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Ability of Vis-PIR spectroscopy to monitor changes in organic carbon of loamy soils at two depths

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Visible-Near Infrared (Vis-NIR) spectroscopy has proven its efficiency in predicting several soil properties such as soil organic carbon (SOC) content. In this preliminary study, we explored the ability of Vis-NIR to assess the temporal evolution of SOC content. Soil samples were collected in a watershed (ORE AgrHys), located in Brittany (Western France). Two sampling campaigns were carried out 5 years apart: in 2013, 198 soil samples were collected respectively at two depths (0-15 and 15-25 cm) over an area of 1200 ha including different land use and land cover; in 2018, 111 sampling points out of 198 of 2013 were selected and soil samples were collected from the same two depths. Whole samples were analyzed for their SOC content and were scanned for their reflectance spectrum. Spectral information was acquired from samples sieved at 2 mm fraction and oven dried at 40°C, 24h prior to spectra acquisition, with a full range Vis-NIR spectroradiometer ASD Fieldspec®3. Data set of 2013 was used to calibrate the SOC content prediction model by the mean of Partial Least Squares Regression (PLSR). Data set of 2018 was therefore used as test set. Our results showed that the variation ΔSOC_{obs}obtained from observed values in 2013 and 2018 (ΔSOC_{obs} = Observed SOC (2018) - Observed SOC (2013)) is ranging from 0.1 to 25.9 g/kg. Moreover, our results showed that the prediction performance of the calibrated model was improved by including 11 spectra of 2018 in the 2013 calibration data set (R^2= 0.87, RMSE = 5.1 g/kg and RPD = 1.92). Furthermore, the comparison of predicted and observed ΔSOC between 2018 and 2013 showed that 69% of the variations were of the same sign, either positive or negative. For the remaining 31%, the variations were of opposite signs but concerned mainly samples for which ΔSOCobs is less than 1,5 g/kg. These results reveal that Vis-NIR spectroscopy was potentially appropriate to detect variations of SOC content and are encouraging to further explore Vis-NIR spectroscopy to detect changes in soil carbon stocks.