Identifying global hotspots of plastic waste accumulation along river networks

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Global plastic pollution is affecting ecosystems and human health globally. Proposing solutions and coping strategies for this threat requires a clear understanding of the processes controlling the fate and transport of mismanaged plastics at multiple scales, going from watersheds to regions and even continents. River corridors are the primary conveyor and trap for mismanaged plastic produced within the landscape and eventually released to the ocean. New approaches that apply technological sensing innovations for monitoring plastic waste in aquatic environments can improve observations and plastic waste datasets globally. However, our understanding of when, where, and how to target monitoring is limited, reducing the benefit gained. There is therefore a critical demand for predictions of hotspots (as well as hot moments) of plastic accumulation along river networks globally, in order to optimize observational capacity.

Here, we present a new global flow and transport model for plastic waste in riverine environments. Our model predicts that only a small fraction (roughly 2.5%) of the global mismanaged plastic that entered rivers since the 1950s has been delivered to the ocean by 2020, with an overwhelming majority sequestered in freshwater ecosystems. Furthermore, we predict the patterns of mismanaged plastic accumulation and its residence time depend on (i) the topology and geometry of the river network, (ii) the relative location of plastic sources, and (ii) the relative location and trapping efficiency of flow regulation structures, primarily large dams. Our results highlight the role of rivers as major sinks for plastic waste and the need for targeted remedial strategies that consider the structure of the river network and anthropogenic regulation when proposing intervention measures and sampling efforts.