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Spatio-temporal variability of water repellency on forest soils in Central Europe

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Water repellency has been suggested to be directly related to soil moisture content and may affect directly runoff and erosion risk. This study aimed to research on the spatial and temporal variation of water repellency, the relationship of water repellency with moisture content and on its influence on generation of runoff and erosion in the forestry area of Holzbach in the Hunsruck low mountain range in Germany. Regarding the spatial variation of the studied variables, 21 rainfall experiments were carried out in 7 different study sites, with 2-4 repetitions of the experiment on each site. WDPT and soil sampling with 100 cm3 cylinders was carried out on each rainfall experiment site before and after each rainfall experiment. For insights into the temporal variation of the studied variables, the analyses were carried out on two different dates. Suspended sediment load, suspended sediment concentration, runoff of the rainfall simulations and volumetric moisture content of the test sites were measured in laboratory. Water repellent conditions were observed in both forest types; coniferous (Spruce) and deciduous (Beech) forests. No temporal variation trends of water repellency or of volumetric moisture content were observed in any of them. The influence of more variables depending on time is suggested, such as: precipitation, temperature, humidity and evapo-transpiration. Significant differences between both forest types were found. Beech forest showed more wettable conditions, higher soil moisture content and later generation of runoff than Spruce forest. In both forest types, no direct relationship between water repellency and volumetric moisture content was observed. Non-linear relationship is suggested between both variables, including the influence of more abiotic and biotic variables. Any transition zone was observed in any of the forest types when relating row data of water repellency and volumetric moisture content, opposite to several researches' suggestions. However, in Spruce forest a threshold value at 30% moisture content was observed above which no water repellent conditions were observed except for non-normal values. On the other hand, significant correlation between water repellency and suspended sediment load was observed in Spruce forest; suggesting influence of water repellency on runoff risk. Water repellency was observed in both forest types within the study area. Spatial and temporal distribution of water repellency is thought to be of high complexity which is not possible to characterize only with the studied few variables. Influence of more variables in water repellency of the studied forests is suggested.