Settling of plastic particles under the simultaneous action of surface waves and wind: preliminary results from laboratory experiments

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Abstract

Energetic processes in the sea coastal zones under stormy conditions play an important role in the re-distribution of plastic pieces. To date, the transport of solid particles by surface waves (Stokes drift) has been studied quite extensively, but only a few works have been devoted to the behavior of microplastics under conditions of simultaneous action of surface waves and wind. Here the preliminary results of laboratory experiments on settling negatively buoyant microplastics under wind-wave conditions in finite water depth are reported.
The experiments were carried out in the High-speed wind-wave channel at the Institute of Applied Physics of the Russian Academy of Sciences. The 10-m long 0.4-m wide wind-wave channel is partially submerged in water at the center of the larger water tank. Regular waves in the medium were produced by a wave-maker and modulated by the wind. Different wind and wave cases were considered. Experimental particles with sizes along different dimensions ranging from 0.1 mm to 4 cm were grouped in the three sets by the measured terminal settling velocity in the still water: 1, 2, and 4 cm/s. Each set of particles consisted of an isometric, plane, and elongated ones manufactured from rigid and flexible materials. The settling of particles initially placed under-surface of water was filmed on a high-speed camera. Settling trajectories were later reconstructed from video records. In this particular study, net settling velocity values and net drift velocity profiles were obtained from particle paths.
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Keywords: settling, stokes drift, wind, waves, lagrangian period

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