Application of the DNDC model to predict emissions of N2O from Irish agriculture - DTU
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Models are increasingly used to examine the potential impacts of management and climate change in agriculture. Our aim in this paper was to assess the applicability of the field-DeNitrification DeComposition (DNDC) model in Irish agriculture. This study provides the results of that evaluation, which is a prerequisite for using the model for assessing management impacts in the future. The DNDC model was tested against seasonal and annual data sets of nitrous oxide flux from a spring barley field and a cut and grazed pasture at the Teagasc Oak Park Research Centre, Co. Carlow, Ireland. In the case of the arable field, predicted fluxes of N2O agreed well with measured fluxes for medium to high fertilizer input (70–160 kg N ha⁻¹) but poorly described those fluxes from zero fertilizer treatments. In terms of cumulative flux values, the relative deviation of the predicted fluxes from the measured values was a maximum of 6% for the highest N fertilizer inputs but increased to 30% for the medium N and more than 100% for the zero N fertilizer treatments. There is a linear correlation of predicted against measured flux values for all fertilizer treatments (r² = 0.85) but the model underestimated the seasonal flux by 24%. Incorporation of literature values from a range of different studies on arable and pasture land did not significantly improve the regression. The description by DNDC for measured fluxes of N2O from reduced tillage plots was poor with underestimation of up to 55%. For the cut and grazed pasture the relative deviations of predicted to measured fluxes were 150 and 360% for fertilized and unfertilized plots. A sensitivity analysis suggests that the poor model fit is due to DNDC overestimating WFPS and the effect of initial soil organic carbon (SOC) on N2O flux. As the arable and grassland soils differed only in SOC content, reducing SOC of the grassland field to that of the arable field value significantly improved the fit of the model to measured data such that the relative deviations decreased to 9 and 5% respectively. Sensitivity analysis highlighted air temperature as the main determinant of N2O flux, an increase in mean daily air temperature of 1.5 °C resulting in almost a 65% increase in the annual cumulative flux. This is interesting as with future global warming, N2O flux from the soil will have a strong positive feedback. It can be concluded that DNDC is unsuitable for predicting N2O from Irish grassland due to its overestimation of WFPS and effect of SOC on the flux.

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