

Wind Energ. Sci. Discuss., referee comment RC2
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Comment on wes-2022-3

Anonymous Referee #2

Referee comment on "Reduction of wind-turbine-generated seismic noise with structural measures" by Rafael Abreu et al., Wind Energ. Sci. Discuss.,
<https://doi.org/10.5194/wes-2022-3-RC2>, 2022

General remarks

The paper is well written and easy to follow, therefore in my opinion there is no need for major changes in the text.

The authors theoretically evaluate possibilities to reduce the influence of wind turbines (WT) in seismic records by placing empty or filled cavities into the travel path of seismic noise waves. The efficiency of the the noise reduction depends on the shape of the cavities and on the observed frequencies. When focusing on the relevant frequencies between 1 and 10 Hz which are observed in many previously published examples at distances above 1 km from the WT it turns out that the most effective noise suppression (among the investigated models) is achieved with empty half-circular trenches of certain dimensions. Regarding the ongoing discussions on the necessity of restrictions of WT operations in the vicinity of seismic stations this is a valuable contribution to the search for remedies in this conflict of interests between the operators of seismic stations and the operators of WT. It shows that there exists at least a theoretical possibility of noise suppression, however, the practical feasibility remains unclear and this probably cannot easily be answered by seismologists. Below I collected some questions concerning this topic. Details need to be further investigated also by engineers and constructors of WT.

Some part of the paper deals with the influence of topography on seismic wave propagation. The result of this section, however, does not lead to unique recommendations concerning the possible locations of WT if the geologic structure of the whole area is not really well known. So there might be noise reductions or enhancements depending on the velocity relations

between the mound-like structures and the ground below. Also the frequencies affected depend on the dimensions and shape of the hill structures and are not easily predictable. Only in specific cases the location of a WT on top of a hill does help to reduce emitted noise. It is good to know that topography may influence the propagation of noise but the mentioned uncertainties and the fact that in many cases the location of WT is restricted by a number of site selection conditions will most probably not make topography a decisive factor in noise mitigation. To give an example, one could have a look at the station GR.GRB1

(<https://opentopomap.org/#marker=13/49.3903/11.6506>) where 5 WT are installed in an approximate distance of 3 km to the north-east of the station (marked in the opentopo map). The WT are located on top of a small mountain range with an elevation difference of about 100m to the station level. The noise spectrum of GR.GRB1 shows one of the largest WT noise peaks at 1.1 Hz observable at German permanent stations:

https://www.szgrf.bgr.de/cgi-bin/send_windspec.py?station1=GRB1&station2=None&year1=2017&year2=None&night1=Night&night2=Night&minfrq=0.9&maxfrq=8.0&lospd=10.0&hipsd=1.0e5&linlog=linlog&smooth=3&operation=overlay&shownumbers=nonumbers&submit=Create+Figure

Of course, this does not prove anything, but it is an example that even with

WT installed on top of a hill there may exist very large noise signals.

Specific comments/questions

What is the radius of the half-circle trenches? This is nowhere explicitly mentioned. The reader just can guess from the "distance of the WT from the trench" that it is 10m.

As far as I know the concrete foundation of a WT can have dimensions (diameter) in the order of 20m. That means that the trench is right at the border of the foundation (if not within). I guess this cannot be realized as it affects the stability of the WT and therefore I see problems to install circular trenches in proposed dimensions. What radius would be necessary in practice instead? The trench should be significantly decoupled from the foundation otherwise there will be no mitigation effect.

I understand that using a point source makes things easier and when looking from large distances principal effects may be well described by such a simplification. However, the foundation of a WT plays a major role in the generation of seismic waves by its movement as a whole in different directions. If the source dimension and the dimension of the wave blocking cavity around it are in the same order, how much can we rely on the results using a point source approximation?

Can you descriptively quantify the mitigation effect somehow? For example, how many more WT with trenches could be installed in comparison to one

without to have the same effect at the station? Or how closer a WT with trench could be situated to a station compared to one without?

Since water in the trenches seems to foil the mitigation effect, the trenches need to be properly protected against intrusion of water (from below and above). On the other hand the two walls of the trench should be decoupled from each other as much as possible to prevent vibrating of the trench stabilizing construction as a whole. This seems to be a quite challenging task for the constructors of such an installation.

I could imagine that readers would be interested in the computing costs of your simulations. It is of course strongly dependend on the hardware, but giving an idea on the computing times would be helpful.

Technical corrections (giving line numbers):

25: affected range 1-10Hz, correct for distances above 1km or so. At smaller distances higher frequencies will be observed.

40: tress -> trees

45: larges -> larger

48 *have* shown

114: comma missing

116: "placed 10m in front of the trench": is this the center of the (half-)circle?

152: "as in the first scenario" -> "as in the scenario with cross shaped holes"

196: reduces -> reduce

204: efficient*ly*

figure 3a) and 3b) diferent -> different (2 times)