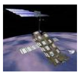

Envisat / Jason-2 cross calibration

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Introduction

Cross calibration of Jason-1/2 measurements with other flying precise altimetric missions is essential to assess data quality and performances. Cross calibration with Envisat is important for data quality assessment but also for allowing combination of altimeter datasets as required by applications and operational oceanography. This poster is complementary to the Envisat/Jason-1 Cross calibration poster where the whole set of Envisat and Jason-1 data are studied.

Cross calibration using Envisat

Years of experience enables to develop various methods to Crosscalibrate the Jason's mission with Envisat. Concerning short time series, two methods are presented here:

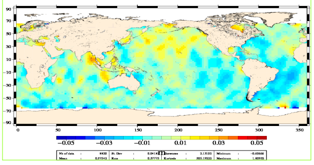
-Differences of SLA averaged by boxes over the globe

-Differences at cross-overs with monitoring of the statistics and maps of averages over several cycles.

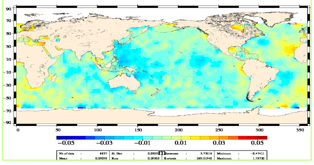
The second method (cross over analysis) enables to reduce the ocean variability effect seen on the unsmoothed SLA differences.
For a better consistency between missions, all SLA/SSH used for the study are computed with ECMWF tropospheric correction and the GIM Ionospheric correction, in order to be consistent with Envisat data for which the S-band is no longer available (since January 2008).

Envisat mission gives a 3rd point of comparison to explain discrepancies between Jason-1 and Jason-2's IGDR Geographically correlated biases.

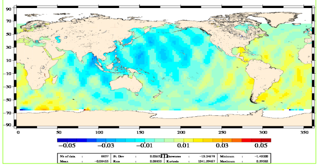
Jason-1 – Envisat SLA using MOE: Est West bias



Jason-2 – Envisat SLA using MOE: Homogeneous map



Jason-1 – Jason-2 SLA using MOE: East West bias



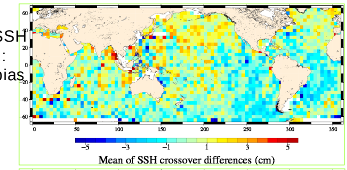
Both analyses show that Est-West Geographically correlated biases for the comparisons concerning J1/EN and J1/J2 are higher than for J2/EN. This enables to show that J2/EN are very consistent.

Mean cross-overs for IGDR products using MOE orbit :

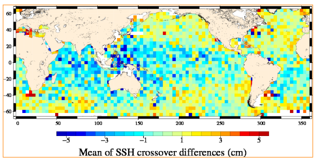
-Geographically correlated bias are observed between the three missions. Like for SLA differences,

-East-West biases observed for the comparisons concerning J1/EN unlike for J2/EN.

Jason-1 /Envisat X_SSH using MOE: East West bias



Jason-1 /Envisat X_SSH using POE



GDR products using POE orbit :

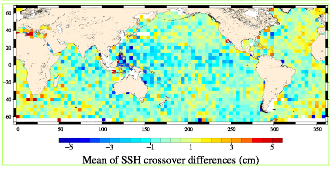
- Higher noise due to a smaller time series but

-The biases repartition changes: J1/EN and J2/EN maps are now consistent.

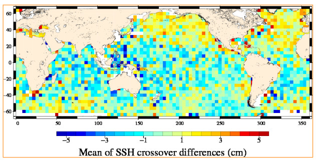
This is in agreement with the improved quality of Jason-1 POE compared to its MOE (cf poster "Assessment of Jason-2 and Jason-1 orbit quality from SSH analysis")

Comparison between IGDR and GDR products show a good consistency of data. Performances using POE orbit are better as expected but the calval and cross calibration with IGDR data already show a good consistency between missions.
In terms of geographically correlated bias, using POE instead of MOE changes the patches repartition.

Jason-2 /Envisat X_SSH using MOE : homogeneous data

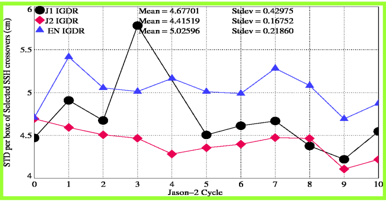


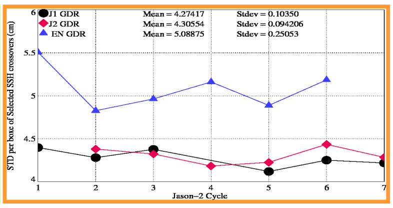
Jason-2/Envisat X_SSH using POE



IGDR products using MOE orbit :

Monitoring of the standard deviation at cross overs is performed. 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. The statistics are very similar for the three missions, with slightly better performances for Jason-2 (smaller Standard deviation at cross overs (4.4cm), in front of Jason-1 (4.7cm) and Envisat (5cm).





GDR products using POE orbit:

Monitoring of the standard deviation at cross overs is performed with the same average per boxe than for NRT study. The statistics are very similar for the three missions, around 4.2cm for the Jasons missions, that is to say, better than using NRT products and 5cm for Envisat.

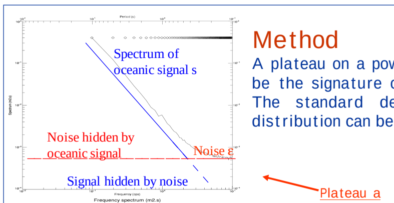
On longer periods, such monitorings on independant missions enables to enlight/explain drifts, caused by processing/instrumental anomalies. This is largely developped in the poster Envisat/Jason-1 Cross calibration.

Conclusion 1

Differences of SLA and standard deviation at Cross-over show that the three missions have very good and very similar performances. Geographically correlated biases are observed between the three missions, high-lighting a better consistency between Jason-2 and Envisat than between Jason-1 and the two other missions when using the MOE. On the other hand, biases concerning Jason-1 and 2 are very week concerning the POE Orbit. Although Envisat's sampling is different from the two Jasons, cross calibration with its data enables to provide a precise quality assessment of the Jasons's data, thanks to a set of several Cross calibration methods.

Spectral analysis of the HF content

The following study is based on user products and aims at analysing the high frequency (HF) part of the Sea Surface Height (SSH) signal of Jason-1, Jason-2 and Envisat. This signal includes instrumental noise, processing noise, correction noise, residual geophysical signals.. Comparing the HF content of several missions enables to compare the performances but also to better understand the physical content of each signal. The spectral analysis allows us to quantify accurately the global SSH HF for 1Hz and 20Hz data. Comparison are performed for Envisat and Jason-1 GDR data and Jason-2 IGDR data.



Method

A plateau on a power spectrum can be the signature of a white noise. The standard deviation of its distribution can be obtained by :

$$s = \sqrt{\frac{a}{2.\Delta t}}$$

1Hz spectra

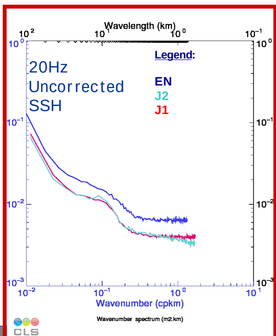
• 1Hz spectra are computed from 10 days of data

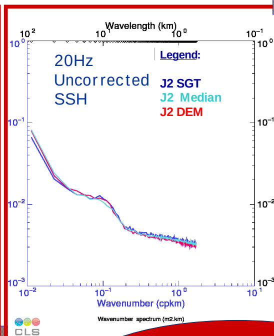
•High frequency content is compared for Jason-1, Envisat, and concerning Jason-2 using its two tracker modes: Median and DEM (Digital Elevation Model). The shape of the high frequency content is, as expected very similar for the three missions. When using uncorrected SSH, Envisat SSH is slightly above the others in terms of noise. This effect is cancelled when the SSH is corrected from instrumental and geophysical corrections.

20Hz spectra

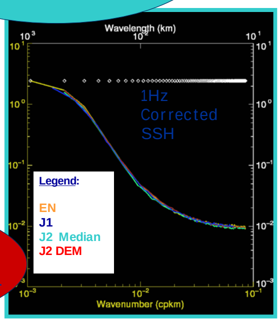
•20Hz spectra are computed from 2 days of data

•On 20Hz data, at frequencies higher than 3Hz, the Envisat signal is hidden by a plateau at $10^{-3}m^2s$. This plateau is the signature of a 9.2 cm white noise. Assuming uncorrelated 20 Hz noise, it is equivalent to 2.1 cm for the 1 Hz averages. The Jason-1 spectra has a similar shape as Envisat but with a lower plateau (7.9cm). Unlikely, on Jason-2, the spectrum does not behave as a white noise. A weak slope is noticed for the frequencies higher than 3Hz, showing a coloration on the noise at these frequencies. This effect is seen for all the tracker modes including SGT one (chosen for Jason-2's Cycle 1) which is identical to the one used on Jason-1. This different behavior is currently under investigations. By now, it was seen to be unchanged by selections on data (distance to coast, 20 valid data per second, selection on mispointing, waves or MQE criteria..) Elsewhere, the spectrum is similar to the other missions. Note that a higher energy in the 0.1-0.4 Hz (20-50km) bandwidth is noticed for the three missions.





1Hz data high frequency content show a complete agreement for the three missions, undependently from the tracker used on Jason-2



Jason-2's noise level is the same as Jason-1's. However, high frequency content of Jason-2 presents an unexplained coloration for frequencies above 3Hz

Conclusion 2

The high frequency content of the mission is another way of quantifying the data quality.
At 1Hz, the three missions compared have a complete agreement. On the other hand, an unexplained coloration of the noise above 3Hz is noticed for Jason-2. This coloration is particularly evidenced when the spectrum is compared to other missions 's spectra (here Jason-1 and Envisat) who present a white noise at these frequency, consistently to the theory.

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