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Large-eddy simulation (LES) of small-scale Langmuir circulation and scalar transport[1] ANDRES TEJADA-MARTINEZ, AMINE HAFSI, University of South Florida, CIGDEM AKAN, University of North Florida, FABRICE VERON, University of Delaware — Previous laboratory experiments have revealed that small-scale (centimeter-scale) Langmuir circulation (LC) beneath an initially quiescent air-water interface appear shortly after the initiation of wind-driven gravity-capillary waves and provide the laminar-turbulent transition in wind speeds between 3 and 6 m/s. LES reveals Langmuir turbulence characterized by multiple scales ranging from small bursting eddies at the surface that coalesce to give rise to larger (centimeter-scale) LC over time. The growing LC scales lead to increased vertical scalar transport at depths below the interface and thus greater scalar transfer efficiency. Simulations were performed with a fixed wind stress corresponding to a 5 m/s wind speed but with different wave forcing parameters. It is observed that longer wavelengths lead to more coherent, larger centimeter-scale LC providing greater contribution to the turbulent vertical scalar flux. In all cases, the molecular diffusive scalar flux at the water surface relaxes to the same statistically steady value after transition to Langmuir turbulence occurs, despite the different wave forcing across the simulations.

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