Budget analysis of aerosols in China: interannual variation in aerosol concentration and outflow

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Aerosols and their precursor emitted from polluted regions strongly influence climate and atmospheric environment not only at local areas but also in remote areas due to long-range transport. Therefore, it is needed to investigate temporal variations of aerosol concentration in source region and associated ouflow from the region in order to evaluate impacts of air pollutants on climate and atmospheric environment. In this study, we evaluate main factors of changes in aerosol concentrations in the China region (18°N-46°N, 104°E-123°E) and aerosol outflow there focusing on black carbon (BC) and sulfur oxides (SOx) by budget analysis of aerosols using a global chemical climate model CHASER. As a consequence, we found that aerosol outflow from the China region has a seasonal peak in winter and the outflow across the east boundary in the region and the inflow across the west boundary both have peaks on March. Our analysis also shows that variations of net zonal outflow largely contribute to the interannual variability of outflow from the China region. We also found that aerosol outflow largely controls the interannual variation of aerosol concentration in the China region (deposition in the region makes only a small contribution to it). Additionally, our sensitivity experiments with BC emission which has a positive radiative forcing and climate impacts, indicate that the domestic sources in the China region and long-range transport from India account for 75% and 12% of the tropospheric BC burden in the China region, respectively. About a half of the BC inflow across the west boundary in the China region is contributed from BC emitted from India. BC emitted from the China region and from India contribute by about 60% and 20% respectively to the total BC outflow across the east boundary. This study, therefore, suggests that BC transported from South Asia such as India influence variabilities of BC concentration in China, and this BC can be farther transported to Japan and the North Pacific regions.

Keywords: aerosol, long-range transport, black carbon, China

