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Within-field estimation of soil organic carbon using a regional VisNIR model in a post-glacial landscape

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

This work describes the constraints and opportunities of performing an estimation of soil organic carbon (SOC) in a field scale, using a visible and near infrared (VisNIR) spectral SOC model developed for a relatively large post-glacial geographical mezoregion. The Poznan Lakeland (bounding box: 52^{o}05'N, 15^{o}30'E; 52^{o}45'N, 16^{o}58'E), which is the region of interest, covers the area of over 3100 km^2 and its soil cover comprises of a number of various soil types, such as: Haplic Luvisols, Albic Luvisols, Haplic Albeluvisols Haplic Phaeozems, Gleyic Chernozems, Brunic Arenosols and Mollic Gleysols. The soils of the region developed from different parent materials and several geomorphological landscapes are present in the region, including: undulating ground moraines, sandur fields, marginal aggradation plains, subglacial troughs and kame terraces.

The initial regional dataset of 72 samples was built to 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 diversity of soil forming factors made it difficult to develop a well performing VNIR model that would explicitly explain the diversity of all soil types within the analyzed region. Therefore several sub-models were proposed. The sub-sets of soil samples were delimited according to a given soil type, soil texture or inherent spectral properties revealed by the clustering of soil spectra, which is discussed in detail in the corresponding study.

Two study sites were selected within the boundaries of the Poznan Lakeland region to test the regional SOC modeling and perform field-scale predictions of SOC. Both sites were located within the undulating ground moraines landscape, but the areas comprised of different soil cover. The predominant soil types of Chlewiska site (centroid: 52^{o}30'48"N, 16^{o}38'27") are Gleyic Chernozems and Albic Luvisols, developed from the clayey parent material. On the other hand, Brunic Arenosols and Haplic Luvisols occurring in the Sobota site (centroid: 52^{o}31'23"N, 16^{o}49'01"), developed from sands.

The SOC estimation results obtained for both local datasets (Chlewiska: 68 samples; Sobota: 90 samples) were compared with the cross-validation of the SOC local models and the decline of the results was assessed and then compared between the two analyzed sites. Additionally, the spatial distributions of SOC content measured using the reference method was obtained using kriging interpolation. Finally, they were confronted with the spatial distributions predicted either by a local or a regional model.