Tagungsnummer
V290

Thema
AG Bodengase

Neue Entwicklungen bei Methoden zur Messung und bei der Modellierung von Spurengasflüssen

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Titel
Validating soil denitrification models based on laboratory N_2 and N_2O fluxes and underlying processes derived by stable isotope approaches: concept, methods and regulation of measured fluxes

Abstract
Robust denitrification data suitable to validate soil N2 fluxes in denitrification models are scarce due to methodical limitations and the extreme spatio-temporal heterogeneity of denitrification in soils. Numerical models have become essential tools to predict denitrification at different scales. Model performance could either be tested for total gaseous flux ($NO + N_2O + N_2$), individual denitrification products (e.g. N_2O and/or NO) or for the effect of denitrification factors (e.g. C-availability, respiration, diffusivity, anaerobic volume, etc.). While there are numerous examples for validating N_2O fluxes, there are neither robust field data of N_2 fluxes nor sufficiently resolved measurements of control factors used as state variables in the models. Here we present the concept, methods and first results of collecting model validation data. This is part of the coordinated research unit "Denitrification in Agricultural Soils: Integrated Control and Modelling at Various Scales" (DASIM). Novel approaches are used including analysis of stable isotopes, microbial communities, pore structure and organic matter fractions to provide denitrification data sets comprising as much detail on activity and regulation as possible. This will be the basis to validate existing and calibrate new denitrification models that are applied and/or developed by DASIM subprojects. To allow model testing in a wide range of conditions, denitrification control factors are varied in the initial settings (pore volume, plant residues, mineral N, pH) but also over time, where moisture, temperature, and mineral N are manipulated according to typical time patterns in the field. This is realized by including precipitation events, fertilization (via irrigation), drainage (via water potential) and temperature in the course of incubations. Moreover, oxygen concentration is varied to simulate anaerobic events. The ^{15}N gas flux method is employed to quantify N_2 and N_2O emissions from various pools and processes.