Response to Anonymous Referee #2

Han and colleagues address the important challenge of agricultural water management in a region prone to water stress. They develop a spatially explicit model of the Treasure Valley area in Idaho, U.S. that couples biophysical processes and water rights. Specifically, this model aims to diagnose the times and places where water supplies are insufficient to meet agricultural demands by incorporating the quantity and seniority of water rights from the Boise River. Irrigation water significantly alters the water balance and its application is determined not just by hydrological availability but the laws governing water rights. The integration of water rights in a spatially explicit model has the potential to lead to new insights on the challenges of water management and the opportunities for improvement. The manuscript is well written and the topic is of interest to Hydrology and Earth Systems Science readers. However, I do have a series of minor comments that would strengthen the paper. I recommend publication after minor revisions.

Response: We appreciate the reviewer's summarization of our research, and the encouragement on publication. We are addressing the reviewer's comments below in details, and will have all of them included in our revision.

1) The terms defined starting on line 315 would be clearer in a numbered or bulleted list.

Response: We use numbered list in the revision.

2) On line 339 'simulates' should read 'simulating.'

Response: We will change the word in the revision.

3) The Nash-Sutcliffe Efficiency Coefficient is referred to as both the 'Nash-Sutcliffe Coefficient' (line 352) and the 'Nash-Sutcliffe Efficiency' (line 366) and abbreviated as both 'NS' (line 399) and 'E' (line 366). Please revise for consistency.

Response: Thank you for catching the inconsistencies. We will consistently use 'Nash-Sutcliffe Coefficient' and abbreviate it as 'NS' in the revision.

4) In Figure 4, label the two panels a and b or similar for clarity

Response: Thank you for the suggestion. We will label the panels as suggested.

5) In the model, the reservoir operations pass through natural flows within target range. However, fall flows at the Parma Station are consistently under predicted. Please discuss the potential causes of this discrepancy.

Response: We appreciate the reviewer bringing up the point. We realized this issue and discussed about it in lines 386 – 393 and lines 527 - 537. The major reasons are: 1) The model groundwater supply is assumed to be unlimited for the current situation. This reflects the truth of the current situation and simplifies the model, but will lead to unbalance of water budget; 2) The water pumped out of the watershed has not been considered in the current study. This is a relatively small portion of water use, but will specifically affect the discharge at Parma River station. The water management has to deal with the conflicts between political boundaries and watershed boundaries, and that is one of the directions for further work.

6) Figure 5 is hard to read in black and white. Making this figure consistent with Figure 4 would resolve the issue.

Response: We apologize for placing the wrong caption for the figure, and will correct it in the revision. We will also change the line style to make it more readable in black and white.

7) Figures 7 and 8 offer a useful visual to compare the spatial allocation of water based on water rights and the modeled spatial allocation of water. However, the different units (feet vs. mm) make this comparison misleading. Please revise using consistent units, color scheme, and scale.

Response: Thank you for the suggestion. We will consistently use the SI units in the revision.

8) In Figures 8 and 11 the domain is circled not outlined as noted in the caption. Please revise for clarity.

Response: We have had the domain circled in the figure. The confusion may be due to the black and white printing, but we will definitely double check to make sure it is clear in the revision.

9) On line 455 note the average surface and groundwater usage in the model and Figure 10 shows the average unsatisfied surface water per month. Is there any available data to compare these results to? Are summer water shortages reported by local farmers?

Response: Unfortunately, there are no quantified numbers to compare to. The summer shortages have been reported by local farmers through our stakeholder conversations, and that is a big concern for local farmers right now. But so far, we do not have quantified data for that.

10) How does Figure 9 support the claim that allocated water is a complex nonlinear issue (line 553)?

Response: We will reword the sentence to make it clear. We meant to remind readers that the water allocation and water scarcity in a certain year is not linearly related to the current year precipitation amount. Figure 9 can demonstrate that water allocation is high in the dry year 2007 as irrigation water can be received from the snow fall from the previous year.

11) On line 566 ‘corporation’ should read ‘cooperation.’

Response: Thank you. We will change it.

12) This model assumes all farmers make irrigation decisions rationally based on water availability. However, the heterogeneity of decision making may have important implications here (see Noel and Cai 2017). I understand that an analysis of this is out of the scope of the current work, but speaking to the implications of rational decision making as a simplifying assumption would augment the discussion section.

Response: Thank you. We will add discussions on the complexity of decision making.