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Predicting management effects on soil organic carbon stocks of agricultural ecosystems by simple regression based on the analytical solution of RothC.

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Whether agriculture soils act as CO_2 source or sink depends on the SOC budget defined by the stored SOC stock, the carbon input characterized by the quality and quantity of incoming carbon and the SOC loss by decomposition and erosion. The decomposition of soil organic carbon is assumed to be regulated by factors like temperature, soil moisture and soil properties. Soil organic models like the model RothC (1) can estimate the trends of soil organic carbon stocks by considering a range of factors regulating SOC cycling. On the other hand farmers and decision makers require transparent tools to harmonize numerous management options and strategies in order to preserve or increase soil organic carbon stocks while maintaining productivity. Here biogeochemical models are not very intuitive in use for practical issues.

Based on the analytical solution of RothC we show that SOC trends modelled by RothC can be described by a linear regression equation with initial SOC stocks and carbon input rates as independent variables. The coefficients of these regression can be analytically derived from the RothC model and depend on temperature, soil moisture, initial pool distribution and clay content. The analytical solution of RothC is based on a set of assumptions like assumed temporally constant decomposition responses driven by weather conditions and constant carbon input rates. For a data set of 117 field sites of a longterm observational network spread across Germany we show that the developed regression equation sufficiently approximates modelled SOC time series using RothC for common land management on arable soils. The developed analytical model can thus serve as a link between biogeochemical process description and stakeholder support by providing site specific decomposition and humus reproduction coefficients.

[1] Coleman, K., & Jenkinson, D. S. (1996). RothC-26.3-A Model for the turnover of carbon in soil. In Evaluation of soil organic matter models (pp. 237-246). Springer, Berlin, Heidelberg.