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Improved Technique to Measure the Size Distribution of Black Carbon Particles Suspended in Rainwater and Snow Samples

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Black carbon (BC) aerosols strongly absorb visible solar radiation. Quantitative understanding of wet removal process, which strongly affects the spatial distribution of BC, is important to improve our understandings on climate change. For this purpose, a measurement technique for BC in rainwater and in snow samples has been developed, as a combination of a nebulizer and a single particle soot photometer (SP2) (Ohata et al. 2011, 2013; Mori et al. 2014). We show two important improvements in this technique: (1) We have introduced a pneumatic nebulizer and experimentally confirmed its high extraction efficiency (∼50%) independent of particle-size up to 2 μm. (2) We have extended the upper limit of detectable BC size range by the SP2 from 0.9 μm to 4 μm by modifying a photo-detector for incandescence. Using this technique, we have measured the size-resolved mass concentration in air and in rainwater, simultaneously, during last summer in Tokyo. We observed significant amounts of BC particles with diameters larger than 1μm in rain samples. The correlation between BC mass concentration in air and in rainwater was high (r^2 = 0.59), suggesting that the major sources of BC in rainwater were BC in the atmospheric planetary boundary layer. The size distribution of BC in rainwater was shifted to larger size as compared with that in air, indicating that larger BC particles in the air were removed more efficiently by precipitation.

Keywords: Black Carbon, Measurement, Wet deposition