Dear Editors and Reviewer:

Thank you for your letter and for the reviewers' comments concerning our manuscript entitled "Determination of the runoff threshold for triggering debris flows in the area affected by the Wenchuan Earthquake". Those comments are all valuable and very helpful for revising and improving our paper, as well as the important guiding significance to our researches. We have studied comments carefully and have made correction which we hope meet with approval. The main corrections in the paper and the responds to the reviewer's comments are as flowing:

Responds to the reviewer's comments:

1. The title should be consistent with the work only if authors compare their laboratory based threshold equation with discharge values, measured or computed by consistent hydrological modeling, in the debris flows initiation areas in Wenchuan Earthquake zone. They introduce a classical peak discharge design formula without any calculation (eq. 9).

Responds: Thanks for your comments of "the title is not consistent with our work".

The abundant loose material triggered by Wenchuan Earthquake has been associated with debris flow frequencies and magnitudes according to the field investigations. It was found that: (1) debris flows are more frequent and widespread distributed than those before the earthquake; (2) the peak discharge and volume of the debris flows has increased compared with those occurred under the similar conditions before the earthquake; and (3) the debris flows will last for a long period, and maybe with probability 10-15 years of activity (Cui et al. 2010; Zhuang et al. 2010; Hu et al. 2010; Liu et al. 2010; Cui et al. 2011). With considering of these, it is significant to determine the runoff thresholds for the debris flows in this area, which is the objective of this study. To do so, we carried out 61 experiments in the flume and proposed the runoff thresholds based on the experiment results. Then the thresholds were also compared with the real debris flow behaviors post earthquake in this study area, to have a validation.

Although this manuscript includes the comparison and validation, we think they are not suitable to be added in the title, because they were carried out for the effectiveness of the thresholds. So, preliminarily, we think that our work was carried out around the objective and therefore consistent with the title. But we would like to improve it as a better title is proposed.

2. The author introduces a dimensionless surface discharge different from that used by Gregoretti, (2000) and Tognacca et al. (2000) because they do not consider the relative density in their expression.

Responds: it is a very important comment. As our understanding, Tognacca et al. (2000) did not consider the relative density in the experiment design, and it is the same with our experiment, when we dimensionless the surface discharge. However, Gregoretti, (2000) considered the relative density in his expression. According to Gregoretti and Fontana（2008）, a dimensionless method was proposed by considering the density to have a comparison with others. The dimensionless surface discharge was expressed as:

$$q^* = Q / \left(\left(\rho_s / \rho - 1 \right)^{0.5} g^{0.5} D_M^{1.5} \right).$$

This study followed this expression, and discussed below the equation (7) in the manuscript as :

Where $q^* = Q / \left(\left(\rho_s / \rho - 1 \right)^{0.5} g^{0.5} D_M^{1.5} \right)$ is the dimensionless critical discharge per unit width, and ρ_s and ρ are the sediment and water densities, respectively.

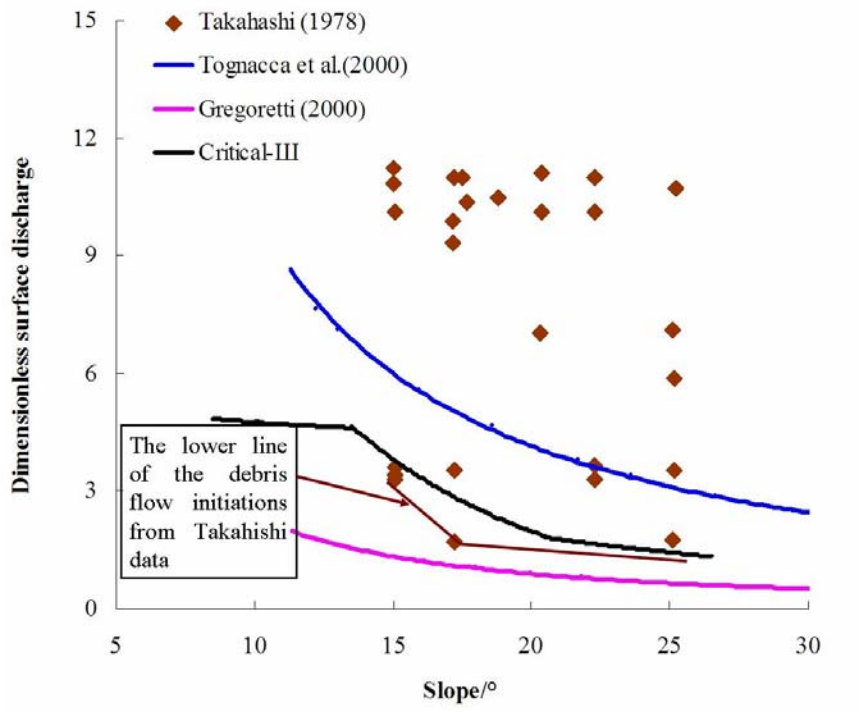
3. Threshold obtained by the experimental results is compared with the threshold of Gregoretti, (2000) and Tognacca et al. (2000): this is misleading because they mix relationship obtained through different quantities (see above).

Responds: We are grateful for this comment. The experiments carried out by Gregoretti (2000) and Tognacca et al. (2000) used flume with slope ranging from 12° -20° and 14° -30° , respectively, which are similar with this study (12-25°). And the experiment design and processes are also similar. The most notable difference of this study with the two previous studies is the experimental material used. Therefore we have a comparison with them to illustrate the effect of materials to the water discharge thresholds. And this part was stated in Discussion (see Section 5.1)

4. Moreover, in Figure 7 the threshold proposed by the authors is larger than experimental values of surface discharge that triggered debris flows in flume laboratory provided by Takahashi (1978), although authors underline (page 4668, lines 5-10) the use of material similar to that used by

Takahashi (1978)

Responds: Thanks for this comment. According to Fig 7, the results of the this study is higher than Gregoretti (2000)`s and lower than Tognacca et al. (2000)`s. If we linked the lowest events in Takahashi (1978), as shown in the figure below, it was found that our results are little higher than, but similar with that proposed by Takahashi (1978). And most of the experiments events in Takahashi (1978)`s experiments were above our thresholds lines. With regards to the events that lower than our lines, we have a discussion in Section 5.1, that may be caused by the criterion of debris flow formation. In our study, we assumed that a debris flow forming at a bulk density exceeds 1.3 g/cm^3, which is a widely used convention in Western China (Kang et al., 2004). However, in most of other studies, the onset of the scour was assumed to coincide with the critical condition for the initiation of debris flow.



5. A description of the experiments is missing. For this reason is not acceptable the explanation of the three lines that compose the proposed threshold (see page 4666, lines 3-12).

Responds: Special thanks for this suggestion. The experiment processes is necessarily required because that is the basement of the results analyzing, and those have been added in the revised manuscript.

We added the experiment processes in Section 4.1 as "**4.1 Experimental processes and**

experiment data", and the texts were as following:

Sixty-one experiments (with 16 failures) were conducted to test the critical values of the selected parameters. it can be summarized as following:

For the experiments with slope as 12±2° inclination, the debris flow initiated with rill erosion, then the rills was down cut and deepened. Then the rill side failed and deposited landslide deposited formed. Ultimately the dam failures mixed the discharge and formed debris flow. The whole processes lasted in 15-20 min.

For the experiments with 12±2° slope, the initiation mechanism was erosion-debris flow. Similarly with the previous experiments, the rills formed in the beginning, then the soils was eroded headward synchronous with down cutting and side erosion. After the rills were widened, lengthened, and deepened, the density and discharge of the materials downwards were increased. Although landslides occurred at the rill sides, they were transported instantly by the sufficient hydrodynamic of surface water discharge and formed debris flows. during this processes, the seepage incorporated transportation duration range 2.5-5min, deposits failed from the toe, nevertheless, it provided small percentage volume for debris flows and is not the main debris flow formation type.

For the experiments with 22.5±2.5° slope, the debris flows formed more easily and quickly. Surface flow incorporated into soil body, and fluidizing the deposit shorter than 30 s. then the deposit failed from the toe, subsequently, debris flow formed as the deposit body slide down in a short time, no longer than 1 min .

6. Moreover, is the measured discharge the surface discharge or the total discharge (seepage+surface)? If the measured discharge is the surface discharge, how did the authors measure the seepage discharge?

Responds: The discharge was measured on the outlet of the valve; therefore the measured discharge is the surface discharge in the beginning of the experiments, which is as the same with other previous studies (e.g. Takahashi, 1978; Gregoretti, 2000; Tognacca et al. 2000) are proposed to analyze the critical surface discharge for debris flow initiation (see section 3.2).

7) At page 4667 (lines 15-25) author state that Takahashi's criterion is an upper limit after

reasoning on erosion of sediment by stream flow and their dispersion all over flow depth. Really Takahashi,s criterion for debris flow occurrence is based on the "geotechnical" equilibrium of a debris layer without any consideration on the hydrodynamic forces exerted by stream flow over the bottom.

Responds: it is a very important comment.

Firstly, we have to admit that it was our mistake to attribute the “Takahashi’s criterion is an upper limit” to “erosion of sediment by stream flow and their dispersion all over flow depth”. And we abandoned this misunderstanding, and rewrote the texts. On the other hand, although Takahashi,s criterion for debris flow occurrence is based on the "geotechnical" equilibrium of a debris layer without any consideration on the hydrodynamic forces, the events (points) in Fig 7 was proposed by the flume experiments by Takahashi. Therefore, in our opinion, these events considered the hydrodynamic forces. The texts were improved in **Section 5.1,** as “Comparing our results with those of other studies, one of the most notable differences is the criterion of debris flow formation. In our study, we assumed that a debris flow forms at a bulk density greater than 1.3 g/cm^3, which is a widely used convention in China (Kang et al., 2004). However, in most of other studies, the onset of the scour was assumed to coincide with the critical condition for the initiation of debris flow. Therefore, the thresholds are higher than those proposed by Gregoretti (2000) and lowest events in Takahishi (1978).

8) At page 4669 author refer to runoff calculated at a rainfall frequency of P= 99% by eq.(7); equation (7) is the threshold given by Tognacca et al. (2000) so the writer does not understand the meaning of this sentence. 7) Which is the sense of equations (4) and (9) ? They are not used.

Responds: Actually, this is a miswriting and thanks for pointing out this.

Eq. 7 hereby should be taken place by Eq. 9.

The Eq. 4 was deleted in the revised manuscript.