



Jun 26th, 10:40 AM - 12:00 PM

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Yang, Jingyi Dr; Drury, Craig F. Dr; and Yang, Xueming Dr, "Simulating Ammonia Emission from Fertilizer Application to Canadian Farmland" (2018). *International Congress on Environmental Modelling and Software*. 8.

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Simulating Ammonia Emission from Fertilizer Application to Canadian Farmland

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Abstract: An ammonia emission model was developed based upon the European Environmental Agency Tier 3 modelling approach. This ammonia model was integrated into the Canadian Agricultural Nitrogen Budget (CANBv4.0) model at the soil landscapes of Canada (SLC) 1:1 M scale. Simulations of ammonia emissions by fertilizer type and crop type were performed for the period from 1981 to 2011. Data for annual nitrogen fertilizer sales for eight fertilizer types was obtained from the Canadian fertilizer industry. Fertilizer N application rates were based upon the agronomic recommendations for crops and these varied by soil type. These fertilizer N addition rates were adjusted for manure application types and rates in regions with livestock. The total fertilizer N application rate at the provincial scale was harmonized with the total fertilizer N sales data. The maximum emission rates were developed from both literature and field experiments. The emission factors that reduced ammonia emission included fertilizer application rate, application methods, soil pH, temperature and rainfall. Each year, the model calculated ammonia emission for 3000 soil polygons, and the results were scaled up to regional, provincial and national using a crop area weighting procedure. Ammonia emission ranged from 2.5-6.6% in 1981 and from 2.6-9.8% in 2011 of the fertilizer applied at the provincial scale and the losses varied by fertilizer source (ranged between 3-30%). Urea had the highest ammonia emission rates while ammonium nitrate and anhydrous ammonia had the lowest ammonia emissions. Environmental factors that affect the ammonia emission will be discussed in this paper.

Keywords: Ammonia emission model; emission factor; fertilizer types; Canadian farmland