

# REFIMEVE: a network as a sensor

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Optical fiber networks, typically associated with data traffic, serve as versatile conduits for transmitting optical signals enabling fundamental research as innovative applications. These include quantum key distribution, synchronization of large-scale instruments, and the transmission of ultra-precise time and frequency reference signals, highlighting the diverse capabilities of fiber optics beyond conventional data transfer. Numerous studies explore the utilization of dedicated fibers for ultra-sensitive sensing applications, presenting a significant challenge in integrating these systems into active telecommunication networks. In recent years, it has been demonstrated that optical fiber connections with ultra-stable optical signals possess the capability to detect acoustic waves resulting from earthquakes<sup>1</sup>. This endeavor aims to leverage existing large-scale infrastructures, maximizing their societal impact while advancing sensing capabilities.

In France, the REFIMEVE research infrastructure distributes ultra-stable optical frequencies across over +3,800 km of RENATER's telecommunications network. REFIMEVE benefits from signal high availability and robust frequency transfer, aided by the mature knowledge transfer to Exail and an integrated supervision system, enabling seamless integration of open-access databases like IRIS and EPOS into our computations. In this study, we offer quantitative analyses of utilizing REFIMEVE for seismic detection within the low Fourier-frequency range. We investigate the sensitivity of multiple coherent optical fiber links operated concurrently to seismic events. Our focus will be directed towards the catalogs we have currently constructed, where we will evaluate the strengths and weaknesses of machine learning algorithms. Additionally, we will outline a potential roadmap for establishing an open-access database of events, facilitating easy access and utilization by the geophysics community.

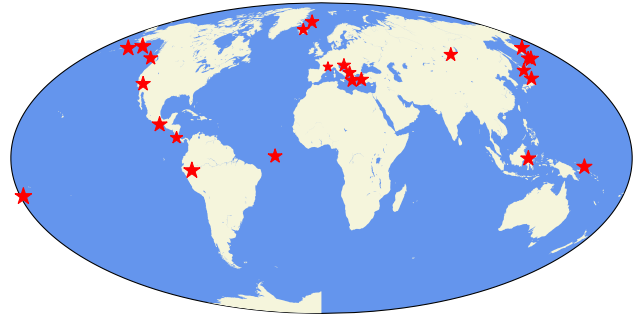


Fig. 1: The stars depicted on the map represent events from one of the catalogs we have compiled. REFIMEVE has the capability to detect events globally. Currently, our catalogs predominantly feature larger and long-range events compared to smaller, shorter-range ones.

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<sup>1</sup> E. Ip *et al.*, in *Optical Fiber Communication Conference (OFC) 2022* (2022), doi: [10.1364/OFC.2022.Th4A.2](https://doi.org/10.1364/OFC.2022.Th4A.2).