



## **Disturbances in a VLF radio signal prior of the offshore earthquake (M=4.6) occurred on August 22, 2005 (central Italy)**

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On August 22, 2005 an earthquake with  $M = 4.6$  occurred in the Anzio (central Italy) offshore area. The epicenter is located 5 miles from the Tor Caldara “Diffuse Degassing Structure” where the 222Rn and 220Rn content in air is sampled by researchers of the INGV (National Institute of Geophysics and Volcanology) and anomalies before and after the earthquake were revealed. From long time, a VLF-LF radio receiver operates in Bari (southern Italy). The intensity and the phase of the signals transmitted by GB ( $f=16$  kHz, United Kingdom), FR ( $f=20.9$  kHz, France), GE ( $f=23.4$  kHz, Germany), IC ( $f=37.5$  kHz, Island) and IT ( $f=54$  kHz, Sicily, Italy) has been monitored with a 5s sampling rate. The previous epicenter is near enough to some of the radio paths and the data collected were analyzed in order to reveal possible seismic effects. In order to manage the huge amount of data we analysed the time series smoothed at 10 minutes, that is one datum each 10 minute averaged between the raw data 5 minutes before and 5 minutes after the datum. A clear drop was observed in the intensity of the FR radio signal on August 19. This radio signals is the nearest to the quoted epicentre and a precursor could be claimed. Then, the wavelet analysis was applied to the FR intensity data and in the same day an increase in the power spectra of the band 60-120 min was revealed; a similar effect stood up also in the phase data. This spectral behaviour appears as an anomaly both respect to the FR data collected during the 2005 and to the data of the other radio signals; moreover, no other earthquake with  $M > 3.0$  occurred in the same zone of the earthquake happened on the August 22, 2005. So, the quoted anomaly seems a precursory effect of this earthquake. The duration of the anomaly fits with perturbations in the ionosphere related to

Atmospheric Gravity Waves produced during the preparation of the earthquake.