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Estimation of evapotranspiration over a dehesa ecosystem using satellite data and a simplified soil water balance model

Elisabet Carpintero (1), Pedro J. Gómez-Giráldez (1), Ana Andreu (1,2), and María P. González-Dugo (1)

(1) IFAPA-Centro Alameda del Obispo, Apdo. 3092 14080 Cordoba, Spain, (2) University of California, Berkeley, Department of Environmental Science, Policy and Management, Berkeley (US)

Dehesas are Mediterranean oak savanna woodlands which occupy more than 3 million ha in South Europe. They provide a large number of socio-economic and environmental services, such as rural employment, livestock and forest productions, soil conservation or a high variability of habitats for biodiversity. However, the conservation of this ecosystem has been hampered by significant degradation processes derived from market changes and low profits, inadequate management practices, or pest and diseases infections. This situation is getting worse with current climate change predictions for the Mediterranean, which is expected to make this region both warmer and drier. The water consumption of the vegetation plays a central role in the hydrological behavior of this system, and the evapotranspiration (ET) is a good indicator of its health and productivity.

This work is focused on ET regular estimation over the Martin Gonzalo watershed (Southern of Spain) with predominant dehesa landscape, by applying a daily soil water balance. The vegetation index (VI)-canopy coefficient approach (called VI-ETo) has been used in this work. This model is based on FAO56 methodology, complemented with VIs derived from remote sensors to compute more accurately the canopy transpiration. A set of Landsat-8 satellite data (30m spatial resolution) has been integrated into the VI-ETo model combined with local meteorological data, soil properties and vegetation parameters previously adapted to the study area. This simplified soil water balance has been applied to monitor ET for the hydrological years 2013/14 and 2014/15.

To validate the VI-ETo approach at point scale, ET estimations have been compared with field observations taken over a dehesa experimental site (Santa Clotilde; 38º12'N, 4º17' W; 736 m a.s.l.). An eddy covariance system was installed on a 17.5 m tower, measuring all the surface energy balance components over the combined tree + grassland system. At watershed scale, modeled results have been evaluated using ET values derived from the application of the ALEXI/DisALEXI model based on the Two Source Energy Balance (TSEB). This approach has proven to be robust to monitor the vegetation water consumption of dehesa ecosystem, and it may be considered as a useful tool to assist water resources management in these areas.