Users Newsletter

September 2010, #5

Project News

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In-orbit missions

Jason-1 is now more than 8.5 years old. It is still providing very good data even though the star tracker performances generate some degradation when the satellite is flying under a specific configuration ; during these periods the star tracker availability is often low leading to increased mispointing angles. Thanks to the ground retracking used for offline I/GDRs products, the impact is minimized, but if the off-nadir angle is too large (i.e. more than 0.9 degrees) the altimeter may lose the return echoes, thus leading to some loss of data.

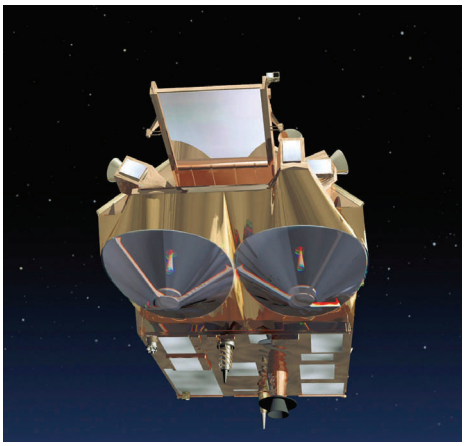
Many scenarios have been envisaged by a Joint Working Group composed of experts to find the best solution for the Jason-1 Extension of Life. On July 12, a CNES/NASA Joint Steering Group (JSG) Meeting approved the plan to keep the satellite on its current orbit after a partial tank depletion. The reason for partially depleting the fuel tank is to reduce the impact of an explosion in the event of a debris hit. The JSG also approved an emergency scenario in case of definitive satellite failure. The partial fuel tank depletion operations have been planned for the period from the end of July to the beginning of August but manoeuvres have been stopped due to a thruster problem currently under investigation. This has had an impact on products both in terms of quality and delay.

Jason-1 artist view (Credits CNES/D. Ducros).

More than 2 years after launch, the **Jason-2** products continue to provide high quality data to the altimetry community. New DORIS navigator software was uploaded in February 2010 greatly improving the performance of the real time orbit. With this new software, the radial rms is about 5 cm. The improved quality of orbit data positively affects near-real time OGDR products. Moreover, by modifying the processing chronology, Jason-2 IGDR products are now available to users within 1.5 days, meeting the mission requirements. Finally, GDR products are always open to improvement and will be modified to take into account the modifications required by the OSTST: new rain flag, new tide model, new calculation of radiometric parameters, added parameters in SGDR products, corrections of minor "bugs" and the usual file updates (altimeter characterization file, instrumental correction tables, wind & SSB tables). As a result, complete reprocessing of Jason-2 GDR-C products is planned for the end of 2010. To conclude Jason-2 news, the prototype aiming at improving altimetry products in coastal and hydrological areas (called PISTACH and tested on Jason-2 S-IGDR) still routinely, and for 2011 also, provides data and encouraging results. These new products are still under analysis by specific groups and users and the associated products handbook will be available in October on the AVISO website.

Concerning **ENVISAT**, the products are of very good quality (considering that there is no longer an S-band available). Complete reprocessing of the entire ENVISAT mission began in March 2010 but has been temporally stopped due to anomalies concerning Level 1 processing. This reprocessing is about to restart in October 2010 and will give better consistency between ENVISAT and Jason-1/2 missions. From the 22nd of October 2010, ENVISAT will be moved to new orbit and will continue its mission up to 2013.(http://envisat.esa.int).

Cryosat-2, ESA's ice mission, was successfully launched on the 8th of April 2010 from Baikonur by a Dnepr



Cryosat-2 front view (Credits ESA/AOES Medialab).

launcher. A few manoeuvres were necessary to correct the Cryosat-2 trajectory, as it was launched on an too elliptic orbit. First results of the mission were presented during the 2010 European Space Agency Living Planet Symposium, in June in Bergen (Norway). After almost three months in orbit, the satellite was in excellent health and scientists found the first ice-thickness data presented at the symposium very encouraging. (http://www.esa.int/export/esaCP/SEMBC5PZVAG_index_0.html)

Data from the DORIS instrument on Cryosat-2 are now available to users on the IDS website. For the moment, the Cryosat-2 altimetry data are available for selected scientists only, as part of the calibration and validation procedure. About 150 scientists from some 40 international research institutes have access to the data for analysis and fine-tuning. The commissioning meeting will take place in late October 2010 after a 6-month Calval period. Finally, the LTA (Long Term Archive) system, operated by CNES, has recently begun archiving the complete mission.

Ongoing developments

SARAL/AltiKa is a mission conducted jointly by ISRO and CNES. The satellite is due to be launched from India by mid-2011. Integration of the PIM (Payload Integrated Module) has now been completed. Environment tests, which began at THALES/Cannes in mid-May 2010, are continuing and the thermal vacuum test has just finished in mid-September. In October 2010, the PIM should be sent to ISRO, where an integrated platform should be completed in order to begin AIT around December 2010. The different parts of the SARAL ground segment have now been developed and integration tests of the SARAL PDS (Payload Data Segment) were finished by the end of July. Finally, validation tests of the ground segment, called GSOV (Ground Segment Overall Validation), have been scheduled for the end of 2010.

HY-2A is a joint French-Chinese project between CNES and CNSA/NSOAS for altimetry and orbitography products. The satellite is currently in its integration phase and launch is planned for June 2011.

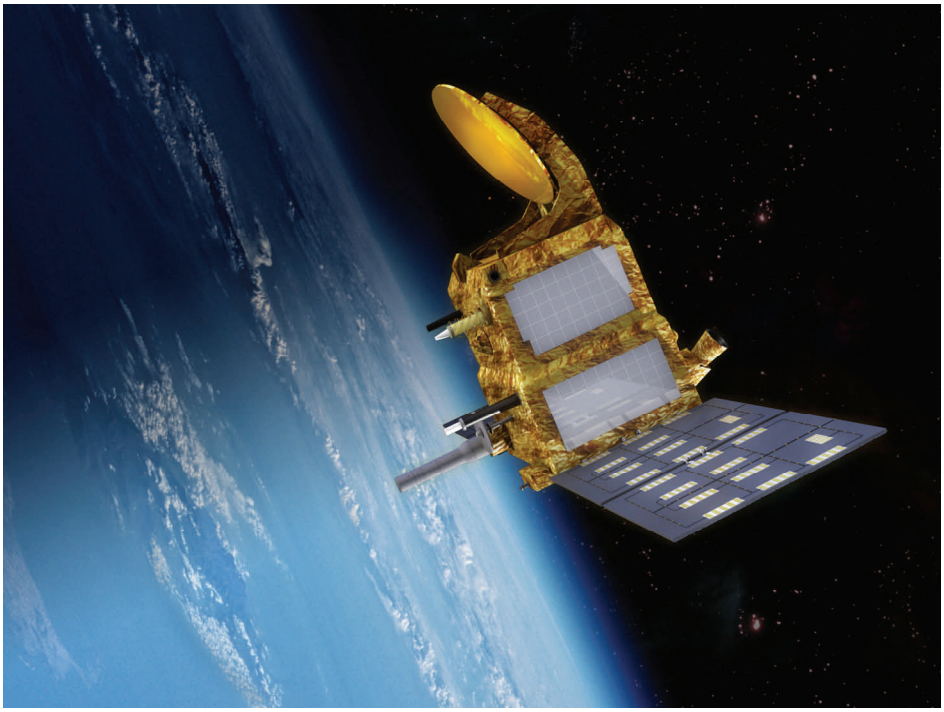
The **Jason-3** project (a joint EUMETSAT, NOAA, CNES and NASA mission) started officially at the beginning of March 2010 for the European part and mid-May 2010 for the US part.

The 4-partner Memorandum Of Understanding (MOU) was signed at the end of July 2010.

Instrument development is in progress. The integration of the PROTEUS platform equipment will be completed in the autumn of 2010. The Jason-3 features will be the same as those for Jason-2.

The launch is planned for summer 2013.

The ESA Sentinels will be the first series of operational satellites to meet the Earth observation needs of the European Union-ESA Global Monitoring for Environment and Security (GMES) programme. **The pair of Sentinel-3** satellites will provide global, frequent and near-real time ocean, ice and land monitoring. They will provide continuity with ENVISAT's altimetry, the multispectral, medium-resolution visible and infrared ocean and land-surface observations of ERS, ENVISAT and Spot, and include enhancements to meet the operational revisit requirements and to facilitate new products and evolution of services. Sentinel3-A development is going well with a system CDR (Critical Design Review) scheduled for early 2011. The launch is planned for April 2013.



Artist view of the SARAL satellite (Credits CNES-ISRO/GEKO).

New, reprocessed, delayed-time multi-mission (DUACS) data

AVISO is distributing the multi-mission SSALTO/DUACS products. Since 2002 these data have been reprocessed about every two years to provide users with a homogeneous series that is of the best possible quality and that covers as long a period as possible. A brief overview of the latest reprocessing is given here.

The multi-mission processing of altimeter data was developed by CLS as part of the Developing Use of Altimetry for Climate Studies (DUACS) European Commission project which started in February 1997. The project's purpose was to demonstrate that climate applications could receive multi-mission altimetry data in near-real time under operational conditions. Since the end of the original project, the near-real time (NRT) and delayed time (DT) components have continued to serve operational oceanography and climate forecasting projects. Thirteen years later, the system has been redesigned and significantly upgraded many times as the knowledge of altimetry processing was refined and as the oceanography needs evolved. It is now part of the CNES multi-mission ground segment SSALTO, and it is the backbone of the Sea Level Thematic Assembly Centre of the European project MyOcean. It also provides data and algorithms to ESA's Climate Change Initiative.

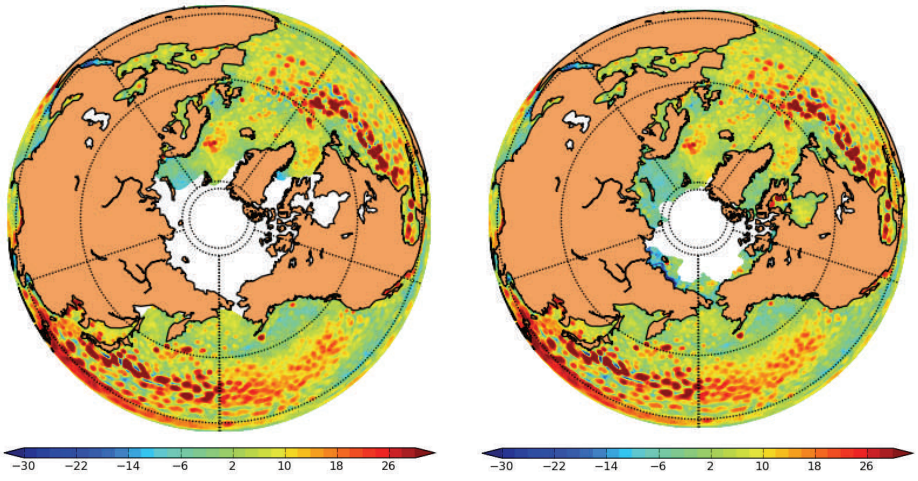
The main input data for the DUACS Delayed Time processing are the Geophysical Data Records produced by NASA or CNES (T/P, Jason-1, Jason-2), ESA (ERS-1, ERS-2, ENVISAT), or NOAA (GFO, Geosat) which are therefore of the highest quality, notably in terms of orbit determination.

However, it must be noted that in order to cross-calibrate the data, the DUACS processing needs the GDR data provided by all the missions at a given time. Since these are processed cycle by cycle (those ranging from 10 to 35 days), with a delay for getting the best quality for every correction and especially the best possible orbit, sometimes with a further delay due to investigation, missing data, etc., the delay between actual measurements and DT processing is of the order of several months.

About every two years, DUACS performs global reprocessing of data from all missions, taking into account recent improvements and new recommendations from the altimetry community, or new GDR releases from the Agencies as well as alternate ancillary datasets from other projects. Reprocessing on this scale is no small matter as it involves an update of the full climate data record with 60 years-worth of accumulated altimetry from 8 satellites (or 10 altimeters) and thousands of multi-mission maps. With the improvements from Jason-2 standards, DUACS carried out extensive reprocessing in 2009. It led to the DT-2010 product generation, released on AVISO on May 31, 2010.

Major changes from the previous generation (DT-2007, released on the AVISO website in early 2008) include the implementation of the so-called "GDR-C" standards (i.e. the standards adopted in Jason-1 GDR version C processing), either from actual reprocessing (Jason-1) or operational products (Jason-2) or from equivalent updates applied directly on the DUACS database (e.g. GOT4v7 tide model, High Resolution Dynamic Atmospheric Correction, etc.). New orbit solutions were used (CNES GDR-C for ENVISAT, GSFC for T/P and GFO) and various corrections were updated: new Sea State Bias solutions on T/P, ENVISAT and GFO (from Tran and Labroue, updated with GDR-C standards and the latest orbit solutions), minimization of brightness temperature drifts on ERS and computation of a new wet troposphere correction derived from activities carried out by CLS for ESA, together with new Mean Dynamic Topography (MDT_CNES-CLS09) for a sharper description of absolute topography features.

New Mean Profiles (i.e. mean sea surface height under the satellite's track) were computed from the GDR-C database update with a focus on interannual variability and coastal and high latitude coverage. Previous DUACS mean profiles were conservative in the trade-off between coverage and the risk of quality loss associated with coastal zones or ice coverage. The DT-2010 provides an extended coverage of multi-mission maps at high latitudes, as well as along-track products in coastal zones. The improved coverage comes from better editing processes and slightly relaxed confidence intervals on the mean profiles. In DT-2007 the time average was considered invalid if it was computed on less than 60% of the dataset lengths, whereas this criterion is now relaxed at higher latitude and complemented with cross-validation algorithms. Extensive validation of both mean profiles and along-track SLA were carried out to ensure that the extended coverage was still in line with quality control procedures.



Old (left) and new (right) MSLA Duacs Delayed-Time dataset on 2008/08/13 highlighting the better spatial coverage in high latitudes. (Credits CNES/CLS).

DUACS processing was also adjusted with minor changes in the mapping and editing and cross-calibration process. Climate applications were a priority for this reprocessing, so the transition date and the cross-calibration between consecutive reference missions exploited the most recent findings from the CalVal and Mean Sea Level communities (e.g. global or regional biases between TP/Jason-1 and Jason-1/Jason-2 are better accounted for). This reprocessing tries to ensure that the global and regional Mean Sea Level derived from multi-mission products are as consistent as possible with the regional Mean Sea Level derived from T/P and Jason-1 and Jason-2. The difference between the global sea level trend for DT-2007 and DT-2010 is 0.1 mm/year, and at basin scale the difference can be larger than 1 mm/year.

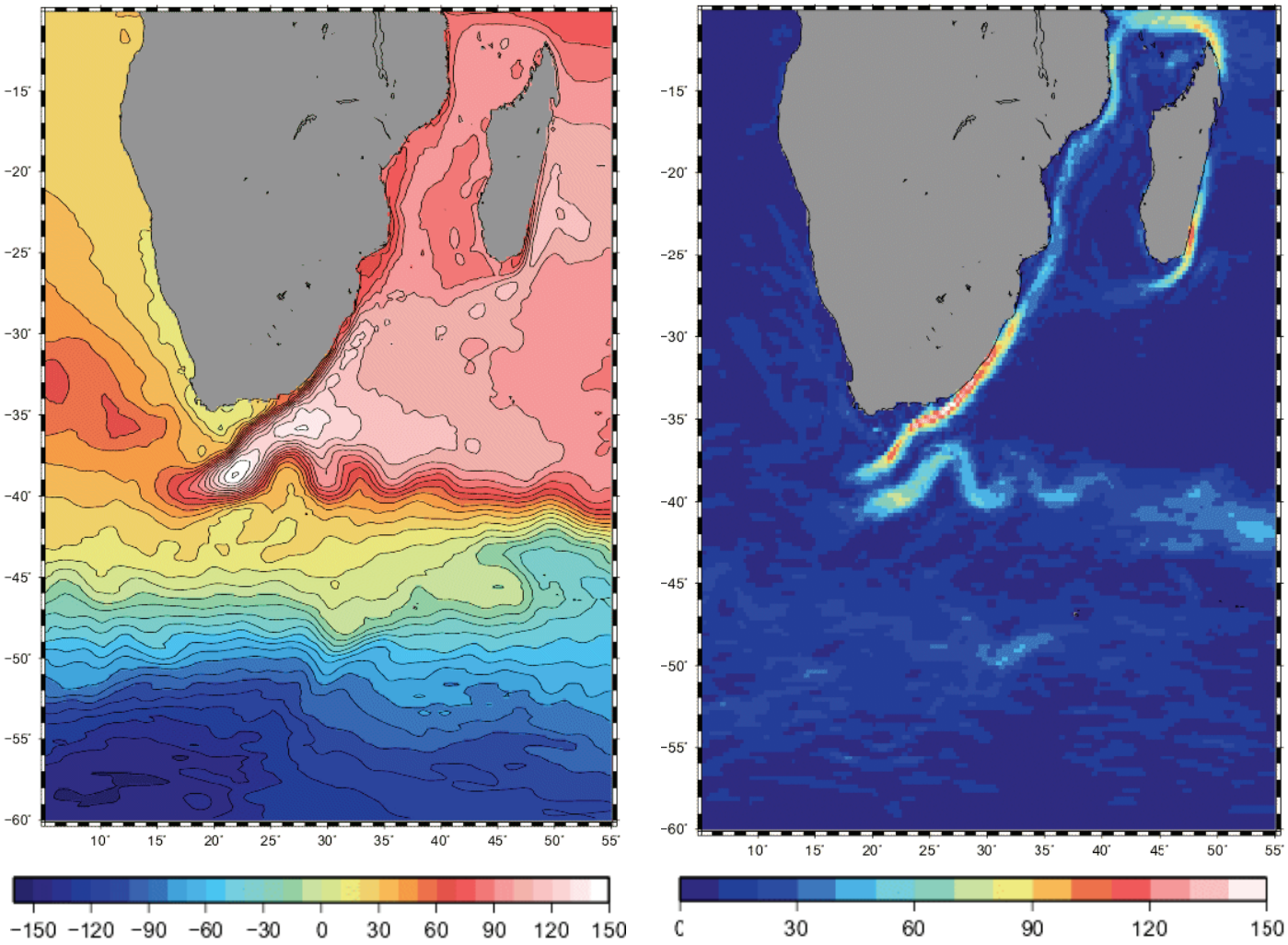
New Mean Dynamic Topography

The MDT is the mean sea surface above geoid, corrected for geophysical effects. MDT_CNES-CLS09 has been produced in the frame of the Sloop project, funded by CNES/SALP, aiming at improving the quality of altimetric products in open ocean.

Compared to the previous MDT RIO05, the main improvements are the use of geoid fields (EIGEN-GRGS.RL02.MEAN-FIELD) based on 4.5 years of GRACE data, of a longer dataset of drifting buoy velocities (1993-2008) and dynamic heights (1993-2007), which lead in part to a finer grid (1/4° instead of 1/2° for RIO05). Several processing improvements were also achieved.

New Mean Sea Surface

The mean sea surface corresponds to the sum of geoid plus mean ocean circulation. The mean sea surface MSS_CNES-CLS10 has been computed using a 16-year period of altimetry data. All these data have been preprocessed in order to be more homogeneous, and referenced to the period 1993-1999 (i.e. GDR-C standard in DUACS products), less contaminated by the variable ocean topography signal (the mean ocean topography signal contained in the surface thus corresponds to the mean sea level for the period 1993-1999). The surface has been estimated on a 1/30 of a degree (2 minutes) grid using a local inverse method, which also provides an estimation error field.

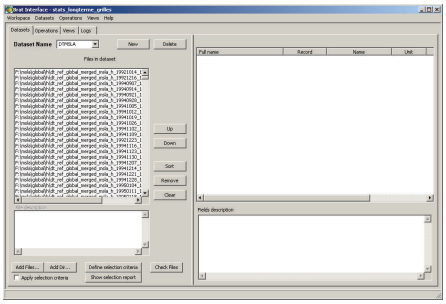


Agulhas mean dynamic topography (left, in cm) and current speed deduced from it (right, in cm/s). The use of seven more years of in situ data and of the Grace gravimetry satellite data enabled to precise the mean current path with respect to the old version (Credits CNES/CLS).

Making the most of 17 years of data

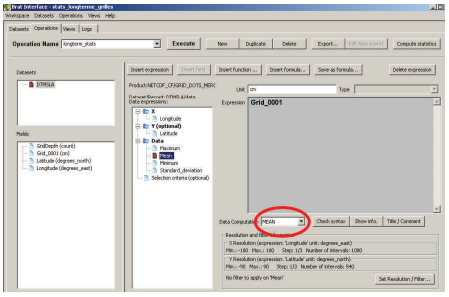
Thanks to the latest reprocessing, 17 years of homogeneous altimetry data are now available. This will enable you to examine the long-term statistical aspects of sea level anomalies.

The Basic Radar Altimetry Toolbox (BRAT) enables you to compute point by point statistics over a long period. The first step in this "Data use case" is to download a long time series (DT MSLA merged upd, h).



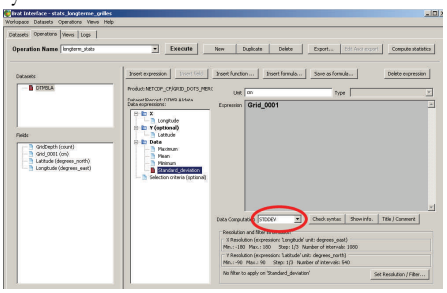
BRAT 'Datasets' tab, with the MSLA DT time series loaded.

The first task when using BRAT is to create a new workspace. A workspace enables you to save and re-use all the choices, computation formulas etc. you use during a session. The first time it is run, the software should open on the "Datasets" tab. Click on "New" (next to "Dataset name"), then on "Add Dir" at the bottom. Choose the folder where you have downloaded your time series data. The whole list of files will then appear in the box.



BRAT 'Operations' tab with the MSLA variable selected as data expression. Note, below right, 'Mean' chosen as Default in the 'Data computation' rolling list.

BRAT works by creating intermediary files (NetCDF) to visualise altimetry data. You therefore need to select a field or to compose an expression including several fields and create the file (by executing an "Operation"). Only then you will be able to visualise your data. Click on the "Operations" tab. Click on "New". A default name is given (operation_1). You can then start defining the expression you want to compute. Choose the dataset you have just defined. Below, you can see the list of available fields, with a short explanation in a popup tooltip that appears when your mouse hovers over a field.



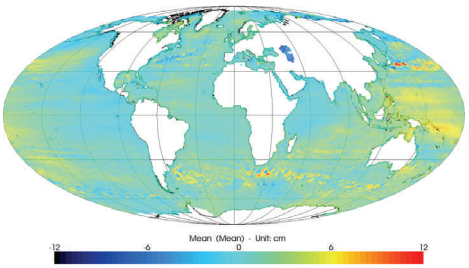
The same than before, but with 'Standard Deviation' chosen; this computation applies on the Data expression below.

In the "Data expressions" box you can see four items:

- "X", to be filled with the longitude; choose "longitude" in the list of fields, drag it and drop it in the "X" box.

- "Y" will be filled with "latitude"

- "Data expression": drag & drop "grid_0001" (which contains the MSLA height values) into the "Data expression" box several times. Below the box (left), you have a rolling list. The default value is "Mean". Leave the first Data expression as it is (re-name it "mean"); change the second for "std_dev", and change the name of the expression; you can also compute the minimum and maximum in the same way.

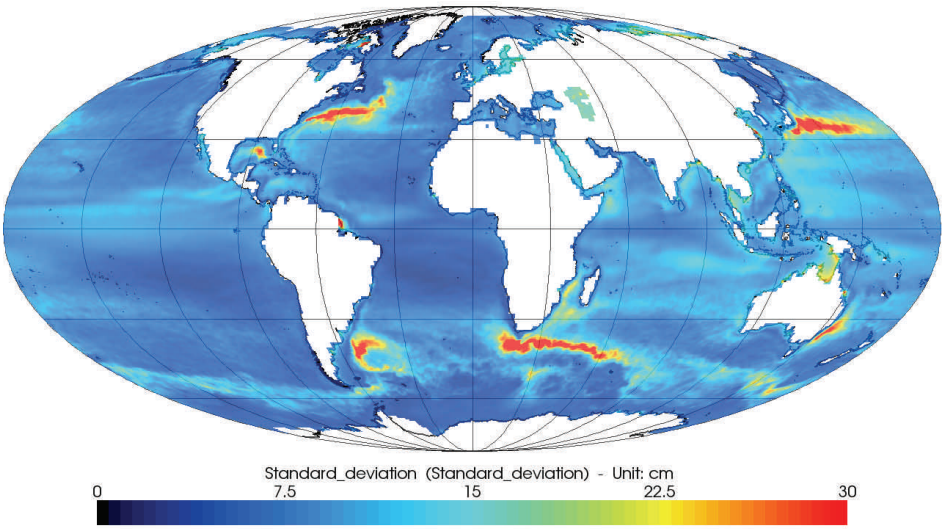


Graphic output for the 'Mean' computation.

Now, **click on "Execute"**, The "Log" tab opens, to monitor the operation. The full 17 years of data take quite a long time to compute (you can test on less data, e.g. one year, or 4 files 3 months apart). When the operation is finished ("ENDED"), the software switches automatically to the Operations tab (the tab from which the last operation was launched).

Go to the "Views" tab, and click on "New".

A list of available fields is given on the left; drag & drop the mean field or use the arrows to move it to the right. Then click on "Execute". The visualisation window opens, and you should see a map like the graphic output presented above. Repeat for the standard deviation.and obtain the graphic output presented below.



Graphic output for the 'Standard deviation' computation. Note, in red, the main areas of ocean variability.

Surveys and subscriptions: what you are telling us

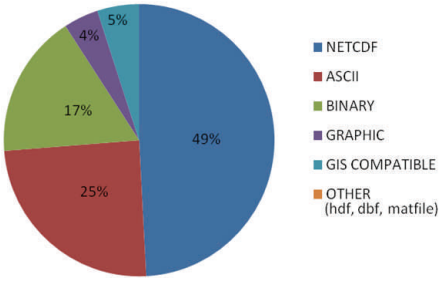
Over the past two years, AVISO asked its registered users to participate in surveys. Moreover, the online subscription form introduced in late May also serves (in part) the same goal: helping us get to know AVISO data users and their needs. Here is a summary of the answers we received, and how we intend to respond to them.

The main result of all the surveys, user feedback etc. we have is that, all in all, most AVISO users are quite satisfied (and even full of praise) with the data and information as they are. Which, to be honest, is very encouraging, but doesn't stop us trying to do better!

In September 2010 there are currently about 1425 registered AVISO data users (even more people have registered for the Newsletter). Teams using the data are based on all continents and in almost all countries. Most of the users are interested in gridded data. Some use several different levels of data, but where only one kind was chosen, it was MSLA/MADT or the derived geostrophic velocities. There are also many users who prefer the reference surfaces, especially Mean Dynamic Topography (in September 2010, 450 teams are registered around the world). About 500 requests were processed in 2009 by the AVISO User Service team (far more in 2010, due to the subscription process).

The first, more extensive survey, combined with an "open ocean" user survey was undertaken as part of the Sloop project (funded by CNES/SALP). It revealed that most users are oceanographers (42%), which was no great surprise. However, quite a lot of other applications were mentioned (climate 16%, atmosphere 15%). All the same, completely non-ocean (ice and hydrology) applications account for about 12% of users' fields of interest (note that several fields could be selected by the same user; indeed, an average of 5 fields were selected per user). In a similar vein, the subscription form showed that 5% of users work with both ocean colour and altimetry, concerning either phytoplankton or marine animals. "Mean Sea Level" is also one of the top sub-fields of interest mentioned, whether in the survey or in the subscription form.

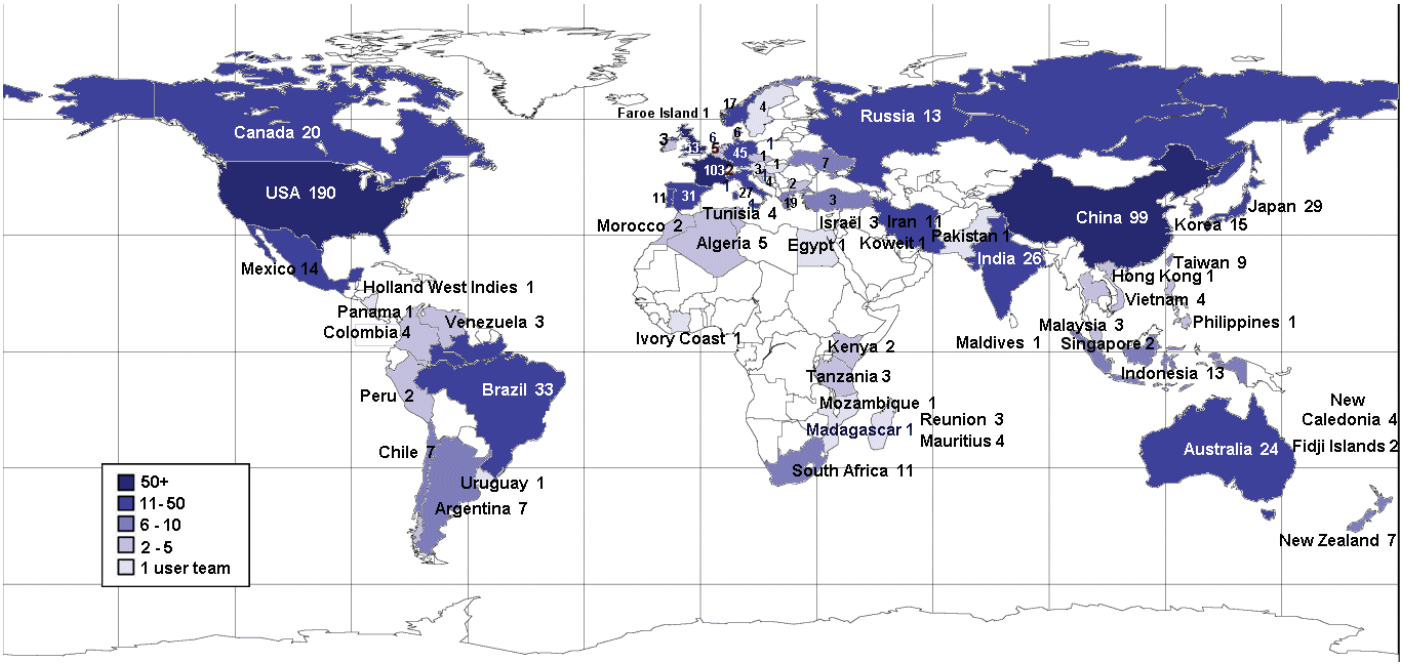
A question in that first survey asked users about their interest in coastal applications. An overwhelming number of them (80%) replied that they were interested. The "experimental Coastal and Hydrology products" produced in the framework of the "PISTACH" project (funded by CNES/SALP, see AVISO Users Newsletter #4) partly fulfil this need. However, what most users mean by "coastal" is "the ocean up to the beach", which is a rather difficult request to meet with altimetry.



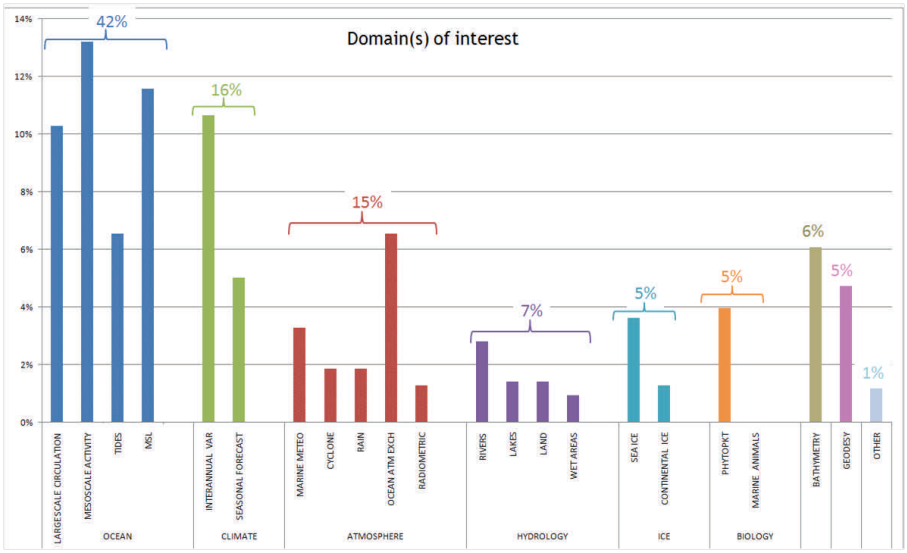
Data formats preferred by users (multiple answers possible).

In the latest survey (March-April 2010), the need for more information was the most obvious point to be improved. In particular, the corrections applied in the multi-mission data were one of the most frequent requests made in the comment field. This information has been added to the latest version of the "SSALTO/DUACS User Handbook: (M)SLA and (M)ADT Near-Real Time and Delayed Time Products".

The latest survey also revealed some dissatisfaction over FTP delays. Since the survey was very brief, this aspect is difficult to interpret – the delays were considered "average". Consequently, more frequent updates of the delayed time data are envisaged. It should be noted, however, that updating these data



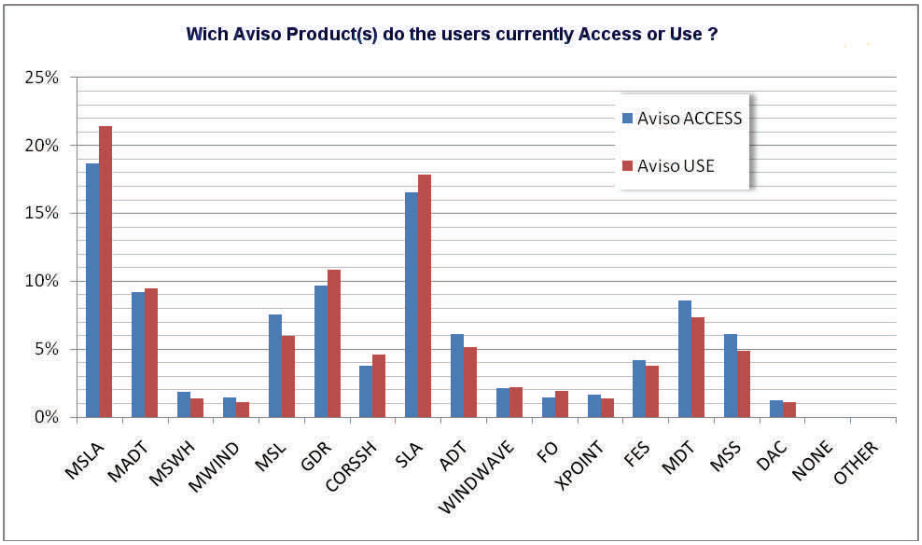
In June 2010, 949 user teams, representing 73 countries, were registered to get access to one or several Aviso data product.



Domains of interest chosen by users (multiple answers possible) in 2008 survey. This illustrates the wide variety of altimetry applications (note that the registration in place since June 2010 shows a much higher number of users in the 'marine animals' fields).

implies that all the satellites' GDRs have been processed and validated for a given date (this being done at the cycle level, i.e. a maximum of 35 days for Envisat; moreover, GDRs require precise orbit data, so at least 30 days are necessary to have all the elements to build these data, with not infrequently some more delay). Thus about three to four months after measurement is an absolute minimum for DT delivery delay.

ASCII data seem to be quite popular, even if NetCDF is the preferred format for nearly half of the respondents polled persons. On this question, the size of the ASCII file is one of our problems, which is why we tend to prefer NetCDF, which is now a standard in ocean data anyway. GIS formats are also on the rise and/or of common use in some application fields (such as hydrology, in particular); some thought will be given to this possibility. Users are definitely interested in being able to extract data according to geographical, time or variable criteria (or all of them), if only to lighten the downloads. AVISO already enables extraction on its gridded data. However, much more could be done especially at the level of multi-variable data such as GDRs or CorSSHs, and CNES is considering this possibility for the near future. This should also enable more frequent updates of GDR-like data, while also enabling some more fields to be added in a base that could be accessed by users.



Users answers to the 2008 survey: Aviso datasets accessed/subscribed to, and used (the higher number of datasets used with respect to the one accessed mostly means that not everybody retrieve his/her data himself/herself). Gridded data, and especially MSLA are the most wanted ones. (848 data selected, by 170 users having answered the question).

Acronyms Used in the graph above	**FO** Waveforms
(M)SLA (Map) of Sea Level Anomalies	**XPOINT** Crossover Point
(M)ADT (Map) of Absolute. Dynamic Topo	**MDT** Mean Dynamic Topography
MSL Mean Seal Level	**MSS** Mean Sea Surface
MSWH Map of Significant Wave Height	**DAC** Dynamic Atmospheric Correction
GDR Geophysical Data Record	**FES** Finite Element Solution (tides)
CORSSH Corrected Sea Surface Height	**MWIND** Map of Wind Speed Modulus

Events

- **14-15 October 2010** 4th Coastal Altimetry Workshop (Porto, Portugal)
- **18-20 October 2010** 2010 Ocean Surface Topography Science Team meeting (Lisbon, Portugal)
- **21-22 October 2010** International Doris Service Workshop (Lisbon, Portugal)
- **21-22 October 2010** Towards High-Resolution Remote Sensing of Ocean Dynamics and Terrestrial Surface Waters (Lisbon, Portugal)
- **3-17 December 2010** AGU Fall meeting (San Francisco, USA)

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