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Discussions

Interactive comment on "Evaluation of land surface model simulations of evapotranspiration over a 12 year crop succession: impact of the soil hydraulic properties" *by* S. Garrigues et al.

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We would like to thank referee#1 for the review of our paper. Your remarks were very useful to improve the overall quality of the paper. We have carefully considered your comments and modified selected parts of the paper. Below, we provide answers to each of your comments.

0/"Many parts are redundant, and need to be shortened, simplified and well-stated." :

We carefully reviewed the paper, removed redundancies and clarified the text. This mainly concerns:

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- Introduction, paragraph on uncertainties in soil hydrodynamic parameters: we identified redundancies with Discussion.

- Section 3: redundant sentences were removed.

- Section 5 (Results) and 6 (Discussion): part of the results are interpreted and discussed in the Result section. These sentences were moved to the Discussion to avoid redundancies and improve the structure of the paper. We added subsections in section 6.1 to improve the clarity of the discussion.

1/"by referring to Table 4, all the different simulation cases have to be clearly explained one by one in Section 4.1" :

We agree and we clearly described each simulation case.

2/"the experiments are not well described. More details have to be added. "At which depth did you install the 4 neutron probes? Why do you average soil moisture at saturation (wsat) for different field locations if the model refers to an experimental soil profile? Not clear at all. How many samples (and which depth) were collected for the Richard plate appa- ratus? Explain better point 2 at page 11695: how do you retrieve rooting depth (d2), wilting point (wwp) and field capacity (wfc) from the measurements of the water content values? Can you show a graph where you point wwp and wfc in each growing season (to integrate Table 3)"

We improved the description of the experiment. We clarified the following points:

- The simulations were designed to be representative of the field. They were not conducted for a particular experimental soil profile. This is the reason why we used soil and vegetation parameter values which were spatially averaged over the field.

- Neutron probe was used to retrieve volumetric soil moisture over a 0–1.90 m soil profile with a vertical resolution of 10 cm. To implement the measurements, 3 to 6 neutron probe access tubes were installed at the centre of the field along a north-south transect. A calibration was done for every access tube and soil layer by relating neutron count rates to soil moisture measured by gravimetric method. The average soil moistures at given depth were then used.

- the soil moisture at saturation was derived from soil bulk density measurements performed within the 0-1.2 m soil layer at different field locations and times. We used the spatiotemporal average value to be representative of the soil structure at the field scale at which the simulations were conducted. The spatial mismatch between the footprint of the various measurements used to drive the model (vegetation and soil parameters) or to evaluate its outputs (LH measured from eddy-covariance) is discussed in Section 6 (p19). The impact of the spatiotemporal variability of soil moisture at saturation which can be large due to occurrence of macroporosity is now analyzed using the Monte Carlo analysis which has been incorporated in the work (see below point 3).

- The measurements done with the Richard plate apparatus cover water potentials of -1, -2, -3, -5, -10, -30, -50, -100, and -150 m. 3 samples were collected at depths of 0-0.4 m, 0.4-0.8 m and 0.8-1.2 m. These measurements are described in Bruckler et al., (2004). A retention curve model from Brooks and Corey (1964) was adjusted for each soil layer. It was used to retrieve the soil moisture at field capacity (wfc) and wilting point (wwp) for each soil layer. wwp and wfc were averaged over the 0-1.2m soil profile and were used in the experiment.

- point 2 page 9: we clarified how the rooting depth, the wilting point and the field capacity were retrieved from the field measurements of soil moisture.

The rooting depth (d2) was estimated for each crop cycle from the analysis of the time evolution of the vertical profiles of soil moisture measurements over the growing season. d2 was approximated by the depth at which the soil moisture change in time vanished. We assumed that at a given depth, the time variations in soil moisture due to the vertical diffusion and gravitational drainage were smaller than those generated by the plant water uptake. This is a reasonable hypothesis for low hydraulic conductivity soil as the one under study.

HESSD

11, C6010–C6014, 2015

Regarding wfc and wwp, we considered typical evolution cycle of the root-zone soil moisture under Mediterranean climate. Soil moisture generally starts from a upper-level which approximates wfc. It generally reaches a lower-level at the end of the growing season which often approaches wwp. To be consistent with the Richard plate measurements, we integrated soil moisture measurements over 0-0.4 m, 0.4-0.8 m and 0.8-1.2 m soil layers. wfc and wwp were estimated for each soil layer as the maximum and minimum soil moisture value over the growing season. The mean values of wfc and wwp over the 0-1.2m profile were computed and reported in Table 3.

The evolution of the measured root-zone soil moisture over each growing season is displayed in Fig. 1. For clarity reason, we did not point wfc and wwp for each crop cycle. We chose to plot them in Fig. 2b for wheat. This is a typical example to illustrate how wilting point and field capacity were retrieved from the measurements of the water content over the growing season.

3/"uncertainty is not properly addressed. It is just qualitative in Section 6. It is mandatory to quantify the uncertainty propagation on ET by running a Monte-Carlo analysis (for example 100 simulations for each case) and plot it (grey lines for all, black lines for the average ET-values). Same for the measured ET through the eddy-covariance. I understand this suggestion requires numerical effort, but the paper would be optimal by presenting this analysis."

We agree with your remark. We acknowledged in conclusion that complementary works are required to provide a full understanding of the impact of the uncertainties on the simulation of evapotranspiration over cropland.

We propose to quantify the impact of the uncertainties in soil parameters on ET by conducting a Monte-Carlo analysis for the "best" simulation (simulation Sd). The Monte-Carlo process is applied to the soil parameters investigated in this work (soil moisture at saturation, at field capacity and at wilting point). The uncertainties in these parameters are represented by their spatiotemporal variability given in Table 2 and 3. We assume that these parameters follow a Gaussian distribution. We will show a graph with the ensemble of simulations. To represent the uncertainties in ET measurements, we will plot the three estimates of ET measurements given in Section 6.4. We discuss these additional results in a new sub-section 6.5.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 11687, 2014.