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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Tailings-flow runout analysis: Examining the applicability of a semi-physical area–volume relationship using a novel database" *by* Negar Ghahramani et al.

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The authors wish to thank the anonymous referee for a very detailed review of this manuscript.

Specific comments and the responses:

line 97. Here you cite the dam factor parameter and in Table 1, the same is called predictor. I would stick to one definition and possibly describe the rationale behind this derived parameter. Furthermore, there is an erroneous under script parenthesis in the parameter equation. lines 99-100. Unclear. Hf and dam factor are the same thing. Its

relationship with runout distance improves with the updated database.

1) In response to the first and second comments, the dam factor and Hf are not the same. Larrauri and Lall (2018) presented a new predictor in their paper and called it Hf which is defined as H× (VF âĹŢ VT)× VF, while the dam factor is defined as H× VF. To make it more clear, we modified the manuscript as follows: Lines 99-100- They introduced a new predictor, called Hf which is defined as H× (VF âĹŢ VT)× VF, where VT is the total volume of the tailings impoundment and VF is the total released volume. Table1- The word "predictor" is removed.

Table 2 (and Table 5). The dataset used by Berti and Simoni (2007) was later expanded with new cases (Simoni et al., 2011) resulting in a slightly different relationship: A=18VËĘ2/3. 12. Simoni A., Mammoliti M., Berti M. (2011) Uncertainty of debris flow mobility relationships and its influence on the prediction of inundated areas. GEOMORPHOLOGY, 132: 249–259.

2) Thank you for bringing this up, Table 2 has been updated to include the more recent information.

lines 183-184. The definition of uncertainty is incomplete. I guess it is the ratio (expressed as % in Table 3) between area of pixels intersected by the perimeter and total area of pixels mapping Zone 1. Please define unambiguously.

3) Thank you for the comment. The uncertainty values presented in Table 3 are the percentage uncertainty. We modified the definition of uncertainty in the text to be matched with percentage uncertainty values provided in Table 3. Here is the new definition: Lines 185-186- The maximum percentage uncertainty due to image resolution was considered to be equal to the ratio of the total area of the pixels intersected by the perimeter of Zone 1 to the inundation area multiplied by one hundred.

lines 209-210. Here you explain an important simplifying assumption. You should discuss this assumption and its possible impact on results. You can do it here or later when discussing the results (e.g., lines 275-280). In my opinion, the deposited volume is likely underestimated in your case due to entrainment of material along the flow path. Therefore, the Volume-Area relationship has higher intercept compared to the method used by other researchers, which relates deposited volume and inundated area. However, I believe the assumption is reasonable because in case of tailings dams the release volume can be used of predictive purposes.

4) This is a valid point. The following sentences are added to the manuscript:

Lines 288-290- One of the possible impacts of the assumption that the released volume approximately matches the volume deposited downstream in Zone 1 (Section 3.2.1) is the deposited volume may be underestimated due to the entrainment of material along the flow path. This simplification may lead to overestimating the y-intercept of the regressions.

Figure 7. Please insert y-axis name and unit measure in the boxplots. Specify whether the regression line shown here is best-fit or 2/3 slope.

5) Thank you for the comment. Figures 7a and 7b are updated. The solid black line is the specified 2/3 regression line. This statement is added to the caption of Figure 7.

Figure 8. This figure contains the same info as Figure 6; only 95% prediction intervals are added. Consider adding them to figure 6 and eliminate Figure 8.

6) Thank you for the suggestion but we prefer to keep them separate. In Figure 6, we plotted the 95% confidence interval of the best-fit regression to investigate the adaptability of the proposed relationship for tailings-flows. In Figure 8, which appears later in the Discussion section, we plotted the 95% prediction interval of the specified 2/3 slope to present the variability of tailings-flows and highlight the considerable uncertainties in the prediction of inundation area using this approach. Combining these intervals in one figure may result in misinterpretation and confusion.

line 277. I could not find highlighted cases in Figure 9. Figure 9. Please specify how

your 2/3 slope fitting line is obtained in this case. Fonts used for this figure differ from other figures, please fix.

7) The sentence in Line 277 has been removed from the manuscript since we specified those two cases with their ID numbers later on in Section 5 (line 305). In Figure 9, the 2/3 slope line is not a fit and it serves as a guide for visual comparison only. We modified the caption of Figure 9, accordingly.

Table 5. Most of the data reported here have been reported in Table 2. Consider eliminating.

8) The information in Table 5 is combined with Table 2 and Table 5 is removed.

Discussion section. Here you describe a couple of interesting real cases in more detail. In my opinion, the paper would also benefit from the insertion of one (or more) example of predictions that could be obtained on your cases. More particularly, it would be interesting to compare on a map, the actual inundated area with the areas predicted using your equation and 95% prediction intervals.

9) Thank you for the great suggestion. This study only presents the relationship between the planimetric inundation area and the release volume. This relationship must be combined with other empirical and/or numerical methods that estimate cross-sectional area and runout distance to determine an appropriate spatial distribution of the estimated area.

We are currently expanding this study by estimating the cross-sectional area for the tailings-flow cases that are presented in this manuscript and implementing both volume-planimetric and cross-sectional area relationships in Laharz, a GIS-based empirical model. The preliminary result is going to be published in the proceeding of the 2020 Tailings and Mine Waste Conference (Innis et al., 2020).

The Manuscript is updated as follows: Lines 272-277- Note that, while the method is able to provide independent estimates of inundation area, it must be combined with other empirical and/or numerical methods that estimate cross-sectional area and runout distance in order to determine an appropriate spatial distribution of the estimated area, similar to the approaches that have been used for other hazard types, such as Iverson et al. (1998) and Mitchell et al. (2020). Further study is currently underway to estimate the cross-sectional area for tailings-flows and incorporate both volume-planimetric and cross-sectional area relationships in a GIS-based empirical model (Innis et al., 2020): Regardless of the approach used, significant professional judgement must be applied in interpreting the empirical results.

Innis S., Ghahramani N., et al., (2020). "Automated Hazard Mapping of Tailings Storage Facility Failures". Tailings and Mine Waste 2020 (accepted).

line 314. The extreme runout behavior could have been also favored by an increase of the transported volume due to entrainment along the narrow channel that you describe.

10) Thank you for the input. We agree with your opinion. The new sentence is added to the manuscript: Line 325- iii) a potential increase of the transported volume due to entrainment along the narrow channel.

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