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Using the ECOSSE model to simulate soil N and N2O fluxes from European cropland soils

Madeleine Bell, Jagadeesh Yeluripati, Edward Jones, Jo Smith, and Pete Smith

Institute of Biological & Environmental Sciences, School of Biological Sciences, University of Aberdeen, Cruickshank Building, St Machar Drive, Aberdeen, AB24 3UU, Scotland, United Kingdom (m.j.bell@abdn.ac.uk)

Soil is the single largest source of Nitrous oxide (N_2O), with 60 % of global anthropogenic emissions of N_2O originating from agricultural soils. At a time when there is increasing pressure for countries to limit their greenhouse gas (GHG) emissions, and reduce their impact on global warming, there is a requirement to better estimate the extent of current agricultural emissions of N_2O, and to understand how these emissions from agricultural land can be reduced. Before estimates of N_2O emissions can be made for large areas globally, and before the impacts of future land-use and climate change on these emissions can be stated with confidence, it is essential to understand and accurately simulate the processes responsible for N_2O emissions from agricultural soils.

Models have been produced to simulate soil nitrogen (N) and N_2O fluxes to the atmosphere, based on simulations of N and carbon (C) turnover. Simulations of N_2O fluxes rely on accurately simulating the processes of nitrification and denitrification, which requires knowledge of the impact of environmental conditions and land management on these processes. The ECOSSE model has been developed to be used on both mineral and organic soils, and requires only limited metrological and soil data, therefore making it simpler to use than other more complex models. The model includes the major processes of N turnover, with material being exchanged between pools of SOM at rates modified by temperature, soil moisture, soil pH and crop cover. Despite the complexity within the model, the equations to run it require only the following readily available input data: crop yield, fertiliser and manure application rates, temperature and rainfall data, soil water content, and soil physical properties.

The ECOSSE model has been run for three European croplands, and the model outputs compared to measured data from these sites. Results will be presented showing the accuracy of model runs, and the ability of the ECOSSE model to predict soil N contents and N_2O fluxes from agricultural land in Europe. At the Grignon site in France r^2 values of 0.62 and 0.45 indicate a significant association between modelled and measured soil NH_4^+ and soil NO_3^- respectively. Statistical analysis reveals no significant bias in the simulation of N_2O, NO, NH_4^+ or NO_3^-. A significant association was also found between modelled and measured values of soil NH_4^+ and NO_3^- at the Gebesee cropland site in Germany. The ability to simulate measured data using this model suggests that process knowledge relating to N turnover contained within ECOSSE is adequate. With the model predicting soil N turnover and N_2O fluxes with such accuracy at site level, predictions of current fluxes on a larger scale, and the impact of future land-use and climate change scenarios can now be made with greater confidence.