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# Identifying and using environmental variables for the prediction of spatially-explicit soil organic carbon stocks in cropland on a regional scale

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At present, methods and research to characterize the horizontal and vertical variability in carbon (C) stocks and the processes controlling C accumulation or depletion in soils are either limited to local slope scales or, if applied to larger scales, to surface soil horizons with large uncertainties when extrapolated to deeper layers. In this study, we use soil profile data collected in two zones of differing soil texture (loam and clay-rich soils) in Luxembourg to calibrate a linear mixed-effect model to predict the 3D soil C stock distribution on a regional scale for cropping systems using a set of spatially-explicit hydrologic, climatic, pedologic and geomorphologic variables. We demonstrate that due to a high spatial variability of C stocks it is mandatory to consider various environmental processes to predict C accurately on a regional scale, especially in deeper soil layers, and to avoid simple depth extrapolation of topsoil C data. Using estimates of topsoil C contents derived from hyperspectral remote sensing, we predict spatial patterns of C stocks for cropland on a regional scale and provide new insights into the spatial heterogeneity of soil C storage covering a large area.