ESC2016-58, 2016
35th General Assembly of the European Seismological Commission

35th General Assembly of the
European Seismological Commission
4–10 September 2016
Trieste

Ten years of electromagnetic recordings by the Central Italy Electromagnetic Network (CIEN)

Cristiano Fidani
SARA Electronics Instruments, Earthquake Physics, Perugia, Italy (c.fidani@virgilio.it)

A network of wide band electromagnetic detectors consisting of identical instruments that continuously record the electrical component of the electromagnetic field, ranging from a few Hz to tens of kHz has been operating in central Italy for more than ten years. These signals are analysed in real time, as well their power spectrum contents and time/frequency data are saved for further analysis. The spectral contents have evidenced very distinct power spectrum signatures in ELF band that increase in intensity when strong seismic activity occur near the stations. For example at the time of the Emilia earthquakes in 2012, when nine stations were operative, and at the time of the L'Aquila earthquakes in 2009, when only two stations were operative. CIEN is presently composed of 14 stations. Recently, many other types of detectors have been added at each station: 8 stations with vertical conductivity detectors, 4 with magnetometers, 2 with gamma detectors, 2 with meteorological stations, one with a ground thermometer and another one with a camera for transient luminous phenomena in atmosphere; so updating the network in a multi-parameter. For this analysis no correlations have been observed between ELF signals recorded by different stations, and no magnetic components have been recorded during ELF electric activity by none of the 4 magnetometers.
Regarding a possible model, one has been proposed to explain ELF signatures. It is made up of a rough spherical charge distributions which could have formed in the atmosphere by expelled charged gases from the ground. The balancing electrostatic forces, due to air ions of net zero charge and external pressure, could have been responsible for spheroidal confined structures which were stable and oscillating. At the same time, such symmetric structures, which oscillate radially, also create no electric fields beyond a certain distance and infinitely small magnetic fields out of the structures, due to the symmetry. Furthermore, regarding high charge concentrations, corona discharges in the space between the separated charges can render the object luminous, therefore explaining the occurrence of spheroidal earthquake lights.
Electric field oscillations have also been recorded by CIEN prior to rainfall without seismic activity. In fact, the L'Aquila and Emilia earthquakes occurred in the spring, when meteorology tends to be more unstable. Thus, the observed increased ELF activity during these events could also be explained by the high level of recorded rainfall during the spring. Subsequently, a statistical correlation between ELF signals and earthquakes was calculated. Finally, a probability of earthquake occurrence based upon ELF activity was estimated including a reliability parameter. The meteorological processes can generate spurius anomalies that create a noise factor. This factor can be quantified by the reliability parameter, which is defined by the ratio: genuine anomaly numbers / the total ones.