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Use of VIS-NIRS for land management classification with Support Vector Machine and prediction of several soil properties

Guillaume Debaene, Jacek Niedźwiecki, and Dorota Pikuła

Institute of Soil Science and Plant Cultivation, Soil Science and Land Conservation, Puławy, Poland (gdebaene@iung.pulawy.pl)

The objective of this work was to investigate the effect of a long-term experiment on soil spectral characteristics (visible and near-infrared) and to develop prediction models for several soil properties (soil organic carbon (SOC), N, pH, hydrolytic acidity (Hh), P2O5, K2O, Ca, Mg, K, and Na content) from texturally homogeneous samples (loamy sand, USDA soil classification). The farm (Grabów Experimental Station 51°21'N, 21°40'E and 167 m.a.s.l., Institute of Soil Science and Plant Cultivation – State Research Institute, Puławy) is located in the Eastern Poland. The long-term experiment is based on crop rotation systems with humus enrichment and depletion and on the treatment with different amounts of organic and inorganic fertilizers. Chemometric techniques such as partial least square (PLS) regression and support vector machine (SVM) classification have been applied on 80 samples for prediction and classification. In the view of the results, visible and near infrared spectroscopy (VIS-NIRS) is suitable for soil properties prediction of texturally homogeneous samples. The effect of fertilizer applications were sufficient to modify the soil chemical composition to a range suitable for using VIS-NIRS for calibration and modeling purposes. The best results were obtained for SOC and N content prediction using the full dataset with cross-validation (r2 = 0.77, RMSECV = 0.04, RPD = 2.08 and r2 = 0.83, RMSECV = 0.01, RPD = 2.20 respectively) and with an independent validation dataset (r2 = 0.72, RMSEP = 0.04, RPD = 1.80 and r2 = 0.74, RMSEP = 0.03, RPD = 1.35 respectively). The use of fertilizers and the type of crop rotation seem to have a significant impact on soil spectral properties since SVM methodology with a linear kernel function was able to classify soil samples as functions of the applied doses of organic and inorganic fertilizers with 75% accuracy and the type of crop rotation with more than 90% accuracy with full validation of separate datasets.