MS No.: egusphere-2026-1124

Title: Reservoir-Induced Seismicity in China: Systematic Characterization and Implications for Hazard Assessment

Author Response to the First Referee

We sincerely thank Dr. Abhineet Gupta for his thorough and constructive review comments. Below, we provide a point-by-point response to each comment. All modifications to the manuscript are highlighted in the revised text.

General Response: We are grateful to Dr. Abhineet Gupta for his detailed and insightful comments. In response, we have made substantial revisions to the manuscript, including: (i) explicit acknowledgment of the spatiotemporal uniformity assumption in the W-score framework (Section 4 and Discussion); (ii) addition of *Supplementary Material* S2 validating the W-score model with four independent reservoirs; (iii) systematic clarification of terminology and references in the Introduction; (iv) tempering of causal language regarding pore-pressure diffusion; and (v) correction of typographical errors and figure captions as noted. All textual changes are incorporated into the revised manuscript and are traceable in this response.

[1] For majority of their analysis and for constructing the W-score, the authors have made a crucial assumption: Both the spatial and temporal behavior of induced earthquakes is uniform throughout China, and across all geologies. This assumption of uniformity in the authors' analysis is a major limitation as their data covers a very large geographical area. However as one of the first studies exploring this relationship, this first order assumption is reasonable, but I suggest listing it clearly in the manuscript.

RE: We thank the reviewer for this critical observation. We fully agree that the assumption of spatiotemporal uniformity, while necessary for a first-order national-scale model, constitutes a major limitation given the vast geographical and geological diversity of our dataset.

We have now explicitly acknowledged this assumption in two places. First, in Section 4, immediately before introducing the W-score equations, we state that "**the characteristic distance decay and post-impoundment time lag are treated as statistically uniform across all tectonic provinces and reservoir geologies**" as a deliberate first-order simplification to obtain a robust nationwide baseline, while noting that this neglects regional variations in crustal permeability, stress regime, and lithology. Second, in Section 7 (Discussion), we have inserted a dedicated paragraph elaborating that this ensemble-average approach may underestimate RIS potential in high-permeability extensional regimes or overestimate it in stable cratonic interiors, and we identify the development of region-specific W-score variants as a key direction for future research.

We believe this explicit framing strengthens the manuscript by accurately calibrating the scope and limitations of our national-scale findings without diminishing their value as an exploratory baseline for China's RIS hazard assessment.

[2] The authors have demonstrated their W-score for only 1 reservoir, which makes it

difficult to determine its effectiveness for other reservoirs. Suggest providing additional examples to support the score effectiveness.

RE: We sincerely thank the reviewer for raising this critical point. We fully agree that relying solely on the Jinping-I Reservoir to illustrate the W-score model limits the reader's ability to assess the method's portability and robustness across China's highly heterogeneous geological and hydrological environments. To address this concern, we have prepared a new *Supplementary Material section* (S2) that provides systematic validation of both the manual identification protocol and the W-score model using four additional reservoirs: **Xiluodu, Xiangjiaba, Guangzhao, and Shuikou**.

These supplementary cases were deliberately selected to span the broad range of settings represented among the 88 identified induced-type reservoirs:

Tectonic regimes: from the high-strain, fault-intersected canyon reaches of the eastern Tibetan Plateau margin (Xiluodu, Xiangjiaba) to relatively stable intraplate blocks lacking surface active faults (Guangzhao in Guizhou, Shuikou in Fujian).

Reservoir geometries: canyon-type, sinuous, compact, and wide-valley configurations.

Storage capacities: ranging from 23.4×10^8 m^3 to 126.7×10^8 m^3.

For each case, we present the same diagnostic evidence used for Jinping-I in the main text:

Spatial-temporal identification maps (Figs. S2, S4, S6, S8) showing manually delineated induced-seismicity clusters, distance-from-shoreline normalized frequency distributions (for multiple completeness magnitudes M_C = 2.0, 2.5, and 3.0), and cumulative-frequency temporal analyses.

W-score distributions (Figs. S3, S5, S7, S9) demonstrating the segregation of induced earthquakes into the high-probability region ($0.6 < W < 1.0$) and background earthquakes into the low-probability region ($W < 0.4$).

The results consistently demonstrate that:

The diagnostic signatures of reservoir-induced seismicity—sharp post-impoundment increase in activity, pronounced spatial clustering in near-shoreline zones, and temporal behavior clearly separable from background seismicity—remain robust across all tested environments.

The W-score model independently recovers the manually identified induced sequences in every case, confirming that the manual cluster boundaries are not arbitrary but reflect genuine seismogenic responses to impoundment.

The spatial confinement of induced sequences to the near field and their characteristic temporal delay relative to impoundment further support the pore-pressure-diffusion-dominated mechanism discussed in the main text.

In the revised manuscript, we have added a sentence in Section 4 (where the W-score is introduced) noting that the model has been validated on multiple independent reservoirs spanning contrasting geological conditions, with full details provided in *Supplementary Material* S2. We have also uploaded Figs. S2~S9 as part of the revised submission's *Supplemental Material*.

For the reviewer's convenience, the complete text of *Supplementary Material* S2 is reproduced below.

Supplemental Material

Article: Reservoir-Induced Seismicity in China: Systematic Characterization and Implications for Hazard Assessment

Authors: *Jiashan Zhang, Changsheng Jiang*, Fengling Yin, Yiming Zhu, Hongyu Zhai, Jinmeng Bi, Yan Zhang*

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S1. Validation of induced-seismicity identification and the W-score model across diverse reservoir settings

The main text establishes a unified identification framework that couples manual spatiotemporal clustering criteria with a probabilistic W-score model to systematically detect reservoir-induced seismicity (RIS) at the national scale. Operationally, three concurrent criteria are employed: (1) a significant post-impoundment increase in seismic frequency and intensity that is clearly distinguishable from pre-impoundment background levels; (2) pronounced spatial clustering of earthquakes, often exhibiting linear geometric features consistent with fault activation; and (3) close spatial association with the reservoir, typically within several tens of kilometers of the shoreline. While the Jinping-I Reservoir is presented in the main text as a representative illustration of this procedure, relying on a single case study inevitably limits the ability to assess the portability and robustness of the method across China's highly heterogeneous geological and hydrological environments. Indeed, the 88 identified induced-type reservoirs are distributed across markedly different tectonic regimes—from the high-strain eastern margin of the Tibetan Plateau to relatively stable intraplate blocks—and encompass a wide spectrum of reservoir geometries, ranging from narrow canyon-type impoundments to wide-valley configurations, and of storage capacities spanning more than an order of magnitude.

The **Xiluodu Reservoir**, a large (Type-1) canyon-type facility on the lower Jinsha River (capacity 126.7×10^8 m^3, first impounded 4 May 2013), exhibits a pronounced post-impoundment cluster in its northeastern sector (purple dashed line, Fig. S2) where pre-impoundment seismicity was weak and small events subsequently showed spatiotemporal aggregation near the shoreline, whereas clusters in the northern (~20 km) and southwestern (~10 km) fault-proximal zones were excluded because strong background activity and proximity to active faults preclude unambiguous separation from natural tectonic earthquakes, a distinction corroborated by normalized frequency and cumulative-frequency analyses for $M_C = 2.0$, 2.5, and 3.0 (Fig. S2b–c) and by the W-score table (Fig. S3), where induced earthquakes (circles) plot in the high-probability yellow-green region ($0.6 < W < 1.0$) and background events (squares) concentrate in the low-probability blue-cyan region ($W < 0.4$). The **Xiangjiaba Reservoir**, a large sinuous facility on the Jinsha River (capacity 51.63×10^8 m^3, normal pool level ~380 m, impounded 10 October 2012), similarly shows intensified post-impoundment microseismicity within its purple dashed boundary; although the central cluster lies near a seismogenic belt, its near-reservoir location and brief temporal separation from background activity support its classification as an induced sequence (minor background contamination may be present but does not affect the statistical results), with cumulative frequency curves diverging ~250 days after impoundment (Fig. S4c), and its W-score distribution (Fig. S5) reproduces the high-versus-low segregation observed at Xiluodu. The **Guangzhao Reservoir** on the Beipan River in Guizhou Province (capacity 32.45×10^8 m^3, compact geometry, no active faults within the image area, impounded December 2007) displays a marked post-impoundment cluster within ~10 km of the shoreline in a previously quiescent zone, a dominant distance peak at 0~4 km (Fig. S6b), and a delayed onset relative to background seismicity (Fig. S6c), with its W-score diagram (Fig. S7) again placing induced events in the high-W zone and background events in the low-W zone. Finally, the **Shuikou Reservoir** on the Min River in Fujian Province (capacity 23.4×10^8 m^3, wide-valley type, no surface active faults, impounded 31 March 1993) generated dense swarms of micro-earthquakes within 10 km where background activity had been extremely weak (Fig. S8), a temporal delay verified by cumulative curves (Fig. S8c), and its W- score assessment (Fig. S9) shows the same induced-high/background-low pattern.

Collectively, these four supplementary cases demonstrate that the diagnostic signatures of reservoir-induced seismicity remain robust across markedly different geological settings, reservoir morphologies, and storage capacities. Despite variations in local tectonics—from active fault-intersected canyon reaches to stable blocks devoid of surface faulting—all four reservoirs exhibit induced sequences that display a sharp post-impoundment increase in activity, pronounced spatial clustering in near-shoreline zones, and temporal behavior clearly separable from background seismicity. Crucially, the W-score distributions consistently segregate these manually identified induced earthquakes into the high-W interval (0.6 < W < 1.0) while background natural tectonic earthquakes remain confined to the low-W region (W < 0.4). This congruence confirms that the manual selection boundaries are not arbitrary geometric delineations but reflect genuine seismogenic responses to reservoir impoundment that are independently recoverable by a quantitative probabilistic metric. Moreover, the spatial confinement of induced sequences to the near field and their characteristic temporal delay relative to impoundment further corroborate the pore-pressure-diffusion-dominated mechanism discussed in the main text, supporting the argument that the effective physical influence range of reservoir water extends considerably beyond the 10 km threshold currently prescribed in Chinese standards. By validating both the manual identification protocol and the W-score model under contrasting conditions, this supplementary section affirms that the combined methodology provides a reliable, reproducible framework for probabilistic RIS identification across China's diverse reservoir environments.

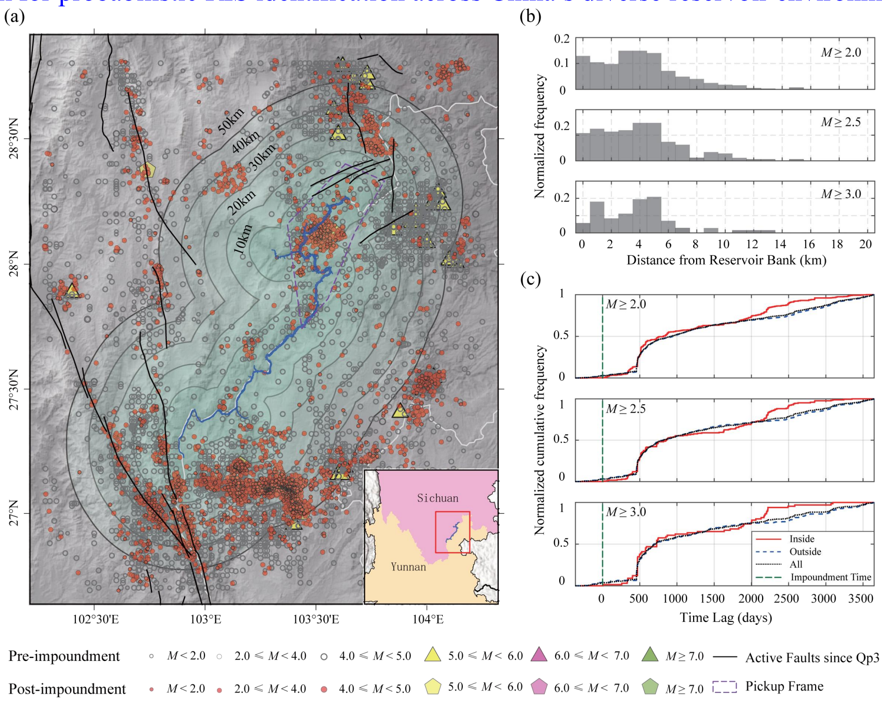


Fig. S2. Xiluodu Reservoir: example of induced seismicity sequence identification. (a) Reservoir boundary and spatial distribution of seismicity. Gray dots represent background seismicity recorded from 1970 to the initial impoundment (4 May 2013); red dots represent post-impoundment earthquakes; purple dashed lines outline the spatiotemporal cluster boundary of the induced sequence; black curves denote active faults since the Late Pleistocene; gradient green shading indicates zones within 10, 20, 30, 40, and 50 km of the reservoir shoreline. The inset shows the location of the study area. (b) Normalized frequency distribution of induced earthquakes as a function of distance from the reservoir shoreline (0~20 km range, 1 km bins). Subplots from top to bottom correspond to completeness magnitudes M_C = 2.0, 2.5, and 3.0. (c) Temporal comparison of cumulative earthquake frequency from one year before to ten years after initial impoundment. "Inside" denotes the induced sequence, "outside" denotes background seismicity, and "all" denotes all earthquakes; curves are normalized to their maximum values. The green vertical dashed line marks the time of initial impoundment. Subplots from top to bottom correspond to M_C = 2.0, 2.5, and 3.0.

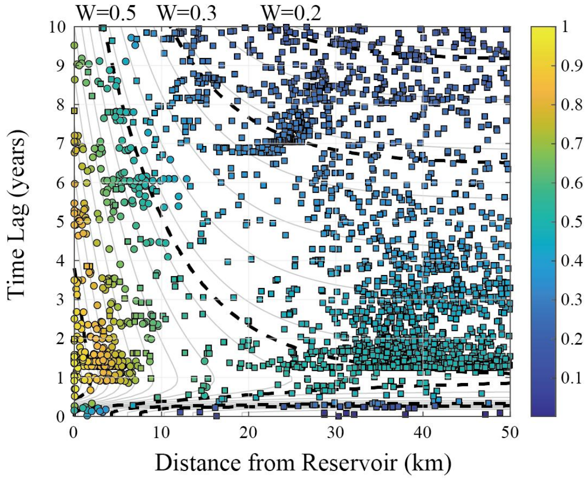


Fig. S3. Xiluodu Reservoir: W-score distribution of the earthquake catalog. Circles represent identified induced earthquakes, which cluster in the high-W yellow-green region; squares represent background earthquakes, concentrated in the low-W blue-cyan region.

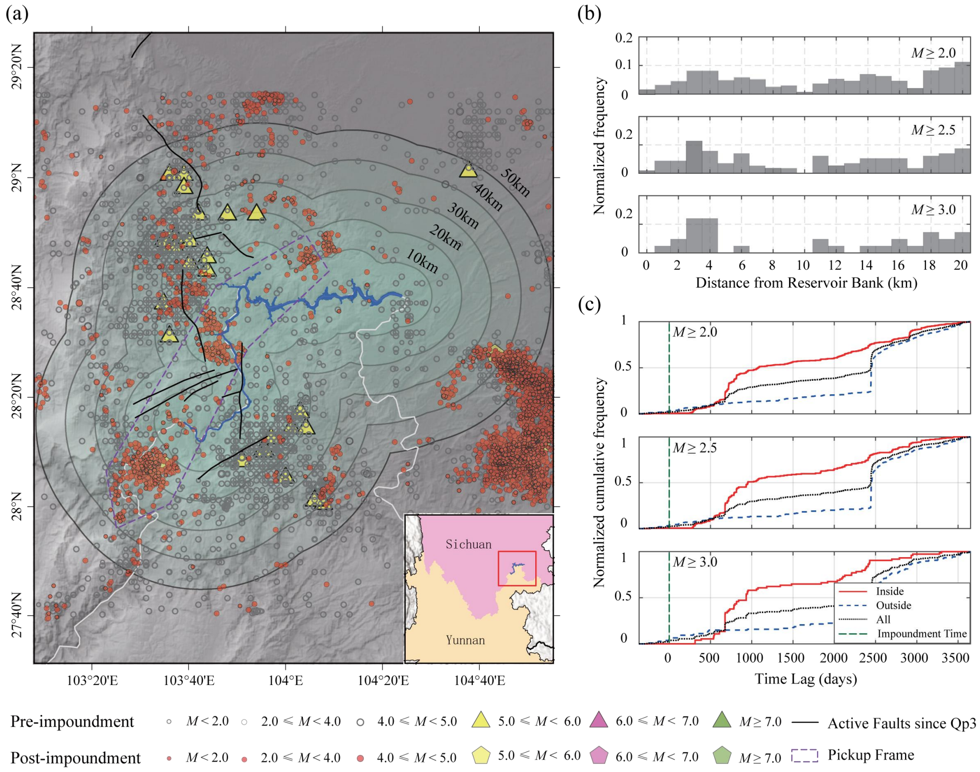


Fig. S4. Xiangjiaba Reservoir: example of induced seismicity sequence identification. Panel elements are identical to those in Fig. S2.

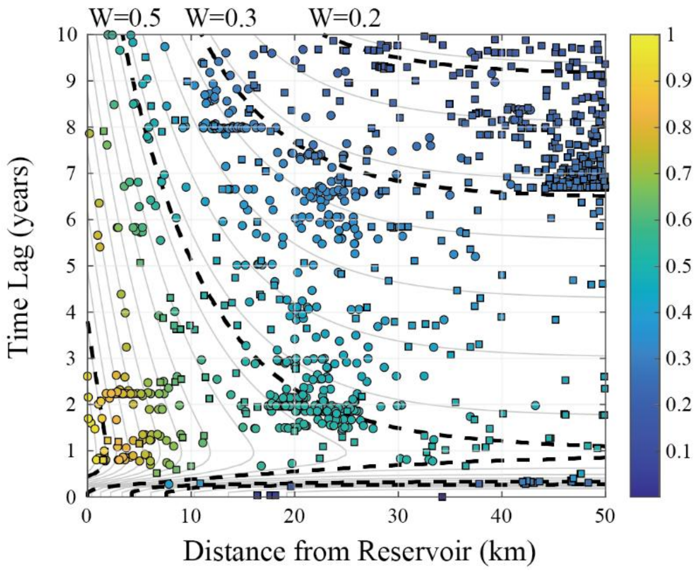


Fig. S5. Xiangjiaba Reservoir: W- score distribution. Symbols are as defined in Fig. S3.

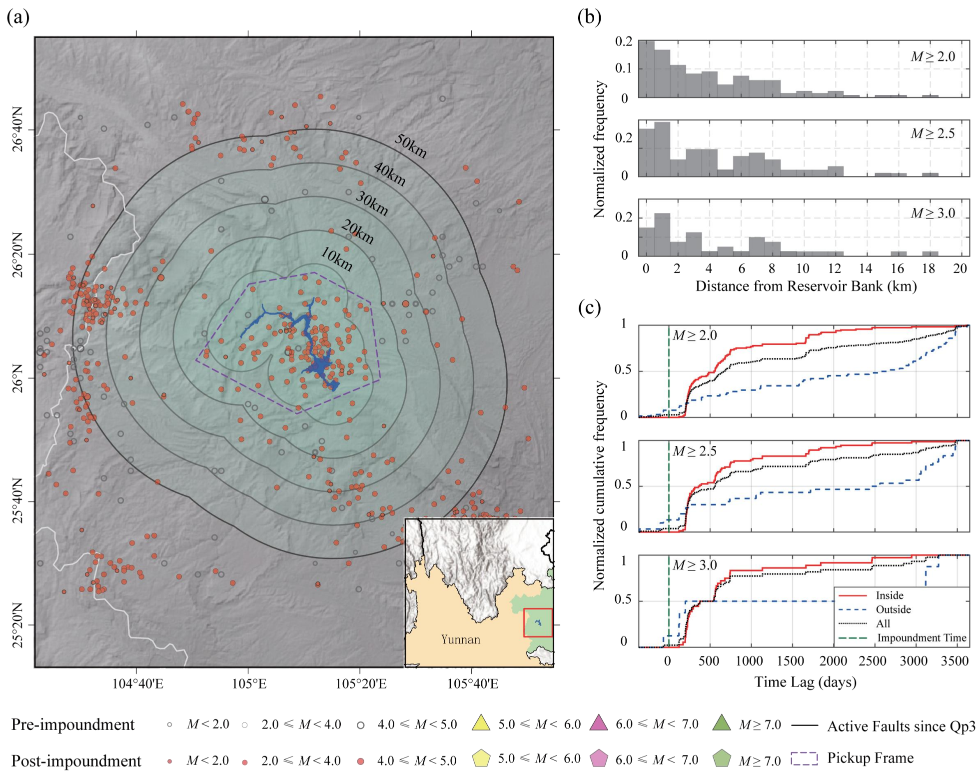


Fig. S6. Guangzhao Reservoir: example of induced seismicity sequence identification. Panel elements are identical to those in Fig. S2.

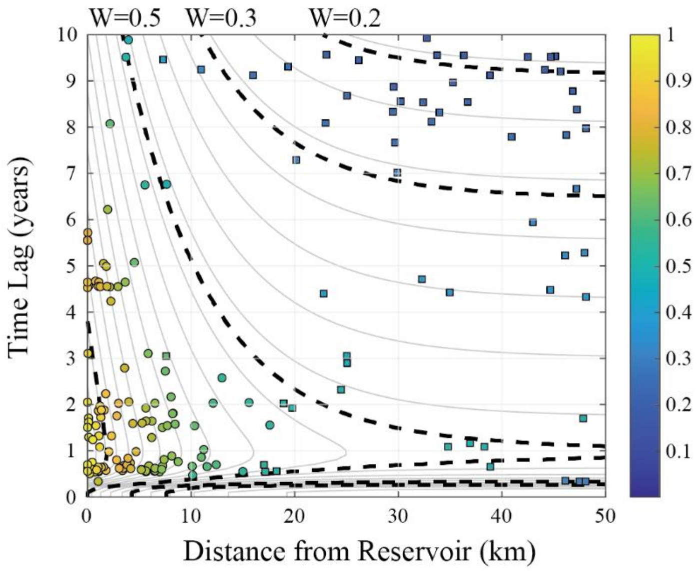


Fig. S7. Guangzhao Reservoir: W- score distribution. Symbols are as defined in Fig. S3.

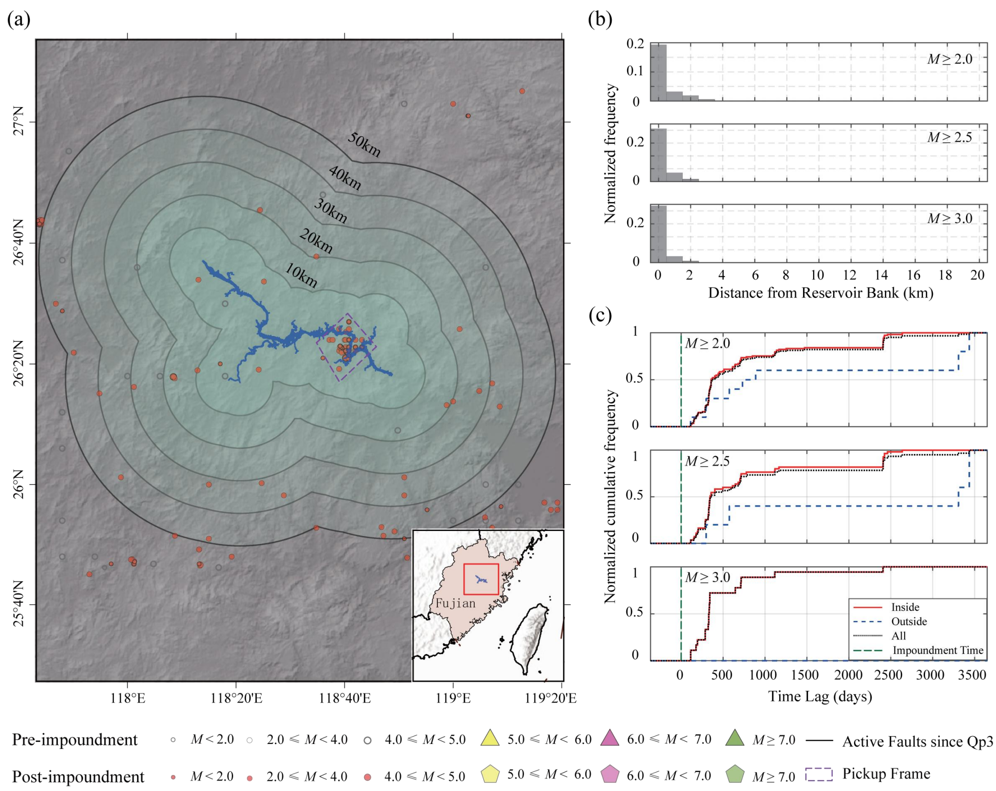


Fig. S8. Shuikou Reservoir: example of induced seismicity sequence identification. Panel elements are identical to those in Fig. S2.

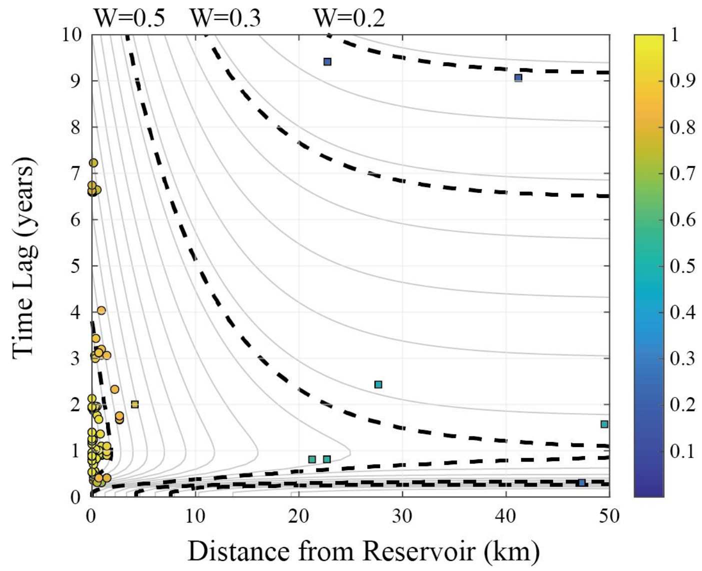


Fig. S9. Shuikou Reservoir: W-score distribution. Symbols are as defined in Fig. S3.

[3] Introduction: Please include references where missing. Please define non-typical terminology prior to first usage.

RE: We thank the reviewer for this important general comment regarding the self-containedness and accessibility of the Introduction. We have addressed it through a systematic, line-by-line review focusing on both bibliographic completeness and terminology clarity.

Missing references: We identified that the statement on China's current standards relying on "early international experience and static models" lacked a direct citation to the foundational literature representing that early experience. We have now added Gupta (2002)—the authoritative global review compiling early international RIS cases—and Simpson et al. (1988)—the source of the classical static-model typology—at this location. All other factual claims in the Introduction (regional characteristics in Canada, France, and Brazil; findings from Chinese case studies at Xinfengjiang, Three Gorges, and Xiluodu-Xiangjiaba) were already supported by the cited works. The claim that the Xinfengjiang case is "globally recognized" has also been substantiated by seminal international reviews (Talwani, 1997; Gupta, 2002) as detailed in our response to comment [17].

Non-typical terminology: We have ensured that every specialized term is defined at its first appearance. In addition to spelling out surface-wave magnitude (M_S) at its first appearance in the main narrative (see revised sentence in the Introduction discussing the Jinsha River cascade reservoirs), we have implemented the following definitions in the Introduction in response to related line-specific comments: (i) "screening sample" is now defined parenthetically as the initial pool of candidate reservoirs subjected to induced-seismicity screening; (ii) "induced-type reservoirs" is defined as those exhibiting spatiotemporally clustered seismicity significantly associated with impoundment; (iii) "RIS maximum magnitude" is clarified as the largest-magnitude event within the identified induced sequence for a given reservoir; and (iv) the ambiguous term "characteristic map" has been replaced with the self-explanatory phrase "comprehensive, multi-dimensional characterization". These changes ensure that readers from engineering, hazards-assessment, or non-seismological backgrounds can follow the manuscript without prior specialist knowledge.

[4] Introduction: Suggest adding a paragraph briefly describing the mechanism of induced earthquakes from reservoir impoundment, to improve understanding for unfamiliar readers.

RE: We sincerely thank the reviewer for this valuable suggestion. To improve accessibility for non-specialist readers, we have inserted a new paragraph in the Introduction (immediately following the opening paragraph and before the global review of national-scale studies). This paragraph briefly outlines the two primary triggering mechanisms of RIS—elastic loading (rapid, near-field stress changes) and pore-pressure diffusion (delayed, far-field pore-pressure increase along fractures and faults) — and explains how their interplay governs the characteristic spatiotemporal signatures (distance-dependent decay and post-impoundment time lag) analysed in this study. The added text is anchored by existing references already in our list (Talwani, 1997; Simpson et al., 1988) and provides the physical context necessary for interpreting the statistical findings and the W-score model developed in Sections 4 and 7.

[5] Line 195: Please describe the manual selection approach to facilitate understanding, e.g., how was it determined that seismic activity was clearly distinguishable from background activity (and not distinguishable), how was spatial clustering separated from natural spatial clustering, etc. for each of the 1435 reservoirs.

RE: We thank the reviewer for this important suggestion. We have retained our original rationale for using manual selection rather than automated ETAS or NND methods (Zhuang et al., 2002; Zaliapin et al., 2008; Bi and Jiang, 2019), but have now clarified in Section 3 that this manual selection was conducted through a standardized three-step protocol applied reservoir-by-reservoir to all 1,435 candidates. The protocol explicitly defines: (1) temporal distinguishability—requiring a sharp post-impoundment inflection in cumulative frequency curves, clearly separable from background; (2) spatial separability — distinguishing compact, near-shoreline induced clusters from diffuse natural clustering along major regional faults; and (3) spatiotemporal congruence—requiring temporal and spatial anomalies to coincide in the same near-reservoir volume. Representative applications of these rules, including examples of both accepted and rejected clusters, are provided in *Supplementary Material* S2.

[6] Line 676: Since the analysis of this study is purely statistical, the causal conclusion: spatiotemporal evolution is dominated by the pore pressure diffusion mechanism, cannot be strongly stated. Suggest tempering this conclusion and stating it as indicative from the analysis.

RE: Tempered causal language throughout. "Dominant mechanism" / "is related to" replaced with "consistent with... as a primary process" or "contributing mechanism"; added caveats that elastic loading effects in the near field are not excluded. Specific changes in Section 4, Discussion Line 676, and Conclusions Point 2.

[7] Line 681 and elsewhere: The conclusion is not as strongly demonstrated from the analysis as stated in the manuscript: The W-score model established based on these characteristics

effectively quantifies the spatiotemporal coupling effect, providing a new tool for the probabilistic identification of RIS events. Results were shown for only 1 reservoir. There is not enough information in the manuscript to determine whether the analysis was dominated by a handful of reservoirs that caused the most earthquakes, e.g., the Jinping-I reservoir, or the behavior is distributed among all reservoirs.

RE: We have revised Section 4 to clarify that the W-score (Eq. 3) is formulated from normalized dimensionless parameters, rendering it insensitive to absolute event counts. The four validation reservoirs in *Supplementary Material* S2 span order-of-magnitude differences in induced-seismicity intensity yet exhibit consistent W-score segregation, confirming that no single high-activity reservoir dominates the statistical signature. We have also tempered the Conclusions to frame the W-score as a "quantitative screening tool" rather than claiming it "effectively quantifies" spatiotemporal coupling.

[8] Line 23: "screening sample" in unclear.

RE: We thank the reviewer for pointing this out. We agree that "screening sample" was insufficiently clear and could be misinterpreted.

We have revised the Abstract to "a screening-eligible sample" to more accurately reflect that these 1,435 reservoirs constitute the pool of reservoirs meeting data-availability criteria (impoundment dates between 1971 and 2015, ensuring complete pre- and post-impoundment seismic records) for induced-seismicity assessment, from which the 88 induced-type reservoirs were identified.

[9] Line 25: "induced-type" is unclear.

RE: We thank the reviewer for highlighting this important issue. The term "induced-type reservoir" is introduced in our study as an operational classification for reservoirs whose post-impoundment seismicity exhibits clear spatiotemporal clustering significantly associated with impoundment, distinct from background tectonic seismicity. We acknowledge that this term was insufficiently explained at its first mention in the Abstract.

[10] Line 29: The sentence begins with "temporally", but describes a spatial relationship of 24.8 km. Please clarify.

RE: We thank the reviewer for catching this logical inconsistency. The reviewer is absolutely correct: the sentence was incorrectly introduced with "Temporally" while describing a spatial metric (24.8 km). This resulted from an oversight during manuscript drafting where two distinct observations—spatial decay and temporal lag—were merged under a single, incorrect transitional marker.

We have revised the Abstract (Lines 29~31) to clearly separate the spatial and temporal dimensions: "**In the near field, 95% of RIS events occur within 24.8 km of the reservoir shoreline. Temporally, the time lag (Time Lag) between impoundment and peak seismicity, together with the distance-dependent occurrence rate, follows patterns governed primarily by pore pressure diffusion, leading to the development of a W-score model for probabilistic RIS identification**."

[11] Line 38: Please list examples of "static reservoir parameters" to improve understanding.

RE: We thank the reviewer for this helpful suggestion. We agree that listing representative examples of "static reservoir parameters" at their first mention in the Abstract will significantly improve reader comprehension, particularly for those less familiar with reservoir engineering terminology.

We have revised the Abstract (Line 38) to explicitly introduce these parameters with concrete examples: "**Correlation analysis shows that static reservoir parameters (*e.g.*, reservoir capacity, dam height, and reservoir major axis length) are statistically intercorrelated; thus, only one parameter should be selected for hazard analysis**."

[12] Line 39: Is interdependent = correlated?

RE: We thank the reviewer for this important clarification. The reviewer is correct that "interdependent" implies a stronger bidirectional dependency than what our correlation analysis alone can demonstrate.

Our Pearson and Spearman correlation matrices show strong statistical correlations (r = 0.39~0.95, ρ = 0.59~0.95, P < 0.01) among static reservoir parameters, which likely arise from shared geometric constraints in hydropower engineering design (*e.g.*, dam height, reservoir capacity, surface area, and major axis length are mutually constrained by engineering specifications and topographic conditions). However, we acknowledge that these statistical correlations do not necessarily prove true physical interdependence.

[13] Line 46: "characteristic map" is unclear.

RE: We thank the reviewer for pointing out this ambiguity. The term "characteristic map" was intended to describe the first systematic, multi-dimensional characterization of reservoir-induced seismicity (RIS) patterns across China, integrating spatial distribution, spatiotemporal evolution, and sequence parameter features, rather than a literal map product.

To avoid confusion, we have revised this sentence in the Abstract (Line 46) to:

"**This study provides the first national-scale systematic characterization of RIS in China, a quantitative identification tool (W-score), and key engineering thresholds for RIS risk assessment in China, pointing towards future directions beyond traditional empirical models**."

[14] Line 72: What is meant by PGA > 0.1g, in relation to natural seismicity?

RE: We have clarified that PGA > 0.1g refers to a standard engineering seismic-hazard parameter. We now specify that it corresponds to the peak ground acceleration with 10% probability of exceedance in 50 years (approximately 475-year return period), consistent with Chinese national seismic-zonation standard GB 18306-2015.

[15] Line 76: Suggest restructuring sentence to improve clarity.

RE: We thank the reviewer for this valuable suggestion. The original sentence indeed suffered from a top-heavy structure in which a lengthy subject clause ("whether these patterns...") preceded the main verb ("remains"), hindering readability. We have restructured the sentence to improve clarity and logical flow. The revised text now reads:

"Consequently, a key scientific question is whether these patterns apply to the world's most active tectonic domains. Addressing this question remains urgent."

[16] Line 80, 84: Suggest adding Province (region) of Xinfengjiang Reservoir, Three Gorges Reservoir.

RE: We thank the reviewer for pointing out the lack of geographical information for the specific reservoirs. In addition to the Xinfengjiang Reservoir (Guangdong Province) and the Three Gorges Reservoir (Hubei Province and Chongqing Municipality) mentioned in Lines 80 and 84, we have also added provincial/regional identifiers for other reservoirs at their first mention in the revised manuscript: (1) Xiluodu and Xiangjiaba (Introduction): added "in southwestern China (Sichuan and Yunnan Provinces)"; (2) Guangzhao and Shuikou (Section 4): added their respective provinces (Guizhou and Fujian) when introducing them as validation cases for the W-score model.

[17] Line 80: Suggest adding references to support the case being globally recognized.

RE: We thank the reviewer for this valuable suggestion. We fully agree that the statement regarding the Xinfengjiang Reservoir being "globally recognized" requires authoritative international citations to substantiate the claim. Accordingly, we have added references to seminal review papers (Talwani, 1997; Gupta, 2002) at this location.

[18] Line 90: Suggest adding magnitude type, e.g., M_w, M_L, etc., instead of just representing using M, depending on how the magnitude is specified.

RE: Thank you for the suggestion. As recommended, we have specified the magnitude type at Line 90 . The generic "M" has been changed to "M_S" (surface-wave magnitude), which is the standard magnitude scale reported in the Chinese earthquake catalog for events of this size. The sentence now reads: "…a series of M_S>4.5 earthquakes…".

[19] Line 103: Please add reference for China's current risk assessment standards.

RE: We thank the reviewer for this constructive suggestion. As suggested, we have added the reference to the Chinese national standard GB/T 21075-2007 (Reservoir-induced earthquake hazard assessment) in the revised manuscript. The complete reference has also been included in the reference list. This addition provides a clear source for the risk assessment standards discussed in the paper.

[20] Line 109: Please define "characteristic map" prior to first usage for clarity.

RE: We thank the reviewer for this suggestion. To improve clarity without introducing an unexplained metaphor, we have replaced "characteristic map" with "a comprehensive, multi-dimensional characterization". This phrasing is self-explanatory in academic context and avoids the definitional ambiguity noted by the reviewer. The specific aspects characterized are elaborated in the following sections.

[21] Line 111: Please define "screening sample".

RE: We thank the reviewer for pointing this out. We have added a concise parenthetical definition at the first occurrence of "screening sample", clarifying that it refers to the initial pool of candidate reservoirs subjected to the induced-seismicity screening. This mirrors the terminology used for the final identified set of "induced-type reservoirs" discussed subsequently.

[22] Line 113: Please define "induced-type reservoirs".
RE: We thank the reviewer for this suggestion. We have clarified the term at its first occurrence (Line 113) by adding a parenthetical definition: "induced-type reservoirs" are those exhibiting spatiotemporally clustered seismicity significantly associated with impoundment. The detailed quantitative criteria and screening protocol are fully described in Section 3.

[23] Line 115: The sentence indicates questions, but the following list only includes statements. suggest restructuring sentence for clarity.
RE: We thank the reviewer for this careful observation. We have restructured the sentence to eliminate the mismatch between the introductory clause and the list items. Instead of framing the list as "core questions" followed by statements, we now use the verb "examines" to introduce four parallel noun phrases that summarize the scope of this work. This revision removes grammatical inconsistency without resorting to numbered or interrogative lists, thereby maintaining the flow of the introductory narrative.

The revised text reads:
"**Based on this, to date, the most complete national-scale RIS dataset, this paper systematically examines the spatial distribution pattern of RIS in China and its coupling with the regional tectonic background, the spatiotemporal evolution and sequence characteristics of induced seismicity, the statistical differences between RIS and natural earthquake sequences, and the quantitative correlations between reservoir attributes and the RIS maximum magnitude (defined as the largest magnitude within the identified induced sequence for a given reservoir)**."

[24] Line 122: Please define "RIS maximum magnitude".
RE: We thank the reviewer for this suggestion. We have added a concise parenthetical clarification at the first occurrence of "RIS maximum magnitude", stating that it refers to the largest-magnitude event within the identified induced seismicity sequence for a given reservoir.

[25] Line 154: Please list the most relevant advantages.
RE: We thank the reviewer for this helpful suggestion. We have revised the comparative statement in Section 2 to explicitly list the most relevant advantages of the CRD over mainstream international databases.

The added text now clarifies that:
(i) Coverage: the CRD contains ~97,435 reservoirs in China, roughly 1~2 orders of magnitude more than the Chinese subsets of GRanD, GeoDAR, or GOODD;
(ii) Small-reservoir completeness: it achieves near-complete mapping of reservoirs <1 km^2 (and especially <0.1 km^2), which constitute the vast majority of China's reservoirs but are largely missing from global databases;
(iii) Spatial resolution: reservoir boundaries are vectorized from high-resolution satellite imagery

(including 10 m Sentinel-2 for narrow valley reservoirs); and

(iv) Attribute richness: it provides key engineering parameters such as storage capacity and surface area that are essential for the present study.

All of these points are supported by the quantitative benchmarking presented in Song *et al*. (2022).

[26] Line 170: Suggest adding a map showing the locations of all reservoirs and those for which data was not available, to better understand their spatial distribution.

RE: We sincerely thank the reviewer for this constructive suggestion. To demonstrate that our screening procedure does not introduce spatial bias, we have prepared a new *Supplementary Material* section (S1) and Figure S1, which compare the spatial distributions of (a) all 4,854 medium and large reservoirs in the CRD, (b) the 1,435 reservoirs retained in our screening sample, and (c) the 3,419 excluded reservoirs. As shown in Figure S1, the geographic patterns are closely similar across all three maps; the excluded reservoirs are not preferentially clustered in any tectonically distinct region relative to the full set or to the retained sample. Therefore, the screening process does not bias the national-scale spatial characterization of induced-type reservoirs. We have also revised Section 2 of the main text to explicitly reference *Supplementary Material* S1 and Figure S1.

For your reference, the newly added map is provided below as Figure S1.

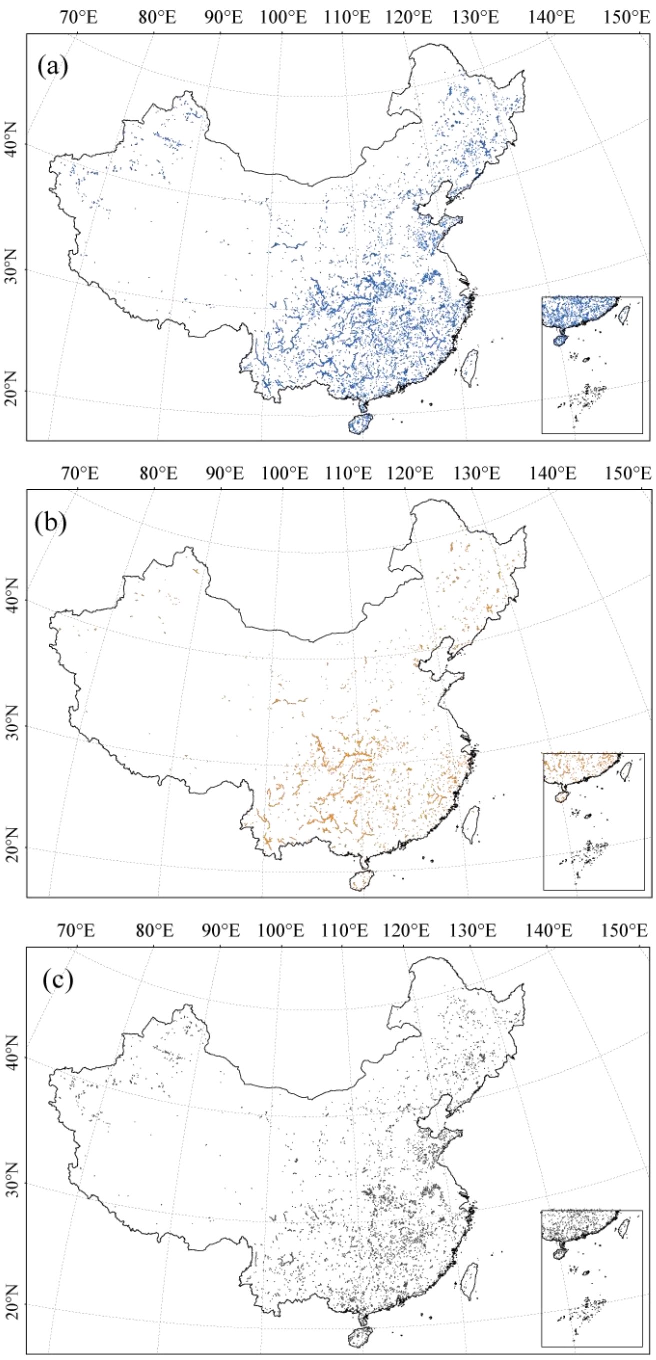
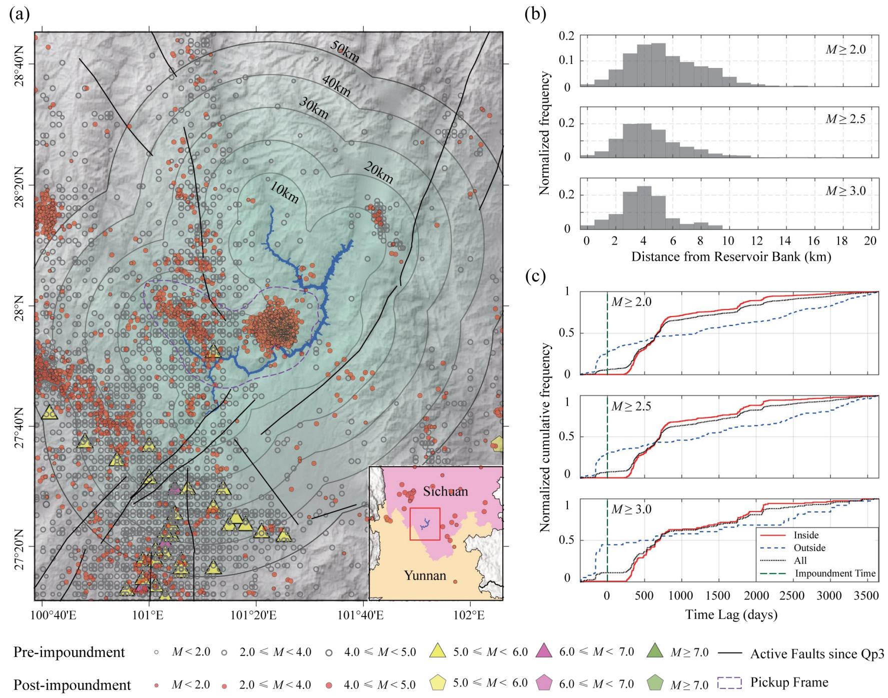


Fig. S1. Spatial representativeness of the reservoir screening sample. (a) Spatial distribution of all 4,854 medium and large reservoirs (Reservoir Capacity ≥ 0.1×10^8 m^3) in the CRD. (b) Spatial distribution of the 1,435 retained reservoirs with complete parameters and initial impoundment dates between 1 January 1971 and 27 March 2015. (c) Spatial distribution of the 3,419 excluded reservoirs lacking complete information or falling outside the required impoundment time window. The similar geographic clustering across all three panels indicates that data exclusion does not preferentially remove reservoirs from any specific tectonic province, ensuring that the spatial patterns of induced-type reservoirs reported in the main text are not biased by the screening process.

[27] Figure 1: The unfilled circles are difficult to see on the map. Suggest increasing border thickness.

RE: We sincerely thank the reviewer for this helpful suggestion. We agree that the unfilled circles were difficult to discern against the complex base map (distance-gradient shading and active-fault lines). In the revised Figure 1a, we have increased the border thickness (stroke width) of the earthquake symbols. These adjustments ensure that both the pre-impoundment (gray) and post-impoundment (red) events are clearly visible, even when the figure is printed in grayscale or viewed at reduced scale. For your convenience, the revised Figure 1 is pasted below.



[28] Figure 1a: It is difficult to compare the pre and post impoundment events because their time horizons are different. For example, there appears to be cluster of events prior to impoundment within the purple dashed lines. Did that cluster occur within a short period of time or over the ~40 years pre-impoundment?

RE: We appreciate the reviewer's careful observation regarding the comparability of pre- and post-impoundment events in Figure 1a. The reviewer is absolutely correct that the two symbol categories cover very different time horizons: the gray dots represent cumulative background seismicity over approximately 42 years (1970 to November 2012), whereas the red dots represent cumulative seismicity over only 10 years (December 2012 to 2022). Consequently, the spatial densities are not directly comparable. To prevent visual misinterpretation, we have added an explicit statement of these respective time windows to the revised Figure 1a caption.

Regarding the gray dots that appear within the purple dashed polygons: these are not a short-period cluster. They are sparse background earthquakes that occurred randomly and relatively uniformly over the entire ~42-year pre-impoundment interval. This is corroborated by Figure 1c, where the cumulative frequency of the candidate "inside" sequence remains nearly flat during the one-year pre-impoundment baseline window, and the "outside" background seismicity shows only a gradual, linear accumulation.

[29] Figure 1c: How is reservoir area defined for classifying "inside" and "outside"?

RE: We apologize for the ambiguous wording. In Figure 1c, the terms "inside" and "outside" do not refer to the physical water-body area of the reservoir. Instead:

"**Inside**" denotes earthquakes located within the manually delineated induced-seismicity clusters (outlined by the purple dashed polygons in Figure 1a).
"**Outside**" denotes background earthquakes located within 50 km of the reservoir shoreline but outside those cluster boundaries (i.e., the unselected events used as a local background comparison).

To eliminate any confusion, we have revised the Figure 1c caption to read: "'Inside' denotes earthquakes within the identified induced-seismicity clusters (purple dashed polygons in Fig. 1a); 'outside' denotes background seismicity within 50 km of the shoreline but outside the identified clusters."

[30] Figure 1c: Why is there a sudden increase in seismicity outside the reservoir area prior to impoundment?
RE: We thank the reviewer for this perceptive observation. The apparent "sudden increase" in the outside curve at $t < 0$ in Figure 1c is primarily a visual effect of the normalization scheme, not a genuine abrupt rise in seismic activity.

As stated in the figure caption, all cumulative-frequency curves are normalized to their own maximum values. During the one-year pre-impoundment baseline window ($t < 0$), a small number of background earthquakes naturally occur and accumulate in the outside region (background seismicity within 50 km of the shoreline but outside the identified clusters). Because the total post-impoundment maximum of the outside curve is used as the normalization factor, this modest pre-impoundment accumulation is compressed into a short one-year interval and therefore appears as a steep initial slope. In absolute terms, the number of these pre-impoundment outside events is small and consistent with the long-term background rate; there is no anomalous seismicity surge.

Crucially, the inside curve remains essentially flat during this same pre-impoundment interval, confirming that the induced-sequence area (purple dashed polygons in Fig. 1a) was seismically quiescent before reservoir filling. The sharp divergence of the inside curve only after ~250 days post-impoundment, while the outside curve continues its gradual trend, provides the key evidence for reservoir triggering.

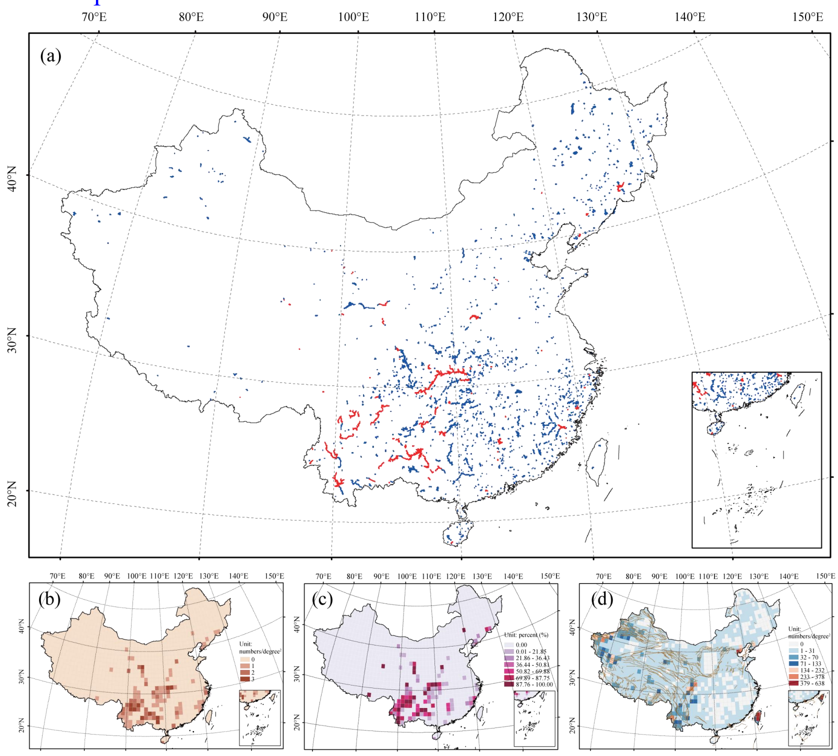
To avoid misinterpretation, we have revised the Figure 1c caption to explicitly note that the curves are normalized to their maxima and that the initial slope of the outside curve reflects normalization of sparse background events during the one-year baseline. This clarification highlights why the normalized representation is useful for comparing the relative temporal evolution of inside versus outside sequences, while acknowledging that absolute event counts are not directly readable from the normalized axes.

[31] Line 210: What is M_S? I am not familiar with this magnitude scale.
RE: Thank you for raising this point. We have added an inline definition of the surface-wave magnitude (M_S) at its very first appearance in the manuscript to clarify the scale for readers more

familiar with M_W or M_L.

[32] Figure 2a: The map is difficult to read. Suggest enlarging and providing as a separate figure.

RE: We agree that the national-scale map is crowded. We have enlarged the map and will provide it as a larger figure, to ensure that symbols and labels are legible. For your convenience, the revised Figure 2a is pasted below.



[33] Figure 2d: Why is M>4 selected for this figure when Mc=2.5 is used for analysis?

RE: We have clarified in the caption that the M≥4.0 threshold is used to illustrate the long-term regional tectonic setting and active fault framework, not for RIS sequence analysis.

[34] Lines 244: It is unclear how PGA>0.1g is used to reference natural seismicity? Do the authors mean PGA at a particular return value, e.g., 475 years?

RE: We have clarified that PGA > 0.1g refers to a standard engineering seismic-hazard parameter. We now specify that it corresponds to the peak ground acceleration with 10% probability of exceedance in 50 years (approximately 475-year return period), consistent with Chinese national seismic-zonation standard GB 18306-2015.

[35] Line 320: Can an explanation be added to "nonlinear dependence of triggering probability on pressure changes"?

RE: We appreciate this suggestion. We have inserted a brief physical explanation directly at the first occurrence of this phrase in Section 4, using em-dashes to avoid disrupting sentence flow.

[36] Line 466: How is peak seismicity rate identified?

RE: We thank the reviewer for this important question. We agree that the identification of the peak seismicity rate should not be presented as an isolated methodological note. Instead, we have incorporated the identification criterion directly into the definition of Peak Lag (the delay time of the peak seismicity rate relative to initial impoundment) where this parameter is first introduced in Section 6. To ensure full reproducibility, we explicitly state in Section 6 that Peak Lag is derived by aggregating post-impoundment earthquakes into 0.25-year (3-month) time bins, identifying the peak-frequency bin, and calculating its delay relative to the initial impoundment date. This preserves the conceptual integrity of Peak Lag as a unified dynamic-response parameter.

[37] Line 513: 10^2.5 -> 10^0.5

RE: Thank you for catching this typographical error. 3.2×10^8 m^3 corresponds to $10^{0.5} \times 10^8$ m^3, not $10^{2.5}$. We have corrected this in the text.