Geophysical Research Abstracts
Vol. 21, EGU2019-15112, 2019
EGU General Assembly 2019

Ammonia versus nitrous oxide: an emission experiment on a Swiss pasture

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Intensive livestock production is the main contributor to the air pollutant ammonia (NH3), and it is also responsible for a large share of emissions of the anthropogenic greenhouse gas nitrous oxide (N2O). Grazing is considered to reduce NH3 emissions compared to indoor housing, while enhanced N2O emissions are expected according to the IPCC default emission factors. Thus there is a risk for "pollution swapping" for grazing management.
We present results of a field study, where grazing related NH3 and N2O fluxes were measured simultaneously over a full grazing season in 2016. During the experiment, the pasture was grazed by 12 dairy cows in a rotational grazing management. The NH3 concentrations up- and downwind of an emitting paddock were measured with line-integrating miniDOAS devices and the paddock emissions were calculated by applying a backward Lagrangian stochastic dispersion model (bLS) to the observed concentration differences. The field scale emissions of N2O were quantified using the eddy covariance technique. In order to calculate emission factors (EF), the nitrogen (N) in the excretion was estimated by an animal nitrogen budget model taking into account the measurements of feed N content, milk yield and body weight of the cows.
We found, that NH3 emissions on the pasture were low and that the calculated EF of 6.4 $\pm$ 2.0 % of the applied urine N was in the range of the EF (8.3 %) used by the Swiss inventory model Agrammon. However, the measured N2O emissions were much lower than expected. Thus, the study demonstrated the ability of grazing systems to mitigate effectively NH3 emissions. Moreover, the experiment also showed that pollution swapping with strongly enhanced N2O emissions was less pronounced than expected.