Toward high resolution altimeter products

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Ssalto/Duacs regional high resolution L3 products

Ssalto/Duacs system objectives is to provide operational applications with homogeneous and directly usable high quality altimeter data from all missions (Jason-1, Jason-2, T/P, ENVISAT, GFO, ERS1/2 and even GEOSAT). The system uses common processing facilities for global and regional applications. It ensures that upgrades are consistently applied on all products to better serve the altimetry user community.

The system delivers different validated and inter-calibrated SLA products with full resolution 1Hz, in delayed time. These products are available in Mediterranean Sea, Black Sea and Global Ocean (Fig 1). No filtering and sub-sampling were applied to this production and thus, the users must keep in mind that measurement noises still affect the data (at the opposite to filtered and sub-sampled version of the product also delivered) (Fig 2).

More details in the (M)SLA and (M)ADT NRT and DT Products user handbook available on the website [1]
Free Data Access* on AVISO (/Data /Products /Sea surface height products /Global (or Regional)/DT-SLA (or NRT-SLA)

Product Name	SLA full 1Hz resolution	SLA extended
Level	L3	L3
Editing	✓	✓
InterCalibration	✓	✓
LWE	✓	✗
Filtering/sub-sampl.	✗	✗
Time delivery	DT	DT and (N)RT
Provided with corrections	✗	Tides DAC IB
Global coverage	✓	✗
Regional coverage	Med. Sea Black Sea	G. Mexico NE Atlantic West. Med

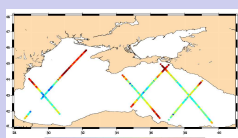Tab: Characteristics of full 1Hz resolution along track data delivered by Ssalto/Duacs.

Fig 1: Example of 1Hz along track data in the Black Sea. (Duacs DT regional production)

Fig 2:Illustration of differnces between **full 1Hz resolution** and **filtered/sub-sampled product**. Case of Duacs DT production in the Mediterranean Sea, J2 track 222.
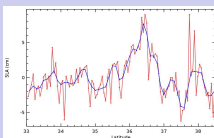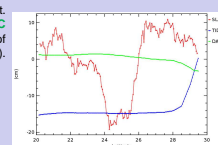
Fig 3:SLAext production areas.

Fig 4: Example 1 Hz SLAext product. Evolution of **SLA**, **ocean tide** and **DAC** component along EN track 52 in the Gulf of Mexico (Duacs RT production).

Ssalto/Duacs also delivers "extended" products available in 1Hz resolution (no filtering) for North-East Atlantic and Gulf of Mexico regions (Fig 3). In addition to SLA field, ocean tides correction, inverse barometer and Dynamic Atmospheric Correction (DAC) are available (Fig4), allowing the user to play with physical content of SLA field (e.g. replace DAC with simple IB; change product ocean tide correction with different version, …) .

More details in the Mersea regional products user handbook available on the website [1].
Free Data Access* on AVISO (/Data /Products /Sea surface height products /Regional/DT-SLAext (or NRT-SLAext)

PISTACH : New satellite altimetry L2 products for regional and coastal ocean

The **PISTACH** project, funded by CNES as part of Jason-2 project, aimed at improving satellite radar altimetry products over coastal areas and continental waters. It dealt with the analysis of user needs in order to design of coastal/hydrological products, with the development of new dedicated algorithms(retracking of the waveforms, tropospheric corrections, ...) and finally with the prototype implementation, validation and operations.

The prototype is currently operated and **products in V1.0 are accessible** for all the Jason-2 mission. It provides **along-track level 2 products** dedicated to the monitoring of **coastal areas** and **continental waters** using new standards. These products are provided at both 1hz (7km) and 20 Hz (350m) sampling rate. They contain around 80 additional fields compared to standard Jason2 I-GDR: new retracking algorithms, new wet tropospheric corrections, new tidal correction, new Mean Sea Surface.

More details in the PISTACH USER HANDBOOK available on website [1].

Free Data Access* on AVISO (/Data /Products / Sea surface height products /Global /Coastal and Hydrological products)
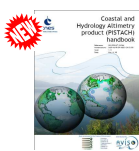
Data Use Case

The PISTACH **20hz** data contain **too much noise** to be used at this sampling. A **data Selection** is also needed to eliminate isolated erroneous measurements.
⇒To filter and select data at the same time, an iterative strategy has been tested. Both a **median filter** and a **Low-Pass filter**, associated with a 3-sigma data selection on the difference (filtered-non filtered), have been applied on 20Hz SSHA data.
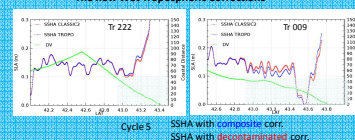
Several cut-off length have been tested for the LP filter :
• With L=20, data resolution is close to 1hz data non filtered
• With L=60, data resolution is close to 1hz data filtered with L-21 km (as classical « AVISO » products)
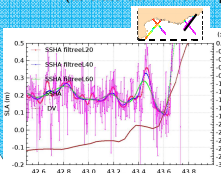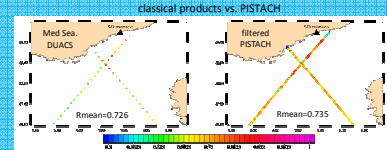
Applying this method with **cut L=7km (red)** provides high-resolution SSH anomalies along the tracks without instrumental noise nor erroneous data but with **more pronounced meso-scale signals** than its classical products (green).

The new Wet Tropospheric Corrections

Cycle 5   SSHA with **composite** corr. SSHA with **decontaminated** corr.

In-Situ –Altimetry SSH comparisons: classical products vs. PISTACH

Med.Sea DUACS   filtered PISTACH

Rmean=0.726   Rmean=0.735

Time correlation on 55 cycles between the Monaco Tide Gauge SL (black triangle) and two SLA Jason-2 altimeter Products : The DUACS regional SLA for the Med.Sea (left) and a SSHA computed with PISTACH products (right)

On the need of a precise Mean Sea Surface...

➤Impact of the MSS quality on the High-Resolution PISTACH SSHA?

In the framework of SLOOP project, a new version Mean Sea Surface (MSS) was computed, taking advantage of most than17 years of altimeter measurement for different altimeter missions.
When the new **MSS CNES-CLS-10** is used to compute the SSHA in the part of the Med. Sea, the SSHA profiles are more stable approaching the coasts than with the old **MSS CLS 01** (the red one is also the MSS CLS 01 but not interpolated similarly than the others) (Fig 5). Stability is underlined when considering Jason1 tandem tracks (after cycle 261) (cf Tab)
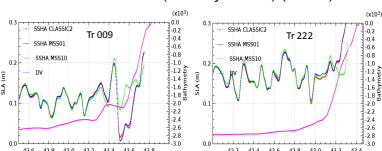
Fig 5: Example of SLA along Jason2 tracks, using different MSS.

MSS	Mean Cy 1 :307	Mean >Cy 261	Standard deviation Cy 1 :307	Standard deviation >Cy 261
CLS 01	11.86	13.03	16.31	18.01
DNSC 08	14.47	15.42	17.13	16.31
CNES CLS 10	11.39	12.63	15.15	15.10

Tab: Statistics on Jason1 along track SLA using different MSS, in the coastal areas (selection bathy < 100m).

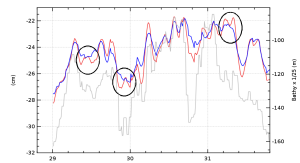### ➤Computation of High-Resolution Mean Profiles

Along-track precise Mean Profile (MP), consistent with standards and geophysical corrections used in SLA computation, and corrected from ocean variability, is more accurate than MSS. Accessing High Resolution (HR) MP is thus a crucial issue for precise HR L3/L4 altimeter product generation.
Use of **PM with 5Hz resolution** allows to sample signature of **bathymetry** variations than are not visible in **MSS.** Some examples are underlined in Fig 6.
5Hz resolution is suitable with applications such as geodesy internal waves, sub mesoscale, coastal ocenography.

Fig 6: Comparison between **MSS** and **mean track** with **bathymetric features** (Both are referenced to Geoid). Example along J2 track 226

Tailored Altimeter Products for Assimilation Systems (TAPAS)

In the framework of the MyOcean project, the ambition of the TAPAS workshop, which took place in Toulouse on April, 13-14 2010, was to initiate a common definition of a new generation of altimeter products better dedicated to assimilation and validation of model outputs.

In order to achieve this goal, the workshop had two main objectives to be reached:
• **to share the state of the art of altimeter processing and the needs for assimilation**: both CLS/Sea Level-Task Assembly Center (SL-TAC)and Marine Forecasting Centers (MFCs) have to understand the possibilities and the constraints on the usage of altimetry in assimilation scheme
• **to define new products to be developed and tested**. This requires also to have a common work plan between TAC and MFC

This workshop had been thought **as a first step** by which we might be able**, by the end of MyOcean project, to define and set up a new generation of products** for assimilation and validation of model outputs. This is a clear opportunity for the **west shelves and arctic** products that are expected for version 2 of MyOcean.

All along the workshop, a clear need has been expressed by the MFCs to clearly understand the different processings applied on altimetric data, that may have an impact on their oceanographic physical content. The different needs- sorted by main topics- expressed by the MFCs all along the workshop has expressed below:

This has led to the definition of a common dataset based on Delayed-Time products, that could be tested by the different MFCs in the framework of the MyOcean project. Two intermediate versions of this common dataset have been identified, corresponding to different production timings:
• Version-1 is characterized by its no filtering, nor sub-sampling
• Version-2 is similar to the first one, except that an additional correction (Long-Wave-Errors) is provided

A common action plan has been decided to evaluate the interest of such products. This synergical R&D activity will be carried on in 2011.

Studies are on going to improve high resolution altimeter products. Computation of a precise reference mean track with at least 5Hz resolution and improvement of editing processing allowing a better selection of valid data in open ocean and also in coastal areas, are two main points to be addressed.

[1] AVISO User Handbooks page : http://www.aviso.oceanobs.com/ in the directory /Data / Tools /AVISO user handbooks
* Since June 2010, the distribution policy through AVISO has shifted to an **authentified FTP access**. You **need to be registered** even if the access **remains FREE**.