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Discussions

Interactive comment on "Response Time to Flood Events using a Social Vulnerability Index (ReTSVI)" *by* Alvaro Quezada-Hofflinger et al.

Anonymous Referee #1

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Summary: This manuscript describes a promising method of incorporating social vulnerability into evacuation analyses. The review of the social vulnerability literature is relatively strong but the review of research on evacuation analysis is rather weak. Two very extensive reviews of research on hurricane evacuation concluded that sociodemographic variables have weak and inconsistent correlations with evacuation decisions (Baker, 1991; Huang et al., 2016) and the research on evacuation departure times is extremely sparse, even for hurricane evacuations. There is a more directly relevant literature on pedestrian evacuation for tsunamis (see the references cited below) but it does not address social vulnerability to any significant extent. In addition, there are also some unanswered questions about the reliability and validity of the evacuation departure time data reported in this study. Overall, the weak empirical foundation in the

existing literature and in this study suggests that the authors should be very cautious about any claims about the contribution that social vulnerability indicators can make in improving evacuation analysis.

Page, Line, Comment 10 L12. The description of the data from the first responders lacks specificity about the process by which the data were collected. One possibility is that each responder was asked to describe the response curve for a specific neighborhood that she or he assisted in evacuating, after which the authors classified the neighborhoods in terms of their social vulnerability. Alternatively, all responders might have been asked to generate separate curves for low, medium, or high vulnerability neighborhoods. The first procedure is much more likely than the second one to generate reliable data. The description of the data also lacks any measures of interrater agreement for the ratings of the percent evacuated at each point in time. The authors should present some measure of variability such as the standard error of the mean for each point in Figure 5. That information should be accompanied by statistical tests of the differences among the curves for low, medium, or high vulnerability neighborhoods. Given the small sample of responders, it seems quite possible that there are no statistically significant differences among the curves even at 5 minutes. If there are nonsignificant differences among social vulnerability neighborhoods at any given time point, the most appropriate estimate of percentage of evacuees at each point in time would be the median estimate. For example, Figure 5 shows that there is almost certain to be a nonsignificant difference among neighborhoods at 60 minutes. Thus, the median of the three estimates (the estimate of .89 for moderate vulnerability) would be the most appropriate statistical estimate for all three levels of social vulnerbility. If there are significant differences at some time points, then those significantly different estimates should be used. However, all time points at which there are nonsignificant differences should have the high and low vulnerability estimates replaced by the median estimate for that time point (the estimate for the moderate vulnerability group).

11 L8. If all six components were included in the SVI, what is the justification for believ-

ing that all of them are relevant to evacuation vulnerability? This issue of evacuation vulnerability (as distinct from general social vulnerability) is important because most of the Cutter et al. (2003) examples of social vulnerability in their Table 1 refer to disaster recovery rather than evacuation. There are some authors that have addressed evacuation vulnerability but, to the best of my knowledge, only Chakraborty et al. (2005) and Kusenbach et al. (2010) have examined social vulnerability in evacuation. (Cova's papers on evacuation vulnerability examine vulnerability due to evacuation route system geometry and link capacity.) Even the Chakraborty and Kusenbach studies assumed that their measures of social vulnerability would actually make a difference in evacuation rather than demonstrated it empirically. There is a broader literature on household evacuation, but the available data show no evidence that any of the sociodemographic variables measured in these studies is consistently related to evacuation (Baker, 1991; Huang et al., 2016), let alone evacuation departure time distributions. The only evacuation review to cite evidence in support of any relationships of sociodemographic variables with household evacuation only cited positive instances and ignored reports of nonsignificant correlations (Dash & Gladwin, 2007).

L11. Figure 6 does indeed show that there are many blocks of high social vulnerability located close to the river, but there are also blocks of medium and low vulnerability there as well. The authors' argument would be more persuasive if they would overlay the expected inundation zone onto the map and calculate the proportion of high, medium, and low vulnerability blocks within the inundation zone.

L27. The differences among the neighborhoods with respect to the outcomes of the evacuation model are necessarily a direct result of the presumed differences among the three evacuation rate curves. If the differences among the three curves are not significantly different from each other, then a single departure time curve should be used and the differences among the neighborhoods with respect to the outcomes of the evacuation model will vanish.

L29. The finding that evacuations were completed more rapidly with the earth-

quake/tsunami response data than with the LIFESim equations is due to the fact that, as long as the local population recognizes earthquake shaking as a tsunami warning cue, the shaking is an instantaneous broadcast mechanism (see Lindell et al., 2015; Wei et al., 2017). In those situations, k = 1 in Equation 3, which makes the time-consuming contagion process unnecessary.

12 L7 would be more accurate if restated with the following qualifications. Social vulnerability is thought to be an important factor that needs to be included in evacuation analyses but there are no systematic frameworks to do so. Moreover, although it seems intuitively plausible that people with different levels of social vulnerability would differ in their evacuation rates and departure times, there are no empirical data that support this assumption. One imitation of the available research is that Baker (1991) and Huang et al. (2016)âĂŤthe two most relevant literature reviewsâĂŤaddressed (primarily vehicular) hurricane evacuation in the Unites States. It is unclear if these results would generalize to pedestrian evacuation in other countries.

L29. Morss et al. (2011) did not address any studies of evacuation, let alone the effects of social vulnerability on evacuation departure times, so the claim in this sentence about the comparability of the sample size is unsupported.

13 L4. This study does not "estimate the percentage of people that evacuate an inundation hazard zone" (my emphasis); it estimates the rate at which people evacuate an inundation zone.

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