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Influence of wave age on the structure of the airflow above surface waves. MARC BUCKLEY, FABRICE VERON, University of Delaware — The role of the surface waves on the airflow dynamics is known to be significant but our physical understanding remains incomplete. In this talk, we present detailed airflow measurements taken in the laboratory for 17 different wind-wave conditions with wave ages C_p/u_* ranging from 1.4 to 66.7. For these experiments, a combined Particle Image Velocimetry (PIV) and Laser Induced Fluorescence (LIF) technique was developed. Two-dimensional airflow velocity fields were obtained as low as 100 μm above the air-water interface. When the wind stress is too weak to generate surface waves, the mean velocity profile follows the law of the wall. With waves present, turbulent structures are directly observed in the airflow, whereby low horizontal velocity air is ejected away from the surface, and high velocity fluid is swept downward. Airflow separation is observed above young wind waves ($C_p/u_* < 3.7$) and the resulting spanwise vorticity layers detached from the surface, produce intense wave coherent turbulence. On average, the airflow is sheltered downwind of wave crests, above the critical height (defined by $U(z_c) = C_p$). Below z_c, the coupling of the airflow with the waves causes a reversed, upwind sheltering effect. Finally, we also show preliminary field measurements.

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