An Experimental Method to Quantitatively Analyse the Transport of Microplastic Particles in Fluvial Systems

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Abstract

The majority of microplastics (MPs) in marine environments originate from terrestrial sources and are transported by rivers and streams. In fluvial systems, interactions between particles, biota and sediments influence particle mobility and retention. It has been shown that the transport behaviour of MPs differs from the one of natural sediments. However, specific transport mechanisms for MPs are not yet fully understood, mainly because of the limited availability of reliable experimental data. As part of this study, transport mechanisms for MPs in fluvial systems (surface flow and hyporheic sediments) were investigated using an experimental flume environment. Realistic flow conditions were represented by varying sediment characteristics (e.g. glass beads or sand) and bedform structures (e.g. riffle-pool sequences, ripples and dunes). To track MPs in i) surface flow, ii) at the streambed interface and iii) within hyporheic sediments, we developed a quantitative method for fluorescent MP particles (1-10 μm) based on state-of-the-art fluorometric techniques. Particle velocities in surface flow were measured by Particle-Image Velocimetry and Laser-Doppler-Velocimetry. With this setup, for the first time it was possible to quantitatively track advective MP transfer from surface flow into the streambed sediments. Empirical results obtained from this study can be used in a next step to establish and validate transport models for MPs.

Keywords: Microplastic transport, Hyporheic Zone, Fluorescence, Imaging, System, Particle, Image, Velocimetry

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