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# Quantification of dynamic soil – vegetation feedbacks following an isotopically labelled precipitation pulse

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The presence of vegetation alters hydrological cycles of ecosystems. Complex plant-soil interactions govern the fate of precipitation input and water transitions through ecosystem compartments. Disentangling these interactions is a major challenge in the field of ecohydrology and pivotal foundation for understanding the carbon cycle of semi-arid ecosystems. Stable water isotopes can be used in this context as tracer to quantify water movement through soil-vegetation-atmosphere interfaces.

The aim of this study is to disentangle vegetation effects on soil water infiltration and distribution as well as dynamics of soil evaporation and grassland water-use in a Mediterranean cork-oak woodland during dry conditions. An irrigation experiment using $\delta^{18}$O-labeled water was carried out in order to quantify distinct effects of tree and herbaceous vegetation on infiltration and distribution of event water in the soil profile. Dynamic responses of soil and herbaceous vegetation fluxes to precipitation regarding event water-use, water uptake depth plasticity and contribution to ecosystem evapotranspiration were quantified.

Total water loss to the atmosphere from bare soil was as high as from vegetated soil, utilizing large amounts of unproductive water loss for biomass production, carbon sequestration and nitrogen fixation. During the experiment no adjustments of main root water uptake depth to changes of water availability could be observed, rendering light to medium precipitation events under dry conditions useless. This forces understory plants to compete with adjacent trees for soil water in deeper soil layers. Thus understory plants are faster subject to chronic drought, leading to premature senescence at the onset of drought. Despite this water competition, the presence of Cork oak trees fosters infiltration to large degrees. That reduces drought stress, caused by evapotranspiration, due to favourable micro climatic conditions under tree crown shading. This study highlights complex soil-plant-atmosphere and inter-species interactions in both space and time controlling the fate of rain pulse transitions through a typical Mediterranean savannah ecosystem, disentangled by the use of stable water isotopes.