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The influence of vegetation covers on soil moisture dynamics at high temporal resolution in scattered tree woodlands of Mediterranean climate

Javier Lozano-Parra (1), Susanne Schnabel (1), and Antonio Ceballos-Barbancho (2)

(1) University of Extremadura, Land Sciences and Art Department, Cáceres, Spain (jlozano@unex.es), (2) University of Salamanca, Geography Department, Spain

Soil water is a key factor that controls the organization and functioning of dryland ecosystems. However, in spite of its great importance in ecohydrological processes, most of the studies focus on daily or longer timescales, while its dynamics at shorter timescales are very little known. The main objective of this work was to determine the role of vegetation covers (grassland and tree canopy) in the soil hydrological response using measurements with high temporal resolution in evergreen oak woodland with Mediterranean climate.

For this, soil water content was monitored continuously with a temporal resolution of 30 minutes and by means of capacitance sensors, mainly for the hydrological years 2010–2011 and 2011–2012. They were installed at 5, 10 and 15 cm, and 5 cm above the bedrock and depending on soil profile. This distribution along the soil profile is justified because soils are generally very shallow and most of the roots are concentrated in the upper layer. The sensors were gathered in 8 soil moisture stations in two contrasting situations characterized by different vegetation covers: under tree canopy and in open spaces or grasslands. Soil moisture variations were calculated at rainfall event scale at top soil layer and deepest depth by the difference between the final and initial soil moisture registered by a sensor at the finish and the beginning of the rainfall event, respectively. Besides, as soil moisture changes are strongly influenced by antecedent conditions, different antecedent soil moisture conditions or states, from driest to wettest, were also defined. The works were carried out in 3 experimental farms of the Spanish region of Extremadura.

Results obtained revealed that rainwater amount bypassing vegetation covers and reaching the soil may temporarily be modified by covers according to precipitation properties and antecedent environmental conditions (from dry to wet) before the rain episode. Rainfall amounts triggering a positive soil hydrological response decreased as initial states became drier, being more accentuated below tree canopies. The frequency of the antecedent states seem to be as important or even more than duration or precipitation amount. The role of vegetation was more decisive under drier environmental conditions, where events lower than 6 mm and 2 mm never caused soil hydrological response either below tree canopy or grassland, respectively. This is important because initial conditions were independent of seasonality and because more than half of all rainfall events registered amounts smaller than 5 mm. If changes on temperature regime or precipitation patterns turn out in drier conditions, dry spells as well as the evaporative demand could increase, causing an increase of interception capacity of vegetation and consequently affecting ecological processes.