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Wave-resolved direct numerical simulation of the generation of Langmuir circulations under progressive waves. MENG LI, DI YANG, University of Houston — In open-water environment, the interaction of progressive surface waves with the shear turbulence generated by wind-induced surface shear stress causes the generation of Langmuir circulations – a flow phenomenon frequently occurring in oceans and large lakes. In this generation process, the accumulated effect of the periodic distortion of the vortical structures in the shear-driven turbulence by the wave strain-rate field plays an essential role for the incipient generation of the Langmuir circulations. In this study, the detailed generation process of the Langmuir circulations by the wave-turbulence interaction is simulated using a wave phase resolved direct numerical simulation (DNS) approach. The complex flow motions are decomposed into an irrotational wave velocity field and a rotational turbulence field. With the wave field being imposed, the DNS solves the evolution of the turbulence field under wave distortion. This DNS model is found to successfully capture the incipient generation and evolution of the Langmuir circulations caused by wave-turbulence interaction. In this talk, both the time evolution of the instantaneous flow field obtained from the DNS and the statistical analysis results will be presented.

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