Preliminary results of broadband and selective EMF measurements using a drone system

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Nemzeti Média- és Hírközlési Hatóság

Outline

- Background and previous studies on EMF exposure recording by drones
- Why and when using drones?
- Methods of our experiment
- Results and recordings
- Experiences and conclusions

Former studies on recording of EMF exposure by drones

The measurement methods of electromagnetic environment currently used are mostly ground-based measurements.

Till now helicopters were used to perform measurements at altitude.

In recent years drone based measurements are widely used.

The IEC case reports includes technical supporting information on drone measurements (IEC TR 62669:2019)

There are several examples worldwide

Examples of former studies on EMF exposure recording by drones

Bioelectromagnetics 37:195–199 (2016)

Spectrum Monitoring with drones in France : ANFR's experiments

ANFR's Drone Project : Experiments (10/11)

2018

Using drones to test RF signals in EMF scenarios

narda
Safety Test Solutions®

IEC TR 62669

Edition 2.0 2019-04

TECHNICAL REPORT

– 104 – IEC TR 62669:2019 © IEC 2019

Annex G
(informative)

Technical information supporting the case study "Macro site in-situ measurements using drones" (Clause 12)

G.1 Technical parameters of the measurement system

The information of the components in the drone-based measurement system are shown in Table G.1.

Why and when using drones?

- The sources at locations difficult to access
- Compliance measurements of high power RF transmitters
- Near field study close to high power RF transmitters
- Measurement of antenna radiation pattern
- Heat map around RF transmitters

- Compliance test in the area of future planned area (e.g. new buildings)

The drone

- Strong, 8 rotors to carry on the RF devices
- Mostly non-metallic elements
- Driving by experts

RF device #1: broadband RF field meter

- ***Narda NBM-550*** **broadband field meter** *(Narda-STS, New York, USA)* **+ Narda 0391 E-Field-Probe.**

- **Frequency range: 100 kHz–3 GHz**

- **E-field range: 0.2-320 V/m**

- **The sample interval was 1 second.**

- **The weight of the meter was 550 g and the probe was 90 g (∑ 640 g).**

RF device #2: Band selective field meter ExpoM-RF *(Fields at Work GmbH)*

Band name	Frequency range	Typical dynamic range	
FM Radio	87.5 – 108 MHz	0.02 V/m	5 V/m
DVB-T	470 – 790 MHz	0.005 V/m	5 V/m
LTE800 downlink	791 – 821 MHz	0.005 V/m	5 V/m
LTE800 uplink	832 – 862 MHz	0.005 V/m	5 V/m
GSM900 uplink	880 – 915 MHz	0.005 V/m	5 V/m
GSM900 downlink	925 – 960 MHz	0.005 V/m	5 V/m
GSM1800 uplink	1710 – 1785 MHz	0.005 V/m	5 V/m
GSM1800 downlink	1805 – 1880 MHz	0.005 V/m	5 V/m
DECT	1880 – 1900 MHz	0.005 V/m	5 V/m
UMTS uplink	1920 – 1980 MHz	0.003 V/m	5 V/m
UMTS downlink	2110 – 2170 MHz	0.003 V/m	5 V/m
ISM 2.4 GHz	2400 – 2485 MHz	0.005 V/m	5 V/m
LTE2600 uplink	2500 – 2570 MHz	0.003 V/m	5 V/m
LTE2600 downlink	2620 – 2690 MHz	0.003 V/m	5 V/m
WiMax 3.5 GHz	3400 – 3600 MHz	0.003 V/m	3 V/m
ISM 5.8 GHz / U-NII 1-2e	5150 – 5875 MHz	0.05 V/m	5 V/m

+GPS

Sampling rate: 3 sec.

Sensitivity (max): 0,005 V/m

16x5x8 cm@300g

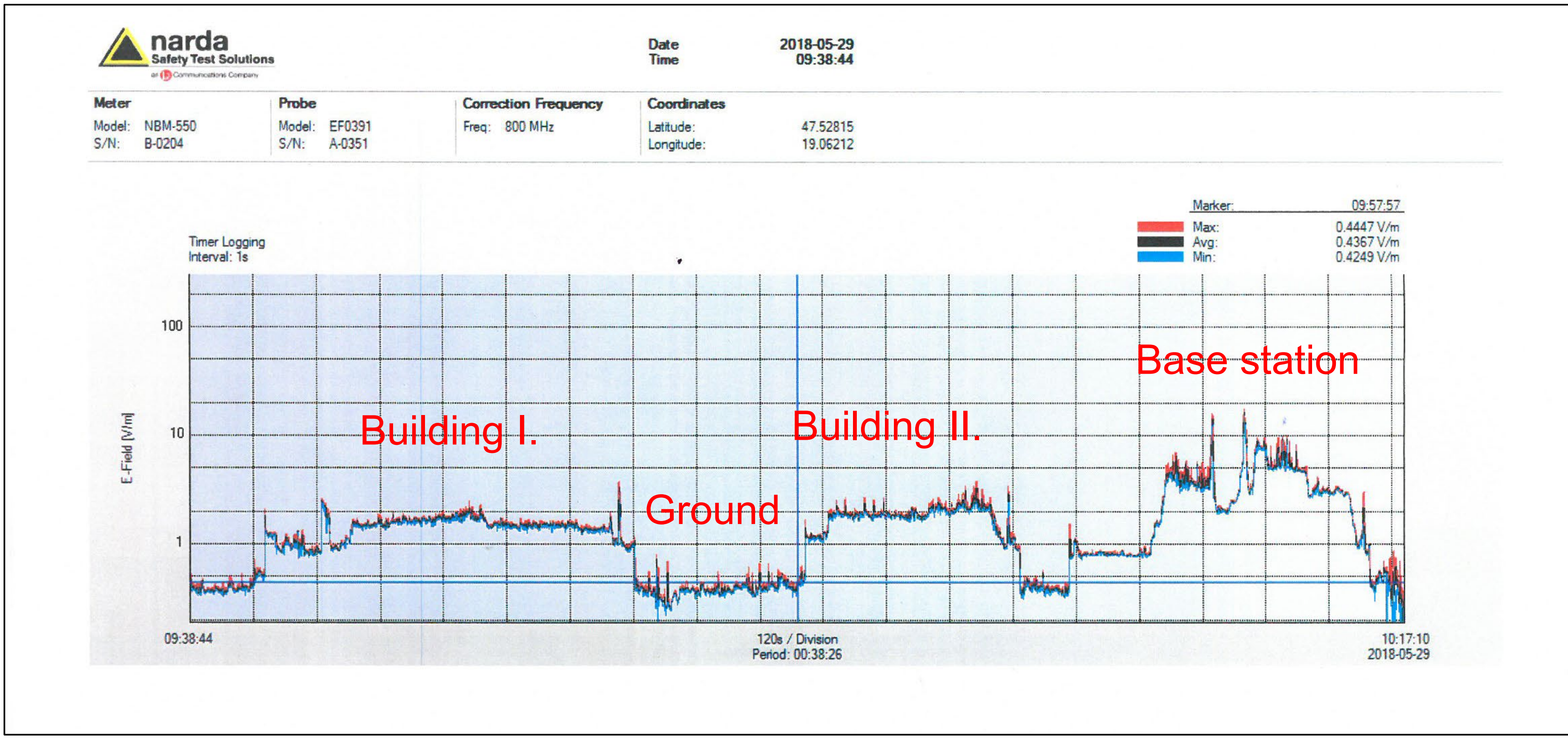
Placement of RF devices

RF#1: Broadband field meter

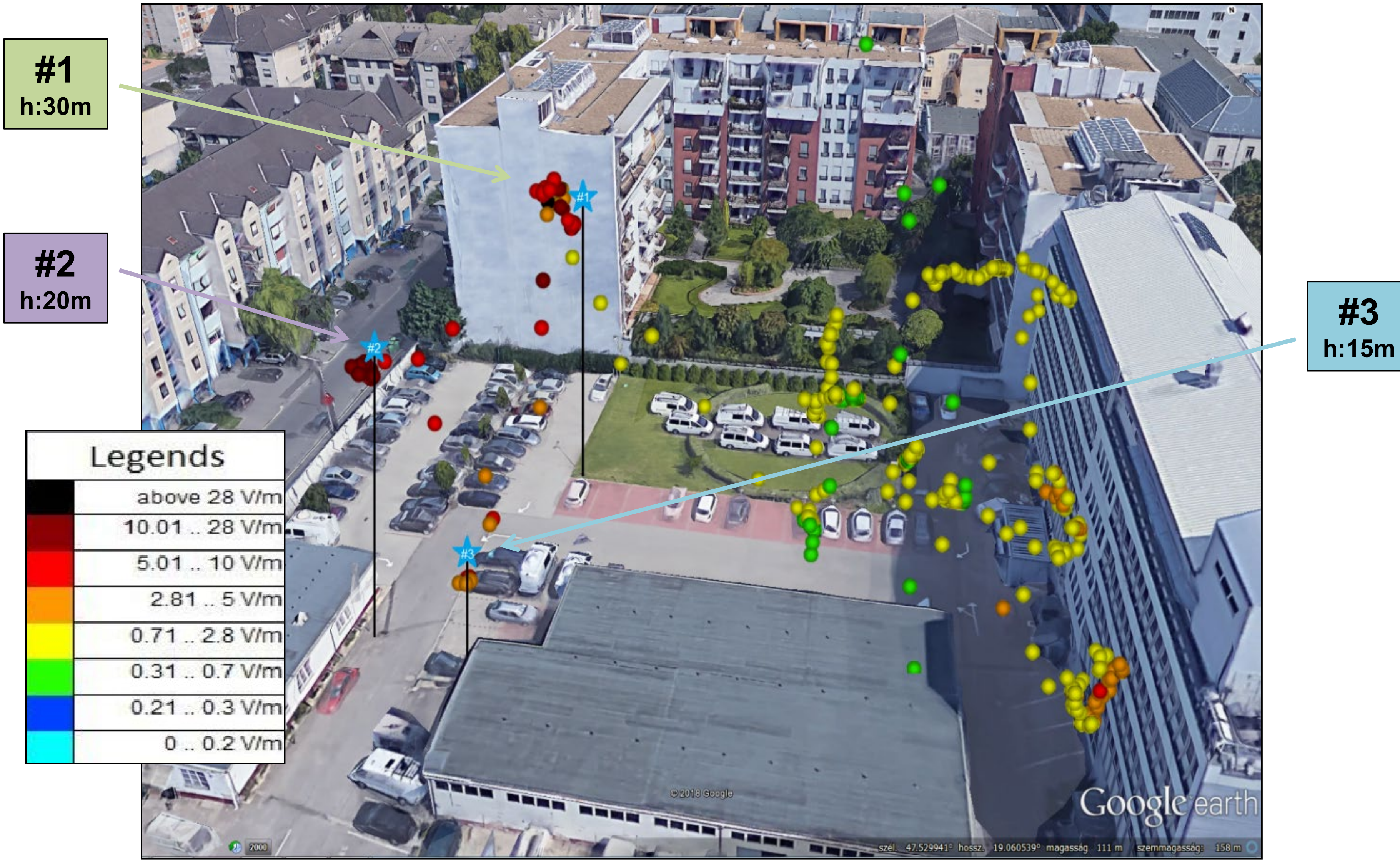
RF#2: Band selective field meter

Location of the measurement

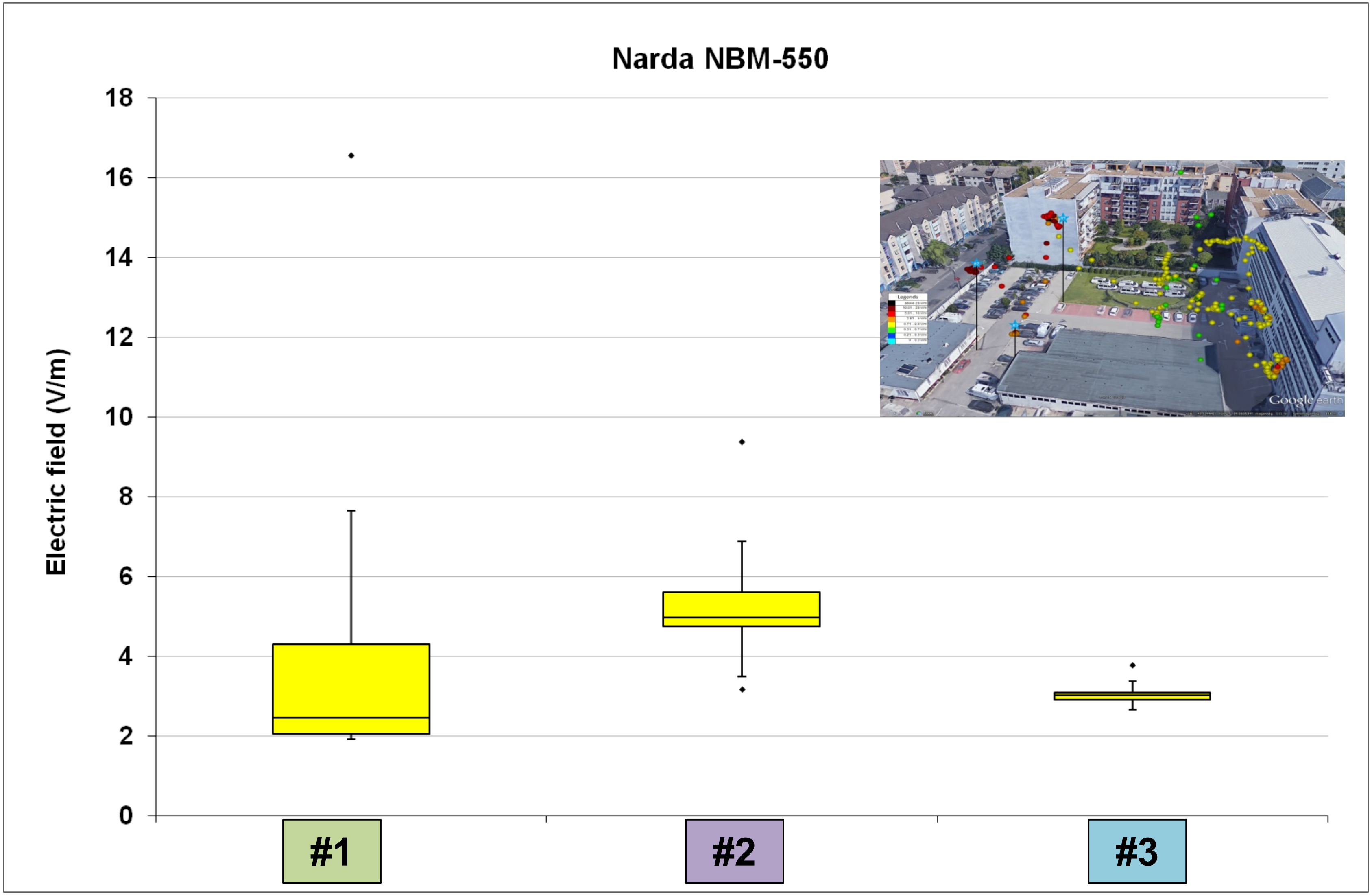
Recording by broadband field meter during the drone pathway



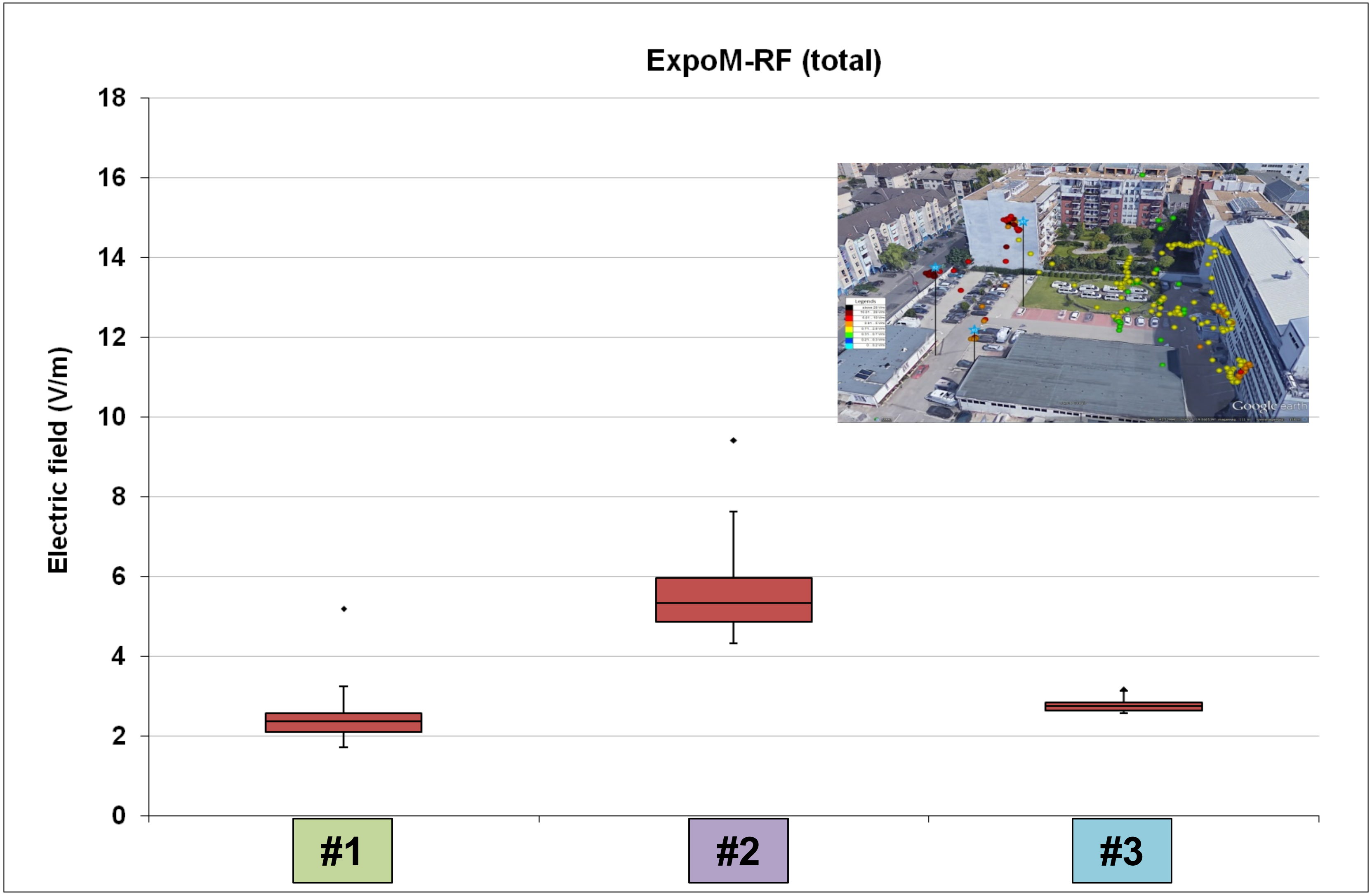
Recording positions and field strengths at by broadband field meter



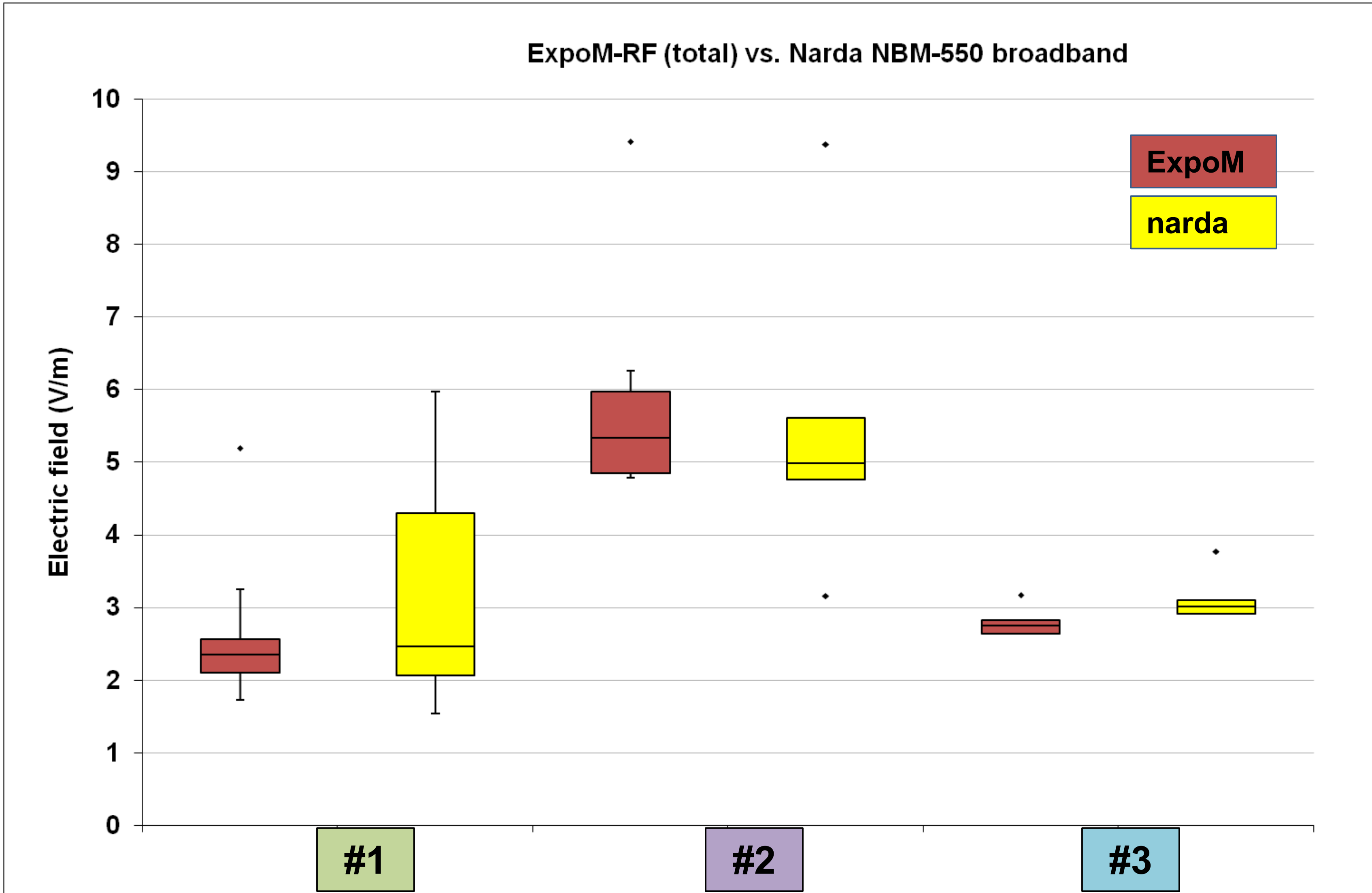
Field strengths at selected (#1; #2, #3) positions by broadband field meter



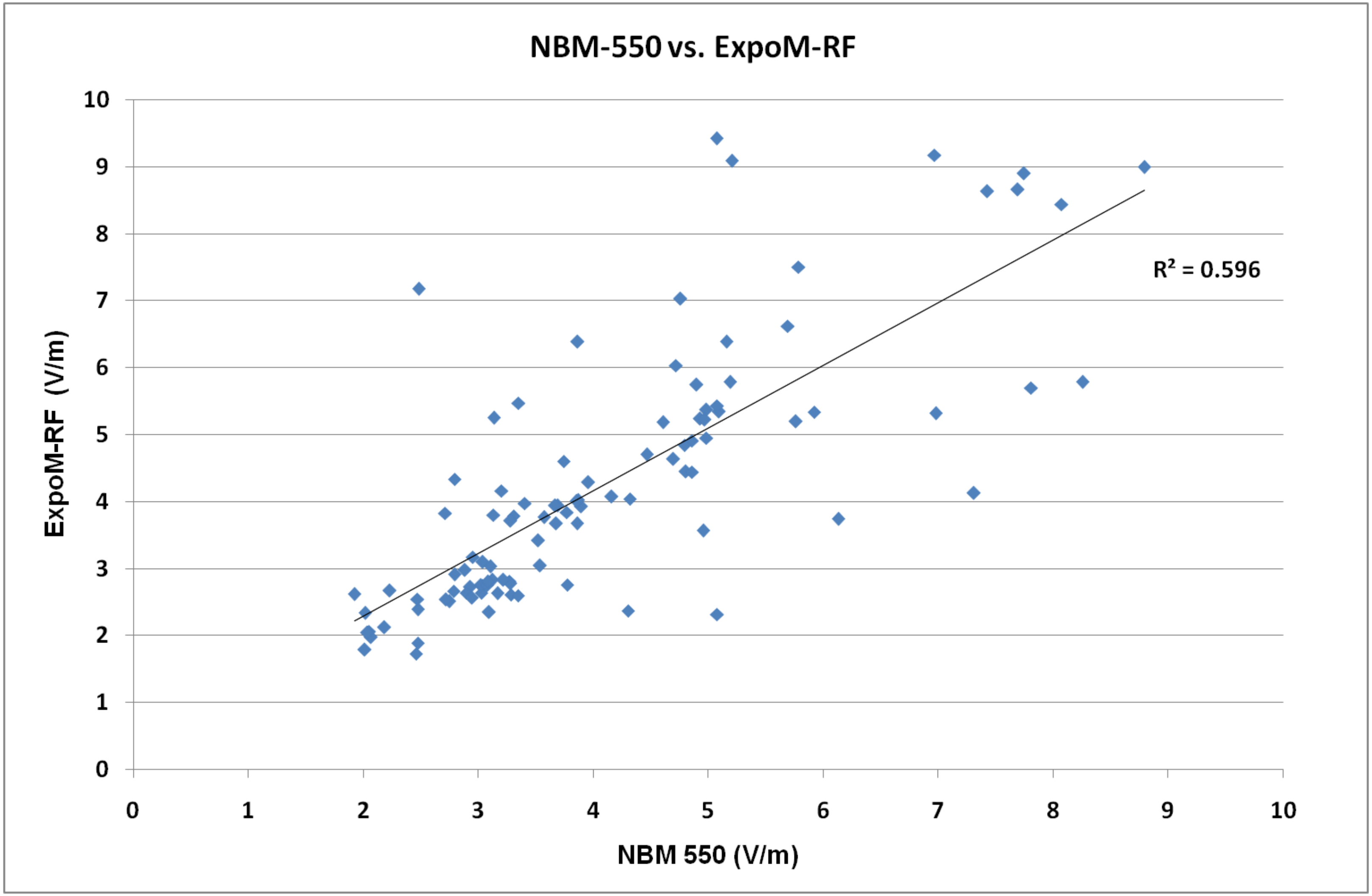
Field strengths at selected (#1; #2, #3) positions by *band selective* field meter



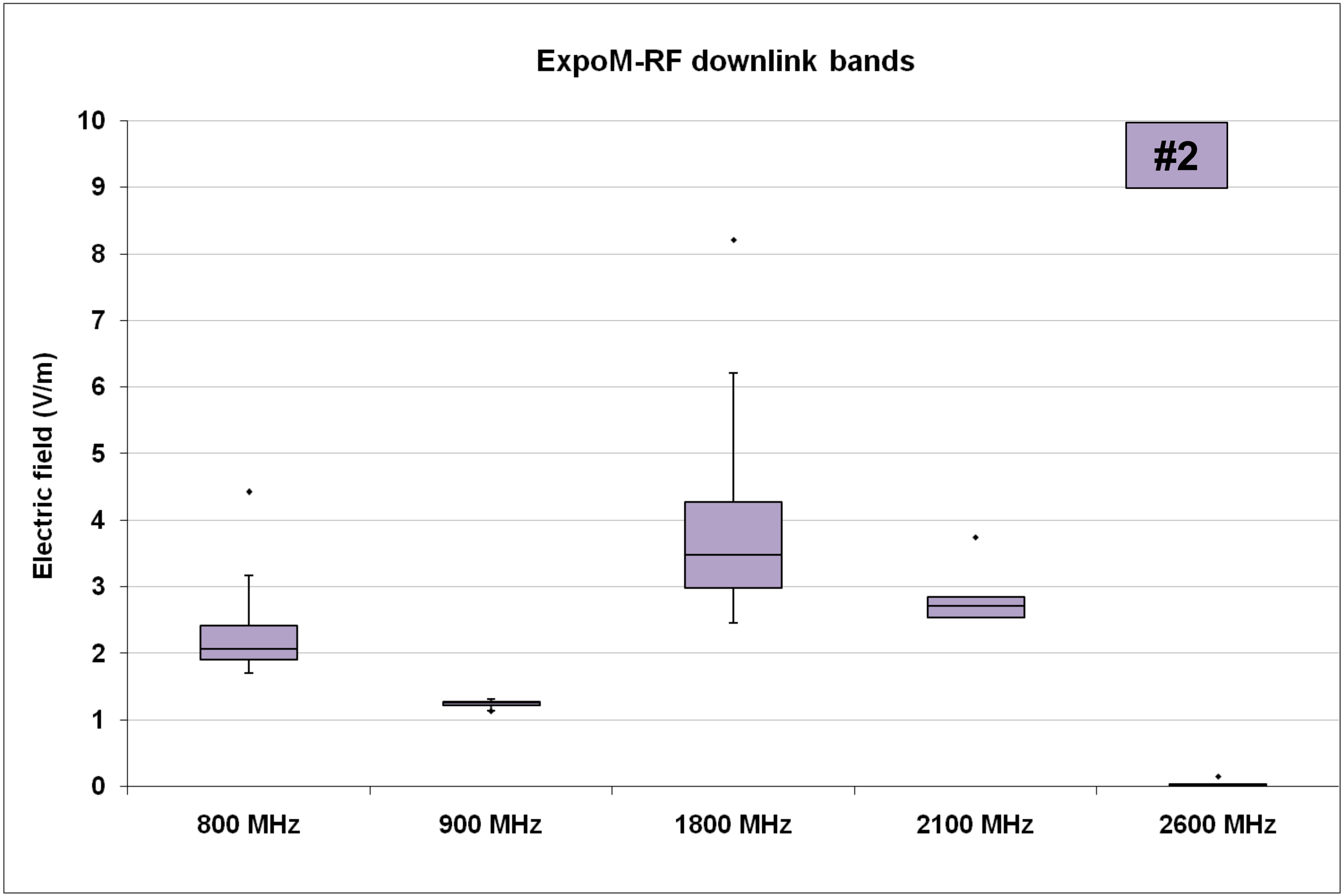
Comparison of field strengths at selected (#1; #2, #3) positions by broadband vs. *band selective* field meter



Comparison of field strengths broadband vs. *band selective* field meter in front of *Building II*



Field strengths of dowlink bands at position #2 by *band selective* field meter



Experiences (1)

- **The drone should have suitable power. The working lifetime of battery must be enough to carry the devices during the planned flight route.**

- **The RF devices must be fixed strongly on the drone.**

- **The position of altitude generated by GPS built in the RF devices looks inaccurate.**

- **The GPS data of the drone and the devices must be recorded simultaneously. Therefore the synchronization of the sampling time within the drone and the RF meters is the key point**

- **The setting the clocks in the devices must be carefully considered**

Experiences (2)

- **The feasibility of the measurement by drones strongly depends on the weather conditions. The wind the most important parameter.**

- **Trained drone driver must be hired**

- **The sound noise of the drone should be considered when the flight route passes in front of the buildings (windows).**

- **The band selective devices (i.e. personal exposimeters) looks suitable for frequency selective measurements due to their light weight and lower cost.** *(e.g. Narda SRM 3006 2,8 kg)*

- **The perturbation of the RF field and the unwanted RF noise of the drone may cause uncertainty in the measurement***.* *(Fortunately most of the parts of the drones made from plastic.)*

Questions asked me by the organizers previously

- **Why** such an idea for EMF measurement using drones at all? Is it an original idea based on own measurement problems? If so what **problems occurred**? ✓

- What is the **benefit** of using such a solution - measurement at different heights, regardless of the presence of residents? ✓

- Was the methodology **validated**? Was it verified how the drone design influences the results or does it not disturb the field distribution? X

- **Risks** associated with drone measurement ✓

- **Sample results** and own experience from the measurements carried out ✓

Summary

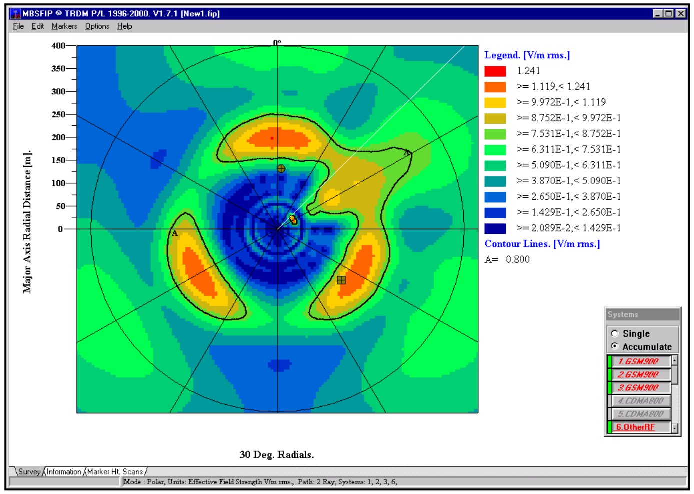
- Our trial was to use the drone system to perform RF exposure measurement in the vicinity of base station and around buildings.
- Other aim was to check how to use common RF survey broadband meter and lightweight personal exposimeter in the study.
- Using drone systems may open a new approach to perform measurements locations difficult or impossible to access.
- Nevertheless several conditions must be considered in the planning phase and carrying out such studies.

Finally: permanent debate

measurements vs. modelling?

Everyone believes a measurement except the person who did it.

No one believes a modelling except the person who did it.



Thanks for your attention!

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