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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Measuring and modelling water related soil–vegetation feedbacks in a fallow plot" *by* N. Ursino et al.

N. Ursino et al.

nadia@idra.unipd.it

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We would like to thank Referee 1 for the detailed and constructive review. The specific comments concerning the organization of the manuscript (comments to lines: 75, 96, 125), the references to be cited (comments to lines 104, 165, 196, and 334, since p values are taken from literature) or Figures to be added (comments to lines 185, or Section 2.4) will be certainly address in a revised version of this manuscript.

Two main points raised by the Referee, in our opinion, deserve to be discussed in the open forum: the reinterpretation of the ERT data and the modelling approach.

The referee makes specifically the point that some of the data presented and the modelling approach is already part of a previous paper. The data presented in this paper

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are indeed partly presented in Cassiani et al., 2012. However the analysis presented in the current, new manuscript is conducted with different methods (e.g. using time-lapse inversion of ERT data) and it is focused primarily on the behaviour of the fallow plot (as highlighted also in the title). The 2012 paper contained, among other topics, mainly the comparison between vegetated and fallow plot. Here the behaviour of the vegetated plot is only mentioned for comparison, and not deeply analyzed per se.

We will make sure that the separation between this and the previous paper be clearly stated in terms of new from old data/interpretations/analyses. At the end of the introduction a clear statement will be made to this end, as suggested by the referee.

The Referee asks to clarify the objective statement of this research paper, since it deals with an irrigation experiment that was described also by Cassiani et al. (2012). In a revised version of the manuscript we will certainly state clearly that the ERT data have been reinterpreted, the local TDR and VIA measurements have not been published before and the modelling framework differs substantially from the one proposed by Cassiani et al. (2012).

With reference to the comment to line 495, we must say that in our previous interpretation of the ERT data (Cassiani et al., VZJ, 2012) runoff was overestimated since, by neglecting water salinity the soil saturation was underestimated by the ERT measurement. This is indeed a common problem in the analysis of this type of experiment, and we realized the importance of this phenomena only conducting a specific, detailed analysis of the fallow plot infiltration data, and particularly from the comparison of ERT and TDR data. The fact that infiltration occurs into the bare soil as well as into the cultivated soil was evident when we analyzed the new TDR data (see Figure 8). Apparently the macro-pores created by the weed roots allowed the irrigation water to reach the deeper soil layers, and the fact that the electrical conductivity of the bare soil increased in the top 10-50 cm and decreased below had to be attributed to the fact that the irrigation water pushed downward more saline water rather than decreasing soil moisture. The new analysis of ERT data in the fallow plot, using ratio inversion, highlights the problem

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in a manner not previously appreciated using standard ERT inversion.

The new experimental evidence questioned the role of the vegetation-infiltration feedback at the time scale of the experiment and on the yearly water budget. Apparently the higher electrical conductivity that was measured before the experiment could be due to the water salinity and the salt content could be attributed to the residence time of the water within the soil.

In the new paper we try to use the combination of VIA and local TDR measurements to highlight the local infiltration to be attributed to a soil vegetation feedback and to evaluate the impact of this feedback on the yearly water balance (this should address also the comment to line 568). The seasonal variation of soil saturation was not resolved by the model proposed by Cassiani et al. (2012).

In the new paper, we model the infiltration experiment and compare the model outcome with the TDR measurements, and then we model the yearly water budget in order to infer the impact of the positive feedback on the water balance.

The modelling framework proposed in our previous paper (Cassiani et al., VZJ, 2012) (model a), and the one proposed in the new paper submitted to HESS (model b) differ substantially with respect to the characteristic time scale. In model a we analyzed the impact of a positive feedback between vegetation growth and infiltration on a time scale of several decades. Thus the biomass balance came into play and we found that if the feedback exists, there may be a characteristic root length that maximizes the biomass production in a water scarcity scenario, and the estimated optimum root length was approximatively equal to the observed one.

Model b considers the impact of the positive feedback on the yearly water balance, demonstrating that the patchy vegetation that grows on the bare soil relies on the water stored before the growing season thanks to the preferential infiltration that occurs where the vegetation grew before creating a discontinuity in the upper crusty soil layer and that this old water together with the new one infiltrating during the growing season

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when it rains corresponds to the effective evapo-transpiration volume. The fact that water is stored in the soil for months could support and validate our intuition of the relevant impact of salinity on the ERT measurements, and the yearly water balance supports our new interpretation of the experimental data, in terms of yearly water budget.

As for some specific comments related to ERT data analysis: Comment to L370: we did not experience severe contact problems due to the dry crust, as electrodes managed to have some effective contact with the more conductive soil just below the crust. Comment to section 3.2; a discussion on the influence of temperature, salinity and moisture content changes is given in section 3.2, albeit we lack supporting independent data for pore water salinity (in particular) to support some of our conclusions – in the revised manuscript we will try to make the points we make much clearer. Comment to L450-455: unfortunately we do not have suction cup data to support this conclusion, but we think it is reasonably deducted from the evidence we have. Note also that this type of observation is not trivial in these experiments, and highlighting this phenomenon is an interesting contribution of the paper. The sensitivity of ERT cannot explain what is observed, as the decrease of sensitivity with depth is not that sharp, and anyway would smear the image rather than showing such a clear increase in resistivity. This increase is, by the way, mostly observable in the shallower part of the ERT profile, i.e. precisely where ERT sensitivity is maximal!

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 11151, 2013.