

Sezione 2 – Ricerche sulle sostanze pericolose nel lago di Lugano



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Lake Lugano – research activities carried out by the CIP AIS

Research and monitoring activities (variable from year to year) on lake Lugano

- 2009 – 2012: DDTs, PCBs, Hg
- From 2013 – organic (partially) hydrosoluble micropollutants
- From 2015 – PFAS & PBDE
- 2016 – 2019: antibiotic resistant genes

Matrices: water, biota (fish, molluscs), sediments, passive sampler, ..

Initial focus similar to lake Maggiore, subsequent evolution diversified towards emerging pollutants

Sostanze pericolose - annualità precedenti		
Rapporto campagna 2022	Rapporto campagna 2021	Rapporto campagna 2020
Rapporto campagna 2019	Rapporto campagna 2018	Rapporto campagna 2017
Rapporto campagna 2016	Rapporto campagna 2015 e triennio 2013-2015	Rapporto campagna 2012
Rapporto campagna 2011		

Reference values

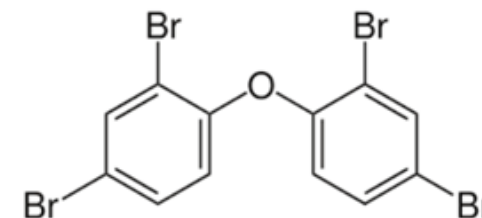
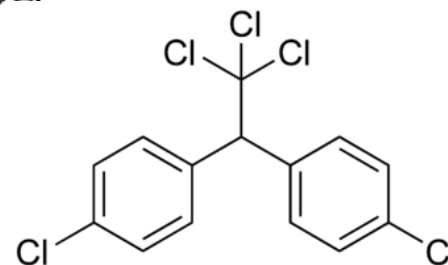
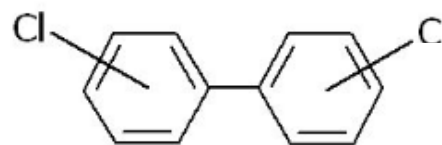
Acute environmental quality standard (Maximum allowable concentration, MAC-EQS) and chronic environmental quality standard (Annual average, AA-EQS)

- Directive 2013/39/EU for priority substances in the field of water policy and D.Lgs. N. 172/2015 in application for Italy of the EU Directive
- Quality criteria proposed by the Ecotox Centre of the EAWAG

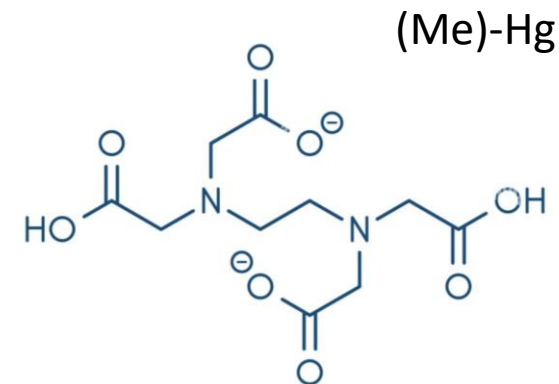
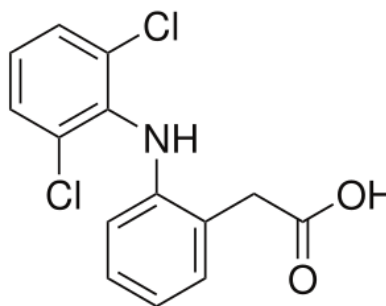
Comparison between literature data of other lakes

In this presentation

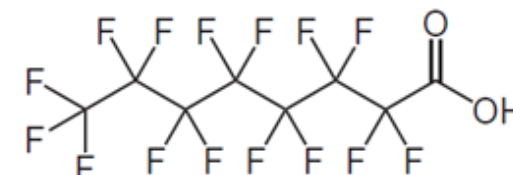
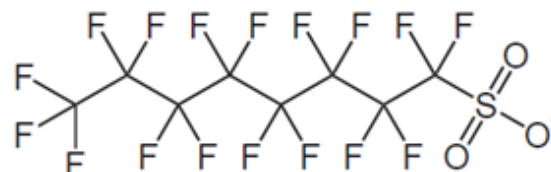
Persistent organic pollutants (lipophilic)



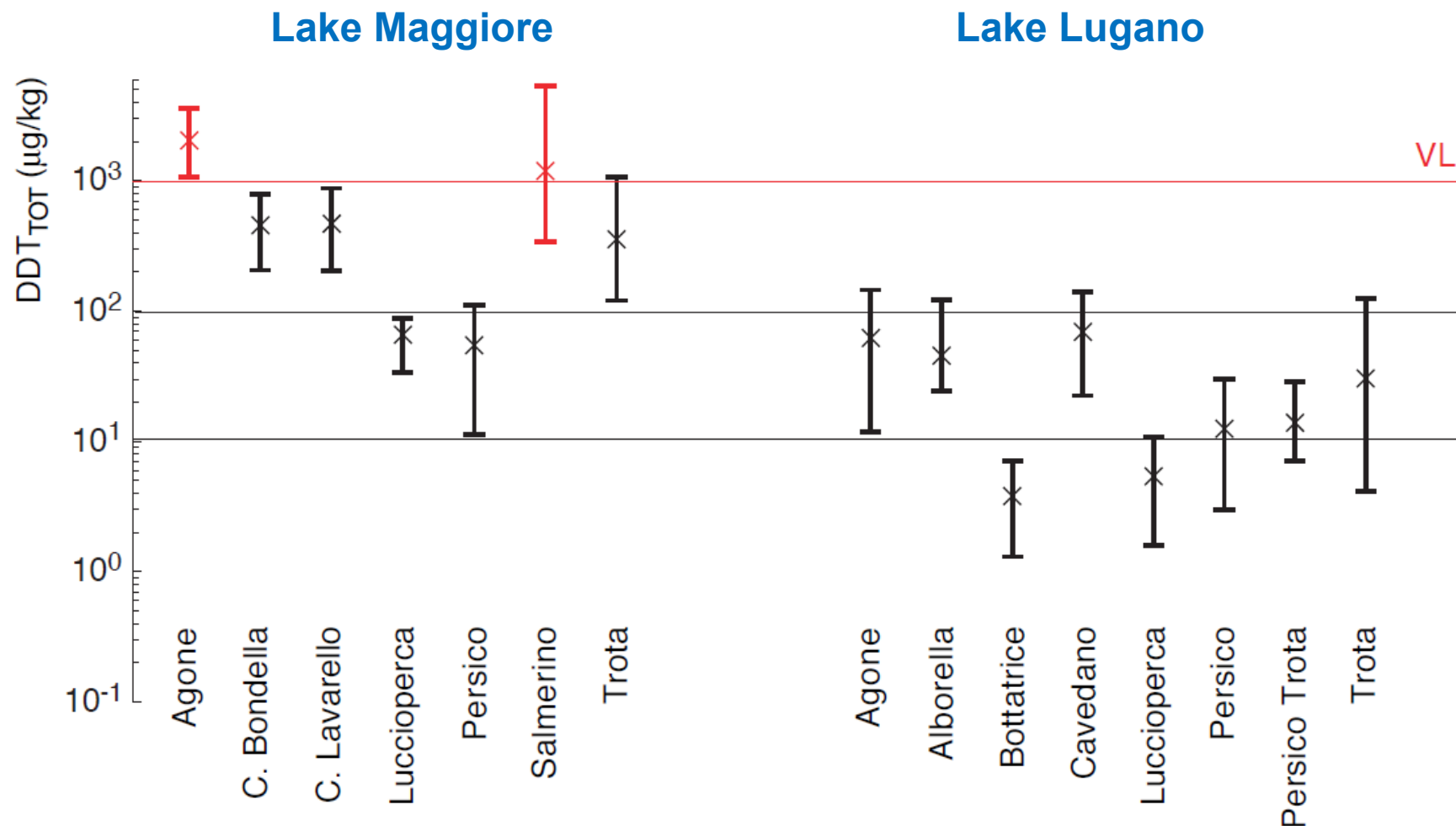
(Slightly) soluble organic contaminants



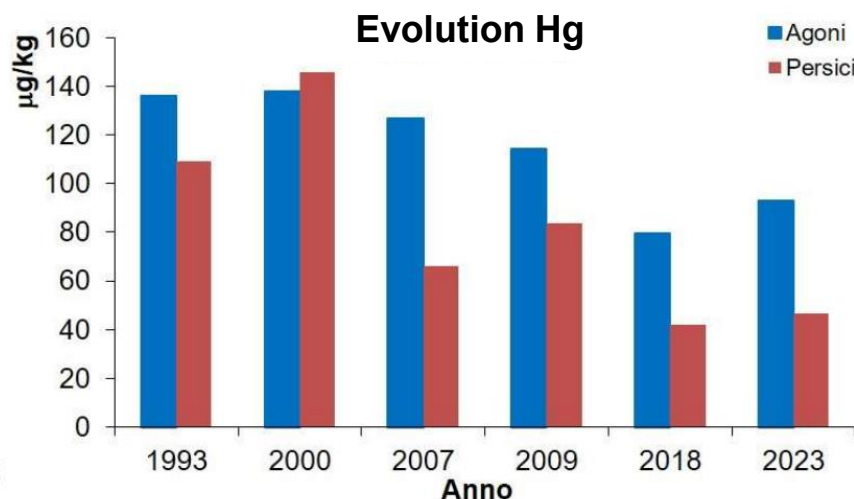
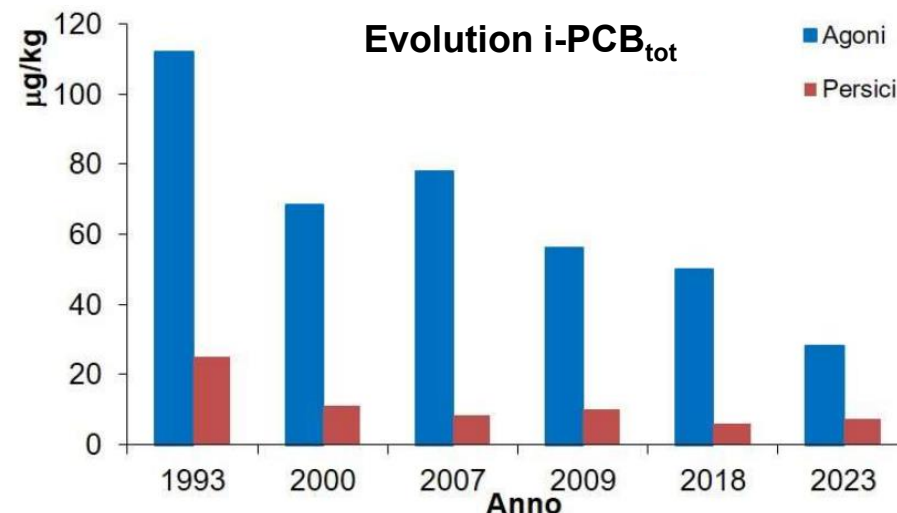
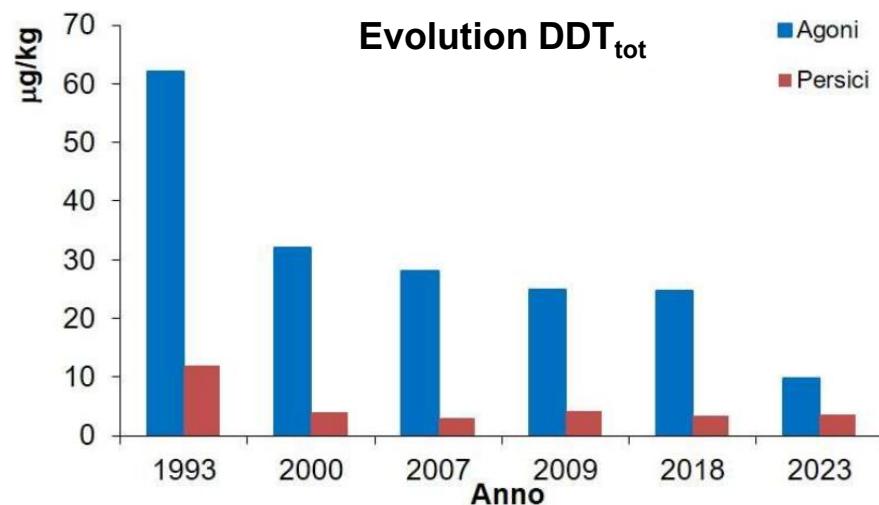
Per- and Polyfluoroalkyl Substances (PFAS)



DDTs in fish fauna – lake Lugano vs. lake Maggiore (1993-1996)



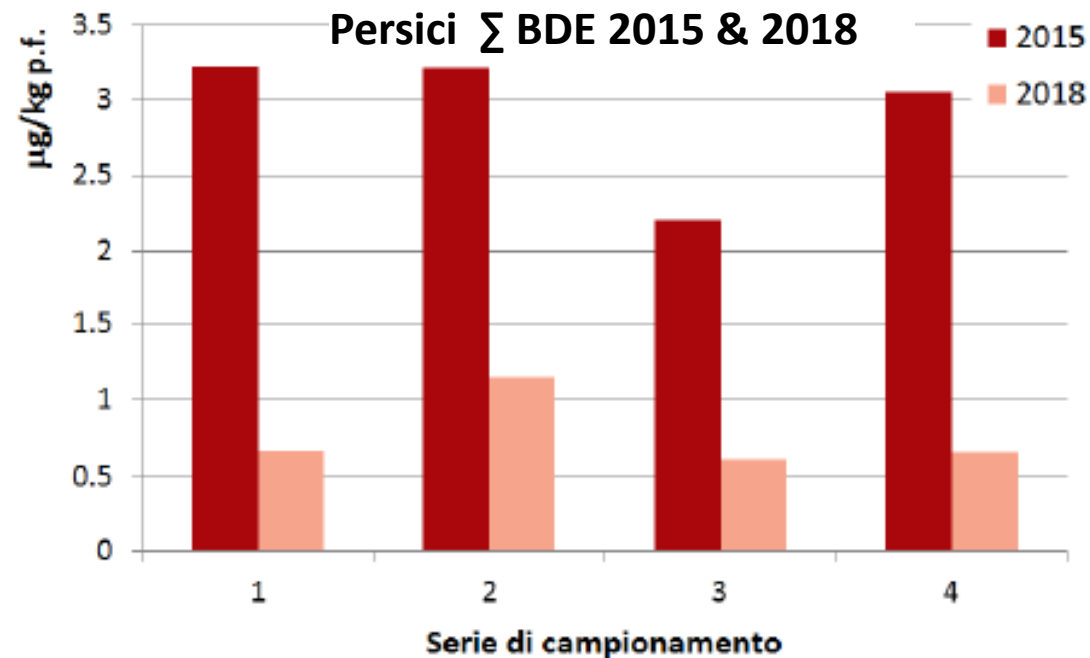
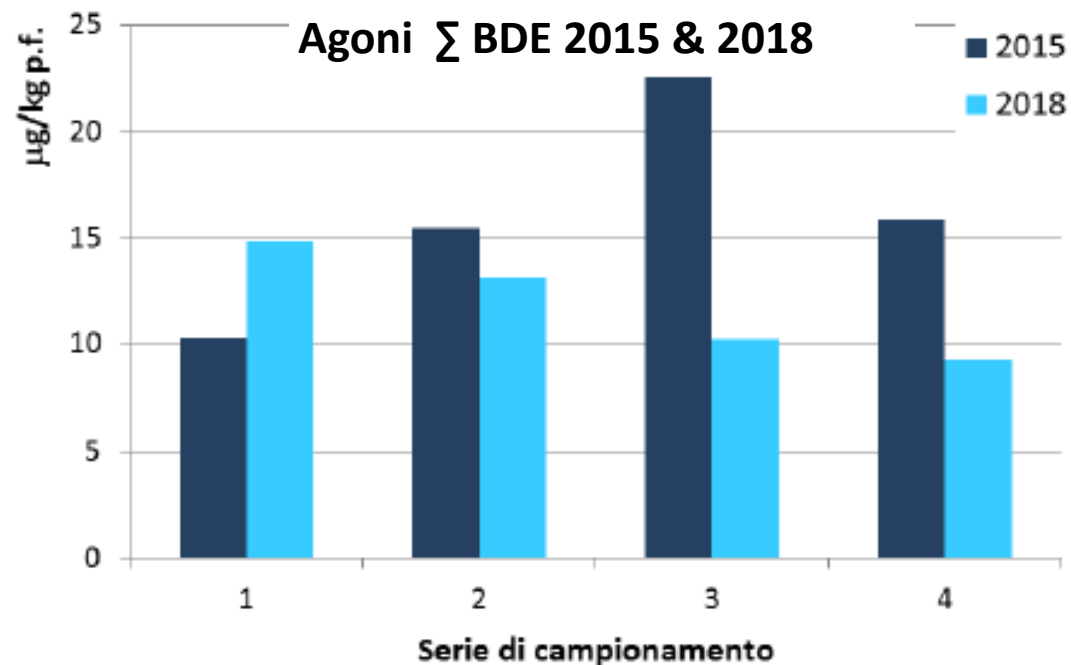
DDTs, PCB & Hg – evolution in the fish fauna of lake Lugano



**EQS of DDTs in biota (50 / 100 µg/kg f.w.)
and PCB (125 µg/kg f.w. i-PCB, 6.5 pg TEQ /
g dl-PCB) respected**

**EQS of Hg in biota (20 µg/kg f.w.) is lower
than the residues in fish, as for most other
european lakes**

PBDE in biota (2015, 2018)



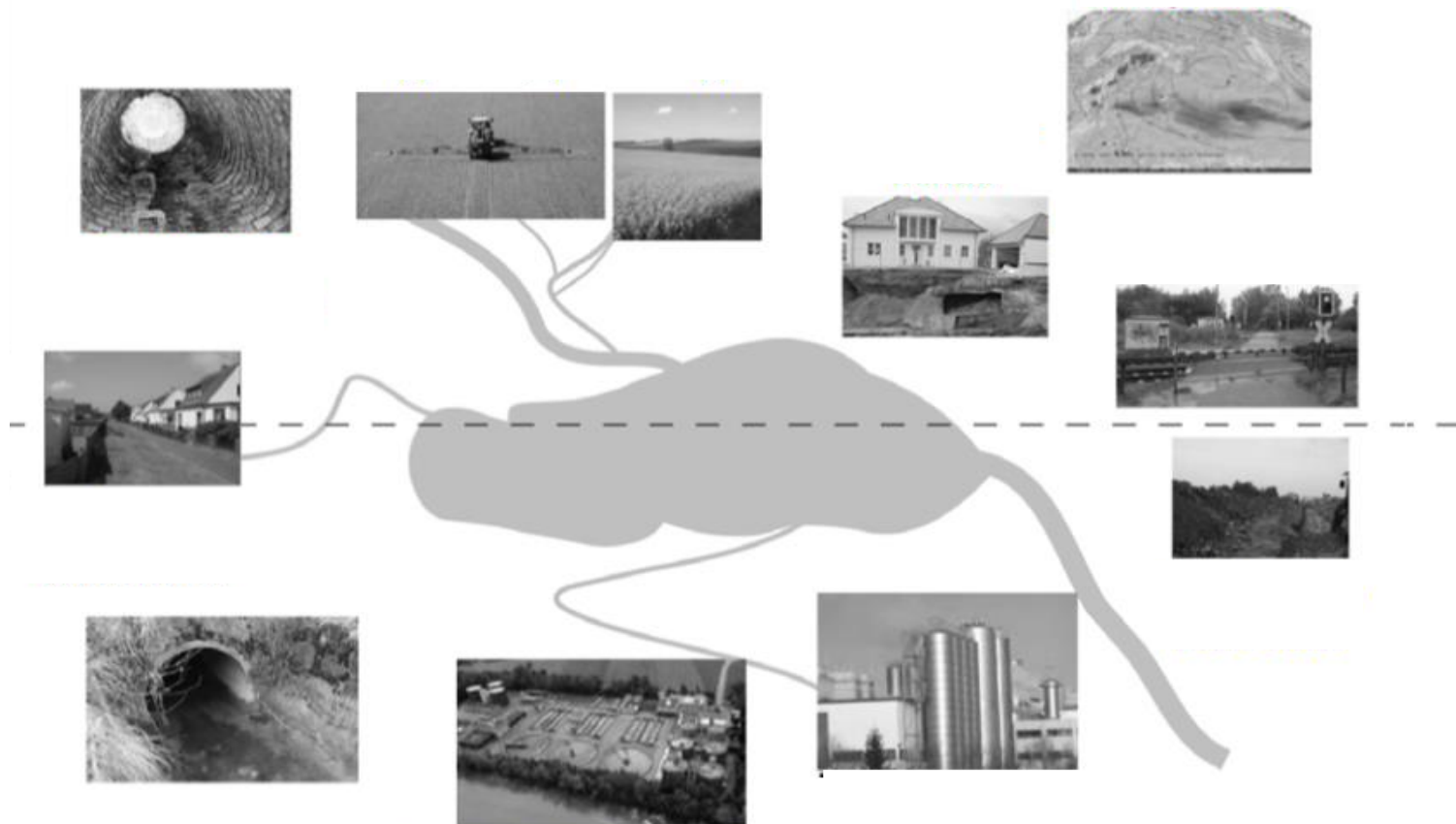
Decreasing contamination similar or higher as compared to other alpine lakes (probably due to a higher urbanization of the catchment). Difficult to identify possible point sources, residues over the EQS in biota systematic for PBDE (Σ 6BDE $0.0085 \mu\text{g/kg f.w.}$), as for most EU lakes

Organic (partially) hydrosoluble micropollutants - origin

Focus on:

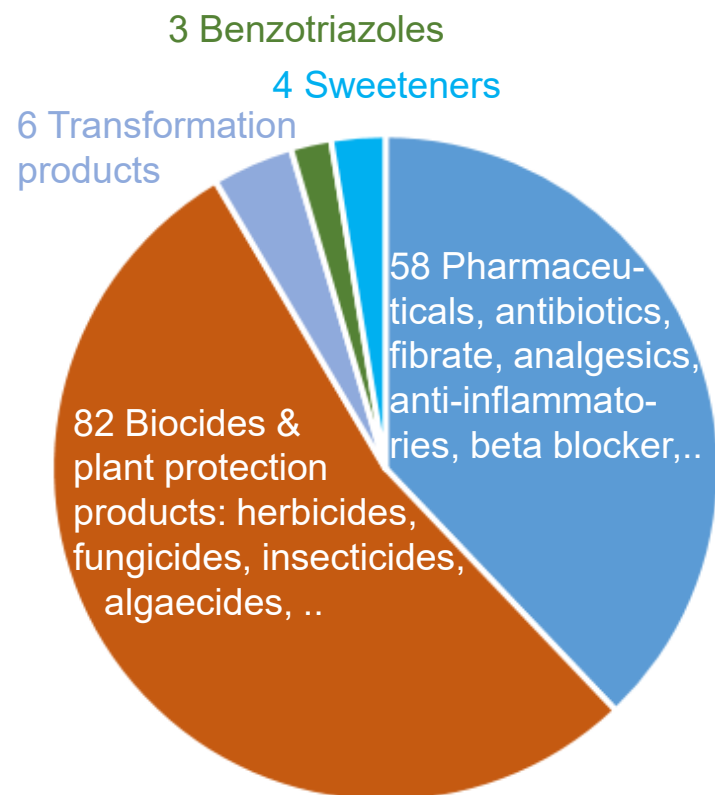
Pharmaceuticals, biocides,
plant protection products,
endocrine disruptors,
complexing agents, additives,
PFAS...

Widespread Sources

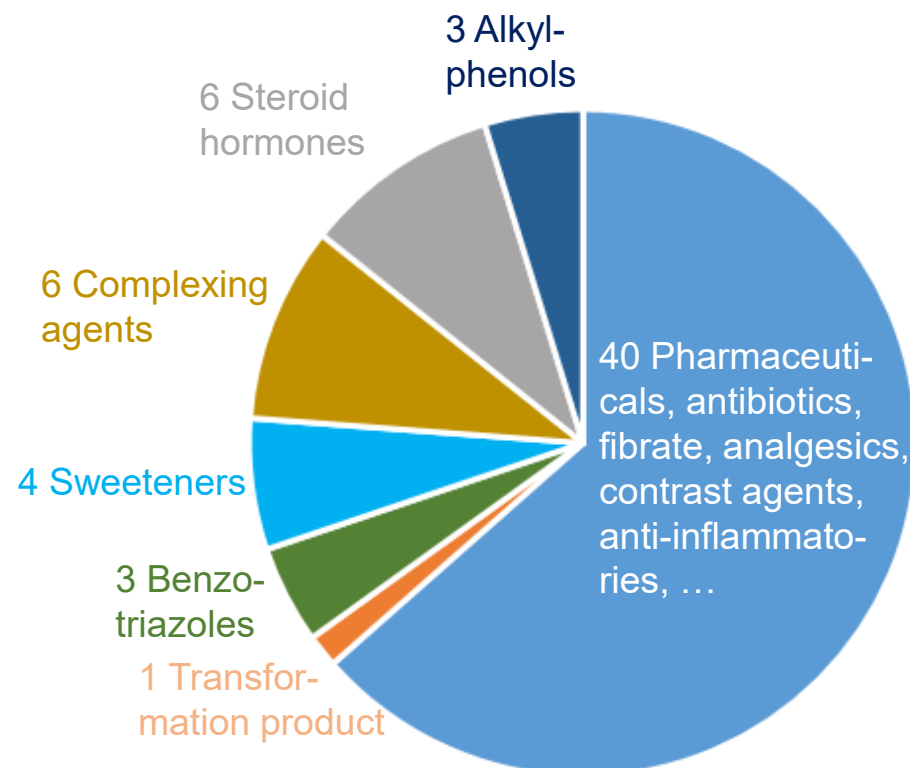


Organic (partially) hydrosoluble micropollutants - parametrization

2014: 153 substances



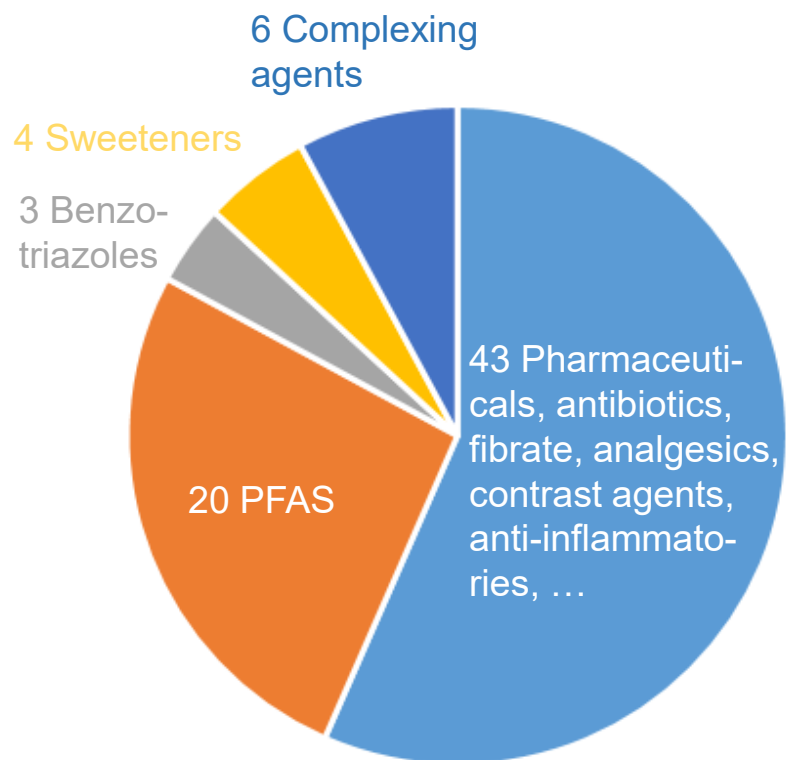
2017: 63 substances



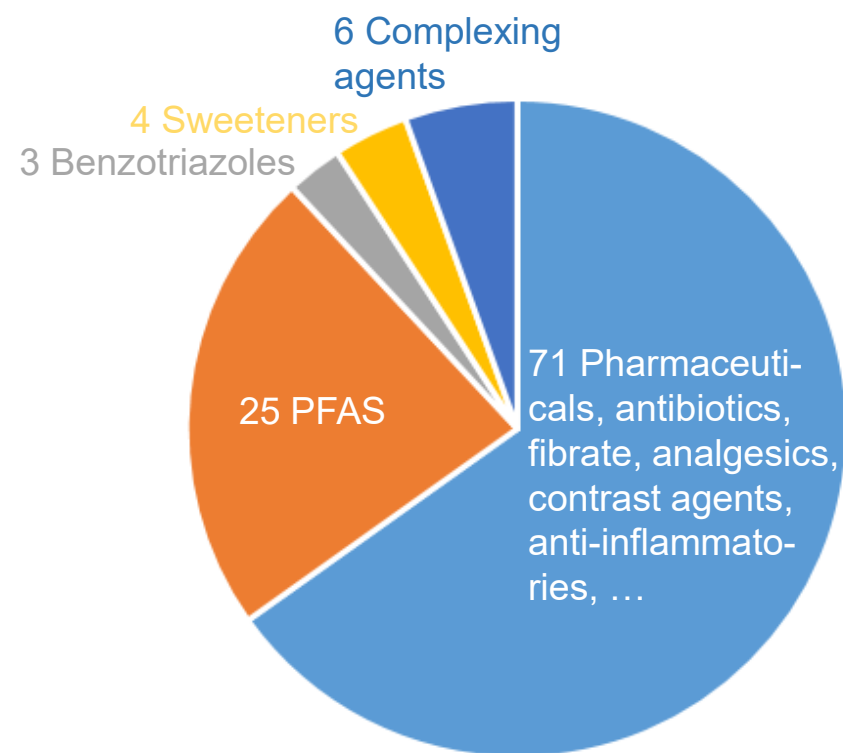
Parametrization adjusted on the basis of previous results and other trends

Organic (partially) hydrosoluble micropollutants - parametrization

2021: 76 substances

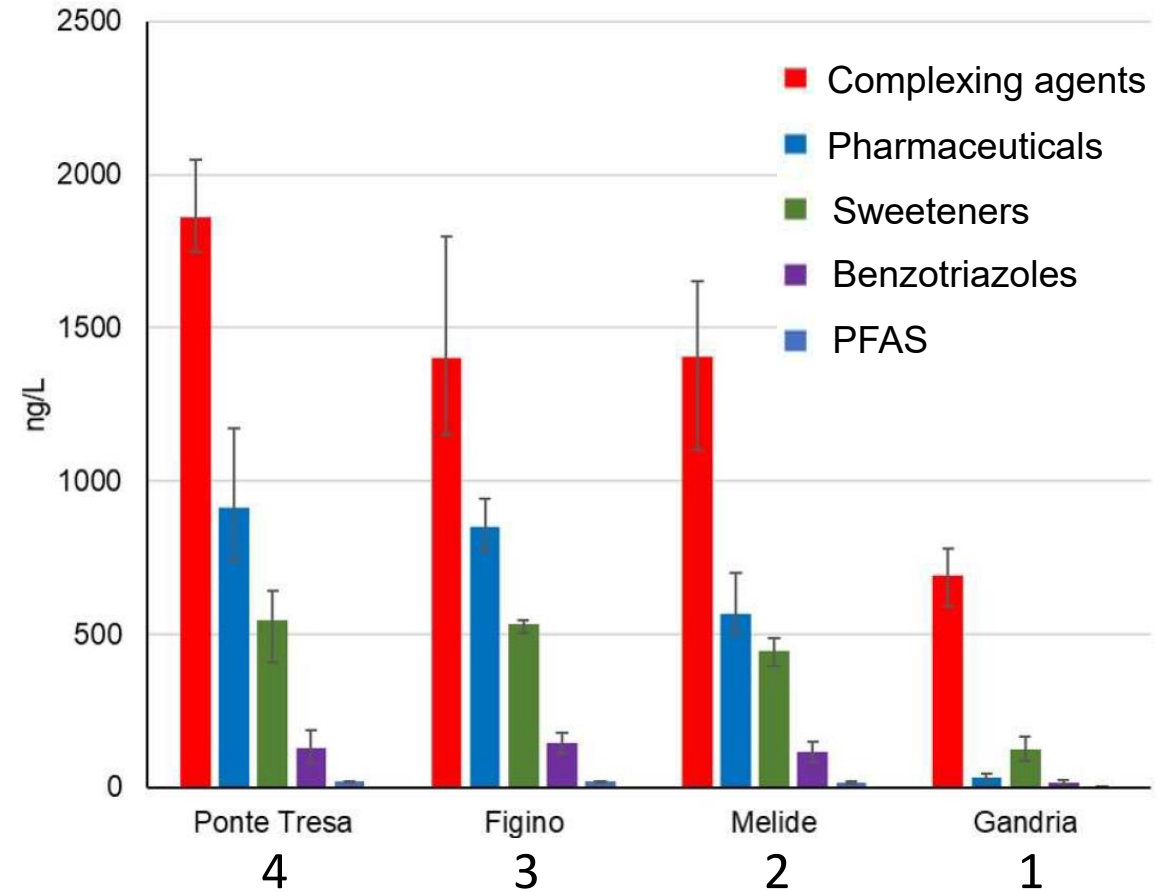
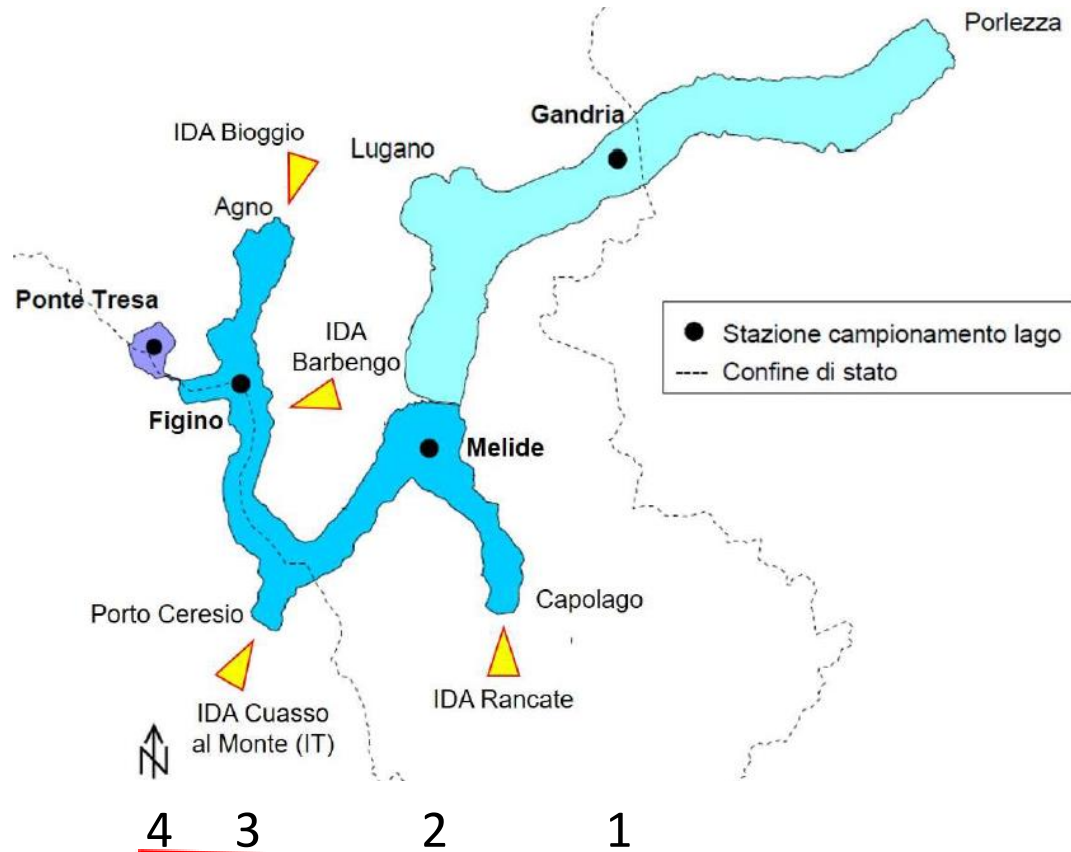


2024: 109 substances

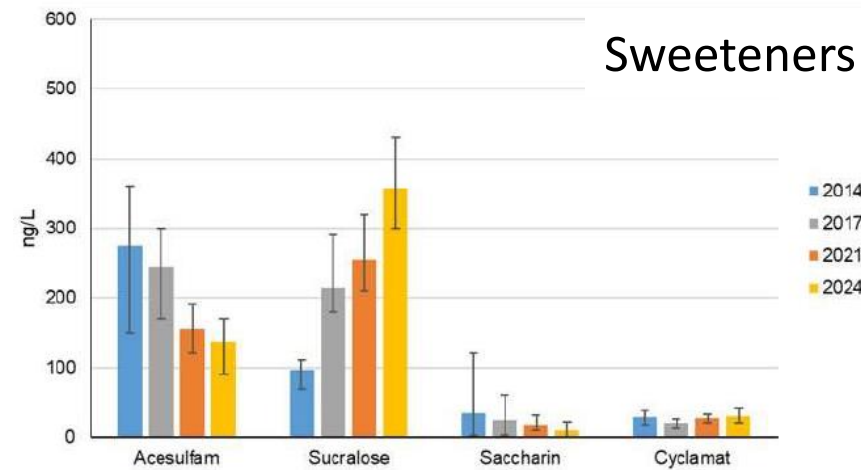
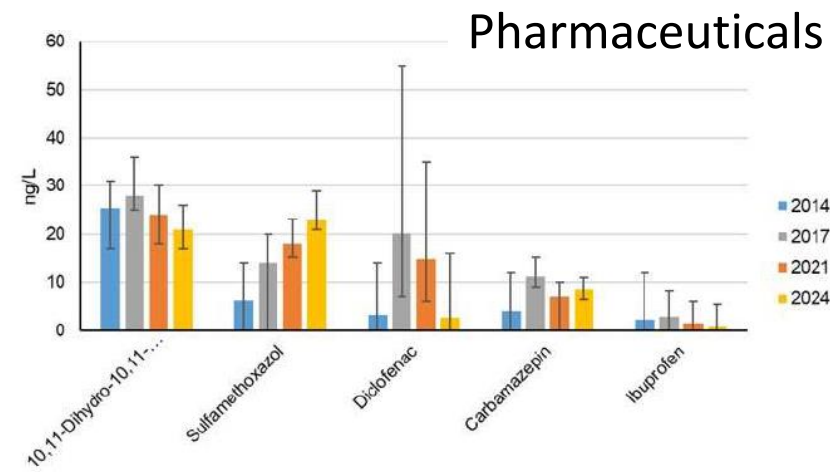
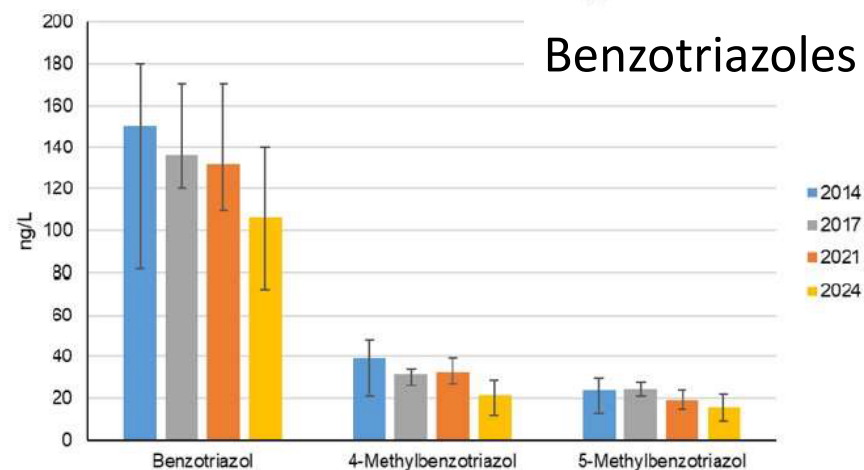
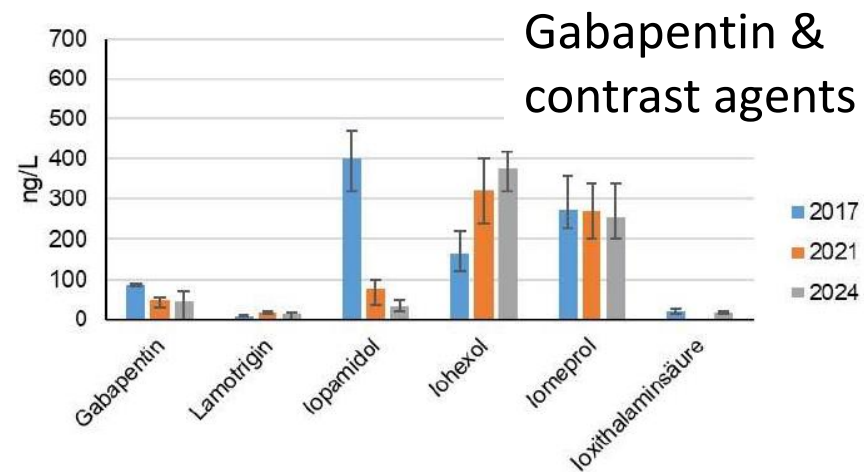


Parametrization adjusted on the basis of previous results and other trends

Organic (partially) hydrosoluble micropollutants – results 2024



Interesting trends over the last 10 years (ex. Ponte Tresa)



Acquired knowledge and quality of the lake water

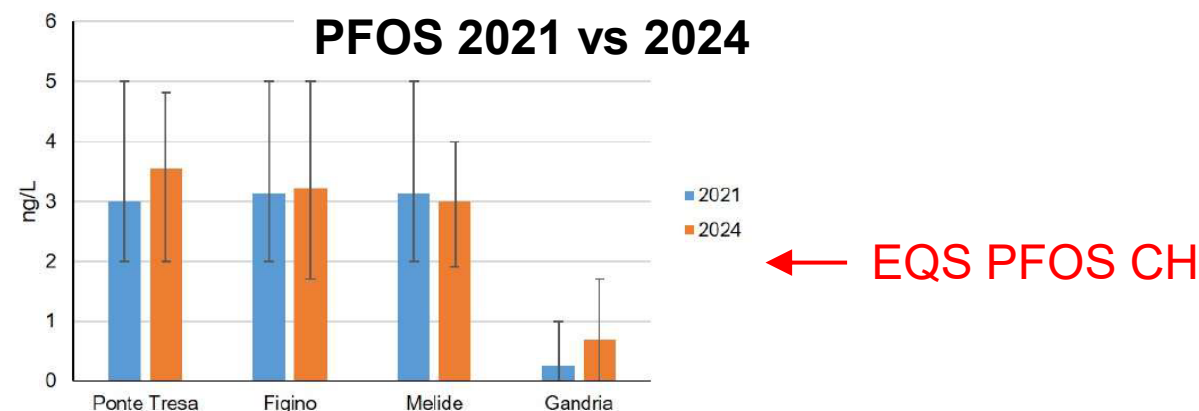
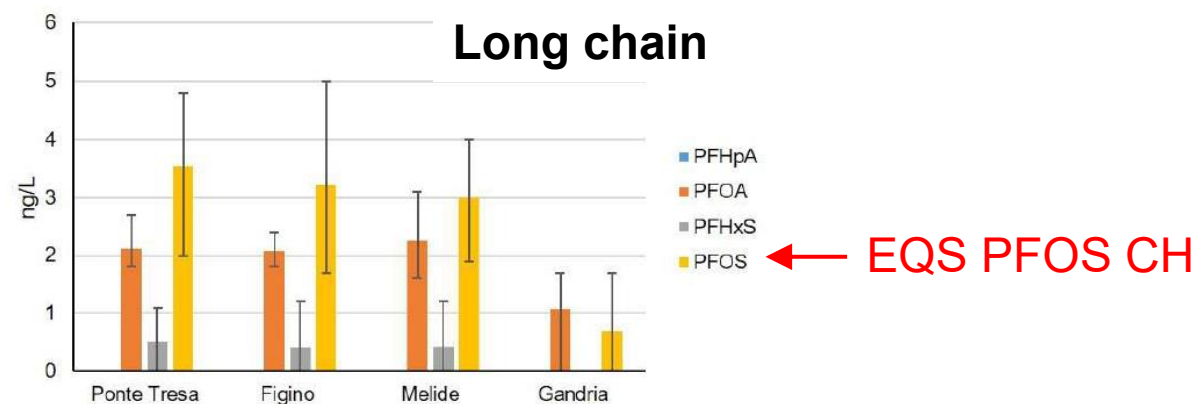
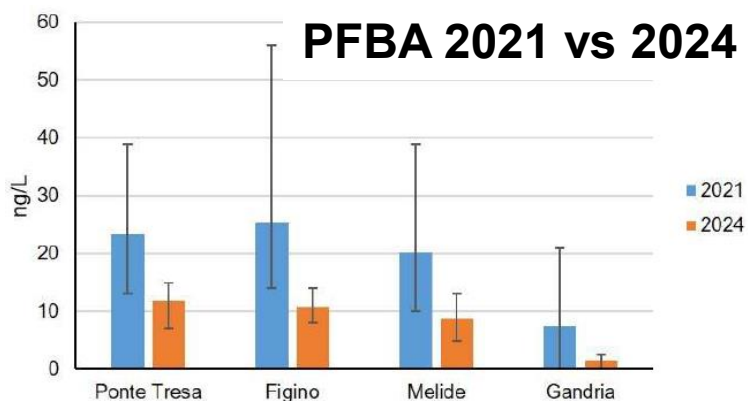
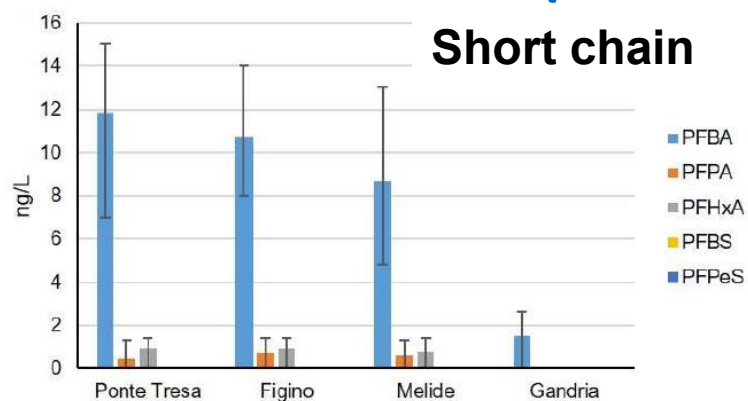
Over 250 micropollutants have been searched, for 60 substances at least one positive detection.

List of the typical concentrations in different basins for the most critical substances found (concentrations closest to EQSs)

	Ponte Tresa	Figino	Melide	Gandria	AA-EQS
Diclofenac 2014	12 - 16	3 - 11	< LOQ	< LOQ	50
Diclofenac 2017	28	20	6 – 7	3 - 7	50
Diclofenac 2021	9	15	4 – 6	4 – 6	50
Diclofenac 2024	3 – 5	2 – 5	< LOQ	< LOQ	50
Ibuprofen 2014	9 - 10	2 - 5	< LOQ	< LOQ	300
Ibuprofen 2017	4 – 6	3 – 5	1 – 4	1 – 3	11
Ibuprofen 2021	2 – 4	1 – 4	< LOQ	< LOQ	11
Ibuprofen 2024	1 – 5	1 – 3	< LOQ	< LOQ	11
Azitromycin 2014	< LOQ	< LOQ	< LOQ	< LOQ	90
Azitromycin 2017	4 – 6	4 – 5	2 - 4	< LOQ	19
Azitromycin 2021	< LOQ	< LOQ	< LOQ	< LOQ	19
Azitromycin 2024	< LOQ	< LOQ	< LOQ	< LOQ	19
PFOS 2021	3	3	3	< LOQ	2
PFOS 2024	3	3	3	< LOQ	2
Giudizio qualità delle acque 2024	Mediocre	Mediocre	Mediocre	Buone	

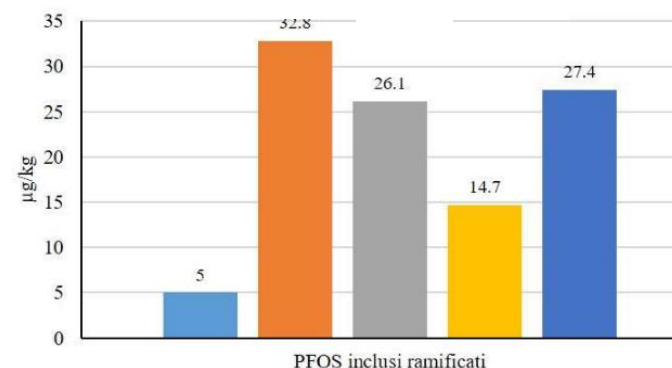
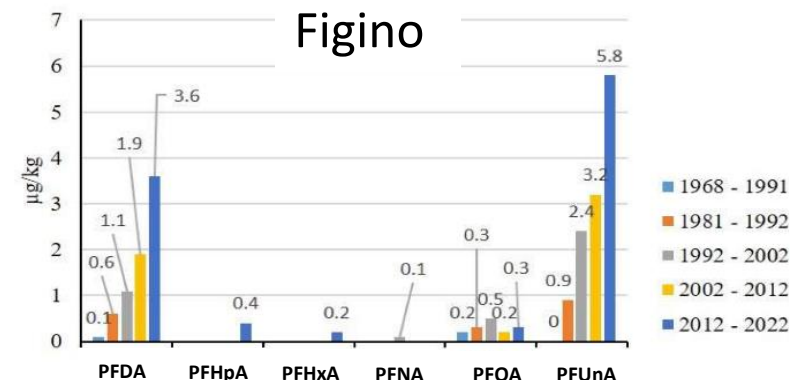
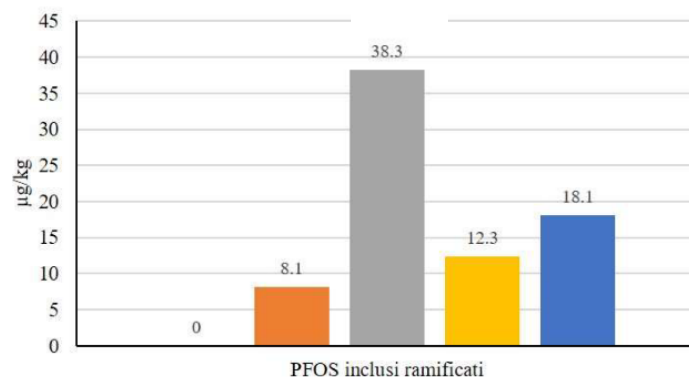
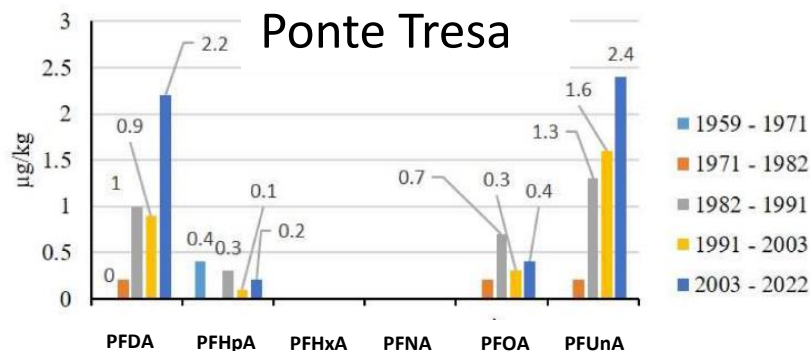


PFAS - lake waters (2021, 2024)



- **PFBA in higher concentration as compared to other PFAS**
- **Residues of other PFAS relevant (EQS PFOS: 2 ng/l), but similar to other lakes**

PFAS - lake sediments (2022)



PFAS banned for longer (C8 - PFOS, PFOA): peak between the 1980s and early 1990s, do not appear to have decreased in the last 10 years, after the ban (PFOS). PFAS only recently limited: clear increase over the recent decades

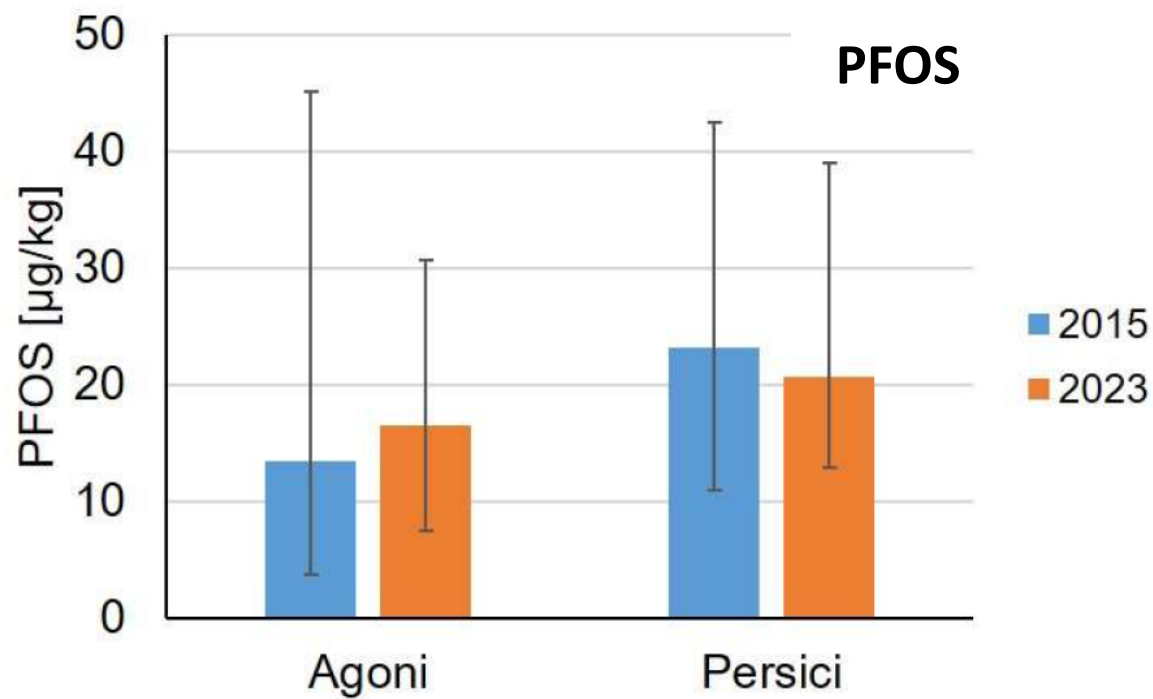
PFAS - fish (2015, 2023)



Perca fluviatilis



Alosa fallax lacustris



← EQS PFOS CH

← EQS PFOS EU

- PFOS dominates in fish
- High variability of results, seasonality / dependence on the catchment area difficult to ascertain
- Also in fish, PFOS does not appear to have decreased significantly in the last 10 years

General conclusions and outlook

- «Classic» contaminants as DDT or PCB – residues not problematic and in steady decrease
- The quality of lake water is determined by PFOS. Improvements with respect to (slightly) soluble organic contaminants are expected in the near future thanks to the update of swiss WWTPs
- Widespread residues of PBDE, Hg and PFAS exceeding the EQA in biota, as for a lot of other alpine and european lakes. Contamination of PBDE and PFAS appears similar or higher with respect to other european lakes, probably due to a higher degree of urbanization of the catchment.
- It is surprising (and worrying) to note that PFOS, despite being banned in 2011, seem to persist steadily in environmental matrices.

Acknowledgements

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- Members of the Section 2
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