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# Integrating depth functions and hyper-scale terrain analysis for 3D soil organic carbon modeling in agricultural fields at regional scale

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Soil Organic Carbon (SOC) represents a key component in the global C cycle and has an important influence on the global $CO_2$ fluxes between terrestrial biosphere and atmosphere. In the context of agricultural landscapes, SOC inventories are important since soil management practices have a strong influence on $CO_2$ fluxes and SOC stocks. However, there is lack of accurate and cost-effective methods for producing high spatial resolution of SOC information. In this respect, our work is focused on the development of a three dimensional modeling approach for SOC monitoring in agricultural fields.
The study area comprises ∼420 km2 and includes 4 of the 5 agro-geological regions of the Grand-Duchy of Luxembourg. The soil dataset consist of 172 profiles (1033 samples) which were not sampled specifically for this study. This dataset is a combination of profile samples collected in previous soil surveys and soil profiles sampled for other research purposes.
The proposed strategy comprises two main steps. In the first step the SOC distribution within each profile (vertical distribution) is modeled. Depth functions for are fitted in order to summarize the information content in the profile. By using these functions the SOC can be interpolated at any depth within the profiles. The second step involves the use of contextual terrain (ConMap) features (Behrens et al., 2010). These features are based on the differences in elevation between a given point location in the landscape and its circular neighbourhoods at a given set of different radius. One of the main advantages of this approach is that it allows the integration of several spatial scales (eg. local and regional) for soil spatial analysis. In this work the ConMap features are derived from a digital elevation model of the area and are used as predictors for spatial modeling of the parameters of the depth functions fitted in the previous step.
In this poster we present some preliminary results in which we analyze: i. The use of different depth functions, ii. The use of different machine learning approaches for modeling the parameters of the fitted depth functions using the ConMap features and iii. The influence of different spatial scales on the SOC profile distribution variability.

Keywords: 3D modeling, Digital soil mapping, Depth functions, Terrain analysis.

Reference

Behrens, T., K. Schmidt, K., Zhu, A.X. Scholten, T. 2010. The ConMap approach for terrain-based digital soil mapping. European Journal of Soil Science, v. 61, p.133–143.