Nat. Hazards Earth Syst. Sci. Discuss., 3, C1380–C1387, 2015
www.nat-hazards-earth-syst-sci-discuss.net/3/C1380/2015/

Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Determination of rainfall thresholds for shallow landslides by a probabilistic and empirical method" *by* J. Huang et al.

J. Huang et al.

huangjian2010@gmail.com

Received and published: 28 July 2015

Determination of rainfall thresholds for shallow landslides by a probabilistic and empirical method

J. Huang et al. huangjian2010@gmail.com Submitted on 14 Feb 2015, Received and Published: 27 May 2015

The authors would like to thank the two reviewers for their thorough work on the manuscript providing us with insightful and constructive comments and suggestions, which helped improve this manuscript. We have tried our best to carefully consider

and respond to all the comments raised.

Response to Anonymous Referee #1 Thank the reviewer for the kindest article summary.

General Assessment: 1. In terms of the scientific contribution, the results are not particularly novel, since more sophisticated analysis on this topic has already been published.

The original model of rainfall threshold is for sure referenced from the previous researchers, but improvements and modifications have been studied in this paper, please refer to Section 3.2 (D. modification and application in Huangshan region).

2. The manuscript itself is short and focused, reasonably well written, and provides sufficient information to understand the potential utility of the proposed warning system.

Thanks.

3. The figures are clear, though somewhat repetitive given the limited new content presented in each.

Some of these figures have been removed or modified to provide more information in this revision.

4. There is very limited discussion of background information on landslide warning systems (20 reference total) and absolutely no discussion of how the present system compares to previous warning systems.

More discussion of background information on landslide warning systems have been added in the introduction in this revision, please refer to Lines 73-83. Discussion of how the present system compares to previous warning systems have been added in this revision, please refer to Lines 309-313.

5. It would be worth analyzing how the derived rainfall threshold functions compare to previous studies in terms of their actual rainfall intensity and duration values as well as

their accuracy.

The authors completely agree with the reviewer's comments. During the preliminary stage, warning thresholds need to be provided at first, and then the study work still can be continued in this area.

6. In its present form the manuscript does not provide much probabilistic evaluation of how appropriate the threshold is.

The probabilistic evaluation has been added in this revision, Lines 309-313. But it's only a preliminary assessment right now, and the subsequent study will present more information in the near future.

7. Although the topic is important and the contribution would be of interest to readers of NHESS, the manuscript reads more like a technical note or brief communication than like a full research article.

This manuscript has been greatly improved to express itself in a clear way. Thanks.

Specific Concerns:

1. There is not much information about the type of landslides or when and how they occur in this particular region.

More information about the landslides have been added in the revision, please refer to Table 1.

2. Several typos and English language errors should be corrected for improved clarity and readability.

The language has been improved thoroughly and the text has been well edited.

3. Figures 2 and 4 present a lot of the same information and could potentially be combined.

The updated Figures 4 has been added more information, and the authors think that

it's better to introduce them separately.

4. Figure 3 is not informative and could be removed.

Figure 3 has been removed in this revision.

5. Figures 5-8 present new information in small incremental steps and could be combined into just one or two figures.

Figures 5-8 has been combined into two figures, and more information has been added to express them clearly in this revision.

Response to Anonymous Referee #2

General comments:

1. In general the paper is well written and the objectives of the research are clear, but it lacks of novelty and shows several issues to be resolved before it can be published.

This manuscript has been greatly improved to express itself in a clear way. Thanks.

2. The main issue of this paper is the missing of a real validation of the methodology, since one pluviometric event (with MAX hourly intensity recurrence time over 100 years) is not sufficient as validation.

The authors completely agree with the reviewer's comments. During the preliminary stage, the rainfall records with landslide occurrence are very small. The aim of this paper is to present a simple and suitable method for shallow landslide early warning in these mountainous area, in order to reduce the losses at present condition.

3. The whole paper is based on the outcomes of the work of Jan et al. (2002), that is a kind of internal report or something similar, so cannot be read from international scientific community.

The original model was presented by Jan et al. (2002), and this model can be read from the work of Zhuang et al. (2014).

Specific comments:

1. The authors calculated several probability threshold, but they used only three, so it useless to describe how they calculated them and to plot these thresholds. The blue and red lines described in sections 3.2.1 and 3.2.2 are defined on the basis of the lowest landslide events and highest no-landslide rainfall respectively. So it is quite strange that these lines, defined by an empirical (or, better, by a graphical) approach, are perfectly parallels.

The original model was presented by Jan et al. (2002) for debris flow in Taiwan, and used by Zhuang et al. (2014) for shallow landslide in Shanxi. The graduate of blue and red lines were determined by experts' experience before, but which has been improved in this study. And the four color-coded scale of warning levels have to be determined by the probability threshold lines which are calculated by the equations provided in this paper. Because of their graduate are the same value, so they are parallels in the graph, Fig. 4.

2. Page 3492 rows 14-15: Authors write that they selected only ca.50 events that not triggered landslide. In my opinion they should consider all the rainfall events recorded from 2007-2014 to properly calculate the probability of landslide occurrence and therefore the thresholds. Furthermore the number and the location of rain gauges are missing. (Location could be added to fig.4).

The authors completely agree with the reviewer's comments. During the preliminary stage, the more rainfall records with landslide occurrence or non-occurrence are better for this study. Therefore, several ways of collecting data had been used during the work. Finally, there are 50 records with accurate dates of occurrence and rainfall records collected in the data sets, and more than 50 rainfall historical events with no landslide occurrence also were collected to be used during the analysis. The aim of this paper is to present a simple and suitable method for rainfall threshold in these mountainous area at the initial stage, then there will be a foundation to be improved in the future.

The number and the location of rain gauges has been added in the revision.

3. Page 3492 rows 24-25: The whole paper is based on the paper of Jan et al. (2002), that is not an accessible journal paper; the authors should be better describe how Jan et al. defined the I and R values for the beginning and the end of a rainfall event, otherwise it looks like they are defined subjectively. In this case the whole work is not suitable to be used in a landslide warning system. Furthermore that work (Jan et al. 2002) was developed for debris flows, but in this paper it has been applied to shallow landslides. Please clarify these points.

The original model was presented by Jan et al. (2002) for debris flow in Taiwan, and successfully used by Zhuang et al. (2014) for shallow landslide in Shanxi, which can be read from the international journal (Journal of Mountain Science). Meanwhile, more information has been added in this revision to express itself in a clear way, please refer to Lines 167-186. The parameters defined in this paper were obtained by a statistic result from a long history records in other mountainous regions. For the reason that there is lack of rainfall records in the study area, those definitions of parameters were cited from their results based on the similar geology condition.

4. Page 3492 row 26 and page 3493 row 1.: ": : : the end is when the rainfall intensity is less than 4 mm for a period lasting 6 h." Do the authors mean 4 mm/h for 6 hours or 4 mm in 6 hours ($\sim$ 0.7 mm/h)? Please clarify.

The sentence has been changed into:" The beginning of each rainfall event is defined at the moment that the hourly rainfall amount is more than 4 mm/h, and the end is when the hourly rainfall amount is less than 4 mm/h, and which should be lasting for 6 hours at least. "

5. Page 3493 section 3.2.1 and 3.2.2., figure 5. The blue line in not under the lowest points. Point at coordinates $\sim$ (100, 8) seems to be above this line. Similarly points used for red line seem to be under and above the line. Please check.

The blue line was determined by empirical method before, presented by Jan et al. (2002) and Zhuang et al. (2014), but improvements and modifications have been provided in this paper, please refer to Section 3.2 (D. modification and application in Huangshan region).

6. Page 3494 row 1: ": : : Ih is the hourly rainfall intensity". In page 3492 authors state that Ih is maximum hourly intensity, now that it is hourly rainfall intensity. Pleas clarify.

These sentences have been revised in this revision. Maximum hourly intensity is a history record selected for establishing the rainfall threshold curves, and hourly rainfall intensity is a current monitoring data for a real-time early warning in a rainstorm.

7. Pag. 3495 rows 11-12: "There are 16 points of landslides in the area that occurred where PRO = 10–50% (C10–50), as shown in Fig. 6, and 38 points in the area where PRO = 10–90% (C10–90)." The number of landslides should be 50 (16+38=54!), as stated in section 3.1 Please check the number of landslides.

These sentences have been revised in this revision, please refer to Lines 244-248. We feel very regret for such a mistake again.

8. Equation 4: the W parameter seems to be not used in the following equations. Please clarify where and if it is used; otherwise please consider removing this equation.

Equation 4, provided in this paper was an improvement to make sure the gradient of the blue line. Combined with other equations, then the blue line can be determined in a quantitative way.

9. Pag. 3495 row 3: "are defined" is defined

Thanks. It has been addressed.

10. Pag 3496 row 15: ": : :the rainfall intensity: : : " Is this maximum hourly rainfall intensity?

Thanks. It has been addressed.

11. Pag 3497 row 4. "At 10 a.m. the point is down in the diagram again in the red zone." The thresholds have been defined using the maximum hourly rainfall intensity, as described in section 3.2, so once the maximum has been reached, it is not possible to have lower intensity values in the graph. Please check.

Thanks. It has been addressed. Maximum hourly intensity is a history record selected for establishing the rainfall threshold curves, and hourly rainfall intensity is a current monitoring data for a real-time early warning in a rainstorm, which is calculated 1 hour per circle right now.

12. Pag. 3497 row 1: "landslides, induced" landslides induced

Thanks. It has been addressed.

13. Fig. 4 some landslides seem to be located in plain areas. Please clarify.

More information has been added in this revision, please refer to Lines 147-149.

14. Fig. 6 This figure is useless. The necessary thresholds have been already presented in fig. 5 and 7. Please consider to remove it.

Figures 5-8 has been combined into two figures, and more information has been added in this revision.

Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/3/C1380/2015/nhessd-3-C1380-2015-supplement.pdf

---

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 3, 3487, 2015.