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Monitoring drought impact on Mediterranean oak savanna vegetation using remote sensing

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A holm oak savanna, known as dehesa in Spain and montado in Portugal, is the largest agroforest ecosystem in Europe, covering about 3 million hectares in the Iberian Peninsula and Greece (Papanastasis et al., 2004). It is considered an example of sustainable land use, supporting a large number of species and diversity of habitats and for its importance in rural development and economy (Plieninger et al., 2001). It is a combination between an agricultural and a naturally vegetated ecosystem, consisting of widely-spaced oak trees (mostly Quercus Ilex and Quercus suber) combined with a sub-canopy composed by crops, annual grassland and/or shrubs. It has a Mediterranean climate with severe periodic droughts. In the last decades, this system is being exposed to multiple threats derived from socio-economic changes and intensive agricultural use, which have caused environmental degradation, including tree decline, changes in soil properties and hydrological processes, and an increase of soil erosion (Coelho et al., 2004).
Soil water dynamics plays a central role in the current decline and reduction of forested areas that jeopardizes the preservation of the system. In this work, a series of remotely sensed images since 1990 to present was used to evaluate the effect of several drought events occurred in the study area (1995, 2009, 2010/2011) on the tree density and water status. Data from satellites Landsat and field measurements have been combined in a spectral mixture model to assess separately the evolution of tree, dry grass and bare soil ground coverage. Only summer images have been used to avoid the influence of the green herbaceous layer on the analysis. Thermal data from the same sensors and meteorological information are integrated in a two source surface energy balance model to compute the Evaporative Stress Index (ESI) and evaluate the vegetation water status. The results have provided insights about the severity of each event and the spatial distribution of their impacts.