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Greenhouse gas fluxes (CO2, CH4, N2O) in alpine grasslands: effects of management

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Land management directly influences the terrestrial sources and sinks of greenhouse gases (GHGs). In particular grassland ecosystems are known to sequester 3-4 times more carbon in the soil than forest ecosystems, when calculated per unit of carbon input. Recent studies have shown that the carbon uptake (CO2 only) of alpine grassland ecosystems is largely driven by management activities. Still, little is known about the effects of management on other GHGs.

We measured fluxes of CO2, CH4 and N2O at three grassland sites, representing the typical three-stage grassland farming system in Alps, during the season of 2010. The three sites were located along an altitudinal and management gradient (400 m a.s.l. intensive management, 1000 m a.s.l. moderate management to 2000 m a.s.l. extensively managed). Up to date it is unknown if these systems are characterized by a positive or negative GHG balance. More important, typical drivers of GHG fluxes in these ecosystems are temperature and moisture (abiotic), whereas the effects of biotic drivers such as changes in biomass (harvest) and nutrient inputs (fertilization) are not well understood.

In this study we present the impact of different management on ecosystem methane and nitrous oxide fluxes during the season of 2010. Mean flux rates of CH4 and N2O are commonly low (-0.3 +/- 0.1 nmol m-2 s-1 CH4 and 0 - 0.4 nmol m-2 s-1 N2O). In contrast we found significantly larger emissions during/after management activities (+ 0.5 nmol m-2 s-1 CH4 and 2.5 nmol m-2 s-1 N2O). The magnitude of these emissions was dependent on the type of management (deployment of slurry, harvest, grazing).
Our results contribute to better understanding of the seasonal variations of GHG fluxes in managed grassland ecosystems, the abiotic and biotic drivers and can further be used for the parameterization of models as well as in upscaling activities.