Human exposure to PFAS and organofluorine compounds in northern Norway between 1986 and 2015: a fluorine mass-balance study in pooled human serum samples

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PFAS human exposure

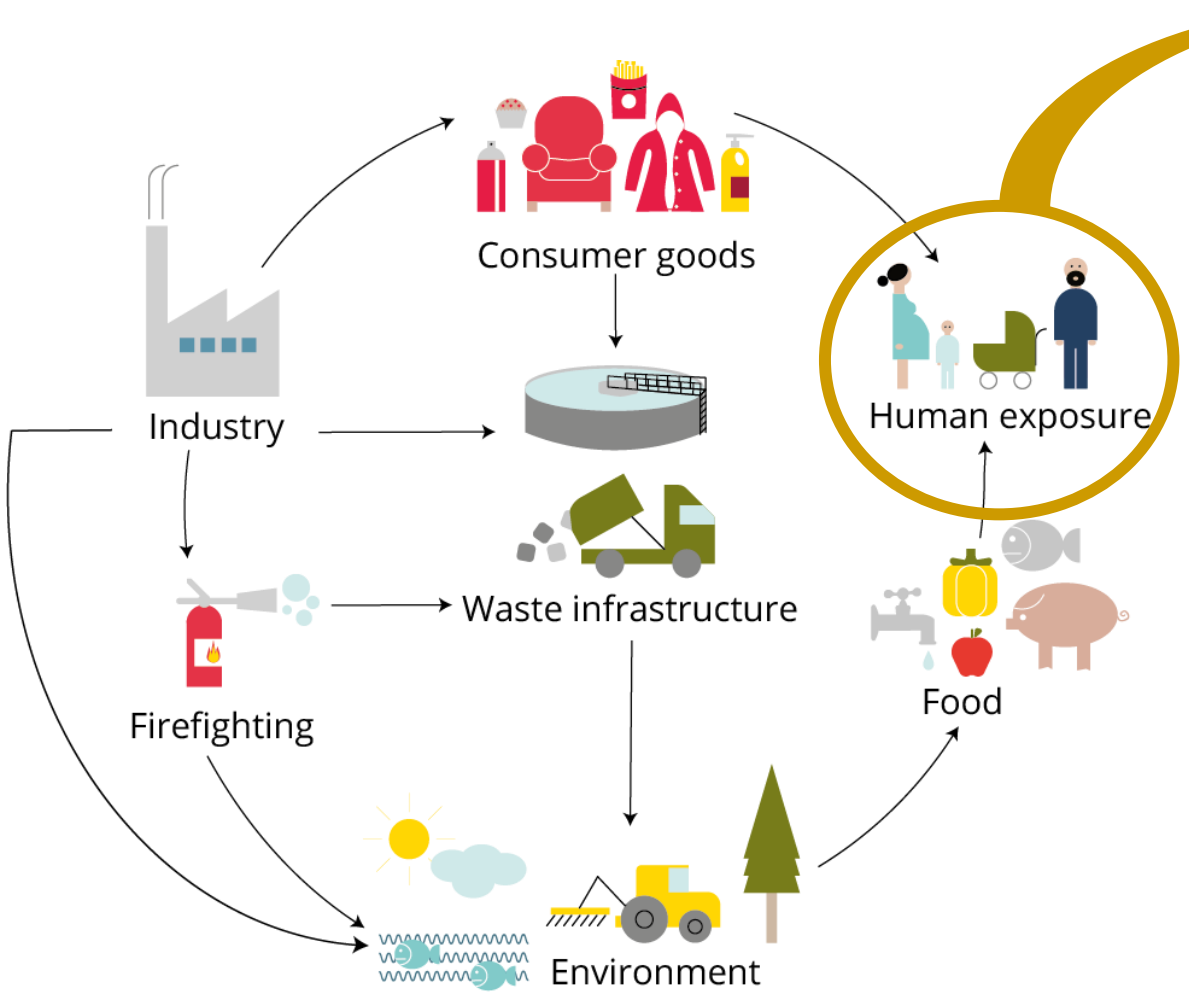


Figure from European Environment Agency

Almost all humans have detectable PFAS in the blood [1]

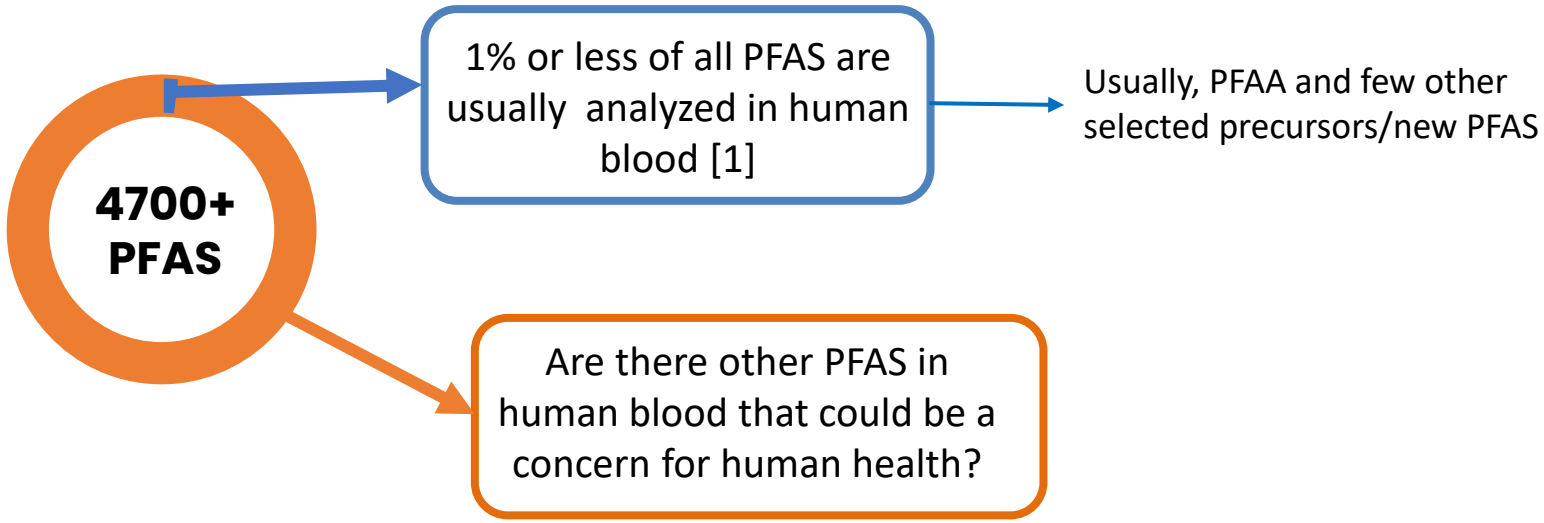
Some PFAS can cause adverse health effects [2]

[1] Sunderland et al., 2019, J Expo Sci Environ Epidemiol 29(2)
[2] Fenton et al., 2021, Environ Toxicol Chem 40(3)

PFAS in human blood

PFOA and PFOS concentrations declining globally [1]

Unidentified organic fluorine increasing [2]



[1] Sunderland et al., 2019, J Expo Sci Environ Epidemiol 29(2)
[2] Yeung et al., 2016, Environ Chem,12(1)

Study questions

Q1: What was the overall exposure to organofluorine chemicals between 1986 and 2015 in northern Norway?

Q2: What were the levels of legacy PFAS between 1986 and 2015?

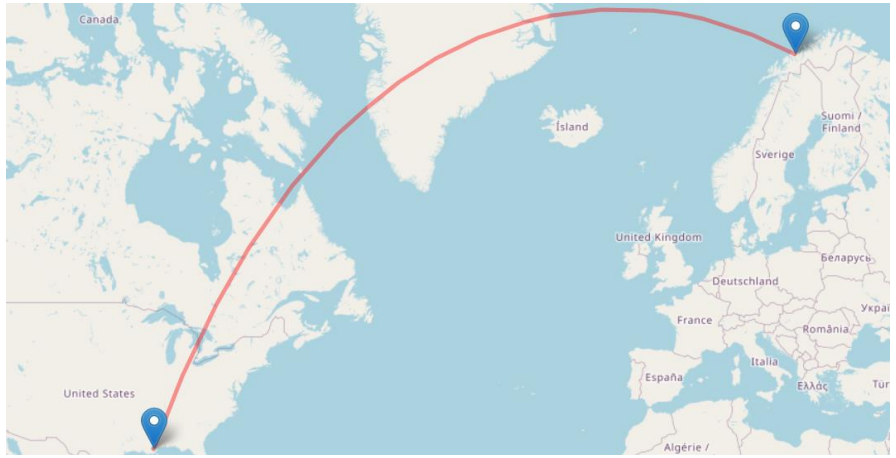
Q3: Can legacy PFAS explain the full extent of exposure to organofluorine compounds?

Q4: Are precursors contributing to organofluorine compounds exposure?

Q5: Are there sex and age differences in exposure?

Study design - Tromsø Study and pooling

The Tromsø Study



Source: https://www.distancefromto.net/

~ 70 thousand inhabitants
~ 7594 km (4719 miles) from New Orleans

1986
208 individuals
15 pools

2007
191 individuals
17 pools

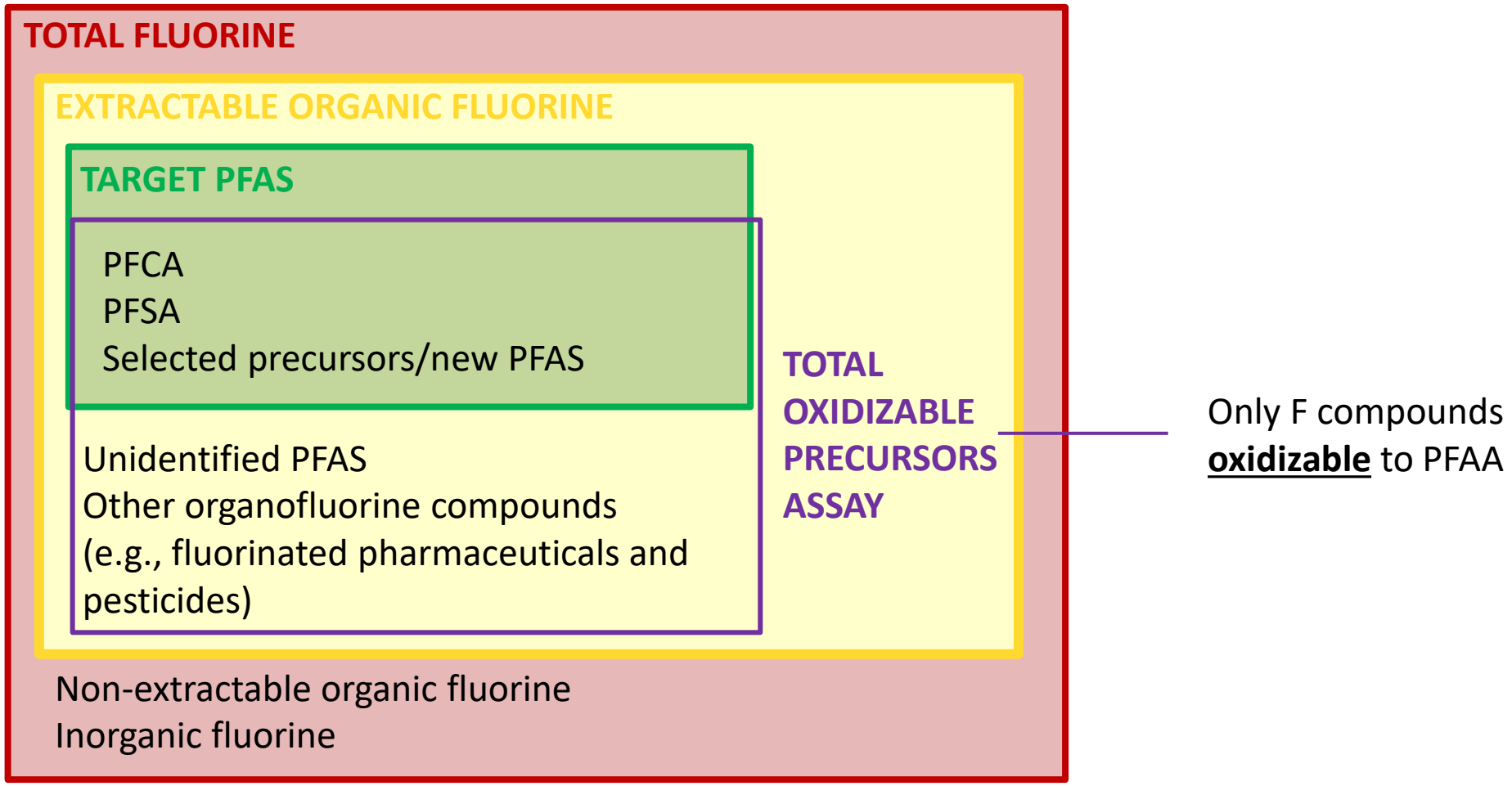
2015
130 individuals
14 pools

2000-2002
Voluntary PFOS phase-out by 3M

2009
PFOS and its salts listed as POPs under Stockholm Convention

Serum samples pooled based on:
- Sex
- Age

Study design - F mass balance approach



Study design - F mass balance approach

750 µl

100 µl — **TOTAL FLUORINE**
Method from Miaz et al. (2020)

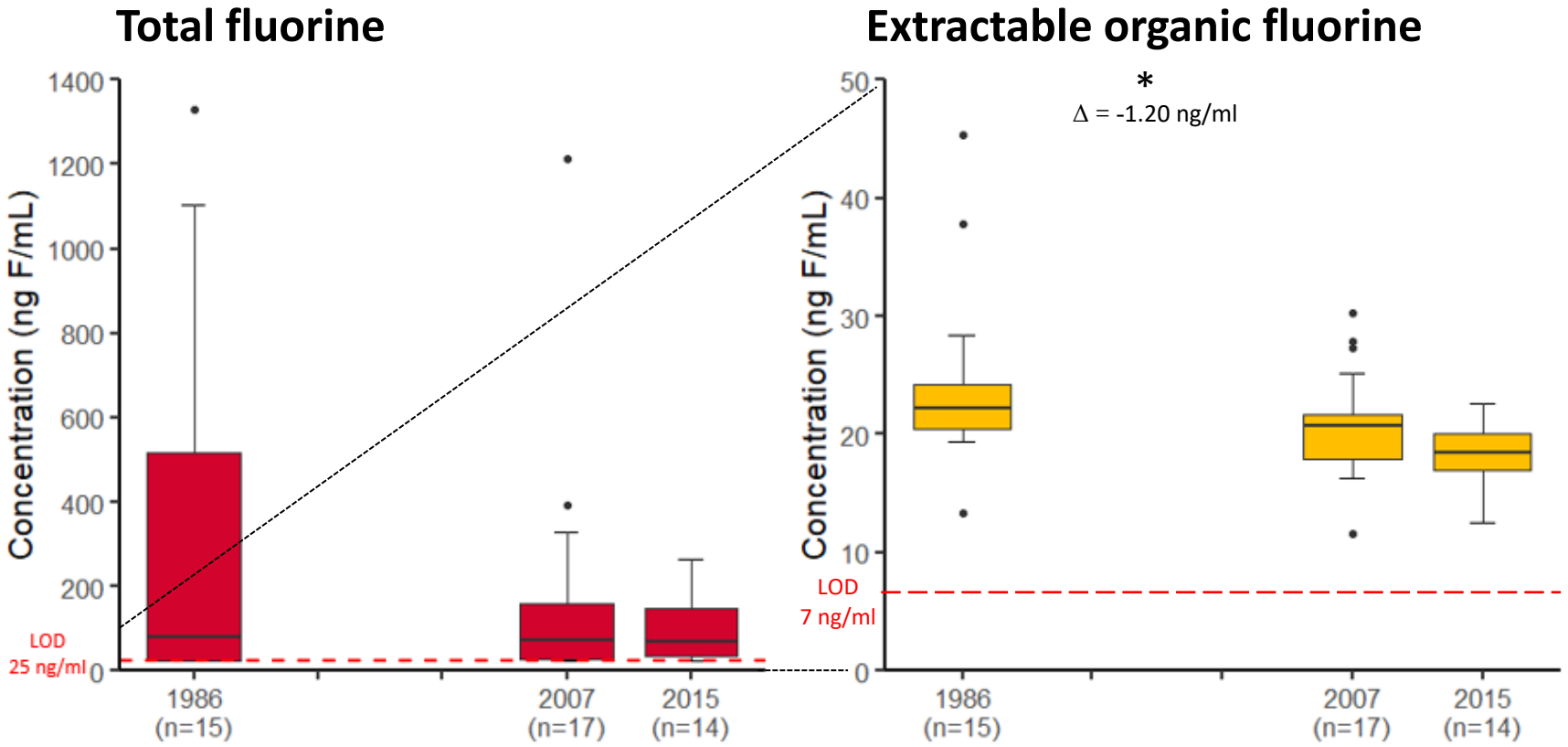
500 µl — ACN extract
- **EXTRACTABLE ORGANIC FLUORINE**
  Method from Miaz et al. (2020)
- **TARGET PFAS**

150 µl — ACN extract +ISTD — **TOTAL OXIDIZABLE PRECURSORS ASSAY + target PFAS**
Method from Cioni et al. (2022)

Time differences and predictors (sex and age) assessed using **multiple linear regression**

Miaz et al., 2020, Environ Sci Process Impacts, 22 (4)
Cioni et al., 2022, ChemRxiv (pre-print, under review)

Q1: What was the overall exposure to organofluorine chemicals between 1986 and 2015?



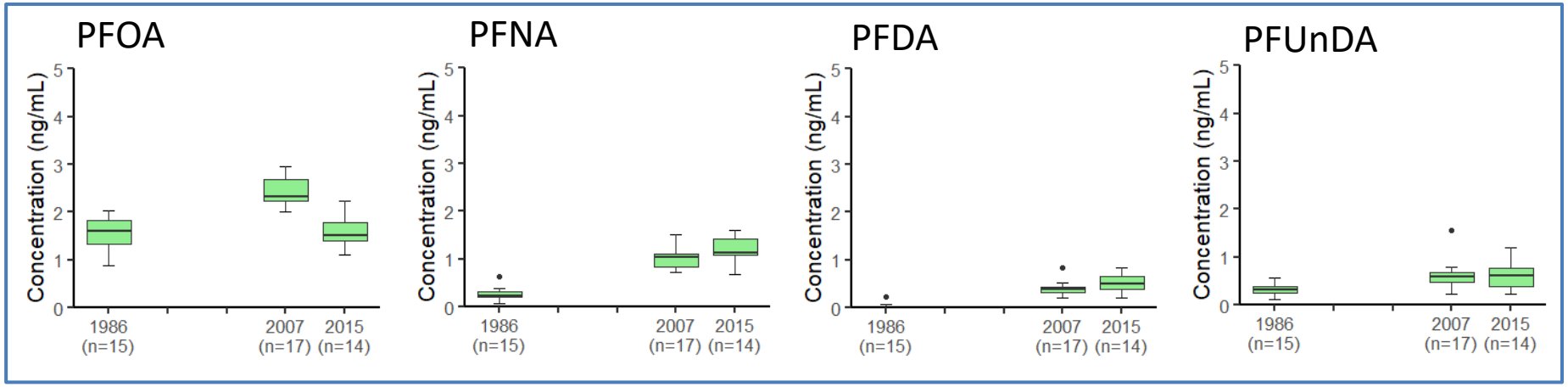
* p-value < 0.5
** p-value < 0.1
*** p-value < 0.005

Figure from Cioni et al. (manuscript in preparation)

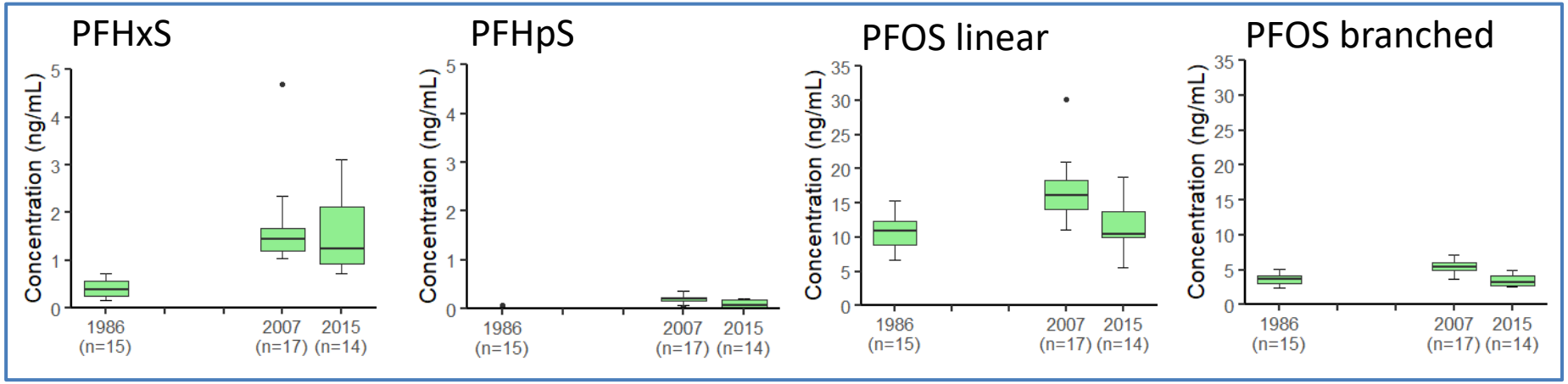
Q2: What were the levels of legacy PFAS between 1986 and 2015?

10 of 54 PFAS detected in 25 µl of serum

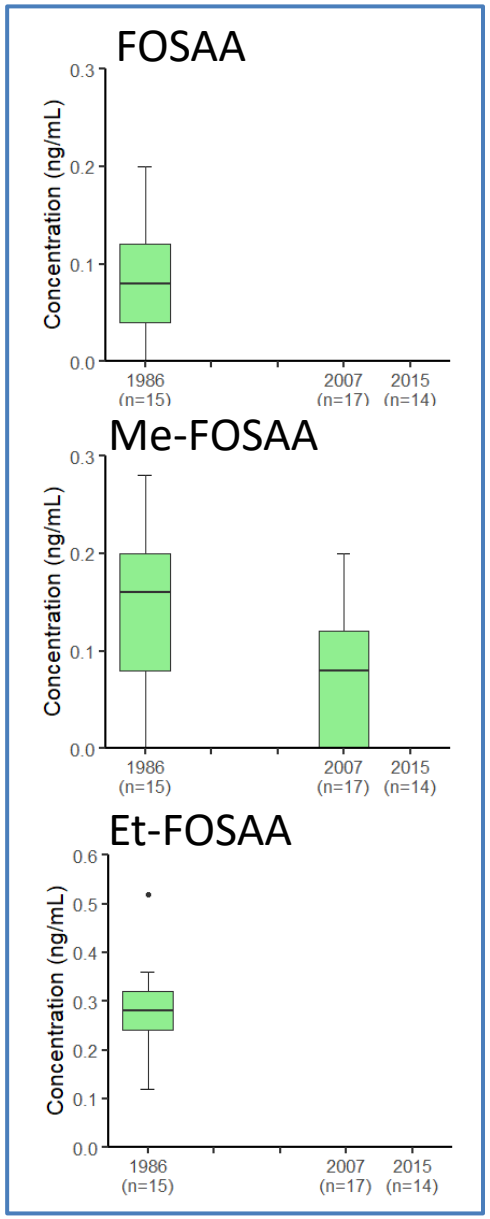
PFCA



PFSA



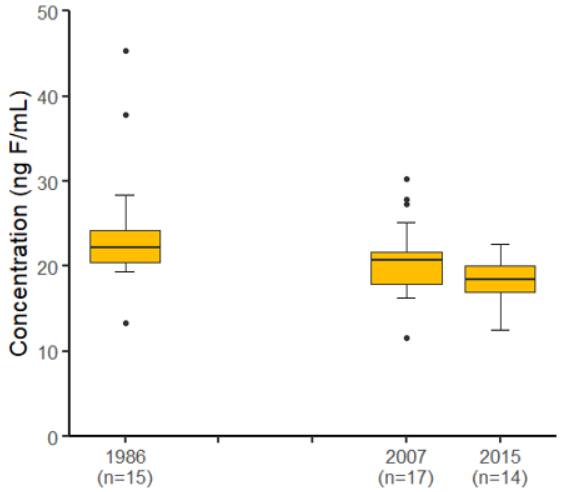
FOSAAs



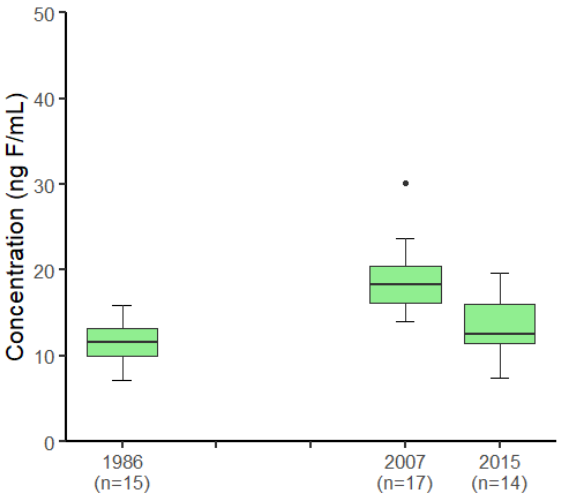
Figures from Cioni et al. (manuscript in preparation)

Q3: Can known PFAS explain the full extent of exposure to organofluorine compounds?

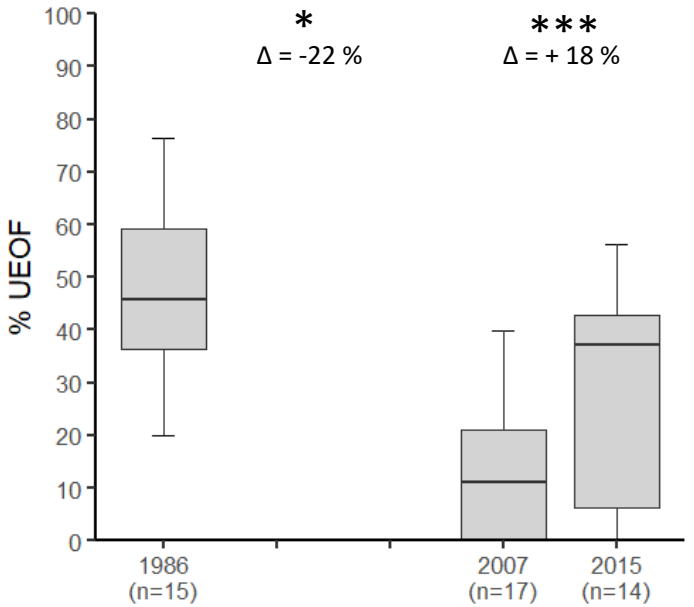
Extractable organic fluorine



Sum known PFAS



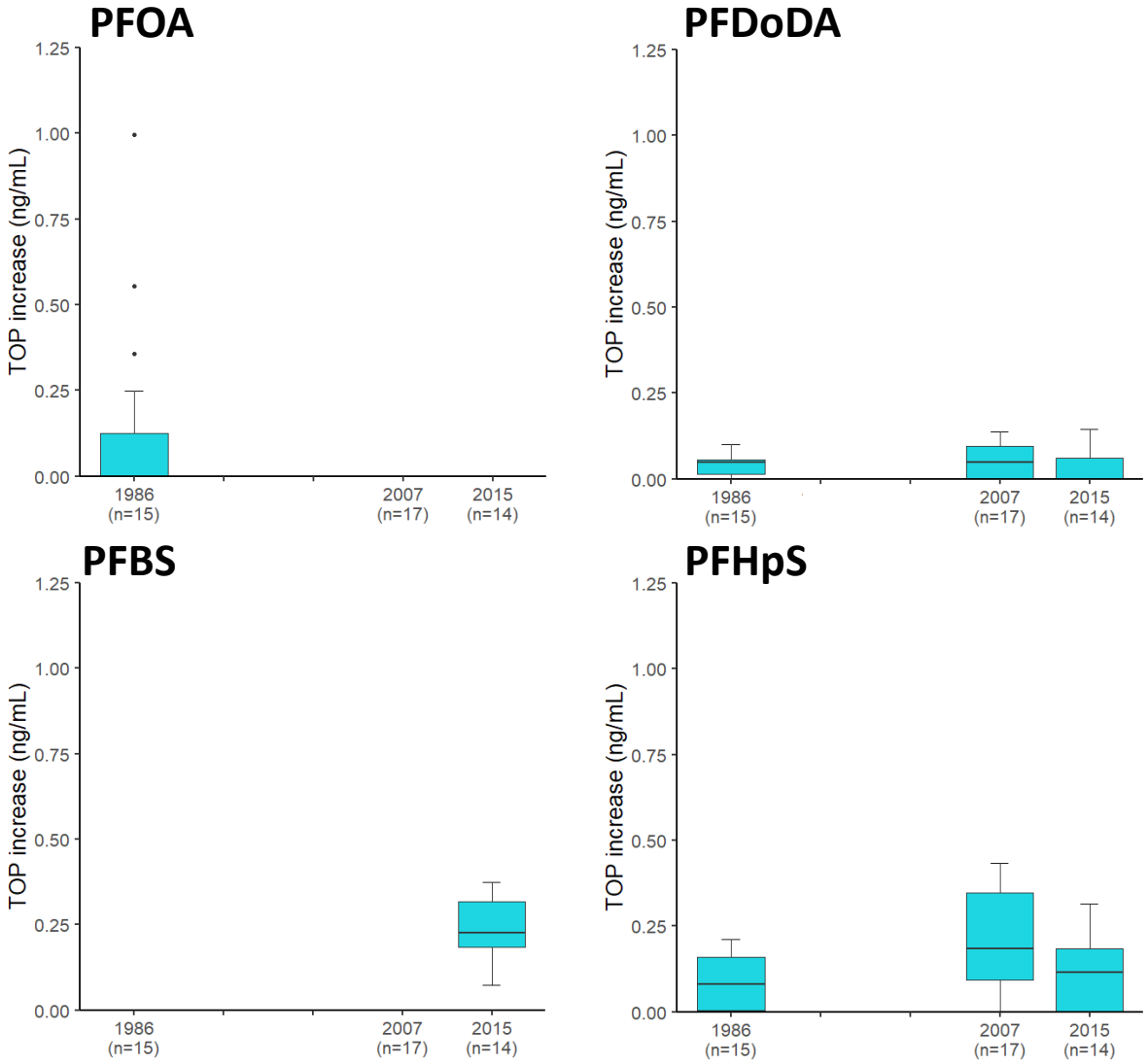
Unidentified organic fluorine



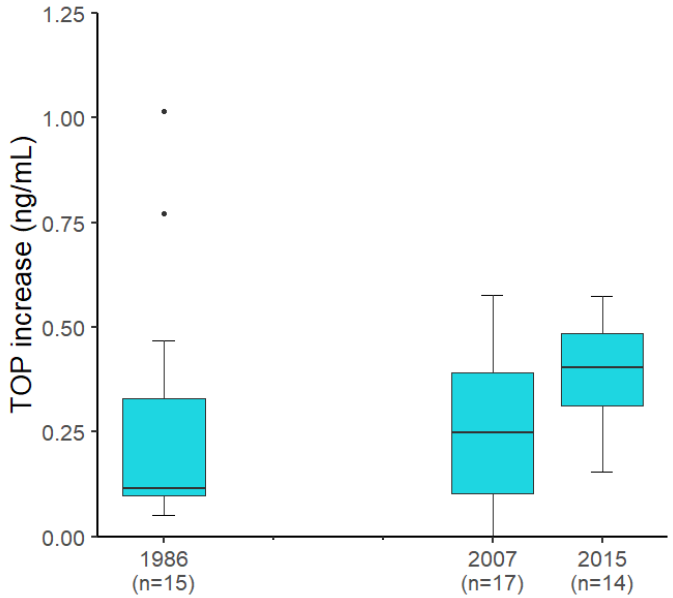
* p-value < 0.5
** p-value < 0.1
*** p-value < 0.005

Figures from Cioni et al. (manuscript in preparation)

Q4: Are precursors contributing to organofluorine compounds exposure?



Total oxidizable precursors estimate



0-3% of the unidentified EOF

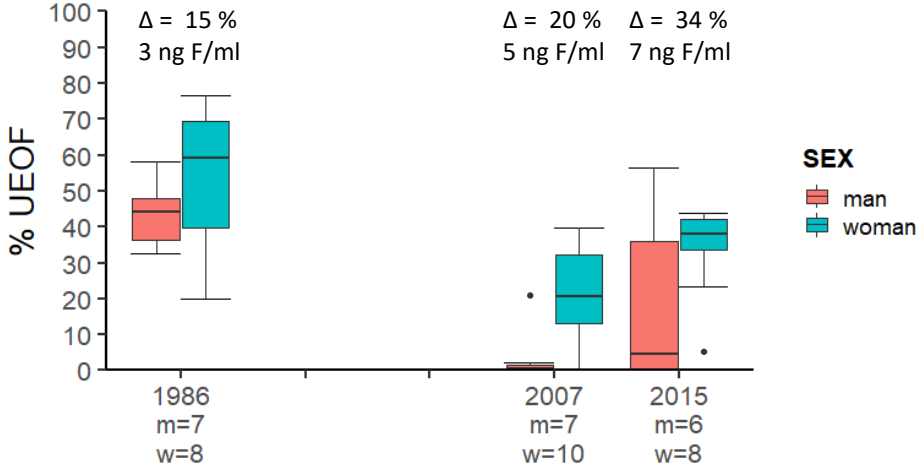
Figures from Cioni et al. (manuscript in preparation)

Q5: Are there sex/age differences in exposure?

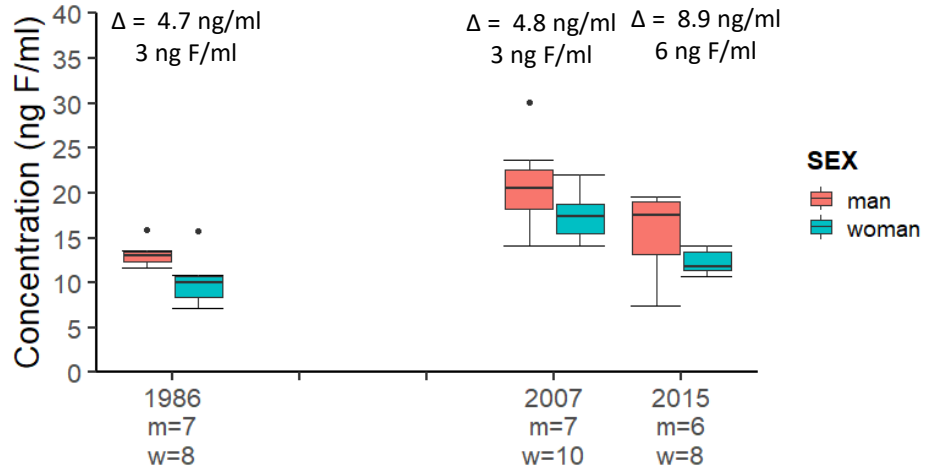
Sex

Sex was not a predictor for TF and EOF levels.

Unidentified organic fluorine



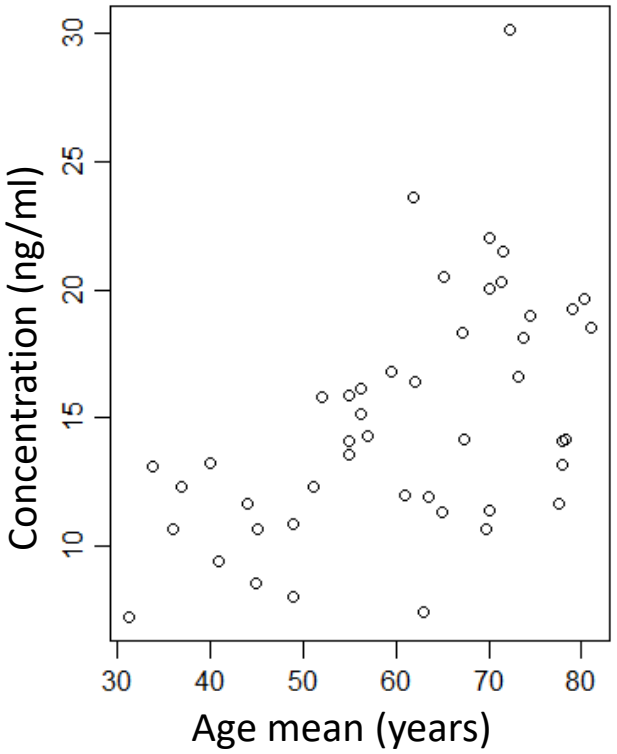
Sum known PFAS



Age

Age was not a predictor for TF, EOF and unidentified EOF levels.

Sum known PFAS



Figures from Cioni et al. (manuscript in preparation)

Conclusions

1. No temporal trends for **overall concentrations of organofluorine compounds** were observed between 1986 and 2015

2. **Target PFAS concentrations** were higher in 2007 than 1986 and 2015

3. **Unidentified EOF** concentrations were lower in 2007 than 1986 and 2015

4. **Oxidizable precursors** only account for a small portion of the unidentified EOF

5. Women have **higher unidentified EOF** than men (opposite to legacy PFAA)

NILU

Acknowledgements

PERFORCE

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Questions?

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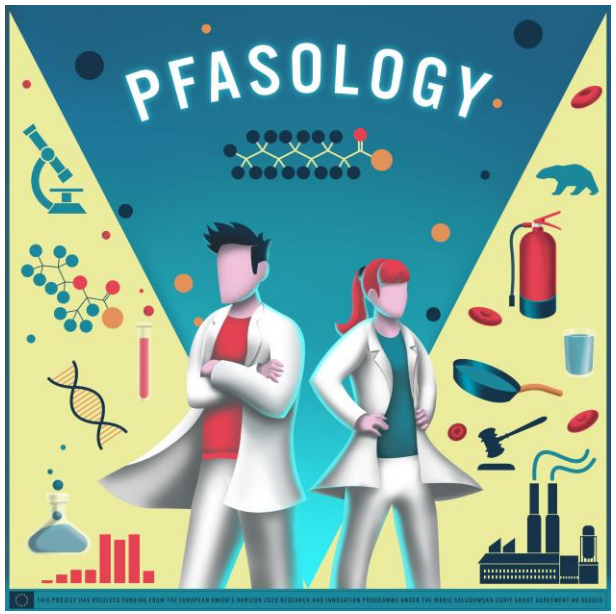
Do you want to hear more about PERFORCE3 PFAS research?



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