Y. Faugère, A. Ollivier, P. Thibaut – **CLS**
N. Picot – **CNES**, P. Féménias – **ESA**.

Analysis of the high frequency content of Jason-1, Topex and Envisat data

Introduction

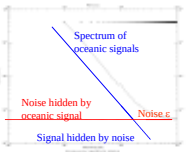
The present study is based on user products and aims at analysing the high frequency (HF) part of the Sea Surface Height (SSH) signal of Jason-1, Envisat and Topex This signal includes instrumental noise, processing noise, correction noise, residual geophysical signals… Comparing the HF content of several missions enables to compare the performances but also to better understand the physical content of each signal. Two types of methods have been used to analyse such a signal: a spectral analysis, and a filtering technique. The first method allows us to quantify accurately the global SSH HF for 1Hz and 20Hz data. The second method is used here to characterize the geographical distribution of this HF signal at 1Hz.

Data

- 20Hz and 1Hz Envisat/Jason-1 comparison is performed over the periods 7-8 and 7-26 September 2006. (Jason-1 GdrA and B)
- 1Hz Topex/Jason-1 comparison is performed over the period 22 July-1 August 2002 (Jason-1 GdrB and Topex RGdr)

Caracterisation methods of the HF content

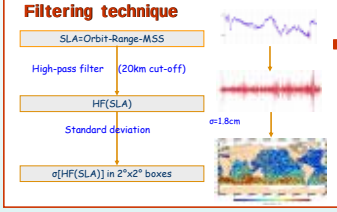
Spectral analysis



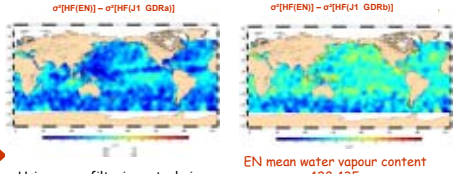
A plateau on a power spectrum can be the signature of a white noise. The standard deviation of its distribution can be obtained by : $\sigma = \sqrt{\frac{\alpha}{2.\Delta t}}$

- 1Hz spectra are computed from 10 days of data
- 20Hz spectra are computed from 2 days of data

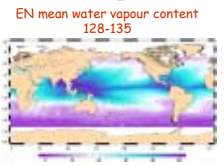
Filtering technique



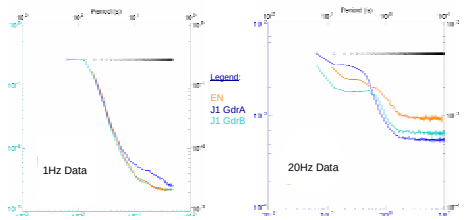
Improvement of consistency EN / J1 with GdrB



Using a filtering technique allows us to know the geographical distribution of the high frequency content for Envisat and Jason-1 over cycles 128-135. The consistency between Envisat and Jason-1 is especially improved in wet areas.

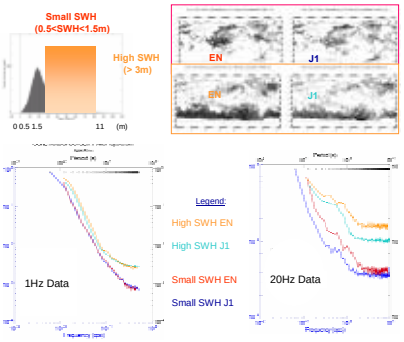


Improvement of consistency EN / J1 with GdrB



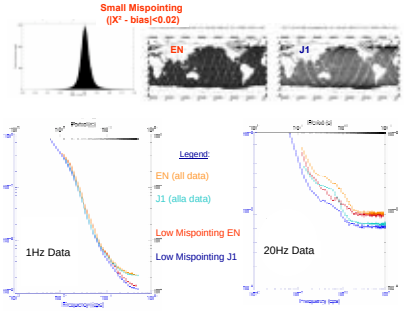
From 1 Hz data, there is no clear plateau at high frequencies. The strange shape of 1Hz Jason-1 spectra in the 0.1-0.4 Hz bandwidth disappears with the use of MLE4 retracking. 1Hz Envisat and Jason-1 spectra are superimposed.
On 20Hz data, at frequencies higher than 3Hz, the Envisat signal is hidden 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 (GDR a and b) spectra has a similar shape as Envisat but with a lower plateau (7.3 cm for version a and 7.9 for version b). The higher energy in the 0.1-0.4 Hz bandwidth is reduced with the use of MLE4 retracking. Jason-1 HF energy is now lower than Envisat at all frequencies

Impact of SWH on HF spectra



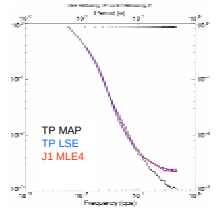
- Here, 1Hz and 20Hz Envisat and Jason-1 are selected to separate SSH by classes of wave height.
- At 1Hz the noise level increases logically with the wave height. Envisat and Jason-1 1Hz spectra are superimposed in both cases, high waves and small waves. A pseudo-plateau appears for high waves only.
- At 20hz Envisat and Jason-1 spectra are closer for small waves (plateau almost superimposed) than for high ones.
- The energy in the 0.1-0.4 Hz bandwidth increases with the waves. The pseudo-plateau visible at 1Hz on high waves is not the signature of an instrumental white noise. It is the signature of the energy between 0.1-0.4Hz on the 20Hz spectra

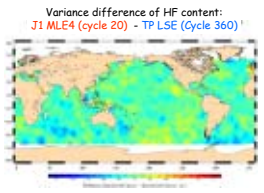
Impact of Mispointing on HF spectra



- Contrary to the wave selection, the mispointing selection removes a very low amount of points.
- As for the wave selection, 1Hz Envisat and Jason-1 are consistent in both cases. For the two satellites, the HF energy level is also very sensitive to the mispointing selection.
- At 20Hz the plateau is not impacted by the selection on both satellites. However the energy between 0.1-0.4Hz is strongly reduced when selecting low mispointing.

Good consistency TP LSE / J1 GdrB





- TP LSE and J1 MLE4 1Hz spectra superimposed.
- The geographical distribution of the difference of HF content is very homogeneous.

Conclusions

Cross comparison between Jason-1 and Envisat HF content

- The energy at 0.1-0.4Hz is reduced with the use of MLE4 on Jason- at 1Hz and 20Hz. GdrB enables to improve the Envisat/Jason-1 consistency at 1Hz and 20Hz.

  BUT some differences remain:

  - There is a remaining suspicious high energy in the 0.1-0.4Hz bandwidth on 1Hz spectra
  - The perfect superimposition of 1Hz Envisat and Jason-1 spectra is in contradiction with the lower energy on Jason-1 20Hz spectrum
- At 20Hz, in the case of small waves selection, the energy is reduced at all frequencies whereas only the remaining energy in the bandwidth 0.1-0.4Hz is reduced in the case of the low mispointing selection

  => the remaining suspicious high energy in the 0.1-0.4Hz bandwidth is due to perturbed data with high mispointing values

  => The pseudo-plateau visible at 1Hz on high waves is not the signature of an instrumental white noise. It is linked to the energy between 0.1-0.4Hz on the 20Hz spectra
- 1Hz Envisat and Jason-1 are superimposed whatever the selection applied on the 2 parameters. The contradiction with the 20Hz on that particular issue is yet unexplained.

First results on the cross comparison of Jason-1and Topex RGDR HF content

- Good consistency between Topex LSE and Jason-1 MLE4

CLS
Collecte Localisation Satellites
8-10 rue Hermes
31526 Ramonville Saint Agne - France

OSTST meeting
Hobart, March 2007

esa cnes