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**EVAPOTRANSPIRATION AND WATER STRESS RETRIEVAL  
PERFORMANCES OF SINGLE-PIXEL ENERGY BALANCE MODELS OVER  
IRRIGATED AND RAINFED AGRICULTURAL CROPS.**

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Evaporation is an important component of the water cycle, especially in semi-arid lands. Its quantification is crucial for a sustainable management of scarce water resources. Up-to-now, evaporation at large scales is estimated through integrated water balance models forced by distributed meteorological forcing. This forcing includes irrigation inputs from surface and groundwater uptakes. Those amounts are largely unknown at most scales, including the regional scale, i.e. the working scale of institutional stakeholders. An alternative way to quantify evapotranspiration is to exploit the available surface temperature data from remote sensing as a signature of the surface energy balance, including the latent heat flux. Remotely sensed energy balance models enable to estimate stress levels and, in turn, the water status of most continental surfaces. Single-pixel energy balance models such as SEBS (Su, 2002) or TSEB (Norman et al., 1995) are particularly well suited to derive evapotranspiration at high and low resolution over a wide range of land use and landscape types. Two source models, such as TSEB, are interesting since they allow deriving a rough estimate of the water stress of the vegetation instead of that of a mixed surface. Such frameworks can be used with either component surface temperatures (soil and vegetation components retrieved from directional surface temperature data) or a single mixed surface skin temperature. For the latter, a realistic

underlying assumption enables to invert two unknowns (evaporation and transpiration) from a single piece of information. This assumption states that, in most cases, vegetation is unstressed, and that if vegetation is stressed, evaporation is negligible. In the latter case, if vegetation stress is not properly into account, the resulting evaporation will decrease to unrealistic levels (negative fluxes) in order to maintain the same total surface temperature. This work challenges the limits of such hypothesis by 1- studying evaporation and transpiration retrievals using two versions (parallel and series resistance networks) of a two source energy balance model similar to TSEB, and 2- testing the water stress retrievals (vegetation water stress and moisture-limited soil evaporation) over contrasted test sites in Tunisia (irrigated wheat, rainfed wheat, rainfed olive tree) and Mexico (irrigated wheat). Results show that stress retrievals are most of the time consistent, in their occurrence at least rather than in their exact intensity. However, over a limited number of situations, none of the algorithms converge to a realistic level. Series and parallel resistance networks have similar performances for total evapotranspiration retrievals but lead to different evaporation/transpiration partitions. Bounding relationships and temporal consistency tests are proposed to ensure that convergence is reached at all times to provide robust estimates of evaporation and transpiration.

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