Dear Yolanda C. Lin, Aaron A. Velasco, Marianne S. Karplus, Susan L. Bilek, Jeffrey Weidner, Monica Alvillar, Conevery Bolton Valencius, Michael R. Brudzinski, Divya Chandrasekhar, John E. Ebel, Tiegan E. Hobbs, Steven C Jaumé, Eric C. Jones, Alan L. Kafka, Anne-Marie Núñez, Kristine L. Pankow, Zhigang Peng, Iris Tien, Elizabeth Vanacore:

I hope this email finds you well. I have reached a decision regarding your submission to Seismica, "Pathways to engaging in community-centered earthquake science: Lessons learned and tangible tools". Thank you once again for submitting your work to Seismica.

Based on reviews I have received, your manuscript may be suitable for publication after some additional some revisions (for editor only).

When you are ready to resubmit the revised version of your manuscript, please upload:

- A 'cleaned' version of the revised manuscript, without any markup/changes highlighted.
- A pdf version of the revised manuscript clearly highlighting changes/markup/edits.
- A 'response-to-reviewers' letter that shows your response to each of the reviewers' points, together with a summary of the resulting changes made to the manuscript.

Once I have read your revised manuscript and rebuttal, I will then decide whether the manuscript either needs to be sent to reviewers again, requires further minor changes, or can be accepted.

If you deem it appropriate, please check that the revised version of your manuscript recognises the work of the reviewers in the Acknowledgements section.

Please note that Seismica does not have any strict deadlines for submitting revisions, but naturally, it is likely to be in your best interest to submit these fairly promptly, and please let me know of any expected delays.

I wish you the best with working on the revisions. Please don't hesitate to contact me with any questions or comments about your submission, or if you have any feedback about your experience with Seismica.

Kind regards,

Carmine Galasso
University College London
carmine.galasso@seismica.org

> **Response from authors:** Dear Carmine Galasso, thank you for the updated decision about the manuscript. We have included an acknowledgement of the reviewers, who we are grateful to for their detailed and thoughtful feedback from both rounds of

review. Please find our responses and revisions to the Reviewer A's comments below, along with a tracked-changes and clean version of the manuscript. We look forward to hearing back on your decision for this manuscript.

Reviewer A

I thank the authors for responding to the first round of comments. I have a few relatively minor outstanding comments on the revised version of the manuscript, provided below. Please note that line numbers refer to the version of the revised manuscript with tracked changes.

1. It is clear from reading the revised version of the manuscript that the work is strongly rooted in a specific U.S. context. I would suggest to make this more explicit in the title of the manuscript.

   Response from authors: Thank you for the suggestion, we have considered this suggestion carefully, and have chosen to leave the title as-is because we have researchers who are based in Canada, we draw from examples from both U.S. and Canada in the introduction, and we believe these lessons have relevance in other countries. To address your concern, we have clarified that the Center for Collective Impact in Earthquake Science is based in the U.S. in the abstract. The sentence now reads (new text in bold): "We identify lessons learned and offer tangible tools based on the coauthors' collective experience through the **primarily U.S.-based** Center for Collective Impact in Earthquake Science. "

2. Lines 282 to 290: While I appreciate the authors' efforts to address the reviewer's comments by adding this passage, it is not so clear how this example relates to the lesson of taking time- perhaps mentioning the timeframe across which this partnership formed and these activities were carried out would help. (I am also not sure why it is described as an "additional example").

   Response from authors: We have re-worded this section to make it more clear that it builds on the theme of taking time to build trust and familiarity, potentially over years. The section now reads (new text in bold: " **Because the UTEP researchers had spent years building trust and familiarity in their community of** El Paso, TX, **the local office of emergency management and a local hospital reached out to the UTEP researchers after instances of felt earthquakes in the area**. **We built on this community-driven interest to develop strong partnerships where we** shared

information about the earthquake hazards, and this **planted the seed** for Pilot Project C.

3. Related to the previous comment, some of the additional examples provided for lessons learned in the revised version of the manuscript are included in the corresponding “lessons in action” section, whereas others are included in the main text above the “lessons in action” sections. To improve clarity, I would suggest placing all of the descriptions of specific examples from the pilot projects in the corresponding “lessons in action” sections.

   Response from authors: We wanted to keep the “lesson in-action” to one bite-sized, contained example for readers per lesson for ease of . In cases where the additional detail or example build on a sub-theme within the lesson, we include the example close to that theme (ie, as is the case in Lesson 1). In the case of Lesson 4, we included the new text in the “about” section because it is more generalized, while the “in-action” section focuses on a specific event of logistical/centralized support.

4. It is great that the authors have added examples of how CI core principles were applied to Table S1. Having said this, I do think that these examples could be more consistently described across the table. In my opinion, the explanations for Pilot Projects C and D provide the clearest link to the CI core principles, by mentioning relevant ones in parentheses after each point. I believe that the explanations for Pilot Projects A and B could be enhanced by restructuring them in this way. Furthermore, I would expect each description to explain how each (rather than only a few) of the core principles applied in a given pilot project.

   Response from authors: We thank the reviewer for their suggestions and appreciate that they found value in our addition to Table S1. We have restructured A and B, and added additional detail to make it more similar to detail as Pilot Projects C and D, but we have chosen not to include all five aspects for all projects such that we can highlight the aspects of Collective Impact that were most noteworthy and/or insightful in each project. Instead, we have ensured that there are examples of all five principles represented across the pilot projects.

   The modified descriptions for Pilot Project A and B’s examples in Table S1 now read (new text in bold):

   Pilot Project A: **Project A leveraged** regular meetings and interviews **(continuous communication) to identify priority locations and impacts for developing future integrated earthquake scenarios (Common Agenda). Team members based in Puerto Rico engaged in additional activities such as the** Shakeout, talks, Caribe Wave, and Instagram **to further engage with community members (Mutually**

Reinforcing Activities). A student training workshop **(Mutually Reinforcing Activity)** on spatial autocorrelation **(Shared Measurement as a shared analysis method)** was organized by project leads at the University of Utah and made available over Zoom **as an additional means of collaboration across the center.**

Pilot Project B: Pilot Project B developed relationships with community organizations and interested individual community scientists **to identify priorities for which faults to focus on and** for where the low-cost seismographs could be installed **(Common Agenda). Community engagement through updates about recent earthquakes, attendance at community meetings (e.g., at libraries and schools) (Continuous Communication) also supported additional ways to engage** new groups and individuals in earthquake science **(Mutually Reinforcing Activities).**

More minor comments:

1. Line 179, page 8: I don't believe that the UTEP acronym has been defined

   Response from authors: Thank you for catching this, the acronym has now been defined by adding "(The University of Texas at El Paso)" after the first instance of UTEP.

2. Line 413: It is not clear to me what is meant by the term "future scenarios" in this context; future scenarios of what?

   Response from authors: We modified this to read "future **earthquake** scenarios" to clarify.

3. Line 461: I think it would be helpful to add to the abstract the additional description of the fifth lesson provided here

   Response from authors: Thank you for catching this inconsistency, we have modified the abstract as suggested and now reads: "5) be flexible to ensure that community needs guide research directions"

Dear Yolanda C. Lin, Aaron A. Velasco, Marianne S. Karplus, Susan L. Bilek, Jeffrey Weidner, Monica Alvillar, Conevery Bolton Valencius, Michael R. Brudzinski, Divya Chandrasekhar, John E. Ebel, Tiegan E. Hobbs, Steven C Jaumé, Eric C. Jones, Alan L. Kafka, Anne-Marie Núñez, Kristine L. Pankow, Zhigang Peng, Iris Tien, Elizabeth Vanacore:

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Kind regards,

Carmine Galasso
University College London
carmine.galasso@seismica.org

> **Response from authors:** Dear Carmine, we appreciate the careful feedback from reviewers. We have updated the acknowledgements to include the work of the reviewers, and have provided detailed responses to all the reviewer comments below. Major changes include: additional definitions for terms specific to the United States, additional details for our examples, including major additions to the Table in the supplement, and clearer articulation of this paper's contribution to the Collective Impact Model literature. Attached to the resubmission is also the clean and track-changes version of the revised manuscript. Please do not hesitate to let us know if you need anything else at this time for the review. Note our responses are in blue and indented from the reviewer's original comments.

Reviewer A

Pathways to engaging in community-centred earthquake science: Lessons learned and tangible tools

This manuscript provides strategies for building meaningful connections between earthquake science research and local communities, with the overarching aim of facilitating realistic, impactful research around populations at risk from earthquake hazards. The work is timely and would be of interest to readers of Seismica, in my opinion. Having said this, there are several comments below that the authors should address before I would deem this manuscript to be publishable.

- **Response from authors:** We thank the reviewer for their thoughtful comments, especially in providing specific examples for where additional detail would be valued by potential readers of this paper. We provide specific responses to each of the reviewer's comments in the point-by-point responses below.

Major comments:

1. My biggest concern is that some aspects of the lessons learned seem too vague to be actionable in other contexts. It is surprising to see that, for the most part, the descriptions of these lessons are not grounded in specific examples from the pilot projects, which seems like a missed opportunity.

- No specific timelines are discussed as part of the first lesson, which makes it difficult for the reader to understand the extent of time that should be allocated for various components of the work. I appreciate that the exact amount of time involved is inherently project-specific, but more general measurements (e.g., in terms of relative proportions) would be useful to add here, based on the team's experiences across all pilot projects.
    - **Response from authors:** We have expanded the "lesson 1 in action" subsection to include some details about the timeline, relative to the school year, and time commitment on the project and school teacher. This section now reads (new text in bold): "One pilot project (**Pilot Project D in Table S1**) experienced challenges when their community partner **(in this case, an elementary school)** did not have bandwidth to continue the collaboration, despite the partner wanting to do so. **The project was initiated towards the end of the summer break. In retrospect, the pilot likely would have been successful if it had been in the academic-year planning pipeline, which typically starts towards the end of the prior year and continues in some form over the summer. This would have required more concentrated meetings and planning over the summer, and regularly scheduled meetings and activities in the school year (estimated 1-2 hours per week)."**

- Lesson 2 talks about tangible, small actions but no examples of what these actions might be are provided. Which research questions were better bridged with community needs as a result of using the evaluation framework?
    - **Response from authors:** Thank you for this suggestion. We have added the following specific example from Pilot Project C to the end of "Lesson 2 in action": **"Pilot Project**

C, for example, identified a tangible, small action as planning a meeting with community partners to revisit the project goals and listen to desired outcomes from a variety of voices. This improvement in communication and understanding between partners helped facilitate improvements in how the research addressed community needs."

- Lesson 4: What types of skills are most important for this centralized support role? How much time is necessary for this role? What leadership structure worked best across the pilot projects?
    - **Response from authors:** We clarify that the staff role was full time (line 397), and have added the following sentence to describe the skills needed for this role: **"To best support the key principles of the Collective Impact Model, the person in the centralized support role needs to be an outstanding communicator to facilitate meetings that develop a common agenda and shared measures, keep track of activities, and communicate to all stakeholders in multiple forms. In our case, the Director organized and planned with the PIs all meetings, arranged travel, and communicated with all stakeholders. As an example of her outstanding communication skills, the director also led the creation of a C-CIES podcast to reach non-traditional audiences as a creative form for continuous communication. "**

For context, I think the "in action" parts of lessons 3 and 5 are pretty much spot on in terms of their detail, as they provide specific examples directly from the pilot projects that help to clarify the values of these lessons. Similar specific examples for other lessons would better help to convey their importance and applicability in other projects.

Along these lines, I would suggest that a brief outline of how the collective impact model was applied to each pilot project is added to the project descriptions provided in Table S.1.

- **Response from authors:** We included a new row for each pilot project in Table S1 titled **"Example of how CI core principles were applied:".**

2. This comment centres on the novelty of the insights gained in this process. The authors mention several previous applications of the collective impact model, including in the context of science. I wonder how the lessons learned here compare to those of these previous applications? What are the new insights from this specific application of the collective impact model? How do these insights align with broader literature on community engagement in science? How have the proposed tools built on the state-of-the-art in community-centred science – or are these the first tools of their kind? (Disclaimer: I am an earthquake risk modeller, so it is hard for me to precisely gauge the novelties of the study's outputs).
    - **Response from authors:** Thank you for this suggestion. The original manuscript was not very clear that the previous applications of collective impact within geosciences were pulled from conference abstracts, rather than peer-reviewed journal papers, so the detail available in the cited abstracts is very limited. We believe this is one of the first contributions in the peer-reviewed literature space for applying collective impact to geosciences. We have clarified this in the first and last paragraphs of section two. The new text in the first paragraph of the section reads (new/revised text in bold): "Collective

impact's application in community-engaged geoscience education s**uggests promising potential through available conference abstracts** (e.g., McGill et al., 2017; Tesser et al., 2021). **But, to the authors' knowledge and at the time of writing, detailed accounts of collective impact within geoscience in peer-reviewed literature is not yet available, and the Collective Impact Model has not previously been formally implemented within an earthquake science context."**

We have also clarified this in the last paragraph of section 2, which now reads (new text in bold): "We share our experiences through C-CIES below to provide an illustrative example for how the Collective Impact Model can be applied to real earthquake science projects. **We believe this paper provides one of the first examples of applying the Collective Impact Model in the peer-reviewed geosciences literature.**"

Tangible Tool 1 was developed newly for this project as well as for a synergistic Collective Impact project, CIELO-G, led by the same PI (Aaron Velasco). Tangible tool 2 is built on principles of collective impact, so these are not completely new, but have been tailored for the needs of the project. This is described in the Tangible Tool 2 section, which has existing text that reads: "The evaluation tool was developed internally based on the Collective Impact Model as described in Kania & Kramer (2011), and from previous experience in participatory and community engaged research."

3. I am not convinced that the central messages of the conclusions section are generally reflective of the preceding text. The study does not provide conclusive evidence to suggest that "broadening community engagement and creating shared community resources will greatly improve the potential to respond to the needs of vulnerable populations that have been historically underserved". The specific "role that MSIs– particularly HSIs–can play in supporting both broader community engagement and in supporting a more diverse earthquake science research community" is not discussed. I don't see how the findings of the study specifically support the statement that "through the Collective Impact Model, the earthquake science community can help ensure that resources are dedicated to a more complete range of seismic hazards to solve real-world problems that require a coordinated effort beyond our academic silos"; this manuscript does not specifically discuss the extent of success associated with the collective impact model implementation.
    - **Response from authors:** Please see the added examples in the supplement (Table S1) for more detail on pilot project successes to better communicate and support this statement that "through the Collective Impact Model, the earthquake science community can help ensure that resources are dedicated to a more complete range of seismic hazards to solve real-world problems that require a coordinated effort beyond our academic silos." As another example of how the Collective Impact model led to more coordination and more complete range of seismic hazards, we present the example of the work accomplished through C-CIES in El Paso in the conclusion after the quoted statement: **"One example of this success can be seen in El Paso, TX, where in the last three years, C-CIES was actively working with local El Paso partners, Office of the Emergency Management, and local school districts to support the Great ShakeOut exercise. In 2025, El Paso**

County had over 83,000 participants, mostly school children, where Texas has a total of 89,555 in the Great ShakeOut. The impact of C-CIES in El Paso's participation is evident: In 2024, participation was registered at 14,080; in 2023, it was 3,608; in 2022, it was just 125."

We have also added additional background on how MSIs and HSIs support broader community engagement earlier in the paper (Approx lines 166-174) . The new text reads: **"It is important also to emphasize the institutional contexts within which the research for this project took place, led by broad-access HSIs. In the U.S., the HSIs have missions that focus on lifting up their local communities and serving their regions (Crisp et al., 2022), and are therefore well-positioned to lead community-engaged work. HSIs graduate disproportionately high numbers and shares of low-income and minoritized students in science fields, including specific science fields that see among the lowest representations of these students, like the geosciences (NASEM, 2019). MSIs and HSIs have led U.S. higher education institutions in developing and implementing innovative educational strategies to serve students from communities that have historically been underserved in higher education (NASEM, 2019; Núñez et al., 2021, Núñez, 2022)".**

Minor comments:

2. The abstract could benefit from a brief description of the "Collective Impact Model" concept, for readers that may be unfamiliar with this term
    - **Response from authors:** Thank you for this suggestion, we have expanded the abstract to include : "We offer strategies and tools to help bridge this gap in earthquake science, drawing on the Collective Impact Model, **defined by principles of developing a common agenda, mutually reinforcing activities, centralized support, shared measurement, and continuous communication.**" (new text is bolded).

3. I think it is worth remembering that your audience is not necessarily based in North America:

    - Please specify the geographical scope of the statistics mentioned in the first paragraph of the "Introduction" section

      Response from authors: Thank you for noting this ambiguity. We have added clarification in the mentioned statistics to clarify the scope of these statistics: "By measure of geoscience Ph.D. recipients **earned by United States (U.S.) citizens and permanent residents,**" and "Within the broader geoscience workforce **in the U.S.**," (new text is bolded)

    - It would be good to specify what the acronym NSF INCLUDES stands for

      Response from authors: Thank you for catching this oversight. We have added the definitions such that the sentence now reads (new text is bolded): "Due to more recent

trends, such as the application of the Collective Impact Model to large-scale alliances designed to broaden participation in science through the **U.S's. National Science Foundation's Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science** (NSF INCLUDES) program (Payton & Gates, 2023; Villa et al., 2020), there is a growing movement to adapt this as a framework for community science **in the U.S.** (e.g., Derrien et al., 2024)."

- Line 152: Not all readers will understand the "R1" term used here

  Response from authors: Thank you again for catching our US-centric terminology that has not been properly defined. We have added the definition (new text is bolded): "on-Minority-Serving Institution R1 schools and engagement of both diverse scholars and communities, **where R1 indicates the Carnegie Foundation designated classification for the highest level of research spending and doctorate production for U.S. universities (Carnegie Foundation & American Council on Education, 2025;** National Academies of Sciences, Engineering, and Medicine, 2019)."

4. Lines 244 -249: this material is not technically related to the lesson learned on allocating time
   - **Response from authors:** We have re-worded this section to clarify this material's relationship to the concept of allocating time. These sentences now read (new text in bold): "**Taking the time to understand** individual goals and contexts across diverse partners can help groups facilitate a sustainable path forward for mutually beneficial collaboration. Similarly, **making to time to articulate** shared values across the group, respecting the knowledge that each stakeholder brings, creating space for all stakeholders to speak, and demonstrating reciprocity, in some cases showing that a partner will **invest time to do something** "without expecting anything in return," also enhances the collective impact of such an effort (Núñez et al., 2021)."

5. Line 321: I think "about to consider" should instead be "able to consider"
   - **Response from authors:** Revised as suggested, thank you!

6. I may have missed it, but I did not see a direct reference to the supplementary material in the main text
   - **Response from authors:** We had an existing reference in line 167, "(see Supplemental Materials, Table S.1)", but we have added a reference to the Supplemental Materials in all places where we mention Table S.1 for further clarity.

7. The descriptions of Table S1 use inconsistent tenses
   - **Response from authors:** Thank you for pointing out this inconsistency. We have modified the table to be in past-tense for descriptions related to pilot activities and projects, please see Table S1 for all updates.

Reviewer B

This paper presents an example of how the Collective Impact Model was implemented in a center to support community-engaged earthquake science research, namely C-CIES. The paper provided a great introduction and motivation for the need for community-centered work in the geosciences. I also really liked the structure of the paper, with lessons learned, specific examples of each lesson, and tangible tools shared at the end of the paper, which enable the reader to apply the paper findings in their own contexts. Thank you for taking on this work and for sharing your experiences with the larger research community!

I recommend the paper be revised and resubmitted for review after addressing the following comments. Some of my more significant comments below are to enable broader adaptation of community-centered practices beyond the U.S. and to further push against the exclusionary practices of the scientific culture that the authors so nicely laid out in the introduction of the paper.

- **Response from authors:** We thank the reviewer for their thoughtful comments, especially in strengthening the connection of the body of the paper and the conclusions. and have provided a point by point response to the comments below.

Comments:

- Lines 133-134: Is it worth noting who those partners were (i.e., what organizations/agencies/institutions) or how the initial partnerships were formed? For example, if someone wants to replicate your approach, how might you suggest establishing those initial partnerships, and what it the importance/value of having partnerships that span across governmental, nonprofit, industry, and educational sectors?
    - **Response from authors:** We have added a reference to Table S1 that includes the partner affiliations, and to the coauthor affiliations which represent the university partners. We have also added this example in the second paragraph of Lesson 1 to illustrate how partnerships were formed in C-CIES: **"As an additional example, in El Paso, TX, felt earthquakes in the areas led to researchers in C-CIES being contacted by the local office of emergency management and a local hospital. We leveraged this interest into developing strong partnerships where we shared information about the earthquake hazards, and this developed into Pilot Project C. As part of this partnership, we attended the local Office of Emergency Management meetings and facilitated meetings with local hospitals. We also worked with the Office of Emergency Management to develop tabletop exercises for a realistic earthquake scenario that the Office of Emergency Management has since secured funding from FEMA to conduct."**
- Line 147-152 – the terminology used to describe universities (e.g. MSI, R1) have meanings specific to the US. To make the paper more broadly accessible and useful to an international audience, I suggest providing generalized definitions for these can.
    - **Response from authors:** Thank you for noticing this oversight in definitions. We have added definitions for both R1 and MSI, as well as better defining the geographic scope in the paper.

      The added R1 text reads (new text in bold): "Hispanic-Serving Institutions, which constitute the majority of Minority-Serving Institutions, can serve as a link between the

"traditional" non-Minority-Serving Institution R1 schools and engagement of both diverse scholars and communities, **where R1 indicates the Carnegie Foundation designated classification for the highest level of research spending and doctorate production for U.S…** "

The added MSI text reads: **""MSI" is an umbrella term that covers institutions that serve specific groups of students, and earn specific designations (including but not limited to "Hispanic-Serving Institution," "Historically Black Colleges and Universities,") through enrollment and/or expenditure thresholds (National Academies of Sciences, Engineering, and Medicine, 2019)."**

- Line 155 – what do you mean by "broad-access"?
    - **Response from authors:** We have added a definition for broad-access. This new sentence reads: "**Broad access institutions are defined as those that have missions to provide a variety of communities, including those from low-income and minoritized backgrounds, with access to postsecondary education (Crisp et al., 2021)"**
- Line 165 – I'm curious why Puerto Rico was a focus area for a project when there are no lead faculty from this region? My initial reaction was that you need a faculty lead that lives in/is from the region of interest to avoid the sense of "outsiders" coming in to study an area (akin to the "helicopter research" you described earlier). But, upon further reflection, I think it's important to highlight that your pathways for implementing the Collective Impact Model can work for doing work in places where you (the faculty lead) do not live. This tension between people who do work in geography-specific areas feeling like "outsiders" may be a barrier to implementation of community-centered research, and they can employ your methodology to overcome this barrier. However, if your model only worked in Puerto Rico because you found another faculty partner in that region to work with (i.e., the last co-author of this paper), then I would ask in that case for you to expand on how you determine the hierarchy of "lead" vs. non-lead faculty roles in these partnerships? If this is the case, is this aspect of scientific culture (i.e., the need to define lead or principal investigators in collaborative efforts) something that you can call out and push back on here as a means to further promote equitable and broadened participation in science?
    - **Response from authors:** Thank you for pointing out the need for further clarification here. The center's lead faculty are not the same as pilot project lead faculty, and coauthor Vanacore, as you have noticed, is from UPRM and was a critical member of C-CIES throughout the project, hence why this became a focus of one of the pilot projects. Initially the project spanned Utah (Pankow) and UPRM (Vanacore), but the scope was reduced due to feasibility and this reduced scope is what is reflected in Table S1. To clarify, we have added the following text at the end of this paragraph to explicitly explain that the project leads are not necessarily the Center leads (who dealt more with center operations, coordination, and collaboration rather than scientific research activity within each project):
      "Additionally, we had a number of additional MSIs (e.g., University of Puerto Rico at Mayagüez) and Primarily Undergraduate Institutions (e.g., College of Charleston) represented across the pilot project leads (see Table S1). " Project leads meanwhile also conducted meetings within their projects for the students and faculty

involved in each pilot project. We have also added a line in each pilot project to the project leads of each pilot project so that it is more explicit that these additional faculty at additional institutions played a critical role in the center.

- Line 242-244 – I appreciate the authors' suggestion of compensation and time-bound outcomes that can support partners in their career progressions. Thus far in the paper, the only examples I've seen of these are still focused on the academy (paying grad/undergrad students and publications for students and junior faculty). Can you give more examples of how compensation and time-bound outcomes to support career progression was done for community partners outside of higher ed?
    - **Response from authors:** Thank you for this suggestion. We added examples for compensation for community partners (new text: " (e.g., through supplemental income or gift cards for relevant outlets)" and for career progression (new text in bold) "(e.g., publications for students and junior faculty, **or professional conference presentations for partners)"**
- Line 321 – did you mean "the group was about to"? Or did you mean to talk about what the group did or was well-poised to do?
    - **Response from authors:** This was a typo and has been revised to "the group was **able** to…"
- Line 330-332 – I appreciate the authors acknowledging the challenges for junior faculty in engaging in community-centered scholarship and the suggestion you have for the team to support their junior faculty collaborators. I would also suggest adding a bigger suggestion for institutions to value community-engaged research and recognize its additional time commitments when evaluating someone for promotion (rather than only putting it on the junior faculty member to limit their participation in community-engaged work).
    - **Response from authors:** Thank you for your encouragement to emphasize this point more strongly. We open the paragraph with the fact that support for this work is growing, and we have added a sentence at the end of this paragraph to circle back to the role that more senior faculty can play in supporting this type of research. The new sentence reads: **"In addition, more senior and established faculty can advocate for institutions to value community-engaged research and the significant time commitment required for engaging in this type of work, especially in the faculty promotion process."**
- Line 437 – You use "CI" as an acronym that hasn't yet been defined (I think it refers to "collective impact," but it would be clearer to define "(CI)" in an earlier instance of the term)
    - **Response from authors:** Thank you for noticing this oversight, we have added the definition and acronym as suggested. Please note that in the body of the paper, we have elected to spell out "Collective Impact" for ease of reading, but are using it in the table for space considerations.
- Line 466 – I'm not sure I see much in the paper on how MSI/HSIs can support broader community engagement, beyond the fact that you explicitly called out that the leadership team were all from HSIs. Can you elaborate more in the paper on how this unique factor of the institutional affiliations of the faculty leads enabled more success in terms of community engagement (e.g., what were the faculty from HSIs able to do that would have been harder for faculty from PWIs to achieve in the model you presented? E.g., was it because of the demographics of the students they employed in the research, or was it because of partnerships the

institutions had that facilitated connections to minoritized community groups). Similarly, in Line 200 – I didn't see much in the body of the paper talking about partnerships between MSIs (i.e. the institutions of the lead faculty members) and non-MSIs (not sure any non-MSI partners were explicitly called out in the paper).

- **Response from authors:** We have added additional background on how MSIs and HSIs support broader community engagement earlier in the paper (Approx lines 166-174) . The new text reads: **"In the U.S., the HSIs have missions that focus on lifting up their local communities and serving their regions (Crisp et al., 2021), and are therefore well-positioned to lead community-engaged work. HSIs graduate disproportionately high numbers and shares of low-income and minoritized students in science fields, including specific science fields that see among the lowest representations of these students, like the geosciences (National Academies of Sciences, Engineering, and Medicine, 2019). MSIs and HSIs have led U.S. higher education institutions in developing and implementing innovative educational strategies to serve students from communities that have historically been underserved in higher education (National Academies of Sciences, Engineering, and Medicine, 2019; Núñez, 2022; Núñez et al., 2021). In addition, many MSIs have internal infrastructure that supports community engagement, since many support the local student population. UTEP, for example, has the Center for Community Engagement, and UNM has a similar center (Center of Community Engagement). Since these types of institutions serve local communities, it makes engagement into the community much easier and valued within the institution."**
- In addition, in Table S1, we added the affiliations of project leads at non-MSIs to clarify the collaboration between MSIs and non-MSIs.

Reviewer C

Reviewer: Elizabeth Sherrill

This paper definitely deserves to be published. The authors lay out strategies for community engagement in earthquake science. They take it a step further than normal broader impacts by guiding their research plans and methodology with input from communities and valuing community priorities and goals equally with research goals. This is a very important topic and methodology and it is a great addition to our field. The authors apply the Collective Impact Model to pilot projects in earthquake science (all of which are very exciting and great applications of the method!). They then detail five lessons learned and provide three tangible tools that others can use to apply the same method to new projects. I think it will be very useful for others looking to follow a similar methodology.

I think the manuscript could be published as is, but I think it would benefit from having more specificity in a few places (detailed in moderate revisions). I also have a few suggested minor revisions to improve the clarity of the manuscript.

- **Response from authors:** We thank the reviewer for their thoughtful comments, especially in providing specific examples for where additional detail would be valued by

potential readers of this paper and areas for improvement in clarity. We provide specific responses to each of the reviewer's comments in the point-by-point responses below.

Moderate revisions:

1. I suggest making the fifth lesson learned more specific. Be flexible is very vague and I think could be assumed from anyone before reading this manuscript. It seems from your description and the lesson in action that something like "Ensure community needs guide research directions" or something similar would be more apt. I would also suggest making the lesson 5 takeaway (L400-402) a little more specific.
    - **Response from authors:** Thank you for this comment. We have changed the title to (new text in bold) "be flexible to **ensure that community needs guide research directions**", and added text in the first sentence to reflect this. We also expanded on the "takeaway" which now reads (new text in bold): "Organizational and research flexibility enabled us to take advantage of interest as well as expertise. **Rather than framing meeting community needs and advancing scientific discovery as orthogonal, we saw examples where we were** ultimately better at supporting our communities while simultaneously supporting research aims."
2. Following along the lines of suggestion 1, I suggest adding more specificity to the "in action" examples for lessons learned 3, 4, and 5. I think in these examples it is much more helpful to be specific rather than vague.
    - Lesson 3 – What were the community concerns and values that guided data collection? How was this different than other studies where interviews are not done first? You provide a nice example of how the "non-ideal" placement of seismometers in lesson 5 lead to fruitful science (ambient noise, etc.). Do you have any example like that for this one? I think that would further support the assertion in the conclusions that community-centered science can lead to better science outcomes.
        i. **Response from authors:** Thank you for this suggestion, we have added the following sentence to make this more detailed: **"We found that linking the impacts of a potential earthquake to buildings and community locations that support mental health, learning, and economic activity would be critical to developing future scenarios, and data collection should be focused on these locations (e.g., schools)."**
    - Lesson 4 – This one seems to be more general and almost hypothetical than the other "in action" examples. I think maybe because of the verb tense. An example of a suggested change for the first sentence (L362-364) that is more specific, "Centralized organizational support was critical for arranging in-person meetings between our 20 team members. Additionally, a meeting facilitator helped improve productivity in our all-hands meetings by clearly identifying the purpose and boundaries of conversations." Or if this was not the case, be frank and say, "It was difficult for our PIs to arrange in-person meetings between all collaborators and it would have been helpful to have someone dedicated to this task."
        i. **Response from authors:** We did have a full time staff dedicated to the logistics of hosting in-person meetings, but in our last meeting we decided to hire a trained facilitator, which is the experience we intend to describe in Lesson 4. We have

edited this "lesson in action" to better reflect the specific addition of the trained facilitator at our last all-hands meeting. This section now reads (new text in bold): " In addition to the logistical challenges of arranging a meeting, especially an in-person meeting **with 30-50 attendees**, we found that centralized support in the form of a specified meeting facilitator can increase likelihood of having productive conversations by clearly identifying the purpose and boundaries of conversations. **For our last all-hands meeting as a center, we hired a trained facilitator to help keep our** meeting from spiraling off-topic. **We made this decision after recognizing** that this type of intentional meeting planning takes time to think through well before the meeting, a**nd this planning was beyond the bandwidth of the existing centralized support team who were focused on the logistics and content of the meeting.** Having a trained facilitator also helped us provide an opportunity for all involved to provide input, and support each participant (stakeholder, researcher, or otherwise) in feeling heard. Without dedicated support for facilitation (either internally designated or an external facilitator brought in for this purpose), it is all too easy for someone to dominate the conversation and cause other people to disengage once that happens."

- Lesson 5 – Similar to lesson 3, give a more specific description of where the seismometers were initially planned to be deployed (ex: a rural farm) and where they were eventually deployed for community engagement (ex: a community center near road traffic).
    i. **Response from authors:** Thank you for the suggestion. Thank you for the suggestion. We agree that additional detail on the experience from that pilot would strengthen the paper in Lesson 5, so we have added the following example in the "in action" part of Lesson 5: **"In this case, an installation of a Raspberry Shake seismograph on an upper floor of a condo home near a busy highway, with an interested and invested community scientist, led to a denser network in the area because the homeowner helped find additional local sites, including a site at a local library."**

3. I think it might be helpful to provide an example of how Table 1 was applied to one of the Pilot Projects in the supplement. Or to provide a description of what constitutes as high, moderate, or minimal, particularly for the second, third, and fourth sections of Table 1 in the supplement.
    - **Response from authors:** As we describe in this section on Tangible Tool 1, we developed this rubric primarily for a hypothetical future where a fully funded center could support new pilot pilots and other ongoing work, but also saw potential for teams to use this in an ongoing assessment capacity. In this light, we do not feel providing significant detail on its application is appropriate, since it is a proposed tool rather than one we tested (in the same way as Tool 2). Similarly, we think that minimal, moderate, and high may depend on the values and experience of a specific group, so we are hesitant to provide more prescriptive descriptions of these levels, but agree that they warrant a conversation within a group who is interested in using this rubric. We have added the following sentence in the caption of Table 1to clarify this: **"Before use of the rubric, we recommend that the team discuss what "minimal," "moderate," and "high" means**

in the context of their project(s), as this may be different from one group to another.“

Minor revisions:

1. L85 – I think it’s better to remove the word “too” here. It is not needed to convey the point and adds unneeded judgement.
    a. **Response from authors:** Revised as suggested, thank you!
2. L170-172 – I find this sentence confusing. I would suggest rewording for clarity. A suggestion, “It is difficult to determine how communities with low earthquake awareness will respond to an earthquake and how increased awareness would change their response.”
    a. **Response from authors:** Revised as suggested, thank you!
3. L198 - There is inconsistency on the capitalization of collective impact starting here. It is especially noticeable in the subsection titles on L222 and L265-266. I would suggest capitalizing Collective Impact Method but keeping any mention of collective impact by itself in lowercase. Alternatively, you could abbreviate collective impact to CI as is done in Table 2.
    a. **Response from authors:** Thank you for noticing this inconsistency. Our intention is as you described, to capitalize Collective Impact Model but keep “collective impact” by itself as lowercase. We have gone through to revise the inconsistent instances and believe the manuscript is now consistent with this intention. We have opted to not abbreviate collective impact as CI throughout the manuscript for accessibility and clarity (ie, a desire to minimize the use of acronyms when possible).
4. L209 – coauthor’s should be possessive.
    a. **Response from authors:** Apostrophe added make this possessive
5. L282 – it is referred to as Tangible Tool earlier and now only Tool. My preference is to always say, “Tangible Tool X”, but I think either is fine. Just be consistent.
    a. **Response from authors:** Our intention was to consistently refer to the tools as Tangible Tools, unless being described more generally outside of this numbered framework (eg, “this evaluation tool…”). We have added “Tangible” to the places where we believe they were inconsistent, thank you for noticing the inconsistency!
6. L315 – Similar to the last comment. Pilot Project is referenced previously but it is just called Project A here.
    a. **Response from authors:** Thank you for catching this, we have added “Pilot” to this instance, as it is our intention to refer to the specific projects consistently as “Pilot Project X”
7. L341-344 – this is a run-on sentence. Fix by replacing “projects and center” on L343 with “projects, center”
    a. **Response from authors:** Edited as “**projects, intentional center processes…, and…”** to make the list read more clearly.
8. L460 – are there direct examples of “achieving better scientific outcomes” while employing a community focused methodology?
    a. **Response from authors:** The example brought up in Lesson 1 around “imperfect” sites for the community seismographs here is one strong example of “better” scientific outcomes that are made possible through a community-focused methodology. We have

added a reference to that previous example here. The sentence now reads (new text in bold) “We hope to learn alongside local communities that have been historically marginalized to simultaneously achieve better scientific outcomes, **such as in the example of “imperfect sites” of community science seismographs in Lesson 5**,...”

Reviewer D

Review for manuscript ‘Pathways to engaging in community-centered earthquake science: Lessons learned and tangible tools’ by Y. C. Lin, et al. for publication in Seismica

The manuscript essentially reports on the findings of pilot projects associated with the Center for Collective Impact in Earthquake Science, an NSF GOLD-EN funded propoposal with the program focused on development and capacity building at Minority Serving Institutions. Part of the center’s vision was to improve resilience from seismic hazards in an equitable, accessible, and sustainable manner (https://www.nsf.gov/awardsearch/showAward?AWD_ID=2225395&HistoricalAwards=false). The manuscript describes how the authors used princples of the Collective Impact model to provide tested strategies and tools that enhance community engagement in earthquake science. Perhaps the most interesting and valuable aspect for scientists interested in enhancing community engagement in their research projects and work is the section ‘lessons learned’ that is based on the experiences gained during the pilot projects.

I found this to be an interesting read and thought-provoking. Community engagement and a broader involvement in geosciences are very important. The manuscript is a valuable resource to get pointers what to consider and how to proceed that has been tested via example projects. Publicaton in a seismology journal reaches the scientific audience often challenged by these concepts.

The manuscript is well-written and reads well. The structure is easy to follow. My main point of critique is the length of the manuscript (and most of my smaller suggestions are about shortening). The authors make a good case for why community engagement is important and the need to implement measurable approaches on how to do that providing examples and tangible tools. All could be shortened - I understand the desire to be complete - a more concise paper possibly makes it easier for readers to stay engaged.

> **Response from authors:** Thank you for the suggestion to make the paper more concise and for your thoughtful and detailed review. We have implemented your specific suggestions to shorten the paper and reduce any redundancies below. We want to note, however, that due to other reviewer comments, some sections have expanded to include extra definitions and detail in examples. We welcome additional specific suggestions on how the paper could be shortened and made more readable if the reviewer and editor still find the paper to be too long.

When it came to the pilot projects, described in the supplement, I was surprised about the descriptions - they sounded like cut-and-paste from initial proposals, particularly for the first two - and the lack of specifics with regard to the partners and how they were involved considering the five principles of the Collective Impact model. For example, how was the Raspberry Shake community organized and how did

members interact? We all can go to the Raspberry Shake data server and download data for research projects if we want to. But that was not the point of the pilot. Similarly for the Puerto Rico pilot; seems it involved other scientists and emergency managers (is that correct?). I think the specific examples, or at least one of them, could be expanded in the supplement to provide a fuller flavor of how the community engagement worked (or did not work). This could, for example, include how the tangible tools described in section 4 of the manuscript were used. The tangible tools, particularly Table 2 about initial evaluation, are abstract; an example with 'real observations' could be helpful.

> **Response from authors:** Thank you for the suggestion. We have added new rows to the table (Table S.1) that specifically call out how different elements of collective impact were applied in each project. Additionally, we added a "real" outcome from Table 2 in Lesson 2 (last sentence of "Lesson 2 in action").

Along a similar line, I found the 'Lessons in action' to be too abstract. For example, the text in 'Lesson 5 in action' is so general that it could be written completely independent of any actual pilot project. What are the actual experiences from that pilot? Anyone can buy and set up a Raspberry Shake. Did the leads of the pilot interact with citizen scientists who had installed one and talk about considerations where to place them? Of course, the sensors need power and internet, that places serious restrictions on where they can be placed.

> **Response from authors:** Thank you for the suggestion. We agree that additional detail on the experience from that pilot would strengthen the paper in Lesson 5, so we have added the following example in the "in action" part of Lesson 5: **"In this case, an installation of a Raspberry Shake seismograph on an upper floor of a condo home near a busy highway, with an interested and invested community scientist, led to a denser network in the area because the homeowner helped find additional local sites, including a site at a local library."**

For Figure 1, I would suggest to focus on the big picture items in both parts - General Description and Applied In C-CIES- for each of the five principles. I got lost reading the text and found the graphic not very effective because of that.

> **Response from authors:** Please see response below in the detailed comment related to Figure 1

This is an interesting manuscript and could be very useful for scientists trying to improve community engagement in their work. Publishing the manuscript in a seismology journal increases the chance that it reaches the target group.

> **Response from authors:** We thank the reviewer for their careful review and thoughtful comments, and support of the paper's placement in a journal like *Seismica* to reach the intended audience.

Line L69. Perhaps be more specific about the geoscience workforce. The numbers refer to the U.S., I assume.

Response from authors: Thank you for noting this ambiguity. We have added clarification in the mentioned statistics to clarify the scope of these statistics: "By measure of geoscience Ph.D. recipients **earned by United States (U.S.) citizens and permanent residents,**" and "Within the broader geoscience workforce **in the U.S.**," (new text is bolded)

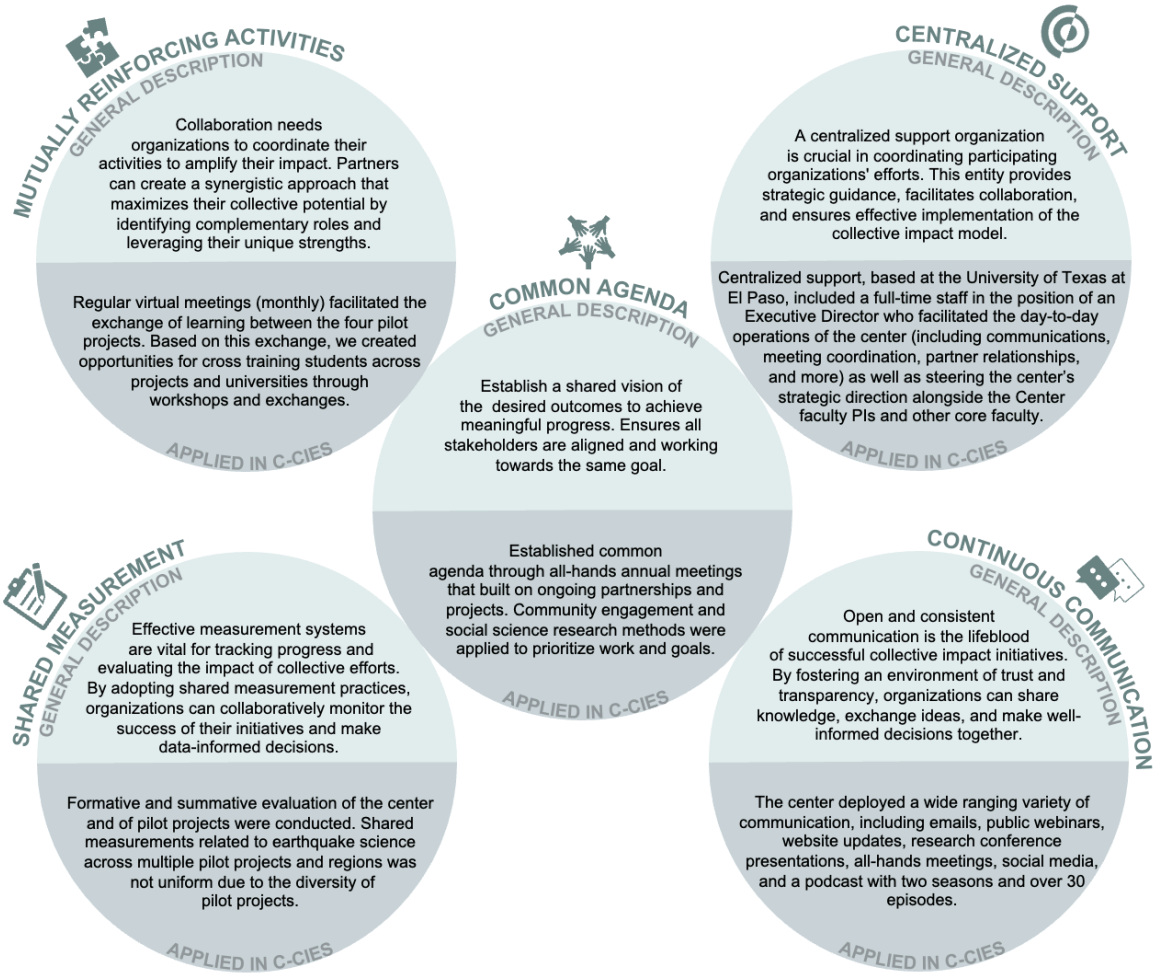
L116. cut '(see Figure 1)' - The next sentence starts with 'Figure 1 provides …'

Response from authors: removed as suggested

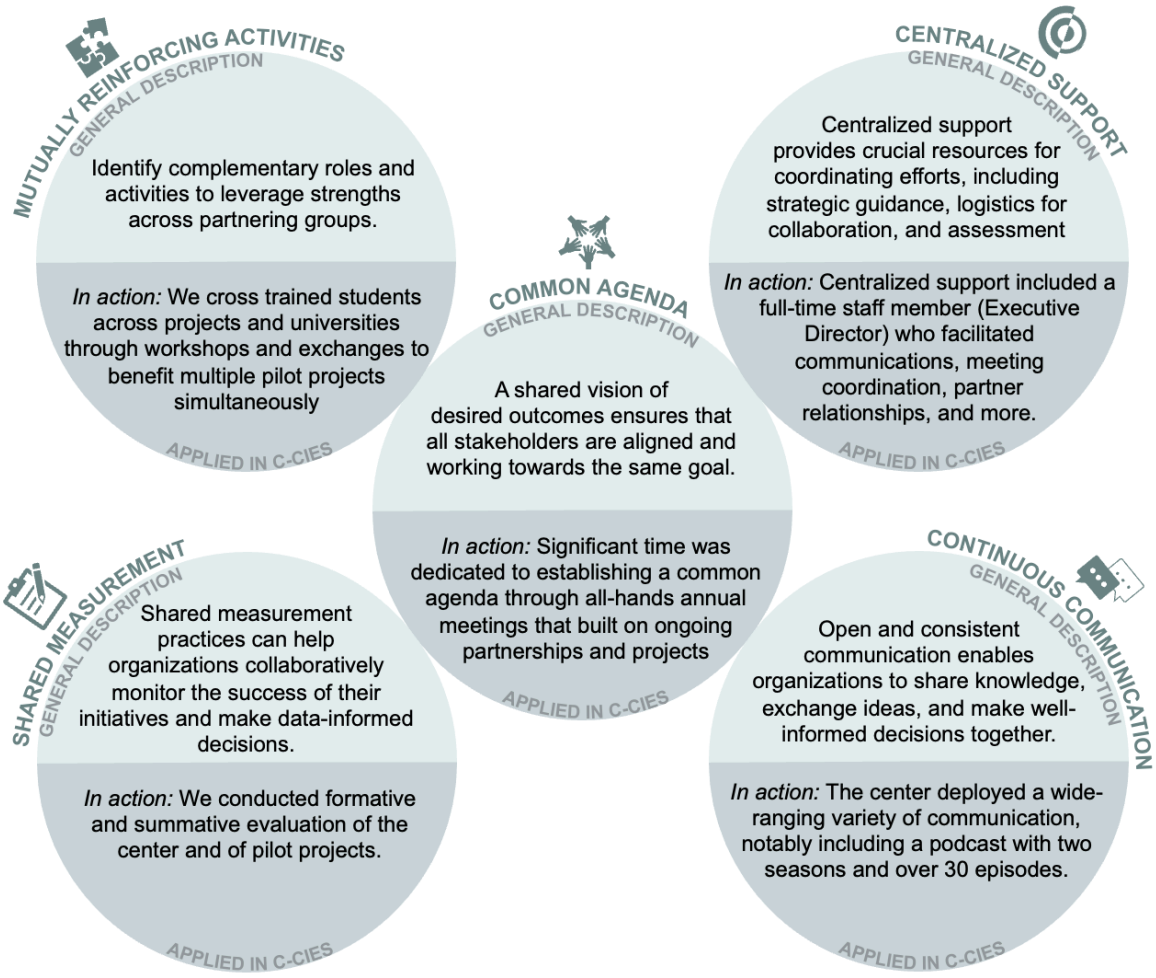
Figure 1. If possible, please reduce the text. This is not a figure but a summary of the method and C-CIES implementation. That's a lot in a 'figure.' I think any reduction would make it easier for readers to digest the figure. Perhaps distill the text to the bigger picture from the model and implementation part for each principle.

Response from authors: Thank you for this feedback, and we agree this was a lot of prose to pack in one figure. We have shortened each of the descriptions and increased the font size so that the information is more accessible.

Figure before:



New revised figure:



L156. remove ‘of this core team’ as it is redundant.

Response from authors: removed as suggested

L157. perhaps place ‘the’ in front of ‘New Mexico’?

Response from authors: revised as suggested

L158, 159. Perhaps cut co-author as this is clear from the context (line 156-157).

Response from authors: We have decided to include this because we feel it provides additional context for the reader and does not take up too much extra space.

L159-160. ‘which are notable … Institutions.’ is redundant, see lines 150-151 and 155-156 were this is already explained.

> **Response from authors:** This phrase has been removed as suggested.

L168-169. ‘… eartquakes occur — for example, away from plate boundaries (Liu & Stein, 2016) where … for earthquakes’ — no need for ‘generally’. Not sure to what the reference is referring to (plate boundaries?).

> **Response from authors:** We have removed “generally” as suggested. The reference refers to intraplate earthquakes (away from plate boundaries) that we are focusing on as part of the HiC-LoFI earthquakes. To clarify, we have added: “...away from plate boundaries and where spatiotemporal patterns of earthquake occurrence are not well understood (Liu & Stein, 2026).“

L178-181. I get the point, but most (?) magnitude ~6 earthquakes near densely populated areas cause significant damage. For example, the Wiki page for the M5.9 1987 Whittier Narrows earthquake lists $213-358 million in the Los Angeles area where people are aware of earthquakes and larger earthquakes are not HiC-LoFI events.

> **Response from authors:** We agree that these events also cause significant damage, but that higher awareness and better understanding of the hazard allow for greater investment in earthquake resilience (eg, through building codes, earthquake insurance, awareness of drop cover and hold on, etc).

L185. ‘about other aspects’?

> **Response from authors:** revised as suggested

L194-196. This sentence is how C-CIES worked in terms of student involvement but seems not relevant w.r.t the projects. At least it is not clear why the sentence is there.

> **Response from authors:** Student involvement was a critical component of the pilot projects, and projects were designed such that students could receive training across projects, institutions, and institutions. To clarify the link between this and the previous sentence, we have reworded this sentence to read (new text in bold): “O**ne way that projects promoted interdisciplinary research was through** funded students (graduate and undergraduate) **who were** cross-trained between projects, **disciplines,** and institutions. “

L208-209. ‘and other … science’ starts to sound repetitive. This has already been said and explained in the opening section.

> **Response from authors:** Removed as suggested.

L210. ‘in the context of earthquake science’ can be cut. The section heading says that already.

Response from authors: Removed as suggested.

L209-210. no need for ‘from the coauthors cumulative experiences’ as the next sentence picks up on the coauthors experiences. Please do not repeat things in a single paragraph.

Response from authors: we have revised these sentences to remove the redundancy you have pointed out. These sentences now read: **“To address this challenge, we share five “lessons learned” that are based on our two-year catalyst center and other related experiences of the coauthors. These “lessons learned” are intended to support other earthquake scientists interested in engaging in community-centered research. “**

L234-235. Not sure if the examples are needed. Essentially each seismologist sooner or later is interviewed and quoted.

Response from authors: While we acknowledge this may be a common occurrence for seismologists, we provide these examples as specific instances where our team has engaged in this way as we expect some of the readers interested in this paper to come from additional backgrounds where such interviews/quotes may be less common.

L321. ‘… was about to consider how …’ - did you think about considering it or did you consider it? In the latter case, simply say ‘our group considered …’?

Response from authors: This was a typo, it has been revised to say **“able to consider”**

Table 1. There’s something missing in ‘Potential to motivate …’ between ‘patnerships’ and ’scientific’?

Response from authors: Thank your for catching this, we have added “between” to correct this.