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ASSESSMENT OF A LAND SURFACE MODEL OVER A MEDITERRANEAN CROP SITE FOR A LONG PERIOD OF TIME : IMPACT OF UNCERTAINTIES IN SOIL PARAMETRS

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Land surface models (LSMs) are relevant tools to analyse and predict the evolution of energy budget and water balance at the regional scale. However, these models were originally designed to be coupled with atmospheric or hydrological models in large-scale simulations. Their implementation at smaller scales requires i) finer representation of key processes in the soil-vegetation-atmosphere continuum and ii) more accurate soil and vegetation parameters. One shortcoming of LSMs concerns the representation of crops. The succession of crop periods and bare soil inter-crop periods can impact the energy and the water balance of the field. This raises the rarely investigated issues of:

1. What is the influence of crop rotation on simulated evapotranspiration ?
2. How important is the propagation of LSM errors over a long period of time ?
3. What are the uncertainties related to the representation of soil water transfers ?

In this study, the SURFEX/ISBA-A-gs LSM was implemented at local scale, over a Mediterranean crop site. The force-restore and the multi-layer diffusion schemes for soil water transfers were tested. The model was driven by local climate, soil texture and vegetation dynamic observations. Continuous simulations of evapotranspiration (ETR) were evaluated through a 12-year crop rotation encompassing 14 arable crop cycles (wheat, maize, sorghum, sunflower, peas) and 14 inter-crop bare soil periods.

This work highlights the influence of crop rotation on the amount and the temporal dynamic of ETR simulated over a long period of time. Significant plant transpiration rate concerned short-time period. Soil evaporation comprises more than 50% of ETR for 80% of the days. Soil evaporation is the prevailing source of uncertainties in ETR when ETR is continuously simulated over a succession of crop and inter-crop periods.

The implementation of ISBA-A-gs using the force-restore scheme at local scale causes substantial underestimation of ETR. An RMSE of 52 $W.m^{-2}$ and a bias of -12 $W.m^{-2}$ are reported for latent heat flux. The RMSE and bias for daily daytime ETR are 0.87 $mm.day^{-1}$ and -0.24 $mm.day^{-1}$. A deficit of 1490 mm (24%) in simulated cumulative ETR computed over 65% of the 12-year period is obtained. This illustrates the substantial error propagation when the model is implemented over a long period of time.

Most uncertainties are related to the use of the pedotransfert estimate of the soil hydraulic parameters. Soil moisture at wilting point is overestimated. This causes the underestimation of the root-zone water stock available for the crop and thus the underestimation of transpiration during senescence. Soil moisture at saturation is overestimated. This triggers underestimation of soil evaporation. The use of *in situ* estimates of these parameters reduces the bias in latent heat flux by 98 %. Measurement uncertainties related to the non-closure of the energy balance comprise between 22% and 44% of the random differences between the measured latent heat flux and the simulated latent heat flux. The multi-layer diffusion scheme is compared to the force-restore scheme. Its ability to better represent the effect of crop rotation and soil vertical heterogeneity on water transfers is analyzed. Its performances are better than the force-restore ones if the soil vertical heterogeneity is accurately accounted for. The influence of the parametrization of root profiles is investigated.