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Total kinetic energy associated to wave and current evolution under accelerated wind conditions

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Most efforts in the study of the generation and evolution of wind waves and surface drift current have been conducted under constant wind. The balance of the transfer of different properties has been studied mainly for situations where the wave has already reached the equilibrium with the constant wind conditions. Besides, the effect of the vertical section of the drift surface current generation mix in the boundary layer has been poorly studied. The purpose of these experiments is to study the early stages of the generation of waves and drift current under non-stationary wind conditions and to determine a balance in the exchange at the air-water interface for non-equilibrium wind conditions. A total of 16 experiments with a characteristic acceleration and deceleration rate of wind speed were conducted in a large wind-wave facility of Institut Pythéas (Marseille-France). The wave tank is 40 m long, 2.7 m wide and 1 m deep. The air section is 50 m long, 3 m wide and 1.8 m height. The momentum fluxes were estimated from hot wire anemometry at station 7. Also, the free surface displacement was measured along the channel tank at 11 stations where resistance wires were installed, except at stations 1, 2, and 7 where capacitance wires were installed. The sampling frequency for wind velocity and surface displacement measurements was 256 Hz. Water-current measurements were performed with a profiling 3-D acoustic velocimeter. This device measures the first 3.5 cm of the water column with a 100 Hz frequency rate, and a 1 mm vertical space-step. During experiments the wind intensity was abruptly increased with a constant acceleration rate over time, reaching a constant maximum intensity of 13 m/s. This constant velocity remains some time until the intensity is again reduced suddenly. The turbulent kinetic energy flux from the air to the water was determined. In order to analyze the balance of the turbulent kinetic energy in the waterside during accelerated wind conditions, the evolution of surface drift current and Stokes drift current was characterized. Also, the evolution and contribution of mean flow shear production and Stokes shear production will be presented and discussed, as well as the rate of turbulent kinetic energy dissipation.
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