Geophysical Research Abstracts
Vol. 20, EGU2018-14007, 2018
EGU General Assembly 2018

Linking the number of biopores to different soil parameters and land use types using piecewise SEM

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Earthworms impact the soil structure by creating large biopores, thereby affecting the infiltration capacity and soil aeration. Despite the fact that several hundreds of biopores larger than 2 mm may occur on one m^2 of soil, research on the interdependence of soil properties, land use and biopore number is still scarce.
In this study, we investigated the number of biopores (> 2 mm) as function of different soils and land uses in Thuringia, Germany. Depth-differentiated samples and biopore numbers were obtained in 15, 30 and 50 cm soil depth. The earthworm community was determined by the mustard and hand-sorting method. Additionally, the vegetation cover was estimated as well as the root biomass. The correlations between biopores and soil properties were identified by a piecewise structured equation model (SEM). The hierarchically structured parameters were analyzed from the study sites over the land use types – pasture and cropland – and the single soil parameters to the earthworm and root level and finally, the biopores. Especially large biopores (> 6 mm) were correlated with large, anecic earthworms, whereas roots play a minor role and are stronger correlated with pores smaller than 4 mm. Since the root biomass is decreasing with increasing depth, the importance of biopore formation by roots is decreasing with depth. Intensively managed fields have a negative influence on the biopore number, especially in the plough horizon. In general, the portion of large biopores increase with increasing depth due to the activity of anecic earthworms. Hence, the possible amount of drainage in biopores depends on the present earthworm community. Indirectly, the number of biopores is influenced by the present soil properties along the whole soil profile as well as the vegetation cover and root biomass in the top soil. This implies that location factors as soil properties and land use define the number of large biopores and hence the possible infiltration. Since large biopores can conduct large amounts of water they become important with regards to heavy rain events whose frequency will increase in the future. Furthermore, it is possible that with the seepage water nutrients and microorganisms can be transported in the subsoil and groundwater and affect the present ecosystems and nutrient cycles.