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A new in-situ technique for the determination of small scale spatial distribution of contact angles

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Water repellency is a common phenomenon in soils around the world. Its hydraulic impact reaches from decreased infiltration rates to preferential flow of water through the soil. The contact angle (CA), that forms at the three phase boundary solid-liquid-gas, has been established to quantify water repellency in soils. However, this CA is generally determined at a small amount of dry soil originating from homogenized samples. Thus, its spatial information is dependent on the size of the homogeneous sample. Information about the small scale spatial distribution of soil water repellency (SWR) cannot be obtained with this kind of sample preparation and thus the hydraulic relevance of the measured CA is questionable. Therefore we suggest a new sample preparation technique for measuring the spatial distribution of SWR of natural soils using the sessile drop method (SDM).
Two horizontal and one vertical transects of about 1.2 m length have been measured on a sandy forest soil in northern Germany. The litter layer and vegetation, present at the site have been removed prior to the sampling. One side of a double sided adhesive tape has been pressed against the soil surface. This results in a mono-layer of sand grains attached to the tape that reflect the wetting properties in their original spatial surroundings. Using the Sessile Drop Method (SDM), CA have been measured on a straight line transect every 0.5 cm (Drop size 0.005 mL) in the laboratory with a contact angle microscope.
Spatial differences in SWR can be measured at the research site. Results have been analyzed using spectral-analysis to reveal spatial correlations in SWR. Different spatial dependencies can be found in different depths of the soil. Results show that the new sampling technique is capable of detecting the spatial variability in natural soils. Thus, it might improve the hydraulic relevance of the small scale CA.