



Spatial structure of soil properties at different scales of Mt. Kilimanjaro, Tanzania

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Soils of tropical mountain ecosystems provide important ecosystem services like water and carbon storage, water filtration and erosion control. As these ecosystems are threatened by global warming and the conversion of natural to human-modified landscapes, it is important to understand the implications of these changes. Within the DFG Research Unit "Kilimanjaro ecosystems under global change: Linking biodiversity, biotic interactions and biogeochemical ecosystem processes", we study the spatial heterogeneity of soils and the available water capacity for different land use systems. In the savannah zone of Mt. Kilimanjaro, maize fields are compared to natural savannah ecosystems. In the lower montane forest zone, coffee plantations, traditional home gardens, grasslands and natural forests are studied. We characterize the soils with respect to soil hydrology, emphasizing on the spatial variability of soil texture and bulk density at different scales. Furthermore soil organic carbon and nitrogen, cation exchange capacity and the pH-value are measured.

Vis/Nir-Spectroscopy is used to detect small scale physical and chemical heterogeneity within soil profiles, as well as to get information of soil properties on a larger scale. We aim to build a spectral database for these soil properties for the Kilimanjaro region in order to get rapid information for geostatistical analysis. Partial least square regression with leave one out cross validation is used for model calibration. Results for silt and clay content, as well as carbon and nitrogen content are promising, with adjusted R^2 ranging from 0.70 for silt to 0.86 for nitrogen. Furthermore models for other nutrients, cation exchange capacity and available water capacity will be calibrated. We compare heterogeneity within and across the different ecosystems and state that spatial structure characteristics and complexity patterns in soil parameters can be quantitatively related to biodiversity and functional diversity parameters.