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Oil droplet plume evolution in Langmuir turbulence: a Large Eddy Simulation study[1] DI YANG, Department of Mechanical Engineering, Johns Hopkins University, BICHENG CHEN, MARCELO CHAMECKI, Department of Meteorology, Pennsylvania State University, CHARLES MENEVEAU, Department of Mechanical Engineering, Johns Hopkins University — When the oil plumes from deep water blowouts reach the ocean mixed layer (OML), their fates on the sea surface are highly affected by the interactions with wind and wave-generated Langmuir turbulence in the OML. In this study, we use large eddy simulations (LES) to quantify the complex oil dispersion phenomena. We find that although the instantaneous surface oil slick patterns are very complex, the time-averaged surface oil plume can be parameterized as a Gaussian-type plume. The centerline of the surface plume is inclined clockwise (in the Northern Hemisphere) with respect to the wind and wave direction due to Ekman transport. The initial width of the mean surface plume and the inclination angle increase as the droplet size decreases. The surface plume width grows downstream, with a growth rate that varies non-monotonically with oil droplet size. Using LES data, we evaluate the eddy viscosity and eddy diffusivity following the K-profile parameterization (KPP) framework. We also evaluate stress-strain misalignments caused by Stokes drift and evaluate means of parameterizing these effects. Improvements to the KPP model will be discussed.

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Di Yang
Department of Mechanical Engineering, Johns Hopkins University

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