

**HELCOM action on micropollutants in effluents of
wastewater treatment plants
&
input by BSR-water project platform**

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HELCOM

HELCOM joint action on Micropollutants in effluents from wastewater treatment plants

- **INTERREG BSR-water project**
- **INTERREG CW PHARMA project**

HELCOM Ministerial Declaration 2018

WE AGREE:

- to re-examine **the effectiveness of measures and recommendations for legacy pollutants**;
- to identify the scale of problems of **contaminants of emerging concern**, including **micro-pollutants** in coastal and marine waters and based on this knowledge, to consider possible cost-effective mitigation measures.
- **WE WELCOME** the joint HELCOM-UNESCO-EUSBSR status report on pharmaceuticals in the aquatic environment in the Baltic Sea Region as the information basis for developing measures, as appropriate, to prevent pharmaceuticals from reaching the Baltic Sea, and also **WELCOME** the EU Strategy for the Baltic Sea Region (EUSBSR) regional cooperation platform to reduce pharmaceuticals in the Baltic Sea;

Joint documentation of regional coordination of programmes of measures for the EU MSFD

ACTION 4: Micropollutants in effluents from wastewater treatment plants (PRESSUE WG)

- *Step 1: Compilation and assessment of available information and data of micropollutants of concern for Contracting Parties in the Baltic Sea*
- *Step 2: Compile information from CPs of treatment techniques and experiences—during*
- *Step 3: Summary report on advanced treatment techniques, including consideration of feasibility, costs, good practice and management options*

Micropollutants in effluents of WWTP identified by the HELCOM countries.

- Why call for data?
 - Better understanding of monitoring data
 - Assess need for focused measures in future HELCOM activities
- Long term goal = revise list of Priority substances
- Information request to Contracting Parties - "concern about inputs of various POPs"
- Concern = CPs *consider or believe* being transported to Baltic Sea Via MWWTPs and RIVERS

Substance (group)	WWTP
Dioxins (PCDD, PCDF, dioxin-like PCBs)	3
Other PCBs (other than dioxin-like)	5
Organotin compounds (TBT, TPhT, etc)	6
PBDEs (pentaBDE, octaBDE, decaBDE)	4
PFAS (PFOS, PFOA)	8
HBCDD	4
Nonylphenols (NP, NPE)	12
Octylphenols (OP, OPE)	12
Short-chain chlorinated paraffins (C10-13)	5
Medium-chain chlorin. paraffins (C14-17)	3
Endosulfan	2
DDTs (sum-DDT, DDE, etc)	2
PAHs (incl. metabolites)	8
BFRs (PBDEs etc)	5
HCHs (alpha, beta, gamma)	4
Heptachlor	4
Heavy metals	14
Pharmaceutical residues	12
Herbicides (except listed above)	6
Fungicides (except listed above)	5
Insecticides (except listed above)	5
Endocrine disrupting substances (EDS, except listed above)	9
Animal/veterinary drug residues (except listed above)	2
Disinfectants (except listed above)	5

Overview of the data on micropollutants collected from 241 WWTPs

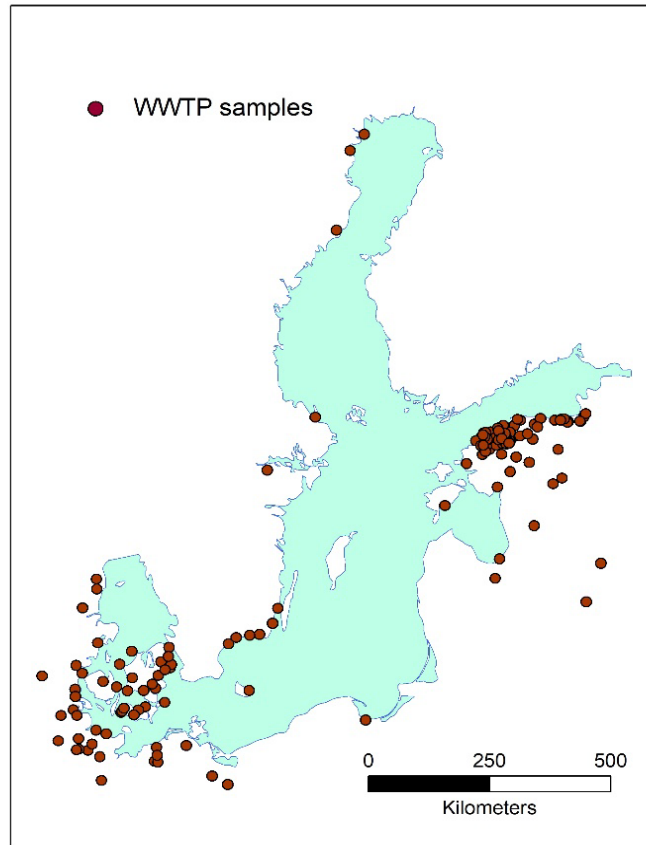
		Denmark	Estonia	Germany	Latvia	Sweden	Poland	Data points
phenols	Effluent	x	x	x		x		1680
	Influent	x					x	
	Sludge		x			x		
PFAS	Effluent	x		x	x	x	x	3730
	Influent	x					x	
	Sludge			x		x		
HM	Effluent	x	x	x	x	x	x	6920
	Influent	x	x		x		x	
	Sludge		x			x	x	

Overview of the data on pharmaceuticals collected from 102 WWTPs

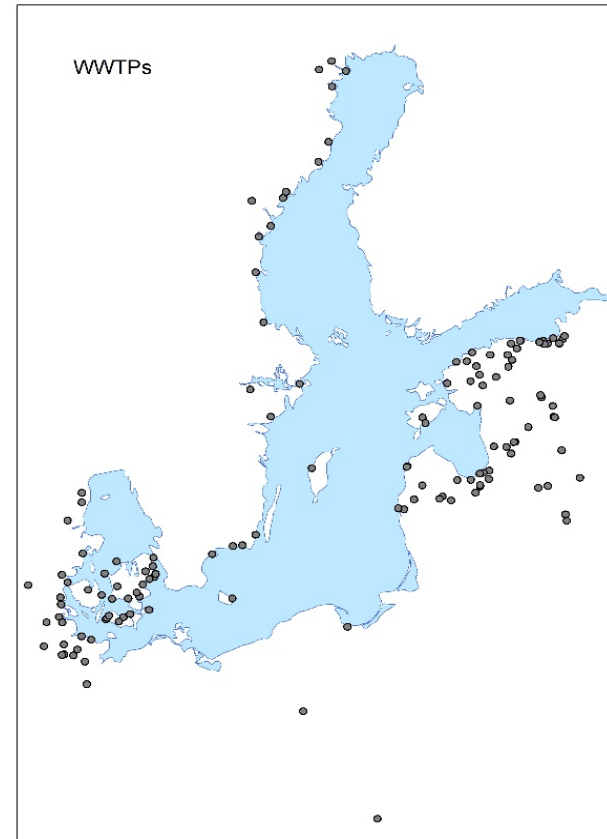
Country	Data points		Number of WWTPs	
	MP	SR	MP	SR
Denmark (DK)	5687	4255	34	37
Estonia (EE)	0	270	0	3
Finland (FI)	515	895	10	19
Germany (DE)	1045	977	11	16
Latvia (LV)	25	0	5	0
Poland (PL)	316	0	13	0
Sweden (SE)	0	396	0	4

Data coverage

Phenols and PFAS

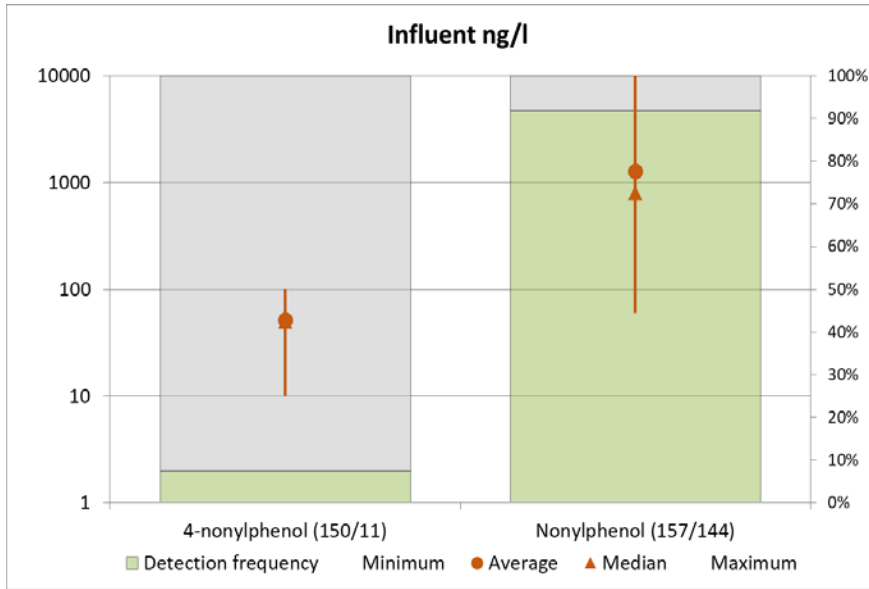


Metals



total 241 identifiable WWTPs

Phenols in WWTP



Octylphenol:
 blue = current AA-EQS 100 ng/l (inland waters),
 red = AA-EQS 10 ng/l (other waters)

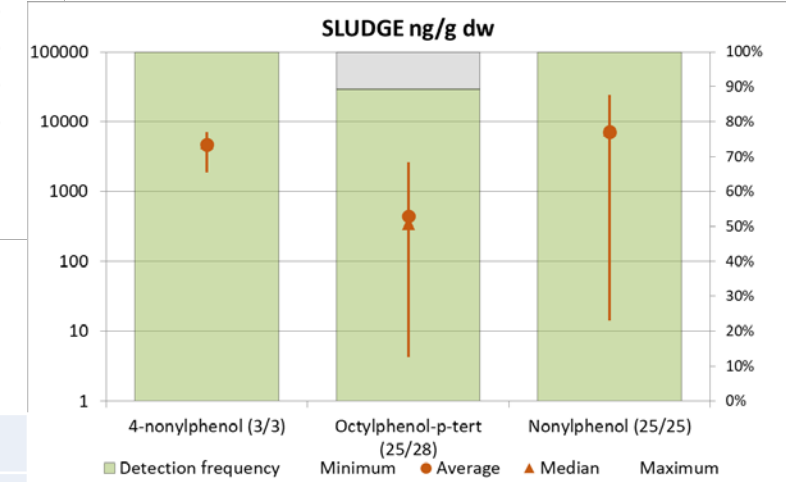
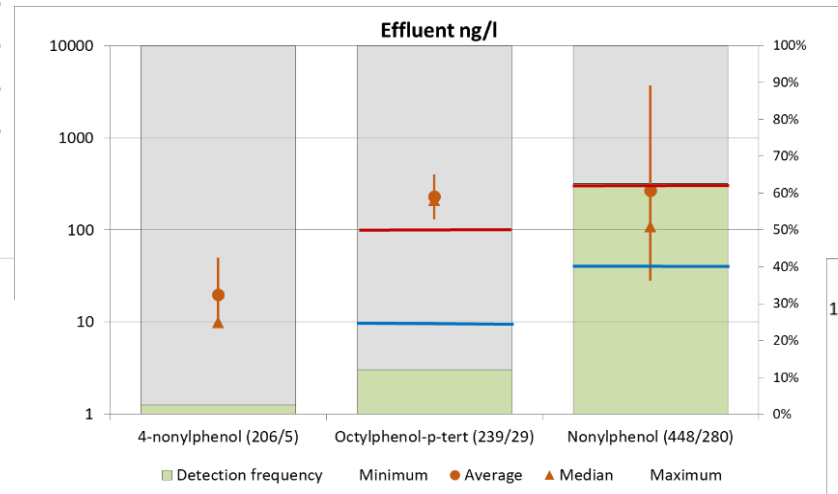
Nonylphenol:
 blue = current AA-EQS 300 ng/l (inland waters),
 red = suggested new chronic EQS 43 ng/l

Influents

	4-nonylphenol	nonylphenol
Avg.	18,5	1178
Med.	10	730

Effluents

	4-nonylphenol	Octylphenol-p-tert	Nonylphenol
Avg.	10	58	210
Med.	10	20	78



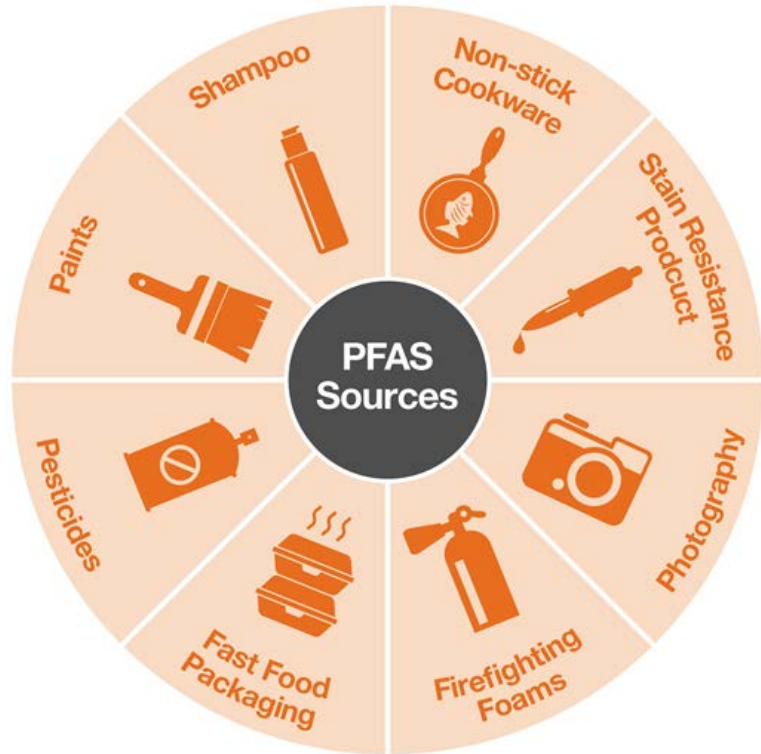
Sludge

	4-nonylphenol	Octylphenol-p-tert	Nonylphenol
Avg.	4700	448	7202
Med.	5000	350	7600

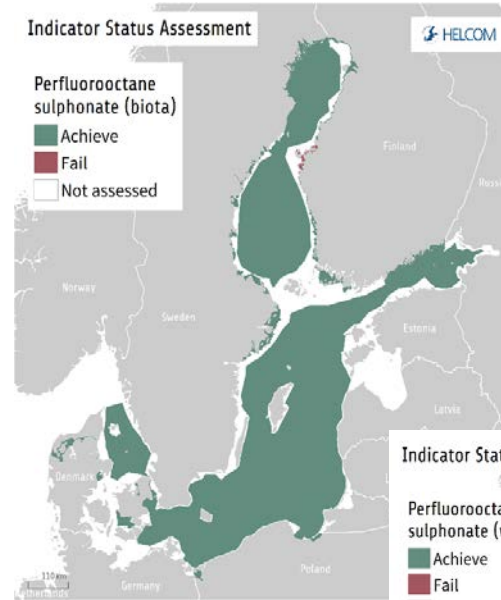
Key conclusions on phenolic substances

- Data on concentrations of phenolic substances are not sufficient for comprehensive estimation of the magnitude of input of these substances to the aquatic environment from sewage systems in the Baltic Sea region.
- However, the data demonstrate that at least two phenolic substances nonylphenol and p-tert-octylphenol isomer are being currently released to municipal sewerages.
- Conventional municipal wastewater treatment plants almost ten times reduce concentrations of phenolic substances in wastewater. However, additional treatment still needed as high concentrations are measured in individual samples.
- During wastewater treatment process, phenolic substances tend to be accumulated in sludge. Concentrations of some substances in sludge are significantly elevated but remain below identified PNECs.
- Systematic monitoring of octyl-, nonylphenols and their isomers, based on harmonised monitoring methodology, across the Baltic Sea region is needed. Analytical methods, providing sufficient quality of measurements, should be elsewhere applied for the monitoring.
- Safety requirements for recycling products based on sludges from WWTPs potentially containing phenolic substances need to be developed.
- Targeted measures to prevent releases of octyl- and nonylphenols as well as their isomers, need to be developed based on the best available scientific knowledge, to prevent contamination of the aquatic environment.

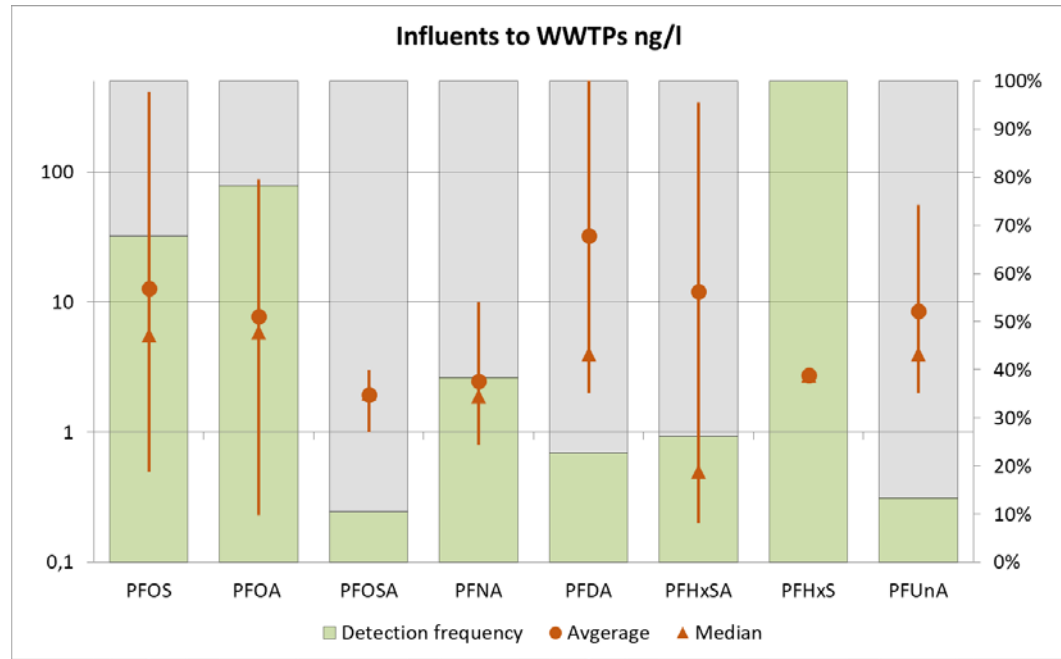
PFAS



Source: EuChemS newsletter



Perfluorohexane sulfonate (PFHxS)
Perfluoroheptanoic acid (PFHpA)
Perfluorohexanoic acid (PFHxA)
Perfluorooctanoic acid (PFOA)
Perfluorobutane sulfonate (PFBS)
Perfluorooctane sulfonate (PFOS)
Perfluorononanoic acid (PFNA)
Perfluoropentanoic acid (PFPeA)
Perfluorobutanoic acid (PFBA)
Perfluorohexanesulfonic acid (PFHxS)
Perfluorododecanoic acid (PFDoDA)
Perfluorodecanoic acid (PFDA)
Perfluoroundecanoic acid (PFUnA)
Perfluorooctane sulfonamide (PFOSA)
Perfluorodecane sulfonate (PFDS)
Perfluorotetradecanoic acid (PFTeDA)
Perfluoropentadecanoic acid (PFPPDA)
Perfluorotridecanoic acid (PFTDA)

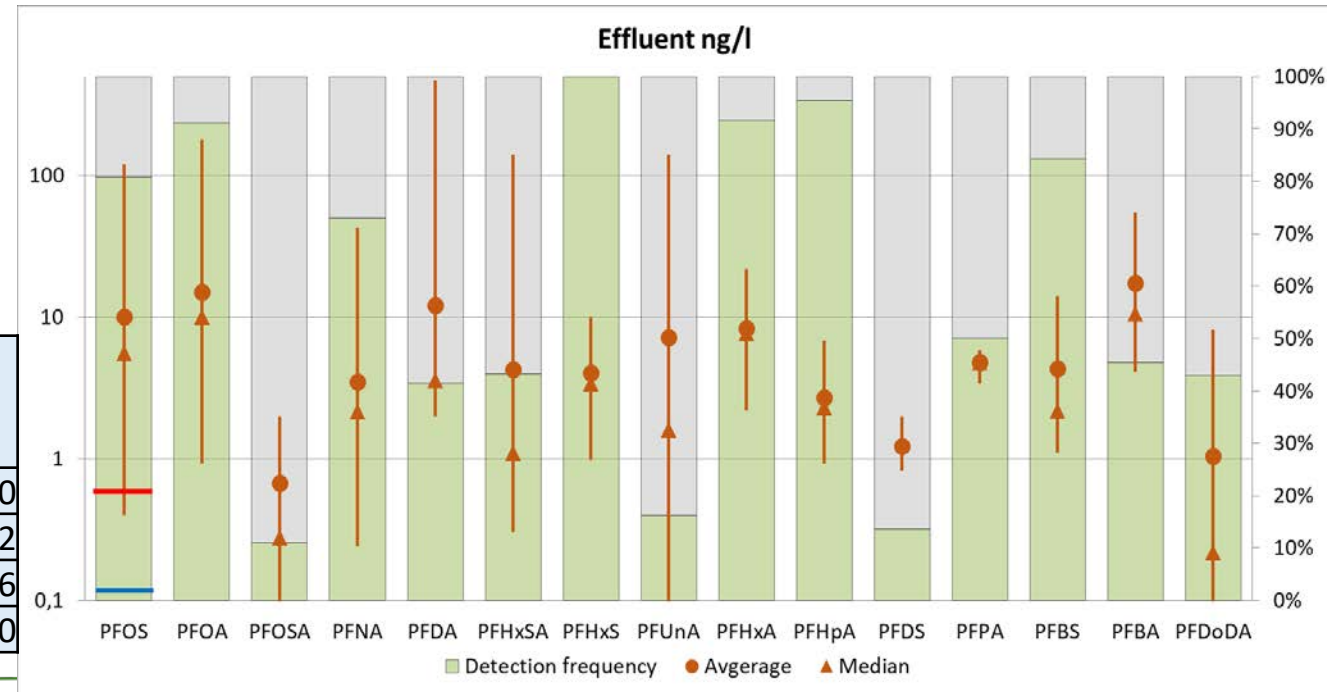


Influents

conc. ng/l	PFHxS	PFHxSA	PFNA	PFOSA	PFOS	PFOA	PFDA	PFUnA
Min	2,67	0,20	0,80	1,00	0,49	0,23	2,00	2,00
Avg	2,75	12,06	2,48	1,95	12,67	7,81	32,31	8,49
Med	2,76	0,50	1,90	2,00	5,60	5,90	4,00	4,00
Max	2,83	340,00	10,00	3,00	410,00	88,00	1100,00	56,00

Effluents

conc. ng/l	PFOS	PFOA	PFBS	PFBA	PFDS	PFDoDA	PFHpA	PFHxS	PFHxSA	PFHxA	PFNA	PFOSA	PFPA	PFDA	PFUnA
Min	0,4	0,9	1,1	4,1	0,8	0,0	0,9	1,0	0,3	2,2	0,2	0,1	3,4	2,0	0,0
Avg	10,1	15,1	4,3	17,5	1,2	1,1	2,7	4,1	4,3	8,4	3,5	0,7	4,8	12,2	7,2
Med	5,6	10,0	2,2	10,7		0,2	2,3	3,4	1,1	7,7	2,2	0,3	4,9	3,6	1,6
Max	120	180	14	55	2	8,1	6,8	10	140	22	43	2	5,8	470	140

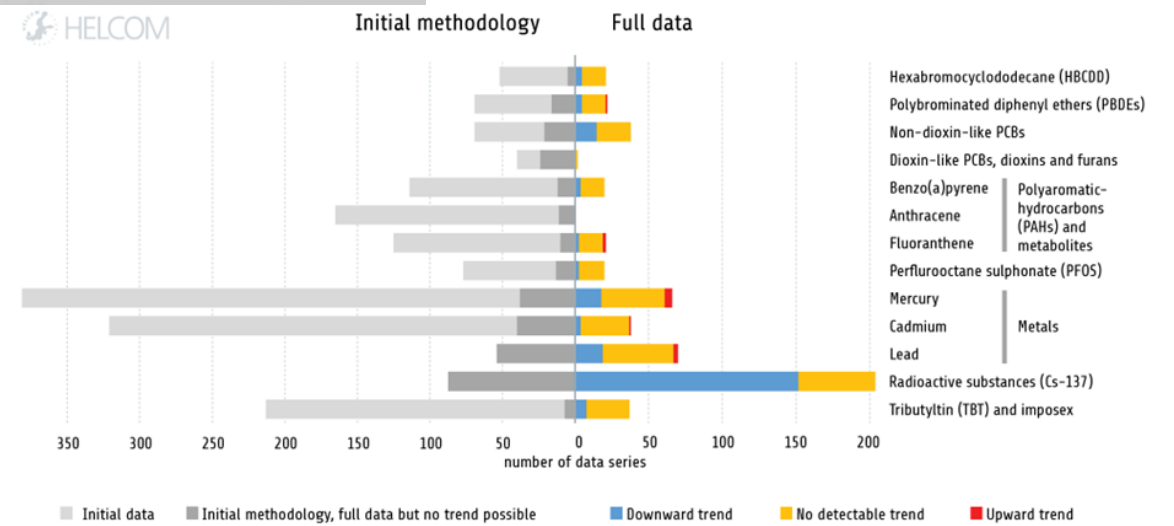
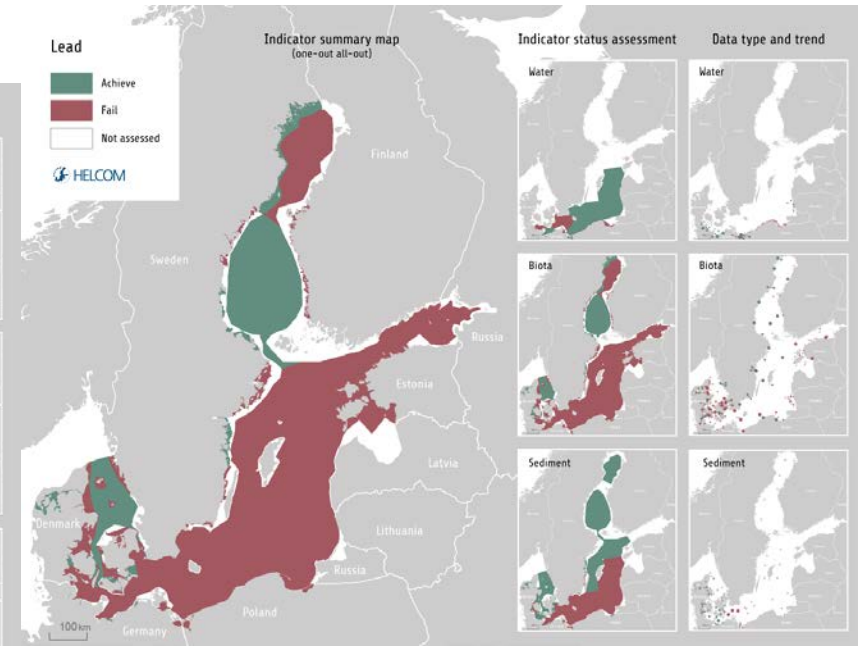
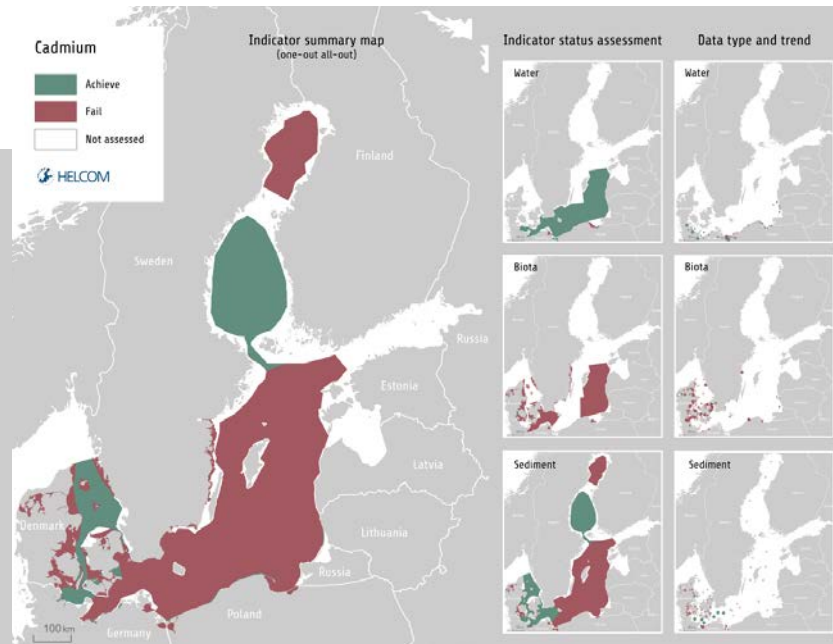
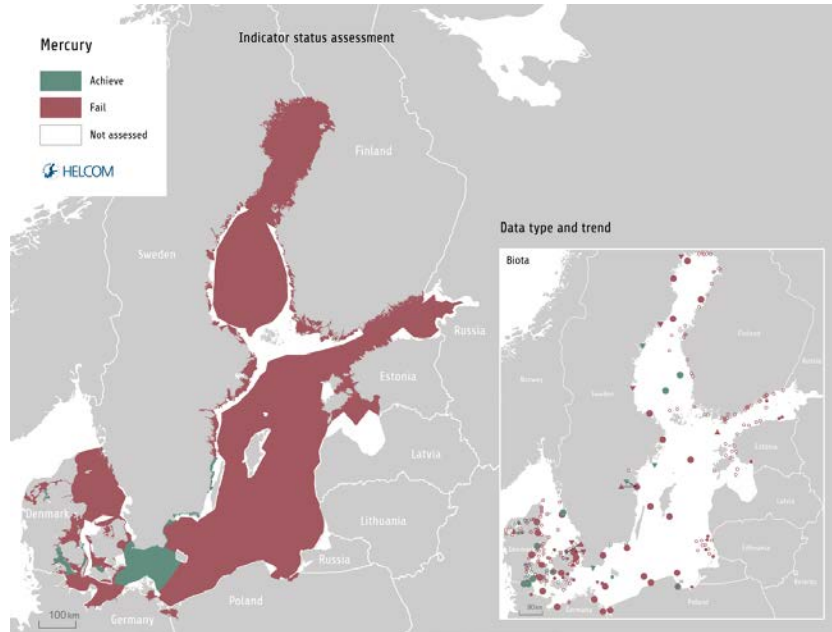


EQS PFOS surface water = 2 ng/L (WFD)

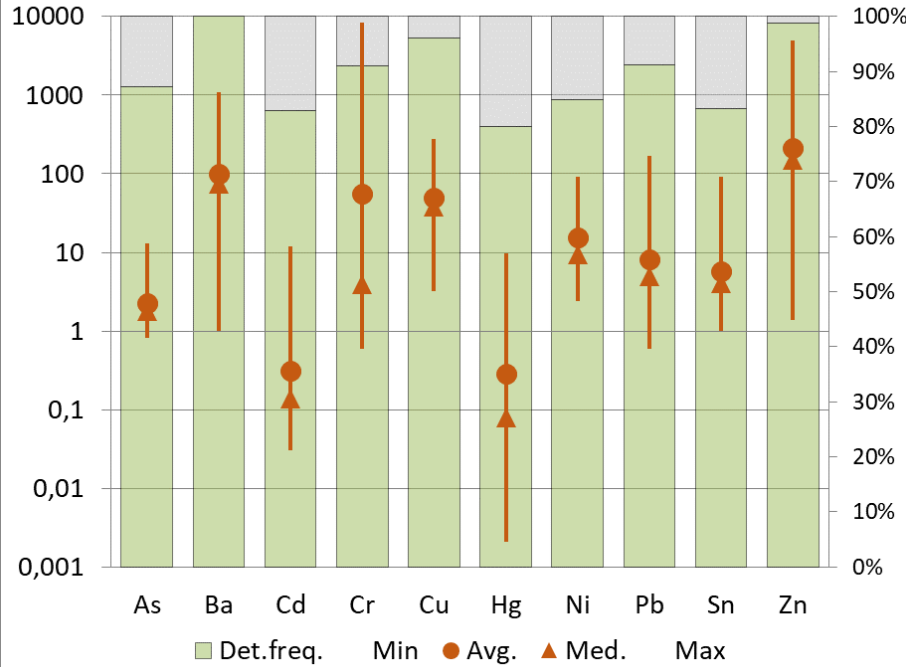
AA-EQS PFOS marine water = 0.65 ng/L (WFD)

- Data compiled through the HELCOM call for micropollutants provides the most comprehensive information on releases of these substances to the aquatic environment from sewage systems in the Baltic Sea region.
- Several toxic substances belonging to PFAS are currently being released to the aquatic environment through wastewater treatment plants across the region and pose remarkable threat to the Baltic Sea marine environment.
- Scarcity of observations together with insufficient quality of analytical procedures do not allow to assess prevalence of various types of PFAS (e.g. long-chained, short-chained etc) in the effluents as well as assess contamination of sludge.
- Conventional wastewater treatment is inefficient for removal of PFAS from wastewater. In some cases, transformation of substances from precursors might even lead to increasing of their concentrations during wastewater treatment process.
- Systematic monitoring of PFAS, based on harmonised monitoring programmes, has to be organized across the Baltic Sea region. Analytical methods, providing sufficient quality of measurements, should be elsewhere applied for the monitoring.
- Biological effects of PFAS should be further investigated, Environmental Quality Standards and safety requirements for potentially PFAS containing recycling products based on sludges from WWTPs to be established.
- General regulation, including restrictions, for the whole PFAS group needs to be developed, based on the best available scientific knowledge to cease continuous contamination of the aquatic environment, and prevent substitution of one toxic PFAS compound by another.

Heavy metals



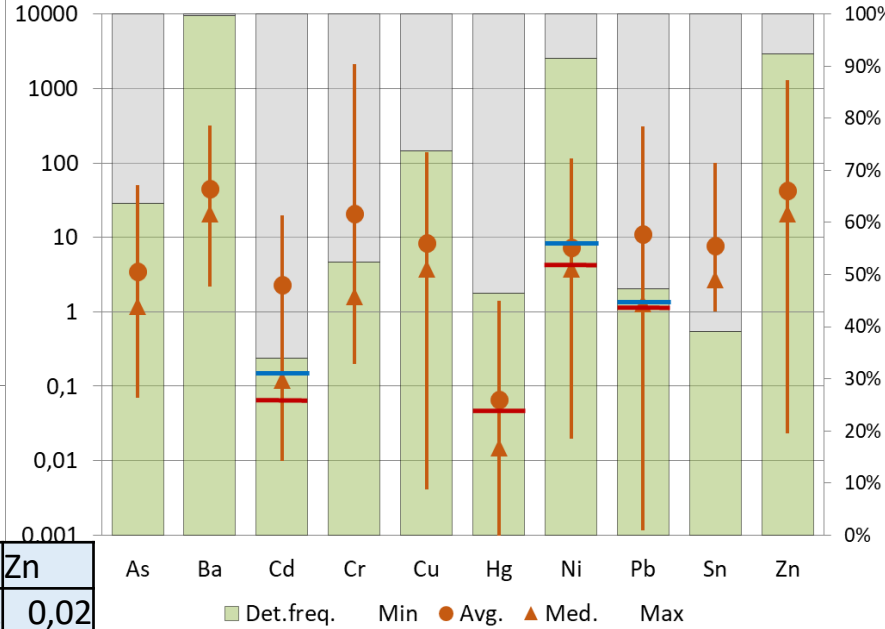
Influent µg/l



Influents

	As	Ba	Cd	Cr	Cu	Hg	Ni	Pb	Sn	Zn
Min	0,8	1	0,03	0,6	3,2	0,002	2,4	0,6	1	1,4
Avg.	2,2	99	0,3	55	50	0,3	15,4	8,1	5,8	212
Med.	1,8	75	0,1	3,9	38	0,08	9,5	5	4	150
Max	13,0	1100	12	8300	280	9,6	91	170	92	5000

Effluent µg/l

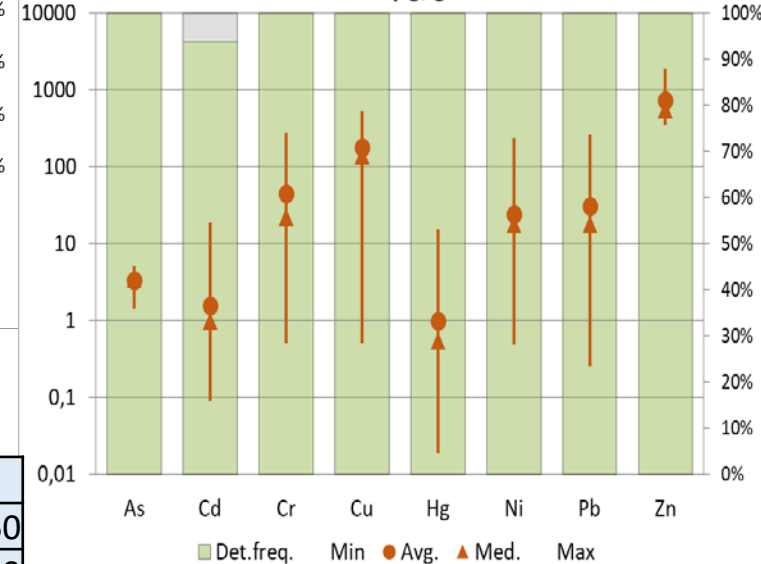


Effluents

	As	Ba	Cd	Cr	Cu	Hg	Ni	Pb	Sn	Zn
Min	0,07	2,2	0,01	0,2	0,004	0,001	0,02	0,001	1	0,02
Avg.	3,5	45	2,3	21	8,5	0,07	7,3	11	7,8	43
Med.	1,2	21	0,1	1,6	3,8	0,02	3,8	1,3	2,7	21
Max	50	319	20	210	140	1,4	115	310	100	1300

	AA-EQS µg/l	
	in land waters	other waters
Pb	1,20	1,30
Ni	4,00	8,60
Hg	0,05	
Cd	0,08	0,20

SLUDGE µg/g dw



Sludge

	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Min	1,4	0,09	0,5	0,5	0,02	0,5	0,3	350
Avg.	3,4	1,6	45	180	1,0	24	31	719
Med.	3,5	1	22	140	0,6	18	18	550
Max	5,2	19,1	272	530	15	234	261	1852

Key conclusions on heavy metals

- Large amount of data on occurrence of heavy metals in influents, effluents and sludges of WWTP were collected. Reported data displays high detection frequency of heavy metals and sufficient accuracy of analytical methods.
- Conventional wastewater treatment is relatively efficiently remove these contaminants from sewage water. However, individual samples sometimes demonstrate extremely high concentrations of heavy metals in effluents.
- Continuous monitoring of heavy metals in sewage water should be obligatory maintained in WWTPs.
- Moderately elevated concentrations of heavy metals were observed in sludge. The level of contamination in most cases complies with existing safety criteria, which vary largely between countries.
- Only three heavy metals Cd, Hg and Pb are included in the HELCOM regional assessment. Some other heavy metals (e.g. copper or arsenic) might be of relevance for the assessment and the development of respective indicators.
- Safety standards for recycling products based on sewage sludge are to be developed. These safety standards could be based on harmonized regional criteria for assessment of sewage sludge quality.
- Treatment technologies should be advanced to minimize the release of heavy metals to the environment. Regional requirements to the quality of effluents from WWTPs could be strengthened.
- Effort to minimize the release of heavy metals to the aquatic environment should be limited by advancement of wastewater treatment technologies, the sources of heavy metals to sewage, including industrial wastewater and storm waters are to be addressed.

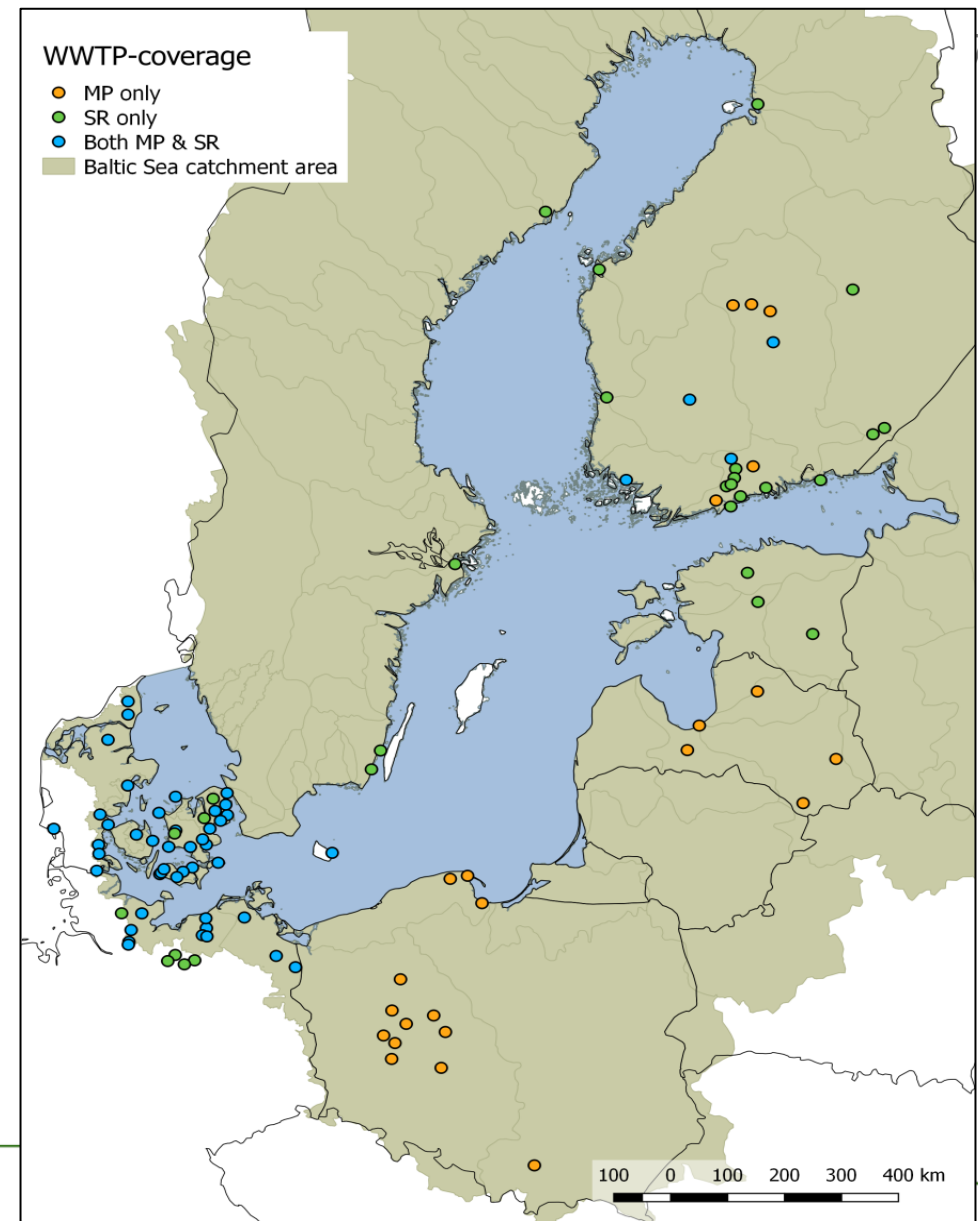
Pharmaceutical data coverage

102 WWTPs for two data calls

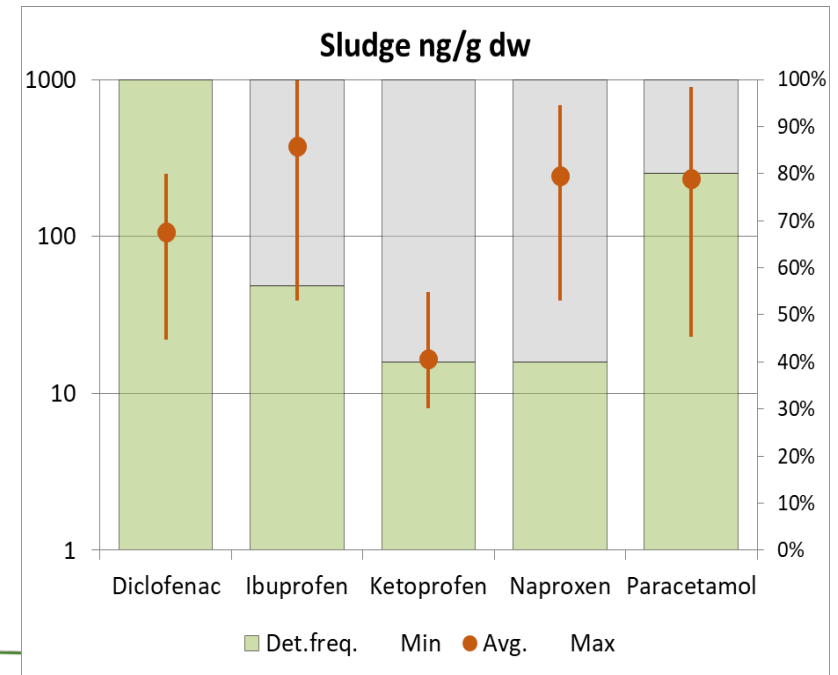
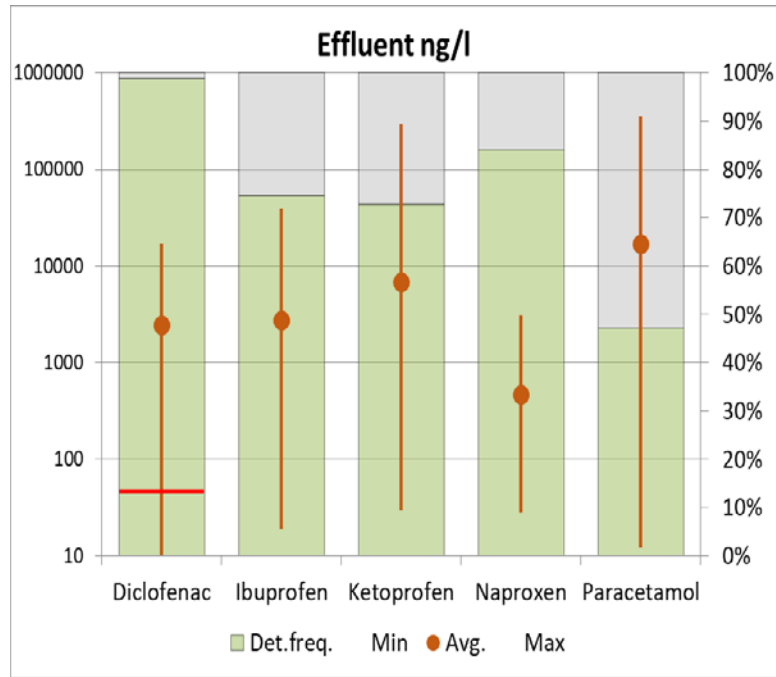
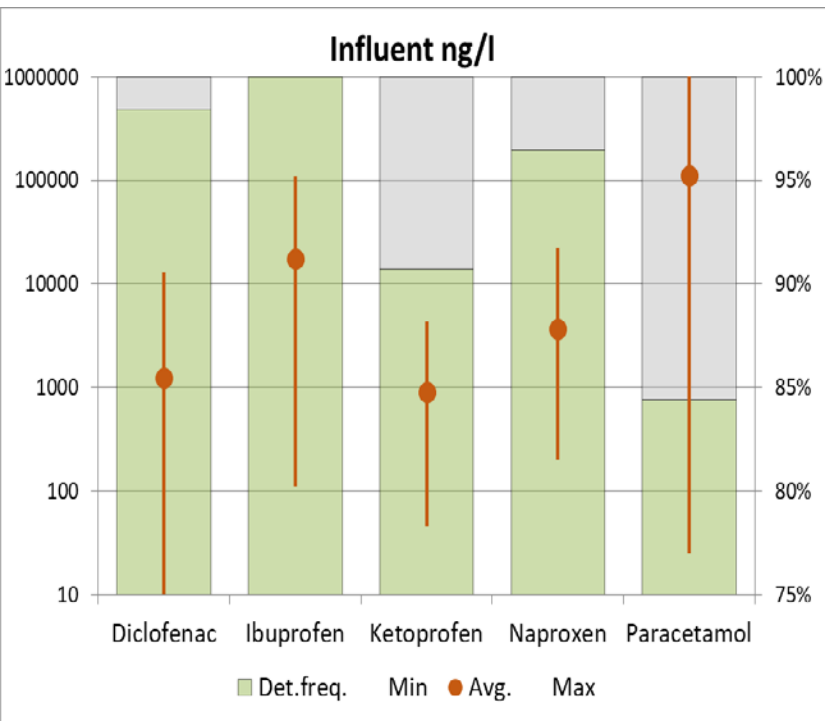
Data on 117 individual substances were compiled.

11 therapeutic groups:

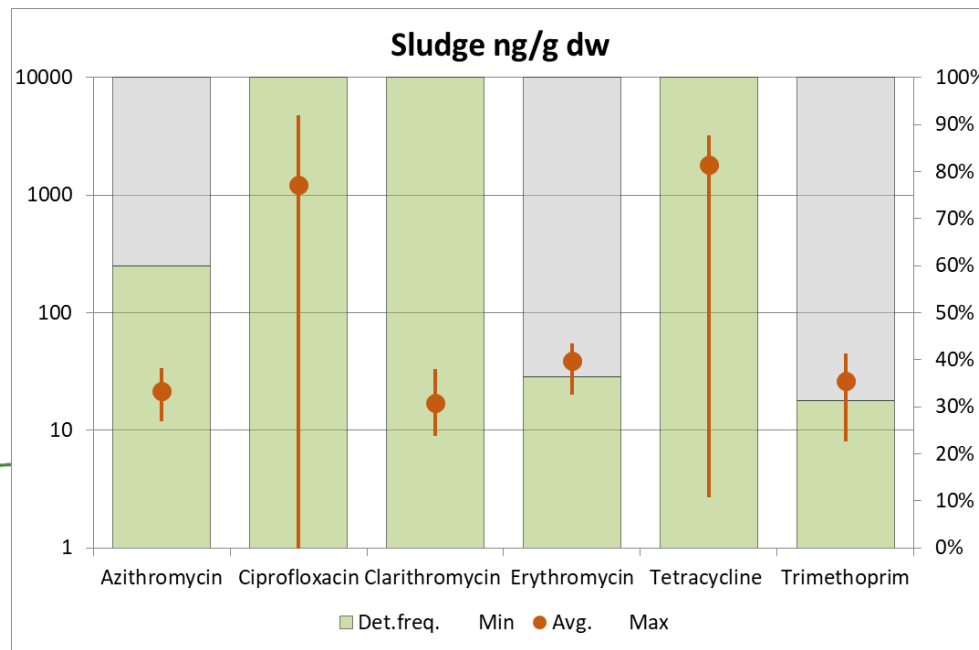
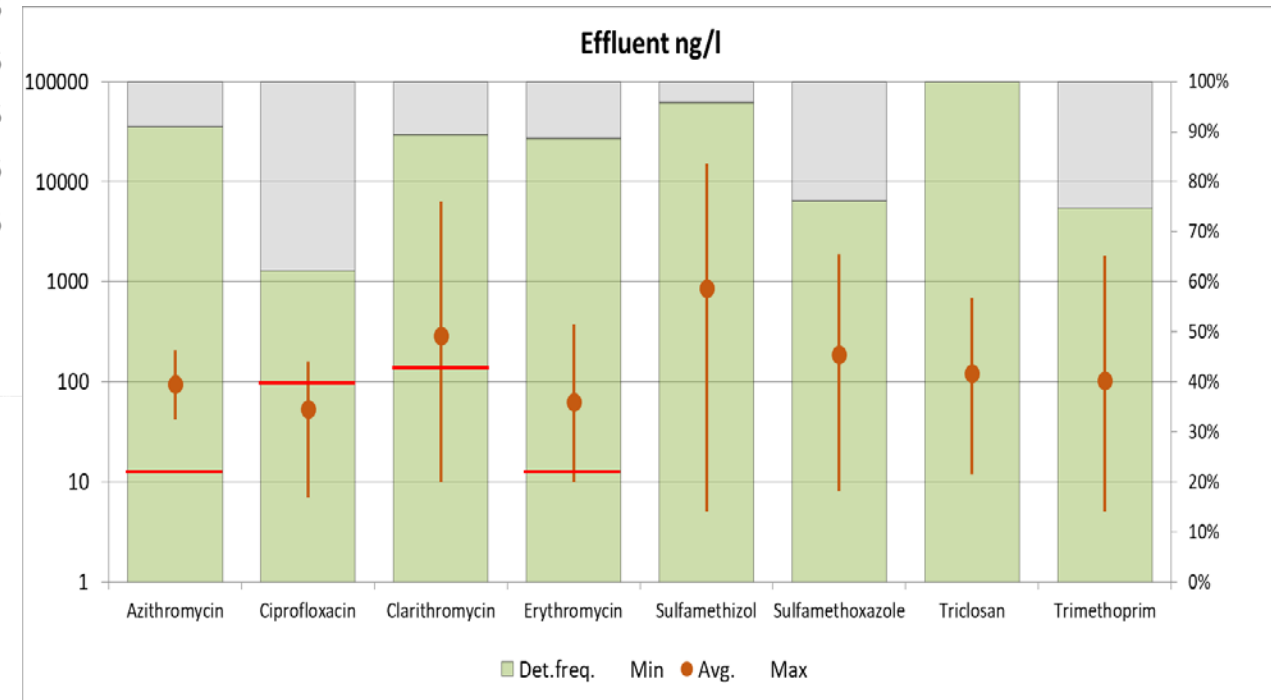
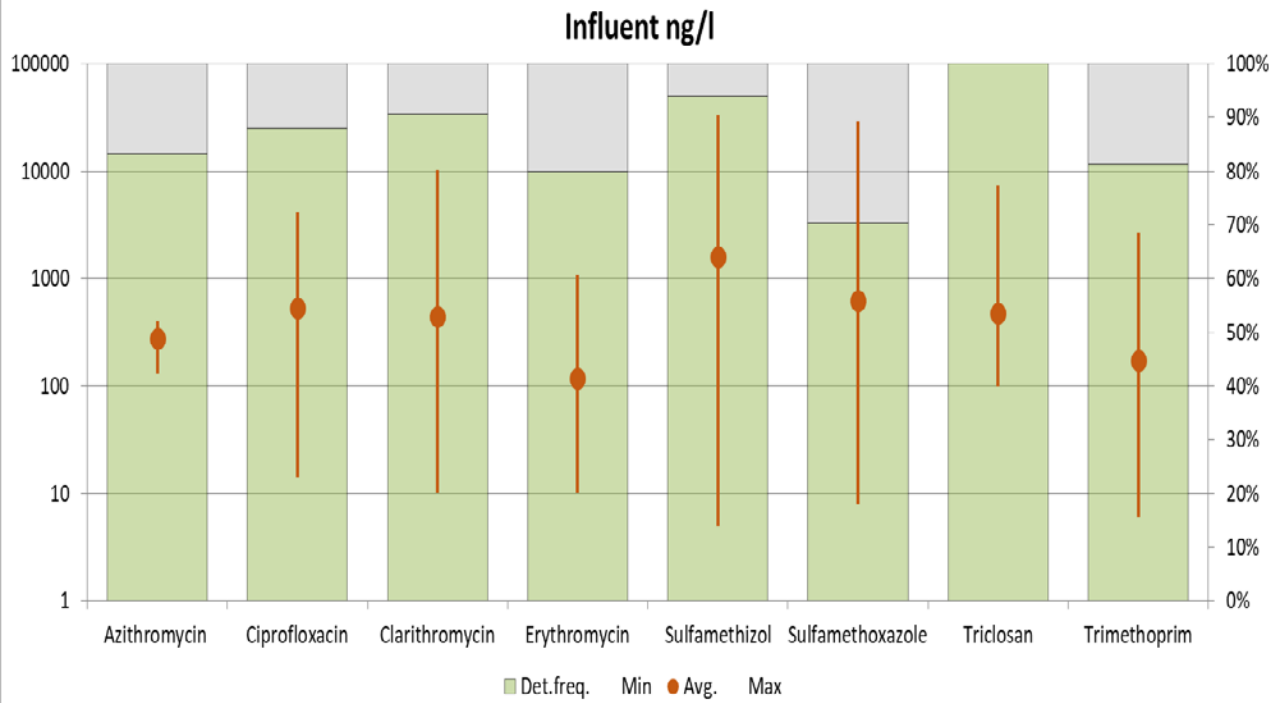
- anti-inflammatory and analgesic substances,
- antimicrobial and antiparasitic,
- cardiovascular agents,
- central nervous system,
- contrast agents,
- chemotherapeutic agents,
- metabolic and gastrointestinal agents,
- respiratory agents,
- hormones and hormone antagonists,
- recreational drugs,
- metabolites.

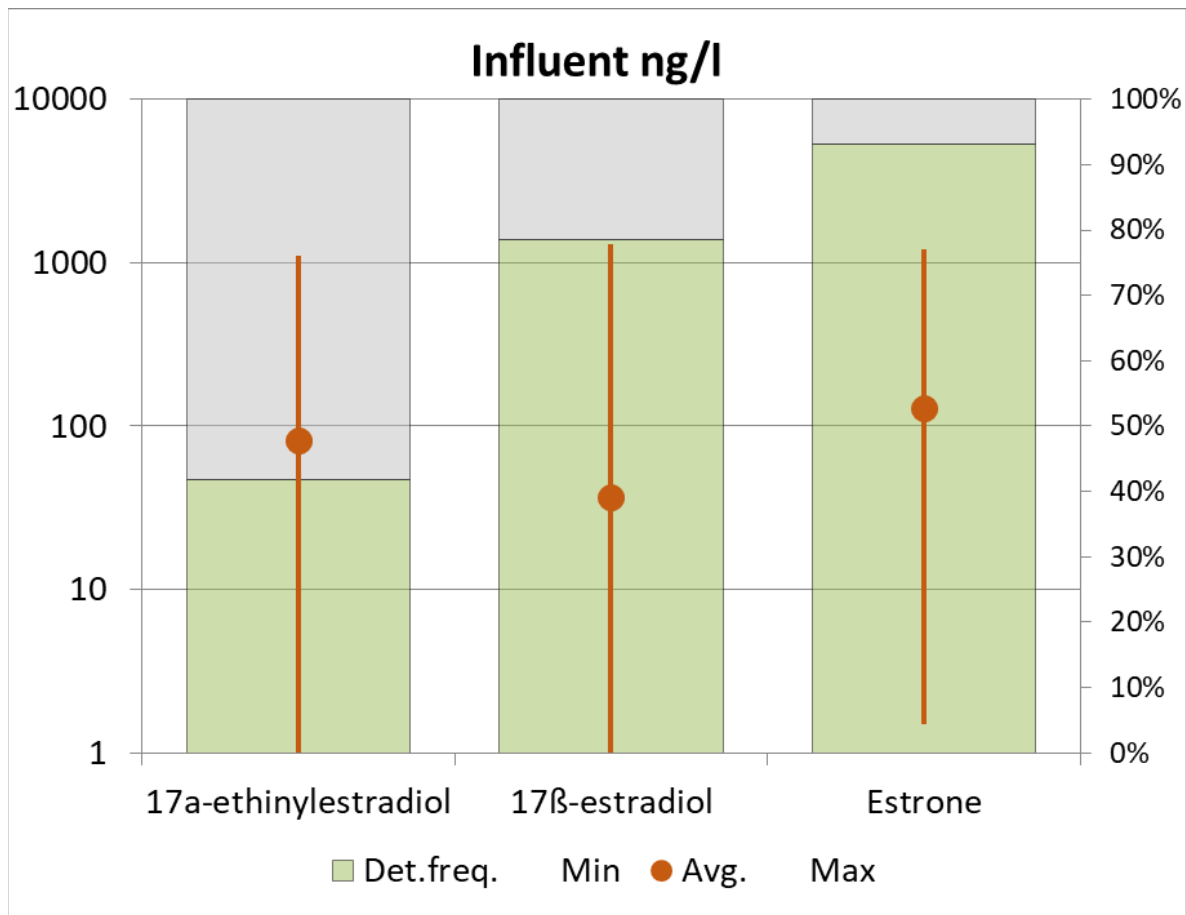


Anti-inflammatory and analgesic substances (detected 13 out of 18 substances)



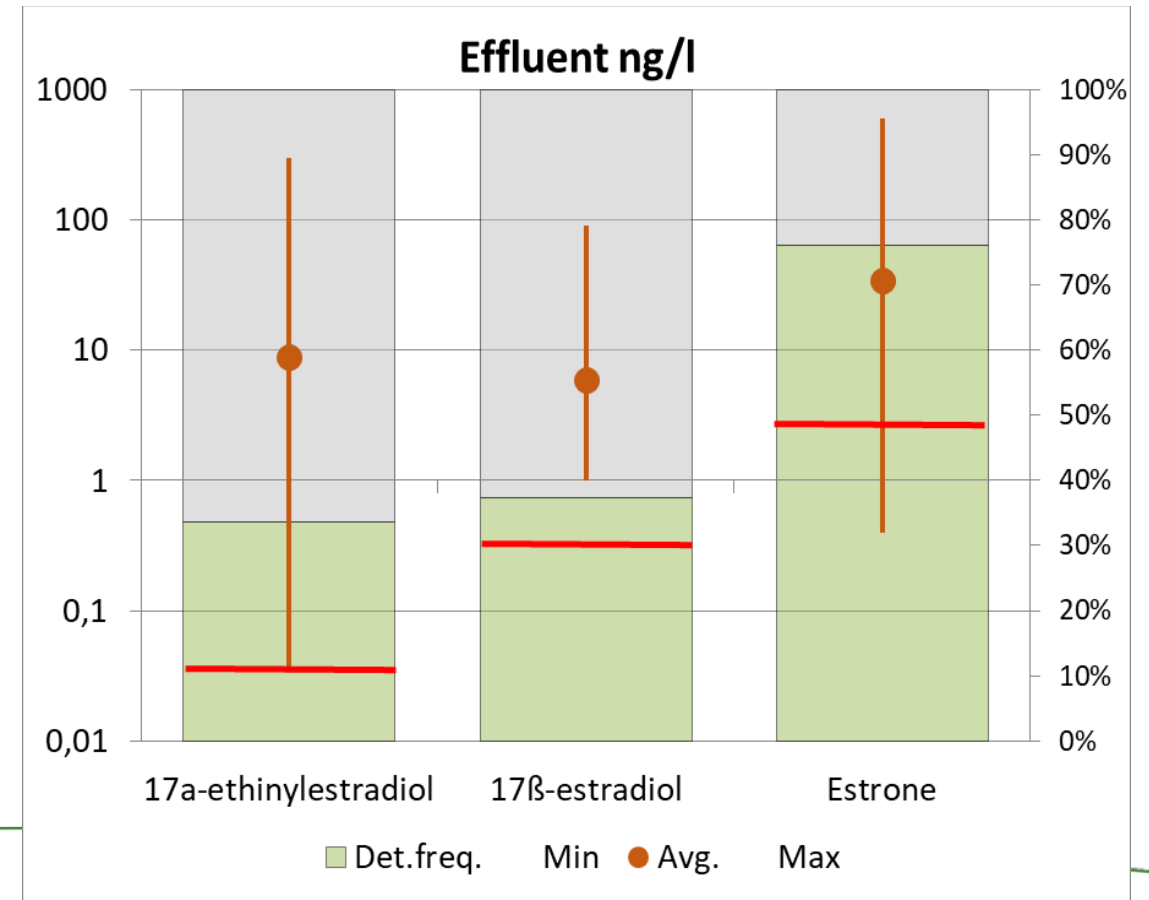
Antimicrobial and antiparasitic *(detected 24 out of 29 substances)*





Hormones and hormone antagonists

(detected 11 out of 15 substances)



Key conclusions on pharmaceuticals

- The most comprehensive compilation of data on pharmaceutical in WWTP in the Baltic Sea region was produced in cooperation with CWPCHARMA project. However, the analysis demonstrates large knowledge gaps.
- **Compiled data demonstrate that a lot of various APIs are continuously released from WWTPs.**
- Further investigation of environmental effects of various API and identification of their non-effect concentrations and consequently environmental quality standards is needed.
- **Since distribution of manure or the use of sewage-based recycled products might be a pathway for some pharmaceuticals to the aquatic environment, respective safety standards are to be developed.**
- Detection limits and analysis method should be aligned among countries. Analytical methods, sufficient to detect these substances at concentrations close to environmental quality standards should be applied throughout the region.
- **An equally distributed database containing information on the occurrence and concentrations of APIs in wastewater, inland surface waters, ground waters and in the marine environment is to be established.**
- More APIs are to be included in the regional assessment of the state of the Baltic Sea and respective indicators developed or advanced.
- **Conventional wastewater treatment is not efficient for removing pharmaceuticals from sewage water.**
- Additional treatment should be applied at WWTPs to increase removal efficiency. However targeted measures at source of API are of even higher importance (e.g. pretreatment of sewage from hospitals, prescription, consumption reduction, responsible handling and disposal).

Post scriptum

- The study of micropollutants in the WWTPs demonstrates that existing system of regional environmental management with regard to hazardous substance is not efficient.
- Current regional assessment of the BS contamination is based on limited knowledge mainly focused on legacy contaminants. It does not reflect the problem of emerging pollutants.
- Various components of management cycle for hazardous substances should be strengthened, including monitoring data, data on environmental effects, information on the use and potential releases of contaminants and coordinated efficient decision-making process for identification priorities and adequate measures.
- The problem of contamination of marine environment by hazardous substances is extremely complex task which can't be solved by countries individually, it requires regional coordination, including sharing of information and resources and involvement of external funds.
- International projects, including project platforms, are vital for achieving progress towards the BSAP goal – Baltic Sea unaffected by hazardous substances.



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