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Is mean residence time a useful tool to evaluate carbon sequestration in soils? Limits and potential

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Soils are increasingly recognized as a serious candidate to store large amounts of carbon. International efforts, like the 4 per mil initiative, are promoting soil-related solutions to retain carbon at long timescales. The options are quite diverse, from biochar or root promoting agricultural techniques to existing large vulnerable soil organic matter stock conservation policies. However, the evaluation of these techniques is not easy. The changes of soil organic carbon stocks are difficult to detect on the short term: carbon stock estimations suffer from technical hurdles, like bulk density estimation or access to the subsoil carbon; the soil is by nature heterogeneous, and generalization of results for a given situation are difficult to upscale.
The evaluation of soil organic matter mean residence time (MRT) may be used to describe the potential of these solutions. In soils, MRT is calculated by isotopic techniques (i.e. stable or radioactive isotopes) or by mass balances (i.e. measured or calculated based in CO_2 emissions). Depending on the method applied, results may vary greatly and may also describe different facets of the soil organic matter continuum. For example, MRT calculated with 14C data depends on molecules with long residence time while MRT based on mass balance calculations are triggered by fresh inputs that may decompose relatively fast in soils. Based on a comprehensive Swiss forest soils dataset allowing us to calculate soil organic matter MRT by different approaches and a series of recent literature considerations about the MRT, we will discuss the potential of MRT to be applied for carbon storage evaluation.