Assessment of PFAS Deposition via Precipitation at Selected Locations in the Eastern U.S.

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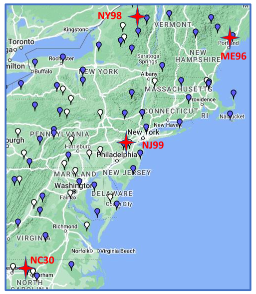
Background & Introduction

Atmospheric cycling of PFAS compounds is a significant, yet often overlooked, contributor to their widespread environmental distribution. For many terrestrial and aquatic environments, atmospheric deposition represents the largest PFAS loading source. PFAS compounds, known for their stable carbon-fluorine bonds, persist and accumulate in ecosystems, leading to adverse impacts on both the human population and the environment. Conducted by researchers at the Wisconsin State Laboratory of Hygiene (WLSH), with support from EPA-ORD, this program utilizes weekly precipitation samples from the National Atmospheric Deposition Program (NADP) National Trends Network (NTN) to identify trends in concentrations and fingerprints of PFAS compounds and PFAS deposition at selected sites across the US. Here we report on early outcomes of the program at four NTN study sites in the Eastern US (ME96, NY98, NJ99, NC30) on samples collected from September 2020 through December 2021.

Field & Laboratory Methods

Precipitation sample collection, handling, and laboratory processing for PFAS followed methods detailed in Photenhauer et al., 2022: [PFAS concentrations and deposition in precipitation: An intensive 5-month study at National Atmospheric Deposition Program – National trends sites (NADP-NTN) across Wisconsin, USA.]

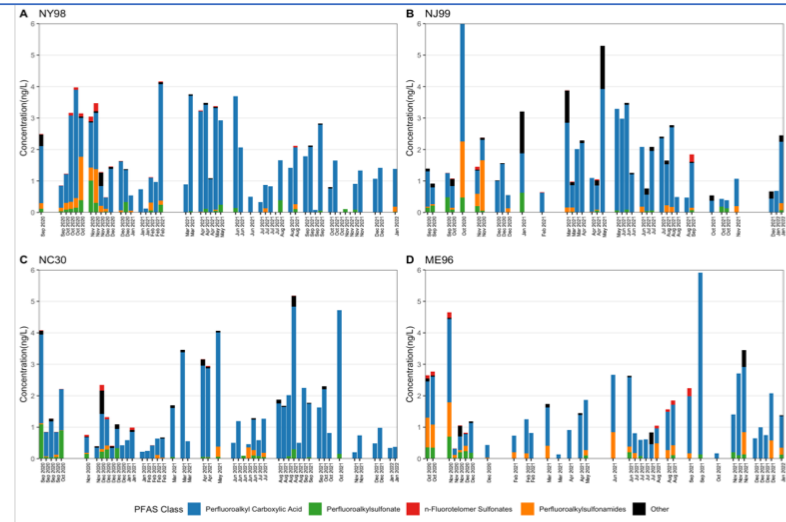
PFAS compounds in weekly collected precipitation samples (>500 mL) were isolated and concentrated by WAX SPE. PFAS in the SPE extracts were quantified by isotope dilution LC-tandem mass-spectrometry (ID-LC/MS/MS). 33 PFAS compounds, with method LODs in the range of 0.1 to 0.3 ng/L were examined.



- Median PFAS deposition fluxes range from 3.0 to less than 0.1 ng/m^2/day.
- The 4-carbon (PFBA) and 6-carbon (PFHxA) carboxylates are consistently across sites the greatest loaders.

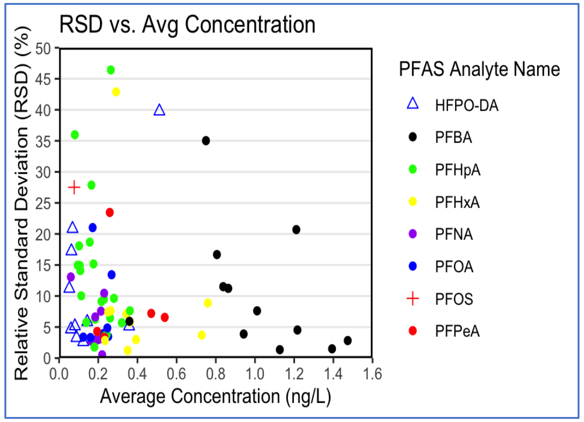
Results 1. Trends in PFAS Concentration over Time

- Summed PFAS concentrations of all compounds usually exhibit lower values around January and July, with notable increases around April and October.
- The highest summed concentrations across all sites range around 4-5 ng/L.
- Throughout the study period and at all sites, perfluoroalkyl carboxylic acids consistently exhibit the highest concentrations.
- Substantive variances in PFAS concentrations occurred in October 2020 (NJ99) and September 2021 (ME96).



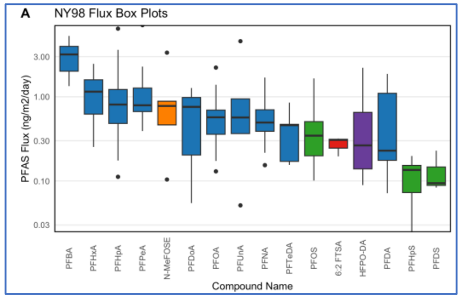
Overall PFAS Method Uncertainty

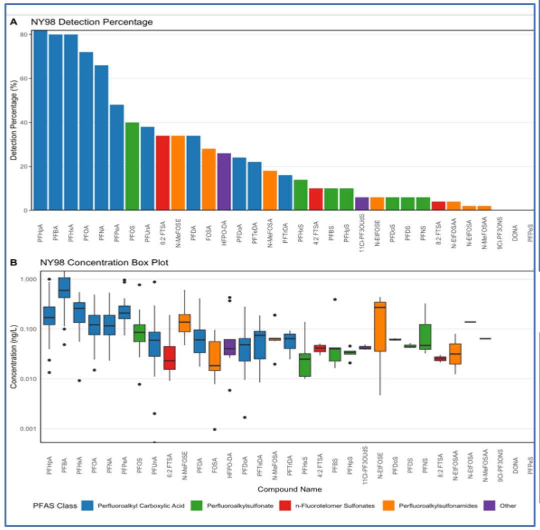
- At the Duke Forest (NC) site, three NTN NCON precipitation collectors were co-located (NC30, NC96, NC97) to enable, for the 1st time, an assessment of the overall method precision (field & laboratory components).
- The plot below shows data for NC30, NC96, and NC97 and involves the calculation of average concentrations of the co-located samples and relative standard deviations (RSD) for eight PFAS compounds.
- Notably, the concentration data cluster around low RSD values, indicating a high degree of reproducibility in our PFAS dataset.



Results 2. PFAS Detection Percentage and Concentration & Flux Boxplots (NY98 as an example)

- The class of PFAS detected most frequently across all sites was perfluoroalkyl carboxylic acids, with notable emphasis on PFHxA, PFOA, PFBA, PFNA, and PFHxA.
- Among the top three most detected compounds at all four sites, the concentration ranges (25th percentile to 75th percentile) were as follows:
- PFHpA: Approximately (0.7, 2) ng/L
- PFBA: Approximately (2, 4) ng/L
- PFHxA: Approximately (0.4, 1.4) ng/L





Conclusions

- Perfluoroalkyl carboxylic acids emerged as the predominant class of PFAS observed across the samples.
- PFBA exhibited the highest concentration in precipitation , followed by PFHxA and PFHpA, emphasizing the significance of shorter-chain PFAS compounds.
- The consistency of the data across the three co-located sites reinforces the reliability and robustness of the findings.
- Seasonal trends and "fingerprints" of PFAS concentrations will likely provide valuable information on PFAS sources and ultimately mitigation strategies.

Acknowledgements

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