United States Environmental Protection Agency

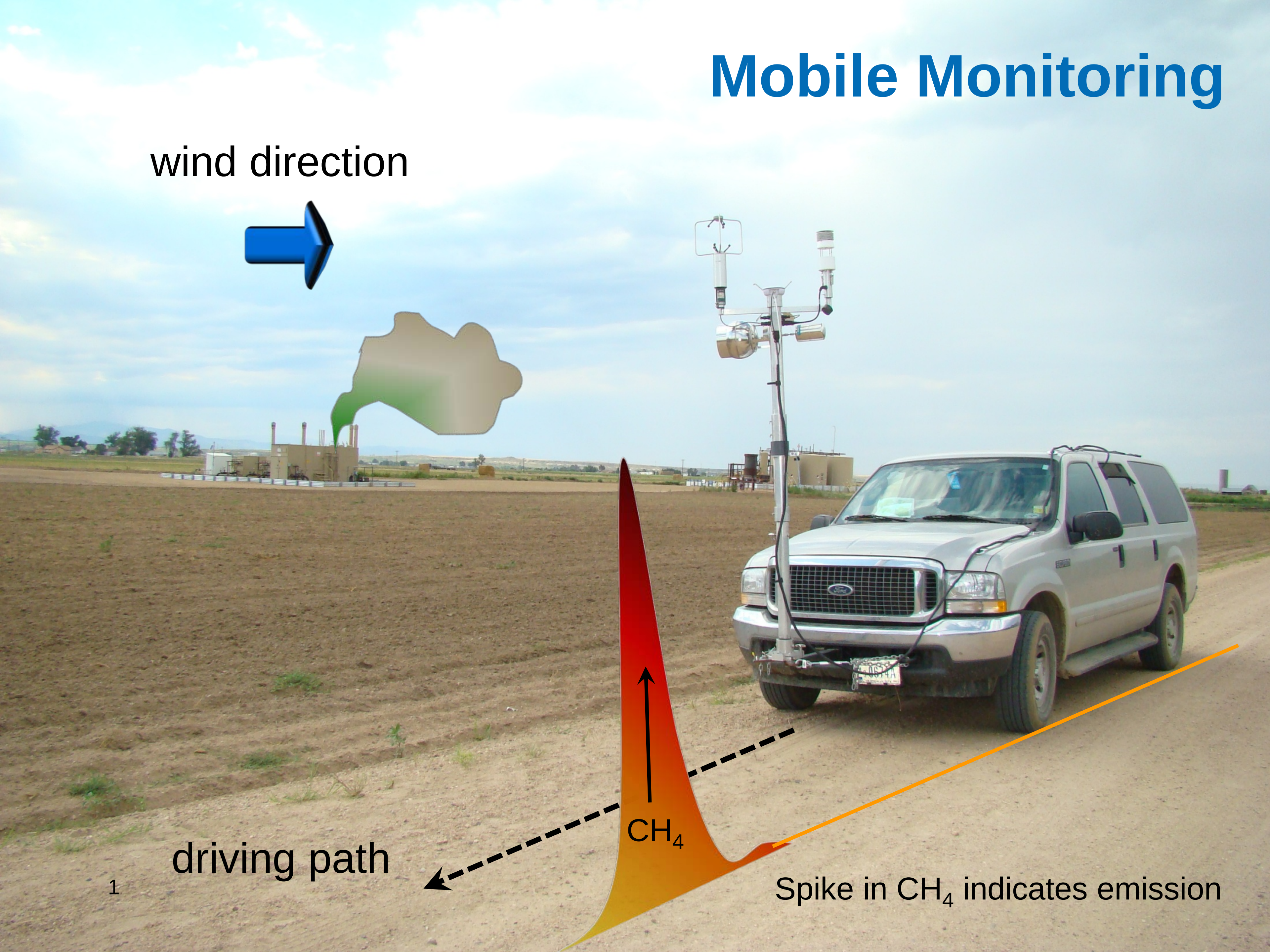
# Mobile Monitoring Data Processing and Analysis Strategies

*Halley Brantley, Gayle Hagler, Eben Thoma*

**Office of Research and Development**
Full Name of Lab, Center, Office, Division or Staff goes here.

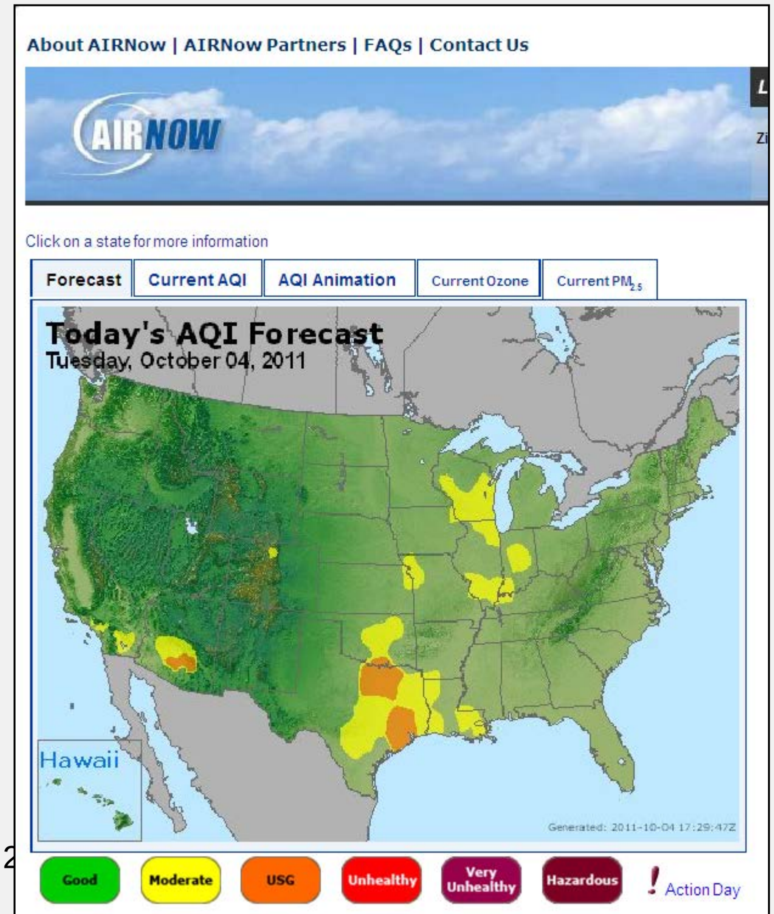
**Date**

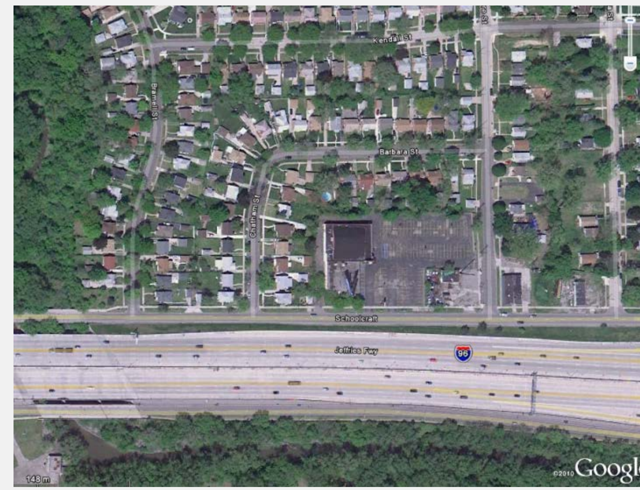
# Mobile Monitoring

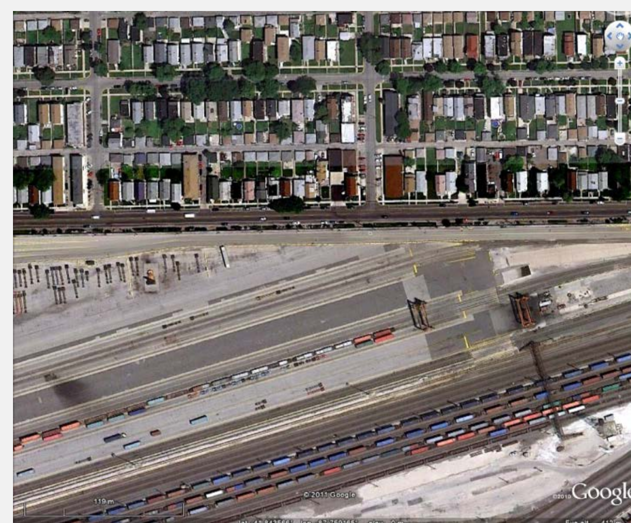


# Fine spatial scale – stretching measurement and modeling limits

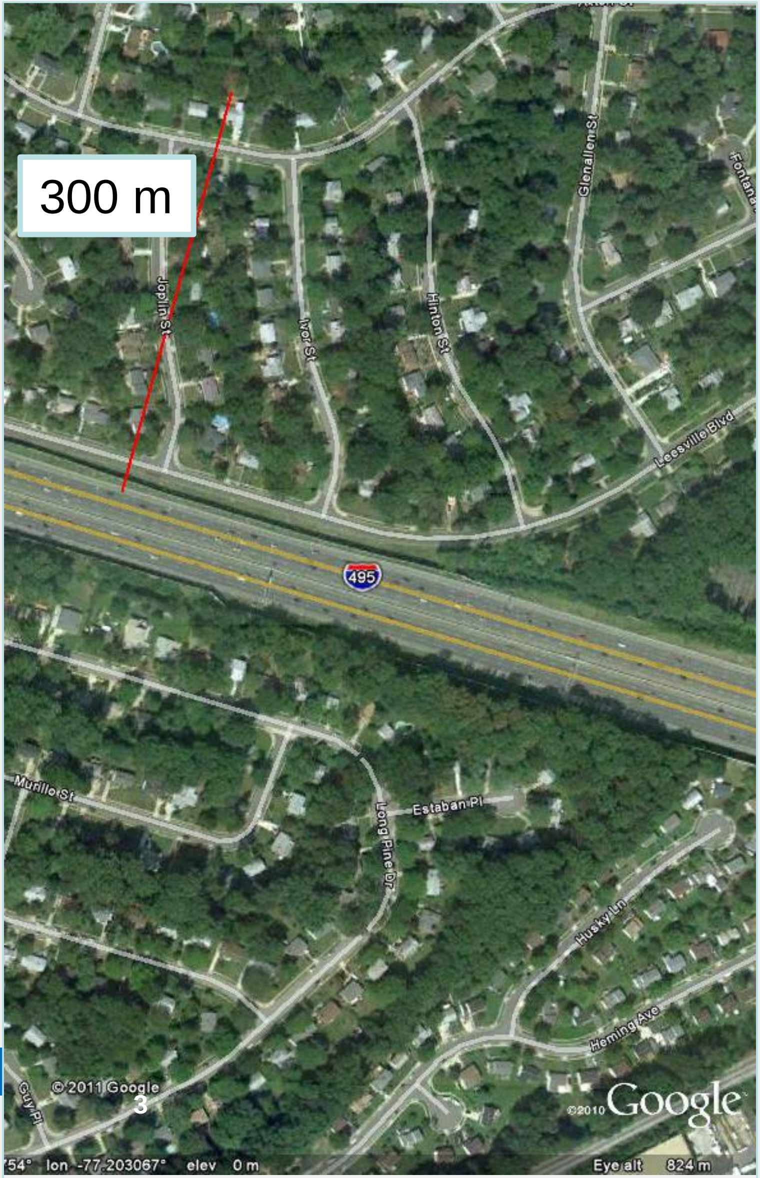
Moving from regional-scale (10s of km) to local-scale (10s of meters) assessment



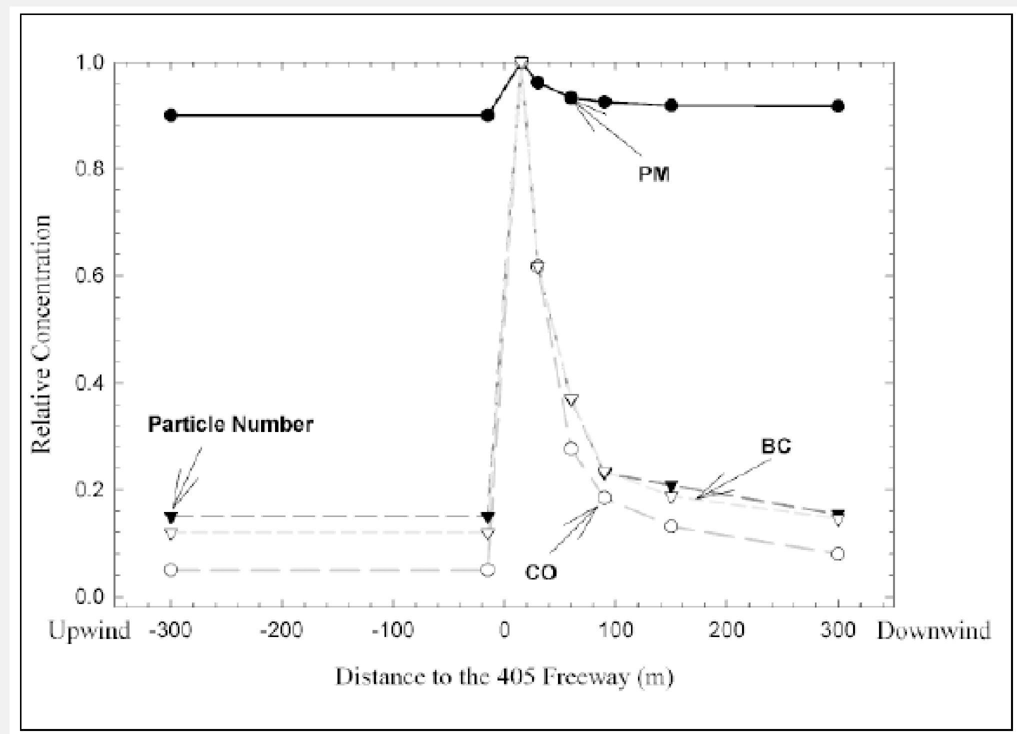



# What do we mean by “near-source” air pollution?




Over 45 million people in the United States live within 100 meters of a major transportation system.




Zhu et al (2002)

EPA
United States
Environmental Protection
Agency

# Traffic-related air pollution and health effects


Sufficient evidence

Exacerbation of childhood asthma

Suggestive, but more evidence needed

Onset of childhood asthma

All-cause and cardiovascular mortality from long-term exposure

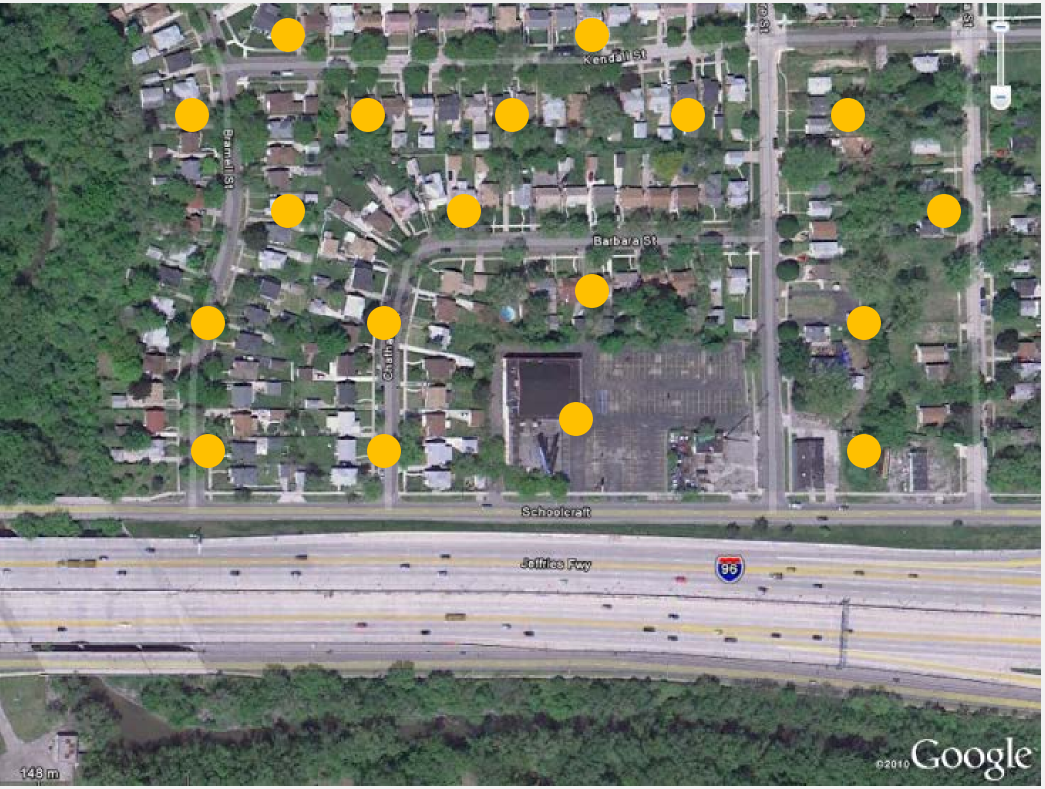
Cardiovascular morbidity

Impaired lung function

Nonasthma respiratory symptoms

# Fine spatial scale – measurements

Assessing near-source areas – what you'd love to have:




Measurements in many locations in near-source areas

Robust, long-term measurements

Key species indicating local emissions impact

Real-time data (minutes)

Ability to handle multi-site real-time data and quickly identify important features

# Fine spatial scale – measurements

Moving towards these goals on several fronts….

→ Developing mobile monitoring approaches: map air quality with one set of advanced air pollution instruments

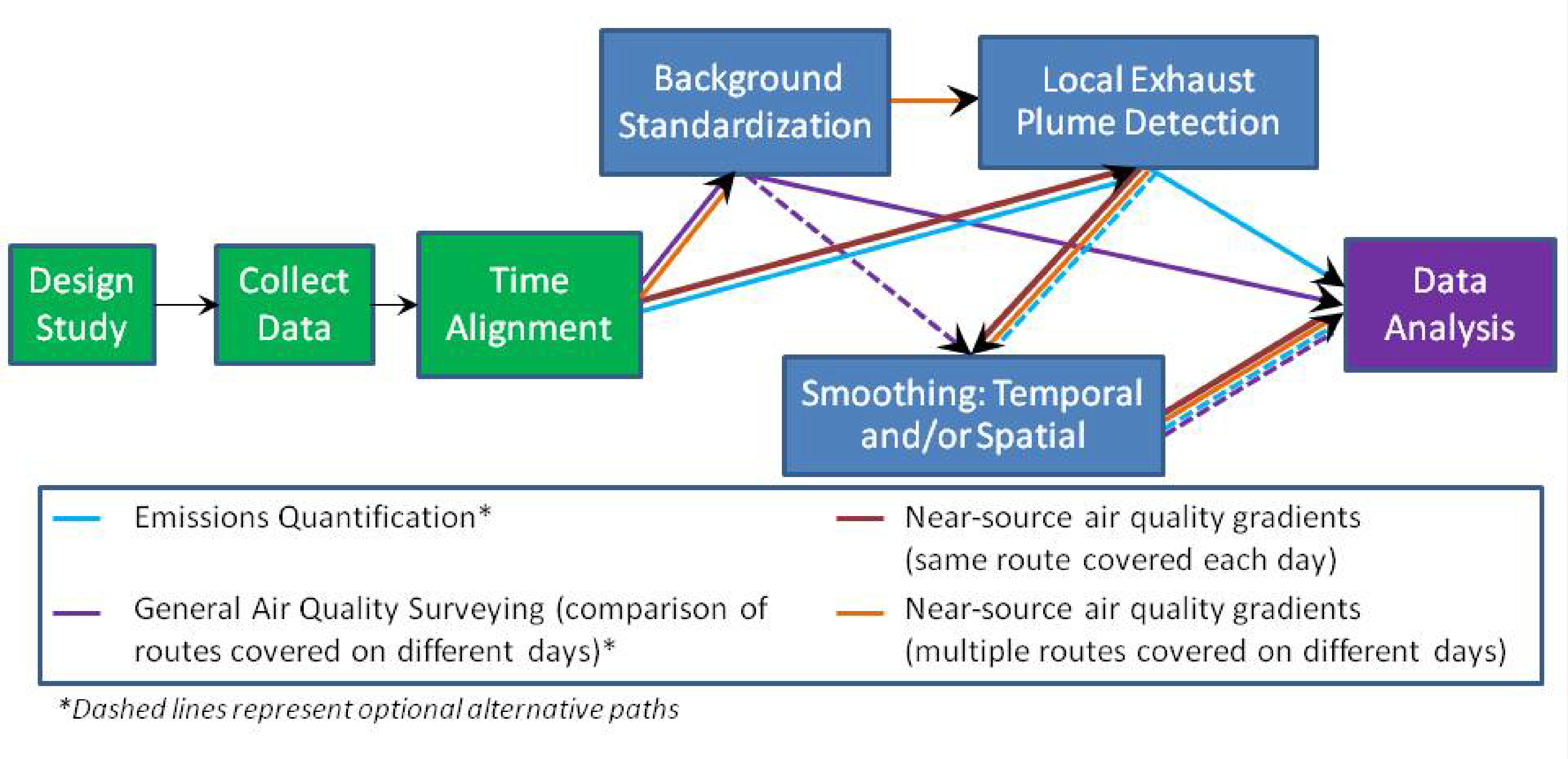
<u>Electric platform:</u>

- Zero-emissions
- 100 mile range
- Customized for on-board sampling

<u>Measurements:</u>

- Particulate matter (ultrafine to coarse)
- Carbon monoxide
- Black carbon
- Nitrogen dioxide
- 1 Hz sampling → ~10-15 m spatial resolution


# Framework for mobile monitoring studies



# Definitions

1. Local exhaust plumes – tail pipe exhaust near sampling inlet.
2. Local air pollution – well-mixed air affected by one or more known local sources and modulated by local wind.
3. Background – representative ambient air quality conditions without detectable impact of a nearby source.

EPA
United States
Environmental Protection
Agency

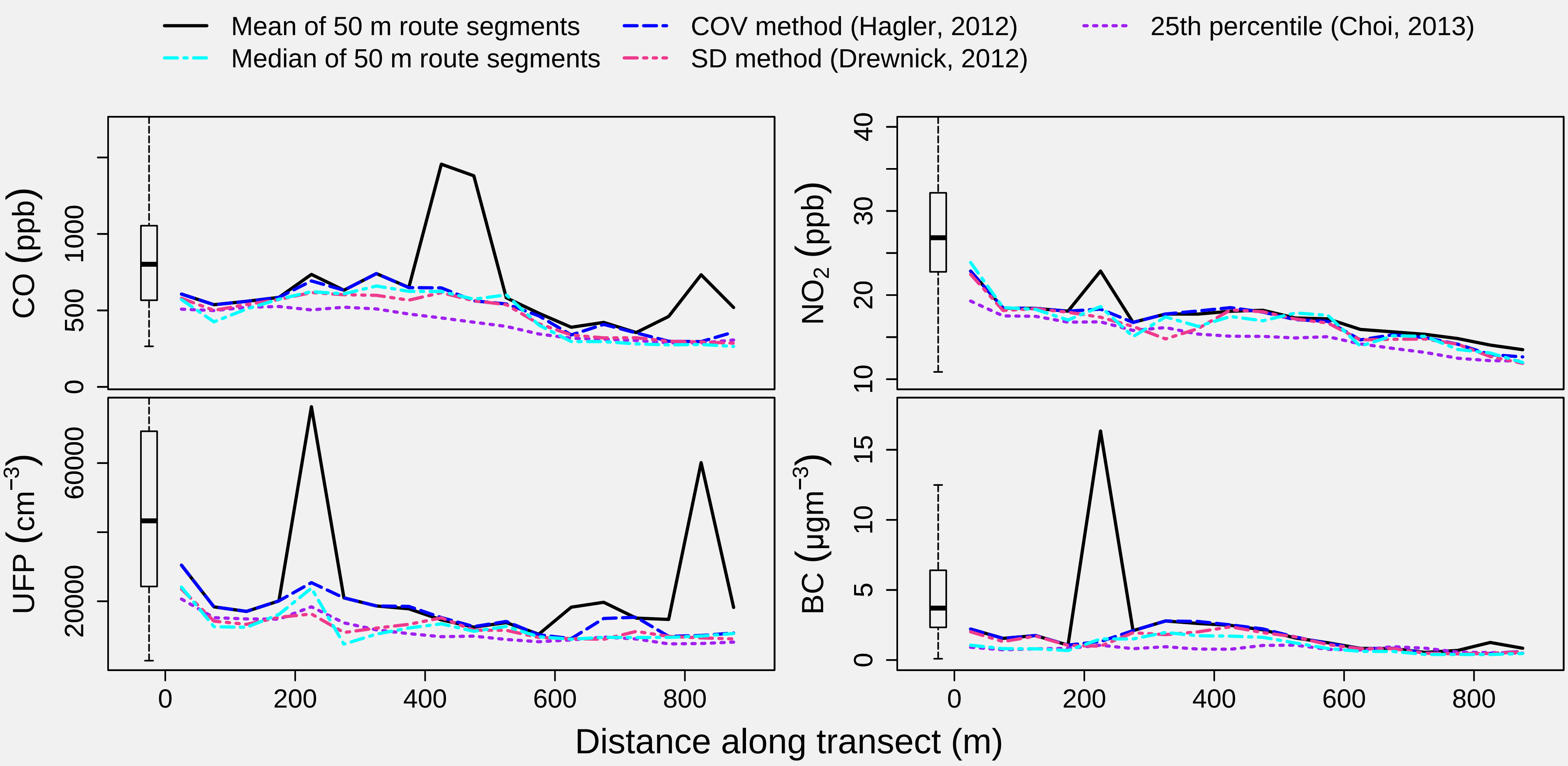
# Description of Data used to compare analysis strategies

- Field study conducted in the summer of 2012 in Raleigh, Durham and Chapel Hill.
- Goal: characterize spatial variation in traffic related air pollution.
- 40 hours of data collected during weekday mornings on 24 days spanning 12 routes.

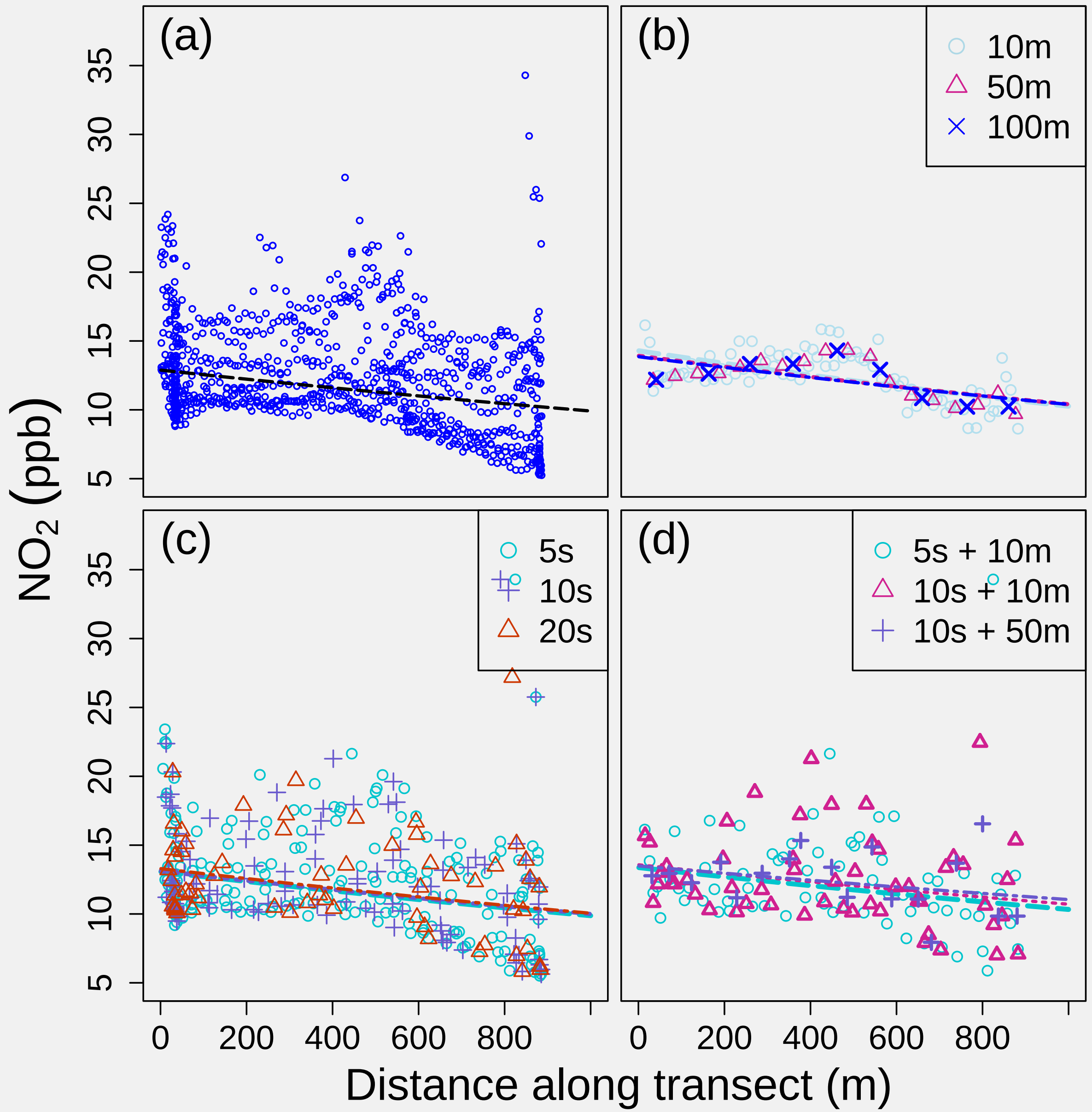
# Example mobile monitoring data

(c)

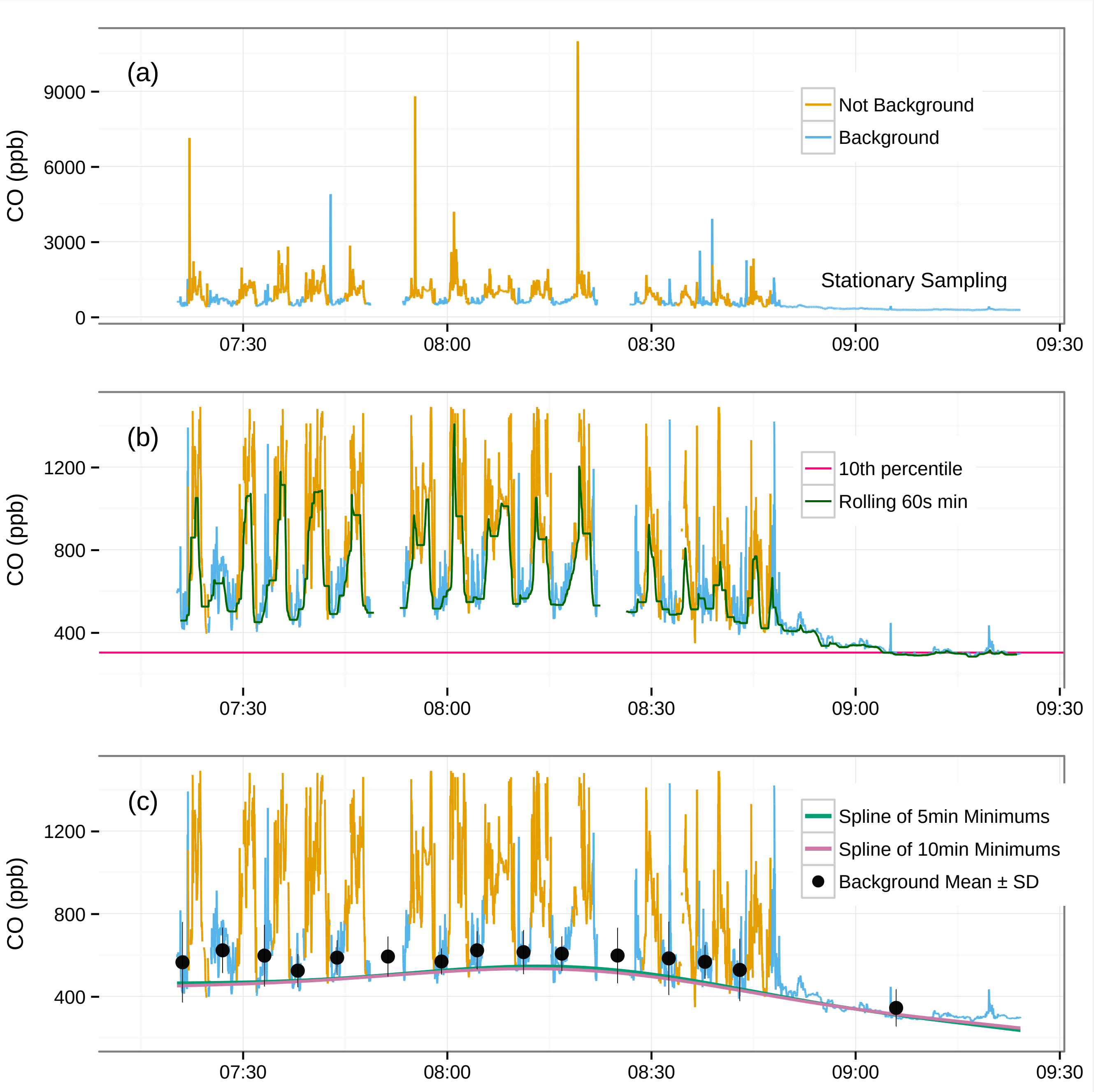
# Removing influence of local exhaust plumes when analyzing near-source pollution gradients



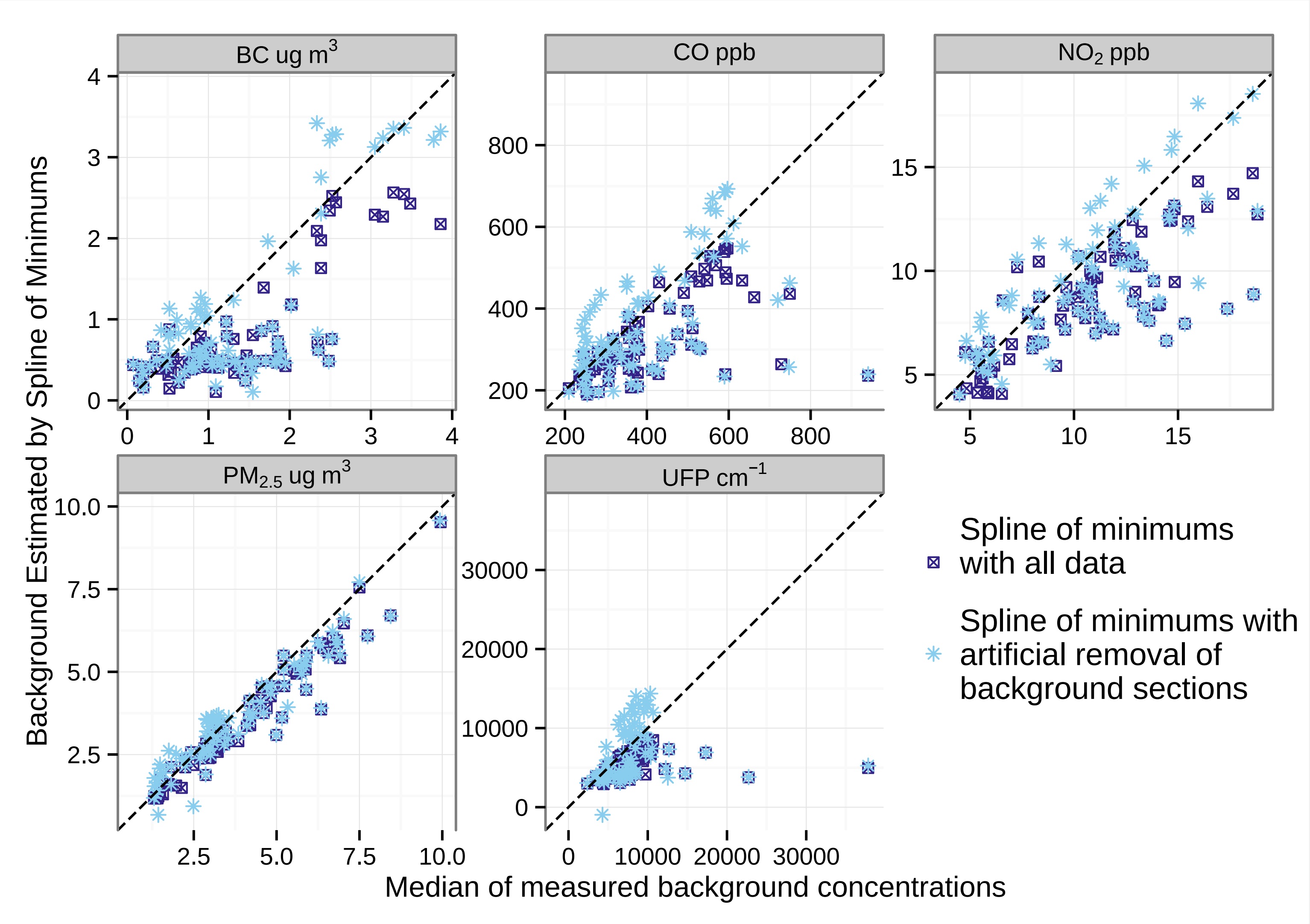
# Effect of spatial and temporal smoothing when analyzing near-source pollution gradients



# Different Methods of Estimating Background Concentrations



# Estimating Background Concentrations: Comparing a location based method with a time-series based method

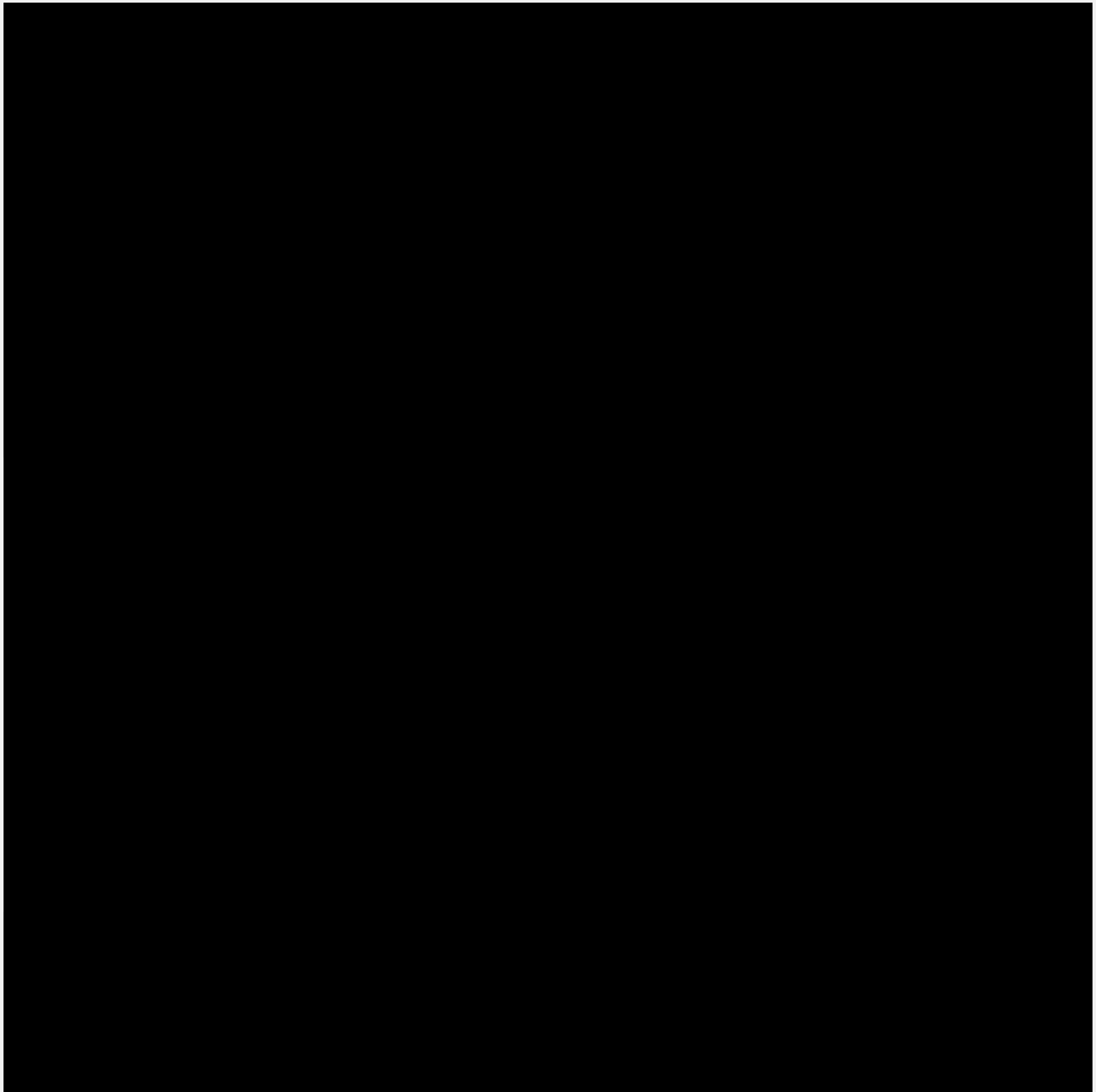





11/3/2015

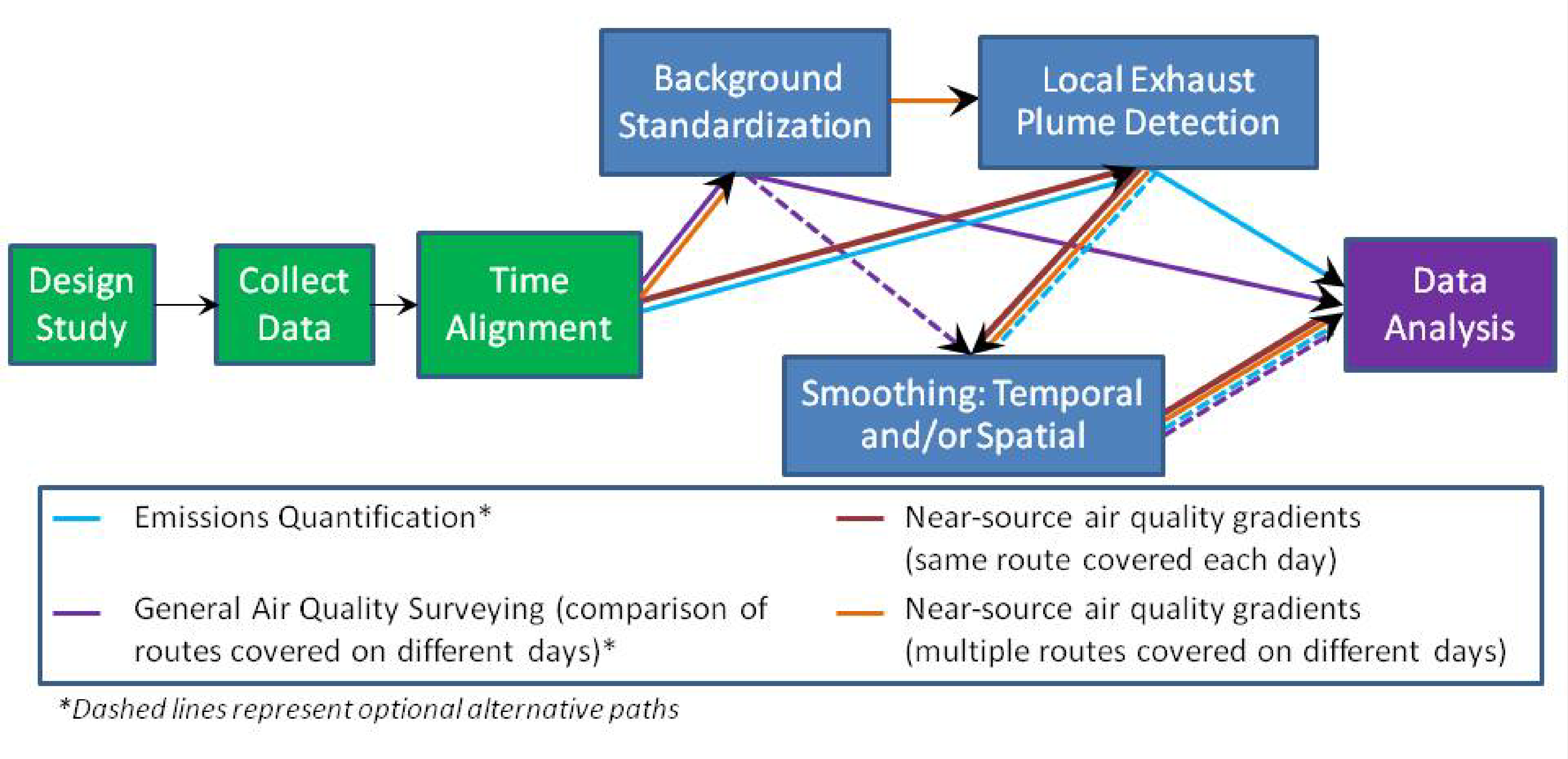
United States Environmental Protection Agency

# Effect of background standardization on general air quality surveys



EPA United States Environmental Protection Agency

# Framework for mobile monitoring studies



# Acknowledgements

**EPA**

**ORD:** Sue Kimbrough, Ron Williams, Lucas Neas, Shaibal Mukerjee, Richard Shores, Bob Wright

**Arcadis**

Parikshit Deshmukh

# References

Brantley, H. L., Hagler, G. S. W., Kimbrough, S., Williams, R. W., Mukerjee, S., & Neas, L. M. (2013). Mobile air monitoring data processing strategies and effects on spatial air pollution trends. *Atmospheric Measurement Techniques Discussions*, *6*(6).

Health Effects Institute. Panel on the Health Effects of Traffic-Related Air Pollution. (2010). *Traffic-related air pollution: a critical review of the literature on emissions, exposure, and health effects* (No. 17). Health Effects Institute.

Zhu, Y., Hinds, W. C., Kim, S., & Sioutas, C. (2002). Concentration and size distribution of ultrafine particles near a major highway. *Journal of the air & waste management association*, *52*(9), 1032-1042.