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Transport of microplastics in coastal seas

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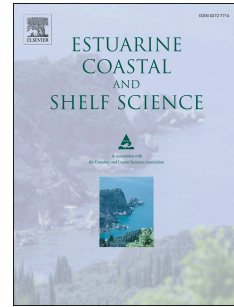
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1 **Transport of microplastics in coastal seas**

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6 **Abstract**

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

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