Measurement of the time-evolution of the exposure to electromagnetic fields by exposimeters

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INTRODUCTION

In anFor in-situ exposure measurements, the electromagnetic fields are measured at a certain time. However, the exposure varies in time (day versus night). So, in order to estimate the exposure at another time, the time-evolution of the exposure should be known. Within the framework of the FP7 project Seawind, exposimeter measurements are performed at typical locations (schools, crèches, homes and offices) and environments (rural, urban, sub-urban) in Belgium and Greece. In this on-going study, exposimeter measurements are performed to investigate the time-evolution of the exposure to radio-frequency electromagnetic fields in selected specific environments.

MATERIALS AND METHODS

Nowadays, exposimeters are intensively used in epidemiological studies to characterize the exposure of a person and exposimeters are typically worn on the body. In this study, exposimeters are used to investigate the time-evolution of the electromagnetic fields in different frequency bands from 80 MHz to 5 GHz. Hence, exposimeters are not worn on the body, but placed at a fixed location. The exposimeters record the electromagnetic fields during one week. The interval between two measurements is minimized, so that a maximum number of measurement points are obtained over the week. After one week the exposimeters are collected and the results are investigated. In this study the SATIMO exposimeters EME Spy 121 and EME Spy 140 are used. The first measures the RF electric field in 13 different frequencies bands, while the latter measures the field in 15 bands. The post processing of the measured fields starts by defining time intervals, e.g., two-hours intervals. In every time interval the cumulative distribution function (cdf) of the exposure is determined. To cope with non-detects (samples below the sensitivity of the exposimeter), a robust regression on order statistics (robust ROS) [1] is applied in every time interval. Finally, the time-evolution of the exposure is calculated from the cumulative distribution in terms of a percentile of the cdf, e.g., 95th percentile (p_{95}).

RESULTS

As an example, Figure 1 shows the 95th percentile of the cdf of the rms electric field (E_{rms}) in a two-hours interval. The electric field was measured in a school in Flanders, Belgium using the exposimeter EME Spy 140. Every 30 seconds a measurement was performed in 15 different frequency bands ranging from 80 MHz to 5 GHz. For clarity only the results of FM and GMS900 downlink (GSM900rx) are shown. The observations are in line with our expectations. For the broadcasting antenna of radio (FM) the exposure is almost constant during a day. A cellular communication network such as GSM downlink at 900 MHz shows a clear increase in exposure during day hours, from 8:00am till 10:00pm. After working hours (4:00pm-6:00pm) exposure decreases slowly until late in the evening (10:00pm). During the night exposure is the lowest.

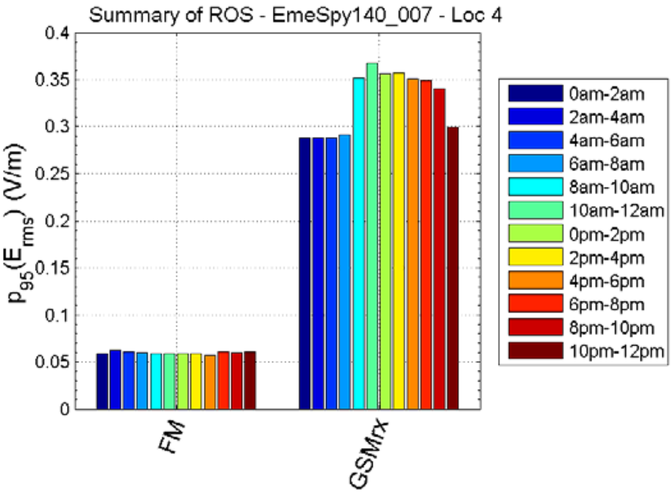

Figure 1: Time evolution of the 95th percentile of the rms electric field in a school in Flanders, Belgium.

CONCLUSIONS

In this study the time-evolution of the exposure is investigated using exposimeters. The exposimeters are not worn on the body, but placed at a fixed location. The knowledge of the time-evolution of the exposure is can be used to determine the exposure during a day based on a single (at a certain time) exposure measurement performed by using a spectrum analyzer and a triaxial measurement probe.[A1]

"The research leading to these results has received funding from the European Union's Seventh Framework Programme ([FP7/2007-2013]) under grant agreement n° 244149"

REFERENCES

[1] M. Roösli, P. Frei, E. Mohler, C. Braun-Fahrländer, A. Bürgi, J. Fröhlich, G. Neubauer, G. Theis, and M. Egger. Statistical Analysis of Personal Radiofrequency Electromagnetic Field Measurements With Nondetects. Bioelectromagnetics. 29:471-478, 2008.