Reviewer 1

Natural fluctuations in the river are essential to the ecosystem productivity of basins. Which has less been investigated in the dammed Mekong River Basin. In view of this, this manuscript integrated a framework consisting of hydrological model, 3D hydrodynamic model, response time to address this issue. Results show that significant fluctuations in the river's daily flow were evident before the advent of the era of human activities. Further, the sub-basins were found to significantly contribute to mainstream discharge fluctuation. Overall, this manuscript is interesting, which can attract a lot of attention from readers. However, there were still some drawbacks before it is published on this journal and were listed below for references.

Response: Many thanks for your positive feedback and valuable comments and suggestions on our manuscript. Below please find our responses to all the comments on a point-to-point basis.

(1) The author stated that "research on the daily assessment of large river flow alterations is limited, with most researchers focusing on monthly, seasonal, and annual scale studies." (lines 59 to 60), which could be hard to make readers convinced. Many studies related to the discharge or floods (especially for floods) in the Mekong River Basin focused on daily scale, such as Wang et al., 2017, Wang et al., 2021 (listed by authors as references in the manuscript), Try et al. (2020), Yun et al. (2024). The word "most" could be not proper. More importantly, there should be an overview of researches on daily assessment of river flow before stating the lack of daily assessment of large river flow alterations.

Response: Thank you for your insightful comment. We agree with the reviewer's observation that the term "most" might not be appropriate in this context. Indeed, there are several studies focusing on daily scale analysis of flooding and time series discharge analysis. Our intention was to highlight that while many studies address daily river flow changes, there is a limited focus on analyzing the significant daily fluctuations in river flow and the underlying drivers of these events. To make it clearer, a discussion will be added to the revised manuscript.

(2) The description for data was simple. Data from seven stations extending from Chiang Saen (CS) to Kratie (KR) stations were collected, however, these stations were not clearly marked in Figure 2 (only with red circles, no name was shown). This could have an impact on readers who were not familiar with this basin. In addition, the authors said that they collect many meteorological and precipitation data, but no spatial map for these sites was shown or information for these sites was revealed. It was worthy to note that the description for meteorological and precipitation data should be placed in 2.2.1, instead in 2.2.2.

Response: We agree with the reviewer's comment. In the title of Figure 2, we mentioned that "the name of each defined sub-basin is based on its upstream and downstream stations." For example, in the JingHong-Chiang Sean (JH-CS) sub-basin, which is distinguished by a different color, JingHong is the upstream station, and Chiang Saen is the downstream station. We will update the legend of Figure 2 by assigning different colors to each station for clarity.

Regarding the meteorological and precipitation data, we concur that a spatial map showing the data collection locations would be beneficial. Consequently, we will add spatial maps to the SM file.

Additionally, we agree with the suggestion to move the description of the meteorological and precipitation data from sub-section 2.2.2 to sub-section 2.2.1, together with details associated with the spatial maps showing the location of stations where meteorological data was obtained.

(3) The methods were described relatively simple, with many confusions left, though the supplement information also contained some basic information. Firstly, readers did not know how authors calibrated the THREW model and the Delft-3D flow model, who also did not know what the parameters and inputs for these models were. Secondly, people also did not know how authors inputted the outputs of THREW model to Delft-3D flow model. I guessed that the authors used the simulated discharge near the mainstream to input to the hydrodynamic model. More importantly, how author used the meteorological data to prepare the inputs of THREW model remained uncleared (e.g., interpolating the meteorological data from in-situ scale to gridded scale).

Response: Thanks for the comment. Regarding the calibration of the THREW model, we calibrated the THREW hydrological model using an automatic parallel computation program to adjust hydrological parameters (see line 130 of the submitted paper). The input data for the THREW model, which includes elevation, land cover, precipitation, and meteorological data, is presented in Figure 2. The output of the THREW model is daily discharge, as shown in the right panel of Figure 2. The left panel of Figure 2 illustrates that the output data of the THREW model (daily discharge) is used as input data for defining additional boundaries in the Delft-3D model. This information can also be found in lines 105 to 111 of the submitted paper.

For site-based data, such as potential evapotranspiration and precipitation, we employed the Thiessen Polygon method to calculate inputs for each representative watershed (REW). Please note that THREW model has been developed based on the Representative Elemental Watershed (REW) (See line 123 of the submitted manuscript). The whole basin is covered by 651 REWs. Thus, for raster data, such as the Leaf Area Index (LAI) and Normalized Difference Vegetation Index (NDVI), we conducted spatial intersection analysis to determine the raster cells within each REW and their respective weights. These weighted values were then averaged to obtain the inputs for the respective REW. We can add these explanations to the revised manuscript for clarity.

Regarding the Delft-3D model, three datasets were used as input data: discharge, water level, and DEM data (bathymetry). This information is presented in the right panel of Figure 2. However, we omitted the explanation for the DEM data used in the Delft-3D model, though it is included in the SM file. We will add explanations for the bathymetry data in section 2.2.1 for better clarity.

(4) I noticed that the author used discharge to calculated the contribution to discharge, then why the hydrodynamic model was used in this manuscript. Many studies have shown that the hydrological model can well produce the discharge upstream Kratie. The author can only used hydrological model to make analyses. By the way, I am not sure why the author analyzed the velocity, which could be not important as discharge.

Response: Thank you for your nice comment. We incorporated the travel time model into the hydrodynamic model to determine the time required for daily upstream changes to be experienced at the downstream station (see section 2.2.4). When a significant daily river flow occurs at the downstream station, we cannot simply attribute this change to the discharge of the previous day at the upstream station, especially considering the large distances between stations in our study area. For instance, the distance between Chiang Saen and Chiang Khan is approximately 700 km, meaning any upstream changes require several days to propagate downstream (see Figure 6).

The integrated hydrodynamic and response time models allow us to calculate how long it takes for upstream changes to be felt at downstream stations. This capability helps us understand the causes of significant daily flow fluctuations in the Mekong River.

One important variable that can significantly influence the accuracy of the response time is velocity. High uncertainty in velocity can lead to underestimating or overestimating the response time for daily river flow changes to propagate from the upstream to the downstream station.

(5) Delft-3D flow model is a small-scale hydrodynamic model, how could the author apply this model to the large basin (i.e., Mekong River Basin).

Response: Thank you for your comment. The study area covers the river course from JingHong to Kratie station and does not encompass the entire Mekong River Basin. We have successfully applied the Delft-3D model to other regions of the Mekong, such as the stretch from Kratie station to the Tonle Sap Lake floodplain, which spans approximately 500 km and covers a larger area (km^2) compared to the present study. Additionally, we have successfully developed a Delft-3D model for the Bohai Sea, which has an area of 77,000 km^2, significantly larger than the area examined in this paper. For more details, please refer to our published papers.

Morovati, K., Tian, F., Kummu, M., Shi, L., Tudaji, M., Nakhaei, P., Olivares, M. A. (2023). Contributions from climate variation and human activities to flow regime change of Tonle Sap Lake from 2001 to 2020. Journal of Hydrology, 616, 128800.

Wu, M., Sun, J., Shi, L., Guo, J., Morovati, K., Lin, B., Li, Y. (2024). Vertical water renewal and dissolved oxygen depletion in a semi-enclosed Sea. Journal of Hydrology, 131369.

(6) The authors used "sub-basin" and "upstream station" terms many times in Section 3. For a given station, what did "sub-basin" and "upstream station" refer to. For example, in Figure 7, what did "upstream station" and "sub-basin" refer to for "PA". Could I think the "upstream station" was the nearest upstream station for a given station.

Response: Thank you for your comment. A sub-basin refers to the area located between two stations, as illustrated in Figure 2 with different colors (see also lines 106 and 107 for details). In other words, each sub-basin is defined by its upstream and downstream stations. For example, the MD-PA sub-basin covers the area between Mukdahan (upstream station) and PA (downstream station). Regarding PA, we realized that we had omitted the name of the sub-basin, which should be PA-ST, with PA as the upstream station and ST (Stung Treng) as the downstream station. We apologize for this oversight and have re-drawn the figure accordingly. Thank you.

(7) The legends in Figures 9, 10 were missing. In Figure 9, what did red line, grey and blue bars represent. In Figure 10, what did the x-axis represent, For CS, why did eight bars occur. and then what did the red line represent.

Response: Thank you for your insightful comments, and we apologize for the oversight.

Regarding Figure 9, the grey and blue bars represent the contributions of the upstream region and sub-basin, respectively. Specifically, for this figure, which addresses significant daily river flow changes at the Chiang Saen (CS) station, the grey bars show the contribution from the area upstream of the JingHong (JH) station, while the blue bars indicate the contribution from the JH-CS sub-basin to the large daily river flows at CS. Additionally, the red line represents the precipitation received in the corresponding sub-basin. We will update the figure caption and add a legend to enhance clarity.

Regarding Figure 10, the x-axis represents the large daily river flow reductions at mainstream stations, with the number of such reductions varying by station. As observed, these events occur more frequently at the CS station compared to downstream stations. Each bar corresponds to a single event, i.e., one large daily river flow reduction exceeding 1 meter. The colored bars denote the contributions of defined sub-basins during each studied period, while the grey bars represent the upstream station's contribution. The red line indicates the precipitation received by the JH-CS sub-basin. Based on these explanations, we will update the legend of Figure 10 for greater clarity.

Minor comments:

(1) Line 63: Usually the trend of discharge change is similar to that of water level. Here, I am not sure why discharge increased by 98% while the water level decreased by -1.55m.

Response: Thank you for your insightful comment. We agree with the reviewer's observation. The reduction in water level mentioned in line 64 pertains to the wet season, which was not specified. We have revised the sentence as follows to address this oversight:

"Findings reveal that monthly discharge during the dry season from 2010 onward at Chiang Saen station located in Thailand (see Figure 2), the nearest one to the China border, increased by 98% compared to the years before 2010 while the water level during the wet season experienced a reduction of 1.55 m (Lu and Chua, 2021)"

(2) Line 88: The length of the Mekong River needs further confirmation. It seems that 4500km is not a commonly used result. According to MRC (2006), the correct value is 4800km. Further, "Mekong River constitutes the third most diverse aquatic ecosystem", what were the first and second most diverse aquatic ecosystem. Mekong River should not be the second most diverse aquatic ecosystem (just followed by Amazon River Basin)?

Response: Regarding the river length of the Mekong River, we agree with the reviewer's comment. The correct length should be approximately 4800 km, which has been updated in the revised manuscript.

Concerning the Mekong River being the second or third most diverse aquatic ecosystem, there are conflicting references. Some sources state it is the second most diverse, while others indicate it is the third (e.g., Intralawan et al., 2018). We have revised the sentence to align with the reviewer's suggestion and to be consistent with our previous publications. Thank you.

Intralawan, A., Wood, D., Frankel, R., Costanza, R., Kubiszewski, I. (2018). Tradeoff analysis between electricity generation and ecosystem services in the Lower Mekong Basin. Ecosystem Services, 30, 27-35.

(3) Lines 96-97: The authors took June-December as the wet season, while took November-May as the dry season. This was not consistent with the facts. Actually, the flood season is from June to December for Mekong River Basin, while wet season is from May to October (see Räsänen and Kummu, 2013, Wang et al., 2022 for reference)

Response: Thanks for your comment. We acknowledge that several papers define the wet season from May to October. However, in our study, we defined the wet season from June 1 to November end and the dry season from December 1 to May end (see Figure 5 and its caption, lines 238-239). This choice was informed by current projects conducted by the Mekong River Commission (MRC) and experts from the six riparian countries, who have concluded that June to November can be considered the wet season (reference provided below).

While we understand there are different definitions of the wet season, it's important to note that our research focus does not center on monthly, yearly, or seasonal flows, and thus, our findings are not affected by the specific definition of the wet season.

Thank you for bringing this clarification to our attention.

1. Lancang-Mekong Water Resources Cooperation Center and Mekong River Commission. (2023). Technical Report – Phase 1 of the Joint Study on the Changing Patterns of Hydrological Conditions of the Lancang-Mekong River Basin and Adaptation Strategies. Beijing: LMC Water Center or Vientiane: MRC Secretariat. http://www.lmcwater.org.cn/cooperative_achievements/collaborative_projects/ http://www.mrcmekong.org/ publications/

(4) Line 226: how authors defined the daily river flow alteration, whether the authors using the water level in the next day minus that in the current day.

Response: In section 2.2.1 of the manuscript, we emphasized that the water level and discharge data are recorded daily and simultaneously. Therefore, when we refer to daily river flow alterations, we mean changes that occur within a 24-hour cycle, either from one day to the next or from one day to the previous day.