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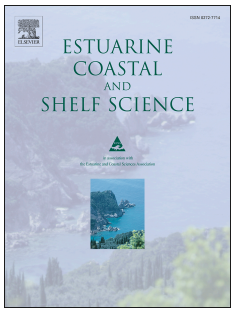

Transport of microplastics in coastal seas

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Transport of microplastics in coastal seas

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Abstract

Microplastic pollution of the marine environment has received increasing attention from scientists, the public, and policy makers over the last few years. Marine microplastics predominantly originate near the coast and can remain in the nearshore zone for some time. However, at present, there is little understanding of the fate and transport of microplastics in coastal regions. This paper provides a comprehensive overview of the physical processes involved in the movement of microplastics from estuaries to the continental shelf. The trajectory and speed of microplastics are controlled by their physical characteristics (density, size, and shape) and ocean dynamic conditions (wind, waves, tides, thermohaline gradients, and the influence of benthic sediments). Microplastic particles can be subjected to beaching, surface drifting, vertical mixing, and biofouling, as well as bed-load and suspended load transport processes, until reaching terminal deposition on beaches, in coastal marshes, in benthic sediments or until they are carried by ocean currents to subtropical convergence zones. The dynamic interaction of released microplastics with the shoreline is regulated by onshore/offshore transport, which is impacted by the source location as well as the geometry, vegetation, tidal regime, and wave direction. Wind and wave conditions dominate surface drifting of buoyant particles through Ekman drift, windage, and Stokes drift mechanisms. Neustic microplastic particles travel in the subsurface because of vertical mixing through wind-driven Langmuir circulation and heat cycling. Increasing accumulation of microplastics in benthic sediments needs to be quantitatively explored in terms of biofouling, deposition, entrainment, and transport dynamics. Further studies are required to understand the following: 1) the primary parameters (e.g., windage, terminal velocity, diffusivity, critical shear stress) that determine microplastic transport in different pathways; 2) dynamic distribution of microplastics in various coastal landscapes (e.g., wetlands, beaches, estuaries, lagoons, barrier islands, depocenters) regulated by hydrodynamic conditions; and 3) interactions between the physical transport processes and biochemical reactions (degradation, flocculation, biofouling, ingestions).