Significant Wave Height evolution towards a climate dedicated multimission product

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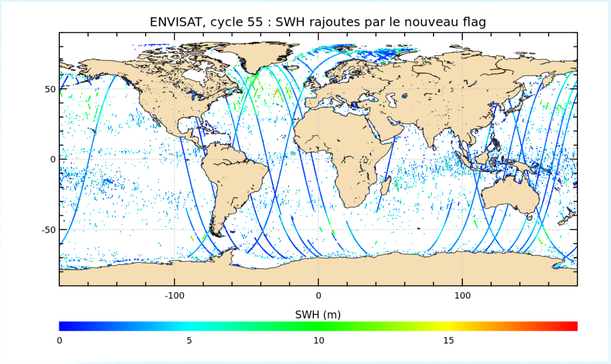
Overview

In this poster, resuming a 6 months training course, we focus on the characterization of Significant Wave Height from different altimetric missions like Envisat, Jason-1, Jason-2, Topex/Poseidon, ERS-1, ERS-2, GFO and Cryosat-2. Their behaviour is analysed and characterized in terms of long term and interannual trends. For a finer analysis, comparisons to ECMWF ERA Interim model (Abdalla and Hersbach 2004) were also used as an external reference.

A new specifical selection of data for SWH study

The criterias of validity adapted to SLA are not necessarly relevant for SWH purpose. For instance a measure without radiometer maybe degraded in term of Surface Height whereas it has no impact on SWH quality.

For this study, a new selection of data with the following criterias is defined: SWH maximum = 20 m, Ice zone recognition Manœuvre period recognition. The criterias selection impacting the height determination were relaxed.



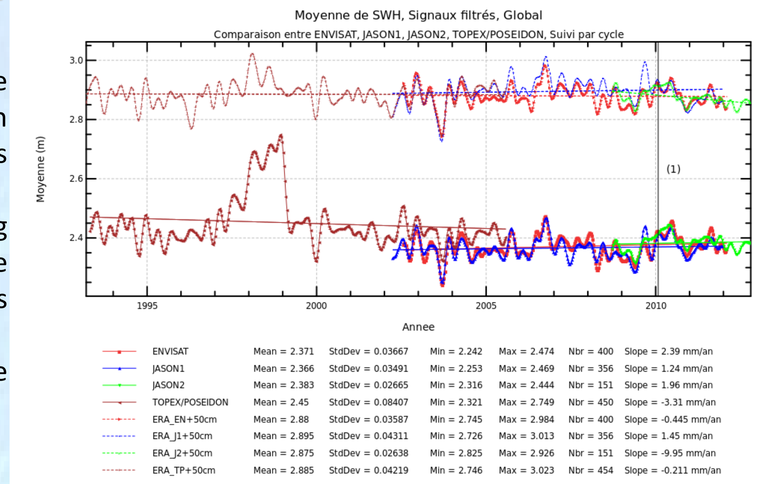
This figure (ENVISAT example) higlights coherent waves recovered over the globe with this new selection.

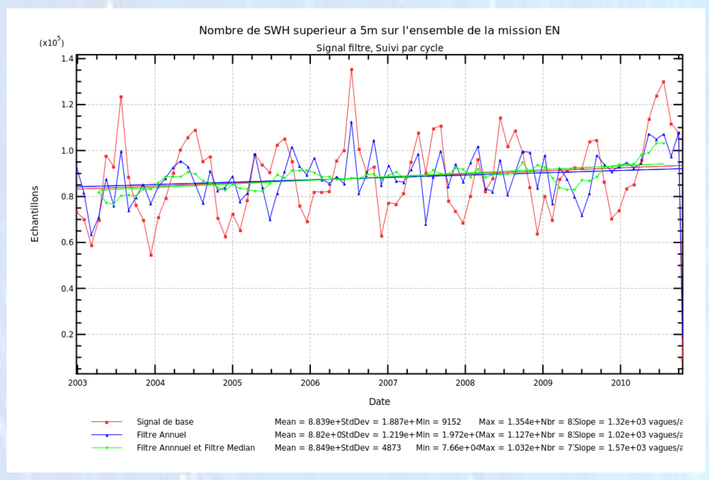
Long term trend multimission and comparison with ERA model

In order to compare the different missions to eachother, the analysis are performed for latitudes beetween -66° et 66° in statistical boxes of 2°x2° Latitude/Longitude, over 10 days periods.

The figure on the right shows the superposition of the long term analysis for altimeters datas at the bottom and the ECMWF ERA model at the top. We introduced a 50 cm bias for more lisibilty.

The figure at the bottom, illustrates the increase of the number of SWH>5 m, (signal filtered).

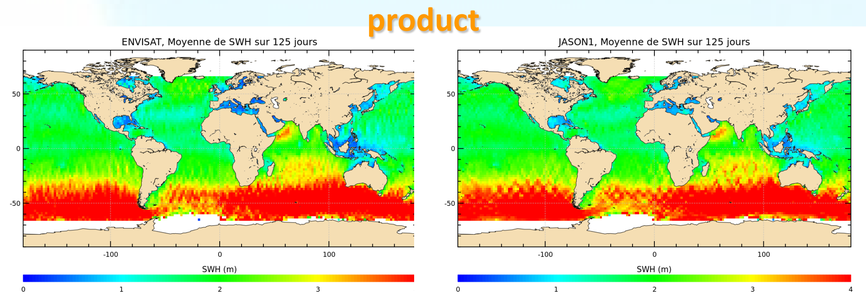




Altimeter datas are globally in agreement for ENVISAT, Jason-1 and Jason-2. On Topex/Poseidon, a biais can be identified during the period 1997-1999.as already described in [Ray and Beckley, 2012]

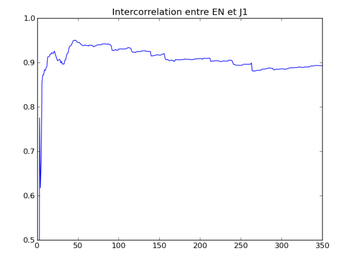
Unlikely, the ERA model does not present the anomaly for Topex. The figure at the top shows ERA model is not the same for each mission especially beetween ENVISAT and Jason-1. This comparisons underlines somes discontunuities in the model

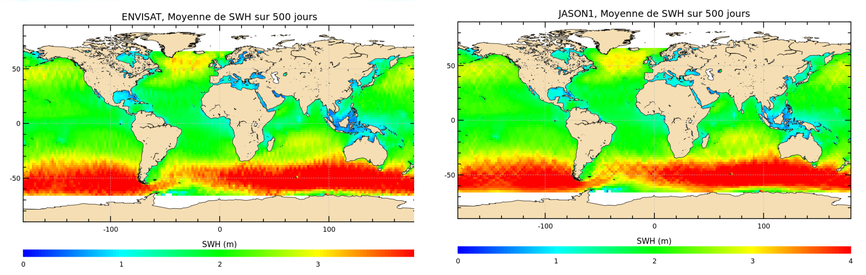
Frequency sampling estimation for multimission SWH product



The figure on the top shows that the cartography of SWH mean for ENVISAT and Jason-1 during the same short period, are different. (figure at the top)

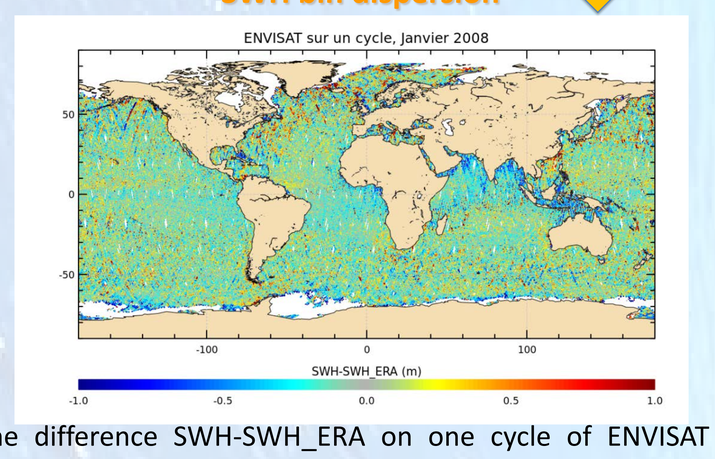
The maximum intercorrelation beetween this 2 missions depending on time was calculated to estimate the period maximasing the correlation beetween both missions (500 days for the example of ENVISAT and Jason-1). Averaged over this period, the physical information is more correlated and would ease the computation of a multimission product.





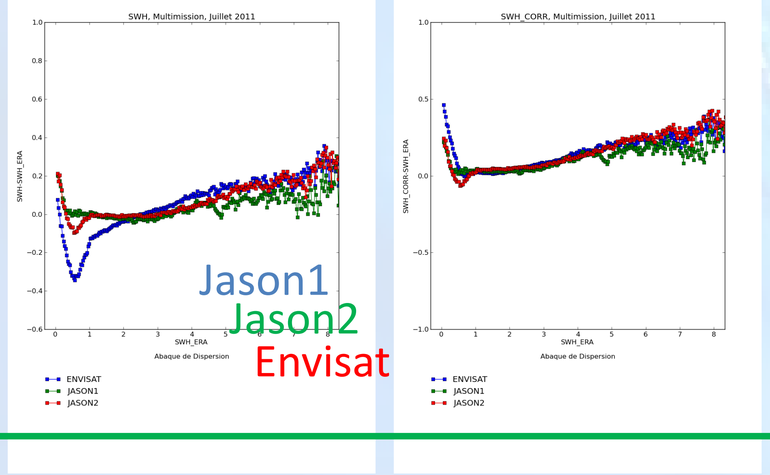
Critical analysis of the ECMWF ERA-Interim Model

SWH bin dispersion

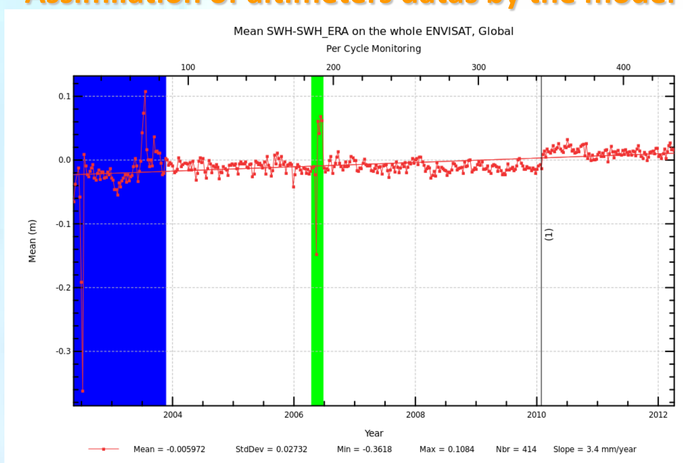


The difference SWH-SWH_ERA on one cycle of ENVISAT in january is mapped above. The differences are low except near the North Pole, a high waves zone, and in the Indian Ocean and the Oceania, a very low waves zone (<1m).

This differences are illustrated in a dispersion diagramm (figure at the bottom) in which we can notice a big difference for the low waves. As performed with reference to in situ buoys [Queufeullou et al 2012], the comparison to ERA model enables to characterize fine discrepencies beetween missions. Notably concerning different behaviors on small waves for different missions, this difference (below left) is reduced as shown on the (figure below right) using the polynomial correction of [Queufeullou et al 2012] :.



Assimilation of altimeters datas by the model

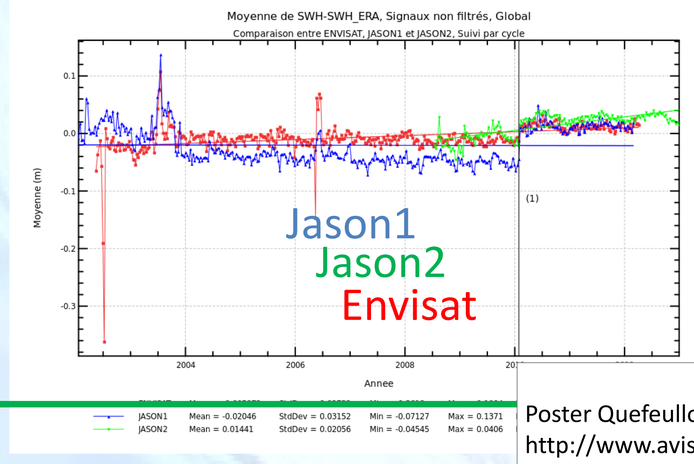


The long term trend of the difference SWH (homogeneous V2.1 reprocessed data -SWH_ERA-Interim for the whole mission ENVISAT is visible on the top figure.

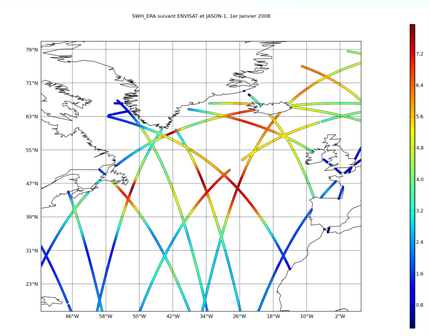
-The blue zone is the beginning of the mission and is significant of some already suspected problems.

-The green corresponds to the Side B period.

-The jump in january 2010 corresponds to the beginning of the ENVISAT reprocessing. The model is not homogeneous and assimilates non reprocessed real time data. On the figure at the bottom, the same jump is present with the same variations on Jason-1 than on ENVISAT. The inhomogenety of the data assimilated in the models affect the model and the monitoring of all the others missions.



Temporal dispersion on ECMWF ERA model



Each satellite has its own itinerary as illustrated on the figure here above. ENVISAT doesn't register datas in the same place at the same time as Jason-1.

Moreover, the ECMWF ERA model provides datas every 6 hours. With the high variability of the waves, a large high waves zone is observed in the morning that diseappears in the evening.

The difference of values plotted for ENVISAT and Jason-1 at the south of Groenland and near Iceland explains the phenomenon of temporal dispersion.

Conclusion

The model ERA-Interim of ECMWF presents some limits to be a stable reference for climatic studies because of the assimilation of inhomogeneous altimetric data.

⇒Utility of building a homgeneous SWH product in order to be assimilated by models for climatic studies

In DUACS system, wave/wind products already exist in real time corrected approximatively by a bias beetween missions but they could be complemented by a more stable products, with a finer multimission merging for more relevant climate orientated studies.

References:

Poster Quefeullou pour corrections vagues Abdalla pour description modèle ERA
http://www.aviso.oceanobs.com/fr/donnees/produits/produits-ventvagues/mswhmwind.html
Ray et Becley pour identification erreur topex sur vagues Ablain pour étude climatique sur vent

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