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Soil organic carbon distribution in an agricultural catchment in Southern Brazil: from hillslope to catchment scale.

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Understanding the soil organic carbon (SOC) distribution a few decades after conversion to cropland and plantations in a hilly catchment in southern Brazil is challenging due to scale-dependent controlling factors. Firstly, SOC, bulk density (BD) and texture were measured by depth intervals along 18 soil profiles located in three topographical positions (sloping plateau, central back slope and concave foot slope) in cropland and forest with contrasting slopes. SOC stocks in concave footslope position were not significantly different between fields on steep (11.1 kg C m-2) and gentle slopes (12.8 kg C m-2). However, in eroding profiles, SOC stocks are twice as high in fields on gentle slopes (17.6/12.6 kg C m-2) compared to steep slopes (8.3/7.1 kg C m-2). SOC stocks on steep slope on cropland (8.8 kg C m-2) are three times lower than SOC stocks on steep slope under undisturbed forest (23.7 kg C m-2). On gentle slopes, the effect of deforestation on SOC stocks was not so drastic (14.3 and 14.4 kg C m-2). Therefore, contrasting topography generates different patterns of SOC redistribution in the catchment. The effect of conversion to cropland is probably due to soil redistribution by water and tillage erosion aggravated by the steep terrain. Secondly, in order to assess the heterogeneity of SOC distribution at catchment scale, samples were collected at 10-20; 40-50 and 75-85 cm in 167 soil profiles sampled with an auger. SOC concentrations (gC kg-1) in numerous bulk soil samples (n = 378) were predicted by VIS-NIR spectroscopy and partial least-square regression models. SOC stocks were assessed by a mass preserving spline tool by interpolating SOC mass at the three non-contiguous depth intervals. Samples of calibration-validation dataset (n = 95) were used for physical SOC fractionation allowing the measurement of carbon associated with < 20 μm fraction. Multivariate linear regression models and Pearson correlation coefficients were used to assess the influence of several covariates on SOC stocks, SOC in bulk soil and fractions.
This integrated approach highlights how SOC distribution is influenced by different proximal or distal controlling factors that are scale-dependent. Spectroscopy increases the density of samples available at catchment scale while SOC fractionation provides information on SOC quality on a representative subset of samples.