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Landnutzung und Kohlenstoffhaushalt

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Titel
Effects of climate and land use on carbon and nutrients cycles control soil organic matter pools at Mount Kilimanjaro

Abstract
Ecosystem functions of tropical mountain ecosystems and their ability to provide ecosystem services are particularly threatened by the combined impact of climate and land-use change. Soils, as the linkage between abiotic and biotic components of an ecosystem, are strongly affected by these changes. To understand impacts of climate and land use changes on biodiversity and accompanying ecosystem stability and services at Mt. Kilimanjaro, detailed understanding and description of the current biotic and abiotic controls on ecosystem Carbon (C) and nutrient fluxes are needed. Therefore, we quantitatively described cycles of C and major nutrients (N, P, K, Ca, Mg, Mn, Na, S) on pedon and stand level scale along a 3500 m elevation gradient and in up to three stages of land-use intensification. Qualitative indicators (composition of soil organic matter and microbial communities) were used to relate pool changes to underlying processes. Annual pattern of litterfall and decomposition were closely related to rainfall seasonality and temperature. Several factors, such as decomposition rate, C & N contents, microbial biomass (MBC) and leaf litter quality, increased at mid elevation. This was reflected in shifts of soil organic matter composition and microbial communities controlling soil C stability. Land-use intensification led to 40-80% losses in topsoil C and MBC contents as well as an increased turnover through higher microbial demand for new C sources. In ecosystems with strong seasonal variations (savanna and alpine helichrysum cushion) the effectiveness of C storage and N turnover was strongly affected by spatial vegetation heterogeneity. Ecosystems at mid elevation (~2000 m) represent the interception zone of optimal moisture and temperature conditions. High inputs and fast turnover control the C sequestration in these ecosystems, while climatic restrains on input and decomposition limit the C turnover in soils at lower and higher elevation. Land-use intensification increases C and nutrient cycling, decreases stabilization from new C inputs through increased microbial C demand and thus decreases soil C storage.