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Spatial distribution of urea induced ammonia loss potentials of German cropland soils

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Urea is currently the most distributed nitrogen fertilizer in the world. Its application to soil is accompanied by loss of ammonia (NH3), which contributes to eutrophication, soil acidification, formation of particulate matter and results in economic losses for farmers. Predicting susceptibility of cropland soils to release NH3 after urea fertilization is therefore of high interest for both society and farmers.
The present study aimed at (i) developing a process-driven model that estimates susceptibility of cropland soils to release NH3 after urea application based on the most relevant processes occurring within the soil and (ii) to use this model to derive the spatial distribution of urea induced NH3 loss potentials of German cropland soils. Therefore, urea induced NH3 loss potential was studied in the lab for 26 German cropland soils and CEC, initial
soil pH (pHi), texture and SOC were determined. For a subset of these soils (n = 12) soil buffer capacity and pH dynamic after urea application were also analysed.
Ammonia loss potential of cropland soils was found to be primarily dependent on CEC, but is superimposed by pHi as well as SOC as they directly affect maximum soil pH during urea hydrolysis. Two process-driven models for estimation of Potential Ammonia Loss (PAL) were developed using either CEC and pHi (PAL 1; $r^2 = 0.82$) or CEC, pHi and SOC (PAL 2; $r^2 = 0.88$) as input variables. Due to limited availability of suitable spatial SOC data only PAL 1 could be applied for evaluating NH3 loss potentials of German cropland soils. The spatial distribution revealed a strong heterogeneity. Cropland soils susceptible to NH3 release due to urea fertilization are primarily located in northern and eastern Germany. Therefore, future large-scale estimations of NH3 loss due to urea fertilization need to consider regional soil characteristics identified here as most relevant for soil NH3 loss.