Supporting Information

Mobile and fixed-site measurements to identify spatial distributions of traffic related pollution sources in Los Angeles

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Discussion of seasonal and regional differences of correlations between the mobile and fixed-site PSD data

Correlations between the mobile and fixed-site PSD data for some pollutants differed by season. One explanation for this seasonal difference could be that the correlation was between the background-adjusted mobile measurements and integrated fixed-site PSD measurements, the higher emission level compare to background could have resulted in a stronger correlation. For example, mobile CO measurements did not show any correlation with fixed-site PSD measurements in summer, but were significantly correlated with some PSD VOCs and NO_x in the spring (Table S2 and S3). High traffic congestion that tends to occur the most in March in Los Angeles increases vehicle emission.[1] According to Sjodin et al., CO emissions showed a 4-fold increase with congestion compared to congestion-free conditions.[2] The higher CO emissions in spring along with increased other traffic related emissions might contribute to the stronger correlation in Table S3. Higher emissions could also explain the stronger correlation among pollutants within either the mobile or fixed-site PSD campaign as shown in Table S6-9. This pattern is consistent with previous findings.[3] Ultrafine PN_1 and fine particle counts are only significantly correlated with PSD NO_2 concentrations in the spring, possibly because particle formation near major highways tends to be greater in spring rather than in summer in Los Angeles.[4] Increased atmospheric stability, as well as increased emissions from non-traffic sources such as heating (e.g., fireplaces, gas stove) from near-road residences, could also contribute to these higher correlations in spring.

Correlations between pollutants were weaker in this study in Los Angeles compared to those from a similar study in Baltimore.[5] For example, the NO_x correlations were 0.53 in Los Angeles and 0.84 in Baltimore in summer, while they were 0.43 in Los Angeles and 0.48 in Baltimore in spring/winter. As discussed above as a possible explanation for different correlations between summer and spring, the reason for different correlations in different cities may have been due to the background pollutant levels in general being much higher in Los Angeles than in Baltimore (Table S10).

Table S1. List of pollutants measured in the mobile and fixed-site PSD campaigns

Mobile

Pollutant	Unit	Instrument	Manufacturer
Black Carbon (BC)	ng/m^3	micro-Aethalometer AE52	AethLabs
UFPN (diam. 25-400 nm)	Counts/ cm^3	NanoCheck 1.320	GRIMM
PN_1 (diam. 50-1000 nm)	Counts/cm^3	PTRAK 8525 with diffusion screen	TSI
PN_{fine}(diam. 0.25-1 μm)	Counts/L	Spectrometer 1.109	GRIMM
$PN_{Intermodal}$ (diam. 1-3 μm)	Counts/L		
CO	ppm	CO Monitor T15N	Langan
CO_2	ppm	CO2 K-30-FS sensor	CO2Meter.com
NO_2	ppb	CAPS NO_2 monitor	Aerodyne Research, Inc.
NO_x	ppb	NO Model 410, Converter #401	2B Technologies

Fixed-site

Pollutant	Unit	Instrument	Manufacturer
Pentanes [a]	$\mu g/m^3$	Organic Vapor Monitors 3500 & 3520	3M Company
Benzene	$\mu g/m^3$		
Toluene	$\mu g/m^3$		
m-Xylene	$\mu g/m^3$		
o-Xylene	$\mu g/m^3$		
Nonane	$\mu g/m^3$		
Decane [b]	$\mu g/m^3$		
Undecane [b]	$\mu g/m^3$		
NO_2	Ppb	Ogawa sampler	Ogawa & Company
NO_x	Ppb		

[a] Pentanes includes pentanes and hexanes.
[b] Only includes summer measurements.

Table S2. Fixed-site vs. mobile Pearson's correlation coefficients (summer campaign)

	UFPN	PN_1	PN_{fine}	$PN_{(1\text{-}3\mu m)}$	BC	NO_2	NO_x	CO	CO_2
Pentanes	-0.30	-0.37	-0.11	-0.18	-0.38	-0.23	-0.02	-0.07	-0.25
Benzene	-0.32	-0.35	0.06	0.05	-0.32	-0.13	0.12	0.01	-0.02
Toluene	-0.24	-0.19	0.02	0.07	-0.18	-0.02	0.20	0.00	0.07
m-Xylene	-0.07	-0.02	0.02	0.37	-0.01	0.17	0.23	-0.07	0.27
o-Xylene	-0.09	-0.08	0.05	0.31	-0.07	0.14	0.25	0.01	0.24
Nonane	-0.05	0.11	0.04	**0.50**	0.10	0.17	0.18	-0.22	0.24
Decane	0.00	0.18	-0.02	**0.44**	0.19	0.25	0.18	-0.20	0.26
Undecane	0.02	0.18	-0.03	**0.45**	0.23	0.28	0.21	-0.21	0.25
NO_2	0.20	0.23	0.18	**0.41**	**0.50**	**0.62**	**0.51**	0.15	**0.62**
NO_x	0.21	0.37	0.23	**0.51**	**0.57**	**0.74**	**0.53**	0.15	**0.51**

The 2-sided probability p=0.01 critical value for Pearson's correlation coefficients is 0.40 for N=40; significant p-values are in bold.

Table S3. Fixed-site vs. mobile Pearson's correlation coefficients (spring campaign)

	UFPN	PN_1	PN_{fine}	$PN_{(1\text{-}3\mu m)}$	BC	NO_2	NO_x	CO	CO_2
Pentanes	-0.22	-0.17	0.06	-0.19	-0.18	-0.11	-0.04	0.17	0.02
Benzene	-0.26	-0.21	0.01	-0.17	-0.23	-0.13	-0.01	0.18	0.03
Toluene	-0.07	-0.20	-0.02	-0.37	-0.28	-0.16	-0.10	**0.46**	-0.18
m-Xylene	-0.10	-0.17	-0.05	-0.23	-0.27	-0.15	-0.07	0.34	-0.13
o-Xylene	-0.09	-0.19	-0.02	-0.34	-0.24	-0.11	-0.02	**0.46**	-0.15
Nonane	0.09	0.14	0.08	0.13	-0.03	-0.01	-0.08	0.16	0.00
NO_2	0.35	**0.54**	**0.49**	0.20	**0.61**	**0.79**	**0.71**	0.34	**0.45**
NO_x	0.21	0.31	0.37	-0.09	0.28	**0.48**	**0.43**	**0.45**	0.29

The 2-sided probability p=0.01 critical value for Pearson's correlation coefficients is 0.40 for N=40; significant p-values are in bold.

Table S4. Summary of mobile platform pollutant concentrations (summer campaign)

	NO_2 (ppb)	NO_x (ppb)	CO (ppm)	CO_2 (ppm)	BC (ng/m^3)	UFPN ($\#/cm^3$)	PN_1 ($\#/cm^3$)	PN_{fine} (#/L)	$PN_{intermodal}$ (#/L)
Mean C*	14	29	1.7	657	705	13210	4860	254800	2659
Median C	13	26	1.6	637	545	12000	4336	219500	2600
Mean $C_{adjusted}$**	6.3	16	0.32	33.2	460	6714	2163	28290	1017
Median $C_{adjusted}$	4.5	13	0.24	13.1	313	5255	1579	19590	873

* C is C_i across all days of *i*;

**$C_{adjusted}$ is $C_{i,adjusted}$ across all days of *i*.

Table S5. Summary of mobile platform pollutant concentrations (spring campaign)

	NO_2 (ppb)	NO_x (ppb)	CO (ppm)	CO_2 (ppm)	BC (ng/m^3)	UFPN ($\#/cm^3$)	PN_1 ($\#/cm^3$)	PN_{fine} (#/L)	$PN_{intermodal}$ (#/L)
Mean C*	16	42	4.2	689	1023	16280	4918	684700	3317
Median C	12	37	4.1	668	829	12740	4390	622800	2925
Mean $C_{adjusted}$**	10	20	0.92	47.2	515	8856	1967	73490	1264
Median $C_{adjusted}$	7.9	16	0.55	24.1	373	5003	1406	43030	1065

* C is C_i across all days of *i*;

**$C_{adjusted}$ is $C_{i,adjusted}$ across all days of *i*.

Table S6. Pearson's correlation coefficients from mobile monitoring (summer campaign)

	UFPN	PN_1	PN_{fine}	$PN_{intermodal}$	BC	NO_2	NO_x	CO	CO_2
UFPN	1.00	**0.77**	-0.06	0.04	**0.53**	**0.40**	0.18	0.18	0.14
PN_1	**0.77**	1.00	0.31	0.30	**0.70**	**0.53**	0.32	0.20	0.26
PN_{fine}	-0.06	0.31	1.00	**0.40**	0.14	0.10	0.08	0.16	0.29
$PN_{intermodal}$	0.04	0.30	**0.40**	1.00	0.36	0.30	0.36	-0.10	0.38
BC	**0.53**	**0.70**	0.14	0.36	1.00	**0.83**	**0.62**	0.15	**0.44**
NO_2	**0.40**	**0.53**	0.10	0.30	**0.83**	1.00	**0.66**	0.31	**0.58**
NO_x	0.18	0.32	0.08	0.36	**0.62**	**0.66**	1.00	0.27	**0.58**
CO	0.18	0.20	0.16	-0.10	0.15	0.31	0.27	1.00	0.36
CO_2	0.14	0.26	0.29	0.38	**0.44**	**0.58**	**0.58**	0.36	1.00

The 2-sided probability p=0.01 critical value for Pearson's correlation coefficients is 0.40 for N=40; significant p-values are in bold.

Table S7. Pearson's correlation coefficients from mobile monitoring (spring campaign)

	UFPN	PN_1	PN_{fine}	$PN_{intermodal}$	BC	NO_2	NO_x	CO	CO_2
UFPN	1.00	**0.81**	0.21	0.01	**0.50**	0.38	0.18	0.26	0.17
PN_1	**0.81**	1.00	**0.43**	0.30	**0.76**	**0.57**	0.38	0.13	0.24
PN_{fine}	0.21	**0.43**	1.00	0.08	**0.68**	**0.73**	**0.70**	0.17	**0.40**
$PN_{intermodal}$	0.01	0.30	0.08	1.00	0.20	0.20	0.18	-0.23	0.11
BC	**0.50**	**0.76**	**0.68**	0.20	1.00	**0.82**	**0.70**	0.12	**0.40**
NO_2	0.38	**0.57**	**0.73**	0.20	**0.82**	1.00	**0.88**	0.20	**0.58**
NO_x	0.18	0.38	**0.70**	0.18	**0.70**	**0.88**	1.00	0.23	**0.59**
CO	0.26	0.13	0.17	-0.23	0.12	0.20	0.23	1.00	-0.13
CO_2	0.17	0.24	**0.40**	0.11	**0.40**	**0.58**	**0.59**	-0.13	1.00

The 2-sided probability p=0.01 critical value for Pearson's correlation coefficients is 0.40 for N=40; significant p-values are in bold.

Table S8. Pearson's correlation coefficients from fixed-site PSD monitoring (summer campaign)

	Pentanes	Benzene	Toluene	m-Xylene	o-Xylene	Nonane	Decane	Undecane	NO_2	NO_x
Pentanes	1.00	**0.83**	**0.73**	0.31	**0.48**	0.02	-0.17	-0.22	-0.17	0.11
Benzene	**0.83**	1.00	**0.75**	**0.49**	**0.69**	0.13	-0.10	-0.13	-0.05	0.31
Toluene	**0.73**	**0.75**	1.00	**0.52**	**0.67**	0.23	0.09	-0.01	0.02	0.34
m-Xylene	0.31	**0.49**	**0.52**	1.00	**0.95**	**0.86**	**0.73**	**0.71**	0.15	0.36
o-Xylene	**0.48**	0.69	**0.67**	**0.95**	1.00	**0.68**	**0.50**	**0.48**	0.16	**0.45**
Nonane	0.02	0.13	0.23	**0.86**	**0.68**	1.00	**0.95**	**0.93**	0.12	0.17
Decane	-0.17	-0.10	0.09	**0.73**	**0.50**	**0.95**	1.00	**0.98**	0.13	0.10
Undecane	-0.22	-0.13	-0.01	**0.71**	**0.48**	**0.93**	**0.98**	1.00	0.14	0.10
NO_2	-0.17	-0.05	0.02	0.15	0.16	0.12	0.13	0.14	1.00	**0.62**
NO_x	0.11	0.31	0.34	0.36	**0.45**	0.17	0.10	0.10	**0.62**	1.00

The 2-sided probability p=0.01 critical value for Pearson's correlation coefficients is 0.40 for N=40; significant p-values are in bold.

Table S9. Pearson's correlation coefficients from fixed-site PSD monitoring (spring campaign)

	Pentanes	Benzene	Toluene	m-Xylene	o-Xylene	Nonane	NO_2	NO_x
Pentanes	1.00	**0.96**	**0.76**	**0.66**	**0.63**	**0.43**	-0.11	0.27
Benzene	**0.96**	1.00	**0.78**	**0.68**	**0.66**	**0.41**	-0.08	0.35
Toluene	**0.76**	**0.78**	1.00	**0.86**	**0.90**	**0.55**	-0.03	0.39
m-Xylene	**0.66**	**0.68**	**0.86**	1.00	**0.96**	**0.75**	0.00	**0.43**
o-Xylene	**0.63**	**0.66**	**0.90**	**0.96**	1.00	**0.62**	0.04	**0.45**
Nonane	**0.43**	**0.41**	**0.55**	**0.75**	**0.62**	1.00	0.16	**0.40**
NO_2	-0.11	-0.08	-0.03	0.00	0.04	0.16	1.00	**0.72**
NO_x	0.27	0.35	0.39	**0.43**	**0.45**	**0.40**	**0.72**	1.00

The 2-sided probability p=0.01 critical value for Pearson's correlation coefficients is 0.40 for N=40; significant p-values are in bold.

Table S10. Summary of mobile platform background pollutant concentrations in Los Angeles and in Baltimore

Season	Region	NO_2 (ppb)	NO_x (ppb)	CO (ppm)	CO_2 (ppm)	BC (ng/m^3)	UFPN ($\#/cm^3$)	PN_1 ($\#/cm^3$)	PN_{fine} (#/L)	$PN_{intermodal}$ (#/L)
Summer	Los Angeles	8.1	13	1.4	624	245	6496	2697	226510	1642
	Baltimore	NA	10	1.1	553	223	4721	2162	237300	210
Spring/Winter	Los Angeles	5.6	21	3.3	642	508	7424	2951	611210	2053
	Baltimore	NA	13	NA	483	165	9240	3222	256850	132

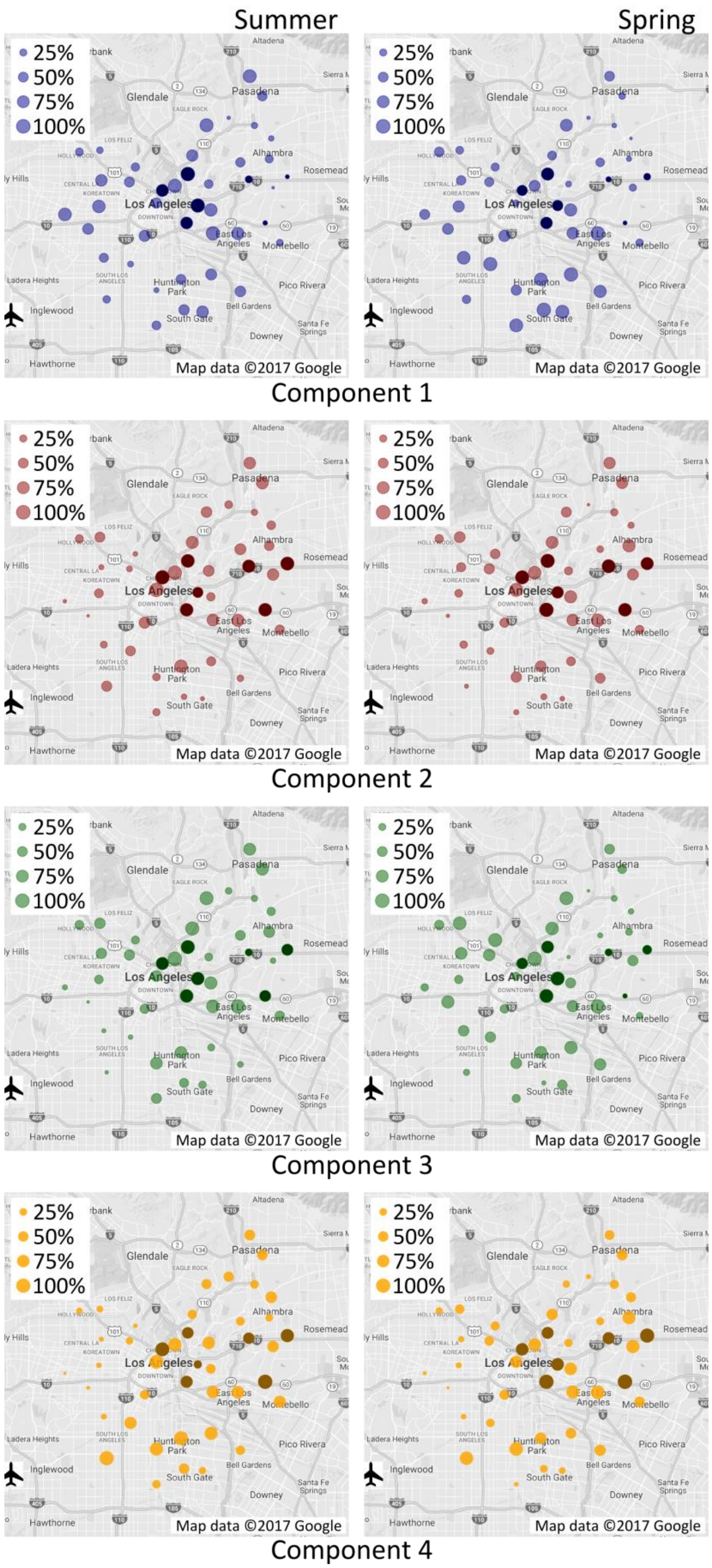

Figure S1. Absolute PCA component score percentiles at locations near truck routes (< 500 meters, in darker color) and far from truck routes (≥500 meters, in lighter color). Larger circles indicate larger contributions to pollutant concentrations.

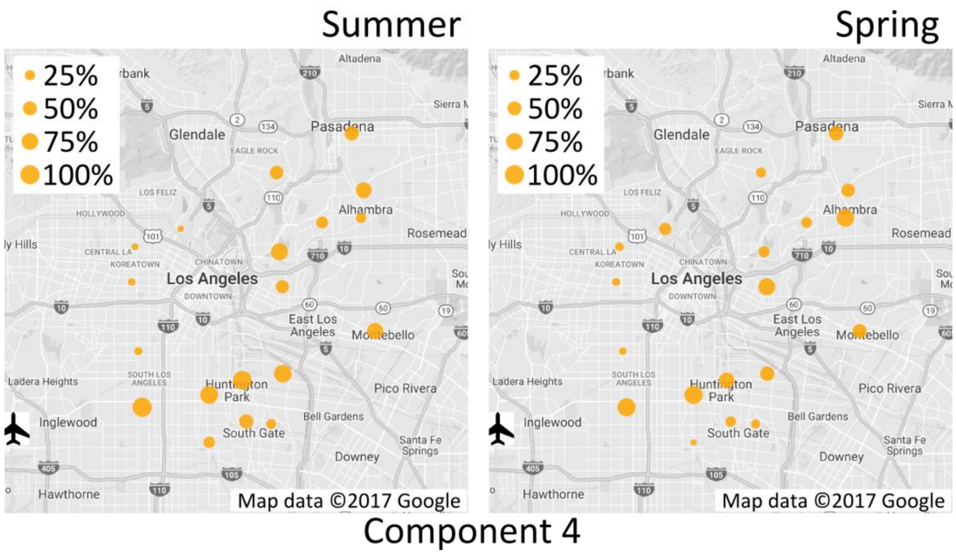

Figure S2. Absolute PCA component 4 score percentiles at locations far from major highways (≥1000 meters). Larger circles indicate larger contributions to pollutant concentrations.

References

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