

Mobile Platform Program



AWMA Meeting
Sacramento, CA
February 2011
Kathleen Kozawa

Acknowledgements

- Dane Westerdahl
- UCLA
 - Arthur Winer
 - Suzanne Paulson
 - Shishan Hu (ARB)
- USC
 - Scott Fruin
 - Costas Sioutas
- ARB
 - Steve Mara
 - Jorn Herner
 - Seong Park
- Toyota
- SCAQMD

Mobile Platform



Measurement Parameters

Instrument	Measurement Parameter
TSI Portable CPC, model 3007	UFP Count 10 nm-1um
TSI FMPS	UFP Size 5.6-560 nm
TSI Model 8520 DustTrak	PM2.5
Magee Scientific Aethalometer	Black Carbon
EcoChem PAS 2000	Particle Bound PAH
TSI Q-Trak Model 8554	Carbon Monoxide (CO) Carbon Dioxide (CO ₂)
Teledyne API 300e CO Analyzer	CO
LI-COR, LI-820 CO ₂ Gas Analyzer	CO ₂
Teledyne-API NO _x analyzer, model 200e	Nitrogen Oxides (NO _x , NO, NO ₂)
Garmin GPSMAP 76CS	GPS
Vaisala Sonic Anemometer and Temperature/RH Sensor	Local Wind Speed and Direction, Temp, RH
Video Camera	Traffic Documentation

Timeline

- **2003:** Begin mobile measurements on Los Angeles freeways
- **2006-2007:** Monitoring in neighborhoods of Wilmington and West Long Beach
- **2008-2009:** Monitoring in southern California for other studies, on-road measurements
- **2010:** Near-roadway monitoring in West Long Beach, on-road measurements

Particle Gradients and Freeway Proximity



Shishan Hu¹, Suzanne Paulson¹, Kathleen Kozawa², Steve Mara², Scott Fruin³, Arthur Winer¹

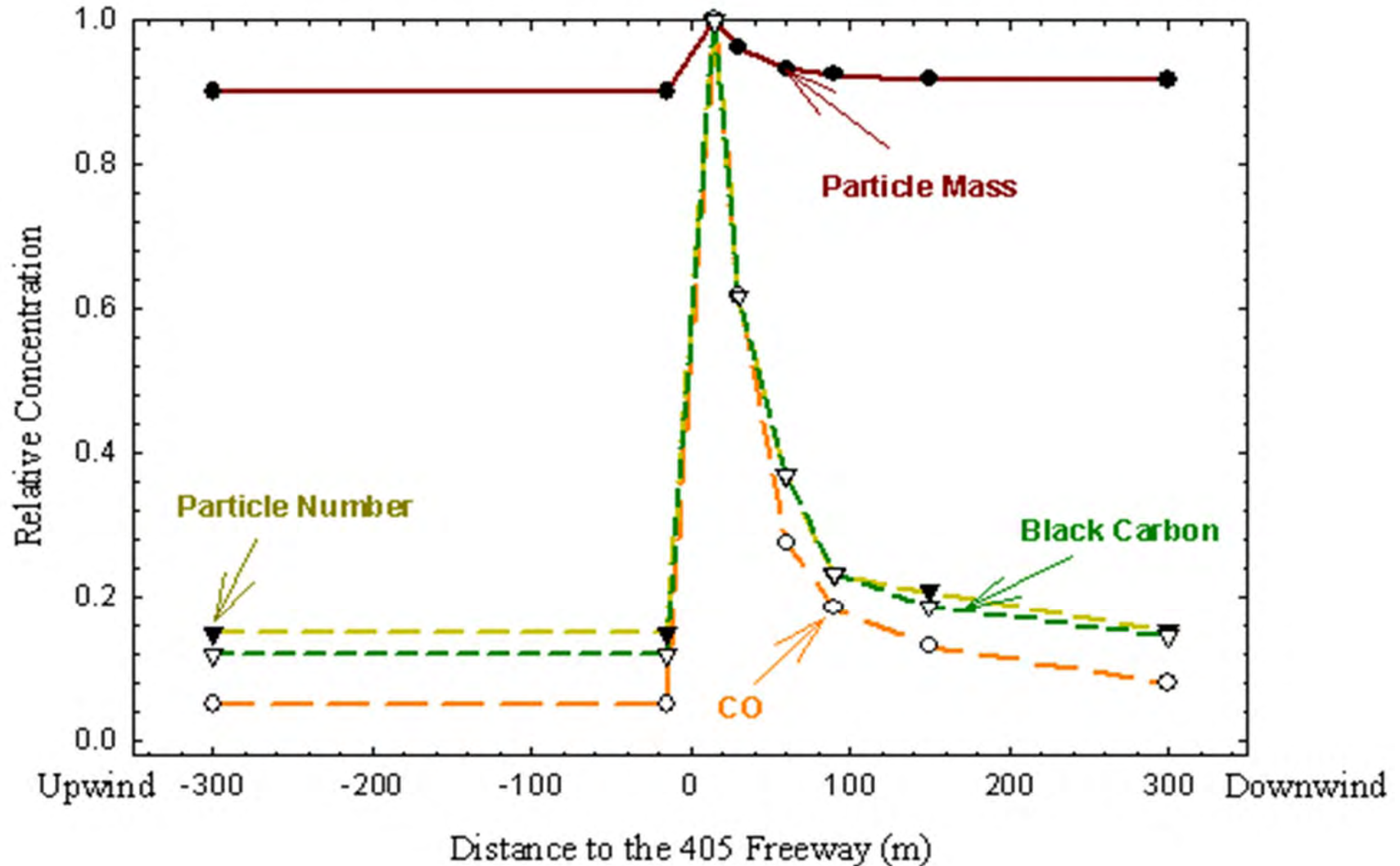
¹UCLA ²California Air Resources Board

³USC

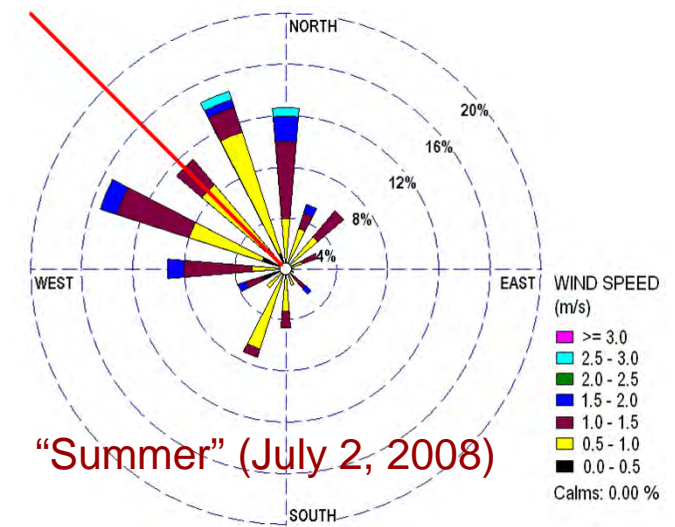
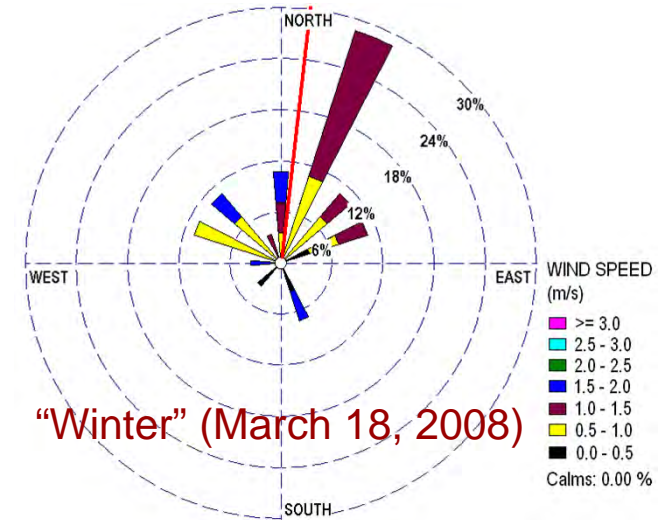
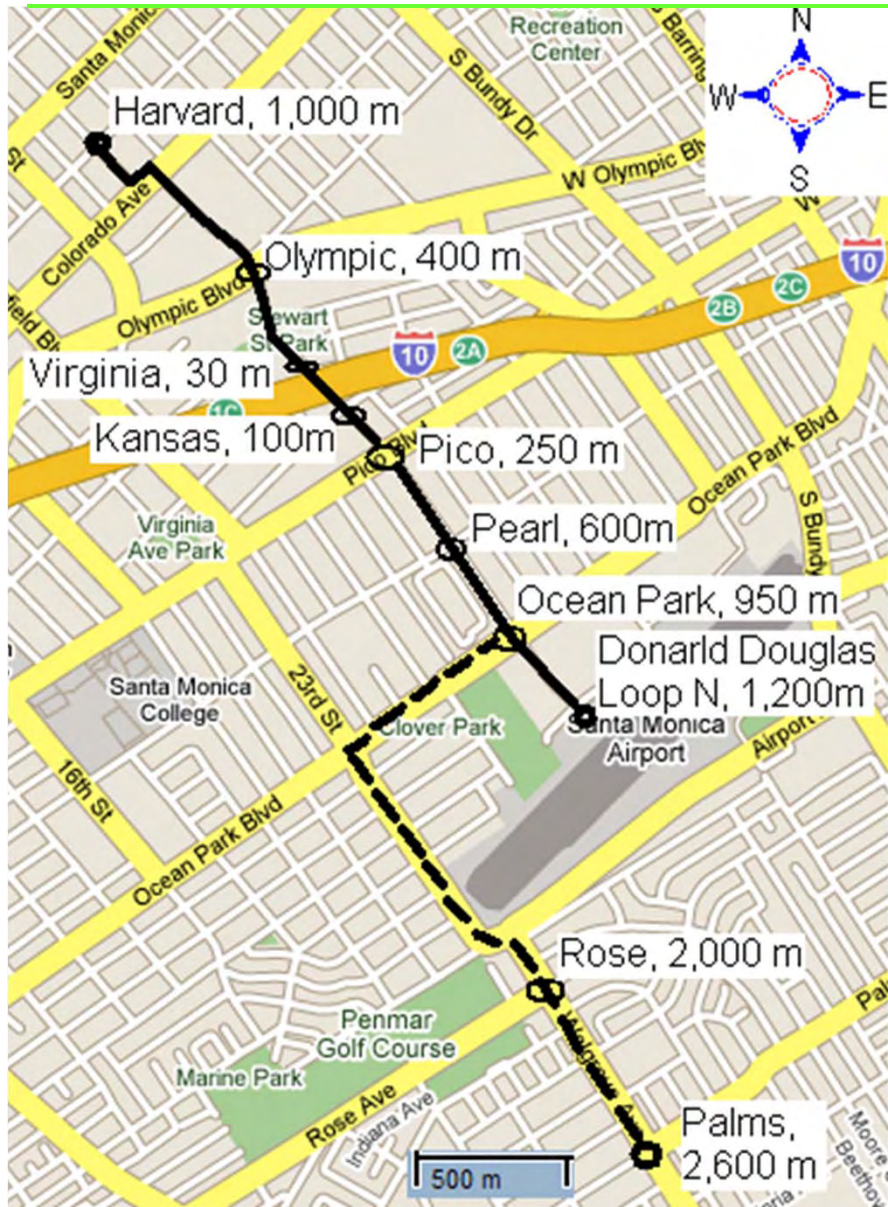
Supported by the California Air Resources Board

Relative Pollutant Concentrations vs. Distance from I-405 Freeway

(Zhu et al., 2002a)



Winds are Weak and Predominantly From the North Side of the Freeway

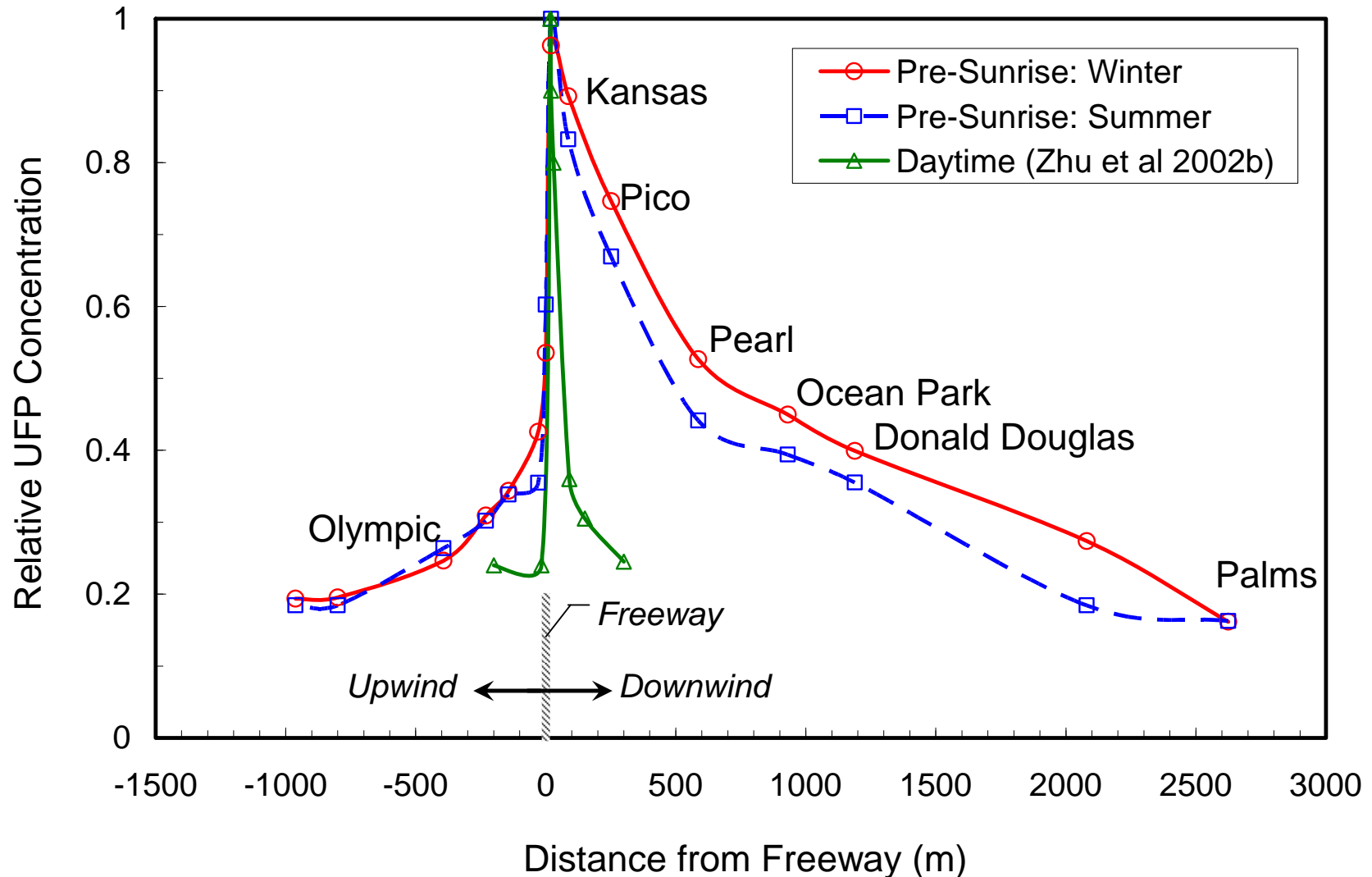


Pre-Sunrise Meteorological

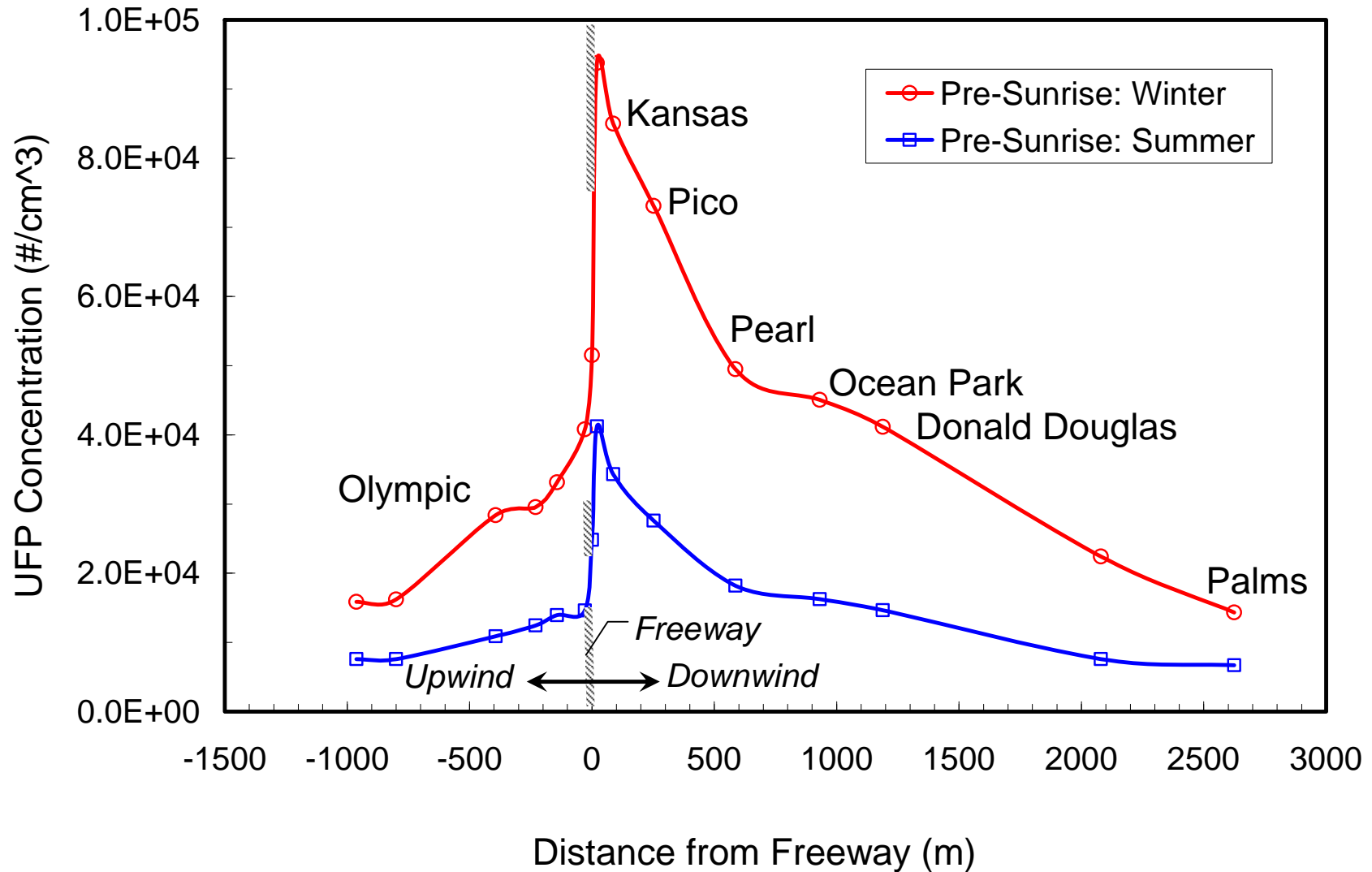
Conditions: Very Stable as Usual

- Clear nights with a land breeze or weak offshore flow on all nights
- LAX data showed inversions from 130 m (or lower) in winter, and neutrally stable with a capping inversions from 190-260 m in summer.
- Low wind speeds, averaging $0.7-1.0 \text{ m s}^{-1}$
- Moderate temperatures
 - Winter $9-13^{\circ}\text{C}$;
 - Summer $15-17^{\circ}\text{C}$

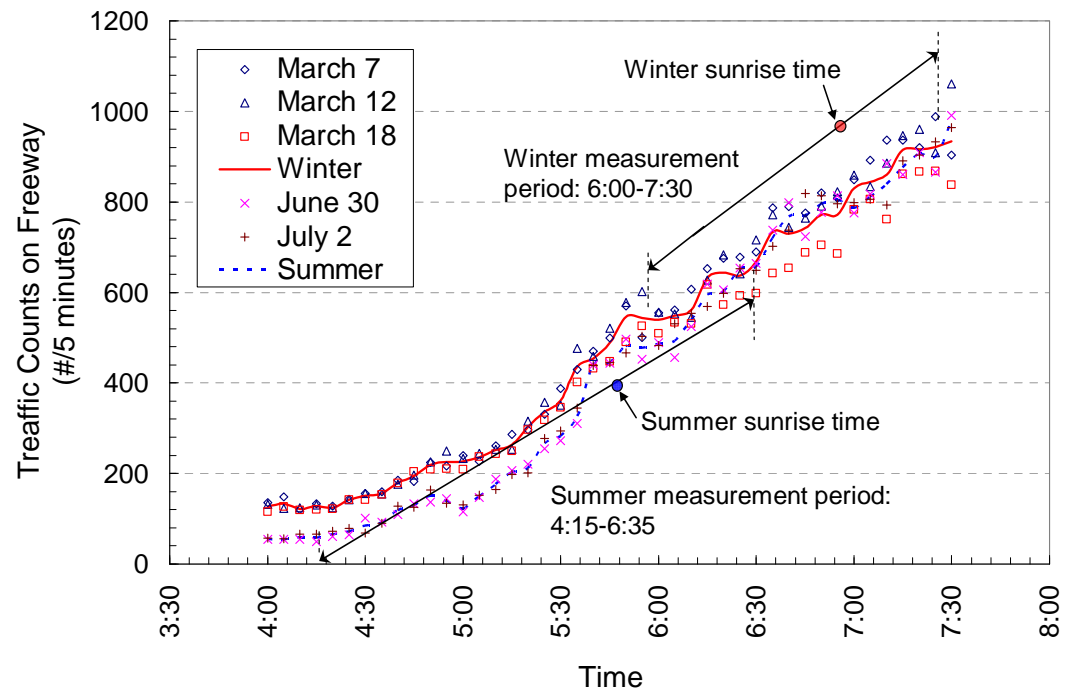
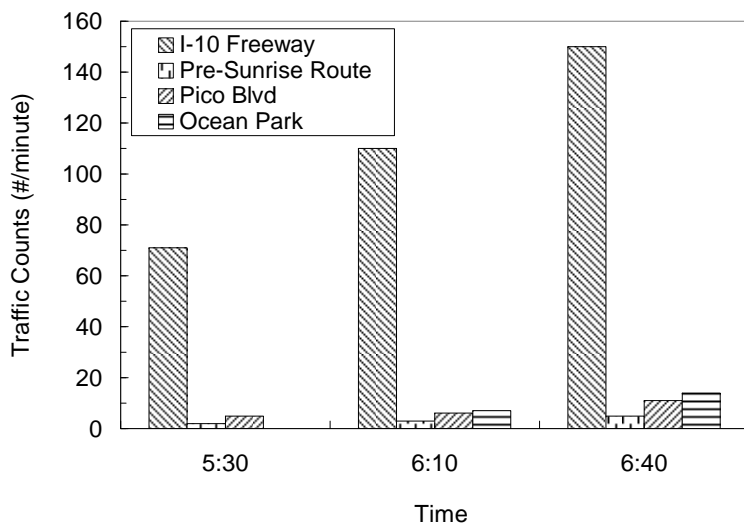
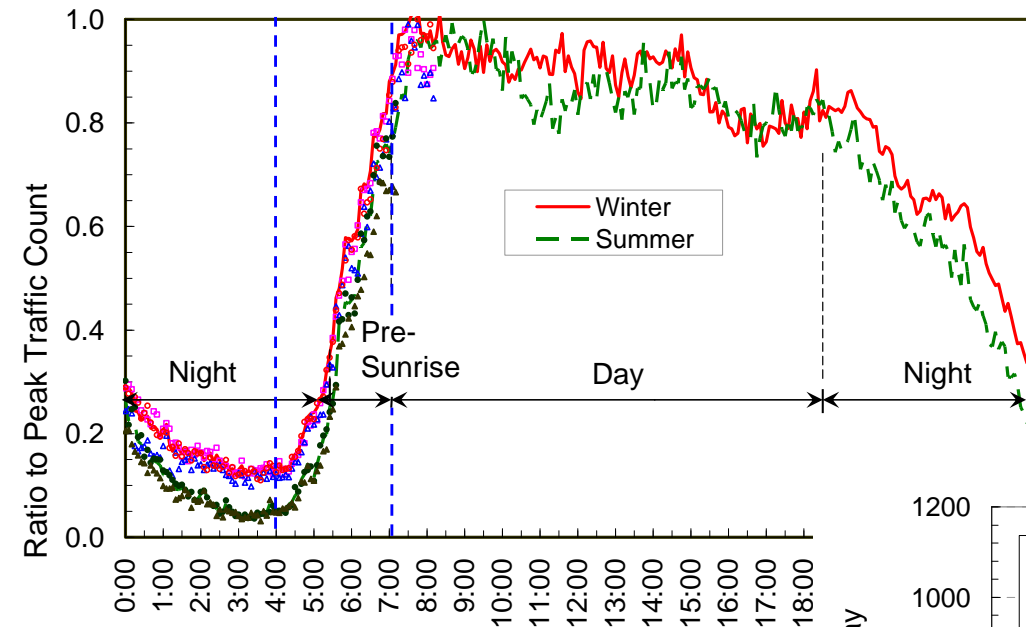
The Freeway Imprint is Many Times Larger Just Before Sunrise (normalized data)



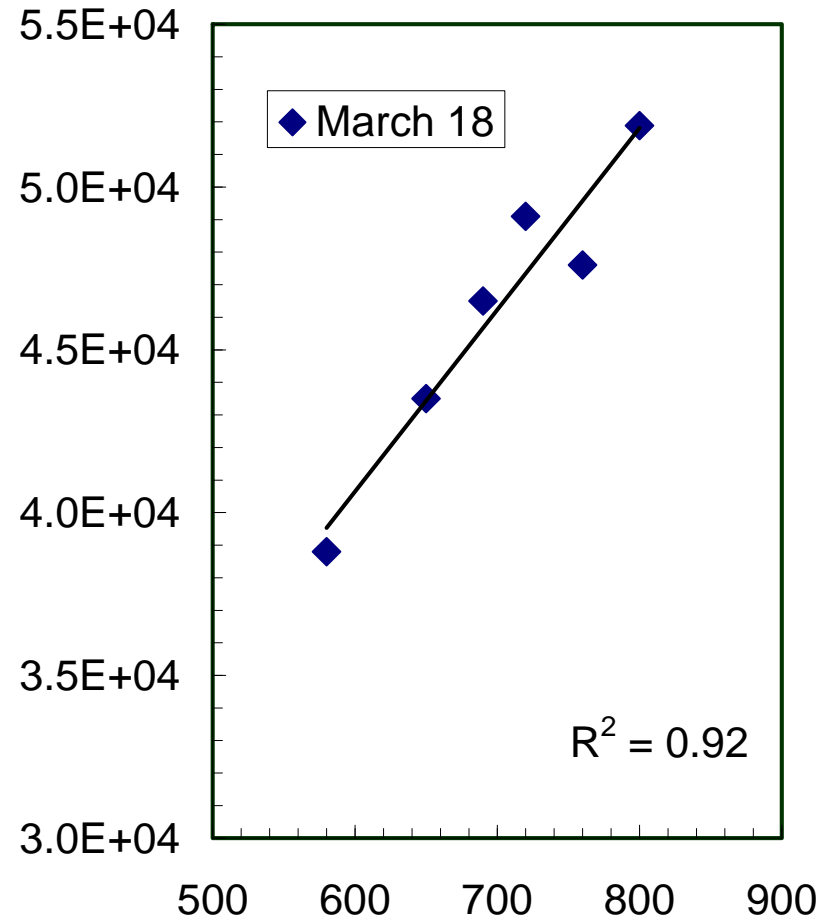
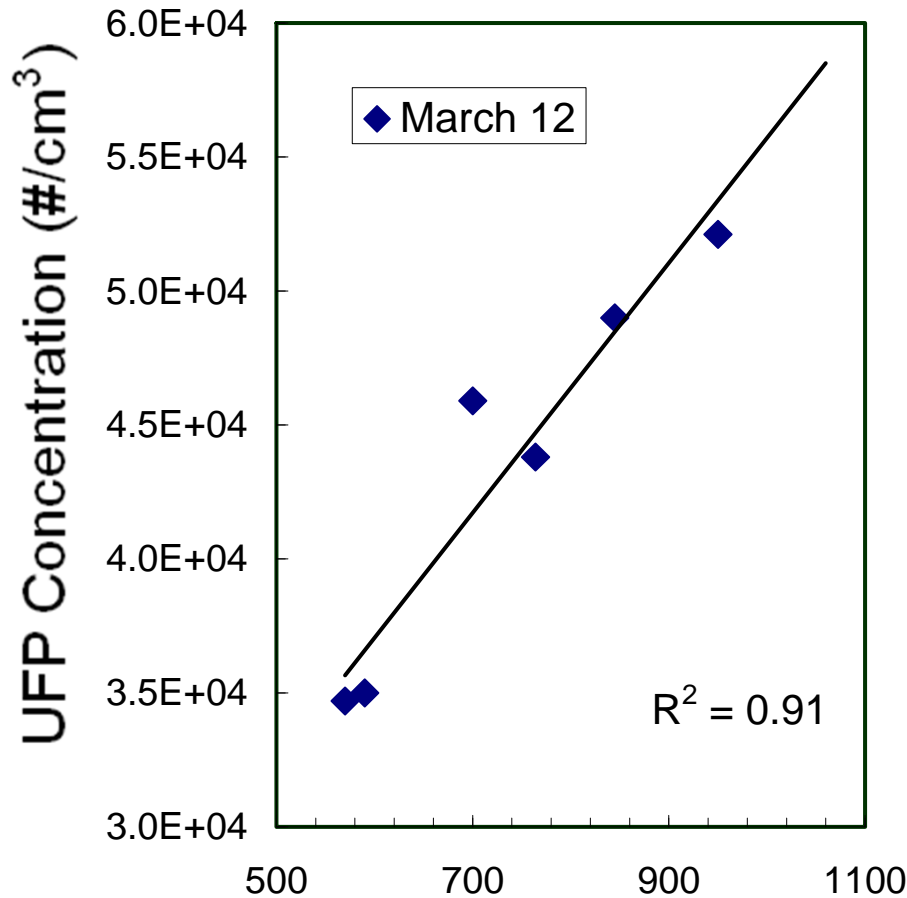
Summer is Cleaner; why?



Traffic Counts Increase Rapidly in the Early AM

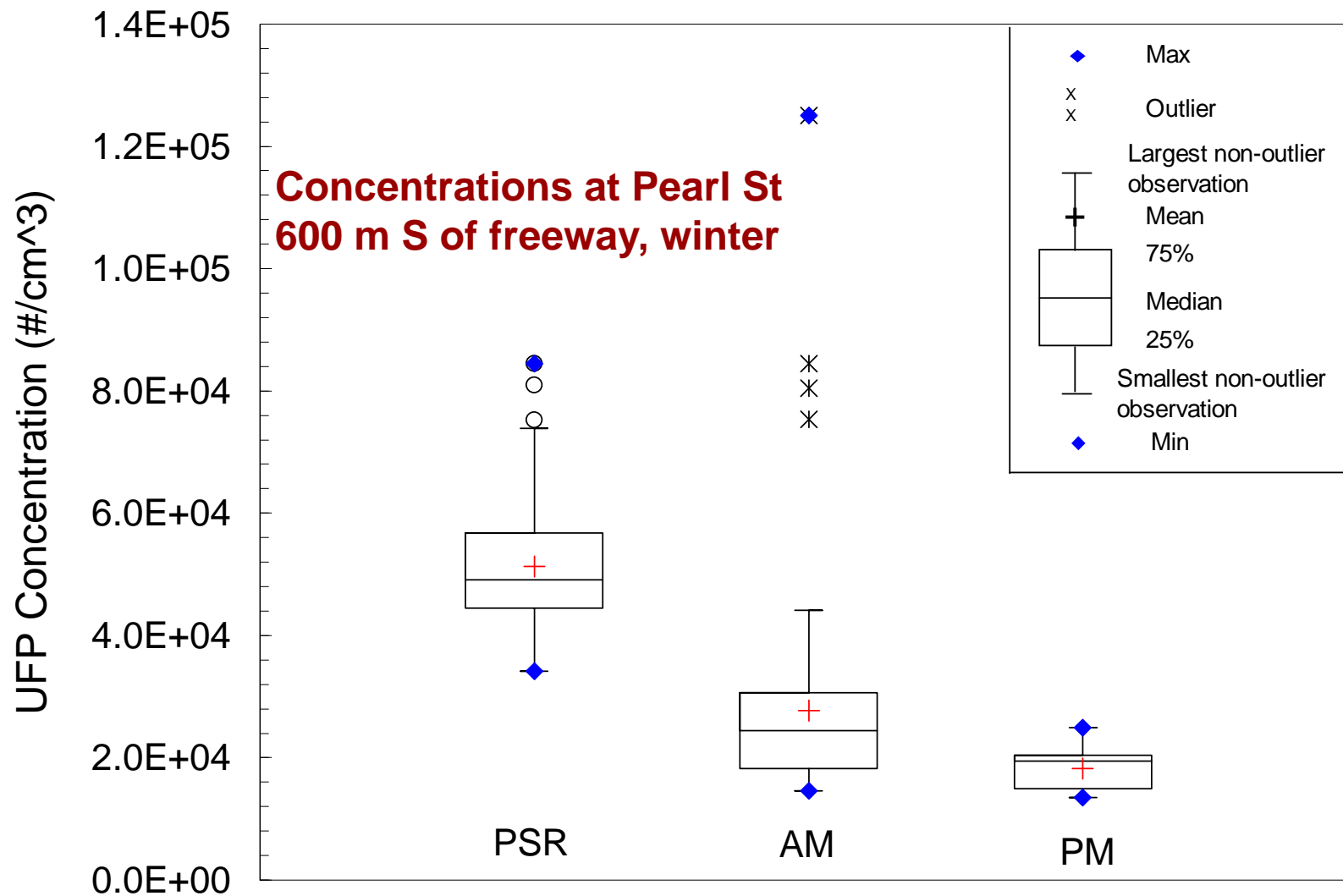


Excellent Correlation between UFP ~1000m Downwind and Traffic Counts on I-10 Fwy



Traffic Count (#/5 minutes)

Things Get Better Later in the Day



Summary

- **There is a wide impact area, up to 2,000m downwind and 600 m upwind, of a major freeway during pre-sunrise hours.**
- **It is likely this occurs for other major roadways under similar PSR conditions**
- **Raises major implications for exposure assessment and modeling**

Exposures at Busy Intersections: Effect of State/Local Regulations



State and Local Regulations

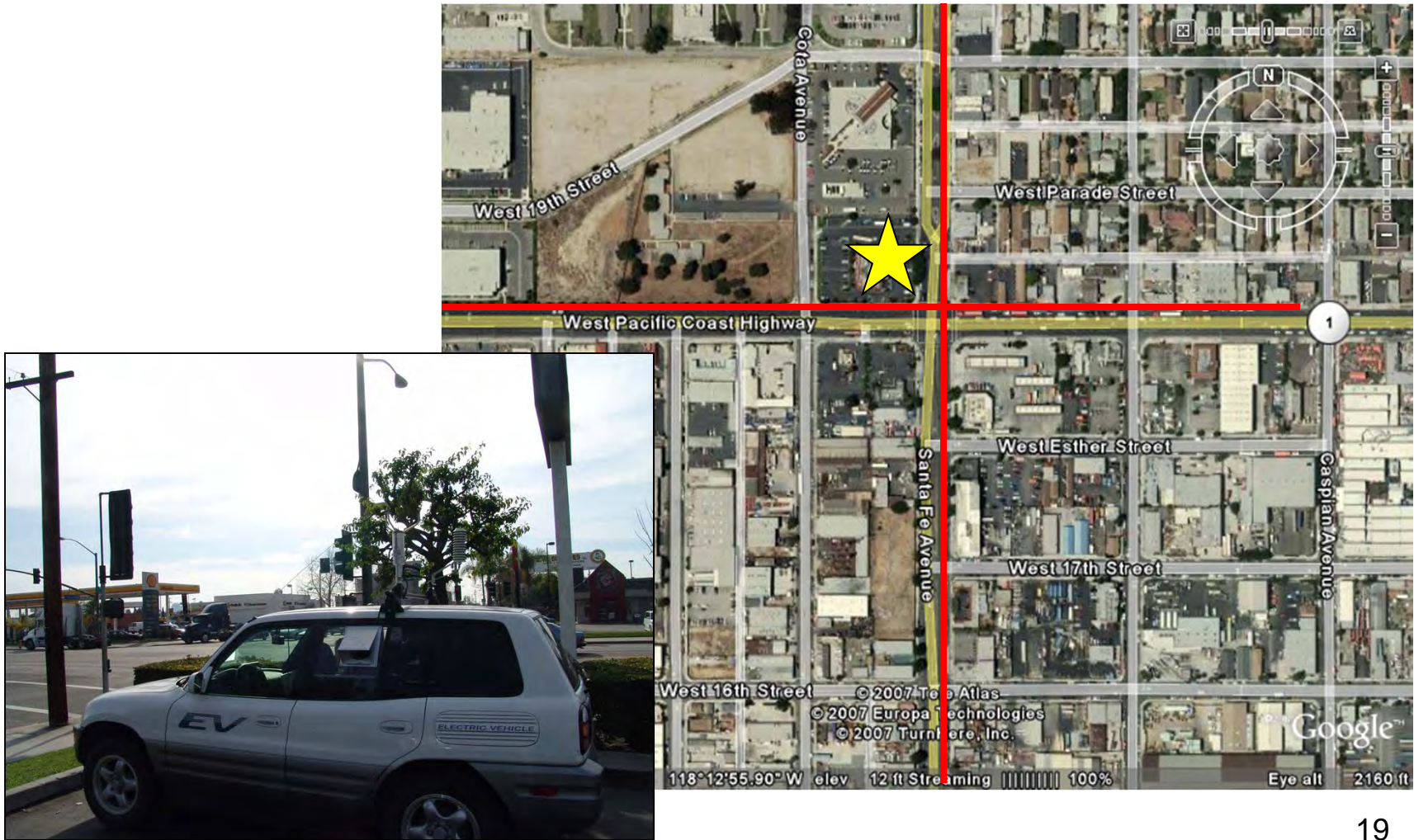
- ARB Drayage Truck Rule (December, 2007)
 - Must meet 2007 standards by 2013
 - Reduce PM emissions by 85%
- San Pedro Bay Clean Trucks Program
 - Must meet 2007 standards by 2012
 - Reduce truck emissions by 80% in 2012

Method

- Mobile Platform Measurements
 - Black Carbon (Aethalometer), PB-PAH (PAS2000), NOx (Teledyne API)
 - **Stationary (fast food site)** and mobile (neighborhoods near freeway)
- Time of Year (July 2007, July 2010)
- Meteorology
- Truck data
 - Video Analysis
 - CalTrans
 - 2006 UCTC Study (Houston et al. 2008)

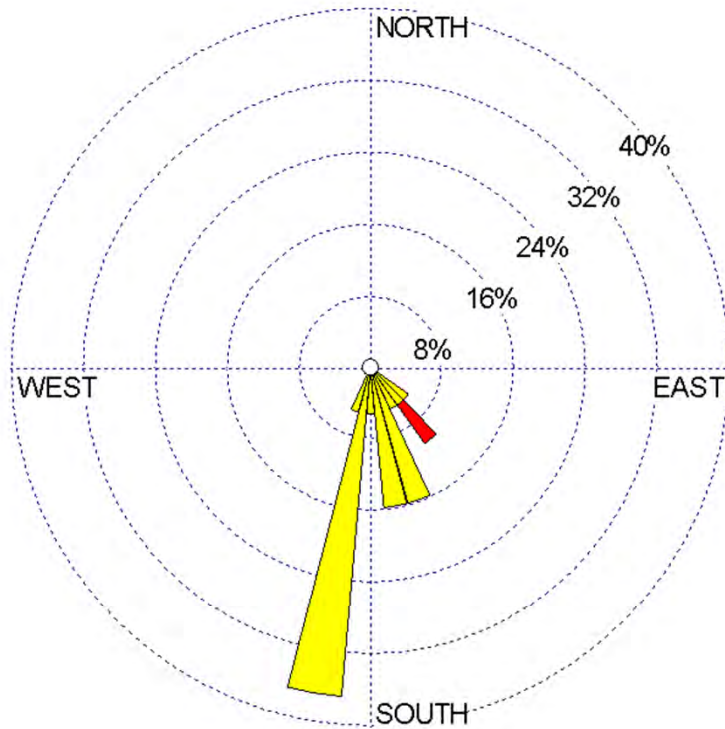
Houston et al., 2008. Diesel Truck Traffic in Low-Income and Minority Communities Adjacent to Ports: Environmental Justice Implications of Near-Roadway Land-Use Conflicts. Journal of the Transportation Research Board, 2067: 38-46

Fast Food Parking Lot Stationary Site



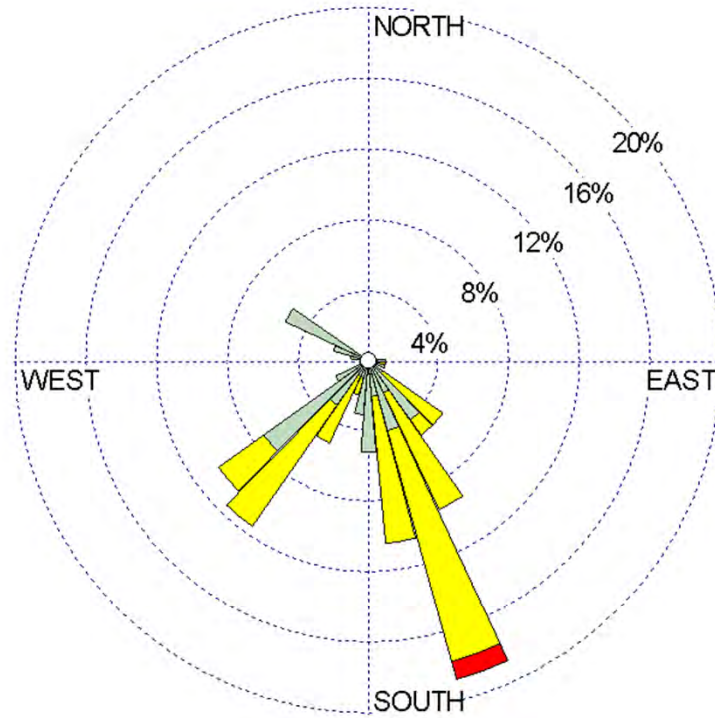
Meteorology

July 2007 (NOAA)

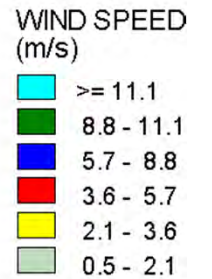


Temp (C): 19
RH (%): 81

July 2010 (NOAA)

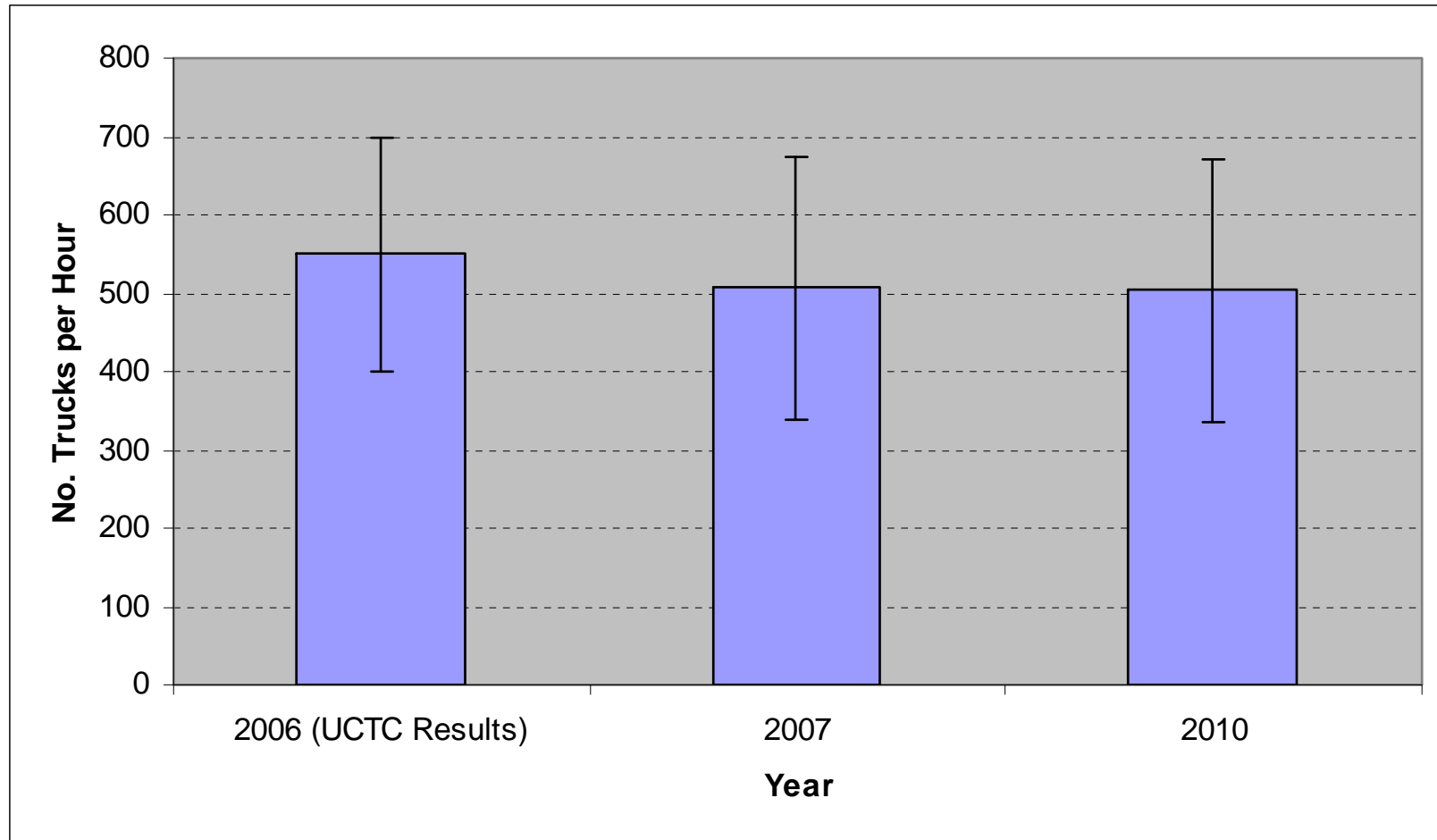


Temp (C): 24
RH (%): 68



20

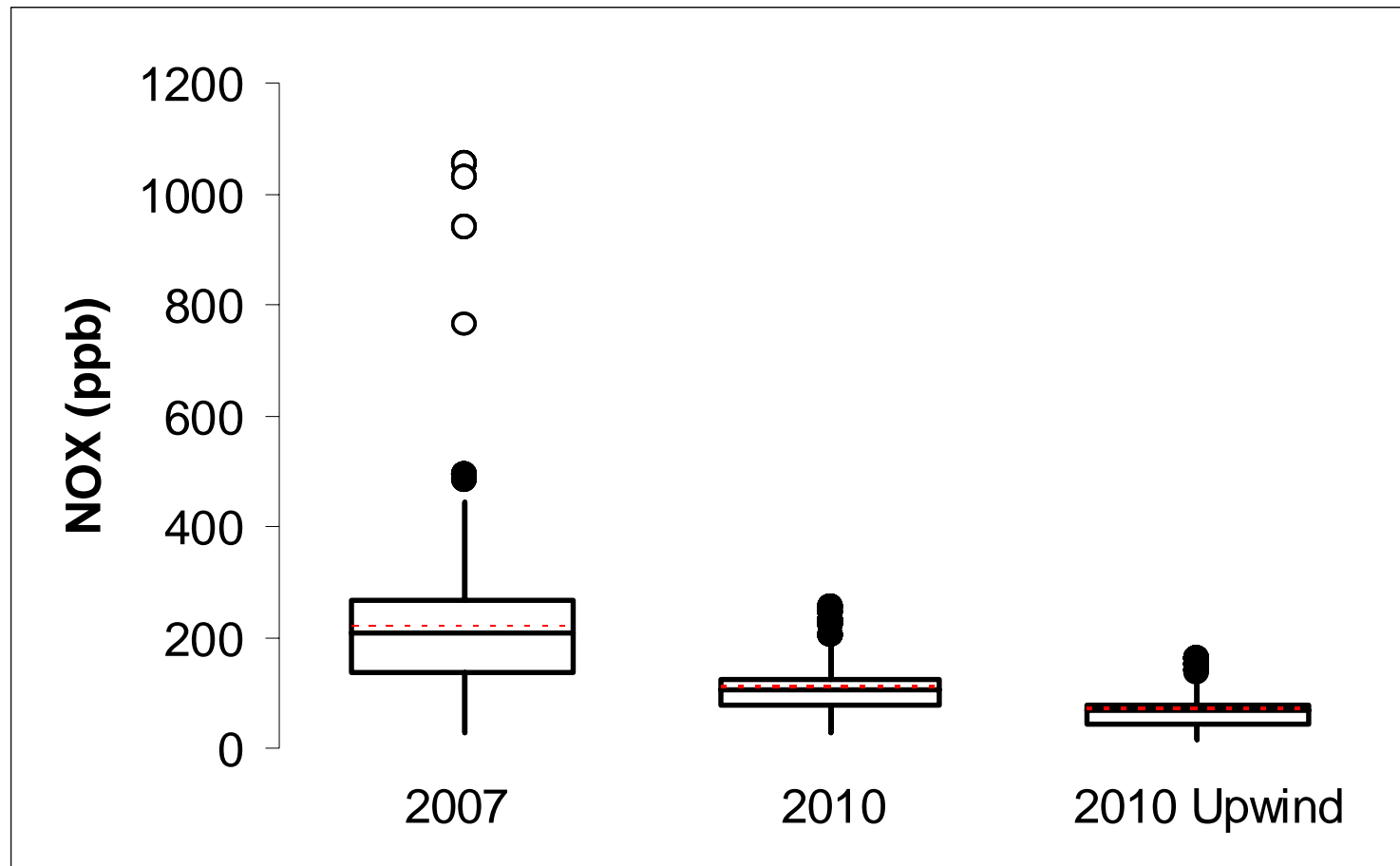
Truck Counts/Hour on PCH



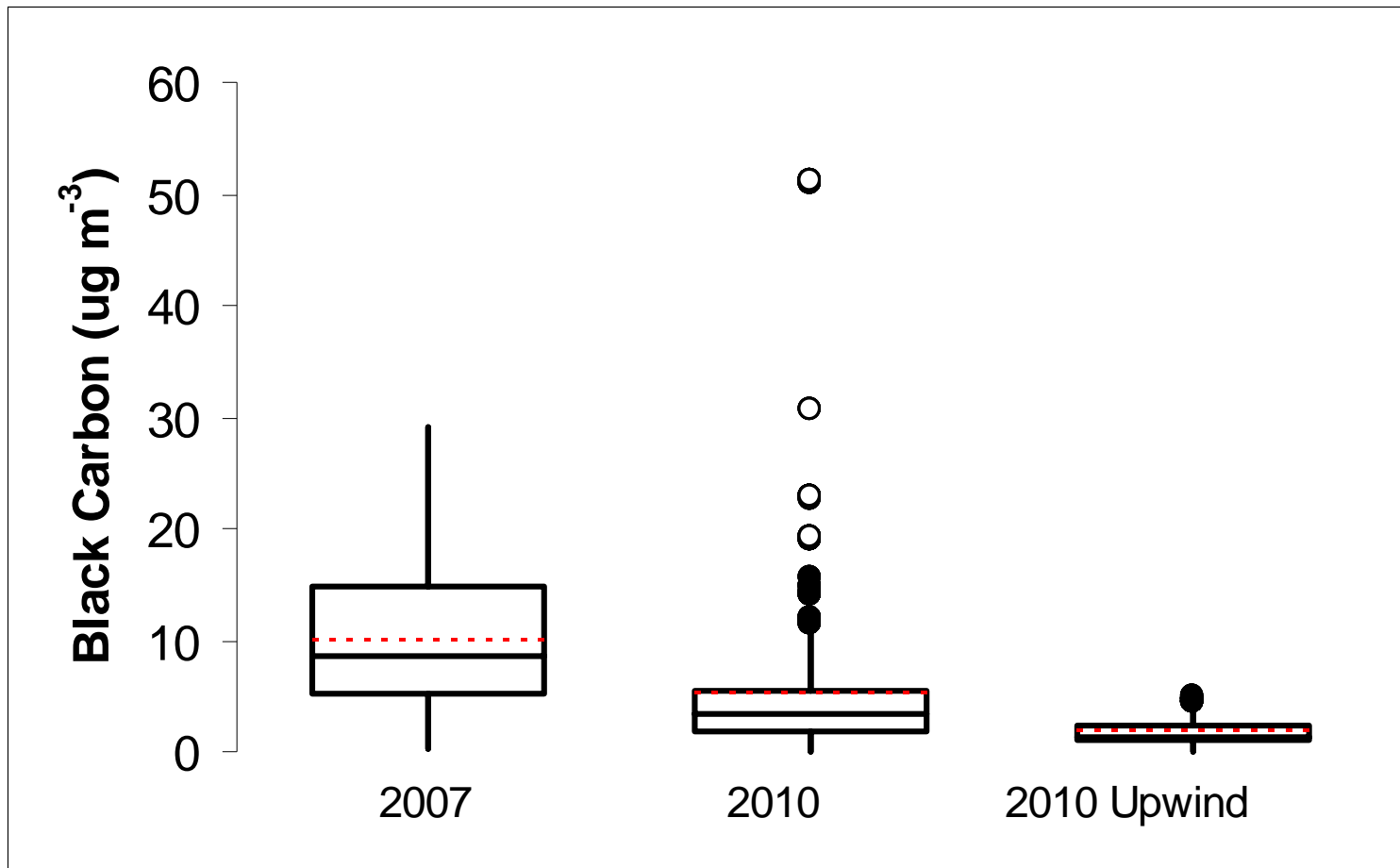
Downwind Exposures Near a Busy Intersection: PB-PAHs

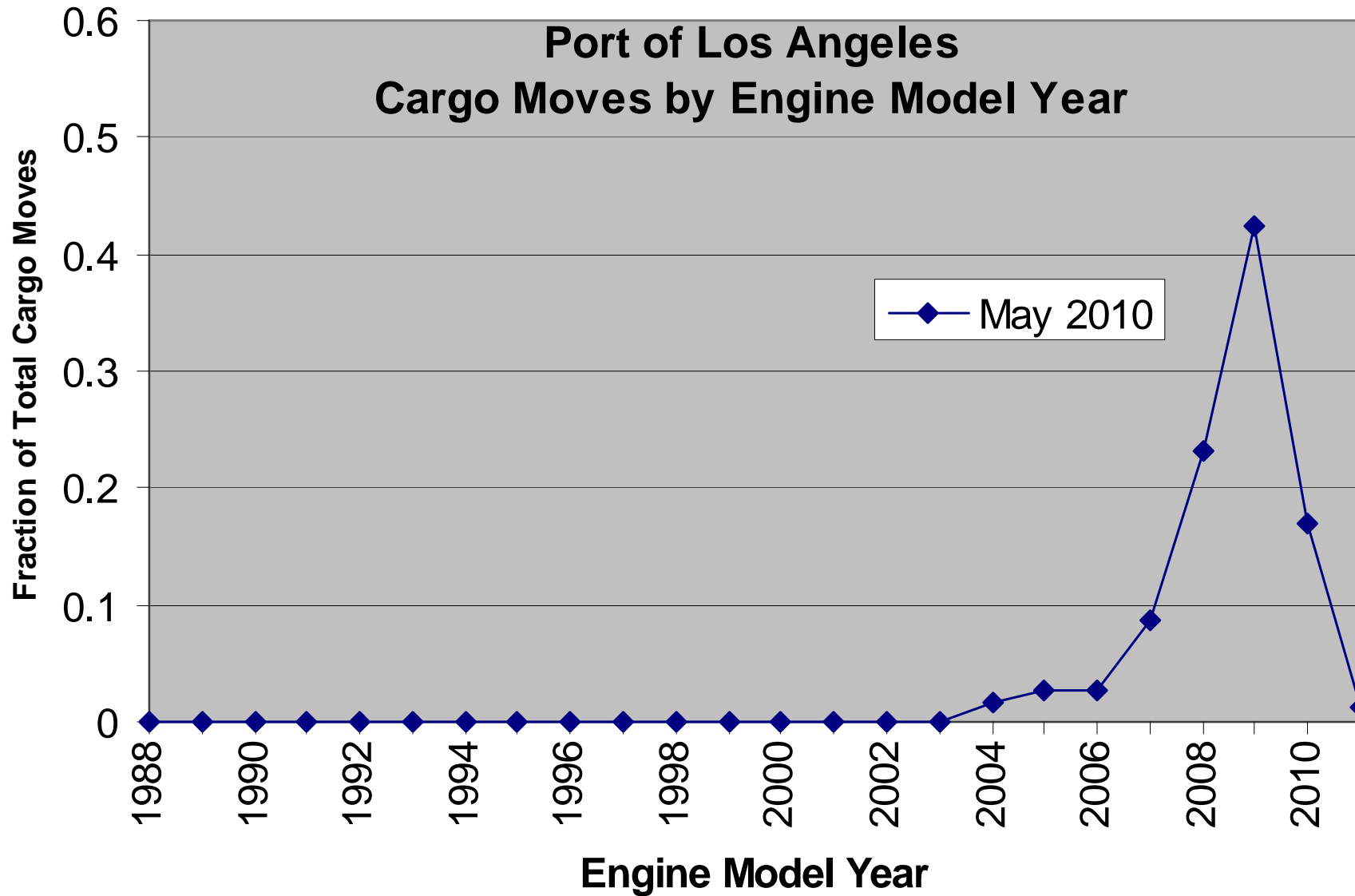


Downwind Exposures Near a Busy Intersection: NO_x



Downwind Exposures Near a Busy Intersection: Black Carbon





Summary

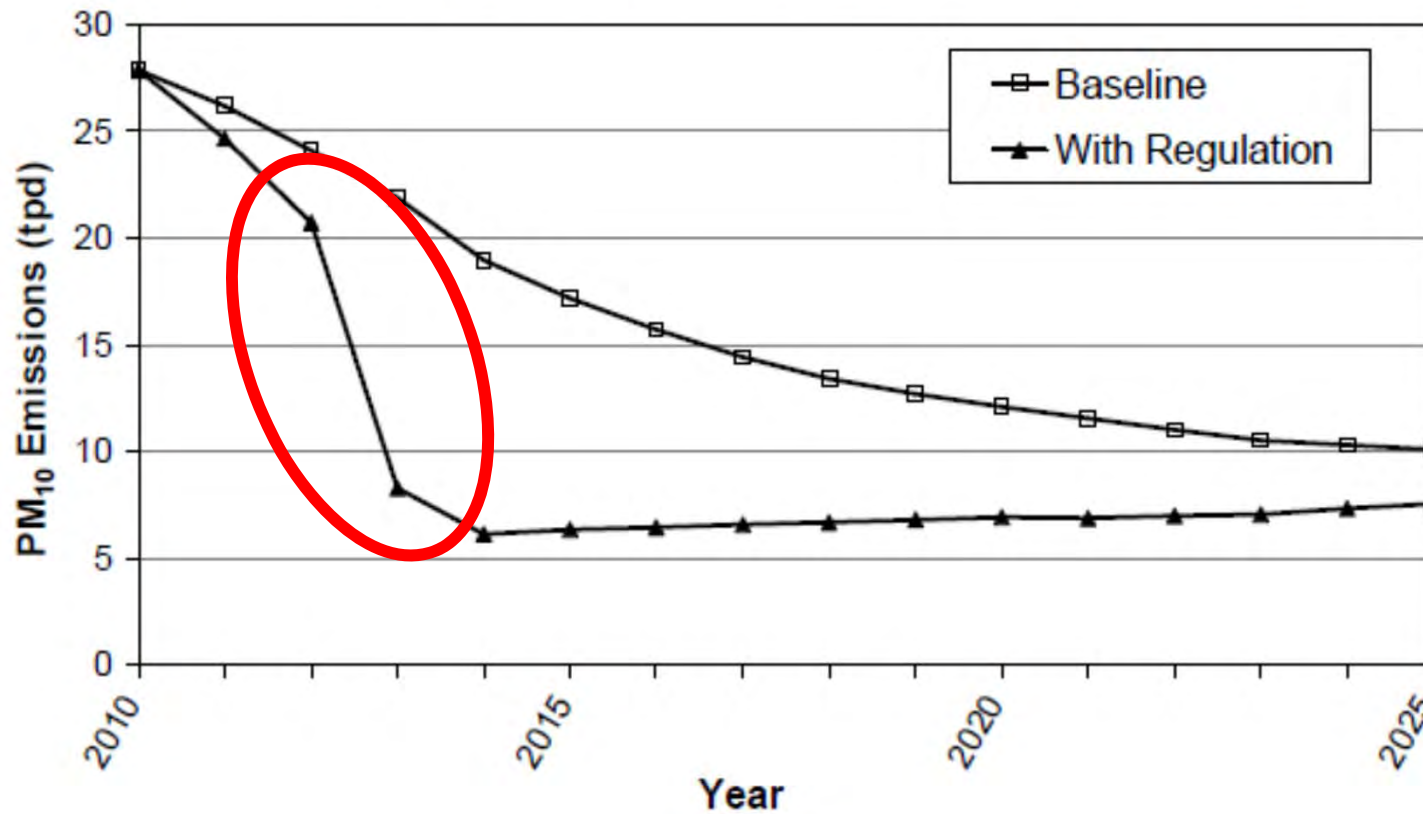
- July 2007 and July 2010 sampling campaigns:
 - Similar meteorological conditions
 - Similar truck flows
- Potential for high exposures at intersections
- Exposures are reduced by a factor of 2 likely due to state and local regulations

Tracking Reductions of Heavy-Duty Truck Emissions over the Next Five Years using a Mobile Platform



Introduction/Purpose

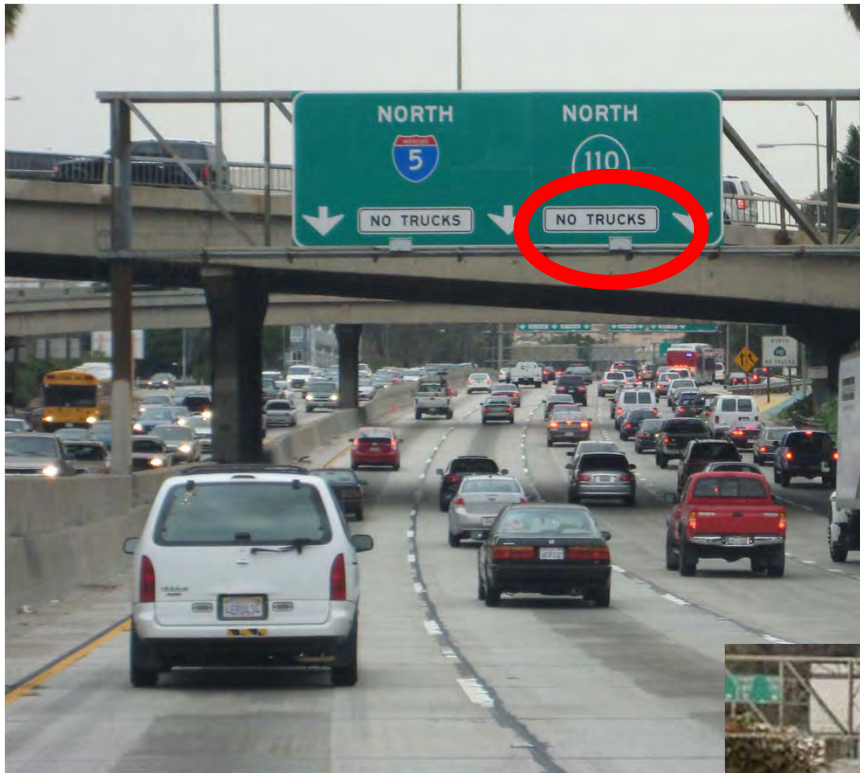
Figure VII-2: Projected PM Emissions With and Without the Regulation



Methodology II-Route

- 70 miles round trip
- Diesel vs. gasoline dominated freeways
- Sampling during peak truck fraction (midnight/midday)



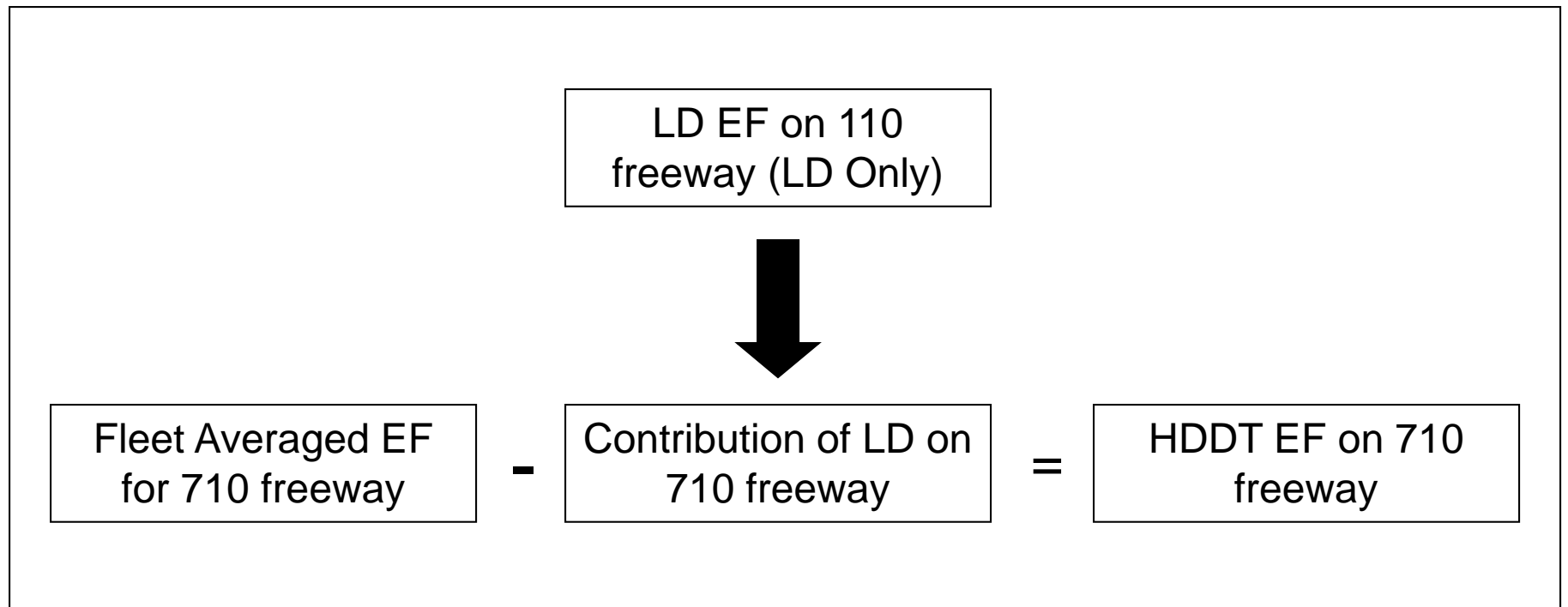


← CA-110

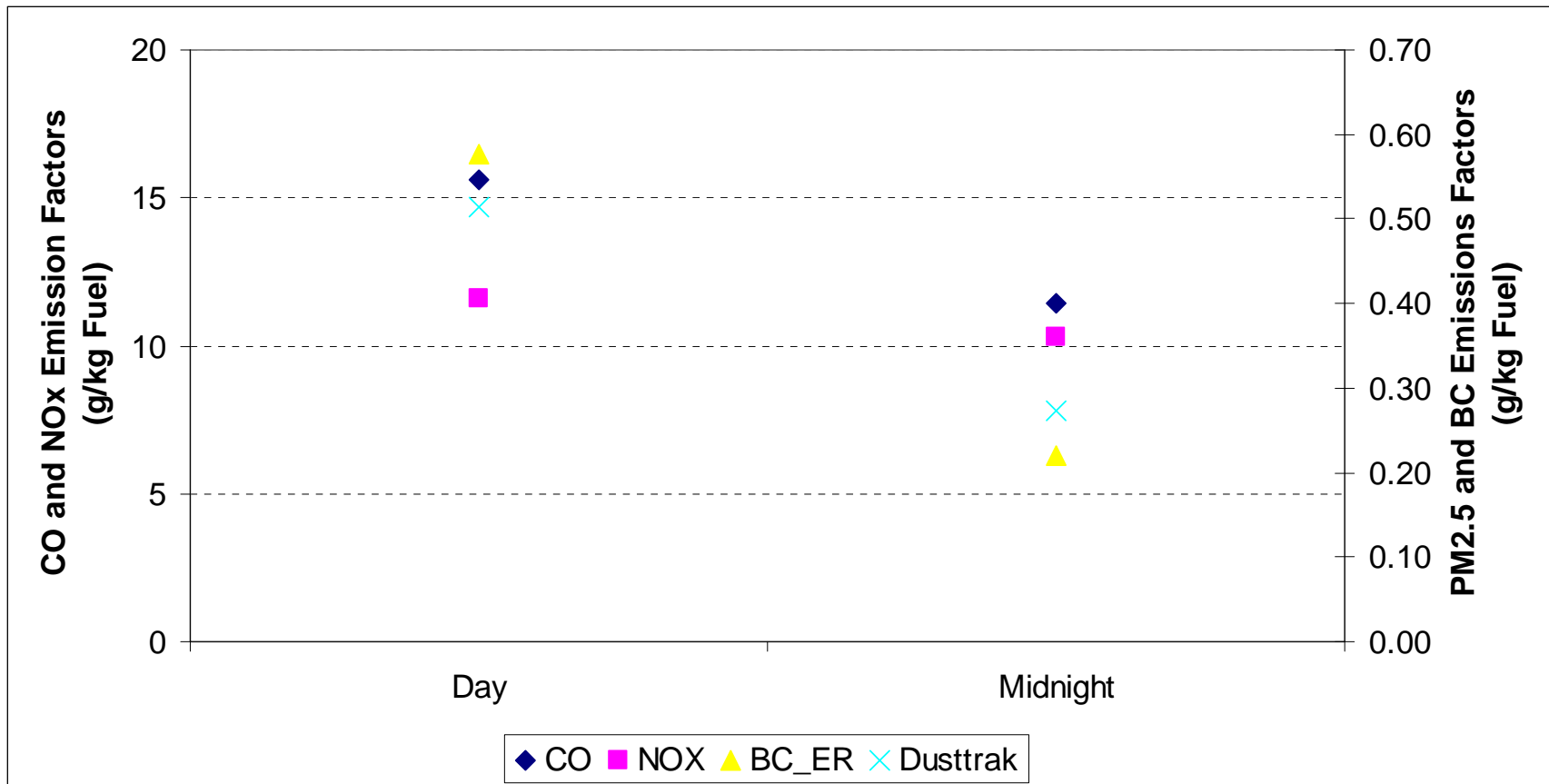
I-710 →



Methodology III-Calculation of Emission Factors (EF)



2009 Daytime versus Midnight



Port Truck Activity

- 60% of moves made by 2007 compliant trucks (Clean Trucks Program)
- Ports Pier Pass Program-shift to evening and weekend moves
- Increased port truck counts with decrease in afternoon rush hour commuters on surface streets (Houston et al., 2009)

Trends in NO₂/NO_x Ratios

Year	Time of Day	NO ₂ /NO _x	SD
2003	Morning	0.13	0.04
2007	Morning	0.09	0.03
2009	Morning	0.25	0.005
2009	Midnight	0.28	0.009

Summary

- Strong diurnal variation in emission factors measured in 2009 possibly due to sampling of different truck populations
- Downward trend in emission factors compared to studies from previous years
- NO_2/NO_x ratios in 2009 have increased by 1.5-2 times since 2007, 60% of the Ports truck fleet were 2007 compliant
- Mobile platform 5 year sampling plan includes quarterly sampling based on anticipated emissions reductions

What Next?

