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N_2O-emission risk assessment tool for nitrogenous fertilizer applications

Henrik Vestergaard Poulsen[1], Sander Bruun[2], Cecilie Skov Nielsen[1], and Søren Kolind Hvid[1]
[1]SEGES Innovation, Crop & Environment, Aarhus N, Denmark (hevp@seges.dk)
[2]Department of Plant and Environmental Sciences, University of Copenhagen, Copenhagen, Denmark

Nitrous oxide (N_2O) emitted from agricultural soils makes up a significant part of the collective agricultural greenhouse gas (GHG) emissions. These emission are to a large extent caused directly or indirectly by the application of nitrogenous fertilizer and there is a strong demand for mitigation strategies.

Nitrous oxide is produced in the soil in a range of different processes but mainly in microbial nitrification and denitrification. A number of factors exert influence on these microbial processes in the soil, most notably the oxygen concentration, availability of ammonium and nitrate, available organic matter and diffusivity, and fairly advanced process-based simulation models are often used in attempts to simulate the amount of N_2O emitted. Here we propose using more a simplistic modelling approach to provide a novel risk assessment tool for nitrogenous fertilizer applications to be implemented in Danish farmers field management programmes.

At SEGES Innovation we have unique database access to field activity data from Danish farmers - e.g. crop sequence, fertilizer applications, residue handling, soil texture - covering more than 85 % of the Danish cultivated area. Based on these data and field specific climate data, a soil water balance model (Plauborg et al. 1995) and soil organic carbon model (Taghizadeh-Toosi et al. 2014) are running in daily timesteps for all fields in the database. These models provide, respectively, the daily level of WFPS in the soil and the organic matter turnover rate in the soil simulated during the weather forecast period of 10 days. Those two outputs are combined with a simulated soil temperature in a simplified version of the NGAS-model (Parton et al. 1996) to give a rough simulated N_2O-emission for any planned fertilizer application throughout the weather forecast period.

The risk assessment tool exhibits this daily simulated N_2O-emission as a risk evaluation of fertilizer application to the farmer in field management programmes, where future field activities are entered and logged. The objective is to lower the GHG emission by reducing the number of

fertilizer applications right at peak N_2O-emission conditions, once the farmers are presented with this information.