IWAS
Brazil
ÁGUA-DF

TECHNISCHE UNIVERSITÄT DRESDEN

Water Quality of Lake Paranoá: Emerging Pollutants

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1 Introduction

The main objective of the subproject „Water Quality“ consisted in the characterization of the **water quality** with respect to a future use of Lake Paranoá water for **drinking water supply**.

The significance of the study results in particular from the specific conditions of this urban lake located within the city of Brasilia.

Brasilia and the Federal District are characterized by:

- High population density
- Increasing population
- Limited water resources

The **Lake Paranoá** is the **receiving water body** for two municipal wastewater treatment plants.

1 Introduction

Source: CAESB

Source: CAESB

Possible location of future raw water extraction

2 Screening Strategy

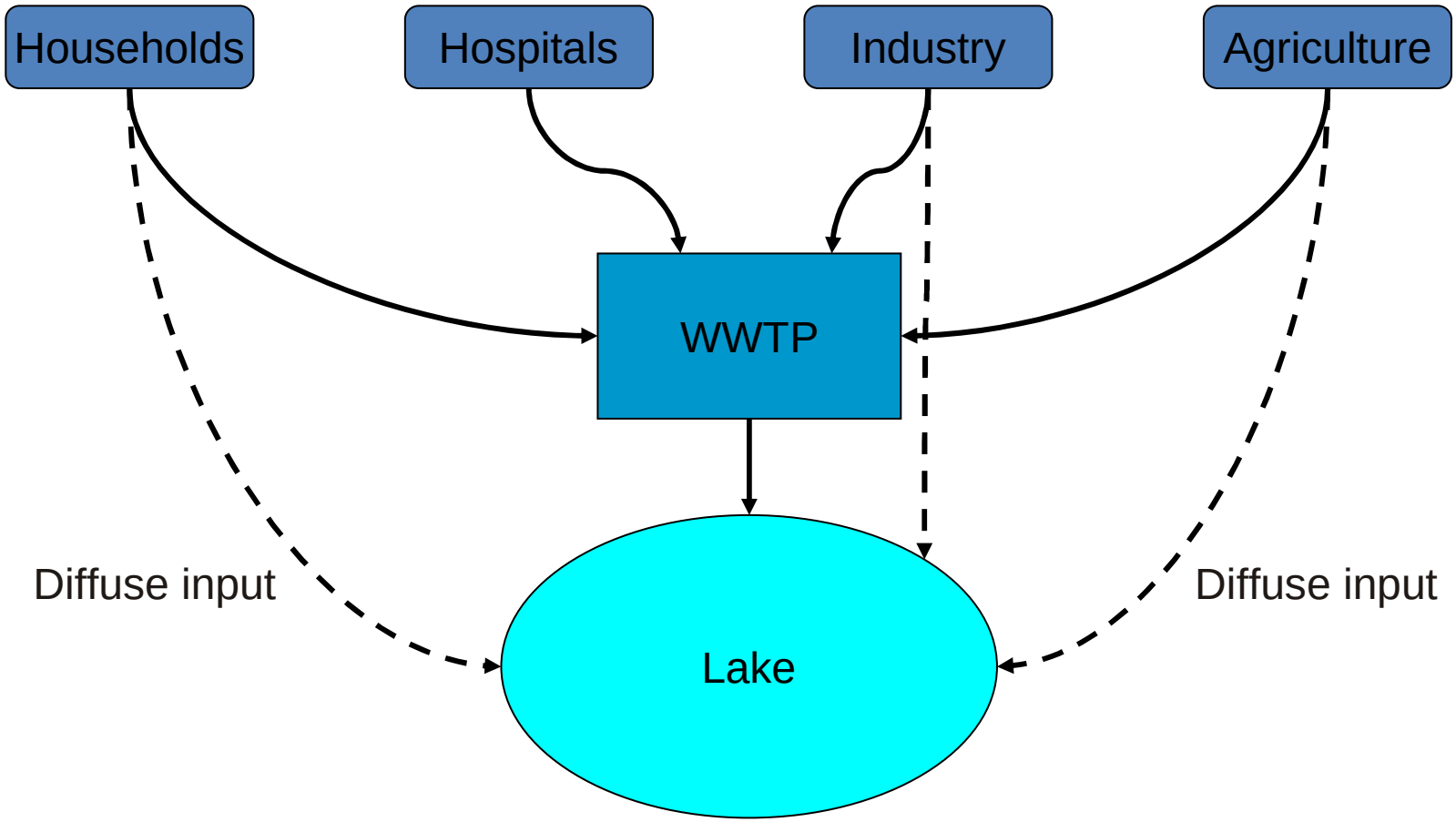
Before starting the experimental work two questions had to be answered:

- Which **sampling points** should be chosen?
- Which **compounds** can we expect?

The sampling points were selected with help of CAESB.

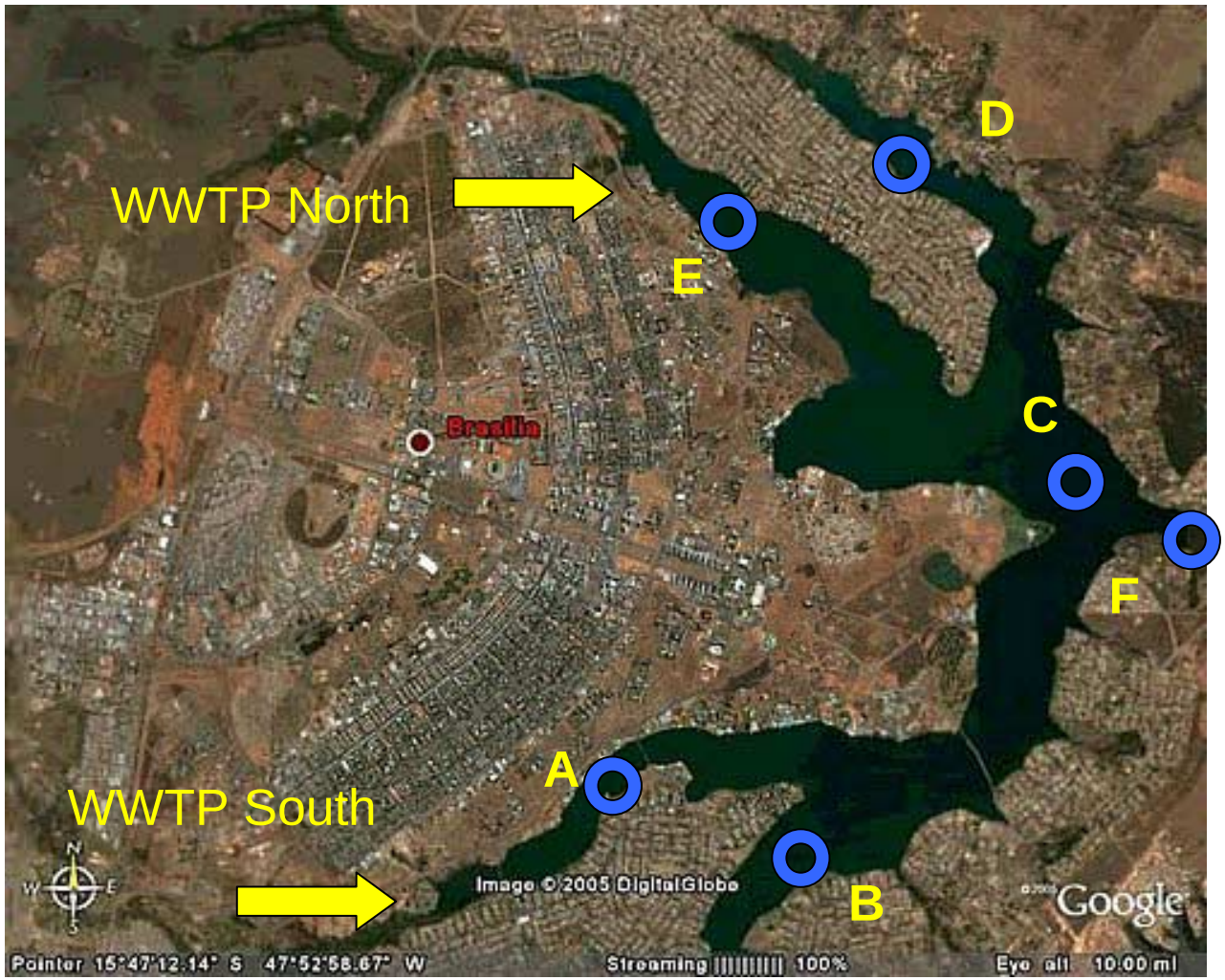
The compounds were selected on the basis of experience from Europe and North America (compounds typical for wastewater-influenced surface waters)

2 Screening Strategy



2 Screening Strategy

Sampling points



Classical Micropollutants	vs.	Emerging Pollutants
e.g. pesticides, PAHs, halogenated compounds		e.g. pharmaceuticals and personal care products
Well known for long time (30 – 40 years)	**Knowledge - occurrence?**	Known for 10 – 15 years (analytical limitations in the past)
Often from industry, agriculture, contaminated sites	**Origin?**	Different sources (WWTPs, polar degradation products)
Mostly non-polar / lipophilic, high accumulation potential; partly volatile	**Characteristics?**	Mostly polar/hydrophilic, often with acidic/basic functional groups, low concentrations
Conventional enrichment (headspace, SPE, LLE) and analysis (LC/RP, GC)	**Determination?**	Modern MS-techniques (LC) or derivatization (GC)
Extensively investigated	**Knowledge - fate/effects?**	Up to now - relatively poor

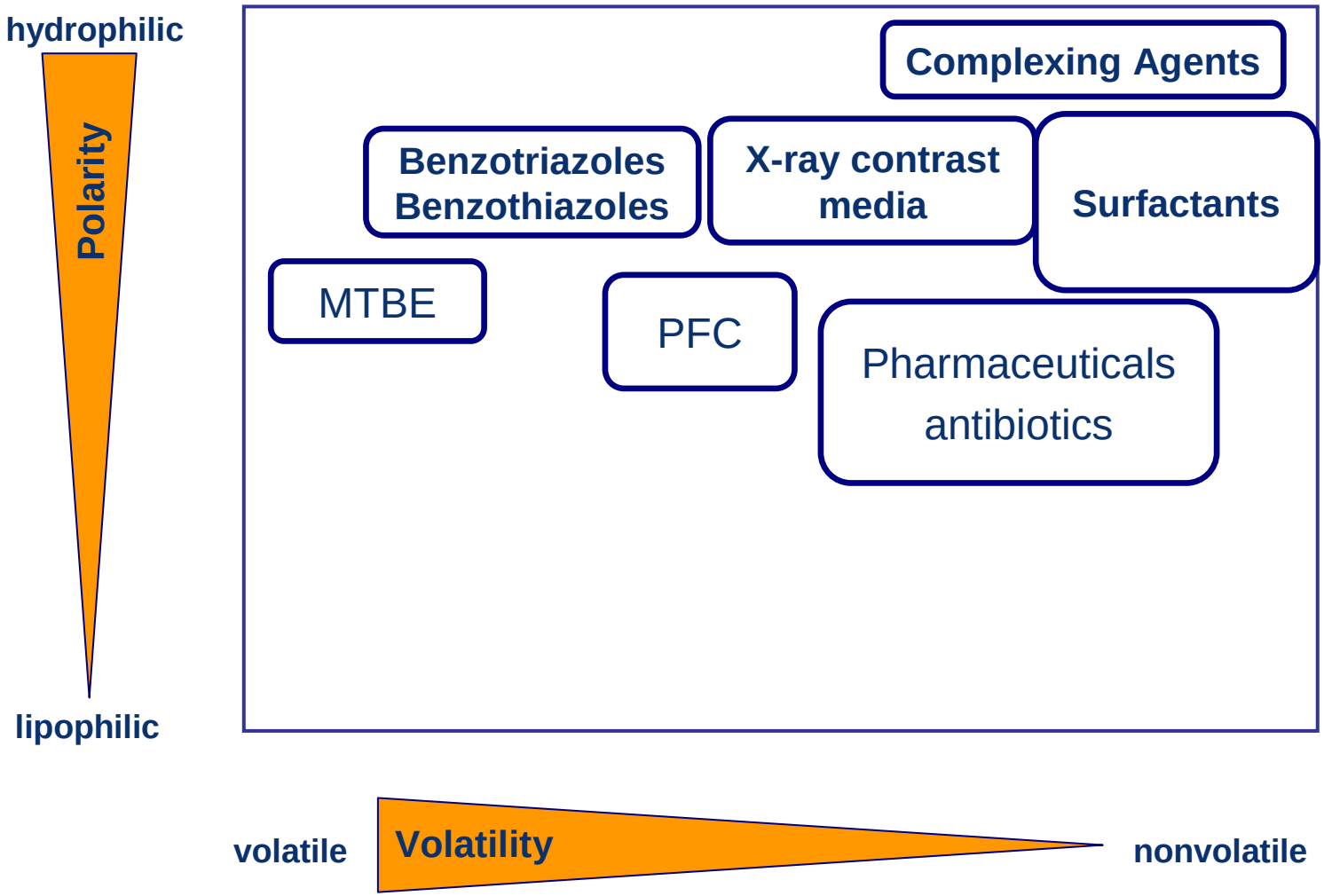
2 Screening Strategy

- 92 different substances (typical for surface waters influenced by wastewater effluents)
- Sampling supported by CAESB and UnB
- Analyses: carried out by TU Dresden & KIT
- Analytical methods: GC/MS and LC/MS-MS

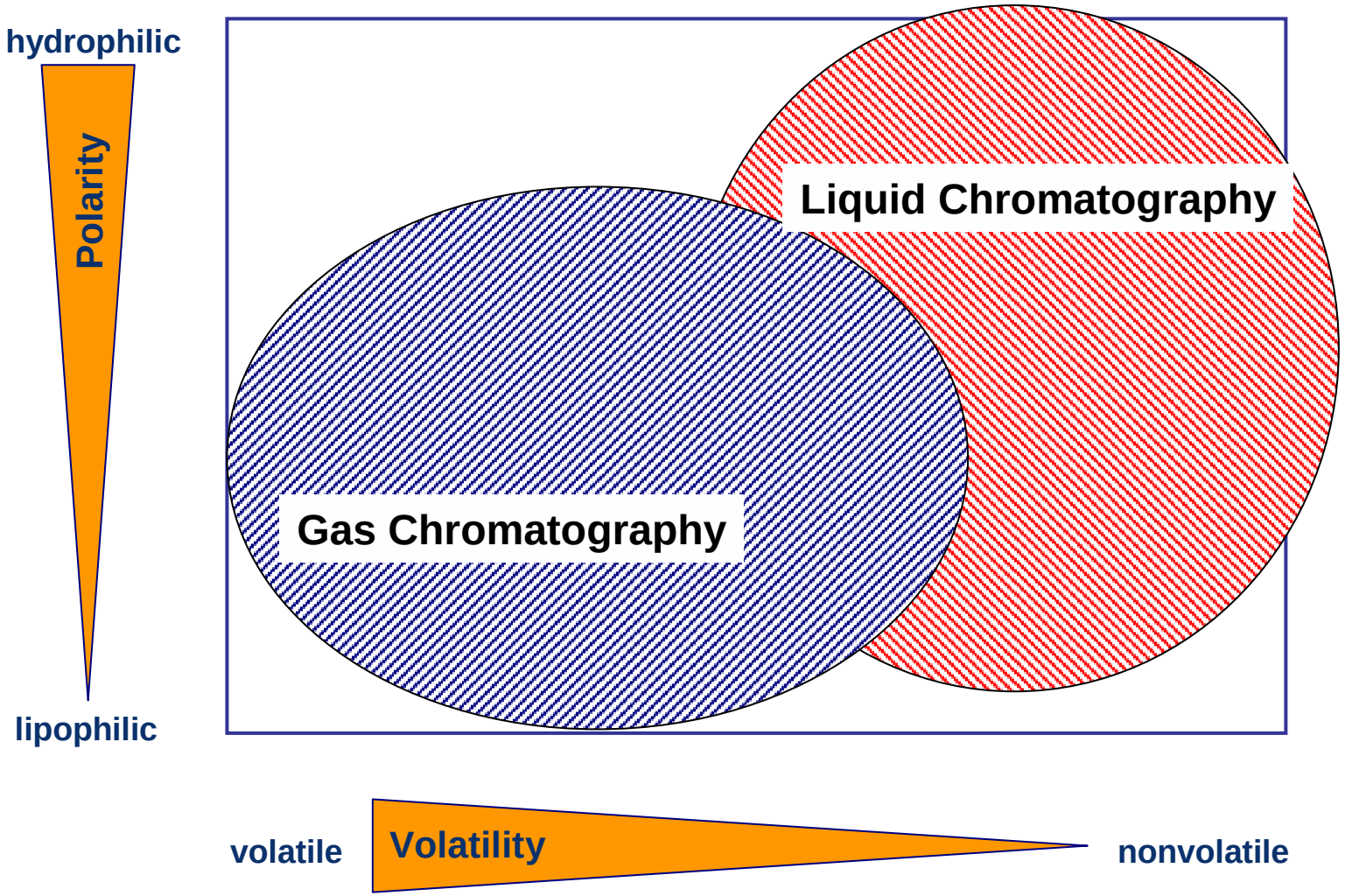
Substance classes

- Pharmaceuticals (33)
- X-ray contrast media (9)
- Algae toxines (4)
- Sweeteners (5)
- Pesticides (17)
- Perfluorinated tensides (2)
- Wastewater tracers (7)
- Corrosion inhibitors (2)
- Plasticisers (5)
- Personal care products (8)

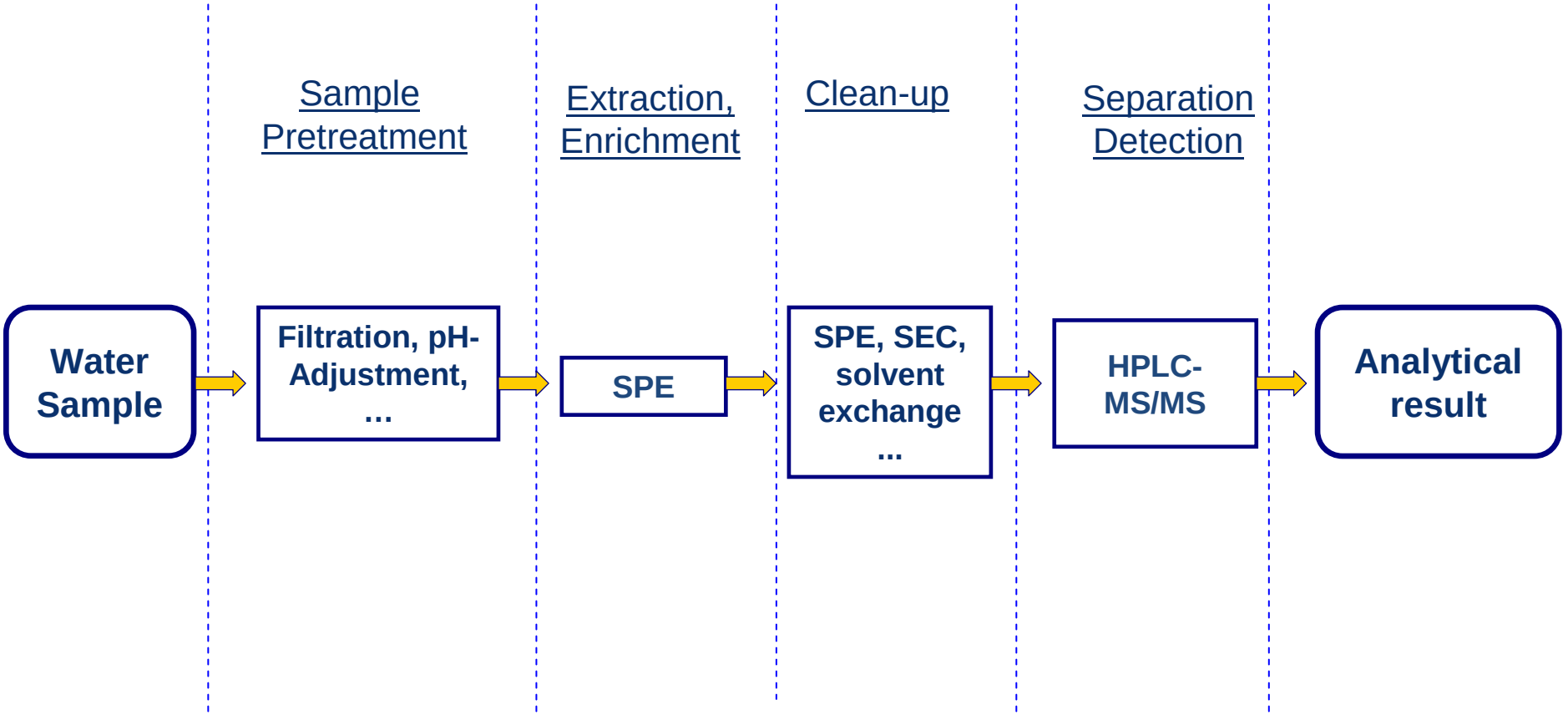
3 Analytical Method



3 Analytical Method



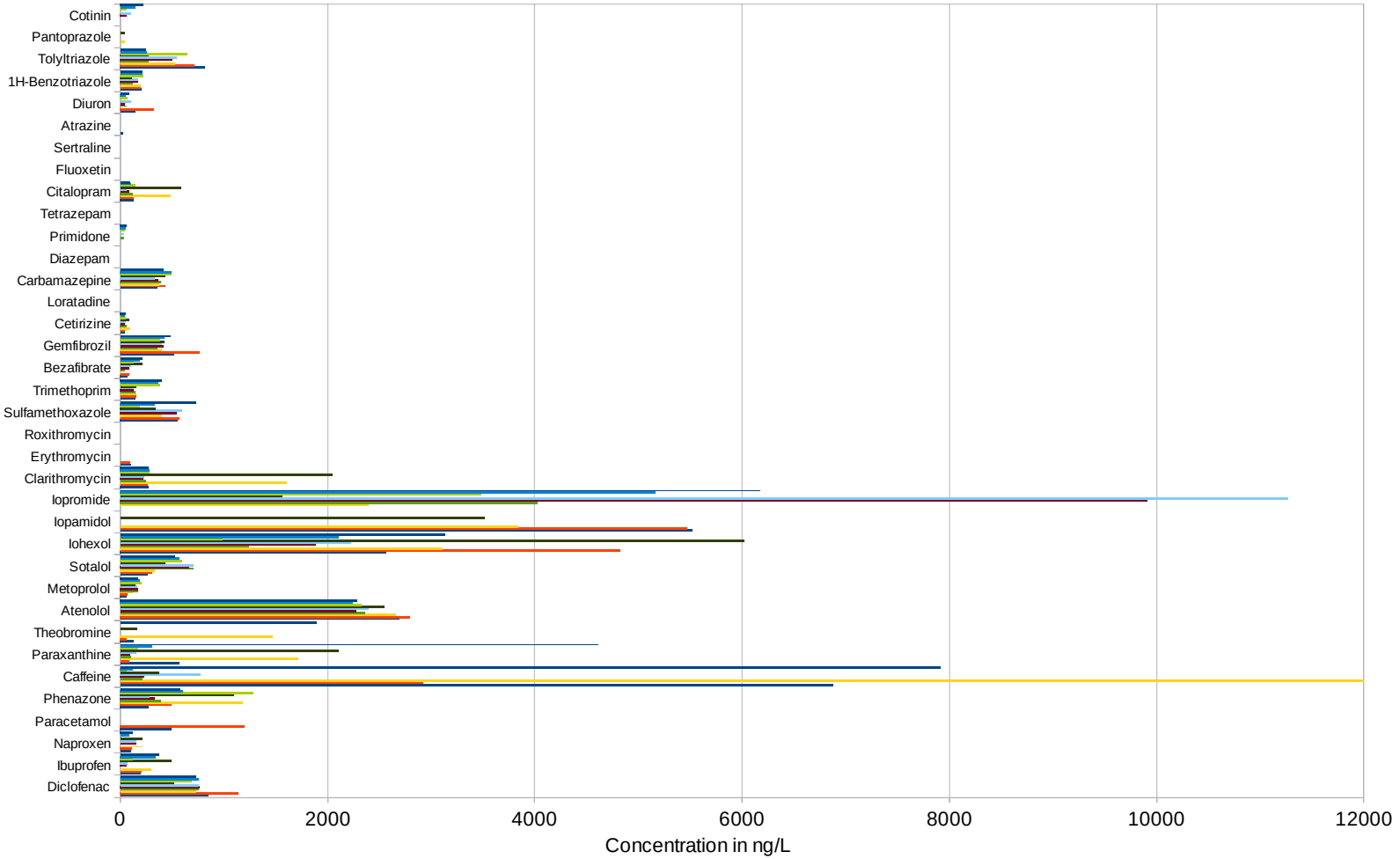
3 Analytical Method



Note: LC/MS/MS was also a main topic of the capacity building activities

4 Results

WWPT effluents



4 Results

Problem: How to deal with a high number of data to give comprised information?

Solution: Clustering of the results and definition of key compounds!

4 Results

Clustering method:

The results were clustered with regard to **occurrence** and **concentration.**

Occurrence: no occurrence, temporal occurrence, always above LOD

Concentrations:

Lake: < LOD, LOD-25 ng/L, 25-50 ng/L, > 50 ng/L

WWTPs: < LOD, LOD-100ng/L, 100-500 ng/L, > 500 ng/L

4 Results

Risk matrix

Relevance	No relevance	Low relevance	Medium relevance	High relevance
Lake Paranoá (C)	31	9	5	5
WWTP South	16	4	14	16

No monitoring	Low-frequency monitoring	Medium-frequency monitoring	High-frequency monitoring

Recommendation for a future monitoring strategy

4 Results

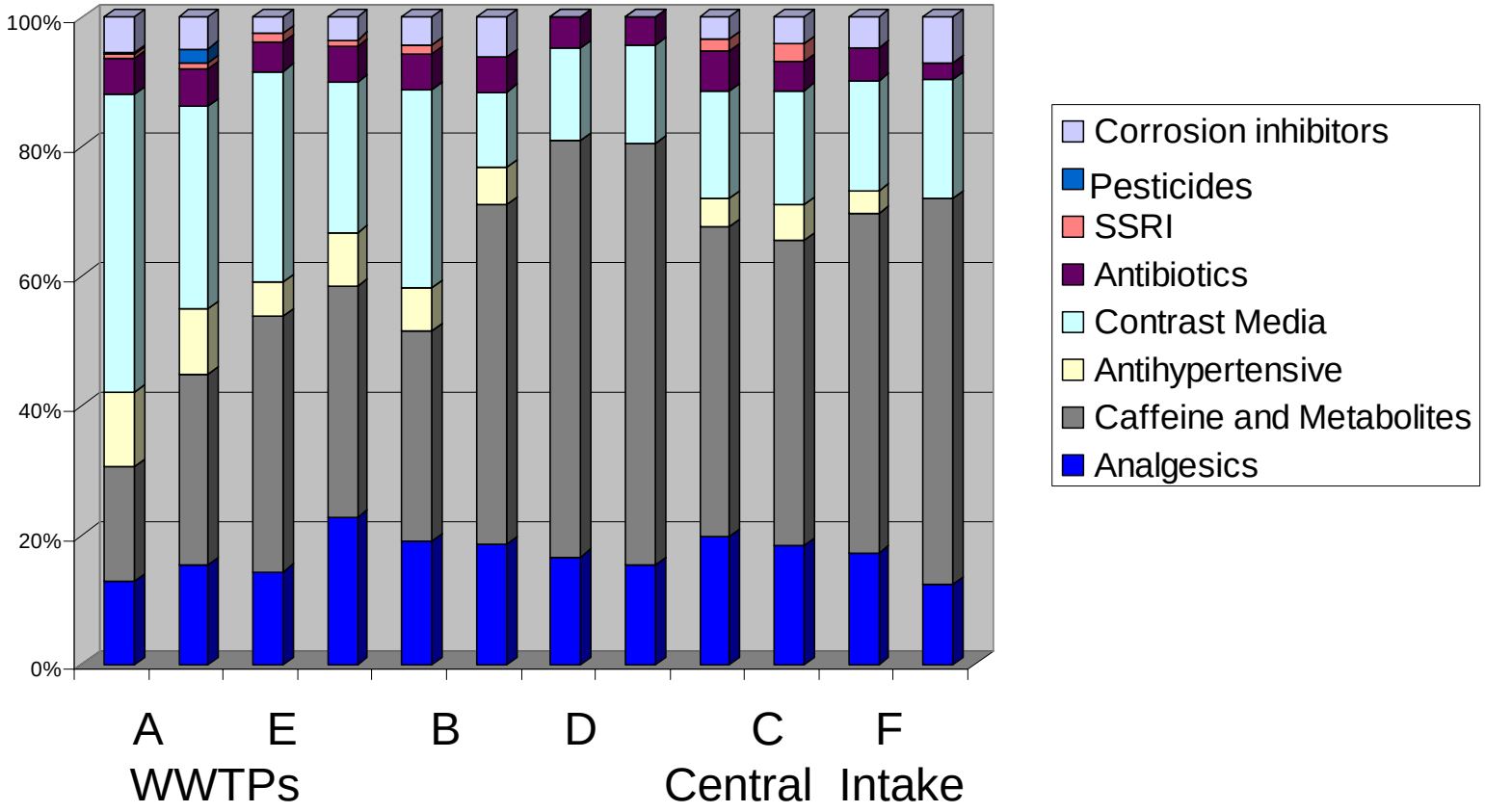
Based on the results from the risk matrix the following **compounds** are recommended for **high-frequency monitoring**:

Phenazone, caffeine, atenolol, sulfamethoxazole, tolyltriazole, iohexol, iopromide, iopamidol, gemfibrozil, carbamazepine, and 1-*H*-benzotriazole

These compounds have either high/medium relevance in central point C or low relevance in C but high or medium relevance in A and thus future increase of the concentrations in the central branch of Lake Paranoá can be expected.

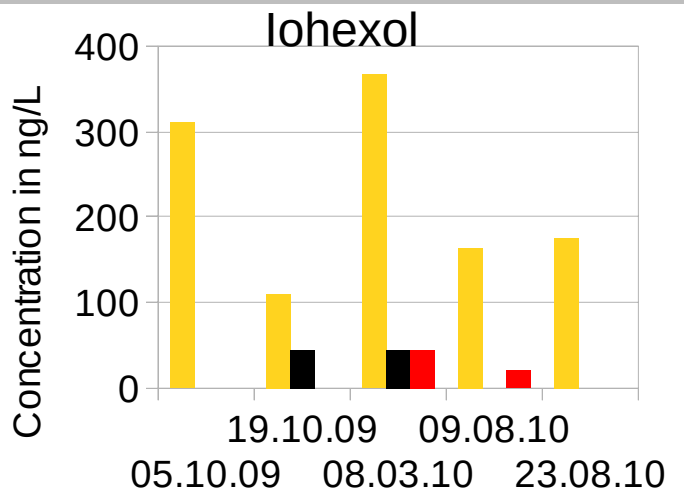
4 Results

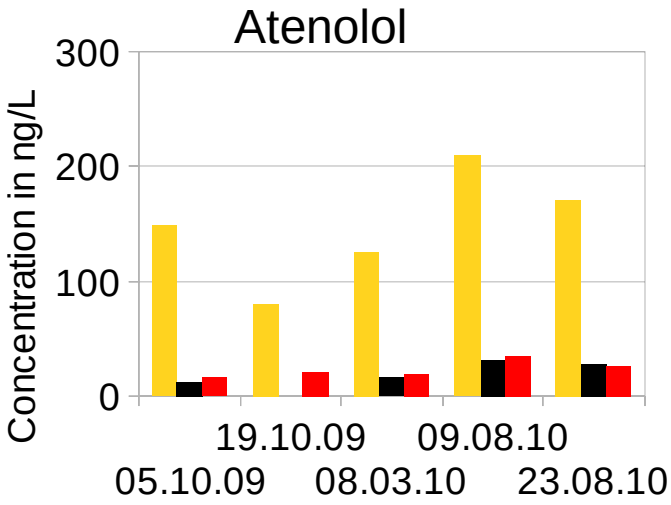
Lago Paranoá: relative amounts of selected organic micropollutants

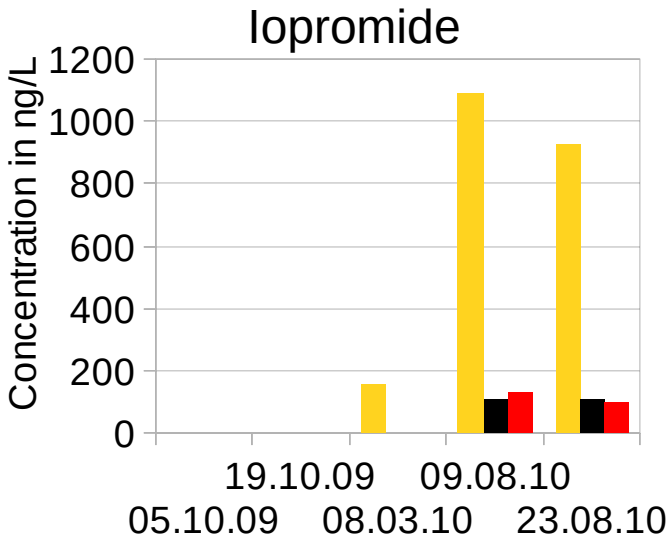


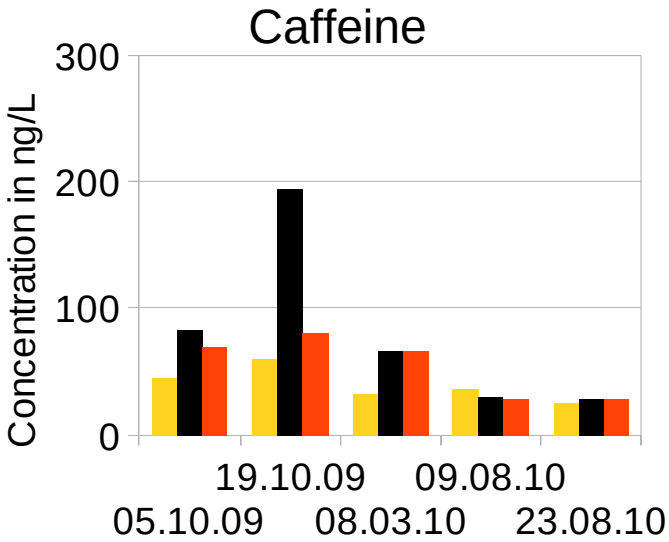
4 Results

Fate of pollutants





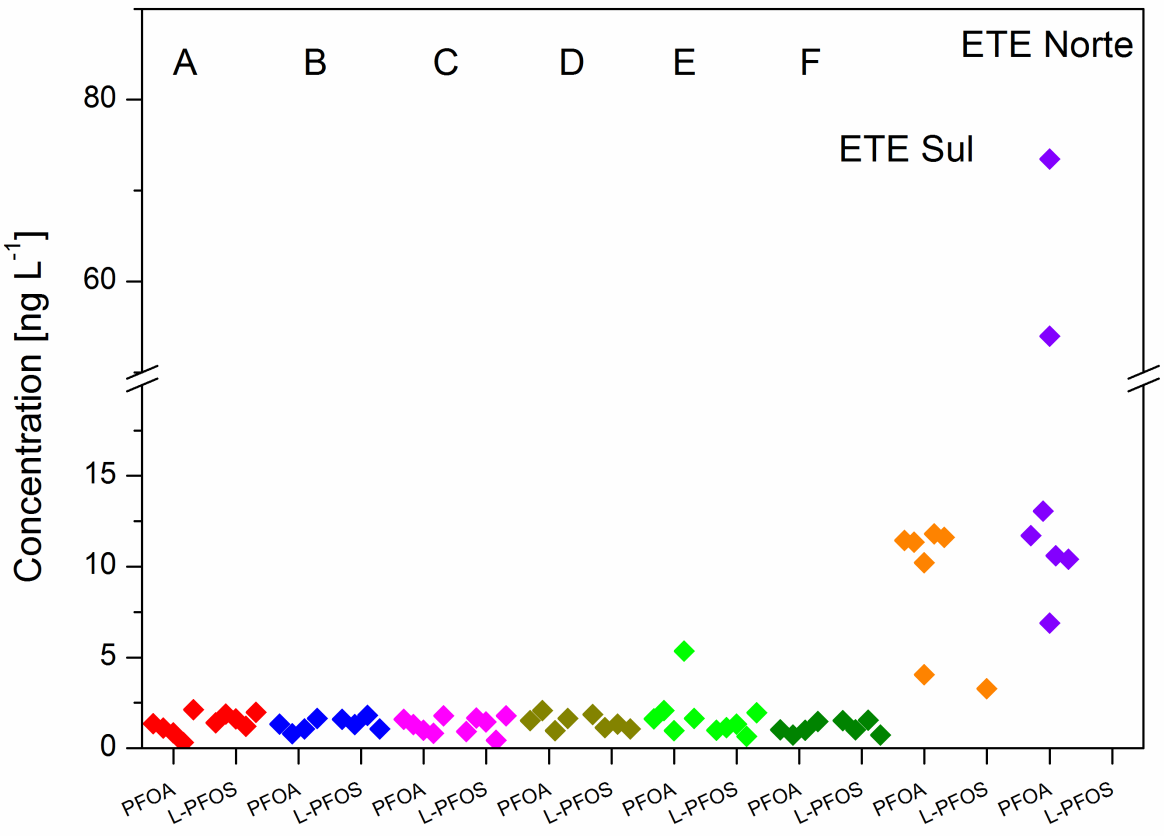




- Point A
- Central Point (C)
- Point F (future DWTP)

4 Results

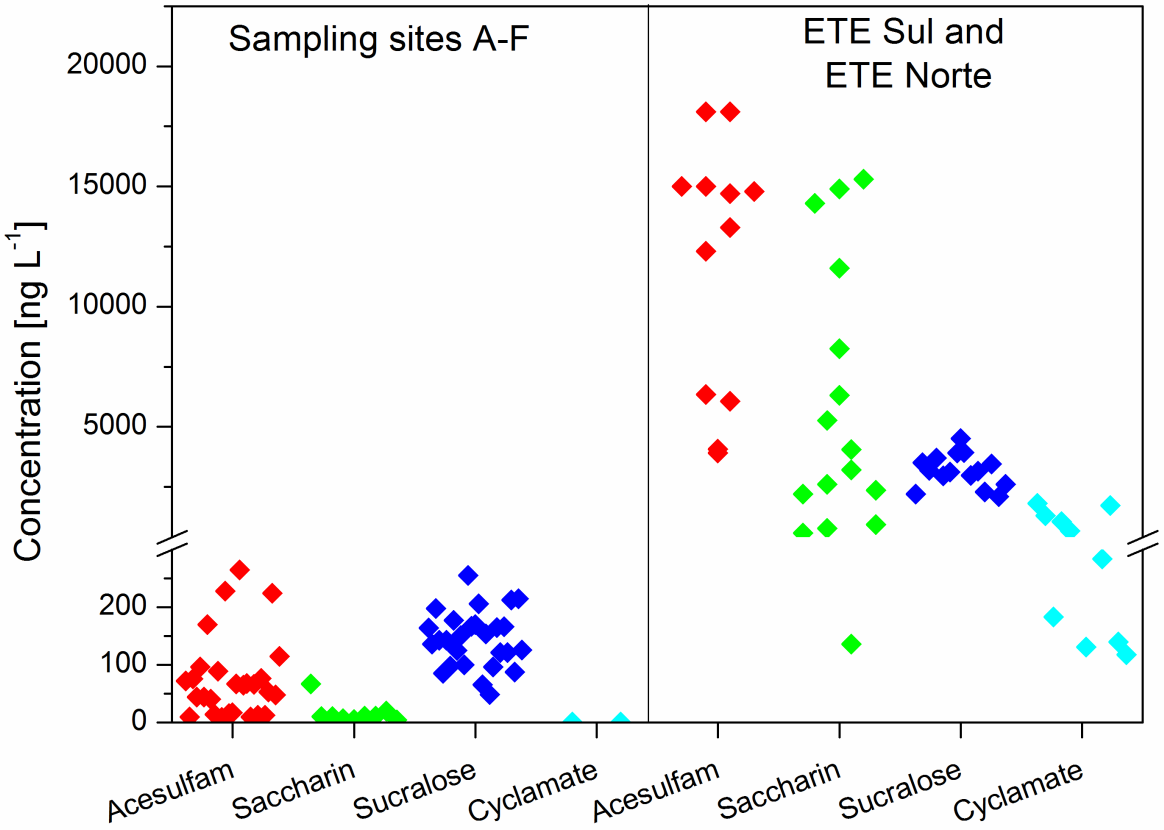
Perfluorinated compounds



Comparable to River Rhine and German WWTPs

4 Results

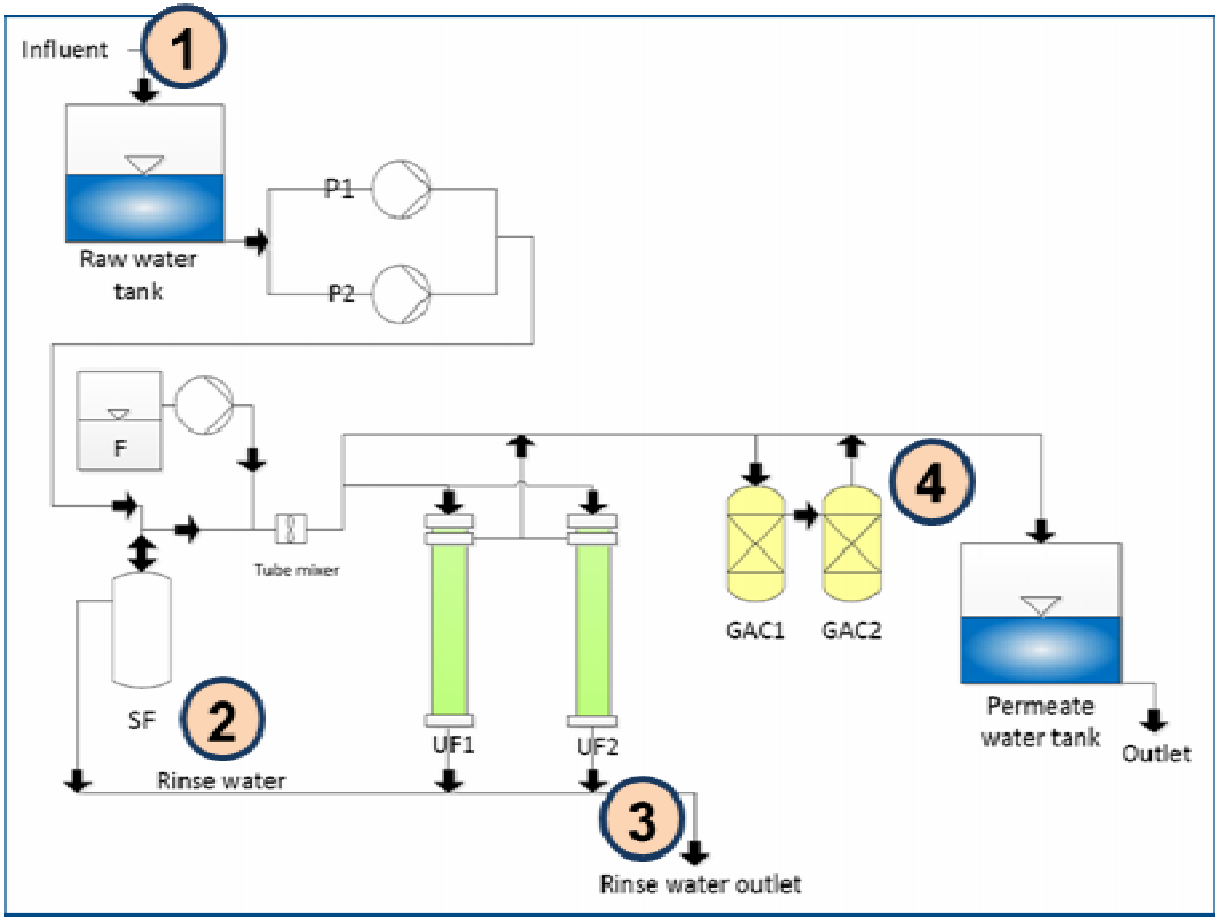
Artificial sweeteners



Comparable to German surface waters (Rhine, Danube, Neckar) and WWTPs

4 Results

Pilot Plant - Advanced Waste Water Treatment Using Ultrafiltration and Activated Carbon: Fate of Organic Micropollutants



Pesticides

Sampling points:

-Influent

-After sand filtration

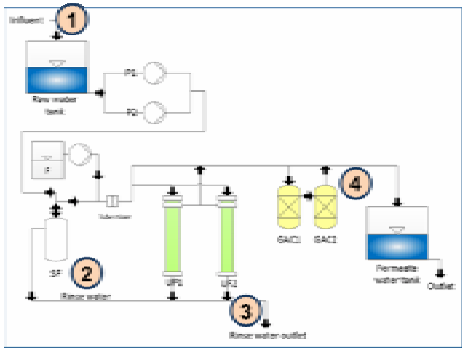
-After ultrafiltration

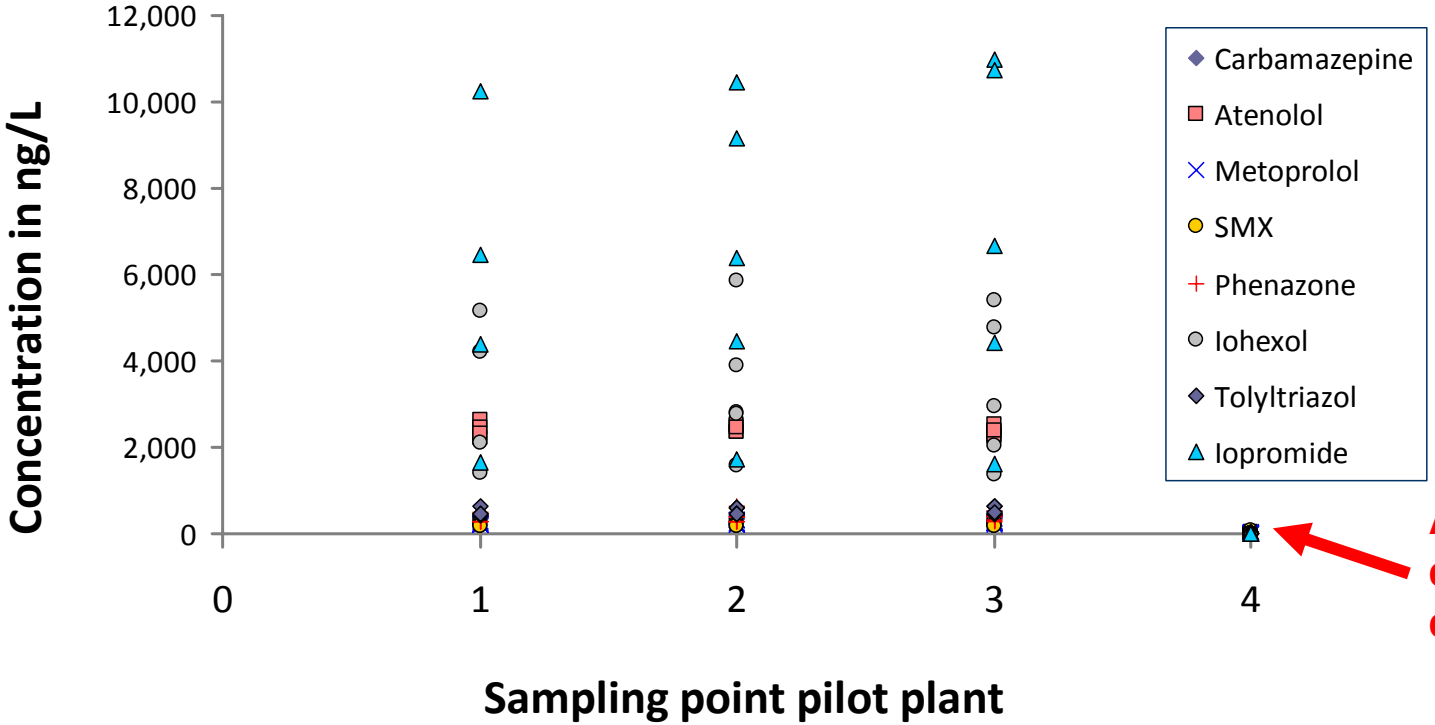
-After GAC treatment

4 Results

Pilot Plant - Fate of Organic Micropollutants

Results of sampling campaigns 25.03.12 – 03.10.12





After GAC: concentration of all compounds < LOQ

5 Summary

- The water quality with respect to organic pollutants was assessed on the basis of analytical investigations of about 90 substances.
- The concentration levels are relatively low and comparable to the concentrations found in European or North American surface waters.
- There are only small differences between dry and rainy seasons.
- For most substances, the concentrations in the central part of the lake are much smaller than in the WWTP effluents due to dilution and/or degradation.

5 Summary

- A risk matrix could be established on the basis of concentration and occurrence.
- From the risk matrix 11 key compounds could be derived which can be considered as indicators for the water quality.
- These key compounds are recommended for future monitoring and for testing the water treatment technology.
- Although the concentrations in the lake are relatively low, an appropriate treatment step, e.g. adsorption onto activated carbon, is recommended.

Thanks to:

- BMBF for funding
- all IWAS Água DF colleagues for good cooperation