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Electromagnetic Fields in the Environment: An Update of Monitoring Networks in Europe

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Abstract

The first monitoring networks of electromagnetic fields (EMF) in the environments emerged about two decades ago, due to public concern about the ever-increasing use of wireless technologies. The aim of this work is to provide a brief overview of major EMF monitoring networks currently operating across Europe. Nine networks in seven different countries with different characteristics are presented here.

1 Introduction

Radiation monitoring networks were established as a response to public concerns about potential health effects in humans exposed to radiofrequency electromagnetic fields. The advantage of these networks over in-situ ("ad-hoc") measurements is that they provide 24/7 data for the temporal and spatial variation of electromagnetic fields (EMF). Moreover, measurement data are easily communicated through interactive web portals, to become available to all citizens. Several networks have been developed worldwide during the past twenty years. A significant number of these are currently active in Europe and are presented in this work.

2 EMF monitoring networks in Europe

2.1 Hungary

In Hungary, the EMF measuring program operated by NMHH (National Media and Infocommunications Authority) [1] has 3 major categories of measurement sites: (a) Children's institutions, (b) Housing estates, and (c) Broadcast transmitters. Measurement stations are installed at a site for a limited period (2-3 weeks approximately) and moved to another location afterwards. Thus, a vast number of measurement sites is covered, but for a limited period only.

2.2 Spain

In Spain, three independent monitoring networks are currently active in different regions.

The EMF monitoring network in the municipality of Vitoria Gasteiz consists of 6 monitoring stations [2]. Stations are installed permanently at fixed locations, monitoring EMF levels on a constant basis. The earliest installation dates in April 2017. Broadband stations are used, measuring emissions at frequency ranges of the mobile telephony network (GSM-UMTS).

The Catalan Government has implemented many projects in recent years, aiming at providing citizens with objective information about EMF in the environment. The SMRF (Radiofrequency Monitoring System) is a large continuous EMF monitoring network with 336 stations, installed in several municipalities of Catalonia [3]. More specifically, 282 stations measure the electromagnetic field emissions in mobile telephony frequency bands (900 MHz, 1800 MHz and 2100 MHz), 47 stations measure the electromagnetic field levels in a broadband fashion (from 100 kHz to 8 GHz) and 7 stations measure the electric and magnetic field levels (from high voltage power lines) at extremely low frequencies (ELF). The results are presented in an interactive web site which also includes in-situ broadband and frequency selective measurements (Figure 1).

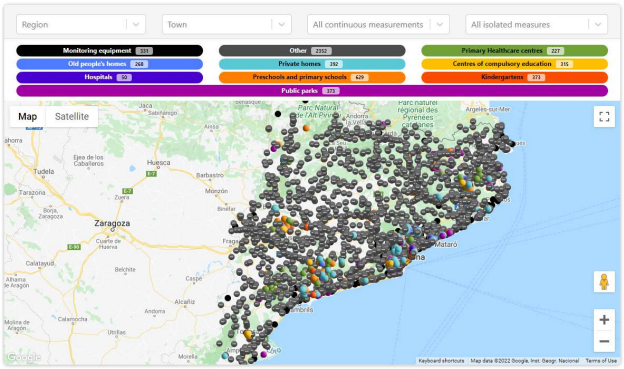

Figure 1. SMRF GIS portal in Catalonia

In Santander, 40 monitoring devices were deployed to cover an area of approximately 0.5 km^2 as part of the "SmartSantader" project [4]. A custom low cost and low-complexity device was specifically designed and developed for this purpose. The device can monitor EMF levels in the cellular frequency bands of 900 MHz, 1800 MHz, 2100 MHz (downlink) and in the ISM band (2400 MHz). The sensitivity of the monitoring device is

5 mV/m with a range up to 5 V/m. The measurements are publicly available through a web portal, where visitors can distinguish whether the measuring device is installed indoors or outdoors.

2.3 Romania

The National Authority for Management and Regulation in Communications (ANCOM) of Romania implemented the "monitor EMF" radiation monitoring network in Romania [5]. Its operation started in 2015 and includes 150 monitoring stations of environment EMF. Stations are installed outdoors. They are located in Bucharest and 103 others sites, all over the country. The results of the monitoring network are presented through an interactive web site which is available to the public.

2.4 Serbia

In Serbia, the Regulatory Agency for Electronic Communications and Postal Services (RATEL) has developed a network consisting of 90 stations, monitoring EMF at various locations all over the country [6]. Most of the installed stations are broadband, measuring the cumulative field in the 100 kHz to 7 GHz frequency range. There are also a few frequency-selective stations conducting measurements within predefined bands in the 100 kHz to 6 GHz frequency range (Figure 2).

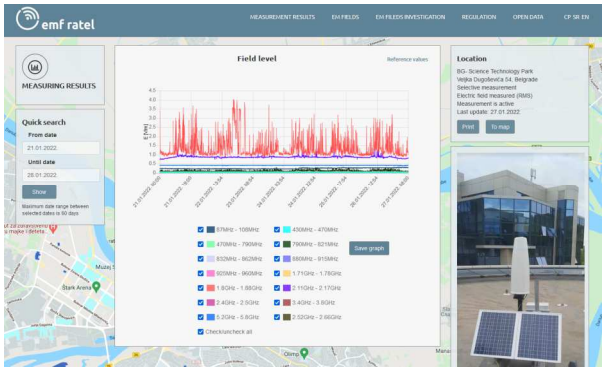

Figure 2. EMF RATEL measurements presentation

2.5 France – Belgium

In France – Belgium, a common network is deployed by the EXEM company in cooperation with the National Frequency Agency of France (ANFR) [7]. It consists of 102 sensors installed in 8 cities across France as well as Brussels in Belgium. The monitoring stations measure the electromagnetic field in the 80 MHz to 6 GHz frequency range and are placed exclusively in the vicinity of 5G antennas (Figure 3).

2.6 Greece

In Greece, two independent monitoring networks are currently active and regularly maintained.

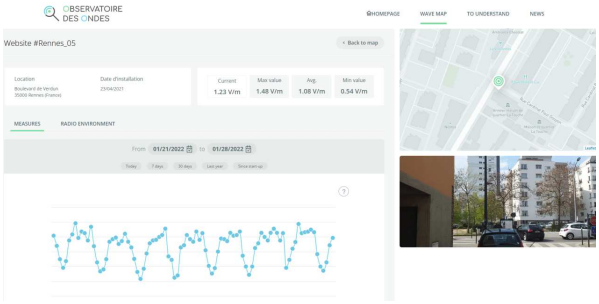

Figure 3. Measurement presentation in France/Belgium

The National Observatory of Electromagnetic Fields (NOEF) [8] operated by the Greek Atomic Energy Commission, consists of 500 measurement stations installed at fixed locations across Greece. There are 480 broadband stations measuring environmental EMF in the 100 kHz to 7 GHz frequency range and 20 frequency-selective stations conducting measurements in 20 predefined bands in the 100 kHz to 6 GHz frequency range. The results are presented through an interactive web portal in which data are updated daily (Figure 4).

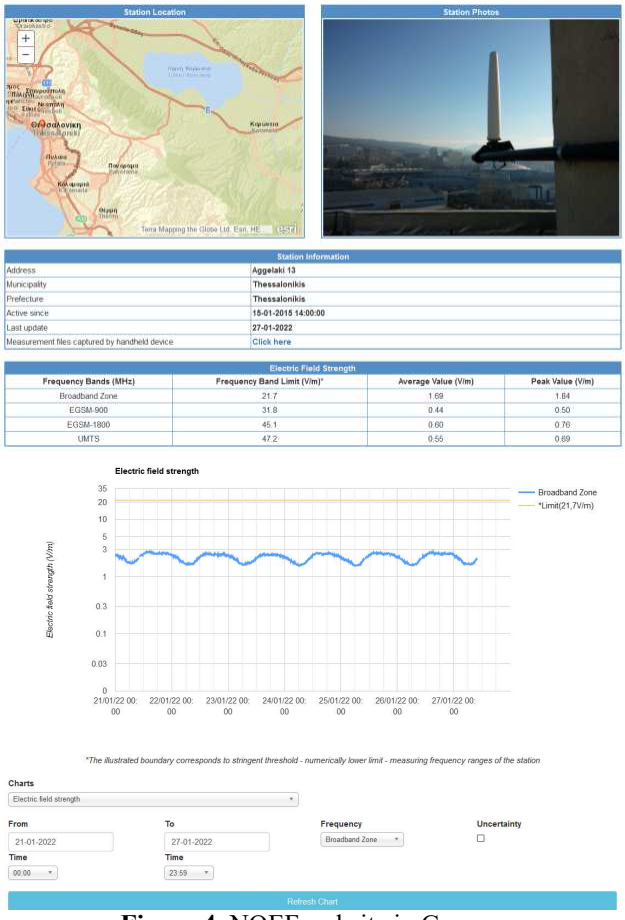

Figure 4. NOEF website in Greece

The EMF monitoring network "Pedion24" [9], operated by four university laboratories, consists of 246 monitoring stations. Stations are installed nationwide both at public and private buildings in response to applications of concerned citizens about EMF levels in their region. The network, operating since 2007, uses broadband monitoring

stations covering a frequency range of 100 kHz to 3 GHz. More than 50 million 6-minute measurements have been gathered at the time of writing.

Table 1: Active EMF monitoring networks in Europe

Country	Starting date (year)	Number of stations	Frequency range
Hungary	-	-	100 kHz – 7 GHz
Spain (Catalonia)	2005	336	10 Hz – 3 kHz 900 MHz / 1800MHz / 2100MHz (bands) 100 kHz – 8 GHz
Spain (Santander)	2014	40	900 MHz / 1800 MHz / 2100 MHz / 2400 MHz (bands)
Spain (Vitoria Gasteiz)	2017	6	900 MHz / 1800 MHz / 2100 MHz (bands)
Romania	2015	150	100 kHz – 7 GHz 925 – 960 MHz 1805 – 1860 MHz 2110 – 2170 MHz
Serbia	2017	90	100 kHz – 7 GHz 925 – 960 MHz 1805 – 1860 MHz 2110 – 2170 MHz
France/ Belgium	2020	102	80 MHz – 6 GHz
Greece (NOEF)	2015	500	100 kHz – 7 GHz / 100 kHz – 6 GHz
Greece (Pedion24)	2007	246	100 kHz – 3 GHz

3 Summary

The increasing prevalence of wireless communication has resulted in an increase of general public exposure to EMF in the radio frequency (RF) spectrum. This led to the establishment of EMF monitoring networks. Currently more than 1400 stations across Europe provide useful measurement data to both citizens and academia. Some of these networks cover only previous generation of cellular networks (2G, 3G and 4G) while the majority cover a wide frequency range up to 7 GHz and can directly measure the FR1 frequency band (0.41-7.125 GHz) of 5G. However, the imminent deployment of the 5G technology in FR2 (24.25-52.60 GHz) band will require a significant upgrade to the monitoring equipment.

The way of presenting measurement results to the public varies among monitoring networks. In most cases, graphs are employed to show the measurements with respect to a value that represents the lowest national limit (or reference level) within the frequency range of measurement. This comparison can also take the form of percentage of the respective limit value. Where continuous measurements are performed, the user of the web portal can choose the period of interest for constructing the graph, although in one case the selectable periods are predefined [5]. Finally, in two networks [6],[8] the measurement uncertainty can be displayed on the graph.

7 References

[1] "Nemzeti Hírközlési hatóság," NMHH Mérésügy. [Online]. Available: http://emirpub-prod.nmhh.hu/pubrendszer-eb/eszmog/eszmogMeresek.jhtml. [Accessed: 29-Jan-2022].

[2] "Vitoria-Gasteizko Udalaren web-Orria - Udaleko Hezkuntza ..." [Online]. Available: https://vitoria-gasteiz.org/wb021/was/contenidoAction.do?lang=eu&locale=eu&idioma=eu&uid=u6abb8acd_15de950965e__7ef2. [Accessed: 29-Jan-2022].

[3] "Radioelectric Governance," Digital Policies. [Online]. Available: https://politiquesdigitals.gencat.cat/en/tic/governanca/. [Accessed: 29-Jan-2022].

[4] Smartsantander.eu. 2022. SmartSantander. [online] Available at: <https://www.smartsantander.eu/> [Accessed 29 January 2022].

[5] Monitor EMF. [Online]. Available: https://www.monitor-emf.ro/map. [Accessed: 29-Jan-2022].

[6] "EMF Level Monitoring," emf ratel. [Online]. Available: https://emf.ratel.rs/eng/index. [Accessed: 29-Jan-2022].

[7] Observatoire des ondes. 2022. L'observatoire des ondes électromagnétiques. [online] Available at: <https://www.observatoiredesondes.com/fr/> [Accessed 29 January 2022].

[8] User, S., 2022. Observatory. [online] Paratiritirioemf.eeae.gr. Available at: <https://paratiritirioemf.eeae.gr/en/> [Accessed 29 January 2022].

[9] Pedion24. 2022. Classic Home - Pedion24. [online] Available at: <https://pedion24.gr/> [Accessed 29 January 2022].