Users Newsletter

May 2012, #8

Project News

Prepared by E. Bronner and CNES project managers

Close to 4 years after launch, the **Jason-2** products continue to provide high quality data to users. It is considered as the reference mission for DUACS value added products. A reprocessing of the currently mission is planned by the end of 2012 to take into account historical bias corrections (datation and absolute range bias), algorithms improvements, geophysical corrections updates and products enhancements. The standard version of altimetry products and orbits will be GDR-D.

Envisat (Credits ESA).

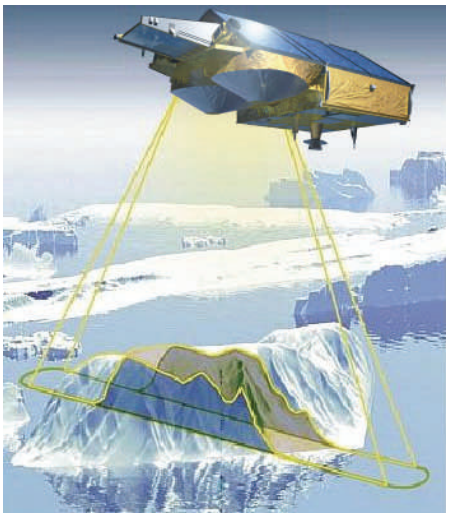
Concerning **Envisat,** on April 8 this year, the communication with the satellite was suddenly lost. In spite of many attempts to re-establish contact, the end of the Envisat mission was officially announced by ESA on May 9, 2012. Several failure scenarii have been elaborated but the failure reasons are not precisely known for the moment. Until April 7, 2012, the products are of very good quality but the observed increase in the solar activity has started to impact the product quality (no S-band altimeter). A complete reprocessing of the entire Envisat altimetry data set has been performed in 2011 and all products are available on the ESA ftp server hosted on F-PAC side. A validation report has also been issued to describe the major improvements between the previous GDRs products and the new v2.1 standard. Moreover, the POE has been updated with the latest GDR_D standard. Those GDR_D POE files are also available on the ESA ftp server hosted on F-PAC side.

Until mid-February 2012, the **Jason-1** data were of good quality and all the mission has recently been reprocessed in altimetric standard "C", meaning that more than 10 years of homogeneous GDR datasets are available. The Jason-1 ten years in orbit have been celebrated a few months ago but recent safe-hold modes have quickened the new mission phase scenario. After a partial tank depletion in 2011 (to reduce the impact of an explosion due to a potential debris hit), Jason-1 was moved to a long-repeat geodetic orbit at the beginning of May 2012, 12 km below the historical altimetric orbit shared with TOPEX/Poseidon and OSTM/Jason-2. From May 7, 2012, Jason-1 continues its ocean monitoring mission on a long repeat orbit that will provide valuable new information about the marine gravity field. Furthermore, its POE has been updated with the latest GDR_D standard to account for the update gravity field models (detailled in the Technical Note and Cerri et al. OSTST 2011, pdf). Finally, the Mean Sea Surface field of the product has been updated to take into account a more recent version (MSS_CNES-CLS-2011). Happy second life to you Jason-1!

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

About **CryoSat-2**, the overall performance of the mission is satisfactory, the space segment performed well with no major issues on the platform and payload. The overall ground segment performed nominally and the Payload Data Ground Segment (PDGS) has improved its performance markedly since launch. At the recent Ocean Surface Topography Science Team (OSTST) meeting, held in San Diego, 16-18 October, CryoSat was considered as a special guest. The meeting confirmed the great interest of the oceanographic community on CryoSat data and in particular the interest of exploiting SAR mode and SARIN

over the oceans. A general feeling is that this is the future of altimetry over the oceans.



Cryosat (Credits ESA/CLS)

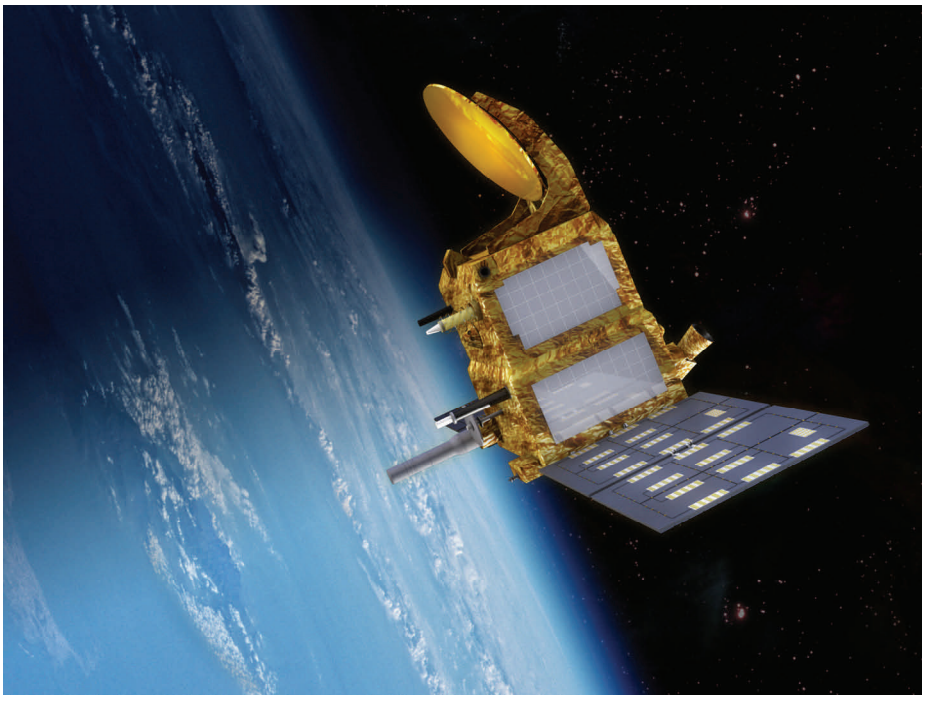
HY-2A is a Chinese mission and a French-Chinese collaboration between CNES and CNSA/NSOAS for altimetry (DUACS) and orbitography products (IDS). The launch took place from Taiyuan in China, on August 15 at 22h57 UT, using a "long march 4B" rocket. The DORIS instrument and the GPS were swiched-on on August 31 at 00h27 UT. The other instruments were switched-on in the following days. DORIS has converged in less than 5 hours and the instrument works nominally. POD products made with three techniques (Laser, GPS and DORIS) are very good. In addition, the CalVal is still running for altimetry products.

On-going developments

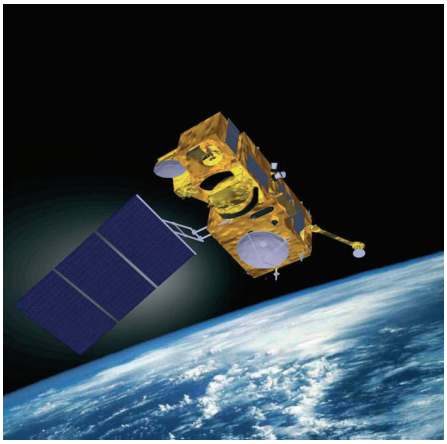
SARAL/AltiKa is a mission conducted jointly by ISRO and CNES with a launch currently planned by ISRO on PSLV during the 2nd half of 2012 from the Sriharikota launch site situated on the eastern coast of India. The technical validation tests of the Payload Data Ground Segment have been successfully completed in 2011, and the same kind of tests between CNES and the ISRO satellite Control Center are on going to validate the Flight Control Ground Segment.

Since summer 2011, the Payload Integrated Module developped by CNES with THALES has completed the whole sequence of qualification tests. It will be soon shipped to Bangalore to be integrated with the SSB platform realized by ISRO in order to perform the satellite electrical, performance and environmental tests in ISRO Satellite Center premises.

The **Jason-3** project (a joint EUMETSAT, NOAA, CNES and NASA mission) development is ongoing. The platform (PROTEUS bus) has been manufactured and validated end 2010. It is stored by waiting for instruments integration. Instruments development is nominal with delivery dates before March 2013. The ground segment development is nominal. Jason-3 products will be similar to the Jason-2 ones. First tests are planned in 2012. The launcher is on the critical path and is not yet selected for the mission. This induces delay that is why the launch date is postponed from mid-2013 to April 2014. The schedule will be revisited in case of no launcher decision is taken in coming months.



Saral (Credits CNES ISRO/GEKO)



Sentinel3 (Credits ESA)

Sentinel-3A development is going well, instruments flight model developments are ongoing and the integration on the platform is scheduled to start in September 2011. The launch is still planned for November 2013. The ground segment PDR has been achieved in April 2011 and the work sharing is clearly defined between ESA and EumetSAT. ESA will be responsible for the land products while EumetSAt will be responsible for the marine one's. CNES is providing expert support for the topography payload performances and for the ground processing. CNES has so initiated several studies to work on the retracking algorithms, in particular the SAR data retracking algorithm is extensively studied.

Integration of Cryosat-2 in DUACS multi-mission system

Since the launch of the altimetry satellites ERS in 1991 and Topex/Poseidon in 1992, radar altimetry has been observing continuously ocean surface topography and geostrophic currents, monitoring their variations all around the oceans.

During major crises such as the Deepwater Horizon and Fukushima disasters, ocean modeling centers were able to exploit remote sensing data, among which altimetry is of highest importance to predict the evolution of local marine currents in near real time, to help operations in the area and to help monitor these crises.

Cryosat-2 is an ESA mission ice-oriented but thanks to a long collaboration between ESA and CNES (initiated in altimetry with ERS-1), CNES is now authorized to process Cryosat-2 data over ocean and integrate them into the multi-mission DUACS system. These value added products, are distributed via AVISO since February 2012, to be used in the ocean community and assimilated in ocean models such as the MERCATOR-ocean one.

Interest of Cryosat-2 ocean data

Integrating Cryosat-2 in DUACS multi-mission products is of particular interest to reach high latitudes, only monitored by ENVISAT but not by the Jason family limited to a latitude of 66°. Moreover, the spatial resolution of gridded products can be globally improved adding new measurements. Finally, this integration has reinforced the data providing to operational oceanography users when ENVISAT mission suddenly stopped.

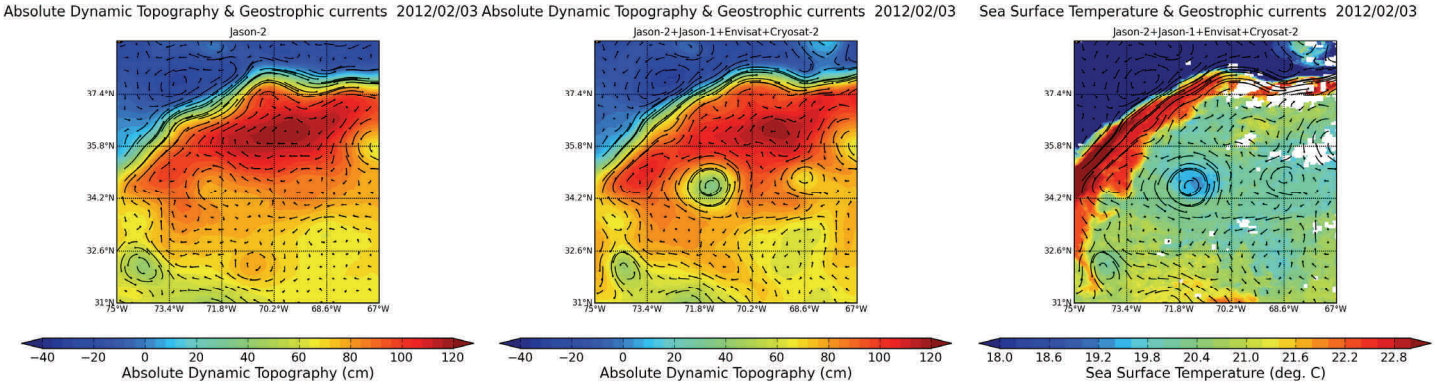
Cryosat-2 Processing Module at CNES

Cryosat-2 has an innovative altimeter measuring the Earth in 3 different modes: LRM*, SAR and SAR-in. In order to prepare the future and the processing strategy of Sentinel-3, CNES has decided to take the opportunity of the availability of Cryosat-2/SIRAL data to develop and test classical and innovative processing methods of Cryosat-2 data over ocean.

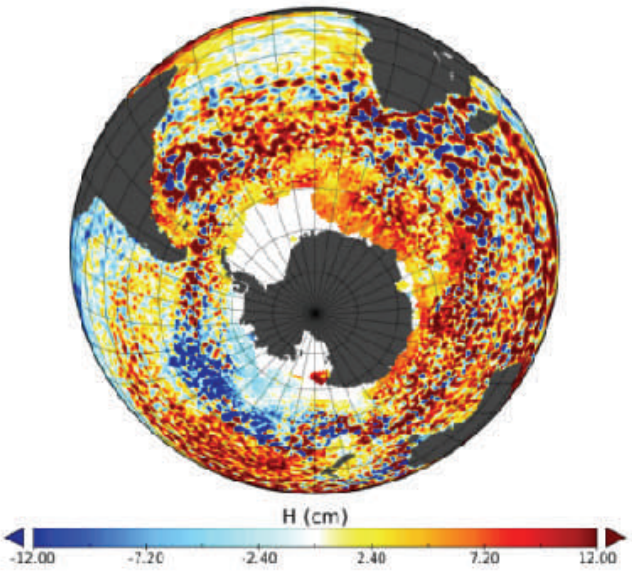
In that framework, CNES has developed a processing module of Cryosat-2 ocean data called CPP (Cryosat Processing Prototype). For the moment, this module consists in a LRM processing chain and a pseudo-LRM (SAR reduced data) processing chain ingesting Level0 data flows.

The outputs of this module feed the DUACS multi-mission system that is then more robust and benefits from a better data coverage, especially at high latitudes (up to 89° for the first time ever). The SAR processing chain development is achieved and under validation while the SAR-in processing development is not yet started.

All Cryosat-2 products from CNES are generated within 24 to 48 hours on a best effort basis, and Cryosat-2 has a higher error budget than other altimeters altimeters because of its cryosphere-oriented design (no radiometer, no dual frequency ionosphere, drifting orbit).



Maps of Absolute Dynamic Topography (in m) superimposed to absolute geostrophic currents (m/s) in the Atlantic Ocean on 2012/02/03 made from Jason-2 (left) and Jason-1+Envisat+Jason-2+Cryosat-2 (middle). Sea Surface Temperature-SST (in °C, right) superimposed to geostrophic currents. Merging of the four satellite data shows eddy that is invisible, or just barely visible with only one satellite and much better sorted out with four of them. The SST map shows the same eddy which corroborates the findings of the altimetry (Credits CLS/Cnes).



Multi-mission map of Sea Level Anomalies on 2012/01/01 exploiting 4 satellites: Jason-2, Jason-1, Envisat and Cryosat-2. (Credits Cnes-Ssalto/Duacs-Esa)

*LRM stands for Low Rate Mode corresponding to conventional altimetry, while SAR stands for Synthetic Aperture Radar and SAR-in for Interferometric SAR.

Data Use Case: Sampling in eddy structures

Adding Cryosat-2 in the Near-Real Time Ssalto/Duacs multimission system bring significant contribution to mesoscale observations. Here, an example mapping with the last release of BRAT.

The software

Developed under contract with ESA and CNES, the Basic Radar Altimetry Toolbox (BRAT) is an "all-altimeter" collection of tools, tutorials and documents designed to facilitate the use of radar altimetry data. The latest release v3.1.0 was performed in March 2012 including some upgrades in the software; which can be downloaded from the Basic Radar Altimetry Toolbox website.

Create a workspace and a dataset

We have chosen to represent and compare the Eddy Kinetic Energy (EKE, expressed in cm^2/s^2) for the current satellite constellation (Cryosat-2/Jason-2) computed from the maps of Sea Level Anomalies in Near-Real Time (NRT-MSLA) in the region of theGulf Stream. Firstly, create the workspace: Menu File > Workspace > New. Then download the first file onto your computer, for the Cryosat-2 satellite and for a given date (see how to access MSLA data from the AVISO website) from the authenticated ftp server : ex:/donnees/ftpsedr/DUACS/global/nrt/msla/c2/hnrt_global_c2_msla_h_20120328_20120328_20120404.nc.gz. Do the same for Jason-2 satellite, for the same given date.

With BRAT, list the data files needed to create your Dataset: on the Dataset tab, click on "New". A default name is given (Datasets_1), rename it with the corresponding satellites, (Dataset_C2, for Cryosat-2). Click on "Add Files" at the bottom left. Retrieve the file previously loaded onto your computer. Create a new Dataset for Jason-2.

Create an operation

Click on the "Operations" tab. Click on "New". A default name is given (Operation_1), rename it with the corresponding satellites (Operations_C2). You can then start defining the expression you wish to compute. Choose the dataset you have just defined (Dataset_C2). Below, you can see the list of available fields. In the "Data expressions" box (in the middle) four items are displayed:

• "X", to be completed with the longitude; choose "Longitude" from the list of fields on the left, drag and drop it in the "X" box, on the right.

• "Y" to be completed with "Latitude"

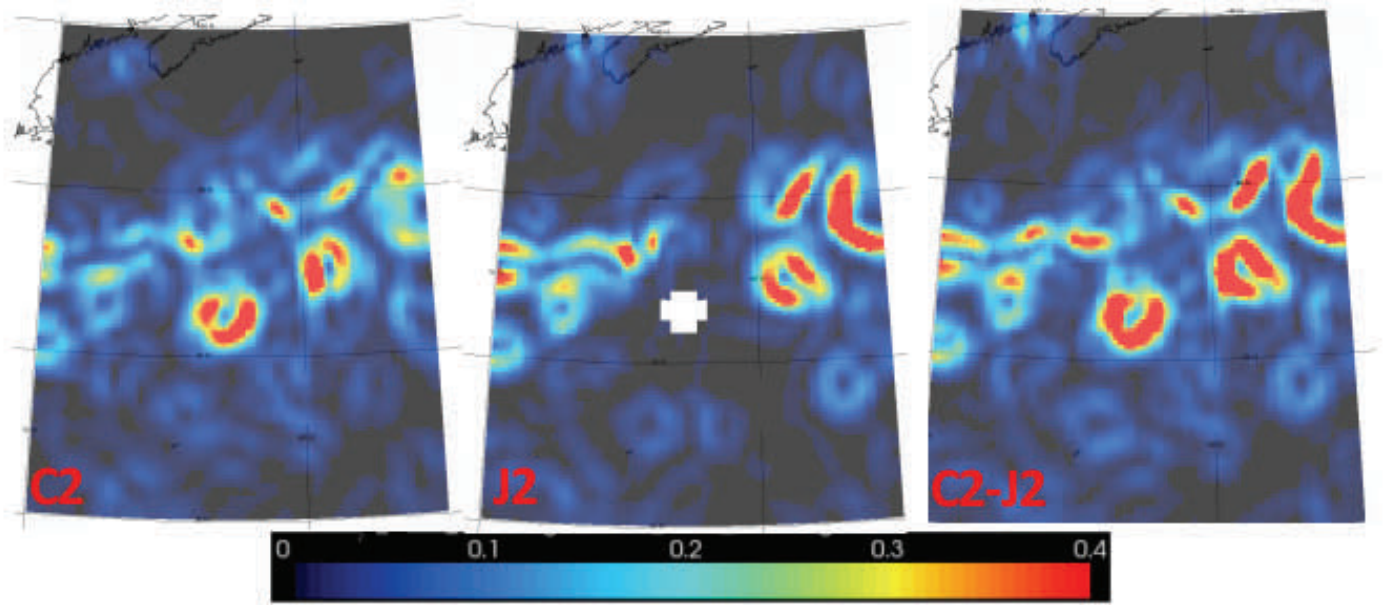
• "Data expression":

o drag and drop "Grid_0001" from the Fields (which contains the NRT-MSLA height values) into the "Data expression" box.

o With a right-mouse click on Data, select "Insert empty expression", and rename this new expression with "EKE_C2". Click on the grey box "Expression" and then on the "Insert algorithm" button. A pop-up window opens. Define the EKE computation ($EKE=1/2*(U^2+V^2)$) from the proposed algorithms: BratAlgoGeosVelGridU and BratAlgoGeosVelGridV which are the algorithms for the Geostrophic velocity Zonal and Meridional components respectively. Finally, the computation of EKE_C2 is: 0.5*((exec("BratAlgoGeosVelGridU", %{lat}, %{lon}, Grid_0001,5)*exec("BratAlgoGeosVelGridU", %{lat}, %{lon}, Grid_0001,5))+(exec("BratAlgoGeosVelGridV", %{lat}, %{lon}, Grid_0001,5)*exec("BratAlgoGeosVelGridV", %{lat}, %{lon}, Grid_0001, 5)))

From the Brat v3.1.0 version, some aliases are available. In the previous formula, they are applied to the longitude and latitude and are noted %{alias}. They enable you to use the same names for the most frequent data fields (even if they have not the same name in the file).

The spatial resolution for the downloaded NRT-MSLA data is 1/3° x 1/3°. We have chosen to increase it with a better resolution filter. When the EKE_C2 computation in Data is selected, press the "Set Resolution / filter"

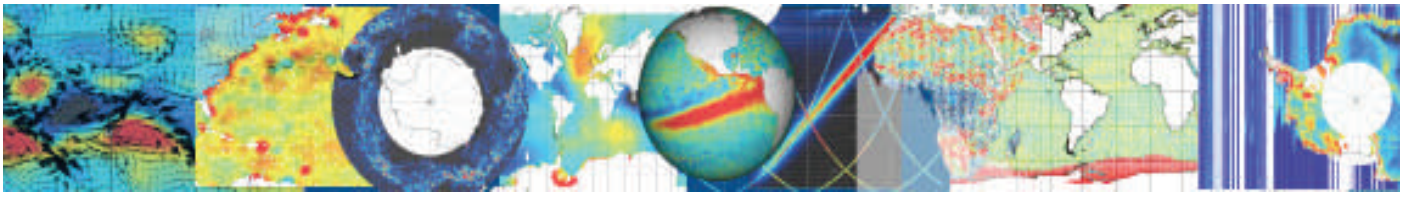


Maps of Eddy Kinetic Energy (in cm^2/s^2) for Cryosat-2 (left), for Jason-2 (middle) and for the merged Cryosat-2/Jason-2 (right, not computed in BRAT but with the merging process used in DUACS), in the area of the Gulf Stream, made from MSLA data on 2012/03/28.

button. A pop-up window opens. Choose to apply the "Loess" filter, to fill in the steps at 1/8 and the Loess cut-off at 7 for X and for Y. Close this window by clicking on OK. On the Operations tab, click on Execute to launch the EKE computation for Cryosat-2.
On the basis of the Cryosat-2 Operation, create one operation for Jason-2 in the Operation tab, by using the button "Duplicate" (when the Operations_C2 is selected). Be aware to well select the corresponding Dataset with the corresponding Operation_satellite; rename the Operation (Operations_J2) and the Data. Execute the operation.

Display the maps

Go to the "Views" tab, and click on "New" to create a new view. Rename it "Display_C2" for the Cryosat-2 view. A list of the available operations is given on the left; drag and drop the Operations_C2 to move it to the right. Finally, click on "Execute". Do the same for the Operation_J2. Due to its orbit parameters (sub-cycles adapted to cryosphere observations), Cryosat-2 missed the EKE spot around 62.5°W/37°N (but well tracked by Jason -2, see the three maps page 4). But, despite these limits in the sampling pattern, Cryosat-2 also enables to track some eddies not well plotted by Jason-2. In this example of a strong current, Cryosat -2 improves the position, shape and amplitude of some eddy structures (North-Eastern part of the maps) and can compensate the lost coordination between the Jason tandem.



An easy-to-use PISTACH coastal altimeter product

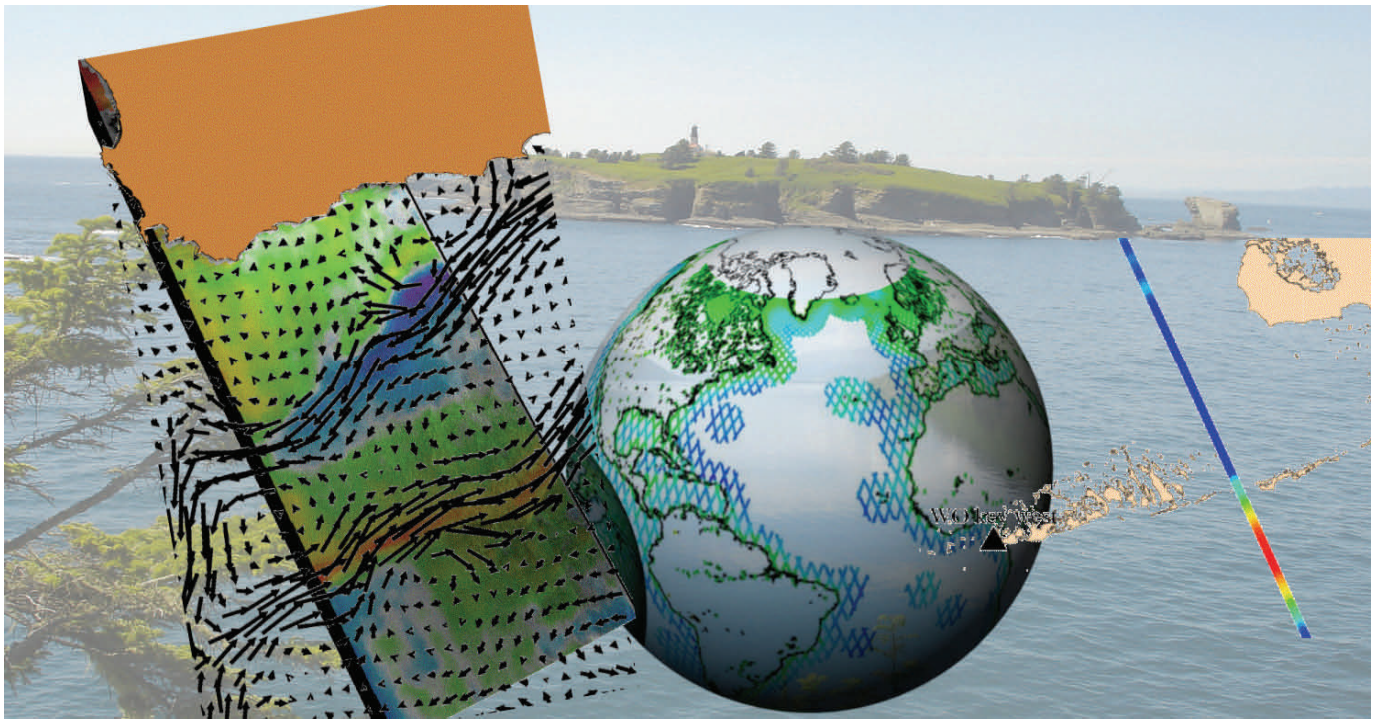
The experimental Jason-2 Level 2 coastal products, commonly called Pistach products, are distributed via AVISO since 2008. They offer new processing methods and corrections dedicated to coastal applications (80 extra fields in addition to the Jason-2 IGDR products (See the AVISO website).

The Level 2 Pistach products address altimetry experts and are quite difficult to use for non expert users. This is why Cnes envisionned simpler products for a wider dissemination. This new initiative will provide a directly usable Level 3 coastal product to address the needs of the scientific community: high resolution sea surface height on reference tracks. These products have been produced by CLS with the support of NOVELTIS and LEGOS and will be soon distributed via AVISO early in summer 2012.

On the basis of regional studies (Florida Keys, Agulhas current, …) and different means of validation (SAR, current meters, tide gauges data, CTOH products), these added value products show the following results:

- The high resolution data provides a better coverage approaching the coast with a better quality,
- The high resolution data helps to detect and map the small scale structures that are missed with standard 1 Hz products.

The new coastal processing method experimented on a few test zones will be provided to users and can be generalized to all coastal regions. Several scientific groups have already shown their interest for these PISTACH data, tell us your own interest by contacting AVISO to be kept informed with the next release.



Altimetry data to understand the biological pump

In last November, the scientific cruise KEOPS-2[1] was under way to cross the cold waters of the Southern Ocean. A specific support from CNES allowed to deliver the satellite data in real-time and in delayed-time, specifically processed for this area.

Fifty scientists were onboard the research vessel Marion Dufresne for the cruise KEOPS-2, which crossed the Kerguelen Plateau in the Howling Fifties, in the Southern Ocean. KEOPS-2 is a project funded by the Agence Nationale de la Recherche (ANR), the Centre National de la Recherche Scientifique / Institut National des Sciences de l'Univers (CNRS / INSU) and the Institut Polaire Paul-Emile Victor (IPEV).

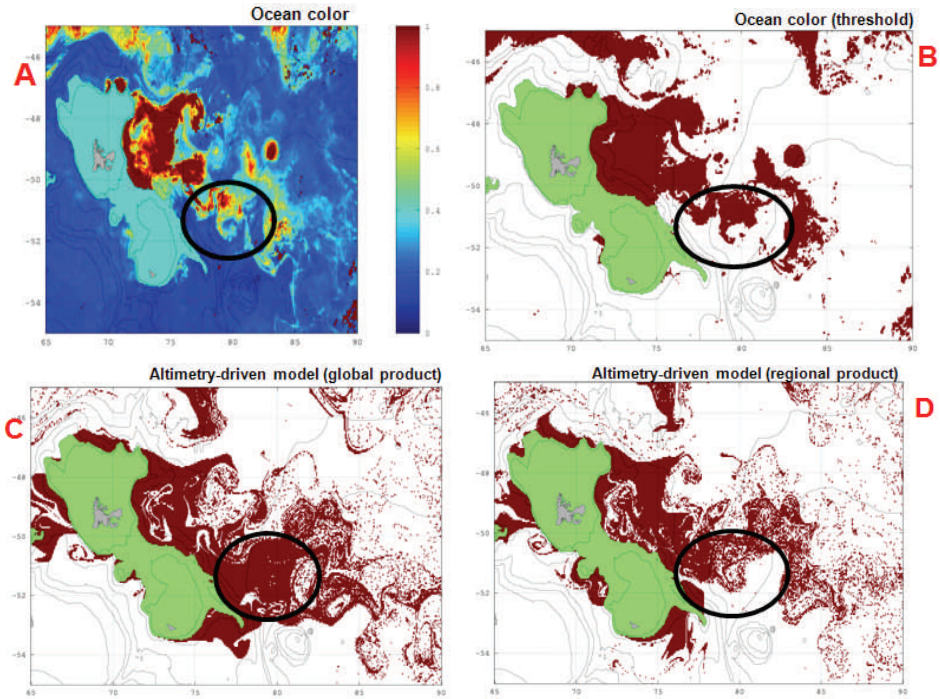
The biological pump

The phytoplankton within the upper ocean's sunlit zone enables to fix the atmospheric CO_2 through the process of photosynthesis. When it naturally die (when it is not grazed by the zooplankton), it sediment through the water column by trapping the CO_2, which will not return to the atmosphere for a long time period. This is called the biological pump, a major process in controlling the content of CO_2 and hence, the Earth's climate.

In several ocean regions, including the Southern Ocean, the biological pump is not optimal, despite the presence of abundant nutrients[2] The Kerguelen Plateau is an exception representing an oasis in the middle of an ocean desert. Its singularity has been demonstrated: some upwellings bring iron-rich waters toward the surface, dope the phytoplankton (diatoms), and trigger a bloom.

In this natural laboratory, in multiple stations and depths, the scientific team took seawater samples to measure nutrients (Nitrogen, Iron, Silica, Phosphate), to collect the microorganisms in order to understand the mechanisms between them.

One of the difficulties is to locate the research vessel in the right place, at the right time, exactly where the phytoplankton bloom develops. The remote sensing of ocean color enable to measure these blooms rich in chlorophyll, but they become inappropriate in case of cloudy weather. In this case, the radar altimetry takes over and becomes an advantage to adapt the sampling strategy.



(A-B) Ocean color image from MODIS / MERIS for the 11/11/2011. (A) shows the expected Chlorophyll concentration, (B) provides the pattern of the chlorophyll plume (obtained by setting a threshold on (A)). (C-D) Prediction of the bloom extension by a model driven by SSALTO/DUACS altimetry data. Panel C uses the global product, panel D the regional one. Credits LOCEAN/ F. d'Ovidio.

Dedicated data to model the plume

Thus during KEOPS-2, in partnership with CNES and in collaboration with the LEGOS, the SSALTO/DUACS data were specifically processed over the area of interest in order to describe in time and with a better spatial resolution the fronts and eddies where the biological activity is enhanced. A dedicated regional Mean Dynamic Topography has been computed with an improved spatial resolution (1/8°), an update of the *in situ* datasets, the use of the latest geoid model including GOCE data and a correction of the drifting buoy dataset on undrogued drifters. Altimeter sea surface heights products have been specifically processed for the area with an optimized inter-track decorrelation radius, and with an optimized along-track noise reduction, with specifically ajusted low-pass filtering.

During KEOPS-2, a model of the plume extension developed by LOCEAN, ran in near-real time on board the research vessel. The model was fed by the SSALTO/DUACS regional product and allowed to adapt the sampling strategy, by which the position of the sampling stations were adjusted day-by-day to the position of the plume.

The comparison between observed and modeled patterns, and, the comparison, when it is possible, between the ocean color and the altimetry data have shown nice fit. Similarly, some comparisons between both altimetry products (the global and the regional ones) have shown that the regional products is clearly better

Currently, even if the scientific cruise finished, the project follows. *In situ* data collected at sea will contribute to calibrate the satellite measurements and to improve the models. The near-real time altimetry data used during the campaign will be reprocessed through the process of SSALTO/DUACS Delayed-Time products and will be also used for the interpretation of the results.

1 KErguelen Ocean and Plateau compared Study
2 These areas are called HNLC : High Nutrients-Low Chlorophyll.

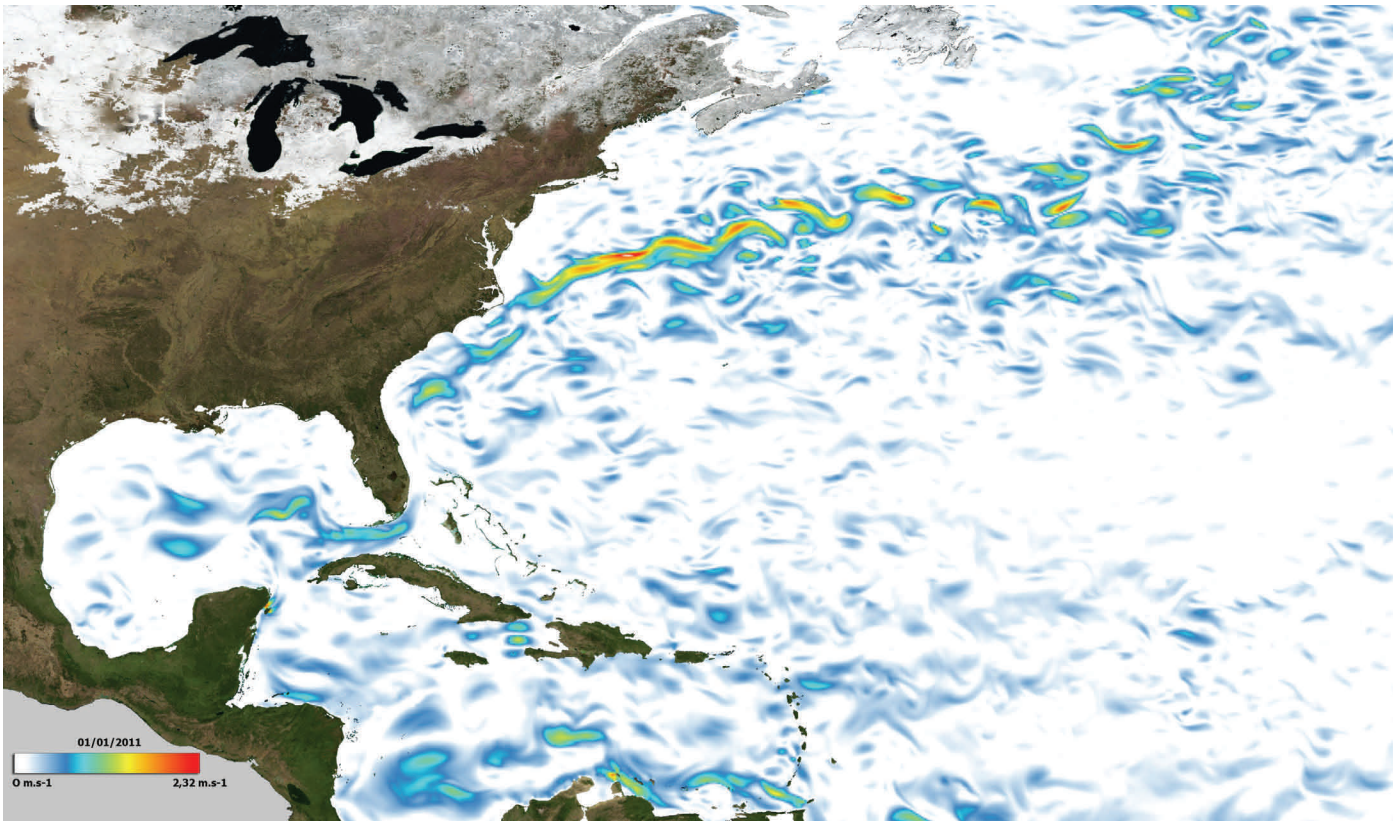
Calls for contribution

During the next Venice event, combining the "20 years of Altimetry" symposium and the OSTST meeting, we organize an exhibition called **"20 years of Art-imetry and Models"**.

This event will aim at showing how science and models can be impressive and beautiful representing natural events. We already have 10 to 15 images summarizing main phenomena that occurred in the past two decades and we are searching for users or PI's contributions to complete the exhibition.

If you have research results that are nice to look at or that speak for themselves, do not hesitate to send an image to aviso@oceanobs.com. A jury will select the best AVISO users contribution and they will be printed in high resolution and be part of the exhibition in the Palazzio Casino, in Venice.

Credits MIRA



Events

17 - 22 July 2012 : IGARSS, Munich, Germany

3 - 7 September 2012: Eumetsat conference, Sopot, Poland

20 - 21 September 2012: 6th Coastal Altimetry Workshop, Riva de Guarda, Italy

24 - 29 September 2012: 20 years of progress in Altimetry - OSTST Meeting – IDS, Venice, Italy

6 - 10 December 2012: AGU San Francisco, USA

Aviso Users Newsletter

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