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3D pathways and distribution of microplastics in the Ocean Surface Boundary Layer

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Microplastic (MP) in the ocean is a major environmental problem. Better understanding of how MP, released from anthropogenic sources, is transported is crucial to quantify and close the global inventory of marine MP. At the same time, neutrally buoyant MP can be considered as a passive tracer that provides the opportunity to learn more about the turbulent dynamics of the ocean across multiple scales.

This work explores the turbulent dispersion of MP with a 3D Lagrangian stochastic model, developed by the authors, with particular attention on the Ocean Surface Boundary Layer (OSBL).

The inputs of the model are operational oceanographic data, downloaded from the Copernicus Marine Monitoring Environment Service, such as current velocities, mixed layer depth and friction velocity. The simulated trajectories are described by a Wiener process in which the vertical turbulent diffusivity is parameterized with a novel method developed by the authors. The advantage of the Lagrangian approach is to reproduce turbulent dispersion processes at sub-grid scales.

A 10-year 3D simulation of the MP dispersion in the Mediterranean basin has been performed. MP pathways and accumulation zones in different periods of the year have been identified.

The distribution of MP in the water column has been obtained. The behavior of different polymers has been investigated showing that particle settling prevails with respect to vertical turbulent dispersion. Despite the concentration of particles is maximum at the sea surface, the quantity spread into the water column is not negligible.