Integrated modeling of microplastics in the hyporheic zone

Franz Dichgans*†[1], Jan-Pascal Boos[2], Pouyan Ahmadi[1], Sven Frei[2], and Jan H. Fleckenstein[1,3]

[1]Department of Hydrogeology, Helmholtz-Centre for Environmental Research, UFZ – Leipzig, Germany
[2]Department of Hydrology, Bayreuth Center of Ecology and Environmental Research (BayCEER), University of Bayreuth – Bayreuth, Germany
[3]Hydrologic Modelling Unit, Bayreuth Center of Ecology and Environmental Research (BayCEER), University of Bayreuth – Bayreuth, Germany

Abstract

Research on the transport of microplastic (MP) in rivers mostly focuses on their function as transport vectors between inland areas and the sea. Nonetheless, field studies indicate that MP particles can be retained in riverbed sediment, i.e. the hyporheic zone. The interaction of various transport processes, such as sedimentation, infiltration, or retention, is not yet fully understood. Our work consists of a mechanistic approach to analyze transport processes and retention of MP in the surface water and hyporheic zone.
In the presented study, we investigate the transport of MP particles from surface water to the hyporheic zone using a novel hydro-numerical modeling approach. The modeling technique is based on the InterFoam solver of the open-source toolbox OpenFOAM and combines 3D hydrodynamic modeling with transport modeling of MP. Bidirectional coupling between the surface water and the hyporheic flow ensures a detailed representation of the hydrodynamic conditions and particle transport in the model system. The model is calibrated and validated with data from an accompanying flume experiment to ensure the accuracy of the modeled results.
We investigate transport mechanisms of the MP particles, retention and transit time of MP in the hyporheic zone as well as the applicability of established transport models to MP.

Keywords: hyporheic zone, openFoam, interFoam, rivers

*Speaker
†Corresponding author: franz.dichgans@ufz.de