



# Variation in removal efficiency of micropollutants in on-site sewage facilities studied using target and non-target analysis

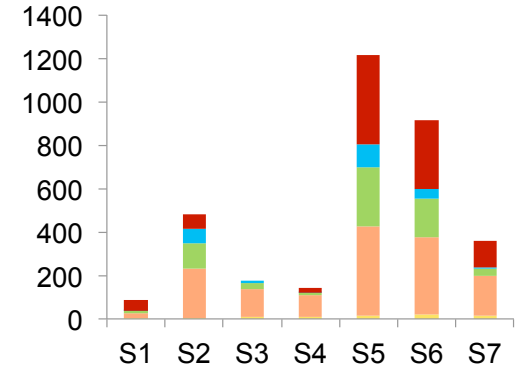
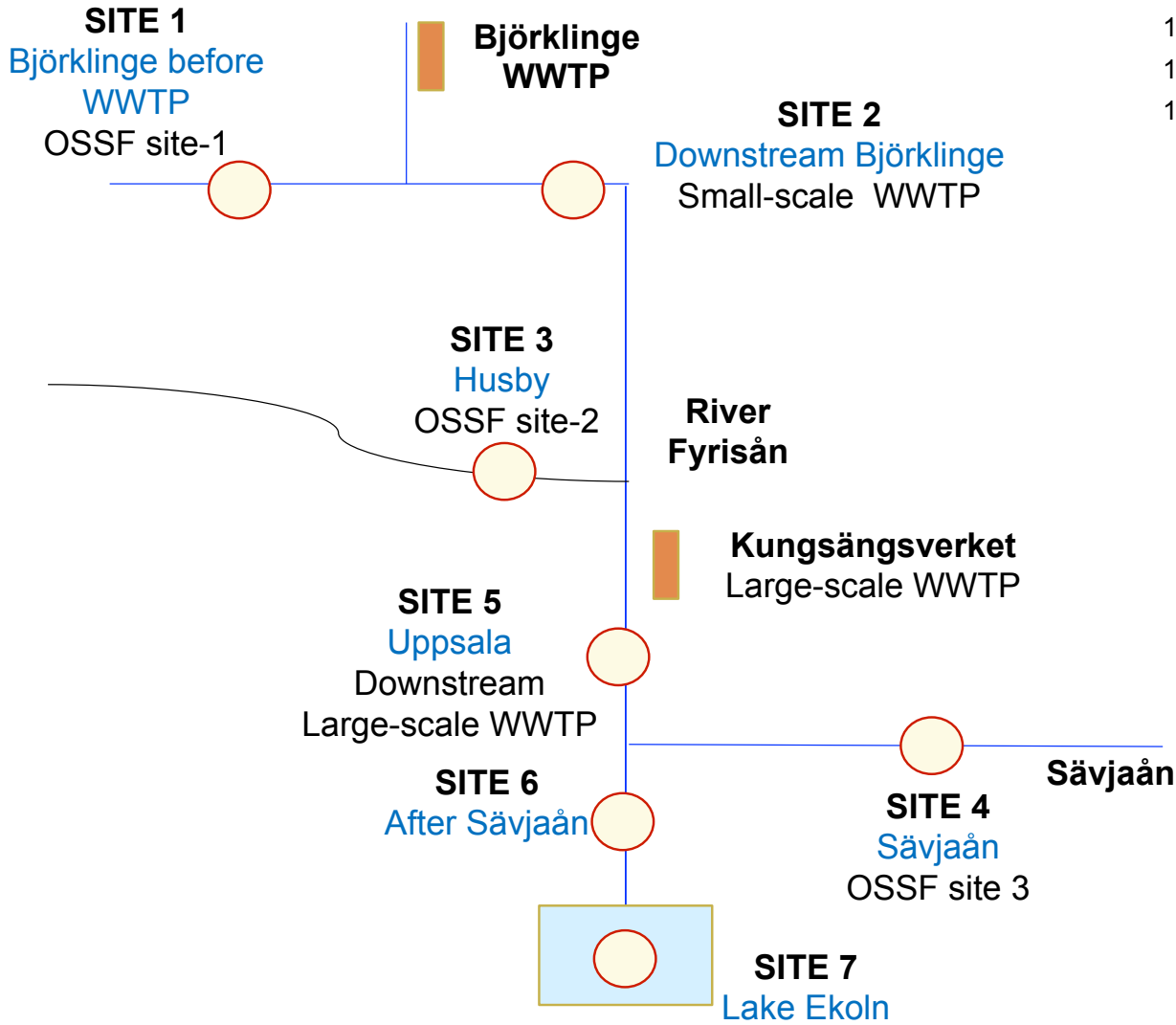
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# Poster: Pablo Gago-Ferrero et al







# Sampling strategy: Stage I

## Soil bed system



## Package STPs



- Several OSSFs monitored in Stockholm and Umeå area (Sweden)
- OSSFs main treatments:
  - Soil beds
  - Mini or package STPs
  - Greywaters
- OSSFs individual samples with similar treatments were pooled
- Influent and effluent samples
- Medium and large STPs also monitored.





# Sampling strategy: Stage II







# Analytical strategy: GC\*GC-MS

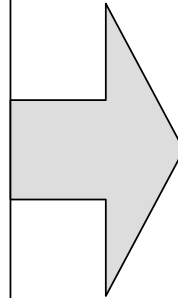
## Stage I

Sampling I

GCxGC-MS based non-target screening

Compound prioritization

Target analyte selection



## Stage II

Method development for target analytes

Sampling II

Removal pattern analysis

Environmental load





# Analytical strategy: LC-MS

Extraction by SPE (Oasis HLB, ENV<sup>+</sup>)

TARGET ANALYSIS

LC-MS/MS (QqQ)

Validated methods

26 perfluoroalkyl  
substances (PFASs)

110 pesticides

SUSPECT SCREENING

LC-HRMS analysis

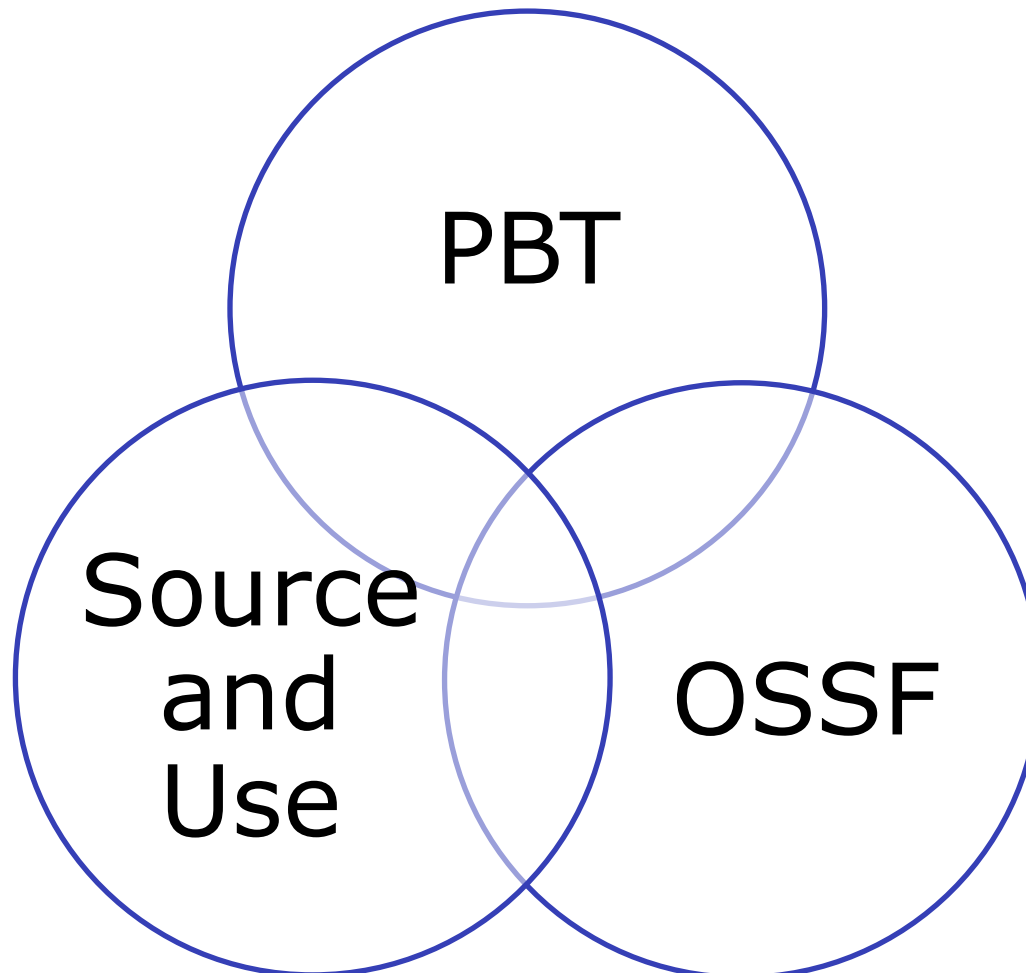
Compound database  
~1300 compounds in  
database (pesticides,  
PhACs, PCPs, EDCs,  
FRs, AS)

List of candidate substances

Confirmation and quantification with reference standards (MS/MS, RT)



# Identification of priority pollutants





- Data Processing in ChromaToF
- NIST Library search
- Peak alignment<sup>1)</sup>

~200 000

### 1. Filtering

- Detection frequency
- Blanks
- Manual investigation

~300

Tentatively identified compounds

### 2. Filtering

- $t_{1/2}$ , BCF, PEC/PNEC<sup>2)</sup>
- Hazard concern<sup>2)</sup> + HPVC/LPVC/EINECS FISCHER<sup>3)</sup>

~60

Environmental relevant compounds

- Reprocessing
- Semi-quantification

### Ranking

Based on scores in PBT, conc and RE criteria

Selection of target analytes



# Selected priority pollutants

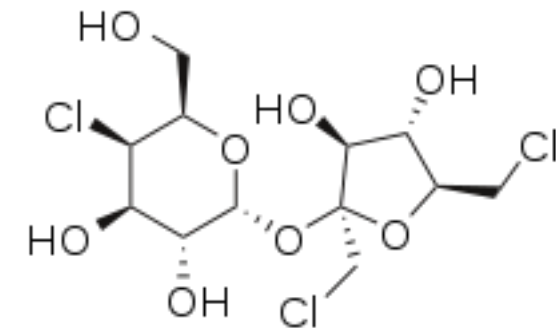
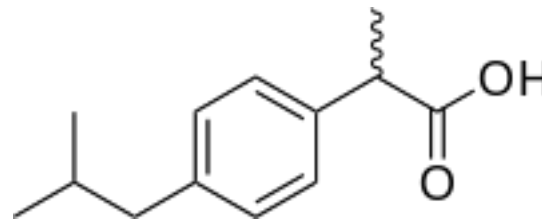
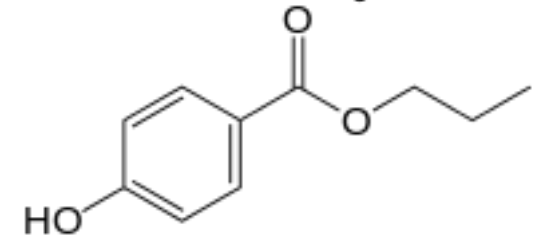
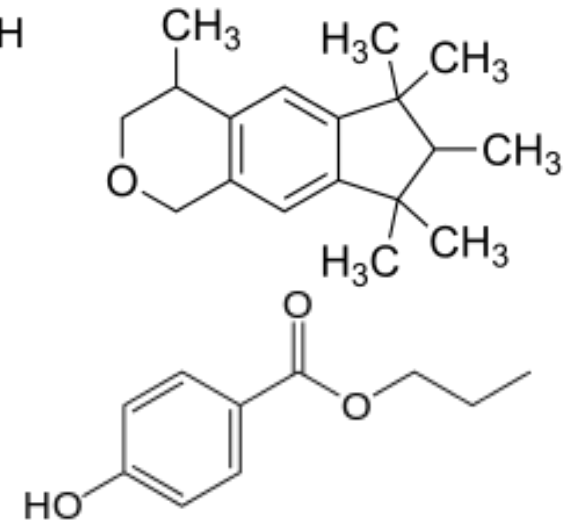
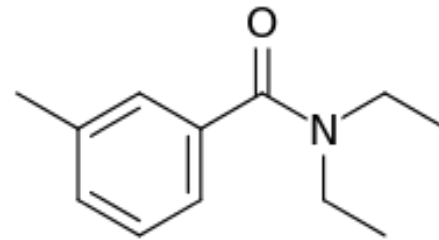
- In total 30 organic micropollutants
  - 9 pharmaceuticals (including caffeine)
  - 6 polymer/rubber additives including UV, flame retardants, plastizisers
  - 4 pesticides
  - 3 PFAS
  - 3 personal care products
  - 2 detergents
  - 2 food additives
  - 1 surfactant





# Examples of priority pollutants

- PFOS
- OPs
- Galaxolide
- Hexachlorbenzene
- DEET
- Probylparaben
- Caffeine
- Ibuprofen
- Carbamazepine
- Sucralose



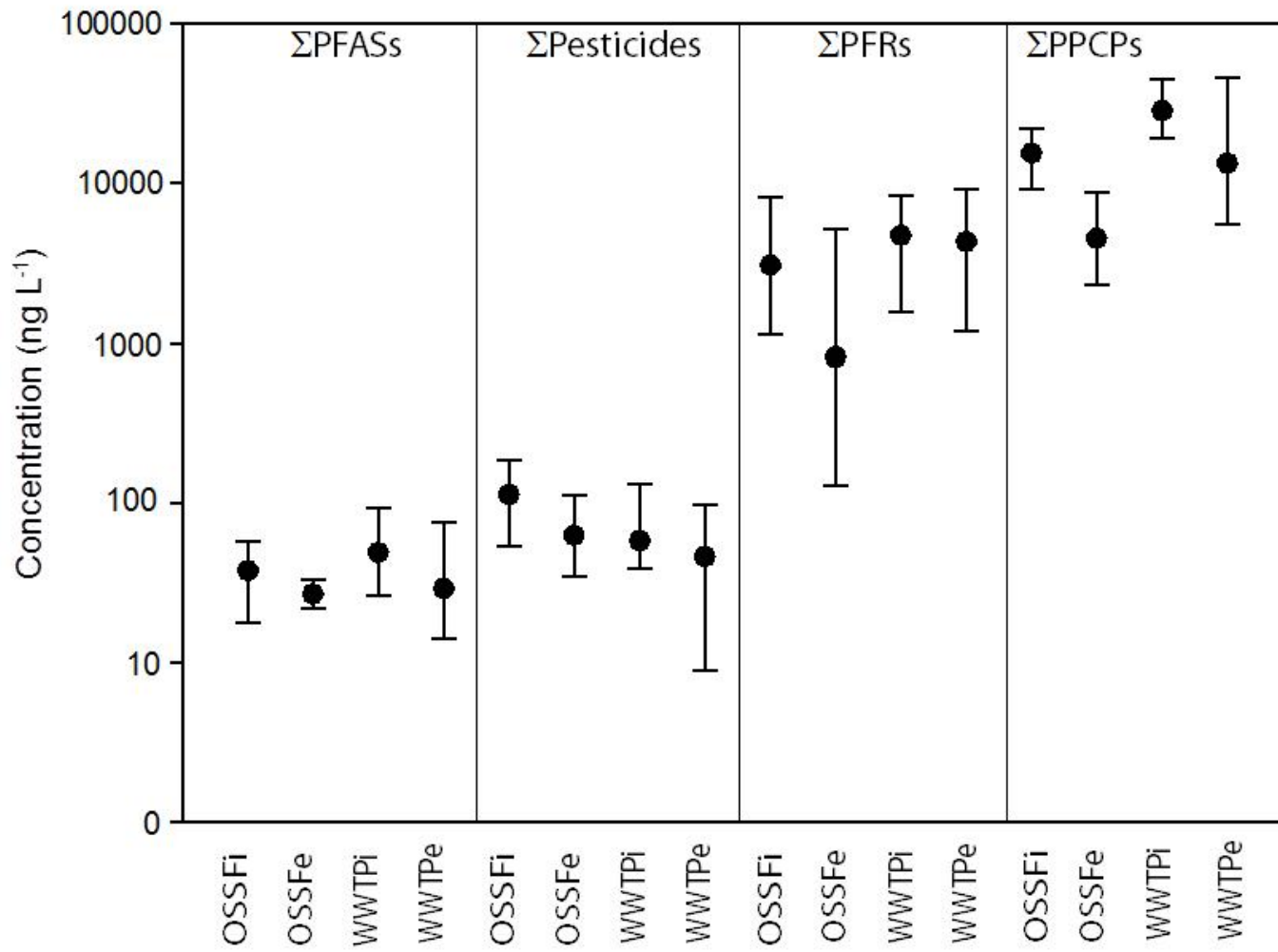
- Ibuprofen

- Carbamazepine

- Sucralose

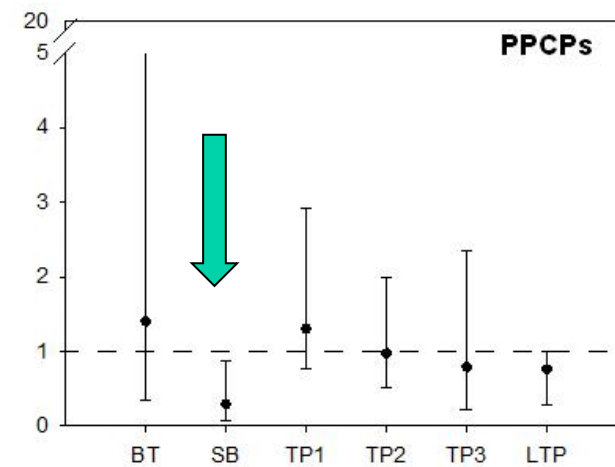
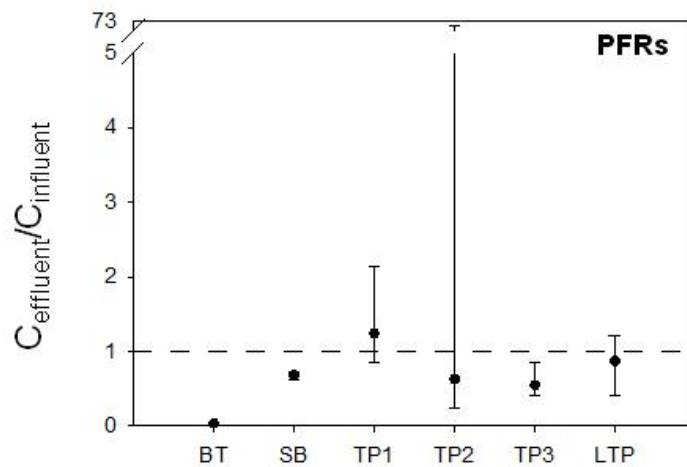
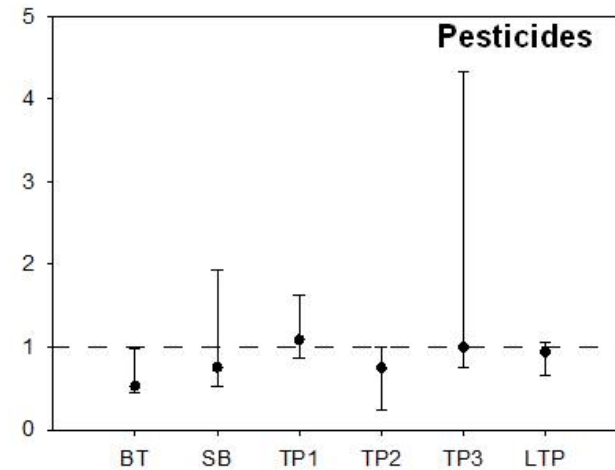
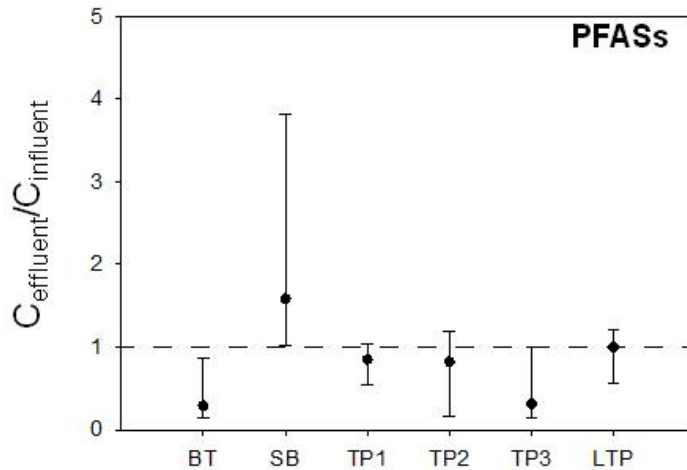


# Fate of polar chemicals in OSSFs (Meri Gros et al)



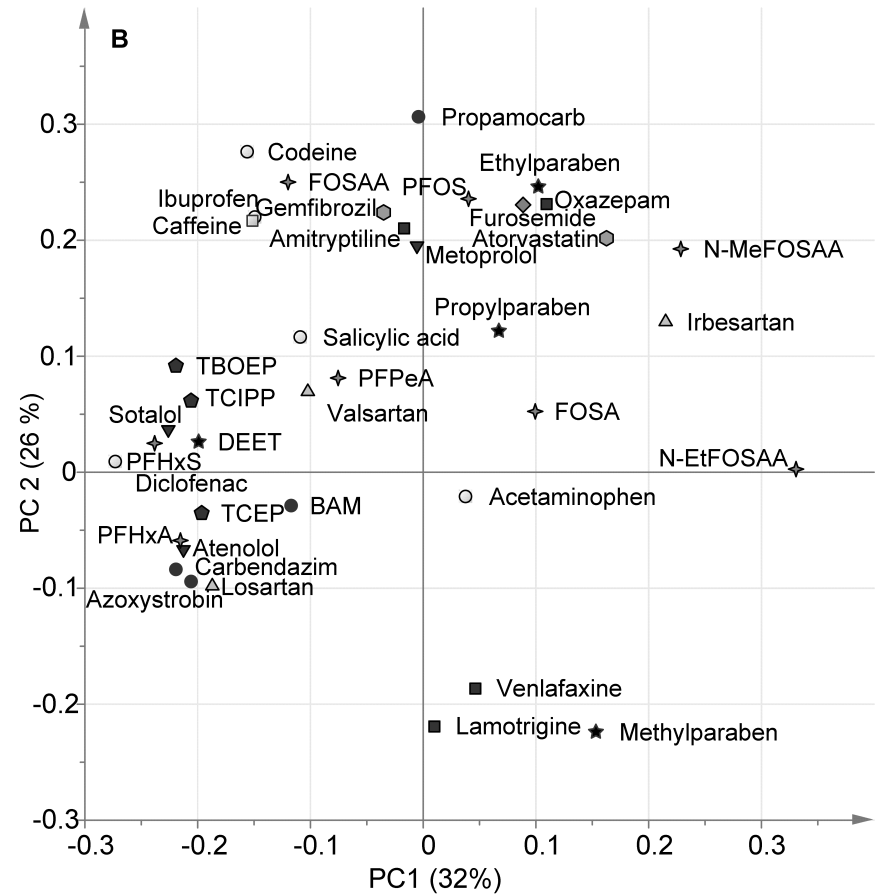
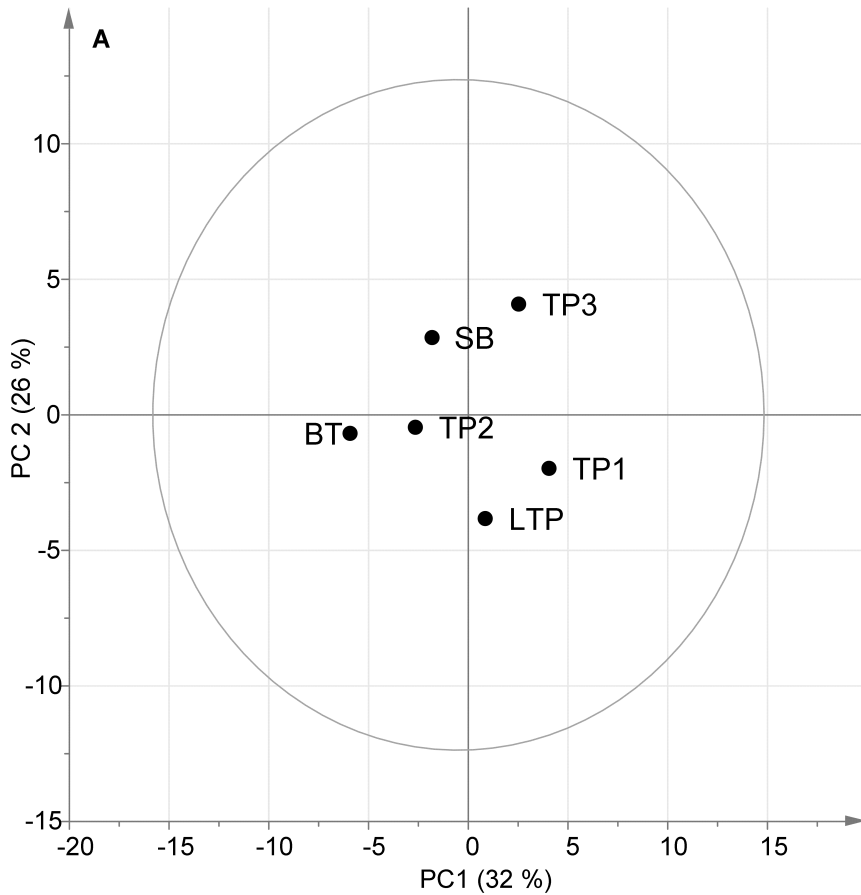


# Fate of polar chemicals in OSSFs (Meri Gros et al)





# Pattern analysis

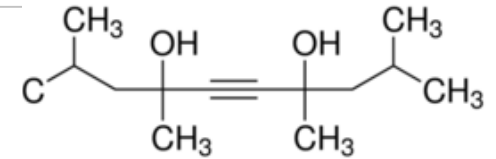
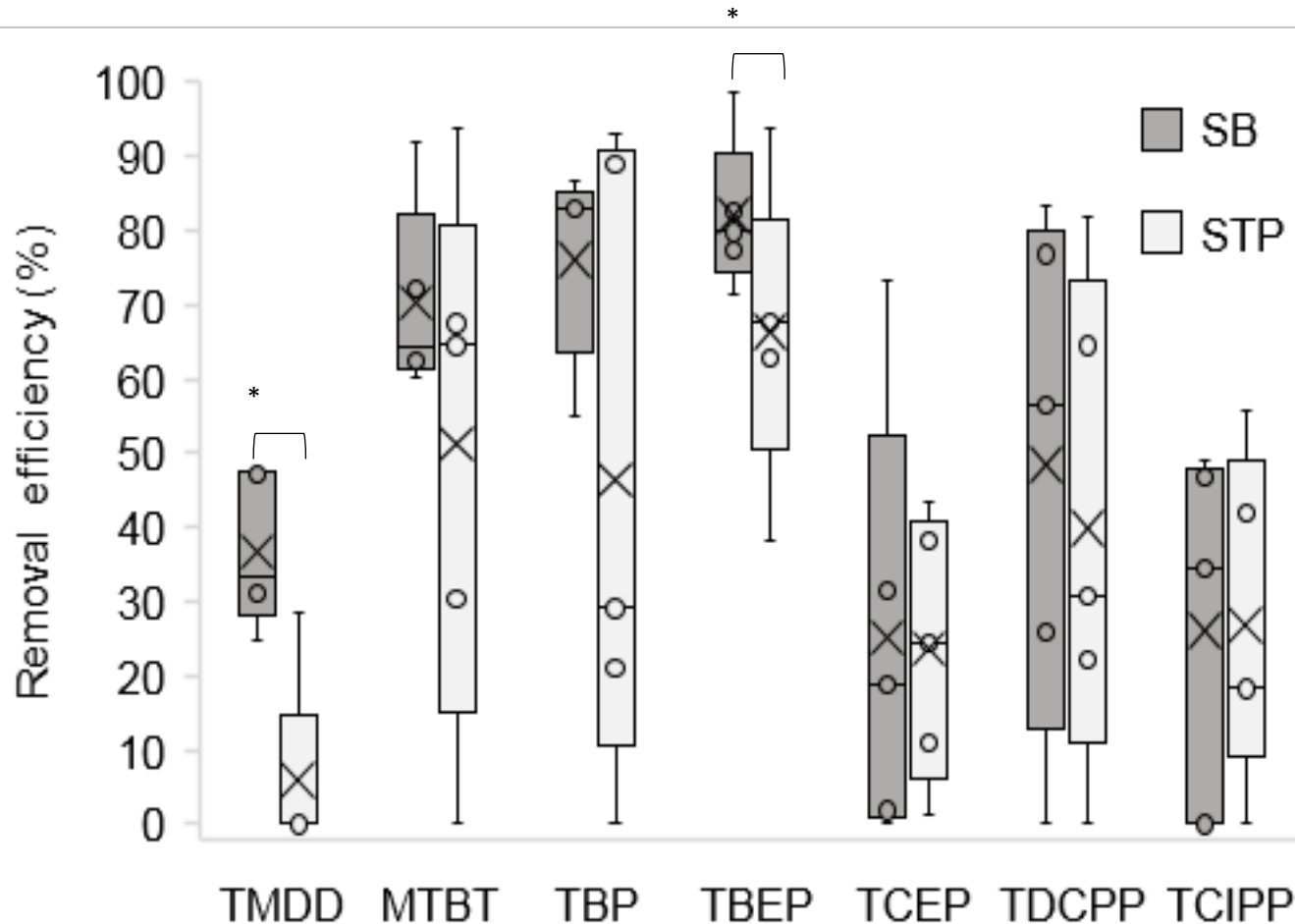


○ Analgesics and anti-inflammatories ■ Antidepressants ▲ Antihypertensives ▼ B-blockers ◆ Diuretics ● Flame retardants ● Lipid regulators + Perfluorinated chemicals ★ Personal care products

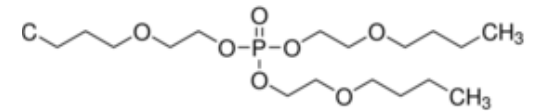




# Removal efficiency of apolar chemicals



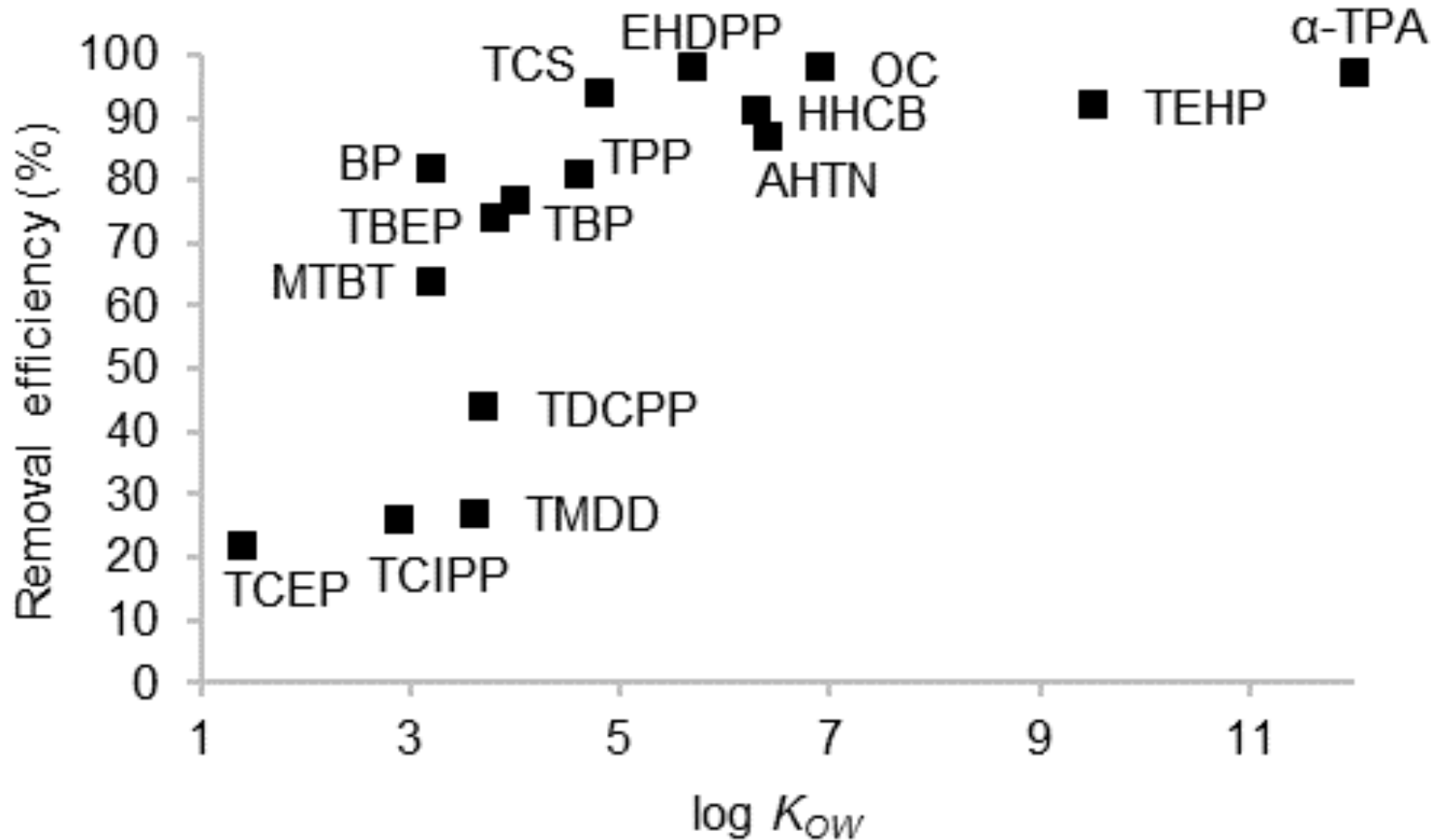
2,4,7,9-Tetramethyl-5-decyn-4,7-diol



Tris(2-butoxyethyl) phosphate



# Removal efficiency vs $K_{ow}$





# Summary

- A set of priority chemicals identified for studies on fate in OSSFs
- No major differences in levels between OSSFs and large STPs
- No major differences in removal efficiencies between OSSFs and large STPs
- Larger variation in removal for STPs
- Better removal of hydrophobic chemicals
- Removal of PFASs and PFRs was higher in package treatment facilities while removal of PPCPs was more efficient in soil beds



