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Supplement of

Measuring the morphology and density of internally mixed black carbon with SP2 and VTDMA: new insight into the absorption enhancement of black carbon in the atmosphere

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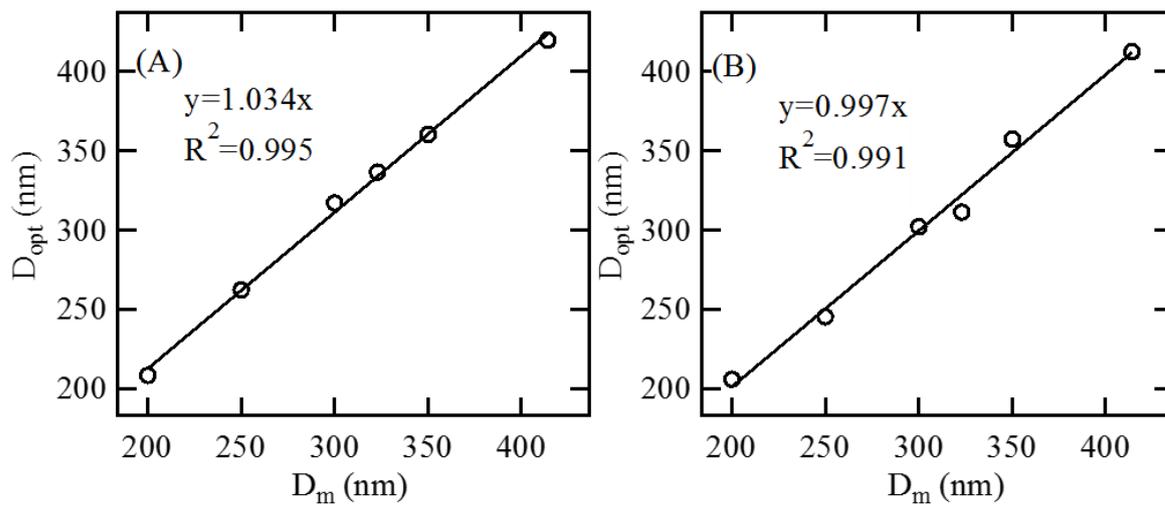
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1 For ambient BC-free and BC-containing particles, the optical diameters at peaks of
2 number size distribution derived from SP2 measurement were chosen to compare with
3 the prescribed mobility size (through DMA), shown in Fig. S1. The difference between
4 optical size and mobility size was 3% and 0.3% for ambient BC-free particles and BC-
5 containing particles, respectively. The excellent coherence demonstrated the validity of
6 LEO method for ambient measurements.

7 In our study, two types of ambient BC particles was divided based on the delay time
8 distribution, shown in Fig. S2. The observed two peaks of delay time distribution is due
9 to the difference in behavior of Ex-BC and In-BC particles during SP2 measurement.
10 The first peak with lower delay time represents the Ex-BC particles. Corresponding,
11 the second peak is considered as the proxy of In-BC particles. Therefore, the particles
12 with delay time more than 1.6 μs was chose to investigate their core morphology and
13 density.

14 The RI_{nonBC} was determined by combining SP2 and VTDMA measurements in our
15 study. In previous SP2 studies, the RI_{nonBC} is usually given an assumption value of
16 around 1.50. The RI_{nonBC} shown in Figure S3 was calculated using the scattering
17 properties from SP2 measurement and particle sizes from DMA1, respectively. The
18 RI_{nonBC} distribution ranged from 1.2 to 1.8 for single charged non-BC particles at 200-
19 350 nm. We selected the peak value of 1.42 as the RI_{nonBC} for Mie theory calculations.

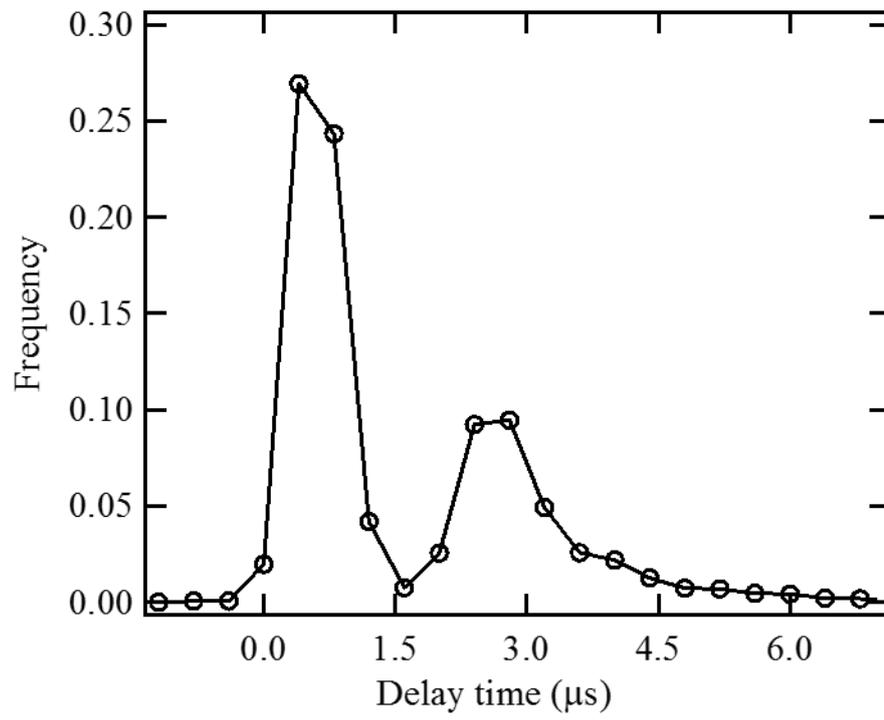
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1

2 Figure S1. Mobility size vs. optical size for ambient BC-free particles (A) and BC-
3 containing particles (B) observed in Xianghe site.

1



2

3 Fig. S2. The distribution of delay time in our SP2 measurement.

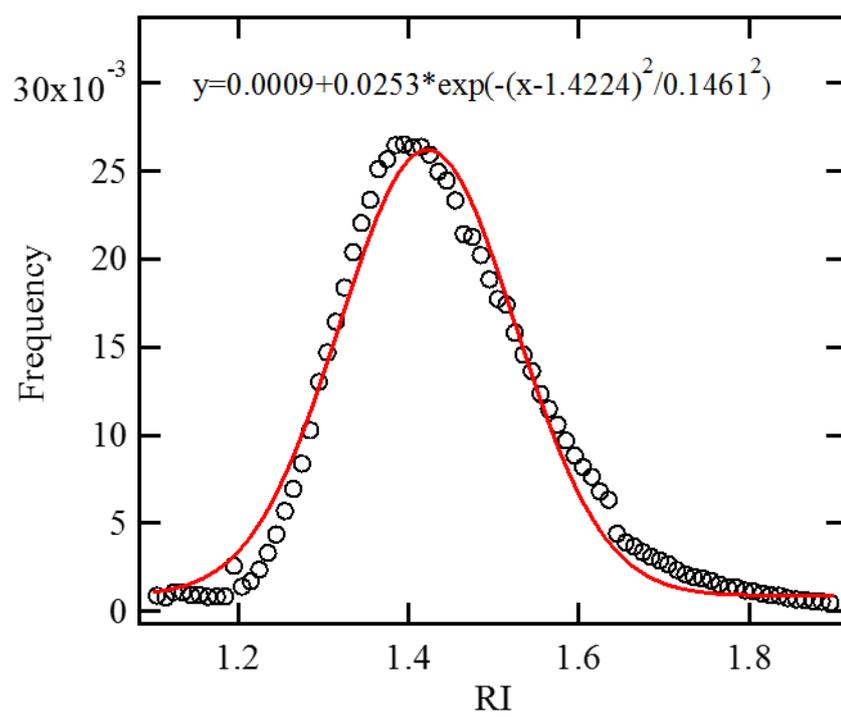


Fig. S3. The RI distribution for non-BC particles.

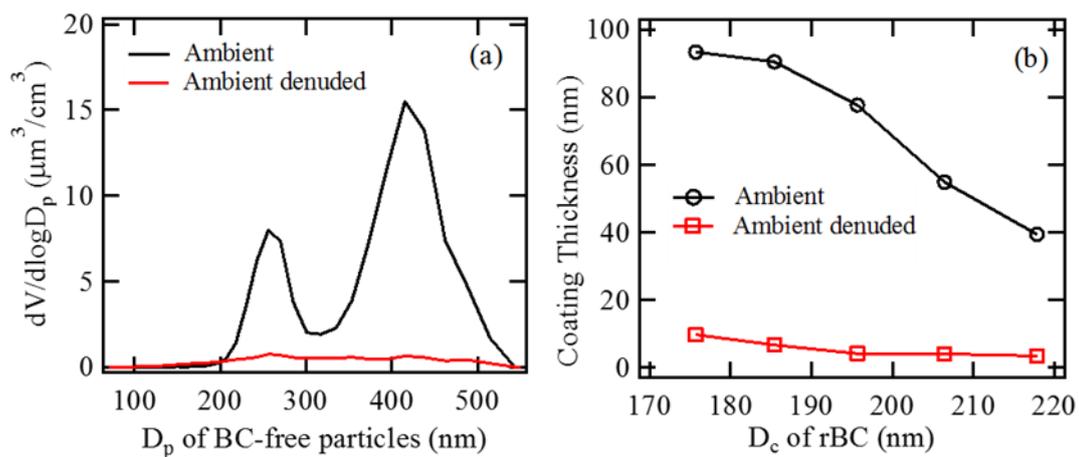


Figure S4. The removal of non-refractory component for ambient BC-free and BC-containing particles using a thermo-denuder at 300 °C: (a) the volume size distribution of ambient BC-free particles before and after heating, (b) coating thickness of size-resolved rBC. The ambient particles was selected by the DMA1 prescribed 250 nm.