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On nonlinearity of optical and radar methods for investigations of surface wave variability

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Since optical and radar methods are widely used for investigation of surface wind waves variance in the presence of surfactant films, it is important to compare results obtained by these two methods. When discussing optical and radar models of imagery of the sea surface nonlinearities of the methods should be taken in account. For optical imaging of the water surface the nonlinearity is connected with nonlinearities of diffuse (sky) illumination, Fresnel coefficient and long waves on the ocean surface, for radar methods the higher order terms rather that the first order, Bragg backscattering are included in the model. The optical and radar contrasts (the ratio between signals from the clean and contaminated surface) are obtained to be different one from another and from hydrodynamic contrast (the ratio between wave spectra on the clean and contaminated surface), the variations of signals can be larger or smaller than the variance of waves depending on wavelength, observing conditions and characteristics of marine films. The strongest differences are observed in the wavelength ranges, where the hydrodynamic contrast strongly depends on wavelength. Moreover the nonlinearity of methods leads to limited optical and radar contrasts in the cases when the surface waves can not be exited by wind because of strong damping due to films on the water surface. Nonlinearity of short gravity-capillary waves, in particular parasitic capillary ripples, is taken into consideration when wind surface waves are described.
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