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Soil organic carbon content assessment in a heterogeneous landscape: comparison of digital soil mapping and visible and near Infrared spectroscopy approaches

Didier Michot (1), Youssef Fouad (1), Pichelin Pascal (1), Valérie Viaud (2), Inès Soltani (1), and Christian Walter (1)

(1) UMR SAS AGROCAMPUS OUEST-INRA, 35042, Rennes, France (didier.michot@agrocampus-ouest.fr), (2) UMR SAS INRA-AGROCAMPUS OUEST, 35042, Rennes, France

This study aims are: i) to assess SOC content distribution according to the global soil map (GSM) project recommendations in a heterogeneous landscape ; ii) to compare the prediction performance of digital soil mapping (DSM) and visible-near infrared (Vis-NIR) spectroscopy approaches.
The study area of 140 ha, located at Plancoët, surrounds the unique mineral spring water of Brittany (Western France). It's a hillock characterized by a heterogeneous landscape mosaic with different types of forest, permanent pastures and wetlands along a small coastal river.
We acquired two independent datasets: j) 50 points selected using a conditioned Latin hypercube sampling (cLHS); jj) 254 points corresponding to the GSM grid. Soil samples were collected in three layers (0-5, 20-25 and 40-50cm) for both sampling strategies. SOC content was only measured in cLHS soil samples, while Vis-NIR spectra were measured on all the collected samples.
For the DSM approach, a machine-learning algorithm (Cubist) was applied on the cLHS calibration data to build rule-based models linking soil carbon content in the different layers with environmental covariates, derived from digital elevation model, geological variables, land use data and existing large scale soil maps.
For the spectroscopy approach, we used two calibration datasets: k) the local cLHS ; kk) a subset selected from the regional spectral database of Brittany after a PCA with a hierarchical clustering analysis and spiked by local cLHS spectra. The PLS regression algorithm with "leave-one-out" cross validation was performed for both calibration datasets.
SOC contents for the 3 layers of the GSM grid were predicted using the different approaches and were compared with each other. Their prediction performance was evaluated by the following parameters: R^2, RMSE and RPD. Both approaches led to satisfactory predictions for SOC content with an advantage for the spectral approach, particularly as regards the pertinence of the variation range.