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Debris flow initiation characteristics and occurrence probability after extreme rainfalls: case study in the Chenyulan watershed, Taiwan

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Comments for Reviewer 1

The manuscript presents a statistical analysis of debris flow occurrence after extreme rainfall. The rainfall index was used to analyze the return period and the characteristic of debris flow occurrence after extreme rainfalls in an area also affected by earthquakes. An empirical method based on a relationship between probability of debris flow occurrence and return period was developed and it is successfully applied to the case of Chenyulan watershed (Taiwan).

The main purposes of the manuscript are clearly defined. Even though the scientific question, the method is interesting and the scientific approaches are valid, the authors should modify the structure of the manuscript presenting the method before the case study. The desirable outline of manuscript should be Introduction; Model and related sub-paragraph about model input data, variables and outputs; Case study and results of the model; conclusion.

This is basically a good paper. The authors however need to address the following comments before being accepted: - Debris fall initiation should be replaced by debris fall triggering (e.g. lines 17 and 22 p.1); - Line 19 p.3 the equation should be labelled. The number of RI equation could be cited in Table 1. - Figure 1 should be improved (blue instead of light blue). - More details on study area and characteristic of debris flow (as volume involved and run out area and kind of soil involved) should be added. - The applicability or unapplicability of the model to other case study could be further discussed in the section 6 (Conclusion) - Numbering of sub-paragraph is suggested.

Response to Reviewer 1

We appreciate the helpful comments from the reviewer and thank you for your kind words of encouragement. The manuscript has been revised following the suggestions of the reviewer. Point by point responses are listed as follows:

1. The authors should modify the structure of the manuscript presenting the method before the case study. The desirable outline of manuscript should be Introduction; Model and related sub-paragraph about model input data, variables and outputs; Case study and results of the model; conclusion.

Response:

This study mainly focused on the debris flow triggering characteristics and occurrence probability. The application of model to the study area is one part of this study. In particular, in the revised version, we have further addressed the debris flow triggering characteristics including rainfall event and rainfall index. However, the structure of the manuscript could not be completely modified to follow the reviewer's suggestions. As such, in the section of *Application of the empirical model*, we have added a *Procedures* section (section 6-1) describing the model's input data, variables and outputs, etc., before the case study (Lines 8-15, Page 20).

2. *Debris fall initiation should be replaced by debris fall triggering (e.g. lines 17 and 22 p.1)*

Response: All instances of “debris flow initiation” have been replaced with “debris flow triggering” in the revised manuscript following the reviewer’s suggestions.

3. *Line 19 p.3 the equation should be labelled.*

Response: The equation has been labelled as Eq. (2) (Line 13, Page 7).

4. *The number of RI equation could be cited in Table 1.*

Response: The number of RI equation has been cited in Table 2 (original Table 1) (Line 3, Page 14).

5. *Figure 1 should be improved (blue instead of light blue).*

Response: Figure 1(a) has been improved following the reviewer’s suggestion (Page 4).

6. *More details on study area and characteristic of debris flow (as volume involved and run out area and kind of soil involved) should be added.*

Response:

We have added more details of the geological condition in the study area, as shown in Lines 24-28, Page 3; Line 1, Page 4, and Figure 1(b).

The characteristics of significant of debris flows, such as Typhoons Herb, Toraji, and Morakot, have also been collected and presented, as showed in Table 1 (Page 5).

7. *The applicability or unapplicability of the model to other case study could be further discussed in the section 6 (Conclusion) - Numbering of sub-paragraph is suggested.*

Response:

(1) The limitations of the model and the applicability of the model to other cases have been added and addressed in the Conclusion section (No. 5, Pages 23-24).

(2) Sub-paragraphs have been numbered in the Conclusion section.