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Spatial and temporal variability of N2O emission on grazed pastures – influence of management and meteorological drivers

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Grazed pastures are considered as strong sources of the greenhouse gas nitrous oxide (N2O) with local hot-spots resulting from the uneven spatial distribution of the excretion of the grazing animals. Especially urine patches can result in a high local nitrogen (N) surplus, which can cause large deviations from average soil conditions. The strong spatial and temporal variability of the gaseous emissions represents an inherent problem for the quantification, interpretation and modelling.

Micrometeorological methods integrating over a larger domain like the eddy covariance method are well suited to quantify the integrated ecosystem emissions of N2O. In contrast, chamber methods are more useful to investigate specific underlying processes and their dependences on driving parameters. We present results of a pasture experiment in western Switzerland where eddy covariance and chamber measurements of N2O fluxes have been performed using a very sensitive and fast response quantum cascade laser (QCL) instrument. Small scale emissions of N2O from dung and urine patches as well as from other "background" pasture surface areas were quantified using an optimized 'fast-box' chamber system.

Variable and partly high N2O emissions of the pasture were observed during all seasons. Beside management factors (grazing phases, fertiliser application), temperature and soil moisture showed a large effect on the fluxes. Fresh urine patches from grazing cows were found to be main emission sources and their temporal dynamics was studied in detail. We present a first approach to up-scale the chamber measurements to the field-scale and compare the results with the eddy covariance measurements.