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Impacts of single and recurrent wildfires on topsoil moisture regime

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The increasing fire recurrence on forest in the Mediterranean basin is well-established by future climate scenarios due to land use changes and climate predictions. By this, shifts on mature pine woodlands to shrub rangelands are of major importance on forest ecosystems buffer functions, since historical patterns of established vegetation help to recover from fire disturbances. This fact, together with the predicted expansion of the drought periods, will affect feedback processes of vegetation patterns since water availability on these seasons are driven by post-fire local soil properties. Although fire impacts of soil properties and water availability has been widely studied using the fire severity as the main factor, little research is developed on post-fire soil moisture patterns, including the fire recurrence as a key explanatory variable.

The following research investigated, in pine woodlands of north central Portugal, the short-term consequences (one year after a fire) of wildfire recurrence on the surface soil moisture content (SMC) and on effective soil water (SWEFF, parameter that includes actual daily soil moisture, soil field capacity-FC and permanent wilting point-PWP). The study set-up includes analyses at two fire recurrence scenarios (1x- and 4x-burnt since 1975), at a patch level (shrub patch/interpatch) and at two soil depths (2.5 and 7.5 cm) in a nested approach. Understanding how fire recurrence affects water in soil over space and time is the main goal of this research. The use of soil moisture sensors in a nested approach, the rainfall features and analyses on basic soil properties as soil organic matter, texture, bulk density, pF curves, soil water repellency and soil surface components will establish which factors has the largest role in controlling soil moisture behavior.

Main results displayed, in a seasonal and yearly basis, no differences on SMC as increasing fire recurrence (1x- vs 4x-burnt) neither between patch/interpatch microsites at both two soil depths. Otherwise, in a yearly basis and during soil drying cycles, it was found less effective water on soil at the surface layers of the 4x-burnt and between shrub interpatches, based on the worst soil hydrological conditions (PWP) and the increasing percentage of abiotic soil surface components as increasing fire recurrence.

Our results suggest that the inclusion of soil hydrological properties, as pF-curves, on the soil water effectiveness calculation seems to be a better indicator of water availability that volumetric SM per se. Otherwise, the use of a nested approach methodology, stresses how fire recurrence, expected increases in the summer drought spells and, the increasing dominance of abiotic soil surface components, are the factors that much influence soil eco-hydrological functioning in fire prone ecosystems. Furthermore, this research point out how post-fire soil structural quality into plant interpatches could provoke looping feedback processes triggering desertification situations also in humid Mediterranean forestlands.