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A study on the aerosol optical properties over East Asia using a combination of CMAQ-simulated aerosol optical properties and remote-sensing data via a data assimilation technique

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For the purpose of producing the accurate aerosol optical properties, AOD over East Asia was first investigated in this study. The CMAQ model simulations were conducted for the entire year, 2006, and were improved in several ways including the evaluations of emission inventories, the adoption of Malm and Hand (2007)'s algorithm and the data assimilations of meteorological wind fields and AOD. The results from the CMAQ model simulations (without assimilation) were improved greatly, compared to the previous study (Song et al., 2008) (e.g., from R=0.48–0.68 to R=0.77–0.89 for four seasons, R is correlation coefficient between CMAQ-simulated and MODIS-retrieved AODs). It was also found that there were great matches between the vertical profiles of CMAQ-simulated σext and LIDAR-derived σext. The contributions of sulfate in summer, nitrate in winter, sea-salt in winter and dust in spring were large in East Asia. Especially, the large contribution of nitrate in winter to the AOD distribution over East Asia is remarkable compared to the previous study (Chung et al., 2010). In order to produce more accurate AOD products, the CMAQ-simulated AOD was assimilated with MODIS-retrieved AOD. Both the assimilated and AERONET AODs were better correlated with each other, compared to the correlation between CMAQ-simulated AOD and AERONET AODs (e.g., from R=0.59-0.79 to R=0.71-0.8 for four seasons: R is correlation between the assimilated or CMAQ-simulated AOD and AERONET AOD). The obvious benefits for this study are that, with the improved aerosol optical properties, particulate pollution or PM forecasting over East Asia (e.g., AOD can be served as a proxy to PM2.5) and direct radiative forcing by aerosols can be much better estimated in future.