Geophysical Research Abstracts
Vol. 13, EGU2011-13224, 2011
EGU General Assembly 2011

Building a regional soil organic carbon calibration model using VisNIR spectroscopy in a postglacial landscape

Krzysztof Kuśnierek and Cezary Kaźmierowski
Department of Soil Science and Remote Sensing of Soils, Adam Mickiewicz University, Poznan, Poland (kus@amu.edu.pl)

The spectral measurements of the radiant energy reflected from a soil sample, taken in the visible and near infrared (VisNIR) region, between 400 and 2500 nm, reveal the information about the chemical composition of soil. This allows the quantitative empirical calibration of a number of soil constituents. Here, the soil organic carbon (SOC) content is taken into account. Although, SOC is the most popular soil constituent to model using VisNIR spectroscopy, it is also considered as one of the most difficult ones.

Various soil forming factors influence the bonding of carbon nuclei into molecules of a diverse structure. Therefore, not only the quantity of SOC but also the qualitative composition of humic substances containing SOC is revealed by diffuse reflectance spectroscopy (DRS). This introduce an uninformative variance to the calibration model, not to mention the spectral influence of other soil constituents and varying mechanical composition of soils, which also is a reason of reducing the predictive power of DRS as a tool in estimation of SOC content.

While building local SOC calibrations (similar soil forming factors) gives the measurement errors comparable to other laboratory techniques traditionally used to assess SOC content, the modeling performed on soils collected on large areas (diverse soil forming factors) is likely to produce poor calibrations and may require robust troubleshooting.

This work describes the results on optimizing the performance of the regional SOC calibration model of Poznan Lakeland. In this relatively large postglacial region (∼3100km2), the diverse parent material, the geomorphology of the terrain, natural drainage conditions and a short period of pedogenesis, result in a very diverse soil cover. 72 samples were collected to build a dataset that would reflect the soil diversity of the region. The soil samples were air dried, ground, and sieved through 2mm sieve. SOC content was measured in the collected samples by the dichromate oxidation (Walkey Black's) method. The VisNIR reflectance measurements were taken in the laboratory conditions using ASD Fieldspec 3 spectrometer.

The regional model derived from the initial dataset was not calibrated well. Therefore, the sensitivity of the model upon the rejection of particular soil samples and grouping them according to land use, soil type and soil texture was investigated. Also, the inherent spectral properties of soils revealed by grouping of soil samples using several clustering algorithms were taken into account.

All in all, SOC calibration performed on the regional dataset was substantially improved by removing the samples of poorly drained and carbon rich soils under pastures and crop-fields converted from grasslands. More accurate calibrations were obtained when the dataset was divided into groups of similar soil type or texture. This led to a theoretical conclusion that SOC regional calibration may be dependent upon the structure of humic substances in soils, which shall be verified in the following investigation.