EFFECT OF PROXIMITY TO A FREEWAY WITH HEAVY-DUTY DIESEL TRAFFIC ON THE AMBIENT CONCENTRATIONS OF CRITERIA AND AIR TOXIC POLLUTANTS

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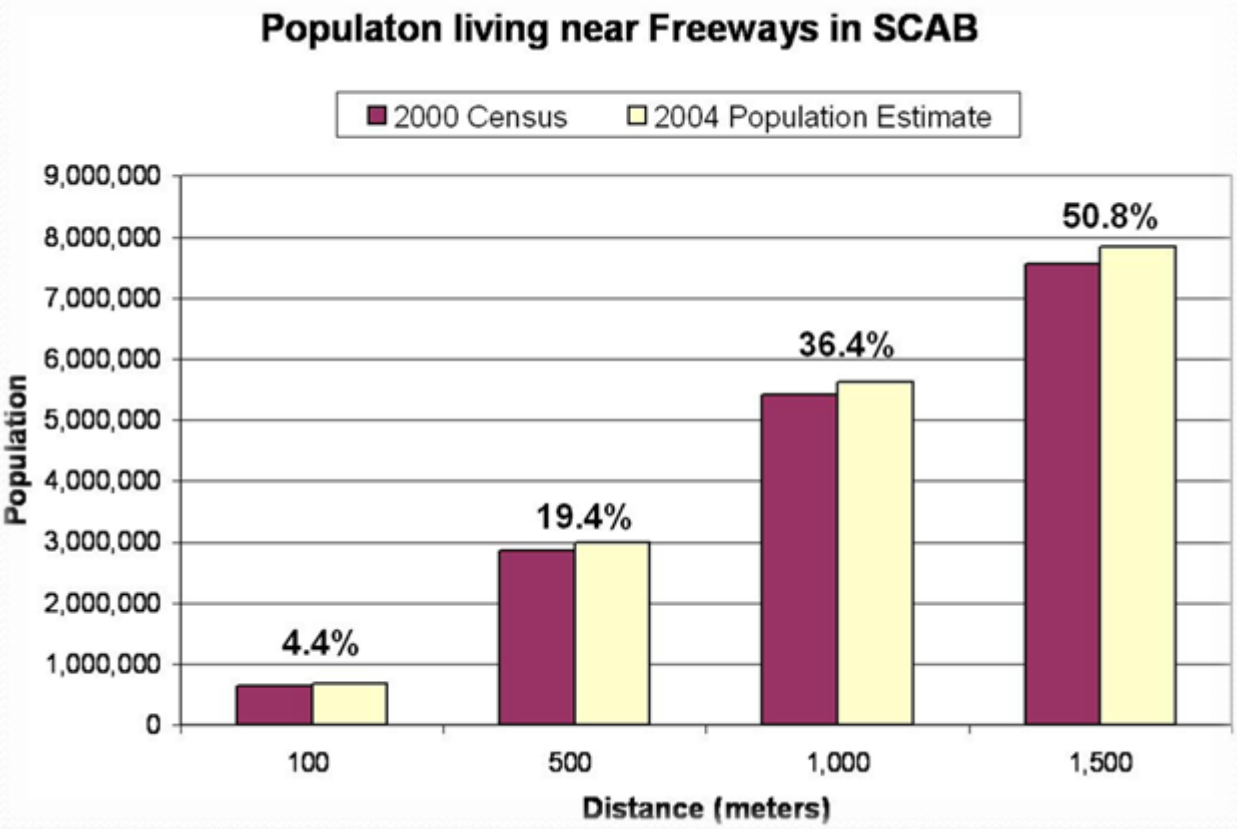
INTRODUCTION

- Over 35 million Americans live within 100 m of a major roadway (4 lanes or larger)

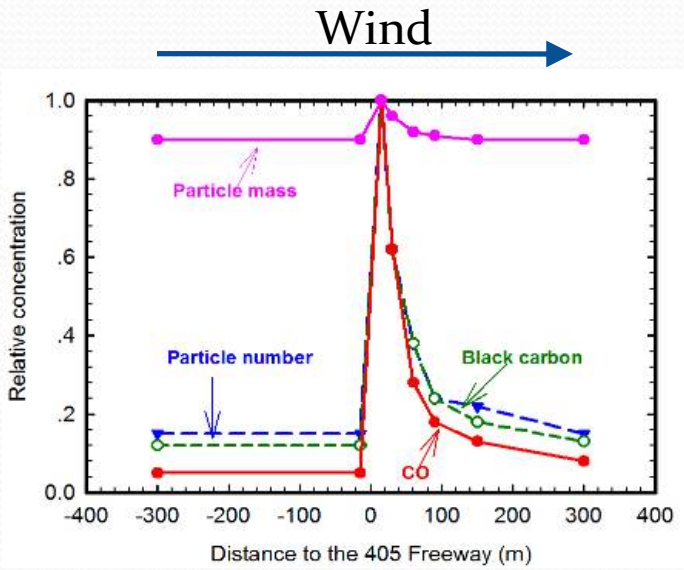


INTRODUCTION

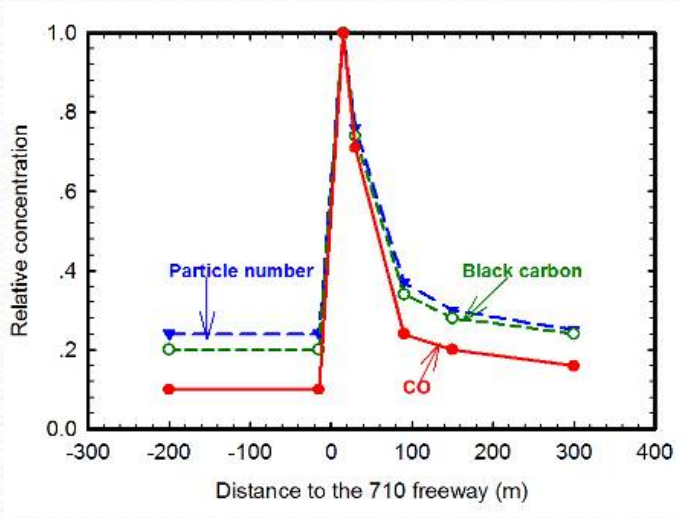
- Motor-vehicle emissions consist of a complex mixture of particulate and gaseous pollutants such as $PM_{2.5}$, UFP, metals, OC, BC, VOCs, NOx and CO

- Living near major roadways has been identified as a risk factor for respiratory and cardiovascular problems:
  - Asthma and allergic disease
  - Reduced lung function growth
  - Increased risk of adverse birth outcomes
  - Cardiac effects
  - Respiratory symptoms
  - Premature mortality
  - Lung cancer

INTRODUCTION

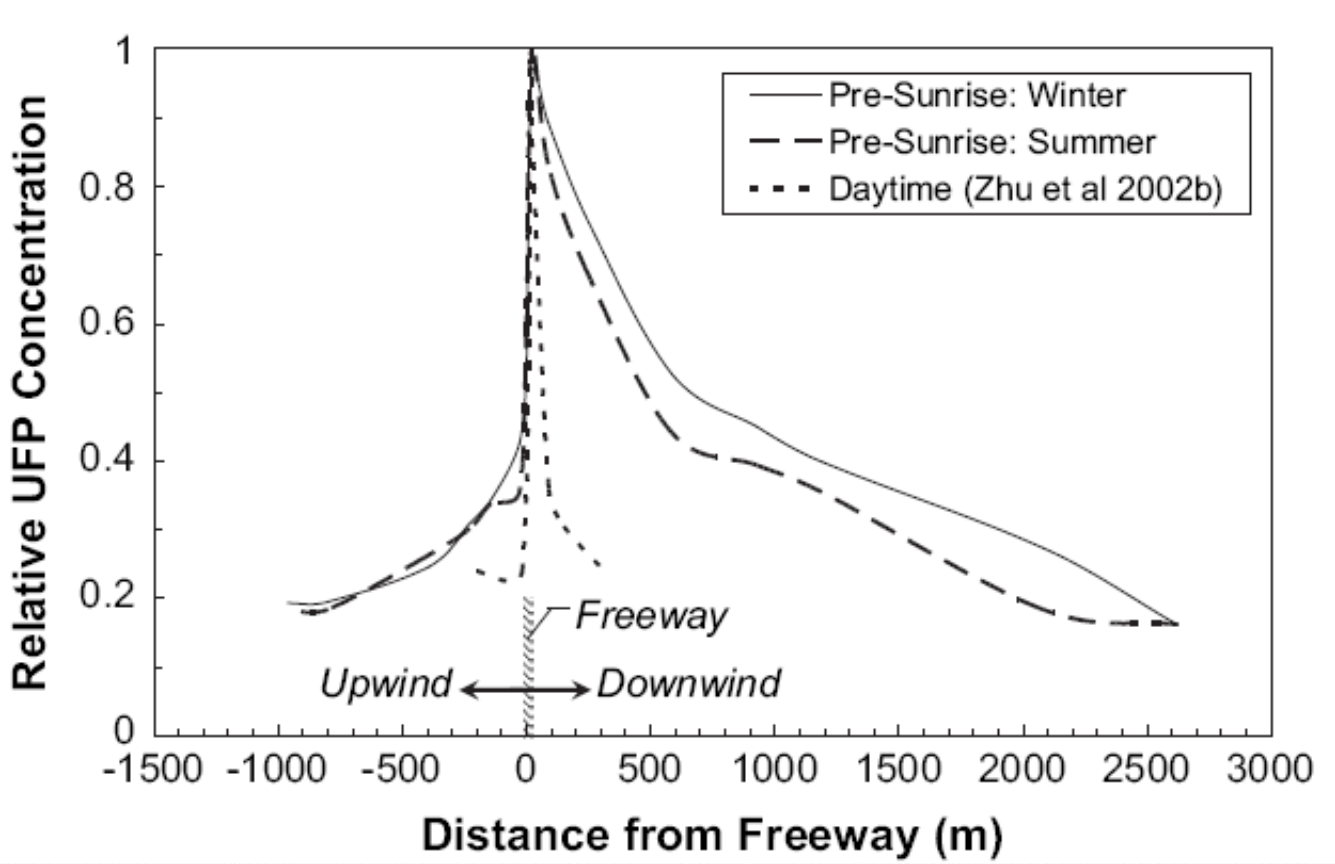


Zhu et al., JAWMA, 2002



Zhu et al., Atm. Env., 2002

INTRODUCTION



Hu, et al., Atm. Env., 2009

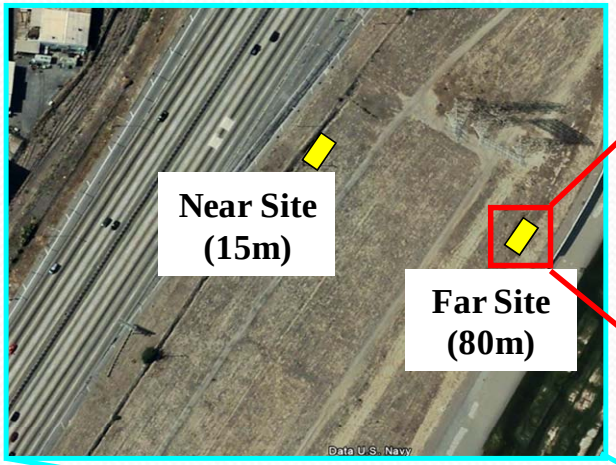
NEAR ROADWAY MONITORING OBJECTIVES

- Potential NAAQS implications (e.g. CO, NO_2, Pb, PM)
  - Near roadway monitoring requirements
  - Maximum pollutant concentrations
- Other Potential Objectives:
  - Trends sites to evaluate control strategies and fuel changes
    - Accountability of regulatory programs
    - SIP development
  - Monitoring data to evaluate dispersion models used for local assessments
    - Environmental Impact Assessments (e.g. CEQA, NEPA)
    - Emission factor development and evaluation
    - Urban and land use planning
  - Community-scale monitoring
    - Evaluate concentrations near transportation sources
    - Support health studies/determine population exposures
    - Evaluate mitigation measures

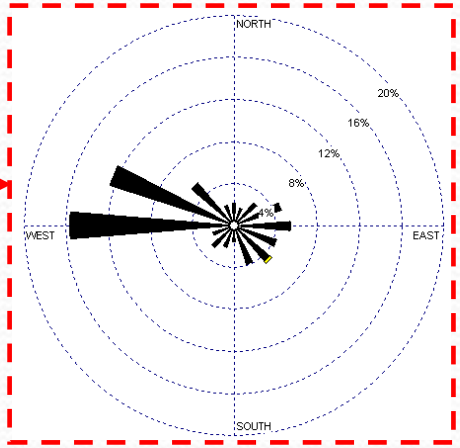
STUDY DESIGN

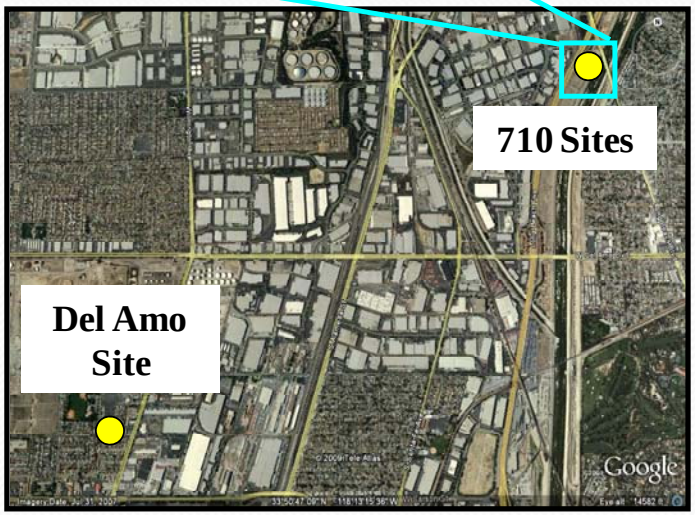
- One-month intensive
  - February - March 2009 (winter campaign)
  - July – August 2009 (summer campaign)
- I-710 - three sites
  - Nearest downwind of freeway(15 m)
  - Further downwind of freeway (80 m)
  - Upwind/background (Del Amo)
- Measurements
  - Continuous particle number, BC, $PM_{2.5}$ mass, NO_X, CO, WS, WD, T and RH
  - PM_{10} mass, OC and EC (24-hr samples; 1-in-2 day)
  - $PM_{2.5}$ mass (24-hr FRM samples; daily)
  - TSP Lead (24-hr samples; 1-in-2 day)
  - VOC Air Toxics (4 samples per day; 5am-9am, 9am-3pm, 3pm-7pm, 7pm-5am; 1-in-2 day)

SAMPLING SITES

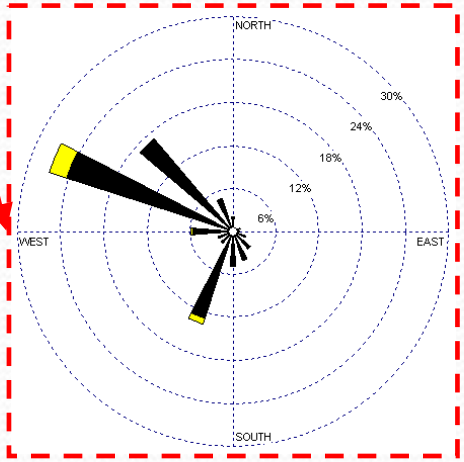


01/28/09 to 03/20/09





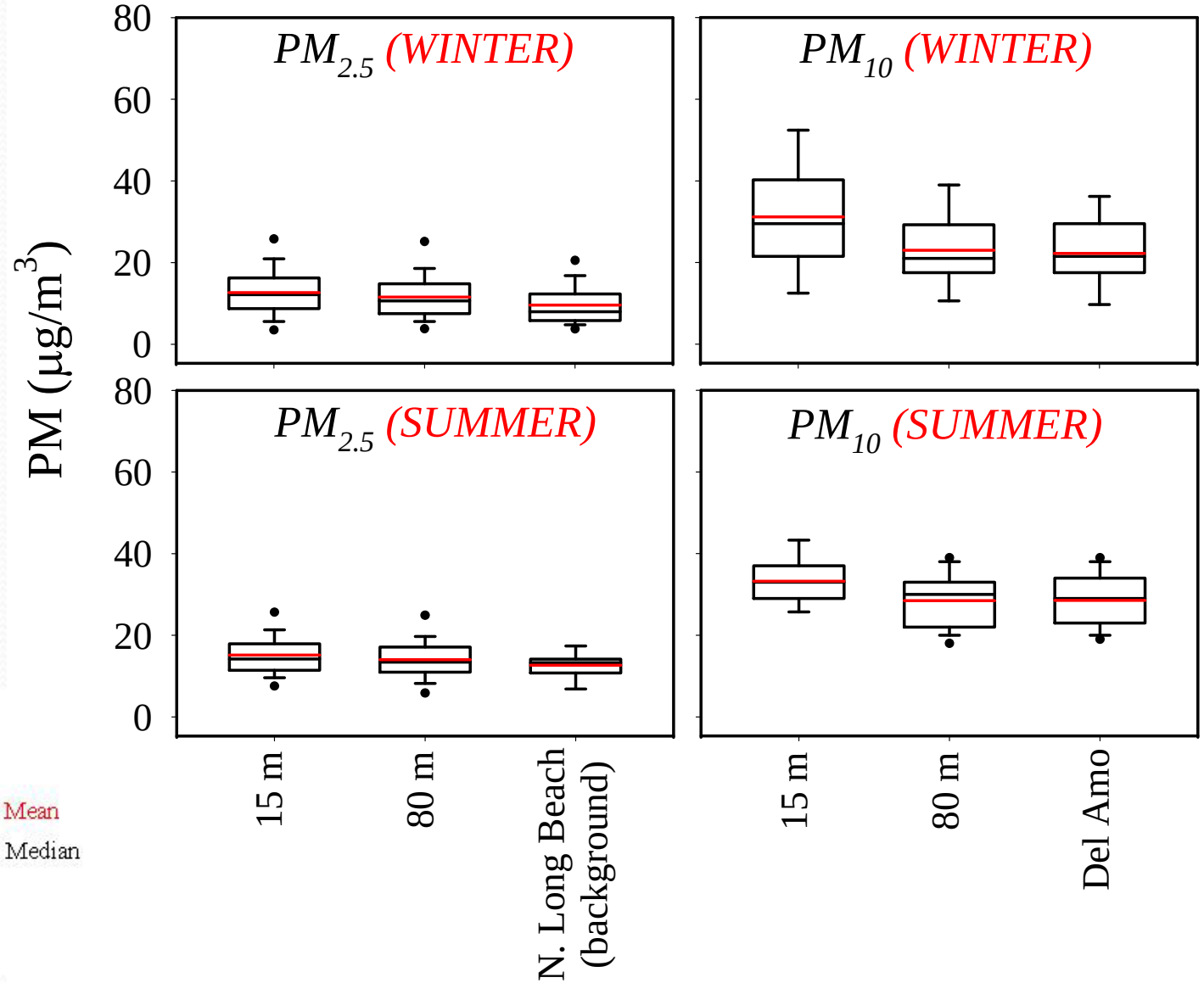
07/10/09 to 08/19/09

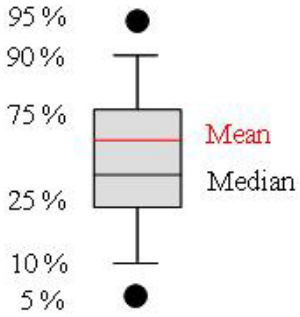


WIND SPEED
(m/s)

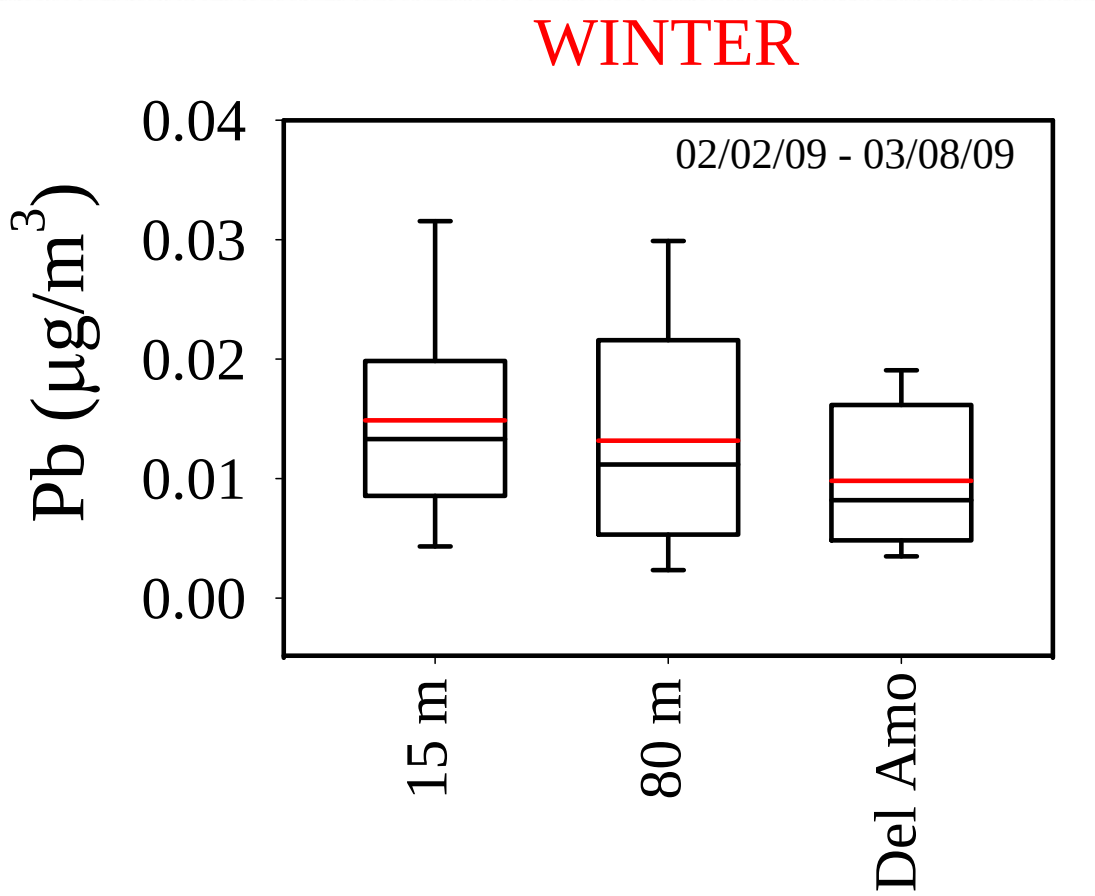
- >= 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

RESULTS: PM_{10} and $PM_{2.5}$ (FRM)

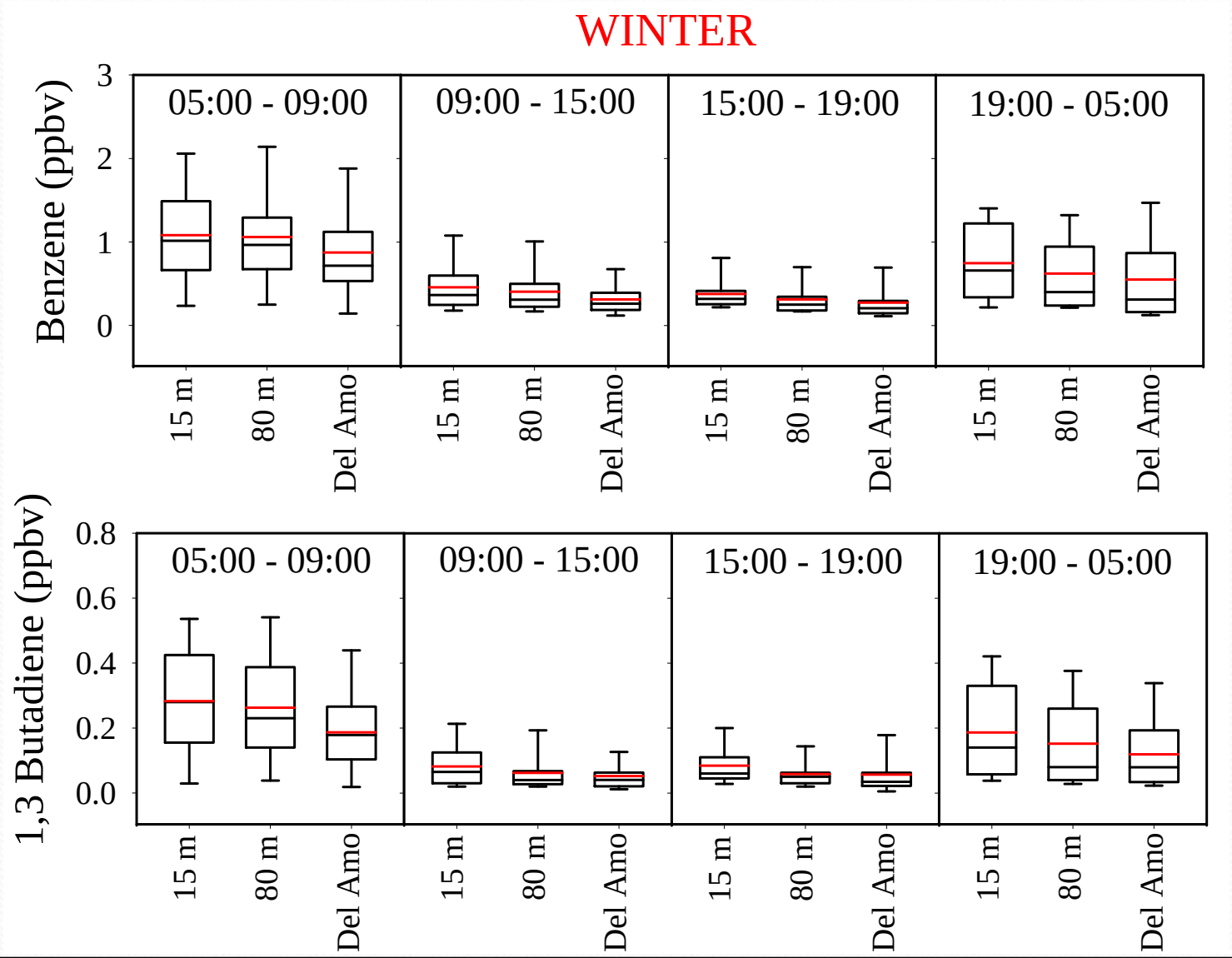




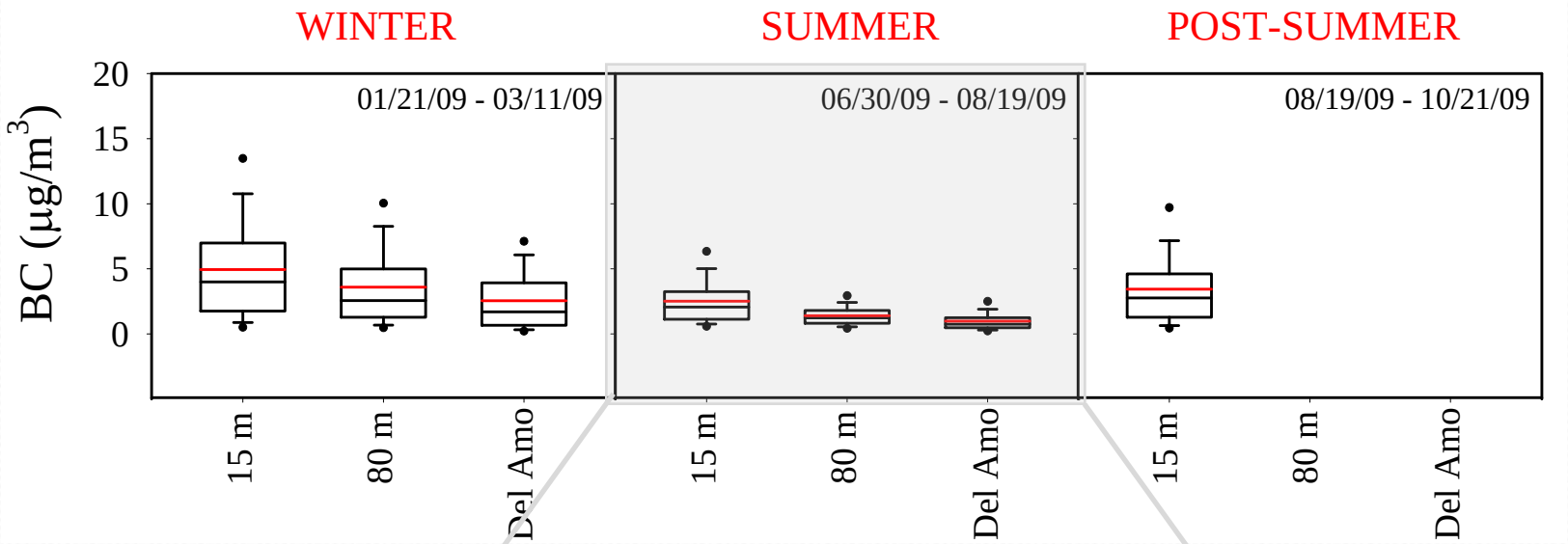
RESULTS: *Lead (TSP)*

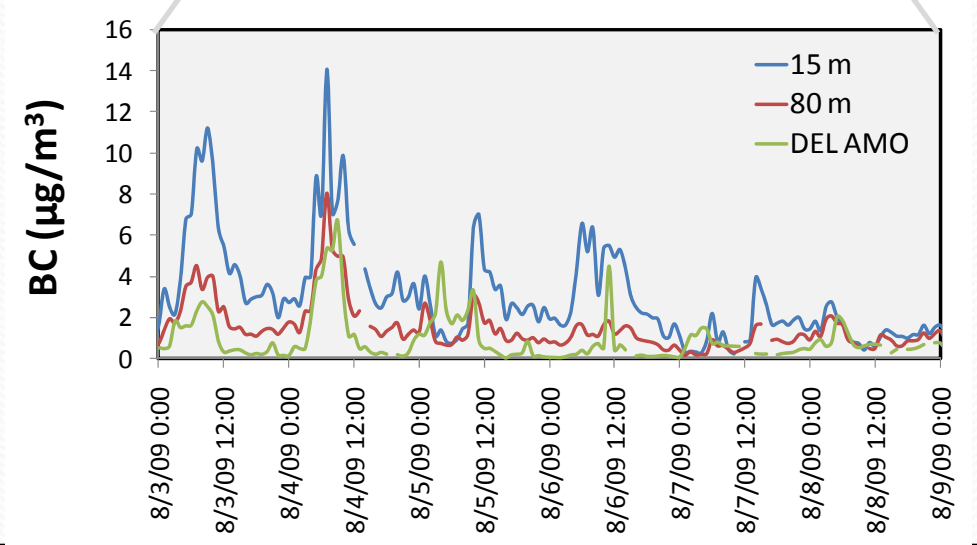


RESULTS: *VOCs*

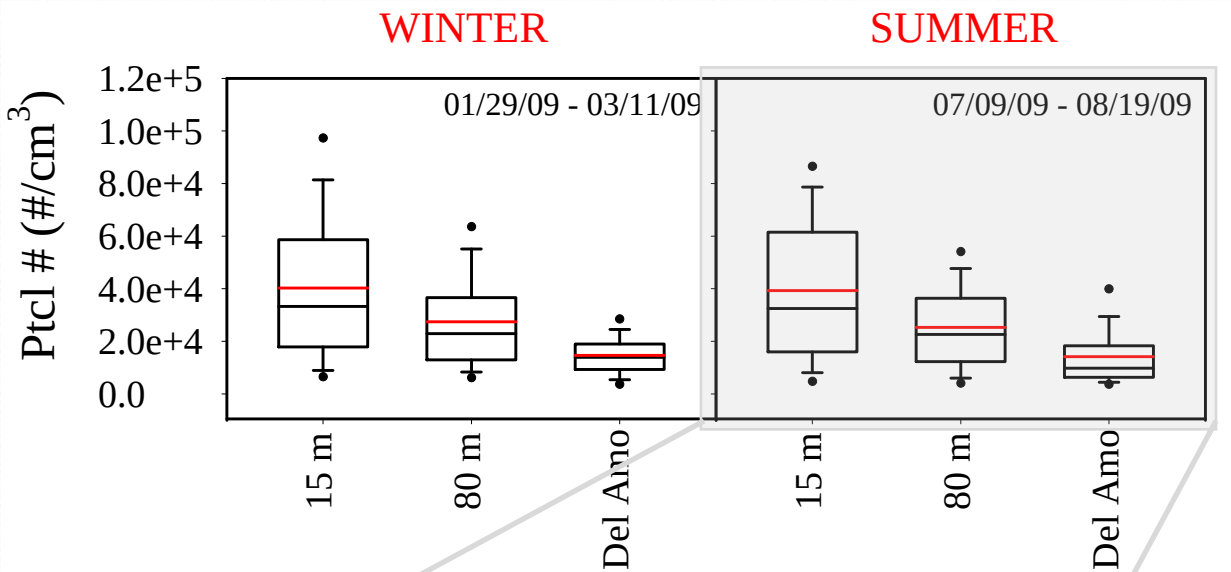


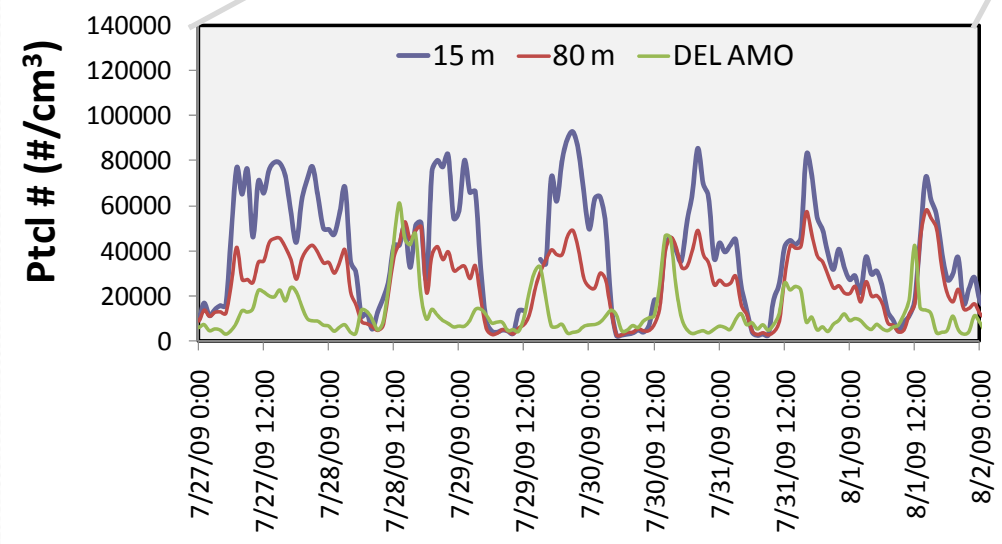
RESULTS: *Black Carbon*



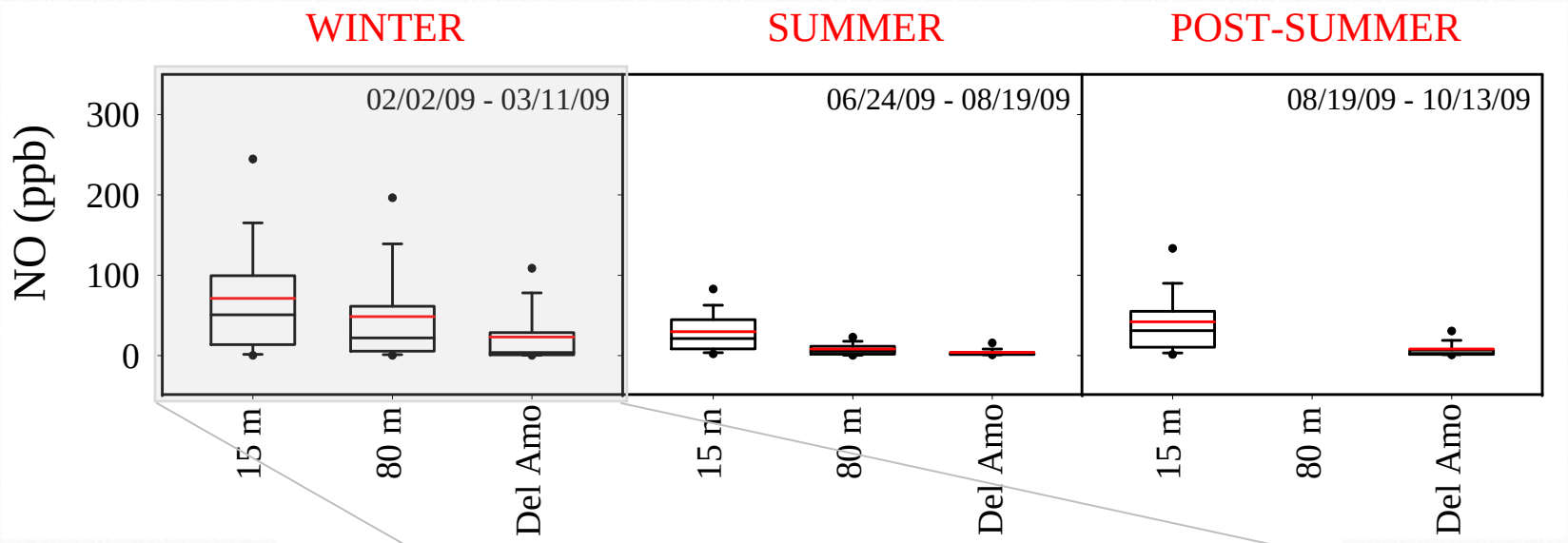


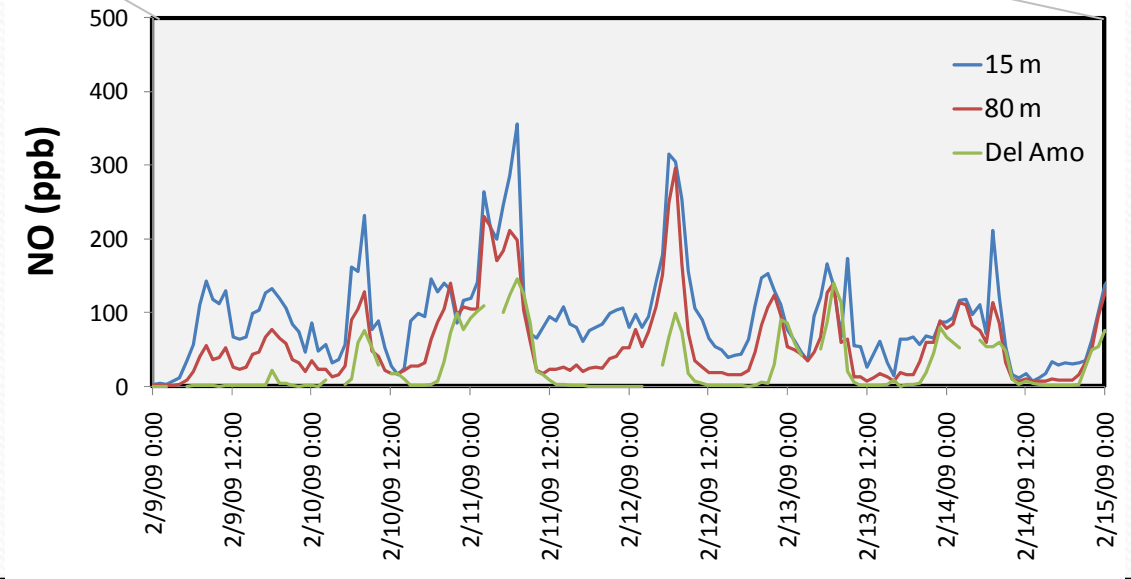
RESULTS: *Ultrafine Particles*



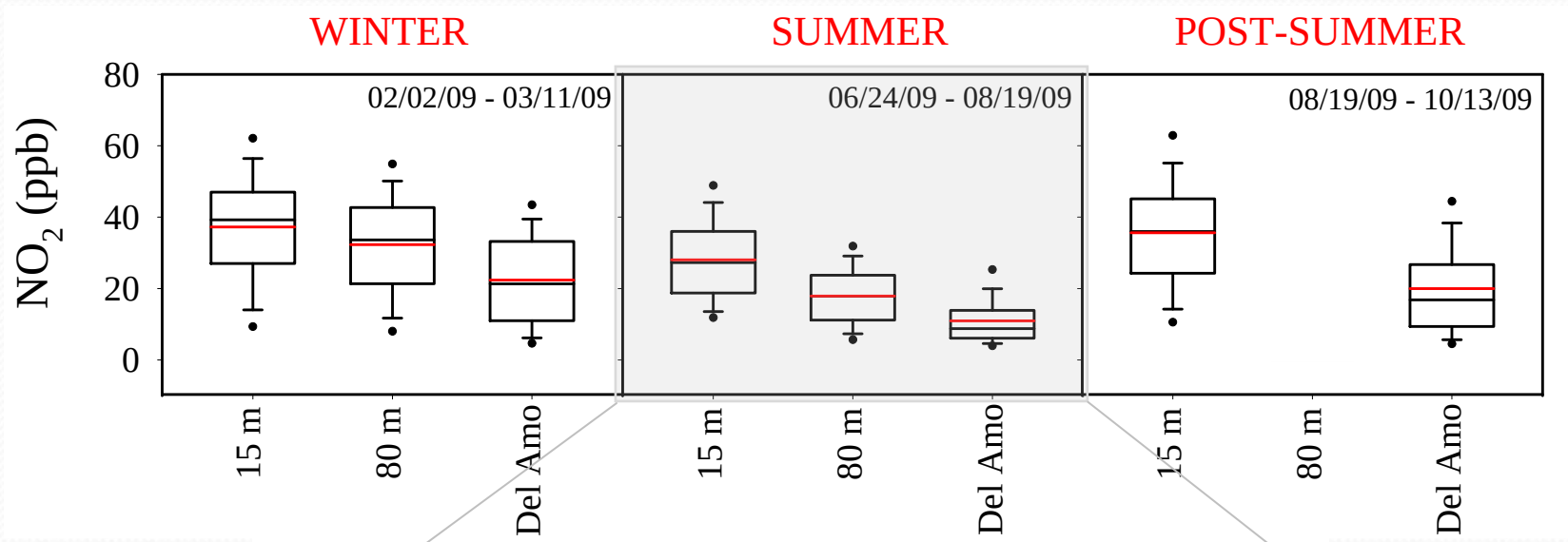


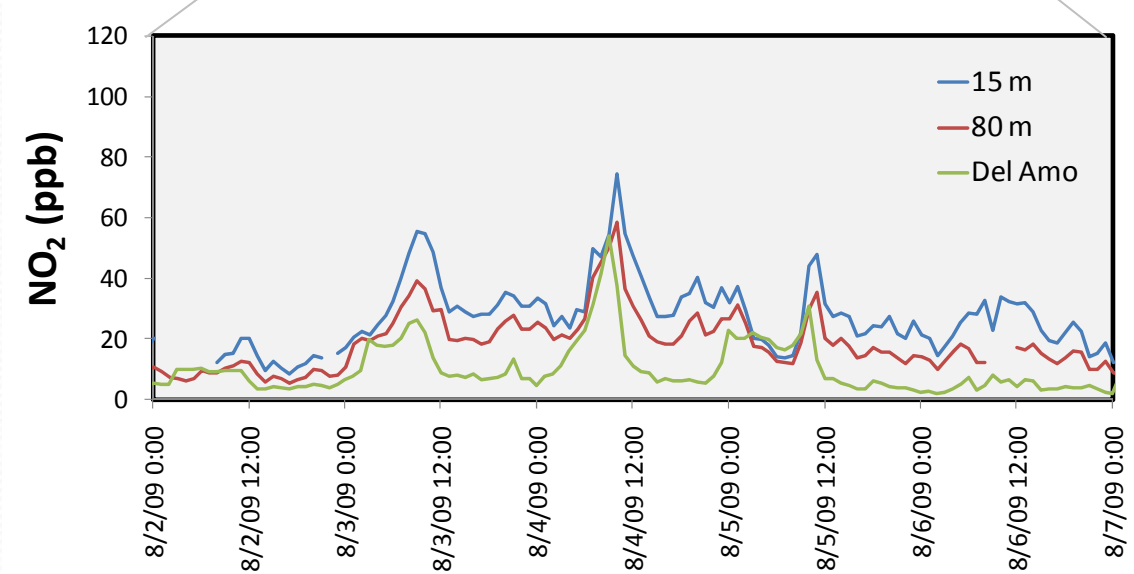
RESULTS: *NO*


WINTER
SUMMER
POST-SUMMER
02/02/09 - 03/11/09
06/24/09 - 08/19/09
08/19/09 - 10/13/09
NO (ppb)
300
200
100
0
15 m
80 m
Del Amo
15 m
80 m
Del Amo
15 m
80 m
Del Amo


NO (ppb)
500
400
300
200
100
0
15 m
80 m
Del Amo
2/9/09 0:00
2/9/09 12:00
2/10/09 0:00
2/10/09 12:00
2/11/09 0:00
2/11/09 12:00
2/12/09 0:00
2/12/09 12:00
2/13/09 0:00
2/13/09 12:00
2/14/09 0:00
2/14/09 12:00
2/15/09 0:00

RESULTS: NO_2


WINTER
SUMMER
POST-SUMMER
02/02/09 - 03/11/09
06/24/09 - 08/19/09
08/19/09 - 10/13/09
NO2 (ppb)
80
60
40
20
0
15 m
80 m
Del Amo
15 m
80 m
Del Amo
15 m
80 m
Del Amo

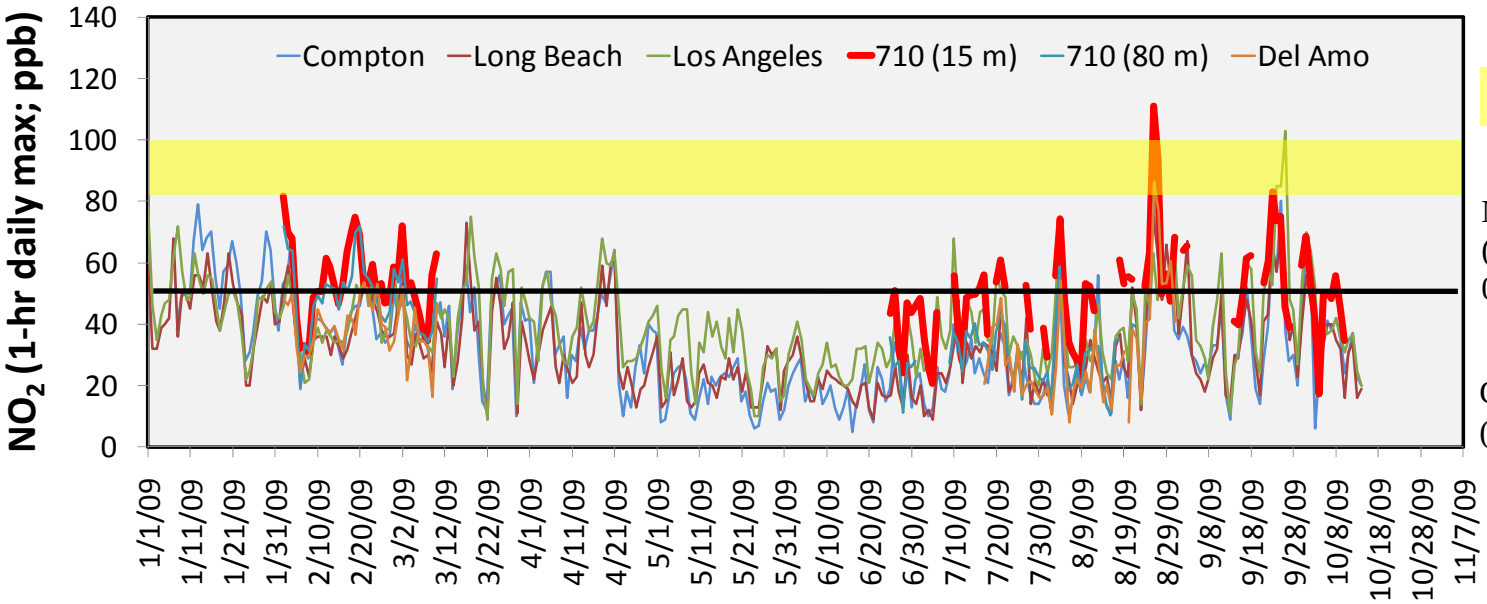

NO2 (ppb)
120
100
80
60
40
20
0
15 m
80 m
Del Amo
8/2/09 0:00
8/2/09 12:00
8/3/09 0:00
8/3/09 12:00
8/4/09 0:00
8/4/09 12:00
8/5/09 0:00
8/5/09 12:00
8/6/09 0:00
8/6/09 12:00
8/7/09 0:00

EPA PROPOSED NO_2 NAAQS

- Current NAAQS (53 ppb; annual)
- Proposing a short-term standard
  - One-hour daily maximum
  - 3-year average of 99th percentile (or 4th highest)
  - 80 – 100 ppb
  - Require monitors within 50 m of major roads
- NO_2 monitoring issues
  - Identifying maximum concentration locations
  - Cost and logistics of establishing and accessing sites

RESULTS: *NO_2 1-hr Daily Max*

CO = Compton
LB = Long Beach
LA = Los Angeles
710 = Near site (15m); Far site (80m)
DA = Del Amo

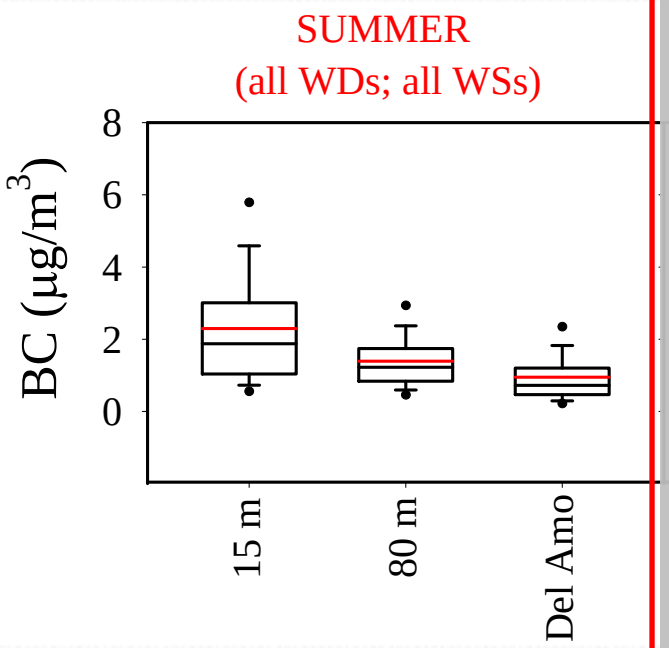


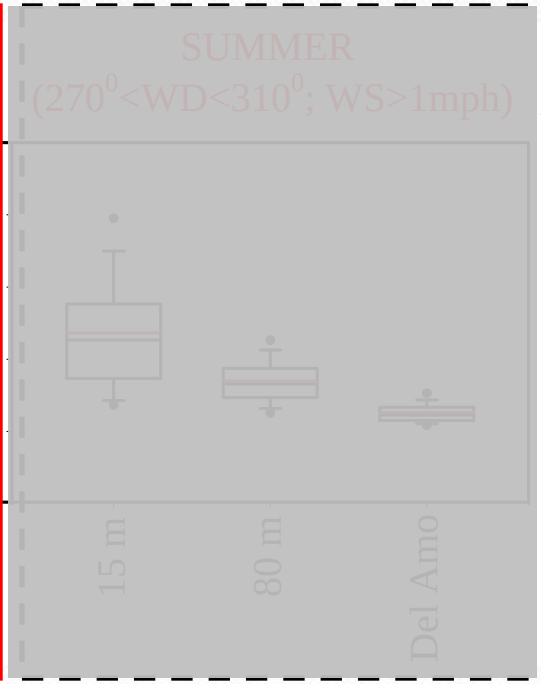
Range of proposed standard

Near site (15 m) = **51 ppb** (arithmetic mean from 01/01/09 to 10/10/09)

Current NAAQS = **53 ppb** (annual arithmetic mean)

RESULTS: *Wind Effect (Black Carbon)*





Near site average = 2.30 (µg/m^3)

Far site average = 1.39 (µg/m^3)

Del Amo average = 0.95 (µg/m^3)

Near site / Far site ratio = 1.58

Near site average = 2.73 (µg/m^3)

Far site average = 1.40 (µg/m^3)

Del Amo average = 0.52(µg/m^3)

Near site / Far site ratio = 1.86

SUMMARY

- Emissions near (15 m) the I-710 were enriched in BC, ultrafine particles, and NO_x
- Near roadway emissions did not significantly affect the concentration of $PM_{2.5}$ mass
- Variations in VOC levels were minimal 15 m from the I-710
- The 1-hr daily maximum NO_2 concentrations can be higher than the proposed NAAQS range in this worst-case scenario, but concentrations are mostly driven by regional levels
- BC and NO_x are still being monitored at the "Nearest Site" (15m)

ACKNOWLEDGEMENTS

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