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Combining remote sensing and hydrological information for improving hydrological characterization of *dehesas* in Mediterranean mountain areas: a study case in Cardeña-Montoro Natural Park (Spain)

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Mediterranean mountain areas are especially vulnerable to changes. Climatic trends observed in the last decades point out to an increasing number of extreme events (i.e., number of heat waves and droughts) and consequently, a direct alteration of the hydrological states of their associated ecosystems. The savanna type ecosystem called *dehesa* is one of them. This system is the result of a long-term co-evolution of indigenous ecosystems and human settlement in a sustainable balance, with high relevance from both the environmental (biodiversity) and socioeconomic (livestock farming, including Iberian pork food industry) point of view. *Dehesa* systems have a complex vegetation cover structure, where isolated trees, mainly holm oak, cork oak and oak, Mediterranean shrubs, and pastures coexist. Different problems have arisen in *dehesa* during last years, an example of them are seca episodes, a disease of oak trees that results in drying and final death. This condition is caused by a fungus, but very likely triggered by external hydrological related conditions like air temperature and soil water content. Remote sensing techniques have been widely used as the best alternative to monitor vegetation patterns over these areas. However, the presence of clouds and the fixed spatiotemporal resolution of these sensors constitute a limitation in more local studies.

This work proposes the combined use of remote sensing by both terrestrial photography and satelital sensors, and hydrometeorological information as data sources for improving the hydrological characterization of vegetation in *dehesa* areas. The study was carried out in the Santa Clotilde experimental area, within the Cardeña-Montoro Natural Park (southern Spain). Three years of local sub-daily terrestrial photography and hydrometeorological information allowed us to define different hydrometeorological/ecohydrological indicators that are representative of key vegetation states. This local information is linked with vegetation indexes derived from high spatial resolution satellite information (i.e., Landsat TM, ETM+ and OLI (30 m x 30 m) and Sentinel-2 (10 m x 10 m) and distributed meteorological variables to extend the results from the local to the watershed scale. The promising results will be used in a short future as the basis of an advanced

monitoring service where meteorological seasonal forecast information could be used to derive key indicators and help in a priori diagnosis of the system facilitating decisions making.

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