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Application of vis-NIR spectroscopy for estimation of SOC and SOC fractions on soil samples burned under different laboratory conditions

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Abstract

Fire is one of the principal disturbances acting on forest soil organic carbon (SOC) (Nave et al., 2011). Fire affects both quantity and quality of SOC, with consequences depending on many fire characteristics such as duration or intensity. The impact on the SOC pools (i.e. labile, intermediate and recalcitrant pool) is also different, providing a complete vision of the real impact of fire on soils (Knicker, 2007). Laboratory analysis for the quantification of SOC and its fractions are complex and time-consuming. Alternatively, diffuse reflectance spectroscopy (DRS) has widely demonstrated its potential to estimate SOC with great accuracy in a time- and cost-effective way (Bellon-Maurel and McBratney, 2011). In this study we apply spectroscopic techniques in the vis-NIR spectral range to develop chemometric models (PLSR- partial least square regression) to estimate the oxidisable C and the three C pools. Surface (0-1 cm) and sub-surface (1-3 cm) samples (n=50) from soil monoliths burned under laboratory conditions at four levels of temperature and residence time, simulating different fire severity levels, were used. We also tested the performance of different spectral pre-treatments (i.e. derivative, absorbance transformation and normalization) for the development of the regression models. Results show the great capabilities of this technique, providing good estimates of oxidisable C and recalcitrant pool ($R^2CV \sim 0.70$) and moderate results for the intermediate pool ($R^2CV \sim 0.50$). The analysis of regression coefficients has also allowed the identification of spectral intervals for the prediction of SOC pools.

Keywords: soil carbon pools, spectroscopy, chemometric modeling

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