



Supplement of

Size distribution and mixing state of black carbon particles during a heavy air pollution episode in Shanghai

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1 **1. SP2 data analysis and a way to enhance the LEO-fit accuracy**

2 The SP2 data were analyzed using PSI v4.100 (Martin Gysel, Paul Scherrer Institute, 5232
3 Villigen, Switzerland) for the IGOR Pro software package (Wavemetrics, Inc., Portland, OR,
4 USA).

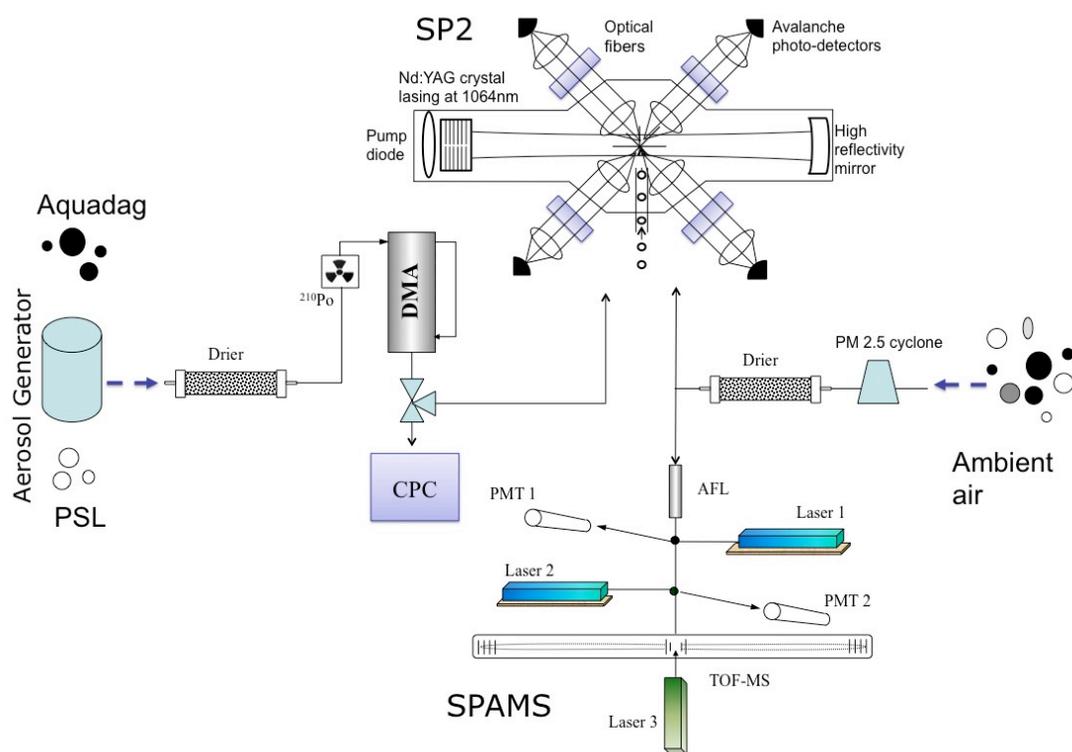
5 The small particles are not necessarily heated to full incandescence in SP2. Therefore, one can
6 get a peak that is smaller than it should be for a small mass of BC because the particle is not
7 getting sufficiently hot. Furthermore, a high-gain on the narrowband detector, as used in this
8 work, can introduce a decrease for the smallest particle sizes. The color ratio could possibly help
9 with this issue. The color ratio was calculated from the ratio of the broadband to narrowband
10 signals (Moteki and Kondo, 2010). We excluded BC-containing particles with color ratio in
11 excess of 3.0 from analysis. This improved the LEO-fit accuracy, especially for small core
12 BC-containing particles.

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14 **Table S1.** Symbols and abbreviations

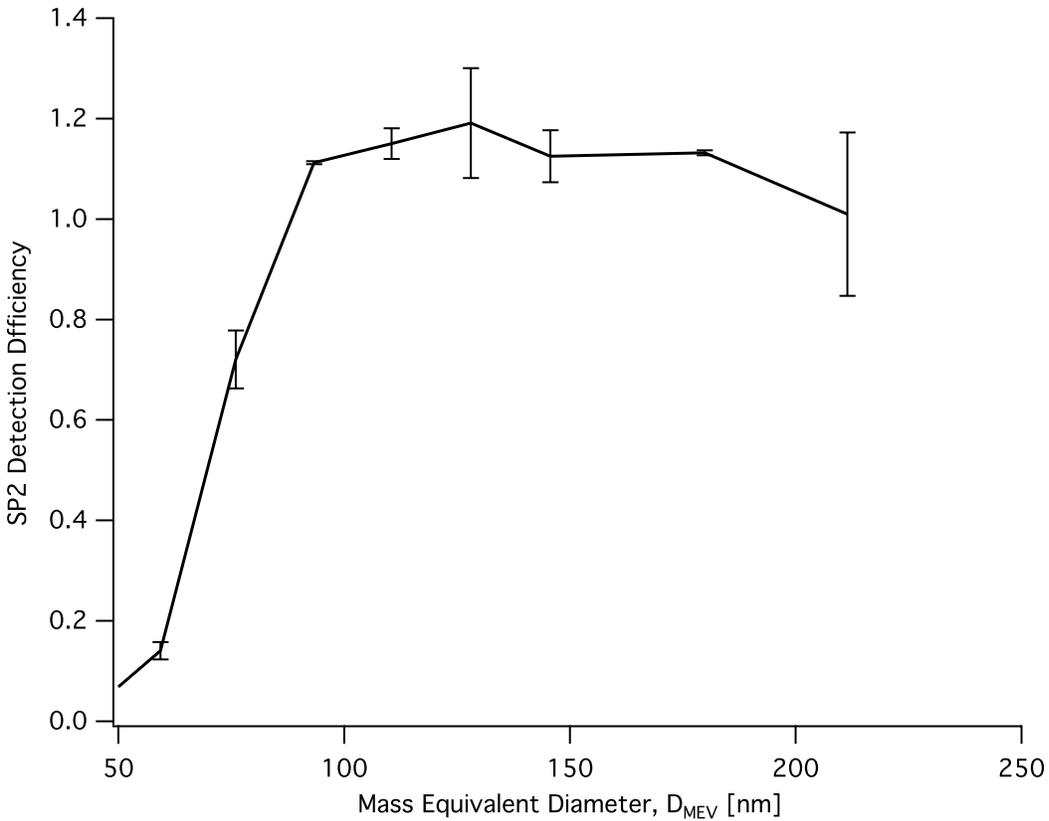
Symbol or abbreviation	Meaning
BC	Black carbon
D_c	The black carbon core diameter
D_p	The entire particle diameter
D_{ME}	Mass equivalent diameter
D_{va}	The vacuum aerodynamic diameter
SP2	Single-particle soot photometer
SPAMS	Single particle aerosol mass spectrometer
sccm	Standard-state cubic centimeter per minute
ACT	Absolute coating thickness
RCT	Relative coating thickness

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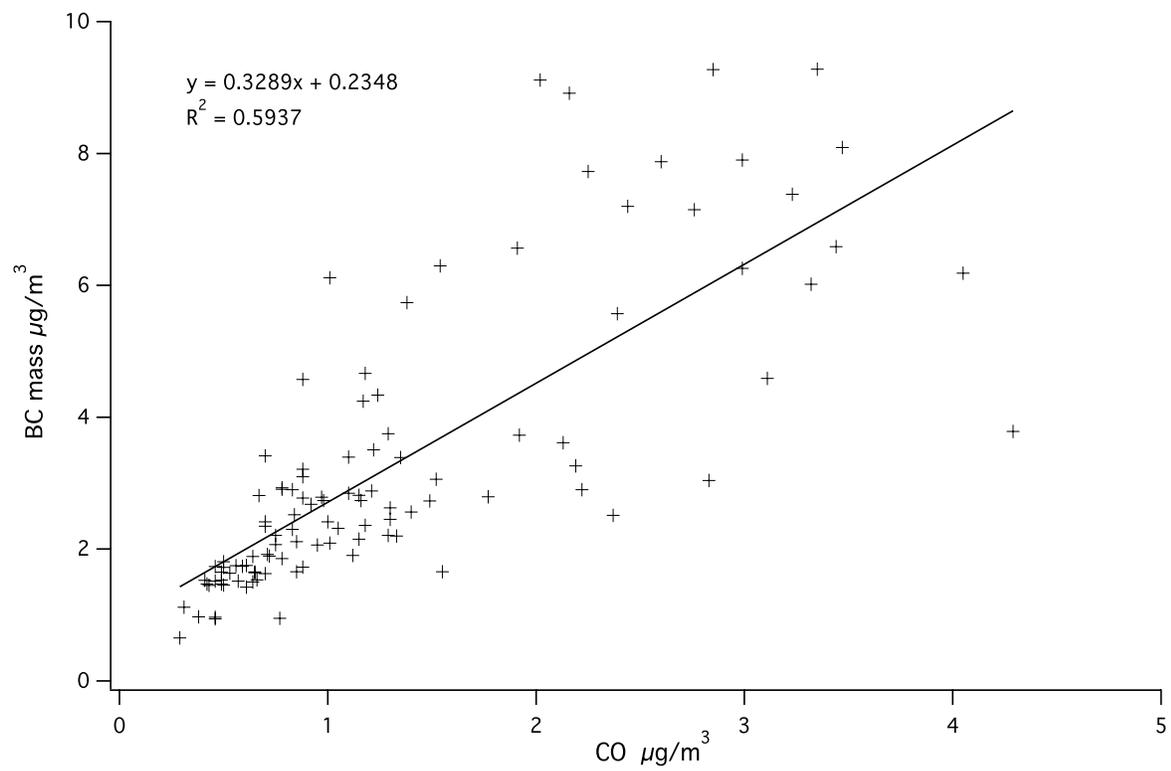
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17 **Figure S1.** A schematic diagram of the calibration and measurement system. The DMA, CPC,
 18 SP2 and SPAMS represent Differential Mobility Analyzer, Condensation Particle Counter,
 19 Single Particle Soot Photometer, and Single Particle Aerosol Mass Spectrometer, respectively.



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21 **Figure S2.** The average detection efficiencies in each BC size-bin at fixed laser intensity
 22 (1750 mA). Whiskers represent the standard deviation of the values in each size bin. In
 23 order to understand the mass and number size distribution of ambient BC particles, here
 24 we transformed the mass equivalent diameter (D_{MEV}) of Aquadag[®] BC to D_{MEV} of
 25 ambient BC according to their mass and different density

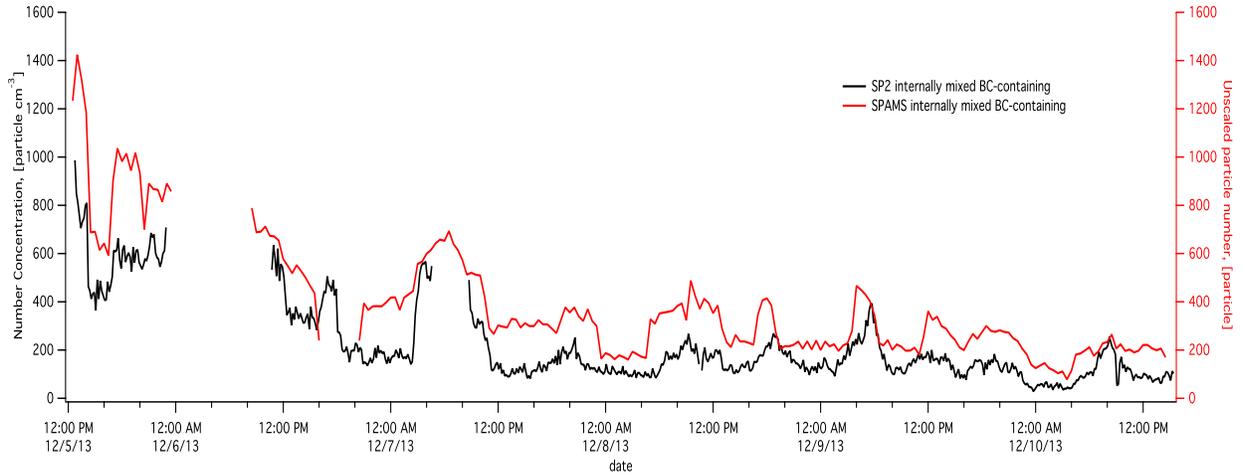


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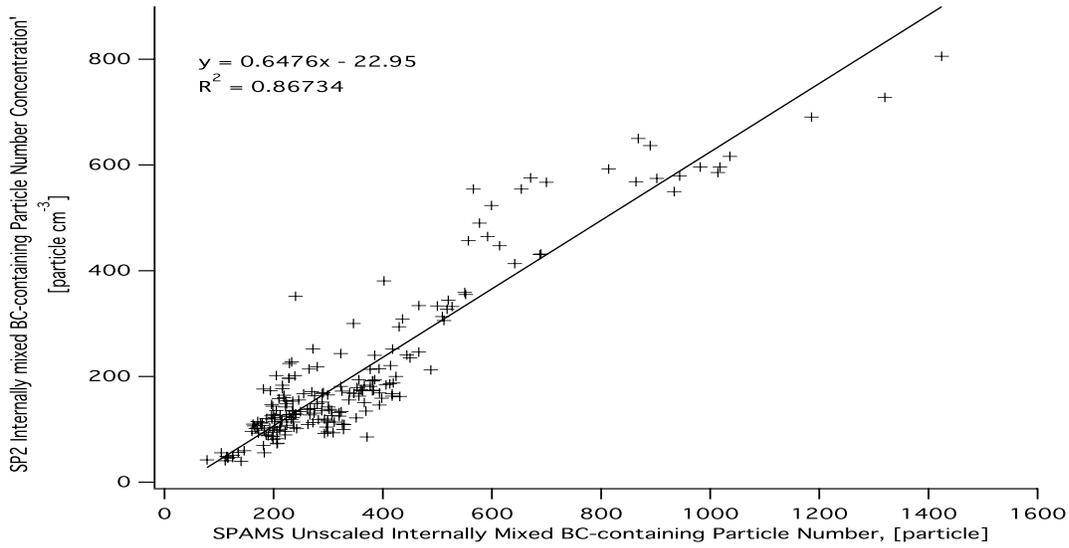
27 **Figure S3.** A comparison between the measured CO and BC mass concentration.

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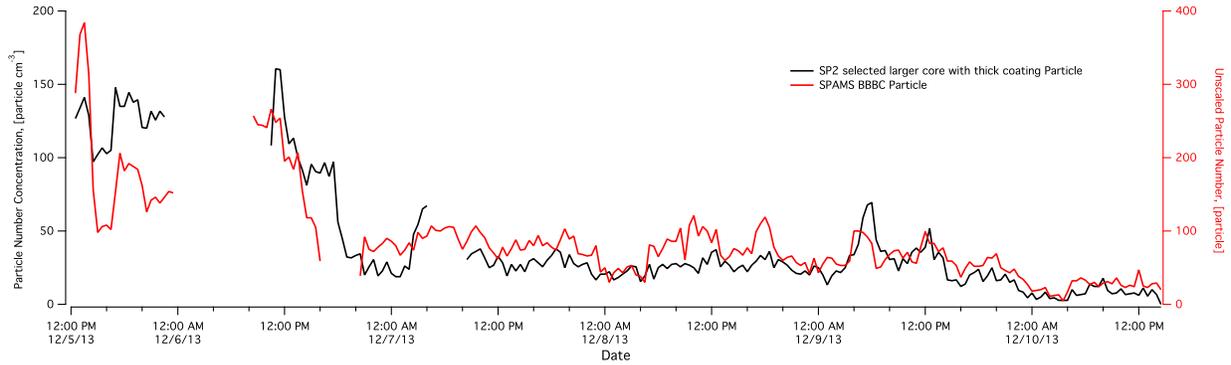
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32 **Figure S4.** A comparison of the SPAMS-detected and SP2-detected internally-mixed

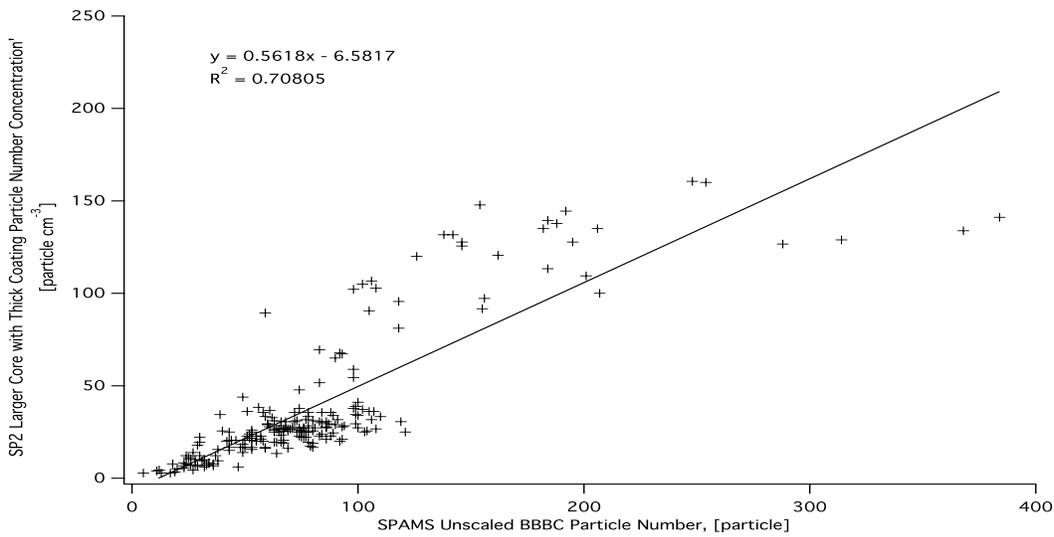
33 BC-containing particles.

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38 **Figure S5.** A comparison of the SPAMS-detected and SP2-detected biomass burning
39 BC-containing particles.

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41 **References**

42 Moteki, N., and Kondo, Y.: Dependence of laser-induced incandescence on physical
43 properties of black carbon aerosols: Measurements and theoretical interpretation, *Aerosol*
44 *Sci. Technol.*, 44, 663-675, 2010.

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