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# *Interactive comment on* "Passive seismic recording of cryoseisms in Adventdalen, Svalbard" *by* Rowan Romeyn et al.

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Comment from Referee 1

"In the aim of continuous long-term deployment to perform temporal monitoring of the permafrost, the fit "by hand" of the dispersion curves with their forward modelling in a 1D model seems inadequate. The best strategy, in this case, is to invert the dispersion curves to obtain the best fitting layered velocity model. There are many examples in the literature using this approach. However, it is quite rare to observe that many higher modes in data and existing inversion strategies might not be able to take all the modes into account. From your forward modelling strategy, would it be easy to design an inverse procedure? If yes, how would you do it? If no, what approach would you take?



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I think discussing this point would be a nice adjunction to the manuscript."

Comment from Referee 2

"I agree with the comment of referee #1 that I would typically attempt to invert the set of dispersion curves to obtain a layered velocity model result, if only to determine the range of models that fit the data. It's possible that this would illuminate features of interest and allow more predictive analyses. However, I don't consider this necessary for the acceptance of the paper itself."

Response:

Within the context of a long-term monitoring application, it would be highly advantageous to develop an inversion scheme capable of robustly selecting the physical model(s) that fit the observed dispersion spectra. Implementing such an inversion scheme is a non-trivial undertaking due to the non-uniqueness and non-linearity of the problem, exacerbated by the complex multimodal dispersion structure that makes it difficult to optimise inversion parameters by exploiting partial derivatives. A valuable discussion of this topic is found in Ryden & Park, (2006). Because of this complexity, inversion of dispersion spectra fell outside the scope of the present study. However, a global optimisation technique such as the fast-simulated annealing approach implemented by Ryden & Park (2006) may provide a useful template that is likely applicable also for the type of data we have recorded. This method appears capable of dealing with the problems of cost-function local minima and correlated parameters, assuming that the parameter perturbation size and "cooling schedule" of the simulated annealing can optimised to the specific set of dispersion spectra. We also see potential value in working further to understand the physical significance, from a wave-theoretical perspective, of some of the high-level structures observed in the dispersion spectra, such as the frequency spacing of mode transitions. Such features could also provide a means to measure some of the important physical properties of the system in a potentially more transparent way than a multi-parameter inversion of the entire dispersion



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spectrum.

Actions for revised manuscript:

(1) Include a discussion of the challenges of inversion and the relevant previous implementation of Ryden & Park, (2006) in the discussion section of the manuscript.

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