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Hydrology and Earth System Sciences
Discussions
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Interactive comment on "Develop a coupled agent-based modeling approach for uncertain water management decisions" *by* Jin-Young Hyun et al.

Anonymous Referee #1

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This study aims to demonstrate that a hybrid modeling approach, coupling agent-based, Bayesian, cost-loss, and reservoir management models, yields a more representative simulation of stream flow and changes in irrigated area of the San Juan River Basin. To achieve this, the authors model the interaction between farmer agents and a river routing and reservoir management model. Individual behaviors of farmers are developed using the Theory of Planned Behavior, accomplished by applying Bayesian and cost-loss modeling approaches. In modeling coupled natural-human systems, developing hybrid models to utilize the advantages of each is an interesting approach. However, in its current state, I believe the manuscript needs substantial revision before I can recommend it for publication.

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My greatest objection to the manuscript is that it needs to be better focused. The Introduction wanders in both scope and topic. Additionally, the research objectives are not clearly defined. The study area has clearly defined conflicts for water supply; however, these are not brought up until the Discussion section. Defining the importance of this study earlier in the manuscript is important to justify the research. The Results section contains a significant amount of interpretation that needs to be moved to the Discussion section. Finally, the Conclusion section doesn't address the greater impacts of the study.

Another concern is that although the authors have a substantial amount of time-series data, they make no attempt to reserve some of their data in order to validate their model. I would like to see an attempt or justification as to why no validation was conducted.

More detail on specific sections below:

Introduction: The Introduction section is too long and needs to be condensed. In its current form, the Introduction does not funnel from general to specific information relevant to the study and instead gets bogged down by the history of each modeling approach. Perhaps reframe in the following way: water policy challenges in a CNHS (including uncertainty) -> ABM -> TPB, the quickly explain how BI and CL will address the three components of TPB.

The last paragraph of the Introduction should clearly lay out all of the objectives of the paper. For example: It is the purpose of the study to demonstrate the utility of TPB in modeling human decision-making by 1) evaluating the impacts of uncertain risk perception on agent behavior, 2) comparing model results with conventional agent behavior rules, etc. . ..

Structure the Results section in the same order for ease of comprehension.

Methodology: The description of the Bayesian Inference Mapping section suffers from

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excessive detail in regards to the manipulation of the Bayesian equations. Some of this should be moved into the Supplemental Materials.

In the agents' decision-making methodology, the authors are calculating the farmer's beliefs for each direct link in the cognitive map, but only choosing one link (resulting from the most extreme variable) to insert into the cost-loss model. Since the authors are not examining the joint probability of making a decision from all preceding factors, it is disingenuous to describe the methodology with the Bayesian network presented. Instead the authors should be explicit in their methodology that they are examining each preceding factor independently. This can be accomplished by describing the model's decision-making process at the beginning of Section 2.2 with the aid of Figure 1. The authors should note in their discussion that by only limiting decision-making to one preceding factor, the agents cannot respond to the cumulative effects of their environmental conditions.

In the calculation of "extremity" of environmental factors, the authors use the distance of the current value from half of the max value. If the mean of a variable is greater than that, most the of extremities will be artificial inflated. Using outliers within a variables' natural distribution of values will yield a more accurate characterization of extremities.

The authors need to be more explicit in describing the decision model of individual agents. How did the authors determine which factors were important in the agent's decision to increase/decrease irrigation area?

Case Study: This section (3.1) should be moved to the beginning of the methodology. Precipitation, NIIP Diversion, and Flow Violation are the main factors in your decision network; however, you do not describe their characteristics (mean, standard deviation) in your study area.

Section 3.2 and 3.3 should be relabeled to define it as the setup conditions of the coupled model.

Results: The methodology of the comparative study is introduced in the third paragraph of this section. It should be moved to the methodology section, described sufficiently, and stated as an objective of the paper, or removed entirely.

This section should be strictly limited to presenting the results of the model; however, the authors spend a significant amount of time interpreting the meaning of the results. These interpretations should be moved to the Discussion section.

Discussion: The authors introduce significant new information in the discussion section, particularly in regards to San Juan Basin water policy, that would be better served in the case study section. The conflict introduced here will help bring a sense of urgency to the research if presented earlier.

Conclusions: Since the authors used TPB to frame the human decision-making model, the authors should revisit TPB in regards to the successfulness of the approach.

Figures 5: The authors should explore whether presenting the data as a scatterplot will increase comprehension of model performance.

Specific Comments: The title is phrased awkwardly and not does give readers enough information on the content of the manuscript.

Table 1: Group 3b should be WITH shortage sharing

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