

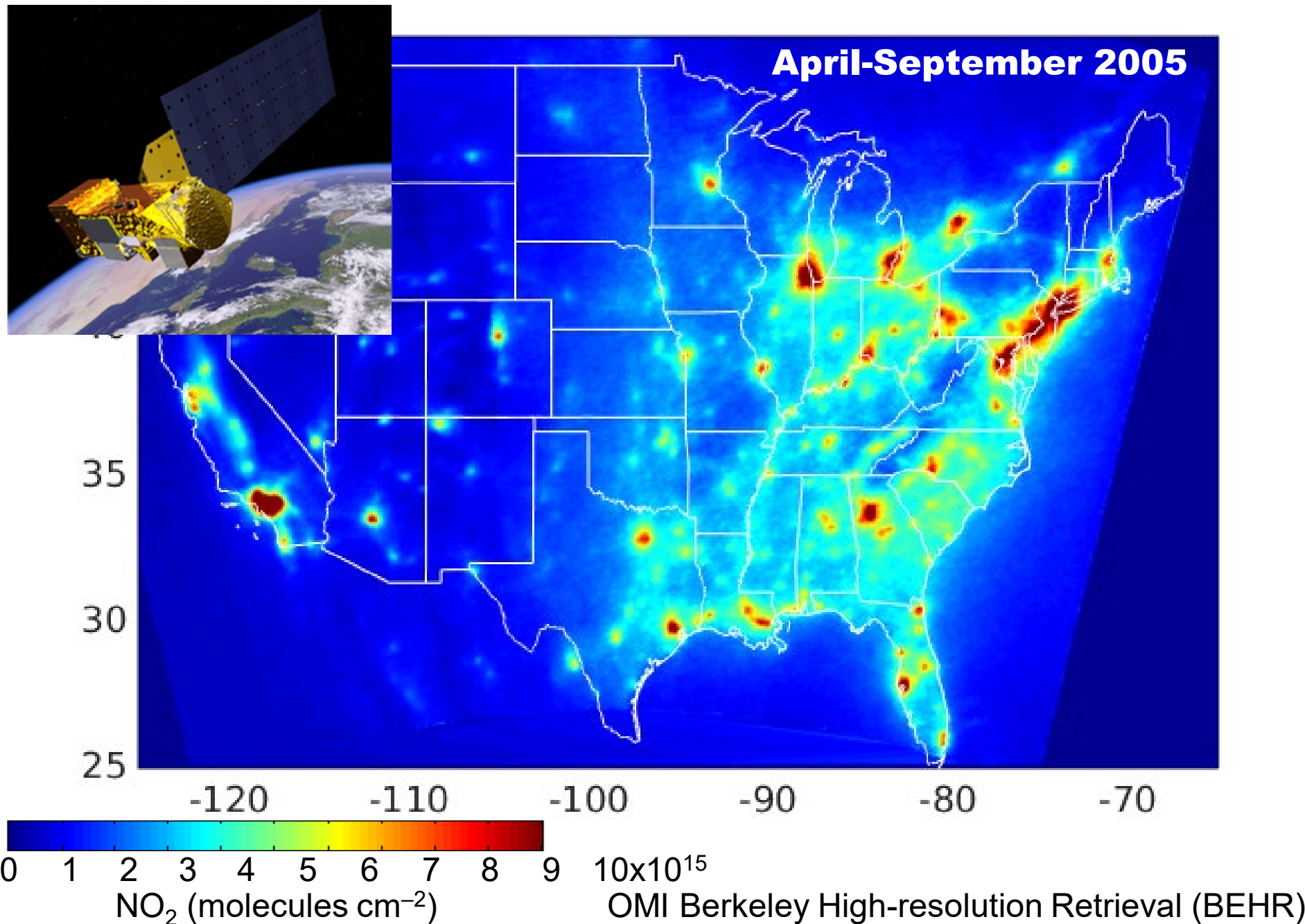
An aerial photograph of a city, likely Los Angeles, showing a dense urban area with a grid-like street pattern. The city is surrounded by a thick, hazy layer of smog or air pollution, which fades into a clear blue sky. The perspective is from a high altitude, looking down at the city.

GHGs:

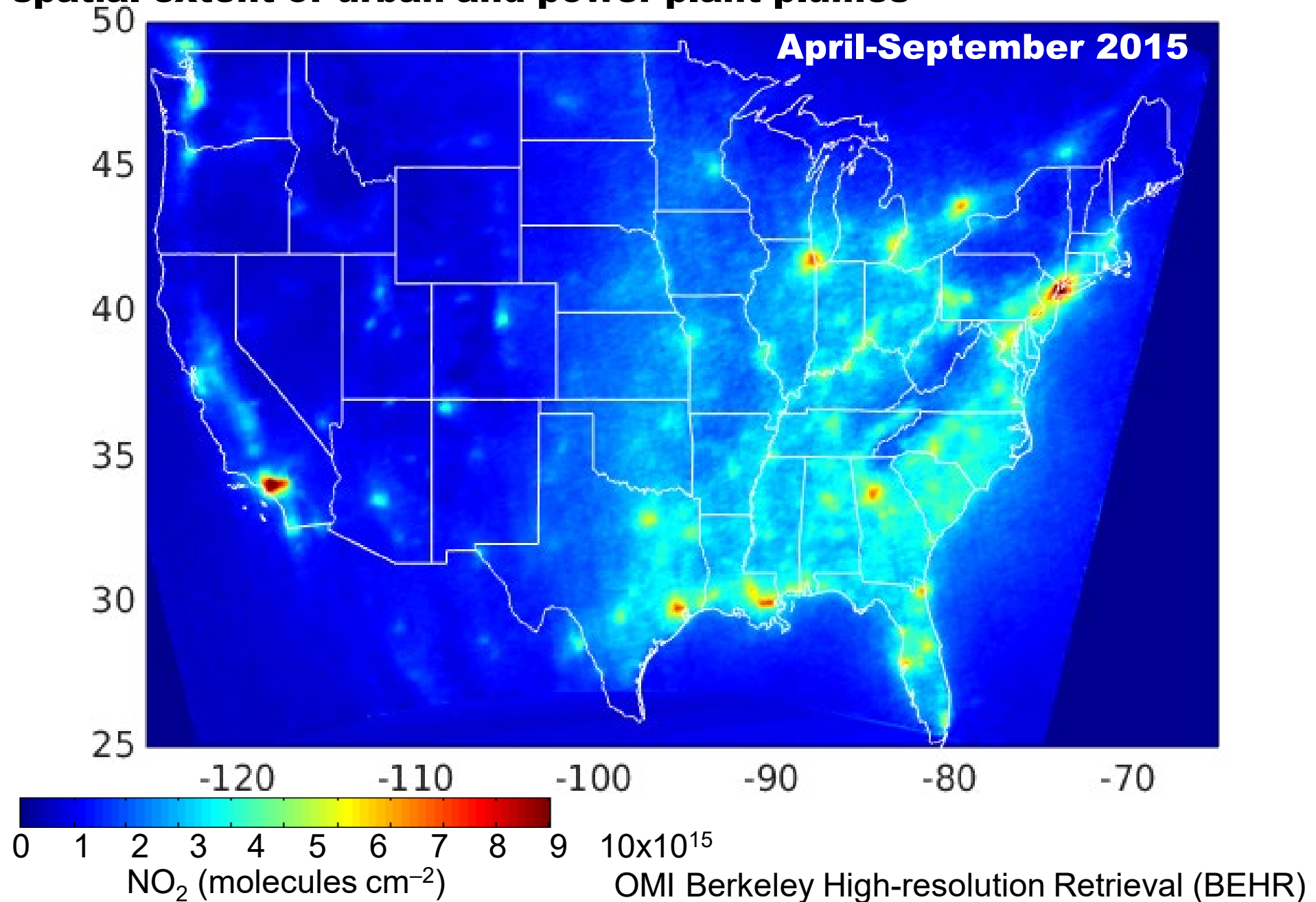
Mapping Emission Factors and Detecting Trends

**Ron Cohen
UC Berkeley**

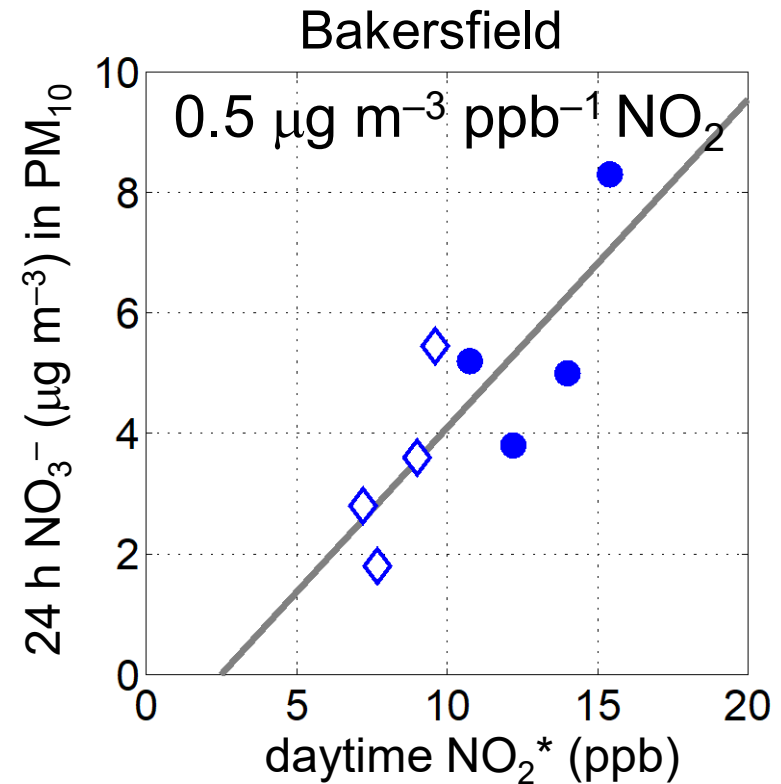
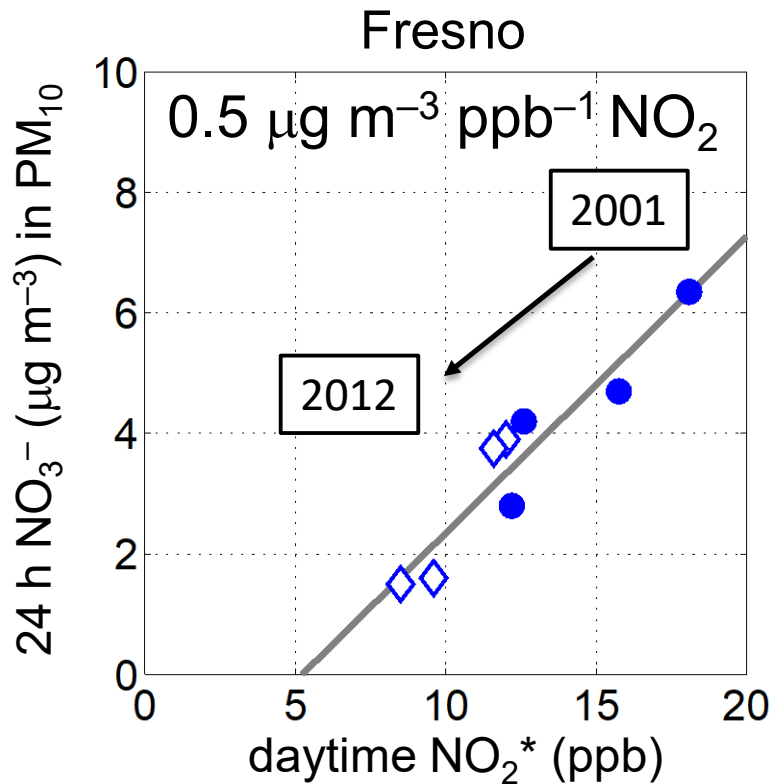
Nitrogen oxides (NO_x)



Large decreases over the last decade in U.S. result in smaller spatial extent of urban and power plant plumes



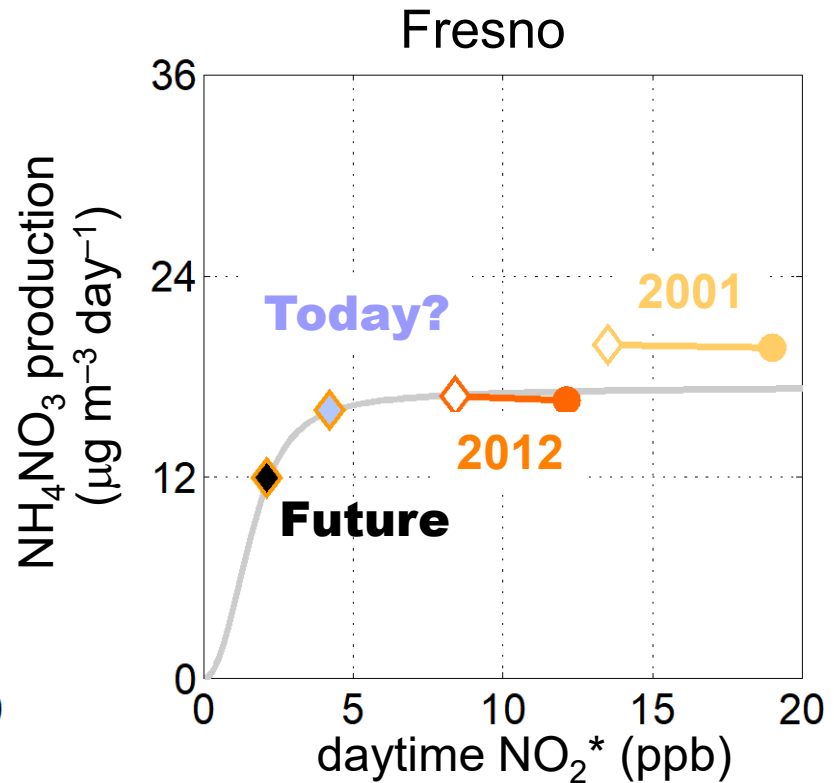
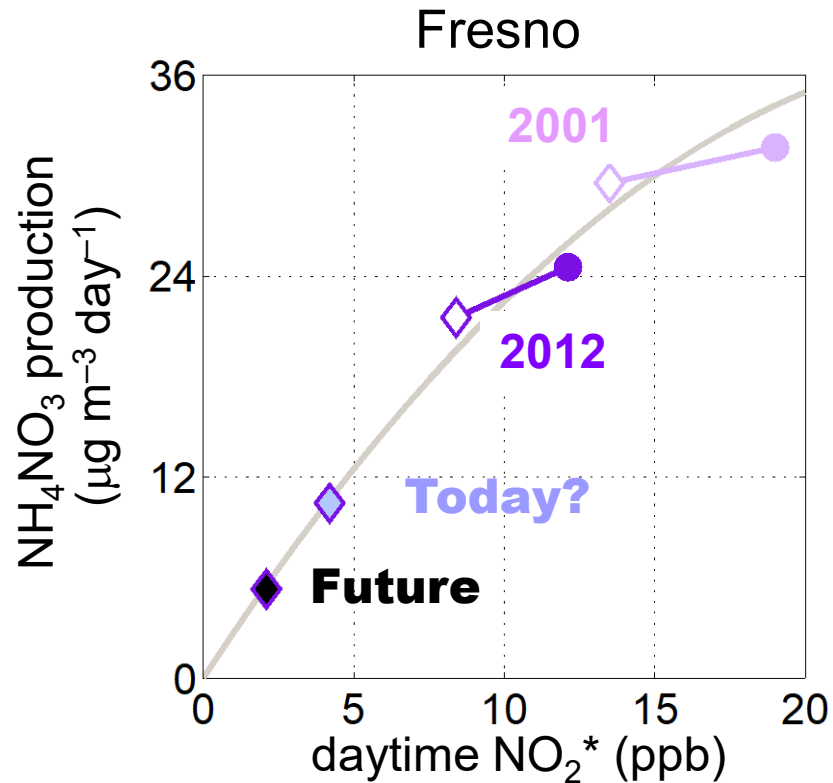
Wintertime NO_3^- : **lifetime ~ 1 day** and is directly proportional to NO_x concentrations



- weekdays
- ◇ weekends

Pusede, et al. ACP 2016

Nighttime chemistry was the story. Daytime now?



Pusede, et al. ACP 2016

● weekdays
◇ weekends

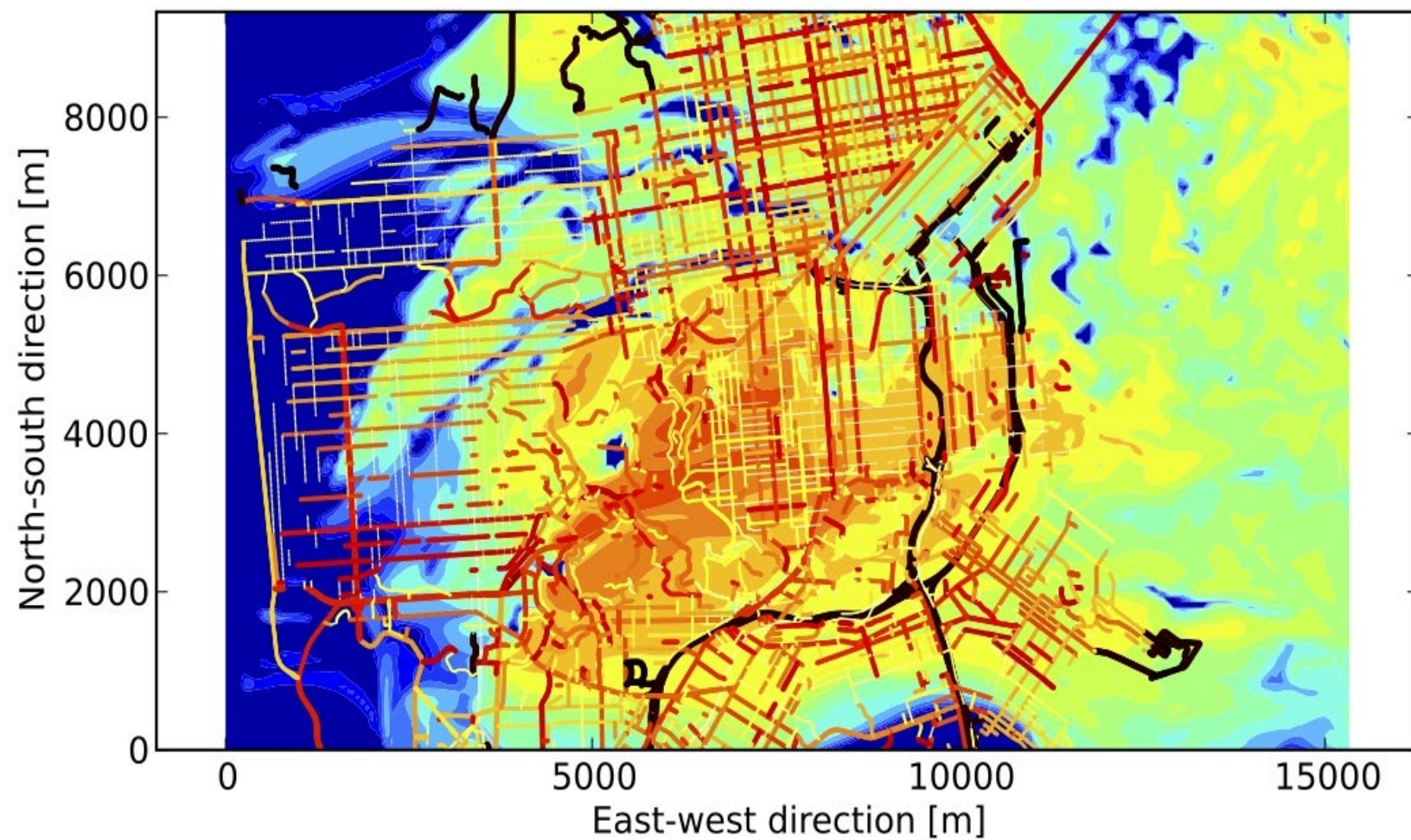


We are interested in neighborhood scale allocation and interannual trends in specific processes related to urban air.

GHGs: Patterns of CO₂ emissions/uptake: vehicles, homes, industry, biosphere.

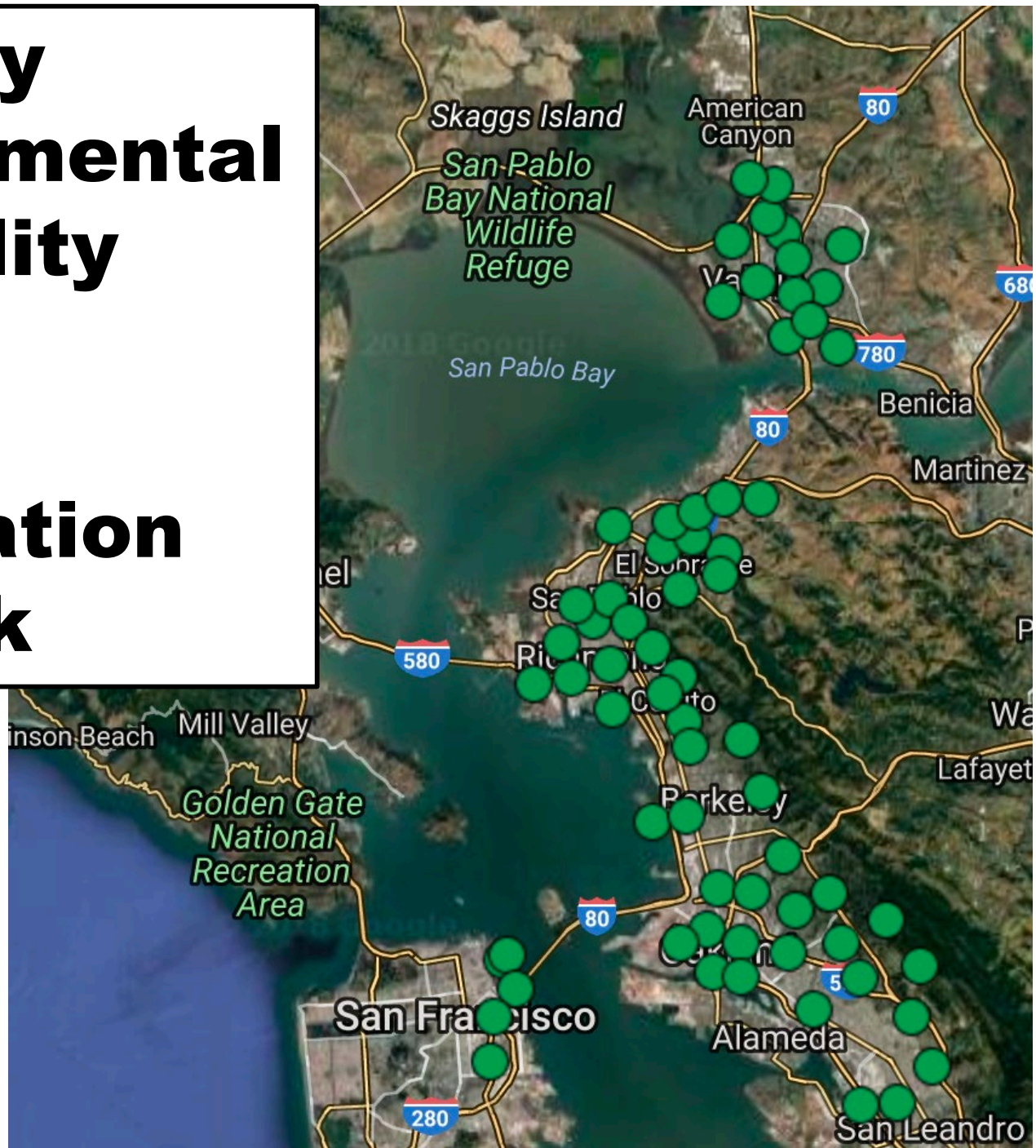
AQ: Is cold start the dominant source of NO_x, VOC, ... ; if so what changes in spatial pattern and correlations with CO and CO₂ have occurred; are occurring? (e.g. Saliba, et al. ES&T 2017)

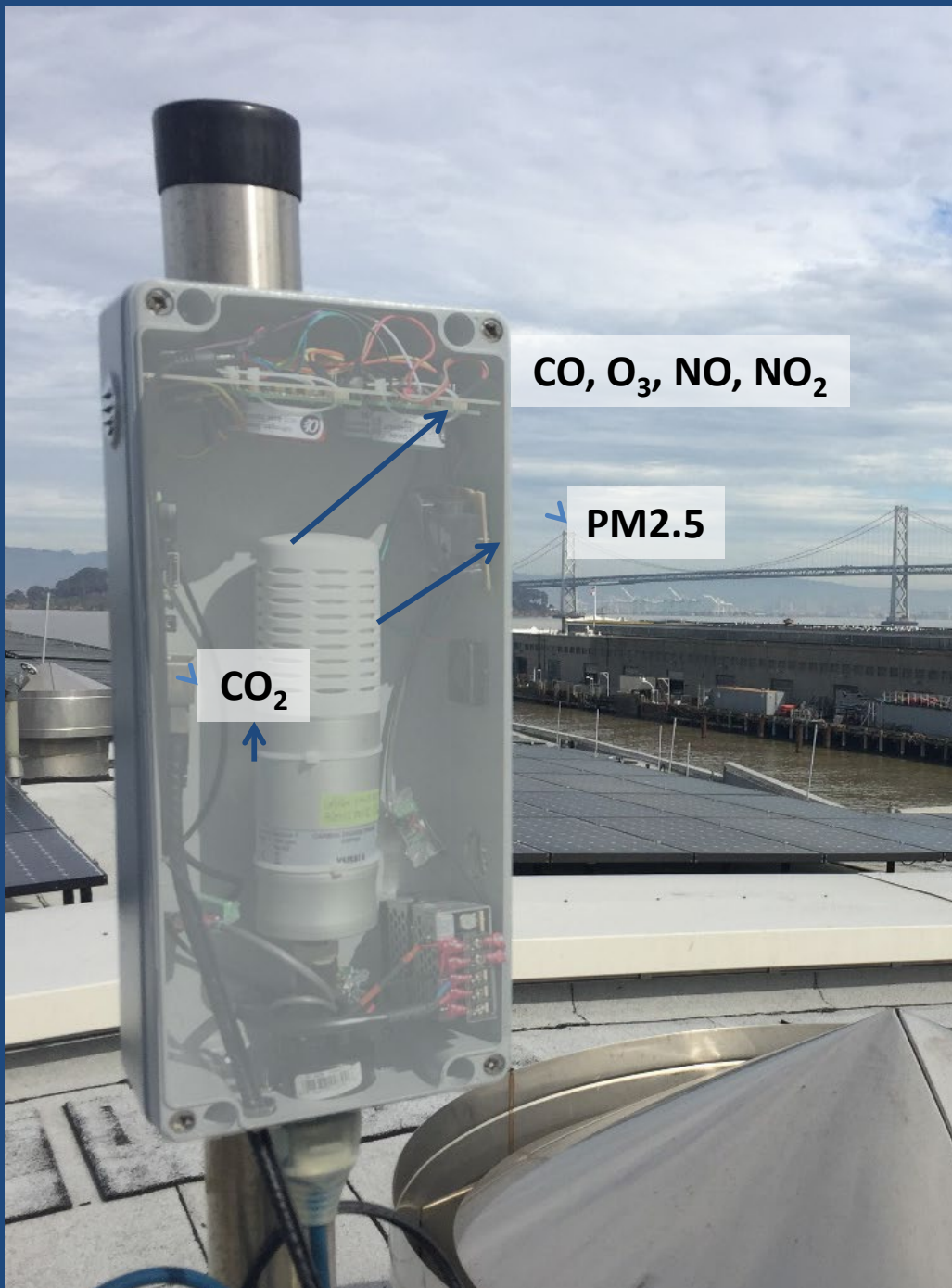
AQ: Are emissions of household organics (e.g. solvents for paint) competitive with emissions from vehicles as source of urban reactive carbon? (and therefore urban SOA?) (McDonald et al. Science 2018)



Courtesy Tina Katopodes Chow

Berkeley Environmental Air Quality and CO₂ Observation Network





CO, O₃, NO, NO₂

PM2.5

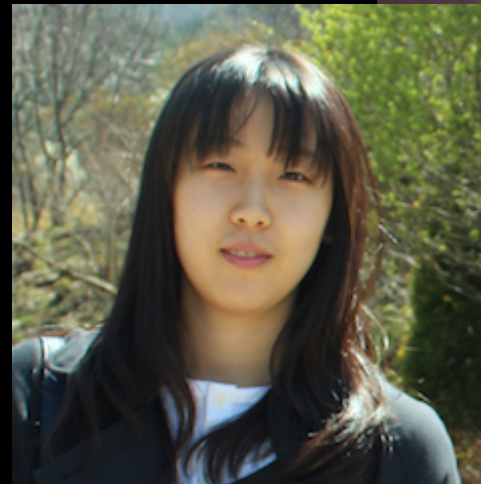
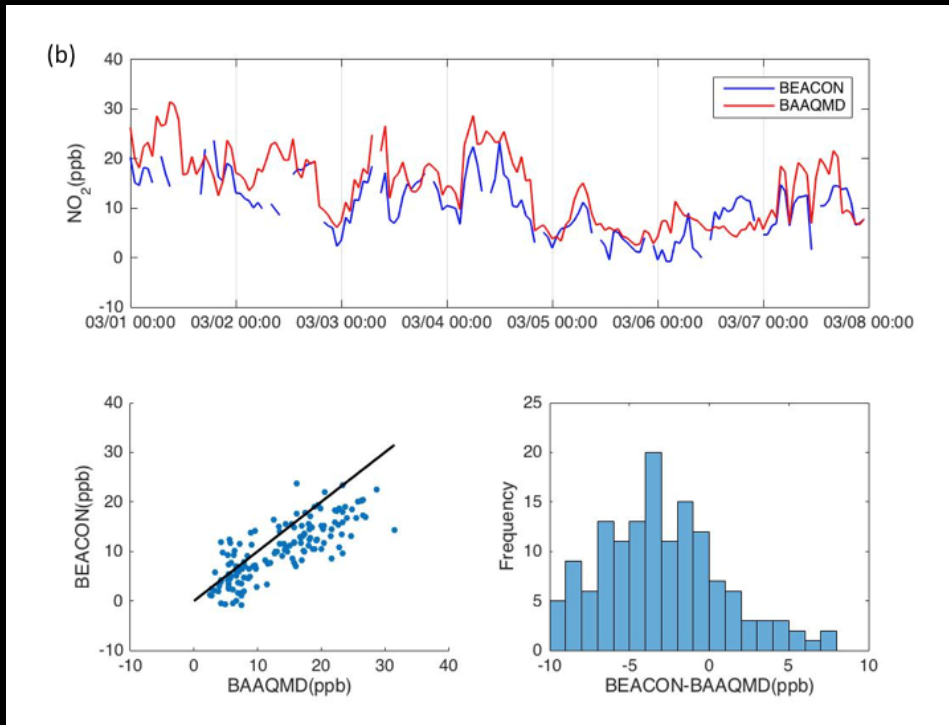
CO₂

**Measure NO₂,
NO, O₃, CO,
CO₂, particles**

**Low cost:
\$6000/node**

**A.A. Shusterman, et al.,
Atmos. Chem. Phys.,
2016**

Calibrating sensors in many locations without gas standards, reference material, ...



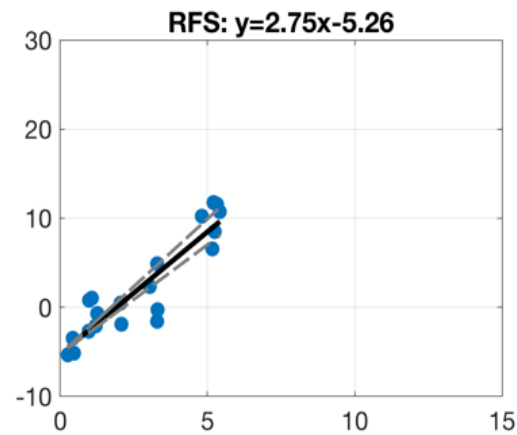
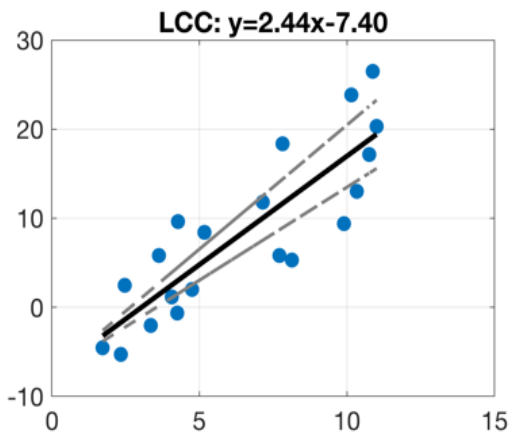
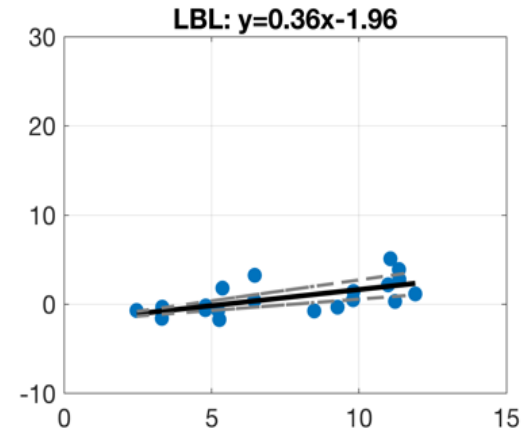
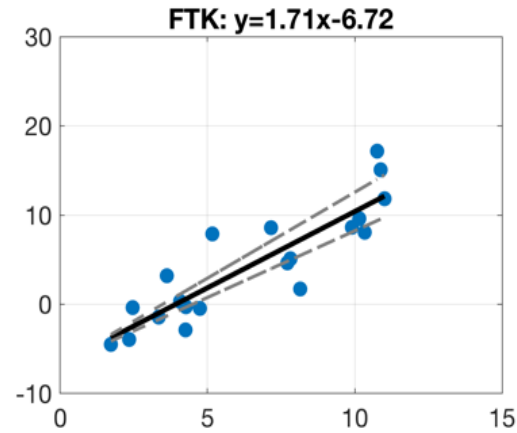
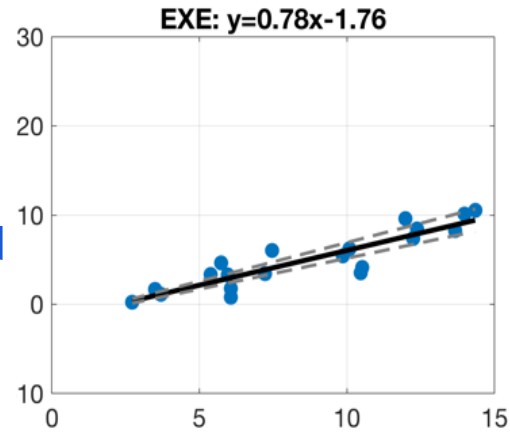
A.A. Shusterman, et al. *The BERkeley Atmospheric CO₂ Observation Network: initial evaluation*, Atmos. Chem. Phys., 2016.

J. Kim, et al. *The BERkeley Atmospheric CO₂ Observation Network: field calibration and evaluation of low-cost air quality sensors*, Atmos. Meas. Tech., 2018.

CO₂



Normalized
Vehicle CO₂

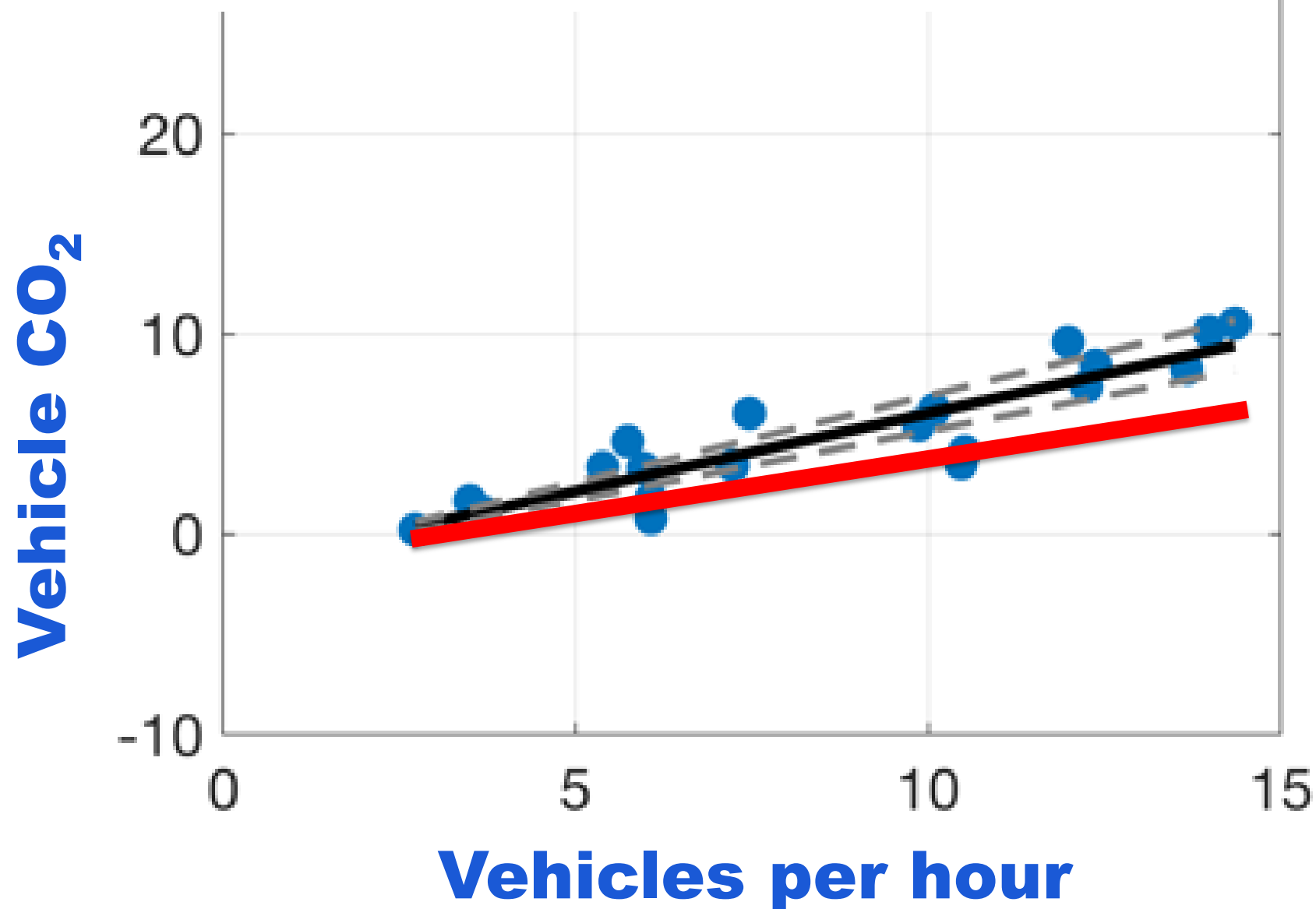


**Shusterman, et al.
ACP 2018**

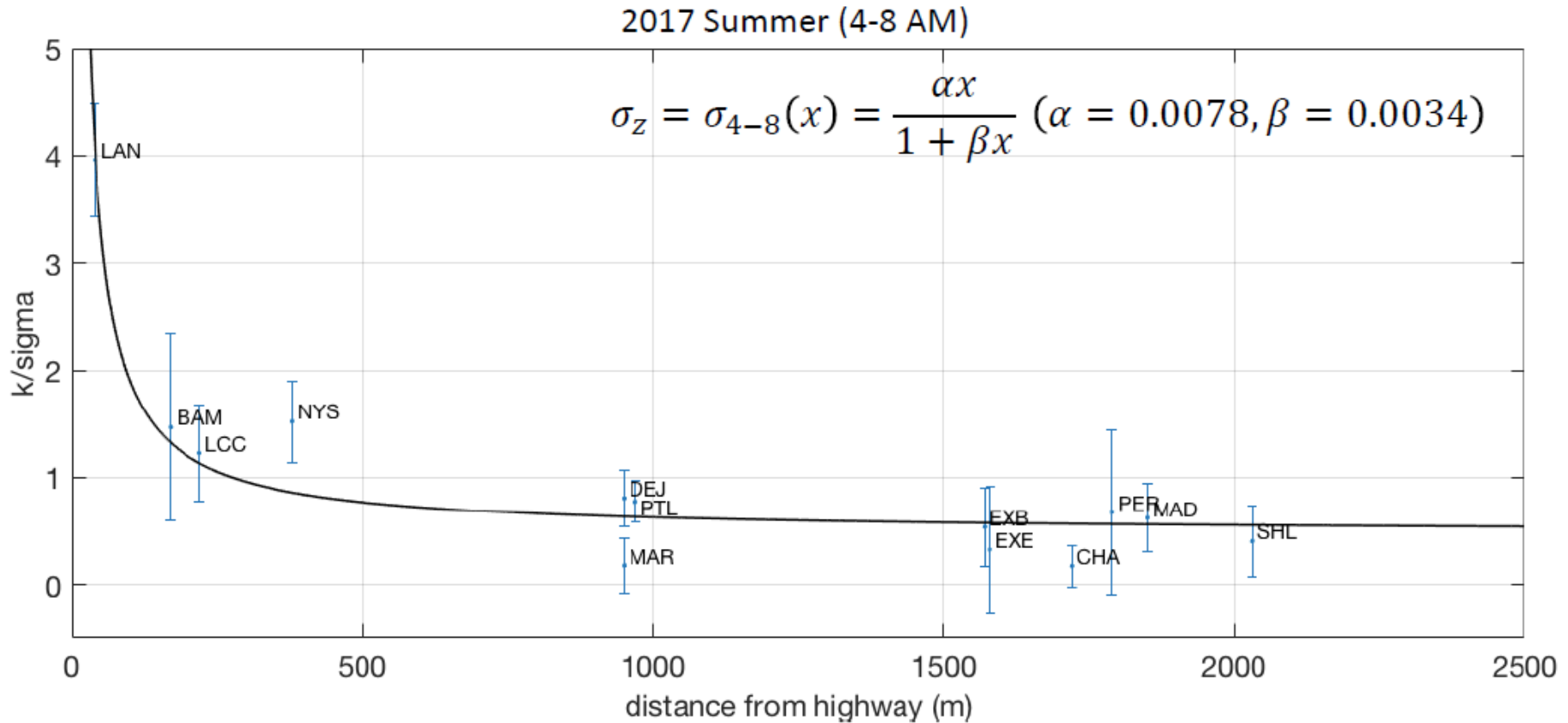
Vehicles per hour

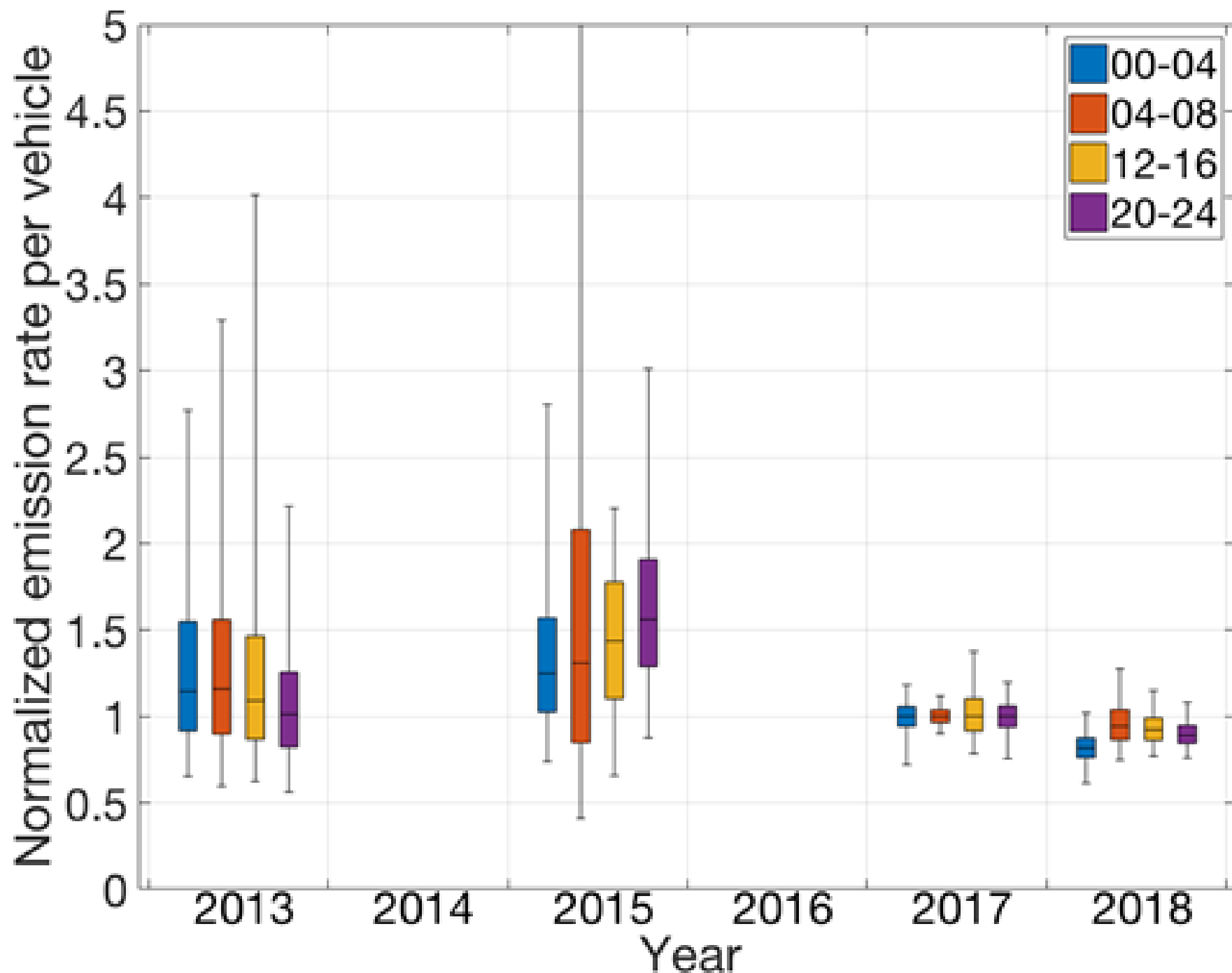
1)

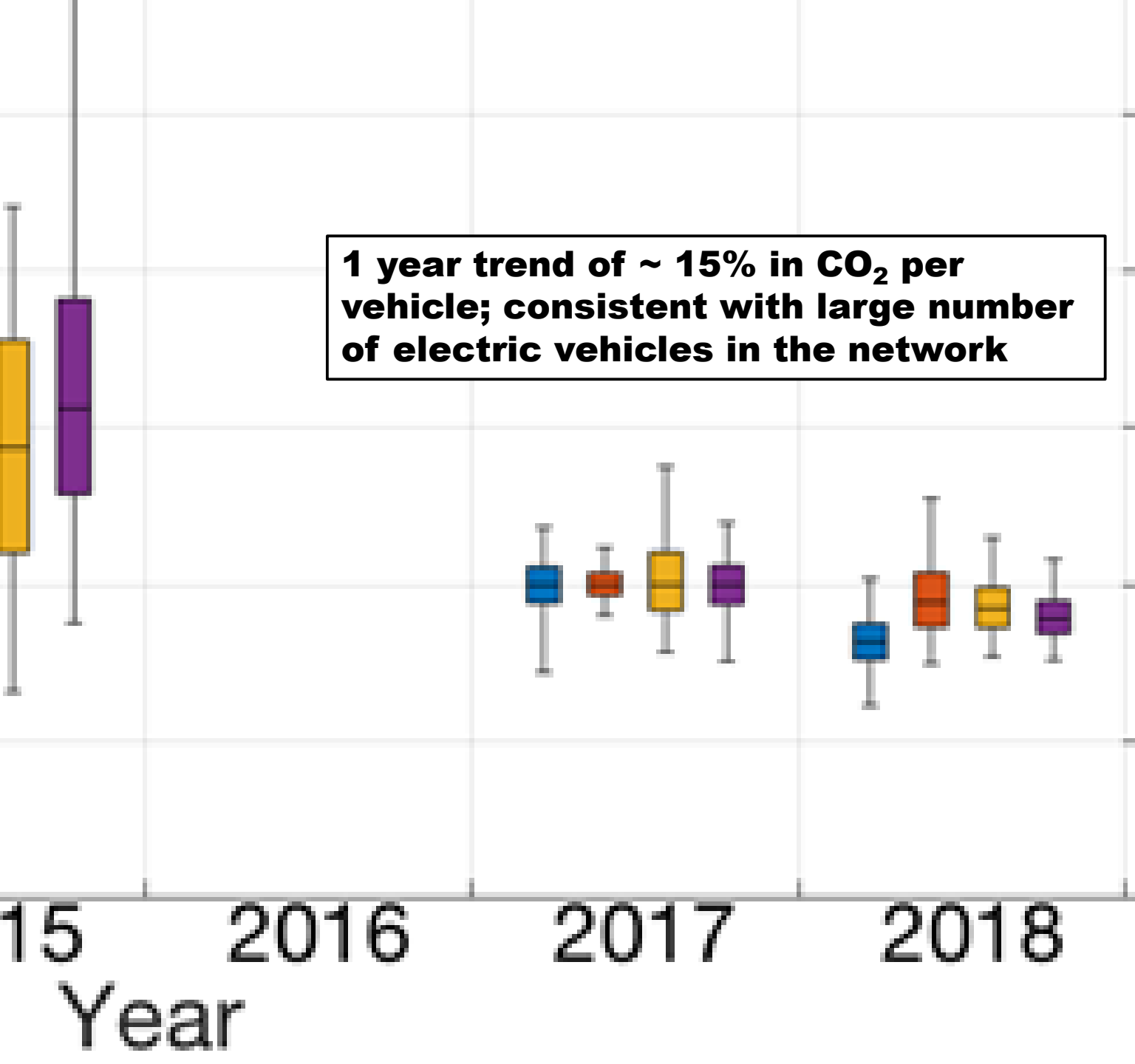
California regulations require 35% decrease by 2025



Organize correlation with vehicle number by distance from the highway—and treat as Gaussian dispersion



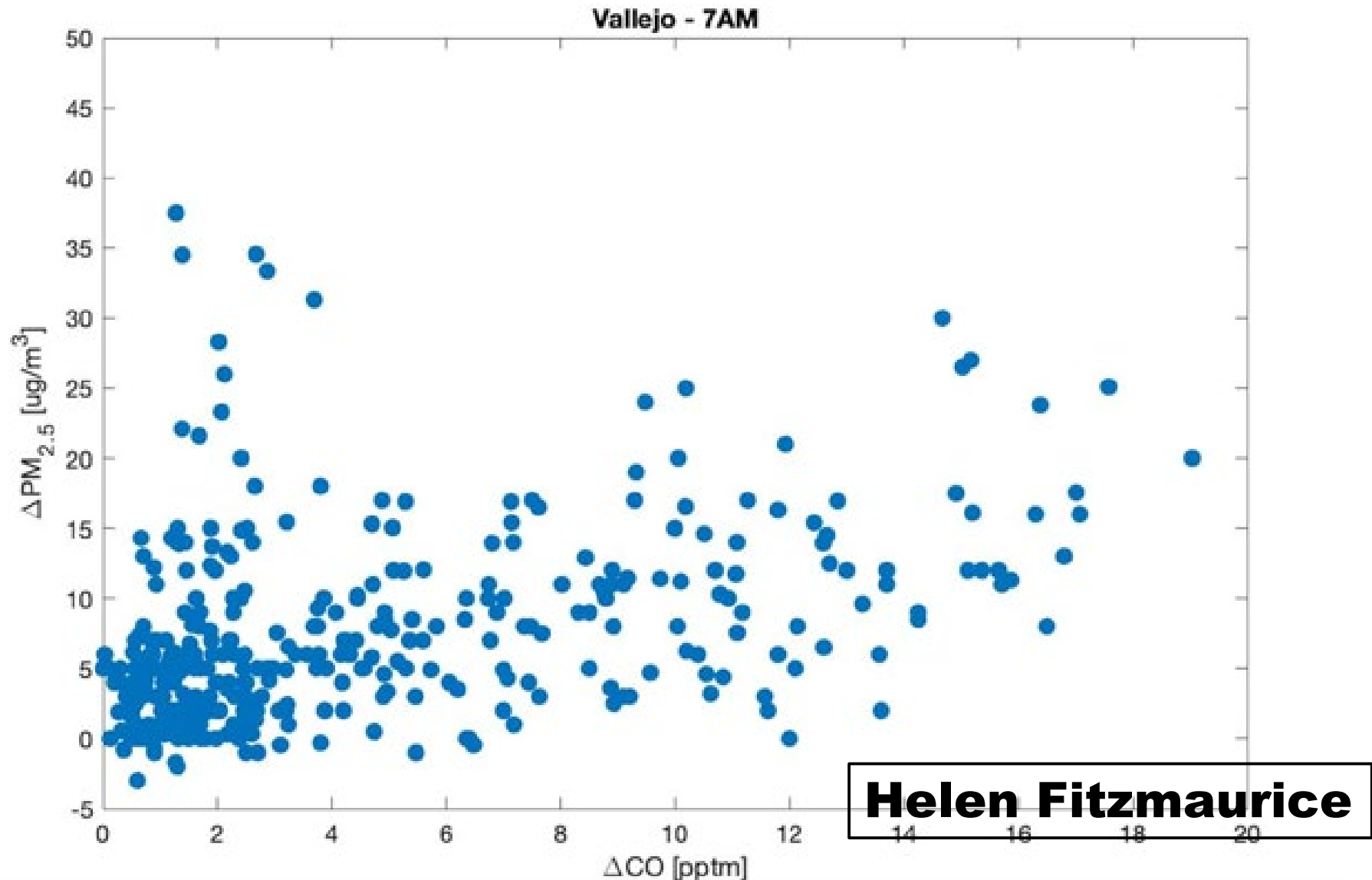




Questions at the core of AQUARIUS where GHGs could help?

- 1) Emissions factors (EF) by sector; trends over time and with season (heating vs. cooling GHGs)**
- 2) What distances from sources are relevant for wintertime exposure to high aerosol?**
- 3) Changes in dominant process/pattern over time:**
 - NO_3 vs OH as a source of HNO_3**
 - NO_x emissions: cold start vs. highway driving vs. zero for electric vehicle**
 - woodstoves vs. vehicles/industry/agriculture**
 - growing importance of non- NH_4NO_3**
- 4) Special case of multiday stagnation**

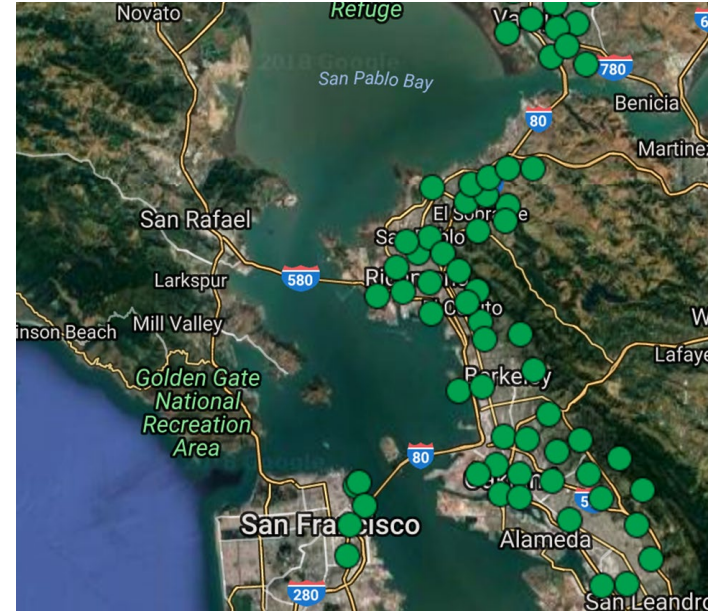
Near road in Bay Area: PM_{2.5} enhancement vs. CO enhancement



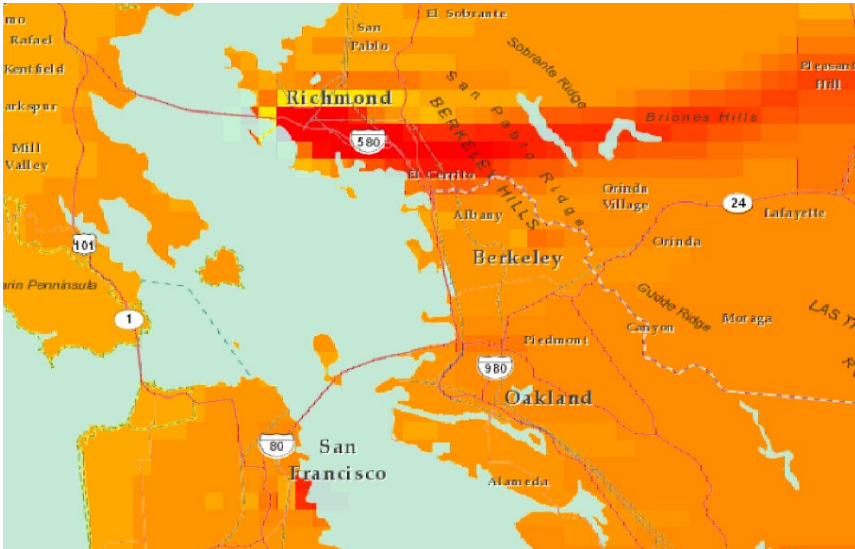
Process Snapshot



Temporal Context



Synthesis through models



Thanks!