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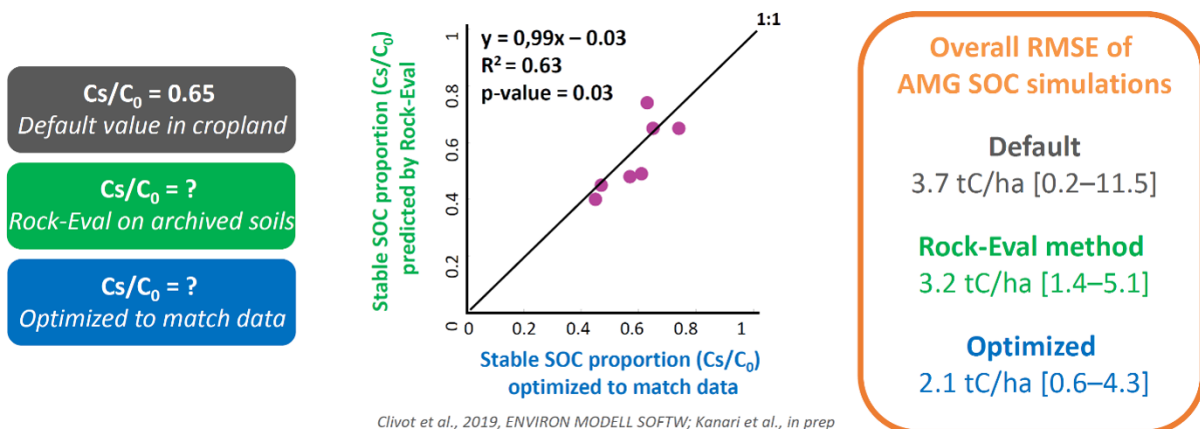
Improving the accuracy of soil organic carbon models by initializing their pool partitioning using Rock-Eval thermal analysis

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Abstract

Changes in the size of the soil organic carbon (SOC) pool can have major effects on climate regulation as well as soil quality and fertility. Many factors influence the stability of SOC, leading to highly variable residence times, ranging from hours to millennia. Accordingly, models of SOC dynamics used to predict the evolution of SOC stocks separate SOC into pools of variable stability. Initial conditions, namely the initial pool partitioning at the onset of simulations, have been shown to be important for the accuracy projections of SOC change. However, methods currently used to estimate the size of SOC pools are indirect, time-consuming, poorly validated and not standardized. Recently, Rock-Eval thermal analysis has been proposed as a new method for direct determination of SOC stability. Based on this technique, a machine learning model (PARTY_{SOC} model) was developed, that allows the estimation of the size of the centennially persistent SOC fraction in a soil sample. Here, using archive soil samples from nine French long-term agricultural experimentation sites, we show that the PARTY_{SOC} model optimally partitions the pool distribution of a simple, well established model of SOC dynamics (AMG), accounting for legacy effects of land use and soil management history. Then, we used the PARTY_{SOC} predictions to initialize the pool partitioning of the AMG model for the nine sites. We show that the CP_{SOC} (RE model) and optimized C_s (ex-post AMG simulations) fractions are in good agreement (slope b=1.01, intercept a=0.04 / spearman ρ=0.88). This observation serves as a successful independent validation of the RE model. Finally, we show that the use of the RE based model improves the accuracy of the AMG model compared to default initialization (\overline{RMSE} decreased by 13.5%), especially for sites with complex land-use history.



Clivot et al., 2019, ENVIRON MODELL SOFTW; Kanari et al., in prep