Geophysical Research Abstracts
Vol. 14, EGU2012-1004, 2012
EGU General Assembly 2012


# Spatiotemporal variability of soil hydrological properties and its implication on small catchments hydrology

C.S.S. Ferreira (1,2), T.S. Steenhuis (3), D. Soares (2), A.J.D. Ferreira (2), C.O.A. Coelho (1), and R.P.D. Walsh (4)

(1) CESAM, Department of Environment and Planning, Aveiro University, Aveiro, Portugal, (2) CERNAS, Coimbra Agrarian Technical School, Bencanta, Coimbra, Portugal, (3) Department of Biological and Environmental Engineering, Cornell University, New York, USA, (4) Department of Geography, Swansea University, Swansea, United Kingdom

The increasing population pressure on the environment implies changes to land use and to landscape patterns within catchments, with impacts on hydrological processes. Some of the changes are linked to soil properties modification, directly disturbing water infiltration and runoff generation processes, which affects local and regional water resources. Although there has been considerable research on soil properties, few studies focused its spatial and temporal variability at the catchment scale and how they affect hydrology.
In this paper, we aim to assess the spatial and temporal variability of water repellence, soil moisture and water infiltration, in a small catchment under Mediterranean climate. The study was carried out at Ribeira dos Covões, a small catchment (620ha) located in central Portugal. This is a partly urbanizing catchment, where the urban landuse covers 32% of the area, while the forest represent 48% and farmland 20%. The catchment has a sub-humid Mediterranean climate, with long dry summers. The soil is deep overlaying sandstone and limestone lithology.
Thirty one representative sites were monitored within the catchment. Each site has two replicated experiments for water infiltration (performed during 30 minutes, through minidisk tension infiltrometer at the soil surface), soil moisture content (at 0-5cm depth, by gravimetric method) and soil water repellence (assessed at 0cm, 2cm and 5cm depth through ethanol percentage test). These experiments were carried out along one entire year, during nine monitoring campaigns performed in dry and wet periods, mainly immediately after different rainfall events and long dry spells. During one of the monitoring campaigns, undisturbed soil samples were collected (0-10cm depth) in all the location sites for bulk density and stone content analyses. Composite samples were also collected from the top soil layer (0-5cm and 5-10cm) for organic content (by measuring carbon dioxide emission after combustion at 1200ºC) and particle size distribution (Robinson pipette method) analyzes. Each composite sample represents seventeen individual samples collected in line with a distance interval of 15cm.
The results show a high spatial and temporal variability of the soil hydrological properties monitored within the study area. Due to water-repellent nature of the soils, forest areas (especially under eucalyptus and pines trees) have a very slow or even null infiltration capacity, mainly during dry periods. However, during wet periods, water repellence breaks down and infiltration capacity increases, reaching values of 20mm/h. On the other hand, in agriculture areas and discontinuous urban areas the soil is predominantly hydrophilic along the year. On these areas, infiltration capacity reaches 50mm/h in dry periods, but it is strongly reduced in the winter season due to soil moisture increase as a result of their location on the landscape. This indicates that Hortonian overland flow tends to be important during and immediately after the summer, while in the wet period saturation-excess controls the surface runoff. The results point out the importance of land uses discontinuities to break the flow connectivity, which should be considered for hydrological modelling and urban planning.