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Biogeochemical milieu and attenuation of trace organics in the hyporheic zone of an urban river with short-term discharge fluctuations

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Rivers receiving treated wastewater are characterized by varying hydraulic and biogeochemical conditions as well as often high concentrations of trace organic compounds (TrOCs). Therefore, high frequency sampling over multiple operation cycles of the wastewater treatment plant (WWTP) allow for a thorough insight into the biogeochemical processes of this unsteady system. The River Erpe, Berlin, Germany, is a eutrophic lowland river and receives up to 80 % of its discharge from the WWTP Muenchehofe. In order to study the biogeochemical milieu and attenuation of 17 TrOCs in surface and pore water of the hyporheic zone, a high frequency sampling campaign was conducted at a sandy side channel branching off the River Erpe. This sampling campaign was undertaken within the framework of the Worldwide Hydrobiogeochemical Observation Network for Dynamic River Systems (WHONDRS) by the Pacific Northwest National Laboratory. At two sites about 750 m apart from each other, water pressure, water temperature as well as temperature profiles in the sediment, electric conductivity and oxygen were measured continuously. Furthermore, surface water samples were taken at both sites and pore water in 25 cm depth at the downstream site was sampled every three hours for 48 hours. Surface water flow velocity was calculated using cross-correlation of electric conductivity time series and infiltration time in the sediment was obtained using cross-correlation of temperature time series. Means of TrOCs concentrations were used to calculate attenuation in the surface water as well as between the surface water and pore water concentrations. While water level, temperature and electric conductivity followed a diurnal cycle, there was no distinguishable diurnal pattern for the other chemical parameters and TrOCs. Biogeochemical conditions indicated reducing conditions in the sediment at the sampling depth of 25 cm. Oxygen measurements identified a shallow aerobic zone at the surface of the hyporheic zone and support the findings of reducing conditions at the sampling depth. The mean concentration of 12 TrOCs out of 17 decreased by 6 – 29 % along the 750 m long surface water flow path, 16 TrOCs were attenuated between surface and pore water by 1 – 93 %. High frequency sampling campaigns can provide profound knowledge for management strategies of urban rivers. Our results confirm that the hyporheic zone contributes to the self-purification of the River Erpe. Therefore, management practises aiming for a natural and well-functioning hyporheic zone of urban rivers are needed in order to increase the potential for the attenuation of anthropogenic contaminants.