



# Envisat GDR Cross calibration Report

**Cycle 123**

***03-11-2011 13-11-2011***

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## 1. Introduction. Document overview

The purpose of this document is to report the major features of the cross-calibration between Envisat and Jason-2 missions. The document is associated with data dissemination on a cycle by cycle basis.

The objectives of this document are :

- To present the major useful cross-calibration results for the current cycle
- To report any change likely to impact the comparison between Envisat and other missions, from instrument status to software configuration

It is divided into the following topics :

**Cycle overview**

**Cross Calibration with Jason-2**

**Particular Investigations**

## 2. Cycle overview of each mission

### 2.1. Versions and Cycles used for Jason-2

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**Envisat** cycle 108 has been produced with the IPF processing chain V6.04 and the CMA Reference Software 9.3\_05. The content of this science software version is described in a document available on the ESA PCS web site ([4]). The Envisat quality assessment report ([5]) summarizes the major features of the Envisat data quality for this cycle of data.

Note that for an unknown reason, a change of behaviour of the Ultra Stable Oscillator (USO) clock frequency occurred in February 2006. Since Envisat cycle 65 pass 451 (2008/01/23), the anomaly has disappeared.

Users are strongly advised not to use the range parameter in Ku and S Band without this correction, even for the non-anomalous periods, in order to correct the range from the long term drift of the USO device. More information is available on <http://earth.esa.int/pcs/envisat/ra2/auxdata/>. Users are strongly advised not to use the range parameter in Ku and S Band without this correction, even for the non-anomalous periods, in order to correct the range from the long term drift of the USO device. More information is available on <http://earth.esa.int/pcs/envisat/ra2/auxdata/>.

Note that since Envisat GDR cycle 93, users do not have anymore to correct data from any external USO correction.

Ten hours after the recovery of the HSM anomaly on the 17 January 2008, a drop of the RA2 S-band transmission power occurred. Consequently, all the S-band parameters, as well as the dual ionospheric correction are not relevant and **MUST NOT** be used from the following date : 17 January 2008, 23 :23 :40 (Envisat Cycle 65 pass 289). Users are advised to use the Ionospheric correction from GIM model, which is available in GDR data products.

This quality assessment has been done using the USO correction included in the products and using a mix bifrequency-GIM ionospheric correction (since cycle 93).

The cross-calibration with **Jason-2** GDRs has been performed with Jason-2 GDRs cycle 123. The Jason-2 quality assessment report ([2]) summarizes the major features of the Jason-2 data quality for these cycle of data.

## 2.2. Contains of SLA

The different parameters used to compute the sea surface height (SSH) for Envisat, Jason-1, Jason-2 and ERS-2 are :

| Contain                         | Envisat                        | Jason-1                             | Jason-2                   | ERS-2                      |
|---------------------------------|--------------------------------|-------------------------------------|---------------------------|----------------------------|
| Ku range                        | Ocean Retracking               | Ocean Retracking                    | Ocean Retracking          | From OPR                   |
| POE Orbit                       | From GDR-C (1)                 | From GDR-C (2)                      | From GDR-C                | From D-PAF                 |
| Iono Correction                 | IONO GIM Since S Band loss (3) | Filtered Bifrequency                | Filtered Bifrequency      | GIM (6)                    |
| Wet Tropo Correction RADIOMETER | From WMR                       | From JMR                            | From AMR                  | From MWR                   |
| Wet Tropo Correction MODEL      | From ECMWF                     | From ECMWF                          | From ECMWF                | From ECMWF                 |
| Dry Tropo Correction            | From ECMWF Cartesian Grids (4) | From ECMWF Cartesian Grids (4)      | From ECMWF Gaussian Grids | From ECMWF Cartesian Grids |
| Non parametric sea state bias   | GDR-B Standards                | GDR-C Standards since Cycle 233 (5) | GDR-C Standards           | From Mert et al, 2005      |
| Barometer Correction            | MOG2D High Resolution          | MOG2D High Resolution               | MOG2D High Resolution     | MOG2D High Resolution      |
| Ocean tide height               | GOT00                          | GOT00                               | GOT00                     | GOT00                      |
| Geocentric pole tide height     | Wahr J.W 1995                  | Wahr J.W 1995                       | Wahr J.W 1995             | Wahr J.W 1995              |
| Solid earth tide height         | Cartwright and Edden 1973      | Cartwright and Edden 1973           | Cartwright and Edden 1973 | Cartwright and Edden 1973  |

TAB. 1: Geophysical corrections used corresponding cycle

(1) GDR-A until Cycle 41 and GDR-B until Cycle 68

(2) GDR-B until Cycle 233

(3) S-Band loss : 17/01/08 Cycle 65

(4) Model with the solar S1 and S2 atmospheric tide components

(5) Before Cycle 233 : Venice 2006 Version Standards

(6) Before Cycle 36 : Bent Model

Most comparisons were performed using the ECMWF wet troposphere correction for both Envisat and Jason-2, to prevent possible discrepancies from radiometer corrections. In some particular cases, the radiometer corrections are also used. It will be precised in the document.

Different corrections are updated for each mission with reference to the products. They are detailed in Tab.1.

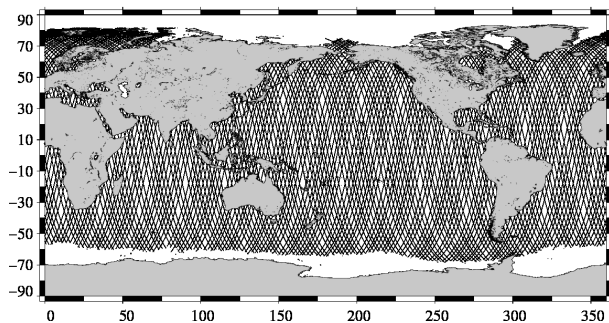
### 3. Cross Calibration with Jason-2

Jason-2 GDRs data (cycle 123 to 123) are used for this cross calibration.

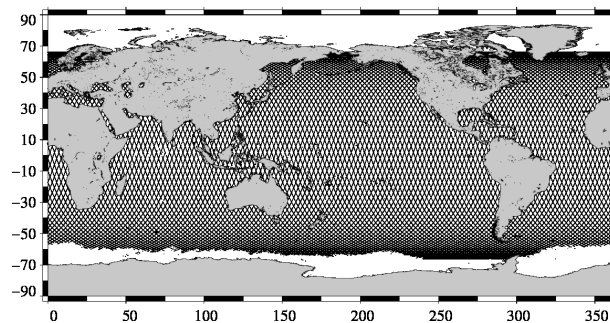
Statistics are computed on a J2 cyclic basis (10 days). An average per boxes is performed, prior to the statistics in order to allow us to have homogeneous sampling of the ocean for the 3 satellites .

As Envisat have 35 days cycles (respectively 30 day after cycles 95 for its drifting orbit phase), EN data are considered on subcycles (corresponding to J2 10 days cycles).

ENVISAT 10-day coverage for Jason-2 cycle 123



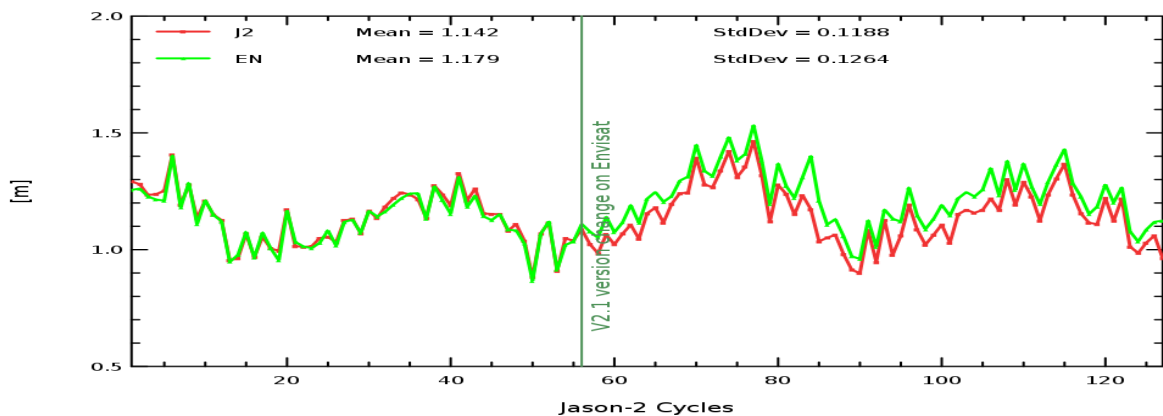
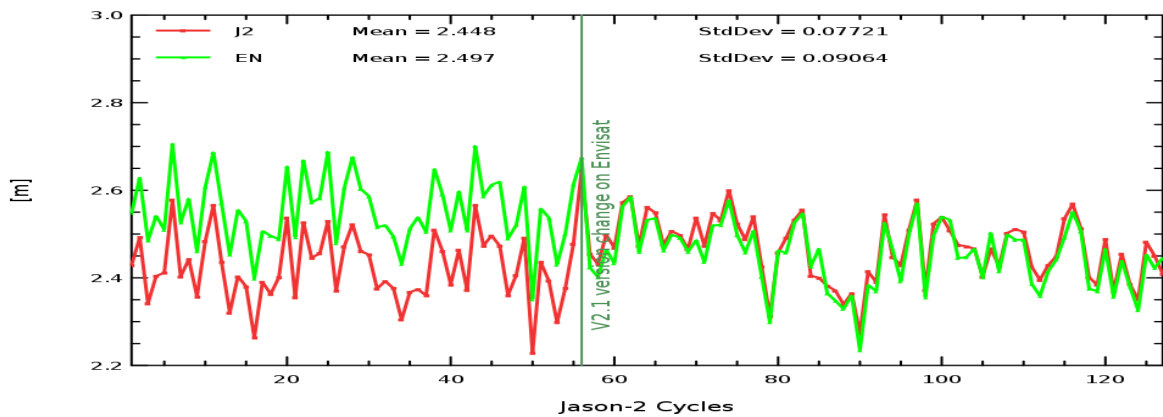
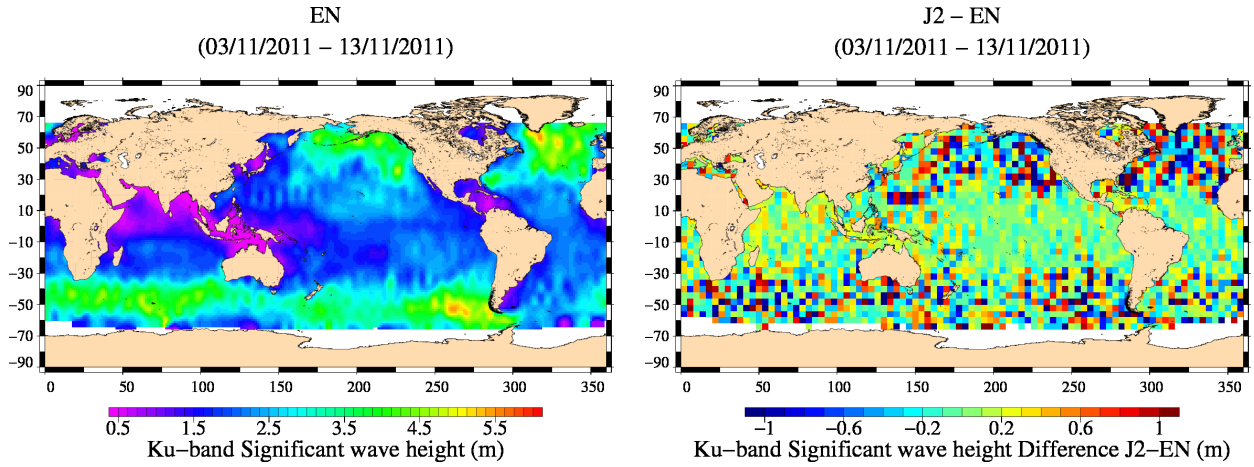
JASON 2 10-day coverage for Jason-2 cycle 123



### 3.1. Instrumental and geophysical parameter analysis

#### 3.1.1. Significant Wave Height

The J2-basis cycle per cycle mean and standard deviation of Ku-band SWH for J2 and EN is plotted as a function of the cycles number on the following figure :

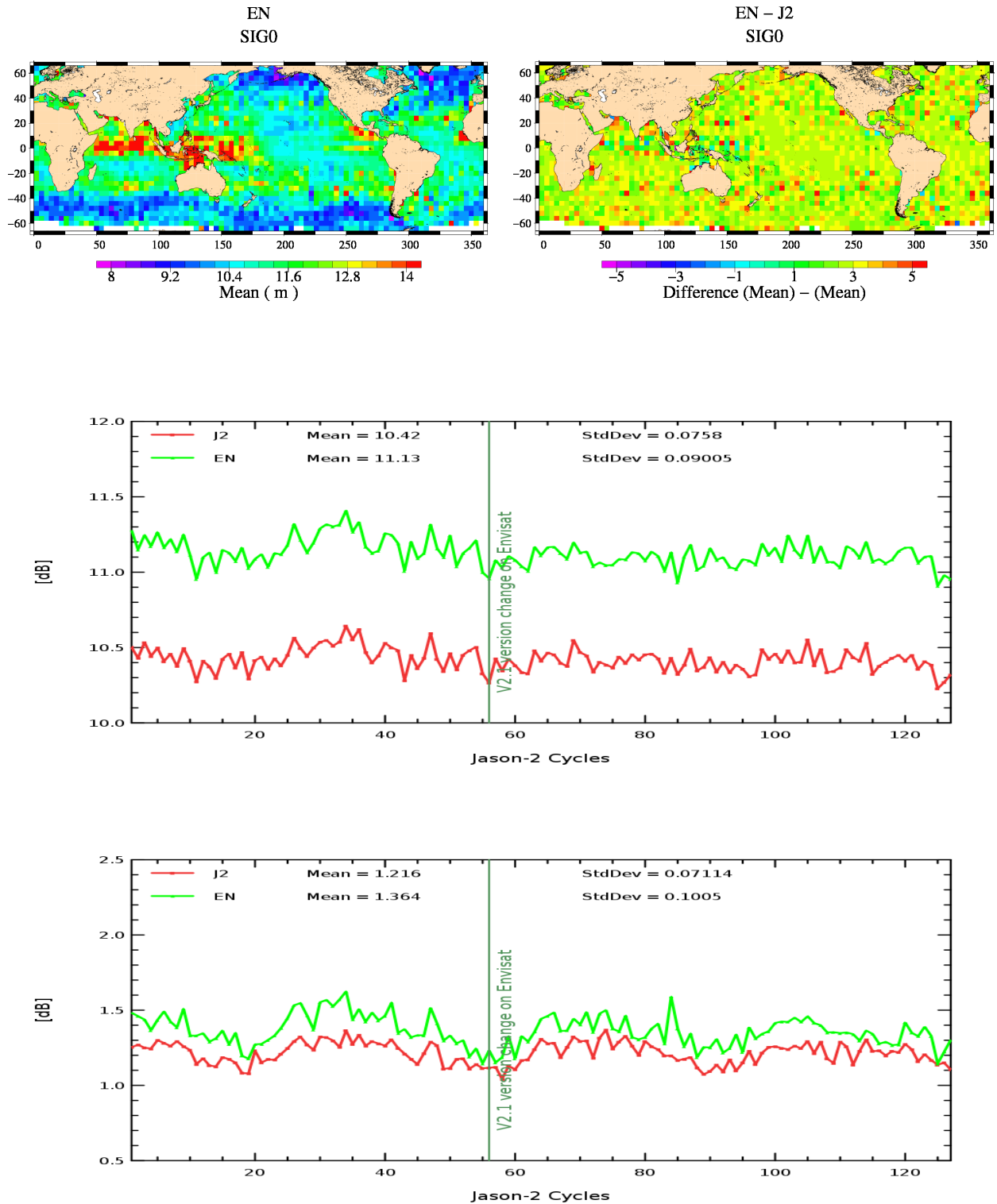


Since cycle 56 of Jason-2, mean of Envisat SWH decreases by about 13 cm due to the IPF/CMA upgrades (See particular investigations). The bias between J2 and EN SWH is reduced.

Weak impact is noticed before/after cycle 85 of Jason-2 (Envisat change of orbit).

### 3.1.2. Backscattering coefficient (Sigma0)

The J2-basis cycle per cycle mean and standard deviation of Ku-band Sigma0 for J2 and EN is plotted as a function of the cycles number on the following figure :

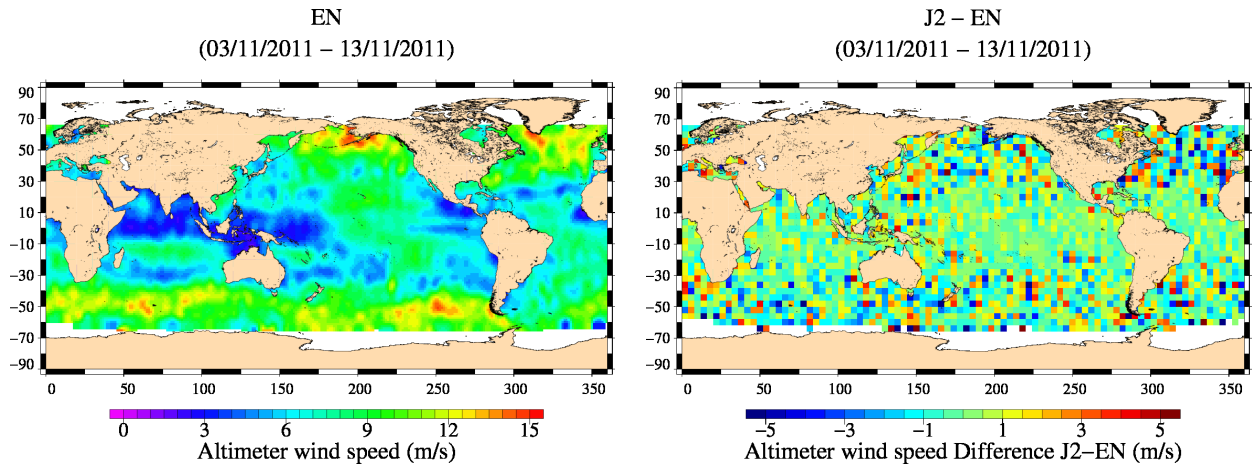


Note that in EN Gdr products, a -3.5dB bias has been applied (Roca et al., 2003 [63]) on Envisat's Ku-band Sigma0 in order to be compliant with the wind speed model (Witter and Chelton, 1991 [77]). For this particular figure, the same bias was applied on J2 curves.



### 3.1.3. Altimeter Wind Speed

The J2-basis cycle per cycle mean and standard deviation of Wind Speed for J2 and EN is plotted as a function of the cycles number on the following figure :



## 3.2. Crossover analysis

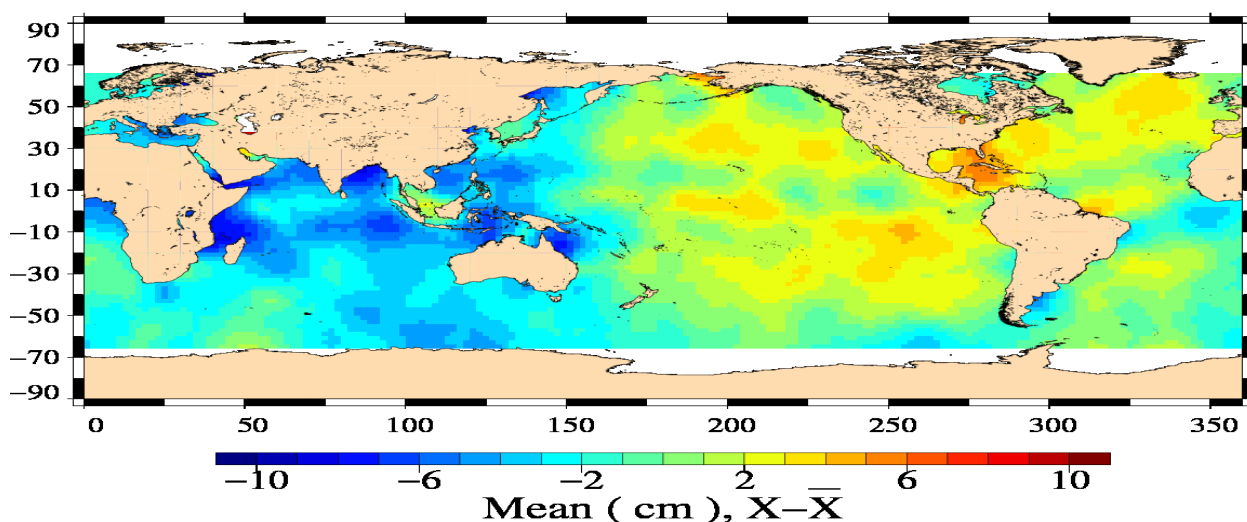
### 3.2.1. [Envisat - Jason-2] Maps of SSH crossover differences

[Envisat - Jason-2] SSH differences at crossover points with 10 day time lag are computed in two configurations :

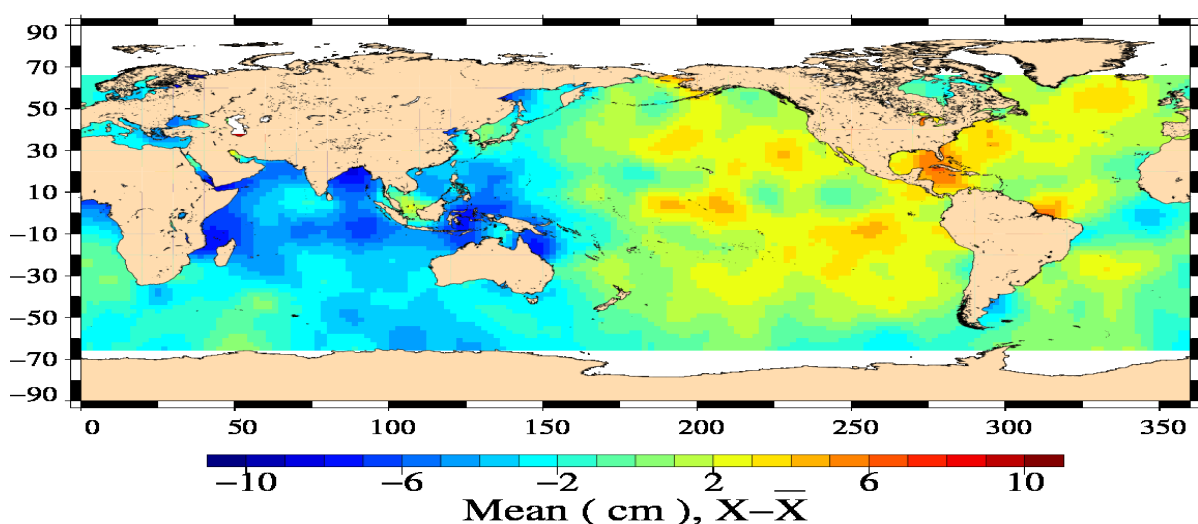
- using the radiometer wet troposphere correction
- using the ECMWF wet troposphere correction

The differences are plotted on the following figure (data are centered about the mean value) :

**EN/J2 Crossover mean Differences (cm)  
(03/11/2011 – 13/11/2011)**

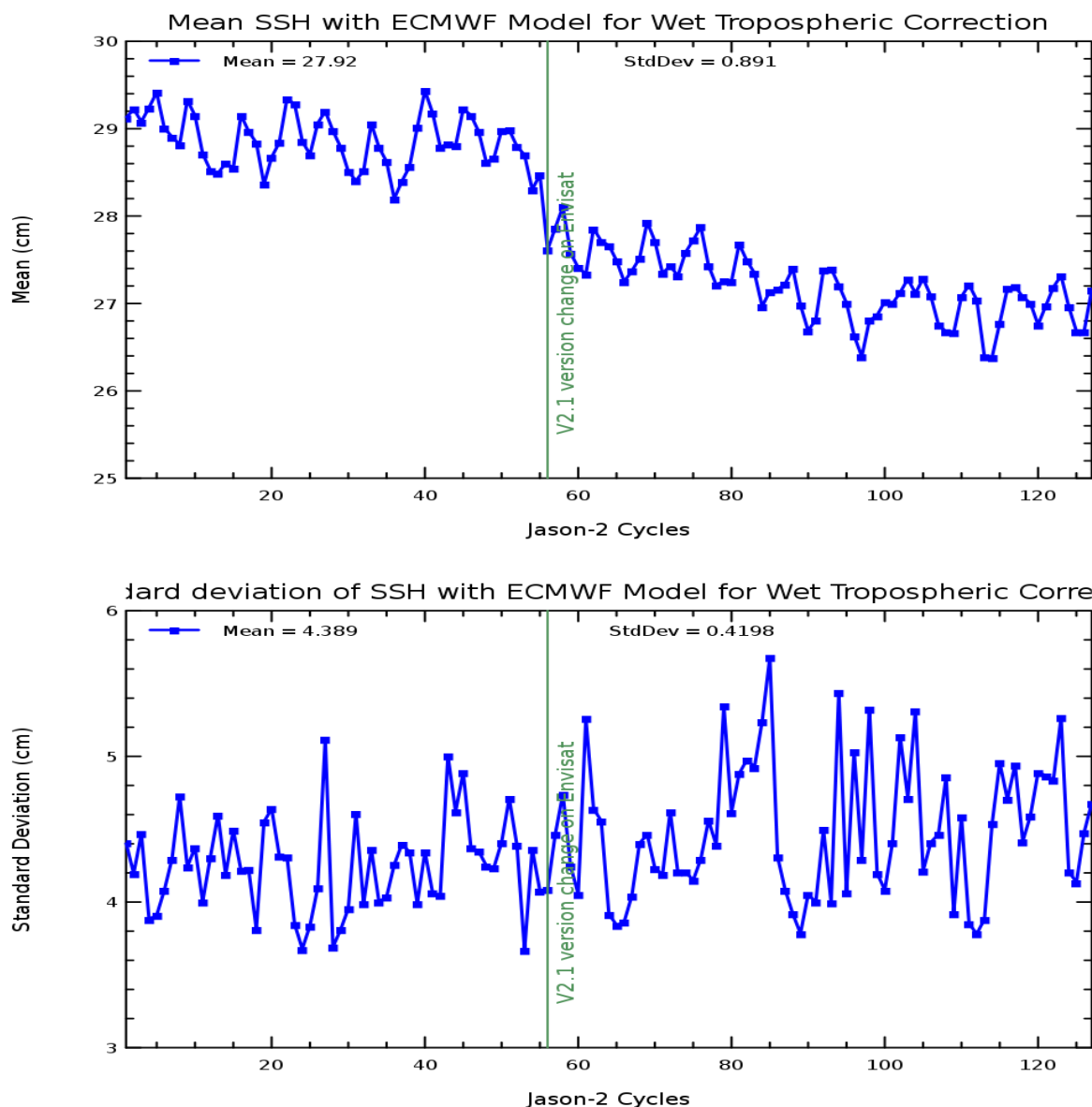


**EN/J2 Crossover mean Differences with ECMWF Wet Tropo (cm)  
(03/11/2011 – 13/11/2011)**



The two maps are very close and present large EAST/WEST basin scale [Jason-2 - Envisat] differences.

The cycle by cycle mean and standard deviation of [Jason-2 - Envisat] differences of SSH at 10-day dual crossover using the ECMWF wet troposphere correction are plotted in the following figure :



Since cycle 56 Jason-2, (Jason-2 - Envisat) SSH difference decreased by about 1.5 cm due to IPF/CMA upgrades.

In fact, after ENVISAT's Cycle 86, first GDR cycle entirely produced with the IPF processing chain V6.02L04 and the CMA Reference Software V9.3. The IPF / CMA upgrades have impacts on different parameters and notably on the altimetric parameters. The global impact noticed on the SLA monitoring consists in the sum of :

- around -6.8 mm due to the new PTR resolution increasing (included in the range instrumental correction)
- around -4.3 mm due to the new SSB solution

Impact is also notice on SWH monitoring :

- around -13 cm biais on the SWH due to the PTR width estimation
- around -0.5 cm increase of the SWH standard deviation

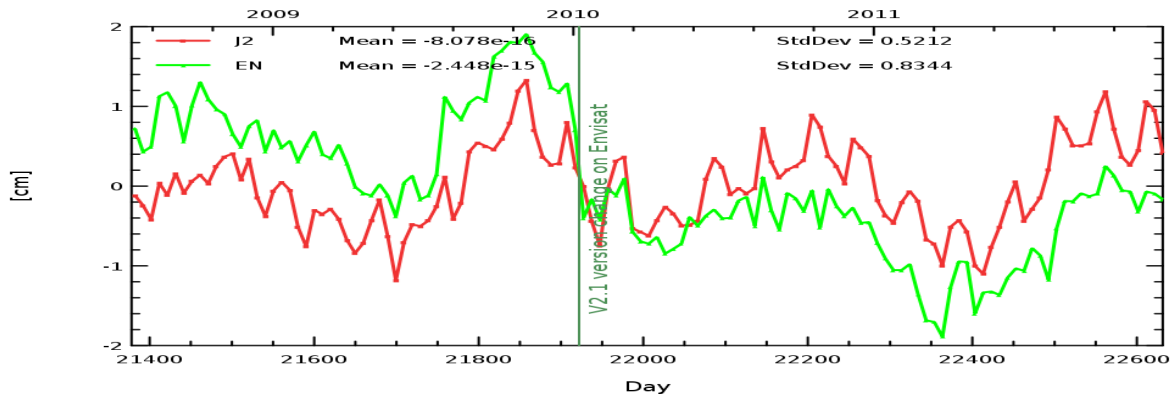
For more informations, see Envisat Calval Report Cycle 86.

The increasing drift noticed since the change of v2.1 Envisat version is likely due to the new PTR correction,

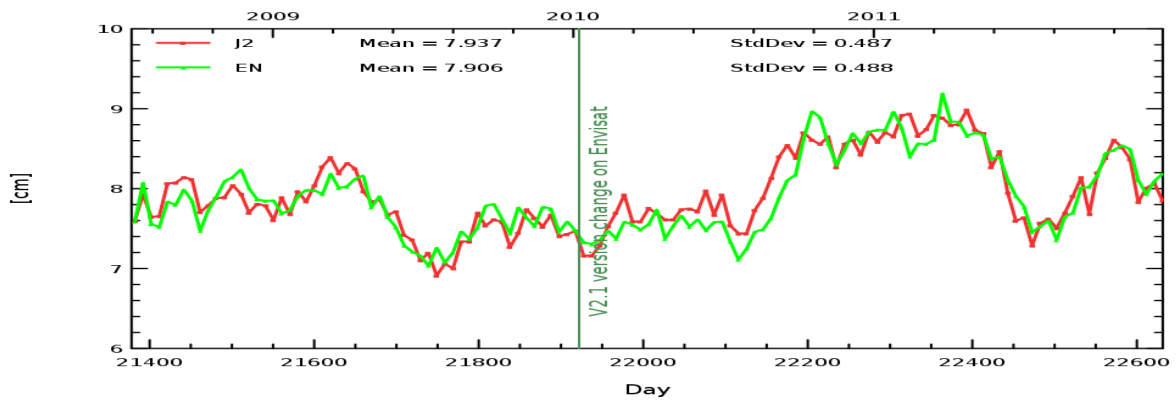
taken into account in the SLA with a wrong sign (as shown by P. Thibaud and M. Rocca).

### 3.3. SLA Comparisons

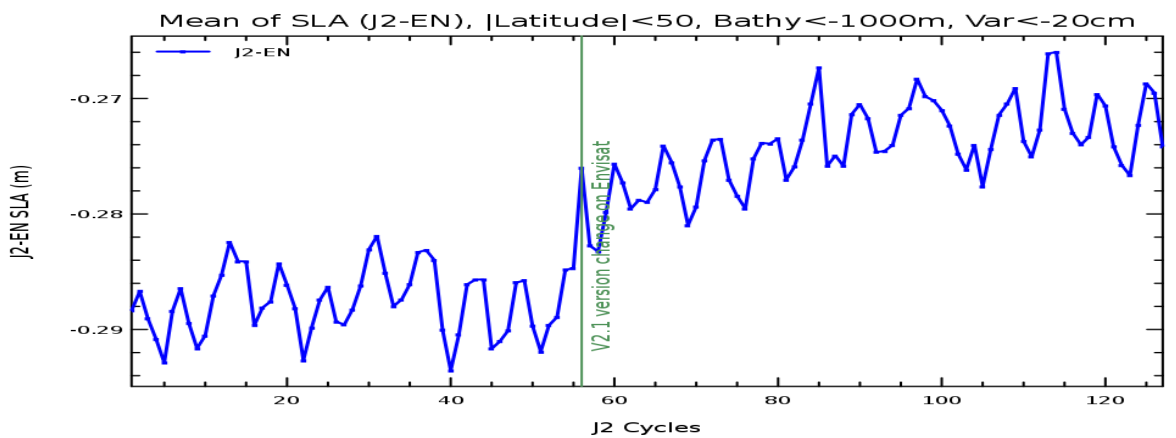
Envisat and Jason-2 Sea Level anomalies relative to CLS01 Mean Sea Surface are computed. Differences are mainly due to the spatial and temporal sampling of the ocean.



The annual signal seen by both missions is very consistent. The impact on MSL trend is detailed on next part.



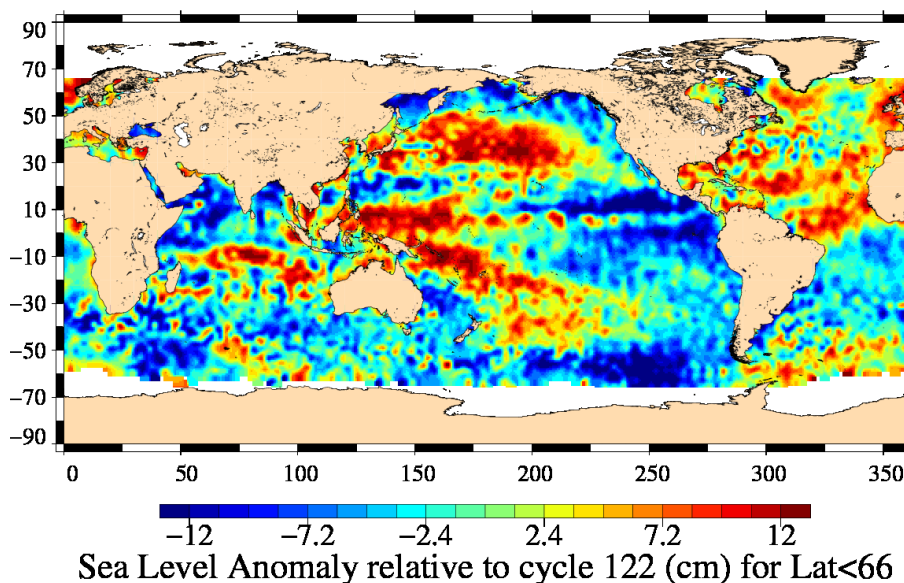
The SLA standard deviations for both missions, Envisat and Jason-2, are similar.



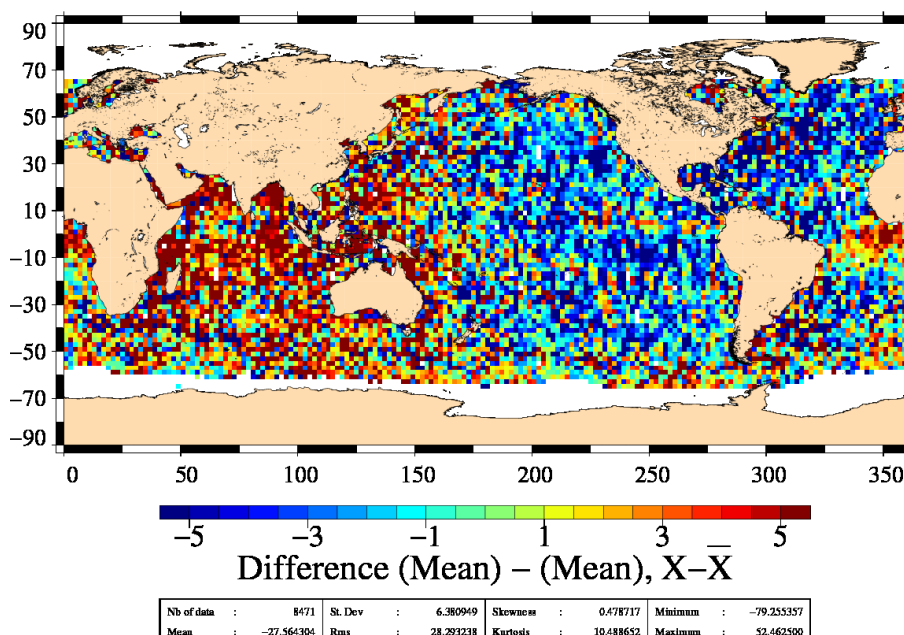
For a best visualisation, measurements have been centred. The mean bias between both missions is quite stable, around 2.8 cm. Since cycle 56 of J-2, the mean of SLA (J2-EN) has increased by about 1.5 cm due to a Envisat SLA decrease. (see Envisat Calval Report Cycle 86)

Global statistics are computed over deep ocean areas (1000 m) and low variability. In order to see fine features, maps are centered about the mean value.

Variability relative to MSS (cm) Cycle 123  
EN (03/11/2011 to 13/11/2011)



Differences of SLA before orbit error correction  
J2 – EN (03/11/2011 to 13/11/2011)



There is a very good correlation between the two maps. The East/West basin scale difference observed on dual crossovers remains.

## 4. Particular Investigations

- [1] Commien L. et al. : Jason-1 GDR quality assessment report, Cycle 362 to 363. *Technical note SALP-RP-MA-EA-21631-CLS* Available at [http://www.aviso.oceanobs.com/fileadmin/documents/calval/validation\\_report/j1/annual\\_report\\_j1\\_2008.pdf](http://www.aviso.oceanobs.com/fileadmin/documents/calval/validation_report/j1/annual_report_j1_2008.pdf)
- [2] Philipps S. et al. : Jason-2 GDR quality assessment report, Cycle 123 to 123. *Technical note SALP-RP-MA-EA-21632-CLS* Available at [http://www.aviso.oceanobs.com/fileadmin/documents/calval/validation\\_report/j2/annual\\_report\\_j2\\_2008.pdf](http://www.aviso.oceanobs.com/fileadmin/documents/calval/validation_report/j2/annual_report_j2_2008.pdf)
- [3] Dorandeu J., 2000 : Note on ERS-2 Sigma0 variations since January 2000. *Technical note CLS/DOS/NT/00.286*
- [4] EOO/EOX, October 2005, Information to the Users regarding the Envisat RA2/MWR IPF version 5.02 and CMA 7.1 Available at <http://earth.esa.int/pcs/envisat/ra2/articles/>
- [5] Faugere Y. et al. : Envisat GDR quality assesement report (cyclic), Cycle 123, *Technical note SALP-RP-P2-EX-21121-CLS123* Available at [http://www.aviso.oceanobs.com/html/donnees/calval/validation\\_report/en/welcome\\_uk.html](http://www.aviso.oceanobs.com/html/donnees/calval/validation_report/en/welcome_uk.html)
- [6] Gaspar P. and F. Ogor, 1996 : Estimation and analysis of the sea state bias of the new ERS-1 and ERS-2 altimetric data (version6). *Report of task 2 of IFREMER Contract N° 96/2.246 002/C.*
- [7] Labroue S. and E. Obligis, 2003 : Neural network retrieval algorithms for the ENVISAT/MWR. *Technical note CLS.DOS/NT/03.848*
- [8] Le Traon,P.-Y., F. Ogor, 1998 : ERS-1/2 orbit improvement using TOPEX/POSEIDON : The 2cm challenge. *Journal of Geophys. Res., COL. 103, NO. C4, pages 8045-8057*
- [9] Martini A., and P. Féménias, 2000 : The ERS SPTR2000 altimetric range correction : Resultats and validation. *ERE-TN-ADQ-GSO-6001*
- [10] Martini A., 2003 : Envisat RA-2 Range instrumental correction : USO clock period variation and associated auxiliary file, Technical Note ENVI-GSEG-EOPG-TN-03-0009 Available at [http://earth.esa.int/pcs/envisat/ra2/articles/USO\\_clock\\_corr\\_aux\\_file.pdf](http://earth.esa.int/pcs/envisat/ra2/articles/USO_clock_corr_aux_file.pdf)
- [11] Mertz F. et al. : Validation of ERS-2 OPR Cycle 191. *Technical note CLS.OC.NT/03.702 issue 191* Available at <http://www.ifremer.fr/cersat/en/documentation/references/oprmon.htm>
- [12] Obligis E., L. Eymard, N. Tran, 2003 : ERS-2/MWR drift evaluation and correction. *Technical note CLS.DOS/NT/03.688*
- [13] Picot N., October 21, 2005 : New Jason-1 operational production chain. *Electronic communication.*
- [14] Scharroo R. and P. N. A. M. Visser, 1998 : Precise orbit determination and gravity field improvement for the ERS satellites. *J. Geophys. Res., 103, C4, 8113-8127*
- [15] Vincent,P., Desai S.D., Picot N. and Case K., 2003 : The first generation of IGDRs and GDRs products to be made available after completion of the Jason-1 verification phase. *Memo to Jason-1 PIs and CoIs.*