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Interactive comment on "Socio-hydrology from the bottom up: A template for agent-based modeling in irrigation systems" *by* Dimitrios Bouziotas and Maurits Ertsen

Anonymous Referee #1

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I read this paper with a lot of interest due to the catchy title. However, I came away somewhat disappointed in that it did not deliver on its promise of "socio-hydrology from the bottom-up".

I am not an expert in agent-based modeling, although it is becoming more common in hydrology and water resources applications. This paper is not the first application of its kind. I have seen several in the literature, some even in a socio-hydrologic context. On that point, as an aside, the authors should include at least a brief literature review of ABM applications in this field for completeness.

However, I reserve most of my comments for the topic of the title: socio-hydrology from the bottom-up. I do agree with the authors that the bottom-up approach that includes

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ABM has potential to make a contribution to socio-hydrology.

However, I am not clear what this paper contributes to socio-hydrology in a fundamental way. Of course, the paper presents the mechanics of constructing an ABM, and the necessary details of the application to a particular place for a particular problem (irrigation). But what is the purpose of the ABM, what was found, or what was discovered from the modeling. What were the authors hoping to achieve?

I know ABMs have the capability to do up-scaling, i.e., the aggregate behavior of a population of interacting agents. In typical scaling, if everything works well, then ABM must reveal some kind of emergent behavior. The emergent behavior would be a community response, so some aspects of individual agent behavior are lost or left behind, and some macro-scale feature emerges through. I was looking for expressions of such emergent behavior: if they were there they were not brought out well in the presentation. Also for it to make a contribution to socio-hydrology, one needs to highlight the "socio" of the socio-hydrology of the system. This too was not brought out well. The outcomes of the modeling was somewhat underwhelming.

So, at a minimum I expect the paper presentation to be revised to make the goals of the study clearer, and to articulate more clearly and concretely what was learned or discovered through the modeling. Of course, I expect the outcomes to be place-based, and so there needs to be a discussion on what aspects of the place get reflected in the collective community behavior, and in what way they show up in the outcomes. I guess one can elucidate this through doing sensitivity analyses: I admit I am not an expert on the mechanics and will leave it to the authors about how to do it.

Having said that, I want to also raise a philosophical point in respect of the bottom-up and top-down approaches to socio-hydrologic modeling. The authors critique the lumped, top-down approaches more prevalent in the literature. I do agree these models face major challenges, the most difficult of which is about how to simulate collective human-social behavior at the scale of a river basin in the absence of appropriate ob-

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servations.

Presently the functional forms of these behaviors are arbitrarily assumed, and then validated through calibration of their parameters using observations gross behavior. What social factors (wealth, political systems, institutions, norms and values) impact the behaviors are not well understood.

Surely, Agent Based Models can potentially help – however, this paper only pays lip service to this topic. If the authors want to make serious claims about the potential of ABMs to be turned into socio-hydrology models, then a lot more must be done – the social factors must be highlighted, and the ABM simulations must be designed very carefully to look for emergent dynamics that can be tracked as a function of broad-scale social factors – such as changing norms and values. The ABM framework presented in the paper does not even begin this process. The authors must think deeply about this, and improve the presentation if they want to sustain their claims in this context.

Overall I am very supportive of publication of the paper in HESS, eventually, but the presentation must be substantially improved, and some of the claims about contribution to socio-hydrology tempered.

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