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Thema
Kommission II: Bodenchemie

Korrelative Analyse biogeochemischer und struktureller Komplexizität im Boden

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Titel
Classification of West African (peri)-urban and rural agricultural soils based on mid-infrared diffuse reflectance spectroscopy (DRIFT) and multivariate statistics and data mining

Abstract
Urban and peri-urban agriculture has long been part of West African society. In Sub-Sahara Africa with its low soil fertility and high vulnerability for droughts, food security not only depends on rural food production but also on this (peri)-urban agriculture. The interdisciplinary GlobE – UrbanFood^{Plus} project aims to enhance the resource use efficiency of such agricultural sites in West African cities to improve the economic situation and food security for the people in this area.
To assess soil productivity inside this project, several randomized surveys were conducted to characterize urban and peri-urban agriculture in Tamale (Ghana), Ouagadougou (Burkina Faso), and in rural Northern Ghana. All sample sites were situated in the West African Savannah zone. These surveys systematically described the status of urban agriculture by collecting soil samples, as well as additional socioeconomic and land use data. For our study, the spectra of more than 1000 soil samples were analyzed using diffuse reflectance infrared Fourier transform (DRIFT) spectroscopy in the mid-infrared range (MIR 4000–400 cm^{-1}) at a resolution of 4 cm^{-1}. Based on the large data set of spectra, we exploratory analyzed the data for clustering and grouping based on latest improvements in multivariate statistics and data mining.
Statistically, we were able to find classes inside the spectral data. This grouping could be explained by sample location using the Random Forest algorithm at a very low error of about 5%. By mathematical pretreatment of the data, the error could further be reduced to <2%. Due to the spectral difference by geography location, potential caused by differences in climate, we continued to determine groups within one location using cluster algorithms. With this technique, we could determine further subgroups in the data. We then used topographic, land use, and socioeconomic data to explain the statistically found clustering in the MIR spectra.
We herewith present a novel approach by combing multivariate MIR spectra analysis with socioeconomic data. Although we showed that soil spectra seemed to be largely affected by topography and climate, there were also differences in the spectra that could be explained by differences in land use practices.