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Integrated numerical modeling of microplastic transport in fluvial systems

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Although rivers and streams are major transport vectors of microplastics into the marine environment, little research has been conducted to understand the transport behavior of microplastic particles in fluvial systems. This work contributes to the understanding of these transport processes, specifically focusing on the interface of the surface water flow and the hyporheic zone.

Transport of microplastic particles in fluvial systems is currently modeled mainly at larger, river- or basin-wide scales using existing hydrodynamic and sediment transport models. To investigate the transport behavior of microplastic particles along the interface between the hyporheic zone and the open water flow domain, smaller-scale models are required so that the complex processes in this region can be adequately represented and analyzed.

To this end, a novel modeling technique will be presented based on the open source CFD toolbox OpenFOAM. It combines a new coupling approach for the hydrodynamic processes in the surface water and hyporheic zone with transport modeling of microplastics.

The methodology considers the latest findings regarding deposition and resuspension of microplastic particles as well as the hyporheic exchange in a fully coupled model. The model is validated by accompanying flume experiments and relevant transport processes are identified from the presented scenario simulations.