ELECTROMAGNETIC MONITORING OF THE NEW MADRID FAULT US AREA WITH THE RDF SYSTEM - RADIO DIRECTION FINDING OF THE RADIO EMISSIONS PROJECT

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Abstract: The study presents the monitoring data of the pre-seismic signals, detected with the RDF System, of the New Madrid Fault. The experimentation was carried out in 2018 and concerned 57 earthquakes of M2.5 + magnitude of the Richter scale, including earthquakes of magnitude 3.3 and 4.4 occurred in the New Madrid area in December 2018. The earthquakes analyzed in the course of the experimentation were preceded by electromagnetic frequencies between 1000 Hz and 32000 Hz, appeared a few hours to a few days before earthquakes. Thanks to this new technology, developed in Rome by Daniele and Gabriele Cataldi, thanks to the use of a radio receiver designed for the amplification of low-frequency electromagnetic signals (between the SELF band and the VLF band, 0-32000 Hz) it is possible to identify the origin of the electromagnetic signals and to identify, with the triangulation method, the future epicentral area. The development of the RDF methodology, applicable to all areas of the Earth Globe, will contribute to a greater understanding of the crustal diagnosis of a potentially high-risk seismic zone, as evidenced by the violent earthquakes in New Madrid in 1811 and 1812.

Keywords: RDF system, earthquake prediction, SELF-VLF, New Madrid fault.

INTRODUCTION

The RDF - Radio Direction Finding system of the Radio Emissions Project - is a electromagnetic detection system that covers the entire terrestrial surface. This coverage is subdivided into colorimetric areas to which very precise azimuths are associated. The first monitoring station was built in Lariano (Rome, Italy), and was created by the LTPA Observer Project and the Radio Emissions Project and allows monitoring of "crust diagnosis" in real time, on a global scale (Straser et al., 2018).

During the experimentation of the Radio Emissions Project it was possible to detect strong and precise radio emissions to precede destructive earthquakes worldwide (Straser et al., 2015; Straser et al., 2016; Cataldi et al., 2017). Given these results, it was necessary to develop a system capable of detecting the position or azimuth of origin of these electromagnetic signals to better understand the evolution and nature of the electromagnetic signals. Against this need, the RDF monitoring technique was developed (Straser et al., 2018).

Between February 2, 2018 and November 30, 2018, the Radio Emissions Project monitored the area of North America, characterized by the Fault of New Madrid, long indicated as a dangerous seismic area subject to destructive earthquakes (Fig. 4) (Choi et al., 2018). This study served to understand if the monitoring technique developed by the Radio Emissions Project, by means of the RDF - Radio Direction Finding system, was able to ascertain a relationship between electromagnetic emissions and the occurrence of earthquakes.

The Fault of New Madrid, after the very strong earthquakes of 1811 and 1812, is one of the areas subject to monitoring, as early as the first half of the seventies of the last century. The succession of

jolts felt and recorded by seismic networks, generally of low magnitude, testify to the tectonic vivacity of the area that stretches from New Madrid, in the north-west of Arkansas, southwest of Kentucky, southeast of Missouri and northwest of Tennessee. It is an intraplate type seismicity and the seismic hazard in the Mississippi area is well known to American geologists, who expect new important events in the coming decades. In 1968 the last major earthquake occurred at Illinois with magnitude 5.4 Richter. If, on the one hand, an interpretation of the current tectonic activity is associated with the seismic tail of the earthquakes of the winter of 1811 and 1812 (Morgan and Hough, 2014) that had caused extensive damage along the Mississippi, on the other, seismic sequences could be a prelude to a new crisis with the fear of destructive events deemed, not wrongly, a Big One, aggravated by the anthropization that was not present more than two centuries ago. The areas located along the Fault of New Madrid could also be involved in land liquefaction processes, as revealed by the data on paleoseismology. The new technologies, such as the RDF System, made in Italy in Rome by Gabriele and Daniele Cataldi, allow to detect in real time, 24/7, the electromagnetic activity of the areas subjected to tectonic stress, with indication of the provenance of electromagnetic anomalies. Thanks to the triangulation method, having multiple monitoring stations, it is possible to approximate the future epicentral area with sufficient approximation. In this context, given the importance of monitoring potentially high-seismic areas, the New Madrid area was chosen to add new data and information useful for monitoring crustal stress and, in perspective, the forecast of destructive seismic events.

1. The RDF Network

Starting from the use of a first radio reception station RDF (Straser et al., 2018), experimented in 2018, the Radio Emissions Project, has started to install other stations equipped with the "Radio Direction Finding" technology, thus creating the network monitoring called "Radio Emissions Project Network". The Radio Direction Finding (RDF) Network, developed by the Radio Emissions Project is based on technology that evolved starting from the late 1800s thanks to the studies of Heinrich Hertz, who discovered the directionality of an open loop of wire used as an antenna. Compared to other electromagnetic monitoring systems employed within the scope of scientific research to forecast potentially destructive earthquakes (MW=6+), the RDF system allows 24/7 monitoring of a wide bandwidth of the Earth's background electromagnetic emissions to trace radio anomalies in seismically active areas of the terrestrial surface.

1.1 The World Mapping

The Radio Direction Finding (RDF) system developed by the Radio Emissions Project, is a electromagnetic detection system that covers the entire surface of the Earth. This coverage is divided into colorimetric areas to which very specific azimuths are associated (Fig. 1).

In 2017, the Radio Emissions Project created an interactive world map, divided into colored spatial axes that identify the azimuth of origin of the electromagnetic signals (Fig. 1) with respect to the detection station (positioned at the center of this mapping). This map represents a zoonization of the entire terrestrial surface, from which the detected electromagnetic signals can come, identifying in this way the geographical area of origin of the signals.

To understand the operation of the RDF system it's necessary to assume that the receiving system is able to provide a stereo signal coming from the antennas, arranged orthogonally and oriented towards the cardinal points. The flow of radio signals coming from the antennas is subdivided into "colors" to which a forward direction is then associated.

According to the colorimetric scheme used by the RDF station, the cardinal points and the goniometric values associated with the individual composing this scheme, indicate geographic areas (near or far) radially displaced with respect to the position of the monitoring station.

The result is a subdivision into "strips" all having the same length (about 20.000 km) that start from the geographic position where the station is located and all join at the "antipodal point" of the station itself.

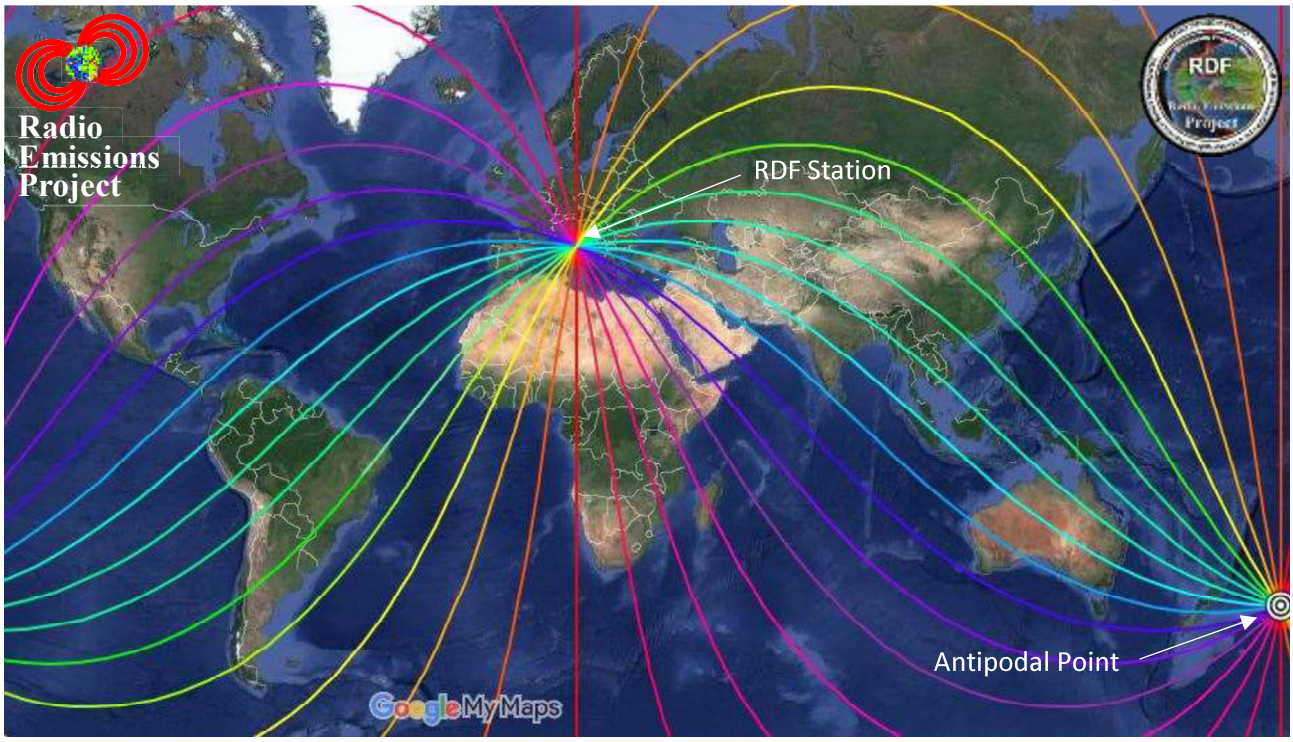


Fig. 1 - World Mapping of the RDF system, developed by the Radio Emissions Project, located in Lariano (Rome, Italy).

2 The Study

On 2 February 2018 the electromagnetic monitoring of the US area began in the area of New Madrid, as shown in Fig. 2.
This electromagnetic monitoring was made possible thanks to the RDF - Radio Direction Finding station of the electromagnetic detection system developed by the Radio Emissions Project, installed in Lariano, (Rome, Italy). The station began to provide the first data on the origin of electromagnetic signals in March 2017 (Straser et al., 2018), while the monitoring of the New Madrid Fault began almost a year later.
The geographical area examined for this study has an extension of approximately 266.851 million square kilometers, and a perimeter of 1.917 kilometers. The area covers 7 US states in North America:

1. Illinois
2. Indiana
3. Kentucky
4. Tennessee
5. Mississippi
6. Arkansas
7. Missouri

North American area

The extension of this area confirms the high degree of seismic hazard of the fault, as it is able to generate intense earthquakes as occurred in the past (Choi et al., 2018): as already mentioned, the most intense seismic events recorded in the New Madrid Fault began between 1811 and 1812 with an initial earthquake of magnitude Mw 7.5-7.9 of 16 December 1811, followed by an earthquake of magnitude Mw 7.4 (aftershock) on the same day. These remain the most powerful earthquakes that have ever hit the United States east of the Rocky Mountains in US history (source: USGS).

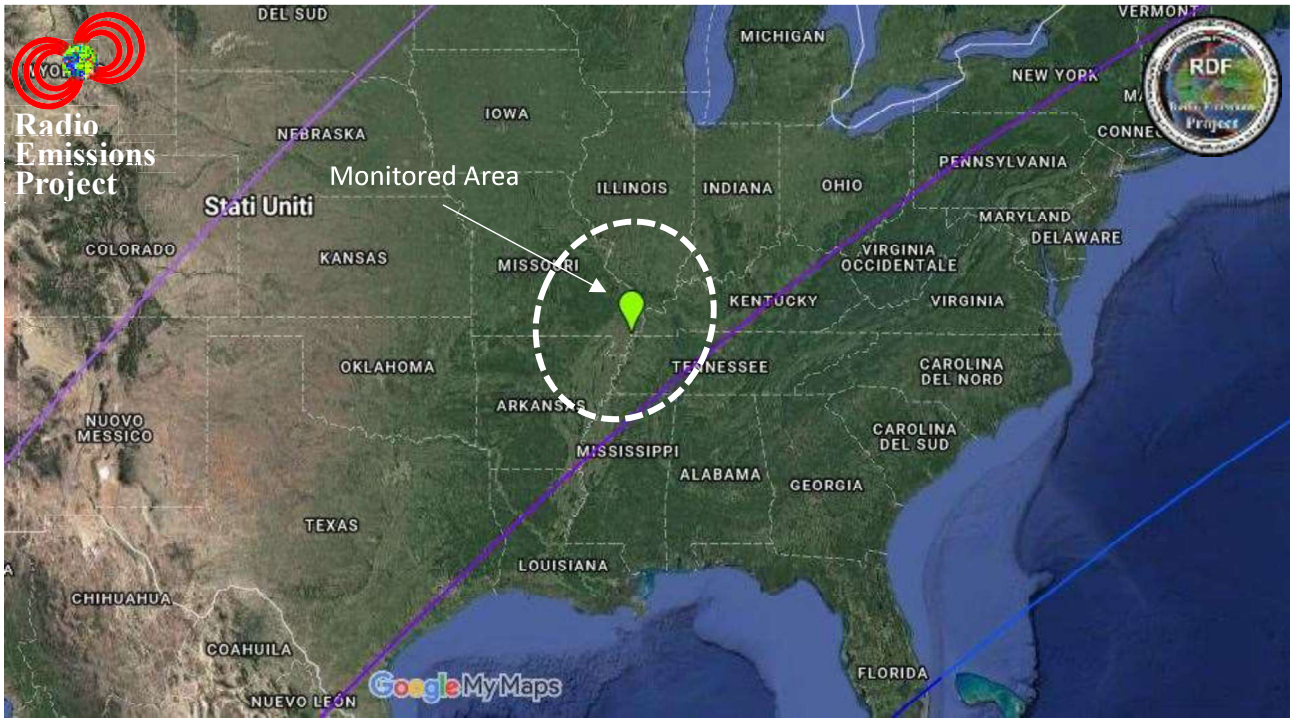


Fig. 2 - Mapping of the RDF system developed by the Radio Emissions Project, with reference to the area of North America (Fault of New Madrid) under monitoring.

The experimentation study, in relation to the results obtained by the Radio Emissions Project (Straser et al., 2018), took place in this area, to test the RDF monitoring system of the Radio Emissions Project and to find information and results useful for understanding the nature of the electromagnetic emissions recorded by the monitoring system if there were earthquakes of a certain intensity.

In this case the azimuth that the Radio Emissions Project has kept under strict control was the "dark purple" (as seen in Fig. 3 and Fig. 4), in the proper direction of the United States where the New Madrid Fault is present. . This monitoring had to monitor the possible appearance of signals having this origin azimuth, compared to the position of the receiving station, located in Lariano, Rome, Italy.

The experimentation was able to record numerous signals coming from the area, first identifying their azimuthal origin in the direction of the US area, discarding all the others accordingly, then checking their electromagnetic frequency, the time of appearance and the bandwidth. (average of the width) of the same.

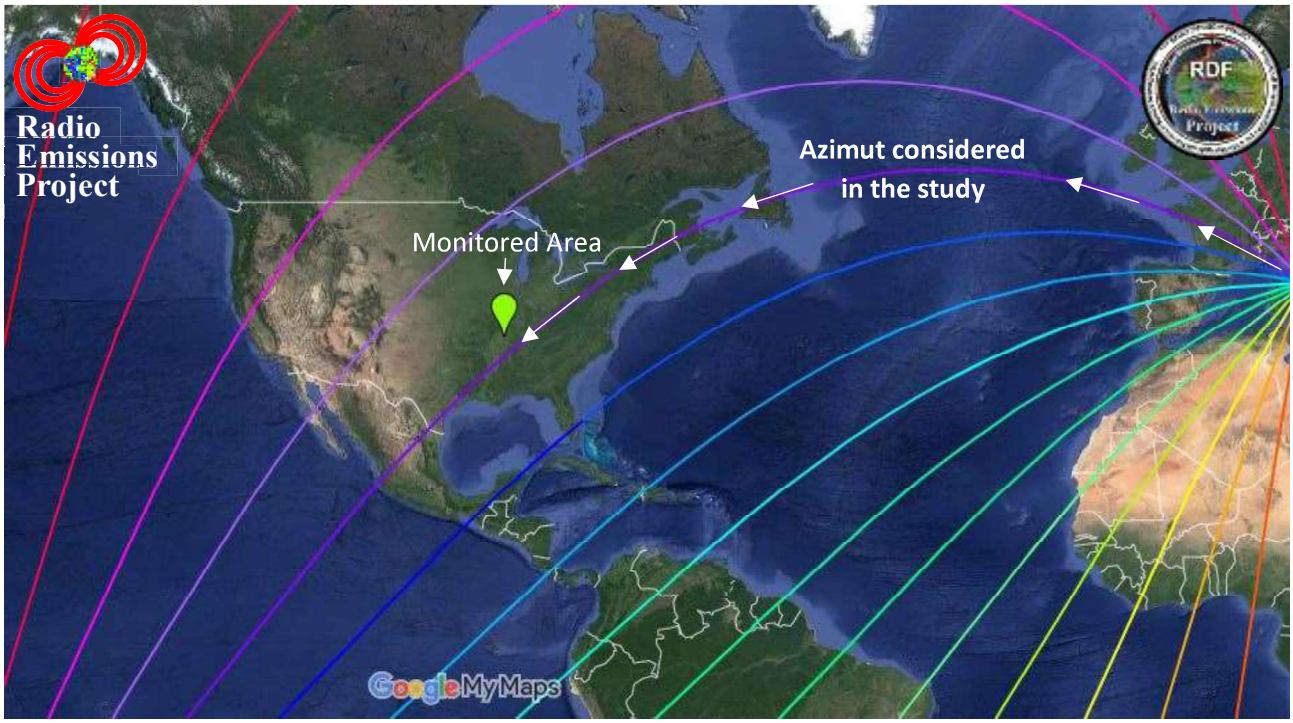


Fig. 3 - Mapping of the RDF system developed by the Radio Emissions Project, with reference to the area of North America (Fault of New Madrid) - View of part of the world mapping of the oceanic area, with reference to the dark violet azimuth examined.

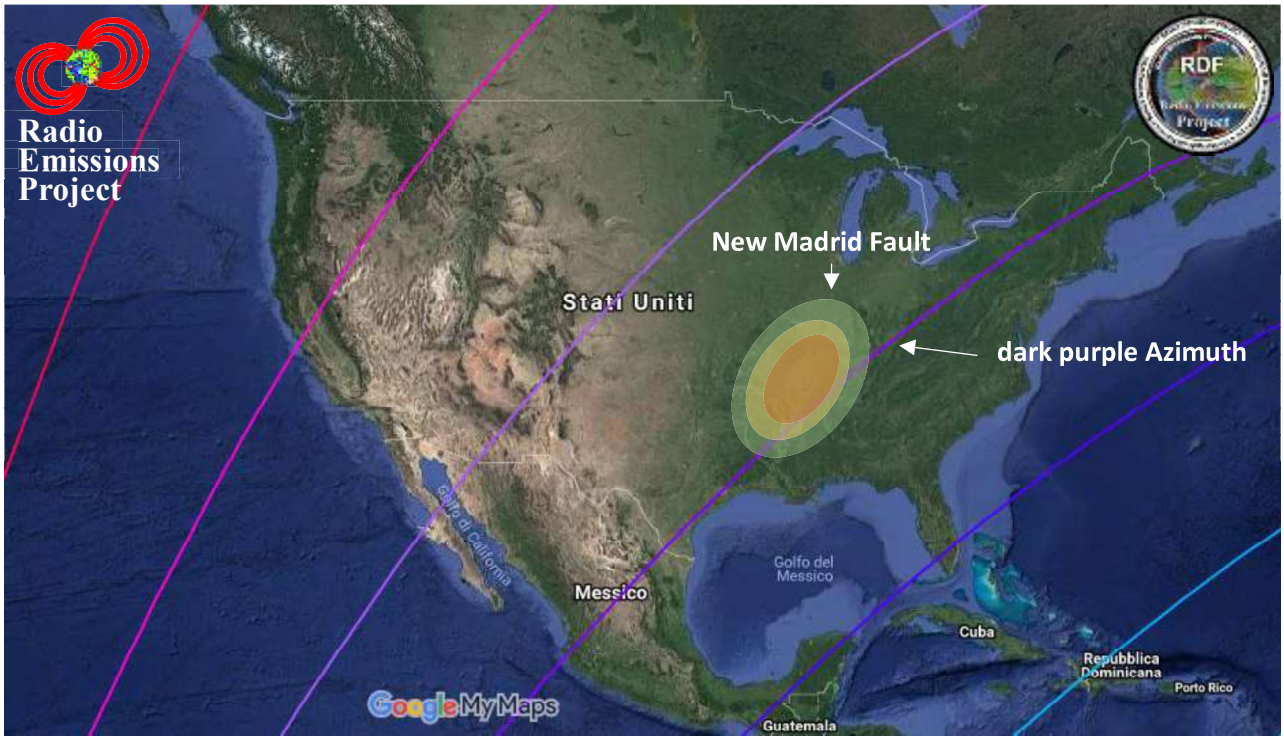


Fig. 4 - Area of the New Madrid Fault - Source: Radio Emissions Project. The map indicates the seismic hazard of the area, which is monitored by the RDF system of the Radio Emissions Project.

The area examined was identified by means of the global mapping of the RDF system. It is located in correspondence of the dark violet azimuth (as already mentioned), or on the N-W - S-E axis (direction N-W) with respect to the Lariano station (Rome, Italy). This area (Faglia di New Madrid) is about 8,500 km away from the monitoring station (Fig. 5).

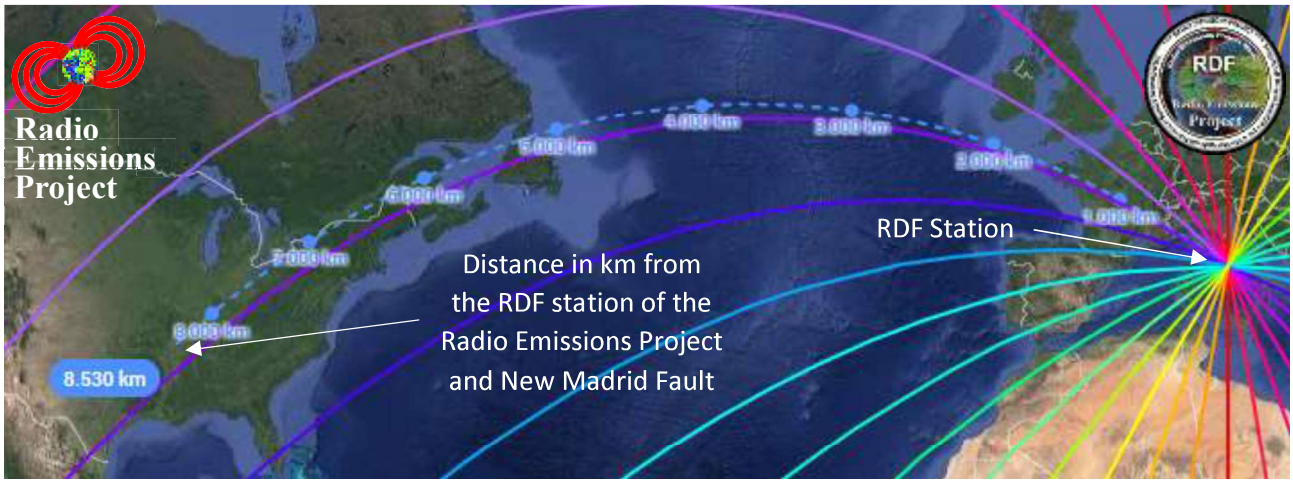


Fig. 5 – World mapping of the RDF system of the Radio Emissions Project - Distance of the New Madrid Fault area compared to the RDF monitoring station, ot 8500 km in the direction of N-W from Lariano (Rome, Italy). In this image the violet azimuth on which the area is located is visible. Source: Google Maps. Source: Google Maps.

During the study, there were 57 M2.5 + seismic events on the Richter scale, all preceded by intense radio emissions; the RDF - Radio Direction Finding system has been able to provide important indications on the origin azimuth of electromagnetic signals, on their temporal behavior, on their frequency variation, on the intensity and on their morphological behavior: data that allowed to improve the reliability of the RDF monitoring system and confirm, also in this case, the existence of important radio broadcasts (with wide bandwidth) that appeared before non-underestimable seismic events.

3 The data

The data of the study realized through the recordings made by the RDF station of Lariano (Rome, Italy) have confirmed the existence of electromagnetic signals with wide bandwidth related to the azimuth of the New Madrid Fault. The characteristics of these electromagnetic signals are listed below.

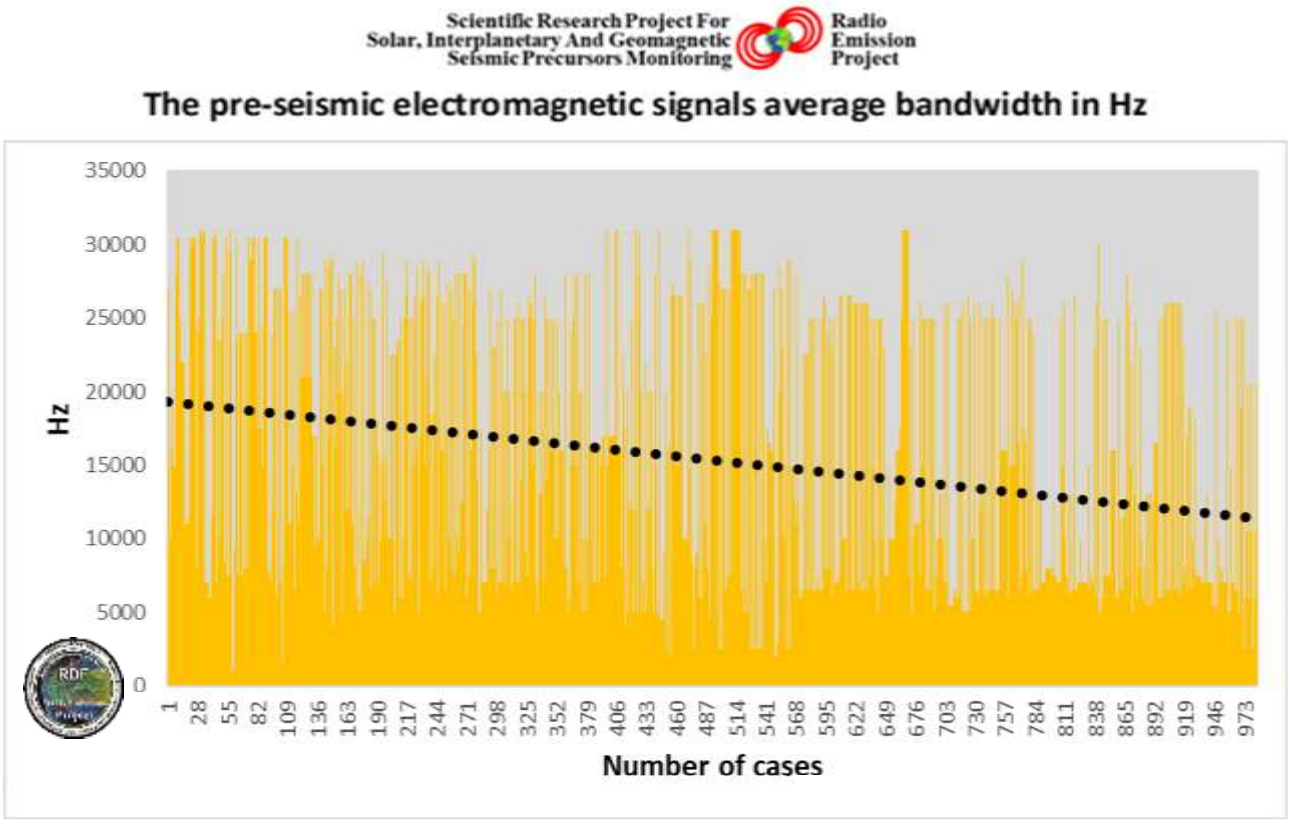
3.1 Frequency of electromagnetic signals

The electromagnetic signals having the area of the New Madrid Fault as azimuth of origin, have shown a reduction in their frequency of emission with respect to the period considered (2 February 2018 - 30 November 2018) as shown in Fig. 6.

The study of the emission frequency of these signals appears important if the data on the reduction of solar activity (solar minimum) are considered, confirming the previous studies of the Radio Emissions Project.

In fact, Fig. 6 confirms that the average frequency of radio emissions detected by the RDF system of the Radio Emissions Project follows the trend of solar activity, which in recent months is being reduced due to the approach to the "Solar Minimum", as shown in Fig. 7.

This indicates that the Lariano RDF detection system (Rome, Italy) has detected electromagnetic phenomena influenced by geomagnetic activity, ie linked to solar activity, having a precise azimuth.



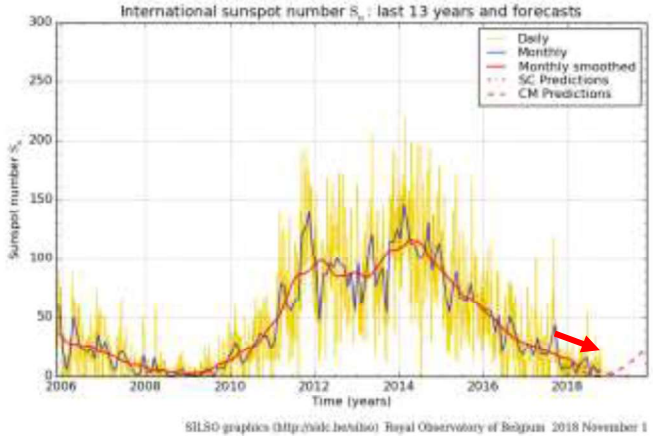


Figura 7 - Andamento dell'attività solare (sunspot number).

The solar minimum, is the period of lower activity of the Sun in the solar cycle; during this period, the activity of sunspots and flares tends to decrease, until it becomes almost absent for several consecutive days.

According to recent studies the solar minimum period coincides statistically with the greatest disasters occurred on a global scale, due to the energy release accumulated during the period before the solar minimum itself (Choi and Casey, 2015).

The RDF system, as already mentioned, has detected a decrease in the electromagnetic frequency of the natural signals in the direction of the monitored area, which follows the same trend of the solar cycle, it is indeed possible that solar activity influences our planet and with it also the natural electromagnetic emissions generated by this interaction.

3.2 Time of Occurrence

Analyzing the time at which these signals appeared, it was discovered that the greatest number of radio emissions are concentrated in the daytime hours, that is at times when there was solar lighting in the Italian geographical area where the monitoring station is located. . It can be deduced that this factor has influenced the detection of electromagnetic signals in general; after which the number of recorded radio signals is reduced by 50%.

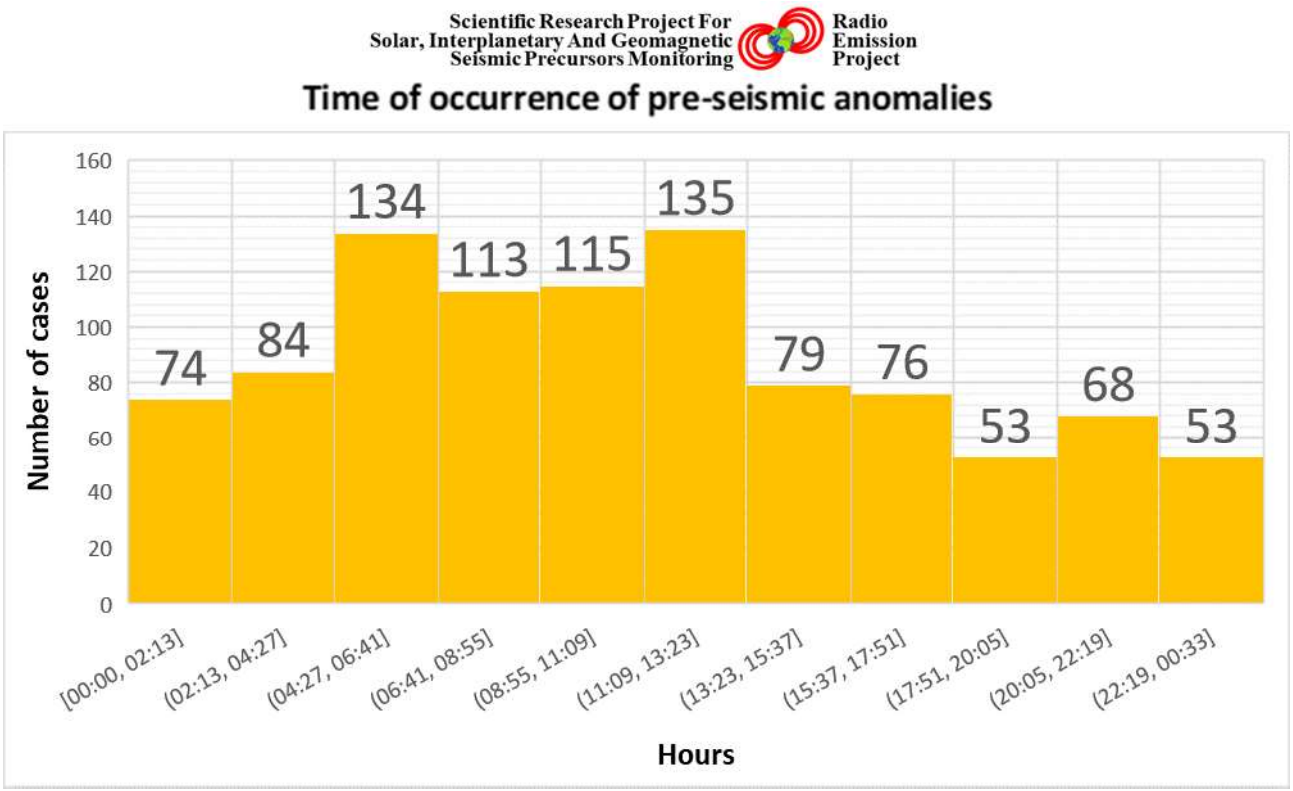


Fig. 8 - Time of occurrence of the geomagnetic signals with the azimuth of New Madrid as the arrival direction.

This data shows that the solar interaction with the magnetosphere and the ionosphere is one of the factors influencing the radio emissions recorded by the RDF system (Fig. 8). It is evident that on the detection capacity of the RDF system, especially for the areas very far from the detection station, ionospheric phenomena induced by solar activity can influence which can interact with the propagation of long distance ionospheric signals (Appearance and disappearance of ionospheric Layers). In this context, the experimentation of the monitoring system highlighted this important data.

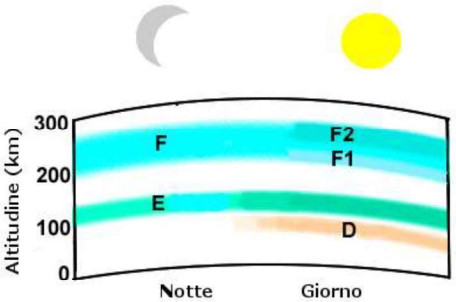


Fig. 8b – Schematization of the number and type of ionospheric Layers between the day and night hours. The modification of these Layers is determined by solar irradiation.

3.3 Number of radio-anomalies

Also the number of radio-anomalies is extremely important compared to their appearance. The highest concentration of recorded signals, whose direction is the azimuth of the New Madrid Fault (azimuth of dark purple color), appear to be those visible in Fig. 10.

- A first peak of concentration of radio signals appeared between 22 February 2018 and 21 May 2018.

- A second peak of concentration of radio signals appeared instead between June 12, 2018 and November 30, 2018.

Analyzing this graph shows how the number of electromagnetic emissions is inversely proportional to the Sunspot Number, or the index of solar activity in the period considered by this study (Fig. 9). The average frequency of emissions seems to be again influenced by the trend of solar activity, and the number of daily emissions seems to follow this index (Sunspot Number) in an inversely proportional way.

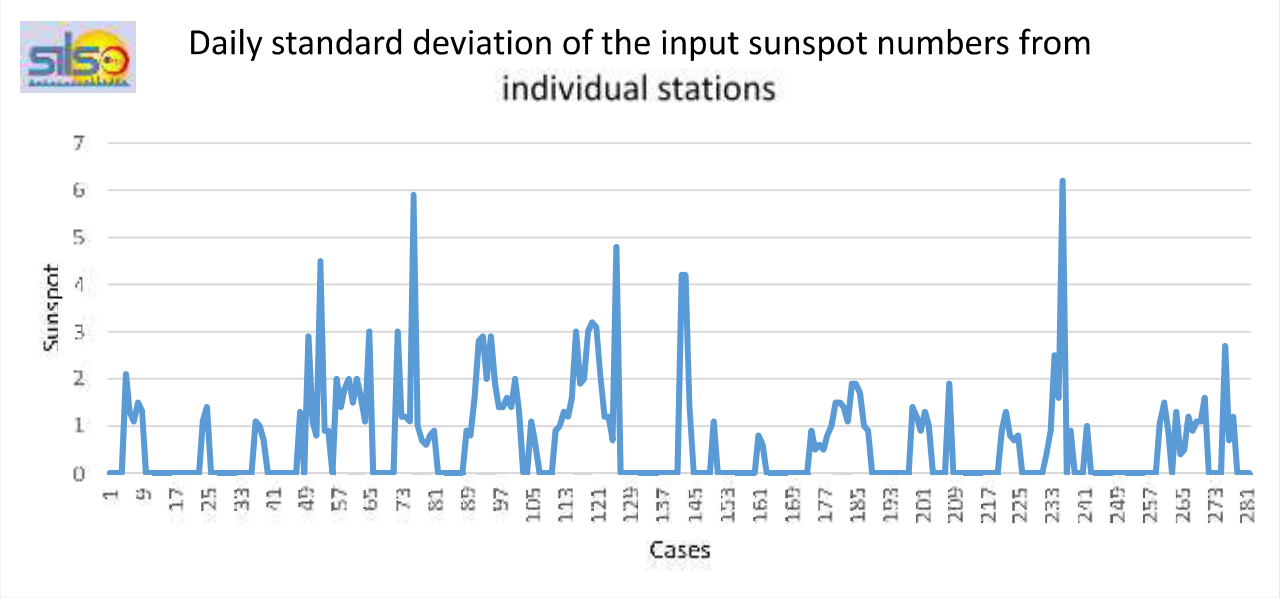


Fig. 9 - Sunspot Number - Source: http://www.sidc.be.

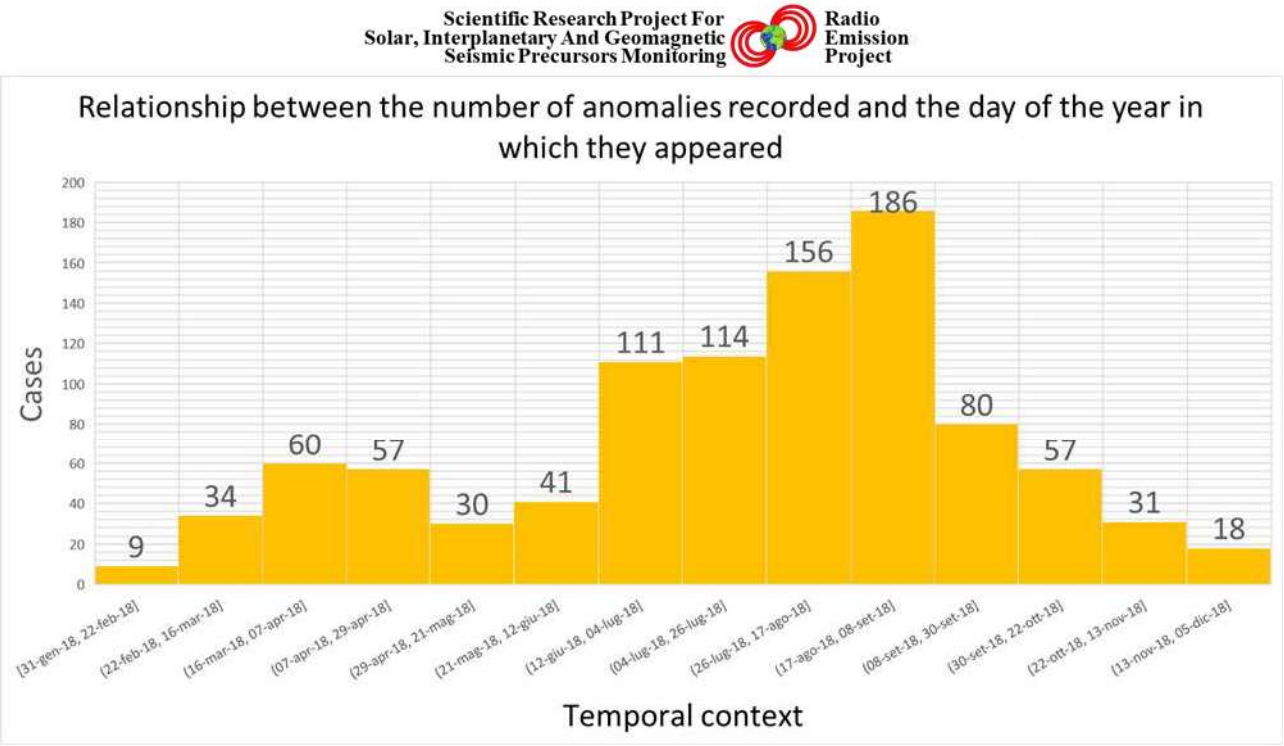


Fig. 10 - Number of radio-anomalies with respect to the temporal context. They follow inversely proportional the number of sunspots, or the number of sunspots that appeared on the Sun's chromosphere.

3.4 Frequency of the radio-anomalies

Very important data appear to be the frequency of the radio-anomalies appeared on a total of 984. As shown in Fig. 11, the highest number of radio-anomalies, as many as 259 (26.32%) were observed with a frequency included between 4.1 and 7.2 kHz. Then there were 151 radio-anomalies (15.35%), with a frequency of three 7.2 and 10.3 kHz. A third grouping of radio-anomalies concerns signals with a frequency included: between 25.8 and 28.9 kHz (132 cases - 13.41%).
Also in this context the rest of the other radio emissions decrease considerably in frequency, except for the range between 13.4 and 16.5 kHz (98 cases - 9.96%) which represents a fourth grouping of important radio emissions.

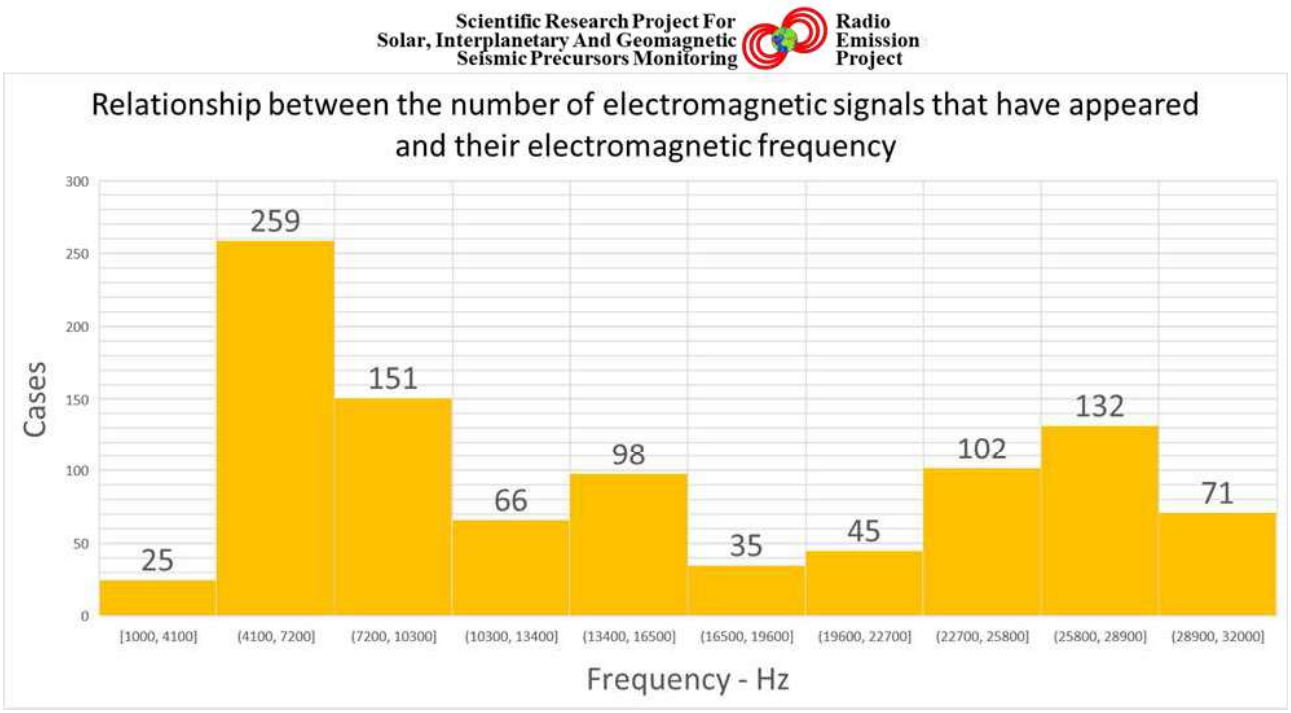


Fig. 11 - Frequency range of registered radio-anomalies and their grouping.

The graph confirms the principle of attenuation of radio wave propagation, given that the highest number of radioanomalies that have come to Italy, where the monitoring station is present, has exhibited a lower electromagnetic frequency.

Low-frequency electromagnetic signals are able to reach farther due to the reduced resentment of "Static Fading" due to absorption by oxygen and atmospheric water vapor (mostly at certain absorption peaks) and for effect of the "Reflection Fading" of the ground that produces reflected waves that are added, with different phases, to the direct wave creating interference and evanescence aleatory and not least due to the "Fading for Diffraction" due to the presence of physical obstacles. A higher frequency means a greater number of oscillations of the sinus wave that produces a greater effect of Fading on such frequencies.

The evidence of the experimentation of the RDF system in this area of the United States poses an obvious result already known by the mechanics of the physics of the propagation of electromagnetic waves. Given the distance, in fact, the type of ionospheric propagation is the propagation of radio waves that exploits electromagnetic reflection by the ionized atmospheric layer (conductor which is the ionosphere) allowing its propagation beyond the simple optical range between natural carrier and receiver, or beyond the limits imposed by terrestrial curvature. This is precisely the case with the monitoring of the New Madrid Fault.

3.5 Distribution of radio-anomalies

Interesting seems to be the distribution of radio-anomalies (with a total of 984 radio-emissions detected during the study) compared to the time of day, as shown in Fig. 11 and 12. They seem to be distributed mainly between 5 and 10 kHz and above 25 kHz. In many cases the radio anomalies were presented in broad band (those always indicated in Fig. 12 with frequency at 31 kHz), which appeared above all in the night time and in the time of maximum solar illumination.

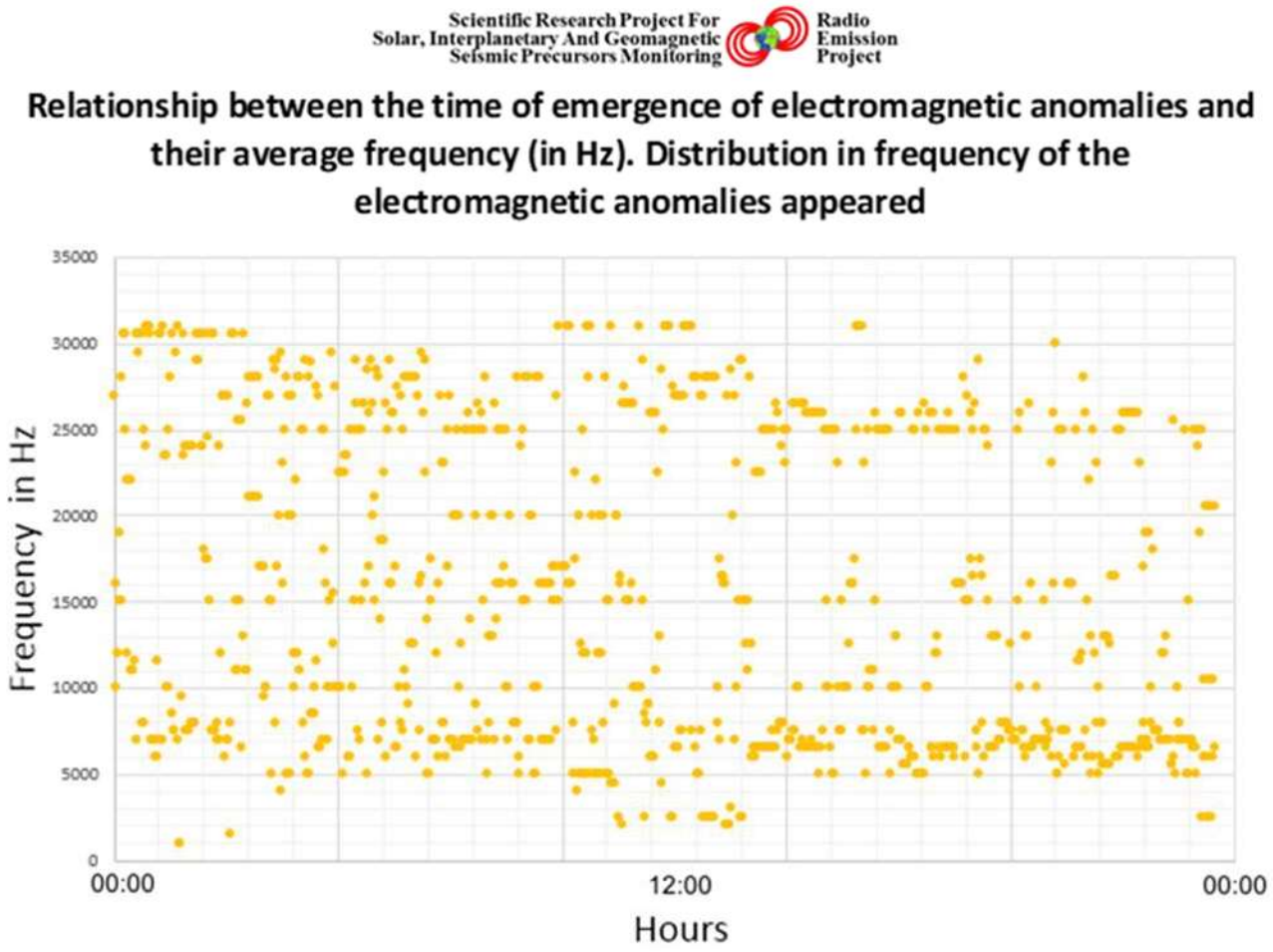


Fig. 12 - Distribution of radio-anomalies with respect to the hours of the day.

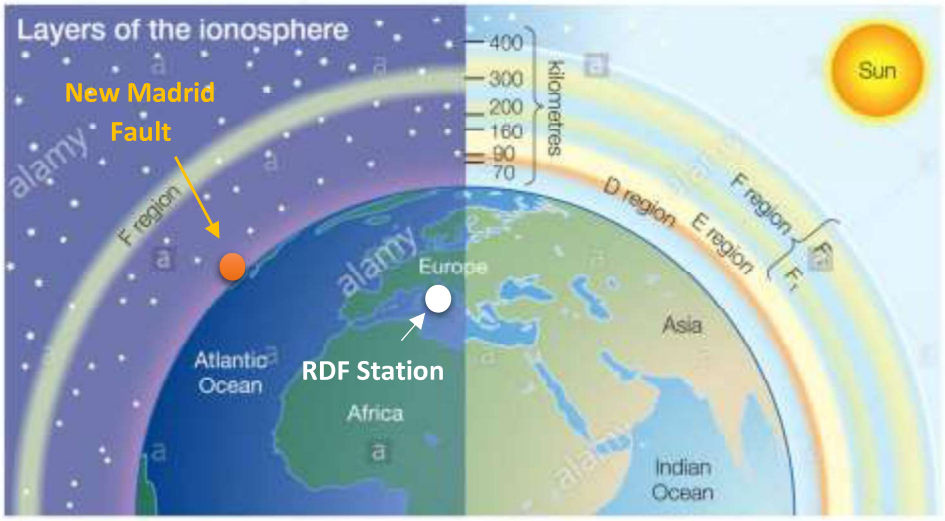


Fig. 13b – Schematic representation between the effect of solar irradiation and the formation of ionospheric Layers.

The variation of the ionospheric layers in relation to the signals received by the RDF system may have certainly influenced the recording of radio signals, coming from the US area under monitoring, on their frequency distribution and their number, with respect to the time of appearance.

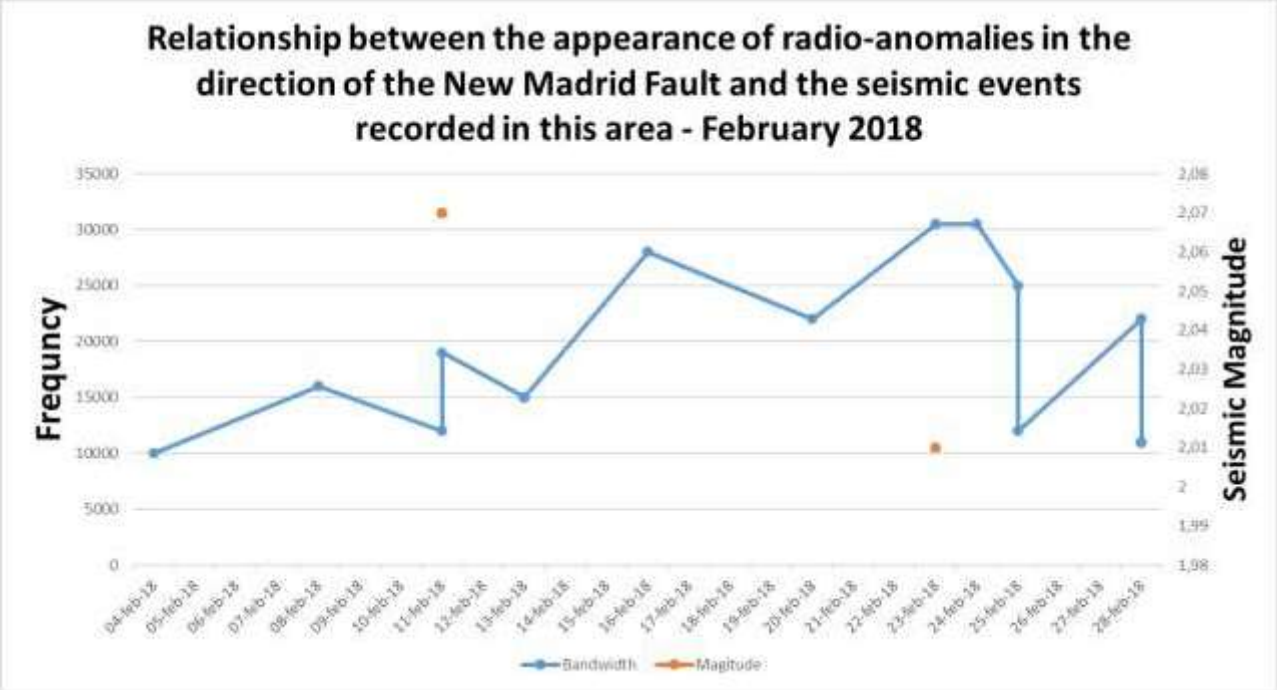
3.6 Distribution of the rafio-anomalies respect to the months considered

Following are the graphs related to the study, which incorporate the data relating to electromagnetic signals (number of radio-anomalies and their frequency) and the appearance of earthquakes in the period considered.

Graph 1

Scientific Research Project For Solar, Interplanetary And Geomagnetic Seismic Precursors Monitoring — Radio Emission Project

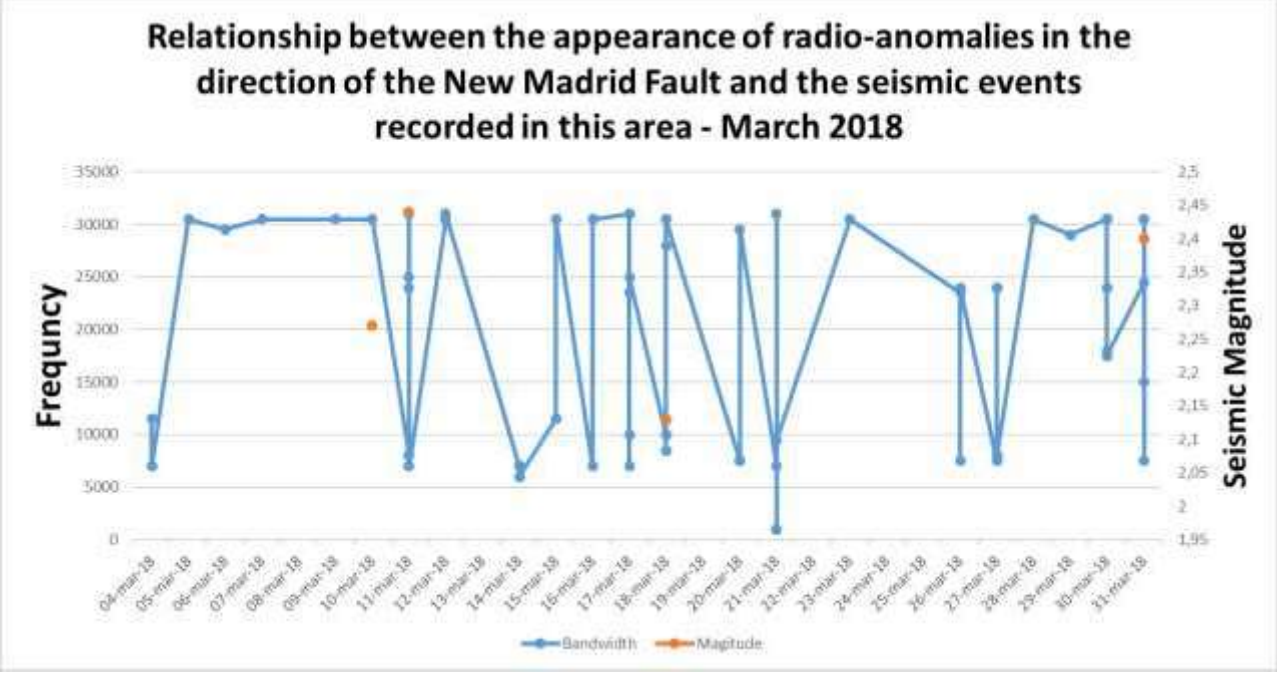
Monthly



Graph 2

Scientific Research Project For Solar, Interplanetary And Geomagnetic Seismic Precursors Monitoring — Radio Emission Project

Monthly

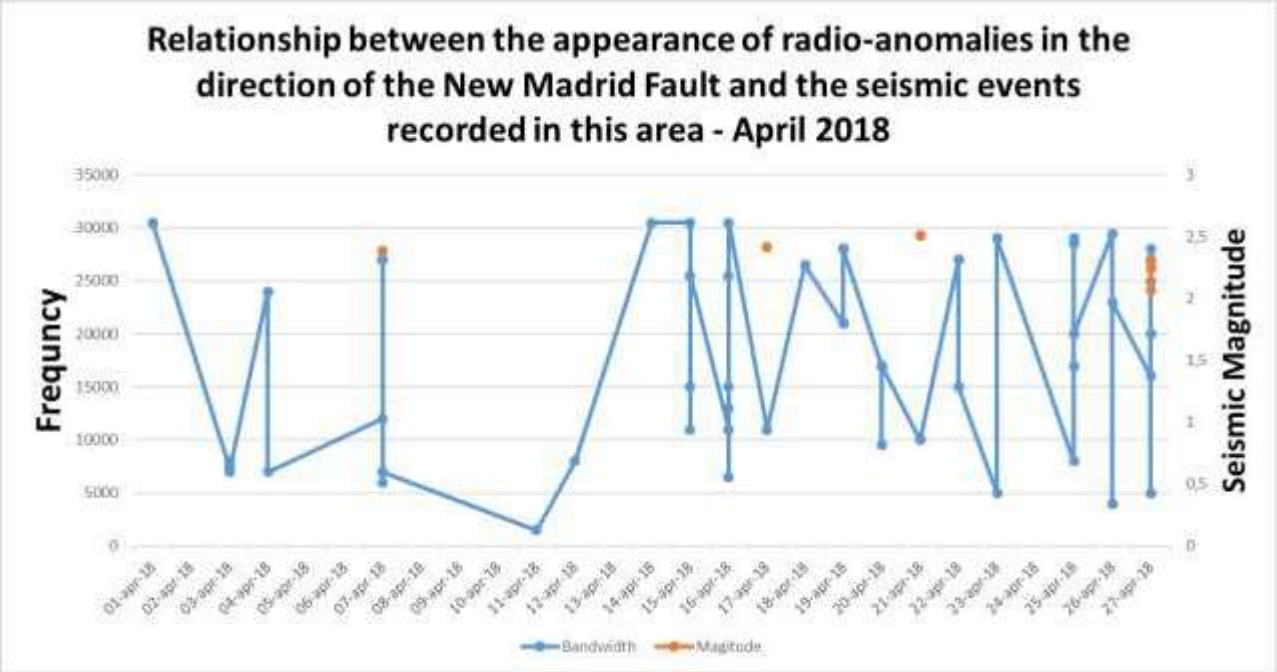


Graph 3

Scientific Research Project For Solar, Interplanetary And Geomagnetic Seismic Precursors Monitoring

Radio Emission Project

Monthly

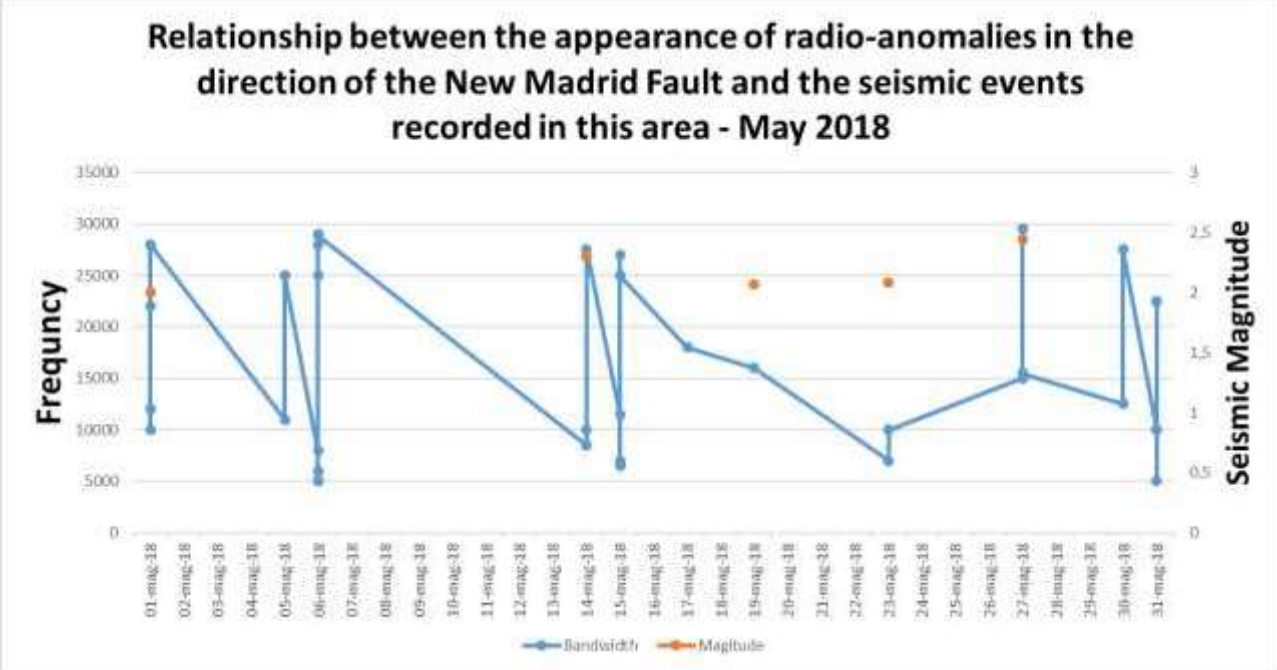


Graph 4

Scientific Research Project For Solar, Interplanetary And Geomagnetic Seismic Precursors Monitoring

Radio Emission Project

Monthly

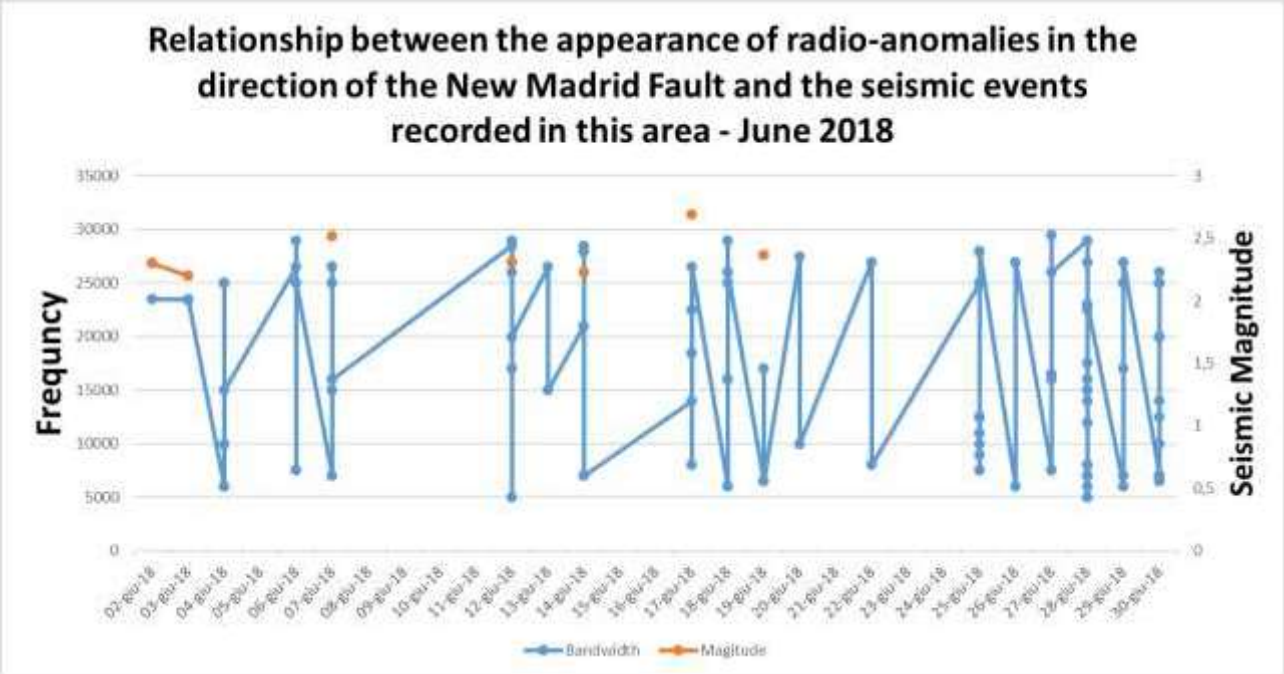


Graph 5

Scientific Research Project For Solar, Interplanetary And Geomagnetic Seismic Precursors Monitoring

Radio Emission Project

Monthly

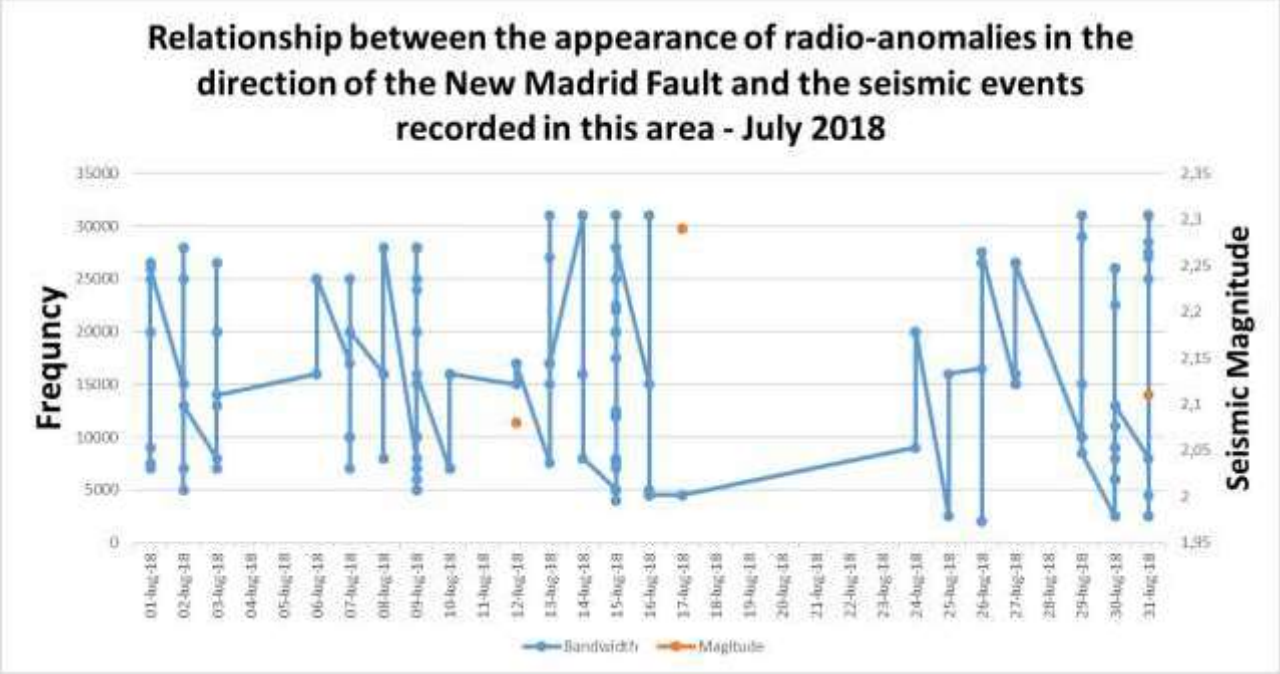


Graph 6

Scientific Research Project For Solar, Interplanetary And Geomagnetic Seismic Precursors Monitoring

Radio Emission Project

Monthly

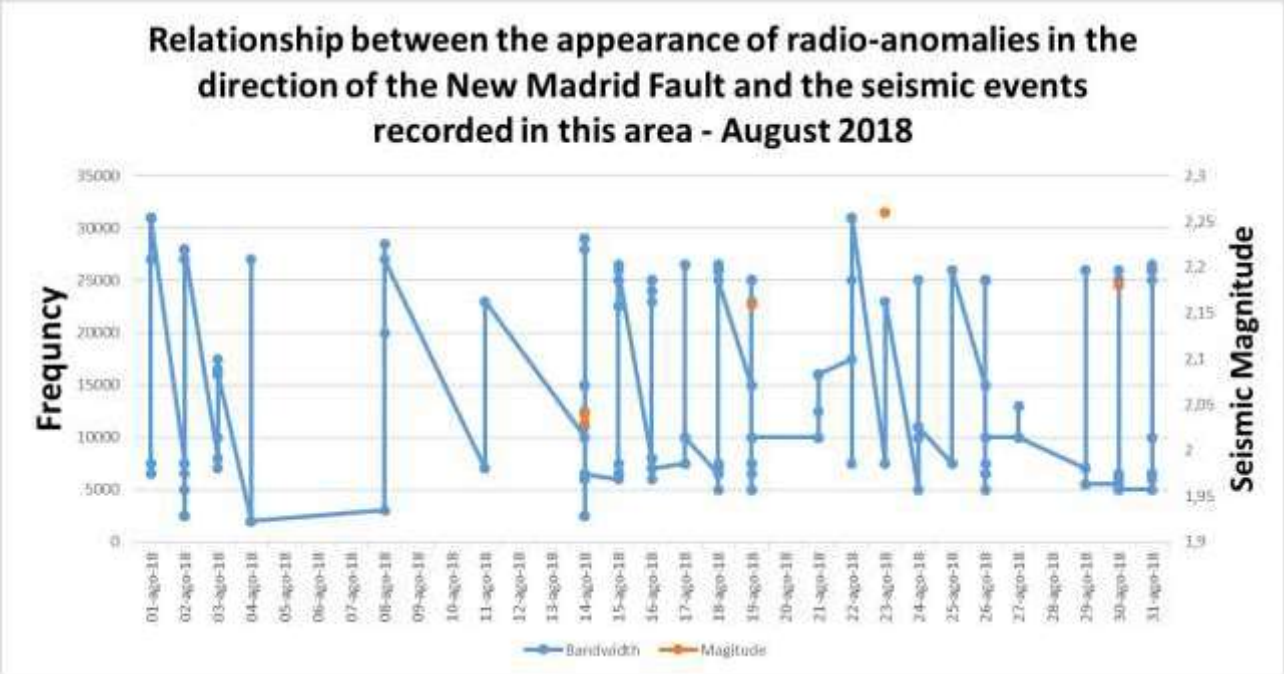


Graph 7

Scientific Research Project For Solar, Interplanetary And Geomagnetic Seismic Precursors Monitoring

Radio Emission Project

Monthly

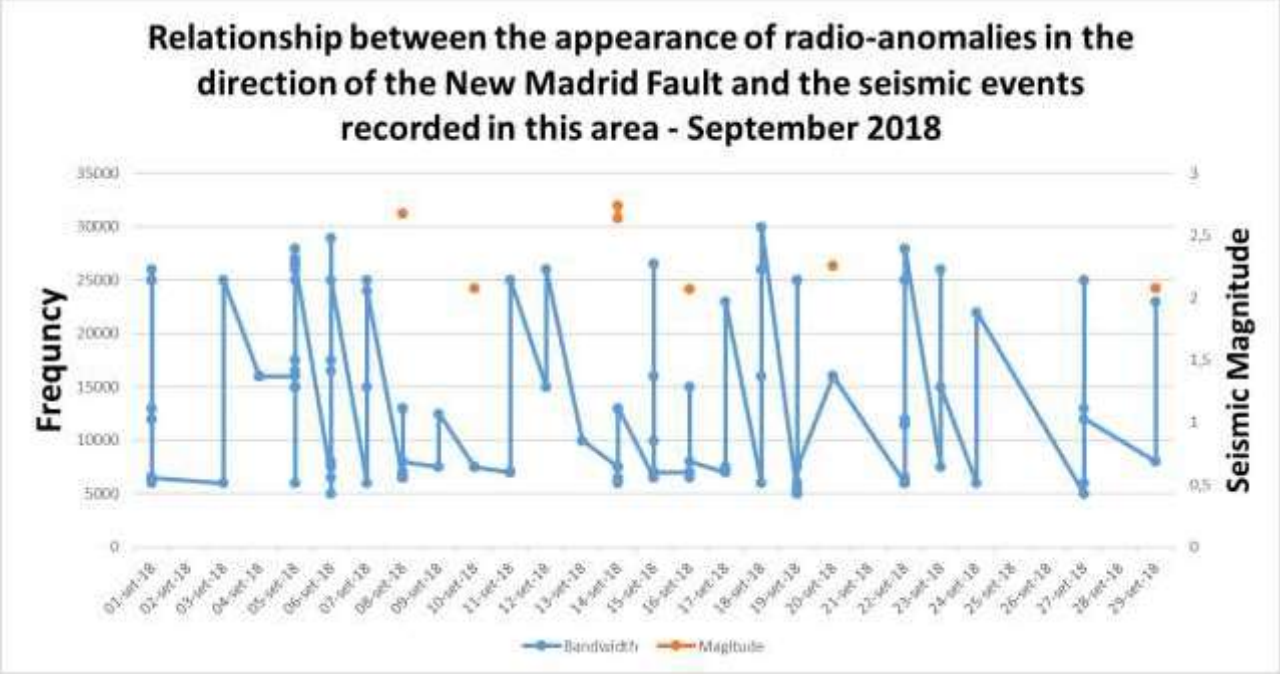


Graph 8

Scientific Research Project For Solar, Interplanetary And Geomagnetic Seismic Precursors Monitoring

Radio Emission Project

Monthly

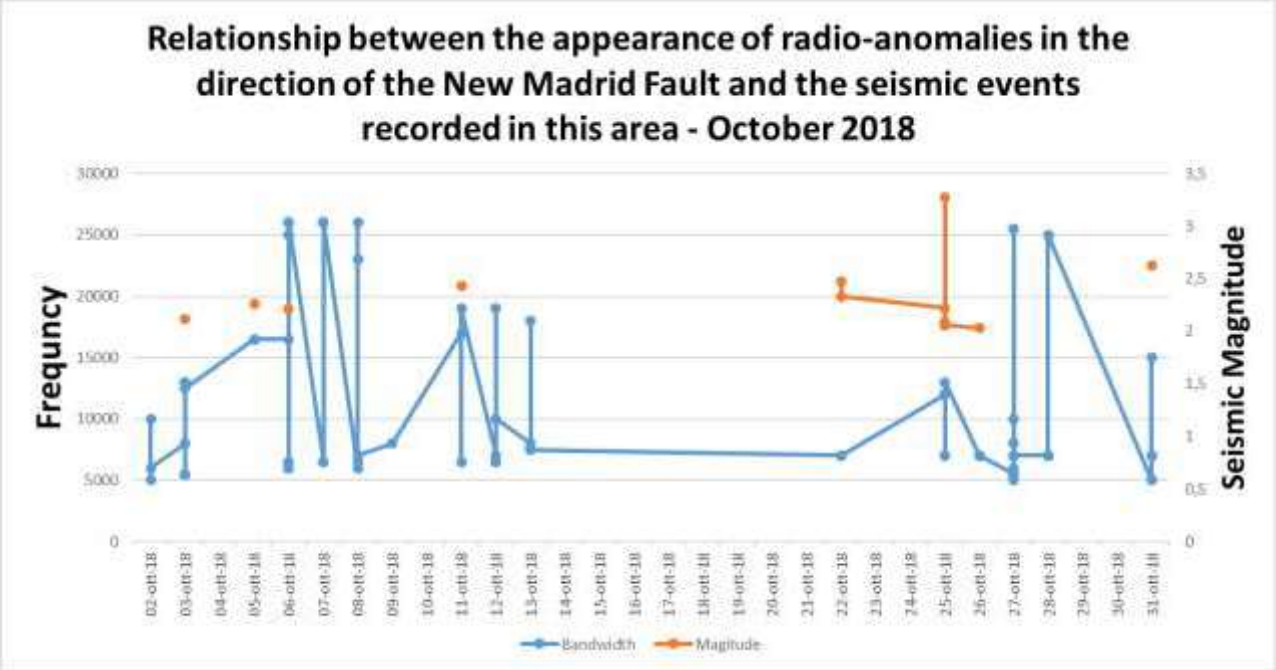


Graph 9

Scientific Research Project For Solar, Interplanetary And Geomagnetic Seismic Precursors Monitoring

Radio Emission Project

Monthly

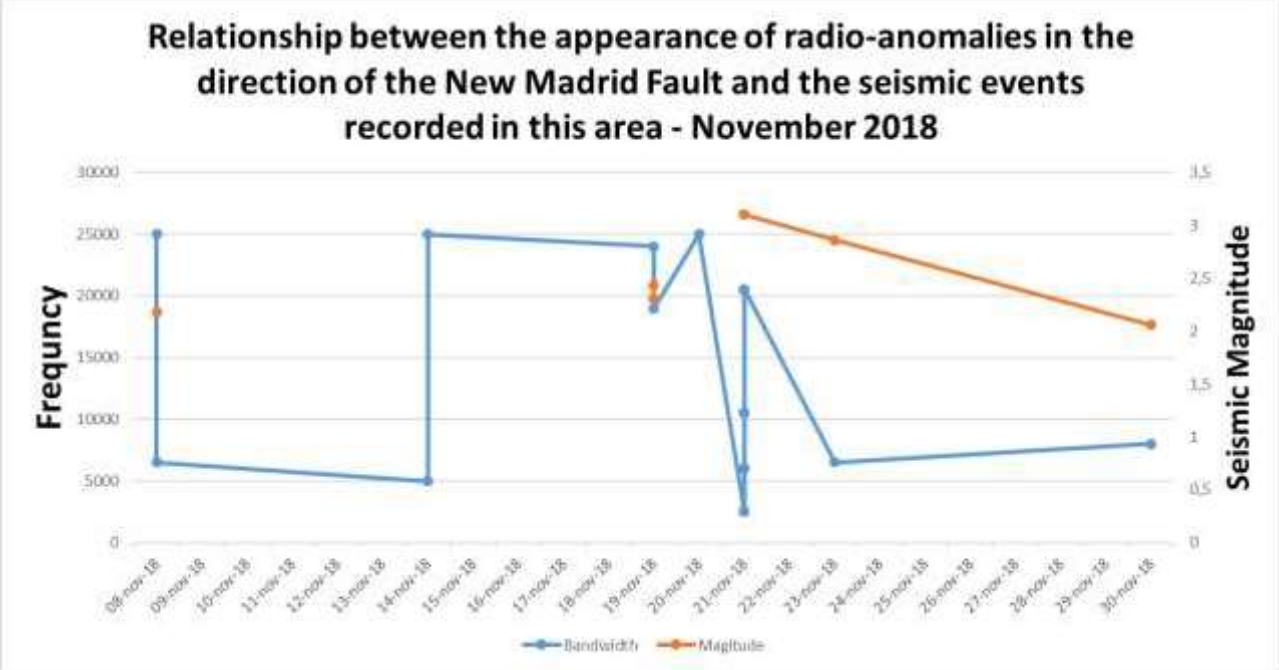


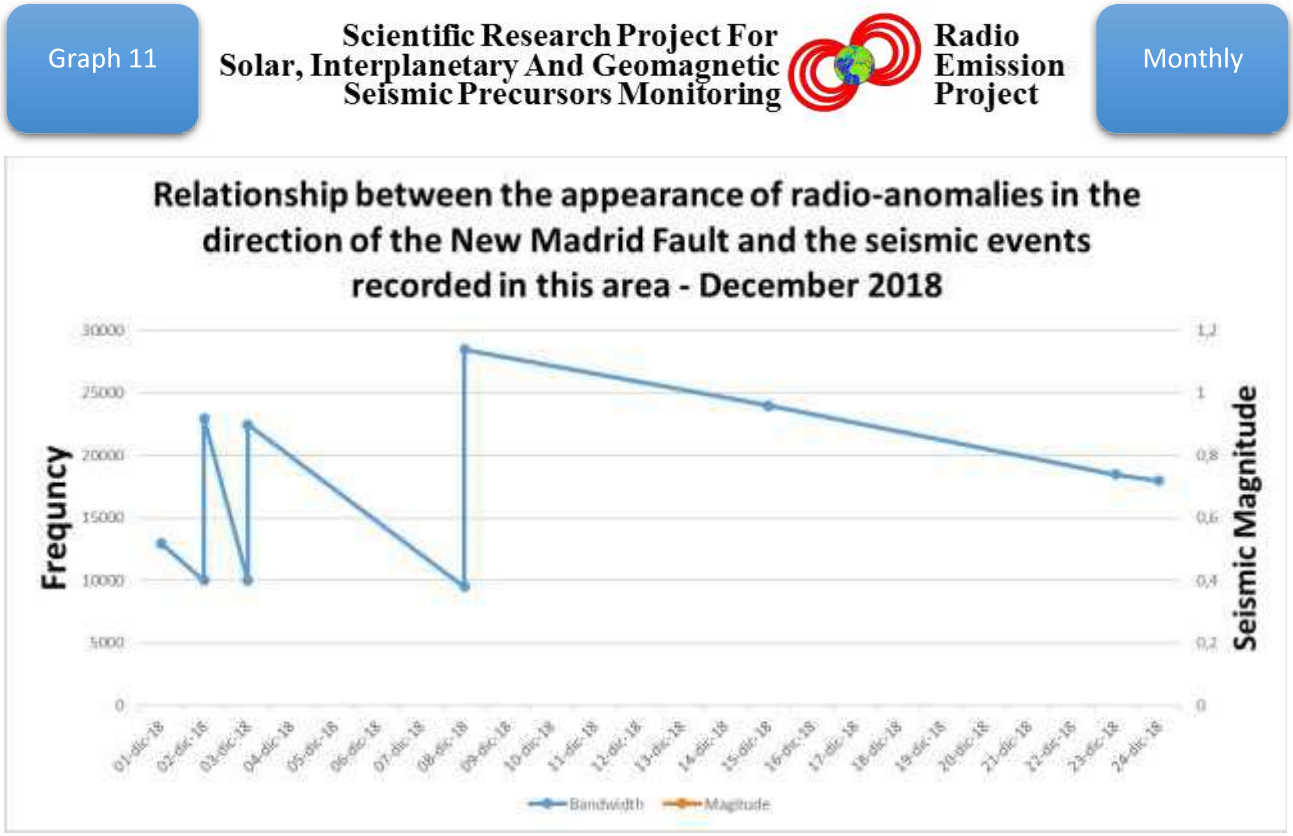
Graph 10

Scientific Research Project For Solar, Interplanetary And Geomagnetic Seismic Precursors Monitoring

Radio Emission Project

Monthly





The monitoring of the New Madrid Fault area, clearly shows on the monthly charts, a close relationship between the increase in the number of radio-anomalies and the occurrence of more or less intense seismic events with magnitude M2.5 + of the Richter scale.

This indicates that the electromagnetic signals recorded by the RDF system are interesting, if we consider the seismic trend of the area, and this from a detection distance of more than 8500 km away.

4 Relationship between monitoring data and seismic events

Between February 2, 2018 and November 29, 2018, 57 Mw2.5 + magnitude earthquakes of the Richter scale were recorded in the area of the New Madrid Fault, in the same period of time during which the electromagnetic monitoring of the area from part of the RDF station in Lariano (Rome, Italy).

The data considered in this area concerned the magnitude and depth of earthquakes (Fig. 13), compared with the electromagnetic monitoring data of the Italian RDF station.

The aim was to understand whether there was a direct correlation between the observation and the appearance of radio-anomalies, their characteristics and the occurrence of such earthquakes.

The observation of these data (visible in Fig. 13) shows how the appearance of radio-anomalies and the occurrence of geophysical phenomena has a link. The data show that earthquakes of greater magnitude, are preceded by radio-anomalies that possess a lower electromagnetic frequency and vice versa, the lower magnitude earthquakes, are preceded by higher-frequency geomagnetic increments.

This evidence demonstrates that there are indeed phenomena of interaction between the geomagnetic variations recorded by the RDF system and the seismic events.

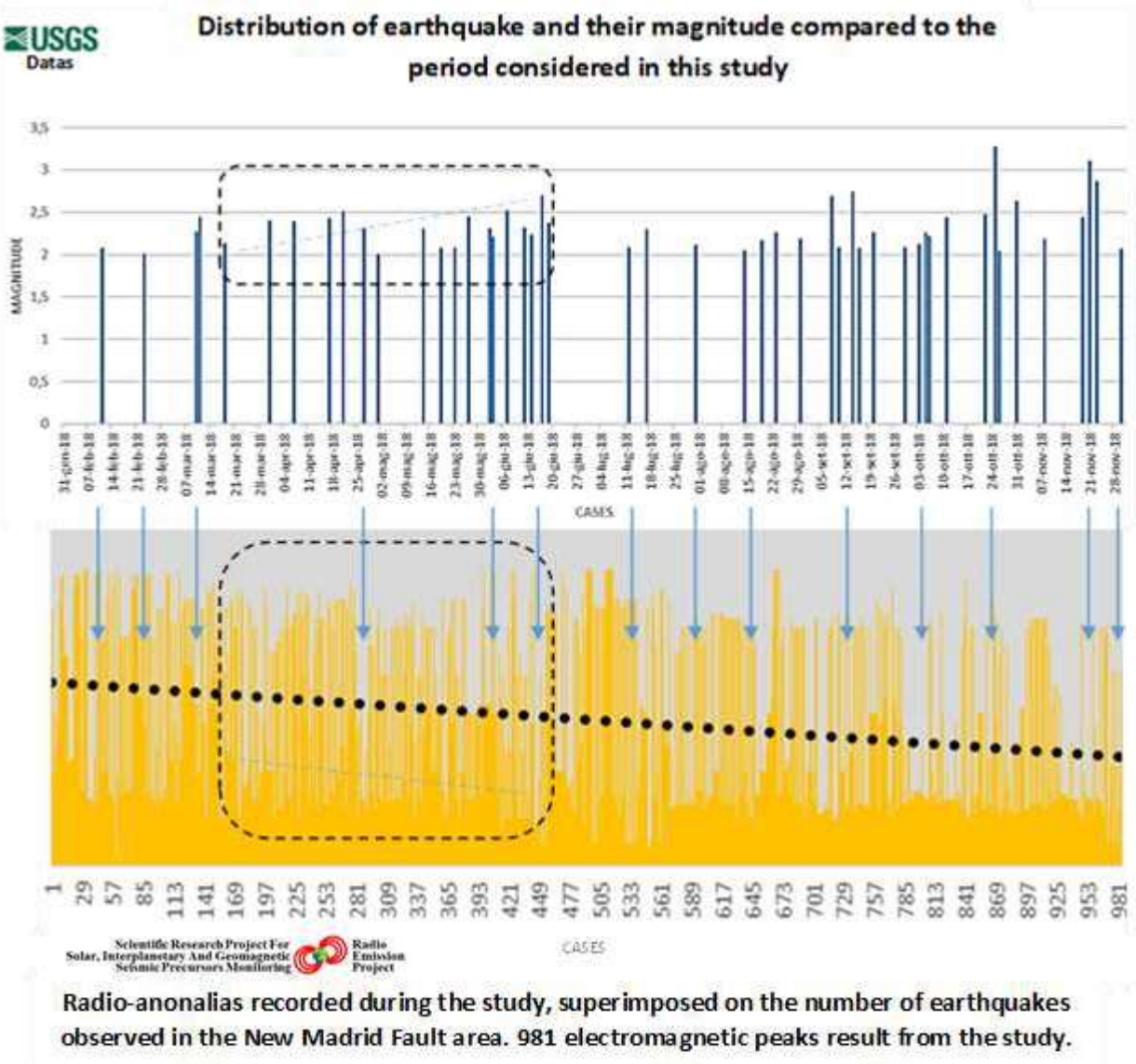


Fig. 14 - Correlation between the appearance of radio-anomalies, their frequency and the seismic events occurring in the New Madrid Fault.

The total of the signals recorded by the RDF system consists of 984 radio-anomalies (as already mentioned) that appeared during the study. The results are as follows:

- Groups of single signals or single very intense signals preceded the occurrence of earthquakes.

- Another important fact, emerged from the study, is that the impulsive appearance of electromagnetic phenomena was then followed by alternating seismic intensities, or by earthquakes with a magnitude that has changed little (see Fig. 13b). This last evidence could indicate impulsive accumulations of mechanical energy at the crustal level, which in a cadenced manner is released, giving rise to earthquakes having a similar magnitude.

- The data thus indicate a close influence between the electromagnetic frequency of the radio emissions detected by the Radio Emissions Project, preceding the low-intensity earthquakes detected in the same geographical area.

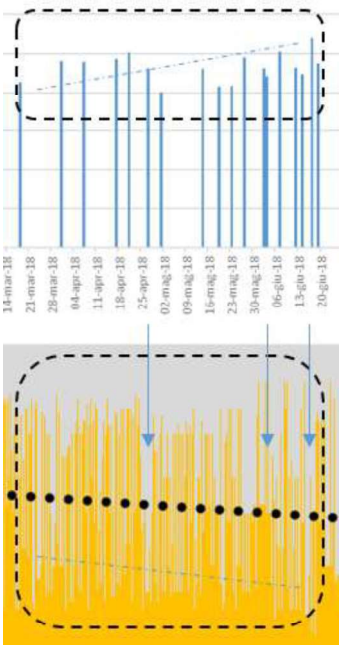


Fig. 13b - Impulsive signals with significant frequency variation and little temporal variation, precede magnitude of seismic events with low variations.

- The periods of considerable frequency variation of the electromagnetic signals always precede earthquakes of strong magnitude, this could always depend on the accumulation of mechanical energy at the crustal level which emits radio frequency. This high number of signals would in fact indicate a certain amount of energy in the lithosphere that within a certain time is then able to free itself giving rise to more intense earthquakes.

The evidence of this morphological behavior of radio-emissions, is for the first time visible thanks to the RDF system, which is able to filter all the signals that are polarized with the azimuth considered.

5 Conclusions

It is evident that the RDF system developed by the Radio Emissions Project has detected electromagnetic increments preceding low-magnitude telluric events in the same area of origin of the signals (dark violet azimuth). The data indicate that electromagnetic monitoring in this context is important for understanding the azimuth of origin of the pre-seismic signals and thus identifying the probable seismic epicenter.

This suggests that it is necessary and important to use two or more electromagnetic monitoring stations equipped with RDF technology in order to triangulate the epicentral emission source in a precise and global way. The study demonstrates how the frequency of radio-anomalies is associated with the seismic magnitude, such as its decrease or increase inversely proportional to the average electromagnetic frequency of the signals themselves. The periods in which there are many electromagnetic emissions always precedes earthquakes of a strong or greater intensity than the average of the period (see Fig. 13 and Fig. 13b).

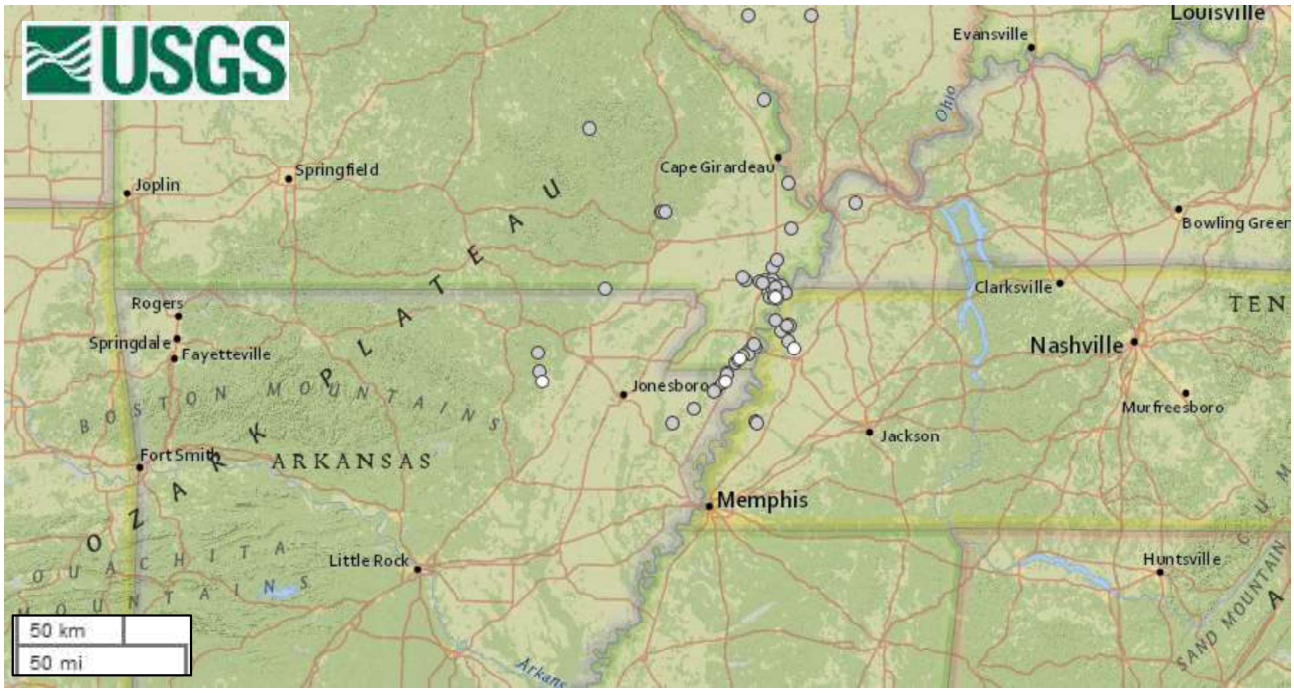


Figura 15 - Map of the North America relating to the New Madrid Fault, with its 57 earthquakes greater than Mw 2.5. Source: USGS.

It is also evident that solar activity has an important influence on the electromagnetic emissions detected with the RDF system. The study in this case has found that these emissions (their concentration in a given period of time) follow the Sunspot Number inversely proportionally, ie solar activity (Fig. 9 and Fig. 10).

References

- Cataldi, D., Cataldi, G. and Straser, V., 2017. SELF and VLF electromagnetic emissions which preceded the M6.2 Central Italy earthquake that occurred on August 24, 2016. European Geosciences Union (EGU), General Assembly 2017. Seismology (SM1.2)/Natural Hazards (NH4.7)/Tectonics & Structural Geology (TS5.5). The 2016 Central Italy Seismic sequence: overview of data analyses and source models. Geophysical Research Abstracts Vol. 19, EGU2017-3675.
- Cataldi, G., Cataldi, D. and Straser, V., 2017. Solar and Geomagnetic Activity Variations Correlated to Italian M6+ Earthquakes that Occurred in 2016. European Geosciences Union (EGU), General Assembly 2017. Geophysical Research Abstracts, vol. 19, EGU2017-3681. Seismology (SM1.2)/Natural Hazards (NH4.7)/Tectonics & Structural Geology (TS5.5) The 2016 Central Italy Seismic sequence: overview of data analyses and source models.
- Cataldi, G., Cataldi, D., Rossi, R. and Straser, V., 2016. SELF-ELF Electromagnetic signals correlated to M5+ Italian Earthquakes that occurred on August 24, 2016 and January 18, 2017. NCGT Journal, vol. 5, no. 1, p. 134-143.
- Straser, V., Cataldi, G. and Cataldi, D., 2015. Radio-anomalies: a tool for earthquake and tsunami forecasts. European Geosciences Union (EGU) General Assembly 2015, Natural Hazard Section (NH5.1), Sea & Ocean Hazard - Tsunami, Geophysical Research Abstract, vol. 17, Vienna, Austria. Harvard-Smithsonian Center for Astrophysics, High Energy Astrophysics Division, SAO/NASA Astrophysics Data System.
- Straser, V., Cataldi, G. and Cataldi, D., 2016. SELF and VLF electromagnetic signal variations that preceded the Central Italy earthquake on August 24, 2016. NCGT Journal, vol. 4, no. 3, p. 473-477. Harvard-Smithsonian Center for Astrophysics, High Energy Astrophysics Division, SAO/NASA Astrophysics Data System.
- Straser, V., Cataldi, G. and Cataldi, D., 2017. Seismic signals detected in Italy before the Nikol'skoye (off Kamchatka) earthquake in July 2017. NCGT Journal, vol. 5, no. 3, p. 391-396.
- Straser V., Cataldi D., Cataldi G., Radio Direction Finding System, a new perspective for global crust diagnosis. New Concepts in Global Tectonics Journal, v.6, no. 2, June 2018, p. 203-211.
- Choi, D.R., Casey, J.L., Leybourne, B. and Gregori, G.P., The January 2018 M7.5 offshore North Honduras earthquake: its possible energy link to the New Madrid Seismic Zone, Mississippi Valley. NCGT Journal, 2018, v. 6, no. 1, p. 21-36.
- Choi, D.R. and Casey, J.L., New Madrid Seismic Zone, central USA: the great 1811-12 earthquakes, their relationship to solar cycles, and tectonic settings. Global Climate Status Report, 1-2015. Space and Science Research Corporation.
- Morgan T. Page and Susan E. Hough, The New Madrid Seismic Zone: Not Dead Yet. Science 2014, vol. 343, Issue 6172, pp. 762-764. DOI: 10.1126/science.1248215