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Hydrology and Earth System Sciences Discussions

Interactive comment on "

Capillary rise quantification by field injection of artificial deuterium and laboratory soil characterization" *by* O. Grünberger et al.

Anonymous Referee #1

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The article presents a method of quantification of the capillary rise flow based on the peak displacement 35 days after local injection of deuterium enriched solution at a depth of 50 cm below the soil surface. Results are compared to quantification based on integration of hydraulic functions depending on hydraulic conductivity and tension head. Results are also compared to other published study. Actually, the question of such a new method for local quantification of rise flow from shallow aquifer in arid zone

area is within the scope of HESS. The aim is quite important with regard to the methodology and with regard to the aquifer budget in arid zones. In general, the text is clear and the language is fluent. However, in several different places, the text needs rewording. And also, in some places, assumptions are not clearly outlined or comments on published papers should be corrected. Precisions on these points are presented below. Moreover, some complement would be welcome. As steady state is assumed, characterization of the conditions would have been important on this point. The simulations presented on this (7768, 12) are interesting. An isotopic vertical profile, before the injection and after the sampling 35 days after would have been usefull to get an estimation of the evaporation by such method and to check the stability of the upward flux from the aquifer. Precisions on the rainfall are also not sufficient, as for example how far are the stations, what is the spatial gradient of rain, etc. Discussion is needed on porosity – kinematic one with respect to the volumetric water content. As a conclusion, the study and the results are quite interesting, and need some corrections and additions.

The title: it refers to elements of the work but does not account properly for the study. The “Capillary rise quantification” is not “by” field injection neither “by” laboratory soil characterization, it is based on the injection of deuterium-enriched solution and subsequent evaluation of the peak displacement. Abstract: the word “observed” is not correct, a rate cannot be observed, it is estimated on the base of peak displacement and of porosity measurements. “This value was higher, than other estimates based on natural diffusion with the same depth of aquifer” is not clearly outlined. A relationship between capillary rise and water depth established for arid area where steady state rise from the aquifer is established. This study gives a range: 28 z-1.8 à 205 z-1.6, hence the 3,7 cm y-1. For a water depth at 2.44 m, this range is 0.6 to 4.9 cm y-1 that is within the range. p. 7758, line 22 “high suction values in soil (lower that -800 cm)”; suggestion : “low suction values in soil (lower than . . .)” 7759, 6 “to other contexts” explain which other contexts, where pseudo steady-stage mentioned before is not valid ? 7759, 9 : Shimojima not in references 7759, 19 : precise that it was for steady state

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here, then the following sentence would begin by “This” instead of “The” and “assumed to be constant” can be removed. 7759, 23: Gardner and Fireman, not in references. And the sentence “Although . . .flux” does not refer clearly to previous studies: when steady state is established, vapor flux in the upper part equals the one below. 7759, 28: reference to Coudrain-Ribstein et al study is not correctly outlined. This study that application of Gardner method taking into account sufficient range of permeability and suction, up to to vapor conditions, leads to estimated rates ranging between two curves 28 z-1,8 and 205 z-1,6 ; that is between 0.6 and 4.9 cm y-1 for a water depth at 2.44 m below soil surface. 7760, 1: not clear, what is the limiting rate of phreatic evaporation after the reference cited. 7760, 10: As Garcia et al is mentioned as the solely study of artificial tracer used to quantify field capillary rise, more information on this studies would be welcome as a comparison of present one on the method and on the results. 7760, 23: precision on “some distance” is needed, and on local space gradient of rainfall amount 7760, 25: where were measures 86 mm of rain amount and for which period ? 7761, 1: Stour and Agoumi 2008 in text, 2009 in references 7761, 3: “nearest station”, precision on the distance is needed 7761, 7: need of table with depth and data range of relative humidity monitored during sampling day 7761, 17: precise that all the fifty injections were performed at a depth of 50 cm and precise how long it took. 7761, 21: “with water” precise nature of this water, the one of the aquifer ? same salinity ? 7762, 1: precise the number of samples collected (16 after fig. 3?), is “above” correct as fig 3 sho results below ? Precision on how were collected the samples would be appreciated. The sentence “A steel . . . coating” is not clear. 7762, 19: Van Genutchen not in references 7762, 23: “Real saturated water contents were kept unchanged” : not clear 7763, 20: “When the soil saturation depth is known, the knowledge of another potential head at a different depth may lead to another estimate of evaporation.” Is not clear. In fact, E is assumed constant along the vertical profile. Hence, when values of K are known with respect to psi, the integration is made between two values. In the present study, the integration has been carried on between three couples of boundaries. In two cases, one boundary is the one of the saturation depth . . . 7763, 15:

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31% need to be in a table with other measured values 7765, 21: “observed”: saturated hydraulic conductivity my not be observed, measurements lead to estimated values of Ks 7766, 5: range of fluxes in text is 0.59 to 3.46 when in table the range appears as from 0.58 to 3.74 (correct?). Precision on the “geometric means” is needed and from last line of table 1, values of average range from 0.47 to 1.71. 7766, 25: “the values computed from the laboratory measurements were 1.6 to 9.84 higher” is not clear, as far as the reviewer understand the values are those estimated by integration of equation 5 using lab measurements of hydraulic soil characteristics. 7768, 20: Precision on why the evaporation front is assumed above 40 cm is needed. 7769, 5: sentence with “vapor flow processes may mitigate the evaporation flux” should be reworded, at steady state flux above and below the evaporation front have same value when permanent conditions are achieved. 7769, 26: sentence corresponding to point (i) is not clear ; 7769, 28: “density” or “porosity” ? 7770, 6: use the range proposed in Coudrain et al and then the value 3.7 cm y-1 fit into the range. 7774, Table 1: this important table should be separated into two tables; one should present results of experiments in laboratory that were performed to estimate the hydraulic soil characteristics. Another table would present the results of computation of E and be more precise on the condition of the integration of equation 5, using the i; ii; iii of the three couples of boundaries described in 7764. 7775, fig 1: precisions on the dimensions of samples in right part 7776 Fig 2: need precision on the empty circles

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