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Quantification of greenhouse gas mitigation measures in an experimental dairy housing at herd level on a practical scale

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Dairy farming causes a large proportion of global GHG emissions, which also applies to Switzerland. The Swiss "Agricultural Climate Strategy" defines a reduction of at least one third in greenhouse gas emissions from Swiss agriculture by 2050 compared with 1990 (BLW 2011). To achieve this goal, effective GHG emission mitigation strategies have to be developed and evaluated. Up to now GHG emission measurements are mostly restricted to individual animal level (metabolic studies, respiration chamber). Whereas the efficiency of abatement strategies on herd level has hardly been investigated. However, these data are needed for national inventories and the development of suitable mitigation strategies, which form the basis for agricultural and environmental policy decisions.

Comparative emission measurements on a practical scale were conducted in the experimental dairy housing at Agroscope. It consists of two spatially separated experimental compartments – each for 20 dairy cows – and a centre section for milking and analytics. Thereby, the reduction potential of abatement measures can be quantified relative to reference conditions. To determine emissions under natural ventilation, a tracer-ratio method with two tracer gases, SF_6 and SF_5CF_3 is used. The diluted tracer gases are dosed continuously via steel tubes with critical capillaries into different experimental compartments. Integrative air samples are collected with a piping system consisting of teflon tubes and critical glass capillaries. The analytical instrumentation for CH_4 and CO_2 (CRDS, Picarro Inc., USA) as well as tracer gas analysis (GC-ECD, Agilent, USA) are located in an air-conditioned trailer.

Systematic validation experiments with different dosing variants demonstrate that this technique is suitable for areal and point emission sources and the equivalence of both tracer gases (Mohn et al. 2018). The accuracy of the tracer ratio method was demonstrated by CH_4 dosing experiments and the uncertainty of the tracer ratio method, which is in the range of 3–10 % and considered superior to existing alternative approaches.

In this experimental set-up, the sum of enteric and slurry-derived emissions of feeding measures (e.g. supplementation with extruded linseed) as well as structural (e.g. floor type) and organizational measures (e.g. dung removal interval) were quantified. At the conference, first results will be presented, showing typical diurnal patterns of concentrations and emissions of CH_4 and CO_2.

Keywords: greenhouse gas, dairy cows, methane, tracer ratio method, mitigation