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Earthquake focal mechanisms from Distributed Acoustic Sensing data

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An earthquake focal mechanism (FM) describes faulting kinematics and geometry. It is a key parameter for understanding stresses acting in the crust. For weak seismic events, the ambiguity in determining the FM is often associated with insufficient azimuthal coverage by close seismic stations. This issue can be partly solved using Distributed Acoustic Sensing (DAS), a rapidly developing technology that allows recording seismic waves using optical fibers and an interrogator. The advantage of this technology, crucial for FM determination, is the ability to build extended virtual seismic arrays with extremely high spatial resolution based on pre-existing optical cables. In this study, we consider two methods allowing us to constrain FMs of weak earthquakes. The first one is proposed in [1]. It is based on P-wave first-motion polarity detection from cross-correlation of DAS records for a pair of earthquakes. The second approach utilizes S/P amplitude ratios from DAS records for a single earthquake [2]. We perform both procedures to the data used in [1, 2]. Different Python libraries, including the DASPy toolbox [3], are applied for data processing. Finally, we propose a new approach integrating the discussed methods and allowing us to estimate FM for a single earthquake based on DAS data.

References

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