

# New assessment of the RA-2 instrumental

## corrections and impact on the Mean Sea Level

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<u>Abstract</u>: The aim of this poster is to demonstrate the key role played by the altimeter instrumental corrections on the accuracy of the main estimated oceanic signals: sea height, significant wave height and backscattering coefficient. A special focus is given on the Mean Sea Level trend estimation which is directly impacted by any variation of the instrumental characteristics due to ageing and/or thermal environment fluctuation.

In order to meet the objective of extreme accuracy of the altimetry measurement, it is crucial to regularly calibrate the altimeter hardware, to continuously monitor the instrumental characteristics and to apply corrections to the data. Regarding the sea surface height, instrumental corrections take values from tenth of millimeters to a few meters. Their temporal variations are also very diverse from high frequency variations linked to thermal instrument fluctuations to very long drifts caused by the ageing of the electronic components. Simultaneously, requirements for the mean sea level are stringent (with precision level below one millimeter/year). It is thus essential to measure and apply instrumental corrections in an extremely accurate manner.

In this context, instrumental corrections applied on Envisat/RA-2 data have been revisited and sometimes improved. Their resolutions have been increased. Their trends have been theoretically understood and corrected (the sign of the drift of the Point Target Response has been reversed). Then, the ESA Sea Level Climate Change Initiative has been giving us the opportunity to evaluate their impact on the RA-2 Mean Sea Level Trend. We present in this poster some illustrations of the results obtained in the frame of the Sea Level CCI project. Based on strong hypotheses on the instrumental processing applied on-board on the waveforms and on the PTR data (sometimes difficult to confirm 10 years after the launch), these evolutions provide a mean sea level trend which is much more in agreement with the MSL observed by tide gauges and Jason-1.



#### Relation between the Point Target Response, the IF filter and the waveform position and shape

A waveform can be modelized (Brown model) by the double convolution of the Flat Sea Surface Response (FFSR), the Probability Density Function of the specular points (PDF) and the Point Target Response of the Instrument (PTR, Fig.2).

### W(t) = [FSSR(t) \*\* PDF(t) \*\* PTR(t)] \*Filter

Any evolution (long or short term) of the PTR modifies (Fig.1):

- the position of the waveform which impacts the range and thus the MSL
- the shape of the waveform which impacts
  - $\checkmark$  the width of the leading edge directly related to the SWH

 $\checkmark$  the Power of the waveform which is linked to the backscattering

coefficient (Sig0) and the windspeed (WS)

The Sea State Bias is defined as a function of SWH and WS. Evolution of SWH or WS will have impact ranges and MSL.



#### Instrumental variations

Because of the thermal variations along the orbit, oscillations (within 1mm) are observed on the Ku band PTR Time\_Delay (Fig.3). This can be observed thanks to the improvement of the resolution of the PTR via zero-padding technique.

- →Accounting for these variations will impact the small scales and short time sea surface height \_ (mesoscale and hemispherical signals)
- → Differences of corrections are plotted on fig.4 showing strong impact on inter-annual signals

#### Small scales and short term variations







#### Cross-calibration between ENVISAT and JASON-1/2 : Cf talk from A.Ollivier and Y.Faugère



ConclusionsThe improvement of the PTR resolution allows to reach small structures of the signal : mesoscale structures, dependency along the orbit, inter-annual signalsThe reversion of the sign of the PTR correction has a strong impact on climate applications modifying the MSL trend by +2 mm with an improved agreement with<br/>tide gauges and Jason-1 measurements.

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