Dear editor,
Dear reviewers,

Thank you very much for working through our manuscript and for providing feedback so quickly! We improved the manuscript according to your suggestions. Changes in the manuscript are marked in red. Please find a point-by-point response below.

With kind regards

Andreas Fichtner

Reviewer A (Martijn van den Ende):

General comment: the authors investigate the contribution of the prior to the results, which in this case is conveniently provided as an existing earthquake catalogue entry. Perhaps the authors could include 2-3 lines to comment on the envisioned use-case, e.g. a trans-oceanic observatory, for which the prior is broadly distributed (no conventional instruments, potential source region spanning hundreds of km, …).

This is of course a very good point. To address this issue, we added the following sentence to the Discussion section: "Generalized least-squares inversions require prior knowledge, which we extracted from existing earthquake catalogs. In future applications, the provenance of prior knowledge will depend on the use case. When PNC or other integrated fiber-optic sensors are operated as stand-alone systems, prior information may most easily and rapidly be obtained from a coarse grid search with a simplified Earth model. In scenarios where integrated fiber-optic sensors are part of a heterogeneous sensing system, prior information may alternatively be extracted from the standard inversion of seismometer data or beamforming. Fiber-optic sensors would then contribute additional data that further improve resolution."

L39-41: there is also this related study by Bohan Zhang et al.: https://doi.org/10.1364/OE.456172. They developed a bi-directional sensing inversion method that seems to fall in between the Marra approach and the one proposed in the present study.

We are aware of this work but would prefer not to cite it. Just as the work of Marra et al. (2018), also this one merely hypothesises about the possibility to locate an earthquake without considering actual data. Furthermore, the authors use a completely unrealistic model of the Earth, where all wave speeds are constants. We do not think that this is actually a useful contribution.

Fig. 2a: it might be a bit easier to get a sense of distance if the lat/lon coordinates are converted into UTM coordinates.

Thank you for the suggestion! We added a distance arrow.

L133-134: Recommending “conventional seismic sensors” seems to defeat the main objective of PNC and related technologies (“closure of the most prominent data gap: the oceans”; L34). Perhaps a better recommendation would be to systematically evaluate the performance of PNC when operating as a stand-alone instrument.

While we realise that our statement was not quite complete, we also do not fully agree that PNC should be used as a stand-alone system. In the end, the goal is to optimise the inversion results, and this will need to include the diverse range of sensors that are available. We modified the sentence in that direction.

Reviewer B (anonymous):

Line 52: “METAS to user laboratories perfroming precision”
It could be useful for me (and perhaps, some of the readers) to know what METAS is. So, that part of Line 63 can be provided here, instead of there. Additionally, would it be “performing”, instead of “perfroming”?

Thank you! Of course, we should explain what METAS is when the acronym appears first in the text. We corrected this, and also the typo.

Figure 1. That the depicted beachball and the data processing is for the Mw 3.9 event can be mentioned in the caption. Map coordinates on the axes would be also useful.

Thank you for these suggestions! We improved the figure accordingly.

Figure 1. Caption - " .. 1-D Earth model of the Alpine region by (Diehl et al., 2009) ..", perhaps the sentence should read " .. 1-D Earth model of the Alpine region (Diehl et al., 2009) .."

We agree and changed this.

Line 83-85: Perhaps, "In terms of m_i, the moment tensor for the event given by GEOFON (Hanka and Kind 1994) have the following: m_1 = 7.77 x 10^14 Nm, m_2 = −8.09 * 10^13 , Nm, m_3 = −1.73 x 10^14 Nm, m_4 = −1.83 x 10^14 Nm, m_5 = 2.52 * 10^13 Nm".

Indeed, this is better.

Line 126-130: Would it be useful or even possible to indicate what could be reasonable typical estimates of good SNR and proximity for resolvability of source parameters?

For the SNR we have a rather precise idea. Values of around 10 or above are useful for this kind of inversion. (We added this to the text.) We had also included period bands where the SNR is lower, but that did not contribute much. For the proximity of the source to the fiber, please see our response to the following question.

A general question for the discussion/future study: Would it be possible to set up a validation study using synthetic datasets?

Yes, absolutely. We think that this should be one of the next things to do and also included such a comment in the revised discussion section.