

Attenuation of organic micropollutants in an urban lowland stream under varying seasonal and hydrological conditions

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Transport and fate of polar organic micropollutants in urban streams are of increasing concern for urban water management. Appropriate river management techniques may support a river's ability to self-purify. The river Erpe, an urban lowland stream located in Berlin, Germany, receives treated wastewater which increases its discharge up to 4-fold. Numerous micropollutants (e.g. pharmaceuticals, personal care products, performance chemicals) which survive the treatment process are released into the river and threaten ecosystems and aquatic groundwater quality. In the present work the transport of 57 substances was investigated along a 4.7 km stretch of the river with the aim of understanding the influence of varying seasonal and hydrological conditions on micropollutant fate. We hypothesized that particularly transient storage is a main driver of micropollutant attenuation. A Lagrangian sampling scheme was applied to follow water parcels down the river using the diurnal fluctuations of conservative solute concentrations as an intrinsic tracer. Water samples were collected at two (April) and three (June) stations along a 4.7 km reach downstream of the wastewater inflow. In June the experiment was conducted twice, before and after the first stretch was cleared of macrophytes. Each experiment comprised of hourly sample collection for 48 hours, accompanied by discharge measurements and continuous data logging of water-level, -temperature and electric conductivity. The set of micropollutants, which included both parent compounds and transformation products, was analysed by a newly developed direct injection-UHPLC-MS/MS method. The behaviour of individual micropollutants was compound-specific. Carbamazepine and benzotriazole were persistent along the river stretch while substances such as valsartan and metoprolol were attenuated by up to 15% of their original concentration. Interestingly, some transformation products, such as valsartan acid increased in concentration, indicating their formation along the reach. The extent of attenuation or formation was different between the two stretches, changed seasonally and diurnally and was impacted by macrophyte removal. These findings indicate that the self-purification capacity of urban rivers is variable in time and sensitive to changes in the river's hydrological regime.