INTERRELATIONSHIPS BETWEEN SAVANNA AND FOREST BIOMES AND SOIL FORMATION IN THE SUMMER RAINFALL REGION OF SOUTH AFRICA

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Abstract

As part of a study to describe the soils of the Savanna Biome and surrounding Grassland, Forest and Nama Karoo Biomes in South Africa, using land type data, interesting interrelationships between the influence of climate and parent material on the occurrence of broad soil patterns within these regions were found. Mean annual rainfall and Class A pan evaporation data were used to calculate an aridity index (AI) for certain land types within a vegetation region. Potential profile available soil water (AW) was calculated by using a formula derived from soil texture and depth (effective rooting depth) of the dominant soils in a land type that falls within the same macroclimate zone. Multiplying AI with AW integrated the combined effect of climate and available soil water. This index was called Profile Available Water Index (PAWI). The effect of temperature was quantified using the heat unit values (HEOM) for the same macroclimatic zones.

It appeared that climate (especially rainfall, evapotranspiration and heat units during the summer months) and soil type (especially texture and depth) play a very important role in separating the Savanna Biome from the Grassland and Forest Biomes (Higher PAWI and lower HEOM than for the Savanna Biome) or the Nama Karoo Biome (lower PAWI and higher HEOM than for the Savanna Biome). When an index of PAWI/HEOM was calculated to give a single value for the combined effect of water and temperature, the order from low to high was: Nama Karoo < Kalahari savanna < Sub-escarpment Savanna < Lower Bushveld Savanna < Central Bushveld Savanna < Dry Highland Grasslands < Forest < Mesic Highland Grassland < Sub-escarpment Grassland. For the broad soil patterns (indicated by the landtype symbols Ag, Fb, etc.) the PAWI/HEOM index, grouped from low to high were : Ag<Fb<Ae<Fa<Ea<Ca<Ba<Bc<Ac. The distribution(expressed as percentage total coverage of the measured region) of the broad soil patterns show that Ag only occurs in the Nama Karoo; Ae dominate in the Savanna and Nama Karoo Biomes; Ac in the forest and grassland Biomes while soils with a plintic subsoil (Ba, Bc and Ca) are mostly associated with the Grassland Biome with only limited occurrence in the Forest and Savanna Biomes. Swelling clay soil, supporting grasses, occur in the Grassland and Savanna Biomes on basic parent material.

The results indicate the close relationship between vegetation, climate, terrain and parent material (the time factor was not taken into consideration) in the summer rainfall region. It therefore seems that the trees and shrubs that use water throughout the year and prefer warmer conditions and characterestics of the Savanna Biome may be responsible for the limited occurrence of plintinc soils (soils where a water table is present during/after the rainy months). In that way they contribute to the formation of more red apedal, high base status soils in this region, compared to the Grassland Biome regions where it is cooler and where less water is used during the winter months (therefore higher leaching possible for lower base status soils) when the grasses die off. Also, in the different Savanna regions, the trees are more sparsely spaced in the dry regions (e.g. Kalahari Savanna) but they then need deep soils for survival, while in the higher rainfall areas within the Savanna Biome (e.g. Mopane Savanna), a denser spacing on shallower soils is possible. An interesting observation was that pedologically formed layeres (e.g. hardpans or clay pans) seem to be rare in the Savanna regions (if present they are grass covered) but common in the Grassland regions. Trees and shrubs also do not favour swelling clay soils, the latter which occur in both Grassland and Savanna Biomes. This is due to the seasonal occurrence of root pruning.