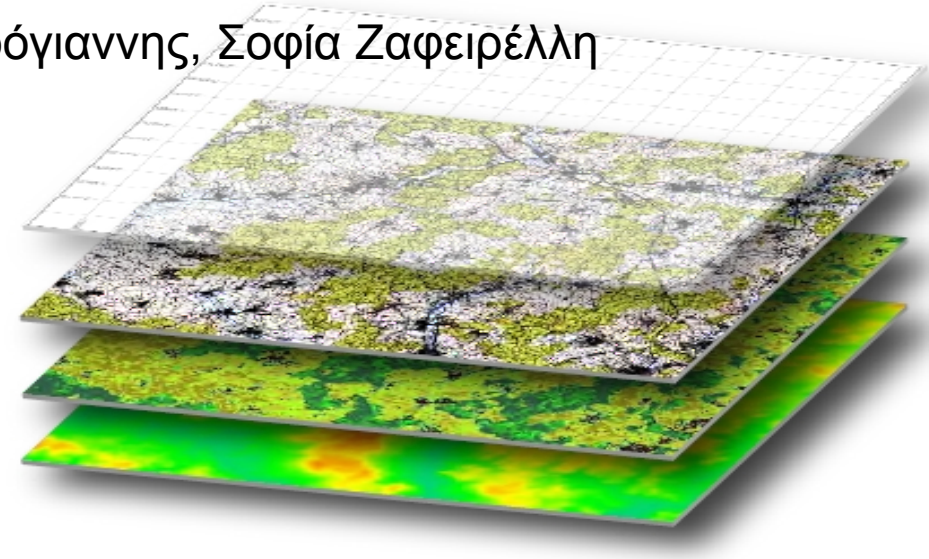
Έξυπνες συσκευές για δημόσια κτίρια:
Από τα δεδομένα, στη γνώση

Δημήτρης Καβρουδάκης
Μον. Επίκουρος Καθηγητής Γεωγραφικής Ανάλυσης
Πανεπιστήμιο Αιγαίου, Τμήμα Γεωγραφίας

Μάριος Μπάτσαρης, Παναγιώτης Αγουρόγιαννης, Σοφία Ζαφειρέλλη

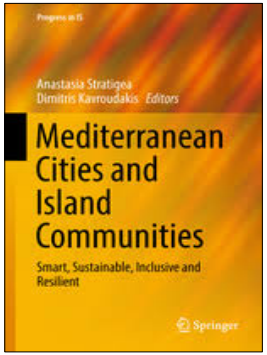


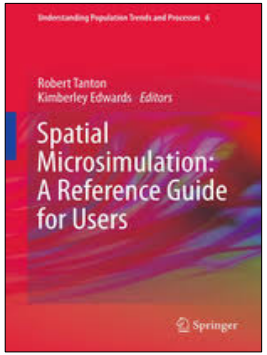
Πανεπιστήμιο Αιγαίου
Τμήμα Γεωγραφίας

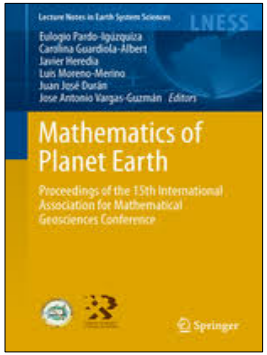
SAGISRS
ΧΑ-ΣΓΠ-ΤΗ
Spatial Analysis, Geographical Information Systems and Remote Sensing
Ερευνητική ομάδα Χωρικής Ανάλυσης, Συστημάτων Γεωγραφικών Πληροφοριών και Τηλεπισκόπησης

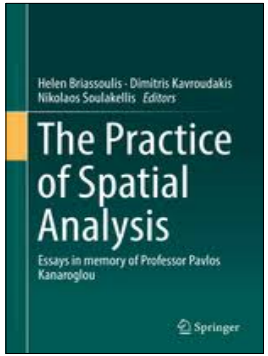
Recent Books

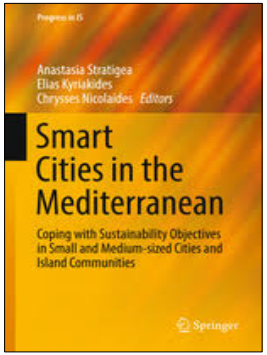
- dimitrisk@aegean.gr www.dimitrisk.gr

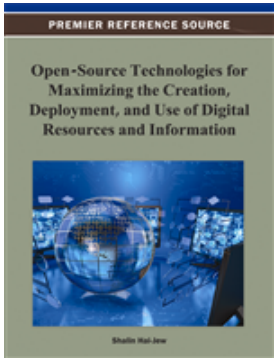


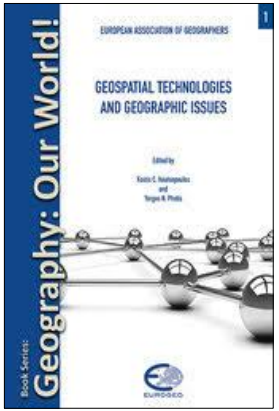




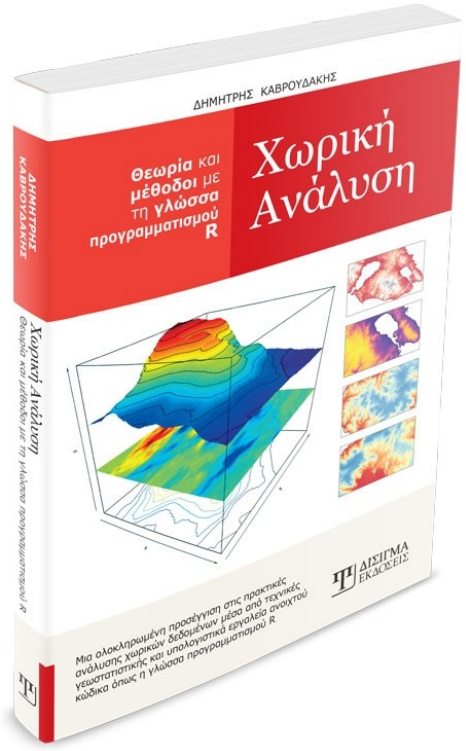


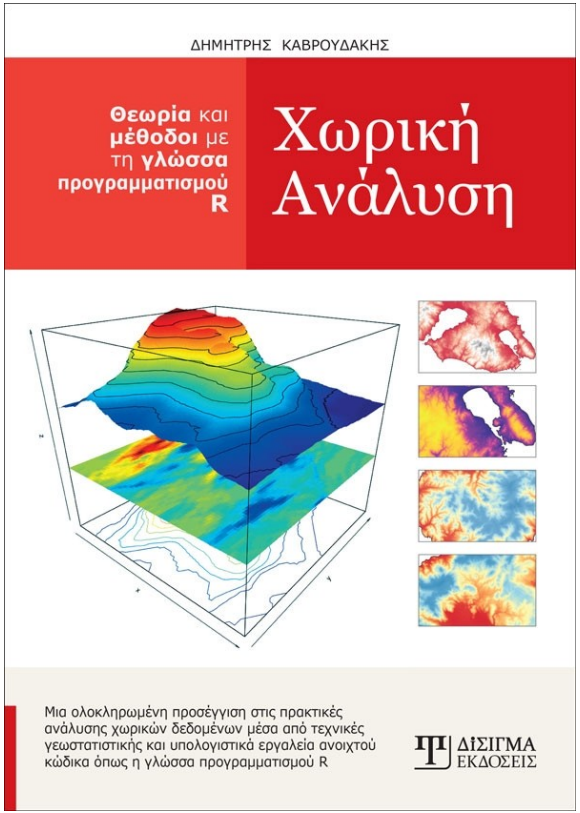






Δημήτρης Καβρουδάκης (2020) **Χωρική Ανάλυση**
Εκδόσεις ΔΙΣΙΓΜΑ, ISBN13: *978-618-202-021-0*





- Τμήμα Γεωγραφίας: http://geography.aegean.gr

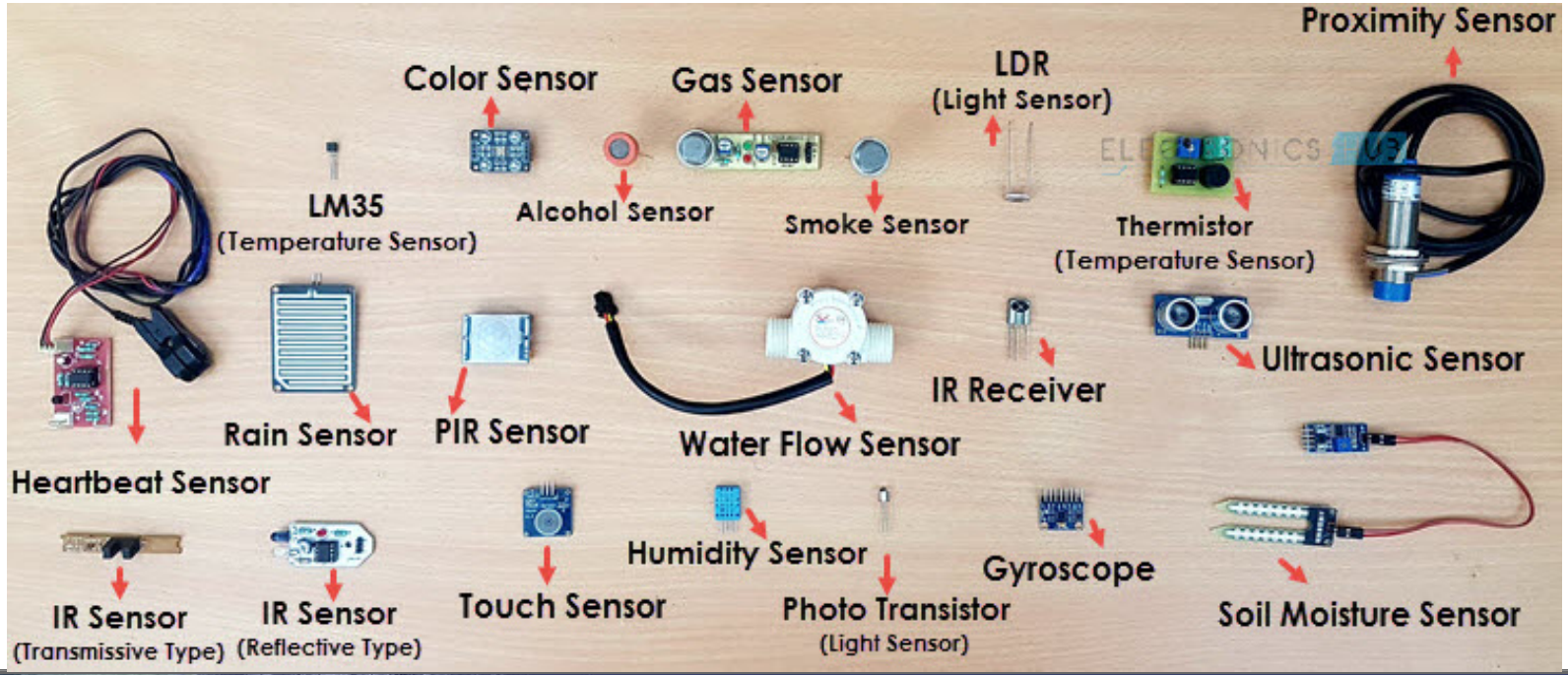
- Project funding: “Greek Green Fund”
- Research Group: SAGISRS
  - **S**patial **A**nalysis - **GIS** - **R**emote **S**ensing
- Title:
  - Smart Devices of Environmental Monitoring for Public Buildings “SDEM”
- Duration: 24 months, Budget: 32000€
- Aim
  - Development, installation and use of smart devices for two public buildings for environmental parameters monitoring
- Objectives
  - Development of Open Hardware devices
  - Validation of sensor measurements
  - Development of a Big-Data server for storage and analysis
  - Transformation of data to knowledge for decision making

ΠΡΑΣΙΝΟ ΤΑΜΕΙΟ

Benefits

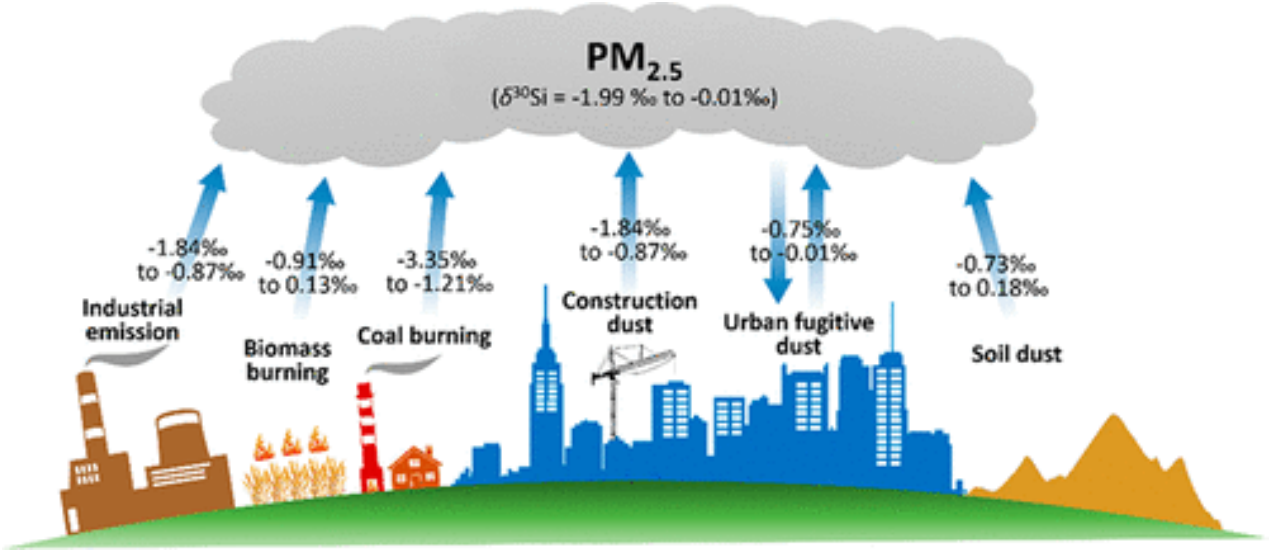
- Monitoring of building's environmental characteristics
- Knowledge discovery for spatio-temporal changes of environmental characteristics
- Cost savings
  - Heating, lighting, ventilation
- Air quality
  - better working environment
- It's an affordable alternative to environmental monitoring stations
  - that can cost tens of thousands of pounds
- it's small and hackable
  - and lets you contribute vour data to citizen science efforts to monitor air quality

- Temperature, Humidity, Pressure
- Light and proximity sensor
- Analog gas sensor
- particulate matter (PM) sensor
  - measure air quality (pollutant gases and particulates)



Particulate matter (PM)

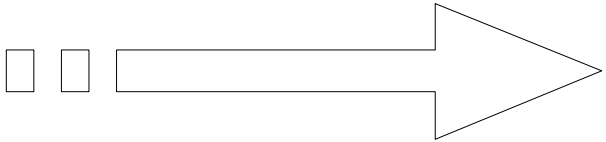
- Particulate matter (PM) is made up of tiny particles that are a mix of sizes and types,
  - like dust, pollen, mould spores, smoke particles, organic particles and metal ions, and more.
- Particulates are much of what we think of as air pollution.
- They can be measured, in size and quantity, by particulate matter sensors
  - like the PMS5003

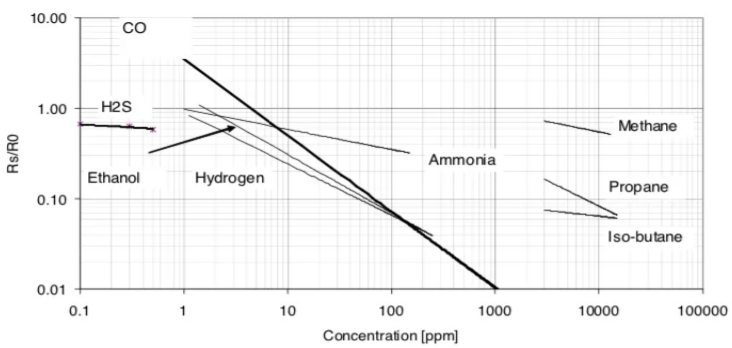


- Analog gas sensor: measurements of changes in gas concentrations
  - broad estimation if the three groups of gases are increasing or decreasing in abundance.
- Without laboratory conditions or calibration
  - you won't be able to say "the concentration of carbon monoxide is ***n*** parts per million", for example.

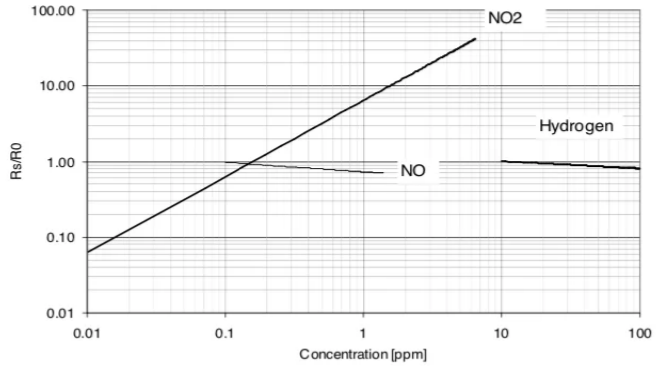
- analog gas sensor detect 3 groups of gases
  - reducing, oxidising, and NH3
- The major gases/vapours that the sensor detects are:
  - carbon monoxide (reducing), nitrogen dioxide (oxidising), and ammonia (NH3)
    - it is also sensitive to others, including: hydrogen, ethanol, and hydrocarbons.
- Each of the 3 groups of gases is effectively its own sensor within the MICS68141
- the analog voltage readings is converted into resistance
  - These resistances range: low hundreds of Ohms - tens of thousands of Ohms
  - and vary depending on the levels of each group of gases
- Because each group of gases could be a mix of different gases
  - it's not possible to single out any one gas specifically or to quantify their levels precisely
- the best way to interpret the data is to take readings until they stabilise, set a baseline, and then look for changes relative to that baseline
  - This gives you a rough idea of whether the air quality is increasing or decreasing.

- Reducing and NH3 resistance readings will drop
  - with increasing concentrations of gases they detect
- The oxidising sensor will increase
  - with increasing levels of nitrogen dioxide
- how the sensor reacts to the different gases?

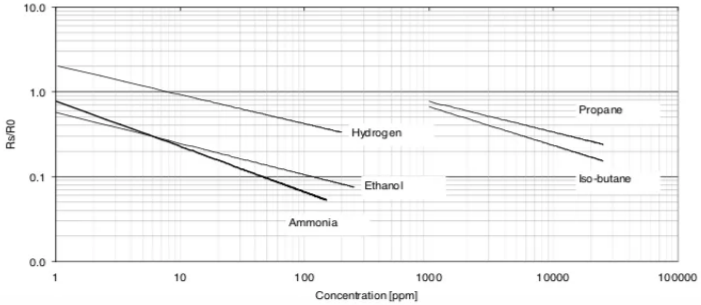




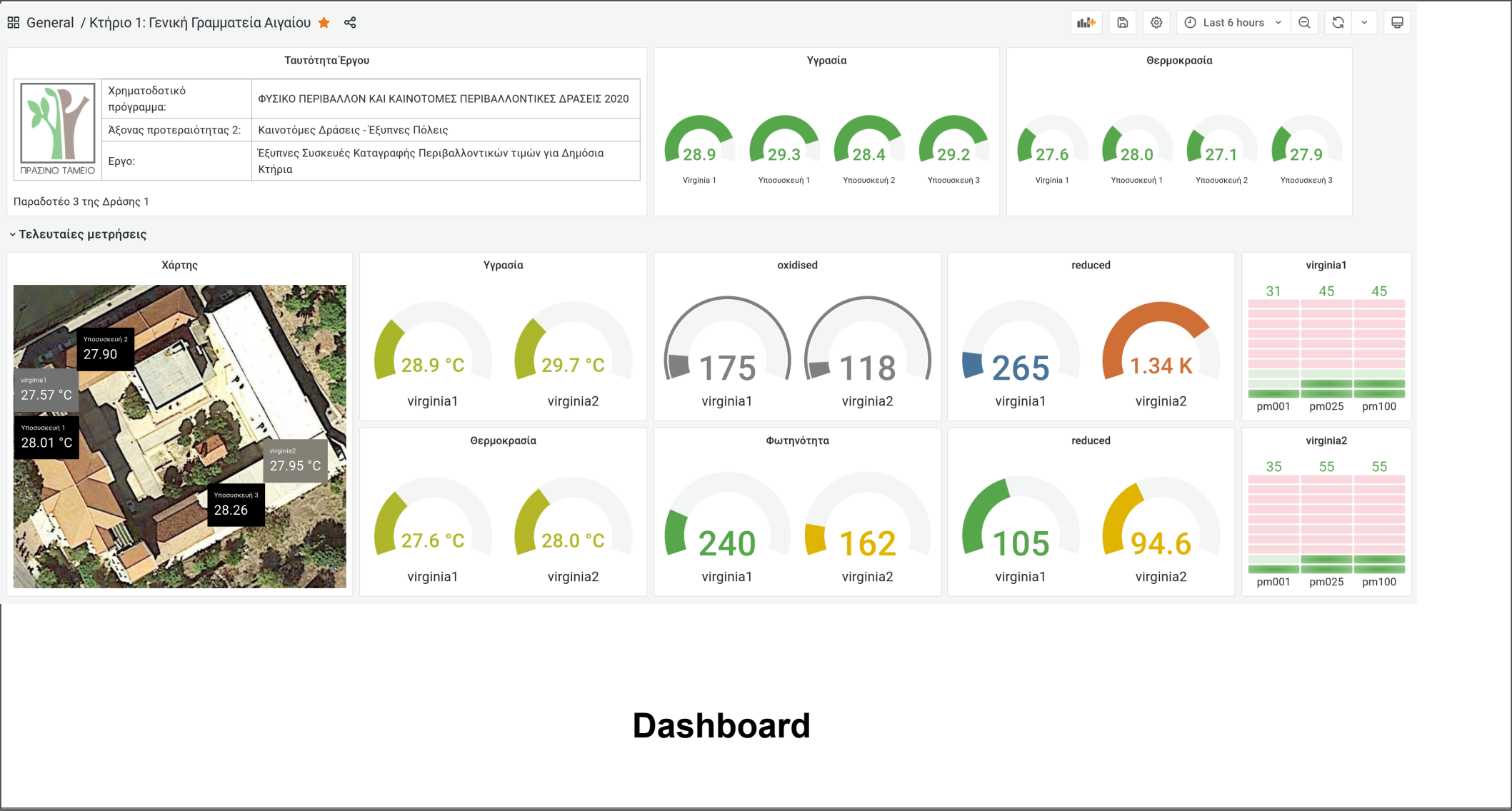
RED sensor, continuous power ON, 25°C, 50% RH



OX sensor, continuous power ON, 25°C, 50% RH



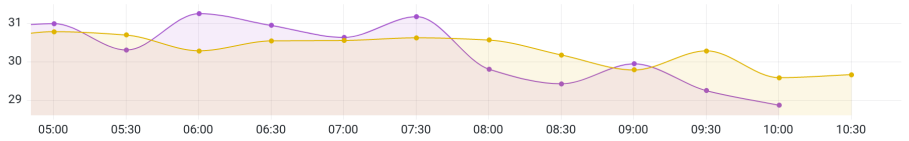
NH3 sensor, continuous power ON, 25°C, 50% RH


General / Κτήριο 1: Γενική Γραμματεία Αιγαίου
Last 6 hours
Ταυτότητα Έργου
ΠΡΑΣΙΝΟ ΤΑΜΕΙΟ
Χρηματοδοτικό πρόγραμμα:
ΦΥΣΙΚΟ ΠΕΡΙΒΑΛΛΟΝ ΚΑΙ ΚΑΙΝΟΤΟΜΕΣ ΠΕΡΙΒΑΛΛΟΝΤΙΚΕΣ ΔΡΑΣΕΙΣ 2020
Άξονας προτεραιότητας 2:
Καινοτόμες Δράσεις - Έξυπνες Πόλεις
Εργο:
Έξυπνες Συσκευές Καταγραφής Περιβαλλοντικών τιμών για Δημόσια Κτήρια
Παραδοτέο 3 της Δράσης 1
Υγρασία
28.9
Virginia 1
29.3
Υποσυσκευή 1
28.4
Υποσυσκευή 2
29.2
Υποσυσκευή 3
Θερμοκρασία
27.6
Virginia 1
28.0
Υποσυσκευή 1
27.1
Υποσυσκευή 2
27.9
Υποσυσκευή 3
Τελευταίες μετρήσεις
Χάρτης
Υποσυσκευή 2
27.90
virginia1
27.57 °C
Υποσυσκευή 1
28.01 °C
virginia2
27.95 °C
Υποσυσκευή 3
28.26
Υγρασία
28.9 °C
virginia1
29.7 °C
virginia2
oxidised
175
virginia1
118
virginia2
reduced
265
virginia1
1.34 K
virginia2
virginia1
31
45
45
pm001
pm025
pm100
Θερμοκρασία
27.6 °C
virginia1
28.0 °C
virginia2
Φωτηνότητα
240
virginia1
162
virginia2
reduced
105
virginia1
94.6
virginia2
virginia2
35
55
55
pm001
pm025
pm100

Dashboard

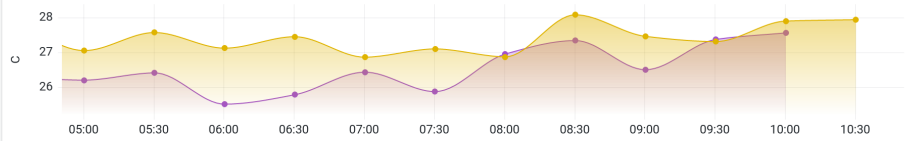
Βασικές ενδείξεις

Υγρασία



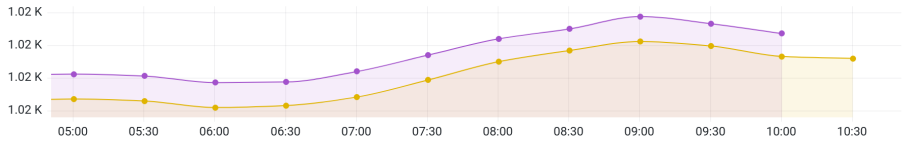
	Last *	Min	Max	Mean
virginia1	28.9	8.38	33.0	23.6
virginia2	29.7	14.1	32.1	23.3

Θερμοκρασία



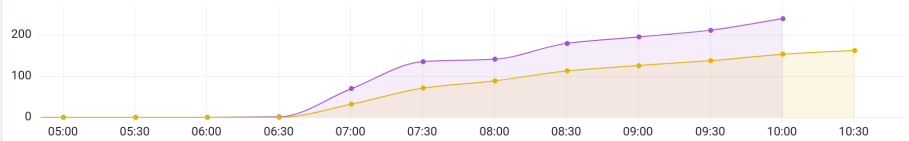
	Last *	Min	Max	Mean
virginia1	27.6	22.0	43.1	29.1
virginia2	28.0	23.0	32.5	28.2

Βαρομετρική Πίεση



	Last *	Min	Max	Mean
virginia1	1.02 K	1.00 K	1.02 K	1.01 K
virginia2	1.02 K	1.01 K	1.02 K	1.02 K

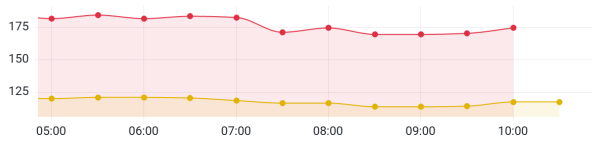
Φωτηνότητα



	Last *	Min	Max	Mean
virginia1	240	0	1.23 K	51.6
virginia2	162	0	543	42.6

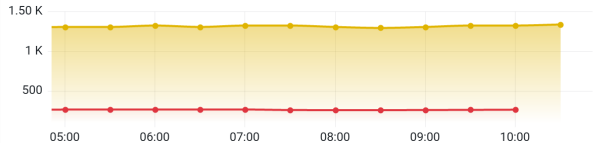
Ποιότητα αέρα

oxidised



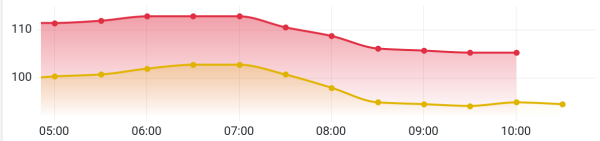
	Last *	Min	Max	Mean
virginia1	175	11.5	1.57 K	285
virginia2	118	15.5	433	146

reduced



	Last *	Min	Max	Mean
virginia1	265	66.9	875	497
virginia2	1.34 K	208	1.75 K	966

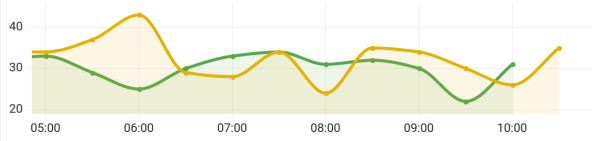
NH3



	Last *	Min	Max	Mean
virginia1	105	1.68	246	121
virginia2	94.6	6.35	125	54.3

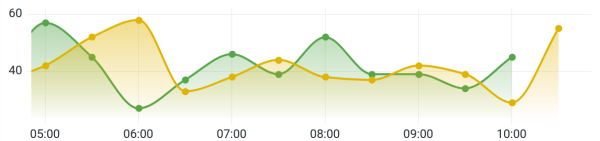
PM

pm001



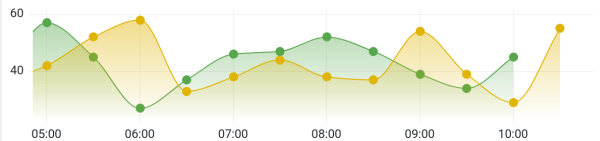
	Last *	Min	Max	Mean
virginia1	31	0	249	14.2
virginia2	35	0	405	18.0

pm025

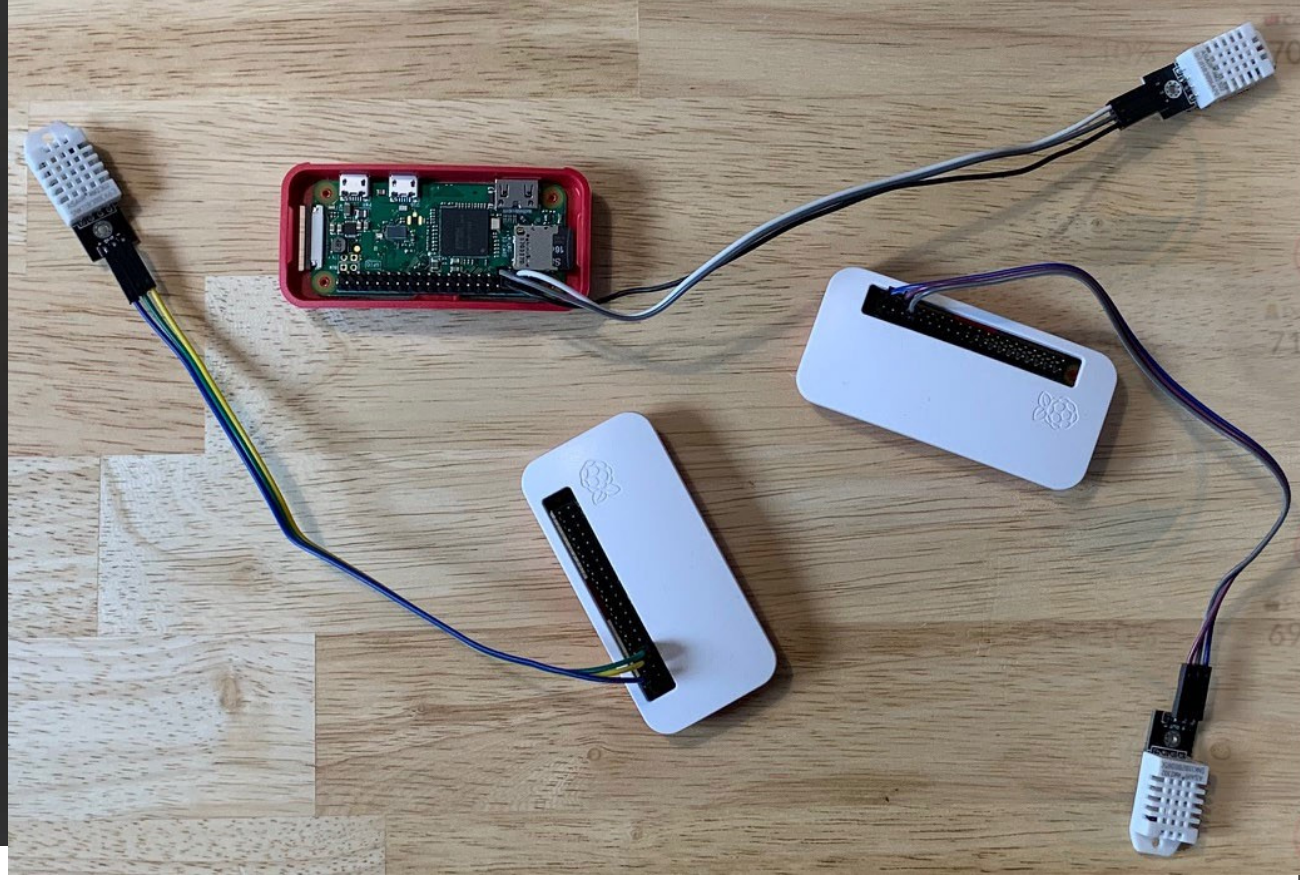


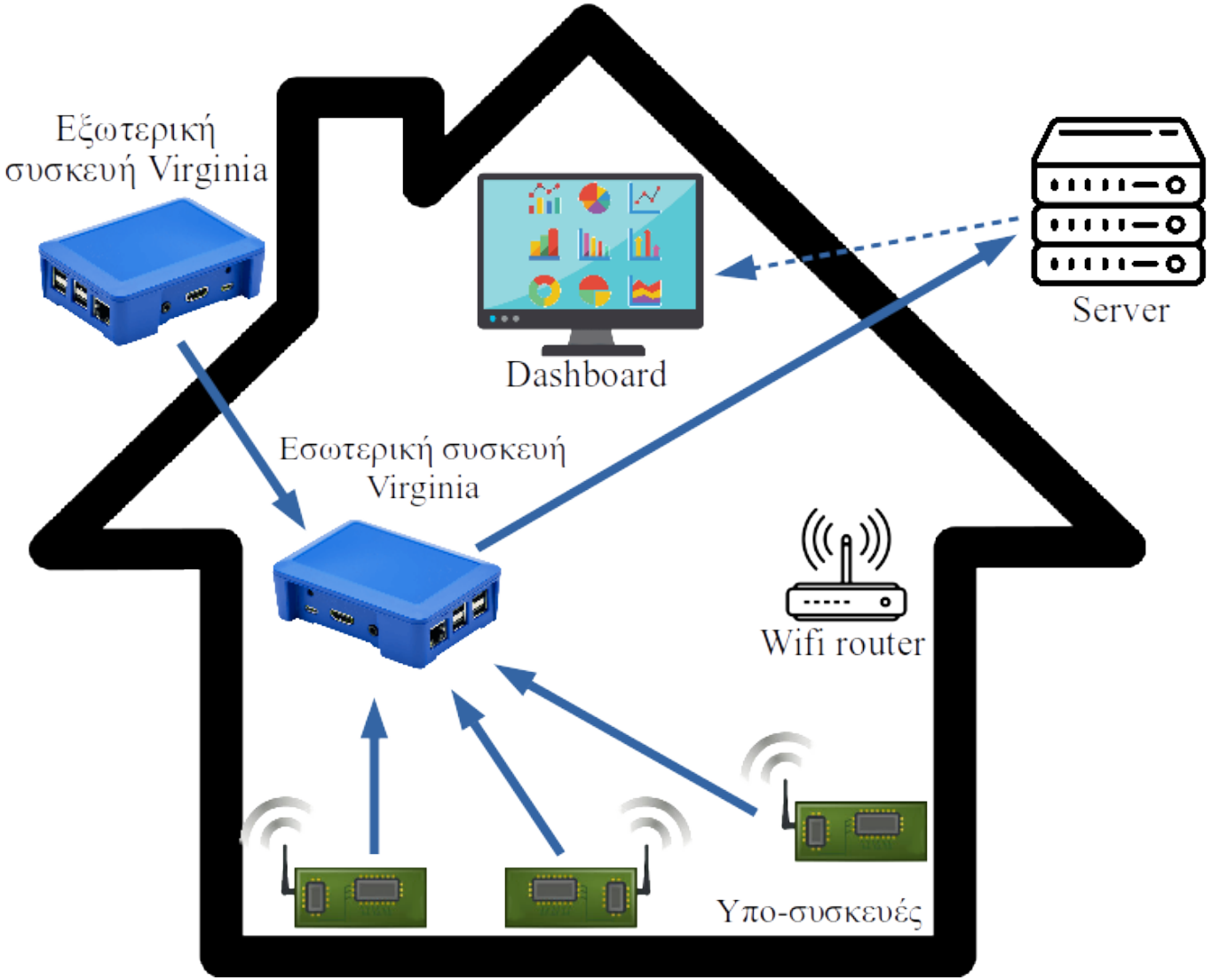
	Last *	Min	Max	Mean
virginia1	45	0	354	18.0
virginia2	55	0	499	22.9

pm100

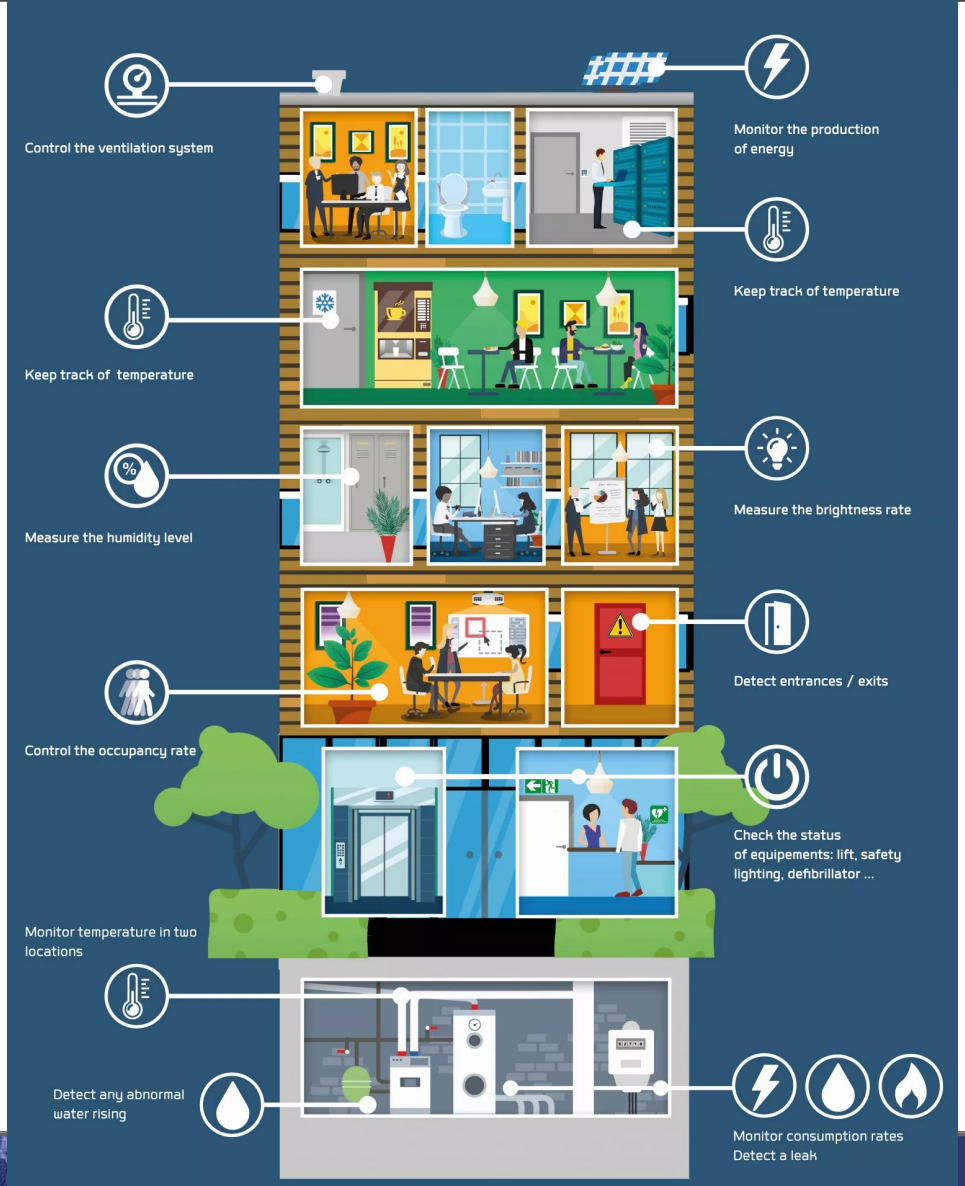


	Last *	Min	Max	Mean
virginia1	45	0	378	18.6
virginia2	55	0	499	23.4



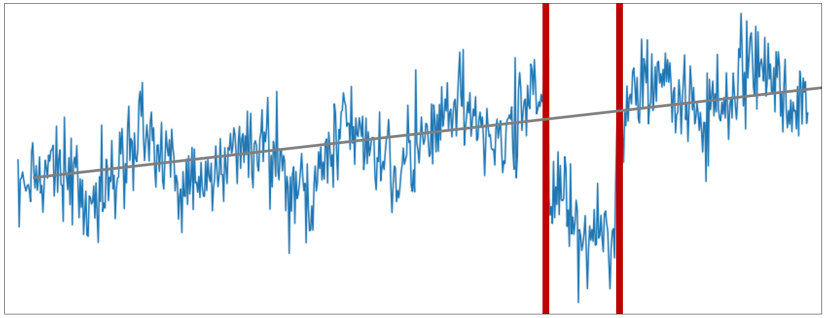

Εξωτερική συσκευή Virginia
Dashboard
Server
Εσωτερική συσκευή Virginia
Wifi router
Υπο-συσκευές


Cluster Status
Uptime
3.1 week
CPU Usage
2887MHz
RAM Usage
8.34 GB
Cluster CPU
Cluster RAM
Cluster Network Usage
Cluster Storage Adapter
Datastores - Usage Capacity
ISOS
VMS-NFS41
ZEXT-NETAPP-01
ZEXT-QNAP-001
ZINT-ESXi-01
ZINT-ESXi-SSD-01
ZINT-ESXi2-00
Datastore Status
VeeamBackup_veeamsrv.zimbra.io
91%
91%
N/A
5.0%
34%
0.3%
63%
15%
ZINT-ESXi2-01
ZINT-ESXi2-02
ZINT-ESXi2-NVMe-01
ZINT-ESXi2-SSD-01
ZINT-ESXi2-SSD-02
ZINT-ESXi2-SSD-03
87%
66%
45%
47%
32%
77%
Hypervisor Status
Hypervisor CPU
Hypervisor Memory
Hypervisor Net Usage
vCenter CPU/RAM

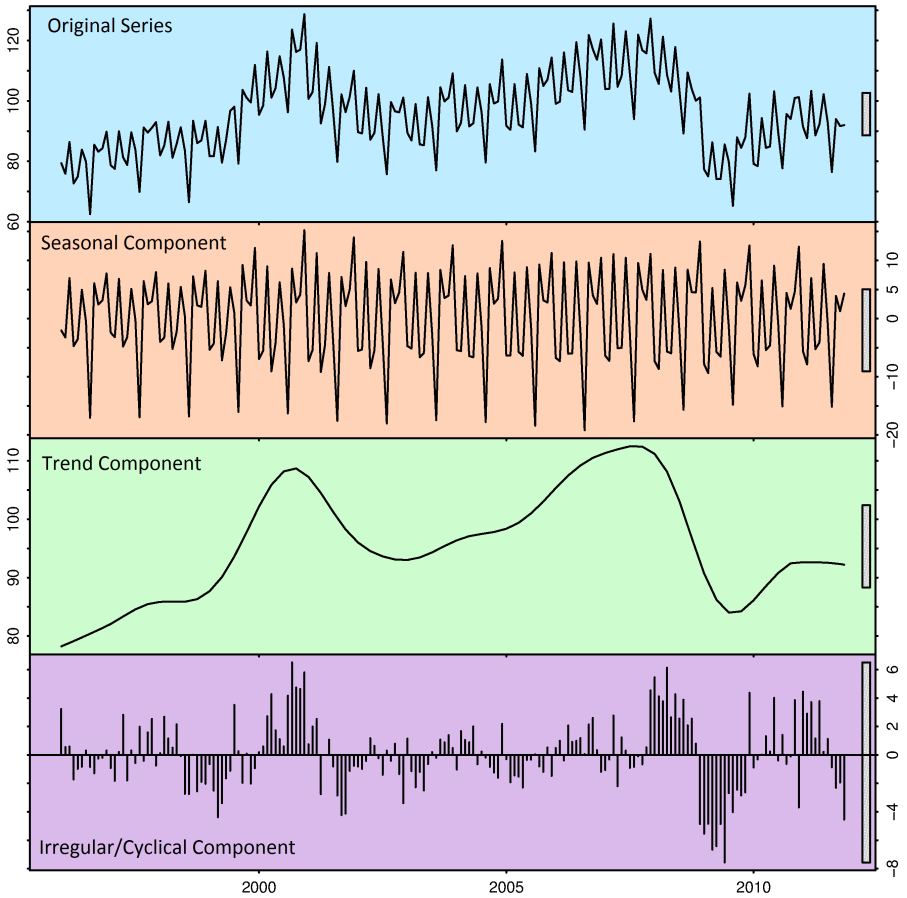

Control the ventilation system
Monitor the production of energy
Keep track of temperature
Keep track of temperature
Measure the brightness rate
Measure the humidity level
Detect entrances / exits
Control the occupancy rate
Check the status of equipements: lift, safety lighting, defibrillator ...
Monitor temperature in two locations
Monitor consumption rates Detect a leak
Detect any abnormal water rising

Δεδομένα $\longrightarrow$ Γνώση

- Time series analysis
  - extract **meaningful** characteristics of the data
  - in order to understand it
- Help to make better predictions
- Understand the nature of the series
  - for future forecasting and simulation
- **Forecasting**: involves taking models fit on historical data
  - and using them to predict future observations
- Deterministic time series
  - can be expressed explicitly by an analytic expression. It has no random or probabilistic aspects
- Non-stationary time series
  - the statistical properties change over time

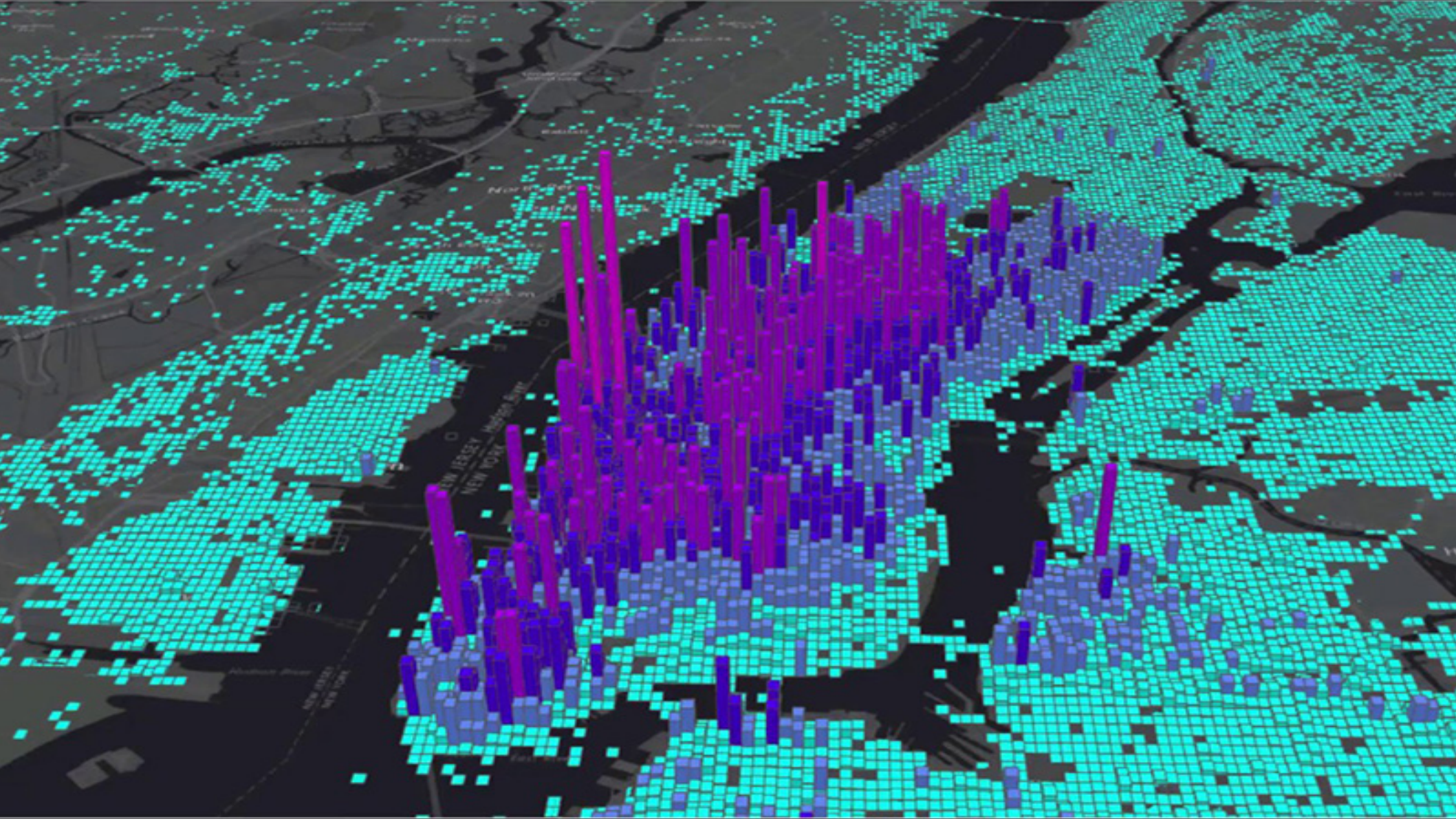


- **Trend component**: The general tendency of the data to increase or decrease during a long period of time
- **Cyclical component**: Any pattern showing a up and down movement around a given tren is identified as a cyclical pattern.
- **Seasonal component**: Peaking and troughing in regular intervals the pattern is called seasonal pattern
- **Random component**: the residual is what's leftover when all other patterns have been removed
  - random fluctuations, noise component



- Temperature in rooms – outside weather
  - heating (winter), AC (summer). When do we start the heating period?
- Air-quality in rooms – outside weather
  - when should we open windows for ventilation? Levels: $PM_{0.1}$, $PM_{0.25}$, $PM_{0.5}$, PM_{10}

AQI Category	AQI Value	24-hr Average $PM_{2.5}$ Concentration ($\mu g/m^3$)	24-hr Average PM_{10} Concentration ($\mu g/m^3$)
Good	0 - 50	0 - 15.4	0 – 54
Moderate	51 - 100	15.5 - 40.4	55 – 154
USG	101 - 150	40.5 - 65.4	155 – 254
Unhealthy	151 - 200	65.5 - 150.4	255 – 354
Very Unhealthy	201 - 300	150.5 - 250.4	355 – 424
Hazardous	301 - 500	250.5 - 500.4	425 – 604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dimitris_k