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DNS of scalar transport across a wind-driven air-water interface[1]

AMINE HAFSI, ANDRES TEJADA-MARTINEZ, Univ of South Florida, FABRICE VERON, Univ of Delaware — When wind blows over an initially quiescent air-sea interface, it first generates short capillary waves which in time coexist with longer waves as part of a broad spectrum of waves. The interaction between the wind-driven waves and shear current on the waterside leads to Langmuir turbulence characterized by Langmuir circulation (LC) consisting of counter rotating vortices roughly aligned in the direction of the wind. The typical length scale of LC ranges from several centimeters when short capillary waves first appear up to tens of meters when the spectrum of waves broadens. Results are presented from direct numerical simulation (DNS) of a coupled air-water interface driven by an air flow with free stream speed of 5 m/s. The evolution of the air-water interface starting from rest and the accompanying development of centimeter-scale Langmuir turbulence on the waterside during the first 20 seconds of simulation are investigated. Emphasis is placed on the impact of the Langmuir turbulence on scalar transfer from the airside to the waterside, in particular the transfer velocity which is a measure of scalar transfer efficiency. Simulations are made with a finite volume discretization employing the volume of fluid method for interface tracking.

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Amine Hafsi
Univ of South Florida

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