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Evaluation and adjustment of description of denitrification in the DailyDayCent and COUP models based on N_2 and N_2O laboratory incubation system measurements

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Denitrification is an anaerobic key process by microbes where the NO_3^- is step-by-step reduced and emitted as NO, N_2O and finally N_2 gas from the soil. The accurate knowledge of the reduction of nitrate (NO_3^-) and nitrite (NO_2^-) to N_2O and molecular N_2 is important because the N_2O fraction is further reduced to N_2 and constitutes the main emission source of this greenhouse gas from agricultural soils. Hence, our understanding and ability to quantify soil denitrification is crucial for mitigating nitrogen fertilizer loss as well as for reducing N_2O emissions. Models can be an important tool to predict mitigation effects and help to develop climate smart mitigation strategies.

Ideally, commonly used biogeochemical models could provide adequate predictions of denitrification processes of agricultural soils but often simplified process descriptions and inadequate model parameters prevent models from simulating adequate fluxes of N_2 and N_2O on field scale. Model development and parametrization often suffers from limited availability of empirical data describing denitrification processes in agricultural soils. While in many studies N_2O emissions are used to develop and train models, detailed measurements on NO, N_2O, N_2 fluxes and concentrations and related soil conditions are necessary to develop and test adequate model algorithms. Composition of denitrifying communities, coinciding effects of management and local conditions on the development of denitrification hotspots are highly variable in space and time.

To address this issue the coordinated research unit „Denitrification in Agricultural Soils: Integrated Control and Modelling at Various Scales (DASIM)" was initiated to more closely investigate N-fluxes caused by denitrification in response to environmental effects, soil properties and microbial communities.

Data suitable to validate denitrification models are still scarce due to previous technical and/or methodical limitations of measuring N_2 fluxes, but large data-sets are needed in view of the extreme spatio-temporal heterogeneity of denitrification. DASIM will provide such data based on laboratory incubations including measurement of N_2O and N_2 fluxes and determination of the relevant drivers.

Here, we present how we will use these data to evaluate common biogeochemical process models (DailyDayCent, Coup) with respect to modeled NO, N_2O and N_2 fluxes from denitrification. The models are used with different settings. The first approximation is the basic "factory" setting of the models. The next step would show the precision in the results of the modeling after adjusting the appropriate parameters from the result of the measurement values and the "factory" results. The better adjustment and the well-controlled input and output measured parameters could provide a better understanding of the probable scantiness of the tested models which will be a basis for future model improvement.