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Hysteretic soil water retention functions from field time series for initial development phases of an artificially-constructed hydrological catchment

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Soil water retention functions are frequently obtained by determining the main drainage branch on standard-sized soil cores in the lab. Effects of spatial scales, hysteresis, and changes of the pore structures and pore size distributions in time are often neglected. Especially for the initial phases in constructed systems, the estimation of water retentions functions is uncertain because many assumptions of hydraulic pedotransfer functions for established soil systems (i.e. pore rigidity and homogeneity) may not be valid. In this contribution, field-measured data of soil water contents and pressure heads are evaluated to obtain hysteretic water retention functions for characterizing initial soil pore structure development phases directly after artificially constructing a hydrological catchment and during first water table establishment.
The construction of the 6 ha size catchment “Chicken Creek”, located in the Lusatian mining district in eastern Germany was finished in 2005. The catchment body consisted of a layer of 2 to 3 m coarse-textured quaternary overburden sediments. Tensiometers and TDR-probes were installed in 30, 50, and 80 cm soil depth at for locations in July 2008. The hourly logged time series were analyzed separately for wetting and drying periods and for seasonal changes to characterize the dynamics of the hysteretic water retention.
Clear differences in water retention are found during wetting and drying periods and lab measured data indicating strong hysteretic behaviour. Parameterisation of hysteretic retention functions was tested by combining lab and field data. The seasonal data indicate temporal changes in the water retention, which seem to correspond with episodic water saturation during the establishment and rising of the water table. The analysis improves understanding of dynamics of soil hydraulic properties during initial development phases and helps parameterization of soil hydraulic functions for a quantitative analysis.