

PFAS Fate in Coastal Rivers and Wetlands: Current Research in Kent County, Delaware

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University of Delaware

What are PFAS?

PFAS = per- and polyfluoroalkyl substances

Class of nearly 15,000 synthetic organic compounds

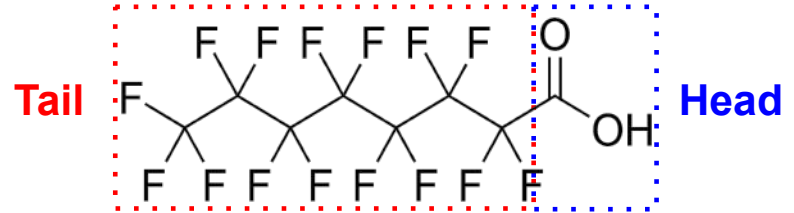
- Acid headgroup
- Fully fluorinated carbon tail

Used in commercial and industrial applications

- Non-stick coatings
- Firefighting foams

Several PFAS identified as immunotoxic and carcinogenic in humans

Example: PFOA (C8)



Why study PFAS in coastal ecosystems?

1. Ocean is the major final sink



3. High population density



2. Unique physical and geochemical properties



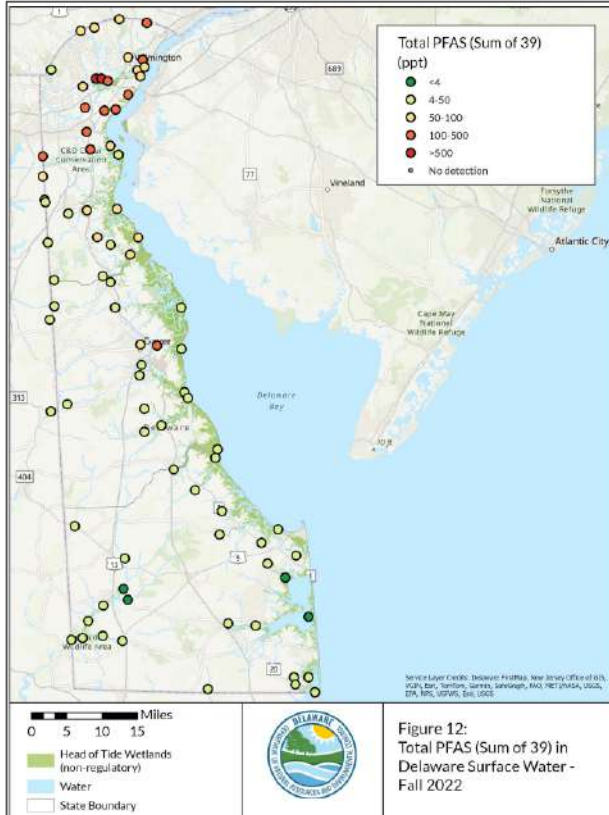
4. Bioaccumulate in coastal wildlife



PFAS are widely detected in sediment and water in coastal systems!

Previous Research in Delaware

2022 DNREC Survey of Delaware Surface Waters



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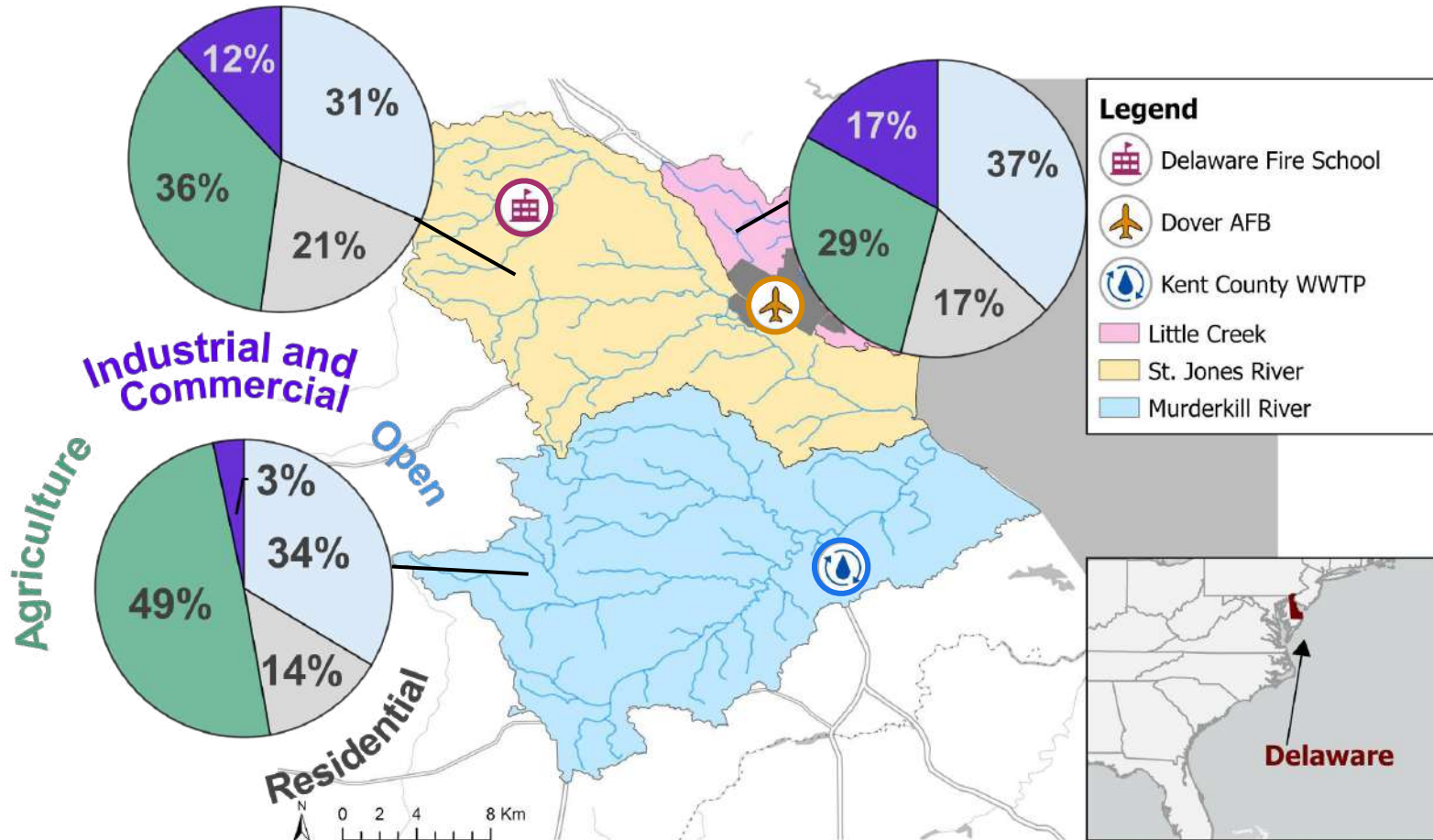
Assessing Bivalves as Biomonitors of Per- and Polyfluoroalkyl Substances in Coastal Environments

Shannon E. Jones*, Nicole Gutkowski, Shayna Demick, Max Curello, Ashley Pavia, Anna R. Robuck, and Mi-Ling Li*

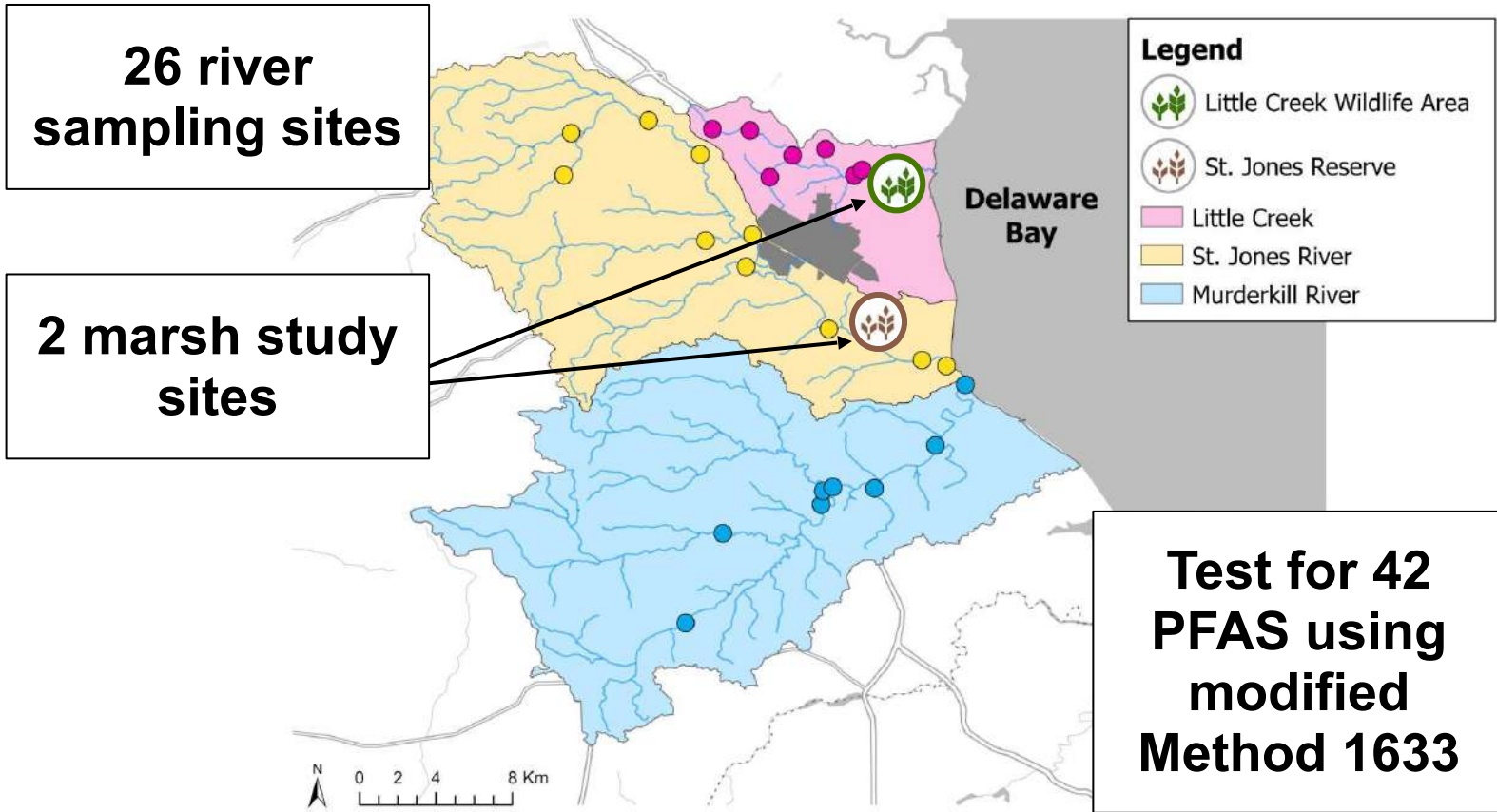
Dr. Mi-Ling Li's CHEER (Chemicals, Health, Ecotoxicology Research) group at the University of Delaware

PFAS in oysters, mussels, and water from the Delaware Bay

Current research focuses on three watersheds in Kent County, DE

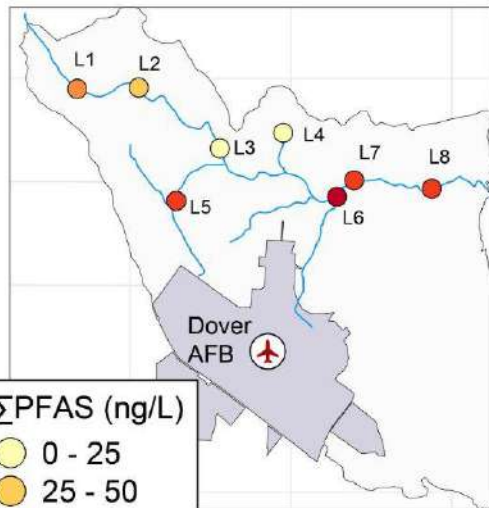


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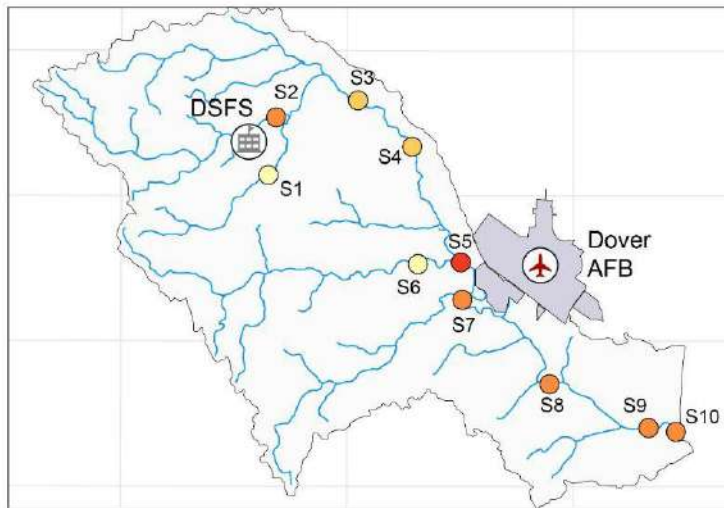


Highest concentrations in surface water are downriver AFFF usage sites

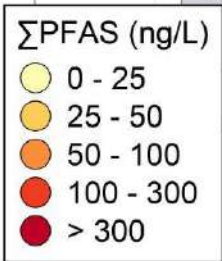
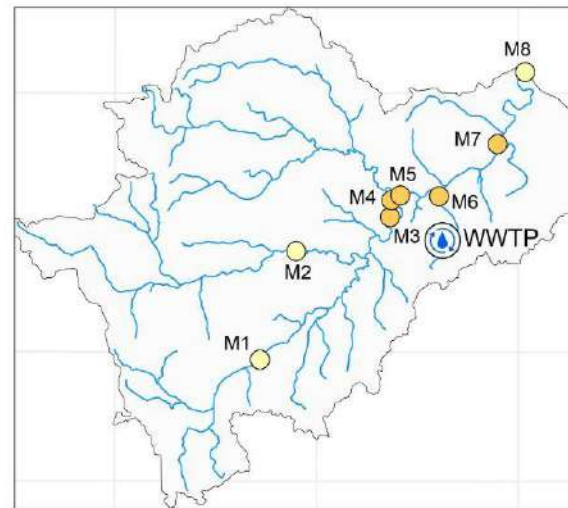
Little Creek



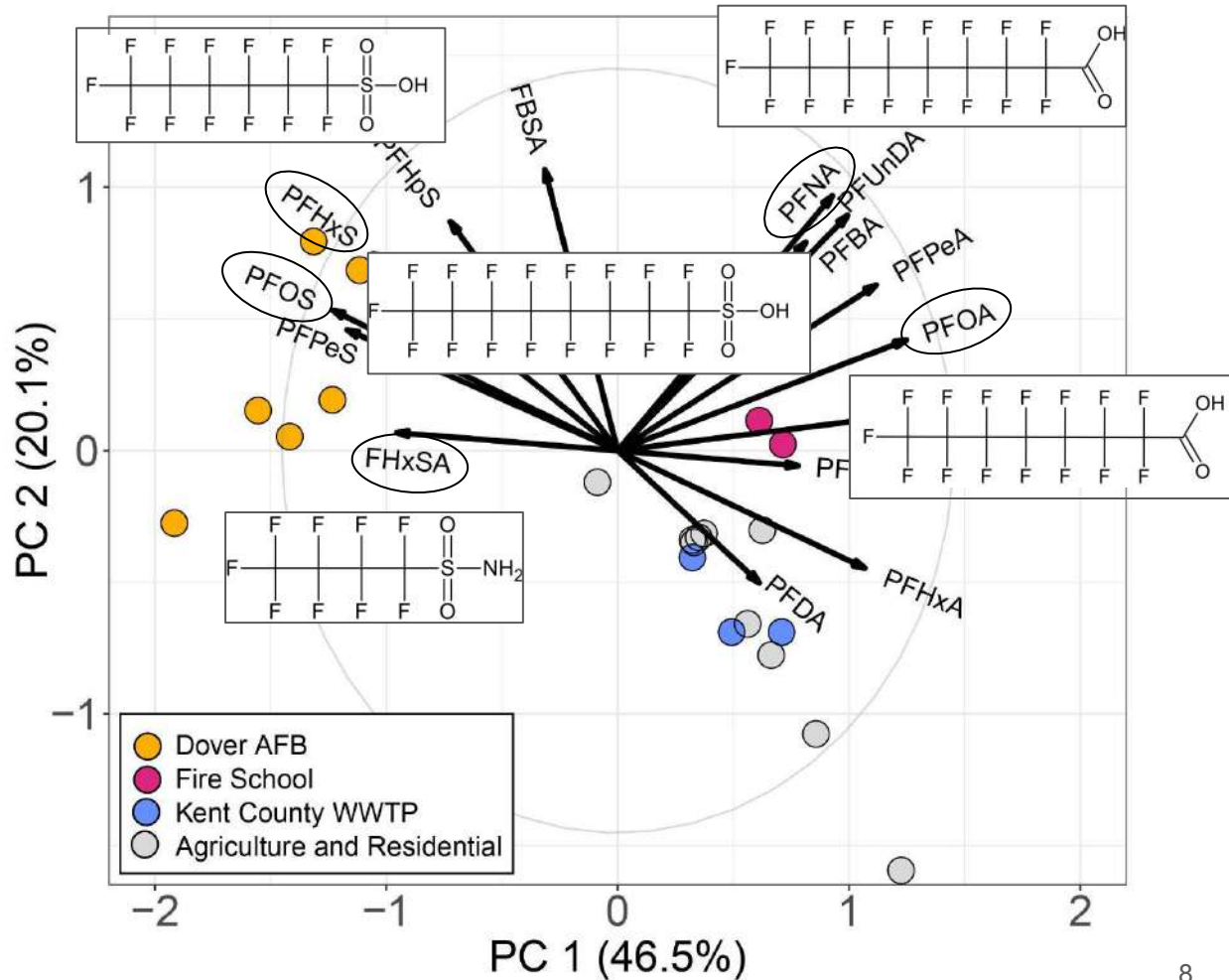
St. Jones River



Murderkill River

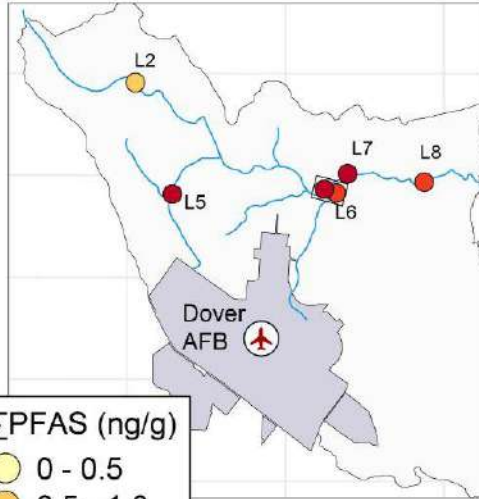


In surface water,
differences in
PFAS
compositions
are related to
proximity to
sources

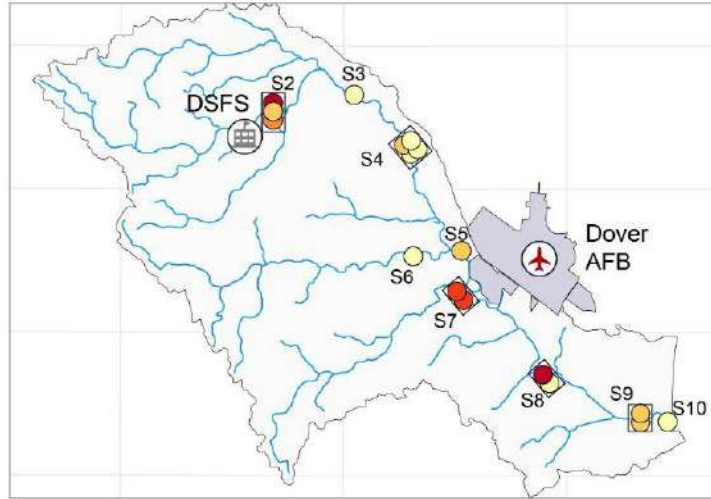


Highest concentrations in sediment are also downriver AFFF usage sites

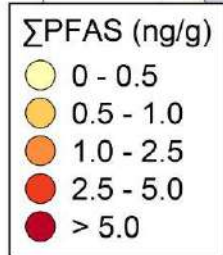
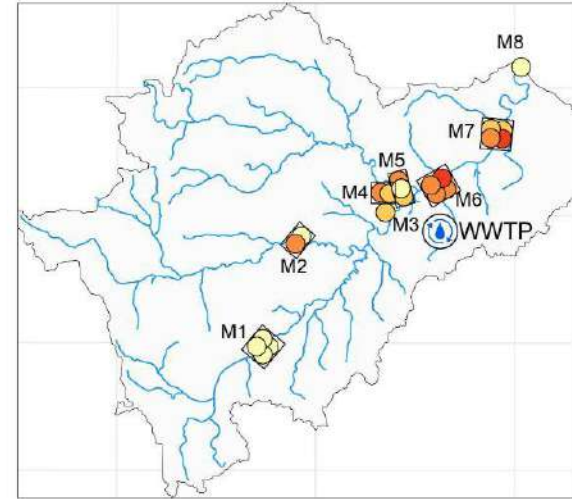
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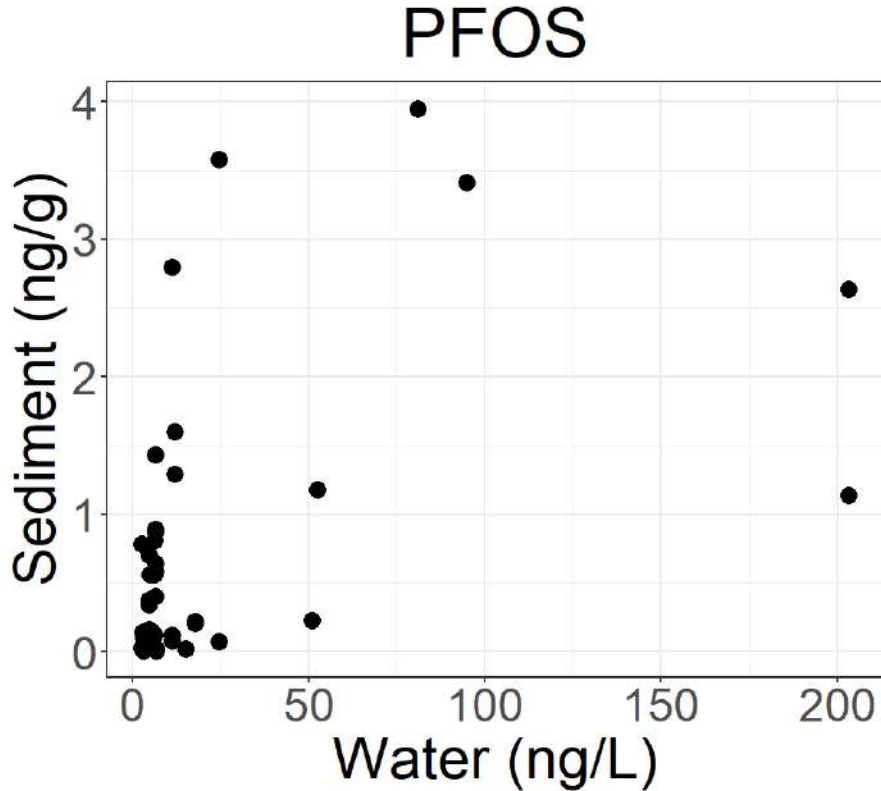
St. Jones River



Murderkill River



Water concentrations explain little about sediment concentrations



Many other factors influence sediment accumulation:

1. Water chemistry
 - Salinity
 - Dissolved organic carbon
2. Sediment properties
 - Organic carbon
3. Depositional dynamics
 - River bank

Can we reduce the information collection burden in rivers using spatial models?

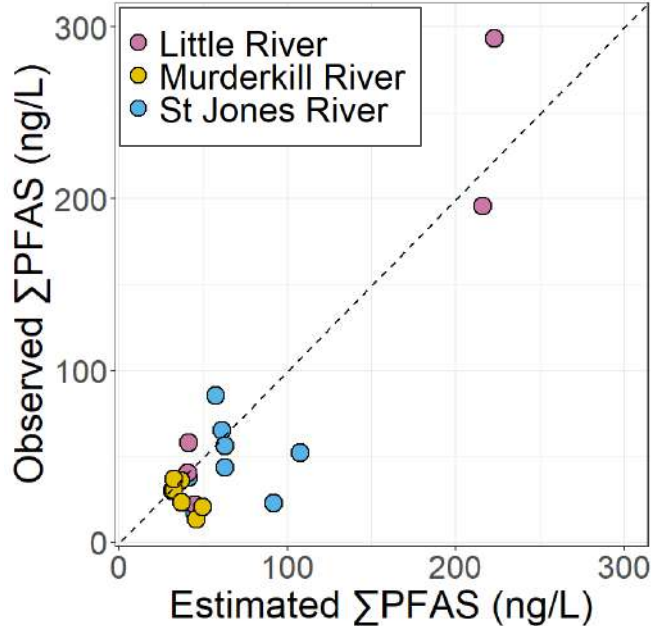
- PFAS are both mobile and persistent
- Multiple river sampling locations may be impacted by the same source
- Spatial Stream Networks (SSNs)- Regression models that accounts for flow connectivity between sites



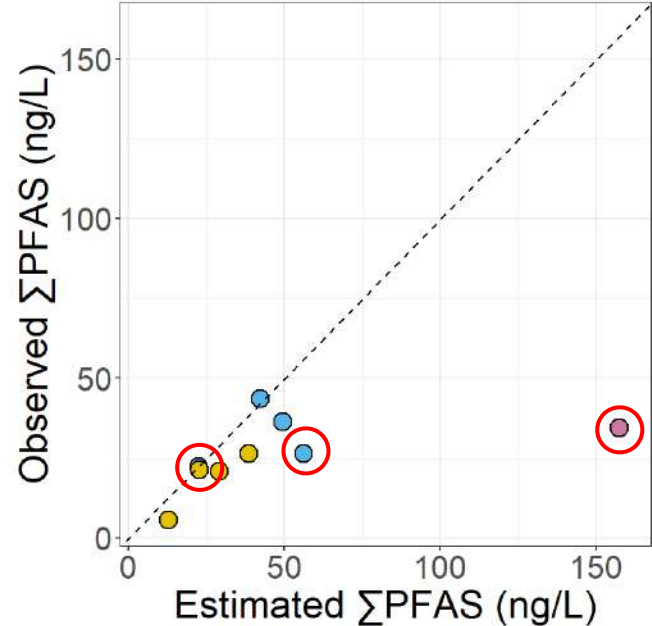
The screenshot shows the EPA website's Risk Assessment section. The header includes the EPA logo and navigation links for Environmental Topics, Laws & Regulations, Report a Violation, and About EPA. A search bar is located in the top right. The main content area features a sidebar with links to Risk Assessment Home, About Risk Assessment, Risk Recent Additions, Human Health Risk Assessment, Ecological Risk Assessment, Risk Advanced Search, Risk Publications, Risk Assessment Guidance, Risk Tools and Databases, and Superfund Risk Assessment. The main article is titled "SSN2: The next generation of spatial stream network modeling in R" and includes a "On this page:" section with links for Overview and Downloads. The article text begins with "The SSN2 R package provides tools for spatial statistical modeling, parameter estimation, and prediction on stream (river) networks. 'SSN2' is the successor to the SSN R package, which was archived alongside broader changes in the R-spatial ecosystem that included 1) the retirement of rcdal, rpeos, and mantools and 2) the lack of active

Considering spatial connectivity improves estimates of Σ PFAS at unsampled locations

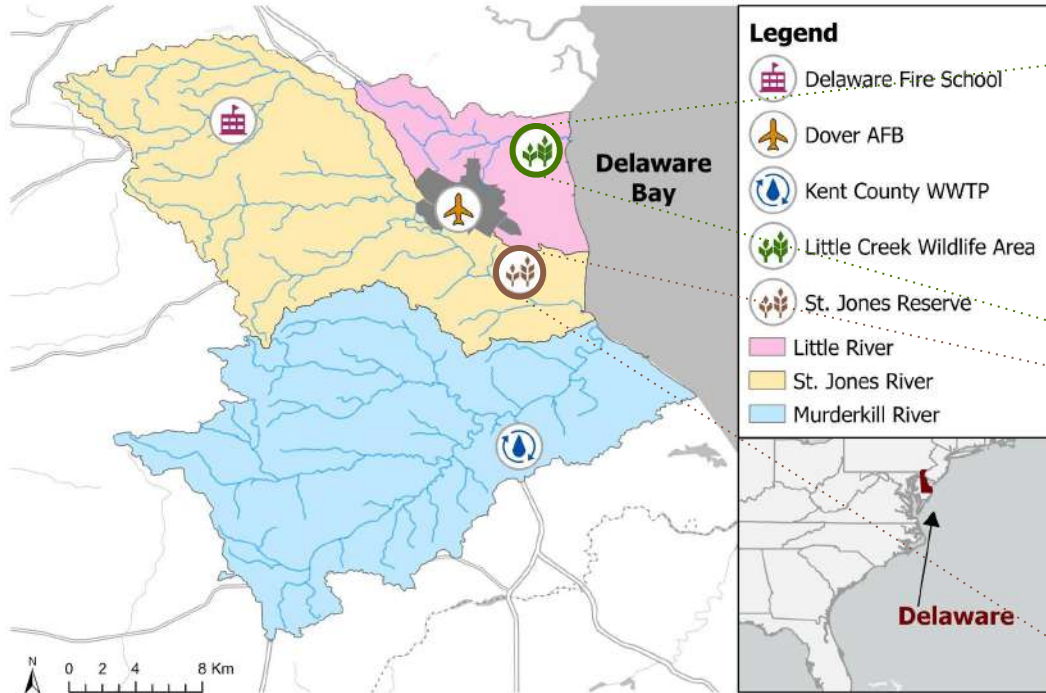
Leave-one-out Cross Validation



DNREC Fall 2022 Campaign



Investigating PFAS distributions in salt marshes



Little Creek Wildlife Area

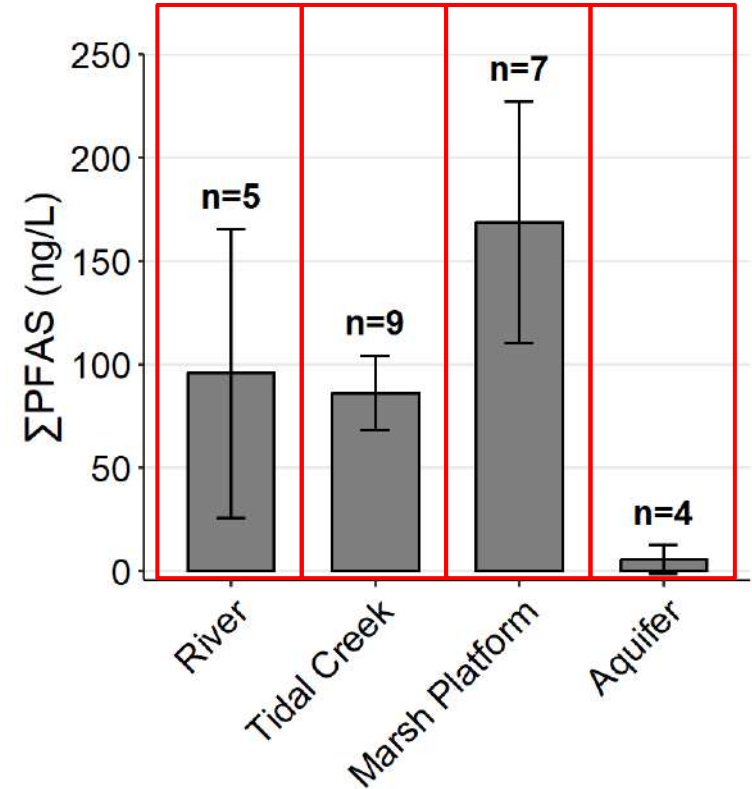
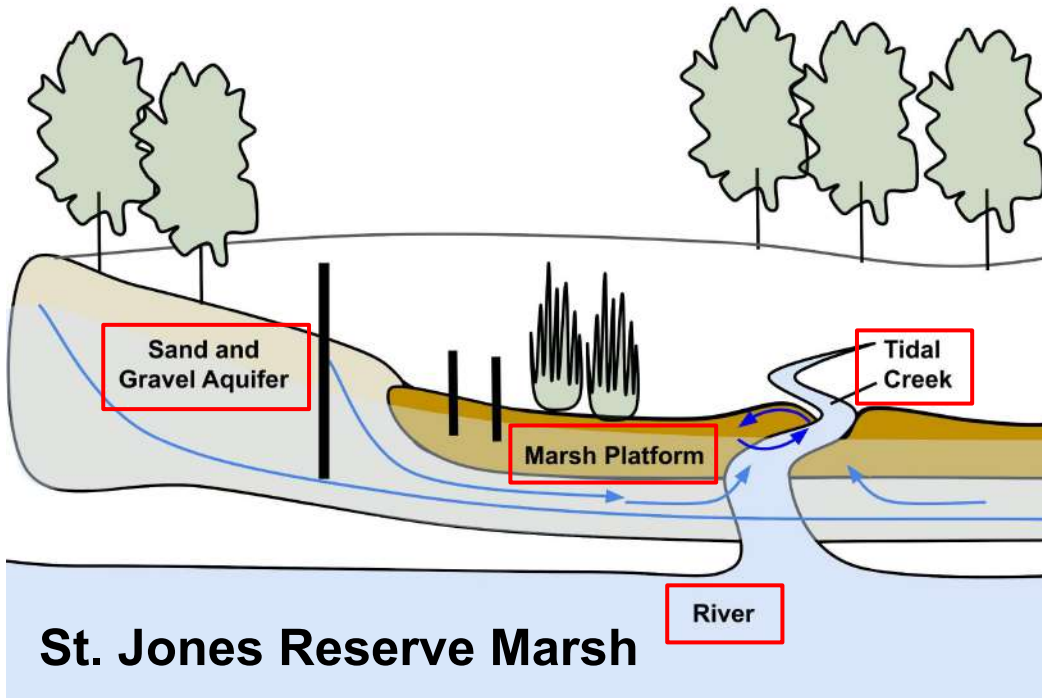
- Management Practices
- Site History



St. Jones Reserve

- Hydrologic processes
- Geochemical conditions

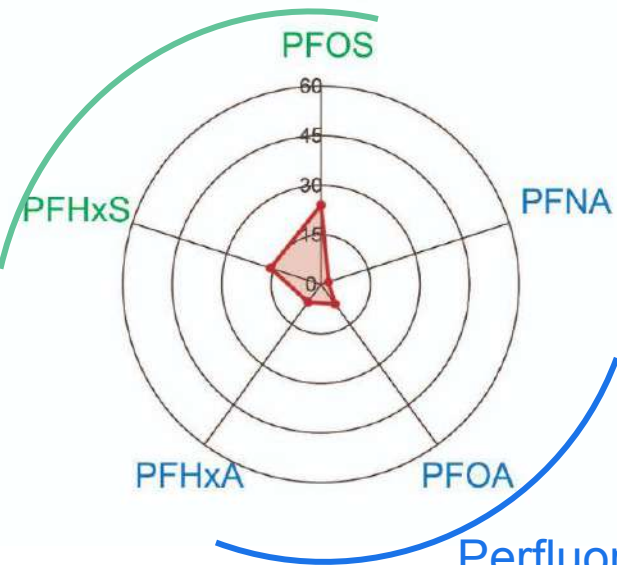
Elevated concentrations in shallow groundwater from marsh platform



Shallow groundwater is enriched in perfluorocarboxylic acids (PFCAs)

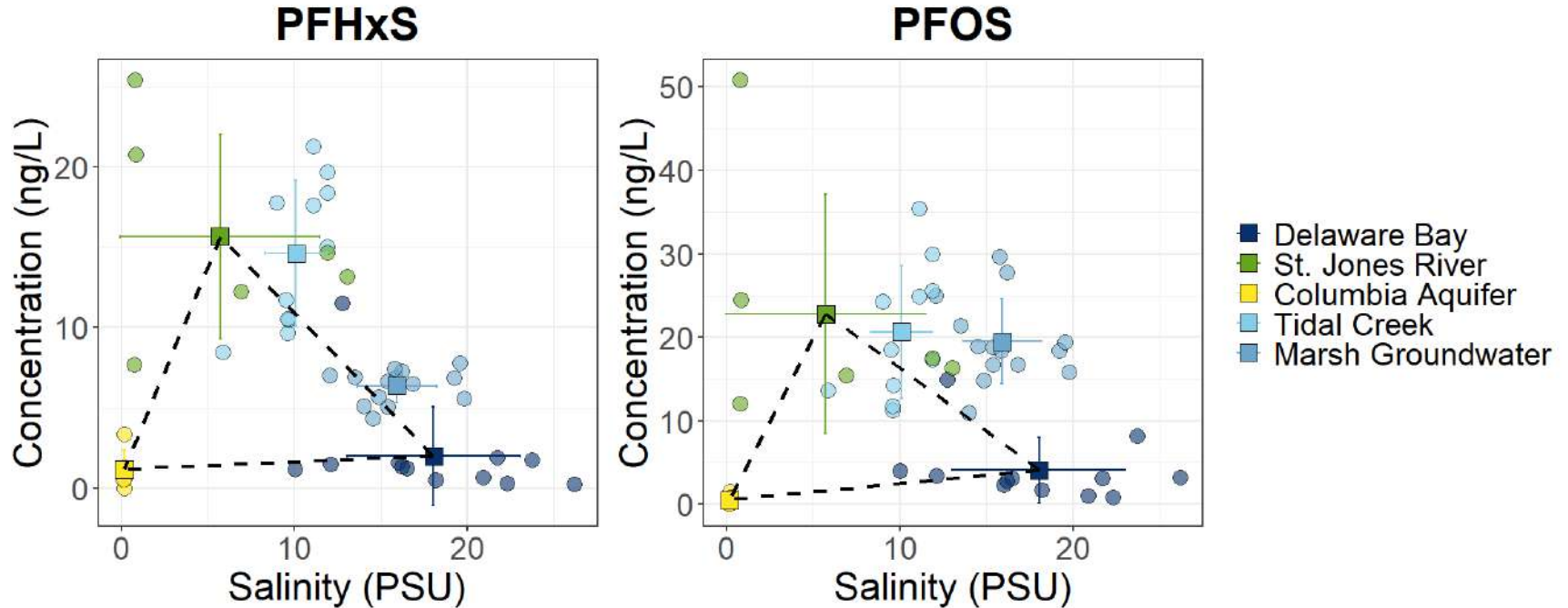
Perfluorosulfonic acids
(PFSAs)

River

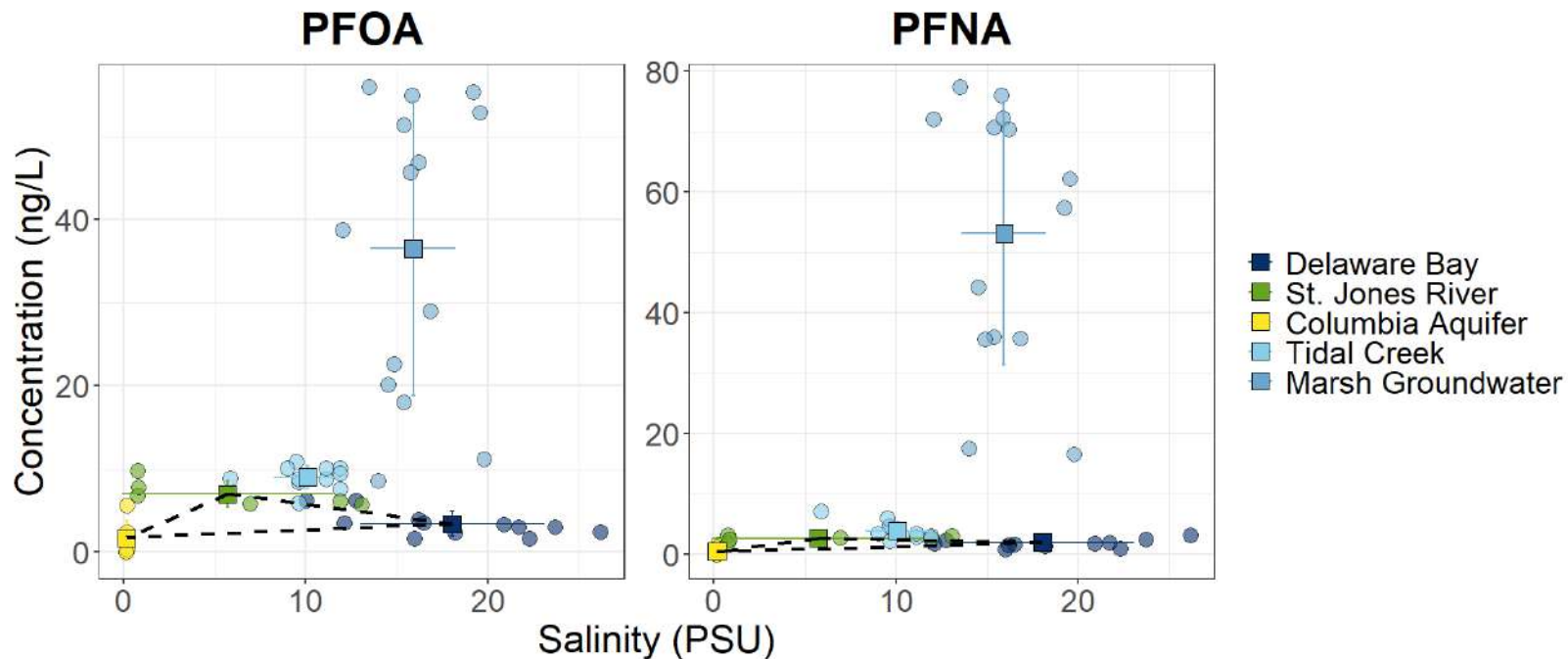


Perfluorocarboxylic
acids (PFCAs)

Mixing of Delaware Bay and St. Jones River explains PFSA concentrations in the marsh



Unexplained source of PFCAs to the marsh



Takeaways

- PFAS are mobile in surface waters, and river flow is a major transport pathway to locations further downstream, including tidal wetlands
- Concentrations in our study area in Kent County, DE, are similar to other AFFF-impacted watersheds
- The type and amount of PFAS observed at a sampling locations can provide useful information about point sources
- Considering connectivity between sampling sites using SSNs can improve estimates of \sum PFAS at unsampled locations

Acknowledgements

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- Li research group

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Thank you! Questions?

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How do we test for PFAS?

PFAS present at low concentrations in the environment

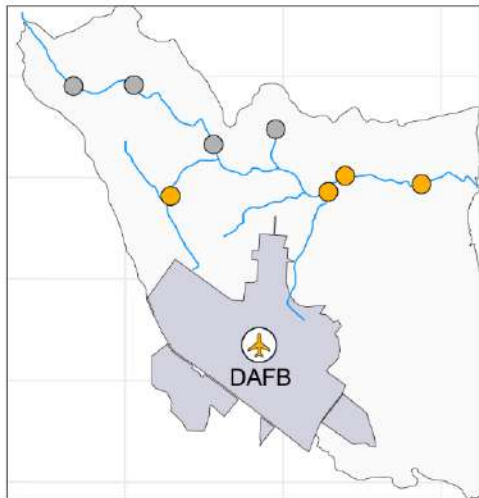
- Parts per trillion (ppt)

EPA Method 1633

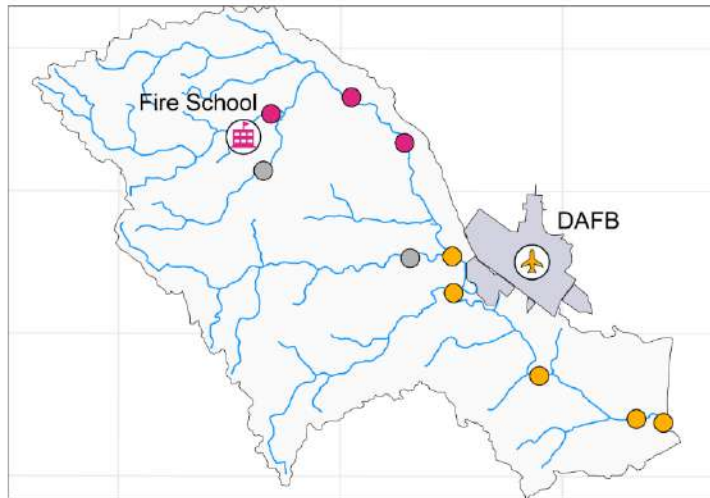
- Finalized in 2024
- Aqueous, solid, biosolids, and tissue samples
- Uses liquid-chromatography tandem mass spectroscopy (LC-MS/MS)
- A “targeted” method – 40 PFAS



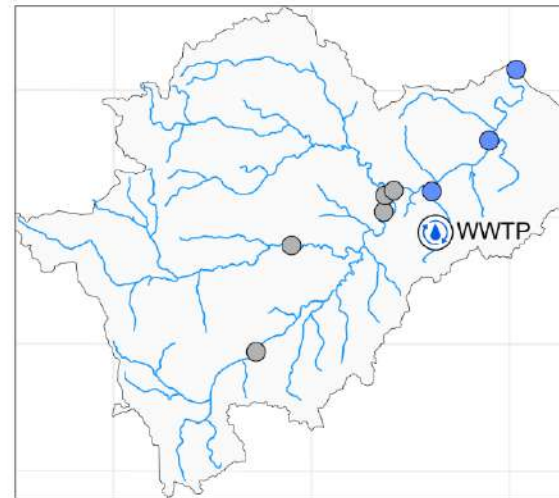
Little River



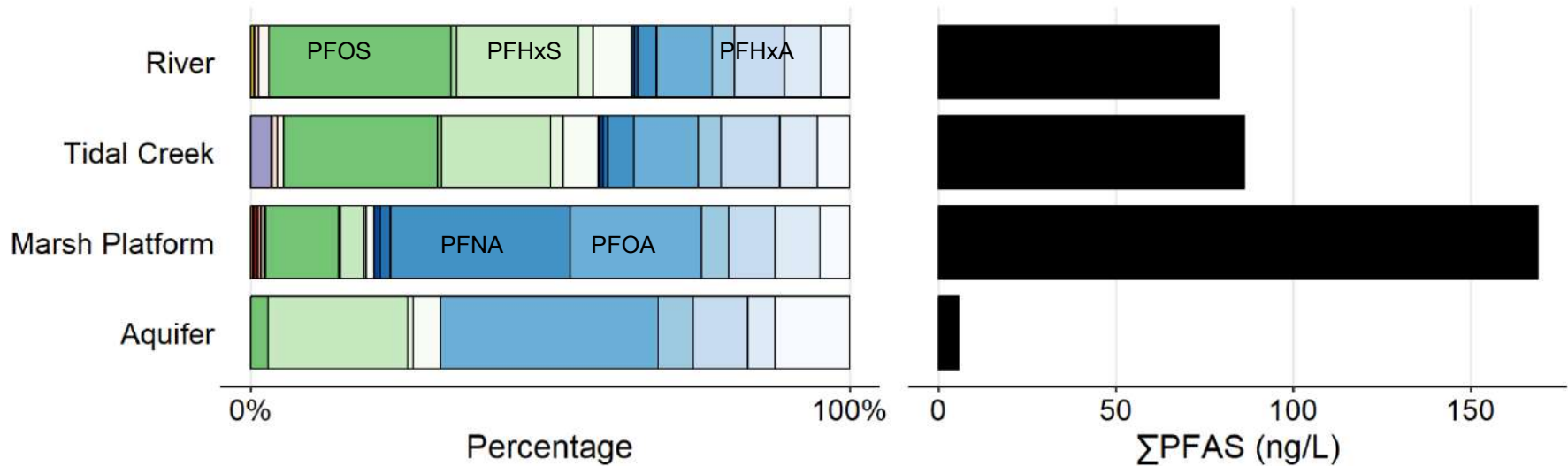
St. Jones River



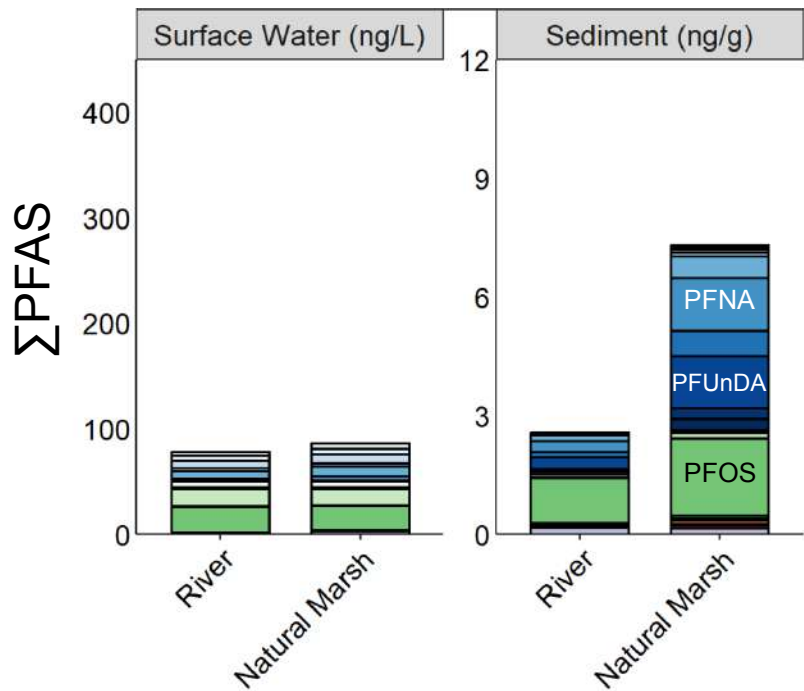
Murderkill River



PCA Groups



St. Jones River



Little Creek

