Comments on the manuscript HESS-2017-643

The manuscript explores the changes of soil hydraulic properties induced by a cover crop using the field measured soil moisture of several plots in a 10-years experiment, on a silty clay loam soil, in central Spain, and the results generated by a model fitted to those data.

The subject is well-known, but since the published results are always limited to the site and managements systems, new works are welcome to enlarge our knowledge on the evolution on soil properties under long term treatments.

The manuscript is well written and the results seem interesting. Nevertheless there are certain problems which require a major revision.

Main comments

1. The use of a hydrological model to evaluate the change of soil properties, in this case the parameters of the van Genuchten soil water retention equation, might not be the best way to detect the modification of soil properties, especially in the case of a 10-years experiment of a cover crop in soil under rainfed periods, with a reduced number of direct measurements of these properties. In this work the authors have selected arbitrary depth intervals, different from the soil horizons described by Gabriel and Quemada (2011, Table 1), with samples of different textural classes. In each of these depth intervals have taken samples to measure, later in the laboratory, the hydraulic conductivity at saturation, and saturated soil water content. Fitting the hydrological model WAVE results to the field measured soil moisture date, the hydraulic conductivity at saturation, the normalizing parameter of the matric component of soil water potential, α, the exponent n, and the water contents residual and saturated, of the van Genuchten soil water retention equation were estimated for the successive yearly periods without a regular crop on the field.

The results shown in Figure 1 of this manuscript do not show great changes between years and treatments. Nevertheless, there are some oscillations, which, at least in the shallower interval, 0-20 cm, seem related to the monthly rainfall shown in Figure 1. To check this apparent similarity, I took the data of rainfall in the three autumn months of every year, the main soil water recharge period in the Spain Mediterranean climate, from Figure 1, and plotted them against some of the van Genuchten parameters. Figure 1 here indicates a decreasing trend of the estimated van Genuchten α parameter with the autumn rainfall for the 0-20 cm depth interval. The trend was not so clear in the case of other parameters at this depth interval, which is the most directly affected by the rain water. Therefore, it seems that the estimated values of some parameters could be affected by the year rain, what is surprising. One could not expect soil properties changing by the rain. The authors must check these results to avoid a distortion in the estimation of soil properties with the model-fitting methods.

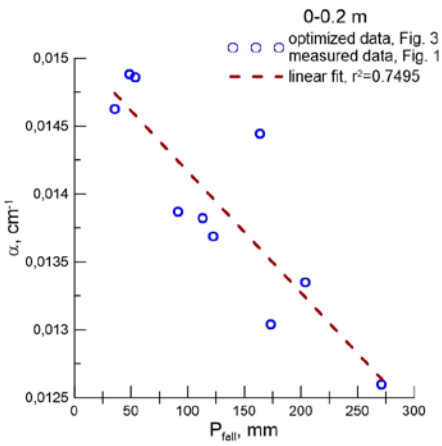

Fig. 1. Comparison of the model-estimated van Genuchten α parameter with the recorded autumn rainfall.

2. Independent of the mentioned trend, the interpretation of the results in the manuscript, section 3.3 is excessively optimistic. The two phases indicated in the line 1, page 10, not too evident in the different plots of Figure 3, could be due to the influence of the successive rainy autumns 2008-2009, and 2009-2010, more than to a soil generated change. The different values of the estimated residual water content in the deeper soil horizons could be due to the relatively stable soil water contents at those depths more than to a compaction, as the authors suggest. In any case the authors should provide additional support other than the reference to other experiments in a different place. The compaction should have induced a reduction of the saturated water content not too different between the two treatments in the second depth interval, 20-40 cm. However, the estimated values of the hydraulic conductivity at saturation at the third depth interval, 40-80 cm, do not suggest any compaction influence. Again, the discussion of the results must be thoroughly revised.

3. Is section 3.2 required for the manuscript? A simpler indication of the role of the crop on the estimation of evapotranspiration rates could probably be enough for the explanation of the results.

Minor comments

1. Some recent relevant articles are missing, among them van Es *et al.* (1999), Basche *et al.* (2016), Rorick and Kladivko (2017), who measured points of the soil water retention curve. Besides, the Introduction could be abbreviated. Possibly some of the other references might not be needed, (many double references for a single statement).

2. In line 2-3, page 2, if the soil bulk density increases the porosity consequently decreases. This part of the sentence is not needed in the text.

3. The sentence in lines 5-8 should be rewritten, (too many dynamics).

4. Is not the Köppen system more universal and more convenient than the Papadakis' one to classify a climate? (*e.g.* Peel *et al.* 2007).

5. What do the authors mean with the term 'field capacity' (line 13, page 4)? Later, line 11, page 11, the term is explained, but I could suggest the use of a more sound definition of the term (e.g. Assouline and Or, 2014) to gain in precision.

6. The statement of lines 25-26 of page 5, is repeated from that of lines 18-19 of page 4.

7. Does figure 1 need to contain the average maximum and minimum temperatures?

8. Could the new index of Willmott *et al.* (2012) be more suited for the occurrence of very different values of soil moisture, (great and small), than the Nash-Sutcliffe efficiency index?

9. Is Figure 4 necessary for the manuscript? If the authors think it is, why the water retention curves are limited to the second and third depth intervals? The numbers on the labels of the x-axis must be negative, since the matric component of soil water potential has negative values.

10. The use of macro- and microporosity, (line 1, page 11), or of the velocity of the infiltration processes, (line 12, page 11), should be based on solid reasons.

11. The sentence in lines 9-10 of page 12 is speculative.

12. The sentences in lines 7-12 are questionable, and not a consequence of the results found in the manuscript.

13. The reference of Scanlan (2009) is incomplete, (line 6-7, page 16).

References

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