Supplementary Information

Year-long aerosol chemistry and meteorological implications of PM2.5 in urban area of the Brahmaputra Valley, India

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Supplementary Figures

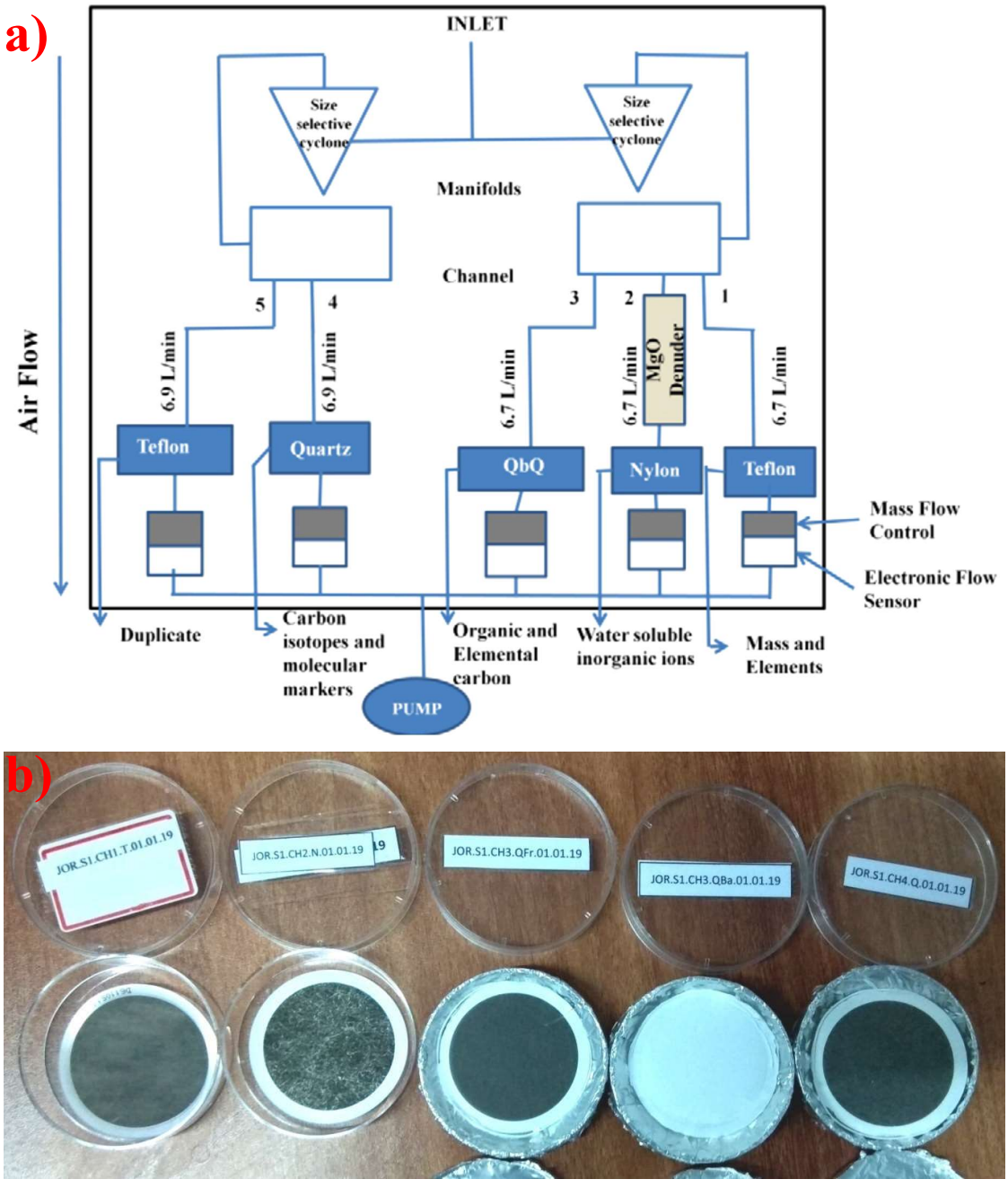

Fig. S1. a) Flowchart of the SASS sampling system and b) filter substrates after sampling (only first three filters were used in the present study)

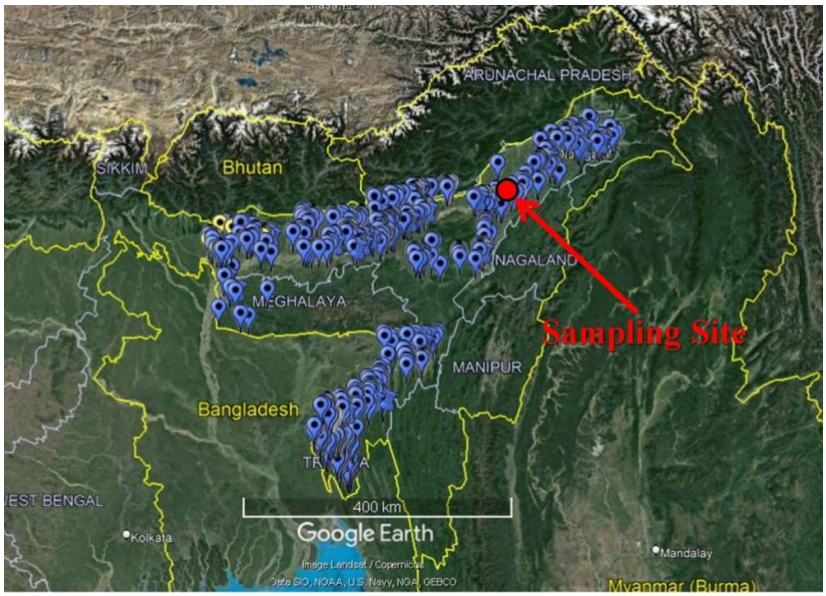

Fig. S2. Location of Brick Kilns in the NER India as per the data retrieved from Google Earth (imagery date from December 2018 to April 2019, date of access was 25th to 30th August 2020).

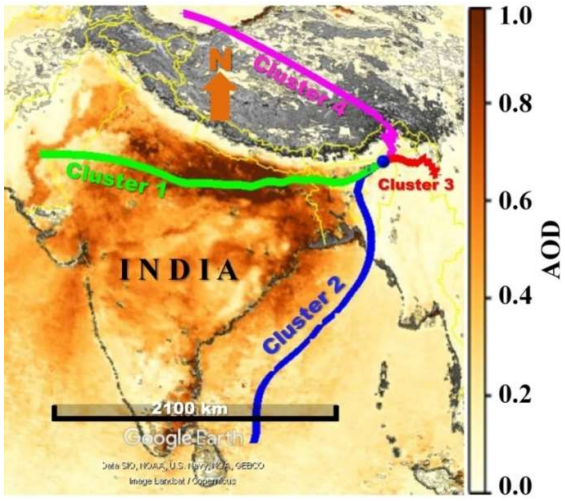

Fig. S3. Mean five-day back-trajectory for the four main clusters at Jorhat and the map shows the annual mean AOD in 2019. It shows that cluster 1 back-trajectory moves over the high AOD region which can carry more pollutants.

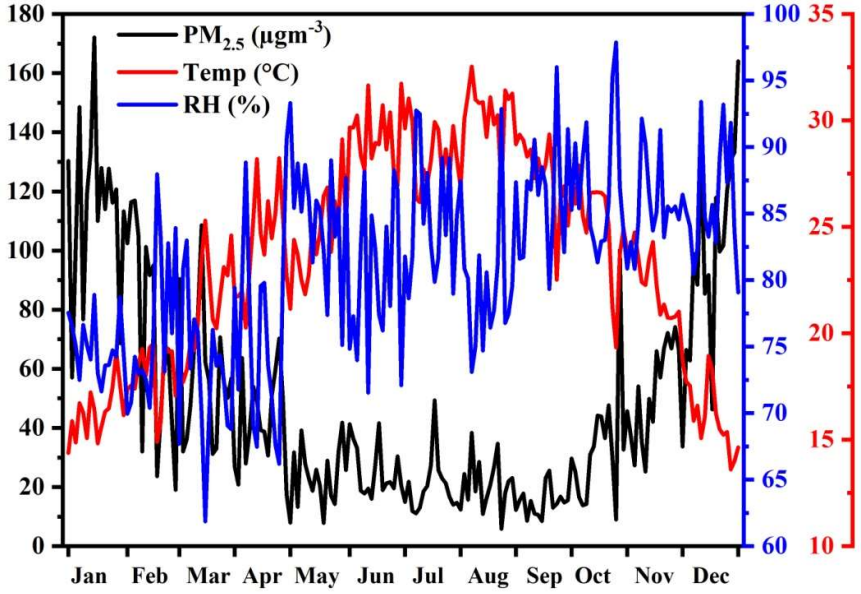

Fig. S4. Graph between daily averages of $PM_{2.5}$ concentration (µg m^{-3}), temperature (°C), and relative humidity (%) for the year 2019.

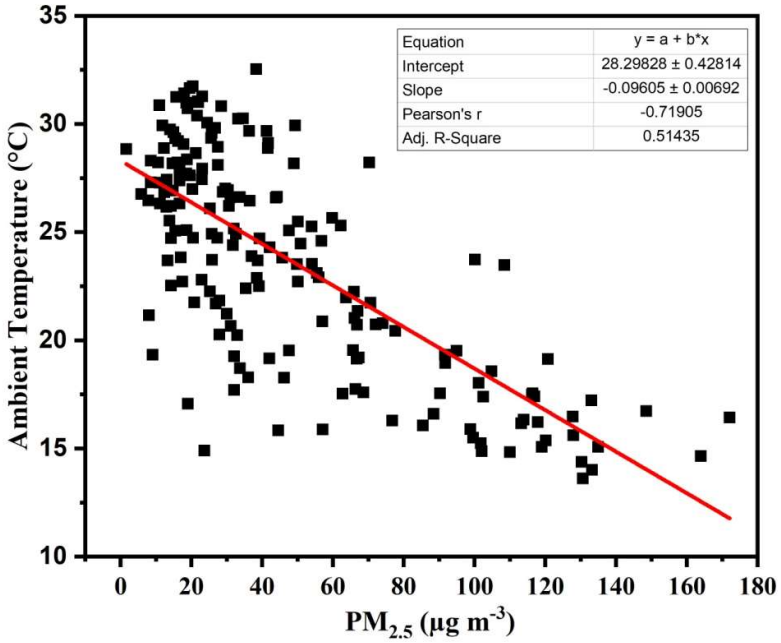

Fig. S5. Scatter plot between $PM_{2.5}$ and ambient temperature showing a strong negative correlation.

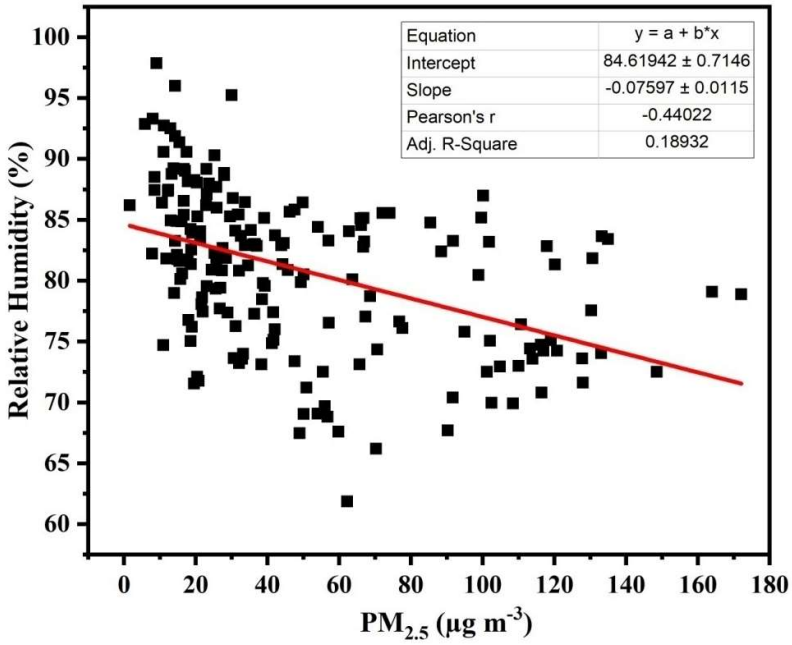

Fig. S6. Scatter plot between $PM_{2.5}$ and relative humidity showing a weak negative correlation.

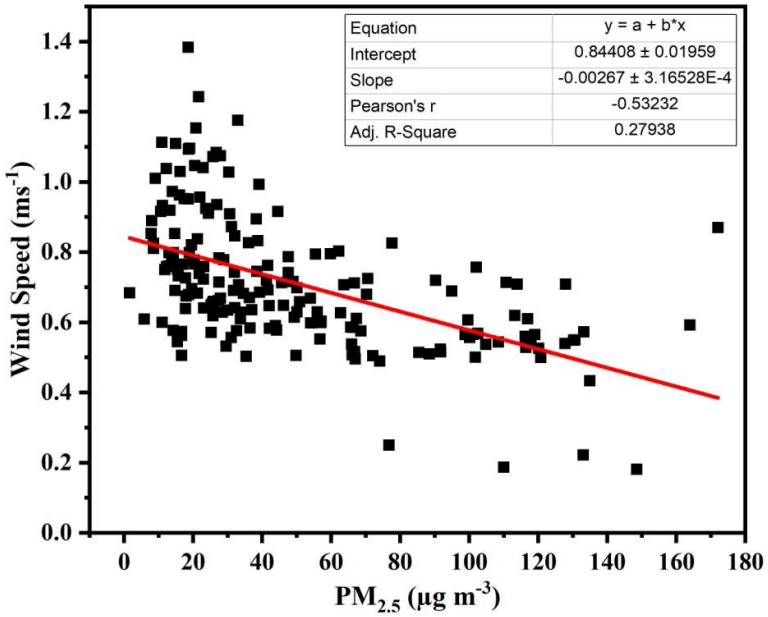

Fig. S7. Scatter plot between $PM_{2.5}$ and wind speed showing a weak negative correlation.

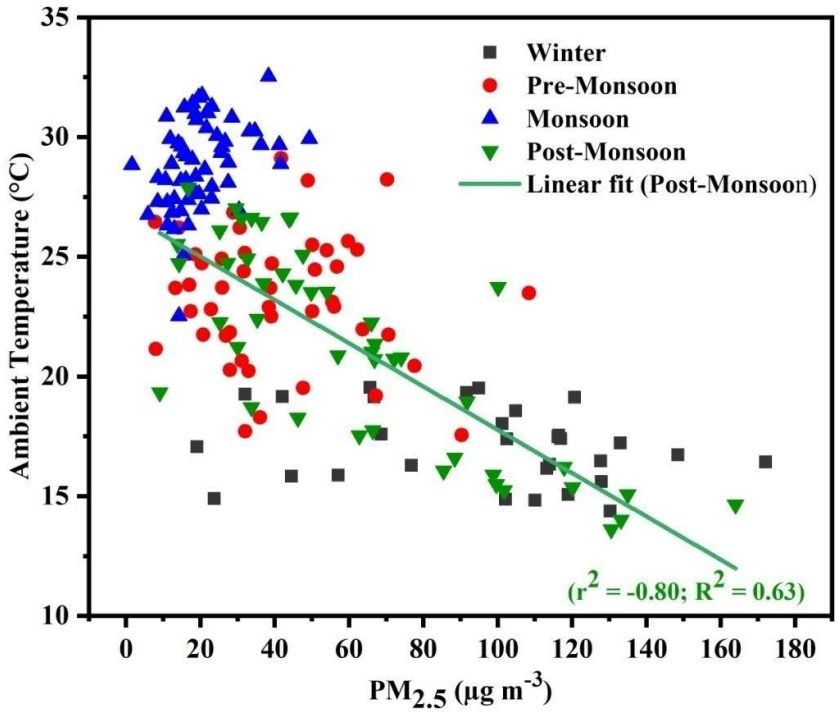

Fig. S8. Seasonal relationship between ambient temperature and $PM_{2.5}$.

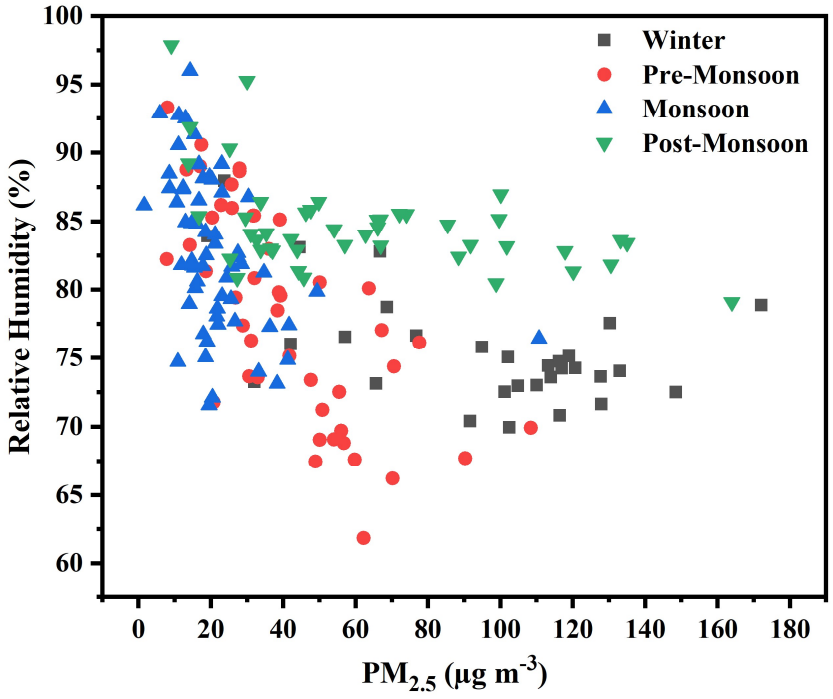

Fig. S9. Seasonal relationship between relative humidity and $PM_{2.5}$.

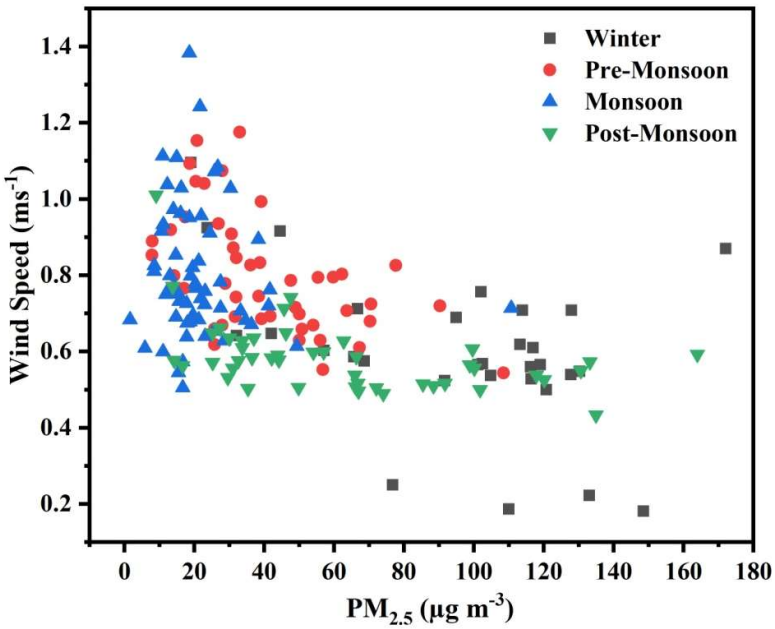

Fig. S10. Seasonal relationship between wind speed and $PM_{2.5}$.

Supplementary Tables

Table S1: Annual, seasonal, and monthly concentration of $PM_{2.5}$ in 2019.

$PM_{2.5}$ ($\mu g\ m^{-3}$)	Average ± SD	Maximum	Minimum
Annual (n= 183)	48.9 ± 37.8	172.1	5.9
Winter (n= 30)	95.3 ± 37.9	172.1	19.1
Pre-Monsoon (n= 46)	41.1 ± 21.8	108.5	7.9
Monsoon (n= 61)	21.8 ± 14.5	110.7	5.9
Post-Monsoon (n= 46)	62.4 ± 37.5	164.0	9.1

*SD = Standard Deviation, n = number of sample

Table S2: Seasonal and annual percentage concentration of cations and anions of total $PM_{2.5}$

Ions	% Concentration				
	Winter	Pre-Monsoon	Monsoon	Post-Monsoon	Annual
Cl^-	20.4	8.7	23.5	33.3	20.5
NO_3^-	14.7	7.5	2.4	10.1	9.7
SO_4^{2-}	30.5	43.3	5.4	23.3	27.3
Na^+	2.4	2.0	0.5	1.4	1.8
NH_4^+	20.4	26.4	60.0	18.9	29.4
Mg^{2+}	0.9	2.7	1.9	1.0	1.6
K^+	7.7	6.4	4.2	9.5	7.0
Ca^{2+}	3.2	3.1	2.1	2.4	2.8
Total Anions	65.5	59.5	31.3	66.7	57.5
Total Cations	34.5	40.5	68.7	33.3	42.5

Table S3: Comparative ionic ratios of aerosols and seawater for determining the marine influence to the $PM_{2.5}$ mass.

	Marine Influence				
	Cl^-/ Na^+	K^+/ Na^+	Mg^{2+}/ Na^+	Ca^{2+}/ Na^+	SO_4^{2-}/ Na^+
Winter	8.6	3.2	0.4	1.3	12.8
Pre-Monsoon	4.3	3.2	1.3	1.5	21.4
Monsoon	50.4	9.0	4.1	4.6	11.5
Post-Monsoon	23.4	6.7	0.7	1.7	16.4
Annual	13.2	4.3	1.1	1.7	16.2
Seawater	1.80	0.04	0.01	0.04	0.25

Table S4: Concentration of water-soluble inorganic ions (WSIIs) in 2019

Ions (μg m^{-3})	Winter ± SD	Pre-Monsoon ± SD	Monsoon ± SD	Post-Monsoon ± SD	Annual Mean ± SD
Cl^-	4.6 ± 0.8	1.2 ± 1.3	2.7 ± 0.3	3.5 ± 0.9	3.0 ± 1.5
NO_3^-	3.4 ± 1.6	1.1 ± 1.5	0.3 ± 0.3	1.1 ± 0.8	1.4 ± 1.5
SO_4^{2-}	6.9 ± 5.5	6.1 ± 3.9	0.6 ± 1.1	2.4 ± 2.4	4.0 ± 4.1
Na^+	0.5 ± 0.4	0.3 ± 0.2	0.1 ± 0.1	0.2 ± 0.2	0.3 ± 0.3
NH_4^+	4.6 ± 1.4	3.7 ± 1.8	7.0 ± 9.8	2.0 ± 1.3	4.3 ± 6.1
Mg^{2+}	0.2 ± 0.1	0.4 ± 0.4	0.2 ± 0.5	0.1 ± 0.1	0.2 ± 0.4
K^+	1.8 ± 0.6	0.9 ± 0.4	0.5 ± 0.2	1.0 ± 1.3	1.0 ± 0.8
Ca^{2+}	0.7 ± 0.5	0.4 ± 0.2	0.3 ± 0.1	0.3 ± 0.1	0.4 ± 0.3
Total Anions	14.9 ± 6.9	8.3 ± 4.4	3.6 ±1.4	6.9 ± 3.7	8.5 ± 5.6
Total Cations	7.9 ± 1.7	5.7 ± 2.2	8.0 ± 9.8	3.5 ± 2.0	6.2 ± 6.1
Total WSIIs	22.8 ± 8.1	14.0 ± 5.6	11.6 ± 9.5	10.4 ± 5.6	15.0 ± 8.6

Table S5: Average annual concentration and seasonal variation of major inorganic/metal elements (ng m^{-3}).

Species	Winter ± SD	Pre-Monsoon ± SD	Monsoon ± SD	Post-Monsoon ± SD	Annual ± SD
Na	73.7 ± 86.1	212.8 ± 124.8	130.5 ± 105.8	134.0 ± 153.4	142.9 ± 130.0
Al	26.4 ± 53.4	413.2 ± 413.6	14.8 ± 58.6	280.1 ± 1836.5	183.4 ± 950.9
Si	602.5 ± 219.7	1671.8 ± 1106.9	262.1 ± 249.5	256.1 ± 94.1	677.6 ± 838.1
S	2252.2 ± 858.3	1873.5 ± 921.6	889.9 ± 675.7	1153.3 ± 729.7	1432.7 ± 951.9
Cl	1215.5 ± 983.9	141.4 ± 149.6	65.5 ± 33.0	751.6 ± 983.6	444.3 ± 775.1
K	1837.1 ± 797.3	900.0 ± 474.9	234.6 ± 156.3	1130.4 ±1967.8	890.7 ± 1197.1
Ca	29.0 ± 27.4	108.4 ± 101.2	23.7 ± 63.2	12.4 ± 31.5	43.5 ± 76.3
Fe	150.6 ± 94.2	479.5 ± 363.4	49.8 ± 93.1	44.2 ± 63.0	181.0 ± 204.9

Table S6: Average annual concentration and seasonal variation of trace inorganic/metal elements (ng m^{-3}).

Species	Winter ± SD	Pre-Monsoon ± SD	Monsoon ± SD	Post-Monsoon ± SD	Annual Mean ± SD
Ti	1.1 ± 3.1	27.5 ± 28.8	2.7 ± 7.5	<MDL	7.8 ± 13.2
V	83.4 ±10.2	76.8 ± 18.7	100.3 ± 16.5	71.5 ± 23.0	83.0 ± 12.5
Mn	2.4 ± 3.4	5.9 ± 6.8	0.1 ± 0.5	3.3 ± 8.2	2.9 ± 2.4
Co	9.8 ± 3.7	9.4 ± 6.2	15.0 ± 5.7	7.4 ± 6.5	10.4 ± 3.3
Ni	14.4 ± 1.8	12.9 ± 1.6	14.1 ± 3.6	14.6 ± 0.8	14.0 ± 0.8
Zn	57.2 ± 40.5	44.2 ± 58.2	9.1 ± 19.4	41.5 ± 50.3	38.0 ± 20.5
Br	3.1 ± 2.4	0.7 ± 1.0	<MDL	1.2 ± 2.0	1.2 ± 1.3
Rb	2.5 ± 3.5	0.1 ± 0.4	<MDL	1.1 ± 3.9	0.9 ± 1.2

Sr	17.5 ± 4.5	14.2 ± 3.5	10.6 ± 2.0	12.6 ± 4.7	13.7 ± 2.9
Zr	2.4 ± 1.0	2.6 ± 1.9	2.8 ± 1.6	1.1 ± 1.2	2.2 ± 0.8
Mo	6.8 ± 9.9	9.2 ±13.8	30.0 ± 20.3	13.8 ± 16.8	15.0 ± 10.4
Sb	8.9 ± 9.9	11.9 ± 16.2	23.6 ± 17.8	8.1 ± 14.29	13.1 ±7.2
I	2.4 ± 2.8	0.2 ± 0.4	<MDL	0.8 ± 2.0	0.8 ± 1.1
Cs	15.4 ± 8.4	3.8 ± 6.4	<MDL	5.0 ± 7.6	6.1 ± 6.6
Ba	53.0 ±10.3	42.8 ± 21.6	51.1 ± 17.6	43.2 ± 37.2	47.5 ± 5.3
Pb	11.8 ± 8.1	7.8 ± 9.0	1.3 ± 4.5	7.5 ± 7.1	7.1 ± 4.3

Table S7: Average annual concentration and seasonal variation of carbonaceous matters (μg m^{-3}).

Species	Winter ± SD	Pre-Monsoon ± SD	Monsoon ± SD	Post-Monsoon ± SD	Annual ± SD
OC	14.8 ± 7.3	4.9 ± 3.1	2.2 ± 1.4	10.5 ± 7.5	6.1 ± 5.4
EC	12.1 ± 6.7	2.8 ±1.2	1.0 ± 1.2	8.7 ± 7.0	4.3 ± 3.8
SOC	7.9 ± 4.5	3.3 ± 2.1	1.6 ± 1.3	5.5 ± 4.0	3.7 ± 1.6
OC+EC	26.9 ± 14.0	7.7 ± 4.3	3.2 ± 2.6	19.2 ± 14.5	10.4 ± 9.3
Char-EC	3.0 ± 2.5	0.0 ± 1.5	0.1 ± 0.7	2.2 ± 3.1	1.1 ± 2.4
Soot-EC	9.1 ± 4.6	2.8 ± 2.1	0.9 ± 0.9	6.5 ± 4.4	4.3 ± 4.4

Table S8: Percentage (%) of air mass back-trajectory arriving at Jorhat from different clusters during the sampling period.

Season	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Winter(n= 30)	70	-	23	7
Pre-Monsoon(n= 46)	67	21	12	-
Monsoon(n= 61)	10	68	22	-
Post-Monsoon(n= 61)	38	22	40	-