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Soil and Soil Quality Mapping for an Extreme Relief Region using Detailed Fuzzy Slope Forms

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Abstract

Slope forms at different positions along a slope are often gradual which reflects the nature of a slope. Some studies have computed different fuzzy slope positions for digital soil mapping. However, there has not been a system calculated for a large area with extreme relief conditions. This study examines all possible slope forms that can be achieved for a large area of 860 km^2 with extreme relief conditions and used later for fuzzy soil mapping. This fully achieved slope form system together with slope gradients can be used to rule out the variations of organic matter content at different slope positions and slope angles as a very important index for soil and soil quality mapping. Firstly, a classification of five major slope positions (ridge, upper slope, middle slope, foot slope, and valley) was defined. Nine basic slope forms (FAO guideline for soil description, 2006) were computed as nine fuzzy slope forms for each of the three middle major slope positions. This resulted in 29 fuzzy slope forms extracted for a single slope. Secondly, soil mapping was carried out using SoLIM software(Soil and Land Inference Model). To prepare for the model, calibration of different reference soil groups based on the environmental parameters as major soil-forming factors was carried out. The development of a soil database for the area based on 125 soil profiles resulted in 10 major reference soil groups. The soil information was collected with information of slope, elevation, geology, and land use types. Soil prototypes or distinctive combinations of soil-forming parameters to formation of soils were defined for every soil group. These prototypes were then set as fuzzy rules in SoLIM to derive a soil map of 10 major soil groups. Thirdly, soil quality indices were calculated for every soil profile in which slope form-dependent organic matter content played a very important role. From these calculations soil quality prototypes were then defined based on the available soil database and set as fuzzy rules. SoLIM was then applied to derive a map of different quality classes. This soil quality map tells us where the best soils are located and can be used for many purposes, such as land evaluation, land use planning.

Keywords: Extreme relief, fuzzy rules, organic matter content, prototypes, slope forms, SoLIM, soil mapping, soil quality mapping

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