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Chemical Characterization and Source Apportionment of PM_{10} Using Receptor Models over the Himalayan Region of India

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Table S1. S/N of species and MDL used for calculation of uncertainty at different study sites.

Species	Mohal-Kullu		Nainital		Darjeeling		MDL
	S/N	Category	S/N	Category	S/N	Category	(μg m^{-3})
OC	6.05	Strong	5.54	Strong	6.0	Strong	0.87
EC	9.09	Strong	4.27	Strong	4.4	Strong	0.38
WSOC	5.64	Weak	8.00	Weak	7.4	Weak	0.4
Na^+	6.54	Weak	1.05	Weak	4.1	Strong	0.34
NH_4^+	9.63	Strong	6.65	Strong	5.2	Strong	0.27
K^+	7.97	Strong	0.84	Weak	1.8	Strong	0.32
Mg^{2+}	-	-	-	-	0.4	Weak	0.18
Ca^{2+}	-	-	-	-	2.0	Strong	0.31
F^-	6.52	Strong	0.05	Weak	0.1	Bad	0.10
Cl^-	8.85	Strong	0.47	Weak	1.4	Strong	0.26
NO_3^-	8.33	Strong	6.46	Strong	3.3	Strong	0.37
SO_4^{2-}	9.07	Strong	8.60	Strong	8.8	Strong	0.23
B	7.04	Strong	9.67	Strong	9.6	Strong	0.01
Al	8.76	Strong	6.72	Strong	9.7	Strong	0.18
P	6.30	Strong	2.87	Strong	3.7	Strong	0.05
S	8.15	Weak	8.11	Weak	7.4	Weak	0.12
Ti	-	-	4.72	Strong	2.5	Strong	0.03
Cr	0.05	Weak	9.07	Strong	6.1	Strong	0.02

Fe	4.88	Strong	8.60	Strong	7.2	Strong	0.07
Ni	-	-	2.45	Strong	3.2	Strong	0.02
Cu	-	-	7.83	Strong	3.1	Strong	0.01
Zn	6.99	Strong	1.01	Weak	1.7	Strong	0.06
Zr	0.00	Weak	6.24	Bad	3.2	Strong	0.01
Mo	-	-	5.47	Strong			0.01
Mn	-	-	2.67	Strong	-	-	0.02
Br	-	-	4.67	Strong	-	-	0.01
Mg	6.68	Strong	6.46	Strong	-	-	0.03
Ca	8.72	Strong	7.62	Strong	-	-	0.03

Table S2. Model summary and the results of error estimates at Mohal-Kullu PMF.

Model summary and the result of BS, DISP and BS-DISP error estimates					
No. of base runs: 100					
Base random seed: 13					
Number of factors: 4					
Extra modeling uncertainty (%): 5					
Base run summary table:					
Run # Q(Robust) Q(True) Converged # Steps Q(true)/Qexp					
1 1124.29 1124.29 Yes 189 2.007					
BS-DISP Diagnostics:					
	# of Cases Accepted: 94				
	% of Cases Accepted: 94%				
	Largest Decrease in Q: -0.41				
	%dQ: -0.04				
	# of Decreases in Q: 0				
	# of Swaps in Best Fit: 0				
	# of Swaps in DISP: 6				
	Swaps by Factor: 0	0	0	0	
DISP Diagnostics:					
	Error Code: 0				
	Largest Decrease in Q: -0.056				
	%dQ: -0.0049				
	Swaps by Factor: 0	0	0	0	
BS Mapping:					
	Base Factor 1	Base Factor 2	Base Factor 3	Base Factor 4	Unmapped
Boot Factor 1	100	0	0	0	0
Boot Factor 2	0	98	2	0	0
Boot Factor 3	0	0	100	0	0
Boot Factor 4	0	0	0	100	0

Table S3. Model summary and the results of error estimates in PMF at Nainital.

Model summary and the result of BS, DISP and BS-DISP error estimates

**** Base Run Summary

****

Number of base runs: 100

Base random seed: 92

Number of factors: 5

Extra modeling uncertainty (%): 2

Base run summary table:

Run #	Q(Robust)	Q(True)	Converged	# Steps	Q(true)/Qexp
1	1303.43	1303.43	Yes	1135	1.32

BS-DISP Diagnostics:

# of Cases Accepted:	99				
% of Cases Accepted:	99%				
Largest Decrease in Q:	-0.18				
%dQ:	-0.01				
# of Decreases in Q:	0				
# of Swaps in Best Fit:	0				
# of Swaps in DISP:	1				
Swaps by Factor:	0	0	0	0	0

DISP Diagnostics:

Error Code:	0				
Largest Decrease in Q:	-0.061				
%dQ:	-0.005				
Swaps by Factor:	0	0	0	0	0

BS Mapping:

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Unmapped
Boot Factor 1	100	0	0	0	0	0
Boot Factor 2	0	100	0	0	0	0
Boot Factor 3	0	0	100	0	0	0
Boot Factor 4	0	0	0	100	0	0
Boot Factor 5	0	0	0	0	100	0

Table S4. Model summary and the results of error estimates in PMF at Darjeeling.

Model summary and the result of BS, DISP, and BS-DISP error estimates						
Number of base runs:	100					
Base random seed:	73					
Number of factors:	5					
Extra modeling uncertainty (%):	2					
Base run summary table:						
Run #	Q(Robust)	Q(True)	Converged	# Steps	Q(true)/Qexp	
1	2099.47	2099.47	Yes	805	1.1922	
BS-DISP Diagnostics:						
# of Cases Accepted:	99					
% of Cases Accepted:	99%					
Largest Decrease in Q:	-5.781000137					
%dQ:	-0.275361773					
# of Decreases in Q:	0					
# of Swaps in Best Fit:	0					
# of Swaps in DISP:	1					
Swaps by Factor:	0	0	0	0	0	
DISP Diagnostics:						
Error Code:	0					
Largest Decrease in Q:	-0.005					
%dQ:	-0.000238161					
Swaps by Factor:	0	0	0	0	0	
BS Mapping:						
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Unmapped
Boot Factor 1	100	0	0	0	0	0
Boot Factor 2	0	100	0	0	0	0
Boot Factor 3	0	0	99	1	0	0
Boot Factor 4	0	0	0	100	0	0
Boot Factor 5	0	0	0	0	100	0

Table S5. Annual and seasonal average concentration of PM_{10} and its elemental composition at study sites of IHR.

Values are in μg m-3	**Mohal-Kullu**					**Nainital**					**Darjeeling**				
	Annual	**Winter (Jan-Feb)**	**Summer (Mar-May)**	**Monsoon (Jun-Sept)**	**Post-monsoon (Oct-Dec)**	**Annual**	**Winter (Jan-Feb)**	**Summer (Mar-May)**	**Monsoon (Jun-Sept)**	**Post-monsoon (Oct-Dec)**	**Annual**	**Winter (Jan-Feb)**	**Summer (Mar-May)**	**Monsoon (Jun-Sept)**	**Post-monsoon (Oct-Dec)**
Samples (n)	**n= 76**	**n= 5**	**n= 8**	**n= 34**	**n= 29**	**n= 86**	**n = 17**	**n = 27**	**n = 9**	**n = 33**	**n = 134**	**n = 25**	**n = 32**	**n = 31**	**n = 46**
PM_{10}	58 ± 32	51 ± 16	52 ± 15	44 ± 26	76 ± 36	62 ± 39	38 ± 9	100 ± 50	49 ± 17	47 ± 14	54 ± 18	52 ± 18	63 ± 21	47 ± 9	50 ± 15
B	1.73 ± 1.13	1.41 ± 0.24	1.26 ± 0.35	1.54 ± 1.31	2.15 ± 1.03	0.4 ± 0.3	0.22 ± 0.16	0.51 ± 0.38	0.65 ± 0.34	0.31 ± 0.12	0.37 ± 0.23	0.29 ± 0.19	0.52 ± 0.26	0.38 ± 0.20	0.24 ± 0.13
Na	2.64 ± 1.67	2.19 ± 0.37	2.07 ± 0.62	2.38 ± 1.92	3.22 ± 1.55	0.36 ± 0.33	0.53 ± 0.31	0.28 ± 0.19	0.22 ± 0.19	0.35 ± 0.43	0.05 ± 0.04	0.05 ± 0.03	0.08 ± 0.05	0.05 ± 0.04	0.03 ± 0.02
Mg	0.15 ± 0.10	0.13 ± 0.10	0.22 ± 0.10	0.12 ± 0.10	0.17 ± 0.09	0.42 ± 0.49	0.17 ± 0.08	0.83 ± 0.60	0.62 ± 0.55	0.16 ± 0.13	0.14 ± 0.15	0.20 ± 0.27	0.18 ± 0.14	0.09 ± 0.08	0.11 ± 0.04
Al	1.22 ± 0.70	1.08 ± 0.38	1.26 ± 0.38	1.05 ± 0.81	1.44 ± 0.62	1.65 ± 1.73	0.67 ± 0.32	3.07 ± 2.06	2.54 ± 1.91	0.75 ± 0.54	0.85 ± 0.75	0.78 ± 0.34	0.91 ± 0.64	1.06 ± 1.37	0.72 ± 0.27
P	0.01 ± 0.001	0.006 ± 0.005	0.009 ± 0.004	0.005 ± 0.004	0.006 ± 0.004	0.05 ± 0.06	0.01 ± 0.008	0.10 ± 0.07	0.05 ± 0.03	0.02 ± 0.01	0.06 ± 0.30	0.21 ± 0.67	0.03 ± 0.02	0.02 ± 0.01	0.02 ± 0.01
S	1.02 ± 1.01	0.91 ± 0.37	1.20 ± 0.33	1.13 ± 1.43	0.84 ± 0.38	1.36 ± 0.71	1.13 ± 0.57	1.66 ± 0.66	1.80 ± 0.97	1.09 ± 0.60	1.12 ± 0.72	1.27 ± 0.76	1.67 ± 0.75	0.66 ± 0.47	0.97 ± 0.54
Cl	0.44 ± 0.59	0.64 ± 0.22	0.23 ± 0.11	0.20 ± 0.16	0.78 ± 0.84	0.40 ± 0.44	0.58 ± 0.42	0.358 ± 0.40	0.09 ± 0.009	0.43 ± 0.51	0.12 ± 0.13	0.17 ± 0.22	0.07 ± 0.05	0.08 ± 0.07	0.13 ± 0.10
K	0.91 ± 0.55	0.73 ± 0.20	0.84 ± 0.23	0.81 ± 0.65	1.10 ± 0.48	1.30 ± 1.09	0.56 ± 0.26	2.20 ± 1.36	1.62 ± 1.06	0.86 ± 0.39	0.60 ± 0.37	0.71 ± 0.30	0.78 ± 0.44	0.29 ± 0.21	0.62 ± 0.32
Ca	0.49 ± 0.29	0.39 ± 0.14	0.50 ± 0.15	0.42 ± 0.34	0.58 ± 0.26	1.81 ±1.88	0.88 ± 0.63	3.32 ± 2.14	2.22 ± 1.93	0.95 ± 1.16	0.57 ± 0.38	0.53 ± 0.21	0.65 ± 0.45	0.41 ± 0.25	0.62 ± 0.43
Ti						0.11 ± 0.09	0.05 ± 0.02	0.19 ± 0.11	0.19 ± 0.07	0.05 ± 0.03	0.06 ± 0.02	0.06 ± 0.01	0.07 ±0.03	0.05 ± 0.02	0.05 ± 0.01
Cr	0.01 ± 0.001	0.004 ± 0.001	0.006 ± 0.001	0.005 ± 0.004	0.007 ± 0.003	0.13 ± 0.01	0.14 ± 0.01	0.11 ± 0.02	0.13 ± 0.008	0.13 ± 0.01	0.13 ± 0.10	0.15 ± 0.22	0.09 ± 0.01	0.13 ± 0.03	0.13 ± 0.02
Fe	0.19 ± 0.13	0.16 ± 0.12	0.28 ± 0.11	0.16 ± 0.12	0.22 ± 0.11	1.42 ± 1.16	0.73 ± 0.29	2.41 ± 1.27	2.01 ± 1.31	0.80 ± 0.49	0.61 ± 0.26	0.62 ± 0.23	0.70 ± 0.39	0.49 ± 0.21	0.60 ± 0.15
Ni	-	-	-	-	-	0.06 ± 0.02	0.03 ± 0.004	0.10 ± 0.36	0.03 ± 0.003	0.03 ± 0.006	0.04 ± 0.01	0.05 ± 0.02	0.04 ± 0.01	0.04 ± 0.01	0.03 ± 0.10
Cu	-	-	-	-	-	0.13 ± 0.01	0.04 ± 0.03	0.23 ± 0.18	0.15 ± 0.07	0.09 ± 0.07	0.03 ± 0.02	-	-	0.04 ± 0.02	0.02 ± 0.003
Zn	0.29 ± 0.18	0.23 ± 0.06	0.26 ± 0.07	0.26 ± 0.21	0.34 ± 0.14	0.08 ± 0.07	0.10 ± 0.07	0.07 ± 0.08	0.03 ± 0.009	0.09 ± 0.06	0.09 ± 0.03	0.09 ± 0.03	0.08 ± 0.02	0.08 ± 0.04	0.09 ± 0.03
Zr	0.005 ± 0.004	0.001 ± 0.001	0.001 ± 0.0001	0.0001 ± 0.0001	0.001 ± 0.001	0.11 ± 0.11	0.02 ± 0.003	0.21 ± 0.10	0.17 ± 0.11	0.06 ± 0.09	0.04 ± 0.01	-	0.05 ± 0.01	0.04 ± 0.01	0.03 ± 0.009

Mo	-	-	-	-	-	0.05 ± 0.06	0.04 ± 0.01	0.07 ± 0.11	0.03 ± 0.01	0.04 ± 0.01	0.05 ± 0.06	0.06 ± 0.01	0.05 ± 0.01	0.06 ± 0.01	0.05 ± 0.01
Pb	-	-	-	-	-	0.06 ± 0.02	0.05 ± 0.008	0.07 ± 0.04	0.06 ± 0.009	0.05 ± 0.08	0.06 ± 0.02	-	-	0.12 ± 0.13	0.21 ± 0.23
Mn	-	-	-	-	-	0.08 ± 0.14	0.05 ± 0.04	0.11 ± 0.19	0.08 ± 0.05	0.06 ± 0.16	0.08 ± 0.14	0.05 ± 0.01	0.05± 0.02	0.04± 0.02	0.04± 0.02
Ba	1.13 ± 0.69	0.90 ± 0.22	1.03 ± 0.28	1.01 ± 0.83	1.35 ± 0.58	-	-	-	-	-	-	-	-	-	-

average ± Standard deviation, all values are in μg m^{-3}.

Table S6. Diagnostic mass ratios of carbonaceous and water soluble inorganic ionic components of PM_{10} at different study sites.

	Mohal-Kullu					**Nainital**					**Darjeeling**				
	Annual	**Winter**	**Summer**	**Monsoon**	**Post Monsoon**	**Annual**	**Winter**	**Summer**	**Monsoon**	**Post Monsoon**	**Annual**	**Winter**	**Summer**	**Monsoon**	**Post Monsoon**
OC/EC	2.95	2.61	2.98	2.84	3.14	3.44	2.33	3.84	3.4	3.70	2.60	2.04	1.74	3.04	3.21
WSOC/OC	0.68	0.55	0.42	0.82	0.60	0.72	0.74	0.75	0.7	0.68	0.68	0.74	0.61	0.59	0.76
SOC/OC	0.30	0.14	0.31	0.25	0.34	0.43	0.23	0.50	0.4	0.42	0.43	0.34	0.23	0.42	0.49
nss K^+/OC	0.05	0.03	0.03	0.05	0.05	0.09	0.10	0.09	0.12	0.09	0.10	0.10	0.13	0.08	0.10
nss K^+/EC	0.14	0.08	0.08	0.16	0.15	0.31	0.23	0.31	0.39	0.32	0.26	0.21	0.22	0.22	0.33
Cl^- /Na^+	0.76	0.77	0.56	0.77	0.81	0.97	1.23	1.06	0.63	0.85	0.50	0.51	0.61	0.48	0.44
NH_4^+ / SO_4^{2-}	0.68	0.73	0.63	0.63	0.75	0.45	0.45	0.44	0.37	0.49	0.50	0.62	0.58	0.41	0.45
NO_3- / SO_4^{2-}	0.97	1.17	1.00	0.92	0.99	0.52	0.53	0.53	0.52	0.51	0.50	0.49	0.51	0.37	0.57
Mg^{2+}/Ca^{2+}	0.32	0.27	0.10	0.55	0.11	0.59	0.18	1.23	0.94	0.18	0.23	0.20	0.21	0.19	0.28
K^+/ NH_4^+	0.34	0.28	0.35	0.31	0.38	0.33	0.39	0.30	0.40	0.31	0.77	0.40	0.29	0.62	1.39
Cl^-/NO_3^-	0.80	0.73	0.71	0.77	0.87	0.18	0.23	0.21	0.07	0.17	0.34	0.28	0.32	0.47	0.31
Ca^{2+}/ NO3$^-$	0.66	0.78	0.69	0.59	0.71	0.47	0.41	0.50	0.40	0.48	0.50	0.47	0.51	0.69	0.38
K^+/ Ca^{2+}	0.59	0.26	0.36	0.78	0.49	2.94	1.15	6.17	3.08	1.17	1.70	1.76	0.91	0.55	2.99
K^+/ SO4^{2-}	0.22	0.21	0.23	0.17	0.28	0.12	0.12	0.13	0.13	0.12	0.22	0.24	0.13	0.11	0.35
K^+/NO_3^-	0.22	0.18	0.22	0.18	0.27	0.25	0.27	0.24	0.24	0.25	0.51	0.44	0.28	0.34	0.84
K^+/ Cl^-	0.29	0.25	0.42	0.25	0.31	2.37	1.87	2.08	3.52	2.55	2.98	3.98	1.76	1.01	4.62

Table S7. PCA factor loadings of PM_{10} at different locations of IHR.

	Mohal-Kullu					**Nainital**					Darjeeling					
	PC1	**PC2**	**PC3**	**PC4**	**PC5**	**PC1**	**PC2**	**PC3**	**PC4**	**PC5**	PC1	PC2	PC3	PC4	PC5	PC6
OC	-0.03	-0.01	**0.67**	**0.55**	-0.02	0.32	**0.83**	0.23	0.15	0.18	0.25	0.10	**0.69**	0.18	**0.35**	0.01
EC	**0.39**	0.18	**0.62**	**0.43**	-0.10	-0.12	**0.73**	0.40	**0.37**	0.13	0.05	0.28	**0.81**	**0.43**	**0.27**	0.26
WSOC	-0.06	0.19	**0.82**	-0.04	0.05	0.32	**0.78**	0.33	0.28	0.19						
Na^+	0.17	0.08	**0.55**	0.10	**0.33**	0.41	-0.03	0.07	**0.54**	0.59	0.11	0.03	-0.11	0.29	-0.26	**0.60**
NH_4^+	0.04	**0.95**	0.08	0.09	-0.08	0.18	0.28	**0.86**	-0.03	0.02	0.24	**0.86**	0.25	0.10	0.00	0.14
K^+	0.58	0.28	**0.44**	0.08	0.20	0.33	**0.70**	0.41	0.09	0.10	0.11	0.40	**0.61**	0.29	-0.19	-0.04
Mg^{2+}	0.06	-0.08	0.00	-0.01	**0.92**	-	-	-	-	-	0.08	0.10	0.21	**0.74**	0.12	0.08
Ca^{2+}	**0.37**	0.05	**0.64**	-0.04	**0.35**	-	-	-	-	-	**0.34**	0.45	-0.01	**0.58**	-0.13	0.23
F^-	**0.69**	0.29	**0.45**	-0.02	-0.05						0.09	0.18	0.23	**0.81**	-0.03	**0.42**
Cl^-	**0.69**	0.30	**0.37**	-0.18	**0.34**	0.57	0.21	0.09	-0.04	0.49	0.22	**0.86**	0.17	**0.43**	**0.50**	0.02
NO_3^-	**0.19**	**0.90**	0.21	0.05	-0.02	0.30	0.32	**0.84**	0.05	-0.05	0.26	**0.89**	0.15	0.12	0.08	0.07
SO_4^{2-}	**0.29**	**0.89**	0.12	0.10	-0.01	0.30	0.17	**0.84**	0.17	-0.09	0.18	0.21	-0.04	0.17	**0.49**	0.49
B	**0.84**	0.11	0.09	0.28	0.00	0.46	**0.60**	0.41	0.02	-0.06	**0.80**	0.22	-0.11	0.25	-0.24	0.06
Al	**0.68**	0.22	0.07	**0.66**	-0.02	0.90	0.25	0.25	0.21	0.09	**0.87**	0.13	-0.06	0.15	-0.10	0.07
P	-	-	-	**-**	-	**0.78**	**0.40**	0.23	0.25	0.23						
S	-0.06	-0.09	0.21	**0.70**	-0.06	**0.34**	0.18	0.60	**0.43**	-0.03						
Ti	-	-	-	**-**	-	**0.91**	0.19	0.21	0.22	0.03	**0.78**	0.24	0.20	-0.08	0.16	0.10
Cr	-	-	-	**-**	-	-0.31	-0.19	-0.12	-0.07	-0.66	0.02	-0.10	-0.27	0.08	-0.05	-0.81
Fe	0.22	0.26	-0.13	**0.83**	0.04	**0.89**	0.18	0.27	0.23	0.10	**0.83**	0.21	0.19	0.10	0.06	0.13
Ni	-	-	-	**-**	-	-	-	-	-	-						
Cu	-	-	-	**-**	-	0.31	0.18	0.26	**0.77**	0.10	-0.01	-0.04	-0.14	-0.09	**0.82**	-0.13
Zn	**0.78**	0.25	0.03	**0.48**	-0.01	-0.13	-0.25	0.37	**0.52**	0.39	0.61	0.11	**0.34**	**0.34**	-0.05	-0.26
Zr	-	-	-	-	-	-	-	-	-	-	-0.11	-0.06	-0.17	0.08	**0.84**	0.03
Ba	-0.57	0.13	**0.35**	0.13	-0.04	-	-	-	-	-	-	-	-	-	-	-
Mn	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Br	-	-	-	-	-	0.09	0.05	-0.28	0.08	0.79	-	-	-	-	-	-
Mo						0.39	**0.63**	-0.12	-0.28	-0.05	-	-	-	-	-	-
Mg						**0.91**	0.27	0.20	0.15	0.49	-	-	-	-	-	-
Ca						**0.92**	0.16	0.18	0.15	0.12	-	-	-	-	-	-
Variance	37.0	11.6	11.1	10.0	5.7	50.3	11.4	7.5	6.0	5.4	33.56	12.54	9.18	6.02	5.99	5.34
Eigenvalue	6.7	2.1	2.0	1.8	1.0	11.1	2.5	1.6	1.3	1.2	7.38	2.76	2.02	1.32	1.32	1.18
% Contribution	8.7	16.7	34.8	37.7	2.0	25.1	19.6	30.8	15.2	9.4	31.2	21.4	27.5	12.3	4.5	3.0
Source	VE	SA	Combustion (BB+FFC)	SD	SMS	SD	BB	SA	VE	SMS	SD/CD/RD	SA	BB	VE	FFC/CC	SS

Table S8. Source composition of PM_{10} sources by UNMIX at different study sites.

	Mohal-Kullu				**Nainital**					**Darjeeling**				
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
OC	-0.18	3.14	4.21	1.47	0.39	0.30	1.18	1.34	1.39	0.36	-0.53	0.88	3.47	0.83
EC	-0.18	2.03	1.11	0.61	0.28	-0.18	0.16	0.59	0.72	0.12	0.12	0.49	1.18	0.29
WSOC	0.51	1.80	1.15	0.79	0.56	-0.01	0.58	1.36	0.85	0.43	-0.65	0.39	2.95	0.42
B	0.16	0.72	0.24	0.43						0.02	0.14	0.21	-0.17	0.13
Al	0.07	0.40	0.30	0.39	-0.07	0.03	1.12	0.27	0.08	0.08	0.09	0.05	0.13	0.47
P										0.002	0.003	0.003	0.003	0.02
S														
Ti						0.003	0.08	0.01	0.01	0.001	0.01	0.01	0.01	0.02
Fe	0.01	0.02	0.08	0.09	-0.001	-0.06	0.80	0.23	0.25	0.04	0.05	0.13	0.11	0.29
Zn	0.02	0.10	0.06	0.09	0.003	0.03	0.01	-0.04	0.08	-0.002	0.001	0.02	0.03	0.03
Zr	0.00	0.00	0.00	0.00	0.11	-0.01	0.01	0.01	-0.01	-0.004	0.004	0.03	0.00	0.01
Cr	0.00	0.00	0.00	0.00						-0.004	-0.01	0.05	0.05	0.03
Mg					-0.002	0.01	0.34	0.01	0.01	0.02	0.02	0.01	-0.01	0.08
Ca					-0.22	0.14	1.61	-0.15	0.25	0.08	0.03	0.06	0.09	0.30
Mo					0.01	0.01	0.002	-0.01	0.02	-0.004	0.002	0.03	0.01	0.02
Na^+	0.16	0.66	0.52	0.51	-0.05	0.37	0.07	0.06	-0.03	0.04	0.07	0.57	0.16	0.65
NH_4^+	0.02	0.55	0.16	1.04	0.20	0.03	0.44	0.07	0.92	0.03	2.87	0.07	-0.24	0.29
K^+	0.02	0.51	-0.03	-0.04	0.03	0.02	0.10	0.06	0.21	0.12	-0.03	0.11	0.42	0.02
Mg^{2+}	0.21	-0.02	0.01	0.01										
Ca^{2+}	0.21	0.98	0.12	-0.13										
F^-	0.01	0.05	0.00	0.02										
Cl^-	0.11	1.15	0.02	0.22	0.06	0.07	0.03	-0.07	0.12	0.57	-0.02	0.03	-0.02	0.03
NO_3^-	0.10	0.96	0.19	0.94	0.17	-0.09	0.65	0.17	1.04	0.33	1.79	0.14	0.02	0.06
SO_4^{2-}	0.13	1.12	0.08	1.21	0.06	0.02	1.37	0.33	1.93	-0.38	5.12	1.24	-1.05	0.71
% Contribution	4.4	45.1	26.2	24.3	6.7	3.0	37.4	18.6	34.3	6.8	33.2	16.6	26.2	17.3
Source	SMS	Combustion	SD	SA	VE	SMS	SD	BB	SA	CC	SA	VE	BB	SD

Table S9. Percent contribution of PM_{10} sources by PMF at different study sites.

	Mohal-Kullu				**Nainital**					**Darjeeling**				
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
OC	41	7	38	14	18	23	13	18	28	10	10	56	12	11
EC	41	9	32	18	0	28	26	14	32	11	0	43	27	19
WSOC	38	14	46	2	14	17	23	16	30	12	13	63	0	12
Na^+	39	8	41	12	29	37	3	25	6	3	29	36	28	3
NH_4^+	0	54	30	15	15	60	11	4	11	0	5	0	10	85
K^+	8	6	86	0	11	30	21	19	19	15	10	53	10	13
Mg^{2+}	-	-	-	-	-	-	-	-	-	24	30	23	23	0
Ca^{2+}	-	-	-	-	-	-	-	-	-	9	25	34	20	12
F^-	39	8	53	0	9	3	16	52	19					
Cl^-	31	19	44	6	11	9	8	53	18	13	15	51	14	7
NO_3^-	12	39	35	14	20	51	7	7	15	14	2	16	10	58
SO_4^{2-}	6	48	32	14	21	52	3	8	15	55	7	0	6	32
Mg	17	1	29	53	70	0	13	3	14					
Ca	29	5	32	33	76	1	3	6	14					
B	34	8	42	16	15	5	80	0	0	0	11	0	86	3
Al	32	5	29	34	67	1	13	1	17	1	88	0	8	4
P	10	3	27	60	57	3	11	3	27	0	74	5	17	4
S	23	1	15	61	22	17	35	11	15	5	15	23	44	12
Ti	-	-	-	-	63	2	13	6	16	2	38	29	25	6
Cr	32	9	35	24	4	17	16	51	12	0	9	69	22	0
Fe	19	0	30	51	61	5	10	10	15	1	65	16	15	4
Ni	-	-	-	-	11	19	14	44	11	0	21	44	31	3
Cu	-	-	-	-	16	0	0	0	84	2	11	54	29	4
Zn	33	7	34	26	1	51	0	47	0	3	27	47	17	5
Zr	67	0	9	25	-	-	-	-	-	0	5	52	43	1
Mo	-	-	-	-	0	10	11	63	16					
Mn	-	-	-	-	35	2	15	31	18	-	-	-	-	-
Br	-	-	-	-	6	0	16	62	17	-	-	-	-	-
Ba	69	26	0	5	-	-	-	-	-	-	-	-	-	-
% Contribution	29.5	13.2	34.3	23.0	26.1	17.8	15.2	22.1	18.8	8.2	23.2	32.5	22.6	13.5
Source	VE	SA	BB	SD	SD	SA	BB	FFC	VE	CC	SD	BB	VE	SA

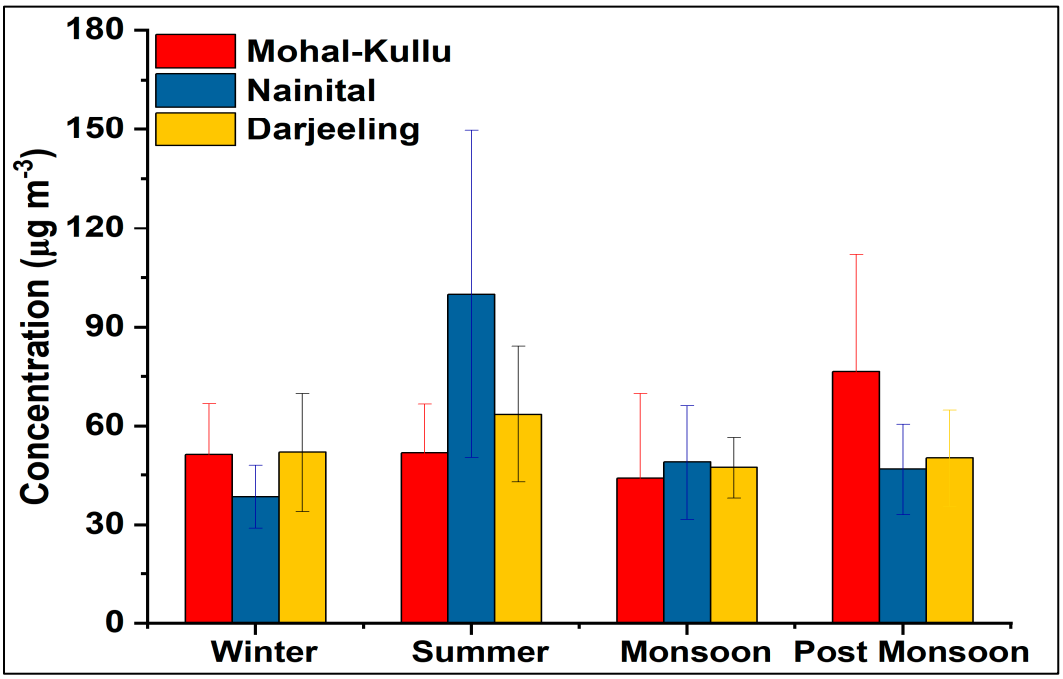

Figure S1. Seasonal variations in the concentration of PM_{10} at different study sites (in µg m^{-3}).

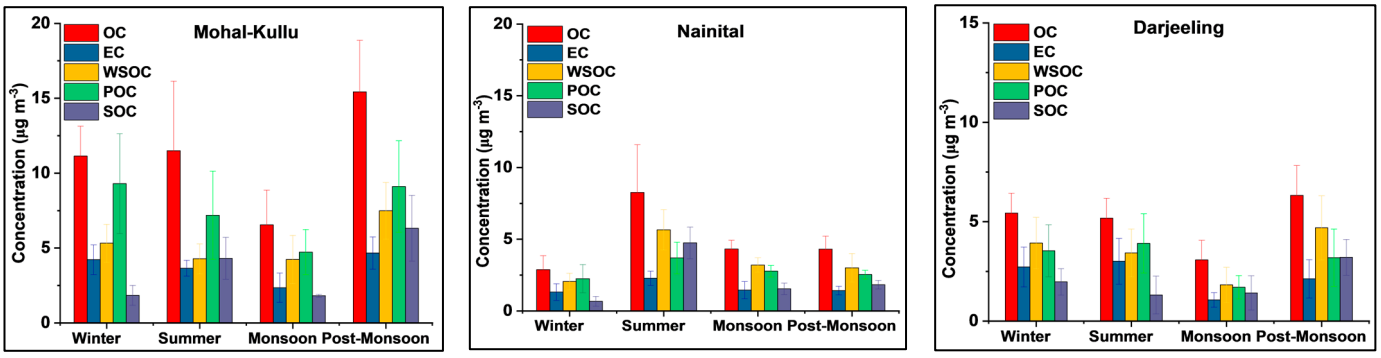

Figure S2. Seasonal variations in the concentration of carbonaceous components (OC, EC, WSOC, POC, SOC) of PM_{10} at different study sites (in µg m^{-3}).

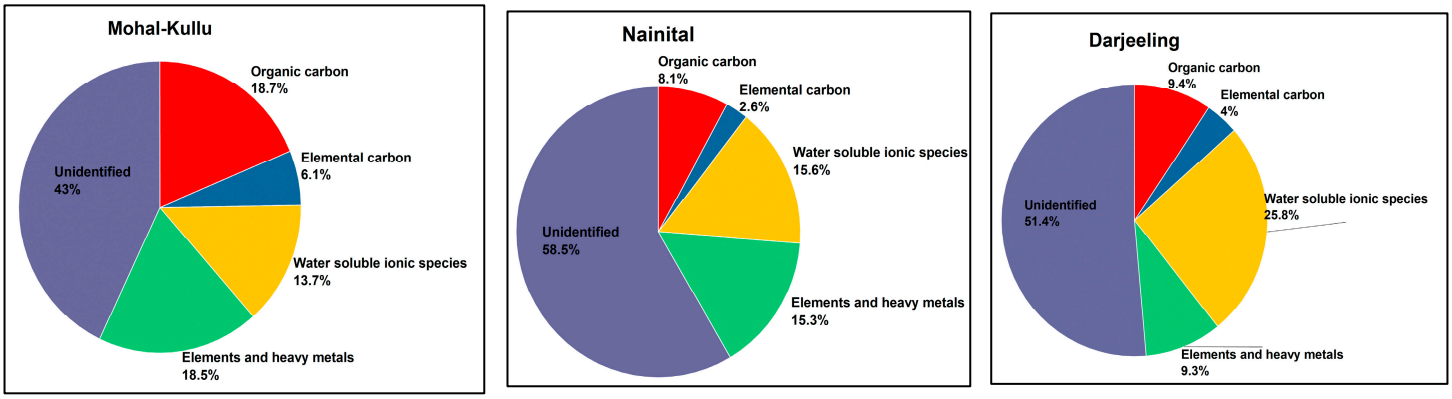

Figure S3. Pie chart showing percentage contribution of analyzed species to PM_{10} at study sites in IHR.

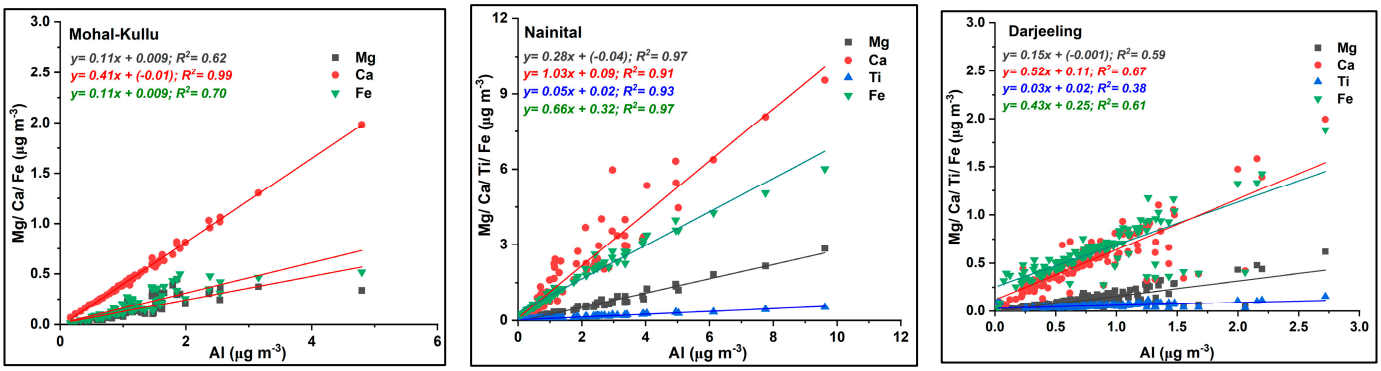

Figure S4. Scatter plots between crustal elements Al with Mg/Ca/Fe, and Ti of PM_{10} at different study sites.

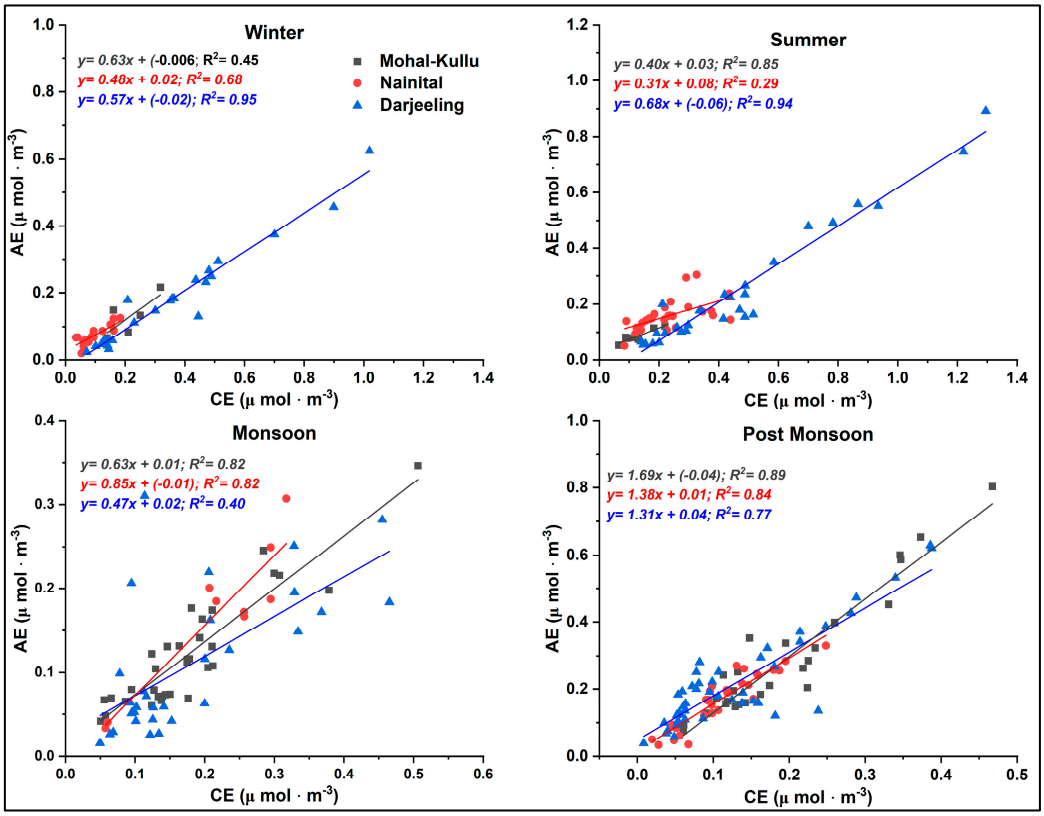

Figure S5. Seasonal CE/AE ratio for aerosol acidity at study sites.

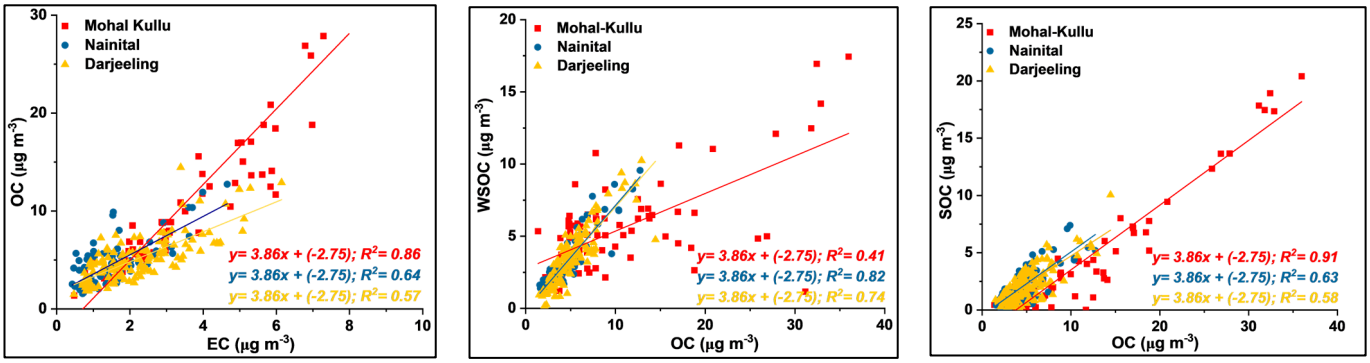

Figure S6. Scatter plots between OC/EC, WSOC/OC, SOC/OC of PM_{10} at different study sites.