Dear Dr Okuwaki,

Thank you for facilitating the speedy reviews of this fast report. Please find herein the responses to the reviewers' helpful suggestions.

Additions to the text are in green (and similarly in the tracked changes copy),

Comments in this document only are in blue, and

Deletions are in orange.

Many thanks,

Dr Benjamin Fernando

Reviewer A

Paper submitted by Benjamin Fernando focuses on temporal changes in anthropogenic noise levels. The topic has become popular in recent years thanks to improvements in seismic networks and the availability of cost-effective sensors developed in recent decades. Unlike previous studies that focus on increases in anthropogenic noise levels during certain social events, the author also considers decreases in noise levels due to the same event. In that sense, this fast report is quite interesting.

Thank you for your encouragement!

The paper needs some minor improvements to be published. My suggestions are as follows:

1. Anthony et al. (2022) show that noise levels are amplified by soil conditions. Can the author mention the possibility that local site conditions may affect noise levels? https://doi.org/10.1785/0120210176

Thanks for this suggestion, we have added this reference in to Section 2. The relevant paragraph now reads:

The actual amplitude of any of these signals is also modulated by their distance from the noise source and local geology, including the site response (Field et al, 1993; Anthony et al, 2022).

2. Line 30 - Decrease of anthropogenic noise levels are also observed during the COVID-19 lockdown periods. Maybe this can also be pointed out here. The papers given below are also compared the noise level reductions with special days like Chrismas as the author did.

https://doi.org/10.1126/science.abd2438

https://doi.org/10.1785/0220200147

https://doi.org/10.3389/feart.2024.1507241

https://doi.org/10.26443/seismica.v4i1.1347

https://doi.org/10.26443/seismica.v4i2.1491

Some of these papers were already cited, but we have added in additional references to this point in the introduction:

Such changes in behaviour may hence result in a decrease in the amplitude of anthropogenic seismic noise, if `loud' activities such as driving and construction are (e.g. Lecoq et al, 2020; Xiao et al, 2020; Nimiya et al, 2021, Ertuncay et al, 2025).

3. Line 47 - If there are any land-use maps, they can be plotted too. This may help readers to better understand the environment where the stations are located.

This is a great idea, we have added in a link to these databases provided by the City of Seattle (it is difficult to see how we could directly account for this in our analysis within the city itself, where most areas are marked in broad categories such as “residential” or “both commercial and residential”) as a footnote:

Land use maps for metropolitan Seattle are available at https://data-seattlecitygis.opendata.arcgis.com/datasets/SeattleCityGIS::current-land-use-zoning-detail/about

4. Line 66-67 - Thanksgiving, Christmas, and New Year can also be highlighted in Figure 2.

We also thought of this, but unfortunately none of these days occurred on a Sunday in 2025.

5. Line 118 - Quantifying the dB decrease can improve the discussion.

This is a great idea, we have actually added it in Section 3 (results) rather than the conclusion so we can be more specific about which stations and frequency bands we are talking about (and accordingly have quoted the decrease in spectral power rather than the RMS amplitude):

These changes are substantial; in the above-mentioned 10-14 Hz band at SP2, a -3 dB change in the spectral power is observed; in the 15-20 Hz band at MS99 the decrease is -1.8 dB).

6. Line 132-133 - Or lower-density areas do not create enough anthropogenic noise in the first place. Can the author express their opinion about this option?

This is a great point, we have edited the penultimate bullet point:

- That no significant difference from the median Sunday noise levels was observed at stations in uninhabited areas, similarly indicating that this quietening was not primarily due to weather or other environmental factors (presumably these areas had little anthropogenic noise to begin with);

Minor issues:

1. Author contributions - Contributor Roles Taxonomy (https://www.elsevier.com/researcher/author/policies-and-guidelines/credit-author-statement) has many other terms that are applicable to this paper.

Thank you, we have added appropriate terms to the taxonomy listing.

2. Line 3 - "... Superbowl LX" sports event can be added here.

We have added this in, the text now reads:

…observed during the Superbowl LX American Football Game (February 8, 2026)…

3. Line 3 - State name can be added here.

We have added this in, the text now reads:

…in the city of Seattle, Washington (hometown of the Seattle Seahawks)…

4. Line 22 - The paper published by Tepp et al. also focuses on a similar topic, and it would be nice to cite this work https://pubs.geoscienceworld.org/ssa/srl/article/95/4/2179/636176/Shake-to-the-Beat-Exploring-the-Seismic-Signals

Thanks for the suggestion, we have added this reference in to the first paragraph:

It is well accepted that cultural activities often have a seismic impact. In particular, large stadium-based gatherings such as sports games and music concerts have been shown to produce appreciable increases in recorded seismicity (Malone et al. (2015); Díaz et al. (2017); Caplan-Auerbach et al. (2023); Yabe et al. (2022); Tepp et al. (2024).)

5. Line 37 - The event's start and end times can be entered here.

We have added this in:

Kickoff was scheduled for 15:30 local time (UTC-8)/23:30 UTC, and the final whistle occurred around three hours and forty-five minutes later.

6. Figure 1 - The border of the state of Washington can be drawn in the figure. A dot is missing at the end of the caption.

We have corrected the missing dot; but the border is already shown (between Washington and Oregon it follows the Columbia River which is marked in grey).

7. Line 70 - Maybe the sentence can be ended by referring to Fig. 1.

This has been added, the sentence now reads:

In this study we present data from ten stations in Washington, shown in Fig. 1.

8. Line 71 - Definition of the PNSN needs to be provided.

We have added this:

We focus on vertical-component data from the Pacific Northwest Seismic Network (PNSN)

9. Line 75 - Hz can be used instead of sps.

Personally, I have always used sps for sampling rate, but if there is a house style that the editor prefers I am happy to make this change!

10. Line 78 - First sentence is a repetition of Line 69-70.

We have edited this to be clearer that we are making a point about why we are only looking at a limited selection of stations:

Although this report presents only ten stations, there are indeed others which show similar trends. We discuss only a limited selection here as our purpose in this article is to investigate whether a quietening occurred, rather than undertaking a complete characterisation of the seismic noise during the Superbowl across the entire state. We have chosen the stations that best illustrate our observations.

11. Line 79 - The author can choose between Fast Report and Article and use it.

We have switched to ‘report’ throughout.

12. Figure 2 - Annotations can be plotted outside of the subplots.

I am not quite sure what the reviewer is referring to here as there are no annotations present, only legends and figure labels. Nonetheless it should be explicitly clear that the same legend applies to all subplots:

In each panel, each black line…

13. Line 83 - Station names can be given.

Unfortunately not all of the stations on the UW network have appropriate names, for example ‘CTR’ which we show in Fig. 2 is simply labelled as ‘Seattle’ in the FDSN index. For this reason, we have given the names in caption instead (e.g. ‘Seward Park’, ‘Microsoft’, etc).

14. Line 96 - The author can use the style NW.STA style throughout the paper. If they all belong to the same network, they can just use the station name.

We have removed the UW. prefix throughout, and only use the network name when referring to the extra stations introduced at the end of the paper.

15. Figure 2-3 - Does converting the x-axis to a log scale help in understanding the figure better?

Given that the axis spans only about 40 Hz in linear space, I don’t think that this change makes the figure easier to understand, but it is a good suggestion to explore nonetheless.

16. Figure 3 - Legend can be given here, or the color codes can be linked to Figure 2 in the caption.

Thank you for catching this omission, we have added in to the caption:

As per Fig. 2, in each panel, each black line is the PPSD for a non-Superbowl Sunday. The blue line is the median of all Sundays, including the Superbowl Sunday. The red line is the Superbowl Sunday (February 8, 2026).

17. Figure 3 - Maybe the same y-scale can be used to be able to compare them better.

Again this is a good suggestion, and we did experiment with it, but the challenge is that the data span around 7 orders of magnitude, and if they are all plotted on the same vertical scale some of the differences become impossible to see (especially those for which the PPSD is basically flat in frequency, like TOUT).

18. Line 111 - I think exemplar is a typo.

I'm afraid I do not follow why this is a typo?

19. Line 126 - "centres" is written twice.

Thank you, we have removed the duplication.

20. Figure 4 - annotation and legend overlaps.

Hopefully this is not too big an issue, as the overlap is only on the vertical lines rather than the text, and we have set the transparency to make it easier to read.

21. References - Please provide DOI for the cited works

We have added these in.

Reviewer B

The submitted manuscript, “Did Seattle go silent during the Superbowl?”, authored by Benjamin Fernando, investigates local seismic-noise quiescence during a major sporting event. The author analyzes continuous seismic records from the PNSN network in Seattle and computes the probabilistic power spectral density (PPSD). The PPSDs for the date of the major sporting event (Sunday, 2026-02-08), which took place at a distant location from Seattle, are compared with those from other Sundays. In addition, the root-mean-square (RMS) amplitudes of the seismic records are calculated and compared in a similar manner.

The author finds that seismic noise levels decreased at many stations in Seattle during the event and concludes that major sporting or cultural events can influence seismic noise levels even in geographically remote areas.

I find the manuscript interesting, as it demonstrates seismic quiescence associated with a sporting event held at a distant location, whereas previous pioneering studies have primarily reported seismic excitation in the immediate vicinity of such event sites (e.g., football stadiums or music concert venues). I have only minor comments. In particular, I would like the author to clarify several aspects of the data processing procedures and to further elaborate on the potential significance of the observed quiescence and its possible applications in geophysical research.

Thank you! I am glad that you found this interesting and am pleased to make your proposed changes.

1. L8: I think the author did a good work on exploring the seismic impact (silence) itself from the sport/cultural events, but I am missing a significance of the hypothesis in a geophysical context. What kind of seismological impact can we expect from such a silent occasion? For example, can we expect a higher chance of detecting smaller earthquakes or any other non-seismic events during such a silent occasion?

This is a great question. In my opinion, the main insights are showing how seismic data can be used to offer further insight into human behaviour (along the lines of the work already cited that does this for the COVID-19 pandemic), rather than geophysical. It is possible that lower seismic noise levels may enable us to record smaller earthquakes than would otherwise be possible, but given that the overnight period (e.g. 3am-4am local time) is normally quieter anyhow, this is not a huge benefit. Nonetheless, we have edited the final paragraph of the introductory section to suggest that human insights are the most valuable outcome of this work:

Unlike the previous three Superbowls, the LX edition involved a team based in a city (Seattle) with a high density of seismic instrumentation. As such, this iteration of the competition enables us to perform a more detailed study of whether the

seismicity recorded in Seattle also changed as a result during the game, despite it occurring more than a thousand kilometres away. In this way, we aim to use seismic data to study human behavioural phenomena.

2. L20–24: Another intriguing context can be found in the following paper, where they explore a possibility of estimating smaller-scale subsurface structure, which might be good for conveying appreciation of anthropogenic noise studies to the readers in general. Yabe, S., Nishida, K. & Sakai, S. Earth-shaking J. LEAGUE supporters. Earth Planets Space 74, 123 (2022). https://doi.org/10.1186/s40623-022-01686-3

Thanks for the suggestion, we have added this reference in to the first paragraph:

It is well accepted that cultural activities often have a seismic impact. In particular, large stadium-based gatherings such as sports games and music concerts have been shown to produce appreciable increases in recorded seismicity (Malone et al. (2015); Díaz et al. (2017); Caplan-Auerbach et al. (2023); Yabe et al. (2022); Tepp et al. (2024).)

3. L37 and Fig. 1: Perhaps it would be nice to include a broader map involving the locations of the stadium (Levi's Stadium in Santa Clara?) and the study area (Seattle).

I have added in a distance and direction measurement to the caption, as I am not sure that the overall figure would be as useful if the focus was the broad, unlabelled area between Seattle and San Fransisco:

Superbowl LX took place in the Levi's Stadium in Santa Clara, approximately 1,300 km to the south.

4. L39–40: I am feeling a bit difficult to find a reason why the author chose the specific target area in Seattle. For example, could it be possible to quantitatively show how dense the seismic network is in a target area, compared to other regions, or any other measures?

This is a great question, but is challenging to quantify. We have added in a comparison to the two hometowns of the teams from Superbowl LIX in the introduction to attempt to do this:

For comparison, Superbowl LIX featured teams from Kansas City and Philadelphia,

neither of which have professional-grade seismic networks within their metropolitan boundaries.

5. L45: Pacific Northwest Seismic Network -> Pacific Northwest Seismic Network (PNSN)

We have added this:

We focus on vertical-component data from the Pacific Northwest Seismic Network (PNSN)

6. L62–80: Could it be possible to explain further details for selection of dates and data, for example, how many Sundays in total are considered in this study? I presume that the target time window should be fixed for all Sundays (five hours?), but is that correct?

We have clarified this in the text:

We do this by considering data from the same time window for all previous Sunday afternoons local time (Sunday nights/Monday mornings UTC) back as far as the Sunday after the last Superbowl in February 2025, for a total of 51 non-Superbowl Sundays.

7. L70: ten stations in Washington -> ten stations in Washington (Fig. 1)

This has been added, the sentence now reads:

In this study we present data from ten stations in Washington, shown in Fig. 1.

8. L78: I appreciate the authors if they could clarify a bit more how these ten stations are selected. I am asking this because there seem to be more seismic stations (either broadband, strong motion or both) hosted by PNSN (e.g., UW.OCRES..HNZ), but how are these stations eliminated? https://pnsn.org/stations/map. I agree with the authors that it is beyond the scope of this study to explore the seismic stations in the entire state, but I believe it would be more convincing if the authors could clarify how they selected the stations from all available PNSN stations.

This is a good point, please see the response to Reviewer A, point 10 (above) for details of how the manuscript has been modified to reflect this point.

9. L83: probabilistic power spectral densities -> probabilistic power spectral densities (PPSD)

We have edited the text:

Fig. 1 shows probabilistic power spectral densities PPSDs between 1 and 40 Hz for four stations in metropolitan Seattle (one downtown and three suburban), as computed via ObsPy.

10. L83: Could it be possible to narrate a bit more in detail how the author computed the PPSD? Did they use some obspy module?

We have edited this sentence:

Fig. 1 shows probabilistic power spectral densities PPSDs between 1 and 40 Hz for four stations in metropolitan Seattle (one downtown and three suburban), as computed via ObsPy.

11. L101–102: Can the author provide a reference for the hurricane event mentioned there so that the readers could evaluate how such an event can impact on noise level?

Fortunately, there was no actual hurricane! The location of this seismometer is simply on a geographical feature called ‘Hurricane Ridge’, which is so named for its high noise levels.

12. L109–116: I assume the author computed the root-mean-square (RMS) values of the seismic records in this section (as far as I see Fig. 4), could it be possible to show how exactly the RMS values are computed? How did the author set a time window for calculating the RMS; e.g., 1-minute window?

Thanks for catching this omission. We have edited the text:

The bandwidth here is 1-20 Hz and the window length is 5 s.

13. Fig. 2 legend: Is "Sunday Median" a median of "Other Sundays"? Please clarify either in the caption or main text.

This is already present in the caption, “The blue line is the median of all Sundays, including the Superbowl Sunday”.

14. Figs. 1 and 2 can be put together into one figure, so that the readers could easily get the locations for the seismic station.

I fear that this would confuse the issue as well though, as we are also referring to specific stations marked on the map in Figs. 3 and 4, so if the editor is amenable I prefer to leave this as is.

15. L138: "4.1 Conclusions" can be a section as "5 Conclusions".

Thanks, the conclusions is now its own section.

Dear Editors,

Thank you for your helpful suggestions. I have actioned all of them, including:

- Updating the abstract to note that Seattle is the hometown of the Seahawks
- Changing the way that the time zone is written
- Combining Figs. 1 and 2 into a single figure
- Moving the labels on Fig. 3 (was Fig. 4) so that they do not overlap the annotation.
- Adding all in all missing DOIs.

Many thanks
Ben