Review of the manuscript 'Multi temporal LiDAR-DTMs as a tool for modelling a complex landslide: a case study in the Rotolon catchment (Eastern Italian Alps)'

submitted to "Natural Hazards and Earth System Sciences" by G. Bossi, M. Cavalli, S. Crema, S. Frigerio, B. Quan Luna, M. Mantovani, G. Marcato, L. Schenato and A. Pasuto

Reviewer: Martin Mergili

The authors present an interesting study on the spatially distributed quantification of debris flow release, entrainment and deposition by comparing pre-and post-event LiDAR DTMs. They use their results for back-calculating the event with the software DAN3D and highlight the importance of that type of multi-temporal data for the calibration of computer models and therefore for hazard analysis and risk mitigation. The work is certainly interesting for the audience of NHESS. Further, it is generally clearly presented, and the discussion paper is well structured. I would like to place a number of comments the authors should consider before final publication of the work. In summary, I suggest **minor-moderate revisions**.

The authors are welcome to contact me at martin.mergili@boku.ac.at in case they disagree with my comments or if they wish to further discuss the one or the other issue.

General comments

1. Fig. 2 and the associated text are not clear to me. Why do you need a special tool for the change detection (6457, 25f) – as it is described, you could just do it with the ArcMap Raster Calculator, r.mapcalc in GRASS or whatever. Please explain better what it is that makes this issue more difficult. Further, I do not understand why the maximum of erosion or deposition is 95.24 m in Fig. 2, but only 27.9 m in Fig. 4. Please explain the difference in a clearer way. Note also the specific comments concerning the figures.
2. Be consistent with the tense used in the Methods chapter. E.g., in 6459, 21 you use past tense, in the following line you use present tense for two aspects which should be in the same tense.
3. In the Discussion and conclusions you should mention that a further step from back-calculation to prediction is necessary, requiring certain assumptions/scenarios.

Specific comments

6455, 18f: The sentence starting with "Dynamic computer models …" is formulated in a quite optimistic way – all of us know about the connected problems and uncertainties. I suggest to add a sentence emphasizing the limitations such as the parameter uncertainties (incl. the need to back-calculate parameters based on observations) and the need to appropriately assess the uncertainties and sensitivities of the parameters.

6456, 6f: "… from 1930 m down to 590 m a.s.l. where …"

6456, 12f: I do not think that the term "alluvial" is used in a correct way here. My suggestion: "Thick layers of residual rock and rock fall material cover the upper part …"

6456, 20: "… evolve into debris flows …"

6456, 23: "… located farther downstream …"

6457, 1: "… In the last event, which occurred on 4 November 2010, …"

6457, 8: The term "model" is ambiguous here, there are many types of models. Please specify in a clearer way which type of model you mean.

6457, 14: "… was carried out on 21 October 2010 …"

6458, Eq. 1: Check formatting of equation and define q.

6458, 26: You state that the error in both DTMs was set to 0.2 m. Before (6457, 18) you have specified the RMSEs associated with both of the surveys. Please explain in a clearer way why you finally chose to work with 0.20 m.

6459, 2: "… was performed with the DAN3D software …"

6459, 4: "… discretized into numerous …"

6459, 8: "… curvature on the erosion/deposition pattern …"

6459, 28: "… the cells were resampled to a 5 m x 5 m grid."

6460, 3: I am not sure if the reference to Fig. 3 is correct here. In my opinion, the reference should rather point to Fig. 4. As far as I see, Fig. 4 is not referenced at all whilst Fig. 3 is not really described in the text.

6460, 10: As far as I can see from Table 1, the discrepancy of 15,000 m³ could also just be a result of data uncertainty, as the error in volume may be 50,000 m³ - therefore, the difference could also point in the other direction.

6460, 21: "Agno di inlet" or "Agno inlet"? Further, show this place in Fig. 1.

6460, 26: "… due to the increase"

6461, 5ff: Please check the grammar of this sentence.

6461, 22: "… while in the lower tract it was …"

6461, 23: I suggest to give the errors not only in absolute values, but also as percentages (also in Table 2).

6461, 23: Again, "Agno di inlet" or "Agno inlet"?

6461, 23ff: "… downstream. This is an acceptable …"

6461, 24: Maybe better: "… for a large debris flow."

6462, 1f: "… transversal dynamics of deposition in the external part of the curve and erosion in the internal part, …" Further, are you sure that deposition occurred in the external and erosion in the internal part and that it was not the reverse?

6462, 5: "… downstream from the Agno inlet …"

6462, 6: "… upstream from the Agno inlet …"

6463, 1: "a spatially distributed …"

6463, 2: "… of fast moving does …": it seems that a word is missing here.

6463, 4: Strictly speaking, the DoD does not compensate for the lack of velocity data – these are two different things which provide reference data for different output parameters of the model.

6463, 5: "…it is advisable for future studies …"

6463, 6: What do you mean with geotechnical instrumentation here?

6463, 13f: "… cost has dramatically decreased …"

Table 1: Remove the colon after "Estimate"

Table 2: In my opinion, it would be fine if you could give the differences also in per cent.

Fig. 1: Some of the labels are not readable, further you should use larger fonts in general.

Fig. 2 (see also general comment): 0 should be no colour, fonts should be larger.

Fig. 3, caption: "(a)" after "distribution" should probably be removed.

Fig. 4: (see also general comment): Larger fonts would be better.

Fig. 5: The legend is inconsistent: e.g., to which class does a value of 0.25 belong? >0-0.2; >0.2-0.3 etc. would be correct. Fonts should be enlarged. Further, the legend of the deposit classes of Fig. 4 should be in line with the legend of Fig. 5. To facilitate comparison, it should also be ensured that both figures are shown on the same page of the final paper e.g., by putting them into 1 single figure with the panes (a) and (b).