

Studies on Transport and Spread of Marine Plastic Debris from Coastal to the World's Oceans

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[Abstract]

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A total of 8,218 pelagic microplastic samples from the world's oceans were synthesized to create a dataset composed of raw, calibrated, processed, and gridded data which are made available to the public. The raw microplastic abundance data were obtained by different research projects using surface net tows or continuous seawater intake. Fibrous microplastics were removed from the calibrated dataset. Microplastic abundance which fluctuates due to vertical mixing under different oceanic conditions was standardized. An optimum interpolation method was used to create the gridded data. Using the dataset for validation, a budget for ocean plastic mass was estimated based on a combination of numerical particle tracking and linear mass-balance models. In the particle tracking mode, ocean-beach exchanging processes are included on the basis of the field experiment to estimate average residence time of macro and microplastics littered on beaches. Integrating the time series of worldwide macroplastic emission from both rivers and the fisheries industry over the period 1961–2017 yielded a total mass of 25.3 million metric tonnes (MMT). Overall, 23.4% of ocean plastics were macroplastics on beaches. Meanwhile, 66.7% of ocean plastics were heavier than seawater or microplastics removed from the upper ocean and beaches, which are difficult to monitor under current observation frameworks adopted worldwide. Part of removal from the upper ocean is caused by settling processes into the deep layers. The settling processes were also evaluated using a sediment trap and sediment cores sampled from the actual ocean.

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