Abstract

Near infrared and soil science: new challenges for spectroscopists

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Introduction

Papers in NIR applied to soil appeared in the 1980s and gradually increased in number. Analytical issues in soil science are varied: analysis of major (organic matter, clay, sand, and carbon content) and even minor constituents (ions), of contaminants (nitrate, pesticides), estimation of physical characteristics (particle size, bulk density) and functional properties (fertility, microbial activity). Most studies have been carried out in laboratory. There is a growing interest in measuring these properties, e.g. C content, directly in fields. New scientific questions arise from these conditions. The aim of this paper will be to report the first attempt to reduce the effect of moisture and soil structure on predictions, as well as to point out the new and specific challenges that spectroscopists have to face when applying NIR to soil issues.

Materials and Methods

Soil sample cores were extracted from an agricultural Australian land. Then 45 selected samples were collected from the core and scanned by an ASD spectrometer in 3 conditions: fresh ("wet"), after drying ("unground") and then after 2mm sieving ("ground"). Reflectance spectra (500-2450 nm) were recorded. Carbon (C) content was measured (dry combustion method). A model was created on ground samples using PLS and then tested on unground and wet samples, respectively without and with application of External Parameter Orthogonalisation (EPO).

Results and Discussion

Without EPO, the model built on ground samples (SECV = 1.9 g C/kg) was unusable for both unground and wet samples (SEP resp. equal to 3.9 and 8.9 g.C/kg). With EPO, the SEP obtained on unground and wet samples were 2.5 and 2.2 g C/kg respectively, paving the way for the prediction of C using NIR.

Conclusion

A first attempt to solving the issue of effect of moisture and structure of the soil has been carried out by using EPO. This is only one out of the numerous scientific bottlenecks brought by the application of NIR on soils. Other spectroscopic and chemometric scientific issues are typically brought by the application of NIR on soils: light-diffuse matter interaction, log-normal distribution of analytes, choice of the model type, database building.

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