

3.08P.11: Direct analysis of river water for monitoring emerging contaminant influx from agricultural runoff and wastewater treatment plant effluent

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1. Introduction

Contaminants of emerging concern (CECs) including illicit drugs, pharmaceuticals, personal care products, pesticides and their metabolites/transformation products are found in a variety of different waters such as wastewater and river water. High spatial frequency monitoring of selected river water catchments as well as wastewater from Germany for >100 of those contaminants using direct injection liquid chromatography tandem mass spectrometry (LC-MS/MS) is presented herein.

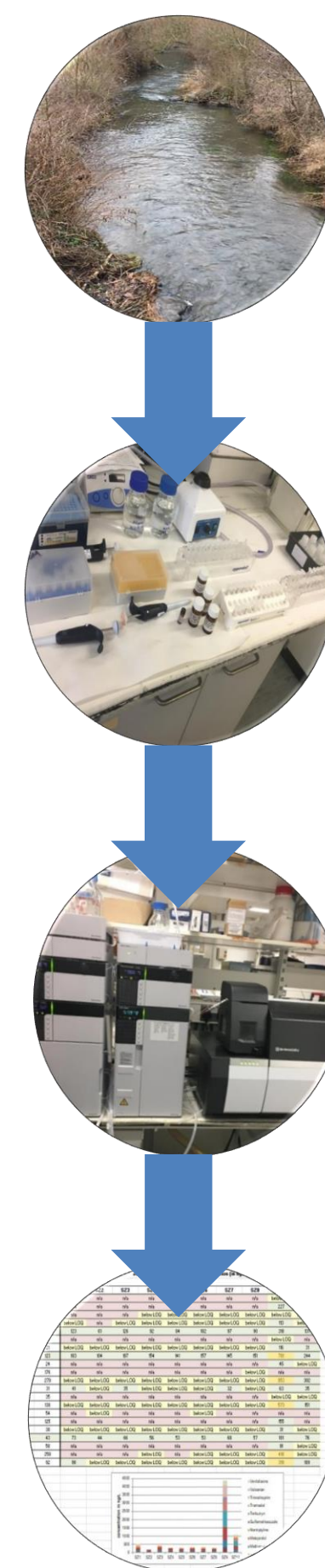
AIM:

Rapid analysis of river courses receiving treated wastewater to determine the impact of emerging contaminants

Objectives

- ✓ Characterisation of influent and effluent wastewater to determine % removal efficiency
- ✓ Rapid spatial analysis of two small rivers in Germany selected for influx of wastewater from municipal sewage treatment works

2. Experimental



Sampling

- Grab samples: 22 sampling sites; 2 rivers
- Influent and effluent wastewater samples (n=4)

Sample Pre-Treatment

- Filtration using single-use Whatman™ 0.2 µm PTFE membrane filters configured to 1 mL Plastipak™ syringes

Analysis

- Rapid direct injection LC-ESI-MS/MS analysis
- Further information about method: Leon Barron, 3.14.1

Data processing

- 10-point external background subtracted matrix-matched calibration curve
- Application of weighted regression (1/x)

3. Results & Discussion

% Removal Efficiency

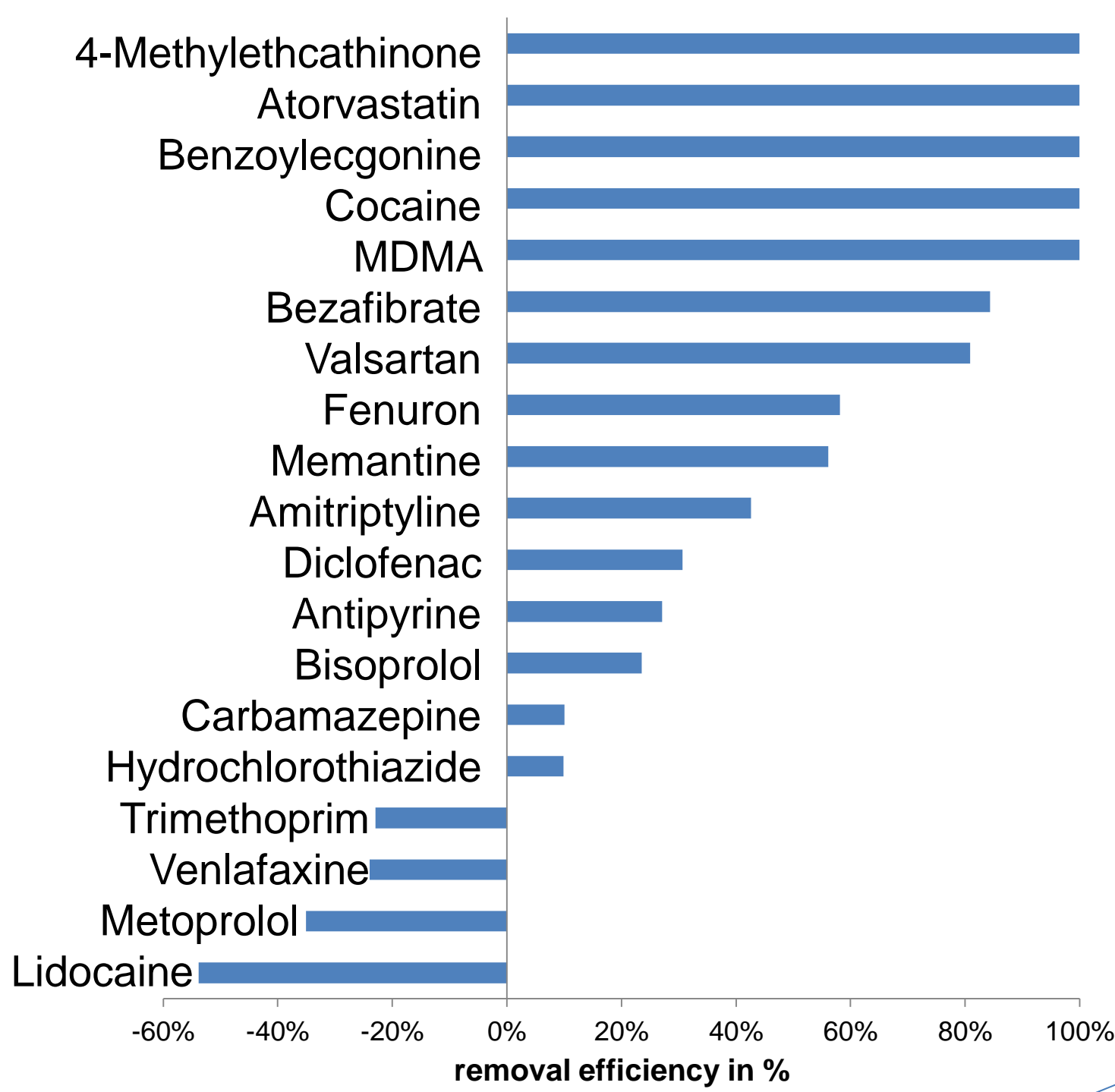
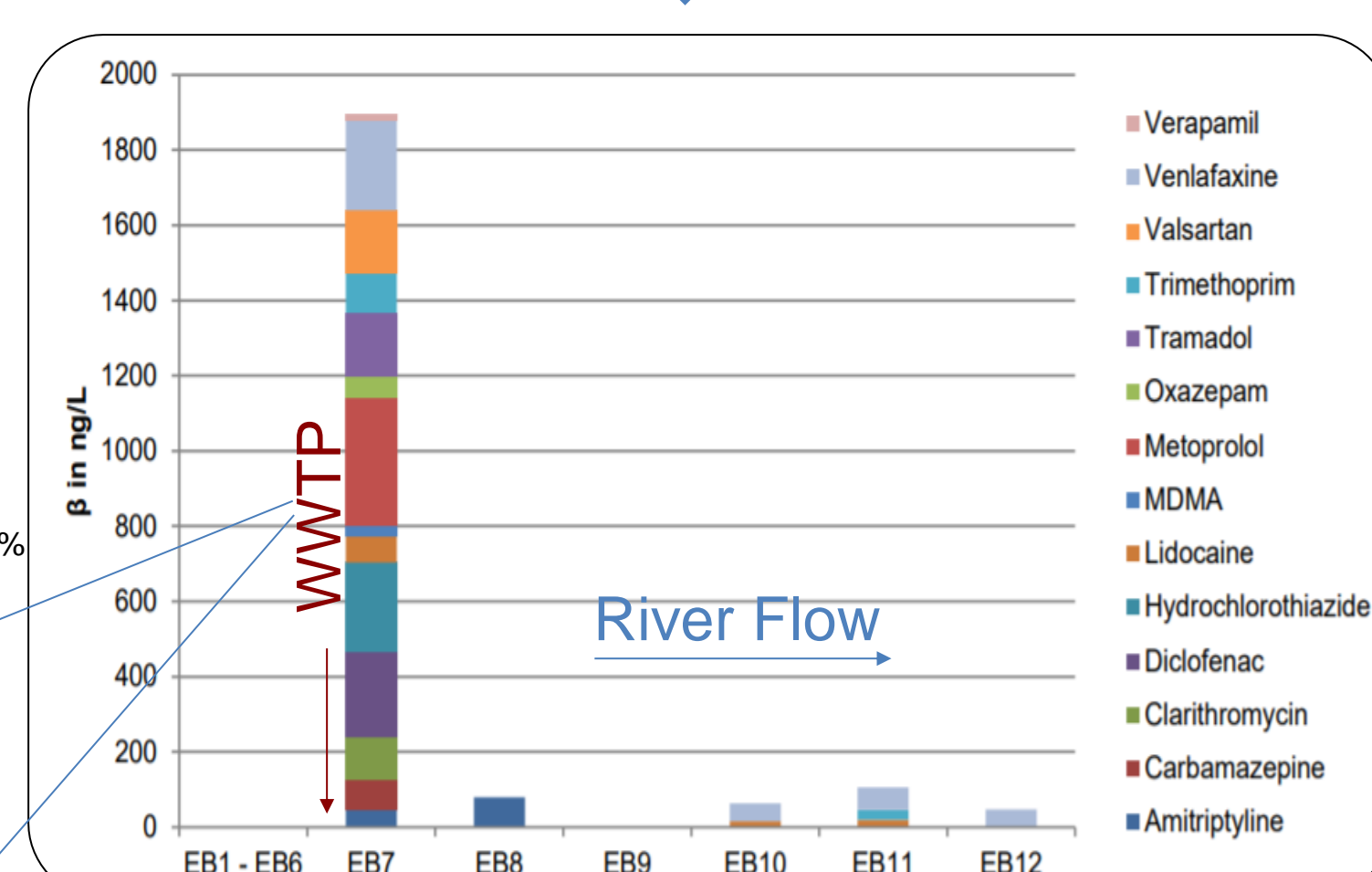
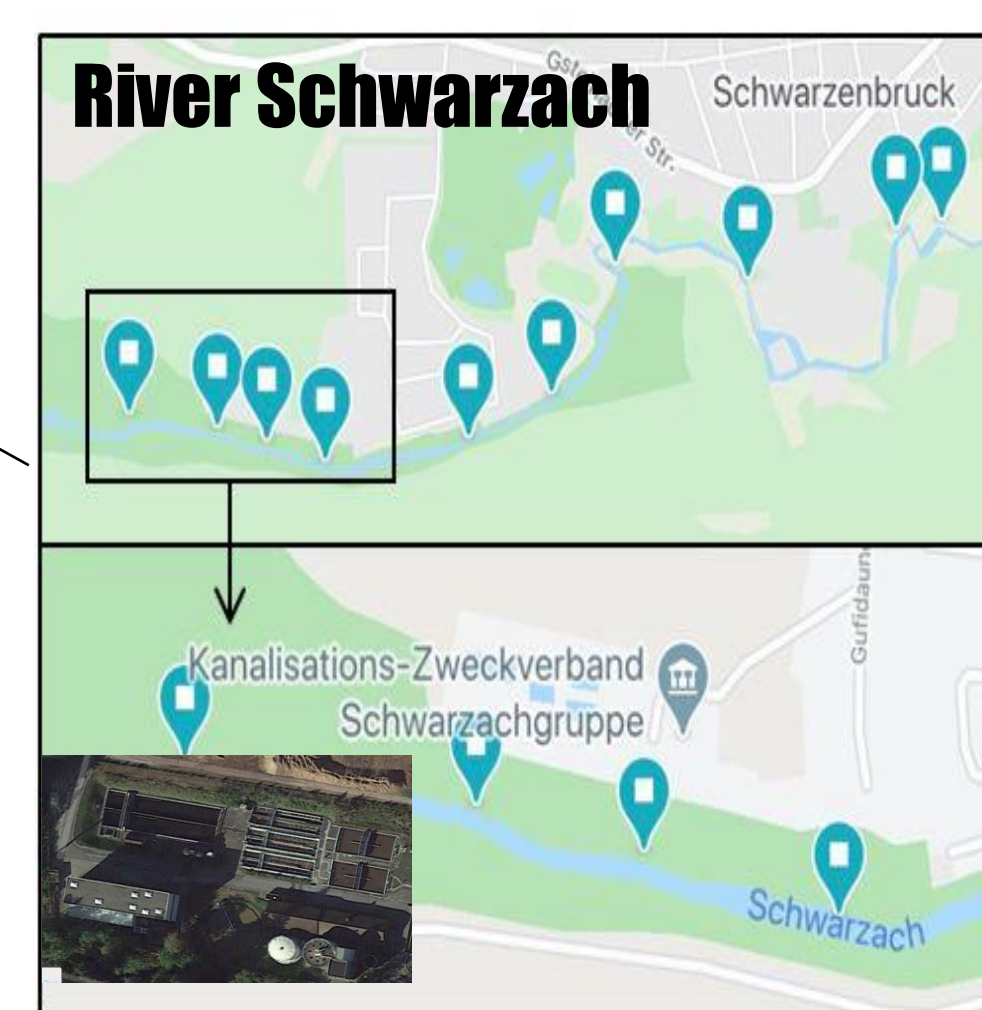
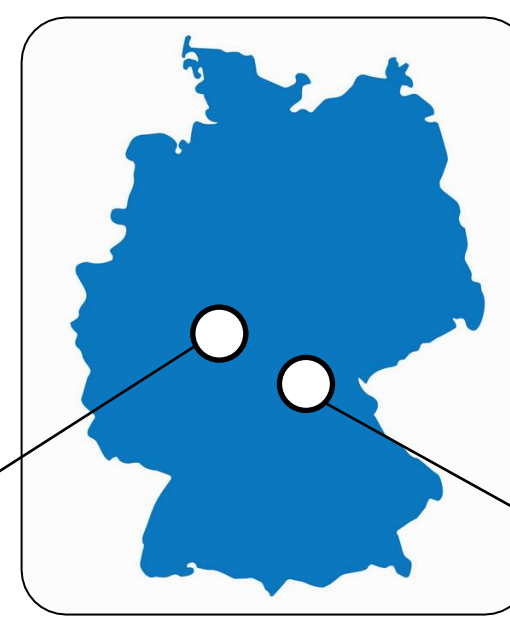
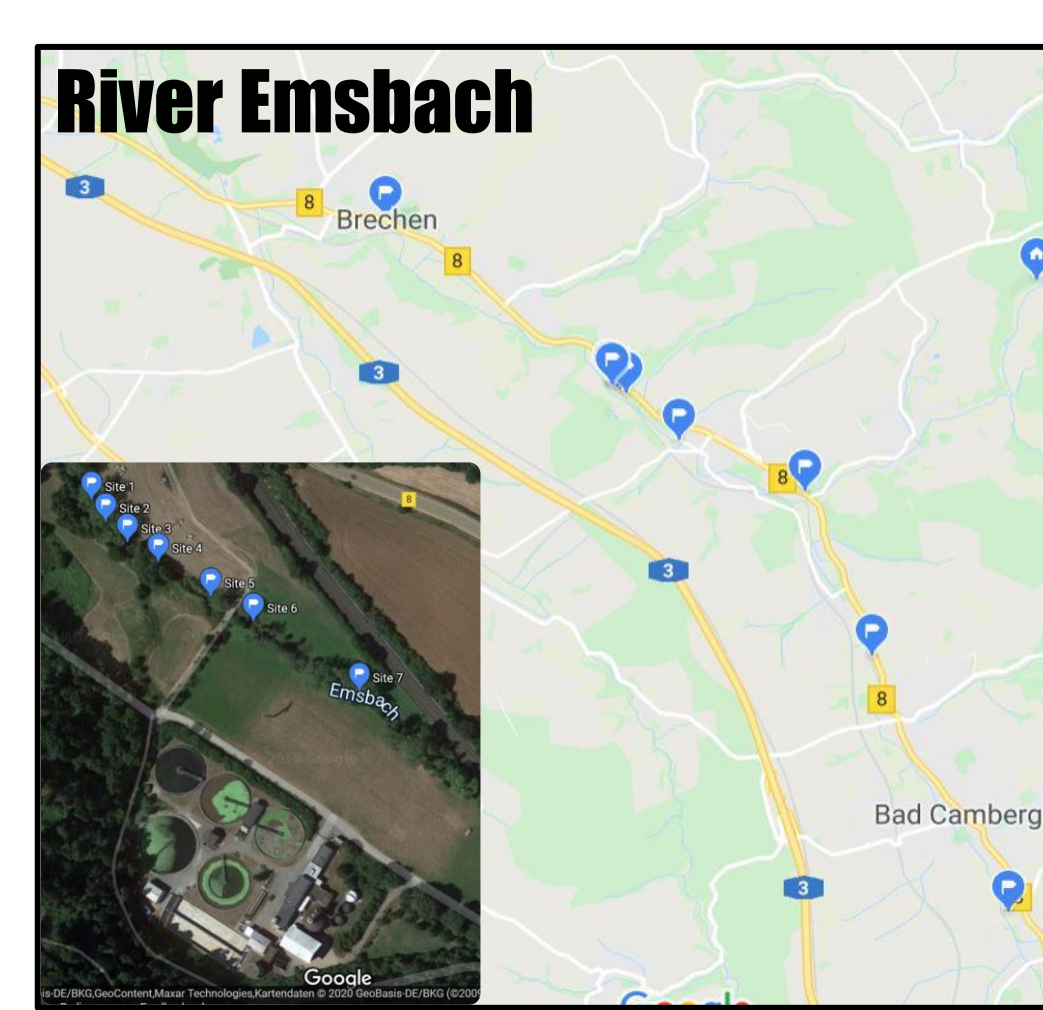
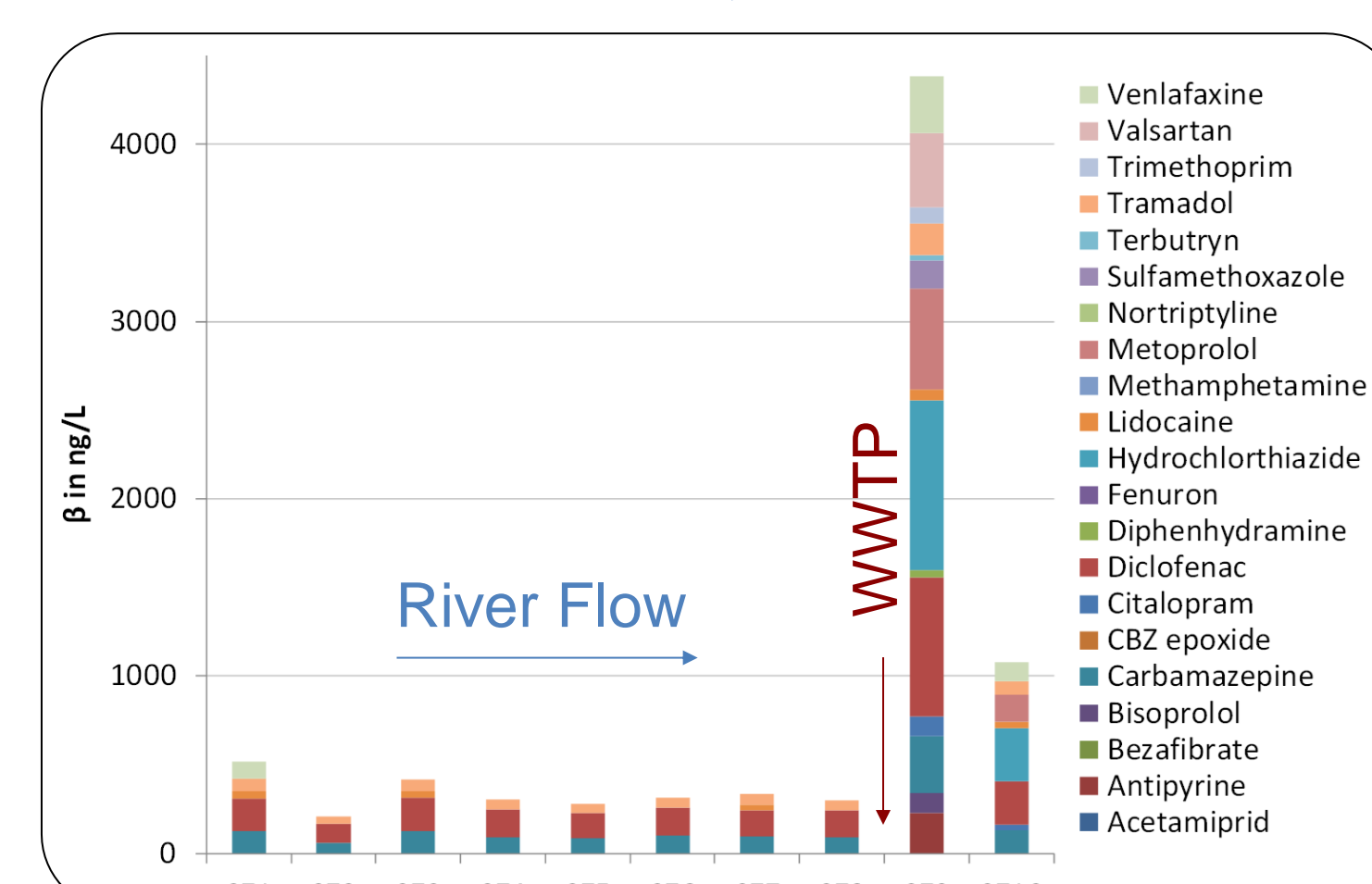


Fig. 1: Contaminant removal efficiency during water purification for 19 analytes.



Concentration of 14 CECs in River Emsbach (EB1-12)



Concentration of 21 CECs in River Schwarzbach (SZ1-10)

Fig. 2: Concentration of 27 compounds in total along river courses from the River Emsbach and River Schwarzbach.

Diclofenac

Metoprolol

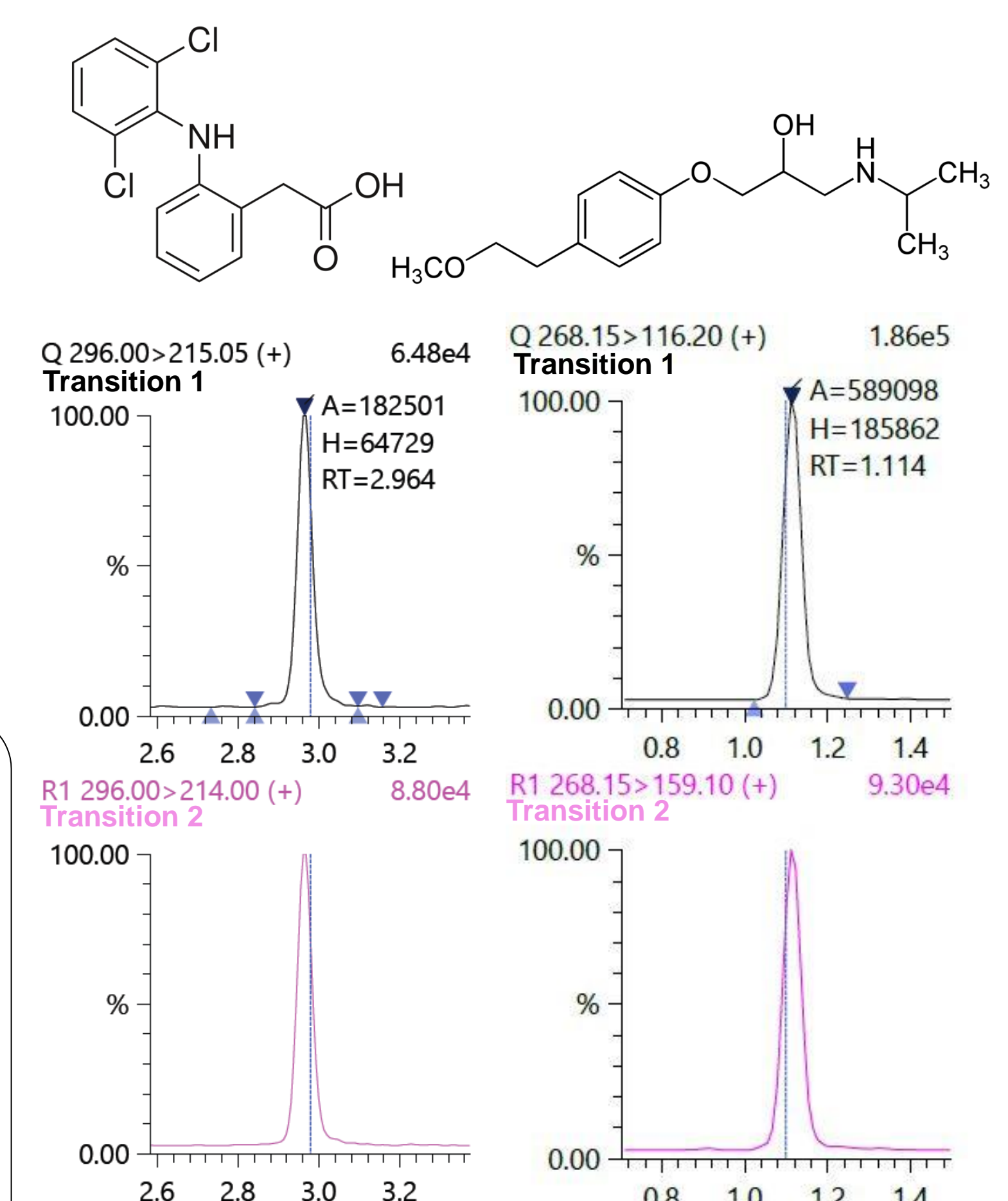


Fig. 3: Example mass chromatograms for diclofenac and metoprolol (SZ9) using direct LC-MS/MS analysis.

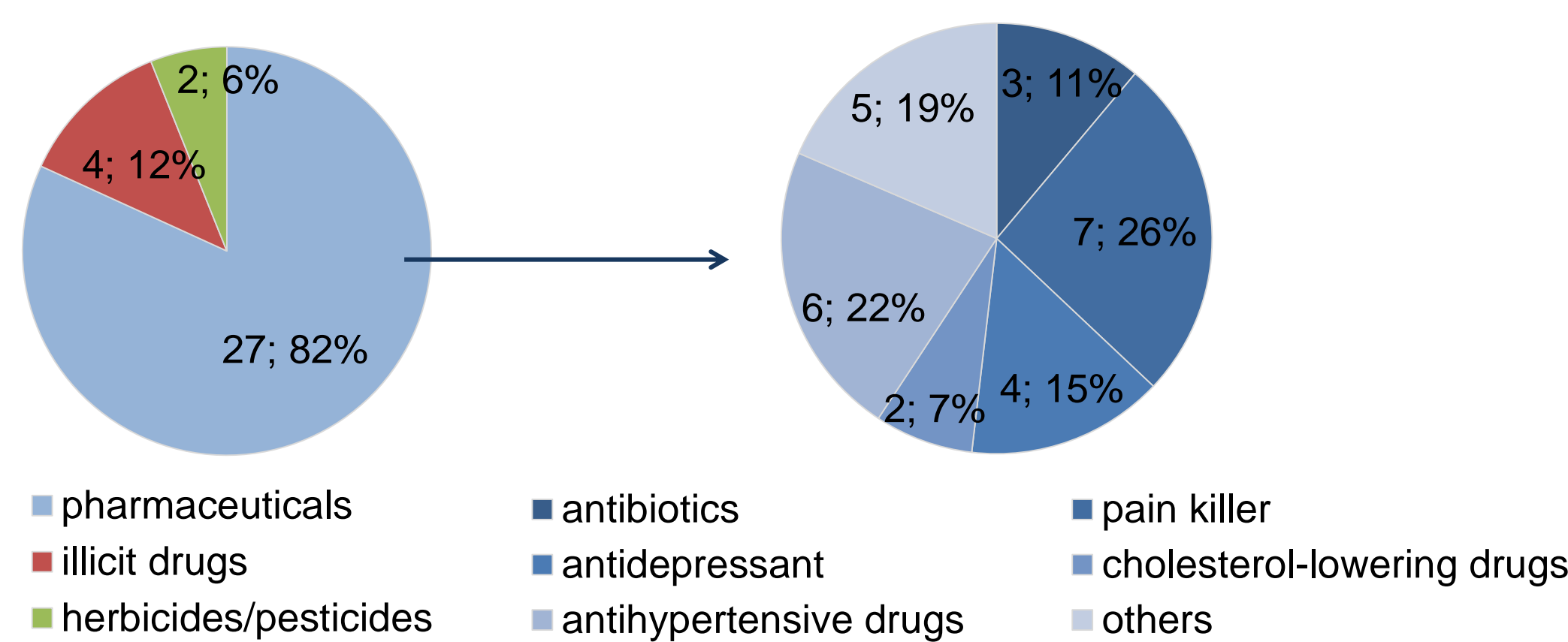


Fig. 4: Distribution of the 33 analytes detected in influent and effluent wastewater from WWTP Emsbachtal (in %).

Key Observations

1. Rapid LC-MS/MS enabled determination of 27 compounds across two rivers
2. At effluent point, concentrations markedly increased and reduced back to baseline over short distances
3. Highest concentrations in Emsbach was 342 ng/L (metoprolol); highest concentration in Schwarzbach was 953 ng/L (hydrochlorothiazide)
4. Considering concentrations in waste water effluent and the removal efficiency, effluent discharge could be identified as the primary source of contamination of CECs in rivers (observations were made under dry weather conditions)

4. Conclusion

- ✓ Significantly higher concentrations of CECs were detected near the discharge points of wastewater effluent discharge points
- ✓ Pharmaceuticals were detected most frequently in comparison to pesticides