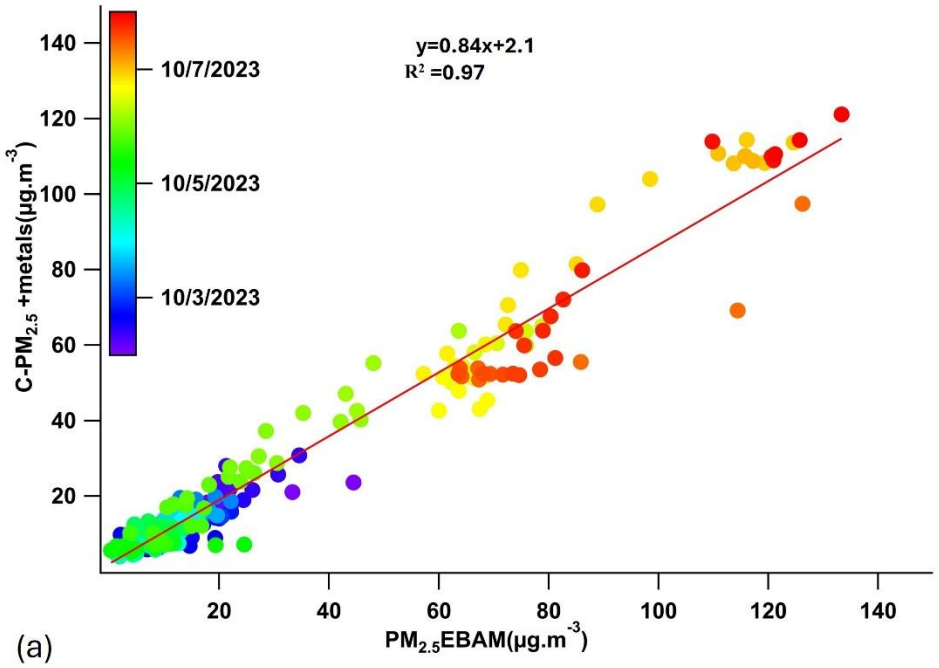
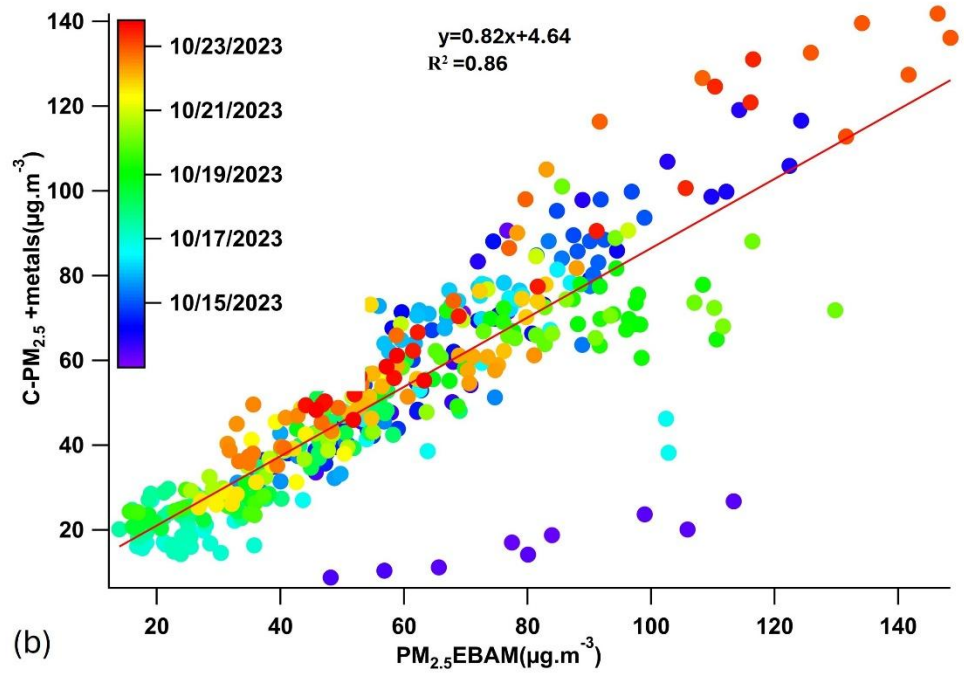
Supplementary File:





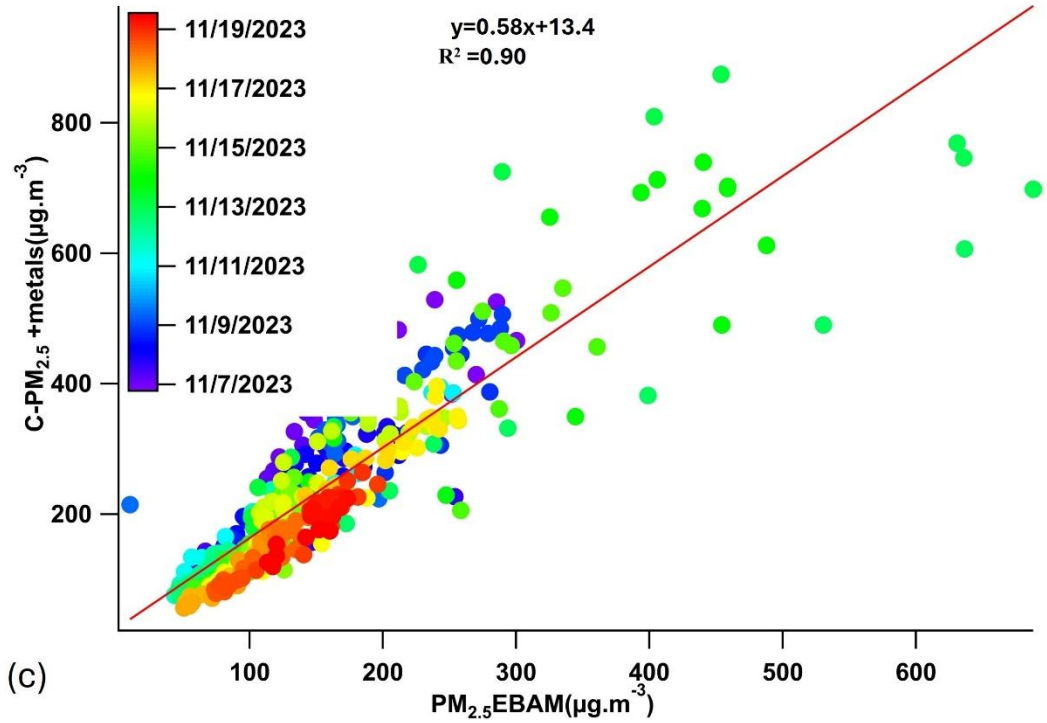


Figure S1i(a-c). Shows the correlation between C-$PM_{2.5}$ and $PM_{2.5}$ EBAM during measurements at the measurement Sites.

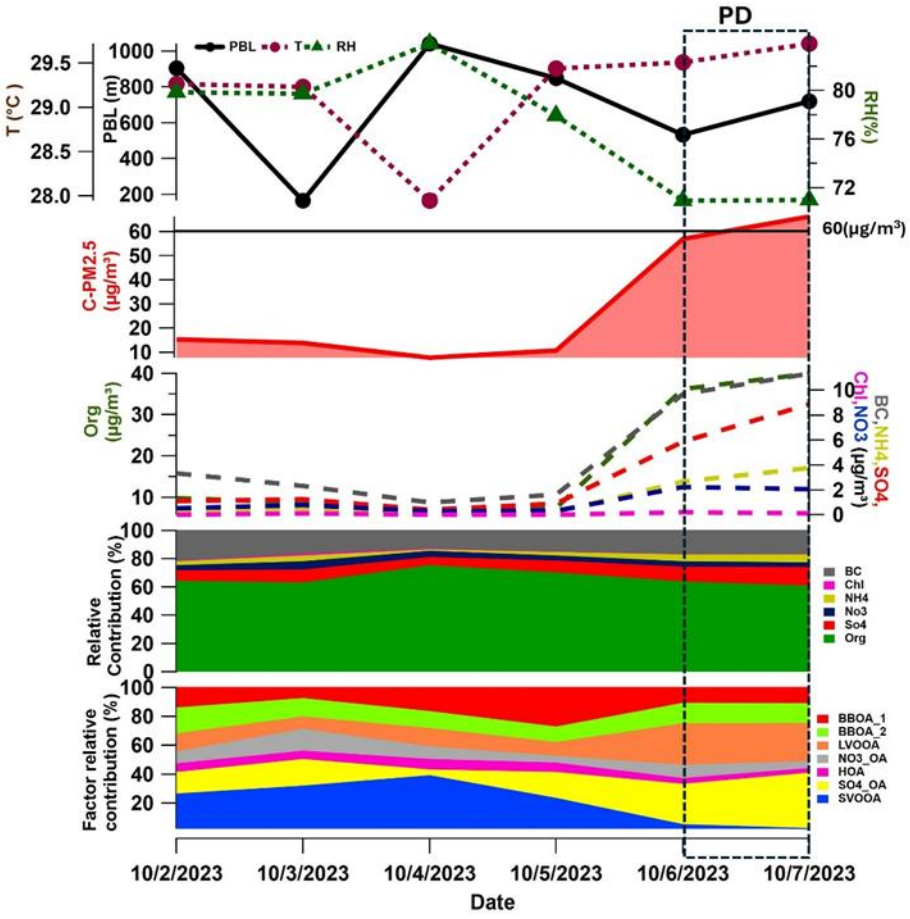


Figure S1. ii. Daily averaged temporal C-$PM_{2.5}$ variations(3rd Subplot) and constituent species (4th Subplot) (Org, NO_3, So4, NH_4, Chl, BC) were measured at the CSIR –CIMAP during 2- 7 October 2023.

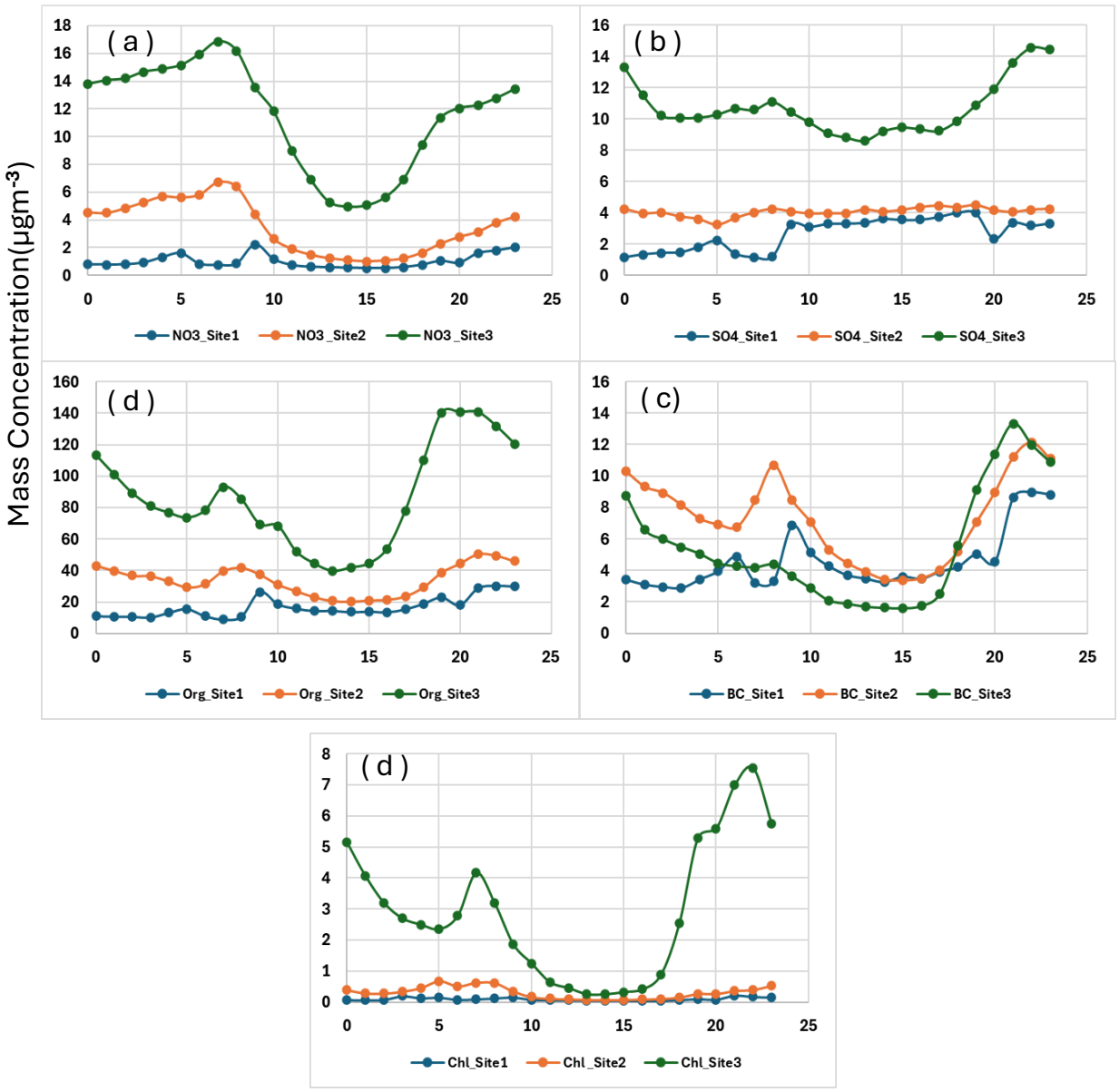


Figure S2(a-d). Diurnal variation of the measured C-$PM_{2.5}$ composition during the campaign in Lucknow over the measurement Sites.

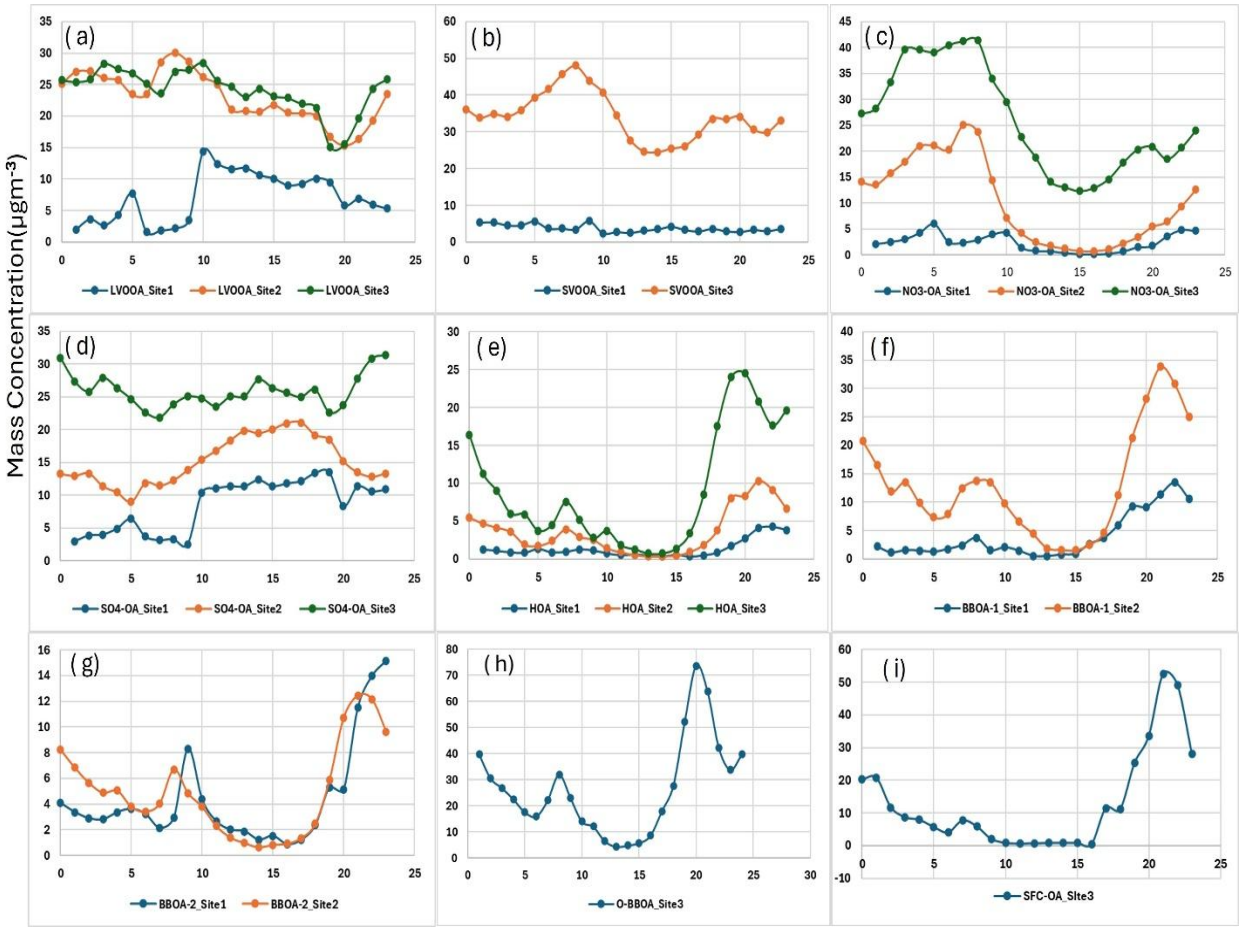


Figure S3(a-i). Diurnal variation of factors, viz. HOA, SFC, BBOA-1, SVOOA, BBOA-2, LVOOA, SO_4-OA, and NO_3-OA from the obtained organic and inorganic source apportionment during the measurement period at Sites 1, 2, and 3, respectively.

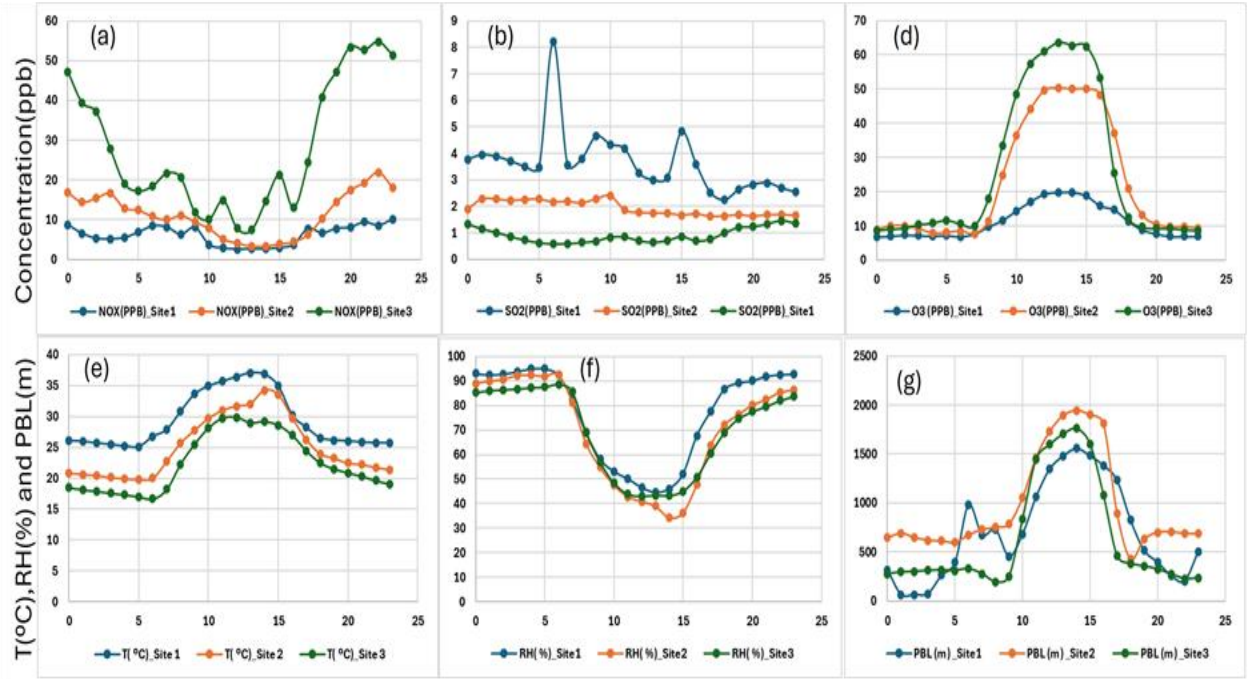


Figure S4 (a-e). Diurnal variation of the pollutant gases and meteorological parameters during the measurement period over Sites 1, 2, and 3, respectively.

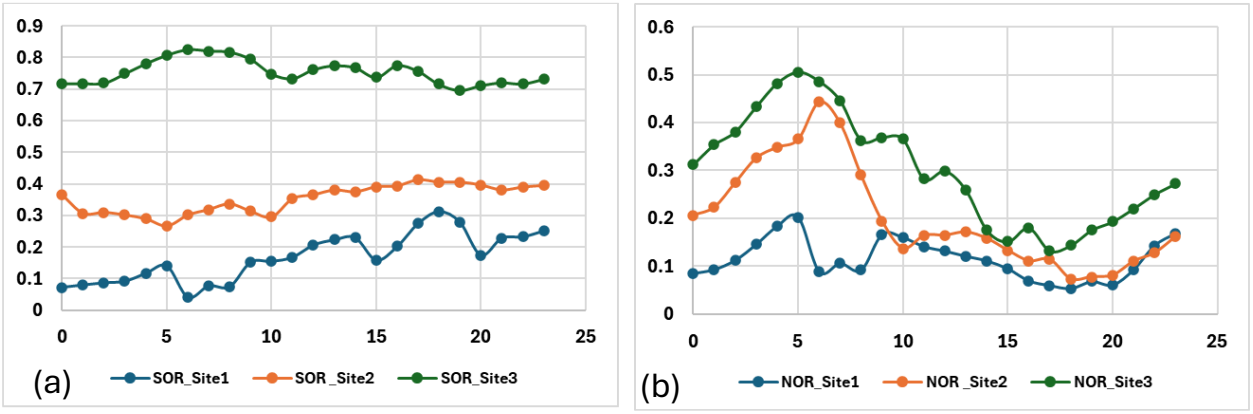
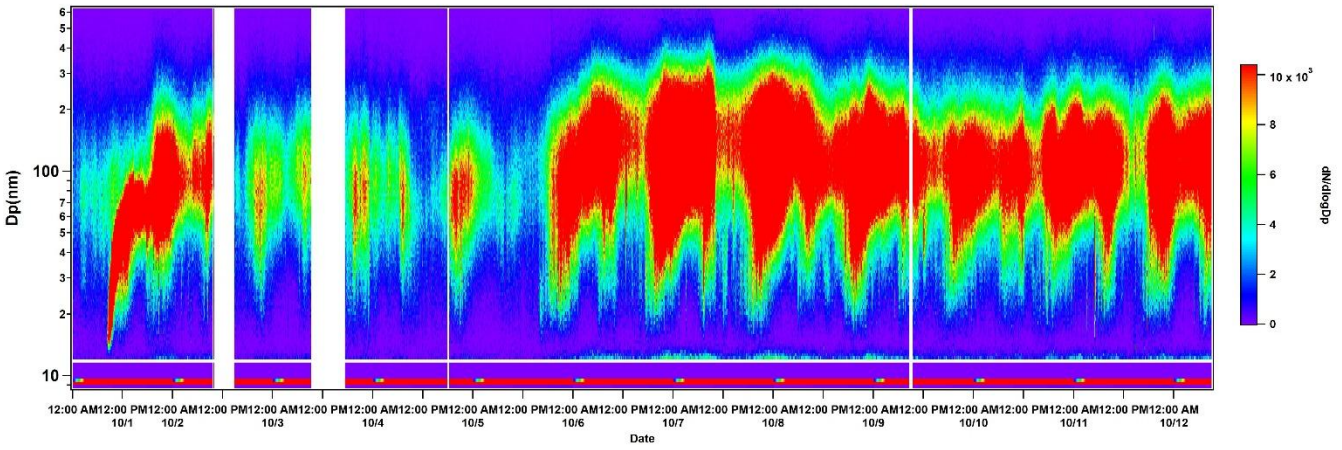
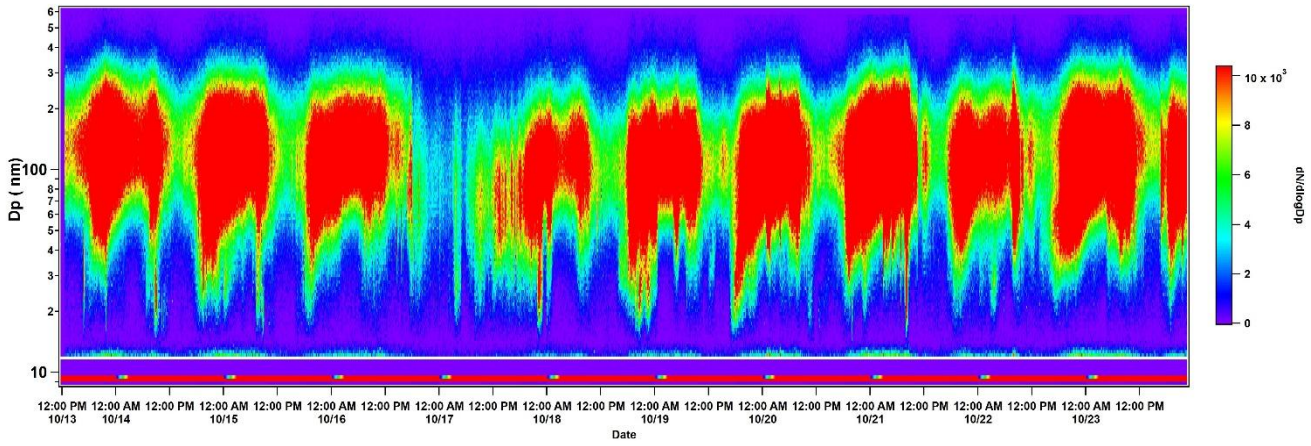


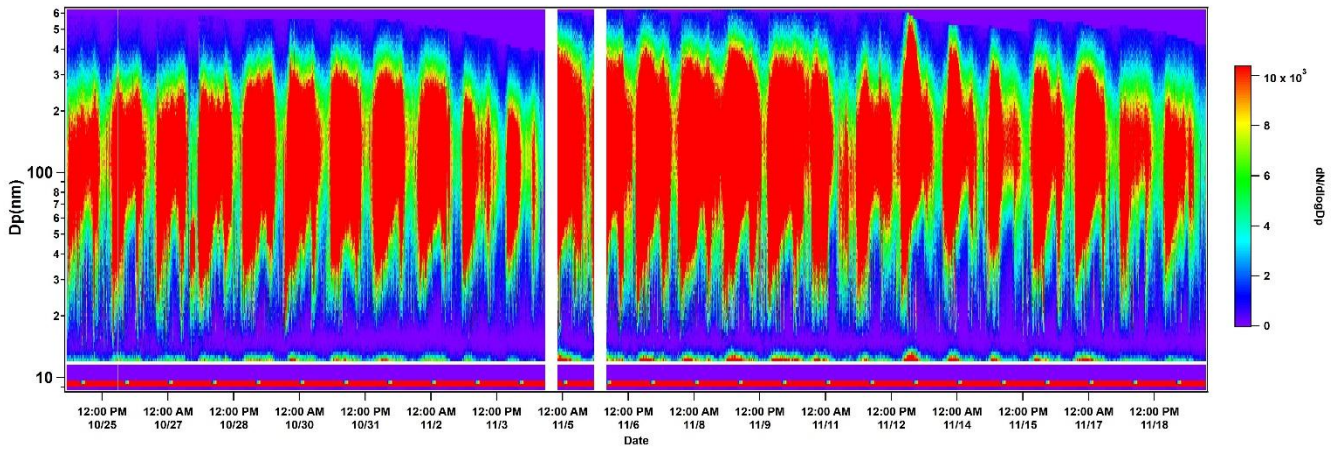
Figure S5. Shows the estimated a)SOR and b)NOR during the campaign in Lucknow using the VSAAQMP-based over measurement Sites.


Dp(nm)
100
10
Date
dN/dlogDp
10 x 10^3

(a)


Dp (nm)
100
10
Date
dN/dlogDp
10 x 10^3

(b)



(c)

Figure. S6. Time series of aerosol size distribution measured using SMPS at a) Site 1, b)Site 2, and c) Site 3 over Lucknow during the measurement period.

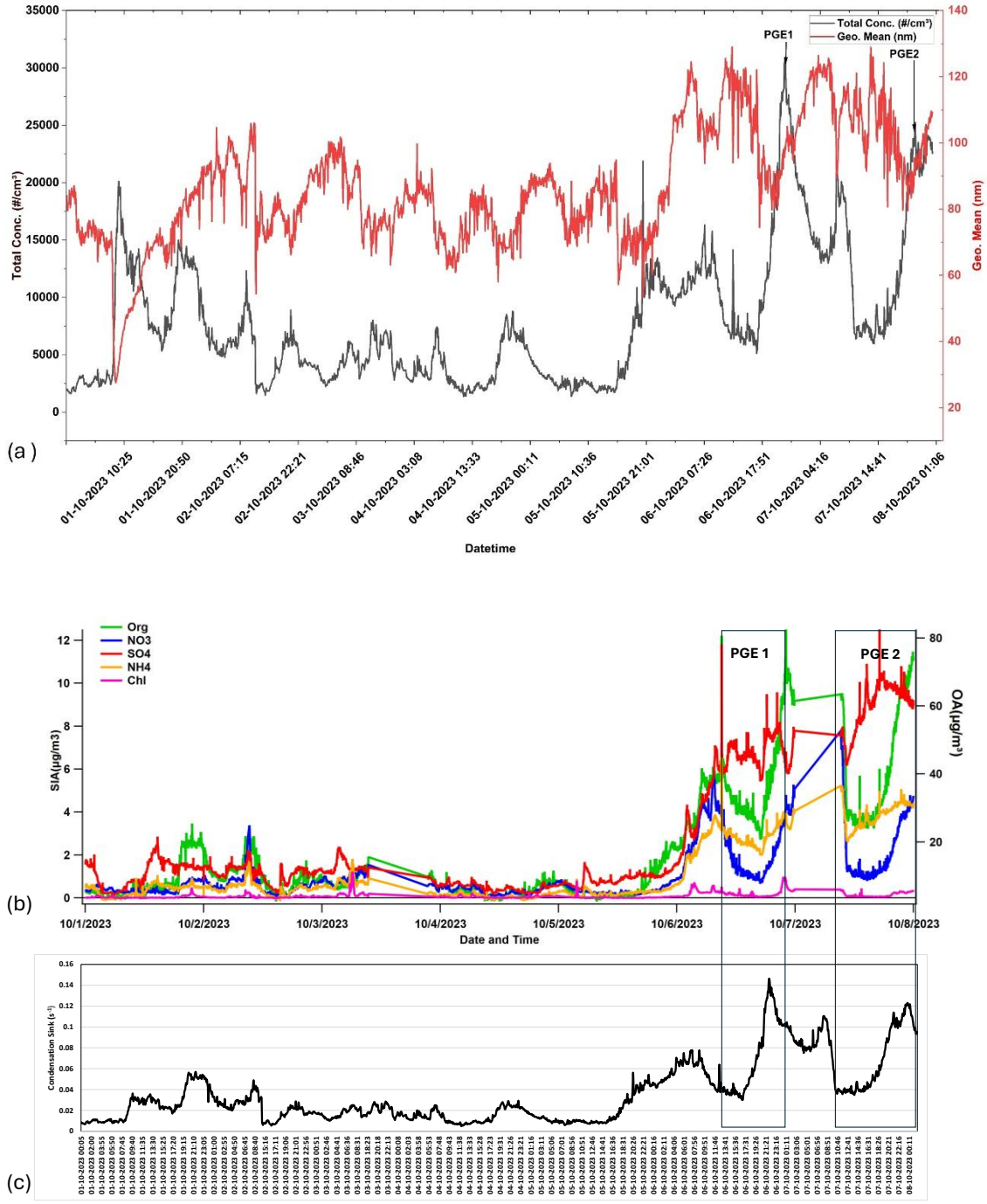


Figure.S7(i). Time series variation of a) Total particle concentration with Geo.Mean diameter b) secondary organic and in organic aerosols(OA and SIA), c) estimated condensation sink in per seconds at Site 1, from 1st October 2023 to 8th October 2023.

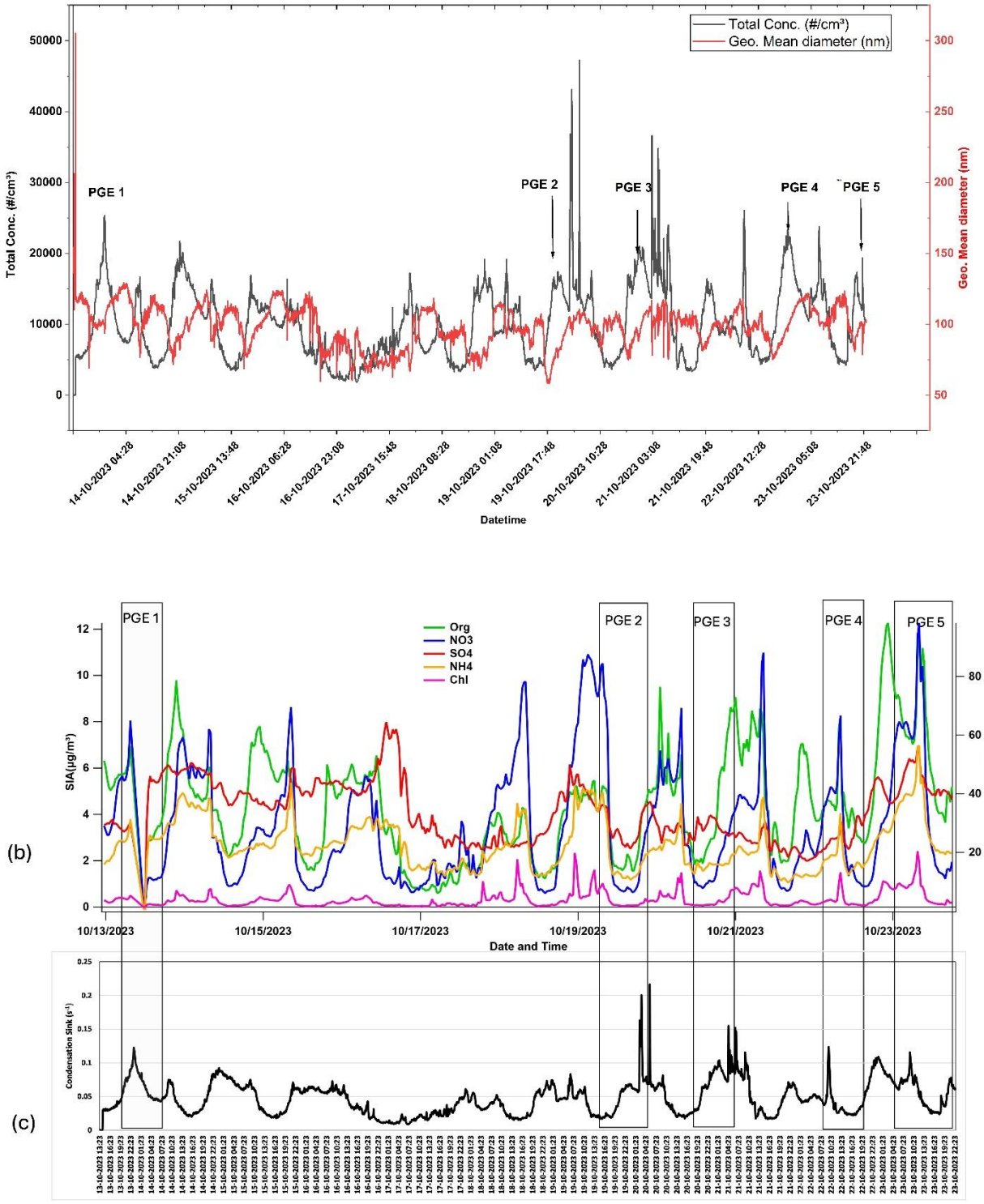


Figure S7.(ii) Time series variation of a) Total particle concentration with Geo.Mean diameter b) secondary organic and inorganic aerosols(OA and SIA), and c) estimated condensation sink in per seconds at Site 2, from 13th October 2023 to 23rd October 2023.

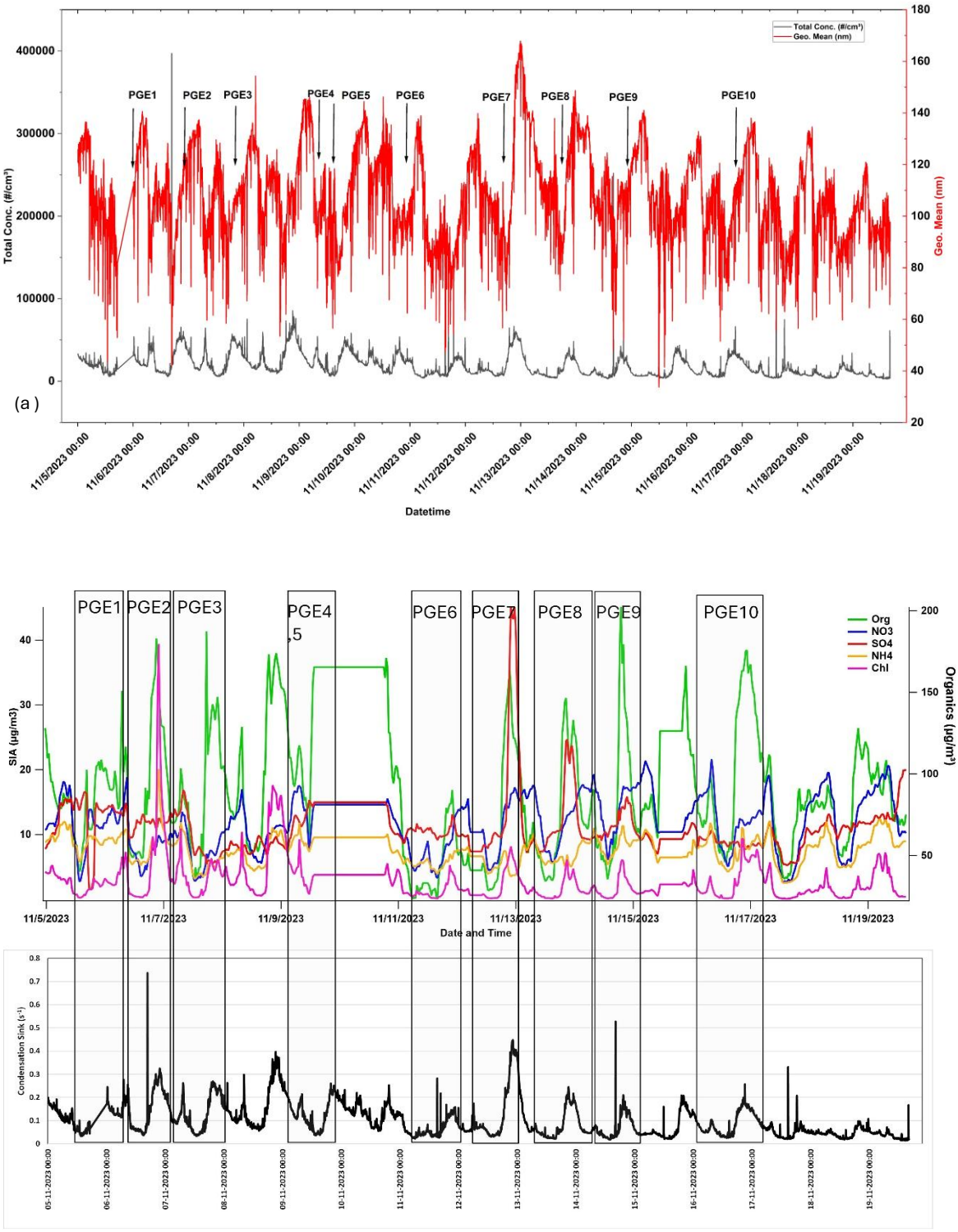


Figure.S7(iii). Time series variation of a) Total particle concentration with Geo.Mean diameter b) secondary organic and inorganic aerosols(OA and SIA), and c) estimated condensation sink in per seconds at Site 3, from 5th November 2023 to 23rd November 2023.

Site	PGE events	Time of Events	Growth Rate
1	1	06-10-23,17h31m-06-10-23,23h16m	2.68nm/hr
	2	07-10-23,20h21m-08-10-23,00h11m	4.82nm/hr
2	1	13-10-23,4h28m – 13-10-23,23h33m	1.59nm/hr
	2	19-10-23,19h23m-19-10-23,22h03m	1.12nm/hr
	3	20-10-23,19h23m-21-10-23,00h03m	6.15nm/hr
	4	22-10-23,16h23m-22-10-23,22h08m	1.31nm/hr
	5	23-10-23,07h23m-23-10-23,13h23m	1.26nm/hr
3	1	06-11-23,06h51m-06-11-23,11h05m	5.38nm/hr
	2	06-11-23,17h40m-06-11-23,20h00m	10.51nm/hr
	3	07-11-23,17h05m-07-11-23,22h30m	5.51nm/hr
	4	09-11-23,08h05m-09-11-23,10h40m	9.74nm/hr
	5	09-11-23,16h50m-09-11-23,19h50m	7.86nm/hr
	6	10-11-23,17h35m-09-11-23,21h40m	4.97nm/hr
	7	12-11-23,17h40m-12-11-23,20h55m	16.51nm/hr
	8	13-11-23,17h55m-13-11-23,20h00m	13.05nm/hr
	9	14-11-23,16h20m-14-11-23,22h00m	11.58nm/hr
	10	16-11-23,17h30m-16-11-23,19h30m	9.1nm/hr

Table 1. The table highlights the duration of the PGE events and their respective estimated particle growth rates.

IE Value	L-CIGP
Site 1	7.65E-08
Site 2	7.47E-08
Site3	1.09E-07

Table TS2. (a) Ionization efficiency (IE) calibration during the beginning of the campaign at Site 1, Site -2, and Site 3

RIE Value	L-CIGP	
	NH_4	SO_4
Site 1	4.48	1.47

Table TS2.(b) Relative Ionization efficiency (RIE) calibration during the beginning of the campaign.

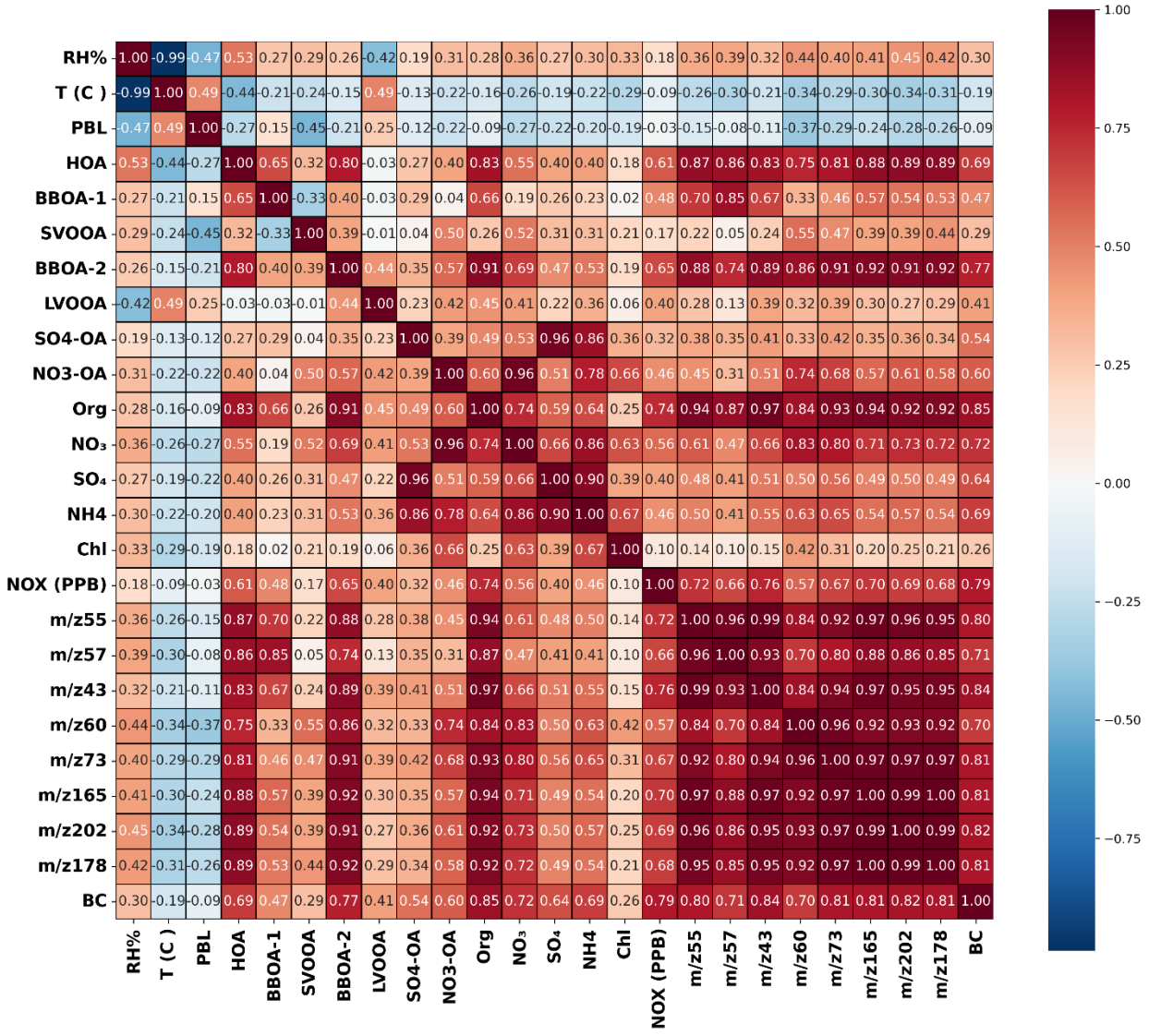


Figure S8 a) Heat map showing the correlation between the NR-$PM_{2.5}$ composition sources obtained from the combined OA and IOA sources apportionment with external factors during the measurement period over Site 1(excluding the PD event).

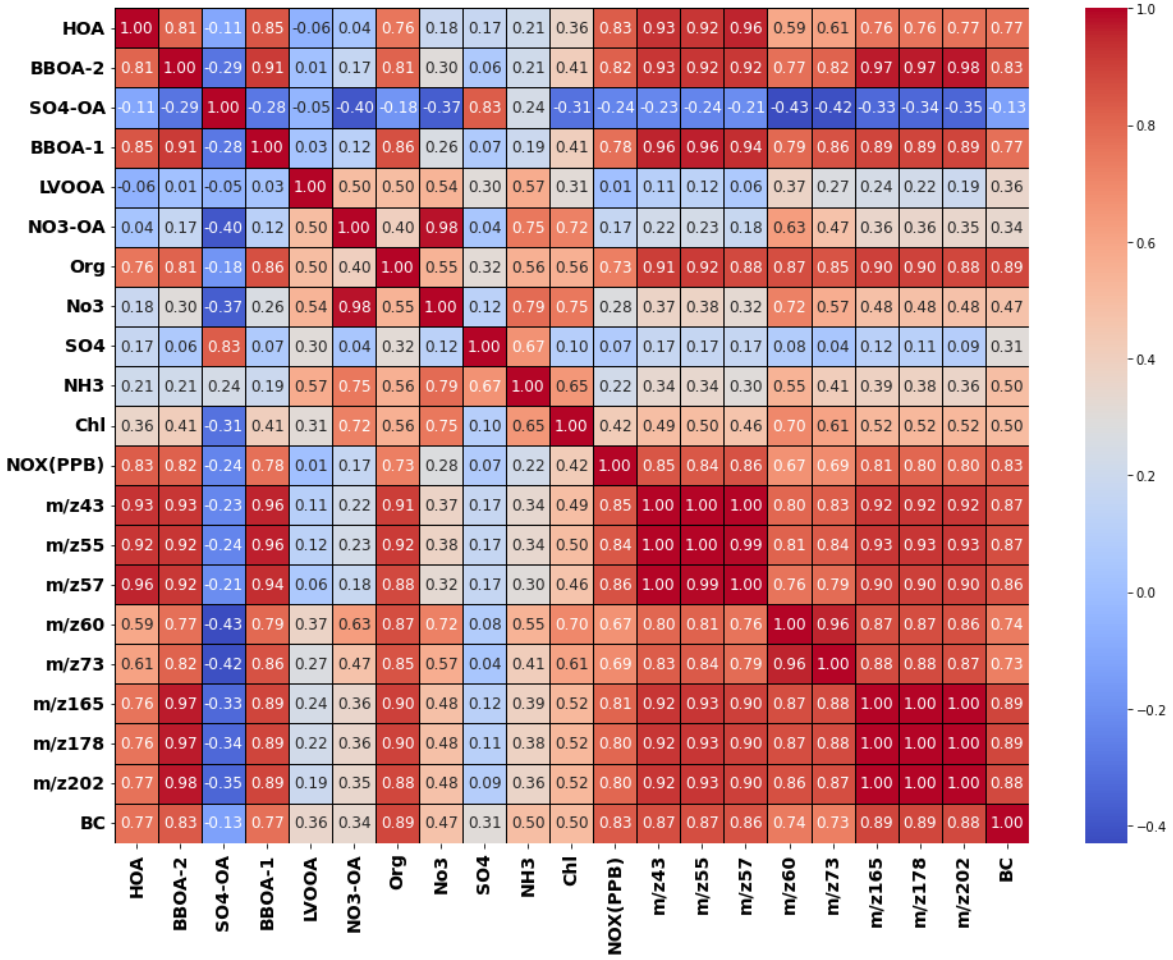


Figure S8. b)Heat map showing the correlation between the NR-$PM_{2.5}$ composition sources obtained from the combined OA and IOA sources apportionment with external factors during the measurement period over Site 2.

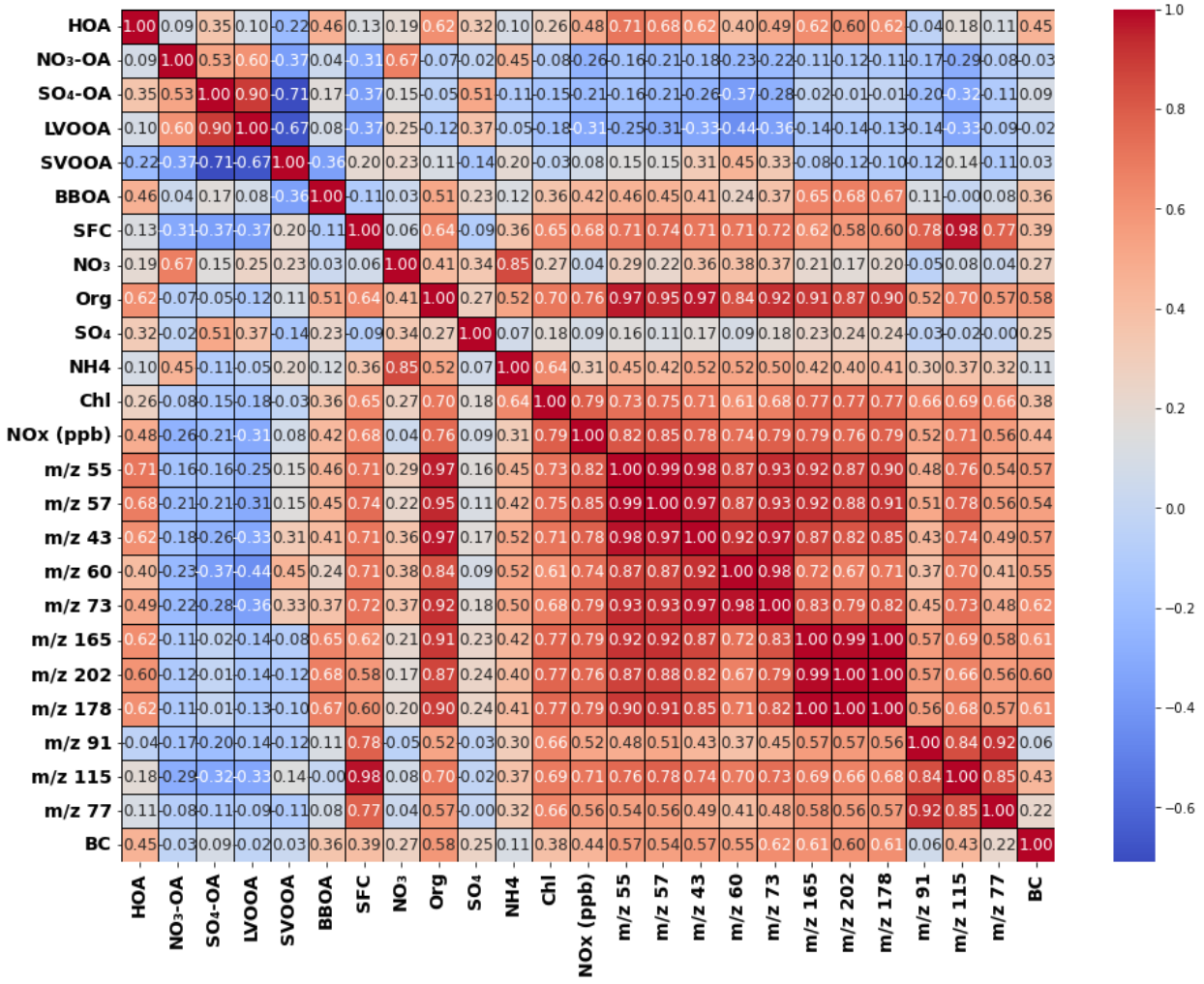


Figure S8. c) Heat map showing the correlation between the NR-$PM_{2.5}$ composition sources obtained from combined OA and IOA sources apportionment with external factors during the measurement period over Site 3.

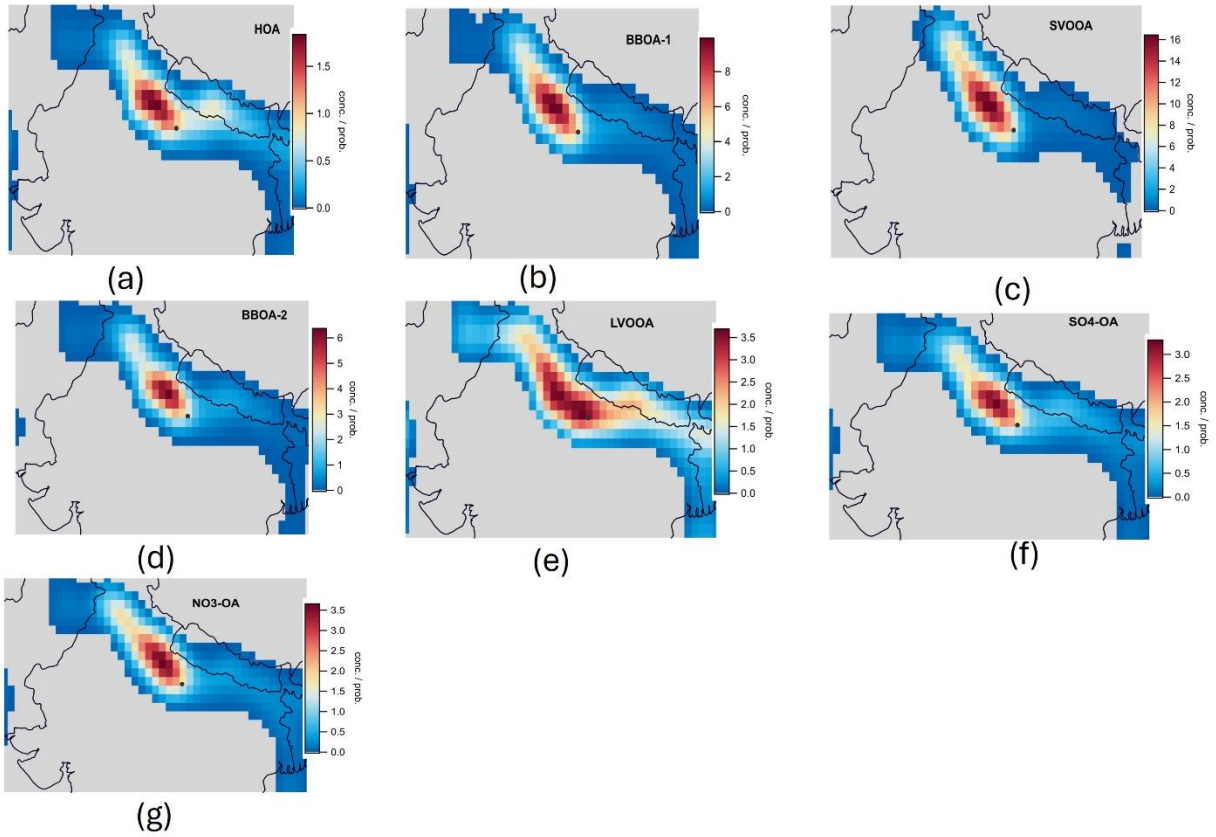


Figure S9 (i): CWT plots of factors viz HOA, BBOA-1, SVOOA, BBOA-2, LVOOA, SO_4-OA, and NO_3-OA from the obtained organic and inorganic source apportionment during the measurement period over Site 1.

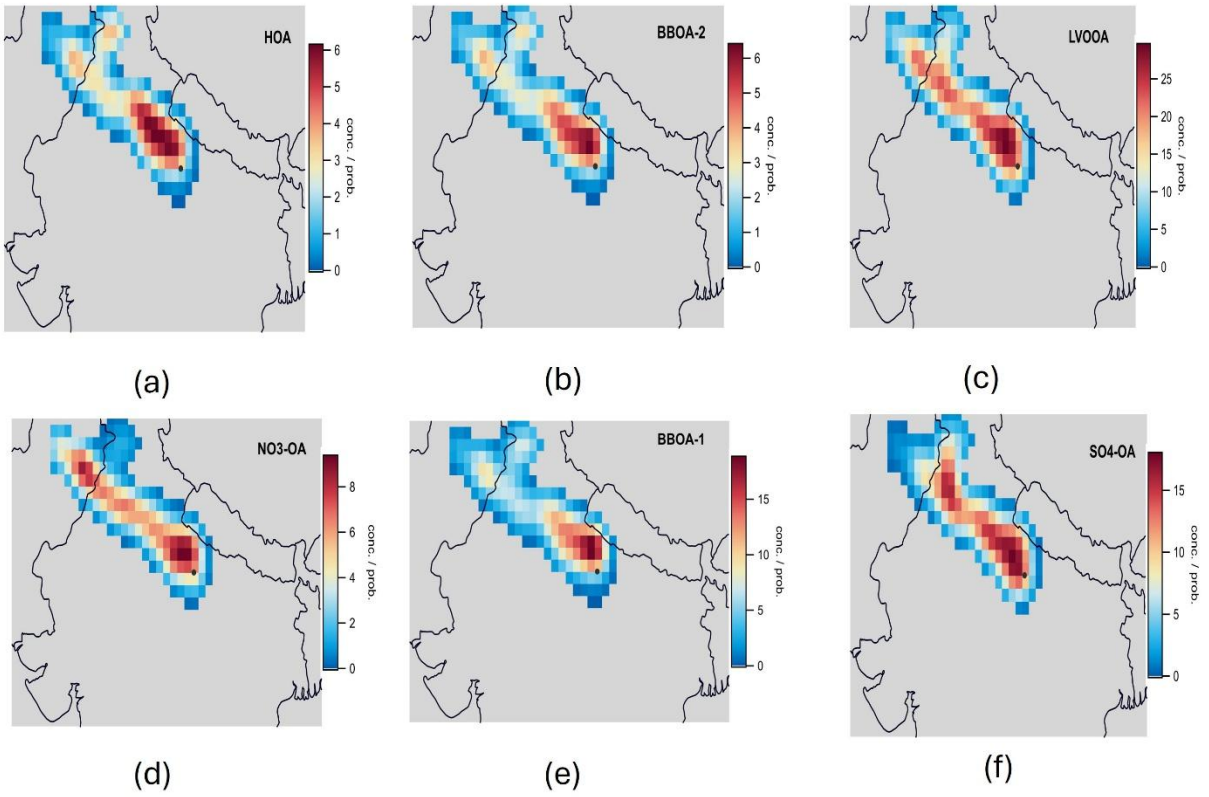


Figure S9. (ii)CWT plots of factors viz HOA, BBOA-2, LVOOA, NO_3-OA, BBOA-1, and SO_4-OA (a-f) obtained from organic and inorganic source apportionment during the measurement period over Site 2.

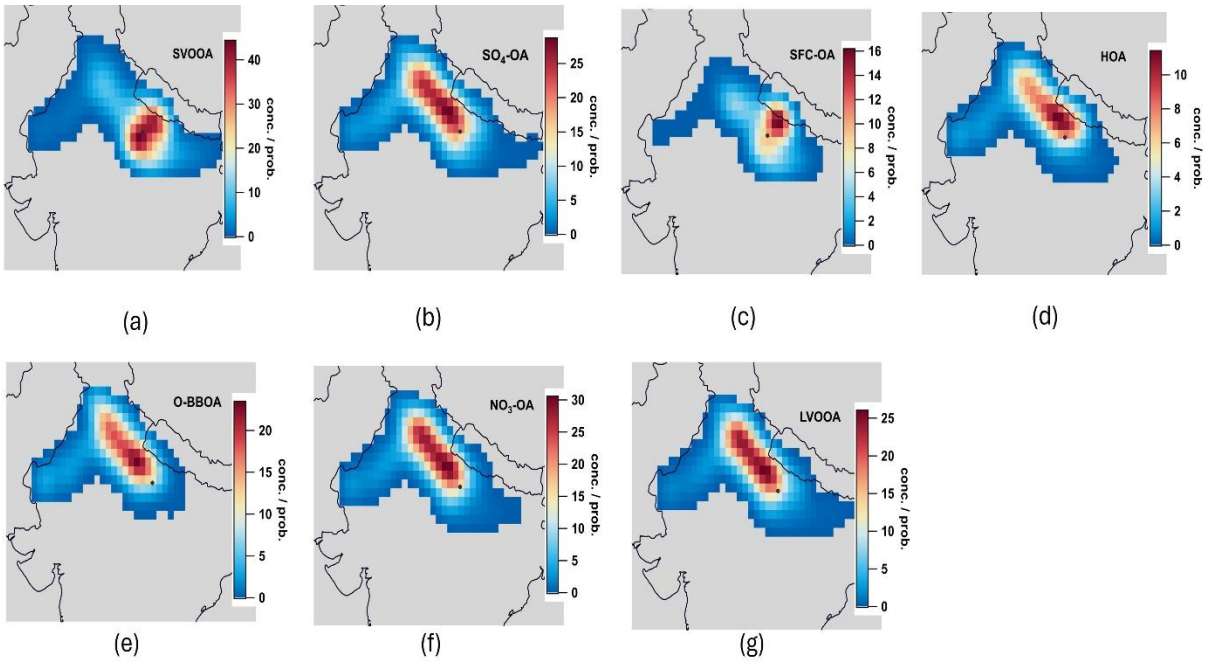


Figure S9. (iii) CWT plots of factors viz HOA, BBOA, LVOOA, SVOOA, SFC, NO_3-OA, and SO_4-OA (a-g) obtained from organic and inorganic source apportionment during the measurement period over Site 3.

Figure. S10 a) Lemon grass filtration activity at Site 1.

Figure. S10 b)The traffic jam on the road near Site 2 with views (i) and (ii).

Figure. S10 c) The industrial stack emission with pollutant plumes from the chimney of the industries at Site 3.