



Increasing trends in ambient ammonia concentrations despite decreasing trends in ammonia emissions in the past decade in North America

Leiming Zhang (1) and Xiaohong Yao (2)

(1) Environment and Climate Change Canada, Toronto, Canada (leiming.zhang@canada.ca), (2) Ocean University of China, Qingdao, China (xhyao@ouc.edu.cn)

Inconsistencies in the long-term trends between ambient ammonia (NH₃) concentration and NH₃ emission have been frequently reported in literature while the proposed causes for the inconsistencies are contentious. In the present study we investigated trends in ambient NH₃ concentration in the past decade at seven Canadian sites with daily (one in every three days) NH₃ data and fifteen sites in the U.S. with bi-weekly data. Supplemental data analyzed in this study include NH₃ emission data at provincial level in Canada and state level in the U.S., NH₄⁺ in PM_{2.5}, meteorological data, and Palmer drought Index. We found that ambient NH₃ concentration increased by >100% at six sites, 50-100% at seven sites, and <50% at nine sites during the study periods (9-14 years) while NH₃ emission decreased by >25% in half of the associated provinces or states. Reduced chemical loss of ambient NH₃ due to the reduced chemical conversion to NH₄⁺ partially contributed to NH₃ increase in concentration at approximately 60% of the sites and played little role at the other sites. Correlation analysis results implied that hot and dry weather increased ambient NH₃ concentrations, likely through impacting soil and vegetation NH₃ emissions. At the majority of the studied sites, multiple factors, including reduced chemical conversion to NH₄⁺, increasing temperature, and decreasing soil moisture, contributed together to the observed NH₃ increasing trend, although one significant factor dominated at some sites.