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Dependence of the size distribution of BC in snow on thawing temperature

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Black Carbon aerosols(BC), mainly consists of soot or soot like matter generated by the combustion of fossil fuel or biomass, absorb the solar radiation to heat the atmosphere. Moreover, BC deposited on snow decrease the snow albedo and contribute to the warming in the higher latitudes. Therefore, BC have the significant influence on the climate but quantitative estimation of it has a large uncertainty, For example, IPCC(2013) estimated the radiative forcing by BC on snow to 0.04(0.02-0.09)(W/m^2), but in Flanner et al.(2007) estimated to 0.049(0.007-0.12)(W/m^2). The snow albedo is estimated by a radiative transfer model in the snow layers considering snow grain size and impurities such as BC. The size distribution of BC particles in snow is significant to estimate BC influence on the snow albedo.

We are measuring the size distribution of BC mass concentration in snow with the incandensence method (MacConel et al. 2007). Before the measurement, snow samples are melted and are aerosolized by a nebulizer. In these procedures, there are some factors to reduce the accuracy or precision. One of them is the influence of the thawing temperature of snow samples on the size distribution of BC in the thawing snow. Many researchers (e.g. Brandt et al., 2011) heated to thaw out snow faster. However, Schwarz et al.(2012) suggested that the size distribution of BC in the thawed snow could be varied with the thawing temperature significantly. In this paper, we present the experiment to examine the thawing temperature influence on the measurement of BC in snow by the incandensence method and the results.

We adopted two snow samples obtained at Hakusan and Shirouma in 2013 for this experiment. The snow samples are well uniformed with a mixer and are divided into 9 bottles, respectively. 3 bottle samples were melted at 70 ℃,20 ℃ and 5 ℃, respectively, using a water bass. Then, we measured the size distribution of BC mass concentration in the melted snow in each bottle with the SP2 instrument.

The mass concentration of BC in the lower thawing temperature samples was higher than those in the higher temperature samples. Their ratio between samples melted at 5 ℃ and 70 ℃ was 40.8% for the Hakusan snow case, and 11% for Shirouma snow case. Smaller size of BC was more sensitive to the thawing temperature. These result showed that the thawing temperature has a significant influence on the mass concentration and size distribution of BC in thawing snow, and that lower thawing temperature is better for the measurement of size distribution of BC mass concentration in snow. Because not only the temperature but also thawing/preserve time may affect the size distribution of BC in the thawing snow BC, we are planning of next experiment to examine the time influence.

Keywords: snow, BC, size distribution, SP2, thawing temperature