Geophysical Research Abstracts
Vol. 15, EGU2013-5113, 2013
EGU General Assembly 2013

Critical water contents of hydrophobic soils in New Zealand

Magdalena Landl (1), Ursula Holzinger (1), Ranvir Singh (2), and Andreas Klik (1)

(1) Universität für Bodenkultur Wien, Department of Water, Atmosphere & Environment, Vienna, Austria (andreas.klik@boku.ac.at, 00431 36006 5499), (2) Massey University, Institute of Natural Resources, Palmerston North, New Zealand

Soil water repellency is an important problem for pasture farming in New Zealand which causes low infiltration rates and increased surface runoff. However, the real extent of this issue is not yet evaluated.
Water repellency is thought to appear on dry soils, when the water content falls below a critical limit. The main objectives of this study was 1) to investigate the effects of different amounts of infiltration water on hydrophobicity of three selected soils under grassland in the North island of New Zealand, and 2) to determine the critical water content for ten sites with five different soil types.
In April 2011 undisturbed and disturbed soil samples from a brown, gley and organic soil have been taken from sites around Mount Taranaki. Soil water repellency was determined using the Water Droplet Penetration Time Test (WDPT) and the Molarity of Ethanol Droplet Test (MED). During the lab experiment four amounts of water were applied to the 270 cm^3 samples: 400, 800, 1600 and 2400 mL . One test was performed with cold and one with hot (80 °C) water. Each test was replicated four times. In the leachate the amount of dissolved organic carbon was analyzed.
The experiments showed that only for the brown soil water repellency decreased significantly with increasing amount of infiltration water whereas for gley soils no correlation was found. Gley soil had initially a lower degree of hydrophobicity compared to the other soils. Possibly due to the higher bulk density of these soils, the carbon compounds directly surrounding the soil particles wre rearranged rather than leached. No clear pattern could be obtained for organic soils. This may be explained by the high initial carbon content of more than 20%. It may take a much greater amount of infiltration to affect hydrophobicity. The critical contact angle of investigated soils above which water repellency is moderately persistent, was 93.8°.
In May 2012 ten more sites were sampled and five soil types were investigated with respect to the critical water content. Soil hydrophobicity was again tested during 4 wetting and drying cycles on 3 replicates each of disturbed and undisturbed soil samples. The tests confirmed that water repellency does not exist at high water contents. It generally starts to appear at a certain limit, increases rapidly up to a peak value and finally decreases slowly when the water content approaches 0. Critical water contents were very high in the first wetting cycle and stabilized at a rather constant level during the 2nd, 3rd and 4th wetting cycle. This phenomenon may be due to inhomogeneous water distributions within the field moist soil samples in the 1st wetting cycle and it was thus chosen to take the critical moisture content from the 2nd wetting cycle for further purposes.
We found relatively broad transition zones where soils were found to be both hydrophilic and hydrophobic. Critical water contents or rather transition zones were found to differ significantly between the various soil orders and showed values between 0.34 (m^3/m^3) for recent soil and 0.44(m^3/m^3) for organic soil.