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Fire Effects on Soil Water Retention Characteristics

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Fire-induced changes in soil water retention characteristics have received little attention so far, despite their large influence on soil water movement in unsaturated soils and their importance in process-based hydrologic and erosion models. We therefore studied the effect of fire on topsoil water retention characteristics and its recovery in time, as well as the possible increase in water holding capacity due to the much discussed infiltration of ashes during the first post-fire rains. In a burned and adjacent unburned site in the Netherlands (Mookerheide) and in Portugal (Pampilhosa da Serra) we took undisturbed soil core samples of the top 2.5 cm of the soil. The Dutch site was subject to medium-intensity wildfires in March 2006 and April 2007, and was sampled in May 2007 before the first rains after the 2007 fire. The Portuguese site was subject to a high-intensity fire in August 2007 and was sampled before (August) and after (October) the first post-fire rains. After saturating the samples, we determined soil moisture content (θ) at different suctions using a sandbox apparatus (10 and 100 cm suctions, undisturbed samples) and a pressure plate (1.000 and 16.000 cm, disturbed samples).

For the Mookerheide fires, burning significantly ($p < 0.05$) reduced volumetric soil moisture content (θ) at saturation when measured shortly after the 2007 fire. A year after the 2006 fire, a reduction is visible but not significant. This in contrast to the 10 cm suction, where θ significantly decreased in the order unburned $>$ previously burned $>$ recently burned soil. Soil moisture content of unburned soil still exceeds

that of burned soil at 100 cm suction, while time since burning doesn't significantly influence soil moisture content at this suction. The absence of a fire effect at large suctions might be due to the relatively low intensity of the fire. The results of the Portuguese study are presented in a similar way.

To test if the reduction of θ at the given suctions is due to the often observed decrease of organic matter after fire, soil organic measurements are being performed. The higher water retention of previously burned soil compared to recently burned soil can possibly be explained by post-fire soil recovery. Vegetation started to recover in fall 2006, and most likely also soil biological activity recovered with time. This recovery is most visible at 0 cm suction and decreases with increasing suction. Our findings are valuable in understanding post-fire changes in hydrological and erosion processes.