Jason-1/2 cross-calibration with Envisat

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Introduction

- Since Envisat was launched, Cross Calibration studies with the Jason-1 mission are performed to assess the data quality and performances of both missions.

- A precise altimetric mission as Envisat can help to understand the observed differences between Jason-1 and Jason-2 by giving a third reference

- This presentation aims at showing the cross-calibration between Jason-2 and Envisat, enlightened by 6 years of cross calibration with Jason-1.

Overview

In this presentation, we will focus on :

1. Short overview Envisat / Jason-1 GDR : *How close are they today?*
   - ➔ Comparisons using GDR products on the whole period

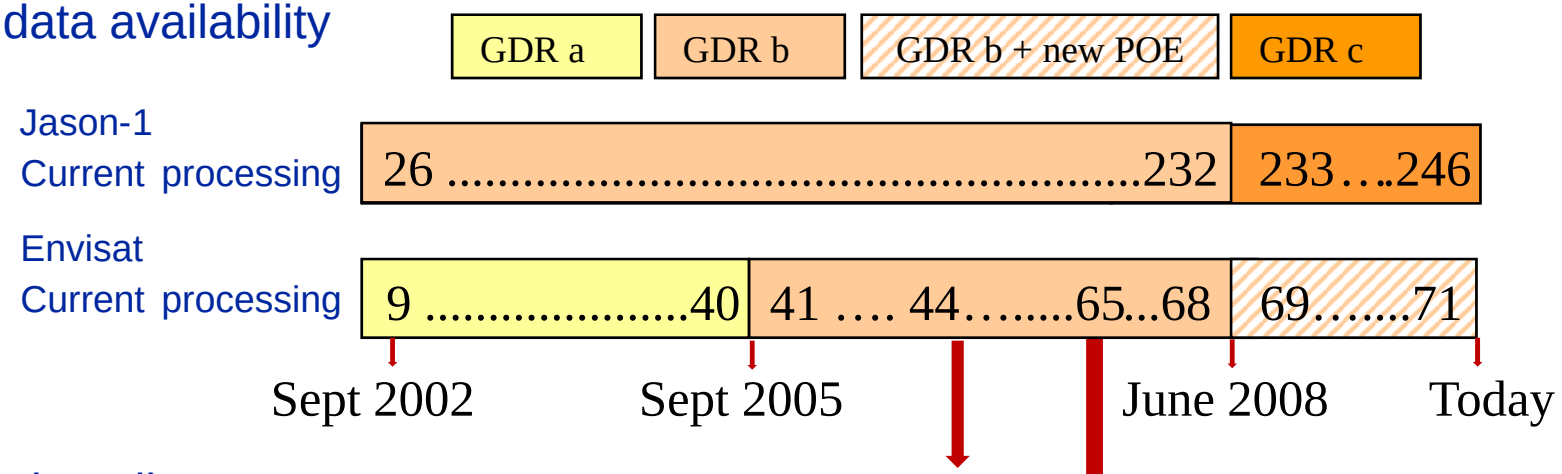
2. Envisat / Jason-2 : *Envisat, a useful third point of comparison between the Jasons*
   - ➔ Comparisons using IGDR products on the 110 days of Jason-2 life time
   - ➔ Engaging results concerning comparisons using GDR products on the 60 days of data

3. Envisat / Jason-2 / Jason-1 : *A specific comparison analysis*
   - ➔ High frequency content comparison.

1. Envisat / Jason-1 GDR :
How close are they today?

Envisat GDR status

•6 years of data availability



•Good general quality :

- •Very good availability of data.
  - **USO anomaly**: In February 2006, the RA-2 Ultra Stable Oscillator (USO) clock frequency underwent, for an unknown reason, a strong change of behavior.

    ➔ Altimeter range can be corrected from this anomaly by users, thanks to **auxiliary files** distributed by ESA since mid 2006
  - **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 A and B-Sides.

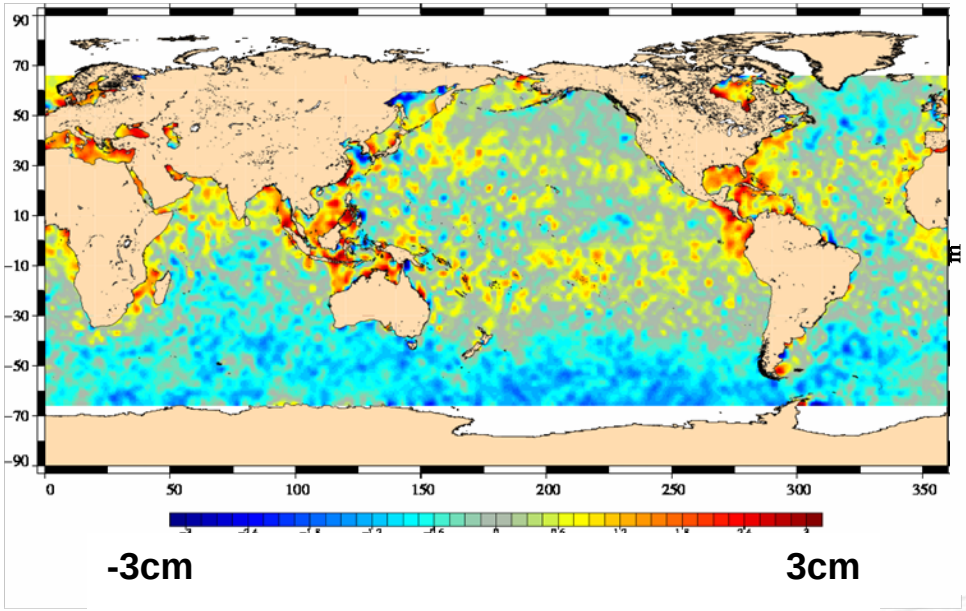
    ➔ GIM ionospheric correction is available in the IGDR and GDR products

•**Reprocessing** of the whole Ra-2 Envisat GDR in version C will be done in 2009

Jason-1 / Envisat consistency

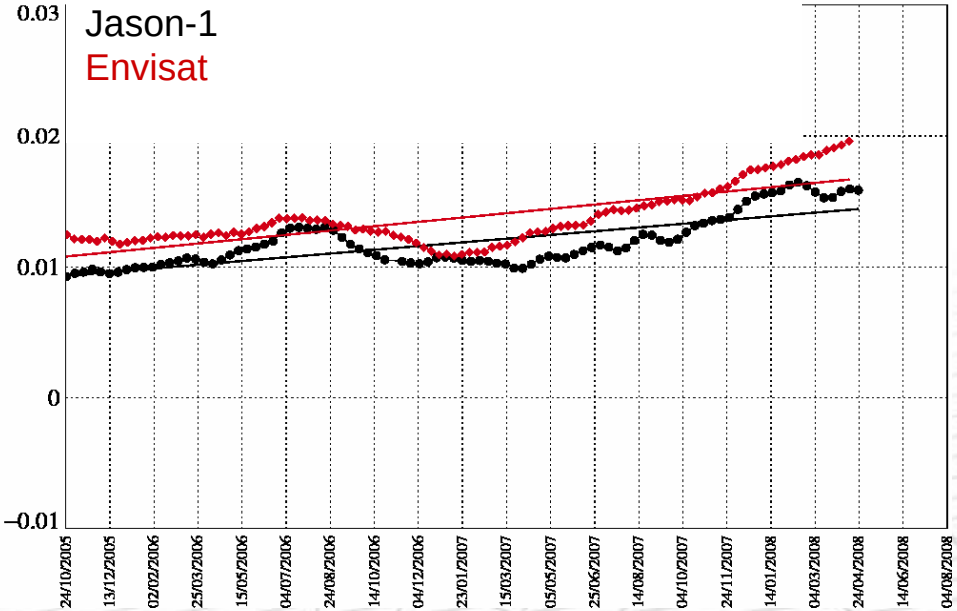
- Good consistency between the two missions.

Envisat –Jason-1 dual cross-overs on cycles 10 to 61 with a homogenised dataset



➔ **Consistency in terms of geographically correlated biases**

Mean Sea Level trend from cycle 41



➔ **Consistency in terms of MSL on mid-2005/2007**

- More details in Poster “Envisat /Jason-1 Cross-Calibration” (Faugère et al.)

2. Envisat / Jason-2 IGDR :
Envisat, a useful third point of comparison between Jason-1 and -2

Data used for Jason-2 / Envisat comparison

- Results are shown here for **IGDR** data using **MOE** orbit on a 110-days period corresponding to :
  - Envisat cycles 70 to 73
  - Jason-2 cycles 1 to 11
  - Jason-1 cycles 238 to 249

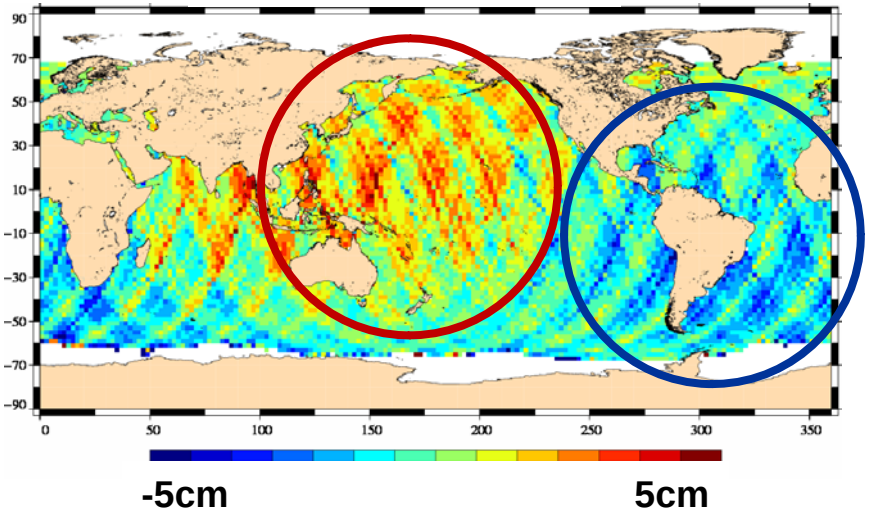
- Preliminary results are then shown for **GDR** data using **POE** orbit on a 60-days period corresponding to :
  - Envisat cycles 70 to 71
  - Jason-2 cycles 2 to 7
  - Jason-1 cycles 239 to 244

- Statistics are computed on a J2 cyclic basis (10 days)

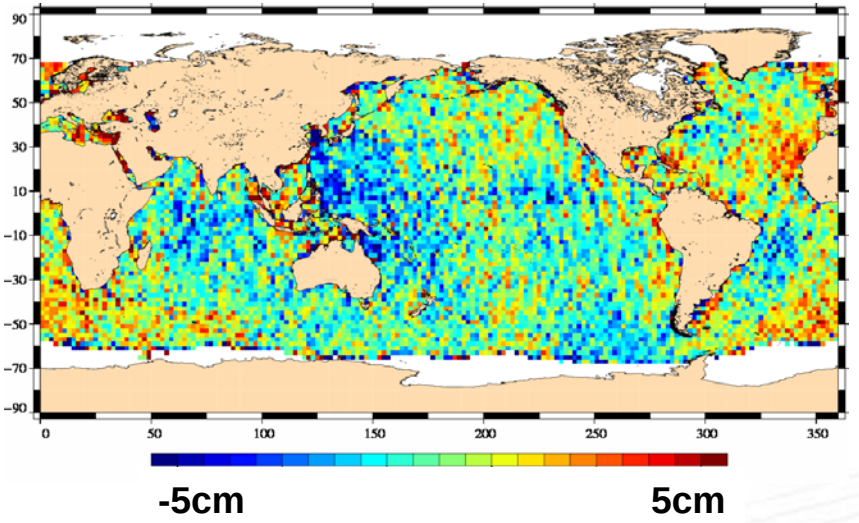
- For a better consistency, all SLA/SSH used here are computed with:
  - **ECMWF** troposphere correction and
  - **GIM** Ionosphere correction, in order to be consistent with Envisat data

Differences of along track SLA

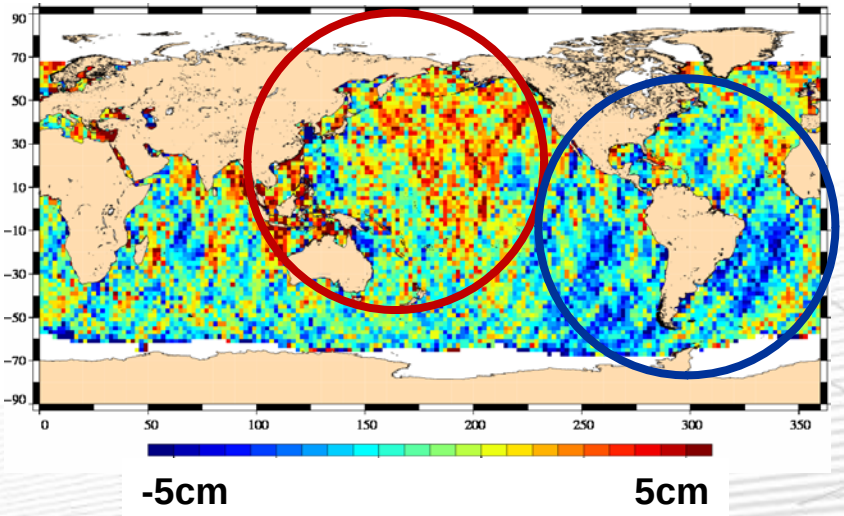
J2- J1 SLA using MOE



EN- J2 SLA using MOE



EN- J1 SLA using MOE

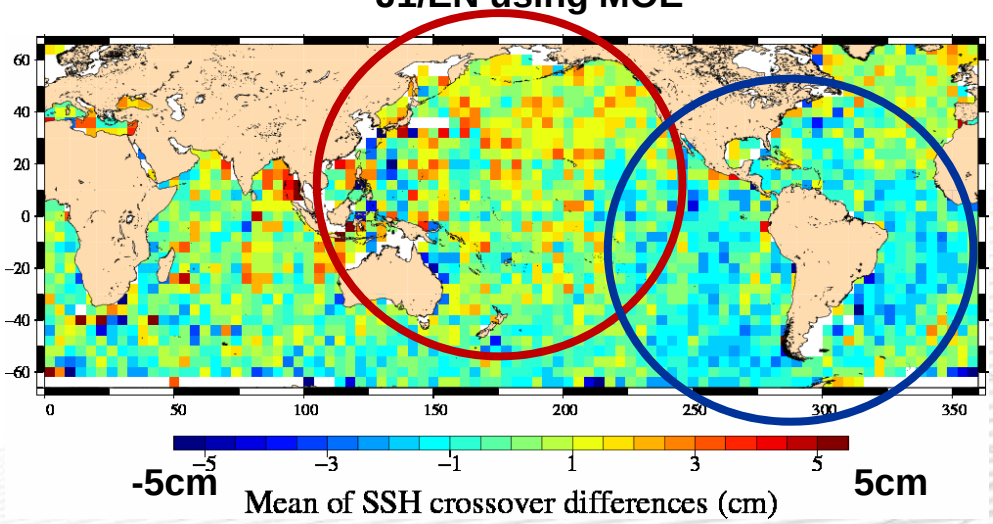


- Differences of averaged IGDR SLA averaged per boxe on the whole period show:
  - ➔East/ West bias seen on J1/J2 and EN/J1 comparison is no more visible on EN/J2 comparison.

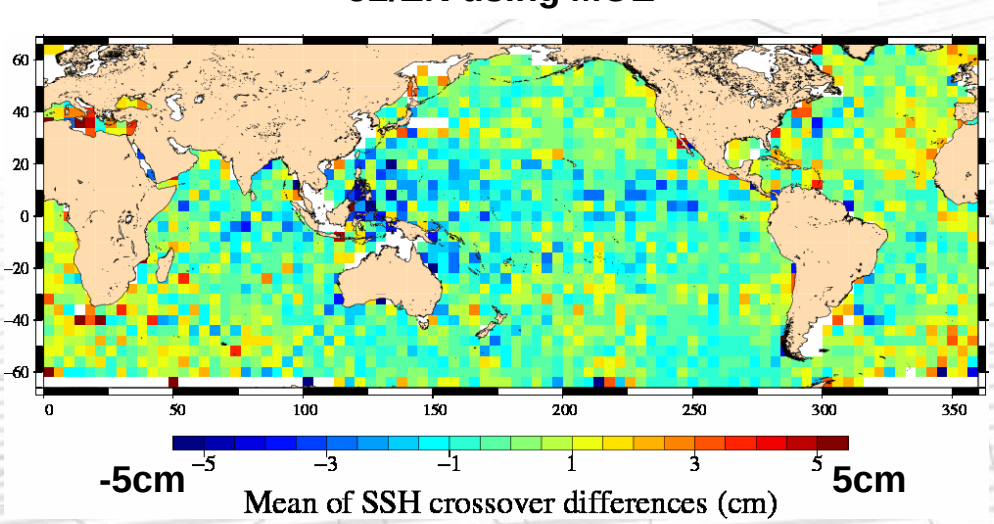
Differences at dual crossovers using MOE

- Averaged SSH crossover difference on the whole period show:
  - ➔East/ West bias seen on J1/J2 and EN/J1 comparison is no more visible on EN/J2 comparison.
  - ➔J2 is much closer to Envisat than J1
  - ➔Balanced by the fact that the differences are small. Standard deviation at dual crossovers = 4.5 cm : enables a precise detection of potential anomalies

J1/EN using MOE

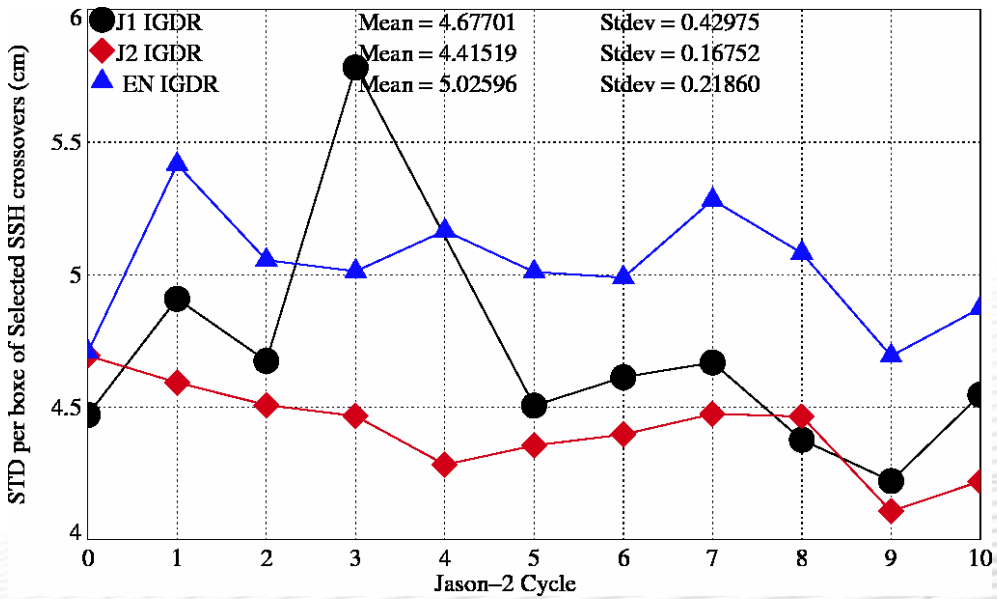


J2/EN using MOE



Monitoring of the standard deviation at crossovers

- Standard deviation of monomission SSH crossover difference cycle per cycle show:
  - ➔slightly better performances for Jason-2 (4.4cm), Jason-1 (4.7cm) and Envisat (5cm).
  - ➔ Good consistency for the three missions



Envisat higher standard deviation is due to a different sampling (reference = J2 cycle → Envisat cycles are not complete).

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.

Engaging preliminary results using POE

- Averaged SSH crossover difference on the whole period show:
  - ➔No more East/ West bias seen on Jason-1 related comparison (see M. Ablain presentation)
  - ➔Jason-2 and Jason-1 are very similar seen from Envisat
  - ➔Standard deviation at dual crossovers = **3.4cm** (< 4.5 cm with MOE) : enables an even more precise detection of potential anomalies than in NRT (IGDR)

- Standard deviation of monomission SSH crossover difference cycle per cycle show for GDR (with POE):
  - ➔As for NRT (IGDR): good consistency for the three missions

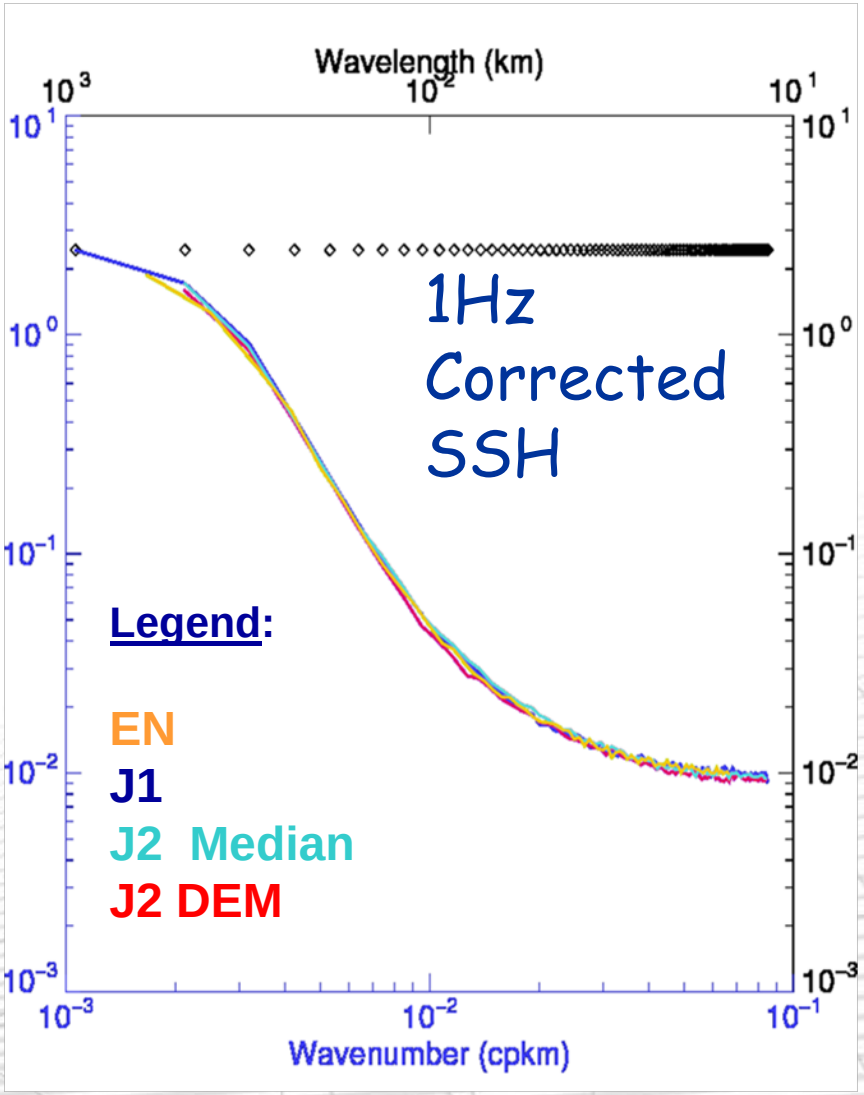
  slightly better performances for Jason- 1 and -2 (4.2cm) and Envisat (5cm). The best improvement between IGDR and GDR is noticed for J1.
  - ➔ Engaging results consistent and slighly better than NRT

3. Envisat / Jason-2 / Jason-1 comparison :
High frequency content

High frequency content

- Spectral analysis are performed (Mean spectrogram) on SSH along tracks with an ocean editing criteria
  - On 10 days cut into 160 seconds samples for 1Hz data
  - On 1 day cut into 15 seconds samples for 20Hz data

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

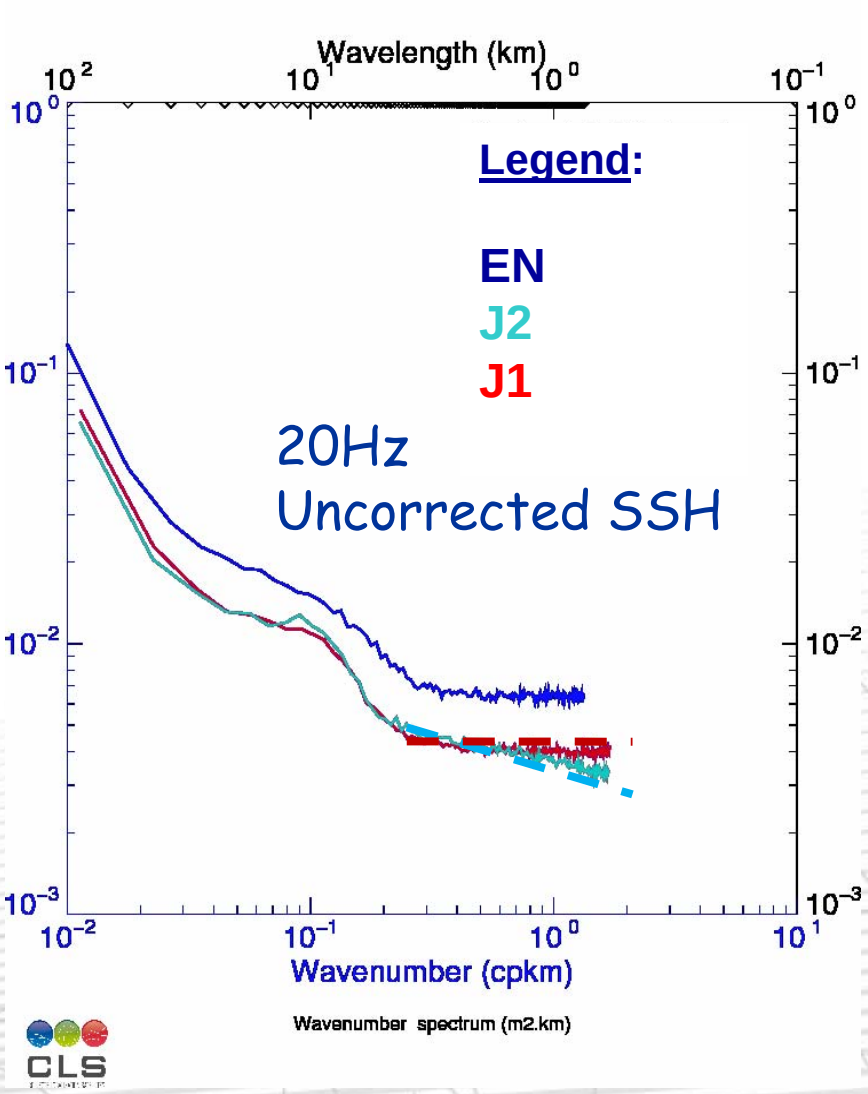


20Hz High frequency content

- Envisat and Jason-1 and -2 spectral content have a similar shape, with a first slope, a small bump around 20-70km and a noise plateau at :
  - 9.2cm white noise for Envisat
  - 7.9cm white noise for Jason-1 and Jason-2
- High frequency content for Jason-1 and Jason-2 are very consistent, exept that Jason-2 presents an unexplained coloration for frequencies above 3Hz.

➔Slight coloration under investigations :

- Unchanged by selections on data (distance to coast, 20 valid data per second, selection on mispointing, waves or MQE criteria…)
- Present for any tracker (remains for the SGT mode, although it is the same as Jason-1)



Conclusion

- **Envisat /Jason-2 are very consistent**
  - standard deviation of cross-over differences = 4,5 cm (IGDR) and 3.4 cm (GDR), which enables a precise cross calibration
- **Envisat is a useful third point of comparison between the Jason-1 and -2**
  - The geographically correlated biases between Envisat and Jason-2 are lower than with Jason-1.
  - High frequency content for Envisat Jason-1 and Jason-2 are very consistent at 1Hz and 20Hz, independently from the tracker used on Jason-2.
  - Concerning the 20Hz content, the comparison with other missions enables to notice a light coloration of the noise above 3Hz.
- **Jason-1 and -2 comparisons with Envisat GDR are very consistent**
  - This is encouraging for insuring a good continuity on the long term monitoring already initiated with Jason-1 since 2002.
- **This cross calibration shows that precise analysis can be performed even if the satellites are not on the same tracks**