Numerical modelling of the transport of microplastics in a wind-wave flume

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Abstract

Nearshore waters can be simultaneously considered as a source of plastic to the open ocean and as a temporary plastic sink. The dynamics of plastic in this region are complex and involve a wide range of processes, which are not well understood. In this study, we combine wave laboratory experiments and numerical simulations to improve our knowledge of the dispersion and behaviour of plastic in the nearshore zone. A numerical model based on SWASH and TrackMPD was developed to simulate the transport of floating and sinking microplastics in shallow, wave-dominated environments. The wave laboratory experiments from Forsberg et al. (2019) were firstly modelled to validate the model capacity to simulate the transport of different types of microplastics (different shapes, densities and sizes) along a comprehensive beach profile by describing the entire water column. The numerical simulations reproduced the observed behaviour of microplastics: heavy particles accumulated in the wave-breaking zone, and the distribution of light particles varied along the coastal profile depending on waves and particle shapes. Future numerical simulations on real-scale beaches will provide further insight into the effect of hydrodynamic processes and particle properties on microplastic dispersion.

Keywords: transport, microplastics, beach, nearshore waters, dynamics

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