Geophysical Research Abstracts
Vol. 13, EGU2011-6560-1, 2011
EGU General Assembly 2011

Natural and fire-induced soil water repellency in a Portuguese shrubland: the role of soil moisture, fire temperature and vegetation removal

Cathelijne R. Stoof (1,2), Demie Moore (1,3), Coen J. Ritsema (1,4), and Louis W. Dekker (4)

(1) Wageningen University, Land Degradation and Development Group, Wageningen, Netherlands (cathelijne.stoof@wur.nl), (2) CERNAS, Escola Superior Agrária de Coimbra. Bencanta, Coimbra, Portugal, (3) Aquatrols Corporation of America, 1273 Imperial Way, Paulsboro, NJ 08066, USA, (4) Soil Physics and Land Use Team, Alterra Green World Research, Wageningen UR. P.O. Box 47, 6700 AA Wageningen, The Netherlands

Post-fire runoff and erosion is often attributed to soil water repellency, despite the fact that soil water repellency is also very common in long unburned areas and in areas where fire is absent altogether. To assess the role of soil water repellency as a driving force for post-fire runoff and erosion events it is therefore not only crucial to know the drivers of post-fire soil water repellency, but also the natural variation of soil water repellency before fire. For this purpose, a long-term monitoring study was performed in the shrub-covered Valtorto catchment in north-central Portugal (40°06'21" N, 8°07'03" W), which was burned by experimental fire on 20 Feb 2009. The temporal variation of topsoil moisture content and the persistence of actual topsoil water repellency (0-2 cm depth, WDPT test, n=100) was captured on 17 occasions before and after fire between Nov 2007 and Mar 2010. In addition, (dis)similarities between burning and clipping were assessed in experimental plots located inside (burned) and just outside the catchment (clipped, unburned) using a factorial design with three plots/treatment. On 15 occasions after the fire, the occurrence of actual water repellency (WDPT > 5 s) in the plots was assessed of the litter, at the soil surface, and at 2 and 5 cm depth.

The natural background repellency of this typical Portuguese schist soil is high and showed considerable temporal variation. Soil water repellency therefore appeared to be the rule rather than the exception – both before and after fire. Soil moisture and total organic matter content were important drivers of the persistence of soil water repellency: soil water repellency was inversely related to soil moisture content, and, for repellent soil, significantly higher with higher organic matter content. Surprisingly, despite the low soil temperatures during the fire (60°C) and the lack of direct soil moisture changes, fire significantly increased the persistence of soil water repellency from strongly (WDPT 60-600 s) to severely water repellent (WDPT 600-3600 s). Burning and clipping showed a similar response as to the occurrence of litter and surface soil water repellency, and both reduced the time needed to develop and eliminate water repellency of litter and surface soil to only a few days.

The results highlight the important role of vegetation removal in determining post-fire litter and surface soil water repellence, and suggest that post-fire water repellency is not only determined by changes to the soil system. Moreover, the abundance of pre-fire soil water repellency indicates that the increased erosion observed in the catchment after the fire cannot be solely attributed to soil water repellency. Nevertheless, fire-induced removal of the protective vegetation canopy and its moisture storage function may increase the hydrological significance of soil water repellency in burned landscapes.