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Greenhouse gas budget of two neighboring pastures measured by eddy covariance

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Intensive livestock production is a large source of the greenhouse gases (GHG) methane (CH4) and nitrous oxide (N2O). However, optimizing grassland management is seen as a potential cost-effective mitigation strategy to counteract these emissions by increasing the soil carbon stock.
We present results of GHG flux measurements in a paired field experiment of two neighboring grazing systems in 2016. Each system was grazed by 12 dairy cows in a rotational grazing management. The systems differed in the energy to protein balance of the diet for the cows (grass with additional maize silage: system M; full grazing system without additional forage: system G) which resulted in different N excretion rates. The field scale emissions of CO_2, CH4 and N2O were quantified using two eddy covariance towers, which were installed in the middle of the two systems. The paired field design allowed for a precise comparison of the two systems, as only random uncertainties had to be taken into account. In order to calculate the net ecosystem carbon budget (NECB) of the pasture systems, additional non-gaseous carbon fluxes were either measured (harvest, slurry application) or estimated based on an animal feed demand model (carbon removal/return by grazing/excreta). For the investigated year, the NECB resulted in a significant C sink for system M whereas system G was carbon neutral. We conclude, that this difference was mainly triggered by the external carbon import to the system M through the additionally provided maize silage. Taking the emissions of CH4 and N2O into account resulted in a neutral net GHG budget for both pastures.
We will show the individual contributions to the NECB, explain the importance of the individual GHGs to the net GHG budget and illustrate the advantages of a paired field design. Furthermore, we will discuss the outcomes of the study in the context of a similar study on the same pasture in 2013.