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The fate of eroded soil organic carbon along a European transect – controls after deposition in terrestrial and aquatic systems

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The potential fate of eroded soil organic carbon (SOC) after deposition is key to understand carbon cycling in eroding landscapes. Globally, large quantities of sediments and SOC are redistributed by soil erosion on agricultural land, particularly after heavy precipitation events. Deposition of eroded SOC takes place on downslope soils within the catchment and in adjacent inland waters, i.e. substantial amounts of SOC are transferred from terrestrial to aquatic ecosystems. However, the net effect on C exchange between soils, atmosphere and inland waters is unknown. We hypothesize that the turnover of deposited C is significantly affected by soil and organic matter properties, and whether deposition occurs in terrestrial or aquatic environments.

We sampled topsoils from 10 agricultural sites along a European transect, spanning a wide range of SOC and soil characteristics (e.g. texture, aggregation, C content, etc.). Turnover of SOC was determined for terrestrial and aquatic depositional conditions in a 10-week incubation study. Moreover, we studied the impact of labile carbon inputs ('priming') on SOC stability using 13C labelled cellulose. We evaluated potentially important controls on the fate of SOC such as amounts and composition of soil organic matter (SOM), distribution of SOC in density fractions and aggregates as well as soil physical and chemical properties. NMR analysis provided an in-depth characterization of SOM quality, showing large similarities in chemical composition among the sites. The role of the microbial biomass was specifically assessed in relation to SOC turnover. The results of our study broadly enhanced our knowledge about controls on SOC decomposition/stabilization after its deposition in terrestrial and aquatic environments. We envisage that our quantitative relationships will contribute to obtain better estimates of the impact of soil erosion on carbon budgets and reduce uncertainties in the linkage between terrestrial and aquatic carbon cycling.