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## Signal analysis between DAS and geophones in a vertical borehole from active and passive sources

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We present an analysis and qualitative comparison between acoustic data recorded on a distributed acoustic sensing (DAS) instrument (Silixa iDAS, version 2) and a three-component geophone chain colocated in a 400 m deep ICDP borehole in the magmatically active Vogtland area, Germany. A tight buffer single-mode fiber optic cable with a structured surface was installed and cemented behind casing down to total depth of the well. Additionally, a vertical array of 10 Hz geophones is suspended within the borehole. At the surface, further geophones were installed to shape a permanent three-dimensional seismic array. For this experiment the DAS system sampled strain-rate data at 10 m gauge length and 1 m spacing, yielding a high-resolution image of the wave field. Both seismic systems recorded data for 24 hours at 1 kHz sampling rate.

Within these 24 hours of recording, we shot a vertical seismic profile (VSP) with a 300 kg heavy and 2.4 m tall drop weight source moving up to a distance of 400 m away from the wellhead. Furthermore, passive seismic events at local and regional distances were recorded.

We compare the signal quality between the DAS system and the calibrated three-component geophones using the active and passive signals, to determine the sensitivity, signal-to-noise ratios and frequency response. Further we investigate the noise characteristics of both systems in this natural and remote environment, and evaluate the feasibility of borehole DAS behind casing for micro-earthquake monitoring. We give an outlook how dense DAS data can be utilized for VSP experiments with the aim to develop methods for fault detection and characterisation for application in DAS data recorded at the surface.