CFOSAT AWWAIS V7.1 main evolutions

Upgrade of the L1b processing

- Correction of the speckle model in across-track direction

An error was identified in the estimation of speckle spectrum coefficients using method 1b (psp1b) for the 8° and 10° beams, outside the along-track directions (±15° with respect to the satellite track). This discovery prompted a correction of the parametric speckle model through an adjustment of the coefficient values. The model is written according to the formula:

$$P_{sp}\,(k,\Phi) = \frac{\delta r}{2\pi N_{ind}} \frac{1}{sin\,\theta}\, tri\left(\frac{k}{2\pi}\frac{\delta r}{sin\,\theta}\right) + (a_0\Phi + a_1)k^2 + (b_0\Phi + b_1)k + (c_0\Phi + c_1)$$

With N_{ind} the number of independent samples, k the wavelength, θ the incidence of the beam under consideration, Φ the azimuth direction and δr the effective radar resolution.

The adjustment of δr for beams 8° and 10°, previously fixed erroneously by assuming a 6° incidence, requires the modification of the coefficients b_1 and c_1 as follows:

$$b_{1,new} = b_{1,old} - \left(\frac{\delta r}{2\pi \sin\theta}\right)^2 \frac{1}{N_{ind}}\left[1 - \left(\frac{\sin\theta}{\sin 6°}\right)^2\right]$$

$$c_{1,new} = c_{1,old} + \frac{\delta r}{2\pi \sin\theta}\frac{1}{N_{ind}}\left[1 - \left(\frac{\sin\theta}{\sin 6°}\right)\right]$$

These corrections resulted in an improvement in the consistency between the omnidirectional spectra and those of the MFWAM model for low wind and small wave height conditions.

Upgrade of the L2 processing

- Parasitic pic filtering

Following the correction of the speckle model out of the along-track directions, as described above, the filtering of parasitic peaks has been refined to change the threshold of the Signal to Noise Ratio (SNR) defined to reject parasitic peaks (see the release note of version 7.0 [CFOSAT_AWWAIS_V7_ReleaseNote_20241017.pdf (altimetry.fr)] which describes the method).

For version 7.1, the SNR threshold has been modified from 1.1 to 0.7 for the 10° beam. This was chosen so as to find a compromise between improving the correlation coefficient between the wave elevation spectra from SWIM and from the MFWAM model, and not degrading the spectra in long and low swells regions (see Figure 1). This change in the SNR threshold value does not change significantly the number of cases affected by the parasitic peak correction, which is about 30%.

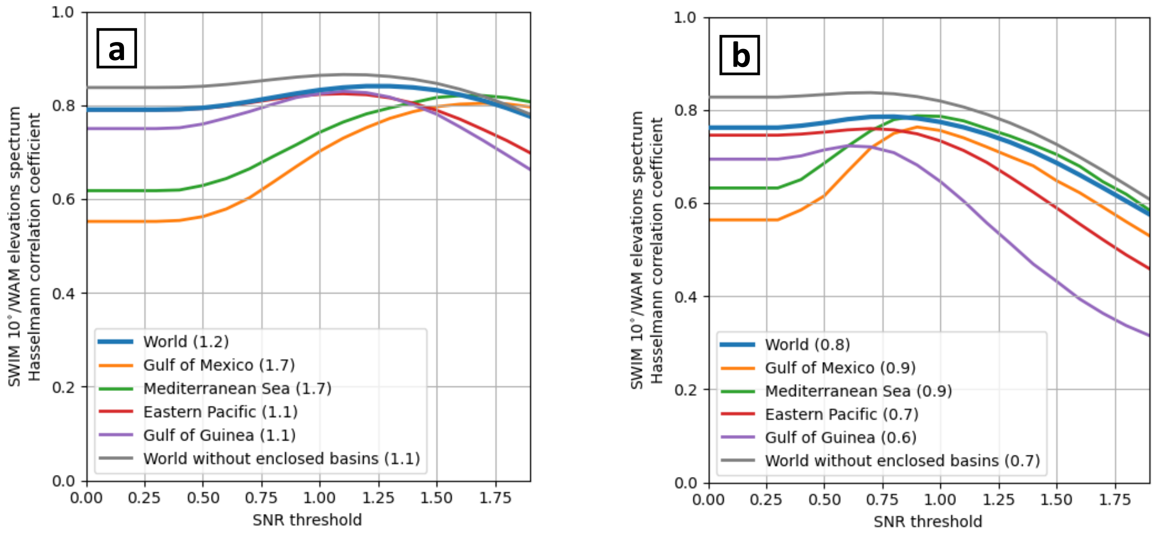

Figure 1 : Reduction of the optimum SNR filtering threshold. (a) Optimal threshold at 1.1 before speckle correction; (b) Same methodology after speckle correction leads to a threshold of around 0.7

The modulation spectrum (pm_mean) is now available for wavelengths ranging from 22 to 1112 m. This expansion involves changing the wavenumber vector k, constructed as follow :

$$k_i = \frac{2\pi}{\lambda_{max}} e^{\frac{i}{\sigma}} \text{ with } i \in \{0,1,\dots,N_k\}$$

Until now, we had a $\lambda_{max} = 500\ m$, $N_k = 32$ and $\sigma = 10$. The new vector k is built with an increased number of point in lower wavenumber, from $N_k = 32$ to $N_k = 40$ and implies in a maximum wavelength of $\lambda_{max} = 1112\ m$.

However, the slope spectra remain unchanged and continue to be provided within the 22 to 500 m range. Similarly, the wave parameters are still calculated over the 22 to 500 m interval. As spectral variables are now calculated over 40 wavenumbers, the spectral energy is set to 0 for wavelengths between 500 and 1112 m.

<u>Impacted parameters:</u>

- pm_mean: the modulation spectrum is now provided between 22 and 1112 m
- k_spectra: the wavenumber vector is now of size 40 to cover the range up to 1112 m

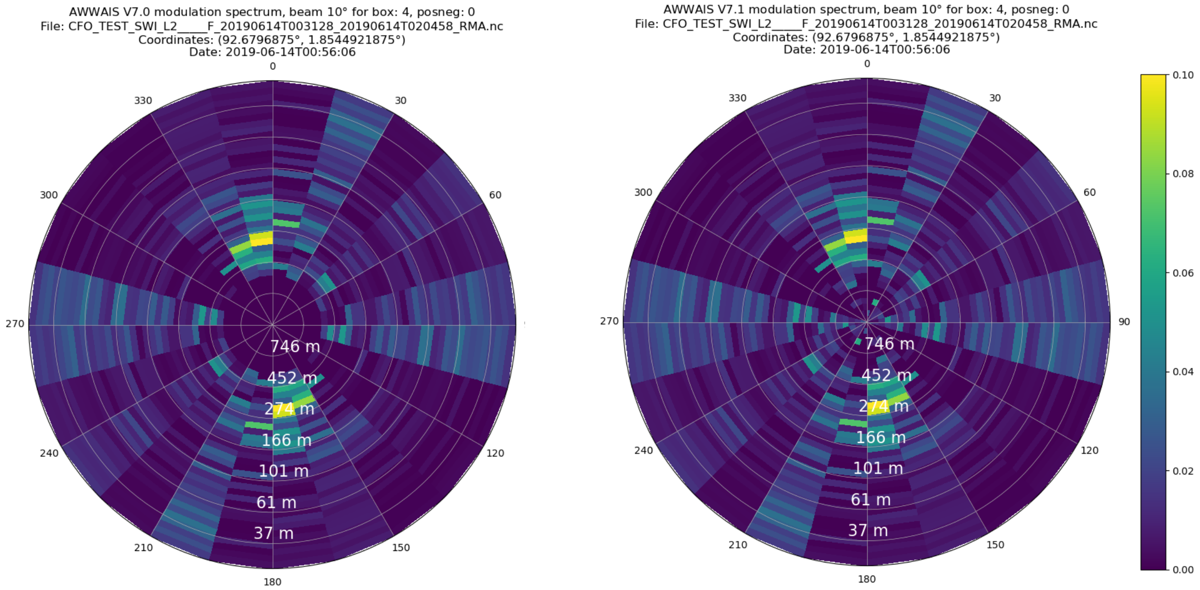

Figure 2 : Modulation spectrum from the V7.1 product (right) and from previous version (left). It can be seen on the right plot that non-zero values are present at wavelengths larger than 500 m (close to the center of the figure).