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Modified Shuttleworth-Wallace model for monitoring evapotranspiration over complex surface: Relationship between the surface resistances and remotely sensed stress indexes

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The main goal of this work was to evaluate the potential of the Shuttleworth-Wallace (SW) model for mapping actual crop evapotranspiration (ET) over complex terrain located within the foothill of the Atlas Mountain (Morocco). This model needs many input variables to compute soil (r_s^s) and vegetation (r_s^v) resistances, which are often difficult to estimate at large scale particularly soil moisture. In this study, a new approach to spatialize r_s^s and r_s^v based on two thermal-based proxy variables is proposed. Land Surface Temperature (LST) and Normalized Difference Vegetation Index (NDVI) derived from LANDSAT data were combined with the endmember temperatures for soil (Ts_{min} and Ts_{max}) and vegetation (Tv_{min} and Tv_{max}), which are simulated by a surface energy balance model, to compute the temperature of the two components, namely the soil (Ts) and the vegetation (Tv). Based on these temperatures, two thermal proxies (SIss for soil and SIsv for vegetation) were calculated and related to r_s^s and r_s^v, with an empirical exponential relationship (with a correlation coefficient (R) of about 0,6 and 0,5 for soil and vegetation, respectively). The proposed approach was firstly evaluated at a local scale, by comparing the results to observations by an eddy covariance system installed over an area planted with olive trees intercropped with wheat. In a second step, the new approach was applied over a large area which contains a mixed vegetation (tall and short vegetation) crossed by a river to derive r_s^s and r_s^v, and thereafter to estimate ET. A Large aperture scintillometer (LAS) installed over a transect of 1.4 km and spanning the total area is used to validate the obtained ET. The comparison confirms the ability of the proposed approach to provide satisfactory ET maps with an RMSE and R^2 equal to 52.51 W/m^2 and 0.80, respectively.