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Quantification of N_2O fluxes and EF values in a pasture using chamber and eddy-covariance technique

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In grassland ecosystems nitrogen (N) inputs are mainly attributed to fertilizer applications for increasing herbage productivity and to excreta of grazing animals. Cattle, for instance, excrete 75-95 % of the N intake. Accordingly, dung and urine patches of grazing animals form hotspots of nitrate leaching and gaseous N emissions as ammonia (NH_3) or the important greenhouse gas nitrous oxide (N_2O). Global default emission factor (EF) values for N_2O, 2.0 % for grazing based nitrogen inputs (EF3) and 1.0 % for nitrogen inputs via fertilizer applications (EF1) have been suggested by IPCC. However, some countries like New Zealand, Canada or the Netherlands have established country-specific EFs showing considerable regional differences.

In the present research study, we examine N_2O emissions of a pasture field in Switzerland in relation to possible drivers. Field scale emissions by eddy covariance are measured in parallel to patch-scale N_2O fluxes from controlled applications of urine, dung and fertilizer. The patch-scale fluxes are measured by a manually operated chamber ('fast-box') connected to an online gas analyzer. Besides estimating EF values on annual and seasonal basis, relevant factors that might control N_2O fluxes like environmental conditions (weather parameters, soil moisture, soil temperature), vegetation characteristics (height, composition, nitrogen and carbon content) and pasture management (patch age, grazing, fertilization, cut events, interactive effects) are analyzed.

We present and discuss results of the first measurement year 2020. Three artificial urine applications during summer and autumn were performed. They show peak N_2O fluxes of 279-1718 µg m^{-2} h^{-1} directly after application that decrease to near-background fluxes within 19-43 days. Using a simple linear interpolation of measured N_2O fluxes, EF values of artificial urine patches vary between 0.57 and 2.44 % indicating a seasonal variability of N_2O fluxes.