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Inventory of ammonia emissions in China

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Ammonia emission from China, a country with vast agricultural area, could play an important role in atmospheric chemistry and climate change in regional and global scale. Numerical simulations had indicated that the ammonia emission was often overestimated in prevalent inventories for eastern Asia. In this study, a comprehensive ammonia inventory is developed for mainland of China, the year of 2006. The major sources of ammonia considered include: 1.crop production (soil and nitrogen-fixing plant emission, fertilizer application and crop residue compost), 2.animal husbandry (free-range, intensive and grazing rearing patterns), 3.biomass burning (forest and grass fires, crop residue burning and fuelwood combustion), 4.urine from rural population, 5.chemstry industry (ammonia synthesis and nitrogen fertilizer production) and 6.waste disposal (wastewater and solid waste treatment). The activity data are mainly from province-specific statistical dataset and MODIS burned area product (MCD45A1). The emission factors are characterized by seasons and provinces in China, in which the ammonia volatilization in fertilizer emissions and animal agriculture was parameterized by the ambient temperature and soil PH.

The total ammonia emission is 9.4 Tg in mainland China. It is obviously lower than the prevalent results. Nitrogen fertilizer application and husbandry manure are two most important sources, which contribute 34% and 53% to total emission respectively. Other miscellaneous sources account for only 13%. Spatially, the ammonia emissions are mainly concentrated in Henan (1.5 Tg), Shandong (1.0 Tg) and Hebei province (0.87 Tg), contributing approximately 36% of the whole country emissions. The major contributors are fertilizer consumption and animal manure. 50% of fertilizer volatilization of China was provided by these three provinces. The high ammonia emissions are caused by the high fertilizer application rate and alkaline soil. Simultaneously, 29% of China's animal husbandry emissions are also found from these provinces due to the large animal amount. Seasonally, peak ammonia emissions often occur in spring and summer, and emission in winter is relatively small. The temporal distribution agrees well with fertilizer application timing and seasonal temperature. At last, the provincial level emissions from animal products and fertilizations are redistributed based on 1km$\times$1km Global Land Cover Data set 2000 (GLC-2000). The emissions from crop burning in the field not reflected in MCD45A1 were gridded using MODIS thermal anomalies/fire products. Emissions from domestic biofuel and human urine are allocated by rural population. The fine ammonia emission inventory presented in this study has high spatial resolution and seasonal variation. It is appropriate for the regional and global atmospheric transport and chemistry models.