Natural Hazards and Earth System Sciences Discussions

Nat. Hazards Earth Syst. Sci. Discuss., referee comment RC1
https://doi.org/10.5194/nhess-2021-243-RC1, 2021

Comment on nhess-2021-243

Anonymous Referee #1

Referee comment on "Quantification of meteorological conditions for rockfall triggers in Central Europe" by Katrin M. Nissen et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2021-243-RC1, 2021

General comments

The manuscript of Nissen et al. deals with the set up of a logistic regression model to derive the probability of occurrence of rockfalls in Germany, based on meteorological and hydrological variables. The paper is interesting and the writing is fluent and clear. I enjoyed reading it. Regarding results, the authors are able to quantify the impact of increasing rainfall and increasing subsurface water (i.e., pore water, water in fractures) in terms of variations of probability of occurrence of rockfalls. Despite its general good quality and interesting findings, I believe there are certain aspects that need improvement.

- While presenting the results of both the selection of predictors procedure and the logistic regression model, often some apsects are not shown. Since the manuscript is very concise and there isn't an excessive number of figures, I suggest to show some additional detail.
- Results are clearly presented, expressed in quantitative terms and well-linked to the performed analysis. However, I believe that presenting them with an additional operative perspective could give a lot of added value to the manuscript. In which conditions did most of the rockfalls occurred? Above which percentile of precipitation, subsurface water content? Would it be possible to translate the probabilities of occurrence in a matrix of no-, low-, mid- and high-hazard? See also specific comments #23, #24, #27.
- In terms of presentation, to favor readability, I suggest to consider a more rigorous and classic structure with Intro – Study Area and Data – Methods – Results – Discussions – Conclusions. Now, each step is presented with methods and results together. I got lost just a couple of times, not compromising the general understanding of the work, but I would find it easier to follow with the suggested modification. In addition, dealing the paper with rockfalls, I suggest a thourough check of the use of terms dealing with subsurface water (e.g., pore water, water in fractures, soil moisture, subsurface moisture etc.), since it is not always clear to what exactly the authors are reffering to.
- Discussions need to be extended with at least an additional paragraph comparing the results with previous literature on the topic (see comment #25)

Comments related to contents

- L9-10: Precipitation minus potential evaporation corresponds to what was defined as simulated soil moisture or parameterised pore water? Also, it was stated that moisture observations are not available so which was the assumption made to evaluate the performance of the proxy?
- L18-20: I believe that the described conditions can be most common between the end of the Winter season and the beginning of Spring (late March-April) buti it could be an Alpine bias of mine.
- L27-28: Consequently […] site specific. The sentence probably needs a couple of example references.
- L34-35: in this sentence, is promote used to say that the weathering mechanisms are preparatory-predisposing factors?
- L36: wetting and drying of porous rocks (esp. argillaceous) à I am pointing out this sentence as an example but I think it should be clarified throughout the manuscript how the term porosity (pore) is used (other example in the abstract, L4). Is it matrix porosity only or does it include discontinuities (joints, fractures, etc)? I suggest to specify it in the text. In this specific case, if talking of matrix porosity, maybe it is better to use sandstones as example rather than argillaceous rocks.
- L40-44: earthquakes could be added to the list, although probably not relevant in Germany.
- L52: water in rock cracks can act as a weathering agent through both physical and chemical processes. I would expect not only water presence but also wet-dry cycles causing repeated high water (over-)pressures in fractures to reduce the rock mass strength (i.e., weather the rock mass). I suggest to add some additional explanation to the sentence.
- L58-72: Rockfalls have the year of occurrence but the model is based on hourly, daily and weekly data. How was it possible to fit the model? How could you relate specific values of the meteorological and hydrological variables to the occurrence of the different rockfalls?
- L94-96: I would move this last paragraph towards the end of section 2.1 and introduce Fig. 2 there.
- L112-119: Please add some details regarding the model. In particular, it is mentioned that it is calibrated using gauge measurments; are these gauge measurements soil moisture sensors or else? Which is the time resolution of the model? Also, the model allows simulations through the entire column from the surface to a depth of approximately 1.8 m; within this depth, does it allow to distinguish between actual soil and rock? Is the water infiltration process modelled in the same way for both materials?
- L120: what is meant for operationally available? If I think of a model used for operational purposes I would refer to numerical weather predictions (short or mid-range, i.e. few days) rather than climate models (decades).
- L133-134: Please specify the accumulation periods that were tested. How was the performance of the different accumalation periods evaluated? The fact that the weekly period behaved best is a result. As stated in the general comment, I suggest to consider the possibility of re-organizing the manuscript with a more rigid and classic structure (Intro- Study area – Methods – Results – Discussion – Conclusion).
- L135-138: it is true that with this approach trivial areas (e.g., flat terrain, no rock) were excluded but it could be that potential unstable areas were excluded too. It is a reasonable approach to set-up the model but if predictions are necessary the areas should be filtered based on other terrain and land-use data. I suggest to motivate it explicitly, including the part on the exclusion of the grid boxes with events occurred in periods not covered by meteorological/hydrological data.

- L145: How are the range of values selected?
- L149-164: Mostly results, therefore same suggestion as comment #12. Also, The manuscript does not have an excessive amount of Figures, so why not showing part of the results?
- L179-180: is resolution intended as spatial, temporal or both? In any case I miss the direct link with model comparison. I would expect two models to be comparable if the input (training) data correspond, while in this section it is said that they might change according to the data used (daily precipitation, soil moisture, hourly precipitation).
- L209: it is not clear to me how the cluster predictor works. Can you please explain with additional detail the rationale of including it in the logistic regression model? From L199-201 I understood that the cluster number was just used to subsample the available data and split them in training and test sets.
- L212-213: Why considering all the interaction terms? Physically, what do you expect the product of two terms can explain that their addition does not?
- L218-219: The introduction of AIC belongs to methods.
- L225: Similarly to comment L212-213, what could be the physical meaning of the interaction term between the local percentile of daily precipitation and soil moisture? Why was it decided to include it in the model?
- L227-228: Where is it possible to see that the customisation of the model for regions does not improve the performance?
- L242: Where is it possible to see it?
- L258-259: Among the 237 events used to fit Model 16, given D at its median value or below, how many events occurred for conditions of precipitation below the median and how many for conditions below the 90th percentile? Is it the same in all the three study areas?
- L262-263: Same as above but given D at its 95th percentile or below.
- L267-298: In the discussion section, at least a paragraph should be dedicated to the comparison of results with analyses of previous studies. Perhaps the subject is not identical, but in the introduction several studies are cited that discuss causes and relationships of climate and hydrological variables with rockfalls (e.g., Bajni et al., 2021; D'Amato et al., 2016; Macciotta et al., 2017; Saas and Oberlechner, 2012). I think it could be interesting to know how your results, or the general indications given by your results, compare to those of these studies and maybe other similar ones.
- L275: Data regarding other regions of Central Europe are not presented. I would phrase it a bit more carefully saying that given the similar climatological, hydrological, geological and topographical characteristics the model could be applied in other low mountain areas of Central Europe with success. An evalutaion of its performance would still be needed. The same comment applies to the conclusions (L303) and the title.
- L277-289: in this paragraph, false alarms and prediction errors are discussed. However, in the results there isn't a real attempt to set probability thresholds and quantify these values. I know how difficult it is but based on the derived models and the recorded occurrences, could you suggest combinations of values to define no (low) hazard, medium hazard, high hazard? This comment is linked to comments #23 and #24 too.
- L312: frost days will decrease, but freeze-thaw cycles could increase at specific elevations. I'll suggest to phrase it more carefully.

Minor editorial comments

- L5: both for the day of the event and the days leading up to it.
- L36: dissolution in carbonatic rocks
- L49: all climatic factors that promote
- L53: a statistical model that
- L58: rockfall data that. Please check throughout the manuscript the use of which/that.
- L61: database, which […]. The database mainly covers the last 200 years
- L62: Information on 670 rockfall events are included in the landslide dataset.
- L68: while the remaining
- With the majority of them (n=621) recorded from
- L105: 1 km x 1 km or 1 x 1 km^2
- L258: Less/more precipitation leads to a below/above