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# Greenhouse gas budgets of managed European grasslands

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Greenhouse gas exchange of grasslands are directly and indirectly related to the respective carbon (C) and nitrogen (N) budget. Within the framework of the NitroEurope project we investigated the greenhouse gas, carbon, and nitrogen budgets of four European grassland systems over several years: Easter Bush (UK), Oensingen intensive and extensive (CH), and Bugac (HU). They span contrasting climatic conditions, management types (grazing, cutting) and intensity. While Easter Bush (pasture) and Oensingen int. (meadow) were intensively managed and received a considerable amount of fertiliser, the unfertilised sites Bugac (pasture) and Oensingen ext. (meadow) depended on atmospheric N input (wet and dry deposition) and biological N fixation. The experimental results of the four sites were also compared to published GHG fluxes of other European grasslands.

While the ecosystem $CO_2$ exchange was measured on the field scale with the eddy covariance method, the soil fluxes of the other greenhouse gases $CH_4$ and $N_2O$ have been detected generally by means of static chambers (only occasional application of eddy covariance). The emission of $CH_4$ by grazing ruminant resulting from enteric fermentation was estimated by animal type specific emission factors.

For characterizing the total GHG effect of the grassland sites, the contributions of the different GHGs were normalised to $CO_2$-equivalents. Except for Oensingen ext., all sites showed positive C budgets (sequestration). The observed positive correlation between C and N sequestration (with a ratio between 10 and 20) agrees with studies reported in the literature. The magnitude of $N_2O$ emission depended mainly on management intensity (fertiliser input) and on the soil moisture conditions.

Whereas for the Oensingen and the Bugac sites, the total GHG budget was dominated by the carbon budget, for Easter Bush the combined effect of $N_2O$ and $CH_4$ emission (including animal enteric fermentation) was in the same order of magnitude as the carbon sequestration leading to a strong compensation of the GHG effects. However, if digestion of harvested biomass is also attributed to the GHG budget of the non-grazed meadows, they become dominated by $CH_4$ emission from enteric fermentation. The results show that the comparison of GHG budgets of grazed and non-grazed grasslands is difficult and needs clearly defined system boundaries.