Pedion24 / National Observatory of EMF Continuous EMF Measuring Programs in Greece

DR. DEMOSTHENES VOUYIOUKAS
ASSOCIATE PROFESSOR
DIRECTOR CCSL

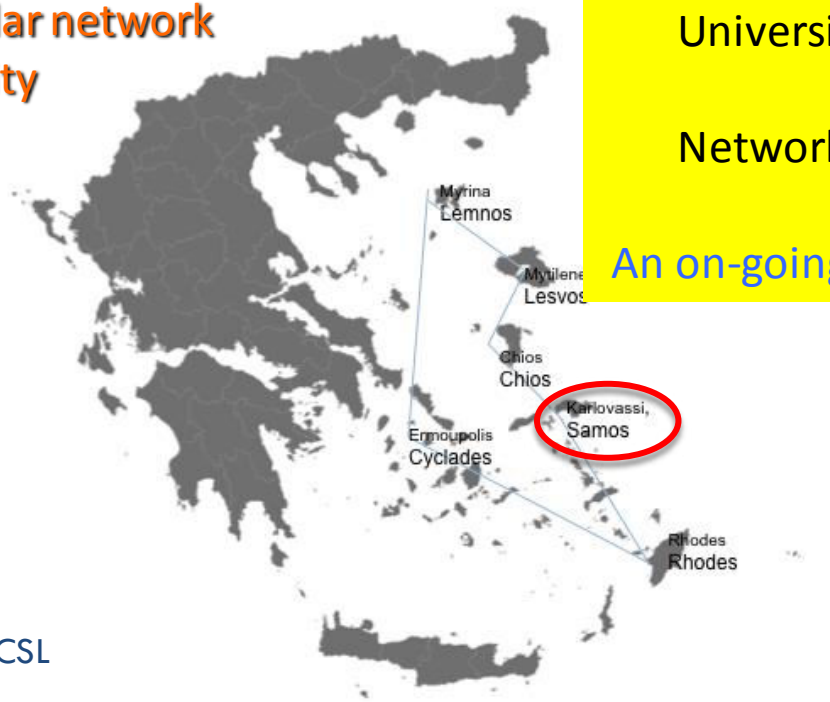
Athens, 29.06.2017

University of the Aegean, Greece
Computer and Communication Systems Laboratory (CCSL)

University of the Aegean

- University of the Aegean
  - Five Faculties in six islands (Samos, Chios, Mytilene, Rhodes, Syros, Limnos)
  - 5 Schools , 17 Departments, 300+ Faculty Members, 17.000+ Students

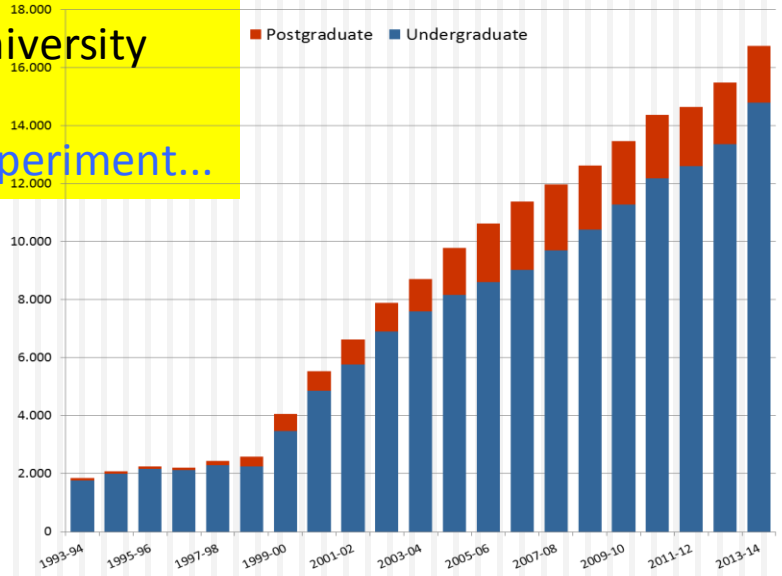
An insular network university



University Network
-or-
Network University

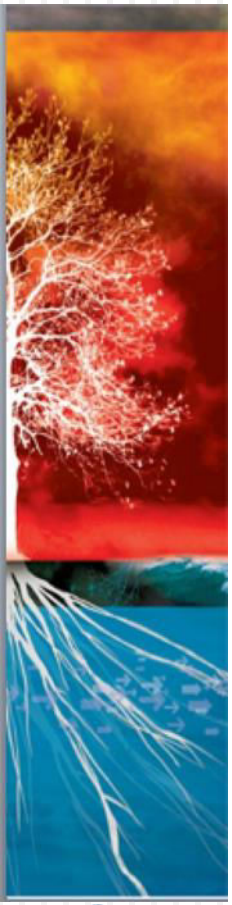
An on-going experiment...

Student population



University of the Aegean

- Modern studies in interdisciplinary thematic areas



Sustainable development

Education

Food &Nutrition

Informatics

Engineering

Economy

Society

Tourism

Product Design

Humanities

Management

Environment

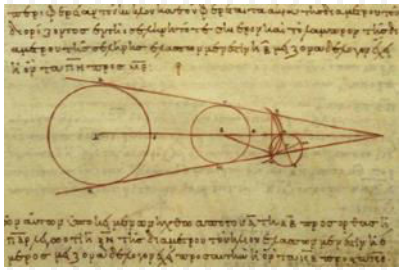
Mathematics

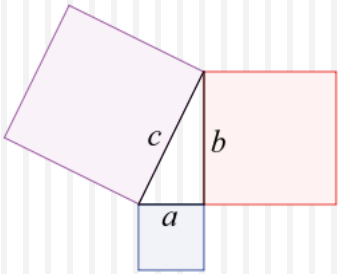
Culture

Shipping & Transport

School of Sciences

- Information and Communication Systems Engineering BSc, MSc (Samos Island)
- Mathematics BSc, MSc (Samos Island)
  - Mathematics
  - Statistics & Actuarial-Financial Mathematics
- Product and Systems Design Engineering BSc, MSc (Syros Island)
- Why Samos?
  - Pythagoras of Samos (496 B.C.) → Pythagorean Theorem
  - Aristarchus of Samos (230 B.C.) → Sun-centric Theory





Department of Information & Communication Systems Engineering

- Information
- Communication
- Systems
- Engineering

Engineer of
Information Systems
&
Communication Systems

- Est. 1997
- Key: Technology + Modern management
- "Information & Communication" indicates that information technology and communications technology converge.
- Located in Samos , 24 faculty members, 800+ students.
- 1 Undergraduate and 4 Graduate study programs

Department of Information & Communication Systems Engineering

- 4 Research Laboratories
  - Computer and Communication Systems – CCSL (Communications, Networks, Infrastructure, Mobile terminals, Internet of Things, Cloud, Software & Hardware)
  - Information and Communication Systems Security (systems authentication and services, trust, eID, legal issues)
  - Artificial Intelligence (Semantic Web, Agent based systems, data mining)
  - Information Systems (e-business, e-government, social networks)

CCSL – Short Description

- **Computer and Communication Systems Laboratory (CCSL)** was founded in 1999 as a research and educational unit in the Department of Information and Communication Systems Engineering of the University of the Aegean

- CCSL has a highly experienced research team with a proven record of providing robust research and practical solutions in **a wide range of Information and Communication Technology (ICT)** fields including:
  - **Electromagnetic** Measurements and Safety Evaluation
    - Accredited to **ELOT EN ISO/IEC 17025:2005** by the Hellenic Accreditation System for the measurement of electromagnetic radiation of high frequency
    - Number of certificate: 824
  - Channel characterization, propagation models and **performance modeling** of wireless systems
  - **RRM** in Cellular, Wireless, Multi-hop and Cooperative Networks
  - **Cognitive Radio Systems**
  - **Energy-aware, Context-aware**, *-aware Next Generation Networks & Services

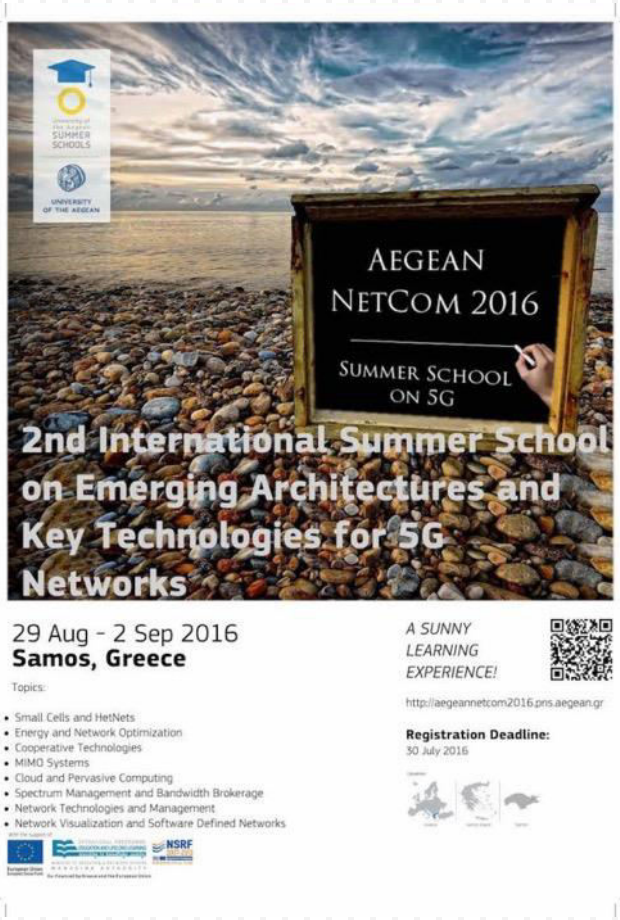
ΕΣΥΔ
Δοκιμές
Αρ.Πιστ. 824

CCSL – Short Description

- **Self-Optimized** and Reconfigurable Networks
- Wireless, mobile and satellite **cooperative systems**
- Integration of **Heterogeneous radio technologies**
- **SDN/NFV/Cloud** Computing
- Design and Programming of **Pervasive Computing Systems**
  - Conceptual and programming models
  - Middleware
  - Ontological Knowledge Representation
  - Tools supporting end-user development
  - Applications (eHealth, smart agriculture, smart home, smart classroom)
- Digital systems design
  - **FPGA-based systems**
  - **Embedded systems** (+ programming)
  - **Industrial control** (PLCs)
- Digital image processing - Digital data forensics
- Security in **virtualized environments**
- **Physical-layer security** for wireless networks

Summer School

- Emerging Architectures & Key Technologies for 5G Networks



CCSL – Research Projects

- **Relevant Research Projects:**
  - **COGEU:** Cognitive Radio Systems For Efficient **Sharing Of TV White Spaces** In European Context, http://www.ict-cogeu.eu, (EU-FP7)
  - **HURRICANE: Handovers** For Ubiquitous And Optimal Broadband Connectivity **Among Cooperative Networking Environments**, http://www.ict-hurricane.eu, (EU-FP7)
  - "Development of Autonomous Measuring System of Electromagnetic Radiation" (General Secretariat of Research and Technology)
  - "Study and Measurement of Electromagnetic Radiation in Municipality of Rhodes" (Municipality of Rhodes)
  - "Study and Measurement of Electromagnetic Radiation in Municipality of Patmos" (Municipality of Patmos)
  - "Study and Measurement of Electromagnetic Radiation in Municipality of Samos" (Municipality of Samos)
  - **PEDION 24:** "Design, Development And Operation Of A Network For The **Monitoring Of the non-Ionizing Electromagnetic Radiation**", http://www.pedion24.gr (COSMOTE - Mobile Telecommunications S.A.)
  - **National Observatory Of Electromagnetic Fields:** Development of a system for the **continuous measurement and recording** in real-time the levels of electromagnetic fields, due to different base stations' emissions, https://paratiritirioemf.eeae.gr (Ministry of Infrastructure, Transport and Networks)

http://www.pedion24.gr

Pedion24

Scope of Pedion24

- Pedion24 is a National Network for continuous measurement of Non-ionizing Electromagnetic Radiation Monitoring in Greece
- Motivation:
  - Lack of previous systematic measurement and recording of electromagnetic field strength levels over the country
- Pedion24 aims to:
  - Monitor electromagnetic fields from various sources on a 24–hour basis
  - Provide information to the public regarding the exposure level to non-ionizing radiation in various areas of Greece
  - Include the results of the telecommunication systems from 100 kHz to 3 GHz

A University Cooperation

- Project Partners:

Mobile Radiocommunications Laboratory, National Technical University of Athens (NTUA)

Radiocommunications Lab, Aristotle University of Thessaloniki (AUTH)

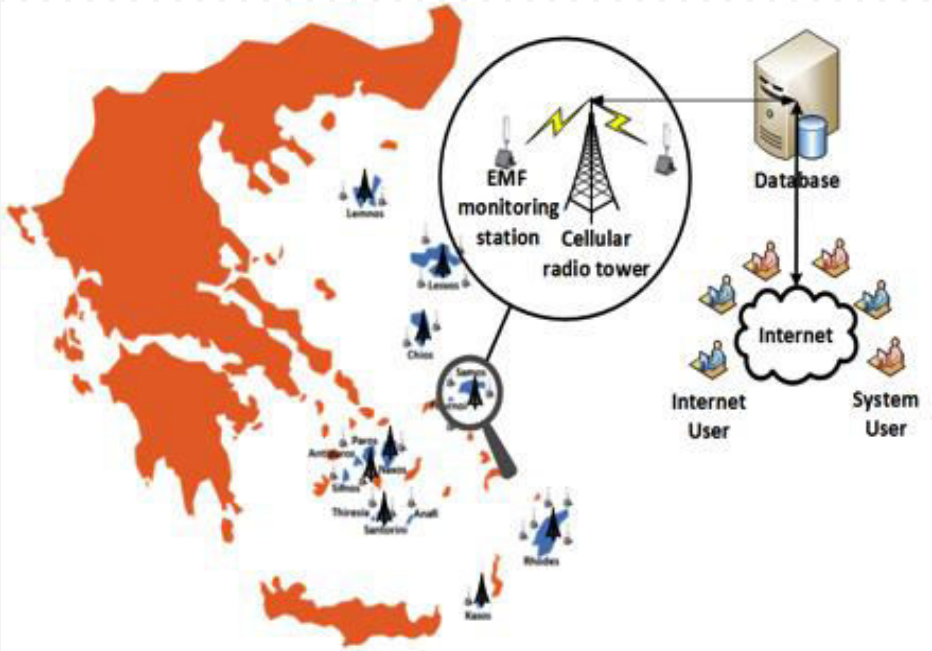
Computer and Communication Systems Laboratory, University of the Aegean (AEGEAN)

Network and Telecommunication Systems, Services and Security Laboratory, University of Piraeus (UNIPI)

- with the support of Cosmote S.A.

EMF Measurement Infrastructure

- **Total 236 measurement stations (100kHz-3GHz)** measure on a 24-hour basis the total electromagnetic field emitted from different sources, such as FM and television broadcasts and cellular telephony base stations
- Each University monitors and controls a portion of stations:
  - **30 are located on 17 Greek Aegean sea islands** (AEGEAN)
  - **141 are located on South-Central Greece and Ionian islands** (NTUA)
  - **65 are located in Northern Greece** (AUTH)



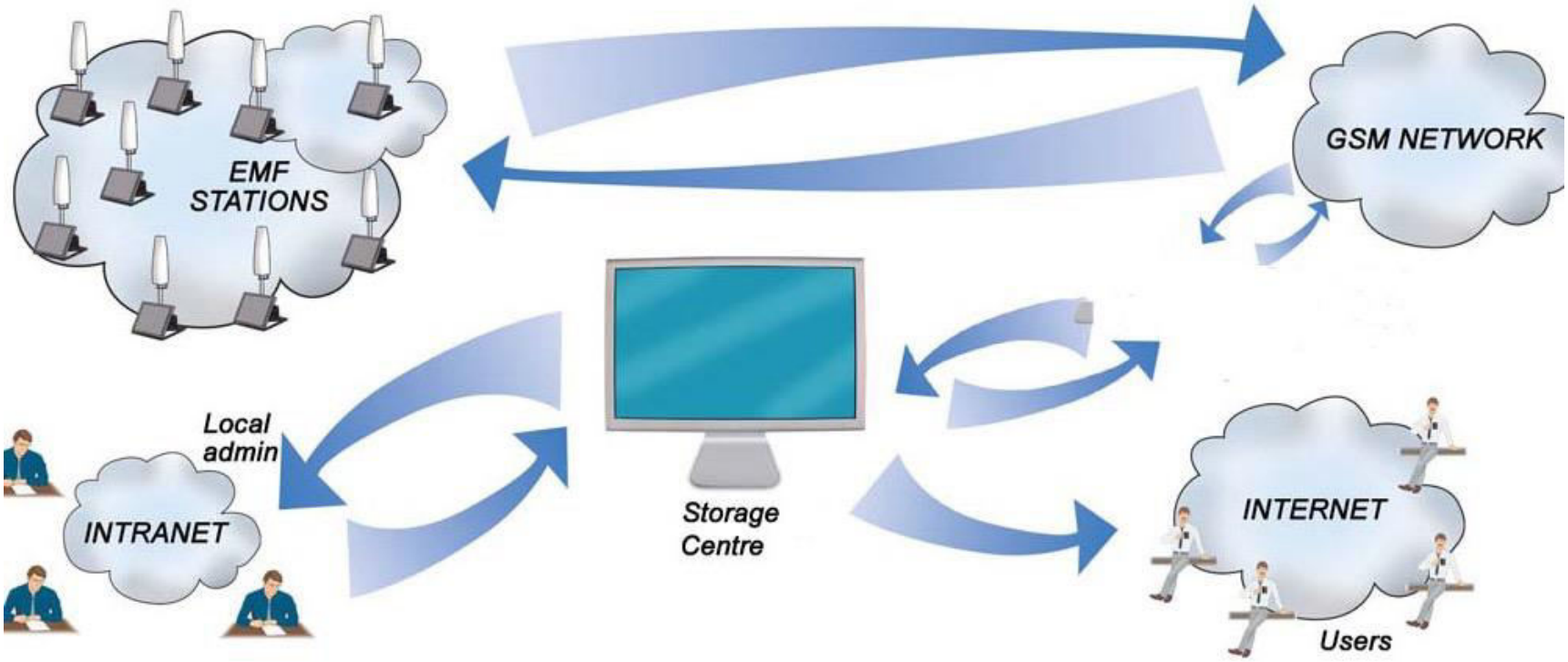
EMF Measurement Infrastructure

- Installation in selective areas with sensitive residents and high population concentration, such as:
  - Schools and kindergartens
  - Public buildings (e.g. Hospitals, Municipalities, etc.)
  - Sensitive areas near base stations

Architecture

- The system consists of:
  - 236 (186 active) monitoring stations
  - 4 control centers located in the premises of NTUA, AUTH, AEGEAN and UNIPI
- Monitoring stations:
  - Equipped with certified probes which record every 3 seconds a root-mean square (RMS) value of the electric field in V/m
  - Calculate every 6 minutes an average of the RMS values
  - Send every 24 hours 240 measurements to the control centers
- Measurements are:
  - Stored in databases
  - Available online on www.pedion24.gr

Architecture



System analysis

Monitoring Station

- Measures the Electric Field E(V/m)
- Broadcast the measurement file to the main server via a GSM modem

Main Server

- Controls all monitoring stations
- Collects data and inserts them to the database
- Creates figures and export final results

End User

- Logs in www.pedion24.gr
- Figures and daily measurement results are available

Specifications of the EMF measurement stations

- Electric field measurement in V/m
- 3-band measurements
  - Wideband
    - 100 kHz – 3 GHz
  - Narrowband
    - 100 kHz – 862 MHz
    - 933 MHz – 3 GHz
- 4 MB memory capacity (~135 days of measurements)
- Dual band GSM modem
- Autonomy and charge with photovoltaic panels
- Autonomy ~40 days without charging

Narda AMB-8057

Narda AMB-8059

Specifications of the EMF measurement stations

- Calibrated 3-band probe that measures the EM field along three axes
- The measurements are complied with EU 1999/519/EC & ICNIRP
- GSM-CSD, GPRS-FTP and SMS remote communication
- Daily report by SMS
- Warning and alarm messages to PC and mobile phones
- Detects any kind of abnormal operation (e.g. self-diagnosis of power loss and overheating problems) and report it to the control unit

Storage Center

- The storage center is a server equipped with a wireless modem and the required software to:
  - Monitor remote monitoring stations and configure their operational parameters
  - Retrieve station measurements over the wireless network
  - Save the data in the hard drive
  - Process the results of the measurements and publish them on the corresponding website

Activities → Daily updates

- Every day the measurements of each monitoring station are updated
- The project engineers follow a daily procedure consisting of:
  - Communication with the stations to acquire their data as .txt files
  - Validation the data
  - Record the values of the electric field in the control center's database

Activities → Daily updates

- The .txt files have the depicted structure
  - Date and time of measurements
  - Root-mean square (RMS) values for the total spectrum
  - RMS values for the spectrum between 100 kHz - 862 MHz
  - RMS values for the spectrum between 933 MHz - 3 GHz
  - Corresponding peak values
  - Temperature
  - Alarms regarding the state of the station

```
8057SW-02
Firmware:  1.30 04/09

Station: Kameiros 321wk80611          (Nsts,AMB-8057-03     S/N 321wk80611)

    Date: 04/07/2014    Time: 12:06   (RMS  6 minute )

Probe EP-3B-01 (Last Calibrated:15.05.12)


Date;Time;TxOn;RMS W.;RMS Lo.;RMS Hi.;Peak W.;Peak Lo.;Peak Hi.;Battery;Temp;Alarms;|
;;;V/m;V/m;V/m;V/m;V/m;V/m;V;C°;AWPLCTV;

04/07/2014;12:06;*;0.43;0.22;LOW;2.68;0.75;0.50;4.69;31;.......;
04/07/2014;12:12;*;0.53;0.26;LOW;2.47;0.63;0.83;4.80;31;.......;
04/07/2014;12:18;*;0.24;LOW;LOW;0.62;0.44;0.50;4.80;31;.......;
04/07/2014;12:24;;0.27;0.21;LOW;0.83;0.48;0.78;4.80;31;.......;
04/07/2014;12:30;;0.23;0.20;LOW;0.77;0.50;0.77;4.80;31;.......;
04/07/2014;12:36;;0.25;0.21;LOW;0.76;0.56;0.31;4.80;31;.......;
04/07/2014;12:42;;0.29;0.22;LOW;1.19;0.65;0.80;4.80;31;.......;
04/07/2014;12:48;;0.29;0.26;LOW;1.08;0.64;0.47;4.80;31;.......;
04/07/2014;12:54;;0.35;0.25;LOW;0.96;0.68;0.96;4.80;31;.......;
04/07/2014;13:00;;0.33;0.24;LOW;0.93;0.61;0.93;4.80;31;.......;
04/07/2014;13:06;;0.28;0.23;LOW;0.79;0.69;0.77;4.80;31;.......;
04/07/2014;13:12;;0.30;0.24;LOW;0.91;0.60;0.36;4.80;31;.......;
04/07/2014;13:18;;0.30;0.24;LOW;1.10;0.59;LOW;4.80;31;.......;
04/07/2014;13:24;;0.27;0.23;LOW;0.77;0.57;0.77;4.80;30;.......;
04/07/2014;13:30;;0.32;0.25;0.20;0.90;0.64;0.90;4.80;31;.......;
04/07/2014;13:36;;0.35;0.27;LOW;1.00;0.74;0.58;4.80;31;.......;
04/07/2014;13:42;;0.29;0.24;LOW;0.87;0.77;0.67;4.80;30;.......;
04/07/2014;13:48;;0.32;0.21;LOW;0.97;0.55;0.97;4.80;30;.......;
04/07/2014;13:54;;0.33;0.26;LOW;0.96;0.70;0.75;4.80;30;.......;
04/07/2014;14:00;;0.31;0.27;LOW;0.95;0.76;0.95;4.80;30;.......;
04/07/2014;14:06;;0.30;0.23;LOW;0.92;0.68;0.48;4.80;30;.......;
04/07/2014;14:12;;0.41;0.27;LOW;1.35;0.68;0.86;4.80;30;.......;
04/07/2014;14:18;;0.39;0.29;0.20;1.17;0.75;1.17;4.80;30;.......;
04/07/2014;14:24;;0.35;0.28;LOW;0.89;0.85;0.89;4.80;30;.......;
04/07/2014;14:30;;0.31;0.26;LOW;0.95;0.72;0.95;4.80;30;.......;
04/07/2014;14:36;;0.32;0.28;LOW;0.95;0.76;0.95;4.80;30;.......;
04/07/2014;14:42;;0.37;0.26;0.29;1.08;0.80;1.08;4.80;30;.......;
```

Activities → Daily updates

- The files are validated through a software (middleware) developed in the context of Pedion24
- If the data is valid, the software provides:
  - The maximum value averaged for 6 minutes
  - The maximum instantaneous value within all 6 minutes averages

pedion24 WEB Server

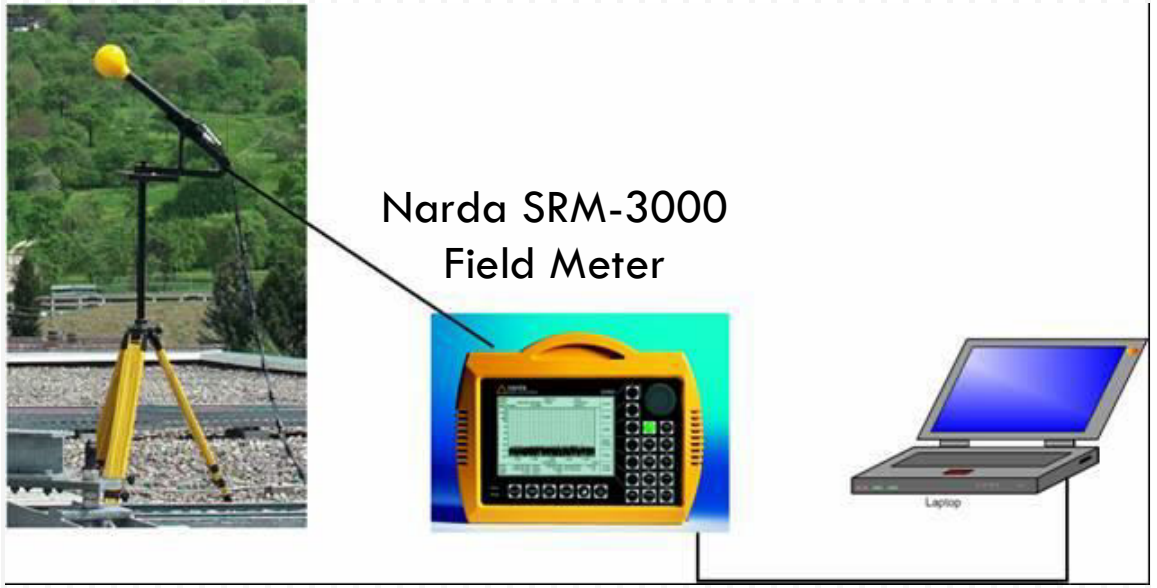
Instruments	Check Files	Add Data	Delete Files	Add SA Measurements
	C:\PMM_SW57\AUTOFILE\POSTAZIONE310wk61211_DAL_2014-07-04_10-48_AL_2014-07-07_10-46.TXT			
	Mistegna Lesvos (PMM8057)			
Max Average Value (6 minutes)				Max Instant Value
0.22 V/m				0.71 V/m
Measurement Time: 05-07-2014 17:42				Measurement Time: 06-07-2014 18:06
	C:\PMM_SW57\AUTOFILE\POSTAZIONE320wk71105_DAL_2014-07-04_10-42_AL_2014-07-07_10-43.TXT			
	Karlovasi Port (PMM8057)			
Max Average Value (6 minutes)				Max Instant Value
0.2 V/m				0.47 V/m
Measurement Time: 04-07-2014 10:42				Measurement Time: 04-07-2014 21:18
	C:\PMM_SW57\AUTOFILE\POSTAZIONE320WK71113_DAL_2014-07-02_09-30_AL_2014-07-07_09-38.TXT			
	Antiparos (PMM8057)			
Max Average Value (6 minutes)				Max Instant Value
0.86 V/m				1.48 V/m
Measurement Time: 04-07-2014 22:24				Measurement Time: 04-07-2014 22:36
	C:\PMM_SW57\AUTOFILE\POSTAZIONE321wk80611_DAL_2014-07-04_12-06_AL_2014-07-07_12-06.TXT			
	Rhodes Appolon (PMM8057)			
Max Average Value (6 minutes)				Max Instant Value
0.42 V/m				1.35 V/m
Measurement Time: 04-07-2014 14:48				Measurement Time: 04-07-2014 14:12
	C:\PMM_SW57\AUTOFILE\POSTAZIONE321wk80639_DAL_2014-07-02_12-12_AL_2014-07-04_12-11.TXT			
	Nisiros (PMM8057)			
Max Average Value (6 minutes)				Max Instant Value
1.12 V/m				1.38 V/m
Measurement Time: 04-07-2014 9:24				Measurement Time: 04-07-2014 9:24
	C:\PMM_SW57\AUTOFILE\POSTAZIONE321wk80665_DAL_2014-07-04_09-54_AL_2014-07-07_09-55.TXT			
	Mitilini (PMM8057)			
Max Average Value (6 minutes)				Max Instant Value
0.73 V/m				0.84 V/m
Measurement Time: 04-07-2014 20:00				Measurement Time: 04-07-2014 21:06

Activities → Daily updates

- The data is selected to be inserted in the database
- The software notifies on:
  - The number of successfully inserted records
  - The table that corresponds to each station

Activities → Ad-hoc measurements

- Periodically, the project engineers perform ad-hoc measurements using a Selective Radiation Meter (SRM) in order to:
  - Acquire narrow-band and frequency selective measurements
  - Investigate on whether or not the installed stations' measurements coincide
  - 75 MHz – 3 GHz



Measurements results

- The final results include:
  - E-field measurements (mean & maximum values) for the following bands:
    - 100 kHz – 3 GHz
    - 100 kHz – 862 MHz (mainly FM, TV and Tetra services)
    - 933 MHz – 3 GHz (mainly GSM900, GSM1800, UMTS, LTE and WiFi services)
- The E-field values along with the limit values for the exposure of the general public to electromagnetic fields instituted by the Greek state (Law 4070/2012)

Measurements results

- ICNIRP Guidelines Directive 2004/40/EC
- Reference levels for general public exposure to time-varying electric and magnetic fields for the general public (rms values)

Frequency range	E-field strength ($V\ m^{-1}$)	H-field strength ($A\ m^{-1}$)	B-field (μT)	Equivalent plane wave power density S_{eq} ($W\ m^{-2}$)
up to 1 Hz	—	3.2×10^4	4×10^4	—
1–8 Hz	10,000	$3.2 \times 10^4/f^2$	$4 \times 10^4/f^2$	—
8–25 Hz	10,000	$4{,}000/f$	$5{,}000/f$	—
0.025–0.8 kHz	$250/f$	$4/f$	$5/f$	—
0.8–3 kHz	$250/f$	5	6.25	—
3–150 kHz	87	5	6.25	—
0.15–1 MHz	87	$0.73/f$	$0.92/f$	—
1–10 MHz	$87/f^{1/2}$	$0.73/f$	$0.92/f$	—
10–400 MHz	28	0.073	0.092	2
400–2,000 MHz	$1.375f^{1/2}$	$0.0037f^{1/2}$	$0.0046f^{1/2}$	$f/200$
2–300 GHz	61	0.16	0.20	10

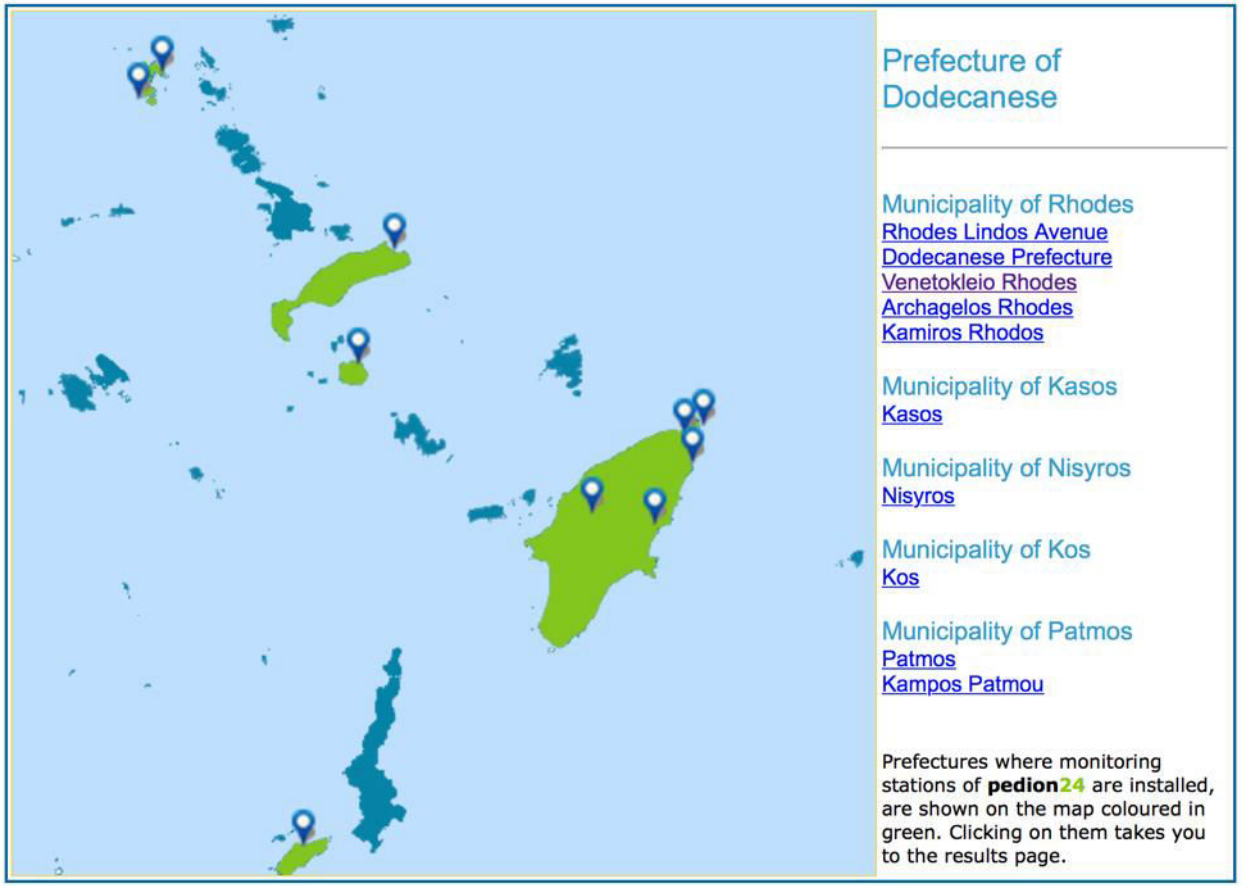
Measurements results

- What applies for Greece?
  - The exposure limits have reduced to 70% of EU limits and to 60% of EU limits for antenna stations located less than 300 meters away where sensitive areas exist.

Service	Freq. Band (MHz)	Electric Field Limit (V/m)		Power Density Limit (W/m^2)	
		70%	60%	70%	60%
Before	75 – 87	23,4	21,7	1,4	1,2
Radio FM	87 – 109	23,4	21,7	1,4	1,2
VHF (Com + TV)	109 – 300	23,4	21,7	1,4	1,2
TETRA, etc	300 – 450	23,4	21,7	1,4	1,2
UHF (TV)	450 – 860	24,4	22,6	1,6	1,4
GSM 900	860 – 1000	33,7	31,2	3	2,6
Others	1000 – 1700	36,4	33,7	3,5	3
GSM 1800 - UMTS	1700 – 2200	47,4	43,9	6	5,1
After	2200 – 3000	51	47,2	7	6

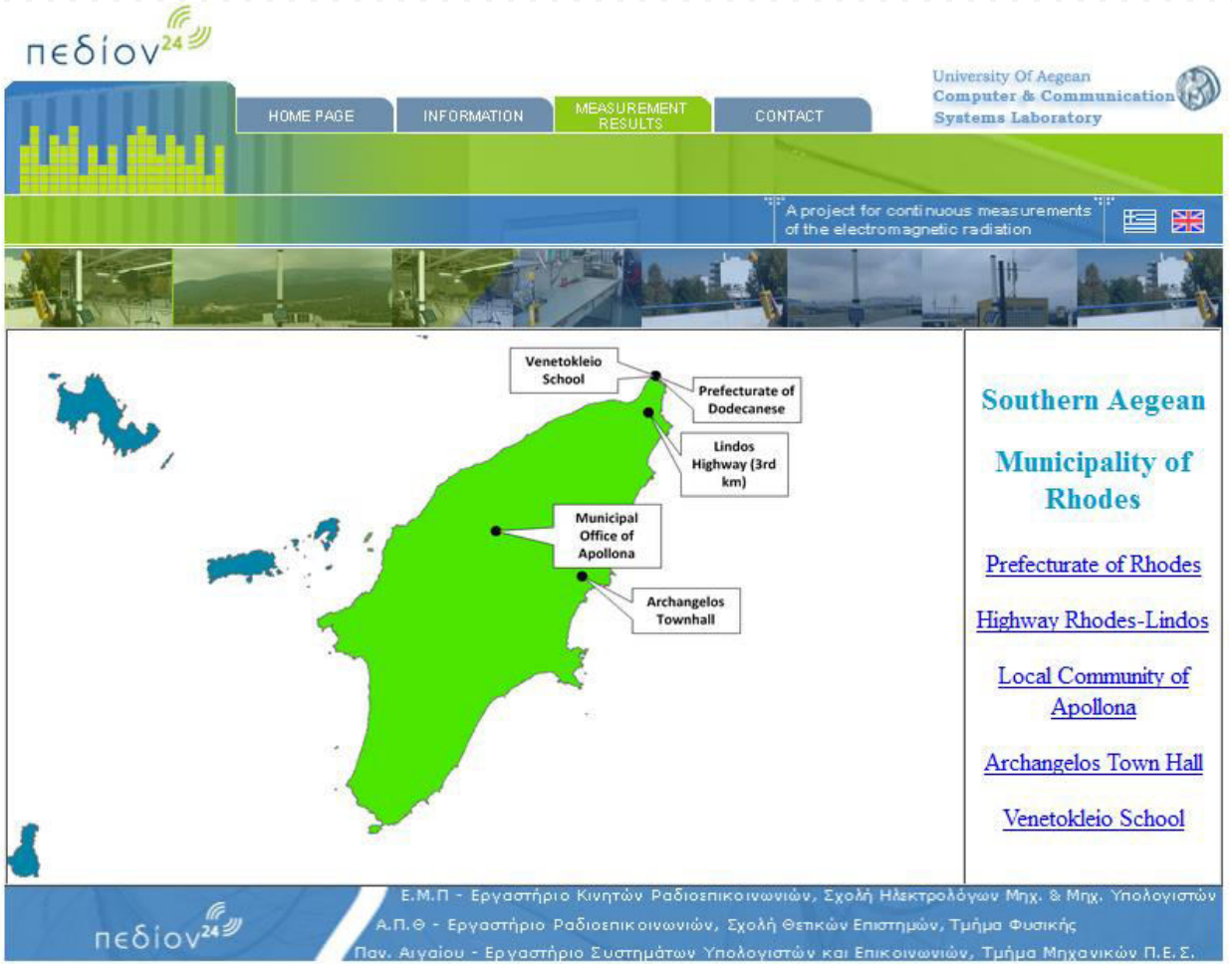
Site tour

- A region of Greece is selected
- Municipalities where Pedion24 stations are installed are shown in green
- Clicking on the map or the links zooms to a specific municipality



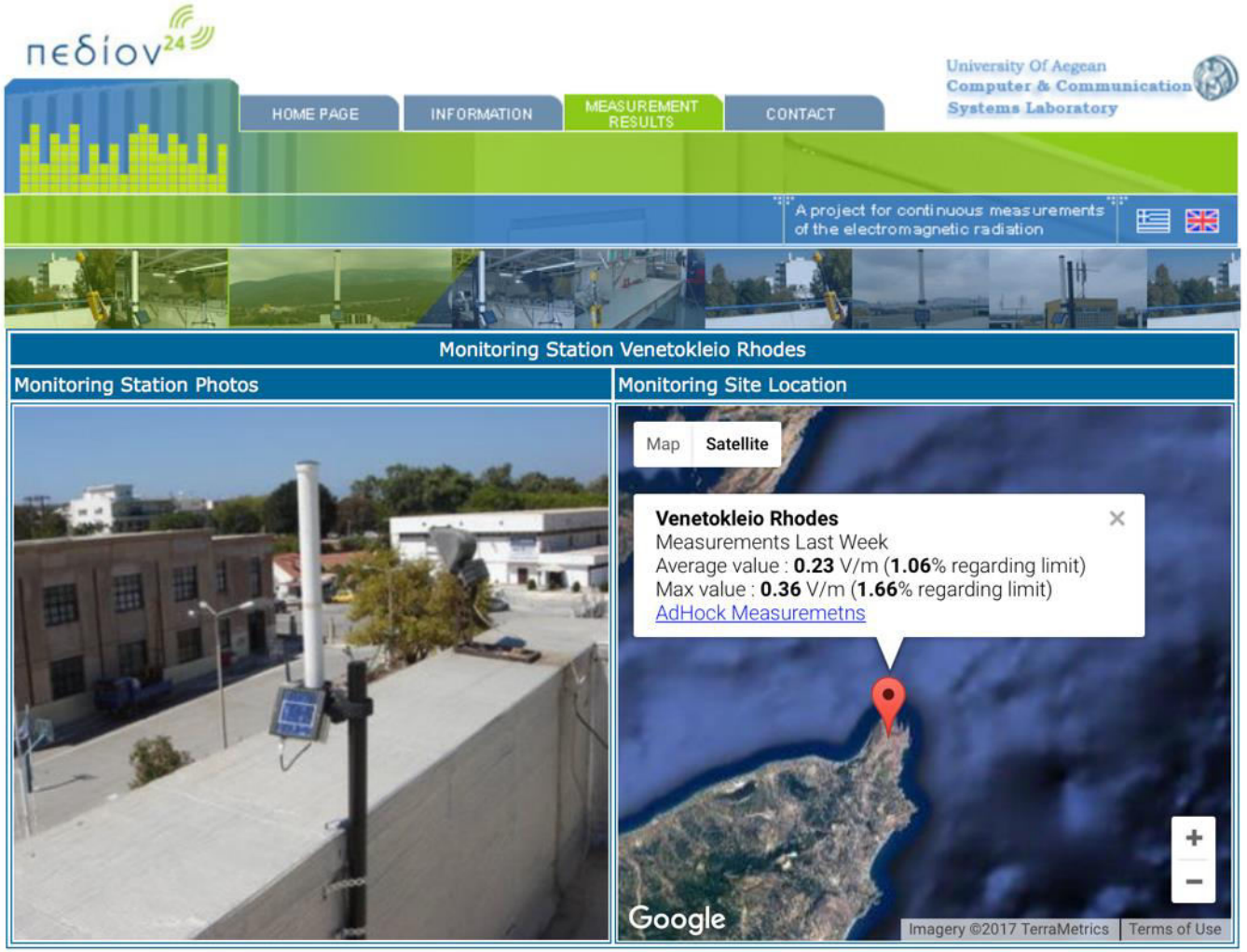
Site tour

- The stations of the municipality are accurately noted on the map
- Clicking on the map or the names of the stations to the right leads to the page of the specific site



Site tour

- Site information is given regarding
  - Photos
  - Location
  - Measurements of the last week
  - Ad-hoc measurements



Site tour

- Site information is given regarding
  - Address
  - Location
  - Activation date
  - Temperature
  - Last update

Site Data	
Address	Venetokleio Rhodes
Longtitude, Latitude / Altitude	28.220833, 36.435833 / 25 m
Activation date	04/09/2012
Temperature (last update*)	30 °C
Last Update	23/06/2017

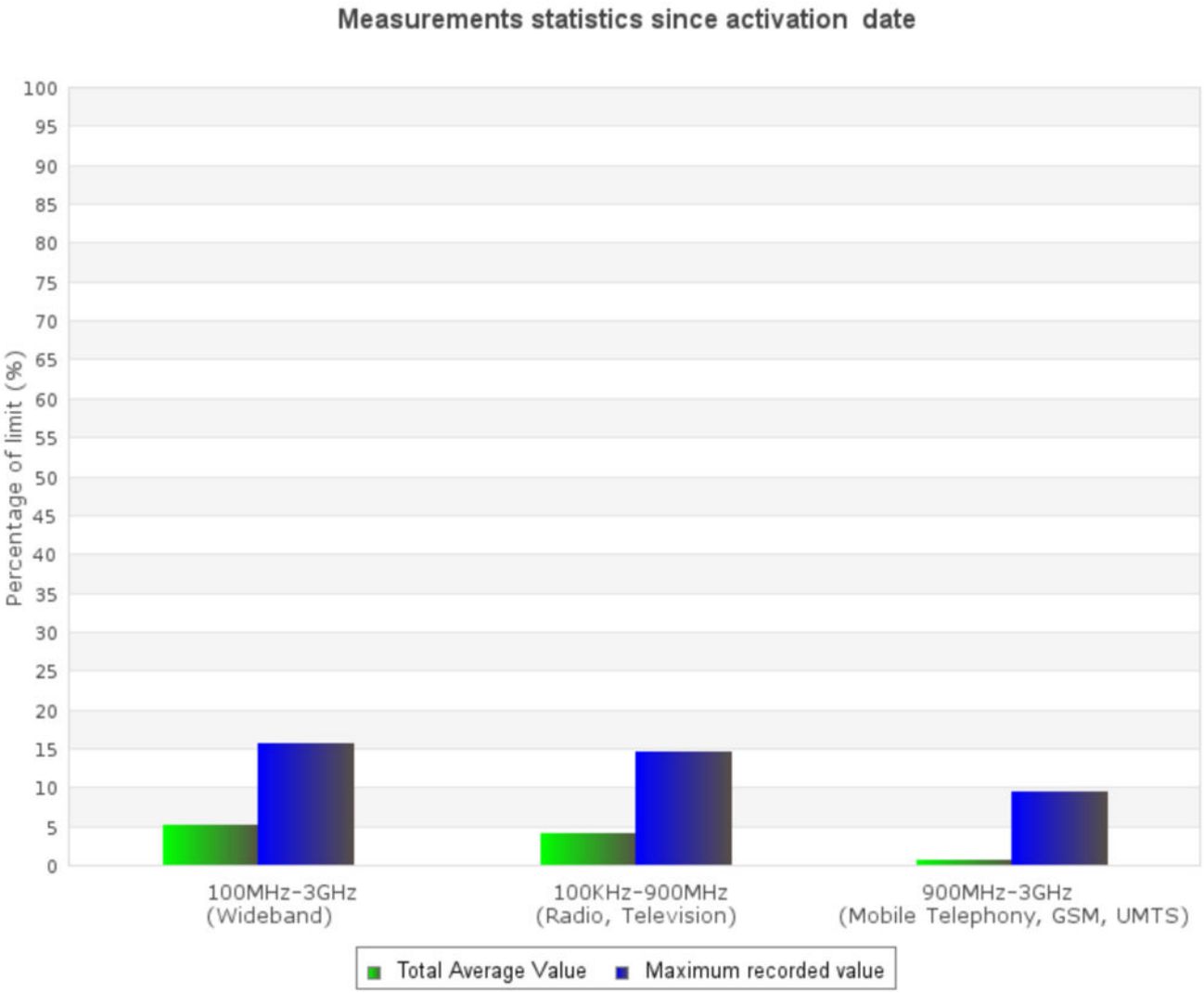
Site tour

- Measurements-specific information is provided through tables and graphs regarding:
  - The mean values as percentage of the safety limits
  - The maximum recorded values as percentage of the safety limits

Electric field strength values (six minute average values)					
Frequency Band	Minimum limit in band (V/m)	Mean Value (V/m)	Percentage of limit (Times below limit)	Maximum recorded value (V/m)	Percentage of limit (Times below limit)
100kHz - 3GHz	21.69	0.23	1.06% (94.3)	0.36	1.66% (60.25)
100kHz-900MHz (Radio,TV)	21.69	0.88	4.06% (24.65)	3.14	14.48% (6.91)
900MHz - 3GHz (Mobile Telephony)	31.95	0.2	0.63% (159.75)	3.02	9.45% (10.58)

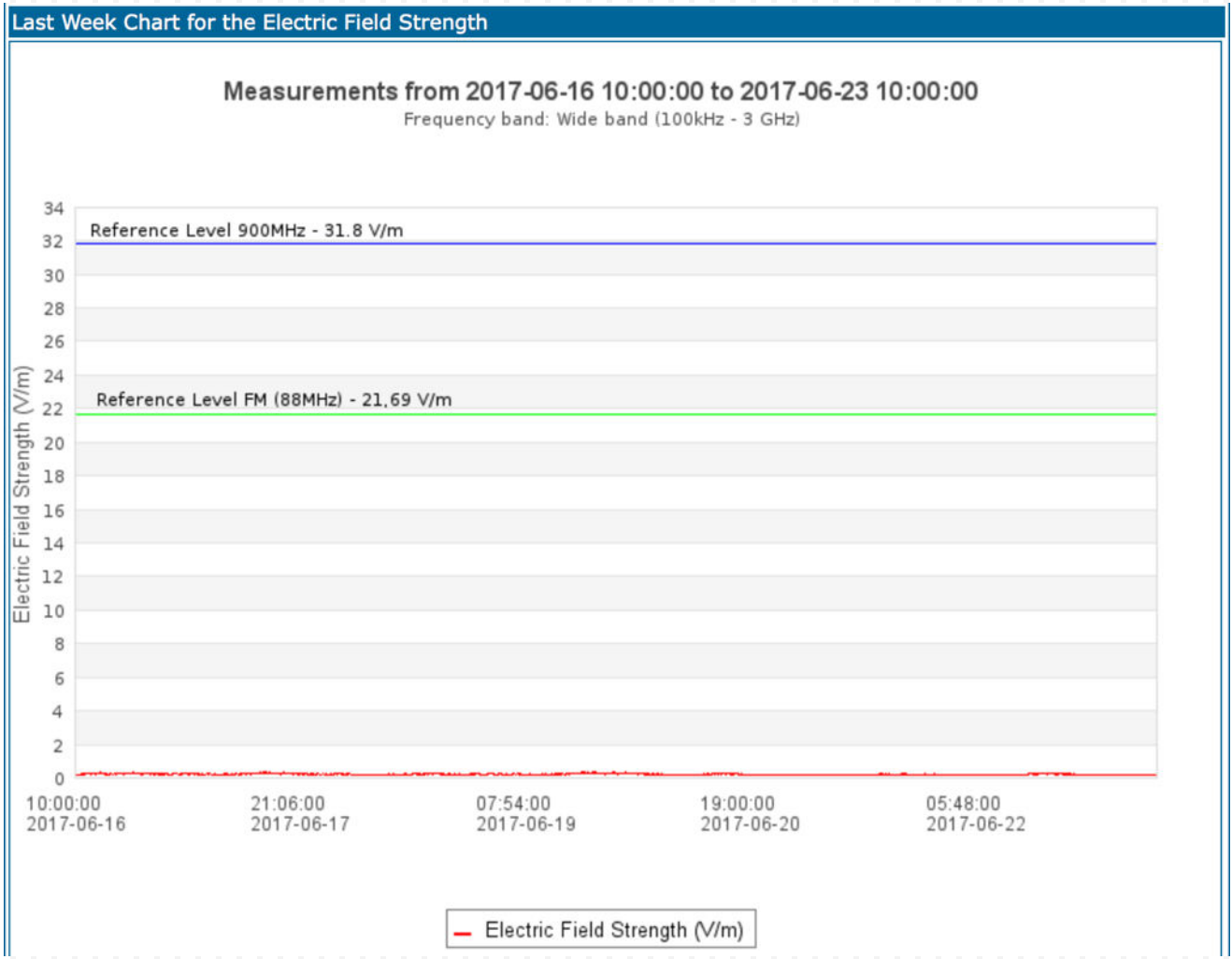
Site tour

- Measurements-specific information is provided through tables and graphs regarding:
  - The mean values as percentage of the safety limits
  - The maximum recorded values as percentage of the safety limits



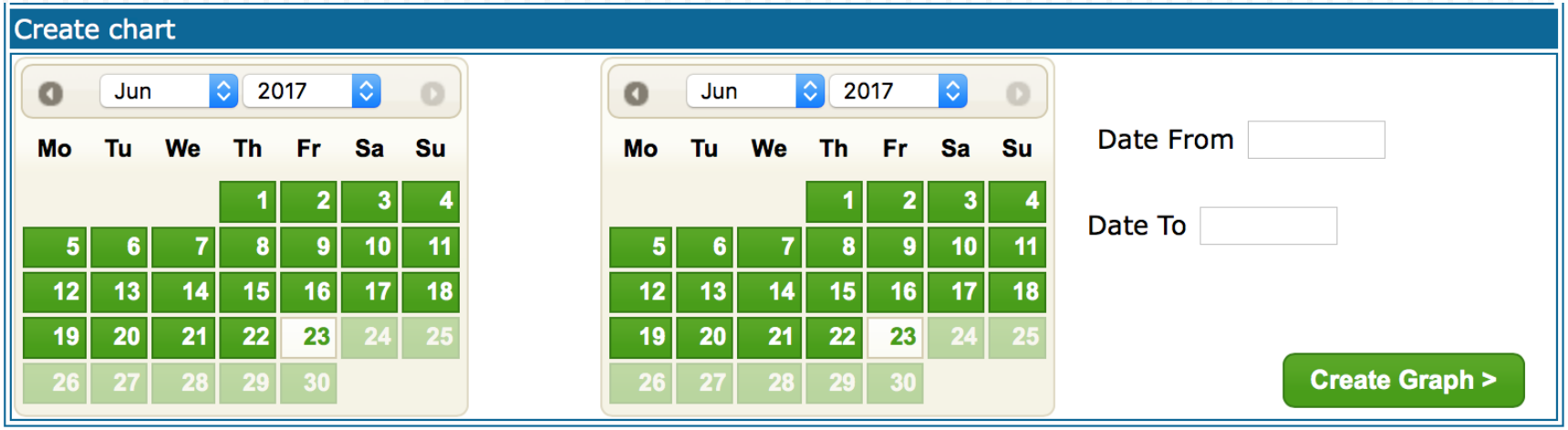
Site tour

- Measurements-specific information is provided through tables and graphs regarding:
  - The mean value up to the date of the last update
  - The maximum recorded value until the last update



Site tour

- Everyone can select the range for the depiction of the electric field strength diagram



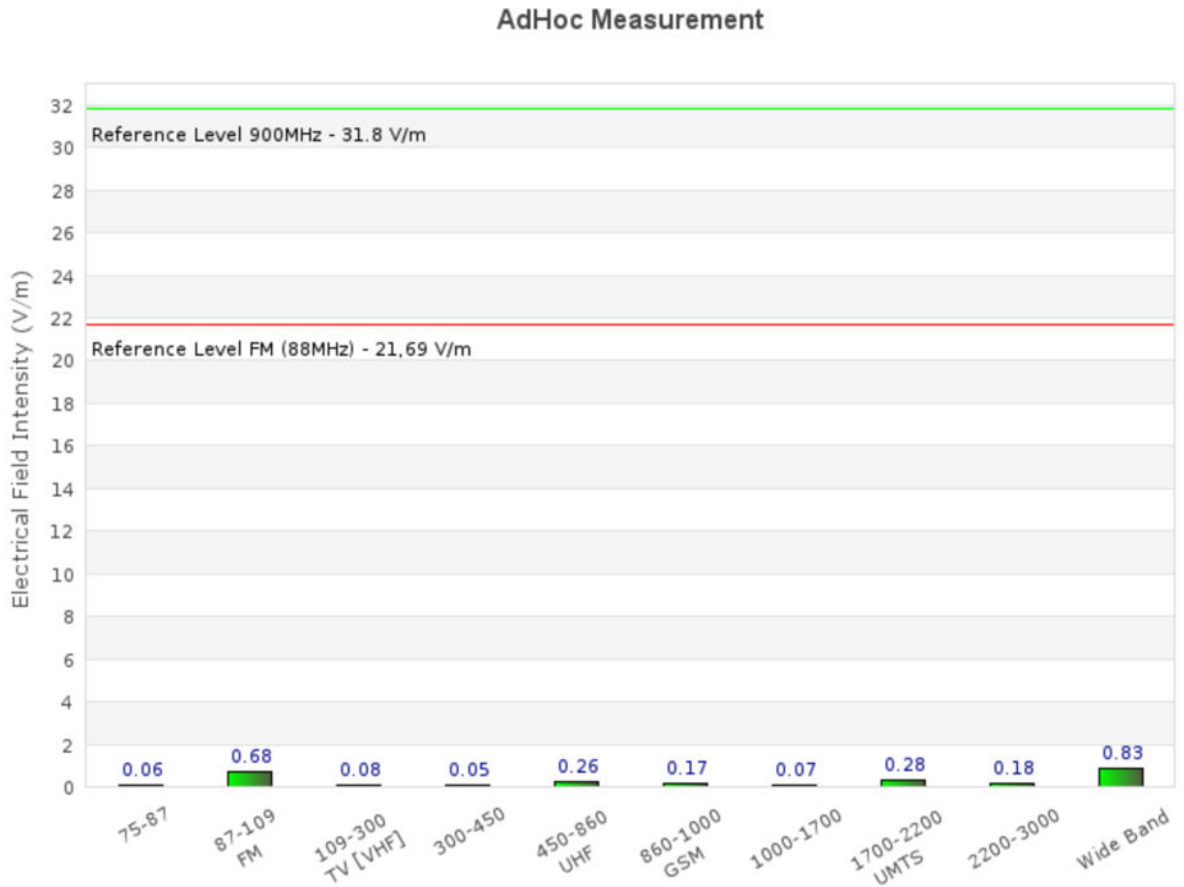
Site tour

- Ad-hoc measurements (frequency selective) are given for each station showing:
  - The recorded values as percentage of the safety limits of each bands
  - The times below the maximum allowed exposure level
  - The percentage that each band contributes to the total radiation level

Site tour

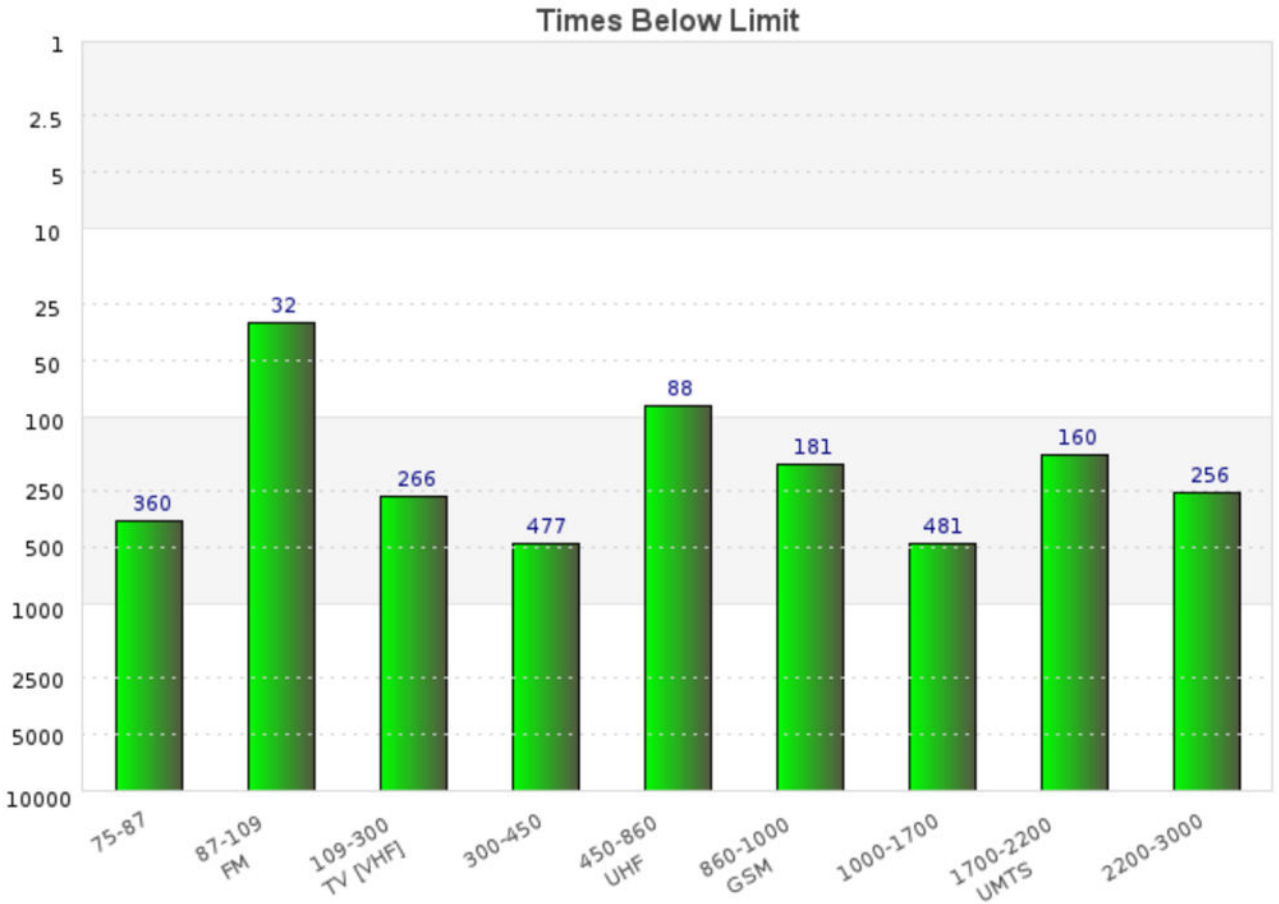
AdHoc measurements exist for this station >>>

Measuremet Data



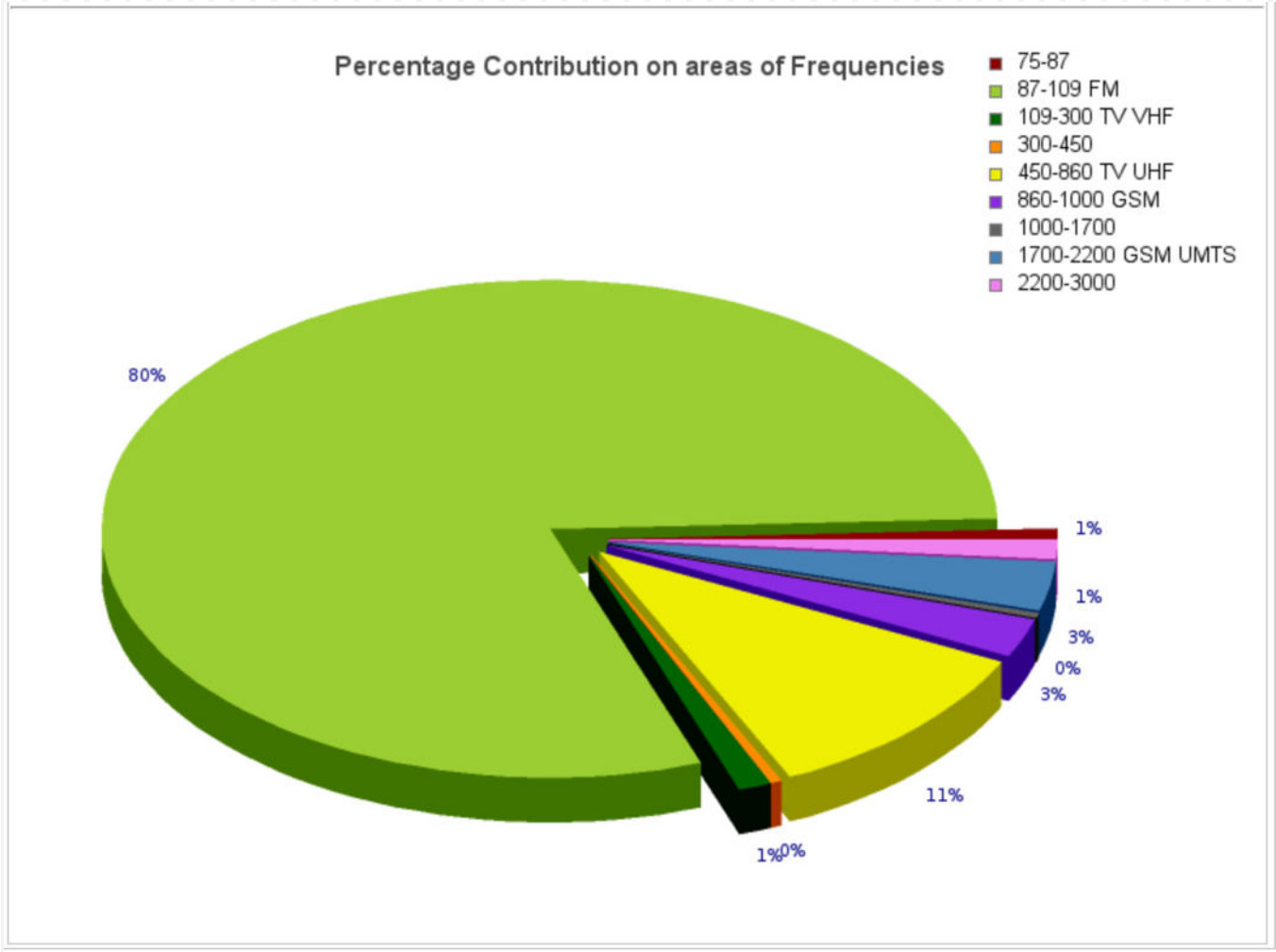
Site tour

AdHoc measurements exist for this station >>>



Site tour

AdHoc measurements exist for this station >>>



Statistics

- Start date: Feb. 2006
- Installed stations: 236 in 41 prefectures
- Total number of measurements: 68,249,392
- Total Ad-Hoc measurements: >300
- Management Center of the Webpage: NTUA

(June 2017)

Statistics

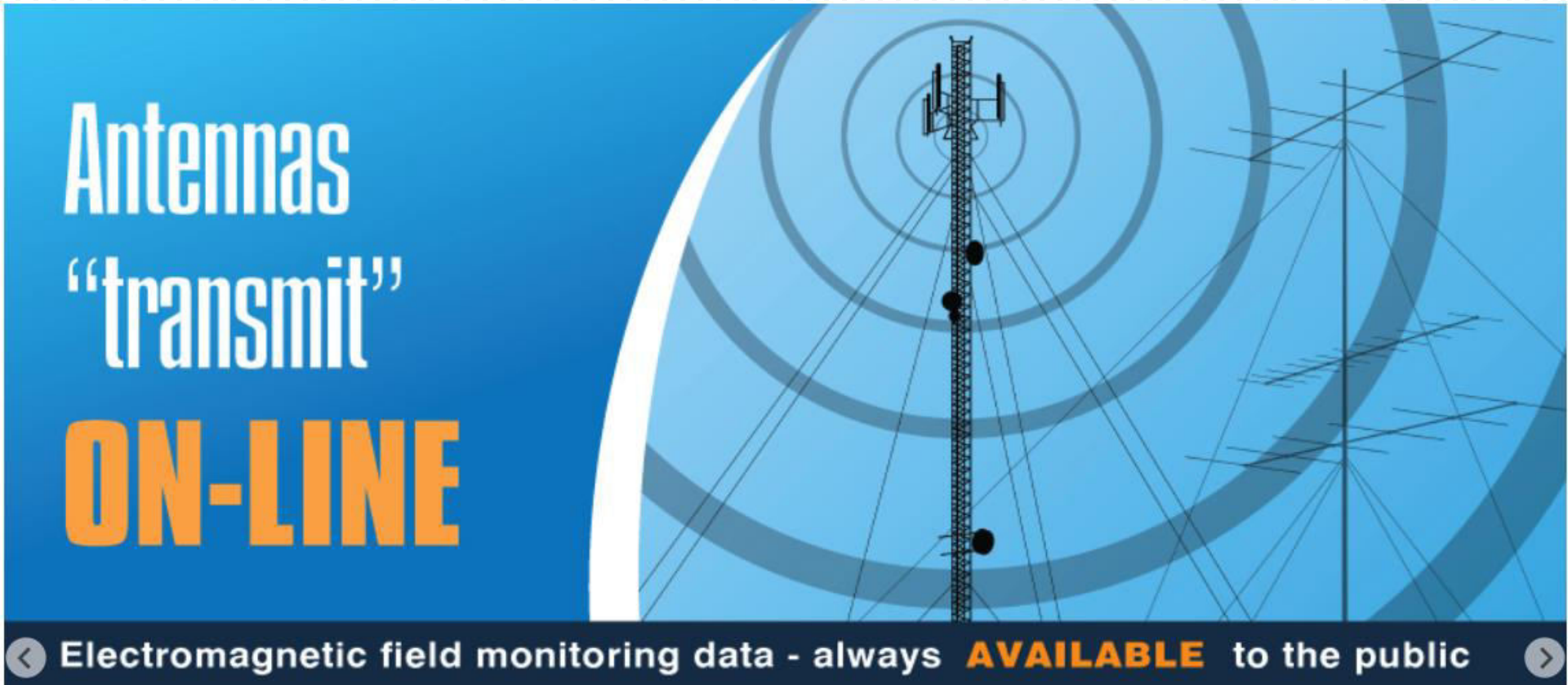
Web page statistics

- Yearly:
  - 2.7K users
  - 6.1K sessions
  - 2m38s session duration
- Monthly:
  - 162 users
  - 325 sessions
  - 1m14s session duration
- Daily:
  - 7 users
  - 10 sessions
  - 1m10s session duration
- New visitors: 61%
- Returning visitors: 39%
- Visitors from Greece: 50%

(June 2017)

https://paratiritirioemf.eeae.gr

National Observatory of EMF



Purpose and benefits

- The purpose of the National Observatory of Electromagnetic Fields is the continuous monitoring of compliance with statutory safety limits public exposure to electromagnetic fields, such as those defined in the applicable legislation, to continuously inform citizens.
- The Observatory's operation contributes to:
  - supporting the mechanism for continuous control and limitation of electromagnetic radiation of a region to the statutory limits of exposure of the public
  - constantly informing citizens about their exposure to electromagnetic radiation
  - the proper functionality of various sources of electromagnetic radiation, benefiting both public health and their efficient operation.
- Benefits also arise for the telecommunication providers, as they can now automatically collect data on electromagnetic radiation required for the installation and licensing of their antenna systems.

NATIONAL OBSERVATORY OF ELECTROMAGNETIC FIELDS

Implementation

- The following organizations worked for the implementation of the project:
  - General Secretariat of Telecommunications and Posts of the Ministry of Infrastructure Transport and Networks (project owner)
  - Greek Atomic Energy Commission (Operator)
  - Information Society SA (contracting authority)

- The project was assigned to Space Hellas SA after an open international procurement → 4,646,377.89 €
  - Start date: Apr. 2014 – End date: Nov. 2015 + 3-year maintenance/support
  - 3 Universities as subcontractors
    - AEGEAN
    - NTUA
    - AUTH

NATIONAL OBSERVATORY OF ELECTROMAGNETIC FIELDS

Main differences between Pedion24

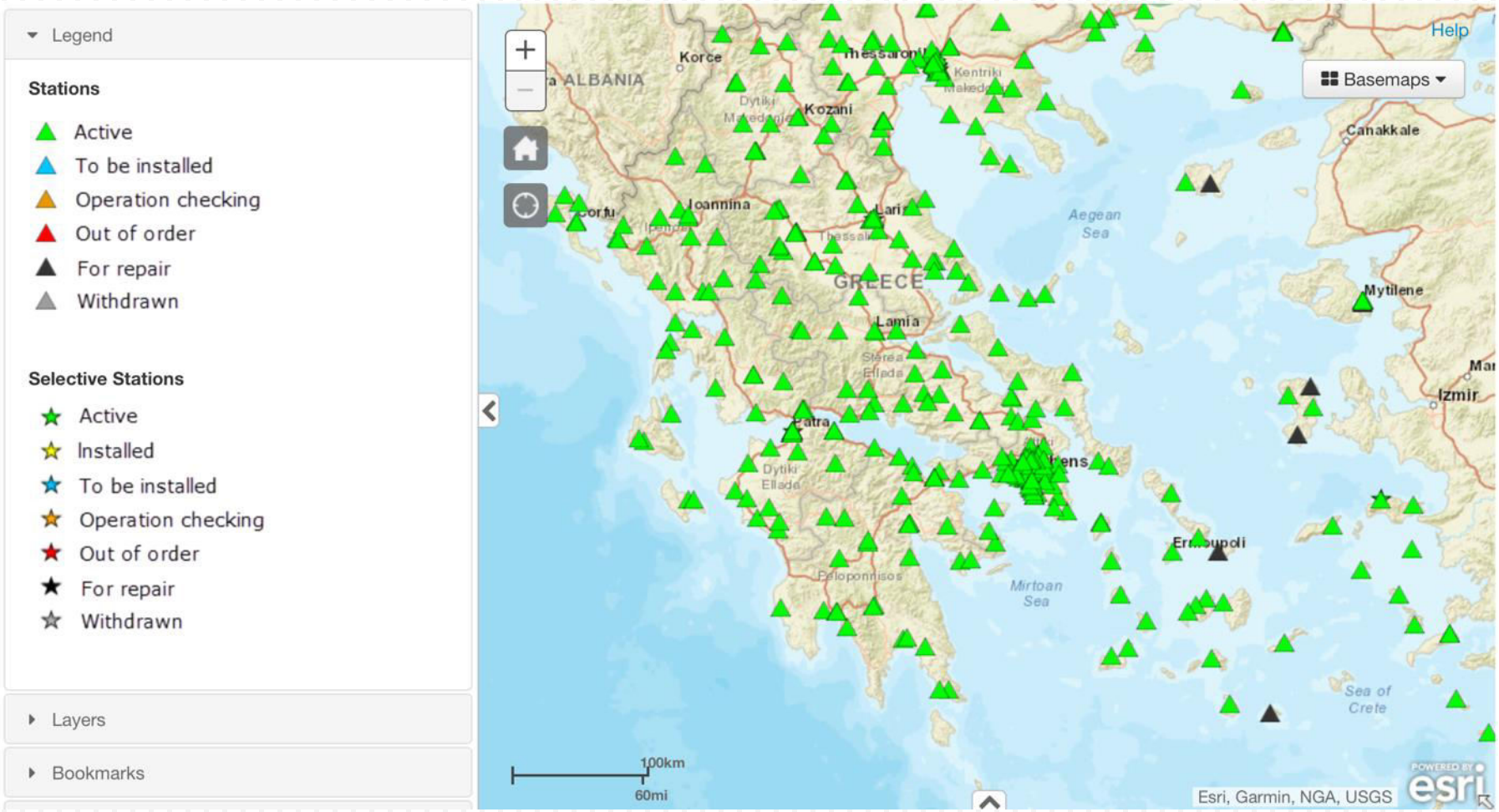
- EMF measurement stations
  - 500 static EMF stations all over Greece
    - 480 wideband (Narda AMB-8059-03/G)
      - Quad-band probes
        - Wide Band: 100 kHz – 7 GHz
        - EGSM 900: 925 MHz – 960 MHz
        - EGSM 1800: 1805 MHz – 1880 MHz
        - UMTS: 2110 MHz – 2170 MHz
    - 20 narrowband (Narda AMS-8061/G)
      - 100 kHz – 6 GHz
      - Spectrum analyzer
      - 20 frequency bands
  - 13 mobile narrowband stations on vehicle tracks
  - Ethernet
  - GPS

Main differences between Pedion24

- Communication between the EMF stations and the storage center:
  - GPRS-FTP
    - Scheduled modem activation
    - Access to FTP Server via mobile network
    - Using a packet switched network (GPRS)
    - Send data & control settings change requests
    - There is no need for a direct connection
    - The central network server does not need a modem
    - Small telecommunication costs
- Installation only on public buildings

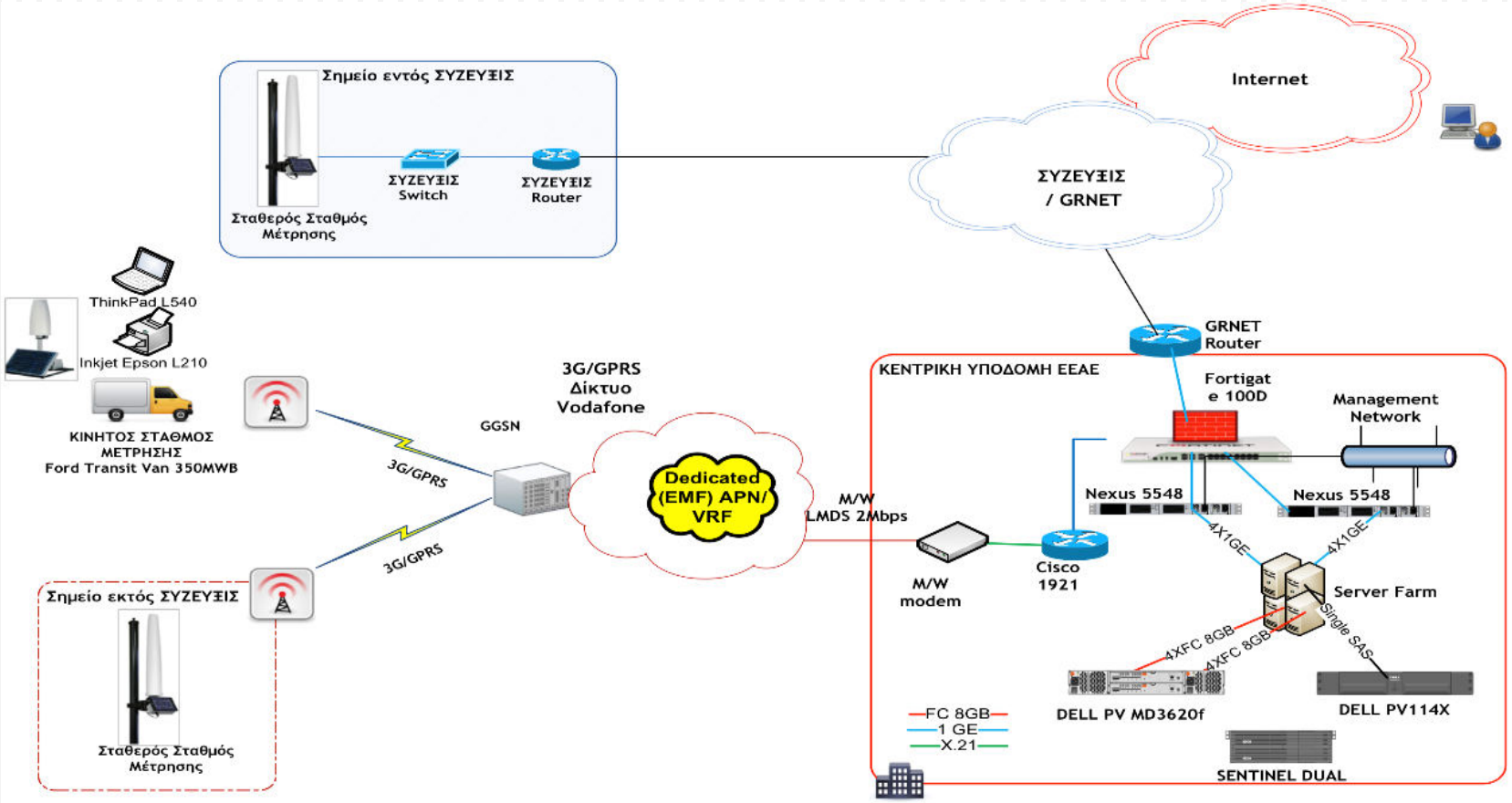
Main differences between Pedion24

- Use of an extended GIS platform



Main differences between Pedion24

- Architecture of the network

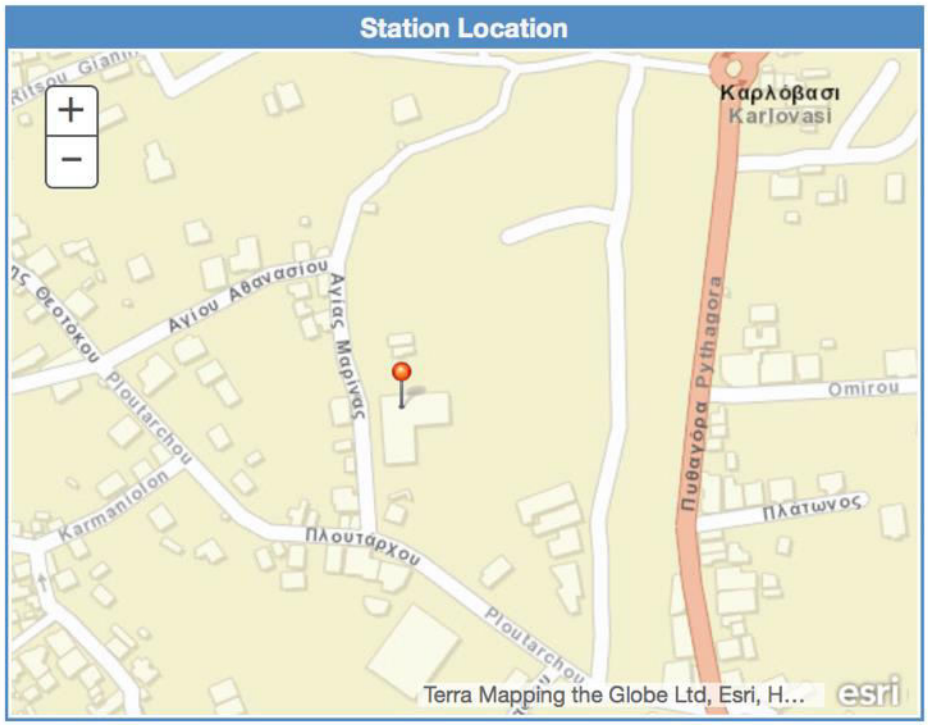


Main differences between Pedion24

- Webpage and services
  - Measurement Depiction Service (historical measurement, comparative and on-site measurements)
  - Radiation, Complaint and Request Submission Service
  - Instant - Periodic Update Service

Main differences between Pedion24

- Measurements and appearance



Main differences between Pedion24

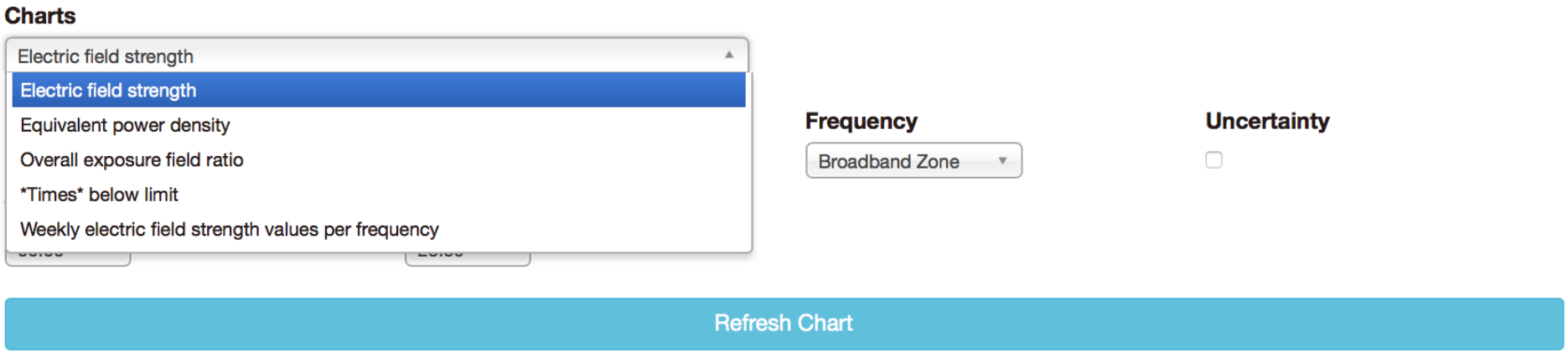
- Measurements and appearance

Station Information	
Serial No.	**000WX41221**
Type	**Broadband**
Station Status	**Active**
Temperature	**31°C**
Humidity	**43%**
Longitude and Latitude	**26.698917, 37.794189**
Address	**Agias Marinas**
Municipality	**Samou**
Prefecture	**Samou**
Active since	**30-01-2015 16:00:00**
Last update	**26-06-2017 10:00:00**
Measurement files captured by handheld device	**Click here**

Electric Field Strength			
Frequency Bands (MHz)	**Frequency Band Limit (V/m)***	**Average Value (V/m)**	**Peak Value (V/m)**
Broadband Zone	21.7	0.31	0.42
EGSM-900	31.8	0.08	0.10
EGSM-1800	45.1	0.09	0.12
UMTS	47.2	0.10	0.13

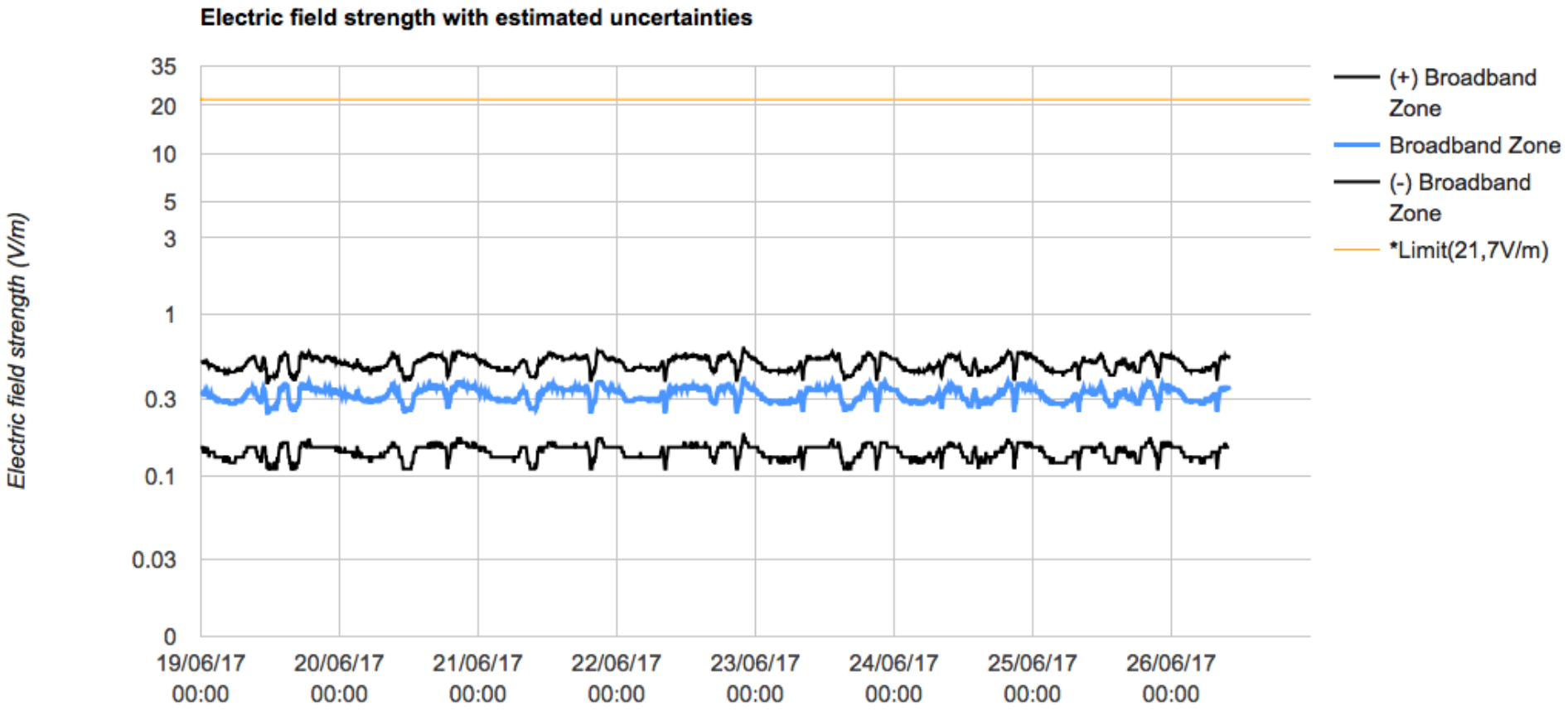
Main differences between Pedion24

- Measurements and appearance



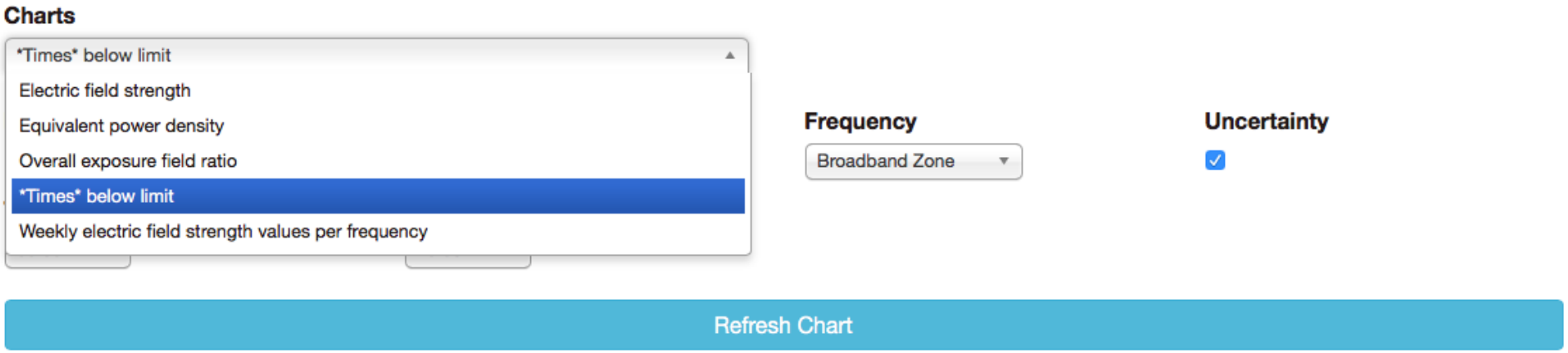
Main differences between Pedion24

- Measurements and appearance



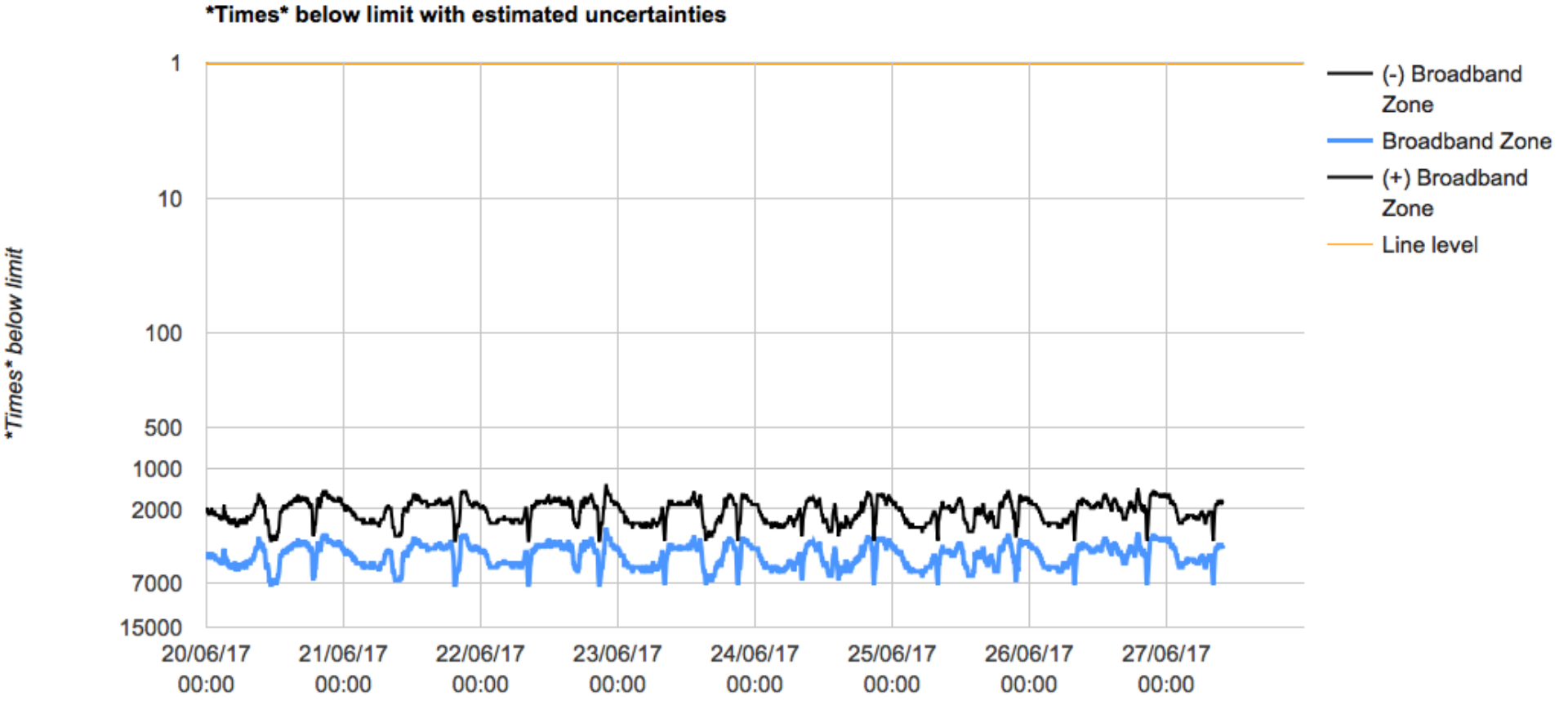
Main differences between Pedion24

- Measurements and appearance



Main differences between Pedion24

- Measurements and appearance



Conclusions

- Continuous recording of electromagnetic radiation gives immediate answers to the following questions:
  - Can we always know the field strengths of the EM field?
  - What are the sources contributing to the EM field?
  - Do mobile operators violate the Greek law by installing their antennas in the cities?
  - Are the emissions of their antennas higher than the statutory limits of the Greek state?
  - Can a reliable and commonly accepted operator guarantee the accuracy of the measurements safely?

Conclusions

- Pedion24 and National Observatory of Electromagnetic Fields provides access to data on non-ionizing radiation in various levels of Greece
- 24/7 monitoring is performed through certified measurement stations
- The levels of non-ionizing radiation are compared to the exposure limit values
- The public is informed via accredited and independent academic institutions (NTUA, AUTH, AEGEAN, UNIPI)
- The Pedion24 platform can be extended to
  - include more advanced probes aiming to:
    - provide continuous narrow-band measurements
    - acquire spectrum occupancy data that can be used by interested mobile providers
  - change the communication between the EMF stations and the storage center

Thank you!

- Contact details:
  - Prof. Demosthenes Vouyioukas
    - dvouyiou@aegean.gr
    - Office.: +30 22730 82270
    - Mob: +30 694 5491615
    - Fax: +30 22730 82009
    - **http://www.icsd.aegean.gr/ccsl**