UNESCO-IWRA ONLINE CONFERENCE
17-19 JANUARY 2023
3RD IN THE IWRA ONLINE CONFERENCE SERIES

Emerging Pollutants: Protecting Water Quality for the Health of People and the Environment

Assessing forever chemicals in South Florida aquatic environments and potential environmental and human health risks

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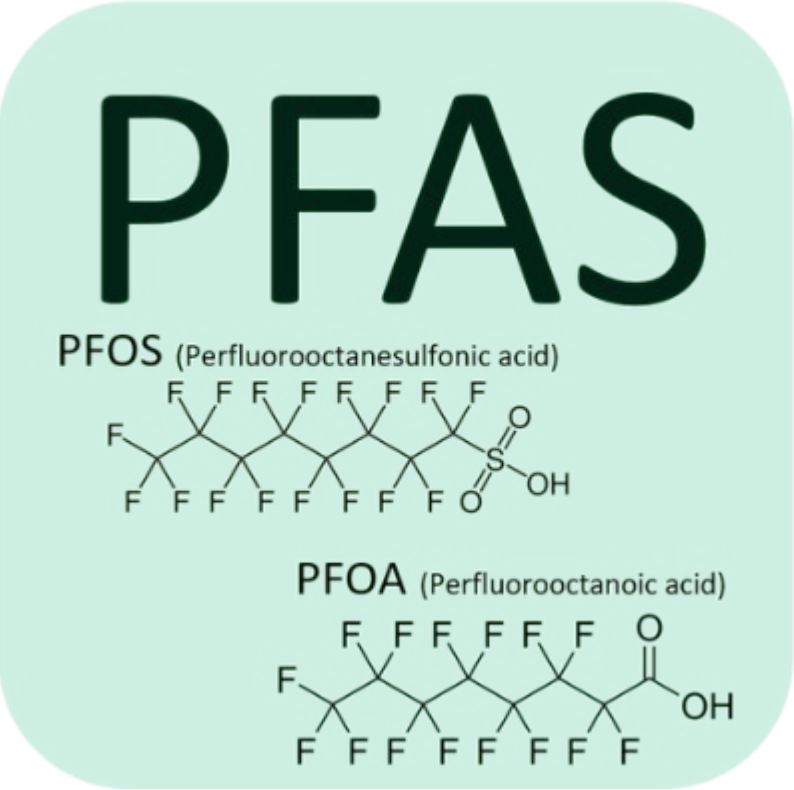
unesco
Programme hydrologique intergouvernemental

IWRA International Water Resources Association

Poly- and Perfluoroalkyl substances (PFAS)

- Synthetized over 60 years ago
- C-F bond stability → ubiquitous presence in the environment and humans.
- Hydrophobic/hydrophilic →Preferential binding to proteins.
- Alternative compounds are still per or polyfluorinated



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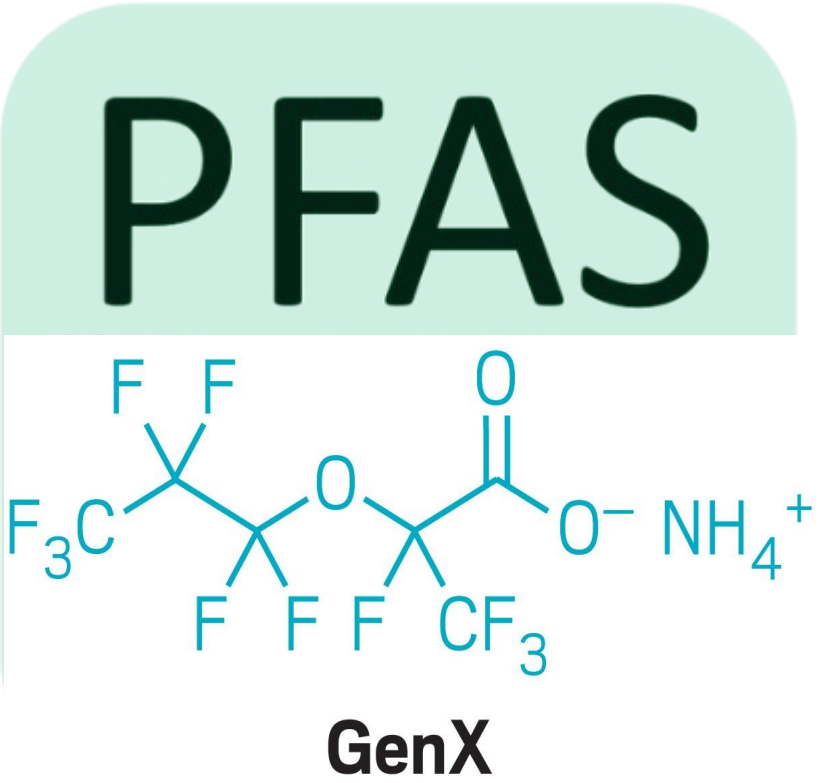


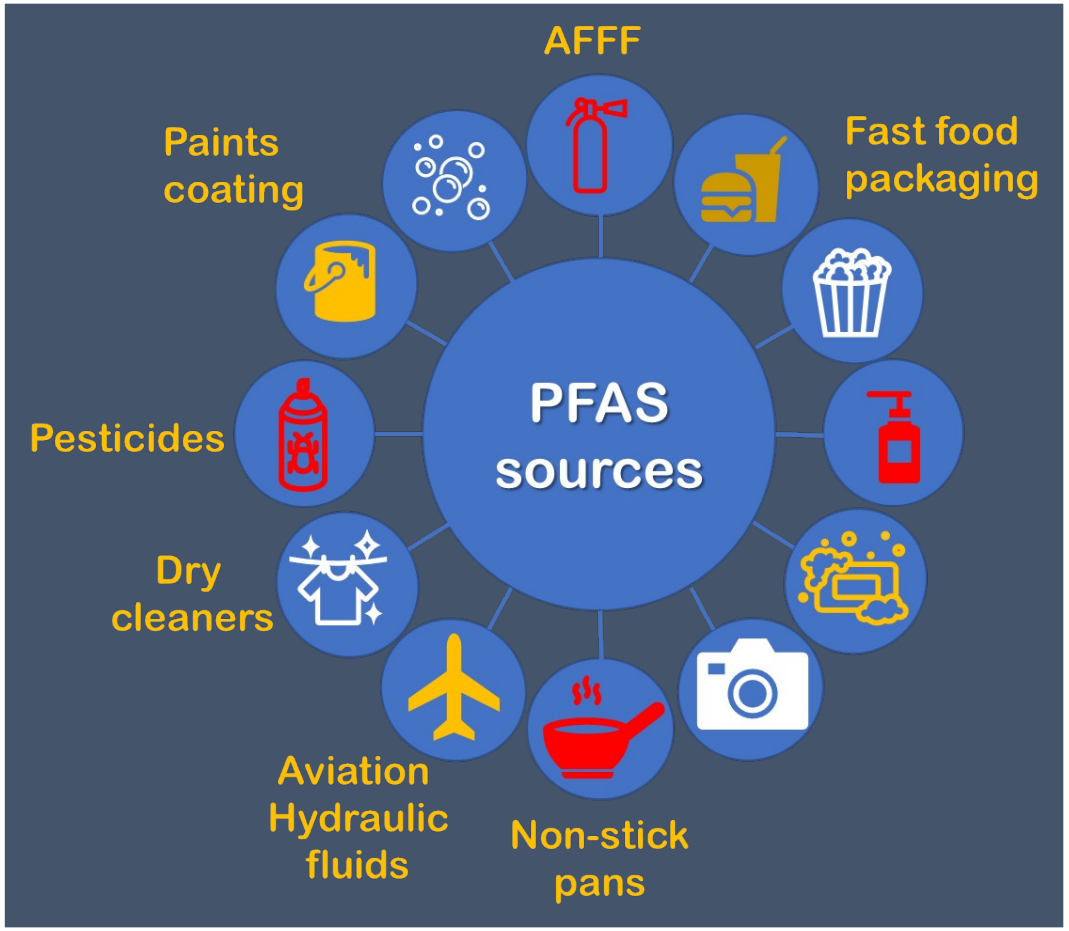
Sources of PFAS

- Used on different applications
- Show adverse health effects to animals and humans (potential carcinogenic).

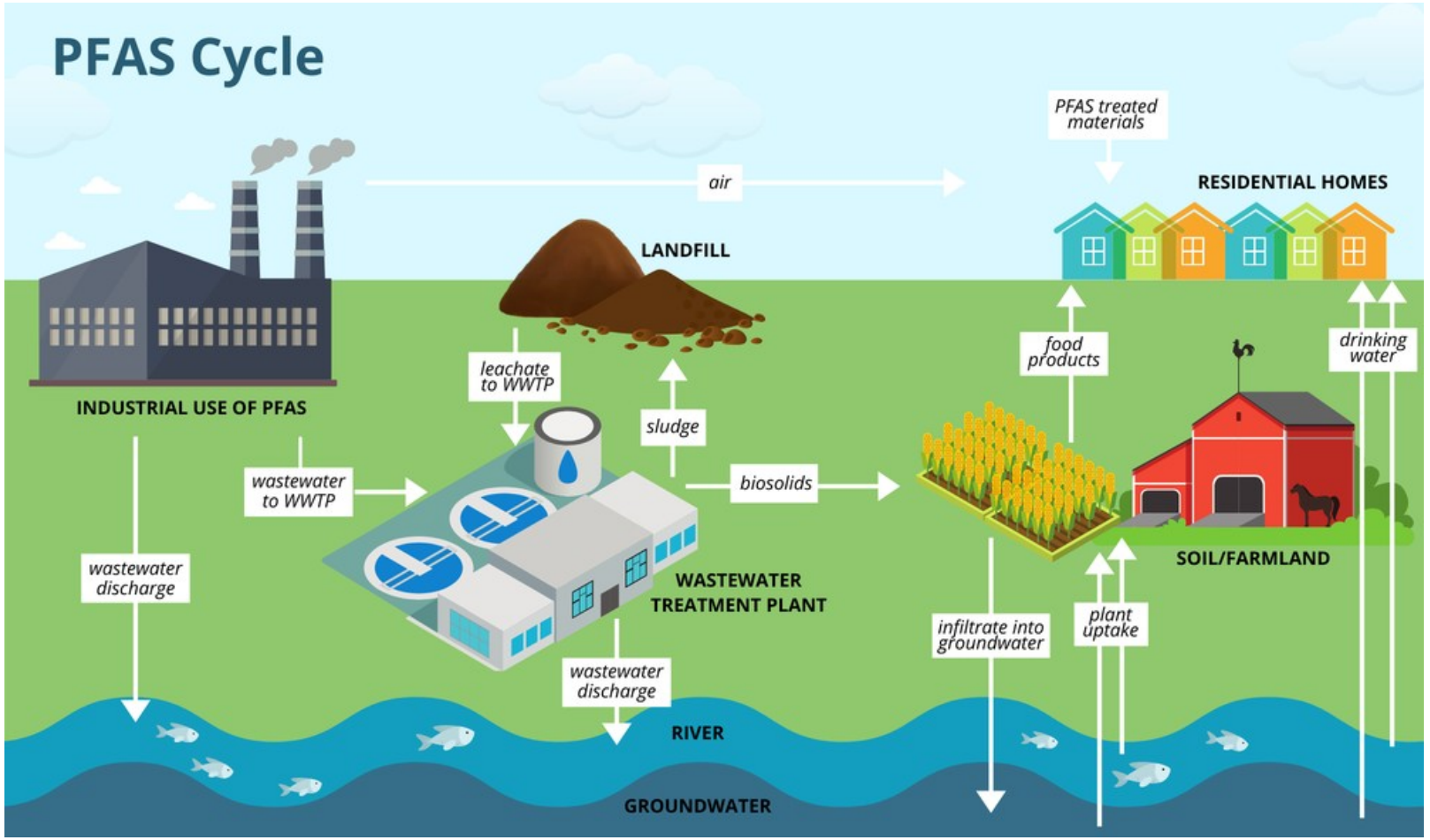
kidney & testicular cancer

infertility & low birth weight

thyroid & heart issues



PFAS transport in the environment



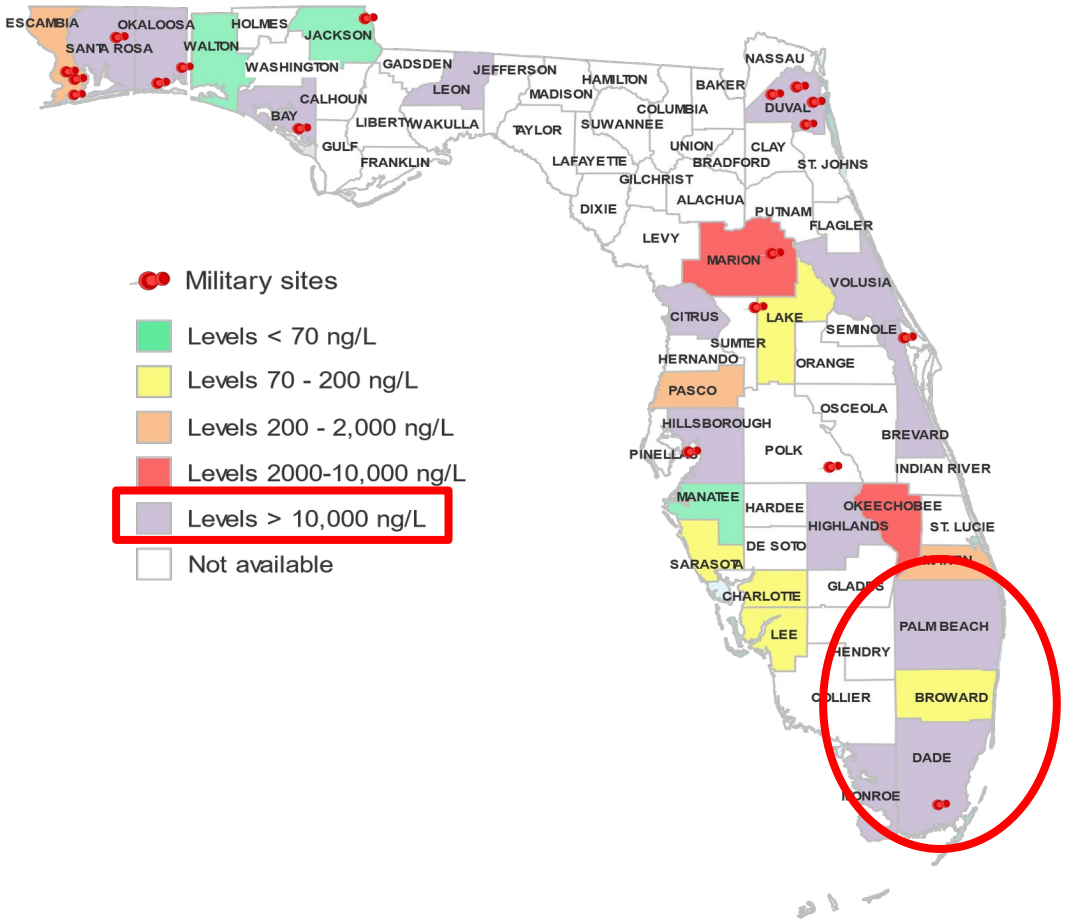
2016:
EPA health advisory guidelines for
PFOA+PFOS= 70 ng/L

2022:
Recently released health advisory guidelines for
PFOA=0.004 ng/L
PFOS=0.02 ng/L
PFBS=2000 ng/L
GenX=10 ng/L

https://www.publichealthmdc.com/environmental-health/environmental-hazards/pfas/pfas-in-madison-dane-county

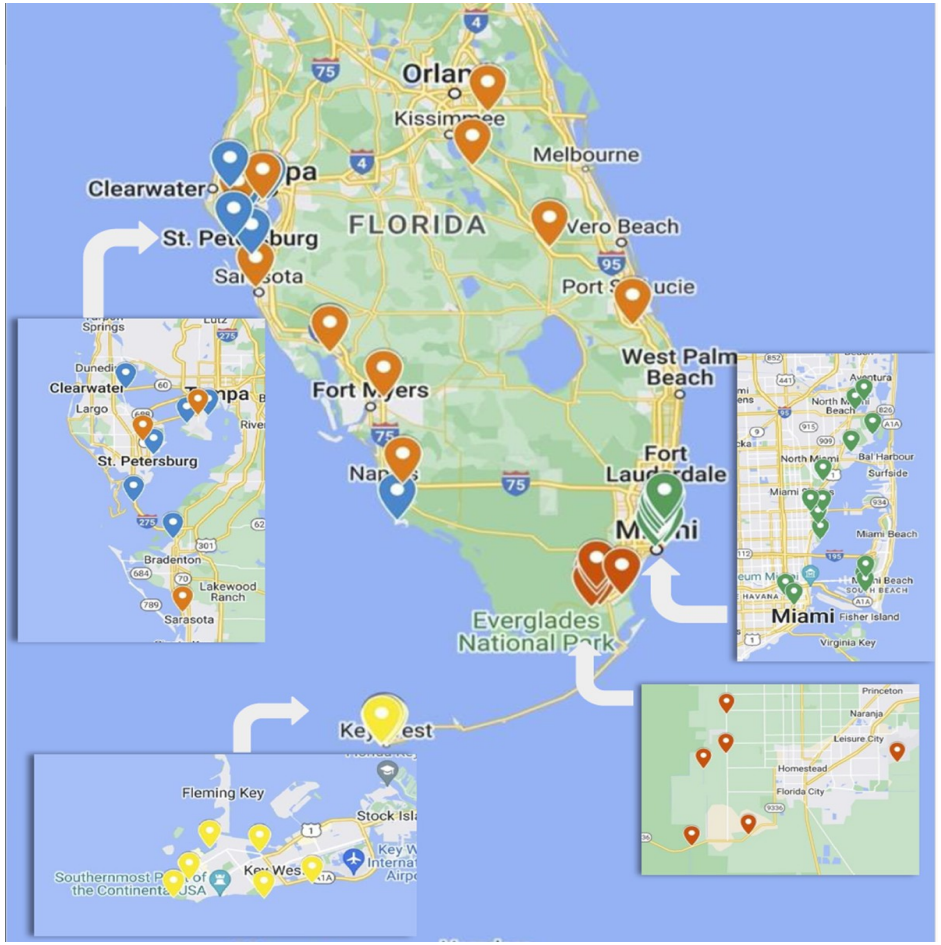
Study objectives

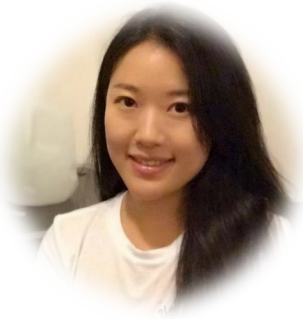
- Lack of knowledge on occurrence, composition, distribution, and sources of PFAS pollution in South Florida.
- Limited information on emerging short-chain PFAS
- There is a need to understand contributions to the aquatic environment and human health risks



Sampling

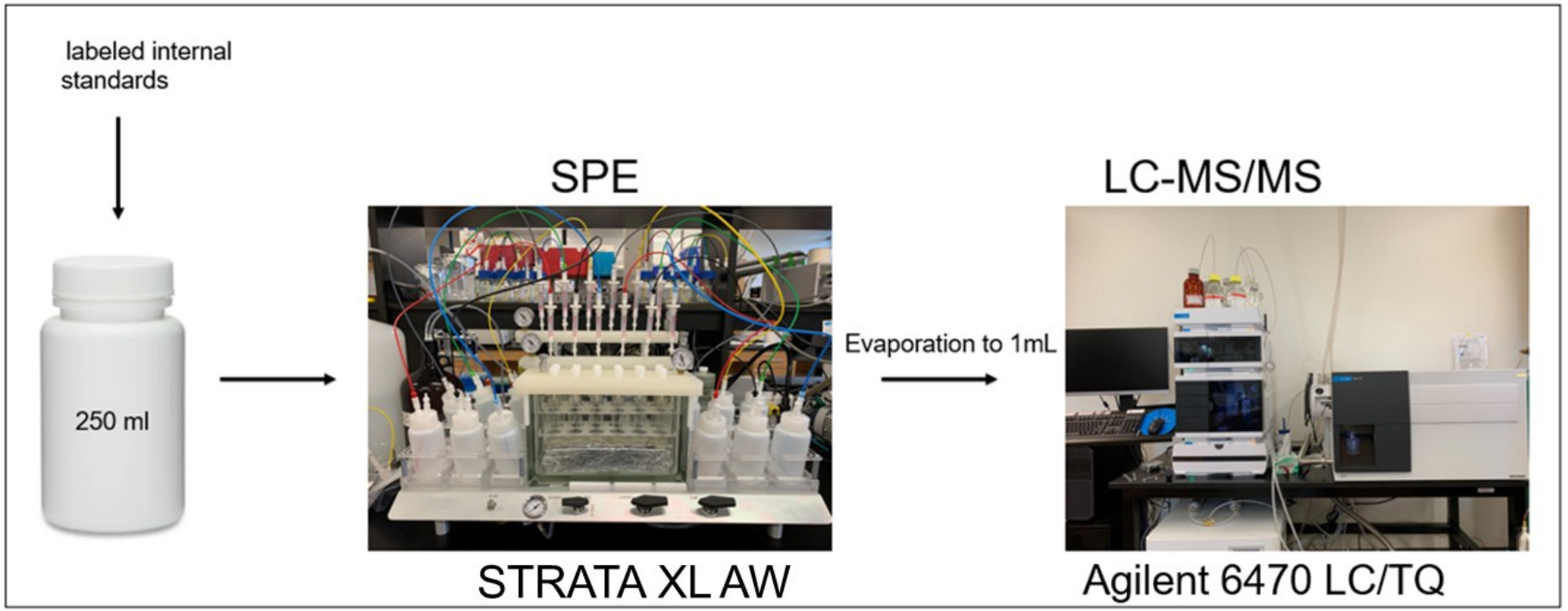
- Tampa Bay surface water
- Biscayne Bay surface water
- ENP surface water
- Key West surface water
- Tap water





Methodology- Water samples

EPA method 537.1 and 1633
Target method development: SPE followed by LC-MS/MS method



Workflow of PFAS determination from sample preparation to analysis

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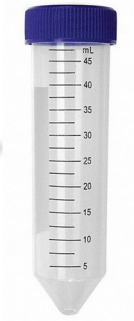
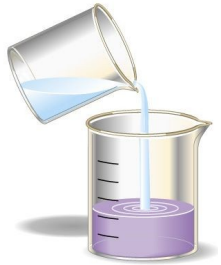
Methodology- Biota samples





+ IS, NS [spiked BLK] &

5 to 20 mL of MeOH:KOH

HOMOGENIZATION

(speed 4)

CENTRIFUGATION

(4500 rpm, 10 min)

2X

EVAPORATION

CLEAN-UP

+ 100 mg Florisil

+ 50 mg graphitized carbon

VORTEX

(2 MIN)

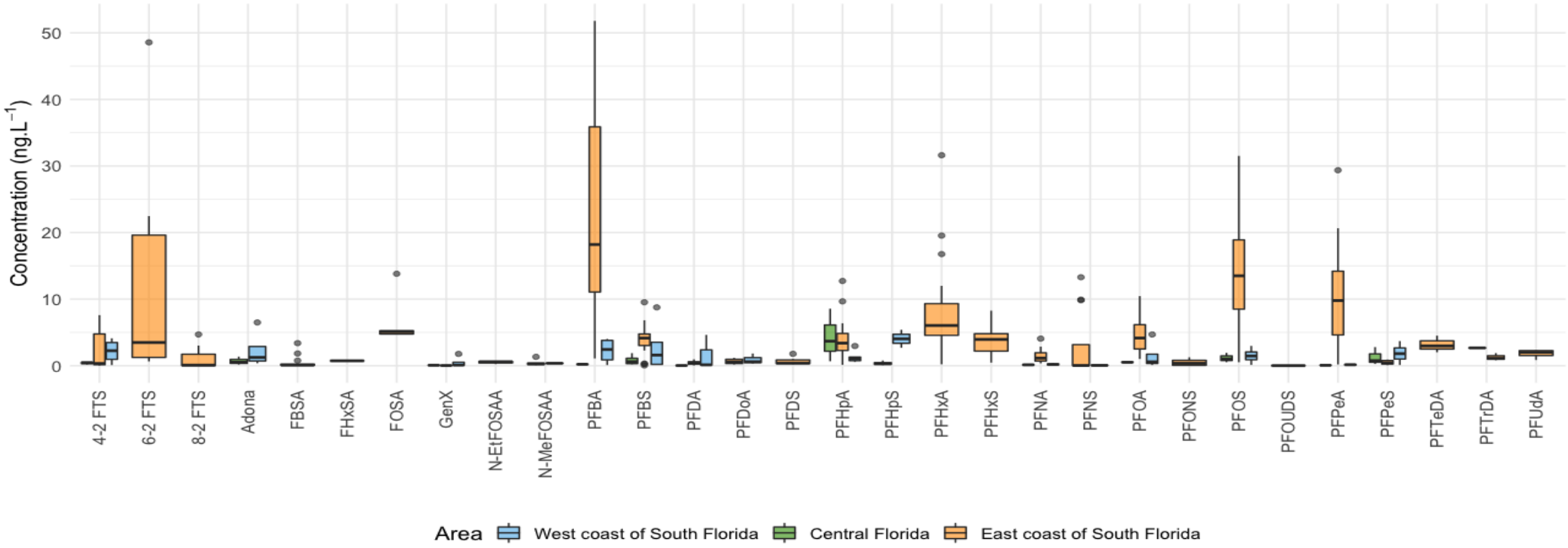
CENTRIFUGATION

(4500 rpm, 10 min)

Syringe-filter system

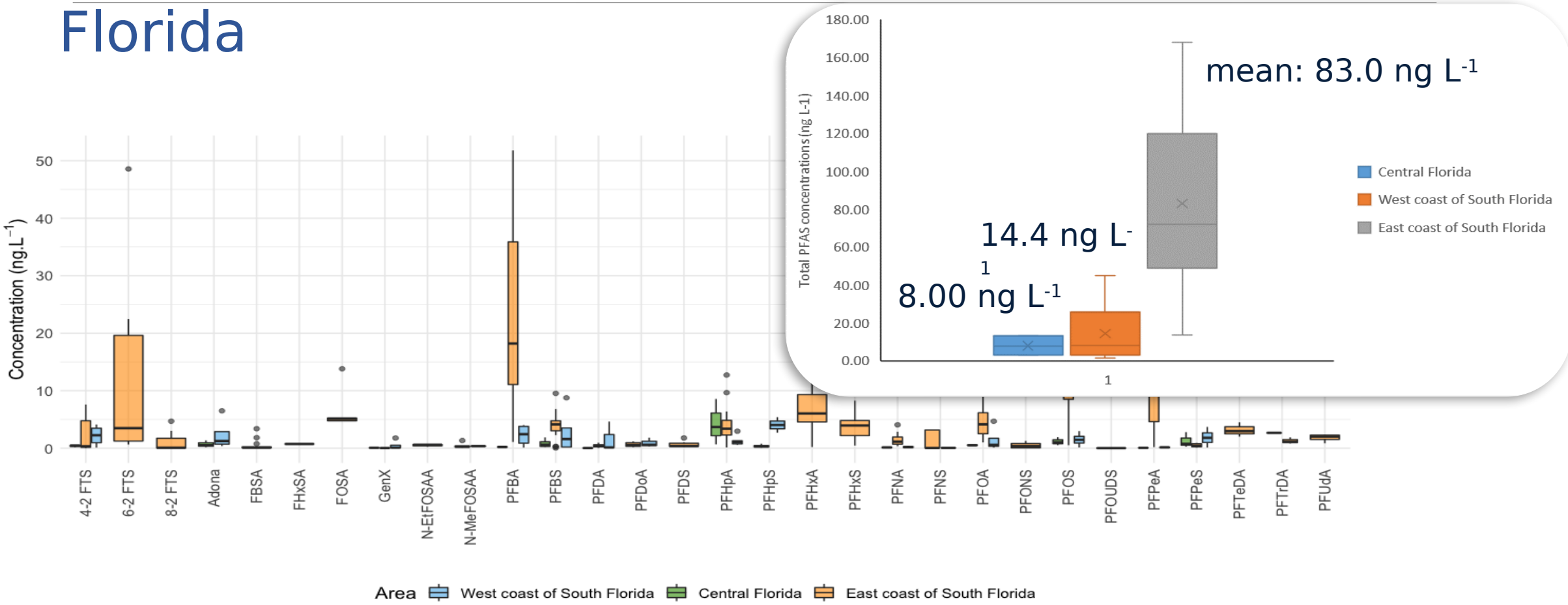
LC-MS/MS

PFAS distribution in tap water in Florida



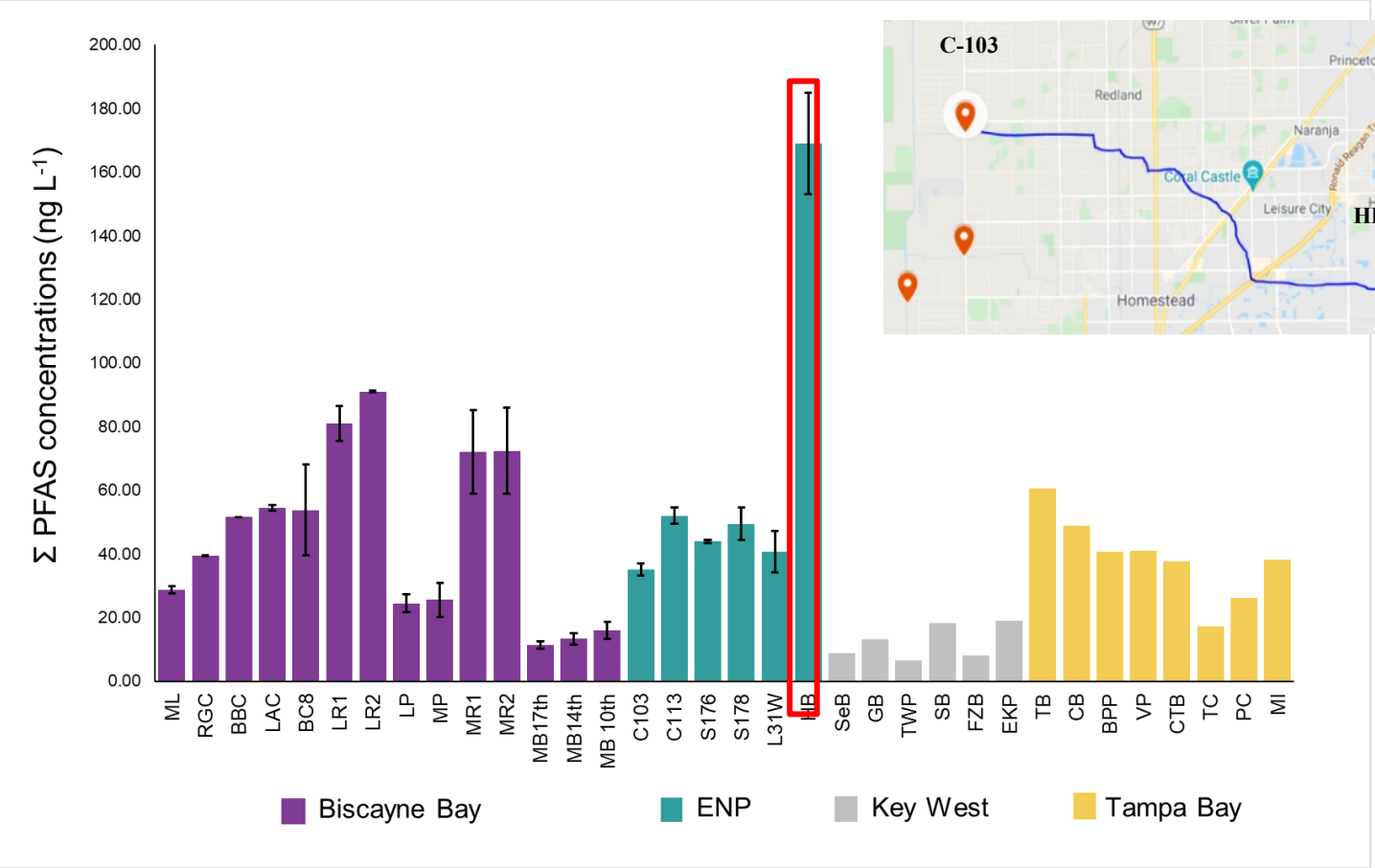
Li et al., 2022. Environ. Sci. Pollut. Res

PFAS distribution in tap water in Florida



Li et al., 2022. Environ. Sci. Pollut. Res

PFAS concentrations in surface waters in Central and South Florida



PFOS was the predominant PFAS in Biscayne Bay: up to 48 ng L^{-1}

FDEP regulated level in saltwater systems: 13 µg L^{-1} of PFOS

Guidelines in Europe, Australia, and New Zealand: 0.23 to 23 ng L^{-1} PFOS) for the purpose of protecting aquatic biota

Li et al., 2022. Environ. Sci. Pollut. Res

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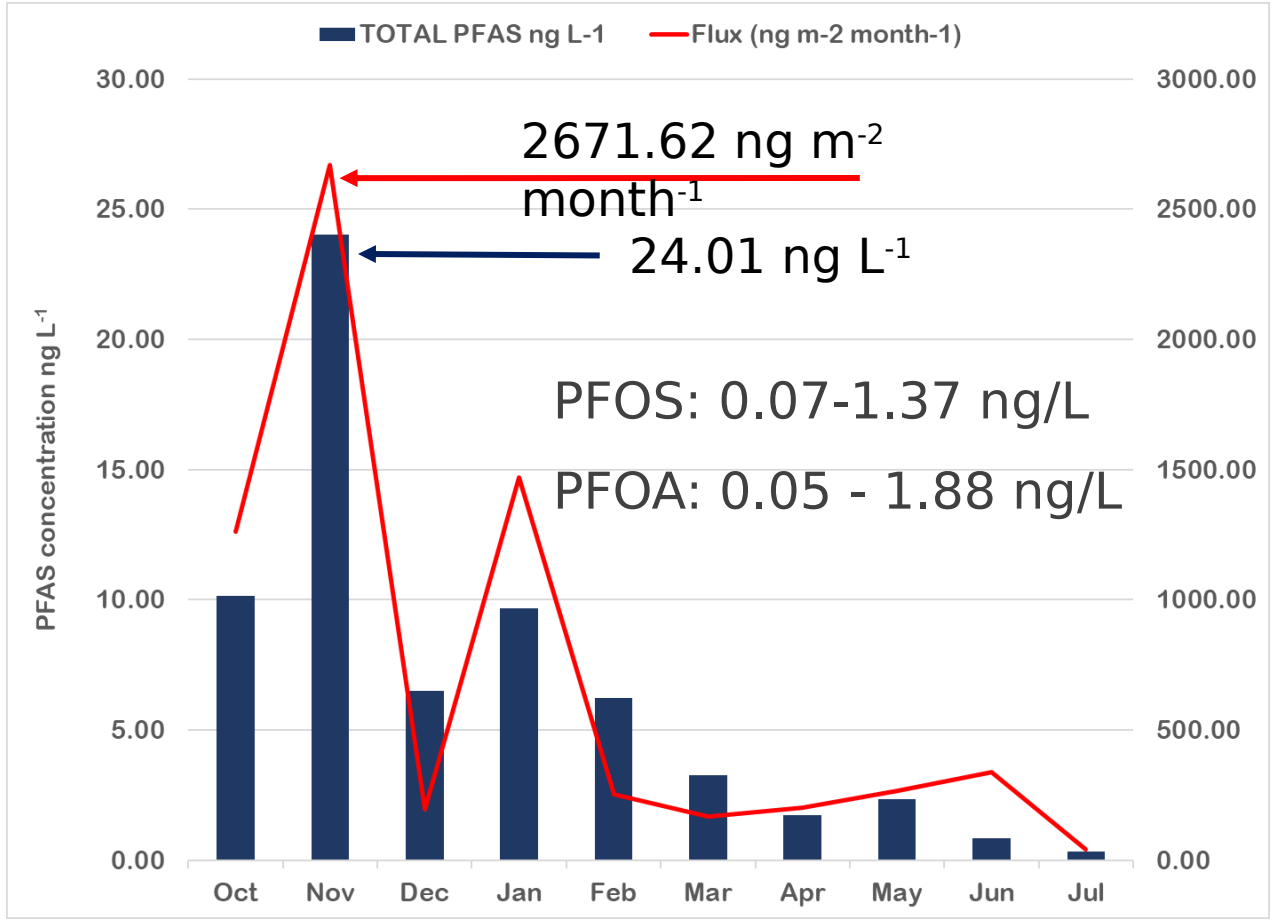
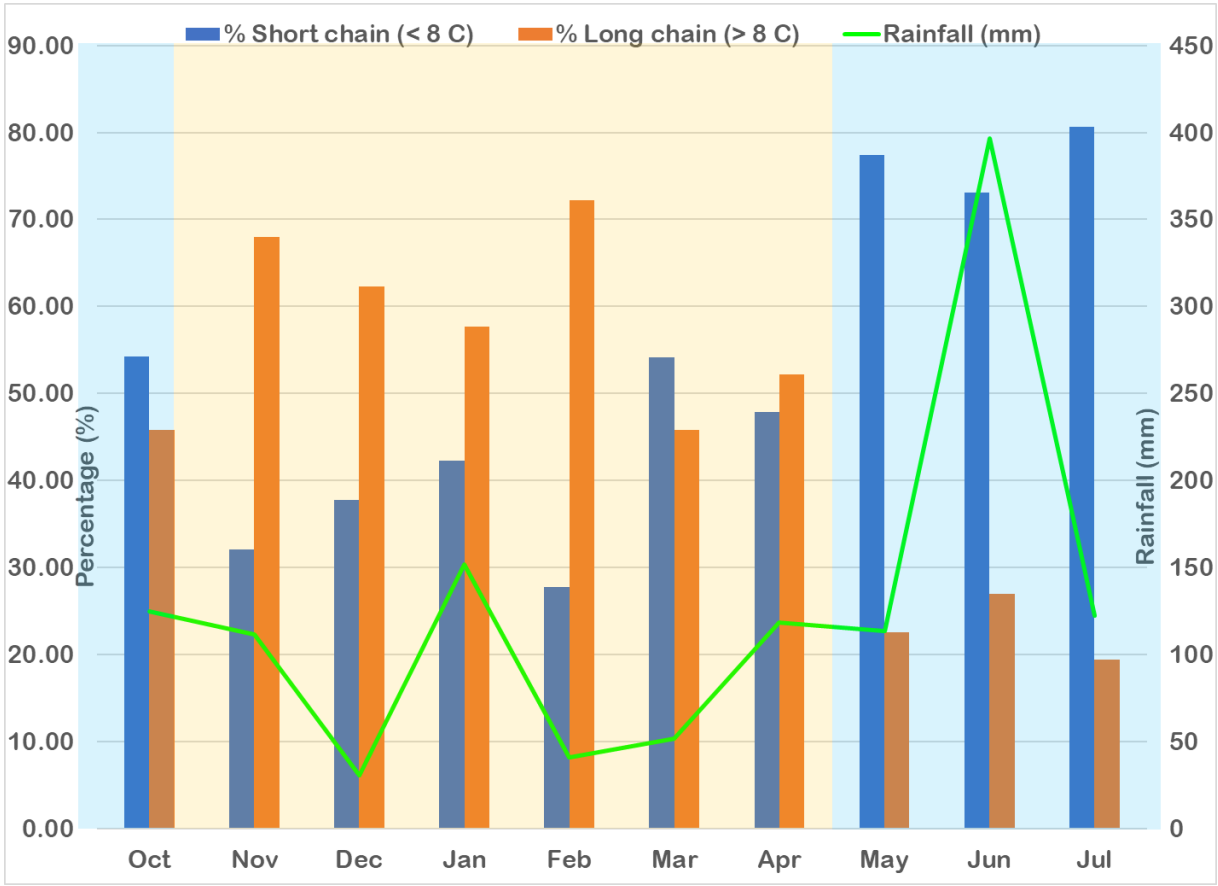
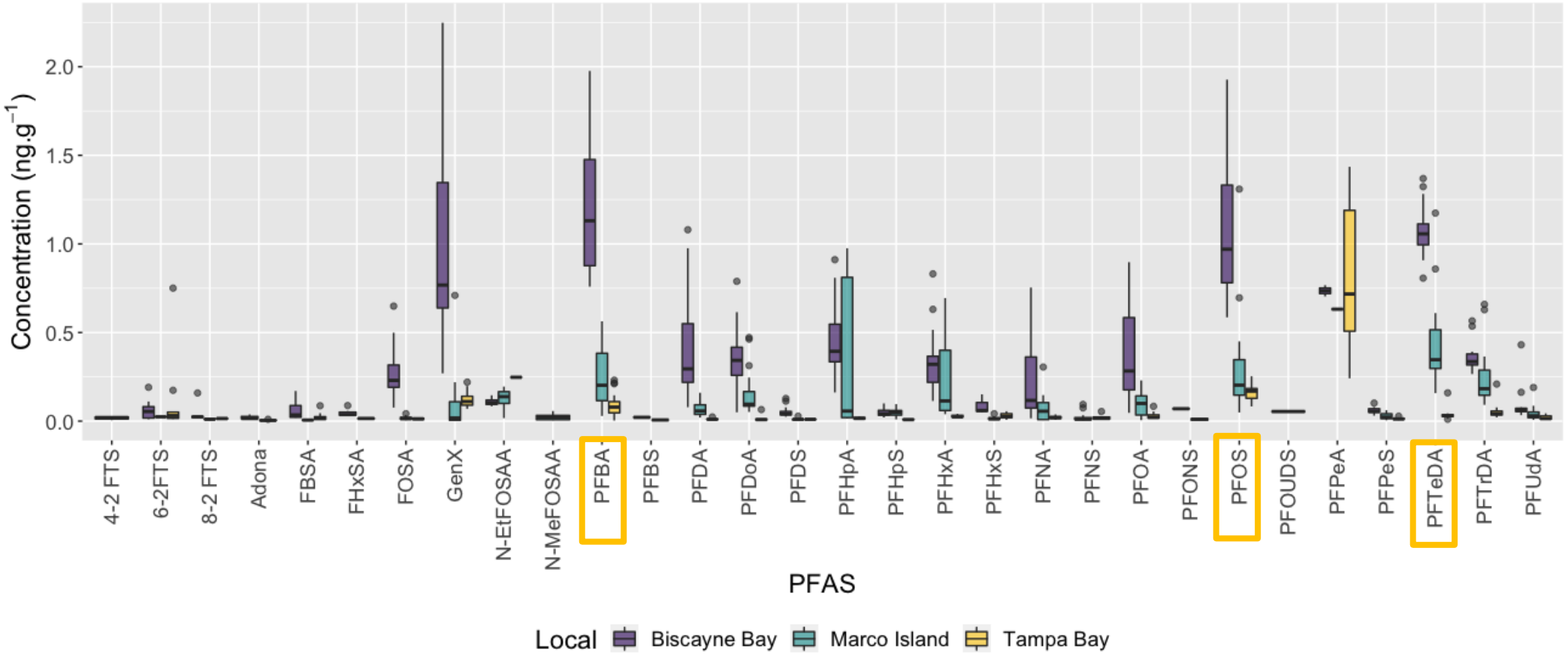
Total PFAS occurrence in Rainwater





What about PFAS in oysters?



Lemos et al., 2022. STOTEN

What about PFAS in oysters?

Tampa Bay > Marco Island > Biscayne Bay

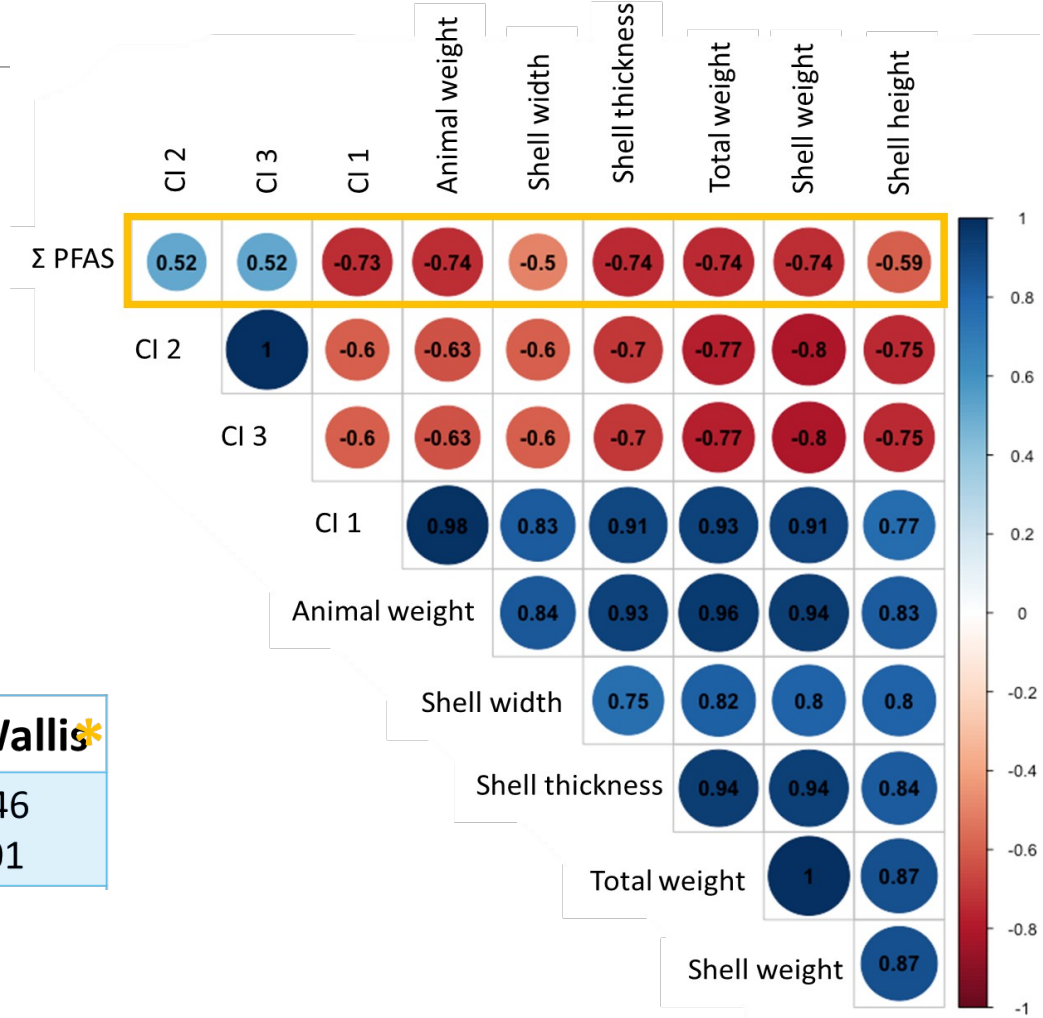
CI 1: [soft tissue wet weight (g)] × [shell height (mm) × 100] $^{-1}$

CI 2: [soft tissue wet weight (g)] × [fresh shell weight (g) × 100]$^{-1}$

CI 3: [soft tissue wet weight (g) x 100] x [total animal fresh weight (g)]$^{-1}$

	Biscayne Bay	Tampa Bay	Marco Island	Kruskal-Wallis*
Mean Σ PFAS	6,963 pg.g^{-1}	1,935 pg.g^{-1}	1,294 pg.g^{-1}	$\chi^2 = 35.46$ $p < 0.001$

* Posthoc - Dunn test: all study sites differ from each other



Risk Assessments considerations

- **Human Health Risk Assessment**

$$EDI = \frac{C_{dw} \times q_{dw}}{m_{bw}} f_{uptake}$$

$$HI = EDI / Rf$$

C_{dw}: concentration of PFAS in water ($ng \cdot L^{-1}$), q_{dw}: daily amount of drinking water consumed per person ($L \cdot day^{-1}$), m_{bw} is the body weight (kg) and F_{uptake}: gastrointestinal uptake fraction

The estimated daily intake of individual PFAS ranged from 0.01 to 2.6 ng/kg∗day

HR > 1 = high risk

HR < 1 = low risk

HI of individual PFAS ranged from 0.01 to 0.86

For total PFAS in drinking water: HI was calculated to be 0.62 (median exposure) or 4.1 (highest exposure)

For oysters: Reference doses available only for PFOA, PFOS, PFHxS and PFNA→ HR < 1 = low risk

Take Away Messages

- The Florida coast has been exposed to PFAS, with Biscayne Bay as the most impacted study site.
- High PFAS concentrations identified close to airports, military airbases, and Biscayne Bay Canal, suggest potential pollution sources.
- We have identified predominant PFAS in tap and surface waters and oysters: PFBA, PFBS, PFPeA, PFHxA, PFHxS, PFOA, PFOS, and PFTeDA.
- The strong negative correlation found between Σ PFAS and weight, shell thickness, and CI 1 may be indicative of oyster development impairment.
- Risk assessment suggests potential human health risks though it should be carefully interpreted due to the lack of available data on the reference dose in the literature.

Acknowledgements

ECC RESEARCH LAB
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