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Spatial carbon distribution along a climatic gradient of the northwestern Negev, Israel

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Climatic gradients are of great interest for predictions of climate change as they give the opportunity to compare changes in space and use the results for the assessment of changes in time. Areas with similar soil parent material and strong precipitation gradients on short distances are ideal regions for such studies. In the dune fields of the northwestern Negev, Israel, a strong precipitation gradient occurs on a distance of 40 km along an area of similar sandy soil material. Here fine to middle sand formed longitudinal dunes. These dunes are covered by biological soil crusts (BSC) and perennial shrubs like Retama raetam. BSC are main biomass contributors to arid ecosystems. Perennial plants form areas of higher nutrient concentration.
In the Nizzana sand dunes at the three study site Nizzana South (90 mm aˆ-1), Nizzana 84 (130 mm aˆ-1) and Nizzana 69 (170 mm aˆ-1) the total soil carbon content (C_total) and the anorganic (C_anorg) and organic carbon (C_org) fractions were examined. To test the spatial variability of the soil carbon concentrations different vertical and horizontal distribution aspects were considered during soil sampling. Therefore at all study sites biological soil crust (0-2 cm) and topsoil (2-10cm) samples were taken beneath Retama raetam and in the bare interspace. The sampling followed a relief transect which included the south exposed and north exposed slope and the interdune area.
The concentrations of C_total and C_anorg showed significant differences between the study sites while the C_org concentration showed no significant differences. At every study site the BSC showed significant higher concentrations of C_total, C_anorg and C_org than the topsoil. The difference decreased with an increase in rainfall. The south exposed slope shows significant lower concentrations in C_total, C_anorg and C_org than the north exposed slope and the interdune area. The difference between the bare interspace and the perennial shrub was lower than expected with a high dependence on relief position. The high spatial variability of carbon distribution does not allow simple predictions of changes due to changing precipitation between the areas. An attempt to deal with this heterogeneity in the areas is the statistical calculation of clusters of similar soil characteristics. These clusters were computed on basis of the carbon (C_total, C_anorg and C_org) and nitrogen (N_total) distribution using the ward-method. In total four clusters could be separated, representing a moisture gradient from dry to wet. Spatial distribution of carbon in landscapes is related to biotic and abiotic factors like BSC cover, vegetation and relief. Predictions of carbon change need to be related to these aspects. Cluster analysis allows the calculation of representative areas of different moisture conditions. These clusters can be used for an assessment of climate change on carbon pools in desert ecosystems.