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Soil Properties Assessment using Apparent Electric Conductivity (ECa) in semi-arid Environments of Northern Tanzania

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Semi-arid environments such as in Northern Tanzania are characterized by a variety of degradation processes due to long dry periods and short but intensive rainfall events. High potential evaporation, high run-off rates, and low water holding capacities are typical for the present soils. The area is mainly covered by semi-arid savannah, the dominating crop is maize and extensive grazing is conducted.

Soil properties and their spatial distribution play a critical role for hydrologic processes. To assess the spatial distribution of these soil properties we utilized a Electromagnetic Induction (EMI) device that induce an electromagnetic field into the soil, creating an electric current. The strength of a resulting secondary electromagnetic field is recorded as the apparent electric conductivity (ECa), measured in mS/m. ECa can provide an indirect indicator of important soil properties. Factors that influence ECa include soil salinity, clay content and cation exchange capacity (CEC), clay mineralogy, soil pore size and distribution, soil moisture content, and temperature. However, in non-saline soils, conductivity variations are primarily a function of soil texture, moisture content, and CEC. There are few studies, related to EMI measurements, conducted in semi-arid environments.

In this study we conducted field measurements with the GSSI Profiler EMP-400. Soil physical characteristics were also measured in field on typical soil profiles to get the respective calibration data, validation was done by lab analysis. We analyzed the spatial pattern of the soil ECa maps to determine relationships with soil properties, with a focus on soil texture. The regionalization was carried out using stochastic models. In this study we tested classification and regression trees as well as advanced stochastic gradient boosting methods.