Soil organic carbon contribution to GHG balance at cropping system scale

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Mitigating the greenhouse gas (GHG) balance at the scale of an agricultural territory implies to identify the most contributing combinations of cropping systems (i.e. crop rotations, management practices) and soil types. Now, GHG balances usually do not account for soil organic carbon (SOC) evolution in time.

Following the IPCC framework, the avoided or additional CO_2 emissions consecutive to SOC changes were integrated to a GHG balance at the cropping system scale. SOC evolution was assessed by C-AMG model. In the case of SOC losses from mineralization, direct and indirect N_2O emissions due to annually mineralised N were added. N_2O direct and indirect emissions from other N sources were also included in the calculation, as well as upstream and direct GHG emissions from fertilisers and agricultural machinery. To manage data availability constraints at the territory and at the cropping system scales, we inferred crop practices influencing SOC and nitrogen inputs in the cropping system from existing databases. The Tardenois (Picardy, Northern France) farming systems are mainly field crop, potatoes, and mixed crop-livestock.

In Tardenois, most of the 2154 assessed situations showed carbon storage. Additional N_2O emissions from SOC mineralization showed limited contribution to total GHG emissions of cropping systems. At the cropping system scale, our approach shows that, in the long term, SOC evolution greatly influences the GHG balance. SOC fluxes can increase the GHG balance of 1 ha up to 70% and decrease it up to 76%, under the combined influences of the cropping system and the soil type.