Impact of the Sentinel-3A SRAL PTR Width Drift on the L2 Marine

Salvatore Dinardo [1], Remko Scharroo[2], Bruno Lucas[1], Cristina Martin-Puig[2] ,Carolina Nogueira-Loddo[2]

[1] HE Space, Darmstadt, Germany [2] EUMETSAT, Darmstadt, Germany

authors' contact: **s3.stm@eumetsat.int**

Abstract

The Sentinel-3A SRAL Point Target Response (PTR) Half-Power Width is drifting over the time. This drift has been estimated to be around -0.5 mm per year and is significant, being five times the PTR width drift as measured for Envisat Altimeter and CryoSat-2 Altimeter.

In this work, we analyse the impact of this Sentinel-3A SRAL PTR width drift on the stability of the L2 marine geophysical measurement in both SAR and PLRM mode over the two years of the mission.

We will show how the PTR Width drift of -0.5 mm/year can give rise to a SWH (significant wave height) drift of around +1 cm per year in SAR mode which translates in a drift of SAR SSB (sea state bias) of about -0.3 mm per year.

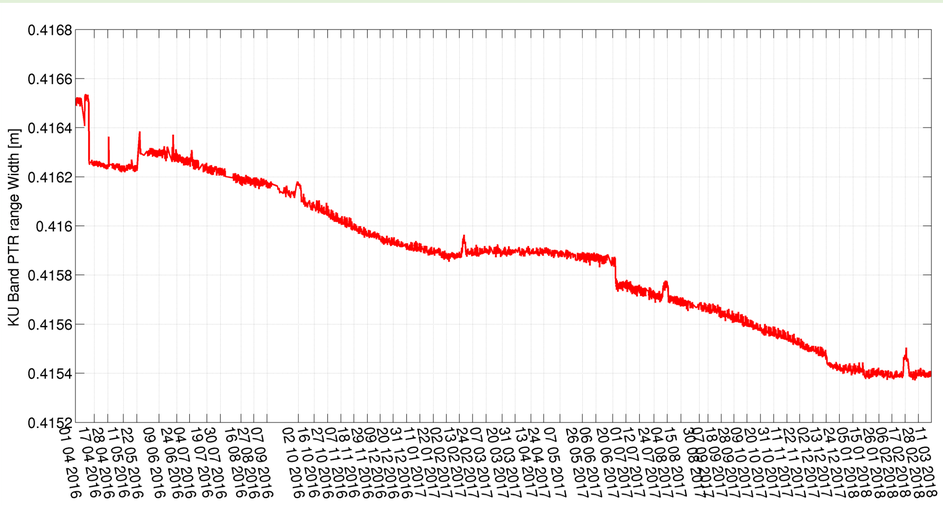
If this SAR SSB drift is not compensated for, it will lead to an over-estimation of the SAR global sea level rise by the same amount.

The SAR SWH drift of around +1 cm per year is consistent with the current observations with respect to the ECMWF model and Jason-3 altimeter.

Finally, an algorithm to compensate for the SAR SWH drift (and hence SAR SSB drift) during the retracking time is proposed and hence validated with numerical simulations.

S3A SRAL KU PTR WIDTH DRIFT

The 3 dB width of the Ku SAR PTR for S3A SRAL drifts in time with a rate of around –0.51 mm/year (five time the ones for CS-2 and Envisat):

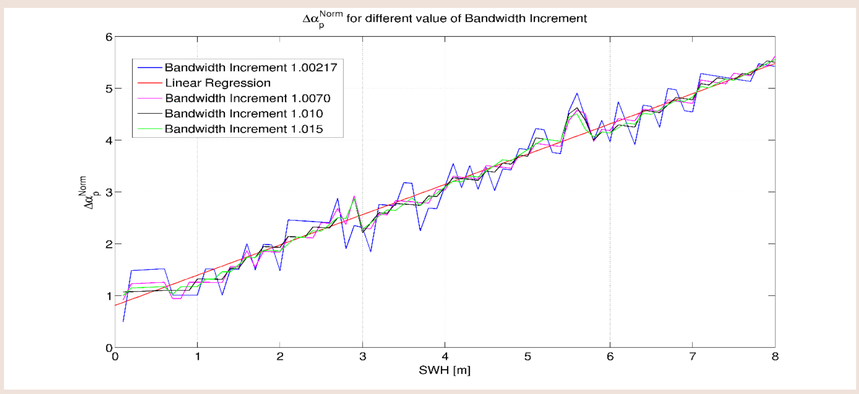


NUMERICAL SIMULATIONS

From numerical simulations, it has been observed that a change of the PTR 3dB width by **0.99783** (decrement observed at 11 03 2018) will translate in a normalized change of the Alphap LUT according to the formula:

$$\Delta\alpha_p^{NORM} = 0.81 + 0.58 * SWH \qquad \textbf{(1)}$$

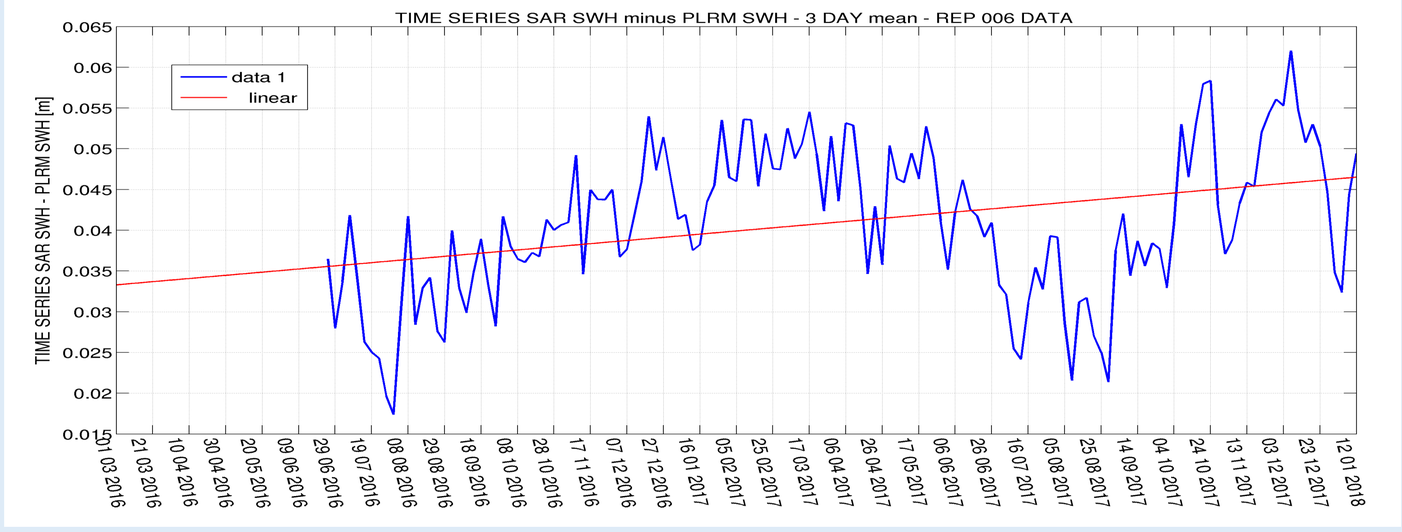
Hence, the impact of the PTR change is not constant but a linear function of SWH:



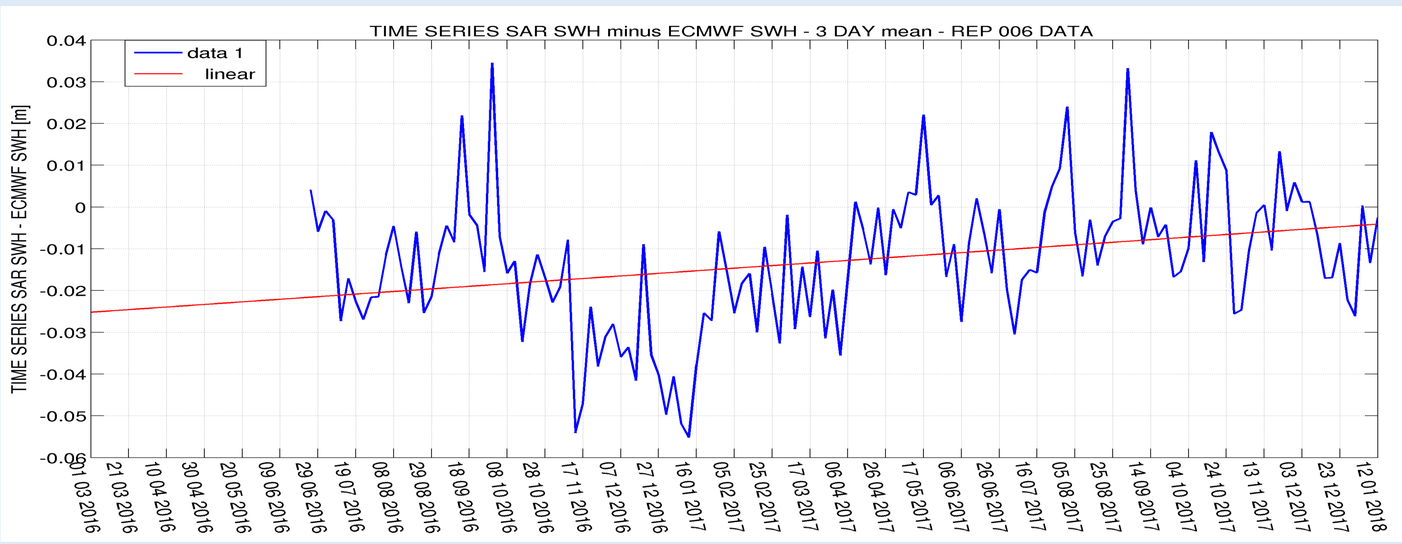
These numerical simulations have been repeated for various values of the PTR change factor in order to prove that the Equation (1) does not depend significantly on the used value of the change factor of the PTR width

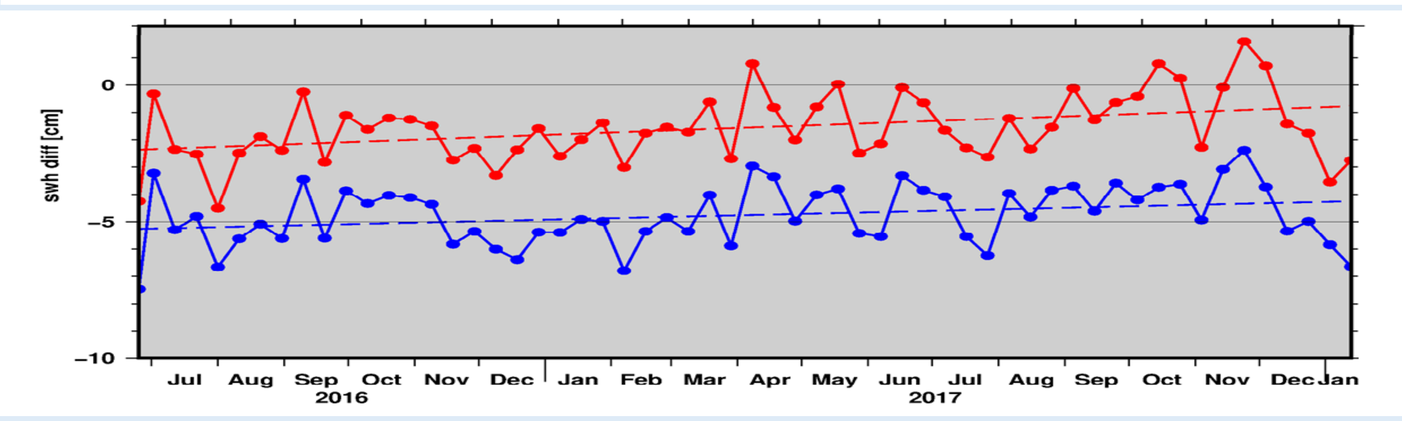
S3A SAR SWH DRIFT

It is observed that the S3A SRAL **SAR** SWH is drifting in time with respect **PLRM** SWH of about 0.70 cm/year

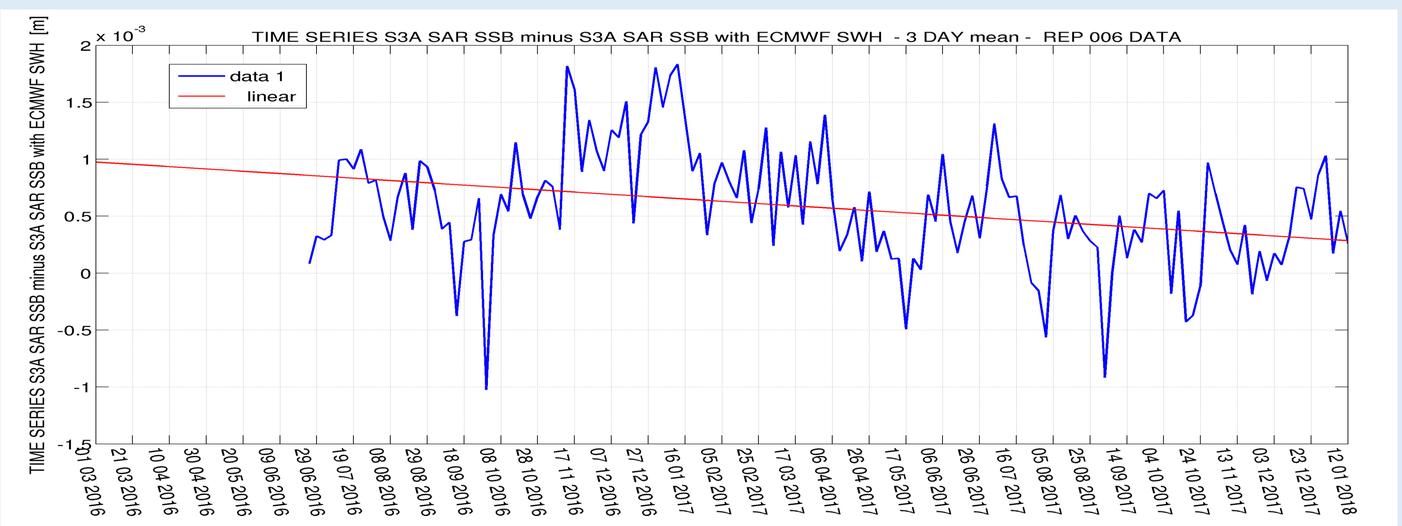


Furthermore, the S3A SAR SWH is drifting in time with respect ECMWF model by 1.12 cm/year and with respect to the Jason-3 mission, the drift of S3A SAR SWH is 1.03 cm/year.





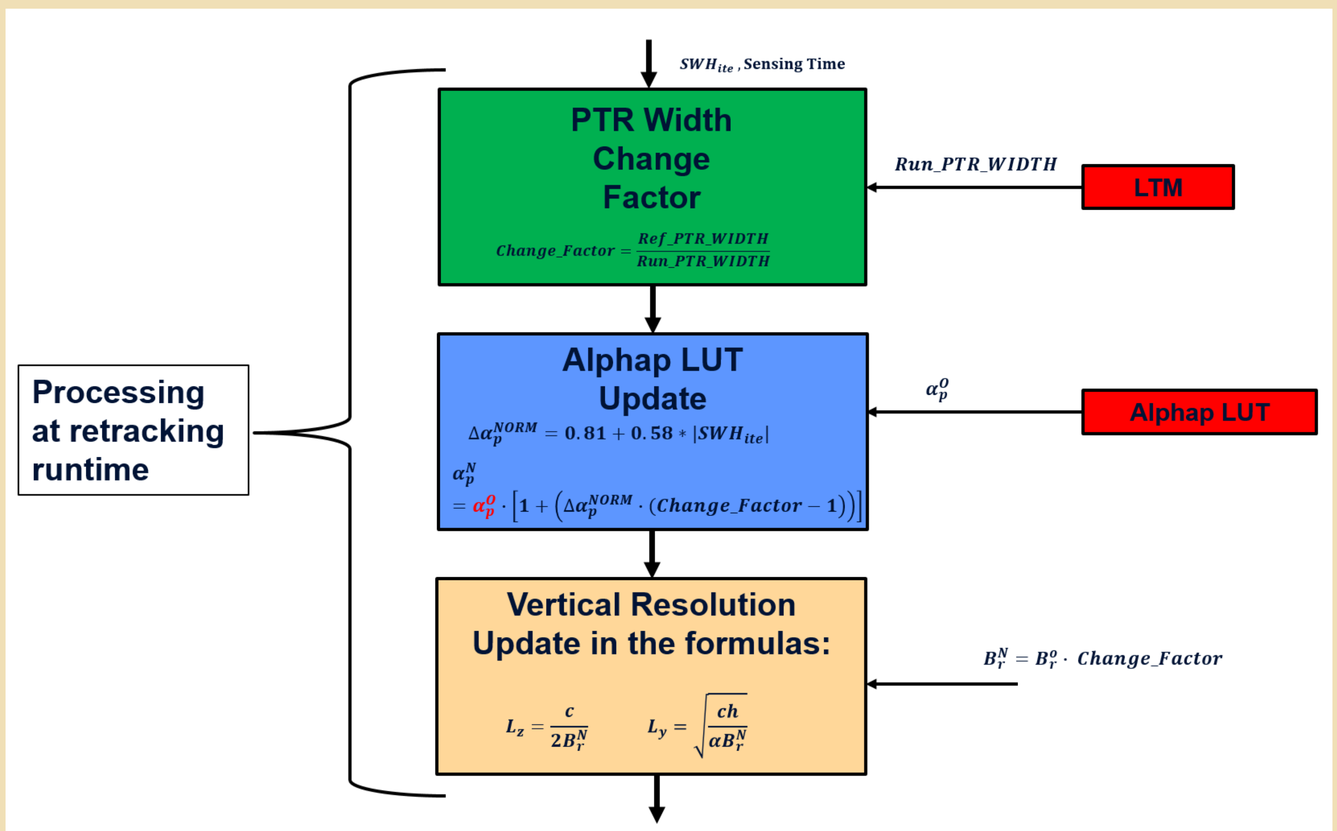
A drift in S3A SAR SWH of +1.12 cm/year translates in a drift in S3A SAR SSB of around -0.36 mm/year which is not a negligible error in the global mean sea level rise estimation.



PROPOSED CORRECTION FOR SAR SWH AND VALIDATION

The proposed approach is to implement a correction for the drift in the PTR width in the Level 2 processor during retracking runtime but In order to implement this correction during the retracking runtime, we need to know the value of the PTR width at runtime (recommended to be added in the LTM).

This value will be used to compute the *Change_Factor* parameter as in the block scheme:



The algorithm will consist basically in :

- Using formula (1) to compute the needed change in Alphap according to the iterated SWH and hence to update the value of the alphap to be used in the fitting scheme
- Update of the range resolutions used in computing the SAR sigmac

The algorithm has been implemented in a retracker consistent with L2 IPF.

The input waveform to the retracking was always a waveform built with the numerical SAMOSA model for an input SWH of 2.6 meter. Different value have been used for the Change_Factor from 1 to 1.00217 (this value observed on 11 03 2018). The final difference was a decrement of the SWH by 2.18 cm which is consistent with the observed increase of SWH with respect ECMWF model over the same time period