

Particle Tracking Model Approach on the Fate of Riverine Macro- and Microplastics released into the Indian Ocean

タヒラ, イルファン

<https://hdl.handle.net/2324/7396281>

出版情報 : Kyushu University, 2025, 博士 (理学), 課程博士
バージョン :
権利関係 :



氏名 Name : TAHIRA IRFAN)
論文名 Title : Particle Tracking Model Approach on the Fate of Riverine Macro- and Microplastics released into the Indian Ocean
(インド洋における河川起源マクロ・マイクロプラスチックの行方に関する粒子追跡モデルによる研究)

区分 Category : 甲

論文内容の要旨 Thesis Summary

Although the Indian Ocean receives a large amount of land-based plastic waste, the studies on the pathways of riverine plastic debris are limited to date. Therefore, in this study, a particle tracking model that included ocean surface currents, horizontal diffusion, Stokes drift, windage, and beaching/re-drifting processes was developed to reproduce the behavior of riverine plastic debris i.e. macroplastics in the Indian Ocean. The modeled particles were released in the model domain based on riverine plastic debris database of Lebreton et al., (2017). The maximum abundance of beached particles occurred during the southwesterly monsoon season, particularly in the Bay of Bengal. The particles released from the rivers were trapped in the northern Indian Ocean unless both Stokes drift and windage were excluded from the transportation velocity. These results suggested that the riverine plastic debris i.e. macroplastics were trapped in the northern Indian Ocean until fragmented into less buoyant small microplastics drifting in the subsurface layer, free from windage and Stokes drift at increasing depths. However, the above model did not include the fragmentation process resulting in the generation of microplastics. Hence, the model was modified by incorporating such breaking processes. Particle tracking model experiments were conducted to examine if the riverine macroplastics were move to the other ocean basin via fragmentation to microplastics. We conducted experiments where microplastics move with ocean currents and Stokes drift by excluding windage for relatively large microplastics floating in the uppermost layer, and where small microplastics move only by ocean current to emphasize the transport process under the Stokes drift layer. Our results suggested that although the microplastics in the Indian Ocean can move southward in the sub-surface layer, and that the leakage to the Pacific Ocean is still remarkably small. According to the model results, only 3.5% of the microplastics could escape to the Pacific Ocean in the small microplastics PTM i.e. in the absence of Stokes drift, suggesting that Indian Ocean is a sink of macro- and microplastics.