Dear Referee,
Thank you for your thoughtful comments, the time and effort towards improving our manuscript. We appreciate your comments on the figures.
We incorporated changes to reflect most of the suggestions you provided. Here is a point-by-point response to your comments and concerns.

As you wondered in your introductive commentary, this manuscript aims indeed to serves as a reference for describing the HIFAVa data set and its collection, further analyses are in progress. We completed the introduction to make this clearer.
In addition to the below comments, all spelling and grammatical errors pointed out have been corrected.

Abstract.

- **Comment 1:** *I suggest to streamline the beginning of the abstract, which is a little bit clumsy. Some examples:*
l. 24: suggest to specify "it"
l. 25: the "Alps that warm at a rate twice as high in the Northern Hemisphere" - although this will probably be understood correctly by informed readers, the statement itself is somewhat unclear

As suggested, we streamlined the abstract in order to make it more understandable. l.24 we specified "it" and we cleared the statement l.25. : "*In France, flooding is the most common and damaging natural hazard. Due to global warming floods are expected to globally exacerbate, and could be even more pronounced in the European Alps as the temperatures have been rising at a rate almost twice as high as the average in the Northern Hemisphere since the beginning of the 20th century. To approach long-term evolutions of past flood occurrence and related socio-economic impacts in relation to changes in the flood risk components (i.e. hazard, exposure and vulnerability), the study of historical records is highly relevant, especially in the context of the a densely populated area gathering at stake human and economic activities."*

Introduction.

- **Comment 2:** *l.118: I suggest to be more precise as far as the "first database documenting a mountainous catchment" is concerned. There are definitely databases on historic flooding and debris flows in other countries in the European Alps, including Switzerland, Austria and Italy. These do comprise natural hazard events on a catchment level, and some have been linked to exposure and mitigation (e.g. https://doi.org/10.1016/j.crm.2021.100294 for torrential flooding; https://doi.org/10.1016/j.gloenvcha.2020.102149 for avalanches), therefore effectively covering the "interactions between social and natural dynamics engendering flood impacts".*

Thank you for your reading recommendations that are very relevant to our study. To reply to your comment, we would like to point out that the specificity of this database is that it was developed from the historical impacts identified during the research in the archives, it is a collection of societal markers of the effects of floods. Most databases are built from hydrological data. However, we reworded this sentence: *"The study of this database ultimately aims at analyzing the interactions between social and natural dynamics engendering flood impacts. In this paper describes the HIFAVa data set and its collection."*

- **Comment 3:** *The term "impact" is a core concept throughout the manuscript. I think a clear definition on what an "impact" actually comprises would be helpful (either in the introduction or in section 3). This is somewhat hidden in section 3.3, I suggest to state this more clearly earlier on.*

We agree. By "impact" we mean any disturbance caused by a flood that has been reported in the varied historical sources available over the extend of the studied period. It can be the flooding of a field, the cutting of a communication route (footbridge, road etc.), the destruction of a building or victims.
An impact entry does not always represent an isolated damage, but can sometimes group together several imprecisely described and uncountable damages of different nature. When the source is not accurate enough to distinguish distinct locations of several impacts, they are all referenced under a unique entry.
We have added a definition in the introduction: L.70. "*The impacts recorded in the database can include any types of human goods that has been damaged by the inundation, like a field, a communication route or a building for example.*"

Study area.

- **Comment 4:** *Figure 1: Please rework the elevation legend. This is a continuous scale and should be presented as such. If a discrete scale is used, intervals need to be reported and not scalar values. Which color does an elevation of say 1000 m a.s.l. correspond to? Is it green or yellow, or something in between? In addition, I would advise to use prettier breaks, and not 401 - 1401 - 2902 - 4810, which seems somewhat arbitrary. The color of the Arve river in the legend does not correspond to the color in the map.*

We agree with this comment and modified the figure accordingly by using a continuous scale in grey shades to ensure the legibility of the other layers of information. We also changed the color of the Arve river to make it more discernible.

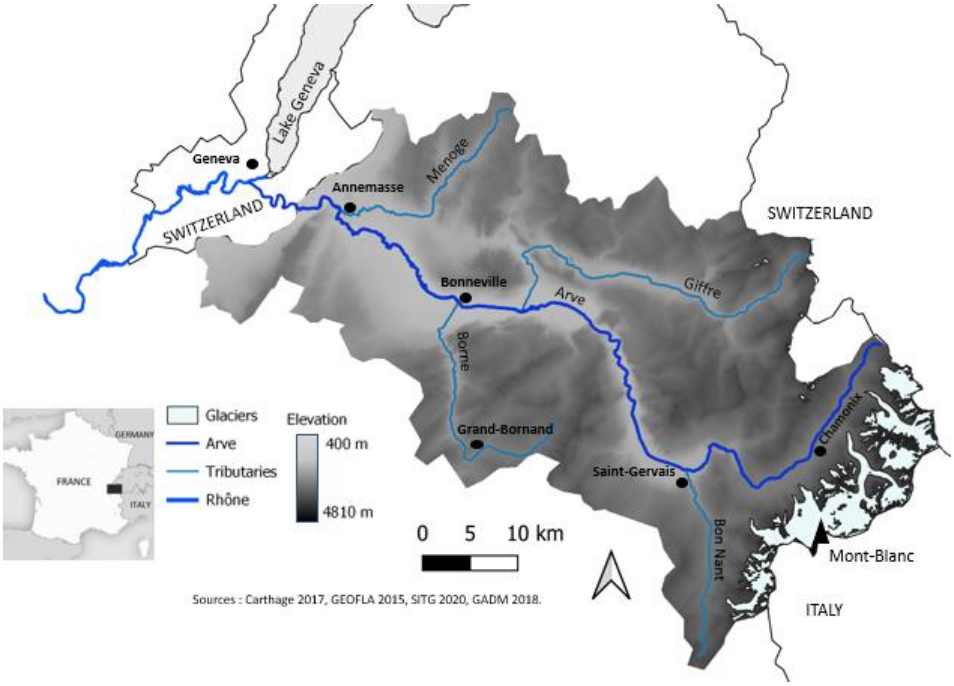


Figure 1. The Arve catchment topography with the primary tributaries and the main cities.

Materials and methods.

- **Comment 5:** *l. 254: ... can not be estimated by ...*

It was corrected.

- **Comment 6:** *l. 255/256: "The most recent sources are often highly informative, allowing impacts to be more precisely located"*

Since 1930, there has been an increase in the number of impacts that can be localized at the scale of a building (e.g. a campground in 2009) or a neighborhood. At the same time, we see a decrease in impacts that could only be localized at the commune level.

- **Comment 7:** l. 285ff: This statement belongs to the "Outlook" section.

We agree with this and incorporated this statement to the “Outlook” section (l. 530).

Results and discussion.

- **Comment 8:** *Figure 2: The caption could be more informative. I assume that ticks indicate mentions, and the shaded area displays cumulative mentions, but this is somewhat speculative.*

Please find below the modified caption.

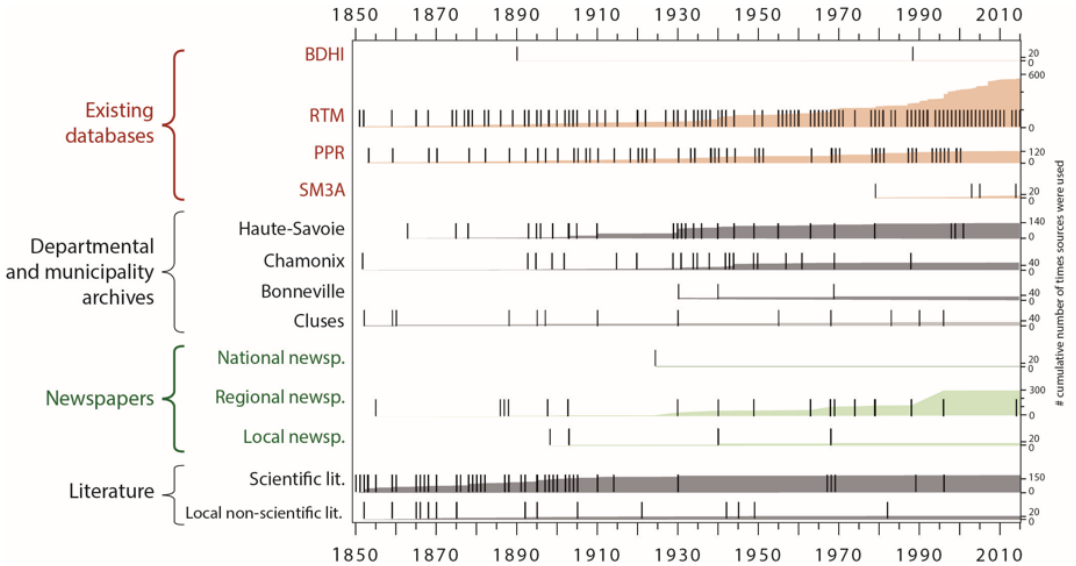


Figure 2. Number and diversity of studied sources to document flood impacts since 1850 in the Arve Valley. The ticks indicate the mentions and the shaded area display cumulative mentions of studied sources.

- **Comment 9:** *Figure 3: I suggest to rework this plot completely. First of all, using x-axis ticks would be helpful here. The dense number of x-axis labels does not help, since single bars are difficult to assign to specific years. Also, the second y-axis is confusing for two reasons. First, a transformation between the two y-axis of f(x) = 0.266666 * x has been used; consequently only 8 and 16 share a common y-grid line with the primary axis. All other labels float around somehow. Secondly, I do not understand why moving averages (especially for the impacts) were put on a secondary axis. Plotting data and a smoothed version of the very same data on different scales in not intuitive.*

The advantage of moving averages is that they allow to see the trend of impacts and events, which is not possible with bars. Combining the two forms of data allows us to see that in certain years peaks in the number of impacts are recorded. We can see that these years start in 1920 and increase thereafter. We choose to indicate the years with more than 25 annual recorded impacts.

If the moving averages were drawn on the left y-axis, the amplitude of the variation would be too small to be clearly visible. Hence, having two scales for the y-axis made the moving average of events makes the figure more readable.

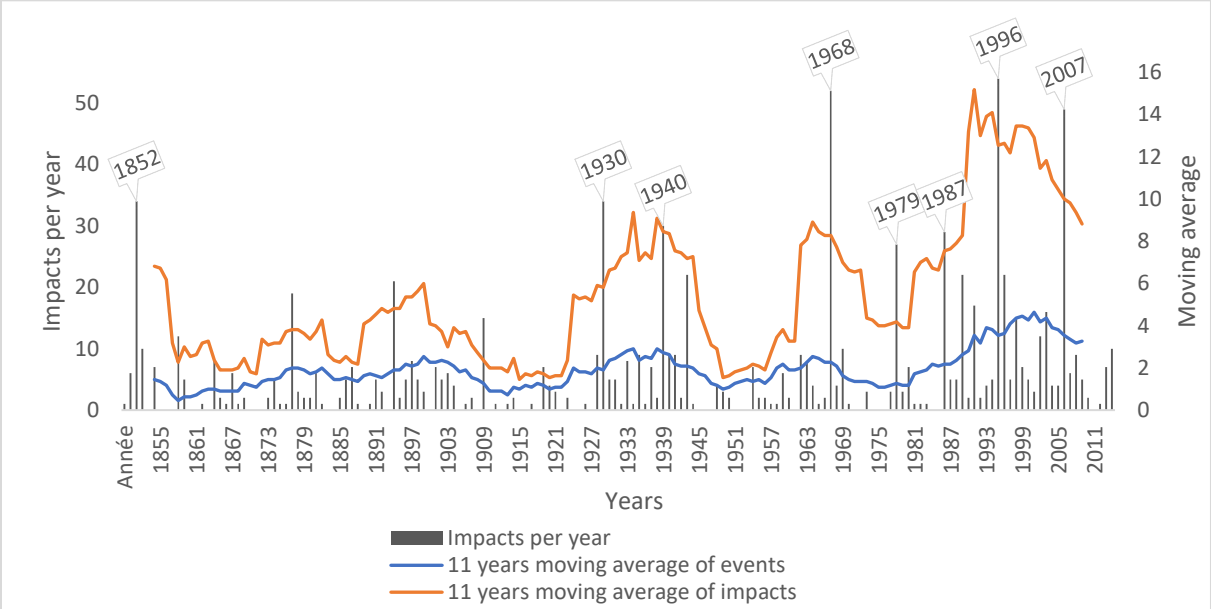


Figure 3. Representation of the yearly occurrence of impacts – as well as years with more than 25 recorded impacts – and decennial moving averages of impacts and associated flood events."

- **Comment 10:** *Figure 4: You could use some alpha/transparency for plotting the location of the impacts. Also, the very colorful background makes it somewhat difficult to discern the different colors. Personally, I find simple bar plots to be easier understandable than bar plots in polar coordinates (i.e. pie charts). Also, point types to not match (circles on the map, ellipses in the legend).*

As suggested, we modified the legend, the background and the chart in order to make it more legible. We couldn't play with transparency much because it made it difficult to discern the impacts. That's why we choose a plain gray background.

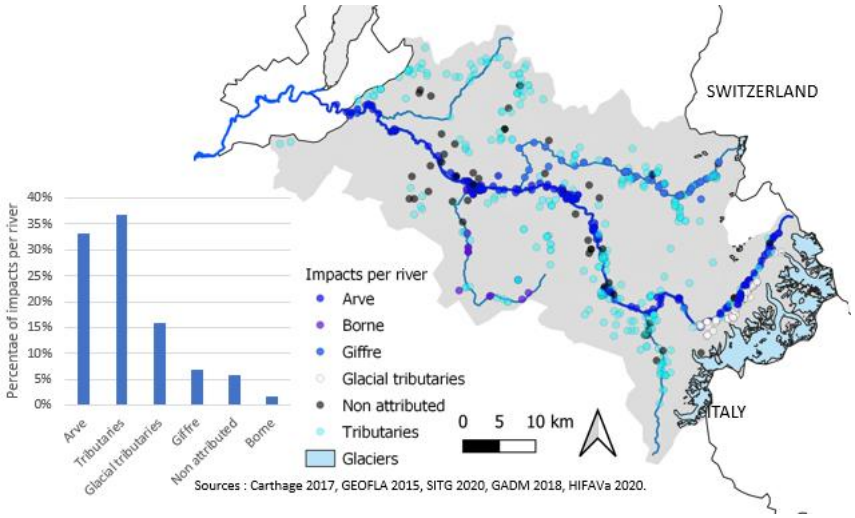


Figure 4. Location and distribution of flood impacts caused by the Arve river and its tributaries. The category "non-attributed" corresponds to the impacts for which it was not possible to attribute a river, either because events are related to overland flows or because the source did not mention the river.

- **Comment 11:** *l.378: The authors write that "The increase in the number of impacts starting in the 1920's and well-marked from the 1960's can be explained by multiple factors such as indirect source effect, increasing flood activity and/or increasing exposure of goods and people." It is hypothesized that this is attributable to increased exposure or the evolution of data sources, but there is no proof for these statements. One core aspect I am somewhat missing in the discussion here is the completeness of the database. It has been shown that underreporting of events is likely in the time period up to the end of WWII. Has this been taken into account, or is the dataset simply assumed to be complete?*

We agree with this, these are indeed assumptions that we question in this article. We modified this statement: "*The increase in the number of impacts starting in the 1920's and well-marked from the 1960's could be explained by multiple factors. We examined three hypotheses: an increase in flood activity, an indirect source effect and an increase in exposure of goods and people*."
Indeed, the question of completeness is always a problem concerning databases. Historical periods, such as wars, can lead to a loss of information. However, since we are interested in societal impacts, if the impacts of a flood are not reported, we considered the impact on society to be negligible since it was not recorded. This database is not intended to be a complete flood record. It apprehends the floods through the lenses of the communities' perception and values at the time it was reported. We modified the statement l. 314 to l. 317 : "*Although very few sources (e.g. the municipal archives of Sallanches) still need to be examined, most of the main sources (newspapers, existing databases and public archives) have been analyzed in order to constitute the database. We believe that this spectrum of multiple sources ensures that no event that was deemed damageable by local communities was missed. Hence, we consider that we have a comprehensive view of past flood impacts since 1850 over the whole Arve catchment*."

- **Comment 12:** *l.381: "Therefore, the increase in impacts cannot be explained by changes in flood occurrence, at least prior to 1990." This is an interesting finding, that of course needs to be discussed. The authors provide some explanations in the following paragraphs. However, I find these paragraphs a little bit difficult to follow. I think this section needs to be reworked with a focus on clarity, e.g. by providing a table detailing the sources per period for easier comparison, or providing some sort of visual emphasis on the main lines of thought here.*

Ultimately, upon reading the paper I am not sure where these observed trends in impacts do come from?

As suggested, we rearranged the section 4.3. in order to make it clearer. Initial analyses of the database show an increase in the number of impacts since the 1920s (Figure 3). In this paper we investigate three hypotheses that could explain the increase in the number of impacts recorded in the database. The first one is an increase in flood activity. However, the occurrence of event responsible for impacts did not change significantly before the 1990's (Figure 3). The second hypothesis in an indirect source effect. The Figures 2 and 5 illustrate the strong emergence of the RTM. The third hypothesis is an increase in exposure, due to significant population growth.

We list our hypothesis and then present each of them.

"*The increase in the number of impacts starting in the 1920's and 1960's could be explained by multiple factors. We examined three hypotheses: an increase in flood activity, an indirect source effect and an increase in exposure of goods and people.*

The hypothesis of an increase in flood activity cannot explain the increase in impacts at least prior to 1990 (Figure 3). In fact, the occurrence of event responsible for impacts did not change significantly before the 1990's.

To decipher the potential source effect in the increase in impacts since 1960, maps of the impacts by sources have been drawn for the periods before and after 1960 (Figure 5). For the first period (1850-1959), three main sources describe 64% of the impacts (literary records 28%, RTM 18% and departmental and municipal archives 18%) and for 29% the information comes from more than one source. The impacts are mainly gathered along the Arve and the Giffre Rivers, especially in the valley of Chamonix and between the towns of Cluses and Bonneville.

For the second period (1960-2015), the RTM reports 65% of the impacts, and 20% come from multiple sources while departmental and municipal archives and the PPR/PPRI describe 5% each. Information coming only from literature decreases substantially (122 described impacts in the first period to 3 impacts in the second), SM3A records start in 1979 and only document the Giffre and the Bon Nant Rivers. The distribution of the impacts is much more scattered across the whole catchment than during the first period. The impacts are not gathered along the Arve River, since most of them result from small tributaries. Impacts described by more than one source are located in the valley of Chamonix and around Bonneville, probably because these economic and tourist centers arouse interest of many sources (newspapers, departmental and municipal archives and RTM). In addition, the strong emergence of the RTM since 1940 (Figure 2) can explain the rise in impacts caused by small tributaries as illustrated by Figure 5. Following the floods of the Rhône, the Loire and the Garonne in 1854, the 1858 law against urban flooding places flood control at the heart of the national legislation for the first time. In the following, the RTM department was formed for the reforestation of mountains slope in order to prevent the reproduction of major floods. The department became quickly efficient and since 1860 collected numerous reports. Built for the study and management of small tributaries, the RTM database became the main source of information since 1930 for the HIFAVa database.

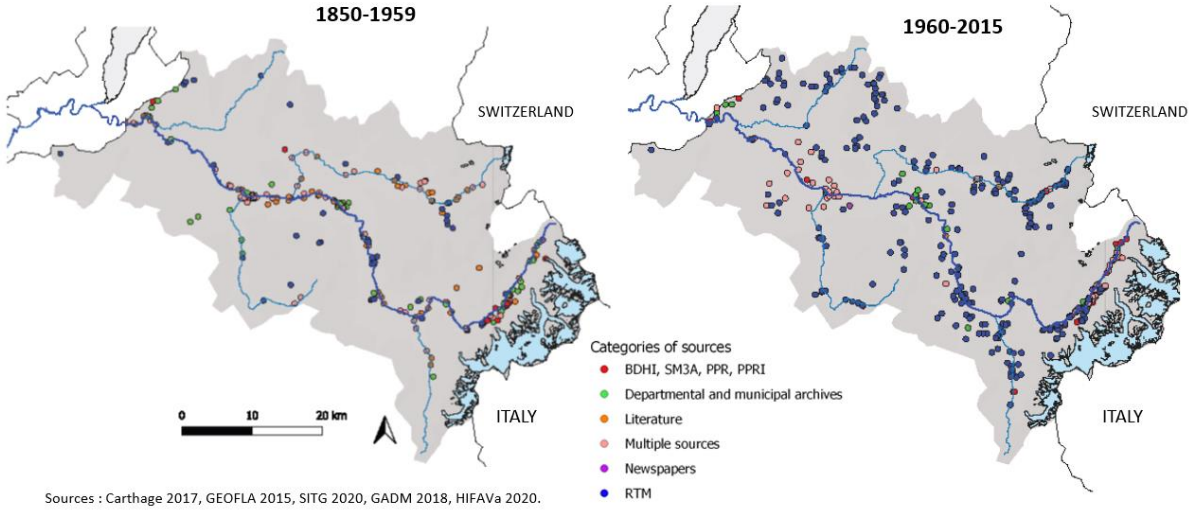


Figure 5. Comparison of the distribution of the sources describing the recorded flood impacts in the Ave catchment during two periods: 1850-1959 and 1960-2015.

The rise in the number of impacts per flood may be partly explained by the fact that distinct impact types in the same location were reported and therefore referenced under distinct impact ID, while they were not differentiated in previous periods. Recent sources seem to provide more accurate information on the impacts and their locations. In older sources, impacts are most of the time documented at the city scale (21% of the impacts for the first period, and 10% for the second period). Thereby, all these impacts are stored in the database in a single line with an uncertainty code for the impact location corresponding to the municipal level. In most recent sources, impacts' locations are described more accurately allowing them to record at a resolution up to the building scale. As a result, impacts are stored in as many lines as impacts locations can be identified, with an uncertainty code for the impact's location corresponding to the building or neighborhood level (85% of the impacts for the second period). For example, in 1996 fifty-three impacts where recorded for same event and fifty of them where located in distinct places in Chamonix. The rise in impacts can also be due to numerous impacts in different locations, as the flood of 1990 which impacted six towns in two different sub-catchments (the Arve and the Giffre catchments). However, in order to overcome the bias induced by the recording of impacts according to their location, we aggregated the impacts at the municipality level. That is to say, all the impacts reported for a given municipality that were caused by the same event (thus the same day) are recorded under the same line in the database. This results in 562 "aggregated" impacts instead of 917 impacts initially. From these data, we have redrawn Figure 3 (Figure A2) comparing the moving average of impacts and associated events. We see that the trends of increasing impacts are comparable. There is an increase of impacts (here starting soon as 1890s) and a late increase of events (1990s). Thus, the way the impacts are stored in the database (by location or by municipality) does not affect the observed temporal changes in impacts.

Changes in exposure and vulnerability related to land use is another potential explanation of the rise in the number of impacts (Magnan et al., 2012; Garnier and Desarthe, 2013; Camuffo et al., 2020). Major population growth happened, especially in Bonneville and Chamonix, leading to a strong and fast urban sprawl in the flood plain between the 1950's and the 2010's as shown by aerial photographs (Figure 6). They also show the vanishing of the alluvial forest (Dufour and Piégay, 2006) and cultivated fields to the benefit of urbanization in both towns. The population growth in the Arve Valley varies according to the towns. Upstream, in Chamonix, the demographic expansion dates back

to the early 20th century with the flourish of mountain tourism. In downstream towns – e.g. Bonneville and Annemasse – the expansion starts in the 1950's because of the economic attractiveness of Geneva.

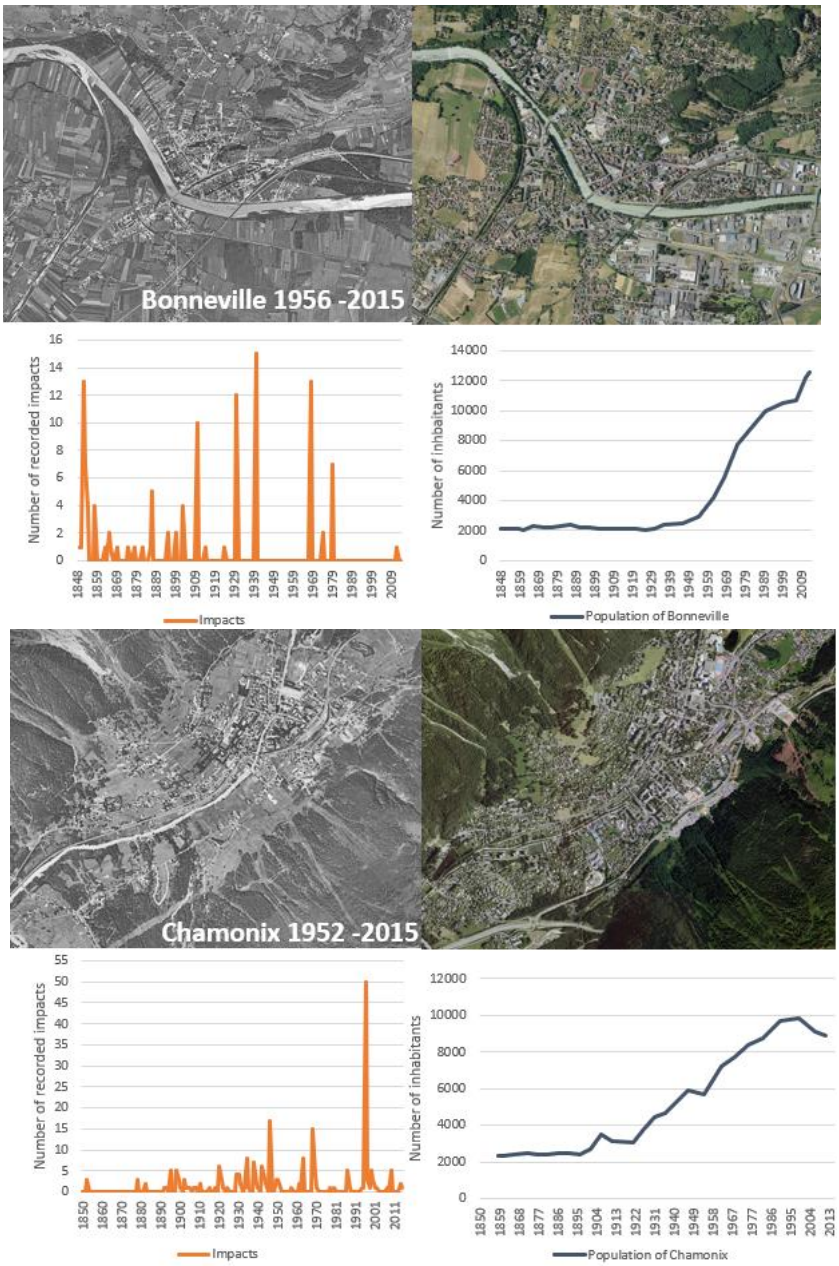
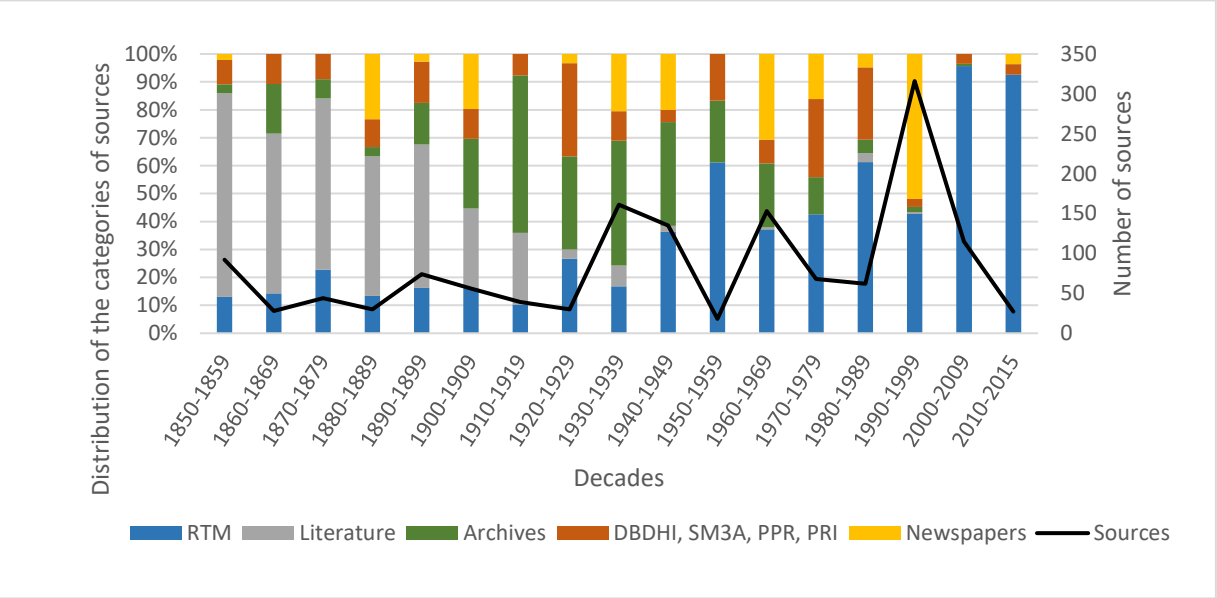


Figure 6. Aerial photographs allowing to visualize the evolution of the land use and the urban sprawl growth in Chamonix and Bonneville – completed by the representation of the impacts and the growth of the population from 1848 to 2011 (© IGN).

Besides these numbers, the urban expansion and the growth in tourism come with the arrival of new residents in the valley (Haute-Savoie : la plus forte croissance démographique de métropole, 2020), unaware of the local hazard history. The valley narrowness, the demand for land and the loss of memory of past events have led to build in historical flood-prone areas, resulting in an increased exposure. For instance, in 1944 recently built houses in Chamonix were washed away by the Grépon River. The same situation also happened during the 1968 flood that destroyed a new residential area in Bonneville. In Chamonix, the number of impacts punctually increase from year to year, somehow mirroring the population growth (Figure 6). Increasing exposure due to population growth and

urbanization may then explain the increasing number of impacts. One can, however, notice the decrease in impacts after the disastrous 1996 flood event. This is due to the heightening of the dikes after the 1996 flood. In Bonneville, the link between the number of impacts and the population growth is not clear.
The three hypotheses studied are not excluding one another, but can be combined and complement each other."

We realized a figure detailing the sources per periods. The figure illustrates clearly the strong emergence of the RTM. It would be provided as supplementary materials to complement the section 4.1.



Decennial histogram of the categories of sources registered in the HIFAVa database.

- **Comment 13:** *l.400: "We can assume that, floods are more likely to be reported in newspapers as when they happen in a location known by the reader." Could the authors elaborate this? I would assume that this does not affect events of a certain magnitude?*

The notion of risk is subjective and its representation varies greatly from one individual to another. We hypothesize that one is more likely to be interested in places that he/she is attached to because it is or has been his/her place of residence or leisure practices. The Arve Valley, especially Chamonix, has been a touristic and famous destination since the middle of the 18th century. Therefore, it is possible that events which take place in the upper Arve valley receive more media covered because it is supposed to attract the attention of a larger audience.
However, we made the choice to delete this passage for more clarity.

- **Comment 14:** *l.403: illustrated by Figure 5.*

The sentence was corrected accordingly.

- **Comment 15:** *Figure 5: See comments on Figure 4. The colors of the sources are even more difficult to spot here, due to the colorful background. I suggest to use a more neutral background, the important information is contained in the points, not in the elevation.*

As suggested, we modified the background in order to make it more legible.

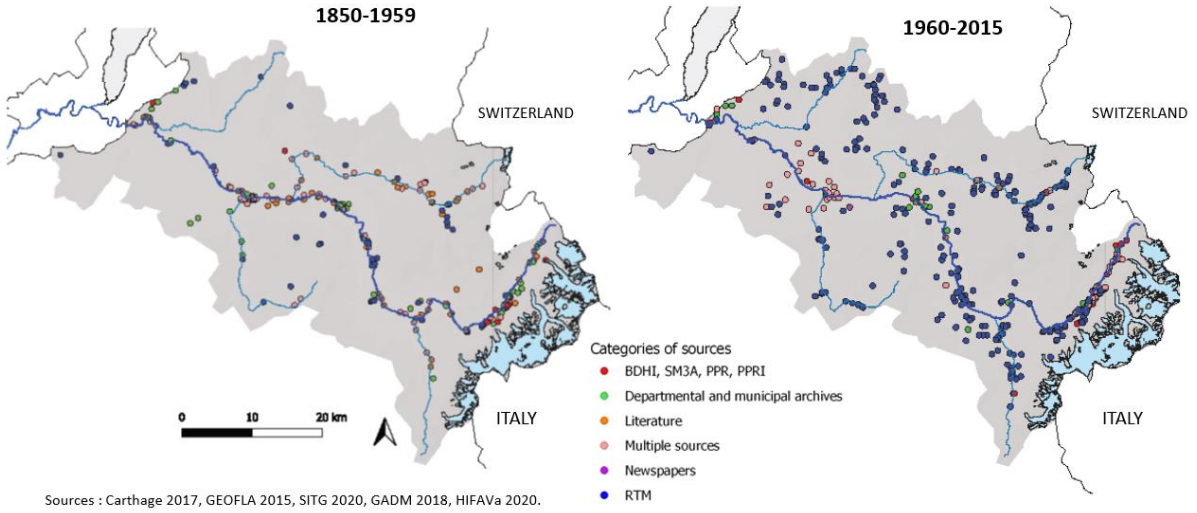


Figure 5. Comparison of the distribution of sources describing the recorded flood impacts in the Arve catchment during two periods: 1850-1959 and 1960-2015.

- **Comment 16:** *l.435: "We can see that the trends are significantly the same." Apart from the fact that trends can only be significantly different, but not significantly the same (from a statistical point of view), I would like to point out here that - naturally - impacts and events show a higher correlation in the Figure from Appendix 4 than in Figure 3.*

Thank you for pointing out this blunder: "*We see that the trends of increasing impacts are comparable*." Indeed, the representation of impacted municipalities (Appendix Figure A2) shows a higher correlation between the moving averages of impacts (impacted municipalities) and events.

- **Comment 17:** *l.440: Changes in exposure and vulnerability are only briefly (basically 1 paragraph) discussed in a qualitative way. I assume that data for providing a more detailed assessment of this line of thought is not available?*

Thank you for this suggestion, that we hope to explore in further analyses. A possibility would be for example to analyze the evolution of land use from the study of aerial photographs. However, this is another story and a complete paper could be dedicated to this subject. This paper aims to describe the HIFAVa data set and its collection.

- **Comment 18:** *Figure 6: top right: again, secondary y-axis is somewhat difficult to read, as 0:120000 is mapped to 0:7. I am not really convinced by these plots with secondary y-axis, especially since there is no natural relationship between these two data sources. The right axis can be plotted from 0:6 (spreading the range from a visual point of view) or from 0:12 (squishing the impacts in relation to the population count), but I am not sure which would be the more "correct" one. At least, I suggest to match the color of the y-axis to the line color.*

In order to make the graphs easier to read, we modified the figure to show the population curve and the recorded impacts curve on two different graphs.

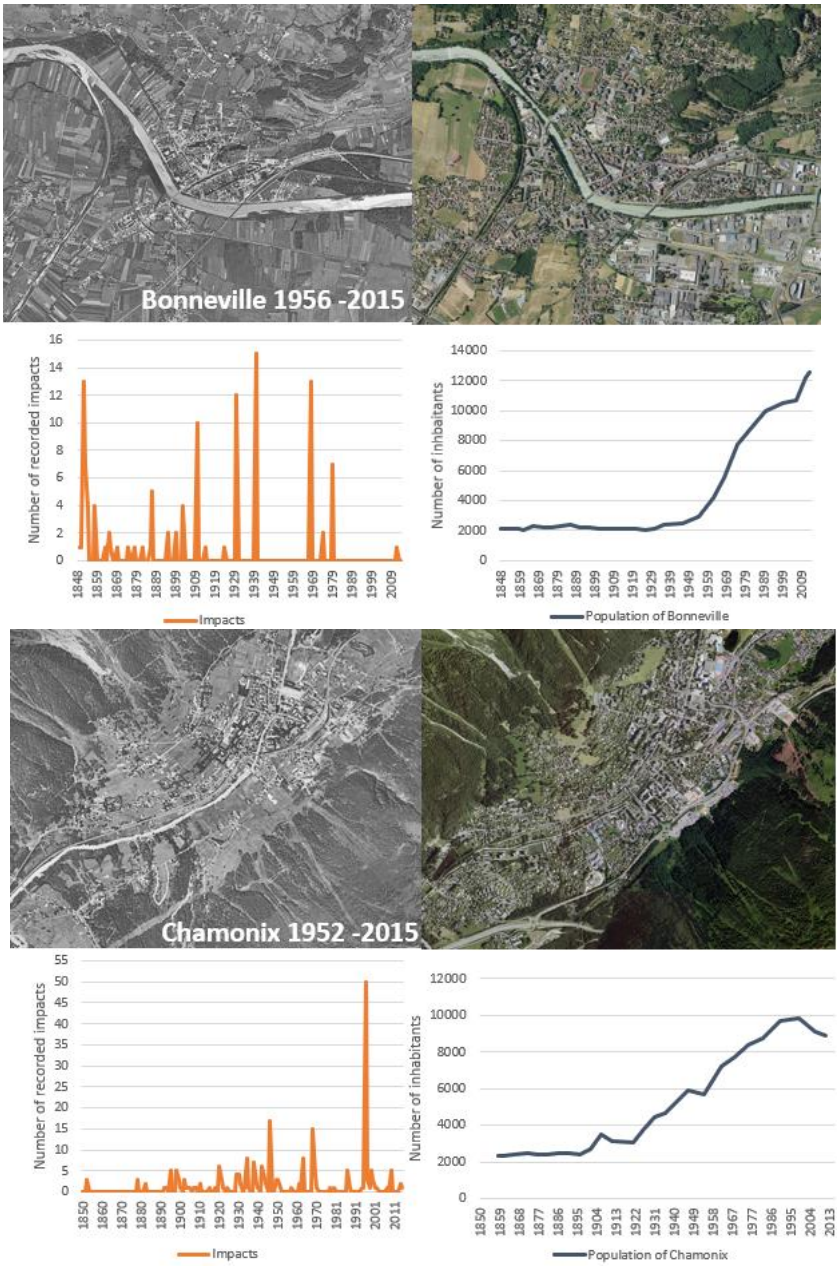


Figure 6. Aerial photographs allowing to visualize the evolution of the land use and the urban sprawl growth in Chamonix and Bonneville – completed by the representation of the impacts and the growth of the population from 1848 to 2011 (© IGN).

- **Comment 19:** *l.475: "...height are only mentioned in rare cases."*

The sentence was corrected accordingly.

- **Comment 20:** *l.481: "Impacts on industrial facilities"*

The sentence was corrected accordingly.

- **Comment 21:** Figure 7: Suggest to try a mosaic plot for visualizing these data.

Thank you for your proposal to transform the graphic into a mosaic plot. Unfortunately, the distribution of impacts by river does not allow the data to be presented in this manner. Indeed, the distribution of impacts by river is not homogeneous: the Borne River represents only 2% of the total number of impacts recorded in the database, whereas the 'Tributaries' category accounts for 53% of the impacts. The representation in mosaic plot would not allow to distinguish the rivers with a few percentage of recorded impacts.
However, we reworked the figure to make it more readable: the river categories are presented in descending order from left to right and the y-axes have been inverted so that the one on the left shows the impacts categories distribution. This facilitates reading. In addition, we pointed out in the text of the article (l.480) that the Giffre and Borne rivers had proportionally very few impacts recorded compared to the Arve or the 'Tributaries' category. "*However, when analyzing the distribution of impact categories (Figure 7), it should be kept in mind that the Borne and Giffre rivers represent respectively only 2% and 7% of the impacts recorded in the database.*"

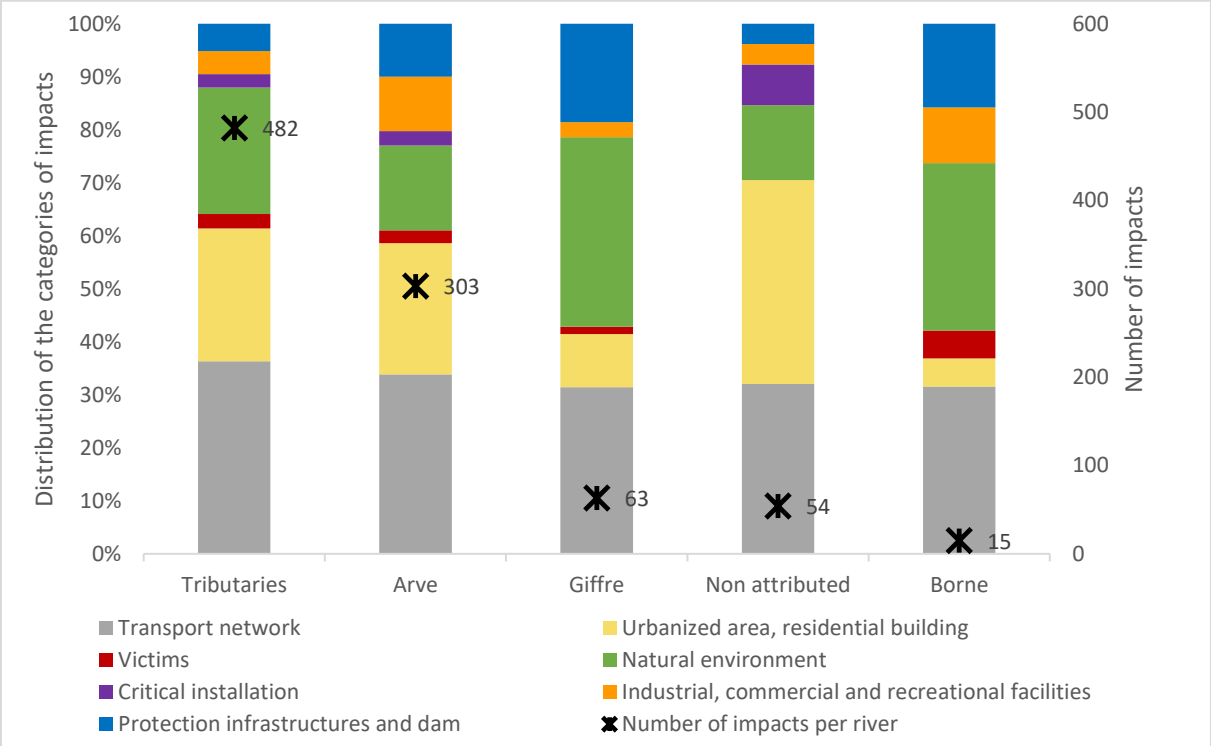


Figure 7. Distribution of flood impacts categories according to the river types. The class "non attributed" correspond to all impact with no assigned river (e.g. overland flows).

- **Comment 22:** *l.507: The categories used for the analysis*

The sentence was corrected accordingly.

- **Comment 23:** *l.509: Please clarify what "evolution of the assigned words" means.*

We mean that it is possible that there is an evolution of the lexicon used. That is to say that the same category can be composed of several words. It is possible that the proportion of each of these words evolves with time. We have not yet analyzed this topic in more detail.

- **Comment 24:** *Figure 8: Histograms usually do not have whitespace between the bars, as they represent continuous variables. Also, I suggest to work on the colors, as impacts have a similar color as victims, and events have a similar color as protection infrastructure.*

Thank you for your comment, we modified the display of the histogram and the colors of the curves.

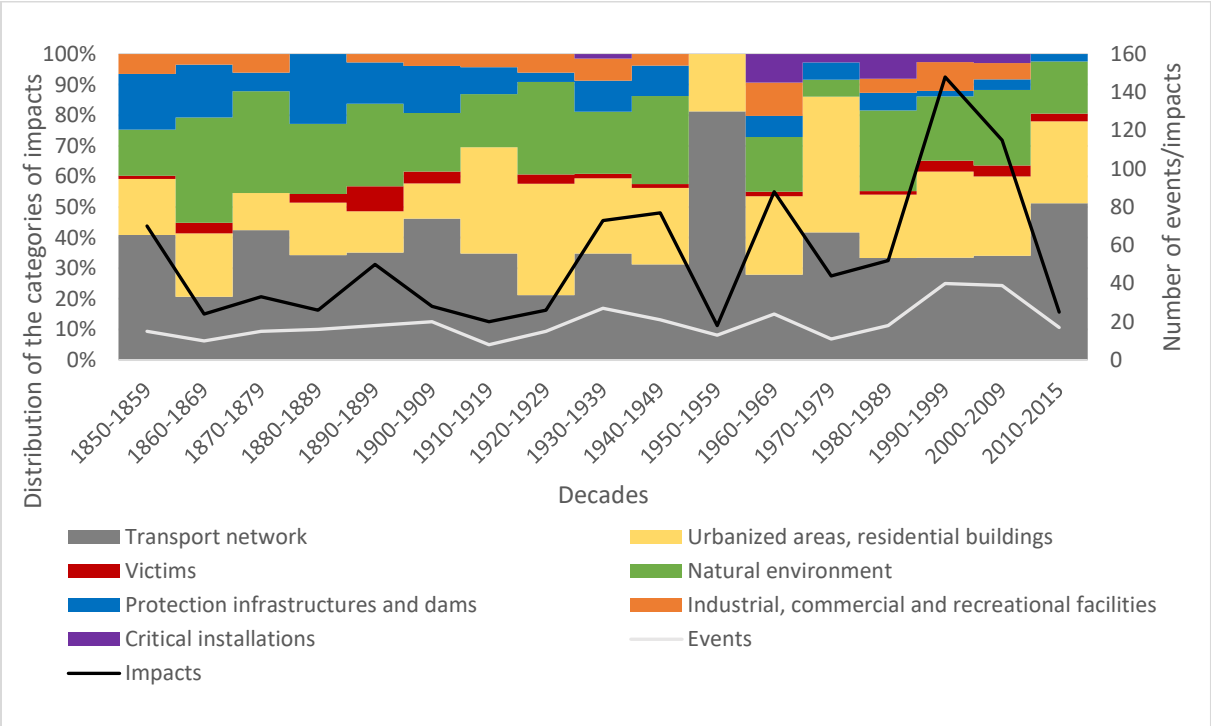


Figure 8. Decennial histogram of the evolution of the categories of impacts divided by the number of events.

- **Comment 25:** *l.515: hinders: do you mean hides? covers? conceals?*

We meant “hides”. We modified the sentence.

- **Comment 26:** *l.517: what is meant by "(16 out of 28)"? I assume an increase from 16 to 28, and not the proportion 16/28 of something? Please clarify.*

We meant that from 1850 to 2015 there are 28 mentions of victims, and 16 mentions are after 1980. This means that there has been an increase in casualty mentions since 1980. We modified the sentence to be clearer. “*For instance, at the catchment scale there is a slight increase in the number of mentions of the victims category since 1980. In fact, during the studied period (1850-2015) there are 28 mentions of victims and 16 of them are recorded after 1980.”*

- **Comment 27:** *l.515-520: I do not fully understand the point the authors try to make here. The "slight increase" (which could also be considered as a not-so-slight increase of 75%) is hardly visible in the plot, because the share of the "victims" category is quite small altogether? This is a rather trivial observation, and in fact just a matter of data presentation.*

The increase is hardly noticeable because there is a strong augmentation in the total number of mentions of impacts since 1930. This increase in casualties is ultimately flooded by the overall increase in the total number of impact mentions.

Conclusion.

- **Comment 28:** *Again, the authors take up the hypothesis that the observed increase in impacts could be explained by exposure and evolution of sources. While I tend to agree in principle, I would like to emphasize that this is not really shown in the paper, but remains a hypothesis. Other aspects such as mitigation measures (either technical ones or soft measures such as awareness raising) are not considered. The effects of data completeness (i.e. underreporting in the earlier years of the time period), effects of exposure and land-use are not investigated in detail.*

This manuscript aims to serves as a reference for describing the HIFAVa data set and its collection, further analyses are in progress. It also allows the presentation of research hypotheses that will be more instigated later on.