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Earthquake detection and characterization with Distributed Acoustic Sensing at the Irpinia Near Fault Observatory

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The Irpinia Near Fault Observatory is a multiparametric infrastructure in the Southern Apennines dedicated to monitoring the seismicity associated with the fault system responsible for the destructive 1980, Mw 6.9 Irpinia earthquake. The observatory integrates seismic, geodetic, and geochemical measurements and has recently been enhanced with two Distributed Acoustic Sensing (DAS) systems within the framework of the national PNRR MEET project (Monitoring Earth Evolution and Tectonics).

A first DAS interrogator has been operating for one year and half and is connected to a 20 km fiber-optic cable deployed in the southern Campania–Lucania Apennines. Eleven months later, a second 60 km–long cable was connected to the same interrogator, covering the central sector of the region and crossing the surface projection of the main fault segments of the 1980 event. Since its installation, the DAS network has recorded about 150 earthquakes, many of which are clearly observed along large portions of one or both cables.

We developed an automatic workflow for DAS data analysis that enables earthquake detection and characterization. Event detection and phase picking are performed using the deep-learning model PhaseNet, demonstrating the effective transferability of conventional seismic models to DAS data. Event association is carried out using at least 50 phase picks, and absolute locations are obtained with the NNLoc software. Local magnitude is estimated from strain-rate data converted to short-wavelength displacement and convolved with the Wood–Anderson response, while moment magnitude and source parameters are derived directly from native strain data. Estimated magnitudes are consistent with those obtained from the conventional seismic network. The ability of the DAS system to detect and characterize earthquakes is controlled by the signal-to-noise ratio variability along the cable and agrees with detection thresholds inferred from power spectral density (PSD) analysis.