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Spatial and vertical Variation of Soil Organic Carbon: the Role of Soil Redistribution

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Recent work highlighted the impact of soil redistribution on the spatial distribution of SOC storage on arable land. Erosion leaves soils depleted of carbon while subsequent deposition leads to burial of quantities of soil and SOC of relevance to the global carbon budget.

By incorporating carbon dynamics into a spatially distributed soil erosion model (SPEROS-C), it is possible to quantify carbon fluxes between soil and atmosphere under water and tillage erosion.

In this contribution we present the results of an extensive fieldwork campaign, conducted to confirm the previously gained insights, explained above, as well as to refine model calibration and validation. We hereby looked at detailed depth profiles of SOC, radionuclides (^{137}Cs) and stable carbon isotopes on different landscape positions (shoulder positions, footslope, plateau) in three agricultural fields in Belgium. The fields have a different soil redistribution history (grassland, reduced tillage and conventional tillage) but a similar 'rolling' topography. We found clear differences, not only in total carbon inventory but also in carbon isotopic composition between different locations at the same field and between fields.

We developed a simple one-dimensional carbon model (based on conceptual work by Wynn et al. (2005)), which can be used to explain the difference between depth profiles of stable carbon isotopes on landscape positions with different soil redistribution history (erosion, deposition and stable). Preliminary model simulations are promising:

first of all, we are able to simulate the observed depth profiles of both total carbon and δ^{13}C using realistic parameter values. However, although the simultaneous simulation of total carbon inventories, total carbon profiles and δ^{13}C allows for a better constraining of essential model parameters such as the turnover time of different carbon pools additional information, e.g. from ^{137}Cs inventories may be necessary to fully constrain model parameter values under various conditions. Furthermore, within-field observations still do not allow to fully close the SOC budget as the fate of the eroded SOC that is evacuated from the field remains uncertain.