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Biogenic and geogenic soil structures as key to soil moisture heterogeneity

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Runoff formation, infiltration and partitioning of radiation into latent and sensible heat flux are mainly controlled by local soil moisture patterns.

We conducted a long-term, highly resolved soil moisture monitoring at two TDR cluster sites installed in the head water of the Wilde Weißeritz catchment (Eastern Ore Mountains, Germany). A grassland site (200 m^2) and a forested site (150 m^2) both located on gentle slopes are instrumented with 39 and 32 TDR probes of 60 cm length. In addition piezometers are installed at the slopes. Gravel content and spatial variability of soil properties on both sites are high.

Both sites show considerable variability of soil moisture around 0.07 m^3/m^3. However, the ranks of the soil moisture time series within a cluster are temporarily stable. A variogram analysis of the long term time series allowed the identification of the variability at different wetness condition. Range and sill increases on the grassland site in contrast to the forest where they stay constant. Moreover, response times at the piezometers consolidate the hypothesis, that dynamics of soil structures is key to soil moisture redistribution and thus soil moisture heterogeneity.

A comparison of the macropore structure of the two sites, model simulations with explicit regard on preferential flow paths and eco-hydrological investigations propose, that low biogenic activity at the forested slope leads to the persistent patterns, while high activity at the grassland site overrides the geogenic prescription.