Improving evapotranspiration estimates by assimilating thermal and microwave data into SAMIR in a semi-arid region

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Accurate estimation of evapotranspiration (ET) is of crucial importance in water science and hydrological process understanding especially in semi-arid/arid areas since ET represents more than 85% of the total water budget. FAO-56 is one of the widely used formulations to estimate the actual crop evapotranspiration ($ET_{c\ act}$) due to its operational nature and since it represents a reasonable compromise between simplicity and accuracy. In this vein, the objective of this paper was to examine the possibility of improving $ET_{c\ act}$ estimates through remote sensing data assimilation. For this purpose, remotely sensed soil moisture (SM) and Land surface temperature (LST) data were simultaneously assimilated into FAO-dualK_c. Surface SM observations were assimilated into the soil evaporation (E_s) component through the soil evaporation coefficient, and LST data were assimilated into the actual crop transpiration ($T_{c\ act}$) component through the crop stress coefficient. The LST data were used to estimate the water stress coefficient (K_s) as a proxy of LST (LST_{proxy}). The FAO-Ks was corrected by assimilating LST_{proxy} derived from Landsat data based on the variances of predicted errors on K_s estimates from FAO-56 model and thermal-derived K_s. The proposed approach was tested over a semi-arid area in Morocco using first, *in situ* data collected during 2002-2003 and 2015-2016 wheat growth seasons over two different fields and then, remotely sensed data derived from disaggregated Soil Moisture Active Passive (SMAP) SM and Landsat-LST sensors were used. Assimilating SM data leads to an improvement of the $ET_{c\ act}$ model prediction: the root mean square error (RMSE) decreased from 0.98 to 0.65 mm/day compared to the classical FAO-dualK_c using *in situ* SM. Moreover, assimilating both *in situ* SM and LST data provided more accurate results with a RMSE error of 0.55 mm/day. By using SMAP-based SM and Landsat-LST, results also improved in comparison with standard FAO and reached a RMSE of 0.73 mm/day against eddy-covariance $ET_{c\ act}$ measurements.