Performance of Two-Source Energy Balance-Soil Moisture model over Olive & Citrus Orchards in a semi-arid region

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Abstract

Evapotranspiration (ET) is the most essential component flux in the water balance in semi-arid regions, which are characterized by a lack and insufficient precipitation, soil moisture and groundwater depletion. Therefore, an accurate quantification of ET over an heterogeneous surface at different scales is crucial and can help the decision-makers to enhance agricultural water productivity and manage the water scarcity in order to fulfill increasing demand. Over the recent years, various remote-sensing based energy balance models (SEB) have been developed to accurately estimate actual ETc. Among them, the two-source energy balance (TSEB) model that uses the land surface temperature (LST) as a key boundary condition to estimate ET across the land-atmosphere interface. However, under water-scarce conditions, LST may not constrain the soil evaporation (E) and plant transpiration (T) concurrently. Accordingly, surface soil moisture (SM) was introduced in the original TSEB as an additional constraint to improve fluxes estimates and a modified model was developed which called "TSEB-SM". In the terrestrial water cycle, the ET is dominated by plant transpiration (T). Thus, the particularity of TSEB-SM model relies on the parameterization of Priestly Taylor coefficient, that has been adjusted in accordance with the soil water content during the cropping season. In the present work, the TSEB-SM was applied to three semi-arid irrigated sites "Agdal, Tahanout & Agafay'' located at Tensift basin and respectively planted with Olive and Citrus trees. The outputs of TSEB-SM are compared to in situ flux measurements derived from the Eddy-Covariance (EC) systems that were installed during a micrometeorological monitoring campaign conducted in these areas. The preliminary findings are promising. Thus, the TSEB-SM model reduces greatly the discrepancies between ET estimates and measurements with an average determinant coefficient (R^2) that reaches 0.6 and an average Root Mean Square Error (RMSE)/ Mean Biais Error (MBE) of 55 / 8 (W/m^2) for the three studied sites. With the incorporation of satellite products including Landsat LST/NDVI and microwave SM, the TSEB-SM could be potentially a robust tool for monitoring ET at a regional scale over an heterogeneous canopy cover.

Key words : Evapotranspiration ; TSEB-SM ; Trees ; semi-arid.