Geophysical Research Abstracts
Vol. 15, EGU2013-7793, 2013
EGU General Assembly 2013

Impacts of crop rotations on soil organic carbon sequestration

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Agricultural land use and crop rotations can greatly affect the amount of carbon sequestered in the soil. We developed a framework for modelling the impacts of crop rotations on soil carbon sequestration at the field scale with test case Flanders. A crop rotation geo-database was constructed covering 10 years of crop rotation in Flanders using the IACS parcel registration (Integrated Administration and Control System) to elicit the most common crop rotation on major soil types in Flanders.
In order to simulate the impact of crop cover on carbon sequestration, the Roth-C model was adapted to Flanders' environment and coupled to common crop rotations extracted from the IACS geodatabases and statistical databases on crop yield. Crop allometric models were used to calculate crop residues from common crops in Flanders and subsequently derive stable organic matter fluxes to the soil (REGSOM). The REGSOM model was coupled to Roth-C model was run for 30 years and for all combinations of seven main arable crops, two common catch crops and two common dosages of organic manure. The common crops are winter wheat, winter barley, sugar beet, potato, grain maize, silage maize and winter rapeseed; the catch crops are yellow mustard and Italian ryegrass; the manure dosages are 35 ton/ha cattle slurry and 22 ton/ha pig slurry. Four common soils were simulated: sand, loam, sandy loam and clay. In total more than 2.4 million simulations were made with monthly output of carbon content for 30 years.
Results demonstrate that crop cover dynamics influence carbon sequestration for a very large percentage. For the same rotations carbon sequestration is highest on clay soils and lowest on sandy soils. Crop residues of grain maize and winter wheat followed by catch crops contribute largely to the total carbon sequestered. This implies that agricultural policies that impact on agricultural land management influence soil carbon sequestration for a large percentage. The framework is therefore suited for further scenario analysis and impact assessment in order to support agri-environmental policy decisions.