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Wave- and shear-induced viscous stress over wind waves[1]
KIANOOSH YOUSEFI, FABRICE VERON, School of Marine Science and Policy, University of Delaware, MARC BUCKLEY, Institute of Coastal Research, Helmholtz-Zentrum Geesthacht — Detailed knowledge of the airflow over the surface of the ocean is essential for evaluating air-sea fluxes. Despite recent numerical/theoretical advances, experimental data near the water interface have been difficult to obtain, especially for scales at which viscosity plays a role. Here, we present direct measurements of the velocity field in the turbulent airflow above wind waves for a range of 10-m wind speed varying from 2 to 17 m/s. Improvements in measuring techniques have allowed us to detect the viscous sublayer in the airflow near the interface and make direct measurements of the airside viscous stresses. In a phase-averaged sense, the viscous stress is highest on the upwind face of wave crest with its peak value close to the wave crest and its minimum about the middle of the leeward side of waves. At wind speeds of 2 m/s, corresponding to winds in which wind waves are first generated, the mean tangential stress represents more than 90% of the wind stress. The contribution of the viscous stress to the total momentum flux decreases significantly with increasing wind speed. In low winds, we also observe the viscous stress generated by the wave motion in the airflow. To the best of our knowledge, these are the first measurements of airside, wave-induced viscous stresses.

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