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Soil carbon storage in a small arid catchment in the Negev desert (Israel)

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The mineral soil represents a major pool in the global carbon cycle. The behavior of mineral soil as a carbon reservoir in global climate and environmental issues is far from fully understood and causes a serious lack of comparable data on mineral soil organic carbon (SOC) at regional scale.

To improve our understanding of soil carbon sequestration, it is necessary to acquire regional estimates of soil carbon pools in different ecosystem types. So far, little attention has been given to Dryland ecosystems, but they are often considered as highly sensitive to environmental change, with large and rapid responses to even smallest changes of climate conditions. Due to this fact, Drylands, as an ecosystem with extensive surface area across the globe (6.15 billion ha), have been suggested as a potential component for major carbon storage. A priori reasoning suggests that regional spatial patterns of SOC density (kg/m^2) in Drylands are mostly affected by vegetation, soil texture, landscape position, soil truncation, wind erosion/deposition and the effect of water supply. Particularly unassigned is the interaction between soil volume, geomorphic processes and SOC density on regional scale.

This study aims to enhance our understanding of regional spatial variability in dependence on soil volume, topography and surface parameters in areas susceptible to environmental change. Soil samples were taken in small transects at different representative slope positions across a range of elevations, soil texture, vegetation types, and terrain positions in a small catchment (600 ha) in the Negev desert. Topographic variables were extracted from a high resolution (0.5m) digital elevation model. Subsequently, we estimated the soil volume by excavating the entire soil at the representative sampling position. The volume was then estimated by laser scanning before and after soil excavation. SOC concentration of the soil samples was determined by CHN-analyser. For each sample, carbon densities (in kg/m^2) were estimated for the mineral soil layer.

The results indicate a large spatial variability of the carbon contents, the soil volume and depths across the landscape. In general, topography exerts a strong control on the carbon contents and the soil depths in the study site. Lowest carbon contents are apparent at the hillslope tops with increasing contents downslope. Because of the significantly larger carbon content at the northern exposed slope, we suggest that solar radiation driven differences of soil moisture content major controls SOC. Regarding the soil depths, the differences are not that clear. Soil depths seem to be higher at the southern exposed slope, but differences with respect to the slope position are not significant. Concerning the total amount of carbon storage in the study area, the results show that soil carbon may not be neglected in arid areas. Our results should provide an indication that carbon contents in dynamic environments are more affected and controlled by surface properties (soil volume) than by climate. Concluding that hint, climate is less important than surface processes in dryland ecosystems.