EGU22-7434
https://doi.org/10.5194/egusphere-egu22-7434
EGU General Assembly 2022

NH_3-Min project: assessment of ammonia measurement methods and evaluation of synthetic nitrogen fertilizer ammonia emissions and nitrogen use efficiency

Sina Kukowski[1], Hannah Götze[1], Alexander Kelsch[2], Jonas Frößl[3], Nicolas Brüggemann[2], Reiner Ruser[3], Andreas Pacholski[1], Christian Brümmer[1], and Heinz Flessa[1]
[1]Johann Heinrich von Thünen-Institute, Institute of Climate-Smart Agriculture, Braunschweig, Germany (sina.kukowski@thuenen.de)
[2]Forschungszentrum Jülich, Institute of Bio- and Geosciences, Agrosphere (IBG-3), Jülich, Germany
[3]University of Hohenheim, Institute of Crop Science, Department of Fertilization and Soil Matter Dynamics (340i), Stuttgart, Germany

Ammonia emissions affect environment, climate and human health and concomitantly reduce fertilizer nitrogen use efficiency. Against the background of environmental and climate protection, the reduction of ammonia losses in the use of synthetic nitrogen fertilisers have become more important. However, there is a lack of data on simultaneous comparative evaluation of fertilizers in multiplot measurements for the assessment of fertilisation strategies and mitigation options. As a challenge, ammonia emission measurements from small plots in a randomized plot design are debated and uncertain.

The joint research project "NH_3-Min" focuses on the most common synthetic nitrogen fertilizers in Germany, i.e. urea (U), calcium ammonium nitrate (CAN), ammonium nitrate urea solution (UAN), ammonium sulphate urea (UAS) and evaluates different options for mitigation of ammonia emissions such as (i) choice of nitrogen form, (ii) use of urease and nitrification inhibitors (UI, NI) and (iii) ammonium sulfate urea injection (CULTAN).

In 2020 and the following 3 years a set of coordinated field trials is conducted in winter wheat, comprising 10 sites across Germany and covering different climatic regions and soil types. A combination of different sensors and flux calculation methods is tested and cross-validated on different spatial scales. In large circular plots (r = 20 m) two types of passive flux samplers, Leuning and Alpha samplers, are tested applying the IHF (integrated horizontal flux), ZINST and bLs (backward Lagrangian stochastic dispersion) flux calculations. Additionally, on one site (r = 70m) an Aerodyne QC-Laser is set-up using eddy covariance flux quantification. On the same field as the micrometeorological methods, Alpha samplers in combination with the bLs method, as well as acid traps in combination with dynamic chamber measurements with Dräger tubes (calibrated passive sampling) are used to determine ammonia fluxes in replicated small quadratic plots (81 m^2).

First preliminary results showed that:

- IHF and ZINST were in close agreement for Leuning samplers.
- Alpha and Leuning samplers yielded similar results by ZINST flux quantification.
- Alpha samplers in combination with bLs method and acid traps were capable of significantly differentiating ammonia emissions between different fertilizer treatments in replicated plot measurements. Though, differences between the two plot approaches were observed.
- Concerning the different treatments, urea showed the highest emissions, however fertilizer injection (CULTAN) also yielded high ammonia emissions. Lowest emissions were recorded in the CAN treatment and urease-inhibited treatment.

More refined experimental results and project details will be presented and discussed.