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Soil moisture simulations based on regionalized soil parameters for the Free State of Saxony, Germany

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According to currently available information, climate change will lead to an increased frequency of extreme precipitation events. This will particularly affect small and medium sized catchments vulnerable to flash flood events. In this context, the EXTRUSO project addresses new methods to describe, assess and predict such events in an interdisciplinary manner. The small temporal and spatial scales of most flash flood events stress the importance of high-resolution data input for hydrological modelling, especially of pre-event moisture and event precipitation.
This study introduces a simulation approach to derive antecedent soil moisture in flash flood prone catchments, which are usually ungauged. It mainly focuses on catchments smaller than 100 km2, whose soil parameters are derived by regionalization based on soil maps. The BROOK90 model is used to estimate water fluxes from available hydro-meteorological measurements and catchment characteristics, in particular topography, soil conditions and land use. Based on a superposition approach, the percentage of the major combinations (i.e. at least 1% of the catchment extent) of land use and soil type in a catchment are classified and used as input for soil moisture modelling (an approach similar to Hydrological Response Units HRU). Hence, resulting in up to 100 sub-models per catchment and the final catchment fluxes are estimated by weighted averaging. The meteorological input for the model run is retrieved from radar precipitation and in-situ measurements in or near the targeted catchment. Wherever available, the model is cross-validated against the observed daily discharge in catchments, which is not used for calibration.
A first evaluation of the approach showed a Nash-Sutcliffe efficiency for the Wernersbach catchment (4.6 km2) in Tharandt forest of 0.74 for daily discharge simulation for the summer months (April-September) in the period of 1970-2016. The approach will be applied further for 10 small catchments in the Free State of Saxony.