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METRIC model for the estimation and mapping of evapotranspiration in a super intensive olive orchard in Southern Portugal

Isabel Pôças (1,2), António Nogueira (1), Teresa A. Paço (1), Adélia Sousa (3), Fernanda Valente (4), José Silvestre (5,1), José A. Andrade (3), Francisco L. Santos (3), Luís S. Pereira (1), and Richard G. Allen (6)

(1) CEER Biosystems Engineering, Instituto Superior de Agronomia, Universidade Técnica de Lisboa, Lisboa, Portugal (ipocas@mail.icav.up.pt), (2) Centro de Investigação em Ciências Geo-Espaciais (CICGE), Porto, Portugal, (3) University of Évora, Instituto de Ciências Agrárias e Ambientais Mediterrânicas (ICAAM), Évora, Portugal , (4) CEF, Instituto Superior de Agronomia, Universidade Técnica de Lisboa, Lisboa, Portugal , (5) INIAV I.P., Dois Portos, Portugal , (6) University of Idaho, Research and Extension Center, Kimberly, Idaho, USA

Satellite-based surface energy balance models have been successfully applied to estimate and map evapotranspiration (ET). The METRICtm model, Mapping EvapoTranspiration at high Resolution using Internalized Calibration, is one of such models. METRIC has been widely used over an extensive range of vegetation types and applications, mostly focusing annual crops. In the current study, the single-layer-blended METRIC model was applied to Landsat5 TM and Landsat7 ETM+ images to produce estimates of evapotranspiration (ET) in a super intensive olive orchard in Southern Portugal. In sparse woody canopies as in olive orchards, some adjustments in METRIC application related to the estimation of vegetation temperature and of momentum roughness length and sensible heat flux (H) for tall vegetation must be considered. To minimize biases in H estimates due to uncertainties in the definition of momentum roughness length, the Perrier function based on leaf area index and tree canopy architecture, associated with an adjusted estimation of crop height, was used to obtain momentum roughness length estimates. Additionally, to minimize the biases in surface temperature simulations, due to soil and shadow effects, the computation of radiometric temperature considered a three-source condition, where Ts=fcTc+fshadowTshadow+fsunlitTsunlit. As such, the surface temperature (Ts), derived from the thermal band of the Landsat images, integrates the temperature of the canopy (Tc), the temperature of the shaded ground surface (Tshadow), and the temperature of the sunlit ground surface (Tsunlit), according to the relative fraction of vegetation (fc), shadow (fshadow) and sunlit (fsunlit) ground surface, respectively. As the sunlit canopies are the primary source of energy exchange, the effective temperature for the canopy was estimated by solving the three-source condition equation for Tc. To evaluate METRIC performance to estimate ET over the olive grove, several parameters derived from the algorithm were tested against data collected in the field, including eddy covariance ET, surface temperature over the canopy and soil temperature in shaded and sunlit conditions. Additionally, the results were also compared with results published in the literature. The information obtained so far revealed very interesting perspectives for the use of METRIC in the estimation and mapping of ET in super intensive olive orchards. Thereby, this approach might constitute a useful tool towards the improvement of the efficiency of irrigation water management in this crop. The study described is still under way, and thus further applications of METRIC algorithm to a larger number of images and to olive groves with different tree density are planned.