Response to Anonymous Referee #1

"Can the combining of wetlands with reservoir operation largely reduce the risk of future flood and droughts?" presents an original study aiming at discussing whether the combining of wetlands with reservoir operation can largely reduce the risk of future floods and droughts in the Nenjiang River Basin. The data of this paper is very comprehensive and the method is reasonable. The results are helpful for understanding the role of wetlands and reservoir operation in mitigating basin hydrological risks under climate change, which make this manuscript worth publishing. I recommend to accept this manuscript after minor revisions to address following general and specific comments.

Response: We are grateful for Referee #1's very positive and constructive comments and suggestions. We have carefully revised this manuscript and provided the following point-to-point responses.

General comments:

Hydrological model is an important tool to understand wetland hydrological functions, and the same is true for observations. This cannot be neglected in research progress and discussion.

Response: Many thanks for your comments here. We completely agree with your opinion here and have added relative contents in Introduction and Discussion as follows:

Added contents in Introduction (Lines 68-76):

To understand how and to what extent wetlands can mitigate hydrological processes, two approaches are commonly used: (i) description of individual wetland service at the field scale (e.g., Park et al., 2014) or wetlandscape scale (e.g., åhlén et al., 2022); (ii) assessment of wetland hydrological services at the regional/watershed scale (Fossey et al., 2016; Wu et al., 2020a, 2020b). However, the former approach only be achieved with field instruments and is mainly used to provide key parameters of wetland processes for model calibration (Fossey and Rousseau, 2016). Recently, several wetland hydrological models (e.g., SWAT model, PHYSITEL/HYDROTEL modeling platform) have been developed and applied to quantify hydrological function of wetlands, particularly the mitigation services on floods and droughts (Evenson et al., 2016; Evenson et al., 2018; Zeng et al., 2020; Fossey et al., 2015a).

Added contents in Discussion (Lines 698-702):

Therefore, there are ongoing efforts to obtain sufficient data on wetland area dynamics and evapotranspiration, water depth and volume, soil water content using multi-source remote sensing data and actual observations to better calibrate/validate watershed hydrological models, which are expected to better provide key parameters for further improving the model's capacity to capture flood and drought patterns.

I understand that wetland and reservoir can be regarded as green and gray infrastructure strategy respectively. The authors showed that the combination of them can experience the risks of hydrologic failure under future climate change. This is an interesting and important finding that can be further discussed beyond the current content.

Response: We appreciate your comments here. Yes, wetland is one of green infrastructures and reservoirs are part of gray infrastructures. We found that based on existing reservoir operations and wetland cover conditions, the combination of the two would experience a failure of flood and drought mitigation under future climate change. We agree with your point, that is, this is an interesting finding, and have enriched the discussion as follows (Lines 719-735):

Wetlands are typically viewed as green infrastructures and reservoirs are generally regarded as important gray infrastructures. Although our study showed that the combining of reservoirs and wetlands does not completely eliminate the risk of future hydrological extremes, they continue to play an important role that cannot be ignored. The reservoir's inherent constraints are one factor contributing to this likelihood of hydrological failure. This is because reservoirs only control floods and droughts that occur downstream of them, limiting their effects to the regional scale (Brunner, 2021). The regulation becomes less effective with distance increased due to "dilutions" effect caused by inflows from downstream tributaries (Guo et al., 2012). Reservoirs cannot, however, play a considerable role in basins where tributaries exist downstream, particularly those sub-basins that are vulnerable to drought and flooding. From these perspectives, widely distributed wetlands can provide a complementary and vital function by providing biological function and hydrological regulation in regions where reservoirs are unable to have an impact. On the other hand, the limited capacity of existing wetlands to regulate hydrology increases the risk of hydrological failure to some extent. This is because, compared with the historical period, the existing wetlands in the NRB have been seriously degraded, such as the weakening of the connectivity between riparian wetlands and the river channel, and the increased fragmentation of wetlands, among other changes (Chen et al., 2021). These degraded wetlands cannot play an effective role in mitigating floods and droughts under future climate change.

For different sub-periods under the constraints of three SSPs, the projected results are somewhat different, no matter floods and droughts, which can come into being some uncertainties and should be discussed.

Response: We appreciate your comments here. We fully agree with you that there will be some uncertainty in the predicted results based on different SSPs. However, we have described in the datasets section that the uncertainty can be reduced to a large extent by using the multi-model ensemble means approach. Moreover, this approach has been recognized and widely used by previous studies. Please see lines 193-196.

The assumption about without wetland scenarios, i.e., “wetland areas are not removed, but they are treated as the land cover of saturated soils”. How the regulation function is not accounted for? I think there may be uncertainty here.

Response: We thank your comments here. Consistent with widely accepted conventional method, we evaluate the impact of wetlands on hydrologic processes using how the magnitude of storage capacity contributes to watershed water yielding and runoff routing. If the wetland area is not removed, and it is considered as saturated soils, this saturated soil is fixed and does not participate in hydrological processes such as water storage and flow yielding. Based on this, a simulation without considering the water storage function of the wetland is implemented. We appreciate your reminder here and have added a relevant description in the manuscript.

In Section 2.3.3, we specified this point as follows (Lines 340-343):

When the wetland modules are turned off in HYDROTEL, wetland areas are not removed, but they are treated as the land cover of saturated soils. Such a saturated soil is fixed and does not participate in hydrological processes such as water yielding and runoff routing, and thus their explicit storage properties are not accounted for in the modeling.

Minor errors and inadequacies in details that need to be double-check and revised. See specific comments below.

Response: We are grateful to your very helpful comments and suggestions, which have helped us clarify and improve the manuscript.

Specific comments:

Line 40 and 718. Diffenbaugh et al., 2015a and Diffenbaugh et al., 2015b are the same paper.

Response: Thanks for your reminder. We have revised it to the same paper.

Lines 42-43. Please cite the references in the main text correctly. Move "Güneralp et al., 2015" to the end of the sentence.

Response: Done.

Lines 45-46. Suggest to say global scale first and then regional scale.

Response: We thank your comment here. We have put the global scale before the regional scale.

Line 64. Inert "However" before unlike.

Response: Done.

Line 132. Delete "and storage".

Response: Done.

Line 137. Insert then after "We".

Response: Done.

Line 146. Insert hydrological after "future".

Response: Done.

Line 158-159. Three wetlands of international importance do not represent much. Please rewrite.

Response: We thank your comments here. We have carefully checked and rewrite the sentence as follows (Line 136-138):

The basin contains several important wetland conservation areas, among which Zhalong and Nanweng River Wetlands have been designated as a Ramsar Site of International Importance.

Line 160. What's the contributing drainage areas of wetlands?

Response: We are sorry for losing the definition of contributing drainage areas here. We have added relevant content and description to the main text as follows:

Lines 138-141. The wetlands and their contributing drainage areas (see Section 2.3.1 for specific definition) within the subbasins monitored by the ten hydrological stations range from

14 to 23% and from 39 to 56% respectively, demonstrating the large wetland coverage of the NRB and its sub-basins (Table 1).

Lines 247-249. The contributing area of wetlands is defined as the sum of the area of all wetland RHHUs and upland RHHUs within their immediate catchment areas situated along active fill-spill pathways to the stream network (Evenson et al., 2016).

Line 163-164. Songnun Plain or Songnen Plain? Please be consistent with Figure 1.

Response: It's the Songnen Plain. We have revised it.

Line 168. Revise "significantly" to largely.

Response: We have deleted this sentence to improve the readability.

Line 228-229. What are the two wetland modules. Please specify here.

Response: They are isolated wetlands and riparian wetlands. We have revised in the text as follows (Line 231-233):

The PHYSITEL/HYDROTEL modeling platform coupled with two wetland modules (isolated and riparian wetlands) (Fossey et al., 2015b), has been used to quantify hydrological function of wetlands (e.g., Fossey and Rousseau, 2016; Blanchette et al., 2019; Wu et al., 2023).

Line 231. The reference format is incorrect.

Response: Done.

Line 242. I still haven't seen a definition of contributing areas here.

Response: We have added relevant content, please see Lines 247-249.

Line 257. Kinematic wave equation, loss reference here.

Response: We have added the reference, please see Beven, 1981.

Line 274. What is the time-step length in this study?

Response: The time-step length is day. We have added it.

Lines 272-274, 277-279. Loss of units for formular parameters.

Response: We apologize for the lack of units here, which we have revised in the text.

Supporting references:

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