

## ***Interactive comment on* “Brief communication: Post-event analysis of loss of life due to hurricane Harvey” by Sebastiaan N. Jonkman et al.**

**Sebastiaan N. Jonkman et al.**

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Received and published: 9 March 2018

Response to reviewer comments

We acknowledge the valuable comments of the reviewers. We respond to all comments below and have made several changes based on these comments. A few more generic issues are discussed below. Both reviewers (Ilan Kelman and anonymous reviewer nr. 3) raise the issue of defining direct and indirect deaths. We agree that this is difficult and sometimes confusing issue and have adopted the classification proposed by the National Weather Service (2016) and have changed the formulation in various parts of the paper accordingly. Most fatalities in our analysis are due to direct causes, in this case drowning (81%). We also note that the study is limited to

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information on fatalities recovered in the first two weeks after Harvey and we recommend to collect information on the longer fatalities and health impacts of the event. Both reviewers Ilan Kelman and anonymous reviewer 3 refer to issues associated with evacuation. We have not found specific evidence of issues related to evacuation of undocumented immigrants or other vulnerable groups, so have not included this in the paper. However, the following press article described some of the challenges in this area: [https://www.washingtonpost.com/local/immigration/for-houstons-many-undocumented-immigrants-storm-is-just-the-latest-challenge/2017/08/28/210f5466-8c1d-11e7-84c0-02cc069f2c37\\_story.html?utm\\_term=.f8d111c52eb4](https://www.washingtonpost.com/local/immigration/for-houstons-many-undocumented-immigrants-storm-is-just-the-latest-challenge/2017/08/28/210f5466-8c1d-11e7-84c0-02cc069f2c37_story.html?utm_term=.f8d111c52eb4) Reviewer number 3 comments on the evacuation (orders) by local authorities. Indeed, during Harvey there seemed to be no mass evacuation order, but during the course of the event several local evacuations were ordered for areas with specific risks and circumstances, e.g. in Fort Bend County near the Brazos River. Within the scope of this (short) paper it is not feasible to describe and evaluate the evacuation practices and their effect on life loss during Harvey. However, we have changed the discussion on the last part of the paper and have a) mentioned the dependence between evacuation strategy and life loss; b) recommended to evaluate evacuation and emergency management performance based on the experiences during Harvey as future work.

Comments by Ilan Kelman

1. In the "other" category, Figure 1 seems to have one sample and Figure 3 seems to have two samples (3%). Surely the exact cause of death could be listed rather than "other"?

Response: we have modified figure 1, so that it is visible that the fatality in the other category occurred in the lower left side of the map

2. "the risks of evacuating millions of people were considered too high". By whom? There was an intense debate at the time regarding evacuation. Furthermore, many immigrants, legal or otherwise, indicated that they would have considered evacuating,

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but they were scared by the lack of guarantee from the government that they would be permitted through checkpoints when evacuating. Please add one sentence here describing exactly who felt that evacuation risks were too high, indicating that some people wanted to evacuate but had reasons not to.

Response: we have clarified that the decision about the evacuation was made by the mayor of Houston. See also: <https://edition.cnn.com/2017/08/27/us/houston-evacuation-hurricane-harvey/index.html>

We could not obtain more specific (and official) information on the evacuation issues for immigrants, although this press source seems to highlight these issues as well: [https://www.washingtonpost.com/local/immigration/for-houstons-many-undocumented-immigrants-storm-is-just-the-latest-challenge/2017/08/28/210f5466-8c1d-11e7-84c0-02cc069f2c37\\_story.html?utm\\_term=.f8d111c52eb4](https://www.washingtonpost.com/local/immigration/for-houstons-many-undocumented-immigrants-storm-is-just-the-latest-challenge/2017/08/28/210f5466-8c1d-11e7-84c0-02cc069f2c37_story.html?utm_term=.f8d111c52eb4)

3. Rather than the word "victim", it would be better to repeat "fatality", "death", or similar.

Response: we have now used fatality throughout the paper.

4. The distinction between direct and indirect deaths ..... Response: see first page

5. "Approximately half of the casualties were located in Harris County". It is implied, but not stated explicitly, that the dominance of Harris County is due to better records. Please make a short, explicit statement.

Response: wording altered to reflect this. This is the most densely populated county in the affected areas and it was severely affected by flooding

6. Is there any material covering whether or not the boat fatalities were wearing PFDs (lifejackets)? Please note this information or just indicate that it is not known.

Response: done

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7. When return periods are given, please indicate the parameter being calculated (e.g. flood depth, volumetric flow rate, areal extent).

Response: we refer to the areal extent, short explanation added.

8. Delete "At the time it [Allison] was the costliest and deadliest urban flood in U.S. history." I think that Johnstown 1889 counts as an urban flood in U.S. history. Allison might not even count as the deadliest urban flood in Texan history depending on how "urban" is defined.

Response: sentence removed

9. "people were warned for flooding beforehand". They were warned before Katrina also. Then, "during Harvey the great majority of fatalities occurred due to drowning, especially in and around vehicles": Could there have been any chance these fatalities occurred during evacuations, i.e. people trying to leave after receiving a warning? The point here is to be wary of assumptions that warnings inevitably reduce death toll, because the social process of warning systems is not straightforward.

Response: we have no evidence that these fatalities occurred during evacuation, Some anecdotal evidence and press articles show that fatalities were rescuers or public officials who ended up in the floodwater. We have mentioned the effect of evacuation and individuals behaviour on life loss in a broader context in the last paragraph.

10. For the title, perhaps simply "Loss of life from Hurricane Harvey". Response: title changed and shortened

Reviewer number 2

Reviewer number 2 requests more literature on specific vulnerabilities such as age and gender and flood and hurricane evacuation literature. Response: since this is a short communication we cannot add many more references. We have added two references related to flood evacuation and the link with life loss (Parker et al and French et al). Vulnerability factors (age, gender) are already addressed in several

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of the references included (e.g Jonkman and Kelman 2005 and Ashley and Ashley 2005). Specific comments: Page 3, line 1; Page 4, lines 1-5: A word of caution should be presented here regarding the use of FEMA-designated zones. When were these data valid for? Though the data were acquired in 2017, how long ago were the zones mapped and approved by FEMA? Are these the regulatory zones in NFIP or the same data that is presented in HAZUS? A reference to recent research on the differing delineations of these zones could be provided to make sure that the reader appreciates that the Federal zones are often thought of as “conservative”; see: <https://link.springer.com/article/10.1007/s11069-017-2806-6> The floodplain maps used for Harris County are the 2016 Effective Floodplains; however, it is important to note that the majority were mapped as part of the Tropical Storm Allison Recovery Project (TSARP) completed in 2007. Frequent updates have occurred for portions of these maps, but we acknowledge that they may underestimate flooding due to changes in land use/land cover, subsidence, and rainfall intensity and duration. Page 3, line 15: The parenthetical about victims is confusing. Response: wording changed Page 3, line 23: Rewrite and incorporate this very short sentence here with the next line. Response: wording changed Figures: Percent(s) between Fig. 1 and 3 are off a bit. Response: see response to the first comment by Ilan Kelman

### Reviewer number 3

This reviewer argues that our recommendations were too broad / vague. We have made the recommendations more specific and have linked them to the findings of the paper. We have also added recommendations for a thorough evaluation of evacuation and emergency management during Harvey. Detailed comments: P2 L16: “victim” should read “victims” – Response: changed P2 L16: “victim” should read “victims” P2 L16: Here I’d suggest replacing “circumstances of death (location, time of recovery, cause and circumstances of death)” with simply “location, time of recovery, cause and circumstances of death”, to avoid repeating “circumstances of death” outside and inside the parentheses, which sounds incorrect. Response: agreed, wording changed.

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Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2017-436>, 2018.

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