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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Debris flow susceptibility mapping using a qualitative heuristic method and Flow-R along the Yukon Alaska Highway Corridor, Canada" *by* A. Blais-Stevens and P. Behnia

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General comments

The paper by Blaise-Stevens and Behnia on "Debris flow susceptibility mapping using a qualitative heuristic method and Flow-R along the Yukon Alaska Highway Corridor, Canada" presents a comparison and validation of two approaches for debris flow susceptibility assessment. The qualitative heuristic method aims at identifying debris flow source areas based on a series of geological and morphological criteria, such as the slope angle and aspect, distance to drainage network, superficial deposit type and

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Interactive Discussion

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permafrost occurrence, which are then ranked and combined into a susceptibility index based on expert knowledge. The second approach is the Flow-R model for debris flow initiation and propagation. Source areas in Flow-R are determined using partly other criteria than in the heuristic model (curvature for example) and computes then the run-out area for each source cell. The authors validated the susceptibility models using an inventory of debris flow events.

The manuscript is complete, nicely illustrated and well written. One of the major flaws of the study is the different way of determining potential debris flows source areas in the two approaches. Why using different criteria and why not combining both approaches. The heuristic approach yields a susceptibility index for each grid cell of the digital elevation model and could thus be used as input parameter in the Flow-R model. Combining thereby both approaches would greatly improve the comparison of susceptibility maps with the debris flow inventory and deposit maps.

Specific comments

Other important improvement to the manuscript include a better justification and discussion of the scores and weights used in the heuristic susceptibility index. I would like to see a discussion why a higher probability of permafrost occurrence gives a higher score for the susceptibility index. I see the role of the active layer in permafrost regions as factor for debris flow initiation, however areas that have certainly permafrost and maybe even permanent permafrost might rather stabilize the hillslope material and impede debris flow initiation. Please also justify the choice of weights when combining the different factors. Some of the parameters used in the source area detection in Flow-R, namely the curvature and the upstream catchment area, should also be added into the heuristic model with appropriate classes, scores and weights.

A significant problem of the produced susceptibility maps is that the debris flows do not cover the entire debris flow fans, but only the present channel. Over long time, however, present channels may get blocked and new channels form all over the fans.

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It is therefore crucial for a debris flow susceptibility map to cover the entire fans. An appropriate choice of the spreading algorithm parameters might solve this problem.

Technical comments (page number/line number):

3510/9-10: remove mention how the slope angle and aspect are obtained

3511/12: observed landslide types include "debris flows" instead of "debris flow deposits"

3511/21: the first sentence is unclear

3512/5: "higher resolution" instead of "higher precision"

3514/14-17: this general part about debris flow modeling should be in the introduction; focus the section 3 on previous works in the YAHC

3515/14: delete "geological" as also other map types (e.g. permafrost) are used

3515/21: insert comma after "slope aspect"

3516/8: problem with formatting of the letters "ff" which transform into a special symbol (at several places throughout the paper)

3516/15-19: long and complicated sentence that should be split in two and partly rephrased, especially to explain the influence of slope aspect on the drainage system

3517/5-20: can be removed when using the source areas of the heuristic model in the Flow-R propagation model. Furthermore, I do not understand the limit of 500 m from the fan apex, as there are many debris flow sources further upstream.

3517-3521: section 4.2 summarizes the Flow-R method in great detail. This can be shorted a lot by focusing on the application of the method, referring the reader to the paper by Horton et al. (2013) for theory and computational aspects. In addition there are issues with the formatting of equations

3521-3522: the source area delineation in Flow-R should be replaced with the source

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areas from the heuristic model, but including some more parameters in it. Move the sections on "Source area delineation" to the appropriate place and rephrase

3521/19: I do not understand the unit 2 /100 m-1. Is this equal to 0.02 m-1 or does it mean something special...?

3521/24: discuss why using very low curvature values as threshold. Are debris flows in the YAHC less channelized than in the Alps or in Norway for example, or are there other reasons for using much lower curvature values than in other case studies?

3523/20: do the chosen inertial algorithm parameters match published data. If yes, please refer to them, else justify the parameter choice

3525/22-23: why is one fan not reached by the model? Was the source area not detected or the run-out too short? Are debris flows with high water content (= debris floods) possible, for example when a debris flows enters a channel with high water flow

3526: remove references to publications and figures in the conclusions

Table 1: did you associate a rating to the unit "Rock, Anthropogenic"?

Figures: some of the figures are very small and nearly impossible to decipher at the current scale. Full-page figures would be appropriate for Figs. 2, 5, 6 and 7; full-width figures for Figs. 1, 4 and 8.

Figure 1: In a) it should be "Denali fault" instead of "Denati fault"

Figure 4: why does the debris flow in Williscroft Creek in a) stop before the fan apex? Remove the number "1" in b). In the legend write " 1.5" instead of " 0.1.5".

Figure 5: legend: delete "of Fig. 5" after "location"

Figure 8: remove the number "1" in c)

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 3, 3509, 2015.