EGU24-13091, updated on 14 May 2024
https://doi.org/10.5194/egusphere-egu24-13091
EGU General Assembly 2024

Long-term monitoring of seismic and volcanic activity using distributed fibre optic sensing: examples in Iceland (2015-2024) and Italy (2018-2024).

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Monitoring of seismic activity around volcanoes has been conventionally performed using data from continuous seismic and deformation networks, which give real-time information on the status of a volcano at any time. In case of a volcanic crisis, the number of earthquakes often increases with time and conventional networks are completed by deployment of additional sensors, which allow for a better hazard assessment, e.g., by lowering the detection threshold and improving earthquake locations. The deployment of such additional sensors is labour intensive and may be dangerous due to increased volcanic hazard.

Existing fibre optic telecommunication cables can be used with distributed dynamic strain sensing interrogators to density and complement the monitoring network. It has been demonstrated that the usage of fibre optic sensing allows for a rapid response and the acquisition of crucial data describing a developing crisis (e.g., at Vulcano, Italy). However, fibre optic interrogators are rarely deployed as permanent interrogating systems, despite the capability of such systems for long-term monitoring as demonstrated during a 7 months continuous recording on the Reykjanes Peninsula, Iceland, in 2020. Instead, interrogators are usually deployed for limited time periods when the activity occurs, ideally before new activity starts. For example, we connected an iDAS interrogator on the telecommunication 16-km long cable running between the Reykjanes and Svartsengi (“Blue Lagoon”) geothermal power plants in 2015 for an initial test of 10 days, in 2020 for 7 months (GFZ rapid response to the seismic crisis and precursory activity to the 2021 and 2022 eruptions of Fagradalsfjall volcano), and in November 2023 (recording still on 10.01.2024) as a GFZ rapid response before the 18 december 2023 eruption.

In this work, we investigate the possibility to use repetitive campaign-based measurements of dynamic strain sensing performed in the course of multiple years on the Reykjanes Peninsula (2015; 2020; 2023-2024) and at Etna volcano (2018; 2021; 2022; 2023-2024). Analysing earthquakes and ambient noise, we search for differences and similarities in the strain-rate response between the different and disjunct recording periods. We report preliminary results.

How to cite: Jousset, P., Hersir, G., Currenti, G., Wollin, C., Díaz-Meza, S., Allegra, M., Maass, R., Prestifilippo, M., Gudnason, E., Napoli, R., and Krawczyk, C.: Long-term monitoring of seismic and volcanic activity using distributed fibre optic sensing: examples in Iceland (2015-2024) and Italy (2018-2024)., EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-13091, https://doi.org/10.5194/egusphere-egu24-13091, 2024.