

## ***Interactive comment on “Scale and spatial distribution assessment of rainfall-induced landslides along mountain roads” by Chih-Ming Tseng et al.***

### **Anonymous Referee #1**

Received and published: 1 November 2017

**General comments** The paper proposes an analysis of landslide susceptibility in a mountain area, crossed by a road and affected by landslides triggered by typhoons. The topic could be interesting to NHES readers, if some issues are more clearly presented, in particular, the aims, the used methods (in a right temporal sequence), and expected results. For this reasons, a major revision is needed before its being accepted for publication.

**Specific comments** Please define clearly what is the aim of scale assessment. The terminology should be checked and made uniform, with reference to the following terms: causal factors, predisposing factors, impact factors, landslide-inducing factors. Refer-

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ence description is not well presented, sometimes redundant, sometimes limited. Too repetition of “studies, many studies, previous studies, several studies, early research”. I suggest to discuss methods and procedures available in literature, avoiding to refer to single reference with expression as, for example, X et al. used [...], Y et al. described [...], Z et al. utilized [...]. The introduction and especially the literature discussion (pages 2 and 3) about the landslide susceptibility assessment methods must be re-organized and rewritten using a clearly and well-ordered structure. Aims, procedures and expected results are not clearly defined either in introduction either in methodological section. It is not clear if the study area is only the highway or the whole catchment crossed by road; the study area seems to be the road according to title, but the final susceptibility map, in figure 4, is referred to the whole area. So the presence of the road is negligible at the aim of the analysis. The title does not reflect clearly the contents of the paper. Please, rephrase the paragraph 3, adding more information and details about the study area. About methodology, does maximum likelihood method have any disadvantages? Was the error associated with this automatic image interpretation technique calculated? Please rewrite the paragraph 2.2 in order to describe more clearly the MHEM method. I suggest to reconsider the title, because the analysis was not performed only along the road but in the surrounding territory and the image interpretation does not emerge from the title. It is not completely coherent with the contents of the paper. Please, reorganize the paper, by separating the description of methodology from the discussion of results. There are too much paragraphs that make confusing and difficult the readability and understanding of performed analyses, in particular from paragraph 5.2 onwards.

**Technical corrections** Pag 1 line 8: please, move “Typhoons” at the end of the sentence. Pag 1 line 10: “topographic changes” or “surface changes” instead of “changes in slope surface”. Pag 1 line 10: “A multivariate statistical method” instead of “The multivariate hazard evaluation method”. Pag. 1 lines 11-12: Please, rephrase the sentence. The evaluation of landslide locations and relationship between landslide and predisposing factors is preparatory for assessing and mapping landslide susceptibility. Pag. 1 line

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26: please, replace “occurrence distribution” with “distribution of existing landslides” and “a set of predisposing factors such as geo-environmental thematic variables” with “a set of geo-environmental predisposing factors”. Pag. 1 line 27: “sediment disaster” is not an appropriate expression; please, replace it with landslides. Pag. 2 lines 1-3: Please modify the terminology used in this sentence. “predisposing factors” instead of “potential causes” and “triggering factors” instead of “impetuses”. Pag. 2 lines 7-8: This sentence is a repetition. Pag. 2 lines 9-10: please add references about model uncertainty evaluation, for example: Wang X, Frattini P, Crosta GB, Zhang L, Agliardi F, Lari S, Yang Z. 2014. Uncertainty assessment in quantitative rockfall risk assessment. *Landslides*. 11:711–722. Pag. 2 line 10: explain what is the meaning of scale in this study: size, intensity of landslide? Pag. 2 line 11: This sentence is a repetition. Pag. 2 lines 12-13: The meaning of this sentence is unclear. Pag. 2 lines 14-16: This sentence is a repetition. Pag. 2: I suggest to add some reference about AHP method (1), multivariate statistical methods (2) and landslide susceptibility assessment along roads (3): (1) Kayastha P., Dhital M.R., De Smedt F. 2013. Application of the analytical hierarchy process (AHP) for landslide susceptibility mapping: A case study from the Tinau watershed, west Nepal. *Computers Geosciences*, 52: 398-408 (1) Zhang G., Cai Y., Zheng Z., Zhen J., Liu Y., Huang K. 2016. Integration of the Statistical Index Method and the Analytic Hierarchy Process technique for the assessment of landslide susceptibility in Huizhou, China. *CATENA*, 142: 233-244. (2) Carrara A, Crosta G, Frattini P. 2008. Comparing models of debris-flow susceptibility in the alpine environmental. *Geomorphology*. 94:353–378. (2) Pellicani R, Frattini P, Spilotro G. 2014. Landslide susceptibility assessment in Apulian Southern Apennine: heuristic vs. statistical methods. *Environ Earth Sci*. 72:1097–1108. doi: 10.1007/s12665-013-3026-3 (3) Pellicani R, Spilotro G, Van Westen CJ. 2016. Rockfall trajectory modelling combined with heuristic analysis for assessing the rockfall hazard along the Maratea SS18 coastal road (Basilicata, southern Italy). *Landslides*. 13:985–1003. (3) Pantelidis L. 2011. A critical review of highway slope instability risk assessment systems. *Bull Eng Geol Environ*. 70:395–400. (3) Devkota KC, Regmi AD, Pourghasemi HR,

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Yoshida K, Pradhan B. 2013. Landslide susceptibility mapping using certainty factor, index of entropy and logistic regression models in GIS and their comparison at Mugling–Narayanghat road section in Nepal Himalaya. *Nat Hazards*. 65:135–165. doi: 10.1007/s11069-012-0347-6 (3) Pellicani R., Argentiero I., Spilotro G. (2017) GIS-based predictive models for regional-scale landslide susceptibility assessment and risk mapping along road corridors. *Geomatics, Natural Hazards and Risk*, 1-22. DOI: 10.1080/19475705.2017.1292411. Pag. 3 line 34: It is not clear how and from where the location of landslides was extracted? Are existing or potential landslides? The evaluation of landslide locations and the relationship between landslides and predisposing factors is preparatory for assessing and mapping landslide susceptibility. Pag.5 line 13: please replace “risk” with “susceptibility”. Pag. 5 lines 14-15: Please avoid repetitions: variability, variance. Pag. 5 lines 18-19: Please rewrite this sentence using a correct terminology, “cell” or “pixel” instead of “grid” and “class” instead of “grade”. Pag. 5 lines 22-23: Please rewrite this sentence, a confusing terminology has been used (causal factor, impact factor, grades). Pag.6: Which is the difference between factor weight and graded score? It is not clear. Pag. 8 line 13: why 0.9? Pag. 8 line 17: Is EAR expressed in mm? Pag. 8 line 21: Is Ir expressed in mm/h? Pag.8 line 26: What is the meaning of rolling hours? Pag. 10 line 6: “thematic map of predisposing factors” instead of “map of the natural environment”. Pag. 10 line 9: please make uniform the terminology, as for example causal factors, predisposing factors, impact factors, landslide-inducing factors, etc. Pag.10 lines 21-22-26: please, modify “grid” and “grades”. Pag. 10 line 27: explicit the values of the six categories. Pag. 11 line 4: what is the meaning of “geological strength”? The geological map should be classified into classes corresponding to different formations or lithological units. Pag. 11 line 9: define the analysis function. Pag. 11 lines 10 and 16: explicit the six classes. Pag. 11 lines 18 and 20: give more information about two factors. Pag. 11 line 21: Land disturbance looks like a reclassified land use map. The highest score of disturbance is assigned to bare land, why not to roads and buildings? This is a qualitative attribution, it should be written somewhere.

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