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Comparison of two simple tools (TSEB and FAO-56) to retrieve evapotranspiration of irrigated agriculture in semi-arid areas.

Alhousseine Diarra (1), Lionel Jarlan (3), Salah Er-Raki (2), Michel Le Page (3), Said Khabba (1), and Gilles Boulet (3)

(1) Faculty of Sciences Semlalia, Cadi Ayyad University, Marrakech,Morocco , (2) Faculty of Sciences and Technology, Cadi Ayyad University,Marrakech, Maroc, (3) Centre d'Etudes Spatiales de la BIOsphère, Toulouse, France

In a context of climate change and an increasing water demand, the semi-arid climate region face heightened pressure on the availability of water resources. About 85% of available water is used for irrigation in these regions. There is thus a crucial need to develop tools for a better management of irrigation through accurate estimates of crop water requirement. The objective of this study was to adapt and evaluate two parsimonious modeling approaches feeded by remote sensing observations, which have potential for the operational monitoring of evapotranspiration (ET): the two-source surface energy balance (TSEB) model developed by Norman et al. (1995) and the FAO-56 dual crop coefficient method (Allen et al., 1998), through the SAMIR tool (Simonneaux et al., 2009). At the field scale, both models were evaluated on four sites located in the Haouz plain (Marrakech, Morocco) during two agricultural seasons: wheat and sugar beet in 2012 and two other wheat crops in 2013; all belonging to an irrigated perimeter of 2800 ha. A time series of 12 high spatial resolution images acquired by SPOT-5 and ASTER images was collected during the growing seasons of wheat and sugar beet. The simulation results showed that both models offer fair performances of ET compared to measured one by eddy covariance with an average root mean square error (RMSE) lower than 1 mm/day for the sugar beet where the simulation are lower by the FAO-56 approach due to water inputs are uncertain. By contrast, the TSEB model, which not needs the water supply as input, offers smoother performances in all cases. At the scale of the perimeter, both approaches show similar spatial patterns because of homogeneous water conditions at the date of remote sensing image acquisitions. The partition of evapotranspiration between soil evaporation and transpiration from vegetation is estimated indirectly by confrontation between simulated soil evaporation and surface (0–5 cm) soil moisture acquired spatially with ThetaProbe sensors (Delta-T). The obtained results showed a linear relationship between both parameters with a correlation coefficient of 0.86 for low values LAI (<1.5 m^2 / m^2). Finally, both approaches are used to evaluate their potentiality to predict a water stress index based on the ratio between actual and potential evapotranspiration. Although the FAO-56 is better suitable to detect high water stresses, the TSEB model is able to detect moderate stresses without a need to prescribe water inputs. This in-depth comparison of two simple tools to monitor evapotranspiration leads us to the conclusion that the TSEB model can reasonably be used to map evapotranspiration on large scale. This constitutes our work in progress based on MODIS products in the objective of monitoring plant water use at the catchment scale.