Reviewer #2:

This paper proposes a method to reconstruct the water level–storage (WLS) relationship of reservoirs by estimating storage capacity loss due to sediment accumulation. The method is applied to a cascade of nine reservoirs along China's Wujiang River, and the reconstructed WLS curves are validated using water balance analysis and DEM-based surface data. Overall, the framework presented in this study provides useful insights and offers practical value for reservoir management to a certain extent. However, the manuscript would benefit from further refinement to improve its clarity, logical flow, and rigor before it can be considered for publication. In particular, some sections of the paper would benefit from a smoother transition between sentences and a clearer presentation of the methodology and results. Below, I outline specific comments and suggestions for the authors' consideration.

Reply: Thank you for your efforts and constructive comments, which have significantly improved the quality of the manuscript. We have provided detailed point-by-point responses to the reviewers' comments and meticulously revised the manuscript. The response document is provided as an attachment, where the line numbers in replies refer to the revised manuscript, while those in the comments refer to the original manuscript. We hope the revised manuscript now meets the publication standard of the Hydrology and Earth System Sciences.

Comment 1. I recommend that the authors consider adjusting or restructuring the paragraphs in the introduction section. The logical flow and overall storyline of the Introduction are currently not entirely smooth. For example, the authors state that "Estimating the storage capacity loss induced by sediment accumulation and reconstructing the WLS curve provides a new direction for the second category of methods," but no clear background or justification is provided to connect this statement with the earlier discussion. Prior sentences only mention that sediment accumulation leads to reservoir storage loss, without adequately building the context for why reconstructing the WLS curve becomes a new methodological direction. Additional examples of logical inconsistencies are noted in my minor comments section.

Reply: Thanks for your valuable comment. We have restructured the paragraph of the Introduction Section in Lines 106-128. The possible effects of sediment on reservoirs, especially on flood control operation, are introduced first. Then, the development of *Te* is described to better highlight the core methodology. Finally, the shortcomings investigated by current studies are summarized, such as, few studies have investigated the validity of reconstructing the WLSV curve based on sediment accumulation, and there has been insufficient attention to the practical effectiveness of the reconstructed curve. Therefore, Using the estimation of storage capacity loss induced by sediment accumulation to reconstruct the WLSV curve provides a new direction for the second category of methods for reconstructing WLSV curves.

Newly cited references (highlighted in red in the manuscript):

Brown, C. B.: Discussion of sedimentation in reservoirs by B. J. Witzig, Proceedings of the American Society of Civil Engineers, 69, 1493–1500, 1944.

Moragoda, N., Cohen, S., Gardner, J., Muñoz, D., Narayanan, A., Moftakhari, H., and Pavelsky, T. M.: Modeling and Analysis of Sediment Trapping Efficiency of Large Dams Using Remote Sensing, Water Resources Research, 59, e2022WR033296, https://doi.org/10.1029/2022WR033296, 2023.

Ren, S., Gao, Y., Wang, W., Zhou, Y., and Zhao, H.: Estimating Sediment Trap Efficiency of Flood Events During Flood Season in the Three Gorges Reservoir, Water Resources Research, 60, e2023WR036975, https://doi.org/10.1029/2023WR036975, 2024.

Tan, G., Chen, P., Deng, J., Xu, Q., Tang, R., Feng, Z., and Yi, R.: Review and improvement of conventional models for reservoir sediment trapping efficiency, Heliyon, 5, e02458, https://doi.org/10.1016/j.heliyon.2019.e02458, 2019.

Comment 2. I suggest that the authors add appropriate references throughout the manuscript, particularly when providing background information in the Study Area and Data section (e.g., indicating the sources of the data) and in the Methodology section. Providing references would enhance the transparency and credibility of the study. In addition, it would be helpful if the authors could clarify the rationale behind the selection of the study area and the specific reservoirs.

Reply: Thanks for your valuable comment. We have added the corresponding references (Wu et al., 2018; Yuan et al., 2022) to the Study Area Section when introducing the background of the Wujiang River Basin. In the Data Section, the water and sediment data utilized in this study were obtained from a professional engineering organization under a data-sharing agreement. We conducted rigorous quality control for the data, involving manual verification and rectification of anomalous and erroneous data. Please see Lines 187-190 in the revised manuscript.

Newly cited references (highlighted in red in the manuscript):

Wu, X., Xiang, X., Chen, X., Zhang, X., and Hua, W.: Effects of cascade reservoir dams on the streamflow and sediment transport in the Wujiang River basin of the Yangtze River, China, Inland Waters, 8, 216–228, https://doi.org/10.1080/20442041.2018.1457850, 2018.

Yuan J., Chen W., Yang C., and Xiong M.: Study on Sediment Retention and Reduction of Reservoirs in Wujiang River Basin, JWRR, 11, 249–259, https://doi.org/10.12677/JWRR.2022.113027, 2022.

Comment 5. For Equations (1) and (2), the authors make certain assumptions to simplify the derivation given that the loss rate (LR) is a key indicator in this manuscript, I suggest that the authors provide more detailed explanations of these assumptions for the benefit of the readers. In particular, it would be helpful to clarify why these assumptions were made, how they affect the methodology, and whether there are existing references that support or justify them.

Reply: Thanks for your valuable comment. This study adopted the multi-year average sediment concentration data of inflow water for each reservoir. The results calculated based on these data reflect the multi-year average reservoir capacity loss, thus we assume that the sediment is uniformly distributed in the bottom and the deposition velocity is the same every year. If detailed annual sediment concentration data of reservoir inflows were available, the methodology proposed in this study could also be applied to estimate annual reservoir capacity loss. The relevant explanations have been added to Lines 211-214 in the revised manuscript.

Comment 4. I suggest that the authors consider creating a table listing all abbreviations used throughout the manuscript for easier reference. Additionally, while the abbreviations for each reservoir are defined and used in the figures and text, the writing in Section 4.1 inconsistently switches between full names and abbreviations. For consistency and to improve readability, I recommend using the reservoir abbreviations throughout the text, especially since the figures present the abbreviations as well.

Reply: Thanks for your comment. A comprehensive list of abbreviations has been added, explicitly defining the abbreviation conventions for reservoir names. The entire manuscript has been revised to consistently use abbreviations (with full names introduced at first mention) in both text and figure.

Table 1. Full names used in articles and their corresponding abbreviations

Full name	Abbreviation
water level-storage volume	WLSV
loss rate	LR
Hongjiadu	HJD
Dongfeng	DF
Suofengying	SFY
Wujaingdu	WJD
Goupitan	GPT
Silin	SL
Shatuo	ST
Dahuashui	DHS
Geliqiao	GLQ

Comment 5. The discussion section should be strengthened and expanded. Specifically, the authors could provide a more detailed comparison of their WLS curve reconstruction method with other existing approaches. Additionally, the current discussion (Lines 491–499) may not be sufficient to fully demonstrate the reasonableness of the reconstructed WLS curves. I encourage the authors to elaborate further on the topic of "Reasonableness and uncertainty in reconstructed reservoir WLS curves".

Reply: Thanks for your valuable comment. We have supplemented the comparison of our reconstruction method for WLSV curve with other approaches. Gui (2025) reconstructed the WLSV curves of HJD Reservoir using Sentinel-1 SAR data, estimating capacity losses of 65 million m^3. Our estimated sediment-induced capacity loss for the same reservoir (69.5 million m^3) shows strong consistency with these results. Furthermore, Pei (2021) validated the rationality of simplified mathematical functions (third-order polynomial fitting) for WLSV curve reconstruction by combining terrestrial 3D laser scanning and unmanned vessel bathymetry, which aligns with our methodological framework.

Furthermore, uncertainties in WLSV curves potentially affect the estimation accuracy of water level and operational reliability. Previous study on the Three Gorges Reservoir (Jia et al., 2021) shows that the reasonableness and uncertainty of WLSV curves critically affect operational reliability: the maximum errors in simulated water level and hydropower output were 3.0 m and 50×10^4 kW when using WLSV scatter points, respectively, but decreased to 2.2 m and 29×10^4 kW with fitted WLSV curve. That results demonstrate that uncertainties in WLSV curves can lead to deviations in reservoir scheduling calculations, thereby impacting power generation efficiency and flood risk management. Relevant content has been added to Lines 513-519 and Lines 525-532 in the revised manuscript.

Newly cited references (highlighted in red in the manuscript):

Gui, X., Ma, Q., Li, J., Duan, Z., Xiong, L., and Xu, C.-Y.: Reconstructing Reservoir Water Level-Area-Storage Volume Curve Using Multi-source Satellite Imagery and Intelligent Classification Algorithms, Water Resour Manage, https://doi.org/10.1007/s11269-025-04205-7, 2025.

Pei, J., Yao, C., Deng, Z., Ren, Z., and Yang, Y.: The Application of 3D Laser Scanning and Unmanned Ship Sounding in the Reexamination of Reservoir Storage Capacity, IOP Conf. Ser.: Earth Environ. Sci., 719, 042052, https://doi.org/10.1088/1755-1315/719/4/042052, 2021.

Jia, B., Zhou, J., Chen, X., Tian, M., and Zhang, Y.: Fitting reservoir stage-capacity curves and its application in reservoir operation, Journal of Hydroelectric Engineering, 40, 89–99, https://doi.org/DOI: 10.11660/slfdxb.20210209, 2021.

Comment 6. Could the authors elaborate on the potential policy implications of this study? How can decision-makers apply these findings to real-world water resource management?

Reply: Thanks for your valuable comment. In the newly added Section 5.2 (Lines 557-569), we analyze the policy implications arising from the study's findings and their insights for reservoir management, as follows: As current design WLSV curves underestimate flood regulation risk, reservoir operations should strengthen sediment accumulation monitoring and conduct periodic recalibration of WLSV curves for high LR reservoirs as mandated by Code for Reservoir Hydrologic and Sediment Survey (2006), to mitigate the negative impacts on the operational efficiency. Furthermore, reservoirs in the upper-middle Wujiang River suffer serious capacity loss from sediment accumulation. For such reservoirs, the reservoir operator should implement optimization of operational strategies to minimize sediment accumulation in the reservoir area. If necessary, the operators should also take engineering measures such as mechanical desilting to restore reservoir capacity.

Newly cited references (highlighted in red in the manuscript):

Ministry of Water Resources of the People's Republic of China: Code for Reservoir Hydrologic and Sediment Survey, SL339-2006, 2006.

Minor Comments:

Comment 1. Lines 60 – 63; and 69: Please add appropriate references.

Reply: Thanks for your comment. We have added the corresponding references in Line 62 and 69.

Newly cited references (highlighted in red in the manuscript):

Cao, W. and Liu, C.: Advance and prospect in research on reservoir sediment control and functional restoration, Water Resources and Hydropower Engineering, 49, 1079–1086, https://doi.org/10.13243/j.cnki.slxb.20180655, 2018.

Li, Q., Yu, M., Lu, G., Cai, T., Bai, X., and Xia, Z.: Impacts of the Gezhouba and Three Gorges reservoirs on the sediment regime in the Yangtze River, China, Journal of Hydrology, 403, 224–233, https://doi.org/10.1016/j.jhydrol.2011.03.043, 2011.

Comment 2. Lines 102 – 105: Consider rewriting these sentences for clarity, as the meaning feels vague based on the previous paragraph. In the earlier paragraph, the authors mention that the first method involves topographic surveys to estimate reservoir storage capacity. However, these lines suggest that most reservoirs have not yet conducted storage capacity estimations. Please clarify — do you mean that most methods have not directly estimated storage capacity?

Reply: Thanks for your comment. In the previous paragraph, the first method of estimating reservoir capacity by topographic survey was introduced, and then its shortcomings, i.e., long survey period, complex topographic conditions and high cost, were mentioned immediately afterward. Therefore, it is expressed that due to the shortcomings of the methods mentioned in the previous paragraph, most of the reservoirs have not yet conducted storage capacity rechecking, rather than that most methods have not directly used to estimated storage capacity. Lines 103-106 have been rewritten to avoid ambiguity.

Comment 3. Lines 114 - 116: Please add appropriate references.

Reply: Thanks for your comment. We have added the corresponding references. Please see Line 124 in the revised manuscript.

Newly cited references (highlighted in red in the manuscript):

Jia, B., Zhou, J., Chen, X., Tian, M., and Zhang, Y.: Fitting reservoir stage-capacity curves and its application in reservoir operation, Journal of Hydroelectric Engineering, 40, 89–99, https://doi.org/DOI: 10.11660/slfdxb.20210209, 2021.

Comment 4. Lines 116 - 118: The logical flow is not smooth; no prior background about flood regulation has been introduced. Please consider revising for better connection and clarity

Reply: Thanks for your comment. We have reorganized the structure of the paragraph to ensure articulation and logical clarity by introducing background at the beginning of the paragraph through the impact of sediment on reservoir flood regulation. Please see Lines 107-129 in the revised manuscript.

Comment 5. Line 133: What is meant by “flood prevention operation”? Is this intended to mean "flood control operation"? Please clarify.

Reply: Thanks for your detailed comment. We have changed “flood prevention operation” to “flood control operation” and have proofread the entire manuscript. Please see Line 144 in the revised manuscript.

Comment 6. Line 151: A period is missing after “Fig. 1.”

Reply: Thanks for your detailed comment. We have added the period after “Figure 1.” and proofread the entire manuscript. Please see Line 162 in the revised manuscript.

Comment 7. Line 171 and Figure 1: Should “GLT” be corrected to “GLQ”? Please double-check.

Reply: Thanks for your detailed comment. We have proofread and standardized the abbreviations throughout the manuscript and added a table of abbreviations. Please see Line 182 in the revised manuscript.

Comment 8. Line 223: Again, a supporting reference is needed here.

Reply: Thanks for your comment. We have added the relevant literature for Section 3.2. Please see Lines 242- 246 in the revised manuscript.

Newly cited references (highlighted in red in the manuscript):

Cao, W. and Liu, C.: Advance and prospect in research on reservoir sediment control and functional restoration, Water Resources and Hydropower Engineering, 49, 1079–1086, https://doi.org/10.13243/j.cnki.slxb.20180655, 2018.

Wang, X.: The calculation method of reservoir water level ~ capacity curve based on DEM used by VBA, Water Sciences and Engineering Technology, 31–33, https://doi.org/DOI:10.19733/j.cnki.1672-9900.2018.02.010, 2018.

Comment 9. Lines 239 – 240: Please ensure the formatting of symbols is consistent with the rest of the manuscript.

Reply: Thanks for your detailed comment. We have proofread the formatting of formulas and symbols throughout the manuscript.

Comment 10. Line 270: Please specify a unit for “Vrain.”

Reply: Thanks for your detailed comment. We have added the unit m^3 for “V_{rain}”. Please see Line 291 in the revised manuscript.

Comment 11. The symbol “*I*” is used with different meanings across equations. Please consider using distinct symbols to avoid confusion and ensure consistency.

Reply: Thanks for your detailed comment. We have modified the formula variables throughout the manuscript to ensure that there is no mixing of the symbol “*i*”.

Comment 12. Line 311: "Figure. 3" should be corrected to "Fig. 3." Please ensure consistent formatting of figure references throughout the manuscript.

Reply: Thanks for your detailed comment. We have proofread and standardized the abbreviations throughout the manuscript.

Comment 13. line 411: “Section 3.2” should be “Section 4.2”?

Reply: Thanks for your detailed comment. We have corrected “Section 3.2” to “Section 4.2” and proofread the entire manuscript. Please see Line 447 in the revised manuscript.

Comment 14. Line 487: Please add a space before "On the other..."

Reply: Thanks for your detailed comment. We have added the missing spaces and proofread the entire manuscript. Please see Line 538 in the revised manuscript.

Comment 15. Lines 507 – 509: Please double-check these sentences for accuracy and consider rewriting them for clarity.

Reply: Thanks for your detailed comment. We have reorganized the sentence structure to ensure smooth logic. Please see Lines 578-580 of the revised manuscript.