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Comparing permeability and hydrological soil processes as first indicators on spatial variability of rainfall runoff relationships at the meso-scale

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The development of soils is a combination of weathering and bio-chemical processes, which act upon the geology. Therefore, depending on parent material and weathering products, different soil types with different hydrological soil characteristics are formed. Additionally, the alteration of permeable and impermeable layers the geology itself is also a determining factor concerning water conveyance. In this study two simple model approaches have been used to identify first order controls on rainfall runoff relationships in the Nahe basin (Germany). The total data set contains 20 meso-scale basins with daily discharge values for over 30 years as well as several rainfall stations. Both models were parsimoniously parameterized: a first model with only the lithology expressed in three types of permeability characteristics as distribution parameter and a second model with a distribution according to seven hydrological soil processes parameters. The objective of the study was to compare the performance of the models and their spatial representation on a local and on a regional scale as well as between the models. The locally optimized models showed no significant difference in their performance compared to the results of models in the regionally optimized configuration. This implies that the spatial distributions of both models are accurately capturing the dominant hydrological processes and their distribution. Furthermore, the results of the permeability model were as good as the results of the soil parameter model at the larger scale. However, for basins with areas to 350 km^2 the more complex spatial distribution performed better. Therefore, we conclude that the averaging effect at the smaller meso- and larger macro-scale basins (600 km^2 to several 1000 km^2) can be very well captured with the permeability as a first indicator on the spatial variability of dominant hydrological processes within regional rainfall runoff relationships.