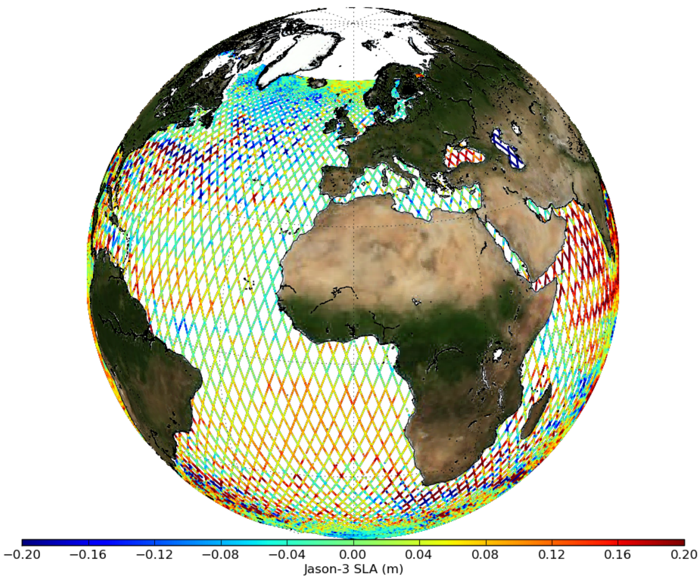

Figure 1: *Example of Jason-3 Sea Level Anomalies (SLA) map for one cycle*

2.2. July 4th 2016, new phase for AltiKa

On July 4th 2016, SARAL/AltiKa has begun its new phase named "Saral Drifting Phase". It now flies free of station keeping manoeuvers; the repetitive ground track is no more maintained and the ground track will drift. This decision - endorsed by Cnes and ISRO management - is due to the technical issues encountered since March 2015. As the SSALTO/Duacs processing was already configured as a geodetic mission, thus no change is foreseen on the chain. Note that the cycle number will jump to #100. And one cycle will always contain 1002 passes but the numbering and localisation are different: for example, pass 20 in cycles 1 to 35 is the same ground track with +/-1 1km deviation. Pass 20 in cycle 100 is different from pass 20 in cycles 1 to 35 and is also different from pass 20 in cycles 101, 102,... .

The following points summarizes the past events on the mission:
1/Due to reaction wheel issues, SARAL station keeping maneuvers couldn't be performed nominally since **March 31st, 2015**. As a result, SARAL/AltiKa's ground track has been drifting with deviations from the nominal track overtaking 10km depending on the latitude, instead of +/-1km usually.
2/Between **April 1st, and August 11th, 2015**, the SARAL/AltiKa's ground track has been drifting from its nominal track.
3/**Since August 11th, 2015** and thanks to many maneuvers, the platform was again under control and the nominal track has been reached.
Consequently, this drift had an impact on the SSALTO/Duacs AL products between **April 1st, 2015 and August 11th, 2015**. As the mission was processed as a repetitive mission (see below), the distance between the theoretical track and the true track position was large, this projection processing induced an additional error in the product. Since mid may 2015, we had indeed observed an increase of the variability of the SARAL/AltiKa SLA at short wavelengths (< about 200km).
4/**Since June 30th, 2015**, in order to limit the degradation of the quality of the product in NRT processing, the SARAL/AltiKa mission was processed as a geodetic mission as decribed below.

Processing for a repetitive mission:
In this case, the position of the points vary from one cycle to another one **within +/- 1 km**. The processing for a repetitive mission (like Jason-2 for example) includes the projection of the measurement onto a theoretical track position in order to benefit from the precise Mean Profile estimated from past missions (see `http://marine.copernicus.eu/documents/PUM/CMEMS-SL-PUM-008-017-033.pdf`).
Processing for a geodetic mission:
In this case, the positions of the points can vary from one cycle to another one of **more than +/- 1km**.The processing for a non repetitive or a geodetic mission (like Crysoat-2 for example) avoids the projection of the measurement into a theoretical track position because it doesn't exists. In order to correct the measurement for computing Sea Level Anomalies, a gridded Mean Sea Surface (MSS) solution is used rather than a more precise Mean Profile for SLA computation (see `http://marine.copernicus.eu/documents/PUM/CMEMS-SL-PUM-008-017-033.pdf`). However, SSALTO/Duacs processing includes an along-track filtering that strongly reduces this error signature on filtered products (see `http://marine.copernicus.eu/documents/PUM/CMEMS-SL-PUM-008-017-033.pdf`).

3. SSALTO/Duacs system

3.1. Introduction

This chapter presents the input data used by the system and an overview of the different processing steps necessary to produce the output data.
SSALTO/DUACS system is made of two components: a Near Real Time one (NRT) and a Delayed Time (DT) one.
In NRT, the system's primary objective is to provide operational applications with directly usable high quality altimeter data from all missions available.
In DT, it is to maintain a consistent and user-friendly altimeter database using the state-of-the-art recommendations from the altimetry community.
Following figure gives an overview of the system, where processing sequences can be divided into 7 main steps:

- acquisition
- homogenization
- input data quality control
- multi-mission cross-calibration
- product generation
- merging
- final quality control.

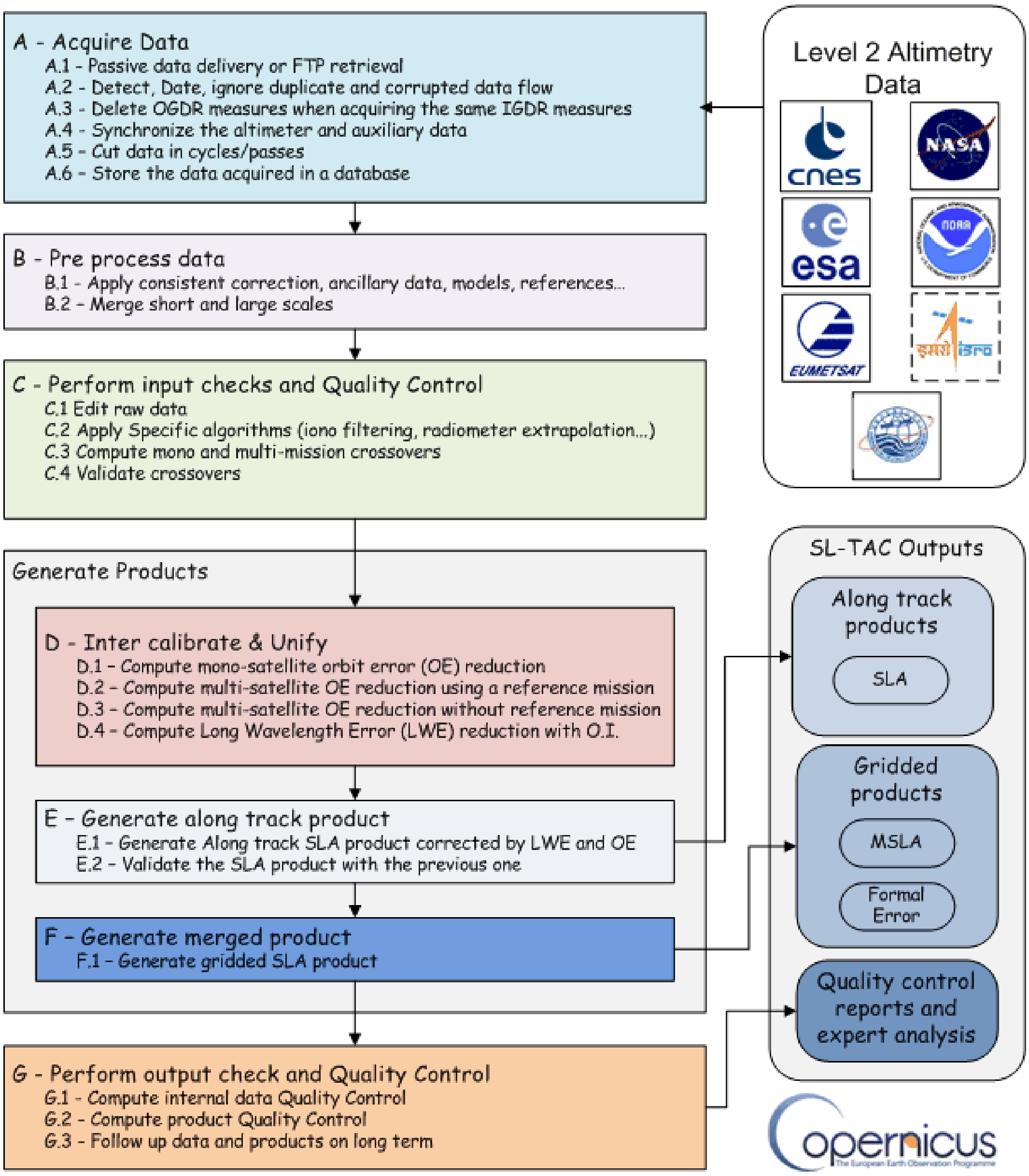

Figure 2: *SSALTO/Duacs processing sequences*

3.2. Input data, models and corrections applied

The input data are the Sea Level Anomalies Heights provided by CMEMS. Two flows are needed: the Near-Real-Time flow and the Delayed-Time flow. All the information about the processing of the input data is available in the CMEMS handbook:
http://marine.copernicus.eu/documents/PUM/CMEMS-SL-PUM-008-017-033.pdf
The details about the products used are the following :

SLA-H	Global	NRT	SEALEVEL_GLO_SLA_L3_NRT_OBSERVATIONS_008_017
		REP	SEALEVEL_GLO_SLA_L3_REP_OBSERVATIONS_008_018
	Mediterranean Sea	NRT	SEALEVEL_MED_SLA_L3_NRT_OBSERVATIONS_008_019
		REP	SEALEVEL_MED_SLA_L3_REP_OBSERVATIONS_008_020
	Black Sea	NRT	SEALEVEL_BS_SLA_L3_NRT_OBSERVATIONS_008_022
		REP	SEALEVEL_BS_SLA_L3_REP_OBSERVATIONS_008_023
MSLA-H	Global	NRT	SEALEVEL_GLO_SLA_MAP_L4_NRT_OBSERVATIONS_008_026
		REP	SEALEVEL_GLO_SLA_MAP_L4_REP_OBSERVATIONS_008_027
	Mediterranean Sea	NRT	SEALEVEL_MED_SLA_MAP_L4_NRT_OBSERVATIONS_008_028
		REP	SEALEVEL_MED_SLA_MAP_L4_REP_OBSERVATIONS_008_029
	Black Sea	NRT	SEALEVEL_BS_SLA_MAP_L4_NRT_OBSERVATIONS_008_030
		REP	SEALEVEL_BS_SLA_MAP_L4_REP_OBSERVATIONS_008_031

Table 2: Input Products and their CMEMS nomenclature (NRT=Near-Real-Time, REP: Reprocessed=Delayed-Time)

3.3. Computation of ADT-H and MADT-H Products

Along-track and gridded ADT (Absolute Dynamic Topography) products are obtained as follows:

$$ADT = SLA + MDT$$

where MDT is the Mean Dynamic Topography. The Mean Dynamic Topography is the part of Mean Sea Surface Height due to permanent currents, so MDT corresponds to the Mean Sea Surface Height minus Geoid. Since DUACS 2014 version, a new MDT has been used: it takes into account the recent geoid mean field (GOCE DIR-R4) and in-situ dataset, as well as improved processing method. Details are presented in Rio et al, 2013 [61].
Note that the ADT products have been computed with consistent SLA and MDT fields:

$$ADT = SLA_{20years} + MDT_{20years}$$

The regional Mediterranean ADT product is computed using a specific regional MDT (Mediterranean Sea only) given in Rio et al., 2014 [62]:

$$ADT_{Med} = SLA_{Med} + MDT_{Med}$$

The MDT is dirtibuted by Aviso+. All information can be found in http://www.aviso.altimetry.fr/en/data/products/auxiliary-products/mdt.html.

3.4. Computation of geostrophic velocities Products (MSLA-UV and MADT-UV)

The combined map is used to generate by-products such as geostrophic currents.
Since DUACS 2014 version, the geostrophic current computation is improved with:

- The use of the 9-point stencil width method (Arbic et al, 2012, [3]) at latitudes appart from $\pm 5^{\circ}$. It contributes to reduce the impact of the anisotropy introduced by the Cartesian 1/4° grid resolution.

- The SLA computation is Largerloef et al, 1999 [37] in the equatorial band is improved in order to smooth the transition at $\pm 5^{\circ}$ and improve the consistency between altimeter products and drifter observations.

More information can be found in
http://www.aviso.altimetry.fr/fileadmin/documents/data/duacs/Duacs2014.pdf.

3.5. Computation of monthly and seasonal means and climatologies (MSLA-Clim)

Three kinds of means are proposed:

- **Monthly MSLA means** correspond to the sea level anomalies averaged by month since January 1993.

- **Seasonal MSLA means** correspond to the sea level anomalies averaged by season (JFL-AMJ-JAS-OND) since January 1993.

- **Climatological monthly MSLA** are calculated by averaging the Sea Level Anomalies over a same month for all the years. We obtain one file and one map for each month.

3.6. Performance indicators

To appreciate the quality situation of the DUACS system, performance indicators are computed daily. They aim at evaluate the status of the main processing steps of the system: the input data availability, the input data coverage, the input data quality and the output product quality. These indicators are computed for each and every currently working satellite, and combined to obtain the overall status.

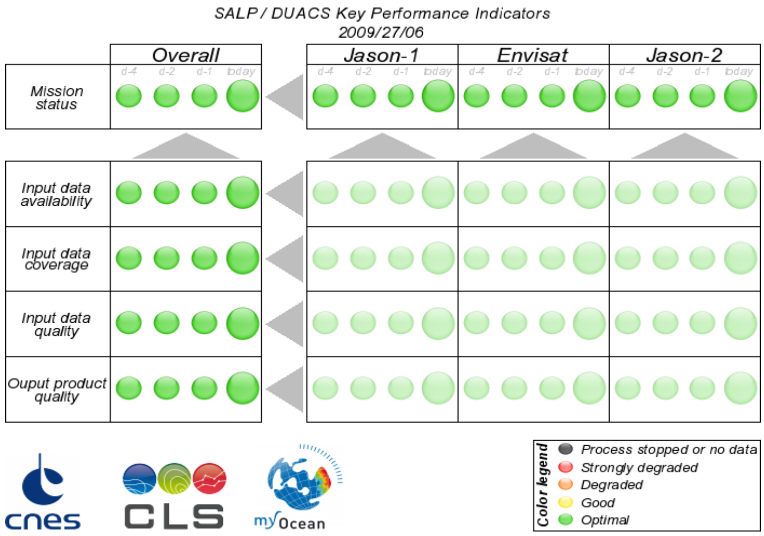

Figure 3: *Example with the key performance indicator on 2009/06/27*

See the description, the latest and previous indicators on Aviso website:
http://www.aviso.altimetry.fr/en/data/product-information/information-about-mono
ssaltoduacs-multimission-altimeter-products/key-performance-indicators.html

4. SSALTO/DUACS Products

4.1. Near Real Time Products

The purpose of the NRT component is the acquisition of altimeter data from various altimeter missions in near-real time (i.e. within a few days at most) and in real-time for global area on all satellites (i.e. within a few hours), the validation and correction of these altimeter data sets (i.e edition and selection, update of corrections and homogenization, orbit error reduction) in order to produce each day along-track and gridded products.
Exploitation of real time OGDR data allows the DUACS system to produce multi-mission maps with 0-day and 3-day delay whereas historical NRT (IGDR-based) production have a 6-day delay (induced by historical trade-off in terms of timeliness vs quality).
The quality measurements in the NRT processing is more sensitive to the number of altimeter missions involved in the system. This is mainly due to the orbit error and the non-centered processing time-window (in NRT case, "future" data are not available; the computation time window takes into account only the 6 weeks before the date).
If two altimeters are acknowledged as the bare minimum needed to observe mesoscale signals in DT maps, three or even four missions are needed to obtain equivalent accuracy in NRT (Pascual et al., 2006[50]).

	Along-track products	Gridded products		
	NRT ADT-H	NRT MSLA	NRT MADT	
	Filtered	UV	H	UV
Global	X	all sat	all sat	all sat
Mediterranean	X	all sat	all sat	all sat
Black Sea	-	all sat	-	-

Table 3: List of the products in NRT

4.1.1. Delay of the products

The availability of the products in near real time is

- for along-track products: three to twelve hours after the measurement for regional products and 2 hours for global Saral and Jason-3 products and 3 hours for global Cryosat-2 products.
- for gridded products: day-0 , day-3 and day-6 days.

Those products are delivered every day.

Three merged maps are produced daily, each with a different delay and quality:

- A 6-day delay, which represents a final NRT map production,
- A 3-day delay, which represents an intermediate map production,;
- and a 0-day delay, which represents a preliminary map production, based on IGDR+OGDR production.

Then, these maps are replaced when a better quality data is available:

- At d_{0+6}, the final NRT map replaces the preliminary map which was produced at d_0.

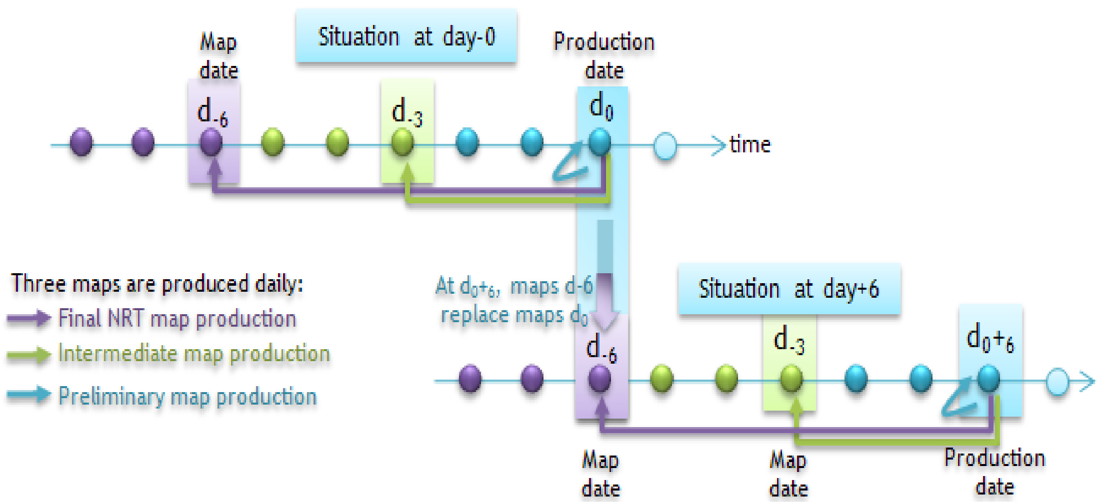

Figure 4: *Three merged maps are produced daily: final map (d-6), intermediate map (d-3) and preliminary map (d0)*

4.1.2. Temporal availibility

The following table presents the available products by mission and by data period:
Near real time products:

NRT	Jason-3	Jason-2	Cryosat-2	Saral/AltiKa	HY-2A	Merged
Temporal Time availability	2016/09/05 ongoing	y/m* 2016/09/05	y/m* ongoing	y/m* ongoing	y/m* 2016/01/05	y/m* ongoing
MSLA-UV (**)						X
ADT-H	X	X	X	X		
MADT-H						X
MADT-UV(***)						X

*y/m: the temporal coverage for NRT products is fluctuating and is updated regularly (3 to 4 times per year when DT products are updated). The users are advised thanks to the Aviso web at: http://www.aviso.oceanobs.com/en/data/product-information/duacs/presentation/updates/index.html
** UV anomalies are Geostrophic velocities anomalies derived from NRT-MSLA
*** Absolute UV are absolute Geostrophic velocities derived from NRT-MADT

4.2. Delayed Time Products

The Delayed Time component of SL-TAC system is responsible for the production of processed HY-2A, Saral/AltiKa, Cryosat-2, Jason-1, Jason-2, T/P, Envisat, GFO, ERS1/2 data in order to provide a homogeneous, inter-calibrated and highly accurate long time series of ADT and MADT altimeter data .
DT products are more precise than NRT products. Two reasons explain this quality difference. The first one is the better intrinsic quality of the POE orbit used in the GDR processing. The second reason is that in the DT DUACS processing, the products can be computed optimally with a centred computation time window for OER, LWE and mapping processes (6 weeks before and after the date) . On the contrary in NRT case, "future" data are not available so the computation time window is not centred and therefore not optimal.
As for NRT products, improved altimeter corrections and processing algorithms are used: ocean tide model to correct altimeter data, improved methods for orbit error reduction and mapping.

	DT Along-track products		DT Gridded products			
	ADT-H		MSLA	MADT		MSLA Clim
	Filtered VFEC	Uniltered VXXC	UV	H	UV	H
Global	X	X	all sat	all sat	all sat	all sat
Mediterranean	X	X	all sat	all sat	all sat	all sat
Black Sea	-	-	all sat	-	-	-

Table 4: List of the Along-track products in DT

All the gridded Delayed-Time products (merged global/regional) have been computed with a daily temporal resolution. This means that the maps are reprocessed for every day.
This ambitious reprocessing was motivated by the fact that the weekly resolution used so far for DT maps in former version was insufficient wherever the time decorrelation scale is close to 15 days, especially when end-users want to perform a simple linear time interpolation between consecutive maps.

4.2.1. Delay of the products

Daily products are delivered. The availability of the products in delayed time is at the best two months after the date of the measurement. The product generation needs all the GDR data of all the missions to take into account the best corrections as possible. The time delay can be longer in the case of a missing mission.

4.2.2. Temporal availibility

The following table presents the available products by mission and by data period:
Delayed time SSALTO/DUACS **all-sat-merged** products:

DT all sat	Temporal availibility		MSLA-UV	ADT-H	MADT-H	MADT-UV	MSLA-Clim
	begin date	end date					
HY-2A	2014/04	y/m[1]		X			
Saral/AltiKa	2013/03	y/m[1]		X			
Cryosat-2	2012/04	y/m[1]		X			
Jason-2	2008/10	y/m[1]		X			
Jason-1 geodetic[2]	2012/06	2013/04		X			
Jason-1 new[2]	2009/02	2012/03		X			
Jason-1	2002/04	2008/10		X			
GFO	2000/01	2008/09		X			
Envisat new[2]	2010/10	2012/04		X			
Envisat	2002/10	2010/10		X			
ERS-1[2]/ERS-2	1992/10	2003/04		X			
Topex new[2]	2002/09	2005/10		X			
Topex	1993/01	2002/04		X			
Merged	1993/01	y/m[1]	X		X	X	X

[1] y/m: the temporal coverage for DT products is fluctuating and is updated regularly (3 to 4 times per year). The users are advised thanks to the Aviso web at: http://www.aviso.altimetry.fr/en/data/product-information/updates-and-reprocessing/ssaltoduacs-delayed-time-reprocessing.html

[2] Jason-1 geodetic orbit: starting 2012/05, Jason-1 new orbit : starting 2009/02, Envisat new orbit : starting 2010/10, T/P new orbit : starting 2002/09, ERS-1 geodetic phases (E-F) are included. No ERS-1 data between December 23, 1993 and April 10, 1994 (ERS-1 phase D - 2^{nd} ice phase). Note that, during that time, merged products are based only on Topex/Poseidon data.

The merged products were obtained with the satellites given in figure 5. Moreover, the global attribute in the gridded file called "platform" gives the list of satellites used to compute the map.

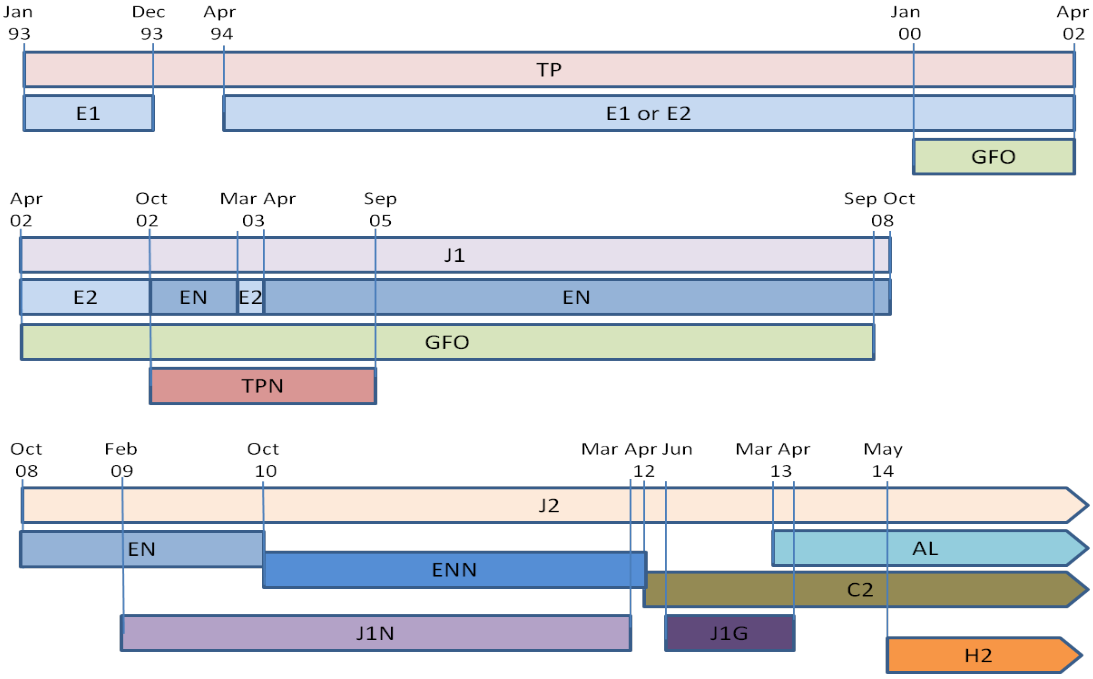

Figure 5: *List of satellites in all-sat-merged products*

5. Data format

This chapter presents the data storage format used for SSALTO/DUACS 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:
http://www.unidata.ucar.edu/packages/netcdf/index.html.

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.

5.2. Structure and semantic of NetCDF along-track (L3) files

The NetCDF SSALTO/DUACS files are based on the attribute data tags 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:

- 1 dimension is defined:
  - **time**: it is used to check NetCDF variables depending on time.
- 6 variables are defined:

  - short **SLA** or **ADT**: contains the Sea Level Anomaly or Absolute Dynamic Topography values for each time given,
  - int **longitude** : contains the longitude for each measurement,
  - int **latitude** : contains the latitude for each measurement,
  - short **track** : contains the track number for each measurement,
  - double **time** : contains the time in days since 1950-01-01 00:00:00 UTC for each measurement,
  - short **flag** : only for NRT products. flag=0, the processed data comes from OGDR; if flag=1, the processed data comes from the IGDR
  - short **cycle** : contains the cycle number for each measurement.
- global attributes:
  - the global attributes gives information about the creation of the file.

5.3. Structure and semantic of NetCDF maps (L4) files

The NetCDF SSALTO/DUACS files are based on the attribute data tags 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:

- 4 Dimensions are defined:
  - **time**: date of the map,
  - **lat**: contains the latitude of grid points ,
  - **lon**: contains the longitude of grid points,
  - **nv**: used for mapping conventions
- 8 or 9 Variables are used for all grids defined below:
  - float **time** : contains the time in days since 1950-01-01 00:00:00 UTC,
  - float **lat** : contains the latitude for each measurement,
  - float **lon** : contains the longitude for each measurement,
  - float **lat_bnds** : contains the min and max in latitude of each box,
  - float **lon_bnds** : contains the min and max in longitude of each box,
  - int **crs**: used for mapping conventions
  - the fields used for msla_h files are:
    - int **sla**: contains the eea level anomalies of the measurements and
    - int **err**: contains the formal mapping error in meters
  - the fields used for msla_uv and madt_uv files
    - int **u**: contains the zonal component of the geostrophic velocity of the measurements and
    - int **v**: contains the meridian component of the geostrophic velocity of the measurements
  - the fields used for madt_h files
    - int **adt**: contains the absolute dynamic topography of the measurements
- global attributes:
  - the global attributes gives information about the creation of the file. Not that there is a new global attribute called "platform" indicating the list of satellites taken into account to compute the maps.

6. Accessibility of the products

Aviso proposes several ways of accessing data. Some of them need an authentication. If you are not registered and want to access to an authenticated service, we request you to fill in the online form.
According to the type of SSALTO/DUACS data, products are available:

- Via **authenticated FTP** on
  ftp://ftp.aviso.altimetry.fr/
  Note that once your request is processed (after filling the online form), Aviso will send you your own access (login/password) by e-mail as soon as possible. If you don't enter your login/password, you will only access to the anonymous FTP, where you won't find the data you're interested in.
- Via the **Live Access Server** (LAS) on the AVISO web site (http://www.aviso.altimetry.fr/en/data/data-access/las-live-access-server.html). The LAS is a tool to draw your own map.
  Only gridded products are accessible via the LAS.
- Via **authenticated OpenDap**, a framework that simplifies all aspects of scientific data networking (http://www.aviso.altimetry.fr/en/data/data-access/aviso-opendap.html).
  Only gridded products are accessible via OpenDap.
- Via the **authenticated** Aviso data extraction (http://www.aviso.altimetry.fr/en/data/data-access/gridded-data-extraction-tool.html) tool enables you to extract a data sub-set from the Aviso gridded datasets. You can choose either an area (by its geographical coordinates or among pre-defined regions), or a period for variable(s) within a given dataset

	FTP	Opendap[1]	Aviso extraction Service[1]	LAS[1]
Near Real-Time	x			
« Historical » NRT (for data >1 month)	x	x	x	x
Delayed time	x	x	x	x

(1) Only gridded products

6.1. Folders on the ftp server

We keep your attention to well enter your login/password to get access to FTP server, if not, you will access only the anonymous FTP
(/donnees/ftpsedr/ftpanonymous/pub/oceano/AVISO/SSH/duacs), where you only find sample data sets.
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.

6.1.1. Gridded Delayed-Time and Near-Real-Time products (ADT, Geostrophic currents)

The nomenclature used for the folders is:

<ZONE>_<DELAY>_grids_<NBSAT>_<PRODUCT>_<VARIABLE>_<YEAR>

ZONE	global	global geographic coverage product
	regional-mediterranean	Mediterranean products
	regional-blacksea	Black Sea products
DELAY	delayed-time	delayed time products
	near-real-time	near-real time products
NBSAT	all-sat-merged	maximum 4 satellites to compute the map
PRODUCT	msla	maps of sea level anomaly (only for uv)
	madt(1)	maps of absolute dynamic topography
VARIABLE	h	sea surface heights and error (only for madt)
	uv	sea surface geostrophic currents
YEAR	YYYY	year of the maps (only in DT)

(1) No MADT files for Black Sea regional products.

6.1.2. Along-track Delayed Time and Near Real Time ADT files

The nomenclature used for the along-track ADT folders is:

<ZONE>_<DELAY>_along-track_<FILTERING>_<PRODUCT>_<MISSION>_<YEAR>

ZONE	global	global geographic coverage product
	regional-mediterranean	Mediterranean products
DELAY	delayed-time	delayed time products
	near-real-time	near-real time products
FILTERING	filtered	filtered and sub-sampled products (*vfec*)
	unfiltered	not filtered and not sub-sampled products (*vxxc*)
PRODUCT	adt	absolute dynamic topography
MISSION	e1	ERS-1
	e2	ERS-2
	tp	Topex/Poseidon
	tpn	Topex/Poseidon on its new orbit
	g2	GFO
	j1	Jason-1
	j1n	Jason-1 on its new orbit
	j2	Jason-2
	en	Envisat
	enn	Envisat on its new orbit
	c2	Cryosat-2
	al	Saral/AltiKa
	h2	HY-2A
YEAR	YYYY	year of the maps (only in DT)

6.1.3. Gridded Delayed-Time Means and Climatologies

The nomenclature used for the folders is:

<ZONE>_<DELAY>_gids_climatology_<AVG>

ZONE	global	global geographic coverage product
	regional-mediterranean	Mediterranean products
	regional-blacksea	Black Sea products
DELAY	delayed-time	delayed time products
AVG	seasonal_clim	maps of seasonal average of sea level anomaly
	monthly_mean	maps of mean average of sea level anomaly
	monthly_clim	maps of climatologies of sea level anomaly

6.2. Nomenclature of files

6.2.1. Gridded Delayed-Time and Near-Real-Time products (ADT, Geostrophic currents)

The nomenclature used for these products is:

DELAY_ZONE_NBSAT_PRODUCT_VARIABLE_DATEMAP_DATEPROD.nc

DELAY	dt	delayed time products
	nrt	near-real time products
ZONE	global	global geographic coverage product
	med	Mediterranean products
	blacksea	Black Sea products
NBSAT	allsat	maximum 4 satellites to compute the map
PRODUCT	msla	maps of sea level anomaly (only for uv)
	madt(1)	maps of absolute dynamic topography
VARIABLE	h	sea surface heights (only for adt)
	uv	sea surface geostrophic currents
DATEMAP	YYYYMMDD	date of the dataset
DATEPROD	YYYYMMDD	production date of the dataset

(1) No MADT files for Black Sea regional products.

6.2.2. Along-track Delayed Time and Near Real Time ADT files

The nomenclature used for the along-track ADT products is:

DELAY_ZONE_MISSION_PRODUCT_VARIABLE_DATEDATA_DATEPROD.nc

DELAY	dt	delayed time products
	nrt	near-real time products
MISSION	e1	ERS-1
	e2	ERS-2
	tp	Topex/Poseidon
	tpn	Topex/Poseidon on its new orbit
	g2	GFO
	j1	Jason-1
	j1n	Jason-1 on its new orbit
	j2	Jason-2
	en	Envisat
	enn	Envisat on its new orbit
	c2	Cryosat-2
	al	Saral/AltiKa
	h2	HY-2A
	j3	Jason-3
ZONE	global	Global geographic coverage product
	med	Mediterranean products
PRODUCT	adt	absolute dynamic topography
VARIABLE	$X_1X_2X_3X_4$	X_1 is "v" for validated data and "x" for non validated data X_2 is "f" for filtered data and "x" for non filtered data X_3 is "e" for sub-sampled and "x" for non sub-sampled data X_4 is "c" for LWE-corrected data and "x" for non-LWE-corrected data or raw data
DATEDATA	YYYYMMDD	date of the dataset
DATEPROD	YYYYMMDD	production date of the dataset

7. News and Updates

7.1. [Duacs] Operational news

To be kept informed on events occurring on the satellites and on the eventual interruption of the services of the processing system, see the [Duacs] operational news on the Aviso website:
http://www.aviso.altimetry.fr/en/data/operational-news/index.html.

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