Mitigation of parasitic peaks appearing on SWIM wave height spectra

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Résumé

The SWIM instrument provides the directional spectrum of wave slopes, directly related to the directional spectrum of signal modulation, after subtracting the speckle density spectrum. From this directional wave slope spectrum, the omni-directional spectrum of wave height spectrum can be derived. However, after converting SWIM wave slope spectra to wave height spectra, we observed that some parasitic peaks appear at low wave numbers (long wavelengths), particularly for low sea state conditions. These spurious peaks are mostly due to an amplification of the noise floor at small wave numbers (large wavelengths), which is non null in spite of the speckle correction efforts.
This induces errors in the estimation of the peak wavelength (or peak frequency) when this latter is estimated from the omni-directional wave height spectrum, and thereby may induce an error on wave age, which is an important quantity in wave physics.

The current study suggests a filtering method of these peaks, with objective to filter the energy of the noise at the small wavenumbers (long wavelengths) while keeping the energy when real long waves (swell) are present.

Following several tests, a threshold of wave number is suggested, where the 2D slope spectrum energy is imposed to zero energy for all wavenumbers less than this threshold. Then the omni-directional wave height spectra is re-calculated from the filtered 2D slope spectra.

The corrected height spectra are evaluated with regard to MFWAM (Meteo France WAve Model), via the comparison between SWIM peak wavelength (before and after correction), and the associated MFWAM peak wavelength.
Overall, the correction enables a better estimation of the peak wavelengths based on the wave height spectra. The important positive biases with respect to the MFWAM values observed mainly at wave heights smaller than 2.5 m are significantly reduced by using the

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filtering method However, our results also show that additional improvements are needed to correctly retrieve the peak wavelengths from the omni-directional height spectra in some areas like the Mexican golf and the Indonesian archipelago.