



## **Advantages of mid-DRIFTS Spectroscopy to initialize soil organic matter models**

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In soil organic matter models, it is often a challenge to estimate, whether soil organic matter (SOM) at the beginning of a simulation is at steady state or not. Major changes of SOM can take centuries, so this is difficult to answer even if time series of SOM are available. One approach is to simulate the land use history of fields, but data on past crop rotations, carbon inputs and weather are usually scarce for timescales of hundred plus years. For this reason, steady state is often assumed, especially for sites under long term agricultural cultivation. It would be desirable to use a measurable proxy to inform about the quality of SOM for pool distribution, which in reality is likely to differ from steady state. Diffuse reflectance mid infrared Fourier transformation spectroscopy (mid DRIFTS) of bulk soils contains such information on SOM quality, because vibrational intensity can be assigned to carbon bonds of different chemical stability. We hypothesized that applying this information to pool based SOM models is an improvement over assuming steady state. To test this, we used the ratio of aliphatic to aromatic peaks from mid DRIFTS spectra as proxy for fast and slow cycling SOM pools in the DAISY model. Bare fallow plots of four regions, the Swabian Alb and the Kraichgau ( together 6 field experiments, Cambisols, 8 years of fallow, with data on total and microbial carbon), Bad Lauchstädt (1 experiment, Chernozem, 25 years of fallow, data on total carbon), all in Germany and the Ultuna frame trial in Sweden (1 experiment, Cambisol, 50 years of fallow, data on total carbon) were used for the modeling exercise. We compared the initialization using the mid DRIFTS SOM pool allocation to the initialization based on the assumption that SOM is in steady state (Bruun and Jensen, 2002). Two published turnover rates and their respective pool allocations under a steady state assumption were used for all four sites: DAISY original turnover rates (Jensen et al., 1997) (83 % SOM in the slow pool), as well as the rates published by Bruun et al., (2003) (49% of SOM in the slow pool). The result of a statistical mixed model showed, that the mid DRIFTS initialization significantly reduced the model error as compared to the steady state with original turnover rates for all but total carbon simulations of the Bad Lauchstädt site. Sometimes the model error was more than halved. Summarized, the mid DRIFTS initializations performed better as the steady state assumption for many parameters, similar for a few, and in no case worse. This shows, that the aliphatic to aromatic mid DRIFTS proxy could be widely applicable for model initialization. The proxy is easy to measure and it would be an important reduction of model uncertainty if less assumptions have to be made by the modeler.