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Measuring denitrification after grassland renewal and grassland conversion to cropland by using the ^{15}N gas-flux method

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Denitrification, the reduction of oxidized forms of inorganic N to N_2O and N_2 is an important pathway of gaseous nitrogen losses. Measuring denitrification, especially the reduction of N_2O to N_2, expressed in the product ratio $(N_2O/(N_2O + N_2))$, is rather difficult and hence rarely performed under field conditions. But using the ^{15}N gas-flux method allows determining N transformation processes in their natural environment. In order to develop effective climate mitigation strategies understanding the N_2O source is essential.

We used the ^{15}N gas-flux method to determine N_2O and N_2 emissions following grassland renewal and conversion techniques. Therefore we selected three different treatments: control (C), mechanical grassland renovation (GR) (autumn 2013) and grassland conversion to maize (GM) (spring 2014) from field plot trials on two different sites (Histic Gleysoil and Plaggic Anthrosol) near Oldenburg, Lower Saxony, Germany. We applied ^{15}N labeled KNO_3^- (60 atom. % ^{15}N) at a rate equivalent to common farming practices (150 kg N*ha^{-1}) using needle injection of fertilizer solution in three different depths (10 cm, 15 cm, 20 cm) for homogeneous soil labeling up to 30 cm in microplots. During the first 10 days after application (May 2014) gas flux measurements from closed chambers were performed every second day and then weekly following a period of 8 weeks. Gas samples were analyzed for $\delta^{15}N$ of N_2 and N_2O by IRMS according to Lewicka-Szczebak et al. (2013). Concentration and ^{15}N enrichment of NO_3^- in soil water was determined on weekly samples using the SPIN-MAS technique (Stange et al. 2007). Fluxes of N_2 and N_2O evolved from the ^{15}N labeled soil nitrogen pool were calculated using the equations of Spott et al. (2006).

Peak events of N_2 and N_2O emissions occurred during the first 10 days of measurement, showing differences in soil types, as well as treatment variations. N_2 fluxes up to 178 g*ha^{-1}*day^{-1} and N_2O fluxes up to 280 g*ha^{-1}*day^{-1} were measured on the Plaggic Anthrosol in the GR treatment, while on the Histic Gleysoil, the GM treatment showed highest fluxes with N_2 fluxes up to 1260 g*ha^{-1}*day^{-1} and N_2O fluxes up to 747 g*ha^{-1}*day^{-1}. Alike the product ratio of initial fluxes was higher on the Plaggic Anthrosol and lower on the Histic Gleysoil. Data analysis is still in progress and further results will be provided.

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