2025 December 17
Response to reviews
Seismica Article 1588

Title: Spatial Changes in Earthquake-Generated Ground Motion Observations: An Examination of Seven Small Aperture Arrays in Southern California
Authors: Debi Kilb & Frank Vernon

In the below we respond the reviewers' comments and concerns, where their comments are in BLACK and our response is in INDENTED BLUE ITALICS.

Response to Reviewer A comments

Data & Methodology Questions:

What types of magnitudes are the reported magnitudes?

We have now updated the manuscript to state that we are using local magnitudes.

What is the range in record distances (e.g., Repi, Rhyp or Rrup)?

For clarity these parameters are epicentral distances (Repi), hypocentral distances (Rhyp) and rupture distance (Rrup, the shortest distance from the station to the fault plane). The original manuscript stated that all earthquakes within 150 km of each array's centroid were considered for use in the study. Including the hypocentral distances is akin to providing the depth extent of these data. The depth information was included in the original manuscript in Table 1. Because the majority of the earthquakes are small ~2.5, the Rrup distances will be equivalent to Repi. No change was made.

Regarding the removal of the M5.41 event, were you concerned about the large event contaminating the small aftershocks, or the small aftershocks contaminating the main shock? Were the aftershocks in that sequence also removed?

We were concerned that the aftershocks from the M5.41 would elevate the mainshock waveform amplitudes, and that potentially aftershocks hidden in the coda of the M5.41 would not have been identified. Aftershocks of the M5.41 event were not specifically flagged for removal, but many events in the Salton Sea region were removed during our test to assure adequate temporal/spatial separation between consecutive events, as stated in the original manuscript.

For SNR calculations, why calculate signal starting before the P-wave arrival?

The P-wave arrival times are theoretically estimated and could be in error. To make sure we include the full earthquake signal we assume these errors might be 2 seconds and adjust the assumed arrival time accordingly (i.e., theoretical P-wave arrival time minus 2 seconds). In this way, if the theoretical estimate is late, we have a better chance of capturing the start of the signal. If the theoretical estimate is too early, no harm done as the early start time will only include noise data. The original manuscript stated, "This two-second gap between the end of the noise trace and the expected P-wave arrival is precautionary and allows for errors in the theoretical seismic wave arrival time estimates." A statement we think sufficiently describes our choices. No change was made.

For the fourth data quality test, what ground-motion model did you use to predict PGA and PGV? Is it the Abrahamson et al. (2014) model mentioned later? Could you elaborate on this, as well as indicate whether you used reference rock values or variable site conditions

in the model?

Thank you for pointing out that we need additional clarification here. We used the Abrahamson et al 2014 rock values, we did not use the variable site condition models. We have updated the text to make this clear to the reader.

Are PGA and PGV computed on all three channels or just the horizontals. Since you are comparing them with model estimates which use rotd50, it would make the most sense to compare with rotd50 ground motions in your dataset.

We are computing PGA and PGV for all three channels. The reviewer makes a good point here, but we find it informative to also include results from the vertical components, as they provide additional information about how variable the ground motions are between the three components and within the array. Previous ground motion studies have successfully used vertical ground motion information to move the science forward (Johnson et al., 2020), and here we follow their lead.

Results & Discussion Questions:

Is it possible the COV in PGA and PGV and the percent of stations recording the same event for maximum PGA and PGV could be influenced by differences in azimuthal coverage between the arrays or the spatial extent of stations within each array?

The azimuthal coverage does not change substantially between the seven arrays, so we do not think that azimuthal coverage is skewing the COV results. We did explore if the COV values are dependent on azimuth, but because the azimuthal distributions are highly non-uniform the error bars are extremely large, making it impossible to discern anything useful from the distributions. We next investigated if 2the COV are dependent on the spatial extent of the arrays (see table below). Because the spatial extent of the TR array is almost three times larger than all the other arrays spatial extent, if there was a spatial footprint signature within the COV, the TR array COV results would drastically differ from the other COV results. That is not what we observe (see below table; values also listed in Figure 9), this shows a lack of correlation between the COV and spatial footprint sizes. In the original manuscript we noted that the COV for the SG array had the largest variability, but the smallest spatial footprint, which likely stemmed from the array spanning multiple basin structures. No change was made.

Array	Median COV (Velocity)	Median COV (Acceleration)	Spatial extent of the array (km)
SG	38%	38%	0.15
BB	34%	32%	0.18
JF	30%	26%	0.37
RA	30%	28%	0.46
DW	30%	30%	1.10
PY	28%	32%	1.10
TR	32%	28%	2.9

Do you observe the same ground motion trends for events originating within the fault zone an array crosses vs originating on another fault?

Good question. We think the manuscript is already quite lengthy and so we reserve

this type of a more in-depth study for a future study.

Is it possible that some of the spatial variation in ground motion with respect to fault core proximity could be biased by your approximation of what is considered the width of the fault zone?

Yes, that certainly could be the case, and it is an important factor, thank you. We have added this additional text to the Figure 10 caption: "These are preliminary results as the exact location and width of the fault are estimates."

Throughout the manuscript, you mention the presence of basin structures. Do any of them have well-known names in the literature, and are there any references you could provide identifying these basins? This would help better orient the readers.

We searched the literature, and to our knowledge, these small basin structures along the San Jacinto fault zone are not named, so no change was made.

Organization:

For the paragraph starting on Line 80, the discussion is heavily biased towards the influence of site effects on ground motion with minimal discussion of the source and path. In hindsight, I can see why the authors chose to structure it that way, as site effects likely contribute the most to variations in ground motion in this study. This is not immediately clear in the introduction though. I think it would be beneficial to add a little more discussion to the source and path and perhaps emphasize early on that the site effect variability can have a strong influence on ground motion, even within a small geographical area.

Thank you, great suggestion! We have added an additional paragraph to the introduction to address this concern. Great idea, thank you.

The Methods section feels extremely sparse, especially compared to the length of the Data Processing section. Since the meat of the paper is not in the data processing, I would recommend restructuring these sections to feel a bit more balanced and expanding the methods section to address why you are computing PGA and PGV and comparing them to a GMPE?

The reviewer makes a very good point! We have now combined the Data Processing and Methods into a single section, as it proved too difficult to try and separate them.

Much of the conclusion includes information also repeated in the discussion. I would suggest removing some of this duplicate text (such as the % of data removed during quality checks) and focus on the key takeaways. Your results are very interesting, but I feel like they sometimes get lost amongst all the other data processing information! It would be beneficial to tie this back to your question of whether ground motions recorded a single site (which might be far from dense populations) can be extrapolated to nearby regions.

We thank the reviewer for the excellent suggestion. We have followed their guidance and updated the conclusion section of our paper to focus on the key takeaways. The conclusions section is now much more concise. Thank you.

Rather than include the URL to your Zenodo datasets in the data section, you could create references to the datasets and add them to your Reference list.

Good idea – this has simplified things substantially. Thank you for these suggestions. We have updated the manuscript to follow the reviewer's recommendations. The manuscript now refers to four Zenodo references.

Minor Comments:

Is it possible to include a subscript with the array abbreviations to indicate whether they span a fault or not? I had trouble keeping track of all the arrays and the implications of the results at each array.

No change was made. The reader should be able to easily get this information from Figure 2 and the figures in the appendices.

Lines 52–53: I would suggest rephrasing the sentence starting with “Ground motions within (off)…”. It took me a few reads to realize “(as expected or smaller)” applies to the off-fault ground motions.

Thank you for the suggestion, the text has now been updated accordingly.

Line 56: List of array diameters probably not necessary, especially since this is within the non-technical summary and isn’t included in the main abstract.

We respectively disagree. The original abstract stated that the apertures of all the arrays were less than 3 km. We find that including the exact aperture lengths in the non-technical summary adds important information for the reader. No change was made.

Lines 92–95: Definitions of low and high Vs30 should be switched

Thank you so very much! Good catch; now fixed.

Line 99: I would recommend changing “minimal” to “flat”.

Good idea, text has been modified accordingly. Thank you.

Lines 166–167: I’m not concerned with potential overprinting from such small events, but perhaps add a statement at the end of the sentence mentioning how these would likely not bias the results.

Thank you, great idea, the text has been updated accordingly.

Lines 256–257: This is a stylistic preference, so you may choose to ignore this comment, but I find the use additional cases in parentheses a bit arduous to read. In particular, this sentence “Acceleration (velocity) data are converted to velocity (acceleration) using integration (differentiation).” Although your syntax is more succinct, as I reader I would prefer it to be written as “Acceleration data are converted to velocity through integration, and velocity data are converted to acceleration through differentiation.”

The other reviewer pointed out a similar dislike to a different part of the manuscript. As both reviewers do not like this format, it is clear a change is needed. The text has been updated accordingly in both places.

Line 261: Please define GMPE

Good catch, thank you. The text has been modified accordingly.

Lines 343–344: Can you mention in the main text how you define being within or outside a fault zone? You mention in the caption for Figure 10 that it’s an approximation from Pischiutta et al. (2024).

Thank you. We now see the confusion. This paragraph is comparing the small aperture arrays that are deployed across faults with those that are not deployed near faults. Here, we are not attempting to pin-point the fault trace locations with respect to the stations. We have added additional text to this paragraph to better clarify these goals. We thank the reviewer for pointing out this problem.

Lines 402–403: I find the sentence starting with “Three PGA and two PGV measurements flagged three or more earthquakes…” confusing. Could you rephrase this?

Thanks for pointing out that this sentence is confusing. For clarity, we have completely rewritten this paragraph. Now, instead of attempting to rank the results, we simply point out which earthquake is usually responsible for generating the largest ground motions across the array. This has simplified the text substantially. Thank you for this suggestion.

Line 422: What do you mean by “complex”?

We have modified the text to add a more specific description as to what we are calling complex.

Line 515: Do you mean 0.22 cm/s?

Thank you so much, yes that is what we meant. The text has been updated accordingly. Great catch, thank you.

Figures and Tables:

This paper could be improved by including some figures showing the spatial variability in ground motions. Perhaps a map with stations colored by PGA or PGV and arrows showing azimuthal direction of peak ground motions.

Thank you for this suggestion. Such a figure, however, would indicate that ground motions from similar directions net similar results. That is not necessarily the case. Ground motions can sometimes change as a function of azimuth (as suggested by the reviewer), but also depth and magnitude, or combination thereof. We find that this type of variability is more easily described in words than in attempting to include a suite of different examples.

In the original manuscript, which also remains in the revised manuscript, we do note that for the BB network, that the “largest ground motions reported on the southwest side of the fault were from seismic waves arriving approximately perpendicular to the fault, and those on the northeast side from seismic waves arriving approximately along fault.”

That said, if there were some consistencies, or if we were looking at a much smaller data set, this would have been an excellent addition to the manuscript. No change was made.

Figure 1: I’m not sure the red box is needed or the events not within any of the three circles as they are not used for this study. What are the squares vs stars?

The events outside the circles, but within the red box are used to identify events close in space and time. Because of that, we will keep the red box for clarity. We now include this information in the figure caption. We have also updated the caption to note that the earthquakes M<5 are blue squares, earthquakes M5+ are blue stars, and that the network locations are shown with orange triangles along with their network codes.

Figure 2: Again, what are the squares and stars?

The figure caption has been updated accordingly to make sure all symbols in the figure are described in the caption.

Figure 4: Might be helpful to include “Duration” or “Window” in each subplot to indicate what the number means, especially since “SNR” is labeled. Or perhaps explicitly mention in the caption that the “network, station, earthquake ID, waveform duration, and SNR” correspond to the text from top to bottom on each subplot.

As suggested, we have added additional information to the figure caption. Thank you. Good idea.

Figure 5: Why for some records does the P-wave amplitude appear larger than the S-wave amplitude?

The reviewer is correct to question this as typically the S-wave is larger amplitude than the P-wave. There are some situations, however, when that is not the case. These include but are not limited to (1) recordings near the source where the P-wave has minimal time to attenuate and the S-wave is not fully developed. This typically

happens for vertical strike-slip events where the station is directly above the earthquake. (2) Radiation pattern effects when the recording is near a S-wave nodal plane. (3) Regions that have strongly different P-wave and S-wave attenuations, such that the S-wave energy is attenuated faster than the P-wave energy. (4) Filtering, as 7the P-wave can carry higher frequency energy. (5) Recordings on vertical components, as is the case for Figure 5 in question, typically show higher P-wave energy than S-wave energy because S-wave are primarily contained in the horizontal components. No change was made.

Figure 8: Is "true" in "log(true/observed)" referring the model? If so, I would not consider that the true value because it's an estimate. I would change "true" to be "model", "predicted", or "estimated".

Good suggestion – the text within Figure 8 has been updated as suggested using the word 'model'. Thank you.

Figure 10: I'm not sure it makes sense to reference the stations located at the fault core since you do not include any figures showing the individual stations. On line 451, I think you mean +/- 100 meters!

We have updated the Figure 10 caption to include a reference to individual station maps in the Appendix, which show the stations distribution, labeled station names and USGS fault traces. These can be used to confirm our estimates of which station is the closest to the fault core. We have also added a summary statement to the figure caption to make it clearer that the fault core locations and fault zone widths are estimates, and these results should be considered preliminary. Also, thank for catching our mistake – 100 km has been changed to 100 meters. These changes have improved the manuscript, and we thank the reviewer for these suggestions.

Figure S1: The caption was a bit confusing to read. Figure 6 has all arrays, but this figure is for stations within one array. Could you clarify that in the caption?

Thank you for alerting us to this problem. Figure S1 caption has been updated accordingly.

Figure S2: Should this say "As in Figure 6"? Also, the figure caption could be clarified ^^

Thank you for alerting us to this error. We have added 'As in Figure 6' as suggested. We have also updated Figure S2 similar to the updates suggested for Figure S1.

All the tables could probably be moved to the supplement.

We prefer keeping the tables in the main text, so they are easier to refer to. No change was made.

Figure S3: Should this say "As in Figure 6"?

Thank you. We have updated the Figure S3 caption accordingly.

Figures A1–A7: Could you add the abbreviation for each array in the captions?

Great idea. We have updated the Figure A1-A7 captions accordingly.

Table 1: Units for depth range?

Good catch, we have added that the depth units are km in Table 1. Thank you.

Tables 4a-4b: The colors are a little confusing. Why are there two colors for the third most common?

Thanks for this feedback. Originally, we struggled with how to add color-coding to assist the reader, good to know what we selected is not resonating. We have updated the table using a simpler approach. We no longer rank these results, as that unduly complicated things as the reviewer pointed out. We have also moved away from multiple colors and now only use a single shade of blue in Table 4a and a single shade of green in Table 4b. These color-coding's now highlight which event is typically responsible for generating the large ground motions within the array, while

also exhibiting that rarely is a single event responsible for the large motions across all stations in a network. The text in the manuscript and table captions have been updated accordingly.

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Response to Reviewer B's review

General Comments

1. Please check out our ScienceBase compilation (https://www.sciencebase.gov/catalog/item/6183f02cd34ec04fc9bf7f8f) and NCEE white paper (attached) both by Huddleston et al. regarding available Vs30 proxies and measured data (described in lines 98-107). We corresponded closely with each of the authors of the three 3 proxies often used in the absence of measured data based on 1) geology (Wills et al., 2015), 2) terrain (see refs below), and 3) mosaic (a hybrid approach that utilizes regional VS30 map insets or topographic-slope based proxies) approaches. The authors do a good job citing the appropriate references but the sentence "Where there is a lack of additional information, topographic slopes can be used as proxy for Vs30 values" isn't entirely accurate. Technically the Yong paper uses the terrain proxy (physiographic province) and Wills et al. uses geology. The wald paper uses topographic proxy (and is behind the Heath paper cited which is a mosaic of the topographic proxy and available measured data). There are details to the mosaic – I think maybe in California the geology proxy is incorporated? Just providing some clarity/insight here in case it is useful. I would just tweak the sentences slightly to acknowledge the various available proxies using the refs below (feel free to use the description in our compilation/NCEE paper) and 9then continue highlighting the importance of the variability in these values and differences when measured data is available.

Huddleston, G.J., Schleicher, L.S., Gee, L.S., Steidl, J.H., and Knudsen, K.L., 2021, Compilation of Geologic
and Seismic Velocity Characteristics at Advanced National Seismic System Strong Motion Accelerometer
Sites: U.S. Geological Survey data release, https://doi.org/10.5066/P9YKIUW2.
Geologic Proxy (Wills et al., 2015)
Wills, CJ, Gutierrez, C, Perez, FG, and Branum, D. A Next Generation VS30 Map for California Based on Geology and Topography, Bulletin of the Seismological Society of America, 105(6), 3083-3091. https://doi.org/doi: 10.1785/0120150105, 2015
Terrain Proxy (Iwahashi and Pike, 2007, Yong et al., 2012, Yong, 2016)
Iwahashi,J. and Pike, RJ., Automated classifications of topography from DEMs by an unsupervised nested-means algorithm and a three-part geometric signature, Geomorphology 86, 3-4, 409-440. https://doi.org/10.1016/j.geomorph.2006.09.012, 2007.
Yong, A, Hough, SE, Iwahashi, J, and Braverman,A .A terrain-based site - conditions map of California with implications for the contiguous United States, Bulletin of the Seismological Society of America, 102, 1, 114-128, 2012.
Yong, A. Comparison of Measured and Proxy-Based VS30 Values in California, Earthquake Spectra 32.1: 171-192, 2016.
Mosaic (Allen et al., 2007, Thompson et al., 2014, Heath et al., 2020; Huddleston, et al., 2021)
Allen, TI, and Wald, DJ., Topographic slope as a proxy for global seismic site conditions (VS30) and amplification around the globe U.S. Geological Survey Open-File Repor t 2007-1357, 69 p., 2007.

Thompson, E, Wald, D. and Worden, C. A VS30 Map for California with Geologic and Topographic Constraints Bulletin of the Seismological Society of America. 104. 2313-2321. https://doi.org/10.1785/0120130312, 2014.
Heath, DC, Wald, DJ, Worden, CB, Thompson, EM, and Smoczyk, GM. A global hybrid VS30 map with a topographic slope– based default and regional map insets Earthquake Spectra. https://doi.org/10.1177/8755293020911137, 2020.

Thank you so much for this information, it is extremely helpful. We have completely revamped the paragraph on Vs30 as suggested by the reviewer and included the suggested references. The reviewers input really helped improve this portion of the 10manuscript. We thank the reviewer for taking the time to list all these references and summarize them into specific categories.

2. The authors do a good job describing the database used in the analysis, including maps of the arrays and earthquakes used in the analysis and what datasets were removed from the analysis and why. I think it would be useful if possible to list the full database as an electronic appendix so its clear what was used and excluded – just as a way to strengthen the paper and make it reproducible. Network and earthquake catalog information changes all the time. I leave it up to the journal editors on if this is a good idea or not though. Figure 3 – just a compliment that I find this figure particularly useful to visualize data availability at each of the sites. With the region of interest being southern CA, I was curious about the influence of the 2019 Ridgecrest mainshock and aftershocks and I think the authors do a good job covering that.

Good idea to assure that the work is reproducible! We now include the full database as a Zenodo csv file and have updated the text accordingly.
Kilb, D., & Vernon, F. (2025). Southern California earthquake catalog (ComCat, magnitude
2.5+, 2010-09 to 2023-06 (Version 1) [Data set].
Zenodo. https://doi.org/10.5281/zenodo.17931800

3. Another compliment – the authors do a good job outlining how the SNR was determined to ensure a quality input dataset. I think these points are well highlighted giving the analysis credibility. I was wondering how the SNR was analyzed. Did you use gmprocess or your own seismology coding approach? If you haven't used gmprocess, it would be interesting to take your dataset and run it through and see how its quality flagging compares to your quality checks. The quality checks in gmprocess have advanced significantly. Just an idea – but this could be a follow up study or just something to strengthen/validate the current study optionally.
https://code.usgs.gov/ghsc/esi/groundmotion-processing/

Thank you for this information – we were not aware of the gmprocess software. We have downloaded the codes but have had trouble getting them compiled and working. Looking at the associated references, we see that the gmprocess software uses different frequency bands and derived corner frequencies to compute the SNR. This is a much more elaborate method than what we have used in our work, and we agree it is a more robust approach. We look forward to figuring out how to use this method in the future, but for this project we think our current method is 11sufficient to make the binary decision of "good data" vs "bad data." This conjecture is support by the examples presented in Figure 4 in the original manuscript. Additionally, our results are used as a continuum, not as individual findings, so any errors introduced by inaccurate SNR values would likely be averaged out when the data is examined in aggregate. While we appreciate these suggestions and do plan to figure out how to use the codes in the future, we found it out of the scope of this

work to implement gmprocess for this work.

4. Line 84 – I think the authors do a good job discussing the impact of directivity and it seems like the database covers a variety of earthquake orientations given the region/timespan. Just a comment/compliment – nothing to resolve. If anything some of the applications of the use of the results from this study could perhaps be outlined in the interpreations/conclusions – what should people do with these results – apply X uncertainty on the values if X distance? Would that work at least in the region of Southern CA where this study was done in the authors' opinions?

Thank you for this comment/compliment – the reviewer noted that there was 'nothing to resolve' here, so no changes were made.

Response to Reviews (Round #2)
18 June 2026
Seismica Article **#1588**

Title: *Spatial Changes in Earthquake-Generated Ground Motion Observations: An Examination of Seven Small Aperture Arrays in Southern California*

Authors: Debi Kilb & Frank Vernon

In the below, we respond to the reviewers' comments and concerns, where their comments are in **BLACK** and our response is in ***BLUE ITALICS.***

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Reviewer A

Hi, I think the revised paper looks great! I don't have any comments and hope to see it published soon.
Recommendation: Accept Submission

We thank Reviewer A for the thoughtful and encouraging comments and for the helpful suggestions provided in Round 1 of this review process.

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Reviewer B

This review is for the revised version of the original manuscript. I thank the authors for their thorough responses to the review comments, and I believe the clarity of the revised version of the manuscript is improved. The science is sound and the results provide valuable insight on the near-fault influence on ground motions, as well as the high spatial variability over short length scales.
Thank you for the kind words.

However, I find myself having some of the same thoughts that I had the during the first review regarding the organization of the paper. In particular, I feel that the authors heavily focused the paper on the data processing and screening, leaving less room for discussion and interpretation of the results (which are really interesting!). **I believe much of the in-depth details of the processing could be moved to the supplement, along with several of the figures, while keeping a more succinct summary in the text.** As my comments are mainly stylistic, I will leave it up to the editor and authors to determine whether they are worth addressing.
We thank the reviewer for their careful consideration of the manuscript and have updated the manuscript accordingly.

General

- As mentioned in my summary above, the manuscript feels predominantly focused on data processing. Although it is relevant and definitely worth detailing, I found myself getting lost in those

sections and forgetting what the main focus of the paper was. I think that moving the in-depth data processing discussion to the supplement would help address this, especially the section on the signal-to-noise ratio. In relation to this, I believe there are too many figures before we get to main results of the paper. Figures 4-7 that focus on the data processing and screening could probably be moved to the supplement.

We thank the reviewer for carefully explaining the issue. We agree that the data processing section of the manuscript was overwhelming the manuscript and that a change was needed. Thank you. We have moved Figures 4-7 to the E-supplement.

• If some of the figures are moved to the supplement, that allows for more figures focused on the results. Although I appreciate the figures the authors have currently included, I think additional figures would strengthen the paper and help readers better visualize what is being discussed. For example, the paragraph starting on line 440 discusses several stations in relation to the fault and EQ azimuths that generated the strongest ground motions. Could you add a figure here plotting the stations, fault, and EQs? This is one example, but there are several other places a figure could be useful.

Good idea! After moving Figures 4-7 to the E-supplement, of the 10 figures in the main manuscript six remain. We agree this makes room for additional figures, and as suggested we now include a detailed study of the BB array Ground Motion Dichotomy Across the Fault, described in more detail below.

• The authors might consider adding sub-headings in the results section.

We appreciate this suggestion and have added sub-headings to the Results section. These additions improve clarity and make the manuscript easier to navigate. Thank you.

• I would not refer to the Abrahamson et al. (2014) model as “theoretical”. I would consider it more empirical, or semi-empirical. The way the sentence is written, it seems to imply the GMPE provides the only true theoretical estimates (rather than being one of many empirical GMPE’s for the region). Additionally, it would be useful to add more information about why you are comparing your observed ground motions to the model estimates (rather than just directly comparing peak amplitudes between the arrays).

The reviewer brings up a good point – we have changed the text from ‘theoretical’ to ‘empirical’. This update required several changes throughout the manuscript. For clarity, we also now include the below information in the manuscript.

Although the arrays are spatially compact, small variations in source-to-site distance, radiation pattern, and site conditions can still dominate absolute peak amplitudes. Comparing observations to empirical estimates provides a reference frame for identifying residual ground-motion behavior that is spatially coherent across each array.

• I’m a bit confused about the network.station IDs. Throughout the text, PY is referred to as one of the arrays, but the Net.Sta code is PY.BP*, so wouldn’t BP be the array?

We have chosen to retain the designation 'PY' for the PY.BP* array because it more clearly identifies the array's location (Pinyon Flat Observatory) for the reader. This is consistent with the location-based logic underlying our other array names: BB = Blackburn Saddle, JF = Jackass Flat, DW = Dry Wash, etc. We have added the following sentence to the first paragraph of section 2, which is the first mention of PY, clarifying this designation.

> ***“Array names use two-letter codes that represent the geographic region: BB = Blackburn Saddle, DW = Dry Wash, JF = Jackass Flat, PY = Pinyon Flat, RA = Ramona, SG = Sagebrush Flat, and TR = Transect.”***

Figures/Tables

• Figure 8 caption: Please specify what the red and dashed green lines represent.

We have updated the caption to make it clearer as to what the red and green lines represent. Thank you.

• Figure 9 caption: The first sentence is a bit difficult to follow.

Good catch – we have updated the caption for clarity.

• Table 1: PY and BP are not defined.

Thank you for catching this mistake, the table caption has been updated.

Line-by-Line Comments

• Line 98: “seven small aperture (< 3 km diameters) arrays”

Thank you. The text has been updated -- we added the word ‘arrays’ as suggested.

• Line 101: I would rephrase this to say site terms are “influenced by Vs30” or they are often modeled using Vs30 scaling.

Great suggestion. The text has been updated accordingly.

• Paragraph starting on Line 107: I’m not sure this Vs30 paragraph is all that relevant? I know this was added in response to another reviewer’s comment, but I think they could state in one sentence that Vs30 can be approximated using a variety of methods.

This is a good point; the reviewer is correct in that this paragraph is not necessarily needed. However, it does provide a nice summary of the topic, which will be helpful for us, and hopefully others, to refer to in the future. While we recognize that a shorter summary could suffice, we believe the paragraph provides useful context and background for readers and therefore have opted to retain it.

• Line 125: “and allows for an increased understanding”

Thanks for catching this grammar mistake – the text has been updated accordingly.

• Lines 417-423: These two sentences include repeated information. Maybe replace with “Five of the arrays are close to consistency, with only one station reporting maximum ground motion from a different earthquake. Four of these five networks (JF, DW, TR, and RA) show the outlier station is at the edge of the array, which is more intuitive than in the middle of the network, as observed within the SG network (station SGBS2 mid-network).”

Excellent suggestion. Now updated. Thank you.

• Sentence on lines 427-429 is a restatement of the sentence starting on line 408.

We expect the line-408 number reference is in error and instead it should be line-393 that points to this text:

“We posit that this large variability stems from the multiple basin structures within this region that produce signal reverberations that can potentially increase ground motion variability.”

We agree that repetition should be avoided. Here, however, we reiterate the basin-structure explanation to connect the earlier discussion with the new results presented in this section. We have clarified this linkage in the revised text.

• Paragraph starting on line 440: I think adding a little more discussion here would be useful. Why do you think you observe these azimuthal differences? Is it because of the fault zone? Do you think the seismic amplitudes from the EQ in the southwest attenuated when crossing the fault? Or is it possible this was a source effect (high stress drop or directivity effects)

Thank you for pointing this out. We have greatly expanded this section by adding seven additional sub-sections (4.6.1 BB array: Ground Motion Dichotomy Across the Fault; 4.6.2 BB array: Signal-to-noise ratio (SNR); 4.6.3 BB array: Seismic Moment; 4.6.4 BB array: Stress Drop; 4.6.5 BB array: Waveforms; 4.6.6 BB array: Directivity; and 4.6.7 BB array: focal mechanisms) and 5 new supporting figures too (4 in the main manuscript; 1 in the E-supplement) in addition to a new csv table in the supplement that contains focal mechanism information. Our findings suggest that source directivity is driving these observed ground motion differences. Fault Zone trapped waves (FZTW) might also be at play, but because the aperture of the array is so short (~180 meters) we are not able to confirm or deny that conjecture. The discussion section was modified to include these new results.

OLD Figure list:

Figure 1. Study region (full scale)
Figure 2. Study region (zoom)
Figure 3. Network deployment durations
Figure 4. SNR examples (moved to the E-supp; now Figure S1)
Figure 5. Waveform duration and move-out (moved to the E-supp; now Figure S2)
Figure 6. SNR histograms (moved to the E-supp; now Figure S3)

Figure 7. Non-seismic signals (moved to the E-supp; Now Figure S4)
Figure 8. Results summary histograms
Figure 9. Coefficient of variation
Figure 10. The 'M' pattern
Figure S1. As in SNR Figure 6, but for individual stations in the SG network.
Figure S2. As in SNR Figures 6, but for individual stations in the RA network.
Figure S3. As in SNR Figures 6, but for individual stations in the TR network.
Figure S4. An example of car traffic signals recorded by the RA array.

NEW Figure list:
Figure 1. Study region (full scale)
Figure 2. Study region (zoom)
Figure 3. Network deployment durations
Old Figure 8 now Figure 4. Results summary histograms
Old Figure 9 now Figure 5. Coefficient of variation
NEW Figure 6: Map of 14 stations BB study
NEW Figure 7: BB study waveforms
NEW Figure 8: BB study directivity
NEW Figure 9: BB study focal mechanism ratios (observed & theory)
Figure 10. The 'M' pattern
Old Figure 4 now Figure S1: SNR examples
Old Figure 5 now Figure S2: Waveform duration and move-out
Old Figure 6 now Figure S3: SNR histograms
Old Figure S1 now Figure S4. As in Figure 6, but for the SG network.
Old Figure S2 now Figure S5. As in Figures 6, but for the RA network.
Old Figure S3 now Figure S6. As in Figures 6, but the TR network.
Old Figure 7 now Figure S7: Non-seismic signals
Old Figure S4 now Figure S8. Car traffic signal examples recorded by the RA array.
NEW Figure S9: Waveform amplitudes

Recommendation: Revisions Required
We appreciate the reviewer's continued engagement with the manuscript. The suggestions have strengthened both the clarity and presentation of the work.