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Changing optical properties of black carbon and brown carbon aerosols during long-range transport from the Indo-Gangetic Plain to the equatorial Indian Ocean

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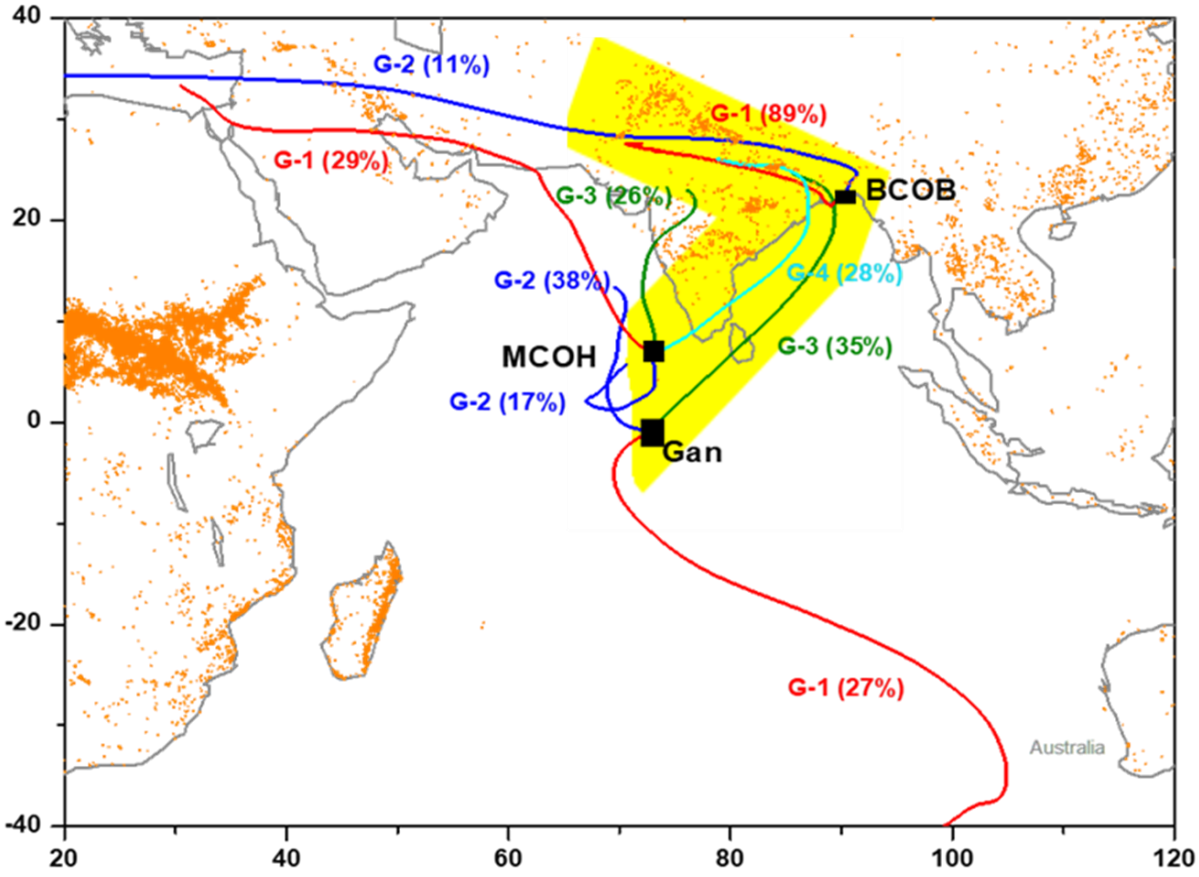


Figure S1: The 10-day air mass back trajectory cluster means ending at Bhola Climate Observatory-Bangladesh (BCOB), Maldives Climate Observatory at Hanimaadhoo (MCOH), and Maldives Climate Observatory at Gan (MCOG), at 50 m above mean sea level with MODIS/Aaua active fires from December 2017 to March 2018. G- represents the group number and percentage in brackets and gives information on percentages of trajectories in the group.

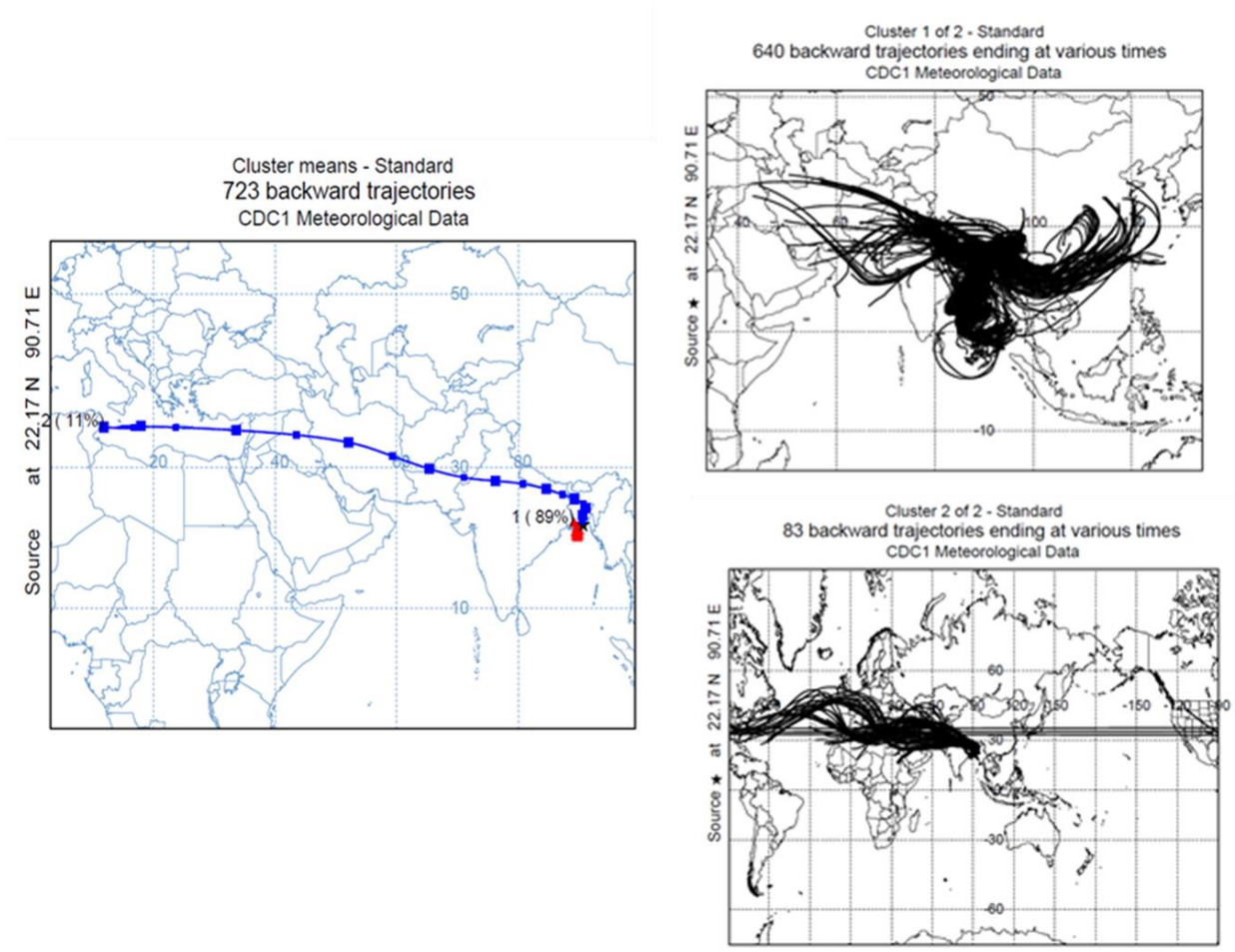


Figure S2: Ten-day air mass back-trajectories (AMBTs) were generated for Bhola Climate Observatory-Bangladesh (BCOB) at an arrival height of 50 m, computed for every three h using NOAA Hybrid Single-Particle Lagrangian Integrated Trajectory Model (HYSPLIT) version 4.

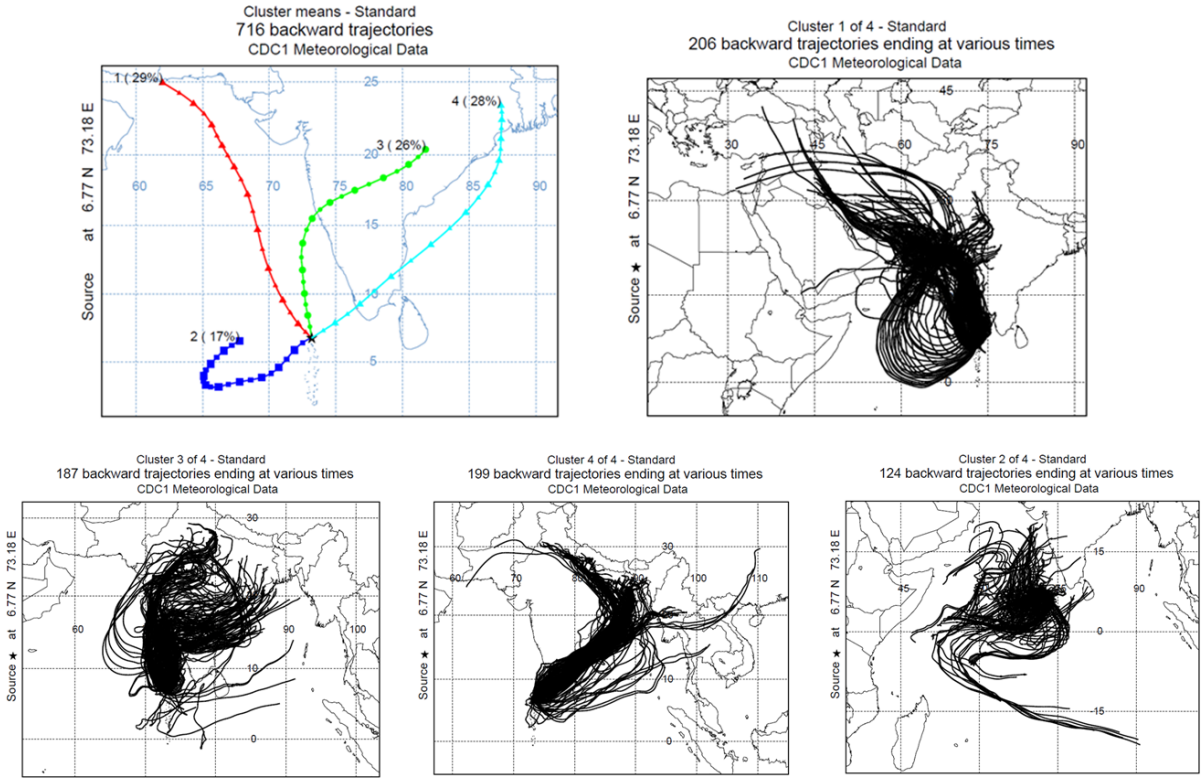


Figure S3: Ten-day air mass back-trajectories (AMBTs) were generated for Maldives Climate Observatory-Hanimaadhoo (MCOH) at an arrival height of 50 m, computed for every three hours using NOAA HYSPLIT model version 4. The AMBTs were clustered into four regions: Western Indian margin, Southern India, IGP, and the Arabian Sea.

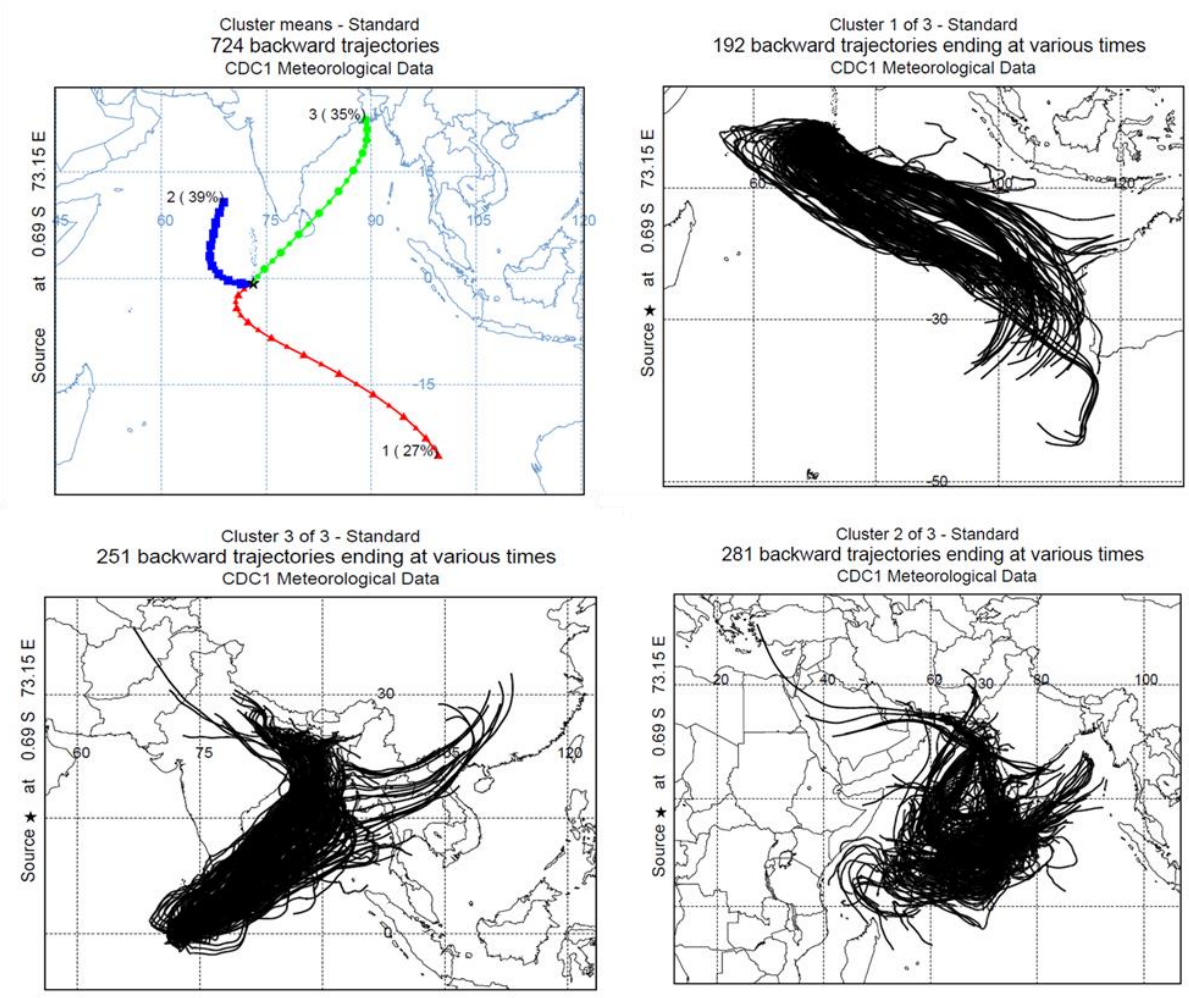
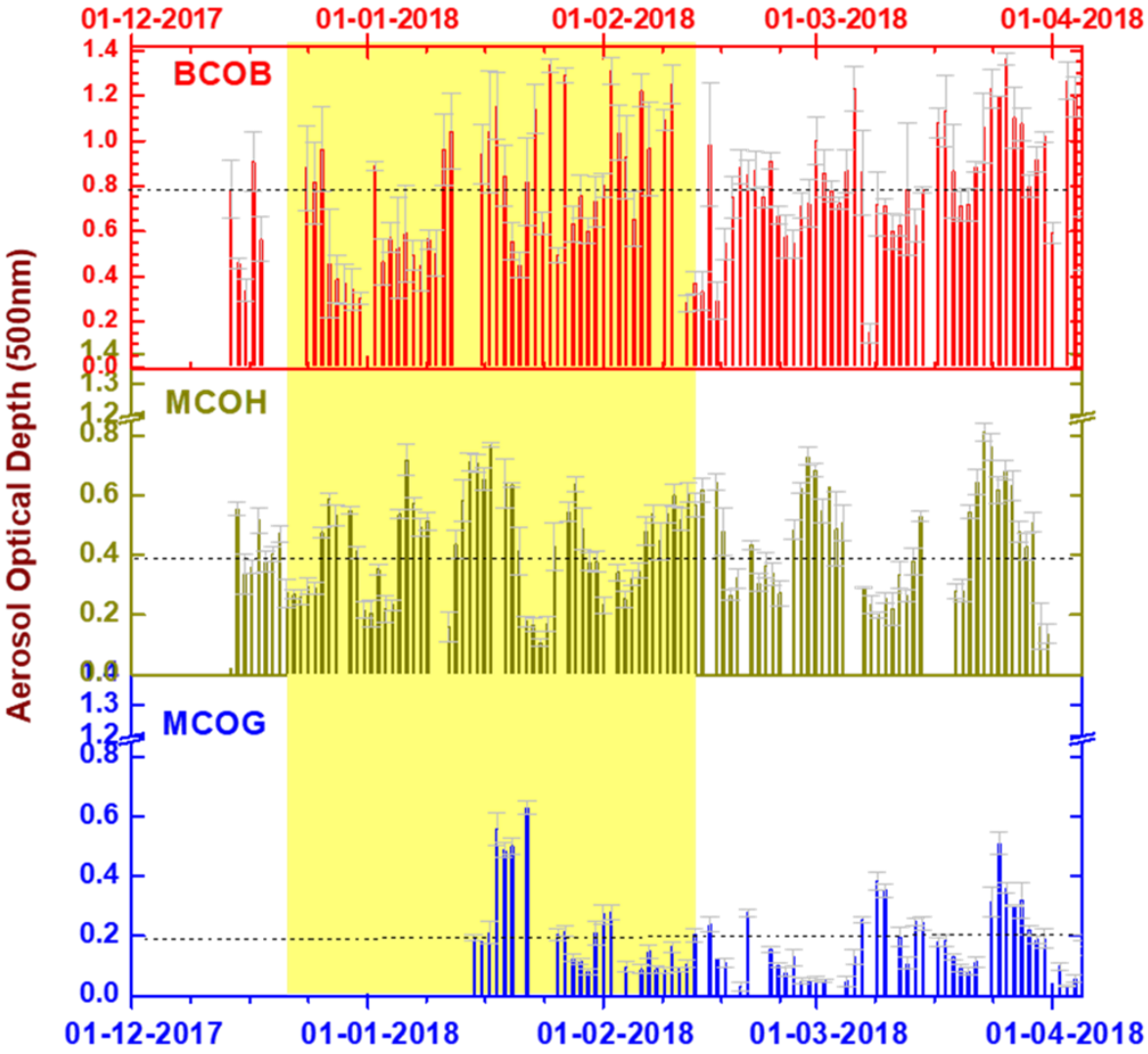


Figure S4: Ten-day air mass back-trajectories (AMBTs) were generated for Maldives Climate Observatory-Gan (MCOG) at an arrival height of 50 m, computed for every three h using NOAA HYSPLIT model version 4. The AMBTs were clustered into four regions: Arabian Sea, IGP, and Indian Ocean.



35 **Figure S5. Daily average aerosol optical depth (AOD) measured over Bhola Climate Observatory-Bangladesh (BCOB), Maldives Climate Observatory-Hanimaadhoo (MCOH), and Maldives Climate Observatory-Gan (MCOG) from December 2017 to April 2018. The vertical yellow field indicates the period dominated by air mass transport through the high-pollution source region Indo-Gangetic Plain (IGP).**

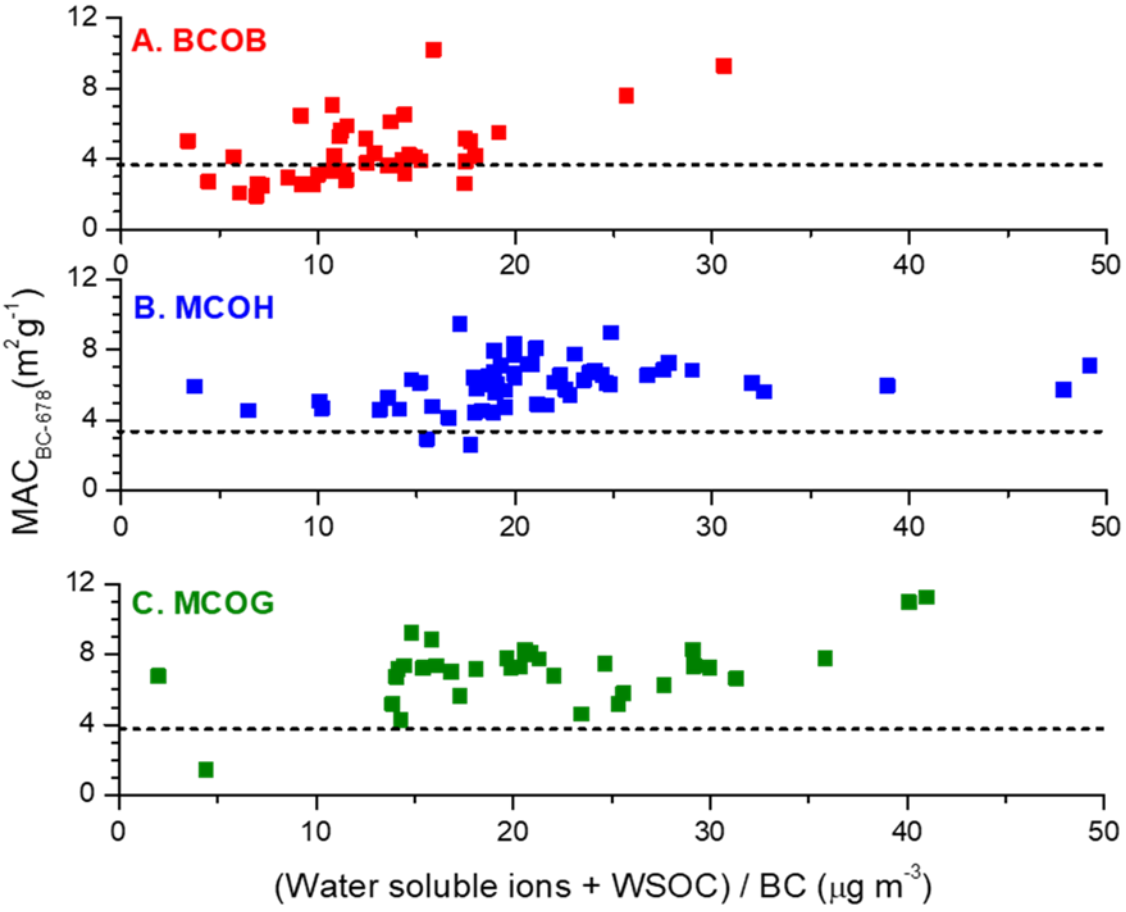


Figure S6: The ratio of black carbon (BC) MAC to [(water-soluble ions + WSOC) / BC] measured at Bhola Climate Observatory-Bangladesh (BCOB), Maldives Climate Observatory-Hanimaadhoo (MCOH), and Maldives Climate Observatory-Gan (MCOG) from December 2017 to April 2018. The horizontal black dotted lines indicate the average MAC (3.5 $m^2 g^{-1}$) measured at the BCOB period when air mass transport dominated through the high-pollution source region Indo-Gangetic Plain (IGP).

Table S1. Matrix of correlation coefficients (r) for the components measured at BCOB station. Correlations coefficients higher than 0.7 are highlighted in bold.

	OC	EC	WSOC	WIOC	nss-SO_4	NO_3	nss-K	nss-Ca	nss-Mg	NH_4	Na	Cl
OC	**1.00**	**0.85**	**0.95**	**0.99**	0.11	**0.80**	**0.85**	-0.36	-0.44	-0.23	0.22	**0.76**
EC	**0.85**	**1.00**	**0.79**	**0.85**	-0.05	0.55	**0.79**	-0.46	-0.54	-0.22	0.08	**0.74**
WSOC	**0.95**	**0.79**	**1.00**	**0.89**	0.10	**0.76**	**0.78**	-0.41	-0.47	-0.19	0.17	**0.69**
WIOC	**0.99**	**0.85**	**0.89**	**1.00**	0.11	**0.78**	**0.85**	-0.32	-0.42	-0.24	0.23	**0.77**
nss-SO_4	0.11	-0.05	0.10	0.11	**1.00**	0.40	0.28	0.21	0.09	-0.03	0.14	0.22
NO_3	**0.80**	0.55	**0.76**	**0.78**	0.40	**1.00**	**0.77**	-0.12	-0.23	-0.28	0.35	**0.73**
nss-K	**0.85**	**0.79**	**0.78**	**0.85**	0.28	**0.77**	**1.00**	-0.38	-0.43	-0.27	0.30	**0.82**
nss-Ca	-0.36	-0.46	-0.41	-0.32	0.21	-0.12	-0.38	**1.00**	0.53	0.40	0.17	-0.14
nss-Mg	-0.44	-0.54	-0.47	-0.42	0.09	-0.23	-0.43	0.53	**1.00**	0.05	0.63	-0.20
NH_4	-0.23	-0.22	-0.19	-0.24	-0.03	-0.28	-0.27	0.40	0.05	**1.00**	-0.17	-0.27
Na	0.22	0.08	0.17	0.23	0.14	0.35	0.30	0.17	0.63	-0.17	**1.00**	0.46
Cl	**0.76**	**0.74**	**0.68**	**0.77**	0.22	**0.73**	**0.82**	-0.14	-0.20	-0.27	0.46	**1.00**

Table S2. Matrix of correlation coefficients (r) for the components in $PM_{2.5}$ measured at MCOH. Correlations coefficients higher than 0.7 are highlighted in bold.

	OC	EC	WSOC	WIOC	nss-SO_4	NO_3	nss-K	nss-Ca	nss-Mg	NH_4	Na	Cl
OC	**1.00**	**0.74**	**0.72**	**0.93**	0.60	0.21	0.55	0.33	-0.13	0.60	0.27	0.11
EC	**0.74**	**1.00**	0.61	0.64	**0.78**	0.40	**0.74**	0.25	0.04	**0.78**	0.67	0.47
WSOC	**0.72**	0.61	**1.00**	0.60	**0.82**	0.32	**0.77**	0.29	-0.08	**0.83**	0.58	0.52
WIOC	**0.93**	0.64	0.60	**1.00**	0.48	-0.01	0.46	0.32	-0.04	0.49	0.67	0.50
nss-SO_4	0.60	**0.78**	**0.82**	0.48	**1.00**	0.38	**0.94**	0.21	0.05	**0.99**	**0.72**	**0.76**
NO_3	0.21	0.40	0.32	-0.01	0.38	**1.00**	0.32	0.12	0.01	0.38	**0.84**	**0.80**
nss-K	0.55	**0.74**	**0.77**	0.46	**0.94**	0.32	**1.00**	0.15	0.08	**0.95**	**0.70**	0.59
nss-Ca	0.33	0.25	0.29	0.32	0.21	0.12	0.15	**1.00**	0.23	0.19	0.10	-0.20
nss-Mg	-0.13	0.04	-0.08	-0.04	0.05	0.01	0.08	0.23	**1.00**	0.05	-0.04	-0.47
NH_4	0.60	**0.78**	**0.83**	0.49	**0.99**	0.38	**0.95**	0.19	0.05	**1.00**	**0.72**	0.49
Na	0.27	0.67	0.58	0.67	**0.72**	**0.84**	**0.70**	0.10	-0.04	**0.72**	**1.00**	0.59
Cl	0.11	0.47	0.52	0.50	**0.76**	**0.80**	0.59	-0.20	-0.47	0.49	0.59	**1.00**

Table S3. Matrix of correlation coefficients (r) for the components measured at MCOG station. Correlations coefficients higher than 0.7 are highlighted in bold.

	OC	EC	WSOC	WIOC	nss-SO_4	NO_3	nss-K	nss-Ca	nss-Mg	NH_4	Na	Cl
OC	1.00	**0.83**	**0.80**	**0.99**	0.55	**0.68**	0.26	0.56	0.39	0.43	0.53	0.48
EC	**0.83**	**1.00**	**0.67**	**0.83**	**0.79**	0.50	0.10	0.39	0.27	0.63	0.53	0.35
WSOC	**0.80**	**0.67**	**1.00**	**0.73**	0.50	0.53	0.02	0.44	0.26	0.43	0.43	0.38
WIOC	**0.99**	**0.83**	**0.73**	**1.00**	0.53	**0.68**	0.30	0.56	0.39	0.41	0.52	0.47
nss-SO_4	0.55	**0.79**	0.50	0.53	**1.00**	0.30	0.17	0.29	0.22	**0.78**	0.54	0.04
NO_3	**0.68**	0.50	0.53	**0.68**	0.30	**1.00**	0.24	**0.92**	**0.85**	0.00	**0.74**	**0.80**
nss-K	0.26	0.10	0.02	0.30	0.17	0.24	**1.00**	0.31	0.47	0.24	0.04	0.14
nss-Ca	0.56	0.39	0.44	0.56	0.29	**0.92**	0.31	**1.00**	0.91	0.04	0.68	**0.70**
nss-Mg	0.39	0.27	0.26	0.39	0.22	**0.85**	0.47	0.91	**1.00**	-0.04	0.62	**0.74**
NH_4	0.43	0.63	0.43	0.41	**0.78**	0.00	0.24	0.04	-0.04	**1.00**	-0.02	-0.23
Na	0.53	0.53	0.43	0.52	0.54	**0.74**	0.04	0.68	0.62	-0.02	**1.00**	0.68
Cl	0.48	0.35	0.38	0.47	0.04	**0.80**	0.14	**0.70**	**0.74**	-0.23	0.68	**1.00**

Table S4. Monthly average concentrations of black carbon (BC), organic carbon (OC), and major ions (μg m^{-3}) were measured at the Bhola Climate Observatory-Bangladesh (BCOB), Maldives Climate Observatory-Hanimaadhoo (MCOH), Maldives Climate Observatory-Gan (MCOG) from November 2017 to March 2018.

Site	OC	EC	Na^+	Cl^-	NO_3^-	NH_4^+	nss-SO_4^{2-}	nss-K^+
				November-2027				
BCOB	24.4±11	3.3±1.0	0.3±0.2	1.9±1.1	9.9±7.2	3.3±4.0	10.0±5.1	3.1±1.2
MCOH	0.4±0.1	0.2±0.1	0.5±0.2	0.1±0.0	0.1±0.1	3.4±0.2	12.5±0.7	0.4±0.1
MCOG	0.7±0.2	0.2±0.1	2.1±0.5	3.2±0.8	1.7±1.0	0.0±0.0	2.0±1.0	0.6±0.2
				December 2017				
BCOB	23.6±8.1	3.8±1.4	0.4±0.2	2.2±1.5	5.9±3.5	2.8±2.3	7.9±3.4	2.7±1.1
MCOH	2.8±1.8	0.9±0.4	0.9±0.4	0.1±0.1	0.1±0.0	3.5±1.8	12.9±6.0	0.3±0.2
MCOG	0.9±0.7	0.3±0.2	0.4±0.4	0.6±0.6	0.2±0.3	0.5±0.5	1.8±1.7	0.1±0.1
				January 2018				
BCOB	32.2±4.4	3.8±0.4	0.6±0.4	3.9±1.8	16.5±7.4	1.8±1.8	13.7±4.7	3.3±1.0
MCOH	2.7±1.5	1.1±0.6	1.1±0.6	0.2±0.2	0.1±0.0	5.2±4.5	16.1±7.7	0.5±0.4
MCOG	1.2±0.5	0.7±0.2	1.5±1.4	0.6±0.3	0.4±0.4	1.8±1.0	8.3±3.9	0.2±0.1
				February 2018				
BCOB	12.7±5.8	2.1±0.7	0.4±0.4	0.5±0.5	4.7±4.7	6.1±1.8	12.5±4.1	1.5±0.6
MCOH	2.4±1.1	1.2±0.4	0.8±0.4	0.1±0.2	0.1±0.0	4.5±1.6	16.7±5.7	0.5±0.2
MCOG	0.8±0.3	0.4±0.2	1.7±0.7	0.4±0.3	0.4±0.3	0.1±0.0	3.4±1.7	0.1±0.1
				March 2018				
BCOB	11.3±8.4	2.3±1.0	0.3±0.1	1.4±1.5	3.6±4.0	7.0±2.1	13.5±2.3	1.8±0.8
MCOH	1.4±0.9	0.9±0.5	0.5±0.4	0.1±0.2	0.1±0.0	3.5±2.6	12.2±9.6	0.4±0.4
MCOG	0.2±0.2	0.1±0.0	0.6±0.5	0.5±0.5	0.1±0.1	0.1±0.2	1.0±0.8	0.0±0.0