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Evaluation of the method to measure black carbon particles suspended in rainwater and snow samples

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The mass concentrations and size distributions of black carbon (BC) particles in rainwater and snow are important parameters for improved understanding of the wet deposition of BC. In this study, we have made a detailed evaluation of the method to measure these parameters. The method consists of an ultrasonic nebulizer (USN) and a Single Particle Soot Photometer (SP2). The USN converts sample water into micron-size droplets at a constant rate and then extracts BC particles to air by drying the water droplets. The mass of individual BC particles is measured by the SP2, based on the laser-induced incandescence technique. The loss of BC particles during the extraction process from liquid water to air depends on their sizes. We determined the size-dependent extraction efficiency using polystyrene latex spheres (PSLs) with twelve different diameters between 107-1025 nm. The PSL concentrations in water were measured by the light extinction at 532 nm. The extraction efficiency of the USN showed broad maximum of about 10% in the diameter range of 200-500 nm, and decreased substantially at larger sizes. Total uncertainty and reproducibility of the measured mass concentration of BC in sample water were +-40% and +-35%, respectively. Measured BC size distributions in rainwater and surface snow collected in Tokyo, Okinawa, and Sapporo showed negligible contribution of the BC particles larger than 600 nm to the total BC amounts. However, surface snow collected in Greenland sometimes contained significant amount of larger BC particles, beyond the upper detection limit of the present method.

Keywords: black carbon, wet deposition