



HDAS (High-Fidelity Distributed Acoustic Sensing) as a monitoring tool during 2021 Cumbre Vieja eruption

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La Palma is the second youngest and westernmost among Canary Island. Cumbre Vieja volcano formed in the last stage of the geological evolution of the island and had suffered eight volcanic eruptions over the previous 500 years. In 2017, two remarkable seismic swarms interrupted a seismic silence from the last eruption (Teneguía, 1971). Since then, nine additional seismic swarms have occurred at Cumbre Vieja volcano. On September 11th, 2021, seismic activity began to increase, and the depths of the earthquakes showed an upward migration. Finally, on September 19th, the eruption started after just a week of precursors.

During recent years, the seismic activity has been recorded by Red Sísmica Canaria (C7), composed of 6 seismic broadband stations, which was reinforced during the eruption by five additional broadband stations, three accelerometers and a seismic array consisting of 10 broadband stations.

Furthermore, as a result of a collaboration between INVOLCAN, ITER, CANALINK and Aragón Photonics Labs, it was possible to install, on October 19th, an HDAS (High-fidelity Distributed Acoustic Sensor). The HDAS was installed about 10 km from the eruptive vent and was connected to a submarine fibre optic cable directed toward Tenerife Island. Since then, the HDAS has been recording seismic with a temporal sampling rate of 100 Hz and a spatial sampling rate of 10m for a total length of 50 km using Raman Amplification. For more than two months, in addition to the intense volcanic tremor, the HDAS recorded thousands of earthquakes as well as regional and teleseismic events. On December 13th, 2021, after an intense paroxysmal phase with an eruptive column that reached 8 km in height, the volcanic tremor quickly decreased, and the eruption suddenly stopped. Only a weak volcano-tectonic seismicity and small amplitude long-period events were recorded in the next month.

This valuable dataset will provide a milestone for the development of techniques aimed at using DAS as a real-time volcano monitoring tool and studying the internal structure of active volcanoes.