

Detecting Human Emissions of Volatile Chemical Products in Urban Atmospheres

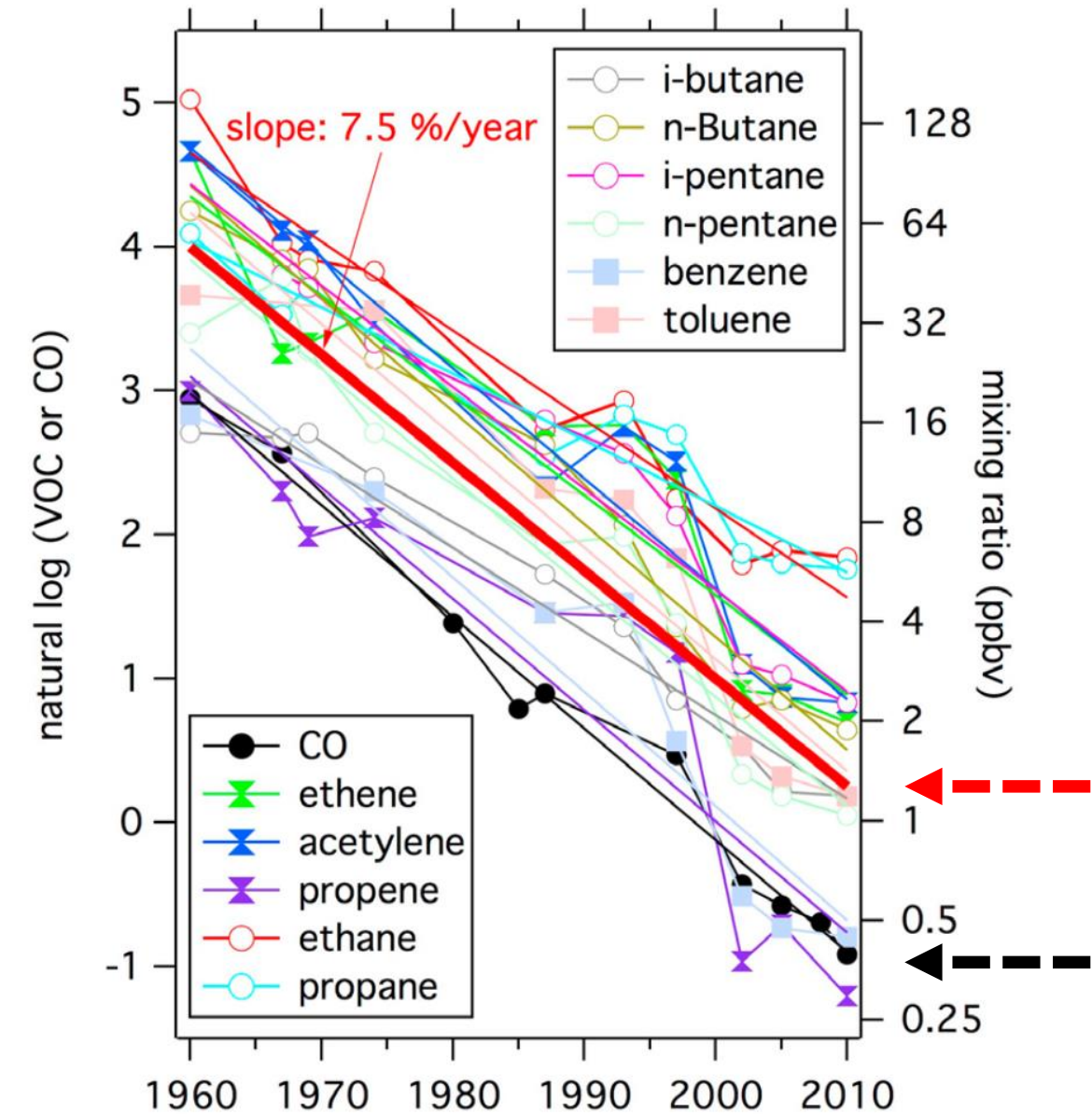


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Acknowledgments: Fred Moshary and Mark Arend (City College of New York)

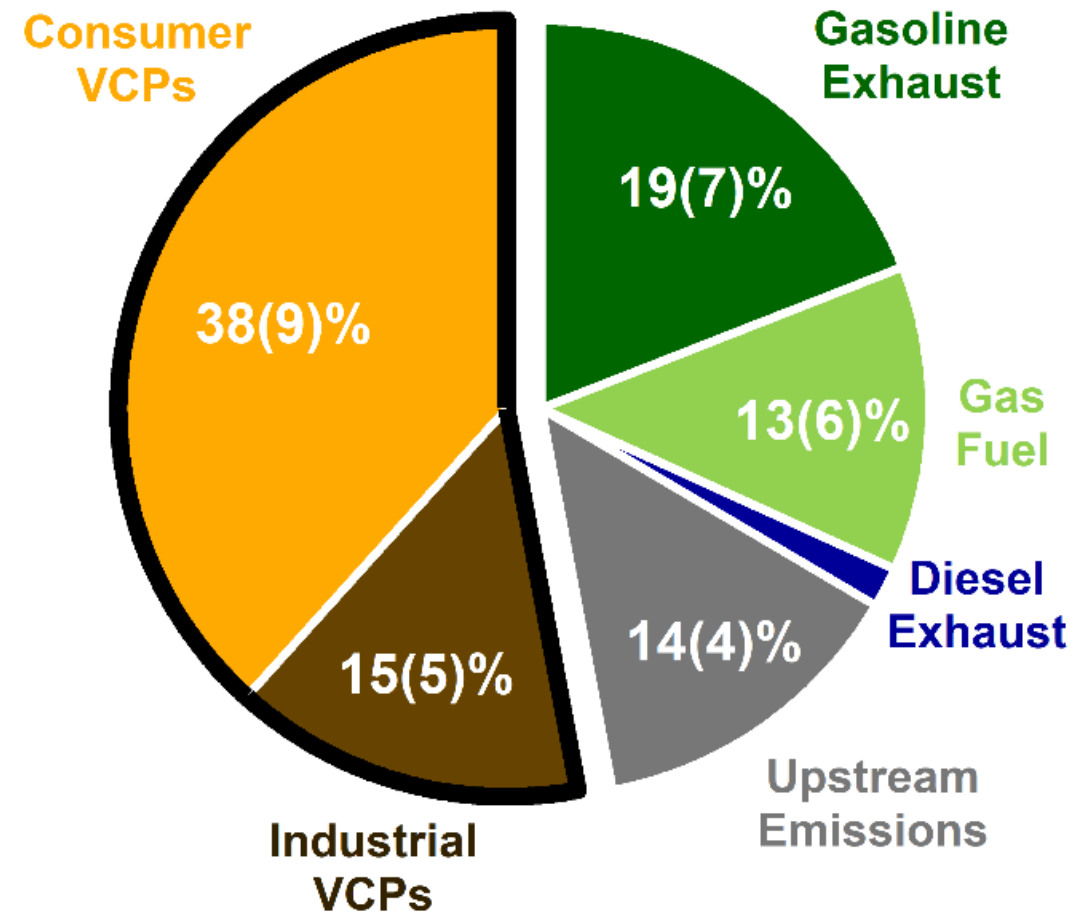
NYSERDA Energy-Related Air Quality & Health Effects Workshop

Long-Term Trend in Ambient VOCs (Los Angeles)



Distribution of Petrochemical VOCs in Los Angeles

Define VCPs as coatings, inks, adhesives, personal care products, cleaning agents, pesticides
(McDonald et al. 2018)



VOC Emissions = 350 ± 50 Gg

Research Objectives

- (1) Identify ambient markers of volatile chemical products (VCPs) in New York City
- (2) Assess spatial and temporal patterns of VCP emissions

D5-Siloxane Mostly Found in Personal Care Products

Example antiperspirant/deodorant

ACTIVE INGREDIENTS

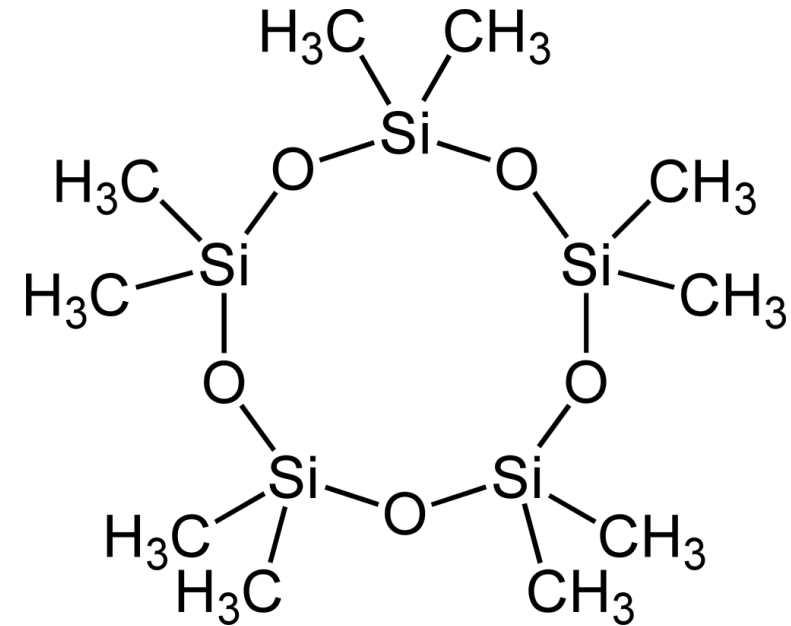
Aluminum zirconium octachlorohydrate Gly 16% (anhydrous)

INACTIVE INGREDIENTS

Water, alcohol denat., **cyclopentasiloxane**, propylene glycol, dimethicone, calcium chloride, PEG/PPG-18/18 dimethicone, fragrance

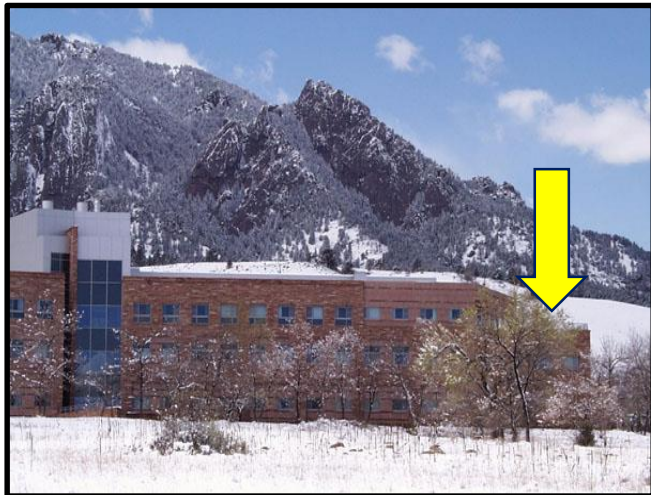
**Antiperspirants
~70%**

**Hair care
~20%**

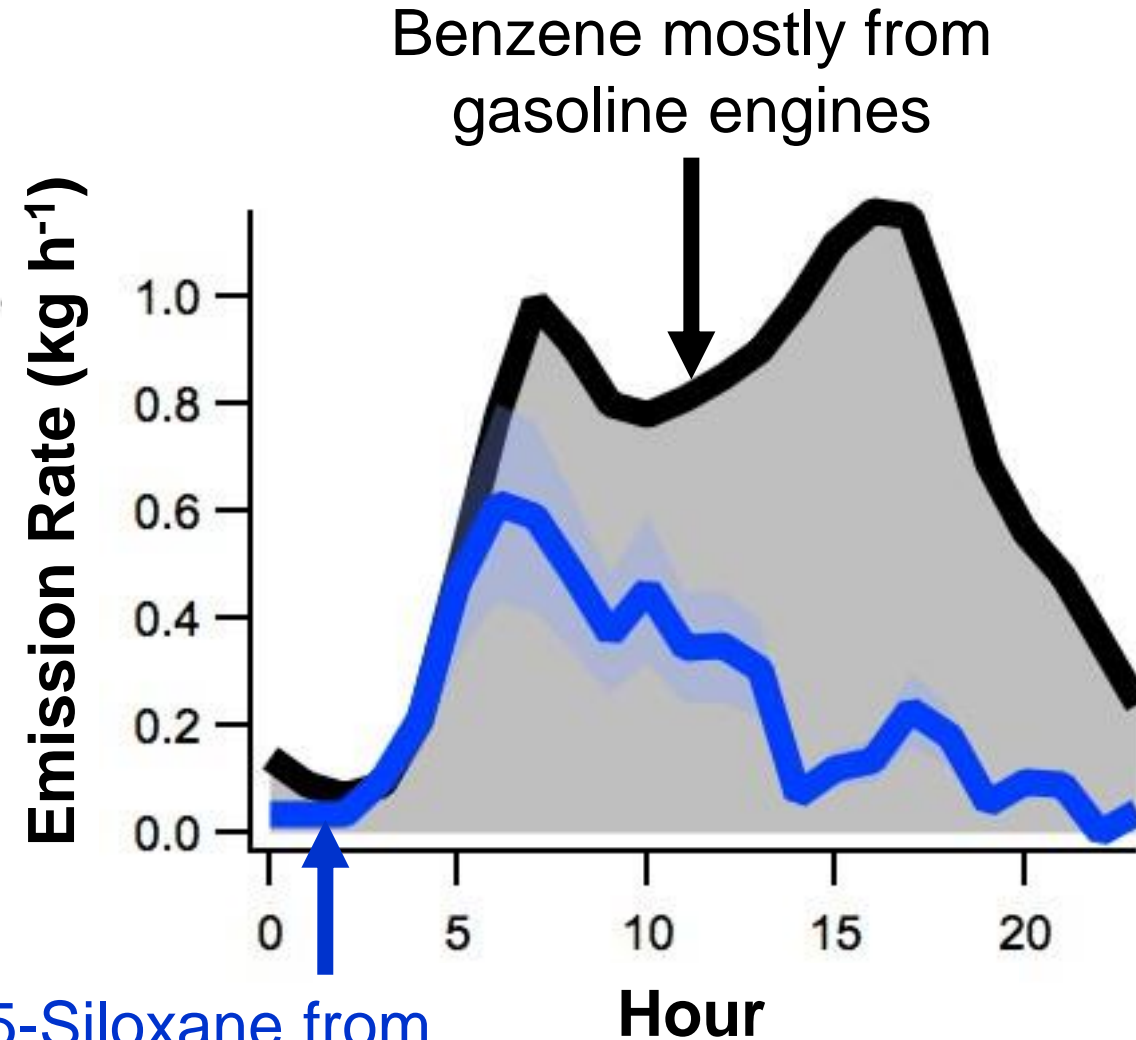


**Cyclopentasiloxane
(D5-siloxane)**

D5-Siloxane Emissions Peak in Morning (Boulder, CO)



D5-Siloxane from
personal care products



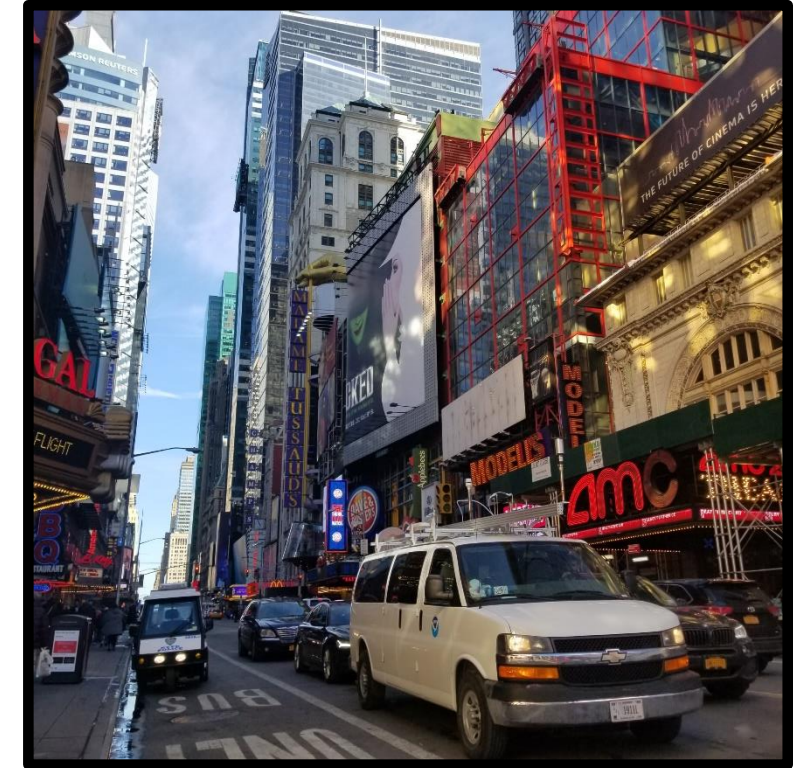
NOAA Field Measurements of VOCs in New York City

March 5 – 28, 2018

July 6 – 26, 2018

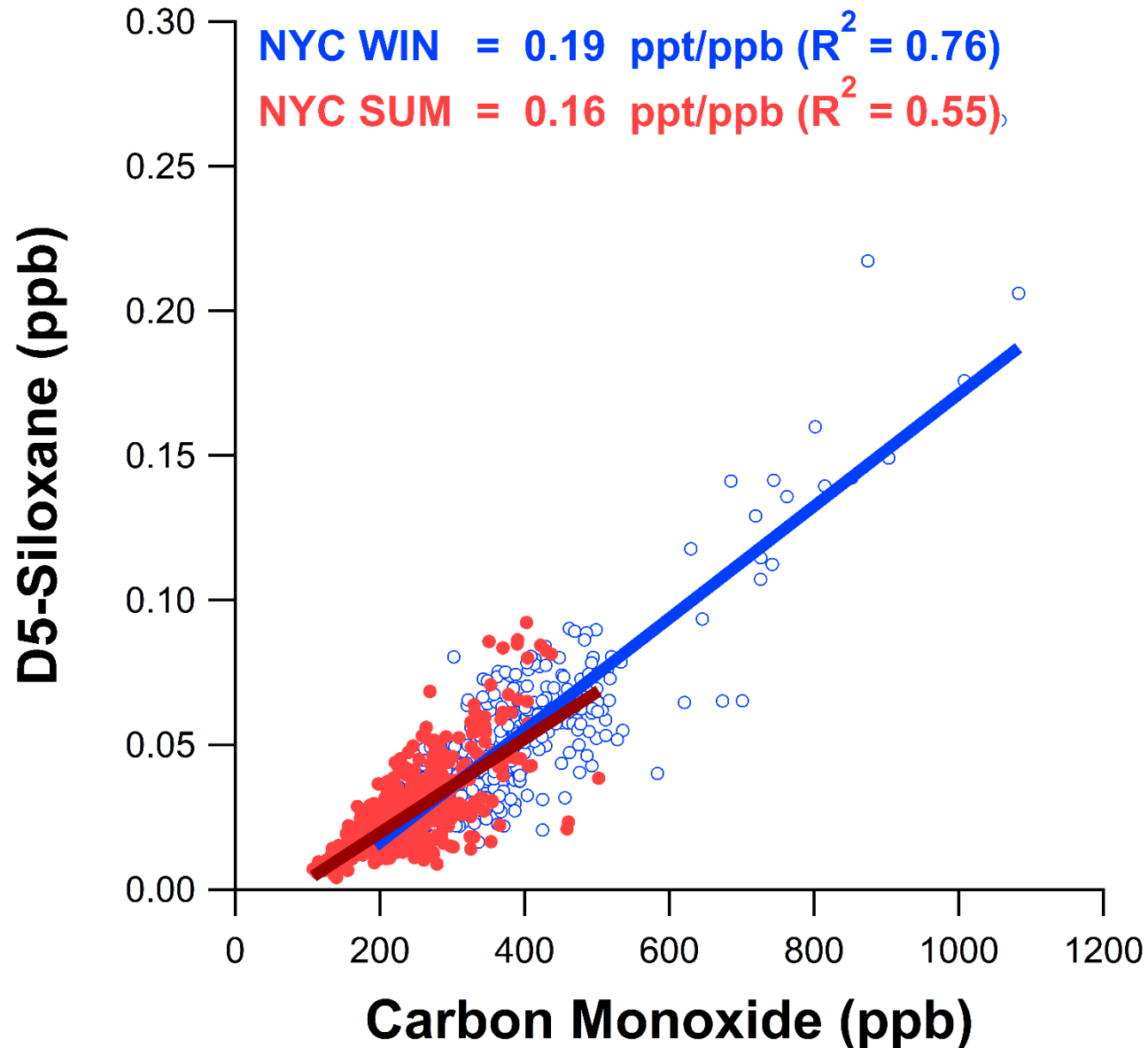
CCNY

Population Density
(ppl/km²)



Deployed mobile van
with PTR-ToF-MS,
iWAS canisters, CO,
CO₂, CH₄, N₂O

Estimating a D5-Siloxane Emission Factor in New York City



New York City (Manhattan only)

CO Emissions = 240 ± 60 t/d

Population = 1.7 million

D5 EF (NYC) = 330 ± 100 mg/person/d

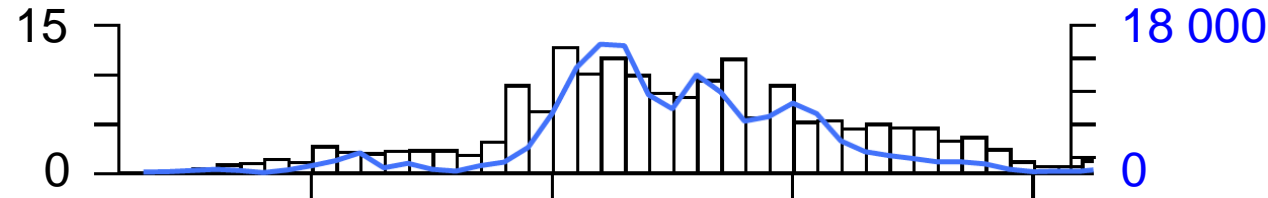
D5 EF (LA) = 390 ± 150 mg/person/d



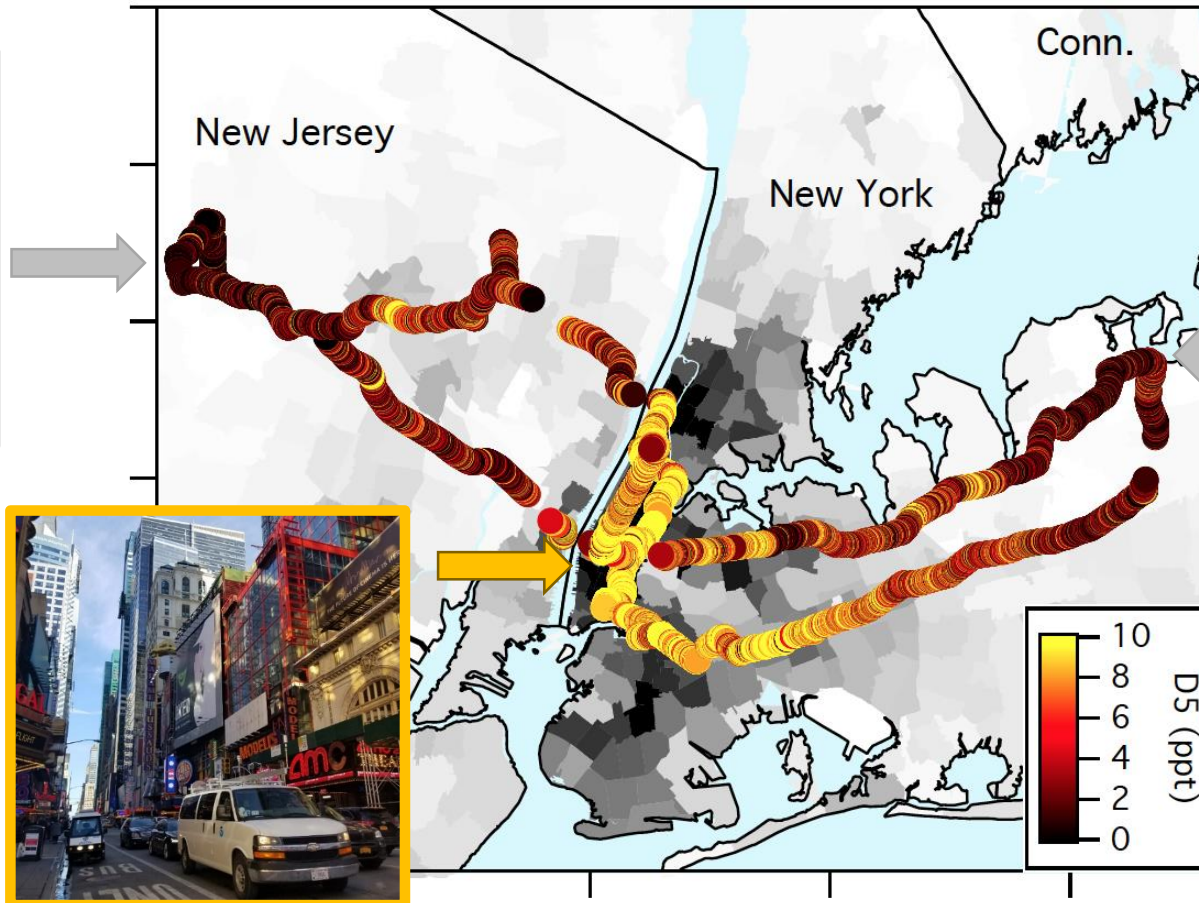
McDonald et al. (*Science* 2018)

D5-Siloxane Exhibits Strong Population Density Relationship

**D5-Siloxane
(ppt)**

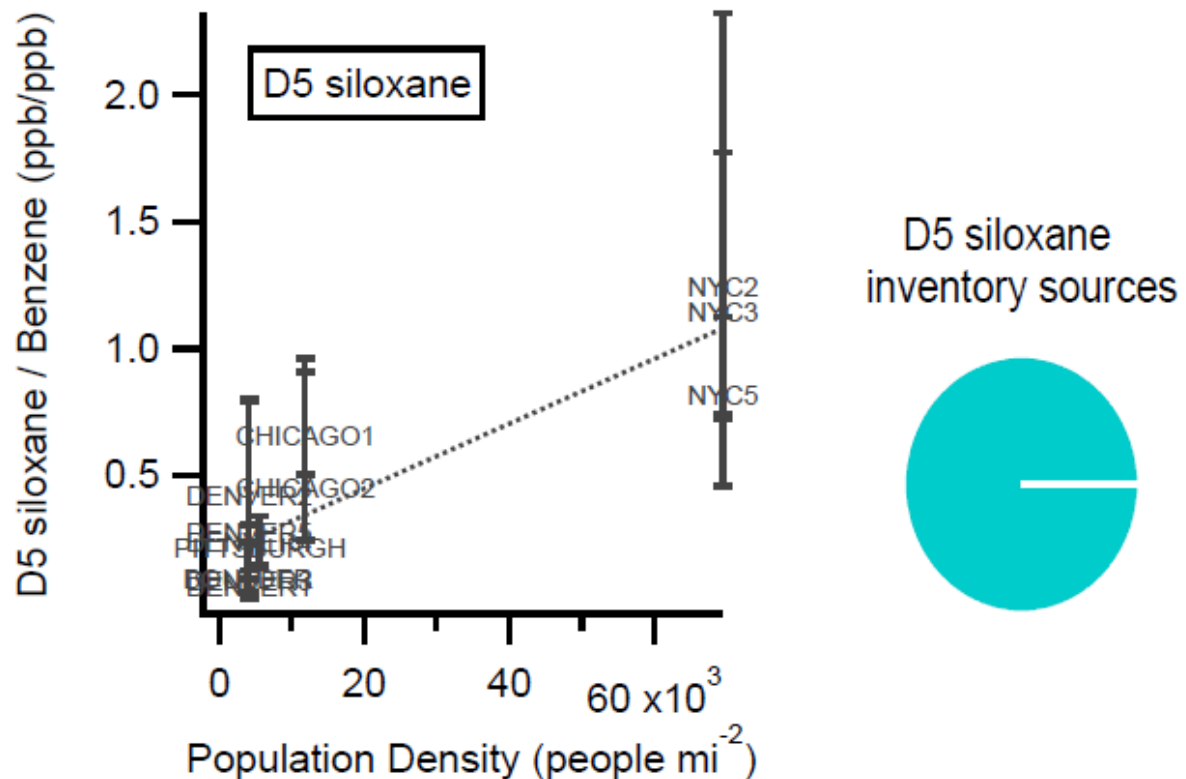


**Population
(km⁻²)**



Personal Care / Traffic Emissions Higher in More Populous Cities

Personal Care Products



Suggests consumer product use similar across cities...

...and per capita driving less as population density increases

Summary

- (1) Ratio of consumer product to traffic emissions of VOCs higher in denser cities
 - Reflected in D5-siloxane/benzene ratio measured across several US cities
 - Highest concentrations of D5-siloxane measured in Manhattan
 - D5-siloxane concentrations highly correlated with population density