Landscape patterns and soil organic carbon stocks in agricultural bocage landscapes

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Soil organic carbon (SOC) has a crucial impact on global carbon storage at world scale. SOC spatial variability is controlled by the landscape patterns resulting from the continuous interactions between the physical environment and the society. Natural and anthropogenic processes occurring and interplaying at the landscape scale, such as soil redistribution in the lateral and vertical dimensions by tillage and water erosion processes or spatial differentiation of land-use and land-management practices, strongly affect SOC dynamics. Inventories of SOC stocks, reflecting their spatial distribution, are thus key elements to develop relevant management strategies to improving carbon sequestration and mitigating climate change and soil degradation.

This study aims to quantify SOC stocks and their spatial distribution in a 1,000-ha agricultural bocage landscape with dairy production as dominant farming system (Zone Atelier Armorique, LTER Europe, NW France). The site is characterized by high heterogeneity on short distance due to a high diversity of soils with varying waterlogging, soil parent material, topography, land-use and hedgerow density. SOC content and stocks were measured up to 105-cm depth in 200 sampling locations selected using conditioned Latin hypercube sampling. Additive sampling was designed to specifically explore SOC distribution near to hedges: 112 points were sampled at fixed distance on 14 transects perpendicular from hedges. We illustrate the heterogeneity of spatial and vertical distribution of SOC stocks at landscape scale, and quantify SOC stocks in the various landscape components. Using multivariate statistics, we discuss the variability and co-variability of existing spatial organization of cropping systems, environmental factors, and SOM stocks, over landscape. Ultimately, our results may contribute to improving regional or national digital soil mapping approaches, by considering the distribution of SOC stocks within each modeling unit and by accounting for the impact of sensitive ecosystems.