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Carbon and N_2O soil fluxes, a combined modelling and stock-inventory approach for Belgium

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Carbon and nitrogen cycles are closely linked in the biosphere. Greenhouses gases emitted from ecosystems thus need to be considered together in order to make the balance between the in- and out- fluxes. Finally, a greenhouse gas balance of soil organic carbon (SOC) and nitrous oxide (N_2O) emissions is presented at the landscape level (CO_2 equivalent).The non-urban part of Belgium is divided into landscape units (LSUs), polygons with unique soil type and land use. Within the climate change issue, SOC is important due to its large reservoir and N_2O fluxes are important due to their high warming potential. For the years 1960, 1990 and 2000, a SOC inventory was carried out for these LSUs. Between 1960 and 1990, increases are observed for 79% of the LSUs in the upper 20 cm of mineral soil. This increase is significant for 28% of the LSUs. Between 1990 and 2000, 68% of the LSUs lose carbon in the 0-20 cm layer and 21% do so significantly. The observed trend in SOC content of LSUs is explained by changes in management, particularly manure application and tillage erosion. The observed regional differences in manure application are reflected by changes in SOC content of grassland.

Fluxes of N_2O are modelled for the LSU over the same time period. Observed annual N_2O emission rates are used to establish statistical relationships between N_2O emissions, land use, seasonal climate, soil characteristics, and nitrogen-fertilisation rate. Two empirical models, MCROPS and MGRASS, were developed for croplands and grasslands. Validated with an independent data set, MCROPS shows that spring temperature and summer precipitation explain 35% of the variance in annual N_2O emis-

sions from croplands. MGRASS allows nitrogen-fertilisation rates and winter temperature to explain 48% of the variance in annual N_2O emissions from grasslands. The models can be used to estimate the effects of inter-annual variation in climate, climate change and land-use change on direct N_2O emissions from soils at the regional scale.

The preliminary results of the greenhouse gas balance led to the following conclusions: 1. the application of manure and slurry increases the SOC content of soils, but also increases N_2O fluxes; 2. the net flux depends as much on N_2O as on SOC content due to the high warming power of N_2O.