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Biogeochemie gekoppelter Stoffkreisläufe (NPK) unter traditioneller Landnutzung

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Titel
Ammonia volatilization from irrigated and non-irrigated winter wheat plots in the North China Plain – Quantification and modeling

Abstract
China's growing population led to a drastic intensification of agriculture and livestock production in the last 50 years. Excessive mineral nitrogen (N) fertilizer application and intensive livestock production cause high N losses to the environment. Pathways of N losses may include gaseous N emissions via nitrification/denitrification (N_2O, N_2), ammonia (NH_3) volatilization, nitrate leaching and surface run-off from soils. Ammonia emissions are one of the most important N loss pathways in the North China Plain (NCP) contributing to soil acidification, eutrophication of ecosystems and causing human health problems through combining with particles in the atmosphere which also impair visibility. For developing mitigation measures in a winter wheat cropping system, systematic measurements of NH_3 volatilization were conducted in the NCP in Zhengding, 260 km southwest of Beijing. Ammonia emissions were measured with the calibrated Dräger-Tube method during the main crop growing season of winter wheat from April to June 2016. The treatments included urea and urea followed by immediate irrigation. Additionally, soil samples were taken from three depth increments (0-30, 30-60 and 60-90 cm) before and after fertilization and the NH_3 volatilization was simulated with the HERMES model. The soils showed highest mineral nitrogen (N_{min}) contents of up to 340 kg ha^{-1} (0-90 cm) after fertilization. A decrease in the calcium carbonate content and soil pH in topsoils (0-20 cm) (pH: 6.7) compared to subsoil horizons (pH: 7.7) was attributed to the long-term application of ammonium-based fertilizers as well as to high atmospheric deposition rates of ammonium and sulfuric compounds. Urea applied to winter wheat showed an NH_3 loss equal to 22% the of applied N. Application of urea to winter wheat followed by irrigation yielded a reduction of the NH_3 volatilization to 0.1% of the applied N. An improved N management based on the soil N_{min} content is recommended to improve nitrogen use efficiency and to reduce N losses to the environment. Irrigation after fertilization can be recommended for reduction of NH_3 volatilization, provided that other N loss pathways are of minor importance. The NH_3 volatilization sub-module of the HERMES model enabled to simulate ammonia volatilization in the NCP satisfactorily. It is suggested to validate the model with further data sets from the NCP or from regions with comparable conditions.