

Chemical characterization of urban waters aimed for managed aquifer recharge in the Hesbaye chalk aquifer (Liège, Belgium)

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[Robin Glaude](#)¹, [Nataline Simon](#)¹, [Philippe Urban](#)¹, [Serge Brouyère](#)¹

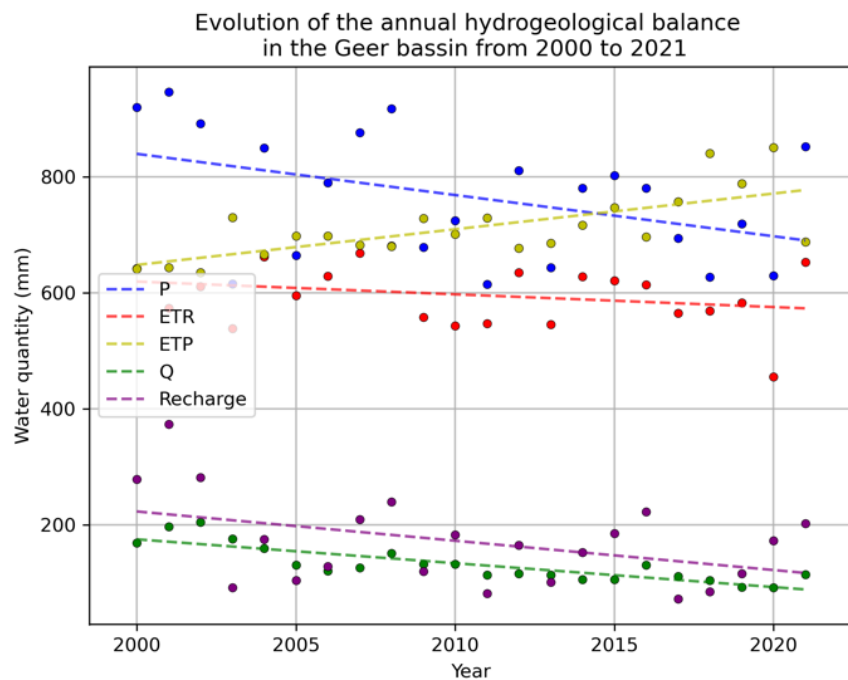
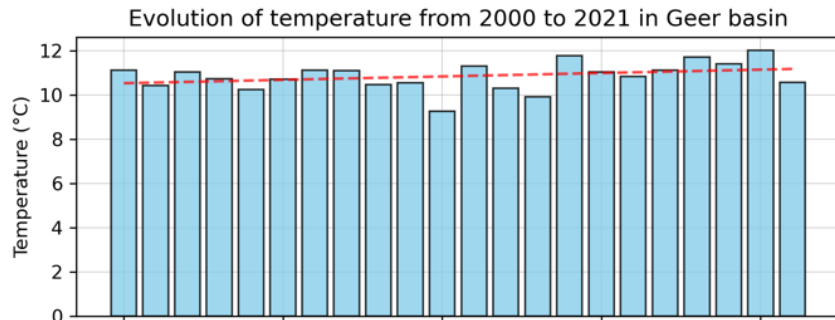
¹ Hydrogeology & Environmental Geology, Urban & Environmental Engineering, University of Liège, Belgium

* Corresponding author (e-mail: Robin.Glaude@uliege.be)

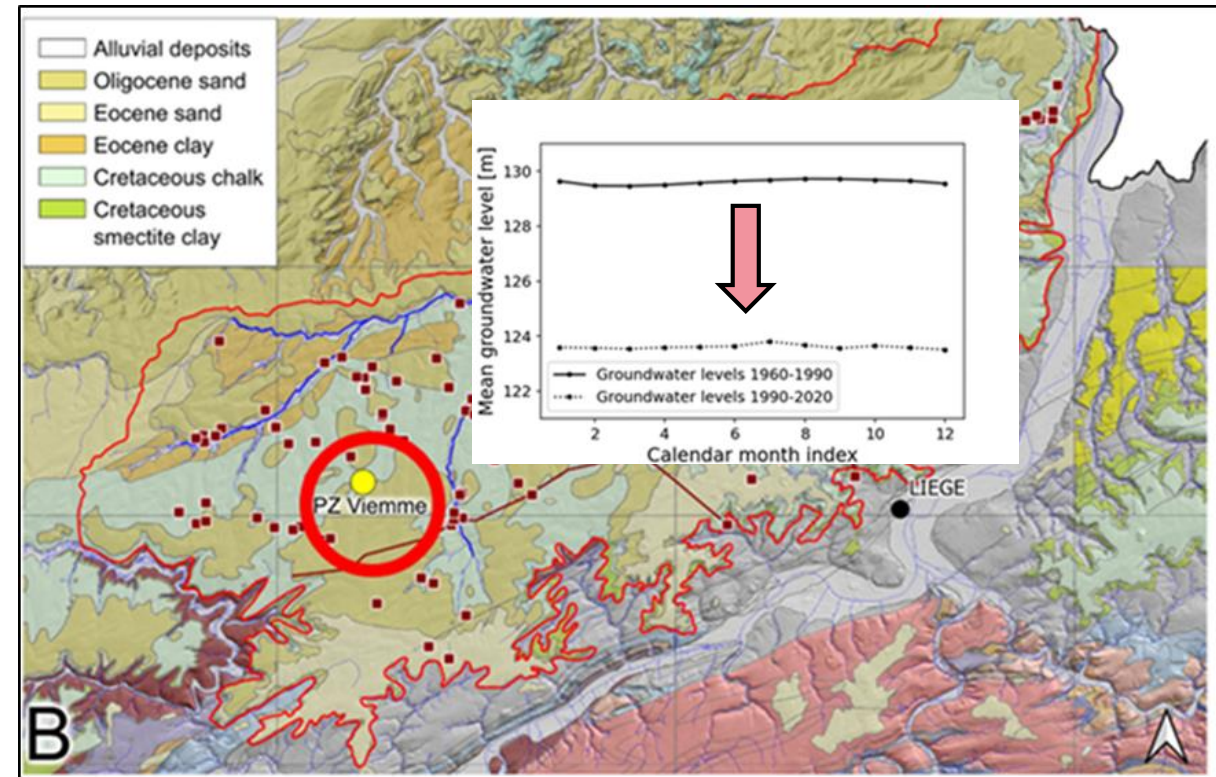
Wednesday, 26th April 2023

General background

Significant decrease of the recharge in the Geer hydrological basin



Mitigation measure



Goderniaux et al, 2021

Orban et al, 2014

Managed Aquifer Recharge (MAR)

Objective

Potential source of recharge water in the Geer basin

Runoff water airport area → Contaminants of emerging concerns (CECs) ?

State of art:

- CECs studied for few years → especially in airport stormwater
- Few MAR studies in airport areas

Objectives:

- I. Identify **CECs in airport stormwater**
- II. Investigate any **temporal/seasonal pattern**



Raimond Spekking

Methodology

What?

Runoff water from stormwater basins

When?

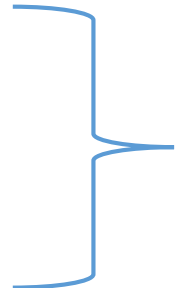
Spring 2022 and winter 2023

Why?

Chemical characterization to evaluate their suitability for MAR

Where?

Liège airport
Traffic roads



How?

Grab samples
4 sampling points



Which parameters?

Classicals: Metals, PAH/PCB, VOC, cyanides, nutrients
CECs: alkylphenols, PFAS, benzotriazoles, OPFRs

Which approach?

Suspect-screening approach → PMT contaminants (persistent, mobile and toxic)

Traffic roads basins

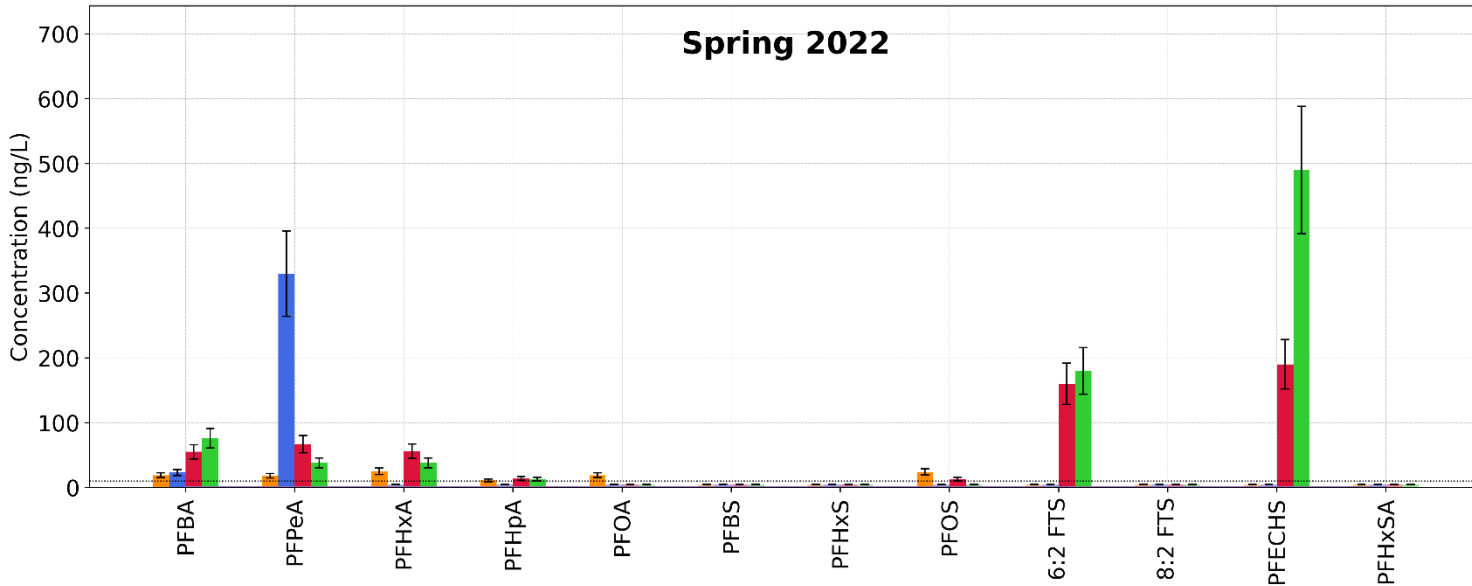
- Burettes 
- Gilon 

Airport basins

- Sud 
- Carlens 

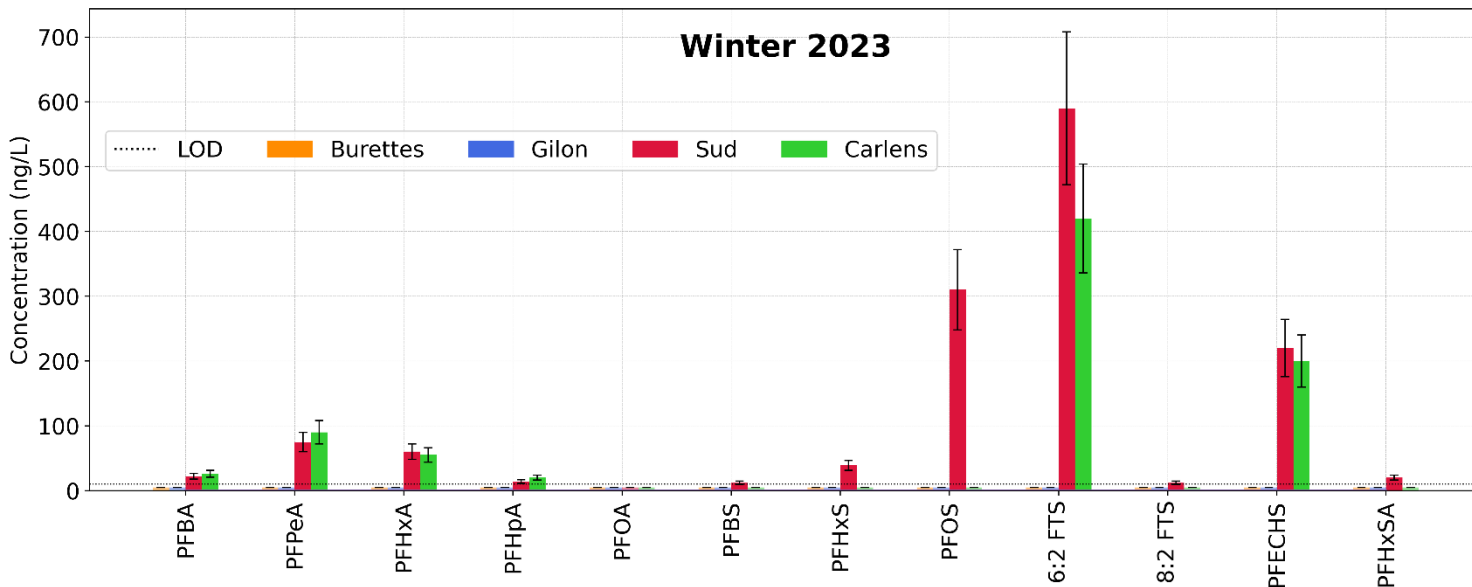


Results [1] : PFAS



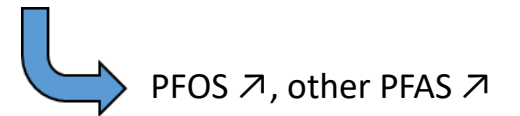
Assumed origin:

1. Firefighting foam additive → 6:2 FTS
2. Corrosion inhibitor in aircraft hydraulic fluid → PFECHS
3. Surfactants in deicing products → PFOS
4. Degradation products of long chains PFAS → PFPeA, PFHxA, PFBA



Seasonal pattern?

Winter → cold season → deicing operations



Quality standard?

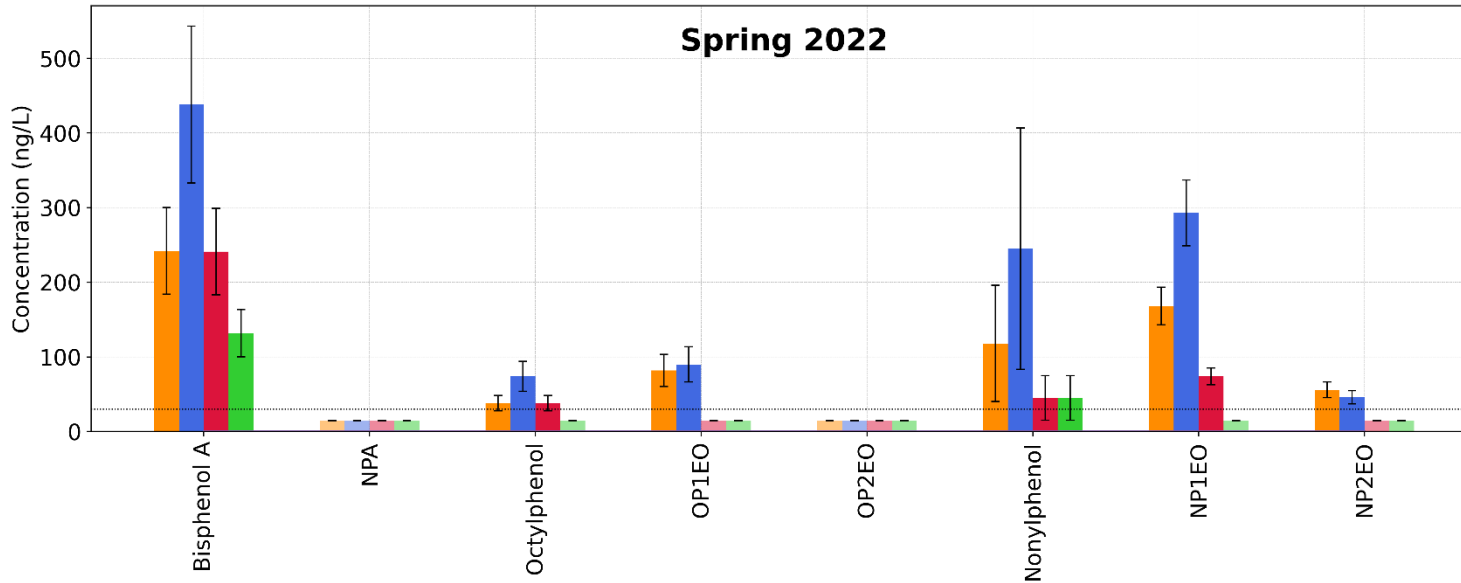
WHO recommendation for PFOS and PFOA only: 100 ng/L

Drinking water directive for sum of 20 PFAS: 100 ng/L



exceeded

Results [2]: alkylphenols



Assumed origin:

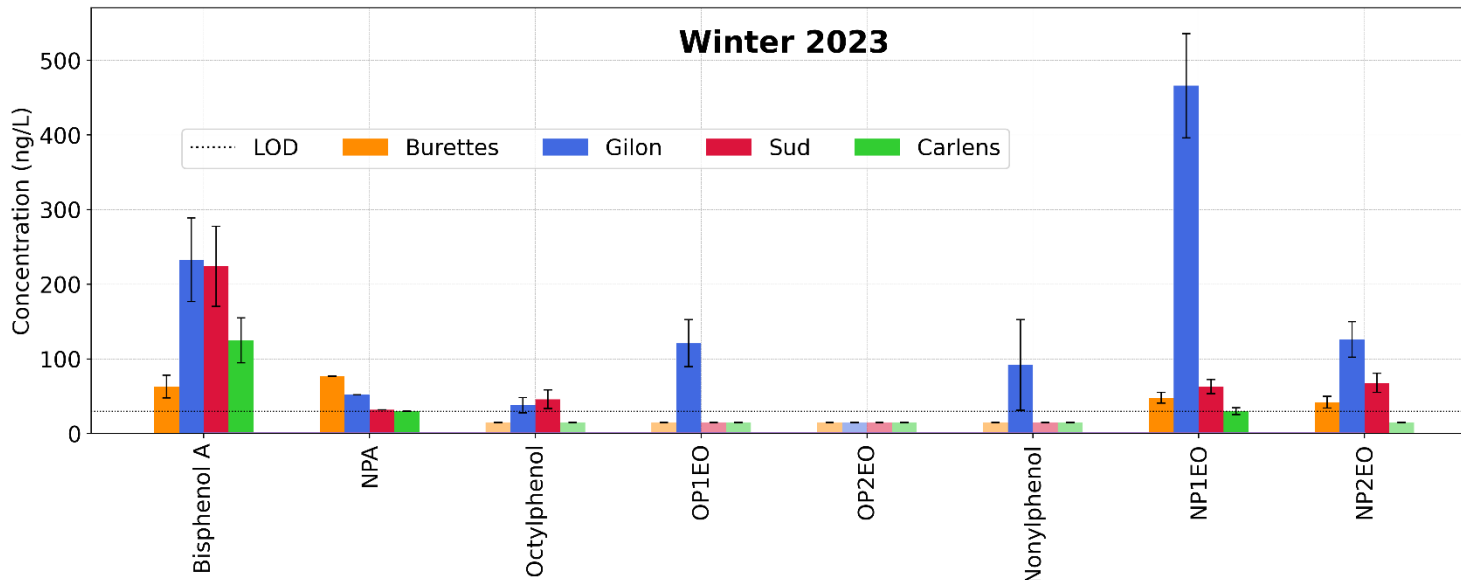
Crisnée municipality: domestic wastewater
 → Personal care products, cleaning agents, etc...

Airport: surfactants
 → Aircraft cleaning, maintenance and repair activities, deicing operations, etc...

Seasonal pattern?

Surprisingly, lower concentration in winter for most alkylphenols

Some identified exceptions such as OP1EO, NP1EO



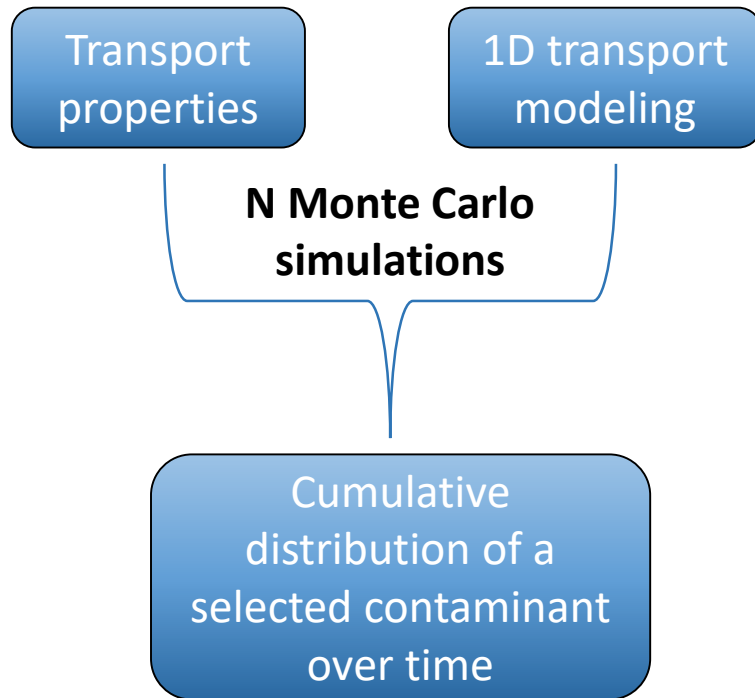
Quality standard?

EQS water Directive

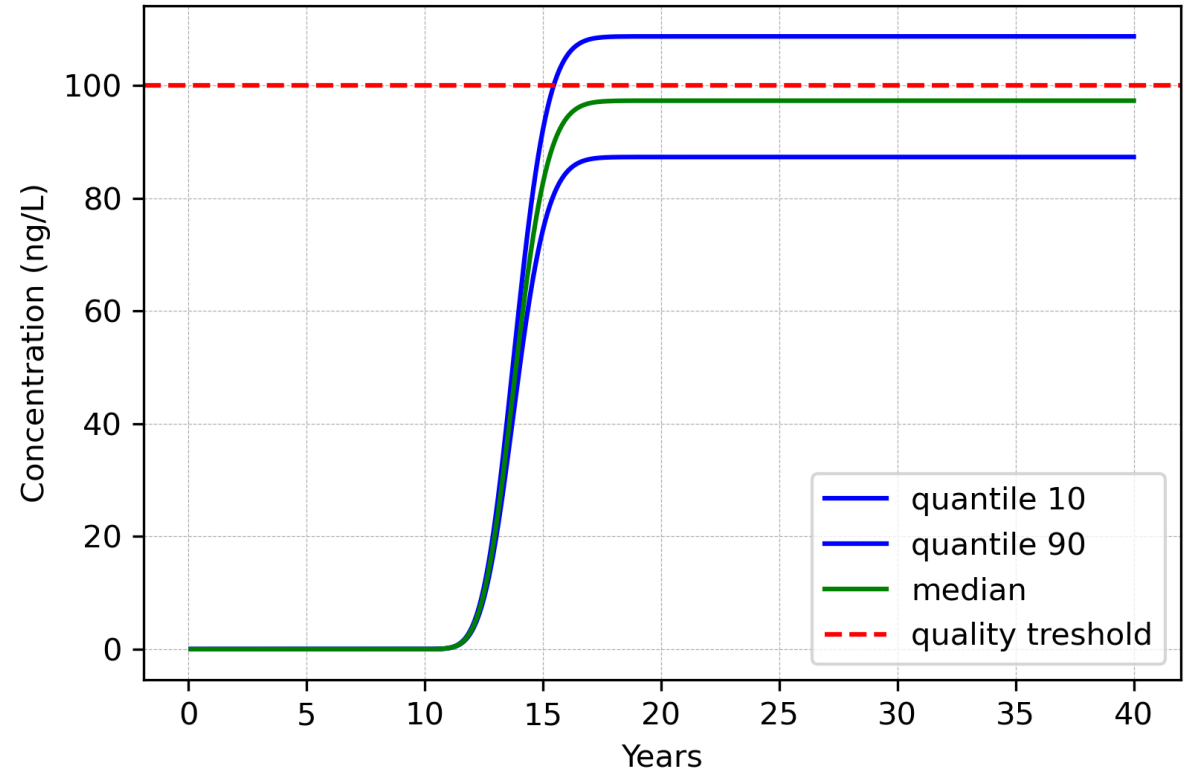


BPA: 1600 ng/L	Not exceeded
OP: 100 ng/L	Exceeded for 1 basin in winter
NP: 300 ng/L	Exceeded for 1 basin in winter and spring

On-Going work



Cumulative distribution curve of PFOS concentration



Example: PFOS with 100 Monte Carlo simulation considering degradation process

$$\text{Risk of groundwater deterioration} = \frac{\text{Number of simulations with } C \text{ above the quality guideline}}{\text{Total number of simulations}} = 37.33 \%$$

Conclusion and perspectives

Take-home message:

- Urban stormwater requires pre-treatment for MAR purposes
- Stormwater quality changes over time, need regular monitoring
- Huge influence of specific airport operation on runoff water quality → deicing, firefighting tests, etc...
- Need more regulations regarding CECs quality guidelines

Perspectives:

- Quantification of the recharge in the study area
- Laboratory column tests to evaluate transport parameters of selected CECs

purpose

Improve modeling for future risk assessment tools

Infiltration test in the Geer basin



Thank you !

Abstract



Contact: Robin.Glaude@uliege.be

Supplementary slides

General background

« Prevent the unmanageable, manage the inevitable. »

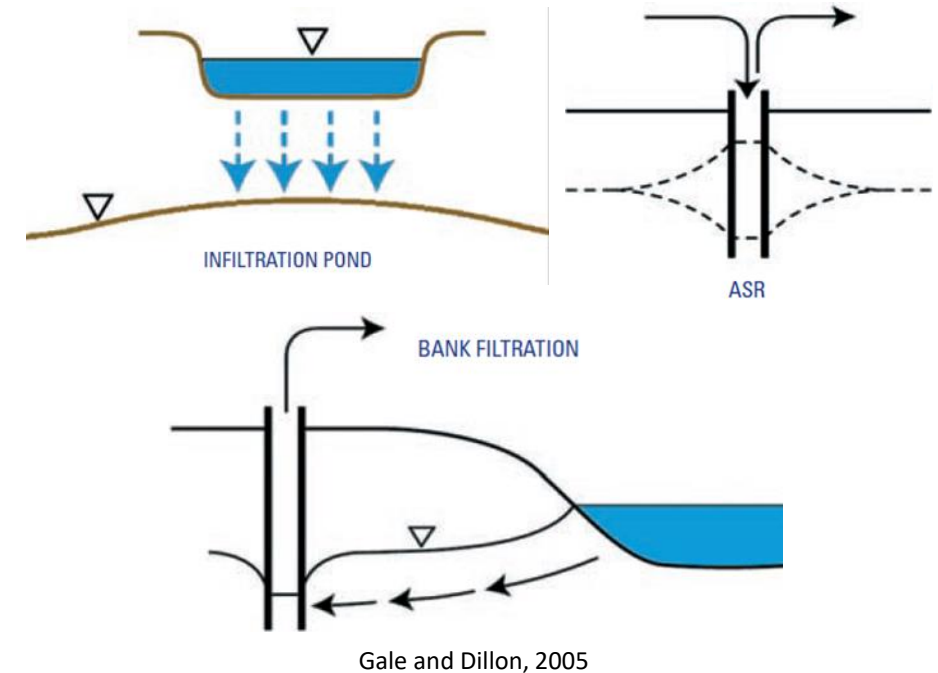
↳ Managed aquifer recharge (**MAR**) is defined as the intentional replenishment of groundwater resources for subsequent recovery or environmental benefits

Sources of water in urban areas

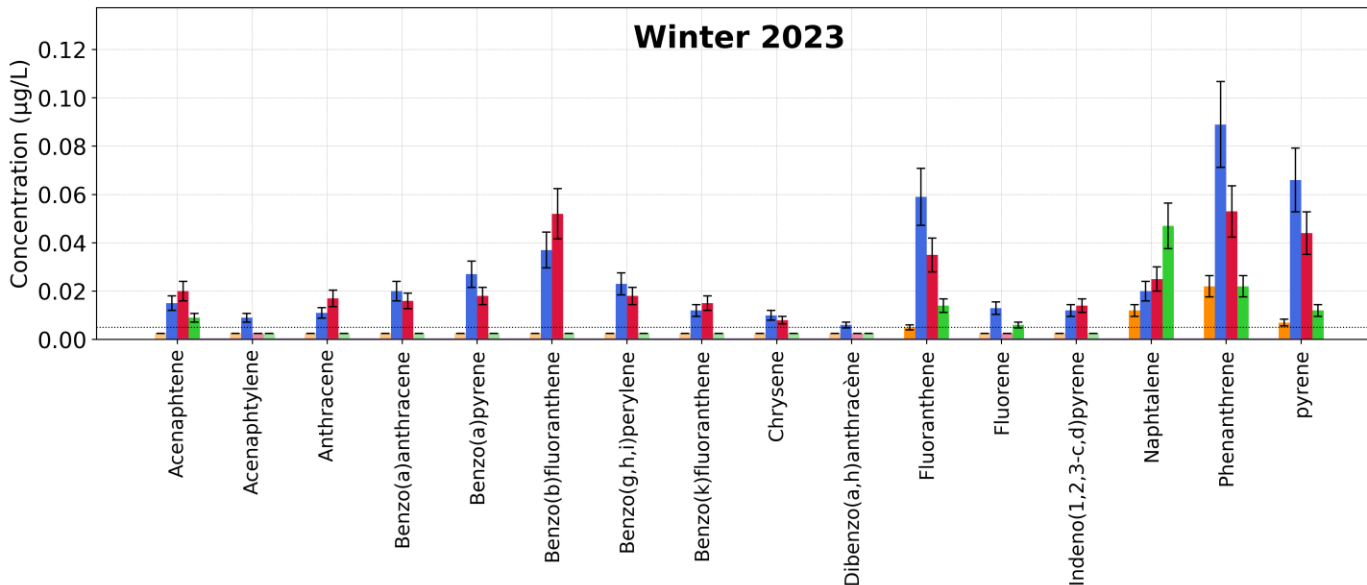
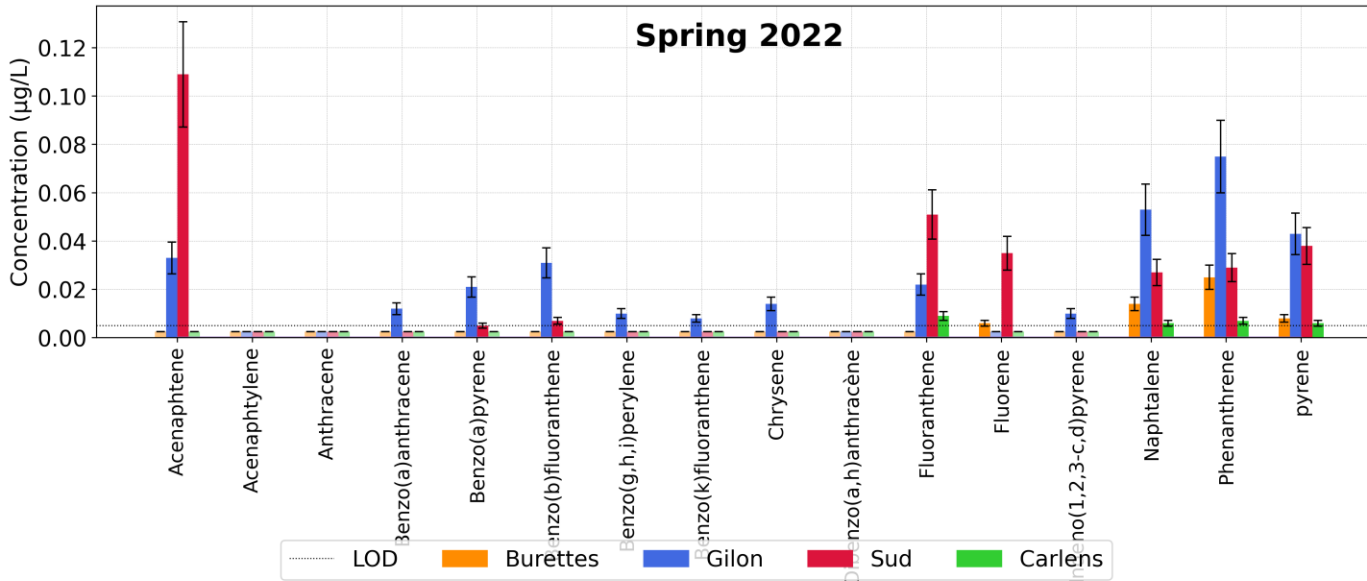
➔ Stormwater, treated wastewater, etc...

Potential
contaminants

- **Classical:** PAHs, heavy metals, etc...
- **Of emerging concern (CECs):** pharmaceuticals, alkylphenols, PCBs, PFAs, flame retardants (OPFRs), etc...



Results: PAH and other contaminants



Other contaminants:

- Benzotriazoles: corrosion inhibitors in deicing products



Benzotriazole: 390 – 1400 ng/L
 4-MeBT: not detected
 5-MeBT: 360 – 440 ng/L

- PCBs and pesticides: not detected
- Total cyanides: 1.9 – 2.7 µg/L in spring
 1.8 – 9.2 µg/L in winter

Modeling

