Seasonal features of black carbon concentrations and the potential sources at Syowa Station, Antarctica

*Keiichiro Hara[1], Kengo Sudo[2], Takato Ohnishi[2], Kazuo Osada[2], Masanori Yabuki[3], Masataka Shiobara[4], Takashi Yamanouchi[4]

1. Fukuoka University, 2. Nagoya University, 3. RIHS, Kyoto University, 4. National Institute of Polar Research

Black carbon (BC) in the atmosphere has strong light-absorption ability. Because of the light-absorption, BC are related closely to atmospheric radiation budget and climate impact. In polar and cold regions, BC can modify considerably surface snow albedo through BC deposition onto snow surface. BC concentrations in the Antarctic regions are lower than the other sites, because of low source strength of BC in the Antarctic Circle. Thus, contribution of BC to atmospheric radiation and change of surface snow albedo is negligible at the moment. Furthermore, the low BC source strength means that BC might be supplied by long-range transport from mid- and low- latitudes to the Antarctic area. In other words, BC can be used as “tracer” of long-range transport to the Antarctic regions. This study aims to elucidate seasonal features of BC in the Antarctic coasts, its potential source, potential source areas, and transport processes.

We have measured BC concentrations at Syowa Station, Antarctica using 7-wavelength aethalometer (AE31, Magee Sci.) since February 2005 (JARE 46). When wind blows from main area of Syowa station to the observatory, aerosol data were contaminated. Before analysis, BC data were filtered using meteorological data (wind speed and direction) and condensation nuclei concentrations measured by condensation particle counter (3010, TSI). CHASER model was used to understand potential BC source and potential source area.

BC concentrations ranged in BDL (below detection limit: 0.6 ng m^{-3}) –114.5 ng m^{-3} (mean: 4.8 ng m^{-3}, median: 3.3 ng m^{-3}) during our measurements. This BC concentrations was similar to BC concentrations observed at other coastal Stations; Neumayer (Weller et al., 2013) and Halley (Wolff and Cachier, 1998). Seasonal features of BC showed maximum in September and minimum in January-March at Syowa Station, whereas BC maximum and minimum were observed in October and April-May, respectively, at Neumayer and Halley (Wolff and Cachier, 1998; Weller et al., 2013). Compared to previous works (Wolff and Cachier, 1998; Pereira et al., 2006; Weller et al., 2013), BC concentrations were lower in higher latitudes in the Antarctic regions. This latitudinal gradient implies that BC was supplied by long-range transport to the Antarctic area. Indeed, high BC concentrations were observed in the air masses transport from south America and southern Africa (Fiebig et al., 2009; Hara et al., 2010). CHASER model showed that biomass burning in south America and southern Africa have important contribution to BC at Syowa Station, Antarctica.

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