right solutions.
right partner.

PFAS in Air : What's Next?

December 2025

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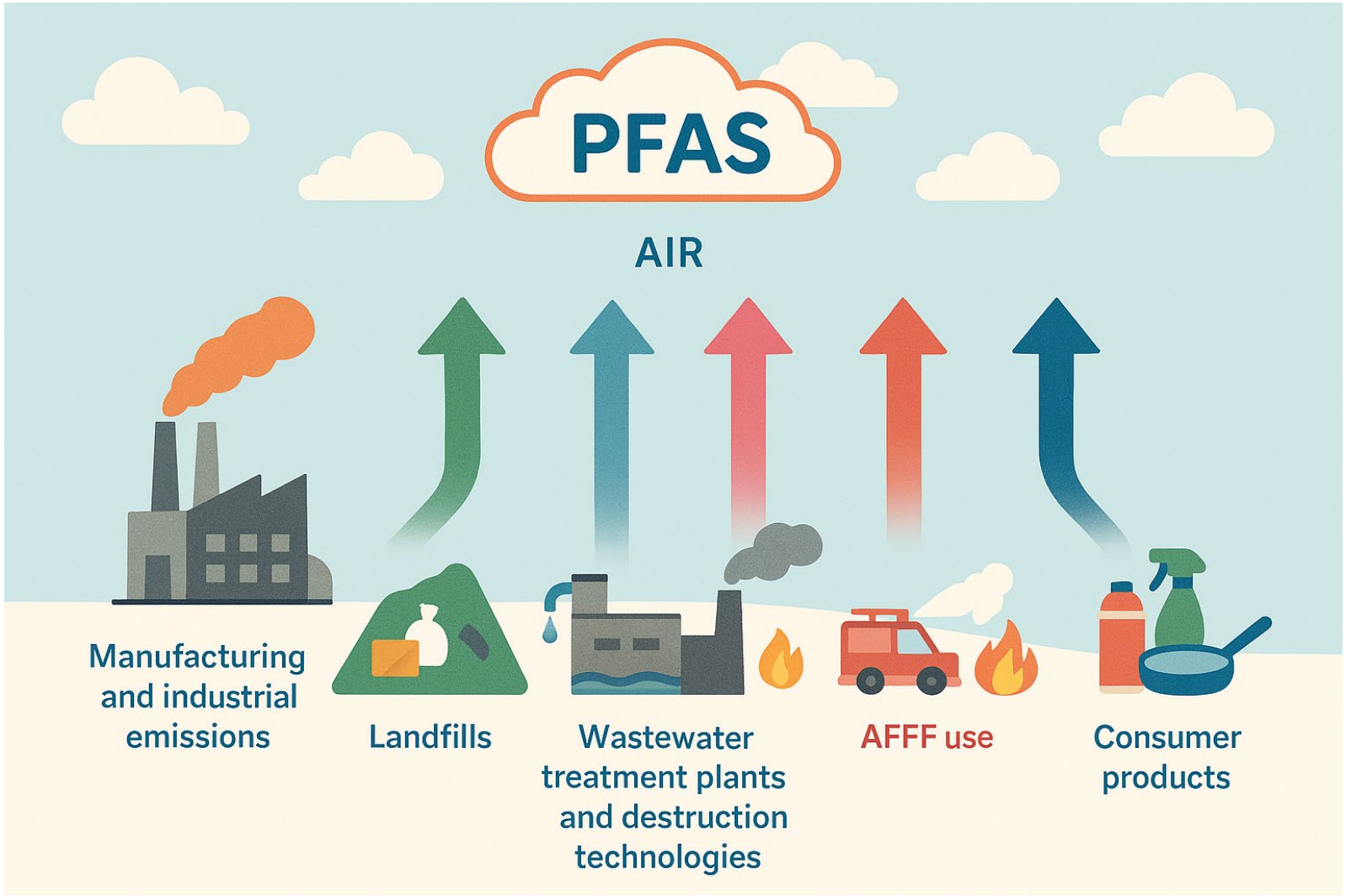
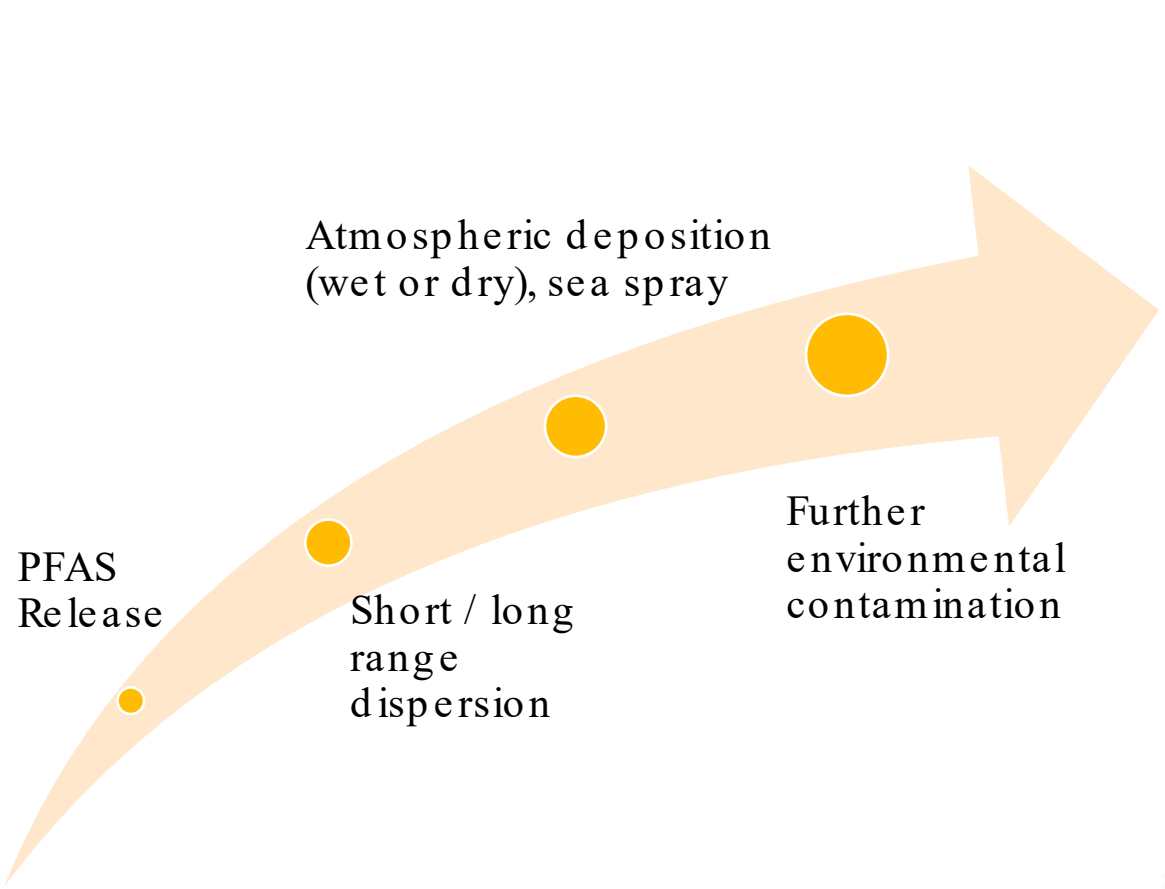
Outline

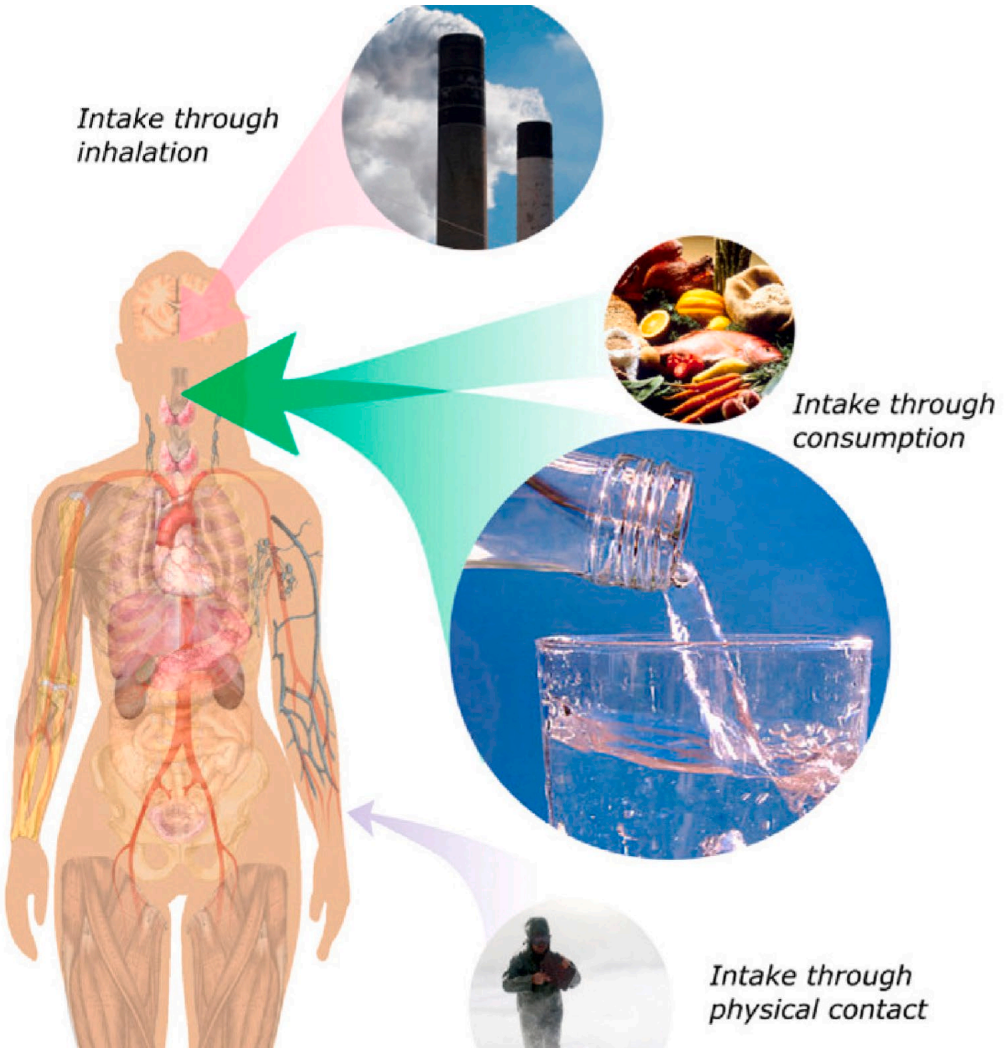
- Where are PFAS Compounds in Air?
- Why are we concerned about them?
- When might PFAS air testing be considered?
- How do we sample and analyze for them?
- What's Next?

Where: The Sources



Why : Environmental and Health Implications



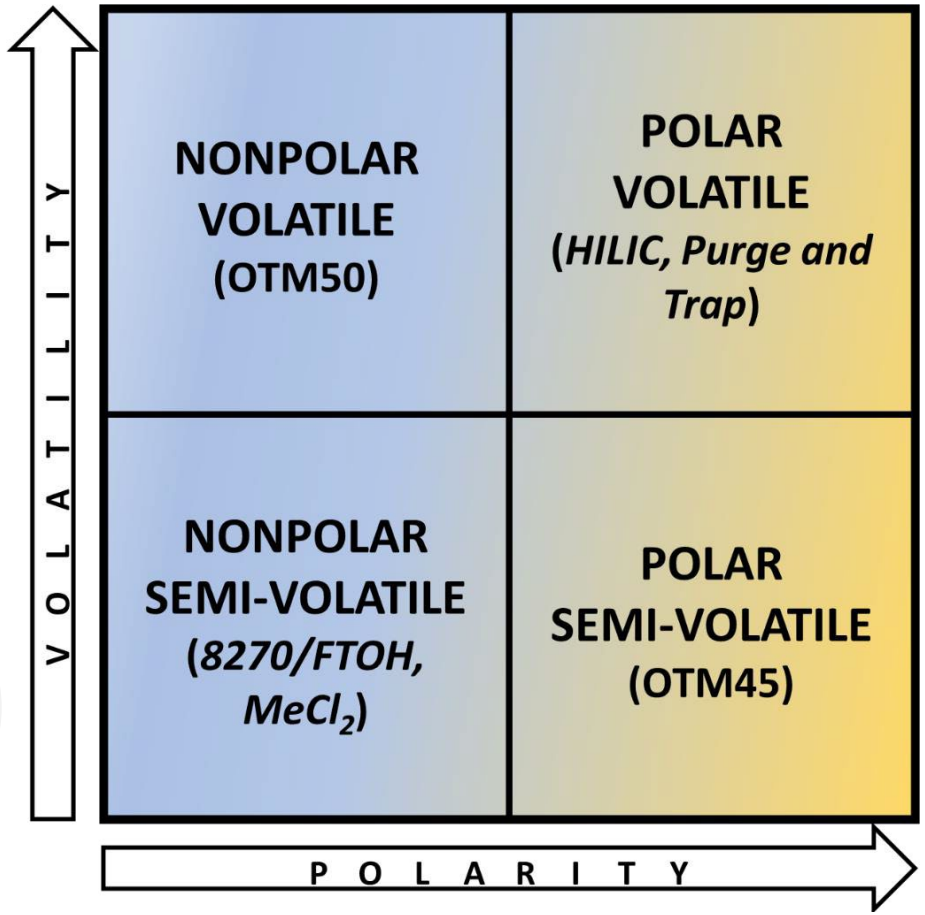


Source: Meegoda et al. 2020

When: Air Monitoring for Survey or Control

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

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



Source: US EPA

Not many known compounds in this category

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

How: OTM-45 (Polar Semi-Volatile)

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

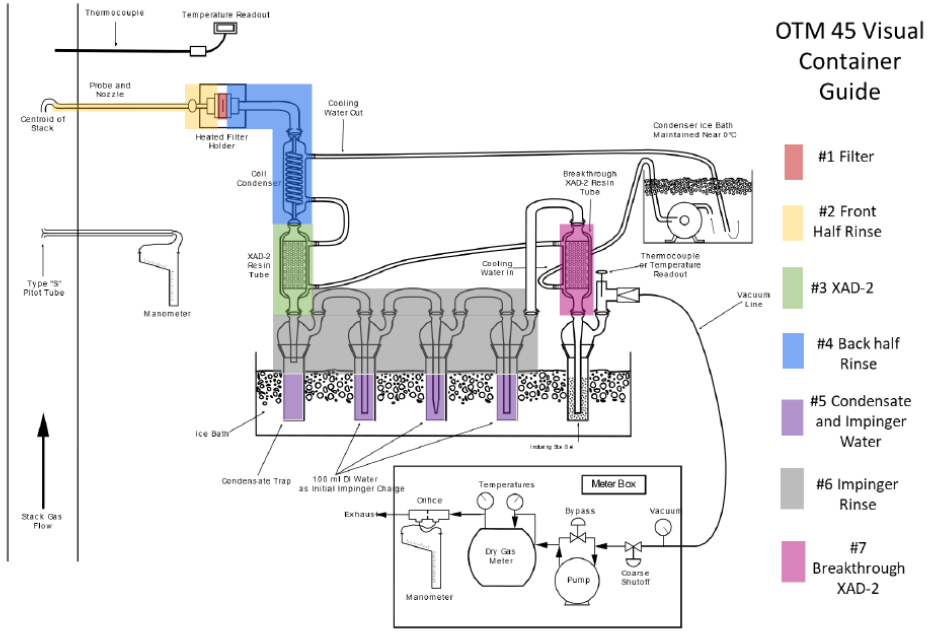


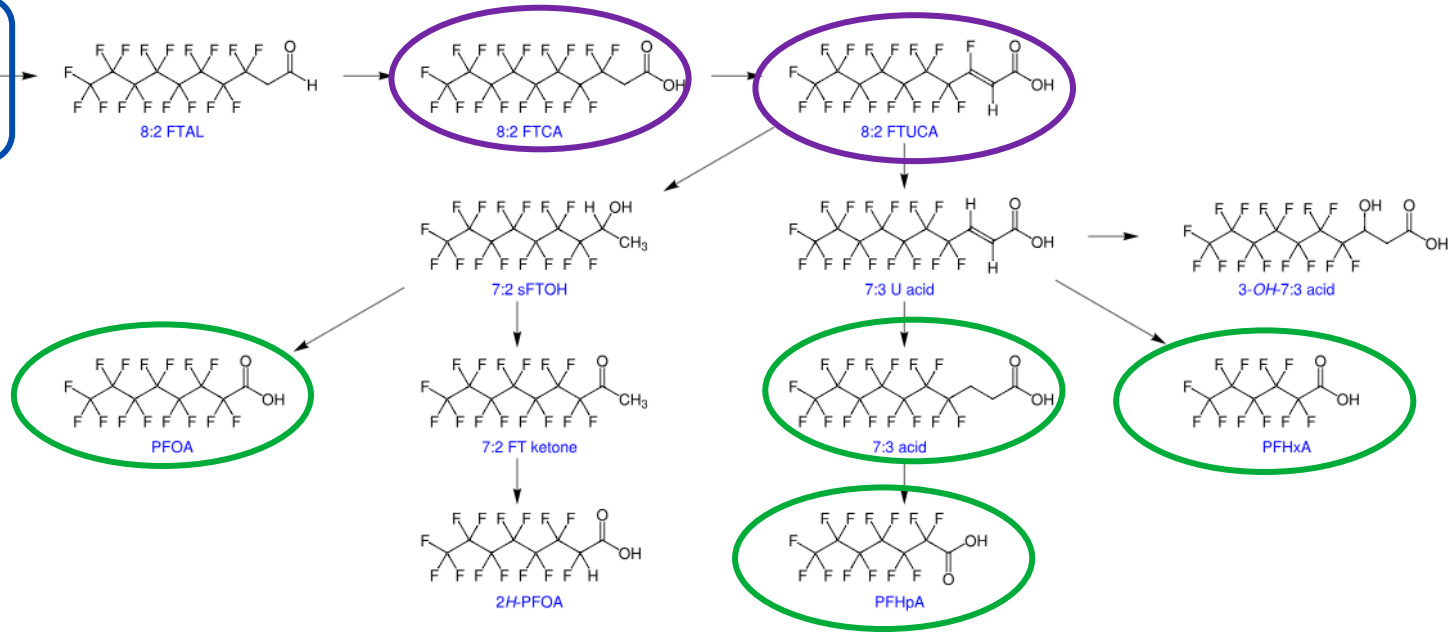
Figure OTM-45-1. Sampling Train

How: OTM-55? / ASTM D8591-24 (Non-Polar Semi-Volatile)

Fluorotelomer Alcohols (FTOH)

- Major category of polyfluorinated PFAS
- High concentrations in indoor air and landfill gas.
- Commonly used in manufacturing and AFFF
- Pending regulation for 6:2 and 8:2 FTOH in Europe
- Testing in air via ASTM D8591-24 and OTM-55 ("under development")
- Testing in soil and water available for select compounds.

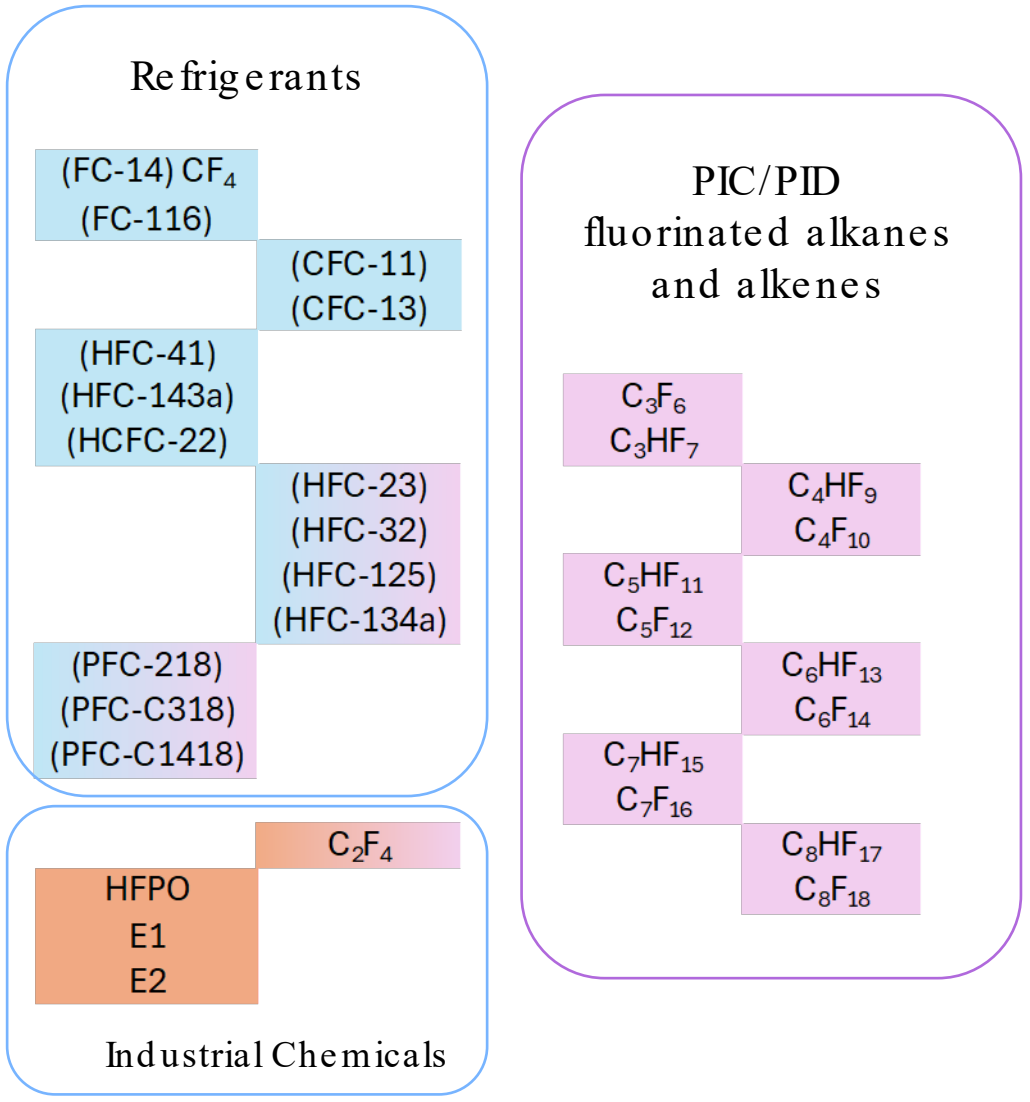
Aerobic Biotransformation of 8:2 FTOH in Soil



Compounds in green ovals: ALS's 40 analyte ALS's PFAS suite
Compounds in green + purple ovals: ALS's extended 52 analyte suite

https://commons.wikimedia.org/wiki/File:Aerobic_biotransformation_8-2_FTOH_soil_labeled.svg.

What: OTM-50 (Non-polar Volatile)



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

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.

Shields et al. ACS EST Eng. 2023, 3, 1308−1317.

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?

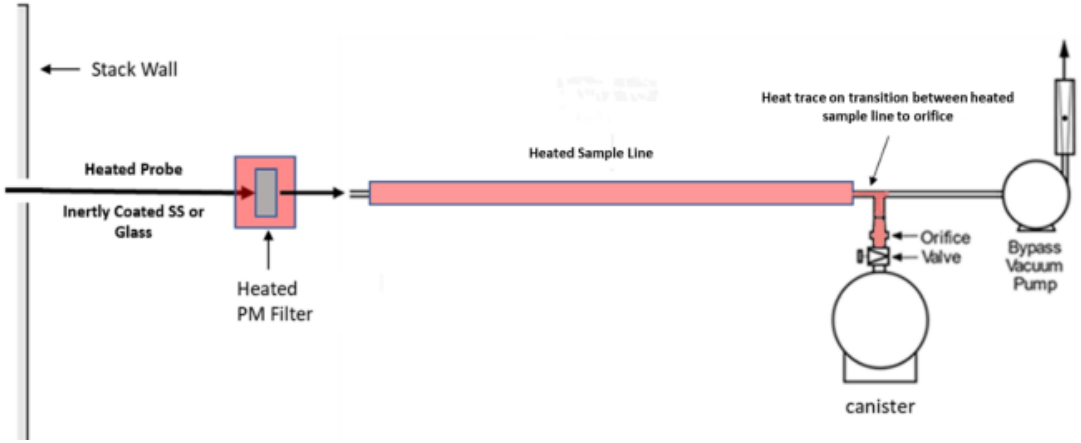
☑Check system background before & after

☑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?

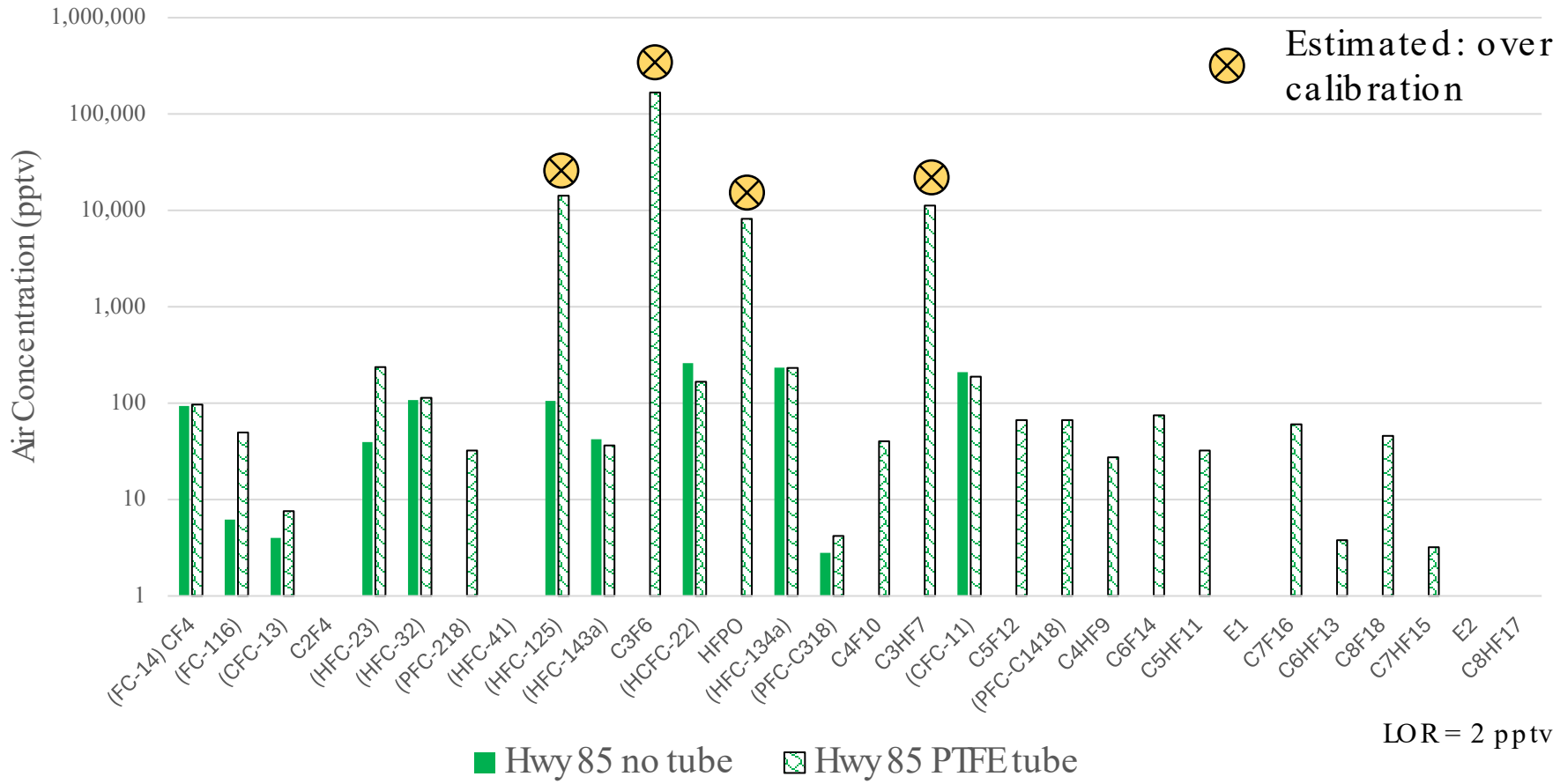
fluoropolymer!

Cleaning & Proofing

Shipping

Handling in the lab

OTM-50 – Sampling Tube Investigation



Sampling Tube NOT pre-conditioned!

What else? We are Clean Freaks!

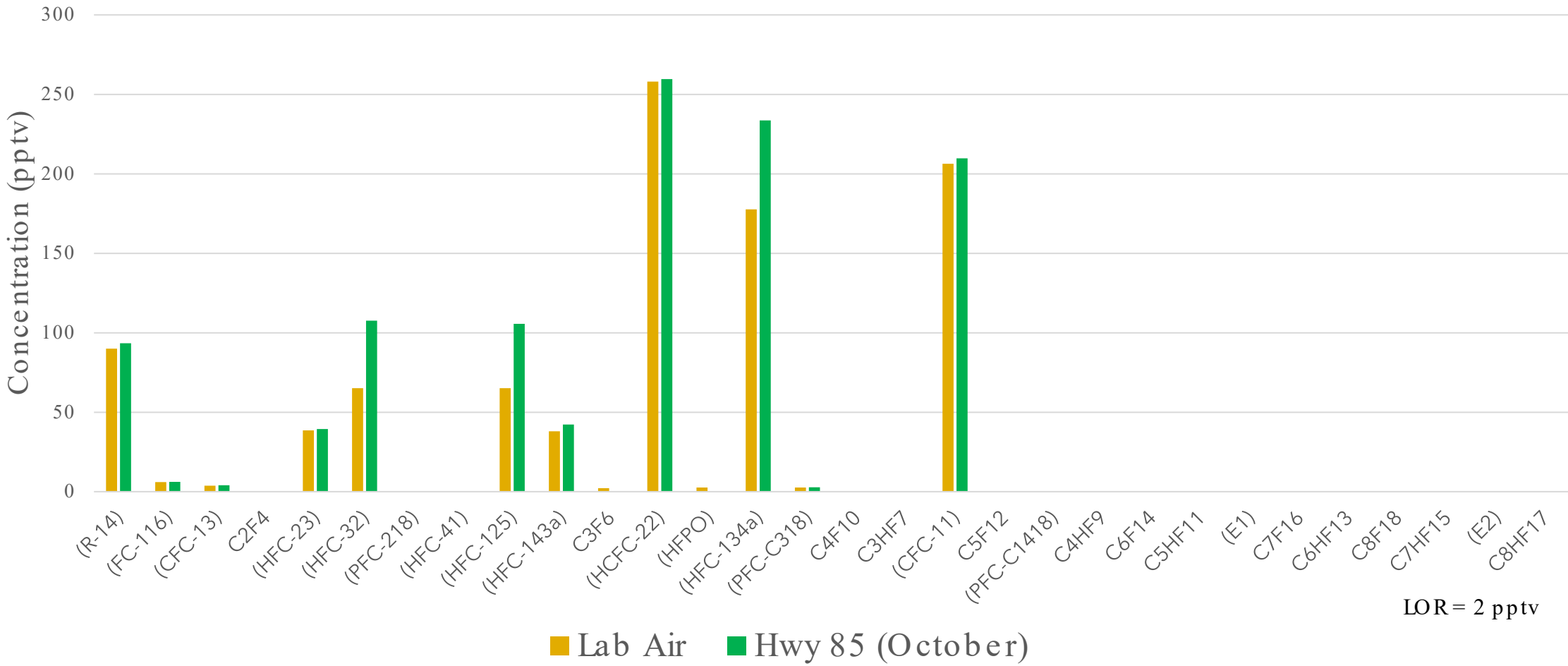
Canister Cleaning Procedure - Specific to PFAS

- 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

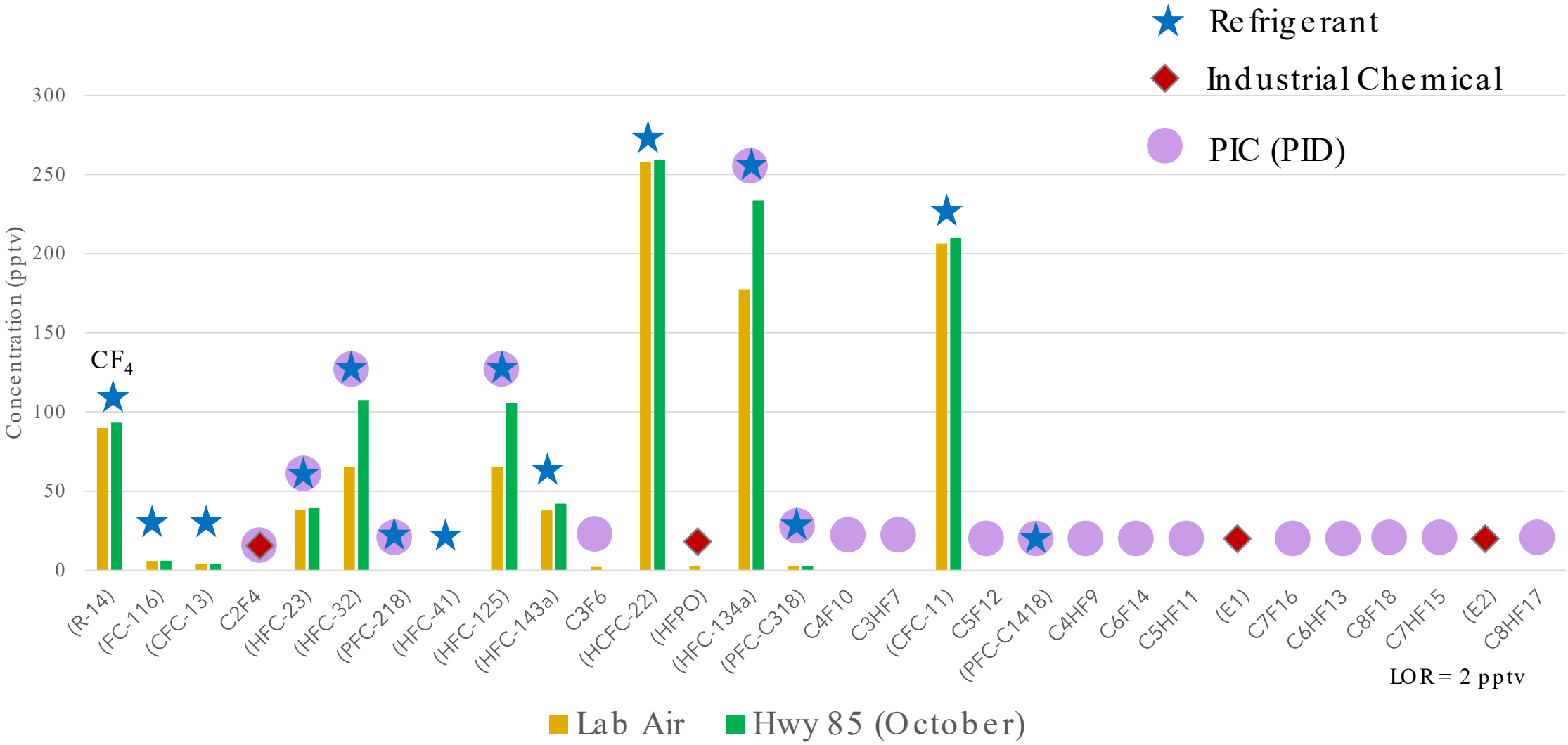
By individually proofing each canister, you are able to request individual proof certificates ($100) after analysis based on data received.

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

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

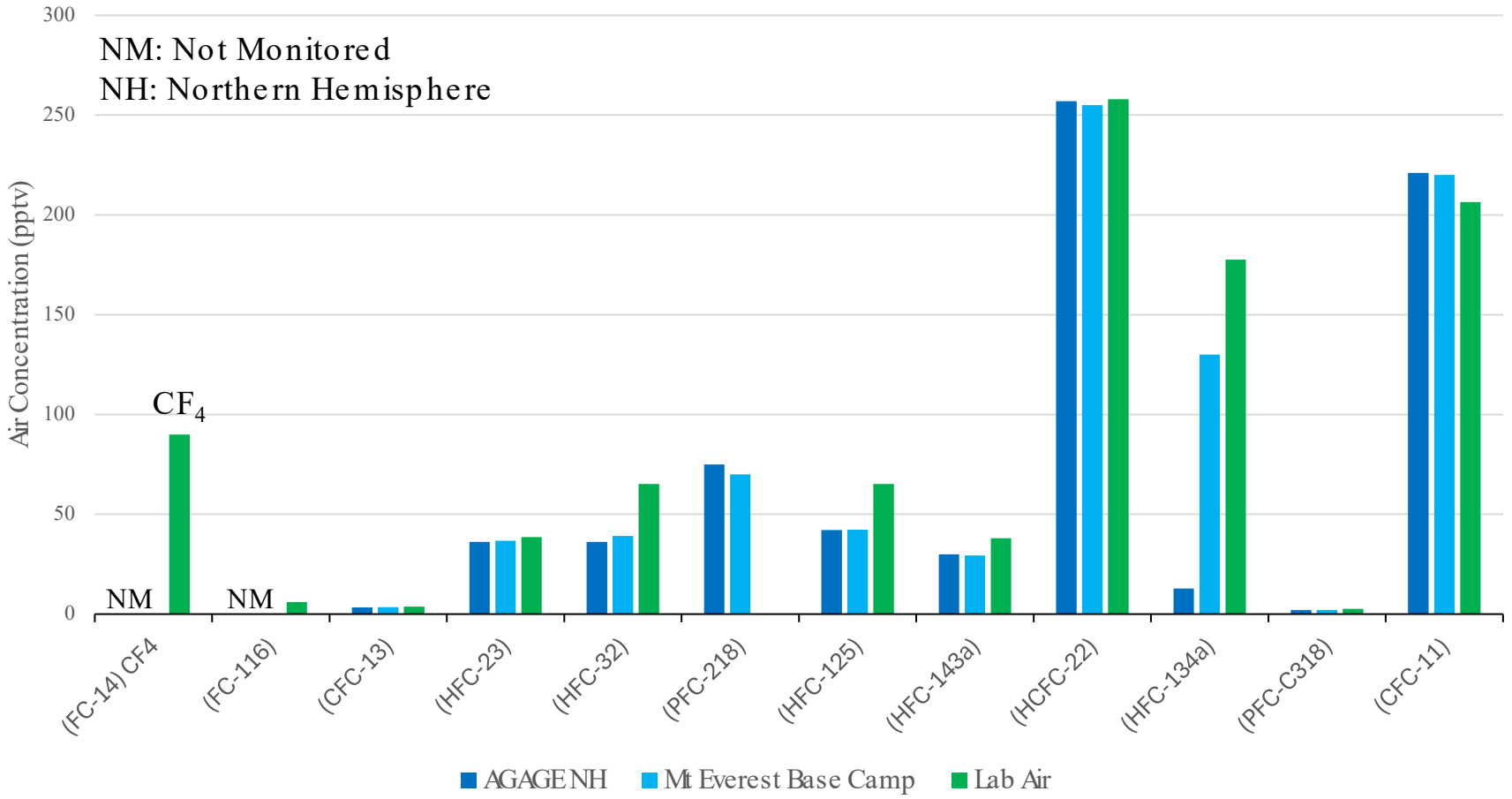


OTM-50 Ambient Air Sampling – Source Identification



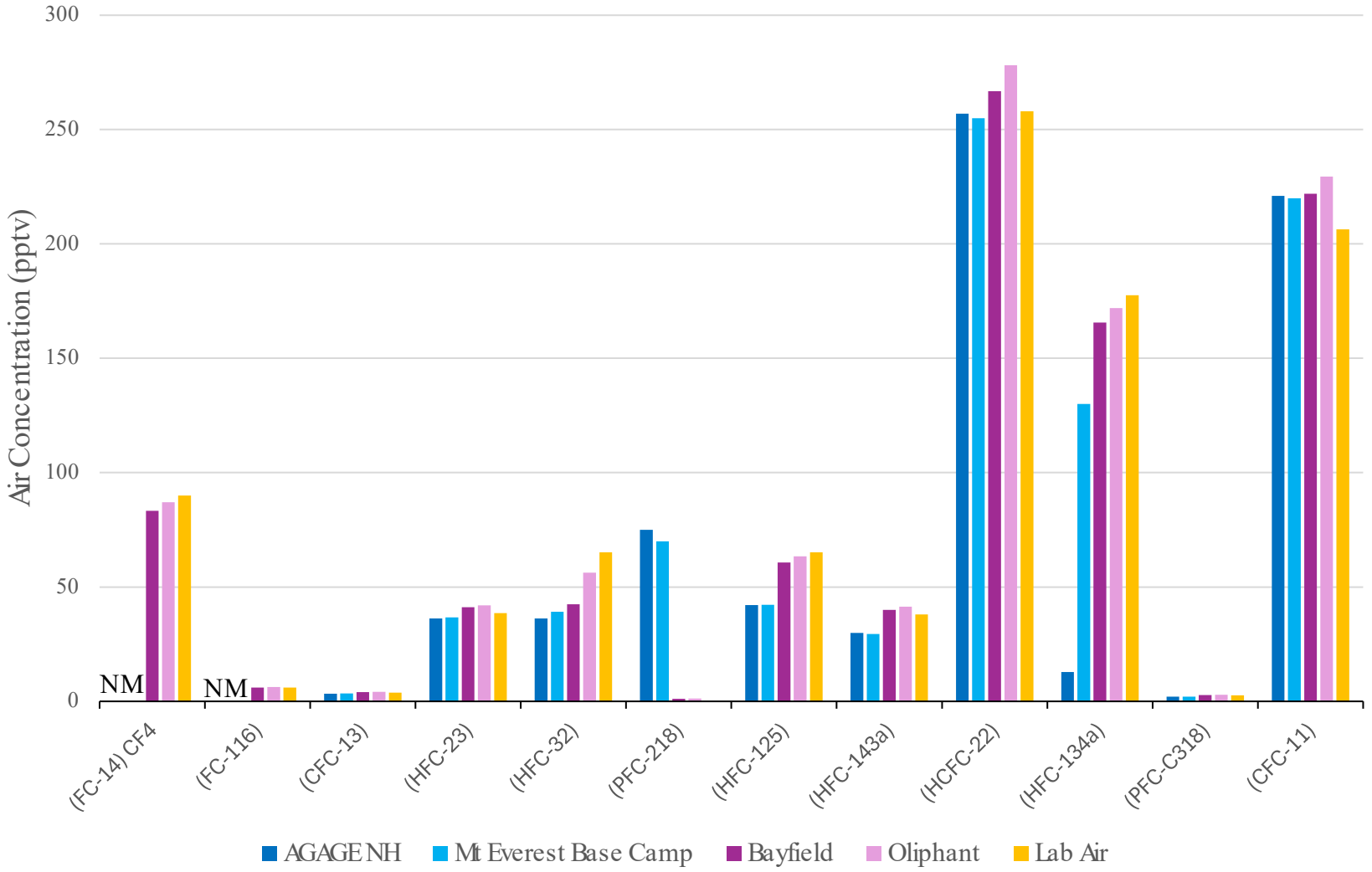
Shields et al. ACS EST Eng. 2023, 3, 1308−1317.

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 our 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.
  - Accreditation pending
  - 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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