Response to reviewer 2

Thank you for your comments. Please find our detailed responses to your comments below in red font.

This paper proposed a new inversion algorithm of tube waves and detailed analysis. However, the logic of this paper is not clear and strange.
We assume that with "logic of this paper" you refer to the ordering of the sections. To address this issue, we have moved the section presenting the synthetic example into the main body of the paper. Now, the paper presents first the method and all the theory related to it, then demonstrates the viability of the proposed algorithm based on a synthetic example, followed by a real-data example, which features a detailed presentation of all the practical aspects of the algorithm. Finally, we address advantages and disadvantages as well as limitations of the algorithm in the discussion section. We think this revised structure now guides the reader in a smooth and logic way through the paper.

(1) There is indeed numerical test. Yet the numerical test is quite just analysis, and there is no real data tests.
There are two examples in the paper: a synthetic example and a real-data example. We use these examples to analyze the viability and the performance of our proposed algorithm. It is not clear to us, what you suggest us to do by saying "the numerical test is quite just analysis". Furthermore, we would like to draw your attention to the results section, which mainly consists of a real-data test.

(2) Take figure 4 as example. How is the simulated result generated in detail? Throughout the paper, what does "synthetic" mean? Concrete inversion results are not found.
For the simulated data, we took the model obtained by our inversion (the last model of the third Markov chain of run 1 and run 2) and generated synthetic data using our forward solver described in the methods section. To further clarify this, we have added some explanatory text in the results section when describing this figure.
The term synthetic refers to any kind of data that is simulated, and thus, not real, measured or observed. So, the forward solver creates synthetic data that are in the course of the inversion compared with the observed data. What we treat as "observed" data in the synthetic example are in fact synthetic data, as they are also simulated.
Concrete inversion results are shown in Figure 5 (the figure number refers to the new manuscript; this was Figure 3 in the old manuscript). These plots show the inferred model parameters for all Markov chains, but we do not show posterior PDFs due to limited convergence as explained between lines 213 and 222 (refering to the updated manuscript). The results are presented in the results section and discussed in the discussion section.

(3) why there is a numerical example in the appendix? Separately, add the reference where formula (4) came from.
We have moved the numerical example to the results section.
Equation 4 is equation 22 in Minato and Ghose (2017). An additional reference has been added to the manuscript to clarify this.