IAQSense

D6.27 Results obtained through the integration of sensors in regulation systems

(Final version due M36)

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START DATE AND DURATION	01/09/2013 - 36 months
ABSTRACT	Deliverable D6.27 (M36) – This document contains experimental studies of the integration of IAQ sensor in a real scale indoor environment perform in ACCIONA and CEA INES.
AUTHOR, COMPANY	SOCORRO Rafael, GARCÍA Raquel / ACCIONA
KEYWORDS	Real environment, TVOC, recommendations, IAQ
RELATED ITEMS	
DOCUMENT HISTORY	

Release	Date	Reason of change	Status	Distribution

CONTENTS

1. Operations Environment

ACCIONA with experience in environment analysis inside buildings has provided the test area with controlled conditions in the form of a scaled constructions. The objective is to compare two sensors with traditional equipment as well as to help to develop new control algorithms.

ACCIONA has provided its own testing facilities in Madrid for the integration of the sensors systems in in-situ monitoring system, consisting of three main assets:

- One test building currently used for testing and monitoring of Indoor Air Quality, thermal performance. The test building is 3 m long and 2.4 m wide, and is equipped with adequate connection to the electrical network, thus enabling the installation of any customized equipment for different testing purposes. Different coatings have been applied in each trial building for testing various scenarios for integration of the sensors in the structure of the building (walls and ceilings).

- This testing facility has been instrumented with a wireless sensor network for one sensor model and a wired connexion system for the other sensor integrated by ACCIONA, and collected in a remotely accessible server.

- Additionally, ACCIONA has used the facilities of its technological Centre, also in Madrid, to characterize the sensors for measurement of IAQ parameters in environments with laboratories where different chemicals and materials are present and processed.

FIGURE 1 LOCALIZATION MAP. ACCIONA DEMO SITE FACILITIES

FIGURE 2 TERRACE CELL

1.1 Sensor Installation Scheme/Pilot architecture

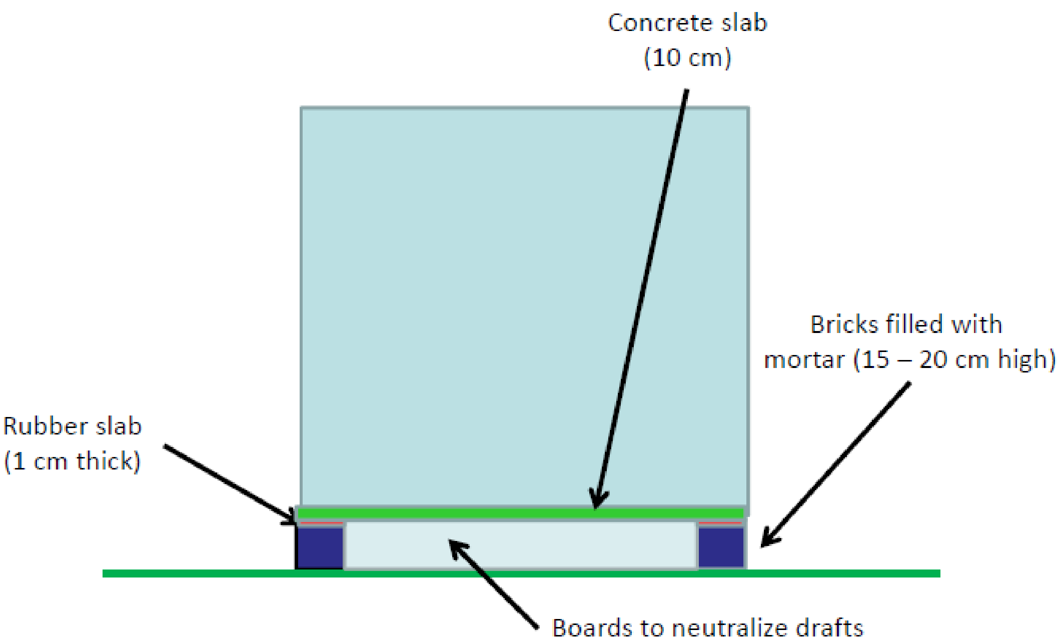


FIGURE 3 CELL MOCK-UP

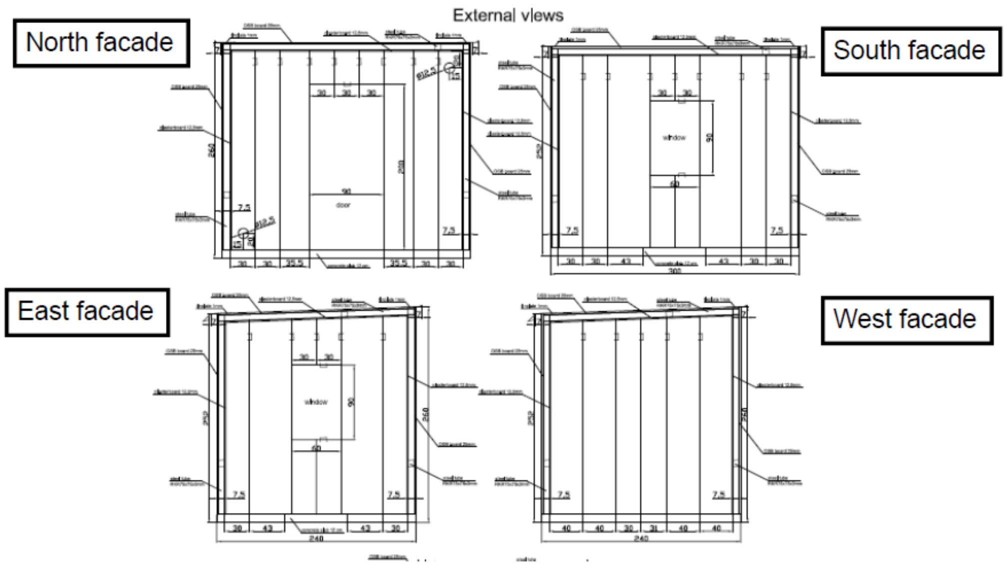


FIGURE 4 CELL FACADES

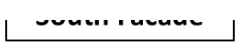


FIGURE 5 PILOT ARCHITECTURE DIAGRAM

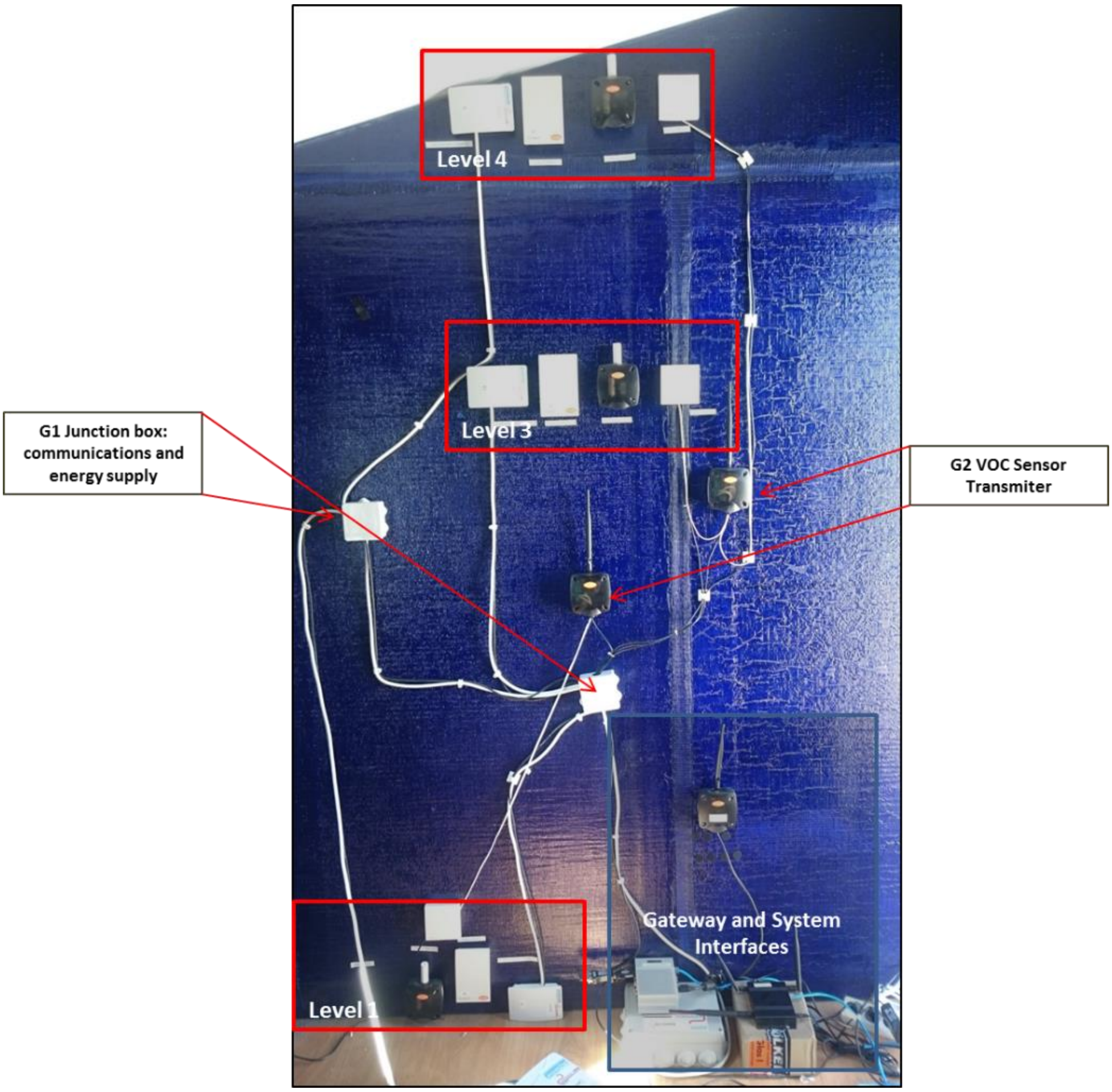


FIGURE 6 SENSORS DEPLOYMENT (LEVEL 1, 2 AND 3)

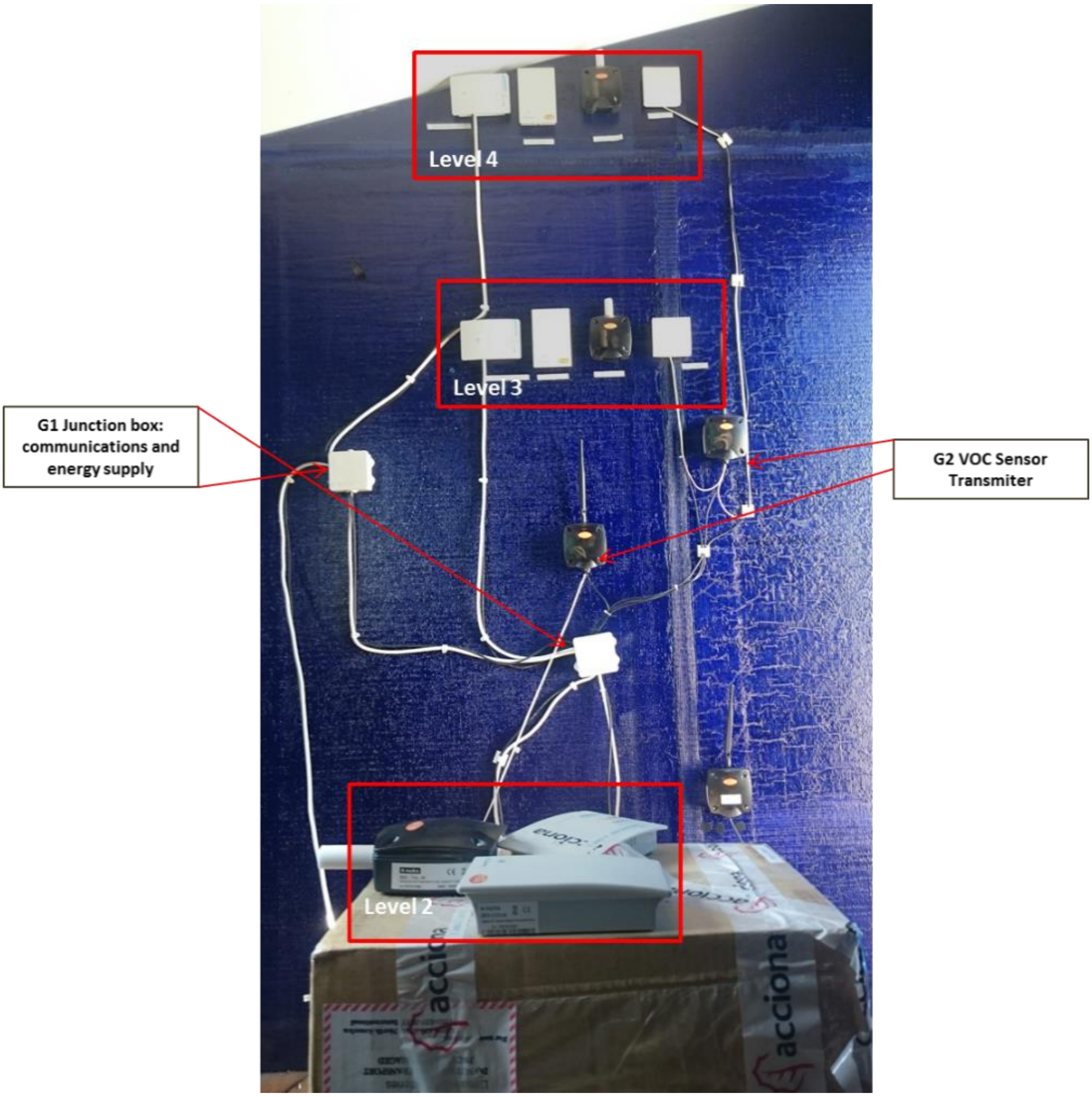


FIGURE 7 SENSORS DEPLOYMENT (LEVEL 2, 3 AND 4)

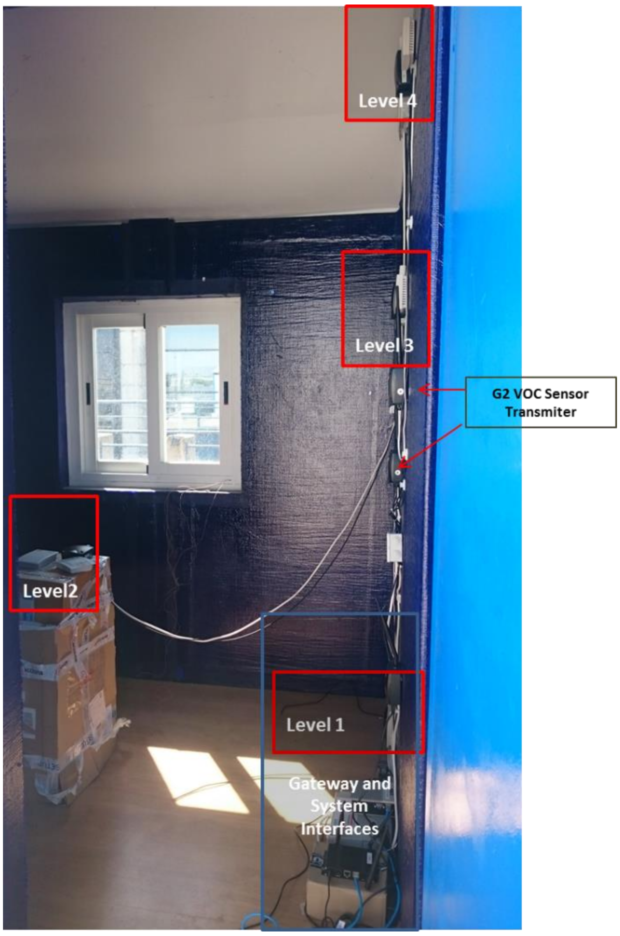


FIGURE 8 SENSORS DEPLOYMENT (ALL LEVELS)

FIGURE 9 DETAILED PICTURE OF THE FIRST AND SECOND GENERATION SENSORS INSTALLED AT EACH LEVEL

A meteorological station has been installed on the building roof in order we could get meteorological calibration data of the zone for a real comparison of the sensors.

FIGURE 10 WEATHER STATION

1.2 System interfaces

1.2.1 Gateway for both Generations

The Gateway is able to modify the behaviour of the nodes, control the root node, give capabilities of remote console and make each installation autonomous: if any problem happens in the remote connection to the gateway and it is not possible to send data to the storage point, the device can store all data captured by the sensors until the connection problem is solved.

An embedded industrial PC and 3G router were installed in the cell building inside an electric box. An electrical box is added with the necessary devices of protection and treatment of voltages and currents, for a correct and safety operation through the device.

The final structure of the system to acquire all the measures from the sensor consists on:

FIGURE 11 GATEWAY SYSTEM: COMPONENTS AND CONNECTIONS

Before the final installation in the cell, some tests were performed in ACCIONA ICT laboratory to verify the communications between devices, gateway, router and sensor nodes.

1.2.2 Meteorological Station / Climatological Reference Point

A weather station has been deployed on the building roof to get meteorological data of the zone. This information will be help in the process of the evaluation of the data collected by the sensors inside the building.

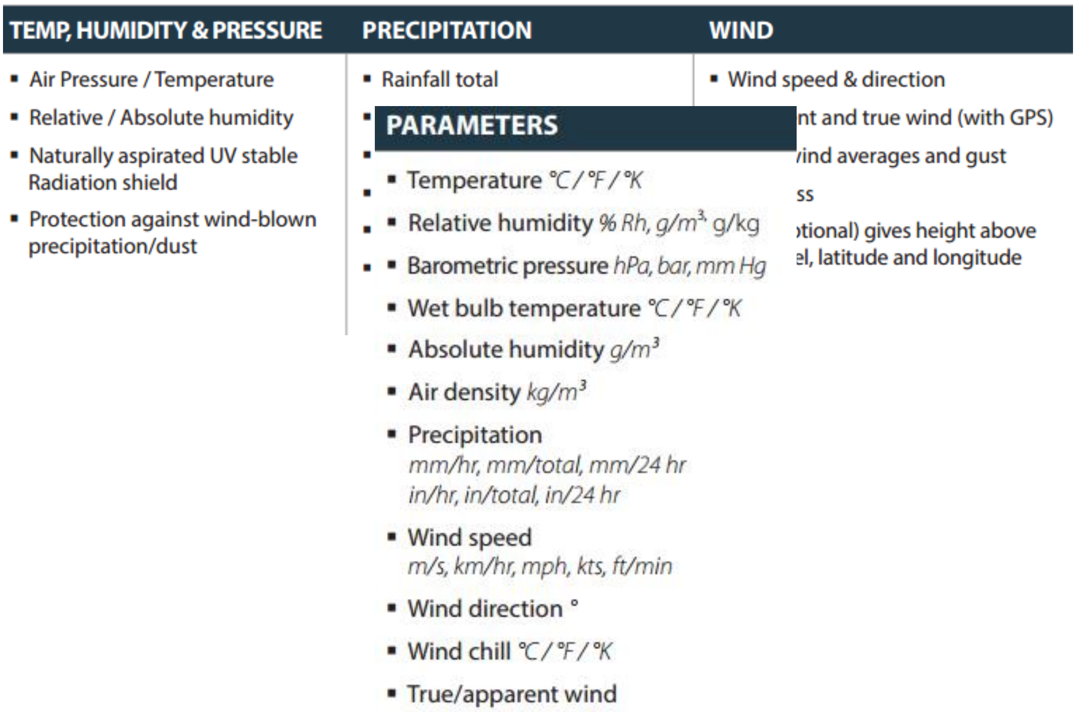
This station is controlled directly by a specific gateway dedicated specifically to this task.

Sensor Hardware Specs

MaxiMet 600 is an advanced compact meteorological and environmental weather station designed to measure parameters to international standards.

MaxiMet incorporates all the measurement parameters that meet the requirements of users in demanding applications where cost, quality and performance are essential:

FIGURE 12 MAXIMET 600



Temperature, humidity, pressure: A combined instrument mounted inside three double louvered, naturally aspirated radiation shields. The results are high performance across each measurement over long periods of time.

Wind: Wind speed and direction measurements are provided via an ultrasonic sensor and the addition of an electronic compass provides apparent wind measurements.

Precipitation: An integrated optical rain gauge that automatically senses water hitting its outside surface and provides measurements based on the size and number of drops. Algorithms interpret this data and simulate the output of a tipping bucket rain gauge in a serial format.

System Architecture

The final structure of the Weather Station system to acquire the chosen atmosphere parameters outside of the Cell building consists on:

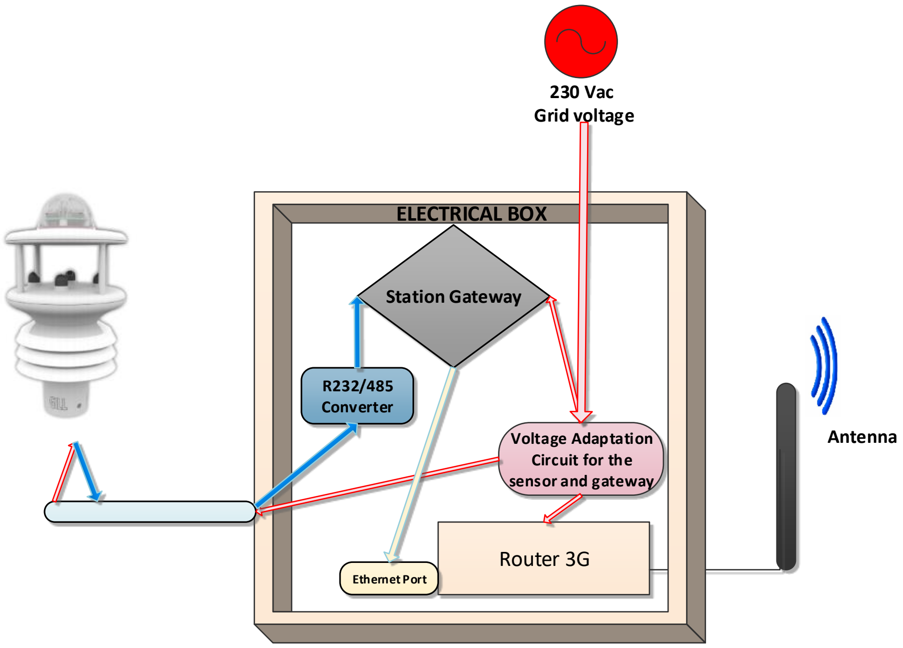


FIGURE 13 WEATHER STATION SYSTEM ARCHITECTURE

Device encapsulation

The final node device is encapsulated by ACCIONA as follows:

FIGURE 14 MAXIMET 600

1.2.3 Sensors: First Generation (1G)

E4000 probe manages HVAC to save energy according to future Building European regulation of 2015 in maintaining safe and healthy indoor air.

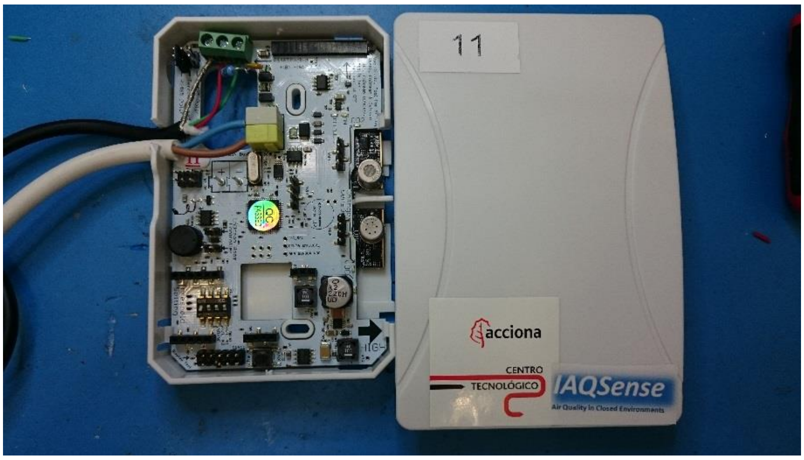


FIGURE 15 E4000 NODE

The E4000 air quality probe is measuring:

- CO_2
- VOC total (compatible with future VOC-IDS1 technology)
- Relative and Absolute Humidity Dew Point
- Temperature (with auto adaptative PID commands)

Gas sensor technology: Solid state (Cheaper than NDIR) or NDIR in option

TECHNICAL DATA

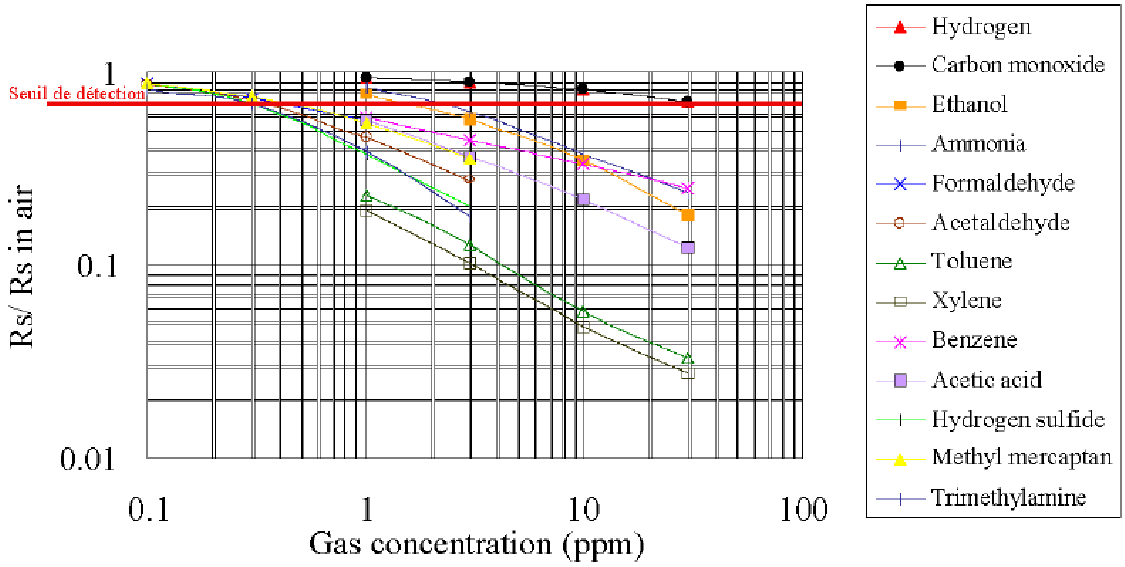
Power supply: from 12V to 24V AC or 15 to 31V DC (+ / -10%) / 45mA for RS485.
Sensors:

- CO_2: solid state or NDIR as an option for severe environment with chlorine.
- VOC: solid state
- Humidity: solid state capacitive
- Temperature: NTC

SPECIFICATIONS

Accuracy:

- CO_2: + / - 100 ppm & 15% (50ppm & 2% in NDIR) at 25°C and 1013mbar, measuring range: 390 to 3500 ppm (2000ppm in NDIR), 10 ppm resolution.
- VOC: + / - 0.1 ppm & 15% (Formaldehyde equivalent, see table). Max 300ppm, 0.01 ppm resolution Above accuracies require the probe to be associated with active air renewal.
- Relative Humidity: + / - 3%, measuring range: 10% to 90%, resolution 1%.
- Temperature: + / - 0.3 ° C, resolution 0.1 ° C, range from 0 ° to + 50 ° C.



SERVICE LIFE

Gas sensors: 10 years under normal use.

Humidity: drift max +/-0.5% RH/Y

Temperature: Unlimited.

STANDARDS

Applicable Standard: EN 60730-1 (electrical controls for household machines and the like)

CALIBRATION

Recalibration of Zero: Automatic every 24 hours for CO2, every 20 days for VOC.

- Solid State CO2 sensor:This type of sensor drift slowly but an ABC algorithm type (Automatic Background Calibration) is used to compensate this drift.
- VOC sensor The VOC sensor is initially heated for 3 days prior factory calibration.

It is then calibrated with an « air zero » (cleaned air) and several injections of VOCs to determine the response curve of each sensor to formaldehyde. Sensor drift is extremely low and auto zero process does not manage this drift. Auto zero is based on environmental conditions of the building. Auto zero also uses zero ABC algorithm (Automatic Background Calibration)

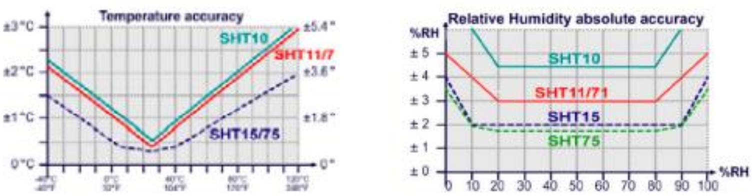
1.2.4 Sensors: Second Generation (2G)

FIGURE 16 SECOND GENERATION SENSORS

Temperature and Humidity SENSOR

ZED-THI-M ZigBee sensor for temperature and humidity.

General characteristics	Chip Ember EM250 Compatible IEEE 802.15.4 Stack EmberZnet3.4.x (ZigBee PRO) Modbus/RTU Device address settable via internal dip-switch
RF characteristics	Frequency: 2405 MHz ÷ 2480 MHz Modulation: DSSS Nominal transmission power: 2mW (3 dBm) Reception sensitivity: -95 dBm Internal antenna gain: 0 dB Coverage outdoor/indoor: 100m/30m
Supply	AA high energy density lithium battery 3,6V/2000mAh Battery life: 3 years in case of 1 transmission per minute at 20°C
Temperature/Humidity Sensor	Sensor used: Sensirion SMD SHT11 series Temperature measurement range: from -40 to 120°C Reading accuracy inside measurement range: +/- 1,5°C max. (view graph) Temperature measurements in tenth degrees Humidity measurement range: from 0 to 100% RH%, Reading accuracy +/- 5 RH% max. (view graph)
Environment parameters	Operating temperature: -10 ÷ +60°C; <80% U.R. not condensing Storage temperature: -20 ÷ +70°C; <80% U.R. not condensing Degree of protection: IP 55
Compliant with 2006/95/EEC, 89/336/ EEC, 99/5/EEC directives **Reference Norms:**	ETSI EN 300 328: Radio Compatibility for digitals wide band transmissions ETSI EN 301 489: Radio Compatibility EN 61000-6-2: Electromagnetic Compatibility - Emissions EN 61000-6-3: Electromagnetic Compatibility - Immunity EN 60950-1: Electric Safety



CO2 SENSOR

ZED-CO2-M ZigBee sensor for carbon dioxide (CO2).

General characteristics	Chip Ember EM357 Compatible IEEE 802.15.4 Stack EmberZnet 4.7.3 (ZigBee PRO) Modbus/RTU Device address settable via internal dip-switch
RF characteristics	Frequency: 2405 MHz ÷ 2480 MHz Modulation: DSSS Nominal transmission power: 2mW (3 dBm) Reception sensitivity: 103 dBm Internal antenna gain: 0 dB Coverage outdoor/indoor: 100m/30m
Measurement	Dual Wavelength NDIR Measurement range 0~2000ppm (0~5,000ppm, 0~10,000ppm optional) Accuracy ± (4%FS+3% Reading) Measurement time interval: 1,5 sec.
Supply	Battery 4xAA
Connections	Wall mounting
Environment parameters	Operating temperature: 0°C ÷ +50°C; <80% U.R. not condensing Storage temperature: -20 °C÷ +70°C; <80% U.R. not condensing Degree of protection: IP 30
Compliant with 2006/95/EEC, 89/336/EEC, 99/5/EEC directives Reference Norms:	ETSI EN 300 328: Radio Compatibility for digitals wide band transmissions ETSI EN 301 489: Radio Compatibility EN 61000-6-2: Electromagnetic Compatibility - Emissions EN 61000-6-3: Electromagnetic Compatibility - Immunity EN 60950-1: Electric Safety

VOC SENSOR

The self-calibrating microprocessor-controlled room air quality sensor AERASGARD® RLQ is used to determine the room air quality on basis of a mixed gas sensor ⁄ VOC sensor (VOC = volatile organic compounds).

It is used:

- For air quality measurement in offices, hotels, meeting rooms and convention centres, apartments, stores, and restaurants, etc.

- For quantitative evaluation of room air pollution with contaminating gases (cigarette smoke, body perspiration, exhaled breathing air, solvent vapours, emissions from building members and cleaning agents).

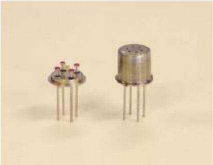
- For adjustable sensitivity regarding the maximum air contamination to be expected.

- For room ventilation as-needed, enabled by air changes only taking place when air is polluted while conserving energy at the same time.

Power supply:	24 V AC / DC, current consumption approx. 70 mA at 24 V
Power consumption:	< 3 VA at 24V DC
Sensor:	VOC sensor (metal oxide), **with automatic self-calibration**
Measuring range:	0...100 % air quality; referred to calibrating gas; **multi-range switching** (selectable via DIP switches) VOC sensibility low, medium, high
Output:	0 - 10 V (0V = clean air, 10V = polluted air) or 4...20 mA (selectable via jumper) or with potential-free changeover contact (24 V), switchpoint adjustable from 0...100 % of output signal
Measuring accuracy:	± 20 % of final value (referred to calibrating gas)
Detection of gases:	not selective
Electrical connection:	0.14 - 1.5 mm² via terminals on circuit board
Long-term stability:	< 10 % per year
Warm-up time:	approx. 1 hour
Ambient temperature:	0...+50 °C
Response time:	< 60 s

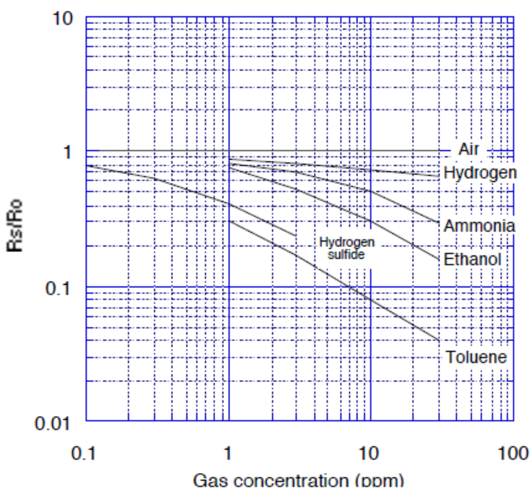
TGS 2602 SENSOR

The sensing element is comprised of a metal oxide semiconductor layer formed on the alumina substrate of a sensing chip together with an integrated heater. In the presence of detectable gas, sensor conductivity increases depending on gas concentration in the air. A simple electrical circuit can convert the change in conductivity to an output signal which corresponds to the gas concentration.

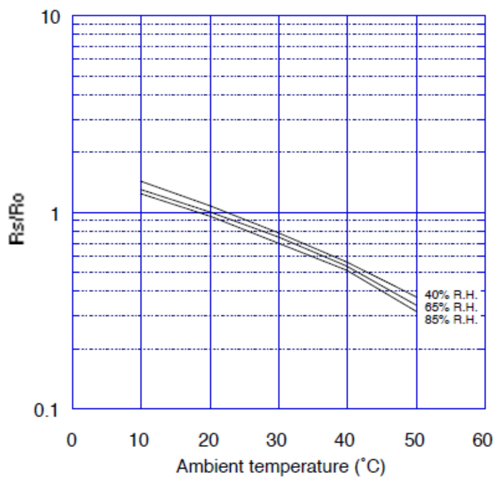


The TGS 2602 has high sensitivity to low concentrations of odorous gases such as ammonia and H2S generated from waste materials in office and home environments. The sensor also has high sensitivity to low concentrations of VOCs such as toluene emitted from wood finishing and construction products. Figaro also offers a microprocessor (FIC02667) which contains special software for handling the sensor's signal for appliance control applications.

Sensitivity Characteristics:



Temperature/Humidity Dependency:



SPECIFICATIONS

Model number			TGS 2602-B00	
Sensing element type			D1	
Standard package			TO-5 metal can	
Target gases			Air contaminants	
Typical detection range			1 ~ 30 ppm of EtOH	
Standard circuit conditions	Heater voltage	V_H	5.0±0.2V DC/AC	
	Circuit voltage	V_C	5.0±0.2V DC	P_S≤15mW
	Load resistance	R_L	Variable	0.45kΩ min.
Electrical characteristics under standard test conditions	Heater resistance	R_H	approx. 59Ω at room temp.	
	Heater current	I_H	56±5mA	
	Heater power consumption	P_H	280mW (typical)	
	Sensor resistance	Rs	10k~100kΩ in air	
	Sensitivity (change ratio of Rs)		0.15~0.5	Rs (10ppm of EtOH) / Rs (air)
Standard test conditions	Test gas conditions		normal air at 20±2˚C, 65±5%RH	
	Circuit conditions		V_C = 5.0±0.01V DC V_H = 5.0±0.05V DC	
	Conditioning period before test		7 days	

SERVICE LIFE

The sensor's service life depends on the type of burden and gas concentration and is more than 60 months under normal load conditions.

STANDARDS

CE-conformity, electromagnetic compatibility according to EN 61 326, EMC directive 2004 ⁄ 108 ⁄ EC

CALIBRATION

The minimum initial value for air quality is memorized within a period of ca. 4 weeks. After that period has lapsed, the output signal is standardised to zero-point (1.0 V). The maximum amount of correction is thereby limited to 1 V ⁄ interval. In this way, long-term drifts and operational aging effects of the sensor element are completely eliminated.

1.2.5 Communications interfaces

First Generation (1G)

Modular Building Automation Interface: Output Bus Communication: Modbus RS485

Information available on the Bus:
- CO2 expressed in ppm
- VOC expressed as equivalent ppm formaldehyde
- Ambient Temperature in °C
- Relative Humidity in % and Absolute in gr/l, Dew Point in °C

Response time < 30 seconds
Start Time for 90% of performance ratings: 24 hours (C02 and VOCs measured after 20 minutes)
http://www.modbus.org/docs/Modbus_over_serial_line_V1.pdf

Second Generation (2G)

The communication between Reference cell and ECO-SEE cell has been implemented over a wireless connectivity using 4-noks ZigBee communications:

4-noks has been a ZigBee Alliance partner since 2006 and specializes in the design, development and production of devices and systems based on ZigBee technology. ZigBee standard permits the creation of innovative and reliable "Internet of Things ready" products with reduced energy consumption.
http://www.zigbee.org/

1.2.6 Hardware interfaces

Wireless Root Node: Gateway Modbus USB

- Protocol converter from Modbus/RTU to ZigBee
- USB interface
- Coordinator function for a ZigBee network
- Local memory stores battery powered sensors data
- Transparent bridge towards other Modbus devices
- Power supplied from the USB port

http://www.4-noks.com/shop/gateways-en/gateway-modbus-usb/?lang=en

ZigBee module with 2 analogical inputs, 2 digital inputs and router for the 2G VOC Sensor

The ZR-AIAO-EM is a multifunction wireless sensor with: one 0-10Vdc analogue input, one 0-10Vdc analogue output, one NTC thermal temperature probe input and one digital input with pulse counting functionality.

This device can perform data transmissions automatically and immediately (regardless of configured sampling rate) in order to signal a status change in one of the two digital inputs.

http://www.zb-connection.com/zigbee-wireless-plug-play-network/environment-sensors/zigbee-sensors-wireless/

1.2.7 User interfaces

In ACCIONA experimentation sites, an appropriate management and visualization tool has been developed to test the performances of the IAQ sensing system in building environment, correlating it with parameters for assessment of occupational safety and health in working sites, and including nomadic application for personal monitoring of exposure to pollutants at work.

The interface is a modular platform for remote monitoring, follow-up and analysis of any type of parameter in construction sites, infrastructures and installations. The platform consists of three differentiated layers: monitoring hardware, data collection and transmission, and web interface.

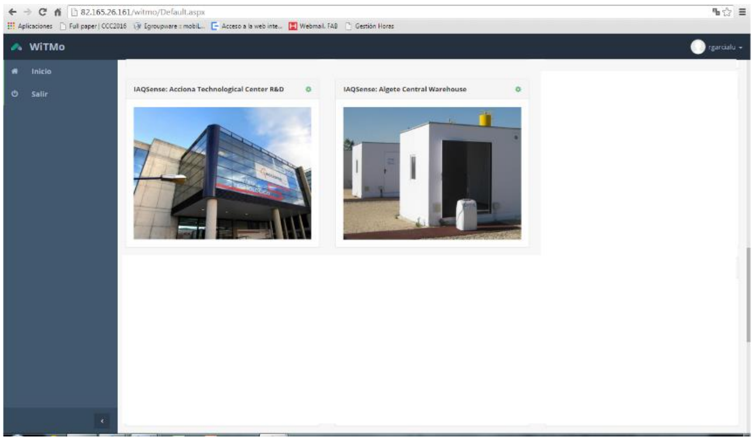


FIGURE 17 WEB INTERFACE MAIN SCREEN

Once that the data are stored in the remote service, they can be accessed through the web interface layer, through which it is possible to visualize and analyse the data from any computer or mobile device (tablet, smartphone) with Internet connection. The design of the interface has been done according to the Responsive Web Design approach, which allows automatic adaptation of the interface layout to the type and screen size of the device that is accessing the interface, so that this is displayed in an optimal way for the user.

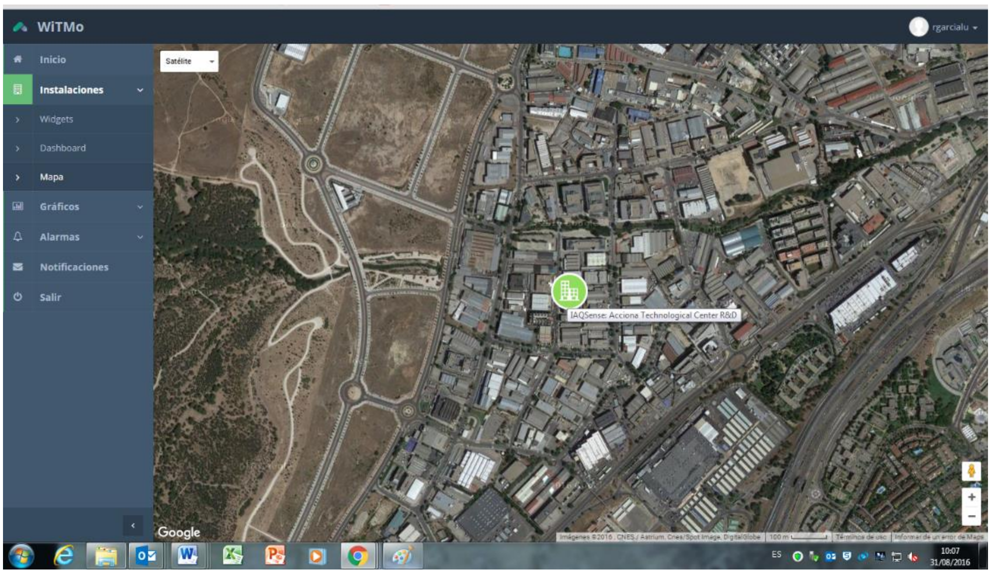


FIGURE 18 WEB INTERFACE MAP SCREEN

The main functionalities of the web interface layer are:

- Authorization management: configuration of the interface pages and of the specific monitoring parameters that each user can visualize for each installation.
- Charts: generation of multiple chart types (e.g. line charts, heatmaps) for visualizing monitored data for a selected time interval. It is possible to visualize variables of different types (with different units of measurement) on the same chart, and it is possible as well to calculate aggregated parameters, such as average values, maximum/minimum values, etc.). The generated charts can be exported to the most widespread file formats (e.g. PDF, JPG…), whereas the data contained in the chart can be exported to CSV to allow its processing in external software applications such as Excel.

- Alerts: alerts configuration based on different criteria: monitored values thresholds, data reception failures, reception of invalid data, etc.
- Dashboard: customizable control panel by each user for each installation, that allows the simultaneous visualization of different parameter values through selected widgets.

2. Implementation and characterization in a real indoor environment

Both generation sensors have been installed in the test facilities according to predefined experimental protocols.

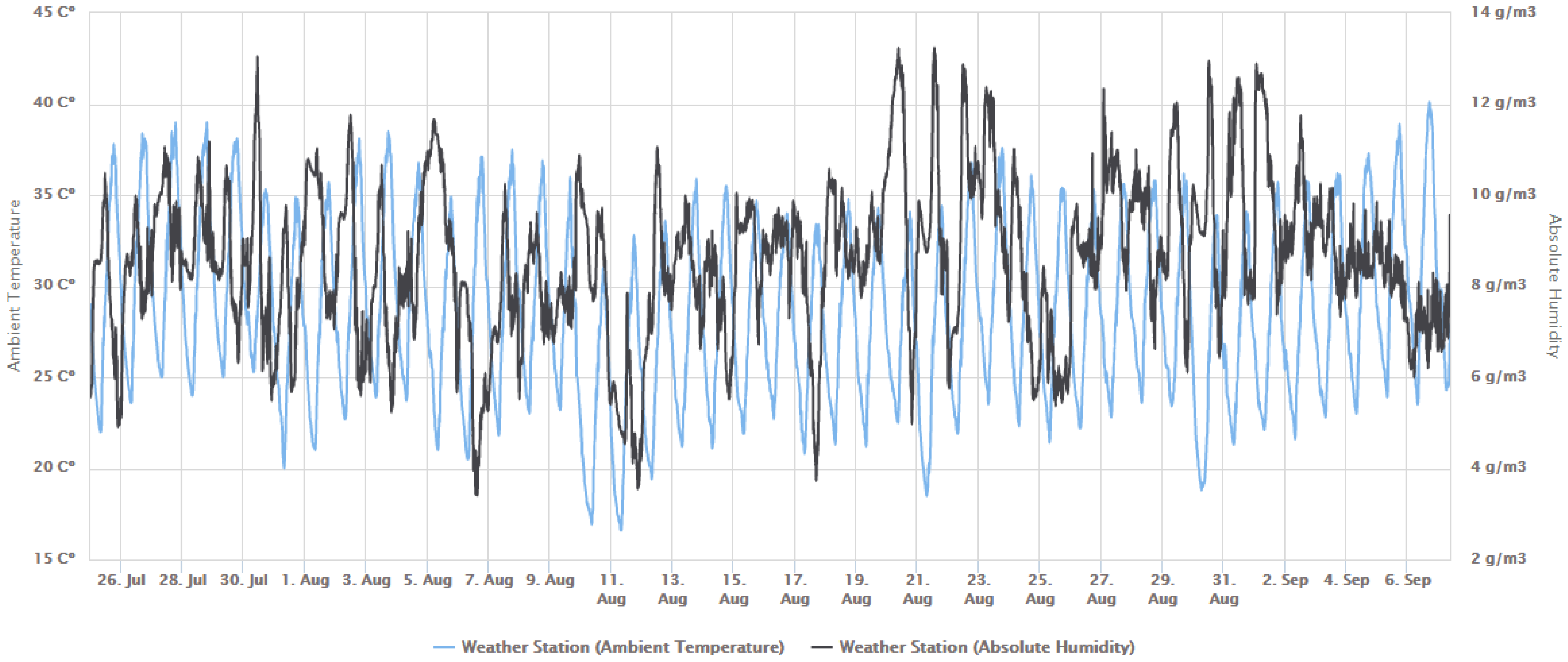
The goal consists in integrating the sensors in given environments, able to recreate a real indoor environment such as a Passys cell. This integration is also including the testing of sensors embedded in the building structure. The adaptation of the energy harvesting technologies and communication nodes integrated in WP4 have been addressed in this works to fit the specific needs of the different experimentation sites.
We have focused on the best positioning of the sensors via a combined approach between a bibliographical review and in situ tests.
This ‘optimum’ depends on the building typology of the experiments, as well as the type of room(s) monitored, the “potential” occupant activities, the HVAC system, and so on.

The experimental environments will be monitored according to the specific spatial sampling and the time sampling.

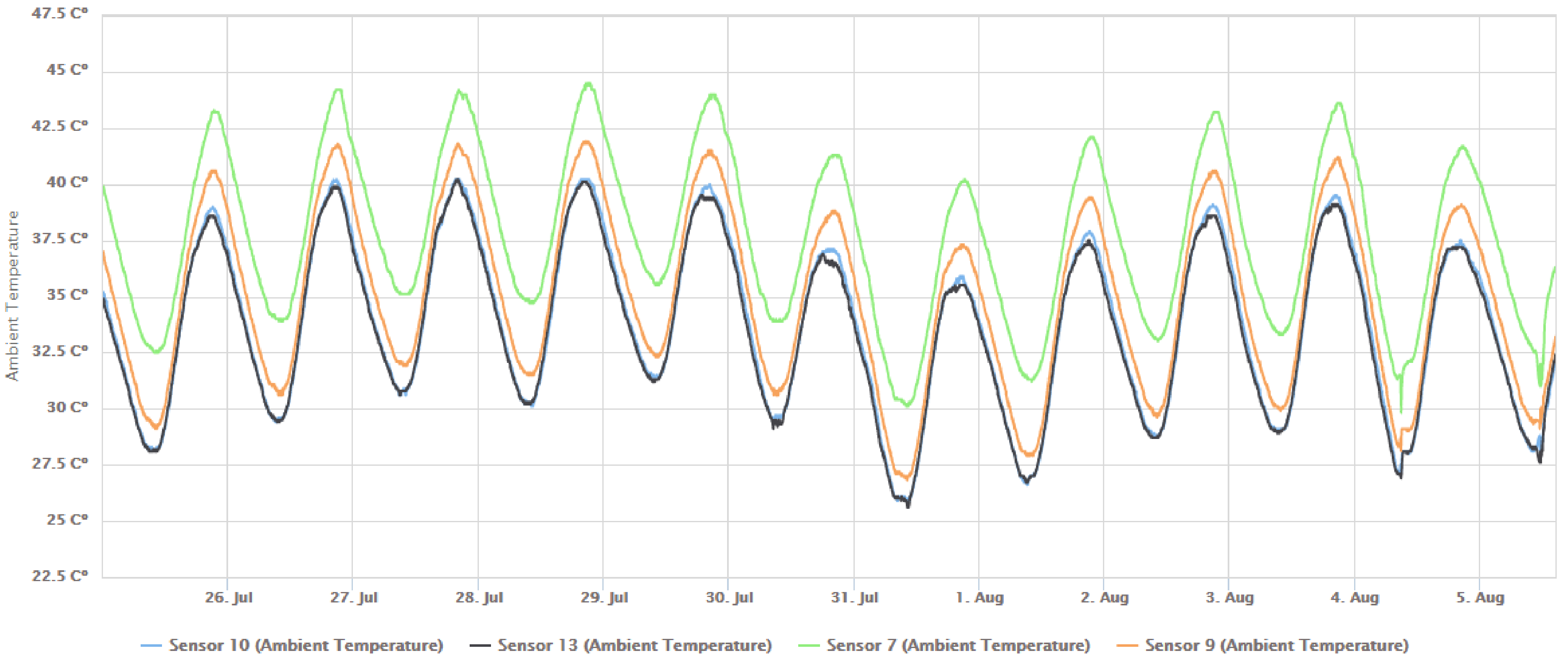
2.1 Temperature and Humidity Sensors

Overview

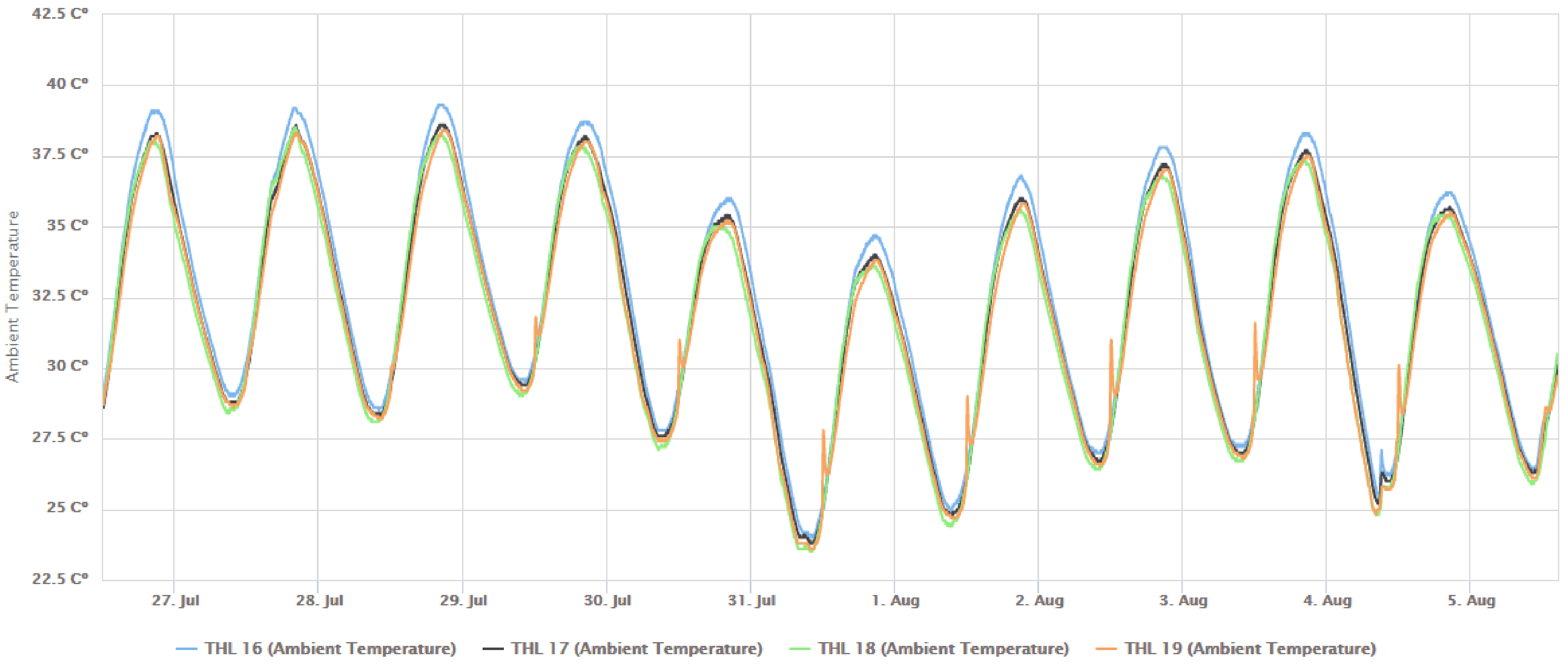
Weather Station



Temperature (1G)



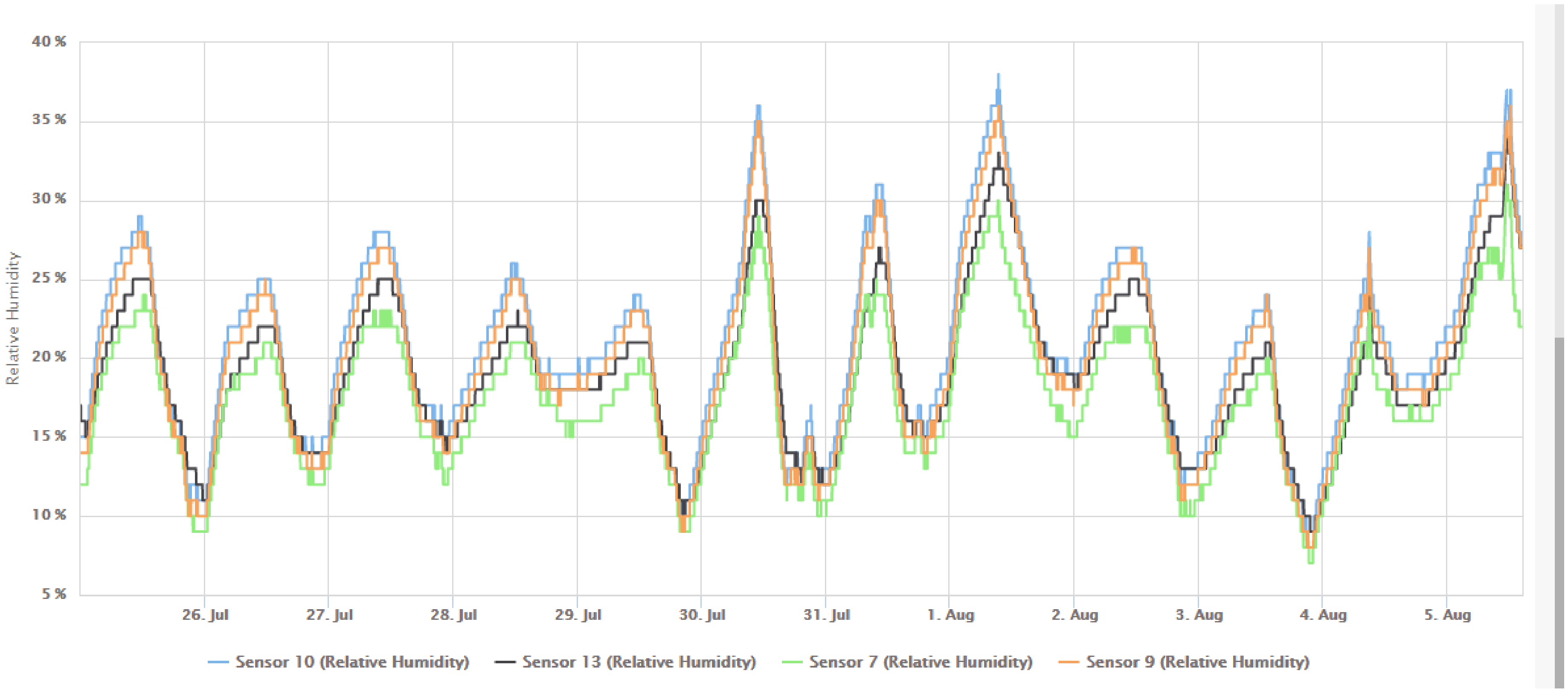
Temperature (2G)



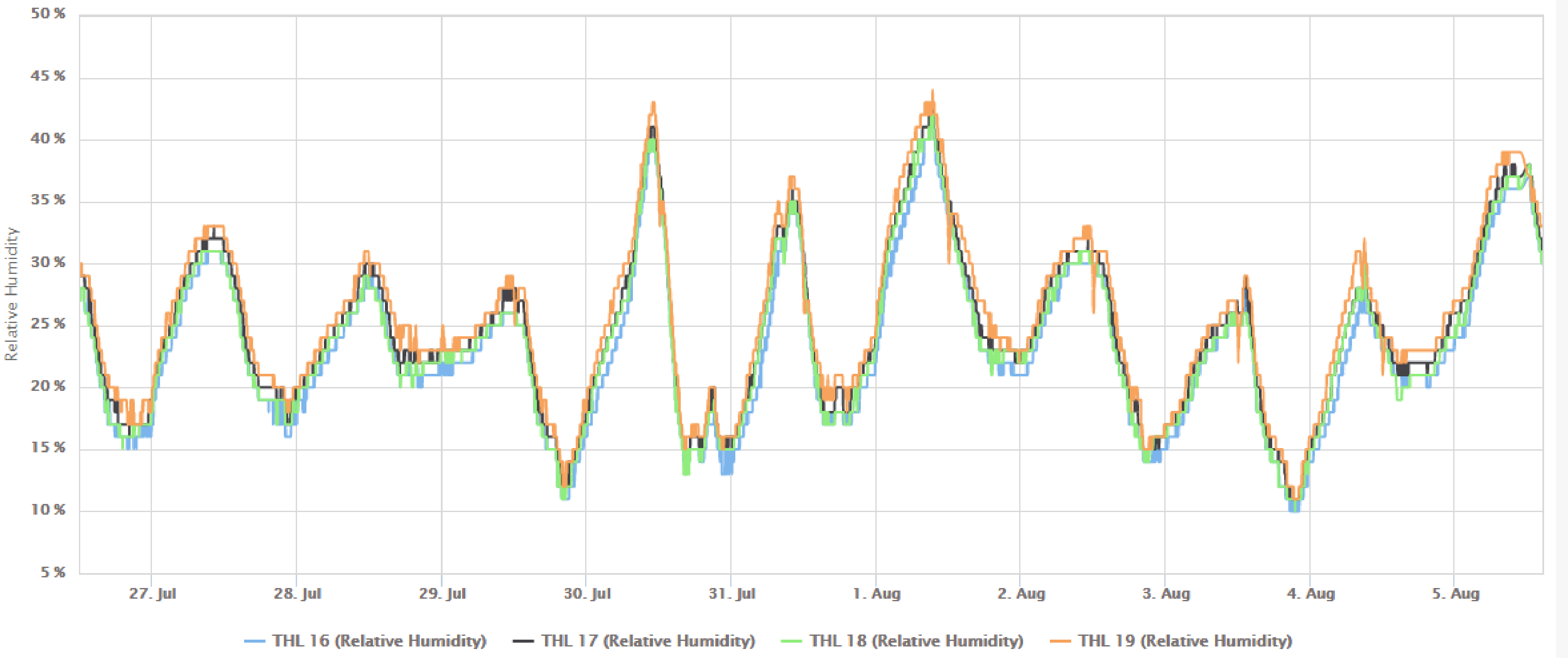
Conclusions

Static sensor characteristics	***1G***	***2G***
Input range		✓
Sensitivity	✓	
Monotonicity	✓	
Hystheresis		✓
Accuracy	✓	
Errors	✓	
Frequency response		✓

Humidity (1G)


40 %
35 %
30 %
25 %
20 %
15 %
10 %
5 %
Relative Humidity
26. Jul
27. Jul
28. Jul
29. Jul
30. Jul
31. Jul
1. Aug
2. Aug
3. Aug
4. Aug
5. Aug
Sensor 10 (Relative Humidity)
Sensor 13 (Relative Humidity)
Sensor 7 (Relative Humidity)
Sensor 9 (Relative Humidity)

Humidity (2G)

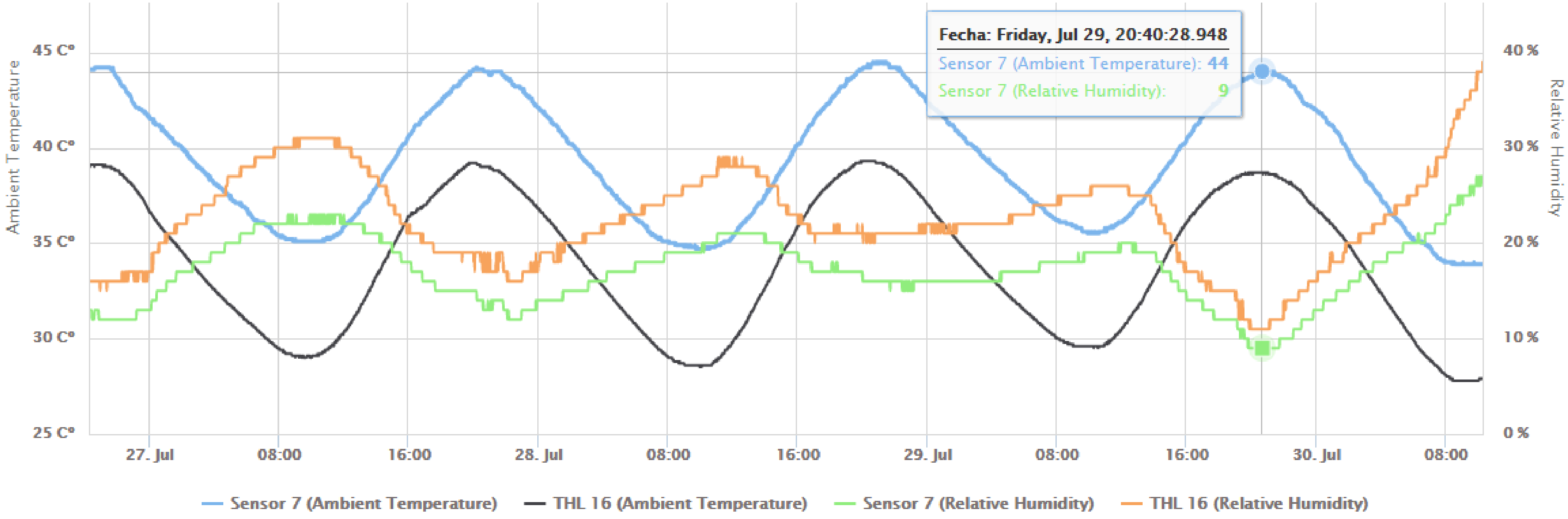

50 %
45 %
40 %
35 %
30 %
25 %
20 %
15 %
10 %
5 %
Relative Humidity
27. Jul
28. Jul
29. Jul
30. Jul
31. Jul
1. Aug
2. Aug
3. Aug
4. Aug
5. Aug
THL 16 (Relative Humidity)
THL 17 (Relative Humidity)
THL 18 (Relative Humidity)
THL 19 (Relative Humidity)

Conclusions

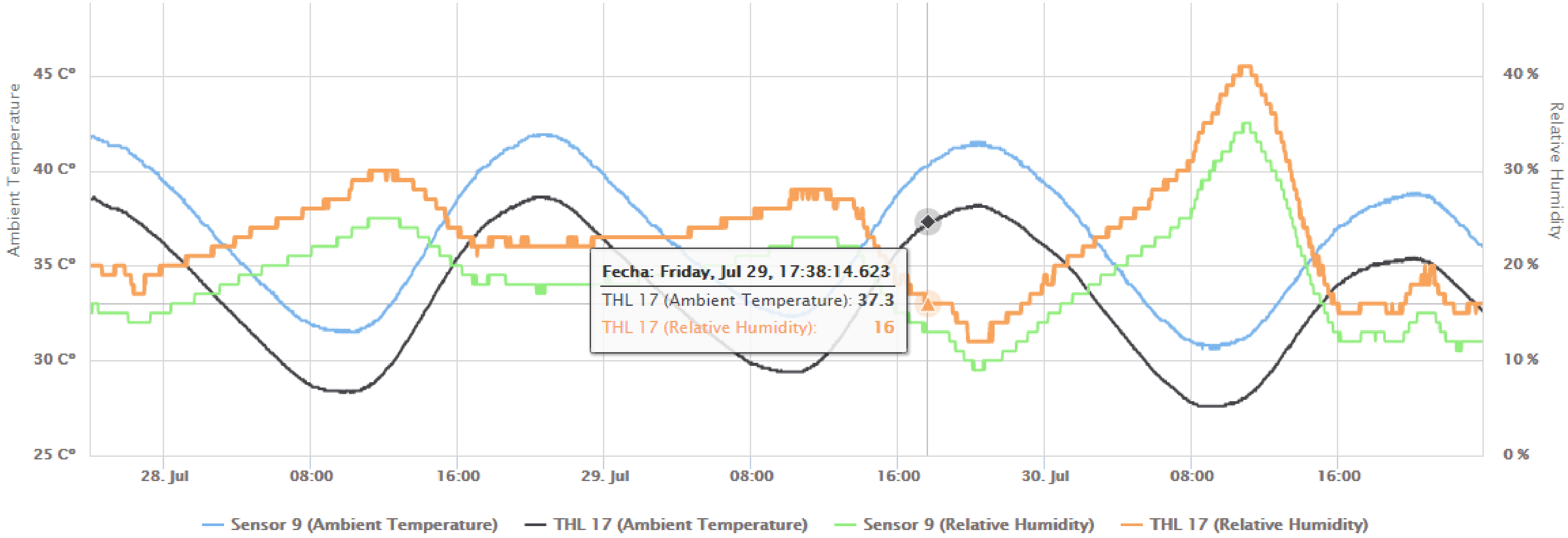
Static sensor characteristics	***1G***	***2G***
Input range		✓
Sensitivity	✓	
Monotonicity	✓	
Hystheresis		✓
Accuracy	✓	
Errors	✓	
Frequency response		✓

Outside High Temperatures days

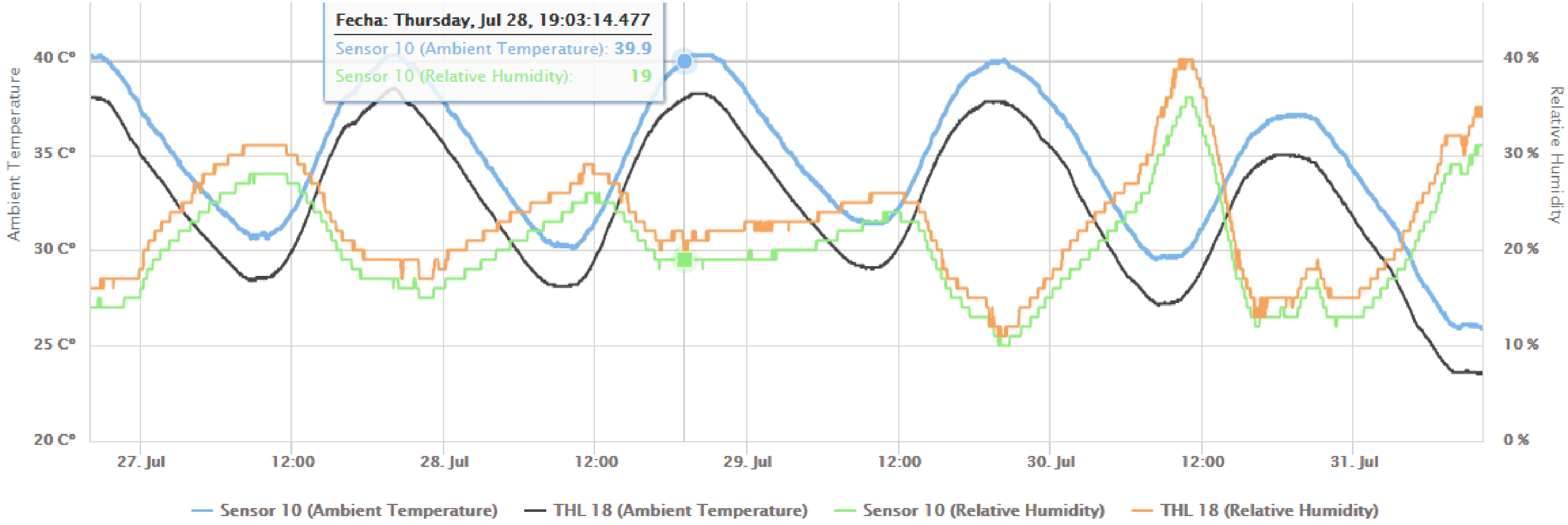
Temperature Level1: 1G vs 2G



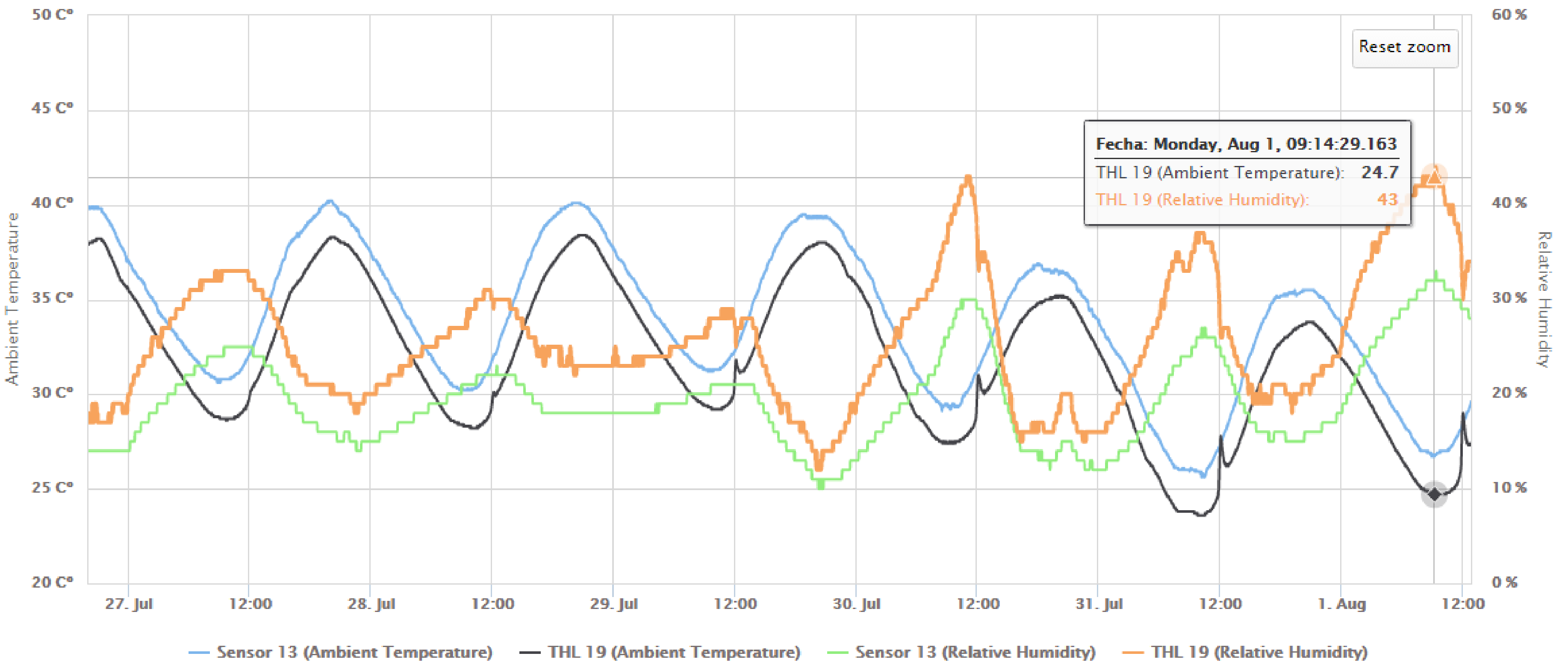
Temperature Level 2: 1G vs 2G



Temperature Level 3: 1G vs 2G



Temperature Level 4: 1G vs 2G



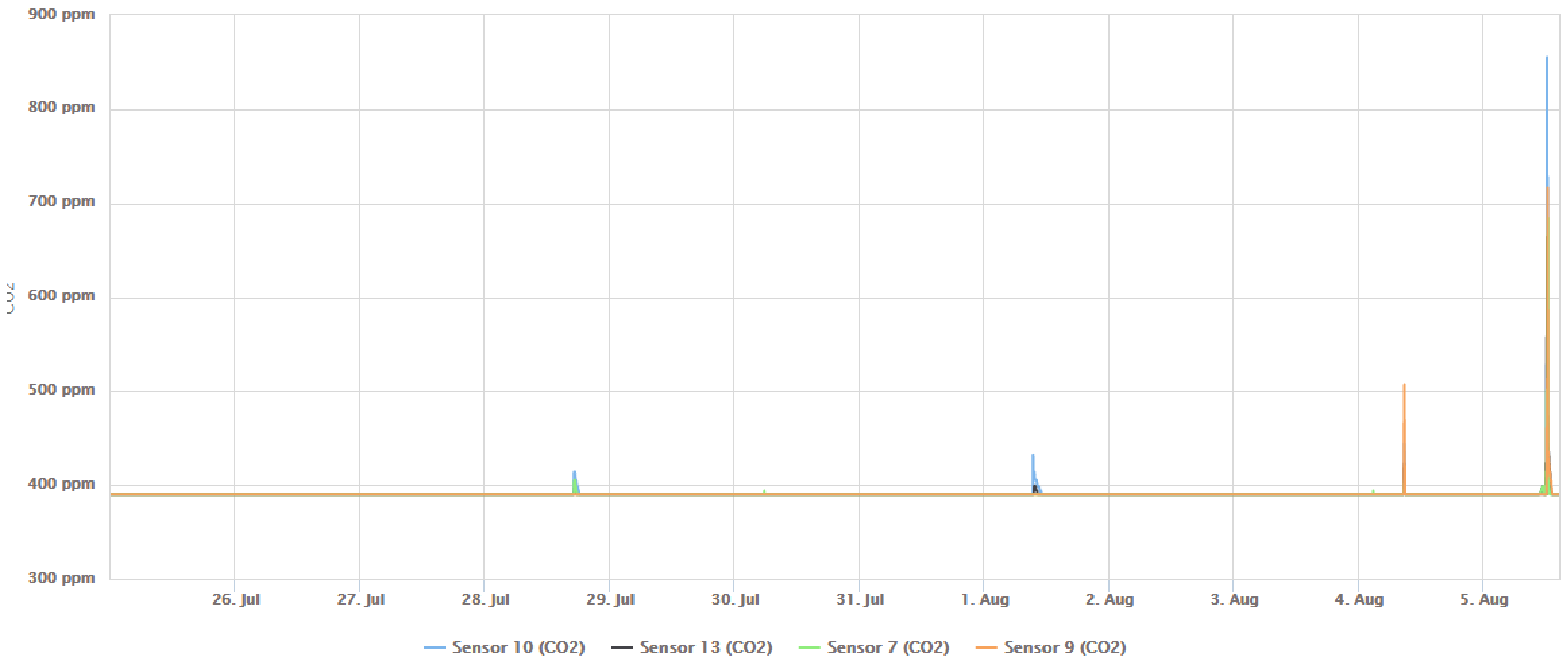
CO2 Sensors

CO2 Baselines expressed in ppm

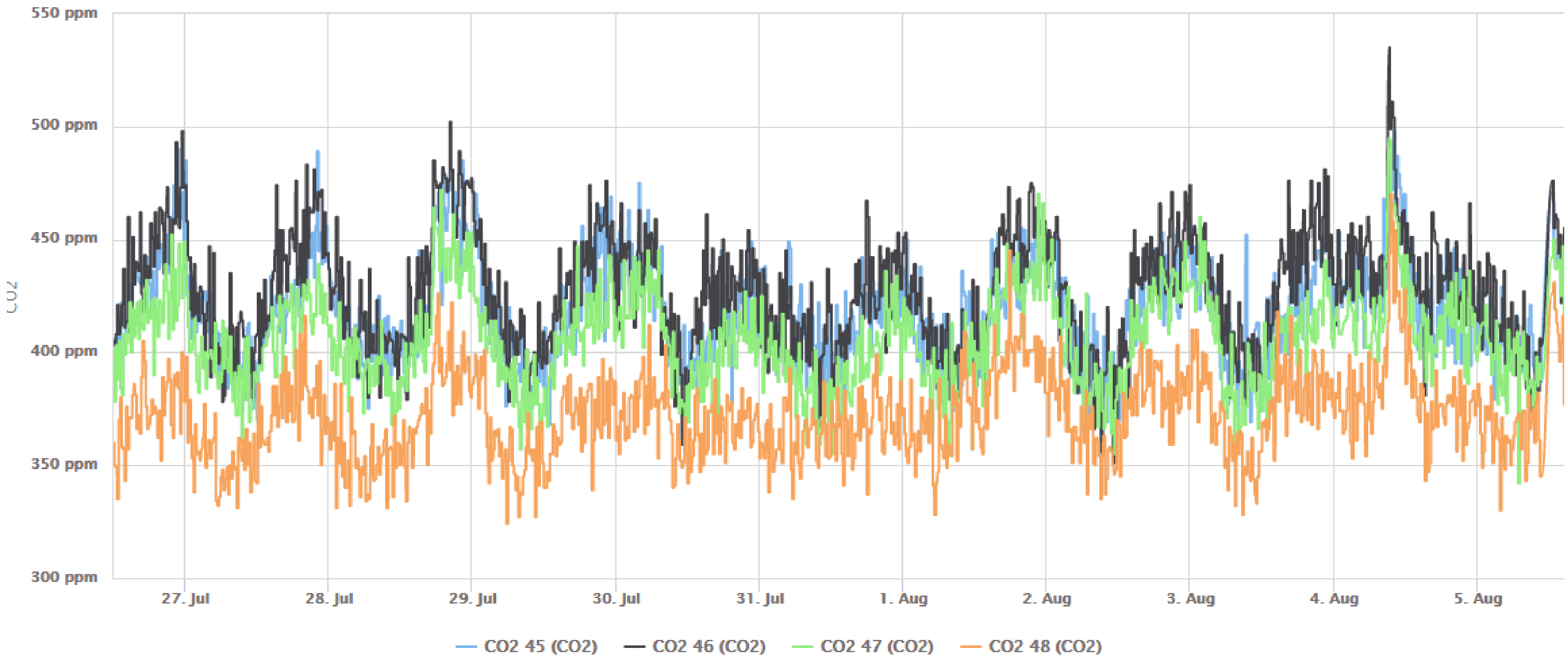
200 000	Lethal (deadly) for humans
100 000	Lethal in 10 minutes without an action for resuscitation
40 000	Threshold of irreversible effects on health
5000	Maximum concentration on workplace (8h)
4000	Bedroom poorly ventilated
1000	Significant decrease in intellectual performance. Factor for asthma or building syndrome. Maximum value allowed inside buildings.
390	Outside air

Overview

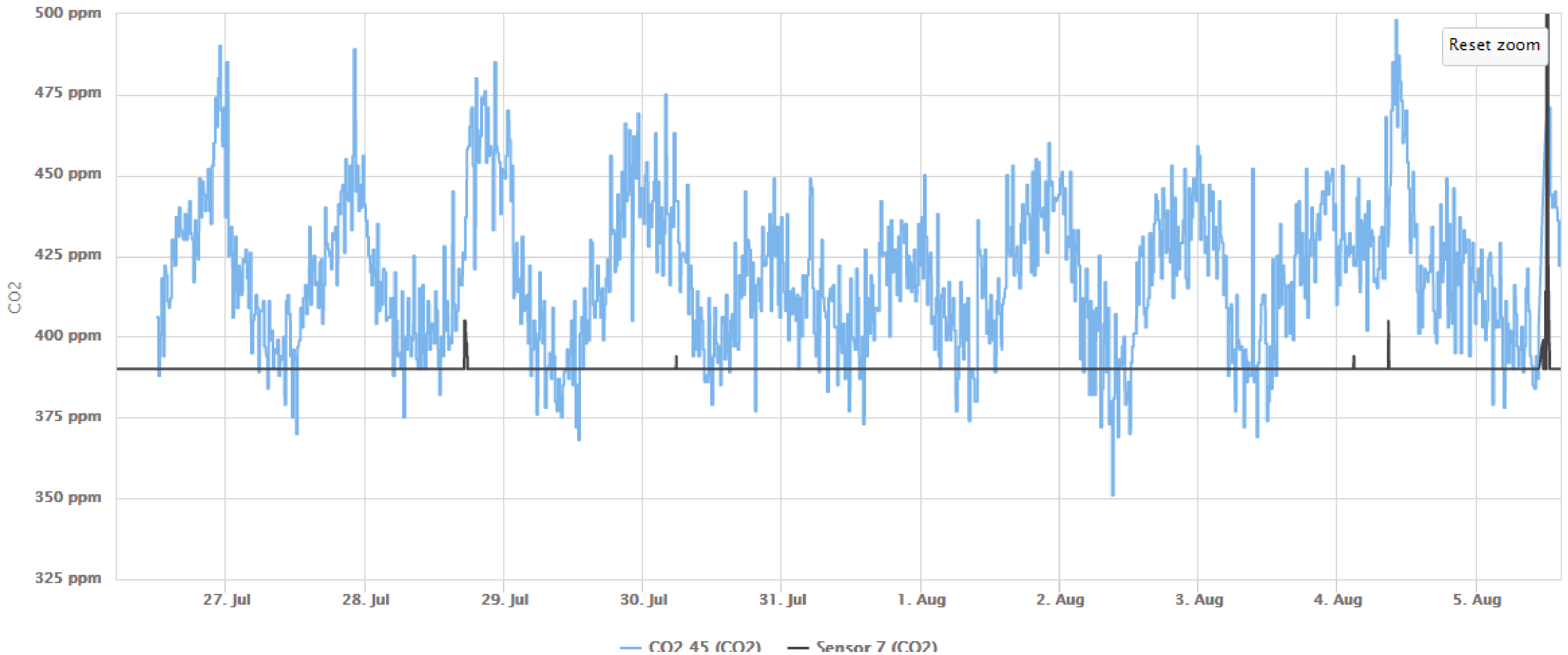
CO2 (1G)



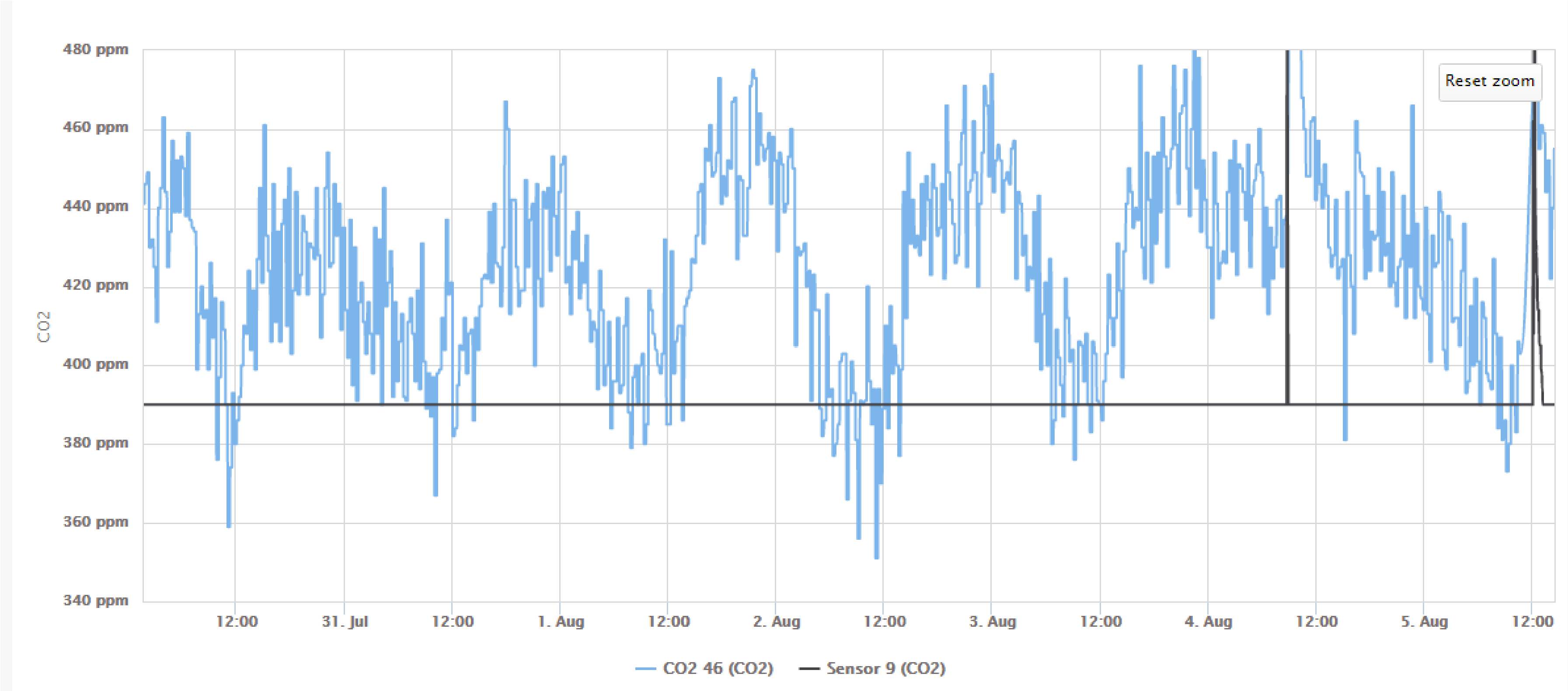
CO2 (G2)


550 ppm
500 ppm
450 ppm
400 ppm
350 ppm
300 ppm
CO2
27. Jul
28. Jul
29. Jul
30. Jul
31. Jul
1. Aug
2. Aug
3. Aug
4. Aug
5. Aug
CO2 45 (CO2)
CO2 46 (CO2)
CO2 47 (CO2)
CO2 48 (CO2)

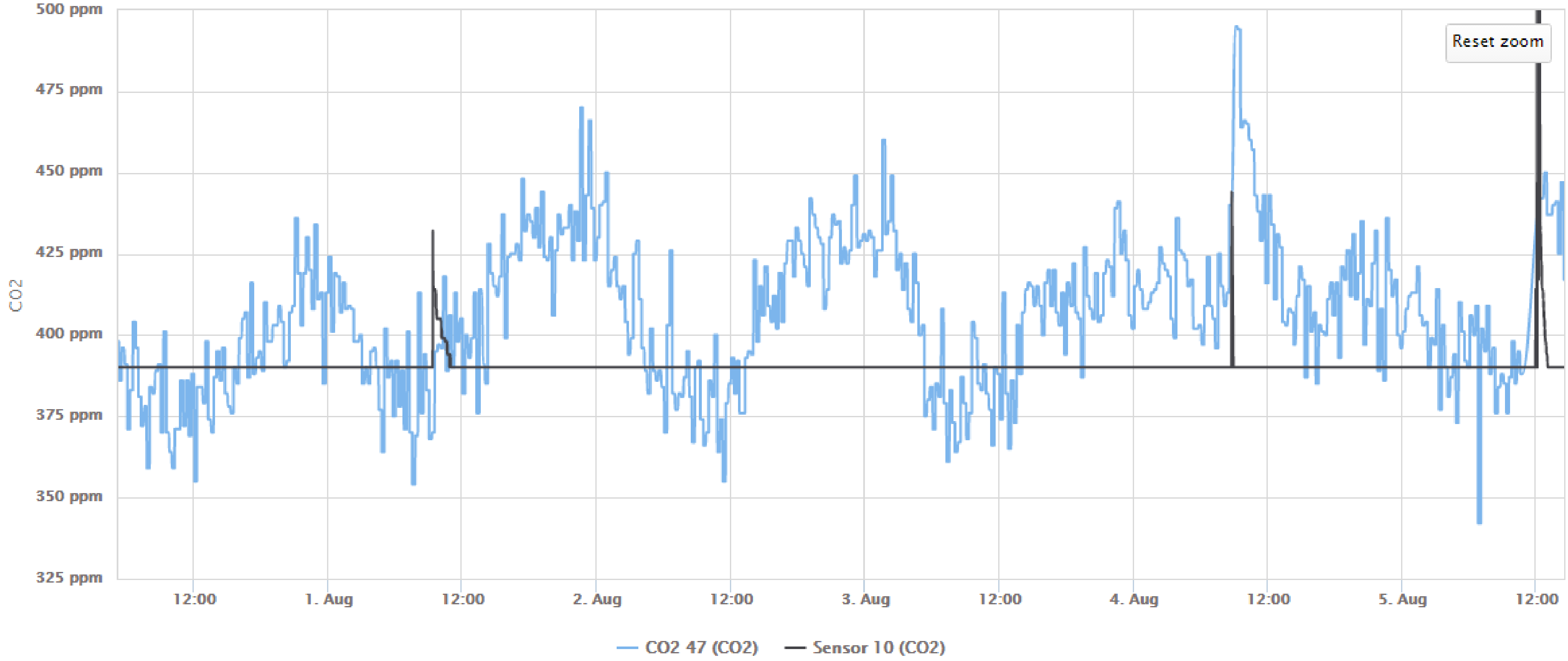
CO2 Level1: 1G vs 2G



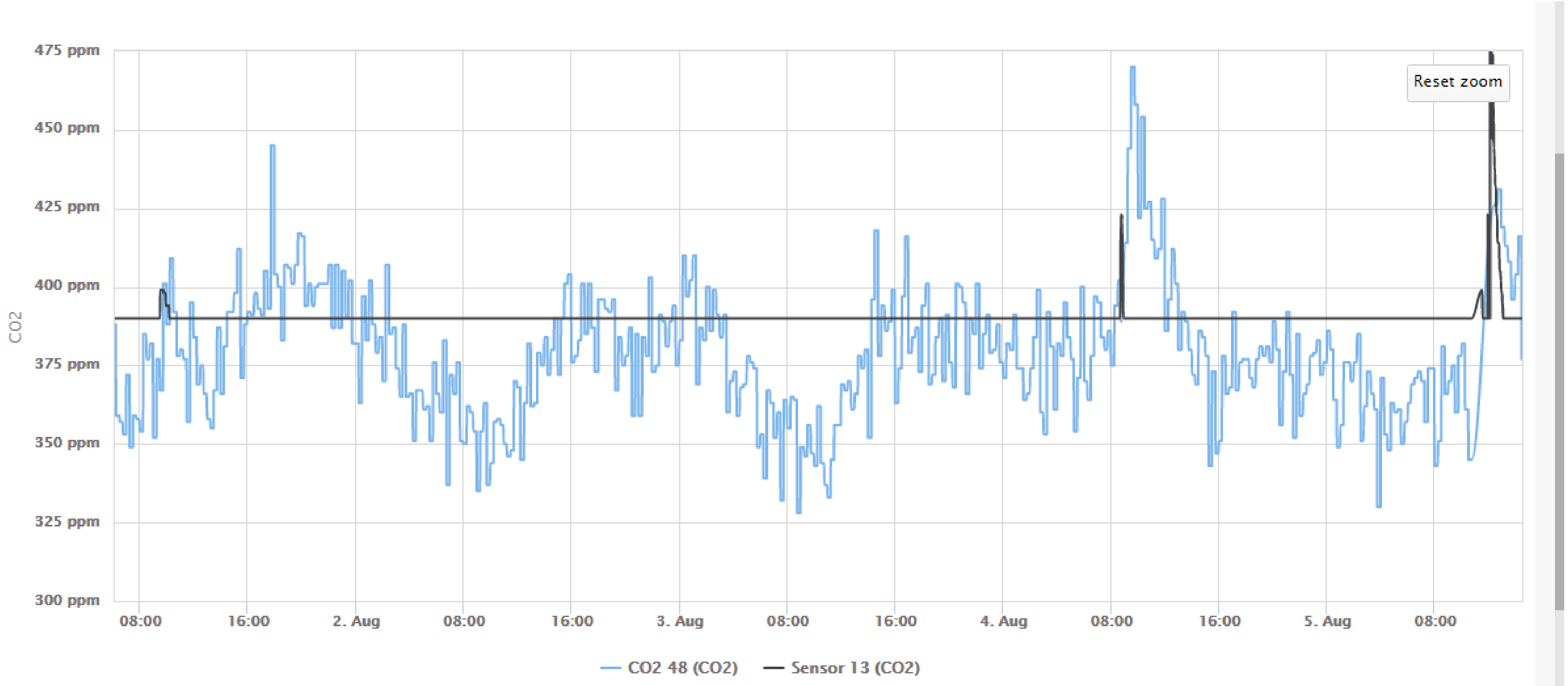
CO2 Level 2: 1G vs 2G



CO2 Level 3: 1G vs 2G



Co2 Level 4: 1G vs 2G



Conclusions

Static sensor characteristics	***1G***	***2G***
Input range	✓	
Sensitivity		✓
Monotonicity	✓	
Hystheresis		✓
Accuracy		✓
Errors		✓
Frequency response		✓

In recent years, CO_2 sensors made of semiconductors, solid electrolytes, optic fibers , laser diodes, and non-dispersive infrared (NDIR) detectors have been developed for monitoring CO_2concentration. For atmospheric CO_2 concentration measurements, NDIR sensors are widely employed since they are stable and very robust against interference by other air components, including pollutants. The NDIR sensor also has excellent durability, and therefore, it seems to be the most reliable sensor for atmospheric CO_2 measurement.

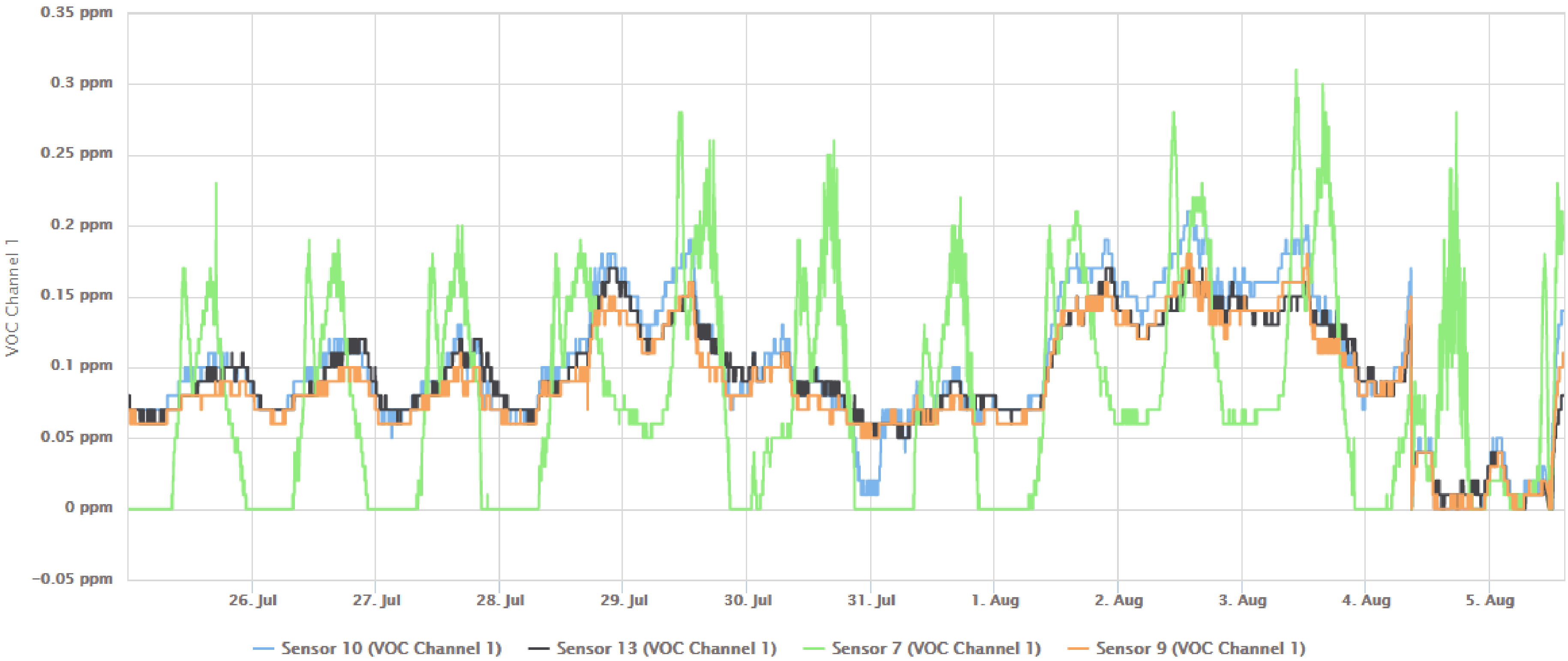
The output of NDIR sensors is affected by temperature, atmospheric pressure, and length of use. To enhance the precision and accuracy of NDIR sensors, it is important to correct the sensors' outputs for these factors. So far, there have been several studies on the calibration of high-cost NDIR analysers. Only a few studies focused on the performance and calibration methods of small commercial CO_2 sensors. There is no report on the recently developed low-cost CO_2 sensors produced by several manufacturers.

To improve the precision and accuracy of recently developed low-cost CO2 sensors, a calibration method combining offset-correction and linear correction should be examined.

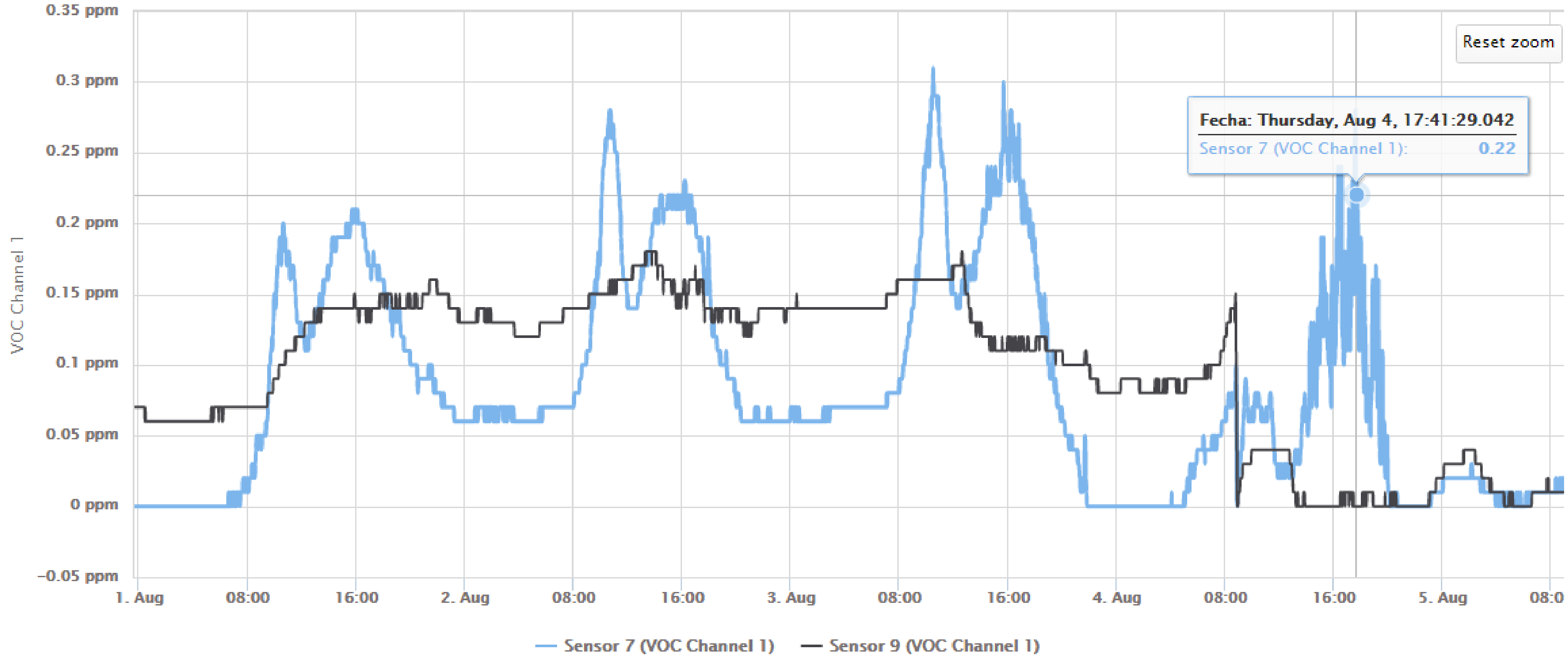
VOC Sensors

TVOC level	Risk and discomfort
≤ 300	comfort target value
> 300 – 1000	no specific impact but it is recommended to increase ventilation
> 1000 – 3000	seek sources of pollution, increase ventilation
> 3000-10000	major impacts
> 10000	unacceptable

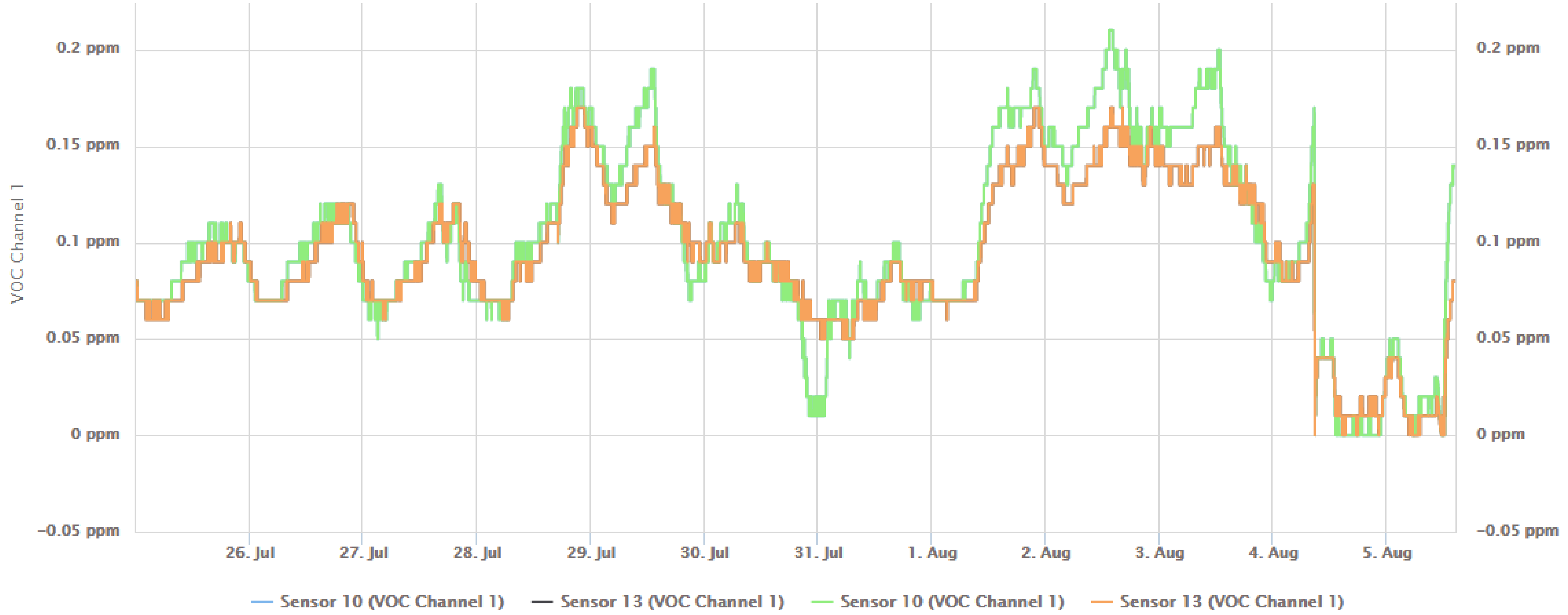
Overview


0.35 ppm
0.3 ppm
0.25 ppm
0.2 ppm
0.15 ppm
0.1 ppm
0.05 ppm
0 ppm
−0.05 ppm
VOC Channel 1
26. Jul
27. Jul
28. Jul
29. Jul
30. Jul
31. Jul
1. Aug
2. Aug
3. Aug
4. Aug
5. Aug
Sensor 10 (VOC Channel 1)
Sensor 13 (VOC Channel 1)
Sensor 7 (VOC Channel 1)
Sensor 9 (VOC Channel 1)

VOC Level1: 1G vs 2G



VOC Level 4: 1G vs 2G



Conclusions

Static sensor characteristics	*1G*	*2G*
Input range	✓	
Sensitivity	✓	
Monotonicity		✓
Hystheresis		✓
Accuracy	✓	
Errors	✓	
Frequency response		✓

Indoor Air quality is becoming a major concern because of the new Building regulation coming into force regarding energy saving to minimize global warming and CO2 emission.

Indoor air quality is affected by CO2 breathing but also by Volatile Organic Compound (VOC) like Formaldehyde (from natural wood or compressed wood), Styrene, toluene or other carcinogenic like benzene coming from furniture, carpet, plastic, decoration, activity.

Air quality is measured through a VOC sensor (metal oxide). Due to its functional principle, the lifetime of the sensor depends on nature and concentration of the pollutant gas burden. The sensitive layer of the sensor element reacts with all volatile organic compounds and is thereby modified in its electrical properties or "exhausted". This process results in a displacement of the characteristic curve. Such characteristic curve displacement however amounts to less than 15 % ⁄ year under normal burden. In measuring air quality, the general condition of air quality is detected. Whether air quality is "good" or "bad" is differently interpreted by each person.

Different pollution burdens and concentrations influence the air quality signal (0...10 Volt) in different ways. Examples for this are cigarette smoke, deodorant sprays, cleaning agents, or also various adhesive materials for floor and wall coverings as well as dyestuffs. Increased burdens e.g. by solvents, nicotine, hydrocarbons, aerosol propellants etc. intensify consumption ⁄ aging of the sensor element. Particularly under high pollutant gas burdens – also during non-operational idle state periods of the devices (transport and storage) – zero-point drift will occur. Consequently, this must be corrected at site according to the respective circumstances or basic burdens.

Air quality measuring instruments of different manufacturers cannot directly be compared because of different functional principles, preset basic burdens (zero-point), and permitted burdens (amplification ⁄ sensitivity). Devices are preset respectively calibrated according to the sensor manufacturer's specifications. Here, a zero-point and a final value is determined and thus a maximum burden. In particular cases, exceeding measuring ranges or excessive basic burdens on the devices will occur (outgassing floor carpeting, wall paint, etc.). In order to enable distinguishing different air qualities, devices need to be adjusted by the customer according to the conditions existing on site that do not correlate to the factory-preset definition range and calibration. Please note that factory calibration is thereby lost and compliance with technical data can no longer be guaranteed.

References

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