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Impacts of crop growth dynamics on soil quality at the regional scale

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Agricultural land use and in particular crop growth dynamics can greatly affect soil quality. Both the amount of soil lost from erosion by water and soil organic matter are key indicators for soil quality. The aim was to develop a modelling framework for quantifying the impacts of crop growth dynamics on soil quality at the regional scale with test case Flanders.

A framework for modelling the impacts of crop growth on soil erosion and soil organic matter was developed by coupling the dynamic crop cover model REGCROP (Gobin, 2010) to the PESERA soil erosion model (Kirkby et al., 2009) and to the RothC carbon model (Coleman and Jenkinson, 1999). All three models are process-based, spatially distributed and intended as a regional diagnostic tool. A geo-database was constructed covering 10 years of crop rotation in Flanders using the IACS parcel registration (Integrated Administration and Control System). Crop allometric models were developed from variety trials to calculate crop residues for common crops in Flanders and subsequently derive stable organic matter fluxes to the soil. Results indicate that crop growth dynamics and crop rotations influence soil quality for a very large percentage. soil erosion mainly occurs in the southern part of Flanders, where silty to loamy soils and a hilly topography are responsible for soil loss rates of up to 40 t/ha. Parcels under maize, sugar beet and potatoes are most vulnerable to soil erosion. Crop residues of grain maize and winter wheat followed by catch crops contribute most to the total carbon sequestered in agricultural soils. For the same rotations carbon sequestration is highest on clay soils and lowest on sandy soils. This implies that agricultural policies that impact on agricultural land management influence soil quality for a large percentage.

The coupled REGCROP-PESERA-ROTHC model allows for quantifying the impact of seasonal and year-to-year crop growth dynamics on soil quality. When coupled to a multi-annual crop rotation database both spatial and temporal analysis becomes possible and allows for decision support at both farm and regional level. The framework is therefore suited for further scenario analysis and impact assessment.

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