



## **Radio Direction Finding (RDF) - Pre-seismic signals recorded before the earthquake in central Italy on 1/1/2019 west of Collelongo (AQ)**

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The study aims to present data on the broadband electromagnetic monitoring (SELF-VLF band, 0.001-30000Hz) able to work 24h7, within the electromagnetic monitoring network with RDF (Radio Direction Finder) technology. It is the first network of this type able to work on a wide bandwidth (ELF-VLF band, 30-30000Hz) specially designed to study the so-called "Seismic Electromagnetic Precursors" (SEPs) and the "Seismic Geomagnetic Precursors" (SGPs).

In particular, some electromagnetic signals appeared six days before an earthquake of magnitude Mw 4.1 occurred on 01/01/2019 at 18:37:46 (UTC) in the area: 3 km W Collelongo (AQ) (data INGV), on the azimuth identified by the monitoring system of the Radio Emissions Project, based precisely on RDF - Radio Direction Finding technology of the Radio Emissions Project.

The signal appeared initially at 03:10 UTC on 26 December 2018, and presented an azimuth identical to that of the seismic epicenter (axis - 80° - 260°) indicating precisely and with low error in degrees, the geographic area of the municipality of Collelongo (AQ) 6 days before this earthquake occurred. The main and strong increase (between 0 Hz and 32000 Hz) lasted until 06:00 UTC on 26 December 2018, while other signals reappeared later, at 09.10 UTC and at 12:52 UTC on 26 December 2018. Also in this case the azimuthal emissions indicating the seismic epicenter had a bandwidth of 32000 Hz.

From 02.10 UTC to 11:50 UTC on 29 December 2018 other signals indicating the azimuth of the seismic epicenter appeared at an electromagnetic frequency of 4000 Hz. The last appearance of the signals associated with the seismic azimuth occurred on December 31st. 2018, at 10:10 UTC, a few hours from the earthquake of Mw 4.1.

The results of the electromagnetic monitoring have allowed to find a close correlation between the seismic event in question, and the background electromagnetic noise inside the band SELF-VLF (0-32000Hz) monitored: the azimuthal data related to the background electromagnetic noise they are superimposable with the azimuth of the seismic epicenter located at 3 km W Collelongo (AQ), and about 60.8 km away from the monitoring station located in Lariano (Rome, Italy) near the Volcano Laziale.