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Can we estimate soil organic matter turnover by combining ^{13}C isotopic and molecular marker information? – Trying a synthesis

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Soil organic matter plays an important role in the global carbon cycle. Models describing soil carbon budgets assume different rates of soil organic carbon (SOC) turnover based on conceptual pools treating SOC as a ‚black box'. Until recently, lipids, lignins and fire-derived (black) carbon were assumed to represent a relatively stable fraction of SOC. One could test this assumption for natural soil systems by taking advantage of exisiting long-term experiments (1 to 40 years) in agricultural systems. Different photosynthetic pathways (eg. C4 maize and C3 wheat) ^{13}C-labelled the biomass and allowed to differentiate "old" and "new" carbon, both in bulk SOC biomass and individual chemical compounds.

We obtained ^{13}C isotopic and molecular marker information from plants and SOC. Results allowed to (i) obtain information on chemical structure, and sources, and to (ii) assess how fast individual molecular compound classes are replaced compared to bulk SOC, and (iii) to infer underlying stabilization processes. The presentation will focus on the use of ^{13}C and molecular markers for lipids, lignins, sugars combined with data from recent literature.

The main conclusions are the following: (i) New bulk carbon replaced old carbon at a rate surprisingly homogenous, considering that results came from 20 different agricultural field experiments spread all over Northern America and Europe. (ii) Comparing replacement of old with new carbon in bulk soil and individual organic compounds revealed a surprising trend. Replacement of n-alkanes and lignins was faster than (or similar to) bulk SOC, but not much slower which had been expected. (iii) Thus, we could not find evidence for a previously postulated intrinsic chemical recalcitrance of n-alkanes and lignins in agricultural soils.