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Fate of trace organic compounds in urban streams and their hyporheic zones

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Many trace organic compounds (TrOCs) are quite stable and are discharged with treated wastewater into urban streams. In the urban lowland River Erpe up to 80 % of the total discharge originates from treated wastewater. Therefore, TrOC concentrations in that river are high, e.g. the average guanylurea concentration was 69 μg/L in June 2016. In urban areas where water cycles are partially closed TrOCs discharged into rivers end up in drinking water. Fortunately, TrOCs concentrations in streams can partly be decreased by processes such as photolysis, biodegradation, and sorption. On the downside these processes partly cause formation of transformation products, which might be even more problematic than the parent compounds and are often neglected in past/current investigations. Some processes occur in the water column, other in the sediment. For many compounds the hyporheic zone (HZ) underlying streams is an efficient bioreactor regarding TrOC removal and transformation because of its high relative surface area and diverse microbial community. Removal of many TrOCs occurs preferentially under oxic and suboxic conditions, i.e. in the upper part of the hyporheic zone. The high microbial activity in the uppermost part of the hyporheic zone favors transformation of TrOCs, which is why TrOC reactivity is often highest in the shallow HZ. Removal of other TrOCs is independent of redox conditions and some TrOCs show hardly any decrease. In general, the intensity of hyporheic exchange and the water residence time in the oxic part of the hyporheic zone govern the fate of TrOCs on a reach scale. Our findings have severe implications for water management, i.e. additional treatment steps in waste water treatment plants should be combined with restoration measures promoting intense hyporheic exchange and short subsurface flow paths.