



Cloudy with a Chance of PFAS: Influence of Precipitation Formation Mechanism & Demographics on PFAS Concentrations in Rain

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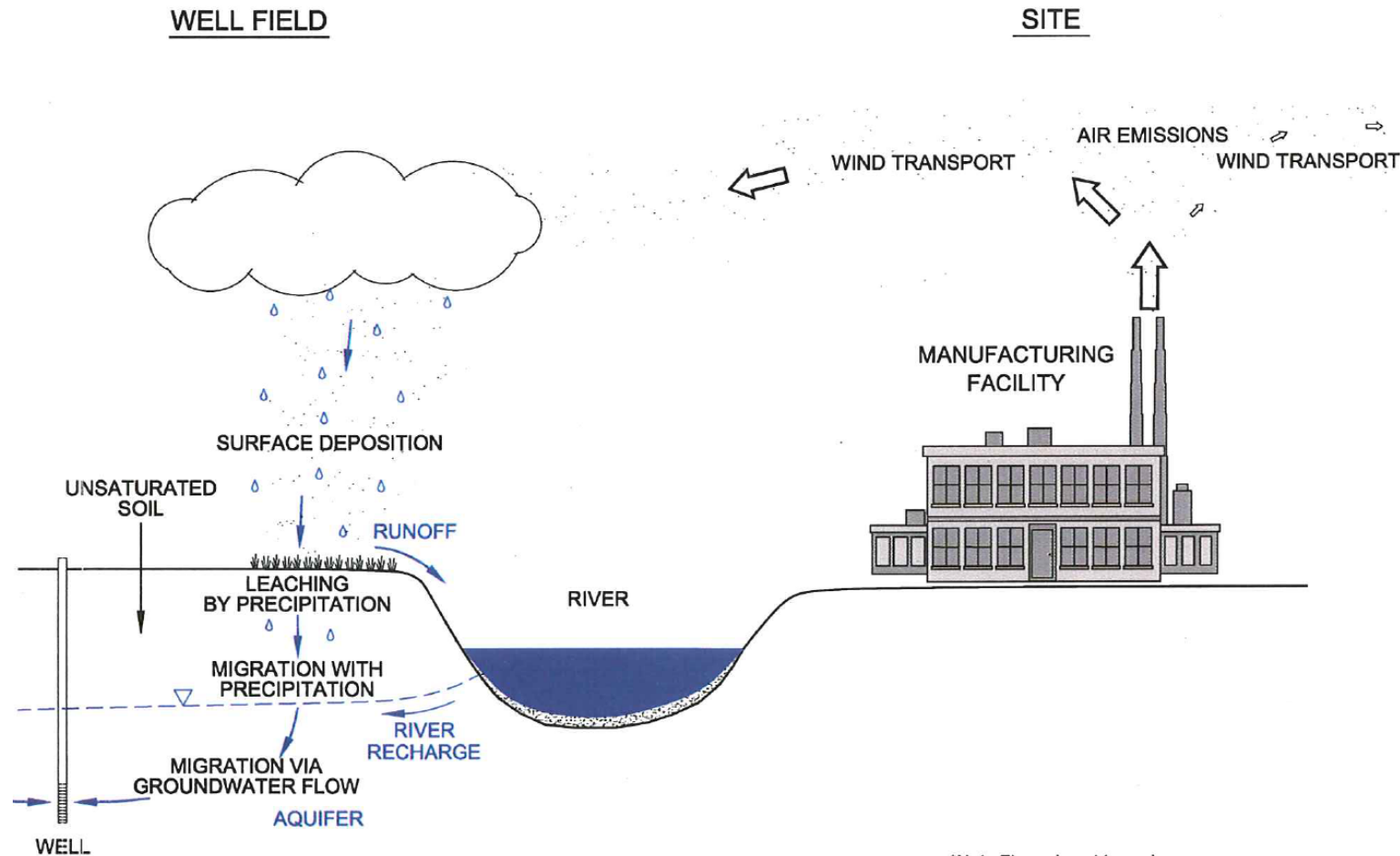
Alpha Analytical

Two Key Questions

Is precipitation a significant background PFAS source?

Does precipitation formation mechanism influence PFAS concentrations?

PFOA aerial transport and wet/dry deposition

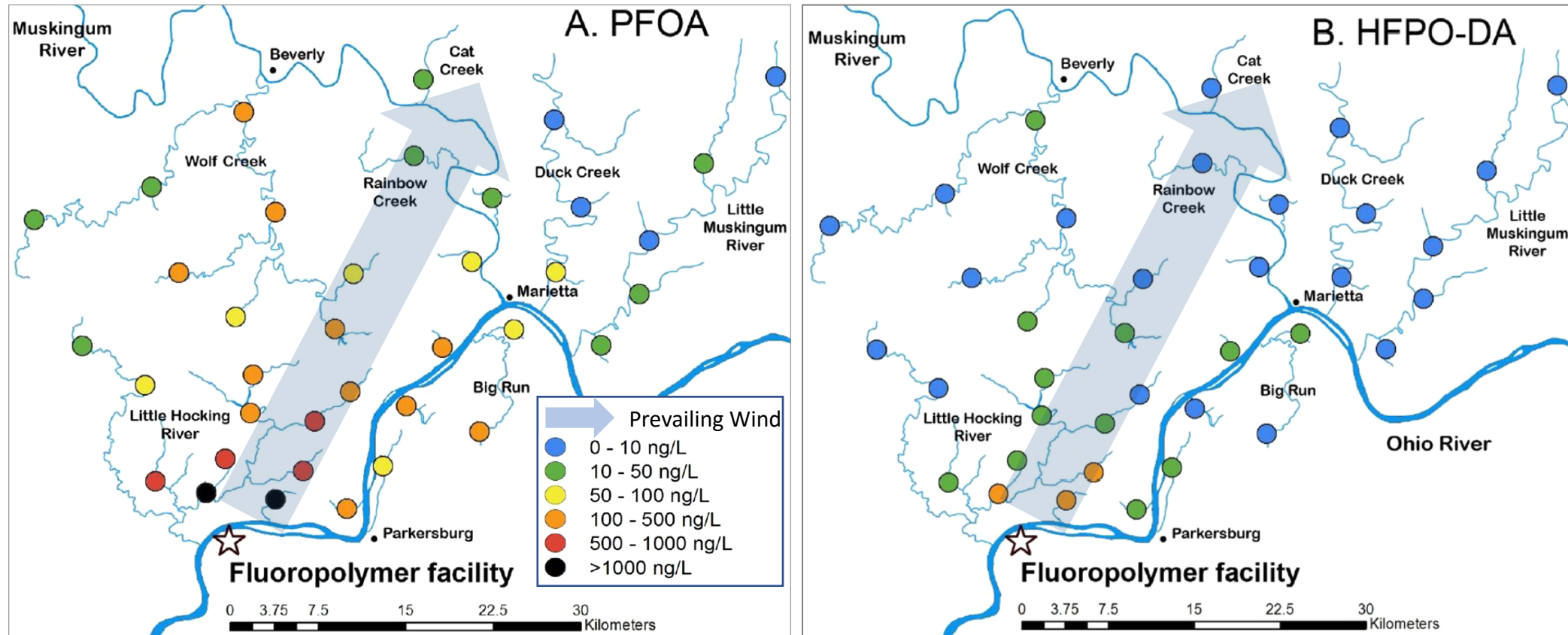


Groundwater impacts attributed to aerial transport from fluoropolymer facility located about 2,000 ft away

*Note Figure is not to scale

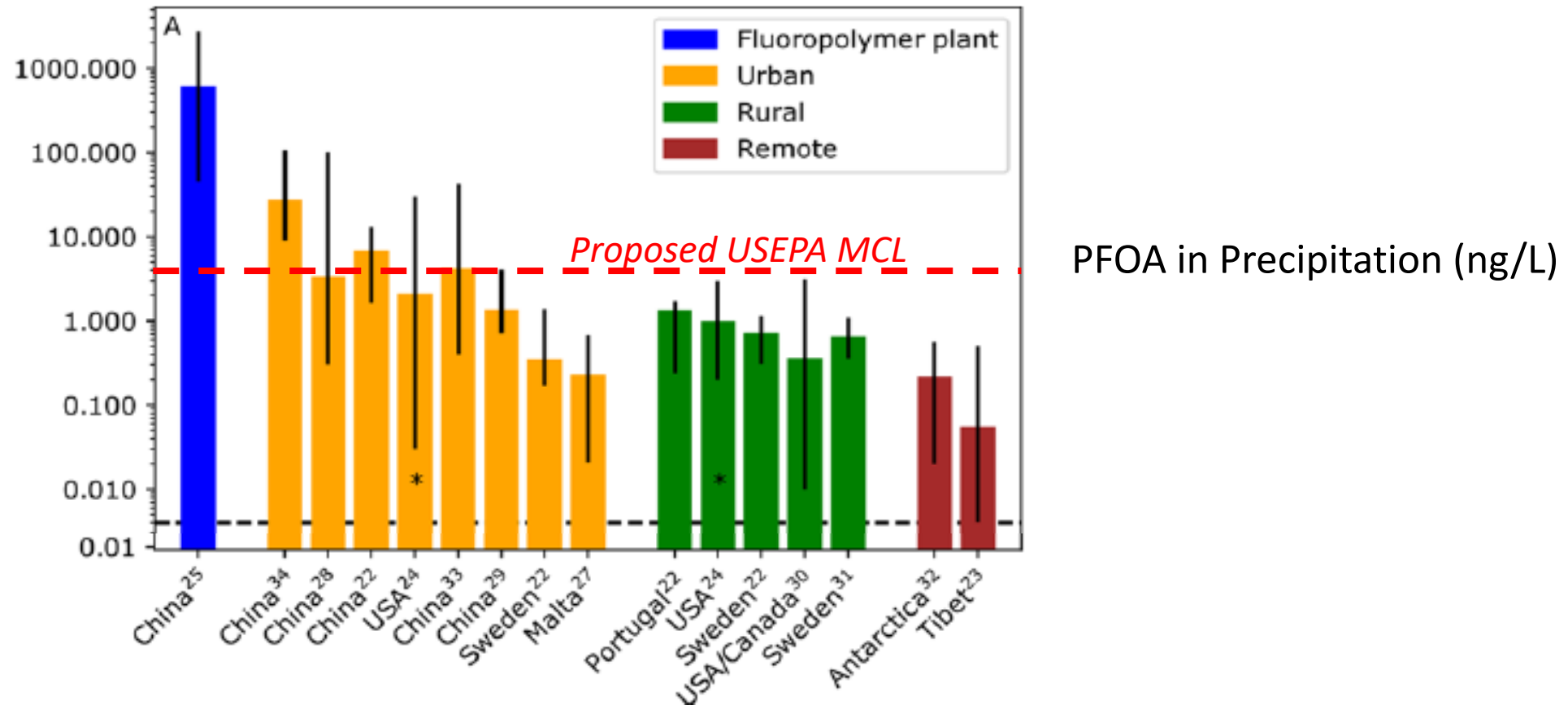
Davis, K.L. et al. 2007. Transport of ammonium perfluorooctanoate in environmental media near a fluoropolymer manufacturing facility. Chemosphere, v. 67, p. 2011-2019.

Surface water PFOA and GenX exceed MCLs at about 41 and 27 km downwind, respectively



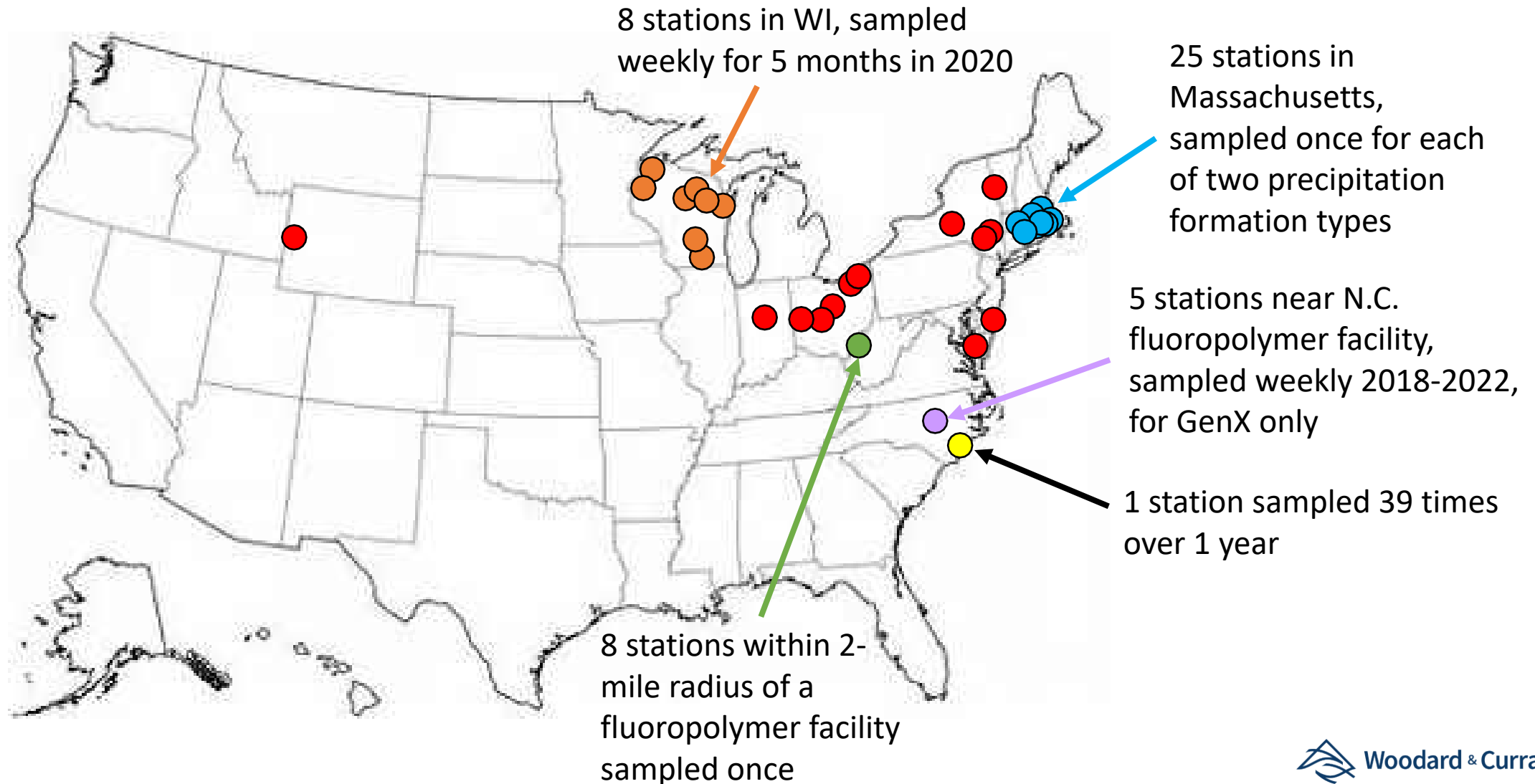
Galloway, J.E. et al. 2020. Evidence of air dispersion: HFPO-DA and PFOA in Ohio and West Virginia surface water and soil near a fluoropolymer production facility. ES&T, v. 54, p. 7175-7184.

Compilation of worldwide precipitation data showed PFAS concentrations could often exceed proposed MCLs



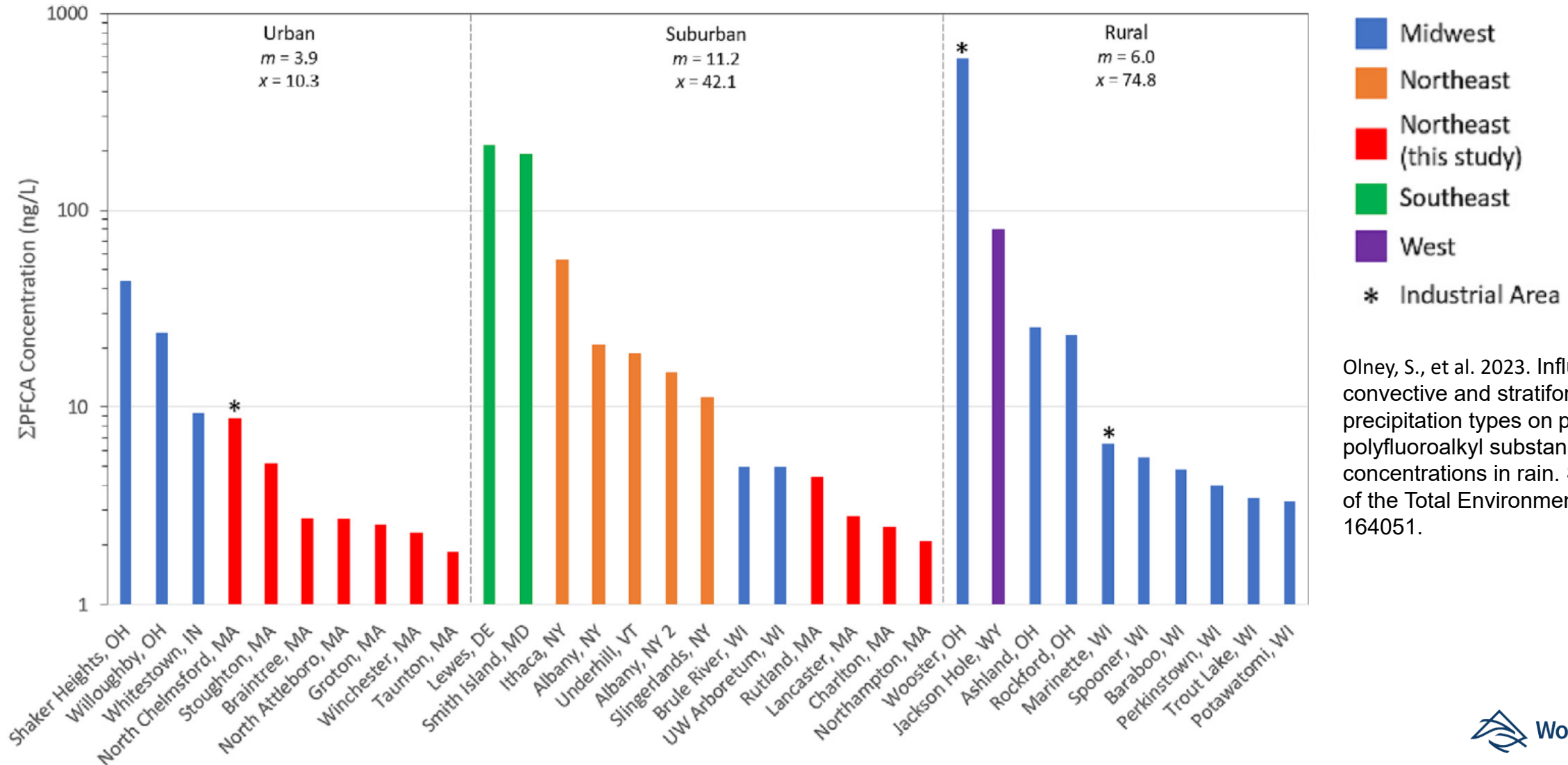
Cousins, I.T., et al. 2022. Outside the safe operating space of a new planetary boundary for per- and polyfluoroalkyl substances (PFAS). ES&T, v. 56, p. 11172-11179.

(Published) U.S. Precipitation PFAS Sampling Locations



Compilation of U.S. Precipitation PFAS Data

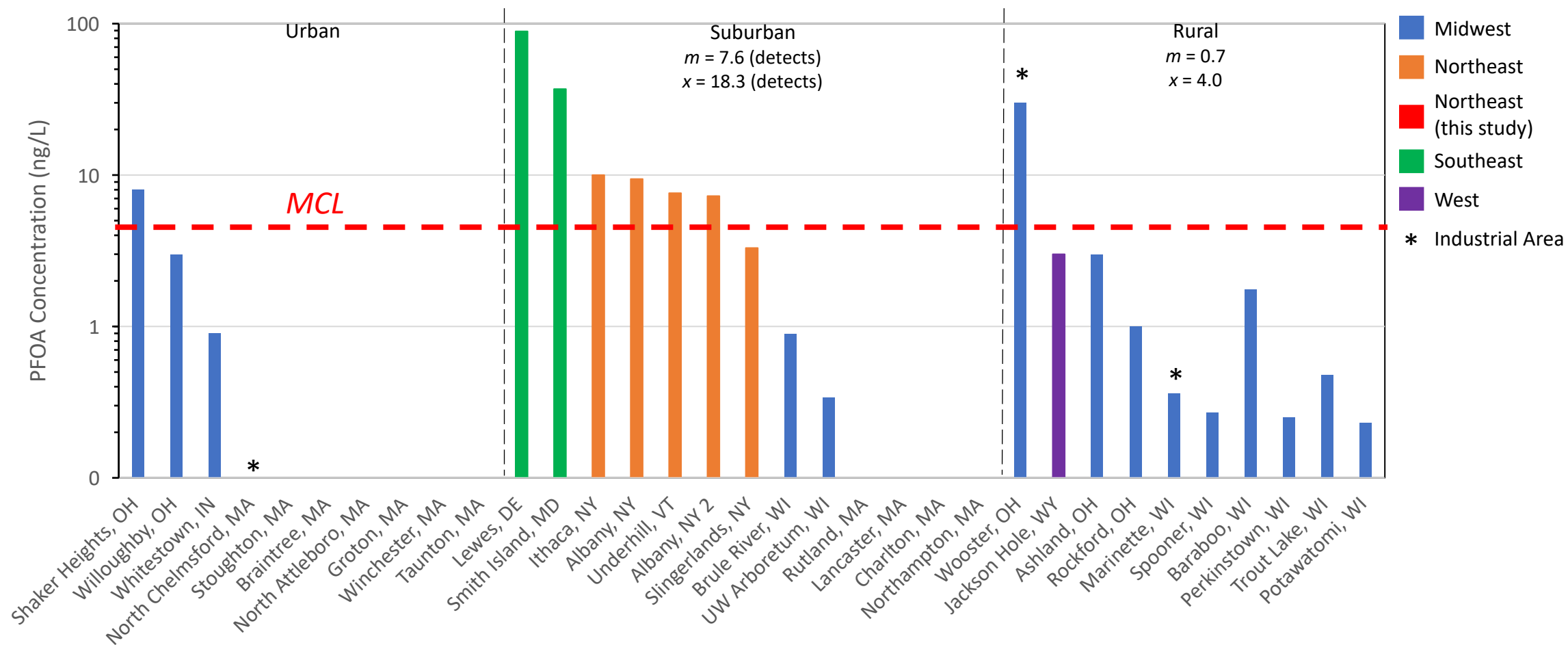
Σ PFCA concentrations; excludes NDs & sites near fluoropolymer manufacturers



Olney, S., et al. 2023. Influence of convective and stratiform precipitation types on per- and polyfluoroalkyl substance concentrations in rain. Science of the Total Environment 890: 164051.

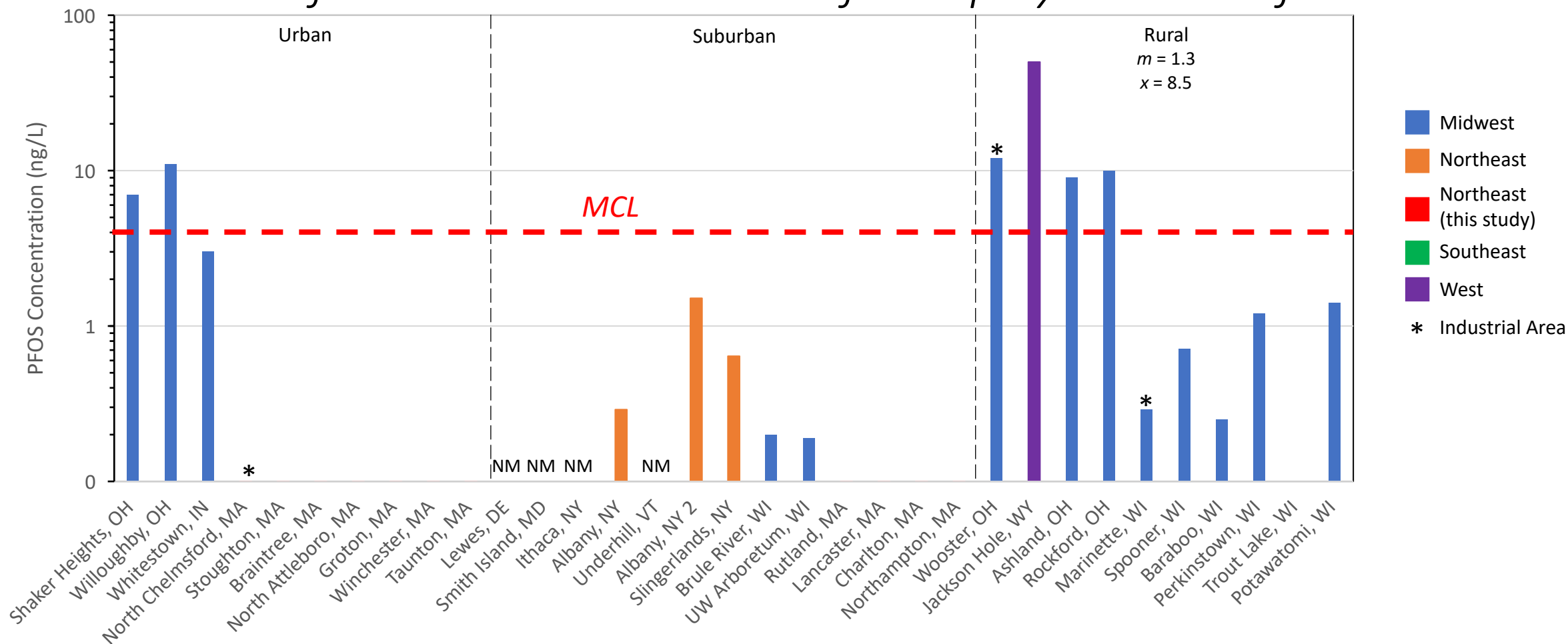
Compilation of U.S. Precipitation PFOA Data

excludes NDs from Σ PFCA & sites near fluoropolymer manufacturers



Compilation of U.S. Precipitation PFOS Data

excludes NDs from Σ PFCA & sites near fluoropolymer manufacturers

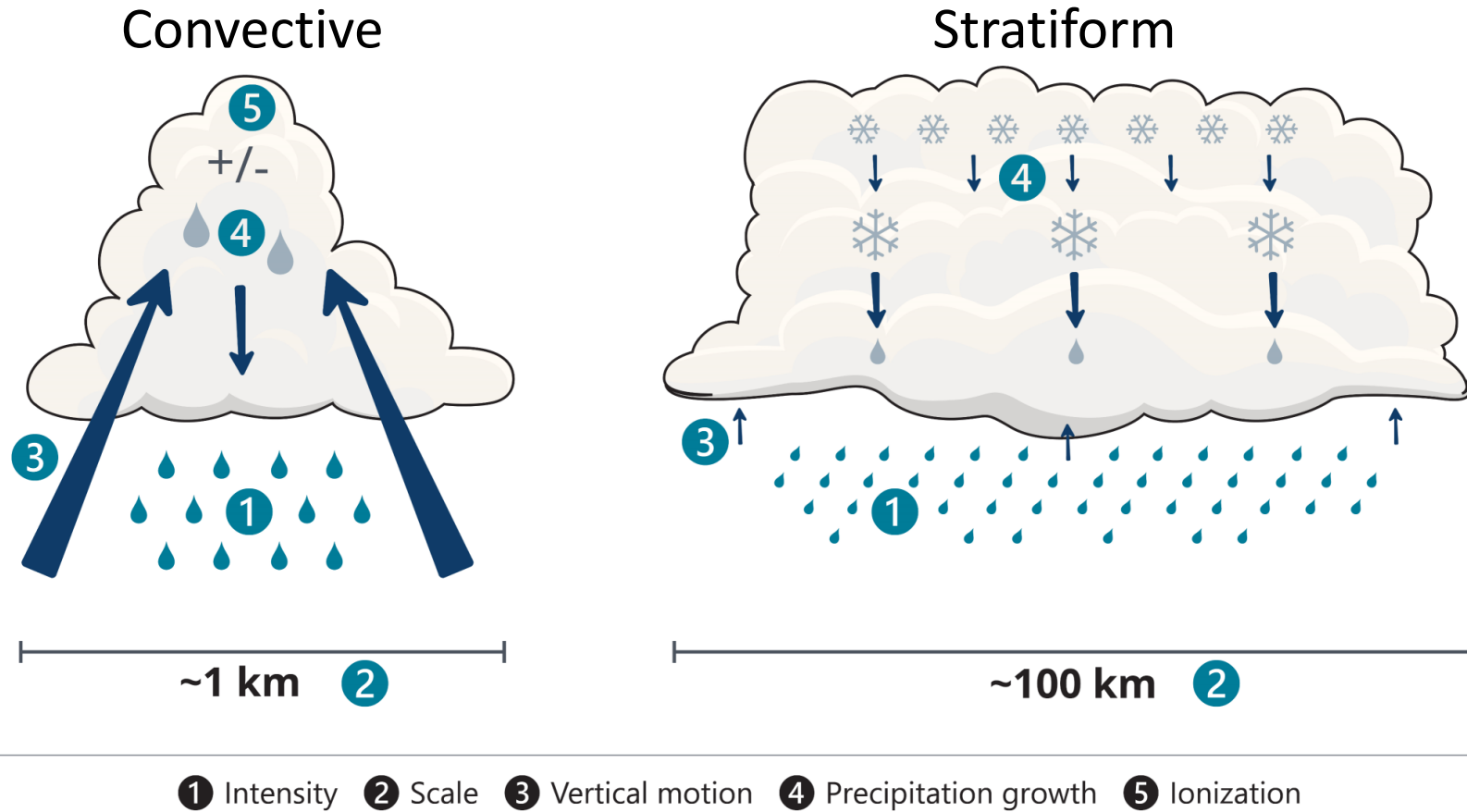


Two Key Questions

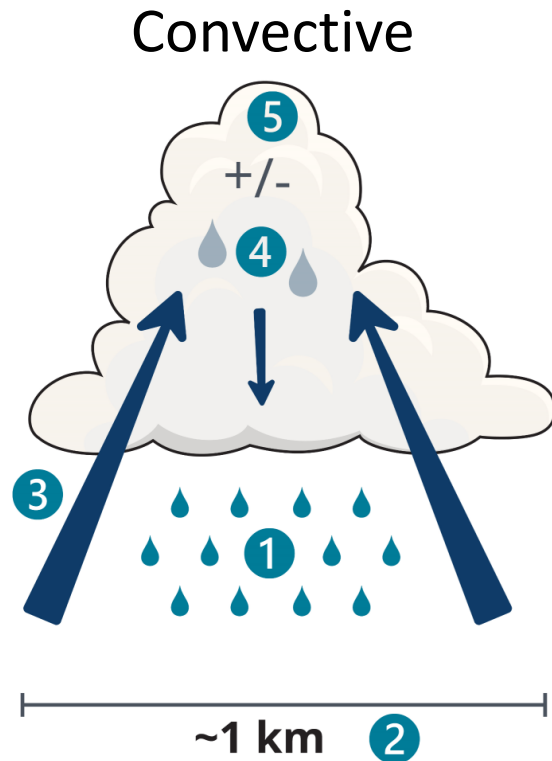
Is precipitation a significant background PFAS source?

Does precipitation formation mechanism influence PFAS concentrations?

Two primary precipitation formation mechanisms

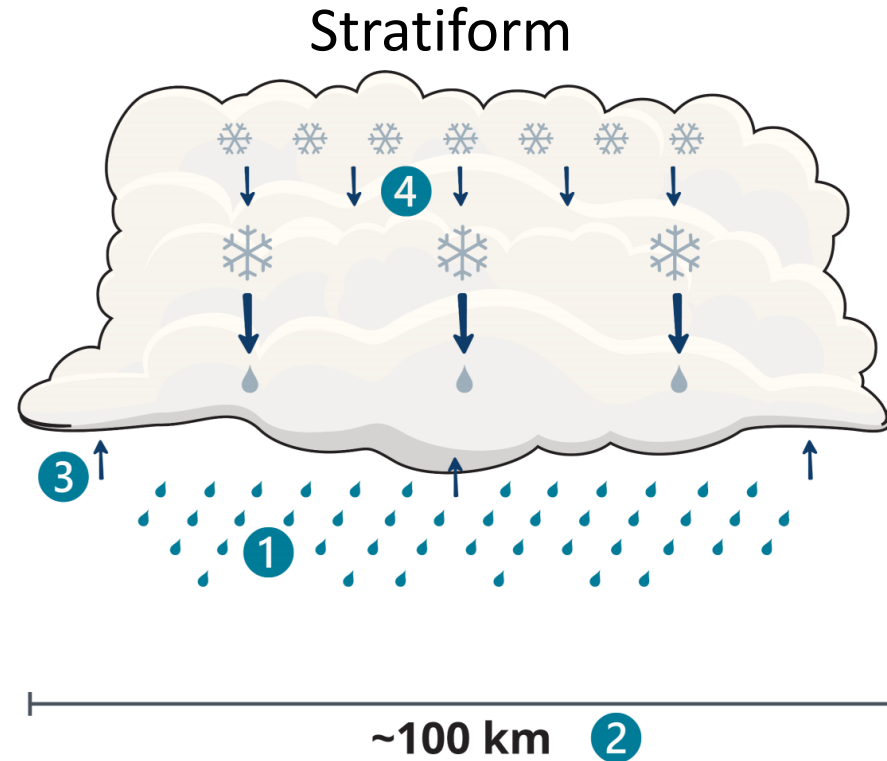


Convective storms draw from local sources with strong updraft and intense precipitation



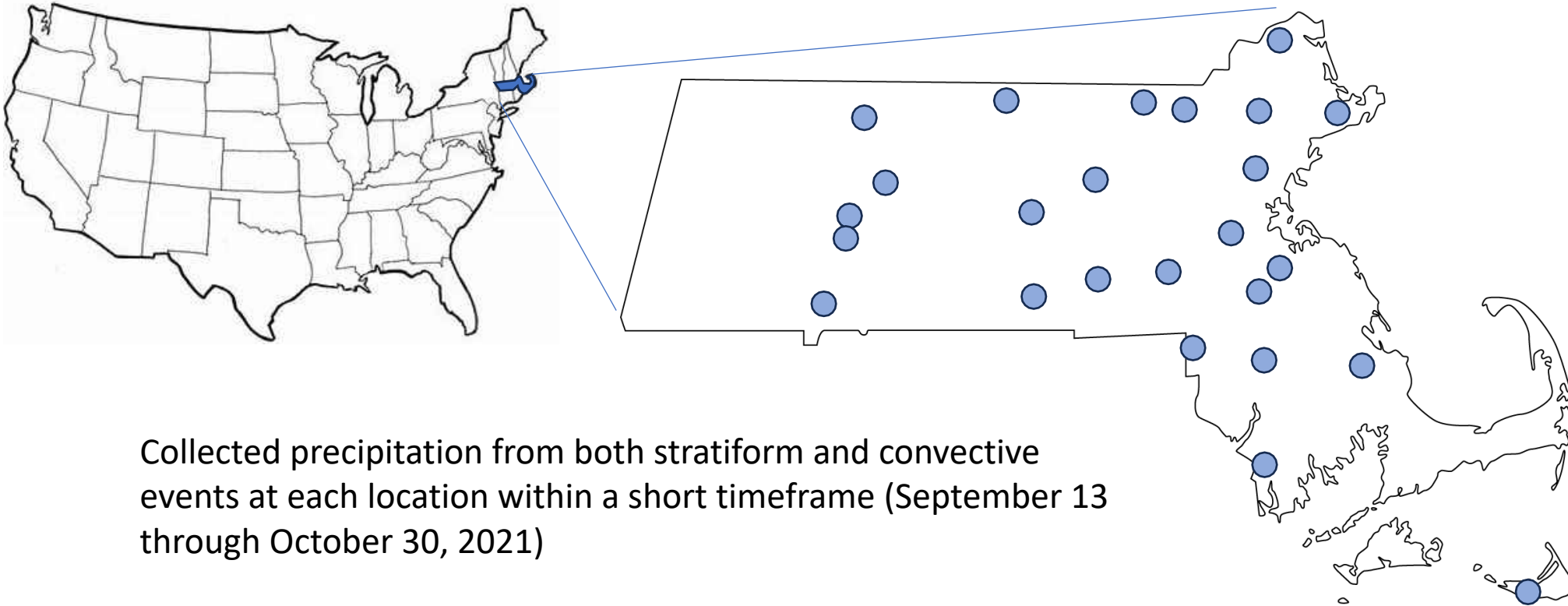
- ① Intensity ② Scale ③ Vertical motion ④ Precipitation growth ⑤ Ionization

Stratiform storms have more horizontal development, longer duration and less intense



① Intensity ② Scale ③ Vertical motion ④ Precipitation growth ⑤ Ionization

25 Sampling Locations Across Massachusetts

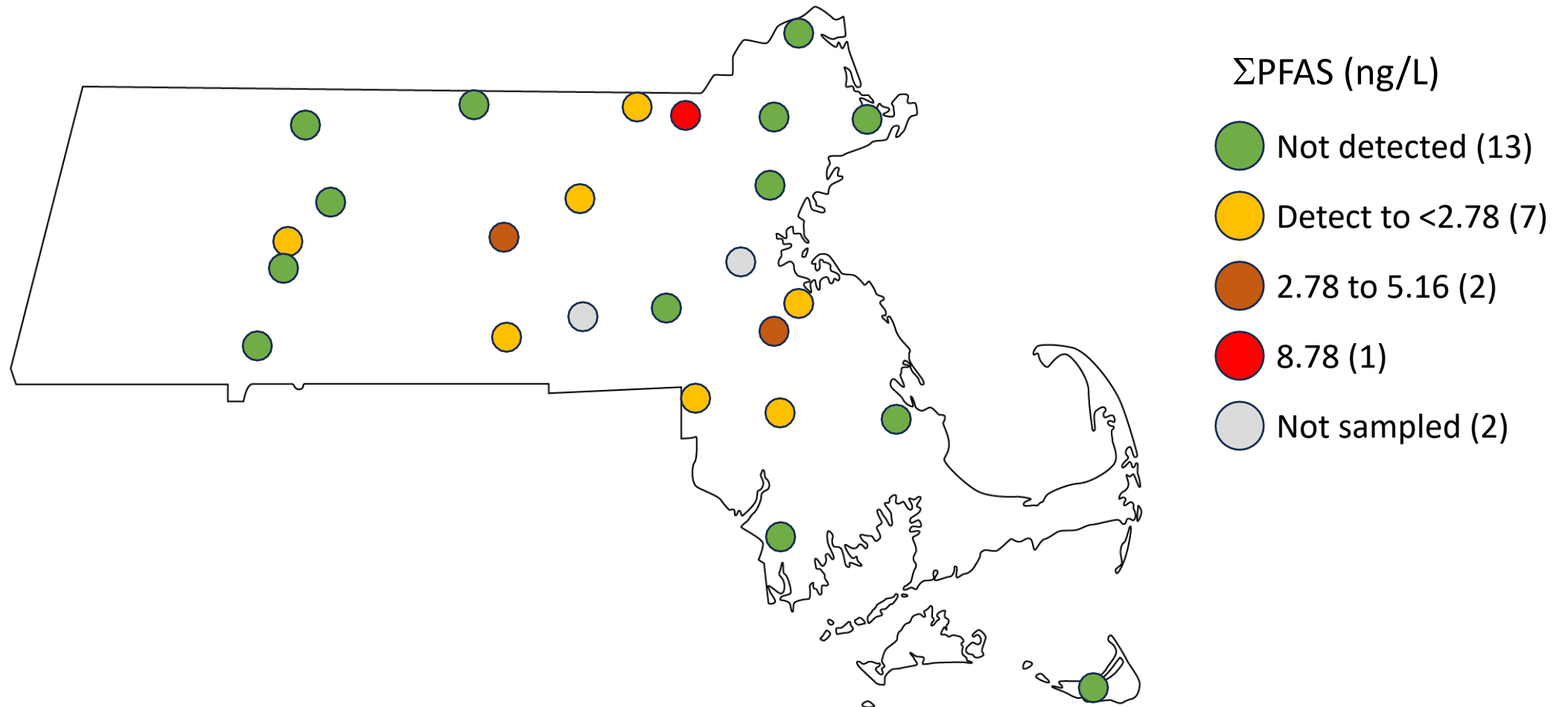


Collected precipitation from both stratiform and convective events at each location within a short timeframe (September 13 through October 30, 2021)

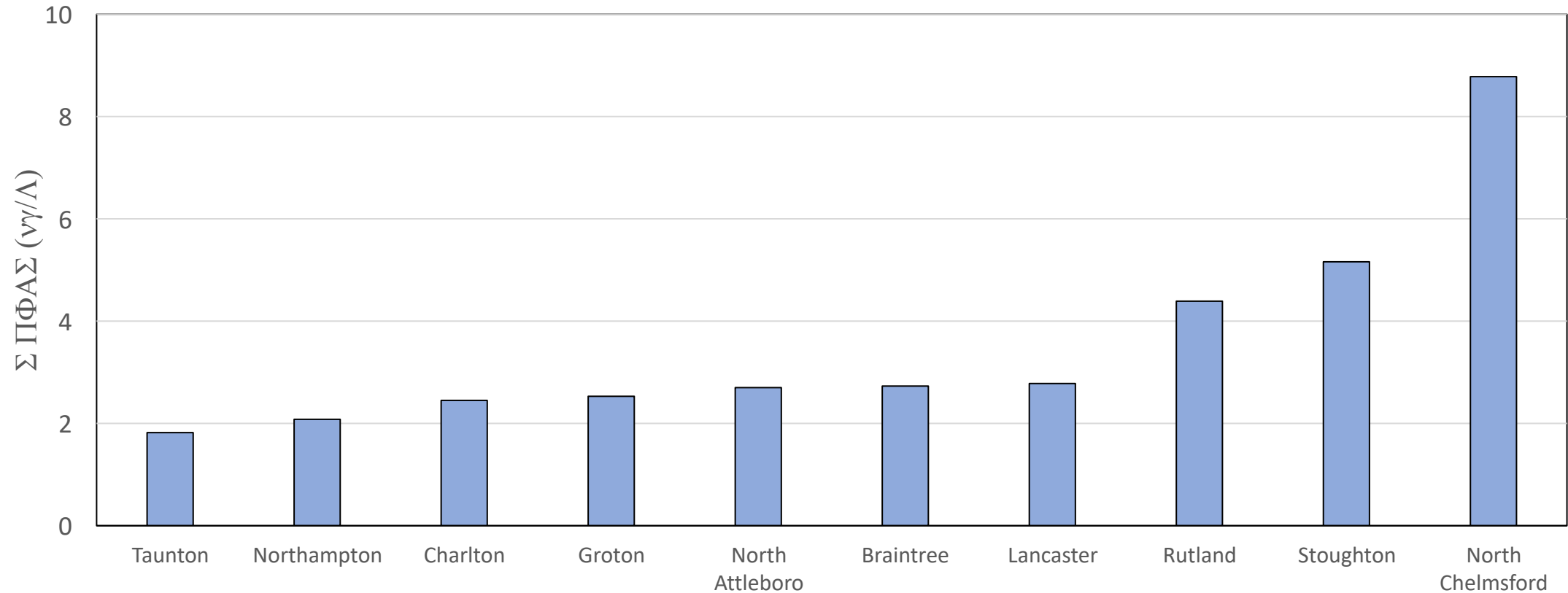
Analyzed for 36 compounds by LC-MS/MS with isotope dilution

Convective Rain Event Detection Summary

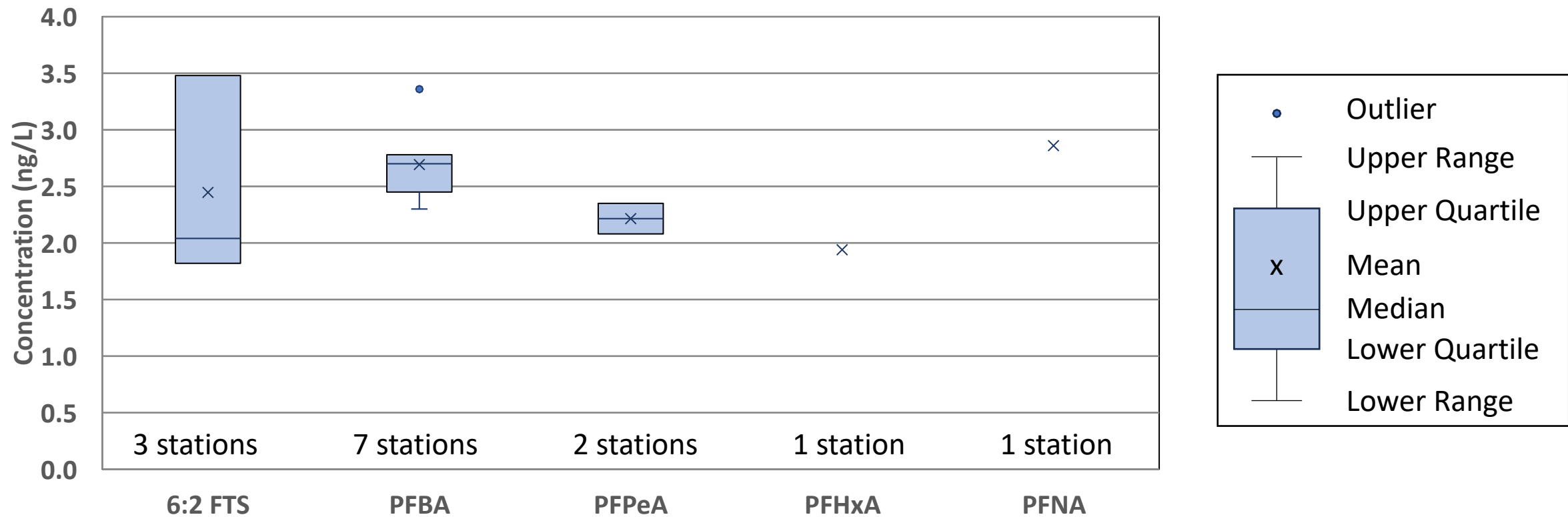
Detected PFAS at 10 of the 25 stations, ≤ 8.78 ng/L



Total PFAS in Convective Precipitation

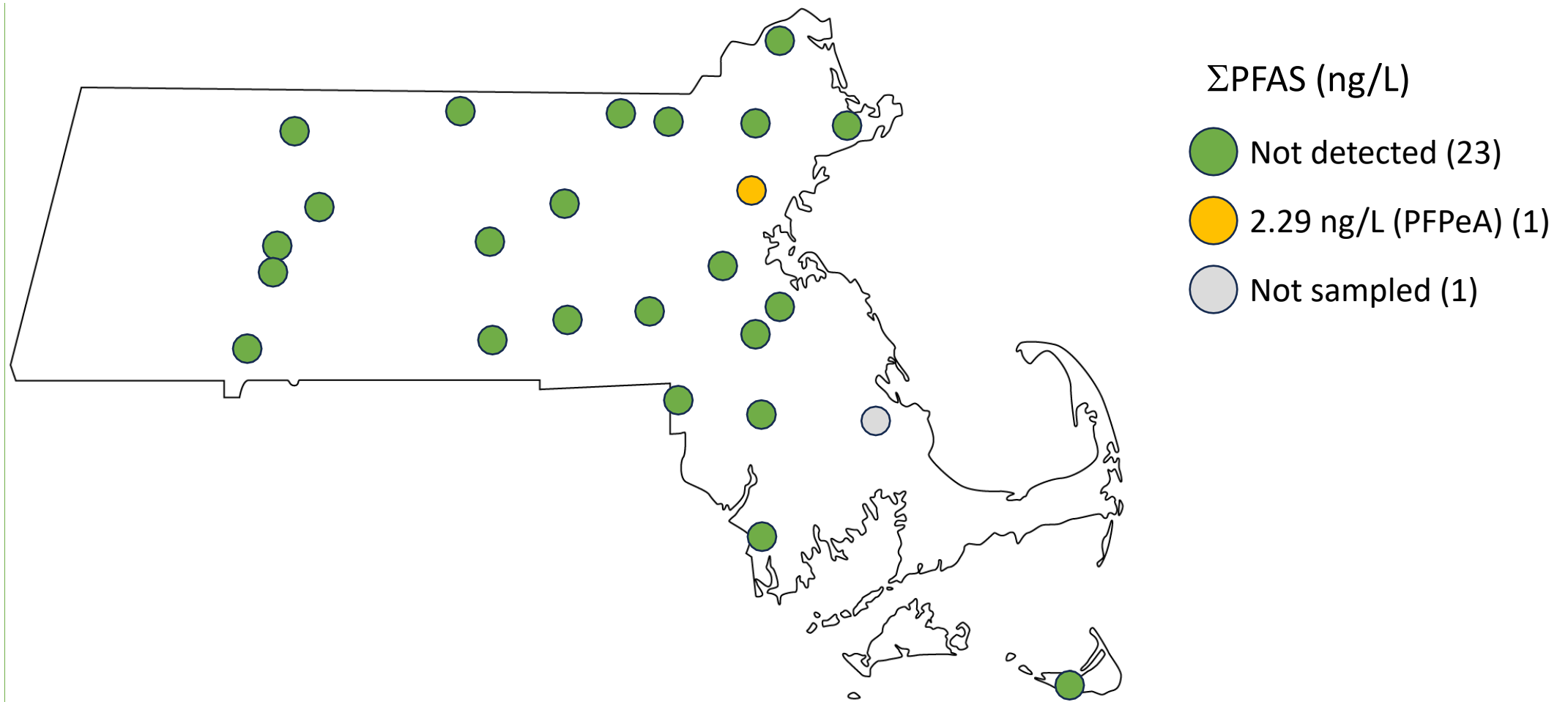


Five compounds detected, all ≤ 3.48 ng/L

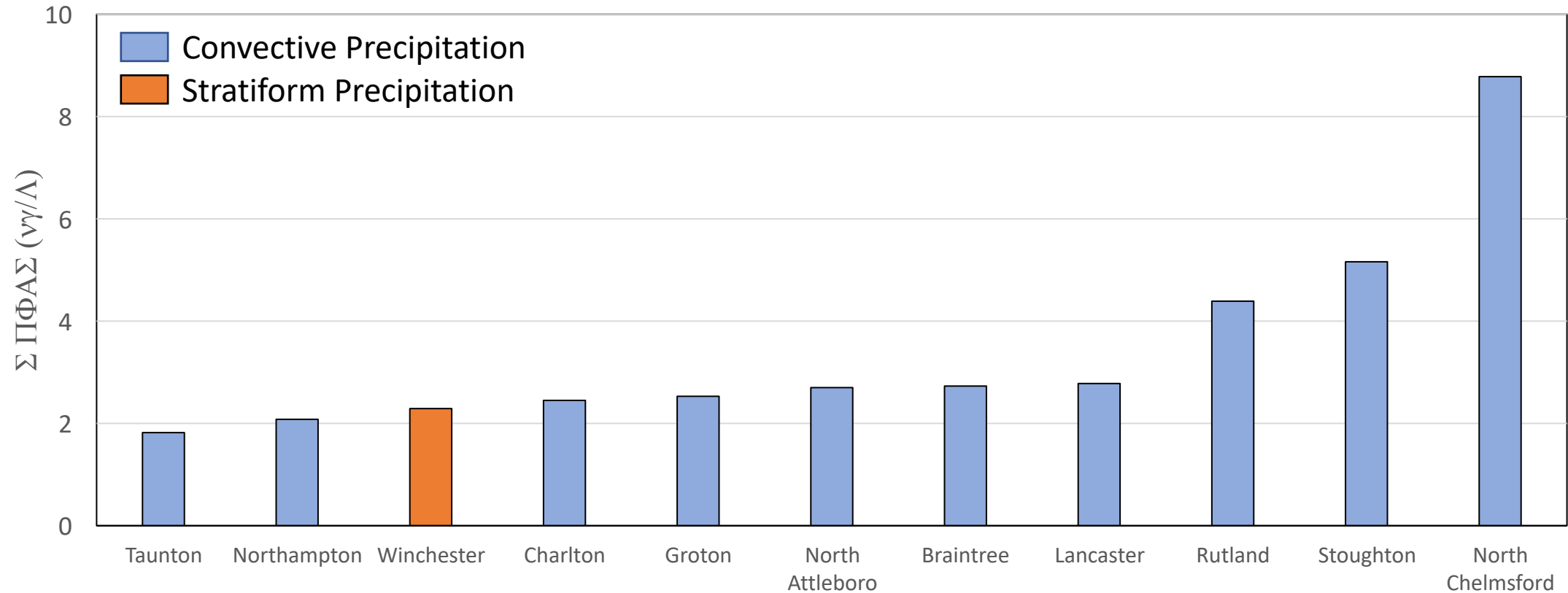


Stratiform Rain Event Detection Summary

Only detected PFAS at one station



Total PFAS in Convective and Stratiform Precipitation



Key Take Aways

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Aerial transport of PFAS is significant

No association with demographics



Precipitation often has [PFAS] > drinking water standards

PFOA→89 ng/L, PFOS→50 ng/L, no industrial source
Higher concentrations near fluoropolymer facilities and other manufacturers (surface water data)



Precipitation formation mechanism may also be significant

Convective storms have higher [PFAS]
Reflects more local sources