

Review of manuscript NHESS-2016-395:

“A 240 year History of Avalanche Risk in the Vosges Mountains from Nonconventional Sources”

by Giacona F., Eckert N., and Martin B.

1) General comments

Dear Editor, dear Authors,

This contribution covers a very important and interesting topic, namely the search, analysis and exploitation of conventional and nonconventional information sources to establish and/or extend databases of past natural hazard events. The article points out the many challenges associated with data acquisition over a long study period during which information sources evolved substantially. The text is generally well illustrated and the overall structure of the manuscript is adequate.

Data on natural hazard processes (especially when destructive) are used by a wide variety of organisations (e.g. scientific institutes, private environment companies, insurance companies, governments). Such data are a very useful instrument in providing basic information for better hazard and risk assessment as well as decision-making. It is therefore important to promote and support studies such as the one presented in this manuscript.

The case study presented by the authors focuses on a single hazard type (snow avalanches) and on regional issues (Massif des Vosges). It is in many ways special which partly makes it even more valuable. Most importantly, (i) it covers a very long time frame, (ii) it covers an area not especially known for the hazard process of snow avalanches and (iii) it treats an area that has experienced fundamental turbulences in the past (e.g. several armed conflicts in the last 150 years; changes in official language etc.). These points reveal methodological research problems that one may not encounter in similar investigations elsewhere.

Given the importance of natural hazard event analyses and data sets, I think this valuable contribution should be published and I hope that it will motivate researches in other regions and dealing with other hazard processes to follow this (obviously quite demanding) path.

However (!), I see several substantial (mainly formal and structural) problems that need to be solved before this text is ready for publication in NHESS.

- First of all, the use of English language is not very good and needs to be substantially improved. In many places, the constructed sentences are much too long and contain too much information that make them often confusing and difficult to understand. The authors should try to formulate short, reader-friendly and clear sentences. I tried to make suggestions/corrections where possible. However, because I am not a native-English speaker my proofreading is not at all

complete. I am strongly convinced that the text would benefit from thorough editing by a native-English speaker.

- Footnotes are used throughout the manuscript. I would strongly recommend to avoid the use of such footnotes. It is not, to the best of my knowledge, acceptable in this journal. The contents of many of these footnotes is not essential for the understanding of the text. They could e.g. be summarised in a supplementary file associated to the article or could partly be deleted. The most important contents should be incorporated in the main text or in figure captions.
- In my opinion, the manuscript is currently too long. A lot of the issues addressed in the text are described in too much detail. In some parts (e.g. Discussion), the text is repetitive. I think it is crucial that the authors rework the manuscript, mainly sections 4 and 5, by carefully picking the main statements they want to make. According their decision, these issues and statements need to be accurately put to paper in simple but significant sentences (see also first point above).
- Some key terms used throughout the manuscript should probably be introduced and precisely be defined in the Methods section.
For example, the use of the term *event* (also *source event*, *historical event*, *observed events*, *avalanche event* etc.) is not clear and confusing at times. At page18/line15 the authors state that "it is not because an avalanche occurs that the event exists" and then produce a definition from literature. This is really complicated to understand and should (in my opinion) be clarified earlier in the text.

In summary, I do not think that this manuscript is ready for publication yet. I suggest the authors revise their text and solve the formal problems mentioned above. As regards content, the article is on a good level. However, the information the authors want to communicate in the latter sections of the manuscript should be reassessed, reorganized and if possible shortened.

I do sincerely think that there is potential for an NHESS article in this manuscript. I thus recommend that the paper be accepted pending major revisions or that it be rejected with an invitation to re-submit when all formal aspects criticised are clarified. I provide below a list of partly detailed comments specific to the different sections of the article as well as to the tables and figures produced by the authors. Additionally, I prepared a list of technical corrections for the authors.

2) Specific comments regarding the different sections of the article

Abstract

The Abstract is well structured and of adequate length.

- P1-L9/10: Why the use of "still"? Consider changing to:
"especially in medium-high mountain ranges with a significant process activity."
- P1-L11: A real problem of this MS is the lack of consistency in the spelling of terms. A good example is the term "north-east of France" at line 11 that throughout the text is also spelled "North-East of France" and "North East of France".
- P1-L12: Same point: "geo-chronology" is also spelled "geochronology" in the MS. Be consistent.
- P1-L17/18: I do not understand what is meant by "for risk changes understanding and mitigation"

Introduction

The Introduction is not so well organized. Towards the end of it the authors include a lot of information that does not belong in an Introduction but should be placed in the study site description (section 2) or in a classic Methods section. The last two paragraphs need to be thoroughly reorganized and shortened. They could be combined with the well-defined aim of the study (P3-L11-14).

- P1-L26: I don't think "duration" (of the database) is the right term here; consider using "ii) a relatively short temporal coverage;"
- P1-L28: Add a reference to underline this statement
- P2-L1-5: This is a very long sentence with a lot of parentheses. Consider simplifying the text by starting a new sentence with:
"They cause deaths and destruction (buildings, tourism infrastructure, power lines, forest stands), sever communications..."
- P2-L10: The information in footnote 1 is too detailed to remain in the main text. If the authors want to keep it, they should consider including it in a list of additional information in a supplement.
- P2-L20: This is confusingly written, consider rephrasing, e.g.:
"with only a few studies on this topic, such as Granet-Abisset..."
- P3-L8/9: The parenthesis is very long and complicated. Consider changing it to an own sentence.
- P3-L10: I do not understand what is meant by "a long lasting occupation of the territory". Do the authors mean "a long-term challenge for the public authorities"?

- P3-L15-18: All the information describing the Vosges does not belong here; it should be incorporated in section 2. Part of it is actually already there (!).
- P3-L19: The data in footnote 2 should probably be included in section 2 or handled in the same way suggested for footnote 1.
- P3-L24/25: The description of the different types of sources should be presented in the Methods section, not here.
- P3-L26-28: Dito. All this information on the social enquiries and surveys do not belong here (incorporate it in the Methods section). They only make the final part of the Introduction complicated

Description of the territorial context

This section is adequately structured but slightly long. I suggest that the second paragraph (P4-L17 to P5-L5) should be considerably shortened. A part of the information given there is interesting indeed, but not essential for the present study.

I like Figure 1 very much; it gives a good overview over the study region and nicely illustrates its main features.

- P6-L1: Incorporate the content of the footnote in the text, if you think necessary.

Geohistorical methodology

Figure 2 gives an excellent overview over the sources that were evaluated in the study. It completes this section well.

- P6-L9: Consider rephrasing to: "Because of the scarcity of data in the archives,"
- P6-21/22: Simplify to: "...focused on the risk cultures of the practitioners of winter activities."
- P6-L26/27: This is formulated in a complicated way. Maybe you could simplify: "This proportion is slightly below one-fifth for oral testimonies and regional media reports each."
- P7-L5: At line 1 the authors use the term "ground observations"; here instead they use "direct field investigations and observations". Do they mean the same? I suggest rephrasing: "Direct field investigations including surveys of avalanche deposits"

Results

The Results section presents the most important findings of this contribution in two tables and three figures. It is of adequate length but quite confusingly written at times. The tables need a little bit of work (see comments below, in the according sub-chapter of

this review) and Figure 5 would greatly profit from the incorporation of cumulative data (see below, too).

Some statements on data uncertainty and accuracy do actually not belong in a classic Results section and should therefore be moved to the Discussion.

- P9-L19: As suggested below (sub-chapter "Tables" of this review) the authors need to clarify how the term "casualties" is used in their MS. My impression tells me they mean "affected people", but I am not sure.
- P9-L20: How is "material damage" defined in this study? Does it only cover damage to buildings or is it also including damage to infrastructure (e.g. roads, train tracks, power lines etc.). Have the authors considered to use the term "financial damage" instead?
- P9-L21/22: See above right above: how is "functional damage" exactly defined? Does it have a financial aspect?
Or put differently, does a functional damage to "road cuttings" include the damaging or destruction of infrastructure or only the blocking of a transportation route for some time? Please clarify these points
- P9-L23-26: These three sentences describe and discuss data limitation and data uncertainty. They do not really belong here and I recommend that they are incorporated in section 5 (Discussion)
- P9-L26: The information given in footnote 5 should actually be introduced in the Methods section. Alternatively it could be placed in the text here in section 4.
- P10-L2-6: These two sentences discuss data accuracy and do actually not belong in this section. I recommend that the point made here is included in section 5 (Discussion)
- P10-L12: In this paragraph (lines 7 to 13), you round all the values of Table 3 with the exception of the "441 m a.s.l." at line 12. Please be consistent in the way you describe your data.
- P11-L14/15: Be exact: not the number occurs, the event/avalanche does. Hence, change to: "(about 5% of all avalanches of the chronology occurred..."
- P11-L15: I suggest you change to "The number of avalanches per winter rise in the 1960s, and increase even more..."
- P13-L1/2: When stating the "negative correlation between avalanches intensity and cold season", do you mean that avalanche intensity shows a statistically significant negative trend with time?
- P13-L2: Footnote 6: I recommend stating in the text which method/test the authors applied. However, the second part of the footnote is not necessary
- P13-L3-5: Regarding the "relative proportion of the types of avalanches over time":
I do not see the statement you make in this sentence in Figure 6, unless you are only talking about material damage. Please be a bit more concise.

- P13-L9/10: What exactly is a "victim" in your context? A person that was injured or killed? Please explain. Also consider my comments regarding your definition of "casualties", e.g. in Table 2.
When you talk of "unscathed people" at line 10, I see a problem. Because in my opinion, somebody that was not killed or hurt during an event is not a "victim" in the proper sense. You could possibly call this "unscathed" person *affected* by the avalanche.
- P13-L7: Footnote 7: This doesn't work like this: The information clearly belongs in the Discussion section and not here in the Results section.
- P13-L11: After "material", "functional" and "environmental" damage, the authors introduce "human damage". What is exactly meant? Fatalities or both injured and killed people? Please explain. However, I recommend avoiding this term in the MS.
- P14-L6-8: First, I am not sure if listing all the years in the text helps the reader. Please reconsider that.
Then, the authors have listed the winter 2009/2010 twice (both in the winters with considerable victims and damage and in the slightly less affected winters). Please chose one of the two.
- P15-L1: Please note that February 1844 falls into the winter of 1843/44 which is not listed at the bottom of page 14 (1844/45 is listed instead)
- P15-L10: What is meant by "spatial extension of the information"? Extension of the affected area?

Discussion

Some parts of this section are not formulated well enough, which makes it hard for the reader to follow the central theme in the text. Also, some statements made in the Discussion are repetitive. Below I only list the points that I think are most important.

- P15-L22/23: I do not understand the definition of the first factor considered by the authors. Please try to explain this more clearly. Especially the second part of the statement ("leading or not to an 'event building' from the facts, and to their transmission") is confusing to me
- P15-L27: This title is a bit puzzling; I suggest something clearer
- P16-L1/2: This statement is not well reflected in Figure 5 because only count data are shown in the two graphs. Consider adding the cumulative number of events and sources
- P16-L25: "The changes to the body of available (re)sources are visible in the shape of the geo-chronology."
Where is this visible? In Figure 5? Please add reference to the figure after this sentence or after the next sentence.
- P16-L28: What do the authors mean by "consecutive"? I do not understand. Consider "...more frequently ever since recreational activities are undertaken"

- P16-L33/34: What do the authors mean in the second part of the sentence "...with some years with very few avalanches."?
Does the number of sources increase linearly with the number of avalanches? Have the authors made that plot (y-axis: sources per year; x-axis: avalanches per year)?
- P17-L4: The formulation "the question of the existence of potential occurrences" seems quite difficult to understand; if possible simplify/clarify
- P18-L2/3: This sentence ("The observation... ..winter sports") is true but not of great importance for the article and should thus be deleted to shorten the text
- P18-L6: Consider deleting "and even more from 1993 to 1994," it makes the sentence even harder to read
- P18-L11-23: This paragraph is confusing me. I wonder if a clear and well written definition of terms used in the MS could help and clarify some points. Such a list of definitions would probably have to be placed in section 3 and would include terms like:
trace, occurred avalanche, event (source event, historical event, observed events, avalanche event), event building, source, source effect etc.
The complicated footnote 10 includes such a definition ("...we see as 'event' all spatio-temporal occurrences of the avalanche phenomenon."). However, there it is not helping very much.
- P19-L7/8: I suggest to clarify slightly as follows:
"...no mention is made of smaller avalanches (intensity class < 3). In contrast,..."
- P19-L8: is "damage/size levels" referring to intensity classes? Please be consistent in the use of these terms (also see my comment regarding the legend of Figure 8).
- P20-L1/2: This first sentence is a very good example of a slightly complicated sentence that could be simplified, e.g. as follows:
"Land use in the Vosges Massif has significantly changed over the 240-year study period."
- P21-L2-43: This sentence is repetitive
- P21-10/11: I am not sure if these questions raised by the authors help here. I would definitely delete the third one to help shorten the text
- P21-L14: Footnote 15 can compactly be integrated into the text here; consider:
"... rather than written culture. This was also suggested for other mountainous areas (Barrué-Pastor (2014))."
- P21-L17-20: Consider simplifying:
"Moreover, it is not sure if avalanches were really perceived as a significant threat since the chronology does not include many avalanches that caused material damage or fatalities."

P22-L7/8: The sentence "Finally, it implies that the memory of the risk is in the 'short time of the event, experienced during a lifetime' (Barrué-Pastor, 2014)." is confusing

P22L28-P23-L1: Very long sentence; please consider making two sentences

Conclusions

This section is of adequate length and contains the important take home messages for the reader. However, it needs to be sharpened here and there.

P23-L10-13: This sentence is way too long and difficult. I recommend dividing the information in two or more clear sentences.

P24-L1-5: Again, this sentence is way too long. Start new sentence at line 4 and consider changing to, e.g.: "This applies particularly to medium high regions where knowledge is still very partial."

P24-L6/7: Again, I suggest clarifying the text by deleting ", in fact," at line 6 and by starting a new sentence at line 7:
"... both in terms of frequency and intensity. Avalanches caused a dozen deaths since 1970, which makes it one of the deadliest natural hazards in the Alsace region".

P24-L8-10: Complicated confusing sentence again. Simplify

P24-L15/16: Consider deleting the first part of the sentence and changing to:
"The geo-chronology reflects only part of the avalanches that actually occurred during the study period."

P24-L18: What is meant by "the prism of the corpus of sources"?

P24-L21-23: Consider simplifying:
"...at least in some sectors. These factors lead to a reduction in event frequency and intensity, and even to the disappearance of avalanches in certain valley sites.

P24L30-P25L2: I would have wished a slightly more down-to-earth last paragraph. Although I fully agree that available sources strongly influence avalanche occurrence as we perceive it (message of the first sentence), I find that especially the second but also the third sentences are a bit confusing.

Tables

Table 2: A number (28) is missing for "Large avalanches (intensity class > 3)"

Table 2: In the caption of table 2 the authors should define how they use the term "casualties". If here "casualties" means "affected people", I would strongly suggest to use "affected people" (i.e. concerned by an avalanche but neither injured nor killed).

- Table 2: I suggest to use the term "With fatalities" or "With people killed" instead of "With dead people"
- Table 2: The different types of damage (material, functional and environmental) should in my opinion be accurately defined/explained in the caption of Table 2. Also, I suggest to use the "damage" in singular everywhere in Table 2.
- Table 3: In the caption, consider changing text to "Topographic characteristics of the avalanche paths..."
- Table 3: It seems strange to me to have listed the mean altitude of the avalanche paths. How was it calculated? I guess the table would considerably benefit from information on the (i) starting zone and (ii) the bottom of the depositional area of the different paths
- Table 3: The unit of "Mean altitude" should be "m a.s.l."

Figures

- Figure 2: (a) Consider slightly rephrasing the figure caption: "Overview over the set of geohistorical resources used in the present study"
- Figure 2: In the upper-left-corner "Written re(sources)" should be changed to "Written (re)sources".
- Figure 2: The fourth box of "Written (re)sources" needs to be translated in English. Also, in the third box "Regional" has no *accent aigu* in English
- Figure 4: In the caption, consider changing text to: "Only the 520 avalanches that could be precisely located are considered."
- Figure 5: The data presented in the two graphs are interesting. However, they will be better shown additionally using a cumulative chart of both avalanche events (A) and sources (B). I strongly encourage to add cumulative data to both panels
- Figure 6: As blue is the only color used in this figure, I suggest to only place the text in the seven panels and leave the colored rectangle out
- Figure 6: Please consider my comments made above (Table 2) regarding affected/injured/killed people and regarding the damage types
- Figure 7: I suggest you chose an alternative indication for the two WWs; the dashed line should only be used to show the sub-periods
- Figure 7: What is the difference between the green (Data contextualization) and the red (Data and data contextualization) symbols? Briefly explain in the figure caption
- Figure 7: In the legend, use "sub-period" instead of "period"

Figure 8: In the caption, consider changing to:
"Location and intensity of the avalanches that were reported in the Honneck-Rothenbachkopf sector during the winters 1951/52 (left) and 2009/10 (right), obtained from the geochronology developed in this study."

Figure 8: In the legend of Figure 8 the authors use the term "Level" instead of "intensity class" (see also Table 2). I strongly recommend to use the same term throughout the text

3) Selection of technical corrections

- P1-L25: You need a semicolon or colon after "i) a close link to vulnerability". A comma doesn't work here.
- P1-L28: Why "the period"? Which period is meant here?
- P1-L25: It should probably read "result" instead of "results"
- P2-L12: Change to: "the latter region has had"
- P2-L16: Consider "probability instead of "chance"
- P2-L22: Consider starting a new sentence at line 23: "However, the study of the evolution..."
- P3-L7: I guess you need "and" before "vulnerability"
- P3-L11: Be consistent in spelling "geohistorical" ("geo-historical" at page 9, line 17)
- P3-L12: Consider changing to "approach for the"
- P3-L12: Consider "a geo-chronology of avalanches and avalanche damage of"
- P3-L27: Be consistent in spelling "Vosges Massif" throughout the text. Also, the use of "Vosges Range"/"Vosges range" is not consistent!
- P4-L4 Consider changing "west" to "western"
- P4-L7 I suggest the use of abbreviations: "km²" instead of "square kilometers", "m a.s.l." instead of "meters" etc.
- P4-L7/8: Here and in many other places in the text, the authors spelled out numbers instead of using figures/numerals. Personally I think that in many cases, the use of figures would be more appropriate (in this case "between 20 and 60 km" instead of "twenty and sixty km"). Again, consistency is the key.
- P4-L13: Consider deleting "long-lasting" (you state right afterwards that it persists until spring or even later).
- P4-L16: Reformulate: "is 20%, 30% and 60% at 700, 1000 and 1350 m a.s.l., respectively (Wahl et al., 2009)."
- P5-L3: Consider adding commas: "This, in turn, had a..."
- P6-L1: I think that the Vosges are plural in English, too. Hence, change "has never been" to "have never been"
- P6-L5: Consider changing to:
"was partitioned at its main ridge into two separate"
- P6-L6: Maybe use "official language" instead of "language"

- P6-L10: Consider using "data set" instead of "corpus"
- P6-L16/17: Simplify to "increased human activity in the"
- P6-L19: Change to "contributions, ranging from"
- P6-L27: Consider using "118" in figures.
- P7-L4: Change to "areas where past"
- P7-L7: Consider rephrasing: "All these (re)sources were sufficiently abundant..."
- P7-L12/13: Confusing, consider changing to:
"However, it was not always possible to..."
- P9-L24: Delete the second "only" at the end of the sentence (repetitive)
- P9-L27: Delete "therefore", it is not necessary
- P10-L1-2: Consider slightly changing to: "Over the whole period, more than 90% of all the 730 identified avalanches (682 events) could be specifically related..."
- P10-L7: Consider changing to "Locating the path of an avalanche was possible for 520 of the 730 events."
- P10-L7-9: A bit awkwardly put; consider:
"All others, except one, have been associated with a sector (geographical area of a few square kilometers in size in which several avalanche paths are located.)"
- P10-L9: Change to
"the characteristics of typical avalanche paths (Table 3). Its length ..."
- P10-L10: Here and below, use abbreviations "m" or "m a.s.l." for "meters"
- P10-L11: Change "forty meters" to "just under 40 m"
- P11-L5: Change to "... in the southern part of the massif in the High Vosges mountains (more than 95% of all events)."
- P11-L6/7: Consider changing to: "... are mainly oriented to the north east, east and the south east and, to a lesser extent, to the south."
- P11-L8: Consider changing to "...of cornices and subsequent avalanches mentioned above."
- P12-L4: Change to "almost always high intensity events (greater than 3 on the scale previously introduced; Table 2)."
- P12-L6: Change to "...difference between the pre-1990 records and the more complete recent records is that the number of recorded low intensity events (intensity less than or equal to three) drastically increased in the latter period (Fig. 6).

- P13-L10: Change to "...half of these have been"
- P15-L6: change "cubic meters" to "m³"
- P15-L11/12: Consider changing to:
"...apart from a few exceptions, avalanches did not occur in the valleys anymore in this most recent period.
- P15-L28: I am not sure what the authors mean by "net" (clear, considerable?).
- P16-L1/2: I guess the authors mean "between the period from the 1940s to the early 1990s and the period covering the 1990s to today"
- P16-L5: I suggest the use of "sub-periods" instead of "periods"
- P16-L5/6: Consider changing to:
"...based on the predominance of different types of (re)sources available during the entire study period (Fig. 7)."
- P16-L22: Change "exponential" to "considerable"
- P16-L25: Consider starting the sentence with "The" instead of "These"
- P16-L27: Instead of "...from when the registering of avalanches becomes more regular, a change linked..." consider using "...when avalanches were more regularly registered. This change is linked..."
- P16-L31: Change "this data" to "then" and change "a winter" to "per winter"
- P17-L9: Consider using "since" instead of "from"
- P17-L10: Instead of "whatever", consider "regardless of"
- P19-L8: Consider changing to "many small intensity events"
- P21-L1: Consider "The increase of visits partly explains..."
- P21-L9: Consider adding a reference: "...mid-twentieth century (Fig. 5B)..."
- P22-L9: Change to "...from persona, experiences..."
- P22-L11: Consider changing to: "this study was carried out in a" or "this study is associated to a"
- P22-L12: Delete "already"
- P22-L13: Instead of the "quality of the snow," I recommend to write "the characteristics of the snowpack," or "the structure of the snowpack,"
- P22-L19: Consider deleting "global"
- P22-L26: Delete "visible"
- P23-L6: Consider changing to: "The absence or scarcity of snow is..."
- P23-L21: Delete comma after "the analysis exploits"

P24-L26: Use a full stop instead of an exclamation mark

P25-L1: Change to "The reproduction of this type of..."