



## Occurrence and Distribution of PFAS in the River and Groundwater at Two Danube Sites

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Per- and Polyfluoroalkyl Substances (PFAS) are chemicals used for many domestic and industrial purposes related to their physicochemical properties. However, those same properties make them mobile and persistent in the environment, and on top of that, they are toxic and can affect human health in the short and long term, as they are bio-accumulative. Many processes govern the transport of PFAS in the surface waters and groundwater, e.g., sorption, biodegradation, co-transport, and transformation. Monitoring PFAS at different locations can help understand these processes and provide datasets to calibrate and validate reactive transport models simulating PFAS fate and transport. This study compares PFAS presence and distribution in river water and groundwater at two Danube river sites. One site is characterized by a steady water level in the river and natural flow from the river to the groundwater, with a clogging layer at the aquifer-river interface. In contrast, the other site has a more dynamic water level in the river, several pumping wells affecting water infiltration rates, and lacks a clogging layer.

Samples were collected monthly for 12 months at the static study site and 8 months at the dynamic study site. Targeted analysis for 32 PFAS compounds has been carried out using liquid chromatography mass spectrometry (LCMS). The concentrations of the compounds were generally less than 20 ng/l, and most of the compounds were lower than the limit of quantification/detection. The results show that 3H-perfluoro-3-[(3-methoxypropoxy) propanoic acid] (ADONA) had the highest concentration at the two sites, both in the river and groundwater. The longer chain PFAS exhibited a slight reduction in concentration from the river towards groundwater due to, most likely, sorption, while the shorter chain did not. The 6:2 FTS precursor was detected in the river but not in the groundwater. For some substances, the concentrations were higher in the groundwater compared to the river, indicating either background water influence, a transformation of PFAS, different transport routes (e.g., accumulation over time), or longer flow paths. Longer chain lengths, greater than 9 carbon atoms, were never detected above

the limit of quantification in the river and groundwater. More PFAS compounds were detected at the dynamic study site than at the static one, even though, it is located further downstream, indicating nearby PFAS sources or/and influents along the river course. It is worth mentioning that large wastewater treatment plants are discharging their effluent downstream of the static site, in addition to sewer overflows from large cities in between. The PFAS concentrations in the river and groundwater during one high-flow event showed little difference compared to the ones during basic monthly monitoring at both study sites, however, another high flow event is needed to confirm this observation.