Geocoding applications for social science to improve earthquake early warning

D. Sumy

The paper is interesting, well written and the topic would be of interest to readers of the journal. However, I have serious concerns over the apparent lack of novelty in the paper. The benefits of geocoding and video reconnaissance have been established by other studies, as acknowledged through the author's referencing of the literature. It is stated that the novelty lies in using geocoding to better understand the functionality and inform potential improvements to the ShakeAlert system, but I don't believe that this is discussed sufficiently in the text (perhaps functionality specifically refers to latency time and receipt of alerts, but this is not made explicit). I don't come away from this paper with an explicit understanding of what potential improvements to ShakeAlert are specifically highlighted through the use of geocoding. Statements like : "*Here I show how geocoding can help understand what people experienced during an earthquake*" in the non-technical summary are not supplemented with text in the main body of the paper that explains why this might be beneficial for an EEW system (e.g., the fact that geocoding in this context could help to calibrate appropriate EEW ground-shaking thresholds for instance). Video reconnaissance does not necessarily require the use of geocoding in order to provide useful insights on human behaviour related to EEW (i.e., a video can provide valuable information on how people reacted to an EEW alert, regardless of whether the exact location it is taken is known); the specific benefits of geocoding in this regard are again missing from the text. Related to this, the author mentions that "*the geocoding of social science data collected via surveys and videos provides information about what people experienced during an earthquake, whether they received an alert (or not), and whether people took protective actions…*"; all three pieces of information mentioned here could be collected by including appropriate questions on a survey, without needing to know exactly where the survey takes place. Key details on the specific benefits of geocoding are once again missing.

As a result, I believe this paper requires substantial modification before it can be considered for publication.

Further comments:

1. There is a slightly tangential discussion around DYFI data throughout this paper. Since EEW and DYFI data are not necessarily directly related (yet), I would suggest to remove it to avoid confusion and diluting the main motivation of the paper implied by the title.
2. A relatively large amount of text is devoted to explaining the method of geolocation using the Google Maps Geocoding API. Since the focus of the paper is on the benefits of geocoding rather than the method of geocoding itself, I think this part could be significantly shortened.
3. Line 270: It is not clear to me what is meant by the phrase "the alerting polygon held" – is it referring to the absence of missed alerts?

Minor comments:

1. There is some switching between "we" and "I" throughout the text. I would suggest to keep it consistent.
2. The section "Limitations and Considerations" should be numbered
3. Line 50, page 2: The first city in the world or in the US? It would be good to clarify this

Review report on
"Geocoding Applications for Social Science to Improve Earthquake Early Warning"

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1 Recommendation

Accepted with some Major Revisions

2 Comments to Authors

Title: Geocoding Applications for Social Science to Improve Earthquake Early Warning

Authors: Danielle F. Sumy

2.1 General comments:

To understand people's reaction to earthquake early warnings it is key to evaluate the effectiveness of the warnings and, if needed, to adjust them. This study explores the potential of geocoding survey response data and crowed-sourced video footage for earthquake early warning systems.

To my knowledge, this is the first study assessing this issue. The author argues that geocoding can help better understand what people experienced during an earthquake, which can be useful information for first responders, social scientists, and other professional stakeholders. With the two case studies the potential of geocoding is shown from two perspectives.

Further, I find the paper to be overall well written. The link to the existing research and the need for this study were elaborated. The figures and tables are good situated in the text and the captions are clear. The referencing is consistent and correct.

Thus, I overall recommend that the study is published. However, I have some major and minor suggestions for improvement to increase the clarity of the report.

2.2 Major comments

1. My first comment refers to the author's statement in the summary that geocoding social science data can help create more resilient and prepared individuals and communities. However, afterwards, this benefit/potential is not sufficiently addressed. I would explain in more detail what exactly the benefits and potential of geocoding are.

2. Throughout the manuscript the author switches between 'I' and 'we' and it is thus not everywhere clear what the author's contribution is and what others have done. And who is 'we'? And is 'we' always referring to same group of people?

3. The literature review does not include many European studies and has a strong focus on the US. I thus suggest that more European studies looking at geocoding in the context of earthquakes (or other natural hazards) are mentioned and discussed in the paper. For example the following studies may be added (not conclusive list):

- Ofli, F., Qazi, U., Imran, M., Roch, J., Pennington, C., Banks, V., & Bossu, R. (2022, July). A real-time system for detecting landslide reports on social media using artificial intelligence. In Web Engineering: 22nd International Conference, ICWE 2022, Bari, Italy, July 5–8, 2022, Proceedings (pp. 49-65). Cham: Springer International Publishing.https://link.springer.com/chapter/10.1007/978-3-031-09917-5_4
- Bossu, R., Landès, M., Roussel, F., Steed, R., Mazet-Roux, G., Martin, S. S., &

Hough, S. (2017). Thumbnail-based questionnaires for the rapid and efficient collection of macroseismic data from global earthquakes. Seismological Research Letters, 88(1), 72-81. https://pubs.geoscienceworld.org/ssa/srl/article/88/1/72/314337/Thumbnail-Based-Questionnaires-for-the-Rapid-and

In the discussion, the comparison to other applications is missing, which would allow one to better understand the future potential of geocoding for EEW.

3. I suggest to add a method chapter, where the case study approach is described in detail. Why were these two case studies chosen? What are the characteristics of the two case studies (e.g., table for the overview)? Which procedure was followed to analyze and compare them; i.e. reference? Which data was used to analyze and compare them? Is an ethical approval available; if not why was none needed and how was the data privacy and anonymization of the data ensured?

4. Currently, the two case studies are two separate chapters. It would make more sense to have one chapter for both case studies and report the finding following the same structure. This would facilitate the comparison between them. Further, the comparison of the cases studies, which is currently also in the conclusion chapter, could be part of the discussion chapter.

5. The discussion is good but I would structure it along certain topics, or introduce research questions in the introduction and then structure the discussion chapter accordingly.

6. In the conclusion, I expected that the initial statement that geocoding social data can increase societies' resilience and disaster preparedness would be addressed. Thus, I miss the scientific and practical implications and potentials.

7. When discussing the ethical considerations, it should also be addressed that certain societal groups are excluded; i.e. without internet access, not technophilic, not using social media. Further, the potential misuse of the data is mentioned but how it could be prevented is missing. There may be possible solutions in the context of other applications the author mentions at the beginning.

2.3 Minor comments:

1. Line 97: I suggest to clearly indicate (throughout the paper) that the author conducted 'two' case studies. And I would briefly mention them on line 97.

2. Line 306: The author states that the data collection needs to be done quickly (over a span of one week). Thus, what does an institution need to be ready to collect and analyze the data; i.e. human resources, financial resources?

3. Line 335 to 336: The link between the two paragraphs is not given. It may help introduce sub-sections.

4. Lines 436 to 439: How is this problem exactly linked to geocoding? The challenge there is that people are not familiar with receiving a second message or may not accept false alerts.

5. Lines 470 to 472: It is written that analyzing videos is especially useful for small earthquakes. But earlier it is stated that videos are especially shared for stronger shaking.

6. Lines 496 to 497: Are there any tools that facilitate to verify the authenticity of a video? What are the experiences from the author's analysis process and do other studies reflect on this/ provide solutions?

7. Lines 528 to 530: Very good that the author addresses this issue.

8. Lines 550 to 553: What is meant with 'careful research'? And how can 'careful research' exactly allow one to reduce the limitations?

2.4 Figures

1. Figure 1: On page 5 & 6, the author describes the different elements of the Geocoding output elements. I suggest to add on the right of Figure 1 short descriptions of the different elements so that readers do not have to go back and forth in the text and the figure is self-explanatory.

2. Figure 3: Is it needed? I first thought that it was an output of the case study analysis, but when reading the caption I understood that it is an output of another paper by McBride et al. (2023). And from the explanations in the text it is not clear what the author in addition to the insights from McBride et al. (2023) analyzed. One problem again is that 'we' is used and the additional findings of the author are not stressed. In some parts it seems like a summary of the paper of McBride et al. (2023).

Review submitted 6th April 2023

Geocoding Applications for Social Science to Improve Earthquake Early Warning
Response to Reviews – Danielle F. Sumy

Reviewer A - Anonymous

Comment #1: The paper is interesting, well written and the topic would be of interest to readers of the journal. However, I have serious concerns over the apparent lack of novelty in the paper. The benefits of geocoding and video reconnaissance have been established by other studies, as acknowledged through the author's referencing of the literature. It is stated that the novelty lies in using geocoding to better understand the functionality and inform potential improvements to the ShakeAlert system, but I don't believe that this is discussed sufficiently in the text (perhaps functionality specifically refers to latency time and receipt of alerts, but this is not made explicit). I don't come away from this paper with an explicit understanding of what potential improvements to ShakeAlert are specifically highlighted through the use of geocoding.

Response: I have significantly revised the paper, specifically the discussion and conclusion sections, to make explicit the key points on coupling geocoding with social science data to improve earthquake early warning. I have specifically referred to data latency time and receipt of alerts, and the future direction of earthquake early warning with the help of geocoding.

Comment #2: Statements like: "Here I show how geocoding can help understand what people experienced during an earthquake" in the non-technical summary are not supplemented with text in the main body of the paper that explains why this might be beneficial for an EEW system (e.g., the fact that geocoding in this context could help to calibrate appropriate EEW ground-shaking thresholds for instance).

Response: I significantly revise the paper, including the non-technical summary, to support these assertions in the text to make the point about why geocoding matters to earthquake early warning much stronger. For instance, I now point out that geocoding can help calibrate EEW ground-shaking thresholds for alerting, especially once we have geocoded questionnaires that can help us do this.

Comment #3: Video reconnaissance does not necessarily require the use of geocoding in order to provide useful insights on human behaviour related to EEW (i.e., a video can provide valuable information on how people reacted to an EEW alert, regardless of whether the exact location it is taken is known); the specific benefits of geocoding in this regard are again missing from the text.

Response: While video reconnaissance does not necessarily require knowing a person's location, the key here is that geocoding (and determining a person's location) can help determine a person's intensity, or severity of shaking felt. For instance, if a person experienced MMI 2-3 (slight shaking) they might not take a protective action compared to someone who experienced larger intensity. Thus, while a video can provide valuable information on how people reacted to an EEW alert, it doesn't tell us why they might have taken that protective action without knowing their location or MMI. Specific information on location, seismic intensity, and why it matters has been added to the text.

Comment #4: Related to this [Comment #3], the author mentions that "*the geocoding of social science data collected via surveys and videos provides information about what people experienced during an earthquake, whether they received an alert (or not), and whether people took protective actions…*"; all three pieces of information mentioned here could be collected by including appropriate questions on a survey, without needing to know exactly where the survey takes place. Key details on the specific benefits of geocoding are once again missing.

Response: Seismic intensity is dependent upon location. Geolocation, the process of determining a location, will help determine the seismic intensity, which relates to how alerts are sent out. All three pieces of information: 1) about what people experienced (seismic intensity) varies by location; 2) whether they receive an alert on not depends on location (due to seismic intensity); and 3) what a person experiences likely informs the protective action they take (due to the shaking they feel). I clarify the important details about the need for location in the introduction and introduce the benefits of geocoding.

Comment #5: There is a slightly tangential discussion around DYFI data throughout this paper. Since EEW and DYFI data are not necessarily directly related (yet), I would suggest to remove it to avoid confusion and diluting the main motivation of the paper implied by the title.

Response: I heavily reduce the discussion on DYFI data in the paper to address this comment.

Comment #6: A relatively large amount of text is devoted to explaining the method of geolocation using the Google Maps Geocoding API. Since the focus of the paper is on the benefits of geocoding rather than the method of geocoding itself, I think this part could be significantly shortened.

Response: I shorten the section on geocoding methods to leave room to better demonstrate the benefits of geocoding.

Comment #7: Line 270: It is not clear to me what is meant by the phrase "the alerting polygon held" – is it referring to the absence of missed alerts?

Response: I provide more information in the text that we want to only have alerts stay within the alerting polygon, and not 'leak' outside of this boundary.

Comment #8: There is some switching between "we" and "I" throughout the text. I would suggest to keep it consistent.

Response: I switch to 'we' throughout the text to remain consistent, where the 'we' is the author and the reader.

Comment #9: The section "Limitations and Considerations" should be numbered.

Response: This section is now numbered. Thanks!

Comment #10: Line 50, page 2: The first city in the world or in the US? It would be good to clarify this.

Response: New Haven, Connecticut is the first city in the world with a geocodable network database. This is now clarified in the text.

Reviewer B - Anonymous

Comment #11: To understand people's reaction to earthquake early warnings it is key to evaluate the effectiveness of the warnings and, if needed, to adjust them. This study explores the potential of geocoding survey response data and crowd-sourced video footage for earthquake early warning systems. To my knowledge, this is the first study assessing this issue. The author argues that geocoding can help better understand what people experienced during an earthquake, which can be

useful information for first responders, social scientists, and other professional stakeholders. With the two case studies the potential of geocoding is shown from two perspectives. Further, I find the paper to be overall well written. The link to the existing research and the need for this study were elaborated. The figures and tables are good situated in the text and the captions are clear. The referencing is consistent and correct.

Response: Thank you for this comment. It is also to my knowledge the first study assessing the issue of geocoding and reporting on its benefits, especially as it pertains to earthquake early warning.

Comment #12: My first comment refers to the author's statement in the summary that geocoding social science data can help create more resilient and prepared individuals and communities. However, afterwards, this benefit/potential is not sufficiently addressed. I would explain in more detail what exactly the benefits and potential of geocoding are.

Response: In accordance with this comment and the comments made by Reviewer A, I revise the non-technical summary to address the benefits/potential of geocoding more clearly, specifically as it pertains to earthquake early warning.

Comment #13: Throughout the manuscript the author switches between 'I' and 'we' and it is thus not everywhere clear what the author's contribution is and what others have done. And who is 'we'? And is 'we' always referring to the same group of people?

Response: I switch to 'we' throughout the manuscript, as writing 'I' is awkward and does not demonstrate that the reader and the author are working through the manuscript here.

Comment #14: The literature review does not include many European studies and has a strong focus on the US. I thus suggest that more European studies looking at geocoding in the context of earthquakes (or other natural hazards) are mentioned and discussed in the paper. For example, the following studies may be added (not conclusive list):

- Ofli, F., Qazi, U., Imran, M., Roch, J., Pennington, C., Banks, V., & Bossu, R. (2022, July). A real-time system for detecting landslide reports on social media using artificial intelligence. In Web Engineering: 22nd International Conference, ICWE 2022, Bari, Italy, July 5–8, 2022, Proceedings (pp. 49-65). Cham: Springer International Publishing. https://link.springer.com/chapter/10.1007/978-3-031-09917-5_4
- Bossu, R., Landès, M., Roussel, F., Steed, R., Mazet-Roux, G., Martin, S. S., & Hough, S. (2017). Thumbnail-based questionnaires for the rapid and efficient collection of macroseismic data from global earthquakes. Seismological Research Letters, 88(1), 72-81. https://pubs.geoscienceworld.org/ssa/srl/article/88/1/72/314337/Thumbnail-Based-Questionnaires-for-the-Rapid-and

In the discussion, the comparison to other applications is missing, which would allow one to better understand the future potential of geocoding for EEW.

Response: I now discuss the comparison to other application in geocoding in the conclusion section, which allows the reader to understand the future potential of geocoding for EEW. I have added the two studies listed here, and included more work from France (Bopp & Douvinet, 2020; 2022), New Zealand (Becker et al., 2020), and Japan (Nakayachi et al., 2019). I hope these additions provide more of a worldwide view of EEW.

Comment #15: I suggest to add a method chapter, where the case study approach is described in detail. Why were these two case studies chosen? What are the characteristics of the two case studies (e.g., table for the overview)? Which procedure was followed to analyze and compare them; i.e. reference? Which data was used to analyze and compare them? Is an ethical approval available; if not why was none needed and how was the data privacy and anonymization of the data ensured?

Response: In lieu of adding a short methods section to the paper, I place the information requested here in the two separate sections that focus on the survey and video data respectively. To answer the questions outlined here:

- The case studies were chosen here because I personally conducted the geocoding work and have first-hand knowledge of the data collection procedures. A comment is added to the introduction section, last paragraph to answer this.
- The characteristics of the two case studies are fully examined in their appropriate sections, and a table would be of limited use here compared to the text. There are also not a whole lot of similarities here to draw from, so I think a table is moot.
- The idea is not to analyze and compare the two case studies to each other, rather to demonstrate the usefulness of geocoding applications to survey and/or video data for use in earthquake early warning. Thus, there is no procedure or data used to analyze and compare the case studies, and the goal is not to compare them here in this manuscript.
- Regarding ethical approval for the survey data, the ethical approval is stated in McBride et al., 2023 (I am second author) as: "Consistent with requirements of the Federal Paperwork Reduction Act, the information-collection activities for the survey described in this study were approved by the Office of Management and Budget [2019, OMB 1090-0011]." There is not direct ethical approval needed to collect open-access videos available on social media platforms. I have added a note in the acknowledgements about the survey ethical approval, as is customary for work that involves approval, and have added a note regarding the video data.

Comment #16: Currently, the two case studies are two separate chapters. It would make more sense to have one chapter for both case studies and report the finding following the same structure. This would facilitate the comparison between them. Further, the comparison of the cases studies, which is currently also in the conclusion chapter, could be part of the discussion chapter.

Response: I disagree with this comment, mainly because the case studies for survey vs. videos are so different, the methodological approach is different, and the main comparison is how you conduct the approach (survey is forward approaching while videos are forensic (backward) approaching) is also different. I am not hoping for a comparison between them, but rather showcasing how geocoding techniques can be applied to two different case studies and the utility of the technique. The conclusion section is meant to wrap-up the manuscript and review what was discussed in the manuscript, not for the sake of comparison. I therefore maintain the current structure of this manuscript.

Comment #17: The discussion is good but I would structure it along certain topics, or introduce research questions in the introduction and then structure the discussion chapter accordingly.

Response: The discussion is now restructured along certain topics, making individual points with 'first, second, third' type designations.

Comment #18: In the conclusion, I expected that the initial statement that geocoding social data can increase societies' resilience and disaster preparedness would be addressed. Thus, I miss the scientific and practical implications and potentials.

Response: I have significantly changed the conclusions section to discuss the broader scientific and practical implications and potentials of geocoding techniques.

Comment #19: When discussing the ethical considerations, it should also be addressed that certain societal groups are excluded; i.e. without internet access, not technophilic, not using social media. Further, the potential misuse of the data is mentioned but how it could be prevented is missing.

There may be possible solutions in the context of other applications the author mentions at the beginning.

Response: A paragraph is added at the end of the conclusions section to address people we are leaving out. We already discuss a lot of bias in the Limitations and Considerations section and why people may choose to fill out a survey or upload a video. The discussion on how the misuse of data could be prevented is out of the scope of this paper and is better left for research around cybersecurity.

Comment #20: Line 97: I suggest to clearly indicate (throughout the paper) that the author conducted 'two' case studies. And I would briefly mention them on line 97.

Response: Throughout the manuscript, stemming from the abstract and introduction and throughout, I now clearly indicate that there are two case studies examined in this work.

Comment #21: Line 306: The author states that the data collection needs to be done quickly (over a span of one week). Thus, what does an institution need to be ready to collect and analyze the data; i.e. human resources, financial resources?

Response: I move this sentence to the next paragraph and write: "Video data must be collected quickly and efficiently through a variety of approaches. Teams already in place and ready to virtually deploy, such as through EERI VERT, gather video information over a span of one week or more after the event (e.g., McBride et al., 2022b)." I also add the conference paper led by Dr. Sara McBride that described the virtual deployments in more detail.

Comment #22: Line 335 to 336: The link between the two paragraphs is not given. It may help introduce sub-sections.

Response: To facilitate the transition between the paragraphs, I made the changes as shown in the response to Comment #21.

Comment #23: Lines 436 to 439: How is this problem exactly linked to geocoding? The challenge there is that people are not familiar with receiving a second message or may not accept false alerts.

Response: The sentence about false alerts is struck, as I agree with the reviewer that this is not direct related to geocoding.

Comment #24: Lines 470 to 472: It is written that analyzing videos is especially useful for small earthquakes. But earlier it is stated that videos are especially shared for stronger shaking.

Response: This phrase is removed and the sentence is restructured.

Comment #25: Lines 496 to 497: Are there any tools that facilitate to verify the authenticity of a video? What are the experiences from the author's analysis process and do other studies reflect on this/ provide solutions?

Response: In the lines in question here, this is where geocoding can help. Determining the location in which the video was taken helps to verify its authenticity. We do discuss how we conduct data reduction procedures with the geocoding, which again can help with authenticity concerns, and how to rule out unrelated videos in the case study section of the manuscript. I add a phrase in the discussion section about data reduction of the videos by location and how this can authenticate the video. Also, the caption for Figure 4 provides additional information about how we verify videos, in context with the content presented in the figure itself.

Comment #26: Lines 528 to 530: Very good that the author addresses this issue.

Response: Thank you so much for this kind comment!

Comment #27: Lines 550 to 553: What is meant with 'careful research'? And how can 'careful research' exactly allow one to reduce the limitations?

Response: This phrase is removed to address the comment. This is not yet possible, but potentially could be in the future.

Comment #28: Figure 1: On page 5 & 6, the author describes the different elements of the Geocoding output elements. I suggest to add on the right of Figure 1 short descriptions of the different elements so that readers do not have to go back and forth in the text and the figure is self-explanatory.

Response: The figure and figure caption is now changed with these updates.

Comment #29: Figure 3: Is it needed? I first thought that it was an output of the case study analysis, but when reading the caption, I understood that it is an output of another paper by McBride et al. (2023). And from the explanations in the text it is not clear what the author in addition to the insights from McBride et al. (2023) analyzed. One problem again is that 'we' is used and the additional findings of the author are not stressed. In some parts it seems like a summary of the paper of McBride et al. (2023).

Response: The use of 'we' is problematic here, as I was a co-author on the McBride et al., 2023 work. I have used 'McBride et al., 2023' whenever possible. I have also replaced Figure 3 with one that is more of an in-depth study of some of the locations that received the most (20+ survey responses) and discussed those more in detail in the text.

Geocoding applications for social science to improve earthquake early warning

D. Sumy

I thank the author for responding to my comments. However, I have a few outstanding concerns that I believe should be addressed before the paper could be published. This may be summarized as follows:

1. Novelty over previous work: It is still not clear to me how the case study 1 advances beyond the McBride et al. (2023) work. The author states that the analysis is "more detailed" compared to that of the aforementioned study, but an explanation should be provided as to what this means. What are the new findings of this case study over those of McBride et al?
2. Some of the text is still not specifically related to the benefits of geocoding for earthquake early warning.
    a. The paragraph around line 470 discusses the use of geocoding for inferring duration magnitude; it is not clear how this relates to earthquake early warning specifically, presumably that it can be used to estimate alerting accuracy or better calibrating alert thresholds?
    b. The subsequent paragraph around lines 485 discusses the use of geocoding for more accurately accounting for earthquake damage. I understand that the insight provided by geocoding into the relationship between seismic intensity and earthquake damage could be used to calibrate better risk-informed earthquake early warning alert thresholds, but this point needs to be made explicit.
    c. The third benefit of geocoding social science data mentioned in the Conclusions section (near line 570) should be framed in terms of more accurately calibrating earthquake early warning alert thresholds.

The author addressed all my comments and suggestions from the first review round appropriately. I especially appreciated to see that i) the structure significantly improved; ii) the relevance for societies' resilience and the potential of EEW systems is now described in more detail; iii) the novelty of the study and the contribution to the on-going research efforts is well explained; and iv) the findings from the study are discussed in an international context and is not anymore only US-focused.

I only have a minor suggestion, namely to cite in the paragraph about vulnerable groups and the need for inclusive communication campaigns Jenkins et al. (2022) paper "*Considerations for creating equitable and inclusive communication campaigns associated with ShakeAlert, the earthquake early warning system for the West Coast of the USA*" (https://www.emerald.com/insight/content/doi/10.1108/DPM-03-2021-0090/full/html) . This piece provides evidence to the author's arguments and, thus, should be cited.

Other then that, I would accept the revised manuscript for submission.

Geocoding applications for social science to improve earthquake early warning
D. Sumy

I thank the author for responding to my comments.

Response: Thank you. I took my time in answering the comments and believed them to be satisfactory.

However, I have a few outstanding concerns that I believe should be addressed before the paper could be published. This may be summarized as follows:

Comment #1: Novelty over previous work: It is still not clear to me how the case study 1 advances beyond the McBride et al. (2023) work. The author states that the analysis is "more detailed" compared to that of the aforementioned study, but an explanation should be provided as to what this means. What are the new findings of this case study over those of McBride et al?

Response: McBride et al., 2023 presented this information in aggregate, examining alerting inside v. outside of the polygon, with no distinction between each location. Here, I examine the data latency at the top ten locations that have survey responses, to show the breakdown in response (e.g., latency of alert, no alert, inexact alert, or delayed (>120 s) alert), which was not discussed nor presented in McBride et al., 2023. I more explicitly describe these new findings in the case study section.

I do two things to address this comment: 1) I cut a sentence in the introduction that says 'in greater detail', as addressing this comment is most useful within the case study section itself; 2) add phrasing around (e.g., lines 199-201, line 245, and lines 280-285, etc.) to describe the originality of the work here; and 3) rephrase a sentence in the discussion to discuss what exactly I presented differently than McBride et al. (2023). In addition, in multiple spots, I write 'extending the work of McBride et al. (2023)' to demonstrate the originality of the work presented here. Also, I note that Figures 2 and 3, and Table 1, as presented here are original to this manuscript.

Also, I decided to change 'we' back to 'I' to reflect that I did the geocoding work here. The change is now reflected through the manuscript.

Comment #2: Some of the text is still not specifically related to the benefits of geocoding for earthquake early warning.

a. The paragraph around line 470 discusses the use of geocoding for inferring duration magnitude; it is not clear how this relates to earthquake early warning specifically, presumably that it can be used to estimate alerting accuracy or better calibrating alert thresholds?

Response: I add an introductory sentence here to discuss why video data are important to human behavior, and how conversely, these social science data can help physical science. I also add the phrasing at the end of the paragraph to say 'Both magnitude and intensity are required parameters in estimating earthquake alerting accuracy and calibrating alerting thresholds,' to address this comment.

b. The subsequent paragraph around lines 485 discusses the use of geocoding for more accurately accounting for earthquake damage. I understand that the insight provided by geocoding into the relationship between seismic intensity and earthquake damage could be used to calibrate better risk informed earthquake early warning alert thresholds, but this point needs to be made explicit.

Response: Here I add an introductory sentence to the paragraph that reads 'In addition, earthquake early warning is simply one mechanism to help individuals and communities prepare for earthquakes, know what protective actions to take during an earthquake, and how to respond in the aftermath of an event'. It's important here to realize that earthquake early warning is one tool in the earthquake preparedness toolbox. In addition, I also add the phrasing you present here at the end of the paragraph: 'Broadly, geocoding can assist in better understanding the relationship between seismic intensity and earthquake damage, which can be used to calibrate risk informed earthquake early warning alerting thresholds.'

c. The third benefit of geocoding social science data mentioned in the Conclusions section (near line 570) should be framed in terms of more accurately calibrating earthquake early warning alert thresholds.

Response: I add this phrasing to the third benefit of geocoding in the Conclusions section. Thank you for the suggestion!