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Nonlinear Processes in Geophysics
Discussions

Interactive comment on "Size distribution law of earthquake-triggered landslides in different seismic intensity zones" *by* Yidan Huang and Lingkan Yao

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We very much appreciate the careful reading of our manuscript and valuable suggestions of the reviewer.Overall the comments have been fair, encouraging and constructive. We have learned much from it. Responds to the reviewer's comments: Comment 1: The author considered that the scale frequency relationship of landslides developed in intensity VII-IX conforms to one law, that of landslides in intensity x conforms to another law, and that in intensity XI onforms to another law. First of all, there are very few landslides in VII and VIII, and there will be a great deal of uncertainty in the law obtained from such a small sample. Response: Landslide data were accessed through

by field investigation and interpretation of high-resolution remote sensing images. We got 108 landslides by field investigation and 706 by remote sensing interpretation in VII zone, 108 landslides by field investigation and 477 by remote sensing interpretation in VIII zone. The field survey data is small because we can only measure the landslides visible along the highway. Furthermore, this study divides the landslide data into seismic intensity zones for statistics, so the samples in each zone are not large. In the study of frequency-magnitude distribution of landslides, the sample number of different landslides databases are quite different. For example, Brunetti (2009) examined 19 landslide datasets. Individual datasets include from 17 to 1019 landslides of different types. Each landslide dataset exhibits heavy tailed (self-similar) behaviour for their frequency-size distributions. (References:Brunetti M., Guzzetti F., and Rossi M.: Probability distributions of landslide volumes. Nonlinear Processes in Geophysics, 16(2):179-188. https://doi.org/10.5194/npg-16-179-2009,2009.)

Comment 2: The ground motion accelerations used in the sand pile experiments carried out by the authors are 0.075-0.125g and 0.15-0.25g, although the phenomena claimed by the author are consistent with those obtained from the spatial distribution of landslides. However, 0.075-0.125g does not correspond to VII-IX intensity area. In fact, in general, 0.2g corresponds to the VIII degree region. Obviously, the boundary conditions of spatial analysis are completely different from those obtained by physical experiments, and it seems that there is no comparability. Response: In the shaking table experiments, the one-side slope sand pile was built by dried sand gravel reaching its natural angle. The strength of the loose slope is less than the natural slope. In other words, a small peak acceleration could cause the sand pile to collapse in the experiment. Therefore, the seismic intensity in the physical experiment is less than in the real earthquake events. The purpose of the experiment is to study the evolution trend of the distribution law with increasing seismic intensity, which is mainly a comparison of the evolution law without a definite numerical correspondence.

Comment 3: The landslide data of different intensities used in this paper come from two

earthquake events. Wenchuan earthquake is mainly high intensity area, while Lushan earthquake is mainly medium intensity area. Undoubtedly, the difference of different seismic characteristics and the nature of earthquake affected area, such as geological and topographical conditions, may greatly affect the results, so that they are not comparable. Response: In general, landslides triggered by earthquakes are rare events, and the probability of two earthquakes occurring in the same area is even lower, providing valuable information for scientific research. Both the Wenchuan and Lushan earthquakes occurred within the Longmen Mountain fold-and-thrust belt. There is a gap extending about 75km between the main-shock of 2008 Wenchuan and Lushan events(Fig.1). Most scholars believe that the terrain and geological conditions are similar, and the thrust mechanism is similar. Some even suggest that Lushan earthquake was a strong aftershock after Wenchuan earthquake. In the study of landslide distribution, the distribution of landslides triggered by different evens (e.g., earthquake, rainfall) is often compared (Dussauge et al., 2003; Brunetti et al., 2009). In this paper, the landslide distribution is analyzed according to different seismic intensity, which is different from other similar studies. (References: Dussauge, C., Grasso, J. R., and Helmstetter, A. Statistical analysis of rockfall volume distributions: implications for rockfall dynamics, J. Geophys. Res., 108(B6), 2286, doi:10.1029/2001JB000650, 2003. Brunetti M., Guzzetti F., and Rossi M.: Probability distributions of landslide volumes. Nonlinear Processes in Geophysics, 16(2):179-188. https://doi.org/10.5194/npg-16-179-2009,2009.)

Comment 4: The data quality of landslides triggered by the two earthquakes does not seem to be perfect. Compared with the existing work, either the whole earthquake area is not covered, or many landslides seem to be missed. There is no doubt that the law revealed by such data may deviate from the actual situation. Response: Because of the difference of image precision, interpretation method and evaluation standard, the number of landslides triggered by Lushan earthquake and Wenchuan earthquake obtained by different experts is quite different. Typical examples are: For Wenchuan earthquake, Huang Runqiu et al. (2009) identified 16704 landslides, and estimated that the number of earthquake landslides in Wenchuan earthquake reached 3.5 $\times$

10^4. Daiet et al.(2011) identified about 5.6 $\times$ 10^4 landslides, Gorum et al. (2011) identified about 6 $\times$ 10^4 landslides. Xu et al. (2014) interpreted the number of landslides as 197 481. For Lushan earthquake, Cui Peng et al. (2013) identified about 1,460 landslides. Chang Ming et al (2013) identified 703 landslides. Pei (2013) estimated 1,800 geological hazard sites. Xu et al. (2015a, 2015b) identified the number of landslides in Lushan earthquake is 15645 and 22528 respectively. In addition, this paper studies coseismic landslides. We believe that the rainy season will cause new landslides, so the collected remote sensing data are mainly before the rainy season in China (June to September). The Wenchuan earthquake data were taken on May 30 and June 4, 2008, and the Wenchuan earthquake data were taken on April 20, 21 and May 13, 2013, which may result in less data than the existing data. As a representative of our group, I express my sincere appreciation here to editors and specialist reviewer for your instructions and helps to the article.

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earthquake in Sichuan,China.Journa1 of Chengdu University of Techno1ogy(Science ïijĘ Technology Edition) ,40(3) : 257- 263. Xu C, Xu X W, Shyu J B H, et al.2015a. Landslides triggered by the 20 April 2013 Lushan, China, MW 6. 6 earthquake from field investigations and preliminary analyses. Landslides,12 (2) :365- 385. Xu C, Xu X W, Shyu J B H.2015b. Database and spatial distribution of landslides triggered by the Lushan, China MW 6. 6 earthquake of 20 April 2013. Geomorphology,248: 77- 92.)

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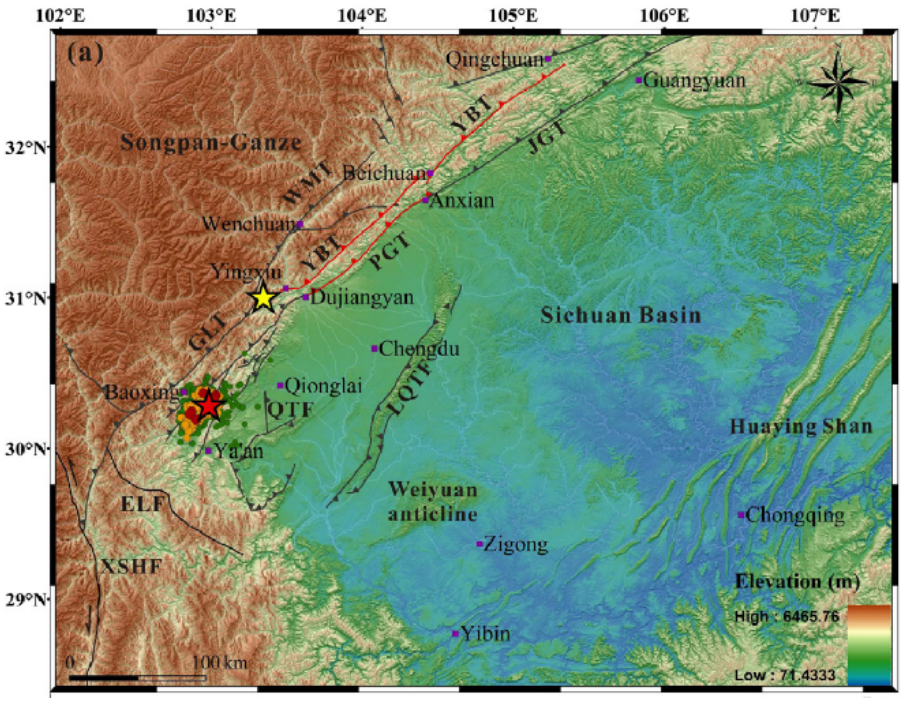

Fig. 1. Yellow star means 2008 Wenchuan earthquake and red star means 013 Lushan earthquake