Assessing nitrogen fluxes from European agricultural soils in response to changes in nitrogen inputs and climate: a systematic model intercomparison study

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Overview

This paper analyses the impact of changes in N inputs, induced by changes in livestock and land management, and climate on nitrogen fluxes from agricultural soils to air and water in EU-27 during the period 1970-2030 using various terrestrial ecosystem models. The models were applied using ca 40.000 calculation units (so-called NCUs). The models involved include Mobile DNDC, DailyDayCent, CAPRI-DNDC and INTEGRATOR. We evaluated the A1 IPCC-SRES scenario and various measures affecting N inputs by manure and fertilizer and N use efficiencies. Models outputs included in the model intercomparison are N crop uptake, N accumulation, NH_3, N_2O, NO_x and N_2 emissions and N leaching/runoff. Results of the simulations will be presented during the conference.

Methods/Approach

In this study, a comparison was made between soil N fluxes from agro-ecosystems in EU-27 for the period 1970-2030 with four process based models including all major soil N flows in response to a scenario affecting land use, climate and N input by fertilizer and animal manure, including a historical reconstruction. Furthermore, measures such as balanced fertilization, maximum manure application rate and reduced residue removal were evaluated. The models included are INTEGRATOR (De Vries et al., 2011), DNDC-EUROPE (Leip et al., 2008), Mobile DNDC (De Bruijn et al., 2009; Chirinda et al., 2011) , and DailyDayCent (Del Grosso et al., 2006). The changes in land use, livestock and national fertilizer N use in response to the A1 IPCC-SRES scenario were calculated by the GTAP-IMAGE model. Furthermore, a crop rotation optimizer was developed which translated regional crop share information from CAPRI into a mixture of cropping sequences for all NCUs. Both inputs were used in INTEGRATOR to assess changes in nitrogen inputs by animal manure and fertilizer for these cropping sequences. Furthermore, a time line generator was developed assigning the timing of ploughing, harrowing, sowing, application of mineral fertiliser and animal manure, and harvesting.

This was done to ensure the same model inputs at the same spatial resolution for all models. Finally, the same climate and soil data were used by all models allowing a strict model intercomparison. The interaction between the crop rotation generator, INTEGRATROR predicting N application rates and the timeline generator is given in Figure 1.

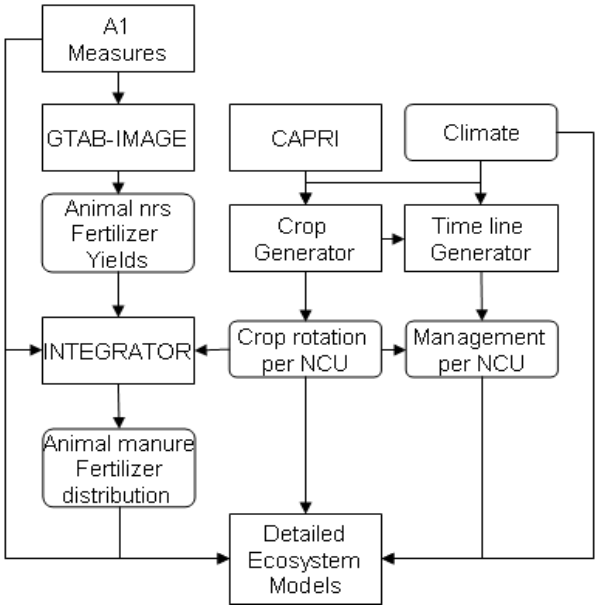

Fig. 1. Interaction between crop rotation generator, INTEGRATROR and time line generator.

Results

A comparison of nitrogen fluxes of agro-ecosystems for all EU 27 by countries together by these four models with different complexity and data requirements show quite comparable results, but there is a large spatial variation. Since all models use the same total N input in European agriculture, it was to be expected that total N fluxes are comparable but on a regional level the differences can be large. Results of the simulations will be presented in detail during the conference.

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