

Dear Editor,

We would like to thank you for taking the time to read our manuscript entitled "The effect of 2020 COVID-19 lockdown measures on seismic noise recorded in Romania" [manuscript no. se-2021-38] and provided useful suggestions to raise the quality of the paper. We have worked step by step through all the issues that have been raised, as outlined in the response below listing your comments in black and our corresponding replies highlighted in red.

Thank you for submitting your revised manuscript and for addressing in detail all comments of the reviewers, particularly also clarifying the choice of frequency band used.

We also thank you and both reviewers for their careful and detailed review.

I have to say that I agree with the main comment of reviewer 2 about the earthquake detectability, that the comparison performed is not entirely fair. Not necessarily the time of day, but the fact that the prelockdown event is on a Thursday and the post-lockdown event is on a Saturday, makes a difference. Looking at the 24-hour clock plots provided, this means that the drop in seismic noise you are considering is larger than that due to lockdown (e.g. a change of 25 nm at station GISR, (from 60 nm on Thursdays 13h pre-lockdown to 35 nm Saturdays 19h post-lockdown), rather than a drop of about 5-10 nm due to lockdown for a particular time/day).

We admit that the subject of earthquake detectability is rather complex involving many features (eg. seismic source, radiation pattern, seasonal and hourly noise level variation, etc). However, by analysing the seismic data recorded pre and post-lockdown periods we emphasized significant noise drops especially in the high-frequency range for many of the selected stations. Although, in our example, as you correctly noticed the difference in noise variation is not so meaningful, this was the most representative earthquake pair, having similar sizes and source characteristics.

I have noted that some text was already altered following the reviewers suggestion, but I ask the authors to adapt the text in the Discussion and Conclusions further. While I agree there is an improved SNR, this is not conclusively due to the lockdown and thus requires further investigation. Perhaps rephrase the text to just mention that there is possibility for improved capability, as reported in other studies.

To address the comment, we changed the paragraph in the Discussion sections as follows:

"The reduction of seismic noise during the Romanian lockdown could also favour an increase in the earthquake detection capability. Figure 13 shows examples of unfiltered accelerograms (from two sensors sited in urban areas) of two moderate (ML=3.8) intermediate-depth (~116km) earthquakes from Vrancea. One of the earthquakes occurred before the lockdown, on 2017-08-03 (Thursday), 13:13:16 local time, and the other during the lockdown on 2020-04-18 (Saturday), 19:17:03 local time. It is worth noting that seismic signals are clearly recorded for the earthquake generated during the lockdown despite that for a local event of this size, the anthropogenic noise usually masks earthquake signals. Although the noise variation between working days and weekends is considerable, noise drop due to the lockdown measures contributes as well, favouring the increase of the signal-to-noise ratio. In this context, the reduction of seismic noise during the lockdown may lead to an improvement in earthquake detection for RSN accelerometers located in urban areas as was also reported by other studies (Lecocq et al., 2020a). This topic, however, requires further, more in depth investigation that is out of scope for the present study."

In addition to the description in the Introduction (third paragraph) of the lockdown measures in Romania, it would be helpful to have this in a Table perhaps, as aid to the reader.

We introduced the requested table (see below) in SI material.

DATE	ACTION	OBSERVATIONS
February 26, 2020	The first case of COVID-19 was reported in Romania	
March 11, 2020	All schools in Romania were closed.	The World Health Organization (WHO) declared the novel coronavirus (COVID-19) outbreak a global pandemic.
March 16, 2020	The state of emergency was declared.	
March 17, 2020	The first military order was issued.	Banned all outdoor activities, the closure of cafes and the restriction of the number of people in outdoor activities to a maximum of 100 persons.
March 21, 2020	The second military order was issued.	Led to the closure of all shopping centers, banning of groups of more than 3 people in the streets during daytime and imposed the curfew from 10 p.m. to 6 a.m.

March 24, 2020	The national lockdown law came into force.	All movements were restricted, except for work purposes, health needs and essential activities.
May 14, 2020	The lockdown ended.	
May 15, 2020	The activities were gradually resumed.	
July 18, 2020	The quarantine law came into force.	

Finally, I have given the manuscript a read-through myself and I have some minor technical comments (mostly rewording of text) as listed below. I would be grateful if you could make these changes in your revised version of the manuscript as well (which I estimate would not take much time). I hope these changes are clear as I could not refer to line numbers.

Given the comments listed above, I recommend that your manuscript is accepted after these minor corrections are done.

Thank you for the positive and detailed comments. We included all of the requested changes as you suggested.

Minor technical comments:

- Consider rephrasing the use of “the COVID-19” everywhere to just “COVID-19” or “the COVID-19 pandemic” if appropriate.

We have rephrased the use of “the COVID-19” throughout the text.

Abstract:

- Consider changing the phrase “mobility and activity in Romania due to the Romanian measures against COVID-19” to “mobility and activity due to the Romanian measures against COVID-19”.

Done.

Introduction:

- First paragraph, page 1: “seismic noise has natural origin” → “seismic noise has a natural origin,”

Done.

- Second paragraph, page 2: “an unprecedented disruption in anthropic activities in many cities around the globe”. Consider removing “in many cities” as I would think activities were affected everywhere, not just in cities.

Done.

- Second paragraph, page 2: "coronavirus disease (COVID-19) and having a direct effect on seismic noise recorded by seismic stations." → "coronavirus disease (COVID-19), having a direct effect on seismic noise recorded by seismic stations."

Done.

- Third paragraph, page 2: "and starting with May 15, 2020 gradual relaxation measures (opening of some shops, museums, etc.) were resumed" → "and from May 15, 2020 gradually some activities (opening of some shops, museums, etc.) were resumed"

Done.

- Third paragraph, page 2: "still needed for limiting the spread of the COVID-19" → "are still needed for limiting the spread of COVID-19"

Done.

Data and methods

- Third paragraph, page 3: "We choose the above frequency intervals taking into account different contributions that the anthropogenic noise sources have in a wide frequency range"
Consider rephrasing to "We choose the above frequency intervals to take into account different contributions from anthropogenic noise sources in a wide frequency range"

Done.

- Fourth paragraph, page 3: "only strong motion instruments and in addition"
Consider starting a new sentence before "In addition", e.g. "only strong motion instruments. In addition"

Done.

Results

- Section 3.1, second paragraph: Consider using numerals for numbers larger than 10, to help readability.

Done. We changed to numerals for all numbers larger than 10.

- Section 3.1, fourth paragraph: "reaches the minimum during the 2020 Easter (April 17-20, 2020). Alternatively, the reduction of noise" → "reaches the minimum during the 2020 Easter weekend (April 17-20, 2020). In contrast, the reduction of noise"

Done.

- Section 3.1, fourth paragraph: "during 2019 holidays, except for the Orthodox Easter in 2020."

Do the authors mean the 2019-2020 holidays?

No, we are referring to the Orthodox Easter 2019, Christmas 2019 holidays. We rephrase the sentence as follows: "The reduction of noise at station DJISU due to quarantine measures wasn't significant since it did not reach a level similar with the one observed during the Orthodox Easter and Christmas holidays in 2019. A similar level of noise drop was noticed only during the Orthodox Easter in 2020."

- Section 3.2.1, third paragraph: "After the quarantine law, a slight decrease in seismic noise is observed" → After the quarantine law came into place, a slight decrease in seismic noise is observed"

Done.

- Section 3.2.3, second paragraph: "The noise level gradually increases before the lockdown is lifted, and after the state of alert is declared it reaches the noise level observed before the lockdown". Do the authors mean to say, "after the state of alert is lifted, it reaches"?

No, we wanted to emphasize that the noise level started to increase even before the end of the lockdown period and after the Romanian authorities declared the state of alert (immediately after the lockdown) the noise level increased reaching the same value as before the lockdown. We rephrase the sentence as follows "The noise level started to increase again before the end of lockdown. After the Romanian authorities lifted the lockdown restrictions, and declared the state of alert, noise level reached the level of the pre-lockdown period."

- Section 3.2.3, second paragraph (and repeated in the third paragraph): "This drop is associated with the start of the campaign for the local elections in Bucharest." Why does the start of this campaign lead to decreased noise levels? Could the authors please clarify this?

We added the following sentence to the text: "We assume that the start of the political campaign for the local election led to numerous meetings with the community. Such meetings are typically held outside of the City Hall and involve many employers This diminishes the number of people and the working hours within the City Hall building."

- Section 3.2.3, fourth paragraph: The authors describe in the pattern of seismic noise variations in a lot of detail, and mention what causes the variations in Band 2. I wonder whether the authors could add some statements on what causes the variations in Band 1 as well, or is this the same?

We added the following sentences to the text: "Band 1 seems to be the most suitable to observe people's activities within the City Hall before lockdown because it better reflects their daily schedule. We could notice, before lockdown, a sharp increase of the noise during Saturdays between 8 a.m. and noon compared to Sundays. During the lockdown the noise significantly decreased on Saturdays in the same time interval. Moreover, noise variation before and after lockdown between working hours (7 a.m.-4 p.m.) and evening (4-10 p.m.) are as well better highlighted in Band 1 as compared with Bands 2 and 3."

- Section 3.2.3, last paragraph: "The seismic noise started to decrease with the closing of the schools on March 11, 2020, and remained at the lowest level between the stay-at-home and the

state of alert orders". Are there schools located in the vicinity of the hotel or is there another reason the seismic noise starts to decrease when the schools closed?

The nearest schools are located at a distance larger than 500m from the hotel. Instead, near the Unirea Hotel, are located medical, educational and cultural centers as well as the City Prefecture, the City Hall and the County Council, which have certainly reduced the activities starting with the closure of schools in Romania.

- Section 3.3, second paragraph: "mainly the staff working there is using the building." → "mainly the staff uses the building"

Done.

- Section 3.3, second paragraph: "several mountain bike trails existing also in the area" → "with several mountain bike trails existing also in the area"

Done.

- Section 3.3, second paragraph: "at station CJR combine the noise" → "at station CJR are a combination of the noise"

Done.

Discussion

- Second paragraph, page 11: "their effects are clearly emphasized by the recordings of many stations of RSN" → "their effects are clearly observed in the recordings of many stations of RSN"

Done.

- Fourth paragraph, page 12: "those located in buildings." → "those located in office buildings."

Done.

- Fifth paragraph, page 12: "preferred by the inhabitants of Bucharest and which at the end of the week is very crowded" → "preferred by the inhabitants of Bucharest, which gets very crowded at the end of the week"

Done.

Data availability

- "the authors have used data provided by the NIEP's Data Center and are available upon request" → "the authors have used data provided by the NIEP's Data Center, which are available upon request"

Done.

Figures

- Temporal evolution plots of seismic noise (e.g. Fig. 3, 7, 8, 10, 11 etc): the titles in these plots are quite small. Please consider enlarging them.

Done. We enlarged the titles in Fig. 3, 7, 8, 10, 11

- Figure 2: Would the authors please consider not using green and red symbols to denote different percentage changes, to aid the readability for readers that are colour blind?

Done. We changed the colours (red and green) to blue and magenta

- Figure 4: It would be helpful to add the time periods used in the clock plots in the caption

Done.