Reviewer #1:

The study proposes a capacity loss rate (LR) index to reconstruct the water level-storage (WLS) relationship of reservoirs, utilizing measured water/sediment data and operational records. The suitability of the proposed method is evaluated through water balance principles and comparison with traditional approaches. Subsequently, the impact of reconstructed WLS curves on reservoir flood control and operation is quantified using a flood regulation algorithm with varying design inflow scenarios. The experimental design from WLS curve reconstruction to flood operation impact assessment is systematic. While the proposed methods offer practical values for reservoir management, issues remain in language expression and method application. Therefore, I recommend Major Revision for this manuscript. The detailed comments are as follows.

Reply: Thanks for your time and invaluable comments, which have substantially improved the study. Based on your comments, we have carefully revised the paper. Please find the detailed point-by-point response to the reviewers' comments in the attachment. The comments have been replied one by one in this document.

The line numbers in the responses below refer to the revised manuscript, while the line numbers in the comments refer to the original manuscript. We hope the revised manuscript can meet the publication standard of the Hydrology and Earth System Sciences at this time.

Comment 1. The terms "Fig." and "Figure" are used interchangeably in the manuscript. Please standardize to one format for consistency. Additionally, proofreading by a native English speaker should be conducted to improve overall language quality.

Reply: Thanks for your valuable comment regarding the language in the manuscript. We have standardized all references to "Figure" (e.g., Figure 1). Further, we engaged a native English speaker to polish the manuscript, improving both language and organization.

Comment 2. This study uses the sediment deposition rate (Te) to calculate LR. It is recommended to introduce the concept and development history of Te in Introduction Section and reduce the examples of traditional methods to better highlight the study's core methodology.

Reply: Thanks for your valuable comment. We have added a brief introduction to the *Te* in the Introduction Section and listed typical approaches for calculation its values, along with corresponding references (e.g., Brown, 1944; Moragoda et al., 2023; Ren et al., 2024, …etc.). Please see Lines 115-123 in the revised manuscript.

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 3. For 2.1 Section of the study area, in Line 151, a period is missing after "Fig. 1". Please revise throughout the manuscript. In Line 152, the phrase "the Wujiang River Basin has aggravated the interception of sediment" should be reworded to "sediment interception in the basin has increased".

Reply: Thanks for your valuable comment. We have added the missing period after "Fig. 1" in Line 162 and the phrase in Line 163-164 has been revised to "sediment interception in the basin has increased" to clarify the intended meaning.

Comment 4. In Methods Section, since the Brune model is an empirical model based on U.S. reservoir siltation survey data, its applicability to reservoir siltation calculation in China may be limited. It is suggested to add a discussion on the model's applicability, supported by relevant literature.

Reply: Thanks for your valuable comment. We introduced four other empirical models commonly used to compare them with the selected Brune model, in Section 3.1 (Lines 222-226). The results shows that the Brune model demonstrates better applicability while the Gill and Jothiprakash (coarse sediments) models yield clearly unreasonable results (notably *Te* = 1.001 > 1 at HJD reservoir), the Brown model overestimates *Te* in three large reservoirs (HJD, WJD, GPT; 0.946-0.990), and the Jothiprakash (medium sediments) model underestimates *Te* in three small reservoirs (SFY, ST, GLQ; 0.604-0.736). Furthermore, the *Te* value derived from the Brune model for WJD Reservoir (0.885) closely matches the result determined by Li and Jin (2014) using hydrological station data (0.88). Fu and He (2007) and Tan et al. (2019) additionally confirm the Brune model's suitability for reservoirs in the Yangtze and Lancang River basins. Please see the details in Lines 539- 547 of the revised manuscript.

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

Fu, K. and He, D.: Analysis and prediction of sediment trapping efficiencies of the reservoirs in the mainstream of the Lancang River, Chin. Sci. Bull., 52, 134–140, https://doi.org/10.1007/s11434-007-7026-0, 2007.

Li, J. and Jin, Z.: Studying the reservoir sedimentation problem in upper Yangtze River by trap efficiency method, 416–420, 2014.

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 5. In 3.1, according to Eq. 1, as ni in the denominator increases, the reservoir capacity loss rate LRi also increases. This implies that LR grows over time, suggesting an unrealistic scenario where reservoirs would silt up indefinitely. Please clarify the constraints of this equation to reflect real-world limitations.

Reply: Thanks for your valuable comment. For physical constraints: According to Hua (2014), the sediment measurements at WJD Reservoir in 1989 and 2012 showed the sediment accumulation of 210 million m^3 and 186.8 million m^3, respectively. Our calculated result (180.3 million m^3, LR=7.84%) aligns closely with this value. Further analysis reveals that the sediment accumulation of WJD Reservoir has slowly decreased in recent years due to enhanced sediment retention by upstream reservoirs and the "Returning Farmland to Forests and Grasslands" policy. In addition, sediment is susceptible to being washed away due to the high variability of the reservoir water level. These real-world factors collectively constrain the continuous growth of LR.

For mathematical parameter constraints: In Eq. (1), n_i in the denominator represents the temporal interval of recorded data, which is bounded by the service life of reservoirs (typically$\leqslant$100 years), thereby imposing a theoretical upper limit on LR. Furthermore, the parameters Q_i (the multi-year average inflow water volume at the dam site) and w_i (the long-term average sediment contained in the inflow water) are dynamic variables. Their values evolve with watershed management practices, reservoir operation strategies, and climatic changes, further curbing the long-term growth trend of LR.

In summary, Eq. (1) inherently incorporates constraints from both physical processes and mathematical parameter, ensuring that LR cannot increase indefinitely as n_i increases.

Comment 6. The study establishes Brune model to calculate Te, but multiple approaches exist for this purpose. It is recommended to compare the results with those from other models in the Methods section to strengthen methodological robustness.

Reply: Thanks for your valuable comment. Thanks for your valuable comment. We introduced four other empirical models commonly used to compare them with the selected Brune model, in Section 3.1 (Lines 222- 226). The results shows that the Brune model demonstrates better applicability, while the Gill and Jothiprakash (coarse sediments) models yield clearly unreasonable results (notably Te = 1.001 > 1 at HJD reservoir), the Brown model overestimates Te in three large reservoirs (HJD, WJD, GPT; 0.946-0.990), and the Jothiprakash (medium sediments) model underestimates Te in three small reservoirs (SFY, ST, GLQ; 0.604-0.736). Please see Lines 345- 356 in the revised manuscript.

Comment 7. The reservoir exhibits complicated morphometry, with significant variations in water depth and width. In the current study, several reservoirs (e.g., Hongjiadu and Goupitan) also cover extensive surface areas. On the other hand, the authors employ mathematical functions with exponential, polynomial and power function forms in Eqs. (3-5) to estimate reservoir water storage changes. Please address potential errors induced by the simplified estimation formula. Could the accuracy of the WLS curve be improved by subdividing the reservoir into smaller sections based on morphometry and summing their contributions?

Reply: Thanks for your constructive comment. Although summing several subsections could improve accuracy, it would require detailed bathymetric data (e.g., high-resolution DEMs of reservoir areas, measured underwater topography, and cross-sectional hydrological profiles), which is indeed unavailable in the present study. We use various mathematical function types including exponential, polynomial and power functions in the quantitative representation of WLSV curve to reduce modeling errors. Additionally, we plan to explore more refined methods in future studies.

Comment 8. In Eqs. (3-5), the water level (Z) is treated as the response variable, while the reservoir water storage is the explanatory variable, Yet, the reservoir WLS curve reconstruction is evaluated based on the water storage variable. This inconsistency needs clarification.

Reply: Thanks for your valuable comment. In Eqs. 7-9, when water level (*Z*) is treated as the explanatory variable, the function exhibits poor fitting performance for the WLSV curve. For instance, the R^2 is 0.91 at HJD Reservoir. However, the R^2 significantly improves to 0.99 when water level (*Z*) is instead designated as the response variable. Consequently, we selected water level (*Z*) as the response variable in our study. For practical applications, the mathematical function can be inverted to derive water level (*Z*) as the explanatory variable. Please see Lines 241-245 in the revised manuscript.

Comment 9. In Figure 1, the abbreviation for the "GLT" reservoir should be corrected to "GLQ" (Geliqiao).

Reply: Thanks for your comment. The abbreviation for "Geliqiao Reservoir" in Figure 1 has been corrected to "GLQ", with consistency verified throughout the manuscript. Please see Line 181 in the revised manuscript.

Comment 10. The Discussion Section should include a comparison of your WLS curve construction method with other existing approaches. Additionally, please elaborate on how the accuracy of WLS curve impacts the reliability of the water storage estimation.

Reply: Thanks for your valuable comment. We have supplemented the comparison of our WLSV curve construction method 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. This analysis 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 11. The abbreviations in the text and figures should be independent of each other. It is recommended that the corresponding vocabulary of the reservoir name abbreviations should also be clearly stated in the data methods in the manuscript text.

Reply: Thanks for the useful 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