

***Interactive comment on* “Characteristics and influencing factors of rainfall-induced landslide and debris flow hazards in Shaanxi Province, China” by Ke Zhang et al.**

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We thank the reviewer for the positive comments and assessment. Overall, all comments can be well addressed in a revised manuscript. These revisions are totally manageable and can be easily achieved.

1. “Globally, the paper is well written and is worth for publication, but minor revisions should be considered. There are a few problems that should be considered. For example, in the results section, there is some discussion mixed with the results the authors found and that should be in the discussion. References are frequently not sequenced chronologically. A few times they are chronologically sequenced.”

Response: We will further revise the discussion section to make it more distinguishable from the result section. The order of references will be further checked as well.

2. “INTRODUCTION: L. 32 – 33: “China is affected by geological disasters (: : :)”. L. 39: Landslide occurrence is a complex non-linear process (: : :)”. L.42-43: “Hence, numerous studies...”. You point several studies but you do not cite any. Cite some of them. E.g., Crosta and Frattini (2001; 2003); Cascini et al., (2010). Crosta GB and Frattini P. - Rainfall thresholds for triggering soil slips and debris flow. In: Mugnai A, Guzzetti F, Roth G (eds) Mediterranean storms. Proceedings of the 2nd EGS Plinius Conference on Mediterranean Storms. Siena, Italy, (2001) pp 463–487. Crosta G.B. and Frattini P. - Distributed modeling of shallow landslides triggered by intense rainfall. Natural Hazards and Earth System Sciences, 3 (1–2) (2003), pp. 81-93. Cascini, L., Cuomo, S., Pastor, M., Sorbino, G. - Modeling of rainfall-induced shallow landslides of the flow-type. Journal of Geotechnical and Geoenvironmental Engineering, 136 (1) (2010), pp. 85-98.”

Response: These are relatively minor issues that will be easily addressed in the revised manuscript. We will correct these typos and cite more appropriate literature.

3. “STUDY AREA AND DATA: Datasets: L. 97: soil texture: did you make a map with texture? You could add it to figure 1. It would be more explicit for the reading and comprehension of the idea.”

Response: We will add a map of soil texture into Figure 1.

4. “METHODOLOGY L. 138: you mention the slope, but it is not in a picture. It would be good if you put it in a picture. Add it to figure 1. And slope curvature. Did you take it into account? Does your study area have great differences when comparing concave and convex areas, for example?”

Response: We accept this suggestion and will revise the figure.

5. RESULTS “L. 158 – 159: the sentence: “The above results (...) than landslide”.

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This is interpretation and would be more appropriate to move into the discussion.”

Response: We accept this suggestion and will move it into the discussion.

6. “L. 163 – 167: You say that landslides concentrate mainly between July and September and debris flows concentrate in July when there are higher precipitation levels. In L. 165 – 167 you put this as a contrast. Both hazards occur in the rainy season. They follow the same general pattern, although debris flows are more concentrated, meaning that: - Debris flows have an almost immediate response to the rainfall event and that these processes are quicker than landslides.”

Response: We will further clarify the statement in the revised manuscript.

7. “L. 170 – 171: “The above results show that the landslide season is longer than the debris flow season”. This is a conclusion.”

Response: This is right. We can add it into the result section.

8. “L. 178: Please include a terrain slope map in Figure 1 with landslides there. Or include the map in figure 5. In both cases, it would be much more explicit and easier when analyzing figure 5.”

Response: We accept this suggestion and will revise Figure 1 per your suggestions.

9. “L. 179 – 185: Here you present results but you are also discussing them. This is a good matter to put in the discussion.”

Response: We accept your suggestion and will make the corresponding changes.

10. “L. 184-185: in this sentence, you are already discussing your results.”

Response: We will make the corresponding changes.

11. “L. 188 – 190: “There are no apparent relationships between the antecedent rainfall amount and the number of landslide events (: : :)”. But figure 6a shows there is a constant increase in the number of landslides with the increasing amount of antecedent

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rainfall, from 10-30 mm up to > 100 mm. Could you explain better your idea?”

Response: Sure. We will make the statement clearer and add more explanation.

12. “L. 194 – 195: when antecedent accumulated rainfall is > 100 mm the number of debris flow rate is larger than landslide rate. Why? Does the rainfall intensity have any influence over the antecedent accumulated rainfall values? Are they more sensitive to rainfall amounts and variations than landslides?”

Response: Additional explanation will be provided in the revised manuscript.

13. “L. 223-224: you state that with increasing terrain slope, landslides occur more often than debris flow. Why? What is the main difference between both hazards? Are landslides more dependent on permanent factors as terrain slope than debris flows? And are debris flows more dependent on rainfall (antecedent amount, duration and intensity) variations than landslides?”

Response: Additional explanation will be provided in the revised manuscript.

14. “L. 228: Do you think this has more to do with the cover type, or with rainfall and the terrain slope?”

Response: Additional explanation will be provided in the revised manuscript.

15. DISCUSSIONS “References in the text are not normalized. Try to order the references chronologically. L. 27, 28, 42, 52, 60, 248, 255-256, 259, 281 and 282, for example, references are not ordered chronologically.”

Response: We accepted the suggestion and will make sure that we use the right reference styles.

16. “In L. 269-270 you state that “(: : :) cultivated lands have higher landslide and debris flow occurrence rates than forests in the same climatic zone”. Is it only due to the roots that draw down the soil moisture that forested areas are more stable? Since you have steep slopes in the southern area of Shaanxi Province, is it possible

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that human impact on land (farming) also contributes significantly to slope instability? It would be important to discuss the human impact on slope stability. Similar areas whether cultivated or not have similar behavior?”

Response: We accept your suggestion and will discuss these results/implications in the revised manuscript.

17. “Human impact/action is not accounted for in your discussion. Do you think it is important to include it in your analysis? The scope of this work is not the analysis of human impact but since you debate conditioning factors as terrain slope, land cover, soil type, etc., human impact probably should be accounted in the discussion, because you say these hazards affect people but aren't people promoting the hazards?”

Response: Thank you for the suggestion. We will discuss these results/implications in the revised manuscript.

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