Envisat GDR
Cross calibration Report

Cycle 055

29-12-2009 08-01-2010

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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, ERS-2 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 :

2. Cycle overview of each mission

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

Envisat cycle 085 has been produced with the IPF processing chain VXX.XX and the CMA Reference Software 9.2_03. 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 cycle Envisat 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/.

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 (Cycle Envisat 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 temporary correction provided by ESA and using a mix bifrequency-GIM ionospheric correction.
The cross-calibration with **ERS-2** OPR2 version 6.5 from CERSAT centre has been performed with ERS-2 OPR cycle 123. The main results for cycle 123 are reported in the ERS-2 Quality assessment report [11]. All the necessary updates were performed on ERS-2 data to be homogeneous with the Envisat data set.

The cross-calibration with **Jason-2** GDRs (CMA Reference Software XX.XX) has been performed with Jason-2 GDRs cycle 055. 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: *G*eophysical 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 : Venise 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 detailled in Tab.1.

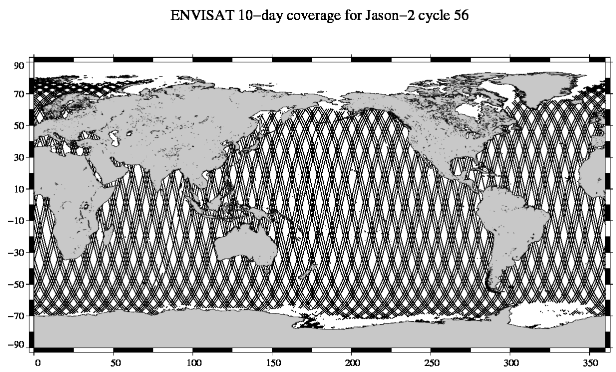
3. Cross Calibration with ERS-2

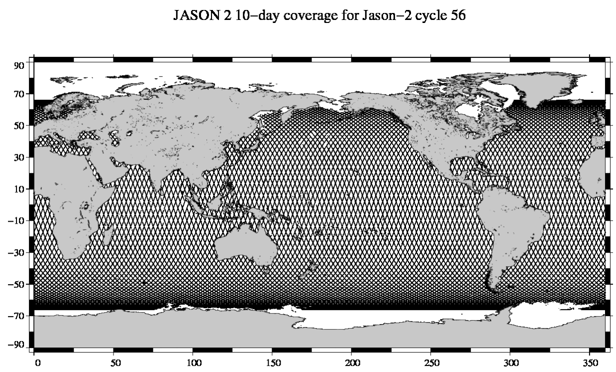
The Envisat/ERS-2 cross-calibration results are not available for this cycle of data.

4. Cross Calibration with Jason-2

Jason-2 GDRs data (cycle 055 to 055) 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, EN data are considered on subcycles (corresponding to J2 10 days cycles).



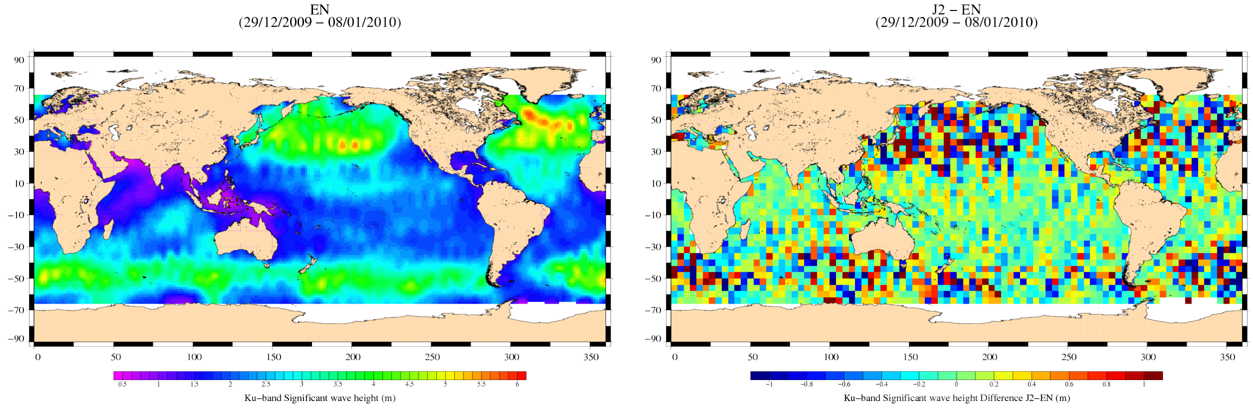


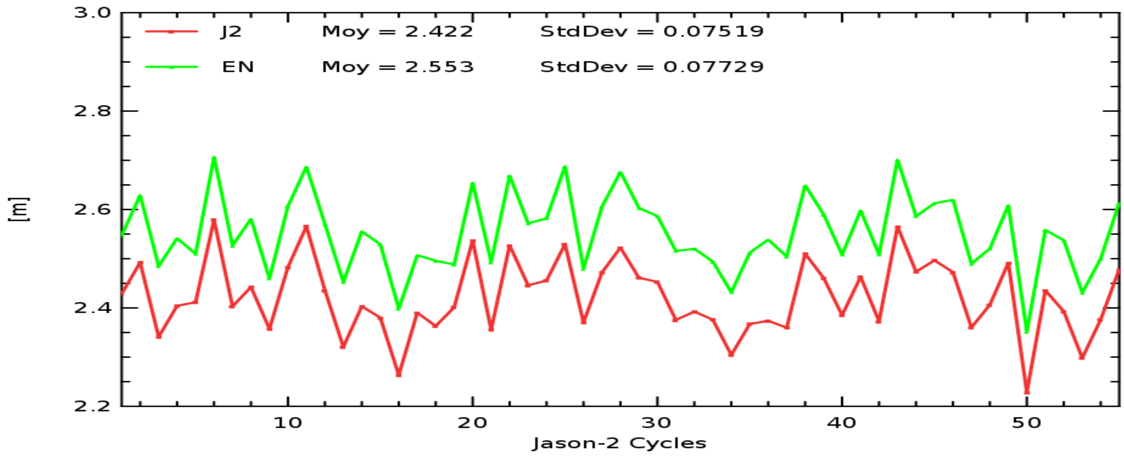
TO BE COMPLETED : data missing

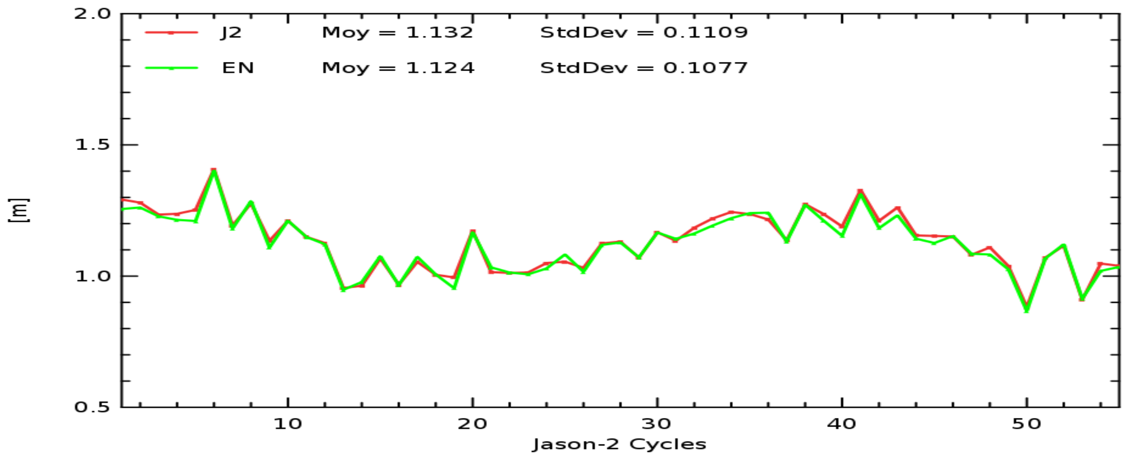
4.1. Instrumental and geophysical parameter analysis

4.1.1. 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 fonction of the cycles number on the following figure :

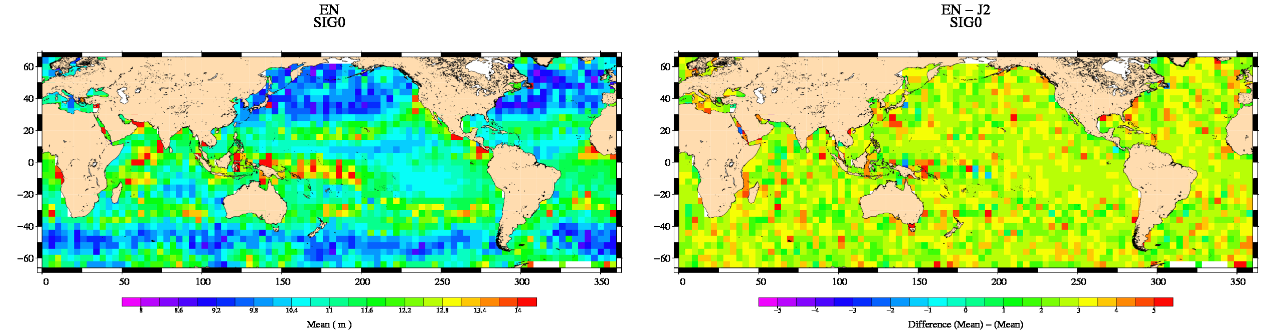


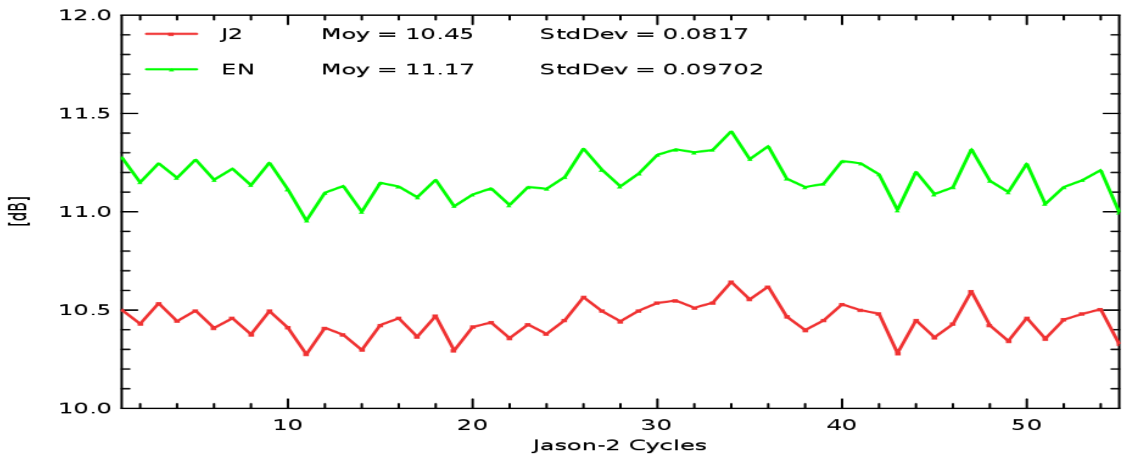


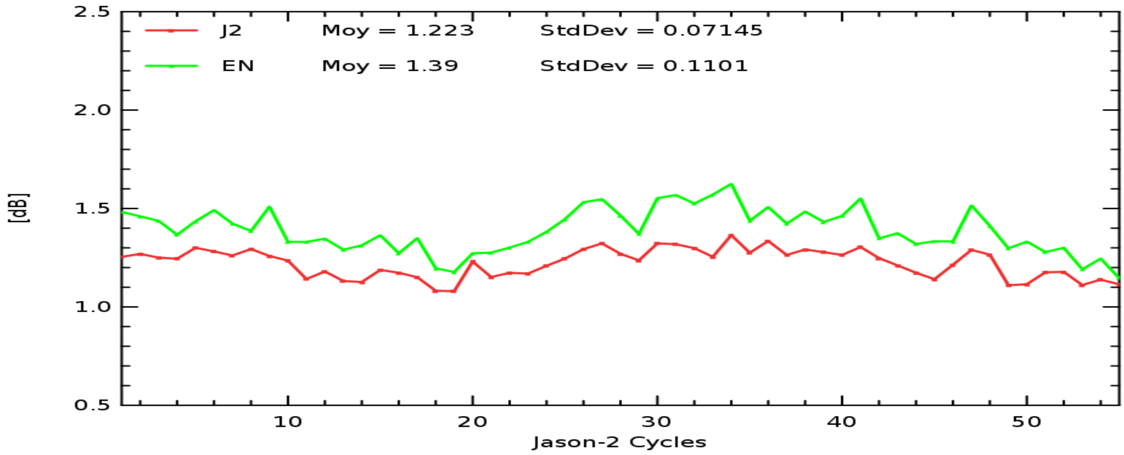


4.1.2. Backscattering coefficient (Sigma0)

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



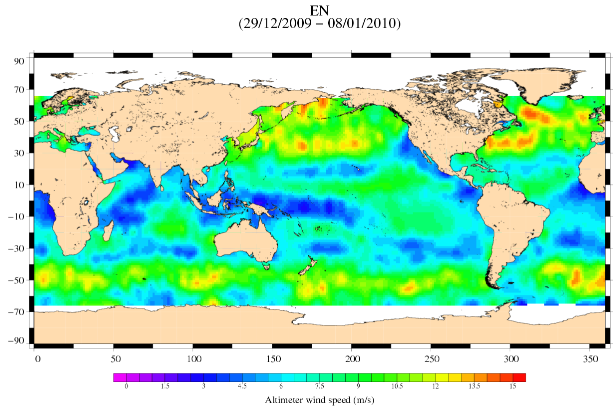


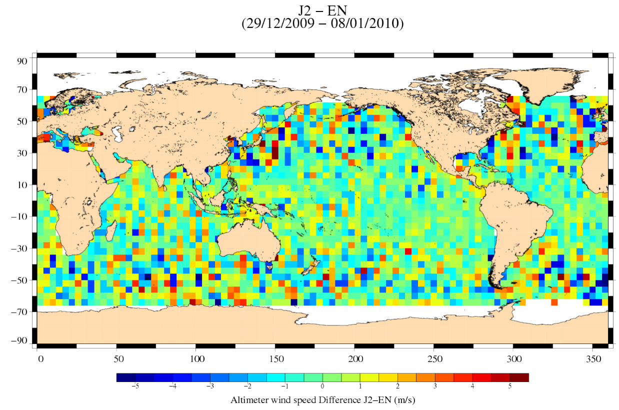


Note that in EN Gdr products, a -3.5dB bias has been applied (Roca et al., 2003 [63]) on Envisat's Ku-band Sigma0 in order to be compliant with the wind speed model (Witter and Chelton, 1991 [77]). For this particular figure, the same bias was applied on J2 curves.

4.1.3. Altimeter Wind Speed

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



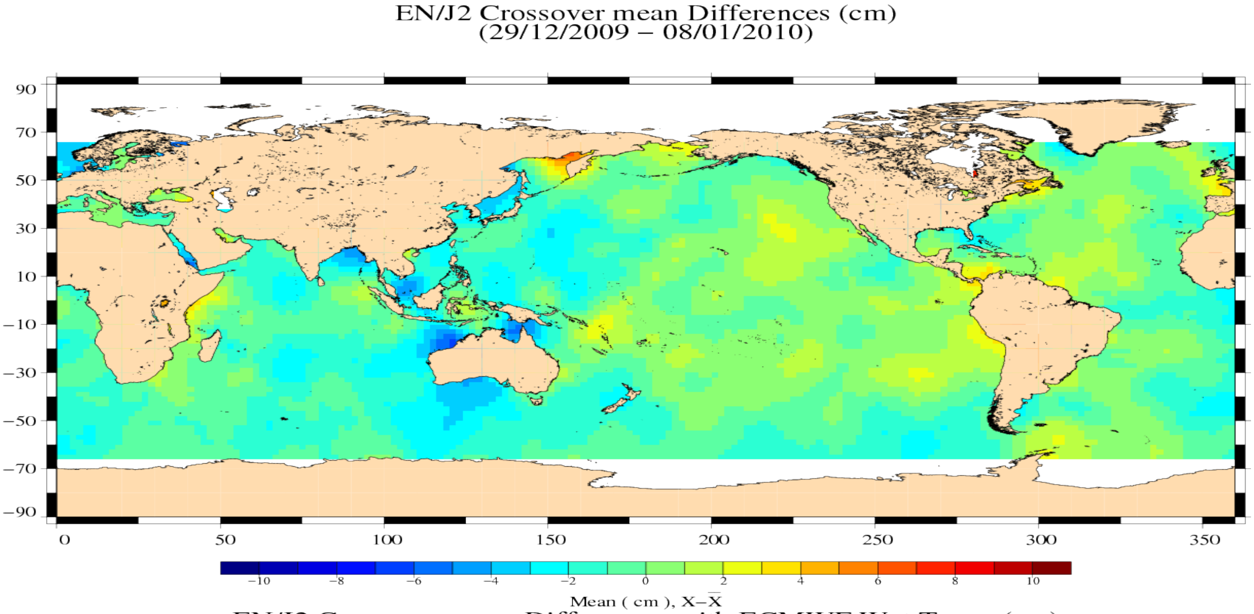


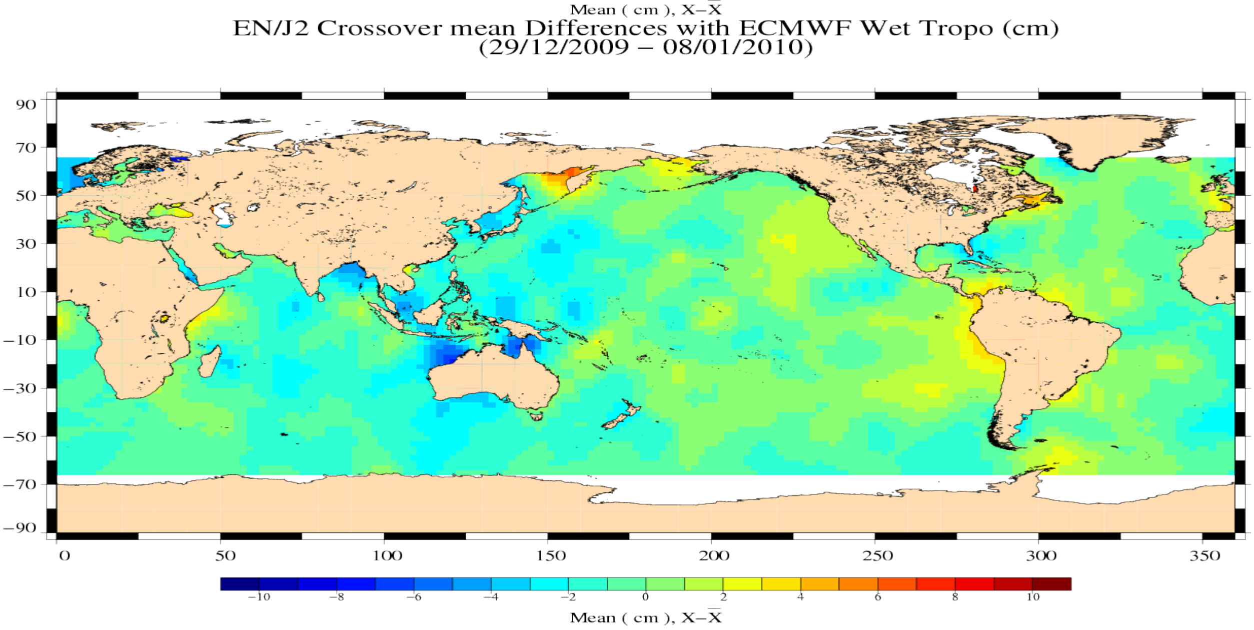
4.2. Crossover analysis

4.2.1. [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

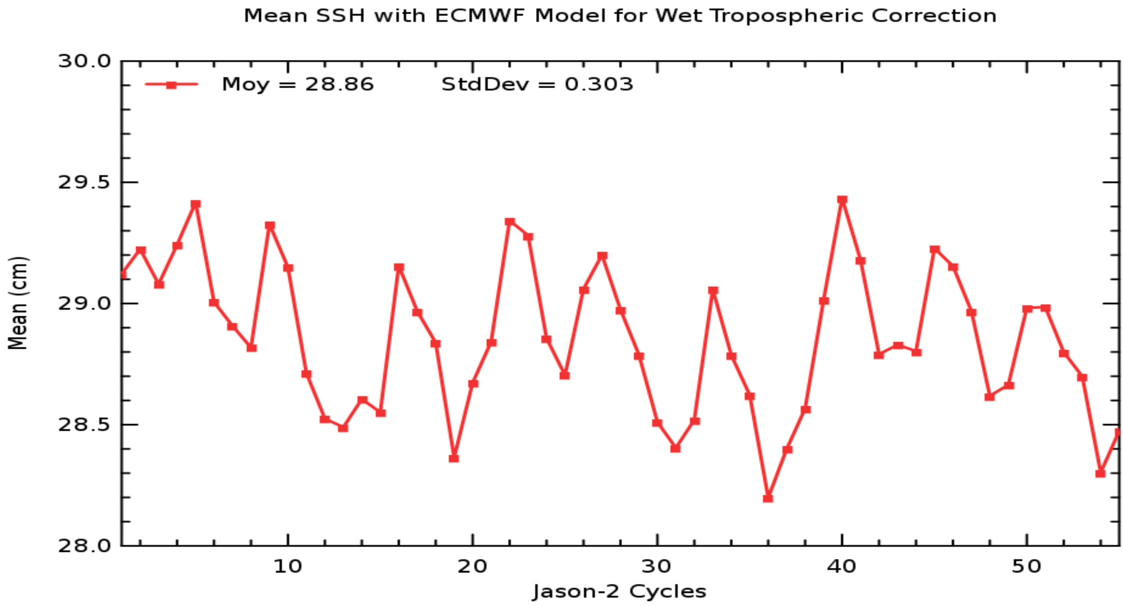
The differences are plotted on the following figure (data are centered about the mean value) :

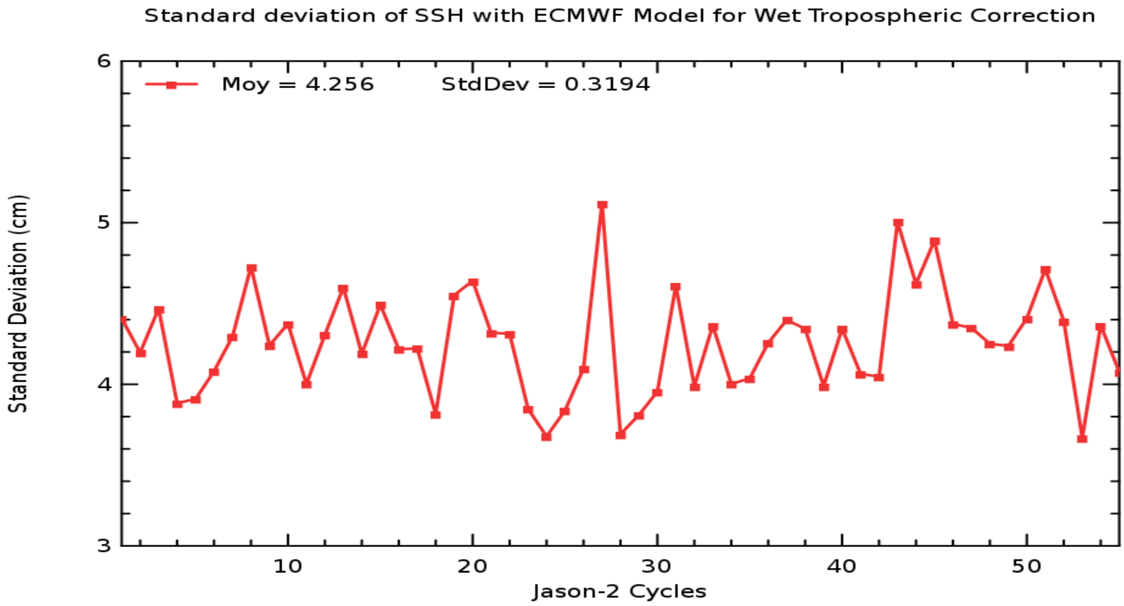




The two maps are very close and present large EAST/WEST basin scale [Jason-2 - Envisat] differences.

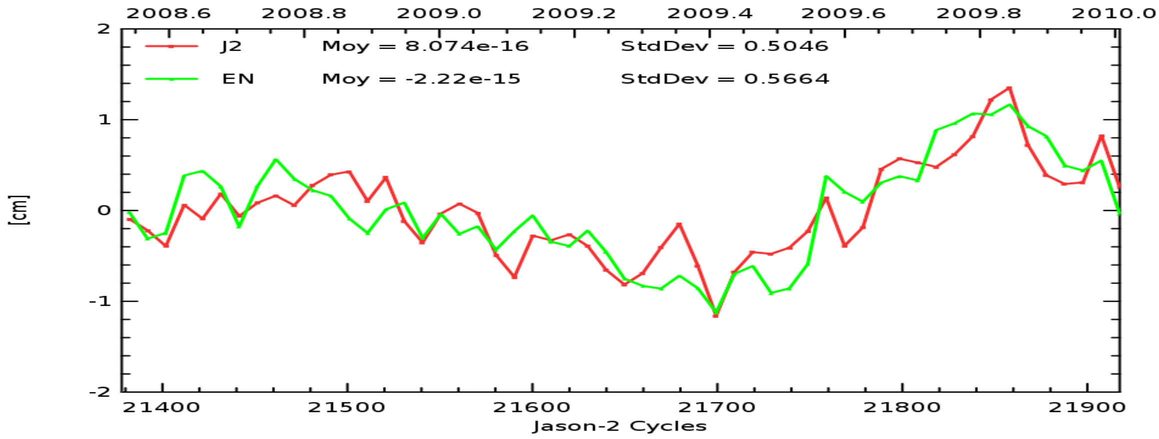
The cycle by cycle mean and standard deviation of [Jason-2 - Envisat] differences of SSH at 10-day dual crossover using the ECMWF wet troposphere correction are plotted in the following figure :



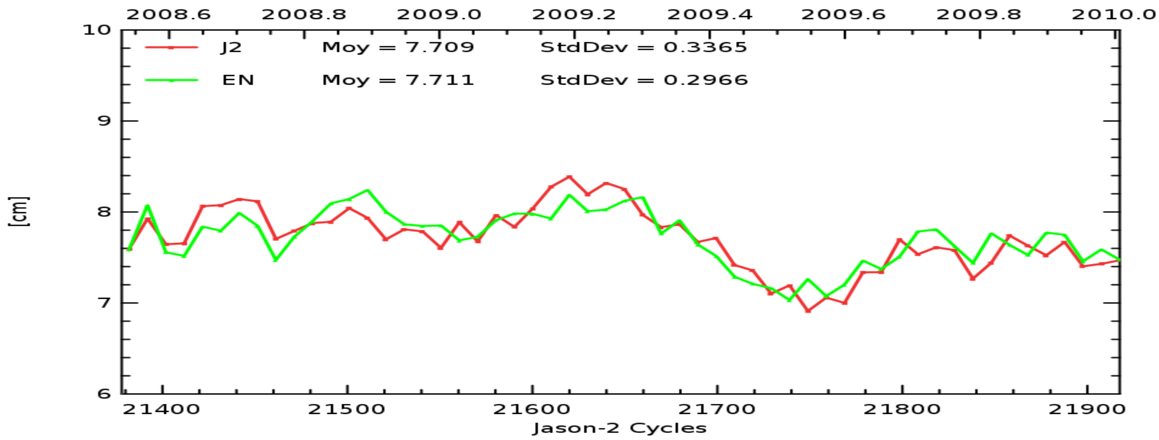


4.3. SLA Comparisons

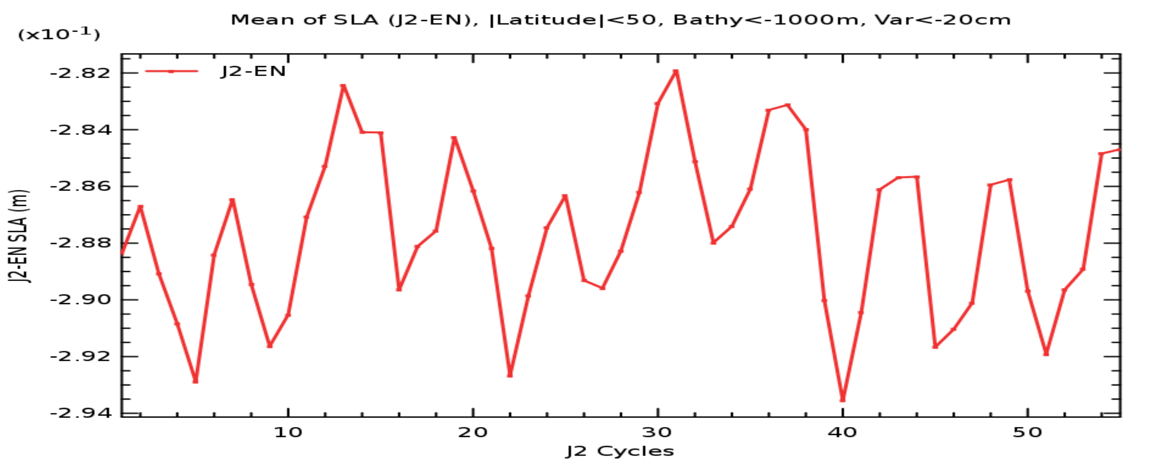
Envisat and Jason-2 Sea Level anomalies relative to CLS01 Mean Sea Surface are computed. Differences are mainly due to the spatial and temporal sampling of the ocean.



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

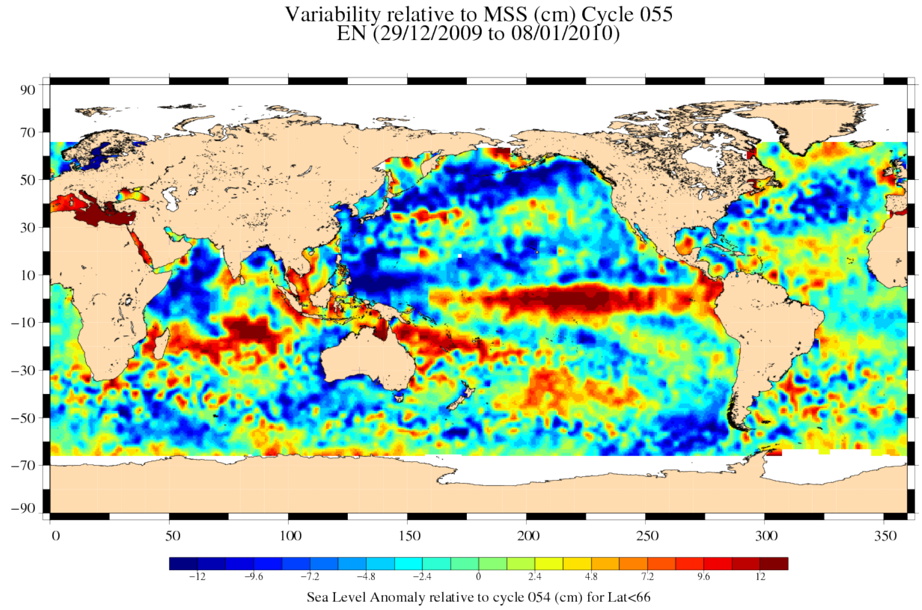


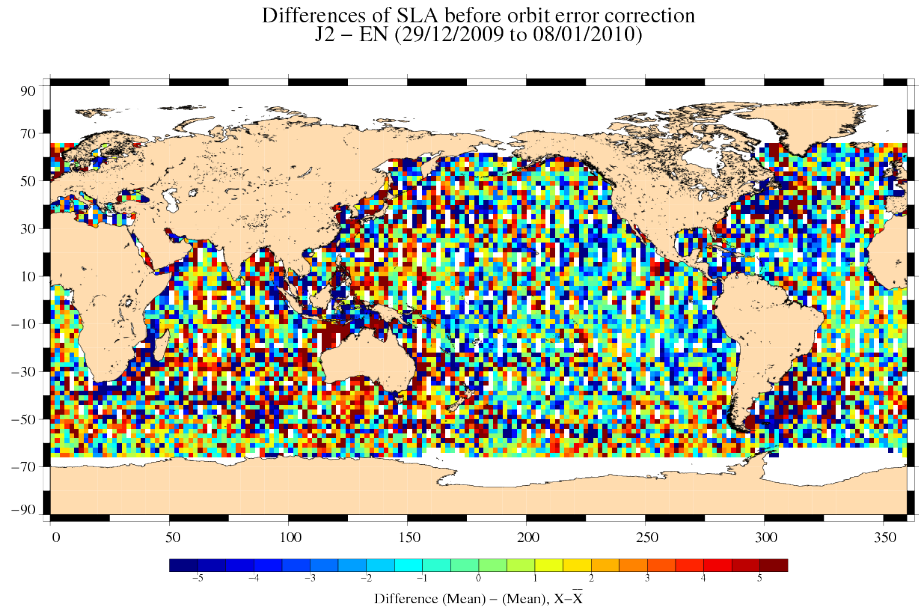
The SLA standard deviations for both missions, Envisat and Jason-2, are similar.



For a best visualisation, measurements have been centred. The mean bias between both missions is quite stable, around 2.8 cm.

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.





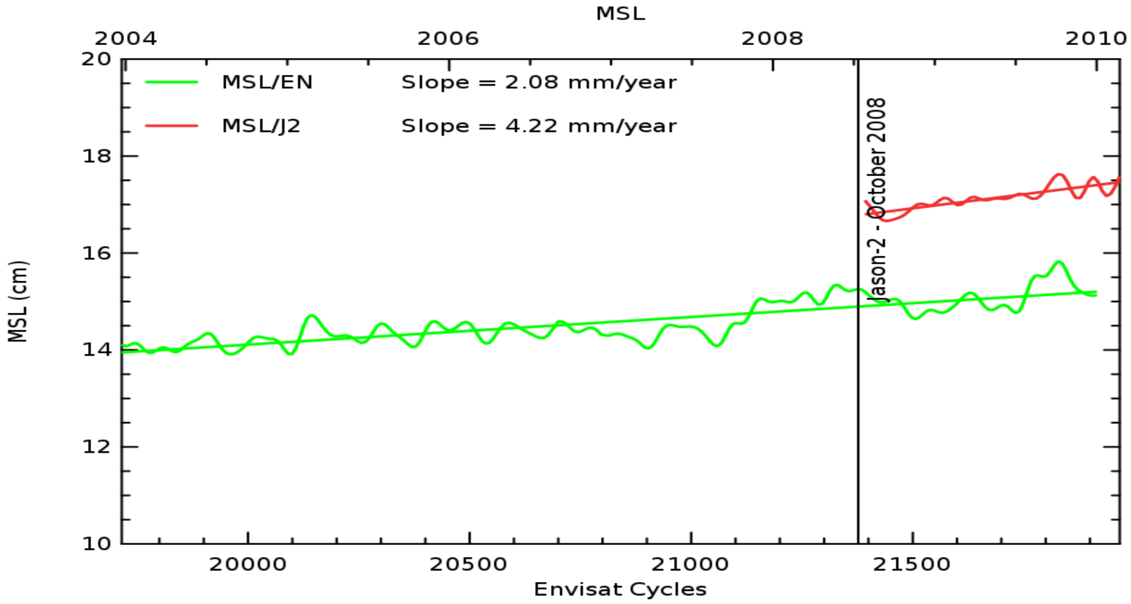
Nb of data :	7963	St. Dev :	5.449206	Skewness :	−0.235633	Minimum :	−82.060000
Mean :	−28.641611	Rms :	29.155372	Kurtosis :	12.849161	Maximum :	25.829615

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

4.4. Mean Sea Level trends

The analysis of SLA long term evolution is performed through the particular Mean Sea Level trend studies. For these studies the same method is applied on all missions. It is described here after.
For each cycle of 10 days for J2 and sub cycles of (35/4=8.75days) for EN, a mean grid of sea level anomalies (SLA=SSH-MSS) of 2˚x2˚ is first calculated in order to distribute the measurements equally across the surface of the oceans. The global or basin mean for each grid is calculated by weighting each box according to its area, in order to give less significance to boxes at high latitudes which cover a smaller area. This gives the time series per cycle, which is then filtered with a low-pass filter in order to remove signals of less than 2 months or 6 months, and the annual and semi-annual periodic signals are also adjusted. The MSL slope is deduced from this series using a least squares method.

The MSL follow-up for Jason-1, Jason-2 and Envisat is plotted on the following figures :



Envisat's MSL has various behaviors during its lifetime, including a very odd decreasing trend at the beginning of the mission for a still unknown reason . After 2004, the slope increases as expected.

To ease the comparison between each mission, a volontary bias is applied on curves.

Note that J2 curve has to be handled with care because of its short period.

Références

[1] Commien L. et al. : Jason-1 GDR quality assessment report, Cycle 294 to 295. *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

[2] Philipps S. et al. : Jason-2 GDR quality assessment report, Cycle 055 to 055. *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

[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 assessement report (cyclic), Cycle 055, *Technical note SALP-RP-P2-EX-21121-CLS055* Available at 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

[11] Mertz F. et al. : Validation of ERS-2 OPR Cycle 123. *Technical note CLS.OC.NT/03.702 issue 123* 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.*