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Uncertainty functions of modelled soil organic carbon changes in response to crop management derived from a French long term experiments dataset

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The land use, land-use change and forestry (LULUCF) activities and crop management (CM) in Europe could be an important carbon sink through soil organic carbon (SOC) sequestration. Recently, the (EU decision 529/2013) requires European Union's member states to assess modalities to include greenhouse gas (GHG) emissions and removals resulting from activities relating to LULUCF and CM into the Union's (GHG) emissions reduction commitment and their national inventories reports (NIR). Tier 1, the commonly used method to estimate emissions for NIR, provides a framework for measuring SOC stocks changes. However, estimations have high uncertainty, especially in response to crop management at regional and specific national contexts. Understanding and quantifying this uncertainty with accurate confidence interval is crucial for reliably reporting and support decision-making and policies that aims to mitigate greenhouse gases through soil C storage.

Here, we used the Tier 3 method, consisting of process-based modelling, to address the issue of uncertainty quantification at national scale in France. Specifically, we used 20 Long-term croplands experiments (LTE) in France with more than 100 treatments taking into account different agricultural practices such as tillage, organic amendment, inorganic fertilization, cover crops, etc. These LTE were carefully selected because they are well characterized with periodic SOC stocks monitoring overtime and covered a wide range of pedo-climatic conditions. We applied linear mixed effect model to statistically model, as a function of soil, climate and cropping system characteristics, the uncertainty resulting from applying this Tier 3 approach. The model was fitted on the dataset yielded by comparing the simulated (with the Century model V 4.5) to the observed SOC changes on the LTE at hand. This mixed effect model will then be used to derive uncertainty related to the simulation of SOC stocks changes of the French Soil Monitoring Network (FSMN) where only one measurement is done in 16 Km regular grid. These simulations on the grid will be in turn used for NIR.

Preliminary results suggest that the model do not adequately simulate SOC stocks levels but succeeds at capturing SOC changes due to management, despite the fact that the model does not explicitly simulate some management such as tillage. This is probably due to inappropriate model parametrization especially for crops and thus Cinput in the French context and/or model initialization.