Response to Anonymous Referee

Response to Anonymous Referee #1

Review of "Can the combining of wetlands with reservoir operation largely reduce the risk of future flood and droughts?"

Wu et al. deals with flood and hydrological drought risk under future climate change by considering the combined effects of wetlands and reservoirs. The author develops a novelty framework coupling wetlands and reservoir operations with a semi-spatially explicit hydrological model and then apply it in a case study basin to project future flood and drought characteristics under CMIP6 scenarios. This topic will be of general interest in view of new insights into the role of grey-green infrastructure such as wetlands-reservoir in mitigating hydrological extremes. The manuscript is well written, the figures are excellent, and the contribution is clear presented. Overall, I think the topic falls into the scope of HESS.

I have a concern with the role of tributary reservoirs in flood and drought management, and some suggestions for improving the manuscript (see details below). Overall, I recommend minor revisions.

> **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 (highlighted in yellow).

Major comments

In this study, the Nierji reservoirs located in mainstream were mainly considered, but the water regulation role of tributary reservoirs cannot be ignored. Some sub-basins of the Nengjiang River basin also have reservoirs and can make a certain degree of impact on streamflow (Meng et al., 2019), i.e. on the characteristics of floods and droughts. Would the risk of future floods and droughts be different if coupled simulations of multiple reservoirs-wetlands in the mainstream and tributaries were carried out? Such point is important for the next work of multi-objective optimization algorithm. Although the authors did not state such concern may be due to data limitations, I think this point is crucial to mention and discuss.

Response: Many thanks for your constructive comments here. We completely agree with your opinion here and have added relative contents in Discussion to clear state this point here as follows (Lines 711-719):

Furthermore, several reservoirs and a large number of wetlands are spread throughout the NRB's tributaries (Meng et al., 2019), which individually and together play an essential role in drought and flood risk reduction. We only investigated the impacts of mainstream reservoirs and wetlands on drought and flood risk due to a lack of sub-basin reservoir operation observations. As a result, future integrated wetland-reservoir simulations of all mainstream and tributaries for flood-drought risk assessment will be done based on further data collection. Since the Nierji reservoir is the largest in the NRB and has the most influence on the mainstream runoff regime, our findings based on the simulation of Nierji reservoir and wetlands can give new insights into future floods and droughts, as well as provide important support for future hydrological extremes adaptation.

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: We thank your comments here. We fully agree with you that both hydrological and observation are important tools that can be used for understanding wetland hydrological functions. We have added relevant content in research progress and discussion to state this point.

Lines 72-74:

However, the former approach can only be achieved with field observation with instruments and is mainly used to provide key parameters of wetland processes for model calibration (Fossey and Rousseau, 2016).

Lines 696-702:

In addition, due to a lack of wetlands water balance monitoring data, this study only used river station data (which only considered the cumulative hydrologic effect of upstream wetlands) for model calibration. Therefore, there are ongoing efforts to obtain sufficient observations on wetland area dynamics and evapotranspiration, water depth and volume, soil water content 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 and better serve basin water management.

The figure has problems such as title and content not corresponding, and wrong unit labeling, which need to be carefully checked and revised to improve readability.

Response: We thank your comments here. We have carefully checked all the figures to make sure the titles and contents are consistent, and we changed the wrong unit labeling.

Lines 158-160: Fig.1.

Line 207. Insert 'basin' between 'a' and 'hydrological' to maintain consistency with subgraph (a).

Response: Done.

Lines 297-298. What are the resolution of the raster datasets used?

Response: We thank your comments here. The resolution of the raster datasets is 1km. We have added the content as follows s (Lines 168):

The land-use/land-cover types for 2015 (including wetland types), digital elevation models and digital elevation models with 1 km resolution were obtained from Resource and Environment Science and Data Center (https://www.resdc.cn/).

Line 309. Delete the sentence 'Of the ten stations, seven are located upstream of the Nierji Reservoir.' to avoid repetition with the first sentence of the next paragraph.

Response: Done.

Line 342. This is the first occurrence of the NSE and needs to be stated in full name, not in the second occurrence of the NSE in line 349.

Response: We thank your valuable comments here and have added the full name in the sentence as follows s (Lines 337):

The KGE was chosen as the objective function because previous research has shown that it can improve flow variability estimates when compared to the Nash-Sutcliffe efficiency (NSE) (Fowler et al., 2018; Garcia et al., 2017).

Line 369. What is SSP, please specify the full name when it first appears.

Response: We thank your comments here and have added the full name in the sentence as follows (Lines 178-179):

In this study, we drove hydrological model using five GCM projections (GFDL-ESM4, IPSL-CM6A-LR, MPI-ESM1-2-HR, MRI-ESM2-0, UKESM1-0-LL) under three Socioeconomic Pathways (SSPs)

Line 394.Change ‘used’ to ‘adopted’.

Response: Done.

Line 411. What is the specific time period of the historical period?

Response: We appreciate your comments here and have added the historical period in the when it first appear in the manuscript follows (Lines 178-179):

The flood and drought characteristics were then compared against historical periods (1971-2020) to discern how future hydrological extremes will be changed under the influence of wetlands and reservoirs (see Part II in Fig.2).

Line 595. Insert ‘scenarios’ at the end of this sentence.

Response: Done.

Line 597. The Y-axis is 'Peak flow' not the ‘Peakflow’; and should be consistent with the other figures and main text.

Response: We thank your comments here and have modified Figure 7 to keep the figure and text consistent.

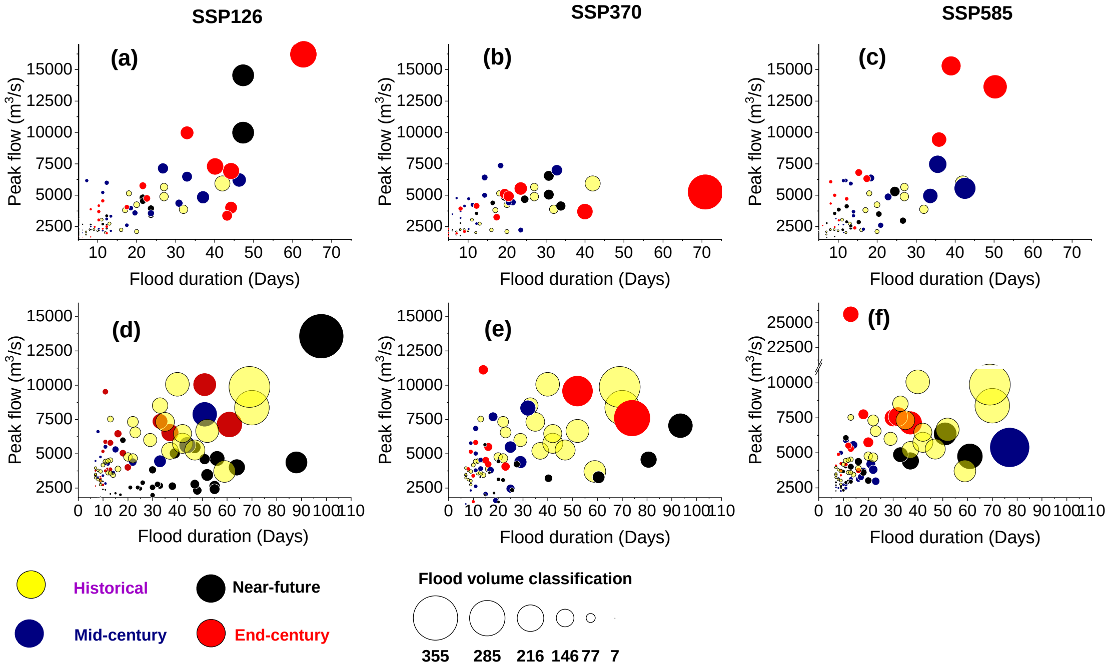

Figure 7. Historical and projected flood duration-peak flow-volume relationships at the Nenjiang (the first row) and Dalai (the second row) Station. The historical period refers to 1971-2020 and the near-future, mid-century and end-century refer to the 2026-2050, 2051-2075 and 2076-2100 under the Socioeconomic Pathways (SSP) 126 (the first column), SSP370 (the second column) and SSP585 (the third column) scenarios.

For Fig.6, Fig.8, Fig.9, and Fig.A3, the unit of drought deficit should be 'm3' rather than 'm3/s' based on equation (4).

Response: We thank your comments here and have modified Fig.6, Fig.8, Fig.9, and Fig.A3 with the right unite. The revised figures are as follows:

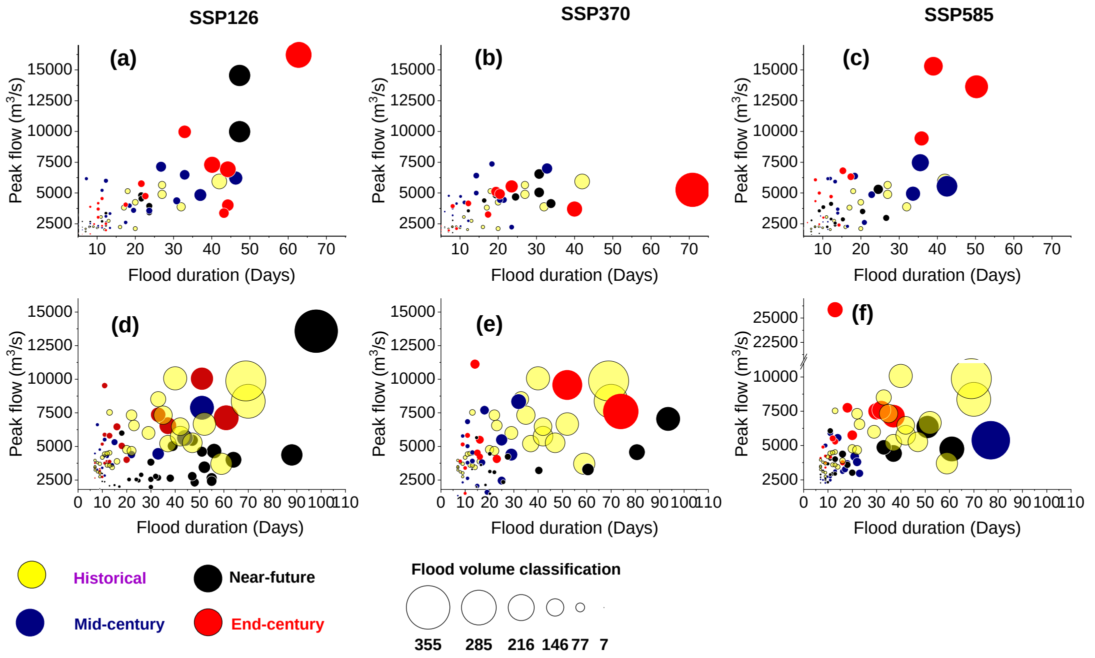

Figure 7. Historical and projected flood duration-peak flow-volume relationships at the Nenjiang (the first row) and Dalai (the second row) Station. The historical period refers to 1971-2020 and the near-future, mid-century and end-century refer to the 2026-2050, 2051-2075 and 2076-2100 under the Socioeconomic Pathways (SSP) 126 (the first column), SSP370 (the second column) and SSP585 (the third column) scenarios.

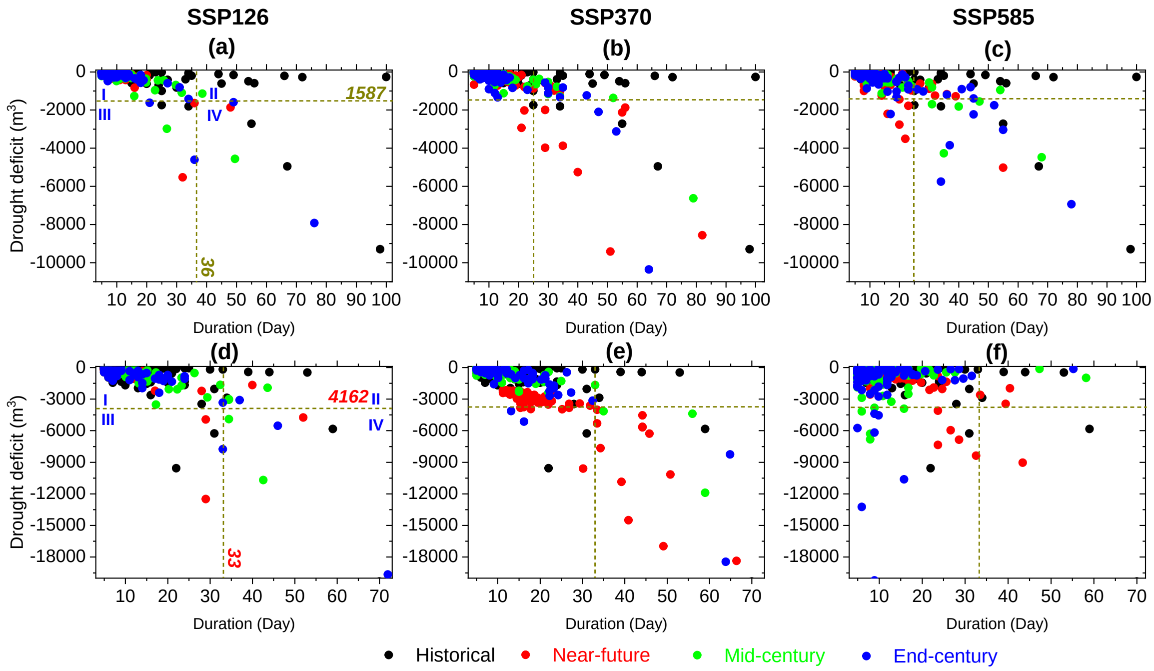

Figure 9. Historical and projected duration-deficit relationship of each hydrological droughts

at the Nenjiang (the first row) and Dalai (the second row) Station. The historical period refers to 1971-2020 and the near-future, mid-century and end-century refer to the 2026-2050, 2051-2075 and 2076-2100 under the Socioeconomic Pathways (SSP) 126 (the first column), SSP370 (the second column) and SSP585 (the third column). The dark yellow lines in the horizontal and vertical directions refer the 95% threshold lines for drought deficit and duration values, respectively. I, II, III and IV refer to short-term light droughts, long-term light droughts, short-term severe droughts, and long-term severe droughts, respectively.

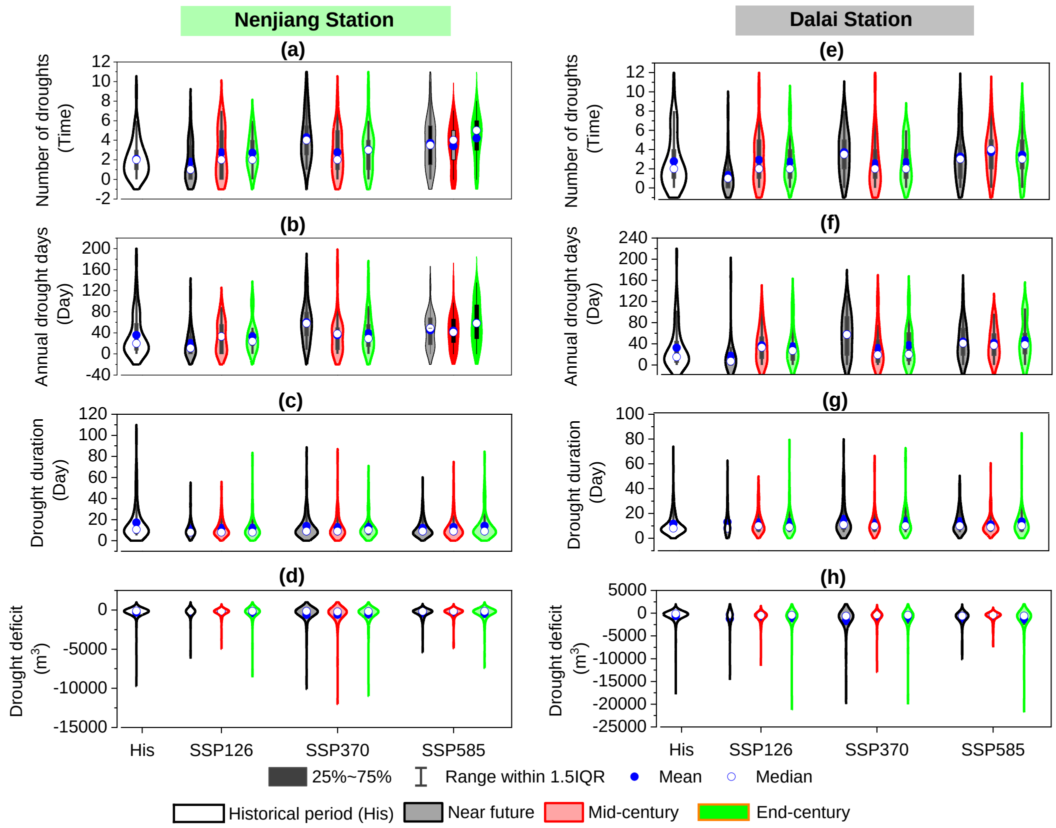

Figure. A4. Historical and projected hydrological drought characteristics (the number of droughts, annual drought days, duration, and deficit) at the Nenjiang (the left column) and Dalai (the right column) Station. The historical period refers to 1971-2020 and the near-future, mid-century and end-century refer to the 2026-2050, 2051-2075 and 2076-2100 under the Socioeconomic Pathways (SSP) 126, SSP370 and SSP585 scenarios. Note that the wider the violin plot, the higher the density.

Lines 903 and 908. Change 'wetlands/wetlands and reservoir' to 'wetlands/wetlands-reservoir'

Response: Done.

Response to Anonymous Referee #2

This is an important manuscript adding to the literature focused on understanding the role of wetlands and reservoirs in flood-risk prevention. The paper is much improved from the original version, particularly in the methodological descriptions (which are now very clear), scientifically sound, and the authors largely addressed my original comments. I have a few very minor comments to consider prior to publication.

Response: We are thankful to Referee 2 for the time and constructive comments and suggestions on our manuscript. Please find our detailed replies to minor comments below (highlighted in Gray).

Title – remove "largely" because it is not very descriptive

Response: Done.

Line 69 – add "s" onto services

Response: Done.

Line 72 – add "can" in front of "only"

Response: Done.

Lines 97-99 – not quite a complete sentence

Response: Done.

Because wetlands are often abundant across many landscapes, which make their water storage and cycling fundamental to estimate a watershed's water balance (Rains et al., 2016; Lee et al., 2018).

Line 105 – delete "a"

Response: Done.

Quick suggestion: Review the paper one more time for small grammatical errors. It would be well worth it before returning it for the second revision. From here forward, I'll stop suggesting these edits directly.

Response: We thank your comments here and have carefully checked the full text to correct the small grammatical errors.

Lines 284-286 – repetition in sentence

Response: We thank your valuable comments here and have revised the sentence as follows.

Based on the simulated runoff at the inlet (the Nenjiang Station), lateral inflow, and the schemes of reservoir operation, we estimated the reservoir outflow using the ResSimOpt-Matlab software package developed by Dobson et al., 2019.

Line 585 – The sentence, "However, the fact that extreme flood events that will still occur in the future" should be changed to "However, extreme floods will still occur in the future".

Response: Done.