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Solid Earth Discussions

Interactive comment on "Near surface structure of Sodankylä area in Finland, obtained by advanced method of passive seismic interferometry" *by* Nikita Afonin et al.

Anonymous Referee #2

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The authors present an application of passive seismic interferometry to image the subsurface of a mineral exploration area in northern Finland (down to 300 m). Passive seismic data were collected in parallel to active reflection/refraction acquisitions (during downtimes) along several linear profiles.

The main purpose of the underlying project being active seismic experiments, only a short amount of continuous passive data could be collected (hours/days). The authors try to address the challenging task of retrieving meaningful surface-wave responses from such a short duration dataset. They claim that they could achieve this despite the non-stationary and non-isotropic distribution of noise sources. For that, they used

an advanced processing algorithm called SNRS (not described in the work). They also claim (using supporting synthetic modeling) that this achievement was favored by strong local scattering conditions (local scattering helps reaching more diffuse field conditions). Using inversion of the extracted dispersion curves, they provide different 2D sections of shear-wave velocity models and propose some geological interpretations.

While I agree that the topic and goals of this work are of high interest, I do not feel at this stage that the claims made by the authors are reliably backed up in the presented work, and I think that many points should be clarified.

My major concerns are the following:

- I do not understand how the numerical simulations address the problem of non-stationary/non-isotropic noise sources. The position/angles of the sources have to be clarified, but it seems from the presented configurations that only the "pseudo-1D" case is tackled. By that I mean that the incoming noise horizontal direction seems to match the direction of the profile. This is a very favorable condition that does not address the main challenge of an off-angle dominant source of noise.

- As explained, the passive acquisition was made in parallel to active seismic acquisitions. This is a great opportunity to make detailed comparisons of active vs passive data and benchmark noise correlation/SNRS in a challenging configuration. One convincing comparison example was made for one subsurface model (Figure 13). This approach could be generalized to compare: EGFs to "active" surface-waves, dispersion curves, and other subsurface models. In my opinion, this would make a much more compelling case for the passive approach than the numerical modeling invoked above.

- The title and paper stress-out the importance of using the advanced SNRS algorithm. However, this algorithm is not described at all in the present work. Additionally, to ensure that SNRS is actually required here, a comparison with traditional Ambient-

noise correlation processing could be a great addition (comparing EGFs with active data for example).

Other concerns:

- In the abstract, the passive dataset is said to contain only several hours of data. In the text, several days of acquisitions are mentioned. The exact record duration(s) should be mentioned as this is a key aspect of this work.

- The workflow from dispersion curves to subsurface models could be explained in more details.

- Why not comparing the resulting models with the results of the main project (reflection/refraction models)?

- The matching or lack of matching between model and boundary of geological units is not clearly discussed (Fig. 17).

- The quality of the figures should be improved, as well as the quality of the language.

Some detailed comments are provided in the attached annotated pdf.

Please also note the supplement to this comment:
https://se.copernicus.org/preprints/se-2020-160/se-2020-160-RC2-supplement.pdf

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