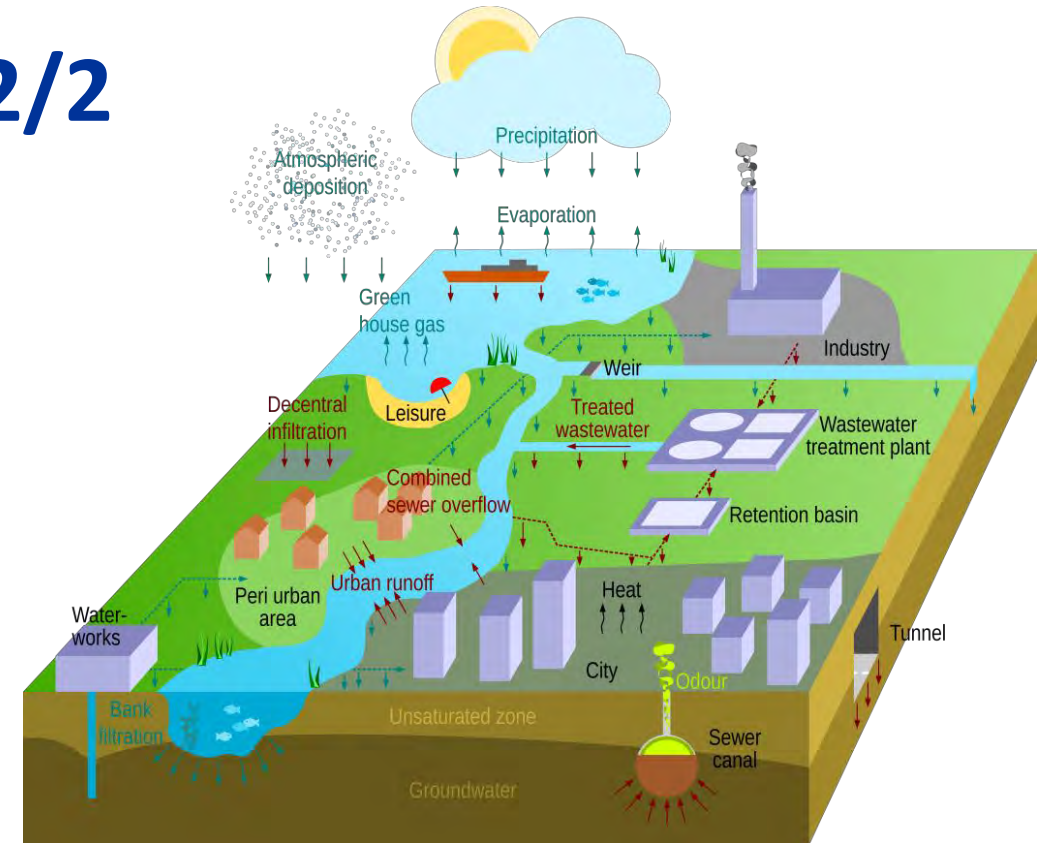


# DFG Research Training Group 2032/2 Urban Water Interfaces (UWI)

## Dealing with extreme weather events and climate change

23 January 2020

3. Fortschrittswerkstatt Wasser, Universität Duisburg-Essen



[www.uwi.tu-berlin.de](http://www.uwi.tu-berlin.de)

Nasrin Haacke<sup>1</sup>, Robert Ladwig<sup>2</sup>, Franziska Tügel<sup>1</sup>, Elena Matta<sup>1</sup> & Reinhard Hinkelmann<sup>1</sup>

<sup>1</sup> Technische Universität Berlin, <sup>2</sup> Leibniz-Institut für Gewässerökologie und Binnenfischerei

# Contents

- **Introduction to UWI**
- **Short-duration extreme precipitation events in Germany and Berlin**
- **Impacts of extreme precipitation on Lake Tegel, Berlin**
- **Flash floods in El Gouna, Egypt (TU Berlin's satellite campus)**
- **Prediction of extreme low water levels in river Rhine**
- **Conclusions**

# Contents

- **Introduction to UWI**
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- Impacts of extreme precipitation on Lake Tegel, Berlin
- Flash floods in El Gouna, Egypt (TU Berlin's satellite campus)
- Prediction of extreme low water levels in river Rhine
- Conclusions

# DFG Research Training Group (RTG 2032/2) Urban Water Interfaces (UWI)

## Overview

### Speakers and Coordinator

Prof. Dr.-Ing. Reinhard Hinkelmann, TUB

Prof. Dr. rer. forest. Birgit Kleinschmit, TUB

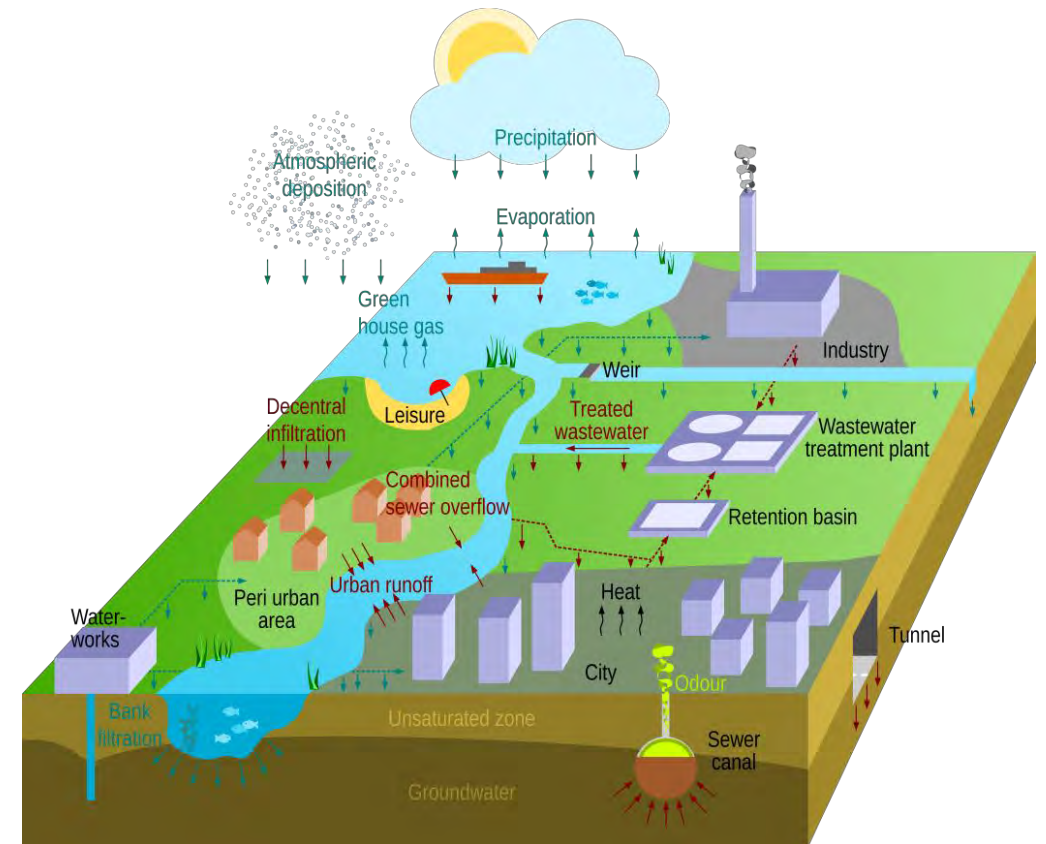
Prof. Dr. rer. nat. Mark Gessner, IGB & TUB

PD Dr. rer. nat. Sabine Hilt, IGB

Dr. rer. nat. Gwendolin Porst, TUB

### A joint initiative of

Technische Universität Berlin (**TUB**) and  
Leibniz-Institute of Freshwater Ecology  
and Inland Fisheries (**IGB**), Berlin



[www.uwi.tu-berlin.de](http://www.uwi.tu-berlin.de)

# UWI doctoral students and kollegiates, 2<sup>nd</sup> cohort

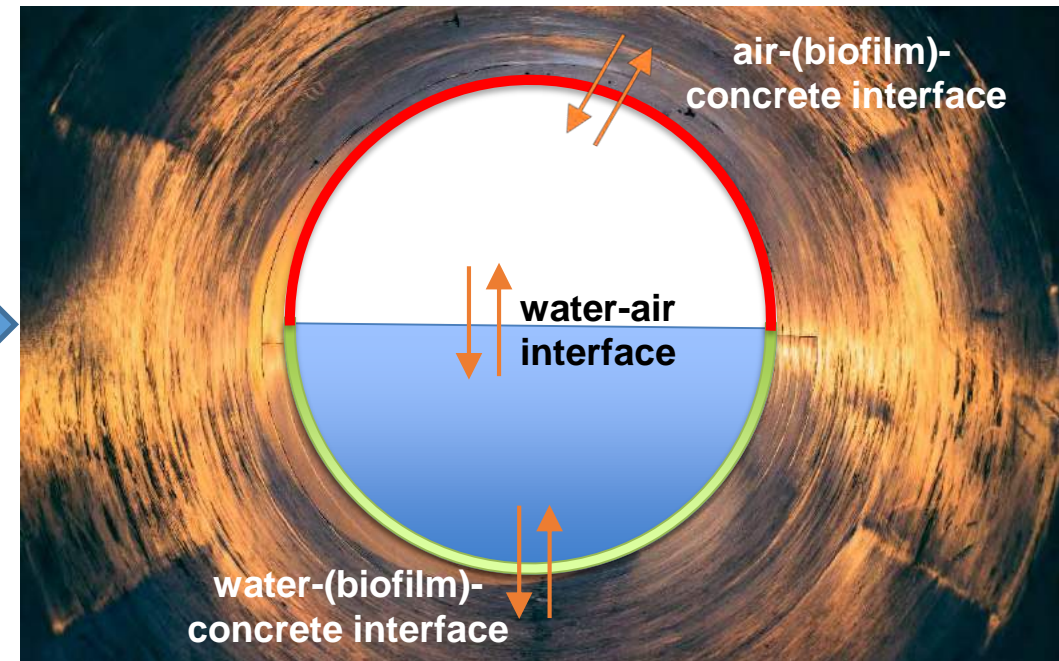
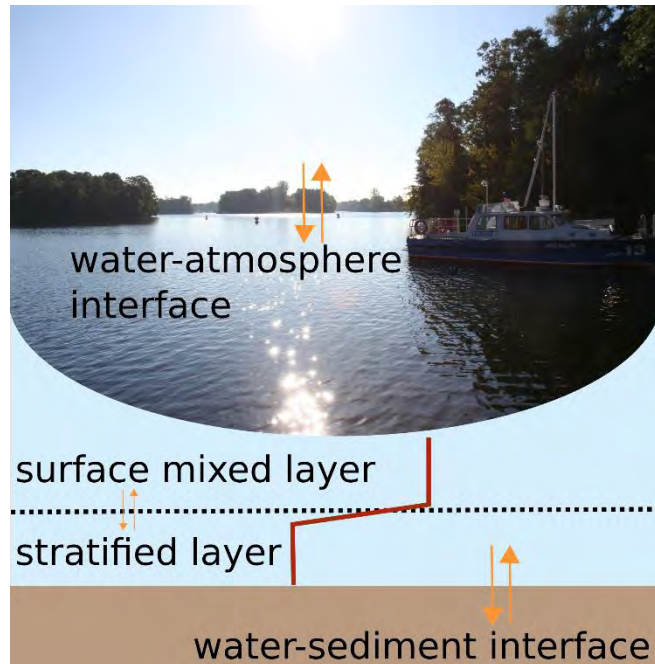


**UWI educates doctoral students from engineering and natural sciences bringing them to a new quality of interdisciplinary knowledge with a strong international component and within a structured framework**



# Overall aims

**Urban water interfaces** play a key role in the **urban water cycle** as they connect a **large number of compartments** and **subsystems** and notably affect **overall system behaviour**.

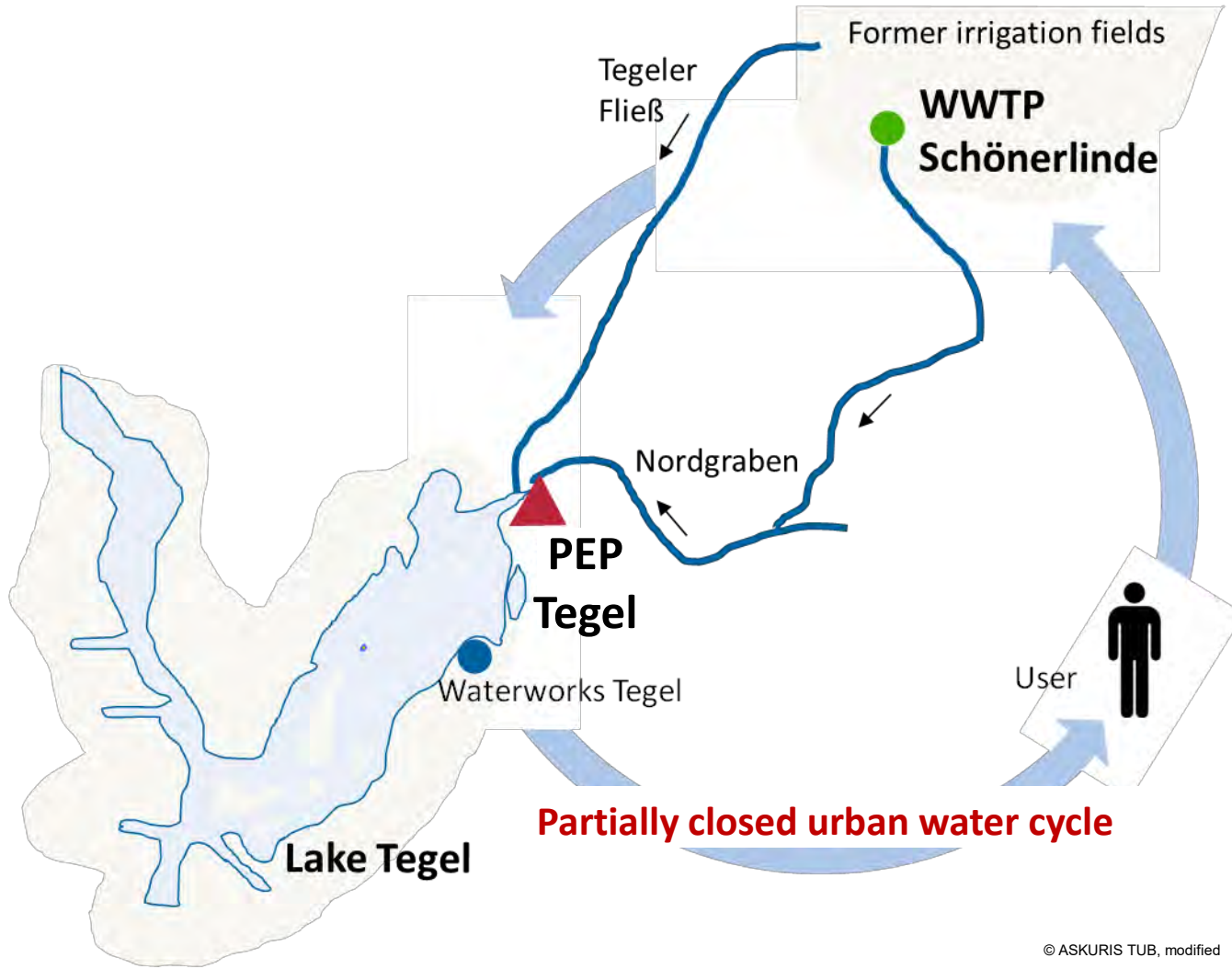


**Advance understanding**

**Predict impacts of future changes**

**Detect vulnerable and resilient conditions for improved management**

# Berlin's water cycle



© ASKURIS TUB, modified

- **Small river discharges**  
low flow conditions: MNQ Havel + Spree  $\sim 7 \text{ m}^3/\text{s}$   
wastewater effluent  $\sim 7 \text{ m}^3/\text{s}$
  - **Phosphorus elimination plant**
  - **Partially closed urban water cycles**
  - **Bank filtration**
  - **Strong interaction of compartments and of natural and technical systems**
- **Ideal location for research on urban water interfaces**

# Five selected natural and technical interfaces



water surfaces



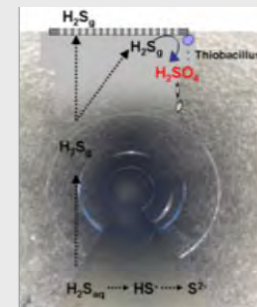
urban soils and  
vegetation



aquifers and  
sediments



water treatment



sewer systems



# Four new common topics

1<sup>st</sup> cohort

natural interfaces

- N 1
- N 2
- N 3
- N 4
- N 5
- N 6
- N 7

technical interfaces

- T 1
- T 2
- T 3
- T 4
- T 5
- T 6

W 1  
W 2  
W 3

interfaces in urban watersheds

F 1  
F 2  
F 3  
F 4

interfaces in urban freshwater ecosystems

H 1  
H 2  
H 3  
H 4

interfaces urban hyporheic zones

S 1  
S 2

interfaces in sewer systems

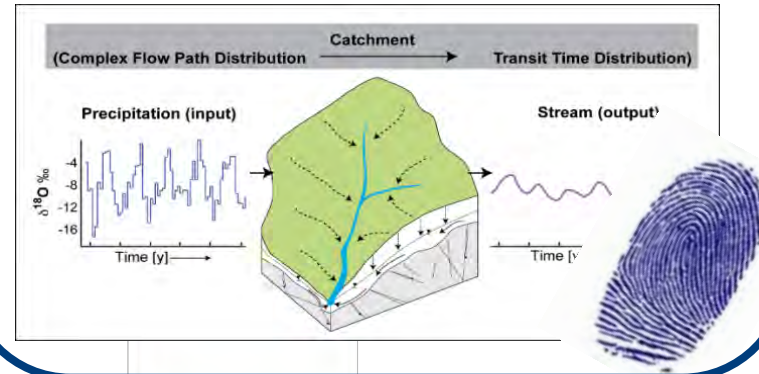
2<sup>nd</sup> & 3<sup>rd</sup> cohort

# Common topic: Interfaces in urban watersheds

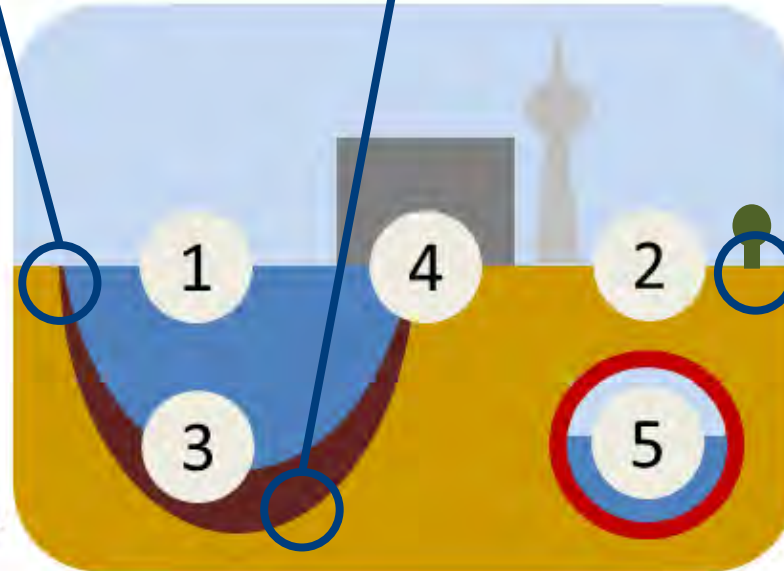
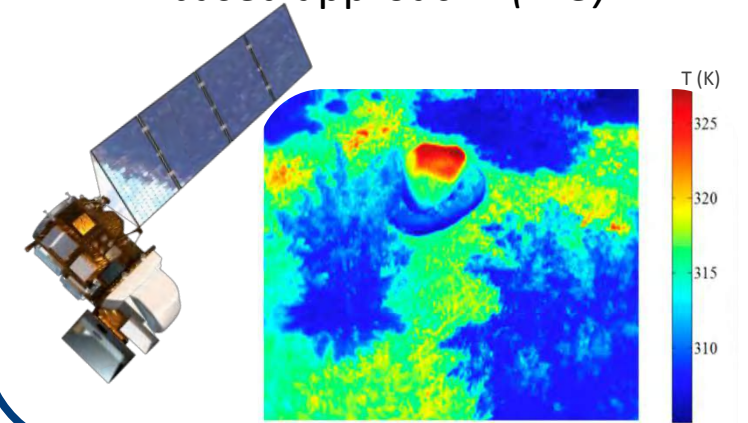
Scaling and connectivity assessment of critical source areas of diffuse pollution in urban catchments (**W2**)



Ecohydrological controls on urban groundwater recharge: an isotope-based modelling approach (**W1**)

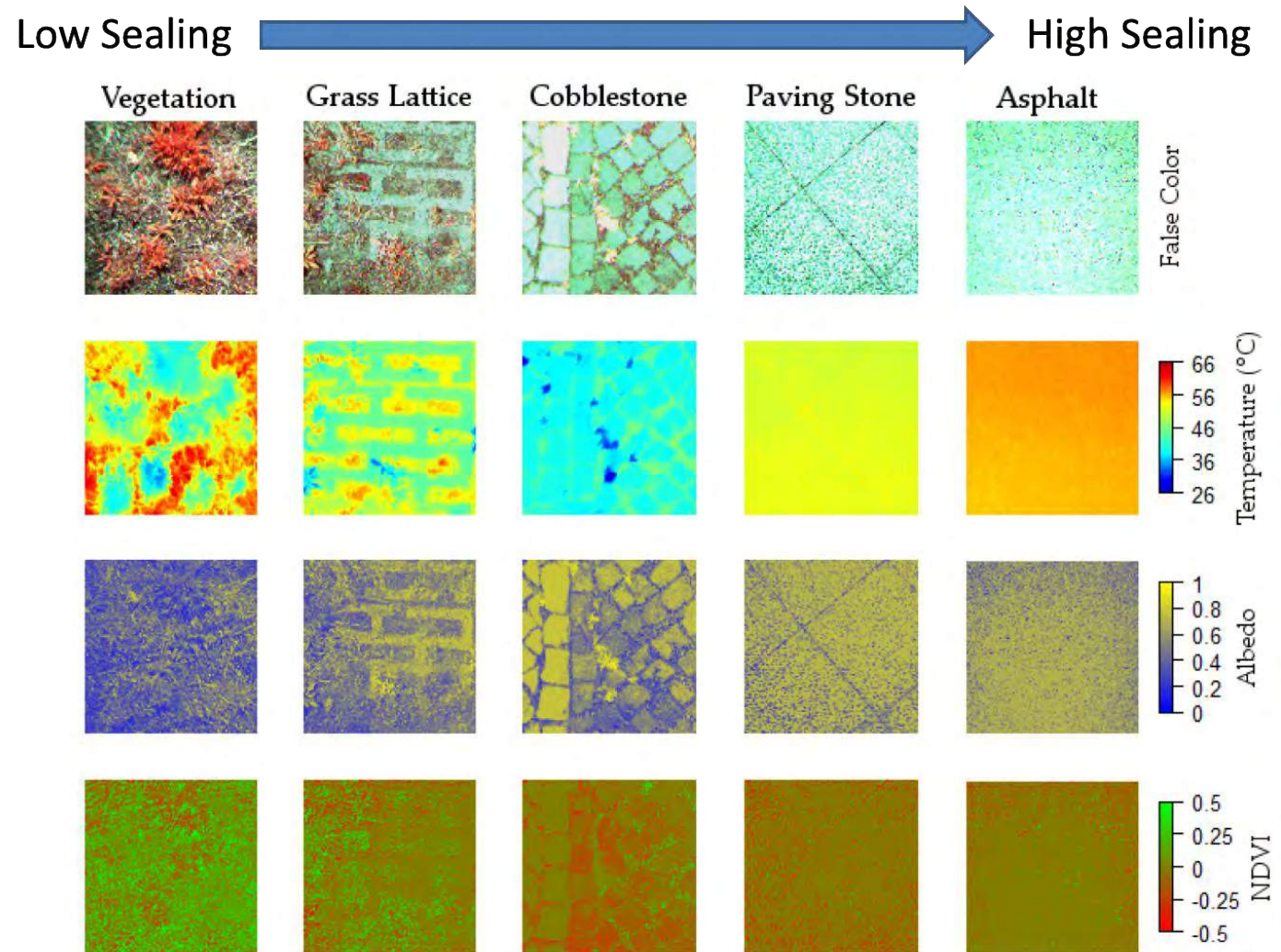


Heat and vapour fluxes of urban vegetation patterns – a remote sensing based approach (**W3**)



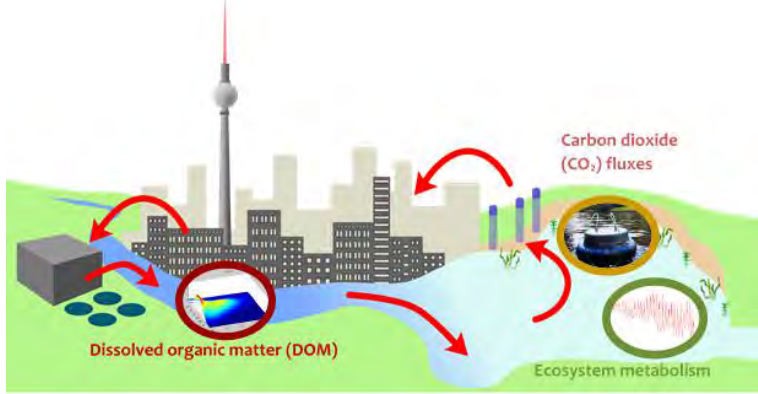
# Common topic: Interfaces in urban watersheds

- **Highlight: Thermal remote sensing** facilitates modelling **heat flux** of **partially sealed urban surfaces** from local to regional scales to improve understanding of urban heat impacts (N2).
- **Further research:** Integration of in situ observation, remote sensing and ecohydrological modelling;  
**soil-vegetation-atmosphere interfaces**

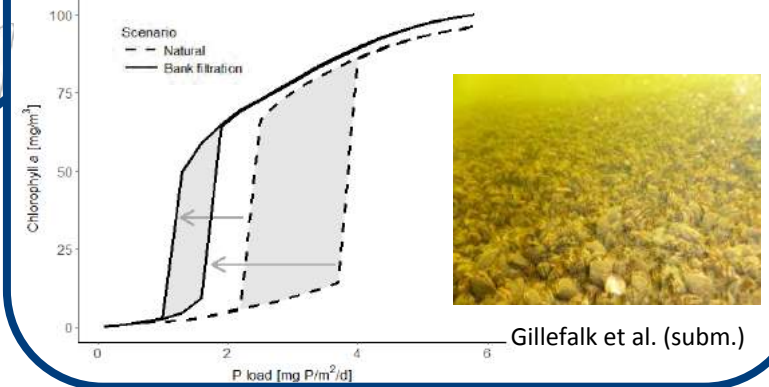


# Common topic: Interfaces in urban freshwater ecosystems

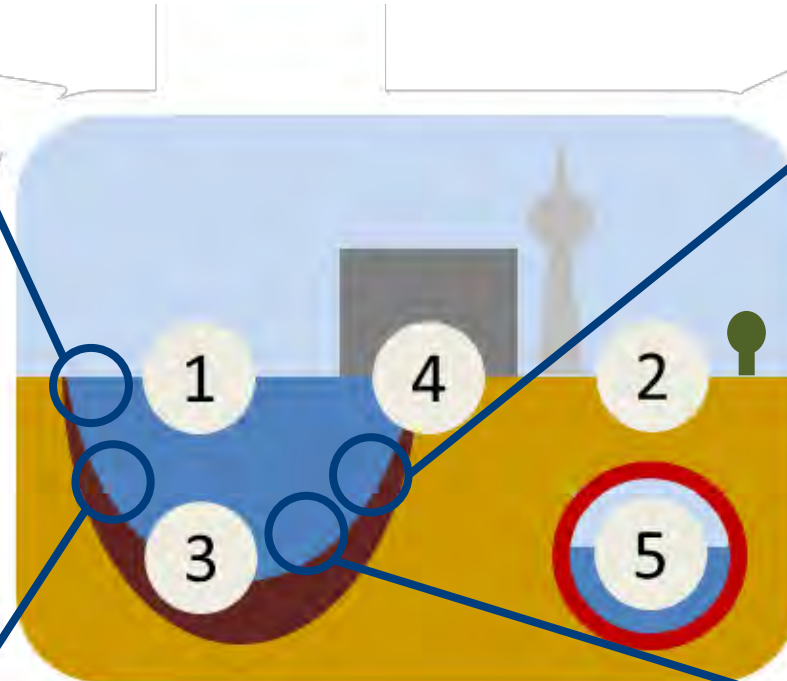
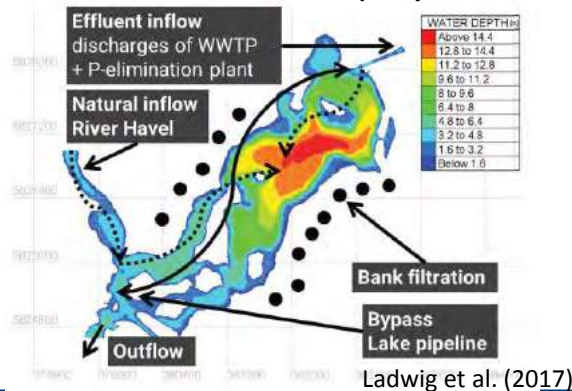
The GHG footprint of a metropolitan area (**F4**)



Transformation of environmentally relevant compounds by invasive ecosystem engineers (**F1**)



Impact of management measures on sediment water interface in an urban lake (**F3**)

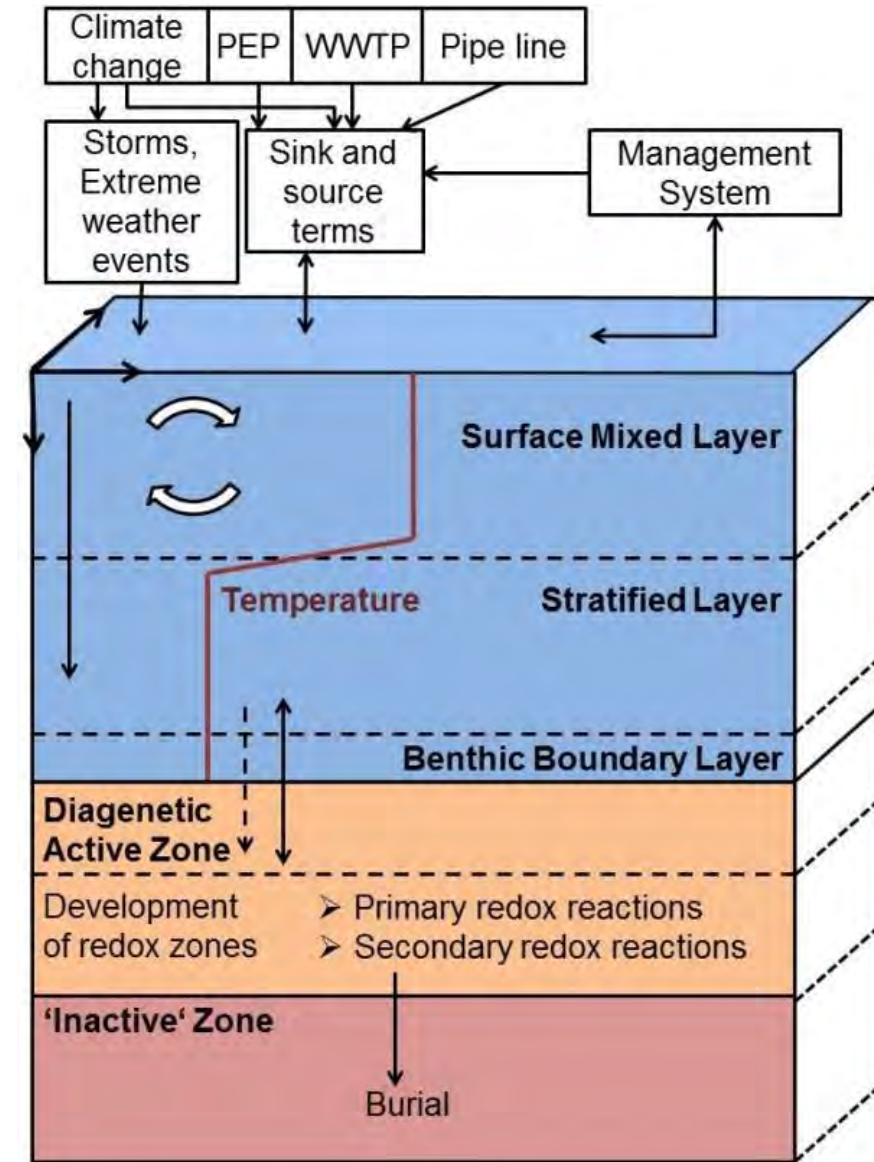


Cyanobacteria dynamics in the littoral lake – land interface (**F2**)



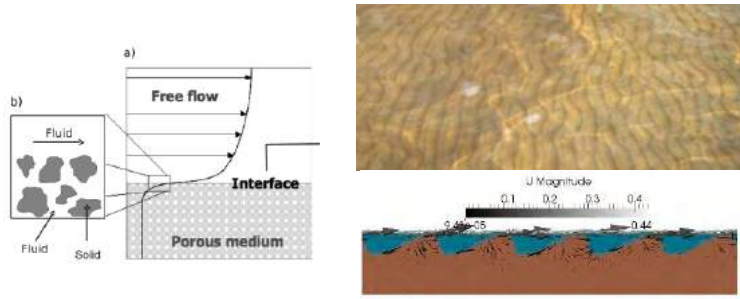
# Common topic: Interfaces in urban freshwater ecosystems

- **Highlight:** Modelling of scenarios enabled adaption of established lake management to mitigate impacts of climate change (T4, N5).
- **Further research:** Phosphorus fluxes across boundaries; **sediment-water interface**



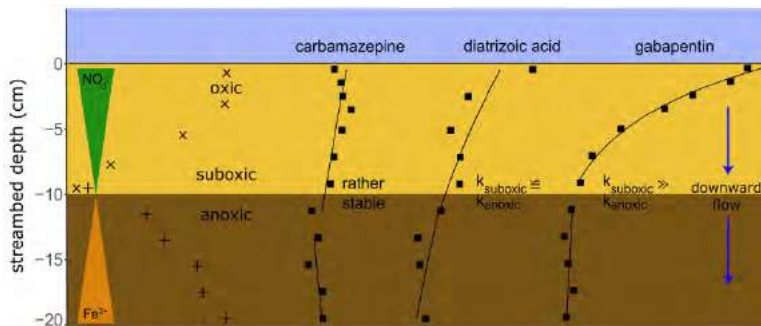
# Common topic: Interface urban hyporheic zones

Integral modelling approach for flow and reactive transport at surface water-groundwater interfaces (**H2**)

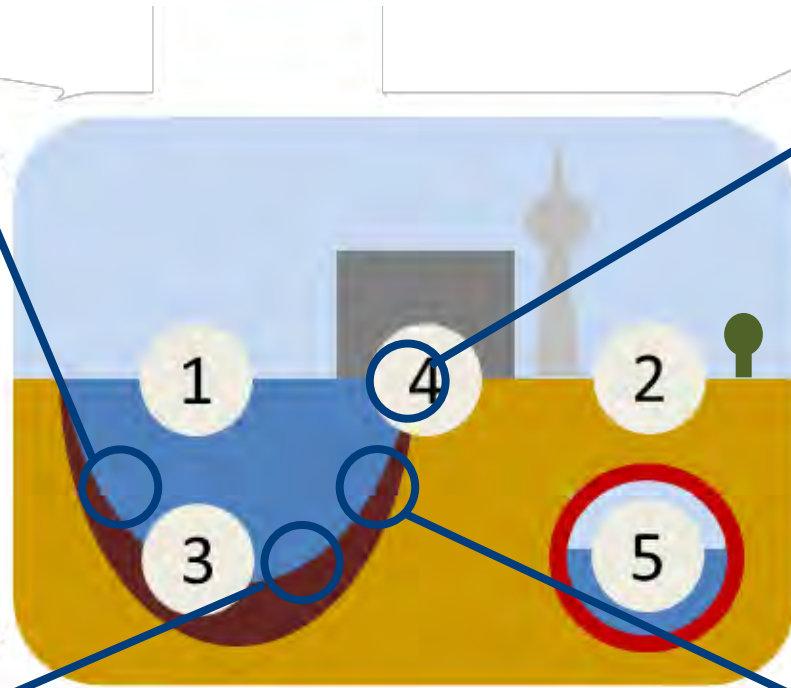


Broecker et al. (2018), *Limnologia* **68**, 46-68

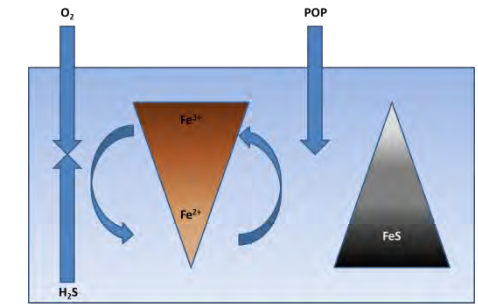
Retention of trace organics in urban hyporheic bioreactors (**H1**)



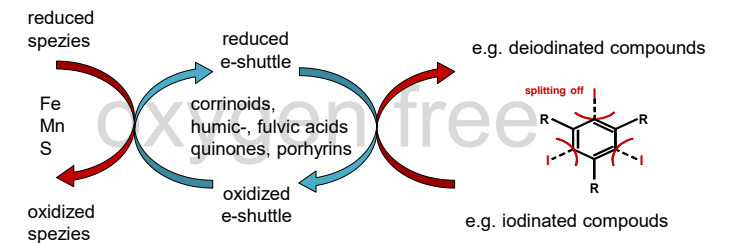
Schaper et al. (2018), *Water Research* **140**, 158-166



Redox gradients in natural & technical systems: Population structure and physiological properties (**H4**)



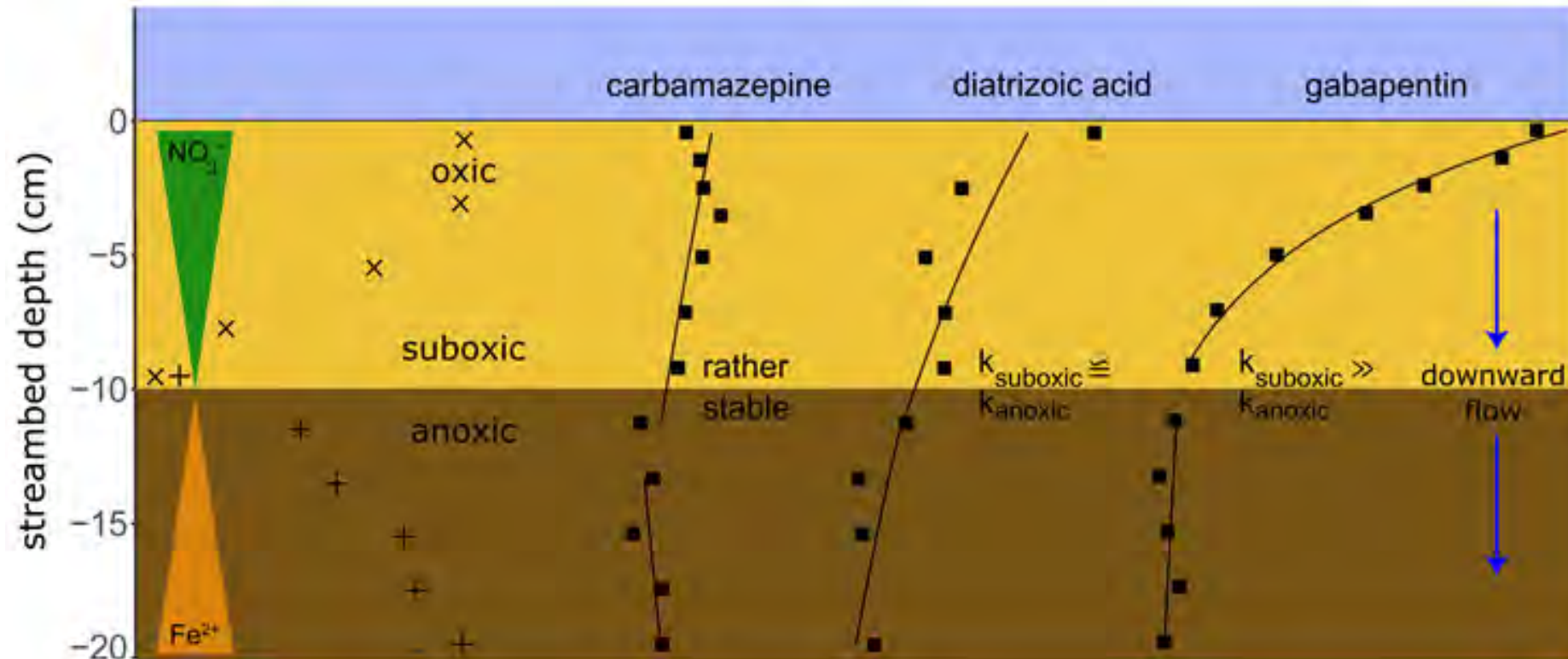
Abiotic transformation of organic trace compounds (**H3**)



El-Athman et al. (2018), *Environmental Science & Technology*, submitted

# Common topic: Interface urban hyporheic zones

- **Highlight:** Trace organic compounds are removed within **interface urban hyporheic zones** and hyporheic exchange flows thus contribute to improve urban water quality (N6).



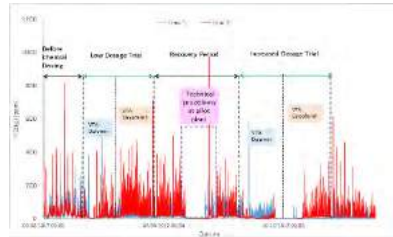
- **Further research:** Stream engineering; investigating ecosystem functions of **interface biofilms**

# Common topic: Interfaces in sewer systems

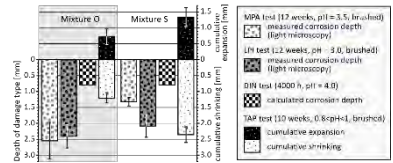
## Analysis and countermeasures of odour and corrosion (S1)



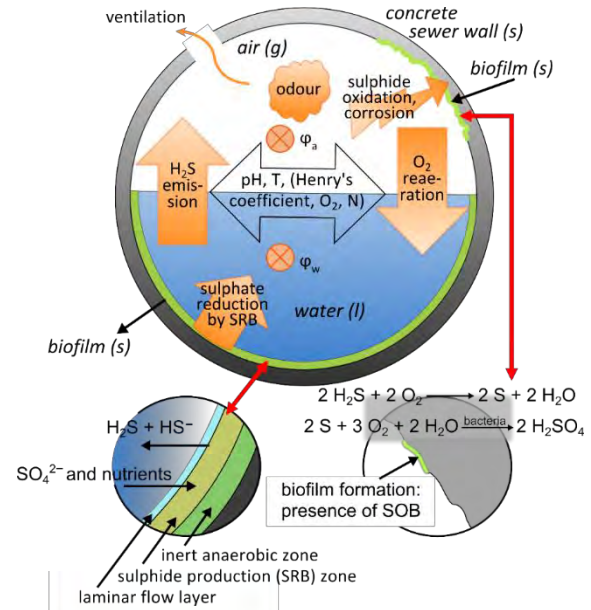
Berliner Wasserbetriebe



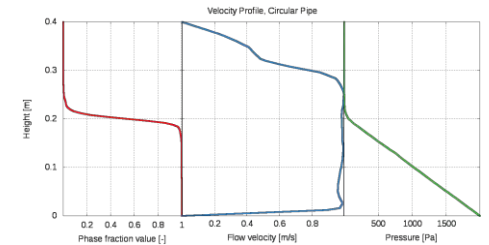
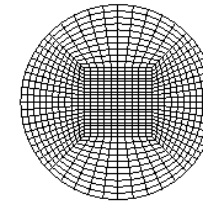
experiments in pilot plant



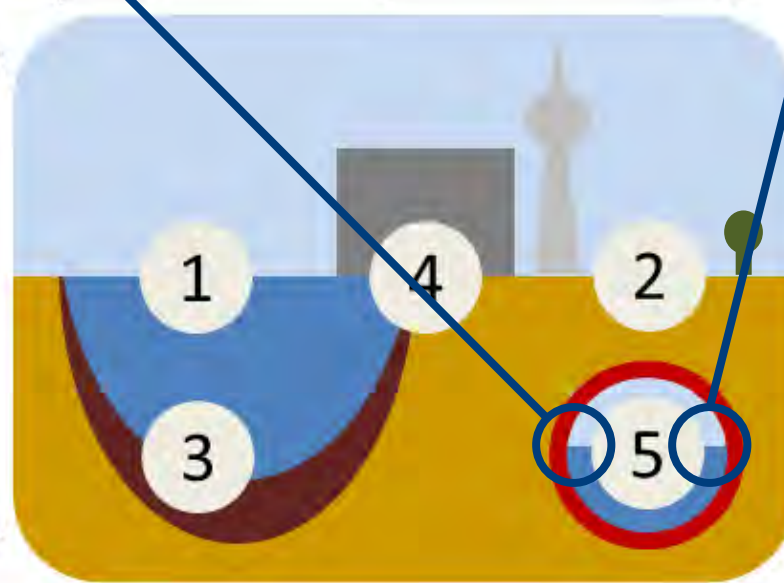
experiments in laboratories



## Three-phase simulation model for odour and corrosion (S2)



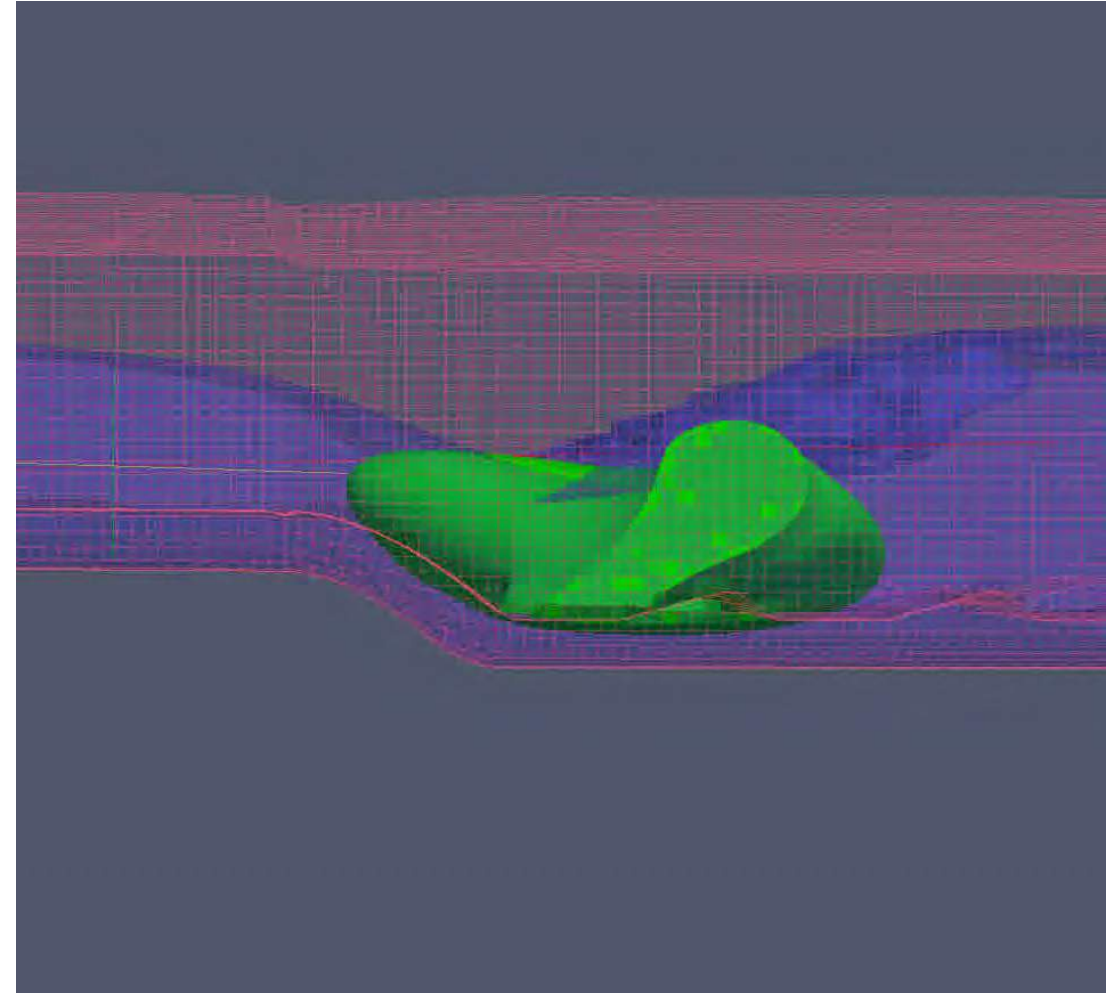
model results of OpenFOAM



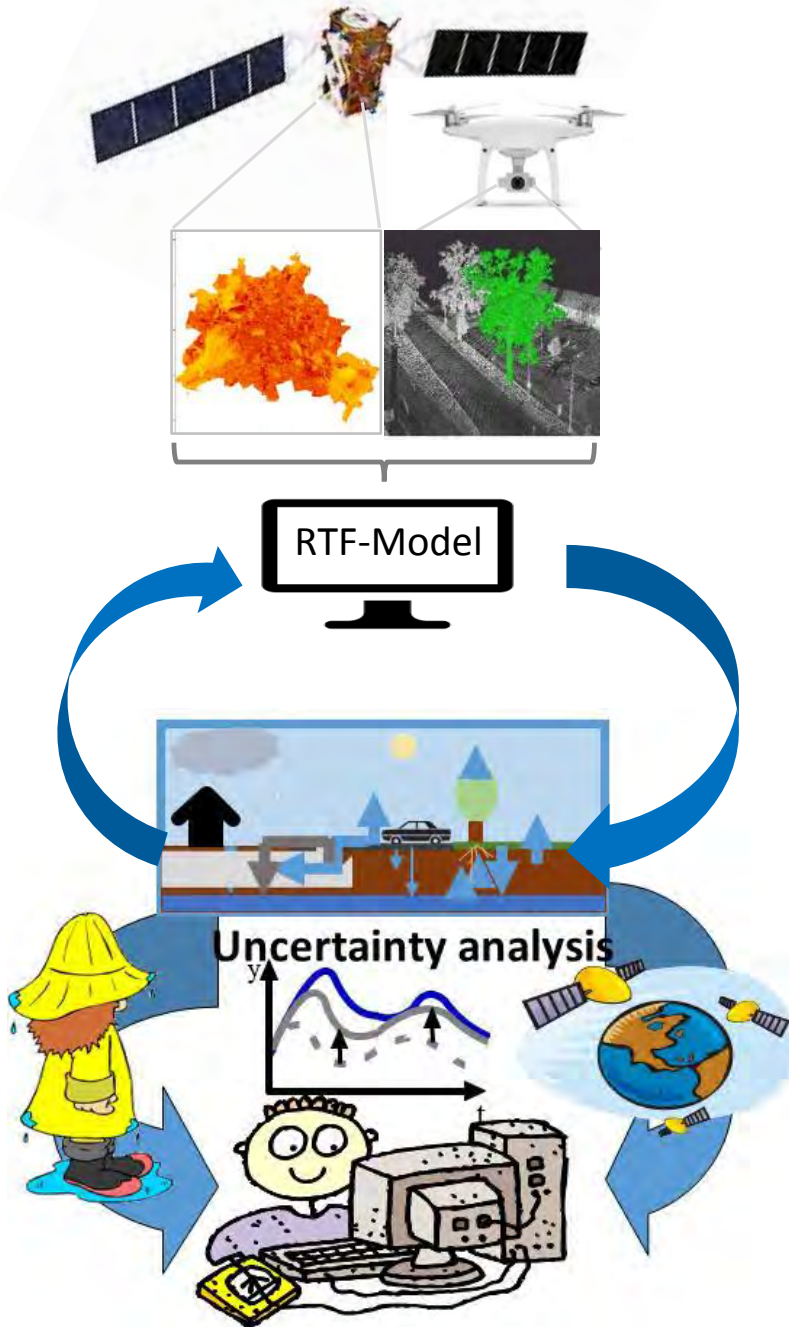


# Common topic: Interfaces in sewer systems

- **Highlight:** First 3D model describing  $H_2S$  mass transfer across **water-air interface** was developed and tested under highly turbulent conditions, enabling, for instance, improved design of stirring tank ( $H_2S$  hotspots; T3).
- **Further research:** Turbulent flow reactor at large-scale BWB pilot plant: experiments and modelling; **interfaces with solids** (concrete) and **biofilms**



# Postdocs



- Postdoc A: **Remote sensing in urban hydrology**
- Postdoc B: **Integrated ecohydrological modelling across scales**
- **Career advancement:** support in proposal writing for
  - ERC Starting Grant
  - Marie Curie Individual Fellowship
  - BMBF Junior Research Group
- Supervisors: Prof. Birgit Kleinschmit, Prof. Doerthe Tetzlaff
- Additional support from TUB and IGB (6 months each)

# UWI has become a nucleus

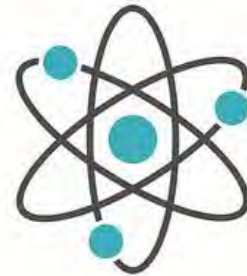
**Prof. Mohammad Zouneman-Kermani:**  
Prediction of odour and corrosion in sewer systems using data-driven methods  
**Georg Foster Research Fellowship for Experienced Researchers**



**Dr. Basem Aljoumani:**  
Water, heat and contaminant transport in urban soils  
**Associated research project**



**Prof. Chris Soulsby:**  
MOSAIC – Modelling surface water and groundwater isotopes in urban catchments  
**Einstein Visiting Fellowship**



**Prof. Andrea Cominola:**  
W1 Junior Professor at TUB for **Smart Water Networks**  
Einstein Center Digital Future



**Adrian Augustyniak:**  
Biofilms in building materials  
**Postdoc Scholarship** from TU funds and **AIF-IGF project**





# Urban Water Interfaces (UWI)



## First International Conference on Urban Water Interfaces (UWI)

22 – 24 September 2020, Berlin

A joint initiative of



Funded by



### Motivation

Interfaces in urban water systems play a key role in the urban water cycle but are still understudied. They connect a large number of compartments and subsystems and notably affect the overall system behaviour. The processes and fluxes of interfaces are highly complex due to, for example, steep physical and biogeochemical gradients, high numbers of microorganisms and reaction rates, non-linear behaviour and feedback effects as well as heterogeneous and dynamic structures. Considerable knowledge gaps still exist - urgently requiring novel interdisciplinary collaboration of engineers and natural scientists. Under this collaborative perspective, we want to develop a new understanding and thinking on future urban water management being faced by multiple stressors such as climate and demographic change, ongoing urbanization and continuous growth of contaminations as well as multiple uses.

### Why you should attend

- We **highlight progress** which have been achieved within the DFG Research Training Group 'Urban Water Interfaces'.
- We aim to **provide a platform** for presenting **state of the art insights** and **novel findings** from an international interdisciplinary community.
- We are **encouraging** contributions from the **international scientific community**, but also **representatives** from water engineering practice and administration.
- We **invite** you to **attend** and **present** at the conference, which will take place in the very exciting and lively city of **Berlin, Germany**.

### Keynote speakers

Prof. Alan Blumberg  
Stevens Institute of Technology  
Hoboken, New Jersey, USA  
Urban oceanography, floods



Prof. Hayley Fowler  
School of Engineering  
Newcastle University, UK  
Climate change impacts on water resources



Dr. Emma J. Rosi  
Cary Institute of Ecosystem Studies  
Millbrook, New York, USA  
Human impacts on freshwaters



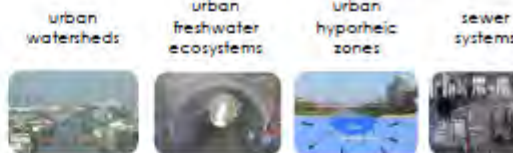
Prof. Daniele Tonina  
Center for Ecohydraulic Research  
University of Idaho, Boise, USA  
Hyporheic exchange, greenhouse gases



Prof. Jes Vollertsen  
Department of Civil Engineering  
Aalborg University, Denmark  
Water treatment, drinking water



### Conference topics are: Interfaces in



### Important dates

- Abstract submission deadline: 1<sup>st</sup> April 2020
- Information about acceptance: 1<sup>st</sup> May 2020

### Registration

- No conference fees!
- Registration includes: coffee and lunch breaks, a conference dinner, digital conference material
- You can apply for 1 of our 5 **student travel grants** when submitting your abstract

Details on abstract submission and registration can be found on the conference webpage:

[http://www.vet.u-berlin.de/traq/news\\_and\\_events/international\\_uwi\\_conference/](http://www.vet.u-berlin.de/traq/news_and_events/international_uwi_conference/)

### Location

Berlin, TSB Conference Center,  
Helmholtzstraße 2-9, Aufgang/Entrance A, 1.OG,  
10587 Berlin, Germany (close to TU Berlin main campus)

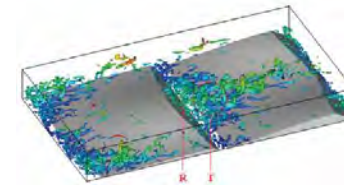
### Organising committee

Prof. Reinhard Hinkelmann, TU Berlin  
Prof. Birgit Kleinschmit, TU Berlin  
Dr. Gwendolin Porst, TU Berlin  
Nasrin Haacke, TU Berlin  
Micaela Pacheco, TU Berlin

# Qualification programme: courses

## Three newly developed core courses (9 ECTS):

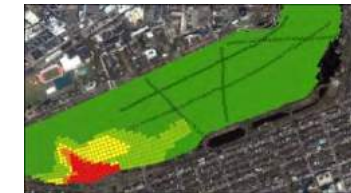
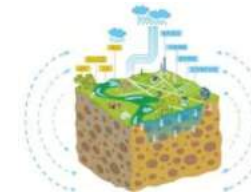
- Urban interface processes – fluxes, transport, interaction



- Urban freshwater ecology



- Modelling and measuring concepts of interface processes

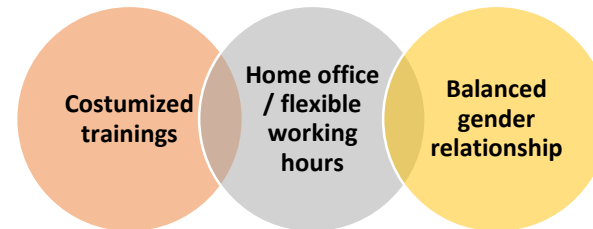
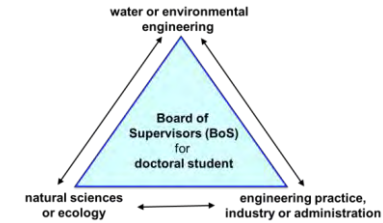


## Elective courses (min. 9 ECTS):

- broadening basis
- specific research areas
- professional skills

# Qualification programme

- Summer schools, internships and visiting researchers
- Board of Supervisors
- Student Research Council
- Gender concept
- Fast track



# Summary statistics January 2020

	13 doctoral students (DFG)	9 kollegiates
Doctoral theses finished	8	1
Published or accepted journal articles	32	23
Conference contributions	76	57

1<sup>st</sup> cohort:

Average duration of eight doctoral theses until submission / completion: **3 years 4 months / 8 months**

**Parental leaves:** 4 females, 2 males; 8 children

Average delay / doctoral student (parental leave, sick leave, later start): 6 months / doctoral

# Organisational structure





# Selected events and activities of funding period 2015-2019



**UWI Summer School**  
18.-19.9.2019  
Kremmen,  
Germany



**Sixth German-Russian Week of the Young Researcher**  
“Urban Studies: The City of the Future”  
Moscow State University of Civil Engineering  
National Research University  
12.-16.9.2016  
Moscow, Russia



**UWI at AGU Fall Meeting**  
12.-16.12.2016  
San Francisco, CA, USA



**UWI Student Research Council**  
20.-21.8.2019,  
Buberow,  
Germany



**UWI at Wasser Berlin International**  
28.-31.3.2017, Berlin



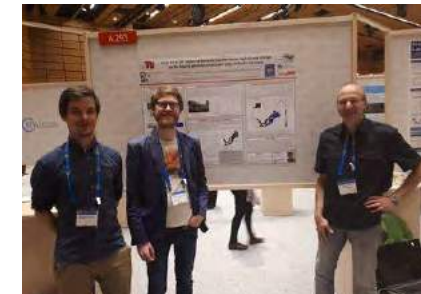
Extreme Wetterschwankungen Säure nagt an Berlins Kanälen



Katharina Teuber kam 2008 aus Niedersachsen zum Studium nach Berlin, machte an der Technischen Universität (TU) ihren Master in Bauingenieurwesen, arbeitete danach ein halbes Jahr in einem Ingenieurbüro, das sich mit Kanalsanierung befasst. Seit 2015 forscht sie an der TU im Rahmen des Graduiertenkollegs „Urban Water Interfaces“ der Deutschen Forschungsgemeinschaft (DFG) an einem Simulationsmodell, das dazu beitragen soll, eines der größten Probleme des Berliner Kanalsystems in den Griff zu bekommen.

Der Grund dafür ist Schwefelwasserstoff, der sich in den Kanälen bildet. Dieser ist zum Teil bereits im Abwasser vorhanden. Vor allem aber entsteht er im Biofilm und den Sedimenten des Abwasserkanals, erklärt Daneish Despot vom Fachgebiet Siedlungswasserwirtschaft der TU Berlin, der an der Kanalforschungsanlage der Berliner Wasserbetriebe in Neukölln arbeitet. „Je langsamer die Fließgeschwindigkeit, desto mehr Schwefelwasserstoff kann sich bilden“, sagt Daneish Despot, der ebenfalls im Fachgebiet Siedlungswasserwirtschaft an der TU Berlin forscht.

**UWI doctoral students in the newspaper**  
20.7.2017, Berlin



**UWI at EGU General Assembly**  
8.-13.4.2018  
Vienna, Austria



**UWI common topics brochure**  
2017



**UWI Welcoming Workshop**  
5.7.2018, Berlin

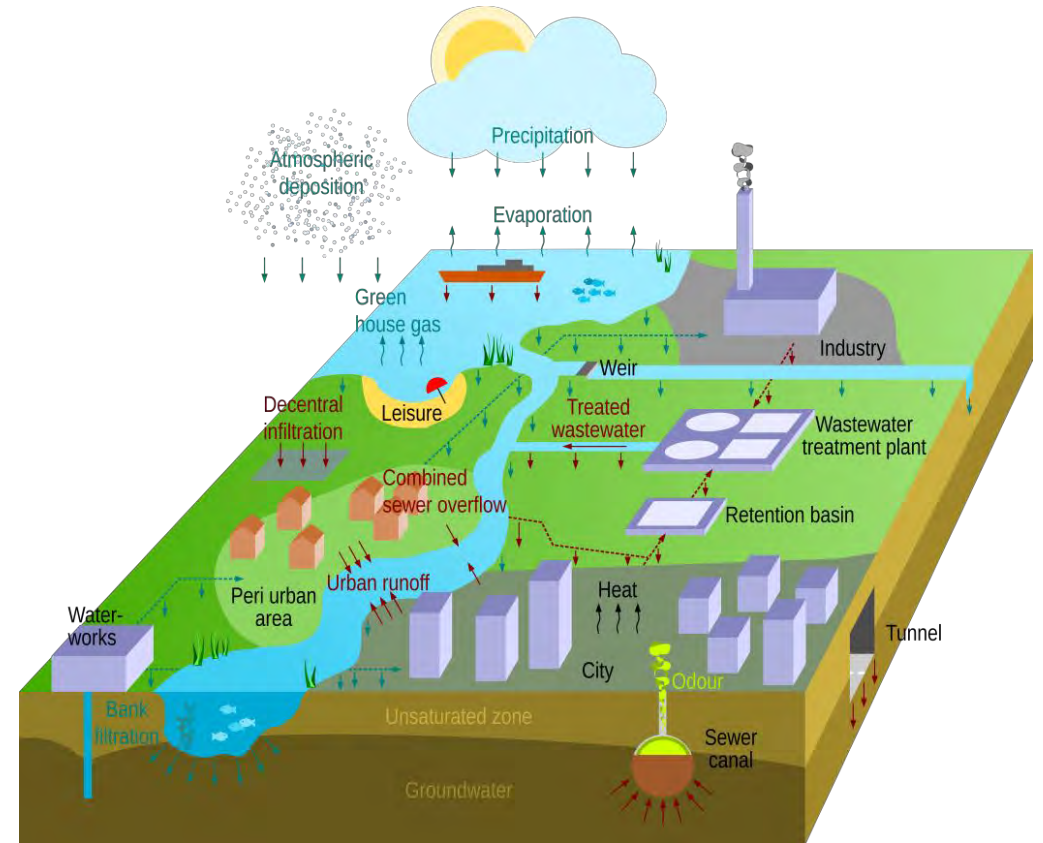
# UWI supervisors and associated researchers, 1<sup>st</sup> & 2<sup>nd</sup> cohort



# DFG Research Training Group (RTG 2032/2) Urban Water Interfaces (UWI)

END

A joint initiative of  
Technische Universität Berlin (TUB) and  
Leibniz-Institute of Freshwater Ecology  
and Inland Fisheries (IGB), Berlin



[www.uwi.tu-berlin.de](http://www.uwi.tu-berlin.de)