Abstract

[Project Information]

Project Title :	Elucidation of the Process of Marine Microplastic Fragmentation and Removal from Surface Waters Based on Long-term Time-series Sample Analysis
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The objective of this study was to develop a high-accuracy ocean simulation model that predicts the distribution dynamics of marine microplastics in the North Pacific, using long-term time-series samples together with in-situ observations and laboratory experiments. A long-term empirical dataset collected between 1949 and 2020 revealed that the density of floating marine plastic debris around Japan exhibited three distinct phases: (1) a period of increase (0–10^4 pieces km^{-2}) from the early 1950s to the late 1970s; (2) a stagnation period with high abundance (10^4–10^5 pieces km^{-2}) from the 1980s to the early 2010s; and (3) a re-increase phase (>10^5 pieces km^{-2}) from the mid-2010s to the present. We also observed a continuous decrease in the size of floating marine plastic debris over the past 70 years. Observations in the Kuroshio recirculation gyres confirmed the presence of abundant small microplastics (<300 μm)—too small to be captured by conventional plankton nets—distributed throughout the water column from the surface to 2000 m depth. Laboratory experiments revealed that UV exposure and biofilm deposition enhanced the sedimentation of small microplastics through their aggregation with phytoplankton particles. Incorporating these datasets enabled the development of an innovative particle-tracking model that accurately reproduces the behaviour of both light and dense polymer particles discharged into the North Pacific Ocean.

[References]

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