EGU2020-15252
https://doi.org/10.5194/egusphere-egu2020-15252
EGU General Assembly 2020

Monitoring volcanic and seismic activity with multiple fibre-optic Distributed Acoustic Sensing units at Etna volcano

Charlotte Krawczyk[1,2], Philippe Jousset[1], Gilda Currenti[3], Michael Weber[1,4], Rosalba Napoli[3], Thomas Reinsch[1], Giorgio Riccobene[5], Luciano Zuccarello[3], Athena Chalari[6], and Andy Clarke[6]

[1]GFZ Potsdam, Potsdam, Germany (lotte@gfz-potsdam.de; pjousset@gfz-potsdam.de)
[2]Technical University, Berlin, Germany
[3]INGV, Italy
[4]Potsdam University, Germany
[5]INFN-LNS, Catania, Italy
[6]Silixa Ltd, Elstree, UK

Volcanic and seismic activities produce a variety of phenomena that put population at risk. Etna volcano provides an example where volcanic and tectonic processes are strongly coupled. Distributed Acoustic Sensing (DAS) technology has been for the first time tested both in 2018 and 2019 as a new tool for monitoring the complex tectonic and volcanic interactions at Etna volcano from summit to the sea floor. We connected up to 3 iDAS interrogators, sometimes simultaneously, to optical cables close to the summit, in urban areas and offshore. Each iDAS measured the dynamic strain rate along the whole length of the optical fibre, from the interferometric analysis of the back-scattered light.

In the summit area, we connect an iDAS interrogator inside the Volcanological Observatory of Pizzi Deneri (2800 m elevation close to Etna summit) to record dynamic strain signals along a 1.5 km-long fibre optic cable that we deployed in the scoria of Piano delle Concazze. We recorded signals associated with various volcanic events, local and distant earthquakes, thunderstorm, as well as many other anthropogenic signals (e.g., tourists). To validate the DAS signal we collocated along the fibre cable multi-parametric arrays (comprising geophones, broadband seismometers, infrasonic arrays). During the survey periods, Etna activity was mainly characterized by moderate but frequent explosive and/or effusive activity from summit craters. Our observations suggests that DAS technology can record volcano-related signals (in the order of tens nanostrain) with unprecedented spatial and temporal resolutions, opening new opportunities for the understanding of volcano processes.

In urban environments, taking advantage of the existence of fibre optic telecommunication infrastructures, we connected iDAS interrogator to fibre optic cables, known to cross active faults linked to the volcano eastern flank dynamics. We recorded dynamic strain rate along a 4 km cable for about 20 days in Zafferana village and along a 12 km-long cable running from Linera to Fleri. We also tested DAS recording along a 40 km-long fiber optic telecommunication cable on the

western side of the volcano, at the border between the sedimentary layer and the volcano edifice.

On the sea floor, we connected an iDAS interrogator to a 30-km long fibre within a cable transmitting data from sub-marine instrumentation to INFN-LNS facility at the Catania harbour. We record dynamic strain signals from local and regional earthquakes and detect some previously unknown faults offsetting the sea floor below the eastern flank of the volcano.

Our results demonstrate that DAS technology is able to contribute to the monitoring system of earthquake and volcanic phenomena at Etna volcano, and thereby could improve the volcanic and seismic hazard assessment in the future.