Prediction performance of "Site specific" and "Regional" pedospectrometric models: example of soil total carbon and soil electrical conductivity in arid area.

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Visible-Near infrared (Vis-NIR) spectroscopy in association with chemometric approaches is nowadays recognized as a promising tool for predicting various soil properties. We coupled spectroscopy to PLS algorithm to predict two interesting soil properties in arid zone: total carbon (Ctot) and electrical conductivity (EC). In three distinct sites, covered by three images from QuickBird satellite (Chamsa : 2800 ha, Oudia : 2800 ha and Oung : 2548 ha), belonging to a same arid region (Djerid: 5600 km^2, south western Tunisia), we collected respectively 30, 29 and 30 samples according to a parsimonious sampling strategy, integrating radiometric image data. We compared those two soil properties prediction performance of two calibration procedures: "specific site" versus "regional". For Ctot, site specific models were effective for the first two sites and showed poor performance for the third. Prediction performances of these models were respectively (R^2 = 0.85, Bias = -0.01%, RMSE = 0.14% and RPD = 2.53; R^2 = 0.83, Bias = -0.01%, RMSE = 0.64% and RPD = 1.64; R^2 = 0.55, Bias = 0.04%, RMSE = 0.43% and RPD = 0.76). For EC, specific site models showed poor performance for the first two sites and appeared effective for the third. Prediction performances of these models were respectively (R^2 = 0.57, Bias = 0.12 dS/m, RMSE = 0.54 dS/m and RPD = 0.32; R^2 = 0.51, Bias = 0.37 dS/m, RMSE = 2.5 dS/m and RPD = 1.42; R^2 = 0.76, Bias = 9.77 dS/m, RMSE = 12.44 dS/m and RPD = 2.01). For both variables, prediction performances declined noticeably when a specific site model was used to predict samples collected on the two other sites. This fact testifies a limited geographical robustness of these specific site models. The regional model of Ctot was acceptable (R^2 = 0.67, Bias = 0.18 dS/m, RMSE = 0.93 dS/m and RPD = 1.72). Its quality can be improved by recalibrating the model on a larger sample set collected from other sites. The regional model of the EC showed medium performance (R^2 = 0.53, Bias = 4.59 dS/m, RMSE = 10.75 dS/m and RPD = 1.44). Results indicated, in case of arid area, that the parsimonious sampling strategy based on satellite images allowed to calibrate spectral models with good prediction performances, especially for predicting soil total carbon content.

Key words: Vis-NIR spectroscopy, PLS Regression, arid zone, specific site model, regional model, total carbon, electrical conductivity.