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Evapotranspiration partition from the multiple energy balance version of the ISBA-A-gs land surface model over two irrigated crops in a semi-arid Mediterranean region (Marrakech, Morocco)

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The main objective of this work is to evaluate the added value of a multi energy budget model (MEB) compared to a single energy budget (or composite approach) to simulate evapotranspiration (ET) and its partition into soil evaporation (E) and plant transpiration (Tr) over an olive orchard and a winter wheat in a semi-arid Mediterranean region (Marrakech, Morocco). Continuous measurements of ET with Eddy covariance system, E and Tr with Sapflow and isotopic methods were used to validate the performance of the soil-vegetation-atmosphere model ISBA-A-gs. To this objective, the composite or single source version of ISBA-A-gs named ISBA-1P is compared to the double source version using two representations: a layer approach named ISBA-MEB where the vegetation canopy is located above the soil and a mosaic representation corresponding to two-adjacent source schemes and named ISBA-2P.

For the winter wheat, the ability of the three configurations (single and dual-sources) to reproduce mixed soil-vegetation fluxes was very similar. As an example, the RMSE differences between ISBA-1P, -2P and -MEB did not exceed 10 W.m-2 for the latent heat flux. These results have shown that the use of a composite energy balance on homogeneous covers is sufficient to better reproduce the total convective fluxes. However, the three configurations showed a contrasted performance in simulating the partition of ET. In particular, the ISBA-2P version, with the soil source directly exposed to incoming solar radiation, showed an underestimation in simulated transpiration with 20% (or an over-estimation of soil evaporation) compared to ISBA-1P and ISBA -MEB. Contrasted results were obtained for the olive orchard. Indeed, for this sparse and heterogeneous canopy, the dual source configurations including both mosaic (ISBA-2P) and layer (ISBA-MEB) representations outperformed the single source or composite version (ISBA-1P) with a slight improvement for ISBA-MEB in predicting sensible and latent heat fluxes. Concerning plant transpiration, the layer approach ISBA-MEB provides also significative better results than ISBA-1P and, to a lesser extent ISBA-2P with RMSEs of 1.6, 0.9, 0.7 mm/day and R^2 of 0.43, 0.69 and 0.7 for ISBA-1P, -2P and MEB respectively. This study represents the first in depth evaluation of the impact of a multiple energy balance in predicting ET partition using a SVAT model in a semi arid region of the South Mediterranea.