FINE-SCALE SPATIAL AND TEMPORAL VARIABILITY OF PARTICLE NUMBER CONCENTRATIONS WITHIN COMMUNITIES AND IN THE VICINITY OF FREEWAY SOUND WALLS

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Background

- Ultrafine particles contribute little to PM mass, but comprise the majority of the number of airborne particles in the atmosphere
- Combustion of fossil fuel in motor vehicles is the major primary emission source of ultrafine particles to urban atmospheres
- In addition to primary ultrafine particle emissions, photochemical secondary formation in the atmosphere also contributes to the formation of ultrafine particles.
- There is little or no correlation between ambient particle numbers and mass, so measurements of ambient particle number concentrations have become increasingly important.
- Measurements of ambient ultrafine particle concentrations at a single central monitoring station mightnot be indicative of actual human exposure in the communities surrounding a single monitoring site.
- Due to their short atmospheric lifetimes and strong dependence on very local sources, ultrafine particle numbers vary significantly on very short spatial and temporal scales.

Background (2)

- To accurately estimate human exposure and the subsequent health impacts of UF particles, more intensive particle number measurements on finer spatial scales is needed.
- Previous studies have either focused on one or two near-roadway sampling sites or few sampling sites separated by large distances
- These studies showed that UF particle concentrations vary dramatically within 100 meters of roadways, pointing out the need for more spatially resolved UF monitoring within impacted communities.
- Most of these studies sampled near freeways without sound walls adjacent to the roadway shoulders. The effects of freeway characteristics, such as the existence of sound walls and the elevation of the roadway, also need to be assessed

Study Objectives:

•To determine the fine-scale spatial variability of ambient particle number (PN) concentrations within communities

•To demonstrate the feasibility of identifying specific ultrafine particle sources within a community using highly time-resolved and spatially-resolved measurements of PN.

•To determine regional vs. local contributions to particle number levels.

•To examine how the variability of particle number concentrations within communities are affected by season and location of the communities (source vs. receptor areas).

•To determine the effects of freeway sound walls on particle number, CO, CO_2 and $PM_{2.5}$ mass emissions into adjacent neighborhoods.

Separate Funding from EPA to Dr. Ronald Henry (USC)

To use the results of this study to explore the development of predictive models of human exposure to particle number concentrations in communities that may have only one monitoring site, using such input variables as:

- wind speed and direction
- known source locations and strength
- regional vs. local contributions
- season
- mixing height

3 Major Components (Sections) of the Study

- Los Angeles/Long Beach Harbor
- Receptor Areas of the Los Angeles Basin
- Sound Wall Study

LA /LB Harbor: USC CPC network

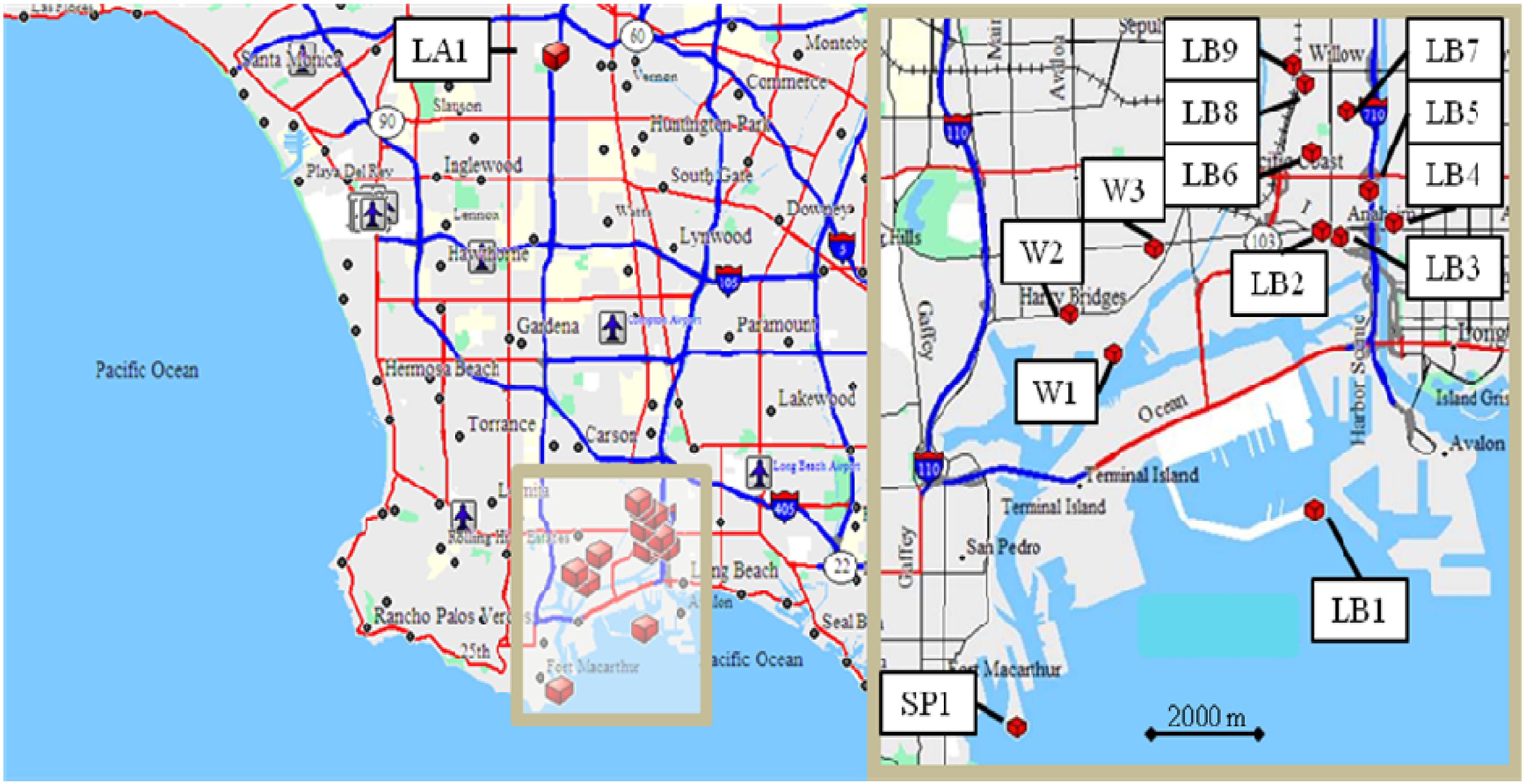
- **Equipment:**
  - 15 CPCs (TSI Model 3022A), weather station, laptop and additional equipment in a weather-proof enclosure
  - 3 Scanning Mobility Particle Sizers (SMPS)
    - Continuous 5-minute data
      - SMPS #1 stationary (USC)
      - SMPS #2 and #3 rotated at ca. 2 week intervals for 5 months

- **"Source" region campaign**
  - **Harbor Communities Monitoring Study**
    - February – December 2007
    - continuous 1-min avg data

On location

@ W2 (CPC & SMPS)

@ LB1



- Onshore/offshore flow patterns predominant
- Prevailing westerly winds during afternoon in northern half of study area

Site Descriptions

LA1 - downtown Los Angeles (USC) to provide a regional context to the observations being made in the vicinity of the Ports

There are two clusters of sites in the Port area—San Pedro/Wilmington and West Long Beach.

- Site SP1 is located at a vacant berth (Berth 47) in the Port of Los Angeles (PoLA) and ships/other harbor craft are not regularly docked there. harbor background site
- Sites W1 and W3 are within ca. 2200 m of each other.
- Site W2 @ intersection of Harry Bridges Boulevard and Fries Avenue - major arterial roadway with significant HDDV traffic.
- Site W1 is located in an industrial area, but not near heavily traveled roadways.
- Site W3 is located in a mixed residential/commercial area affected by traffic and rail lines

The 8 West Long Beach sites are primarily located within a rectangle bounded by the Terminal Island Freeway (SR-103) to the west, Willow Avenue to the north, the I-710 on the east, and Anaheim Street to the south.

• Site LB1 is a companion harbor background site to SP1 located in the Port of Long Beach (PoLB).

• Sites LB2 and LB3 are located in a commercial area

• Site LB4 is an industrial area 10 m north of Anaheim Street, adjacent to the Los Angeles River, 400 m east of the I-710 (25% HDV)

• Site LB5 is adjacent to the I-710.

• Site LB6 is 200 m north and 50 m east of the intersection of the Pacific Coast Highway and Santa Fe Streets.

•Sites LB7 and LB8 are in primarily residential neighborhoods near the commercial strip on Santa Fe Avenue.

• Site LB9 is located approximately 20 m to the north of SR-103's termination at Willow Street

EQUIPMENT

• 15 identical butanol-based CPCs (Model 3022A, TSI, Inc., Shoreview, MN) were obtained for this study

• Nominal 50% detection efficiency diameter of 7 nm increasing to approximately 100% for particles > 20 nm.

• All fifteen CPCs were returned to the manufacturer for factory re-calibration prior to the start of the study.

• The CPCs were controlled and the total number concentration recorded using Aerosol Instrument Manager software (v7.3, TSI, Inc., Shoreview, MN).

• The sampling inlet for each CPC was typically 2 m in length and 0.63 cm in diameter. At selected sites, inlets up to 3.25 m in length were used to locate the sampling point above local obstructions.

- The sampling stream was not conditioned prior to measurement and the sampling flow rate was 1.5 liters min^{-1} (lpm).
- Davis Vantage Pro2 or Pro2 Plus weather stations (Davis Instruments, Hayward, California) were installed at each site except LA1 where data were collected by AQMD (N Main St. station)
- During the summer, the routine CPC maintenance procedure was revised to include repeated drain/refill cycles of the butanol reservoir to remove condensed water.
- Gormeley-Kennedy equations and particle size distribution measurements (Krudysz et al. 2009) were used to predict sampling losses - negligible (less than 5%) for the size range of 7-1000 nm.
- Following factory re-calibration side-by-side operation of the CPCs was conducted measuring ambient concentrations at site LA1.
- 1-min CPC data were compared- The average slope of an individual CPC against the "mean" CPC is 1.04 ± 0.08 (mean ± standard deviation, range 0.93–1.21) with very high correlation (R^2 range 0.9–1.0)

Coefficients of Divergence (CODs)

- Measure of homogeneity between sites

  COD = 0 $\Rightarrow$ homogeneous data

  COD = 1 $\Rightarrow$ heterogeneous data

$$COD_{jk} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left[\frac{\left(x_{ij} - x_{ik}\right)}{\left(x_{ij} + x_{ik}\right)}\right]^2}$$

n = # of values (concentrations, x) for paired sites j and k

Spearman correlation coefficient

- Measure of the linear relationship between sites

  $r = \pm 1 \Rightarrow \pm$ linear relationship

  $r = 0 \quad \Rightarrow$ no linear relationship

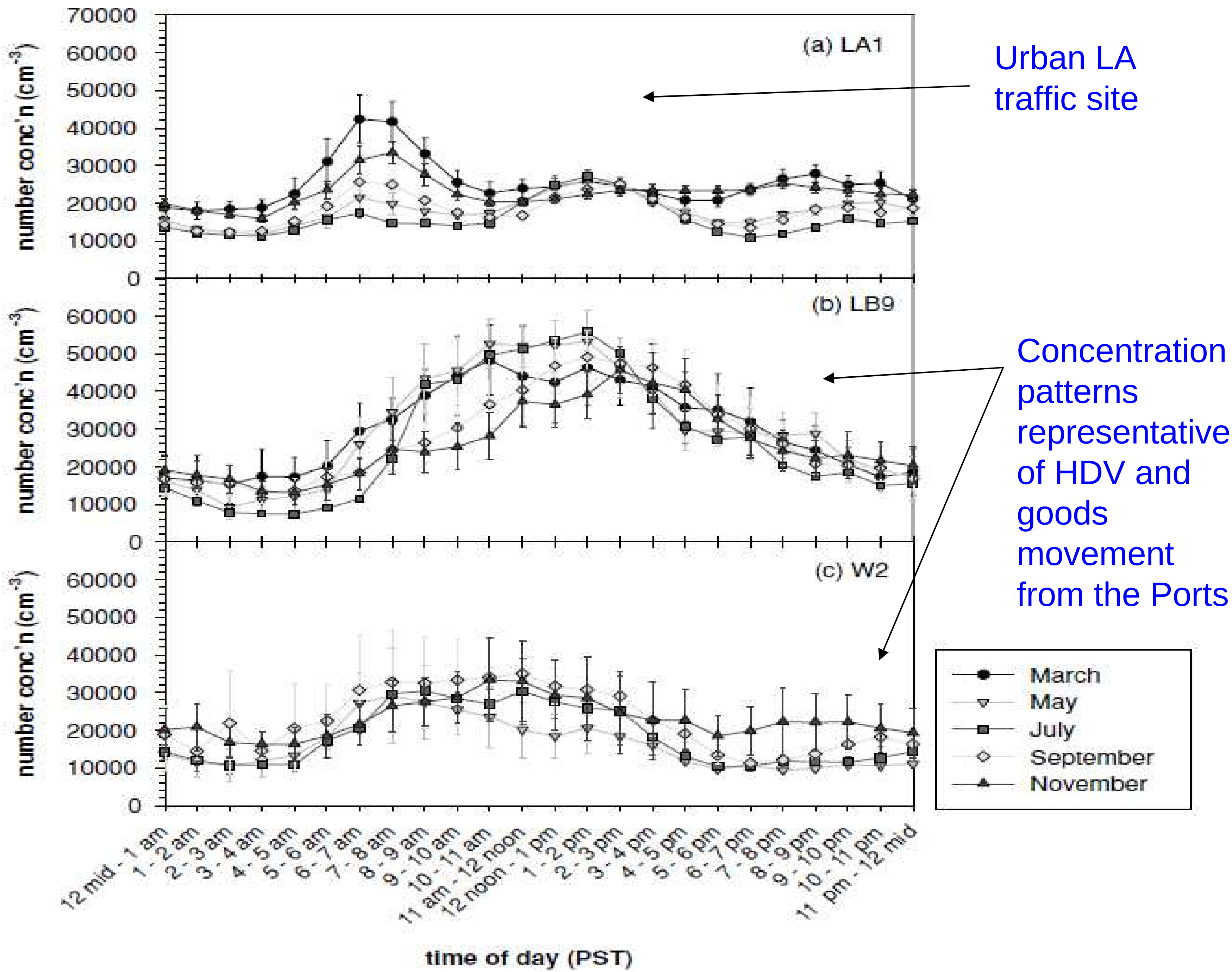
TABLE 2

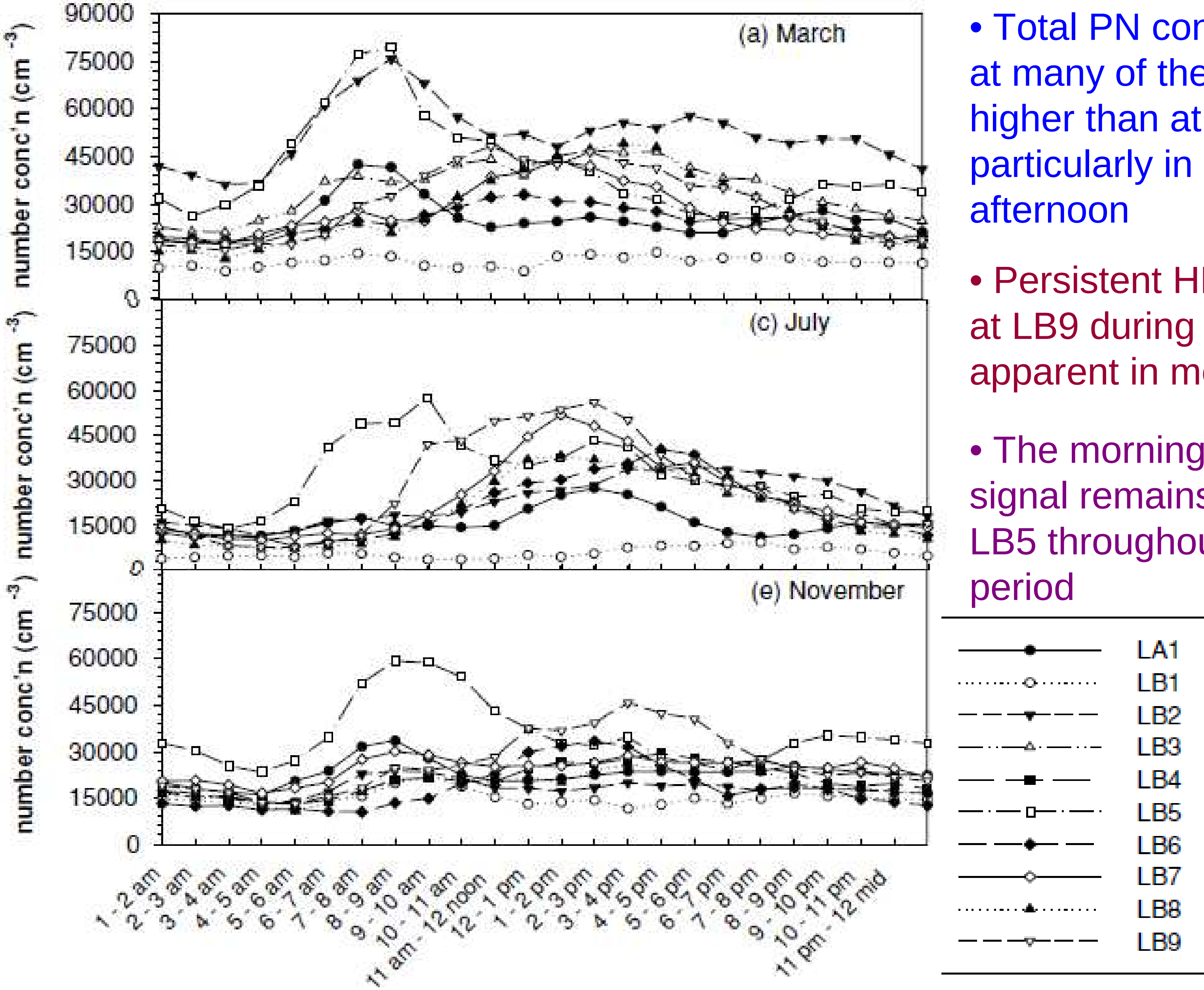
Temperature and Relative Humidity—monthly mean for select sites[a,b]

	LA1		LB1		LB8	
Month	T (°C)	RH (%)	T (°C)	RH (%)	T (°C)	RH (%)
March	16.7 ± 4.4	51 ± 25	14.3 ± 1.2	78 ± 6	15.5 ± 3.0	70 ± 12
April	16.2 ± 3.2	61 ± 19	14.3 ± 0.9	79 ± 4	15.9 ± 2.6	70 ± 11
May	17.7 ± 4.0	59 ± 19	15.5 ± 1.0	78 ± 4	17.3 ± 2.7	68 ± 10
June	19.6 ± 3.5	64 ± 14	17.2 ± 1.1	84 ± 3	19.0 ± 2.6	74 ± 10
July	22.6 ± 3.3	62 ± 14	19.6 ± 1.0	85 ± 3	22.0 ± 2.7	73 ± 10
August	23.5 ± 3.9	58 ± 15	20.7 ± 1.4	82 ± 6	22.9 ± 3.0	70 ± 11
September	21.7 ± 4.7	56 ± 16	18.8 ± 1.3	80 ± 5	21.0 ± 3.1	69 ± 12
October	20.3 ± 4.7	50 ± 23	18.1 ± 1.6	73 ± 6	18.9 ± 4.0	65 ± 14
November	16.9 ± 4.0	58 ± 26	15.6 ± 1.1	78 ± 3	15.9 ± 2.8	73 ± 10

[a]Based upon hourly mean data.

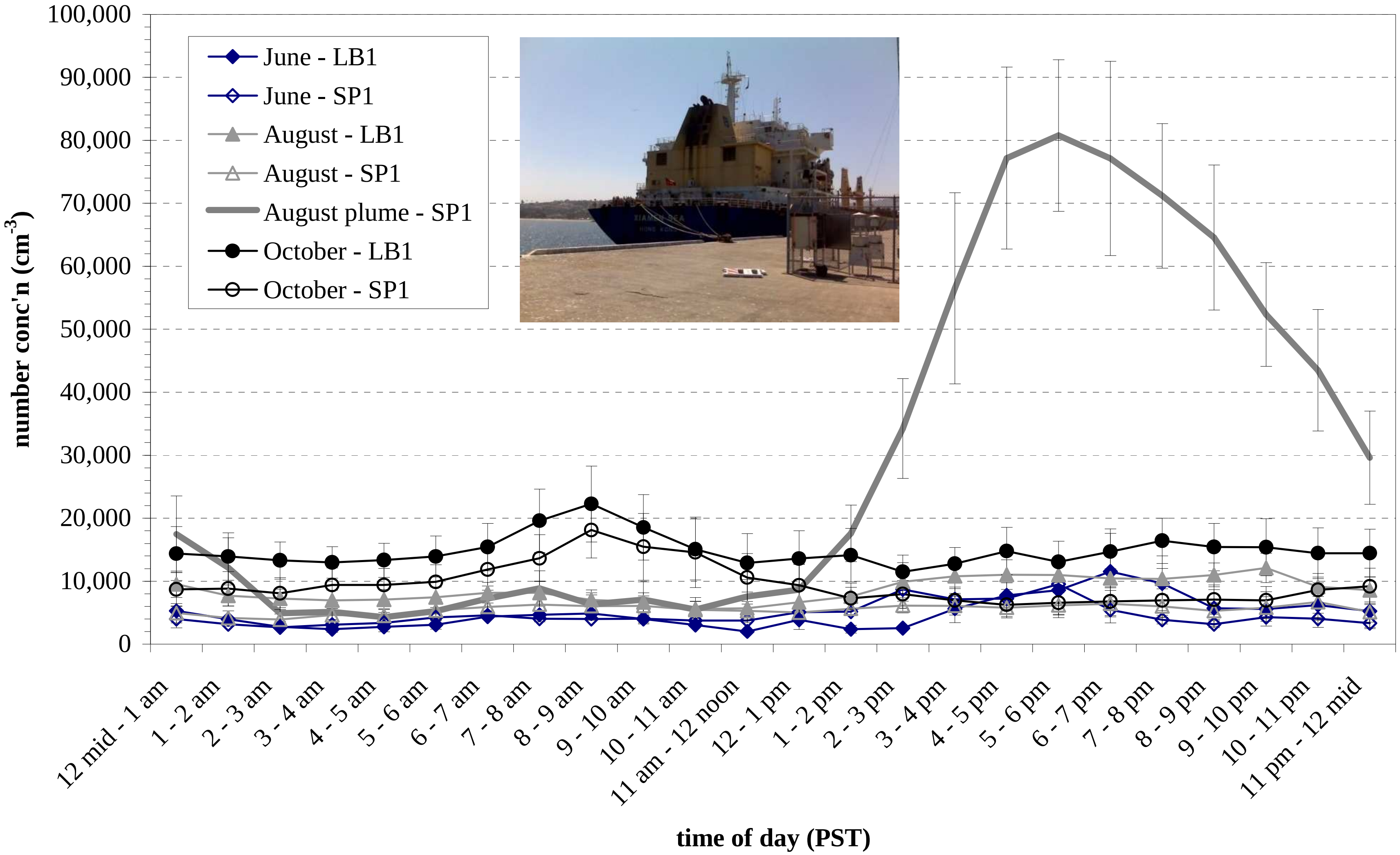
[b]Mean ± standard deviation.


Urban LA traffic site
Concentration patterns representative of HDV and goods movement from the Ports
(a) LA1
(b) LB9
(c) W2
number conc'n (cm^{-3})
time of day (PST)
March
May
July
September
November
12 mid - 1 am
1 - 2 am
2 - 3 am
3 - 4 am
4 - 5 am
5 - 6 am
6 - 7 am
7 - 8 am
8 - 9 am
9 - 10 am
10 - 11 am
11 am - 12 noon
12 noon - 1 pm
1 - 2 pm
2 - 3 pm
3 - 4 pm
4 - 5 pm
5 - 6 pm
6 - 7 pm
7 - 8 pm
8 - 9 pm
9 - 10 pm
10 - 11 pm
11 pm - 12 mid

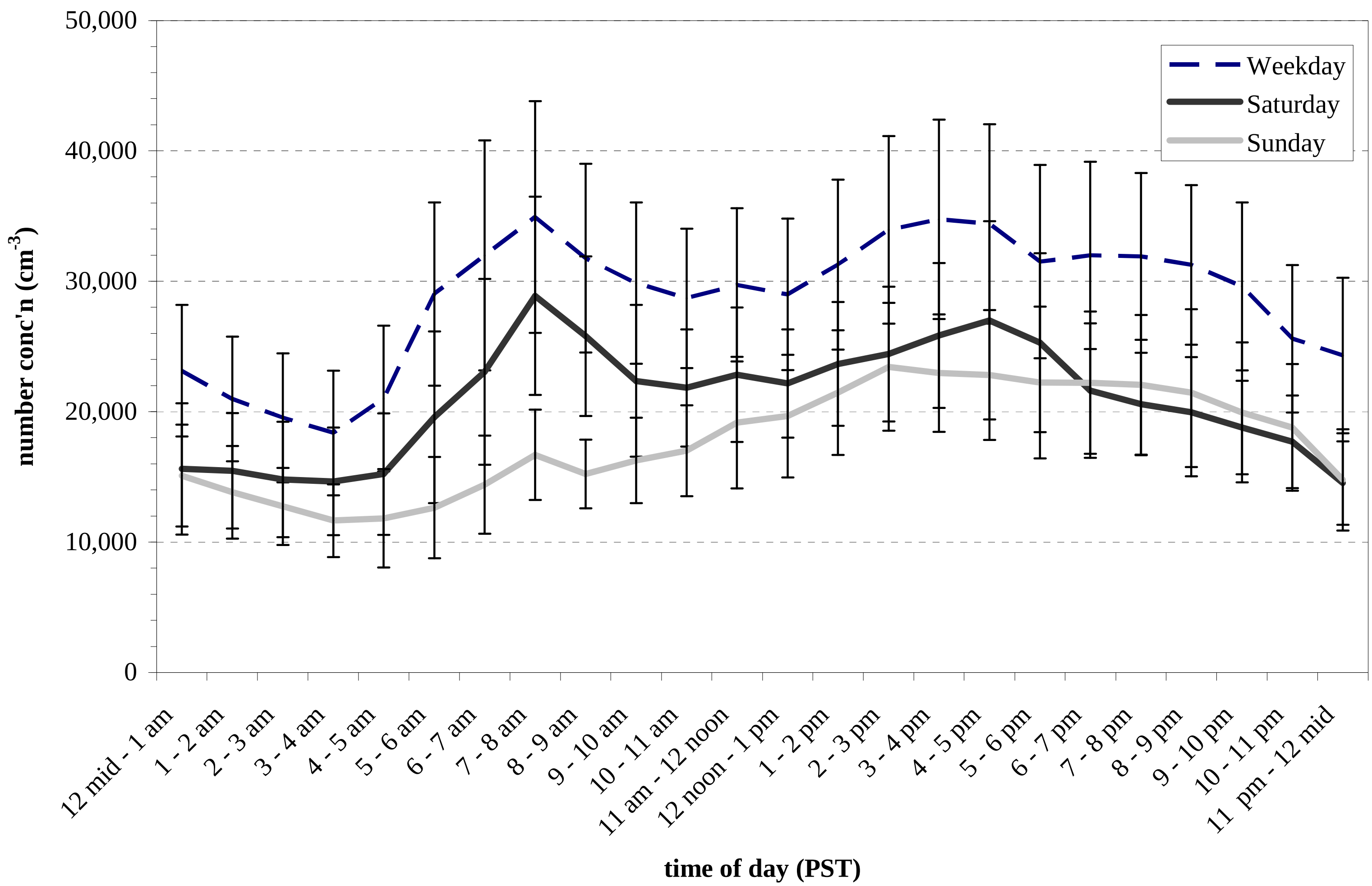


- Total PN concentrations at many of the sites are higher than at LA1, particularly in the afternoon
- Persistent HDV signal at LB9 during the day, apparent in most sites
- The morning commute signal remains evident at LB5 throughout the study period

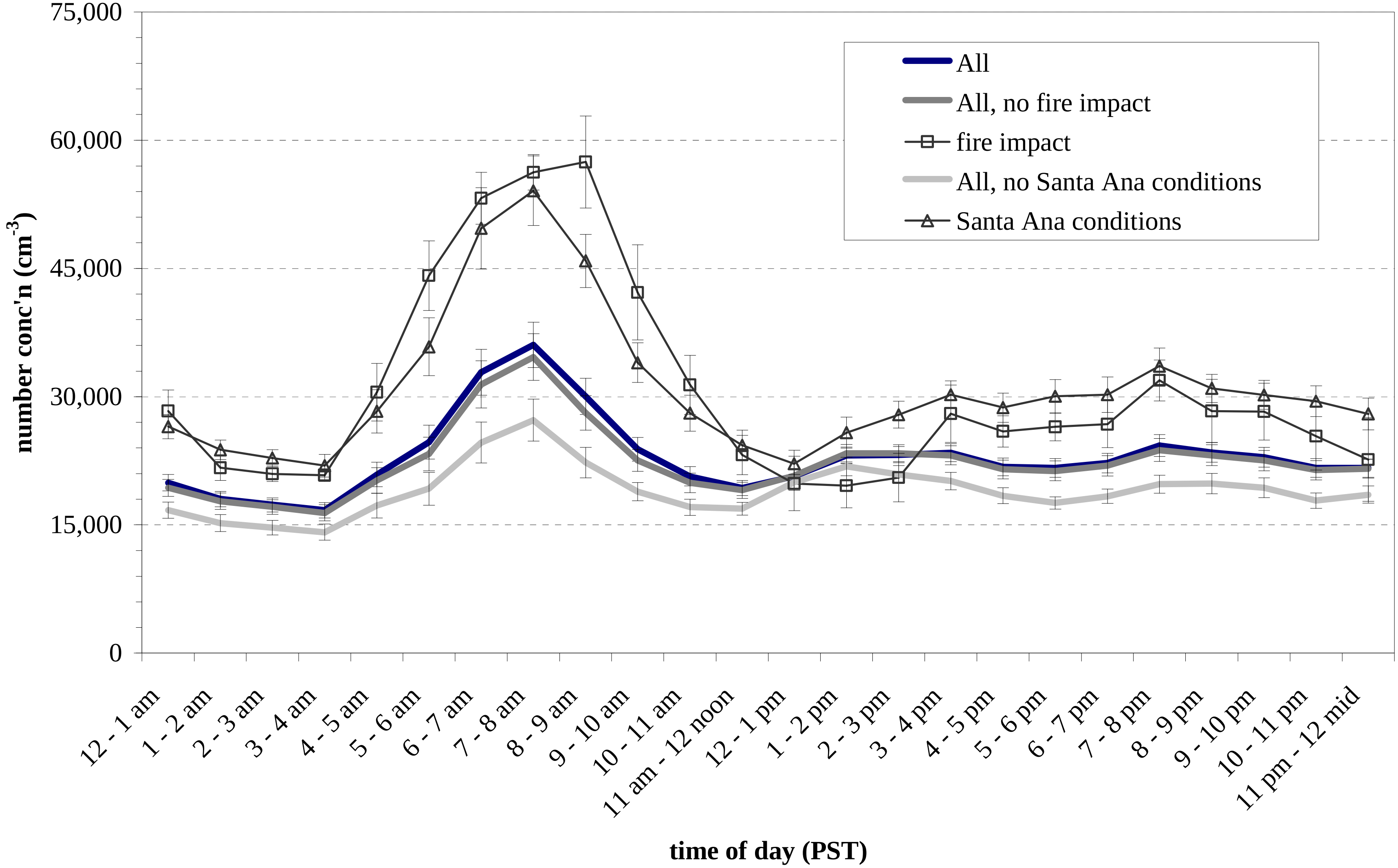
Harbor background sites
with August “plume” (8/5 – 8/13/07 broken out)

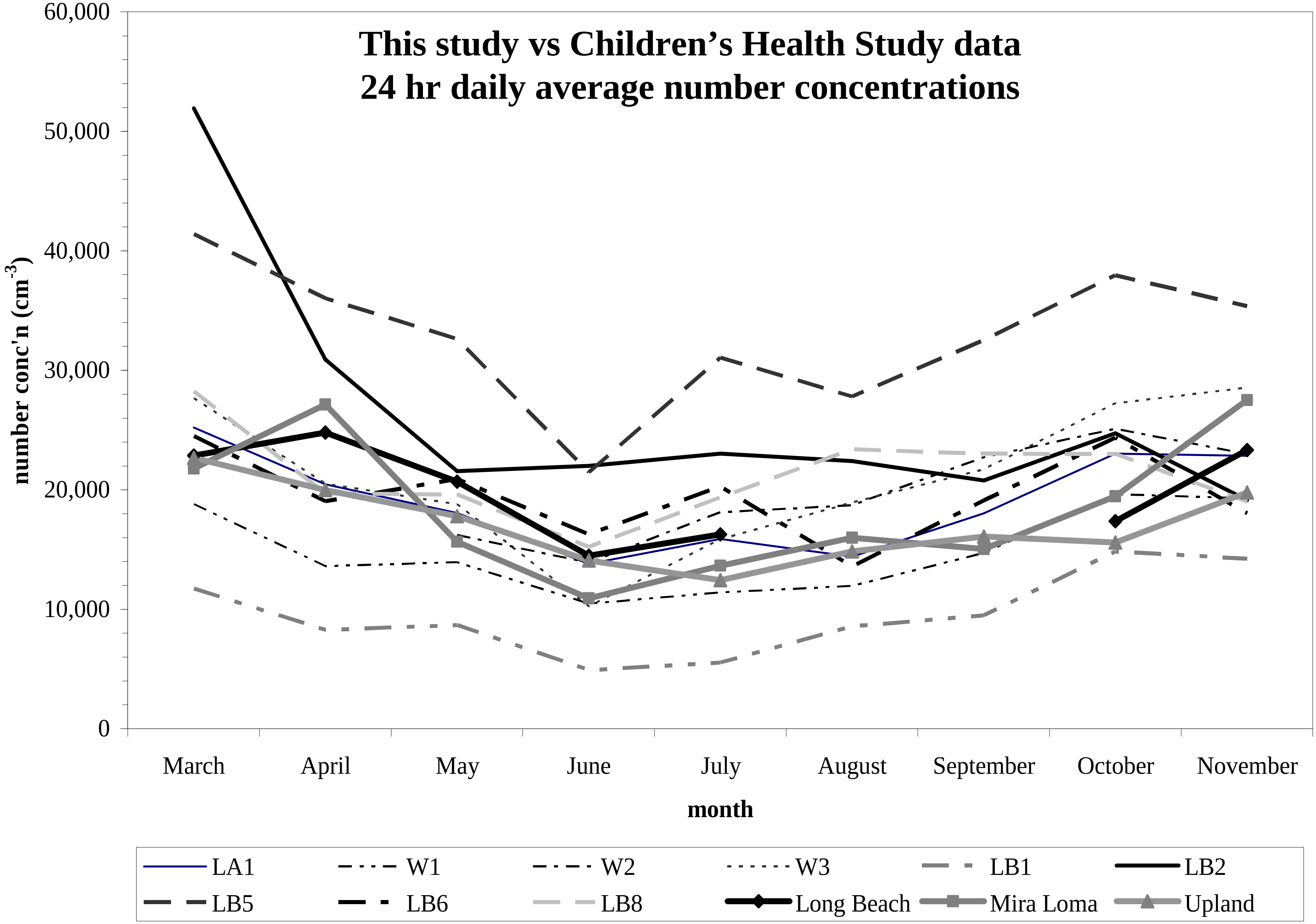


Site LB2 – Day-of-the-week variations

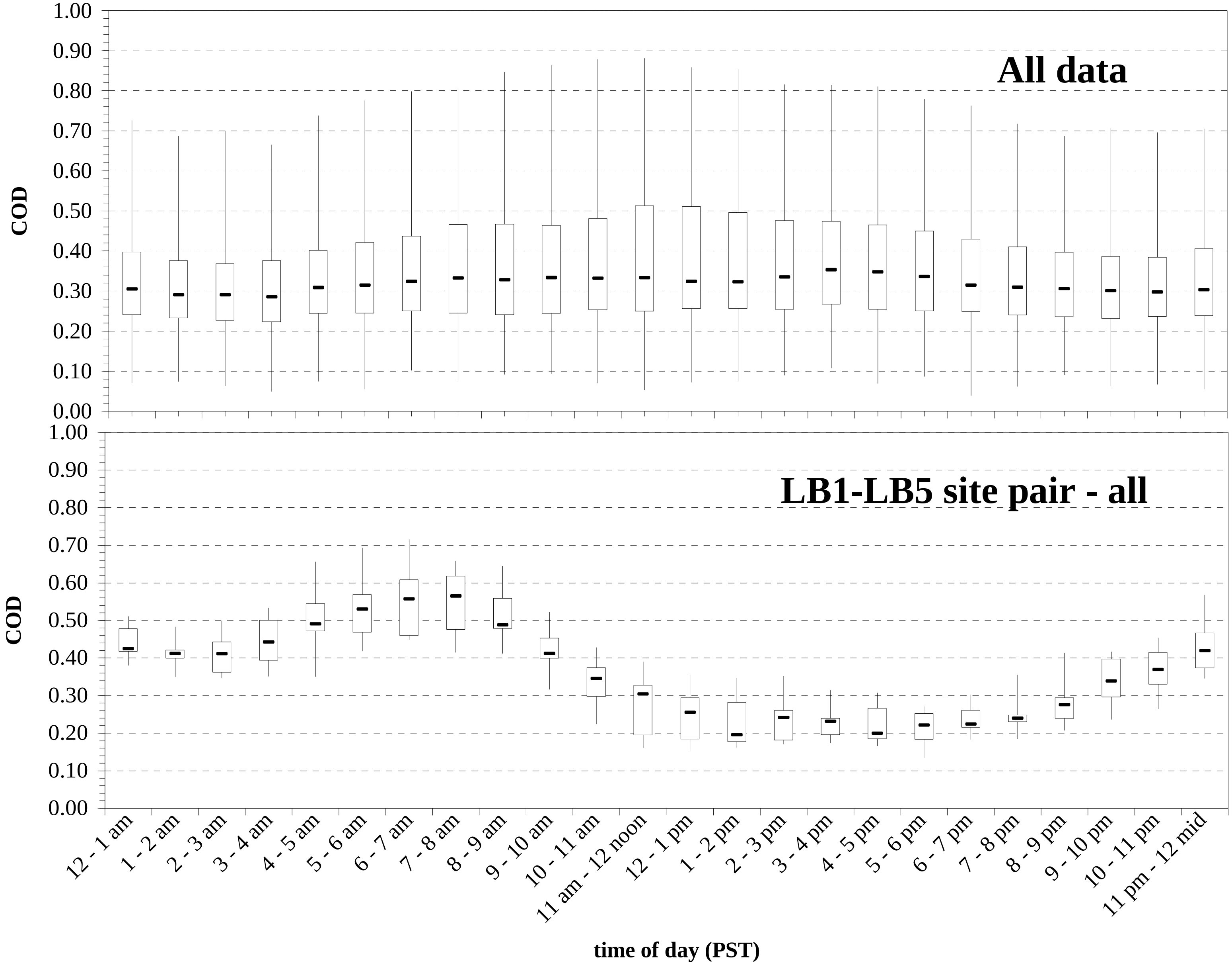


Site LB1 – October & November 2007 data ("all") with Santa Ana wind conditions broken out

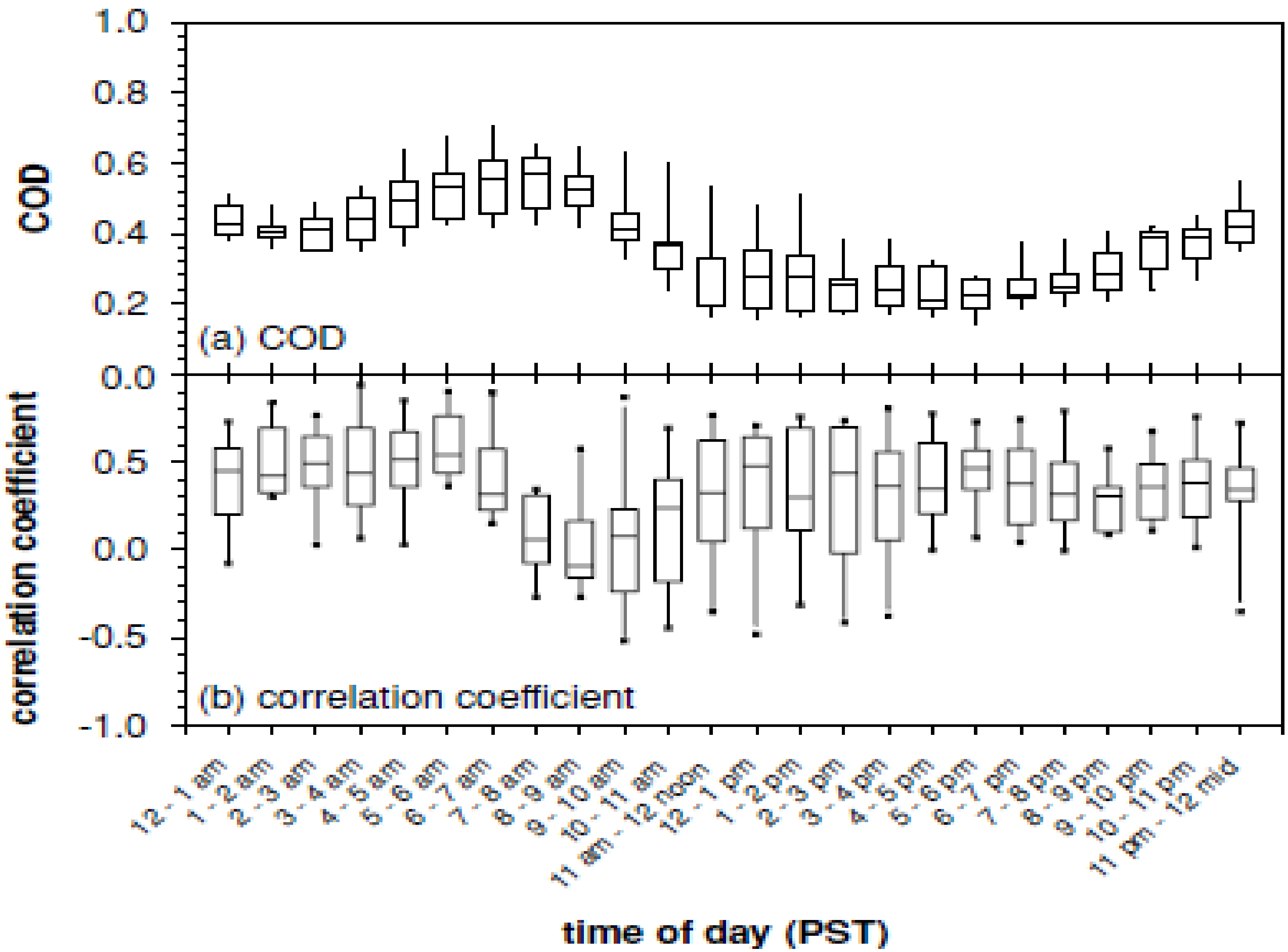




This study vs Children's Health Study data
24 hr daily average number concentrations
number conc'n (cm-3)
60,000
50,000
40,000
30,000
20,000
10,000
0
March
April
May
June
July
August
September
October
November
month
LA1
W1
W2
W3
LB1
LB2
LB5
LB6
LB8
Long Beach
Mira Loma
Upland

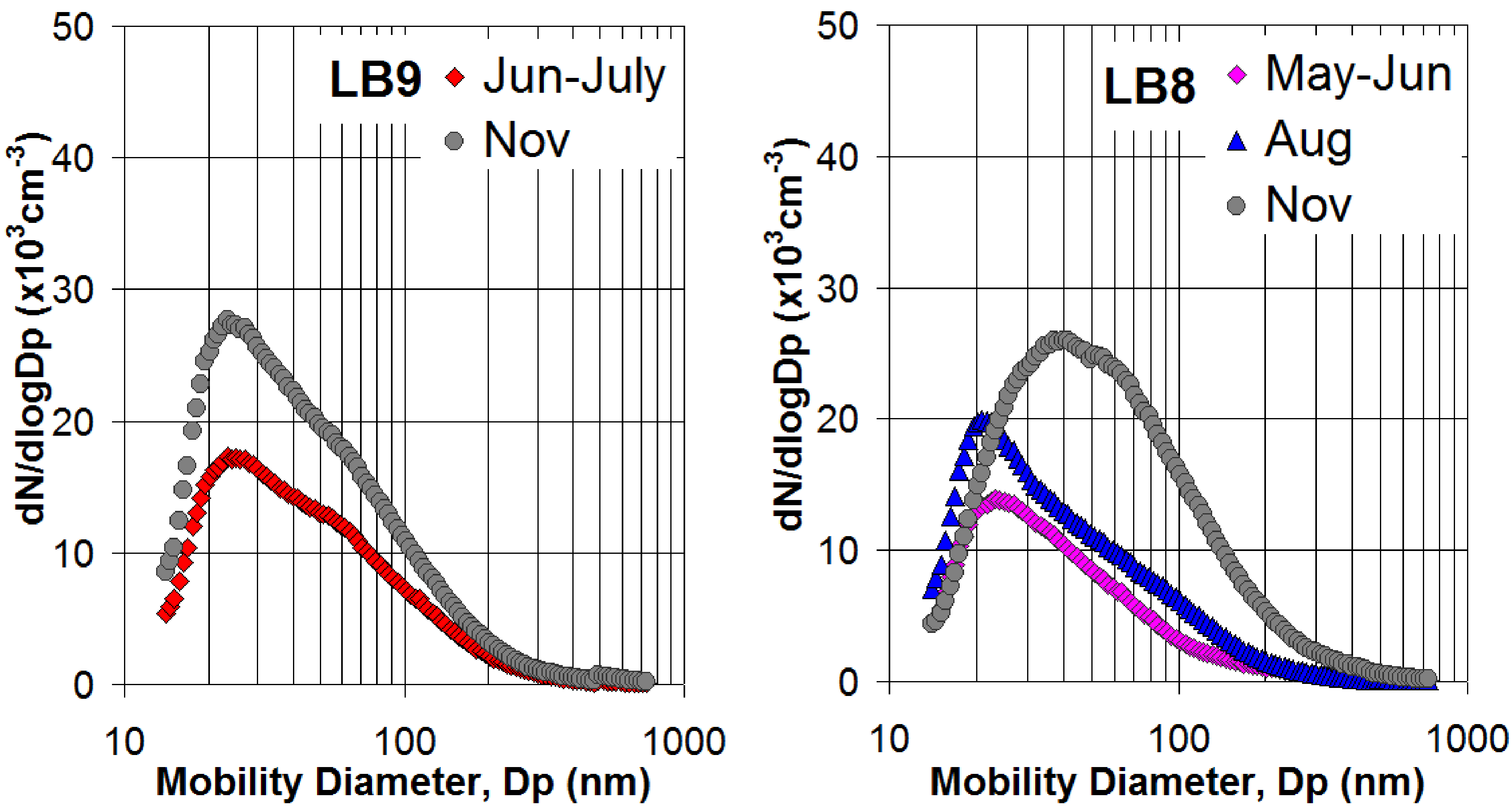

All data
LB1-LB5 site pair - all
COD
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
12 - 1 am
1 - 2 am
2 - 3 am
3 - 4 am
4 - 5 am
5 - 6 am
6 - 7 am
7 - 8 am
8 - 9 am
9 - 10 am
10 - 11 am
11 am - 12 noon
12 - 1 pm
1 - 2 pm
2 - 3 pm
3 - 4 pm
4 - 5 pm
5 - 6 pm
6 - 7 pm
7 - 8 pm
8 - 9 pm
9 - 10 pm
10 - 11 pm
11 pm - 12 mid
time of day (PST)

(a) Coefficients of Divergence (COD) and (b) correlation coefficients (r) calculated for the LB5-LB8 site pair only for all data.

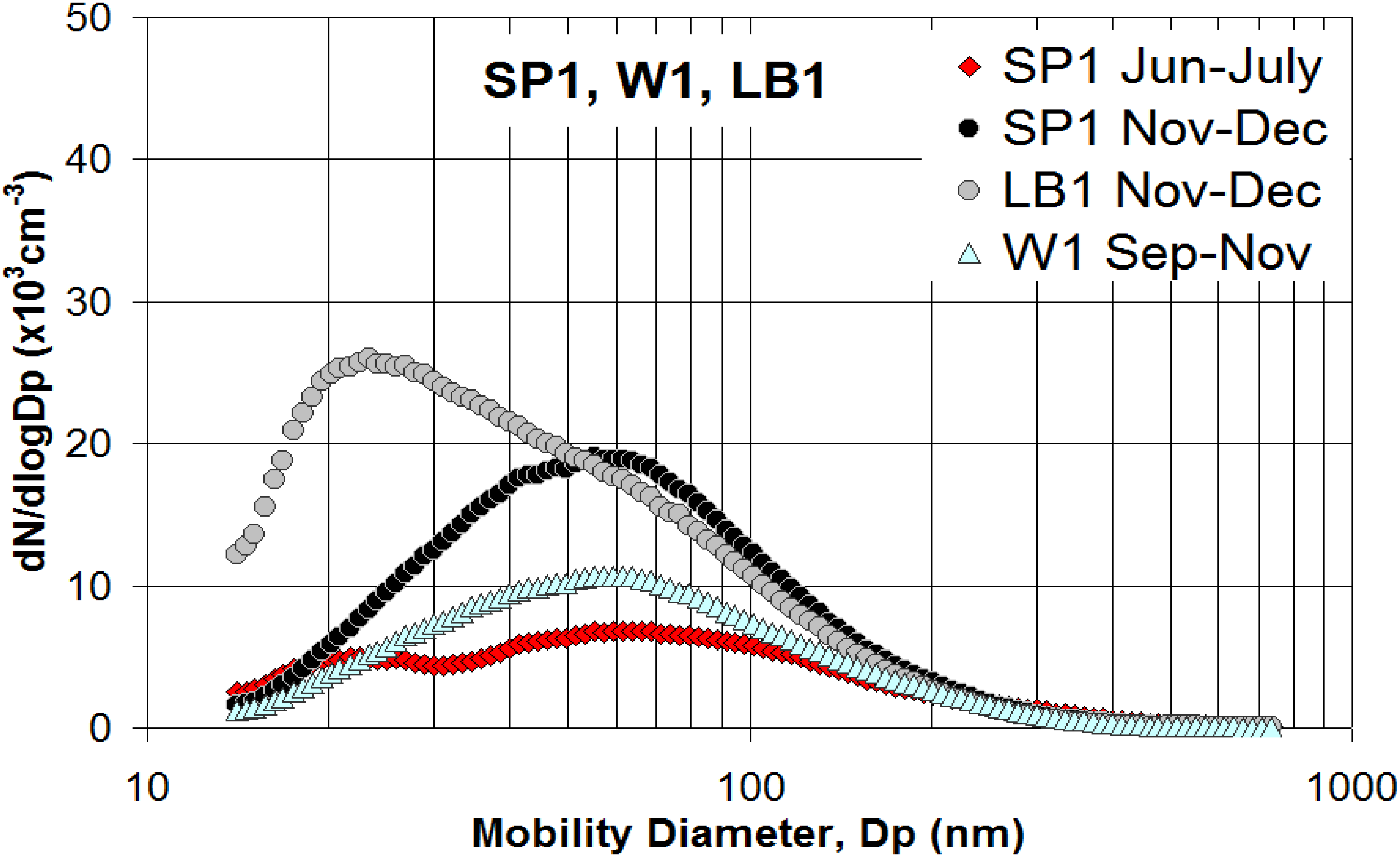


Mean Size Distributions

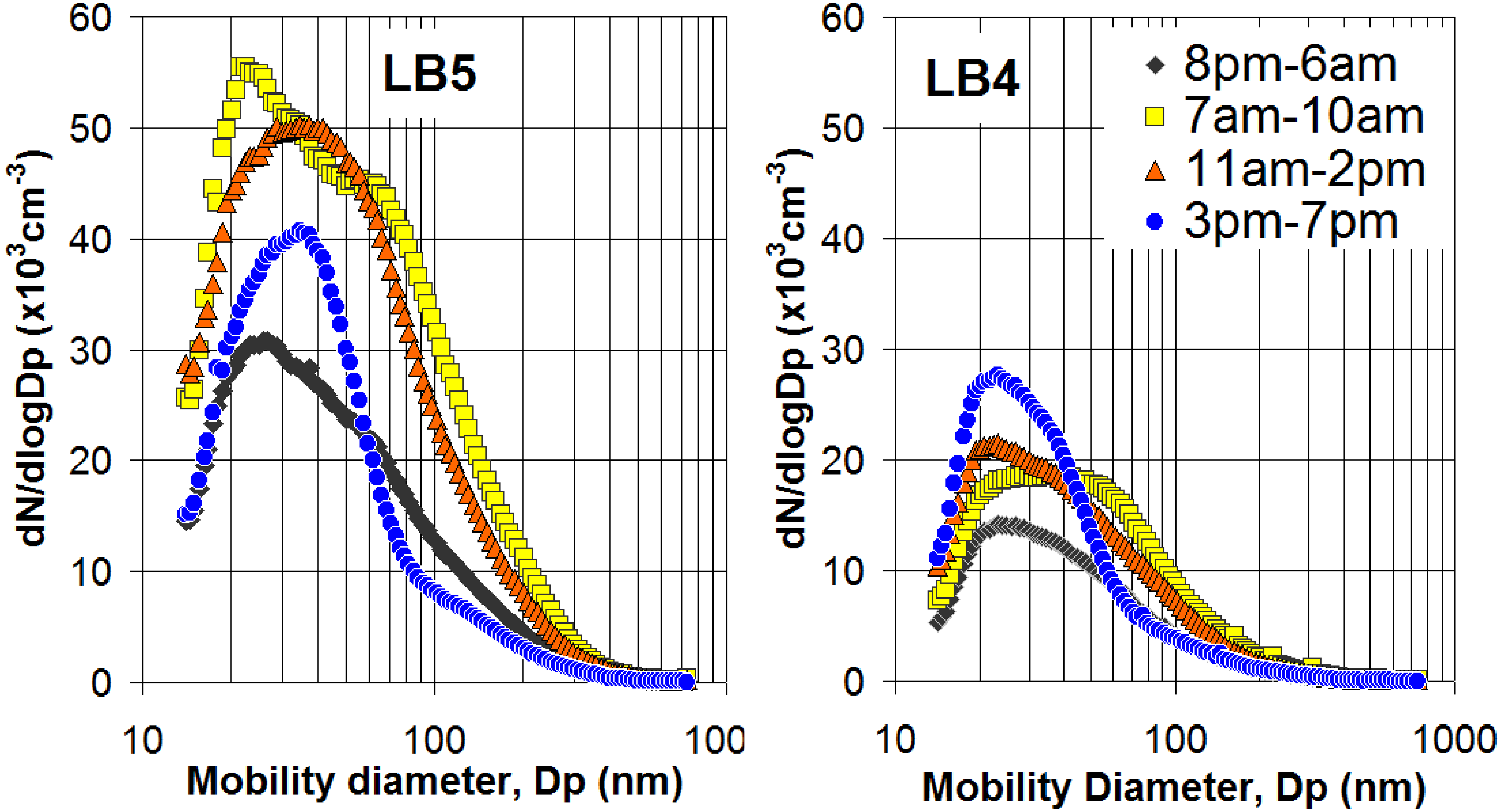
5-minute data – corrected and averaged together



Mean Size Distributions



Diurnal patterns



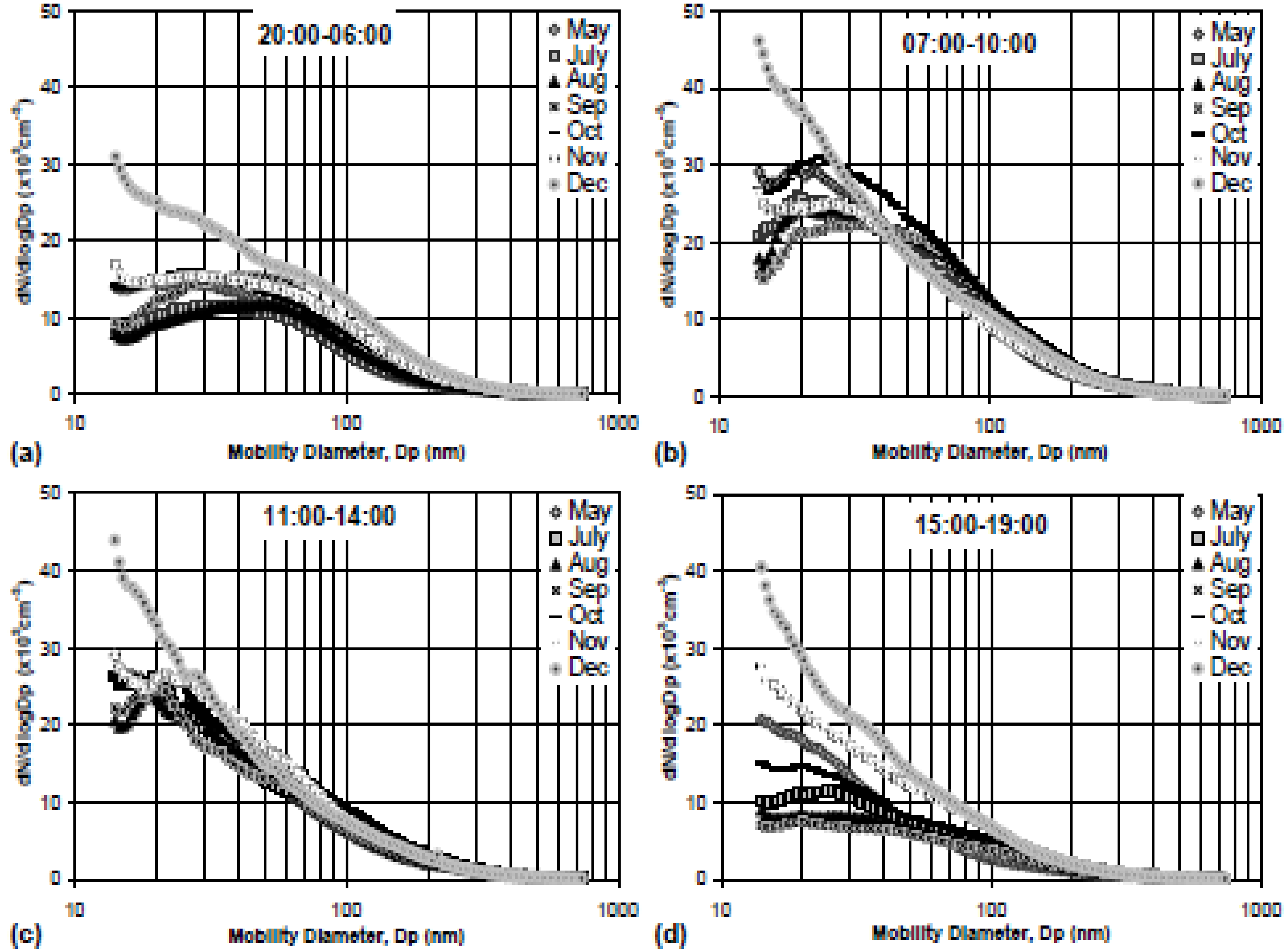
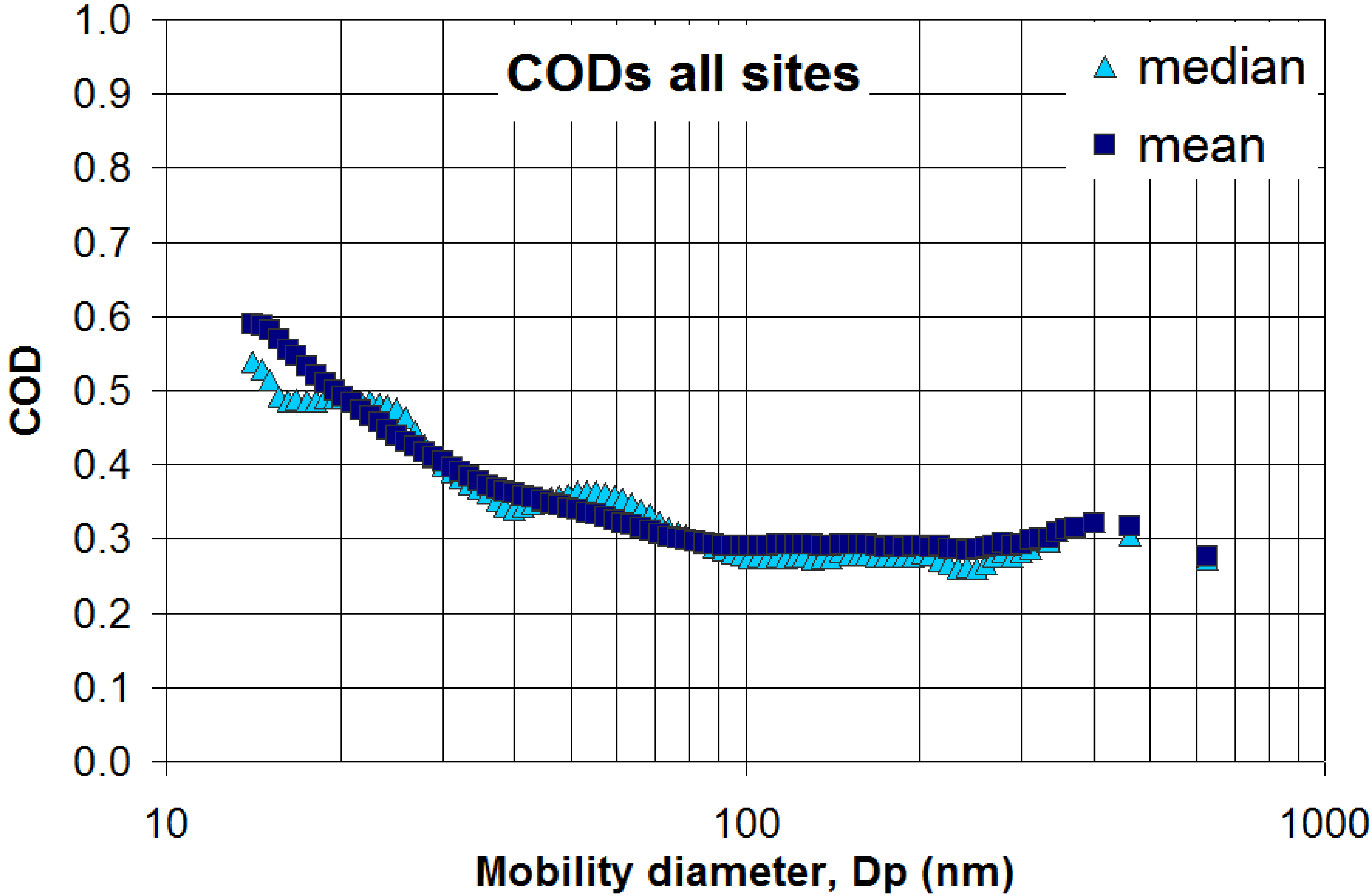
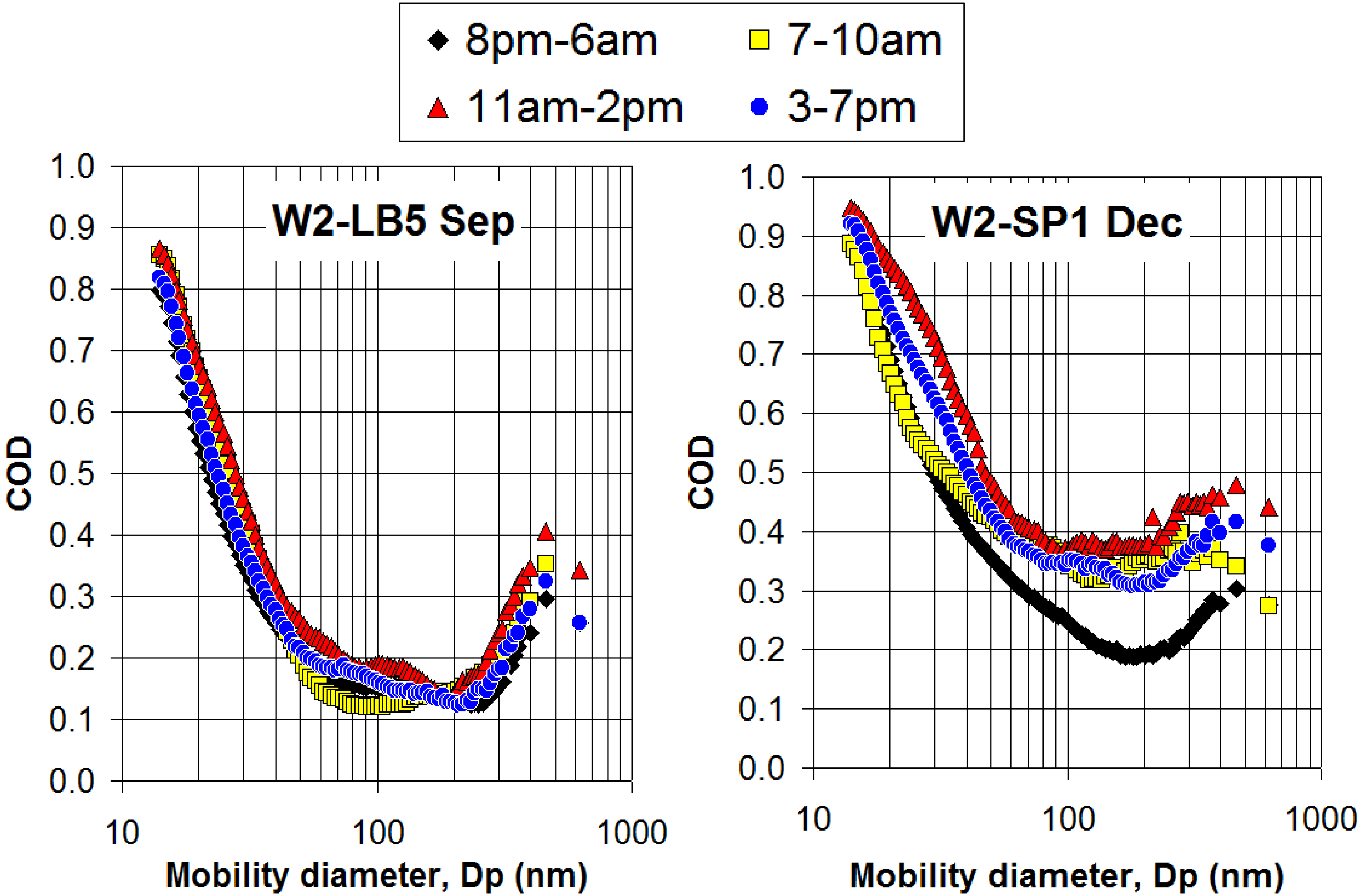


Fig. 3. Diurnal and seasonal patterns in number size distributions at site W2 during: **(a)** nighttime (20:00–06:00), **(b)** morning commute (07:10:00), **(c)** midday (11:00–14:00), and **(d)** evening commute (15:00–19:00). All times are Pacific Standard Time (PST).

CODs


CODs all sites
median
mean
COD
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
10
100
1000
Mobility diameter, Dp (nm)

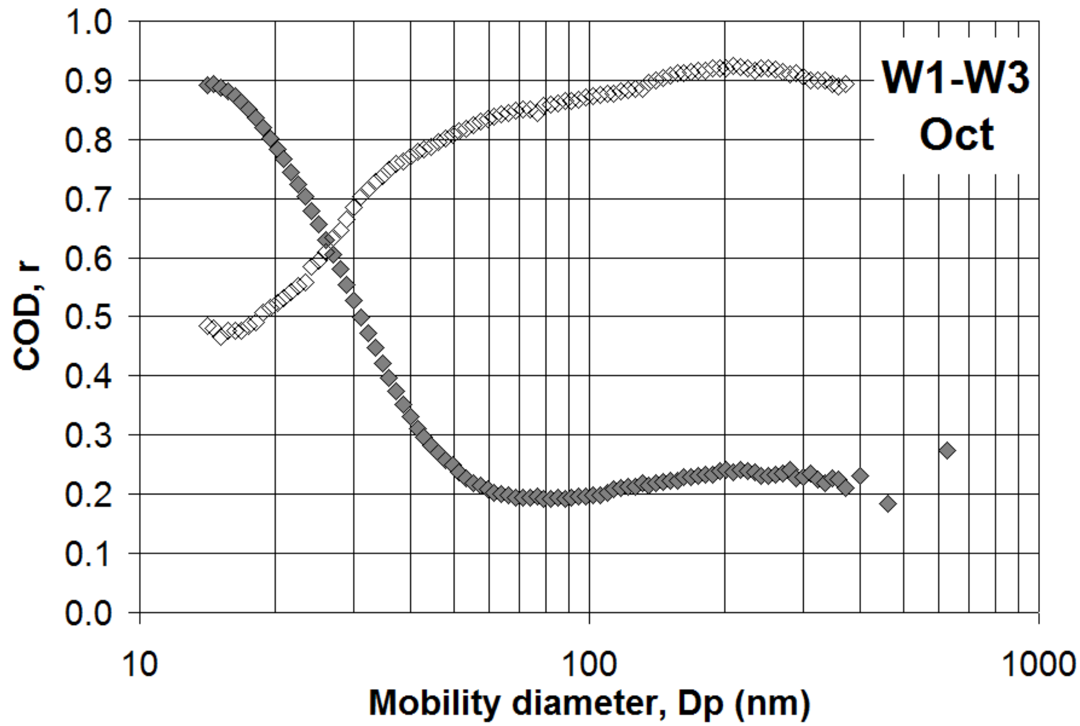
CODs



8pm-6am
7-10am
11am-2pm
3-7pm
W2-LB5 Sep
W2-SP1 Dec
COD
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
10
100
1000
Mobility diameter, Dp (nm)

Correlation & CODs

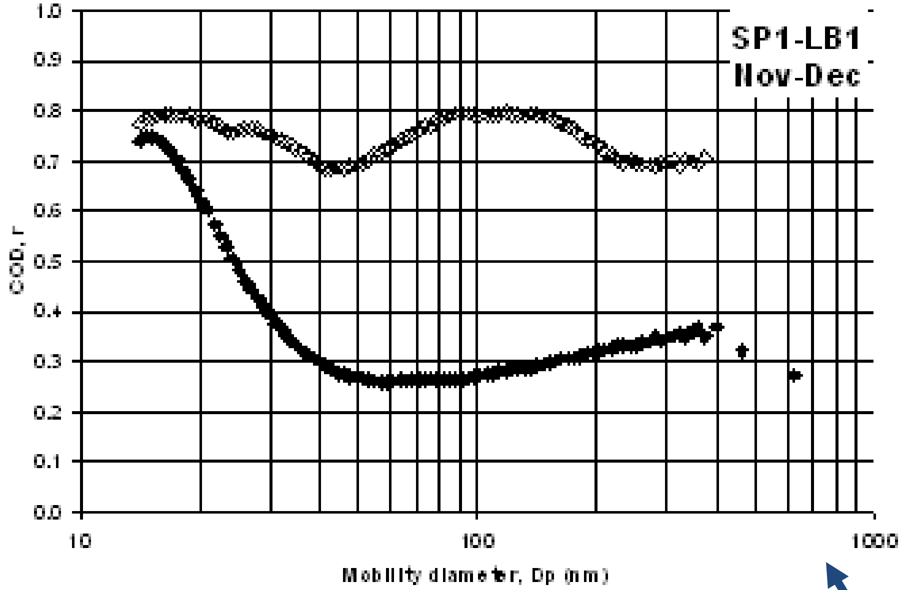
- For paired sites
- Correlation
  r ≈ 0.2 – 0.9
- COD/r relationship varies with site pair

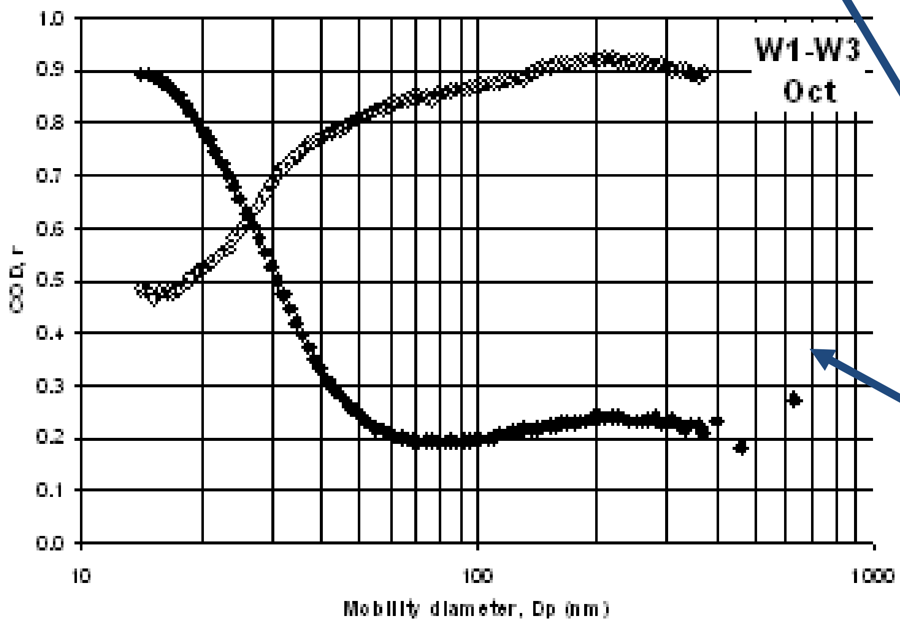


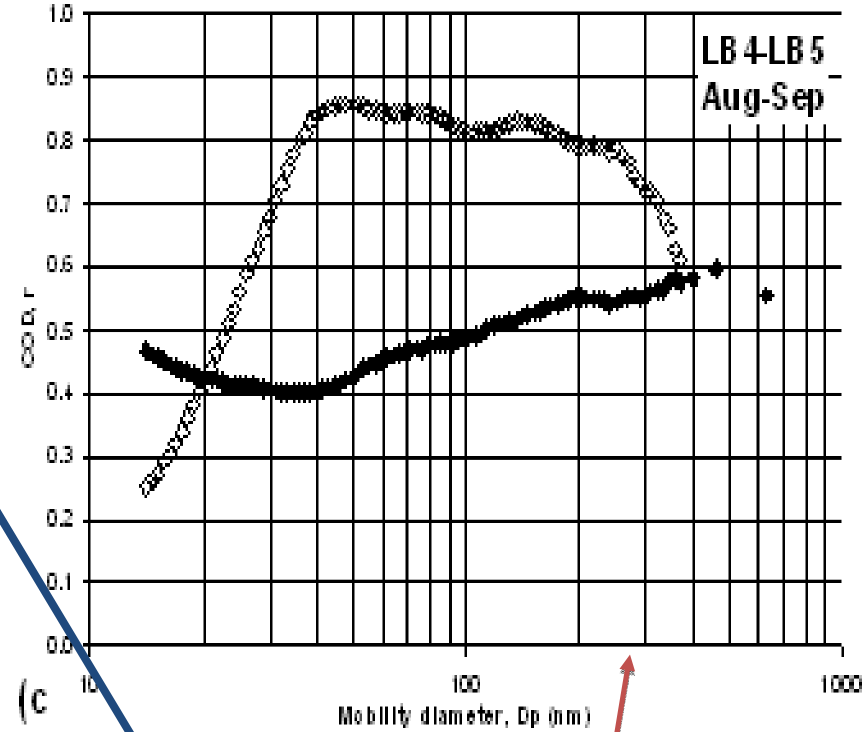
r (open symbols), COD (closed symbols)

COD varies by location

(open symbols: Pearson R; closed symbols: COD)







COD decreases with increasing particle size except of adjacent sites (LB4-LB5)

Summary

- **Size distributions consistent** with close range **emissions** of **light** and **heavy duty vehicle engines**

- Considerable spatial and temporal heterogeneity observed
  - **Strong intra-community variability**

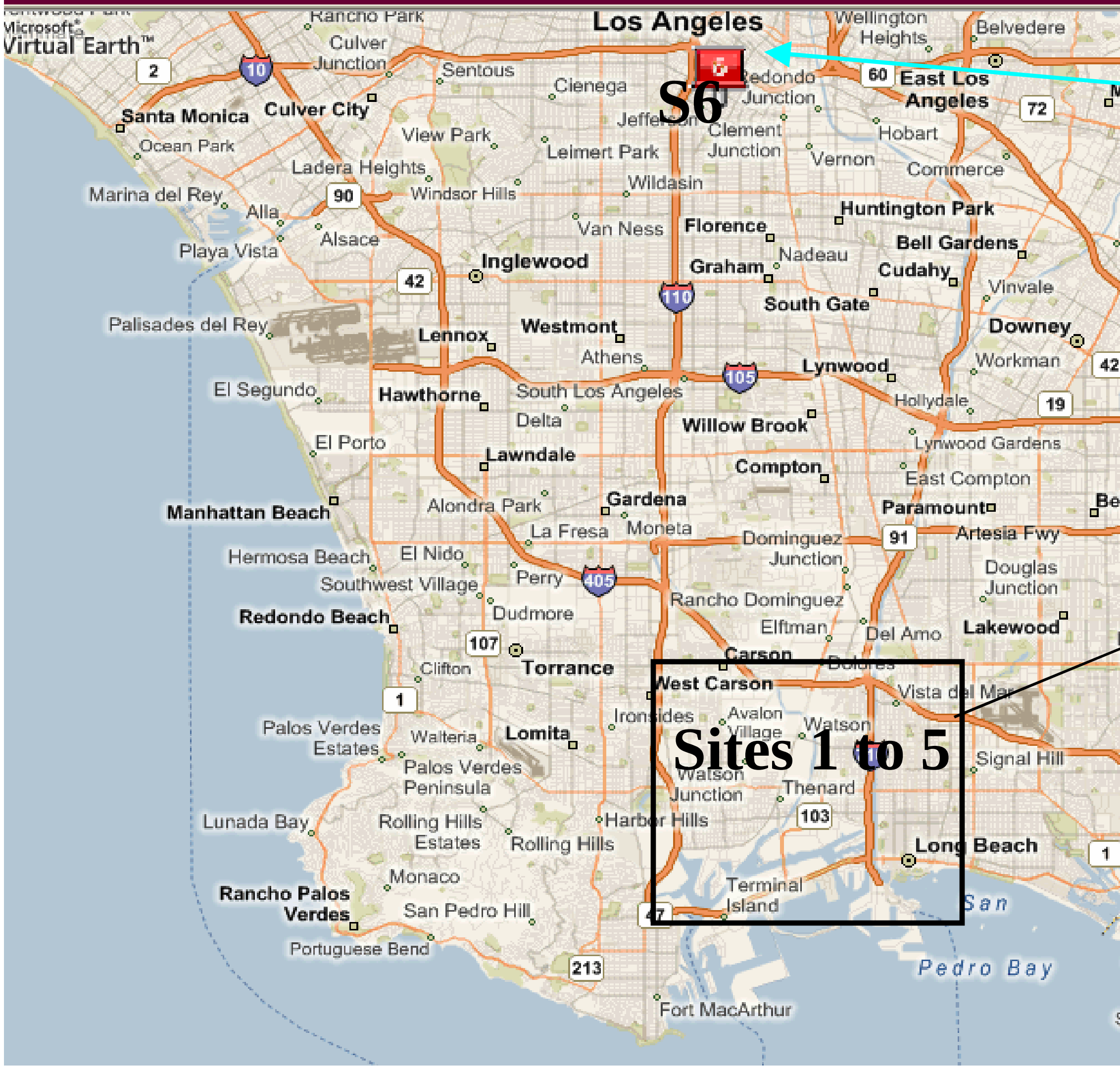
- **Smaller particles (< 50 nm) exhibit more site-to-site heterogeneity than 50 – 300 nm particles**

- COD/r relationship can vary between site pairs & particle size

The LA – Long Beach Harbor Study (SCPC Component)

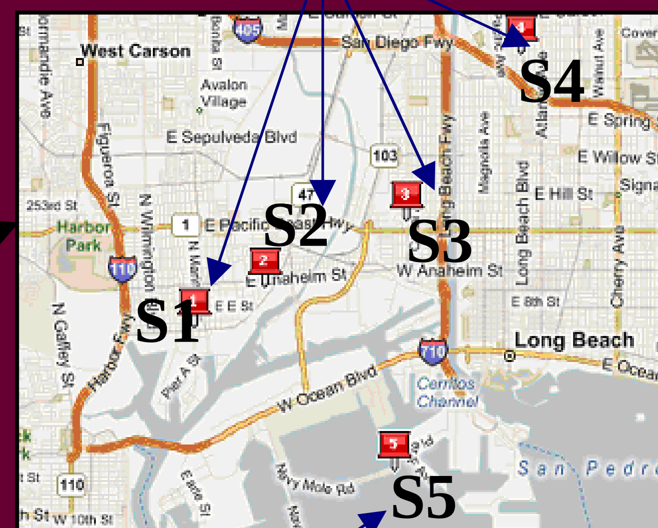
Intra-community variability of PM components as a function of particle size

Collection of PM samples for in vitro toxicity; Source Apportionment

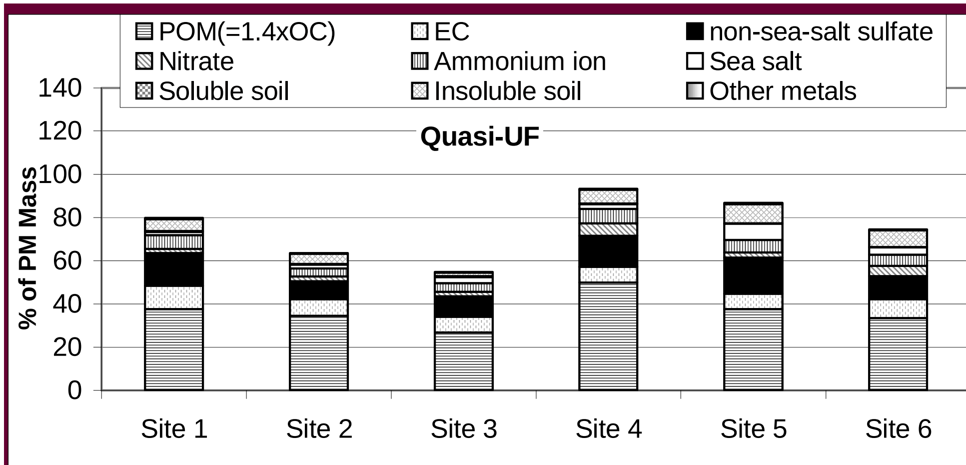


USC, Los Angeles Downtown

S1 to S4 in Communities of Los Angeles Harbor

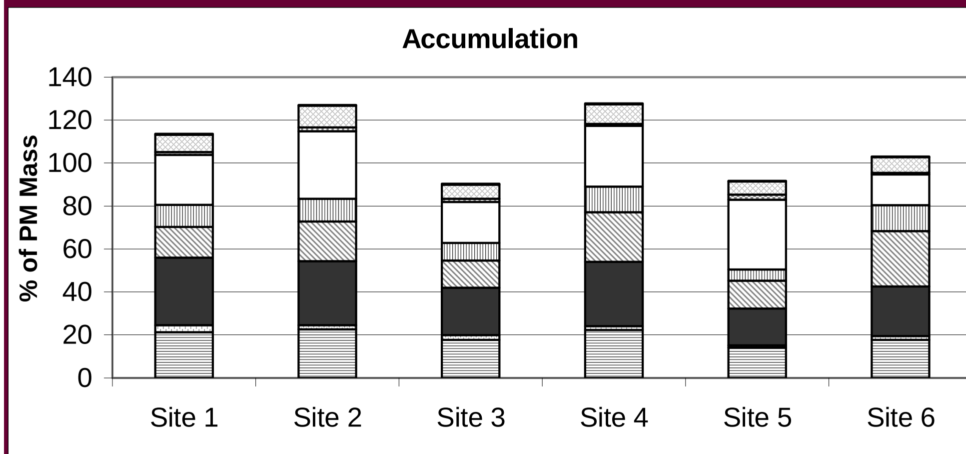


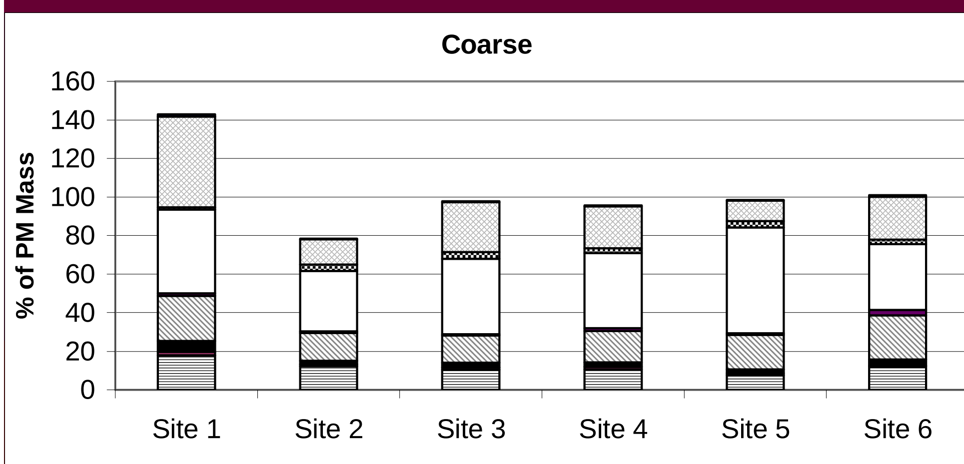
S5 Harbor Background

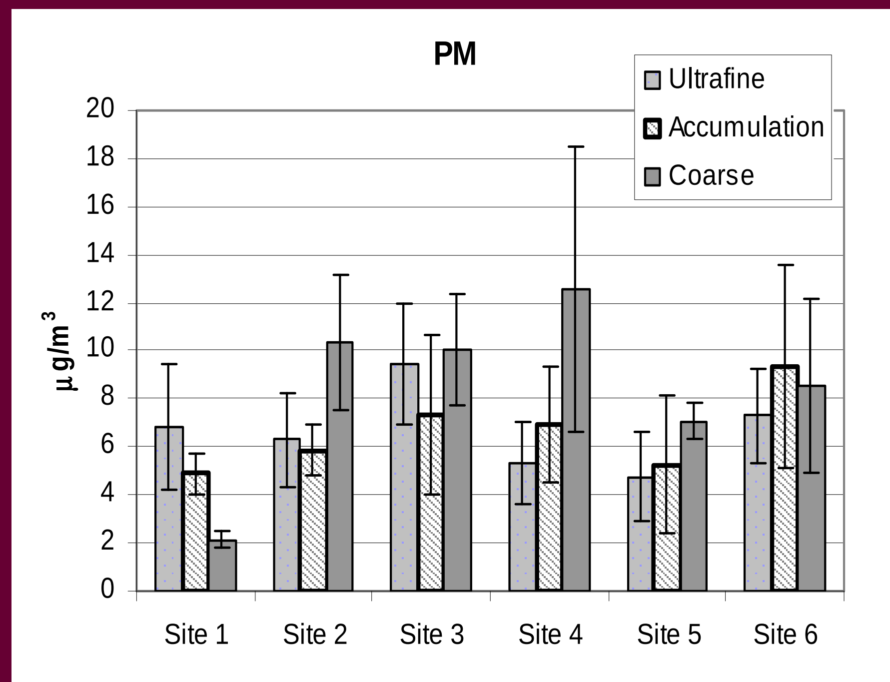


The contributions of nine chemical component-groups to the mass of quasi-UF, accumulation mode, and coarse particles measured at the six sampling sites.

Arhami et al, AS&T, 2008

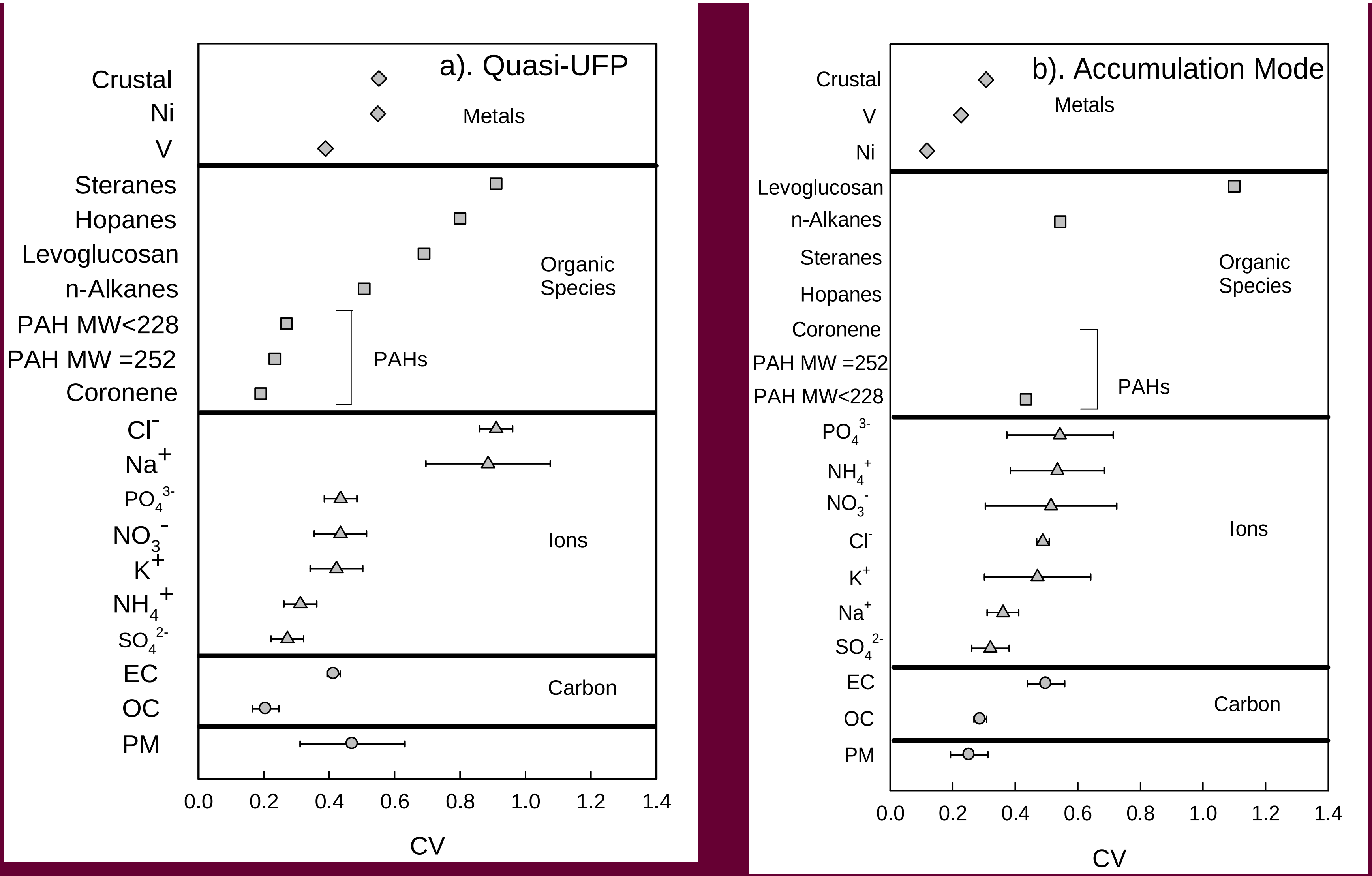




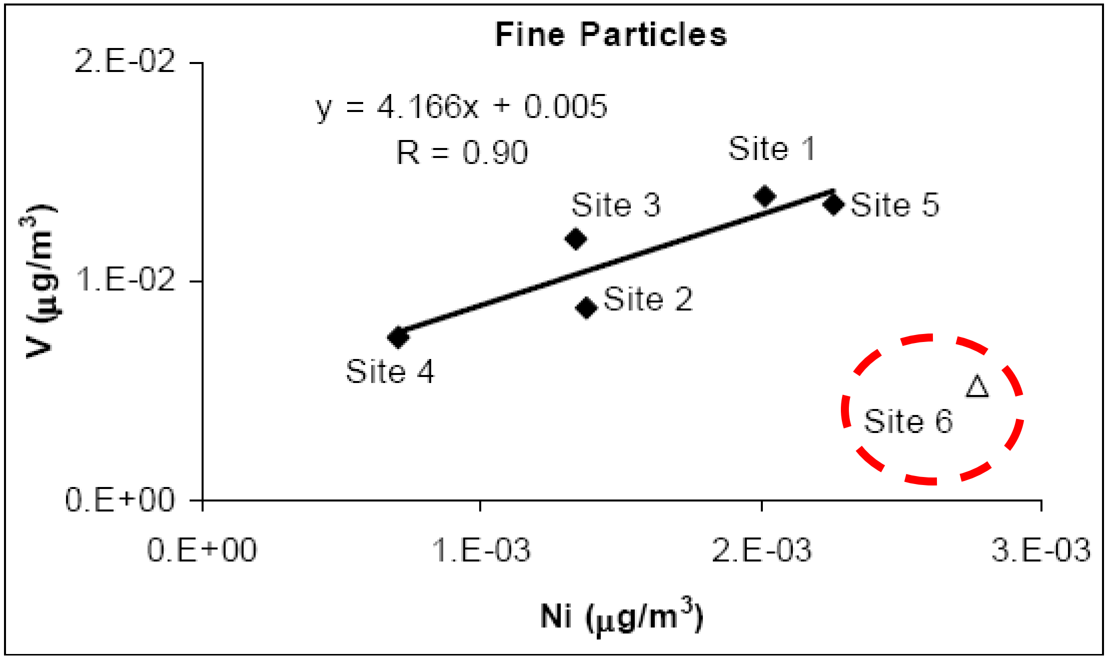


PM mass concentrations

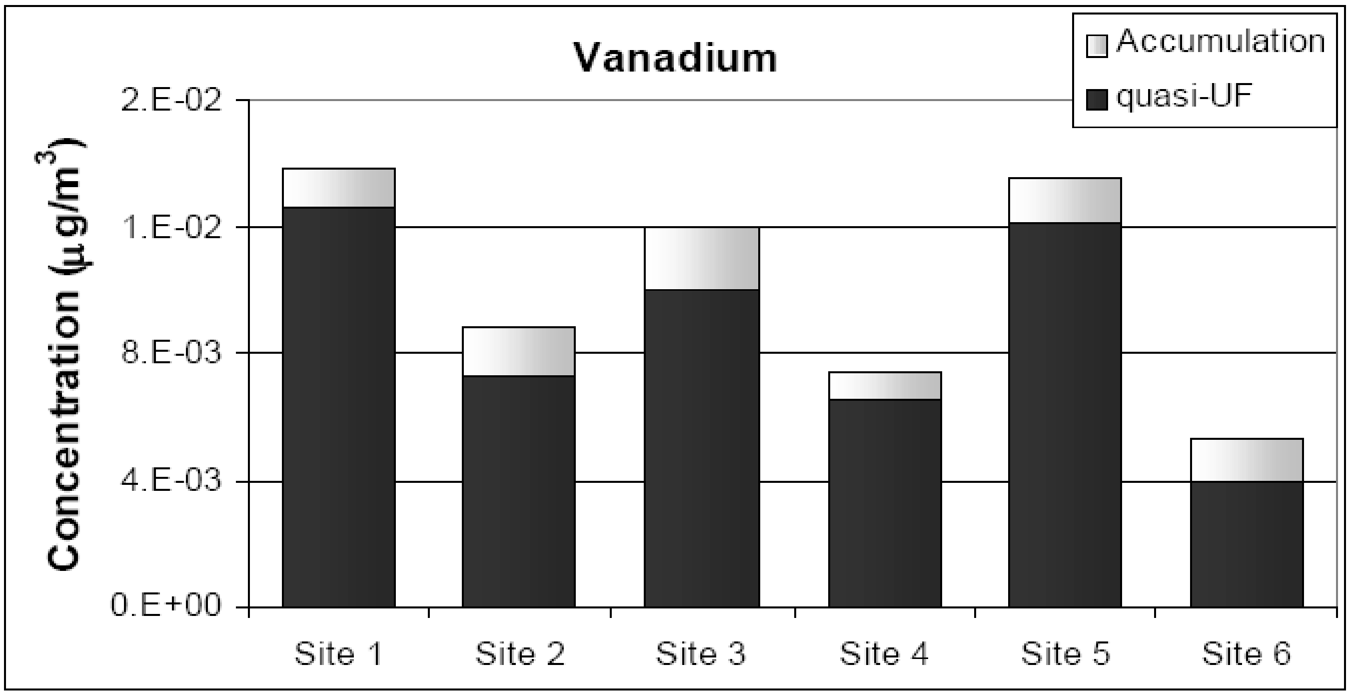
USC



.Coefficient of variance (CV) with standard deviation (SD) of selected chemical components at 2 PM size fractions: a) quasi-UF mode, b) accumulation mode (*a third size fraction (coarse PM) is not shown but is described in Arhami et al., 2008*)



V-Ni highly correlated (ships) except at USC (far from harbor – influenced by traffic sources!)



Vanadium concentrations decrease with distance from port.

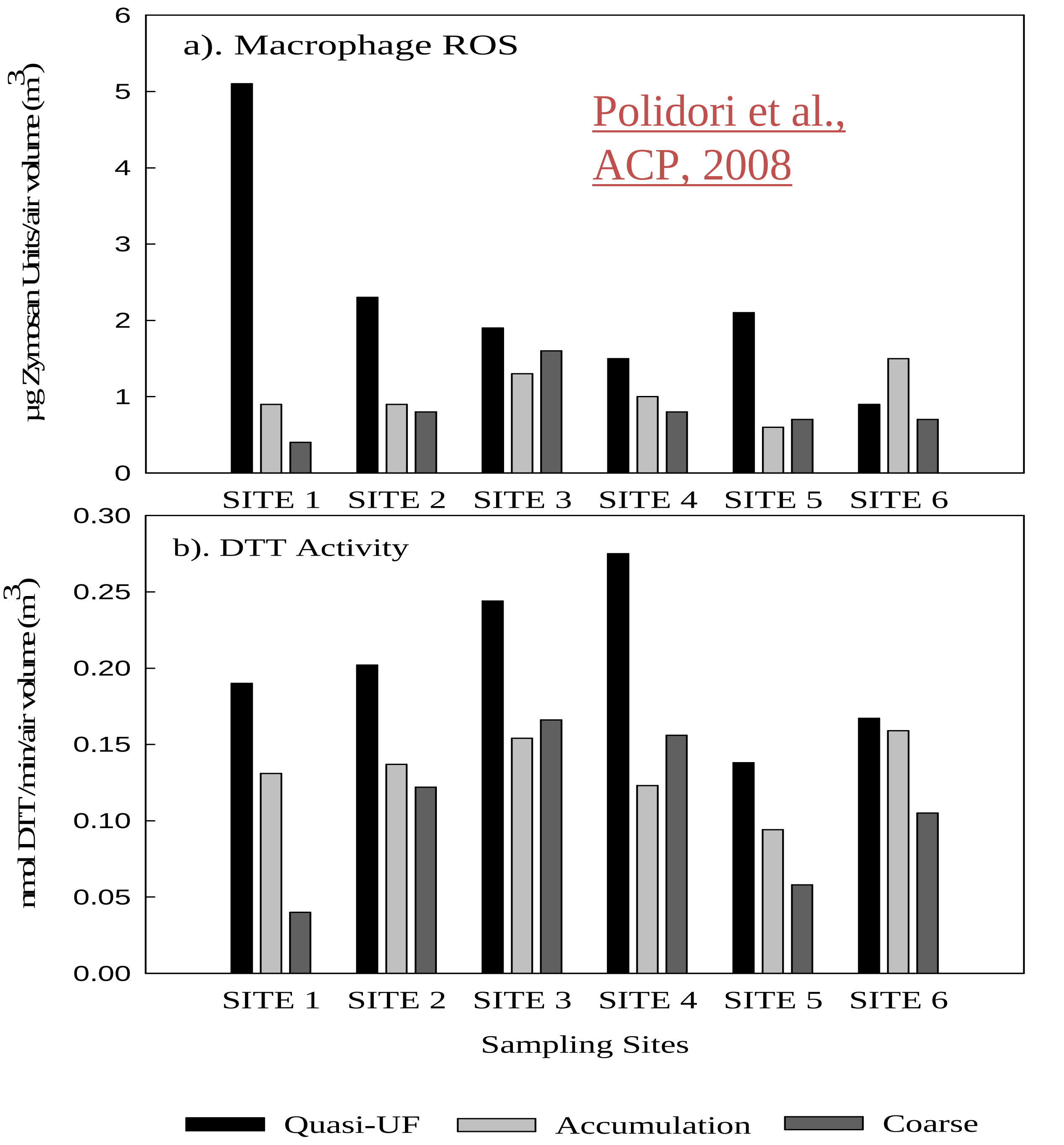
(Site 6 USC - 40 km north; Site 4 next to 710 but low V)

Table 4. Pearson number and P-values of correlation between V and Ni with EC and OC in different size fractions of PM

		Quasi-ultrafine		Accumulation Mode		$PM_{2.5}$	
		V	*Ni*	*V*	*Ni*	*V*	*Ni*
EC	*R*	**-0.08**	**-0.17**	**0.15**	**0.58**	**-0.08**	**0.12**
	P-Value	*0.88*	*0.75*	*0.78*	*0.23*	*0.88*	*0.82*
OC	*R*	**-0.40**	**-0.57**	**-0.25**	**0.39**	**-0.66**	**-0.43**
	P-Value	*0.44*	*0.24*	*0.63*	*0.45*	*0.16*	*0.39*

But traffic sources even at the port are most dominant!

- OC the most significant mass component (traffic)
- OC and EC negatively correlated with V-Ni (the tracer of oil combustion)



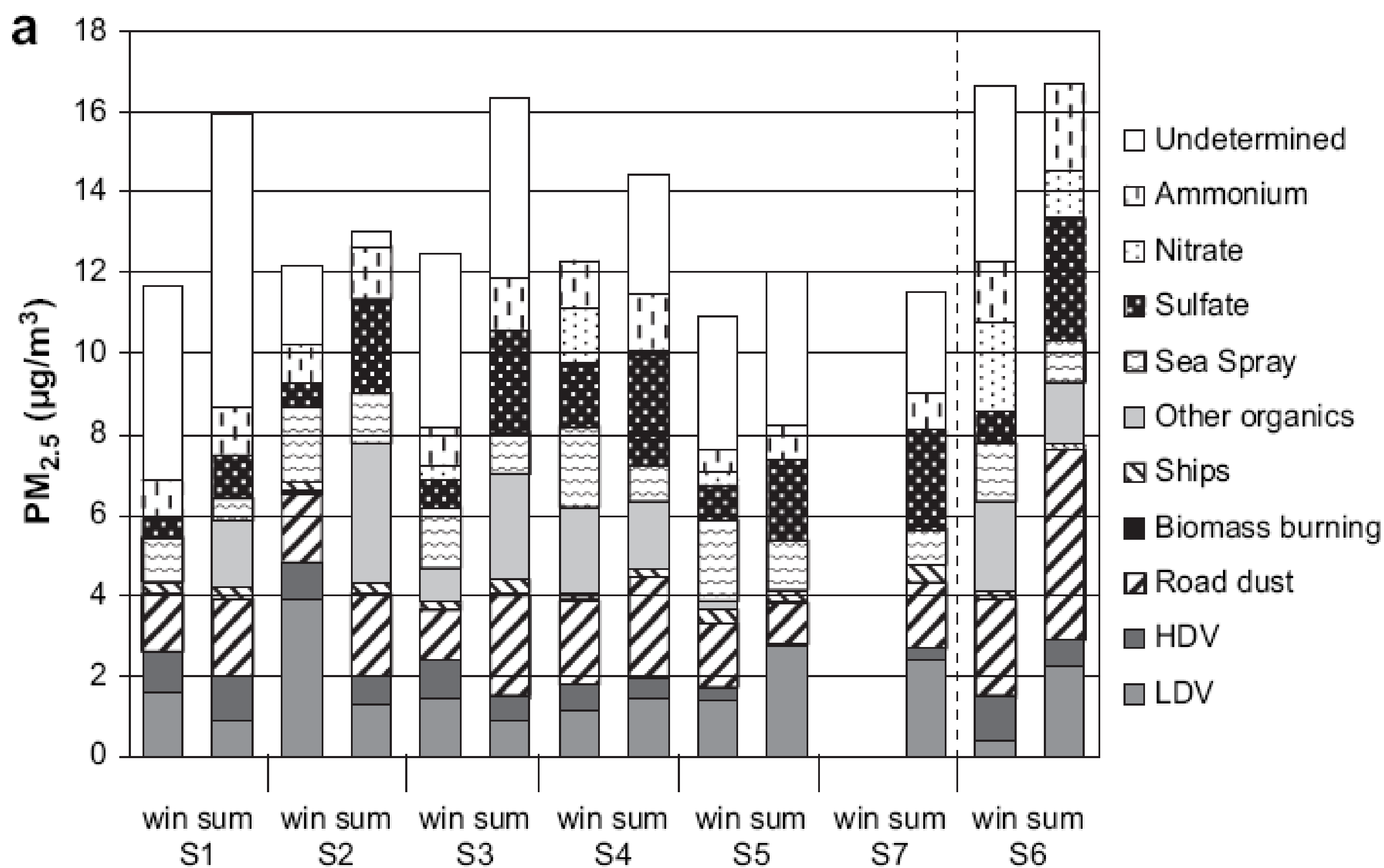
Toxicity of UFP in Los Angeles Port

- **Reactive Oxygen Species (ROS, cellular assay, U Wisconsin)**
- **DTT assay (UCLA)**

On a per m^3 of air inhaled or per PM mass:

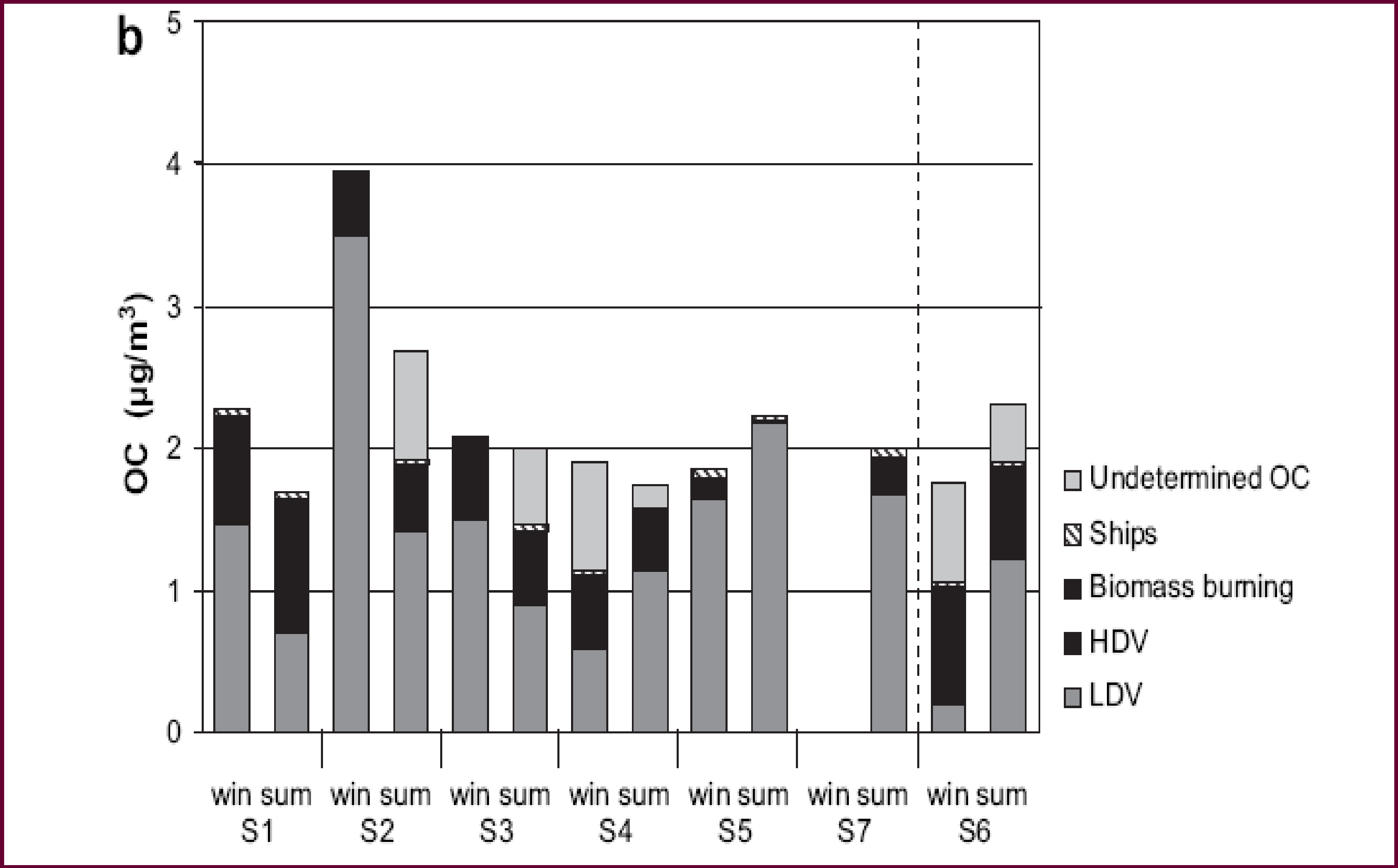
quasi-UFP more toxic than accumulation or coarse PM

USC



• Source apportionment of PM2.5 (ug/m3) in winter and summer at the seven sampling sites. (*Minguillón et al, Atmos. Environ. 2008*)

• **Traffic Contribution to PM2.5 and PM0.25 far exceeds ship emissions even at the busiest US harbor.**

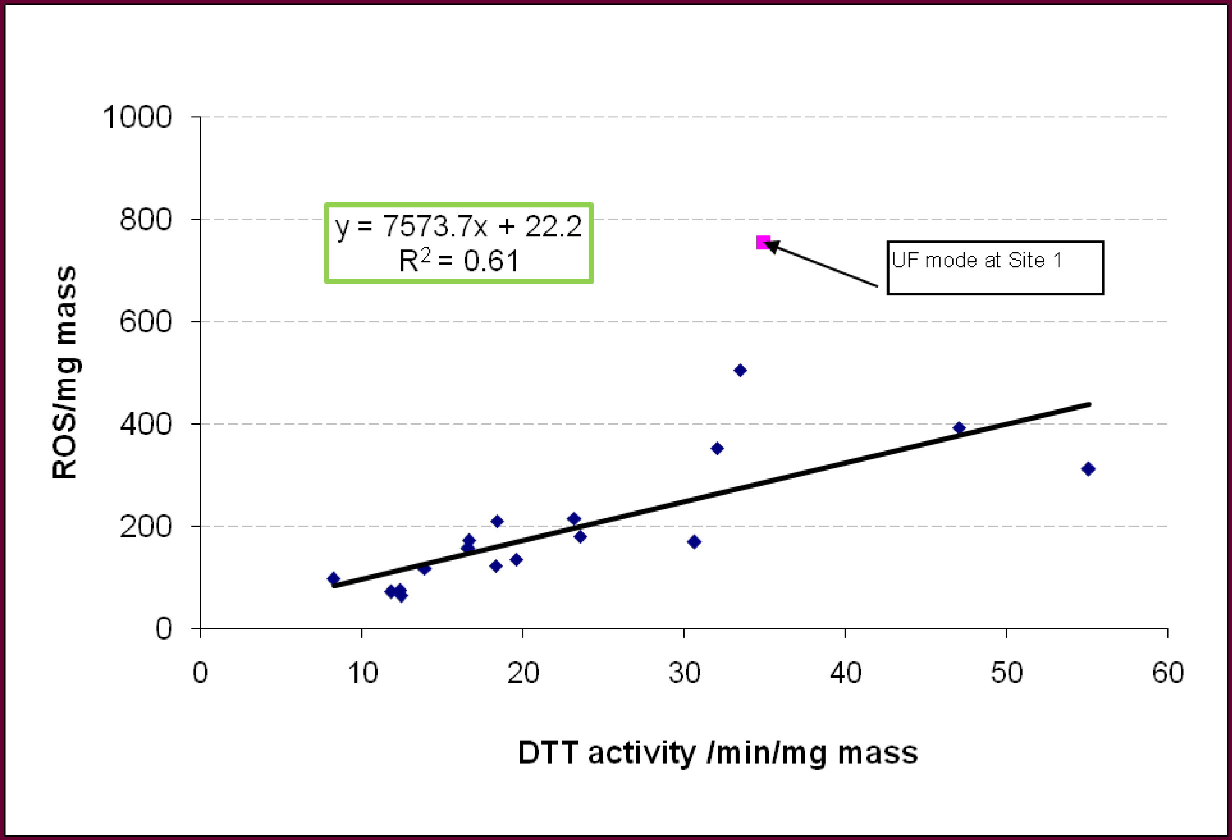


Source apportionment of PM0.25 OC (ug/m^3) in winter and summer at the seven sampling sites. *(Minguillón et al, Atmos. Environ., 2008)*

Same observations about OC as for quasi-UF PM; vehicle emissions predominate.

Correlation of redox activities measured by Macrophage ROS and DTT assays

- Generally good agreement, even though they are intrinsically different assays



Almost all DTT assay can be explained by variability in OC (traffic) content of PM

$$DTT = 0.034 + 5.585\times10^{-02}\cdot OC$$ (R^2 = 0.95)

By contrast, in addition to OC, V (ship emissions) has a significant contribution to ROS variability

$$ROS = 0.332 + 0.399\cdot OC + 2.2\times10^{-04}\cdot V \qquad (R^2=0.93)$$

Inter-community variability in total particle number concentrations in the eastern Los Angeles air basin

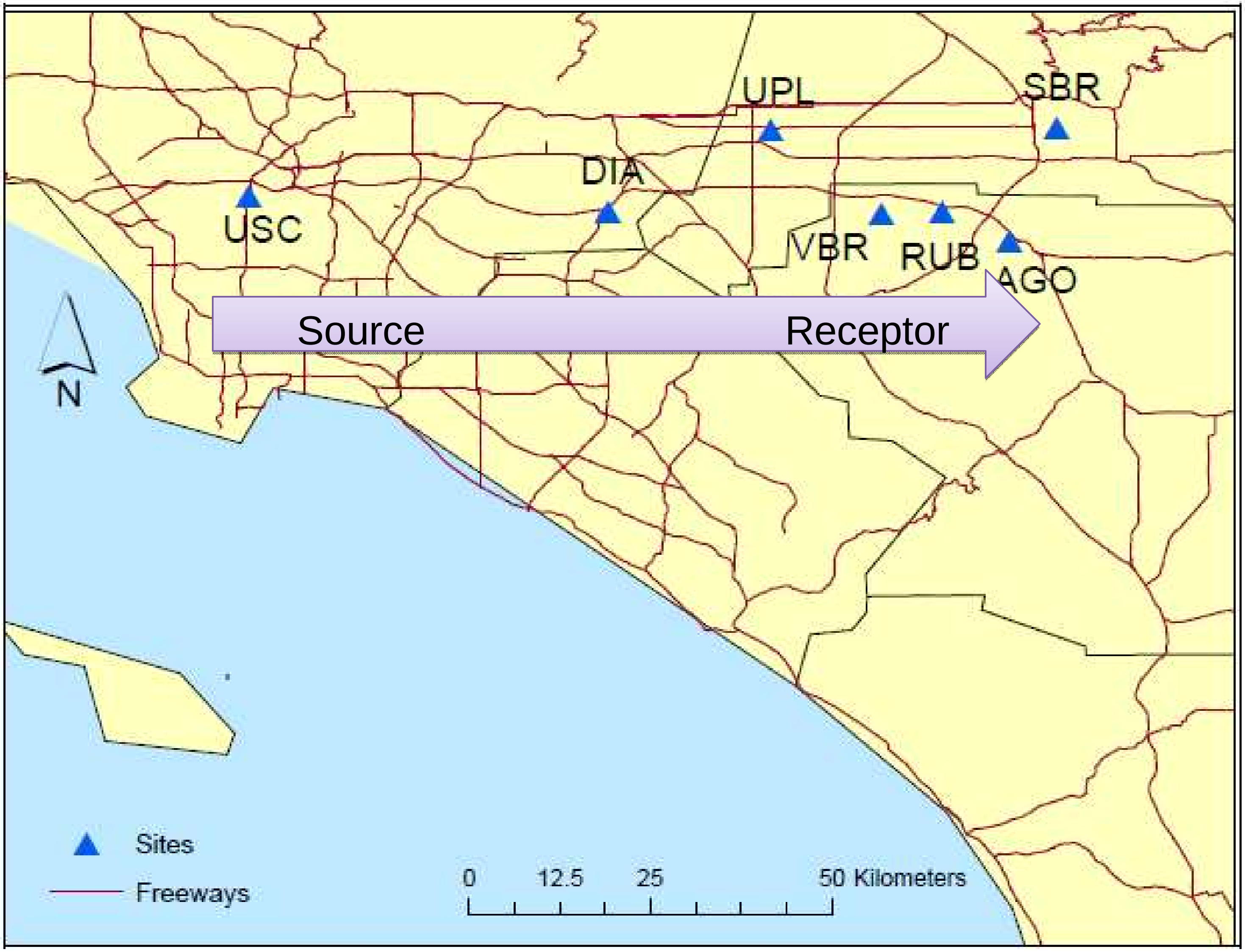
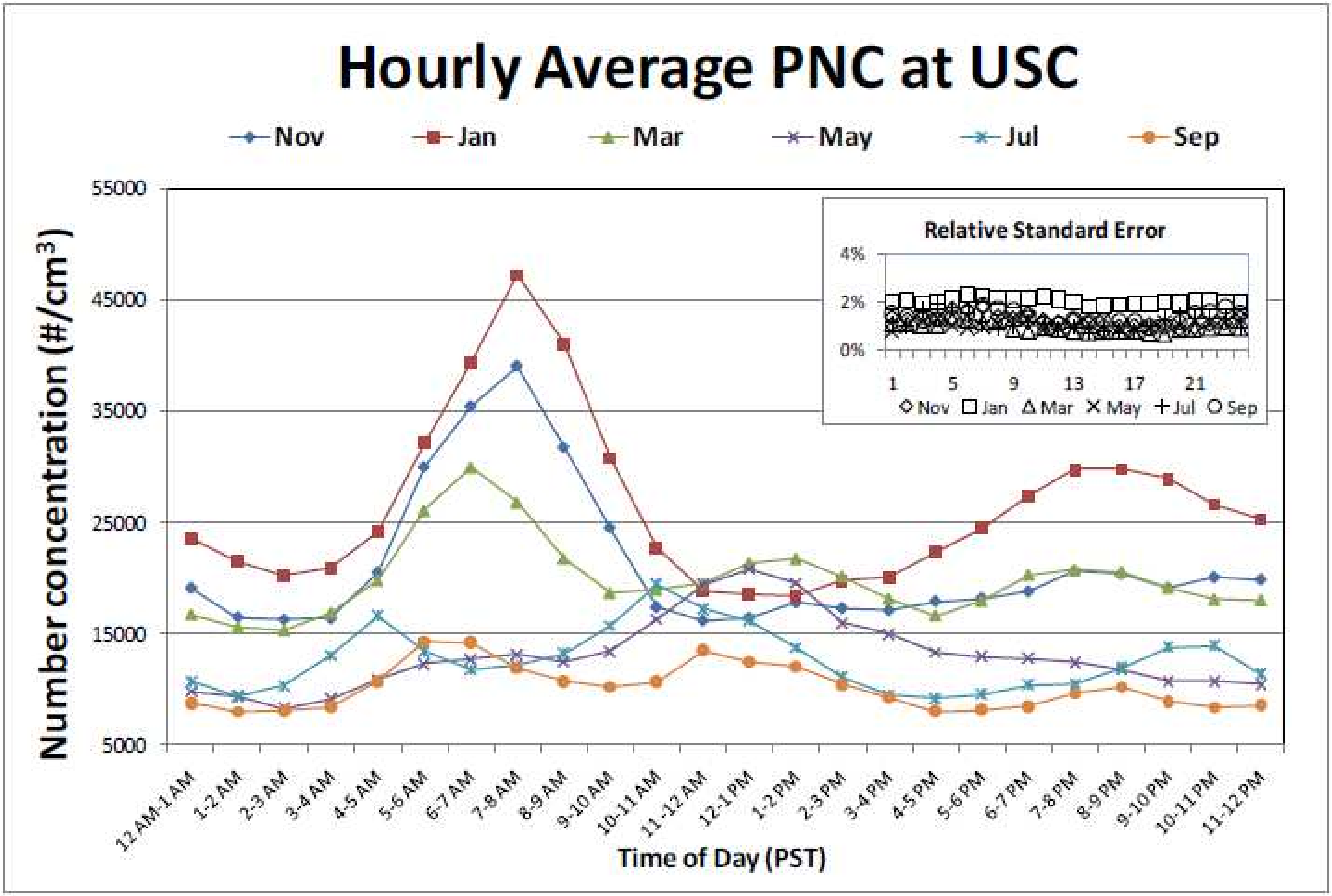
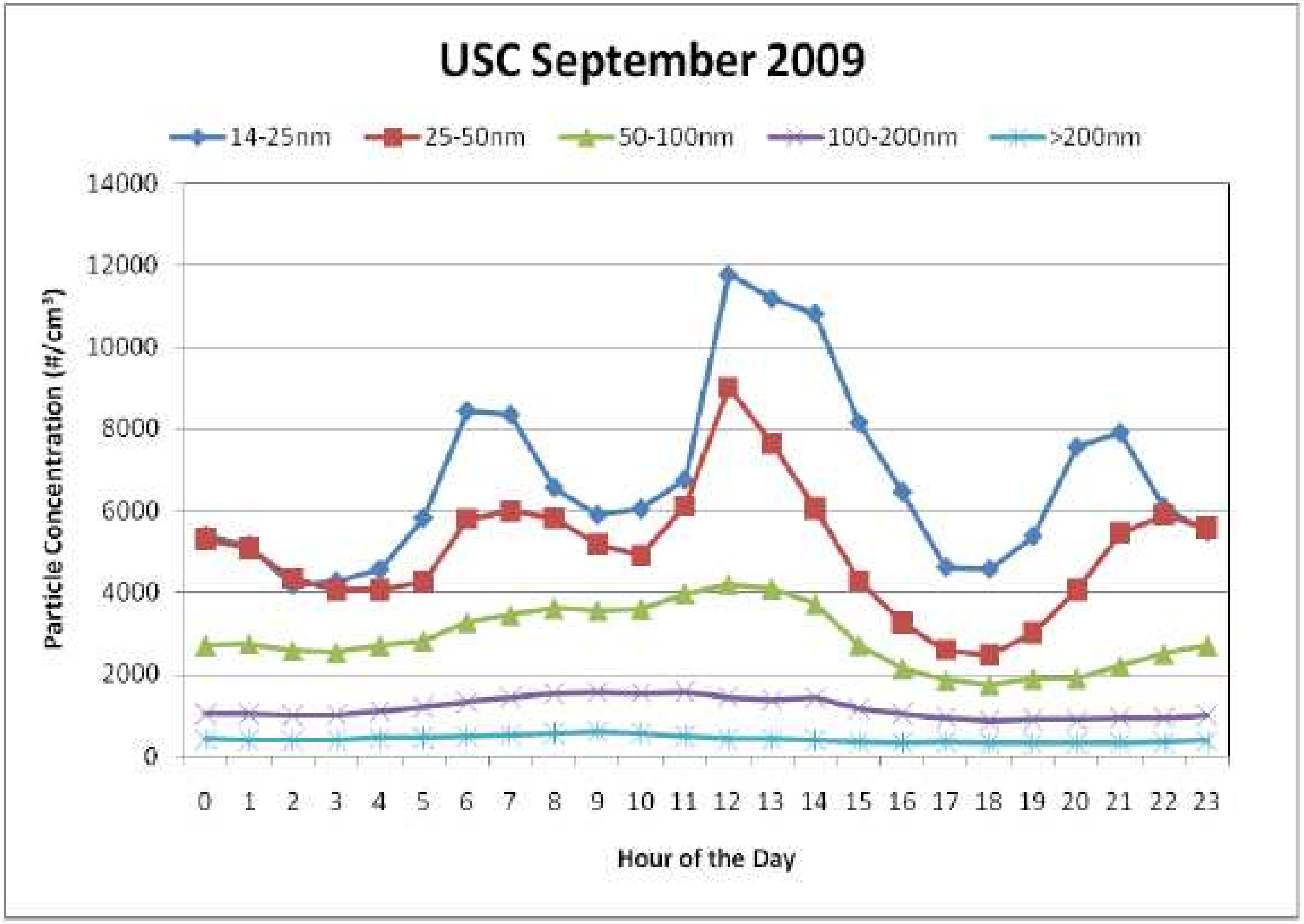


Figure 1 4: Location of Sites



Hourly Average PNC at USC
Nov
Jan
Mar
May
Jul
Sep
55000
45000
35000
25000
15000
5000
Number concentration (#/cm3)
Relative Standard Error
4%
2%
0%
1
5
9
13
17
21
Nov Jan Mar May Jul Sep
12 AM-1 AM
1-2 AM
2-3 AM
3-4 AM
4-5 AM
5-6 AM
6-7 AM
7-8 AM
8-9 AM
9-10 AM
10-11 AM
11-12 AM
12-1 PM
1-2 PM
2-3 PM
3-4 PM
4-5 PM
5-6 PM
6-7 PM
7-8 PM
8-9 PM
9-10 PM
10-11 PM
11-12 PM
Time of Day (PST)



Effects of:

- morning traffic
- SOA formation
- evening traffic
- nighttime condensation

Figure 2b: PNC for different size ranges at USC during September 2009

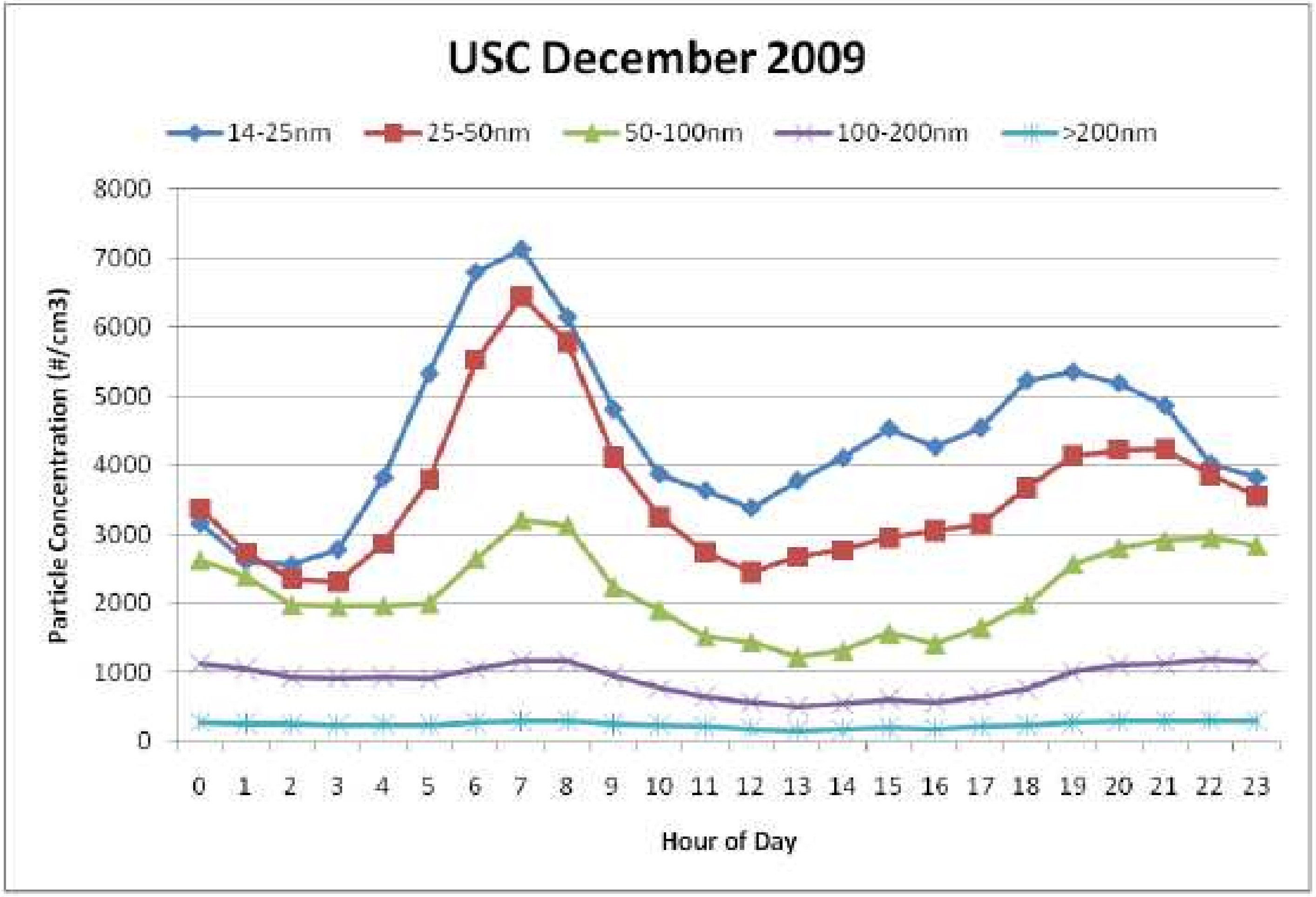


Figure 2c: PNC for different size ranges at USC during December 2009

Effects of:

- morning traffic
- evening traffic

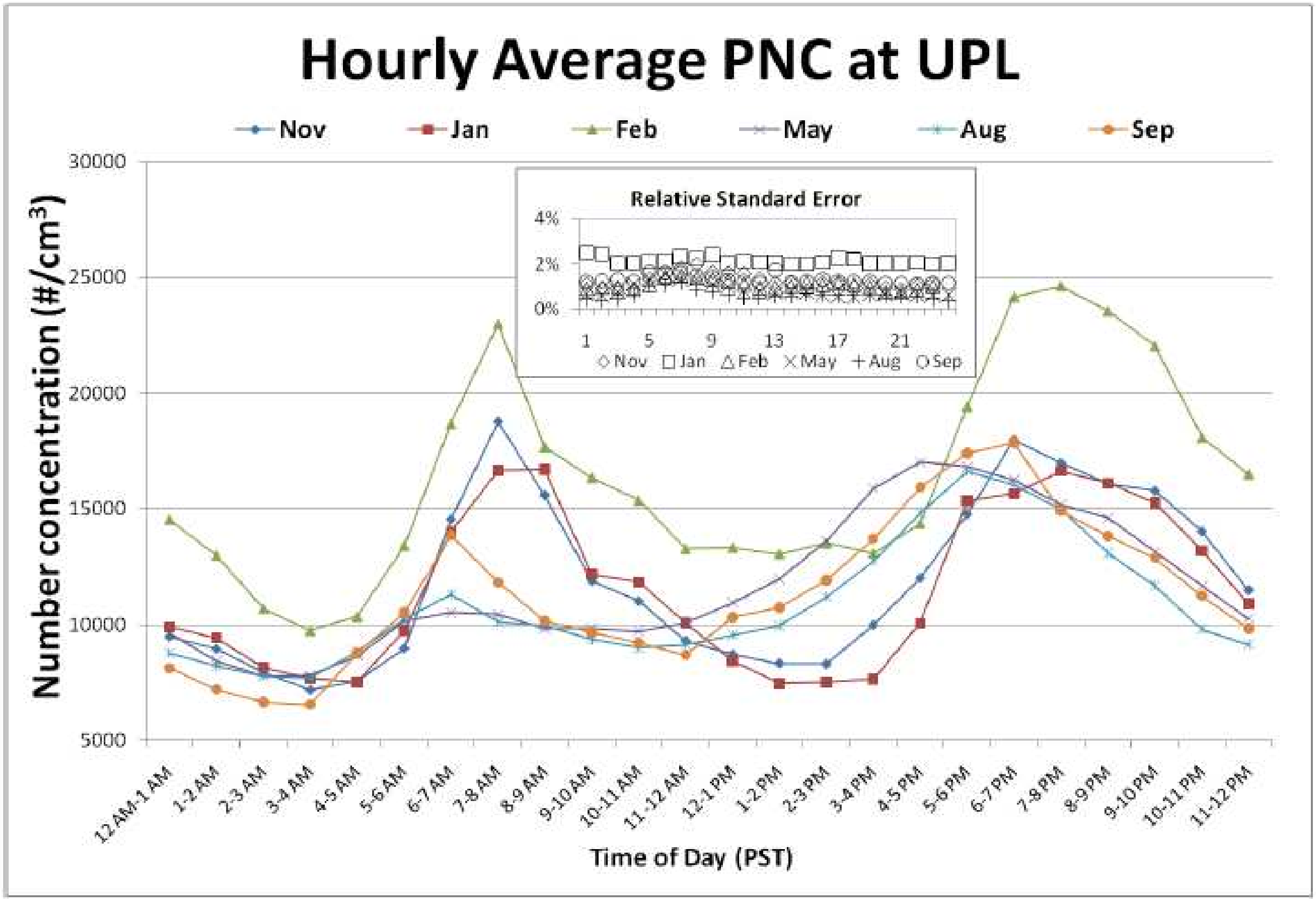


Figure 3a: Hourly average particle number concentration at UPL

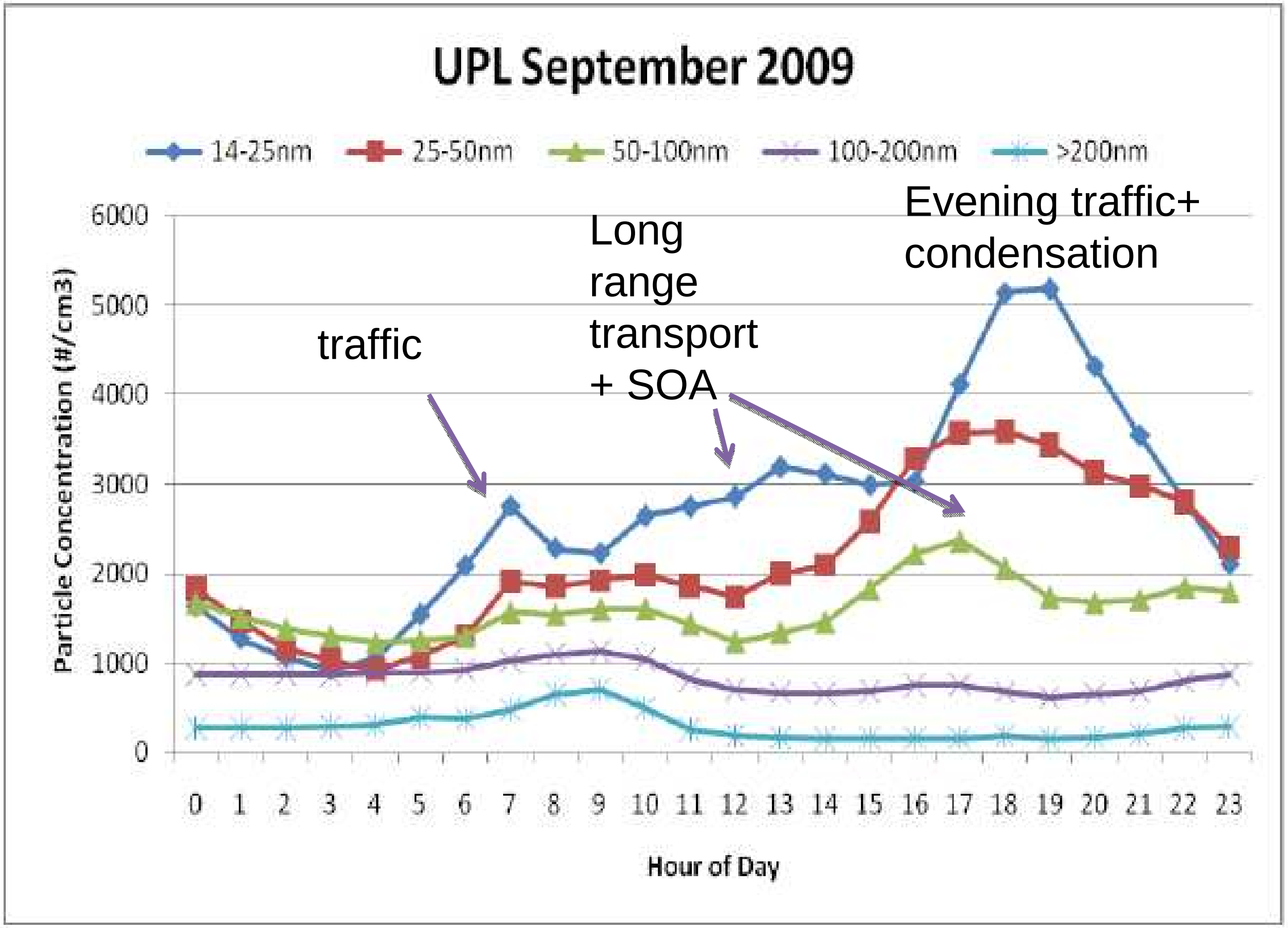


Figure 3b: PNC for different size ranges at UPL during September 2009

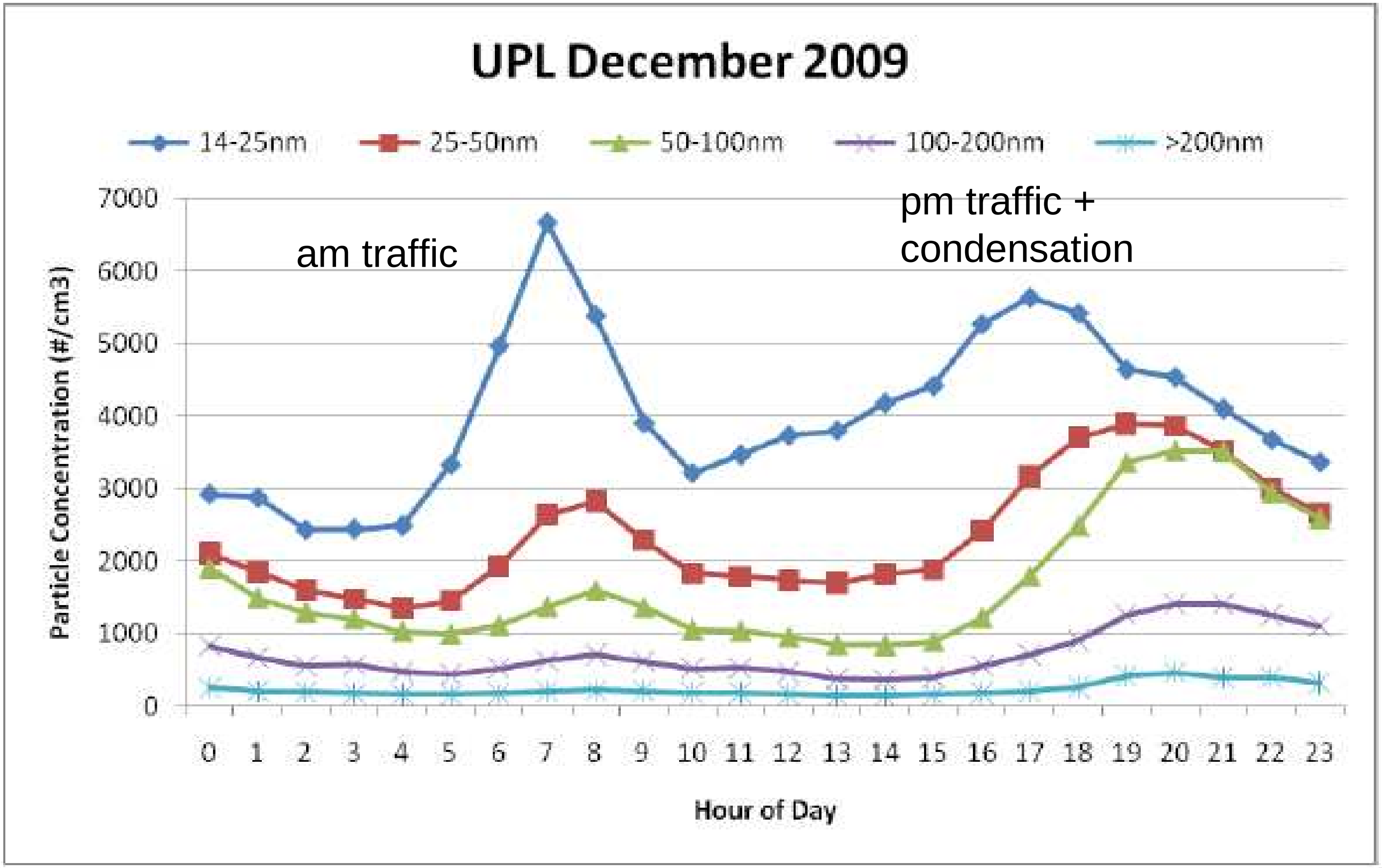


Figure 3c: PNC for different size ranges at UPL during December 2009

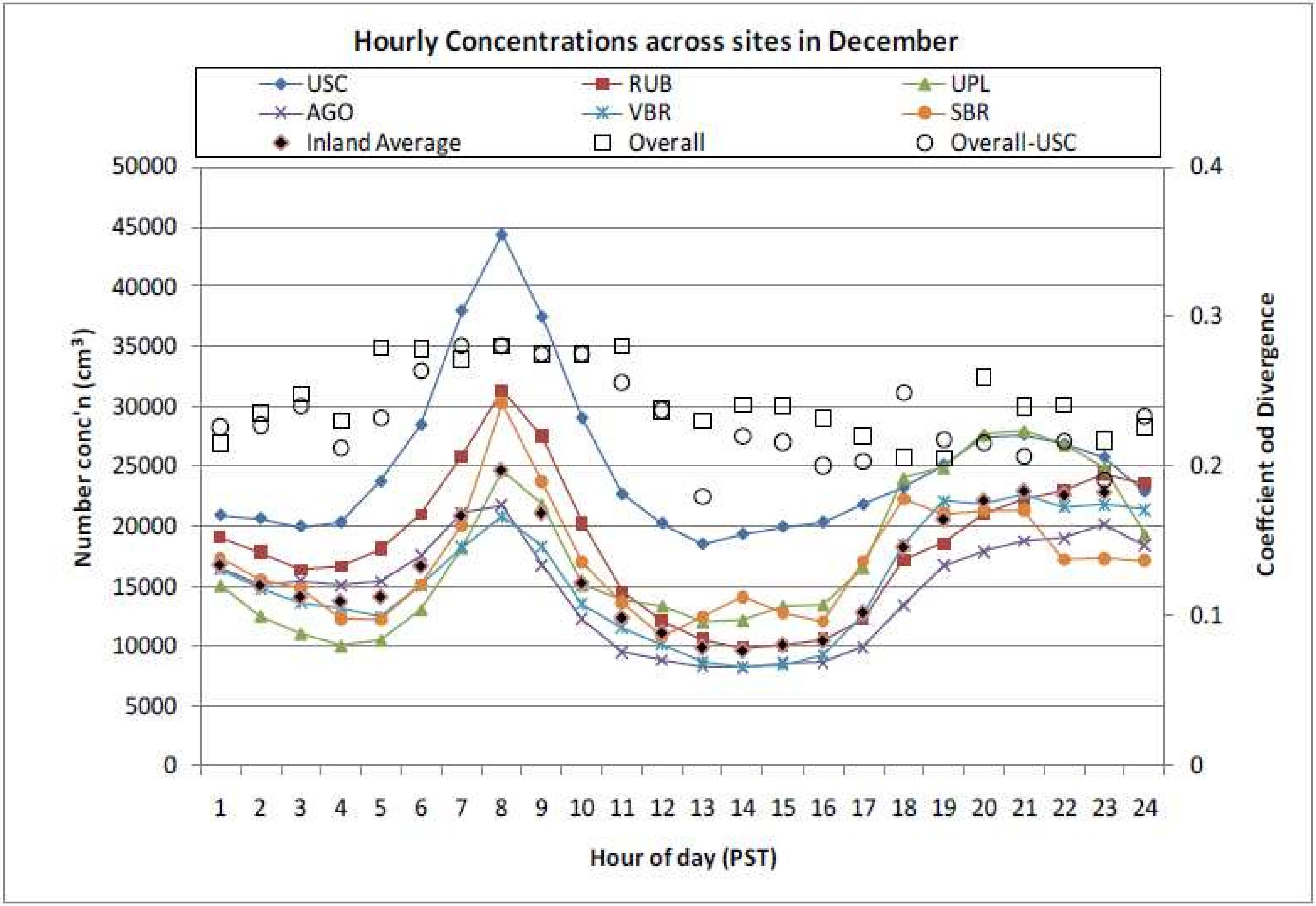


Figure 5a: PNC and Coefficients of Divergence across sites for December 2008

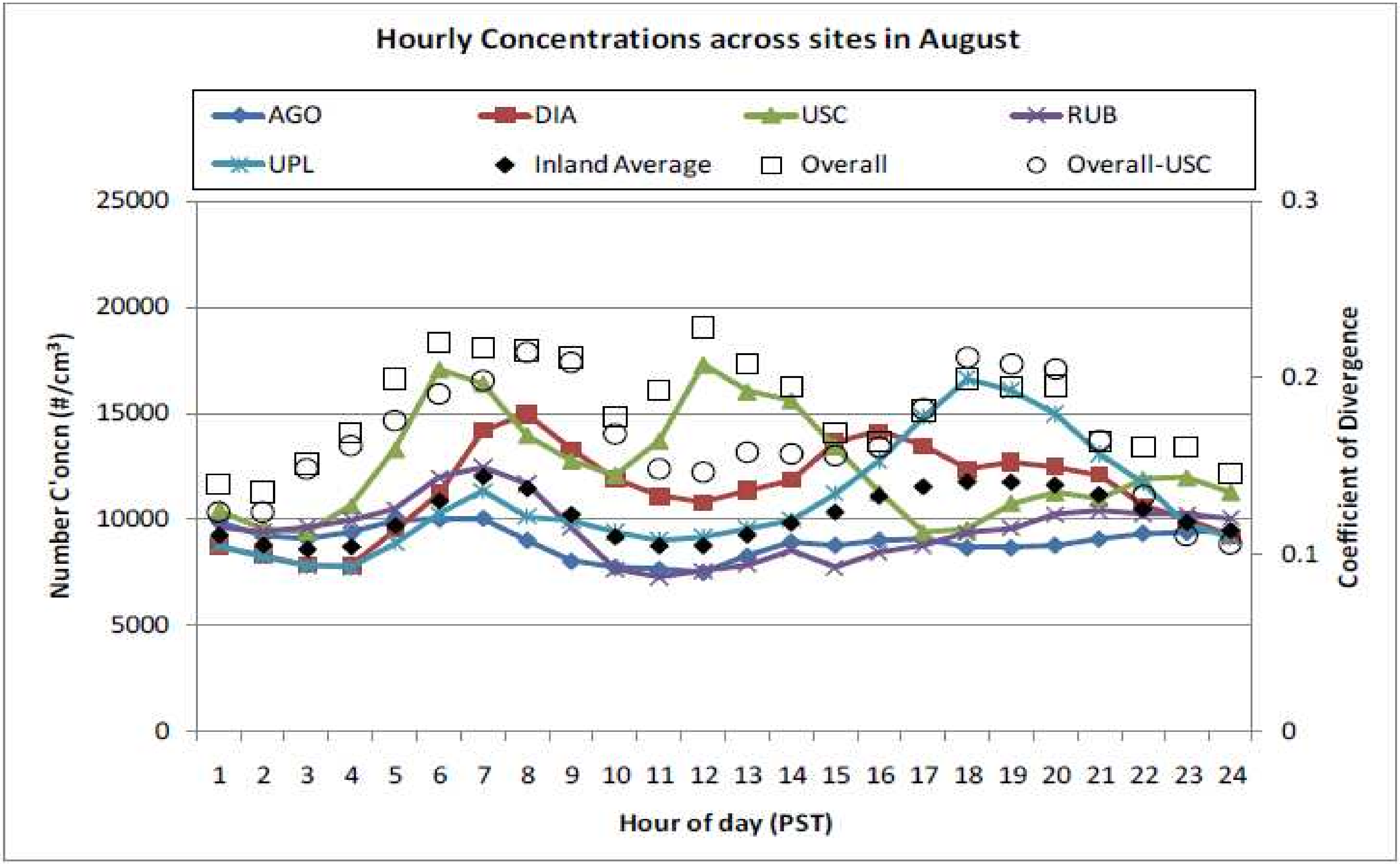


Figure 5b: PNC and Coefficients of Divergence across sites for August 2009

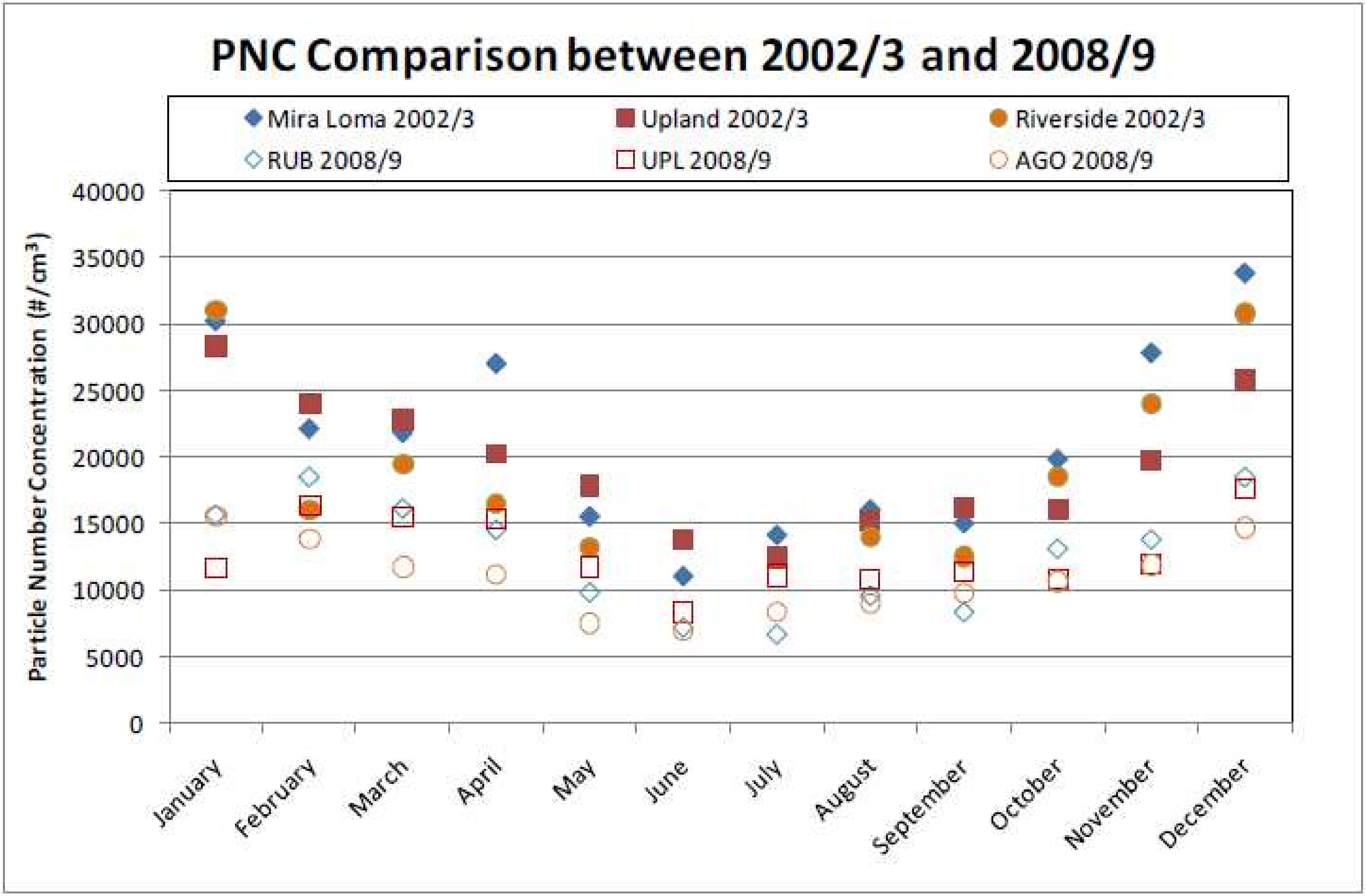


Figure 6: Comparison of PNC at select sites with Singh et al. 2006.

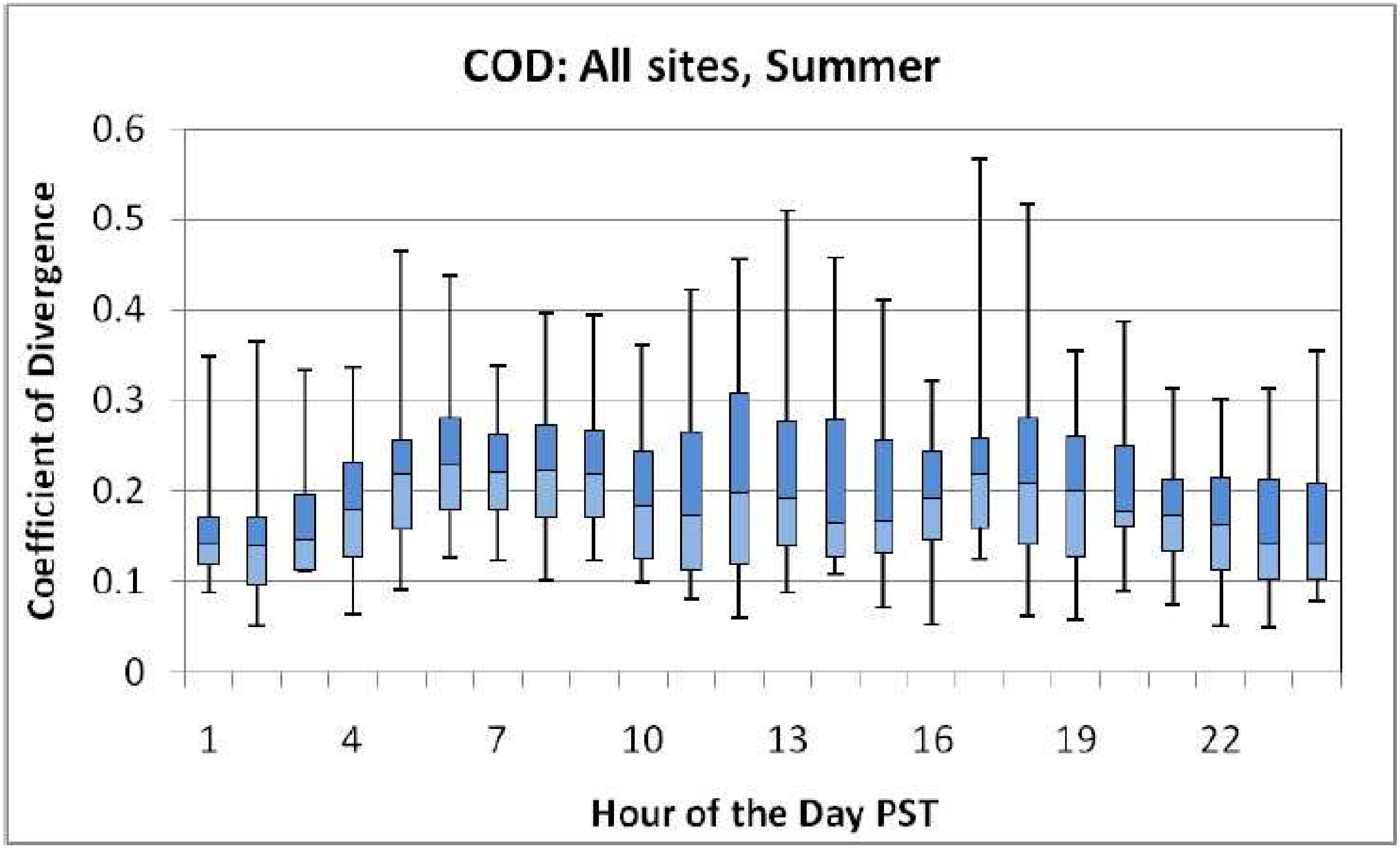


Figure 7a: Coefficients of divergence during the summer months of May-Aug, 2009

Pollutant Concentrations Downwind of Freeway Sound Walls

Locations

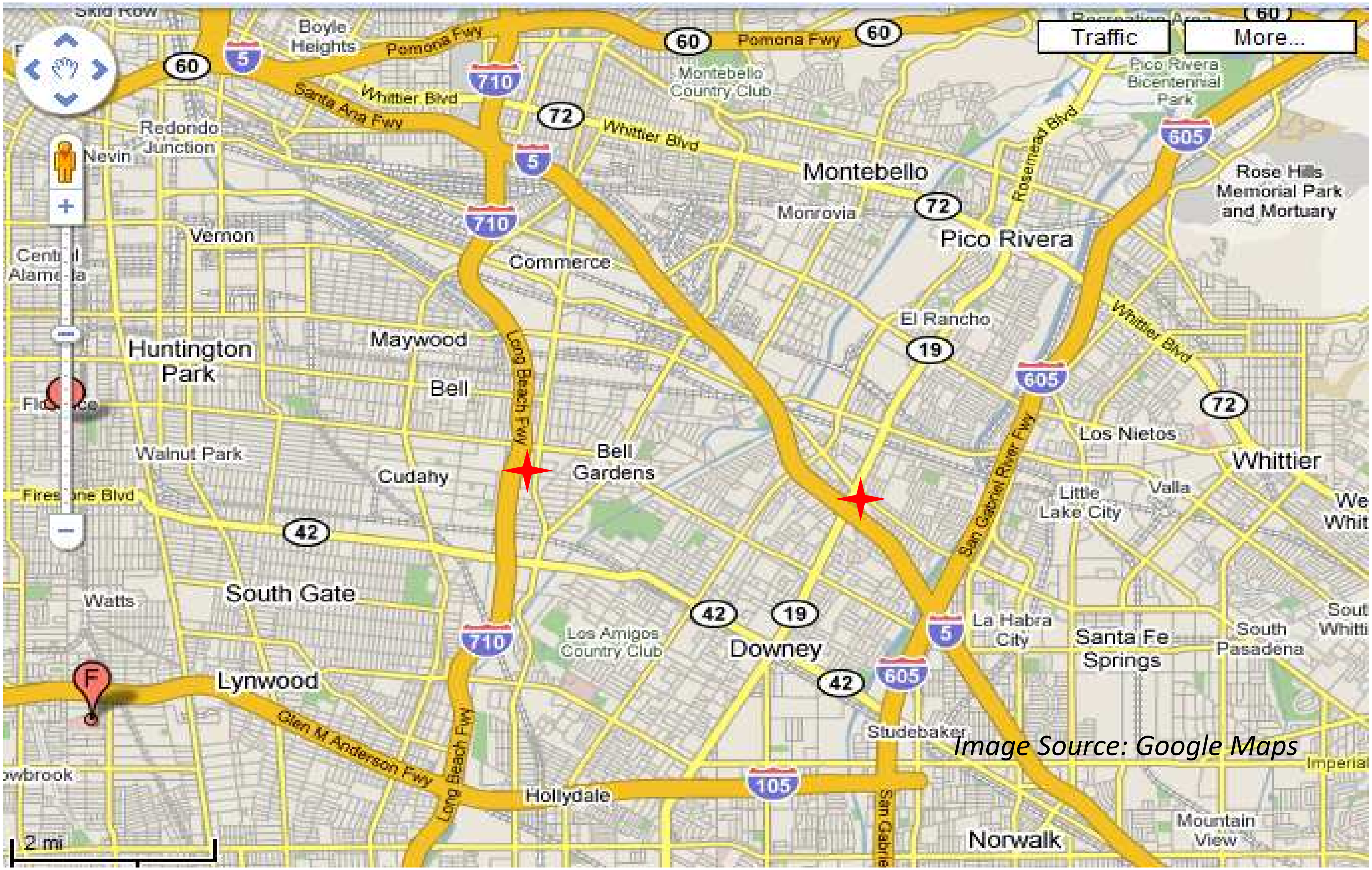


Image Source: Google Maps

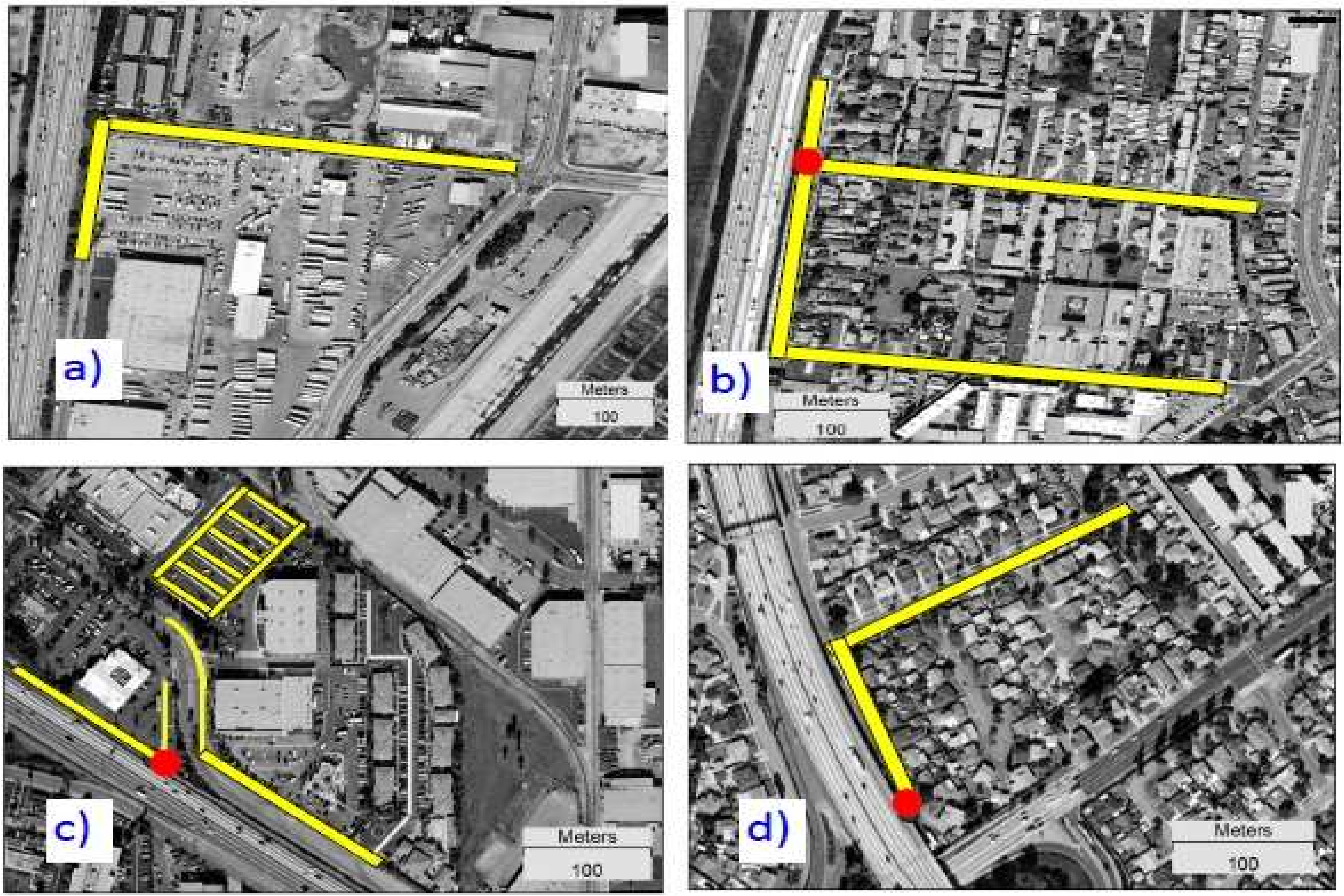


Figure 1 Location of the sampling sites: (a) I-710 without roadside barrier; (b) I-710 with roadside barrier; (c) I-5 without roadside barrier; (d) I-5 with roadside barrier.

Note: Red dot represents the stationary sampling station; the yellow lines represent the route of the mobile platform downwind of the freeway.

Sampling methodology

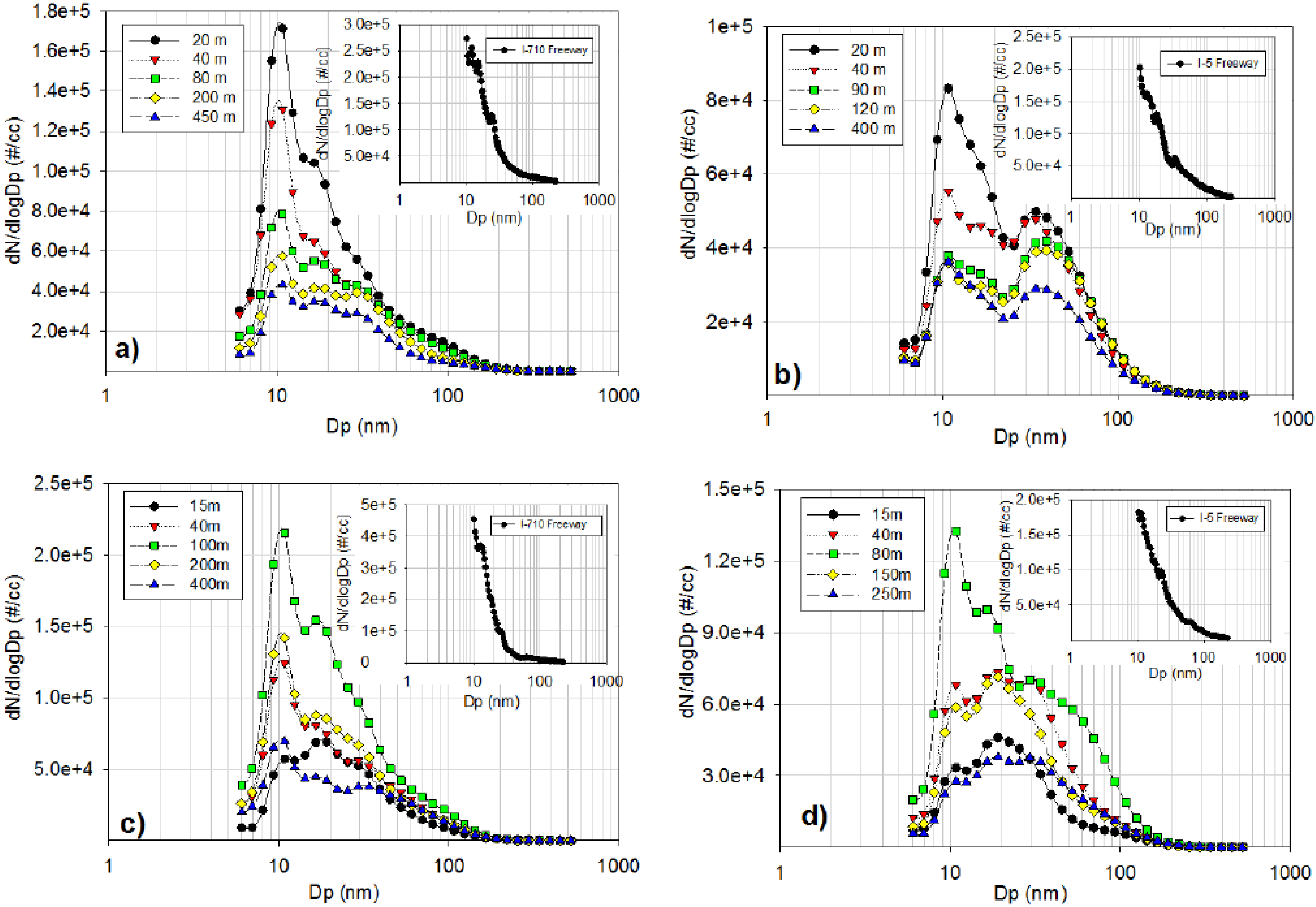
- USC (fixed on-freeway site) and ARB (downwind at various locations) made similar measurements
- USC instruments measured the following at the freeway
  - CO and CO_2
  - $NO/NO_2/NO_x$
  - Particle number concentration
  - Particle size distribution
  - Particle-bound BC
  - $PM_{2.5}$
  - Meteorology
  - Also video (supplemented by Caltrans data for freeway motor vehicle volume, etc .)

Limitations:

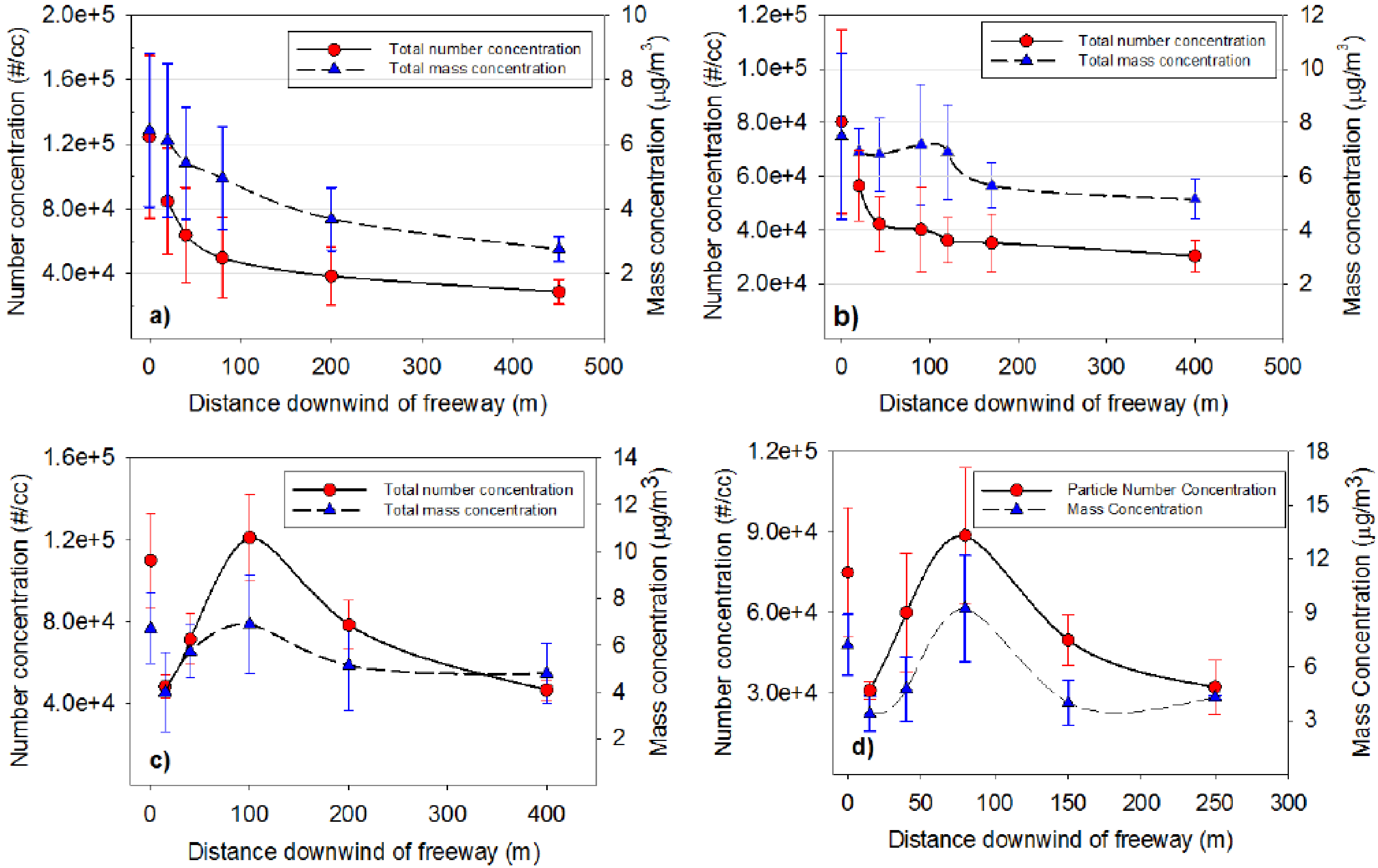
Battery operated, 4-5 hours of data/day

Instrumentation

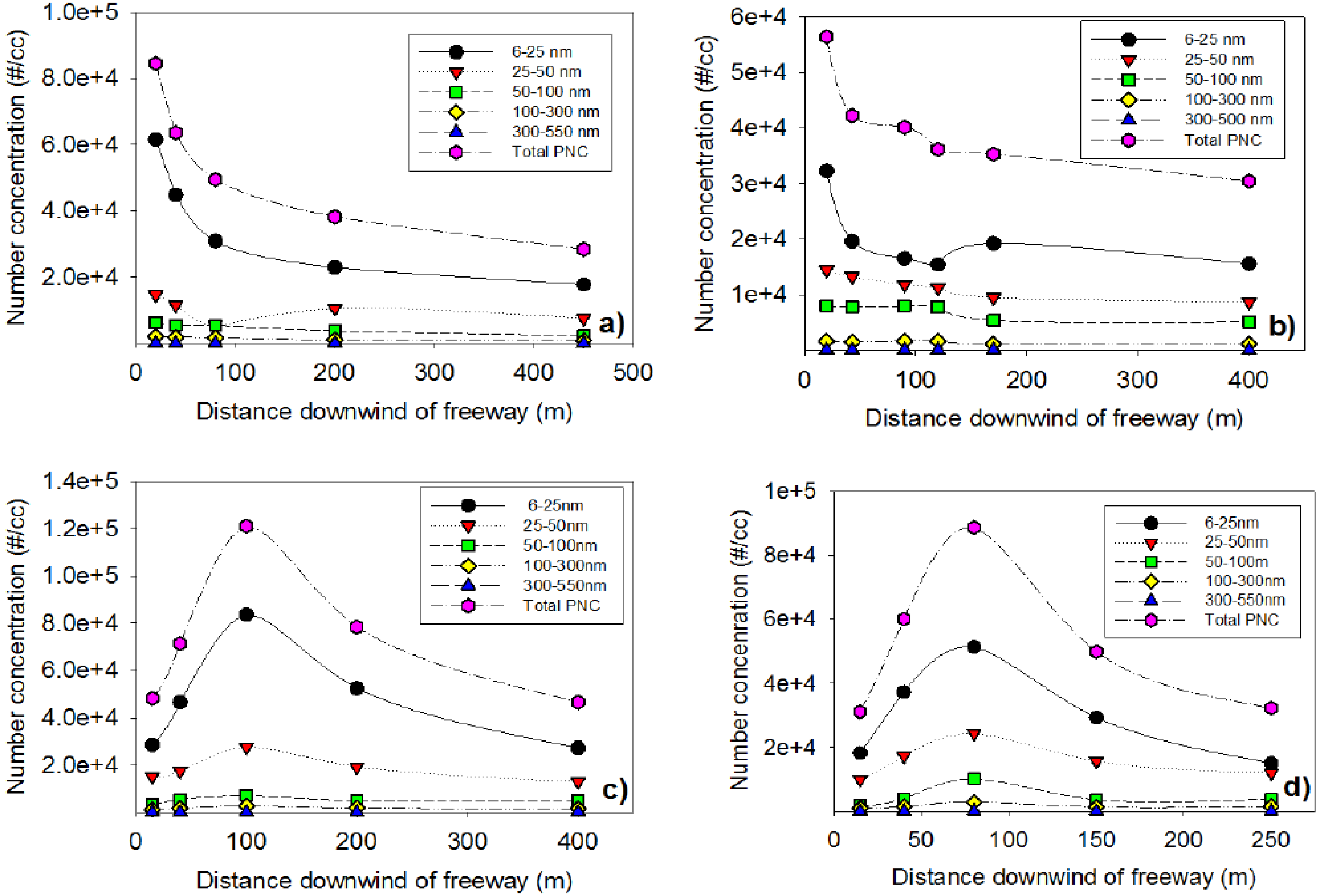
Measurement	Stationary sampling station	Mobile platform
Geodata	GPS (Garmin GPSmap 76CSx)	GPS(Garmin GPSmap 76CSx)
Particle size distribution	SMPS: TSI model 3080 (long DMA) w/TSI model 3022A (CPC) @ 5 min intervals (10 – 225 nm range)	FMPS: TSI model 3091 @ 20 sec intervals (6 – 523 nm range)
Particle-bound Black Carbon	Aethalometer: Anderson model 14 (dual channel) @ 1 min intervals	Aethalometer: Magee Scientific @ 1 min intervals
CO	QTrak – TSI model 7565 @ 1 min intervals	Teledyne API model 300E for CO @ 20 s intervals
NO2	Teledyne-API model 200A @ 1 min intervals	Teledyne-API Model 200E @ 20 s intervals
Meteorological data	3-D ultrasonic anemometer (RS Young model 81000) @ 1 min intervals	2-D Ultrasonic anemometer (RS Young) @ 1 sec intervals



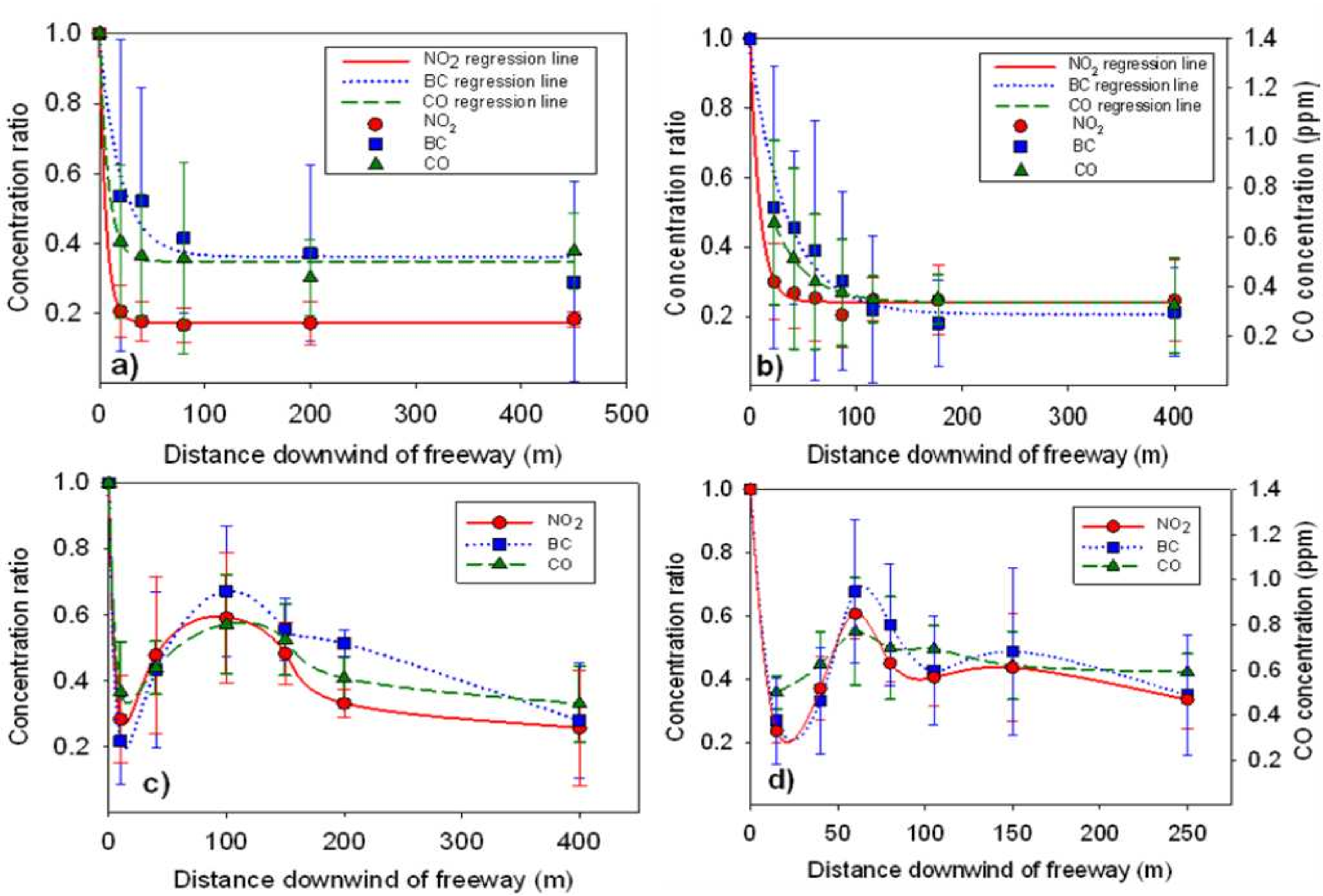
Particle size distributions measured at various distances downwind of freeway using FMPS (6-523nm) and in the immediate proximity of freeway using SMPS (10-225nm) shown as subplot: (a) I-710 without roadside barrier; (b) I-5 without roadside barrier; (c) I-710 with roadside barrier; (d) I-5 with roadside barrier.



Particle number and mass concentrations at different distance downwind of the freeway (a) I-710 no noise barrier (b) I-5 no noise barrier; (c) I-710 with noise barrier; (d) I-5 with noise barrier.



Size-segregated particle number concentrations at different distances downwind of the freeway (a) I-710 no noise barrier (b) I-5 no noise barrier; (c) I-710 with noise barrier; (d) I-5 with noise barrier.



BC and gaseous pollutants normalized concentrations at different distance downwind of the freeway (a) I-710 no noise barrier (b) I-5 no noise barrier; (c) I-710 with noise barrier; (d) I-5with noise barrier.

Publications (1)

1. Krudysz, M.A, Froines, J.R., Fine, P.M. and Sioutas, C. "Intra-community spatial variation of size-fractionated PM mass, OC, EC and trace elements in Long Beach, CA". *Atmospheric Environment*, 42 (21):5374-5389, 2008
2. Minguillón M.C., Arhami M., Schauer J.J., Olson M.R., and Sioutas C. "Seasonal and spatial variations of sources of fine and quasi-ultrafine particulate matter in neighborhoods near the Los Angeles-Long Beach Harbor". *Atmospheric Environment*, 42(32):7317-7328, 2008
3. Hu S., Polidori A., Schafer M., Cho A., Schauer J.J and Sioutas C. "Redox Activity and Chemical Speciation of Size Fractioned PM in the Communities of the Los Angeles - Long Beach Harbor". *Atmospheric Chemistry and Physics*, 8:6439-6451, 2008
4. Arhami M., Sillanpää M., Hu S., Geller M.D., Schauer J.J. and Sioutas C. "Size-segregated Inorganic and Organic Components of PM In the Communities of the Long Angeles Harbor Across Southern Los Angeles Basin, California." *Aerosol Science and Technology*, 43(2):145-160, 2009
5. Krudysz M.A., Froines, J.R., Moore K.F., Geller M.D and Sioutas C. "Intra-community Spatial Variability of Particulate Matter Size Distributions". *Atmospheric Chemistry and Physics*, 9:1061-1075, 2009

Publications (2)

6. Moore K.F., Krudysz M.A., Pakbin P., Hudda N. and Sioutas C. "Intra-community variability in ultrafine particle number concentrations in the communities of the Los Angeles harbor". *Aerosol Science and Technology*, 43:587–603, 2009.
7. Krudysz M.A., Dutton S.J., Brinkman G.L., Hannigan M.P., Fine P.M., Sioutas C. and Froines J.R." Intra-community spatial variation of size-fractionated organic compounds in Long Beach, CA". *Air Quality, Atmosphere and Health*, 2:69–88, 2009
8. Ning Z., Hudda N, Daher N., Kim W., Herner J., Konawa K, Mara S. and Sioutas C. "Impact of roadside noise barriers on particle size distributions and pollutants concentrations near freeways". Submitted for publication to *Atmospheric Environment*, March 2010
9. Hudda N., Cheung K., Moore, K.F. and Sioutas C. "Intra- and Inter-community variability in total particle number concentrations in the eastern Los Angeles air basin. Submitted for publication to *Atmospheric Chemistry and Physics*, March 2010

Conclusions

• Significant intra-community variability in total particle number concentrations was observed near the LA-Long Beach Harbor.

• The intra-community variability in LA-Long Beach Harbor was higher than that in receptor areas or the inter-community variability observed during the Children's Health study conducted earlier in Los Angeles

• In view of these observations, concerns regarding the applicability of centrally located measurements in estimating exposure to UFPs are warranted

• Routine deployment of dense CPC networks measuring particle number concentrations remains prohibitively expensive. Therefore, for the foreseeable future, data such as presented here will not be regularly available.

•The potential importance of exposure to UFPs to adverse health effects suggests that it would be useful to develop models capable of simulating ambient UFP concentrations for typical meteorological conditions and knowledge of local UFP sources and sinks including aerosol processes.

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- **Ports of Long Beach and Los Angeles**
- **The West Long Beach/Wilmington/San Pedro Community**
  - Southern California Edison
  - Orange County Nursery
  - Westside Baptist Church
  - Coalition for a Safe Environment (Wilmington)
  - City of Los Angeles
  - City of Long Beach
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