Investigating drivers of microplastic pollution in urban settings

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As one of the emerging contaminants, microplastics (MPs) have recently been stated as being remarkable contaminants of different environmental matrices including soils, sediments, groundwater, and surface water. Stormwater and flowing surface water are important carriers of MPs to downstream surface water bodies such as ponds and lakes, yet, little work has been done to develop models for predicting MP loads in these systems. One common approach in contaminant load modeling is to couple a hydrological model with relationships relating the contaminant concentration or load to explanatory variables such as water discharge, typically the most important variable controlling concentrations and loads, and variables representing other drivers of contaminant loading such as land use and climate variables. In this work, our goal is to assemble a database of MP load and/or concentration and discharge measurements in different flowing surface water systems as well as potential explanatory variables such as catchment land use and climate conditions to examine the dependencies of MP loading on these explanatory variables. We searched the Scopus and Web of Science databases and found 64 articles focusing on quantifying MP loads or concentrations in different surface water systems and extracted or calculated the relevant data for the database. The main focus of this work is urban settings, or their shear impact on microplastic production in larger areas of mixed land cover types. Despite inconsistencies in the definition of MPs as well as in sampling, extraction, and analytical methods, the results indicated a significant relationship between impervious land cover and MP loading within urban catchments (polynomial $R^2 = 0.75$), where each hectare of imperviousness corresponds up to 7% of increase in MP concentration. MP loads were, unsurprisingly, highly positively correlated with flow (R^2 of up to 0.86), which is the basis for the relationship between MP concentration and climatic factors. We also found that there is a high positive correlation between total suspended solid (TSS) concentrations and MP concentrations, and therefore also between their respective loads, which has been reported by others before and indicates that TSS loads can be used to estimate MP loads in the absence of sufficient data. The relative importance of discharge, land use and climate variables as drivers of MP loading has not yet been investigated, and our assembled database will enable the prediction of MP loads in stormwater, streams and rivers at the watershed scale using the explanatory relationships derived from our analysis.