

Interactive comment on “A Unique Vadose Zone Model for Shallow Aquifers: the Hetao Irrigation District, China” by Zhongyi Liu et al.

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This manuscript reports on field studies and model development for shallow water table dynamics following irrigation in the Yellow River basin. The results of this work will benefit water use efficiency as in this area in Inner Mongolia water use in upstream areas diminishes water available in downstream areas. The shallow-water vadose model is very straight forward, and the calibration-validation approach shows really good fits with observed data.

Major points: 1. Why does the introduction refer to Darcy type models while this manuscript does not include Darcy's law? Please clarify in the manuscript.

2. The importance of the shallow water table effects on soil moisture content is im-

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portant, as this manuscript shows. Authors should refer to Brooks et al. (2007) who showed the importance of the drainable porosity to establish water table heights, and presented a similar calculation. The manuscript can emphasize more clearly the truncation of the soil moisture characteristic curve when water tables become less than 3.3m below the soil surface as part of the equilibrium moisture content calculation. (Brooks, E.S., J. Boll, and P.A. McDaniel. 2007. Distributed and integrated response of a GIS-based distributed hydrologic model. Hydrologic Processes 21:110-122.)

3. What is the reason that the fit of soil moisture is so close and the water table depths are not? Is it entirely due to soil variability or something that the model does not represent physically? Please clarify in the manuscript.

4. The manuscript includes 'additional irrigation' from an adjacent field. I assume this means water moved laterally to the study fields. This begs the question if the reverse did not also occur when the study fields were irrigated and water moved laterally to adjacent fields (some type of 'mounting' in the experimental fields). Three out of the four fields show layers with increased hydraulic conductivity, which can be responsible for such lateral movement. Please clarify.

Editorial comments: Choose 'ground water' or 'groundwater' throughout the manuscript. Line 39: change 'physical' to 'physically' (also elsewhere) Line 51-54: break up this long sentence. Line 68: change 'is' to 'will be' Line 72-73: the positive and negative effects are not clearly defined. In addition, the sentence needs rewording to: "A combination of field experiments and physically-based modeling has the benefits of both approaches with few negative effects. " Line 74-77: this is a single sentence paragraph without any relevant information. Line 78: suggest to change 'grouped' with 'divided' Line 79: it is not clear what is meant here with the 'full Darcy's law'. I would expect it to be the full Richards equation. – Delete 'the' Line 90: are you sure SWAT uses a regionalized Darcy's law model? Line 91: delete 'water' Line 95: why is this cutoff 3.3m? If this is related to field capacity water tension, please mention it here. Line 113: change to 'soil moisture characteristic curve' Line 125: delete 'main'

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Line 127: check on the unit a-1 (not superscripted) as a valid metric unit for 'year' as you do later. Line 129: what is the reason to mention the number of daylight hours per year? Line 135-136: Change to 'The sowing dates were', respectively. Line 134: for clarity, call the fields in 2017 B1 and B2? Line 140: change 'on' to 'at' Line 142: change 'were showed' to 'are shown'; I think you mean to say 'during the growing season' because you are not identifying any growth stages explicitly in the figures. Line 143: change 'experiment' to 'experimental' Line 159: change 'crop growth period' to 'the growing season' Line 161: reword to 'soil moisture at field capacity () and at saturation (), ' Line 163: change 'measured' to 'determined' twice in this sentence. Line 166: please add texture classification to Line 168: change Table heading to 'Soil physical properties' – If fields C and D are the same as field B, what might explain the difference in soil properties shown? I suggest you add standard deviations for the average values provided. Line 180: change heading to 'Soil texture of Fields A and B' Line 188: change to 'in hydrological and soil sciences' Line 192: add comma after 'effective saturation'; note that only S and phi variables are used in this equation, so theta variables do not need to be defined. Line 196: reword (is it reasonable here to assume $\theta_d = 0$? Figure 6 does not support this assumption. Line 201: check wording here Line 204: delete the second 'the' Line 203-206: the paragraph needs better wording; should the vadose zone stay at equilibrium moisture content instead of the groundwater? Line 209: change to 'dependent on' Figure 3: does this Figure assume a capillary fringe (bubbling pressure) of $\sim 40\text{cm}$? Maybe make note of this in the Figure caption Line 224: delete 'drained' Line 254: should the first 'and' be deleted, or is a word missing? Add 'flux' after second 'upward' Line 255: check spelling in 'prede[te]rmined' Figure 5: what explains the earlier predicted changes in groundwater depths compared to observed in 2017C and D? Line 321: the term 'additional irrigation' is not explained well here (but better in Lines 328-332). Does it mean that irrigation was applied to an adjacent field causing lateral inflow? If this is a possible effect, is there a similar lateral outflow flux possible to surrounding fields? Line 334: change 'while' to 'whereas' Line 338: switch the order of Figures 4 and 5, so they match the order of describing ground-

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water and soil moisture results. Line 345: change 'at' to 'during' Line 352: Can you include the value of the bubbling pressure? Line 377: change 'indicates' to 'indicate' Line 392: add 'the' in 'to the maturing stage' Line 393: move parenthesis for the citation to just around the year (and remove the comma) Line 399: change to '... in general are in agreement ...' Line 400: change 'one' to '1' Line 403: change to 'realistically' Line 408: change 'less good' to 'worse' Line 409: change to 'coefficient of determination' Line 416: change to 'depths' Line 421: no need to write out RME; change 'is' to 'being' Line 422: no need to write out RMSE Line 428: insert 'to' as in 'related to groundwater depth' Line 454: add period after 'al' Line 459: change to 'indicate' Line 466: change to 'relatively'

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