

## Response to Reviewer 2 Comments

We thank you for providing us with the evaluation on our manuscript. With this reply we hope to provide adequate answers to the comments of the reviewers. This is done in a point-by-point fashion below. First the comment of the referee (RC) is given, after which our response (AC) is given in green font. We strongly appreciate the insight and feedback provided by both referees and are convinced these have helped in further improving the manuscript.

### (1) General evaluation by referee

**RC:** General comments: In this study the susceptibility of the landslides triggered after the Mw 7.0 Juizaighou earthquake is evaluated by combining the FR and the AHP methods. They first visually interpreted the landslides and used the 80 % to train the model and the remaining 20 % for validation. Topographic, seismic, and geological factors were used as causative factors. Finally, they evaluate the performance of the model using the AUC. The main concern about this analysis is its applicability as they are analysing the susceptibility of something that happened due to a very strong earthquake, impossible to predict and whose effects and evolution can be very different in the future. Therefore, this analysis only proves that the performance of the integrated model is quite good using this combination of factors, but it cannot be used to prevent the damages of a motion as it is applied afterwards. It implies that the manuscript does not represent a substantial contribution in the understanding of natural hazards.

**AC:** Thanks for your comments. We'd like to further discuss and explain this question based on our present knowledge. As pointed out by some studies [1-3], identifying a region's susceptibility to landslides triggered by the earthquake is an important work, and effective susceptibility mapping could provide planners with foreknowledge of landslides regions thereby preventing landslides and reducing the effects of landslides in the zone of high seismic intensity of the earthquake. Landslide inventory and susceptibility mapping studies are widely considered as the first steps towards landslide hazard mitigation [4, 5]. Therefore, we first visually interpreted the landslides triggered by the earthquake, then produced a landslide susceptibility map by using the integrated model. The validation results demonstrated the reliability and feasibility of the integrated model in earthquake-triggered landslide susceptibility mapping. This approach can model the spatial probability of the post-earthquake landslides based on just several hundred mapped landslides, and therefore has the ability to provide a landslide susceptibility map after the earthquake. According to the landslide susceptibility map, engineers and decision makers can understand the probability of landslides in different regions, and may therefore take the prompt effective emergency actions to mitigate hazards of the earthquake-triggered landslides. Therefore, our results can be used to reduce the effects of landslides and mitigate hazard. Indeed, future scenarios are likely to be different from what happened in the past. In the discussion section, we also pointed out that results obtained in the past environmental conditions are not a guarantee for the future, and the susceptibility results need to be adapted as

soon as environmental conditions or their causal relationships obviously change in the future. However, for this study, the main purpose is to map the susceptibility of earthquake-triggered landslides by using the integrated model. We mainly focused on the interpretation of earthquake-triggered landslides, and the susceptibility map is made for the present situation. In addition, earthquakes with magnitudes greater than 6.0 can trigger numerous landslides [6], detailed landslide inventory will require significant time to complete. To some extent, our method has the potential to provide a quick assessment of landslide hazard after an earthquake. Therefore, we have reason to believe that our research is important. Hope that the explanation will meet with approval.

### 【References】:

[1] R. Niu, X. Wu, D. Yao, L. Peng, L. Ai, and J. Peng, *Susceptibility Assessment of Landslides Triggered by the Lushan Earthquake, April 20, 2013, China, IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 7, 3979-3992, 2014.

[2] Xu, C., Xu, X. W., Dai, F. C., and Saraf, A. K., *Comparison of different models for susceptibility mapping of earthquake triggered landslides related with the 2008 Wenchuan earthquake in China, Computers & Geosciences*, 46, 317-329, doi: 10.1016/j.cageo.2012.01.002, 2012b.

[3] Razifard, M., Shoaie, G., Zare, M., *Application of fuzzy logic in the preparation of hazard maps of landslides triggered by the twin Ahar-Varzeghan earthquakes (2012), B Eng Geol Environ*, 78, 223-245, 2019.

[4] Ercanoglu, M., Gokceoglu, C., *Use of fuzzy relations to produce landslide susceptibility map of a landslide prone area (West Black Sea Region, Turkey), Engineering Geology*, 75, 229-250, 2004.

[5] Kamp, U., Growley, B.J., Khattak, G.A., Owen, L.A., *GIS-based landslide susceptibility mapping for the 2005 Kashmir earthquake region, Geomorphology*, 101, 631-642, 2008.

[6] Jibson, R.W., *Predicting earthquake-induced landslide displacements using Newmark's sliding block analysis, Transportation Research Record*, 9-17, 1993.

(2) Specific comments by the referee

1. **RC:** The English needs to be revised.

**AC:** We will try our best to revise the manuscript.

2. **RC:** The authors should be more precise, rigorous and objective in their explanations and keep their personal opinions aside.

**AC:** Thanks for your kind reminding. We will try our best to revise the manuscript.

3. **RC:** When an affirmation is done, it has to be supported with references or results.

**AC:** We will try our best to check and revise the manuscript.

4. **RC:** Some parts of the text need to be re-organised: it has to be well structure and easy to follow. Please describe the study are in the corresponding section, then the methodology, then results and finally conclusion. Do not mix them and repeat things in other sections.

**AC:** Thanks for your comments. We will try our best to revise the manuscript, and some parts will be adjusted.

5. **RC:** Always refer to the tables and figures when you are explaining something.

**AC:** We will try our best to revise the manuscript.

6. **RC:** Methodology needs to be more elaborated.

**AC:** Thanks for your kind suggestion. We will revise it.

### (3) Technical comments by the referee

1. **RC:** Page 1: -Line 1: I would say assessment rather than map as there is a process, not trivial, that leads to its mapping. Mapping sounds like a simple visually interpretation.

**AC:** Indeed, landslide susceptibility is the likelihood of a landslide occurring in an area, estimating “where” landslides are likely to occur. As we mentioned, the objective of the paper is to generate an earthquake-triggered landslide susceptibility map. In other words, it aims to map the locations that are prone to landslides. Different from visual interpretation, landslide susceptibility mapping is the result of landslide susceptibility model. So, to some extent, we prefer to choose “mapping”. Thanks for your understanding.

2. **RC:** -Line 11: Mw instead of Ms.

**AC:** We will modify it.

3. **RC:** -From line 12 to line 15: this is not true. The co-seismic landslides already occurred and the spatial probability of the post-seismic failures can be very different. What are you predicting?

**AC:** Thank the reviewer for the comments. We have discussed previously in Answer #1 (Page 1). Here, we'd like to explain this question again. Although the co-seismic landslides already occurred, the susceptibility of landslides triggered by the earthquake needs to be analysed. The main purpose of this study is to map the susceptibility of landslides triggered by the earthquake. It can help decision makers understand the probability of landslides in different regions. Hope that the explanation will meet with approval.

4. **RC:** -Line 24: “...predictive capability” again what do you want to predict?

**AC:** Here, we used the success and prediction rates [1] to examine how well the results fit the data. As mentioned in the manuscript, 20 % of the landslides (not used in the

training process) was used to investigate the prediction performance of the integrated weighted index model, and 80 % of the landslides was used to assess the fitting performance. Both success and prediction rates were measured to examine the reliability and efficiency of the landslide probability map. Many similar studies have adopted success and prediction rates to evaluate and compare the performance of models [2-5]. This method is acceptable to evaluate the model performance. Hope that the explanation will meet with approval.

### **【References】:**

[1] Tien Bui, D., Pradhan, B., Lofman, O., Revhaug, I., *Landslide susceptibility assessment in Vietnam using support vector machines, decision tree, and Naive Bayes Models, Math. Probl. Eng.*, 1–26, 2012.

[2] R. Niu, X. Wu, D. Yao, L. Peng, L. Ai, and J. Peng, *Susceptibility Assessment of Landslides Triggered by the Lushan Earthquake, April 20, 2013, China, IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 7, 3979-3992, 2014.

[3] Xu, C., Xu, X. W., Dai, F. C., and Saraf, A. K., *Comparison of different models for susceptibility mapping of earthquake triggered landslides related with the 2008 Wenchuan earthquake in China, Computers & Geosciences*, 46, 317-329, doi: 10.1016/j.cageo.2012.01.002, 2012b.

[4] Umar, Z., Pradhan, B., Ahmad, A., Jebur, M. N., and Tehrany, M. S., *Earthquake induced landslide susceptibility mapping using an integrated ensemble frequency ratio and logistic regression models in West Sumatera Province, Indonesia, Catena*, 118, 124-135, doi: 10.1016/j.catena.2014.02.005, 2014.

[5] Song, Y., Gong, J., Gao, S., Wang, D., Cui, T., Li, Y., Wei, B., *Susceptibility assessment of earthquake-induced landslides using Bayesian network: A case study in Beichuan, China, Computers & Geosciences*, 42, 189-199, doi: 10.1016/j.cageo.2011.09.011, 2012.

5. **RC:** -Line 26: What does scientific basis mean?

**AC:** We've recognized that the description is unclear, and we will modify it as follows:

“The generated map can help engineers and decision makers mitigate hazards of the earthquake-triggered landslides to individuals and infrastructures of the earthquake affected region.”

6. **RC:** -Line 27: “...to mitigate hazards of the EQ-triggered landslides to individuals and infrastructures of the EQ affected region”: you evaluated the susceptibility of the landslides triggered by the EQ, i.e. the susceptibility of something that already happened and which is very likely to change fast in the future.

**AC:** We have discussed previously in Answer #1 (Page 1). Effective susceptibility mapping could provide planners with foreknowledge of landslides regions thereby preventing landslides and reducing the effects of landslides in the zone of high seismic intensity of the earthquake. The generated landslide susceptibility map could be useful in hazard mitigation by helping decision makers understand the probability of landslides in different regions. Hope that the explanation will meet with approval.

7. **RC:** Page 2: -Line 4: “Landslides are more likely to occur when the slope becomes unstable”. When the slope becomes unstable it directly implies that a landslide will occur, right? This sentence does not make sense.

**AC:** Your suggestion has been adopted and this sentence will be removed in the revised manuscript.

8. **RC:** -Line 6: “...especially the earthquake and rainfall...” It looks like EQ and rainfall are anthropogenic. Please re-write it again.

**AC:** We appreciate the reviewer for his/her rigorousness. We will modify this sentence as follows:

“Landslides can be caused by several factors, such as strong earthquakes, intense or prolonged rainfall and multiple human actions”

9. **RC:** -Line 15: “Comprehensive EQ-triggered landslides...”. This is true, but it must be done before the EQ occurs.

**AC:** We have discussed previously in Answer #1 (Page 1). Thanks for your comments and understanding.

10. **RC:** -Line 16: “...through the proper prevention actions for the future.” This is also true, but predicting what it will happen in the future, not during the EQ.

**AC:** As mentioned above, landslide susceptibility maps could be useful in hazard mitigation by helping decision makers understand the probability of landslides in different regions. Thanks for your comments and understanding.

11. **RC:** -Line 17: which are these many approaches? Please develop this part.

**AC:** Indeed, these approaches are already mentioned in the next sentence. Please see the manuscript. We will adjust this part.

12. **RC:** -Line 32: “... the mutual relationship between the factors is mostly neglected...” Is it important to evaluate the susceptibility? If so, please explain it.

**AC:** Thanks for your kind reminding. Landslide susceptibility is related to predisposing factors and that susceptibility can be evaluated by analysing the relationships between the predisposing factors and the landslide susceptibility. It is noteworthy that some factors contribute more to landslides than others, however, frequency ratio (FR) cannot reflect this difference. In other word, the mutual relationship between the factors is neglected by FR. Therefore, we apply the AHP to derive the weight of every predisposing factor, and restrain the shortcomings of these two individual methods. Furthermore, AHP is an important method for landslide susceptibility assessment, which has been applied for many years. As mentioned in the manuscript, AHP can be used to identify the mutual relationship between the factors, and it also proves that the mutual relationship between the factors is important for landslide susceptibility mapping. According to your comments, the reference “Zhang et al., 2016” will be included here.

**【References】:**

*Zhang, G., Cai, Y., Zheng, Z., Zhen, J., Liu, Y., and Huang, K.: Integration of the Statistical Index Method and the Analytic Hierarchy Process technique for the assessment of landslide susceptibility in Hui Zhou, China, Catena, 142, 233-244, doi: 10.1016/j.catena.2016.03.028, 2016.*

13. **RC:** Page 3: -Line 9: “Umar et al., 2014”. Please cite the references properly. Do this for all the other ones.

**AC:** Thanks for your kind reminding. We will modify it.

14. **RC:** -Line 18: I suggest using present tense. Furthermore, I would say not only apply but also evaluate how the model performs.

**AC:** Thanks for your kind suggestion. We will revise this sentence as suggested.

15: **RC:** -Line 21: Please define/quantify “complete”.

**AC:** As mentioned in the manuscript, the integrated method of FR and AHP in order to utilize both advantages of these methods and restrain their shortcomings. So, the combination of these two methods can generate the complete model that can assess the impact of landslide conditioning factors and also the contribution of classes of each conditioning factor on landslide occurrence.

16: **RC:** -Line 25: why detailed? Did you apply any specific validation?

**AC:** Thanks for your kind reminding. We will modify it to make it clear.

17. **RC:** Page 4: -Line 4: “...are extremely complex.” This is a personal opinion. Please describe it.

**AC:** Thanks for your kind reminding. The reference “Deng, 2011” will be included here.

**【References】:**

*Deng, G.: Study of Tourism Geosciences Landscape Formation and Protection of Jiuzhaigou World Natural Heritage Site, Ph.D. thesis, Chengdu University of Technology, China, 173 pp., 2011 (in Chinese).*

18: **RC:** -Line 6: “...tectonic movements are very intense...” What does it mean? Please describe it.

**AC:** Thanks for your kind reminding. We will add some descriptions in the revised manuscript.

19: **RC:** -Line 6: Please describe alpine karst terrain topography.

**AC:** Thanks for your kind reminding. We will add some descriptions in the revised manuscript.

20. **RC:** -Line 8: “The geomorphology of the study area is ...” This is evident. Please delete it.

**AC:** Thanks for your kind reminding. We will delete it.

21: **RC:** -Line 12: A reference is needed here.

**AC:** The reference “Florsheim et al., 2013” will be included here.

**【References】:**

*Florsheim, J.L., Ustin, S.L., Tang, Y., Di, B., Huang, C., Qiao, X., Peng, H., Zhang, M., Cai, Y.: Basin-scale and travertine dam-scale controls on fluvial travertine, Jiuzhaigou, southwestern China, Geomorphology, 180-181, 267-280, doi: 10.1016/j.geomorph.2012.10.016, 2013.*

22: **RC:** -From line 13 to line 18: This paragraph is misplaced. You introduced the study area and now you introduce the park again?

**AC:** Thanks for your kind reminding. We will adjust this part.

23: **RC:** -Line 20: You did more than mapping. Assess?

**AC:** As mentioned above, the objective of the paper is to generate an earthquake-triggered landslide susceptibility map. So, in my opinion, we prefer to choose “mapping”.

24: **RC:** -Line 26: Landslide inventory is not just “useful”. It is the basis for assessing the landslide hazard.

**AC:** Thanks for your kind reminding. We will modify this sentence as follows:

“Landslide inventory is essential for assessing landslide hazard or risk on a regional scale.”

25: **RC:** -Line 30: is this information relevant for the paper? If not, please delete it.

**AC:** Sentinel-2A image has 13 spectral bands, however, we just used 3 visible bands. For some readers who are not familiar with Sentinel-2A, we think this information is helpful to understand the data we used.

26: **RC:** Page 5: -Line 1: I do not understand this sentence.

**AC:** We will modify this sentence to make it clear and easy to understand and this sentence will be modified as follows:

“In this study, three visible bands (red, green, blue) with the spatial resolution of 10 m were adopted to analysis the image characteristics of earthquake-triggered landslides.”

27: **RC:** -Line 2: “with the aid of computer and GIS tools...” What does it mean? Please be more specific.

**AC:** Thanks for your kind reminding. We will modify it as follows:

“With the aid of ArcGIS and ENVI tools...”

28: **RC:** -Line 6: “Smaller landslides” what area? Please define it.

**AC:** We will add some descriptions in the revised manuscript.



29: **RC:** -Line 21: “Pioneer studies...” Does it mean that until 2001 no one describe this before? What about slopes <15 degrees? Nothing happens?

**AC:** Thanks for your comments. Indeed, we believe that there are many related studies before 2001, and we also believe that landslides may occur if the slope is less than 15 degrees. Here, we just emphasize the importance of slope, and we will modify this sentence as follows:

“Landslides become more possible once the slope gradient is higher than 15°.”

30: **RC:** -Line 23: “29.92”. This is average. No decimals.

**AC:** Thanks for your kind reminding. We will modify it.

31: **RC:** -Line 26: “In the study area the rugged terrain makes the slope very unstable”. Why? Please develop this idea.

**AC:** Thanks for your comments. We will remove this sentence.

32: **RC:** -Line 29: “Lithology is directly related to the slope stability, which plays...” add some references to justify this please.

**AC:** The references “Guo et al., 2015, Saha et al., 2002” will be included here.

**【References】:**

Guo, C., Montgomery, D. R., Zhang, Y., Wang, K., and Yang, Z.: *Quantitative assessment of landslide susceptibility along the Xianshuihe fault zone, Tibetan Plateau, China, Geomorphology*, 248, 93-110, doi: 10.1016/j.geomorph.2015.07.012, 2015.

Saha, A. K., Gupta, R. P., and Arora, M. K.: *GIS-based Landslide Hazard Zonation in the Bhagirathi (Ganga) Valley, Himalayas, International Journal of Remote Sensing*, 23, 357-369, doi: 10.1080/01431160010014260, 2002.

33: **RC:** Page 6: -Line 1 and 2: “The distances of a slope from faults as well as from the river channels...” All of these statements need to be justified by references.

**AC:** The reference “Kanungo et al., 2006” will be included here.

**【References】:**

Kanungo, D.P.; Arora, M.K.; Sarkar, S.; Gupta, R.P.: *A comparative study of conventional, ANN black box, fuzzy and combined neural and fuzzy weighting procedures for landslide susceptibility zonation in Darjeeling Himalayas, Engineering Geology*, 85, 347-366, doi: 10.1016/j.enggeo.2006.03.004, 2006.

34: **RC:** -Line 3, 4 and 5: “According to the China Earthquake Administration, the epicentre of the Juizhaigou EQ was located near the Minjiang...” This should be explained in the study area. Please add the faults in Figure 1 and refer to them.

**AC:** Thanks for your kind reminding. We will adjust this part, and add the faults in Figure 1.



35: **RC:** -Line 5: “Some studies...” I guess you only mean Fan et al. (2018), so please make it clear: they are not “some studies”.

**AC:** Thanks for your kind reminding. We will revise this sentence to make it clear.

36: **RC:** -Line 7: “streams also have...” This is misplaced. You should move it above when you are talking about the streams.

**AC:** We will adjust this part.

37: **RC:** -Line 8: “LULC” did you mention before what it means? I do not think so.

**AC:** LULC is the abbreviation of land-use/cover. After checking the manuscript, we find that the definition of LULC exists already. Please see Page 5, Line 22.

38: **RC:** -Line 8 and 9: “And the LULC is one of the controlling factors that pose direct impact on the occurrence of landslides.” Why? Please justify this.

**AC:** The references “Song et al., 2012; Mansouri Daneshvar, 2014” will be included here.

#### **【References】:**

*Song, Y., Gong, J., Gao, S., Wang, D., Cui, T., Li, Y., Wei, B.: Susceptibility assessment of earthquake-induced landslides using Bayesian network: A case study in Beichuan, China, Computers & Geosciences, 42, 189-199, doi: 10.1016/j.cageo.2011.09.011, 2012.*

*Mansouri Daneshvar, M. R.: Landslide susceptibility zonation using analytical hierarchy process and GIS for the Bojnurd region, northeast of Iran, Landslides, 11, 1079-1091, doi: 10.1007/s10346-013-0458-5, 2014.*

39: **RC:** -Line 9 and 10: “Most of the landslides in the study are occurred in the wood land.” How do you justify this? Where can the reader see this?

**AC:** Thanks for your kind reminding. We will delete this sentence.

40: **RC:** -Line 10: “In this study, the Lithological data was...” here you are talking again about lithology. This should be re-organised.

**AC:** Thanks for your kind reminding. We will adjust this part.

41: **RC:** -Line 19: “As an important factor...” Why is this sentence located here? Again, reorganise the text to make it clear, understandable and easy to follow.

**AC:** Thanks for your kind reminding. We will adjust this part to make it clear and easy to understand.

42: **RC:** -Line 22 and 23: “Landslide controlling factors...” you already mentioned the controlling factors. Why are you doing this again?

**AC:** We will adjust this part.

43: **RC:** -Line 28: “The assumption behind the integrated weighted index model was that future landslides will occur under similar environmental conditions as historical

landslides” That is the point! The EQ produced a great disruption in the terrain. What happened in Juizhaigou was a consequence of the EQ and you cannot expect that future landslides will occur under the similar environmental conditions as the latter will change very fast over time.

**AC:** We have discussed previously in Answer #1 (Page 1). In the discussion section, we also pointed out that results obtained in the past environmental conditions are not a guarantee for the future, and the susceptibility results need to be adapted as soon as environmental conditions or their causal relationships obviously change in the future. The susceptibility map is made for the present situation. Hope that the explanation will meet with approval.

44: **RC:** Page 7: -Line 22: “The FR method is one of the most widely used approaches to assess the landslides susceptibility at regional scale...” Please cite some examples.

**AC:** Thanks for your kind reminding. The references “Guo et al., 2015; Li et al., 2017; Mohammady et al., 2012” will be included here.

**【References】:**

*Guo, C., Montgomery, D. R., Zhang, Y., Wang, K., and Yang, Z.: Quantitative assessment of landslide susceptibility along the Xianshuihe fault zone, Tibetan Plateau, China, Geomorphology, 248, 93-110, doi: 10.1016/j.geomorph.2015.07.012, 2015.*

*Li, L., Lan, H., Guo, C., Zhang, Y., Li, Q., and Wu, Y.: A modified frequency ratio method for landslide susceptibility assessment, Landslides, 14, 727-741, doi: 10.1007/s10346-016-0771-x, 2017.*

*Mohammady, M., Pourghasemi, H. R., and Pradhan, B.: Landslide susceptibility mapping at Golestan Province, Iran: A comparison between frequency ratio, Dempster–Shafer, and weights-of-evidence models, Journal of Asian Earth Sciences, 61, 221-236, doi: 10.1016/j.jseaes.2012.10.005, 2012.*

45: **RC:** Page 8: -Line 6 to 11: This is methodology, not results and discussion. Furthermore, you should re-phrase it.

**AC:** We will adjust this part.

46: **RC:** -Line 18: This is methodology. Furthermore, this sentence makes no sense here. Please re-phrase it.

**AC:** We will delete this sentence.

47. **RC:** Page 9: -Line 1 to 10: This is very similar to what Fan et al. (2018) did in their analysis. Furthermore, this paragraph is bringing little information. Please extend it and refer to the table where the results are shown.

**AC:** Indeed, our results are similar to what Fan et al. (2018) did in their analysis. However, their purpose was to provide a detailed landslide inventory and deliver a quick statistical assessment of the spatial distribution and controlling factors of the geohazards triggered by the Jiuzhaigou earthquake, which is different from ours. Our

results are basically consistent with those of Fan et al. (2018), which also shows that our results are reliable and acceptable. According to your comments, we will revise and extend this part.

48: **RC:** -Line 12 to 18: This is methodology.

**AC:** We adopted ROC method to evaluate the performance of our results. Here, we briefly introduced this method. In our opinion, it's reasonable to put it here. Hope that the explanation will meet with approval.

49: **RC:** Page 10: -Line 4 to 14: too detailed to be discussions. Please shorten it.

**AC:** We will revise this part.

50: **RC:** -Line 20: 11 % is not very significant.

**AC:** We will modify it as follows:

“From the landslide susceptibility map (Fig. 4 and Table 4), the “very high” and “high” susceptibility areas covered 10.99 % of the whole area and most of the Jiuzhaigou National Nature Reserve was classified as the most landslide susceptible areas.”

51: **RC:** -Line 23: “Firstly, the accuracy of the FR method is highly depended on the quality of the dataset, especially the landslides inventory” Did you observe this? Otherwise, cite any reference where it was observed.

**AC:** Thanks for your kind reminding. The reference “Zhou et al., 2016” will be included here.

### **【References】:**

*Zhou, S. H., Chen, G. Q., Fang, L. G., and Nie, Y. W.: GIS-Based Integration of Subjective and Objective Weighting Methods for Regional Landslides Susceptibility Mapping, Sustainability, 8, 334, doi: 10.3390/Su8040334, 2016.*

52: **RC:** -Line 26 and 27: “We did not accurately identify the landslides...” Did you compare the co-seismic landslides with the previous ones? It has to be explained.

**AC:** Thanks for your comments. As mentioned in [1], the landslide inventory is generally incomplete. Due to the limitations of historical images, we didn't accurately identify the landslides before the Jiuzhaigou earthquake. Because the distribution of historical landslides is very difficult to obtain. Even if we have sufficient historical remote sensing images, it's time-consuming and laborious. As mentioned in the manuscript, the main purpose of this study is to map the susceptibility of earthquake-triggered landslides, so we mainly focused on the interpretation of earthquake-triggered landslides. Some similar studies [2-4] have shown that this is acceptable. In addition, co-seismic landslides were identified using on-screen visual interpretation on pre- and post-earthquake remote sensing images. The distribution of landslides was reasonably accurate and complete by visual comparison with previous studies [5-7]. According to your comments, we will add some descriptions and references in the revised manuscript.

## 【References】:

- [1] Fell, R., Corominas, J., Bonnard, C., Cascini, L., Leroi, E., and Savage, W. Z.: *Guidelines for landslide susceptibility, hazard and risk zoning for land use planning*, *Engineering Geology*, 102, 85-98, doi: 10.1016/j.enggeo.2008.03.022, 2008.
- [2] Kamp, U., Growley, B.J., Khattak, G.A., Owen, L.A.: *GIS-based landslide susceptibility mapping for the 2005 Kashmir earthquake region*, *Geomorphology*, 101, 631-642, 10.1016/j.geomorph.2008.03.003, 2008.
- [3] Niu, R., Wu, X., Yao, D., Peng, L., Ai, L., Peng, J.: *Susceptibility Assessment of Landslides Triggered by the Lushan Earthquake, April 20, 2013, China*, *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 7, 3979-3992, 10.1109/JSTARS.2014.2308553, 2014.
- [4] Xu, C., Dai, F. C., Xu, X. W., and Lee, Y. H.: *GIS-based support vector machine modeling of earthquake-triggered landslide susceptibility in the Jianjiang River watershed, China*, *Geomorphology*, 145, 70-80, doi: 10.1016/j.geomorph.2011.12.040, 2012.
- [5] Fan, X., Scaringi, G., Xu, Q., Zhan, W., Dai, L., Li, Y., Pei, X., Yang, Q., and Huang, R.: *Coseismic landslides triggered by the 8th August 2017 Ms 7.0 Jiuzhaigou earthquake (Sichuan, China): factors controlling their spatial distribution and implications for the seismogenic blind fault identification*, *Landslides*, 15, 967-983, doi: 10.1007/s10346-018-0960-x, 2018.
- [6] Wang, J., Jin, W., Cui, Y.-f., Zhang, W.-f., Wu, C.-h., and Alessandro, P.: *Earthquake-triggered landslides affecting a UNESCO Natural Site: the 2017 Jiuzhaigou Earthquake in the World National Park, China*, *Journal of Mountain Science*, 15, 1412-1428, doi: 10.1007/s11629-018-4823-7, 2018a.
- [7] Wang, W., Chen, H., Xu, A. H., and Qu, M. H.: *Analysis of the disaster characteristics and emergency response of the Jiuzhaigou earthquake*, *Nat Hazard Earth Sys*, 18, 1771-1783, doi: 10.5194/nhess-18-1771-2018, 2018b.

53: **RC:** -Line 32 and 33: “However, results obtained in the past environmental conditions are not a guarantee for the future” Exactly and this is even more important after an EQ. So here my concerns arise again: what is the purpose of you work? Does it really have any application? Is your model reliable if applied in a post-seismic scenario?

**AC:** We have discussed previously in Answer #1 (Page 1). Here, we'd like to explain this question again. The objective of the paper is to generate an earthquake-triggered landslide susceptibility map, and the susceptibility map is made for the present situation. As soon as there are changes in the environmental conditions, the susceptibility information needs to be adapted. In recent years, the integrated approach has been used in many earthquake prone regions for landslide susceptibility assessment, such as Indonesia [1], Nepal [2], and Italy [3]. Many studies have proved the reliability and effectiveness of the integrated model, and our study also demonstrated it. According to the generated landslide susceptibility map, engineers and decision makers can understand the probability of landslides in different regions, and may therefore take the

prompt effective emergency actions to mitigate hazards of the earthquake-triggered landslides. Hope that the explanation will meet with approval.

**References**:

[1] Umar, Z., Pradhan, B., Ahmad, A., Jebur, M. N., and Tehrany, M. S., *Earthquake induced landslide susceptibility mapping using an integrated ensemble frequency ratio and logistic regression models in West Sumatera Province, Indonesia, Catena, 118, 124-135, doi: 10.1016/j.catena.2014.02.005, 2014.*

[2] Shrestha, S., Kang, T.-S., Suwal, M., *An Ensemble Model for Co-Seismic Landslide Susceptibility Using GIS and Random Forest Method, ISPRS International Journal of Geo-Information, 6, 365, 2017.*

[3] Caccavale, M., Matano, F., Sacchi, M., *An integrated approach to earthquake-induced landslide hazard zoning based on probabilistic seismic scenario for Phlegrean Islands (Ischia, Procida and Vivara), Italy, Geomorphology, 295, 235-259, 2017.*

54: **RC:** Page 10: -Line 2: Urban sprawl is not a good example here. What will change the most is the landslide activity. See works carried out by Fan et al. (2018) in the Wenchuan EQ affected area.

**AC:** Thanks for your kind suggestion. We will delete it.

55: **RC:** -Line 2: “Despite its limitations...” They are very important limitations.

**AC:** Indeed, these limitations are important, however, for this study, the validation results demonstrated the reliability and feasibility of the integrated model in earthquake-triggered landslide susceptibility mapping. The integrated model can generate a reliable landslide susceptibility map at regional scale that is useful for engineers and decision makers to mitigate hazards. In the future, we will consider resolving these limitations.

56: **RC:** -Line 2, 3 and 4: The model only predicts what already happened during the EQ and future scenarios are likely to be very different from what happened in the past. Therefore, I cannot see how it can be used as a scientific basis for reconstruction of tourism facilities.

**AC:** Thanks for your comments. We will modify this sentence as follows:

“which can provide rapid assessment for reconstruction of tourism facilities, regional disaster management etc.”

57: **RC:** -Line 17: “...useful for serving the scientific basis for disaster mitigation and management”. Again, if evaluated in advance it can be useful, but now, once the EQ already occurred, what it is useful is the mapping of the landslides to see identify the most affected areas.

**AC:** We will modify this sentence. As mentioned above, the generated landslide susceptibility map could be useful in hazard mitigation by helping decision makers understand the probability of landslides in different regions.

Once again, thank you very much for your comments and suggestions. If you have any other question about this paper, please don't hesitate to let us know.

Yours sincerely,

Yaning Yi

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