Geophysical Research Abstracts
Vol. 20, EGU2018-12741, 2018
EGU General Assembly 2018

Effects of liming on greenhouse gas emissions in grasslands with contrasting soil types

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Increasing evidence suggests that grassland management is a key tool to reduce agricultural greenhouse gas emissions and mitigate the risks of climate change. Where soils are subject to acidification, liming is often used as a strategy to increase soil pH and improve nutrient availability and yield, with implications for greenhouse gas emissions and nutrient leaching. However, net impacts of lime on ecosystem function are not easy to predict because multiple interacting processes may be affected simultaneously. Moreover, impacts of liming may be mediated by underlying soil properties such as organic matter and clay content. Here, we conducted a one-year, outdoor mesocosm experiment using a model grassland community and two grassland soils with contrasting levels of organic matter content and nitrogen availability to investigate the impact of liming on grassland biogeochemical cycling. This experiment in semi-controlled conditions enabled us to standardize climate conditions and plant species identity.

Standardized swards (*Lolium perenne*, *Dactylis glomerata*, *Festuca rubra*, *Poa trivialis*, *Poa pratensis*, *Trisetum flavescens*) were established in Clermont Ferrand, France by planting tillers in pots filled with either an Andosol or a Cambisol. Liming was applied to one half of the mesocosms (2.5T/ha equivalent) in the late winter. During the following plant growing season (April to October), we measured N_2O fluxes and CO_2 emissions, as well as soil nitrogen availability (NO_3^- and NH_4^+) using ion-exchangeable resins. Plant aboveground biomass was cut at the peak of biomass and the end of the growing season. In addition, soil samples were collected to determine pH status, mineral nitrogen content and microbial biomass. Our results showed a positive effect of liming on pH in both soil types. However, liming had a marginal effect on CO_2 emissions, soil nitrogen availability and plant aboveground biomass compared to the influence of soil type. As predicted, the more nutrient-rich Andosol had greater plant productivity and higher CO_2 emissions. Contrary to expectations, N_2O fluxes showed no response to liming or soil type. We discuss these results in relation to plant-soil interactions, and consider their implications for sustainable grassland management practices.