Envisat / Jason-1 cross calibration

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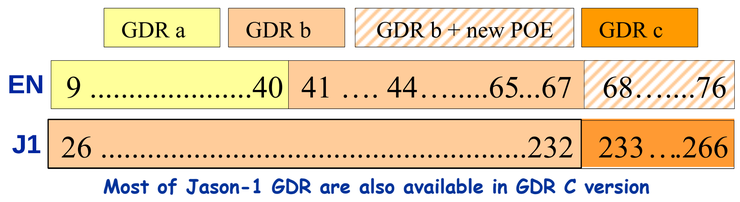
Introduction

Almost 7 years of Envisat and Jason-1 altimetric measurements are available on a common period in GDR. The cross calibration of these two datasets are routinely performed at the CLS Space Oceanography Division in the frame of the CNES Segment Sol Altimétrie et Orbitographie (SSALTO), ESA French Processing and Archiving Center (F-PAC) activities. This poster presents the main Envisat/Jason-1 cross calibration results.

Data

Since 2008, most Jason-1 products are available in GDR b version from the beginning of the mission and until May 2008. The Envisat products are produced in GDR b version since October 2005. In order to have the most homogeneous dataset possible, updates on the first part of the Envisat series were also implemented.



Most of Jason-1 GDR are also available in GDR C version

The whole Ra-2 Envisat GDR will be reprocessed in 2009

Jason-1 updates: a SSB model compatible with the MLE4 retracking (Labroue, 2006) has been updated here.

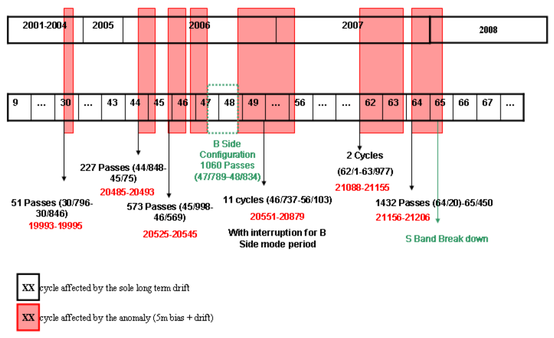
Envisat updates:

- For cycle <41: Geophysical corrections (Mog2D, tides, …), GDRb SSB, Dual frequency ionosphere correction using GDRb SSB, MWR correction with Side lobes
- For all cycles: USO drift + USO anomaly correction
- For some tests the POE produced by the ESOC center is used. The last release uses most of the GDRC standards

USO anomaly: In February 2006, the RA-2 Ultra Stable Oscillator (USO) clock frequency underwent, for an unknown reason, a strong change of behavior. The anomaly consists in a bias, superposed with an oscillating signal with an orbital period. Auxiliary files are distributed since mid 2006 allowing the users to correct the range from this anomaly. The anomaly periods are detailed beside

Loss of the S-Band: On the 17 January 2008, a drop of the RA2 S-band transmission power occurred. There is thus no more dual frequency altimeter both in Side A and Side B

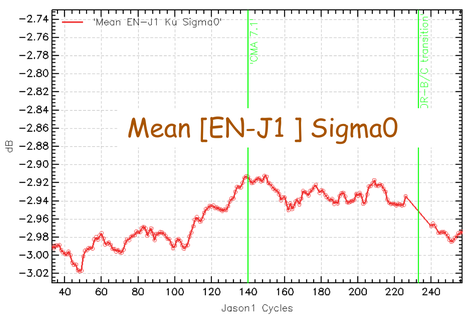
Data impacted by the USO anomaly



References

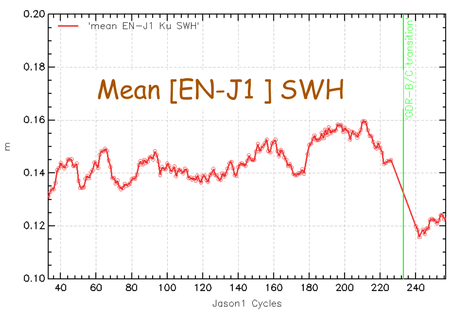
➢Envisat and Jason-1 Cyclic and yearly quality assessment and cross calibration reports
http://www.aviso.oceanobs.com/en/calval/index.html

Long term monitoring of altimeter parameters



•The cycle by cycle mean of Envisat-Jason-1 differences are plotted. The mean difference between Envisat and Jason-1 Ku-band Sigma0 is -2.9 dB. This mean difference has increased by 0.07dB between cycles 48 and 129 which corresponds to 0.04 dB/year.
•EN/J1 difference decreases by -4.10^{-2}dB with Jason-1 GDRC

Good stability of SWH and Sigma0



•The cycle by cycle mean of Envisat-Jason-1 SWH differences are plotted. These differences are quite stable. Envisat SWH is 15 cm higher than Jason-1 SWH.
•EN/J1 Difference decreases by 3cm with Jason-1 GDRC

SSH performance assessment

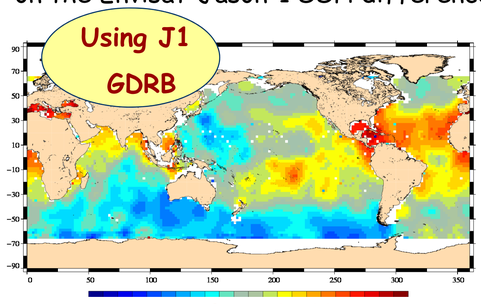
Envisat/Jason SSH differences at 10-day dual crossovers

10-day Envisat/Jason-1 dual crossovers have been computed. Mean differences between the two missions are computed in several periods of time and several configurations of SSH. Systematic differences are visible on the Envisat-Jason-1 SSH differences at crossovers.

Corrections used in the reference configuration

ΣCorrection^i = Dry troposphere correction : new S1 andS2 atmospheric tides applied
+ Combined atmospheric correction : MOG2D and inverse barometer
+ ECMWF wet troposphere correction
+ Filtered dual frequency ionospheric correction
+ Non parametric sea state bias correction
+ Geocentric ocean tide height, GOT 2000 : S1 atmospheric tide is applied
+ Solid earth tide height
+ Geocentric pole tide height

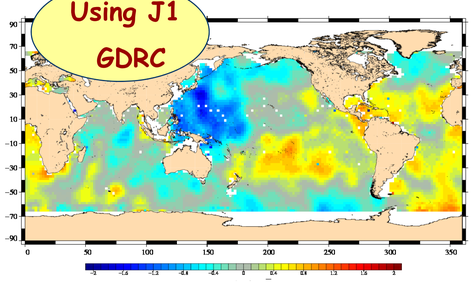
Using J1 GDRB



Cycles 20-40

The geographically correlated differences are reduced mainly thanks to the use of Grace Gravity fields in the orbit calculation. The use of the SSB J1 compatible with the new standards is also a key point in this improvement.

Using J1 GDRC

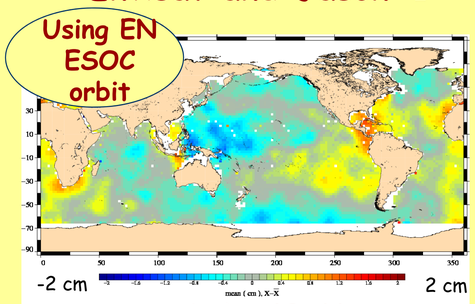


Cycles 41-61

The use of J1 reprocessed in GDRC increases the consistency between the two satellites. Most of the impact is due to the J1 orbit upgrade. A slight East/West structure now dominates the difference.

Very good consistency between Envisat and Jason-1

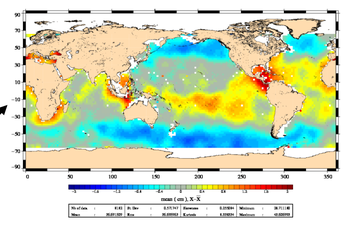
Using EN ESOC orbit



Cycles 10-61

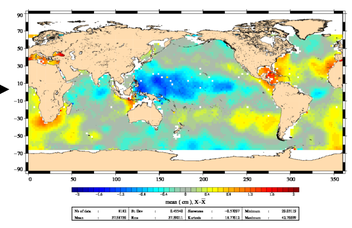
In this configuration , GDRC are still used for Jason-1, and the ESOC orbit is used for Envisat, allowing us to compute a map from the whole time series. The mean differences are **at the cm level**. A

+ MWR correction



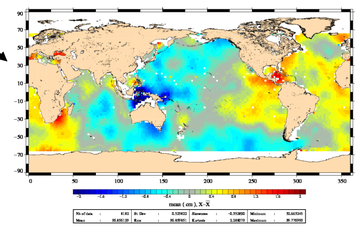
•Using the radiometer correction instead of the model increases the inconsistency. This is expecte: when the same model is used on both satellite, the difference cancels a part of the model errors

+ GIM ionosphere correction



•Using the GIM correction instead of the dual frequency ionosphere correction has an impact around the equator.

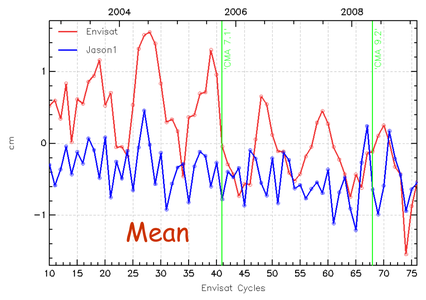
using FES 2004 tide model

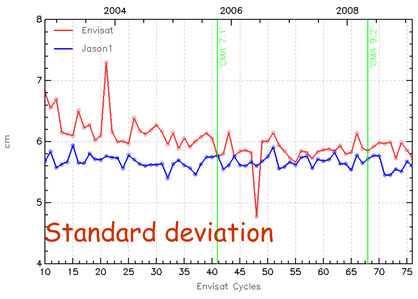


•Using the FES2004 model instead of the GOT00 model increases the inconsistency around South Africa and Australia for exemple.

Cross comparison of the performances

Envisat and Jason-1 crossovers have been computed on the same area excluding latitudes higher than 50° , shallow waters and using exactly the same interpolation scheme to compute SSH values at crossover locations. Annual signal is visible on the mean curve for Envisat. The standard deviation values for Envisat/Envisat and Jason-1/Jason-1 SSH crossover differences are very similar: respectively 6.0 cm and 5.7 cm



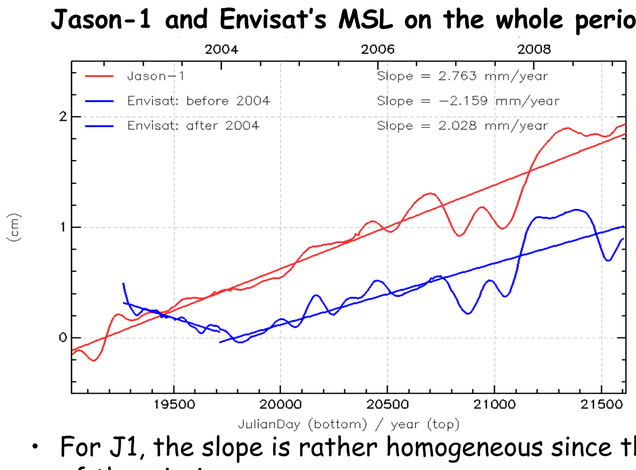


Similar performances for both satellites

Envisat Mean Sea Level trend

MSL trends from Envisat, Jason-1 are compared using the same corrections. The results are obtained after area weighting and removal of annual and semi-annual signals. An additional 60-day period sinusoid has been fitted and removed for Jason series. Note that the ECMWF model is used both on Envisat and Jason-1 in order to have consistent comparisons.

Jason-1 and Envisat's MSL on the whole period



- For J1, the slope is rather homogeneous since the beginning of the mission
- For EN, there is a « before » and an « after » 2004.

Impact of the coming Envisat reprocessing on the MSL

Nature of the different analysed terms related to the orbit determination / physical correction or instrumental corrections	
will be impacted (already taken into account in CLS MSL)	Ionosphere computed with a S-Band SSB range ➔0.4mm/year SSB ➔ 1.5cm step Side Lobes Radiometer correction ➔0.15mm/year (if used) ECMWF Dry troposphere without S1 S2 waves➔ negligible MOG2D-HR ➔ weak impact at the GDR B-C transition (cycle 69) USO ➔ big impact due to the USO anomaly not corrected in the products
will NOT be impacted	Tides through diurnal errors aliasing ➔No (sun-synchroneous orbit) Radiometer 36.5GHz drift correction ➔could be corrected (if used) ECMWF Wet troposphere➔ Tests to be done with ERA-Interim solution DORIS on board processing wait/chained mode ➔ No (on board) UTC-ICU drift ➔ TBC ?
will be impacted in the GDR and in the CLS MSL	DORIS ground pre-processing ➔ Probably New orbit standard ➔ Probably before 41 (2 steps upgrades) and after 41 (one step upgrade) : possible to test them before the whole reprocessing IF Mask effect ➔ Probably negligible (tests performed at CLS) Radiometer new instrument calibration ➔Possibly PTR drift ➔ -0.7mm/year TBC !!! Ascending/Descending discrepencies ➔Probably

To conclude

- The reprocessing WILL impact the MSL trend.
- Some impacts are anticipated and lead to the curent MSL presented here:
  - ➔Envisat and Jason-1 MSL trend close (at the cm/year level) from 2004 onwards
- However,some impact are not well known and cumulated effects are hard to quantify but:
  - the change of PTR processing might have a non negligible impact
  - the new orbit shall also change trends as well as the asc/dsc discrepencies

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