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Solid Earth
Discussions
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Interactive comment on "Vertical seismic profiling with distributed acoustic sensing images the Rotliegend geothermal reservoir in the North German Basin down to 4.2 km depth" *by* Jan Henninges et al.

Anonymous Referee #1

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General comments:

The authors present results of DAS-VSP measurements in a wire-line logging approach applied to the Groß Schönebeck site to acquire more information on the structural setting and geometry of the geothermal reservoir. As the authors mention, the use of DAS in a wireline logging approach is a novel application little used until now. Their results demonstrate this approach can be used to retrieve valuable seismic data down to a large depth up to 4256 m, which has not reported before. In addition some unexpected site-specific DAS data characteristics are reported and discussed in more detail. The

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final processed an interpreted DAS-VSP results show that the acquired DAS data in combination with other well log-data, contributes to an improved characterization of the target reservoir at significant depths. Overall this is an interesting and relevant paper and is well-written. Therefore I recommend its publication after minor revisions, primarily to add more details regarding the used instruments and processing methods.

Specific comments:

-Page 1, lines 23-25: Consider rephrasing. Do you mean that the top and base of the volcanic rocks can not be inferred from the seismic data due to insufficient reflected energy from these interfaces?

-Page 1, line31-32: Consider rephrasing . For instance: 'This technique allows for rapid seismic data acquisition, because DAS provides continuous point measurements along the cable and therefore does not require vertical repositioning of the cable during VSP campaigns, opposed to conventional geophone borehole strings'

-Page 2, line72-73: Please elaborate on how the source positions were optimized using ray tracing.

-Page 3: line 77-78: Is it correct that this hybrid borehole measurement system includes the interrogator? And could you add the specifications of the fiber-optic cables in table 1?

-Page 3, line 88: I presume that the hDVS is an optical interrogator, please mention this in the text as well.

-Page 4, line 123: Please specify ground units for the different parameters from the equation.

-Page 4, line 133-134: Consider to provide the equation for converting strain to strain rate. Also, does the mentioned 90 ° phase shift relate to the 180 ° phase shift mentioned in Table 2, or are these not related to each other?

-Page 5, table 5: Please clarify what is meant in the row ‘’Interval velocities → Correct times to vertical”

-Page 5, line 144-145: Could you comment what the possible cause for the observed zigzag noise pattern is?

-Page 6, line 166-167: Please mention that a comparison between normalized trace amplitudes is made.

-Page 6, line 182: Consider rephrasing, since this is what one would actually expect with DAS data. As for instance Mateeva et al. (2014) state: "Since DAS measures only differential displacement, the polarity of its response is determined by whether a fiber was shortened or elongated over a gauge length, not by the direction of travel of the corresponding seismic wave. "

-Page 6, line 189 with respect to the comparison in Figure 6. The amplitudes of two datatypes seem to be normalized based on their own maximum to [-1,1]. Please mention this. And how do the true unscaled acceleration values actually compare against one another?

-Page 7, line 211-212: And what did their study conclude? Do their modeling outcomes match the observations made in this study? Overall it could be that the effect of the degree of slack is hard to control and largely depends on the well geometry. Maybe certain depth intervals favor from extra slack where coupling is increased, while at other depth intervals the opposite holds depending on trajectory. With this determining optimal slack length could be a matter of trial and error depending partially on well geometry and depth interval/formations of interest for imaging.

-Page 7, line 226-228: Interesting observation. Out of curiosity; did the energy in the noise window increase, or did the energy in the signal window decrease for those intervals?

-Page 8, line 250 regarding section 4.4: Now this section starts with a processing

step and continues with the interpretation of the processed data, although the data processing and interpretation phases should typically be separated. I would therefore recommend to split this in two sections consisting of 4.4 Corridor stack and 4.5 Seismic interpretation.

-Page 10, line 352: Can you comment approximately how much faster DAS-VSP is compared to conventional VSP?

-Page 14, figure 1. Highlight the source positions in the left panel that are further shown in figures 3 and 4 (positions 10, 25, 66 and 17). Please increase the size of the legend in the right panel.

-Page 17, caption of figure 5: Please state that these are normalized amplitudes.

-Figure 18, caption of figure 6. Please state that these are normalized amplitudes. And consider to show and compare non-normalized amplitudes.

Technical corrections:

-Page 8, line 244: Please rephrase the sentence part “For a close to the receiver wells situated zero-offset position, VSP...”

-Page 10, line 398: Regarding the reference to Daley et al. please check the year, because this work seems to date from 2015 instead of 2016.

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