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Discussions

Interactive comment on "Examining the relationship between intermediate scale soil moisture and terrestrial evaporation within a semi-arid grassland" *by* R. B. Jana et al.

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This MS compares measured and modelled actual evapotranspiration (ETa) fluxes with soil moisture dynamics determined by a cosmic-ray probe for the same site located in Australia to analyse the coupling of these processes.

The MS presents an interesting application of Q–Q plots for comparing the shapes of distributions of soil moisture data and modelled fluxes of actual ET in order to evaluate coupling of land surface processes. The MS is well written and the topic fits well to the scope of this journal.

However, there are several issues regarding the methods and the interpretations of the

results (see specific comments). At this stage the results are not sufficient enough to support the interpretations and conclusions. The authors seem to have limited knowledge concerning soil hydrological processes and the CRP method and it would be advisable to add an expert of these topics to the authorship. Additional analysis of the data is needed to support the conclusions.

Chapter specific comments

1) Introduction

The introduction chapter is somewhat confused and includes several repetitions. It needs to be rewritten in a more concise and better structured way. In addition, more appropriate research questions or hypotheses need to be formulated and the structure of the paper should be presented.

There are many different terms related to processes of evaporation are used in the MS with different meanings, which is confusing for the reader. For instance, it should be stated clearly when the process of "total actual evapotranspiration" is meant, e.g. indicated with the acronym "ETa".

Instead of using the acronym "COSMOS", which is basically the US network of cosmic-ray neutron probes, the term "cosmic-ray neutron probe" or CRNP is more appropriate (see e.g. Bogena et al., 2015).

It is wrongly stated that the CRNP have footprint of 300-400 m radius and that the footprint of flux measurements by an EC-tower would be much smaller. In fact the footprint size of a CRNP typically smaller than 300 m radius (see Köhli et al., 2015) and the average footprint of an EC-tower is typically larger, integrating areas larger than 50 ha (e.g. Graf et al., 2014).

It is wrongly stated that a large number of point measurements are not feasible. However, recently established critical zone and terrestrial observatories provide exactly this kind of data (see e.g. Bogena et al., 2015; Qu et al., 2015)

2) Data and Methodology

The three models are only described very rudimentary. The basic equations and flowcharts of the algorithms should be presented to better demonstrate the differences in the methods. This information could be added as a chapter “supplementary materials”. In addition, the input data used for each method should be presented separately. For instance it would be very important to know which soil moisture data was used for the modelling.

It is unclear for which reasons the TDR measurements are used in this study.

3) Analysis and Discussion

Comparing the change in root zone soil moisture with changes in ETa on a daily time scale is not appropriate, given the large differences in temporal dynamics, i.e. soil moisture changes much slower and with time lags compared to ETa, which responses to short-term changes of the meteorological forces.

Arguing that CRP and EC measurements are “rather inferred than measured” is not appropriate. To argue that these measurements a less accurate than model results is a strong statement and needs quantitative proof. Please provide measures for the accuracy of both measurements as well as for the model results.

It is argued that the CRP shows higher variability compared to TDR because it integrates over greater penetration depth. This is wrong for several reasons. First, the integral measurement of soil moisture over a profile should be less dynamic than a point measurement near the surface (e.g. 10 cm). Second, the CRP shows more dynamics, because the measurement sensitivity decreases exponentially with depth. That means the variations of the first cm below the surface are most important. In addition, the CRP is also sensitive to water stored above the surface, e.g. intercepted by leaves and litter layer (see e.g. Bogena et al., 2013).

It needs to be checked if the data standardisation has an effect on the Q–Q plots. I

might be possible that the agreement is partially due to this procedure.

I suggest to add an ANOVA test using the non-standardized data including the p-value.

Why does the SEBS model produce more outliers?

The reasoning behind the selection of the subperiods is not well visible in the data presented in Figure 3. Why is the highly dynamic and thus interesting period between subperiods 1 and 2 not included?

I have difficulties with the statement the similar distribution as shown by the Q-Q-plots alone demonstrate that ETa is driven by rot zone soil moisture. The low correlation of the raw data is telling us a different story. Therefore, this statement needs to be substantiated with further analysis.

The statement that low temperatures have decoupled soil moisture and air humidity duing period during period 4 needs to be better explained.

It is argued that long periods with no rainfall lead to a disconnection of soil moisture and ETa due to non-monotonic variations in soil moisture. I cannot follow this reasoning. Please explain in greater detail.

A soil moisture profile does not become heterogeneous. Do you mean that soil moisture gradients increase?

The statement that ETa models should be validated using soil moisture data is absurd since soil moisture is an important variable of ETa models.

Literature

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