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Implications of spectroscopic and thermo-spectroscopic approaches for pool parameterization of SOM models

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While soil organic matter (SOM) models such as Century or Daisy have been applied in a variety of environments and land uses to simulate measured SOM dynamics, the issue of how to parameterize the compartments or pools of these models is not straight forward. Default pool sizes are not suited for all soils, equilibrium model runs of thousands of years may not well approximate the system if previous land-uses are not known or not at equilibrium. Measured SOM fractions have been used to parameterize the pool sizes, but the intermediate and passive pool sizes have been difficult to relate to measureable fractions. This study examined the use of size/density fractionation (SOM fractions), mid-infrared spectroscopy (MIRS), or thermally evolved gas analysis (EGA) derived pools as compared to a long-term model run (Equilibrium) to parameterize model pools of the Century and Daisy SOM models of two arable soils in Southwest Germany. Initial pool sizes were set via the various methods and measured soil organic carbon (SOC) and crop parameters used for the beginning of the model run. Results were compared with measured data of field soil carbon dioxide (CO_2) fluxes, microbial biomass (SMB), and SOC after several growing seasons. It was found that the different initialization methods resulted in a wide range of pool sizes, with the Equilibrium method the smallest fast turn-over pool allocation and the MIRS method with the largest. The EGA, SOM fractions and MIRS approaches resulted in better modeled CO_2 flux as compared to the Equilibrium method. The active pool size allocation had an effect on short-term dynamics within the first modeling year, but diminished thereafter. During a twenty-year simulation the size of slow turn-over resulted in very different final SOC amounts, showing the importance of proper initialization of the intermediate to passive pools for future predictions of SOC. This study demonstrated several approaches and possible implications of using these methods for model pool parameterization and the considerations that need to be taken into account in order to allocate these measureable fractions as model pools.