Land use, land management and soil organic carbon dynamics

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Although the agricultural sector is considered to have one of the greatest greenhouse gas mitigation potential, largely via soil organic carbon (SOC) sequestration, it remains a challenge to accurately quantify SOC stock changes at regional to national scales. SOC stock changes resulting from SOC inventory systems vary widely between studies, even for a single country. Process-based models can provide insight in the drivers of SOC changes, but accurate input data, in particular historic data, is currently not available at these spatial scales. Here we illustrate the effects of historic land management (1960-2005) on SOC dynamics in the major soil types and agricultural regions in Belgium using region-specific land use and management data and a process-based model. The largest decreases in SOC stocks occurred in poorly drained grassland soils (-25 to -40 Mg C ha-1 in clays and floodplain soils), consistent with drainage improvements post-1960. Large increases in SOC in well-drained grassland soils (+ 12 Mg C ha-1) appear to be a legacy effect of widespread conversion of cropland to grassland prior to 1960. SOC in cropland increased only in sandy lowland soils (+ 10 Mg C ha-1), driven by increasing manure additions. New techniques and approaches are currently being developed to update the trends in SOC of agricultural soils. At the regional scale a combination of hyperspectral remote sensing and spatial modelling provides detailed SOC maps and inventories of croplands showing within field variation that can be used for geostatistical analysis. At the European scale LUCAS-soil (Land Use/Cover Area frame statistical Survey) survey was implemented in 23 Member States of the EU. About 21,000 soil samples were collected and analysed for basic soil properties at the sites where land use and land cover have been registered annually since 2001. LUCAS-soil is the first harmonized survey conducted at EU level. Sampling techniques providing high resolution SOC data, uniform SOC monitoring networks with land cover and management data are crucial steps in predicting SOC changes in agricultural soils.