

Annual review of the in situ measurements of EMF exposure levels from base stations with emphasis on 5G technology

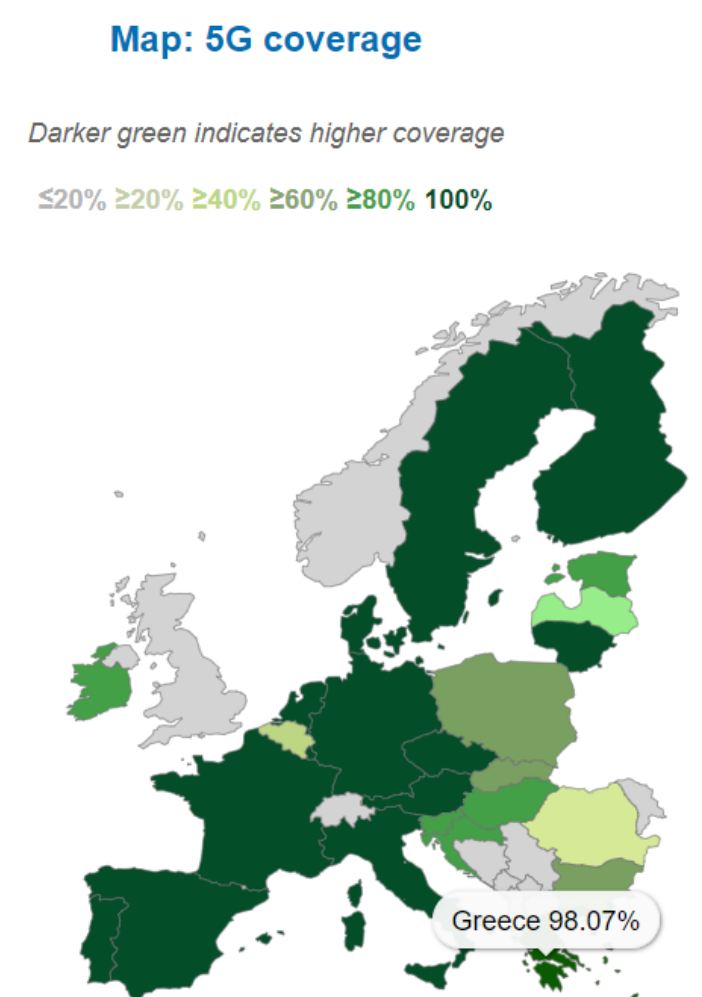
Maria Christopoulou, Arsenoi Ladia, Theodora Kyritsi, Nikiforos Kourmpetis, Dimitris Koutounidis, Eleftheria Carinou

Greek Atomic Energy Commission



Background

Greek Atomic Energy Commission (EEAE) conducts annual in situ measurements in the vicinity of at least 20% of licenced base stations. From 2021, the inspected EMF spectrum was expanded up to 5G FR1 [3400-3800 MHz]



Objective: annual evaluation of exposure levels at FR1, analyzing their contribution to the total exposure levels for the years 2021-2023

Materials & Methods

- ✓ SRM-3006, E-field antenna [420 MHz – 6 GHz]
- ✓ DL measurements at adjacent rooftops
- ✓ all measurements (broadband and frequency-selective) are conducted without inducing downlink traffic
- ✓ frequency selective measurements at three successive heights: 110, 150, 170 cm, where the averaged E-field value over 6 minutes duration is recorded

$$E_f = \sqrt{\frac{\sum_{i=1}^3 E_{i,f}^2}{3}}$$



Data

the highest exposure point identified during each audit is recorded → 2325 measurement data

of measurements increase over the years

- expansion of the 5G FR1 network
- increase of mobile terminals

Procedure B* (2023): includes mandatory measurement at FR1 irrespective of whether the inspected base station operates at this frequency band

Results

exposure ratio

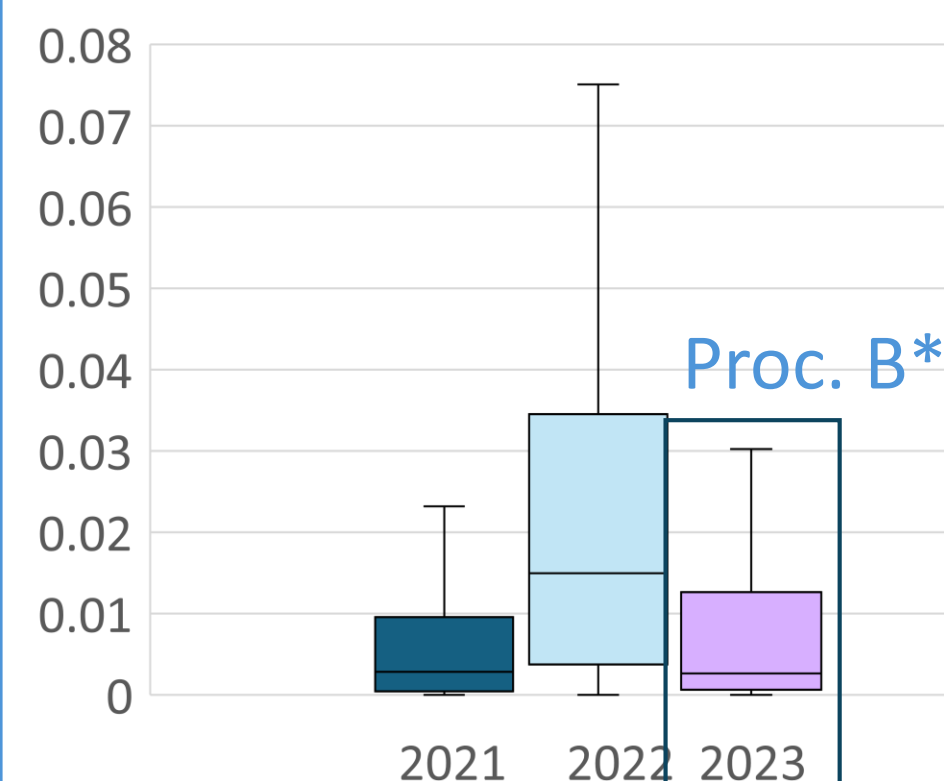
$$\lambda_{i,f} = \left(\frac{E_{i,f}}{L_{E,f}}\right)^2, i = 110, 150, 170 \text{ cm}$$

$$\lambda_f = \frac{1}{3} \sum_{i=1}^3 \lambda_{i,f}$$

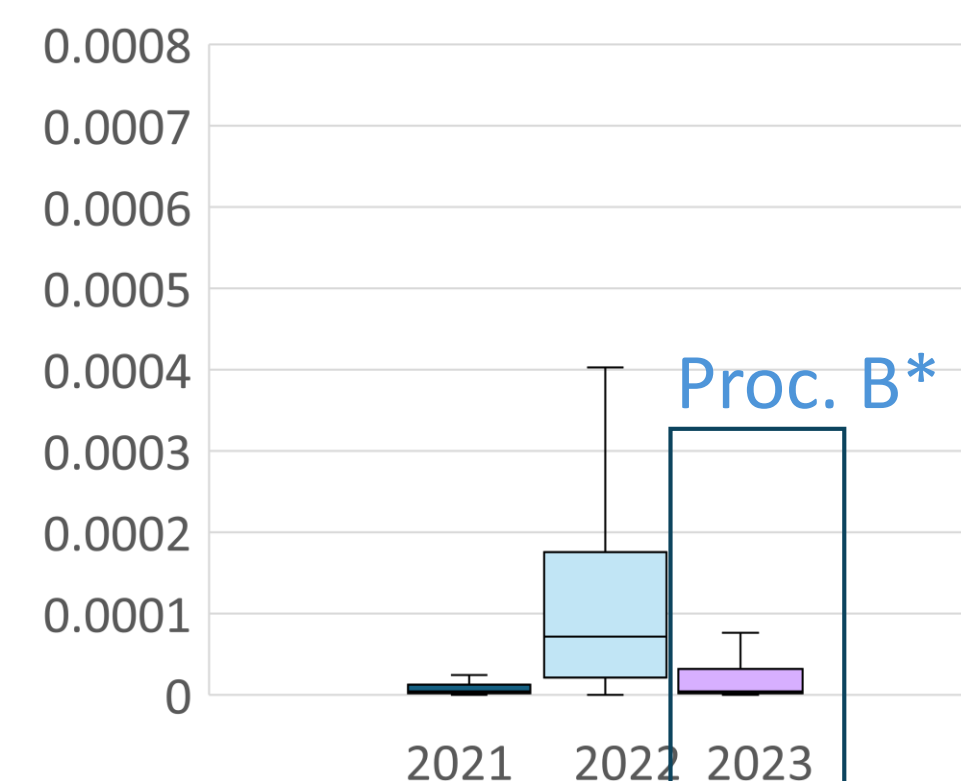
$$\Lambda = \sum_f \lambda_f$$

$\Lambda = 1$ → 60% E.U. reference levels

total exposure ratio Λ

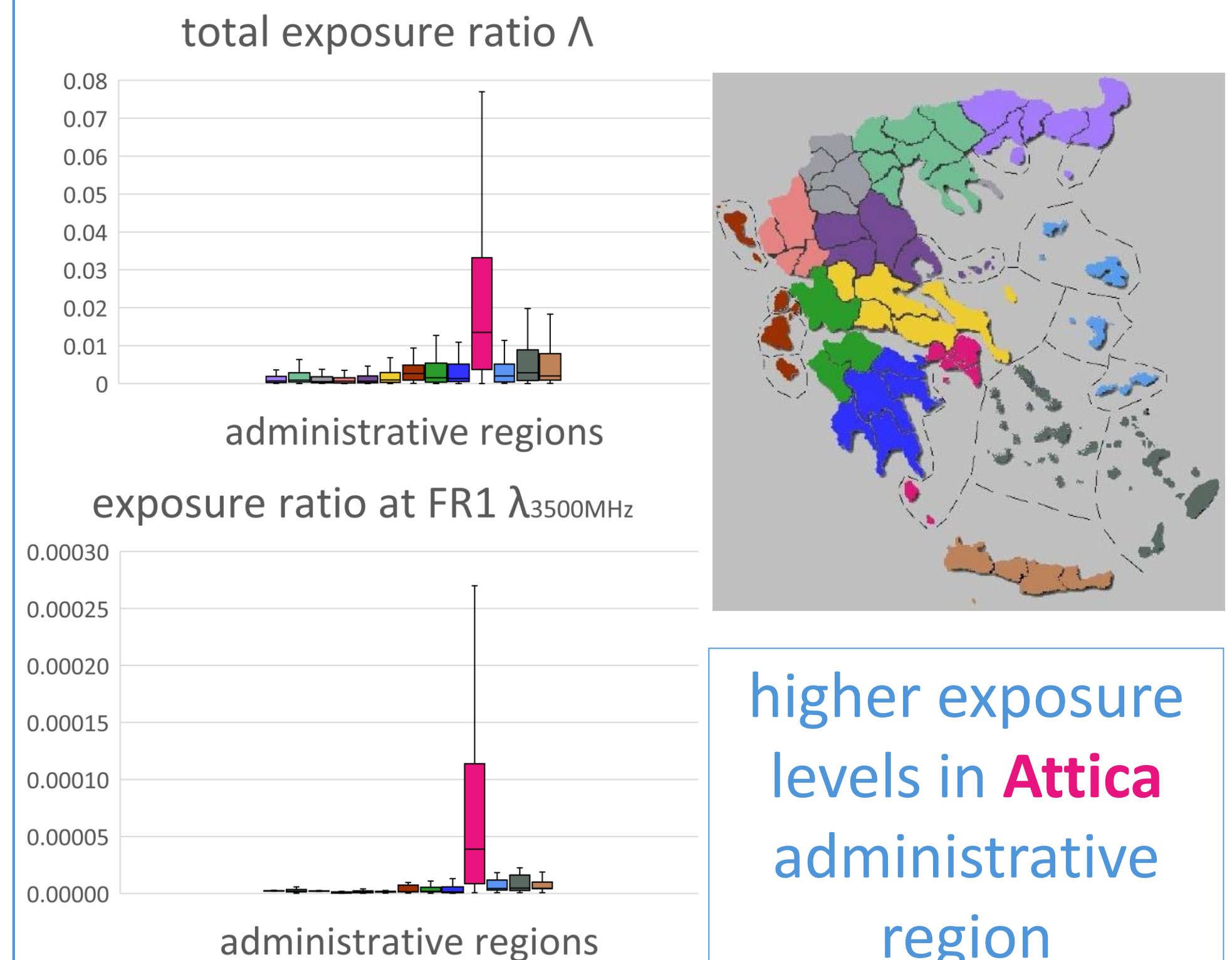


exposure ratio at FR1 $\lambda_{3500\text{MHz}}$



	2021		2022		2023	
	λ_{FR1}	Λ_{total}	λ_{FR1}	Λ_{total}	λ_{FR1}	Λ_{total}
median	4.4E-06	2.8E-03	7.2E-05	1.5E-02	4.4E-06	2.6E-03
mean	1.6E-03	5.6E-03	2.8E-04	2.6E-02	1.4E-04	1.4E-02
max	7.3E-02	2.3E-02	8.4E-03	2.4E-01	2.4E-02	5.1E-01
min	4.0E-12	4.0E-12	6.0E-08	4.2E-08	1.4E-07	4.0E-12
σ	1.0E-02	6.5E-03	9.1E-04	3.4E-02	9.7E-04	3.1E-02

13 administrative regions in Greece (all years)



Conclusions

- ✓ compliance with the reference levels for general public exposure, as defined by the Greek legislation, is confirmed
- ✓ EMF exposure at 5G FR1 is found to be significantly low