Reply to the referee comments on "Analysis of the Relationship between Official Rain-Praying Rituals and Droughts in China over the Past 2000 Years" by Shuo Wang et al

Dear editors and reviewers,

Thank you for your valuable comments and thoughtful suggestions on our manuscript. Following your comments on the manuscript, we made careful revisions, and the point-to-point response of the comments is listed below. We hope these revisions would make this manuscript more acceptable for publication. Please feel free to contact me if you have any questions.

Many thanks again. With best wishes.

Sincerely yours,

Shuo Wang

Anonymous Referee #2

1. The first comment is about the data extraction and quantification.

a) The frequency of rain-praying rituals was first constructed by conducting a lexical search using four keywords, but are those four keywords sufficient to cover all relevant events? In Chinese historical sources, many rain or drought-related ritual records use terms such as 祭 (sacrifice), 祀(worship), 求雨(praying for rain), 请雨(invoking rain), 禜 or 禳(apotropaic sacrifice / expiatory rite), 致祭(to present ritual offerings), and more.

There are plenty of examples like this across the dynastic histories of China, such as the one from 27 CE, 建武三年七月，雒阳大旱，帝至南郊求雨，即日雨. (As the author translated it in the Supplementary Table 1: "In July of the third year of Jianwu, Luoyang suffered a severe drought. The emperor went to the southern suburbs to pray for rain, and it rained that very day."). This record is included, but the whole sentence does not contain any of these four keywords, so how these records were found and included in the primary search data should be further clarified.

(p.s., This should be translated as the seventh month, not July, as it refers to the lunar calendar. This is a problem in several records in the Supplementary Table. Please find and correct them as this can be misleading in terms of seasonality.)

Another example is the record from 1009 CE, which is also in the table but does not include any of the four keywords. From the current explanation, the secondary search is built on the results of the primary search with the four keywords, instead of supplementing it. Whether it is a methodological issue or a language issue, it needs to be further clarified.

Response 1: Accepted and revised. We sincerely thank the reviewer for this insightful comment. We agree that relying solely on four keywords may not fully capture the complexity and diversity of rain-praying terminology in historical documents.

In the original manuscript, we did not sufficiently explain that the keyword search served only as the initial stage of data retrieval. During the subsequent manual screening and verification process, additional expressions related to rain-praying rituals, such as "求雨" (praying for rain), "请雨" (invoking rain), and other contextually relevant descriptions, were also identified and incorporated into the dataset.

To improve methodological transparency, we have revised the data extraction procedure and clarified that the final dataset was not generated mechanically through four keywords alone. Instead, all candidate records were subjected to contextual examination, textual interpretation, and manual verification to identify official rain-praying rituals explicitly associated with drought conditions or requests for rainfall.

This revision also explains why some records listed in Supplementary Table 1 do not contain the four original keywords but were nevertheless included in the final database based on their clearly documented rain-praying context.

Revised text as follow (Section 2.2.2, Step 1＆2, Lines 188–197; Step 3，Lines 207–211; Figure 1):

2.2.2 Official Rain-Praying Rituals Database and Sequence Construction

Step 1: Keyword retrieval and expansion. Chapter-by-chapter searches were initially conducted using the keywords 雩 (rain ritual), 祈 (prayer), 祷(prayer), and 祠(shrine). To increase completeness, additional keywords such as 祭(sacrifice), 祀(worship), 求雨(praying for rain), 请雨(invoking rain) were also incorporated during manual revision. The initial retrieval yielded 10,577 entries. (Fig. 1). These keywords correspond to the official term for rain-praying rituals (雩), the act of supplication (祈/祷/求雨/请雨/祭/祀), and the sites for rain-praying (祠), respectively.

Step 2: Records were examined to retain only official rain-praying rituals explicitly associated with drought or rain-related purposes. Rituals unrelated to rain or lacking a stated drought context were excluded. The screening criteria for this step were as follows: (1) Rituals honoring heaven, earth, mountains, rivers, ancestral temples, etc., were included only when drought conditions or rain-praying intent are explicitly mentioned in the text. (2) Sacrifices to wind, clouds, thunder, and rain were counted only when drought or agricultural impacts were mentioned. (3) Dispatches for sacrifices without explicitly stated rain-praying purposes were excluded. (4) "Thanksgiving for rain" was treated as corroborating evidence of successful rain-praying. If a criterion corresponded to a preceding rain-praying record, it was deduplicated; if not, it was counted separately. (5) When officials petitioned the emperor for rain-praying, records indicating imperial consent ("granted", "approved", etc.) were verified; "denials" were excluded.

Step 3: Manual cross-verification and deduplication. (1) Institutional texts, rain-praying poems, and other non- "actual rain-praying actions" were removed. (2) Each entry was compared across the original texts (printed editions) to remove duplicate records arising from overlapping keywords or repeated mentions in different sections. This step ensures that each recorded rain-praying ritual represents a unique, verifiable event.

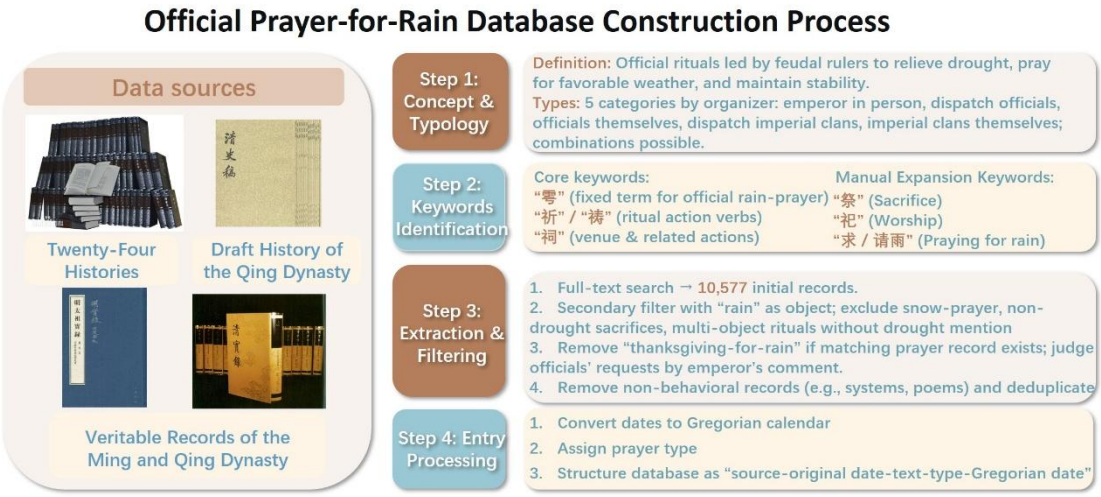

Figure 1: Database and Sequence Construction Flowchart for Official Rain-Praying Rituals.

Response 2: We agree that translating lunar calendar dates as Gregorian calendar months (e.g., translating "七月" as "July" rather than "the seventh lunar month") may cause confusion regarding seasonality and historical chronology. The reviewer is correct that several entries in the Supplementary Table contain this translation inconsistency.

This issue arose because the Supplementary Table, including the original historical records and their English translations, was prepared and submitted at a later stage following the editor's request for additional source materials. Due to time constraints during manuscript preparation, several lunar calendar references were translated imprecisely. We appreciate the reviewer for bringing this matter to our attention.

Importantly, this translation issue is confined to the English rendering of the supplementary materials and does not affect the construction of the analytical dataset used in the study. As described in Section 2.2.2 Official Rain-Praying Rituals Database and Sequence Construction, line 222, Step 4 of the methodology, the reign year, lunar month, and stem-branch date were extracted from the original historical records, and all dates were subsequently converted into Gregorian calendar dates before analysis. Therefore, the statistical analyses, seasonal classifications, and temporal interpretations presented in the manuscript were conducted using standardized calendar dates rather than the translated expressions appearing in the Supplementary Table.

To avoid misunderstanding, we have carefully reviewed the entire Supplementary Table and revised all relevant translations. Lunar calendar dates are now consistently rendered as "the first lunar month," "the seventh lunar month," etc., rather than as Gregorian calendar months. We have also rechecked the translated records to ensure consistency throughout the supplementary materials.

We thank the reviewer again for identifying this issue, which has helped us improve the accuracy and clarity of the manuscript and its supplementary materials.

> Step 4: Standardization and time normalization were recorded. On the basis of the original text in the database, the reign year, lunar month, and stem-branch date for each official rain-praying ritual were
> 215 extracted. These data were converted to Gregorian calendar dates and the event types were determined. For the seasonal events, the month containing the season was used as the statistical timeframe. When the month or season was unclear, the year was used as the time unit. Among the official rain-praying rituals in the Twenty-Four Histories and the Draft History of the Qing Dynasty, 10 entries could not be accurately dated, accounting for 1.93% of all such records from the Western Han Dynasty to the Qing Dynasty.
> 220 These mostly appeared in the biographies of the official histories concerning rain-praying missions by dispatched officials or imperial clan members. For such data, the middle value of the time interval was used as the occurrence year.↵

b) The frequency of rain-praying rituals is mostly drawn from the dynastic histories, while many records from the Collection of Meteorological Records in China for the Past 3,000 Years are also from the same sources, especially before the Ming Dynasty, when local gazetteers were not yet widely used. As explained in Section 2.2.2, in the secondary search, many rituals were included only when drought or its relevant impacts were mentioned, which implies that there is a structural, non-independent coupling between the two sequences. For instance, the first record provided by the author in Table 3, "During droughts and major rain rituals, it is forbidden to light fires" (81 BC), is also the same record used to count the drought of this year in the 3,000-year records. There are lots of cases like this, which means that double encoding can significantly contribute to the correlation. It is necessary to discuss such circularity frankly, at least acknowledge such an issue, and soften the expression regarding causation.

Response 3: Accepted and revised. We appreciate the reviewer's valuable suggestion regarding the comparability of the drought dataset.

Although the drought records used in this study were derived from the authoritative Collection of Meteorological Records in China for the Past 3000 Years, we acknowledge that documentary evidence from earlier dynasties may be less complete than that from the Ming and Qing periods.

To improve the analysis and the reliability of the dataset, we incorporate additional proxy records reflecting drought variability for comparison and cross-validation. The precipitation

reconstructions of Shi et al. (2021) for North China (NC), Central China (CC), and East China (EC) were generated through data assimilation that integrates instrumental observations, multiple proxy records, and climate-model simulations, and were further validated using independent proxy datasets. These regions spatially overlap with the core areas where historical rain-praying records are concentrated, making them highly relevant for comparison with the Rain-Praying Index.

In addition, we employed the precipitation reconstruction of Tan et al. (2011), which synthesizes speleothem records and historical drought/flood indices using principal component analysis to a high-resolution, independently validated precipitation series for north-central China over the last 1800 years.

Relevant descriptions of the proxy records, data sources have been added to the revised manuscript (Section 2.1.2， Lines 118–136).

2.1.2 Precipitation Reconstruction Datasets

To provide independent precipitation proxies for evaluating drought variability, two precipitation reconstruction datasets were incorporated for comparison and cross-validation.

The first dataset was derived from Shi et al. (2021), who reconstructed summer precipitation variations across eight climatic regions of China over the past 22,000 years using an Optimal Information Extraction (OIE) data assimilation framework. The reconstruction integrates instrumental observations, proxy-based precipitation records, and outputs from multiple climate model simulations, including CESM-LME, LOVECLIM-LCE, and TraCE-21ka. In the present study, the precipitation series for North China (NC), Central China (CC), and East China (EC) were extracted for the period 200 BC–1910 AD. These regions correspond closely to the primary distribution areas of historical rain-praying rituals in eastern China.

The second dataset was obtained from Tan et al. (2011), who reconstructed a decadal-resolution precipitation series for north-central China spanning AD 190–1980. The reconstruction was developed using principal component analysis (PCA) of multiple independently dated hydroclimatic archives, including stalagmite $\delta^{18}O$ records from Wanxiang Cave and Huangye Cave, as well as historical drought/flood indices from the Longxi region and the Haihe River Basin. To match the temporal coverage of the documentary drought dataset, the segment covering AD 190–1910 was extracted and used in the present analysis.

c) It has been mentioned in the abstract and conclusion that there were 1,825 records of rain-praying rituals in total, but there were 1,835 in Table 1.

Response 4: Accepted and revised. Thank you very much for your suggestion. In the original manuscript, we considered that surviving historical records are scarce for early periods but far more complete for later eras. For the 10-year time series of official rain-praying rituals spanning the past 2,000 years, we initially used data from History of the Ming and Draft History of the Qing. Meanwhile, the frequency data of Ming and Qing rain-praying rituals were extracted

from more detailed entries in Veritable Records of the Ming and Veritable Records of the Qing. This inevitably created overlaps in records of these official rain-praying rituals.

Following your advice, we re-filtered all rain-praying rituals records and rebuilt the time series. We merged the two formerly independent time series, which relied on disparate historical sources, into one unified dataset using the Twenty-Four Histories, Veritable Records of the Qing, and Draft History of the Qing. The revised total count of rain-praying ritual records is 1,540. Detailed data sources from each historical text are provided in the table below.

Table 1: Historical Records Extracted and Sources

Dataset Title	Extracted Information	Number of Records Extracted
Twenty-Four Histories	Official rain praying rituals from the Western Han to Ming dynasties	430
Veritable Records of the Ming Dynasty	Official rain-praying rituals during the Ming dynasty	190
Veritable Records of the Qing Dynasty	Official rain praying rituals during the Qing dynasty	856
Draft History of the Qing Dynasty	Official rain praying rituals during the Qing dynasty	64

We have substantially revised the dataset and introduced a standardized Official Rain-Praying Index (ORPI). The index was normalized to a scale of 0–1 to reduce the influence of uneven documentary preservation and source-recording intensity across historical periods. The construction of the index considers both the frequency and temporal distribution of official rain-praying records while minimizing the potential bias caused by the greater abundance of historical documentation in the Ming and Qing dynasties.

When calculating the index of official rain-praying rituals, if the maximum number of official rain-praying rituals over a ten-year period is uniformly set at 82, this would artificially lower the composite index for earlier periods due to the scarcity of historical data from the past and the abundance of it in more recent times. Therefore, the composite indices for each period are calculated separately, using the breakpoints of 900 CE, 1730 CE and 1830 CE obtained from Ordered Cluster Analysis as the boundaries. Here, C_{max} represents the maximum number of rain-praying rituals per decade for each period, specifically:

Stage 1 (200 BCE – 900 CE): C_{max}=5

Stage 2 (910 CE – 1730 CE): C_{max}=29

Stage 3 (1740 CE – 1830 CE): C_{max}=82

Stage 4 (1840 CE – 1910 CE): C_{max}=72

In addition, we further clarified the data collection procedure and ensured that duplicate records were removed through manual cross-checking of all identified rituals. The official rain-praying dataset was reconstructed using the Twenty-Four Histories, Draft History of the Qing, and the

Ming and Qing Veritable Records, with each event retained only once in the final database.

The methodology used to calculate the Official Rain-Praying Index has now been added to the revised manuscript, and the original frequency and occurrence-year statistics are still preserved and discussed in Section 3.1.3 and Figure 3 to facilitate comparison with previous studies.

2.2.5 Construction of the Rain-Praying Index Series

To mitigate the bias in the rain-praying rituals series caused by the scarcity of ancient records and the abundance of modern records, the Official Rain-Praying Index (ORPI) is constructed, following the famine index methodology proposed by Teng et al. (2014). This index reflects both the frequency and intensity of rain-praying rituals. The calculation steps are as follows:

$$ORPI_i = \left(\frac{Y_i}{Y_{max}} + \frac{C_i}{C_{max}}\right) \quad (7)$$

where Y_i (C_i) represents the number of years (or number) of official rain-praying rituals within period i, and Y_{max} (C_{max}) represents the maximum number of years (or number) of official rain-praying rituals within a given period.

The resulting time series of the index of official rain-praying rituals is shown below:

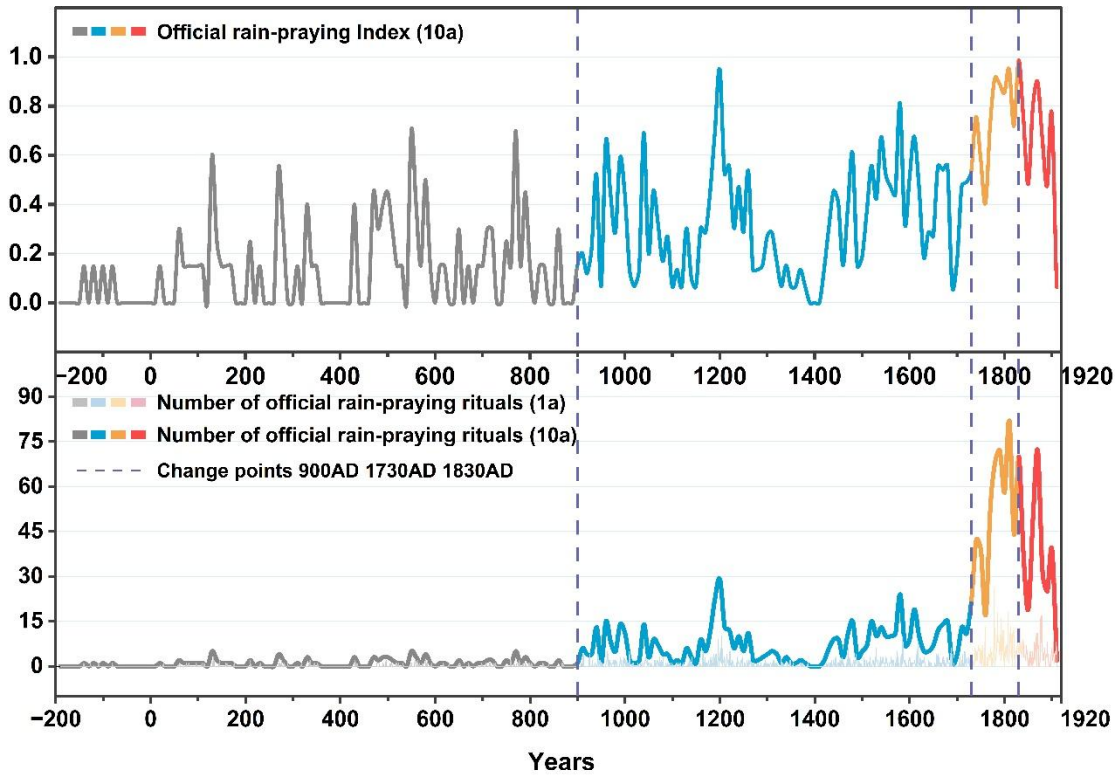

Figure: Number of Official Rain-Praying Rituals (10a) and Official rain-praying Index rituals series (10a).

2. The interpretation of the correlation coefficients: The statistical outcomes may imply

different extents of correlation between the rituals and droughts in different historical periods, but this does not mean that the outcome can be directly explained by historical or political reasons. Statements regarding political legitimacy, state capacity, and administrative collapse are lacking independent evidence at the moment. For example, the paragraph from line 455 is a chunky section with many twists and direct attribution of frequent droughts and few rituals to multiple causation chains that require further proof. Sentences like "The Song Dynasty actively adjusted its policies, implementing practical measures such as constructing water conservancy projects while also emphasizing official rain-praying rituals to reassure the populace and demonstrate the Mandate of Heaven, particularly during confrontations with ethnic regimes such as the Liao and Jin. Influenced by Central Plains culture, ethnic regimes such as the Liao and Jin also adopted Song-style disaster response measures to consolidate their rule, developing hybrid official rain-praying rituals combining indigenous shamanic rituals with Sinicized ceremonies…" are strong claims but without any references or citations. This cannot be treated as common sense that all readers should know or be easily convinced of. If it is a sophisticated statement from other scholars, please cite them properly. If it is from the author's primary research, some evidence from historical texts should be provided. The tone also needs to be softened, as those aspects are possible contributors to the outcome, but not necessarily the direct and only causes.

Response 5: Accepted and revised. We thank the reviewer for this valuable suggestion. We agree that the original version relied primarily on correlation analysis and historical interpretation, which was insufficient to quantitatively evaluate the relationships between rain-praying rituals and broader social, economic, and political conditions.

To address this concern, we incorporated several additional datasets that have been widely used to characterize social and economic variability in historical China. These include a peasant uprising series reconstructed by Fang et al. (2015)based on the History of Chinese Peasant Revolutionary Struggles and the General History of China, a fiscal balance series from Wei et al. (2014), and a grain harvest grade series from Yin et al. (2015). The peasant uprising record was selected because it reflects social instability driven primarily by livelihood pressures and differs from interstate wars, ethnic conflicts, or military rebellions.

The newly incorporated datasets are summarized in the revised manuscript as follows:

Name	Site	Proxy type	Resolution	Period (BCE/CE)	Reference
Precipitation	North China (NC), Central China (CC), and East	CESM-LME, LOVECLIM-LCE, and TraCE-21ka	Decadal	200BCE–1910	Shi et al. (2021)

	China (EC)				
Precipitation	North China Plain (104°–121°E, 33–42°N)	Multi-proxies	Decadal	190–1980	Tan et al. (2011)
Peasant uprising	Whole China (23°–42°N, 80°–127°E)	Historical documents	Decadal	210(BCE)–1910	Fang et al. (2015)
Grain harvest grade	Whole China (23°–42°N, 80°–127°E)	Historical documents	Decadal	210(BCE)–1910	Yin et al. (2015)
Fiscal balance	Whole China	Historical documents	Decadal	210(BCE)–1910	Wei et al. (2014)
Economic level	Whole China	Historical documents	Decadal	210(BCE)–1910	Wei et al. (2015)

In addition, we incorporated independent precipitation reconstructions to further evaluate the climatic significance of the Official Rain-Praying Index. Correlation analyses were conducted between the Official Rain-Praying Index and reconstructed precipitation series. Although the full-length records do not exhibit significant correlations, analyses conducted for periods with relatively complete documentary evidence (200CE–1910 CE) reveal significant relationships during several dynastic periods. Specifically, the Rain-Praying Index shows significant negative correlations with the precipitation reconstructions of Shi et al. (2021)and significant positive correlations with the precipitation reconstruction of Tan et al. (2011), supporting the interpretation that rain-praying rituals were associated with hydroclimatic.

Following the reviewer's suggestion, we also explored multivariate regression models incorporating fiscal balance, grain harvest grades, peasant uprisings, and hydroclimatic variables. The results indicate that simple linear relationships are generally weak and do not adequately explain variations in the Rain-Praying Index. Considering the possibility that rain-praying rituals responded differently under varying levels of environmental and social stress, we further introduced threshold regression analysis to examine potential nonlinear relationships between the Rain-Praying Index and these explanatory variables.

Interpretations concerning political legitimacy, governance capacity, and social crisis are now discussed more cautiously and are supported by the additional statistical analyses where appropriate.

Response 6: We sincerely thank the reviewer for this insightful and constructive comment. We fully agree that the causal chain described in the original manuscript — linking political institutions, religious practices, and agricultural neglect across different dynastic contexts—

was overly complex and not sufficiently supported by independent historical or empirical evidence.

Following the reviewer's suggestion, we have carefully re-evaluated these interpretative sections. The original narrative describing multi-step causal linkages (e.g., from institutional adjustments in the Song Dynasty, to cross-cultural adaptation in the Liao and Jin regimes, and to broader transformations in ritual and agricultural practices) has been removed from the revised manuscript due to the lack of robust supporting references.

Instead, we now restrict the interpretation of our statistical results to relationships that can be directly supported by the quantitative analyses. Historical context is used only in a more cautious and descriptive manner to provide possible background explanations, rather than deterministic causal pathways.

In addition, we have revised the relevant paragraphs to avoid over-interpretation and to soften statements that previously implied direct causal mechanisms. Where appropriate, we now explicitly acknowledge that political institutions, religious practices, and environmental stress may have acted as potential contributing factors, but not necessarily as direct or exclusive drivers of the observed patterns.

We appreciate this suggestion, which has helped improve the methodological rigor and interpretative clarity of the manuscript.

3. The sources, the citation of historical materials, and the historical factual errors.

a) The data on official rain-praying rituals were collected from the Chinese Digital Archives (https://www.zhonghuadiancang.com), which is not an authorized or widely recognized website. The problems with this type of website are that some historical characters are often omitted or replaced by similar characters, which is not good for lexical searches. I can understand that, as the website provides digital copies of dynastic histories, it is convenient to use. However, to make the research more solid, it is recommended that the author use more reliable sources (e.g., the national library) or at least examine the outcomes with those sources.

Response 7: Accepted and revised. We sincerely thank the reviewer for this valuable comment. We fully agree that the reliability and textual accuracy of historical sources are essential for constructing a long-term database of official rain-praying rituals.

In the original manuscript, our description of the data source was insufficiently clear and may have given the impression that the dataset was compiled directly from an online database. In fact, the digital platform was used primarily as a retrieval tool to facilitate keyword searches.

All retrieved records were subsequently cross-checked against authoritative printed editions, including the Complete Translation of the Twenty-Four Histories (二十四史全译), the Draft History of the Qing (清史稿), and the Veritable Records of the Ming and Qing Dynasties (明清实录).

To further improve the transparency and reliability of the dataset, we have revised the description of the data sources and explicitly added the procedures of manual verification and source cross-checking. This revision clarifies that every rain-praying record retained in the final database was verified against the corresponding printed historical source to minimize potential errors arising from OCR recognition, character omissions, variant characters, and transcription inconsistencies.

Revised text as follow (Section 2.1.1, Lines 101–115):

2.1 Data source

2.1.1 Official Rain Praying Rituals Data

This study covers the period from the Western Han to the Qing dynasties (202 BC–1911 AD), spanning 2,113 years of Imperial China. Data on official rain-praying rituals were primarily collected from authoritative printed sources, including the Complete Translation of the Twenty-Four Histories, the Draft History of the Qing, and the Veritable Records of the Ming and Qing dynasties (Table 1). The Complete Translation of the Twenty-Four Histories is a large-scale scholarly project compiled between 1991 and 2003, integrating the original classical Chinese texts with modern Chinese translations. The first edition, published in 2004, served as the principal source for this study. The Scripta Sinica database (https://hanchi.ihp.sinica.edu.tw/ihp/hanji.htm) was used as a retrieval tool to efficiently identify potential entries. To ensure reliability and accuracy, all entries retrieved from the digital database were manually cross-checked against the corresponding printed editions. This procedure minimizes potential errors due to OCR recognition, variant characters, or transcription inconsistencies. The Twenty-Four Histories and the Draft History of the Qing provide consistent historiographical structures across the long-term sequence, while the Veritable Records of the Ming and Qing offer granular, day-to-day accounts of imperial rituals, allowing for precise documentation of ritual date, location, and participants. Utilizing these as primary sources allows for the construction of high-resolution sequences, offering deeper insights into the specific rituals of these two dynasties.

b) There are quite a few historical facts that need to be clarified.

For example, in line 588, during the severe drought in Zhili Province in the tenth year of Shunzhi's reign, Regent Prince Dorgon instructed… The tenth year of Shunzhi's reign is 1653. Dorgon died in 1650, so there may be an error in this direct quote. Also, for direct quotes like this, the proper way to cite such historical texts should clearly provide the name and volume/chapter of the source. It is also suggested that the authors should provide a supplementary document with the original Chinese text of these quotes and the titles of the cited works; otherwise, it is hard to trace or identify the original text from the current English translation.

Response 8: We sincerely thank the reviewer for carefully checking the historical accuracy and source traceability of the cited passage. We fully agree that the original statement contained an error in the dynastic chronology.

After re-examining the original historical source（《清初内国史院满文档案》）, we confirmed that the correct time should be the 4th year of the Shunzhi reign, rather than the 10th year. This mistake occurred during manuscript preparation, and was further propagated during the translation process, resulting in the incorrect attribution in the English version.We have corrected this error in the revised manuscript accordingly.

In addition, we appreciate the reviewer's suggestion regarding citation transparency. In the revised version, all direct historical quotations have been clearly annotated with proper references, including the source title and, where applicable, volume and chapter information. We have also added more precise citation formatting to improve traceability.

Line 577, "Historical context supports this finding: as documented in Studies on Military Expenditures in the Qing Dynasty, following the Qing conquest of the Central Plains during the Shunzhi reign, the Southern Ming forces remained active, compelling the state to prioritize military expenditures—which consistently exceeded 70% of annual budgets."

Response 9: Accepted and revised. We thank the reviewer for pointing out that the original statement lacked sufficient quantitative support and relied on overly general historical interpretation.

Following this suggestion, we have revised the relevant section by replacing the original qualitative description with quantitative evidence from Chen Feng's research on Military Expenditures in the Qing Dynasty (Page 241). According to this study, during the early Shunzhi reign, the standard military expenditure (mainly provincial military stipends and horse maintenance costs) was approximately 13 million taels. During the period of the thirteenth to eighteenth year of the Shunzhi reign, the average annual military expenditure increased to more than 24 million taels, which even exceeded the total fiscal revenue of the early Shunzhi period before the fourteenth year.

This revision provides a more direct empirical basis for describing the fiscal and military pressures during this period. The original generalized statement has been replaced accordingly in the revised manuscript. (Lines 622–627)

> According to Chen (2013) 's *Research on Military Expenditures in the Qing Dynasty*, the standard military expenditure in the early Shunzhi reign(1644–1661CE)—mainly including provincial troop salaries and horse maintenance costs—was approximately 13 million taels. During the thirteenth to
> 625 eighteenth years of the Shunzhi reign (1656–1661CE), the average annual military expenditure increased to over 24 million taels, which even exceeded the total fiscal revenue of the state prior to the fourteenth year. The sacrificial system was still underdeveloped during this era, with official ceremonies limited to

Such a statement involves a number, but lacks a clear source and citation, which needs to be clarified.

Line 534–535, 弘治中兴, the "Middle Revival," usually refers only to the Hongzhi period. It may not be appropriate to use the term to cover the Zhengde reign. Line 733, "…during the Yongzheng reign, disasters were concealed to maintain a facade of stability", is, again, a strong statement without evidence or references, especially since the reporting system in the Yongzheng reign is usually considered cautious. These statements can still be true, but evidence and references are needed.

Response 10: Accepted and revised. We thank the reviewer for pointing out this issue. We agree that the term "Hongzhi Restoration" should be strictly limited to the Hongzhi reign period. In the revised manuscript, we have corrected the usage and removed its extension to the Zhengde period to ensure historical accuracy. (Lines 578–580)

the complete loss of the late rice crop. During the Hongzhi reigns (1488–1505CE), which were characterized by clear governance and steady economic growth—termed the "Middle Revival"—the
580 central government functioned normally and prioritized practical drought relief efforts. Consequently,

We thank the reviewer for this important comment. We agree that the statement regarding disaster concealment during the Yongzheng reign required stronger evidential support and appropriate referencing. Following the reviewer's suggestion, we have carefully checked the relevant literature and added supporting references in the revised manuscript. The revised text now includes proper citations to substantiate this statement. (Lines 775–779)

775 perceptions of calamities directly influence their choice of response strategies. If rulers prioritized human welfare over divine mandates or if, as during the Yongzheng reign, disasters were concealed to maintain a facade of stability, records of rain-praying rituals would diverge from actual drought conditions(Li, 2022). Thus, fluctuations in rain-praying rituals reflect the interplay between environmental pressure and the political system's capacity to respond.↵

There are also other small errors, such as the Chenghua era (1460–1487 CE). The Chenghua era started in 1465 CE. These should be corrected carefully.

Response 11: Accepted and revised. We appreciate the reviewer's careful identification of factual errors throughout the manuscript. The incorrect time span of the Chenghua reign (1460–1487 CE) has been revised to the accurate range 1465–1487 CE in Lines 565. We have fully proofread the whole text to eliminate all similar chronological mistakes.

and droughts fluctuated. The correlation during the Chenghua era (1465–1487 AD) was significantly
565 stronger than that observed from the Xuande to Zhengde periods (1425–1521 AD). During the Chenghua

Technical corrections:

Some expressions need to be fixed. Some sentences have grammatical mistakes. For instance, in line 744, "potentially leading us overestimations" …

Response 12: Accepted and revised. We thank you for pointing out inappropriate expressions and grammatical errors. The problematic phrase "potentially leading us overestimations" in Line 744 has been corrected to grammatically standard wording in the revised manuscript. (Line784)

Although this study reveals the evolutionary patterns of rain-praying rituals on the basis of long-term data, certain limitations remain. First, historical records suffer from survivor bias. As noted above, historical accounts tend to document successful rain-praying instances while overlooking failed attempts, potentially leading to an overestimations of the actual efficacy or frequency of rain-praying rituals at the
785 time. Second, the varying levels of detail in historical materials across different dynasties (e.g., Qing

The mixed use of "Draft History of the Qing" and "Qing Shigao" can be confusing for international readers.

Response 13: Accepted and revised. We acknowledge the confusion caused by the inconsistent dual references of Draft History of the Qing and Qing Shigao for international readers. Following your comment, we uniformly use the official English title Draft History of the Qing across the full manuscript, and the Chinese transliteration Qing Shigao is removed entirely.(Line 15, Table1)

Abstract: Official rain-praying rituals, as an institutionalized cultural response to drought in ancient China, offer a crucial window into the evolution of state governance logic and disaster relief responses during climate crises. In this study, 1,540 official rain-praying records from the Western Han to the Qing
15 dynasties were collated on the basis of the Twenty-Four Histories and the Draft History of the Qing,

Table 1: Historical Records Extracted and Sources

Dataset Title	Extracted Information	Number of Records Extracted
Twenty-Four Histories	Official rain praying rituals from the Western Han to Ming dynasties	430
Veritable Records of the Ming Dynasty	Official rain-praying rituals during the Ming dynasty	190
Veritable Records of the Qing Dynasty	Official rain praying rituals during the Qing dynasty	856
Draft History of the Qing Dynasty	Official rain praying rituals during the Qing dynasty	64

In the paper, especially in the section "Analysis of Types of Official Rain-Praying Rituals," the names of different dynasties appear many times, which may confuse readers who are not familiar with Chinese history. I suggest adding the years of these dynasties at least right after they first appear.

Response 14: Accepted and revised. We have also added the corresponding reign years right after each dynasty name at their first appearance, particularly in the section "Analysis of Types of Official Rain-Praying Rituals", to assist readers unfamiliar with Chinese chronology.

In the abstract, "the Qing dynasty established systems of regular rain prayers," the word "established" is a bit misleading. It is more like "regularized" or "advanced."

Response 15: Accepted and revised. We are grateful for this valuable comment on word choice in the abstract. We agree that the verb "established" may create misunderstanding. We have replaced it with "regularized" as suggested in the abstract (Line 29), to accurately reflect that the Qing dynasty standardized and formalized existing regular rain-praying systems rather than creating such rituals from scratch.

praying. Moreover, the Qing dynasty regularized systems of regular rain prayers and confidential
30 memorials, transforming rain rituals from reactive disaster relief into proactive administrative routines.

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