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Soil sealing and vesicular layer formation as initial structure development and its effect on infiltration

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In the Lusatia mining district (NE-Germany) an artificial catchment was constructed to study initial ecosystem development and runoff generation. As a key process in this early stage, we investigate the surface structure dynamics as it strongly influences erosion, infiltration, matter dynamics, and vegetation establishment. The presented work focuses on observations of soil pore structure formation at the surface at five sites in the catchment and in an adjacent "younger" area composed of comparable sediments. Moreover we've conducted infiltration experiments in the lab and field to relate the soil pore structure to the hydraulic properties.
The surface soil was sampled in cylindrical rings (10 cm^3) down to 2 cm depth from which bulk density profiles were obtained using X-ray computed tomography (CT) (at UFZ- Halle, Germany) with a resolution of 0.084 mm. The influence of structure on infiltration was investigated using neutron radiography (at the NEUTRA facility of the Paul-Scherrer-Institut, Villigen, Switzerland) to visualise two-dimensional (2D) infiltration patterns. The slab-type samples were equilibrated to different initial water contents and then exposed to drip irrigation (to simulate rainfall) while a series of neutron radiographs were taken. In addition, field measurements with a miniature tension infiltrometer were conduced.
The micro-tomographies exhibit formation of surface sealing whose thickness and intensity vary with silt and clay content. The CT images show several coarser- and finer-textured micro-layers at the sample surfaces that were formed as a consequence of repeated washing in of finer particles in underlying coarser sediment. In micro-depressions, the uppermost layers consist of sorted fine sand and silt due to wind erosion. Similar as for desert pavements, a vesicular pore structure developed in these sediments on top, but also scattered in fine sand- and silt-enriched micro-layers. The infiltration rates were severely affected by the surface crusts; however, the rates were independent of the vesicular pore layer.