Interactive comment on “Coupling biophysical processes and water rights to simulate spatially distributed water use in an intensively managed hydrologic system” by Bangshuai Han et al.

Anonymous Referee #1

Water resources management is a comprehensive issue which integrates hydrology cycle and water use. Water scarcity is a pressing problem in the western U.S., and the management is fairly complex. A solid and easy-to-use modeling tool that incorporates water rights information within a hydrological model will definitely help with water management decision making. However, due to the complexity of simulating the water allocation based on prior appropriation water right doctrine, hydrologic modeling research often does not explicitly include water rights. The few examples include the Water Rights Analysis Package (WRAP) and VIC-Cropsys. The current study presented valuable attempts to simulate the water allocation based on water rights. The study is unique than others in that it not only considers evapotranspiration and soil moisture in agricultural land, but also considers the water availability simulated in the streams and maximum allowed water quote/seniority based on the water right regulations. As such, it is truly an integration of social and biophysical processes in a modeling framework, considering hydrology, agriculture, and irrigation based on water law. The authors tested their model in the Treasure Valley, Idaho, which is a typical western semi-arid region, and the model is proved to capture the spatial allocation and timing of irrigation water use quite well. The calibration and validation processes seem a bit simple considering the model parameters involved and the complexity of the model. It is, thought, solid. The model is potentially a great tool that is applicable to many places in the western U.S. facing similar water resources challenges and following Prior Appropriation Doctrine. The approach also has the potential to be extended to simulate other water uses (industrial, domestic, municipal, commercial water use etc.) as long as the same prior appropriation doctrine is used. The manuscript is well organized and easy to follow, and the topic is of interest to HESS readers. I would recommend publication of the work with minor revisions.

Response: We are very glad that the reviewer agrees with our contribution. We appreciate the reviewer nicely summarized the key aspects of our study and pointed out their importance. Below, we respond to the minor concerns from the reviewer in details.

The minor concerns are as follows.

1. The authors calibrated 9 parameters and left 5 parameters as constant. It should be justified how the 5 constant parameters are selected? Based on sensitivity analysis or literature?

   Response: The selection of parameters for calibration is based on a combination of literature review and data availability. The reasons can be summarized as follows:

   (1) HBV is not a new model itself, and has a rich literature to guide on parameter selection. It has been widely tested that LP, CFR and CWH are not sensitive to model performance [Seibert, 1997]. We will include more references in the revision.

   (2) FC and WP values are readily available data for the region. The watershed is quite small and has relatively uniform soil characteristics in agricultural regions, which can be reflected from the NRCS data sources. We will include the citation link of the values in the revision.

2. Figure 5 caption does not match with the content of the figure.

Response: Thank you for the sharp catch. We revised the figure to remove cumulative values which made the daily comparison less clear. We will definitely change the title back in the revision.

3. Table 1 should list the temporal and/or spatial resolution of the data used in the study.

   Response: Thank you for the suggestion. We will include temporal and/or spatial resolution for all the datasets that are applicable.

4. For hydrologic modeling, the longer period of records is always better. However, to model water use, dry years play much bigger role as it is the time competing users need harvest water from hydrologic system simultaneously. The model is calibrated (verified) using 2006 to 2013. Please add short description of the period of records. It is dry or wet when much longer periods are consider? From the figures, one can only see that high flow vary significantly but low flow seems stable over the period.

   Response: Thank you for the suggestion. This is a very critical point. The reviewer is definitely correct that longer calibration and validation period will be better.

   The water use in the Treasure Valley is quite unique in that the water released from the upstream reservoir controls the water amount for downstream users as shown in the hydrograph. From the hydrograph, one can easily see a similar water use pattern every year starting from late spring. The reason is that the upstream reservoir is used for both flood control and irrigation, and has limited storage. If the snow accumulation is high, in early spring, water needs to be released to make sure that downstream city is safe, which reflects the high discharge in the "wet" years. From 2006 to 2013, we have typical wet years (2006, 2008, 2011, 2012) and dry years (2007 and 2013) included, and the relatively shorter periods saves a lot of computational time. So, we used the periods of 2006 ~ 2013 for calibration and validation purposes.

   We will add some sentence describing the reasons for the selection of the period of records.

5. From water resources management perspective, decision making often prefers conservative estimates. If a model is meant to be used to manage water during drought, underestimation of water availability is often preferred than overestimation. I am glad that the authors acknowledged that the limitation of overestimation and provided insights on possible reasons.

   Response: Thank you for the comment.