Measurement of black carbon aerosol in Asian outflow – Implication for heating effect

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Black carbon (BC) aerosol, a by-product of incomplete combustion of fossil fuels and biomass burning, contributes to global and regional radiative forcing. BC efficiently absorbs solar visible radiation, leading to heating of the atmosphere. The physicochemical properties of BC strongly depend on mixing state. If BC is internally mixed with other compounds such as sulfate and organics, the light absorbing property of BC could be largely enhanced. Therefore, it is extremely important to understand the mixing state of BC. So far, our group has investigated the mixing state of BC using a single-particle soot photometer (SP2) [Moteki et al., 2007; Shiraiwa et al., 2007]. To investigate the mixing state of internally mixed BC aerosol, we modified SP2 by introducing a new scattering detector. The purpose of this study is to investigate the mixing state of BC in Asian outflow and to estimate the heating effects on regional climate by BC.

Ground-based observation was conducted at the Fukue Island (32N, 129E) in March-April 2007. Based on back-trajectory analysis, the observed air masses were classified into 5 types according to their possible source regions: China (19%), Korea (17%), Japan (11%), marine (10%), and free troposphere (20%). The concentration of aerosols and trace gases showed enhancement in continental polluted air mass (China and Korea). For example, the average mass concentration of BC in China air masses was 1.1 ug/m3, whereas that in marine air mass was only 0.34 ug/m3. The peak diameter of BC in mass size distribution was ca. 220 nm, regardless of the air mass types. This value is high compared to that of 150 nm measured in Tokyo [Shiraiwa et al., 2007]. The shell/core ratio increased in continental polluted air mass, reaching to ca. 1.6 with core diameter (D) of 200 nm. PMF analysis was applied to investigate the relative contributions of different materials to the BC coating. It has been found that organics and sulfate are major contributors to the coating of BC particles in Asian outflow during the measurement period.

Absorption coefficient of BC aerosol in Asian outflow was estimated with wavelength of 532 nm, assuming the shell/core model of Mie theory. Mixing state of BC is found to be critical in calculating absorption coefficients. In continental polluted air mass, they showed 2-3 times higher than those in clean air, which showed possible influence on regional climate by heating the atmosphere.