

# The impact of NH<sub>3</sub> emissions on aerosol optical depth and aerosol optical properties over East Asia

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Gaseous ammonia neutralizes sulfuric and nitric acids, forming ammonium sulfate ((NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>) and ammonium nitrate (NH<sub>4</sub>NO<sub>3</sub>) in fine-mode aerosols. Particularly, the production of particulate NH<sub>4</sub>NO<sub>3</sub> is controlled by the levels of gas-phase NH<sub>3</sub> and HNO<sub>3</sub>. However, the NH<sub>3</sub> emission rates over East Asia have been reported to be highly uncertain. Therefore, in this study the impacts of the variations in the NH<sub>3</sub> emissions on the formation of NH<sub>4</sub>NO<sub>3</sub> and thus aerosol optical depth (AOD) over East Asia were investigated. For this investigation, US EPA Models-3/CMAQ v4.5.1 modeling was carried out with INTEX-B emission inventory over China and CAPSS emission inventory over South Korea for the entire year of 2006. However, for the NH<sub>3</sub> emissions, both the ACE-Asia and EDGAR NH<sub>3</sub> emissions were used. Here, the EDGAR NH<sub>3</sub> emissions were approximately 51% of ACE-Asia NH<sub>3</sub> emissions over the East Asian domain. In addition, seasonal variations for the NH<sub>3</sub> emissions were also applied to improve the CMAQ modeling simulations. Two CMAQ-derived AOD products (from the CMAQ model simulations, using both the ACE-Asia and EDGAR NH<sub>3</sub> emissions) were calculated and then evaluated by comparing the model-simulated AOD products with AOD retrieved from Terra/MODIS sensor. Although CMAQ model well simulated seasonal and spatial distribution patterns of AOD in comparison with those from the MODIS instrument, the CMAQ-simulated AOD simulated from the ACE-Asia NH<sub>3</sub> emission inventory was in general overestimated with high Mean Normalized Bias (13.31–70.31%) over Central East China. However, CMAQ-simulated AOD with the EDGAR NH<sub>3</sub> emission inventory showed smaller MNBs (-3.68–32.96%) than CMAQ-simulated AOD with the ACE-Asia NH<sub>3</sub> emission inventory. Although there are many possible causes, this may indicate that the EDGAR NH<sub>3</sub> emissions could be closer to the real NH<sub>3</sub> emission rates over East Asia.