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Regionalisation of soil properties in the semi-arid Drâa catchment (South Morocco)

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This work is part of the GLOWA-IMPETUS-project, an integrated project for the efficient management of scarce water resources in West Africa. The aim of the project is to forecast the impacts of climatic and socio-economic changes on the hydrological cycle considering different scenarios and driving forces. Spatial Decision Support Systems are developed in order to provide management tools for local decision makers. Two catchments are investigated, the Ouémé river in Benin and the Wadi Drâa in Morocco. This work focusses on the 30.000 km^2 Drâa catchment, reaching from the semi-arid High Atlas Mountains with altitudes of up to 4071 m a.s.l. to the hyper–arid Saharan foreland (450 m a.s.l.). Soil information is only available for approximately 2 % of the catchments surface, namely the agriculturally used oases areas. In the framework of the IMPETUS - project, various models (e.g. the hydrological model SWAT, the soil erosion model PESERA and the vegetation growth model SAVANNA) require spatially continuous information on soil properties.

Point data on soil depth, texture, skeleton content as well as carbonate, organic carbon and nitrogen content from 211 soil profiles is analysed for spatial trends depending on the five soil-forming factors. These are Climate, Organisms, Relief, Parent material and Time (CORPT), information on the first four factors is available. Soils are generally shallow and feature high skeleton and low organic matter contents, in situ weathering is expected to be low. Most soil parameters vary on two spatial scales: At the scale of the entire catchment, the gradient of increasing aridity and decreasing altitude influences the soil distribution, e.g. via reduced vegetation cover and thus organic matter content of the soil in the more arid zones. At the hillslope scale, erosion processes dominate the formation of soil catenas, e.g. by the selective removal of fine

material from the upper slopes leaving high skeleton contents behind. The identified trends are quantified using multiple linear regression including dummy variables. The resulting regionalisation rules are used to extrapolate soil information for the whole catchment. The regression equations explain between 22 and 89 % of the variance of the soil data, depending on the considered parameter. All regression equations are significant at a 95 % - level and Mean Square Errors normalised by the variance of the soil property range from 0.81 to 0.11. Geostatistical techniques could neither be applied directly to the soil parameters nor to the regression residuals due to missing spatial autocorrelation. Soil hydraulic properties are calculated via pedotransfer functions subsequent to the regionalisation procedure. The resulting maps of soil properties are reasonable for a regional application.