

A harmonized Danube Basin-wide multi-compartment concentration database to support inventories of micropollutant emissions to surface waters

S. Kittlaus, M. K. Kardos, K. M. Dudás, N. Weber, A. Clement, S. Petkova, D. Sukovic, D. Kučić Grgić, Á. Kovács, D. Kocman, C. Moldovan, M. Kirchner, O. Gabriel, J. Krampe, M. Zessner, O. Zoboli

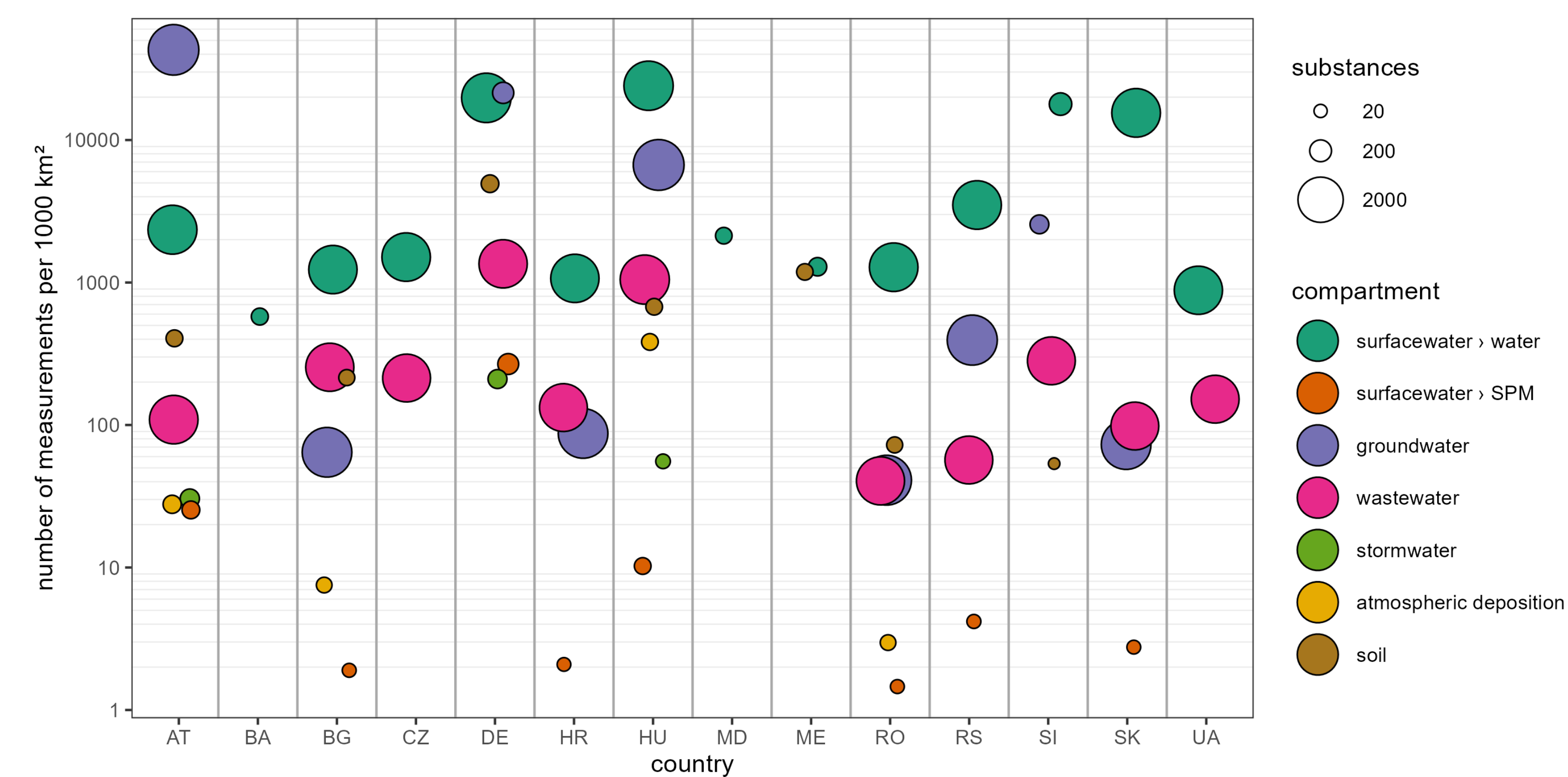


Fig. 1: Data availability on country level. All countries with > 2000 km² area in the DRB (contracting parties of the ICPDR) are shown. The number of measurements is normalized with the area of the country in the DRB. Where no data for an environmental compartment are available, no point is shown.

Results

We collected and harmonized MP measurements across multiple compartments and countries together with key metadata, harmonized and combined them into a new database. The resulting tool, available for download, facilitates the assessment of current data availability, in terms of quantity and quality:

DOI 10.48436/yaecs-dgr27

For example, Fig. 1 shows, that the majority of available data stems from groundwater and surface water, other highly relevant compartments are scarcely represented. By examining differences in MP concentration level across compartments, the database can lead to understand the relevance of specific emission pathways (Fig. 2) and thus to prioritize data-retrieval and calculation efforts in modelling applications. Selected examples show how to exploit the metadata associated to the measurements to extrapolate the results to regions not covered by specific monitoring programs. For example, PFAS concentrations in treated wastewater show significant dependence on the design capacity of the treatment plant (Fig. 3).

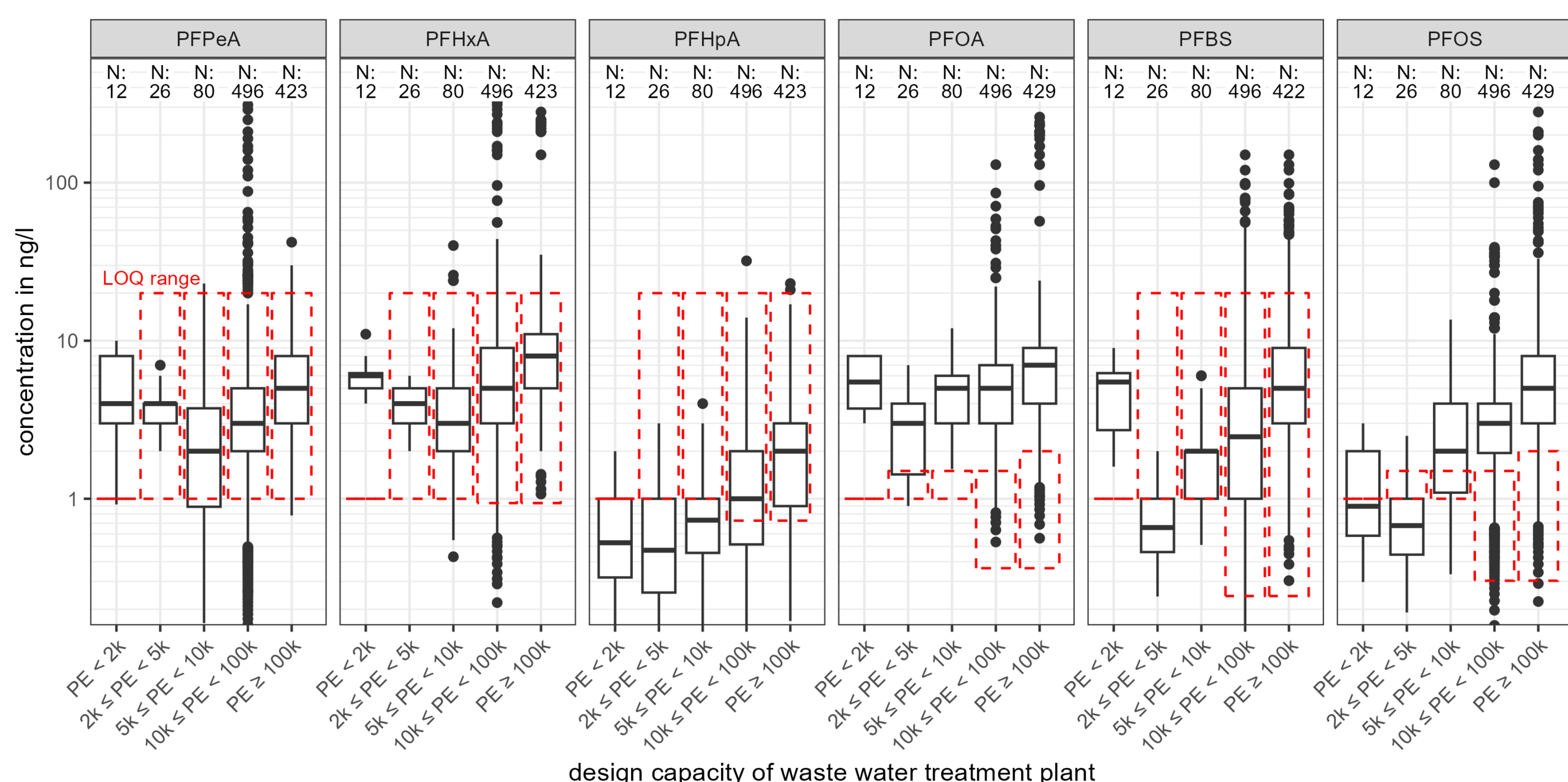


Fig. 3: PFAS concentration in effluent of municipal WWTP in the DRB depending on the size of the WWTP given in PE. Values below LOQ (range given as red dashed boxes) were imputed using ROS under assumption of a lognormal distribution. The number of observations (N) is shown above each boxplot.

Background

The European Water Framework Directive foresees the establishment of emission inventories for micropollutants (MP) to facilitate an evidence-based development of mitigation measures. Regionalized pathway analysis constitutes a moderately data-intensive approach to quantify the contribution of different pathways to the total pollution of surface waters. So far, only few European member states have created an inventory, which includes diffuse pathways. The fundamental basis to enable it is an accessible, well-structured and harmonized database with data on the concentration of MPs in multiple compartments, such as soils, groundwater, atmospheric deposition and urban systems. Combined with the water and suspended substance balance in river basins, such data enables the estimation of emission loads via specific pathways. In the Danube River Basin, but in general in Europe, a public data management platform with such scope and criteria is still lacking.

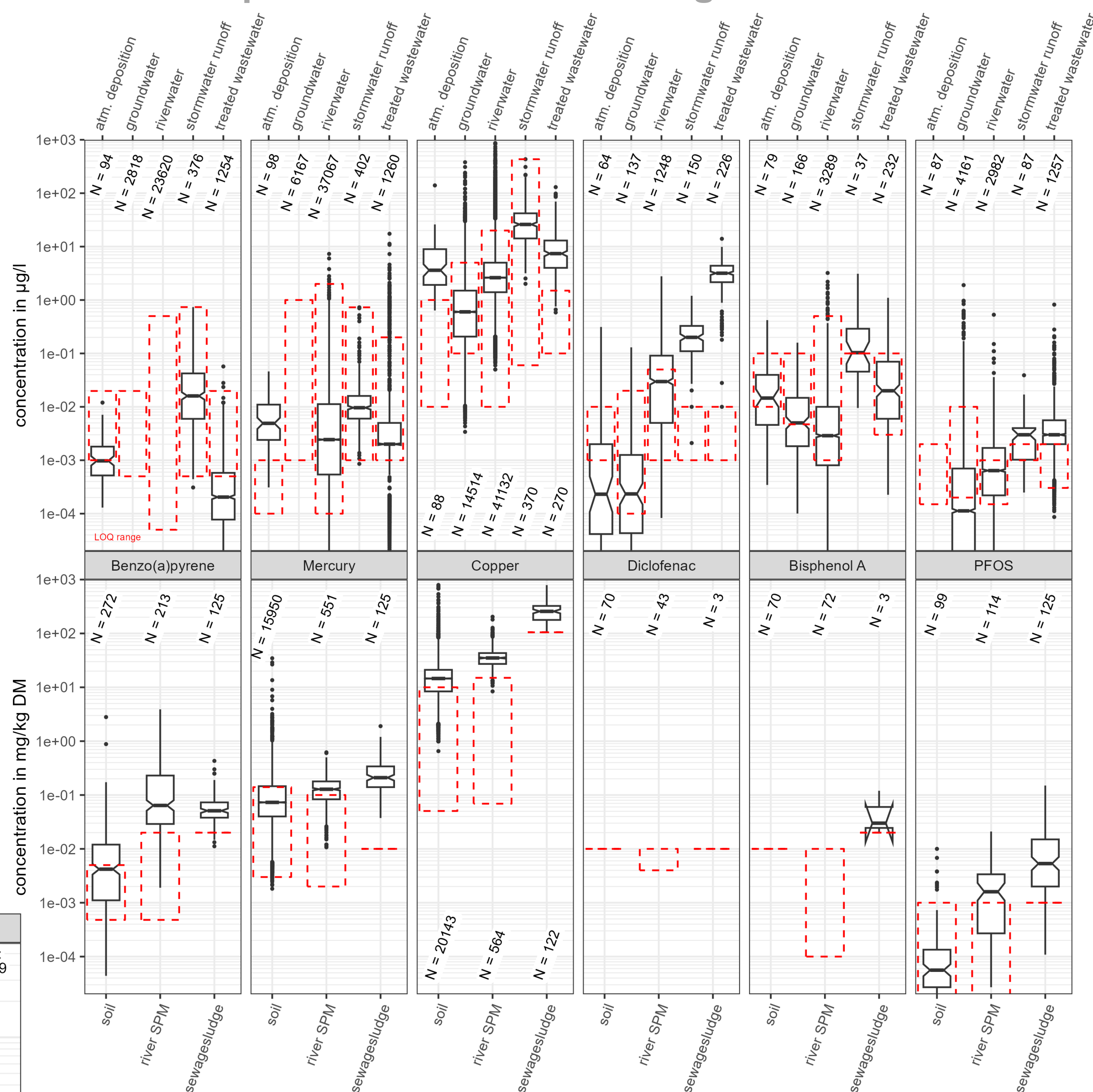


Fig. 2: Concentrations of selected MPs in different environmental compartments. Concentrations are shown as box-whisker plots with values below LOQ imputed by means of ROS under assumption of a lognormal distribution. If more than 80% of observations were below LOQ, no boxplot is shown. Notches in the boxes indicate roughly 95% confidence interval for comparing medians. The range of the LOQ is indicated by red dashed box. The number of observations (N) is shown as annotation above or below the boxes.

Conclusions

This poster showcases how such database can support the setup of emission inventories, guide data providers and national authorities in prioritizing the allocation of resources for new surveys and in optimizing their national data collection and management systems. The process tested showed a great need for enhanced data literacy across countries and institutions to increase data availability and quality to secure the exploitation of the full information potential generated via monitoring programs.

References

Kittlaus, S., Kardos, M.K., Dudás, K.M. et al. A harmonized Danube basin-wide multi-compartment concentration database to support inventories of micropollutant emissions to surface waters. Environ Sci Eur 36, 52 (2024). <https://doi.org/10.1186/s12302-024-00862-4>

