Responses to Reviewer:

General comments: *This paper proposes a method for calculating rainfall thresholds for rainfall-induced landslides using the Multilayer Perceptron regression method and the feasibility of this method has been verified. In addition, the authors use a large amount of data and various data-driven modeling techniques. The research results have practical significance for the early warning and prevention of rainfall-induced landslides. It is recommended that the paper be published after revisions, addressing the following comments:*

Response: We thank you for your recommendation and valuable comments that have ultimately improved this manuscript. We greatly appreciate you for the very extensive and thoughtful review of the manuscript. According to your comments, we have made point by point corrections which we hope meet with your approval.

Point by point responses to the nine comments:

1. Comment: *The originality of the study is not prominently highlighted in the abstract. It is recommended to enhance this aspect.*

Response: Thank you for pointing this out. We recognize the issue of not sufficiently highlighting the originality of our study in the abstract. Based on your suggestion, we have revised the abstract to better emphasize the originality of our research. The revised abstract can be found in lines 6-20 (in red font).

Abstract. Rainfall is intrinsically linked to the occurrence of landslide catastrophes.

Identifying the most suitable rainfall threshold model for an area is crucial for establishing effective daily landslide hazard warnings, which are essential for the precise prevention and management of local landslides. This study introduces a novel approach that utilizes multilayer perceptron (MLP) regression to calculate rainfall thresholds for 453 rainfall-induced landslides. This research represents the first attempt to integrate MLP and ordinary least squares methods for determining the optimal rainfall threshold model tailored to distinct subregions, categorized by topographical and climatic conditions. Additionally, an innovative application of a three-dimensional convolutional neural network (CNN-3D) model is introduced to enhance the accuracy of landslide susceptibility predictions. Finally, a comprehensive methodology is developed to integrate daily rainfall warning levels with landslide susceptibility predictions using a superposition matrix, thus offering daily landslide hazard warning results for the study area. The key findings of this study are as follows: (1) The optimal rainfall threshold models and calculation methods vary across different subregions, underscoring the necessity for tailored approaches. (2) The CNN-3D model substantially improves the accuracy of landslide susceptibility predictions. (3) The daily landslide hazard warnings were validated using anticipated rainfall data from July 19, 2020, thereby demonstrating the reliability of both the landslide hazard warning results and the rainfall threshold model. This study presents a substantial advancement in the precise prediction and management of landslide hazards by employing innovative modeling techniques.

2. *Comment*: *The use of the Multilayer Perceptron (MLP) for analyzing rainfall thresholds is a commendable innovation. However, since this method has been widely used in other fields, it would suffice to mention it with appropriate references. The MLP framework in Figure 1 is relatively simple and takes up significant space; consider removing it.*

Response: We fully agree with your suggestion. MLP is an important model in machine learning and has been widely applied in various research fields by scholars worldwide. Given that the description of the MLP framework in this paper occupied considerable space, we have removed the related basic description and framework diagram in the revised manuscript.

3. *Comment*: *Given the length of the article and the complexity of the methods and procedures involved, it is suggested that the authors create a flowchart to further elucidate the methodological steps.*

Response: Thank you for bringing this to our attention. We understand your concern regarding the complexity of the content and the lack of a flowchart. To more clearly illustrate the methods and steps involved in the study, we have created a flowchart and included it in the revised manuscript (lines 72-74, in red font).

The flowchart for the study is shown in Fig. 1.

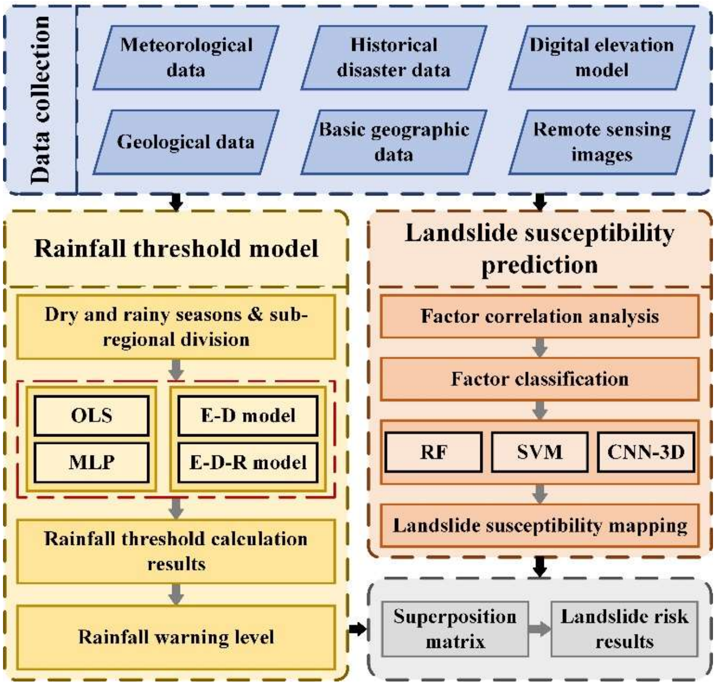

Figure 1. Flowchart of this study.

4. ***Comment****: The paper mentions dividing the study area based on topography and climate, followed by partial merging based on the number of historical disasters. It is suggested to include the final regional division results in Figure 4 to avoid any ambiguity.*

Response: Your feedback has been extremely helpful in improving our work. We fully agree with your suggestion that the final regional division results were not displayed in Figure 3 (previously Figure 4), which could cause confusion for readers. Therefore, we have added black outlines and labels to the figure to show the final regional divisions. Additionally, following your seventh suggestion, we have also merged the original Figure 6 with it. The revised content can be found in lines 152-154 (in red font).

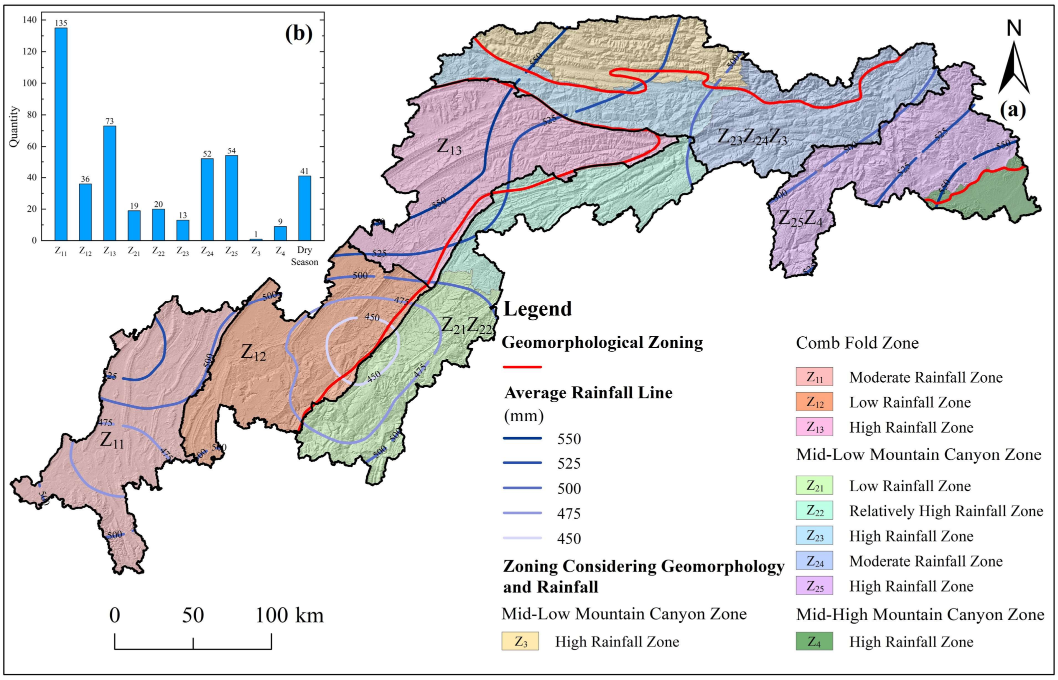

Figure 3: Zoning map of the study area. (a) Schematic diagram of the sub-region merger; (b) Number of historical landslide hazard sites in each sub-region.

5. Comment*: In Table 6, the categories of slope structures are represented by A-H, which is unclear and it is recommended to change them to professional terms.*

Response: Thank you for pointing this out. As you mentioned, using A-H to represent different slope structures could indeed be misleading for readers. We have revised the categories of slope structures in Tables 6 and 7 to use professional terminology. The revised content can be found in lines 262 and 287 (in red font).

Table 6: Classification of slope structure types and their respective percentages within the study area.

Class	Relationship between α, β, γ and σ	Area (%)
Nearly horizontal slope	α≤5°	1.720
Over-dip slope	α>5°, |γ-β|∈[0°, 30°) or |γ-β|∈[330°, 360°), σ>α	5.127
Flat-dip slope	α>5°, |γ-β|∈[0°, 30°) or |γ-β|∈[330°, 360°), σ=α	0.000
Under-dip slope	α>5°, |γ-β|∈[0°, 30°) or |γ-β|∈[330°, 360°), σ<α	13.581
Dip-oblique slope	α>5°, |γ-β|∈[30°, 60°) or |γ-β|∈[300°, 330°)	17.559
Transverse slope	α>5°, |γ-β|∈60°, 120°) or |γ-β|∈[240°, 300°)	32.066
Anticlinal-oblique slope	α>5°, |γ-β|∈[120°, 150°) or |γ-β|∈[210°, 240°)	15.089
Anticlinal slope	α>5°, |γ-β|∈[150°, 210°)	14.857

Table 7: Classification of landslide-inducing factors used in this study (only the revised part is shown).

Predisposing Factor	Classification Criteria	Code
Slope Structure	Nearly horizontal slope Over-dip slope Under-dip slope Dip-oblique slope Transverse slope Anticlinal-oblique slope Anticlinal slope	k

6. Comment*: In Table 7, the units of some landslide susceptibility factors are given, but the units for factors such as road density are missing.*

Response: Thank you for bringing this issue to our attention. We apologize for the omission of units for road density and two other landslide susceptibility factors. In the revised manuscript, we have added these missing units (line 287, in red font).

Table 7: Classification of landslide-inducing factors used in this study (only the revised part is shown).

Predisposing Factor	Classification Criteria	Code
Road Density (km/km^2)	[0,0.5] (0.5,1.2] (1.2,2.5] (2.5,5.0] >5.0	d
Tectonic Density (km/km^2)	[0,0.03] (0.03,0.12] (0.12,0.24] (0.24,0.38] >0.38	f
Curvature (m^{-1})	≤-3 (-3,-1] (-1,0] (0,1] >1	i

*7. **Comment**: There are many images in the article. Consider combining some of them for display.*

Response: Thank you for your suggestion. Due to the extensive content of the article, the manuscript contains a large number of images and tables, which has resulted in excessive length, with some figures conveying limited information. Therefore, we have integrated the Thiessen polygon results from the original Figure 5 into Figure 2 (previously Figure 3), and combined the bar chart of historical disaster points from the original Figure 6 with Figure 3 (previously Figure 4). Additionally, the original Figure 11, which did not present meaningful information, has been removed. The revised content can be found in lines 138-139 and 152-154 (in red font).

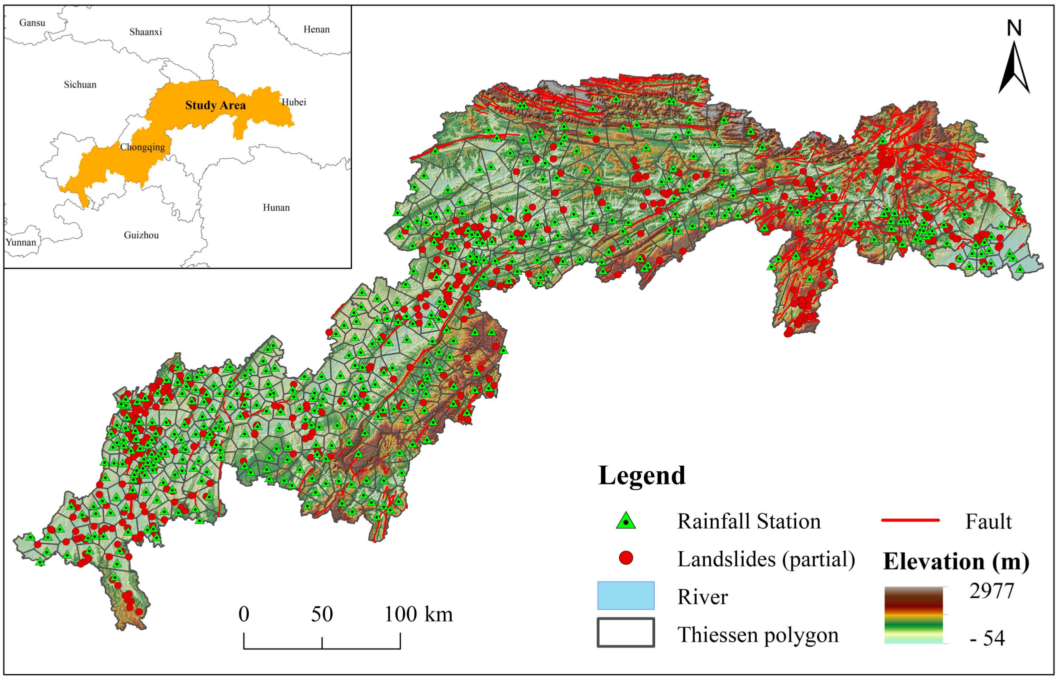

Figure 2: Geographic location of the study area and Thiessen polygon results for rainfall stations.

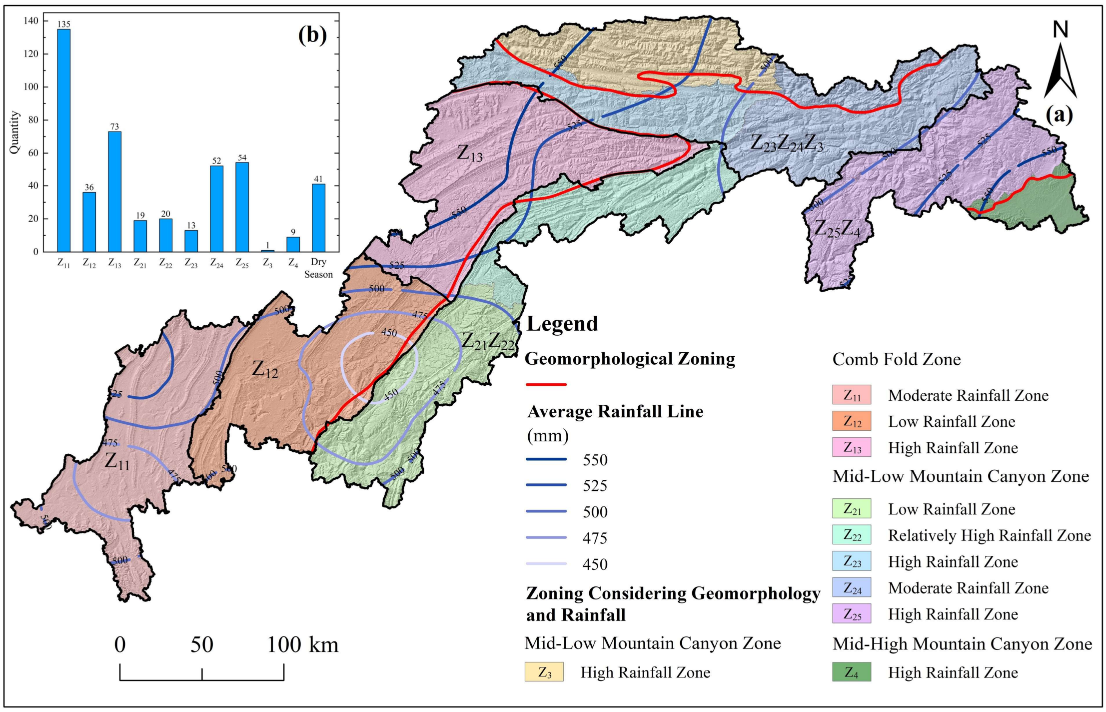

Figure 3: Zoning map of the study area. (a) Schematic diagram of the sub-region merger; (b) Number of historical landslide hazard sites in each sub-region.

8. Comment*: Some descriptions of the figures, such as the explanation of different colors in Figure 9 in lines 223-224, should be moved from the main text to the figure captions.*

Response: Thank you for pointing this out. We apologize for placing some explanatory notes that should have been in the figure or table captions within the main text, making the text overly cluttered. In response, we have reviewed and revised the explanatory text for all figures and tables in the manuscript. The revised figures and tables include Figure 5 (previously Figure 8), Figure 6 (previously Figure 9), Table 9, Figure 13 (previously Figure 17), and Figure 15 (previously Figure 19). The revised content can be found in lines 192-197, 209-213, 315-317, 329-332, and 352-355 (in red font).

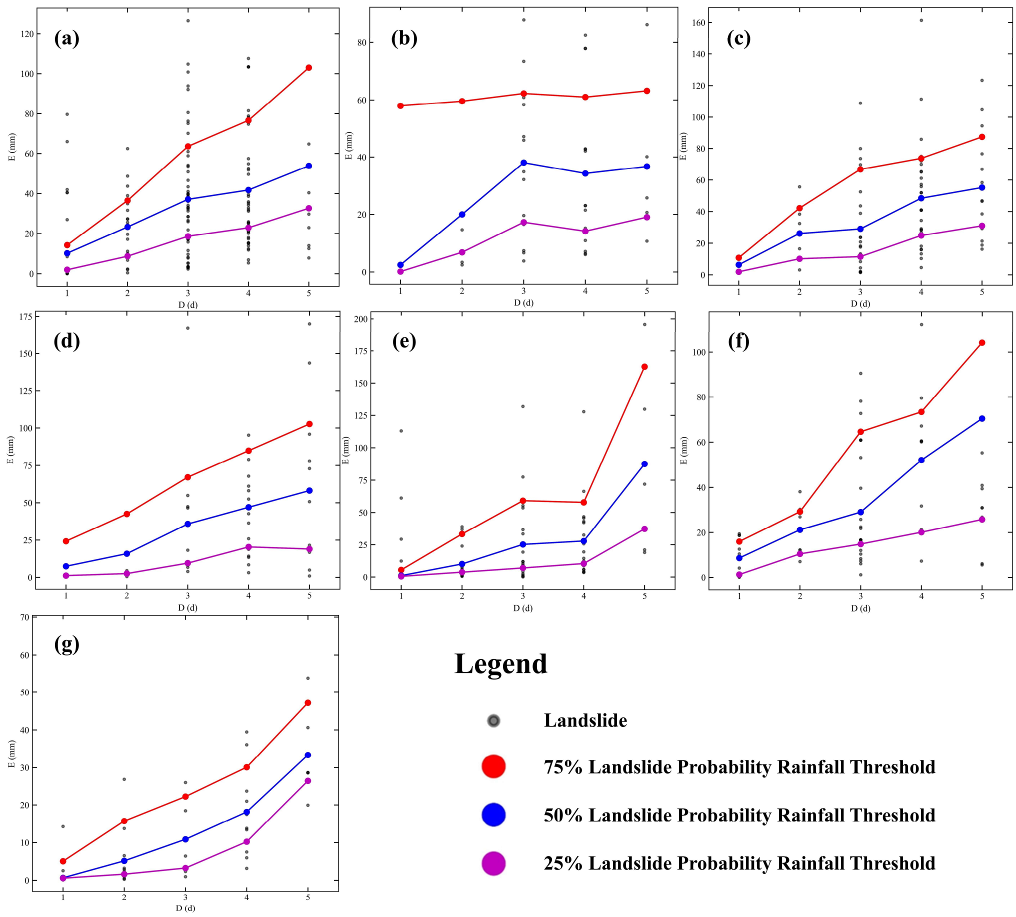

Figure 5: E-D rainfall threshold model results plotted using MLP regression. In the figure, regions are labelled as follows: a represents the Z11 region, b represents the Z12 region, c represents the Z13 region, d represents the Z21Z22 region, e represents the Z23Z24Z3 region, f represents the Z25Z4 region, and g represents the Dry Season. The red, blue, and purple points denote rainfall threshold values fitted for various landslide probabilities. Line segments are included solely for visual clarity and do not convey any practical information.

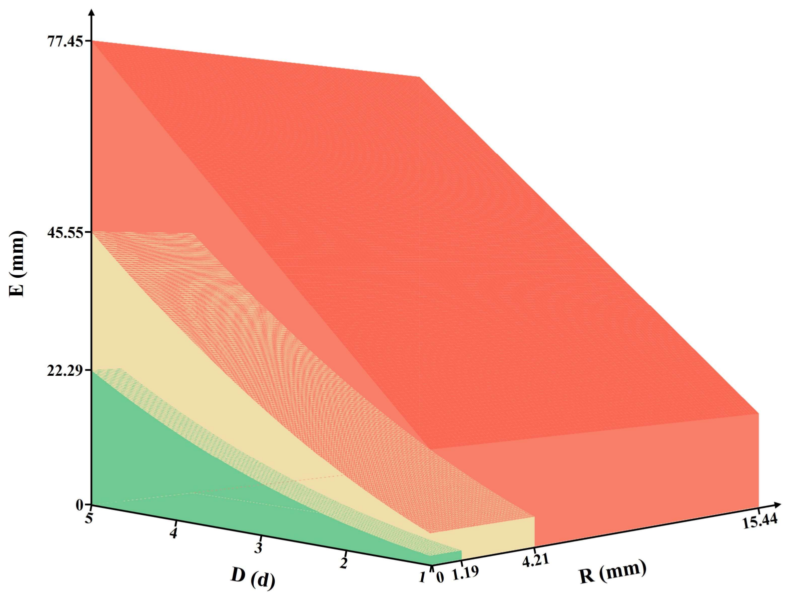

Figure 6: Schematic diagram of the E-D-R rainfall threshold model illustrated using the OLS regression results from the Z13 region as an example. The green, yellow, and red boxes in the figure represent landslide probabilities corresponding to rainfall thresholds of <25%, 25-50%, and 50-75%, respectively.

Table 9: Superposition matrix of landslide susceptibility and rainfall warning levels. In the table, the numerical codes represent the following zones: 1 – Relatively stable zone, 2 – General

prevention zone, 3 – Secondary prevention zone, and 4 – Priority prevention zone.

Rainfall Threshold Level \ Susceptibility	Very Low	Low	Moderate	High	Very High
Caution	1	1	1	1	2
Special Caution	1	1	1	2	3
Warning	1	1	2	3	4
Severe Warning	1	2	3	4	4

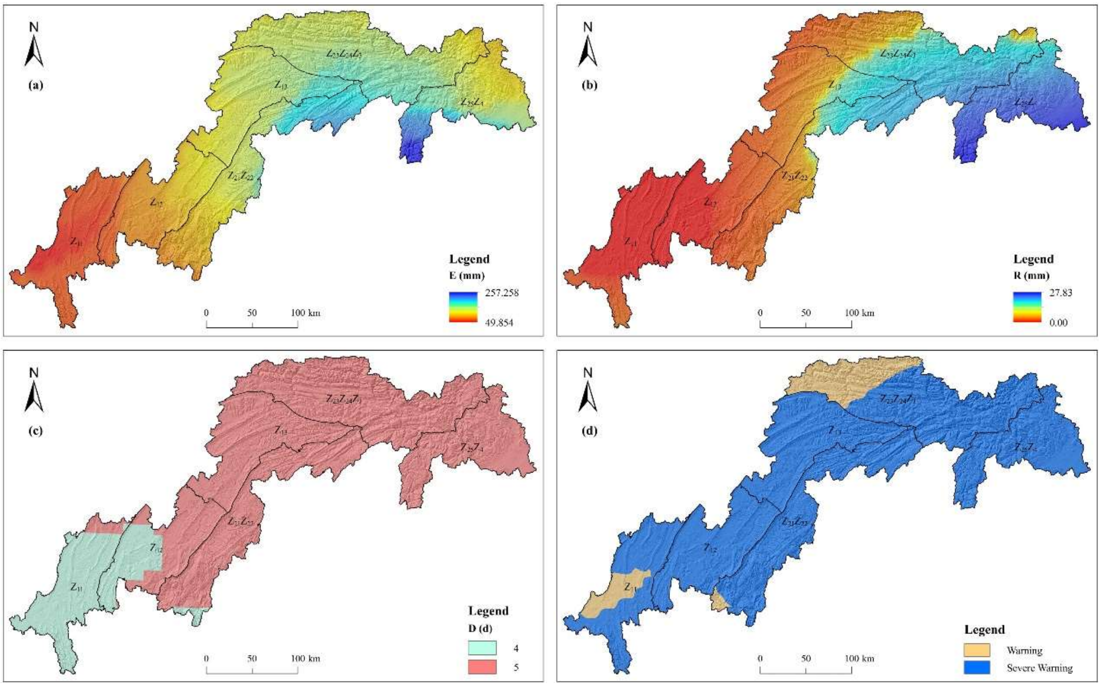

Figure 13: Various rainfall parameters and rainfall warning levels for July 19, 2020. (a) Effective rainfall interpolated by Kriging; (b) Daily rainfall interpolated by Kriging; (c) Duration of rainfall estimated using Thiessen polygons; (d) Rainfall warning levels calculated using the optimal rainfall threshold model.

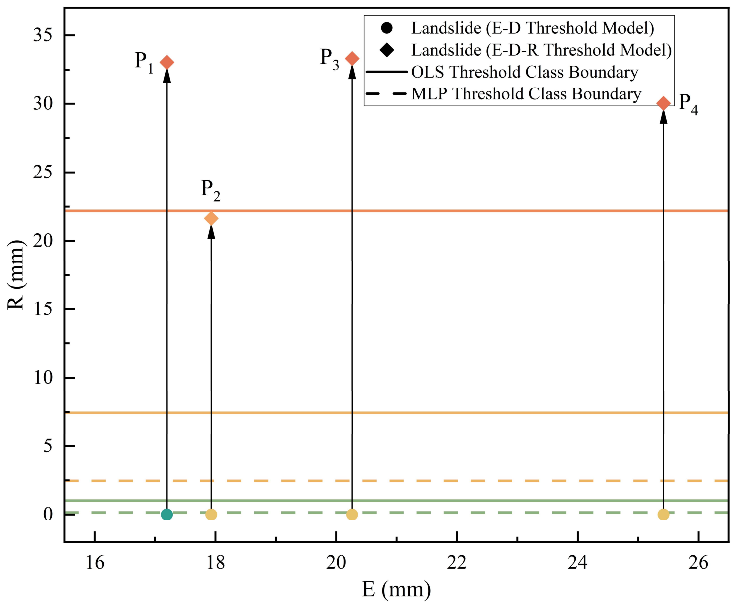

Figure 15: Transition process of rainfall warning levels in the Z12 region. The green line indicates the boundary between the Special Attention and Attention levels, the yellow line denotes the boundary between the Warning and Special Attention levels, and the orange line marks the boundary between the Severe Warning and Warning levels.

9. Comment*: The clarity of Figure 14 is insufficient. It is recommended to change the layout from three columns to two columns.*

Response: Thank you for bringing this issue to our attention. Following your suggestion, we have changed the layout of the figure to two columns. The revised content can be found in lines 288-293 (in red font).

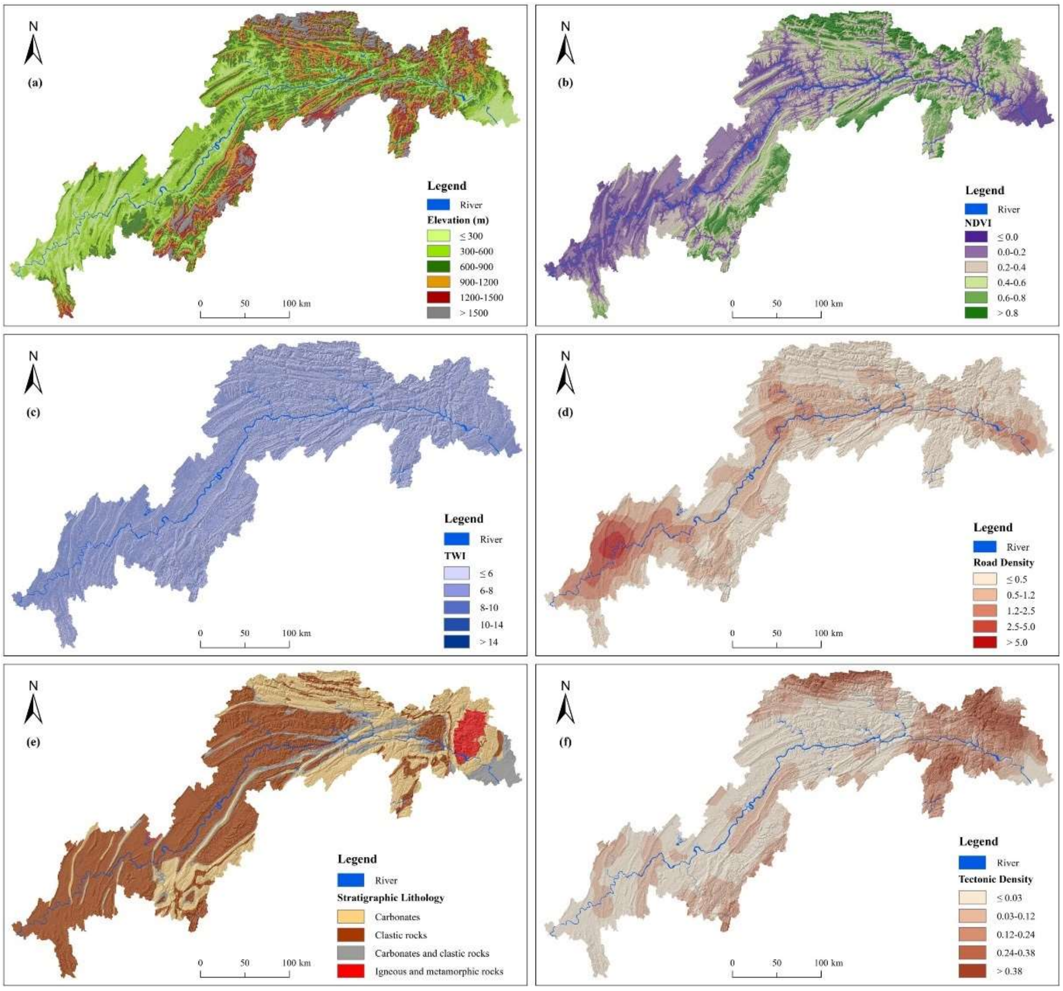

Figure 10-1: Grading results for landslide-inducing factors. (a) Elevation; (b) NDVI; (c) TWI; (d) Road density; (e) Stratigraphic lithology; (f) Tectonic density.

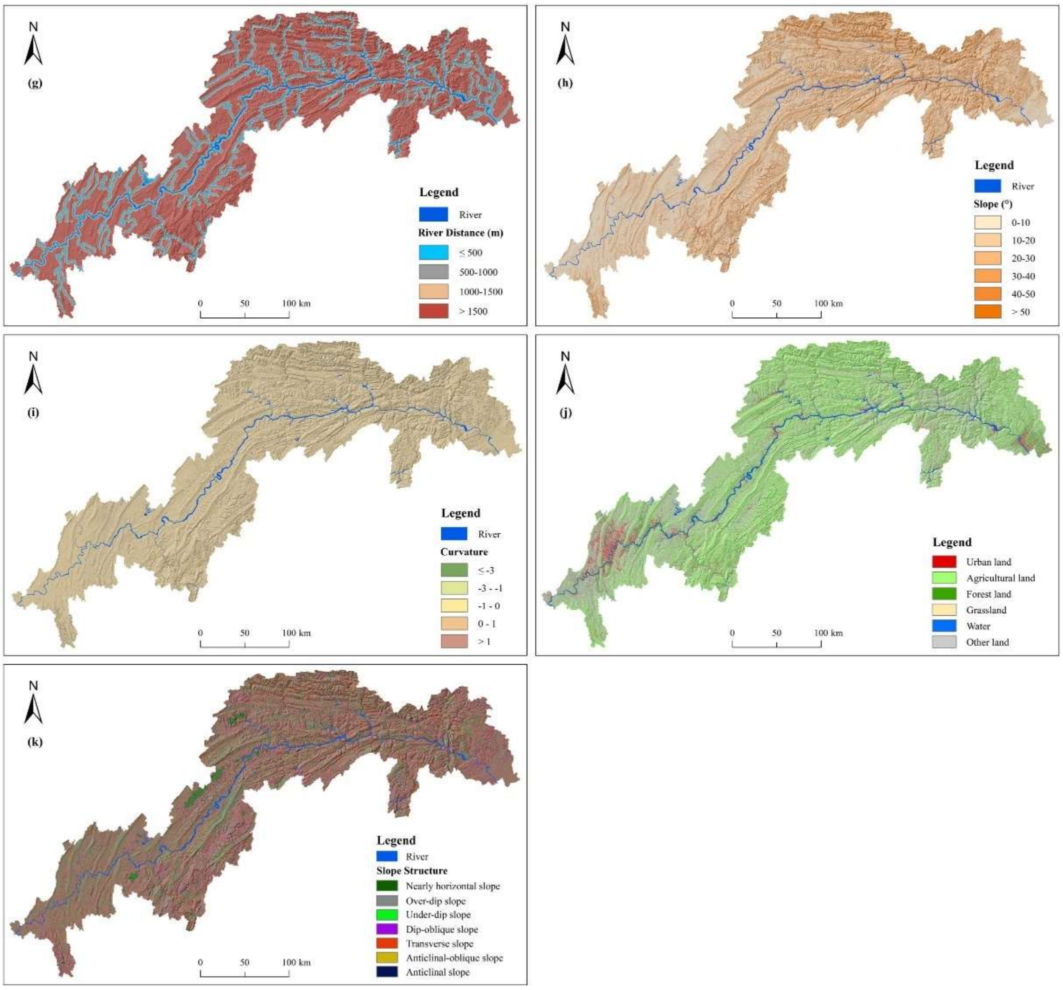

Figure 10-2: Grading results for landslide-inducing factors (continued). (g) River distance; (h) Slope; (i) Curvature; (j) Land cover; (k) Slope structure.

Special thanks to you for your insightful and valuable comments in detail.