Cindy Hu

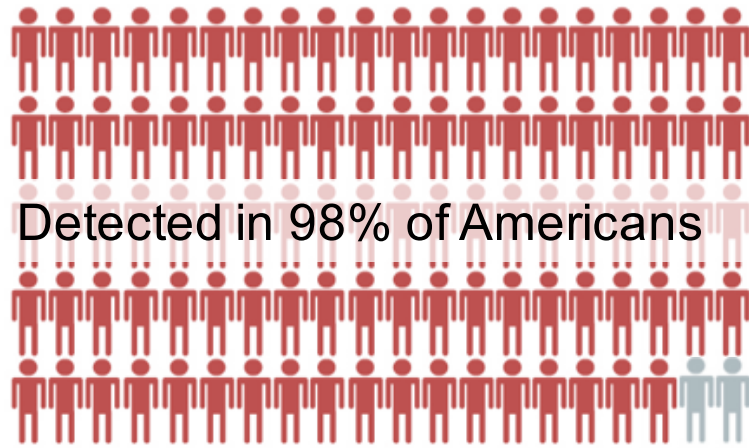## Postdoctoral Fellow, Harvard T.H. Chan School of Public Health

STEEP

Sources, Transport, Exposure & Effects of PFASs
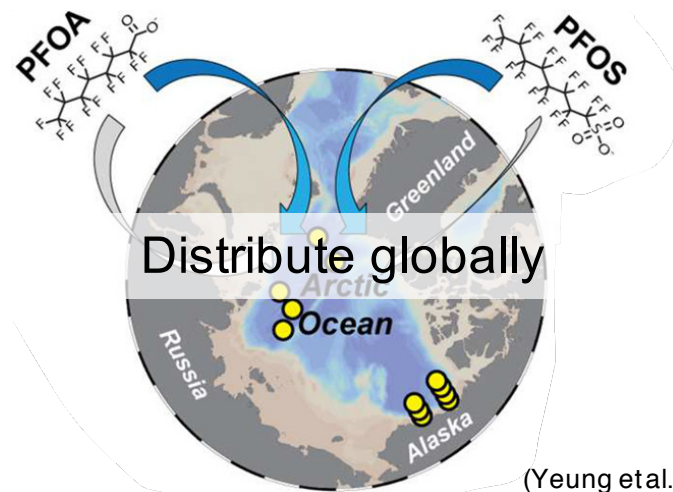UNIVERSITY OF RHODE ISLAND SUPERFUND RESEARCH PROGRAM

PFASs: Where are they from, how do they change in the environment, and how are humans exposed to them?

Xindi (Cindy) Hu
Harvard T.H. Chan School of Public Health

What are poly- and perfluoroalkyl substances (PFASs)?

Detected in 98% of Americans

(Khalil et al., 2016)

Widely used, anthropogenic

Distribute globally

(Yeung et al., 2017)
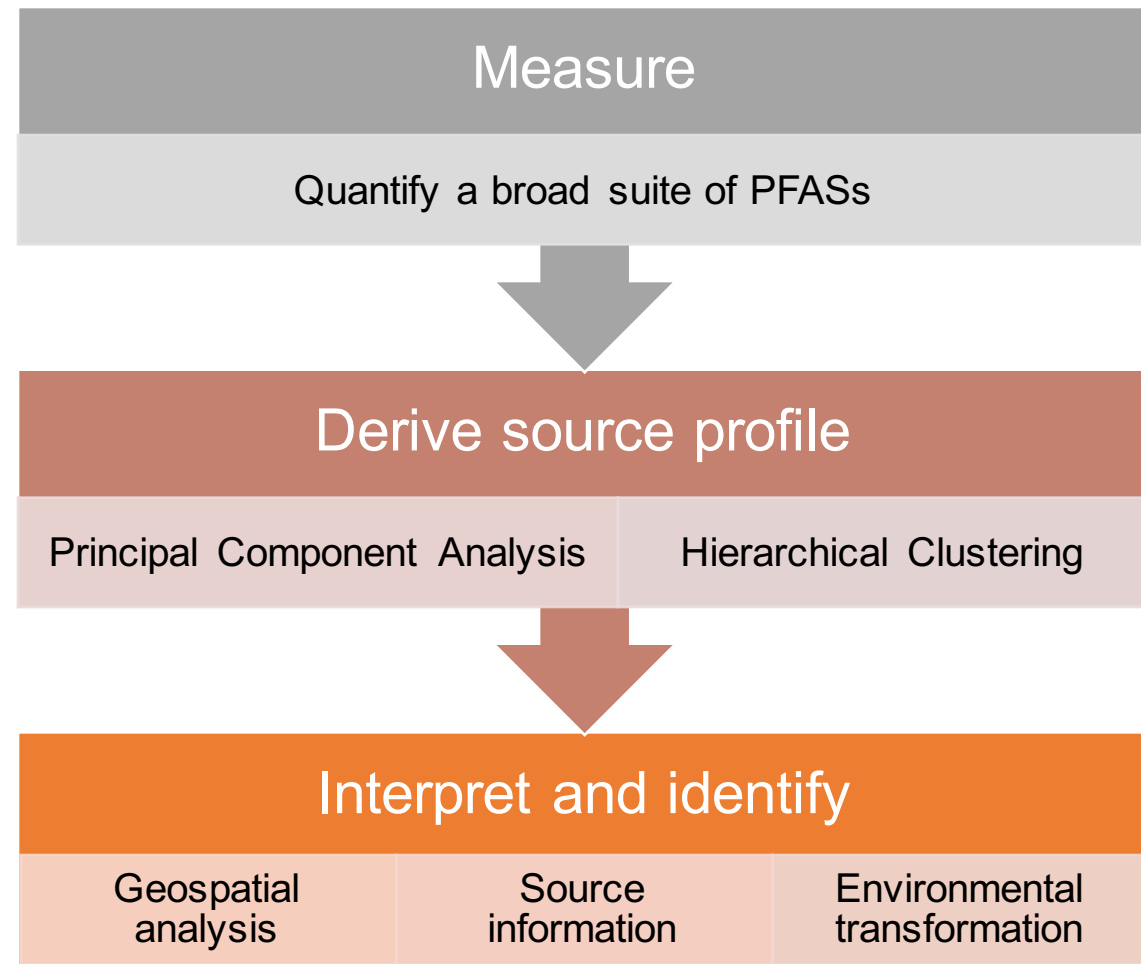

Impacts on communities

Nathaniel Brooks The New York Times

Source attribution of PFASs

Source attribution is essential for effective environmental regulation

- Congener composition within chemical classes can be useful to identify major sources, such as PCBs, PAHs

- Application of such techniques to PFASs is complicated by dramatic shifts in production over time and the complex transformations of PFAS precursors
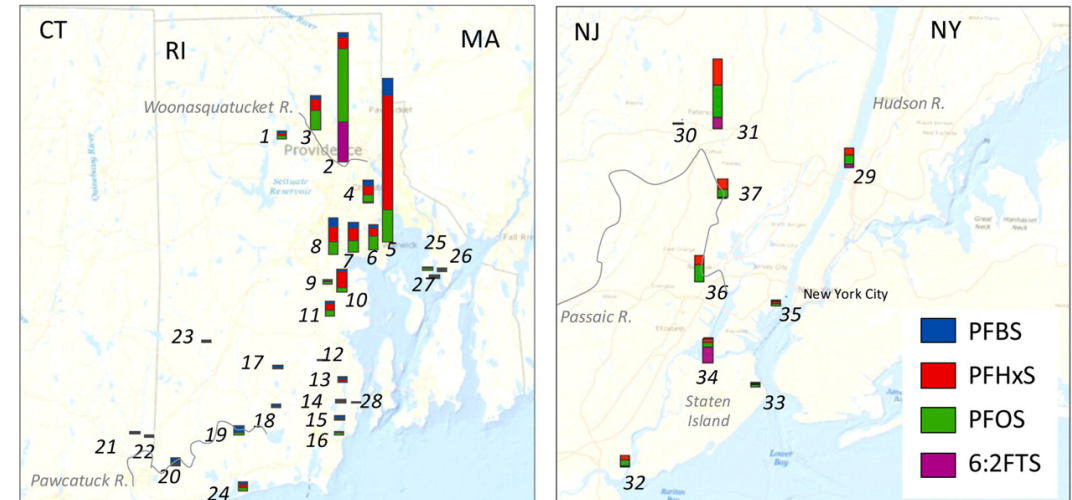
Measure

Quantify a broad suite of PFASs

Derive source profile

| Principal Component Analysis | Hierarchical Clustering |

Interpret and identify

| Geospatial analysis | Source information | Environmental transformation |

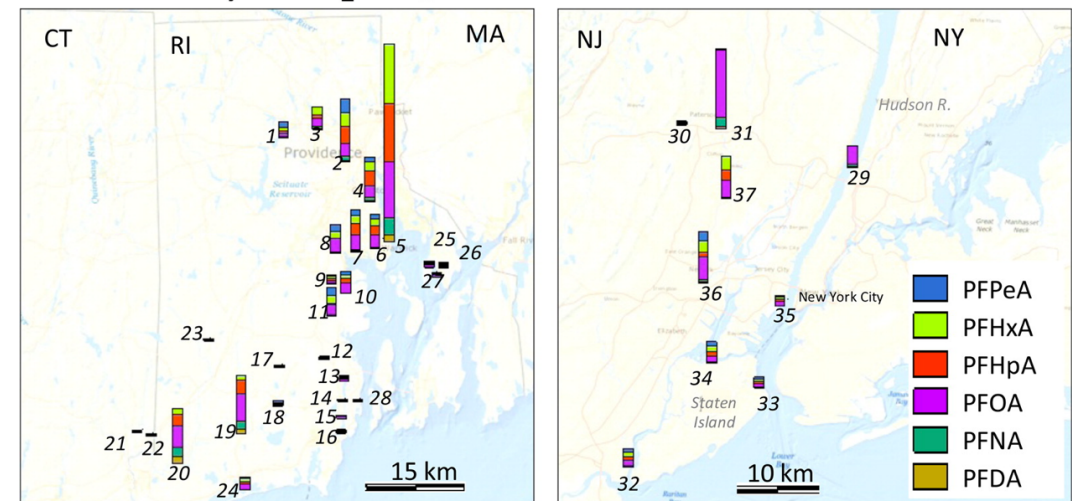# Surface water samples collected in 2014

Sample Information:

- Rhode Island (*n*=28) and New York (*n*=9)
- 20 from urban area, 17 from rural area
- 21 PFASs including PFCAs, PFSAs, preFOS
- 14 PFASs detected in more than 60% of samples
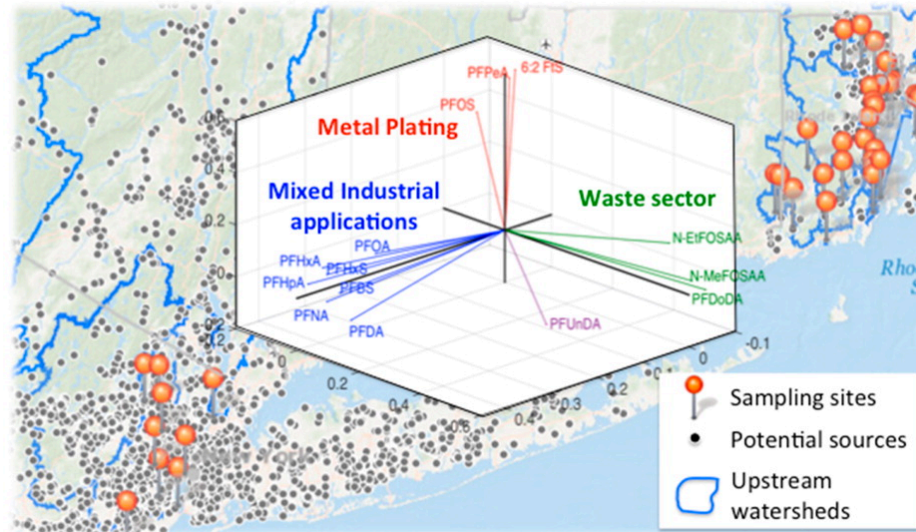
(Zhang et al, ES&T Letters, 2016)

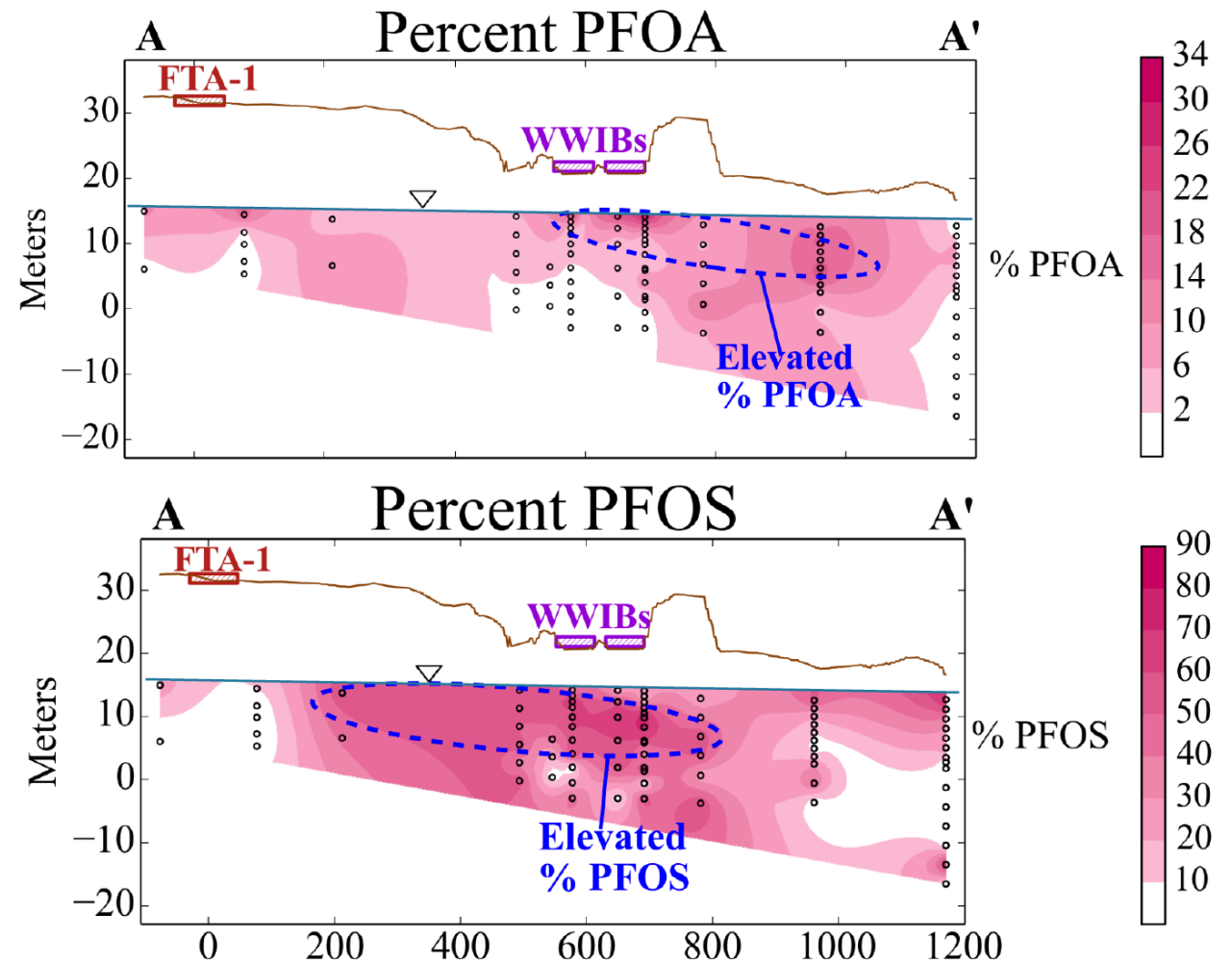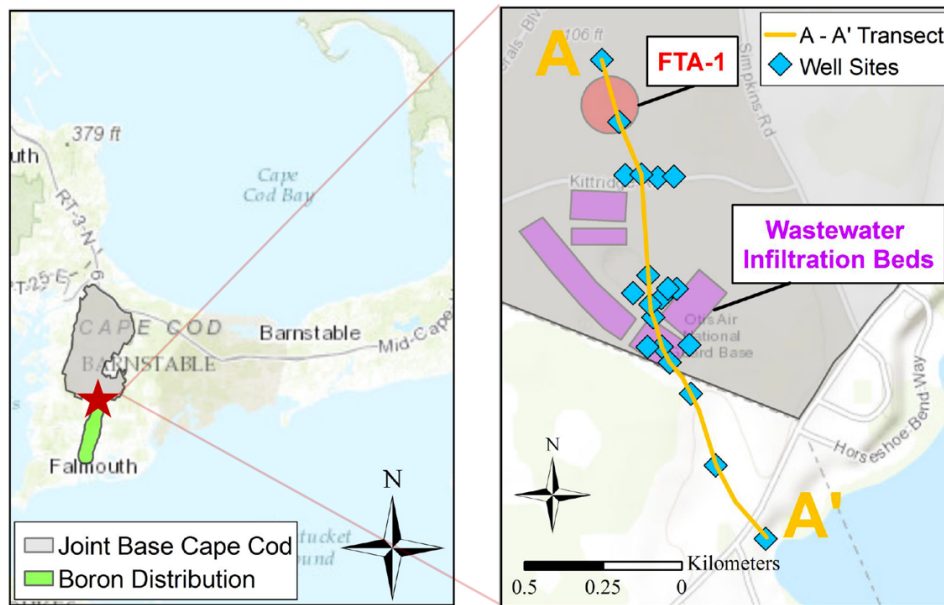# Identify groupings of PFASs and potential point sources

(Zhang et al, ES&T Letters, 2016)

- PC1: a mixture of contemporary point sources, e.g. airports and textile mills
- PC2: atmospheric sources from the waste sector
- PC3: metal plating industry
- This analysis could be refined by adding emerging short-chain PFASs and precursors to develop more unique chemical signatures for specific industries
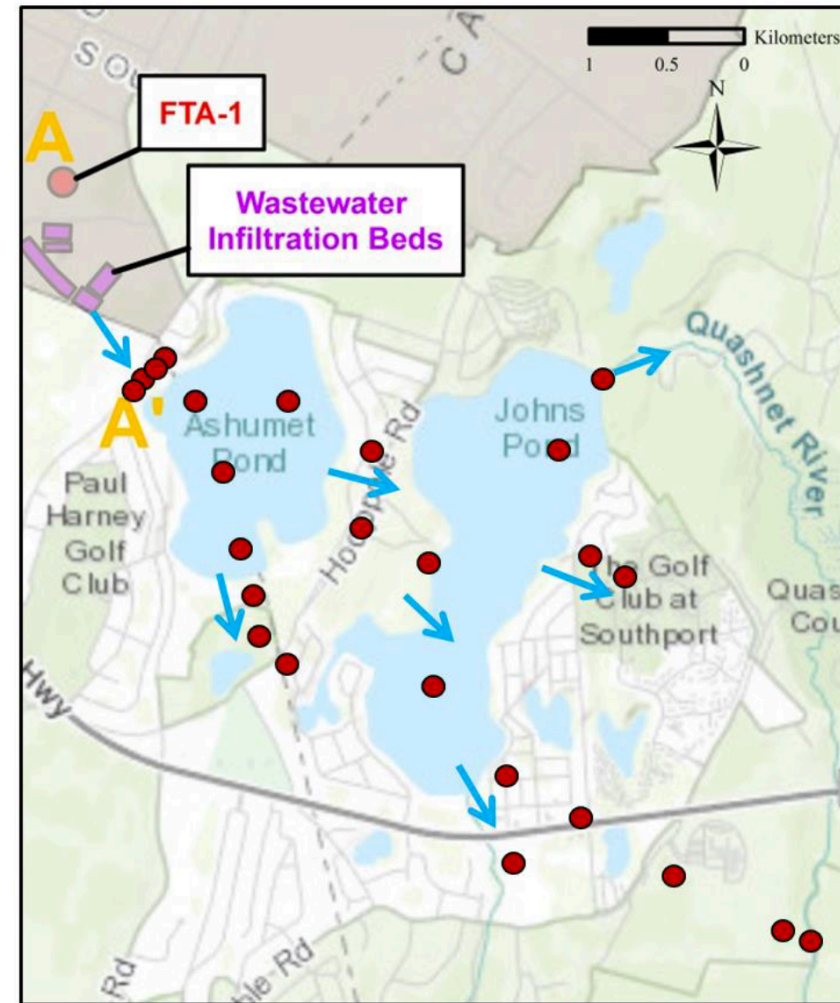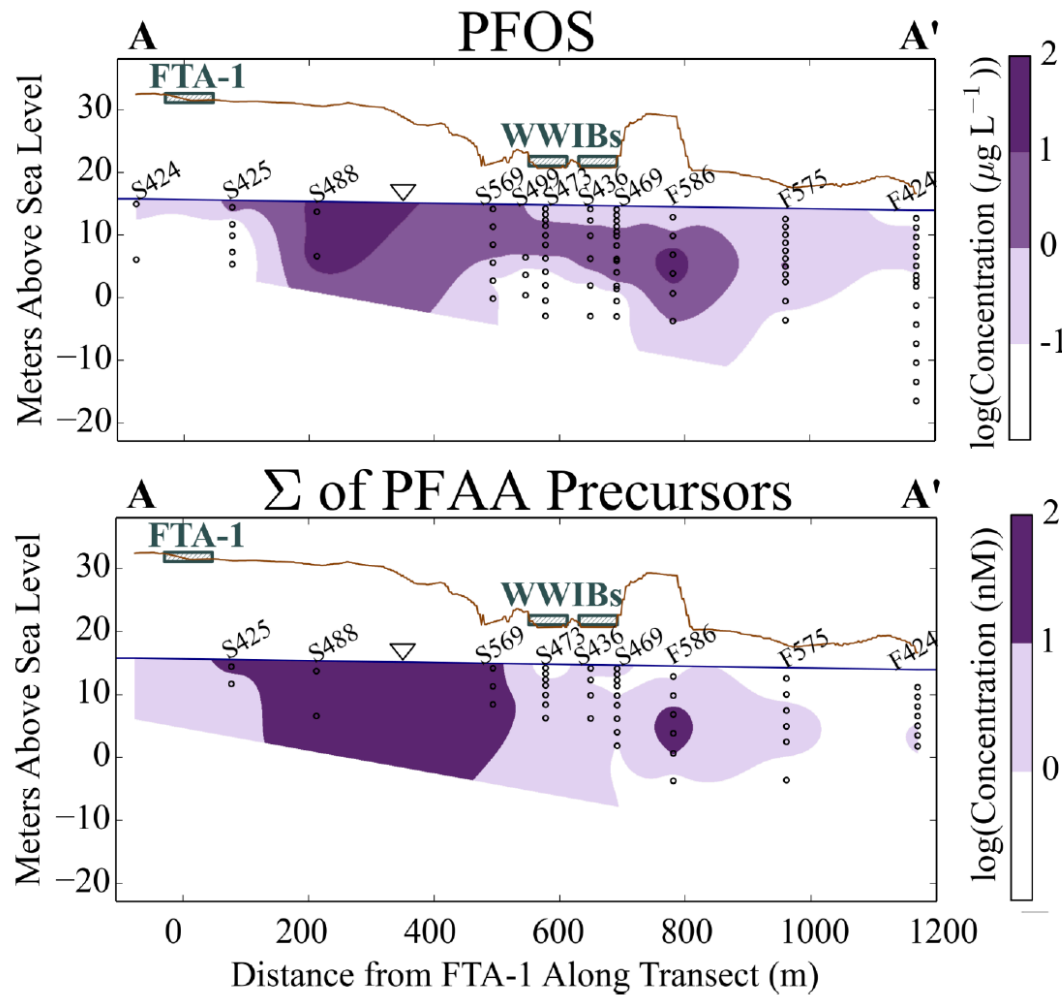
PFASs Fate and Transport in Groundwater and Surface Water

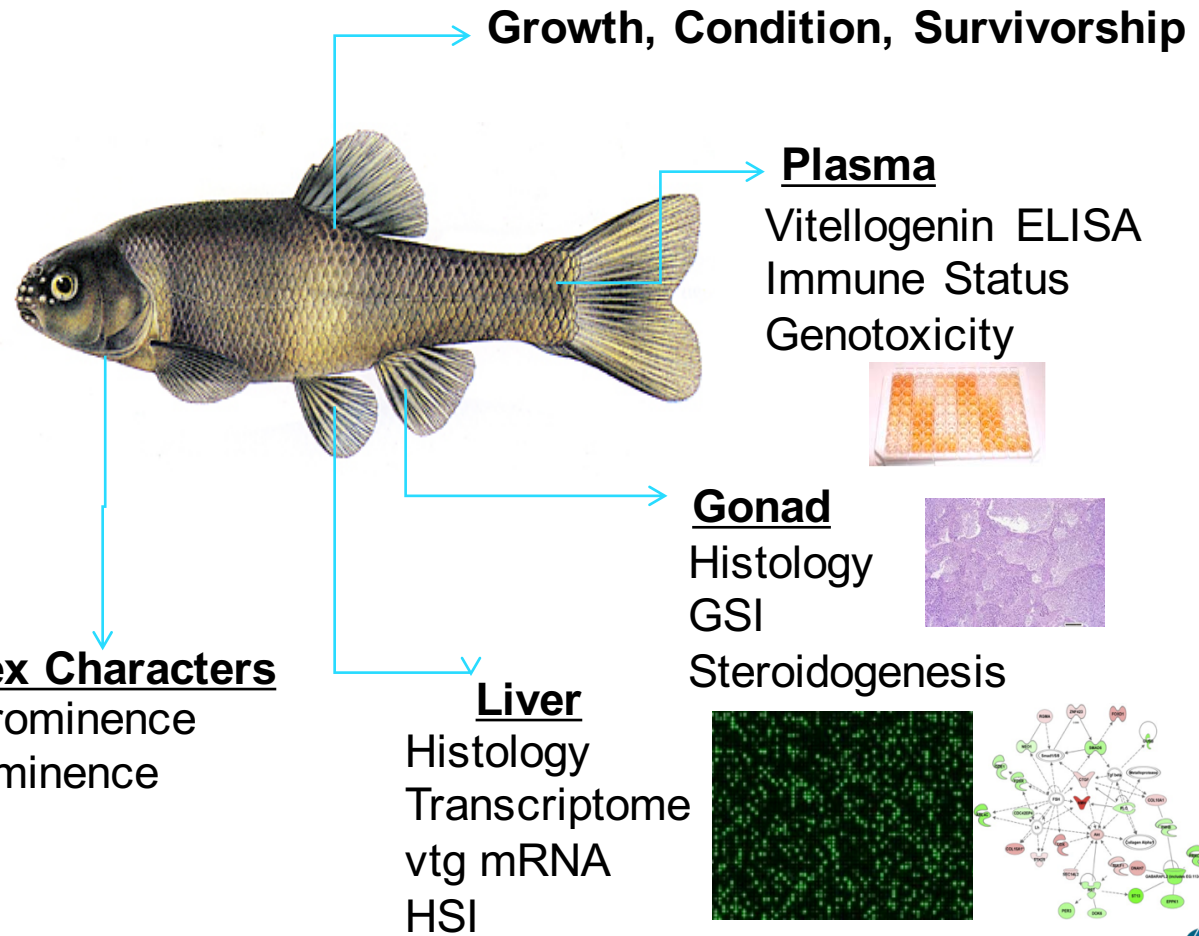# Transport of PFASs at Joint Base Cape Cod reflects different sources

(Weber et al, ES&T, 2017)

Precursors are transporting with PFAAs

Ongoing work: fish mobile laboratory

Growth, Condition, Survivorship

Plasma
Vitellogenin ELISA
Immune Status
Genotoxicity

Gonad
Histology
GSI
Steroidogenesis

Secondary Sex Characters
Nuptial tubercle #/prominence
Dorsal fat pad prominence

Liver
Histology
Transcriptome
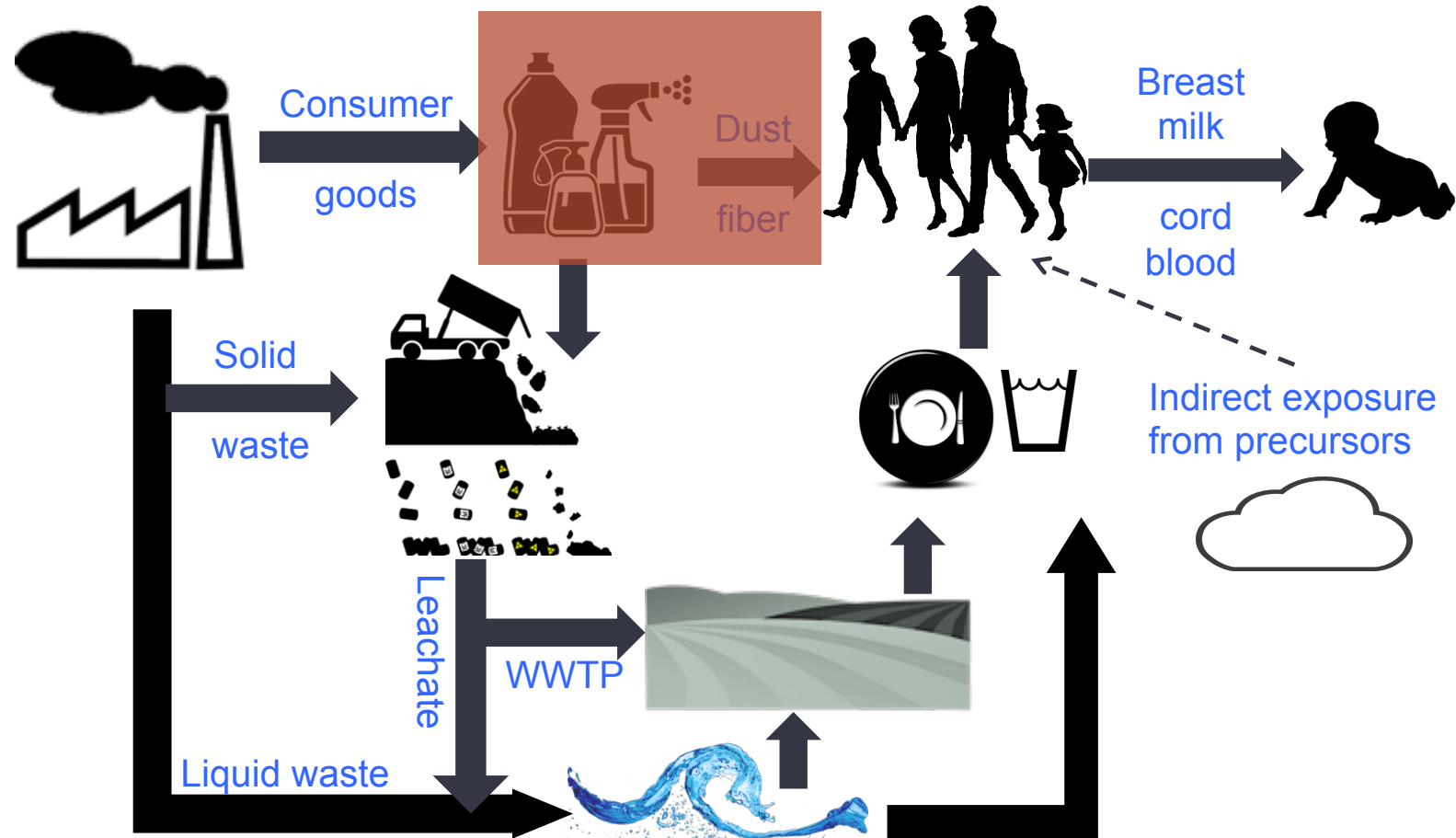vtg mRNA
HSI

How are humans exposed to PFASs?

Different exposure pathways respond to regulations over different time scale

Environmental sources become increasingly important

Shifting Global Exposures to Poly- and Perfluoroalkyl Substances (PFASs) Evident in Longitudinal Birth Cohorts from a Seafood-Consuming Population
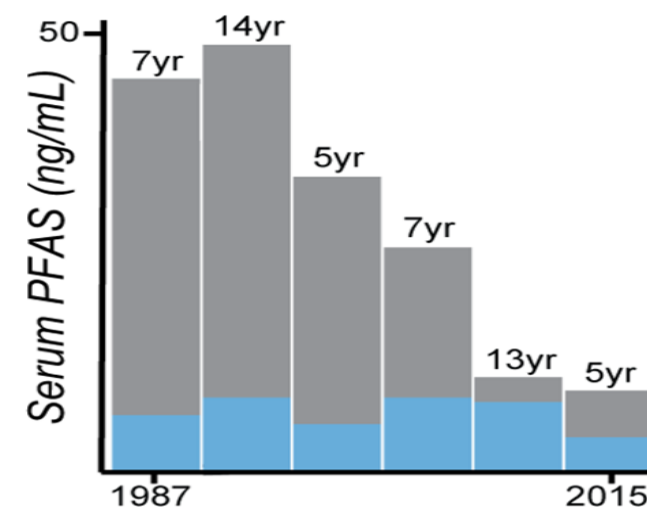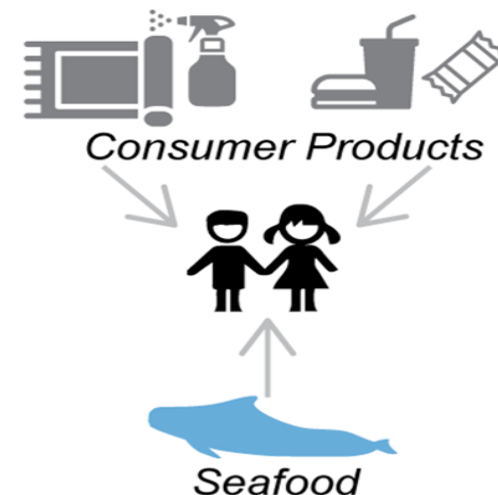
Clifton Dassuncao,[*,†,‡] Xindi C. Hu,[†,‡] Flemming Nielsen,[§] Pál Weihe,[‖] Philippe Grandjean,[†,§] and Elsie M. Sunderland[†,‡]

[†]Harvard T. H. Chan School of Public Health, Boston, Massachusetts 02215, United States
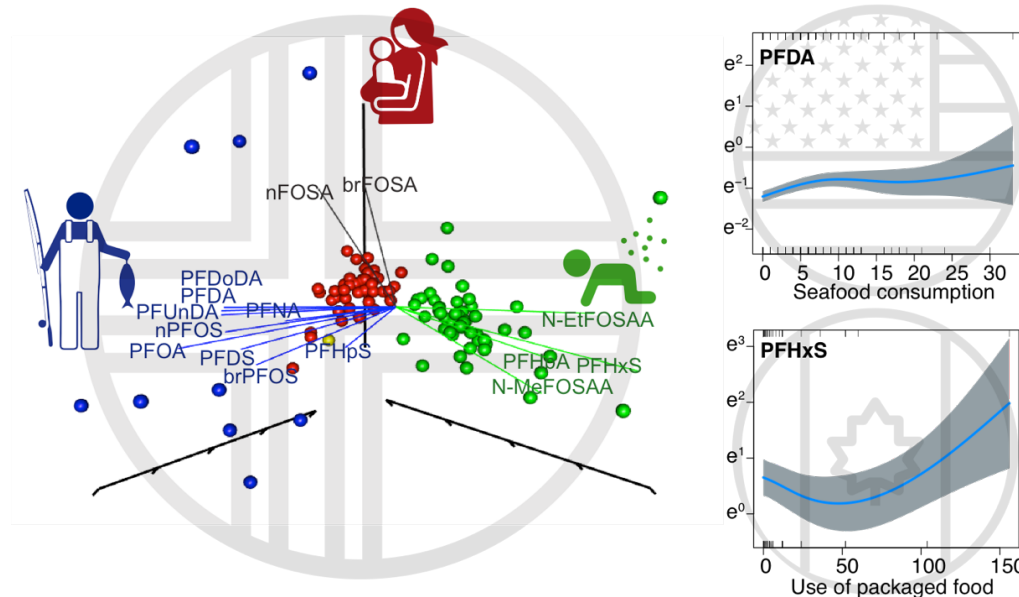[‡]Harvard John A. Paulson School of Engineering and Applied Sciences, Cambridge, Massachusetts 02138, United States
[§]University of Southern Denmark, DK-5000 Odense, Denmark
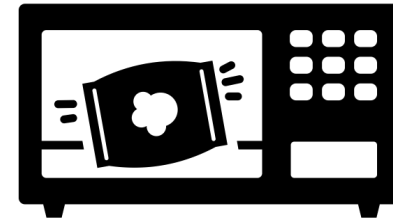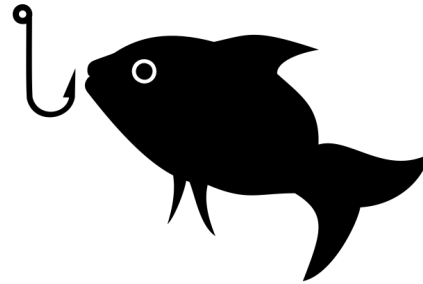[‖]The Faroese Hospital System, FR-100 Tórshavn, Faroe Islands

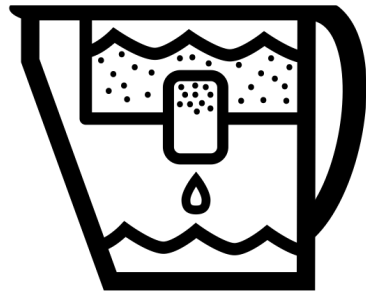# PFAS serum profiles can inform major exposure sources

(Hu et al, Environmental Health, 2018)

- Candidate tracers for marine foods are long-chain PFCAs with C>=9 and for consumer products are PFHxS, N-EtFOSAA.

- This methodology can be made more quantitative with development such as:
  - Expansion of analyte list to identify unique tracers
  - Extractable organic fluorine for total PFASs mass balance calculations

How can you reduce exposure?

Is your drinking water contaminated? (More in CEC presentation)	Avoid eating contaminated fish	Some consumer products may still have PFASs

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