

Nat. Hazards Earth Syst. Sci. Discuss., referee comment RC2  
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## **Comment on nhess-2021-243**

Anonymous Referee #2

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Referee comment on "Quantification of meteorological conditions for rockfall triggers in Germany" by Katrin M. Nissen et al., Nat. Hazards Earth Syst. Sci. Discuss.,  
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### **General comments**

The manuscript proposes a statistically-based approach to quantitatively assess the impact of a set of meteorological and hydrological variables on rockfall occurrence in some selected low-mountain regions in Germany. These variables are thus considered as potential triggering factors and have been analysed for the event day and for the days before. The authors conclude that the logistic regression-based model used is able to detect changes in the probability of rockfall occurrence in the study area. Precipitation at daily scale turn to be the main triggering factor and a 5-parameters model based on the interaction of daily precipitation, freezing-thaw cycles and increase in sub-surface water is the most appropriated in terms of skill.

The manuscript represents a valuable and innovative contribution to the understanding of climate variables-related impact on the hydrogeological risk. Outcomes of the research are very interesting and the paper is in general well-written and fluent. I'm not a mother-tongue but I think that the English is good. Nevertheless, I personally think that some major changes are needed and would improve the overall quality of the paper.

First, I think that the paper should be restructured in a more standardized and classic way to improve readability, in particular the data and methods sections. I suggest to state clearly each part e.g., Data, Methodology, Results etc. The manuscript as is mixes together data, methods and results and I must admit that I encountered some difficulties in following the text.

The description of data and methods (e.g., methods to simulate soil moisture and pore water proxy) is not sufficiently complete. Further specification and clarification should be included throughout the text. Adding some figures related to not shown analysis could be of help in this (see Specific comments).

The Discussion as is lacks of comparisons with similar studies on the same topic (i.e., relations among climate, hydrological variables and rockfall occurrence) to assess how they differ or agree.

Other specific comments are listed hereinafter. Moreover, I think it is a bit ambitious to say that the model is valid for the entire Central Europe as stated in the title as well.

### **Specific comments**

#### *Title*

I suggest to revise the title. The considered dataset is not representative of Central Europe actually.

#### *Abstract*

L 10: Maybe it should be clarified that precipitation minus evapotranspiration is a pore water proxy (as an alternative to simulated soil moisture).

#### *Introduction*

L 33: Is the term "promote" related to predisposing condition for rockfall occurrence? Check the meaning throughout the text.

L 45-55: Actually, studies focusing on statistically-based approach to assess the linkage between climate forcing and rockfall/landslide occurrence are increasing worldwide and especially in mountain-areas like e.g., the one investigated in this work. I suggest to discuss further this point and mention some relevant works in this context, highlighting how this study adds value and contributes to shed light on climate and hydrological-related trigger mechanisms.

#### *Meteorological and hydrological variables*

L 112- 119: I would add some further details on the methodology adopted. What's the resolution of the model? Can the model distinguish between different types of lithologies across the entire column?

L 114: In general, the use of terms related to soil moisture and sub-surface water throughout the text looks a bit misleading to me, since it is not always clear to what the authors refer to.

Figure 1: Please add the meaning of the cluster in the caption.

L 120: It is not clear if the authors refer exactly to climate scenarios or to a shorter-term prediction. Before, there was no reference on the use of climate change scenarios for this analysis.

L 120: Not clear how the authors validated the pore water proxy if soil moisture information are available only for some sites and simulations. In general, I think that the authors should provide more details on the methodology and procedures used to calculate the soil moisture and pore water proxy.

L 128-129: Please rephrase.

L134: Please specify what are the accumulation periods considered.

L 145: How the authors select the range of values for each variable?

L 149: These are part of the results.

L 155-164: This is a mix of results and methods. Please see the general comment.

L 156: Considering time spans before the rockfall events is useful not only for thawing process, but for the antecedent moisture condition as well. It looks like that the time span including the days leading-up to the failure have been considered only for thawing process while, as can be derived from L 134, different accumulation periods prior to the failure have been investigated also for pore water. Please clarify better this point.

L 157: What time spans did the authors consider?

L 161: It is not very clear to me how the authors could compare the importance of such variables if the number of rockfalls and grid change depending on the spatiotemporal resolution of the respective datasets. Maybe it is worth to include the results of the consistency test here or as Supplementary Material.

L 165: This part seem to be more appropriate for a discussion.

L169: Please add some reference.

L 178: It is not very clear to me how the WOE considers the fact that more than one landslide occurs in a grid box.

L 179: I guess that the resolution is intended as spatial?

L 213: This point has to be clarified. Please discuss further why using all possible combinations of predictors instead of simply the sum or product could add value to the analysis.

*Results*

L 218: AIC has not been introduced before. Please add further details in the methodology section.

L 238 The authors should introduce the term "across-site percentile" and clarify it.

L 246 This can be due also to the DEM resolution, that could not be sufficiently higher to detect the exact location of a rockfall.

L 254 AIC considers both how well the model reproduces the data and the number of variables (maximum likelihood estimates of the model) used to build the model. The lower the AIC value, the better the model fits as the authors rightly state at L 220. If I rightly understood, AIC is much lower in model 15 compared to the selected one (16). Is the choice due to the number of rockfall events involved? The authors partially explained the final selection; thus, I would suggest to discuss further this point.

### *Discussion*

L 270: The authors rightly state that there is no guarantee that the three sampling locations are representative for the entire Germany but at L 275 they say that the approach can be reasonably extended in Central Europe regardless of the geographical and local settings. I think that additional analyses are needed to state this actually.

L 284 I would say that also the inclusion of more climate and hydrological variables could be of help in decreasing the number of missed alarms.

L 291 As I understood correctly, time series of different lengths have been used depending on the considered variable. To determine the percentile of the variable in the lead-up of the event with relation to the previous period, the authors use both a local and across-site percentile. Across-site percentiles could be misleading in this context. Does "across-percentile" mean that the same variable is compared across records of different weather stations with different lengths while the local percentile is referred to the local time-series?

L 303 Be careful about saying that the model is representative for low-mountain regions in Central Europe. I would say in Germany, at most.

## **Technical corrections**

L 6: and instead of "as well as"

L 49: "that" instead of "which"

L 105: Be consistent throughout the text: 1 km x 1 km 1 km<sup>2</sup> (L 102).

L 258: "a below" instead of "an below"