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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Interplay of changing irrigation technologies and water reuse: Example from the Upper Snake River Basin, Idaho, USA" *by* Shan Zuidema et al.

Anonymous Referee #2

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The paper explores the impacts of conjunctive introduction of irrigation modernization and managed aquifer recharge in a semi-arid setting, by analyzing different scenarios with a physically-based simulation model. With its conceptual approach and presentation, the paper succeeds in providing new insights in the functioning and management of such a complex system, which makes it highly relevant to the scientific community. The paper is very well written and structured and certainly fits the scope of HESS. My opinion is that it should be accepted after minor review.

Specific comments:

The paper acknowledges that CIE changes can lead to increased consumption at the

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basin scale. This phenomenon mainly occurs when no physical or legal limitations are in place for irrigators to expand their operations (e.g. by increasing surface area or switching to more water-intensive crop types) with the "saved" water. The simulations described in lines 21-25 on page 3 seem to disregard this effect, which is in practice so often observed. It may be outside the scope of the paper to implement this behavioral aspect in the simulations, but it is important to include at least in the discussion. Are the farmers in the USRB in some way incentivized to reduce their withdrawals as CIE increases? If not, it should be acknowledged that this makes the simulations more theoretical than realistic. If yes, this is still relevant for more elaborate discussion, as results are presented in a generalized context of semi-arid basins, which for the large majority do not have such restrictions effectively in place.

Section 3.1 acknowledges model validation issues and discusses implications for the findings of the study. It is quite positive that this is so transparently discussed and helps to put the results into perspective. In particular, snowmelt processes and underestimated irrigation demand issues are discussed here. There are two other striking observations in the model validation demonstrated in the supplementary material, namely the negative NSE in reservoir storage and the lack of representation of seasonal dynamics (at least, in the springs time series). Supposedly, these would affect water availability for irrigation and partitioning in the surface vs. ground water use (or not?). To me it would seem that implications of these two model quality issues can be discussed more explicitly.

The distribution uniformity parameter assumed for different irrigation types seems to have a large impact on the effectiveness of EAR to stabilize the aquifer, as described on page 13 (lines 1-2). This relates to a key result from the study. It would be of added value to provide more information on the way these values were determined (in the Jaegermeyr study), what are uncertainties associated with them, and how these would affect the outcomes of the paper.

Page 15 introduces the Effective Irrigation Efficiency (EIE). It would be good to define

EIE somewhere in the paper using the terms of B, L, etc., to allow for better understanding of the discussion in Section 4.2 which relates EIE to CIE. To my understanding, the key distinguishing feature of EIE is that it includes water quality in its definition, which is not explicitly modeled in this study.

Technical corrections:

Page 4, Line 26: “ provide irrigate”

Figure 1b: the representation of the black shape in the west of the catchment (a line of X’s?) can be improved.

Page 12, Line 17: needs rephrasing

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