

Dear Dr. Chihping Kuo,

Thank you for helping me to submit a revised draft of my manuscript titled **Characteristics of debris flows recorded in the Shenmu area of central Taiwan between 2004 and 2021** to *Natural Hazards and Earth System Sciences*. I appreciate the time and effort that you have dedicated to providing your valuable feedback on my manuscript. I am grateful to the reviewer's insightful comments on my paper. I have been able to incorporate changes to reflect most of the suggestions provided by the reviewers. I have highlighted the changes within the manuscript. After the revision, I believe that this study and its outcomes fulfil the scope of journal.

Here is a point-by-point response to the reviewers' comments and concerns.

### **Comments from Reviewer CC1**

This article presents a valuable evaluating procedure of threshold values to occur debris flow for a site. Some comments were proposed here for the author to revise or add in the article.

- **Comment 1:** *Line 7: the location name "Shebmu" is different from others in the article, please revise it.*

**Response:** Thank you for your suggestion. The name of location is corrected as "Shenmu."

- **Comment 2:** *Line 8: the description "Total of 20 debris flows were observed in this time interval." seems to be 20 times of debris flow events occurred in this time interval but not 20 amounts. It is suggested to rewrite or clarify the description.*

**Response:** Thank you for your suggestion. The content is modified as 20 times of debris-flow events, and the revised content is as follows.

**Abstract.** The data of debris-flow events between 2004 and 2021 in the Shenmu area Taiwan were presented and discussed in this paper. Total of 20 times of debris-flow events were observed in 18 years. Debris flows in the Shenmu area usually occurred in the Aiyuzi Stream during the rainy season, May to September, and about once per year between 2009 and 2017. The rainfall thresholds from the observed data were proposed as  $I_{max}$ ,  $R_{24}$ , and  $R_t$  of 9, 23, and 67.8 mm, respectively. The rainfall data also implied that the trend curves of intensity-duration ( $I-D$ ) were different before and after 2009, which due to the extreme rainfall event, Typhoon Morakot in 2009. The  $I-D$  curve obtained from the post-2009 data was proposed as the baseline of debris-flow  $I-D$  relationship in the study area. The extreme rainfall event also influenced the flow speed (average 14.3 m/sec before 2010 and 4.46 m/sec after 2010) and the occurrence frequency of debris flow (1.83 times per year before 2009 and 0.75 times after 2009). Recent findings

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indicated that the ground surface vibrational signals of debris flows were potentially useful for debris-flow early warning in terms of accumulated energy, and the characteristic frequency of debris flow in the study area was below 40 Hz. The dataset and the rainfall thresholds in this study permits the comparison with other monitored catchments and is advantageous to the global debris-flow dataset.”

- **Comment 3:** *Line 42-45: two important rainfall data resources were proposed here. Please address them in Fig.1 or 2.*

**Response:** Thank you for your suggestion. The rainfall stations are added and marked on Figure 1.

- **Comment 4:** *Line 54-56: is the abbreviation DF a name or index system for Debris Flow in Taiwan or this research?*

**Response:** Thank you for your comment. The abbreviation DF stands for Debris Flow, and the index names of the potential debris flow streams in the study area are used in Taiwan.

- **Comment 5:** *Line 60-62: please unify the expression of slope, i.e. degree or percentage.*

**Response:** Thank you for your suggestion. The slope in the manuscript is expressed in degree format.

- **Comment 6:** *The collection of data in this article is very complete. Does the author possible suggest an enough and proper period of monitoring for evaluating similar threshold values as characteristics of a site?*

**Response:** Thank you for your comment. Based on the monitoring results in the study area, the author would suggest that the initial 5-year monitoring is necessary after the monitoring system started, and additional 5 years, resulting in total of a 10-year monitoring period, is favorable for data collection and analysis, especially when encountering unusual rainfall events and varied weather patterns.

- **Comment 7:** *The format of vertical and horizontal axis is suggested to be uniform in Fig.7 to 11.*

**Response:** Thank you for your suggestion. The format of axes in Figure 7 and Figure 8 are changed to the same format as in Figure 9 to Figure 11.

## Additional clarifications

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In addition to the above comments, all spelling and grammatical errors pointed out by the author and the editing supervisor have been corrected.

I look forward to hearing from you in due time regarding the submission and to respond to any further questions and comments you may have.

Sincerely,

Yi-Min Huang

Feb. 15, 2023