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Interactive comment on "Impact of capillary rise and recirculation on crop yields" *by* Joop Kroes et al.

Anonymous Referee #1

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Comments on "Impact of capillary rise and recirculation on crop yields" by Joop Kroes, Iwan Supit, Jos van Dam, Paul van Walsum, and Martin Mulder. Wageningen University and Research, Environmental Research (Alterra) (JK; IS; PvW; MM); Wageningen University and Research – Chair Water Systems and Global Change (IS); and Wageningen University and Research – Chair Soil Physics and Land Management (JvD). Hydrology and Earth System Sciences Manuscript No. hess-2017-223. Review done April 23-24, 2017.

I am not a modeler, so I can comment on this paper only in a general way.

The authors acknowledge three anonymous reviewers of an earlier version of this manuscript. Because apparently the authors have revised the paper according to their comments, the paper should be in good shape. In addition, one of the authors (J. van

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Dam) is a well-known soil physicist and has published in the literature since at least 1992.

General comments:

In the Introduction, the authors say, "...however, we found only a few studies...to quantify capillary rise...using physically based approaches" (see l. 91-94). In the Conclusions, they say that their "quantification of upward flow on yield is a novelty" (see l. 473). They also say, "Another aspect which cannot be found in the referenced studies is the lack of a quantification of the impact of capillary rise and recirculation on crop yields" (see l. 477-479). The authors are ignoring the work of the early Dutch physical scientist, Symen Barend Hooghoudt. He was famous for developing the theory for the flow of water to ditches and drains in the shallow soils of the Netherlands. See the following biography of him:

Raats, P.A.C., and R.R. van der Ploeg. 2005. Hooghoudt, Syman Barend, p. 188-195. In: D. Hillel (Editor). Encyclopedia of Soils in the Environment. Vol. 2. Elsevier, Amsterdam.

Hooghoudt modified the ellipse equation for equally spaced drainage ditches overlying an impervious layer. He wrote mainly in Dutch. In one publication that I have, he quantifies capillary rise. See:

Hooghoudt, S.B. 1937. Bijdragen Tot de Kennis van Eenige Natuurkundige Grootheden van den Gond. 6. Bepaling van de Doorlatendheid in Gronden van de Tweede Soort; Theorie en Toepassingen van de Kwantitatieve Strooming van het Water in Ondiep Gelegen Grondlagen, Vooral in Verband met Ontwaterings- en Infiltratievraagstukken. Departement van Economische Zaken Directie van den Landbouw. Verslagen van Landbouwkundige Onderzoekingen No. 43 (13) B, p. 461-676. Bodemkundig Instituut te Groningen. Rijksuitgeverij Dienst van de Nederlandsche Staatscourant. 'S-Gravenhage, Algemeene Landsdrukkerij.

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He has a paper in English in which he talks about capillary rise, ground-water level, and crop yield. See:

Hooghoudt, S.B. 1952. Tile drainage and subirrigation. Soil Science 74:35-48.

In this paper, see his Figure 4, where he plots the yield of potatoes versus ground-water level. He considers both arable land and grassland, and he points out that grassland requires less drainage than arable land.

I think the authors should recognize that quantitative work was done on capillary rise and crop yields by Hooghoudt, which was long before computer models were used.

I do not understand Figure 2b. The authors show no impervious layer at the bottom of the figure. So how can water move upward by "recirculation"? Without an impervious layer, it seems to me that Figure 2b should be the same as Figure 2a.

Specific comments:

l. 42 and l. 623: This should be "SSSA," not "SSA." The name of the society is the Soil Science Society of America (SSSA).

l. 52-54: Can the authors give the common names of these soils? Are they sandy soils? Clayey soils?

l. 57, 69, 72, and 125: Give the scientific name of the plant along with the common name (maize, quinoa, soybean, and potatoes).

l. 96: What does "groundwater yield subsidy ss" mean? What does the "ss" stand for? What are the units for "groundwater yield subsidy"?

l. 101: "the difference in soil water potential"âĂŤdifference between what? The authors need to be specific in their definitions.

l. 106: This should be "Richards' equation," not "Richard's equation." The name of the person is L.A. Richards. The authors have written this term in three different ways: as

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here (l. 106); as “Richards’ equation” (l. 143); and as “Richards equation” (l. 254). It is usually written as “Richards equation.” The editions of Soil Physics write it as Richards equation. For example, see:

Jury, W.A., W.R. Gardner, and W.H. Gardner. 1991. Soil Physics. Fifth edition. Wiley, New York. 328 pp.

l. 109: SWAP should be defined the first time it is used (here). It is not defined until l. 160 (soil-water-atmosphere-plant).

l. 109 and 138: What does WOFOST stand for? Please write it out.

l. 153: It should be “van Genuchten” (no capital letter on the “v” in “van”).

l. 179: Put the “2” in CO2 as a subscript.

l. 190: Change “is grown” to “are grown” (“. . .grassland, maize and potatoes are grown. . .”).

l. 195-196: Define DM.

l. 214: What “3 cases”? I do not see where these three cases have been defined in the text so far. The authors refer to “7 case studies” on l. 189.

l. 246: I do not understand what “units 2245, 3859, and 621” mean. Please define these numbers.

l. 259: I do not see where the term “artificial restriction” has been used previously in the text. Can the authors point out where it has been used?

l. 275: I assume that here DM stands for “dry matter.” Is this what DM stands for on l. 195-196?

l. 296, 305, and 306: What do C, D, B, R, and V stand for?

l. 336 (here FDrc) and elsewhere in the text: At the beginning of the paper, I suggest that the authors have a list of abbreviations with units for each parameter, so the reader

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knows what the abbreviations stand for.

l. 345: Delete the capital letters on “potatoes” and “maize.”

l. 349-350: The authors here for the first time in the text capitalize “The” on “The Netherlands.” Previously, they have written it “the Netherlands” (e.g., see l. 75). Be consistent in writing the name of the country.

l. 372: As noted above, the authors need a list of abbreviations. I had forgotten what “Ave” stands for and had to search back in the text to find its meaning (see l. 332âĂŤ“average groundwater conditions”).

l. 383: “differences”âĂŤwhat differences? Difference between what and what?

l. 393, 394: Delete “clearly.” Do not editorialize. This may not be clear to some readers.

l. 421-422: “Low upward flow values were found for loamy soils. . .” This appears to contradict what the authors say in l. 84-86, as follows: “Rijtema (1971) estimated that loamy soils have an almost 2 times higher capillary rise than sandy soils.” Can the authors please clarify these seemingly contradictory statements?

l. 430: Soil type is important in determining capillary rise. See Figure 46 in Tolman’s book, where he shows rate and extent of capillary rise in five different soils (sand, clay, clay loam, fine sandy loam, and sandy loam). The reference is:

Tolman, C.F. 1937. Ground Water. McGraw-Hill Book Co., Inc., New York. 593. See Fig. 46 on p. 157.

Tolman has another figure on p. 157 (Fig. 47) showing that the height of capillary fringe is higher in a subsiding (falling) water table than in a rising water table. This is because super-capillary sized pores are filled in a falling water table, but they are empty in a rising water table. The authors have not considered the difference in amount of water in the capillary fringe in a rising or falling water table (hysteresis). The authors say this on l. 446.

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l. 452: Change “then” to “than” (“. . .higher yield variation than situations. . .”).

l. 460: “The largest difference”âĂŤof what? Some people read only the “Conclusions” of a paper, so everything should be defined in the concluding section.

l. 494, References: Make sure the references are in a common format. For example, sometimes the authors put the year in parentheses and sometimes they do not (e.g., compare l. 515 and l. 518).

Tables: Each table and figure should be self-explanatory, so all abbreviations should be defined.

In Table 1, define DM, C, D, B, R, and V. In Tables 5 and 6, define FDnc, FDrc, and Ave.

Figures 4, 5, 6, and 7: The orientation of the numbers on the y-axis is incorrect. The numbers need to be rotated 90o to the left. The numbers need to face the reader straight on.

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