Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2020-388-AC2, 2020
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Hydrology and Earth System Sciences
Open Access
Discussions

Interactive comment on "Socio-Hydrologic Modeling of the Dynamics of Cooperation in the Transboundary Lancang-Mekong River" *by* You Lu et al.

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Received and published: 23 November 2020

Reviewer #2:

Reviewer comment: This paper presents a socio-hydrological model to analyze different levels of cooperation in the Mekong River basin. From two extremes scenarios – cooperative versus unilateral management – the negotiation space is determined and cooperation demands assessed. The topic is relevant to both scientists and policy makers working on the management of transboundary water resources. The paper is well organized and easy to follow.

Author response: Thank the Referee #2 for the confirmation of rationality of our research. Also, we believe that all the comments will help to improve the manuscript substantially. We will address them in a point-by-point manner below.

Reviewer comment: In its present form, the paper is not ready for publication for the following reasons: (1) The literature review on the modeling and analysis of transboundary river basins is incomplete. I miss a description of the work done with multi-agent simulation models (MAS) or with decentralized hydro-economic models, see e.g. Teasley, 2011 JWRPM; Giuliani, 2013 WRR; Jeuland et al., 2014. Explaining the differences between the proposed socio-hydrological model and those alternatives would enhance the scope of the manuscript. Right now, the novelty of the proposed modeling approach is not clearly established.

Author response: Thank you for the comment. For literature review, several extant hydro-economic models were reviewed in lines 105-109 in the introduction part, and the reviewer's comment reminds us to realize that the literature review on multi-agent simulation models is still insufficient. We would like to review more literature on the modeling and analysis of transboundary river basins, particularly the multi-agent simulation models applied in transboundary rivers. For the novelty, our model has distinctions from the extant models. The extant hydro-economic models regard the cooperation as static and external variable. Whether cooperate or not, or the extent of cooperation, is set as boundary conditions of these models. However, as mentioned in the manuscript, transboundary river cooperation is evolutionary driven by hydrological, economic and political factors. To the best of our knowledge, this model developed in this work is the first one to include the evolutionary transboundary river cooperation as an internal variable, and couple the driven processes including hydrological variability, dam construction, political benefits, etc. To attain the goal, we also proposed the novel quantification of cooperation level and political benefits. This novelty enables the model to analyze the mid- and long-term cooperation dynamics in transboundary rivers, which cannot be achieved by previous models. We will supplement more explanations focusing on the novelty in the revised manuscript, and clarify the differences between this model and the extant ones.

Reviewer comment: (2) The authors should focus on the Lexis-Nexis sentiment analysis and how it can be used to construct scenarios or to "calibrate" a model of a coupled human-natural system. In my opinion, this is where the novelty lies. Shifting the focus on the Lexis-Nexis sentiment analysis however requires major rewriting that may be beyond a simple revision but I am convinced that it would definitely appeal to a broader audience. In that case, the rather coarse socio-hydrological model (see below) would then be used to support the Lexis-Nexis sentiment analysis.

Author response: We thank this comment. Indeed, the sentiment analysis to validate the simulation of cooperation demand is important, and it gives us deeper insights into the influence factors of transboundary river cooperation. However, development of the model is the main work of this manuscript, and we believe that the model itself has its novelty and advantage in understanding and simulating the cooperation dynamics and driven mechanisms. The sentiment analysis in our manuscript is used to prove the validity of the model, instead of being the main work of the manuscript. There is another paper focusing on the sentiment analysis in Lancang-Mekong River, which is titled"An Analysis of Conflict and Cooperation Dynamics over Water Events in the Lancang-Mekong River Basin" and also under review in the same special issue on HESS (https://hess.copernicus.org/preprints/hess-2020-390/hess-2020-390.pdf). We believe both the model and sentiment analysis could be an independent and important work. We will improve the introduction of sentiment analysis, and discuss more deeply on the results of sentiment analysis. Thanks all the same.

Reviewer comment: (3) The description of the socio-hydrological model should be improved. It is not clear why reservoirs are aggregated. Nor do we know how results are disaggregated.

Author response: We thank this comment. In our study, the reservoirs in upstream

China and Laos are simplified and aggregated into 3 reservoirs, because we need to couple the reservoir operation module with the economic calculation and policy feedback module, and a more decentralized model with more agents will face the problem of computation time. According to the reservoir operation rules shown in lines 348-363, the altruistic scenario (full-cooperation scenario) is calculated by maximize downstream benefits, while the weight of this scenario equals to cooperation level. The cooperation level is dynamic and the calculation step is one month, which requires that the calculation time of each step including the optimization processes cannot be too long. Besides, the simplification of the reservoirs is reasonable and acceptable. As mentioned in lines 314-316, Xiaowan and Nuozhadu reservoirs account for 90% of the storage in China. The storage of the proxy Laos reservoir equals to the aggregation of all Laos reservoirs, and its hydropower generation is calibrated against the statistical data of the sum of hydropower generations in Laos. We will modify the description part of the model to clarify the rationality, and supplement more information about reservoir operation module.

Reviewer comment: Moreover, the allocation rules, including reservoir operating rules, are barely described even though they play a critical role in the cooperative management of the river basin. To what extent can the operating rules be adjusted to accommodate downstream water demands? Is hedging considered? In case of water shortages, how is rationing implemented between water users/economic sectors/countries?

Author response: We thank this comment. The regulation operating rules are explained in lines 348-363. Generally, in order to quantify the cooperation level, we assign it as the weight of altruistic scenario in line 367, which is the extent to which the operating rules are adjusted to accommodate downstream water demands. The altruistic scenario is to purely maximize the total downstream benefits. Hedging is not considered in this study. When there is water shortage, water allocation between countries and sectors will be implemented to maximize the total benefits of downstream three countries, with the constraint of water release from upstream countries. We will revise the model description part, and add the explanation above to our manuscript to make it clearer.

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