6.145 Observations of atmospheric black carbon mass concentrations from East Asia to the open oceans: Constraining emission strengths and wet deposition rates.

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Abstract:

Both emission strengths and removal rates of black carbon (BC) particles need to be known to elucidate their atmospheric behavior and impact on the Earth's climate. However, they are still poorly characterized. We selected COSMOS and SP2 instruments as reliable instruments and conducted long-term observations at remote sites in Asia and over the Arctic/Pacific/Indian Oceans using R/V *Mirai* of JAMSTEC, to provide unique information on wet removal rates and the emission strengths of important source regions (China and others). Here we focus on the long-term (2009–2015) measurements at Fukue Island, western Japan (Kanaya et al., ACPD, 2016), receiving outflow from the major source regions within 6–46 hours. Wet removal of BC was clearly suggested from decreasing trend in the observed ΔBC/ΔCO ratios against the accumulated precipitation along backward trajectories (APT) for the last 3 days. The remaining fraction of BC in the atmosphere was fitted reasonably well by a stretched exponential decay curve against APT; a single set of fitting parameters was sufficient to represent the results for air masses originating from different areas. An accumulated precipitation of 15.0 ± 3.2 mm halved the BC mass concentration. BC/CO emission ratios estimated from cases with zero APT (5.2–6.9 ng m^{-3} ppb^{-1}) varied over the air mass origin areas. The significantly higher BC/CO emission ratios adopted in the Regional Emission inventory in Asia (REAS) version 2 (8.3–23 ng m^{-3} ppb^{-1}) over CEC and Korea needed to be reduced at least by factors of 1.3 and 2.8, respectively, but the ratio for Japan was reasonable. After correcting for the wet removal effect, trends in the BC mass concentrations were almost flat for the air masses from CEC and Korea and decreasing for those from Japan during 2009–2015. This long-term data set will provide a benchmark for testing regional/global-scale model simulations.