

Source reduction of personal care products in the urban water cycle of Paris conurbation

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Cosmet'eau

STARTING POINT

Darbre Ph. *et al.* (2004)
Potential link with breast cancer

MEDIATISATION



Envoyé Spécial (2005)
Whistle-blowers

PRACTICE CHANGES



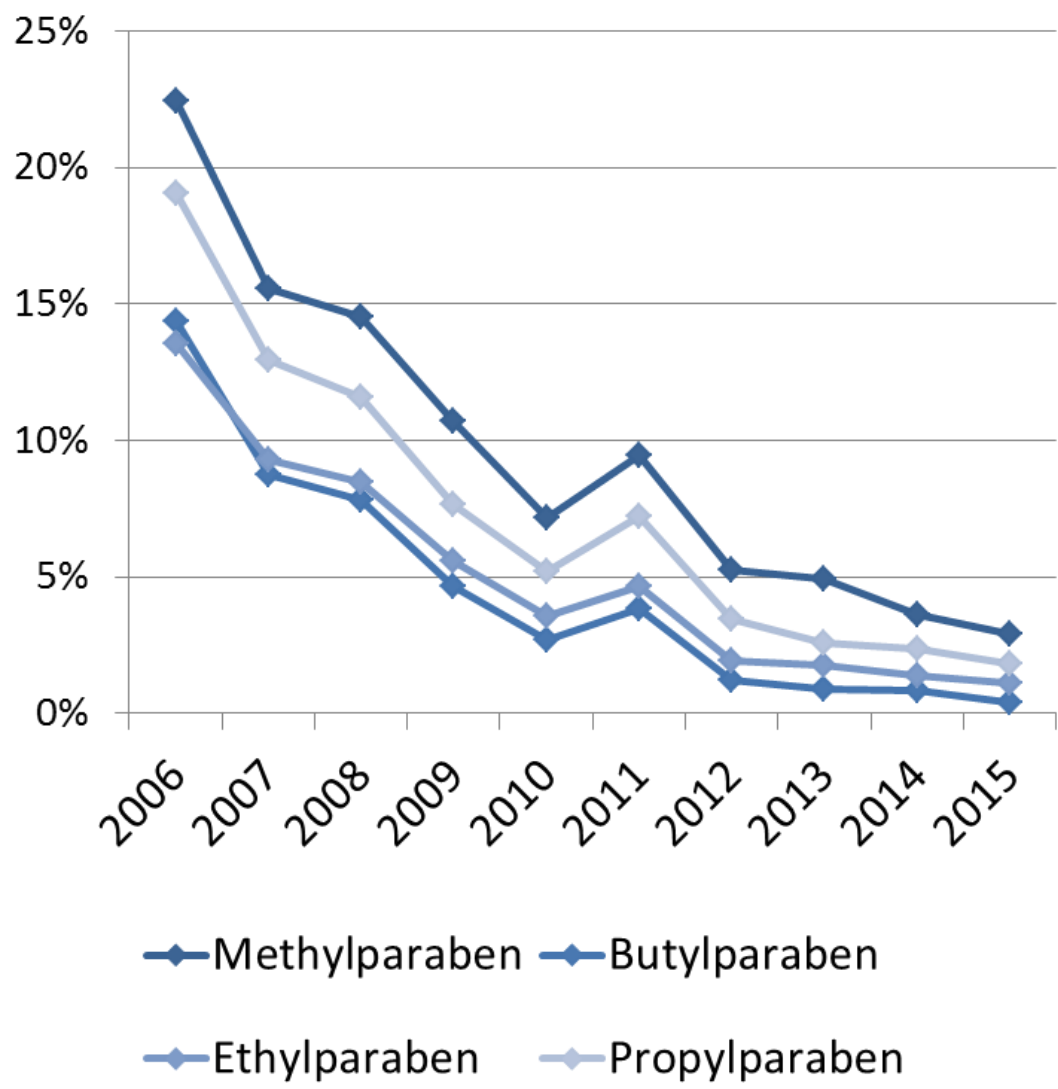
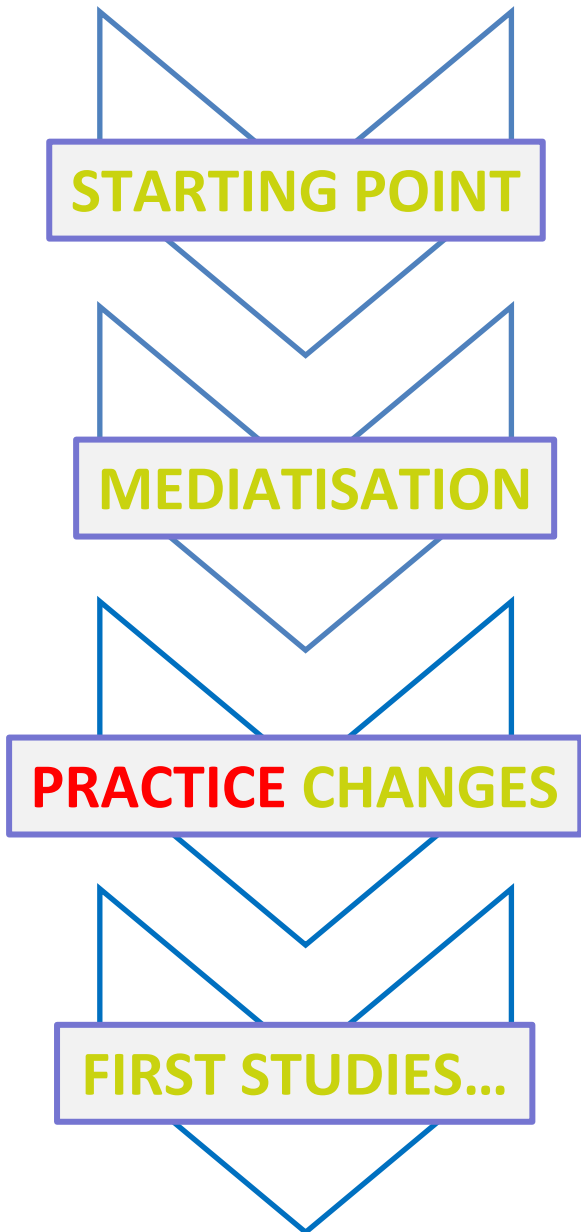
**Consumers
Industrials**

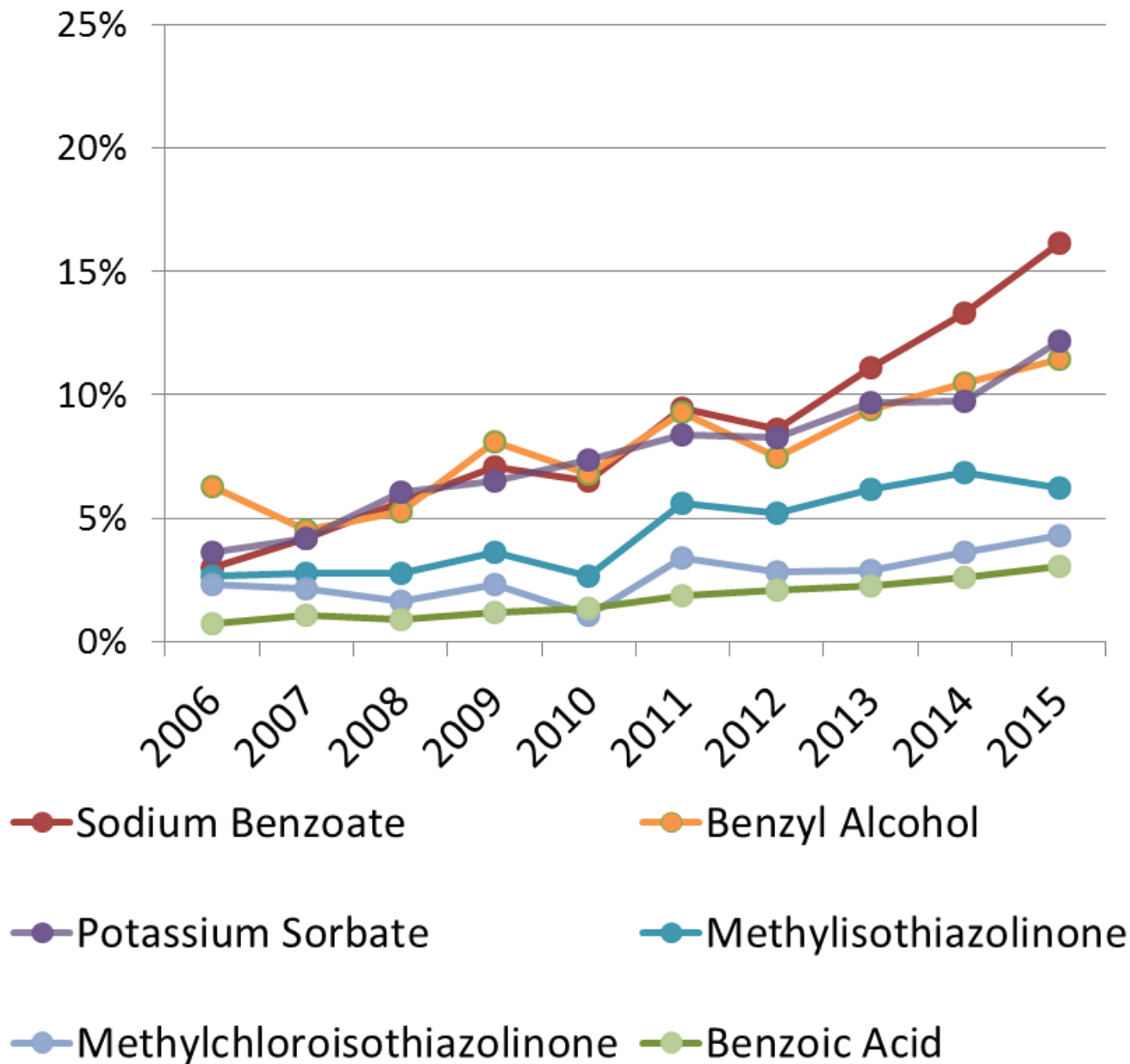


FIRST STUDIES...

Geara-Matta (2012)
Flow and sources of parabens... : comparison
between Paris and Beirut







- **Personal care products:** a pretext to study risks associated with micropollutants and source control solutions
- Two issues
 - **Environmental impact**
 - Effluent monitoring, ecotoxicological impacts of the different types of cosmetic product
 - **Health impact** through:
 - Alert (scientific origin)
 - The responses (from industrials)
 - Perception of risk by consumers of cosmetic products (surveys) and urban managers
- **Multidisciplinary approach to the strategies** of actors likely to interact with micropollutants, in particular risk anticipation (health and environment)
- Possibility of **prevention at source** of the impact of micropollutants on the environment (and on health)
 - Acting on **products** consumed and **consumption practices**,
 - Preventive policy partly promoted by local and regional authorities



To determine the **impact of PCP use** on the quality of urban effluents



To study the transfer from their release into **greywater** up to the **receiving media**

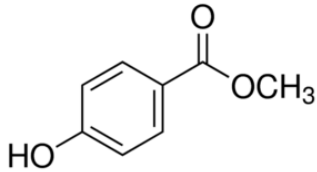


To assess the concentrations observed in the receiving environment

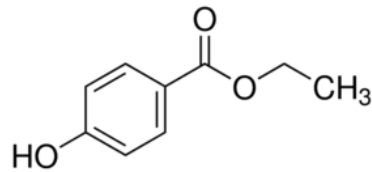
To evaluate **the impact of the Paris conurbation**

What Molecules?

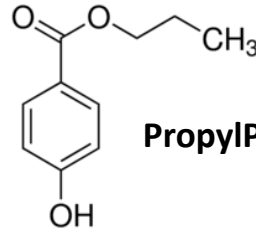
Preservatives and biocides



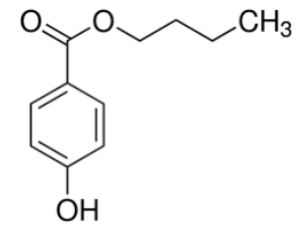
MethylParaben (MeP)



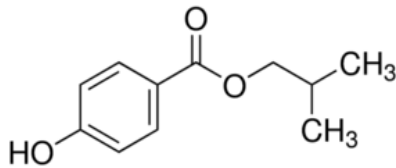
EthylParaben (EtP)



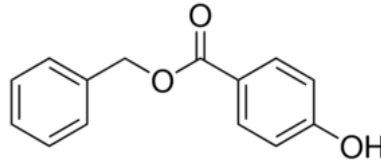
PropylParaben (PrP)



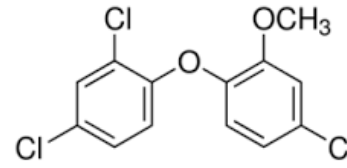
ButylParaben (BuP)



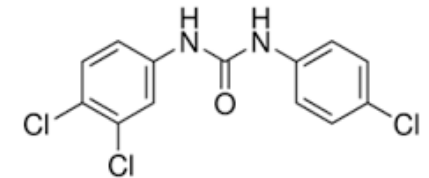
isoButylParabene (IsoBuP)



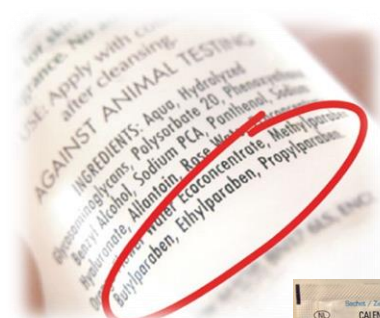
BenzylParaben (BzP)



Triclosan (TCS)



Triclocarban (TCC)



Used in:

- pharmaceuticals
- foodstuffs
- personal care products...



Aqua, glycerin, glucose, calendula officinalis extract, potassium sorbate, sodium benzoate, phenoxyethanol, methylparaben, butylparaben, ethylparaben, propylparaben, isobutylparaben



Part I

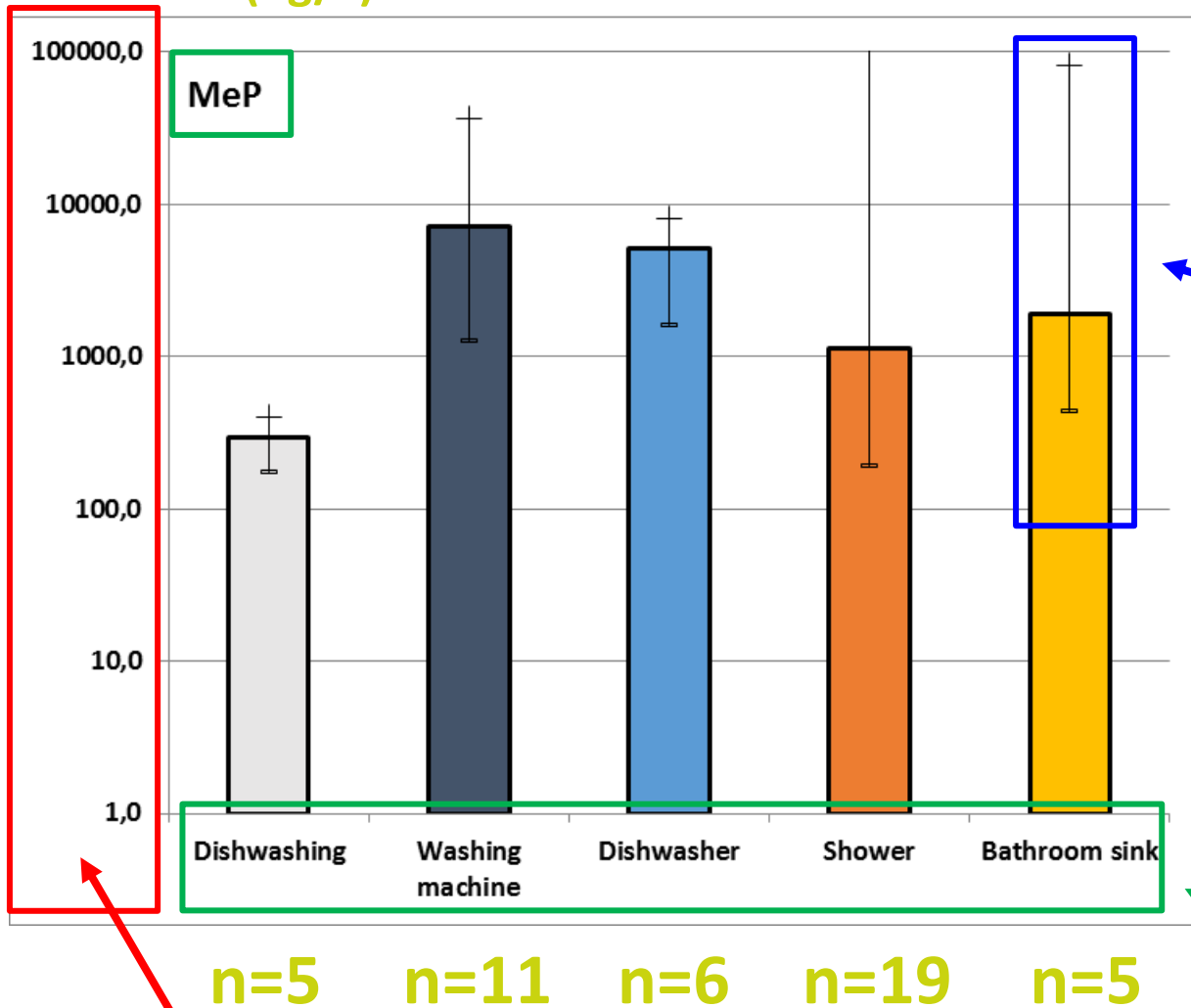
Housing scale: Greywater study



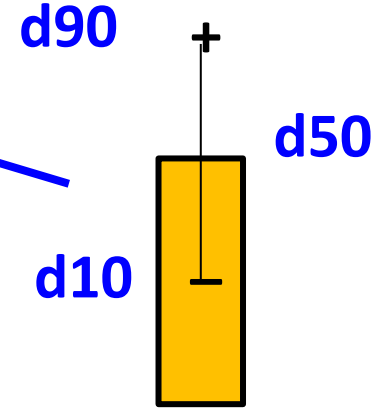
**To determine the origin of domestic
wastewater contamination for source
reduction purposes**



GREYWATER (ng/L)



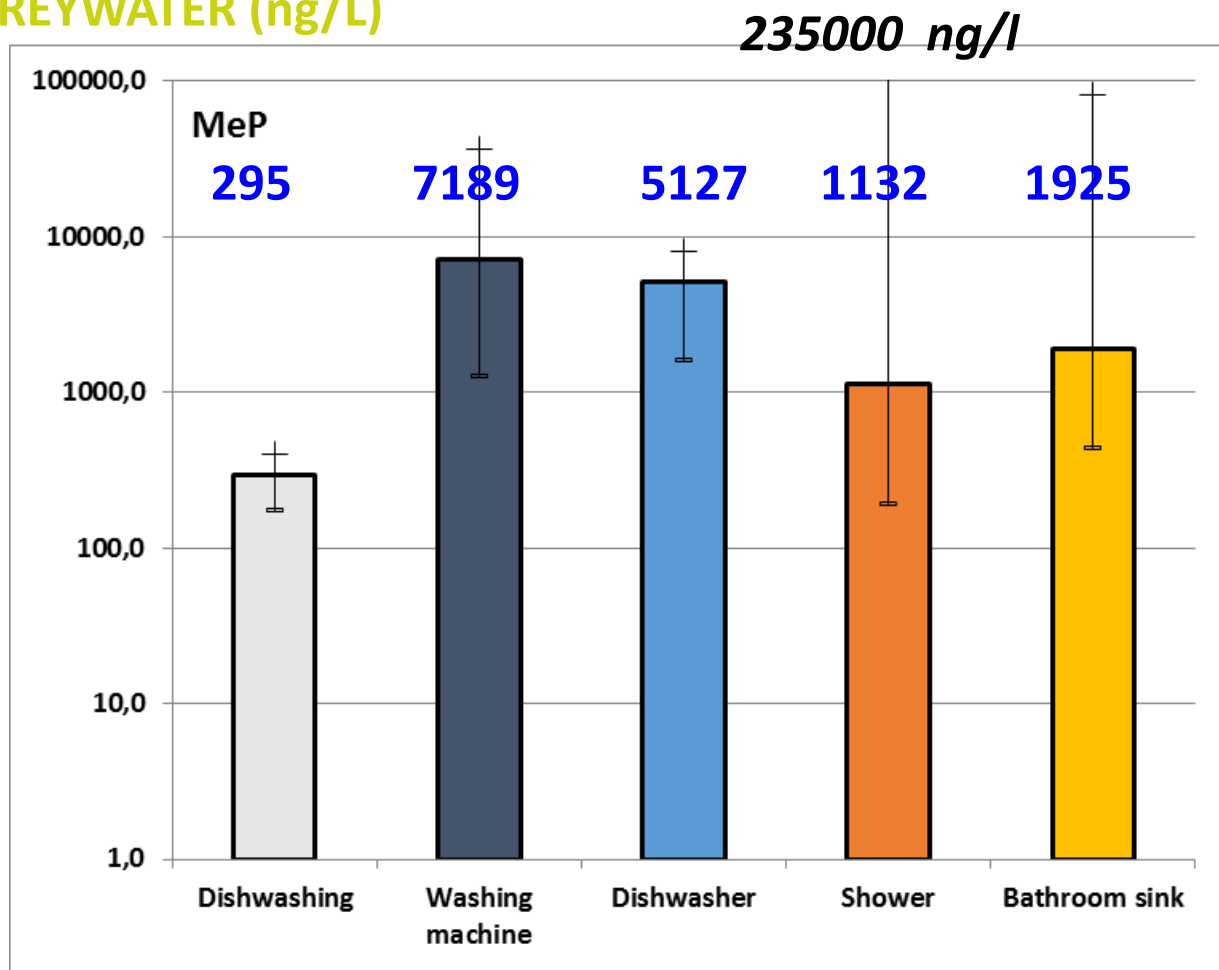
whisker plot



Sample type
or
Compounds

Logarithmic scale

GREYWATER (ng/L)



n=5

n=11

n=6

n=19

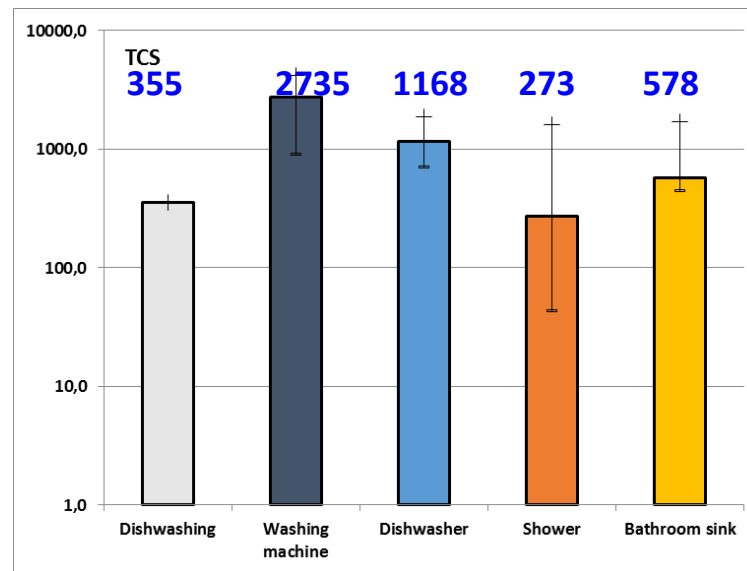
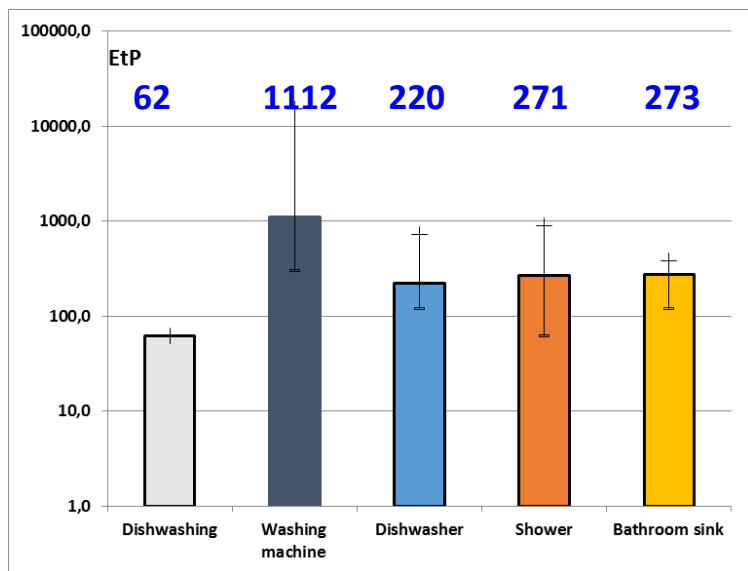
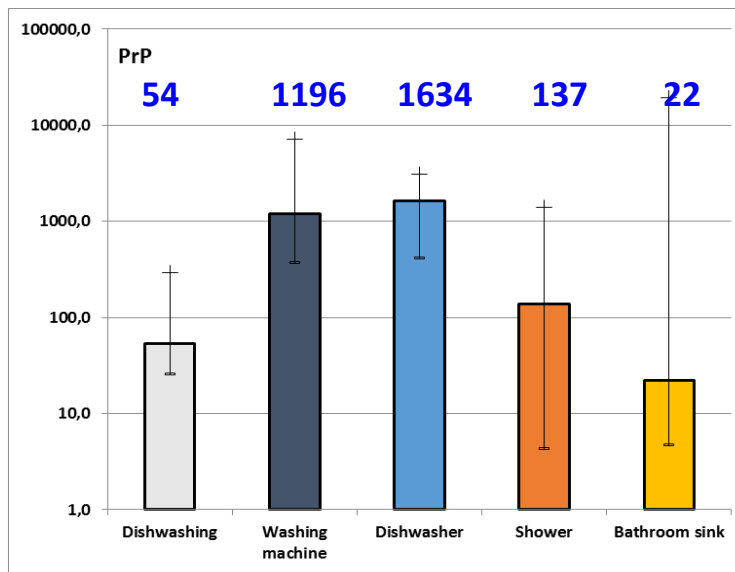
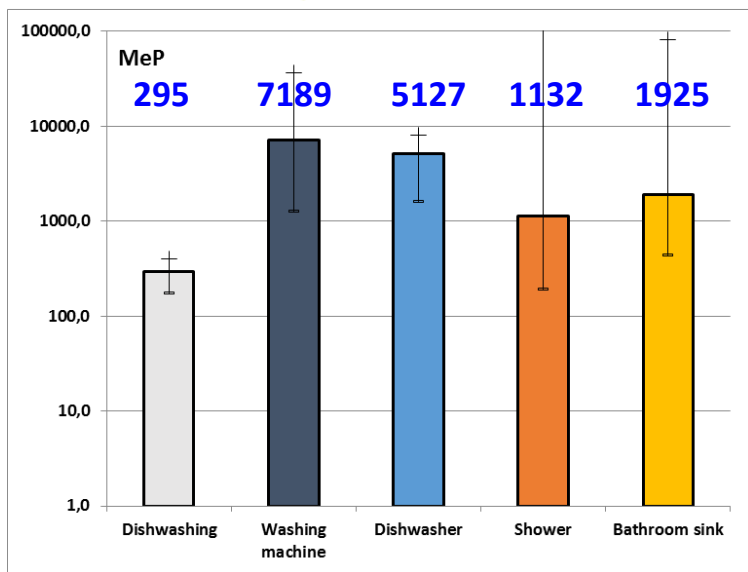
n=5

1. Ubiquitous contamination for every greywater

2. Intra-greywater variability highlighted

3. MeP (> TCS) > PrP = EtP → formulation of cosmetics

GREYWATER (ng/L)



Findings

- Contamination of all greywater waters by parabens, TCS and TCC
 - No unique source... → *questioning of information available to the consumers (INCI regulation)*
- **MeP, EtP & PrP predominate**
 - Consistent with the uses associated with these preservatives... *in personal care products*
- **Significant concentration variability:** from < LOQ up to 2 mg/L (shower) for parabens and from 36 ng/L up to 20 µg/L (shower) for TCS
 - Nature of products used
 - User habits → *need to acquire more data ?*
- Major contribution of **shower and washing machine** (loads)
→ *What are the product origins?*

Part II

Urban watershed scale: Wastewater study

Selected activities



(x2)



(x2)

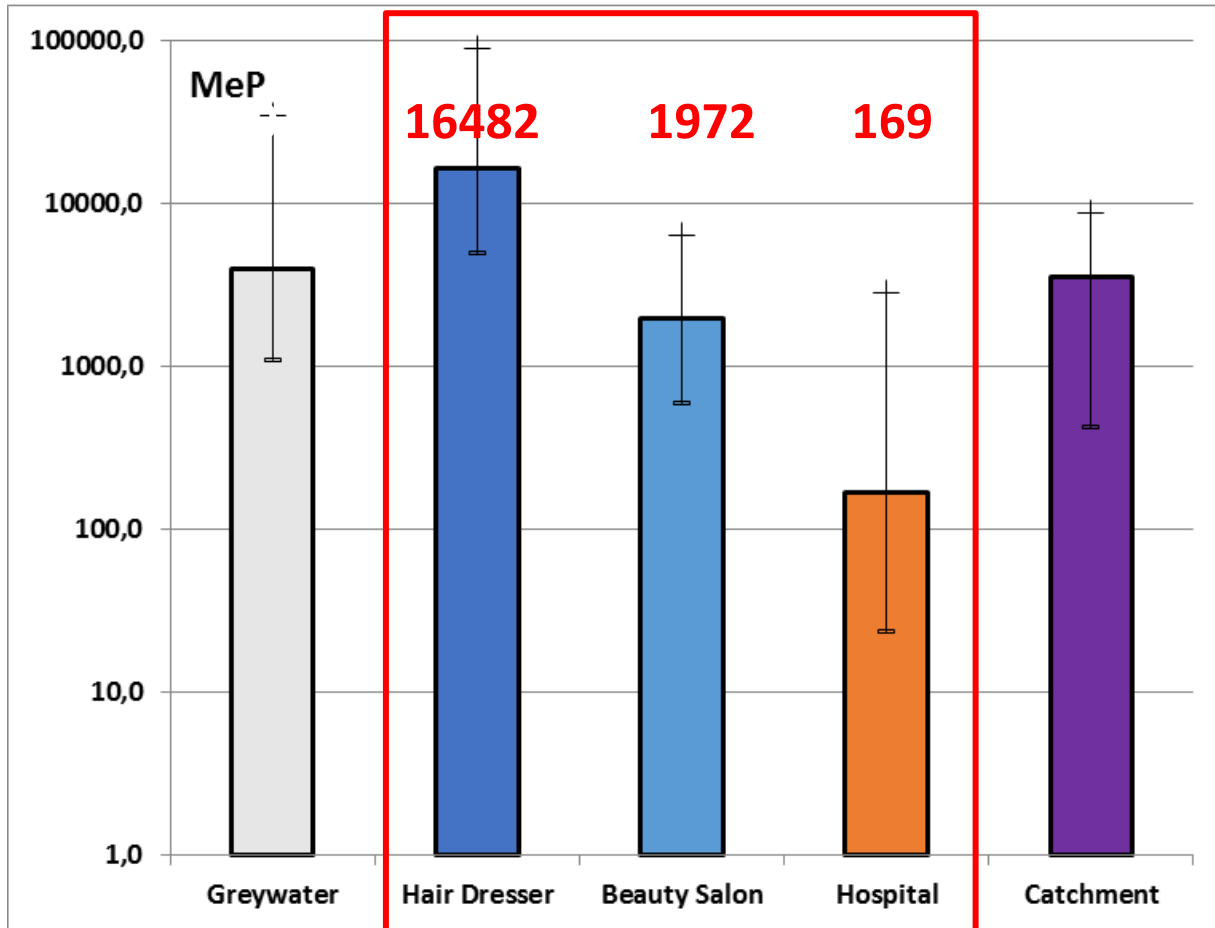


(x1)

Main sewer trunks

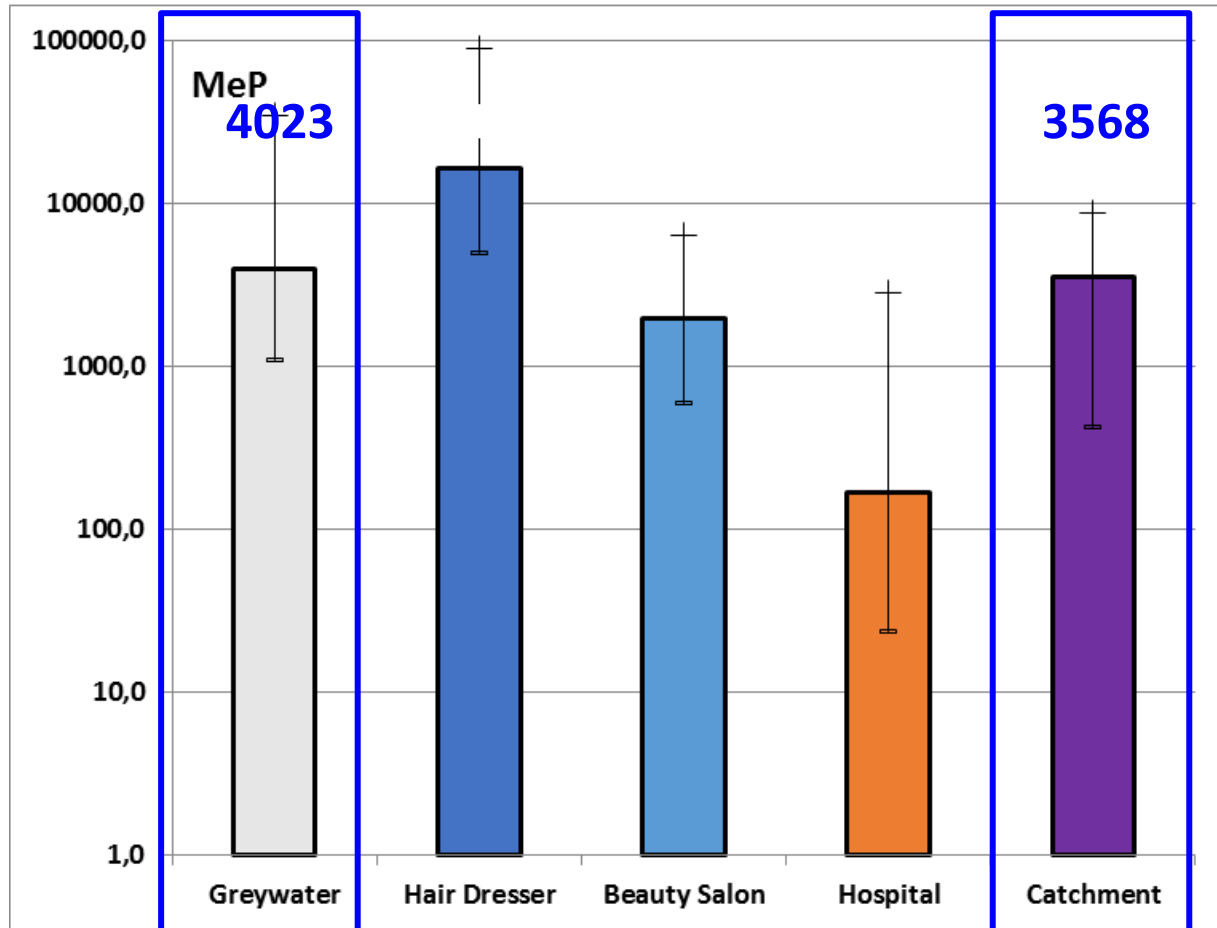


Wastewater (ng/L)



**1. Industrial effluents
(more or less)
contaminated...**

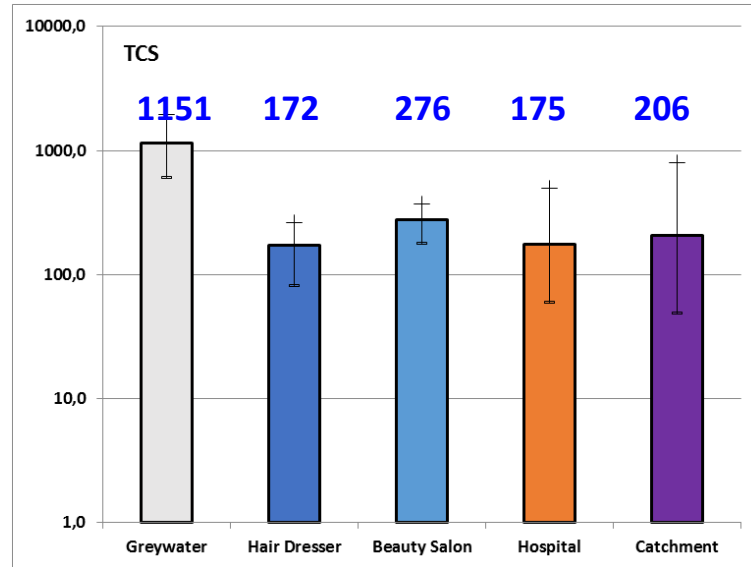
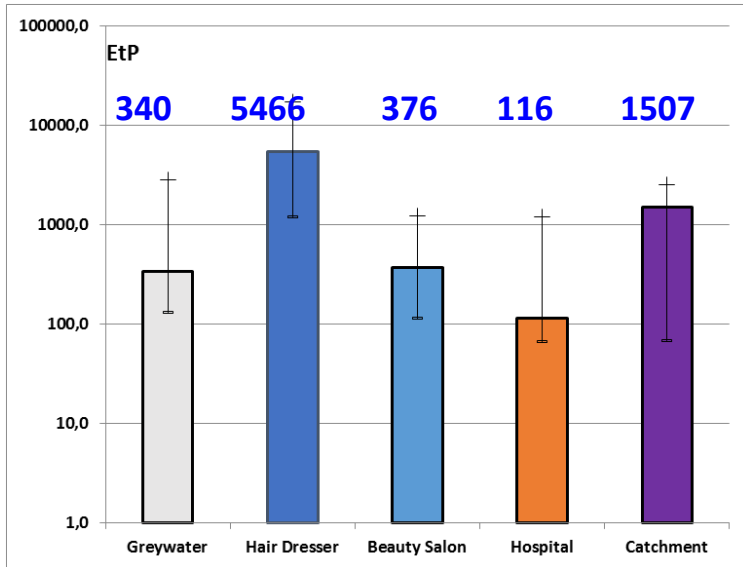
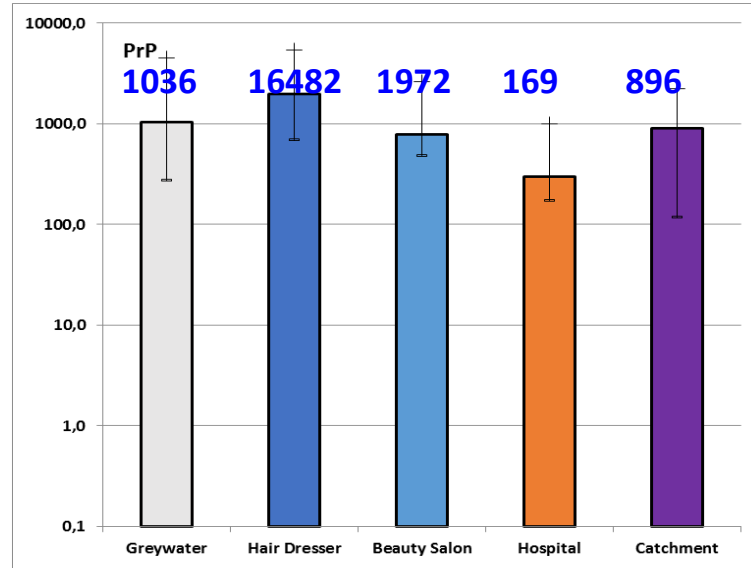
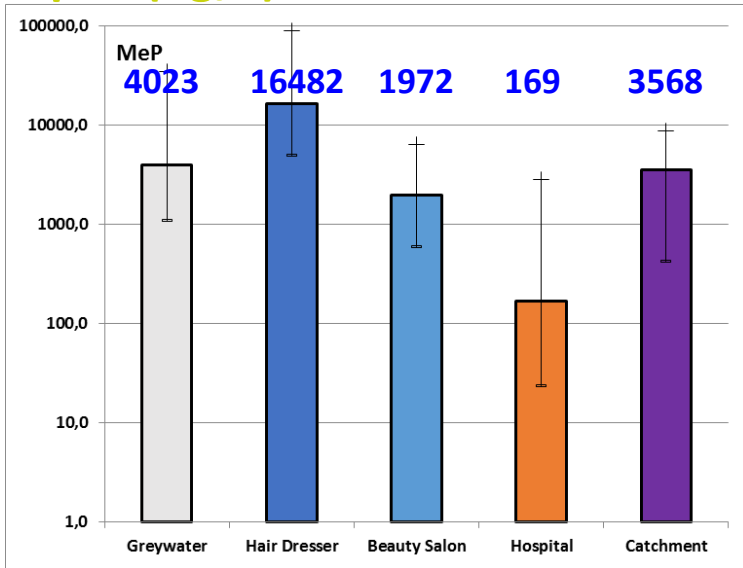
Wastewater (ng/L)



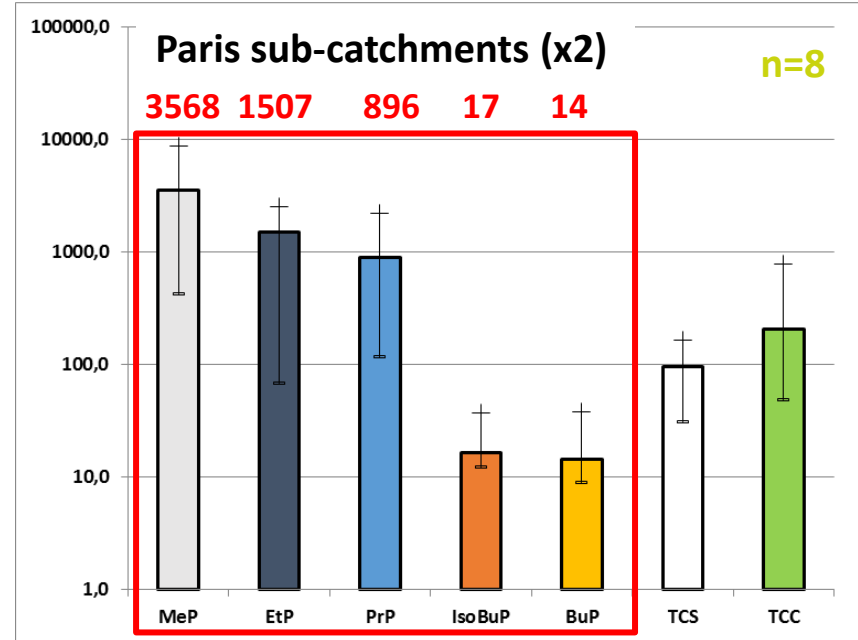
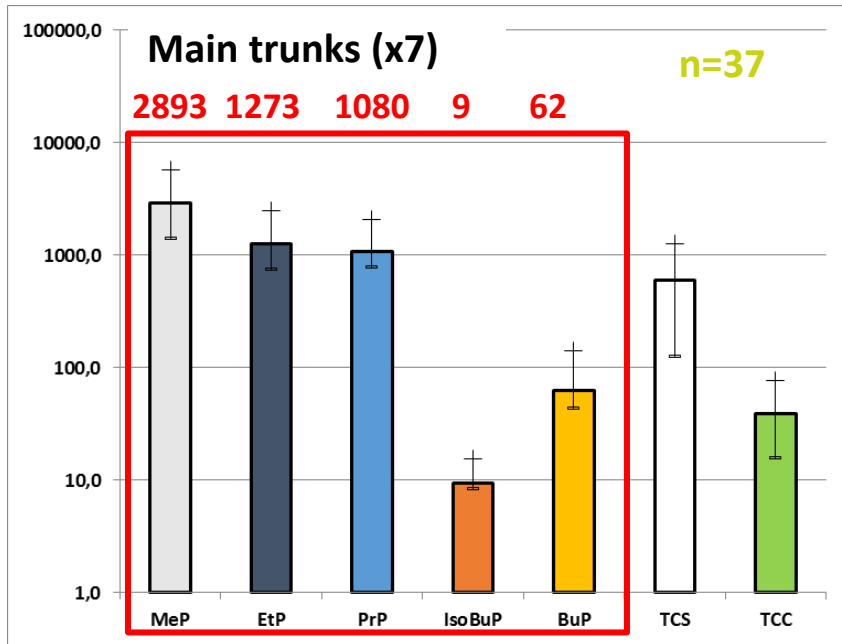
1. Industrial effluents
(more or less)
contaminated...

2. Wastewater levels
similar to greywater
ones

Synoptic (ng/L)

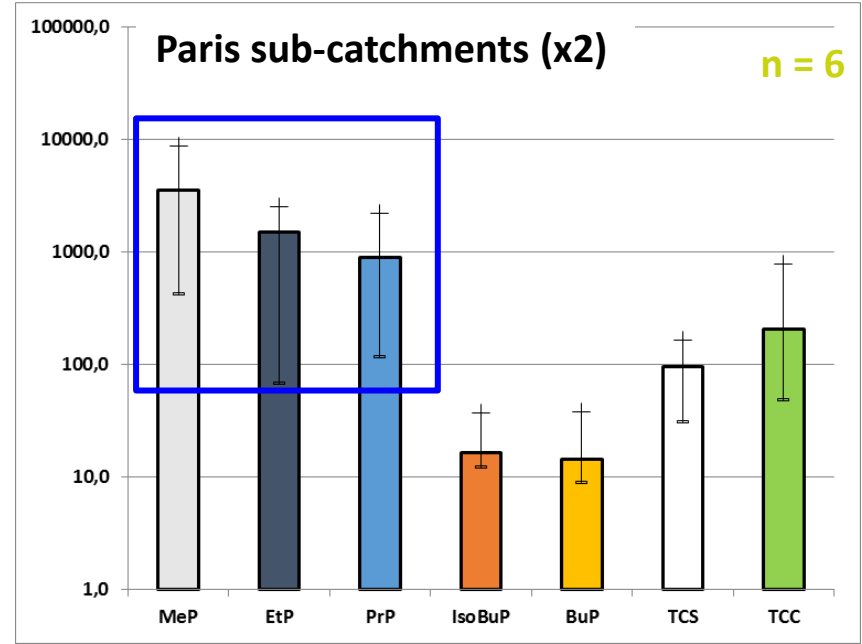
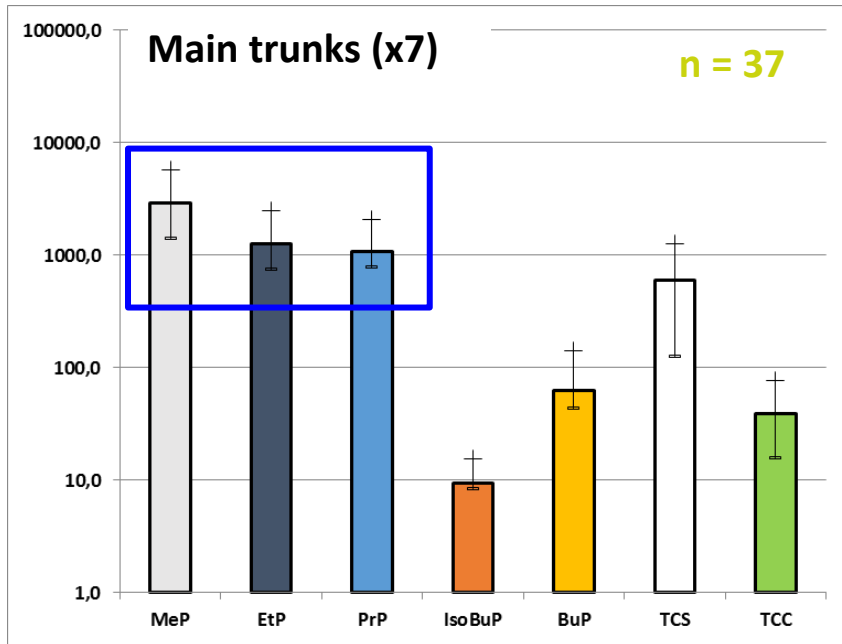


Comparison between main sewer trunks and sub-catchments of Paris (ng/L)



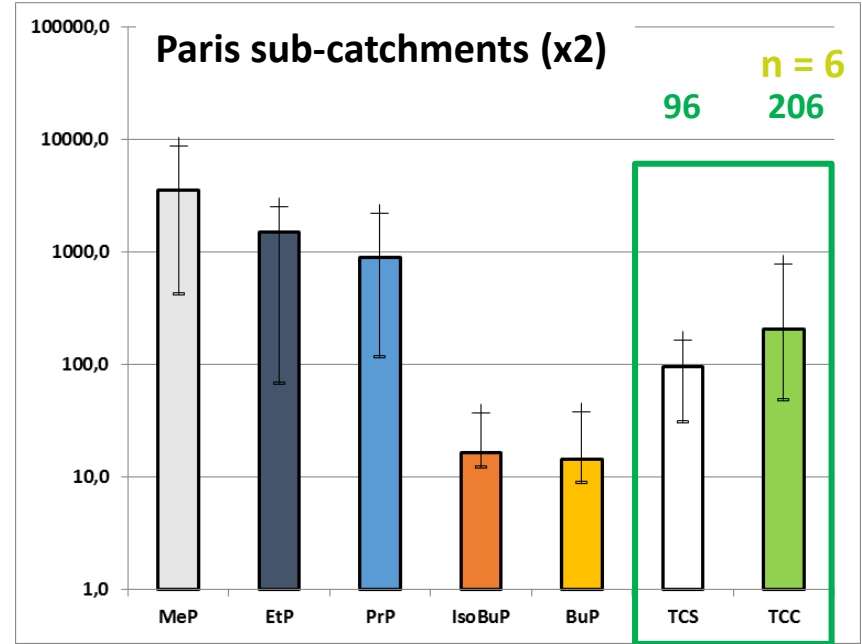
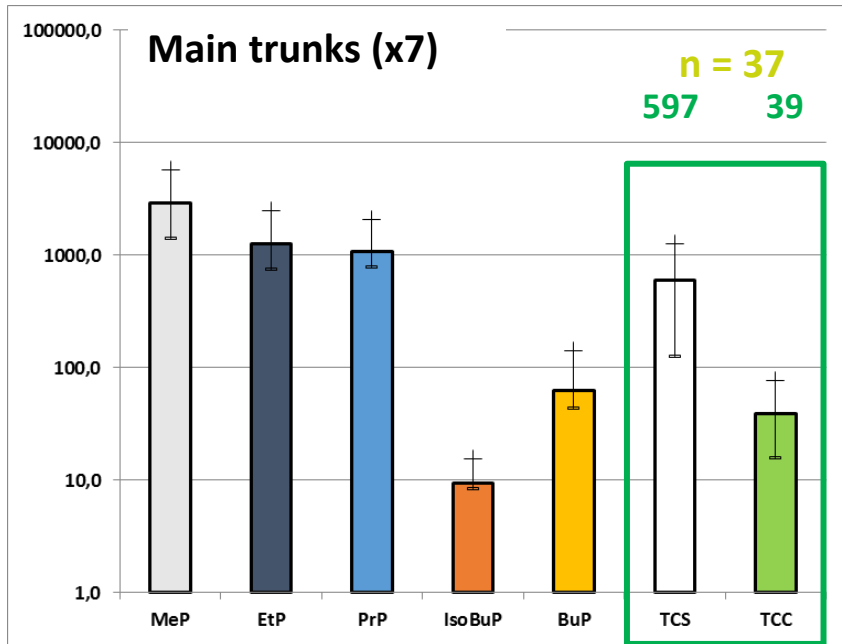
1. Same profiles for parabens

Comparison between main sewer trunks and sub-catchments of Paris (ng/L)



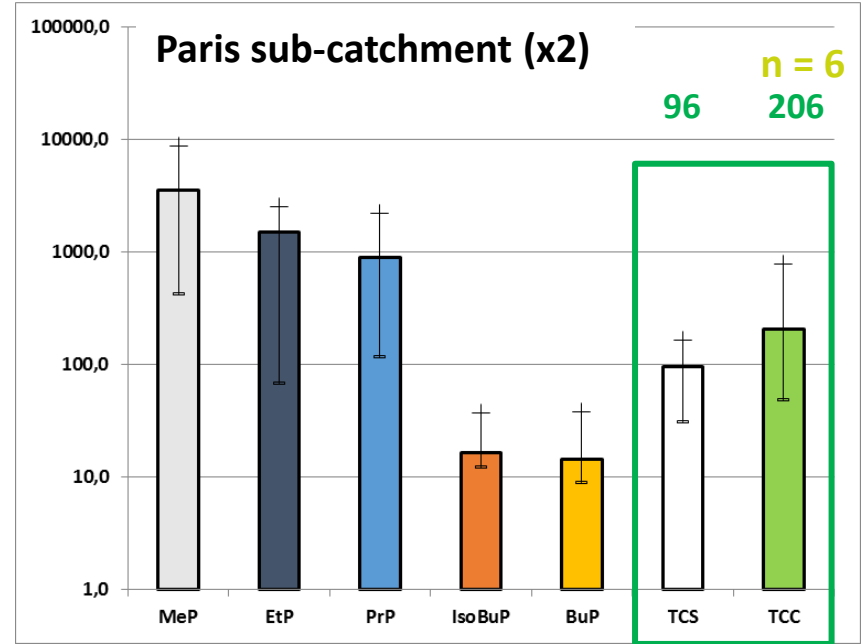
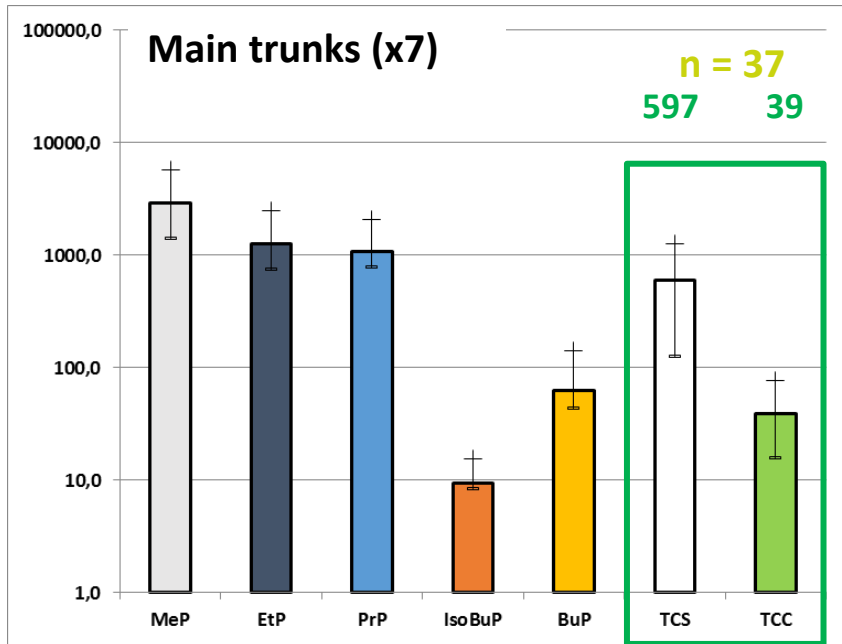
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3. Surprising behaviour of triclosan and triclocarban...

Comparison between main sewer trunks and sub-catchments of Paris (ng/L)



1. Same profiles for parabens
2. When the scale increases, the variability decreases
3. Surprising behaviour of triclosan and triclocarban...

➔ Substantial flows reach WWTPs: what about the receiving environment?

Findings

- Ubiquitous **wastewater contamination** by parabens, TCS and TCC
 - Domestic and industrial origins
 - *Relative contributions to identify levers for action?*
- **MeP, EtP & PrP predominate**
 - Consistent with the uses associated with these preservatives... *in personal care products*
- **Significant variability of concentrations**
 - Within a given sector of activity but also between different sectors
 - *What about the composition of the products used?*
- **Smoothing of observed levels when scale increases**
 - Concentrations close to those in greywater
- Transfer from emission sources to WWTP
 - *Fate at the different stages of WWTP? In fine impact on the environment?*

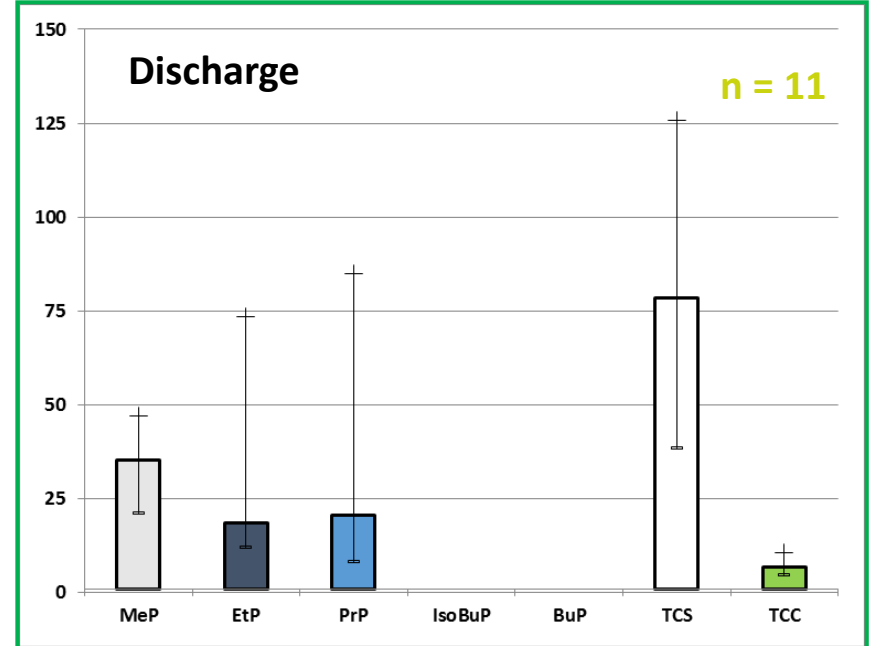
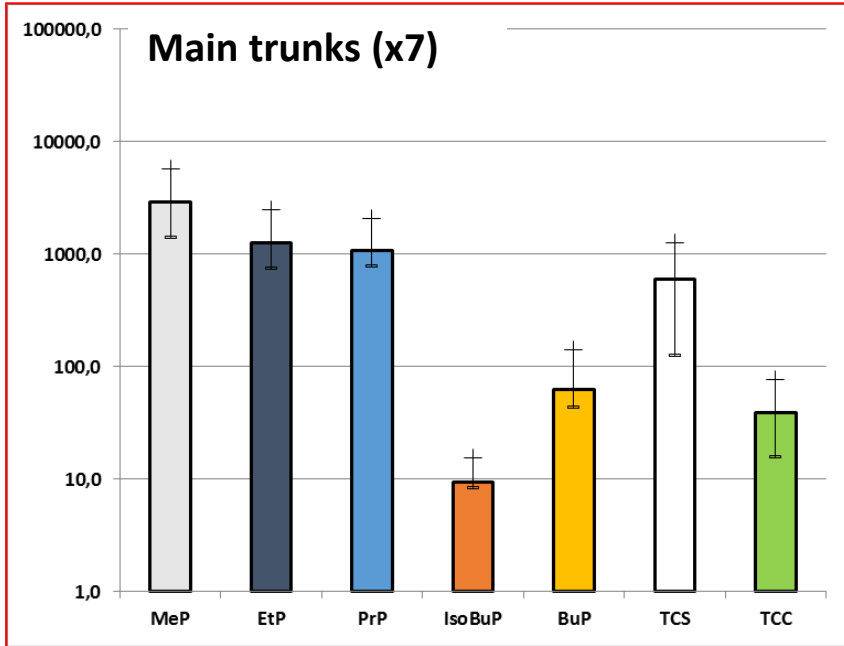
Part III

Surface Water Contamination

**Determine the levels of impregnation of the
Seine River**



Discharge vs main trunks (ng/L)



Trunks (ng/L)

MeP :	2893
EtP :	1273
PrP :	1080
IsoBuP :	9
BuP :	62
TCS :	597
TCC :	39

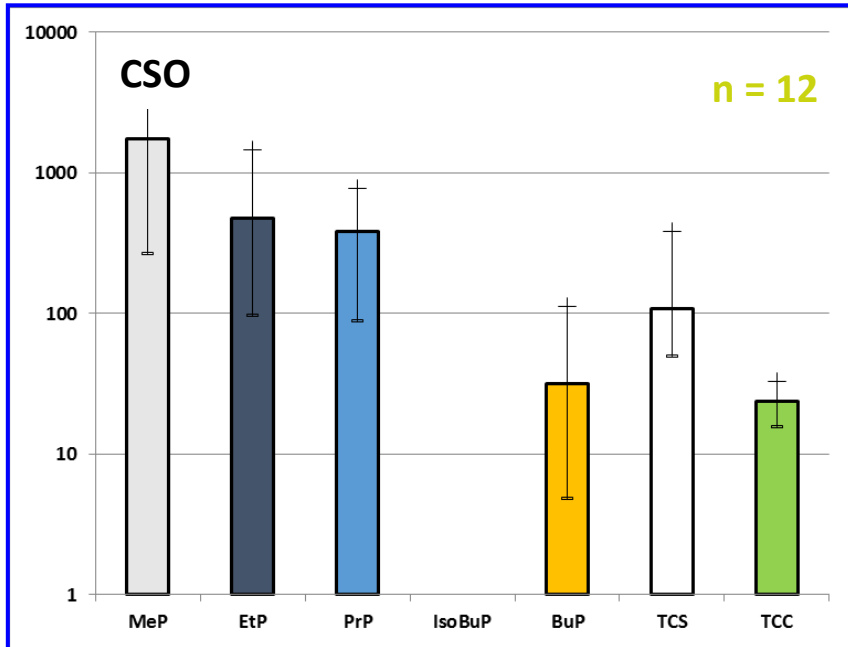
Significant decrease of concentrations

- Efficiency of treatment processes...

Discharge (ng/L)

MeP :	35
EtP :	19
PrP :	21
IsoBuP :	< LQ
BuP :	< LQ
TCS :	78
TCC :	7

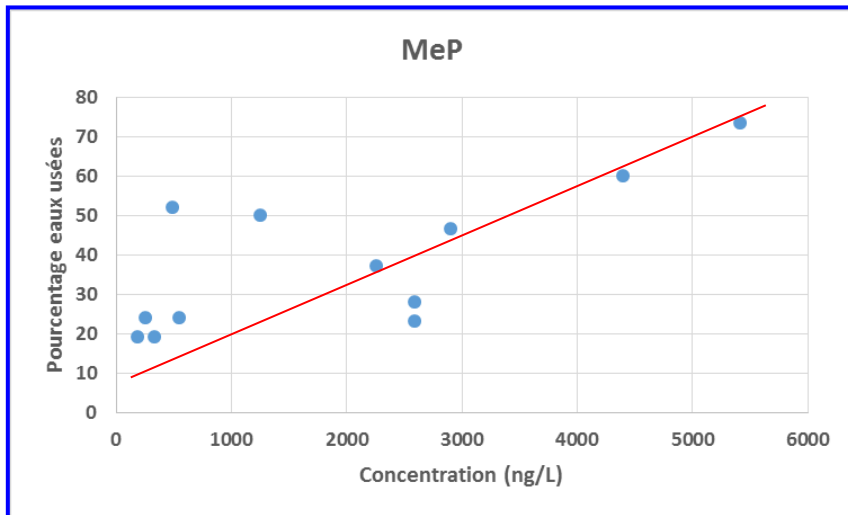
CSOs (ng/L)



CSO levels in between sewer trunks and discharge

DO (ng/l)

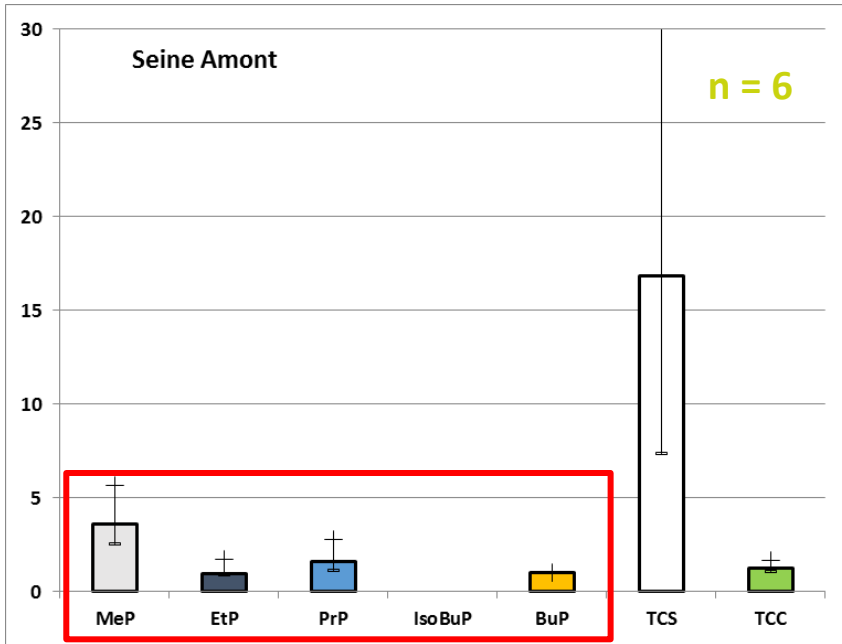
MeP :	1757
EtP :	476
PrP :	381
IsoBuP :	< LQ
BuP :	32
TCS :	109
TCC :	24



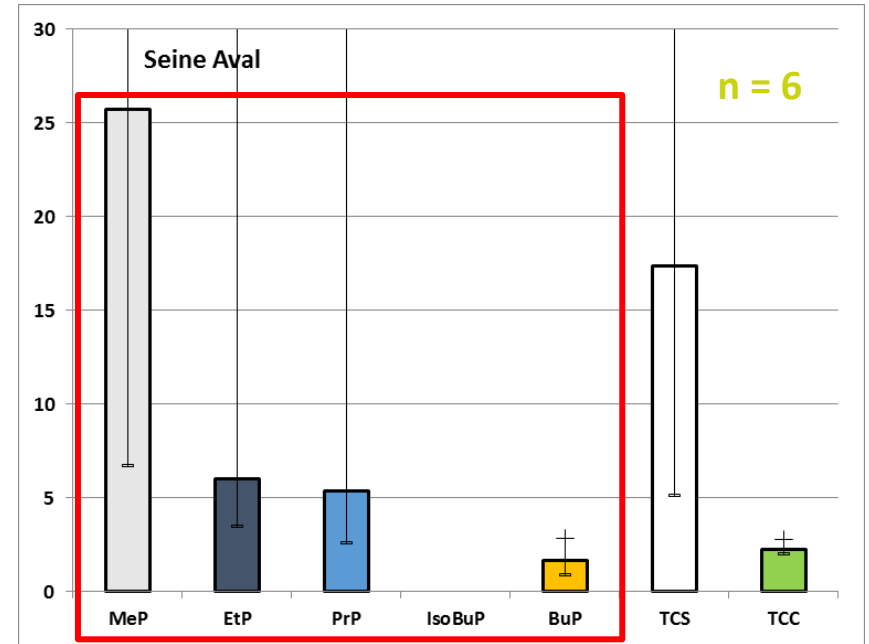
High temporal variability

- Largely related to the intensity of the discharge...
- and *therefore the volume of wastewater mixed to runoff.*

UPSTREAM (ng/L)

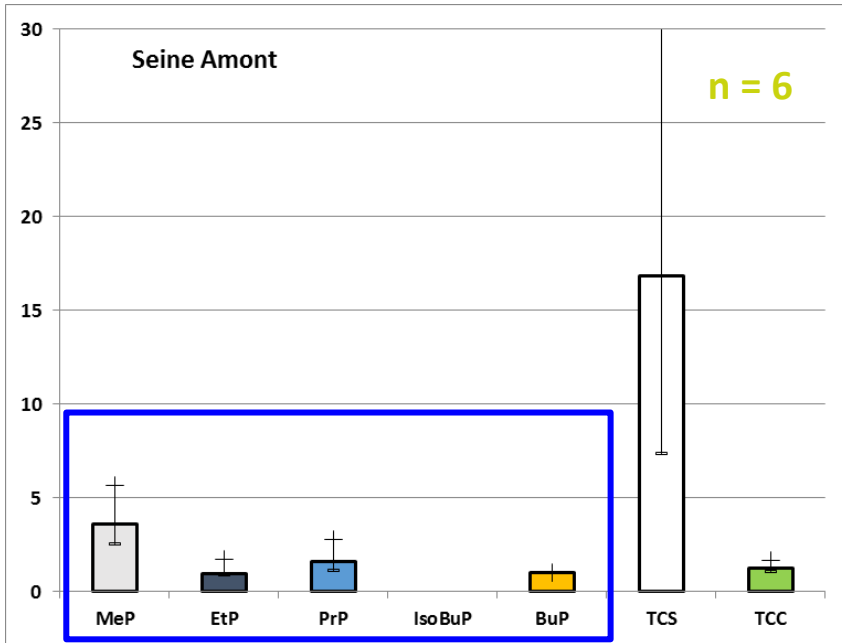


DOWNSTREAM (ng/L)

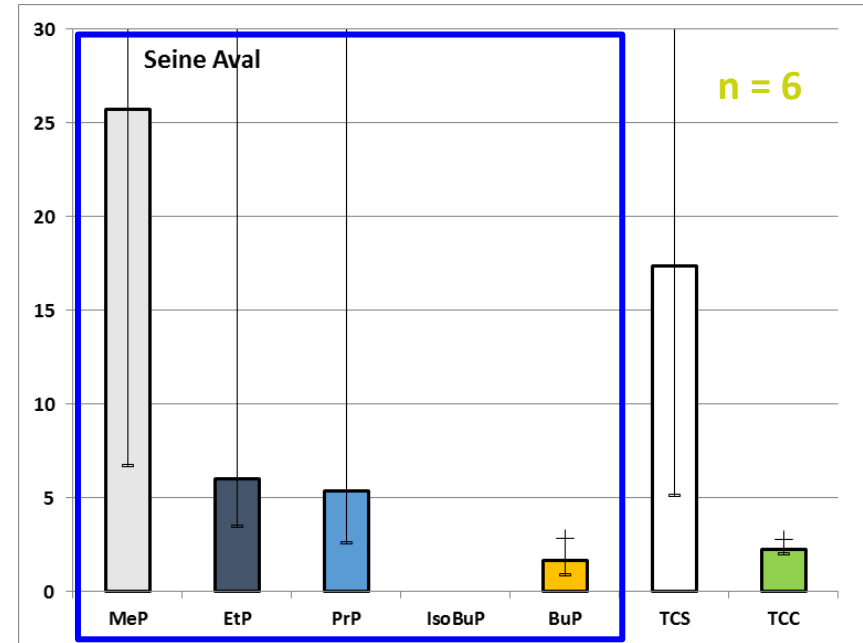


1. Increase in concentrations from upstream to downstream of the Paris conurbation... for parabens

UPSTREAM (ng/L)

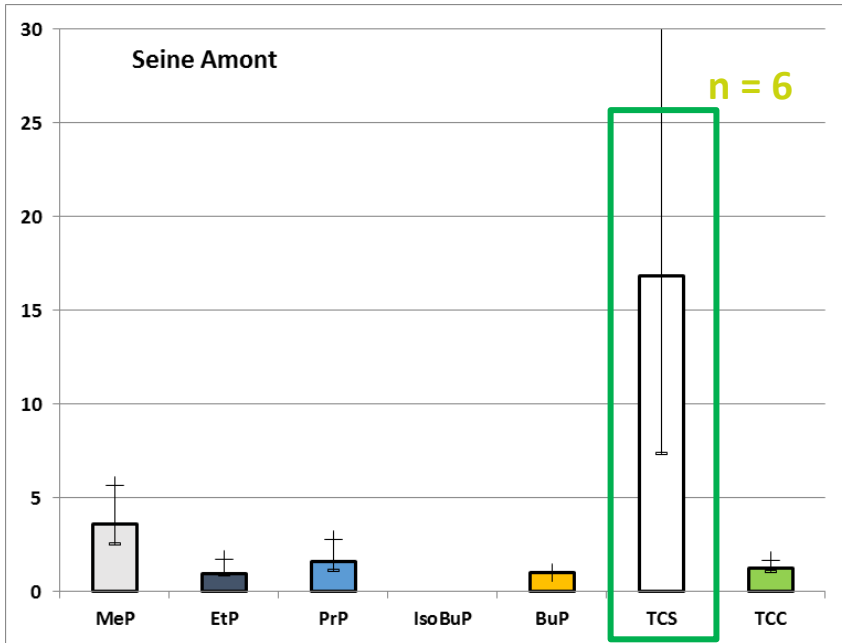


DOWNSTREAM (ng/L)

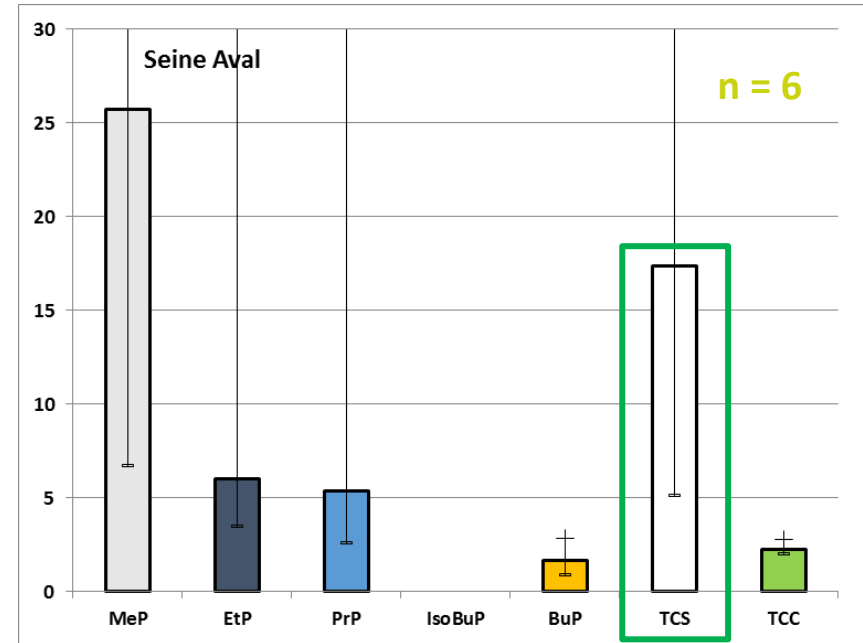


1. Increase in concentrations from upstream to downstream of the Paris conurbation... for parabens
2. Along with spatial variability → *to be linked to contamination sources*

UPSTREAM (ng/L)

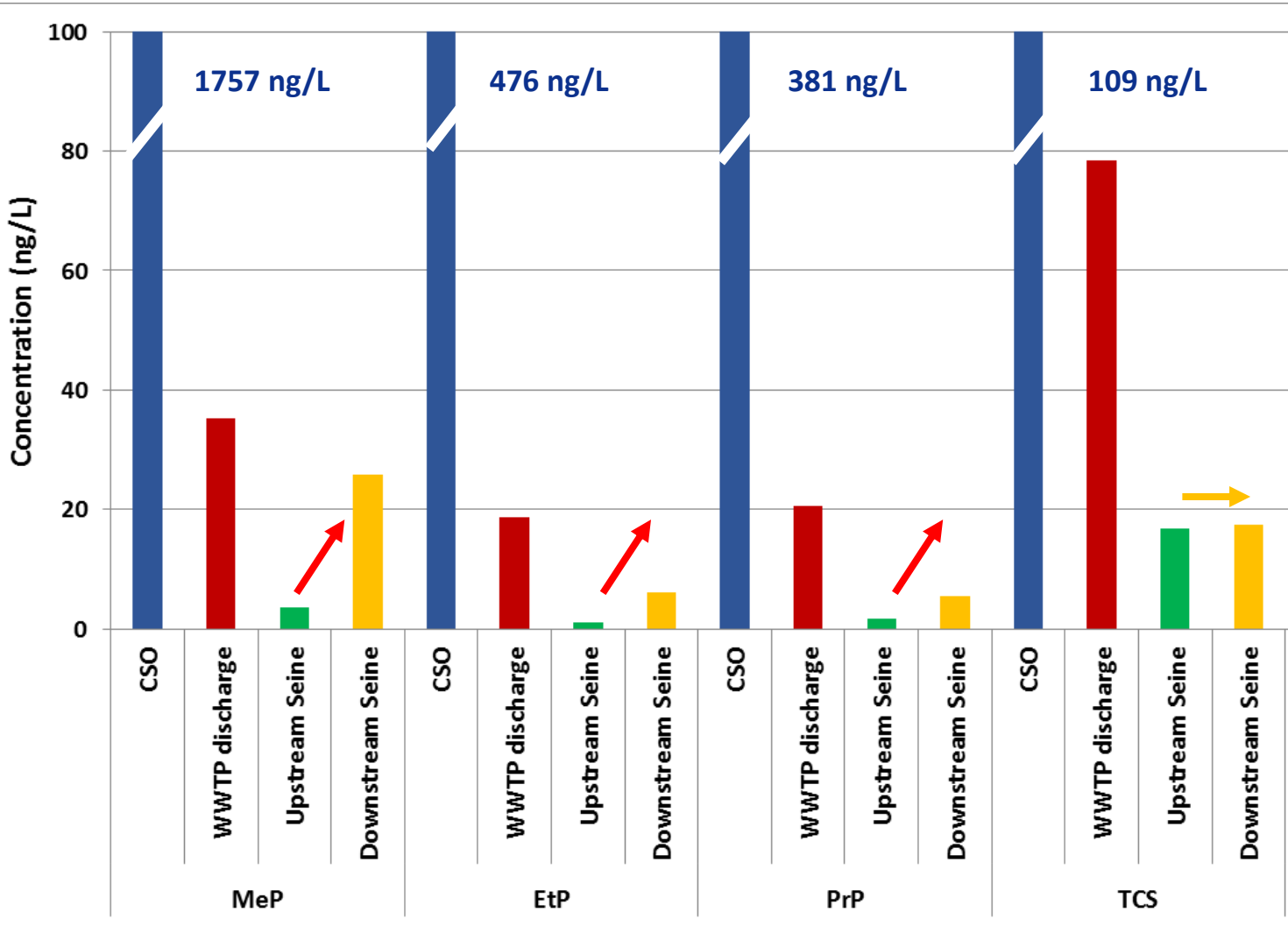


DOWNSTREAM (ng/L)



1. Increase in concentrations from upstream to downstream of the Paris conurbation... for parabens
2. Along with spatial variability → to be linked to contamination sources
3. Less net increase for triclosan...

Evolution of the contamination of the Seine River from upstream to downstream



Findings

- High WWTP removal efficiency...
- However WWTP discharges contaminate the receiving environment
 - ➔ *Need to refine treatments (by promoting tertiary treatment)*
- **CSOs**: significant source of contamination
 - ➔ *Keep on limiting untreated discharges for major events*
- **Impact of the Paris conurbation** on the Seine River quality
 - Increase of the concentrations from upstream to downstream

Conclusion



Wastewater

Ubiquitous Water Contamination in Urban Areas

Fate in sewer network

Discharge into the environment

WWTP

Removal Efficiency

Receiving waters

Impact of Paris Conurbation

Zedek (2016)

Dynamics of emerging pollutants (parabens, triclosan and triclocarban) in the grey waters-receiving environment continuum

Greywater

Significant concentration variability

30th November – 1st December 2017

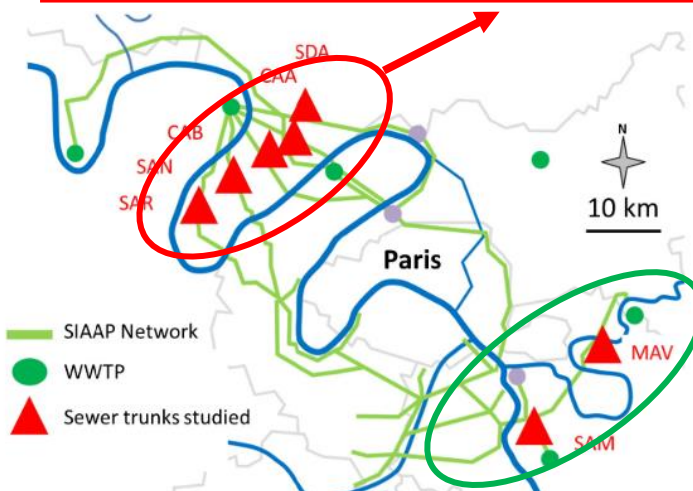
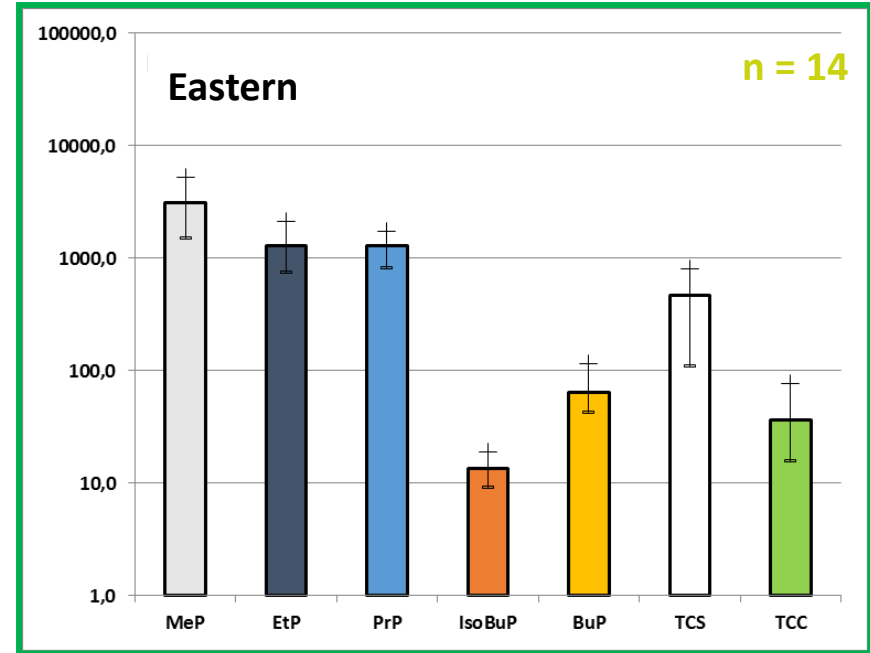
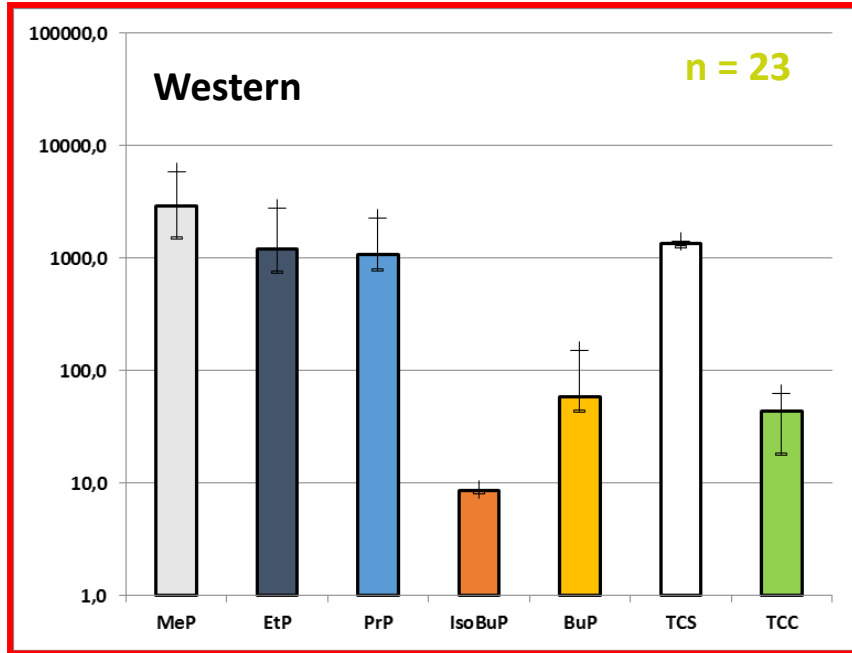
INSA Lyon, France

Colombian - French Conference on Urban Water Systems

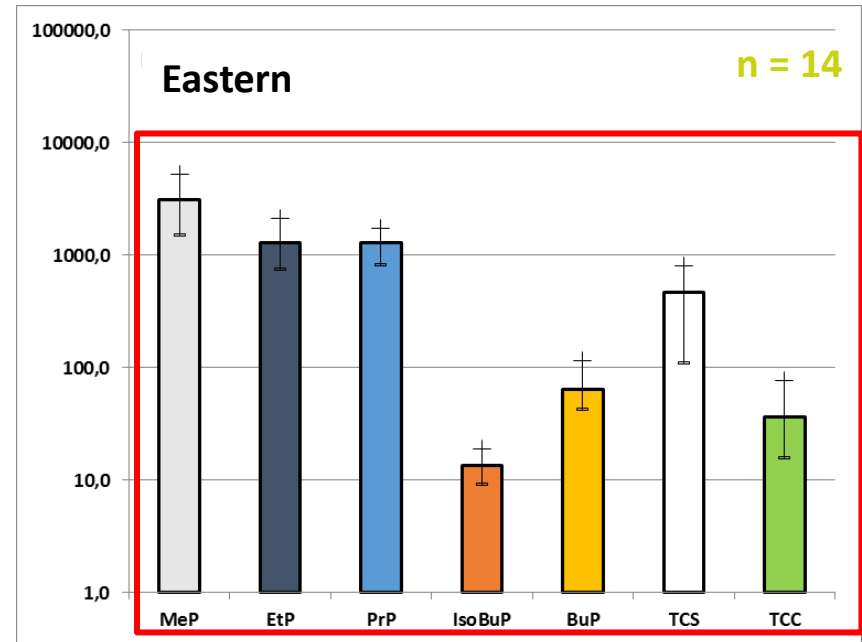
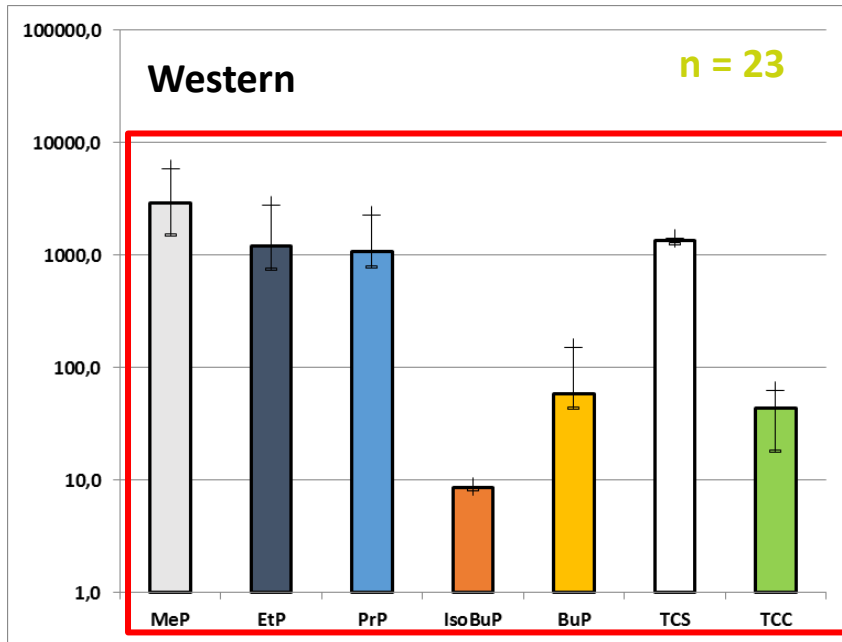


Main sewer trunks of Paris conurbation - results

Comparison between « western » and « eastern » trunks (ng/L)

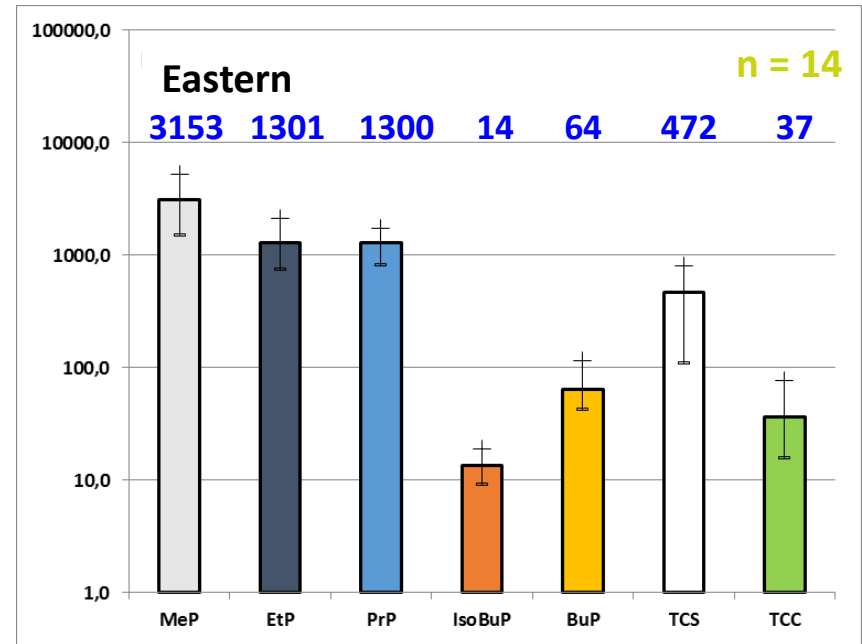
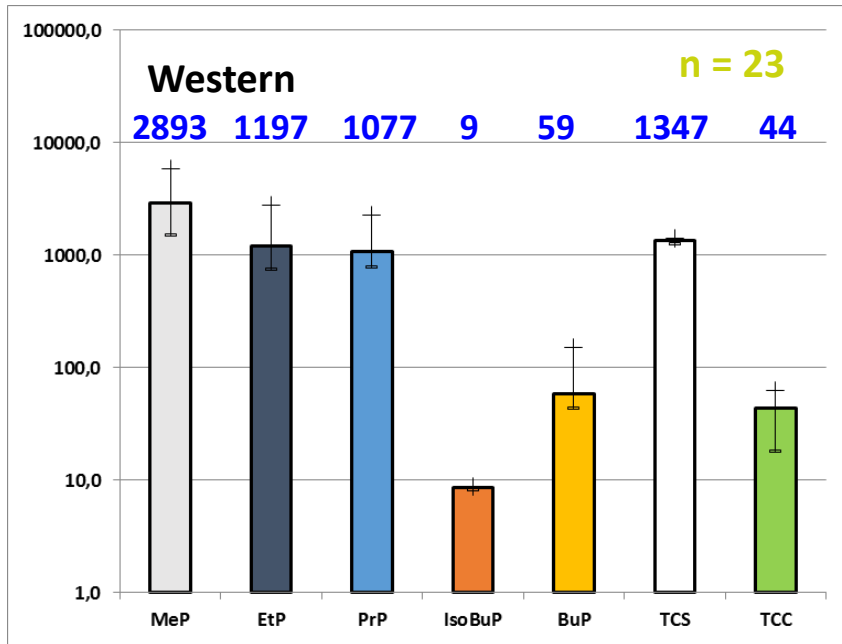


Comparison between « western » and « eastern » trunks (ng/L)



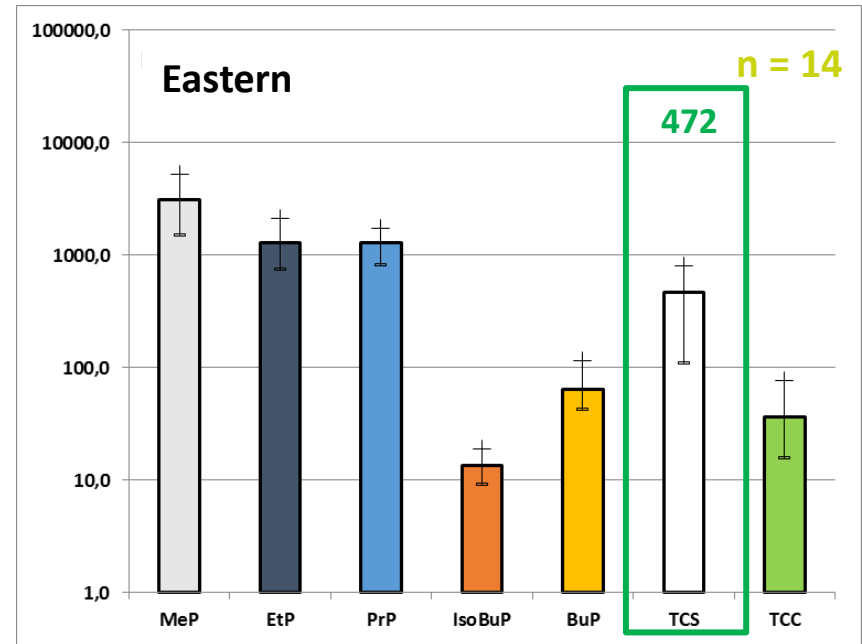
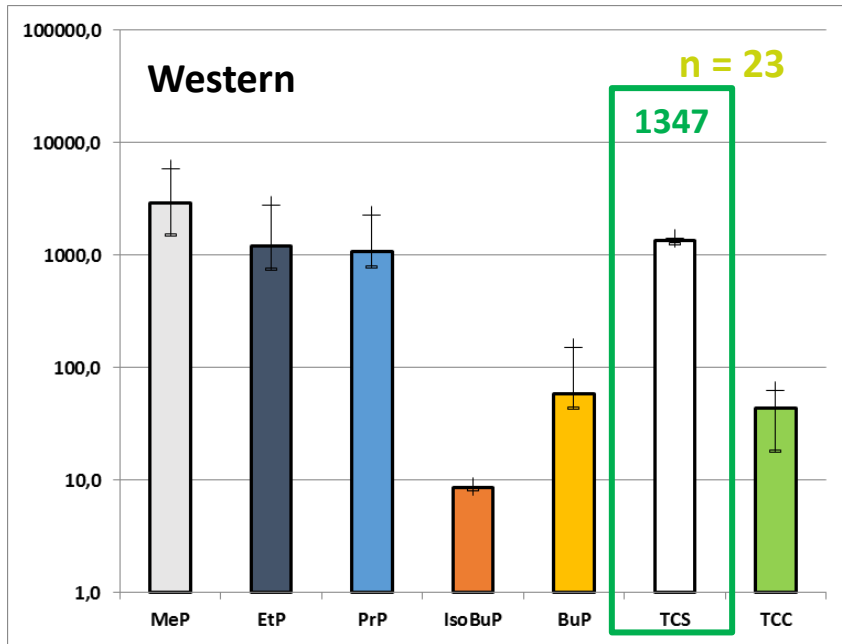
1. (very) similar profiles...

Comparison between « western » and « eastern » trunks (ng/L)



1. (very) similar profiles...
2. Same concentration levels...

Comparison between « western » and « eastern » trunks (ng/L)



1. (very) similar profiles...
2. Same concentration levels...
3. Except for TCS