

# The intensifying effects of natural disasters on exposure to endocrine disrupting chemicals (EDCs)

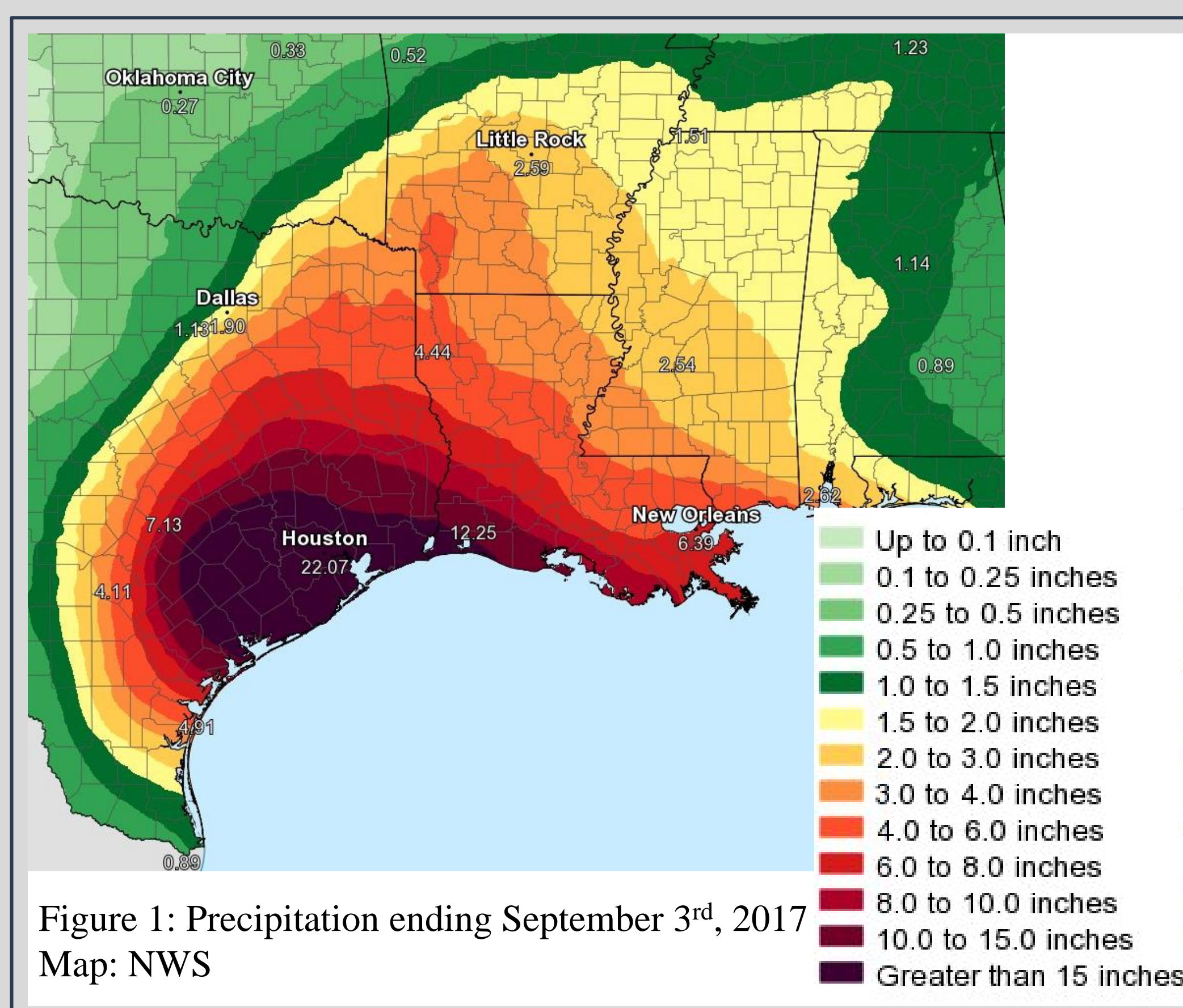
## Hurricane Harvey case study

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### Introduction

**Hurricane Harvey** was a devastating Category 4 hurricane that made landfall on Texas and Louisiana in August 2017, causing catastrophic flooding and more than 100 deaths which caused prolonged period of severe flooding in Houston.

Such incidents can compound natural disaster impacts by increasing exposure risks to various chemicals. This study aims to investigate the population exposure levels of EDCs, including polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and microplastics (MPs) in relation with natural hazard through the case of Hurricane Harvey case and induced landfill sites flooding and spills.



### Materials

**Target PAHs:** 16 EPA priority PAHs including Phenanthrene, Anthracene, and Benzo [a] pyrene.

**Target PCBs:** 42 tri- to nona- PCBs including seven indicator congeners (PCB #28, #52, #101, #118, #138, #153 and #180)

**Target MPs:** 5 major types found in the environment: Polystyrene (PS), Polypropylene (PP), Polyethylene terephthalate (PET), Polymethyl methacrylate (PMMA) and Polycarbonate (PC).

#### Sample extraction and instrumental analysis

- **Used sample volume:** 0.4 mL per class of target compound
- **PAHs:** Digestion, solid phase microextraction (PDMS fiber, 100  $\mu$ m), gas chromatography-mass spectrometry (GC/MS)
- **PCBs:** Digestion, Ultrasonication, Solid phase extraction (HLB, 60 mg, 3 cc), GC/MS analysis
- **Polymers:** Microfiltration (0.7  $\mu$ m size cut off), Single shot Pyrolysis-GC/MS



Figure 2: Sample treatment process (R: SPE, L: Alumina powder clean-up)

### Conclusion

#### PAHs ( $\Sigma$ PAHs: 138–373 ppb)

- Naphthalene and Acenaphthene was most abundant PAHs found in the overall study population whereas Benzo [a] pyrene was never detected.
- Exposed group (Mean: 355.4 ppb) showed slightly higher level of PAHs exposure than non-exposed group (Mean: 180.9 ppb).

#### PCBs ( $\Sigma$ PCBs: 21.6–327 ppb)

- Tri- & tetra- indicator PCBs (#28 & #52) were only detected in exposed group which showed statistical differences.
- Total PCBs concentration showed 3 – 5 times higher in exposed group than non-exposed group.
- Non-ortho or mono-ortho-substituted PCBs (TEF values available “Dioxin-like” 12 PCBs) were not detected in samples.

#### Microplastics (concentration unit: part-per-billion [ppb])

- **PS ( $\Sigma$ PS: 37.13–59.2):** Styrene monomer (33.92–51.28) was the most abundant followed by dimer and trimer.
- **PMMA (34.6–39.1):** Detected in all exposed group samples
- **PET ( $\Sigma$ PET: 82.4–493.2):** Benzene was predominant but without specificity between samples or between groups. Vinyl benzoate is found to be better suitable identifier to assess PET exposure.
- **PC ( $\Sigma$ PC: 116.9–252):** *p*-ethyl phenol > *p*-cresol > others
- Total MPs concentration range: 294 – 840 ppb.

#### Preliminary statistical analyses

- Mild association between distance from exposure sources (confirmed flooded sites) and EDCs' concentration levels.
- Socioeconomic parameters such as education less than high school or lower household income (< \$35000) were weakly related to the pattern of direct impact by the Hurricane Harvey among residents

#### Comparison with previous reports and other studies

- **PAHs & PCBs:** Bera et al., (2019) analyzed PAHs and PCBs in soil collected from Houston residential neighbourhood and found total PAHs ranged from 1,310  $\mu$ g/kg to 85,700  $\mu$ g/kg (Mean: 12,600  $\mu$ g/kg) and PCBs ranged from 5.9–88.5  $\mu$ g/kg (Mean: 27.7  $\mu$ g/kg).
- **Microplastics:** Leslie et al., (2022) reported the detection of PET, PS and PE in majority of their tested human whole blood samples (e.g., 17 out of 22 samples) with maximum concentration observed at 2.4 ppm, 4.8 ppm and 7.1 ppm, respectively.

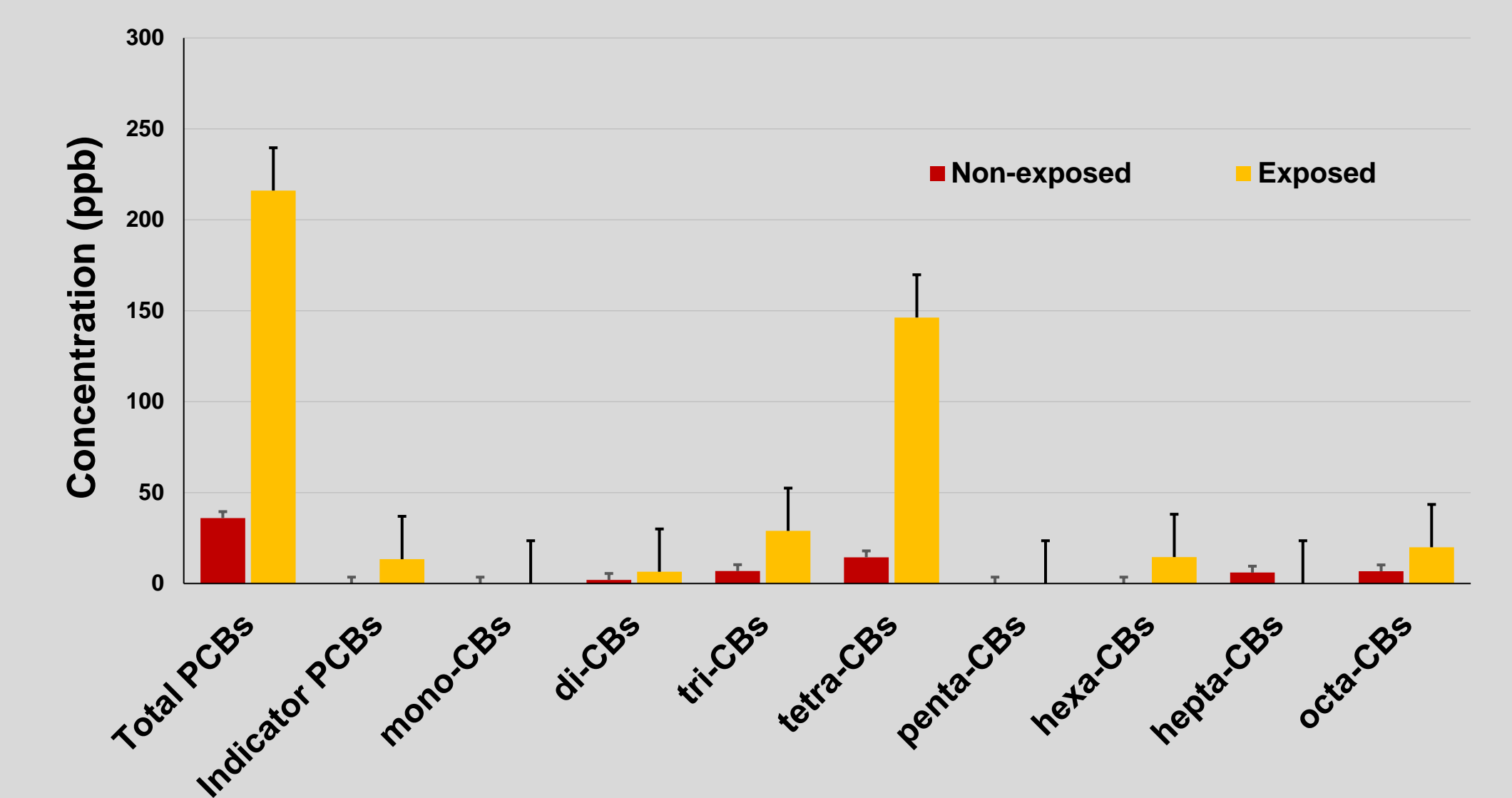


Figure 4: Detected concentration levels of PCBs between exposed and non-exposed group

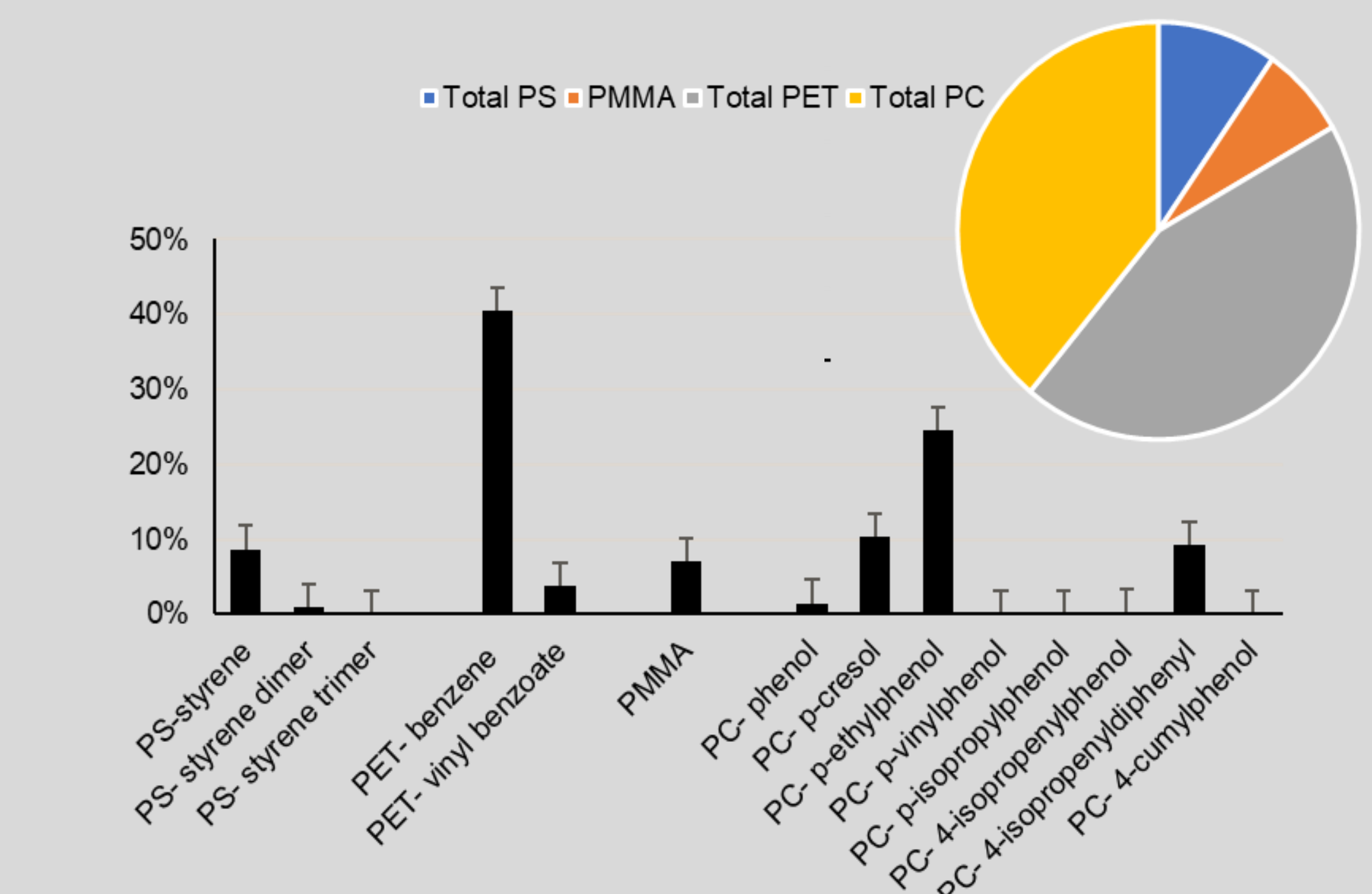
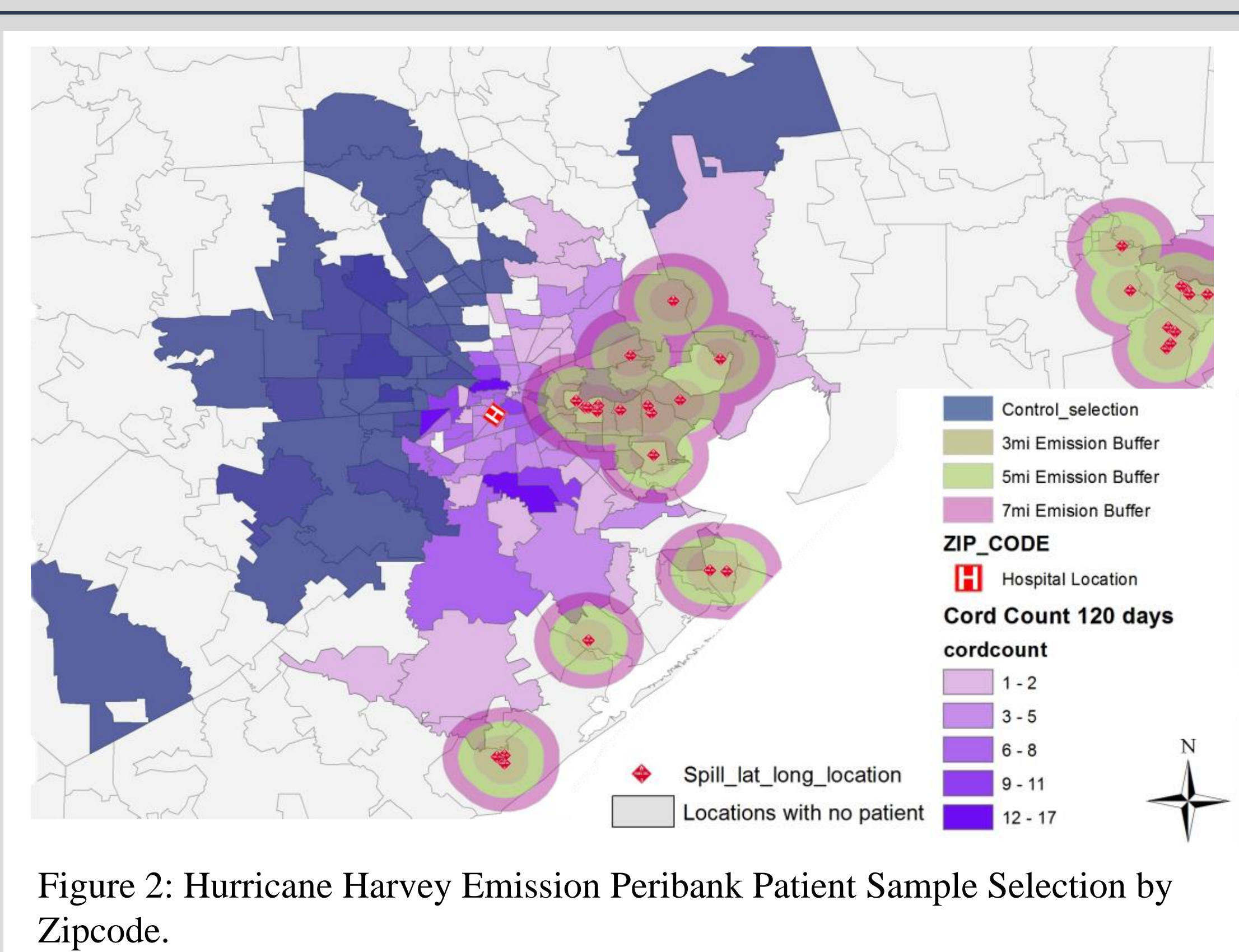


Figure 5: Average compositional profile of microplastics detected in human whole blood

### Study Design and Population Characteristics

- **Source:** Peri Bank, Baylor College of Medicine (BCM)
- **Study region:** Houston metropolitan area and suburbs
- **Donors:** Pregnant women
- **Matrix:** Whole blood (2 mL, n=60)
- **Collection strategy:** Based on zip code, survey
- **Study design:**
  - Exposed (3-7 miles radius from exposure source, n=30)
  - Non-exposed (> 7 miles away from exposure source, n=30)
- **Exposure source:** Superfund sites and spill landfill sites
- **Demographic characteristics:**
  - 92% aged 20 to 40 at delivery
  - 50% white, 40% African American.
  - 40% had a college or university degree



### Acknowledgements

This work was made possible by Research Enhancement Program award from UTA. We would like to thank the anonymous volunteer blood donors, staffs from Baylor College of Medicine and collaborators in Texas A&M Toxicology department team for providing archived blood specimen along with surveyed questionnaires for our study.

### References

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