Dear Editor,

Please find enclosed our responses to the reviewer's comments and suggestions. Each of these comments (shown in bold) are discussion in the above text. We are convinced that the manuscript has been improved thanks to the reviewer's comments. Of course, we would be pleased to attend any further remarks.

Sincerely yours,
Jordi Diaz

REVIEWER 1

For author and editor

This work is of a good quality and is of significant interest to operators of seismic networks. I feel that the conclusions of this article are broadly sound, however, clarification is required to fully support some conclusions. Specifically, the lack of definition for how "high" and "low" amplitudes are being defined makes it very difficult to ascertain whether the conclusions are fully accurate.

As discussed below, it is difficult in our case to be quantitative when using the terms "high" and "low" amplitude, since the percentages relative to the mean can change significantly for each station and/or time interval. However, we have tried to be careful and use these terms only when a clear visual difference can be observed in the spectrograms and other graphics.

This issue is exacerbated by the reference to (and comparison between) specific station plots in the text which are only contained in the supplementary materials. I understand that including these figures in the main section of paper is challenging, however, their absence is a significant impediment to the reader following the arguments of the authors.

We agree with the reviewer that the article could include additional figures in its main section. However, this would result in a long manuscript that would be difficult for the non-specialist to follow. Our idea has been to present the data in a way that would attractive to most seismologists, by showing a limited number of figures to illustrate the discussions in the text and presenting all the figures necessary for a detailed technical analysis as supplementary material.

Below I have included a list of specific issues that I identified with potential suggestions for correction/improvement.

Line 116 Was the instrument response downloaded from FDSN or was a local copy used?

We have clarified that the response is also recovered from the fdsnws server: “In the first stage, data is downloaded from a fdsnws server on a daily basis and the instrument response, also retrieved from the fdsnws server, is removed using the Obspy”

Figure 4 Can you add a line showing the difference between the 0.01 – 0.05 and 0.2-1.00 bands over time? This will make the point from lines 214 - 215 of variation between Summer and Winter much clearer.

The 0.01-0.05 and 0.2-1.0 Hz bands are represented in Figure 4a by red and purple lines using the same amplitude scale, showing their mean amplitude levels and how during the winter season the amplitude difference between them is maximal. If lines showing the difference between the frequency bands were added to the figure, we believe that the figure would be too complex and difficult to read. Note that a more extensive explanation of the summer-winter variations is given later in section 5.1. Therefore, we would prefer not to modify this figure.

Line 230 – 231 This statement is incorrect. The relative difference in amplitude between the day and the night decreases as you go to higher frequencies but it is still readily apparent for 40-47 Hz in Figure 5(i)

We have reworked the sentence as “This amplitude variation is particularly marked for the 10-20 Hz and the 20-30 Hz, and decreases for the highest frequencies analyzed.”

Figure 6 Coloured boxes on the edge of plots are hard to see. Orange and Red colours are too similar

We agree with the reviewer’s comments; we have changes the orange marks to black, used a lighter blue color, and enlarged the size of the boxes to increase the figure readability.

Line 254 This is not the case. Clearly in Winter CMAS and CSOR are distinct from CLLI for the 10-50 mHz frequency band

This discussion was certainly not clear in the submitted manuscript. Thanks to the reviewer’s comments, we have now reworked the paragraph to:

“The 10-50 mHz frequency band shows high uniformity throughout the year for many of the stations. However, eight of them show an amplitude difference between summer and winter months, with lowest values between mid-March and October: Some of these, stations, including CBUD, CFAR, CMAS and, less clearly, CSOR, show two time intervals of high amplitude during late January and early March, marked with red boxes in Figure 6. As discussed further below, the 0.2-1.0 Hz band also shows high amplitudes during the same time periods, while the intermediary bands show a different pattern.”

Line 256 – 258 If you are going to directly reference the variations at these stations then their plots need to be included in Figure 6

See previous answer; two of these stations are shown in Figure 6

Line 259 – 262, Figure 6 How are the "high" amplitudes being identified? By eye it appears that there are also high amplitudes in the 0.1 – 0.2 Hz and 0.05 – 0.1 Hz bands. If this is true it would make the statement that there are no "high" amplitudes in the intermediary frequencies incorrect.

As discussed above, the "high" and "low" amplitude values are identified qualitatively. By inspecting the power amplitude variations and mean amplitude values shown in Supp Fig 1-5, we conclude that the time intervals with high amplitudes do not coincide in the 0.05-0.1 and 0.1-0.2 Hz bands. We have slightly modified the last sentence of the paragraph to clarify this point: "As discussed further below, the 0.2-1.0 Hz band also shows high amplitudes during the same time periods, while the intermediary bands show a different pattern"

Line 263 – 266 Again if the station plot is referenced then it needs to be in the figures of the paper not just the supplementary material

See previous comments

Line 266 – 268 No definition of "low" amplitudes. Are these specific to each trace, to each station, an average between all stations or to a set level for all stations?

As commented before, we cannot provide a formal definition of "low" amplitude, but the different types of plots can be used to identify the periods with lower than average amplitude. As shown in Fig 6 and in the plots in the supplemental material, during summer the amplitude is clearly lower than during winter for all the stations (except ICTA, as explained in the text). This is a well-known feature affecting a large majority of seismic stations wordwide

To clarify the points raised by the reviewer, we have now reworked the paragragh to

"The frequency band including the primary microseismic peak (PM, 0.05-0.1 Hz) shows, as expected, a clear seasonal variation for almost all the stations, with a low level of noise from June to late August, including three time intervals with even lower amplitudes in early June, mid-July and mid-August (blue boxes in Figure 6). Time intervals with consistent high levels of noise, including the early January, early February and early November ones, can also be identified at most of the stations and are highlighted with black boxes in Figure 6. These episodes are not identified in the 10-50 mHz band. The only exception to this amplitude variation pattern is ICJA, located within Barcelona city and affected by leakage currents from the metro and tramway systems (Díaz et al., 2020)."

Figure 6 Why are there orange marks for the SM and PM bands at stations CLLI, CMAS but not on the PM band for station CSOR. The 0.05 – 0.1 Hz plots are very similar for all three stations. This suggests that the thresholding for "high" amplitude needs to be more carefully considered.

This was actually an error in the manipulation of the different layers of the original figure. As the reviewer pointed out, the same markings should appear for the CSOR station PM band. This has now been corrected

Line 293 – 295 If the hypothesis is true that the coastal effects are dominant for the 0.2 – 1 Hz frequency band then should this not be correlated with the distance from the stations to the coast. Can this be seen by arranging the plots by distance from the coast? A figure showing this would help strengthen this argument. If this is not the case then a more detailed explanation is possibly required.

As the manuscript focuses on the benefits of using SeismoRMS to characterize long term variations in the seismic noise recorded by the stations in a permanent network, we decided not to include detailed discussions of the dominant sources of noise for the various frequency bands This is certainly a point of interest, and we are working right now on this subject, analyzing the effect of factors such as the distance to the coast, correlation with meteorological and oceanic data and the use of tools such as Rayleigh waves polarization analysis. We hope to be able to present this ongoing work in a future communication. We have changed the paragraph to:

"This seems to confirm a different origin for the lower and upper part of the SM, with frequencies above 0.2 Hz dominated by near coastal effects, as proposed by Wilgus et al., (2024). However, contributions from local winds can not be ruled out, so further inspection of the data over specific time intervals will be necessary to confirm this hypothesis."

Line 319 – 320 Can you expand on why regional winds are a good candidate to explain these features or can you provide a reference to a paper discussing this?

The reference to regionals winds was based on the consistent pattern observed at different stations, suggesting a common source of natural origin. Most studies on the effect of wind on seismic data highlight its effect at higher frequencies. As an example, Rindraharisaona et a., EPS, 2022 shows spectrograms where the wind effect is stronger for frequencies above 40-60 Hz. As we do not have strong arguments to support that regional winds can be responsible of part of the seismic noise in the 1-10 Hz band, we decided to just suppress the sentence "Regional scale winds appear to be a good candidate to explain these features". On contrary, we have stated at the end of the paragraph that "...a pattern of variation is consistent with wind-generated vibrations, which tend to be stronger during the day (e.g. Ashkenazy & Yizhaq, 2023) and mainly affect frequencies above 40-60 Hz (Rindraharisaona et al., 2022)."

Line 321 – 322 Again I feel that if a station plot is directly referenced in the text, then they should be in the main paper not just the supplementary materials

The problem arises from the fact that CGAR was mistakenly not included in the list of stations with stronger day/night and working day/week-end variations in the manuscript. The choice of stations in the figure includes CFON and CPAL as representative of stations with relatively low day/night and working day/week-end variations, and CGAR, where this variation is stronger.

Line 334 – 335 Can you provide a reference to support the statement that winds are stronger during the daytime?

Generally speaking, winds tend always to be stronger during the day because the heat of the sun adds energy to the system. Following the reviewer's comment, we have included a reference to a recent paper (Ashkenazy and Yizhaq, 2023), that, although addressing rather specific questions, comments in its introduction on the dominance of diurnal winds.

Line 375 Which average is this referring to? A station specific average, network average etc?

We would like to point out that the noise at these stations if higher than at the rest of the network. We have reworked the sentence to clarify this point: "CFAR and CBUD have a higher noise level than the rest of the network stations at frequencies above 1 Hz"

Line 375 Plot for CBUD should be included in Figure 9

We have modified Figure 9a to include the results for CBUD as suggested by the reviewer

Line 486 – 490 This argument would be strengthened by including a figure generated for one of the stations using the more standard software and showing that it does not include the variations observed by the authors using SeismoRMS

To address this comment, we have now added a statement that refers the reader to Figure 2 as an example of a standard quality control tool: "The PSD plots commonly used in quality control procedures, such as those shown in Figure 2, typically do not allow the user to locate short-term periods of increased noise."

REVIEWER 2

Review of the manuscript «Monitoring time variations in seismic noise amplitude at permanent seismic networks" by J. Diaz et al. submitted to Seismica.

The submitted manuscript is in wide parts a demonstration of how the software package SeismoRMS can be applied to monitor the seismic background noise of a seismic network and its variation due to station locations and time. The manuscript is written straight forward and can be published if the following smaller points are cleared/discussed:

Thanks for these positive comments

Line 54: Alexopoulos have not invented V30 models. I would write "(e.g., Alexopoulos et al., 2023 and citations therein)."

We fully agree with the comment and have modified the manuscript accordingly

Please mention somewhere at the beginning of the text that this application uses only vertical sensors.

It was already stated in the introduction that we use vertical components (line 74). However, to make the information clearer, we have now deleted this statement from the introduction and added a sentence in the Data and Method section which clearly states

that: “In this study we have focused only on the vertical components of the seismic signal.” (line 118)

Line 159: please add a “.” at the end of the line.

Done

Fig. 8 and Supplement Figs. 20-24: please add the time scale at least for one example per panel.

In fact there is not time scale for these graphs, as all available data are used to compute the average value for each day of the week. We have modified the paragraph to clarify this point: “Amplitude variations related to anthropogenic sources can be analyzed in more detail using graphics presenting the amplitude variations over the entire investigated time interval, averaged for each day of the week.”

Line 392: please change B) -> b).

Done

Lines 412-419: I don’t understand what the seismometer detector is. As far I understand the text the problem are electric fields coupling in the seismometer electronics. Is this correct?

The data provided by modern broad-band are basically the voltage needed to counteract the effect of the ground motion and keep the reference mass static. Some authors have suggested that strong variations in the local electromagnetic field can generate spurious currents, which are in fact not related to ground motion. We have modified the paragraph to clarify this point and add an extra reference.

Lines 463…: To my understanding the observed microseismicity (PM & SM) can have different source regions: the Atlantic (in particular Bay of Biscay) and the Mediterranean. Since these waves mostly consist of Rayleigh waves, a polarization analysis of the noise may point to the dominant noise source. Then, the amplitude behavior of PM & SM may be explainable with different distances to the source regions or path particularities.

As discussed in one of the responses to Reviewer 1, we are now working on using Rayleigh wave polarization analysis to investigate whether different sources of the microseismic peak can be identified in winter and summer seasons, which would explaining the different amplitude pattern of PM and SM. We are also contrasting our results with meteorological and oceanographic data, and plan to submit a new contribution on this topic in the next future.