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Discussions

Interactive comment on "Minimizing the impact of vacating instream storage of a multi-reservoir system: a tradeoff study of water supply and empty flushing" *by* Chia-Wen Wu et al.

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The general response is as in the reply to the anonymous referee #1.

Point-by-point responses to the specific comments: 1.According to the comments by both reviewers, the structure of the article will be reorganized. The introduction section will be reformed to specifically present the case study system. The case study section is moved in front of the methodology to enhance their linking and avoid divergence. As for the comments about "which of the numerous cited reservoirs are used for the application of the framework", other than the presented case study, we did not see similar implementation in the literature to explicitly address the trade-off of empty reservoir

storage and maintaining water supply in a multi-reservoir system.

2.All the materials about the supplemented data and references, including the field and numerical validation of the estimation of volume of flushed sediments, will be removed from the manuscript and provided in additional supplemented materiel files.

3.In order to recentralize the presentation on the theme of the research, all the suggestions will be undertaken accordingly.

4.The main idea of this study is to jointly operate multiple reservoirs to create opportunities for empty flushing without excessively hindering water supply. The structure of a multi-reservoir system essentially comprises of multiple inflow series to the system. For example, three daily inflow records at separate control points, each with duration more than 4 decades, are in presence in the case study system. This imposes difficulties in synthetically generating hydrological series since the multi-correlation among daily inflows of different sites should be properly modeled in order to correctly represent the temporal and spatial stochastic hydrological nature. According to the recent operating experiences, the return period of extreme drought leading to large scale suspension of irrigation in southern Taiwan is approximately 10 years. The current simulation time span of 43 years should already be adequate to accommodate this frequency of drought occurrence. Further, the insufficiency of inflow during extreme droughts in the past is actually due to the absences of typhoon-induced floods in the previous wet season. This requires simulating the scale, frequency and duration of flood events induced by different weather factors, along with continuous hydrological modeling of the following long-term recession process. All these factors increase the challenges in synthetically generating hydrological series and overload the paper beyond the scope of its theme.

The obtained solutions of initiating and terminating an empty flushing operation inevitably impose risks for water supply, though the research strives to control the incremental risk within manageable range while maximizing performances of sediment flushing. Nonetheless, it is very difficult, if not impossible, to control the water shortage in the next entire year merely by determining whether to implement or suspend an empty flushing operation of several days. In the case study area, 90% of the average annual inflow occurs during May to October, and only 15% of which occurs during the prescribed feasible periods for empty flushing. So that when encountering abundant inflow in the early flood season, no one can foresee that the expected following typhoon-induced floods will be entirely absencet for the remaining 5 months. This rare situation did occur twice in the flood seasons of 2014 and 2020. Thus the water released for empty flushing in the simulation cannot be recovered and incremental shortage created. Nonetheless, this condition always leads to large scale suspension of the first semiannual irrigation, whether empty flushing in the previous year is performed or not. The water originally supplied to the first semiannual irrigation, the volume of which ranges between 0.2∼0.3 billion m3, will be kept to ensure security of public water supply. The annual demand of public purpose is only 0.12 billion m3 and the empty flushing consumes water under 0.09 billion m3 according to the simulation. This shows the risk of increased shortage induced by empty flushing for this particular situation will be completely offset in reality. For the other regular empty flushing events, the incremental shortage only concentrates before the following floods, after which the released water can be recovered, and can be managed by postponing the second semiannual irrigation if necessary. The above discussion will be properly integrated into the revised manuscript.

5. (1)According to the data from the government, the estimated average annual inflowing sediment volume for Twengwen Reservoir is 5.6 million m3 per year. a. With the newly-constructed desilting tunnel with capacity as 1,000 m3/s, the annual volume by sediment venting during floods is estimated as 1.60 million m3 per year. b. The desilting volume of hydro-suction is currently increased to 3.15 million m3 per year. c. While several watershed management measures are expected to reduce the inflowing sediment volume by 0.5 million m3 per year, there is still a gap of 0.35 million m3 per year to be desilt by mechanical excavation. d. The cost for mechanical excavation is

approximately 15∼18 USD per desilt volume (m3) and can be replaced by the empty flushing with manageable incremental water shortage. e. More aggressive flushing operations accommodate the uncertainties of effectiveness of watershed management measures, spillage-required sluicing and removal of hydrosuction deposition, and potentially recover the siltation volume of reservoir.

(2)Figure 18 and Table 5 will be integrated in the revised manuscript according to the precise point by the reviewer.

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