



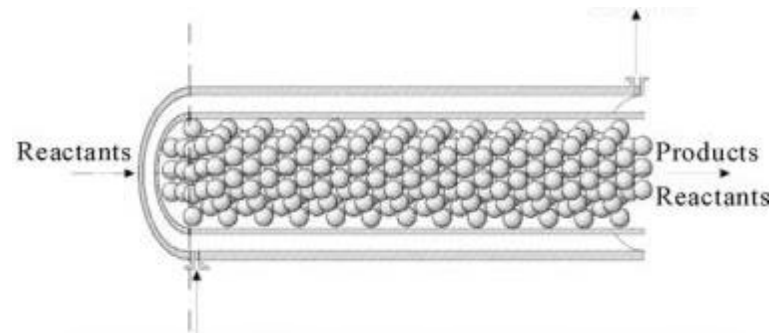
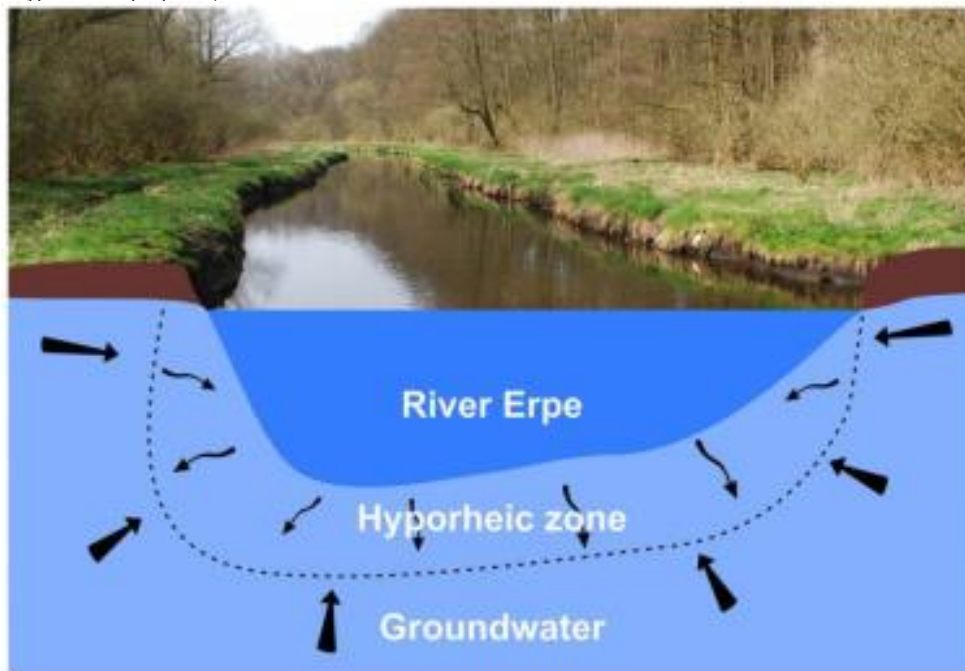
Tracing hyporheic zone-driven attenuation of polar organic pollutants using passive sampling

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'Defining' the Hyporheic Zone

hypo: under; *rheo(s)*: (to) flow;
hyporheic: 'under the flow'

HypoTRAIN proposal, SEP-210147419



Natural fixed-bed bioreactor

H
y
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Central compartment
for pollutant attenuation



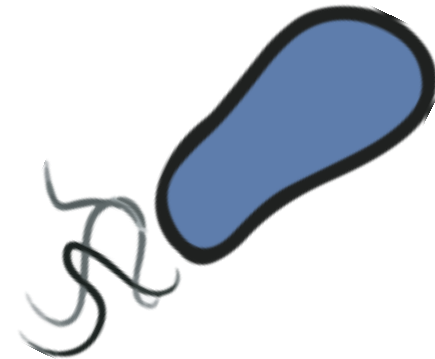
Self-purification
of lotic systems

Barrier against
aquifer contamination

Research Goal

Test hypotheses

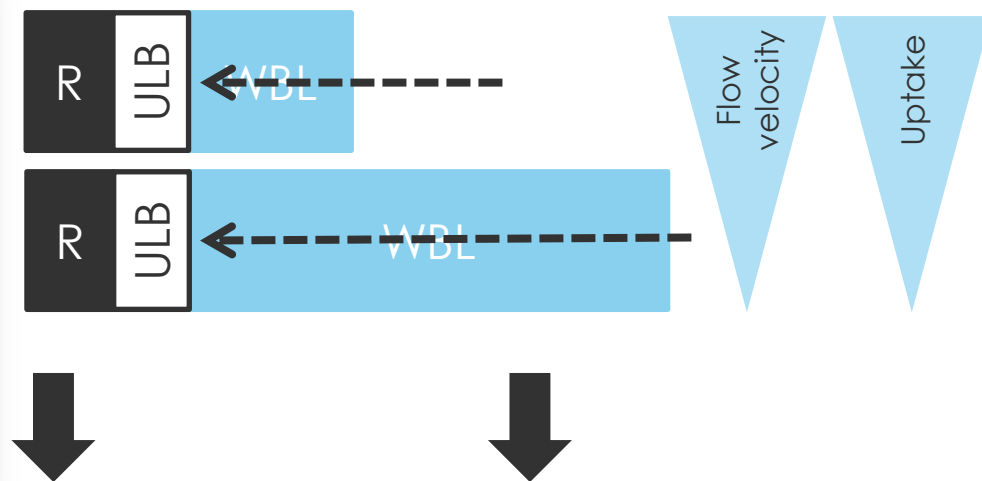
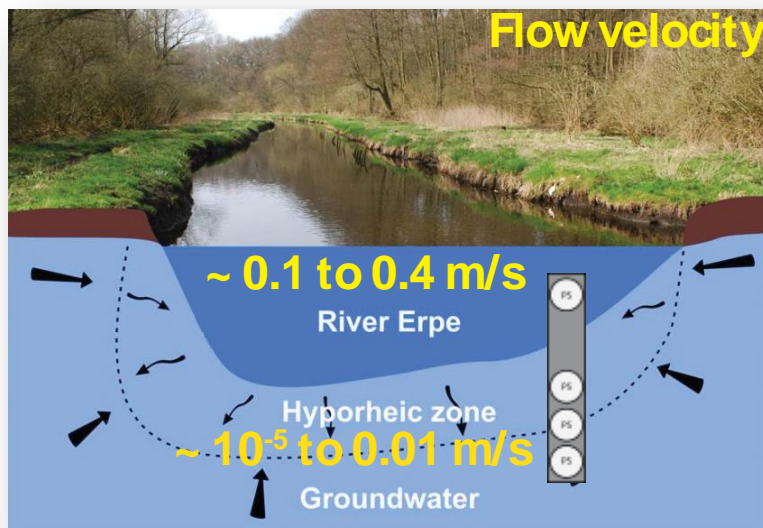
Tracing biotransformation of **polar (mobile)** organic pollutants in the HZ



1. Identification & quantification of organic pollutants
2. Identification of transformation products being indicative of hyporheic (bio)transformation

Passive Sampling in the HZ

R = receiving phase
ULB = uptake limiting barrier
WBL = water boundary layer



As insensitive as possible to changes in hydrodynamic conditions

Accumulation of **sufficient analyte** to enable instrumental analysis



'ULB' control

Step 1 – Passive Sampler Design & Assembly

Inspired by o-DGT sampler



Receiving phase



Diffusion layer II



Diffusion layer I



PTFE spacer

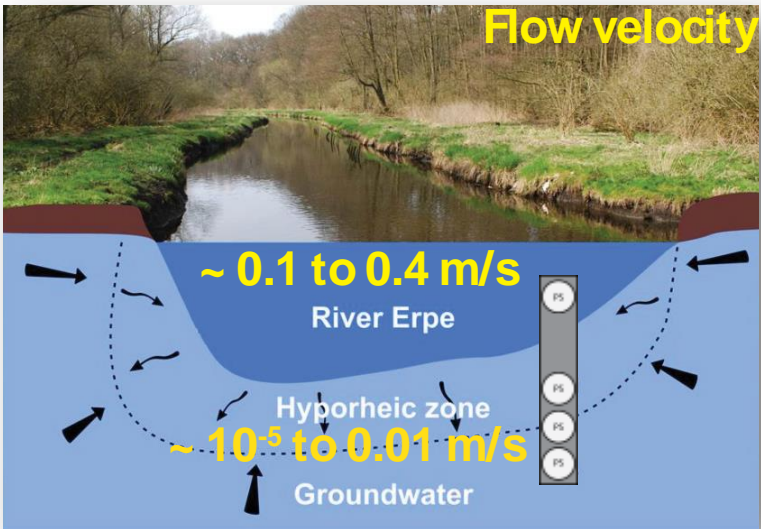


Cover plate

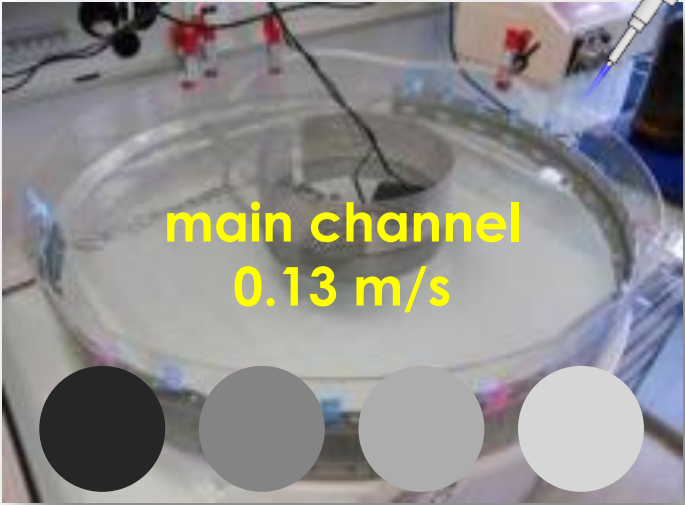
Modifications

- 4x increased surface area
- Stainless steel housing
- 0.1 μm PES filter membrane
- SDB-RPS receiving phase

Step 2 – Uptake Experiment



Retrieval after **2, 4 and 14** days in duplicates.



192 organic pollutants

Renewal (20 L/day)

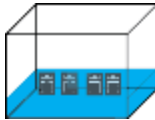


No renewal (static 'tank')

'Sampling rates' – flow rate dependency



mL/day



0.2 to 54



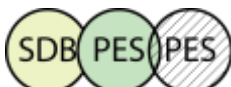
0.2 to 32

4.1 to 63



0.4 to 29

0.2 to 103



0.1 to 41

1.4 to 254



0.1 to 57

ΔR_S (median)

84%

111%

181%

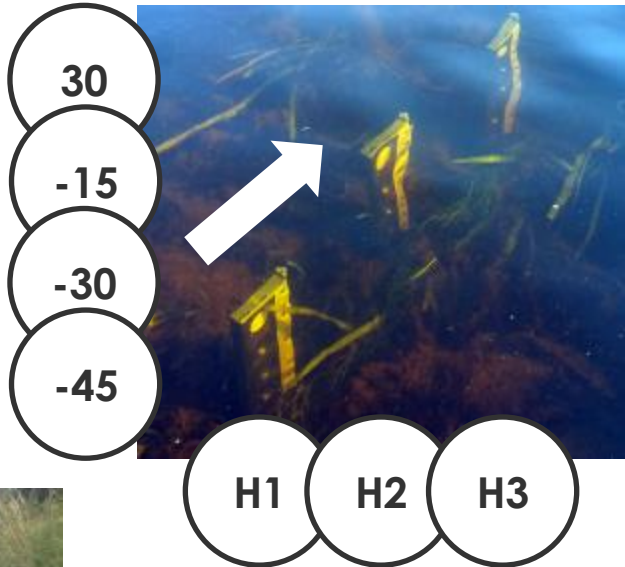
246%

Measure for flow rate dependency of uptake

Criteria: increase of accumulated mass (m_t) from 2 to 14 days; %RSD of m_t among duplicates $\leq 30\%$

Step 3 – Field application

SDB AGA PES ΔR_s 84%



Concentration trends

- 67 compounds analyzed
- Hits: 18 parents, 19 TPs
- Correction of concentrations with 'Field Factor'

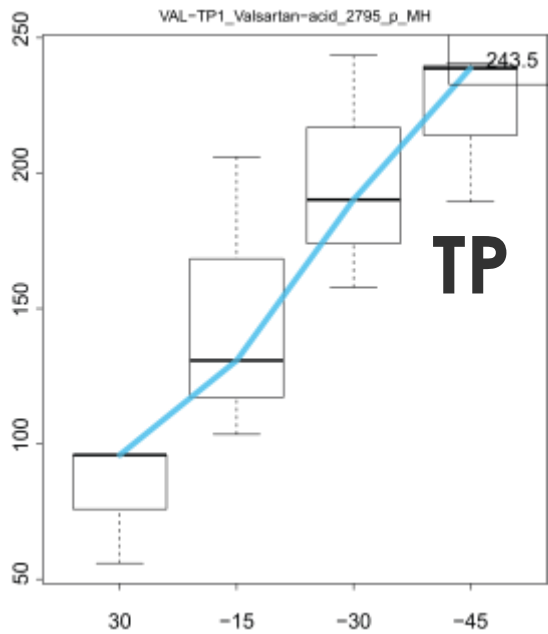
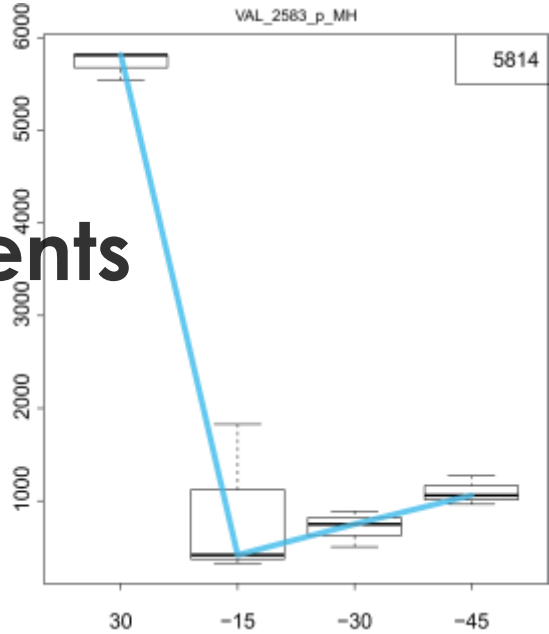
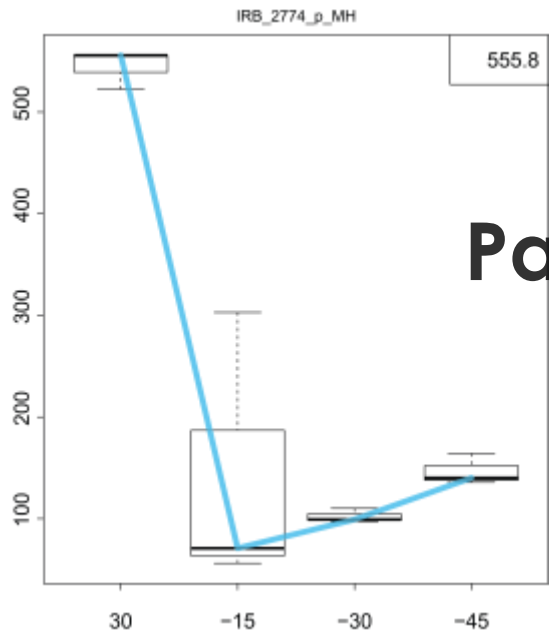
$$\text{Field Factor} = \frac{R_s^{\text{Circular Flume (SW)}}}{R_s^{\text{Aquarium (HZ)}}$$



Selected examples

Sartans

Parents



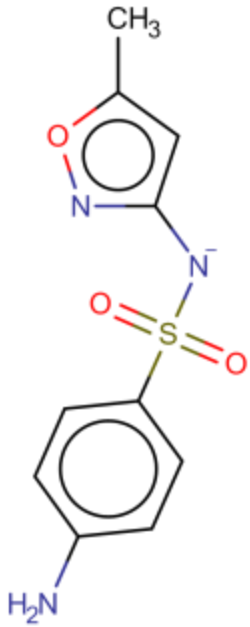
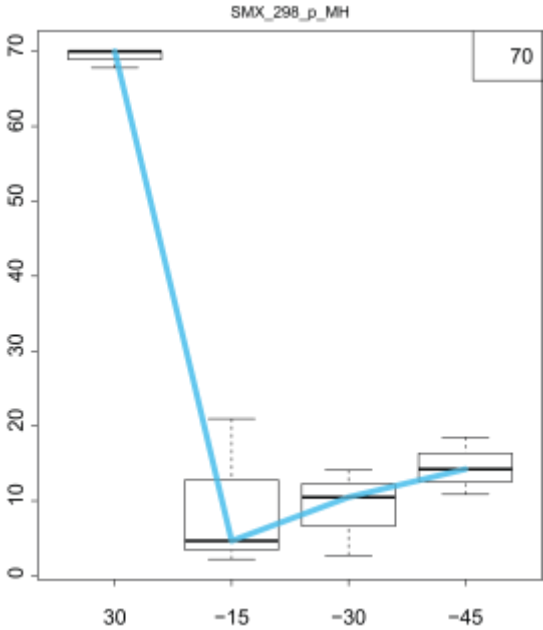
Irbesartan
 $\log D_{pH8.3}$
 5.2, anionic
 FF corrected

Valsartan
 $\log D_{pH8.3}$
 1.6, neutral
 No FF

Valsartan Acid
 $\log D_{pH8.3}$
 -0.6, anionic
 No FF

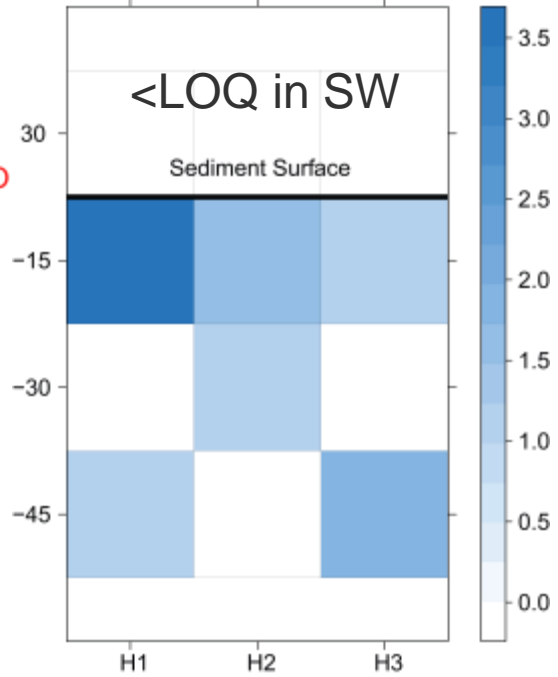
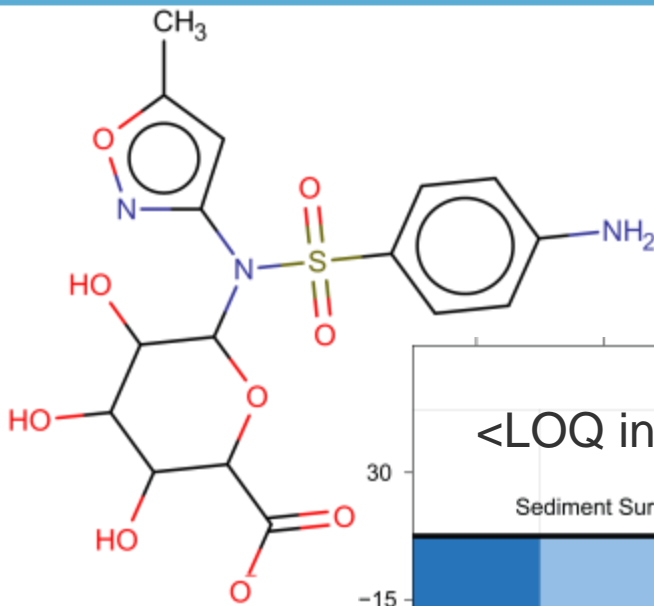
Selected examples

Sulfamethoxazole



Sulfamethoxazole

logD_{pH8.3}
-0.1, anionic
FF corrected



Sulfamethoxazole N1-Glucuronide

logD_{pH8.3}
-4.6, anionic
FF corrected

Conclusions & Outlook

- Uptake by 'novel' passive samplers **not flow rate independent** but less flow rate dependent compared to standard configuration (SDB/PES) – though **on the cost of sampling rates**
- **Static tank** experiment feasible **without renewal due** to minute sampling rates and marginal depletion.
- **Field factors** available for **116 organic pollutants** to correct for differences in hydrodynamic conditions (SDB/AGA/PES)
- **Suspect screening** to elucidate further transformation products characteristic of HZ-driven biotransformation → link parent attenuation to TP formation

Acknowledgements

- Juliane Hollender
- Etiënne Vermeirssen
- Uchem colleagues
- Fellow ESRs

Thank you for listening!



This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 641939.