



right solutions.
right partner.

PFAS in Air : What's Next?

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Outline

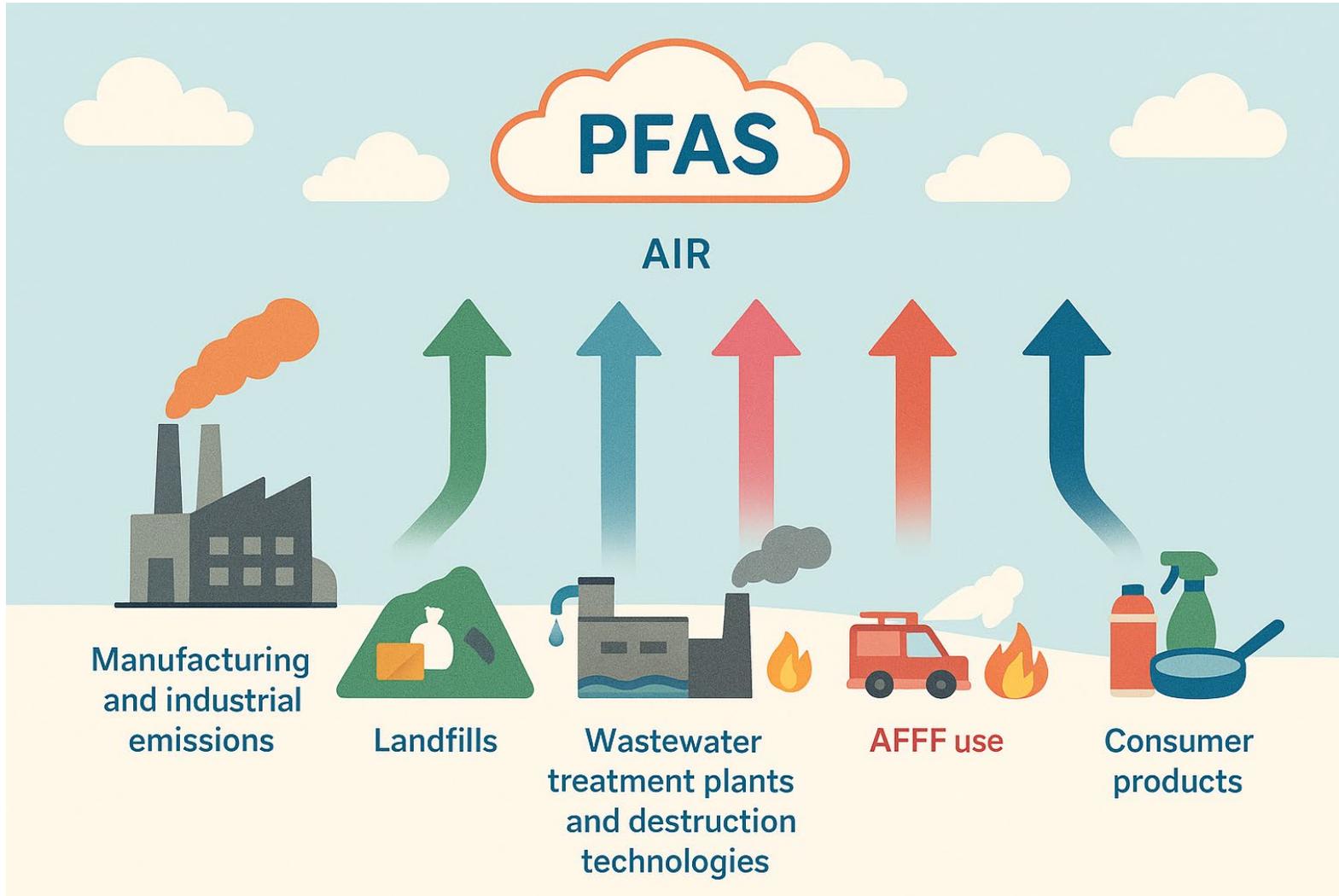


- What PFAS can be found in air?
- Where are PFAS Compounds in Air?
- Why are we concerned about them?
- When might PFAS air testing be considered?
- How do we sample and analyze for them?
- What's Next?

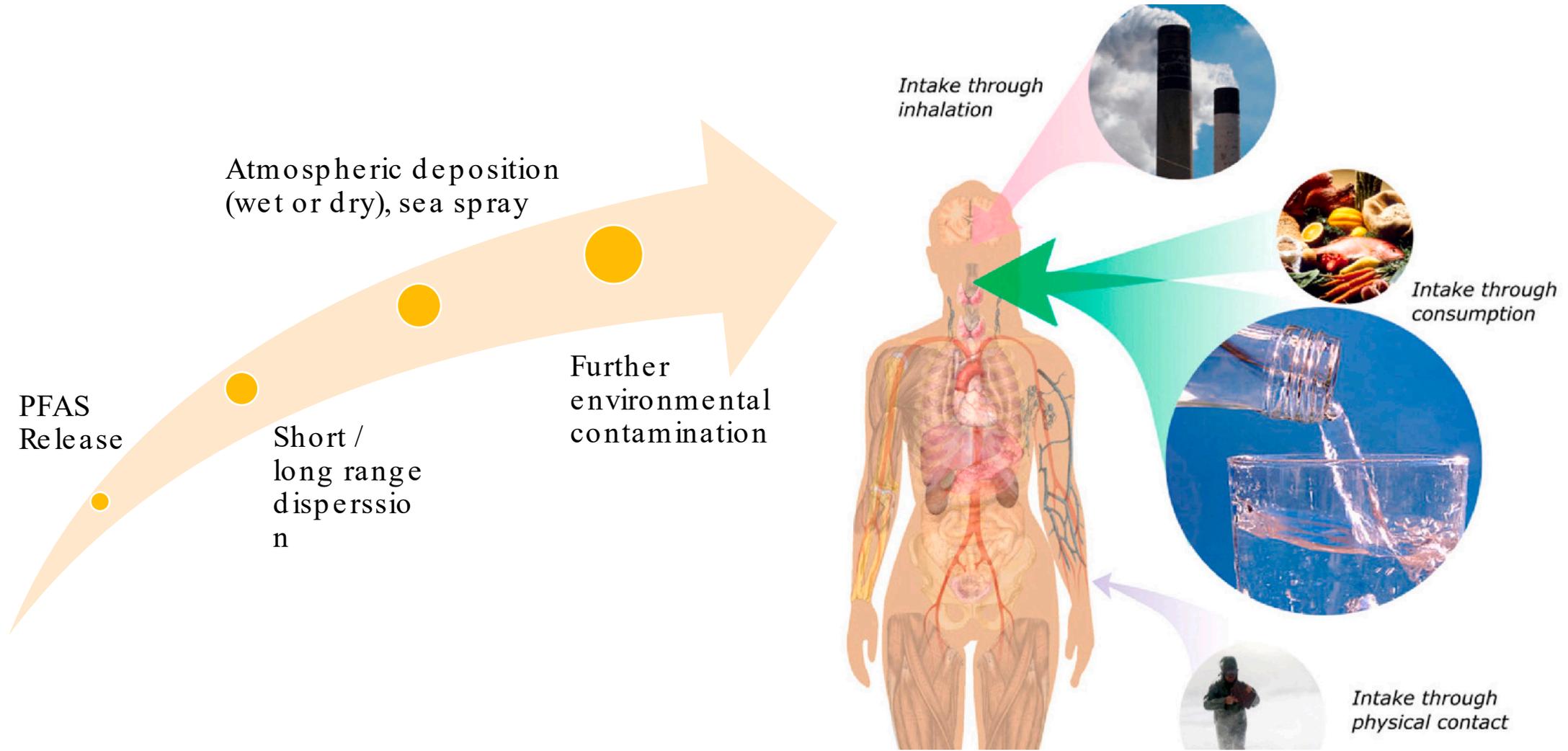




Where: The Sources



Why : Environmental and Health Implications



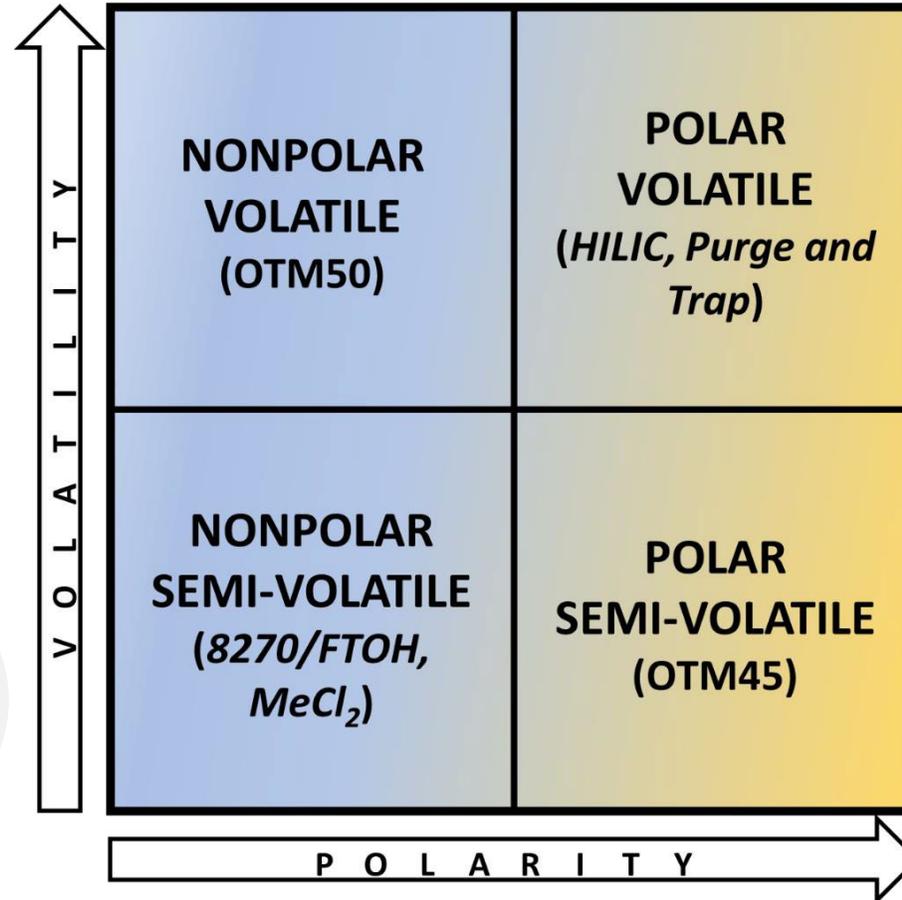
Source: Meegoda et al. 2020



When: Air Monitoring for Survey or Control

- **Stack/source sampling**
- Canister collection
- GC-MS/MS
- 30 compounds (mostly PIC)

- **Ambient sampling**
- ASTM D8591 - TD tubes
- OTM-55 - PUF/XAD traps solvent elution
- GC-MS/MS or LC-MS/MS
- FTOH, sulfonamides and others



Not many known compounds in this category

- **Stack/source sampling**
- Sampling train collection
- LC-MS/MS
- 49 compounds (typical water analytes)

Source: US EPA

How: O TM-45 (Polar Semi-Volatile)



- Stack sampling
- Analysis by LC-MS/MS
- 49 compounds (typical water analytes)

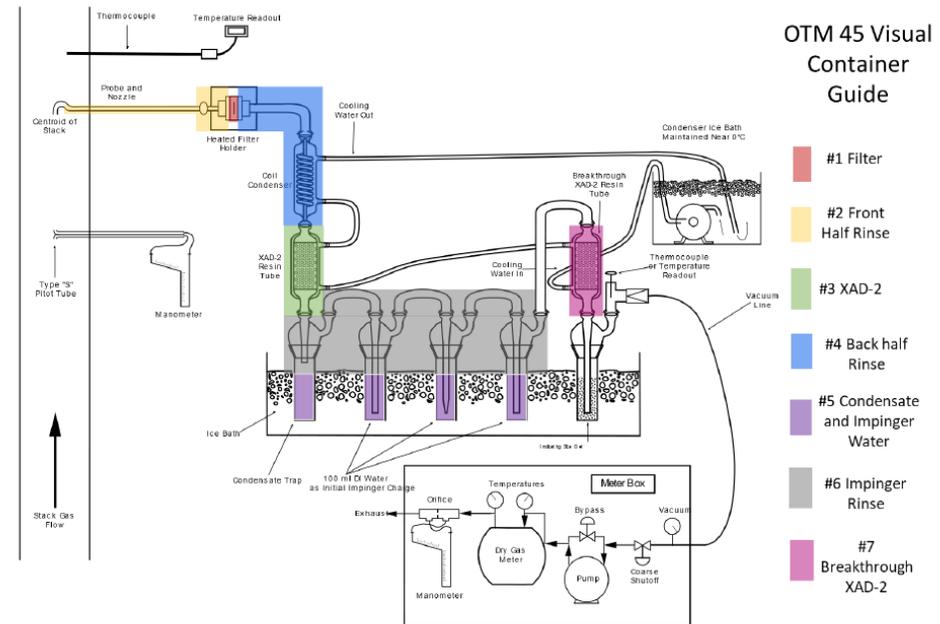


Figure OTM-45-1. Sampling Train



What: OTM-50 (Non-polar Volatile)

Refrigerants

(FC-14) CF_4 (FC-116)	(CFC-11) (CFC-13)
(HFC-41) (HFC-143a) (HCFC-22)	(HFC-23) (HFC-32) (HFC-125) (HFC-134a)
(PFC-218) (PFC-C318) (PFC-C1418)	

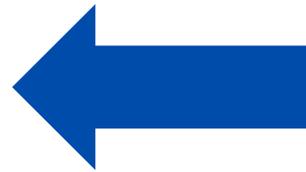
Industrial Chemicals

HFPO E1 E2	C_2F_4
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PIC/PID
fluorinated alkanes
and alkenes

C_3F_6 C_3HF_7	C_4HF_9 C_4F_{10}
C_5HF_{11} C_5F_{12}	C_6HF_{13} C_6F_{14}
C_7HF_{15} C_7F_{16}	C_8HF_{17} C_8F_{18}

- Canister sample collection
- Analysis by GC-MS/MS
- 30 compounds (mostly PIC)



Volatile fluorinated compounds (VFCs)

- Products of incomplete combustion / destruction (PICs/PIDs)
- Fluorinated refrigerants
- Industrial compounds of interest

Some refrigerants and industrial chemicals are formed from PFAS during destruction.

How ? Evacuated Canisters, GC-MS/MS and a BIG Autosampler

Sampling Times : 4, 10, 20
or 60 minutes



1.4L Silonite canister
Dedicated PFAS canisters

Passivated silicon ceramic lined
stainless-steel



Agilent 7010D GC-MS/MS
Entech 7200-PFAS pre-concentrator and SK-75 autosampler

Quality Control – Field



Considerations

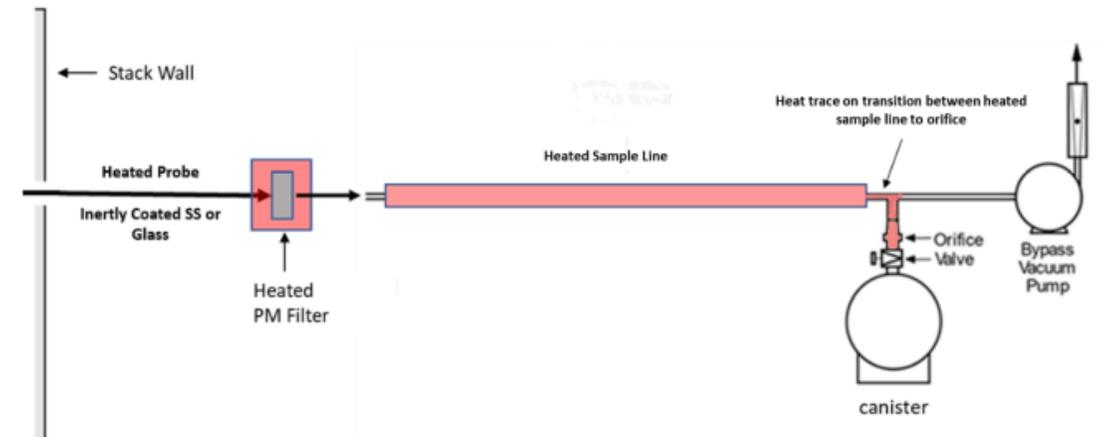
- ☑ Sampling Configuration:
 - moisture and acid gases – configuration varies.
 - duplicate samples – precision or varied volumes?
- ☑ Check system background before & after
- ☑ Pre-heat / flush sampling lines – 2hrs!



Good to Know

- Based on TO-15A
- Particulate matter filter required upstream
- Bypass vacuum pump required downstream

OTM-50 FAQ sheet available from US EPA website: Google it or ask us!



Quality Control – Laboratory



Segregation of
PFAS Canisters



PFA Tubing?
fluoropolymer!



Cleaning &
Proofing

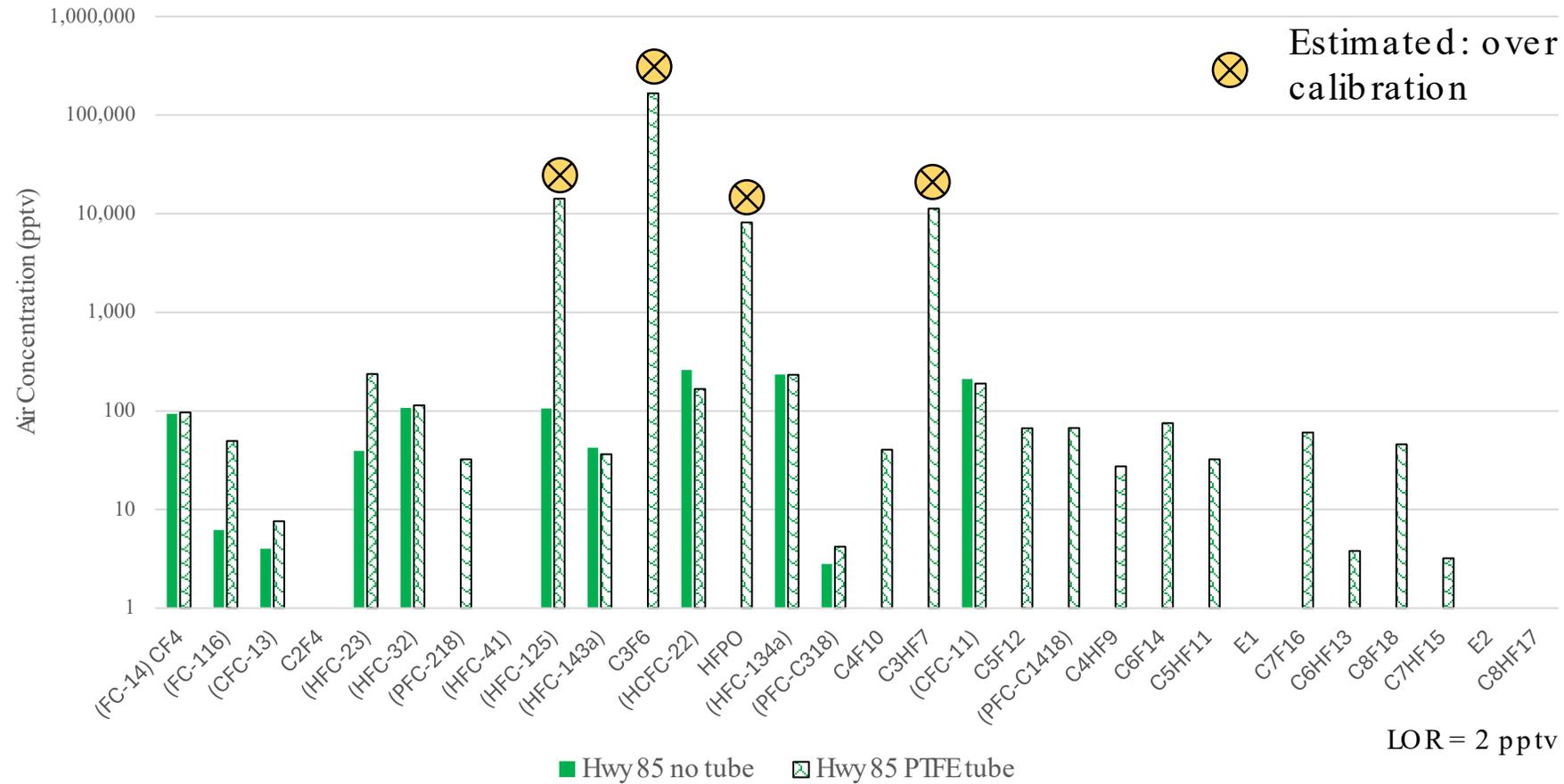


Shipping



Handling in the
lab

OTM-50 – Sampling Tube Investigation



Sampling Tube NOT pre-conditioned!



What else? We are Clean Freaks!

Canister Cleaning Procedure - Specific to PFAS

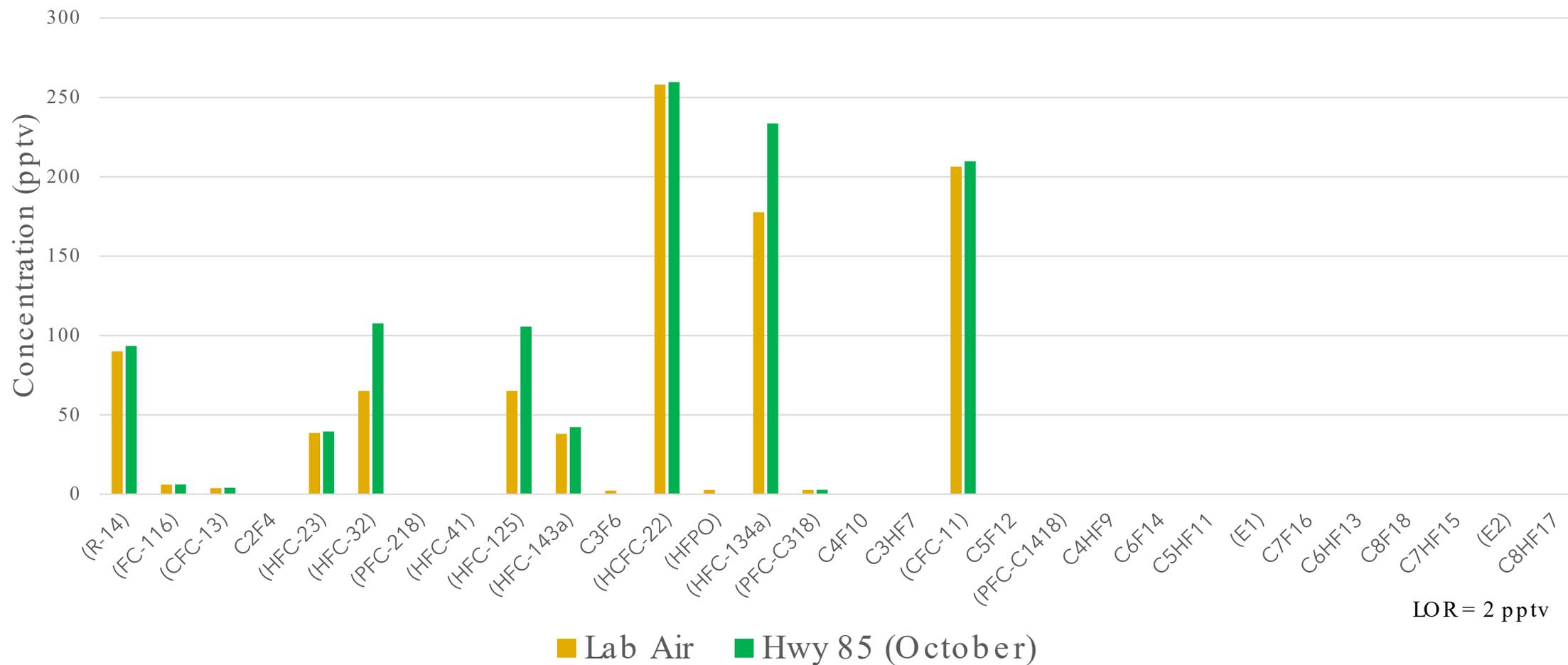
- 1.4 L Silonite canisters are cleaned for 1 week:
 - Heated and purged with clean humidified air, evacuated to 0.0067 kPa.
- Quick Connects cleaned for one week:
 - Rinsed in methanol and water, then heated (100 °C max) under vacuum.
- Flow controllers cleaned, conditioned & checked (digital flow meter) to confirm accuracy
- All canisters are individually proofed; however, we only report 1 per batch on C of As.
 - meets batch proofing requirements, but we actually proof all cans



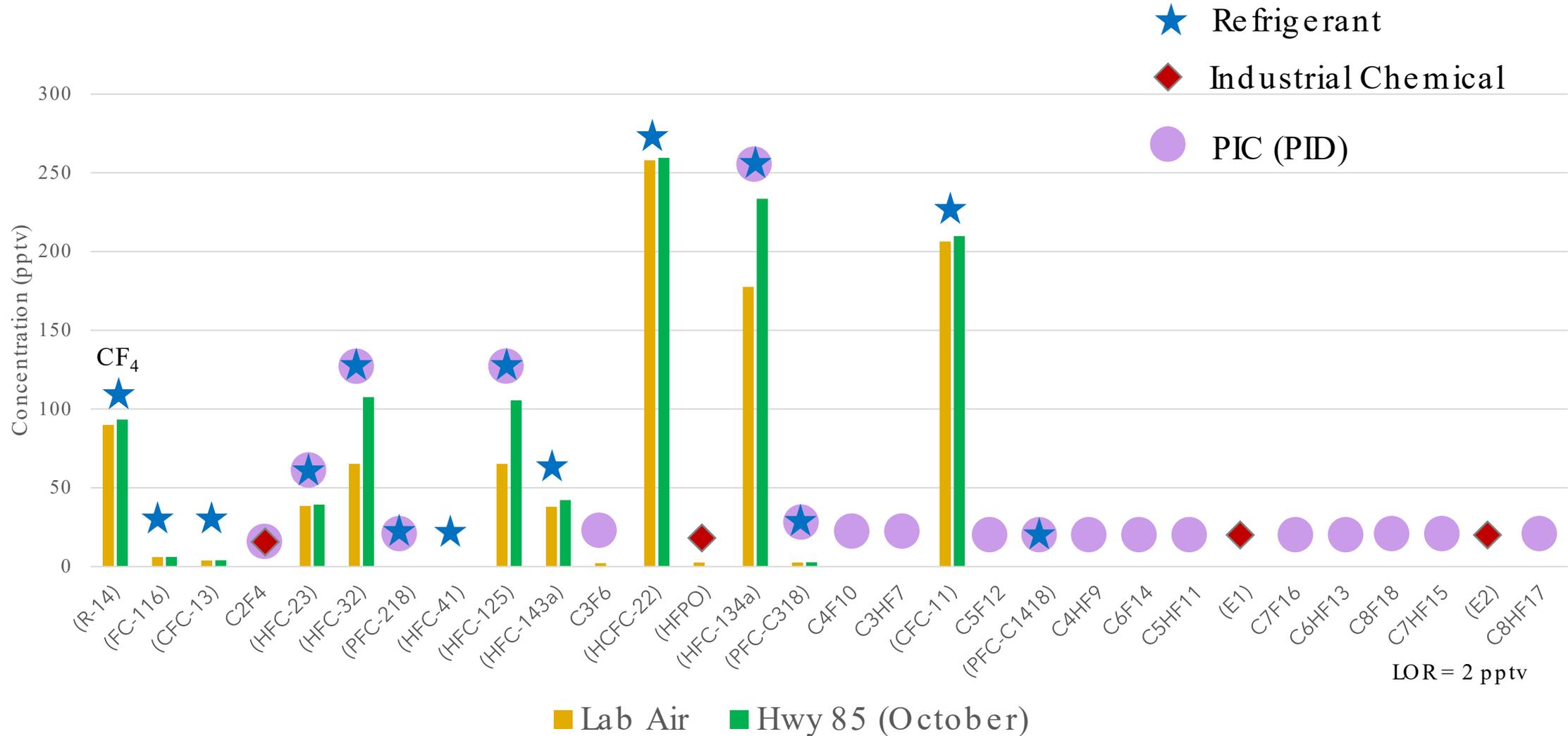
By individually proofing each canister, you are able to request individual proof certificates (\$100) after analysis based on data received.

- This saves \$\$ as you can pick which, if any, individual canister proofs you want.

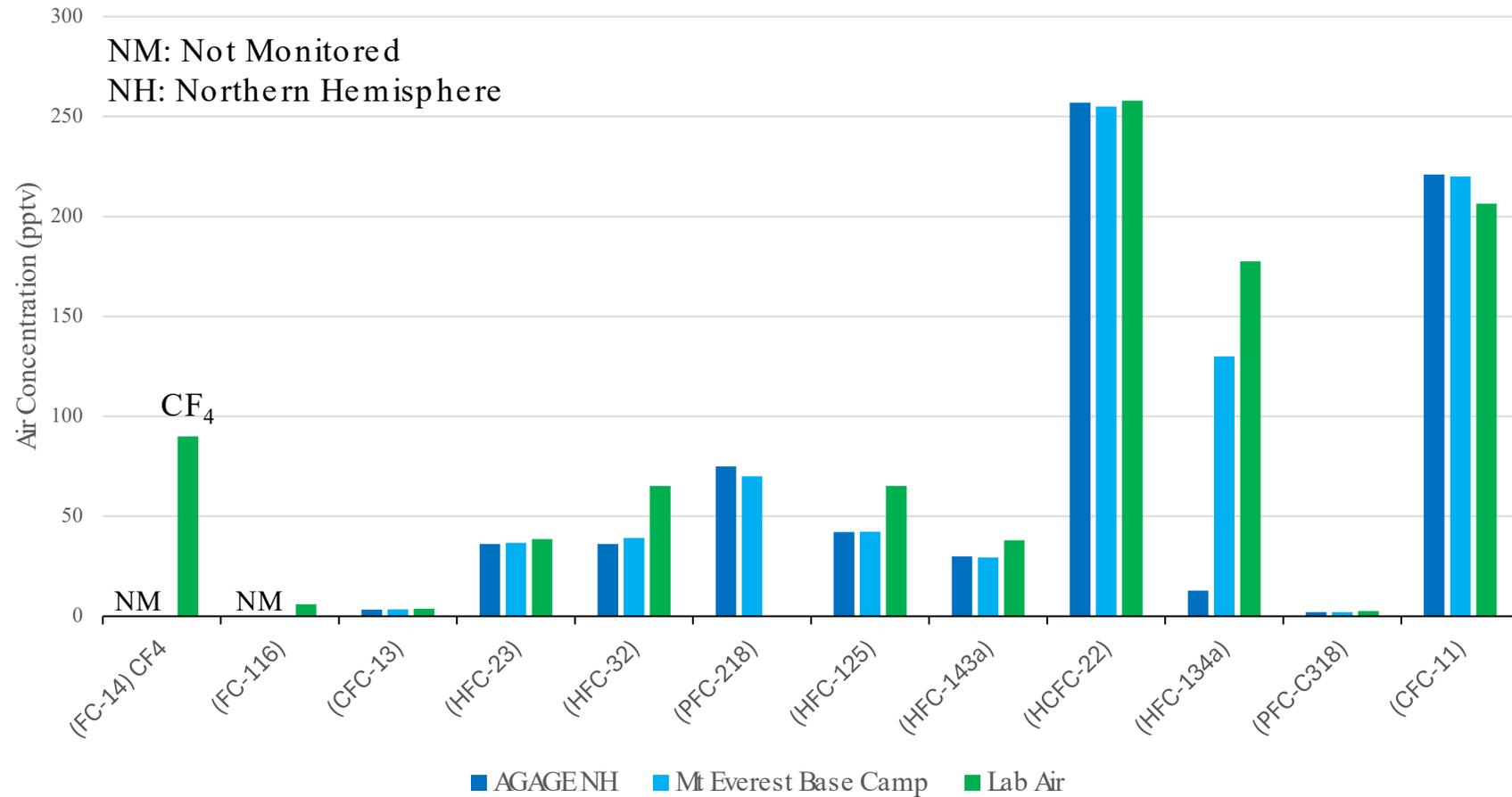
OTM-50 Ambient Air Sampling – Lab & Rush Hour Traffic Air



OTM-50 Ambient Air Sampling – Source Identification

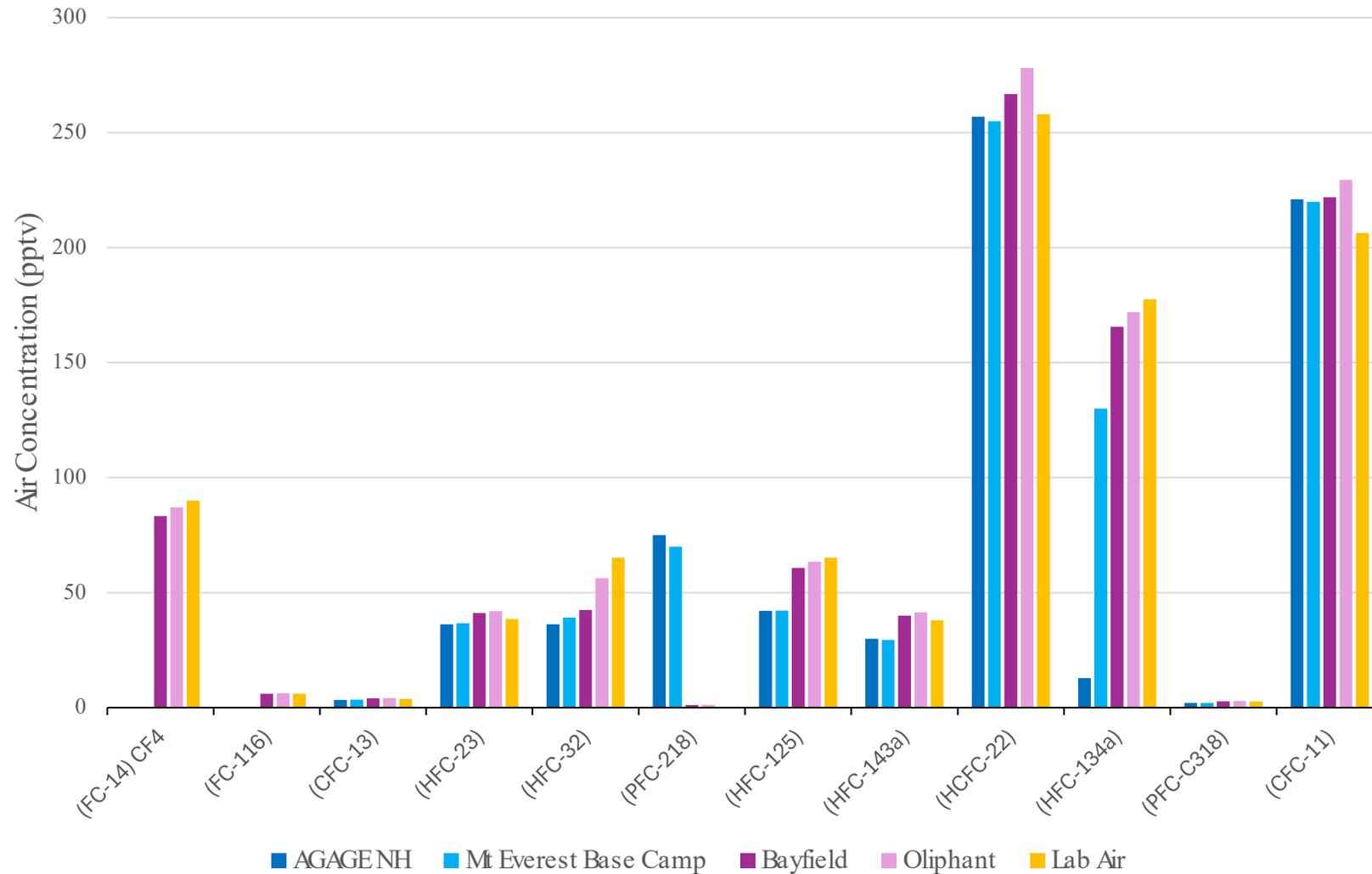


OTM-50 Results vs Global Monitoring



Global data reference: Cong et al. 2024 Science of the Total Environment, 956, 177348.

OTM-50 Ambient Air Comparison



GC-MS/MS Method Reporting Limits



Parameter	Synonym	OTM50 QRL (3xMDL)	ALS LOR
		----- ppbv -----	
Tetrafluoromethane	(FC-14)	0.090	0.002
Hexafluoroethane	(FC-116)	0.037	0.002
Chlorotrifluoromethane	(CFC-13)	0.037	0.002
Tetrafluoroethene	C2F4	0.033	0.002
Trifluoromethane	(HFC-23)	0.150	0.002
Difluoromethane	(HFC-32)	0.048	0.002
Octafluoropropane	(PFC-218)	0.037	0.002
Fluoromethane	(HFC-41)	0.057	0.002
1,1,1,2,2-Pentafluoroethane	(HFC-125)	0.037	0.002
1,1,1-Trifluoroethane	(HFC-143a)	0.096	0.002
Hexafluoropropene	C3F6	0.037	0.002
Chlorodifluoromethane	(HCFC-22)	0.033	0.002
Hexafluoropropylene oxide	HFPO	0.063	0.002
1,1,1,2-Tetrafluoroethane	(HFC-134a)	0.048	0.002
Octafluorocyclobutane	(PFC-C318)	0.037	0.002
Decafluorobutane	C4F10	0.037	0.002

Parameter	Synonym	OTM50 QRL (3xMDL)	ALS LOR
		----- ppbv -----	
1H-Heptafluoropropane	C3HF7	0.042	0.002
Trichlorofluoromethane	(CFC-11)	0.042	0.002
Dodecafluoropentane	C5F12	0.069	0.002
Octafluorocyclopentene	(PFC-C1418)	0.037	0.002
1H-Nonafluorobutane	C4HF9	0.033	0.002
Tetradecafluorohexane	C6F14	0.048	0.002
1H-Perfluoropentane	C5HF11	0.048	0.002
Heptafluoropropyl-1,1,1,2-tetrafluoroethyl ether	E1	0.042	0.002
Hexadecafluoroheptane	C7F16	0.037	0.002
1H-Perfluorohexane	C6HF13	0.048	0.002
Octadecafluorooctane	C8F18	0.037	0.002
1H-Perfluoroheptane	C7HF15	0.033	0.002
2H-Perfluoro-5methyl-3-6,dioxanonane	E2	0.037	0.002
1H-Perfluorooctane	C8HF17	0.037	0.002

- ALS Limits of Reporting (LOR) are higher than the statistically derived LOQ for each compound.



Looking to the future...PFAS in Air – Where are we at?

- EPA OTM-50 is up and running in Waterloo ALS Roll Out completed November 2025.
 - Serving North America and the world - canisters are easy to ship.
- EPA OTM-45 roll out in Australia is nearing completion.
- Looking forward to partnering with destruction technology developers.
- **Next:** Moving on to the next quadrant!
 - Method development for non-polar PFAS in ambient air and soil vapour by canister and/or thermal desorption tube.

Questions?



right solutions.
right partner.

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