Evaluation of BC and CO emission inventory based on long-term in-situ observations over East Asia

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Compared to carbon dioxide (CO_2), which is a major long-lived greenhouse gas, the influence of black carbon (BC) to global warming is not negligible among the short-lived components. To improve the bottom-up emission inventory for enhancing the understanding level of BC, the measured ΔBC/ΔCO ratios were compared with those from the Regional Emission inventory in Asia (REAS) version 2.1 bottom-up inventory. The measurements were conducted at two sites in Korea (Baengnyeong; 124.63˚ E, 37.97˚ N, and Gosan; 126.17˚ E, 33.28˚ N) and two sites in Japan (Noto; 137.36˚ E, 37.45˚ N, and Fukuoka; 130.47˚ E, 33.52˚ N). The instruments for measuring CO concentration are same at all sites as Model 48i (Thermo Fisher Scientific), however, the instruments for BC were different depends on the sites (sunset EC/OC analyzer in Baengnyeong, Continuous Light Absorption Photometer in Gosan, Multi-Angle Absorption Photometer in Noto and Fukuoka). Based on the backward trajectories during past 120 hours calculated from HYSPLIT model, all trajectories were assigned to six study domains which divided by country and/or administrative district (East China, North China, Northeast China, South Korea, North Korea, and Japan). To exclude the wet-removal effect, the ΔBC/ΔCO ratio was considered only when the accumulated precipitation along a backward trajectory (APT) for three days is equal to zero. Also, we confirmed that the comparison of ΔBC/ΔCO by six study domains could be reasonable since there were no significant differences in ΔBC/ΔCO ratio depending on traveling time (dry deposition effects) and residence time over the emission source areas. Compared to measured ΔBC/ΔCO ratio (6.6 –8.4 ng/m^3·ppb), ΔBC/ΔCO from REAS emission inventory (8.0 ng/m^3·ppb for East China –23.2 ng/m^3·ppb for South Korea) were overestimated by factor 1.2 for East China to 2.9 for South Korea whereas those for North Korea (3.7 ng/m^3·ppb from REAS) was underestimated by factor 2.0. The measured ΔBC/ΔCO ratios in Japan (6.8 ng/m^3·ppb) were similar to those from REAS emission inventory (6.5 ng/m^3·ppb). The seasonal and spatial differences of ΔBC/ΔCO ratios between measured and emission inventory will be examined to identify the over- and under-estimated administrative districts.

Keywords: Black Carbon, Carbon monoxide, REAS emission inventory, ΔBC/ΔCO ratios

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