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Nitrous Oxide Emissions from the Agriculture of China

X. Zheng (1), S. Han (1), Y. Wang (1), Y. Huang (1), Y. Li (2)

(1) Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China

(2) Institute of Sustainable Agriculture Development, Chinese Academy of Agricultural Sciences, Beijing, China

Agricultural activities, especially those in association with nitrogen application and management, are important to contribute to the undergoing rise of atmospheric N_2O, which is one of climatically/environmentally important trace gases. Accurate quantification of regional/national or global N_2O emission is one of current key issues in the research field of global change. Our study based on the Intergovernmental Panel on Climate Change (IPCC) methods shows that the direct emission from the cultivated soils accounts for about 60% of the total N_2O released due to the agricultural activities in China. However, there is a huge uncertainty (ranging from -80% to 130%) for the current estimate of the direct N_2O emission from the agricultural soils, which is mainly due to the uncertainties in emission factors. Of the 54 available direct N_2O emission factors obtained in China, about 2/3 were underestimated by 29%, and 1/3 overestimated by 50%, though their mean is comparable with the average value obtained from the observations of the global-wide sites (i.e., the default value for the direct emission factor recommended by the IPCC methods). These negative or positive biases are resulted from some or all of the inevitable shortages in the field observations, which in turn are identified as 1) low measurement frequency, i.e., intermittently at an interval of at least 1 day, 2) less-representative observation periods, i.e., measurement missing during non-growing period of crops, 3) absence of the no-nitrogen treatment for the field observation, 4) dominant management practices not completely covered by field treatments, and 5) too few inter-annual replicates. We present a statistical method for correcting the biases due to the observational shortages. The corrected specific direct emission factors for the cultivated soils of China reveal that the emissions factors for the growing period of the paddy rice are comparable to those of the permanently dry upland fields, which in turn in most cases are lower than the direct emission

factors of the cultivated soils in Europe. Our data also show that the rotation cropping systems of paddy rice and upland crops or dry fallow, which account for about 20% of the cropping area in China, significantly enlarge the direct emission factors, due to the alternation of seasonally wetting and drying the soils; and under similar soil and climate conditions, increasing nitrogen input rates may also enlarge direct emission factors, but this fact has never been taken into account in national inventory study yet. Using the corrected direct emission factors, we estimate the direct N_2O emission by 29 types of cropping systems in China at provincial level. Our results suggest that the uneven development in economy most likely accounts for the high spatial variability (up to 94%) in the intensity of direct N_2O emission, i.e., the emission from unit area of croplands. Consumption of synthetic nitrogen fertilizers, which is driven by the increase in population, is thought to be the principal contribution to the N_2O emission from the agriculture of China. The enlargement of population may exclusively be the root driving force for the dramatic increase in N_2O emission from the agriculture of China during 1978 and 2000. Population-based projection shows that the N_2O emission due to the agricultural activities in China will likely increase by 30 - 90% in 2020 - 2040, as compared to that in 2000, provided that no effective mitigation measures are adopted.