Fate of floating plastic debris released along the coasts in a global ocean model

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Abstract

Marine pollution from plastics is a global issue that infests the ocean from coastal regions to the open sea. The pathway and fate of plastic debris in the oceans are still uncertain for many reasons, including a misperception of its sources, both in terms of quantity and distribution. Understanding the pathway and fate of plastic debris remains fundamental to better manage and reduce plastic pollution. In our study, we diagnose the fate of floating plastic pollution discharged along the coasts by comparing two different types of sources in the global ocean: one based on rivers and the other based on the population density along the coasts. We use a Lagrangian numerical analysis in a global ocean circulation model with a resolution of 1/12. In both scenarios, approximately 6 million particles are released each month for 23 years of simulation. To study the pollution of floating plastics, we force the particles to travel only in the surface layer. Particles may experience a different fate: particles may either end up in the ocean or on the coast after traveling in the open ocean, or they may never leave the coast and instead move along the coastline. This study first underlines the importance of the input scenario on the contribution of particles to the main convergence zones. Even more interestingly, this study shows that the input scenario plays a key role on the number of beached particles that end up in several coastal areas. Beachings occur mainly locally, but a significant number of particles can travel several thousand kilometers before reaching coastal areas, allowing long-distance connectivity between two remote regions. In summary, some coastal regions contribute strongly, locally or remotely, to the pollution of specific convergence zones and coastal areas.

Keywords: Marine Debris, Microplastics, Lagrangian analysis, Ocean surface pathways, Coastal pollution, Ocean connectivity, Numerical model

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