Electronic Supplementary Material (ESI) for Environmental Science: Atmospheres.

Supporting information for

An Automated Size and Time-resolved Aerosol Collector Platform Integrated with Environmental Sensors to Study Vertical Profile of Aerosol

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Table S1. SGP TBS sampling summary

STAC Impactor	Impactor 1 (IM1)	Impactor 2 (IM2)	Impactor 3 (IM3)	Impactor 4 (IM4)	Impactor 5 (IM5)
Flight Type	Loitering	Ascending	Loitering	Ascending	Loitering
Altitude	200 m	200-400 m	400 m	400-700 m	700-850 m
Time (UTC)	18:35-19:04	19:05-19:34	19:35-20:04	20:05-20:34	20:35-21:05
Mean CPC Concentration (#/cc)	4807±2473	13959±2479	2228±5865	3123±6750	9777±6750
Mean Temperature (°C)	11.8±0.3	11.1±0.4	10.8±0.2	10.5±0.6	8.3±0.3
Mean RH (%)	27.5±0.5	28.3±0.6	29.0±0.4	29.7±1.4	33.4±0.7
# of CCSEM-EDX Analyzed Particles	1315	1931	1883	1794	1611
Na-rich (%)	1.9	3.6	1.6	1.7	1.6
Na-rich/Sulfate (%)	0.1	0.6	0	0.6	0.1
Sulfate (%)	2.4	7.0	1.0	1.8	2.0
Carbonaceous (%)	91.4	79.8	96.2	93.5	93.7
Dust (%)	2.8	3.7	0.4	0.9	1.5
Si+S (%)	0.1	0.4	0.0	0.1	0.1
K+S (%)	1.0	1.1	0.4	0.8	0.5
Other (%)	0.3	3.8	0.4	0.6	0.5
# of STXM-NEXAFS analyzed particle	440	NA	NA	NA	NA
OC (%)	79.3	NA	NA	NA	NA
OC+IN (%)	9.1	NA	NA	NA	NA
OC+EC (%)	8.4	NA	NA	NA	NA
OC+EC+IN (%)	3.2	NA	NA	NA	NA

Table S2. SAIL ground sampling summary

	Stage A	Stage B	Stage C	Stage D
Na-rich (%)	1.5	1.1	0.2	0.0
Na-rich/Sulfate (%)	0.8	3.9	2.6	1.2
Sulfate (%)	26.7	31.8	43.7	10.9
Carbonaceous (%)	29.2	36.4	46.0	86.8
Dust (%)	24.7	21.2	5.3	0.7
Si+S (%)	12.3	3.7	0.9	0.3
K+S (%)	4.0	1.5	0.6	0.0
Other (%)	0.8	0.4	0.6	0.1

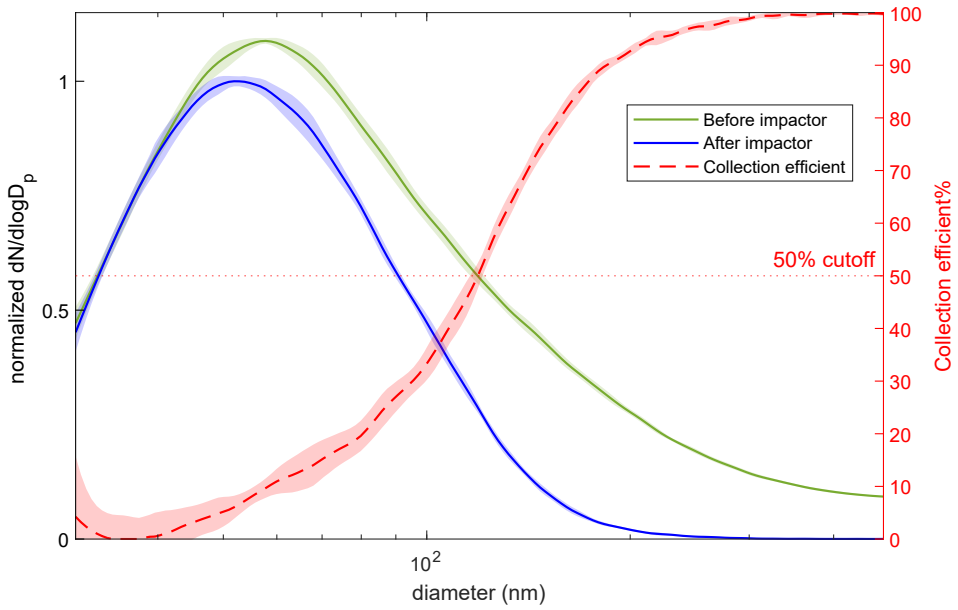

Figure S1. Representative normalized average particle size distribution normalized before (solid green line) and after (solid blue line) STAC impactor stage D and size-resolved collection efficient (red dash line). Size distributions were normalized by the size distribution mode after the STAC impactor. Shaded areas represent measurement uncertainties. The dp50,exp was determined as the diameter where collection efficiency (calculated by equation 3) equals 50%.

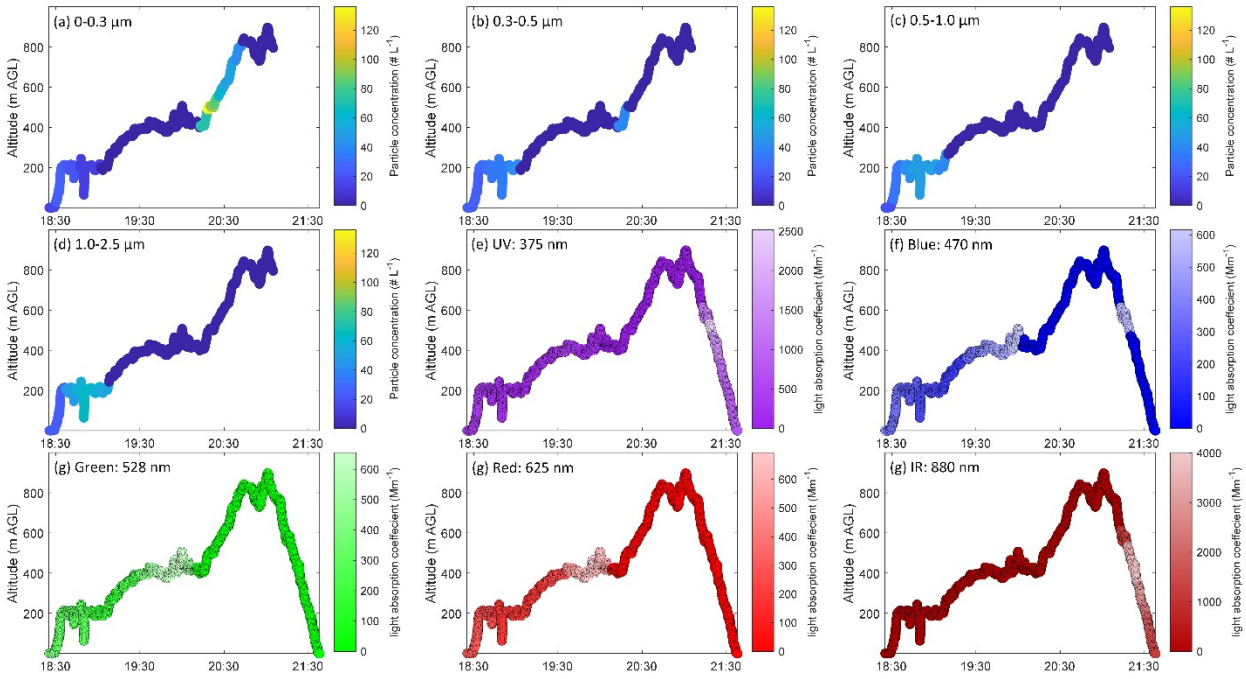

Figure S2. Particle concentration from OPC and light-absorption coefficient from microAeth profile during the flights on February 14th, 2022, at the ARM SGP site. The time is in UTC. (a to d) show the particle concentration profile in size range of 0-0.3 µm, 0.3-0.5 µm, 0.5-1.0 µm, and 1.0-2.5 µm, respectively. Color

bars represent the particle concentration (# L^{-1}). (e to g) show the light-absorption coefficient profile of ultraviolet (UV, 375 nm), blue (470 nm), green (528 nm), red (625 nm), and infrared (IR, 880 nm), respectively. Color bars represent the value of the light-absorption coefficient (Mm^{-1}).

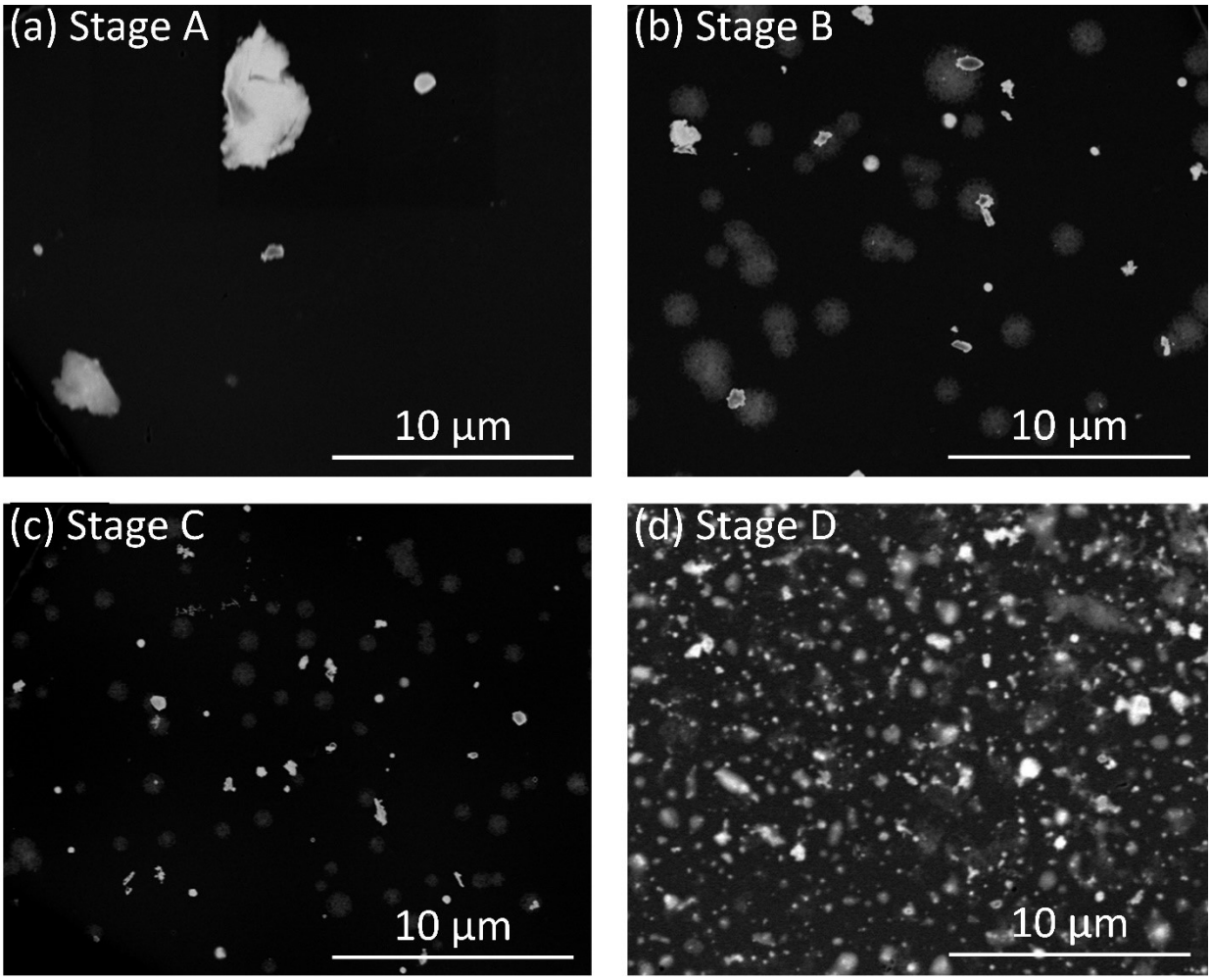

Figure S3. Representative ESEM images of particles collected on (a) Stage A, (b) Stage B, (c) Stage C, and (d) Stage D for the IM5 (850 m) sample.