

## ***Interactive comment on “Development of bridge failure model and fragility curves for infrastructure overturning and deck sliding due to lahars” by Joaquín Dagá et al.***

**Joaquín Dagá et al.**

jadaga@uc.cl

Received and published: 19 February 2018

REPLY TO REFEREES AND GUIDE TO THE REVISION OF THE PAPER Natural Hazards and Earth System Sciences Title: Development of Bridge Failure Model and Fragility Curves for Infrastructure Overturning and Deck Sliding due to Lahars Authors: Joaquín Dagá, Alondra Chamorro, Hernán de Solminihac, Tomás Echaveguren MS N°: nhess-2017-330

Anonymous Referee #1

Point 1a: The improper use of pronouns and adjectives causes difficulty in following the

C1

logic of the discussions. I recommend being managed this matter prior to discussing the details of the manuscript. Examples of the improper pronouns and adjectives are follow Page 3, line 30, 'latter' what this means? fragility curve, fragility probability or others? Page 3, line 21, 'they' what this means? Page 4, line 5, 'they' what this means? Page 18, line 6, 'they'. I think it is better to be replaced to 'we'. We appreciate the comments of Referee #1 and we realize that several pronouns and adjectives were not used properly. The paper was edited and grammar was improved. On page 3, line 21, the use of the term 'they' refers to 'debris flows'. The text was corrected as follows: "Debris flows are capable of transporting gravel-sized debris in suspension, and their concentration of solid particles ranges between 75 and 80 % in weight or 55 and 60 % in volume." On page 3, line 30, the term 'latter' refers to fragility curves; therefore, the word 'latter' was replaced by 'fragility curves'. The corrected text reads as follows: "In order to incorporate the uncertainty of the characteristics of lahar flows and the bridge engineering design (X), the use of fragility curves to quantify the probability of bridge failure due to lahars is proposed. Fragility curves express the probability that a system exceeds different damage states ( $\tilde{A}_{ds,i}$ ) as a function of the hazard intensity (IM) (See Eq. 1)." On page 4, line 5, the word 'they' refers to 'fragility curves'. The text was adjusted as follows: "Fragility curves can also be developed using an analytical approach through models that characterize the limit state of the element, based on probabilistic and deterministic variables defining the system." Section 'Acknowledgements' (Page 18, line 6) was rewritten in first person. The corrected text reads as follows: "Likewise, we express our gratitude to the institutions that participated and contributed to this research project, especially to: [...]."

Point 1b: Other minor suggestions. Page 1, line 21, insert 'simulation' following to 'Monte Carlo'. The term 'simulations' was included following to 'Monte Carlo' as suggested. The new text reads as follows: "Monte Carlo simulations were applied to quantify the probability of bridge failure given by different lahar depths."

Point 1c: Page 4, line 13, I cannot understand why 'on the other hand' used here (both

C2

Tsubaki et al. and Wilson et al. use the flow depth as the hazard intensity measure). We agree with Referee #1, the term 'on the other hand' generates confusion since both Tsubaki et al. and Wilson et al. recommend using the flow depth as the intensity measure. The term 'on the other hand' was removed from the sentence. The new text reads as follows: "Tsubaki et al. (2016) use the same variable (flow depth) for measuring the flood intensity when developing embankment fragility curves. Wilson et al. (2014) propose the flow depth as one of the potential intensity measures for developing fragility curves related to lahar flows as well."

Point 1d: Page 4, line 13-15, 'Moreover, the existing velocity and scour models use the flow height' doesn't make sense. Again we agree with Referee #1 and the sentence was not written properly. The purpose of the phrase was to provide a justification for the use of the flow height as a measure of lahar intensity. The original sentence was modified as follows: "In this paper the lahar depth was proposed as lahar hazard intensity, considering that this variable is correlated to other lahar flow characteristics, such as velocity and scour demand (Arneson et al., 2012)."

Point 1e: Pointed-out above are all minor points, but make difficult to follow the logic flow of the manuscript so discussing the detail of the present manuscript may cause many inessential discussion caused by misinterpretation of the authors' intentions. Thus, I suggest to revise the English language first. As Referee #1 pointed-out, we agree that grammar was misleading in the initial version of the article. Language was revised and edited throughout the entire text to avoid misinterpretation.

Once again, the authors appreciate the comments made by Referee #1 and believe that the manuscript improved significantly after including the suggested adjustments.

Please also note the supplement to this comment:

<https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2017-330/nhess-2017-330-AC1-supplement.pdf>

---

C3

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2017-330>, 2017.

C4