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Prediction models for soil organic carbon (SOC) using spectral data have shown variable accuracy due to multivariate calibration methods and the number of samples used for model calibration. However, few studies have demonstrated the performance of the models when using a regional spectral library (RSL) composed by samples with distinct soil properties, characterizing a heterogeneous RSL (HRSL). Considering the hypothesis that the predictive ability of the models is linked to soil data complexity, the stratification of a spectral library based on soil texture is a strategy to improve the accuracy of SOC predictions. Therefore, the objective of this study was to evaluate the performance of SOC prediction models after the stratification of a HRSL, using soil texture as criterion. A HRSL (n = 1,922 samples) from the Rio Grande do Sul (RS) and Santa Catarina (SC) state, south of Brazil, was used. The database is composed by samples from the Planalto and Depressão Central of RS and from the mountain region of SC. The spectral reflectance measurements were performed in laboratory with a spectroradiometer in the 350-2500 nm range. Spectral data were submitted to normalization preprocessing analysis. The multivariate partial squares regression (PLSR) calibration method was used to generate the models. Firstly, a model was generated using all the samples in the HRSL and then the spectral library was stratified in two groups based on soil texture, namely sandy, silt and medium texture (> 15% sand and < 35% clay – 332 samples) – T1; and, clayey and very clayey texture (> 35% clay – 1,590 samples) – T2. Models were built with 70% of the samples for calibration and 30% for validation. Coefficient of determination (R^2_V) and root mean square error ($RMSE_V$) of validation were used to assess the performance of the models. The model generated with all the samples reached an accuracy of R^2_V = 0.60 and $RMSE_V$ = 0.67%. After stratification, the model generated for group T2 showed the best accuracy (R^2_V = 0.70, $RMSE_V$ = 0.46%), followed by group T1 (R^2_V = 0.41, $RMSE_V$ = 1.52%). This study highlights that samples with sandy and medium texture have smaller accuracy of regional prediction models for SOC. The application of VIS-NIR spectroscopy shows potential as a reliable and inexpensive tool to quantify SOC for subtropical soils with high clay contents. Predictive models for soil properties can be improved when the variability of soil characteristics is considered in HRSL.
Keywords: Hyperspectral remote sensing; soil carbon; regional spectral library; partial least squares regression
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(7624 - 3204) The Brazilian Soil Spectral Library (BSSL): a general overview

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The Brazilian Soil Spectral Library (BSSL) began its collection in 1995 at the Department of Soil Science (ESALQ-USP). Currently, SSLB has gathered data from all the 26 States of Brazil, reaching more than 38,000 soil samples. This achievement was only possible to reach due to the collaboration (33instituitions) and 49 researchers. The objective of this manuscript is to present the system on the utilization and applications of this dataset. The spectral data range from visible to shortwave infrared (350 to 2.500 nm). The BSSL allow identify the main spectral behavior of Brazilian soils. With the development of BSSL, it is possible to: a) locate partners for joint research development; b) assess, via internet, whether a local, regional, or national estimative of your own spectra, based on calibrated models. In this context, we also can perform the prediction of soil color by using the reflectance data. In the present work, we determined how many spectral patterns are required to represent Brazilian soils. The preliminary results showed that 5 spectral curves can represent the spectral patterns of Brazilian soils. The BSSL can be informative regarding classification, soil surveys and quantification. It will be presented the utility of national spectra to predict soil attributes, such as organic matter (OM), sand, silt, clay, cation exchange capacity (CEC), and pH. The result of national estimation model for these attributes showed that the granulometry presented good performances (R^2 between 0.55 and 0.70) and slightly smaller for OM, CEC and pH. New contributions to the BSSL are still encouraged for a second round for 2019. We hope that this work reinvigorate our community's discussion towards the importance of sensors in agriculture, environment and extend the soil researches.
Keywords: Soil sensing, library, remote sensing, soil mapping, environment, big data
Financial support: Grant #2014-22262-0, São Paulo Research Foundation (FAPESP)

(1791 - 3209) The geographic and environmental characterization of the Brazilian Soil Spectral Library (BSSL)

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The Brazilian Soil Spectral Library (BSSL) started with a collection of soil samples in 1995 at the Department of Soil Science (ESALQ-USP). Currently, BSSL has gathered data from 26 States of Brazil, totaling more than 38,000 soil samples. Thus, the objective of this work was to present the first results of this databank in relation to Brazilian soils and its soil attributes. The BSSL allows to extract and associate the inherent spectral information with the geographic and environmental variables. With the development of BSSL, it was possible to demonstrate the potential of this tool for tropical soils management, and relate the soil spectral reflectance to the regions and states, biomes, geology, soil classes, and vegetation. Principal component analysis was performed to explore and visualize correlated data. The average spectrum was determined for each group. The group of spectra of Amazonas and Pernambuco States, the North and Northeast regions showed higher reflectance corroborating the presence of sandy soils. While spectra from the States of Rio Grande do Sul, Rio de Janeiro, and Mato Grosso do Sul, also the South, Southeast and Center-West regions revealed low spectral

reflectance. This low reflectance is correlated with clayey soils, which are iron oxides and organic matter abundant. In relation to the types of geology, spectral curves from igneous rocks, rich in calcium and iron, had low reflectance, while metamorphic rocks exhibited with high reflectance and well-defined features mainly linked to the minerals of feldspar, quartz, and plagioclase. Among the soil classes, the behavior of the Oxisol spectral curve showed the lowest reflectance due to the high levels of clay and iron oxide contents. The spectral curve of the Histosol presented low reflectance in the visible region due to the high content of organic matter in these soils. On the other hand, the Spodosol had the highest reflectance followed by Aridisol class, since these soils present very high sand content. With SSLB, it was possible to characterize and group the intrinsic spectral soil information geographically and environmentally. The use of sensors and geotechnologies, due to their agility and low cost in the analysis, allows a higher sample density practice, improve the problem of detailed soil mapping, and generate data for the soils survey and mapping that can assist in the management of agriculture in a rational way.

Keywords: Soil sensing, library, remote sensing, soil mapping, big data.
Financial support: Grant #2014-22262-0, São Paulo Research Foundation (FAPESP)

(7452 - 519) The Research of Paddy Soil Quality Spatial and Temporal Change in Fengxin County, Jiangxi Province of China

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Soil Quality is the comprehensive reaction of soil properties, and the crop yield react the crop grow situation. The differences of the soil quality cause the crop growth difference and then intensify the soil fertility variability. To research the spatial and temporal change of soil quality is the basis of scientific to manage soil fertility and crop fertilization. In the research, 2016 paddy soil samples was surveyed and analyzed in Fengxin County, and then, the analysis results was compared with the results from the second soil survey to research spatial and temporal change of the soil properties by GIS. Then, the soil quality was evaluated and classified. The results show that soil fertility in Fengxin County was raised in last 30 years, the highest raised paddy field are located at east low hill region, especially the field at plain nearby the main road by compared the soil properties between soil samples analysis and the second soil survey paddy. The ratio of soil quality class which highest raised for effective phosphorus to total paddy field is 98.2%, especially the ratio of class rise 2 or 3 are 37.87% and 33.40%, respectively. The ratio of raised soil quality class for effective potassium, organic matter content and total nitrogen are 71.34%, 68.39% and 47.44%, respectively. Based on GIS, the paddy soil quality evaluation index system and evaluation models were established, and the paddy soil quality was evaluated comprehensively. The results include 7 soil quality class, the ratio of each class area to the total area are 10%, 13.86%, 17.81%, 18.63%,11.80%,15.35% and 12.55%, respectively.

Keywords: Paddy soil, Quality evaluation, GIS, Fengxin County
Financial support:

(5122 - 2152) Accuracy of clay content prediction through spectroscopy affected by multivariate method

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The determination of clay content is important for sustainable soil management. Soil particle size distribution have a direct impact on physical, chemical and biological functions of soil. Clay content can be predicted allying the spectroscopy technique with multivariate statistical models. Among the factors that influence the accuracy of prediction models are the many different of multivariate methods. According to the literature, the method of partial least squares regression (PLSR) is better for samples of homogeneous areas at local scale. However, there is a lack of papers using a spectral library derived from distinct soils and places, presenting samples with a sharp variation in the physical, chemical and mineralogical attributes. Therefore, the objective of this study was to evaluate the accuracy of different multivariate methods for clay content prediction from of a heterogeneous soil spectral library. A database with 1992 samples from the south region of Brazil was used, encompassing soils from Planalto and Depressão Central of Rio Grande do Sul and mountain region of Santa Catarina. Clay content was determined via pipette method. Spectral analyses were performed using a spectroradiometer in range 350-2500 nm. The spectral data was submitted to smoothing pre-processing with a mobile window of 9 nm. The following multivariate methods were tested: PLSR, random forest (RF), support vector machine (SVM) and multiple linear regression (MRL). 70% of samples were used for calibration and 30% for validation of the models. Model accuracy was evaluated coefficient of determination (R^2_V) and root mean square error ($RMSE_V$). The models were generated in the graphic interface AlradSpectra. The best accuracy was achieved using the PLSR model, with $R^2_V = 0.78$ and $RMSE_V = 8.82\%$, followed by the models SVM, with $R^2_V = 0.77$ and $RMSE_V = 9.09\%$, MRL, with $R^2_V = 0.76$ and $RMSE_V = 9.19\%$ and RF, with $R^2_V = 0.68$ and $RMSE_V = 10.72\%$. The PLSR method demonstrated superiority in the accuracy in relation to the others, however, the difference was less accentuated than in the studies with homogeneous samples. More studies should be performed approaching the effect of spectral processing techniques and number of samples in the calibration of models with heterogeneous data.

Keywords: pedometry, spectral analysis, multivariate calibration, clay prediction;
Financial support: CAPES; FAPERGs;

WG06 Soil Monitoring: Soil monitoring evolving tools and challenges

(4231 - 542) Turning Band Co-simulation algorithm approach to multivariate mapping of heavy metals spatial contamination in a Cu-Ni exploration field

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The mining and smelting of copper and nickel around Selibe-Pikwe in the Central Province of Botswana is capable of releasing heavy metals including Pb, Fe, Mn, Co, Ni and Cu into the soil environments, thereby exposing humans, plants and animals to health risks. In this study, turning band co-simulation, a multivariate geostatistical model, was presented here as a tool for spatial uncertainty quantification and probability mapping of cross-correlated heavy metals (Co, Mn, Fe and Pb) risk assessment in a semi-arid Cu-Ni exploration field of Botswana. A total of 1050 soil samples were collected across the field at a depth of ~10 cm in a grid sampling design. Rapid elemental concentration analysis was done using an Olympus Delta Sigma portable x-ray fluorescence device. Enrichment factor (EF), geoaccumulation index (Igeo) and pollution load index (PLI) were used to assess the potential risk of heavy metals contamination in soils. The partially heterotopic nature of the dataset and strong correlations among the heavy metals favours the use of co-simulation instead of independent simulation in the probability mapping of heavy metal risks in the study area. The strong correlation of Co and Mn to iron infers they are of lithogenic origin, unlike Pb which had weak correlation pointing to its source in the area being of anthropogenic source. Manganese, Co and Fe show low enrichment,