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# Endless journey of macroplastics in rivers: From hours to decades tracking in the Seine River

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Rivers are major pathways of plastics from lands into the Ocean. However, there is still a huge lack of knowledge on how riverine litter, including macroplastics, is transferred into the Ocean. Quantitative measurements of macroplastic emissions in rivers even suggest that a small fraction (0.001 to 3%) of the Mismanaged Plastic Waste (MPW) generated within a river basin finally reach the sea. Instead, macroplastics may remain within the catchment and on coastlines because of complex transport dynamics that delay the transfer of plastic debris. In order to better understand those dynamics, we performed tracking of riverine litter over time. First, hundreds of date-prints items were collected on riverbanks in the Seine estuary. The distribution of their Use-By-Dates suggest that riverine litter may remain stored on riverbanks for decades. Second, we performed real time tracking of floating and sub-floating bottles using GPS-trackers. Between March 2018 and April 2019, 39 trajectories were recorded in the estuary under tidal influence and 11 trajectories upriver, covering a wide range of hydrometeorological conditions. Results show a succession of stranding/remobilization episodes in combination with alternating upstream and downstream transport in the estuary related to tides. In the end, tracked bottles systematically stranded somewhere, for hours to weeks, from one to several times on different sites. The overall picture shows that different hydrometeorological phenomena interact with various time scales ranging from hours/days (high/low tides) to weeks/months (spring/neap tides and highest tides) and years (seasonal river flow, vegetation and geomorphological aspects). Thus, the fate of plastic debris is highly unpredictable with a chaotic-like transfer of plastic debris into the Ocean. The residence time of these debris is much longer than the transit time of water. This offers the opportunity to collect them before they get fragmented and/or reach the Sea.