Prof. Kang-tsung Chang
Editor
Natural Hazards and Earth System Sciences

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Dear Prof. Chang,

In this letter you can find my comments on the manuscript entitled as "Tangjiaxi Landslide and Impulse Wave Analysis in Zhexi Reservoir of China by Granular Flow Coupling Model" as a reviewer. I hope you find my comments helpful and constructive. Please feel free to contact me in case you need any further information or you have any question regarding my comments.

Best regards

This manuscript introduces a granular flow coupling model to study landslide-generated water waves. Landslide motion is described based on Mih (1999)'s equation. The sliding mass/water interactions are modeled using a coupled system of model equations for a two-phase flow. Finally, the water wave characteristics are simulated based on a RNG k-ε model. The model is validated and applied for the Tangjiaxi landslide event in Zhexi reservoir, Hunan, China. I found this paper interesting. However, some parts of the manuscript are expressed so poorly worded that makes them ambiguous and confusing for the readers. A narrative English speaking person should read through the text. The paper can be considered for publication in NHESS after serious improvement of its English and minor revisions.

The following inquiries should be addressed by the authors as minor revisions:

1- Page 1 L11: What do you exactly mean by "non-coherent granular flow equation"? May be it is better to mention your governing equation as "Shallow water type", "Depth-averaged type", "Incompressible Euler equations" or …. If the following explanations are the meaning of "non-coherent granular flow equation" write "non-coherent granular flow equation; i.e. Mih equation …" instead of "non-coherent granular flow equation. In this model, Mih equation …"

2- Page 1 L29: What is "landslide dam"? Is it suitable to be applied as a keyword for this paper?

3- Page 2 L15-16: "mesh-less methods" and "particle-based methods" can be considered as a one category as "mesh-less methods". There are two major categories: Mesh-based and Mesh-less methods.

4- Page 4 L8: The continuous granular flow model may consider the granular material as a viscous or inviscid fluid not necessarily a viscous fluid! Some rheological models such as Coulomb and Voellmy consider no viscosity or shear rate in their rheological formulations. Iverson (1997) has mentioned this rhelologies.

5- Page 4 L30: Parameter "*d*" in defined twice! One of them should be "*D*" which is missing here! Please correct the definition of the parameters of Eq. (1). Define parameters "*u*" and "*y*".

6- Page 5 L7: What do you mean by "dispersed pahse"?

7- Page 5 L24: Mention a reference for RNG k-ε model.

8- Page 13 Fig. 10: Are the locations of V0-V3 fixed or they move with the motion of landslide? Can you add a figure showing the average depth of landslide at different times in these four locations? Commonly, landslide velocities are sketched for landslide front, middle, and rear edges which move with the motion of the sliding mass along its path (For example see Yavari-Ramshe et al. 2015 in Computers and Geotechnics).

9- Page 16 L23: Please show the location of run-up data on a figure. For example, you can mark each point in Fig. 8 and use your marks in this table to show the location of each point.

10- The manuscript needs to be checked carefully regarding its English. A native English speaker should read through the entire text. Some of the cases are mentioned in the following.

- Page 1 L1: The title of the manuscript may be changed to “Analysis of the Tangjiaxi Landslide-generated waves in Zhexi Reservoir, China, by a granular flow coupling model”.

- Page 1 L8: Write “A rocky granular flow commonly is formed after the failure of rocky bank slopes. An impulse wave disaster may also be initiated if the rocky granular flow rushes into a river with a high velocity.” Instead of “Rocky granular flow usually forms after rocky bank slopes are failed and rushes into rivers at a high velocity, causing impulse wave disasters.”

- Page 1 L10: Write “In this paper, …” instead of “In the paper, …”.

- Page 1 L11: It is better to write “is developed based on …” instead of “is built based on …”.

- Page 1 L13: Write “controls movements of the sliding mass” instead of “controls the movement of sliding mass”. Please check the entire manuscript for the application of “the” wherever is needed.

- Page 1 L14: Write “water, and the Re-Normalisation Group (RNG) …” instead of “water, Re-Normalisation Group (RNG) …”.

- Page 1 L15: Write “The proposed model is validated and applied for the 2014 Tangjiaxi landslide of Zhexi Reservoir located in Hunan Province, China, to analyze the characteristics of both landslide motion and its following impulse waves.” instead of “Taking Tangjiaxi landslide as an example, which is located at Zhexi Reservoir in Hunan Province, China, the motion characteristics of Tangjiaxi landslide and the following impulse wave process were analyzed by the coupling model, and the validity of this model was checked.”

- Page 1 L18: Write “On July 16, 2014, a rocky debris flow was formed after the failure of Tangjiaxi landslide, damming Tangjiaxi stream and causing an impulse wave disaster with three dead and nine missing bodies.” instead of “On July 16, 2014, rocky blocks debris flow was formed after the failure of Tangjiaxi landslide, damming Tangjiaxi stream and thus causing an impulse wave disaster with which left three persons dead and nine persons missing.”

- Page 1 L20: Write “Based on the full coupling numerical analysis, the granular flow impacts the water with a maximum velocity of about 22.5 m/s. Moreover, the propagation velocity of the

generated waves reach up to 12 m/s." instead of "The full coupling numerical analysis showed that after the failure of Tangjiaxi rockslide, rocky granular flows impacted the water at the maximum velocity of about 22.5 m/s, with waves propagating at the maximum celerity of up to 12 m/s."

- Page 1 L23-27: Write "The maximum calculated run-up of 21.8 m is close enough to the real value of 22.7 m. The predicted landslide final deposit and wave run-up heights are in a good agreement with the field survey data. These facts verify the ability of the proposed model for simulating the real impulse wave generated by rocky granular flow events" instead of "The deposited topographic modeled is similar to that accumulated in the actual situation. The maximum run-up calculated is 21.8 m, close to the value of 22.7 m obtained in the field survey. A series of run-up values in the field survey matches well with the calculated values. Therefore, the full coupling numerical model built in this study can be used to simulate impulse waves generated by rocky granular flows."

- Page 1 L32: Put "," after lakes as "rivers, lakes, and seas …".

- Page 1 L37: "formulae" is not an applicable word! Consider writing "A large number of researches have been done on landslide-induced impulse wave including analytical, physical, and numerical methods." instead of "A large number of researches have been done on landslide-induced impulse wave with formulae, physical experiment method and numerical analysis method.".

- Page 1 L38: Write "The analytical solutions are derived from …." Instead of "The formulae derive …".

- Page 1 L39: Write ", where their application scope is limited to their sources" instead of ", with its application scope closely related to sources".

- Page 1 L41: Write "Due to the considered simplifications for analytical solutions, …" instead of "Due to relatively simple results after calculation by the formulae, …".

- Page 2 L2: Write "the generation process of landslide impulse waves" instead of "the process of how landslide induces impulse waves".

- Page 2 L3-4: Write ". However, it requires a large amount of data, time, and money, and occupies a big space (Huang et al.2014)." instead of ", but it need large data, occupy big space, spend much money, and take a long time (Huang et al.2014).".

- Page 2 L6-7: Correct “it has the advantage of precise, economic and reasonable, as well as highly visible results (Heller et al. 2009).” As “it has the advantages of being precise, economic and reasonable, as well as having highly visible results (Heller et al. 2009).”.

- Page 2 L7: Write “is an efficient tool” instead of “is an important tool”.

- Page 2 L8: Correct “Yuvari-Ramshe” as “Yavari-Ramshe” within the entire manuscript.

- Page 2 L9: Consider “Regarding the granular mass/water body coupling system, three major numerical simulation methods have been recently applied, i.e.” instead of “In the field of granular mass/water body coupled numerical analysis, three main numerical simulation methods are now used to analyze the landslide-induced impulse wave disaster, i.e.”.

- Page 2 L10-12: Eliminate repeated “for landslide-induced impulse wave” as “ a) single model, b) simplified model, and c)full coupling model …”.

- Page 2 L13-17: Write “Each model may apply a mesh-based (e.g. finite difference method (FDM), finite element method (FEM), finite volume method (FVM), boundary element methods (BEM), et al.), or a particle-based (smoothed particle hydrodynamic (SPH), material particle method (MPM), et al.) method (Yavari-Ramshe and Ataie-Ashtiani, 2016) for numerical discretization of its model equations.” Instead of “Their numerical calculation is constructed by the mesh-based methods (finite difference method (FDM), finite element method (FEM), finite volume method (FVM), boundary element methods (BEM), et al.), meshless-based methods (smoothed particle hydrodynamic (SPH), material particle method (MPM), et al.), and particle-based discrete element method (Yuvari-Ramshe and Ataie-Ashtiani, 2016).”.

- Page 2 L22: Put “,” after “Then” as “Then, various …”

- Page 2 L23: Write “to calculate the characteristics of the initial impulse wave …” instead of “to calculate initial impulse wave …”.

- Page 2 L27-29: Write “Some examples of these models are TUNAMI” instead of “This type of numerical simulation models includes TUNAMI”. And, mention the reference of each model in front of it (e.g. TUNAMI (), MOST (), ….).

- Page 2 L32: Some words such as “come up with” are not suitable academic words for applying in an academic writing. Please consider this point for the entire text. You may use “introduce” or “summarize” instead of “come up with”.

- Page 2 L37: “and coupling calculated the impulse waves” vague statement. Please rewrite!

- Page 2 L38-39: Correct “at western Norway Åkerneset fjord” as “at Åkerneset fjord, western Norway”.

- Page 3 L6-8: “The full coupling model for landslide-induced impulse wave, is a currently emerging method, which is booming recently, can have a relatively accurate description of the motion of sliding mass, interaction with water, and consequent generation, propagation and run-up of impulse waves” this is a very long sentence. Please rewrite this as two or three sentences.

- Page 3 L8-11: Some parts of the manuscript have grammatical mistakes. Please check the entire manuscript for English grammar. Correct “As a simple mathematical motion model has much difficulties in achieving real description of the motion of landslide, the model mostly used is the complicated rheological model or discrete element model.” As “Simplified models have obvious difficulties in achieving an accurate description of the landslide motion. Accordingly, numerical models which consider the rheological behavior of the sliding mass in their calculations have been recently applied more often.” Try to use simple short sentences which are more practical than using long complicated sentences!

- Page 3 L11-12: Write “The most applied continuous rheological models so far includes” instead of “In researches so far, models that describe flow-liked landslide or debris flow in continuous rheological models are”.

- Page 3 L18: Correct “large deformation free surface” as “large free surface deformations”.

- Page 3 L21: Write either “submarine landslide and tsunami. The landslide motion was …” or “submarine landslide and tsunami, where the landslide motion was …” instead of “submarine landslide and tsunami, the landslide motion was …”.

- Page 3 L23: Correct “By combined landslide dynamic model and tsunami model, …” as “By combining a landslide dynamic model and a tsunami model, …”.

- Page 3 L25: Finish the sentence after tsunami as “a landslide-induced tsunami. This model was applied to the 1792”.

- Page 3 L27: Correct “In the paper, …” as “In this paper, …”. Check thiswithin the entire manuscript.

- Page 3 L27-30: Write ““In this paper, a full coupling model is developed for landslide-induced impulse wave based on non-coherent granular flow equation. The continuous granular flow model of Mih (1999) is applied to simulate the motion process of the rocky granular flow after rockslide. Then, a two-phase flow model is adopted for granular mass / water interaction

coupled calculation." Instead of "In the paper, a full coupling model for landslide-induced impulse wave based on non-coherent granular flow equation is built and then the continuous granular flow Mih (1999) model is introduced to simulate the process of rocky granular motion after rockslide, and the two-phase flow model is adopted for interaction coupled calculation."

- Page 3 L38: Correct "After rocky slopes fail, high concentration and non-coherent rocky granular motion" as "The failure of a rocky slope is commonly followed by a high concentration and non-coherent rocky granular motion".

- Page 3 L43-44: "The discontinuous model features natural intuitive similarity when used to study the motion of non-coherent granular flows." Vague statement! Please rewrite!

- Page 4 L8: Mention "The present continuous granular flow model" instead of "The continuous granular flow model"

- Page 4 L9: Write "was studied by several researchers such as Bagnold (1954) …." Instead of "was studied by Bagnold (1954) ….".

- Page 4 L25-26: Write "He described the shear stress of a granular flow as follow:" instead of "The equation for shear stress of Mih (1999) granular flow is as follows:".

- Page 4 L28: Increase the writing quality of μ and ρ. Write "interestial fluid density" instead of "density between granular".

- Page 5 L24: Correct "when the granular flow into the water" as "when the granular flow enters the water".

- Page 6 L24-26: Rewrite "The case of Tangjiaxi landslide in Zhexi Reservoir, Hunan, China, is taken as an example, the whole process of the landslide and impulse wave induced are analyze, as well as the validity of numerical model." As "The Tangjiaxi landslide event in Zhexi Reservoir, Hunan, China, is simulated as an example to analyze the whole process of the landslide motion and the impulse wave generation, propagation, and runup."

- Page 6 L29-30" Write "destroyed the nearby residential area" instead of "destroyed resident living area nearby".

- Page 7 L4: Correct "much attention" as "more attention".

- Page 10 L16: Write "within its path" rather than "it met".

- Page 10 L18: Correct "six of which were badly hurt" as "six of them were badly hurt"

- Page 11 L3-4: Write “The computational domain which is considered to simulate the Tangjiaxi landslide-induced impulse wave by the full coupling numerical model covers the landforms of the valley where Tangjiaxi landslide occurred.” Rather than “the full coupling numerical model for Tangjiaxi landslide-induced impulse wave is built based on the landforms of the valley where Tangjiaxi landslide occurred.”

- Page 11 L4: Write “The domain is 792 m long and 684 m wide including the valley source of …” rather than “The model is 792 m long and 684 m wide. The model area covers the valley source of …”

- Page 11 L8-8: Eliminate “Tangjiaxi landslide model is set to be a granular flow model.”

- Page 11 L11: Write “Thus, the sliding material is can be supposed to be saturated.” Rather than “Thus, the fluid in Tangjiaxi landslide granular flow gaps was water.”

- Page 11 L21: In Table 1, please mention the unit of each parameter.

- Page 12 L11: It is better to say “3.3 Numerical results” rather than “3.3 Results”.

- Page 12 L12: Write “In this simulation, the following aspects of the Tangjiaxi landslide event are analyzed:” rather than “The coupled results were analyzed in the following aspects:”

- Page 12 L16: Write “The model analysis starts with the movement of the sliding mass” rather than “Upon the start of the model analysis, the sliding mass started to move.”.

- Page 12 L16-17: Write “The depth-averaged velocity curves at different elevation points of the sliding mass show that the time of reaching to the maximum velocity is varied for different parts of the landslide” rather than “From the depth-averaged velocity curves at different elevation points in the sliding mass, it can be seen that the time that different parts of the sliding mass took to reach the maximum velocity varied.”

- Page 12 L18-20: Write “Most of the landslide parts reached to the maximum velocity before impacting the opposite valley at the 6th second.” instead of “Generally the parts of sliding mass reached the maximum velocity before the sliding mass impacted the opposite valley (the 6th second).”

- Page 13 L7: Correct “at different time” as “at different times”.

- Page 13 L16-17: Write “The depth profile of Section A-A' (Fig. 12) in Fig. 13 shows that the solid grains of the sliding mass gradually moved toward the valley and accumulated.” instead of

"From the A-A' section dynamic process of the landslide in Fig. 13, we can see that as the time went, solid grains of the sliding mass gradually moved to the valley and accumulated."

- Page 14 L4: Write "The slide front edge" rather than "the leading of the sliding mass".

- Page 14 L7: Write "and it remained unchanged forming a landslide dam …" rather than "and it almost kept unchanged from then on, thus forming a landslide dam …".

- Page 14 L14: Write "show no significant differences" rather than "don't show significant differences".

- Page 15 L10: Correct "impacted to houses in A" as "impacted the houses of area A".

- Page 15 L13-15: Write "Based on the numerical results, it has taken about 20 sec since the landslide start moving until the impulse waves reached the first residential area." rather than "Based on calculation, the duration from the time the sliding mass started to the time impulse waves attacked the houses was about 20 s."

- Page 15 L17-18: Write "As it can be seen in Fig. 2, the Tangjiaxi valley is narrow. Therefore, it is hard to distinguish the generation, propagation and run-up phases of the impulse wave. Accordingly, this event was not a typical landslide-induced impulse waves." rather than "We can also see from Fig. 2 that as Tangjiaxi valley was narrow, the phases of generation, propagation and run-up of the impulse wave were hard to distinguish at the reach where the landslide slid into water, so it was not a typical process of impulse waves."

- Page 16 L1-4: Write "As it can be observed in the water level lines of various points in Tangjiaxi river surface in Fig. 15, there was only one large peak for the impulse waves, close to the landslide impact area (H3 in Fig. 15)." rather than "As shown in the water level process line of various points in Tangjiaxi river surface (Fig. 15), there was only one large peak for the impulse waves in the landslide, especially typical at the reach where the landslide slid into water (H3 in Fig. 15)."

- Page 16 L18: Write "Table 2 shows …" rather than "Table 2 shew …".

- Page 16 L21: Write "are in a good agreement with" or "adequately match with" rather than "had high goodness of fit with".

- Page 16 L21: Please try to avoid long sentences within the entire manuscript. Write ". Thus, the numerical model is a valid and reasonable tool for simulating landslide-induced impulse wave hazards." Rather than ", so the numerical model for landslide-induced impulse wave is reasonable and valid."

- Page 16 L23: The title of Table 2 can be changed to “Table 2 The calculated and measured run-up values at different points”.

- Page 16 L26: Write “In this paper” rather than “In the paper” and “was developed” rather than “was built”. These are repeated several times. Please check the entire manuscript. Also, finish the sentence after “was built,” as “was developed.”.

- Page 16 L28: Write “The non-coherent granular flow model of Mih (1999)” rather than “non-coherent granular flow Mih model”. Correct “dynamic characteristic” as “dynamic characteristics”.

- Page 17 L4: Eliminate one of the “wave” words.