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Optimization of Marine Waste Collection Considering Dynamic Transport and Ship's Wake Impact

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Abstract : Marine waste quantities increase more and more, 5 million tons of plastic waste enter the ocean every year. Their spatiotemporal distribution is never homogeneous and depends mainly on the hydrodynamic characteristics of the environment, as well as the size and location of the waste. As part of optimizing collect of marine plastic wastes, it is important to measure and monitor their evolution over time. In this context, diverse studies have been dedicated to describing waste behavior in order to identify its accumulation in ocean areas. None of the existing tools which track objects at sea had the objective of tracking down a slick of waste. Moreover, the applications related to marine waste are in the minority compared to rescue applications or oil slicks tracking applications. These approaches are able to accurately simulate an object's behavior over time but not during the collection mission of a waste sheet. This paper presents numerical modeling of a boat's wake impact on the floating marine waste behavior during a collection mission. The aim is to predict the trajectory of a marine waste slick to optimize its collection using meteorological data of ocean currents, wind, and possibly waves. We have made the choice to use Ocean Parcels which is a Python library suitable for trajectoring particles in the ocean. The modeling results showed the important role of advection and diffusion processes in the spatiotemporal distribution of floating plastic litter. The performance of the proposed method was evaluated on real data collected from the Copernicus Marine Environment Monitoring Service (CMEMS). The results of the evaluation in Cape of Good Hope (South Africa) prove that the proposed approach can effectively predict the position and velocity of marine litter during collection, which allowed for optimizing time and more than 90% of the amount of collected waste.

Keywords : marine litter, advection-diffusion equation, sea current, numerical model
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