Solid Earth Discussions

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Comment on se-2020-216

Anonymous Referee #1

Referee comment on "On the comparison of strain measurements from fibre optics with a dense seismometer array at Etna volcano (Italy)" by Gilda Currenti et al., Solid Earth Discuss., https://doi.org/10.5194/se-2020-216-RC1, 2021

General comments:

Distributed Acoustic Sensing (DAS) is a technique to measure strain (or strain rate) along a fiber optic cable at an unprecedented spatial resolution and is now used even in seismology. One concern of DAS is fidelity in the absolute amplitude of measured strain attributed to the coupling between the ground and the cable. In this study, based on a laborious seismic array observation at Etna volcano, the authors estimated strain by interpolating the seismic wave field with two different methods: the spatial interpolation methods and the seismo-geodetic method. Comparing these seismically estimated strain and DAS strain, the authors showed that both strains agreed well, which shows the fidelity in amplitude of DAS observation. This result made an essential contribution to validating seismological applications of DAS. And I highly evaluate the elaborate array observation by the authors in such a high mountain. The manuscript is clearly written. The subject of this manuscript is up-to-date and suitable for this journal. I would suggest this manuscript for a minor revision. The following comments should be addressed in the revised manuscript.

Specific comments (Major):

- The two interpolation methods introduced different smoothing parameters. I am curious how these smoothing parameters are related to the gauge length of DAS. Can the authors comment on that?
- The average inter-station distance of the seismic array observation is approximately 70m that is larger than the gauge length of 10m. Therefore, it seems reasonable that the seismically estimated strain's spatial distribution is smoother than that of the DAS strain. I wonder if the authors can increase the gauge length by taking the spatial average of DAS strain records and compare that with the seismically estimated strain. I am interested to know to what degree such a smoothing averages out the small-scale medium heterogeneities.

- It is necessary to show the correspondence between the location and the number of DAS channels. I would suggest showing the channel number in Figure 1 with a step of 100. Or the authors will be able to indicate the channel numbers at the corners and bends of the cable in Figure 1.
- In equation (1), the second term on the top equation's right-hand side should be w, not p. And q, p, and w may be better to be explicitly shown even in this manuscript.

Specific comments (Minor):

- On page 5, line 113, the authors mentioned that the authors used the least-squares method to solve the system. However, since the number of data and the number of unknown parameters are the same, the authors will solve the system directly. It is not necessary to use the least-squares method.
- In equation (5), the authors can show T (transposition operator) on the right-hand side, not on the left-hand side.
- Page 6, line 155, fmax is about 7Hz, not 6Hz.
- In Figure 1, the authors need to mention the red circle at Bb04. Otherwise, I misunderstand that Bb04 malfunctioned.
- At the end of the caption of Figure 2, an average scaling factor should be 1s/km, not 1000m/s.
- In Figures 3 and 4, the authors just mentioned that the discrepancies are large around fault zones. However, it is necessary to mention clearly if the seismically estimated strain is overestimated or underestimated.
- I want to ask the authors to show Figures 7 and 8 on precisely the same scale as Figure 2.