SUPPLEMENTARY INFORMATION

Measurement Report: Interpretation of Wide Range Particulate Matter Size Distributions in Delhi

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Figure S1: IIT Sampling Location in Delhi.

Table S1: Merged Data Grade and Set limits . [O: Is there an overlap? N: Is the data scattered over the overlap? F: Fraction of points which match, S: Smoothness of overlap across the SMPS and GRIMM data.]

Criterion				Point
O: 1: Yes; 0: No.	N: 3 – None; 2- either SMPS or GRIMM; 1 – over both SMPS and GRIMM.	F: 3 – All; 2- most; 1- None	S: 3 – smooth; 2- bumpy; 1- Stepped.	(9/27) x O x N x F x S 9 is perfect, 0 and 1 are unacceptable and are excluded from data set.
1	3	3	3	9 (PERFECT)
1	3	3	2	6 (KEEP)
1	3	2	3	6 (KEEP)
1	2	3	3	6 (KEEP)
1	3	1	2	6 (ACCEPTABLE)
1	3	1	3	6 (ACCEPTABLE)
1	2	1	3	6 (ACCEPTABLE)
1	1	2	3	2 (IMPROVE)
1	1	3	2	2 (IMPROVE)
1	3	2	1	2 (IMPROVE)
1	1	1	3	1 (REJECT)
1	1	3	1	1 (REJECT)
1	3	1	1	1(REJECT)
0	3	3	3	0 (REJECT)

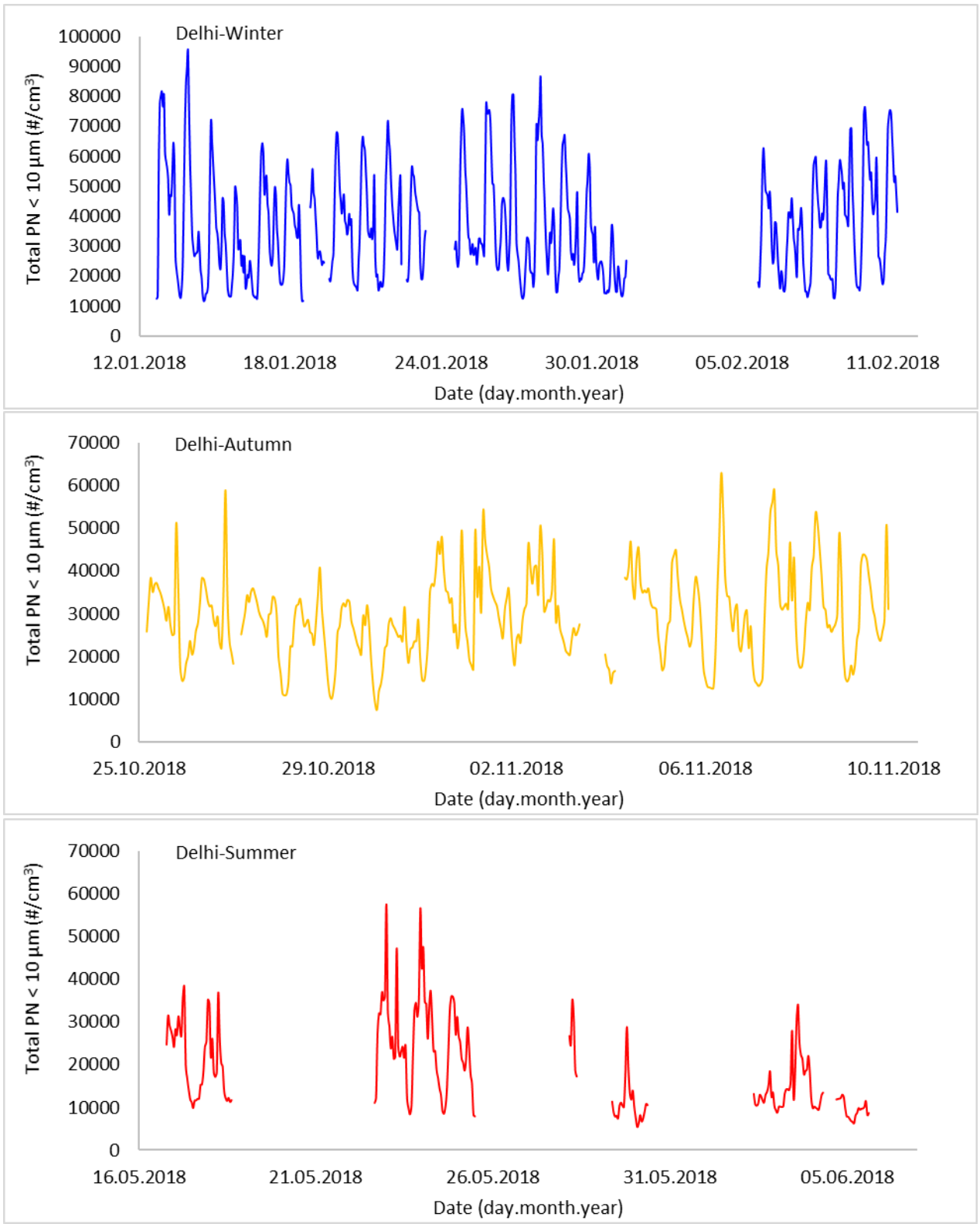


Figure S2: Time series of particle number counts for the sum of nucleation, Aitken, accumulation, fine and coarse modes of PM from the SMPS and Grimm instruments for all season in Delhi.

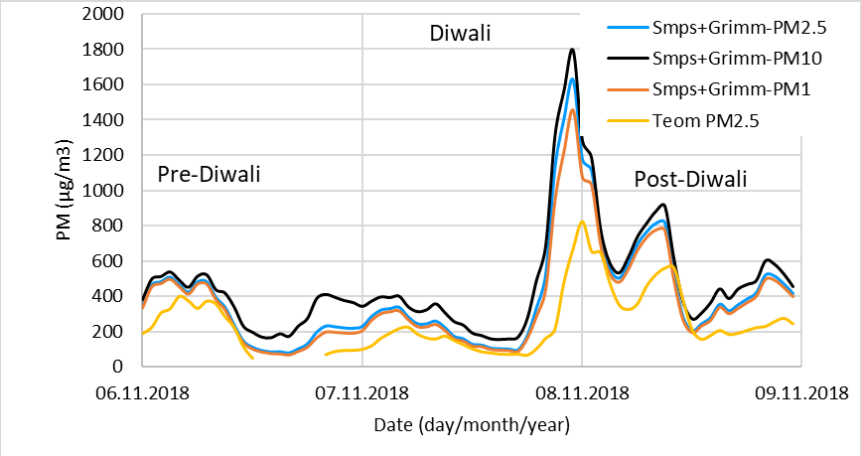


Figure S3: Particle concentration change during Diwali in 2018 in Delhi.

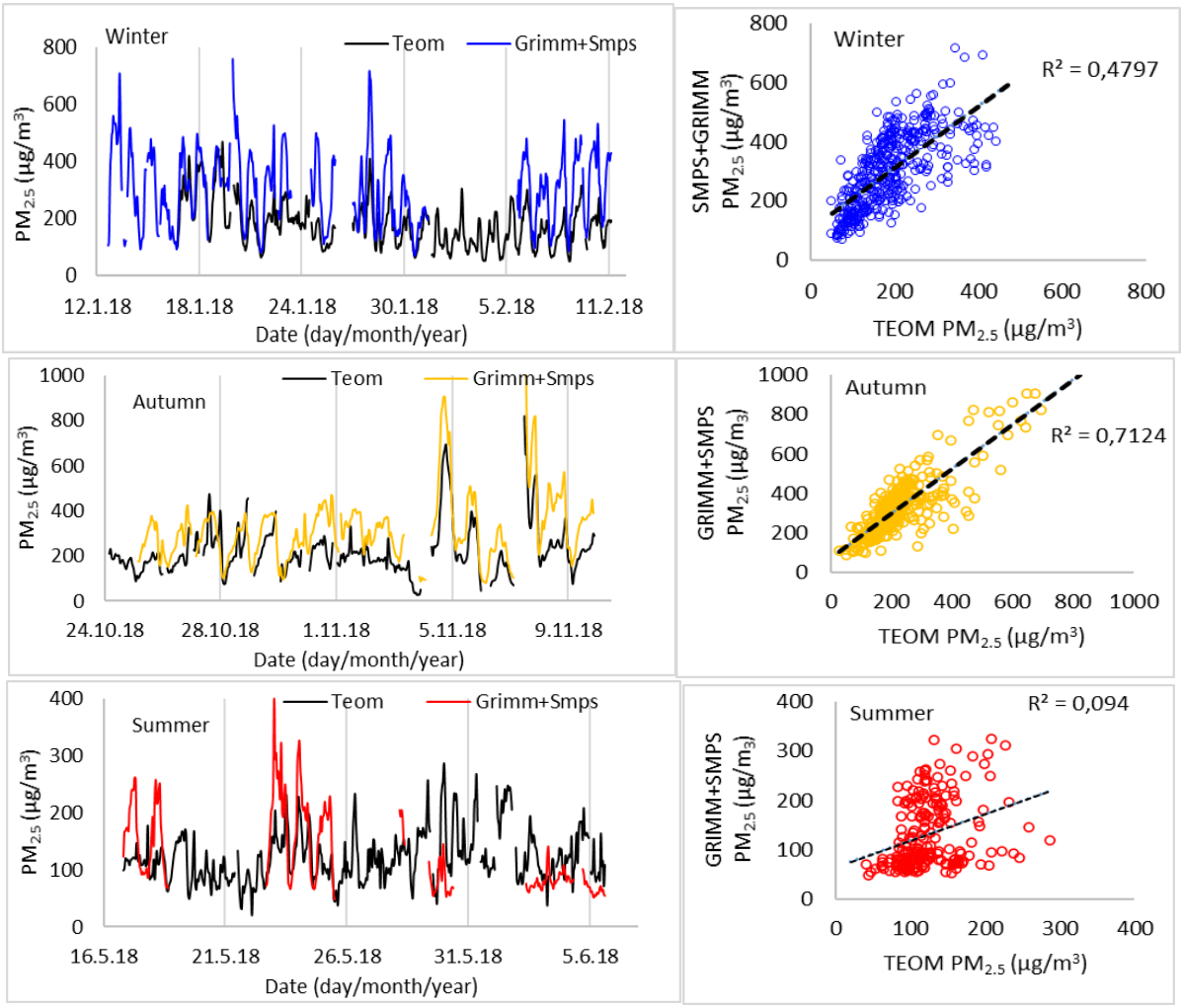


Figure S4: Comparison of $PM_{2.5}$ measured by SMPS+GRIMM and TEOM in Delhi for three seasons.

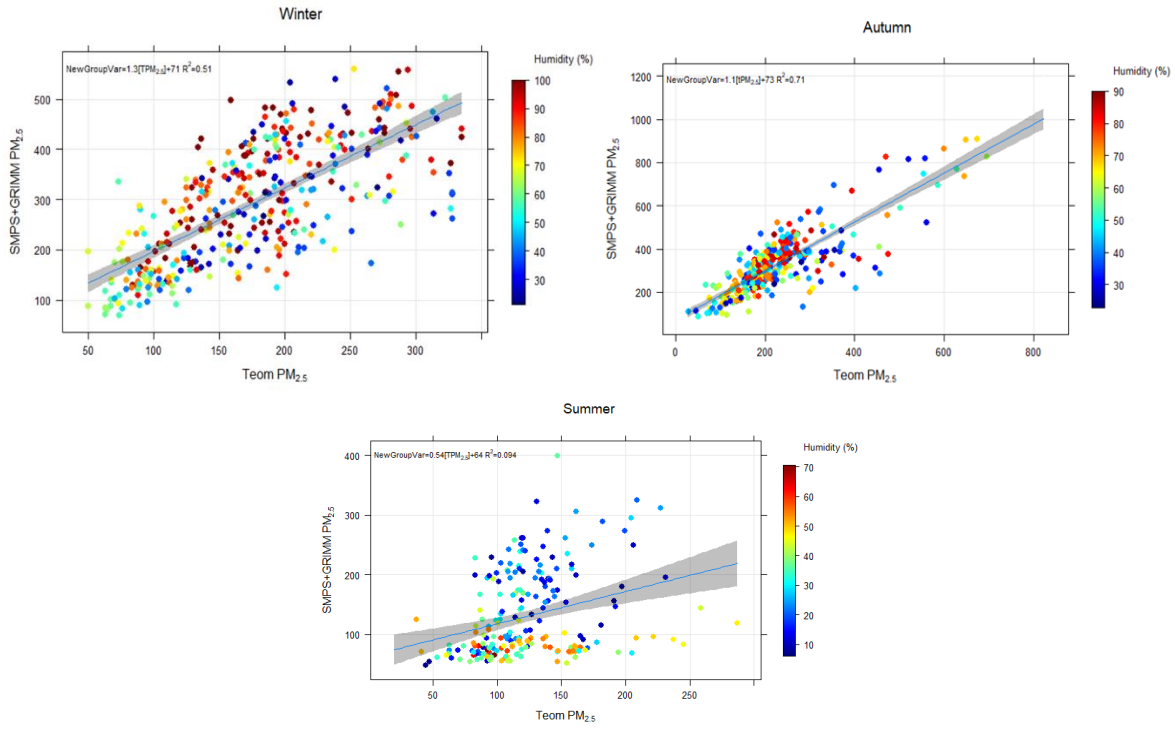
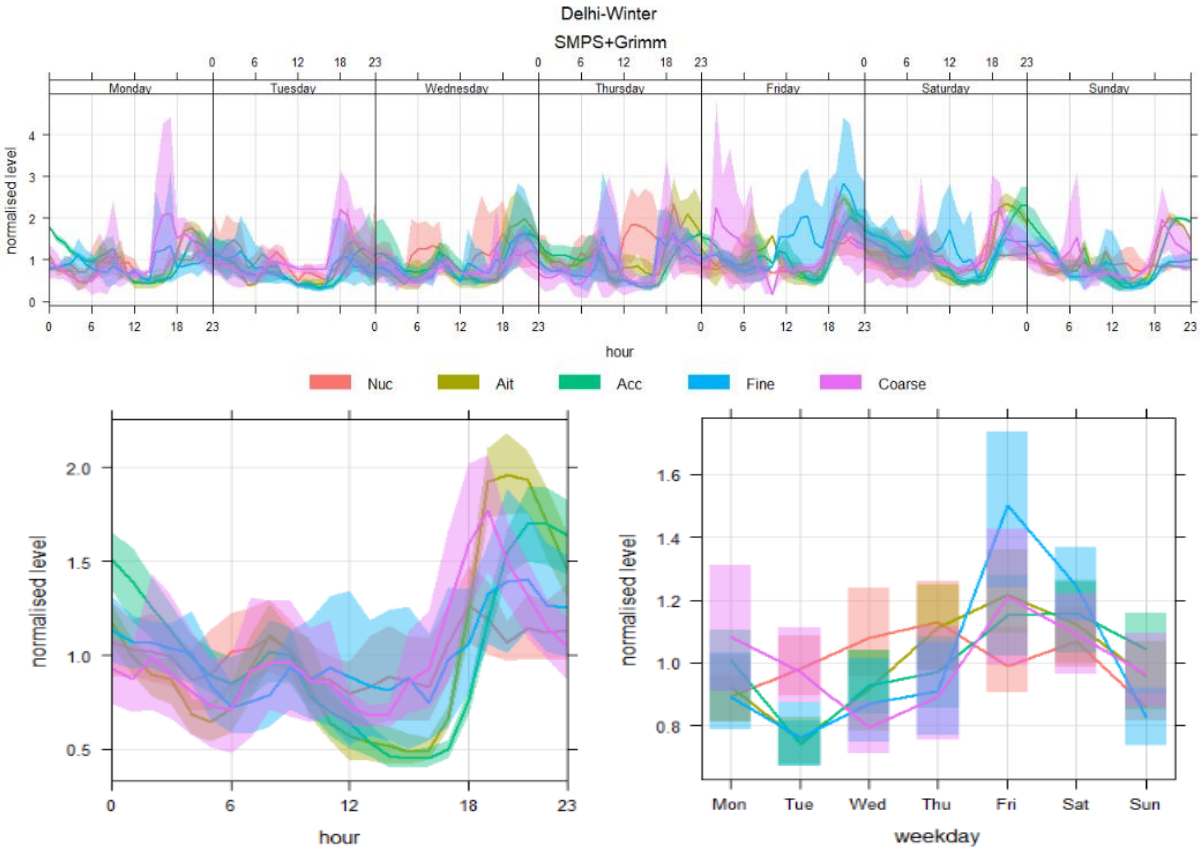
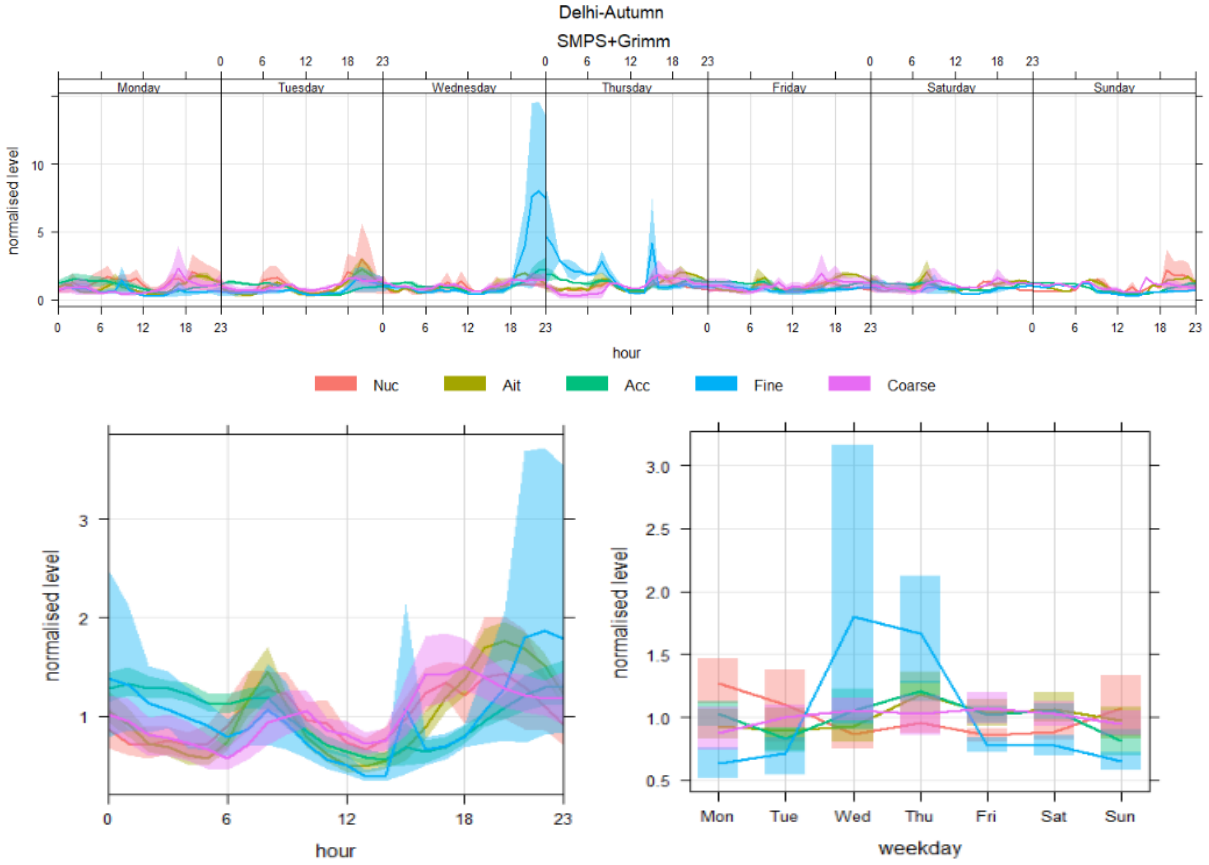


Figure S5: Comparison of $PM_{2.5}$ measured by SMPS+GRIMM and TEOM with relative humidity in Delhi for three seasons.

Table S2: Descriptive statistics of particle number counts (#/cm^3) calculated using every 1 hour measurements for nucleation, Aitken, accumulation, large fine and coarse modes of PN between 15 nm and 10 µm derived by SMPS and Grimm in all seasons.

Seasons	PN modes	**Descriptive Statistics**			
		Range (Min-Max)	Mean	Median	Std. Deviation
Autumn	Nucleation	338-5033	1296	1147	617
	Aitken	2406-44009	12828	11416	6429
	Accumulation	4620-46655	15186	15191	5677
	Large Fine	1-126	9	6	13
	Coarse	0-5	1	1	1
	Total	7507-62756	29355	28528	9883
Summer	Nucleation	302-2504	821	780	310
	Aitken	2237-32521	9965	7963	6084
	Accumulation	2871-27211	8107	5899	4736
	Large Fine	21186	11	6	9
	Coarse	0-5	2	2	1
	Total	5436-57565	18906	15362	10121
Winter	Nucleation	510-3159	1489	1430	541
	Aitken	3356-51293	17610	15571	9682
	Accumulation	3901-50466	17599	15221	9276
	Large Fine	21976	12	10	8
	Coarse	0-9	2	1	1
	Total	11506-95068	36730	33053	17815


Delhi-Winter
SMPS+Grimm
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
normalised level
hour
Nuc
Ait
Acc
Fine
Coarse
normalised level
hour
normalised level
Mon
Tue
Wed
Thu
Fri
Sat
Sun
weekday


Delhi-Autumn
SMPS+Grimm
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
normalised level
hour
Nuc
Ait
Acc
Fine
Coarse
normalised level
hour
normalised level
Mon
Tue
Wed
Thu
Fri
Sat
Sun
weekday

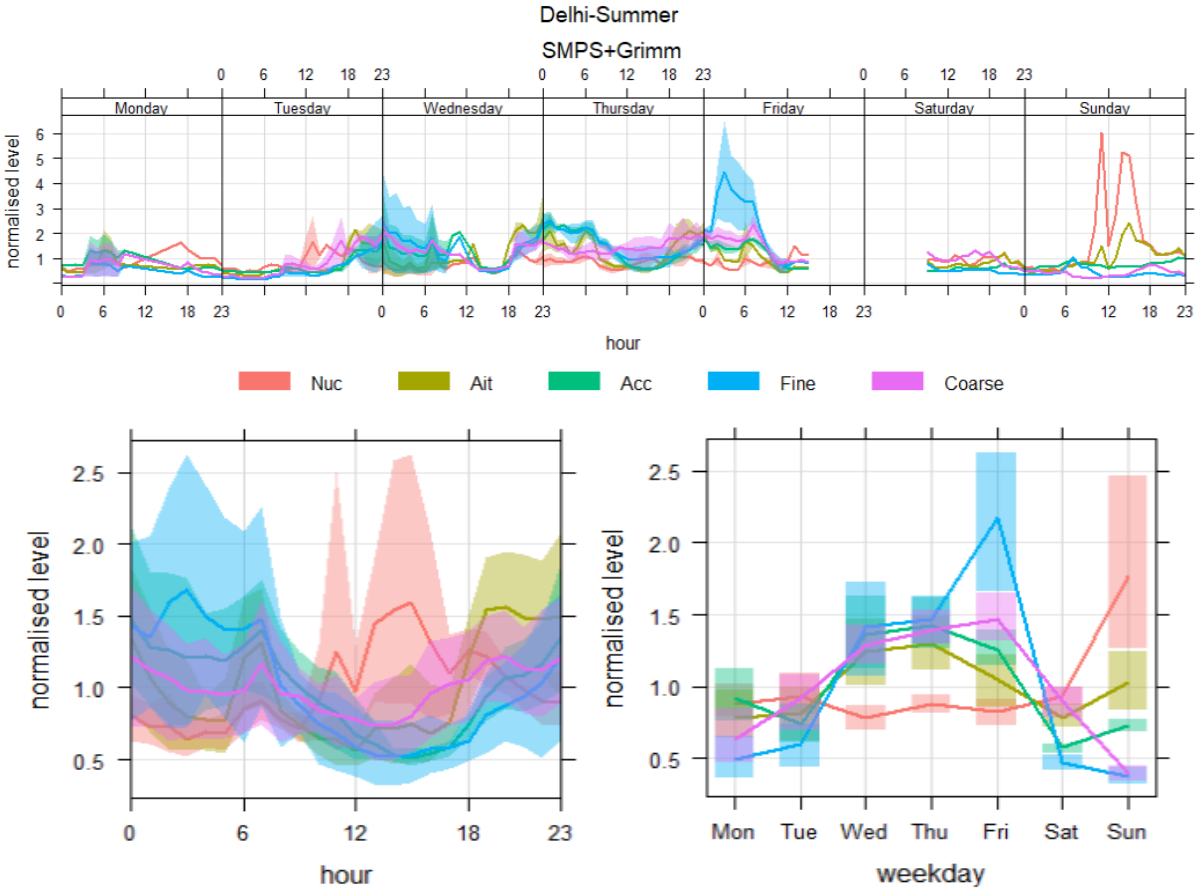


Figure S6: Normalized time variation of all particle fractions (Nuc: Nucleation <25 nm, Ait: Aitken 25-100 nm, Acc: Accumulation 100-1000 nm, Fine: 1-2.5 µm, Coarse: 2.5-10 µm number counts (between 15.1 nm and 10 µm) derived from the SMPS and Grimm instruments for winter, autumn and summer in Delhi.

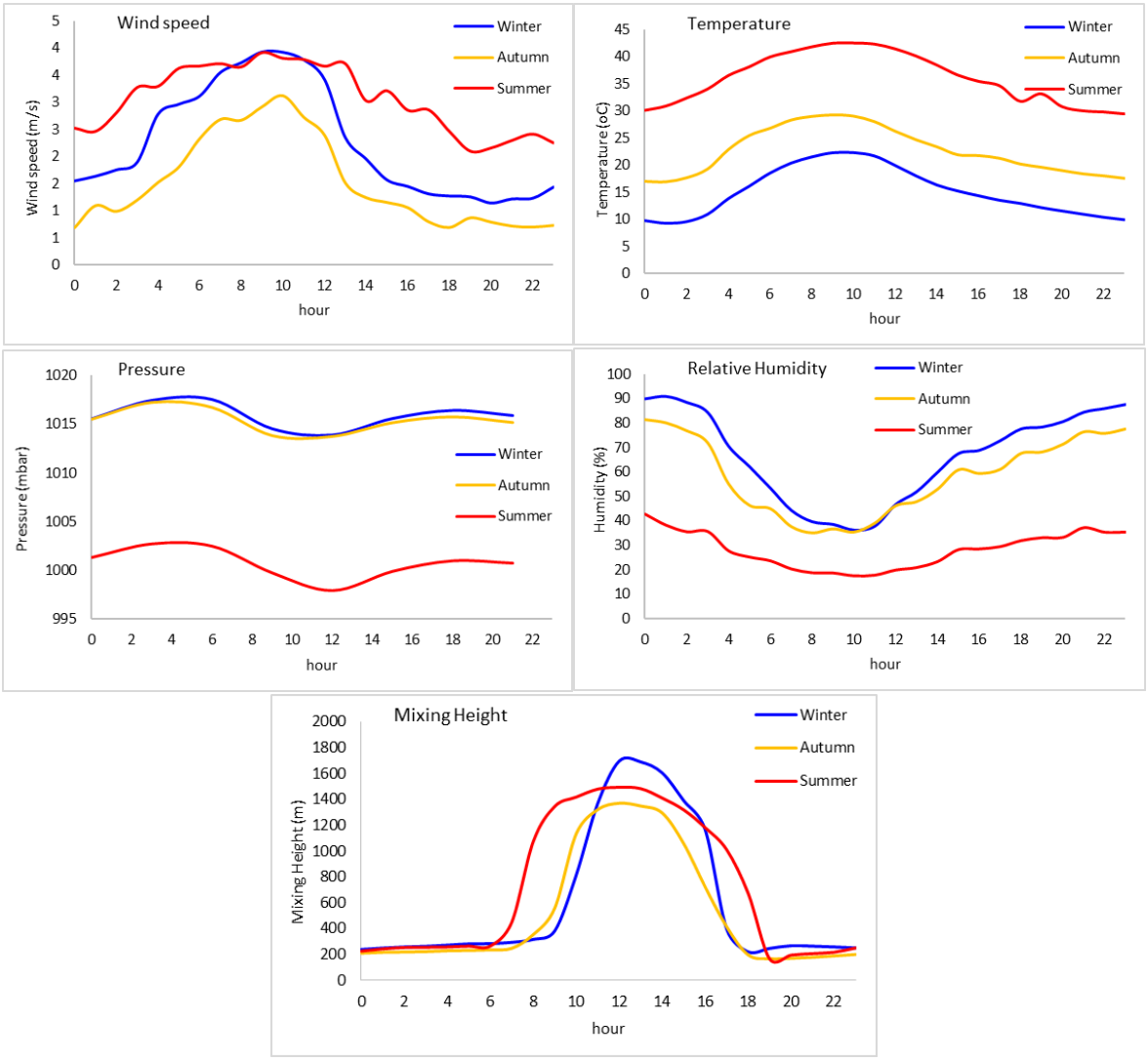


Figure S7: Average diurnal variation of meteorological parameters during the PN measurement campaign in autumn, summer and winter.

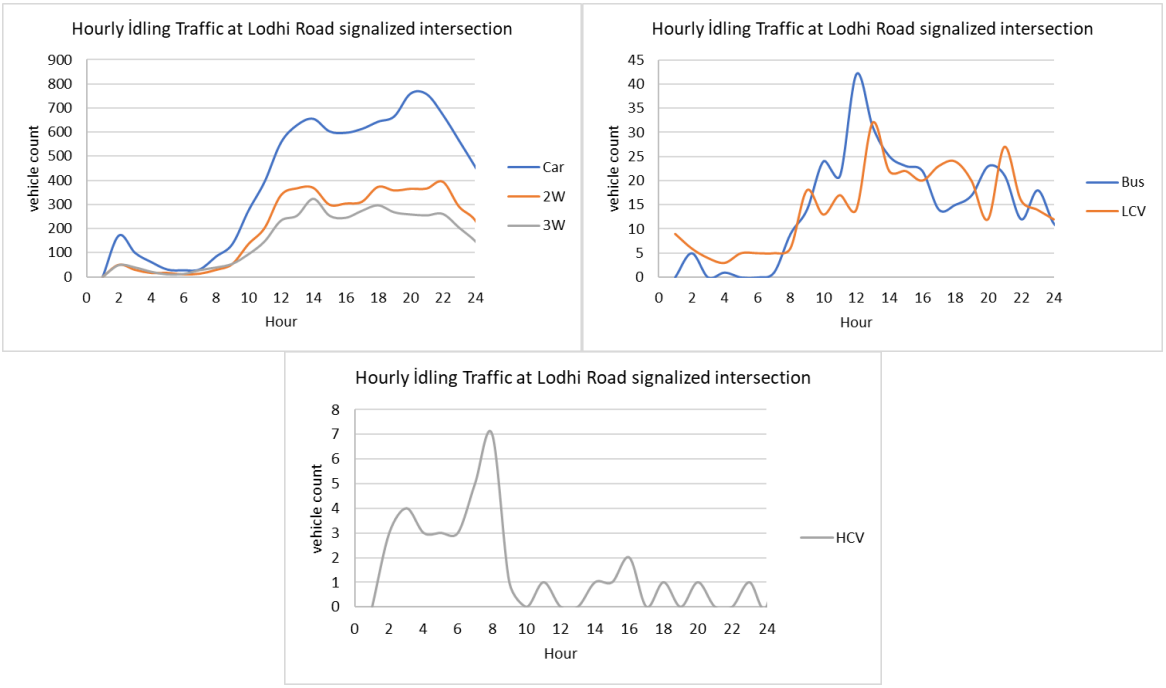


Figure S8: Hourly idling traffic at Lodhi Road signalized intersection in Delhi (data from Dhyani et al. 2019).

Table S3: Day and night summary of the wide range particle sizes derived from the merged data. Mean and standard deviation calculated by hourly data. The modes are based on SMPS and GRIMM observations. Nucleation = 10 - 25 nm, Aitken = 25-100 nm, Accumulation = 100-1000 nm, Large Fine = 1000-2500 nm, Coarse = 2500-10000 nm. UFP =Nucleation +Aitken, PN1 = UFP+Accumulation, PN10= PN1+Large Fine+Coarse, N/D=the ratio of Night to Day.

	Winter			Autumn			Summer		
	Day (N=252)	Night (N=284)	N/D	Day	Night	N/D	Day (105)	Night (111)	N/D
Number Concentration from GRIMM+SMPS									
Nucleation (#x10^3 cm^{-3})	1.3±0.5	1.6±0.5	1.3	1.2±0.5	1.3±0.7	1.1	0.8±0.4	0.8±0.2	1.0
Aitken (#x10^3 cm^{-3})	13.5±6.7	21.3±10.4	1.7	10.7±5.4	13.1±6.2	1.2	8.3±4.7	11.5±6.8	1.4
Accumulation (#x10^3 cm^{-3})	11.8±5.9	22.7±8.7	1.9	12.1±4.7	17.8±3.8	1.5	6.5 ±3.6	9.6±5.1	1.5
Large Fine (# cm^{-3})	10.1±8.6	13.0±7.6	1.3	6.1±5.8	8.5±7.3	1.4	7.7±5.9	13.1±11.3	1.7
Coarse (# cm^{-3})	1.6±1.3	1.8±1.2	1.1	1.1±0.6	1.1±0.6	0.9	1.9±0.9	2.2±1.2	1.2
UFP (#x10^3 cm^{-3})	14.7±7.6	22.9±11.3	1.6	13.0±6.5	15.1±7.7	1.1	9.1±5.5	12.3±7.0	1.3
PN1 (#x10^3 cm^{-3})	26.5± 13.5	45.6±20.0	1.7	25.0±11.1	33.3±12.5	1.3	15.6±9.1	21.9±12.1	1.4
PN10 (#x10^3 cm^{-3})	38.1±11.8	60.4±28.8	1.6	32.2±18.2	45.2±29.8	1.4	25.2±15.9	37.2±24.6	1.5
Mass Concentration									
Grimm+Smps-PM_1 (µg m^{-3})	202.7±103.3	340.3±109.3	1.7	259.5±151.8	357.7±182.8	1.4	84.8±47.5	121.8±62.3	1.4

Grimm+Smps $PM_{2.5}$ (µg m^{-3})	231.8±113.5	375.3±117.7	1.6	277.2±156.5	382.4±198.5	1.4	106.4±55.5	151.5±76.5	1.4
Grimm+Smps PM_{10} (µg m^{-3})	377.3±161.5	532.5±175.9	1.4	362.1±159.5	455.3±198.1	1.2	260.2±122.6	331.8±171.8	1.3
Teom-$PM_{2.5}$ (µg m^{-3})	158.0±78.9	196.3±84.0	1.2	214.8±121.3	228.5±112.5	1.0	117.2±53.8	123.7±56.2	1.0
BC (µg m^{-3})	5.0±4.0	14.8±11.7	2.9	11.4±7.8	20.1±9.0	1.8	11.2±9.5	5.2±3.5	2.1
NO (ppb)	17.6±42.4	103.9±99.8	6.1	32.9±58.5	123.8±85.8	3.7	4.4±12.7	107.1±127.8	26.5
NO2 (ppb)	59.5±28.0	76.7±25.5	1.3	88.2±44.0	69.5±21.0	0.8	40.3±34.0	87.2±49.4	2.1

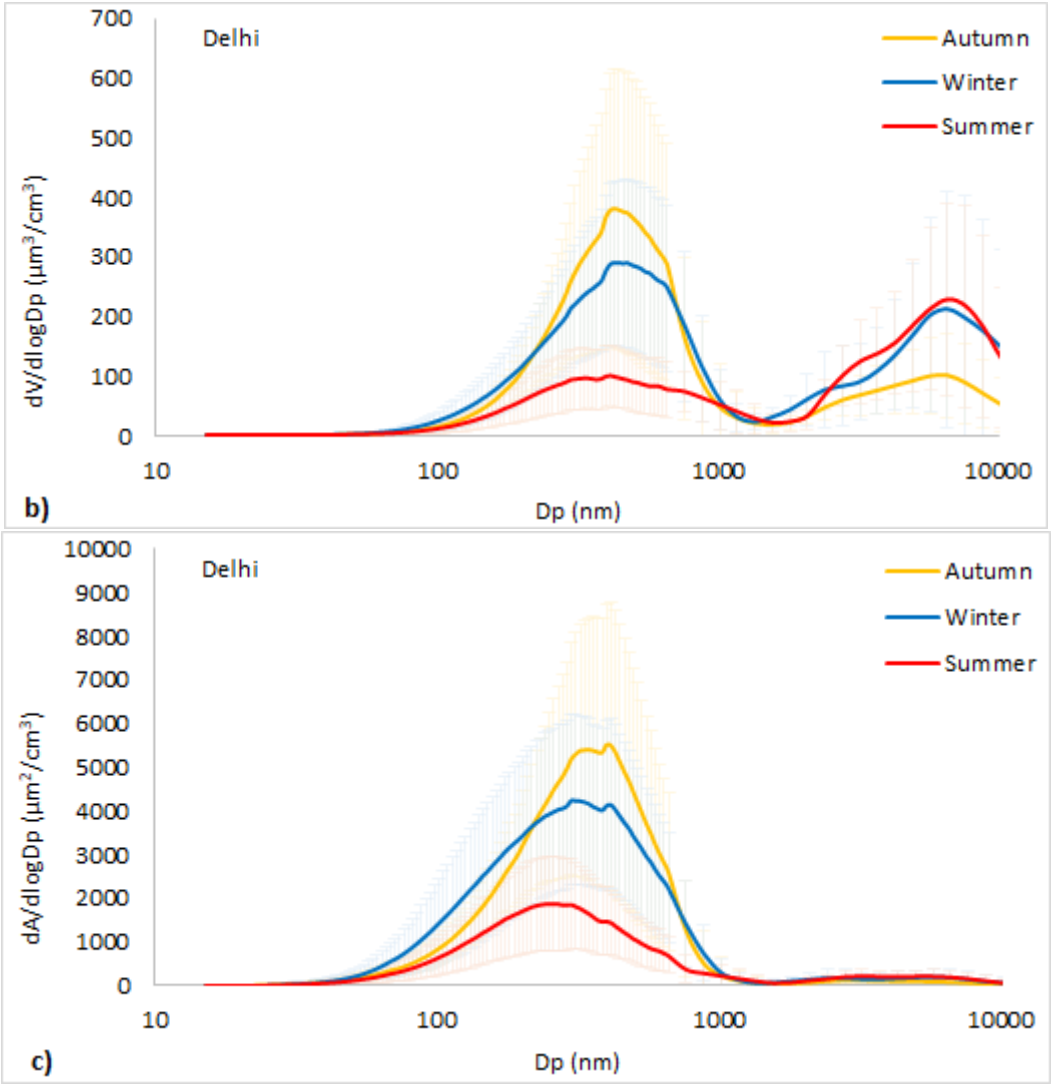


Figure S9: Hourly average particle number (a), volume (b) and area (c) distributions derived from the SMPS and Grimm instruments in autumn, summer and winter in Delhi. (Between 15 nm and 10000nm).

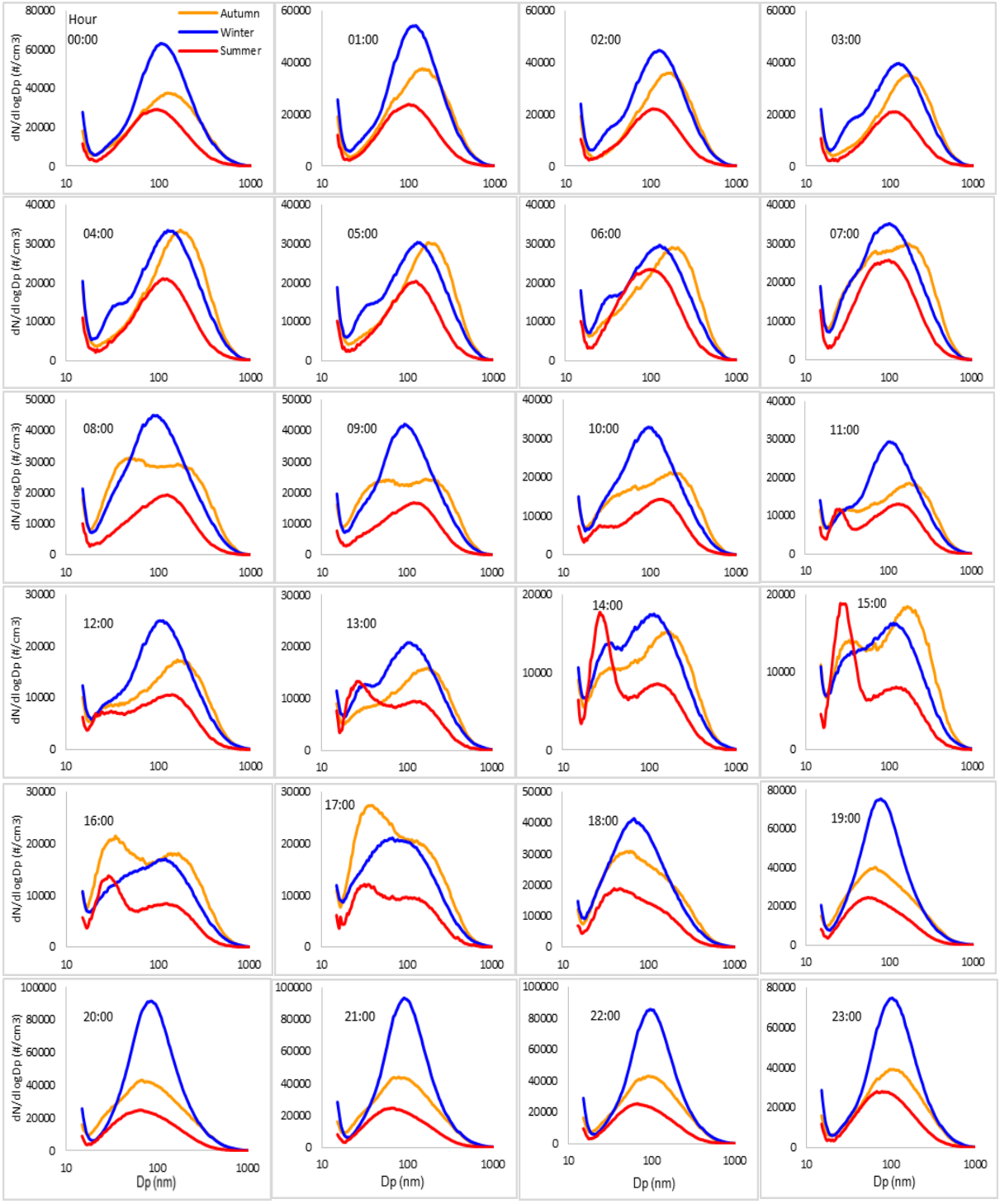


Figure S10: Average PSD for each hour and season in Delhi.

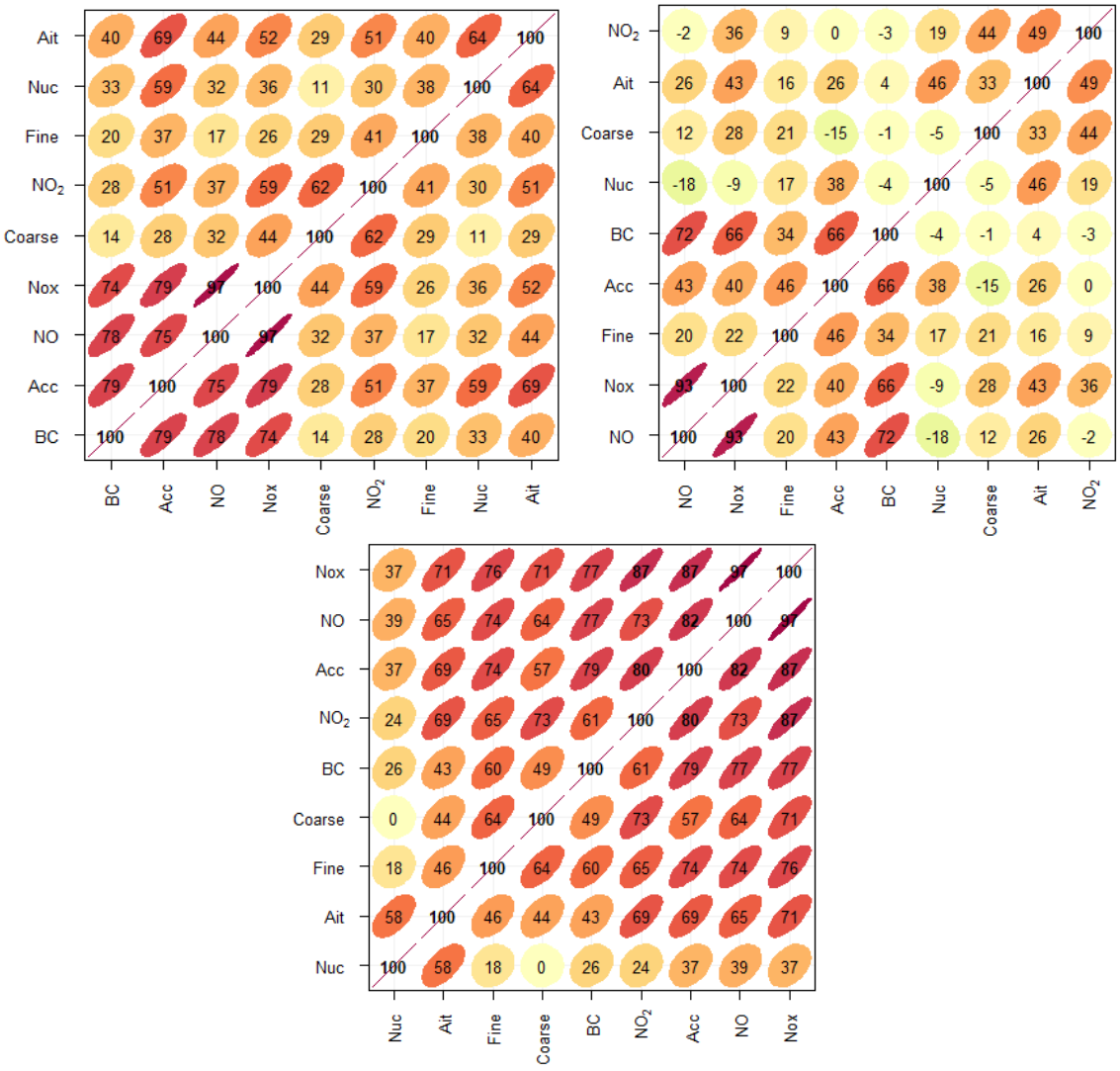


Figure S11: Correlation coefficients (x100) of PN within size fractions and NO, NO_2, BC.

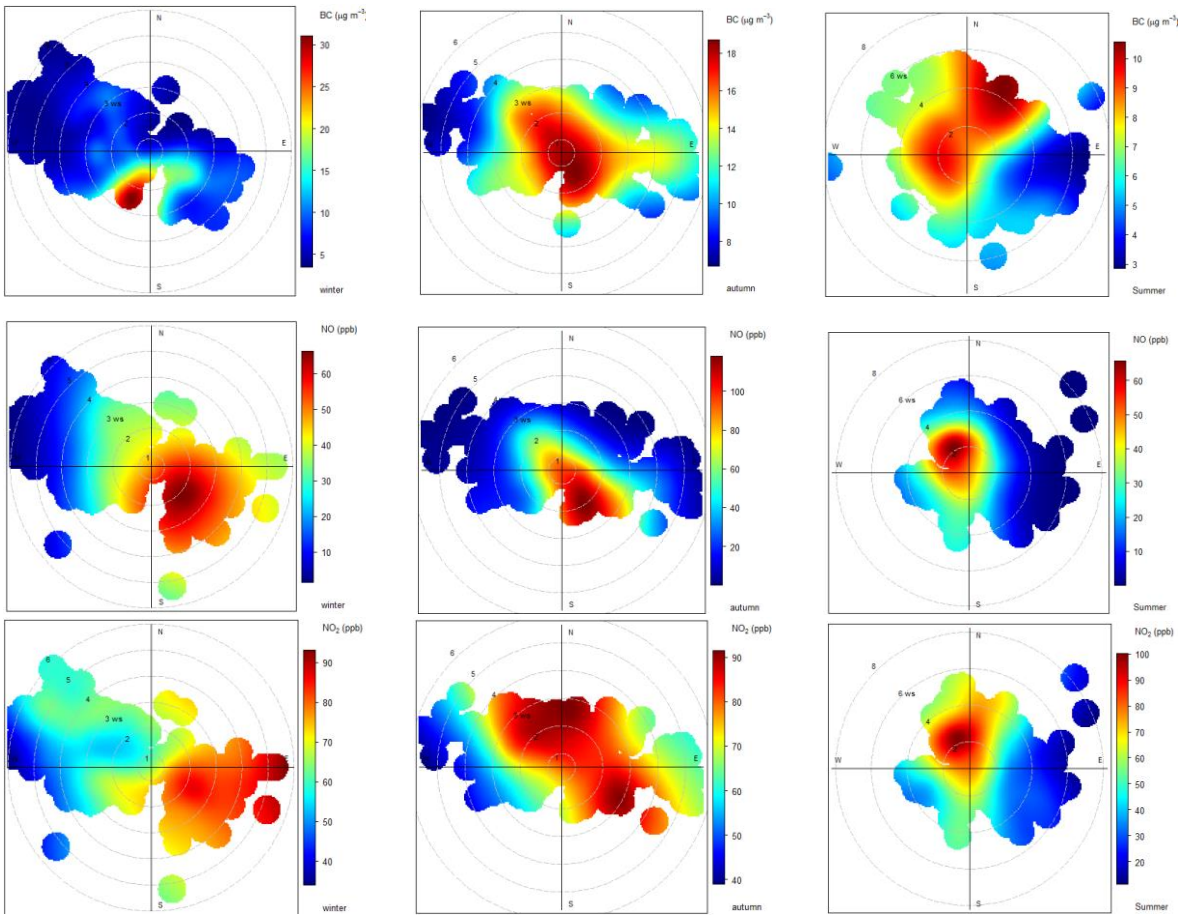


Figure S12: Polar plots of BC (top panels) NO, NO_2 (bottom panels) in winter (left), autumn and summer (right) in Delhi.