Introduction to the PFAS Testing Network

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PROGRAM DIRECTOR, PFAS TESTING NETWORK

NC PFAS Testing (PFAST) Network, a research program funded by the NC Policy Collaboratory

Jason D. Surratt, PhD

Program Director, PFAS Testing Network

Professor, Department of Environmental Sciences and Engineering, UNC Gillings School of Global Public Health

PhD, Chemistry, Caltech 2010

- *Dissertation: Analysis of the Chemical Composition of Atmospheric Organic Aerosols by Mass Spectrometry*

BA, Chemistry & BS, Meteorology, North Carolina State University 2003

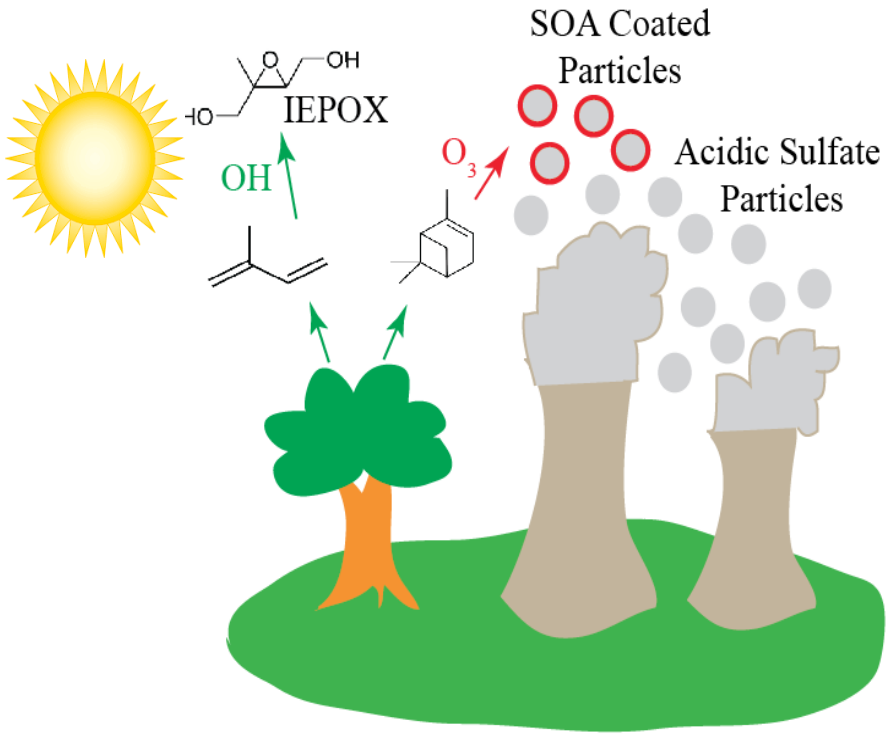
North Carolina native, grew up in Charlotte, NC

Research foci: **resolving underlying atmospheric chemistry** (or sources) **that produces *harmful*** fine particulate matter (or aerosol particles) contained within **outdoor air pollution** (**“smog”**)

Surratt Lab's Current Research

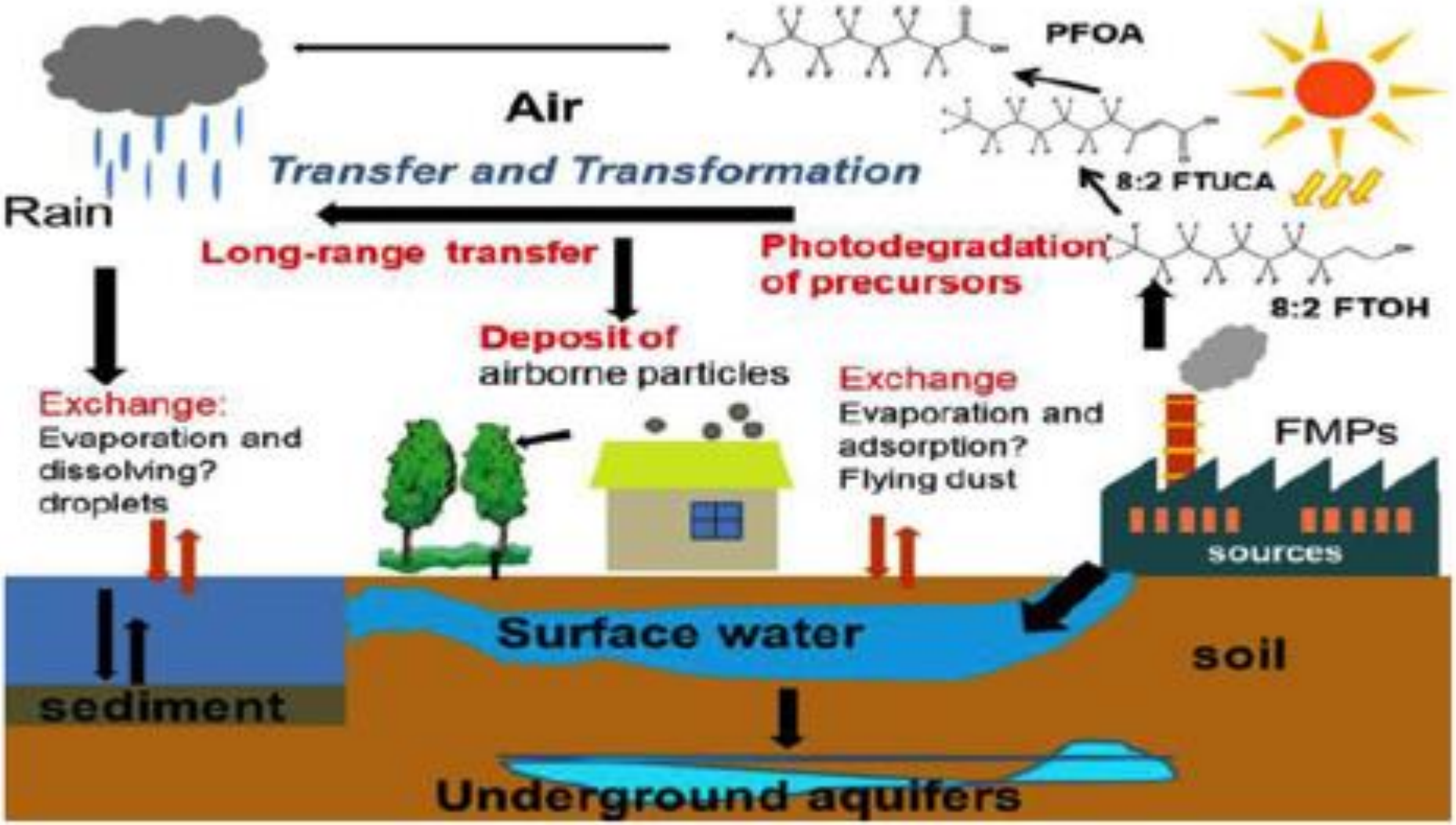
We **use targeted and non-targeted mass spectrometry analyses** to study **organic contaminants in air**

We focus on **how these organics result from the interaction of natural emissions** (trees) and **human emissions** (from coal and other combustion sources)



This atmospheric chemistry plays key role in po**or air quality**, **changes to climate**, and **potential health effects** in southeastern USA

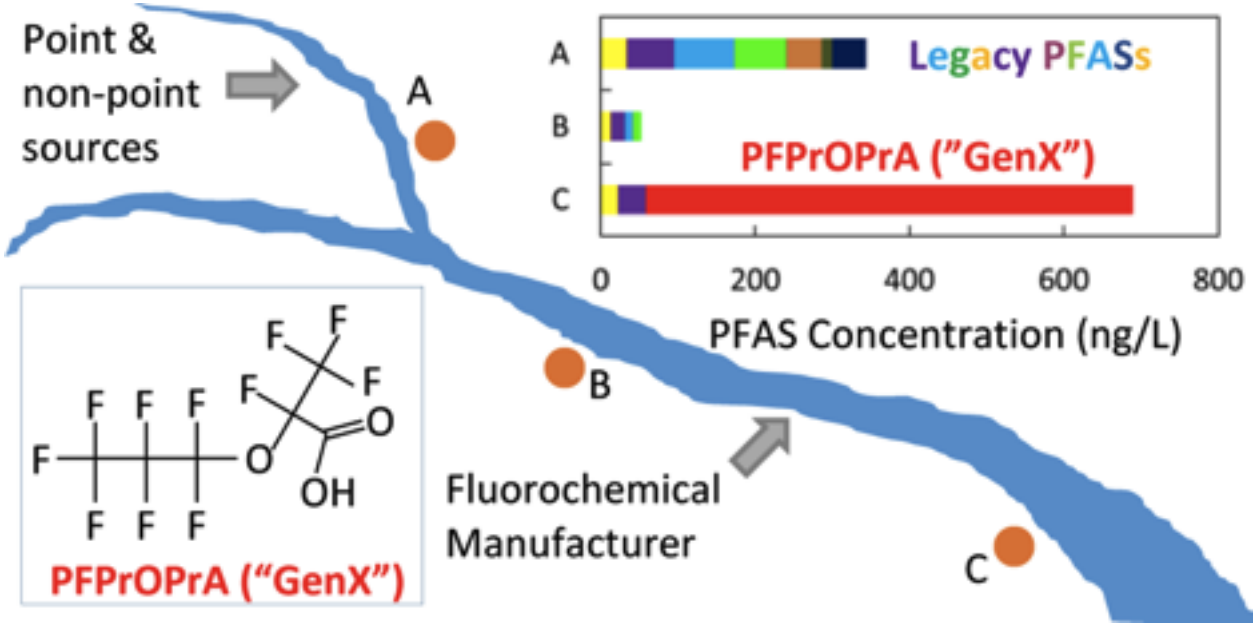
Per- and Polyfluoroalkyl Substances (PFAS) in Environment



FMPs = fluorochemical manufacturing plants

[Chen et al., 2018, ES&T]

PFAS in North Carolina – Example Cape Fear River

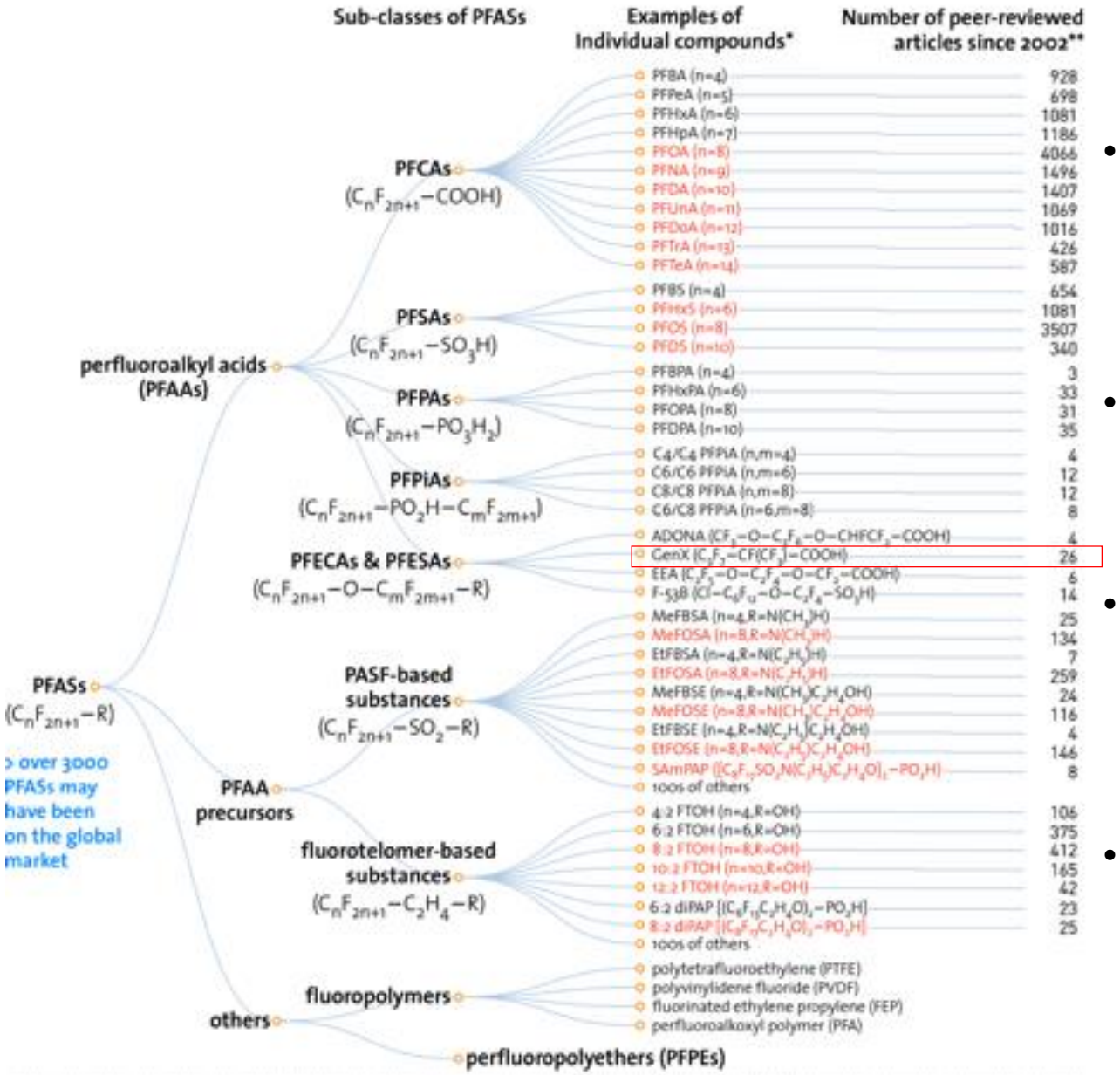


Prof. Detlef Knappe (NCSU)

- Long-chain PFASs are being replaced by short-chain PFASs (e.g., GenX) and fluorinate alternatives
- In headwater region (**point A**), no GenX detected but legacy PFASs detected
- In raw water of a drinking water treatment plant (DWTP, **point C**), GenX detected. Normal DWTP removal processes (e.g., ozonation, coagulation, disinfection, etc.) were not effective in removing it from drinking water
- EPA established lifetime health advisory level of 70 ng/L for sum of PFASs in drinking water

[Sun et al., 2016, *ES&T Letters*]

Family Tree of PFASs



* PFASs in RED are those that have been restricted under national/regional/global regulatory or voluntary frameworks, with or without specific exemptions (for details, see OECD (2015), Risk reduction approaches for PFASs. http://oe.cd/1AN).
** The numbers of articles (related to all aspects of research) were retrieved from SciFinder® on Nov. 1, 2016.

Figure 1. "Family tree" of PFASs, including examples of individual PFASs and the number of peer-reviewed articles on them since 2002 (most of the studies focused on long-chain PFCAs, PFSAs and their major precursors.).

- **Sources:** fire-fighting foams, food contact materials, household products, inks, medical devices, oil production, textiles, leather, pesticide formulations, apparel, and many others

- PFASs are generally ***highly persistent*** under natural environmental conditions

- Although **some PFASs may partially degrade** in the environment, they ultimately transform into highly stable end products, usually the highly persistent PFAAs

- For most PFASs, ***NO comprehensive understanding of their environmental & human exposure routes exists*** due to lack of information on their life cycles – **impedes development of proactive mitigation strategies**

- **GenX is known in NC, but as this "Family Tree" shows, there is likely many more PFASs here!**

Legislative Mandate: 2018 Appropriations Act *(S99; SL 2018-5)*

FUNDING TO ADDRESS PER- AND POLY-FLUOROALKYL SUBSTANCES, INCLUDING GENX/USE OF EXPERTISE AND TECHNOLOGY AVAILABLE IN INSTITUTIONS OF HIGHER EDUCATION LOCATED WITHIN THE STATE

SECTION 13.1.(f) The General Assembly finds that (i) per- and poly-fluoroalkyl substances (PFAS), including the chemical known as "GenX" (CAS registry number 62037-80-3 or 13252-13-6), are present in multiple watersheds in the State, and impair drinking water and (ii) these contaminants have been discovered largely through academic research not through systematic water quality monitoring programs operated by the Department of Environmental Quality or other State or federal agencies. The General Assembly finds that the profound, extensive, and nationally recognized faculty expertise, technology, and instrumentation existing within the Universities of North Carolina at Chapel Hill and Wilmington, North Carolina State University, North Carolina A&T State University, Duke University, and other public and private institutions of higher education located throughout the State should be maximally utilized to address the occurrence of PFAS, including GenX, in drinking water resources.

Legislative Mandate: 2018 Appropriations Act *(S99; SL 2018-5)*

Section 13.1.(f) – Findings statement that academic expertise & instrumentation in public and private universities in NC should be “maximally utilized to address the occurrence of PFAS, including GenX, in drinking water resources.”

Legislative Mandate: 2018 Appropriations Act *(S99; SL 2018-5)*

Section 13.1.(g) – Water sampling scope

- ALL public water supply surface water intakes (n=190)
- One well selected by each muni water supply system operating groundwater wells for public water supply (688 total wells in 158 munis; n=158)

TOTAL SAMPLE UNIVERSE n=348

Legislative Mandate: 2018 Appropriations Act *(S99; SL 2018-5)*

Section 13.1.(h) – Reporting requirements

Quarterly progress reports due to NCGA Environmental Review Commission and regulatory agencies (NCDEQ, NCDHHS, EPA) starting **October 1, 2018**

Legislative Mandate: 2018 Appropriations Act *(S99; SL 2018-5)*

Section 13.1.(i) – Appropriation

$5,013,000

(FY 2018-19; non-recurring but non-reverting)

Legislative Mandate: 2018 Appropriations Act *(S99; SL 2018-5)*

Section 13.1.(l) – Other Research Directives

- Predictive modelling of private well contamination
- Performance testing of removal technologies
- Air emissions & atmospheric deposition
- Evaluate other research opportunities

Formulation of Research Teams and Approval of Projects

June 2018	Proposals (scopes of work) requested from each research team by Program Director
Mid-July, 2018	Proposals submitted to Program Director
July-Sept, 2018	2 external, expert reviewers provide feedback and recommendations on each proposal 1 Executive Advisory Committee member provides an internal review of each proposal
Mid-Sept, 2018	Reviewers' comments provided to research teams to improve proposals
Oct. 8, 2018:	Revised proposals submitted to Program Director based on reviewer comments
Late Oct 2018:	Executive Advisory Committee meets with Program Director to make final recommendations on all proposals
Nov 2018:	First set of water and air samples will be collected

Core Academic Teams Formulated Across N.C. Institutions

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

NC STATE UNIVERSITY

UNCW

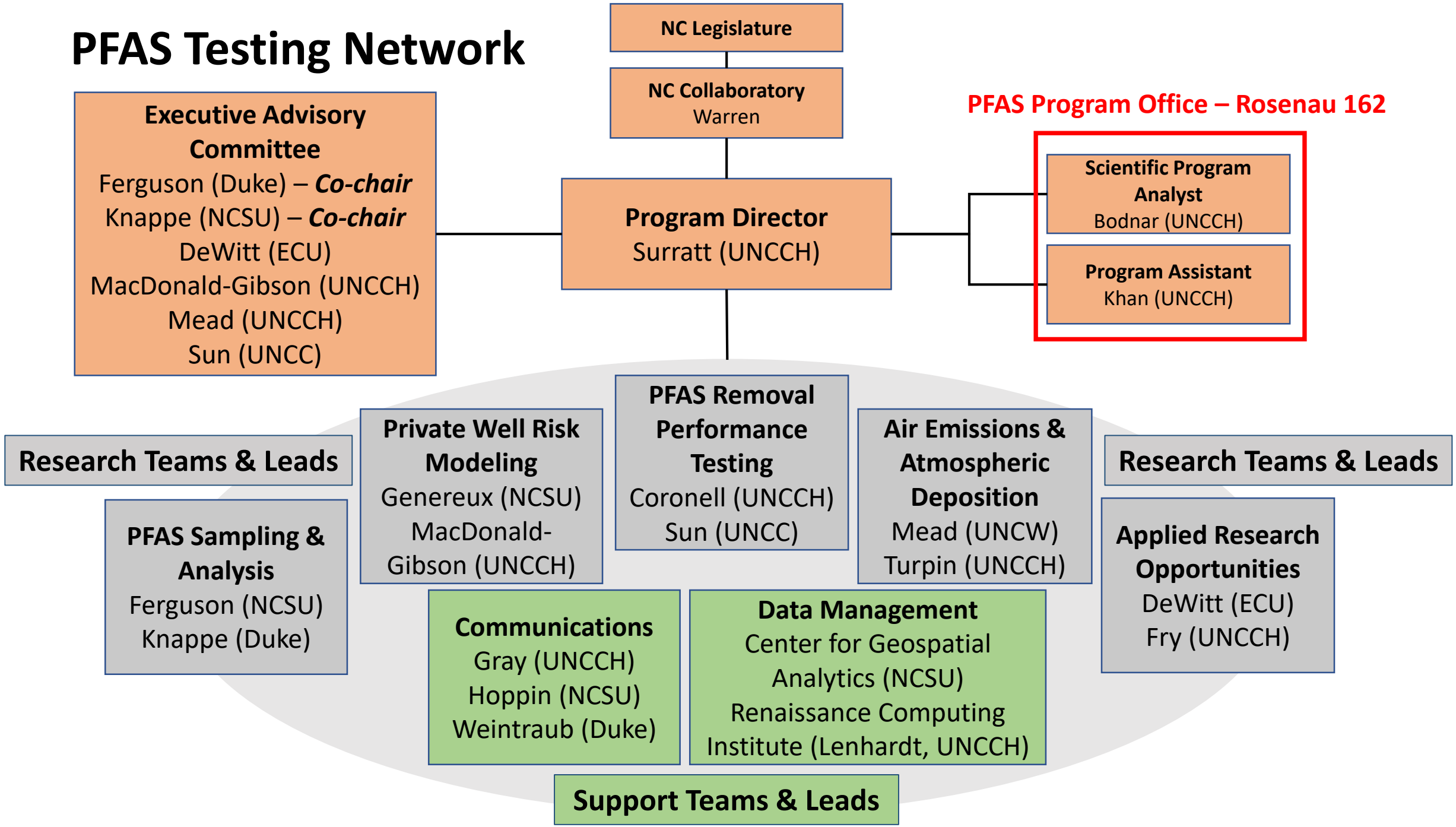
UNC CHARLOTTE

ECU

North Carolina Agricultural and Technical State University

Duke UNIVERSITY

PFAS Testing Network



Team 1: PFAS Sampling & Analysis

Lee Ferguson, PhD
Associate Professor, Civil and Environmental Engineering
Duke University

Detlef Knappe, PhD
Professor, Civil, Construction, and Environmental Engineering
NCSU

Research Questions for Water Sampling Team

What are the concentrations of targeted legacy and emerging PFAS contaminants in North Carolina public drinking water sources?

- Collect and analyze raw water samples during two consecutive quarters of 2018/2019 at all 191 municipal surface water intakes and all 149 municipal drinking water systems treating groundwater in NC for PFAS measurement
- Repeat this sampling for systems with detectable PFAS in the third quarter of 2019

What unanticipated and untargeted PFAS compounds occur in North Carolina public drinking water sources?

- Apply high-resolution mass spectrometry methods to screen samples collected above for presence of > 5,100 known PFAS compounds as well as for unknown fluorinated organic compounds

How much of the total organic fluorine in North Carolina public drinking water sources can be accounted for by targeted PFAS quantitation?

- Utilize adsorbable organic fluorine (AOF) measurements in concert with the quantitative PFAS measurements outlined above to assess fluorine “mass balance” in water samples

Team 2: Private Well Risk Modeling

David Genereux, PhD
Professor, Marine, Earth, & Atmospheric Sciences
NCSU

Jacqueline MacDonald-Gibson, PhD
Associate Professor, Environmental Sciences & Engineering
UNC-Chapel Hill

Research Objectives for Private Well Risk Modeling Team

- **For GenX and other PFASs, determine current rates of input to the aquifer and output from the aquifer to tributaries of the Cape Fear River.**
  - How long will it take to flush PFAS from the aquifer by natural groundwater flow?
- **Determine why some wells are contaminated and others are not.**
  - What features of the wells, landscape, geology, weather, and geographic location influence risks to wells?
- **Develop user-friendly web site with interactive maps to help private well owners assess risks.**

Team 3: PFAS Removal Performance Testing

Orlando Coronell, PhD
Associate Professor, Environmental Sciences & Engineering
UNC-Chapel Hill

Mei Sun, PhD
Assistant Professor, Civil & Environmental Engineering
UNC-Charlotte

Research Questions for PFAS Removal Testing Team

- What is the best option to remove PFAS from drinking water among commercially available activated carbons (AC), ion exchange (IX) resins, and membrane filters?
- What do we do with the waste streams with enriched PFAS, generated during resin regeneration and membrane filtration?
- Are there promising novel PFAS removal methods we can develop?
- How successful are the household filters in removing PFAS from tap water?




Team 4: Air Emissions & Atmospheric Deposition

Ralph Mead, PhD
Professor, Chemistry & Biochemistry
UNC-Wilmington

Barbara Turpin, PhD
Professor & Chair, Environmental Sciences & Engineering
UNC-Chapel Hill

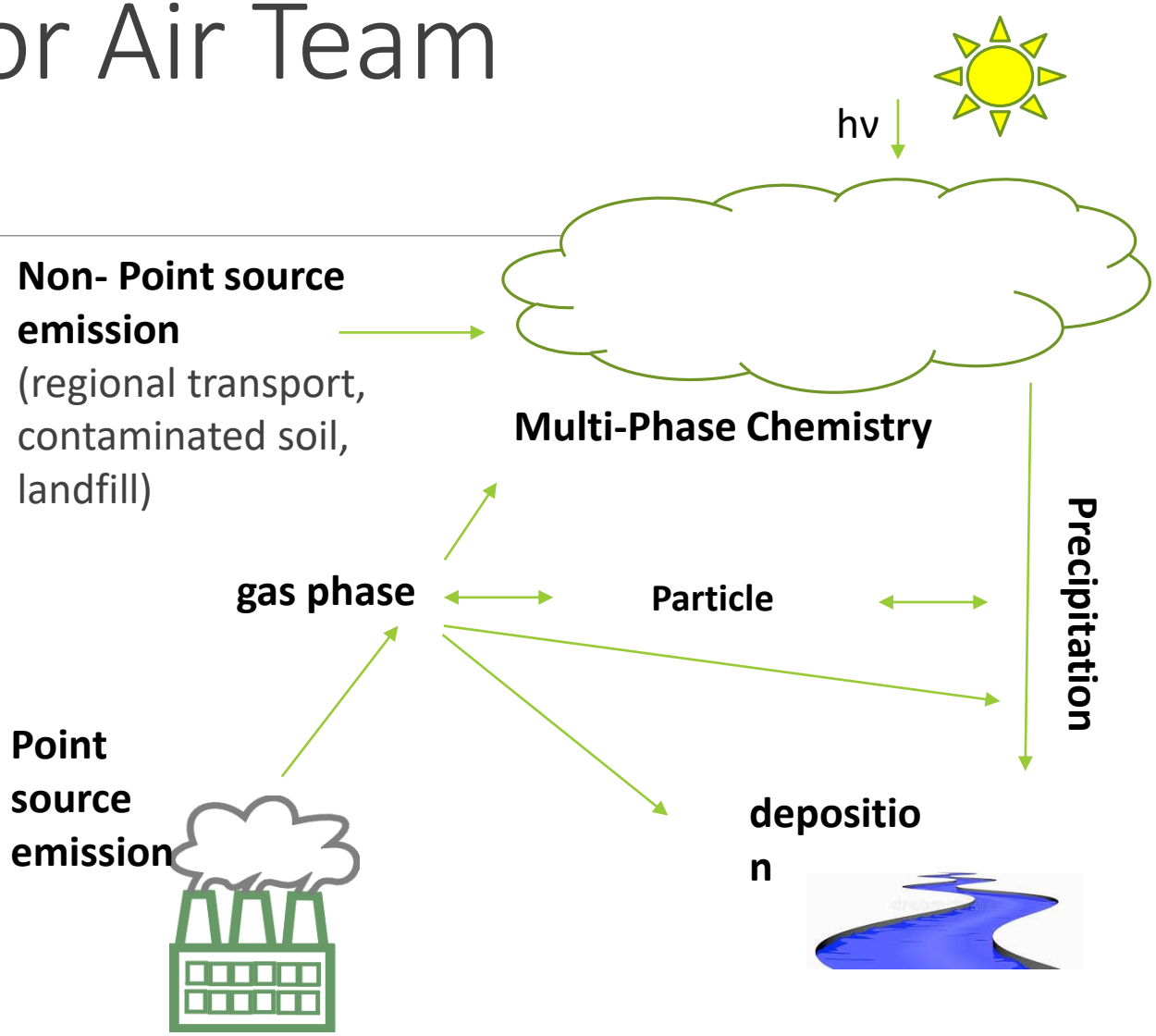
Research Questions for Air Team

What PFAS compounds are present
in ambient NC air?
in wet deposition?

What is the geographic distribution and what does this tell us about sources?

What is the contribution of wet deposition to the Cape Fear watershed?

Does gas-to-particle conversion (multiphase atmospheric chemistry) alter the fate of small polar gaseous PFAS species, as we have seen for similar non-fluorinated organics?



Team 5: Applied Research Opportunities

Jamie DeWitt, PhD
Associate Professor, Pharmacology & Toxicology
East Carolina University

Rebecca Fry, PhD
Distinguished Professor & Director, Institute for Environmental Health Solutions
UNC-Chapel Hill

Research Questions for the Applied Research Team

- What are novel sources of PFAS to surface and groundwater, i.e., from municipal solid waste landfills and unlined construction and demolition landfills?
- How do PFASs bioaccumulate from the environment into ecologically important species?
- Do emerging PFASs impact the immune system to the same degree as legacy PFASs?
- Can PFASs be taken up by important food crops and do soil properties affect this uptake?
- Do PFASs in drinking water pose a risk to pregnant women and could they affect the cells of her placenta?
- Can we develop models to predict where PFASs go in organisms and in the environment?