

Interactive comment on “Rapid post-earthquake modelling of coseismic landslide magnitude and distribution for emergency response decision support” by Tom R. Robinson et al.

Anonymous Referee #1

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This paper aims to analyse co-seismic landslide distributions using a fuzzy logic approach that takes into account seven variables which are mostly derived from an Aster DEM for the 2015 Gorkha earthquake. It addresses a relevant scientific question within the scope of NHES. Although interesting, the claim that the authors make to provide a novel method for rapid post-earthquake modelling of coseismic landslide magnitude and distribution that will support emergency response, is not entirely valid in my opinion, and overstates the importance of the work. The authors state they have generated a new method that can be applied to quickly predict the locations of landslides, after the occurrence of an earthquake, with a “limited” sample of mapped landslides. The authors use a sample of 2006 co-seismic landslides that were mapped within 12 days

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after the earthquake, and test the prediction map with 4312 landslides mapped by another group. - This cannot be considered a “small initial sample of identified landslides”. In fact it is half of the testing sample. - It is important to show how many of the landslides of the two samples overlap and how many are mapped differently in the same area. If the landslides are mapped more or less the same, than the test sample is about twice the input data, and it is logical that is predicted well. - If the landslides mapped by the two teams do not match well, then it is strange that it is possible to predict the landslides that occurred in different locations. This needs to be explained more in detail. The method was generated and tested using coseismic landslides generated by the Gorkha earthquake. However, the claim that this method could be applied to other earthquakes is not substantiated. It is not realistic to assume that the same number of variables, and the same fuzzy membership function can be used for other earthquake induced landslides inventories elsewhere. Many earthquake induced landslide inventories show different patterns that cannot be explained by the seven variables used in this study. For example the fault type plays an important role, and the difference between the hanging wall and footwall parts. Also lithological differences are very important, as well as the climatic situation (arid, glacial, tropical). Therefore it is not likely that the set of seven variables that are derived from a DEM explain the co-seismic landslide distribution for other events. Unless this is properly proven, the authors cannot make the claim that you have made a new method to quickly assess co-seismic landslide distributions using a small sample set. The authors state that they only use factors that show a relationship with coseismic landslides, and that can be mechanically explained. The authors should explain therefore why factors such as the distance from river confluences, elevation above sea level, distance from rivers and others mechanically cause landslides. The choice of a bivariate fuzzy logic model and the use of the gamma operator for multiple factors, should be further explained/defended. Since the relationships between factors and co-seismic landslides are multi-variate ones, and the individual factors probably have a substantial degree of conditional dependence, the use of multi-variate statistical analysis is more logical. There are indeed papers

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that have used fuzzy gamma operator in landslide modelling, but this doesn't mean that it is the best in this case. The authors should better explain why the use of this combination rule, and the use of a gamma operator of 0.9, which means that the result is almost completely controlled by the Fuzzy algebraic sum. The result is always larger (or equal to) the largest contributing membership value. The effect is therefore "increasing". Two pieces of evidence that both favour a hypothesis reinforce one another and the combined evidence is more supportive than either piece of evidence individually. The use of the term landslide magnitude is confusing. Authors like Malamud have used the term landslide event magnitude to represent the size-frequency distribution of earthquake events, which can be also calculated as the total landslide area, and the relative distribution in various size classes. The author just calculate the density of pixels that fulfil the threshold criteria of the prediction map, and this does not indicate landslide magnitude. Furthermore the maps displaying this are very general (Figure 7) and not really useful for emergency response planning.

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