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A new optical method coupling light polarization and Vis-NIR spectroscopy to improve the measured absorbance signal's quality of soil samples.

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Visible - Near-infrared spectroscopy (Vis-NIRS) is now commonly used to measure different physical and chemical parameters of soils, including carbon content. However, prediction model accuracy is insufficient for Vis-NIRS to replace routine laboratory analysis. One of the biggest issues this technique is facing up to is light scattering due to soil particles. It causes departure in the assumed linear relationship between the Absorbance spectrum and the concentration of the chemicals of interest as stated by Beer-Lambert's Law, which underpins the calibration models.

Therefore it becomes essential to improve the metrological quality of the measured signal in order to optimize calibration as light/matter interactions are at the basis of the resulting linear modeling. Optics can help to mitigate scattering effect on the signal.

We put forward a new optical setup coupling linearly polarized light with a Vis-NIR spectrometer to free the measured spectra from multi-scattering effect. The corrected measured spectrum was then used to compute an Absorbance spectrum of the sample, using Dahm's Equation in the frame of the Representative Layer Theory. This method has been previously tested and validated on liquid (milk+ dye) and powdered (sand + dye) samples showing scattering (and absorbing) properties. The obtained Absorbance was a very good approximation of the Beer-Lambert's law absorbance.

Here, we tested the method on a set of 54 soil samples to predict Soil Organic Carbon content. In order to assess the signal quality improvement by this method, we built and compared calibration models using Partial Least Square (PLS) algorithm. The prediction model built from new Absorbance spectrum outperformed the model built with the classical Absorbance traditionally obtained with Vis-NIR diffuse reflectance. This study is a good illustration of the high influence of signal quality on prediction model's performances.