Statistical comparison of ocean wave directional spectra derived from SWIM/CFOSAT satellite observations and from buoy observations

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2022.9.12

SWIM

- Real Aperture Radar(RAR) system with a near-nadir scanning beam geometry

- World-wide directional spectra of ocean waves

- Less frequent smearing and distortion effects comparing with SAR

Relative works

- Hauser et al. and Le Merle et al.

  Performance of wave parameters, angular spread of the dominant waves

- Liang et al. and Li et al.

  Comparison study between SWH from SWIM spectrum/ nadir beam and buoy data, HY-2B, Jason-3 altimeter data.

A new comparison method

- An assumption that for a given sea state and surface condition parameters, the wave directional spectrum is independent of time and location.

- Comparison between SWIM and buoy 1D-spectral data under the same sea state and surface conditions. (In deep water and no strong current area)

Data

- NDBC buoy wave spectral data

- SWIM wave spectral data

- MFWAM wave data

Sea state classification

	Criteria
Wind wave	Developing，$\Omega = 1.3$
	Mature，$\Omega = 1$
	Fully developed，$\Omega = 0.84$
Swell	$k_p = 0.0133 \text{ m}^{-1}$, $\lambda_p = 472 \text{ m}$
	$k_p = 0.0157 \text{ m}^{-1}$, $\lambda_p = 400 \text{ m}$
	$k_p = 0.0211 \text{ m}^{-1}$, $\lambda_p = 298 \text{ m}$
	$k_p = 0.0308 \text{ m}^{-1}$, $\lambda_p = 204 \text{ m}$
	$k_p = 0.0580 \text{ m}^{-1}$, $\lambda_p = 108 \text{ m}$

$$\eta^* = \eta^2 g^2 / U_{10}^4$$

$$\Omega = \omega_p U_{10} \cos\theta' / g$$

$$\eta^* \leq 3.64 * 10^{-3} \ and \ \Omega > 0.84, \text{Wind wave}$$

$$\eta^* > 3.64 * 10^{-3} \ and \ \Omega < 0.84, \text{Swell}$$

Omni-directional wave height spectra
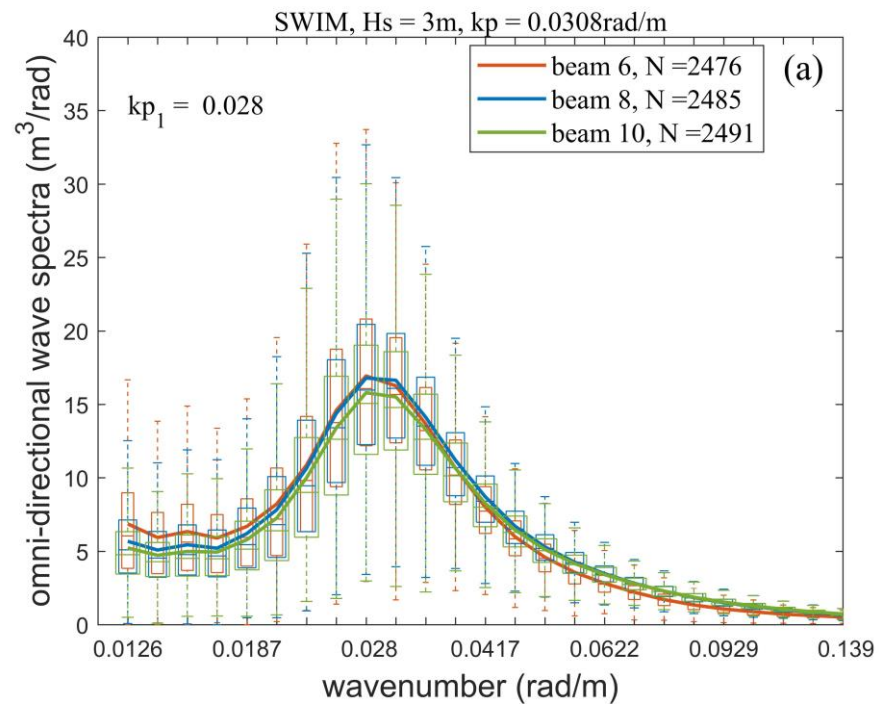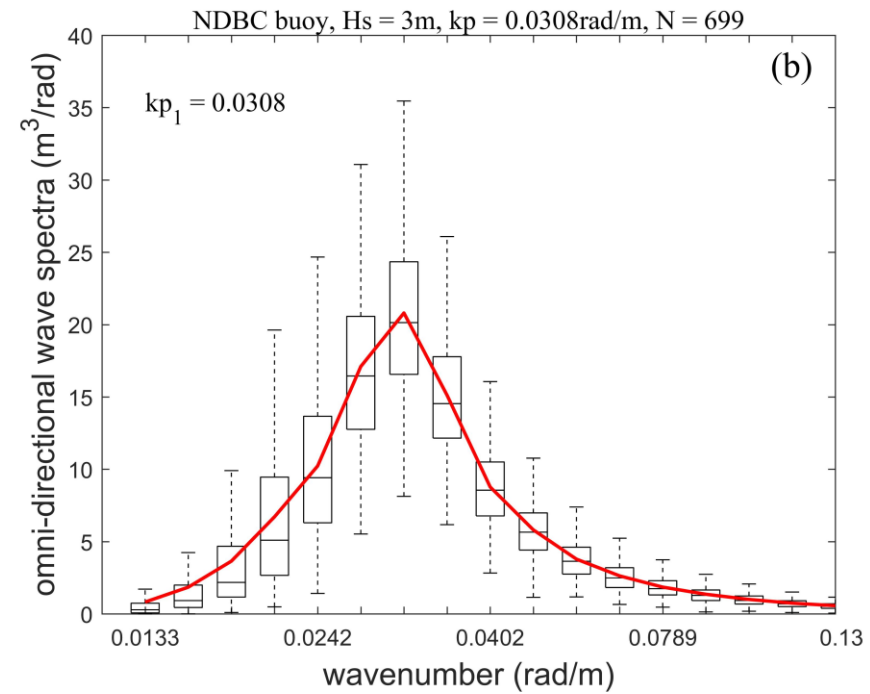
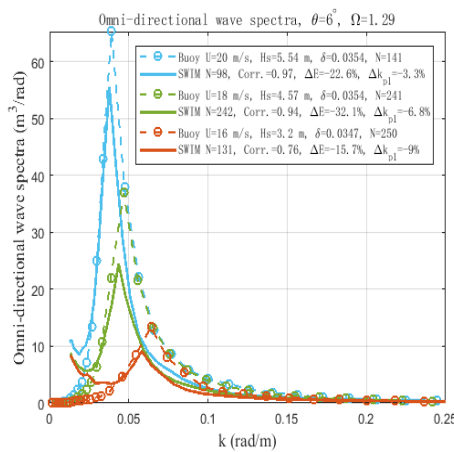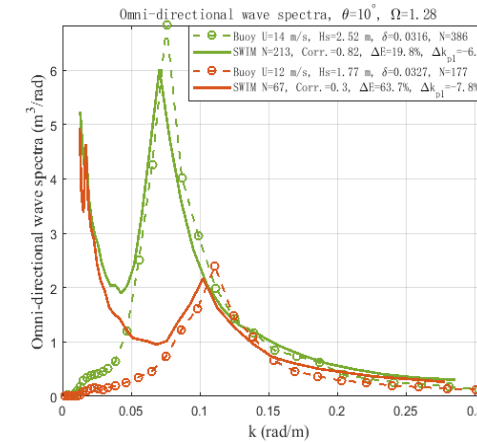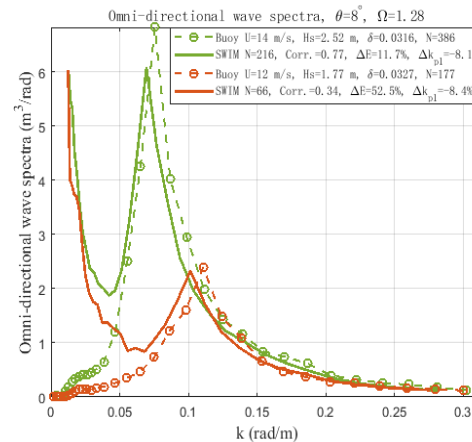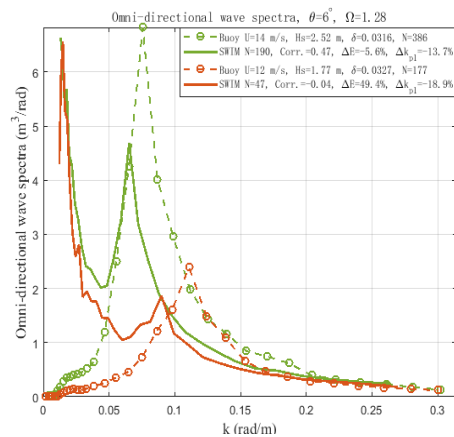SWIM 1D spectral   Buoy 1D spectral
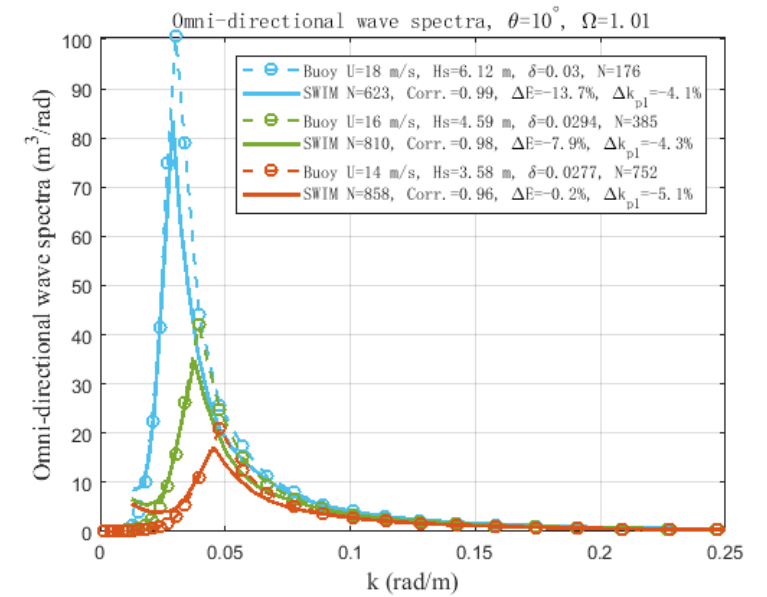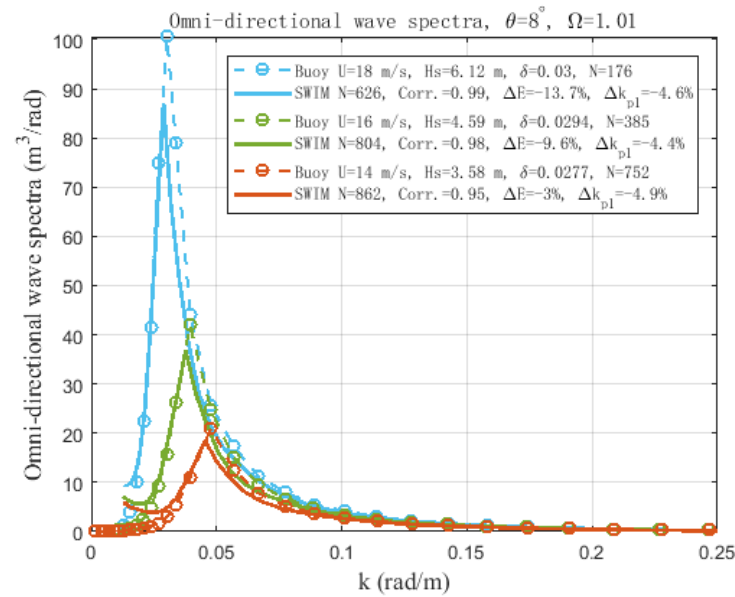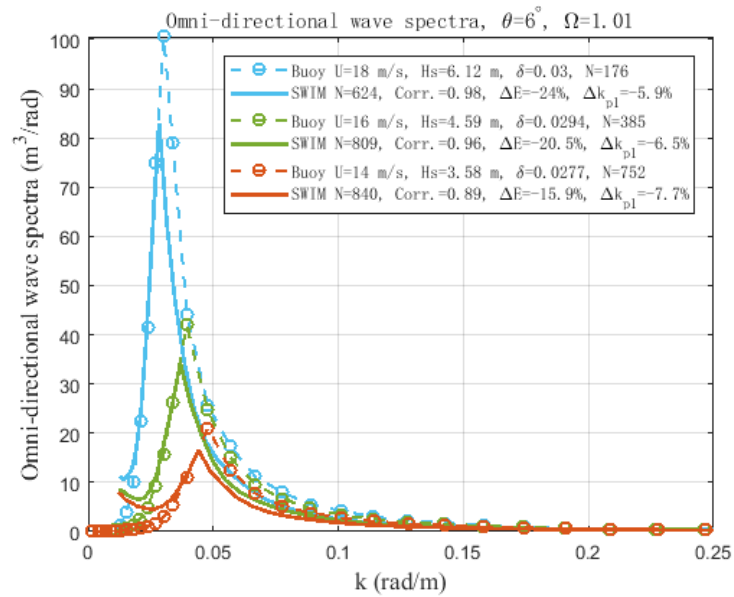
COMPARISON OF OMNI-DIRECTIONAL WAVE HEIGHT SPECTRA
Wind wave conditions-young developing wind waves
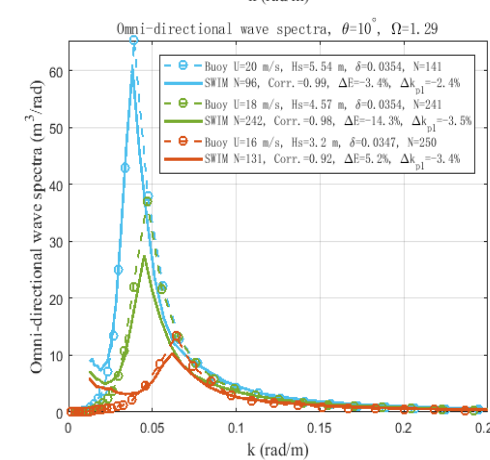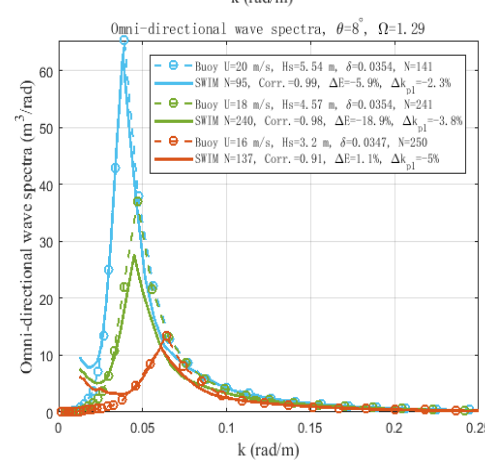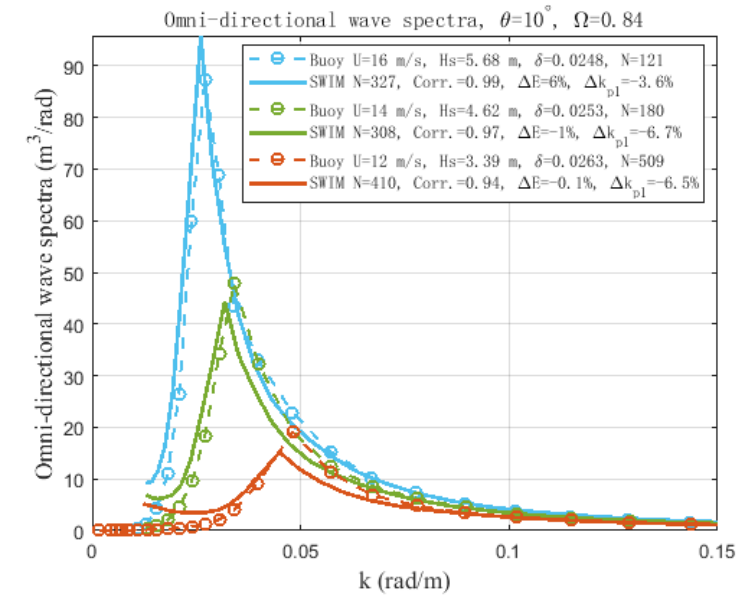
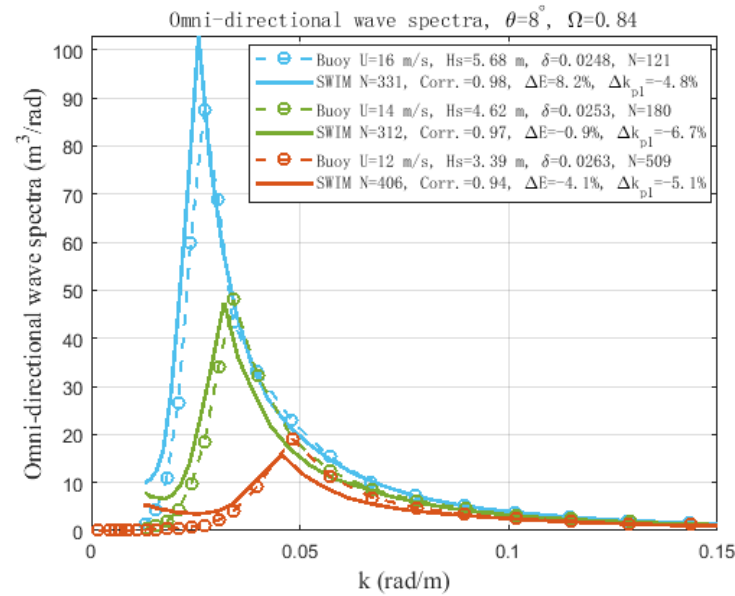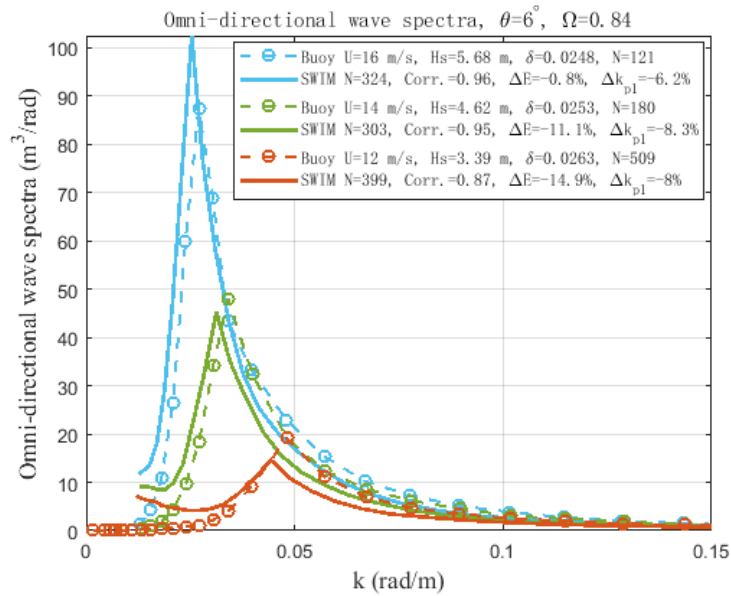# COMPARISON OF OMNI-DIRECTIONAL WAVE HEIGHT SPECTRA
Wind wave conditions-mature wind wave

COMPARISON OF OMNI-DIRECTIONAL WAVE HEIGHT SPECTRA
Wind wave conditions-fully developed

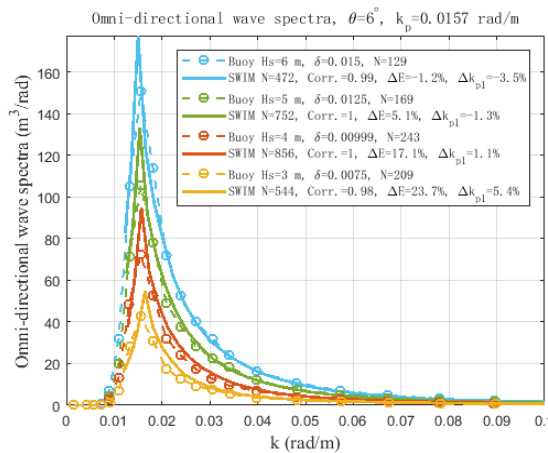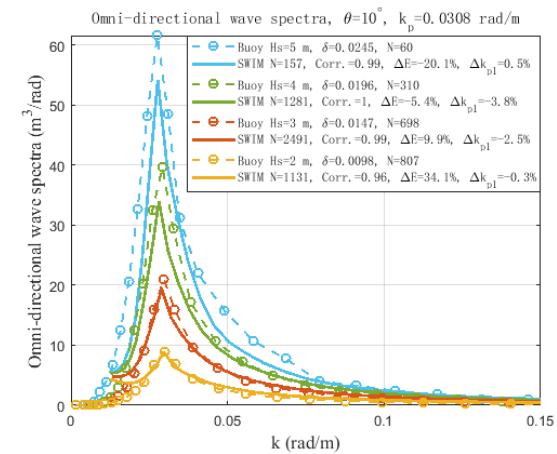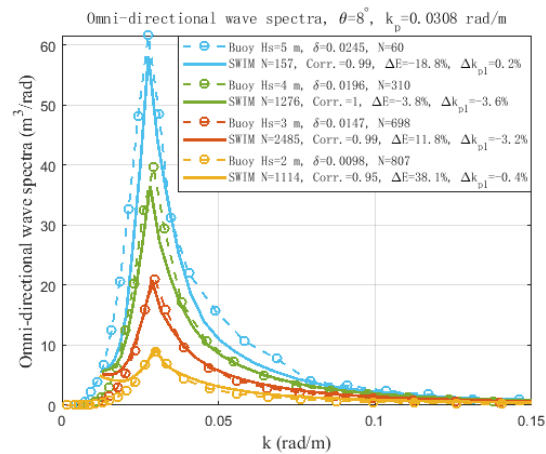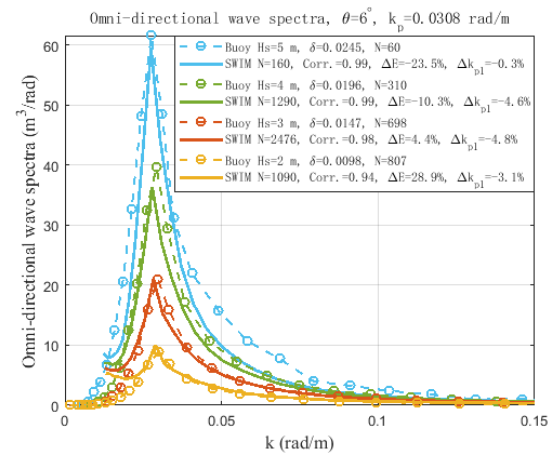# COMPARISON OF OMNI-DIRECTIONAL WAVE HEIGHT SPECTRA
Swell conditions
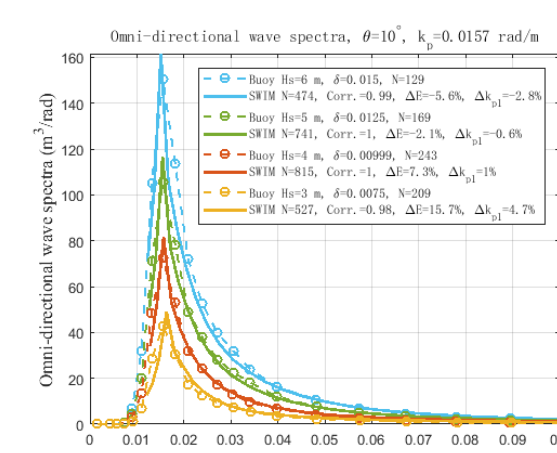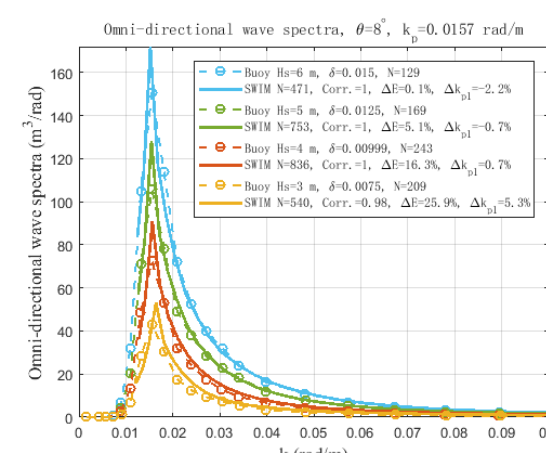
Conclusion

- Both in wind wave conditions and swell conditions, omni-directional spectra and spectra in the dominant direction from $8°$ and $10°$ beam in good agreement with buoy data (SWH larger than about 2.5 m).

- Surfboard effect, parasitic peak problem, speckle noise affect the SWIM data. Surfboard effect only affects SWIM data at low wind/wave conditions and mainly for the SWIM beam $6°$

- Another nonlinear effect related to long wavelength may lead lager spectral value of SWIM

Paper online: *https://ieeexplore.ieee.org/document/9858171*

谢谢！

Merci!