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Emerging contaminants in the aquatic environment at the watershed scale

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Quality and quantity of urban water resources are matter of growing concern. A major task is the drinking water supply on the one hand and collection, transport and treatment of sewage on the other hand. In this context emerging contaminants from sewage are matter of concern. This group of substances includes pharmaceuticals, additives from personal care products (collectively: PPCP) as well as endocrine disrupting industrial chemicals. Emerging contaminants may pose a threat to human health and the aquatic ecosystem. Over the last years large effort was spend to detect emerging contaminants in sewage, surface water and groundwater and learn about transport and fate. So far no attempts were made to characterize mass fluxes of emerging contaminants within an urban watershed. The UFZ launched a project called WASSER Leipzig – Water- and sewershed study of environmental risk in Leipzig. The aim is to quantify emerging contaminant input to surface water and groundwater within an urban watershed and learn more about transport and fate in groundwater. The knowledge on input, transport and fate will contribute to a risk assessment of emerging contaminants. The working area is a watershed covering 18 km^2 within the city of Leipzig in eastern Germany. The sewer system forms a catchment area congruent to the watershed. Snapshot samples are taken from treated and untreated sewage, surface water and groundwater at regular intervals. As heterogeneity of the input is high, passive sampling devices help to determine time-integrated concentrations. From the variety of emerging contaminants we chose bisphenol A, technical nonylphenol, caffeine, galaxolide, tonalide and carbamazepine. This monitoring program is supported by measurements of inor-

ganic sewage markers, isotopes of water, nitrogen, boron and sulphur. Measurements of groundwater and surface water temperature help to understand water fluxes within the watershed. Results show an ubiquitous presence of emerging contaminants in urban waters up to thousands of ng/l. Highest concentrations are found in the untreated sewage. Sewage treatment reduces significantly the concentration of nonylphenol and caffeine. Galaxolide, tonalide and carbamazepine are characterized by a higher persistence and show considerably high concentrations in the sewage treatment plant effluents. Therefore treated sewage is an important input pathway of several emerging contaminants to the surface water. Temporally high concentration of caffeine and nonylphenol compared to the sewage treatment plant effluents can be led back to the input of raw sewage by combined sewer overflow. Concentrations in groundwater are considerably lower than in the surface water. An exception is bisphenol A with comparable concentrations in all urban waters. Concentration heterogeneity in time and space is high in groundwater and may vary an order of magnitude. Input pathways to the groundwater are provided by losses from leaky sewers and losses of contaminated surface water to the groundwater. So far the methodology proved to determine input pathways of emerging contaminants to groundwater and surface water. After finishing one year of sampling we will concentrate on numerical groundwater models to learn more about transport and fate of emerging contaminants in the urban watershed.