IAHS2017-332-1
IAHS Scientific Assembly 2017

Evapotranspiration and water stress retrieval performances of the SPARSE dual-source energy balance model over irrigated and rainfed agricultural crops

Gilles Boulet (1,2), Emilie Delogu (1), Sameh Saadi (1,2), Malik Bahir (1,3), Albert Olioso (3), Bernard Mougenot (1,2), Bruno Raimbault (1,2), Pascal Fanise (1), Zohra Lili-Chabaane (2), Vincent Rivalland (1), and Jean-Pierre Lagouarde (4)

(1) CESBIO - Université de Toulouse, CNES/CNRS/IRD/UPS, Toulouse, France (gilles.boulet@ird.fr), (2) Institut National Agronomique de Tunisie, Tunis, Tunisie, (3) EMMAH, INRA, Université d'Avignon et des Pays de Vaucluse, Avignon, France, (4) ISPA, INRA, Bordeaux Sciences Agro, Villenave d'Ornon, France

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. Evaporation at large scales is often 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.

This works evaluates the SPARSE model (http://tully.ups-tlse.fr/gilles.boulet/sparse) forced by in-situ or MODIS surface temperatures. SPARSE is built on the same rationale as the widely used TSEB model. Its new features involve state-of-the art resistance formulations as well as the possibility to run the model in two modes: a retrieval mode to simulate evaporation and transpiration from TIR data, and a prescribed mode which simulates potential evaporation and transpiration rates. This enables to simulate not only actual fluxes but also surface and plant water stress. It ensures also an increased robustness through bounding the actual fluxes by the corresponding potential rates. A wide range of flux datasets acquired over rainfed and irrigated crops in temperate, Mediterranean and semi-arid regions are used to check the robustness of both stress levels and evapotranspiration retrievals. Two flux datasets are relevant for assessing the performance of the MODIS scale retrievals. One is an extensive rainfed oliveyard with very low (7%) vegetation cover. For this site, evapotranspiration from eddy covariance (EC) as well as transpiration from sapflow measurements are available to check the accuracy of evaporation and transpiration components computed by SPARSE. A second dataset has been acquired over a complex agricultural landscape with an eXtra-Large Aperture Scintillometer (XLAS) set-up over a 4 km transect between two water towers. Instantaneous retrievals of sensible heat (XLAS) or latent heat (EC towers) are satisfactorily compared to TSEB. Temporal evolution of stress is also consistent at all sites. The Oliveyard site is too sparse to retrieve efficiently the vegetation water stress, while for the complex landscape SPARSE stress and daily ET outputs are more consistent with the XLAS estimates than what is obtained with an agrohydrological model calibrated on EC data.