Standardization of microlitter sampling at river-sea interfaces: A comparison of the in-situ methodologies aquatic drone and ferry box

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Rivers are known to be an important source of anthropogenic litter, which can accumulate in both estuarine and coastal areas before being transported to the open sea. Scientists have long assumed that the ocean acts as the ultimate sink for the majority of riverine litter. However, studies in recent years have shown that rivers and estuaries may act as reservoirs of anthropogenic litter, which may be released under extreme weather events (Everaert *et al.*, 2022; van Emmerik *et al.*, 2022; Kaandorp *et al.*, 2023). Hotspot areas in river-sea interfaces, such as estuaries (that can serve as nursing areas), can induce extra pressure on vulnerable organisms due to this plastic accumulation. Yet, the monitoring of litter is lacking standardized *in-situ* sampling methodologies that enable access at confined areas, independently from the usage of a ship or vessel. The goal of this work was to demonstrate how the sampling methodologies aquatic drone and ferry box are used to sample floating microlitter debris (0.3 - 5 mm) within the project TREASURE (Targeting the REduction of plAStic oUtflow into the noRth sEa), in river-sea interfaces. In this work, we also aimed to compare both methodologies regarding the abundance, size, shape and polymer type of the caught microlitter particles. The aquatic drone is an adaptation of the Jellyfishbot® (developed by IADYS) created in collaboration with ULCO (Boulogne sur Mer) for the collection of microplastics. It is highly efficient in covering large sampling areas and volumes, and accessing difficult-to-reach locations (Pasquier *et al.*, 2022). The ferry box is a semi-automated device that combines a filtration system – consisting of a collection module with sieves of three successive size fractions- with a submersible pump. The ferry box enables flexible sampling at different water depths by adapting the pump's height. Another advantage is its cost-effectiveness due to low operational costs. Samples were taken simultaneously with the aquatic drone (300 µm mesh size) and ferry box (500 µm, 300 µm and 100 µm sieves) from a pontoon in the area of the Yser estuary in Belgium at two different times (Spring 2023 and Autumn 2024). Sampling consisted of three replicates per sampling methodology and was conducted at a depth of 0.25 m below the water surface for five and fifteen minutes for the aquatic drone and the ferry box, respectively. At an average of 10,600 litres, the filtered volume of the water drone was more than 31 times higher than the filtered volume of the ferry box (approx. 340 litres). A preliminary assessment indicated that both methodologies provide reliable data, but the aquatic drone showed slightly higher feasibility in detecting smaller microlitter particles. Both methodologies were suitable for sampling floating microlitter from a pontoon and can be broadly applied in the aquatic environment. Based on specific research goals, budget constraints, and the required resolution of data, both aquatic drone and ferry box methodologies are suitable as standards for floating microlitter observations. Our findings are valuable for the research community to enhance understanding of floating microlitter fluxes, thereby contributing to more effective environmental monitoring and management strategies in key river-sea interfaces. Further research should conduct long-term studies using both methodologies to assess seasonal and annual variations in microlitter fluxes in different river-sea interfaces.

Keywords
Microlitter; Sampling; Aquatic Drone; Ferry Box; Standardization; Harmonization