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Developing a method to estimate the ammonia loss from fertilized cropland and the part of soil emission recaptured by the canopy, applying field scale bidirectional models and flux measurements

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In parameterization of the bidirectional ammonia exchange models over vegetated surfaces there are some crucial parameters: the stomatal, the soil, and the cuticular compensation point concentrations as the function of [NH4+]/[H+] ratio in the apoplast, soil, and droplets on leaves, as well as the cuticular resistance. These factors determine the direction and the magnitude of the ammonia flux. Two-layer bidirectional exchange models are generally used to partition the measured flux into different parts. However, the parameterizations are mostly based on empirical relationships involving uncertainties and resulting in disagreements among the applied models in the estimation of the stomatal/soil/cuticular flux ratio. The main reasons for the deviations may be the following: i) Overestimation of the soil compensation-point when calculated from the bulk ammonium content of the soil because a part of ammonium content in the soil is bound in the solid phase. Hence Henry's law for the liquid phase cannot be applied to this fraction. ii) Neglecting the part of soil-derived ammonia recaptured by leaves. For this reason, soil emissions may be underestimated. iii) Lack of bioassay measurement. The models generally use empirical approximations to calculate the stomatal compensation point concentration e.g., by deriving it from the bulk ammonium content of the leaf tissue, which can be a source of bias. iv) Inaccurate or rough estimate of cuticular resistance, which is determined by the ratio of acidic air components and ammonia, besides the temperature and humidity. Models often consider a constant site-specific average for this parameter, even though the ratio of acidic substances to ammonia gas has diurnal and annual variations. Due to these uncertainties, the estimation of the

share of fluxes controlled by soil and vegetation is often uncertain. Furthermore, the uncertainty of the parameterization limits the model's applicability and reduces its robustness. As a conception, we aim to simultaneously measure the ammonia flux above the canopy and on the soil. Hence, as the difference between the two fluxes we can determine the amount of ammonia recaptured by the canopy. By means of the soil flux measurement, we can also estimate the bias of empirical soil flux parameterization from soil bulk ammonium content. We also plan performing bioassay measurements to exclude the potential error derived from empirical estimation. Also, we intend calculate the acid/base gas ratio using daily mean concentrations, considering the diurnal variations of humidity-dependent nitric acid/ammonia/ammonium nitrate equilibrium. We will use different conceptional models separately, based on previously developed simulation for all variations of day/night, wet/dry bare soil/vegetation cases in flux estimation at a fertilized crop, making it possible to partition the ratio of ammonia emitted by soil and recaptured either by stomata (built up in plant tissue) or by wet cuticula (net loss).