THEME 1

Effect of the continuum removal in measuring SOC with NIRS in the Senegal Sahelian Soil

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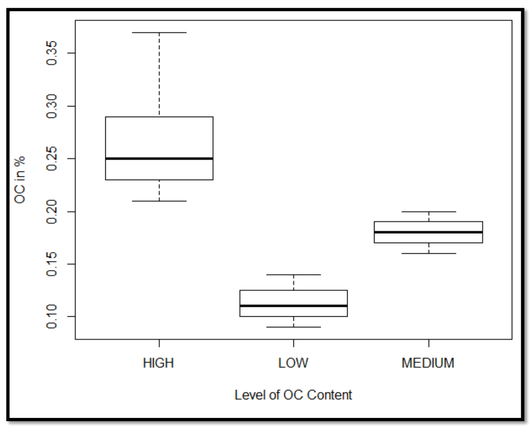
INTRODUCTION

The need to have detailed information on soils using alternative methods, at lower cost, is a real challenge in the developing countries where the availability of analytical equipment of soils remains widely insufficient. Organic Carbon (OC) is recognized as a good indicator of soil quality in the sahelian agrosystem in Senegal. In this fact, calibration of models to measure the agro-pedological variables becomes an issue of sustainable development knowing that agricultural production plays a major role in food security and climate change .

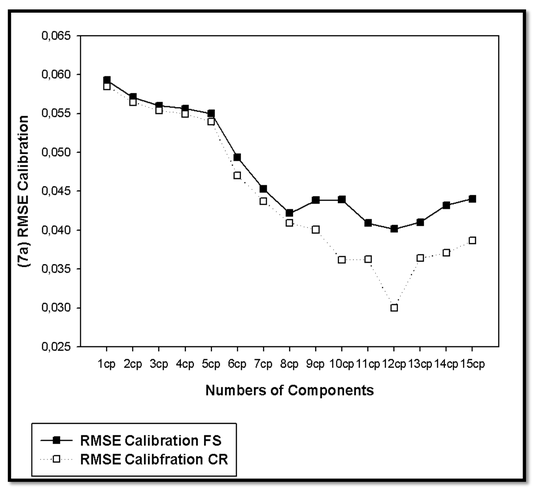
The interest of pursuing research in spectroscopy was to implement more accurate and reproducible model estimation of soil properties. For the exploration of these spectral data, pre-processing functions were carried out to determine the most relevant spectral wavelengths for estimating soil properties. The (CR) Continuum Removal is an examples of pre-treatments which allows to isolate particular absorption features in diffuse reflectance spectra on the soils . After isolation, these absorption wavelengths were removed in the explanatory variables of the model in order to minimize errors prediction. The CR was calibrated with the PLSR (Partial Least Square Regression) model to evaluate the level of accuracy in predicting soil organic carbon from the spectral data.

OBJECTIVES

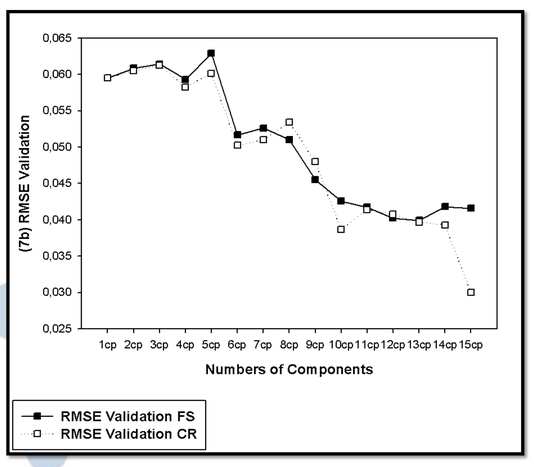
The objective of this study was to evaluate the effect of the continuum removal (CR) in the validation of the accurate prediction model of the soil properties with Vis-NIR spectroscopy data. We used the remote sensing software ENVI 4.7 to compute the CR function where the value of the continuum for each sample and for each spectral wavelength was obtained by dividing the reflectance values of the full spectrum (FS) with those of the continuum curve (CC). The partial least square regression (PLSR) model was applied in the spectral data from the soil of the Senegal Sahelian region.



Graph 1: The range of the SOC content in % of the data set



Graph 2: Effect of the CR in the RMSE SOC of Calibration



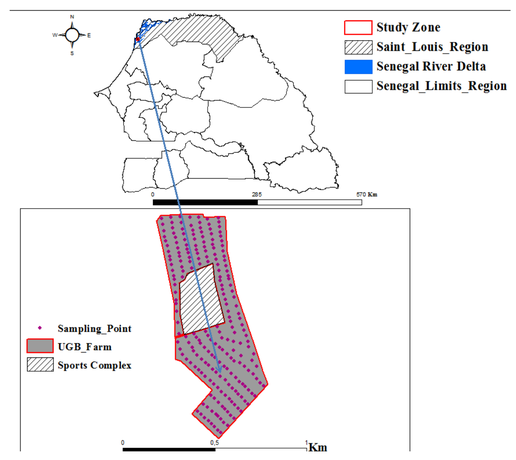
Graph 3: Effect of the CR in the RMSE SOC of Validation

MAIN RESULTS

Our findings show a positive effect of the application of CR in the measure of soil organic carbon. In calibration, the R2 increased up to 10% with the continuum removal in the model of 12 components (CP). In terms of validation, it's the 15-component model which is the most accurate with the same range. The lowest RMSE ranged from 0.04 with the FS to 0.03 with the application of the CR in calibration and validation. The average OC content for the observed data is 0.21%. The predicted one with the continuum removal is also 0.21%. With the full spectrum (FS), predicted data equal 0.20 %.

Tab. 1: Observed and Predicted organic carbon content using the PLS model on the some samples data

Samples	OC_Obs	OC_Pred_FS (12 Cp)	OC_Pred_CR (15 Cp)
156	0.17	0.19	0.18
157	0.25	0.26	0.26
158	0.28	0.25	0.24
159	0.17	0.14	0.13
160	0.20	0.21	0.19
161	0.18	0.14	0.23
162	0.26	0.23	0.25
163	0.32	0.27	0.26
164	0.20	0.18	0.16
165	0.23	0.22	0.22
166	0.16	0.21	0.22
167	0.39	0.38	0.40
168	0.27	0.27	0.27
169	0.17	0.21	0.22
170	0.22	0.18	0.19
171	0.35	0.30	0.32
172	0.14	0.14	0.15
173	0.21	0.17	0.18
174	0.22	0.19	0.20
175	0.17	0.16	0.18
176	0.15	0.19	0.17
177	0.16	0.24	0.21
178	0.16	0.20	0.20
179	0.25	0.25	0.25
180	0.23	0.21	0.22
181	0.18	0.20	0.19
182	0.36	0.30	0.34
183	0.14	0.16	0.14
184	0.16	0.12	0.12
185	0.19	0.24	0.24
186	0.13	0.15	0.16
Averag	0.21±0.	0.20 ± 0.06	0.21 ± 0.06



Map 1: The range of the SOC content in % of the data set

Tab. 2 Evolution of the rainfall over the last five years (2010-2015)

Year	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
2010	28.0	70.0	66.0	320.0	109.0	0.0	0.0
2011	0.0	49.0	108.0	116.0	4.0	0.0	0.0
2012	0.0	74.0	106.0	190.0	8.0	0.0	2.0
2013	0.0	60.0	151.0	152.0	4.0	1.0	8.0
2014	0.0	2.0	69.0	26.0	16.0	0.0	0.0
2015	0.0	7.0	137.5	83.0	13.0	0.0	0.0

CONCLUSION

This study has allowed to understand better the application modalities of the CR method in the spectroscopy of soil samples. Indeed, when the value of the (CR) is equals to 1, the full spectrum (FS) and the continuum curve (CC) will present the same values of reflectance. The one perspective of this study will be to perform the neural network model on this dataset in order to better evaluate the effect of the CR in the estimation of physical and chemical properties of the soil. Other method of pre-processing data like the Multiplicative Scatter Correction function must be tested for improving the accuracy of the prediction of soil properties with Vis-Near Infrared Spectroscopy.