Response to RC2:

General comments

This paper presents an evaluation of the monthly water balance using an extended Budyko framework to analyze the contribution of snow storage to runoff seasonality. The topic is timely and offers valuable insights into the understanding of hydrological processes. The manuscript is well written, with a clear description of the methodology and a solid explanation of the results, especially an additional experiment incorporating reservoir data to validate the Budyko approach. The hypotheses employed and limitations of Budyko framework is also discussed. I have only minor comments regarding the paper structure, which I hope will help improve the overall readability of this manuscript.

To my understanding, the idea of including nested catchments is related to identifying the influence of hydropower. If this is correct, I would suggest clarifying this when introducing the nested catchments in the study area section. This will help readers understand the rationale for this design early.

Response: We sincerely thank the reviewer for the encouraging and constructive comments. We are glad that you found the study timely and valuable, and we appreciate your recognition of our methodology and presentation.

Regarding your suggestion about the rationale behind using nested catchments, we fully agree that this should be made clearer in the manuscript. As you correctly inferred, the nested catchment design aims to distinguish between natural runoff conditions in the upstream sub-basins and regulated conditions in the downstream sub-basins affected by cascade hydropower operations. This contrast enables a spatially explicit analysis of hydropower impacts within the Budyko framework.

To address this, we will revise Section 2.1.1 (Study Area) to explicitly state the purpose of the nested catchment design and clarify how the upstream and downstream sub-basins differ in terms of both hydrological conditions and anthropogenic influences.

Specific Comments

Comments 1: Line 29, “increasingly” here better be “increase”.

Response 1: Thank you for your valuable suggestion regarding the wording in Line 29. To improve clarity and avoid potential misunderstandings, we will revise the sentence as follows:

“*Results showed that snow accumulation and snowmelt are main drivers of runoff seasonality in the upper sub-catchments, and their effects propagate to the lower-elevation snow-free sub-catchments, which are also subject to additional influence from hydropower reservoirs.*”

We believe this revision better conveys the intended meaning.

Comments 2: Line 31, consider rephrasing “other world regions” to “other global regions.”

Response 2: Thank you for your helpful suggestion. We will revise the phrase “other world regions” to “other global regions” in the manuscript to improve clarity.

Comments 3: Line 99, missing a period here at the end of the sentence.

Response 3: Thank you for pointing this out. We will add the missing period at the end of the sentence to correct the punctuation.

Comments 4: Line 165, Figure 1 needs a more detailed explanation. While it is introduced as an overview in Line 149, the description lacks details on its components (e.g., Part 1, Part 2). I recommend providing a brief explanation of the figure in the text, highlighting how it corresponds to the subsections under 2.1. This would make the structure easier to follow.

Response 4: Thank you for your helpful suggestion. We agree that Figure 1 would benefit from a clearer and more detailed explanation in the main text. In the revised manuscript, we will provide a brief but explicit description of Figure 1, highlighting its components (e.g., Part 1, Part 2) and clarifying how it corresponds to the subsections

under Section 2.1. This addition will help improve the logical flow and readability of the methods section.

Comments 5: Line 235, regarding the section on cross-correlation, partial correlation is also discussed in the results (Line 355). It would improve consistency to include a brief introduction to partial correlation in the methods section here.

Response 5: Thank you for pointing this out. You are correct that partial correlation is discussed in the results section (Line 355), but not sufficiently introduced in the methods section. To improve consistency and clarity, we will revise the manuscript to include a brief introduction to the partial correlation analysis in the methods section. This will help readers better understand its role and relevance in the analysis presented later.

Comments 6: Line 239 to 241, the sentences here appear incomplete or unclear. Please revise for clarity and ensure complete sentence structure.

Response 6: Thank you for your valuable suggestion. We agree that the original sentences were unclear and lacked complete structure. In the revised manuscript, we will improve the clarity of this section. Specifically, we will revise the text as follows:

"*After undergoing complex surface and subsurface hydrological processes, the catchment responses to precipitation tend to become smoothed and delayed (Brutsaert and Hiyama, 2012). To characterize the hysteresis relationship between monthly precipitation and runoff in the Yalong River basin, we introduced the variable τ, representing the lag time between precipitation events and corresponding runoff responses.*"

This revision enhances the clarity and ensures the sentence structure is complete. Thank you again for your helpful comment.

Comments 7: Line 324, Figure 3, there is a purple vertical line at the right border of the figure, which seems unintended. Please check and correct if necessary.

Response 7: Thank you for pointing this out. We will correct this issue in the revised manuscript to ensure the figure is clear and accurately presented.

Comments 8: Line 355, “downtrending” here seems likely to be “detrending”? As noted in the previous comment, it would be helpful to move this information to the Methods section and include a brief explanation.

Response 8: Thank you for your careful reading. We will revise “*downtrending*” to the correct term “*detrending*” in the manuscript. As you suggested, we will also move this information to the Methods section and include a brief explanation of the detrending procedure to enhance clarity and improve consistency across the manuscript.

Comments 9: Line 399, here seems a typo error before “degree of correlation.”

Response 9: Thank you for pointing this out. We intended to express the following: “*The lagged response in months between R and P is denoted “τ”. The colors indicate the degree of correlation with darker colors reflecting stronger correlations. The dots represent significant correlations (p≤0.05). Each basin’s best fitted τ is indicated by an asterisk.”*

We will revise this sentence in the manuscript to clarify the intended meaning and eliminate any ambiguity.

Comments 10: Line 435, typo error here.

Response 10: Thank you for pointing out the typo. We will carefully review and correct the error in the revised manuscript to ensure clarity and accuracy.

Comments 11: Line 487, typo error here too.

Response 11: Thank you for pointing out the typo. We will carefully review and correct the error in the revised manuscript to ensure clarity and accuracy.

Comments 12: Line 571, the phrase "less than a month", does this mean "concurrent" or does it also include a "one-month lag"? Please clarify.

Response 12: Thank you for your insightful comment. We agree that the phrase "less than a month" may be ambiguous. To improve clarity, we will revise the sentence as follows:

"*Regarding lag times, the upstream mountainous headwater catchments of the Yalong basin showed relatively prompt runoff (R) responses to precipitation (P), with lag times (τ) of one month or less (i.e., $\tau \leqslant 1$), despite the presence of seasonal snow storage. In contrast, downstream nested catchments, including those containing man-made reservoirs, exhibited more significant delays (i.e., $\tau > 1$).*"

This revision enhances clarity and aligns with your valuable suggestion.