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Air Toxics: Some thoughts on what we might be missing

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Challenges in assessment of exposure and risk from air toxics

- The number of recognized air toxics – 189 EPA-listed HAPS
- The number of non-listed compounds with potential toxicity – e.g. PFAS
- Measurement challenges
- Individually low concentrations, but potential interactions and cumulative risk not clearly understood
- Not just cancer risk - many chronic and potentially acute non-cancer risks.
- Preventing and responding to accidental high-level releases are a whole other series of challenges

Some general considerations about cancer risk

- According to NCI about 40% of people will get cancer in their lifetimes

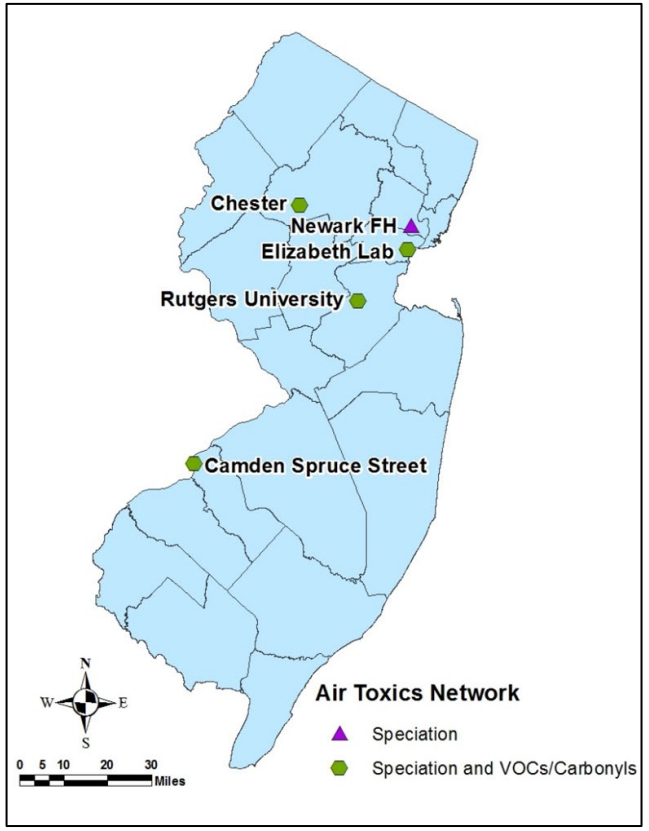
  4 in 10 = 400,000 in a million

- Cancer risk from several HAPs are relatively quite low, but exceed the NJDEP benchmark of one-in-a-million lifetime cancer risk
- Cancer risk from diesel particulate matter ranges up to about 500 per million in some parts of the state for diesel particles

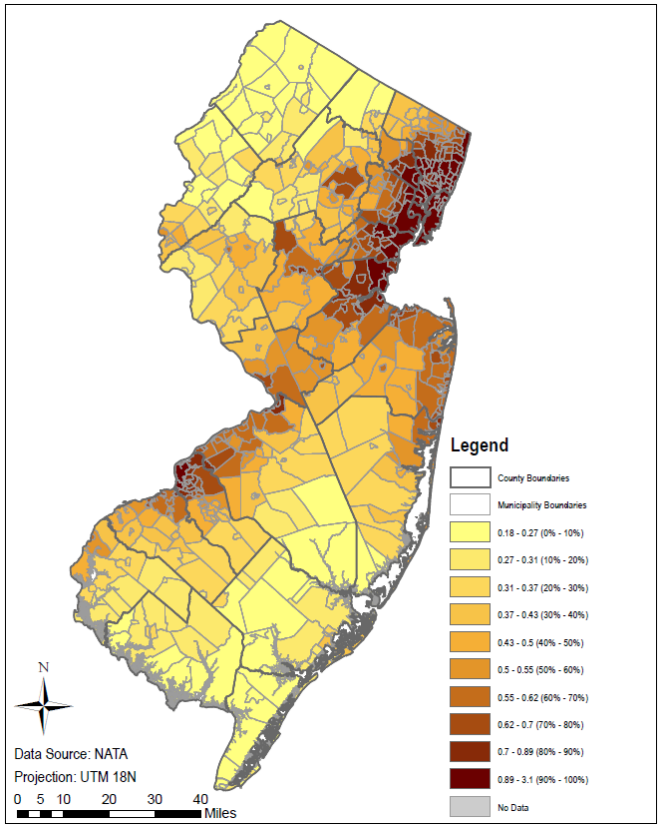
  500 in a million = 1 in 2,000 = 0.05%

- But the same compound may cause cancer at other sites as well as non-cancer health effects.
- And, of course, there are many cancer-causing compounds: we generally assume additivity
- Regardless of the true absolute risk, air toxics is clearly an Environmental Justice issue

Characterizing exposure and risk from HAPs



Central site measurement



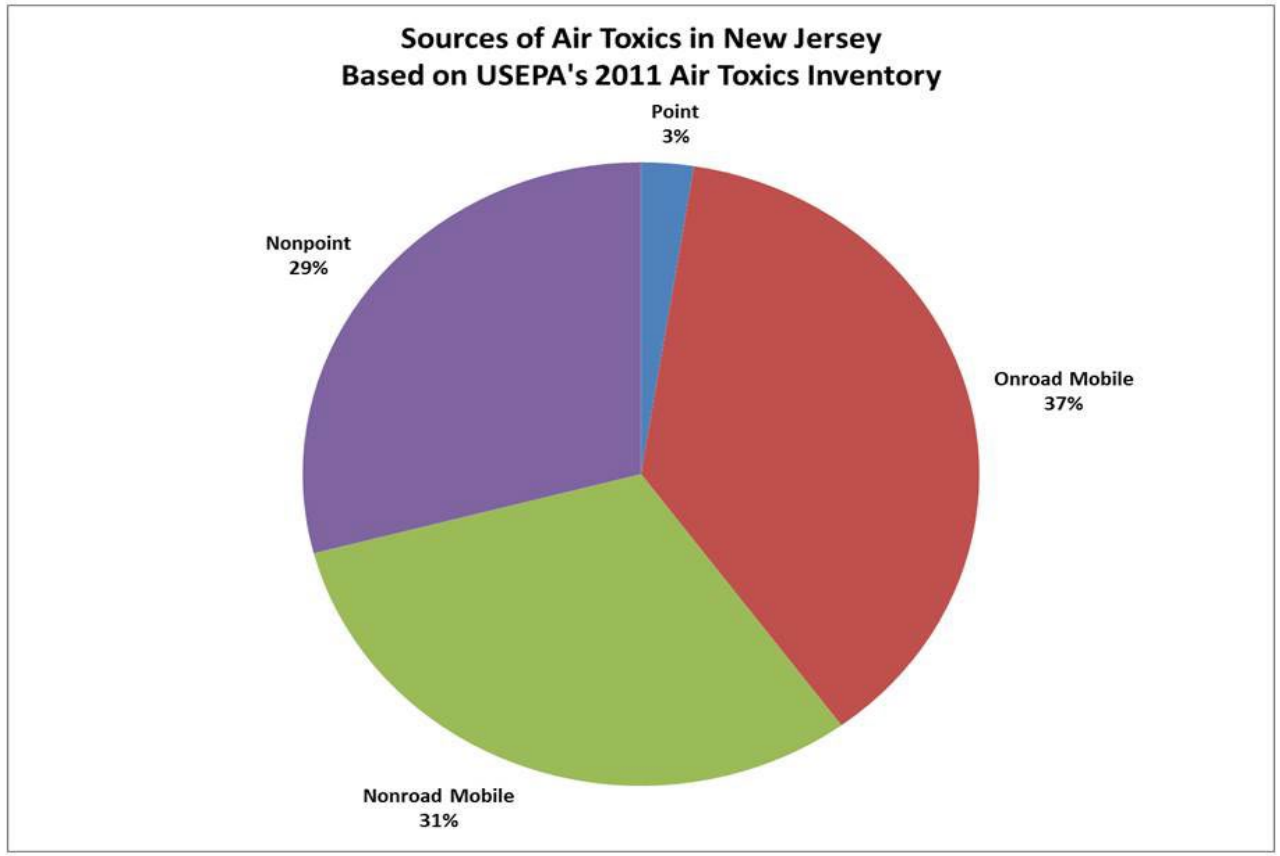
2014 NATA DPM

Modeling

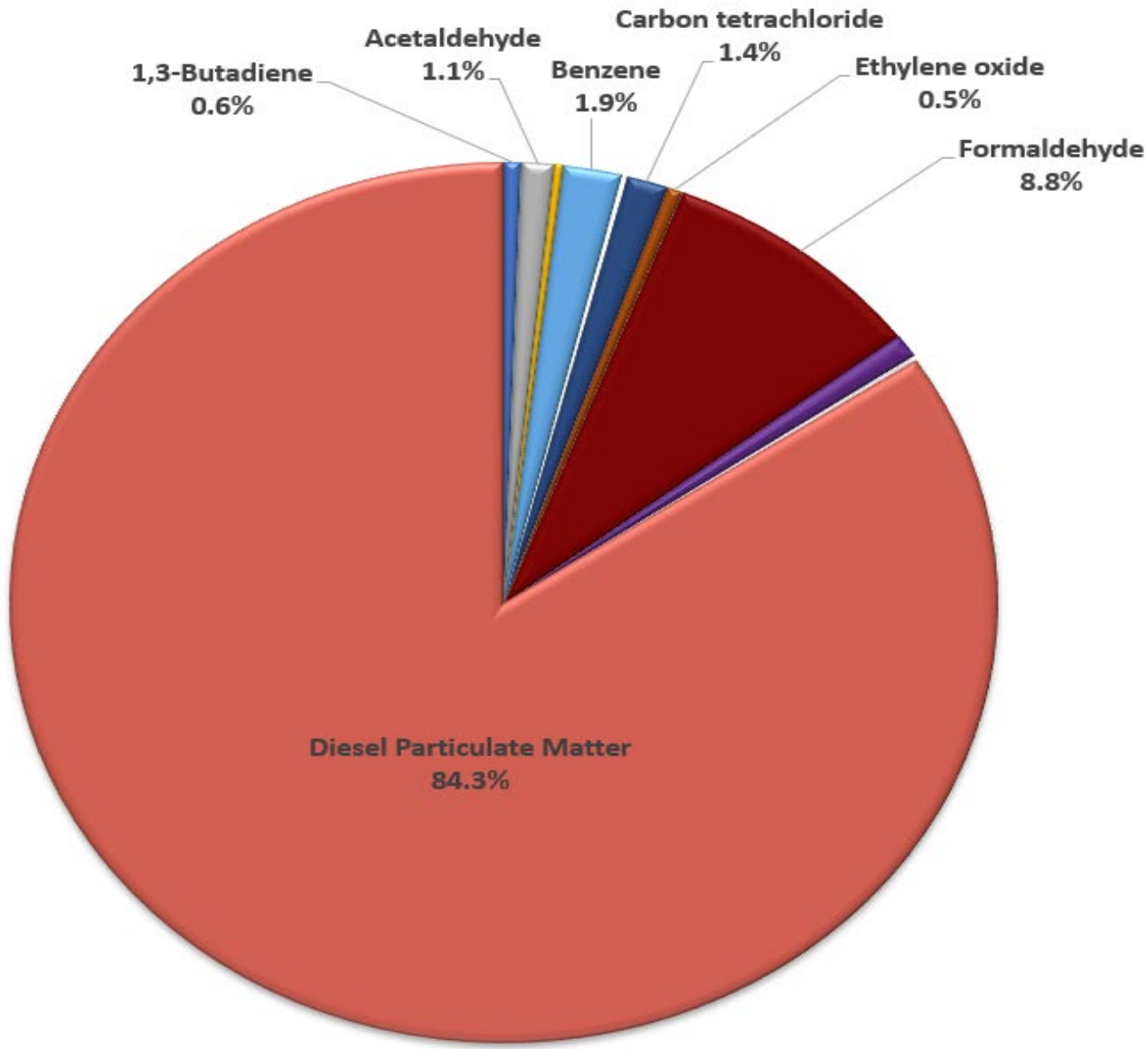
- More central sites?
- Local monitoring at potential hotspot locations (fence-line?)?
- Distributed, low-cost monitor networks?
- Stationary and/or mobile?
- Personal measurements?

A closer look at diesel particulate matter, benzene and formaldehyde

- The top 3 known contributors to air toxics cancer risk in NJ
- Mostly arising from mobile sources: on-road and non-road

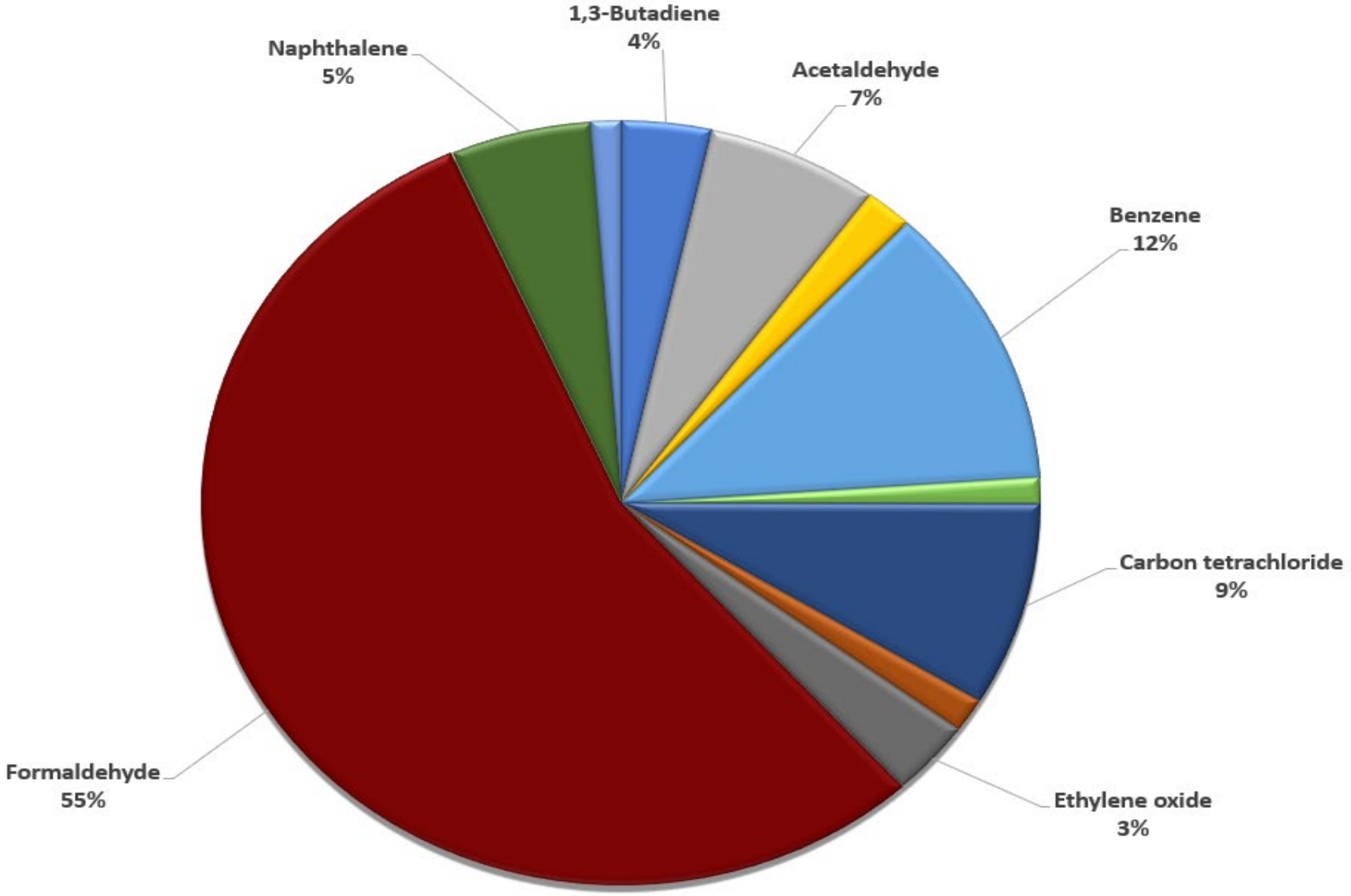


2018 AirToxScreen Pollutant Contribution to Cancer Risk for New Jersey

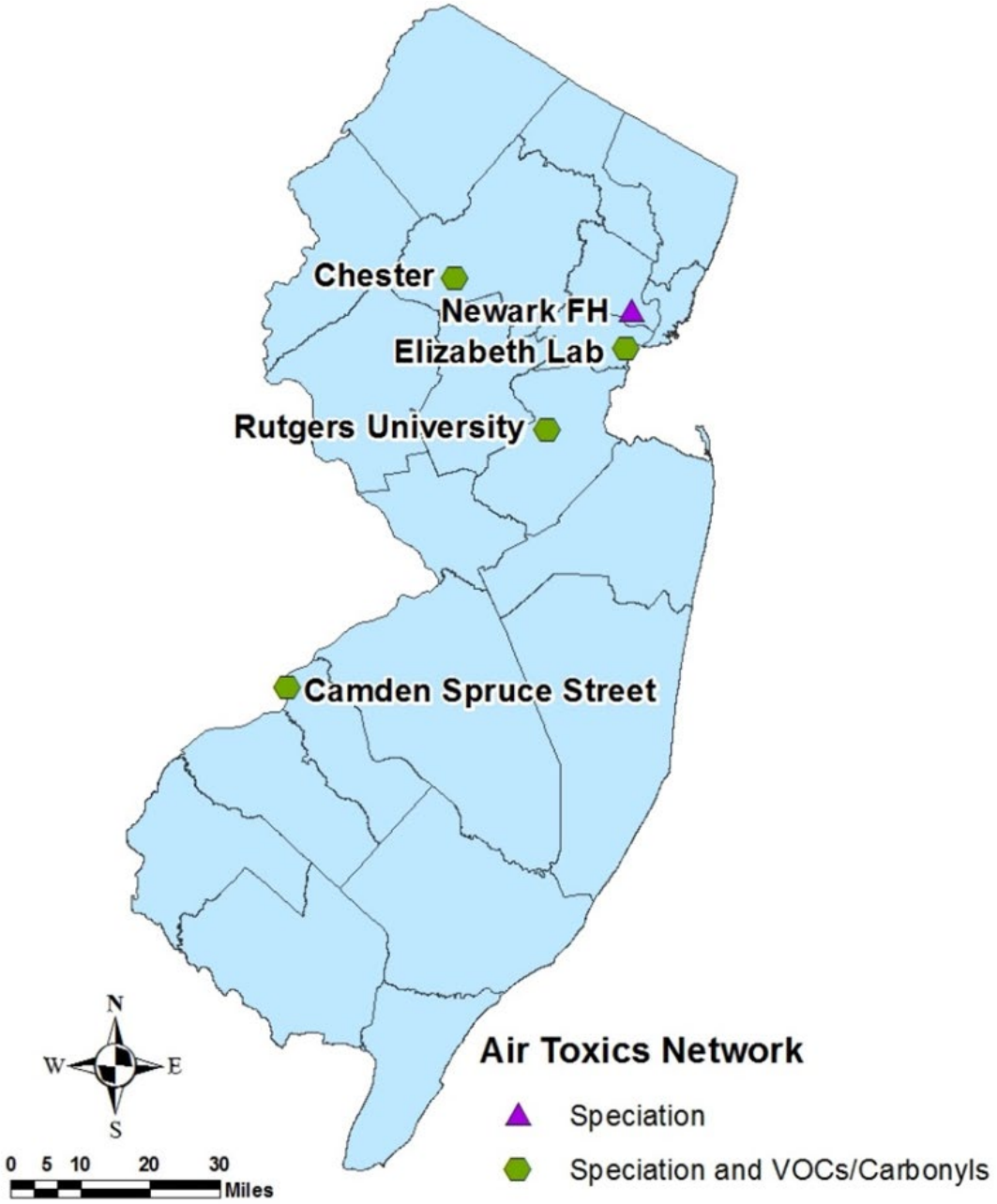


NJDEP

2018 AirToxScreen Pollutant Contribution to Cancer Risk without Diesel



NJDEP


Chester
Newark FH
Elizabeth Lab
Rutgers University
Camden Spruce Street
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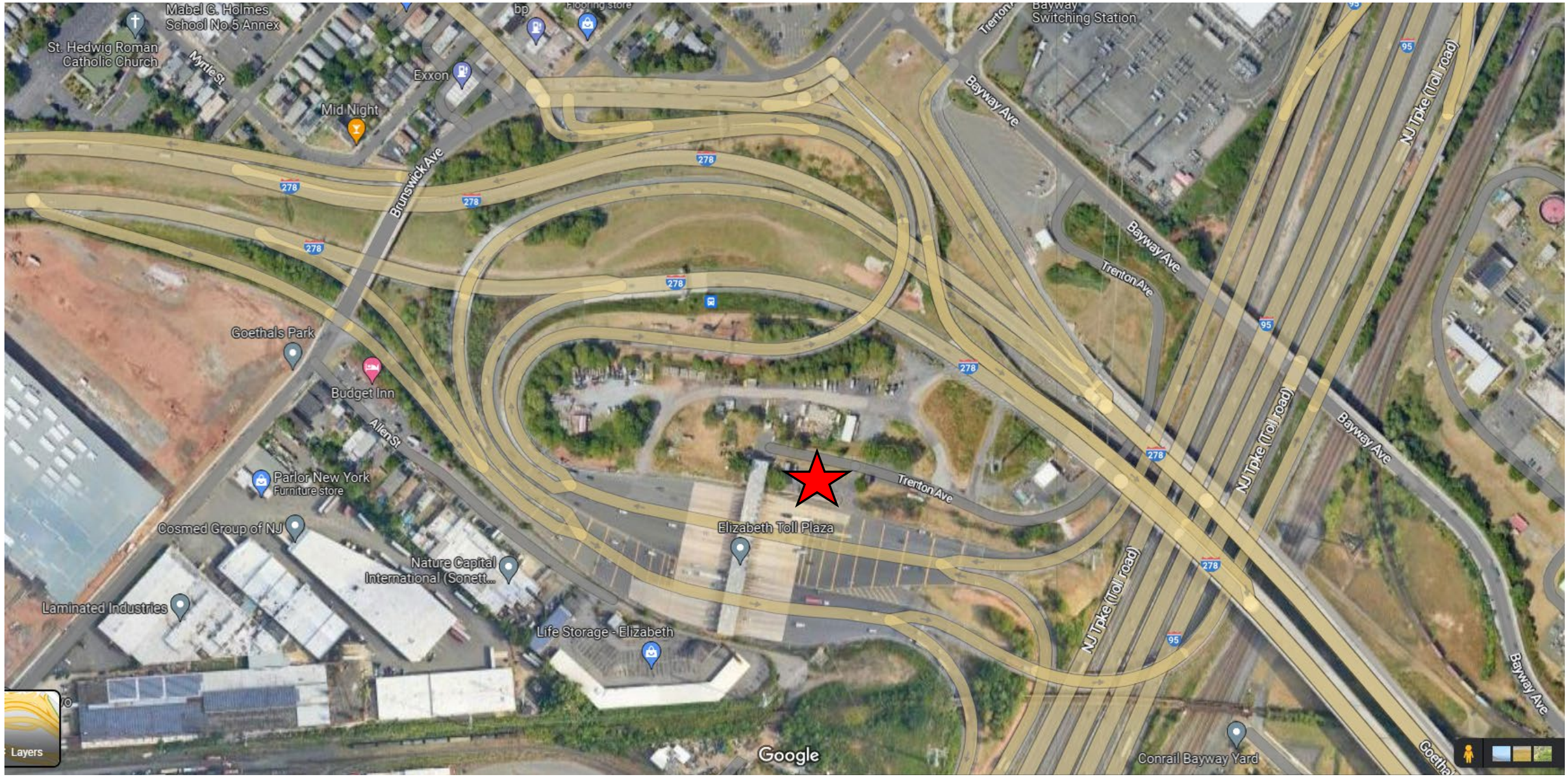
Miles
Air Toxics Network
Speciation
Speciation and VOCs/Carbonyls

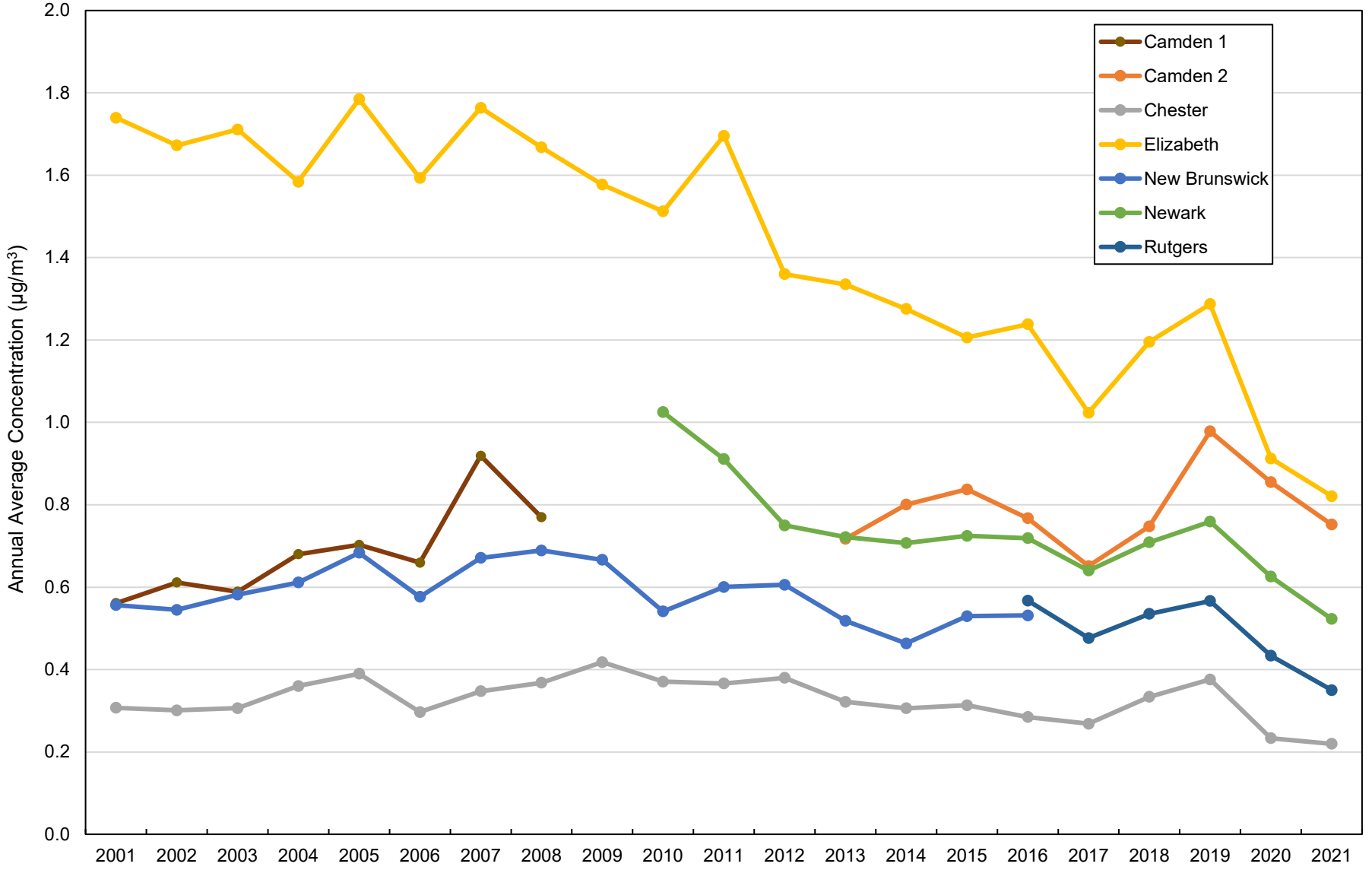
NJDEP

Elizabeth Lab central monitoring station located at NJTP Exit 13



Camden central air monitoring station located at Spruce and Locust

ELEMENTAL CARBON



Elizabeth
Camden

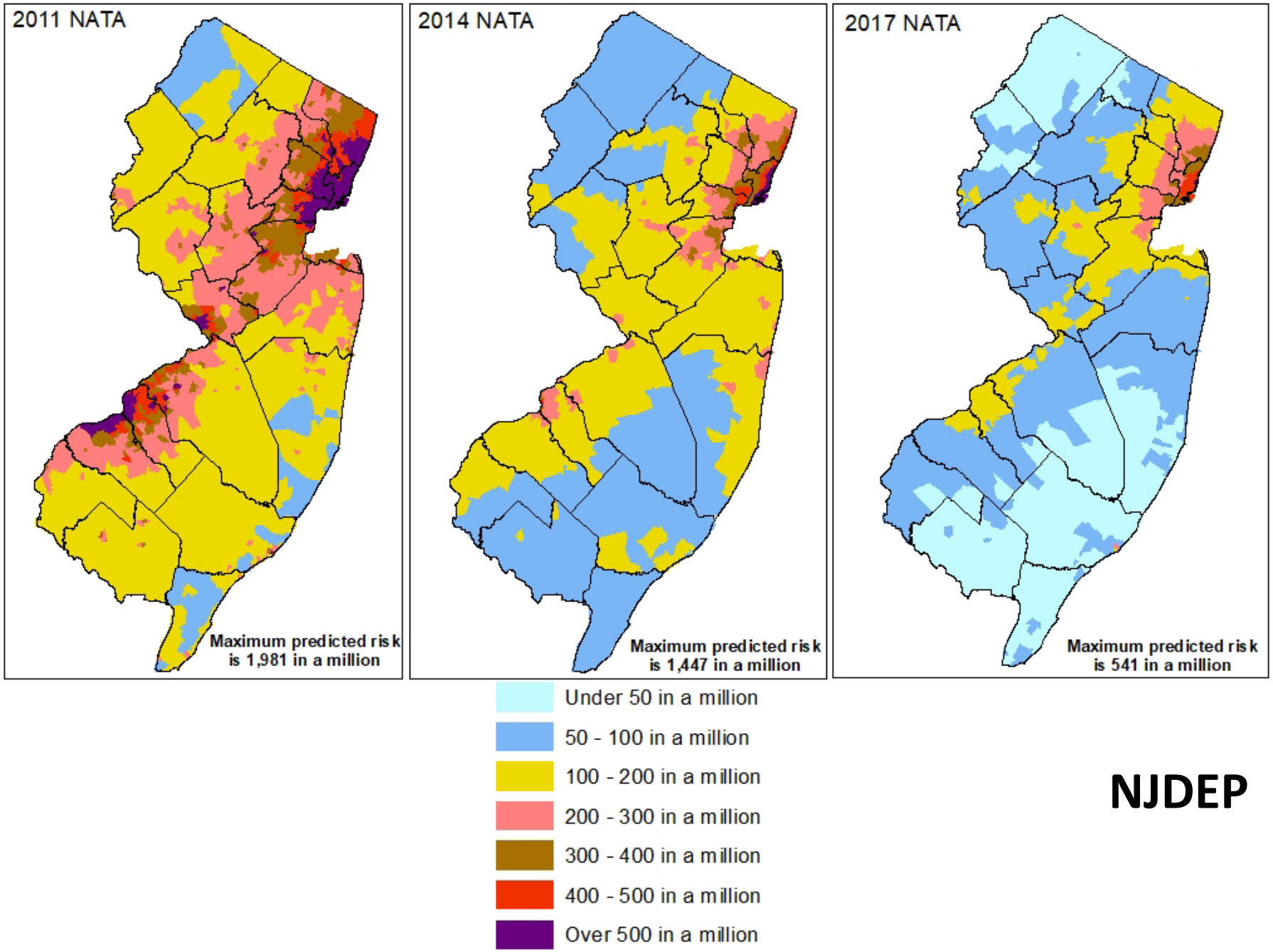
Newark

Rutgers

Chester

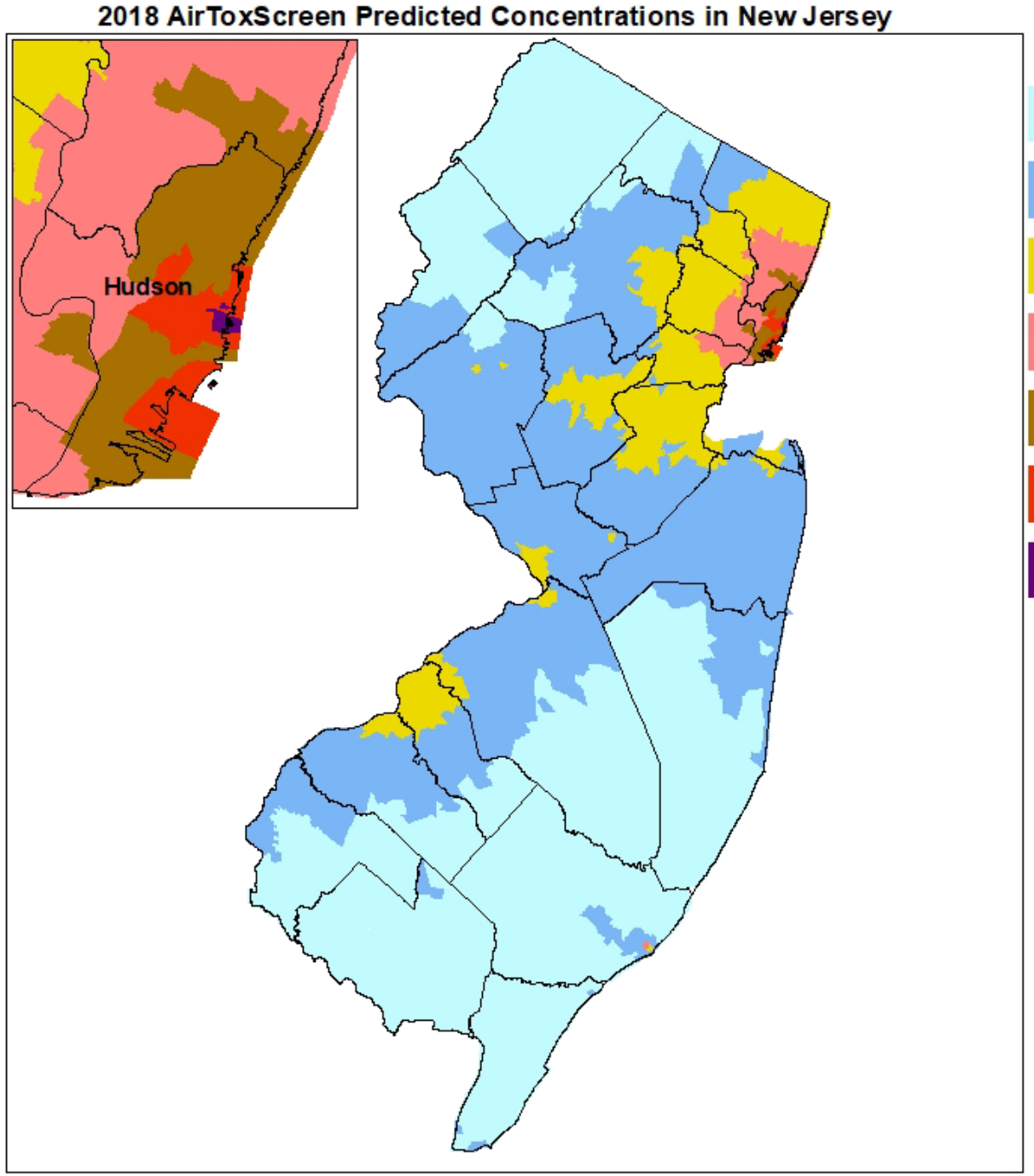
Lung Cancer Risk

Diesel Particulate Risk



NJDEP

Lung Cancer Risk



Diesel Particulate Risk

- Under 50 in a million
- 50 - 100 in a million
- 100 - 200 in a million
- 200 - 300 in a million
- 300 - 400 in a million
- 400 - 500 in a million
- Over 500 in a million

Maximum predicted risk is 516 in a million

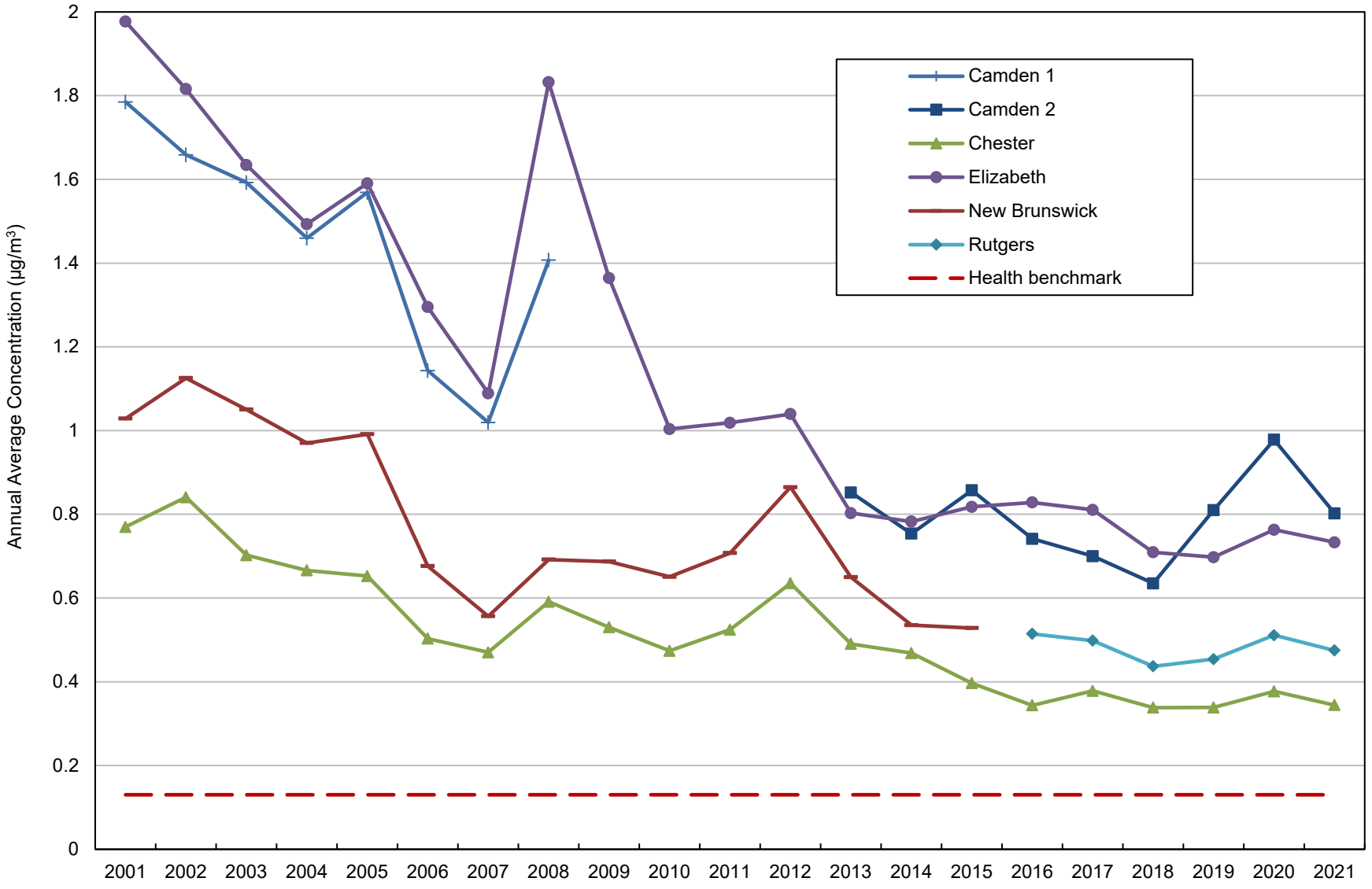
Source Contribution

On-road - 43%
Nonroad - 57%

*Based on EPA's 2018 AirToxScreen Ambient Concentrations & California Cancer Risk Factor

NJDEP

BENZENE



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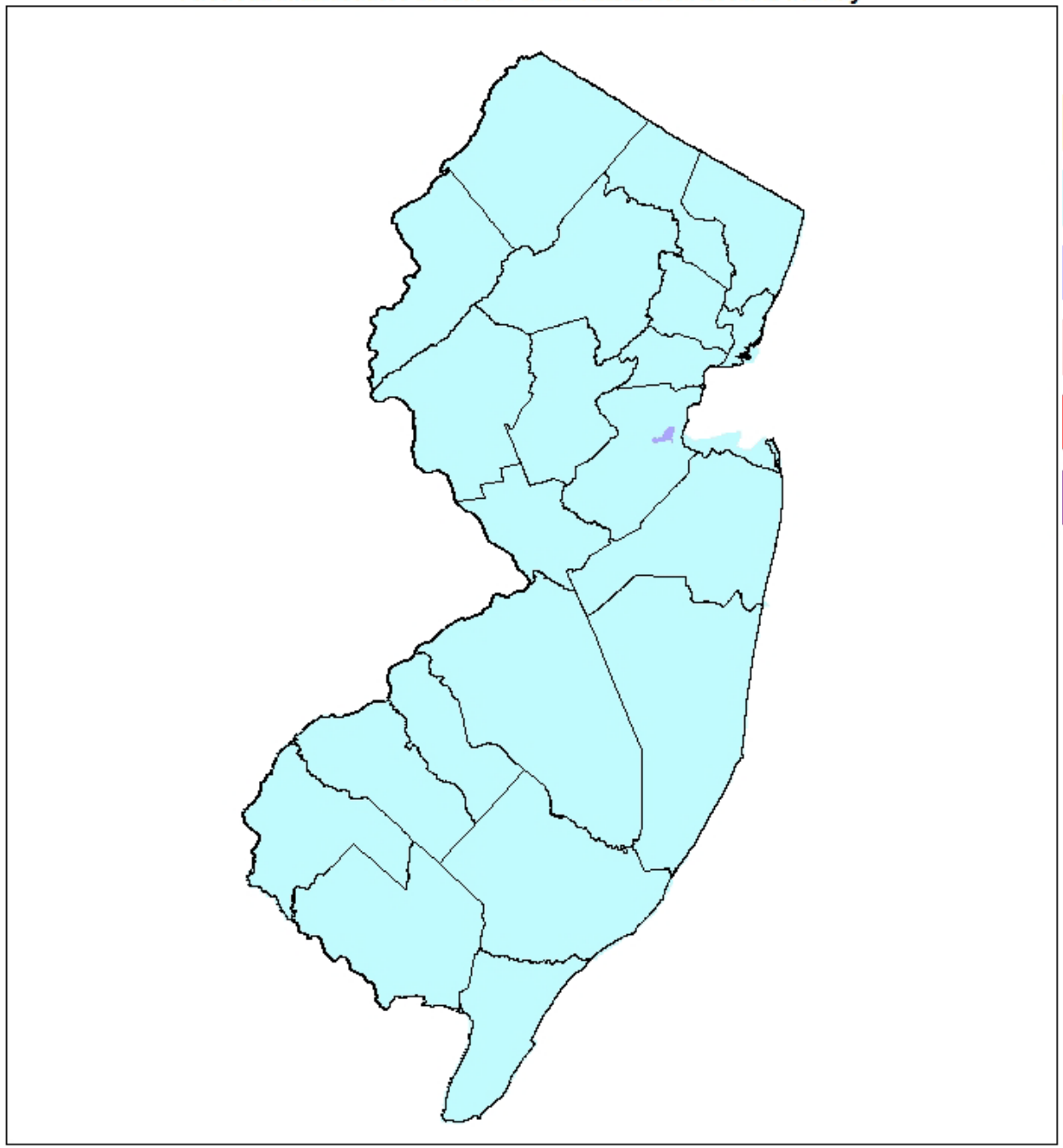
Leukemia Risk

2018 AirToxScreen Predicted Concentrations in New Jersey



Benzene Risk

- Under 1 in million
- 1 - 5 in a million
- 5 - 10 in a million
- 10 - 25 in a million
- 25 - 50 in a million
- Over 50 in a million

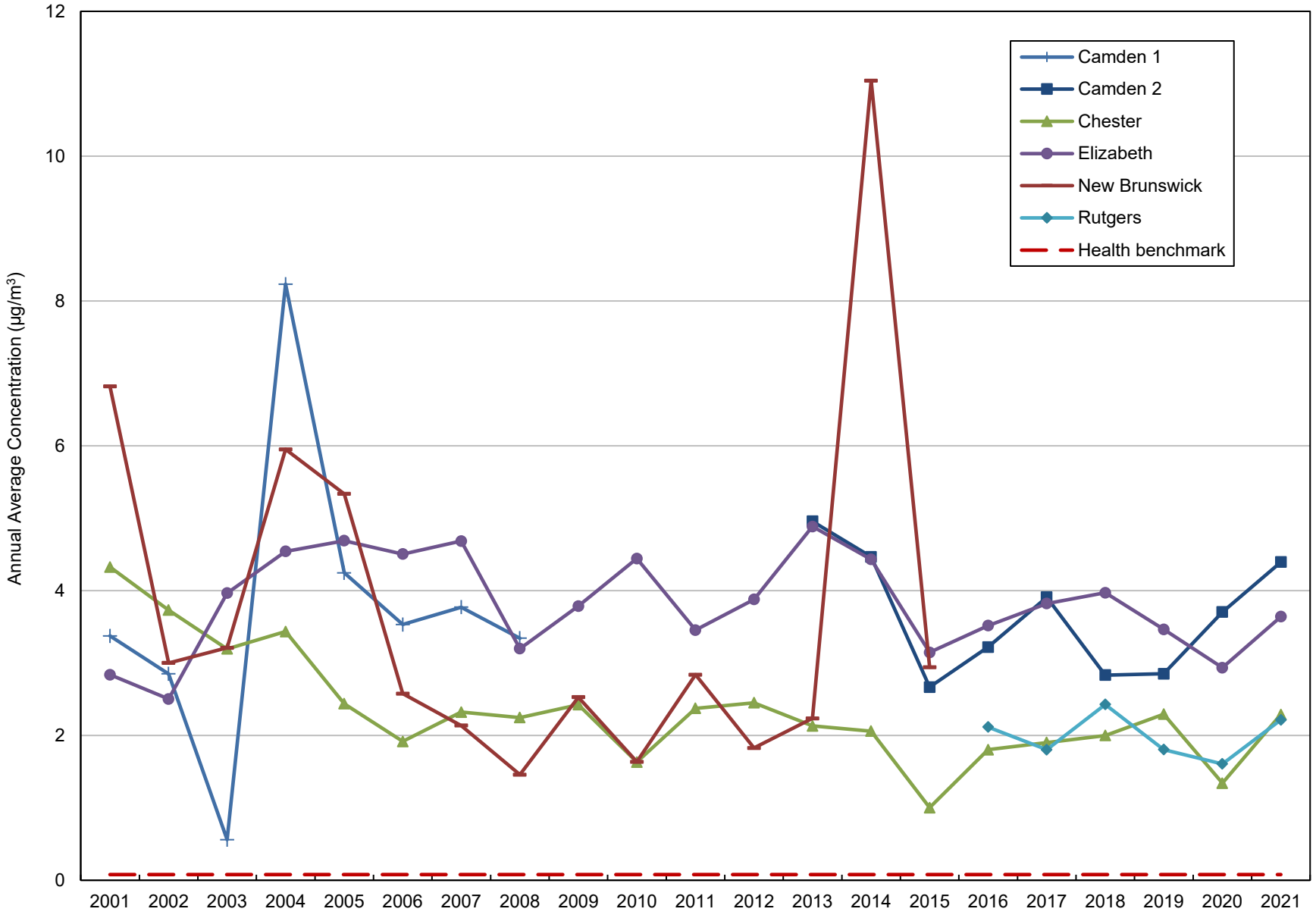
Maximum predicted risk is 5 in a million

Source Category

Point - 3%
Nonpoint - 32%
On-road - 34%
Nonroad - 31%
Secondary - 0%
Background - 0%

*Based on EPA's 2018 AirToxScreen Ambient Concentrations

FORMALDEHYDE

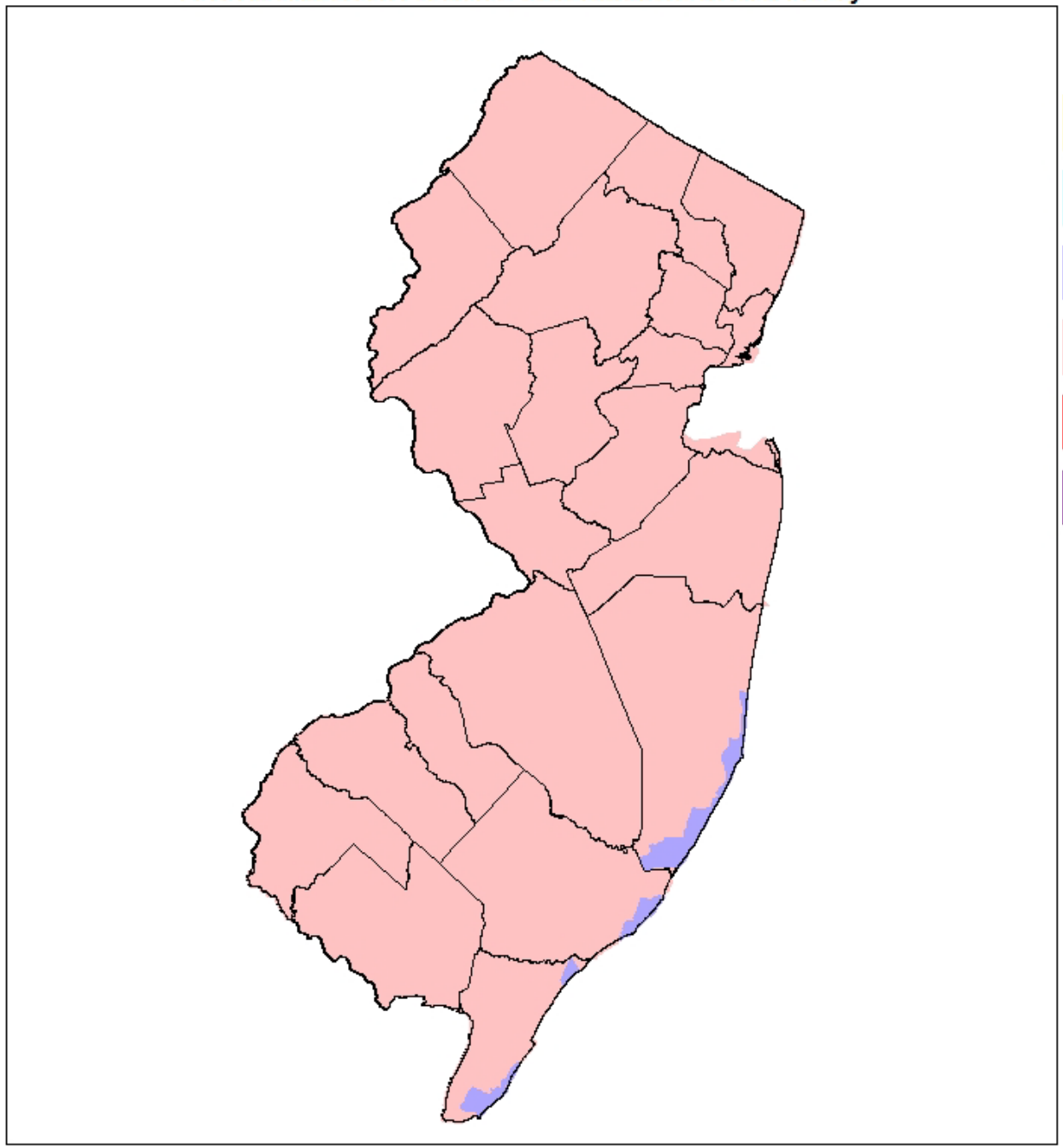


Camden
Elizabeth

Rutgers, Chester

Respiratory tract cancer and leukemia

2018 AirToxScreen Predicted Concentrations in New Jersey



Formaldehyde Risk

- Under 1 in million
- 1 - 5 in a million
- 5 - 10 in a million
- 10 - 25 in a million
- 25 - 50 in a million
- Over 50 in a million

Maximum predicted risk is 24 in a million

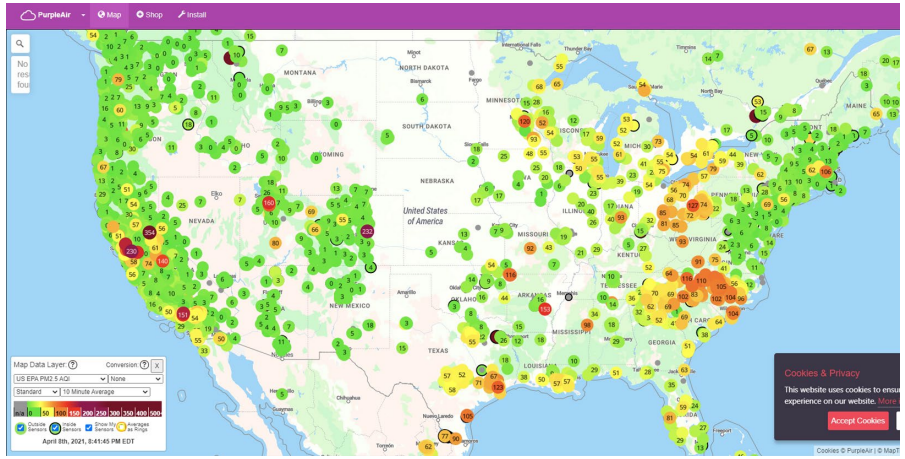
Source Category

Point - 3%
Nonpoint - 6%
On-road - 3%
Nonroad - 5%
Secondary - 75%
Background - 8%

*Based on EPA's 2018 AirToxScreen Ambient Concentrations

More monitoring with low-cost air pollution sensors?

- Potential for high-density, real-time sensing
- $100-$500 each
- But do not meet stringent criteria for regulatory decision-making
- EPA encouraging community monitoring with low-cost sensors
  - Filling gaps
  - Identifying “hot spots”



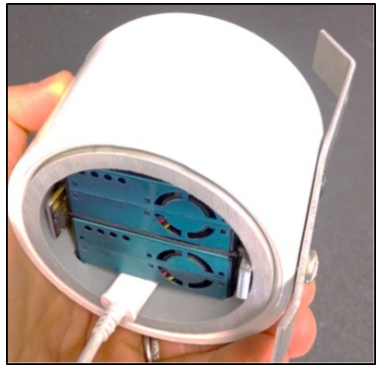
Purple Air Monitors

Installing PurpleAirs with Elizabeth Housing Authority

Reproducibility of measurement from PurpleAir sensors is limited

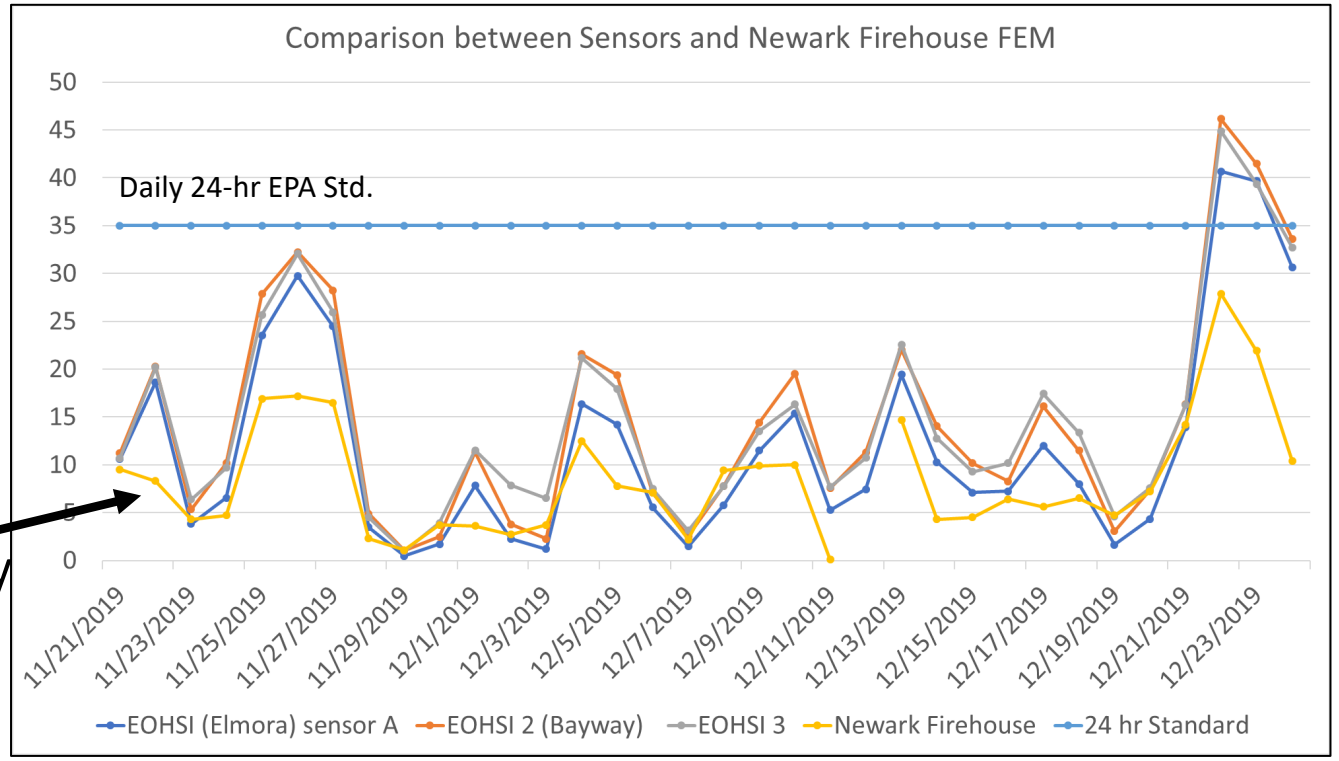
Example: Co-location 3 PurpleAir sensors with a federal reference-equivalent monitor

PurpleAir sensor



Co-location of PurpleAirs at Newark Firehouse

Regulatory monitor



Is PM2.5 a sensitive indicator of local (hotspot) traffic emissions or traffic-related air toxics in New Jersey?

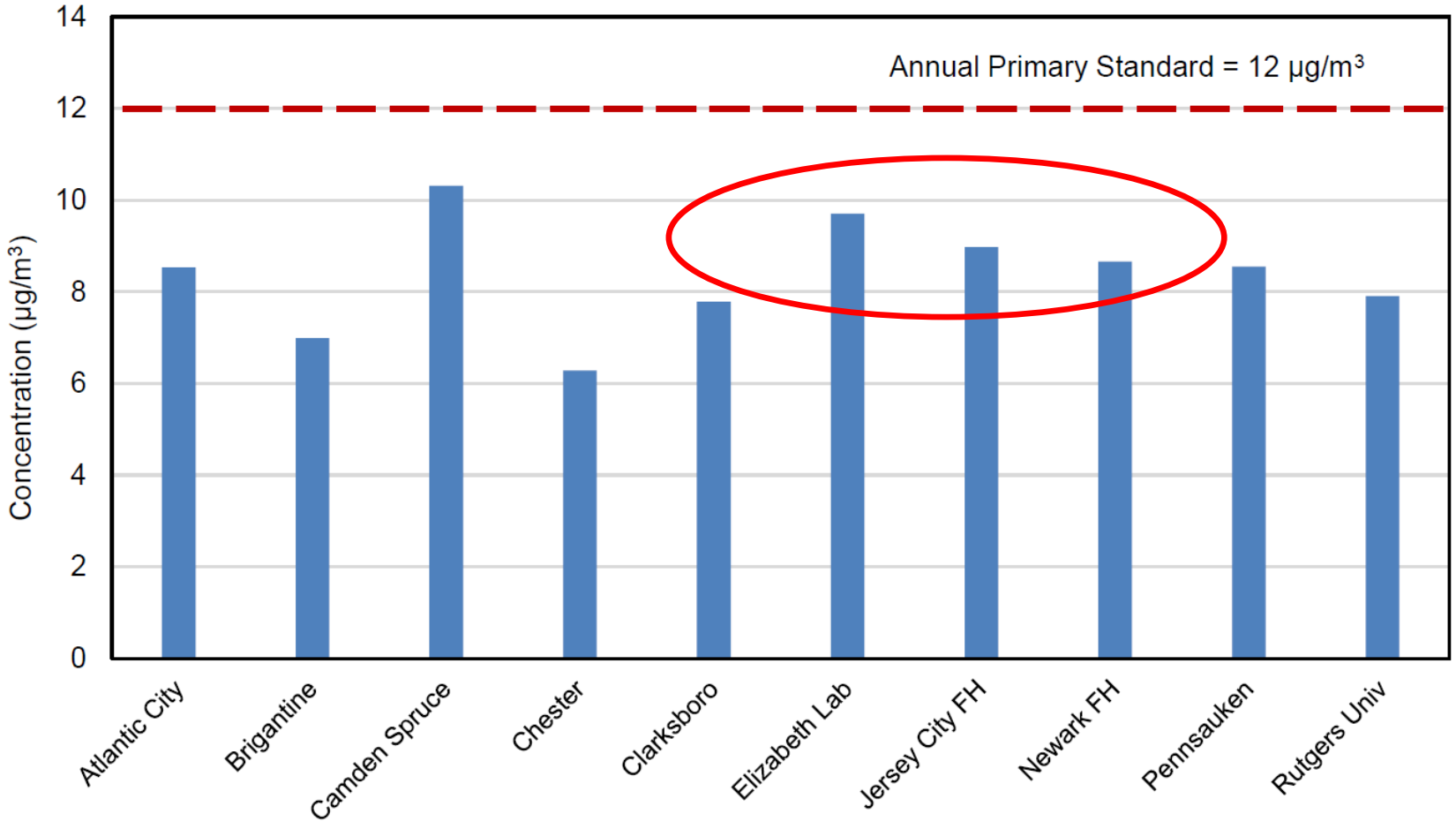
About 10% difference between Elizabeth Exit 13 and central sites in similar urban areas

PM2.5 is apparently not a good surrogate for local traffic air toxics

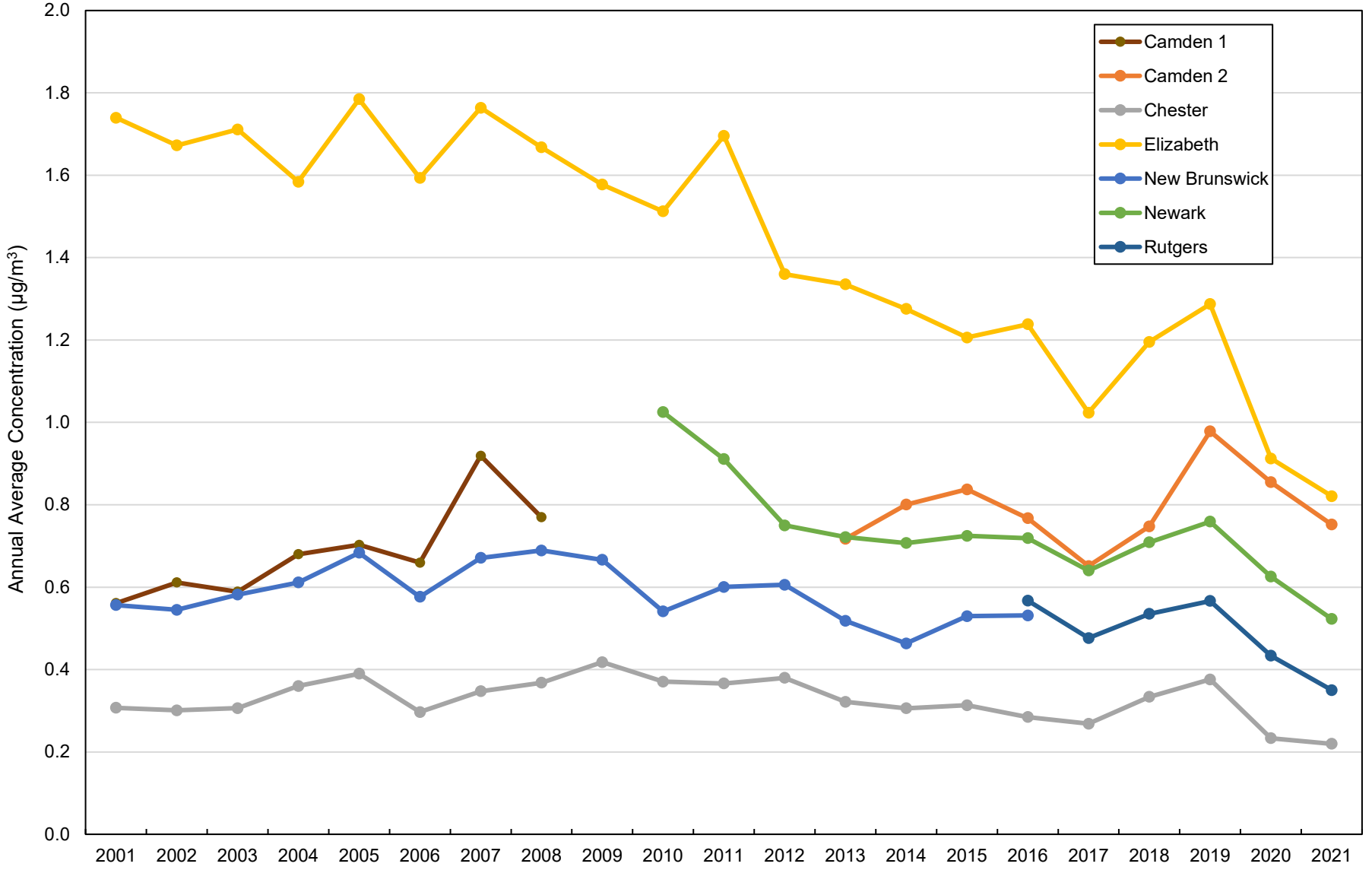
Highly unlikely that PurpleAir sensors can identify such hot spots

Planned projects using PurpleAirs in Newark, Elizabeth, and Jersey City are unlikely to see impacts of mobile sources

Figure 5-4
2021 $PM_{2.5}$ Concentrations in New Jersey
Annual Averages for Filter-Based Monitors
Micrograms Per Cubic Meter (µg/m³)



ELEMENTAL CARBON



Elizabeth
Camden

Newark

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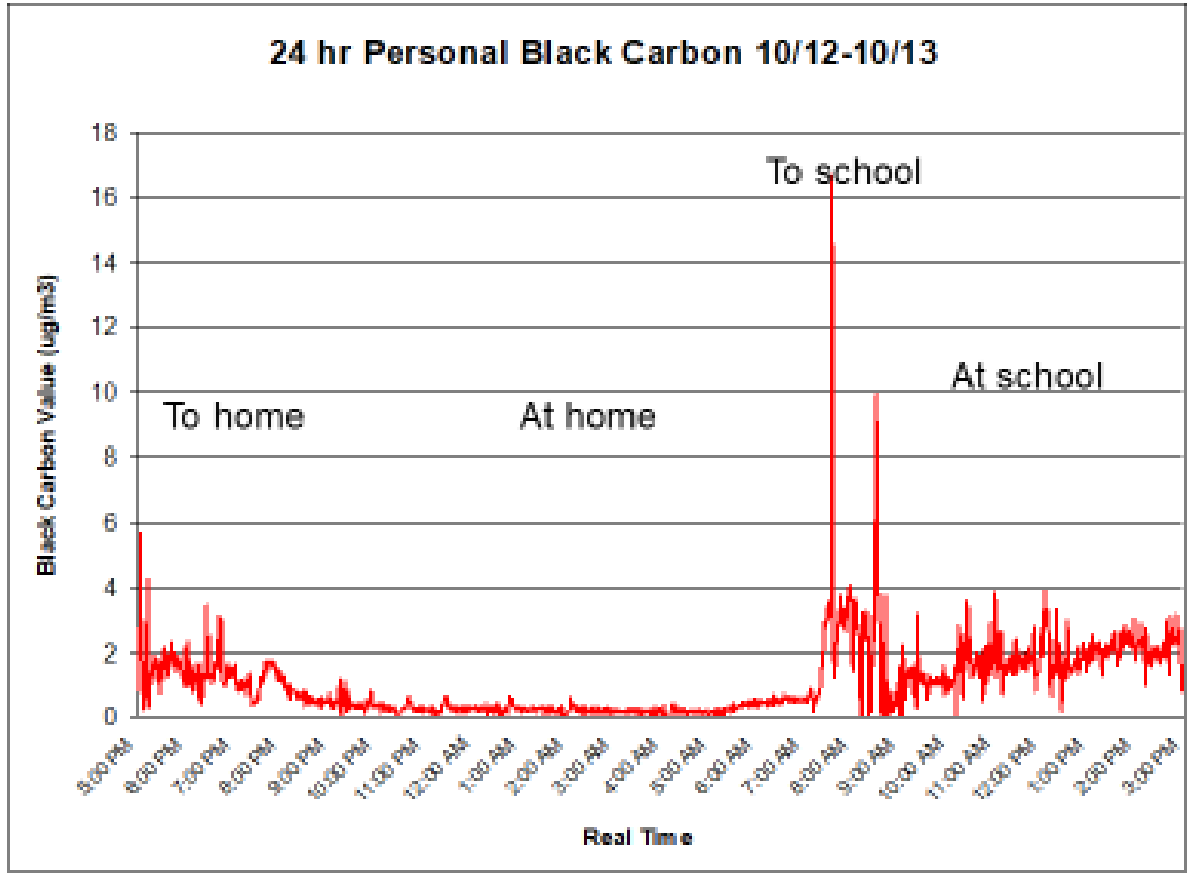
Chester

Mobile/personal monitoring for black carbon (correlated with elemental carbon)

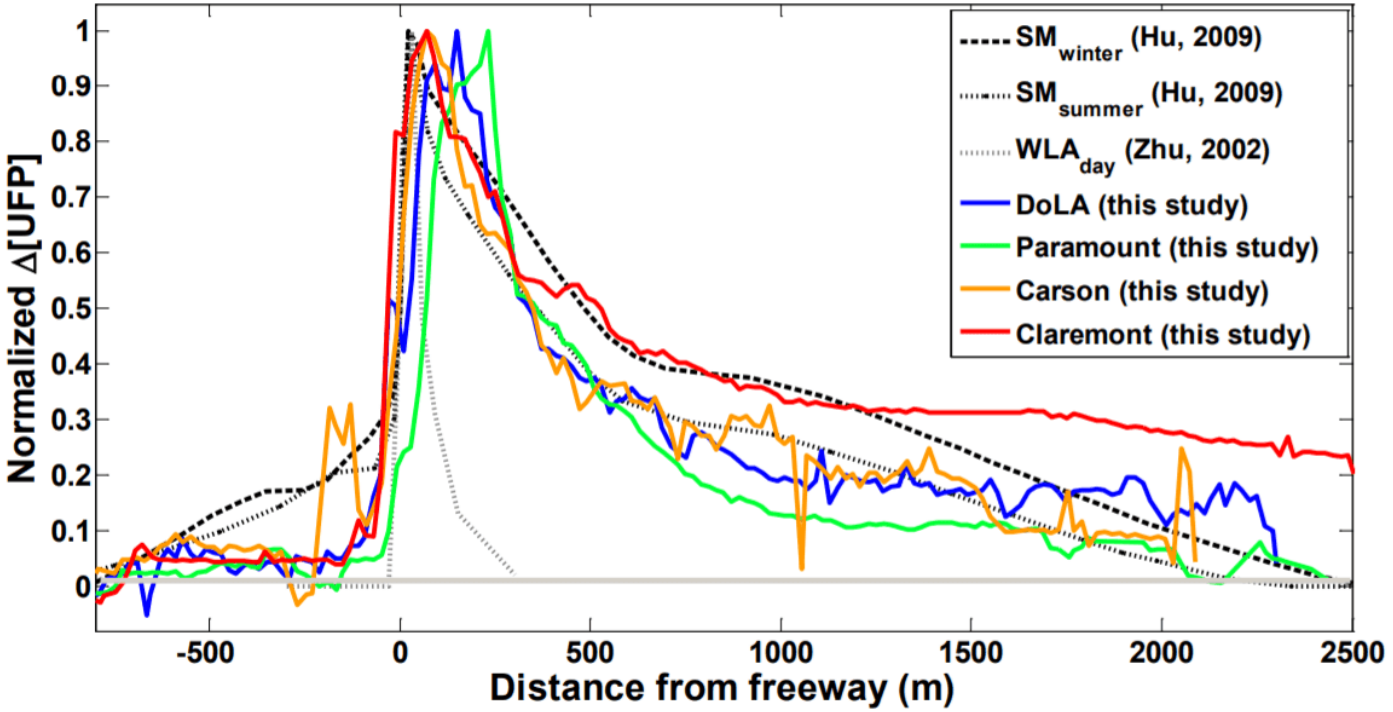
- 38 children with asthma in Newark and Elizabeth
- Wore microaethalometers as personal monitors (2011-2013)

Black carbon levels during one day for one participant



More-sensitive markers of DPM concentrations: ultrafine particles as well as black carbon

Example: Relative Ultrafine Particle Count Concentrations along Freeway Transects



SE Paulson et al. Mobile Platform III: Characterizing Spatially Inhomogeneous Non-Criteria Pollutants in the Los Angeles Air Basin 2012

Recommendations

- Prioritize the most significant air toxics: Diesel particulate matter is #1
- Consider innovative approaches to assessing exposure
  - Sensitive markers of exposure: black carbon, UFP (not PM2.5)
  - Mobile monitoring
  - Personal monitoring
  - Continue and strengthen “citizen” science initiatives
- Community-engaged monitoring with low-cost monitors requires careful consideration of:
  - Clear and reasonable expectations
  - The expected fit-for-purpose results
  - Optimizing use of limited community and NJDEP (and academic) resources