Reply on RC2

Yaogeng Tan et al.

Author comment on "Identifying the dynamic evolution and feedback process of water resources nexus system considering socioeconomic development, ecological protection, and food security: A practical tool for sustainable water use" by Yaogeng Tan et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-68-AC2, 2021

Thank you very much for your positive feedback on our paper and the comments posted last time (hess-2020-461). I have thoroughly revised the paper based on the last comments. And I believe the current comment can greatly help improve the quality of the paper. Here are the responses to your comments:

First, in section 2.1, the authors should add one or two sentences to explain the connections (or relationships) between external drivers (as authors stated as "pendulum model") and core methods (SD and optimal model). In other words, what are the mechanism and methodological bases of nexus changes driven by external changes? Please explain it in the revised paper, or it will be confusing.

Response: Thank you for this point. Actually, referee #1 also pointed out this issue, in point 5. The water resources system is exposed to external drivers and will influence the status of the system. The system dynamic model is exactly the powerful tool to simulate the dynamic interaction of the water resources system and its components. However, according to the theory of "complex adaptive system" (CAS), the external drivers not only influence the system's status but also starts the self-adjust process of both the whole system and its components to attain the adaptive status. Such a process can be characterized by the optimal model that can consider the coordination process among multiple agents, but it is unable to simulate the dynamic interactive process in a precise way. That's the reason why the SD and optimal model should be coupled. In the revised paper, we will make it clear.

Second, as the authors stated in L88-90, "those methods are used to simulate the dynamic status and feedbacks just in an objective way but no optimal function inherently, which limits the goal of sustainable water uses to some extent". But in the following sections, I didn't see any qualitative or quantitative analysis and proof about the advantages of the methods used in this paper compared with the current methods. Does it improve the model's reliability, or, achieve the coordination more accurately among different agents under external changes? Or either of the two models cannot achieve the desired effect? Or other better effects? Such analysis should be implemented in the Discussion section to better enhance the contribution of the paper and better answer the research question.

Response: Thank you for your suggestion. In fact, SD model is used to simulate the dynamic status of a large system, and it can also reveal the dynamic interactions among the components under external drivers. However, only SD model is unable to ensure the coordination among each agent. That is, it does not ensure its best status, just a tool for simulating the dynamic changes. Then the optimal model is used to attain the coordination status based on CAS theory. We will try to make a quantitive analysis to verify this assumption in the discussion section. For example, comparing the value of some variable(s) (e.g. SDD, optimal function, etc.) under different conditions (SD only, SD and optimal model).

Third, some comparisons should be made between other studies. For example, I saw the relative research from Tan et al., (2019) which deals with a similar area using similar optimal approaches but, some results and conclusions are not consistent. For example, in that paper, the authors state that the socio-economic agent is more sensitive. But in this paper, they claim that river ecological agent is more likely to influence the model's robustness. Why do the different results happen? Please explain it. By the way, I didn't read the entire paper (Tan et al., 2019, Water, 11, 4) in-depth and just see its conclusion section. But I believe every reader will have this question if only read the conclusion part of both papers. They may not read the entire paper but the abstract and conclusion.

Response: A very good question. In fact, they are different methods of robustness analysis. In this paper, the robust analysis is based on the changes of the weighting factors. Many previous studies also used this method. For example, Feng (2019) established the integrated framework of the water resources system and applied it in Danjiangkou Reservoir by introducing many parameters. The robust analysis is conducted based on the changes of these parameters, and the model performance (revealed by certain variables) under the different values of these parameters are analyzed. In our study, the parameters are the weighting factors of the entire optimal model. But in that study (Tan et al., 2019), the robust analysis is conducted by changing the reservoir's streamflow and comparing the value of the objective functions of both in-stream and off-stream water users. The increasing streamflow results in decreasing water supply of off-stream, which leads to the higher increasing rate of the off-stream objective function. In fact, they are like apples and oranges due to the quite different methods. Therefore, there are lots of ways for robustness and their core content is quite different, which leads to different results. In terms of robust analysis, both two studies just attempt to make the initial analysis, and in our further research activities, we can find more advanced methods of robust analysis along with a more extensive literature review.

Reference: Feng, M., Liu, P., Guo, S., David, J. Y., Cheng, L., Yang, G., & Xie, A.: Adapting reservoir operations to the nexus across water supply, power generation, and environment systems: An explanatory tool for policymakers. J Hydrol, 574, 257-275, 2019.