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Reply on RC2

Hossein Hamidifar and Michael Nones

Author comment on "Global to regional overview of floods fatality: the 1951–2020 period"
by Hossein Hamidifar and Michael Nones, Nat. Hazards Earth Syst. Sci. Discuss.,
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Dear Reviewer,

We would like to thank you very much for your comments, which were very helpful to better structure our manuscript, and to drive the key messages. In the revised version we addressed all your comments in detail, trying to combine your feedback with the hints coming from the other reviewer. Our point-by-point answers can be found in the following, where we numbered the reviewer's comments using the format *R2Cn*, with *n* indicating the comment's number.

R2C1: The source of data the authors used is available at global scale, and it is a good point, but it can't be considered a comprehensive overview of the impact that floods produce to the population for most of the countries. The very frequent but less disastrous fatal flood events occurring every year anywhere in the world were not recorded in EM-DAT since the difficulty in capturing the information does not allow the minor events to be recorded. We do not know how much these minor events cumulatively amount to. Moreover, the EMDAT casualties estimates are not always consistent with those available in other sources and, frequently, these estimates include among the flood fatalities those due for other factors. The authors do not at all discuss the problem of the estimates uncertainty and how it might affect their results.

Thanks for the comment and suggestions. We have emphasized this at the end of the Conclusions as a limitation of our study. It is stated there that: "It is worth note that the presented conclusions derive from a single database, and are therefore influenced by the data availability and the uncertainty of the collected information. Future studies will concentrate on integrating information coming from multiple databases, aiming to obtain more structured and event-based outcomes. Moreover, a comparison between different datasets will allow for gaining major insights in the data uncertainty (namely, differences between the datasets) and its sources."

It should also be noted that EM-DAT adopts a recognized ranking method to select sources for flood disaster statistics, combining data from the United Nations, governmental and non-governmental agencies, insurance companies, research institutes and press agencies[1]. We revised the text to better pinpoint this approach.

R2C2: I wonder if it makes sense to compare data on flood fatalities on a global scale when the geographical, demographic, social and economic characteristics of different nations are so profoundly different. Can the GDP as unique parameter explain the relation between the flood fatalities and the effort done to increase knowledge and technologies to mitigate the effects of flood events? Maybe the authors should consider additional socio-economic parameters and assess, for example, the social vulnerability of the single countries. I can support the authors in considering administrative limits as important in calculating true fatality coefficient of floods in order to compare them with each other. But this is true only in relation to the economic and political conditions of each country and how government choices can affect flood risk management. However, the administrative limits have nothing to do with the risk zoning where the people, who are most at risk, live. How did the data were spatialized? I bring this question to the attention of the authors since the distribution of the population within very large countries cannot weigh as much as the distribution of smaller ones, where the average density is approximately equal throughout the national territory. Have they considered this aspect? to strengthen the work, it could be helpful the estimation the real number of the population exposed to risk using, for example, the dasimetric maps.

English translation.

Thank you very much for the comments. We revised the text to further detail the study goals and to avoid misunderstandings, as well as improved significantly the Discussion section to compare our work with past investigations.

While it is true that floods fatalities are functions of several parameters, the individual participation of these unique parameters on floods fatalities is not yet clear. For example, a previous study has shown that mortality varies by region, but the expectation that floods in areas with lower living standards will cause higher mortality cannot be supported [2].

As one of the goals of the current study is to visualize the trend of variations of floods fatalities over a 70-years period, and keeping in mind the fact that there is not much information available for the early floods in the studied period, GDP was selected as an indicator. Obviously, more studies considering additional indicators should be done to provide a comprehensive picture of floods fatalities.

Although the authors agree with the reviewer that the population is not uniformly distributed in different countries, studying changes in population density and its impact on flood damages was not among the objectives of the current study. Even though investigating the effect of population density can increase the accuracy of the indicators presented in the present study, the application of these challenges may be difficult from a managerial point of view.

R2C3: To compare the human losses caused by floods in the different countries, the authors firstly used the fatality coefficient of floods calculated by dividing the total number of death tolls by the number of flood events for each country. I cannot understand if they calculated this coefficient year by year (for the 70-year period) and then they used the average in the long period, or if they simply divided the total number of fatalities by the total number of fatal event.

Only one coefficient was calculated for the entire range of the years studied. We revised the text to clarify this concept.

R2C4: This consideration points to my second comment concerning the meaning of disastrous event. How can we define disastrous an event at global scale without considering at least the different country population density? Is It possible to quantitatively define "disastrous" merely with the number of fatalities for event, and is this parameter actually useful for comparing data across countries of different size and population density? To define a disastrous event the authors could make a greater effort and estimate a moving threshold, weighed both on the number of victims per event and on the population density.

As mentioned in the text, "... flood casualties in the category of fewer than 10 people include a small part (less than 0.2%) of the total casualties, and therefore, in the present study, this category of data is not considered in the analysis." Also, the selection of disastrous flood events with more than a specific number of deaths in flood fatalities analysis is not a new idea and was reported in previous studies, so we based our approach on literature evidence to allow for comparison. For example, Gaume et al. (2016) analyzed disastrous flash flood events with more than 10 deaths to find a general pattern of the spatial and seasonal distribution of flood magnitudes over the Mediterranean region [3]. In 2006, Barredo assessed information on major flood disasters producing more than 70 casualties for the production of the map and catalogue of major flood disasters in Europe [4]. Also, according to Merz et al. (2021), flood events can be considered disastrous when they are included in EM-DAT [5].

We revised the text considering your feedback, and tried to clarify our approach.

R2C5: Even if the authors attempted to consider the population density and the number of events per unit area (plots in figure 10), it is not clear if they have used the population data by nation and year by year and if the relation they found has changed in time, or if they have counted only the average in the long period. To overcome this weakness, the authors could calculate for the investigated period (1951–2020) the average mortality rates - at nation level - which are given by the number of fatalities recorded every year in a single nation, scaled to the size of the population in the related period of time. The mortality rate is normally used to compare the impact on the population of technological, health and even natural hazards. The authors could rank the nations on the basis of the mortality rates. They should use the annual population data for each country for the 70-year period. If the annual data are not available for the long period, they could reduce the time period.

The authors would like to thank the reviewer for pointing out this issue.

Obviously, the population of every country is not constant and changes with time. As we used the cumulative number of fatalities, the population of each country at the end of the study period, as the reference year, was used in both Figure 9 and Figure 10. However, the temporal variations of the number of fatalities and flood events on a global scale are provided in Figure 7.

As the focus of the present study is a global to regional overview of floods fatality, investigating changes in the number of fatalities and the number of flood events in each of the world' countries individually was outside the objectives of the present study. We revised the text to clarify this, and expanded the Discussion considering your precious feedback.

R2C6: In the discussion section the authors state that reducing flood will reduce the number of fatalities. This is conceptually wrong. It is possible reducing the impact, the losses and the intensity of a flood events, with structural and non-structural mitigation measures, but not the number of the physical processes, since it is due to the combination of many physical variables, firstly the rainfall intensity.

It seems that a misunderstanding happened here. Our purpose was not to reduce rainfall, as we are completely aware that natural phenomena cannot be changed. When rainfall occurs, some of the rainwater flows as runoff and can lead to flooding. If action is taken to reduce runoff, it could be eventually possible to prevent the river flow from increasing too much, so that it does not exit the main channel and overflow the floodplains. There are many solutions to this issue and some examples were given in the text. Following your comments, we revised the text clarifying our idea.

R2C7: I would also like to point out the lack of thoroughness description in the way the authors present their results and outputs. The plots they produced are poorly described and not properly discussed and, in some cases, the citations of the figure numbers in the text are wrong.

We would like to kindly thank you for having pointed out this weakness.

The text has been revised, and more explanations have been added to better describe the plots. Also, the citations of the figures have been double-checked.

R2C7: The data and method section is too poor and the method they used is not described anywhere, they only described why they selected the subset of data from EM-DAT.

Thank you for the comments.

The "Materials and Methods" section has been elaborated to provide more information, which now allow for the study reproducibility.

R2C8: The list of events they include in section 2 should be removed or moved in an appendix section, together with table 1.

Thank you for your suggestion.

We decided to keep the description of the major flooding events (and the related Table 1) in the main text to provide readers with examples of how difficult could be inferring information on flood-related deaths. The text now reads "... the number of events with casualties of more than 10000 people is small (six cases, 1), and the number mentioned in the sources regarding the casualties of these events is mainly mixed with casualties due to incidental events, this category has been investigated on a case-by-case basis..."

R2C9: Most of the results are in the discussion section. The authors should better define what they consider as results of their analysis and what they want highlight and discuss

Following your comments, we revised the text to better clarify our approach: in the Results section, we reported the analysis of the data derived from the EM-DAT database (namely, flood fatalities), while in the Discussion we tried to understand if some patterns of flood fatalities exist, relating them to different drivers, such as population density (physical drivers) or GDP (socio-economic drivers).

We revised the text to stress the differences between the information reported in the Results and the Discussion sections, and we also significantly expanded the latter section by comparing our outcomes with literature evidence.

R2C10: The conclusion should be rewritten.

Thank you for the comment and the opportunity to revise the manuscript.

We revised and expanded the Conclusions, providing more comments on the further use of our results, as well as on open questions to be addressed in the future.

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