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Microplastic accumulation in streambed sediments is driven by hyporheic exchange flow processes

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Global plastic production exceeds 300 million tons per year and waste water treatment plants each release on average over 4 million microplastics (particles < 5 mm) per day to streams. The fate and transport of microplastics in freshwater are critically under-studied and monitoring microplastic concentrations in surface water and sediments at high spatio-temporal resolution represent a major challenge. Furthermore, the few available models of microplastic transport in streams have thus far ignored hyporheic exchange flow processes (i.e. the two-way exchange of surface water with underlying sediments). This is important as hyporheic exchange increases the retention of microplastics in sediments.

We applied a mobile-immobile model of particle transport and hyporheic exchange to a global dataset that synthesized streambed sediment microplastic data to identify high risks zones and conditions for microplastic accumulation in streambed sediments. Our results provide the first global overview of microplastic accumulation rates within streambed sediments and help to both provide new information to improve streambed sampling methods and highlight knowledge gaps in microplastic transport and retention processes in streams.