

Exploring the Spatial Representativeness of NAAQS and Near Roadway Sites Using High- Spatial Resolution Air Pollution Maps Produced by a Mobile Mapping Platform



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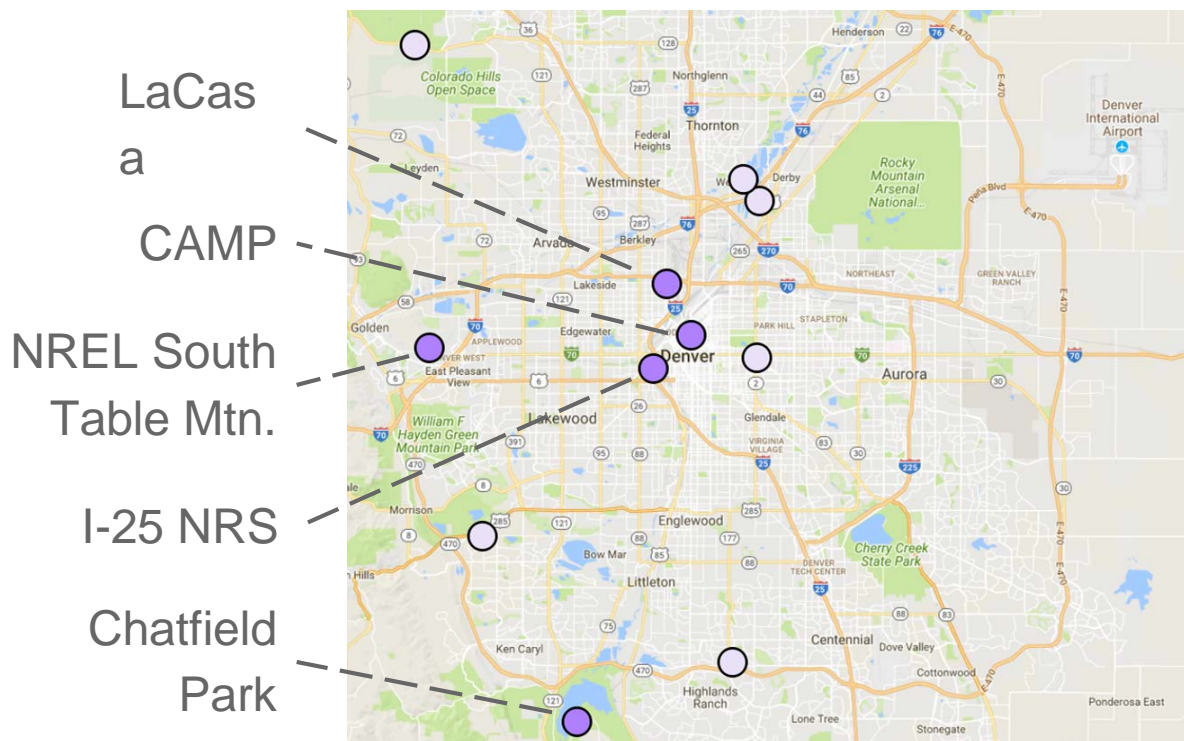
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Denver Street View validation project

- Focused on testing mobile laboratory
 - Accurate measurements for advancing platform
- Instrumented 3 Google Street View cars
 - Deployed simultaneously for QA and spatial analysis
- Evaluate as mobile measurement platform
 - Inlet, manifold, instruments
 - Sampling, power, comms, operations
 - Driving approach
- Validate mobile platform as basis for development and performance verification of small-scale, sensor-based devices





System Validation

1. Mobile Lab (reference equipment) Agreement to Stationary Sites
2. Agreement Between 3 Mobile Labs - moving and parked

Application

3. On-road vs Central Monitoring Site
I-25 Near Roadway Site
4. Stationary Site Representativeness of Nearby Area
5. City-wide Pollutant Variability
6. Local Pollutant Variability



Location + Meteorology

Latitude & Longitude
Vehicle Speed and
Heading
Wind Direction
Wind Speed
External Temperature
External Pressure

Reference Equipment

Ozone
Nitrogen Dioxide
Nitric Oxide
Black Carbon
PN 2.5

Sample rate = 1 Hz

Driving patterns designed to explore variability over different length scales

Very Dense:
~100-200m



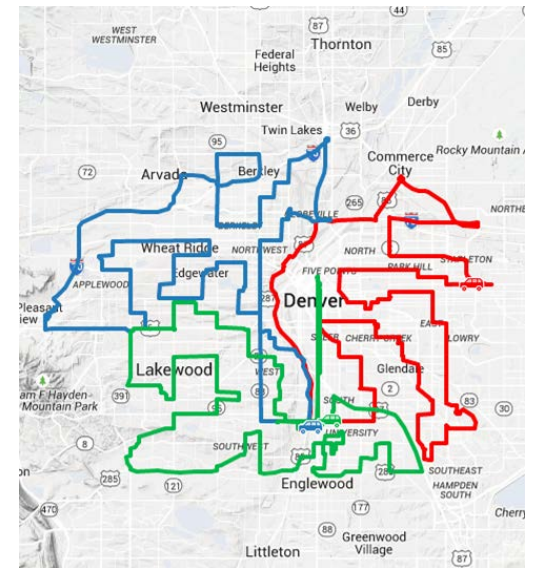
Local

Dense:
~500-1000m



Community

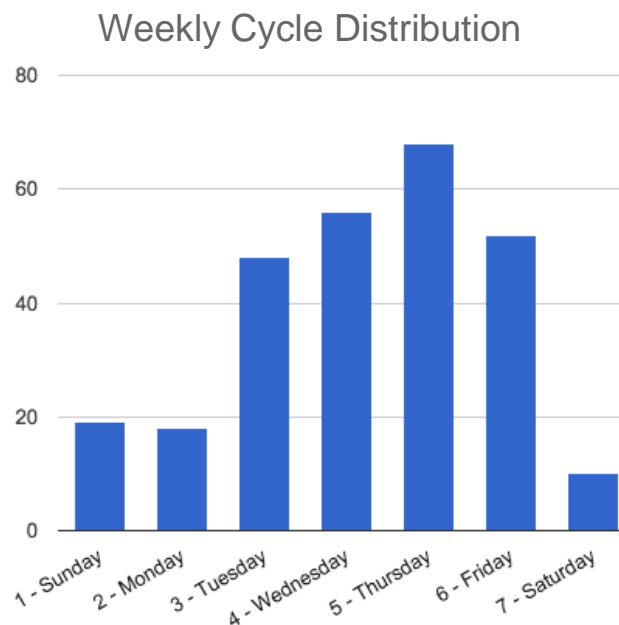
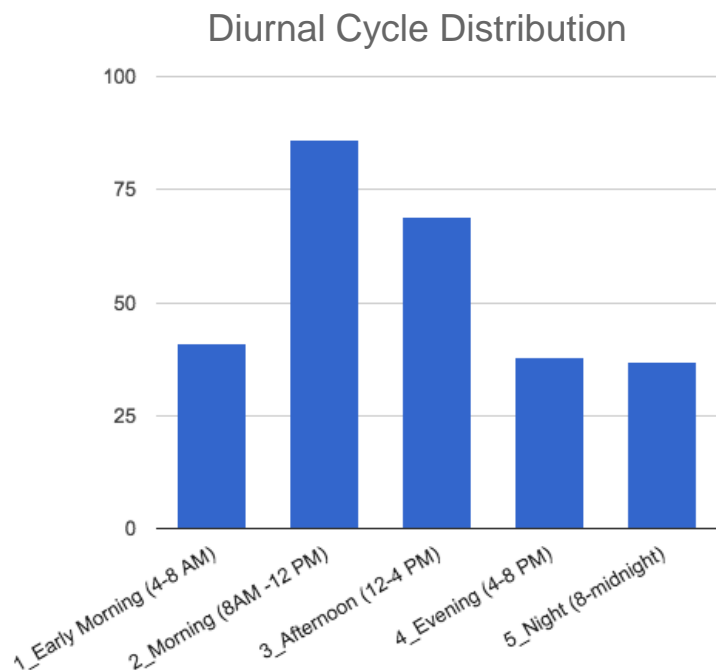
Sparse:
~1500-2500m



Region

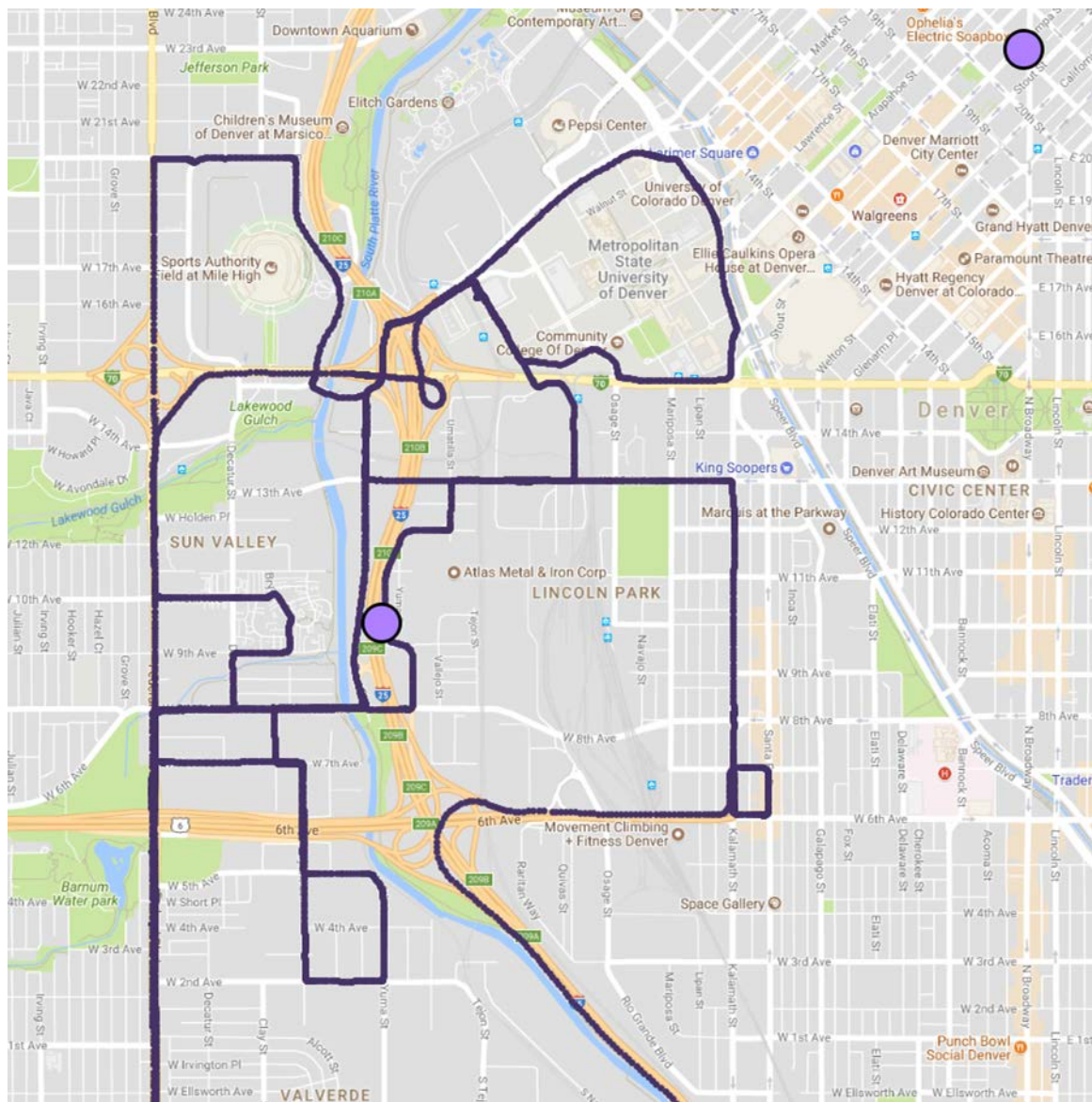
Driving a new class of data

- 22 days of data collection - July 25 through Aug 15
- 750+ hours of drive time
- 150 Million data points correlated to EPA sites
- Driving distributed temporally

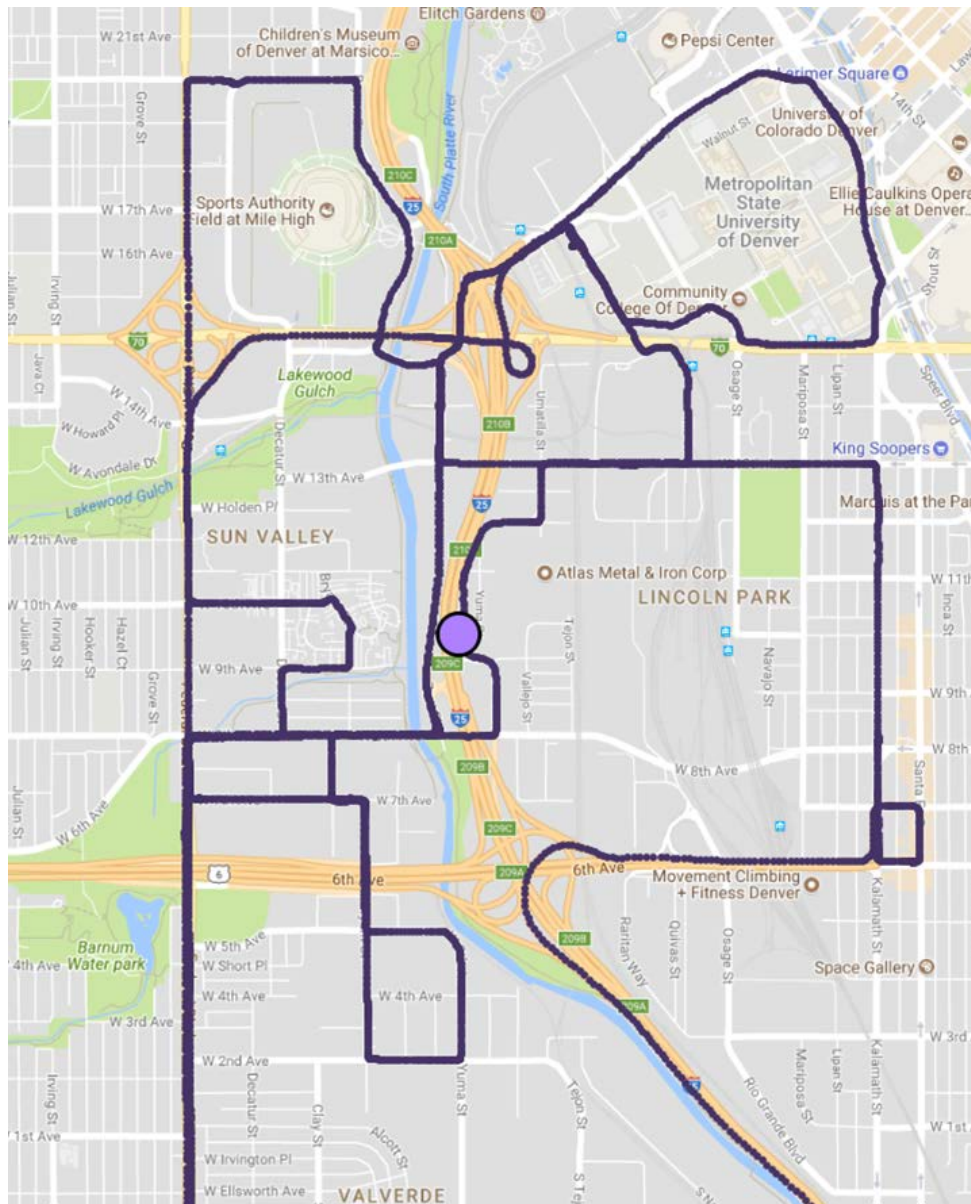


- **Good correlation between cars**
 - Parked - agreement better than 10% (except NO)
 - Moving - correlations better than 0.75
- **Collocation with NAAQS site show influence of street emissions, but results fall around the 1:1 line**

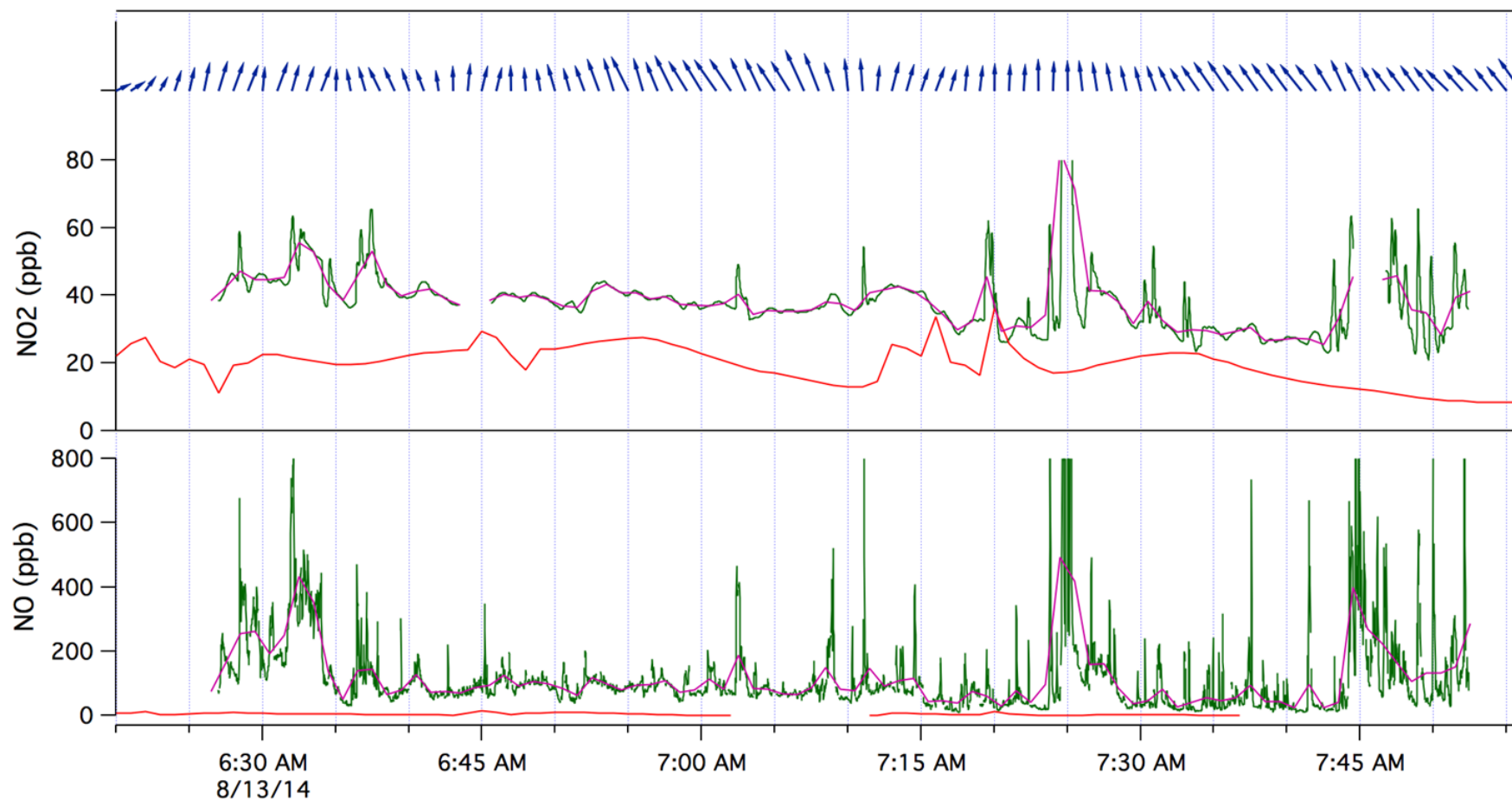
Driving pattern around I-25 NRS



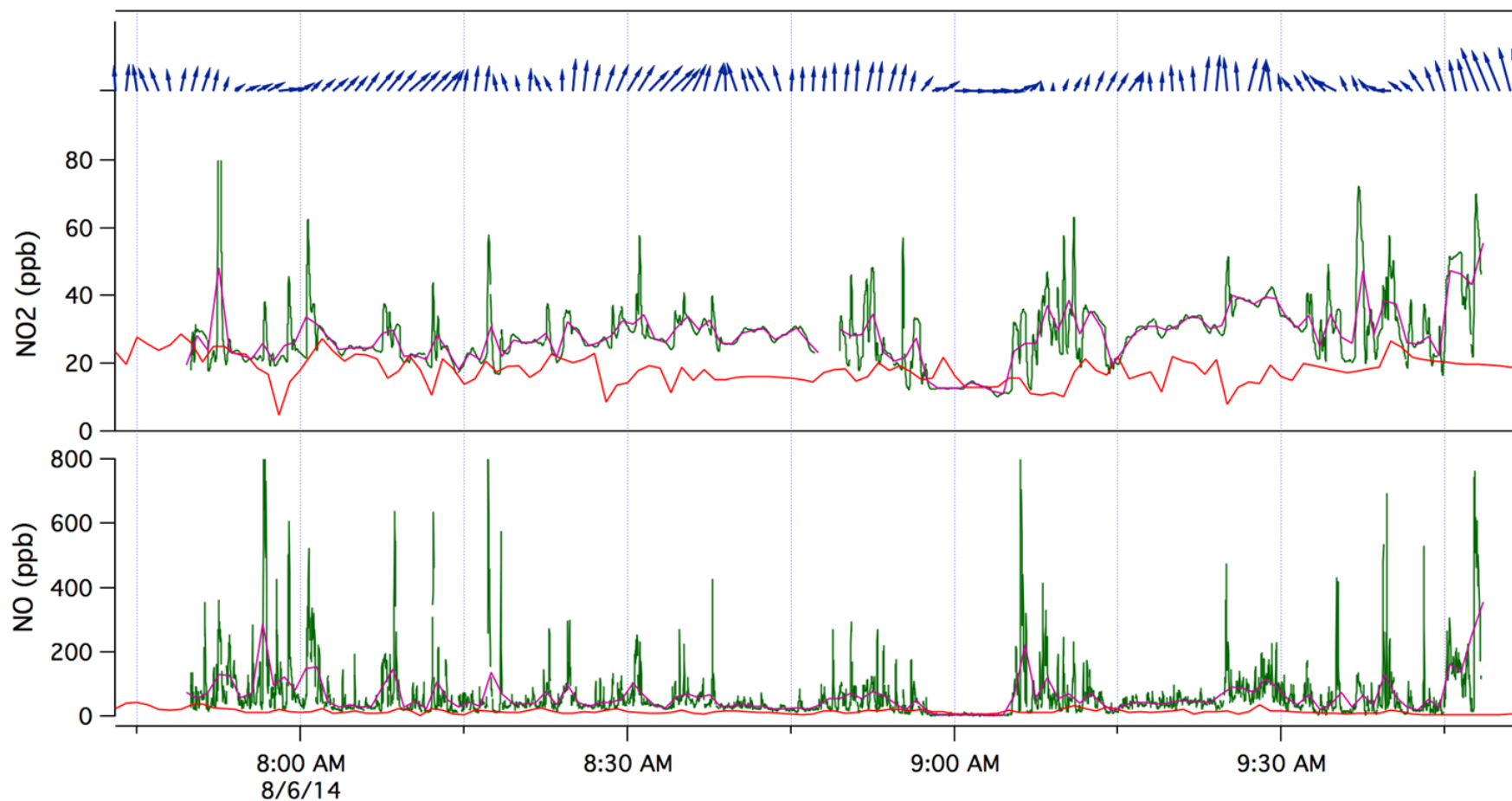
Driving pattern around I-25 NRS



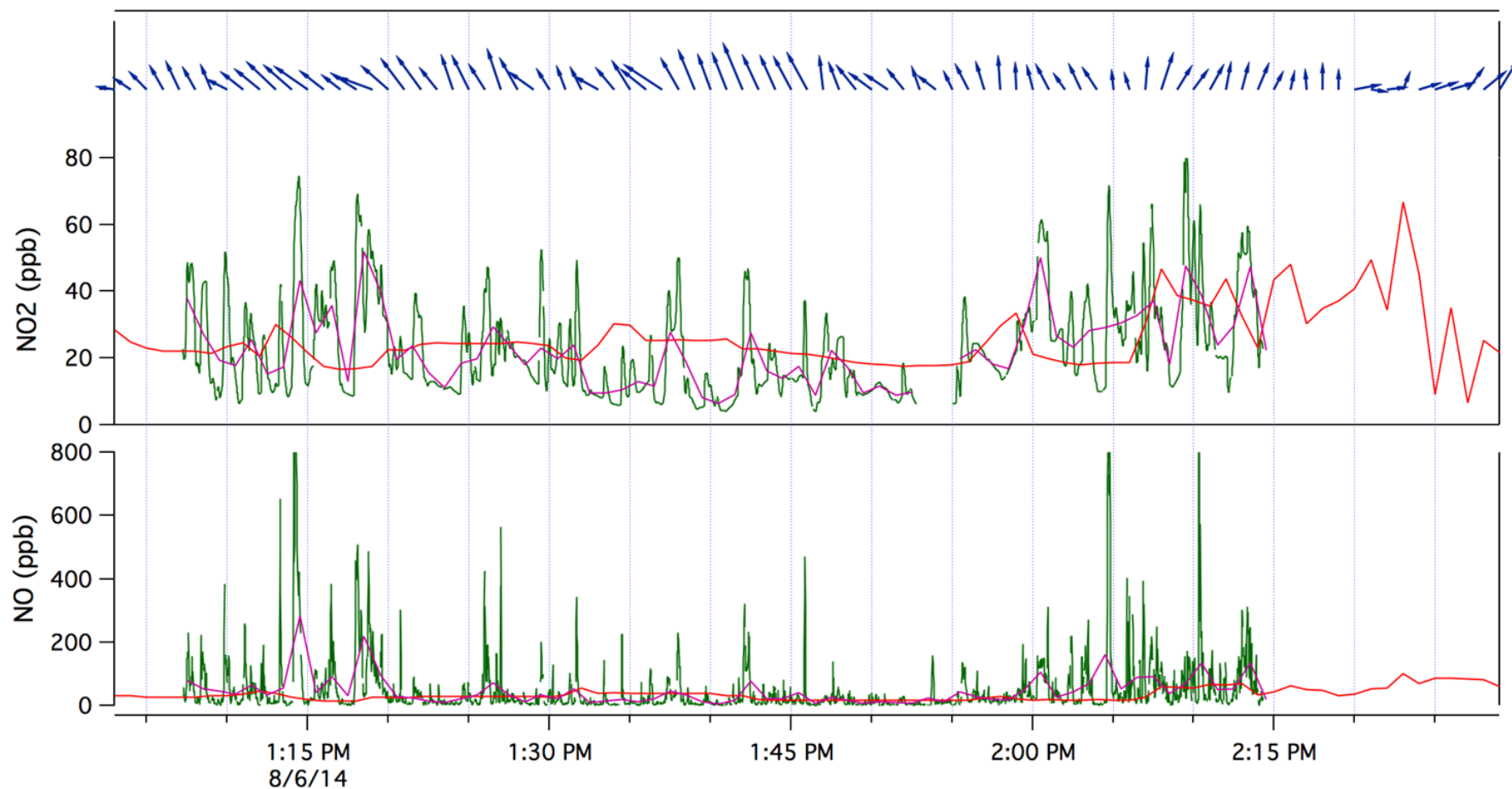
Measured concentrations vary between vehicles and NRS with time of day



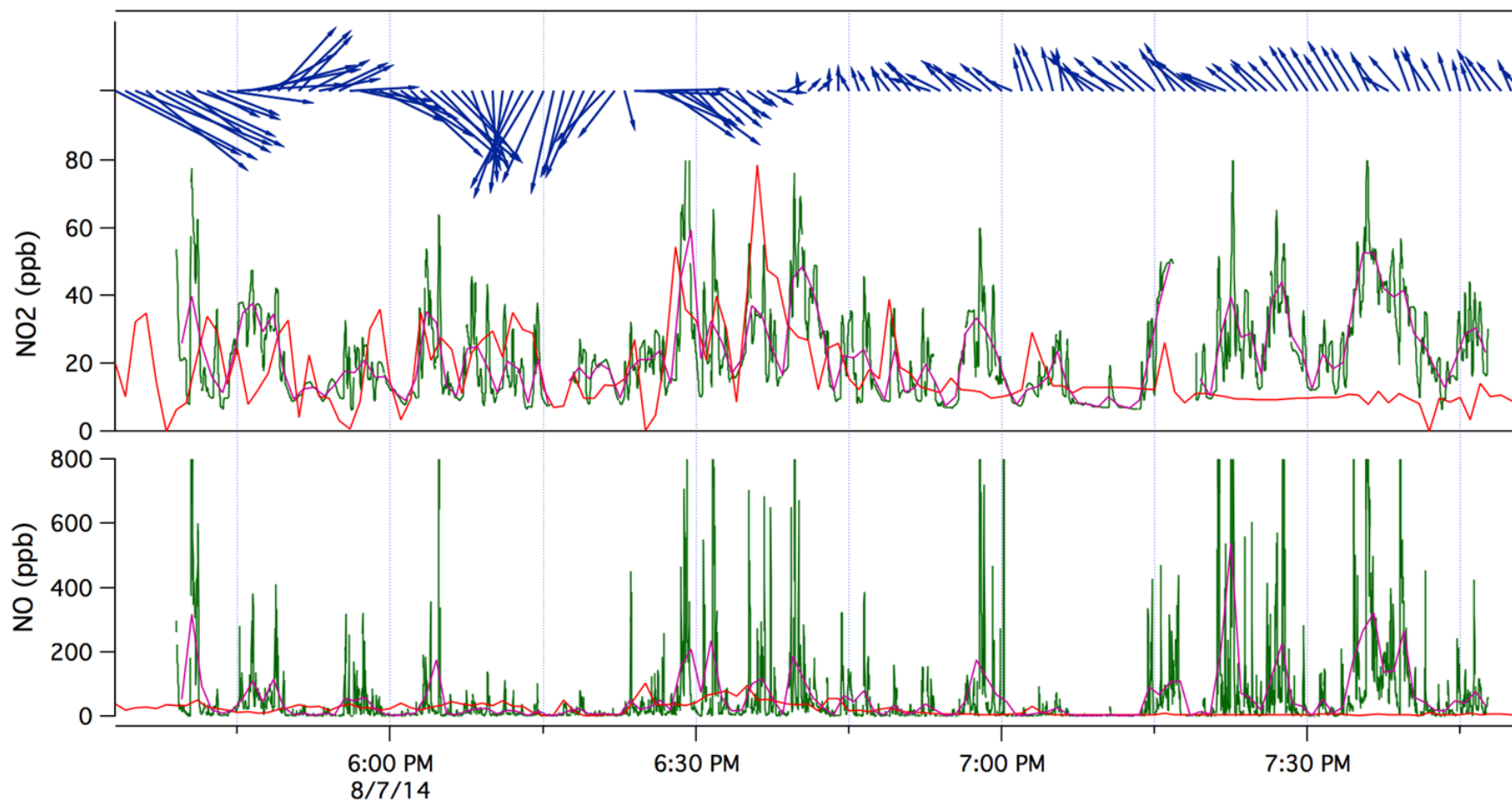
Measured concentrations vary between vehicles and NRS with time of day



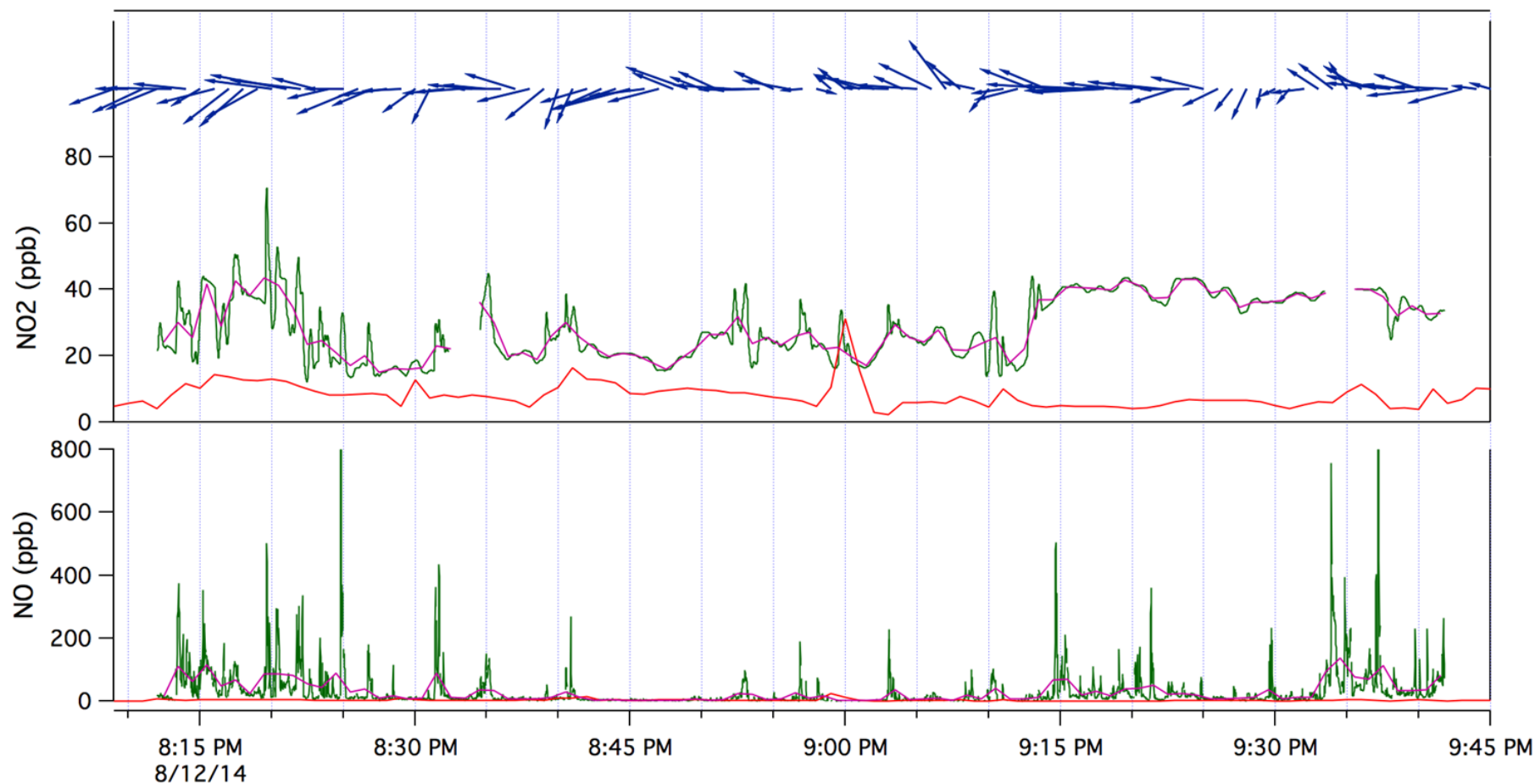
Measured concentrations vary between vehicles and NRS with time of day



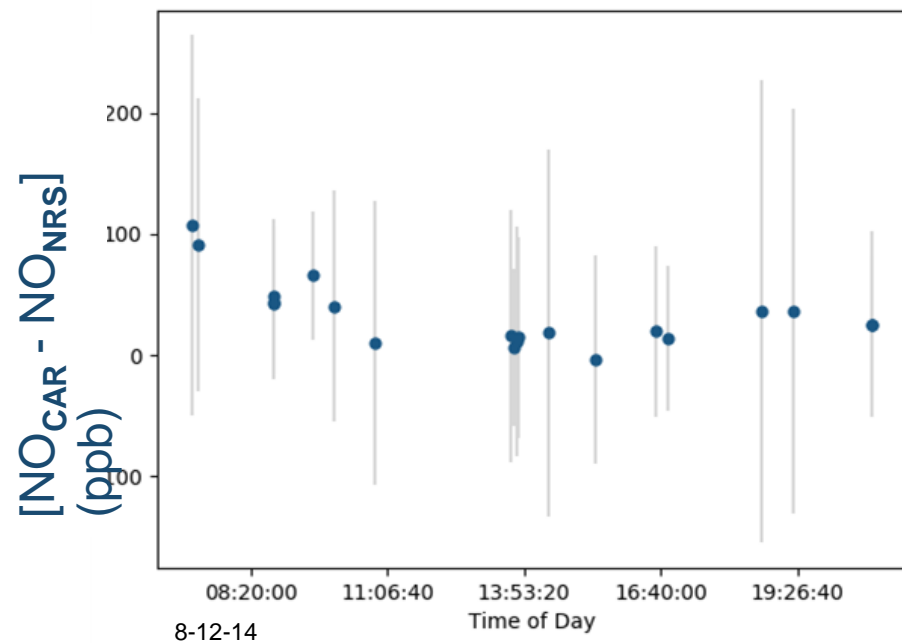
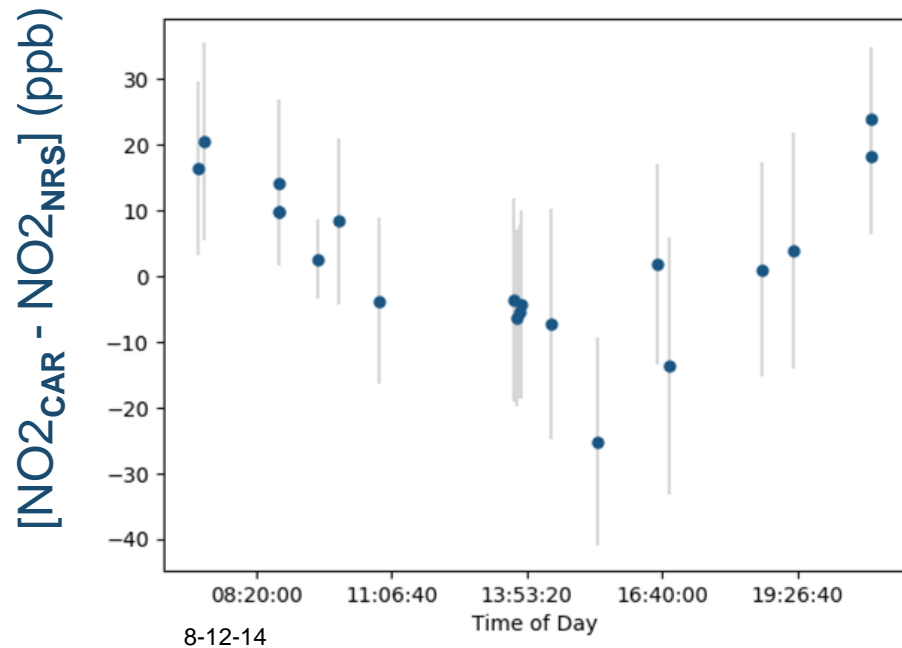
Measured concentrations vary between vehicles and NRS with time of day



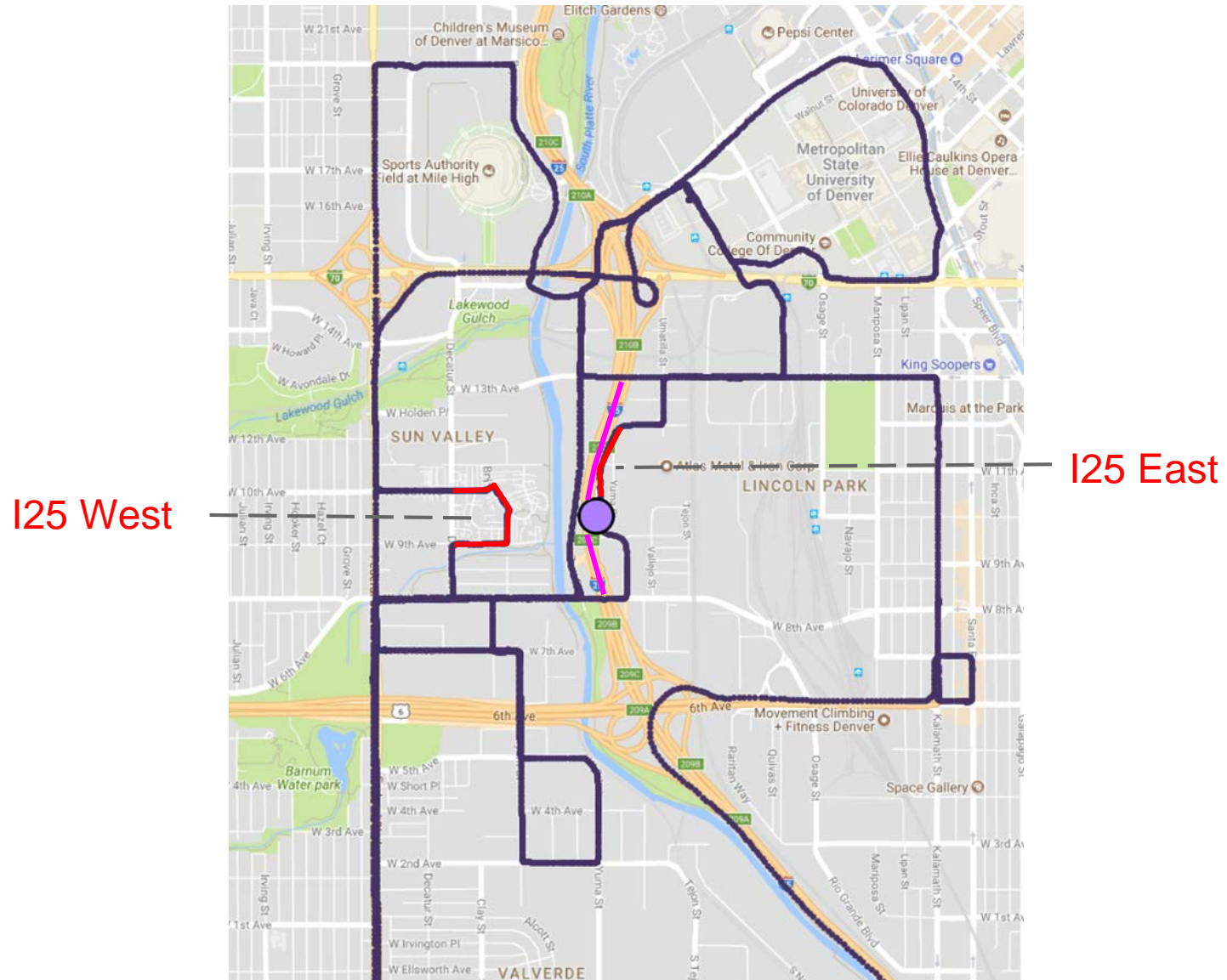
Measured concentrations vary between vehicles and NRS with time of day



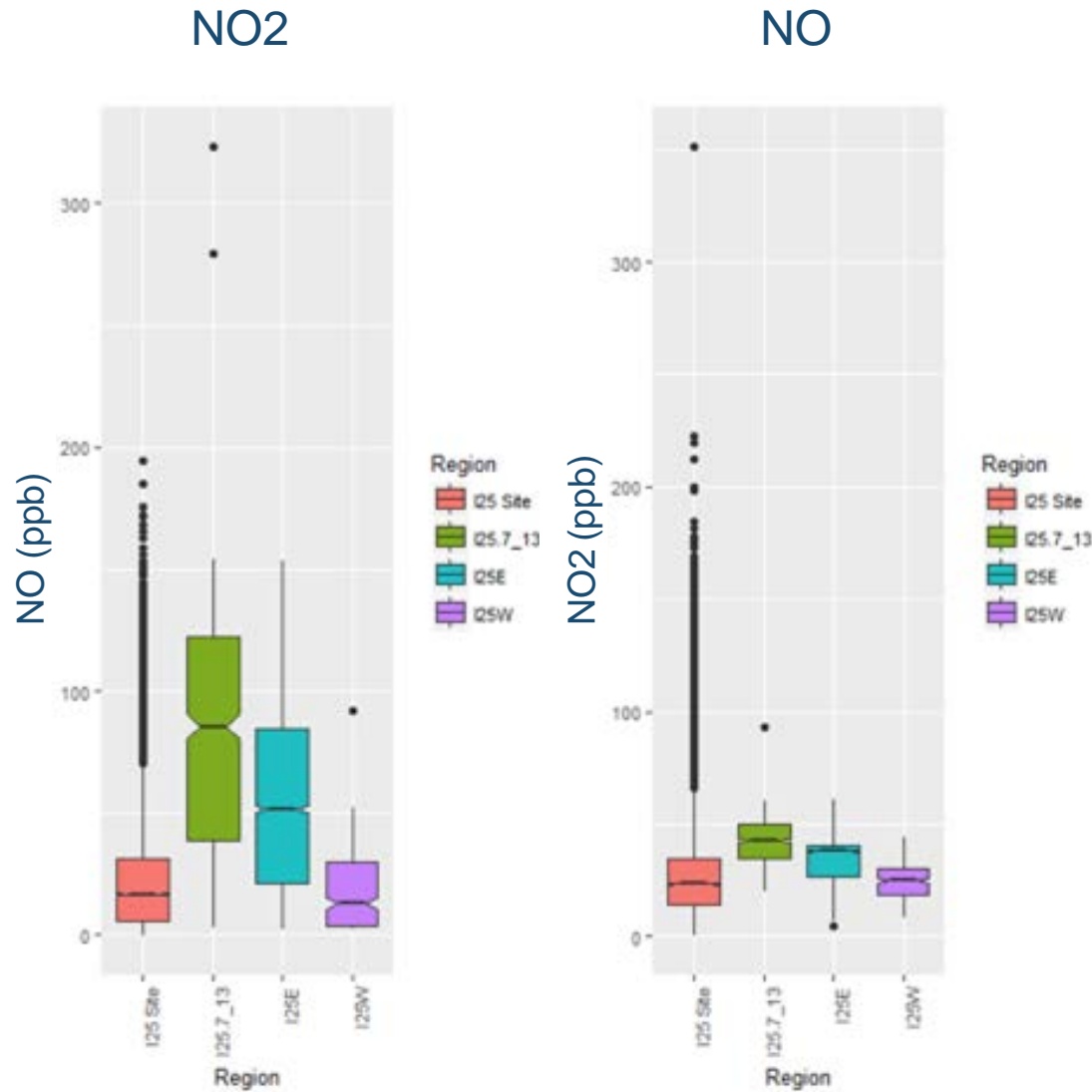
Difference (vehicles - NRS) varies with time of day



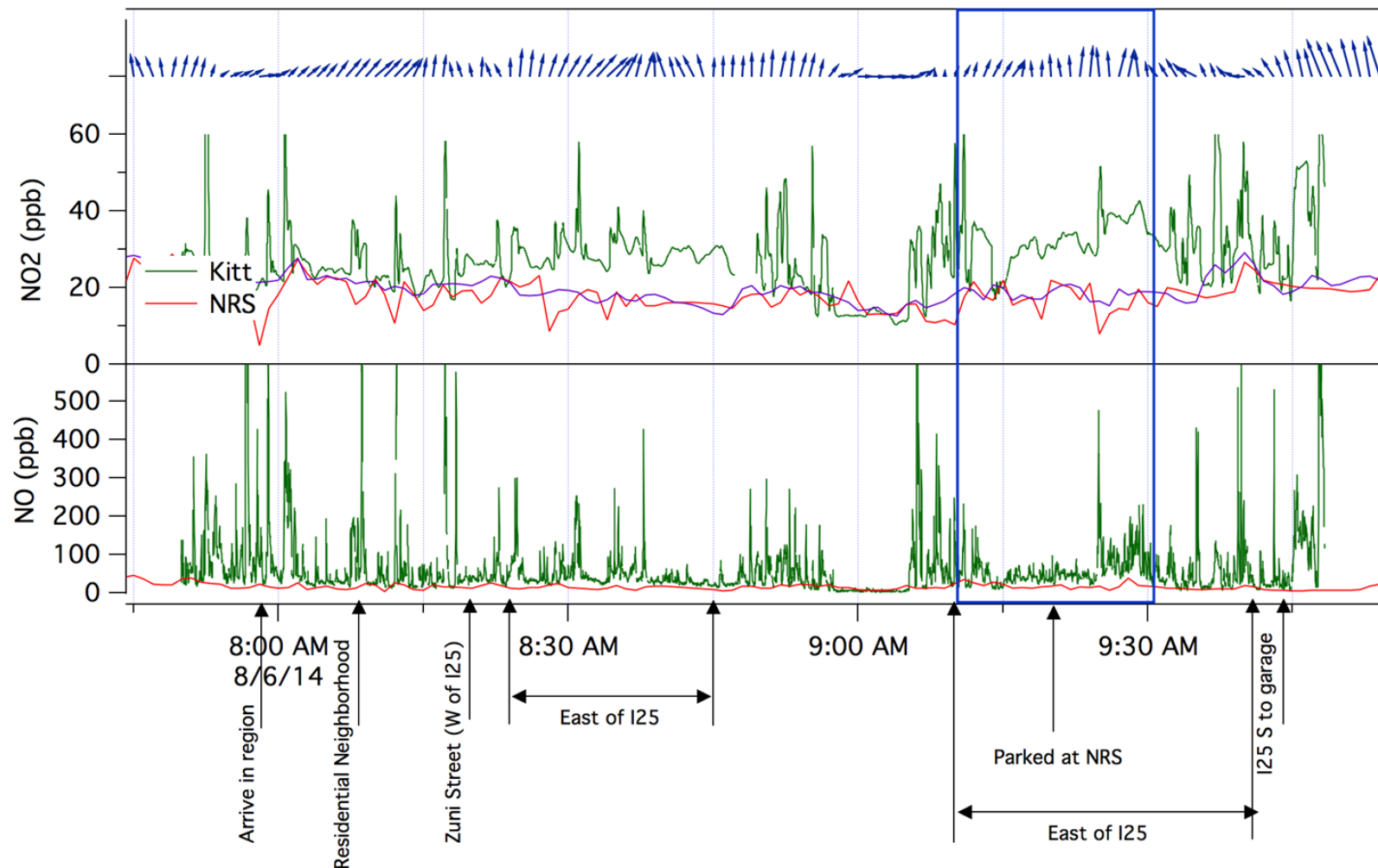
Spatial analysis of street types and neighborhoods



Higher levels in neighborhood east of freeway

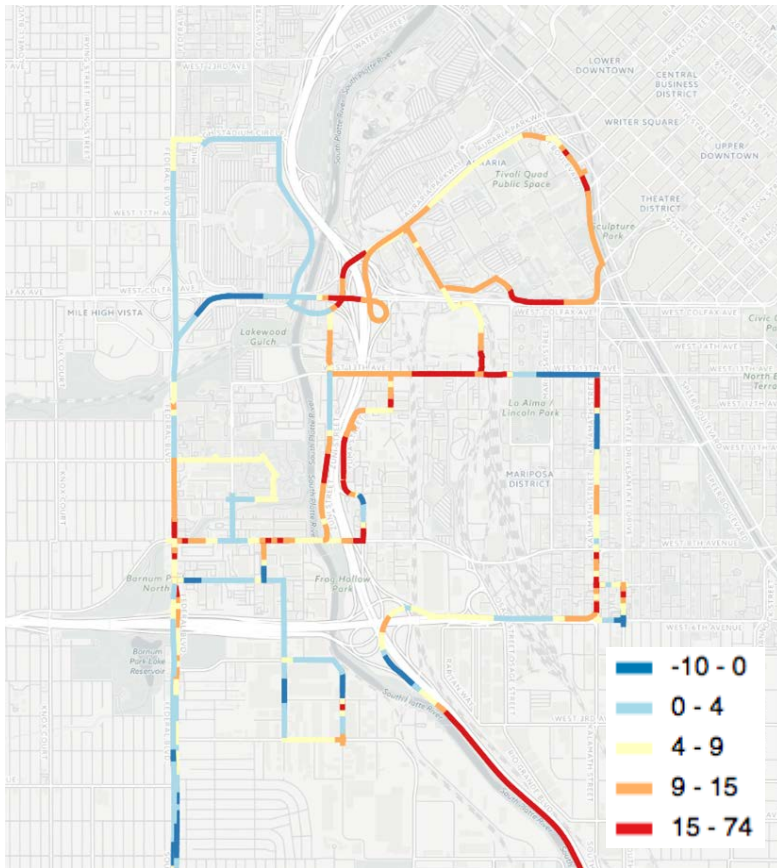


Magnitude of difference between vehicle and NRS is variable

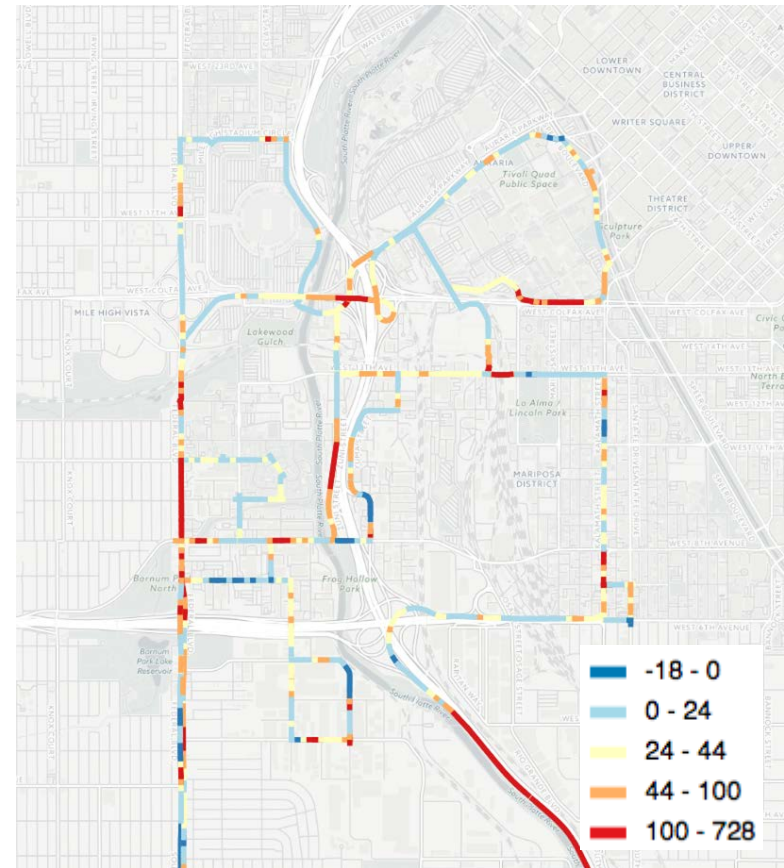


Difference between vehicle and NRS shows spatial variability

NO₂



NO



- **Broke new ground - 3 mobile platforms**
 - **Allows simultaneous measurements of multiple pollutants at different spatial scales**
- **Daily pattern: Car minus NRS**
 - **NO₂ shows strong daily pattern**
 - **NO peaks AM rush hour, flat rest of day**
- **Hyperlocal emissions observed on roadway**
 - **NRS does not necessarily measure highest concentrations on average**
 - **Freeway concentrations can be much higher on average**
 - **Local areas concentrations can be high on average**
 - **NRS may not represent on-road exposures of NO and NO₂**
- **On-road conc of NO and NO₂ exceed NAAQS community site concentrations**

Measurements using multiple mobile platforms allow for more realistic concentration and exposure data for model evaluation and use in air quality models and risk assessment that have not been available before except in special short-term studies

Acknowledgements

- Aclima: Matt Hill, Aclima Mobile Platform team;
- Google: Karin Tuxen-Bettman, Rebecca Moore, Arjun Raman, Luc Vincent;
- US EPA ORD: Melinda Beaver, Russell Long;
- US EPA Region 8

Measurements using multiple mobile platforms allow for more realistic concentration data, which have only been available in short-term studies, to support risk and exposure assessment, air quality model evaluation, and empowering individuals to reduce their health risks from air pollution.