

Numerical analysis of agricultural emissions impacts on PM_{2.5} in China using a high-resolution ammonia emission inventory

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Abstract

China is one of the largest agriculture country in the world. The NH₃ emission from agricultural activities are significantly affects the regional air quality and horizontal visibility in China. To reliably estimate the agriculture NH₃ influence, a high-resolution agriculture NH₃ emission inventory compiled on 1km × 1km horizontal resolution was applied for calculating the NH₃ mass burden in China. The key parameter emission factors of this inventory was enhanced by considering many native experiment results, and the activity data of spatial and temporal information were updated by the statistic data in 2015. Furthermore, a source apportionment tool, ISAM (Integrated Source Apportionment Method), coupled with the air quality modeling system RAMS-CMAQ (Regional Atmospheric Modeling System and Community Multiscale Air Quality), was applied to capture the contribution of NH₃ emitted from total agriculture (Tagr) in China. The aerosol mass concentration in 2015 was simulated and evaluated by the observation data. Then, the simulation results showed that the high mass concentration of NH₃ which exceeded 10 μg m⁻³ mainly appeared in the North China Plain (NCP), Central China (CNC), Yangtz River Delta (YRD), and Sichan Basin (SCB), and the annually average contribution of Tagr NH₃ to PM_{2.5} mass burden was 14-22% in China. Specific to the PM_{2.5} components, Tagr NH₃ provided major contribution to the ammonium formation (87.6%), but tiny contribution to the sulfate (2.2%). In addition, several brute-force sensitive tests were conducted to estimate the impact of Tagr NH₃ emission reduction on PM_{2.5} mass burden. Compared with the result of ISAM, it was found that even though the Tagr NH₃ only provided 10.1% contribution to nitrate under current emission scenario, the reduction of nitrate could reach 95.8% upon removal of the Tagr NH₃ emission. The main reason of this deviation should be that the NH₃ contribution to nitrate should be small under "rich NH₃" and large under "poor NH₃" environment. Thus, the influence of NH₃ on nitrate formation would enhance with the decreasing of ambient NH₃ mass concentration.

Keywords: air pollution, CMAQ, PM_{2.5}
