

# ***Interactive comment on “Monitoring induced distributed double-couple sources using Marchenko-based virtual receivers” by Joeri Brackenhoff et al.***

**Joeri Brackenhoff et al.**

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We thank the anonymous reviewer for their comments and suggestions to help improve this paper. Changes to this article have been tracked through the use of “latexdiff” to demonstrate our revisions to the article. We have some more specific responses to some of the comments.

Regarding the reviewers comments about the accuracy of the method, in order to obtain the first arrivals, we make use of a smoothed version of the model without any density information, this is to simulate a very realistic version for the retrieval of the focusing functions. In a realistic setting, this is the type of data that will be available.

Because of these limitations, the exact amplitude and the sampling of the wavefields are not exactly one to one with a directly modeled wavefield, making a quantitative comparison between the modeled wavefield and the retrieved wavefield very difficult. As such, we used the extracted traces of the data for a more detailed comparison. To improve the comparison, we have added a figure that contains a zoom in of the modeled and retrieved traces overlying each other (Figure 8). This shows some of the sampling issues and we have added a discussion of these results in the paper. We hope that this helps to assess the accuracy concern about the paper.

As to the minor comments, we have addressed them individually as seen below:

p.3, eq. (1): I was wondering if there is a particular reason for using a negative sign and the time derivative for the delta source? In the supplement the wave equation that is employed is derived. Because the source term is located in the stress-strain relation and this equation needs to be subtracted from the equation of motion the negative sign is introduced. The derivative is used to simulate a volume injection rate source rather than a pure point source.

p.3, l. 20: Typo: Missing closing parentheses We added the closing parentheses. See the marked up version of the document.

p.4, Fig. 1: I know it is just a sketch, but I would recommend to add a colorbar for the velocities. The image is a schematic, high contrast representation of the medium and does not represent the actual velocities. As such, adding a colorbar would not make sense. The image has therefore been reconstructed using the actual velocities and a colorbar has been added.

p. 5, l. 3: Instead of “We will not consider” I would rather say, “we will not describe/explain this method”. We changed the wording to “We will not explain this method”. See the marked up version of the document.

p. 5. l. 22: Typo: “an arbitrarily” We fixed the typo. See the marked up version of the

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document.

p. 5, l. 32: Instead of just “where functions” are available, I would explicitly mention what you are referring to. I assume Green’s functions? This part is indeed unclear. We mean in this case the receiver locations of the focusing functions and Green’s functions. This has been added to the document.

p. 6, Fig. 2: Is there a reason why you use the time-domain in the annotations, but the frequency domain in the representation in eq. (10)? The reason is that these type of data that are measured and retrieved through the Marchenko method will be available in the time-domain. The application that we use in the form of eq. (10) makes use of the frequency domain versions. To avoid confusion however, we have changed the quantities to the frequency domain in the figure.

p. 6, l. 16: There is an extra space after reversal. We have removed the space. See the marked up version of the document.

p. 9, Fig. 3: I am not sure if this figure is necessary. Is it just to show that the wavefields emitted by monopole and double-couple point sources are different? If you decide to keep the figure, I would suggest to at least change the caption and say “Sketch of the wavefields caused by...” instead of “Difference between”. We have decided to keep the figure, but we have added the suggested change by the reviewer. See the marked up version of the document.

p. 10, l. 5: No comma after superscript  $k$ . The comma has been removed. See the marked up version of the document.

p. 13, l. 16: Typo: “in” instead of “it”. The typo has been fixed. See the marked up version of the document.

p. 14, Fig. 5: I was wondering whether plotting the differential wavefield in (e) – (h) and in (i) – (l), respectively, would make it easier to see the differences? On a printout, the contrast between the wavefield and the background medium is pretty poor. Maybe

they grayscale is not needed for the medium and/or you can plot the wavefield in color. Please see the response we have posted to your general comments. About the reason for the grayscale, this paper is a companion paper and across the papers, we have decided on a uniform style for the plotting of the wavefields.

p. 15, Fig. 6: Please plot the errors between modelled and virtual receivers in addition to the absolute signals. Please see the response we have posted to your general comments.

p. 16 l. 9 – 13: Could you comment to what extent the results are affected by the specific choice of the random scaling? For instance, would two seeds of random scaling factors still result in similar wavefields? As a related question: are you using the same seeds for the random amplitudes in Fig. 7 (e) – (h), and (i) – (l), respectively? The scaling of the wavefield only affects the amplitude of the events and does not change the presence of events in the wavefield or their arrival times. We have added this to the document. On your related question, yes the same amplitude scaling is used, which is mentioned in the text of the document, however, to avoid confusion, we have made this clearer in the text.

p. 18, l. 10 Could you please provide a few details, how the data was preprocessed? The data was processed through the use of EPSI, source-receiver reciprocity and adaptive corrections for attenuation and incorrect source strength. We have added these details to the document.

p. 19/21, Fig. 9/10: The aspect ratio of the white box in Fig. 9(a) looks different than the zoom-in in Fig. 9(b) and Fig. 10. The aspect ratio of Fig. 9 (a) is not true to life, as the model is much longer in horizontal direction than in vertical direction. For aesthetic reasons, we have decided to plot the data like this, rather than true to life, however, the extent of the model has been plotted. Figure 10 is plotted true to life to not distort the wavefields.

p. 22, Fig. 11: Shouldn't the label in (e) be "Real line source" instead of "Virtual real

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source The label has been changed. See the marked up version of the document.

Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2018-142>, 2019.

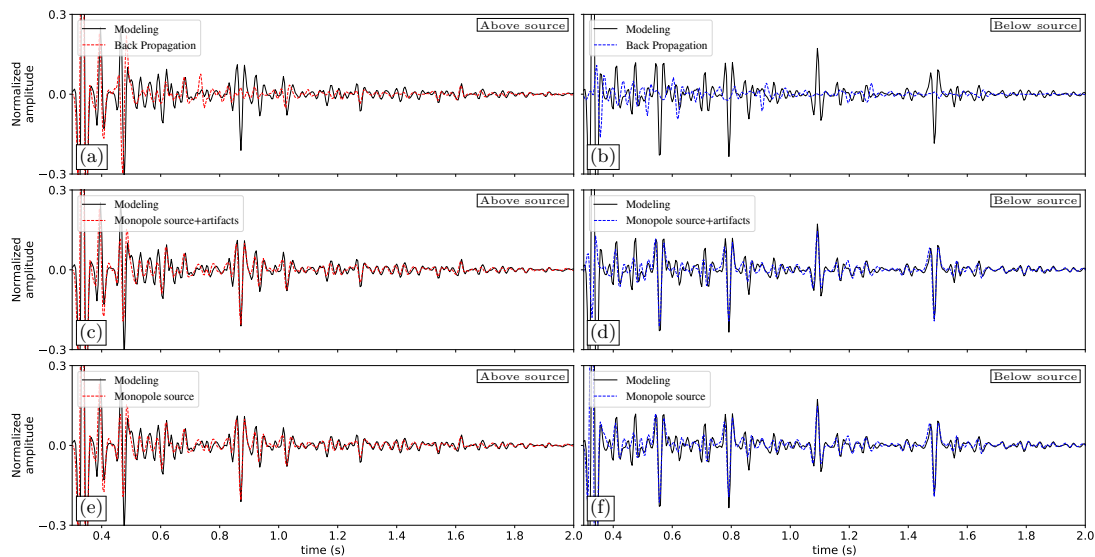
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**Fig. 1.** Comparison between the modeling and the retrieval method

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