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Fiber optic distributed acoustic sensing of local earthquakes at BFO

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Distributed acoustic sensing (DAS) measurement, due to high spatial and temporal resolution, has become very attractive in different applications in seismology, for instance seismic noise analysis and seismic event detection. The physical quantity that is measured by DAS is strain or strain rate of optic fiber cable, which is related to the spatial gradient of displacement and velocity that is usually measured by single point seismometers in seismological studies. The amplitude (and signal to noise ratio, SNR) and frequency resolutions of DAS recordings depend on spatial and temporal acquisition parameters, such as i.e. gauge-length (GL) and derivative time (DT), the latter being of importance only if the device records the strain rate. However, coupling of the measurement cable to the ground and the type of the cable are also key parameters affecting the quality of recorded data.

In this study, we show examples of local earthquakes recorded by DAS at the German Black Forest Observatory (BFO), using different cable types and coupling of the cables to the ground. The spectral characteristics of the strain recording of the earthquakes converted from the DAS raw data are studied. The power spectral densities and amplitude of DAS strain data are compared to the strain meter recordings at BFO site as a benchmark, which is recorded using the strain-meter arrays measuring horizontal strain in three different directions independently from the DAS. We concluded about the lower limit of the DAS signal and noise level that is achievable with employing different acquisition parameters, furthermore, we compared spectral content of local earthquakes recorded by DAS at BFO to the recordings of a seismometer.

Category

Geophysics

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