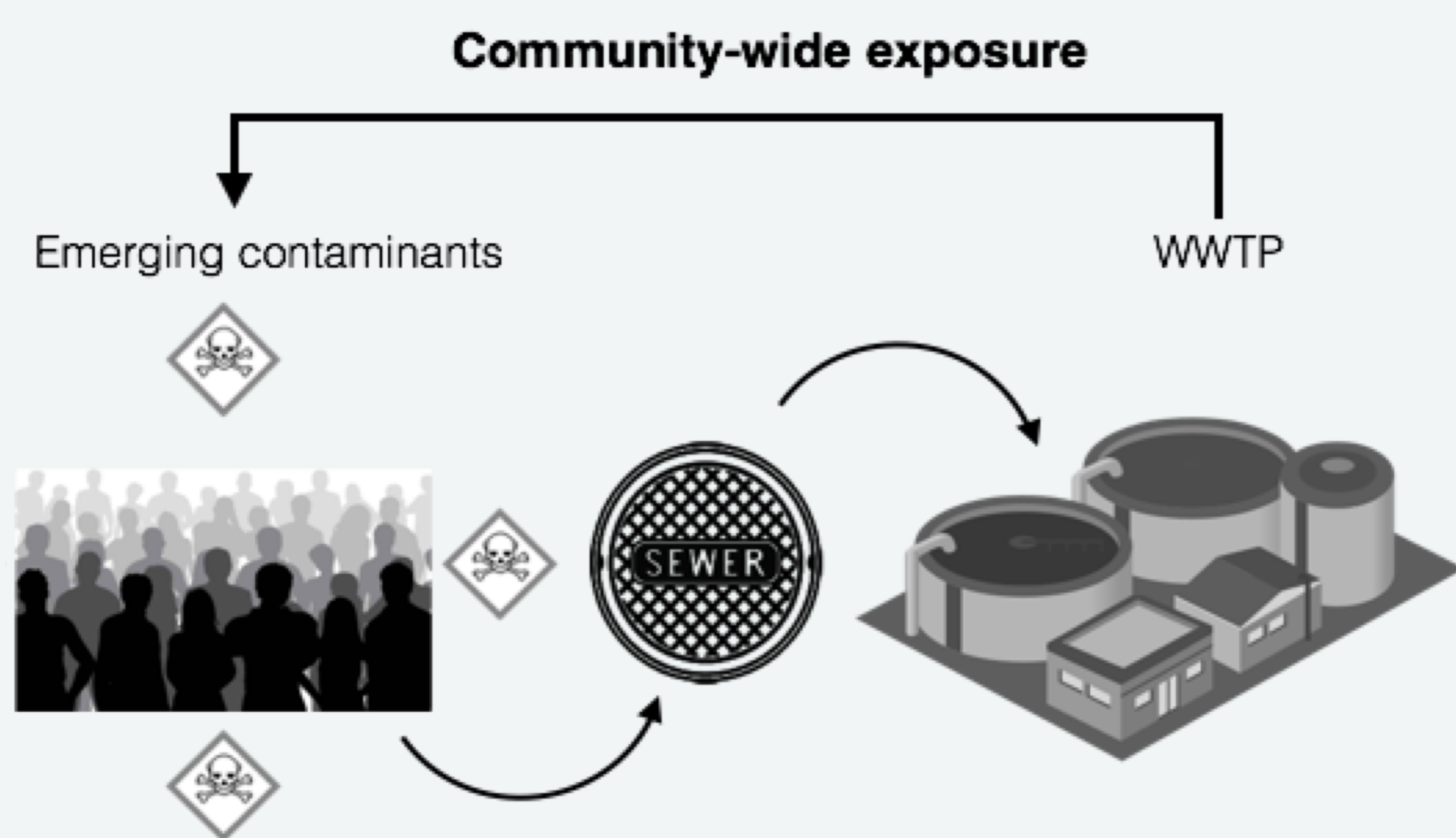


Mining the chemical information of urban wastewater – Monitoring exposure to phosphorus flame retardants and plasticizers

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Introduction

Phosphorus flame retardants and plasticizers (PFRs) are used as flame retardants and plasticizers in a wide range of products such as furniture, textile, electronics, PVC, resins and paints. PFRs are not chemically bound to these materials and are therefore easily released and detected in the environment¹. PFRs may pose a risk to human health: some are suspected carcinogens, neurotoxins and endocrine disruptors. Complementary to classical human biomonitoring, PFR metabolites can be measured in wastewater to assess exposure in the general population^{2,3}.



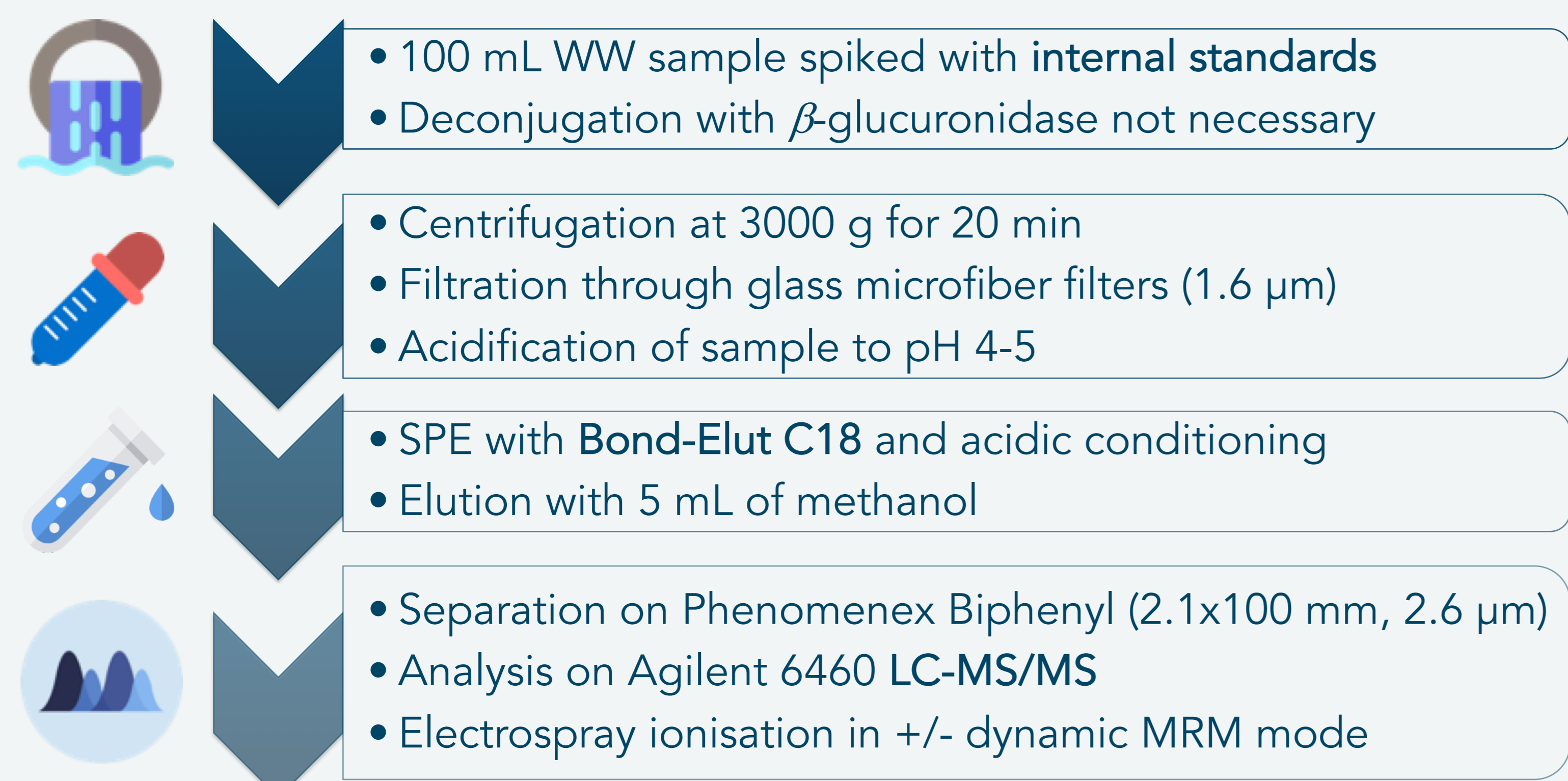
Aims

- Assess geographical differences across five European WWTP's
- Investigate temporal trends over four consecutive years at one WWTP
- Compare to human biomonitoring data and production volumes
- Estimate per capita average urinary concentrations based on population normalised mass loads of PFR metabolites measured in wastewater

Target compounds

Parent PFR	Metabolites	Name
EHDPHP	HO-EHDPHP	2-ethyl-5-hydroxyhexyl diphenyl phosphate
	EHPHP	2-ethylhexyl phenyl phosphate
	DPHP	diphenyl phosphate
TBOEP	BBOEP	bis(2-butoxyethyl phosphate)
	HO-TBOEP	bis(2-butoxyethyl) 3'-OH-2-butoxyethyl phosphate
	BBOEHEP	2-hydroxyethyl bis(2-butoxyethyl) phosphate
TCIPP	BCIPHIPP	1-hydroxy-2-propyl bis(1-chloro-2-propyl) phosphate
	BCIPP	bis(1-chloro-2-propyl) phosphate
TPHP	DPHP	diphenyl phosphate
	HO-DPHP	4-hydroxyphenyl phenyl phosphate
TCEP	TCEP (*)	tris(chloroethyl) phosphate
TDCIPP	BDCIPP	bis(1,3-dichloro-2-propyl) phosphate

Sample preparation and analysis



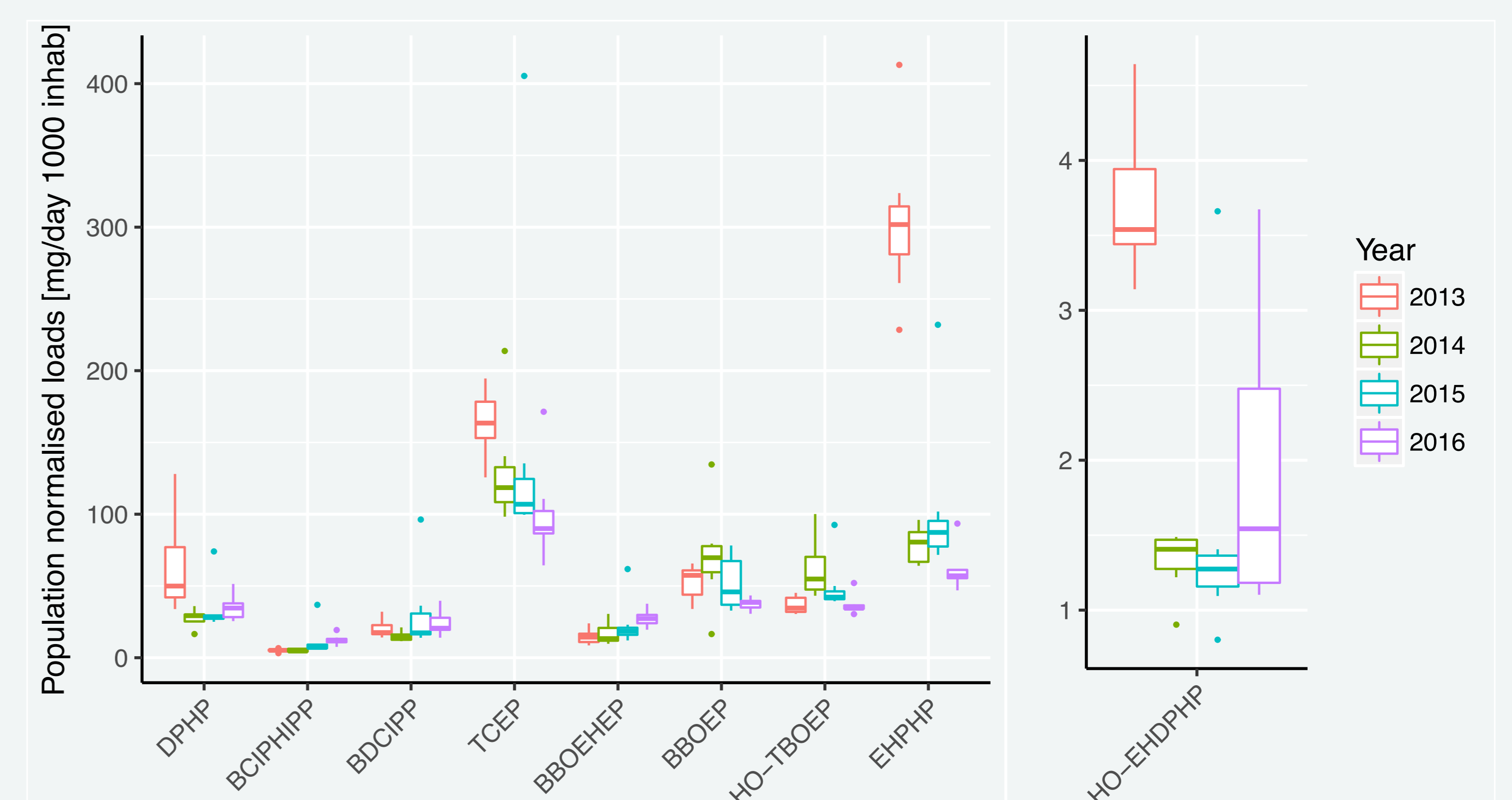
Monitoring Community-wide Exposure to PFRs

Geographical features [Antwerp, Brussels, Athens, Geneva, Vilnius]



- Antwerp & Brussels (BE) show similar results, as well as Geneva (CH)
- Overall low levels in Athens (GR) compared to other cities
- Uniform levels of DPHP at all locations because applied as plasticizer
- EHPHP highest per capita loads at all locations particularly Vilnius (LT), suspected use as plasticizer?

Temporal trends [1 week per year, 2013-2016, using Antwerp WWTP data]



- Substantial changes for most compounds
- TCEP: decreased production in EU
- TCIPP: increased use in replacement of TCEP (see BCIPHIPP)
- TBOEP: increased levels in dust (see BBOEHEP)

Estimating urinary concentrations using Monte Carlo simulations



- Concentrations generally 0.5-1 orders of magnitude higher (i.e., mean and median) compared to recent biomonitoring data
- In some cases concentrations were similar to the upper range measured in biomonitoring studies
- However, uncertainty in simulation: other excretion routes (e.g. faeces?), non-human sources, in-sewer stability (biofilms), and populations estimates

References

- van der Veen, I. et al., *Chemosphere* 88.10 (2012): 1119-1153.
- Been, F., Bastiaensen, M., et al., *Anal. Chemi.* 89.18 (2017): 10045-10053.
- Been, F., Bastiaensen, M., et al., *Environ. Sci. Technol.* 52.12 (2018): 6996-7005.