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Application of canopy coefficients obtained from remote-sensing data for monitoring evapotranspiration of Mediterranean oak savanna

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Mediterranean oak savanna, or dehesa, is the most characteristic agroforestry system of the Iberian Peninsula. It is composed by a mosaic of widely-spaced oak trees (primarily Quercus Ilex L. and Quercus Suber L.), crops, pasture and shrubs. In the last decades, this ecosystem has faced numerous threats, such as low profitability, an intensification of agricultural and livestock uses and environmental degradation (soil erosion, oaks declining, etc). In addition, current predictions identify this region as particularly vulnerable to climate change, which may exacerbate current water scarcity problems. The changes in the vegetation, the soil and the hydrological behavior of the system pose an additional risk for the preservation of the system and the socio-economic and environmental services that provides.

The aim of this work is to monitor the water balance of this ecosystem at point and watershed scale, integrating remote sensing and meteorological data. The evapotranspiration has been estimated for the hydrological years 2013/14 and 2014/15 using a vegetation index (VI) based approach (VI-ETo) over the Martin Gonzalo watershed, part of the larger Guadalquivir river basin (Southern of Spain) and with predominant dehesa landscape. VI-ETo model has been applied on a daily scale and 30 m resolution using a set of Landsat-8 satellite images. This model is based on FAO56 guidelines, complemented with VIs derived from remote sensors to compute more accurately the canopy transpiration. Additional local meteorological data, soil properties and vegetation parameters adapted to the study area have been used.

Modeled ET values have been validated with measurements taken over a dehesa experimental site (Santa Clotilde; 38º12'N, 4º17' W; 736 m a.s.l.), equipped with an eddy covariance system and complementary instruments, which measures all the energy balance components since mid-2012. At watershed scale, the results were compared with ET values modeled using an energy balance approach based on the Two Source Energy Balance (TSEB). Results at both scales support the potential of this little complex approach to monitor the vegetation water consumption and to provide new insights about its role in the water balance of the ecosystem.