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The use of NIR spectroscopy for the estimation of properties in agricultural and forest soils from SE Spain

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For the last years, there is a great interest in the use of near-infrared (NIR) diffuse reflectance spectroscopy for the estimation of soil properties because is a rapid, inexpensive, repetitive and accurate tool.

The first steep needed is the construction of models relating the spectral data with the target soil properties. Once the models are calibrated and validated, they can be used for the estimation of the properties in new samples. However, the applicability of models in new samples could be limited if they are largely different to those used for model construction. Thus, the development of models integrating large numbers of samples from different types of soils is interesting for wider and robust applicability. In this sense, we obtained accurate models using samples from agricultural and forest soils from different areas of SE Spain. The results for soil organic carbon (OC) using 1998 samples gave values of r^2=0.963, and RPD=5.2. The values of OC ranged from 0.97 to 180.39 g C kg^{-1}. Accurate models were also obtained for Kjeldahl nitrogen (NKj) using 956 samples, with values of r^2=0.967, and RPD=5.5. The values of NKj ranged from 0.08 to 8.64 g NKj kg^{-1}. A slightly less accurate model (but useful as well) was also obtained for basal respiration (BR) using 676 samples, with values of r^2=0.864, and RPD=2.7. The values of BR ranged from 0.21 to 37.91 mg C-CO_2 kg^{-1}

h^{-1}. Other models for approximate estimations were obtained for microbial biomass carbon (r^2=0.87; n=609) and carbonates (r^2=0.88; n=1605).

But the accuracy of models can be increased when they are constructed using only samples from a homogeneous area (with the same soil type; local models), and thus reducing the heterogeneity of the calibration-validation set. In this case, the applicability is obviously reduced to the target area, but the estimations were clearly improved. This option could be interesting for those situations where the maximum accuracy is needed, such as organic carbon inventories in soils.

The effect of including the heterogeneity of the target area in the predictive ability of a 'global' model is also discussed in this work.

Another important advantage of NIR spectroscopy is that the spectra of soils could be considered as a 'fingerprint' that can be easily measured and stored. This allows that these spectra could be re-analyzed in the future when extremely accurate models will be available. It is possible that future models can predict accurately other interesting parameters that currently can not be measured, or their measurements are extremely laborious, complex or expensive (such us phospholipids fatty acids [PLFA]). But this needs an improvement of the current calibrations transfer methodology.