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Estimating evapotranspiration over agricultural landscapes with thermal infrared data: comparison of two approaches using Simple Energy Budget and SVAT modeling.

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Evapotranspiration (ET) monitoring presents wide range of applications from agriculture and water resources management to meteorology. Several approaches have been developed to retrieve ET based on a joint use of remote sensing data and land surface modeling, in particular with a SVAT (Soil Vegetation Atmosphere Transfers) model or a SEB (Surface Energy Budget) model.

The objective of our work is to estimate spatialized ET fluxes from Thermal Infra-Red (TIR) imagery, focusing on simulating fluxes at low spatial resolution with 2 methodologies:
1. Simulating with a SEB model directly at low resolution (landscape scale: 4km) with TIR forcing.
2. Aggregating high resolution (agricultural field scale) estimates from a SVAT model constrained by TIR data and based on a high spatial resolution database (landcover, LAI, vegetation height, meteorological forcing and irrigation).

In a first part we sum up previous results about in-situ capabilities of a SEB model (TSEB, Norman & al. 1995) versus a SVAT model (SEtHyS, described by Coudert & al. 2006) over crops. TSEB is driven directly with TIR forcing and does not consider soil water transfers. SEtHyS doesn't rely on TIR data availability but it has more parameters and requires more inputs for initialization.
Simulations of both models were compared to in-situ Eddy-Correlation (EC) fluxes, with data from 3 sites in southern France and Morocco, covering several kinds of cultures, various vegetative states and various meteorological conditions. A sensitivity analysis on inputs was used to better characterize their capabilities and behaviors, and quantify error ranges induced by spatialization.
Globally, models provide estimations of latent heat flux (LE) with RMSD of around 55W/m^2 for TSEB and 45W/m^2 for SEtHyS. Energy fluxes partition in TSEB was shown to be relatively less sensitive to some inputs when using only a single set of parameters. However it has lower performances on rising vegetation and stressed vegetation, limiting is domain of validity. SEtHyS is valid in more cases, however in compensation it requires finer parameters tuning and better knowledge of surface and vegetation.

An in-depth study of the Priestley-Taylor key parameter used in TSEB has been lead and a new value of 1.1 is proposed for simulations performed around midday time to improve the fluxes partition and better reproduce the flux dynamic.

Finally we present first results of spatialized ET fluxes at low resolution, obtained over south France following both methodologies (method 1 with TSEB and method 2 with SEtHyS). Meteorological forcing was obtained using SAFRAN re-analysis from Meteo-France and vegetation forcing was obtained from NDVI imagery and land use data. TIR forcing was collected at low resolution with MSG sensor (4km – 15minutes) and at high resolution with LANDSAT sensor (60m – 16days orbital cycling). Both methodologies are compared in order to discuss ET products uncertainties from thermal imagery.