Supplement of Atmos. Chem. Phys., 25, 3389–3412, 2025
https://doi.org/10.5194/acp-25-3389-2025-supplement

Atmospheric Chemistry and Physics Open Access

Supplement of

Size-resolved hygroscopicity and volatility properties of ambient urban aerosol particles measured by a volatility hygroscopicity tandem differential mobility analyzer system in Beijing

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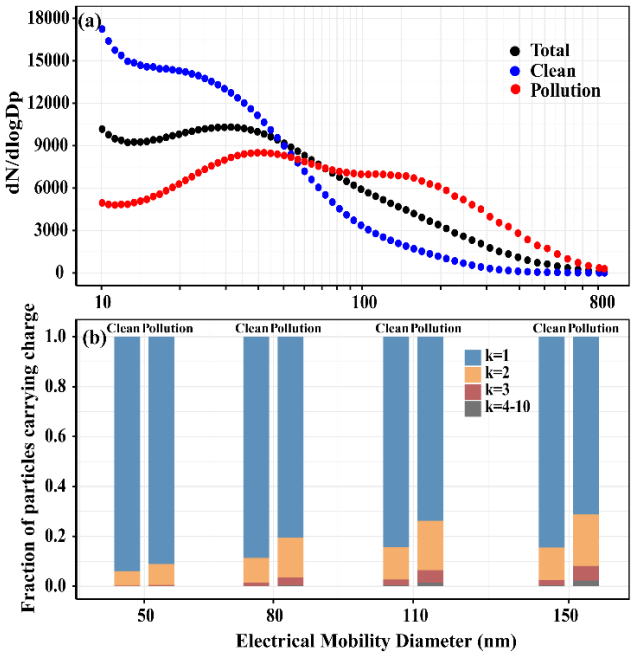

Figure S1. (a) The average particle number size distributions (PNSDs) observed during the total sampling period (black point curve), the clean period (blue point curve), and the pollution period (red point curve), respectively. (b) The number fraction for particles carrying different charges (k) calculated based on charge probability, transfer function of DMA and the PNSD during the clean period and pollution period. For each setting diameter, the left bar corresponds to the clean period, while the right bar corresponds to the pollution period.

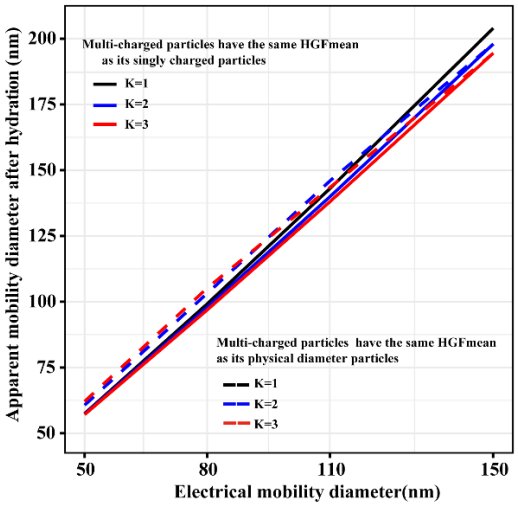

Figure S2. The relationship of apparent electrical mobility diameters of multi-charged particles after hygroscopic growth with its dry electrical mobility diameter. (a) Suppose HGF of the multi-charged particles was the same as that of singly charged particles with the same electrical mobility (solid

line), the mean HGF of total sampling period were used with HGF (50 nm) = 1.15, HGF (80 nm) = 1.24, HGF (110 nm) = 1.30, and HGF (150 nm) = 1.36; (b) Suppose HGF of the multi-charged particles was the same as that of particles of the same physical diameter (dashed line), the mean HGF of total sampling period are used. HGF was interpolated from the measured size-resolved HGF. When the particle's physical diameter exceeded the maximum of the measured size (150 nm), HGF (150 nm) was used (see Table S2 for detail)

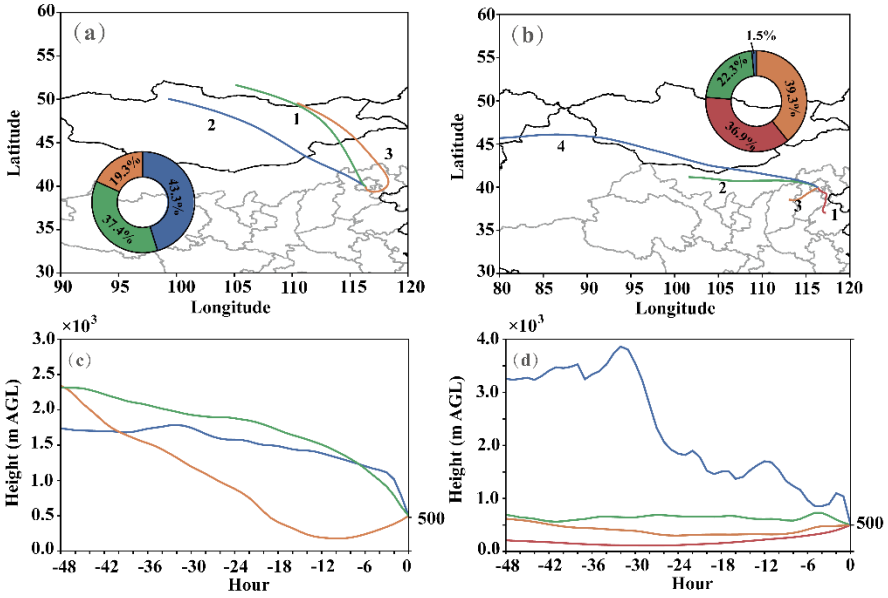

Figure S3. 48-h air mass back trajectories arriving at the height of 500 m AGL at the CAMS site (a) different clusters, (c) the height of the back trajectories of different clusters during the clean period, (b) (d) same as (a) (c), respectively, but during the pollution period.

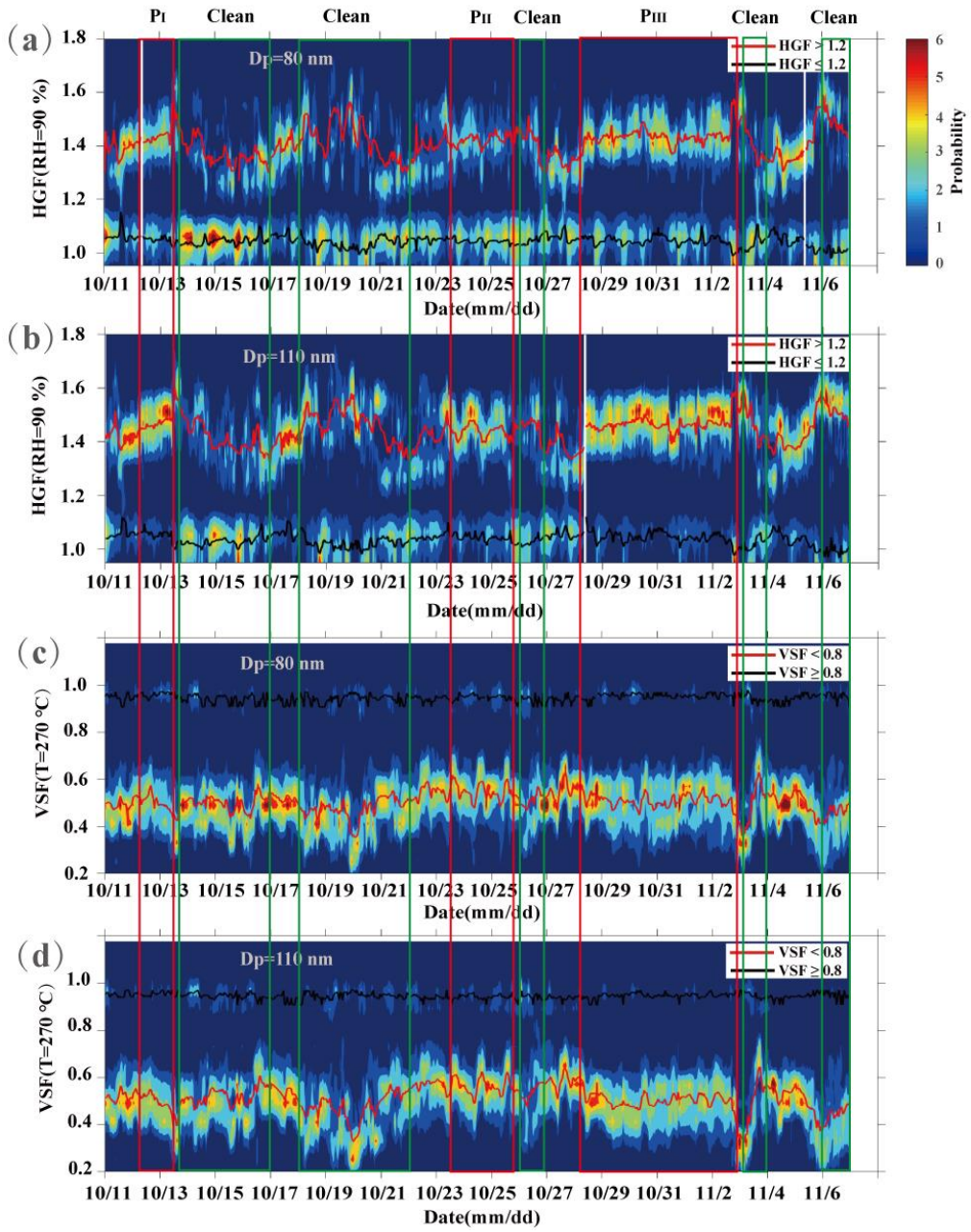

Figure S4. Hygroscopic growth factor probability density function (HGF-PDF) for 80 nm (a) and 110 nm (b) particles at RH = 90%, and volatile shrink factor probability density function (VSF-PDF) for 80 nm (c) and 110 nm (d) particles at T = 270°C. In the HGF-PDFs, the black line represents the mean HGF of the nearly hydrophobic mode (HGF_{NH}), and the red line represents the mean HGF of the more hygroscopic mode (HGF_{MH}). In the VSF-PDFs, the black line represents the mean VSF of the non-volatility mode (VSF_{NV}), and the red line represents the mean VSF of the very volatility mode (VSF_{VV}).

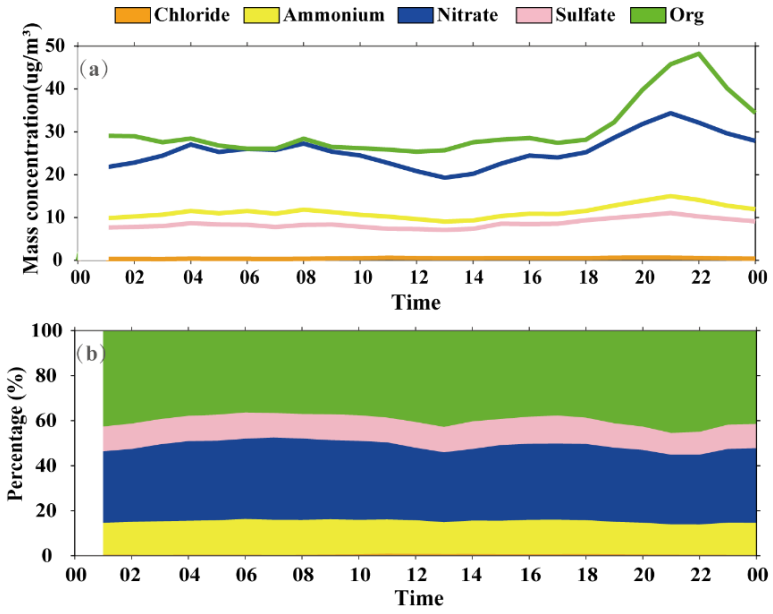

Figure S5. Average diurnal variation of main chemical components in PM_1 during the pollution period based on the available AMS data, (a) mass concentration, (b) mass fraction.

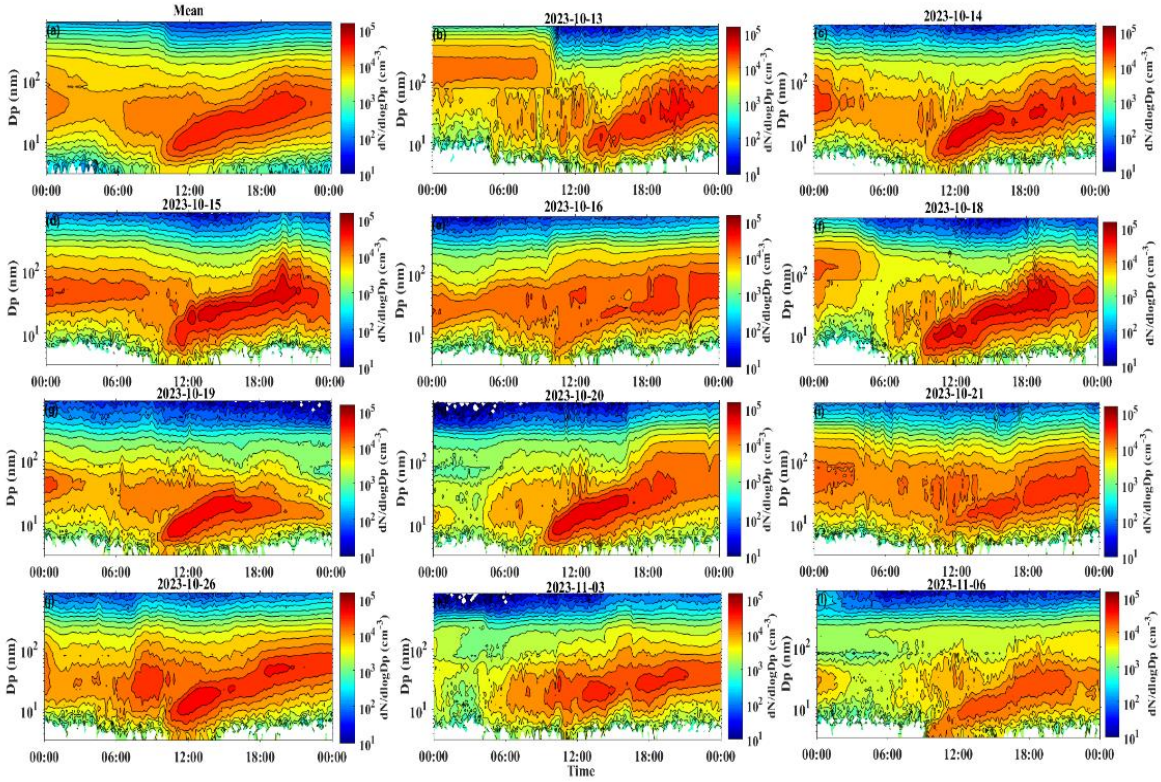

Figure S6. Mean particle number size distribution during the NPF days (a) and particle number size distribution during each NPF day(b-k).

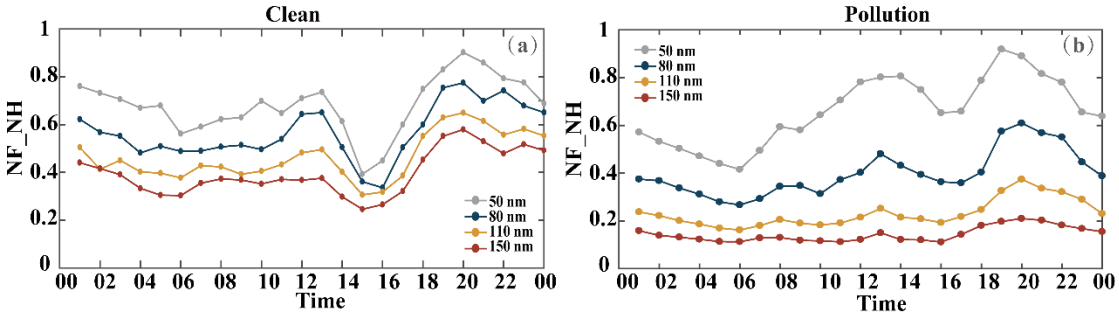

Figure S7. Diurnal variation of the number fraction of nearly hydrophobic particles for different diameters during the clean (a) and pollution (b) periods.

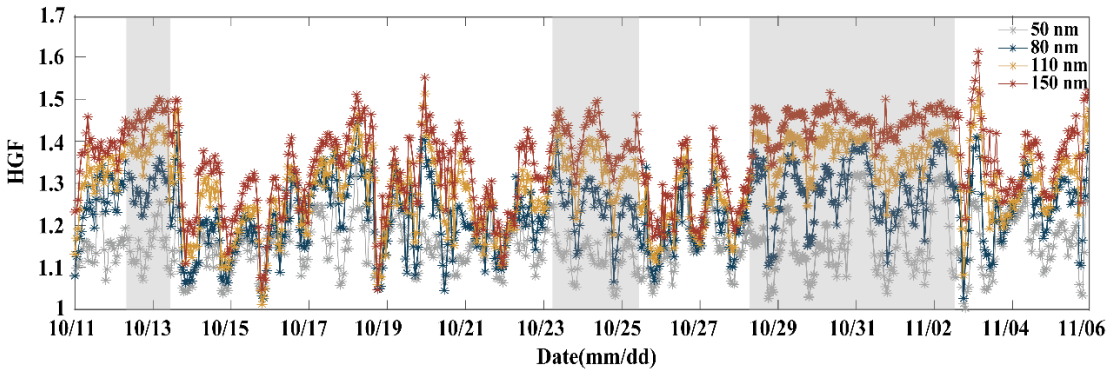

Figure S8. Time series of the hygroscopic growth factor (HGF) during the sampling period. The shadows represent the pollution period.

Table S1. Summary of the size range measured by the DMA after hydration or volatilization for 50-150nm particles under three modes.

CPC number	Mode	Diameter(nm)	Start of scan(nm)	End of scan(nm)
1	V-TDMA	50	10	120
1	V-TDMA	80	10	120
1	V-TDMA	110	10	230
1	V-TDMA	150	10	230
2	H-TDMA	50	30	180
2	H-TDMA	80	30	180
2	H-TDMA	110	60	360
2	H-TDMA	150	60	360
2	VH-TDMA	50	10	120
2	VH-TDMA	80	10	120
2	VH-TDMA	110	10	260
2	VH-TDMA	150	10	260

Table S2. Summary of electrical mobility diameters and their corresponding physical diameters of doubly and triply charged particles, as well as the physical diameters of doubly and triply charged particles after hydration, the apparent electrical mobility diameter after hydration and hygroscopicity used (Temperature =21 °C, Pressure=1013.25 hPa were used in the calculation)

		Electrical mobility diameter (nm)	Physical diameter for different charged particles (nm)			HGF used			Physical diameter after hydration (nm)			Apparent mobility diameter after hydration (nm)		
			Singly	Doubly	Triply	Singly	Doubly	Triply	Singly	Doubly	Triply	Singly	Doubly	Triply
Suppose HGF of the multi-charged particles was the same as that of singly charged particles with the same electrical mobility	The mean HGF of total sampling period are used	50	50	72.9	91.6	1.15	1.15	1.15	57.5	83.8	105.3	57.5	57.2	57
		80	80	119.2	152.4	1.24	1.24	1.24	99.2	147.8	189.0	99.2	97.8	96
		110	110	167.7	218.5	1.30	1.30	1.30	143.0	218.0	284.1	143	139.8	137.8
		150	150	235.4	313.5	1.36	1.36	1.36	204.0	320.1	426.4	204	198.5	194.5
Suppose HGF of the multi-charged particles was the same as that of particles with the same physical diameter	The mean HGF of total sampling period are used	50	50	72.9	91.6	1.15	1.22	1.26	57.5	88.9	115.4	57.5	60.5	62
		80	80	119.2	152.4	1.24	1.31	1.36	99.2	156.2	207.3	99.2	103.1	105
		110	110	167.7	218.5	1.30	1.36	1.36	143.0	228.1	297.2	143	145.8	143.1
		150	150	235.4	313.5	1.36	1.36	1.36	204.0	320.1	426.4	204	198.5	194.5
	The mean HGF of clean period are used	50	50	72.9	91.6	1.15	1.19	1.22	57.5	86.8	111.8	57.5	59.1	60.2
		80	80	119.2	152.4	1.21	1.27	1.32	96.8	151.4	201.2	96.8	100.1	102.2
		110	110	167.7	218.5	1.26	1.32	1.32	138.6	221.4	288.4	138.6	141.8	139.8
		150	150	235.4	313.5	1.32	1.32	1.32	198.0	310.7	413.8	198	192.8	189.8
	The mean HGF of pollution period are used	50	50	72.9	91.6	1.15	1.25	1.31	57.5	91.1	120.0	57.5	61.9	64.2
		80	80	119.2	152.4	1.28	1.39	1.44	102.4	165.7	219.5	102.4	108.8	110.3
		110	110	167.7	218.5	1.36	1.44	1.44	149.6	241.5	314.6	149.6	153.6	150.3
		150	150	235.4	313.5	1.44	1.44	1.44	216.0	339.0	451.4	216	208.3	204.1